EXECUTIVE SUMMARY

Executive Summary

Each day the citizens of McKean, Elk, Forest, Jefferson and Clarion Counties use the Clarion River to provide clean and healthy water for recreation, water supplies, fish and wildlife habitat, and for daily industrial needs. Interest in the restoration of the Clarion River Basin brought together a diverse group of people wanting a long-term protection of this river and improved industrial conditions affecting the river. In August 1994, the Clarion River Basin Commission (CRBC) was formed to bring together the five rural counties to focus on the river as a common resource. Increased public interest also provided Congressman Clinger with the opportunity to protect the Clarion River. The Forest Service evaluated the Clarion River from Ridgway to determine the inclusion in the National Wild and Scenic Rivers system. In October, 1996 51.7 miles of the Clarion River was designated as a component of the National Wild and Scenic Rivers System. This comprehensive study will be incorporated into the management of the Wild and Scenic River with additional needs supplemented by the Forest Service once this study is completed.

The mission of the Clarion River Basin Commission is to provide leadership and action to enhance the quality of the Clarion River Basin to a viable ecological condition. The commission will work to improve the region for future generations. The CRBC will promote cost-effective and ecologically appropriate restoration technology to correct existing pollution. The Commission intends to pursue its mission utilizing the community's resources, provide education consistent with the mission, and support watershed restoration efforts throughout the area.

Direction of the commission lies with the County Commissioners and their appointed representatives. Individuals and organizations can become members of the Commission as well.

Pennsylvania Rivers Conservation Plan

The Keystone Recreation, Park and Conservation Fund Act(Act 50 of July 2, 1993, P.L. 359) authorized the Department of Conservation and Natural Resources (DCNR) to make grants to municipalities and appropriate organizations for the purpose of rivers protection and conservation. The Clarion River Basin Commission, with the assistance of Headwaters Resource Conservation and Development Council, received a river conservation planning grant through the Pennsylvania Rivers Conservation Program. The purpose of the grant is to develop and plan for a detailed assessment of the Clarion River Watershed. Significant environmental, recreational, economic, cultural and aesthetic resources of the watershed will be identified. Potential threats to these significant watershed resources will be investigated. Policies and actions will be recommended to conserve, restore, and enhance the watershed's resources and values. The grant study will also provide the necessary information and documentation for the Clarion River Basin to be included in the Pennsylvania Rivers Conservation Registry.

Study Area

This plan concentrates on the entire Clarion River Watershed, which lies in parts of Clarion, Elk, Forest, Jefferson and McKean Counties. The Clarion River is located in

northwestern Pennsylvania. The watershed is in the headwaters of the Ohio River Watershed. The Clarion River drains a 1,252 square miles watershed and enters the Allegheny River near the city of Parker, Pennsylvania. The watershed is comprised of several smaller watersheds with over 250 perennial streams. The East and West Branches of the river originate in McKean County and flow southerly before merging at Johnsonburg in Elk County. From this confluence at Johnsonburg, the river flows southwest for 101 miles before emptying into the Allegheny River. The mouth of the Clarion River lies about 50 miles north - northeast of Pittsburgh and 75 miles south - southeast of Erie, Pennsylvania.

Relationship to Other Plans

The Clarion River Basin Plan consists of information from past studies and organizations, updated data from state and federal agencies, and facts provided by local municipalities and industries. Public input and assistance is an essential aspect of the plan. Information gathered from a series of town meetings held through out the basin supplied the groundwork for issues identification and possible actions to be taken.

The finished plan will be submitted to the PA Department of Conservation and Natural Resources (DCNR) for the approval and for inclusion in the Pennsylvania Rivers Conservation Registry. The purpose of the registry is to officially recognize plans for conserving watersheds and watershed values. Once established on the registry, the entire Clarion River Basin will be recognized by DCNR as an applicant for further grant funding. Implementation or development grants can be acquired through DCNR to further evaluate an issue, or remediate a problem identified by the plan.

Study Methodology

Upon approval of the river planning grant, the CRBC developed a "study team" consisting of representatives from industry; federal, state, and local government; business; advocacy groups; and individuals. The CRBC hired a technical assistant to research data needed by the study team.

The planning process began with a variety of informational public meetings conducted in Clarion, Jefferson, Forest and Elk Counties. Description of the Clarion River Basin Commission, delineation of the study area and a proposed time line for the rivers conservation program was provided to the attendants. The public had the opportunity to discuss with the study team issues and concerns found within the Clarion River Basin. Based on these issues and the state's recommendations, the technical assistant identified and collected resource data. Resource data was then gathered from sources that helped to clarify these issues. Sources included the U.S. Army Corps of Engineers, DEP Bureau of Water Quality, USGS Water Quality Studies, PA Fish and Boat Commission, Natural Resource Conservation Service, USDA Forest Service, local water quality treatment facilities, historical agencies, non-profit organizations, universities, tourism bureaus, and others. An analysis and evaluation of the resource data as it related to issues and concerns was completed by the study team.

A preliminary findings report was developed and presented to the public at a meeting held at the Clarion University of PA, Peirce Auditorium, April 17, 1997. The

Executive Summary

CRBC study team presented a summary of the data collected, an issues chart depicting the degree of interest voiced at the initial public meetings, and a preliminary list of alternative management options that addressed many of the issues. Approximately 45 people attended the meeting and a few comments and suggestions were made. All information is provided in the minutes of the meeting. Seventy-eight copies of the Preliminary form of the Executive Summary was requested or distributed to people, organizations, and local governments.

A "draft" copy of the complete plan was presented to the public at a meeting held in Ridgway, at the Elk County Courthouse on June 11, 1997. Each county's planning department received a copy of the plan for the public to review. At the closure of the 30-day comment period, one new issue was identified and several comments were stated to support the other issues. The "draft" copy was edited to reflex the changes.

The final copy of the plan and executive summary was presented in Brockway, PA. This location was chosen as a mid-point of the basin. A representative from each county commissioner's office receive an update on the study and had an opportunity to review the document with the "study team" of the Clarion River Basin Commission.

Elements of the Plan

Unlike previous studies of the Clarion River, the Clarion River Basin Commission's efforts will be documented in a comprehensive assessment of the entire basin that includes research on the area's characteristics and the basin's land, water, biological, and cultural resources.

Chapters I through V contain a description of the study area. The Clarion River Basin's setting, land resources, water resources, community aspects, and areas of concerns have been identified, researched, analyzed, and summarized in this section of the plan. This narrative contains the necessary information needed to adequately evaluate the watershed's resources and values.

Chapter VI contains a list of issues, concerns, and comments expressed by the public at the initial meetings. It should be emphasized that these are concerns and issues raised by the public and they are not the result of scientific or environmental studies. The resource data supplied in Chapters I through V may contain information to clarify the public's opinion.

Chapter VII is a closer examination of issues related to the water quality of the Clarion River Basin. The management option chart identifies possible solutions to problems, and is the foundation for future projects and goals of the Clarion River Basin Commission.

As a result of this assessment, the CRBC was able to conclude that the overall water quality of the Clarion River Basin has improved since 1980. Summarized historical water data compared to recent monitoring results illustrate the improvements of the water quality. However, this plan identified watershed areas where there is a deficiency of water monitoring data, hindering the ability to make a proper conclusion on water quality .

Numerous issues were stated and discussed. Mine drainage was proposed by the public as the major pollutant to the watershed. The public was able to search beyond mine drainage to recognize other water quality issues. Pollution produced by improper

or lack of sewage treatment was a primary concern of the people living within the entire watershed. Data was minimal, but preliminary findings could conclude that sewage may be a problem within the watershed and a further study is needed.

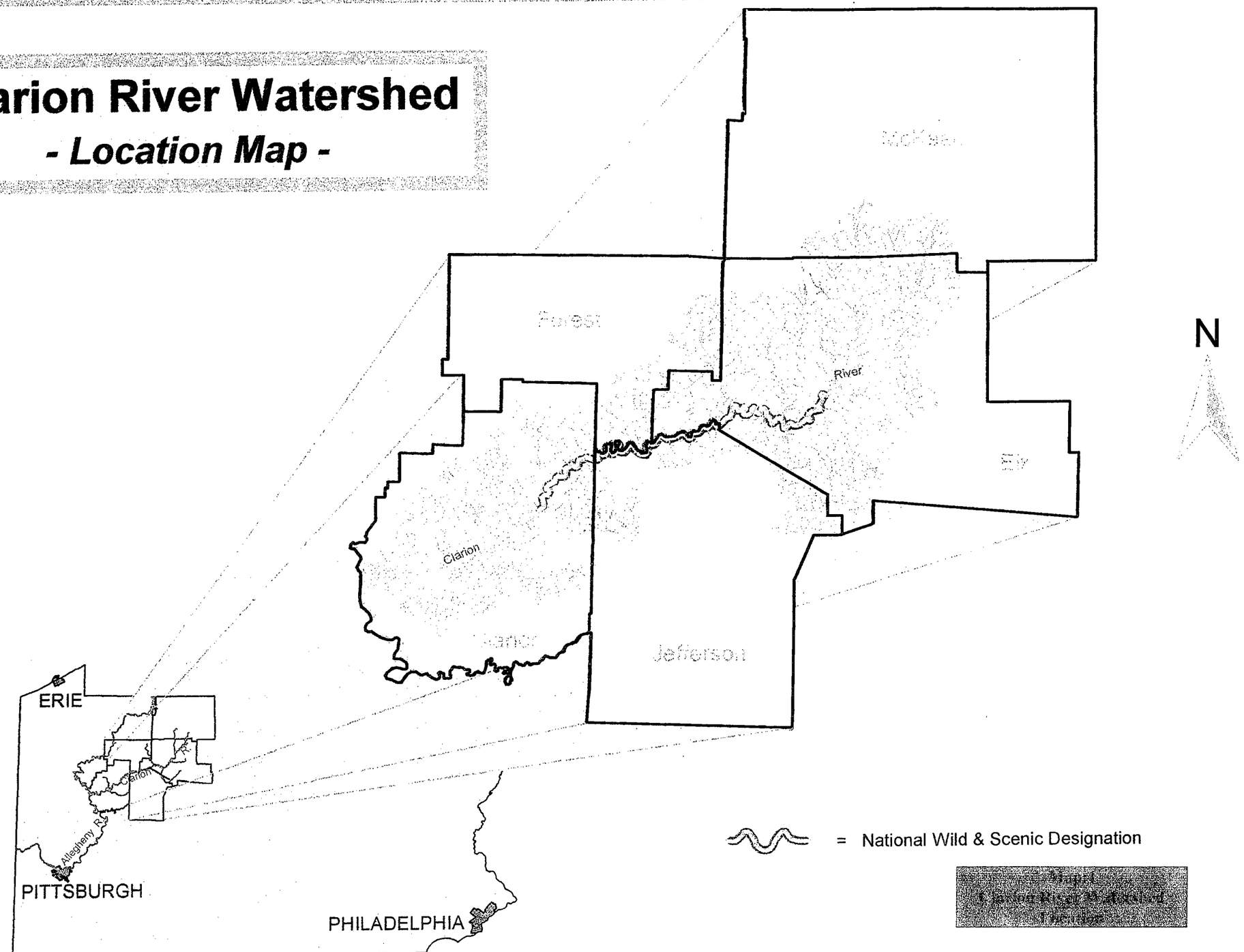
Water pollution brought about by industry was a principal issue in certain regions of the watershed. Citizens living in Elk and parts of Jefferson Counties voiced this belief. Researched documents provided some data to support the public's concern, and the plan recommends that a study of industry's impact on the watershed be conducted.

Interest in the Clarion River Basin appears to be growing. As water quality improves, tourism increases thereby creating economic opportunities for the nearby communities. The citizens of the five counties have accepted this growing industry with caution. The public in the entire watershed expressed a need to identify the "carrying capacity " of the river. The public voiced a desire to retain the unique character of the Clarion River so that naturally changing systems can endure for generations to come.

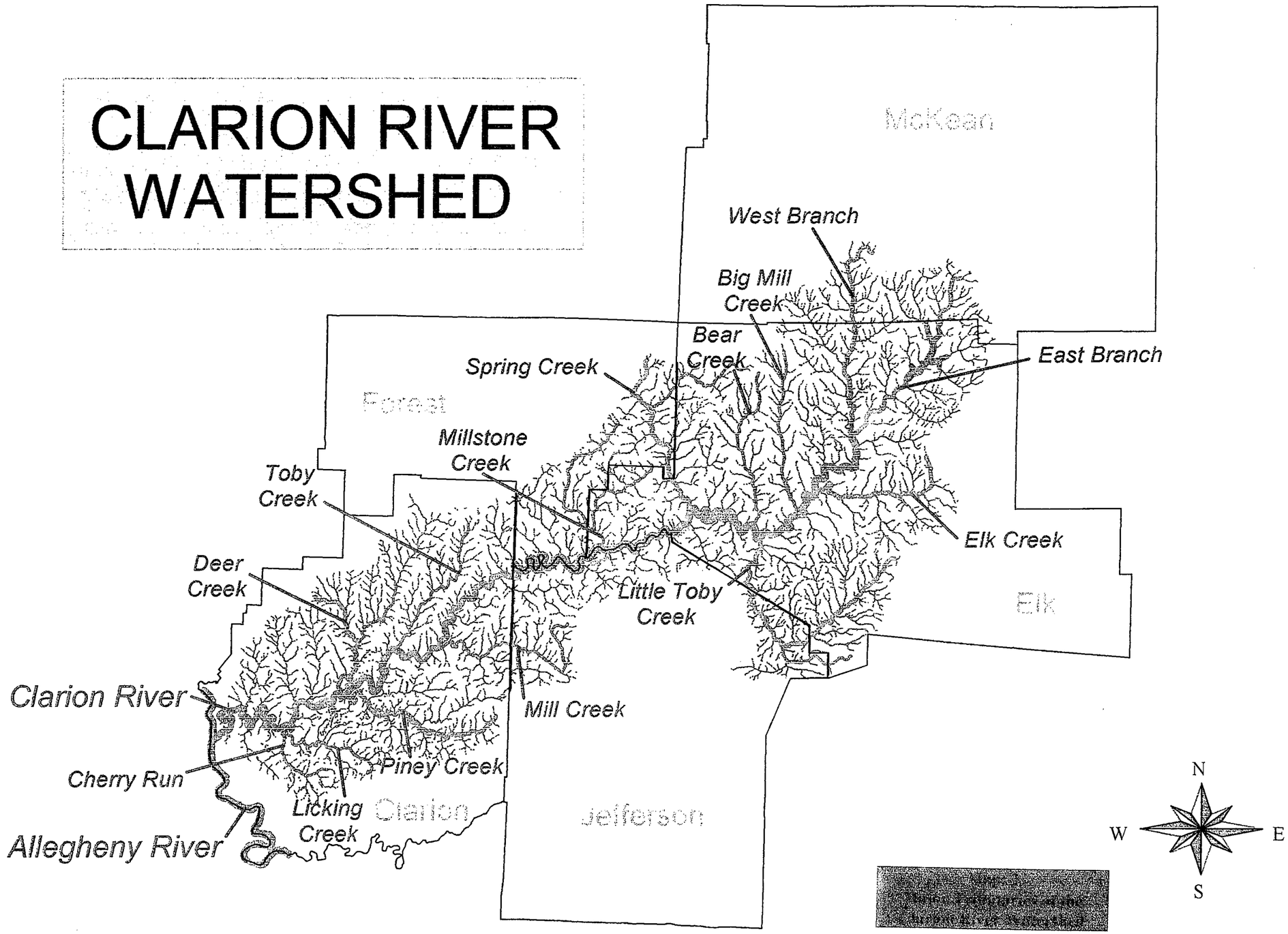
MAPS

Clarion River Watershed

- Location Map -

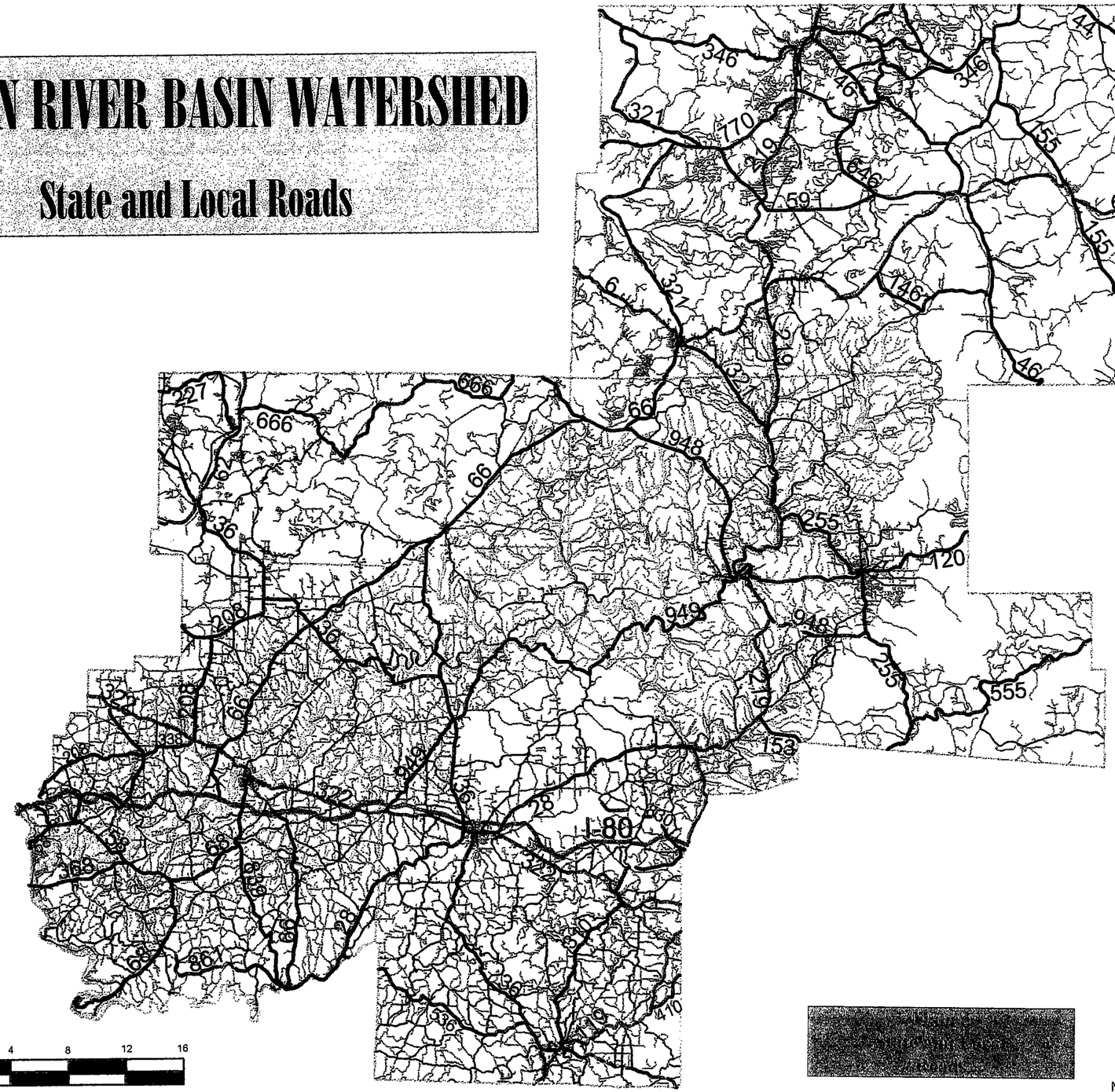


CLARION RIVER WATERSHED



CLARION RIVER BASIN WATERSHED

State and Local Roads



Interstate Highway

U.S. Highway

Major State Route

State Roads

Other Roads

Water

County Boundary

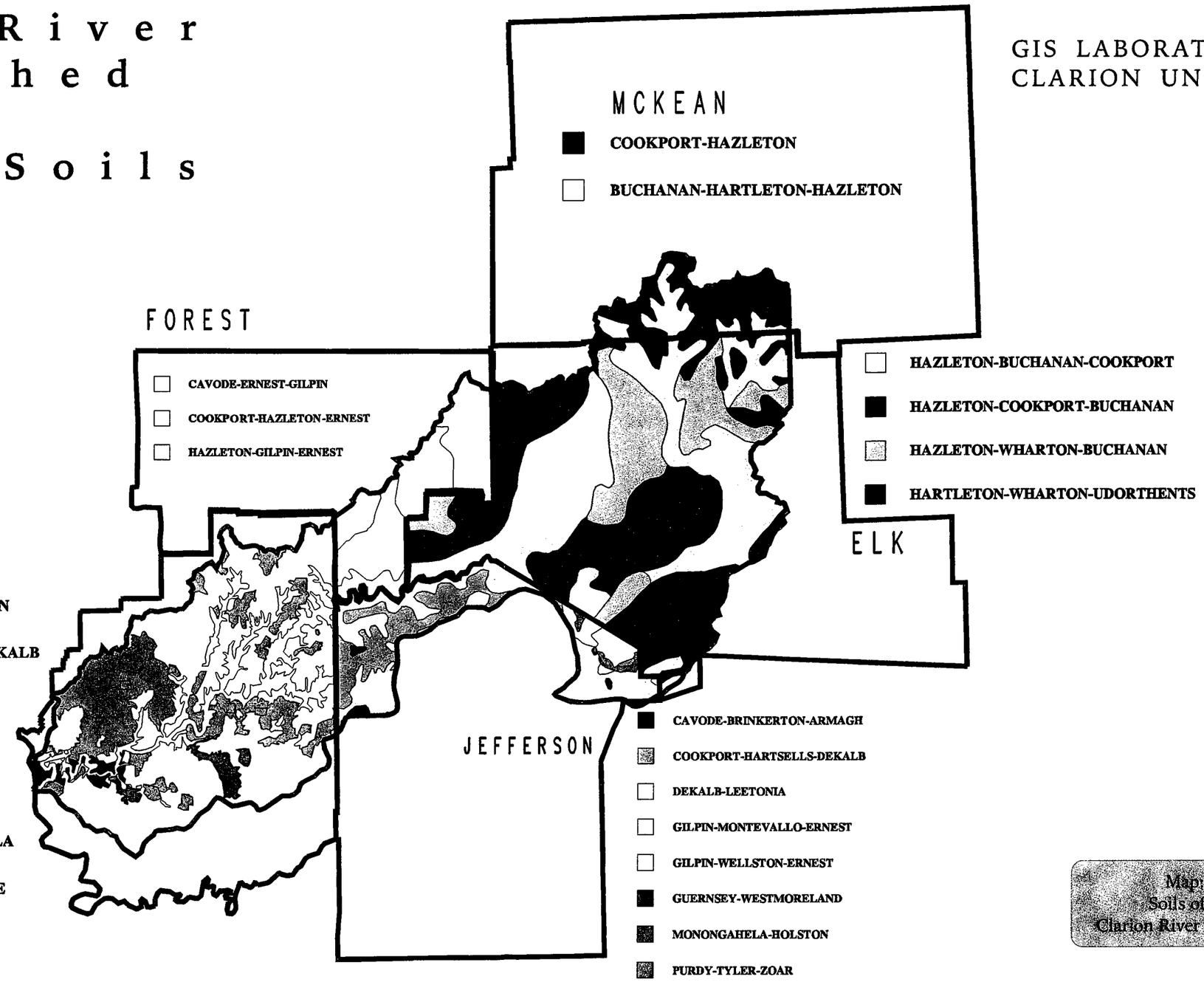
Northwest Pennsylvania Regional Planning & Development Commission

Clarion River Watershed

General Soils

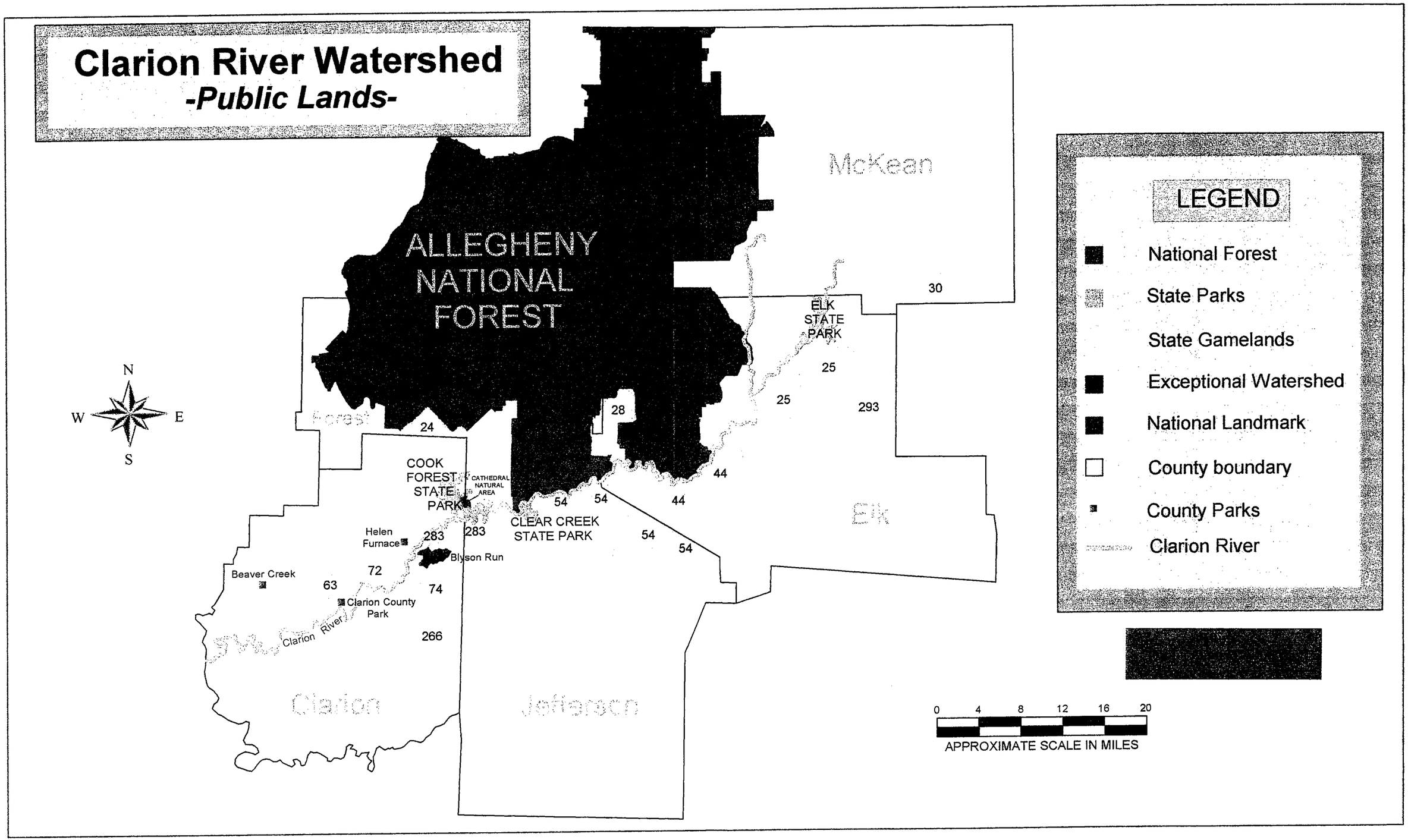
GIS LABORATORY
CLARION UNIVERSITY

1 : 500000
(Approximate)

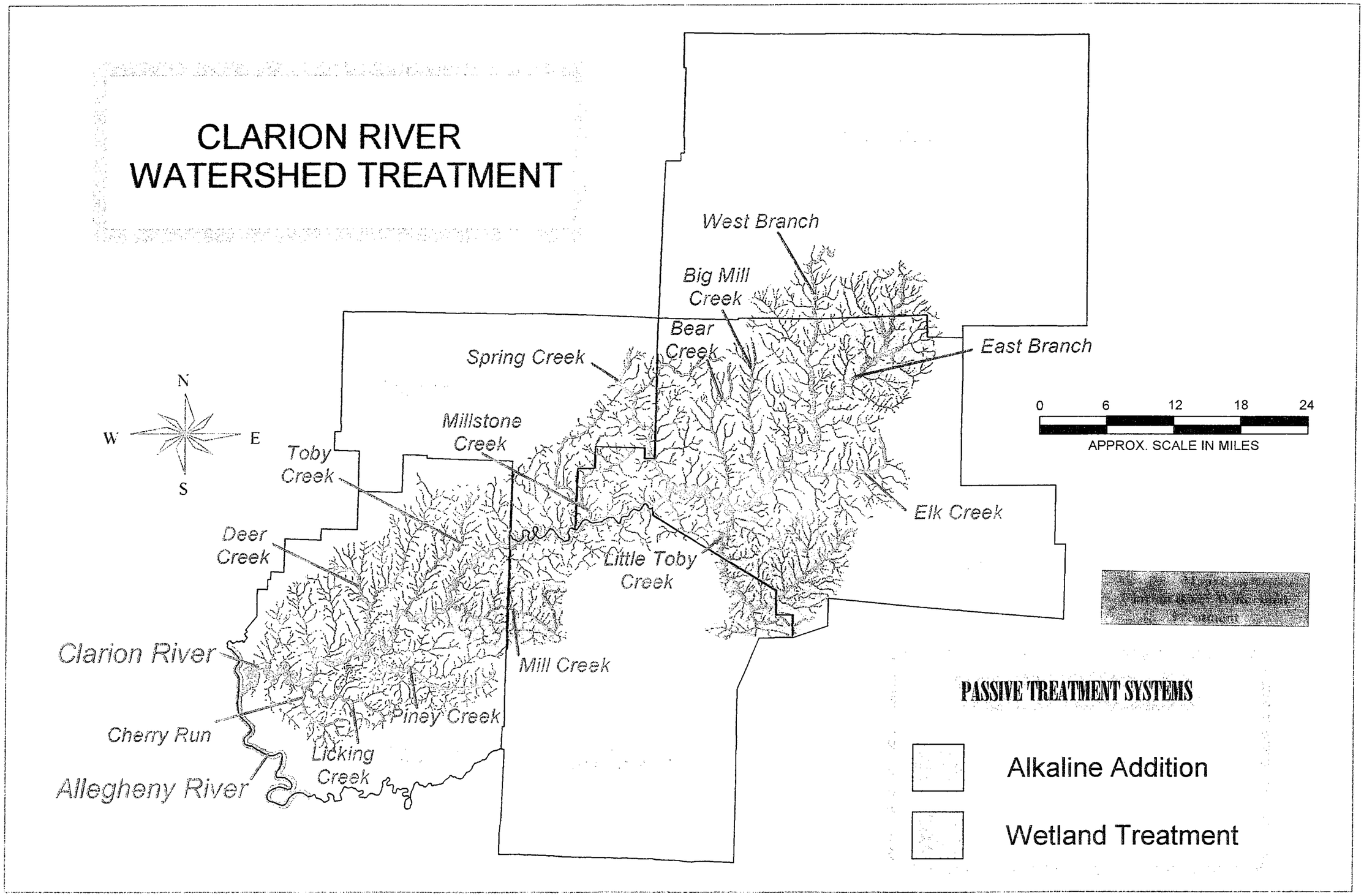


Map: 4
Soils of the
Clarion River Watershed

Clarion River Watershed
-Public Lands-



CLARION RIVER WATERSHED TREATMENT



Pennsylvania Rivers Conservation Program

Clarion River Basin

I. Setting

General Description

The Clarion River is located in northwestern Pennsylvania. The watershed is in the headwaters of the Ohio River Watershed. The Clarion River drains a 1,252 square miles watershed and enters the Allegheny River near the city of Parker, Pennsylvania. The watershed is comprised of several smaller watersheds with over 250 streams. The East and West Branches of the river originate in McKean County and flow southerly before merging at Johnsonburg in Elk County. From this confluence at Johnsonburg, the river flows southwest for 101 miles before emptying into the Allegheny River. The mouth of the Clarion River lies about 50 miles north - northeast of Pittsburgh and 75 miles south - southeast of Erie, Pennsylvania. *Map1: Clarion River Watershed Location*.

The study area is the entire Clarion River watershed which lies in parts of Clarion, Elk, Forest, Jefferson and McKean counties. The overall impression of the area is one of irregular wooded hills and winding valleys. The upper part of the basin above Clarion has narrow, steep-sided slopes and valleys with high hills. The Clarion River has an unique, picturesque quality with its diverse and mature vegetation, sinuous channel, and varying water conditions.

The Clarion River Basin is in the Allegheny High Plateau and Pittsburgh Plateaus sections and is underlain with coal-bearing rocks of the Pottsville and Allegheny Groups. This area is typified by relatively flat to gently rolling plateaus dissected by deep, V-shaped stream valleys. Elevations on plateaus typically range from 460 to 490 meters (m) above sea level. Stream valley floors generally range from 330 to 400 m in elevation. Oil and gas are limited to the lower basin; whereas, the coal beds are evenly distributed throughout the basin. *Chart C1, Appendix A-1* [1] The Clarion River corridor consists primarily of the Lower Mississippian and Upper Devonian Group. Characteristics of this group are sandstone, shale, siltstone, and some red beds. Refer to *Appendix A2-A4* for a complete description of each bedrock formation and group in the Clarion River Basin. Included in the description is an analysis of the ground water found in each group.

Major Tributaries

There are 16 major tributaries of the Clarion River Basin which have a drainage area greater than 25 square miles, *Map 2: Major Tributaries of the Clarion River Watershed.*[2] The East Branch and West Branch tributaries are located in McKean and Elk County. As the river continues to flow southwest through Elk County, the tributaries Elk Creek with its source near St. Mary's, and Big Mill Creek with its source at Lamont, contribute to the water flow. Little Toby Creek , flowing between Elk and Jefferson County enters the river at Carman. Bear Creek the next major tributary is completely in

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[1] Clarion River Basin, Pennsylvania Acid Mine Drainage Abatement Program: Stage I Reconnaissance Report (United States Army Engineer District, Pittsburgh , January, 1980) pg. A-9

[2] Water Resources Bulletin, Bulletin No. 16 Pennsylvania Gazetteer of Streams, (Commonwealth of Pennsylvania, June, 1984) pg. 284-295

Elk County. The mouth of the stream is at Portland Mills. The source of the another major tributary, Spring Creek, is in Forest County and enters the river at Hallton, Elk County. Millstone Creek, also a major tributary found in both Forest and Elk County, has an East and West Branch . In Sigel, Jefferson County, one major tributary, Mill Creek, crosses the county line and enters the river at Millcock, Clarion County. Clarion County is the source of the remaining major tributaries of the Clarion River. Beginning with Toby Creek, the river continues to flow southwest as it is joined by Piney Creek ; Paint Creek, which is a tributary to Deer Creek; Deer Creek ; and Licking Creek For more information on each tributary refer to *Appendix page. A5- A12*

Major Tributaries	Length		Major Tributaries	Length
East Branch	20.5 miles		West Branch of Millstone Creek	16. 3 miles
West Branch	19.1 miles		Millstone Creek	1.8 miles
Elk Creek	16.2 miles		Mill Creek	18.2 miles
Big Mill Creek	16.2 miles		Toby Creek	15.9 miles
Little Toby Creek	28.2 miles		Piney Creek	21.3 miles
Bear Creek	17.0 miles		Paint Creek	14.1 miles
Spring Creek	18.3 miles		Deer Creek	14.4 miles
East Branch of Millstone Creek	10.6 miles		Licking Creek	13.7 miles

Fifty-six percent (9 streams) of the major tributaries are labeled high quality streams by the Department of Environmental Protection; Chapter 93 Water Quality Standards. East Branch, Big Mill, Bear, Spring, East and West Branch of Millstone, Millstone, and Mill Creek are considered to have excellent quality waters and environmental features that require special water quality protection. The remaining major tributaries (West Branch, Elk, Little Toby, Toby, Piney, Paint, Licking, and Deer Creek) as of August 1994 did not meet the criteria for this special protection. All major tributaries within the Clarion River Basin are considered to be cold water fisheries. *Chart C2. Appendix A-13.*

Population Centers

A number of small municipal centers are located within the study area. Based on the 1990 Census Profile, it is estimated that 65,289 persons reside in the Clarion River basin which covers parts of five counties. The total 1990 population of the counties in their entirety was 174, 653, which was a decrease of the 1980 population of 185, 710.

Clarion County continues to exist as the most densely populated portion of the basin. Presently, there are many small urban centers which are scattered throughout the county and development is expected to spread outward. Along the river's edge, Clarion Boro is the largest town center.

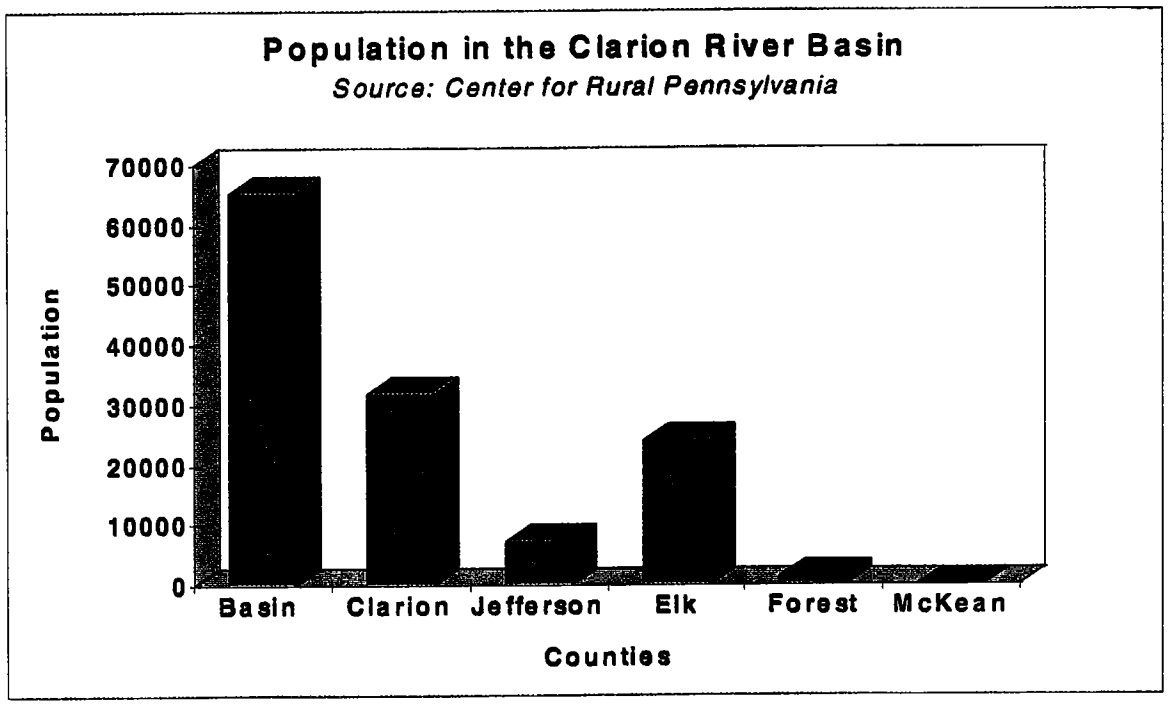
Elk County's population is concentrated in four major urban areas of Ridgway, Johnsonburg, St. Mary's, and Wilcox. These existing town centers are small with commercial activities which cater to local needs. St. Mary's, the most densely populated area of Elk County is within the Clarion River Basin, and is located on Elk Creek, a major tributary of the Clarion River. Ridgway and Johnsonburg Boros are located within the Clarion River corridor and Wilcox, Jones Township, is located on the

populated area of Elk County is within the Clarion River Basin, and is located on Elk Creek, a major tributary of the Clarion River. Ridgway and Johnsonburg Boros are located within the Clarion River corridor and Wilcox, Jones Township, is located on the West Branch tributary of the Clarion River. Despite previous predictions of growth, population continues to decrease in all areas except St. Mary's.

Brockway Borough, Jefferson County, is the site of another populated area within the Clarion River Basin study area. Located within the vicinity of Toby Creek, Brockway is also experiencing a decline in population.

The study area in Forest and McKean County is 100% rural. Development is expected to occur slowly and be rather limited in scope. Most of the growth is expected to be in seasonal development.

Population within the basin is identified in the following chart. *Appendix A-14*, *Chart C3* identifies Percentage of Rural Population, Population Trend, and Area. *Charts C4 and C5*, list the figures for in each municipality within the watershed for population trends, population per square area, population using public and private water systems and public and private sewage disposal.



Basin	Clarion	Jefferson	Elk	Forest	McKean
65289	31988	7387	24039	1321	154
100%	49%	11%	37%	2%	0.02%

Land Use

Land use distribution within the Clarion River Basin was last reported in 1975. At that time an average of 15.7 % of the area was used for agricultural, and 6.44 % of the land was involved in mining. Since that last document, the Center for Rural PA reported that agriculture and mining sector establishments declined in each county.

growth along the Clarion River 's corridor. The majority of the land remains forested as it did in 1975 (average of 62.8 %). As the demand for homes increased, some of the agricultural and forested lands were changed to residential lands. Construction of seasonal homes near the major recreational areas has increased on a small scale . Much of the forest and recreational lands are established public forests and park areas which are protected from industrial or residential encroachment.

According to the Cook Forest State Park Annual Attendance Sheet, recreational usage in some areas is up as much as 35% and this appears to be contributing to a major growth in land use in the immediate Clarion River corridor. [3]

Percent Distribution of Land Use in the Clarion River Basin (1975)

	Residential	Commercial	Instutional	Industrial	Forest	Recreational	Agriculture	Mining	Total
Clarion	3.2	0.1	0.1	0.2	44.9	6	38.4	7.1	100
Elk	2.7	0.1	0	0.1	62.4	16.2	10.6	7.9	100
Forest	4.6	0	0	0.1	83.4	4.7	7.1	0.01	100
Jefferson	5.6	0	0.2	0	49.8	21.6	17.6	5.2	100
McKean	1.7	0.1	0	0.1	73.6	7.7	4.8	12	100
Average	3.56	0.06	0.06	0.1	62.82	11.24	15.7	6.442	

Transportation Facilities

The counties of the Clarion River basin are served by a number of transportation arteries and facilities. Major highways include Interstate 80, U.S. Routes 322 and 219, and a number of less traveled Pennsylvania routes. *Map 3: State and Local Roads.* Between Ridgway and Cooksburg, the Clarion River is paralleled by a series of state and local roads, except near Portland Mills and downstream to Irwin Run. There are some highway bridge crossings across the river ranging from single lane iron bridges to modern Interstate 80 crossings.

Rail freight traffic across the area has been declining for many years. At one time the manufacturing centers and mining areas were all served by Conrail, but since there has been a reduction in service, the railroad system is used primarily for freight service. Formerly known as CSX, the Buffalo & Pittsburgh line is the major railroad operating company in the area.

There are several small private and municipal airports, but commercial airline service is not available in the Clarion River Basin. Local airports within the study area can be found at Clarion and St. Mary's.

Major Source of Employment

Overall employment figures within each sector are provided in *Charts C6-C8* and business establishments are recorded in *Charts C9*, *Appendix A 17-20*. Though the five

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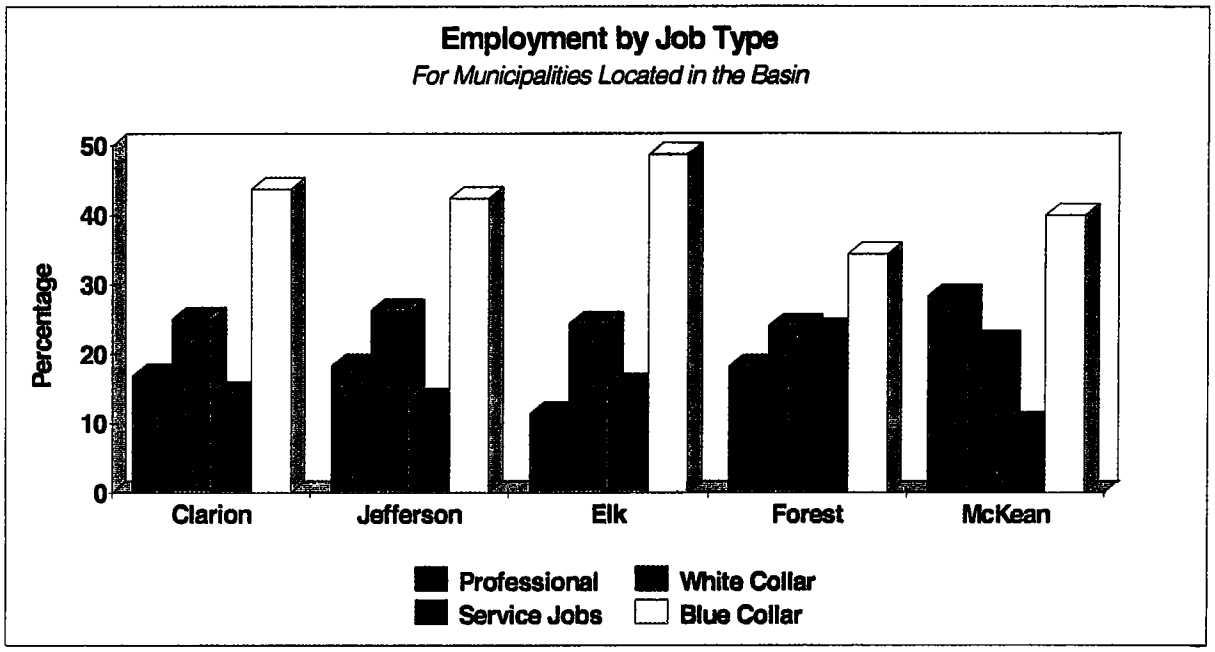
[3] Comprehensive Water Quality Management Plan Upper Allegheny River Basin: Study Area 8 (Pennsylvania Department of Environmental Resources, 1975) Chapter V Existing Population, Economy, and Land Use.

Overall employment figures within each sector are provided in *Charts C6-C8* and business establishments are recorded in *Charts C9*, *Appendix A 17-20*. Though the five counties are similar in rankings among the different job types, there are some differences as to what the major employment is in each particular county.

In the Clarion River Basin manufacturing is the largest employer. This is primarily due to the fact that Elk County has more than 20 industries which employ almost 48% of the county's work force .The major manufacturing industries are powered metals, paper products, glass, and lumber. Overall, the manufacturing sector employs over twenty-seven percent of the basin's work force. Elk , Clarion, Jefferson, McKean and Forest Counties have grown substantially in the service sector, making this sector the second highest employer in the study area. More than twenty-five percent of the basin's work force is employed by the service sector. Employment in agriculture and mining continues to decrease in Clarion, Elk, and McKean county and employs less than 6 % of the basin's working population.



	Professional	White Collar	Service Jobs	Blue Collar
Clarion	16.9	25	14.4	43.7
Jefferson	18.3	26.3	13.4	42.4
Elk	11.4	24.4	15.5	48.7
Forest	18.2	24	23.4	34.4
McKean	28.3	21.7	10	40
Average	**18.62**	**24.28**	**15.34**	**41.84**

Communities in the study area continue to attempt to provide development opportunities for commercial and industrial interests. The amount of land within the Clarion River corridor (1/4 mile of either side of the river) devoted to commercial and industrial uses, however, is not expected to increase dramatically because of the

A comprehensive recreation use study is currently being prepared for the Piney Dam reservoir, however, results will not be available until the Fall of 1997. Based on the Magic Forest Tourism guide, there has been an increase in the recreational usage of the state parks and forest areas, creating an employment rise in this sector. More opportunities exist, but management plans are not in place.

Outstanding or Unique Features

The Clarion River, downstream from the Allegheny National Forest and State Game Land #44 boundary below Ridgway to the backwater of Piney Dam, was added to the National Wild and Scenic River System in October,1996 *Map1: Clarion River Watershed Location* . The Clarion River was noted as possessing "a unique, picturesque quality with its diverse and mature vegetation, steep slopes, sinuous channel and varying water conditions. The river, meandering through mostly undeveloped woodlands, provides the recreationist with spectacular views and a sense of isolation. The changing character of the water, from smooth to riffling, as the river flows over and around large boulders scattered along the river, enhances its natural beauty".[4] In 1971, however, the Clarion River did not meet the National Wild and Scenic River standards. Water pollution from the coal mines, paper mill, and municipal sewage was listed as a major problem. Improvements in industrial plants and municipal sewage treatments have resulted in noticeable improvements in water quality.

Within the Pittsburgh Plateaus section of the Appalachian Plateaus Province northeast of Sigel and east of PA 949 near Clear Creek State Park is a "rock city." There lie large blocks of rock that have weathered extensively producing interconnected tunnels, passageways and crevices. These blocks of sandstone and composites of the Pottsville Group are known as Beartown Rock. Two miles south of Beartown Rock is a weathered remnant of basalt sandstones of the Allegheny Group. This site is known as the Stahlman Roundtop. Within this geological region is another well-known landmark called Alum rock It is located adjacent to PA Route 58 and at the top of a cliff above the Clarion River. It is considered to be the best overlook in the Pittsburgh Plateaus section. (*Outstanding Scenic Geological Features of Pennsylvania*).

Within the Allegheny High Plateaus section of the Appalachian Plateaus Province, five mile north of Brockway is the location of Blue Rock. This area consists of flat-lying beds of sandstone composition which have been eroded by Little Toby Creek, resulting in cliffs along the creek valley. Nearby is a similar feature named Elk Lick Bluff.[5]

In September, 1996, the Swamp Forest area in Cook Forest State Park was included in the PA Natural Areas Program. The 246-acre woodland contains 300-year-old hemlocks and a boulder field formed during the Ice-Age. This designation

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[4] Clarion River and Mill Creek Wild and Scenic River Eligibility Report (Allegheny National Forest, 1996). pg. 12

[5] Alan Geyer and William Bolles, Outstanding Scenic Geological Features (Commonwealth of Pennsylvania, Department of Environmental Resources, Bureau of Topographic and Geologic Survey, 1979), pg. 19, 45, 51, and 72

will protect the unique scenic and geologic resources of the area from development and other human caused pressures *(PA Department of Conservation and Natural Resources).*

In 1975 the PA Bureau of Forestry completed a study of all unique or unusual biological , geologic, scenic and historic areas for possible designation as natural areas. The bureau considered natural area status advisable whenever resource development would have an adverse effect on the future utility or value of the area. *Appendix A21* list the natural areas found within the Clarion River Watershed Basin approved by the Environmental Quality Board in 1975.

II. Land Resources

Soil Characteristics

Soils in the Clarion River Basin are generally formed from noncarbonated sedimentary rocks. The soil depths vary between 30 and 72 inches. This area is largely underlain by sandstone, conglomerates, thin shales, and coals. Slopes range from 3 to 25 percent. Most of the land is sloping except for small areas of flatlands on the valley bottoms. Almost all of the land directly adjacent to the river falls into one of two major categories: upland, well-drained soil which is too steep for development other than residential and some forms of recreation, and alluvial soils which are prone to seasonal flooding and structural instability.

There are numerous soils in the basin even though there are four basic parent materials (limestone, sandstone, shale and siltstone) that produce these soils. Climate, vegetation, and topography greatly influence the development of the numerous individual soil series found in the basin. *Map 4: Soils in the Clarion River Watershed.*

General soil associations found in the Clarion River Basin are identified by each county. *Appendix A22-A29* contains a brief description of the general soils series grouped by similar identification characteristics and arrangements of the soil profiles.[6] Woodland management and productivity of each soil name can be found in *Chart C-10, A-30*. Recreation and building site development according to each soil type is recognized in *Chart C11*. *Chart C12* lists the physical and chemical properties of each soil along with water management guidelines, and *Chart C13* describes the wildlife habitat that could survive in each soil type.[7]

Wetlands

Wetlands are found throughout the Clarion River basin. Despite their differences in size, shape, and location, wetlands have some common elements. To determine that an area is in fact a wetland, the interaction of water, soil, and vegetation need to be taken into account. Proper identification of wetlands must present evidence of all three

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[6] Clarion, Jefferson, Elk, Forest, and McKean County Soil Surveys

[7] Soil and Water Conservation Technical Guide Section I & II Reference Soils
Soils Interpretations Records:

parameters (water, wetland plants, and hydric soils). The area must flood or be saturated during some part of most years, long enough to create non-oxygenated conditions that cause unique chemical changes in the soil and to establish certain water-tolerant plant communities. Wetlands have been identified and labeled within the Clarion River Basin . A wetland composite map of each 7.5" topographic map included in the watershed is available through the research department of the United States Geological Survey (1-800-872-6277).

Ownership Patterns

The CRBC found that it was very difficult to identify total property ownership within the basin, and concentrated its' efforts on the corridor of the river. Land use identification has not been completed since 1975, and property ownership is constantly changing. The corridor in this document refers to approximately 1/4 mile of property on either side of the river. At the time of this document's research, 65% of the Clarion River corridor was in private ownership while the remaining 35 % was considered to be public ownership. Private lands included large industrial sites, boroughs, municipalities, and land owned by the Western PA Conservancy. *Chart 14, Appendix A-33., Map 5 : Public Lands Within the Clarion River Watershed.*

The CRBC did identify ownership on the 7.5 minute topographic maps for the complete watershed. County plat books, state maps, UDSA Forest Service publications, and tourism guides were used as resources. Private lands are identified on the 7.5 minute topographic maps by dark brown markings. Yellow lines are used to identify the lands currently owned by the Western PA Conservancy. Public lands consist of the National Forest, PA State Game Lands, and PA State Forests and Parks. On each 7.5 minute topographic maps the National Forest is outlined in a dark, forest green. Identified on each map are the PA State Game Lands, outlined in lime green, and state parks and forests which are outlined in a heavy green slashed line. Each area is subject to change.

Biological Resources

The PA Natural Diversity Index (PNDI) has developed a preliminary system for classification of natural ecological communities in PA based on features, community structure and function. The system was based on the Department of Environmental Resources literature written in 1991 by T.L. Smith. Using this system and the potential distribution of communities within the Commonwealth, Dr. Charles E. Williams, Biology Department at Clarion University of PA identified 26 major community types that may occur within the Clarion River corridor. According to Dr. Williams the communities occurred in four broad systems: terrestrial, palustrine, lacustrine, and riverine. A general description of each community is provided in the *Appendix A34-A36*

The wildlife habitat in the Clarion River corridor is basically divided into two broad habitat types: 1) the riparian/wetland habitat that occurs immediately adjacent to the river and its tributaries; and 2) the upland forested habitat that occurs mainly on the steep side slopes of the river valley. The study area could potentially support a large and diverse population of mammals, birds, amphibians, and reptiles. According to the

Carnegie Museum of Natural History there is a possibility of 286 species of birds which live in or migrate through the study area. Osprey (state threatened) and the Bald Eagle (federally threatened) are often seen foraging along the river. However, no active nests are currently known to exist within the river corridor.

A survey of dragonflies and damselflies along with Clarion River and its tributaries by the Western PA Conservancy and Carnegie Museum of Natural History (1994) identified 52 species of odonates.

According to Kuchler (1964) the Clarion River lies in a transition zone between the hemlock-northern-hardwood forest and Appalachian oak forest types. In this region, the two types of forest tend to intergrade with the northern hardwood forest dominating the northern portion of the Clarion River corridor; and the Appalachian oak forest dominating the south. Dominant tree species were summarized by Dr. Charles Williams, and hemlock, American beech, white pine, yellow birch, black cherry, and red maple were identified by Dr. Williams to be the governing species in the northern-hardwood forest.

Chart C15, Appendix A37-A39 provides an up to date list of the plants, animals, and areas of special concern contained within the Clarion River watershed. The Pennsylvania Natural Diversity Inventory (PNDI) is a site specific information system describing plant and animal species of special concern, exemplary natural communities and unique geological features of the Commonwealth.

Fisheries surveys conducted in 1990 and 1995 by the U.S. Army Corps of Engineers and PA Fish and Boat Commission documented fifty fish representing 10 species of fish upstream of Piney Dam near Cooksburg, sixty-nine fish representing 12 species of fish from the outflow of the Dam downstream to Piney Creek, and nineteen fish representing 6 species near Callensburg. In June, 1996 fisheries survey revealed a total of 21 species near Johnsonburg, and Ridgway. The list of species are respectively identified in *Chart C16-C18, A-40-42.*

III. Water Resources

Quantity

Within the Clarion River Basin, the U.S. Department of the Interior Geological Survey Water Resource Division documents hydrologic data gathered from the U.S. Geological Survey's collection networks. Each gauging station records streamflow and ground-water levels. The USGS currently has five gauging stations and two groundwater wells operating within the Clarion River Basin. Beginning with the 1975 water year (October 1-September 30), the USGS designed a three-volume report which contain data on quantities of surface water, quality of surface and ground water, and groundwater level. *Appendix 44-A48* lists each station with a brief description of location, gauging system, channel and control, and discharge measurements for water years (wy) 1948-1995.[8] As part of the Flood Forecast and Warning System, the National Weather Service uses the data from the USGS continuous-record stations to

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[8] Water Resource Data Pennsylvania Water Year 1975 : Volume 3. Ohio River and St. Lawrence River Basins. (U.S. Geological Survey Water-Data Report PA-95-3), pg. 63-73

predict flood heights. County emergency management agencies may use the data to initiate evacuations and manage emergency response. The U.S. Army Corps of Engineers will use the data to manage flood-control reservoirs.

Limited data were available which described well yields in the Clarion River basin. The last published report on the water resources of the Clarion River was developed by the U.S.G.S. in cooperation by the PA Dept. of Environmental Resources. The Division of Water Planning and Allocation in the PA DEP has updated the facility type and water source since that 1980 published report.

The Clarion River Watershed geological structure is primarily composed of the Allegheny and Pottsville Group. The Allegheny Group is considered to be generally a good aquifer. Only about one-tenth of wells yield less than 3 gal/min. About one-fifth of wells yield more than 50 gal/min, with the medium yield more than 25 gal/min. The median specific capacities of domestic and nondomestic wells are 0.62 and 3.0 (gal/min)/ft, respectively. Water quality is generally poor. More than half of wells samples have moderately hard to very hard water. Iron in excess of 0.3 mg/L is common. The Pottsville Group is also considered a good aquifer. Only about one-twentieth of wells yield less than 3 gal/min. About one-fifth of wells yield more than 25 gal/min. The median specific capacities of domestic and nondomestic wells are 0.38 and 1.8 gal/min/ft respectively. Water quality is generally poor. In more than half of the wells samples, the water was moderately hard to very hard; iron exceeds 2.0 mg/L; and manganese exceed 0.50 mg/L.*(United States Department of the Interior Geological Survey)*

The major water-quality problems are due to high concentrations of iron, manganese, hardness, and acidity. Some of these problems are related to coal mining that has degraded water quality in parts of Clarion, Elk, and Jefferson Counties. The rock composition of many streams have a low alkalinity concentration and consequently have little capacity to neutralize the acid water from coal mines.

Both surface and ground water are used for supply. There are twenty-seven public water-supply systems in the watershed. There is only one water company which receives its water directly from the Clarion River, the PA American Water Company which supplies Clarion and the surrounding townships. Twelve public water companies use a well for their source of their water supply. A spring is used to furnish water in three of the public supplies. Seven public suppliers use a reservoir intake supply, and the remaining four public water supplies come from a combination of wells, reservoirs, and stream diversions, *Appendix 48-A54*. In addition to the water companies there are 49 other companies which depend on the Clarion River's watershed for their supply of water for treatment or discharge.

Water Quality

The Clarion River is affected by mine drainage along its entire length from the headwaters of the East Branch in McKean County to the Allegheny River in Clarion County. Mine drainage effects are more pronounced in the lower reach of the river downstream of the Clarion-Jefferson County line.

Pennsylvania Rivers Conservation Program

Clarion River Basin

Pollution to the Clarion River caused by mine drainage can first be seen at the East Branch Clarion River watershed. Below this point the river receives only minor mine drainage contributions until the confluence of Little Toby Creek, southwest of Ridgway in Elk County. Little Toby Creek, the principal tributary to Toby Creek is the main source of mine acid in the Toby Creek watershed. Very little mine drainage enters the Clarion River between Toby Creek (Elk County) and the backwaters of the Piney Dam located in Millcreek Township, Clarion.[9]

There is considerable mine drainage flowing into the river from its tributaries in Clarion County as a result of coal strip mines in the area adjacent to Toby Creek, Mill Creek and the Clarion River below Piney Dam. Although the U.S. Army Corps of Engineers recognizes acid mine drainage as the most serious water quality problems in the Clarion River Basin, they also find that the trends of decreasing acidity and increasing alkalinity to be very encouraging and indication that past and present effort to control acid mine drainage pollution are producing significant results.

Chapter 93 of the Pennsylvania Code, Title 25, Part I, Environmental Resources set forth criteria for state surface waters. The standards recommend a pH value between 6.0 and 8.5. At low pH values, the solubility of toxic metals is increased. Waters that do not exceed 58°F (14.4^{o}C) are considered to be cold waters. Although many sampling points during the summer months are higher than 14.4^{o} C., their mean temperatures qualify them as cold water streams. Because of the cold water classification, the dissolved oxygen values must not fall below 5.0 mg/l.

Iron, a parameter measured because of the mining industry, can take several forms in natural water systems depending upon such factors as pH, dissolved oxygen, or the amount of organic matter. The limit for use in public supplies is .30 mg/l.

The alkalinity measurement of water does not refer to pH but to the buffering capacity, which is the ability of the water to resist pH change. If a body of water has a high alkalinity, it is more stable and resistant to changes in pH. For the protection of aquatic life, Chapter 93 of the PA code recommends that alkalinity levels should not fall below 20 mg/l from the normal levels caused by natural conditions. The total acidity measurement of the stream should not exceed the total alkalinity.[10]

The PA American Water Company located in the Clarion River corridor in Clarion test the "raw" (river) water <u>before</u> each treatment to determine the amount and type of treatment the water needs to provide drinking water for the surrounding community. For each day of the year the water is sampled at least three times, averaged, and recorded . The CRBC has used this data as one source of information to indicate the average condition of water quality found in the Clarion River.

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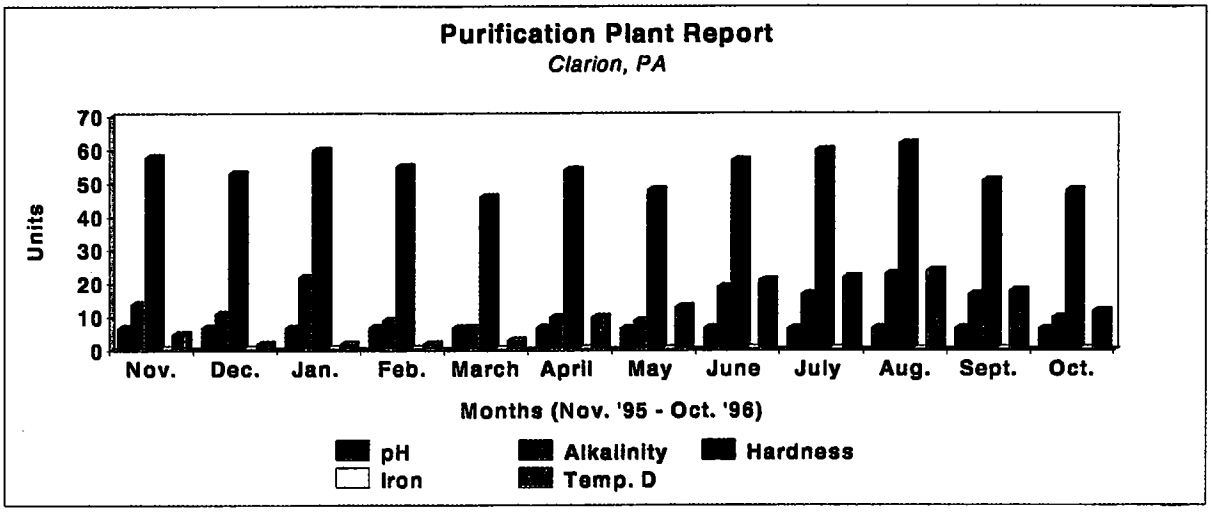
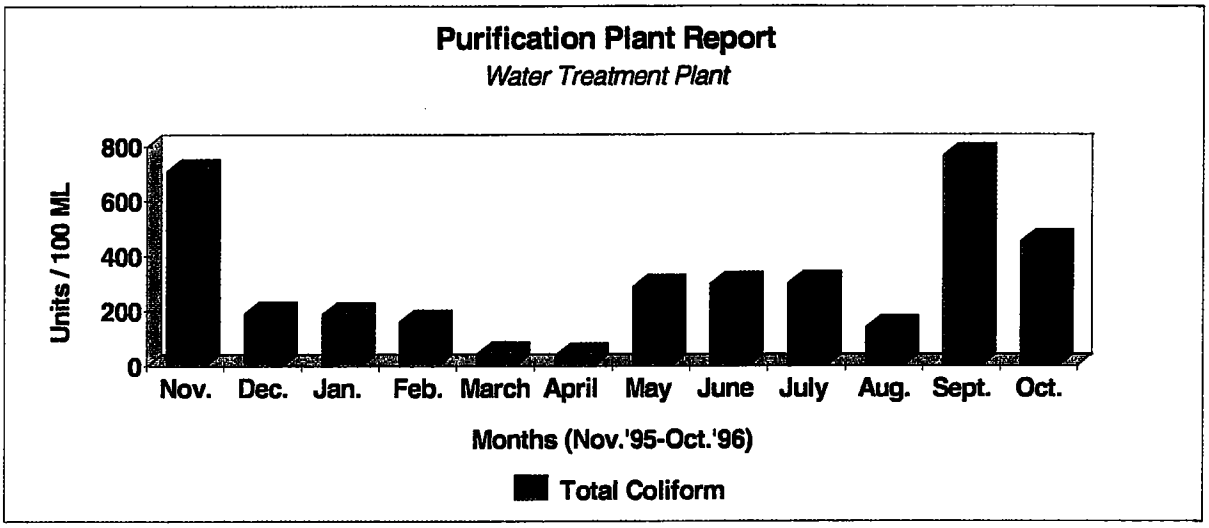
[9] <u>Clarion River Basin, Pennsylvania Acid Mine Drainage Abatement Program</u>: Stage I Reconnaissance Report (United States Army Engineer District, Pittsburgh) , January, 1980: pg. A-40-A-78.

[10] <u>Pennsylvania Code: Title 25. Environmental Resources: Chapter 93. Water Quality Standards</u> (Department of Environmental Resources, Harrisburg, PA), Oct., 1994: pg.93(14-25)

averaged, and recorded . The CRBC has used this data as one source of information to indicate the average condition of water quality found in the Clarion River.



	pH	Alk mg/l	Hardness	Iron mg/l	Temp. Deg C.
Average	6.75	14	54.3	0.54	11.12
Standard Value	7.00	> than 20	75 mg/l	0.3	14.4



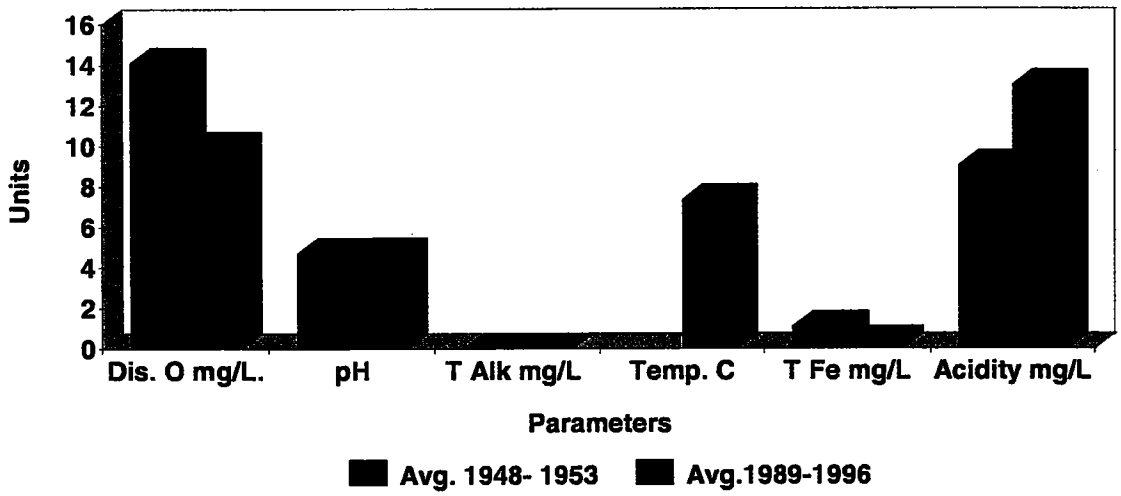
An important parameter, fecal coliform bacteria, are found in the feces of humans and other warm-blooded animals. These bacteria can enter rivers through direct discharge , agricultural and storm runoff carrying wastes from birds and mammals, and from human sewage discharged into the water. If fecal coliform counts are over 200 colonies/100ml of water sample in the river, there is a greater chance that pathogenic organisms are also present. Total coliform measurements include all coliform bacteria strains and <u>may</u> indicate fecal contamination. Total coliform is no longer regularly tested throughout the corridor except at the water treatment plant in Clarion. Results indicate that fecal coliform <u>may</u> be present within the watershed, and future sampling is

recommended to determine a data base. Please note that this data represents "raw" water.

The CRBC gathered recorded data from monitoring points along the Clarion River and its' tributaries. In each situation the water data was compared to historical sampling and the results were charted for a comparative analysis. In all sampling points the CRBC found an improvement in water quality. To grasp a complete overview of water quality, certain parameters were compared in the following charts Many parameters are commonly measured, but the CRBC chose seven parameters to be of primary importance in the study area. In almost all sampling points the parameters consisted of pH, dissolved oxygen, iron, temperature, total alkalinity, and total acidity.

The associated graphs and charts illustrate this improvement in the Clarion River watershed. Acidity levels dropped in 75% of the sampling points. The total amount of iron dropped or remain the same in 83% of the sampling points. Alkalinity levels rose in 50 % of the readings and pH improved in 83 % of the sampling points.

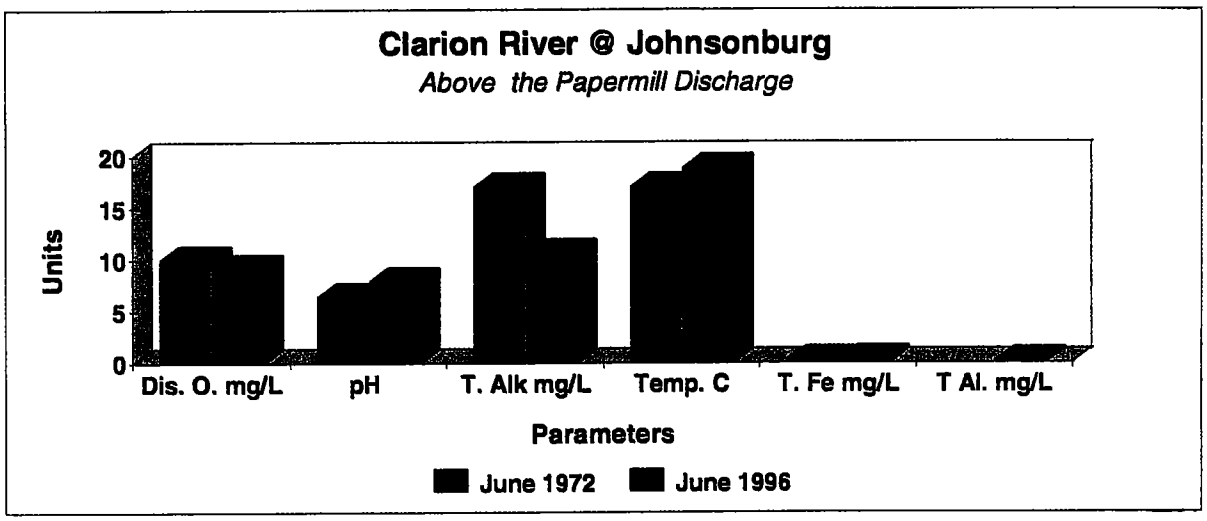
East Branch Lake



East Branch	Dis. O mg/L.	pH	T Alk mg/L	Temp. C	T Fe mg/L	T Acidity mg/L
Avg. 1948- 1953	14.1	4.7	0	6.2.	1.1	9
Avg.1989-1996	9.97	4.73	0	7.34	0.33	13
Standard Value	> than 5.0	6.5-8.5	> than 20	14.4	0.3	< than Alk.

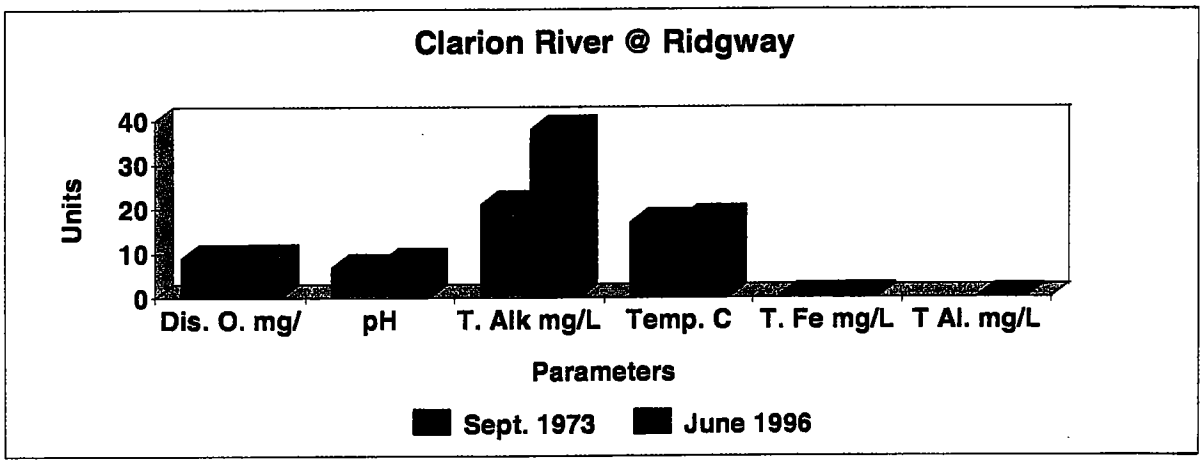
[11]

[11] Auras Raw Data Report for Water Quality: Sampled by the U.S. Army Corps of Engineers, Pittsburgh, PA. (Environmental Protection Agency's Storet Systems)



Johnsonburg	Dis. O. mg/L	pH	T. Alk mg/L	Temp. C	T. Fe mg/L	T Al. mg/L
June 1972	10	6.4	17	17	0.27	NA
June 1996	9.2	7.9	10.6	18.8	0.298	0.17
Standard Value	> than 5.0	6.5-8.5	> than 20	15.5	0.3	.1-.5 max

[12]



Ridgway	Dis. O. mg/L	pH	T. Alk mg/L	Temp. C	T. Fe mg/L	T Al. mg/L
Sept. 1973	9	6.8	21	17	0.34	N.A.
June 1996	9.1	8.2	38	17.8	0.463	0.256
Standard Value	> than 5.0	6.5-8.5	> than 20	15.5	0.3	.1-.5 max

[13]

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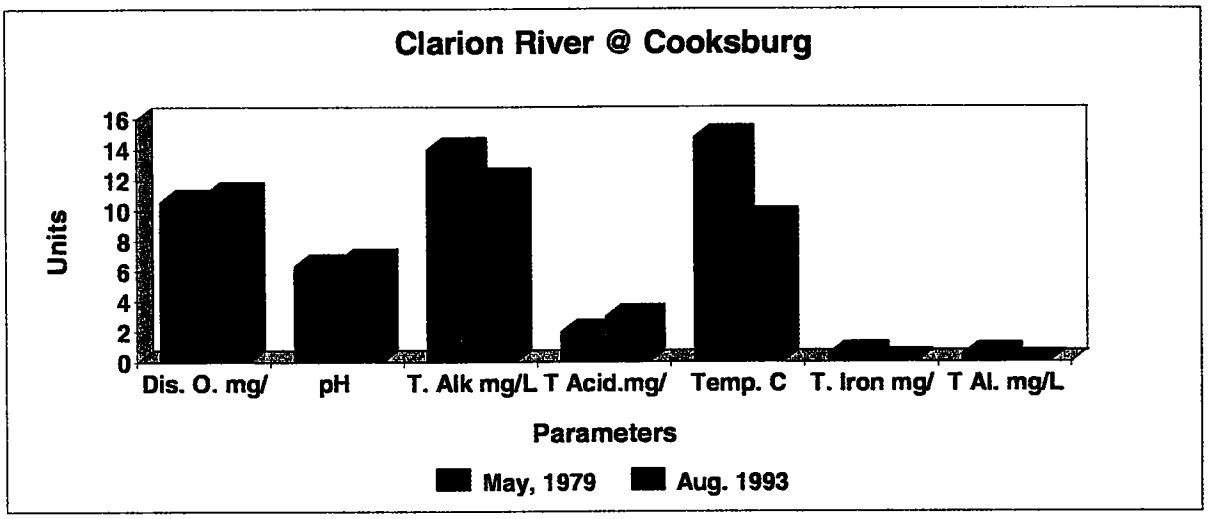
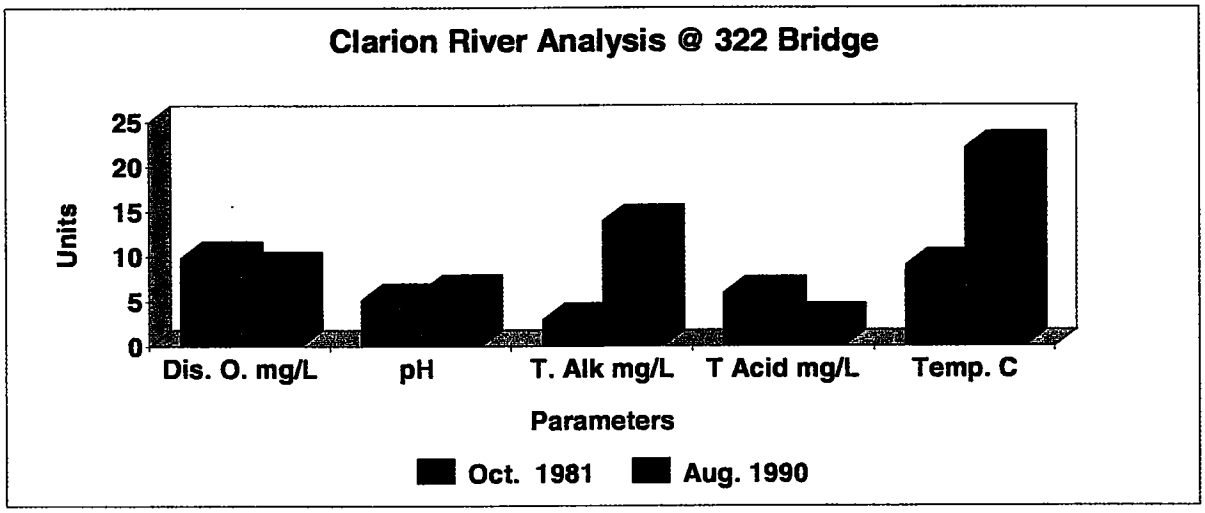
[12] Clarion River Survey, Department of Environmental Protection (Northwest Regional Office), June, 1996 Table 2, and Sampled by the U.S. Army Corps of Engineers, Pittsburgh, PA. (Environmental Protection Agency's Storet Systems)

[13] Ibid



Clarion @	Dis. O. mg/L	pH	T. Alk mg/L	T Acid.mg/L	Temp. C	T. Iron mg/L	T Al. mg/L
May, 1979	10.6	6.3	14	2	14.8	0.545	0.5
Aug. 1993	11.1	6.7	12	3	9.4	0.104	0.05
Standard Value	>5.0	6.5-8.5	> than 20	< than Alk	14.4	0.3	.5 max.

[14]



Clarion @	Dis. O. mg/L	pH	T. Alk mg/L	T Acid mg/L	Temp. C	T. Iron mg/L	T Al. mg/L
Oct. 1981	9.9	5.2	3	6	9	2.6	1.63
Aug. 1990	8.79	6.18	14	3	22.1	0.522	0.059
Standard Value	>5.0	6.5-8.5	> than 20	< than Alk	14.4	0.3	.5 max.

[15]

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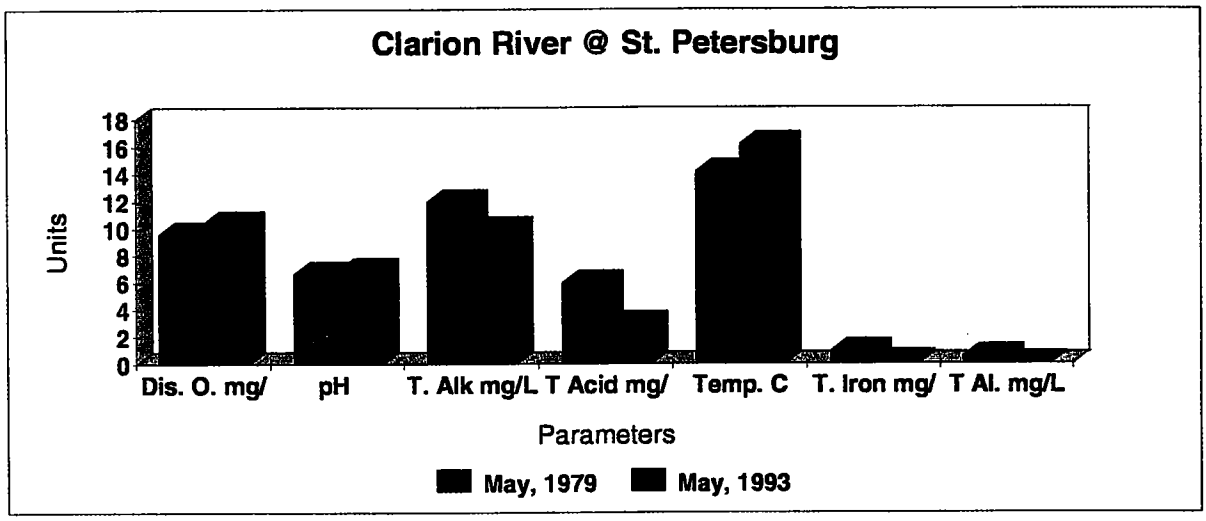
[14] STORET
[15] Ibid



Clarion @	Dis. O. mg/L	pH	T. Alk mg/L	T Acid mg/L	Temp. C	T. Iron mg/L	T Al. mg/L
May, 1979	9.6	6.7	12	6	14.2	0.96	0.55
May, 1993	10.4	6.94	10	3	16.2	0.171	0.05
Standard Value	>5.0	6.5-8.5	< than 20	< than Alk	14.4	0.3	.5 max.

[16]

The CRBC realizes that the tested parameters and charted results indicate an improvement in the Clarion River water quality; however, it must be noted that complete chemical analysis of the water is not included in any of the data. The CRBC was unable to locate a monitoring station which tests for heavy metals or toxic organic compounds.

Another method of water quality evaluation is conducted through qualitative bethnic macroinvertebrates samplings. The term *bethnic* means bottom dwelling and refers to organisms that live in, crawl upon, or attach themselves to the bottom. The term *macroinvertebrates* refers to those invertebrates seen with the unaided eye. Some organisms can survive in a wide range of conditions and are more tolerant of pollution. Others are very sensitive to changes in conditions and are intolerant of pollution. If a noticeable absence or low diversity of aquatic organisms exist the water may contain high levels of heavy metals or toxic organic compounds.

In June 1996, the Department of Environmental Protection and Environmental Services Division conducted a biological sampling of the Clarion River above Willamette Industries' discharge in Johnsonburg (Station 1) and upstream from the mouth of Elk Creek in Ridgway (Station 4). Station 2 was located approximately 1200 feet downstream from Willamette's wastewater treatment plant discharge and provided an analysis of the discharge not the water quality of the Clarion River. Station 2 results will be discussed in more detail in Chapter V. Although the purpose of the study was to provide baseline data on physical, chemical, and biological parameters existing in the river in relation to the industry's industrial wastewater treatment plant, the results can also be used to analyze the water quality of the upper reaches of the Clarion River.

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[16] STORET

Chart C-19, Appendix A-55. The aquatic insect groups Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichopter (Caddisflies), which are generally considered clean water indicators, accounted for 55% of the total taxa. The dominant invertebrates found in the riffles were the mayflies, stoneflies and caddisflies. The presence of several sensitive taxa and increased biological diversity, compared to 1992, indicates water quality conditions have improved at this location since the discharge was diverted to the new treatment plant.

The invertebrate samplings at Station 3 revealed a total of 40 taxa, representing 21 families Chart C-19 A-55. Mayflies, stoneflies, and caddisflies (EPT richness) comprised 60% of the total taxa. Results of this benthos samplings were comparable to or better than the 1992 DEP invertebrate collections taken 4 months after startup of Willamette's new biological waste treatment process. Numbers of organic responders were significantly lower during the 1996 collections. The progress made by Willamette's wastewater treatment system likely contributed to these improvements.[17]

Quantitative bethnic macroinvertebrate data were collected also in the mid section of the Clarion River. In 1994 the Department of Environmental Protection (Resources) completed a study on Toms Run, Cathers Run, and Kahle Run located in Clarion County Chart C-19, A-55. A similar study on the tributaries was completed in 1968 by the Biology Department at Clarion State College . Toms Run at that time received pollutants from the oil, gas, and coal mining industries In 1968 the Pennsylvania Water Resources Coordination Committee recommended the restoration of Toms Run as a model project. The same committee highly recommended that Cathers Run be preserved as a valuable control stream and be spared of all mining and drilling operations. According to the tabulated results minor improvements have been seen in the total number of collected species and the diverse families. The invertebrate samplings taken at Toms Run indicated a taxa index of 22, representing 6 families . EPT richness (clean water indicators) accounted for 14 % of the total taxa In 1968 the taxa index was 7, representing 4 families. Cathers Run sampling collection revealed a taxa index of 16, 5 families were represented with a EPT count of 10%. In 1968, Cathers Run had a taxa index of 14, representing 9 families. Kahle Run's study collected a total of 109 individuals, a taxa index value of 10, representation of 4 families and an EPT index of 6%. [18]

Impoundments

Streamflow in the lower East Branch Clarion River and the mainstem of the Clarion River is partially controlled by the East Branch Clarion River Dam. This dam, built in 1952, is located on the East Branch Clarion River six miles upstream from its confluence with the West Branch at Johnsonburg, PA. It is owned and operated by the Pittsburgh District of the U.S. Army Corps and Engineers. The earth dam rises 184 feet from the valley floor and controls a drainage area of 72.4 square miles, slightly less than

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[17] Clarion River Survey, Department of Environmental Protection , Table 4,5,6, and 7

[18] Semiquantitative Benthic Macroinvertebrate Data and RBP Metric Comparisons, Department of Environmental Resources, October 11-14, 1994. Table 8 and 9

6% of the Clarion River Basin area. East Branch Clarion River Lake has a surface area of 1,160 acres at the normal summer pool elevation of 1,670 feet. Storage to summer pool normally occurs during period March 1 to April 30. Depletion of low-water storage for augmenting flow in Clarion River occurs normally during period June to October. Recreational activities occurring near Ridgway during the summer months frequently request an increase in water releases by East Branch Dam.

East Branch Lake is very lightly buffered and, therefore, is vulnerable to acidification from even modest acid loads. The Pittsburgh District experienced several serious post 1991-92 drought water quality problems in 1993. After dead fish began showing up in the lake in the spring of 1993 and depressed pH levels were identified as the cause of the mortality, the District successfully neutralized the acid pollution by means of emergency applications of soda ash to the lake. Reservoir fishery and other elements were rescued by this application, and the operation assured that good quality storage would be available in the impoundment to augment flows along the reach of the East Branch Clarion, and Clarion River throughout the summer of 1993. In November of the same year, the pH in the lake was dropping again and an emergency soda ash neutralization treatment was repeated. [19]

In the fall of 1996, reclamation projects within the East Branch Dam began to occur. An annual dosage of limestone sand is being added to selected streambeds for neutralization of acid flows. *Chart C -20, A-56* identifies the amount of limestone sand, and A- explains the treatment procedure. Current and historical water data were used to determine the annual dosage rates of limestone sand.

Sixty-eight miles downstream from east Branch Dam, at a point which is 39 miles above its mouth, the Clarion River enters Piney Lake. The 12 mile reach of Piney Lake submerges the natural river channel and the valley sides fall steeply into the lake. Piney dam, is privately owned by the Pennsylvania Electric Company, and operated by GPU Genco Corporation. It is a concrete dam 100 feet high which is used solely for electric power generation. Piney Lake has a surface area of 690 acres, a total storage capacity of 33,742 acre-feet, and controls a 957 square mile drainage area. Its maximum total capacity is about 100,000 acre-feet. Peak-load power generation usually draws down the reservoir by one to five feet to augment the daily flow. This causes a quite irregular flow in the remaining 25 miles below the dam. Because of severe acid mine drainage problems in the Clarion River Basin, the Federal Energy Regulatory Commission (FERC) authorized peaking operation with no minimum release requirement for the protection of aquatic resources. As a result, the project has operated since 1979 with releases that typically fluctuate between a leakage flow of approximately 30 cfs and 4,500 cfs, the discharge when all three hydroelectric units are operating.

Since the time of license issuance, the water quality of the Clarion River has steadily improved. *(Commonwealth of Pennsylvania Fish & Boat Commission; Dec. 8, 1995)*. In 1989, the Corp of Engineers (COE) requested the FERC to require a 100 cubic feet per second (cfs) minimum release from the Piney Dam. The COE raised this issue out of concern that Congressionally authorized flow augmentation from the Corps' East Branch Clarion River Dam for water quality control was being intercepted at Piney

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[19] Pittsburgh District Water Quality Activities During 1993, Memorandum for Commander, U.S. Army Corps of Engineers, Ohio River Division, pg. 2-3

Dam. The COE anticipated that provision of these flows would enhance recovery of the fishery in light of the recent positive trends in water quality. In response to this letter, FERC required the licensee to conduct an assessment of the impact of a 100 cfs minimum flow on the economic viability of the project. The licensee and the Pennsylvania Fish and Boat Commission (PFBC) conducted several studies from 1990-1994 to evaluate the effect of various minimum release scenarios on water chemistry and habitat suitability for fish downstream of Piney Dam. The results of the study concluded..... " that provision of an intermittent release of one unit operating at 1500 cfs for one hour every 24 hours would be at least beneficial to water quality as a continuos minimum release of 100 cfs. The COE and PFBC disagreed with the findings and expressed concerns that extremes in pH and other water quality parameters would be greater with a one-hour release.[20] Since July, 1996 increased flows from East Branch Reservoir have been passed through Piney Dam rather than detaining the water for power generating purposes.

IV. Community Resources

Recreation

The types of recreation opportunities offered by the Clarion River Basin are quite varied. Most prevalent are those types which use the forests or waters of the area. The forests offer excellent opportunities for deer, wild turkey, small game and other hunting activities. Additional common use of the forests include hiking, picnicking, canoeing, fishing, biking and camping. The Department of Conservation and Natural Resources (DCNR) provides outdoor recreation opportunities though a system of state parks. The state parks provide a recreation area to the tourist interested in enjoying an outdoor vacation. Most areas provide areas designated for swimming, hiking, biking, fishing, camping, boating, picnicking, and designated areas for hunting. Within the Clarion River watershed the DCNR administers three main recreation attractions: Bendigo State Park, Clear Creek State Park, and Cook Forest State Park. Bendigo State Park is an 100 acre park located along the West Branch of the Clarion River in Elk County. Clear Creek State Park, a 1209 acre park located along the Clarion River near PA Route #949 in Jefferson County, has grown in the last decade and the amount of visitors have increased by almost 35%. The most distinguished state park within the watershed is Cook Forest. It is a 6422 acre park located in Cooksburg along the Clarion River in Forest, Clarion and Jefferson Counties. Settled by John Cook in 1828, the area contains one of the finest stands of virgin timber in the eastern United States and has been designated as a National Natural Landmark.

Allegheny National Forest covers significant amounts of land in the watershed area found in Elk, Forest, and McKean counties. There are several main attraction areas administered by the Allegheny National Forest (ANF) found within the basin. The

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[20] Biological Monitoring of the Clarion River to Assess Impacts of Piney Dam Releases, Survey Date: 10-11 July 1995, Report Date: 8 December 1995, Leroy Young-Pennsylvania Fish and Boat Commission, pg. 1-4

forest lands are relatively undeveloped and are available for low density recreation uses such as hunting, fishing, hiking, camping, and picnicking. In Elk County the ANF offers to the public: Laurel Mill X-C Ski area and the Ridgway Reservoir located near Ridgway between Big Mill Creek and Bear Creek; Twin Lakes Area located northwest of Wilcox, PA; and Loleta Recreation Area located north of Belltown. Laurel Run Reservoir located on a tributary to Elk Creek near St. Mary's, Elk County is also an area of recreation.

East Branch Lake, Elk County, is also an area frequently visited by people wanting to enjoy the Clarion River resources. The lake which is administered by the U.S. Army Corps of Engineers was created by the East Brach Dam. Elk State Park is a 3192 acre park developed around the East Branch reservoir and is also administered by the U.S. Army Corps of Engineers. A description of each recreational area identifying activities, facilities and the number of participants can be found on *Chart C21, A57-58*.

The aquatic resources have continue to improve in the area creating an increase in recreational activity. The PA Fish Commission regulate fishing and boating on the local streams and the river. Several streams are stocked with either bait or game fish. The Clarion River is considered to be a good early season trip for avid canoeists. Piney Dam offers 16 miles of boating, and skiing. Genco, operator of the hydroelectric dam, issues 300 dock permits a year entitling the use of 20 feet of shoreline. A public boat launch is available at Toby Bridge just below Clarion, and Millcreek. Both launches receive tremendous usage and may be in need of parking facilities, and restroom facilities.

The Clarion/Little Toby Creek Trail has incorporated a section of the old Penn Central Ridgway Secondary Rail Line. Developments are underway for a 13 mile intermodel transportation project. This rail-trail will begin in Brockway and continue northward along Toby Creek. It will continue along the Clarion River and Rt. 949 in Ridgway and Spring Townships, Elk County.

Archaeological/Historical

A total of 34 Historic and 254 Prehistoric sites are on record with the Bureau for Historic presentation as being located in the Clarion River Basin. Little survey work has been completed to document these sites. Sites are determined by following the guidelines of History Code (37 PA.C.S.). The code permits "archaeological field investigations" which are studies "of cultural history at an archaeological site by professionally accepted means of surveying, sampling, excavation or removal of archaeological specimens."

Historic sites are located in all counties except McKean County. Nearly 45% of the historic sites are catalogued as "Unknown Site Type", 33 % are grouped as "Industrial Sites", and very few sites are identified as "Commercial or Domestic". The National Register Status for approximately 75% of the sites considered the data to be insufficient.

Prehistoric sites also exist in each county within the basin except McKean County. Nearly 47% of Prehistoric sites are classified as "Open Habitation Sites", and 36 % are labeled as "Rockshelter/Cave Sites." There are few Burial Mounds and Aboriginal Sites. Approximately 90% of the sites have an "Unknown Condition" and the National Register Status considers the data insufficient. *Chart C22, A-59-64* identifies

each site. There has never been a comprehensive historic or archaeological survey conducted for the basin. The historic and prehistoric sites on record represent only a small fraction of the sites that may actually be present.

Humans first arrived in the Clarion River Basin about 11,000 years ago when the area resembled Arctic Canada. Native Americans hunted Caribou and other large animals. The Clarion River quickly became a key travel route and an important Native American hunting ground.

A considerable number of rock overhangs or "rockshelters" are located in the basin and have been utilized by prehistoric American Indian groups prior to European settlement. Archeological remains in those rock shelters not only contain important clues about past cultures but also yield information on past climatic, floral and fauna changes that have occurred in the basin. In addition to rockshelter sites, the basin also contains stratified open sites, such as State Run Ripple, that have the potential to answer important research questions on the archeological cultures who have occupied the basin in the past.

Native Americans living along the Clarion River used horticulture, ultimately adding semi-sedentary village sites into settlement patterns. The French arrived in the 1800's and named the river "Riviere au Fiel," the River of Hate because it was known as the dividing line between the feuding Seneca and Delaware Indians. It is believed that the river received its present day name by one surveyor who identified the nature sounds of the river as clear and distinct. The sounds were like a "clarion call". The state government formally adopted the name Clarion River in 1819.

Lumbering was an important industry in the area throughout the 1800's because of the area's abundance of hardwood forests. The Clarion River and its tributaries were vital to transporting timber to Pittsburgh. Iron ore, which was mined in the Clarion River valley, was also transported on the river. Both of these industries environmentally impacted the Clarion River. Excessive sawdust from sawmills killed fish and clogged streams while the timbering industry wiped out the hillsides causing erosion and sediment loads in the streams. Another pollutant of the river was mine drainage from large scale mining. More than 75% of the 250 streams that flow into the Clarion River have been affected by mine drainage.

Though the river has been negatively impacted by industry and pollutants, several unique structures survived in the river basin.. Arroyo, a particular heritage resource site, was once larger than the town of Ridgway. The community had residences, hotels, opera houses, businesses, sawmills, tanneries and chemical plants. Foundations still remain from this once bustling town. Indian forts ruins have been documented near Russell City. Also, according to Brian Socolic *(PA Historic Resource Survey, 1994),* there are at least eight dams, some bracket, along Mill Creek and Little Mill Creek. " These dams are important in documenting Pennsylvania's logging practices, lumber history of the Clarion River Watershed, and structures of folk technology. Constructed by lumbermen, the dams are significant rare remnants of an era when Pennsylvania was a leader in lumber production. Other logging boom remnants include a series of man made islands near the town of Portland Mills. Two specific groups of islands, Bear Creek Eddy and Mill Haven, are old logging pools.

Natural Resource Extraction

The Allegheny is Pennsylvania's only National Forest, and it comprises a half million acres of land in northwestern Pennsylvania. It was established in 1923 with ownership of surface rights being of principal concern. Title to oil, gas, and minerals remains in private ownership on 94% of National Forest ownership. The land is primarily timbered and helps to support local industries with fine hardwood timber such as black cherry, maple, ash, and oak. A 1996/97 map is available through the Allegheny National Forest identifying "timber cutting areas." The map is supported by the area's travel promotion agencies, and is titled "Hunting the Alleghenies".

Within the Clarion River Basin the Allegheny National Forest has several areas with restrictions on new road construction. This management procedure significantly limits timbering because of an inability to build an access road. Defined as Management Area 6.1, this area is found along the north side of the Clarion River that is east of the powerline which goes to Portland Mills and south of Township Toad T-307 and LR 24002 between Hallton and Ridgway.[21]

To provide regional as well as statewide information on forest resources in Pennsylvania, the state is broken into eight geographical units. The Clarion River Watershed intersects the Allegheny Region (McKean, Forest, and Elk County) and the North-Central Region (Clarion and Jefferson County). There are two types of forest lands: commercial and noncommercial. On noncommercial forest land, harvesting is legally restricted or unlikely to take place. Included are parks and natural areas, forest land in urban settings, unproductive forests, and Christmas tree plantations. The remaining commercial forest-land category, accounts for 93% of the forest land, and supports more hardwood timber volume than any state in the nation with the exception of North Carolina.

The Clarion River Basin Commission was able to identify areas of timberland by county and ownership class. [22] Each county's figures provides the total amount of timberland, but does not identify timber production.

Ownership Class *(in Thousands of Acres-1989)*

County	National Forest	Miscellaneous	State	Municipal & County	Forest Industry	Farmer	Other Private
Elk	104.3	0	120.2	5.4	59.5	5.4	168.4
Forest	110.2	0	9.9	0	54.8	5.7	69.6
McKean	128.2	0	24.2	5.6	151.2	0	211.1
Clarion	0	0	18.9	0	21.5	10	181.2
Jefferson	0	0	41	0	10.9	10.3	187.7

[21] Land and Resource Management Plan Allegheny National Forest (United States Department of Agriculture, March 1986), pg. 114-115.

[22] Forest Statistics for Pennsylvania--1978 and 1989 ,United States Department of Agriculture, Forest Service, Resource Bulletin NE-126, January 1993, Table 146.

This section of Pennsylvania also has a vast amount of natural resources in the form of oil and natural gas. Pipelines from the gas wells are common in and around the corridor. Many old wells were abandoned after they were no longer economically feasible to operate. This is the case with many wells around the Clarion River. The abandoned wells can leak gas, oil, and brine- making them a pollution hazard. Programs for plugging these wells have been initiated. A new regulation requires that after two years of inactivity a well must be plugged. In 1972, identification and abatement of tributary mine drainage sources, mainly abandoned oil and gas wells, was targeted by a proposed acid mine drainage abatement program in six major pollution-contributing watershed drainages. The status of this reclamation project is unknown.

Planning

Each county, except Elk, within the Clarion River Basin has a Subdivision and Land Development Ordinance. The purpose of this ordinance is " to promote the health, safety, convenience, and orderly development of the County...". Jefferson County developed a comprehensive plan in 1991, and Elk County developed a three year plan in 1996. Barnett Township, Forest County, completed a comprehensive plan in 1996. Similar to Elk and Jefferson County, this plan addresses issues (sewage needs, tourism development, land use, and stormwater drainage), but does not determines or limit the uses of the land. The only requirement is that the design or development must fit the intended use of the land. Reports indicate that Millcreek Township, Clarion County has established a zoning ordinance which will affect the Clarion River Watershed, but at the time of this document details of the ordinance could not be provided. Clarion and McKean County have not completed a comprehensive plan or have developed zoning ordinances.

Johnsonburg (adopted 1978) , Ridgway, (1985), and St. Mary's Borough (1988) have established ordinances which discourages new construction or development within the floodplain district. Existing structures located in any designated floodway area shall not be expanded or enlarged unless the effect of the proposed expansion or enlargement on flood heights is fully offset by accompanying improvements. The boroughs have a zoning map which delineates the floodplain area which is subject to the one-hundred year flood as identified in the Flood Insurance Study (FIS) prepared by the Federal Emergency Management Agency (FEMA).

V. Areas of Concern

Landfills

As of March 1995, there are three permitted landfills within the Clarion River Basin: County Landfill located in Farmington Township, Clarion County; Greentree Landfill operated by Superior Waste Services of West Allis, Wisconsin in Elk County; and Kness Saint Landfill in Sargeant Township, McKean County.

County Landfill, Inc., was issued a solid waste disposal and/or processing permit in June 1990 with an expiration date of June 2000. The landfill is permitted to receive no more than 1,500 tons of solid waste on any single operating day, and no more than 1,000 tons of solid waste on an average daily volume basis over the standard calendar year. Residual and municipal solid wastes are accepted for disposal. No liquid waste is permitted to be disposed of at the landfill. Previously, the leachate was monitored and analyzed by County Landfill, and treated at the Clarion Municipal Sewage Plant. County Landfill initiated an on-site leachate treatment plant in February, 1997.

Kness Saint Landfill has been authorized by the McKean County Solid Waste Authority to discharge from the facility at Sargeant Township to receiving waters named Little Sicily Run. The existing landfill must meet effluent limitations and monitoring requirements established in its industrial NPDES Permit provided by the DEP Bureau of Water Quality Management. This is a temporary discharge permit until the permittee completes the new leachate treatment plant by October 1997.

The Greentree Landfill is owned and operated by Superior Waste Services located in Fox Township, Elk County. The site size is 1336.4 acres with 90.7 acres permitted disposal area. The landfill is permitted to receive a maximum of 6000 tons of solid waste on any single operating day and no more than 3400 tons of solid waste on an average daily volume based over the standard calendar year. Greentree Landfill has a recycling program with containers located on-site to collect glass, aluminum, and plastic recyclables from local municipalities. The existing landfill must meet effluent limitations and monitoring requirements established in their industrial NPDES permit provided by the DEP Bureau of Water Quality Management. The leachate is collected, stored, and treated at the on-site leachate treatment plant. The treated effluent is discharged to the local stream Little Toby. Superior is currently in the process of applying to the PA DEP for an expansion permit for an additional 134.4 acres of disposal space.

Abandoned Landfills

One example of point-source pollutant is the leachate created by abandoned landfills . The Solid Waste Authority in Elk and Jefferson County has begun to identify these landfill sites along with dump sites within the study area. Residents from the counties have the opportunity to report dump sites assisting the county in remediating problem areas. Each site, location, size, and dump items are listed. The sites have been identified, but they have been only evaluated according to the ease of clean up. This topic is of importance to the Clarion River Basin Commission. The abandoned landfills present an opportunity to create a toxic leachate which may be flowing into the watershed. Many of these landfills are unlined and do not have a leachate collection and treatment system. Some of the landfills are remains of the municipal dumps in existence before the current municipal landfill standards and laws were written and enforced. At this time, the Clarion River Basin Commission has not completed an analysis of the sites or possible contaminates leaching into the study area. The Clarion River Basin Commission is unable to locate an organization in Clarion County which is undertaking the task of identifying abandoned landfills.

Mined Areas

A 1976 study showed 474 sources of mine drainage in the Clarion watershed, and past analysis of the magnitude of the Acid Mine Drainage (AMD) sources in the Clarion River Basin was accomplished in a 1981 U.S. Army Corp of Engineers study of the Clarion River Basin. The study identified seven main watersheds which had severely degraded water quality due to mine drainage resulting from abandoned coal mining operations and oil and gas wells. The watersheds identified in the 1981 study affected by mine drainage were those of East Branch Clarion River, Little Toby Creek, Mill Creek, Toby Creek, Piney Creek, Deer Creek, and Licking Creek

Through the Bureau of Abandoned Mine and Reclamation, a division of the Pennsylvania Department of Environmental Protection, an overlay for each quadrant is available which displays abandoned mine land problems, and health and safety problem areas still in existence as of 1989. The overlays identify surface and underground burning pockets; explosive gas vents; dangerous piles, embankments, impoundments, slide, and highwalls; polluted agricultural/industrial water resources; polluted drinking water resource or polluted recreational waters used for swimming; clogged streams; dangerous disposal of industrial or residential waste; and hazardous abandoned mining equipment or facilities. According to the 1981 U.S. Army Corp of Engineers study, there are approximately 30,000 acres of strip mined land which exists in the basin, including 21,000 acres in Clarion County. As the major sources of acid pollution are identified and the problems corrected, the affected watersheds have become repopulated with a diverse assemblage of fishes. The general study area presents a pleasing view to the eye since little development of human kind is readily apparent. Exceptions are the mined areas in the watershed. The coal mining industry has left great scars on the hillsides where restoration and revegetation were not accomplished.

Industrial Waste Sites

Industrial waste sites exist within the Clarion River Basin essentially in The St. Mary's area. Stackpole Carbon Company no longer operates in St. Mary's but continues to work with the Environmental Clean-up Department of the DEP located in Meadville. Stackpole's old plant site is the location of a fully lined encapsulated landfill and a capped electroplating lagoon. The plant site is currently owned by the North Central Pennsylvania Regional Planning and Development Commission. Approximately seven years ago, each site was sealed according to regulations and is monitored every three months.

Stackpole is also responsible for a "Rear Tannery Landfill." This site is closed and sealed with soil. Two wells are used to pump the contaminated water, and the leachate is treated at the St.Mary's Sewage Treatment Plant. Stackpole also had a site in Benzinger Twp. which recently was purchased by another carbon manufacturing company. This site is the location of a ground water remediation system which pumps and pre-treats the contaminated groundwater. This leachate is then sent to the St. Mary's Sewage Treatment Plant.

"The Clay Pits Landfill" is another responsibility of Stackpole. This landfill contains non-hazardous residual waste and is sealed with a soil cap. Stackpole must

monitor this landfill every three months. Stackpole is finalizing the solution to their old dump site which has been in use since the late 1960's. The site is located on an old strip mine and maybe leaking into the groundwater. The residents in the area depend on the city's public water system for consumption.

As this area was once the world's leading tanning and wood chemical industry which often caused on-site disposal of toxic industrial waste other critical areas may exist within the basin. Many of the soils present in the basin are easily erodable, and they are thought to be contributing considerable amounts of sediment to the receiving streams. The disturbance of these soils through natural erosion, agriculture, construction, road building and strip mining has led to this sedimentation.

Treatment Plants

Point-source pollution to the basin could occur as a result of an inadequate discharge system permitted by the DEP. As of May 1, 1996, there were 73 different entities that possessed a National Pollutant Discharge Elimination System (NPDES) permit within the Clarion River Basin. [23] Twenty-seven permits were for industrial waste discharge. Thirty-two discharged permits were for non-public sewage wastes, such as schools, private homes, and hospitals. The remaining fourteen permits were for public sewage systems which are discussed in the next paragraph. Each unit within an industry needs its own permit so some permittees will maintain as many as seven different permits. For an example, Motion Control located in Ridgway Boro has seven industrial waste outfall permits. Thirteen entities are permitted to discharge directly into the Clarion River. Sixty permits allow a discharge into a tributary of the Clarion River. Elk Creek, Elk County is the site of thirteen permits, with many of the industries having multiple permits. The DEP establishes effluent limitations which the permittee must follow. St. Mary's is one of the most populated and industrial areas found within the basin. Unfortunately, St.Mary's relies heavily on Elk Creek for all of its major water supply and discharges. Although Elk Creek appears to be able to handle all of its demands, water monitoring stations within the creek do not exist. The sewage treatment plant must complete an effluent analysis, but this does not provide an accurate report on the complete condition of Elk Creek.

There are fourteen public sewage treatment plants found within the study area. The larger treatment plants are Johnsonburg, Ridgway, St. Mary's, Brockway, and Clarion. Each one of these plants is required to comply with the terms, conditions, or effluent limitations of their permit. Ridgway recently upgraded its facility to correct a problem with meeting its effluent limits. St. Mary's sewage treatment plant is currently in the renewal stage. The plant was upgraded in 1986 to provide adequate capacity and service for the growing area. Future extensions may dictate the need for future evaluations of the system capacity. St. Mary's sewer system serves an industrial area and an adoption and enforcement of pretreatment regulation were initiated to relieve the

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[23] National Pollutant Discharge Elimination System, Bureau of Water Quality Management WQFC304RO, Pennsylvania Department of Environmental Protection, May 1996

heavy metals. Reports indicate that this solution is working well, but St. Mary's sewage treatment plant is stressed with meeting the discharge limit on copper. The other large treatment plants do not have the same effluent limits on metals that is found in the St. Mary's sewage treatment permit. There is a possibility that the other treatment plants are encountering metals and not properly removing them. Without a proper analysis, the measurement of metals is unknown.

All major sewage treatment plants in the Clarion River Basin experience inflow and infiltration problems during heavy periods of precipitation. The plants are permitted to bypass partially or untreated sewage if the plant's system is experiencing an overload. According to the DEP Sewage Inspectors each sewage treatment plant appeared to have a high occurrence of bypass because of heavy rains during the calendar year of this study. An inspector knew of one treatment plant which bypassed plant treatment 26 times in 9 months beginning Jan.1, 1996. Heavy rainfalls overwhelm the treatment systems and rainwater and sewage combined discharges raw sewage into the river resulting in bacteriological contamination throughout the entire length of the river. Stormwater management plans are needed in several areas within the basin, and this could assist sewage treatment plants with its inflow and infiltration problems. Each sewage treatment plant provides secondary treatment and its effluent is sampled on a regular basis.

A principal industry found within the basin is Willamette Industry, a paper mill located in Johnsonburg, PA. Prior to the Willamette's purchase of this mill, the mill had been criticized for introducing pollutants to the river and creating a discharge lethal to the fish. Previous DEP water quality studies (through 1985) of the river did show depressed conditions and a fishery dominated by organic tolerant species. Since the introduction of Willamette's new biological wastewater treatment plant the chemical and biological quality of the river has improved. In June 1996, DEP reports indicated that the water chemistry results and measured field parameters for the river were generally within allowable ranges for aquatic life protection. Biological conditions have greatly improved in the upper Clarion River since Willamette's new biological waste treatment process began in May of 1992 and discharges to Dill Hill lagoon ceased.[24] However, specific conductivity, total alkalinity, color and total dissolved solids (TDS) were significantly higher at river stations below the papermill and Johnsonburg Sewage Treatment Plant discharges. Nutrient levels and biochemical oxygen demand were reported at fairly low levels for the Clarion River.

A noticeable color change (reddish brown) does occur in the river below the papermill's effluent diffuser. Moderate amounts of whitish-pink, flocculent-like material were also noticed. The reason for this flocculent material escaping the treatment system is unknown and should be investigated further.

The discharge temperature and volume continues to create a concern with the DEP due to the fact that the river is designated for Cold Water Fisheries. A thermal variance study is recommended in order to protect the fish and aquatic life. [25]

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[24] Clarion River Survey, Ridgway Township, Elk County. (Department of Environmental Protection, Northwest Regional Office, December 18, 1996)
[25] Ibid.

No sores, external abnormalities or dead fish were found at any of the sampling stations. A total of 21 fish species were found during the sampling session. *Chart C24, A -66* provides the water chemistry, and *Chart C18, Appendix A-42* (Chapter II) identifies the fish samplings.

Non-Point Source Pollution

The Clarion River and many of its tributaries are also adversely impacted by non-point source pollution. Since the completion of the 1981 Corps of Engineer Study on the Clarion River Basin in which seven main tributaries were identified as affected by acid mine drainage, reclamation projects have occurred and are identified on *Map 4: Clarion River Watershed Treatment.* The green shaded areas represent that a passive wetland treatment system is either being used or is currently proposed as an alternative treatment for mine drainage. The coral shaded areas indicate that a passive alkaline addition has been the method of treatment to remediate the mine drainage problem. One other method of treatment is the installation of a lime treatment facility along the Toby Creek in Jefferson County. *Appendix A67 -71* depict the water condition of each watershed and illustrate the reason that reclamation projects are needed. In each proposal the appropriate organization has completed the necessary water analysis and has applied for funding A description of each treatment method can be found on page *A72-73* in the Appendix. Projects such as these have improved the overall quality of the Clarion River. In May, 1997 the DEP issued a permit for a reclamation project on the Millcreek Watershed. The permit will allow the deposit of fly ash over 210 acres. This fly ash which will create an impermeable barrier will cap the former strip mine. The project is set to begin by early June, 1997. Mine drainage is a non-point source pollutant that haunts the clean-up of the watershed, but as organizations continue to work on projects, the restoration of the Clarion River appears to be on the right course.

Non-point pollution may also occur by agricultural activity which may increase the nutrient loading, causing low oxygen levels in some streams. Road conditions may cause a high sediment concentration in streams. This complaint has been reported to the CRBC numerous times during the public meetings. Road conditions adjacent to many of the streams are not paved. The road surface is considered unstable, causing road sanding and streambank erosion. In all counties found within the watershed, the majority of the state roads contain an asphalt surface, but the majority of the municipal roads are surfaced with either dirt or gravel. As shown on *Map 3: State and Local Roads.* the majority of the roads within close proximity to a stream are maintained by the local municipality.

Portions of the Clarion River's watershed could be in jeopardy of becoming acutely degraded by the level of bacteria caused by improper sewage treatment. In Elk County the Planning Commission identified in 1996 that improper sewage treatment and disposal represents a "major problem within the County of Elk." *(County of Elk Three Year Plan, 1996, Community Development and Housing Needs)* . Fox township has been the site of raw sewage from malfunctioning on-lot systems. Recently this township has been able to acquire sufficient funds to alleviate this problem for most of the initial target area. However, Fox Township is also the site of substantial growth and needs to continue to accommodate the growth. The village of James City, at the time of this

report, did not have a sewage collection or treatment system. Funding was being sought and obtained; however, permanent plans have not been established. Jones Township in Elk County has an approved Act 537 Plan for the village of Wilcox. The plan suggest that installation of gravity sewers, pump stations, and force mains should be used to transport wastewater to Johnsonburg for treatment. In May, 1997 a Class II Environmental Assessment was completed and plans are underway to install main lines to serve the village of Wilcox. The lines will establish tie-in and treatment provided by the Johnsonburg Municipal Authority sewage treatment plant.

Jefferson and Clarion Counties have existing sewage treatment in the major residential areas within the Clarion River watershed. The drainage basin in both counties though experience a lack of public sewage lines with the majority of the population utilizing on- lot septic tanks. The problem in both of these counties and Forest County is the non-existence of public restrooms in some tourist areas. As the river's water quality improves, so does the number of tourist, anglers, hunters, and visitors. As the river's corridor and streams fulfill the recreational needs of the people, the surrounding areas need to improved the infrastructure of the area. The State and National recreation areas are well equipped with facilities. The CRBC is receiving complaints from local citizens in areas with a lack of facilities that are frequently used by over-night canoeists or back packers.

Monitoring

The PA Fish Commission has three regular monitoring stations along the Clarion River corridor: Cooksburg, near mid-channel of the river, Cathers Run in Millcreek Twp., and Callensburg, a location close to the mouth of the river. Research has indicated that different entities including DEP also continue to monitor portions of the Clarion River and its tributaries for the purpose of acid mine drainage reclamation. If a pollutant intrudes the upper portions of the Clarion River, the problem should be identified by the PA American Water Company. As mentioned previously though, there is a lack of chemical monitoring data identifying the presence or non presence of trace metals within the water or the bottom sediments of the basin. Trace metals can occur in an area that has manufacturing, improper sewage treatment, or landfill leachate. These pathways are all found within the Clarion River Basin.

Periodically the PA Department of Environmental Protection (DEP) and the PA Fish and Boat Commission will collect fish from selected areas within the basin and send the fish to a laboratory for analysis. The fish are tested for a number of chemicals. In 1991 a small mouth bass was collected near the bridge in Cooksburg. The analysis indicated that actual values of many of the chemicals could not be determined because of such low amounts, but the sample did contain chromium (.225 ug/gm) and total copper (1.940 ug/gm). In 1993 a walleye collected near Callensburg provided similar results with a copper amount of .346 mg/kg, and a mercury level of .379 mg/kg. A brown trout sampled from Cathers Run in 1993 indicated small levels of copper (.381 mg/kg) and small amounts of mercury (.095 mg/kg). East Branch Lake was tested in 1990 for metals only. Two small mouth bass were tested and both indicated a trace amount of arsenic (.060 and .110 mg/kg), copper (.330 and .280 mg/kg), and mercury (.330 mg/kg in both samples). According to the EPA biologist who completed the test on

all fish samples the results identified small amounts of trace metals and should not present a health problem to the human consumer.

The EPA mandates a dioxin study to be completed on all rivers affected by certain industries. Because of the paper industry located in Johnsonburg, the Clarion River near Ridgway was involved in the 1987 National EPA Dioxin Study. The study tested a whole white sucker and the fillet portion of a brown trout. The results showed a 9.51 Toxic Equivalent Concentration (parts per trillion -ppt) in the whole white sucker, and a 4.02 Toxic Equivalent Concentration (ppt) in the brown trout. The CRBC could not find a thorough explanation of a safe level of toxicity in fish for consumption. The EPA and the DEP stressed that the fish sampled from the Clarion River Basin are safe. The age, size, and type of fish and chemicals present determine the amount of fish a person can safely consume. The consumer's age, size, and, sex are also determining factors in safe level of consumption.

The existing monitoring systems within the Clarion River watershed appear to be adequate. The quality and quantity of that water data illustrates improvements within the basin. A problem arises, though, in the location of the data. The different organization and entities involved within the basin do not have the opportunity to share information. Each group maintains its own records, and data are only shared upon request. The CRBC identifies that this system could be improved with minor networking suggestions.

Floodplains

Floodplains were identified on each topographic map with a light gray shading. The Federal Emergency Management Agency (FEMA) maps were used to identify the 100 year floodplain boundary. The floodplain identify is used to administer the National Flood Insurance Program.; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources. Standard hydrologic and hydraulic study methods were used to determine the flood hazard data . A flood event of a magnitude which is expected to be equaled or exceeded once on the average during any 100-year period has been selected as having special significance for floodplain management (see zoning ordinances). This event, commonly termed the 100-year flood, has a 1 percent chance of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of specific magnitude, rare floods could occur at short intervals or even within the same year.

At one time flooding within this basin was the most serious water resources problem. The Corps of Engineers has completed channel improvements work in Johnsonburg and Ridgway and built the East Branch Dam in 1952 to reduced flood stages in the basin. The Department of Environmental Resources (Protection) has two completed local flood control projects in Brockway Borough which have helped the area and its vicinity by reducing flood damages. Major floods have occurred in the basin in 1936, 1942, 1950, 1959, 1964, 1972, and January, 1996 and July 1996.

In 1980 the Department of Environmental Resources completed a State Water Plan for the area. The study suggested that a channel modification occur on Smith Run at Brockway Borough and on Elk Creek in St. Mary's for the purpose of flood damage reduction in the area. Also suggested in the same study was the request to conduct a

feasibility study for the construction of two small potential reservoir sites located on Hoffman Run and Rocky Run respectively for flood damage reduction in the Wilcox area. Research conducted by the CRBC has indicated that neither project has occurred

In 1996 the Clarion River Watershed experienced two major floods. In January the floods were caused by an unusual combination of heavy rain, unseasonably high temperatures, high winds, and the resultant rapid melting and runoff from thick snowpack. Flooding was particularly severe on the West Branch Clarion River at Wilcox and Elk Creek in Ridgway. In July 1996, the lower part of the Clarion River Watershed was hit the hardest. The gauging station at the Piney Dam reached a discharge of 57,200 Cubic Feet per Second (cfs). Piney Creek and Deer Creek appeared to suffer the most damage. Twenty-two township bridges and roads sustained heavy damages, and eight PennDot bridges were structurally impaired as a result of floodwaters. As a result of Ridgway Boro's extensive damage in January, 1996 and the boro council investigated possible solutions to prevent further flooding. According to the Boro manager, though, all plans were aborted when the estimated cost was approaching 8 million dollars.

Issues and Concerns

The Clarion River Basin Commission (CRBC) held a number of public meetings for the purpose of identifying concerns of the citizens living within the Clarion River watershed. The commission presented the first of two public meetings on Wednesday, August 7, 1996 at the Clarion County Courthouse. Over 300 public notices were mailed to individuals, corporations, and political figures living in the Clarion River Basin. Approximately thirty-five people attended the two hour meeting. Each attendee received a copy of the agenda, a Clarion River Basin factsheet, and a description of the watershed Appendix A67-70. The presentation lasted a half hour with the remaining 90 minutes used for comments. There was a good percentage of participation from the audience and the comments concentrated on existing, specific pollutant problems and previous studies. Issues and complaints were recorded.

On. Wednesday, August 14, 1996 the CRBC repeated the public meeting at the Elk County Courthouse in Ridgway. Once again the public notices were mailed and approximately fifty-people attended the meeting. The same format was followed, and the comment period lasted almost two hours. The public was more outspoken with a higher percentage of participation. Issues, concerns, and comments were recorded.

Smaller meetings were arranged on an individual basis. Numerous non-profit organizations requested slide shows and an opportunity to voice opinions. By mid January, 1997 public meetings ended, and a list of issues and concerns were established by the CRBC.

Pennsylvania Rivers Conservation Program

Clarion River Basin

I. Setting

General Description

The Clarion River is located in northwestern Pennsylvania. The watershed is in the headwaters of the Ohio River Watershed. The Clarion River drains a 1,252 square miles watershed and enters the Allegheny River near the city of Parker, Pennsylvania. The watershed is comprised of several smaller watersheds with over 250 streams. The East and West Branches of the river originate in McKean County and flow southerly before merging at Johnsonburg in Elk County. From this confluence at Johnsonburg, the river flows southwest for 101 miles before emptying into the Allegheny River. The mouth of the Clarion River lies about 50 miles north - northeast of Pittsburgh and 75 miles south - southeast of Erie, Pennsylvania. *Map1: Clarion River Watershed Location*.

The study area is the entire Clarion River watershed which lies in parts of Clarion, Elk, Forest, Jefferson and McKean counties. The overall impression of the area is one of irregular wooded hills and winding valleys. The upper part of the basin above Clarion has narrow, steep-sided slopes and valleys with high hills. The Clarion River has an unique, picturesque quality with its diverse and mature vegetation, sinuous channel, and varying water conditions.

The Clarion River Basin is in the Allegheny High Plateau and Pittsburgh Plateaus sections and is underlain with coal-bearing rocks of the Pottsville and Allegheny Groups. This area is typified by relatively flat to gently rolling plateaus dissected by deep, V-shaped stream valleys. Elevations on plateaus typically range from 460 to 490 meters (m) above sea level. Stream valley floors generally range from 330 to 400 m in elevation. Oil and gas are limited to the lower basin; whereas, the coal beds are evenly distributed throughout the basin. *Chart C1, Appendix A-1* [1] The Clarion River corridor consists primarily of the Lower Mississippian and Upper Devonian Group. Characteristics of this group are sandstone, shale, siltstone, and some red beds. Refer to *Appendix A2-A4* for a complete description of each bedrock formation and group in the Clarion River Basin. Included in the description is an analysis of the ground water found in each group.

Major Tributaries

There are 16 major tributaries of the Clarion River Basin which have a drainage area greater than 25 square miles, *Map 2: Major Tributaries of the Clarion River Watershed.*[2] The East Branch and West Branch tributaries are located in McKean and Elk County. As the river continues to flow southwest through Elk County, the tributaries Elk Creek with its source near St. Mary's, and Big Mill Creek with its source at Lamont, contribute to the water flow. Little Toby Creek , flowing between Elk and Jefferson County enters the river at Carman. Bear Creek the next major tributary is completely in

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[1] Clarion River Basin, Pennsylvania Acid Mine Drainage Abatement Program: Stage I Reconnaissance Report (United States Army Engineer District, Pittsburgh , January, 1980) pg. A-9

[2] Water Resources Bulletin, Bulletin No. 16 Pennsylvania Gazetteer of Streams, (Commonwealth of Pennsylvania, June, 1984) pg. 284-295

Elk County. The mouth of the stream is at Portland Mills. The source of the another major tributary, Spring Creek, is in Forest County and enters the river at Hallton, Elk County. Millstone Creek, also a major tributary found in both Forest and Elk County, has an East and West Branch . In Sigel, Jefferson County, one major tributary, Mill Creek, crosses the county line and enters the river at Millcock, Clarion County. Clarion County is the source of the remaining major tributaries of the Clarion River. Beginning with Toby Creek, the river continues to flow southwest as it is joined by Piney Creek ; Paint Creek, which is a tributary to Deer Creek; Deer Creek ; and Licking Creek For more information on each tributary refer to *Appendix page. A5- A12*

Major Tributaries	Length		Major Tributaries	Length
East Branch	20.5 miles		West Branch of Millstone Creek	16. 3 miles
West Branch	19.1 miles		Millstone Creek	1.8 miles
Elk Creek	16.2 miles		Mill Creek	18.2 miles
Big Mill Creek	16.2 miles		Toby Creek	15.9 miles
Little Toby Creek	28.2 miles		Piney Creek	21.3 miles
Bear Creek	17.0 miles		Paint Creek	14.1 miles
Spring Creek	18.3 miles		Deer Creek	14.4 miles
East Branch of Millstone Creek	10.6 miles		Licking Creek	13.7 miles

Fifty-six percent (9 streams) of the major tributaries are labeled high quality streams by the Department of Environmental Protection; Chapter 93 Water Quality Standards. East Branch, Big Mill, Bear, Spring, East and West Branch of Millstone, Millstone, and Mill Creek are considered to have excellent quality waters and environmental features that require special water quality protection. The remaining major tributaries (West Branch, Elk, Little Toby, Toby, Piney, Paint, Licking, and Deer Creek) as of August 1994 did not meet the criteria for this special protection. All major tributaries within the Clarion River Basin are considered to be cold water fisheries. *Chart C2. Appendix A-13.*

Population Centers

A number of small municipal centers are located within the study area. Based on the 1990 Census Profile, it is estimated that 65,289 persons reside in the Clarion River basin which covers parts of five counties. The total 1990 population of the counties in their entirety was 174, 653, which was a decrease of the 1980 population of 185, 710.

Clarion County continues to exist as the most densely populated portion of the basin. Presently, there are many small urban centers which are scattered throughout the county and development is expected to spread outward. Along the river's edge, Clarion Boro is the largest town center.

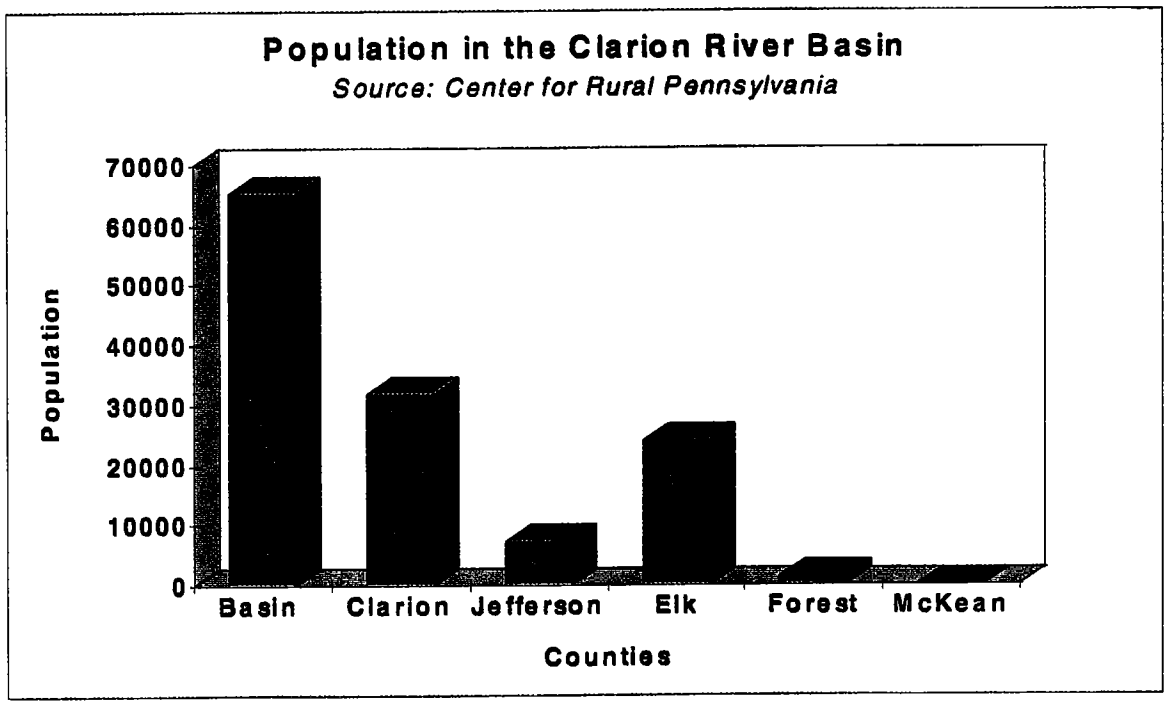
Elk County's population is concentrated in four major urban areas of Ridgway, Johnsonburg, St. Mary's, and Wilcox. These existing town centers are small with commercial activities which cater to local needs. St. Mary's, the most densely populated area of Elk County is within the Clarion River Basin, and is located on Elk Creek, a major tributary of the Clarion River. Ridgway and Johnsonburg Boros are located within the Clarion River corridor and Wilcox, Jones Township, is located on the

populated area of Elk County is within the Clarion River Basin, and is located on Elk Creek, a major tributary of the Clarion River. Ridgway and Johnsonburg Boros are located within the Clarion River corridor and Wilcox, Jones Township, is located on the West Branch tributary of the Clarion River. Despite previous predictions of growth, population continues to decrease in all areas except St. Mary's.

Brockway Borough, Jefferson County, is the site of another populated area within the Clarion River Basin study area. Located within the vicinity of Toby Creek, Brockway is also experiencing a decline in population.

The study area in Forest and McKean County is 100% rural. Development is expected to occur slowly and be rather limited in scope. Most of the growth is expected to be in seasonal development.

Population within the basin is identified in the following chart. *Appendix A-14*, *Chart C3* identifies Percentage of Rural Population, Population Trend, and Area. *Charts C4 and C5*, list the figures for in each municipality within the watershed for population trends, population per square area, population using public and private water systems and public and private sewage disposal.



Basin	Clarion	Jefferson	Elk	Forest	McKean
65289	31988	7387	24039	1321	154
100%	49%	11%	37%	2%	0.02%

Land Use

Land use distribution within the Clarion River Basin was last reported in 1975. At that time an average of 15.7 % of the area was used for agricultural, and 6.44 % of the land was involved in mining. Since that last document, the Center for Rural PA reported that agriculture and mining sector establishments declined in each county.

growth along the Clarion River 's corridor. The majority of the land remains forested as it did in 1975 (average of 62.8 %). As the demand for homes increased, some of the agricultural and forested lands were changed to residential lands. Construction of seasonal homes near the major recreational areas has increased on a small scale . Much of the forest and recreational lands are established public forests and park areas which are protected from industrial or residential encroachment.

According to the Cook Forest State Park Annual Attendance Sheet, recreational usage in some areas is up as much as 35% and this appears to be contributing to a major growth in land use in the immediate Clarion River corridor. [3]

Percent Distribution of Land Use in the Clarion River Basin (1975)

	Residential	Commercial	Instutional	Industrial	Forest	Recreational	Agriculture	Mining	Total
Clarion	3.2	0.1	0.1	0.2	44.9	6	38.4	7.1	100
Elk	2.7	0.1	0	0.1	62.4	16.2	10.6	7.9	100
Forest	4.6	0	0	0.1	83.4	4.7	7.1	0.01	100
Jefferson	5.6	0	0.2	0	49.8	21.6	17.6	5.2	100
McKean	1.7	0.1	0	0.1	73.6	7.7	4.8	12	100
Average	3.56	0.06	0.06	0.1	62.82	11.24	15.7	6.442	

Transportation Facilities

The counties of the Clarion River basin are served by a number of transportation arteries and facilities. Major highways include Interstate 80, U.S. Routes 322 and 219, and a number of less traveled Pennsylvania routes. *Map 3: State and Local Roads.* Between Ridgway and Cooksburg, the Clarion River is paralleled by a series of state and local roads, except near Portland Mills and downstream to Irwin Run. There are some highway bridge crossings across the river ranging from single lane iron bridges to modern Interstate 80 crossings.

Rail freight traffic across the area has been declining for many years. At one time the manufacturing centers and mining areas were all served by Conrail, but since there has been a reduction in service, the railroad system is used primarily for freight service. Formerly known as CSX, the Buffalo & Pittsburgh line is the major railroad operating company in the area.

There are several small private and municipal airports, but commercial airline service is not available in the Clarion River Basin. Local airports within the study area can be found at Clarion and St. Mary's.

Major Source of Employment

Overall employment figures within each sector are provided in *Charts C6-C8* and business establishments are recorded in *Charts C9*, *Appendix A 17-20*. Though the five

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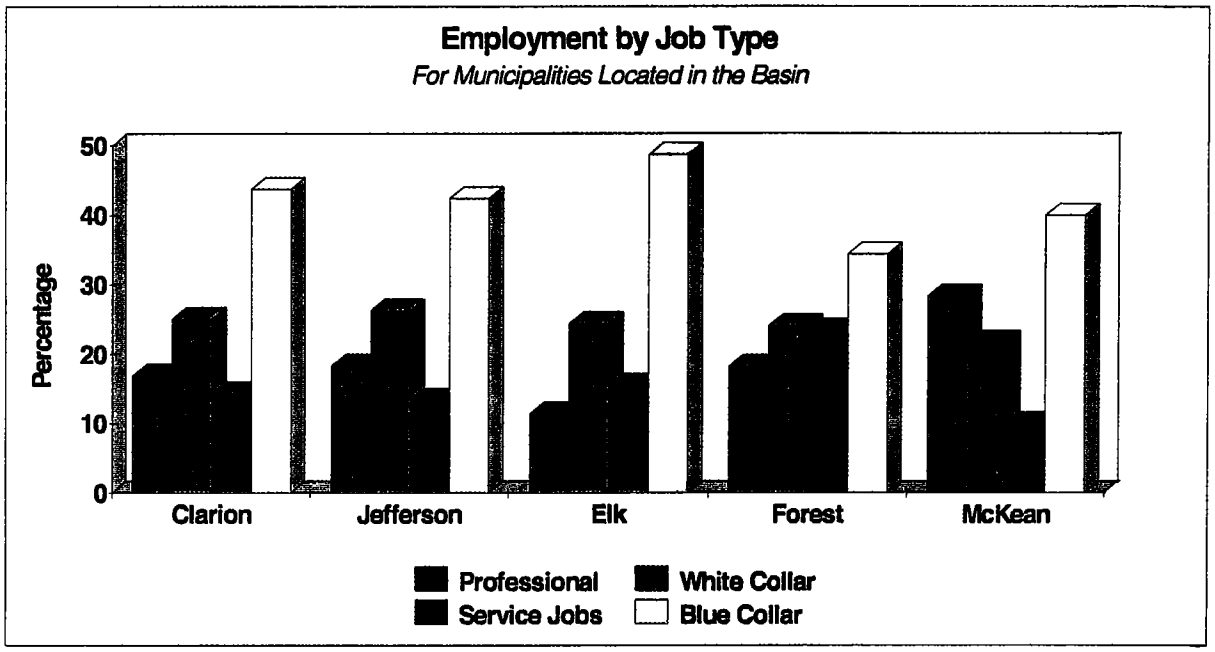
[3] Comprehensive Water Quality Management Plan Upper Allegheny River Basin: Study Area 8 (Pennsylvania Department of Environmental Resources, 1975) Chapter V Existing Population, Economy, and Land Use.

Overall employment figures within each sector are provided in *Charts C6-C8* and business establishments are recorded in *Charts C9*, *Appendix A 17-20*. Though the five counties are similar in rankings among the different job types, there are some differences as to what the major employment is in each particular county.

In the Clarion River Basin manufacturing is the largest employer. This is primarily due to the fact that Elk County has more than 20 industries which employ almost 48% of the county's work force .The major manufacturing industries are powered metals, paper products, glass, and lumber. Overall, the manufacturing sector employs over twenty-seven percent of the basin's work force. Elk , Clarion, Jefferson, McKean and Forest Counties have grown substantially in the service sector, making this sector the second highest employer in the study area. More than twenty-five percent of the basin's work force is employed by the service sector. Employment in agriculture and mining continues to decrease in Clarion, Elk, and McKean county and employs less than 6 % of the basin's working population.



	Professional	White Collar	Service Jobs	Blue Collar
Clarion	16.9	25	14.4	43.7
Jefferson	18.3	26.3	13.4	42.4
Elk	11.4	24.4	15.5	48.7
Forest	18.2	24	23.4	34.4
McKean	28.3	21.7	10	40
Average	**18.62**	**24.28**	**15.34**	**41.84**

Communities in the study area continue to attempt to provide development opportunities for commercial and industrial interests. The amount of land within the Clarion River corridor (1/4 mile of either side of the river) devoted to commercial and industrial uses, however, is not expected to increase dramatically because of the

A comprehensive recreation use study is currently being prepared for the Piney Dam reservoir, however, results will not be available until the Fall of 1997. Based on the Magic Forest Tourism guide, there has been an increase in the recreational usage of the state parks and forest areas, creating an employment rise in this sector. More opportunities exist, but management plans are not in place.

Outstanding or Unique Features

The Clarion River, downstream from the Allegheny National Forest and State Game Land #44 boundary below Ridgway to the backwater of Piney Dam, was added to the National Wild and Scenic River System in October,1996 *Map1: Clarion River Watershed Location* . The Clarion River was noted as possessing "a unique, picturesque quality with its diverse and mature vegetation, steep slopes, sinuous channel and varying water conditions. The river, meandering through mostly undeveloped woodlands, provides the recreationist with spectacular views and a sense of isolation. The changing character of the water, from smooth to riffling, as the river flows over and around large boulders scattered along the river, enhances its natural beauty".[4] In 1971, however, the Clarion River did not meet the National Wild and Scenic River standards. Water pollution from the coal mines, paper mill, and municipal sewage was listed as a major problem. Improvements in industrial plants and municipal sewage treatments have resulted in noticeable improvements in water quality.

Within the Pittsburgh Plateaus section of the Appalachian Plateaus Province northeast of Sigel and east of PA 949 near Clear Creek State Park is a "rock city." There lie large blocks of rock that have weathered extensively producing interconnected tunnels, passageways and crevices. These blocks of sandstone and composites of the Pottsville Group are known as Beartown Rock. Two miles south of Beartown Rock is a weathered remnant of basalt sandstones of the Allegheny Group. This site is known as the Stahlman Roundtop. Within this geological region is another well-known landmark called Alum rock It is located adjacent to PA Route 58 and at the top of a cliff above the Clarion River. It is considered to be the best overlook in the Pittsburgh Plateaus section. (*Outstanding Scenic Geological Features of Pennsylvania*).

Within the Allegheny High Plateaus section of the Appalachian Plateaus Province, five mile north of Brockway is the location of Blue Rock. This area consists of flat-lying beds of sandstone composition which have been eroded by Little Toby Creek, resulting in cliffs along the creek valley. Nearby is a similar feature named Elk Lick Bluff.[5]

In September, 1996, the Swamp Forest area in Cook Forest State Park was included in the PA Natural Areas Program. The 246-acre woodland contains 300-year-old hemlocks and a boulder field formed during the Ice-Age. This designation

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[4] Clarion River and Mill Creek Wild and Scenic River Eligibility Report (Allegheny National Forest, 1996). pg. 12

[5] Alan Geyer and William Bolles, Outstanding Scenic Geological Features (Commonwealth of Pennsylvania, Department of Environmental Resources, Bureau of Topographic and Geologic Survey, 1979), pg. 19, 45, 51, and 72

will protect the unique scenic and geologic resources of the area from development and other human caused pressures *(PA Department of Conservation and Natural Resources).*

In 1975 the PA Bureau of Forestry completed a study of all unique or unusual biological , geologic, scenic and historic areas for possible designation as natural areas. The bureau considered natural area status advisable whenever resource development would have an adverse effect on the future utility or value of the area. *Appendix A21* list the natural areas found within the Clarion River Watershed Basin approved by the Environmental Quality Board in 1975.

II. Land Resources

Soil Characteristics

Soils in the Clarion River Basin are generally formed from noncarbonated sedimentary rocks. The soil depths vary between 30 and 72 inches. This area is largely underlain by sandstone, conglomerates, thin shales, and coals. Slopes range from 3 to 25 percent. Most of the land is sloping except for small areas of flatlands on the valley bottoms. Almost all of the land directly adjacent to the river falls into one of two major categories: upland, well-drained soil which is too steep for development other than residential and some forms of recreation, and alluvial soils which are prone to seasonal flooding and structural instability.

There are numerous soils in the basin even though there are four basic parent materials (limestone, sandstone, shale and siltstone) that produce these soils. Climate, vegetation, and topography greatly influence the development of the numerous individual soil series found in the basin. *Map 4: Soils in the Clarion River Watershed.*

General soil associations found in the Clarion River Basin are identified by each county. *Appendix A22-A29* contains a brief description of the general soils series grouped by similar identification characteristics and arrangements of the soil profiles.[6] Woodland management and productivity of each soil name can be found in *Chart C-10, A-30*. Recreation and building site development according to each soil type is recognized in *Chart C11*. *Chart C12* lists the physical and chemical properties of each soil along with water management guidelines, and *Chart C13* describes the wildlife habitat that could survive in each soil type.[7]

Wetlands

Wetlands are found throughout the Clarion River basin. Despite their differences in size, shape, and location, wetlands have some common elements. To determine that an area is in fact a wetland, the interaction of water, soil, and vegetation need to be taken into account. Proper identification of wetlands must present evidence of all three

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[6] Clarion, Jefferson, Elk, Forest, and McKean County Soil Surveys

[7] Soil and Water Conservation Technical Guide Section I & II Reference Soils
Soils Interpretations Records:

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parameters (water, wetland plants, and hydric soils). The area must flood or be saturated during some part of most years, long enough to create non-oxygenated conditions that cause unique chemical changes in the soil and to establish certain water-tolerant plant communities. Wetlands have been identified and labeled within the Clarion River Basin . A wetland composite map of each 7.5" topographic map included in the watershed is available through the research department of the United States Geological Survey (1-800-872-6277).

Ownership Patterns

The CRBC found that it was very difficult to identify total property ownership within the basin, and concentrated its' efforts on the corridor of the river. Land use identification has not been completed since 1975, and property ownership is constantly changing. The corridor in this document refers to approximately 1/4 mile of property on either side of the river. At the time of this document's research, 65% of the Clarion River corridor was in private ownership while the remaining 35 % was considered to be public ownership. Private lands included large industrial sites, boroughs, municipalities, and land owned by the Western PA Conservancy. *Chart 14, Appendix A-33., Map 5 : Public Lands Within the Clarion River Watershed.*

The CRBC did identify ownership on the 7.5 minute topographic maps for the complete watershed. County plat books, state maps, UDSA Forest Service publications, and tourism guides were used as resources. Private lands are identified on the 7.5 minute topographic maps by dark brown markings. Yellow lines are used to identify the lands currently owned by the Western PA Conservancy. Public lands consist of the National Forest, PA State Game Lands, and PA State Forests and Parks. On each 7.5 minute topographic maps the National Forest is outlined in a dark, forest green. Identified on each map are the PA State Game Lands, outlined in lime green, and state parks and forests which are outlined in a heavy green slashed line. Each area is subject to change.

Biological Resources

The PA Natural Diversity Index (PNDI) has developed a preliminary system for classification of natural ecological communities in PA based on features, community structure and function. The system was based on the Department of Environmental Resources literature written in 1991 by T.L. Smith. Using this system and the potential distribution of communities within the Commonwealth, Dr. Charles E. Williams, Biology Department at Clarion University of PA identified 26 major community types that may occur within the Clarion River corridor. According to Dr. Williams the communities occurred in four broad systems: terrestrial, palustrine, lacustrine, and riverine. A general description of each community is provided in the *Appendix A34-A36*

The wildlife habitat in the Clarion River corridor is basically divided into two broad habitat types: 1) the riparian/wetland habitat that occurs immediately adjacent to the river and its tributaries; and 2) the upland forested habitat that occurs mainly on the steep side slopes of the river valley. The study area could potentially support a large and diverse population of mammals, birds, amphibians, and reptiles. According to the

Carnegie Museum of Natural History there is a possibility of 286 species of birds which live in or migrate through the study area. Osprey (state threatened) and the Bald Eagle (federally threatened) are often seen foraging along the river. However, no active nests are currently known to exist within the river corridor.

A survey of dragonflies and damselflies along with Clarion River and its tributaries by the Western PA Conservancy and Carnegie Museum of Natural History (1994) identified 52 species of odonates.

According to Kuchler (1964) the Clarion River lies in a transition zone between the hemlock-northern-hardwood forest and Appalachian oak forest types. In this region, the two types of forest tend to intergrade with the northern hardwood forest dominating the northern portion of the Clarion River corridor; and the Appalachian oak forest dominating the south. Dominant tree species were summarized by Dr. Charles Williams, and hemlock, American beech, white pine, yellow birch, black cherry, and red maple were identified by Dr. Williams to be the governing species in the northern-hardwood forest.

Chart C15, Appendix A37-A39 provides an up to date list of the plants, animals, and areas of special concern contained within the Clarion River watershed. The Pennsylvania Natural Diversity Inventory (PNDI) is a site specific information system describing plant and animal species of special concern, exemplary natural communities and unique geological features of the Commonwealth.

Fisheries surveys conducted in 1990 and 1995 by the U.S. Army Corps of Engineers and PA Fish and Boat Commission documented fifty fish representing 10 species of fish upstream of Piney Dam near Cooksburg, sixty-nine fish representing 12 species of fish from the outflow of the Dam downstream to Piney Creek, and nineteen fish representing 6 species near Callensburg. In June, 1996 fisheries survey revealed a total of 21 species near Johnsonburg, and Ridgway. The list of species are respectively identified in *Chart C16-C18, A-40-42.*

III. Water Resources

Quantity

Within the Clarion River Basin, the U.S. Department of the Interior Geological Survey Water Resource Division documents hydrologic data gathered from the U.S. Geological Survey's collection networks. Each gauging station records streamflow and ground-water levels. The USGS currently has five gauging stations and two groundwater wells operating within the Clarion River Basin. Beginning with the 1975 water year (October 1-September 30), the USGS designed a three-volume report which contain data on quantities of surface water, quality of surface and ground water, and groundwater level. *Appendix 44-A48* lists each station with a brief description of location, gauging system, channel and control, and discharge measurements for water years (wy) 1948-1995.[8] As part of the Flood Forecast and Warning System, the National Weather Service uses the data from the USGS continuous-record stations to

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[8] Water Resource Data Pennsylvania Water Year 1975 : Volume 3. Ohio River and St. Lawrence River Basins. (U.S. Geological Survey Water-Data Report PA-95-3), pg. 63-73

predict flood heights. County emergency management agencies may use the data to initiate evacuations and manage emergency response. The U.S. Army Corps of Engineers will use the data to manage flood-control reservoirs.

Limited data were available which described well yields in the Clarion River basin. The last published report on the water resources of the Clarion River was developed by the U.S.G.S. in cooperation by the PA Dept. of Environmental Resources. The Division of Water Planning and Allocation in the PA DEP has updated the facility type and water source since that 1980 published report.

The Clarion River Watershed geological structure is primarily composed of the Allegheny and Pottsville Group. The Allegheny Group is considered to be generally a good aquifer. Only about one-tenth of wells yield less than 3 gal/min. About one-fifth of wells yield more than 50 gal/min, with the medium yield more than 25 gal/min. The median specific capacities of domestic and nondomestic wells are 0.62 and 3.0 (gal/min)/ft, respectively. Water quality is generally poor. More than half of wells samples have moderately hard to very hard water. Iron in excess of 0.3 mg/L is common. The Pottsville Group is also considered a good aquifer. Only about one-twentieth of wells yield less than 3 gal/min. About one-fifth of wells yield more than 25 gal/min. The median specific capacities of domestic and nondomestic wells are 0.38 and 1.8 gal/min/ft respectively. Water quality is generally poor. In more than half of the wells samples, the water was moderately hard to very hard; iron exceeds 2.0 mg/L; and manganese exceed 0.50 mg/L.*(United States Department of the Interior Geological Survey)*

The major water-quality problems are due to high concentrations of iron, manganese, hardness, and acidity. Some of these problems are related to coal mining that has degraded water quality in parts of Clarion, Elk, and Jefferson Counties. The rock composition of many streams have a low alkalinity concentration and consequently have little capacity to neutralize the acid water from coal mines.

Both surface and ground water are used for supply. There are twenty-seven public water-supply systems in the watershed. There is only one water company which receives its water directly from the Clarion River, the PA American Water Company which supplies Clarion and the surrounding townships. Twelve public water companies use a well for their source of their water supply. A spring is used to furnish water in three of the public supplies. Seven public suppliers use a reservoir intake supply, and the remaining four public water supplies come from a combination of wells, reservoirs, and stream diversions, *Appendix 48-A54*. In addition to the water companies there are 49 other companies which depend on the Clarion River's watershed for their supply of water for treatment or discharge.

Water Quality

The Clarion River is affected by mine drainage along its entire length from the headwaters of the East Branch in McKean County to the Allegheny River in Clarion County. Mine drainage effects are more pronounced in the lower reach of the river downstream of the Clarion-Jefferson County line.

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Pennsylvania Rivers Conservation Program

Clarion River Basin

Pollution to the Clarion River caused by mine drainage can first be seen at the East Branch Clarion River watershed. Below this point the river receives only minor mine drainage contributions until the confluence of Little Toby Creek, southwest of Ridgway in Elk County. Little Toby Creek, the principal tributary to Toby Creek is the main source of mine acid in the Toby Creek watershed. Very little mine drainage enters the Clarion River between Toby Creek (Elk County) and the backwaters of the Piney Dam located in Millcreek Township, Clarion.[9]

There is considerable mine drainage flowing into the river from its tributaries in Clarion County as a result of coal strip mines in the area adjacent to Toby Creek, Mill Creek and the Clarion River below Piney Dam. Although the U.S. Army Corps of Engineers recognizes acid mine drainage as the most serious water quality problems in the Clarion River Basin, they also find that the trends of decreasing acidity and increasing alkalinity to be very encouraging and indication that past and present effort to control acid mine drainage pollution are producing significant results.

Chapter 93 of the Pennsylvania Code, Title 25, Part I, Environmental Resources set forth criteria for state surface waters. The standards recommend a pH value between 6.0 and 8.5. At low pH values, the solubility of toxic metals is increased. Waters that do not exceed 58°F (14.4^{o}C) are considered to be cold waters. Although many sampling points during the summer months are higher than 14.4^{o} C., their mean temperatures qualify them as cold water streams. Because of the cold water classification, the dissolved oxygen values must not fall below 5.0 mg/l.

Iron, a parameter measured because of the mining industry, can take several forms in natural water systems depending upon such factors as pH, dissolved oxygen, or the amount of organic matter. The limit for use in public supplies is .30 mg/l.

The alkalinity measurement of water does not refer to pH but to the buffering capacity, which is the ability of the water to resist pH change. If a body of water has a high alkalinity, it is more stable and resistant to changes in pH. For the protection of aquatic life, Chapter 93 of the PA code recommends that alkalinity levels should not fall below 20 mg/l from the normal levels caused by natural conditions. The total acidity measurement of the stream should not exceed the total alkalinity.[10]

The PA American Water Company located in the Clarion River corridor in Clarion test the "raw" (river) water <u>before</u> each treatment to determine the amount and type of treatment the water needs to provide drinking water for the surrounding community. For each day of the year the water is sampled at least three times, averaged, and recorded . The CRBC has used this data as one source of information to indicate the average condition of water quality found in the Clarion River.

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[9] <u>Clarion River Basin, Pennsylvania Acid Mine Drainage Abatement Program</u>: Stage I Reconnaissance Report (United States Army Engineer District, Pittsburgh) , January, 1980: pg. A-40-A-78.

[10] <u>Pennsylvania Code: Title 25. Environmental Resources: Chapter 93. Water Quality Standards</u> (Department of Environmental Resources, Harrisburg, PA), Oct., 1994: pg.93(14-25)

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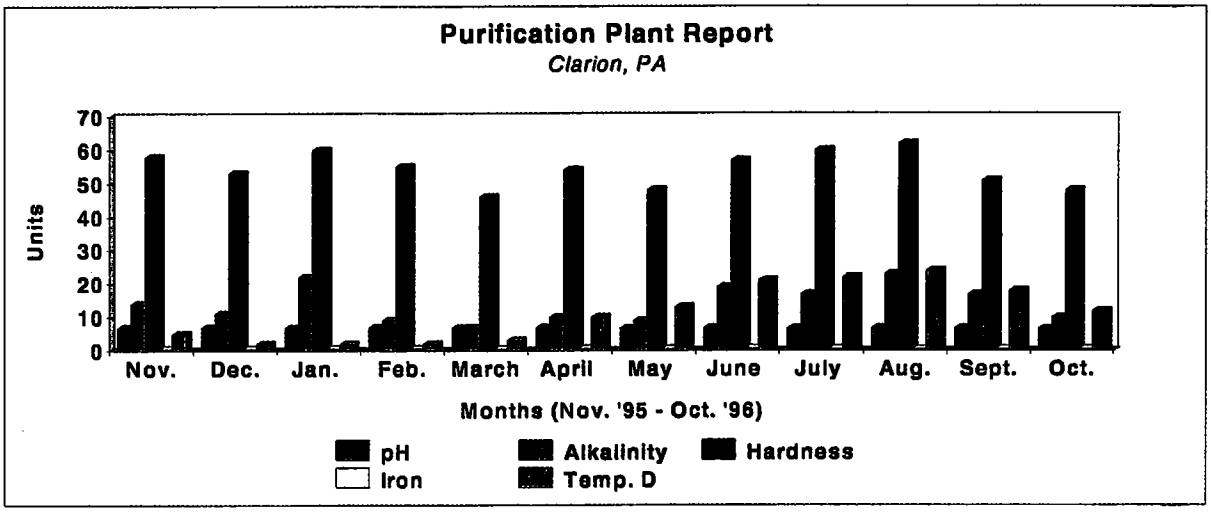
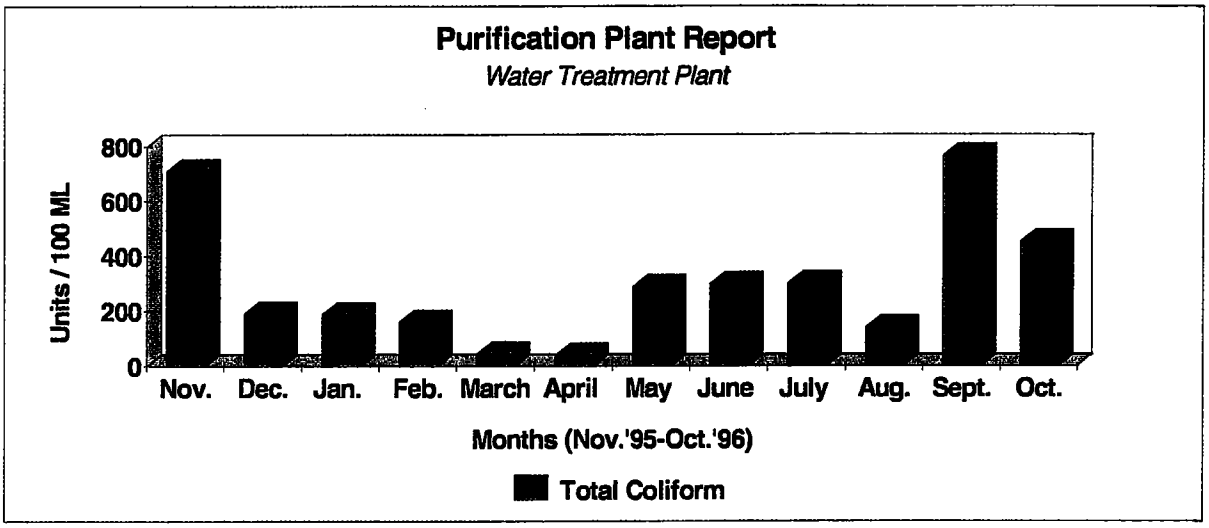


	pH	Alk mg/l	Hardness	Iron mg/l	Temp. Deg C.
Average	6.75	14	54.3	0.54	11.12
Standard Value	7.00	> than 20	75 mg/l	0.3	14.4



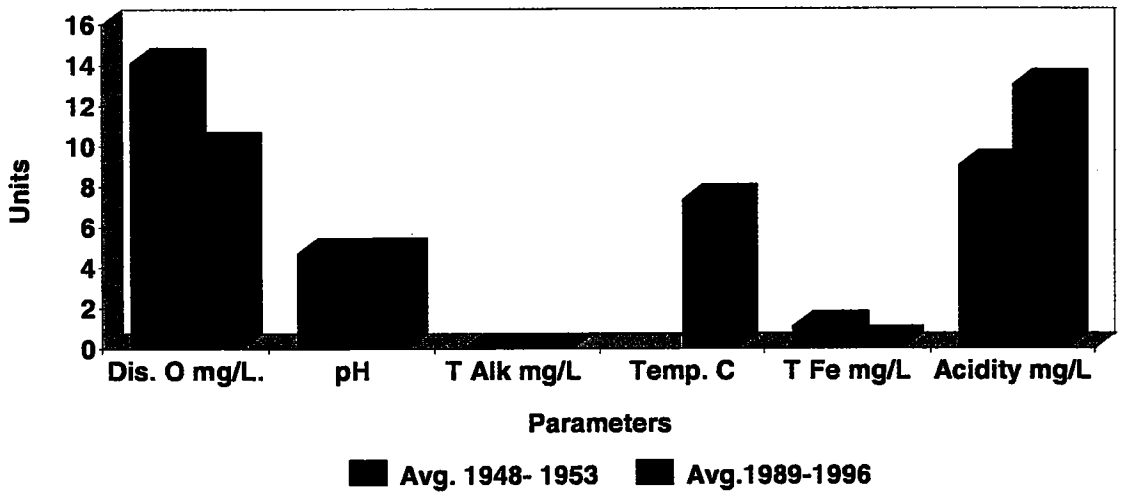
An important parameter, fecal coliform bacteria, are found in the feces of humans and other warm-blooded animals. These bacteria can enter rivers through direct discharge , agricultural and storm runoff carrying wastes from birds and mammals, and from human sewage discharged into the water. If fecal coliform counts are over 200 colonies/100ml of water sample in the river, there is a greater chance that pathogenic organisms are also present. Total coliform measurements include all coliform bacteria strains and <u>may</u> indicate fecal contamination. Total coliform is no longer regularly tested throughout the corridor except at the water treatment plant in Clarion. Results indicate that fecal coliform <u>may</u> be present within the watershed, and future sampling is

recommended to determine a data base. Please note that this data represents "raw" water.

The CRBC gathered recorded data from monitoring points along the Clarion River and its' tributaries. In each situation the water data was compared to historical sampling and the results were charted for a comparative analysis. In all sampling points the CRBC found an improvement in water quality. To grasp a complete overview of water quality, certain parameters were compared in the following charts Many parameters are commonly measured, but the CRBC chose seven parameters to be of primary importance in the study area. In almost all sampling points the parameters consisted of pH, dissolved oxygen, iron, temperature, total alkalinity, and total acidity.

The associated graphs and charts illustrate this improvement in the Clarion River watershed. Acidity levels dropped in 75% of the sampling points. The total amount of iron dropped or remain the same in 83% of the sampling points. Alkalinity levels rose in 50 % of the readings and pH improved in 83 % of the sampling points.

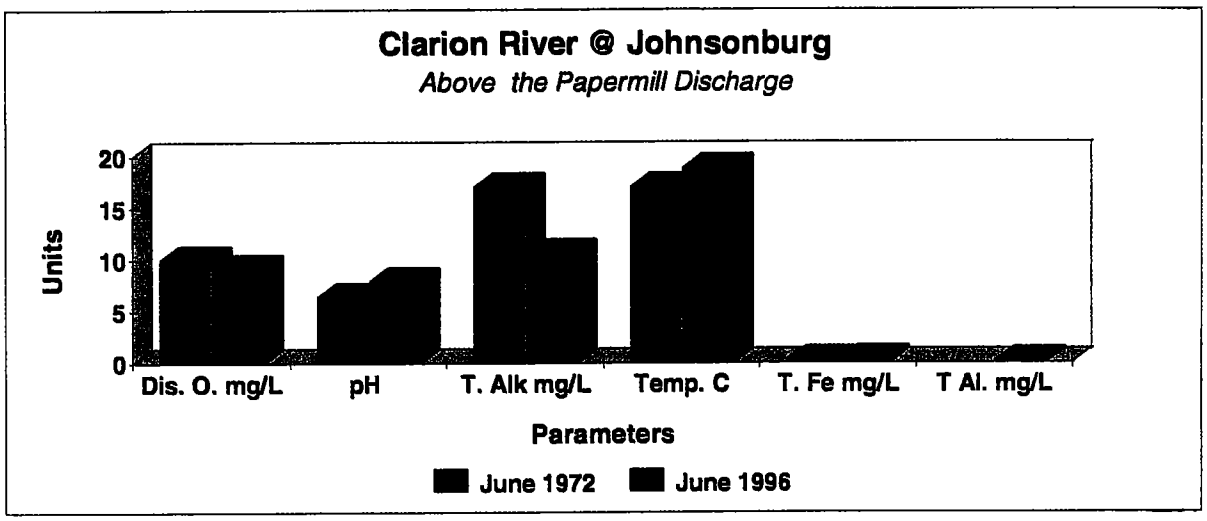
East Branch Lake



East Branch	Dis. O mg/L.	pH	T Alk mg/L	Temp. C	T Fe mg/L	T Acidity mg/L
Avg. 1948- 1953	14.1	4.7	0	6.2.	1.1	9
Avg.1989-1996	9.97	4.73	0	7.34	0.33	13
Standard Value	> than 5.0	6.5-8.5	> than 20	14.4	0.3	< than Alk.

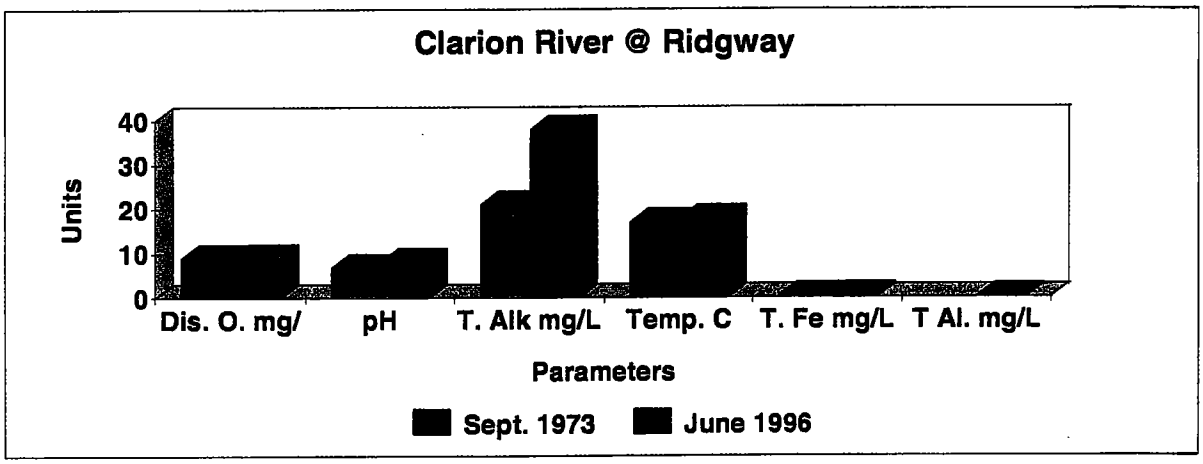
[11]

[11] Auras Raw Data Report for Water Quality: Sampled by the U.S. Army Corps of Engineers, Pittsburgh, PA. (Environmental Protection Agency's Storet Systems)



Johnsonburg	Dis. O. mg/L	pH	T. Alk mg/L	Temp. C	T. Fe mg/L	T Al. mg/L
June 1972	10	6.4	17	17	0.27	NA
June 1996	9.2	7.9	10.6	18.8	0.298	0.17
Standard Value	> than 5.0	6.5-8.5	> than 20	15.5	0.3	.1-.5 max

[12]



Ridgway	Dis. O. mg/L	pH	T. Alk mg/L	Temp. C	T. Fe mg/L	T Al. mg/L
Sept. 1973	9	6.8	21	17	0.34	N.A.
June 1996	9.1	8.2	38	17.8	0.463	0.256
Standard Value	> than 5.0	6.5-8.5	> than 20	15.5	0.3	.1-.5 max

[13]

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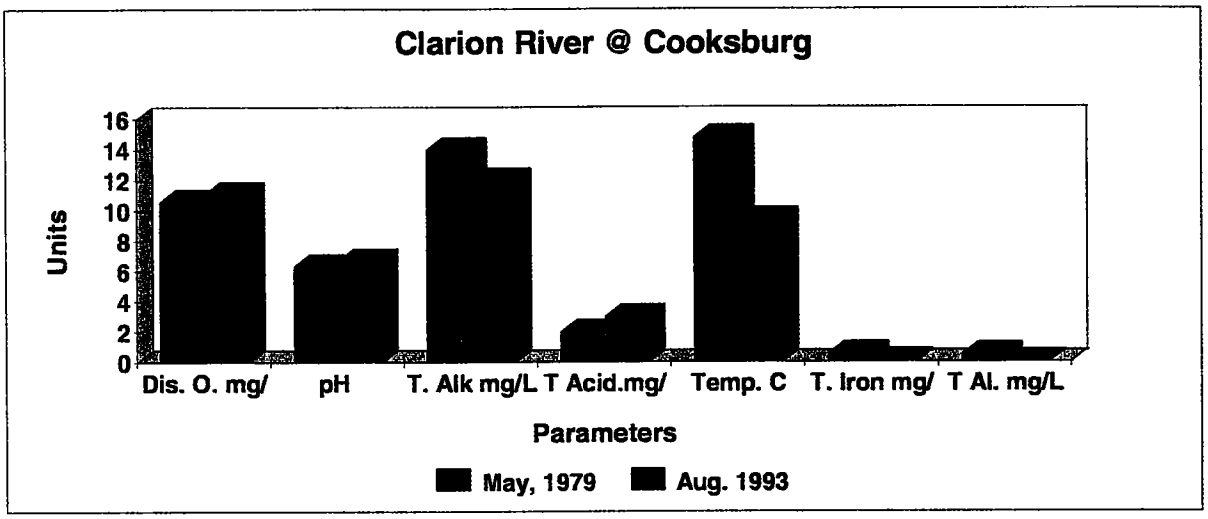
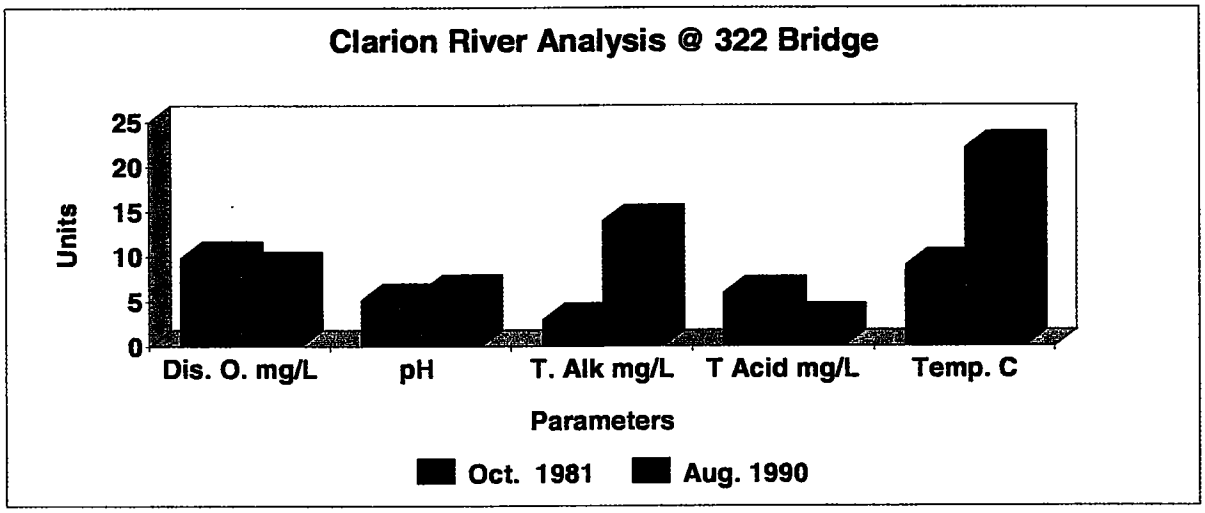
[12] Clarion River Survey, Department of Environmental Protection (Northwest Regional Office), June, 1996 Table 2, and Sampled by the U.S. Army Corps of Engineers, Pittsburgh, PA. (Environmental Protection Agency's Storet Systems)

[13] Ibid



Clarion @	Dis. O. mg/L	pH	T. Alk mg/L	T Acid.mg/L	Temp. C	T. Iron mg/L	T Al. mg/L
May, 1979	10.6	6.3	14	2	14.8	0.545	0.5
Aug. 1993	11.1	6.7	12	3	9.4	0.104	0.05
Standard Value	>5.0	6.5-8.5	> than 20	< than Alk	14.4	0.3	.5 max.

[14]



Clarion @	Dis. O. mg/L	pH	T. Alk mg/L	T Acid mg/L	Temp. C	T. Iron mg/L	T Al. mg/L
Oct. 1981	9.9	5.2	3	6	9	2.6	1.63
Aug. 1990	8.79	6.18	14	3	22.1	0.522	0.059
Standard Value	>5.0	6.5-8.5	> than 20	< than Alk	14.4	0.3	.5 max.

[15]

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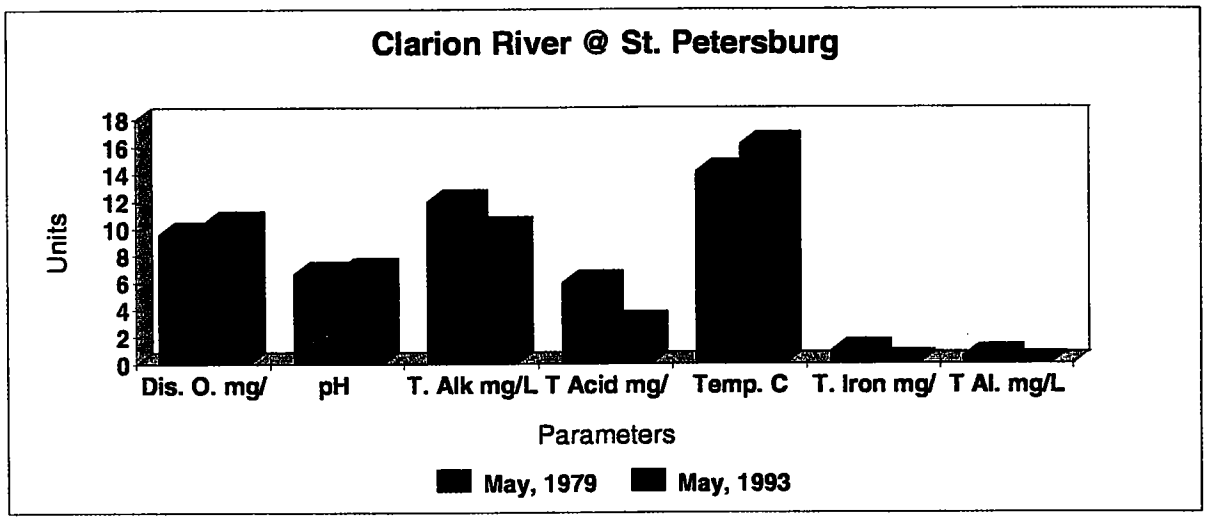
[14] STORET
[15] Ibid



Clarion @	Dis. O. mg/L	pH	T. Alk mg/L	T Acid mg/L	Temp. C	T. Iron mg/L	T Al. mg/L
May, 1979	9.6	6.7	12	6	14.2	0.96	0.55
May, 1993	10.4	6.94	10	3	16.2	0.171	0.05
Standard Value	>5.0	6.5-8.5	< than 20	< than Alk	14.4	0.3	.5 max.

[16]

The CRBC realizes that the tested parameters and charted results indicate an improvement in the Clarion River water quality; however, it must be noted that complete chemical analysis of the water is not included in any of the data. The CRBC was unable to locate a monitoring station which tests for heavy metals or toxic organic compounds.

Another method of water quality evaluation is conducted through qualitative bethnic macroinvertebrates samplings. The term *bethnic* means bottom dwelling and refers to organisms that live in, crawl upon, or attach themselves to the bottom. The term *macroinvertebrates* refers to those invertebrates seen with the unaided eye. Some organisms can survive in a wide range of conditions and are more tolerant of pollution. Others are very sensitive to changes in conditions and are intolerant of pollution. If a noticeable absence or low diversity of aquatic organisms exist the water may contain high levels of heavy metals or toxic organic compounds.

In June 1996, the Department of Environmental Protection and Environmental Services Division conducted a biological sampling of the Clarion River above Willamette Industries' discharge in Johnsonburg (Station 1) and upstream from the mouth of Elk Creek in Ridgway (Station 4). Station 2 was located approximately 1200 feet downstream from Willamette's wastewater treatment plant discharge and provided an analysis of the discharge not the water quality of the Clarion River. Station 2 results will be discussed in more detail in Chapter V. Although the purpose of the study was to provide baseline data on physical, chemical, and biological parameters existing in the river in relation to the industry's industrial wastewater treatment plant, the results can also be used to analyze the water quality of the upper reaches of the Clarion River.

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[16] STORET

Chart C-19, Appendix A-55. The aquatic insect groups Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichopter (Caddisflies), which are generally considered clean water indicators, accounted for 55% of the total taxa. The dominant invertebrates found in the riffles were the mayflies, stoneflies and caddisflies. The presence of several sensitive taxa and increased biological diversity, compared to 1992, indicates water quality conditions have improved at this location since the discharge was diverted to the new treatment plant.

The invertebrate samplings at Station 3 revealed a total of 40 taxa, representing 21 families Chart C-19 A-55. Mayflies, stoneflies, and caddisflies (EPT richness) comprised 60% of the total taxa. Results of this benthos samplings were comparable to or better than the 1992 DEP invertebrate collections taken 4 months after startup of Willamette's new biological waste treatment process. Numbers of organic responders were significantly lower during the 1996 collections. The progress made by Willamette's wastewater treatment system likely contributed to these improvements.[17]

Quantitative bethnic macroinvertebrate data were collected also in the mid section of the Clarion River. In 1994 the Department of Environmental Protection (Resources) completed a study on Toms Run, Cathers Run, and Kahle Run located in Clarion County Chart C-19, A-55. A similar study on the tributaries was completed in 1968 by the Biology Department at Clarion State College . Toms Run at that time received pollutants from the oil, gas, and coal mining industries In 1968 the Pennsylvania Water Resources Coordination Committee recommended the restoration of Toms Run as a model project. The same committee highly recommended that Cathers Run be preserved as a valuable control stream and be spared of all mining and drilling operations. According to the tabulated results minor improvements have been seen in the total number of collected species and the diverse families. The invertebrate samplings taken at Toms Run indicated a taxa index of 22, representing 6 families . EPT richness (clean water indicators) accounted for 14 % of the total taxa In 1968 the taxa index was 7, representing 4 families. Cathers Run sampling collection revealed a taxa index of 16, 5 families were represented with a EPT count of 10%. In 1968, Cathers Run had a taxa index of 14, representing 9 families. Kahle Run's study collected a total of 109 individuals, a taxa index value of 10, representation of 4 families and an EPT index of 6%. [18]

Impoundments

Streamflow in the lower East Branch Clarion River and the mainstem of the Clarion River is partially controlled by the East Branch Clarion River Dam. This dam, built in 1952, is located on the East Branch Clarion River six miles upstream from its confluence with the West Branch at Johnsonburg, PA. It is owned and operated by the Pittsburgh District of the U.S. Army Corps and Engineers. The earth dam rises 184 feet from the valley floor and controls a drainage area of 72.4 square miles, slightly less than

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[17] Clarion River Survey, Department of Environmental Protection , Table 4,5,6, and 7

[18] Semiquantitative Benthic Macroinvertebrate Data and RBP Metric Comparisons, Department of Environmental Resources, October 11-14, 1994. Table 8 and 9

6% of the Clarion River Basin area. East Branch Clarion River Lake has a surface area of 1,160 acres at the normal summer pool elevation of 1,670 feet. Storage to summer pool normally occurs during period March 1 to April 30. Depletion of low-water storage for augmenting flow in Clarion River occurs normally during period June to October. Recreational activities occurring near Ridgway during the summer months frequently request an increase in water releases by East Branch Dam.

East Branch Lake is very lightly buffered and, therefore, is vulnerable to acidification from even modest acid loads. The Pittsburgh District experienced several serious post 1991-92 drought water quality problems in 1993. After dead fish began showing up in the lake in the spring of 1993 and depressed pH levels were identified as the cause of the mortality, the District successfully neutralized the acid pollution by means of emergency applications of soda ash to the lake. Reservoir fishery and other elements were rescued by this application, and the operation assured that good quality storage would be available in the impoundment to augment flows along the reach of the East Branch Clarion, and Clarion River throughout the summer of 1993. In November of the same year, the pH in the lake was dropping again and an emergency soda ash neutralization treatment was repeated. [19]

In the fall of 1996, reclamation projects within the East Branch Dam began to occur. An annual dosage of limestone sand is being added to selected streambeds for neutralization of acid flows. *Chart C -20, A-56* identifies the amount of limestone sand, and A- explains the treatment procedure. Current and historical water data were used to determine the annual dosage rates of limestone sand.

Sixty-eight miles downstream from east Branch Dam, at a point which is 39 miles above its mouth, the Clarion River enters Piney Lake. The 12 mile reach of Piney Lake submerges the natural river channel and the valley sides fall steeply into the lake. Piney dam, is privately owned by the Pennsylvania Electric Company, and operated by GPU Genco Corporation. It is a concrete dam 100 feet high which is used solely for electric power generation. Piney Lake has a surface area of 690 acres, a total storage capacity of 33,742 acre-feet, and controls a 957 square mile drainage area. Its maximum total capacity is about 100,000 acre-feet. Peak-load power generation usually draws down the reservoir by one to five feet to augment the daily flow. This causes a quite irregular flow in the remaining 25 miles below the dam. Because of severe acid mine drainage problems in the Clarion River Basin, the Federal Energy Regulatory Commission (FERC) authorized peaking operation with no minimum release requirement for the protection of aquatic resources. As a result, the project has operated since 1979 with releases that typically fluctuate between a leakage flow of approximately 30 cfs and 4,500 cfs, the discharge when all three hydroelectric units are operating.

Since the time of license issuance, the water quality of the Clarion River has steadily improved. *(Commonwealth of Pennsylvania Fish & Boat Commission; Dec. 8, 1995)*. In 1989, the Corp of Engineers (COE) requested the FERC to require a 100 cubic feet per second (cfs) minimum release from the Piney Dam. The COE raised this issue out of concern that Congressionally authorized flow augmentation from the Corps' East Branch Clarion River Dam for water quality control was being intercepted at Piney

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[19] Pittsburgh District Water Quality Activities During 1993, Memorandum for Commander, U.S. Army Corps of Engineers, Ohio River Division, pg. 2-3

Dam. The COE anticipated that provision of these flows would enhance recovery of the fishery in light of the recent positive trends in water quality. In response to this letter, FERC required the licensee to conduct an assessment of the impact of a 100 cfs minimum flow on the economic viability of the project. The licensee and the Pennsylvania Fish and Boat Commission (PFBC) conducted several studies from 1990-1994 to evaluate the effect of various minimum release scenarios on water chemistry and habitat suitability for fish downstream of Piney Dam. The results of the study concluded..... " that provision of an intermittent release of one unit operating at 1500 cfs for one hour every 24 hours would be at least beneficial to water quality as a continuos minimum release of 100 cfs. The COE and PFBC disagreed with the findings and expressed concerns that extremes in pH and other water quality parameters would be greater with a one-hour release.[20] Since July, 1996 increased flows from East Branch Reservoir have been passed through Piney Dam rather than detaining the water for power generating purposes.

IV. Community Resources

Recreation

The types of recreation opportunities offered by the Clarion River Basin are quite varied. Most prevalent are those types which use the forests or waters of the area. The forests offer excellent opportunities for deer, wild turkey, small game and other hunting activities. Additional common use of the forests include hiking, picnicking, canoeing, fishing, biking and camping. The Department of Conservation and Natural Resources (DCNR) provides outdoor recreation opportunities though a system of state parks. The state parks provide a recreation area to the tourist interested in enjoying an outdoor vacation. Most areas provide areas designated for swimming, hiking, biking, fishing, camping, boating, picnicking, and designated areas for hunting. Within the Clarion River watershed the DCNR administers three main recreation attractions: Bendigo State Park, Clear Creek State Park, and Cook Forest State Park. Bendigo State Park is an 100 acre park located along the West Branch of the Clarion River in Elk County. Clear Creek State Park, a 1209 acre park located along the Clarion River near PA Route #949 in Jefferson County, has grown in the last decade and the amount of visitors have increased by almost 35%. The most distinguished state park within the watershed is Cook Forest. It is a 6422 acre park located in Cooksburg along the Clarion River in Forest, Clarion and Jefferson Counties. Settled by John Cook in 1828, the area contains one of the finest stands of virgin timber in the eastern United States and has been designated as a National Natural Landmark.

Allegheny National Forest covers significant amounts of land in the watershed area found in Elk, Forest, and McKean counties. There are several main attraction areas administered by the Allegheny National Forest (ANF) found within the basin. The

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[20] Biological Monitoring of the Clarion River to Assess Impacts of Piney Dam Releases, Survey Date: 10-11 July 1995, Report Date: 8 December 1995, Leroy Young-Pennsylvania Fish and Boat Commission, pg. 1-4

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forest lands are relatively undeveloped and are available for low density recreation uses such as hunting, fishing, hiking, camping, and picnicking. In Elk County the ANF offers to the public: Laurel Mill X-C Ski area and the Ridgway Reservoir located near Ridgway between Big Mill Creek and Bear Creek; Twin Lakes Area located northwest of Wilcox, PA; and Loleta Recreation Area located north of Belltown. Laurel Run Reservoir located on a tributary to Elk Creek near St. Mary's, Elk County is also an area of recreation.

East Branch Lake, Elk County, is also an area frequently visited by people wanting to enjoy the Clarion River resources. The lake which is administered by the U.S. Army Corps of Engineers was created by the East Brach Dam. Elk State Park is a 3192 acre park developed around the East Branch reservoir and is also administered by the U.S. Army Corps of Engineers. A description of each recreational area identifying activities, facilities and the number of participants can be found on *Chart C21, A57-58*.

The aquatic resources have continue to improve in the area creating an increase in recreational activity. The PA Fish Commission regulate fishing and boating on the local streams and the river. Several streams are stocked with either bait or game fish. The Clarion River is considered to be a good early season trip for avid canoeists. Piney Dam offers 16 miles of boating, and skiing. Genco, operator of the hydroelectric dam, issues 300 dock permits a year entitling the use of 20 feet of shoreline. A public boat launch is available at Toby Bridge just below Clarion, and Millcreek. Both launches receive tremendous usage and may be in need of parking facilities, and restroom facilities.

The Clarion/Little Toby Creek Trail has incorporated a section of the old Penn Central Ridgway Secondary Rail Line. Developments are underway for a 13 mile intermodel transportation project. This rail-trail will begin in Brockway and continue northward along Toby Creek. It will continue along the Clarion River and Rt. 949 in Ridgway and Spring Townships, Elk County.

Archaeological/Historical

A total of 34 Historic and 254 Prehistoric sites are on record with the Bureau for Historic presentation as being located in the Clarion River Basin. Little survey work has been completed to document these sites. Sites are determined by following the guidelines of History Code (37 PA.C.S.). The code permits "archaeological field investigations" which are studies "of cultural history at an archaeological site by professionally accepted means of surveying, sampling, excavation or removal of archaeological specimens."

Historic sites are located in all counties except McKean County. Nearly 45% of the historic sites are catalogued as "Unknown Site Type", 33 % are grouped as "Industrial Sites", and very few sites are identified as "Commercial or Domestic". The National Register Status for approximately 75% of the sites considered the data to be insufficient.

Prehistoric sites also exist in each county within the basin except McKean County. Nearly 47% of Prehistoric sites are classified as "Open Habitation Sites", and 36 % are labeled as "Rockshelter/Cave Sites." There are few Burial Mounds and Aboriginal Sites. Approximately 90% of the sites have an "Unknown Condition" and the National Register Status considers the data insufficient. *Chart C22, A-59-64* identifies

each site. There has never been a comprehensive historic or archaeological survey conducted for the basin. The historic and prehistoric sites on record represent only a small fraction of the sites that may actually be present.

Humans first arrived in the Clarion River Basin about 11,000 years ago when the area resembled Arctic Canada. Native Americans hunted Caribou and other large animals. The Clarion River quickly became a key travel route and an important Native American hunting ground.

A considerable number of rock overhangs or "rockshelters" are located in the basin and have been utilized by prehistoric American Indian groups prior to European settlement. Archeological remains in those rock shelters not only contain important clues about past cultures but also yield information on past climatic, floral and fauna changes that have occurred in the basin. In addition to rockshelter sites, the basin also contains stratified open sites, such as State Run Ripple, that have the potential to answer important research questions on the archeological cultures who have occupied the basin in the past.

Native Americans living along the Clarion River used horticulture, ultimately adding semi-sedentary village sites into settlement patterns. The French arrived in the 1800's and named the river "Riviere au Fiel," the River of Hate because it was known as the dividing line between the feuding Seneca and Delaware Indians. It is believed that the river received its present day name by one surveyor who identified the nature sounds of the river as clear and distinct. The sounds were like a "clarion call". The state government formally adopted the name Clarion River in 1819.

Lumbering was an important industry in the area throughout the 1800's because of the area's abundance of hardwood forests. The Clarion River and its tributaries were vital to transporting timber to Pittsburgh. Iron ore, which was mined in the Clarion River valley, was also transported on the river. Both of these industries environmentally impacted the Clarion River. Excessive sawdust from sawmills killed fish and clogged streams while the timbering industry wiped out the hillsides causing erosion and sediment loads in the streams. Another pollutant of the river was mine drainage from large scale mining. More than 75% of the 250 streams that flow into the Clarion River have been affected by mine drainage.

Though the river has been negatively impacted by industry and pollutants, several unique structures survived in the river basin.. Arroyo, a particular heritage resource site, was once larger than the town of Ridgway. The community had residences, hotels, opera houses, businesses, sawmills, tanneries and chemical plants. Foundations still remain from this once bustling town. Indian forts ruins have been documented near Russell City. Also, according to Brian Socolic *(PA Historic Resource Survey, 1994),* there are at least eight dams, some bracket, along Mill Creek and Little Mill Creek. " These dams are important in documenting Pennsylvania's logging practices, lumber history of the Clarion River Watershed, and structures of folk technology. Constructed by lumbermen, the dams are significant rare remnants of an era when Pennsylvania was a leader in lumber production. Other logging boom remnants include a series of man made islands near the town of Portland Mills. Two specific groups of islands, Bear Creek Eddy and Mill Haven, are old logging pools.

Natural Resource Extraction

The Allegheny is Pennsylvania's only National Forest, and it comprises a half million acres of land in northwestern Pennsylvania. It was established in 1923 with ownership of surface rights being of principal concern. Title to oil, gas, and minerals remains in private ownership on 94% of National Forest ownership. The land is primarily timbered and helps to support local industries with fine hardwood timber such as black cherry, maple, ash, and oak. A 1996/97 map is available through the Allegheny National Forest identifying "timber cutting areas." The map is supported by the area's travel promotion agencies, and is titled "Hunting the Alleghenies".

Within the Clarion River Basin the Allegheny National Forest has several areas with restrictions on new road construction. This management procedure significantly limits timbering because of an inability to build an access road. Defined as Management Area 6.1, this area is found along the north side of the Clarion River that is east of the powerline which goes to Portland Mills and south of Township Toad T-307 and LR 24002 between Hallton and Ridgway.[21]

To provide regional as well as statewide information on forest resources in Pennsylvania, the state is broken into eight geographical units. The Clarion River Watershed intersects the Allegheny Region (McKean, Forest, and Elk County) and the North-Central Region (Clarion and Jefferson County). There are two types of forest lands: commercial and noncommercial. On noncommercial forest land, harvesting is legally restricted or unlikely to take place. Included are parks and natural areas, forest land in urban settings, unproductive forests, and Christmas tree plantations. The remaining commercial forest-land category, accounts for 93% of the forest land, and supports more hardwood timber volume than any state in the nation with the exception of North Carolina.

The Clarion River Basin Commission was able to identify areas of timberland by county and ownership class. [22] Each county's figures provides the total amount of timberland, but does not identify timber production.

Ownership Class *(in Thousands of Acres-1989)*

County	National Forest	Miscellaneous	State	Municipal & County	Forest Industry	Farmer	Other Private
Elk	104.3	0	120.2	5.4	59.5	5.4	168.4
Forest	110.2	0	9.9	0	54.8	5.7	69.6
McKean	128.2	0	24.2	5.6	151.2	0	211.1
Clarion	0	0	18.9	0	21.5	10	181.2
Jefferson	0	0	41	0	10.9	10.3	187.7

[21] Land and Resource Management Plan Allegheny National Forest (United States Department of Agriculture, March 1986), pg. 114-115.

[22] Forest Statistics for Pennsylvania--1978 and 1989 ,United States Department of Agriculture, Forest Service, Resource Bulletin NE-126, January 1993, Table 146.

This section of Pennsylvania also has a vast amount of natural resources in the form of oil and natural gas. Pipelines from the gas wells are common in and around the corridor. Many old wells were abandoned after they were no longer economically feasible to operate. This is the case with many wells around the Clarion River. The abandoned wells can leak gas, oil, and brine- making them a pollution hazard. Programs for plugging these wells have been initiated. A new regulation requires that after two years of inactivity a well must be plugged. In 1972, identification and abatement of tributary mine drainage sources, mainly abandoned oil and gas wells, was targeted by a proposed acid mine drainage abatement program in six major pollution-contributing watershed drainages. The status of this reclamation project is unknown.

Planning

Each county, except Elk, within the Clarion River Basin has a Subdivision and Land Development Ordinance. The purpose of this ordinance is " to promote the health, safety, convenience, and orderly development of the County...". Jefferson County developed a comprehensive plan in 1991, and Elk County developed a three year plan in 1996. Barnett Township, Forest County, completed a comprehensive plan in 1996. Similar to Elk and Jefferson County, this plan addresses issues (sewage needs, tourism development, land use, and stormwater drainage), but does not determines or limit the uses of the land. The only requirement is that the design or development must fit the intended use of the land. Reports indicate that Millcreek Township, Clarion County has established a zoning ordinance which will affect the Clarion River Watershed, but at the time of this document details of the ordinance could not be provided. Clarion and McKean County have not completed a comprehensive plan or have developed zoning ordinances.

Johnsonburg (adopted 1978) , Ridgway, (1985), and St. Mary's Borough (1988) have established ordinances which discourages new construction or development within the floodplain district. Existing structures located in any designated floodway area shall not be expanded or enlarged unless the effect of the proposed expansion or enlargement on flood heights is fully offset by accompanying improvements. The boroughs have a zoning map which delineates the floodplain area which is subject to the one-hundred year flood as identified in the Flood Insurance Study (FIS) prepared by the Federal Emergency Management Agency (FEMA).

V. Areas of Concern

Landfills

As of March 1995, there are three permitted landfills within the Clarion River Basin: County Landfill located in Farmington Township, Clarion County; Greentree Landfill operated by Superior Waste Services of West Allis, Wisconsin in Elk County; and Kness Saint Landfill in Sargeant Township, McKean County.

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County Landfill, Inc., was issued a solid waste disposal and/or processing permit in June 1990 with an expiration date of June 2000. The landfill is permitted to receive no more than 1,500 tons of solid waste on any single operating day, and no more than 1,000 tons of solid waste on an average daily volume basis over the standard calendar year. Residual and municipal solid wastes are accepted for disposal. No liquid waste is permitted to be disposed of at the landfill. Previously, the leachate was monitored and analyzed by County Landfill, and treated at the Clarion Municipal Sewage Plant. County Landfill initiated an on-site leachate treatment plant in February, 1997.

Kness Saint Landfill has been authorized by the McKean County Solid Waste Authority to discharge from the facility at Sargeant Township to receiving waters named Little Sicily Run. The existing landfill must meet effluent limitations and monitoring requirements established in its industrial NPDES Permit provided by the DEP Bureau of Water Quality Management. This is a temporary discharge permit until the permittee completes the new leachate treatment plant by October 1997.

The Greentree Landfill is owned and operated by Superior Waste Services located in Fox Township, Elk County. The site size is 1336.4 acres with 90.7 acres permitted disposal area. The landfill is permitted to receive a maximum of 6000 tons of solid waste on any single operating day and no more than 3400 tons of solid waste on an average daily volume based over the standard calendar year. Greentree Landfill has a recycling program with containers located on-site to collect glass, aluminum, and plastic recyclables from local municipalities. The existing landfill must meet effluent limitations and monitoring requirements established in their industrial NPDES permit provided by the DEP Bureau of Water Quality Management. The leachate is collected, stored, and treated at the on-site leachate treatment plant. The treated effluent is discharged to the local stream Little Toby. Superior is currently in the process of applying to the PA DEP for an expansion permit for an additional 134.4 acres of disposal space.

Abandoned Landfills

One example of point-source pollutant is the leachate created by abandoned landfills . The Solid Waste Authority in Elk and Jefferson County has begun to identify these landfill sites along with dump sites within the study area. Residents from the counties have the opportunity to report dump sites assisting the county in remediating problem areas. Each site, location, size, and dump items are listed. The sites have been identified, but they have been only evaluated according to the ease of clean up. This topic is of importance to the Clarion River Basin Commission. The abandoned landfills present an opportunity to create a toxic leachate which may be flowing into the watershed. Many of these landfills are unlined and do not have a leachate collection and treatment system. Some of the landfills are remains of the municipal dumps in existence before the current municipal landfill standards and laws were written and enforced. At this time, the Clarion River Basin Commission has not completed an analysis of the sites or possible contaminates leaching into the study area. The Clarion River Basin Commission is unable to locate an organization in Clarion County which is undertaking the task of identifying abandoned landfills.

Mined Areas

A 1976 study showed 474 sources of mine drainage in the Clarion watershed, and past analysis of the magnitude of the Acid Mine Drainage (AMD) sources in the Clarion River Basin was accomplished in a 1981 U.S. Army Corp of Engineers study of the Clarion River Basin. The study identified seven main watersheds which had severely degraded water quality due to mine drainage resulting from abandoned coal mining operations and oil and gas wells. The watersheds identified in the 1981 study affected by mine drainage were those of East Branch Clarion River, Little Toby Creek, Mill Creek, Toby Creek, Piney Creek, Deer Creek, and Licking Creek

Through the Bureau of Abandoned Mine and Reclamation, a division of the Pennsylvania Department of Environmental Protection, an overlay for each quadrant is available which displays abandoned mine land problems, and health and safety problem areas still in existence as of 1989. The overlays identify surface and underground burning pockets; explosive gas vents; dangerous piles, embankments, impoundments, slide, and highwalls; polluted agricultural/industrial water resources; polluted drinking water resource or polluted recreational waters used for swimming; clogged streams; dangerous disposal of industrial or residential waste; and hazardous abandoned mining equipment or facilities. According to the 1981 U.S. Army Corp of Engineers study, there are approximately 30,000 acres of strip mined land which exists in the basin, including 21,000 acres in Clarion County. As the major sources of acid pollution are identified and the problems corrected, the affected watersheds have become repopulated with a diverse assemblage of fishes. The general study area presents a pleasing view to the eye since little development of human kind is readily apparent. Exceptions are the mined areas in the watershed. The coal mining industry has left great scars on the hillsides where restoration and revegetation were not accomplished.

Industrial Waste Sites

Industrial waste sites exist within the Clarion River Basin essentially in The St. Mary's area. Stackpole Carbon Company no longer operates in St. Mary's but continues to work with the Environmental Clean-up Department of the DEP located in Meadville. Stackpole's old plant site is the location of a fully lined encapsulated landfill and a capped electroplating lagoon. The plant site is currently owned by the North Central Pennsylvania Regional Planning and Development Commission. Approximately seven years ago, each site was sealed according to regulations and is monitored every three months.

Stackpole is also responsible for a "Rear Tannery Landfill." This site is closed and sealed with soil. Two wells are used to pump the contaminated water, and the leachate is treated at the St.Mary's Sewage Treatment Plant. Stackpole also had a site in Benzinger Twp. which recently was purchased by another carbon manufacturing company. This site is the location of a ground water remediation system which pumps and pre-treats the contaminated groundwater. This leachate is then sent to the St. Mary's Sewage Treatment Plant.

"The Clay Pits Landfill" is another responsibility of Stackpole. This landfill contains non-hazardous residual waste and is sealed with a soil cap. Stackpole must

monitor this landfill every three months. Stackpole is finalizing the solution to their old dump site which has been in use since the late 1960's. The site is located on an old strip mine and maybe leaking into the groundwater. The residents in the area depend on the city's public water system for consumption.

As this area was once the world's leading tanning and wood chemical industry which often caused on-site disposal of toxic industrial waste other critical areas may exist within the basin. Many of the soils present in the basin are easily erodable, and they are thought to be contributing considerable amounts of sediment to the receiving streams. The disturbance of these soils through natural erosion, agriculture, construction, road building and strip mining has led to this sedimentation.

Treatment Plants

Point-source pollution to the basin could occur as a result of an inadequate discharge system permitted by the DEP. As of May 1, 1996, there were 73 different entities that possessed a National Pollutant Discharge Elimination System (NPDES) permit within the Clarion River Basin. [23] Twenty-seven permits were for industrial waste discharge. Thirty-two discharged permits were for non-public sewage wastes, such as schools, private homes, and hospitals. The remaining fourteen permits were for public sewage systems which are discussed in the next paragraph. Each unit within an industry needs its own permit so some permittees will maintain as many as seven different permits. For an example, Motion Control located in Ridgway Boro has seven industrial waste outfall permits. Thirteen entities are permitted to discharge directly into the Clarion River. Sixty permits allow a discharge into a tributary of the Clarion River. Elk Creek, Elk County is the site of thirteen permits, with many of the industries having multiple permits. The DEP establishes effluent limitations which the permittee must follow. St. Mary's is one of the most populated and industrial areas found within the basin. Unfortunately, St.Mary's relies heavily on Elk Creek for all of its major water supply and discharges. Although Elk Creek appears to be able to handle all of its demands, water monitoring stations within the creek do not exist. The sewage treatment plant must complete an effluent analysis, but this does not provide an accurate report on the complete condition of Elk Creek.

There are fourteen public sewage treatment plants found within the study area. The larger treatment plants are Johnsonburg, Ridgway, St. Mary's, Brockway, and Clarion. Each one of these plants is required to comply with the terms, conditions, or effluent limitations of their permit. Ridgway recently upgraded its facility to correct a problem with meeting its effluent limits. St. Mary's sewage treatment plant is currently in the renewal stage. The plant was upgraded in 1986 to provide adequate capacity and service for the growing area. Future extensions may dictate the need for future evaluations of the system capacity. St. Mary's sewer system serves an industrial area and an adoption and enforcement of pretreatment regulation were initiated to relieve the

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[23] National Pollutant Discharge Elimination System, Bureau of Water Quality Management WQFC304RO, Pennsylvania Department of Environmental Protection, May 1996

heavy metals. Reports indicate that this solution is working well, but St. Mary's sewage treatment plant is stressed with meeting the discharge limit on copper. The other large treatment plants do not have the same effluent limits on metals that is found in the St. Mary's sewage treatment permit. There is a possibility that the other treatment plants are encountering metals and not properly removing them. Without a proper analysis, the measurement of metals is unknown.

All major sewage treatment plants in the Clarion River Basin experience inflow and infiltration problems during heavy periods of precipitation. The plants are permitted to bypass partially or untreated sewage if the plant's system is experiencing an overload. According to the DEP Sewage Inspectors each sewage treatment plant appeared to have a high occurrence of bypass because of heavy rains during the calendar year of this study. An inspector knew of one treatment plant which bypassed plant treatment 26 times in 9 months beginning Jan.1, 1996. Heavy rainfalls overwhelm the treatment systems and rainwater and sewage combined discharges raw sewage into the river resulting in bacteriological contamination throughout the entire length of the river. Stormwater management plans are needed in several areas within the basin, and this could assist sewage treatment plants with its inflow and infiltration problems. Each sewage treatment plant provides secondary treatment and its effluent is sampled on a regular basis.

A principal industry found within the basin is Willamette Industry, a paper mill located in Johnsonburg, PA. Prior to the Willamette's purchase of this mill, the mill had been criticized for introducing pollutants to the river and creating a discharge lethal to the fish. Previous DEP water quality studies (through 1985) of the river did show depressed conditions and a fishery dominated by organic tolerant species. Since the introduction of Willamette's new biological wastewater treatment plant the chemical and biological quality of the river has improved. In June 1996, DEP reports indicated that the water chemistry results and measured field parameters for the river were generally within allowable ranges for aquatic life protection. Biological conditions have greatly improved in the upper Clarion River since Willamette's new biological waste treatment process began in May of 1992 and discharges to Dill Hill lagoon ceased.[24] However, specific conductivity, total alkalinity, color and total dissolved solids (TDS) were significantly higher at river stations below the papermill and Johnsonburg Sewage Treatment Plant discharges. Nutrient levels and biochemical oxygen demand were reported at fairly low levels for the Clarion River.

A noticeable color change (reddish brown) does occur in the river below the papermill's effluent diffuser. Moderate amounts of whitish-pink, flocculent-like material were also noticed. The reason for this flocculent material escaping the treatment system is unknown and should be investigated further.

The discharge temperature and volume continues to create a concern with the DEP due to the fact that the river is designated for Cold Water Fisheries. A thermal variance study is recommended in order to protect the fish and aquatic life. [25]

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[24] Clarion River Survey, Ridgway Township, Elk County. (Department of Environmental Protection, Northwest Regional Office, December 18, 1996)
[25] Ibid.

No sores, external abnormalities or dead fish were found at any of the sampling stations. A total of 21 fish species were found during the sampling session. *Chart C24, A -66* provides the water chemistry, and *Chart C18, Appendix A-42* (Chapter II) identifies the fish samplings.

Non-Point Source Pollution

The Clarion River and many of its tributaries are also adversely impacted by non-point source pollution. Since the completion of the 1981 Corps of Engineer Study on the Clarion River Basin in which seven main tributaries were identified as affected by acid mine drainage, reclamation projects have occurred and are identified on *Map 4: Clarion River Watershed Treatment.* The green shaded areas represent that a passive wetland treatment system is either being used or is currently proposed as an alternative treatment for mine drainage. The coral shaded areas indicate that a passive alkaline addition has been the method of treatment to remediate the mine drainage problem. One other method of treatment is the installation of a lime treatment facility along the Toby Creek in Jefferson County. *Appendix A67 -71* depict the water condition of each watershed and illustrate the reason that reclamation projects are needed. In each proposal the appropriate organization has completed the necessary water analysis and has applied for funding A description of each treatment method can be found on page *A72-73* in the Appendix. Projects such as these have improved the overall quality of the Clarion River. In May, 1997 the DEP issued a permit for a reclamation project on the Millcreek Watershed. The permit will allow the deposit of fly ash over 210 acres. This fly ash which will create an impermeable barrier will cap the former strip mine. The project is set to begin by early June, 1997. Mine drainage is a non-point source pollutant that haunts the clean-up of the watershed, but as organizations continue to work on projects, the restoration of the Clarion River appears to be on the right course.

Non-point pollution may also occur by agricultural activity which may increase the nutrient loading, causing low oxygen levels in some streams. Road conditions may cause a high sediment concentration in streams. This complaint has been reported to the CRBC numerous times during the public meetings. Road conditions adjacent to many of the streams are not paved. The road surface is considered unstable, causing road sanding and streambank erosion. In all counties found within the watershed, the majority of the state roads contain an asphalt surface, but the majority of the municipal roads are surfaced with either dirt or gravel. As shown on *Map 3: State and Local Roads.* the majority of the roads within close proximity to a stream are maintained by the local municipality.

Portions of the Clarion River's watershed could be in jeopardy of becoming acutely degraded by the level of bacteria caused by improper sewage treatment. In Elk County the Planning Commission identified in 1996 that improper sewage treatment and disposal represents a "major problem within the County of Elk." *(County of Elk Three Year Plan, 1996, Community Development and Housing Needs)* . Fox township has been the site of raw sewage from malfunctioning on-lot systems. Recently this township has been able to acquire sufficient funds to alleviate this problem for most of the initial target area. However, Fox Township is also the site of substantial growth and needs to continue to accommodate the growth. The village of James City, at the time of this

report, did not have a sewage collection or treatment system. Funding was being sought and obtained; however, permanent plans have not been established. Jones Township in Elk County has an approved Act 537 Plan for the village of Wilcox. The plan suggest that installation of gravity sewers, pump stations, and force mains should be used to transport wastewater to Johnsonburg for treatment. In May, 1997 a Class II Environmental Assessment was completed and plans are underway to install main lines to serve the village of Wilcox. The lines will establish tie-in and treatment provided by the Johnsonburg Municipal Authority sewage treatment plant.

Jefferson and Clarion Counties have existing sewage treatment in the major residential areas within the Clarion River watershed. The drainage basin in both counties though experience a lack of public sewage lines with the majority of the population utilizing on- lot septic tanks. The problem in both of these counties and Forest County is the non-existence of public restrooms in some tourist areas. As the river's water quality improves, so does the number of tourist, anglers, hunters, and visitors. As the river's corridor and streams fulfill the recreational needs of the people, the surrounding areas need to improved the infrastructure of the area. The State and National recreation areas are well equipped with facilities. The CRBC is receiving complaints from local citizens in areas with a lack of facilities that are frequently used by over-night canoeists or back packers.

Monitoring

The PA Fish Commission has three regular monitoring stations along the Clarion River corridor: Cooksburg, near mid-channel of the river, Cathers Run in Millcreek Twp., and Callensburg, a location close to the mouth of the river. Research has indicated that different entities including DEP also continue to monitor portions of the Clarion River and its tributaries for the purpose of acid mine drainage reclamation. If a pollutant intrudes the upper portions of the Clarion River, the problem should be identified by the PA American Water Company. As mentioned previously though, there is a lack of chemical monitoring data identifying the presence or non presence of trace metals within the water or the bottom sediments of the basin. Trace metals can occur in an area that has manufacturing, improper sewage treatment, or landfill leachate. These pathways are all found within the Clarion River Basin.

Periodically the PA Department of Environmental Protection (DEP) and the PA Fish and Boat Commission will collect fish from selected areas within the basin and send the fish to a laboratory for analysis. The fish are tested for a number of chemicals. In 1991 a small mouth bass was collected near the bridge in Cooksburg. The analysis indicated that actual values of many of the chemicals could not be determined because of such low amounts, but the sample did contain chromium (.225 ug/gm) and total copper (1.940 ug/gm). In 1993 a walleye collected near Callensburg provided similar results with a copper amount of .346 mg/kg, and a mercury level of .379 mg/kg. A brown trout sampled from Cathers Run in 1993 indicated small levels of copper (.381 mg/kg) and small amounts of mercury (.095 mg/kg). East Branch Lake was tested in 1990 for metals only. Two small mouth bass were tested and both indicated a trace amount of arsenic (.060 and .110 mg/kg), copper (.330 and .280 mg/kg), and mercury (.330 mg/kg in both samples). According to the EPA biologist who completed the test on

all fish samples the results identified small amounts of trace metals and should not present a health problem to the human consumer.

The EPA mandates a dioxin study to be completed on all rivers affected by certain industries. Because of the paper industry located in Johnsonburg, the Clarion River near Ridgway was involved in the 1987 National EPA Dioxin Study. The study tested a whole white sucker and the fillet portion of a brown trout. The results showed a 9.51 Toxic Equivalent Concentration (parts per trillion -ppt) in the whole white sucker, and a 4.02 Toxic Equivalent Concentration (ppt) in the brown trout. The CRBC could not find a thorough explanation of a safe level of toxicity in fish for consumption. The EPA and the DEP stressed that the fish sampled from the Clarion River Basin are safe. The age, size, and type of fish and chemicals present determine the amount of fish a person can safely consume. The consumer's age, size, and, sex are also determining factors in safe level of consumption.

The existing monitoring systems within the Clarion River watershed appear to be adequate. The quality and quantity of that water data illustrates improvements within the basin. A problem arises, though, in the location of the data. The different organization and entities involved within the basin do not have the opportunity to share information. Each group maintains its own records, and data are only shared upon request. The CRBC identifies that this system could be improved with minor networking suggestions.

Floodplains

Floodplains were identified on each topographic map with a light gray shading. The Federal Emergency Management Agency (FEMA) maps were used to identify the 100 year floodplain boundary. The floodplain identify is used to administer the National Flood Insurance Program.; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources. Standard hydrologic and hydraulic study methods were used to determine the flood hazard data . A flood event of a magnitude which is expected to be equaled or exceeded once on the average during any 100-year period has been selected as having special significance for floodplain management (see zoning ordinances). This event, commonly termed the 100-year flood, has a 1 percent chance of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of specific magnitude, rare floods could occur at short intervals or even within the same year.

At one time flooding within this basin was the most serious water resources problem. The Corps of Engineers has completed channel improvements work in Johnsonburg and Ridgway and built the East Branch Dam in 1952 to reduced flood stages in the basin. The Department of Environmental Resources (Protection) has two completed local flood control projects in Brockway Borough which have helped the area and its vicinity by reducing flood damages. Major floods have occurred in the basin in 1936, 1942, 1950, 1959, 1964, 1972, and January, 1996 and July 1996.

In 1980 the Department of Environmental Resources completed a State Water Plan for the area. The study suggested that a channel modification occur on Smith Run at Brockway Borough and on Elk Creek in St. Mary's for the purpose of flood damage reduction in the area. Also suggested in the same study was the request to conduct a

feasibility study for the construction of two small potential reservoir sites located on Hoffman Run and Rocky Run respectively for flood damage reduction in the Wilcox area. Research conducted by the CRBC has indicated that neither project has occurred

In 1996 the Clarion River Watershed experienced two major floods. In January the floods were caused by an unusual combination of heavy rain, unseasonably high temperatures, high winds, and the resultant rapid melting and runoff from thick snowpack. Flooding was particularly severe on the West Branch Clarion River at Wilcox and Elk Creek in Ridgway. In July 1996, the lower part of the Clarion River Watershed was hit the hardest. The gauging station at the Piney Dam reached a discharge of 57,200 Cubic Feet per Second (cfs). Piney Creek and Deer Creek appeared to suffer the most damage. Twenty-two township bridges and roads sustained heavy damages, and eight PennDot bridges were structurally impaired as a result of floodwaters. As a result of Ridgway Boro's extensive damage in January, 1996 and the boro council investigated possible solutions to prevent further flooding. According to the Boro manager, though, all plans were aborted when the estimated cost was approaching 8 million dollars.

Issues and Concerns

The Clarion River Basin Commission (CRBC) held a number of public meetings for the purpose of identifying concerns of the citizens living within the Clarion River watershed. The commission presented the first of two public meetings on Wednesday, August 7, 1996 at the Clarion County Courthouse. Over 300 public notices were mailed to individuals, corporations, and political figures living in the Clarion River Basin. Approximately thirty-five people attended the two hour meeting. Each attendee received a copy of the agenda, a Clarion River Basin factsheet, and a description of the watershed Appendix A67-70. The presentation lasted a half hour with the remaining 90 minutes used for comments. There was a good percentage of participation from the audience and the comments concentrated on existing, specific pollutant problems and previous studies. Issues and complaints were recorded.

On. Wednesday, August 14, 1996 the CRBC repeated the public meeting at the Elk County Courthouse in Ridgway. Once again the public notices were mailed and approximately fifty-people attended the meeting. The same format was followed, and the comment period lasted almost two hours. The public was more outspoken with a higher percentage of participation. Issues, concerns, and comments were recorded.

Smaller meetings were arranged on an individual basis. Numerous non-profit organizations requested slide shows and an opportunity to voice opinions. By mid January, 1997 public meetings ended, and a list of issues and concerns were established by the CRBC.

ISSUES AND CONCERNS

It should be emphasized that these are concerns and issues raised by the public and they are not the result of scientific or environmental studies. References for discussions concerning these issues are noted in the narrative.

Issue: Water Quality

A. There is a lack of water quality monitoring programs measuring certain parameters throughout the watershed. *Reference: Chapter III, pg. 10-17 Chapter V pg. 29-30*

B. Industrial Waste Treatment Systems: There is some concern that industrial wastes may be polluting the river. *Reference: Chapter III pg.10-15, Chapter V pg. 26-27*

C. The impact of Willamette Industry's effluent discharge may be degrading water quality. Reference : *Chapter V pg. 27, C18 A-42, C24, A66*

D. Industries located within the watershed could provide matching funds for some projects needed to enhance water quality.

E. Elk Creek may be receiving excessive loading from various non permitted sources. Development along this creek is the highest throughout the entire watershed.

F. A participant wanted to know if "ferns" rather than acid rain could contribute to an acidic increase in a stream.

G. * Create a volunteer program for citizens to become more involved with water quality testing. If the streams are in need of a water analysis completed by a certified lab, then the community members could at least collect water samples and bring them to the lab for further testing.

H. *In the area of White's Run, Millcreek Watershed the Department of Environmental Protection has proposed a "fly ash" land application. The CRBC stated that there is a need to look at the analysis of the fly ash, identify the source, identify the application procedure and the monitoring program.

Issue: Sewage Treatment Systems

A: Municipal : Municipal systems may be providing inadequate treatment for communities during high amounts of precipitation. *Reference: Chapter V pg. 26-27*

B. Recreational Needs: There is no comprehensive regional approach to recreation. Public facilities may be inadequate to cope with the increase amount of sewage caused by increased tourism. *Reference: Chapter I pg. 6 Chapter IV 19-20 , C 21:A57-58*

C. On-Lot Systems: Malfunctioning or non-existent septic systems may be contributing to water pollution. *Reference: Chapter V pg. 28-29*

D. Inadequate: Some municipalities in the watershed do not offer the residents proper treatment facilities. *Reference: Chapter V pg. 28-29*

E. *Provide grant writing assistance to the Sewage Management Agency located in Clarion County.

Pennsylvania Rivers Conservation Program

Clarion River Basin

Issue: Roads

A. Access: Many roads are surfaced with either dirt or gravel. Increased usage could lead to deterioration, and budgets in each township may be inadequate. *Reference: Chapter I pg. 4 Map 3*

B. Erosion and Sedimentation.: Unimproved roads adjacent to many streams are considered unstable, and may cause increase sediment loading to the streams. *Reference: Chapter I pg. 4, Map 3, Chapter V, pg. 28*

C. Dust Control: There is a concern that dust control practices may be adversely effecting water quality. *Reference: Chapter V pg. 28*

D. Road and skid trails created by timbering projects could adversely effect the sedimentation loading of the streams. *Reference: Chapter IV pg. 21-22*

E. Oil and brine dust control measures may contribute to an adverse effect on the water quality of streams.

Issue: Impoundment

A. East Branch Dam and Piney Dam: Water release programs may not satisfy the recreational needs of the reservoir, and the biological needs of the river. *Reference: Chapter III pg. 17-19. Chart C20: A56*

B. Each impoundment's release policy may take into account the quantity of flow, but not the quality of flow. *Reference Chapter III pg. 17-19*

Issue: Landfills

A. A number of municipalities have old, once permitted, landfills where there is a possibility that a toxic leachate is seeping into the groundwater, or tributaries found within the basin. *Reference Chapter V pg. 24*

B. Illegal Dumps: Junk, trash and other debris were reported at numerous sites within close proximity to a water channel. *Reference Chapter V pg. 24, Chart C23: A65*

Issue: Tourism/Recreation

A. Infrastructure: The basic facilities and equipment for increased tourism may be insufficient. Increased development created by the economic boost from tourism along the river could adversely effect the character of the Clarion River Basin *Reference: Chapter IV pg. 19-20*

B. The "Carrying Capacity" of the Clarion River has never been analyzed. *Reference: Chapter 1V pg. 19-20*

C. *Build "viewsheds" along the Clarion River Basin where people can see a variety of land management practices.

Pennsylvania Rivers Conservation Program

Clarion River Basin

Issue: Natural Resource Extraction

A. Mine drainage is a major contributor to pollution in the basin.
Reference: Chapter III pg. 10-11, Chapter V pg. 25, 28 Appendix A67-73, Map4

B. Gas and oil wells could be affecting the water quality of the basin.
Reference: Chapter IV Pg. 22

C. Has there been an identification of abandoned oil and gas wells?

D. **Vacated transmission lines such as old gas line and sewer lines have been abandoned by the utility companies. The lines were never sealed, and are now transmitting water through the area with out the source or destination identified.

Issue: Fisheries

A. Quantity: *Reference: Chapter II pg. 9, A:43-A47*

B. Quality: *Reference: Chapter V pg. 29*

1. Management
2. Human Consumption

Issue: Clearinghouse for the Clarion River Basin

A. A clearinghouse or central library is needed for all information concerning the Clarion River Basin.

B. The regional approach taken by the CRBC to analyze the Clarion River Watershed should be continued once this study is completed.

C. *The CRBC could encourage each township to create an Environmental Advisory Council . The CRBC could be the advisory board for the council.

D. *Corporations may become more involved with applying the concept of International Standards Organization (ISO 14000). The idea behind this plan is to promote quality and create a better waste stream. The CRBC could work with the corporations and initiate small changes. An Environmental Excellence Award could be provided.

E. *Contact the Industrial and Economic Development board for each county. Introduce ourselves and make contact for further references.

Issue: Historic and Archaeological Sites:

A. Historic markers should be placed along the river to interpret the history of the river. *Reference : Chapter* IV *pg. 21*

B. *Local, state, and federal agencies should be encouraged to repair, restore, rehabilitate, and preserve historical structures.

C. **Improved documentation and preservation of historic and archaeological sites previously excavated such as State Road Ripple within the basin needs to occur.

Pennsylvania Rivers Conservation Program

Clarion River Basin

Issue: Land Use

A. Property land owner right versus land management restriction. *Reference: Chapter IV pg. 23*

B. Flooding is a concern in the watershed. *Reference: Chapter V pg. 30.*

C. Increased development created by tourism along the river could adversely effect the character of the Clarion River Basin. *Reference: Chapter 1V pg. 19-20*

D. A wildlife sanctuary could be established

E. Location of major utilities could be causing a visual and/or environmental damage to the natural resources

F. Riparian Forest Buffers need protection.

Education was discussed at each public meeting. The CRBC agreed that education must become a component of each issue rather than be an issue of itself.

*A Preliminary Findings Report presented April, 1997 to the general public at Clarion University in Clarion County provided an opportunity for the public to make additional comments or identify issues that have not been discussed. As a result of the meeting, the concerns identified by an asterisk were added to the list of issues.

** A double asterisk indicates that the issue or comment was identified as a result of the "draft " document public meeting, held at the Elk County Courthouse on June 11, 1997.

The CRBC "Study Team" reviewed each issue and calculated the financial, human, and technical commitment needed to resolve or improve the situation. Each issue was analyzed to determine the degree of interest and to the importance of the mission statement of the CRBC. The table defines the action, the agencies responsible for carrying out the action, the timetable for the action, and a descriptive comment regarding funding sources and completed work.

Pennsylvania Rivers Conservation Program

Clarion River Basin

Clarion River Basin Commission's Study Team

Tracy Frampton:	Assistant Director for the Jefferson County Department of Development Brookville, PA
Bob Kaufman:	Chairman of the Clarion Conservation District Clarion, PA
Lionel Lemery	Recreation Program Manager Allegheny National Forest Warren, PA
Tom Matticks:	Assistant State Conservationist: Natural Resource Conservation Service Clarion, PA
Joseph Quattrone:	Elk County Podiatry B.S. Biology; Physician Ridgway, PA
Andy Redmond:	Environmental Supervisor for Willamette Industries, Inc. Johnsonburg Mill Johnsonburg, PA
Bernie Spozio:	District Conservationist: Natural Resource Conservation Service Clarion, PA
Dave Strong:	CEO of Brockway Analytical, Inc. Analytical Chemist Brockway, PA
Pam Zahoran:	Technical Assistant Clarion River Basin Commission Clarion, PA

MANAGEMENT OPTIONS

Management Options

Recommended Actions	Responsibility	Time Table/Possible Funding
Water Quality		
Phase 1		1997-1998
1. Identify existing water monitoring stations within the Clarion River Basin. 2. Review the list of chemical and biological monitoring completed at each station. 3. Identify the areas within the watershed that are in need of increased chemical and biological monitoring stations.	Clarion River Basin Commission (CRBC) PA Fish and Boat Commission (PFBC)	The Clarion River Basin Commission has been able to complete a major portion of this phase. Minimal research is still required.
Phase 2		1998-2000
1. Establish biological and chemical monitoring stations in locations identified in Phase 1. 2. Monitor the water quality of the basin annually. 3. Summarize data and present the results to the Bureau of Water Quality.	CRBC PFBC Department of Environmental Protection (DEP)	The PA Rivers Implementation Grant funds can be used to supplement this study and report
Phase 3		2000-2001
1 Identify areas within the watershed that have poor water quality or low biological diversity 2. Evaluate all treatment systems in the basin that may be a potential point of pollution discharge. 3. Research new technology i.e. Alkaline Addition and recommend changes that could properly treat the source of water pollution. 4. Education: Publicize improvements in treatment systems and identify activities that may contribute to water quality deterioration.	CRBC DEP Private Industry Natural Resources Conservation Services (NRCS) County Conservation District	Private Industry may be able to provide matching funds. 1998-Ongoing DEP Environmental Education Grant Programs Education will be incorporated in each phase of water quality

Management Options

Recommended Actions	Responsibility	Time Table/Possible Funding
Sewage		
Phase 1		1997-2000
1. Comprehensive system evaluation of the entire Clarion River Basin 2. Identify municipalities, rural communities, and public facilities that do not provide adequate sewage treatment and disposal.	CRBC DEP: Sewage authorities Municipalities Local Planning Departments USDA Forest Service PA Department of Conservation and Natural Resources (DCNR)	Partially completed by the CRBC for the PA Rivers Program PA Rivers Implementation Funds
Phase 2		1998-2001
1. Research innovative ideas to prevent or solve improper sewage treatment.. 2. Recommend changes and alternative treatment methods or systems	CRBC Resource Conservation and Development Council (RC&D)	Continuation of the implementation study
Phase 3		1999-2002
1. Research additional funding for municipalities 2. Increase treatment capacity in the corridor that meets tertiary treatment standards. 3. Education: Provide educational programs for township supervisors, local planning departments and the general public stressing the importance of proper sewage treatment.	CRBC DEP:Sewage Authorities RC& D Councils Local Planning Departments Municipalities Conservation Districts	Ongoing Private Resources Economic and Development Grants Act 537 Resources

Management Options

Recommended Actions	Responsibility	Time Table/Possible Funding
Roads		
Phase 1		1998
1. Identify all roads within the Clarion River Basin	CRBC	Completed
2. Assess road conditions within close proximity to tributaries and corridor.	Trout Unlimited PA Department of Transportation	Ongoing
Phase 2		1997-2000
1. Research technology and identify alternative maintenance programs.	Local governments CRBC	
2. Encourage coordination and cooperation among township supervisors and the PA Dept. of Transportation	PA Dept. of Transportation	Ongoing
3. Education:Provide workshops on alternative road maintenance programs.	Trout Unlimited	Ongoing
4. Assist with securing funds that townships and municipalities may use to improve its road maintenance program.	Local Planning Departments CRBC	Ongoing

Recommended Actions	Responsibility	Time Table/Possible Funding
Impoundments		
1. Meet with GPU and the U.S. Army Corps of Engineers to clarify its water release policy and government regulation of Piney Dam and East Branch Dam.	CRBC PFBC Corps of Engineers General Public Utilities Corp. GPU Genco	1997-1998
2. Evaluate each situation and make recommendations towards a management policy that may satisfy the recreational needs of the dams, and the biological demands of the river.	CRBC	1998-2000
3. Education: Clarify the policies to the general public so that misconceptions could be avoided.	CRBC	Ongoing

Management Options

Recommended Actions	Responsibility	Time Table/Possible Funding
Abandoned Landfills		
Phase 1		1997- 1998
1. Identify abandoned landfills once operated that were closed before the new enforced.	Municipalities DEP CRBC	Partially completed by the CRBC for the PA Rivers Program
2. Evaluate the status of each landfill	DEP CRBC	
Phase 2		
1. Research technology that could be used to treat the leachate seeping form the sites	Carnegie Mellon Institute	Ongoing Contract agreement with CMU
2. Coordinate the technology information with the DEP and municipalities	CRBC and DEP	
Illegal Dumps		
1. Identify illegal dumps within close proximity to streams and major tributaries of the Clarion River.	Private Citizens Local Planning Department Non-profit environmental organizations	1997-2000 PA Rivers Sweep Program
2. Organize annual clean-up river days.	County Conservation Districts	
3. Introduce the PA Clean Ways Program	CRBC	
4. Education: Encourage public awareness programs about need for cleanup. Improve recycling efforts.	County; Municipalities: DEP	

Management Options

Recommended Actions	Responsibility	Time Table/Possible Funding
Tourism/Recreation		
Phase 1		2000
1. Determine the carrying capacity of the Clarion River.	U.S.D.A. Forest Service Municipalities	PA Department of Commerce Community and Economic Development
2. Identify the current recreational use of the river throughout the Basin	Tourism Bureaus State Parks and public facilities RC & D Councils and DCNR	1997-1998
Phase 2		1997-2003
1. Identify the need and location of infrastructure required to properly sustain the "carrying capacity of the river."	CRBC Municipalities Private individuals	Penn Vest PA Department of Commerce Community and Economic Development
2. Build one type of public facility per year which would incorporate pollution prevention facilities. i.e. Canoe Launch with restroom facilities, parking areas with proper refuse collection, picnic areas within the natural environment, water access campgrounds etc.	Tourism Bureaus Municipalities CRBC	Bureau of Recreation and Tourism PA Rivers Development Grants
3. Education: Provide information to the tourist explaining proper care of the river and location of pollution prevention infrastructure.	CRBC Canoe liveries/cabin rentals/restaurants Tourism Bureaus	1997-Ongoing Private Funds
4. Promote "Carry-in/Carry-out trash bags at canoe liveries to encourage proper litter disposal.	Canoe Liveries	Private Industry/Advertising Promotion

Management Options

Recommended Actions	Responsibility	Time Table/Possible Funding
Natural Resource Extraction		
Phase 1		1997
1. Complete evaluation of the Clarion River Basin and identify areas impacted by Mine Drainage.	DEP United States Geological Survey (USGS) Natural Resource Conservation Service (NRCS)	Completed
2. Status of mine drainage remediation projects within the watershed.	Watershed Associations and Sportsman Clubs DEP	1997
3. Support and collaborate remediation efforts through the basin.	CRBC	Ongoing
Phase 2		Ongoing
1 Research new technology to provide innovative treatment systems/methods for mine drainage. 2. Pursue funding sources for maintenance of existing treatment systems.	CRBC RC & D Councils NRCS DEP	Office of Surface Mining Abandoned Mine Lands Trust Funds PL-566 funds EPA/DEP Section 319 funds
Phase 3		2002
1. Evaluate the impact that gas and oil wells and vacated transmission lines have on the water quality of the Clarion River Basin.	PA Fish and Boat Commission DEP	
2. Determine future steps based on the results of the impact study.	CRBC	
Education: Provide information to interested parties and the general public on the progress and results of the remediation passive treatment systems within the watershed.	County Conservation Districts	Ongoing -Funding may be provided by private foundation money or through DEP's Environmental Education Funds

Management Options

Recommended Actions	Responsibility	Time Table/Possible Funding
Fisheries		
Phase 1		1998-1999
1. Conduct fish population surveys near the established chemical and biological sampling locations identified in Phase 1 of the water quality study.	PFBC Private Industry DEP	PA Rivers Implementation Grant Program DEP(ongoing)
2. Conduct annual fish tissue analysis at selected monitoring station for one year.	Environmental Protection Agency (EPA)	PA Rivers Implementation Grant Program / Foundation Money
Phase 2		1997-2000
1. Review completed studies and identify areas of concern.	CRBC	Federal Cleanwater Act Money
2. Recommend changes in fish management that would utilize areas best suitable for fish habitat.	CRBC DEP EPA	
3. Construct "fish ladders" and other projects that would assist in the proper management and migration of fish.	CRBC Private Industry	Private Industry PA Rivers Development Grant Program
4. Education: Publicize improvements in fisheries and results of the fish tissue samples related to human consumption.	PFBC	

Management Options

Recommended Actions	Responsibility	Time Table/Possible Funding
Clarion River Basin Clearinghouse		1997-Ongoing
1. Research and Collect pertinent material written about the Clarion River Basin.	CRBC	Partially completed-Ongoing
2. Contact all organizations, agencies, and environmental groups that may be working towards a better environment for the Clarion River Basin.	CRBC	1997 Private Funds
3. Coordinate efforts and support each project proposed to improve the water quality of the Basin.		1997 CRBC Funds
4. Organize an annual meeting with all entities to assist with a Clarion River Basin Status Report.	CRBC	1997
5. Education: Produce an annual report highlighting projects completed within the Basin to improve water quality.	CRBC	Citizen Education Fund League of Women Voters Conservation Districts County Governments

Management Options

Recommended Actions	Responsibility	Time Table/Possible
Archeological Needs		
Phase 1		1998-2000
1. Inventory and evaluate historic and archaeological sites within the basin. 2. Complete documentation of existing sites previously excavated such as State Run Ripple.	Clarion University of PA Public Libraries County Historical Societies	Clarion University PA History and Museum Grants
Phase 2		
1. Proper procedure should be followed for eligible sites for inclusion on the National Registry of Historic Places.	Clarion University of PA Private Citizens	Clarion University PA History and Museum Grants
2. Education: A report presented to local agencies to encourage proper care and preservation, and or interpretation of significant heritage resources in the basin.	CRBC County Historical Societies	CRBC Funds PA History and Museum Grants

Management Options

Recommended Actions	Responsibility	Time Table/Possible
Land Use Management		
Phase 1		
1. Identify all nonplanned communities and municipalities.	CRBC	1997
2. Identify all planning commissions, comprehensive plans and municipal zoning ordinances.	County Planning Departments	Partially completed-Ongoing
3. Identify flood prone areas with a history of contributing debris into the watercourse from periodic flooding.	County Conservation Districts	Partially completed-Ongoing
4. Provide research, sample ordinances, and zoning plans to individual townships.	County Planning Departments	State Planning Assistance Grants
Riparian Forest Buffers		
Phase 1		
1. Identify landowners and agricultural producers of the streamside forests.	CRBC PA State Game Commission	1997 Partially completed-Ongoing
2. Provide information to landowners and agricultural producers relating the importance of conservation practices on streamside riparian buffers.	County Conservation Districts USDA/Forest Service NRCS DCNR-Forest Stewardship Program	1997 Environmental Quality Incentives Program (EQIP)
Phase 2		
1. Develop land management guidelines and farm plans for individual landowners and producers.	County Conservation Districts DCNR	1997 Ongoing
2. Encourage participation in Forest Stewardship Program.	Bureau of Forestry	Ongoing
3. Provide 75 % matching funds to landowners who agrees to follow conservation practices.	USDA-FSA NRCS	EQIP will provide a 75% match cost-sharing with producers.

APPENDICES AND CHARTS

GENERALIZED COLUMNAR SECTION OF EXPOSED ROCKS

SYSTEM	GROUP	FORMATION	MEMBER	SECTION	CHARACTER	FORMATION
PENNSYLVANIAN	CONEMAUGH		Lower Mahoning Sandstone		Sandstone and sandy shales	Generally removed by erosion in the Basin
	ALLEGHENY	Freeport	Upper Freeport Coal		Persistent, average thickness 4'	A variable sequence of shale, sandstone, limestone clay and valuable beds of coal. Average thickness is about 300' - 350'
			Butler Sandstone			
			Lower Freeport Coal		Thin, not persistent	
			Freeport Sandstone			
		Kittanning	Upper Kittanning Coal		Thin, variable	
			Middle Kittanning Coal		Occasionally two seams, irregular	
			Lower Kittanning Coal		Very persistent, average thickness, 2.5' - 3.5'	
		Clarion	Vanport Limestone		Thin, often absent	
			Scrubgrass Coal			
			Upper Clarion Coal		Persistent average thickness 2'	
			Lower Clarion Coal		Persistent average thickness 3.5'	
			Clarion Sandstone		Fine grained, cross-bedded	
			Brookville Coal		Variable, often split	
	POTTSVILLE		Homewood Sandstone		Fine grained, often iron stained	Consists primarily of sandstones, often massive with some unimportant coal beds and fire clay
			Mercer Coal Mercer Clay		Thin, variable. Generally two seams	
			Connequenessing Sandstone		Massive, fine grained	
			Unconformity			
MISSISSIPPIAN	POCONO		Burgoon Sandstone			Only the upper portion of Mississippian age rocks appears in some of the deeper stream valleys.

Geology Formation

The bedrock geology in the Clarion River Basin was formed during the Pennsylvanian, Mississippian, and Devonian Periods of the Paleozoic Era. During this time, many advances and retreats of the sea deposited sands, silts, clays, and coals form delta, sea estuary, and swamp environments. At the close of the Paleozoic Era, a great force was exerted on these sediments from the southeast, and the sediments were raised above sea level and folded into large mountains. This disturbance resulted in only minor uplift and folding of sediments in the Clarion River Basin causing the formation of broad anticline and synclines.

From post-Paleozoic to the present time, streams and tributaries have eroded and dissected the plateau, exposing several formations within the Pennsylvanian through Devonian Systems. The younger rocks are exposed along the top of the plateau, and successively older rocks are exposed on the valley walls and bottoms. Generally, the rocks with the greatest range in age are exposed in the the deeper valleys with the greatest relief.

In sequence from youngest to oldest, the bedrock formations and groups in each system in the Basin are described in the following paragraphs.

A generalized geologic column for the Basin is presented in the diagram. This is only an average composite section constructed from the a Geologic map of Pennsylvania and does not necessarily represent a geologic condition at any locale.

Conemaugh Group

The Conemaugh Group is the youngest of the Pennsylvania Period rock and is composed of consolidated gray shale with interbeds of sandstone and some clay shale. The Conemaugh Group is found in the southwestern portion of the Basin. Thin coal and limestone beds occur but are not continuously persistent.

Because of its small area extent and topographic position on hilltops, this formation is of little value as a source of water. There are no known wells in the Clarion River Basin that obtain water from the Conemaugh Formation.

Allegheny Group

Below the Conemaugh are the older rocks of the Allegheny Group. The Allegheny Group includes all the rock between the top of the Upper Freeport coal and the base of the Brookville coal. The individual units of the group differ in thickness form place to place. The formation is the most extensively exposed formation in the Basin and contains nearly all the productive coal veins in this part of the State.

The Allegheny Group is broken into the progressively older Freeport, Kittanning and Clarion Formations. The Freeport Formation is found only on the higher hills in the vicinity of the lowest reaches of the Clarion River just upstream of its junction with the Allegheny River and in the upper reaches of Little Toby Creek.

The Kittanning Formation, most prominent in the lower reaches of the Basin, contains intermediate rocks consisting of shale, sandstone and clay. Thickness ranges form 110 to 130 feet.

The Clarion Formation underlies the Kittanning and is, therefore, found over a wider area of the Basin. Averaging about 125 feet in thickness, the formation consists of shale, siltstone, coal, clay, and limestone in order of decreasing abundance. The iron

oxide deposits commonly found above the limestone were once utilized as a source of iron ore. The Clarion Formation contains both Clarion coals and Brookville coal, and is the predominant surface material in northeastern Clarion County and in adjacent area of Forest, Elk, and Jefferson Counties.

The Allegheny Group is a reliable source of small to moderate supplies of ground water. Some wells yield more than 100 gpm. Sufficient water from domestic purposes can be obtained at almost any location from wells that are drilled 80 to 100 feet below the water table, but yields large enough for industrial and municipal purposes are more difficult to obtain. Chemical analyses of ground water in the Allegheny Group show it to be of the calcium bicarbonate type when the concentrations of dissolved solids are less than 500 mg/l and of the calcium sulfate type when the dissolved solids are greater than 500 mg/l. Total iron in the water runs high. The median for iron is about 2.1 mg/l. Except for the high iron content the water from the Allegheny Group almost always meets U.S. Public Health Service standards for mineral content.

In summary, the Allegheny Group is the predominant surficial rock of Clarion County. Significant parts of the Basin in Elk and Jefferson Counties have Allegheny Group materials exposed at the surface. The group is of lesser importance in southern McKean County and is practically absent in Forest County.

Pottsville Group

The Pottsville Group consists of consolidated sandy shale, coal, and sandstone. The Pottsville rocks show on many hillsides and are close to the surface on most of the broad, flat ridgetops in the northeastern quarter of the county. The formations of the Pottsville Group are the Homewood, Mercer, and Connoquenessing. The Pottsville Group is found at the surface over much of the Basin. It is found at lower elevations than the Allegheny Group and is more prominent surface material in the middle and upper reaches of the Basin. It predominates in Forest and McKean Counties and is important in Elk and Clarion Counties also.

Ground water in the Pottsville Group occurs in pore spaces between the grains and in secondary openings. The Mercer coal and shale interval is a poor water-producing unit because the fineness of the sediments allows little water storage or movement. the highest yields and specific capacities reported are for wells tapping both types of sandstone found in this group. The average yield for wells found in this group is 28 gpm. Analyses of the water from the Pottsville Group indicates a high iron content and should be removed by treatment to make the water acceptable for most use. The median hardness as $CaCo_3$ is about 94 mg/l.

Pocono Group

The oldest rocks, members of the Pocono formation of the Mississippian series, are exposed in the valley along the Clarion River and in a few place along Mill Creek. The Pocono rocks are mostly hard, gray sandstones that include a little shale. Two formations of the Pocono Group occur very near the surface. The two formations are the Burgoon Sandstone and the underlying Cuyahoga Formation. The Burgoon sandstone and the overlying Connoquenessing sandstone found in the Pottsville Group are very similar and creates a confusing boundary between the Pocono and Pottsville Group.

Good supplies of water can generally be obtained from the Burgoon Sandstone, although only small supplies will be obtained where the sandstone is shaly. Some wells yield more than 200 gpm. and is not dependent upon the depth of the well. The yield of a well depends mostly upon the amount of shale interbedded in sandstone or the number of fractures the well intersects. Ground water from the Pocono Group in Clarion County is generally highly mineralized in the lower part and high in iron The median value for total iron is 4.0 mg/l/ The median dissolved-solids content is about 350 mg/l. The total hardness of the ground water from the Pocono Group ranges from 42 mg/l to 370 mg/l. Most ground water from the Burgoon Sandstone requires softening and iron removal.

Source: Clarion River Basin, Pennsylvania Acid Mine Drainage Abatement Program Pg. A-8 to A-11
Water Resources of the Clarion River and Redbank Creek Basins, Northwestern Pennsylvania Pg. 11-12
Cooperative Mine Drainage Study: selected Areas in the Clarion River Basin Pg. 11-14

MAJOR TRIBUTARIES OF THE CLARION RIVER BASIN

EAST BRANCH CLARION RIVER

TRIBUTARY TO.--Clarion River
COUNTIES.--McKean and Elk
SOURCE.--At Clermont, McKean County
Crosby, 7.5' Quadrangle
Elevation 2,140 feet (652 meters)
MOUTH.--At Johnsonburg, Elk County
Ridgway, 7.5' Quadrangle
Elevation 1,431 feet (436 meters)
COURSE.--Southwest
DRAINAGE AREA.--108 square miles (280 square kilometers)
LENGTH.--20.5 miles (33.0 kilometers)
MEANDER RATIO.--1.12
RELIEF RATIO.--34.6
CHANNEL SLOPE.--31.5 feet/mile (9.6 meters/kilometers)
PHYSIOGRAPHY:
Province.--Appalachian Plateaus
Headwaters.--Allegheny High Plateau Section
Mouth.--Allegheny High Plateaus Section
Rock Units.--Sandstone, shale, conglomerate, limestone, and coal
Drainage Pattern.--Dendritic
Channel Pattern.--Regular
Main Channel:
Hills, narrow valley, steep to moderate slopes
MAJOR IMPOUNDMENT.--East Branch Lake
MEAN ANNUAL PRECIPITATION.--42 to 46 inches (1,067 to 1,168 millimeters)

WEST BRANCH CLARION RIVER

TRIBUTARY TO.--Clarion River
COUNTIES.--McKean and Elk
SOURCE.--At Mt. Jewell, McKean County
Mt. Jewell, 7.5' Quadrangle
Elevation 2,314 feet (702 meters)
MOUTH.--At Johnsonburg, Elk County
Ridgway, 7.5' Quadrangle
Elevation 1,431 feet (436 meters)
COURSE.--South
DRAINAGE AREA.--94.1 square miles (244 square kilometers)
LENGTH.--19.1 miles (30.7 kilometers)
MEANDER RATIO.--1.10
RELIEF RATIO.--46.2
CHANNEL SLOPE.--36.4 feet/mile (11.1 meters/kilometers)
PHYSIOGRAPHY:
Province.--Appalachian Plateaus
Headwaters.--Allegheny High Plateau Section
Mouth.--Allegheny High Plateaus Section
Rock Units.--Sandstone, shale, conglomerate, limestone, and coal
Drainage Pattern.--Dendritic
Channel Pattern.--Regular
Main Channel:
Hills, narrow valley, steep to moderate slopes
MEAN ANNUAL PRECIPITATION.--42 to 46 inches (1,067 to 1,168 millimeters)

ELK CREEK
TRIBUTARY TO.--Clarion River
COUNTIES.--Elk
SOURCE.--Near Saint Marys, Elk County
Saint Marys, 7.5' Quadrangle
Elevation 2,220 feet (671 meters)
MOUTH.--At Ridgway, Elk County
Ridgway, 7.5' Quadrangle
Elevation 1,360 feet (415 meters)
COURSE.--West
DRAINAGE AREA.--63.4 square miles (164 square kilometers)
LENGTH.--16.2 miles (26.1 kilometers)
MEANDER RATIO.--1.14
RELIEF RATIO.--51.9
CHANNEL SLOPE.--24.8 feet/mile (7.6 meters/kilometers)
PHYSIOGRAPHY:
Province.--Appalachian Plateaus
Headwaters.--Allegheny High Plateau Section
Mouth.--Allegheny High Plateaus Section
Rock Units.--Sandstone, shale, conglomerate, limestone, and coal
Drainage Pattern.--Dendritic
Channel Pattern.--Regular
Main Channel:
Hills, narrow valley, steep to moderate slopes
MEAN ANNUAL PRECIPITATION.--42 to 44 inches (1,067 to 1,118 millimeters)

BIG MILL CREEK
TRIBUTARY TO.--Clarion River
COUNTIES.--Elk
SOURCE.--At Lamont, Elk County
James City, 7.5' Quadrangle
Elevation 2,280 feet (695 meters)
MOUTH.--Near Ridgway, Elk County
Portland Mills, 7.5' Quadrangle
Elevation 1,340 feet (408 meters)
COURSE.--South
DRAINAGE AREA.--33.2 square miles (86.0 square kilometers)
LENGTH.--16.2 miles (26.1 kilometers)
MEANDER RATIO.--1.08
RELIEF RATIO.--58.0
CHANNEL SLOPE.--35.6 feet/mile (10.9 meters/kilometers)
PHYSIOGRAPHY:
Province.--Appalachian Plateaus
Headwaters.--Allegheny High Plateau Section
Mouth.--Allegheny High Plateaus Section
Rock Units.--Sandstone, shale, conglomerate, limestone, and coal
Drainage Pattern.--Dendritic
Channel Pattern.--Transitional
Main Channel:
Hills, narrow valley, moderate slopes
MAJOR IMPOUNDMENT.--Ridgway Reservoir
MEAN ANNUAL PRECIPITATION.--42 to 44 inches (1,067 to 1,118 millimeters)

LITTLE TOBY CREEK
TRIBUTARY TO.--Clarion River
COUNTIES.--Elk and Jefferson
SOURCE.--At Coal Hollow, Elk County
Kersey, 7.5' Quadrangle
Elevation 2,080 feet (634 meters)
MOUTH.--At Carman, Elk County
Carman, 7.5' Quadrangle
Elevation 1,315 feet (401 meters)
COURSE.--Southwest, 14 miles (22.5 kilometers)
West, 3 miles (4.8 kilometers)
North 11 miles (17.7 kilometers)
DRAINAGE AREA.--124 square miles (321 square kilometers)
LENGTH.--28.2 miles (45.4 kilometers)
MEANDER RATIO.--1.22
RELIEF RATIO.--27.1
CHANNEL SLOPE.--9.9 feet/mile (3.0 meters/kilometers)
PHYSIOGRAPHY:
Province.--Appalachian Plateaus
Headwaters.--Allegheny High Plateau Section
Mouth.--Allegheny High Plateaus Section
Rock Units.--Sandstone, shale, conglomerate, limestone, and coal
Drainage Pattern.--Dendritic
Channel Pattern.--Irregular
Main Channel:
Upper and Middle Reaches: Hills, narrow valley, widening valley, moderate slopes
Lower Reach: Hills, narrow valley, moderate slopes
MEAN ANNUAL PRECIPITATION.--42 to 44 inches (1,067 to 1,118 millimeters)

BEAR CREEK
TRIBUTARY TO.--Clarion River
COUNTIES.--Elk
SOURCE.--Near Highland Corners, Elk County
James City, 7.5' Quadrangle
Elevation 2,040 feet (622 meters)
MOUTH.--At Portland Mills, Elk County
Portland Mills, 7.5' Quadrangle
Elevation 1,312 feet (400 meters)
COURSE.--South
DRAINAGE AREA.--40.4 square miles (105 square kilometers)
LENGTH.--17.0 miles (27.4 kilometers)
MEANDER RATIO.--1.17
RELIEF RATIO.--42.8
CHANNEL SLOPE.--24.2 feet/mile (7.4 meters/kilometers)
PHYSIOGRAPHY:
Province.--Appalachian Plateaus
Headwaters.--Allegheny High Plateau Section
Mouth.--Allegheny High Plateaus Section
Rock Units.--Sandstone, shale, conglomerate, limestone, and coal
Drainage Pattern.--Dendritic
Channel Pattern.--Regular
Main Channel:
Hills, narrow valley, moderate slopes
MEAN ANNUAL PRECIPITATION.--42 to 44 inches (1,067 to 1,118 millimeters)

SPRING CREEK

WATSON BRANCH

TRIBUTARY TO.--Clarion River
COUNTIES.--Forest and Elk
SOURCE.--Near Sheffield Junction, Forest County
Russell City, 7.5' Quadrangle
Elevation 1,904 feet (580 meters)
MOUTH.--At Hallton, Elk County
Hallton, 7.5' Quadrangle
Elevation 1,246 feet (380 meters)
COURSE.--Southeast
DRAINAGE AREA.--87.6 square miles (227 square kilometers)
LENGTH.--18.3 miles (29.4 kilometers)
MEANDER RATIO.--1.15
RELIEF RATIO.--36.0
CHANNEL SLOPE.--16.6 feet/mile (5.0 meters/kilometers)
PHYSIOGRAPHY:
Province.--Appalachian Plateaus
Headwaters.--Allegheny High Plateau Section
Mouth.--Allegheny High Plateaus Section
Rock Units.--Sandstone, shale, conglomerate, limestone, and coal
Drainage Pattern.--Dendritic
Channel Pattern.--Regular
Main Channel:
Hills, narrow valley, moderate slopes
MEAN ANNUAL PRECIPITATION.--42 to 44 inches (1,067 to 1,118 millimeters)

EAST BRANCH MILSTONE CREEK

TRIBUTARY TO.--Millstone Creek
COUNTIES.--Forest and Elk
SOURCE.--Near Lamonville, Forest County
Marienville East, 7.5' Quadrangle
Elevation 1,840 feet (561 meters)
MOUTH.--Near Millstone, Elk County
Sigel, 7.5' Quadrangle
Elevation 1,240 feet (378 meters)
COURSE.--Southwest
DRAINAGE AREA.--26.1 square miles (67.6 square kilometers)
LENGTH.--10.6 miles (17.1 kilometers)
MEANDER RATIO.--1.15
RELIEF RATIO.--56.6
CHANNEL SLOPE.--51.9 feet/mile (15.8 meters/kilometers)
PHYSIOGRAPHY:
Province.--Appalachian Plateaus
Headwaters.--Allegheny High Plateau Section
Mouth.--Allegheny High Plateaus Section
Rock Units.--Sandstone, shale, conglomerate, limestone, and coal
Drainage Pattern.--Dendritic
Channel Pattern.--Regular
Main Channel:
Hills, narrow valley, moderate slopes
MEAN ANNUAL PRECIPITATION.--42 to 44 inches (1,067 to 1,118 millimeters)

WEST BRANCH MILLSTONE CREEK
TRIBUTARY TO.--Millstone Creek
COUNTIES.--Forest and Elk
SOURCE.--At Byromtown, Forest County
Lynch, 7.5' Quadrangle
Elevation 1,840 feet (561 meters)
MOUTH.--Near Millstone, Elk County
Sigel, 7.5' Quadrangle
Elevation 1,240 feet (378 meters)
COURSE.--Southwest, 12 miles (19.3 kilometers)
Southeast, 4 miles (6.4 kilometers)
DRAINAGE AREA.--24.1 square miles (62.4 square kilometers)
LENGTH.--16.3 miles (26.2 kilometers)
MEANDER RATIO.--1.21
RELIEF RATIO.--36.8
CHANNEL SLOPE.--30.3 feet/mile (9.2 meters/kilometers)
PHYSIOGRAPHY:
Province.--Appalachian Plateaus
Headwaters.--Allegheny High Plateau Section
Mouth.--Allegheny High Plateaus Section
Rock Units.--Sandstone, shale, conglomerate, limestone, and coal
Drainage Pattern.--Dendritic
Channel Pattern.--Regular
Main Channel:
Hills, narrow valley, moderate slopes
MEAN ANNUAL PRECIPITATION.--42 to 44 inches (1,067 to 1,118 millimeters)

MILLSTONE CREEK
TRIBUTARY TO.--Clarion River
COUNTIES.--Forest and Elk
SOURCE.--Near Millstone, Forest County
Sigel, 7.5' Quadrangle
Elevation 1,240 feet (378 meters)
MOUTH.--At Millstone, Elk County
Sigel, 7.5' Quadrangle
Elevation 1,198 feet (365 meters)
COURSE.--Southeast
DRAINAGE AREA.--53.4 square miles (138 square kilometers)
LENGTH.--1.8 miles (2.9 kilometers)
MEANDER RATIO.--1.09
RELIEF RATIO.--23.3
CHANNEL SLOPE.--27.1 feet/mile (8.3 meters/kilometers)
PHYSIOGRAPHY:
Province.--Appalachian Plateaus
Headwaters.--Allegheny High Plateau Section
Mouth.--Allegheny High Plateaus Section
Rock Units.--Sandstone, shale, conglomerate, limestone, and coal
Drainage Pattern.--Dendritic
Channel Pattern.--Regular
Main Channel:
Hills, narrow V-shaped valley, moderate slopes
MEAN ANNUAL PRECIPITATION.--42 to 44 inches (1,067 to 1,118 millimeters)

MILL CREEK
TRIBUTARY TO.--Clarion River
COUNTIES.--Jefferson and Clarion
SOURCE.--At Sigel, Jefferson County
Sigel, 7.5' Quadrangle
Elevation 1,840 feet (561 meters)
MOUTH.--At Millcock, Clarion County
Strattanville, 7.5' Quadrangle
Elevation 1,095 feet (334 meters)
COURSE.--West
DRAINAGE AREA.--59.0 square miles (153 square kilometers)
LENGTH.--18.2 miles (29.3 kilometers)
MEANDER RATIO.--1.13
RELIEF RATIO.--40.9
CHANNEL SLOPE.--43.0 feet/mile (13.1 meters/kilometers)
PHYSIOGRAPHY:
Province.--Appalachian Plateaus
Headwaters.--Pittsburgh Plateau Section
Mouth.--Pittsburgh Plateaus Section
Rock Units.--Sandstone, shale, conglomerate, limestone, and coal
Drainage Pattern.--Dendritic
Channel Pattern.--Regular
Main Channel:
Hills, narrow valley, moderate slopes
MEAN ANNUAL PRECIPITATION.--40 to 42 inches (1,016 to 1,067 millimeters)

TOBY CREEK
TRIBUTARY TO.--Clarion River
COUNTIES.--Clarion
SOURCE.--At Clarion, Clarion County
Tylersburg, 7.5' Quadrangle
Elevation 1,660 feet (506 meters)
MOUTH.--At Clarion, Clarion County
Clarion, 7.5' Quadrangle
Elevation 1,095 feet (334 meters)
COURSE.--Southwest
DRAINAGE AREA.--34.9 square miles (90.4 square kilometers)
LENGTH.--15.9 miles (25.6 kilometers)
MEANDER RATIO.--1.13
RELIEF RATIO.--35.5
CHANNEL SLOPE.--27.0 feet/mile (8.2 meters/kilometers)
PHYSIOGRAPHY:
Province.--Appalachian Plateaus
Headwaters.--Pittsburgh Plateau Section
Mouth.--Pittsburgh Plateaus Section
Rock Units.--Sandstone, shale, conglomerate, limestone, and coal
Drainage Pattern.--Dendritic
Channel Pattern.--Regular
Main Channel:
Hills, narrow valley, moderate slopes
MEAN ANNUAL PRECIPITATION.--40 to 42 inches (1,016 to 1,067 millimeters)

PINEY CREEK
TRIBUTARY TO.--Clarion River
COUNTIES.--Jefferson and Clarion
SOURCE.--Near Corsica, Clarion County
Corsica, 7.5' Quadrangle
Elevation 1,760 feet (536 meters)
MOUTH.--At Piney, Clarion County
Clarion, 7.5' Quadrangle
Elevation 1,000 feet (305 meters)
COURSE.--West
DRAINAGE AREA.--71.4 square miles (185 square kilometers)
LENGTH.--21.3 miles (34.3 kilometers)
MEANDER RATIO.--1.30
RELIEF RATIO.--35.7
CHANNEL SLOPE.--20.0 feet/mile (6.1 meters/kilometers)
PHYSIOGRAPHY:
Province.--Appalachian Plateaus
Headwaters.--Pittsburgh Plateau Section
Mouth.--Pittsburgh Plateaus Section
Rock Units.--Sandstone, shale, conglomerate, limestone, and coal
Drainage Pattern.--Dendritic
Channel Pattern.--Irregular
Main Channel:
Rolling hills, narrow valley, moderate slopes, steep slopes at lower reach
MEAN ANNUAL PRECIPITATION.--40 to 42 inches (1,016 to 1,067 millimeters)

PAINT CREEK
LICKING CREEK
TRIBUTARY TO.--Deer Creek
COUNTIES.--Clarion
SOURCE.--At Wolfs Corners, Clarion County
Tionesta, 7.5' Quadrangle
Elevation 1,640 feet (500 meters)
MOUTH.--At Shippenville, Clarion County
Clarion, 7.5' Quadrangle
Elevation 1,161 feet (354 meters)
COURSE.--West
DRAINAGE AREA.--44.4 square miles (115 square kilometers)
LENGTH.--14.1 miles (22.7 kilometers)
MEANDER RATIO.--1.12
RELIEF RATIO.--34.0
CHANNEL SLOPE.--44.3 feet/mile (13.5 meters/kilometers)
PHYSIOGRAPHY:
Province.--Appalachian Plateaus
Headwaters.--Pittsburgh Plateau Section
Mouth.--Pittsburgh Plateaus Section
Rock Units.--Sandstone, shale, conglomerate, limestone, and coal
Drainage Pattern.--Dendritic
Channel Pattern.--Regular
Main Channel:
Rolling hills, narrow valley, moderate slopes
MEAN ANNUAL PRECIPITATION.--40 to 42 inches (1,016 to 1,067 millimeters)

DEER CREEK
TRIBUTARY TO.--Clarion River
COUNTIES.--Clarion
SOURCE.--At Haynie, Clarion County
Kossuth, 7.5' Quadrangle
Elevation 1,717 feet (523 meters)
MOUTH.--At Piney, Clarion County
Clarion, 7.5' Quadrangle
Elevation 999 feet (304 meters)
COURSE.--South
DRAINAGE AREA.--74.1 square miles (192 square kilometers)
LENGTH.--14.4 miles (23.2 kilometers)
MEANDER RATIO.--1.15
RELIEF RATIO.--49.9
CHANNEL SLOPE.--29.4 feet/mile (9.0 meters/kilometers)
PHYSIOGRAPHY:
Province.--Appalachian Plateaus
Headwaters.--Pittsburgh Plateau Section
Mouth.--Pittsburgh Plateaus Section
Rock Units.--Sandstone, shale, conglomerate, limestone, and coal
Drainage Pattern.--Dendritic
Channel Pattern.--Regular
Main Channel:
Rolling hills, narrow valley, moderate slopes, steeper slopes in the lower reach
MEAN ANNUAL PRECIPITATION.--40 to 42 inches (1,016 to 1,067 millimeters)

LICKING CREEK
TRIBUTARY TO.--Clarion River
COUNTIES.--Clarion
SOURCE.--At Curllsville, Clarion County
Sligo, 7.5' Quadrangle
Elevation 1,580 feet (482 meters)
MOUTH.--At Callensburg, Clarion County
Knox, 7.5' Quadrangle
Elevation 952 feet (290 meters)
COURSE.--Northwest
DRAINAGE AREA.--51.8 square miles (134 square kilometers)
LENGTH.--13.7 miles (22.0 kilometers)
MEANDER RATIO.--1.13
RELIEF RATIO.--45.8
CHANNEL SLOPE.--22.8 feet/mile (6.9 meters/kilometers)
PHYSIOGRAPHY:
Province.--Appalachian Plateaus
Headwaters.--Pittsburgh Plateau Section
Mouth.--Pittsburgh Plateaus Section
Rock Units.--Sandstone, shale, conglomerate, limestone, and coal
Drainage Pattern.--Dendritic
Channel Pattern.--Regular
Main Channel:
Rolling hills, wide valley, gentle to moderate slopes
MEAN ANNUAL PRECIPITATION.--40 to 42 inches (1,016 to 1,067 millimeters)

Source: Water Resource Bulletin, Bulletin No. 16
Prepared in Cooperation with US Dept. of Interior Geological Survey, June 1984

OHIO RIVER BASIN

Clarion River

Stream	Zone	County	Water Use Protected	Stocked Trout	Wild Trout
1-Ohio River					
2-Allegheny River					
3-Clarion River					
4-East Branch	Basin, Source	Elk	HQ-CWF	*	*
Clarion River	to Confluence				
	with West				
	Branch				
4-West Branch	Main Stem,	Elk	CWF	*	*
Clarion River	Source to				
	Confluence				
	with East Branch				
5-Unnamed	Basins, Source to	McKean-Elk	CWF		
Tributaries	Confluence with				
to West	East Branch				
Branch					
Clarion R.					
5-Windfall Run	Basin	McKean	CWF		
5-Sicily Run	Basin	McKean	CWF		
5-Buck Run	Basin	McKean	CWF		
5-Rocky Run	Basin	Elk	CWF	*	*
5-Nearing Run	Basin	Elk	CWF		
5-Wilson Run	Basin	Elk	CWF	*	*
5-Oil Creek	Basin	Elk	CWF		
5-Wolf Run	Basin	Elk	HQ-CWF	*	
5-Meffert Run	Basin	Elk	CWF		
5-Silver Creek	Basin	Elk	HQ-CWF		
3-Clarion River	Main Stem,	Clarion	CWF		
	Confluence of East				
	and West Branches				
	to Mouth				
4-Unnamed	Basins, Confluence	Elk-Forest-	CWF		
Tributaries to	of East and West	Jefferson-			
Clarion River	Branches to Mouth	Clarion			
4-Johnson Run	Basin	Elk	CWF		
4-Powers Run	Basin	Elk	CWF	*	*
4-Riley Run	Basin	Elk	WWF		
4-Little Mill Creek	Basin	Elk	HQ-CWF		
4-Mason Creek	Basin	Elk	CWF		
4-Island Run	Basin	Elk	CWF		
4-Big Mill Creek	Basin	Elk	HQ-CWF	*	
4-Connerville Run	Basin	Elk	CWF		
4-Dog Hollow Run	Basin	Elk	CWF		
4-Gillis Run	Basin	Elk	CWF		
4-Little Toby Creek	Main Stem	Elk	CWF	*	
5-Unnamed	Basins	Elk-Jefferso	CWF		
Tributaries to					
Little Toby					
Creek					
5-Limestone Run	Basin	Elk	CWF		
5-Kyler Run	Basin	Elk	CWF		
5-McCauley Run	Basin	Elk	CWF		
5-Sawmill Run	Main Stem	Elk	CWF		
6-Unnamed	Basins	Elk	CWF		
Tributaries					
to Sawmill					
Run					
6-Lost Run	Basin, Source to	Elk	HQ-CWF		
	Fox Twp. Municipal				
	Authority Dam				
6-Lost Run	Basin, Fox Twp.	Elk	CWF		
	Municipal Authority				
	Dam to Mouth				
5-Brandy Camp	Basin	Elk	CWF		
Creek					
5-Johnson Run	Basin	Elk	CWF		
5-Bear Run	Basin	Elk	CWF	*	*
5-Oyster Run	Basin	Elk	CWF		
5-Mead Run	Basin	Elk	CWF		
5-Boggy Run	Basin	Elk	HQ-CWF	*	*
5-Whetstone	Basin, Source to	Elk	HQ-CWF		
Branch	Brockway				
	Municipal Authority				
	No. 1 Dam				
5-Walburn Run	Basin	Jefferson	CWF		*
5-Rattlesnake	Basin, Source to	Jefferson	CWF	*	*
Creek	Brockway				
	Municipal Authority				
	Dam				
5-Rattlesnake	Basin, Brockway	Jefferson	CWF		*
Creek	Municipal Authority				
	Dam to Mouth				
5-Baghdad Run	Basin	Jefferson	CWF		

Stream	Zone	County	Water Uses* Protected	Stocked Trout	Wild Trout
1-Ohio River					
2-Allegheny River					
3-Clarion River					
4-East Branch	Basin, Source	Elk	HQ-CWF	*	*
Clarion River	to Confluence				
	with West				
	Branch				
5-Jenkins Run	Basin	Jefferson	CWF		
5-Little Vineyard	Basin	Jefferson	CWF		
Run					
5-Vineyard Run	Basin	Jefferson	CWF		*
5-Coward Run	Basin	Elk	CWF		
5-Laurel Run	Basin	Elk	CWF	*	*
5-Bearmouth	Basin	Elk	CWF		
Run					
4-Bear Creek	Basin	Elk	HQ-CWF	*	
4-Manhood Run	Basin	Elk	CWF		
4-Beach Bottom Run	Basin	Elk	CWF		
4-Lake City Run	Basin	Elk	CWF		
4-Cole Run	Main Stem	Elk	CWF		
5-Unnamed	Basins	Elk	CWF		
Tributaries to					
Cole Run					
5-Crow Run	Basin	Elk	HQ-CWF		
4-Irwin Run	Basin	Elk	CWF		
4-Spring Creek	Basin	Elk	HQ-CWF	*	*
4-Maxwell Run	Basin	Elk	HQ-CWF	*	*
4-Elliott Run	Basin	Elk	CWF		
4-Daughtery Run	Basin	Jefferson	CWF		
4-Raught Run	Basin	Elk	CWF		*
4-Painter Run	Basin	Elk	CWF		
4-Church Run	Basin	Elk	CWF		
4-Callen Run	Basin	Jefferson	HQ-CWF	*	*
4-Cline Run	Basin	Elk	CWF		
4-Wyncoop Run	Basin	Elk	HQ-CWF		
4-Leeper Run	Basin	Elk	CWF		
4-Pine Run	Basin	Elk	CWF		
4-Mill Stone Creek	Basin	Elk	HQ-CWF		
4-Shippen Run	Basin	Forest	CWF		
4-Clear Creek	Basin	Jefferson	HQ-CWF	*	*
4-Tadler Run	Basin	Jefferson	CWF		
4-Cherry Run	Basin	Forest	HQ-CWF		
4-Maple Creek	Basin	Forest	HQ-CWF		
4-Coleman Run	Basin	Forest	HQ-CWF		
4-Troutman Run	Basin	Forest	HQ-CWF		
4-Henry Run	Basin	Forest	CWF		
4-Toms Run	Basin	Forest	CWF	*	*
4-Cather Run	Basin	Clarion	HQ-CWF	*	*
4-Maxwell Run	Basin	Clarion	HQ-CWF		
4-Blyson Run	Basin	Clarion	EV		*
4-Mill Creek	Main Stem, Source	Clarion	HQ-CWF		*
	to Little Mill Creek				
5-Unnamed	Basins, Source to	Clarion-	HQ-CWF		
Tributaries to	Little Mill Creek	Jefferson			
Mill Creek					
4-Mill Creek					
5-Parks Run	Basin	Jefferson	HQ-CWF		
5-Martin Run	Basin	Jefferson	HQ-CWF		
5-Rankin Run	Basin	Jefferson	HQ-CWF		
5-Updike Run	Basin	Jefferson	HQ-CWF		
5-McCanna Run	Basin	Clarion	EV		*
(Pendleton Run)					
5-Little Mill Creek	Basin	Clarion	CWF		
4-Mill Creek	Main Stem, Little	Clarion	CWF	*	*
	Mill Creek to Mouth				
5-Unnamed	Basins, Little Mill	Clarion	HQ-CWF		
Tributaries to	Creek to Mouth				
Mill Creek					
5-Douglass Run	Basin	Clarion	CWF		
5-Woods Run	Basin	Clarion	HQ-CWF		
5-Stroup Run	Basin	Clarion	HQ-CWF		
5-Trap Run	Basin	Clarion	HQ-CWF		
5-Whites Run	Basin	Clarion	CWF		
4-Reeds Run	Basin	Clarion	CWF		
4-Toby Creek	Basin	Clarion	CWF		
4-Trout Run	Basin	Clarion	CWF		
4-Courtleys Run	Basin	Clarion	CWF		
4-Piney Creek	Basin	Clarion	CWF	*	
4-Deer Creek	Basin	Clarion	CWF		
4-Canoe Creek	Basin	Clarion	HQ-CWF	*	
4-Beaver Creek	Basin	Clarion	HQ-CWF	*	*
4-Licking Creek	Basin	Clarion	CWF		
4-Turkey Creek	Basin	Clarion	HQ-CWF	*	

*Exceptions to specific criteria for all streams except Blyson

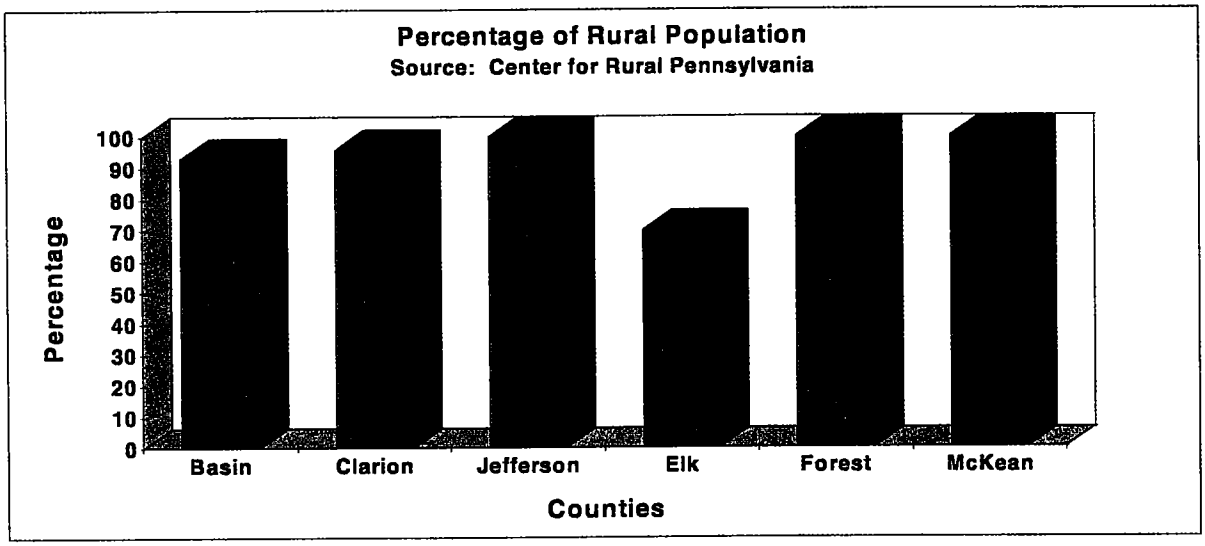
Add Ton: TON is the Threshold Odor Number, maximum 24 at 60 C

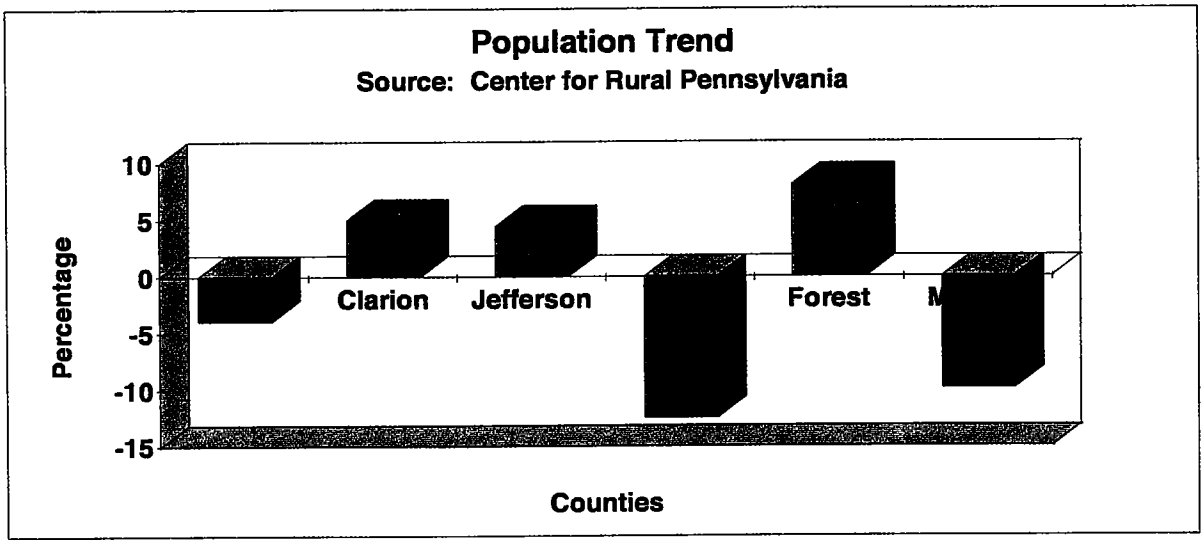
Source: Pennsylvania Code Title 25. Environmental Resources,

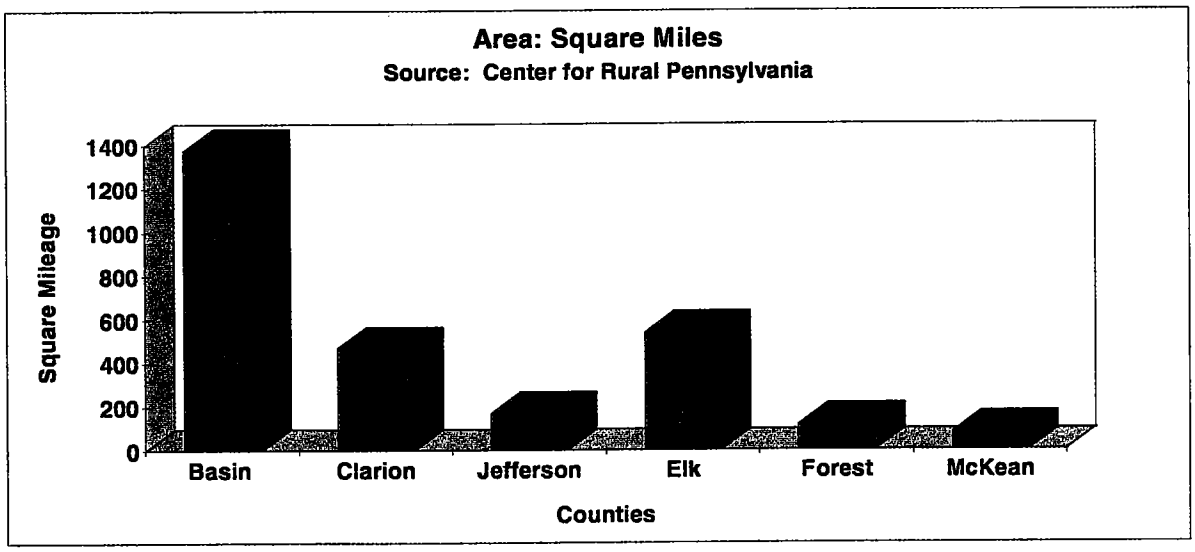
Department of Environmental Resources, Chapter 93. 93 Water Quality Standards

Source: Pennsylvania Fish & Boat Commission: Division of Fisheries Management

Population


Percentage of Rural Population
Source: Center for Rural Pennsylvania
Percentage
100
90
80
70
60
50
40
30
20
10
0
Basin
Clarion
Jefferson
Elk
Forest
McKean
Counties


Population Trend
Source: Center for Rural Pennsylvania
Percentage
10
5
0
-5
-10
-15
Clarion
Jefferson
Forest
Counties


Area: Square Miles
Source: Center for Rural Pennsylvania
Square Mileage
1400
1200
1000
800
600
400
200
0
Basin
Clarion
Jefferson
Elk
Forest
McKean
Counties

PENNSYLVANIA MUNICIPALITIES WITHIN THE CLARION RIVER WATERSHED

	Population Trends			Area			Water		Sewage	
	Population Trend 1990	% Change in Pop. 1990	% Rural 1990	Area sq. miles	Population per sq. mile, 1990	Housing Units 1990	% Units Using Public or Private Water Sys.	% Units Using Drilled Wells	% Units Using Public Sewage Disposals	% Units Using Septic Tanks, Cesspool
JEFFERSON CO.										
Barnett Twp.	269	2.7	100.0	14.6	18.4	396	0.0	100.0	0.0	100.0
Brockway Boro	2207	-7.1	100.0	1.0	2207.0	999	99.0	1.0	98.9	1.1
Corsica Boro	337	-11.5	100.0	0.4	842.5	150	95.3	4.7	16.0	84.0
Eldred Twp.	1197	7.7	100.0	46.8	25.6	811	24.8	75.2	0.2	99.8
Heath Twp.	109	-21.0	100.0	48.0	2.3	564	15.1	84.9	0.5	99.5
Snyder Twp.	2535	-3.5	100.0	41.1	61.7	1039	51.2	48.8	5.0	95.0
Union Twp.	733	1.7	100.0	18.3	40.1	363	41.6	58.4	1.1	98.9
Total/Average	**7387**	**4.4**	**100.0**	**170.2**	**456.8**	**4322**	**46.7**	**53.3**	**17.4**	**82.6**
Jefferson Co. Total	*46,083*	*-4.6*	*70.1*	*672.0*	*68.6*	*21242*	*52.8*	*47.2*	*37.9*	*62.1*
ELK CO.										
Fox Twp.	3392	-8.9	100.0	63.7	53.2	1438.0	72.9	27.1	20.2	79.8
Highland Twp.	551	-18.0	100.0	84.9	6.5	685	45.0	55.0	39.3	60.7
Horton Twp.	1655	4.9	100.0	55.1	30.0	740	52.6	47.4	4.1	95.9
Johnsonburg Boro	3350	-14.9	0.0	3.2	1046.9	1440	97.4	2.6	97.0	3.0
Jones Twp.	1870	-4.5	100.0	140.6	13.3	1153	39.1	60.9	16.3	83.7
Millstone Twp.	85	-29.8	100.0	40.6	2.1	389	12.6	87.4	6.4	93.6
Ridgway Boro	4793	-14.5	0.0	2.8	1711.8	2141	99.5	0.5	99.7	0.3
Ridgway Twp.	2617	-5.8	100.0	83.8	31.2	1110	56.0	44.0	16.1	83.9
St. Marys Boro	5511	-14.1	0.0	1.6	3444.4	2436	100.0	0.0	98.8	0.2
Spring Creek Twp.	215	-19.2	100.0	65.1	3.3	594	3.5	96.5	0.0	100.0
Total/Average	**24039**	**-12.5**	**70.0**	**541.4**	**62.9**	**12126**	**57.9**	**42.1**	**39.8**	**60.1**
Elk Co. Total	*34,878*	*-9.0*	*60.9*	*806.8*	*43.2*	*17249*	*72.1*	*27.9*	*52.1*	*77.9*
FOREST CO.										
Barnett Twp.	400	20.1	100.0	33.8	11.8	784	10.5	89.5	2.0	98.0
Jenks Twp.	1321	-3.9	100.0	84.2	15.7	1538	23.0	77.0	10.7	89.3
Total/Average	**1721**	**8.1**	**100.0**	**118.0**	**13.8**	**2322**	**16.8**	**83.3**	**6.4**	**93.7**
Forest Co. Total	*4862*	*-5.3*	*100.0*	*420.7*	*11.4*	*8445*	*12.1*	*87.9*	*5.8*	*94.2*
MCKEAN CO.										
Sergeant Twp.	154	-9.9	100.0	80.2	1.9	276	51.1	48.9	32.2	67.8
Total/Average	**154**	**-9.9**	**100.0**	**80.2**	**1.9**	**276**	**51.1**	**48.9**	**32.2**	**67.8**
McKean Co. Total	*47131*	*-6.9*	*69.8*	*997.0*	*47.3*	*21454*	*59.9*	*40.1*	*58.1*	*41.9*
Clarion Basin Total	**65289**	**-3.9**	**93.16**	**1379.3**	**36.06**	**32897**	**41.82**	**58.2**	**23.98**	**76.01**
PA Total	**11,881,643**	**0.1**	**31.1**	**45,064.70**	**263.7**	**4,938,140**	**78.1**	**21.9**	**74.3**	**25.7**

Source U.S. Census Bureau, Provided by the PA Data Center

Source: Center for Rural PA

PENNSYLVANIA MUNICIPALITIES WITHIN THE CLARION RIVER WATERSHED

	Population Trends			Area			Water		Sewage	
	Population Trend 1990	% Change in Pop. 1990	% Rural 1990	Area sq. miles	Population per sq. miles, 1990	Housing Units 1990	% Units Using Public or Private Water Sys.	% Units Using Drilled Wells	% Units Using Public Sewage Disposals	% Units Using Septic Tanks, Cesspool
CLARION CO.										
Beaver Twp.	1840	-3.2	100.0	32.9	55.9	729.0	12.9	87.1	10.0	90.0
Callensburg Boro	205	-17.3	100.0	0.2	1025.0	89.0	2.2	97.8	0.0	100.0
Clarion Boro	6457	4.2	0.0	1.2	5380.0	1917.0	98.2	1.8	97.4	2.6
Clarion Twp.	3306	-0.2	100.0	32.0	103.3	1312.0	65.5	34.5	48.1	51.9
Elk Twp.	1526	-5.5	100.0	31.6	48.3	611.0	17.7	82.3	9.7	90.3
Farmington Twp.	1927	0.7	100.0	61.1	31.5	1597.0	2.9	97.1	0.2	98.8
Highland Twp.	573	4.0	100.0	19.7	29.1	362.0	0.0	100.0	0.0	100.0
Knox Boro	1182	-13.3	100.0	0.5	2364.0	538.0	95.9	4.1	96.5	3.5
Knox Twp.	1281	3.0	100.0	17.3	74.0	441.0	8.8	91.2	1.1	98.9
Licking Twp.	483	-17.4	100.0	17.8	27.1	201.0	1.0	99.0	3.0	97.0
Limestone Twp.	1686	8.2	100.0	36.6	46.1	654.0	1.1	98.9	0.3	99.7
Millcreek Twp.	407	9.7	100.0	29.0	14.0	500.0	8.6	91.4	0.6	99.4
Monroe Twp.	1314	5.4	100.0	29.6	44.4	527.0	19.5	80.5	20.5	79.5
Paint Twp.	1730	2.9	100.0	19.8	87.4	702.0	63.7	36.3	61.1	38.9
Perry Twp.	1076	-16.9	100.0	28.8	37.4	517.0	25.0	75.0	1.2	98.8
Piney Twp.	515	7.5	100.0	17.6	29.3	150.0	23.3	76.7	0.0	100.0
Richland Twp.	490	-9.4	100.0	14.8	33.1	260.0	16.5	83.5	3.5	96.5
St. Petersburg Boro*	349	-22.8	100.0	0.4	872.5	156.0	96.2	3.8	3.2	96.8
Salem Twp.	893	-1.4	100.0	16.3	54.8	363.0	0.8	99.2	14.9	85.1
Shippenville Boro	474	-15.1	100.0	0.3	1580.0	206.0	95.6	4.4	91.3	8.7
Sligo Boro	706	-11.5	100.0	1.7	415.3	299.0	95.3	4.7	5.0	95.0
Strattanville Boro	490	-11.7	100.0	0.5	980.0	226.0	99.1	0.9	96.0	4.0
Toby Twp.	1153	-12.3	100.0	28.5	40.5	468.0	14.1	85.9	1.9	98.1
Washington Twp.	1925	-7.4	100.0	31.3	61.5	1026.0	15.4	84.6	13.1	86.9
Total/Average	**31.988**	**5.00**	**95.8**	**469.5**	**56**	**13851.0**	**36.6**	**63.36**	**24.1**	**75.85**
Clarion Co. Total	*41,699*	*-3.2*	*84.5*	*597.2*	*69.8*	*18,022*	*42.4*	*57.6*	*33.6*	*66.4*

Source U.S. Census Bureau, Provided by the PA Data Center

*Approximately half the residence live within the Clarion River Watershed, and half live in the Allegheny River Watershed

Source: Center for Rural PA

PENNSYLVANIA MUNICIPALITIES WITHIN THE CLARION RIVER WATERSHED

	Employment By Sector								
	# Persons Employed 16 Yrs. Old & Older,1990	Agriculture, Forestry & Mining Sectors (%)	Construction Sector (%)	Manufacturing Sector (%)	Comm.,Utilities, & Transport. Sectors (%)	Wholesale & Retail Trade Sectors (%)	Finance, Insurance, & Real Estate Sectors (%)	Service Sector (%)	Public Administration Sector (%)
JEFFERSON CO.									
Barnett Twp.	104	6.7	13.5	9.6	3.8	23.1	2.9	40.4	0.0
Brockway Boro	883	1.4	2.7	39.2	6.3	21.5	3.3	24.5	1.1
Corsica Boro	165	2.4	4.8	20.0	6.1	35.8	0.0	28.5	2.4
Eldred Twp.	513	7.0	6.8	21.6	9.7	17.0	5.3	30.8	1.8
Heath Twp.	27	25.9	7.4	0.0	14.8	37.0	0.0	14.8	0.0
Snyder Twp.	1043	1.1	2.0	45.6	9.0	21.1	1.8	18.7	0.7
Union Twp.	338	7.7	8.3	20.4	5.9	25.4	4.4	24.6	3.3
Total/Average	**3073**	**7.5**	**6.5**	**22.3**	**7.9**	**25.8**	**2.5**	**26.0**	**1.3**
Jefferson Co. Total	*18,320*	*5.9*	*6.3*	*23.5*	*8.2*	*23.1*	*3.1*	*27.3*	*2.7*
ELK CO.									
Fox Twp.	1471	2.2	3.1	26.5	20.4	26.5	0.0	16.3	5.1
Highland Twp.	249	1.6	4.4	43.8	6.4	24.5	1.7	18.5	0.0
Horton Twp.	719	4.2	6.4	44.4	5.3	20.0	1.4	17.1	1.3
Johnsonburg Boro	1307	0.0	3.1	49.9	5.2	13.5	2.5	21.7	4.0
Jones Twp.	778	0.6	3.2	50.8	4.1	17.6	1.5	19.9	2.2
Millstone Twp.	31	9.7	19.4	22.6	0.0	22.6	0.0	3.2	22.6
Ridgway Boro	1995	2.4	2.4	40.7	2.5	14.7	3.0	29.7	4.6
Ridgway Twp.	1103	5.3	3.6	48.1	5.9	14.3	2.5	16.1	4.1
City of St, Mary's	2332	0.9	3.5	42.6	2.8	20.1	3.5	24.1	2.6
Spring Creek Twp.	94	5.3	2.1	43.6	7.4	20.2	2.1	18.1	1.1
Total/Average	**10,079**	**3.2**	**5.1**	**41.3**	**6.0**	**19.4**	**1.8**	**18.5**	**4.7**
Elk Co. Totals	*14,961*	*1.8*	*3.3*	*47.5*	*3.8*	*16.7*	*2.0*	*22.1*	*2.8*
FOREST CO.									
Barnett Twp.	101	4.0	7.9	12.9	14.9	18.8	2.0	33.7	5.9
Jenks Twp.	513	7.0	6.6	18.1	4.1	23.4	3.5	32.9	4.3
Total/Average	**614**	**5.5**	**7.3**	**15.5**	**9.5**	**21.1**	**2.8**	**33.3**	**5.1**
Forest Co. Total	*1,802*	*5.2*	*8.0*	*19.2*	*7.7*	*22.4*	*3.8*	*27.9*	*5.9*
MCKEAN CO.									
Sergeant Twp.	60	3.3	0.0	40.0	5.0	5.0	10.0	25.0	11.7
Total/Average	**60**	**3.3**	**0**	**40**	**5**	**5**	**10**	**25**	**11.7**
McKean Co. Total	*19,317*	*3.6*	*4.4*	*31.2*	*4.6*	*19.9*	*3.4*	*29.3*	*3.6*
Clarion Basin Total	**26,618**	**5.62**	**5.24**	**27.34**	**7.18**	**18.76**	**1.94**	**26.68**	**5.08**
Pa Total	**5,434,532**	**2.4**	**6.1**	**20**	**6.9**	**21.5**	**6.5**	**32.6**	**4**

Source: Center for Rural PA

PENNSYLVANIA MUNICIPALITIES WITHIN THE CLARION RIVER WATERSHED

		Employment By Sector							
	# Persons Employed 16 Yrs. or Older 1990	Agriculture, Forestry & Mining Sectors (%)	Construction Sector (%)	Manufacturing Sector (%)	Comm., Utilities, &Transport. Sectors (%)	Wholesale & Retail Trade Sectors (%)	Finance, Insurance, & Real Estate Sectors (%)	Service Sectors (%)	Public Administration Sector (%)
CLARION CO.									
Beaver Twp.	748	5.9	8.4	17.5	8.2	25.1	4.0	27.8	3.1
Callensburg Boro	56	21.4	3.6	14.3	12.5	14.3	0.0	33.9	0.0
Clarion Boro	2216	0.3	0.9	4.5	2.9	26.0	4.7	58.6	2.0
Clarion Twp.	1505	4.3	7.5	18.1	5.4	31.6	1.6	29.0	2.4
Elk Twp.	658	6.1	7.8	21.1	10.0	24.3	2.4	25.8	2.4
Farmington Twp.	800	7.1	7.3	18.8	8.8	21.9	2.4	31.3	2.6
Highland Twp.	283	5.7	12.4	18.7	5.3	29.0	3.2	24.0	1.8
Knox Boro	493	4.7	5.7	13.8	11.2	27.8	4.7	29.4	2.8
Knox Twp.	551	9.1	8.7	21.6	5.4	24.3	2.5	23.4	4.9
Licking Twp.	182	18.1	4.4	16.5	5.5	30.8	2.7	19.8	2.2
Limestone Twp.	755	11.3	5.3	25.6	5.3	20.3	3.4	27.3	1.6
Millcreek Twp.	175	6.3	7.4	26.9	8.0	21.1	2.9	24.6	2.9
Monroe Twp.	585	4.6	6.2	16.4	7.9	20.9	3.4	38.5	2.2
Paint Twp.	784	5.4	4.8	17.5	6.9	24.5	3.7	34.4	2.8
Perry Twp.	350	25.7	4.0	12.9	10.9	16.3	1.7	24.3	4.3
Piney Twp.	146	11.0	13.7	8.9	8.2	27.4	1.4	25.3	4.1
Richland Twp.	174	10.3	10.3	14.9	11.5	14.9	0.0	31.6	6.3
St. Petersburg Boro*	122	4.9	7.4	28.7	6.6	15.6	0.0	35.2	1.6
Salem Twp.	375	6.4	10.1	18.4	10.7	19.2	0.8	32.8	1.6
Shippenville Boro	225	3.1	4.4	15.6	10.7	17.3	1.8	46.2	0.9
Sligo Twp.	260	8.1	7.3	16.2	9.2	22.7	3.5	29.2	3.8
Strattanville Boro	226	2.7	14.2	15.0	8.4	22.6	0.0	35.4	1.8
Toby Twp.	405	14.3	5.7	20.5	6.9	20.7	4.2	25.4	2.2
Washington Twp.	718	10.4	6.8	22.4	10.4	20.6	6.8	20.1	2.4
Total/Average	**12792**	**8.6**	**7.3**	**17.7**	**8.2**	**22.5**	**2.6**	**30.6**	**2.6**

*Approximately half the residence live within the Clarion River Watershed, and half live in the Allegheny River Watershed

Source: Center fo Rural PA

PENNSYLVANIA MUNICIPALITIES WITHIN THE CLARION RIVER WATERSHED

Employment By Job Type

	# Persons Employed 16 Yrs. Old & Older 1990	% Employed in Professional or Management Jobs	% Employed in White Collar Jobs	% Employed Service Jobs	% Employed in Blue Collar Jobs
JEFFERSON CO.					
Barnett Twp.	104	30.8	32.7	10.6	26.0
Brockway Boro	883	17.3	25.0	15.7	41.9
Corsica Boro	165	17.6	27.9	22.4	32.1
Eldred Twp.	513	17.3	19.5	17.7	45.4
Heath Twp.	27	18.5	33.3	0.0	48.1
Snyder Twp.	1043	9.4	18.8	9.4	62.4
Union Twp.	338	17.5	23.7	17.8	41.1
Total/Average	**3073**	**18.3**	**26.3**	**13.4**	**42.4**
Jefferson Co. Total	*18,320*	*17.2*	*25.1*	*14.7*	*43.0*
ELK CO.					
Fox Twp.	1471	12.6	21.1	11.5	54.8
Highland Twp.	249	6.8	18.1	18.5	56.6
Horton Twp.	719	8.6	18.2	12.8	60.4
Johnsonburg Boro	1307	14.6	24.9	11.3	49.1
Jones Twp.	778	14.5	23.5	10.5	51.4
Millstone Twp.	31	6.5	48.4	9.7	35.5
Ridgway Boro	1995	23.7	24.1	14.4	37.8
Ridgway Twp.	1103	9.3	23.0	15.3	52.3
City of St. Mary's	2332	15.5	26.3	15.9	42.2
Spring Creek Twp.	94	2.1	16.0	35.1	46.8
Total/Average	**10079**	**11.4**	**24.4**	**16.6**	**48.7**
Elk Co. Total	*14,961*	*15.0*	*22.7*	*13.3*	*49.0*
FOREST CO.					
Barnett Twp.	101	12.9	26.7	27.7	32.7
Jenks Twp.	513	23.4	21.4	19.1	36.1
Total/Average	614	18.2	24.0	23.4	34.4
Forest Co. Total	*1,802*	*18.6*	*23.3*	*15.5*	*42.6*
MCKEAN CO.					
Sergeant Twp.	60	28.3	21.7	10.0	40.0
Total/Average	**60**	**28.3**	**21.7**	**10.0**	**40.0**
McKean Co. Total	*19,317*	*21*	*24.4*	*14.6*	*39.9*

	# Persons Employed 16 Yrs. Old & Older 1990	% Employed in Professional or Management Jobs	% Employed in White Collar Jobs	% Employed Service Jobs	% Employed in Blue Collar Jobs
CLARION CO.					
Beaver Twp.	748	15.4	25.9	16.0	42.6
Callensburg Boro	56	14.3	21.4	5.4	58.9
Clarion Boro	2216	31.7	43.4	12.5	12.4
Clarion Twp.	1505	18.3	28.6	13.6	39.5
Elk Twp.	658	16.7	23.4	11.6	48.3
Farmington Twp.	800	17.8	23.4	16.3	42.6
Highland Twp.	283	12.4	25.8	12.4	49.5
Knox Boro	493	21.3	34.5	13.0	31.2
Knox Twp.	551	13.4	21.2	16.0	49.4
Licking Twp.	182	13.7	19.2	21.4	45.6
Limestone Twp.	755	18.7	26.2	11.7	43.4
Millcreek Twp.	175	11.4	31.4	14.3	42.9
Monroe Twp.	585	23.6	23.8	15.9	36.8
Paint Twp.	784	33.8	26.0	12.0	28.2
Perry Twp.	350	13.7	16.6	12.6	57.1
Piney Twp.	146	4.1	26.0	18.5	51.4
Richland Twp.	174	19.0	13.2	19.5	48.3
St. Petersburg Boro*	122	18.9	18.9	14.8	47.5
Salem Twp.	375	15.7	26.9	14.1	43.2
Shippenville Boro	225	17.8	22.7	20.4	39.1
Sligo Boro	260	14.6	25.0	14.6	45.8
Strattanville Boro	226	16.4	29.2	17.3	37.2
Toby Twp.	405	9.4	22.0	12.6	56.0
Washington Twp.	718	12.4	26.2	9.1	52.4
Total/Average	**12792**	**16.9**	**26.0**	**14.4**	**43.7**
Clarion Co. Total	*16,296*	*19.1*	*26.9*	*13.7*	*40.2*
Basin Total	**23545**	**18.62**	**23.76**	**15.34**	**41.84**
Pa Total	**5,434,532**	**25.2**	**31.7**	**13**	**30.1**

*Approximately half the residence live within the Clarion River Watershed, and half live in the Allegheny River Watershed

Source: Center for Rural PA

	CLARION COUNTY	ELK COUNTY	FOREST COUNTY	JEFFERSON COUNTY	MCKEAN COUNTY	Clarion Basin Totals/Average	PA Totals/Average
NEW BUSINESS STARTS							
Total # Establishments (12 month avg.), 1994	961.0	866.0	134.0	1,102.0	1,109.0	4,172.0	272,280
% Change in Total # Establishments, 1990-94	4.1	9.5	14.5	4.5	6.7	7.9	6.6
% Change in # Agriculture & Mining Sector Establishments	(28.0)	(11.8)	20.0	3.9	(23.4)	(7.9)	(1.6)
% Change in # Manufacturing Sector Establishments	(1.6)	12.6	N/A.	18.8	15.4	11.3	0.5
% Change in # Wholesale & Retail Sector Establishments	3.0	(2.8)	-	(8.2)	2.5	(5.5)	5.5
% Change in # Service & Finance Sector Establishments	11.3	16.9	28.6	8.7	12.6	15.6	11
% Change in # State & Local Gov't. Establishments	11.8	(2.7)	9.5	20.6	32.1	14.26	38.1
% Change in # Other Sector Establishments	4.7	24.5	85.7	9.4	3.6	25.6	(2.7)
SMALL BUSINESSES							
Total # Establishments, 1991	957.0	848.0	110.0	1,099.0	1,128.0	4,142.0	279,469
% Establishments With 1-4 Employees	57.7	56.4	71.8	58.1	58.6	60.5	53
% Establishments With 5-9 Employees	21.5	19.5	19.1	21.1	20.0	20.2	20.5
% Establishments With 10-19 Employees	11.0	12.5	2.7	10.5	10.4	9.4	12.8
% Establishments With More Than 20 Employees	9.8	11.7	6.4	10.4	11.0	9.9	13.7
RETAIL TRADE							
# Establishments, 1992	296.0	233.0	44.0	308.0	321.0	1,202.0	71,652
% Change in # Retail Establishments, 1987-92	2.1	13.1	18.9	5.1	(0.6)	7.7	1.2
Total Retail Sales, 1992 ($1000)	$ 245,482	$ 172,859	$ 19,850	$ 257,671	$ 269,523	$ 965,385	$ 87,787,842
% Change in Adjusted Retail Sales, 1987-92	9.4	3.0	25.5	1.5	5.4	9.0	(0.2)
SERVICE INDUSTRY							
# Service Establishments, 1992	176.0	155.0	24.0	251.0	233.0	839.0	77,839
% Change in # Service Establishments, 1987-92	5.4	(0.6)	41.2	15.1	6.9	13.5	11.1
Total Service Sector Receipts, 1992 ($1000)	$ 65,024	$ 34,958	$ 7,599	$ 62,287	$ 57,957	$ 227,825	$ 49,382,550
% Change in Adjusted Service Sector Receipts, 1987-92	48.9	13.6	148.8	20.2	37.4	53.8	20.3
INFRASTRUCTURE							
Total PENNVEST Loans & Grants, 1993 ($1000)	$ 2,354	$ 15,144	$ 1,591	$ 4,413	$ 8,508	$ 32,010	$ 1,242,717
PENNVEST Loan & Grants Per Capita	$ 56	$ 434	$ 331	$ 96	$ 181	$ 220	$105
TOURISM							
Direct Domestic Travel Expenditures, 1993 ($ Million)	$ 22.43	$ 14.49	$ 18.58	$ 16.70	$ 15.39	$ 87.59	$ 10.059.52
% Change in Expenditures, 1992-93	(0.90)	17.60	7.60	(12.30)	0.90	2.58	4.3
Employment, 1993 (1000)	0.32	0.18	0.20	0.20	0.19	1.09	164.04
State & Local Tax Receipts from Tourism, 1993 ($Millions)	$ 1.79	$ 1.64	$ 2.77	$ 1.52	$ 1.38	$ 9.10	$ 542
	Source: Center for Rural PA						

	CLARION COUNTY	ELK COUNTY	FOREST COUNTY	JEFFERSON COUNTY	MCKEAN COUNTY	Basin Total	Pa Total
FARMS							
# Farms, 1982	584	156	44	516	257	1557	55,535
# Farms, 1987	541	168	34	495	243	1481	51.549
# Farms, 1992	444	145	36	410	211	1246	44,870
% Change in # Farms, 1982-87	(7.4)	7.7	(22.7)	(4.1)	(5.4)	(6.4)	(7.2)
% Change in # Farms, 1987-92	(17.9)	(13.7)	5.9	(17.2)	(13.2)	(11.2)	(13.0)
FARM LAND							
Total # Acres in Farms, 1982	100,648	18,449	7,205	87,017	49,044	262,363	8,293,649
Total # Acres in Farms, 1987	102,577	18,609	6,170	84,803	44,930	257,089	7,866,289
Total # Farms, 1992	94,817	16,371	4,702	79,310	39,561	234,761	7,189,541
% Change in # Acres in Farms, 1982-87	1.9	0.9	(14.4)	(2.5)	(8.4)	(4.5)	(5.2)
% Change in # Acres in Farms, 1987-92	(7.6)	(12.0)	(23.8)	(6.5)	(11.9)	(12.4)	(8.6)
AVERAGE SIZE OF FARM							
Avg. Size of Farm, 1982	172	118	164	169	191	814	149
Avg. Size of Farm, 1987	190	111	181	171	185	838	153
Avg. Size of Farm, 1992	214	113	131	193	187	838	160
SIZE OF FARMS							
# Farms, 1992	444.0	145.0	36.0	410.0	211.0	1246.0	44,870
% Very Small Farms (Under 50 Acres)	15.1	26.2	25.0	13.4	18.0	16.5	27
% Small Size Farms (Between 50-179 Acres)	47.7	56.6	47.2	50.7	39.3	48.3	44.9
% Medium Size Farms (Between 180-499 Acres)	28.2	15.9	25.0	30.2	37.0	27.3	22.9
% Large Farms (Over 500 Acres)	9.0	1.4	2.8	5.6	5.7	4.9	5.2
FARM SALES							
Market Values of Agricultural Products Sold, 1992 ($1000)	$ 13,893	$ 3,076	$ 580	$ 14,856	$ 3,797	$ 36,202	$3,570,191
Avg. Market Values of Agricultural Products Sold, 1992	$ 31,291	$ 21,214	$ 16,111	$ 36,234	$ 17,995	$ 45,539	$79,567
% Change in Adjusted Property Taxes Paid, 1987-92	(8.3)	(19.8)	(21.2)	6.5	(25.4)	(13.6)	(6.1)
FARM PROPERTY TAXES							
Property Taxes Paid, 1992 ($1000)	$ 676	$ 202	$ 38	$ 582	$ 373	$ 1,871	$96,902
Avg. Property Tax Paid by Farm, 1992	$ 1,653	$ 1,393	$ 1,226	$ 1,455	$ 1,785	$ 1,502	$2,377
% Change in Adjusted Property Taxes Paid, 1987-92	-9.2	1.6	-16.8	15.5	11.4	0.5	3.3
Source: Center for Rural PA							

Natural Areas on State Forest Lands

Name	Area (acres)	Forest	Location	Features
Marion Brooks *	917	Moshannon	Elk Co.	White Birch, high mountain bog, mixed oak and laurel.
Pine Tree Trail *	276	Elk	Elk Co.	Old field white pine that seeded on an abandoned farm prior to the cutting of surrounding virgin fores
Johnson Run	216	Elk	East side of Johnson Run	Old growth hemlock-hardwood
Swamp Forest	246	Cook Forest	Clarion and Forest	300 year-old hemlocks Boulder Field formed during the Ice Age.

* Located within the Clarion River Watershed Area, but is part of the Susquehanna drainage area.

The guidelines governing the administration of natural area follow:

1. No human habitation is permitted excep backpack camping in designated areas.
2. Access for all, but activities is restrictive to foot trails
3. Buildings and other improvements are restricted to the minimum required for public health and safety.
4. Timber harvesting is not permitted except to maintain public safety.
5. Rights-of-way, leases and mineral development are prohibited.

*Source: Department of Conservation and Natural Resources
Bureau of Forestry

GENERAL SOILS

The following general soil associations are found in the Clarion River Basin.

CLARION COUNTY

1. Cavode-Armagh-Gilpin (CAG)

In this general area soils of the Cavode, Armagh, and Gilpin series are dominant. The Cavode soils have somewhat poor natural drainage, and the Armagh have poor natural drainage. Both are underlain by clay shales, and both occupy upland flats and gentle slopes. The Gilpin soils, which occur on slopes, are shallow or moderately deep over sandstone or shale. The other soils in this general soil area are members of the Lickdale and the Wharton series. The Lickdale soils have a dark-colored surface soil and are very poorly drained. The Wharton soils are moderately well drained but have a tight subsoil that overlies blocky clay shale. Locally, where the bedrock contains some limestone or limy material, there are areas of Westmoreland soils or of concretionary variants of Cavode and Wharton soils. The Westmoreland soils resemble the Gilpin soils but are not so acrid.

On most farms in this area, a large part of the cropland is on moderately sloping soils. These soils are well suited to cultivation but require artificial drainage because of excess surface water. Dairy farming dominates over the other types of farming. Most of the feed is grown locally. There is considerable part-time farming.

Good-sized areas have been strip mines. Coal lies 5 to 50 feet deep under many broad areas on the gently sloping uplands. In some localities blocks of several farms have been abandoned to strip mining.

2. Clymer-Cook-port-Dekalb (CCD)

This soil area consists mainly of soils of the Clymer, Cookport, and Dekalb series. Most of the area is on ridges and slopes in the northeastern part of the county. The soils are underlain chiefly by sandstone, and many of them are sandy. Some of the broad ridges and gently sloping uplands are several miles wide. They form a plain that, for the most part, has gentle slopes and a few low hills rising above it. Into this plain, especially near the Clarion River, the main streams have cut deep, narrow, steep-walled valleys.

In this area, the sloping and steep members of the Dekalb series are extensive on the hillsides. The Dekalb soils are shallow to moderately deep; most of them are sloping and sandy, and many are stony. The main soils on the uplands are the deep, well drained Clymer soils and the deep and somewhat wet Cookport soils. Also on the uplands are smaller areas of Nolo soils, which have poor natural drainage and are shallow over a hard, brittle subsoil layer. Some areas are Leetonia soils, which are highly leached, stoney, and very sandy.

The Cavode, Armagh, Wharton, Lickdale, and Gilpin soils, which were mentioned as occurring in the Cavode-Armagh-Gilpin soil area, occupy minor areas of upland in this general soil area. On lower slopes, mostly in marrow valleys, are some tracts of Ernest soils, which have medium or somewhat poor natural drainage, as well as some Brinkerton soils, which are poorly drained and in seepy spots.

Most of this general soil area has remained as woodland. The second- and third- growth trees provide little sawtimber but are producing mine timbers and pulp wood. Included in this soil area is the Cook Forest State Park, which has a stand of large, old hemlock trees.

Some of the gently sloping upland, mainly that on the less sandy soils, has been cleared for farming. Much of the land cleared after the trees were first cut is no longer famed and is growing up to brush or is only slightly used for pasture. There are few full-time dairy and poultry farms in the area, but most of the farming is part-time operation.

3. Dekalb (D)

This general soil area is dominated by Dekalb soils and lies chiefly along the Clarion River. The soils are mostly stony or channery loams or sandy loams. Nearly all of the area is forested.

4. Gilpin-Ernest (GE)

This area consists mainly of Gilpin and Ernest soils on steep valley slopes. The Gilpin soils, as mentioned previously for the Cavode-Armagh-Gilpin area, are moderately deep over shale or sandstone and range form sloping to steep. The Ernest soils lie on lower slopes, where they were formed from an accumulation of material that washed downhill or was moved down by gravity. The Ernest soils have a mottled layer in their lower subsoil, which is evidence of somewhat poor natural drainage.

Shelocta and Brinkerton soils occupy slopes on the lower parts of hillsides where soil material has accumulated. The Shelocta soils are better drained than the Ernest. Their subsoil is nearly free of mottling. The Brinkerton soils have poor natural drainage, which is indicated by the mottling in the subsurface and subsoil layers.

The Gilpin-Ernest area is occupied mostly by dairy farms and general farms. Some farms have been abandoned; others are operated on a part-time basis, and only the bast fields are used. Most of the farms have some improved pasture. More of the total area pastured, however, is on the thin soils and moderately steep or steep slopes where productivity is low. Many of the pastures are weedy, and many are partly covered with brush. Erosion has been moderate or moderately severe on much of the cleared land.

Most of the farms have some woodland. The large trees have been removed from most of the woodland, and some of it has been clear-cut for everything large enough to make mine props.

5. Gilpin-Rayne-Ernest (GRE)

Soils of the Gilpin, Rayne, and Ernest series are dominant in this area. The area covers most of the upland in the southern third of the county. It contains soils of the same series as the Gilpin-Ernest area, but some of the ridges are wide enough that good-sized areas of Rayne soils occur on them. Slopes range from gentle to steep, but the general landscape is one of much less rugged relief than that of the Gilpin-Ernest area. The Rayne soils are deep and have good natural drainage that makes their subsoil almost free of mottling. The Rayne soils resemble the Clymer but are not quite so leached and acid. This general area contains small bodies of Cavode and Armagh soils and of several other soils.

Farms in this general area are much like those in the Gilpin-Ernest area, but the proportion on gentle or moderate slopes is generally somewhat greater. Considerable strip mining and some deep mining have been done. Strip-mine spoils and mine waste are typical parts of the landscape in both areas, but usually they are of smaller extent than in the Cavode-Armagh-Gilpin area.

6. Holston-Monongahela (HM)

The main soils of this area are the Holston and Monongahela. They lie on the benches of the smaller streams. They have been formed in silty materials that are almost free from gravel. The Holston soils have good natural drainage, as is indicated by a subsoil nearly free from mottling. The Monongahela soils are moderately well drained; they are mottled in the lower subsoil. The Tyler soils have a tight clay subsoil and are mottled from the surface down. Most of the Tyler soils are gently sloping or nearly level.

As a rule, soils of this general area have been partly cleared and are used for farming.

7. Wheeling-Sciotoville (WS)

The soils of this area are mostly members of the well-drained Wheeling, the moderately well drained Sciotoville and the poorly drained and mottled Ginat series. They lie on gravelly benches along the Clarion River. Their slopes are favorable for farming, and most of the acreage not occupied by towns is used as farmland. The towns of Foxburg and Callensburg are within this general soil area.

ELK COUNTY

1. Hazleton-Buchanan-Cookport Association

This association is scattered throughout the survey area. It generally is on rolling hilltops, on benches, and on steep hillsides. Buchanan and Cookport soils are on the lower slopes, and Hazleton soils are on the steeper slopes.

This association is about 49 percent Hazleton soils, 23 percent Buchanan soils, 16 percent Cookport soils, and 12 percent minor soils.

Hazleton soils are deep and well drained. They are channery throughout and are underlain by sandstone bedrock at a depth of about 40 to 60 inches. These soils are gently sloping to steep and generally are on hilltops and hillsides.

Buchanan soils are very deep and moderately well drained. They have a fragipan and a seasonal high water table. They are underlain by sandstone, siltstone, and shale bedrock at a depth of more than 60 inches. These soils are gently sloping to moderately steep and generally are adjacent to drainageways and on foot slopes.

Cookport soils are deep and moderately well drained. They have a fragipan and a seasonal high water table. They are underlain by sandstone and siltstone bedrock at a depth of about 40 to 60 inches. These soils are nearly level to moderately steep and generally are on broad hilltops.

The minor soils on uplands are the well drained Hartleton soils and the poorly drained Brinkerton and Nolo soils. The minor soils on flood plains are the well drained Pope soils, the moderately well drained Philo soils, and the poorly drained Atkins soils.

Most areas of this association are used as woodland. A few areas are in farms. Some areas that formerly were farmed are reverting to indigenous trees and brush.

This association has good potential for use as woodland and as habitat for wildlife. I has fair potential for urban and farm uses. The major limitations affecting urban uses are the seasonal high water table, restricted permeability, the slope, and stoniness.

2. Hazleton-Cookport-Buchanan Association

This association is scattered throughout the survey area. It generally is on rolling foot slopes and benches. Hazleton soils are mainly on side slopes. Cookport soils are on broad ridgetops and benches. Buchanan soils generally are on foot slopes.

This association is about 42 percent Hazleton soils, 32 percent Cookport soils, 11 percent Buchanan soils, and 15 percent soils of minor extent.

Hazleton soils are deep and well drained. They are channery throughout and are underlain by sandstone bedrock at a depth of about 40 to 60 inches. These soils are gently sloping to very steep and are on hilltops and hillsides.

Cookport soils are deep and moderately well drained. They have a fragipan and a seasonal high water table. They are underlain by sandstone and siltstone bedrock at a depth of more than 40 inches. These soils are nearly level to moderately steep and are on uplands.

Buchanan soils are very deep and moderately well drained. They have fragipan and a seasonal high water table. They are underlain by sandstone, siltstone, and shale bedrock at a depth of more than 60 inches. These soils are nearly level to moderately steep and are in drainageways and on foot slopes.

The minor soils on uplands are the well drained Hartleton soils and the poorly drained Brinkerton and Nolo soils. The minor soils on flood plains are the well drained Pope soils, the moderately well drained Philo soils, and the poorly drained Atkins soils.

Most areas of this association are used as woodland. A few areas are in farms. Some areas that formerly were farmed are reverting to indigenous brush and trees.

This association has good potential for use as woodland and as habitat for wildlife. It has fair potential for urban and farm uses. The major limitations affecting urban uses are the seasonal high water table, restricted permeability, the slope, and stoniness.

3. Hartleton-Wharton-Buchanan Association

This association is mainly in an area extending from Brockport to East Branch Dam in Elk County. The association generally is on broad hilltops, hillsides, and foot slopes.

This association is about 57 percent Hartleton soils, 24 percent Wharton soils, 7 percent Buchanan soils, and 12 percent soils of minor extent.

Hartleton soils are deep and well drained. They are channery throughout and are underlain by siltstone and sandstone bedrock at a depth of 40 to 60 inches. These soils are gently sloping to very steep and generally are on hilltops and hillsides.

Wharton soils are deep and moderately well drained. They have a seasonal high water table. They are underlain by siltstone and shale bedrock at a depth of about 40 to 60 inches. These soils are gently sloping to moderately steep and generally are on hilltops.

Buchanan soils are very deep and moderately well drained. They have a fragipan and a seasonal high water table. They are underlain by sandstone, siltstone, and shale bedrock at

depth of more than 60 inches. These soils are gently sloping to moderately steep and are in drainageways and on foot slopes.

The minor soils on uplands are the well drained Hazleton soils, the moderately well drained Cookport soils, the somewhat poorly drained Cavode soils, and the poorly drained Brinkerton soils. The minor soils on flood plains are the well drained Pope soils, the moderately well drained Philo soils, and the poorly drained Atkins soils.

Most areas of this association are used as woodland. A few areas are in farms or are developed for urban uses. Some areas that formerly were farmed are reverted to indigenous trees and brush.

This association has a good potential for use as woodland and as habitat for wildlife. It has fair potential for farming and for urban uses. The major limitations affecting urban uses are the seasonal high water table, the slope, restricted permeability, and stoniness.

FOREST COUNTY

1. Cavode-Ernest-Gilpin

This map unit consists of areas of hilly soils that are strongly dissected by minor drainageways. These soils are mostly sloping and moderately steep; however, some are gently sloping.

This map unit is about 49 percent Cavode souls, 24 percent Ernest soils, and 12 percent Gilpin soils. The rest is minor soils.

The sloping Cavode soils are on broad, upland ridgetops and on benches. They are deep and somewhat poorly drained. A seasonal high water table is at a depth of 6 to 18 inches.

The sloping Ernest soils are on foot slopes and in drainageways. They are deep and moderately well drained. They have a fragipan at a depth of 20 to 30 inches and a seasonal high water table at a depth of 18 to 36 inches.

The sloping to moderately steep Gilpin soils are on hillsides. They are moderately deep and well drained. Bedrock is at a depth of 20 to 40 inches.

Minor soils are the well drained Hazleton soils and the moderately well drained Cookport and Wharton soils on uplands and the poorly drained Brinkerton soils on foot slopes.

About one-half of this map unit has been cleared, and one-half is in woodland. Most of the cleared land is now idle, but a few small areas are being used for farming and homesite development. The soils in the cleared areas are moderately suited to cultivated crops. These soils are suited to trees.

The major limitations for urban uses are slow permeability, a seasonal high water table, slope, and moderate depth to bedrock.

2. Cookport-Hazleton-Ernest

The map unit consists of broad plateaus, which are dissected by small drainageways. These soils are gently sloping and sloping; however, some are nearly level, and others are moderately steep.

This map unit is about 52 percent Cookport soils, 21 percent Hazleton soils, and 9 percent Ernest soils. The rest is minor soils.

The Cookport soils are on hillsides. They are deep and moderately well drained. They have a fragipan at a depth of 16 to 27 inches and a seasonal high water table at a depth of 18 to 36 inches.

The Hazleton soils are on hilltops. They are deep and well drained.

The Ernest soils are on foot slopes. They are deep and moderately well drained. They have a fragipan at a depth of 20 to 30 inches and a seasonal high water table at a depth of 18 to 36 inches.

Minor soils are the well drained Gilpin soils on hilltops, the poorly drained Brinkerton soils in depressions and on foot slopes, and the poorly drained and very poorly drained Wayland soils in drainageways.

About one-tenth of this map unit was once cleared, but almost none is now used for farming. This tenth of the map unit is reverting to brush and woodland. The remainder of the map unit is in woodland. Much of the privately owned land has been sold in one-half acre to several-acre plots for second homes. The soils that are relatively free of stone cover are moderately suited to cultivated crops. The major soils are well suited to trees.

The major limitations for urban uses are the seasonal high water table, the slow permeability, and the stones on the surface.

3. Hazleton-Gilpin-Ernest

This map unit consists dominantly of valley sides along major rivers and creeks. These soils are mostly sloping, steep, and very steep. There are also minor areas of nearly level and gently sloping, narrow flood plains and terraces along the streams.

This map unit is about 49 percent Hazleton soils, 37 percent Gilpin soils, and 7 percent Ernest soils. The rest is minor soils.

The Hazleton soils are on the upper part of the valley sides. They are deep and well drained.

The Gilpin soils are on the lower part of the valley sides. They are moderately deep and well drained.

The Ernest soils are on foot slopes. They are deep and moderately well drained. They have a fragipan at a depth of 20 to 30 inches and a seasonal high water table at a depth of 18 to 36 inches.

Minor soils are the poorly drained Brinkerton soils on foot slopes. The poorly drained and very poorly drained Wayland soils, the poorly drained Atkins soils, and the moderately well drained Philo soils are on the flood plains. The moderately well drained Braceville soils, the poorly drained and somewhat poorly drained Rexford soils, and the well drained Chenango soils are on the terraces.

Nearly all the soils in this map unit are wooded. Trees grow well. There is some farming on the widely separated flood plain, terraces, and more gently sloping foot slopes. Most of this map unit, however, is too steep for farming. Several small villages are on the terraces. Hunting camps and summer homes are relatively common on the foot slopes.

The slope, the moderately slow permeability in the Ernest soils, and the stoniness are the major limitations for urban uses.

JEFFERSON COUNTY

1. Cookport-Hartsells-Dekalb Association

The soils of this association are mainly on sloping ridges and in rolling areas on broad ridgetops. They cover most of the northern part of the county, and they also occur at a higher elevation in the southern part. The Cookport, Hartsells, and Dekalb soils formed chiefly in material weathered from sandstone, and they are generally coarse textured.

The Cookport soils are moderately deep or deep and are moderately well drained. They are on broad ridgetops and on sloping ridges. The Cookport soils have a characteristic fragipan in their subsoil, and in many places they have large sandstone boulders on the surface. The Hartsells soils are deep, well drained, and nearly level or gently sloping. They are mainly on the tops of plateaus. The Dekalb soils are shallow to moderately deep and are mainly on hillsides. In many places they are channery, and in a few places they are stony.

Minor areas of Cavode, Brinkerton, Armagh, and Gilpin soils are near the boundaries of this association. On the toe slopes bordering narrow valleys are bands of moderately well drained. Ernest and poorly drained Brinkerton and Armagh soils. The very wet Brinkerton soils are in small, nearly level or concave areas that are generally ponded in wet seasons. Long, narrow bands of well drained Pope, moderately well drained Philo, and poorly drained Atkins soils are along small, narrow streams in many places. Small areas of Nolo soils, which are poorly drained and are shallow over a hard, brittle subsoil, are in the uplands.

This soil association comprises much of the forested acreage in this county. Most of the forests have been cut over, but the trees in the second-growth stands are large enough to produce sawlogs as well as chemical wood and pulpwood. Dairy farms and farms where beef cattle are raised are common on the less sandy soils that have been cleared and used for farming. A large part of the cleared acreage is no longer farmed but is reverting to trees and brush or is used for pasture. Most of the small farms are operated on a part-time basis.

2. Dekalb-Leetonia Association

The soils in this association are along the steep slopes near the Clarion River and Toby Creek in the northern part of the county. The Dekalb and Leetonia soils are well drained, and they are coarse textured. In many places they are droughty. Sandstone and conglomerate boulders from 1 foot to as much as 20 feet in diameter are on the surface and throughout the profile.

All of this association is in trees, and much of the understory is a dense growth of rhododendron. Most of the areas are too steep and stony for farming.

MCKEAN COUNTY

1. Cookport-Hazleton

This map unit consists of broad plateaus dissected by drainageways. It is mostly nearly level to moderately steep, but some areas are steep and very steep.

This map unit is about 52 percent Cookport soils, 25 percent Hazleton soils, and 23 percent minor soils.

Cookport soils generally are on broad flats and on benches and hillsides. They are deep and very deep and moderately well drained. The subsoil is loamy.

Hazleton soils generally are on hilltops and hillsides. They are deep and well drained. The subsoil is loamy.

The minor soils are deep, moderately well drained Wharton soils on uplands, very deep, moderately well drained to somewhat poorly drained Buchanan soils along draingeways, and well drained Hartleton soils on hillsides.

Nearly all the acreage of this map unit is forested. Some areas are farmed and used as sites for homes and hunting camps. Most cleared areas are suited to farming and to use as woodland.

The major limitations for urban uses are the seasonal high water table in winter and spring and depth to bedrock.

2. Buchanan-Hartleton-Hazleton

This map unit consists of small valleys and narrow ridges. It is mostly steep and very steep, but includes some gently sloping hilltops and nearly level valleys.

This map unit is about 43 percent Buchanan soils, 28 percent Hartleton soils, 10 percent Hazleton soils, and 19 percent minor soils.

Buchanan soils are nearly level to very steep. Generally, they are on the lower slopes. They are very deep and moderately well drained and somewhat poorly drained. The subsoil is loamy.

Hartleton soils are nearly level to very steep. Generally, they are on the upper slopes and on ridgetops. They are deep and well drained. The subsoil is loamy.

Hazleton soils are nearly level to moderately steep. Generally, they are on the upper slopes and on ridgetops. They are deep and well drained. The subsoil is loamy.

The minor soils are very deep, poorly drained Atkins soils on flood plains and deep, somewhat poorly drained Cavode soils on benches.

About 80 percent of the acreage of this map unit is forested. The rest has been cleared and is reverting to brushland and woodland. Most areas of this map unit are too stony or steep for cultivated crops.

The major limitations for urban uses are the seasonal high water table in winter and spring slope.

SOURCES:

Clarion County Pennsylvania Soil Survey
Elk County Pennsylvania Soil Survey
Forest County Pennslyvania Soil Survey
Jefferson County Pennsylvania Soil Survey
McKean County Pennsylvania Soil Survey

WOODLAND MANAGEMENT AND PRODUCTIVITY

Soil name and map symbol	Ordination symbol	Management Concerns: Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Potential Productivity: Common trees	Trees to plant
Armagh	3W	Slight	Severe	Severe	Severe	Northern red oak	Eastern white pine
AgB							Norway spruce
Buchanan	3X	Moderate	Moderate	Slight	Slight	Northern red oak	Eastern white pine
BuB						Sugar maple	Japanese larch
						Black cherry	Norway spruce
						Red maple	Northern red oak
						American beech	Yellow poplar
							Sugar maple
Cavode	4W	Slight	Moderate	Moderate	Moderate	Northern red oak	Eastern white pine
CdB						Black cherry	Norway spruce
						Red maple	White spruce
						Eastern hemlock	Black cherry
						Yellow birch	
Clymer	4A	Slight	Slight	Slight	Slight	Northern red oak	Eastern white pine
ClB						Black cherry	Red pine
						Sugar maple	Norway spruce
							Japanese larch
							Black cherry
Cookport	4W	Slight	Moderate	Slight	Slight	Northern red oak	Eastern white pine
CtB						Black cherry	Red pine
						White ash	Japanese larch
						Sugar maple	White spruce
						Red maple	Black cherry
						American beech	Norway spruce
Dekalb	2F	Slight	Moderate	Moderate	Slight	Northern red oak	Eastern white pine
Df							
Ernest	2W	Moderate	Moderate	Slight	Slight	Northern red oak	Eastern white pine
EsB						Yellow poplar	Norway spruce
						White ash	Japanese larch
						Sugar maple	
						Black cherry	
Gilpin	2R	Moderate	Moderate	Slight	Slight	Northern red oak	Japanese larch
GnD						Yellow poplar	Virginia pine
							Eastern white pine
							Black cherry poplar
Hartleton	4R	Moderate	Severe	Slight	Slight	Northern red oak	European larch
HaF						Chestnut oak	Norway spruce
						Eastern white pine	
						Virginia pine	
Hartsells	2F	Moderate	Moderate	Slight	Slight	Yellow poplar	White pine
HaB						Red oak	Larch
						Black cherry	Norway spruce
							Austrian spruce
Hazleton	3O	Slight	Slight	Slight	Slight	Northern red oak	Japanese larch
HtB						Yellow poplar	Eastern white pine
							Norway spruce
							Austrian pine
							Black cherry
Holston	9A	Slight	Moderate	Slight	Slight	Shortleaf Pine	Eastern white pine
Hc							
Leetonia	2F	Slight	Slight	Severe	Slight	Northern red oak	Virginia pine
La							
Monongahela	4A	Slight	Slight	Slight	Slight	Northern red oak	Eastern white pine
Ma							
Rayne	4A	Slight	Slight	Slight	Slight	Northern red oak	Eastern white pine
Ra						Black cherry	Red pine
						Sugar maple	Norway spruce
							Japanese larch
							Black cherry
Sciotoville	4A	Slight	Slight	Slight	Slight	Northern red oak	Eastern white pine
Sb							
Wharton	4A	Slight	Slight	Slight	Slight	Northern red oak	Eastern white pine
WaB						Black cherry	Norway spruce
						White Ash	Black cherry
						Sugar maple	Japanese larch
						Red maple	
						American beech	
Wheeling	4A	Slight	Slight	Slight	Slight	Northern red oak	Eastern white pine
Wo							

Source: Soil Surveys of Clarion, Elk, Forest, Jefferson, and McKean Counties

RECREATIONAL AND BUILDING SITE DEVELOPMENT

	Recreational Development				Building Site Development		
Soil name and map symbol	Camp Areas	Picnic Areas	Playgrounds	Paths and Trails	Dwellings with Basements	Small Commercial Buildings	Local Roads and Streets
Armagh AgB	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness, frost action, low strength
Buchanan BuB	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
Cavode CdB	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness	Severe: wetness
Clymer ClB	Slight	Slight	Moderate: slope, small stones	Slight	Moderate: depth to rock	Moderate: slope	Moderate: frost action
Cookport CtB	Moderate: perks slowly, wetness	Moderate: wetness, percs slowly	Moderate: slope, small stones	Severe: erodes easily	Severe: wetness	Moderate: slope, wetness	Moderate: wetness, low strength
Dekalb Df	Severe: slope	Severe: slope	Severe: slope small stones	Severe: slope	Severe: slope, depth to rock	Severe: slope	Severe: slope
Ernest EsB	Moderate: percs slowly, wetness	Moderate: wetness, percs slowly	Moderate: slope, small stones	Severe: erodes easliy	Severe: wetness	Moderate: wetness, shrink-swell, slope	Severe: low strength
Gilpin GnD	Severe: slope	Severe: slope	Severe: small stones, slope	Moderate: slope, large stones	Severe: slope	Severe: slope	Severe: slope
Hartleton HaF	Severe: slope	Severe: slope	Severe: slope, small stones	Severe: slope	Severe: slope, large stones	Severe: slope, large stones	Severe: slope, large stones
Hartsells HaB	Moderate: slope	Moderate: slope	Severe: slope small stones	Moderate: large stones	Severe: depth to rock	Severe: slope	Moderate: slope, depth to rock, large stones
Hazleton HtB	Moderate: small stones	Moderate: small stones	Severe: small stones	Slight	Moderate: large stones, depth to rock	Moderate: slope, large stones	Moderate: frost action, large stones
Holston Hc	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope	Severe: slope	Moderate: slope
Leetonia La	Severe: large stones, small stones	Severe: large stones, small stones	Severe: slope large stones, small stones	Slight	Moderate: depth to rock, large stones, slope	Moderate: large stones	Moderate: slope, large stones
Monongahela Ma	Moderate: wetness	Moderate: wetness	Moderate: small stones	Severe: erodes easily	Severe: wetness	Moderate: wetness	Moderate: low strength, wetness
Rayne Ra	Slight	Slight	Moderate: small stones	Slight	Slight	Slight	Moderate: frost action
Sciotoville Sb	Moderate: wetness	Moderate: wetness, percs slowly	Moderate: wetness, percs slowly	Slight	Severe: wetness	Moderate: wetness	Severe: frost action
Wharton WaB	Moderate: percs slowly, wetness	Moderate: wetness, percs slowly	Moderate: slope, percs slowly, wetness	Slight	Severe: wetness	Moderate: slope, wetness, shrink-swell	Severe: frost action low strength
Wheeling Wo	Moderate: slope	Moderate: slope	Severe: slope, small stones	Slight	Moderate: slope	Severe: slope	Moderate: frost action, low strength, slope

Source: Soil Surveys of Clarion, Elk, Forest, Jefferson, and McKean Counties

WATER MANAGEMENT AND PHYSICAL & CHEMICAL PROPERTIES OF SOILS

Soil name and map symbol	Water Management: Septic Tank absorption fields	Water Management: Sewage lagoon areas	Water Management: Drainage	Physical and Chemical Properties of Soils: Depth (Inches)	Permeability (Inches/Hr.)	Available water capacity (In./In.)	Soil reaction (pH)	Shrink-swell potential
Armagh	Severe: percs	Moderate: slope,	Percs slowly,	0-12	0.6-2.0	0.18-0.22	4.5-5.5	Low
AgB	slowly, wetness	depth to rock	frost action,	12-48	0.06-0.2	0.10-0.14	4.5-5.5	Moderate
			slope	48-60	0.06-0.6	0.08-0.12	4.5-5.5	Moderate
Buchanan	Severe: wetness,	Severe:	Percs slowly,	0-8	0.6-2.0	0.14-0.20	3.6-5.5	Low
BuB	percs slowly	wetness	slope	10.0-25.0	0.6-2.0	0.10-0.16	3.6-5.5	Low
				26-83	0.06-0.2	0.06-0.10	3.6-5.5	Low
Cavode	Severe: percs	Moderate: slope,	Slope, percs	0-8	0.6-2.0	0.18-0.22	4.5-5.5	Low
CdB	slowly, wetness	depth to rock	slowly, frost	9.0-25.0	0.06-0.2	0.10-0.14	4.5-5.5	Moderate
			action	26-58	0.06-0.2	0.08-0.12	4.5-5.5	Moderate
				58-62				
Clymer	Moderate: depth	Moderate:	Deep to water	0-10	0.6-2.0	0.10-0.16	3.6-5.5	Low
ClB	to rock, percs	seepage, depth to		10.0-31.0	0.6-2.0	0.08-0.14	3.6-5.5	Low
	slowly	rock, slope		31-48	0.6-2.0	0.04-0.08	3.6-5.5	Low
				48-52				
Cookport	Severe: percs	Moderate: depth	Slope, perks	0-10	0.6-2.0	0.12-0.16	4.5-5.5	Low
CtB	slowly, wetness	to rock, seepage	slowly	10.0-24.0	0.6-2.0	0.12-0.16	3.6-5.5	Low
				24-40	0.06-0.2	0.08-0.12	3.6-5.5	Low
				40-60	0.2-0.6	0.08-0.12	3.6-5.5	Low
				60				
Dekalb	Severe: slope,	Severe: slope,	Deep to water	0-8	6.0-20	0.08-0.12	3.6-6.5	Low
Df	Depth to rock	Depth to rock,		0-8	6.0-20	0.08-0.12	3.6-6.5	Low
	poor filter	seepage		0-8	6.0-20	0.08-0.12	3.6-6.5	Low
Ernest	Severe: percs	Moderate:	Percs slowly,	0-8	0.6-2.0	0.14-0.20	4.5-5.5	Low
EsB	slowly, wetness	seepage, slope	slope	8.0-29.0	0.6-2.0	0.12-0.16	4.5-5.5	Moderate
				29-42	0.2-0.6	0.08-0.12	4.5-5.5	Low
				42-60	0.2-0.6	0.08-0.12	4.5-5.5	Moderate
Gilpin	Severe: depth to	Severe: depth to	Deep to water	0-7	0.6-2.0	0.10-0.18	3.6-5.5	Low
GnD	rock, slope	rock, slope		7.0-27.0	0.6-2.0	0.10-0.16	3.6-5.5	Low
				27-30	0.6-2.0	0.06-0.10	3.6-5.5	Low
				30				
Hartleton	Severe: slope,	Severe: seepage,	Deep to water	0-5	0.6-6.0	0.10-0.14	4.5-5.5	Low
HaF	large stones	slope, large		6.0-37.0	0.6-6.0	0.06-0.10	4.5-5.5	Low
		stones		37-46	0.6-6.0	0.04-0.08	4.5-5.5	Low
				46-50				
Hartsells	Severe: depth to	Severe: slope,	Deep to water	0-8	6.0-20	0.08-0.12	3.6-6.5	Low
HaB	rock, poor filter	Depth to rock,		0-8	6.0-20	0.08-0.12	3.6-6.5	Low
		seepage		0-8	6.0-20	0.08-0.12	3.6-6.5	Low
Hazleton	Severe: poor	Severe:	Deep to water	0-6	2.0-6.0	0.10-0.14	3.6-5.5	Low
HtB	filter	seepage		6.0-32.0	2.0-20	0.08-0.12	3.6-5.5	Low
				32-56	2.0-20	0.04-0.10	3.6-5.5	Low
				56				
Holston	Moderate: slope	Severe: slope	Deep to water	0-9	0.6-2.0	0.12-0.22	3.6-5.5	Low
Hc				0-9	2.0-6.0	0.12-0.16	3.6-5.5	Low
				9.0-40.0	0.6-2.0	0.13-0.18	3.6-5.5	Low
Leetonia	Severe: poor	Severe: slope,	Deep to water	0-7	2.0-6.0	0.03-0.05	3.6-5.0	Low
La	filter	seepage, large		0-7	2.0-6.0	0.03-0.05	3.6-5.0	Low
		stones		7.0-12.0	2.0-6.0	0.03-0.05	3.6-5.0	Low
Monongahela	Severe: percs	Severe: wetness	Percs slowly	0-12	0.6-2.0	0.18-0.24	4.5-5.5	Low
Ma	slowly, wetness			0-12	0.6-2.0	0.16-0.22	4.5-5.5	Low
				0-12	0.6-2.0	0.16-0.22	4.5-5.5	Low
Rayne	Moderate: depth	Moderate:	Deep to water	0-8	0.6-2.0	0.14-0.18	4.5-5.5	Low
Ra	to rock, percs	seepage, depth		0-8	0.6-2.0	0.12-0.16	4.5-5.5	Low
	slowly	to rock, slope		9.0-36.0	0.6-2.0	0.12-0.16	4.5-5.5	Low
Sciotoville	Severe: wetness,	Severe: seepage,	Percs slowly,	0-13	0.6-2.0	0.18-0.22	5.1-6.5	Low
Sb	percs slowly	wetness	frost action	13-34	0.6-2.0	0.17-0.21	4.5-5.5	Low
				34-59	0.06-0.6	0.10-0.14	4.5-6.0	Low
Wharton	Severe: percs	Moderate:	Percs slowly,	0-7	0.6-2.0	0.16-0.20	4.0-5.5	Low
WaB	slowly, wetness	slope	frost action,	70-43.0	0.06-0.6	0.12-0.16	5.1-5.5	Moderate
			slope	43-53	0.06-0.6	0.08-0.12	5.1-5.5	Moderate
				53-57				
Wheeling	Severe: poor	Severe: seepage	Deep to water	0-14	0.6-6.0	0.12-0.18	5.1-6.5	Low
Wo	filter			0-14	0.6-6.0	0.10-0.16	5.1-6.5	Low
				14-60	0.6-2.0	0.08-0.16	5.1-6.0	Low

Source: Soil Surveys of Clarion, Elk, Forest, Jefferson, and McKean Counties

WILDLIFE HABITAT

Soil name and map symbol	Potential for Habitat Elements							Potential as Habitat For —		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
Armagh AgB	Poor	Fair	Fair	Fair	Fair	Poor	Very poor	Fair	Fair	Very poor
Buchanan BuB	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor
Cavode CdB	Very poor	Poor	Good	Good	Good	Poor	Very poor	Poor	Good	Very poor
Clymer ClB	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor
Cookport CtB	Fair	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor
Dekalb Df	Poor	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor
Ernest EsB	Fair	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor
Gilpin GnD	Poor	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Fair	Very poor
Hartleton HaF	Very poor	Poor	Good	Good	Good	Very poor	Very poor	Poor	Fair	Very poor
Hartsells HaB	Fair	Good	Good	Fair	Fair	Very poor	Very poor	Good	Fair	Very poor
Hazleton HtB	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor
Holston Hc	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor
Leetonia La	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor	Very poor	Very poor
Monongahela Ma	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor
Rayne Ra	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor
Sciotoville Sb	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor
Wharton WaB	Good	Good	Good	Good	Good	Poor	Very poor	Good	Good	Very poor
Wheeling Wo	Fair	Good	Good	Good	Good	Very poor	Very poor	Good	Good	Very poor

Source: Soil Surveys of Clarion, Elk, Forest, Jefferson, and McKean Counties

Clarion River's Edge
Total Ownership*

Segment	Nat'l Forest	State Game Land	State Forest/ State Park	Large Industry\ Boro	Western PA Conservancy	Other Private	Total	Public Land %	Private Land %
Clarion County									
Beaver Twp.	—	—	—	—	—	7.70	7.70	0.0	100.0
Clarion Twp.	—	1.10	—	—	—	4.70	5.8	19	81
Farminton Twp.	—	3.8	0.78	—	—	0.78	5.36	85.5	14.5
Highland Twp.	—	0.31	—	—	—	11.60	11.91	2.7	97.3
Licking Twp.	—	—	—	—	—	23.20	23.20	0.0	100.0
Millcreek Twp.	—	2.30	—	—	—	14.8	17.10	15	85
Monroe Twp.	—	—	—	—	—	5.23	5.23	0.0	100.0
Paint Twp.	—	—	—	—	—	6.10	6.10	0.0	100.0
Perry Twp.	—	—	—	—	—	9.9	9.9	0.0	100.0
Piney Twp.	—	—	—	—	—	7.10	7.10	0.0	100.0
Richland Twp.	—	—	—	—	—	10.70	10.70	0.0	100.0
Forest County									
Barnett Twp.	—	—	7.90	—	0.20	3.90	12.00	67.5	32.5
Jefferson County									
Barnett Twp.	—	0.4	7.75	—	—	1.6	9.75	83.6	16.4
Heath Twp.	—	0.30	0.50	—	0.90	4.60	6.30	27	73
Elk County									
Millstone Twp.	3.10	—	—	—	—	—	3.10	100.0	0.0
Springcreek Twp	13.90	3.70	—	—	1.20	6.20	25.00	75.2	24.8
Ridgway Twp.	7.00	4.70	—	5.50	—	3.10	20.30	84.8	15.2
West Branch									
Elk County									
Ridgway Twp.	—	—	—	1.39	—	2.66	4.05	34.4	65.6
Jones Twp.	3.27	—	—	—	—	14.50	17.77	18.5	81.5
McKean County									
Sergeant Twp.	—	—	—	—	—	0.20	0.20	0.0	100.0
East Branch									
Elk County									
Ridgway Twp.	—	—	—	1.1	—	4.2	5.30	20.8	79.2
Jones Twp.	—	0.80	4.10	—	—	2.40	7.30	67.2	32.8
McKean County									
Sergeant Twp.	—	—	—	—	—	6.10	6.10	0.0	100.0
Total	27.27	17.41	21.03	7.99	2.30	151.27	227.3	65.7	161.6
Percent	11.9	7.60	9.3	3.55	0.1	66.6		33.4	66.6
			**All distances are in miles*						

Potential Natural Communities of the Clarion River

Research and Narrative Prepared by Dr. Charles E. Williams
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I. Terrestrial Communities

A. Open Canopy Uplands: Includes upland communities with less than 25% canopy cover of trees; dominant plant species in these communities include shrubs, herbs, mosses and lichens.

1. River Gravel Community: An open, streamside community occurring on deposits of sand, gravel or cobble; the community may be exposes to frequent scour by spring floods.

2. Northern Appalachian Acidic Cliff Community: A community occurring on vertical exposures of resistant bedrock, ledges and/or talus especially of sandstone; soils are acidic, poorly developed and droughty.

3. Riverside Cliff/Outcrop Community: A community occurring in crevices of exposed bedrock outcrops and cliffs adjacent to major rivers; depending on the proximity of the cliff or outcrop to a river, the site may be exposed to spring floods and ice scour; summer conditions can be extremely dry.

B. Forested Uplands: Includes upland communities with greater than 60% canopy cover of trees.

1. Northern Conifer Forest: A community of low species diversity dominated by conifers of northern affinities often with a minor component of northern hardwoods; community occurs on moderately well drained to poorly drained soils; often develops in cool ravines.

2. Northern Hardwood Forest: A community dominated by hardwoods of northern affinities often with a minor component of northern conifers; community occurs on moderately well drained soils, herb layer of low diversity.

3. Northern Hardwood: Conifer Forest: A community similar to the northern hardwood forest but containing a more divers array of northern conifers and a dense shrub layer; occurs on moderately drained soils.

4. Floodplain Forest (Riparian Forest): Community occurring on deep, fertile, mesic floodplain soils particularly larger rivers.

C. Barrens and woodlands: Includes upland communities that are intermediate between forested and open canopy uplands. This category includes savannas (25 to 60% cover), stunted or dwarf woodlands, and woodlands occurring on thin, poorly-developed soils with numerous rock outcrops.

1. Northern Appalachian low elevation acidic rocky summit community: Xeric community occurring below 600 m. in elevation and sheltered from high winds and severe climate.

II. Palustrine communities: Palustrine communities consist of nontidal, perennial wetlands that support emergent vegetation.

A. Forested wetlands: Includes seasonally and permanently flooded or saturated forests; canopy cover in forested wetlands exceeds 50%.

1. Acidic broadleaf swamp: Forest community occurring in a permanent or semipermanent body of water; vegetation is dominated by broadleaved deciduous trees; pH is generally less than 5.

2. Floodplain swamp: Forest community occurring in a permanent or semipermanent body of water located along river floodplains, particularly old oxbows; vegetation is dominated by broadleaved deciduous trees; floodplain swamps receive water from flooding, groundwater and runoff from adjacent uplands.

B. Open canopy wetlands: Includes seasonal or permanently flooded wetlands dominated by herbaceous vegetation; canopy cover is generally less than 50%.

3. Graminoid marsh: Community with water at or near the surface for most of the year; vegetation s dominated by nonrobust grasses sedges and/or rushes.

4. Robust emergent marsh: Community with water at or near the surface for most of the year; vegetation is dominated by generally large statured, late season emergents.

5. Mixed graminoid marsh: Community with water at or near the surface for
most of the year; vegetation is codominated by robust emergent.

6. Nonglacial bog: A low nutrient, acidic peatland community often formed by beaver dams or streamside levees; topography is generally level and the sire is fed by cold groundwater.

7. Northern Appalachian circumneutral seep: Small community found on soils saturated by circumneutral water which flows to the surface in a diffuse manner; little build up of peat.

8. Northern Appalachian acidic seep: Small community found on soils saturated by acidic water (pH less than 5) which flows to the surface in a diffuse manner; little build up of peat; often occurs at edges of maple swamps.

9. Riverside seep community: An open community occurring on alluvial sands along seepy shores of major rivers; a high diversity community subject to seasonal flood scour.

III. Lacustrine communities: Lacustrine communities consist of lentic aquatic systems lacking persistent emergent vegetation but often supporting submerged or floating-leaved aquatic vegetation.

1. Nonglacial lake: A community inhabiting a lake system of nonglacial origin; the size of the system is usually greater than 15 acres and the depth sufficient to permit thermal stratification at certain times of the year; an open, wave swept shore line is often present.

2. Natural pond: A community occurring in a body of water between 0.5 and 15 acres in size; the shallow depth of ponds allows development of rooted aquatic vegetation ; includes beaver ponds.

3. **Stable natural pool**: A community inhabiting a permanent body of water less than 0.5 acres in size; rooted aquatic plants are present.

4. **Ephemeral/fluctuating natural pool**: Similar to a stable natural pool except that water levels fluctuate seasonally from dry or near dry conditions to inundation; due to drawdowns, vegetation may exist in discrete bands along the shoreline; important breeding sites from many amphibian species.

IV. **Riverine communities**: Riverine communities consist of lotic aquatic communities that generally lack persistent emergent vegetation; submerged or floating-leaved aquatic vegetation may be supported in localizes sites. The major riverine systems, creeks and rivers are differentiated on the basis of watershed size and channel gradient. Creek systems drain watersheds less than 520 square kilometers in area; river systems drain watersheds greater than 520 square kilometers. Three channel gradient categories are recognized: 1) low-gradient channels - slow current with a gradient of less than 0.2 meters per kilometer; 2) medium-gradient channels - a gradient between 0.2 to 1.9 meters per kilometer; and 3) high-gradient channels - a gradient greater than 1.9 meters per kilometer.

1. **Clearwater creeks and rivers**: Clearwater systems lack high concentrations of dissolved organics and acids; pH is usually greater than 5.5.

2. **Brownwater creeks**: Brownwater systems have high concentrations of dissolved organics and acids, particularly tannins; water is tea-colored and pH is usually less than 5.5. Brownwater systems are often associated with swamps and bogs.

3. **Ephemeral and intermittent creeks**: Ephemeral creeks flow seasonally and only after adequate rains; intermittent creeks flow sporadically down their length.

4. **Waterfall and plungepool**: A community occurring at a portion of a creek of river where a vertical drop greater than 1.5 meters occurs. Includes the top of the waterfall to the outflow of the plunge pool.

5. **Springs and spring runs**: Spring communities are associated with, and influenced by, a concentrated water source of discrete origin; Water is usually constant in flow, temperature and chemistry. Spring runs include the spring origin and a channel up to its point of encounter with a body of water not directly under the influence of the spring.

Pennsylvania Natural Diversity Inventory of the Clarion River Basin				
Quadname	Common Name	Scientific Name	Global Ranks	State Ranks
Cooksburg	Brotherly Clubtail	Gomphus Fraternus	G5	S2S3
Cooksburg	Eastern Hemlock Forest	Tsuga Canadensis (Mesic) Forest	G?	S?
Cooksburg	Eastern Hemlock-Yellow Birch	Tsuga Canadensis-Betula Alleghaniensis	G?	S?
Cooksburg	Grassy Pondweed	Potamogeton Gramineus	G5	S1S2
Cooksburg	Green-Faced Clubtail	Gomphus Viridifrons	G3	S1
Cooksburg	Harpoon Clubtail	Gomphus Adelphus	G4	S?
Cooksburg	Kirtland's Snake	Clonophis Lirtlandii	G2	SH
Cooksburg	Moustached Clubtail	Gomphus Adelphus	G4	S?
Cooksburg	Ocellated Darner	Boyeria Grafiana	G5	S3
Cooksburg	Queen of the Prairie	Filipendula Rubra	G4G5	SU
Cooksburg	Rapids Clubtail	Gomphus Quadricolor	G3G4	S1S2
Cooksburg	Red Oak-American Basswood	Quercus Rubra-Tilla American -Fraxinus	G?	S?
Cooksburg	White Ash	Quercus Rubra-Tilla American -Fraxinus	G?	S?
Cooksburg	Resolute Damsel	Coenagrion Resolutum	G5	S1
Cooksburg	Ski-Tailed Emerald	Somatochlora Elongata	G5	S2
Cooksburg	Sugar Maple-American Beech	Acer Saccharum-Fagus Grandifolia-Betula	G?	S?
Cooksburg	Yellow Birch	Acer Saccharum-Fagus Grandifolia-Betula	G?	S?
Cooksburg	Sugar Maple-Black Cherry Forest	Acer Saccharum-Orunus Serotina Forest	G?	S?
Cooksburg	Twin-Horned Snaketail	Ophiogomphus Mainensis	G3G4	S3
Cooksburg	Uhler's Sunfly	Helocordulia Uhleri	G5	S3
Cooksburg	White Pine Forest	Pinus Strobus Forest	G?	S?
Cooksburg	White-Pine-Hemlock Forest	Pinus Strobus-Tsiga Canadensis	G?	S?
Cooksburg	Zebra Clubtail	Stylurus Scudderi	G3	S1
Fryburg	Eastern Massasauga	Sistrurus Catenatus Catenatus	G4T3T4	S2
Glen Hazel	Bog Sedge	Carex Paupercula	G5	S2
Glen Hazel	Creeping Snowberry	Gaultheria Hispidula	G5	S3
Glen Hazel	Northern Conifer Swamp	Northern Conifer Swamp	G?	S3S4
Glen Hazel	Oakes'Pondweed	Potamogeton Oakesianus	G4	S2
Glen Hazel	Wiegands Sedge	Carex Wiegandii	G3	S2
Hallton	Brotherly Clubtail	Gomphus Fraternus	G5	S2S3
Hallton	Green-Faced Clubtail	Gomphus Viridifrons	G3	S1

Pennsylvania Natural Diversity Inventory of the Clarion River Basin				
Quadname	Common Name	Scientific Name	Global Ranks	State Ranks
Hallton	Mountain Brook Lamprey	Ichthyomzon Greeleyi	G3	S2
Hallton	Moustached Clubtail	Gomphus Adelphus	G4	S?
Hallton	Oscellated Darner	Boyeria Grafiana	G5	S3
Hallton	Ski-Tailed Emerald	Somatochlora Elongata	G5	S3
Hallton	Twin-Horned Snaketail	Ophigomphus Mainensis	G3G4	S3
Hazel Hurst	Creeping Snowberry	Gaultheria Hispidula	G5	S3
Hazel Hurst	Northern Conifer Swamp	Northern Conifer swamp	G?	S3S4
Hazel Hurst	Wiegands Sedge	Carex Wiegandii	G3	S2
James City	Small-Headed Rush	Juncus Brachycephalus	G5	S3
James City	Water Shrew	Sorex Palustris Albibarbis	G5T5	S3
Kossuth	Cluster Fescue	Festuca Paradoxa	G5	S1
Kossuth	Eastern Massasauga	Sistrurus Catenatus Catenatuas	G4T3T4	S2
Lucinda	Queen-of-the Prairie	Filipendula Rubra	G4G5	SU
Lucinda	Zebra Clubtail	Stylurus Scudderi	G3	S1
Marienville West	Queen-of-the Prairie	Filipendula Rubra	G4G5	SU
Marienville West	Zebra Clubtail	Stylurus Scudderi	G3	S1
Munderf	Brotherly Clubtail	Gomphus Fraternus	G5	S2S3
Munderf	Green-Faced Clubtail	Gomphus Viridifrons	G3	S1
Munderf	Moustached Clubtail	Gomphus Adelphus	G4	S?
Munderf	Oscellated Darner	Boyeria Grafiana	G5	S3
Munderf	Rapids Clubtail	Gomphus Quadricolor	G3G4	S1S2
Munderf	Twin-Horned Snaketail	Ophiogomphus Mainesis	G3G4	S3
Parker	Canadian Milkvetch	Astragaus Canadensis	G5	S2
Parker	Clubshell	Pleirobena Clava	G1	S1
Parker	Heartleaf Meehania	Meehania Cordata	G5	S3
Parker	Illinois Pondweed	Potamageton Illinoenis	G5	S3S4
Parker	Popeye Shiner	Notropis Ariommus	G3	SX

Pennsylvania Natural Diversity Inventory of the Clarion River Basin				
Quadname	Common Name	Scientific Name	Global Ranks	State Ranks
Parker	Wabash Pigtoe	Fusconaia Flava	G5	S2
Portland Mills	Queen-of-the Prairie	Filipendula Rubra	G4G5	SU
Portland Mills	Striped Gentian	Gentiana Villosa	G4	S3
Portland Mills	Twin-Horned Snaketail	Ophiogomphus Mainesis	G3G4	S3
Ridgway	Queen-of-the Prairie	Filipendula Rubra	G4G5	SU
Rimersburg	Alleghany Plum	Prununs Alleghaniensis	G4	S3S4
Rimersburg	Illinois Pondweed	Potamageton Illinoenis	G5	S3S4
Rimersburg	Pocketbook	Lampsillis Ovata	G5	S2S3
Russell City	Mountain Brook Lamprey	Ichthyomyzon Greeley	G3	S2
Russell City	Moustached Clubtail	Gomphus Adelphus	G4	S?
St. Mary's	Coal Skink	Eumeces Anthracinus	G5	S2S3
St. Mary's	Least Weasel	Mustela Nivalis	G5	S3
Sigel	Brotherly Clubtail	Gomphus Fraternus	G5	S2S3
Sigel	Harpoon Clubtail	Gomphus Descriptus	G4	S1S2
Sigel	Moustached Clubtail	Gomphus Adelphus	G4	S?
Sigel	Oscellated Darner	Boyeria Grafiana	G5	S3
Sigel	Rapids Clubtail	Gomphus Quadricolol	G3G4	S1S2
Sigel	Silver-Haired Bat	Lasionycteris Noctivagans	G5	SUB
Sigel	Ski-Tailed Emerald	Somatochlora Elongata	G5	S3
Sigel	Superb Jewelwing	Calopteryx Amata	G3G4	S2S3
Sigel	Twin-Horned Snaketail	Ophiogomphus Mainesis	G3G4	S3
Sigel	Uhler's Sunfly	Helocordulia Uhleri	G5	S3
Sigel	Zebra Clubtail	Stylurus Scudderi	G3	S1
Tylersburg	Queen-of-the Prairie	Filipendula Rubra	G4G5	SU
Tylersburg	Zebra Clubtail	Stylurus Scudderi	G3	S1
West Creek	Drooping Bluegrass	Poa Languida	G3G4Q	S2
West Creek	Quaking Aspen-Birch Forest	Populus Tremuloides-Betula Sp Forest	G?	S?
West Creek	White Oak-Red Oak-	Quercus Alba-Quercus Rubra	G?	S?
	Hickory Forest	Carya Sp. Forest		
West Creek	White Pine Forest	Pinus Strobus Forest	G?	S?

Size Distribution (total length) of fish collected from the Clarion River at Cooksburg (CRO1) in 37 minutes of boat electrofishing (400 VAC), July 10, 1995.

Species	Total Length (mm)											
	25	50	75	100	125	150	175	200	225	250	375	Total
River chub	1	4	3	4	4	1						17
Common shiner					2							2
Rosyface shiner	1	1										2
Northern hog sucker			3	3		3	1					10
White sucker								1	1	4		6
Golden redhorse											1	1
Rock bass									1			1
Smallmouth bass				1	1	1				1		4
Greenside darter		2	2									4
Logperch		1	1	1								3
Total												**50**

Size Distribution (total length) of fish collected from the Clarion River at Callensburg (CRO3) in 43 minutes of boat electrofishing (380 VAC), July 10, 1995.

Species	Total Length (mm)					
	50	75	125	150	175	Total
Northern hog sucker		1				1
Pumpkinseed	1	2				
Logperch		2				2
Blackside darter	4	1				5
Greenside darter	4					4
Yellow perch			1	2	1	4
Total						19

Field Water Chemistry analysis from three stations on the Clarion River, July 10-11, 1995

Parameter	Station		
	Cooksburg	Upstream of Piney	Callensburg
Water Temp.*C	21.05	21.58	23.48
pH	7.64	6.35	6.73
Dissolved Oxygen mg/l	10.62	6.97	7.84
Specific Conductance (umhos/cm)	186	214	228
Redox (V)	329	423	392
Date	**7-10-95**	**7-11-95**	**7-10-95**

Source Biological Monitoring of the Clarion River to Assess Impacts of Piney Dam Releases*
Pennsylvania Game Commission Report Date: December 8, 1995

Size Distribution (total length) of fish collected from the Clarion River upstream of Piney Creek at SR 2007 Bridge (CRO2) in two boat electrofishing runs (380) VAC), July 11, 1995. Run 1 was 10 minutes long at river flow of 2200 cfs. Run 2 was conducted for a period of 39 minutes and started 1 hour 5 minutes after all units at Piney Dam were turned off.

	Total Length (mm)												
Species	**25**	**50**	**75**	**100**	**125**	**150**	**175**	**200**	**225**	**275**	**350**	**475**	**Total**
Run 1													
Golden shriner				1									1
Largemouth bass			1										1
Yellow perch					1								1
Total													3
**Depths and velocity were too great to sample efficiently.													
Run 2													
River chub							1						1
Creek chub		1											1
Golden shiner						1							1
Northern hog sucker		1	1										2
White sucker			1		2		1	6		1	1		9
Brown bullhead							1			2			3
Pumpkinseed	2	30	4	2									38
Bluegill		7	1										8
Green sunfish	1	1											2
Rock bass	1		1										2
Logperch			1										1
Blackside darter	1												1
Total													69

The samples at CRO2 and CRO3 documented the obvious adverse impacts of water quality downstream of Deer and Piney Creeks. Interestingly, the COE 1990 sample at Callensburg (CRO3) exhibited much higher diversity and abundance than in 1995. This may reflect fluctuating water quality conditions at Callensburg related to Piney operation and varying acid loads from downstream tributaries.

Source Biological Monitoring of the Clarion River to Assess Impacts of Piney Dam Releases*
Pennsylvania Game Commission Report Date: December 8, 1995

	Sampling Stations @ Toms Run				
Species	DER 1		DER 2		DER 3
Brook Trout	x		x		x
Blacknose dace	x				
Johnny darter	x				

Station 1: Near the Mouth of Toms Run
Station 2: Confluence of Browns and Tom
Station 3: Upstream of Browns Run on Toms Mainstream

Source:. Toms Run (49853) April, 1991 Department of Environmental Resources

Fish Data: Clarion River Survey June 25-26, 1996

Fish Species & Sizes	Stations 1 (CR)	2 (CR)	3 (CR)	4 (CR)	Fish Species & Species	Stations 1 (CR)	2 (CR)	3 (CR)	4 (CR)
Brown Trout					**Suckers**				
279 mm			1		White sucker	C	P	P	
305 mm		1			N. Hog sucker		R		R
318mm	1								
356 mm		1	1		**Perches**				
432 mm		1			Johnny darter	P			
457 mm	1				Blackside darter	R	R		
495 mm	1				Fantail darter		R		
					Variegate darter				R
Brook Trout					Greenside darter		R		P
203-254 mm				1					
305 mm				1	**Mottled Sculpin**	P	C	C	
Smallmouth Bass					**Catfishes**		R	R	
102 mm				1					
Rock Bass				2					
127-203 mm					**Total No.**				
					Species / Station	**7**	**12**	**7**	**11**
Minnows									
Common shiner	R				**Time**				
Mimic shiner		R	R		**Electrofished (min.)**	**25**	**25**	**27**	**30**
Creek Club	R	R	C	P					
River Chub				C					
Redside dace	R								
Blacknose dace	C	C	C						
Stoneroller				R					
Bluntnose minnow				R					

Relative Abundance: R (Rare) = < 5; P (Present) = 5 to 15; C (Common) = > 15 individuals
Actual numbers collected are provided in some cases.

Source: Department of Environmental Protection
Northwest Regional Office
Water Pollution Biologist, December 18, 1996

CR = Clarion River
Station 1: Clarion River - approximately 350 feet below the Grant Street bridge in Johnsonburg
Station 2: Clarion River - approximately 1200 feet downstream from Willamette's 002 doscharge and upstream from STP outfall.
Station 3: Clarion River - approximately 1000 feet downstream from Powers Run and below Johnsonburg's STP outfall.
Station 4: Clarion River - approximately 1000 feet upstream from the PA route 948 bridge in Ridgway (above Elk Creek).

Gage Station Records

Sevenmile Run Near Rasselas, PA

Location: Lat 41° 37'52", Long 78° 34'37", McKean County, Hydrologic Unit 0510005, on right bank 300 ft. upstream from highway bridge, 600 ft. upstream from Fivemile Run, and 3.2 miles northeast of Rasselas.

Drainage Area: 7.84 mi^2

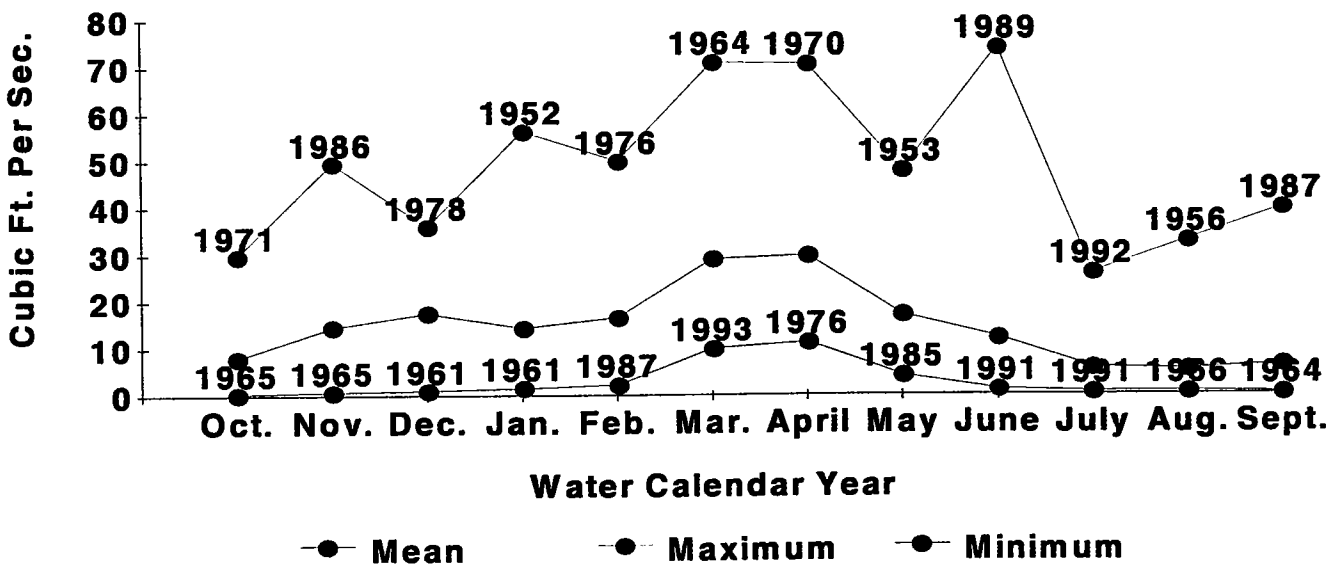
Period of Record: October 1951 to current year.

Gage: Water-stage recorder and concrete control. Datum of gage is 1,690.73 ft. above sea level.

Remarks: Records good except for estimated daily discharges, which are fair. Several measurements of water temperature were made during the year. U.S. Army Corps of Engineers satellite telemeter at station.

Sevenmile Run : 1952-1995

Statistics of Mean Data



Sevenmile Run	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.
Mean	7.96	14.5	17.5	14.3	16.6	29	29.7	17.1	12.2	5.68	5.27	6.23
Maximum	29.7	49.5	35.9	56.4	49.9	70.8	70.6	47.8	74	26	32.8	39.7
Minimum	0.32	0.66	0.94	1.55	2.22	9.85	11.2	4.05	1.14	0.5	0.52	0.28

Gage Station Records

West Branch Clarion River at Wilcox

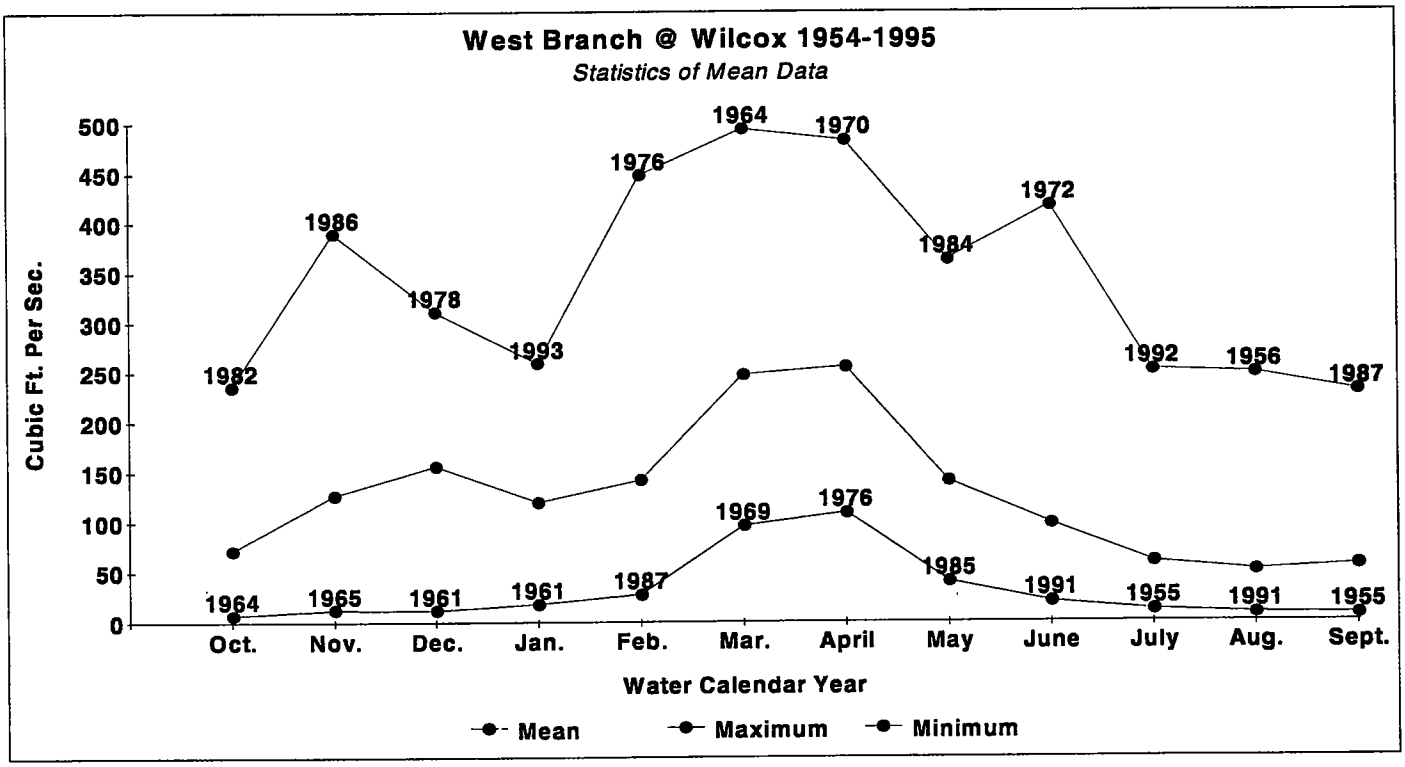
Location: Lat 41°34'31", Long 78°41'33", Elk County, Hydrologic Unit 05010005, on right bank 20 ft. downstream from highway bridge at Wilcox, 100 ft. downstream from Wilson Run, and 0.1 mile upstream from Penn Central Railroad bridge.

Drainage Area: 63.0 mi^2.

Period of Record: October 1953 to current year.

Gage: Water-stage recorder. Datum of gage is 1,502.02 ft. above sea level. Prior to Nov. 18, 1953, non recording gage at site 20 ft. upstream at same datum. Nov. 18 to Dec. 8, 1953, non recordings gage at same site and datum.

Remarks: Records good except for estimated daily discharges, which are fair. Several measurements of water temperature we made during the year. U.S. Army Corps of Engineers satellite telemeter at station.



West Branch	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.
Mean	71.9	12	156.	120.	142.	247	255	141	98.60	60.10	51.30	57.00
Maximum	236	390	311	359.	448	494	483	363	417	252	249	231
Minimum	7.60	12.90	12.40	18.50	27.60	96.40	109	40.90	20.40	12.30	8.30	7.68

Gage Station Records

Johnsonburg Gaging station

Location: Lat 41° 29'10", Long 78° 40'43", Elk county, Hydrologic Unit 0501005, on left bank at upstream side of highway bridge at Johnsonburg, 0.1 mile downstream from Johnson Run, and 0.4 miles downstream from confluence of East and West Branches.

Drainage Area: 204 mi^2

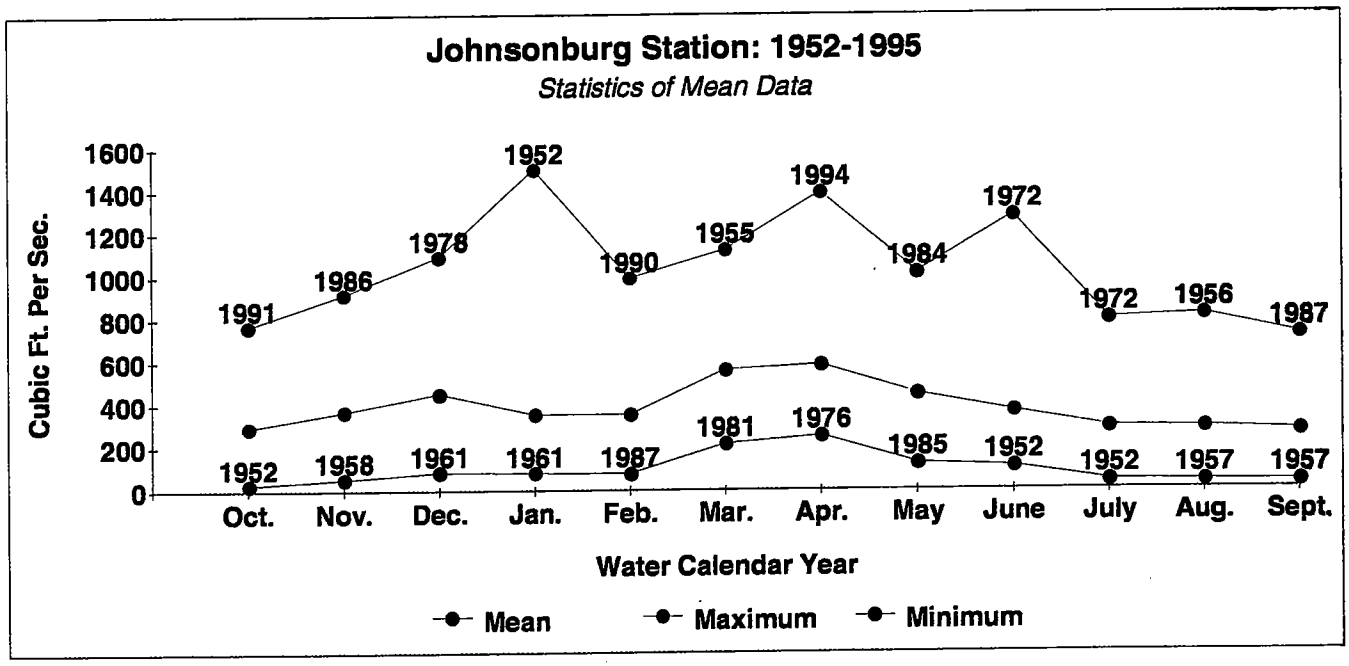
Period of Record: October, 1945 to current year

Revised Records: Drainage Area

Gage: Water-stage records. Datum of gage is 1,432.03 ft. above sea level. Prior to Nov 8., 1951, nonrecording gage at same site and datum.

Remarks: Records good except for estimated daily discharges, which are fair. Flow regulated since June 1952 by East Branch Clarion River Lake 7.9 miles upstream at low flow by industrial plants above station. Several measurements of water temperature were made during the year. U.S. Army Corps of Engineers satellite telemeter.

Extremes Outside Period of Recorded: Flood in July 1942 reached a stage of 16.7 ft. from floodmark.



Johnsonburg	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean	291	367	449	352	351	558	581	448	365	290	286	271
Maximum	767	915	1089	1500	987	1121	1390	1015	1280	797	813	720
Minimum	25	54	84	77	76	214	250	123	108	40	38	36

Clarion River at Cooksburg

Location--Lat 41'19'50", Long 79° 12' 33", Jefferson County, Hydrologic Unit 05010005, on left bank at downstream side of bridge on State Highway 36 at Cooksburg, 300 ft. downstream from Toms Run, and 2.7 mi upstream from Cathers Run.

Drainage Area.--807 mi^2.

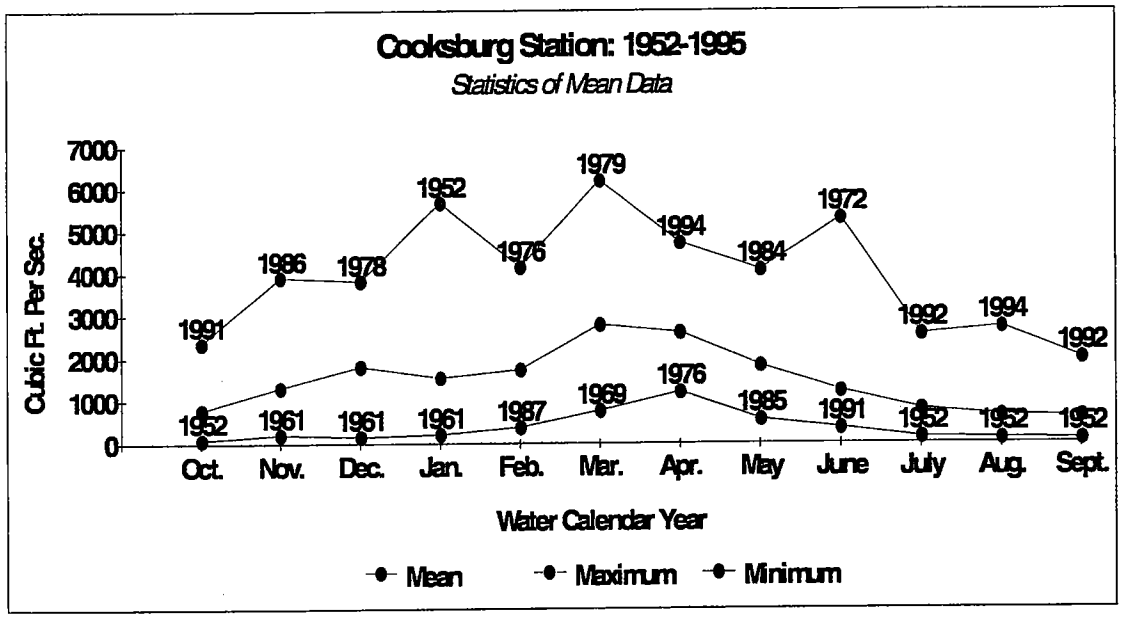
Period of Record.--October 1938 to current year. Monthly discharge only for October, November 1938, published in WSP 1305.

Revised Records.--WSP 1305: 1939 (M). WDR PA-85-3: 1979 (M)

Gage-- Water stage recorder. Datum of gage is 1,147.oo ft above sea level. Prior to May 17, 1939, nonrecording gage at same site and datum.

Remarks--Records good except for estimated daily discharges, which are fair. Flow regulated by East Branch Clarion River Lake since June 1952 and at low flow by industrial plants above station. Several measurements of water temperature were made during the year. U.S. Army Corps of Engineers satellite telemeter at station.

Extremes Outside Period of Record.--Maximum stage since 1935, 19 ft., Mar. 17, 1936, from floodmarks, discharge about 56,000 $ft.^3/s$.



Cooksburg	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean	786	1316	1808	1550	1722	2786	2605	1837	1235	809	652	628
Maximum	2357	3906	3821	5654	4138	6185	4721	4086	5307	2565	2732	1995
Minimum	86.6	204	150	211	369	764	1217	566	365	139	117	109

Gage Station Records

Clarion River Gage Station Near Piney

Location: Lat 41°11'33", Long 79°26'25", Clarion County, Hydrologic Unit 0510005, on left bank 0.2 miles downstream from hydroelectric plant of Pennsylvania Electric Co., 2.3 miles northeas of Piney, 2.4 miles upstream from Piney Creek, and 3 miles southwest of Clarion.

Drainage Area: 951 mi ^{2}.

Period of Record: October 1944 to current year (monthly discharge only October 1944 to September 1947).

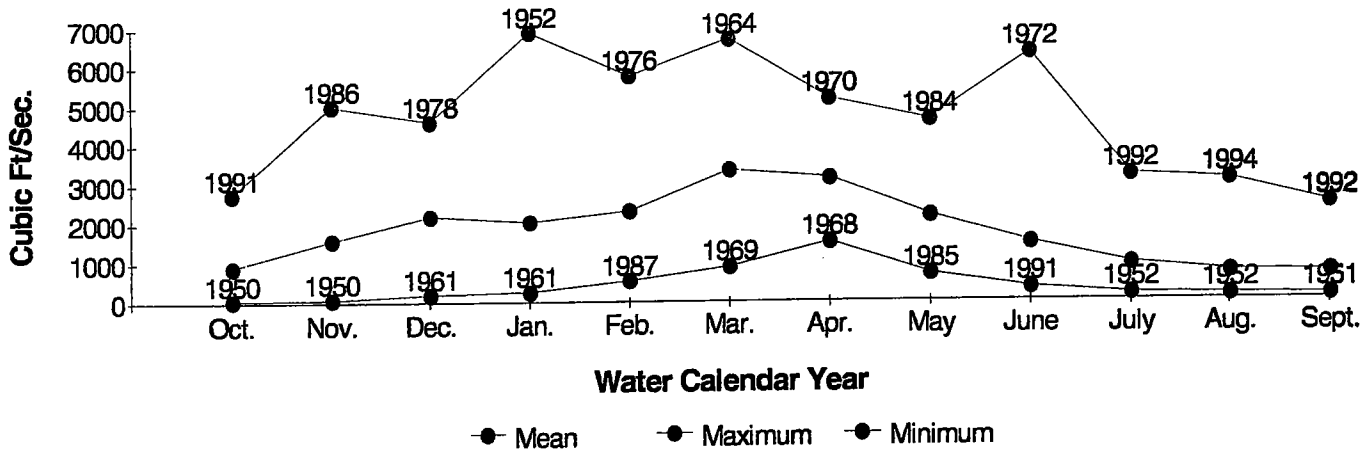
Gage: Water-stage recorder and crest-stage gage. Datum of gage is 1,002.06 ft. above sea level (Pennsylvania Electric Co. bench mark). Prior to Dec. 23, 1947, records from hydroelectric plant 0.2 miles upstream.

Remarks: Records good except for estimated daily discharges, which are fair. Flow regulated by East Branch Clarion River Lake since June 1952 and by hydroelectric plant at Piney Dam 0.2 miles upstream since 1924, combined capacity of reservoirs, 113,200 acre-ft. Several measurements of water temperature were made during the year. Satellite telemeter at station.

Extremes: The flood of Mar. 18, 1936 reached a discharge of 50,000 ft^3/sec., as determined by Pennsylvania Electric Co., elevation 1,028.5 ft., at lower pool of dam. The flood of July 19, 1996 the preliminary measurement reached a discharge of 57,200 ft^3/sec.

Clarion River Near Piney

Statistics Mean Data: 1948-1995



Piney	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean	895	1585	2194	2031	2311	3350	3158	2191	1483	940	733	711
Maximum	2743	5013	4611	6884	5775	6703	5186	4644	6354	3220	3096	2469
Minimum	40.2	82.5	184	244	527	881	1517	700	345	167	135	120

Water Use Data System--Public Water Supply Report

Clarion Twp. General Authority

Total Pop:	3,306	Bulk Sales	0
Unserved Pop:	1,537	Peak-Use	158,916
Pop Served:	623	Peak/Avg. Ratio:	2.28
Percent Served :	18.87%	Gallons/Day	69,700

Corner Water Supply & Service Corp.

Paint Twp.

Total Pop:	1,730	Bulk Sales	0
Unserved Pop:	654	Peak-Use	193,710
Pop Served:	1,075	Peak/Avg. Ratio:	1.50
Percent Served :	62.19%	Gallons/Day	129,140

Elk Twp.

Total Pop:	1,526	Bulk Sales	0
Unserved Pop:	1,275	Peak-Use	combined w/Paint
Pop Served:	18	Peak/Avg. Ratio:	combined w/Paint
Percent Served :	1.24%	Gallons/Day	2,140

Foxburg Municipal Authority

Foxburg Boro

Total Pop:	262	Bulk Sales	0
Unserved Pop:	0	Peak-Use	41,889
Pop Served:	262	Peak/Avg. Ratio:	1.50
Percent Served :	100%	Gallons/Day	27,300

Richland Twp.

Total Pop:	490	Bulk Sales	0
Unserved Pop:	448	Peak-Use	combined /Foxburg
Pop Served:	6	Peak/Avg. Ratio:	combined /Foxburg
Percent Served :	1.42%	Gallons/Day	626

Knox Municipal Water Works

Knox Boro

Total Pop:	1,182	Bulk Sales	0
Unserved Pop:	0	Peak-Use	151,625
Pop Served:	1,182	Peak/Avg. Ratio:	1.25
Percent Served :	100%	Gallons/Day	101,000

Water Use Data System--Public Water Supply Report

Beaver Twp.

Total Pop:	1,840	Bulk Sales	0
Unserved Pop:	1,647	Peak-Use	combined w/Knox
Pop Served:	192	Peak/Avg. Ratio:	combined w/Knox
Percent Served :	10.48%	Gallons/Day	20,300

Lucinda Water Company

Knox Township

Total Pop:	1,281	Bulk Sales	0
Unserved Pop:	1,205	Peak-Use	9,000
Pop Served:	75	Peak/Avg. Ratio:	1.20
Percent Served :	5.90%	Gallons/Day	7,500

PA American Water Co- Clarion District

Clarion Boro

Total Pop:	6,457	Bulk Sales	133,792 (11%)
Unserved Pop:	0	Peak-Use	1,504,675
Pop Served:	6,457	Peak/Avg. Ratio:	1.39
Percent Served :	100%	Gallons/Day	917,000

Clarion Twp.

Total Pop:	3,306	Bulk Sales	combined w/Clarion
Unserved Pop:	1,537	Peak-Use	combined w/Clarion
Pop Served:	888	Peak/Avg. Ratio:	combined w/Clarion
Percent Served :	26.89%	Gallons/Day	126,000

Monroe Twp.

Total Pop:	1,314	Bulk Sales	combined w/Clarion
Unserved Pop:	1,035	Peak-Use	combined w/Clarion
Pop Served:	278	Peak/Avg. Ratio:	combined w/Clarion
Percent Served :	21.23%	Gallons/Day	39,500

Rimersburg Boro Mun Auth

Rimersburg Boro

Total Pop:	1,053	Bulk Sales	0
Unserved Pop:	0	Peak-Use	157,391
Pop Served:	1,053	Peak/Avg. Ratio:	1.30
Percent Served :	100%	Gallons/Day	86,600

Water Use Data System--Public Water Supply Report

Toby Twp.

Total Pop:	1,153	Bulk Sales	combined
Pop:	1,004	Peak-Use	combined
Pop Served:	148	Peak/Avg. Ratio:	combined
Percent Served :	12.92%	Gallons/Day	12,100

Madison Twp.

Total Pop:	1,423	Bulk Sales	combined
Unserved Pop:	1,168	Peak-Use	combined
Pop Served:	254	Peak/Avg. Ratio:	combined
Percent Served :	17.91%	Gallons/Day	20,900

Brady Twp.

Total Pop:	78	Bulk Sales	combined
Unserved Pop:	59	Peak-Use	combined
Pop Served:	18	Peak/Avg. Ratio:	combined
Percent Served :	24.35%	Gallons/Day	1,470

Shippenville Municipal Waterworks

Shippenville Boro

Total Pop:	474	Bulk Sales	0
Unserved Pop:	0	Peak-Use	57,001
Pop Served:	474	Peak/Avg. Ratio:	1.19
Percent Served :	100%	Gallons/Day	34,100

Elk Twp.

Total Pop:	1,526	Bulk Sales	combined
Unserved Pop:	1,275	Peak-Use	combined
Pop Served:	192	Peak/Avg. Ratio:	combined
Percent Served :	12.64%	Gallons/Day	47,900

Strattanville Borough Municipal Waterworks

Strattanville Boro

Total Pop:	490	Bulk Sales	0
Unserved Pop:	0	Peak-Use	75,145
Pop Served:	490	Peak/Avg. Ratio:	1.13
Percent Served :	100%	Gallons/Day	45,300

Water Use Data System--Public Water Supply Report

Clarion Twp.

Total Pop:	3,306	Bulk Sales	combined
Unserved Pop:	1,537	Peak-Use	combined
Pop Served:	230	Peak/Avg. Ratio:	combined
Percent Served :	6.98%	Gallons/Day	21,200

Sligo Borough Mun Authority

Sligo Boro

Total Pop:	706	Bulk Sales	0
Unserved Pop:	0	Peak-Use	76,825
Pop Served:	706	Peak/Avg. Ratio:	1.10
Percent Served :	100%	Gallons/Day	61,400

Piney Twp.

Total Pop:	515	Bulk Sales	0
Unserved Pop:	417	Peak-Use	combined
Pop Served:	97	Peak/Avg. Ratio:	combined
Percent Served :	19.02%	Gallons/Day	8,440

St. Petersburg Mun Waterworks

St. Petersburg Boro

Total Pop:	349	Bulk Sales	0
Unserved Pop:	0	Peak-Use	42,480
Pop Served:	349	Peak/Avg. Ratio:	1.50
Percent Served :	100%	Gallons/Day	28,320

Richland Twp.

Total Pop:	490	Bulk Sales	0
Unserved Pop:	448	Peak-Use	combined
Pop Served:	34	Peak/Avg. Ratio:	combined
Percent Served :	6.9%	Gallons/Day	2,520

Brockport Area Water Association

Horton Twp.

Total Pop:	1,655	Bulk Sales	0
Unserved Pop:	673	Peak-Use	37,900
Pop Served:	569	Peak/Avg. Ratio:	1.00
Percent Served :	34.44%	Gallons/Day	37,900

Water Use Data System--Public Water Supply Report

Fox Twp. Municipal Authority

Fox Twp.

Total Pop:	3,392	Bulk Sales	0
Unserved Pop:	573	Peak-Use	26,125
Pop Served:	362	Peak/Avg. Ratio:	1.25
Percent Served :	10.70%	Gallons/Day	20,900

Horton Twp. Mun Auth/ Brandy Camp Homes

Horton Twp.

Total Pop:	1,655	Bulk Sales	0
Unserved Pop:	673	Peak-Use	10,067
Pop Served:	150	Peak/Avg. Ratio:	1.26
Percent Served :	9.12%	Gallons/Day	7,990

Johnsonburg Municipal Authority

Johnsonburg Boro

Total Pop:	3,350	Bulk Sales	0
Unserved Pop:	0	Peak-Use	808,950
Pop Served:	3,350	Peak/Avg. Ratio:	1.50
Percent Served :	100%	Gallons/Day	521,000

Ridgway Twp

Total Pop:	2,617	Bulk Sales	0
Unserved Pop:	1,091	Peak-Use	combined
Pop Served:	118	Peak/Avg. Ratio:	combined
Percent Served :	4.51%	Gallons/Day	18,300

Ridgway Borough Water Works

Ridgway Boro

Total Pop:	4,793	Bulk Sales	0
Unserved Pop:	0	Peak-Use	1,420,400
Pop Served:	4,793	Peak/Avg. Ratio:	1.34
Percent Served :	100%	Gallons/Day	1,060,000

Water Use Data System--Public Water Supply Report

Ridgway Twp. Mun Authority

Ridgway Twp

Total Pop:	2,617	Bulk Sales	0
Unserved Pop:	1,091	Peak-Use	216,160
Pop Served:	1,407	Peak/Avg. Ratio:	1.12
Percent Served :	53.8%	Gallons/Day	193,000

St. Mary's Area Joint Water Authority

St. Mary's City

Total Pop:	14,020	Bulk Sales	0
Unserved Pop:	0	Peak-Use	4,785,165
Pop Served:	14,020	Peak/Avg. Ratio:	1.65
Percent Served :	100%	Gallons/Day	2,450,000

Fox Twp

Total Pop:	3,392	Bulk Sales	0
Unserved Pop:	573	Peak-Use	combined
Pop Served:	2,455	Peak/Avg. Ratio:	combined
Percent Served :	72.38%	Gallons/Day	429,000

Jay Twp

Total Pop:	2,087	Bulk Sales	0
Unserved Pop:	340	Peak-Use	combined
Pop Served:	121	Peak/Avg. Ratio:	combined
Percent Served :	5.80%	Gallons/Day	21,100

Wilcox Water Company

Jones Twp.

Total Pop:	1,870	Bulk Sales	0
Unserved Pop:	1,290	Peak-Use	57,600
Pop Served:	549	Peak/Avg. Ratio:	1.50
Percent Served	29.36%	Gallons/Day	38,400

Water Use Data System--Public Water Supply Report

Brockway Boro Municipal Authority

Snyder Twp.

Total Pop:	2,535	Bulk Sales	49,216
Unserved Pop	737	Peak-Use	1,327,842
Pop Served:	1,690	Peak/Avg. Ratio:	1.42
Percent Served	66.70%	Gallons/Day	386,000

Horton Twp.

Total Pop:	1,655	Bulk Sales	combined
Unserved Pop	673	Peak-Use	combined
Pop Served:	193	Peak/Avg. Ratio:	combined
Percent Served	11.72%	Gallons/Day	44,100

Eldred Twp. Municipal Authority

Eldred Twp.

Total Pop:	1,197	Bulk Sales	0
Unserved Pop	867	Peak-Use	0
Pop Served:	329	Peak/Avg. Ratio:	2.67
Percent Served	27.49%	Gallons/Day	20,100

Qualitative Benthic Macroinverterate Data

	Station 1 Reference	Station 3 Comparison	Cathers Run Reference	Toms Run Comparison	Kahle Run Comparison	Tolerance Value
Ephemeroptera (Mayflies)	P	P	4	25	0	1
Plecoptera (Stoneflies)	P	P	20	10	10	1
Trichoptera (Caddisflies)	P	P	55	29	21	4
Diptera (Flies, Midges)	P	P	22	52	78	6
Odonata (Dragon/Damsel)	0	0	0	0	0	1
Coleoptera (Aquatic beetles)	P	P	4	5	0	4
Isopoda (Sow Bugs)	0	P	0	0	0	8
Decapoda (Cray Fish)	P	P	0	0	0	6
Megaloptera (Alderflies)	0	0	0	0	0	4
Gastropoda *(Snails, Limpets)*	0	0	0	0	0	6
Pelecypoda *(Clams)*	0	0	0	0	0	5
Hydracarina *(Water Mites)*	0	0	0	0	0	5
Nematoda *(Round Worms)*	0	0	0	1	0	7
Total/Average	38	40	105	122	109	4.46
HBI*			2.8	3.8	4.4	
EPT Index**	55%	60%	14	10	6	

P=Present

Station 1; Located immediately above the papermill discharge at Johnsonburg (1996).

Station 3: Located approximately 1200 ft. below the papemill discharge at Johnsonburg (1996).

The Hilsenhoff Biotic Index (HBI) is a measure of the tolerance of a species. The value for HBI gets larger as the tolerance of a species goes up. Therefore, it is also a measure of toxicity.

EPT Index is the number of taxa , or types of organisms from Ephemeropter(mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). These orders contain many species that are sensitive to water quality changes. Generally, the higher the EPT Index, the better the water quality.

Proposed East Branch Lake Tributaries Receiving Limestone Sand

Stream	Watershed Size (acres)	Average pH	Annual Dosage (tons/year)
Borgardy Run	650	4.3	4.4
Igotta Run	230	4.65	1.2
Instanter Run	657	4.5	3.7
a. West Fork	87	5	0.4
b. Bridge	476	4.9	3
c. Quinn Spring	140	3.5	0.3
Sevenmile Run	5096	6	6.2
West Fork-Smith Rur	356	4.65	1.8
Smith Run	393	4.45	2.4
Cold Spring	405	4.75	1.9
Martins Run	1320	4.75	6
E. Br. Clarion	8516	5.9	12
Twomile Run	318	3.75	3.2
Gum Boot Run	1188	4.5	6.6
Buck Run	729	4.1	5.8
a. Downstream	5260	5.1	18.4
County Line Run	3981	5	15
Doe Run	800	5.2	2.6
a. At Club	480	4.9	2
b. Downstream	N.A.	5.3	7
Luke's Run	860	5	3.3
Whittaker	350	4.25	2.5
Straight Creek	6775	6.3	2.7
a.Upper Trib.	826	4.8	3

Public Recreation Areas Within the Clarion River Watershed

Activities & Facilities	Bendigo State Park	Brush Hollow X-C Ski & Hiking	Buzzard Swamp Wildlife/Hiking Area	Clear Creek State Park	Cook Forest State Park	East Branc Lake	Elk State Park	Irwin Run Canoe Access
Bicycling		X	X	X	X			
Birdwatching		X	X			X	X	X
Boat Launch				X		X	X	X
Boating				X	X		X	
Bridle Trail					X			
Camping				X	X			X
Canoeing				X	X	X	X	X
Cross Country Skiing		X	X	X	X			
Environmental Edu.	X		X	X	X			
Family Cabins				X	X		X	
Family Campground				X	X	X	X	
Fishing	X	X	X	X	X	X	X	X
Hiking		X		X	X		X	X
Horseshoe Court			X	X	X			
Hunting		X	X		X	X	X	X
Iceboating							X	
Icefishing			X					
Iceskating				X	X	X	X	
Picnicing	X			X	X	X	X	
Playground	X			X	X			
Restroom Facilities		X		X	X	X	X	X
Showers				X	X			
Sledding	X			X	X		X	
Snack Bar	X			X	X	X		
Snowmobiling					X			
Swimming	X			X	X			
Wheelchair Accessible				X	X			
Administered By	DCNR	ANF	ANF	DCNR	DCNR	COE	DCNR	ANF

Source: Magic Tourism Bureau, 1995

**Administered By:

DCNR-Department of Conservation and Natural Resources

COE-U.S. Amry Corps of Engineers

ANF-Allegheny National Forest

Source: Pa's State Parks Recreational Guide

Source: Elk County's Visitor's Bureau

Historic Sites

Quad Name	Site No.	Quad	Site Type	Condition of Site
Clarion				
	36CL0040	149	53, Ditch	0
	36CL0041	149	53, Ditch	0
	36CL0073	149	57, Pit	0
	36CL0148	149	57, Pit	0
Emlenton				
	36VE0140	252	53, Ditch	0
	36VE0148	252	53, Ditch	0
Hallton				
	36EL0064	331	57, Pit	0
James City				
	36EL0053	387	57, Pit	0
	36EL0054	387	51, Foundation	0
	36EL0055	387	53, Ditch	0
	36EL0056	387	57, Pit	0
	36EL0057	387	53, Ditch	0
	36EL0058	387	57, Pit	0
	36EL0059	387	57, Pit	0
	36EL0060	387	57, Piy	0
	36EL0061	387	57, Pit	0
	36EL0063	387	51, Foundation	0
Lucinda				
	36CL0052	460	50, Historic and Prehistoric	0
Marienville East				
	36EL0105	476	57, Pit	0
	36FO0021	476	57, Pit	0
	36FO0022	476	57, Pit	0
	36FO0023	476	53, Ditch	0
Parker				
	36AR0256	602	51, Foundation	0
	36BT0182	602	51, Foundation	A, Collector Interview
	36BT0183	602	53, Ditch	B, Collector Interview w/field check
Ridgway				
	36EL0111	664	53, Ditch	X
Rimersburg				
	36CL0116	666	53, Ditch	0
Russell City				
	36FO0057	680	55, Fenceline	0
Sigel				
	36JE0073	717	53, Industrial	0
	36JE0074	717	53, Industrial	0
	36JE0119	717	57, Unknown	0
	36JE0123	717	51, Domestic	C
	36JE0124	717	51, Domestic	D
Wilcox				
	36EL0062	850	57, Pit	0

Prehistoric Sites

Quad Name	Site No.	Quad	Site Type	Condition of Site
Brandy Camp				
	36EL0024	91	0S,	0
	36EL0025	91	03,	0
	36EL0026	91	03,	0
	36EL0027	91	03,	0
	36EL0036	91	03,	0
	36EL0037	91	03,	0
	36EL0046	91	03,	0
	36EL0047	91	03,	0
Carman				
	36EL0003	127	10, Circular Houses	0
	36EL0004	127	04, Burned Areas	D, Systematic surface survery
	36EL0005	127	04, Burned Areas	B, Collector Interview w/field check
	36EL0007	127	11, Other/Unidentified	0
	36EL0012	127	03, Rock Hearth/Fire Pits	0
	36EL0066	127	04, Burned Areas	C, Non-systematic surface survey
	36EL0070	127	04, Burned Areas	C, Non-systematic surface survey
	36EL0071	127	04, Burned Areas	C, Non-systematic surface survey
	36EL0072	127	04, Burned Areas	C, Non-systematic surface survey
	36EL0073	127	04, Burned Areas	C, Non-systematic surface survey
	36EL0074	127	04, Burned Areas	C, Non-systematic surface survey
	36EL0097	127	04, Burned Areas	0
	36EL0098	127	04, Burned Areas	0
	36EL0099	127	04, Burned Areas	0
	36EL0106	127	04, Burned Areas	X
	36EL0107	127	04, Burned Areas	A, Collector Interview
Clarion				
	36CL0037	149	03, Rock Hearth/Fire Pits	0
	36CL0063	149	03, Rock Hearth/Fire Pits	0
	36CL0065	149	03, Rock Hearth/Fire Pits	0
	36CL0071	149	03, Rock Hearth/Fire Pits	0
	36CL0075	149	04, Burned Areas	0
	36CL0076	149	04, Burned Areas	0
	36CL0077	149	04, Burned Areas	0
	36CL0106	149	03, Rock Hearth/Fire Pits	0
	36CL0107	149	03, Rock Hearth/Fire Pits	0
	36CL0137	149	03, Rock Hearth/Fire Pits	0
Cooksburg				
	36CL0023	179	10, Circular Houses	0
	36CL0064	179	03, Rock Hearth/Fire Pits	0
	36CL0089	179	03, Rock Hearth/Fire Pits	0
	36CL0139	179	15, Flexed Burials	0
	36CL0140	179	03, Rock Hearth/Fire Pits	0
	36CL0141	179	03, Rock Hearth/Fire Pits	0
	36CL0142	179	13, Burials	0
	36CL0143	179	11, Other/Unidentified	0
	36CL0151	179	03, Rock Hearth/Fire Pits	0
Corsica				
	36JE0003	184	03, Rock Hearth/Fire Pits	0
	36JE0014	184	03, Rock Hearth/Fire Pits	0
	36JE0048	184	04, Burned Areas	0
	36JE0049	184	04, Burned Areas	0
	36JE0050	184	04, Burned Areas	0
Emlenton				
	36CL0013	252	03, Rock Hearth/Fire Pits	0
	36CL0014	252	03, Rock Hearth/Fire Pits	0
	36CL0019	252	04, Burned Areas	0
	36VE0028	252	02, Storage/Trash Pits	B, Collector Interview w/field check
	36VE0029	252	04, Burned Areas	0

Prehistoric Sites

	36VE0052	252	07, Postmolds	0
	36VE0053	252	04, Burned Areas	0
	36VE0057	252	03, Rock Hearth/Fire Pits	0
	36VE0084	252	04, Burned Areas	0
	36VE0085	252	04, Burned Areas	0
	36VE0086	252	04, Burned Areas	0
	36VE0087	252	03, Rock Hearth/Fire Pits	0
	36VE0088	252	04, Burned Areas	0
	36VE0089	252	04, Burned Areas	0
	36VE0197	252	03, Rock Hearth/Fire Pits	0
	36VE0198	252	03, Rock Hearth/Fire Pits	0
	36VE0211	252	03, Rock Hearth/Fire Pits	0
	36VE0249	252	04, Burned Areas	0
Falls Creek				
	36JE0025	272	07,	0
	36JE0027	272	03,	0
	36JE0028	272	03,	0
	36JE0029	272	03,	0
Fryburg				
	36CL0080	299	03, Rock Hearth/Fire Pits	0
	36CL0138	299	03, Rock Hearth/Fire Pits	0
Glen Hazel				
	36EL0019	311	04, Burned Areas	0
	36EL0020	311	04, Burned Areas	0
Hallton				
	36EL0018	331	04, Burned Areas	0
	36EL0032	331	03, Rock Hearth/Fire Pits	0
	36EL0033	331	03, Rock Hearth/Fire Pits	0
	36EL0044	331	03, Rock Hearth/Fire Pits	0
	36EL0075	331	04, Burned Areas	C, Non-systematic surface survey
	36EI0076	331	04, Burned Areas	C, Non-systematic surface survey
	36EL0077	331	04, Burned Areas	C, Non-systematic surface survey
	36EL0078	331	04, Burned Areas	C, Non-systematic surface survey
	36EL0079	331	04, Burned Areas	0
	36EL0080	331	04, Burned Areas	C, Non-systematic surface survey
	36EL0081	331	04, Burned Areas	0
	36EL0082	331	04, Burned Areas	0
	36EL0100	331	03, Rock Hearth/Fire Pits	0
	36EL0110	331	16, Bundle Burials	X
James City				
	36EL0065	387	07, Postmolds	0
	36EL0083	387	11, Other/Unidentified	0
	36EL0084	387	04, Burned Areas	0
Knox				
	36BT0023	408	03, Rock Hearth/Fire Pits	A, Collector Interview
	36BT0079	408	03, Rock Hearth/Fire Pits	0
	36BT0086	408	16, Unknown Function	A, Collector Interview
	36BT0110	408	03, Rock Hearth/Fire Pits	0
	36BT0111	408	03, Rock Hearth/Fire Pits	B, Collector Interview w/field check
	36BT0224	408	03, Rock Hearth/Fire Pits	A, Collector Interview
	36BT0305	408	03, Rock Hearth/Fire Pits	0
	36BT0306	408	03, Rock Hearth/Fire Pits	0
	36CL0012	408	04, Burned Areas	0
	36CL0031	408	03, Rock Hearth/Fire Pits	0
	36CL0038	408	03, Rock Hearth/Fire Pits	0
	36CL0039	408	Buchanan Furnace	0
	36CL0044	408	04, Burned Areas	A, Collector Interview
	36CL0045	408	03, Rock Hearth/Fire Pits	0
	36CL0047	408	03, Rock Hearth/Fire Pits	0

Prehistoric Sites

	36CL0048	408	03, Rock Hearth/Fire Pits	0
	36CL0051	408	03, Rock Hearth/Fire Pits	0
	36CL0057	408	07, Postmolds	0
	36CL0059	408	03, Rock Hearth/Fire Pits	0
	36CL0060	408	03, Rock Hearth/Fire Pits	0
	36CL0069	408	03, Rock Hearth/Fire Pits	0
	36CL0070	408	Cemetary	0
	36CL0082	408	03, Rock Hearth/Fire Pits	0
	36CL0108	408	03, Rock Hearth/Fire Pits	0
	36CL0109	408	03, Rock Hearth/Fire Pits	0
Kossuth				
	36VE0013	410	04, Burned Areas	0
	36VE0015	410	04, Burned Areas	0
	36VE0248	410	04, Burned Areas	0
	36VE0259	410	03, Rock Hearth/Fire Pits	0
	36VE0260	410	03, Rock Hearth/Fire Pits	0
	36VE0261	410	03, Rock Hearth/Fire Pits	0
Lucinda				
	36CL0052	460	03, Rock Hearth/Fire Pits	0
	36CL0068	460	03, Rock Hearth/Fire Pits	0
Marienville East				
	36EL0085	476	04, Burned Areas	C, Non-systematic surface survey
	36EL0086	476	04, Burned Areas	C, Non-systematic surface survey
	36EL0087	476	04, Burned Areas	0
	36EL0109	476	04, Burned Areas	X
	36FO0051	476	04, Burned Areas	0
	36FO0052	476	04, Burned Areas	0
	36FO0053	476	04, Burned Areas	0
Munderf				
	36EL0015	545	04, Burned Areas	0
	36EL0088	545	04, Burned Areas	0
	36JE0023	545	03, Rock Hearth/Fire Pits	0
	36JE0024	545	03, Rock Hearth/Fire Pits	0
	36JE0103	545	04, Burned Areas	0
	36JE0104	545	04, Burned Areas	C, Non-systematic surface survey
	36JE0120	545	01, Present/Prehistoric	0
	36JE0121	545	04, Burned Areas	0
	36JE0122	545	01, Present/Prehistoric	0
	36JE0125	545	16, Bundle Burials	0
	36JE0126	545	16, Bundle Burials	0
	36JE0128	545	13, Burials	0
	36JE0129	545	16, Bundle Burials	0
	36JE0130	545	04, Burned Areas	0
	36JE0131	545	04, Burned Areas	0
	36JE0132	545	04, Burned Areas	0
	36JE0133	545	16, Bundle Burials	0
	36JE0135	545	04, Burned Areas	0
Parker				
	36AR0016	602	01, Present/Prehistoric	0
	36AR0234	602	01, Present/Prehistoric	0
	36AR0236	602	01, Present/Prehistoric	0
	36AR0392	602	01, Present/Prehistoric	0
	36BT0032	602	04, Burned Areas	A, Collector Interview
	36BT0033	602	04, Burned Areas	B,
	36BT0036	602	10, Circular Houses	A, Collector Interview
	36BT0037	602	04, Burned Areas	A, Collector Interview
	36BT0039	602	04, Burned Areas	A, Collector Interview
	36BT0196	602	03, Rock Hearth/Fire Pits	A, Collector Interview
	36CL0001	602	10, Circular Houses	0

Prehistoric Sites

	36BT0039	602	04, Burned Areas	A, Collector Interview
	36BT0196	602	03, Rock Hearth/Fire Pits	A, Collector Interview
	36CL0001	602	10, Circular Houses	0
	36CL0015	602	07, Postmolds	0
	36CL0018	602	04, Burned Areas	E, Systematic sub-surface testing
	36CL0081	602	03, Rock Hearth/Fire Pits	0
	36CL0084	602	03, Rock Hearth/Fire Pits	0
	36CL0130	602	03, Rock Hearth/Fire Pits	0
	36CL0145	602	02, Storage/Trash Pits	0
Portland Mills				
	36EL0008	633	04, Burned Areas	0
	36EL0009	633	04, Burned Areas	0
	36EL0010	633	04, Burned Areas	0
	36EL0011	633	04, Burned Areas	0
	36EL0028	633	03, Rock Hearth/Fire Pits	E, Systematic sub-surface testing
	36EL0089	633	04, Burned Areas	0
	36EL0095	633	04, Burned Areas	0
	36EL0096	633	04, Burned Areas	0
	36IN0291	633	03, Rock Hearth/Fire Pits	0
Ridgway				
	36EL0006	664	04, Burned Areas	0
	36EL0014	664	04, Burned Areas	0
	36EL0021	664	04, Burned Areas	0
	36EL0022	664	04, Burned Areas	0
	36EL0023	664	04, Burned Areas	0
	36EL0030	664	03, Rock Hearth/Fire Pits	0
	36EL0035	664	04, Burned Areas	0
	36EL0049	664	04, Burned Areas	E, Systematic sub-surface testing
	36EL0090	664	03, Rock Hearth/Fire Pits	0
	36EL0091	664	03, Rock Hearth/Fire Pits	0
	36EL0101	664	03, Rock Hearth/Fire Pits	0
	36EL0108	664	04, Burned Areas	E, Systematic sub-surface testing
Rimersburg				
	35AR0009	666	01, Present/Prehistoric	0
	36AR0237	666	01, Present/Prehistoric	0
	36CL0017	666	03, Rock Hearth/Fire Pits	0
	36CL0027	666	03, Rock Hearth/Fire Pits	0
	36CL0028	666	03, Rock Hearth/Fire Pits	0
	36CL0029	666	03, Rock Hearth/Fire Pits	0
	36CL0030	666	03, Rock Hearth/Fire Pits	0
	36CL0032	666	03, Rock Hearth/Fire Pits	0
	36CL0033	666	03, Rock Hearth/Fire Pits	0
	36CL0034	666	03, Rock Hearth/Fire Pits	0
	36CL0035	666	03, Rock Hearth/Fire Pits	0
	36CL0036	666	03, Rock Hearth/Fire Pits	0
	36CL0042	666	03, Rock Hearth/Fire Pits	0
	36CL0043	666	Prospect Furnace	0
	36CL0050	666	03, Rock Hearth/Fire Pits	0
	36CL0053	666	03, Rock Hearth/Fire Pits	0
	36CL0054	666	07, Postmolds	0
	36CL0055	666	03, Rock Hearth/Fire Pits	0
	36CL0056	666	04, Burned Areas	0
	36CL0058	666	16, Unknown Function	0
	36CL0061	666	03, Rock Hearth/Fire Pits	0
	36CL0062	666	03, Rock Hearth/Fire Pits	0
	36CL0066	666	03, Rock Hearth/Fire Pits	0
	36CL0085	666	03, Rock Hearth/Fire Pits	0
	36CL0110	666	04, Burned Areas	0

Prehistoric Sites

	36CL0115	666	03, Rock Hearth/Fire Pits	0
	36CL0116	666	16, Unknown Function	0
	36CL0121	666	03, Rock Hearth/Fire Pits	0
	36CL0131	666	03, Rock Hearth/Fire Pits	0
	36CL0132	666	03, Rock Hearth/Fire Pits	0
	36CL0133	666	03, Rock Hearth/Fire Pits	0
	36CL0134	666	15, Flexed Burials	D, Systematic surface survery
Russell City				
	36EL0001	680	07, Postmolds	0
	36EL0002	680	07, Postmolds	0
	36EL0017	680	07, Postmolds	0
	36EL0067	680	07, Postmolds	0
	36EL0092	680	04, Burned Areas	0
	36EL0093	680	09, Longhouses	0
	36EL0094	680	03, Rock Hearth/Fire Pits	A, Collector Interview
	36EL0102	680	11, Other/Unidentified	0
	36FO0055	680	04, Burned Areas	0
	36FO0056	680	04, Burned Areas	0
Saint Marys				
	36EL0031	684	03, Rock Hearth/Fire Pits	0
	36EL0052	684	15, Flexed Burials	E, Systematic sub-surface testing
Sigel				
	36JE0068	717	00,	0
	36JE0127	717	16,	0
	36JE0134	717	04,	0
Sligo				
	36CL0049	724	03, Rock Hearth/Fire Pits	0
	36CL0095	724	16, Unknown Function	0
	36CL0100	724	03, Rock Hearth/Fire Pits	0
	36CL0101	724	04, Burned Areas	0
	36CL0102	724	04, Burned Areas	0
	36CL0103	724	10, Petroglych/Pictograph	0
	36CL0117	724	03, Rock Hearth/Fire Pits	0
	36CL0126	724	03, Rock Hearth/Fire Pits	0
	36CL0127	724	03, Rock Hearth/Fire Pits	0
	36CL0135	724	03, Rock Hearth/Fire Pits	0
	36CL0159	724	16, Unknown Function	0
Tylersburg				
	36FO0019	798	04, Burned Areas	0
Wilcox				
	36EL0034	850	03, Rock Hearth/Fire Pits	0
	36EL0103	850	06, Cache Pits	X
	36EL0104	850	06, Cache Pits	X

Unpermitted Disposal Sites

Site #	Municipality	Site Location	Water Proximity	Rural/Res.	Active	Difficulty	Size	Items
F-3	Fox	Coal Hollow Rd.	unknown	unknown	unknown	unknown	200 sq. Ft.	household
		Between Coal						garbage
		Hollow & Toby						
F-4	Fox	Browns Rd.	unknown	unknown	unknown	unknown	unknown	55 gal. drums
HI-4	Highland	FR 125 (T-322	yes	rural	yes	1	30' X 30"	household trash/tires
		Corduroy						
HO-1	Horton	off of Rt. 219	unknown	unknown	unknown	unknown	100 + acres	everything
		old strip mine						
HO-2	Horton	off of RT 219	unknown	unknown	unknown	unknown	300 + acres	everything
		Oyster Run						
		old strip mine						
		Bendigo Rd					roadway	con./demo. wastes
JO-11	Jones	SR 4005	yes	rural	yes	3	1 mile	trash bags/car parts
		State/Clarion Rd						55 gal. drums/tires
								recyclables
J-2	Johnsonburg	Rt. 219	yes	residential	yes	3	unknown	55 gal. drums/trash bags
		top of Brick Hill						recyclables/car parts
R-12	Ridgway Twp.	T-307	yes	rural	no	2	10' X 10'	trash bags/household
		Spring Creek Rd.						
R-16	Ridgway Twp.	FR 135	yes	rural	yes	1	80' X 90'	con/demo waste/cement
		Bingham Rd						recyclables/yard waste
SM-1	St. Mary's	1008 W. CreekRd.	yes	rural	yes	3	unknown	55 gal. drums/tires/t.v.'s
SM-4	St. Mary's	Jackson Rd	yes	rural	yes	3	unknown	55 gal. drums/trash bags
								recyclables/tires/yd. waste
SM-11	St. Mary's	RT 120	yes	rural	yes	3	1/2 acre	trash bags/55 gal. drums
								recyclables/tires/misc.
	Union Twp.	Old State Road	yes	rural	yes	1	unknown	55 gal. drums/ appliances
	Jefferson Co.	near Markle Rd.						demo./cons. wastes
	Union Twp.	Work Dr. near	yes	rural	yes	2	unknown	55 gal. drums/trash/junk
	Jefferson Co.	Updike Run	yes	rural	yes		unknown	trash bags/ appliances/misc.

* Difficulty is determined by the amount of trash and the location of the illegal dump.
A rating of "3" indicates a that a problem may exist in reaching the dump and "clean-up" may be hard.
The rating is determined by the "volunteer" identifying the dump and reporting the site to the Solid Waste Authority.

Water Chemistry Data: Clarion River Survey June 25-26, 1996

Station	1 (CR)	Outfall 2	2 (CR)	3 (CR)	4 (CR)	Water Qualtiy Standard
Field Parameters						
Water Temp (C)	18.8		17.2	18.6	17.8	18
pH	7.9		9.97	8.1	8.2	6.5-8.5
Diss Oxygen (ppm)	9.2		9	9.7	9.1	>5.0
Spec. Cond (umhos/cm)	72		184	186	202	Less than 850
Labroratory Parameters						
Color Pt-Co	<5.0	400	30	30	35	Less than 75
pH	6.7	8.1	7.3	7.2	6.9	6.5-8.5
Spec Cond (umhos/cm)	67	1860	*	*	200	Less than 850
Alk-T CACO3	1036	432	36	34	38	20-200
T.O.C.	2	55	5.2	5	4.8	
BOD 5 Day	0.4	14.3	1.5	1.5	2.5	2.0-5.0
Tot. Diss. Solids	66	1426	136	144	144	Less than 500
Susp. Solids	22	8	22	12	4	
NH3-N	0.49	<.02	0.04	0.14	0.02	0.1
NO2-N	,.004	0.05	0.006	0.006	0.006	10
NO3-N	0.37	0.19	0.36	0.36	0.36	10
Phos-T	<.02	0.49	0.04	0.04	0.05	Max. = .1
T Hard	23.3	51.9	15.3	23.4	69.8	Max. = 150
Chlorides	25	174	14	14	14	Max. = 50
SO4 Tot.	<10	299	27	20	38	100
Phenols (ug/l)	0	25	2.5	2.5	**	Max.= 20
Al, tot (ug/l)	170	736	224	150	256	Max.= 100
Fe, tot. (ug/l)	298	276	325	317	463	Max = 300
Mn. tot. (ug/l)	123	902	185	178	162	Max. = 100
Ti, tot. (ug/l)	<20	39	<20	<20	<20	

Station 1: Clarion River - approximately 350 feet below the Grant Street bridge in Johnsonburg and upstream from Willamette's 002 discharge.

Station 2: Clarion River - approximately 1200 feet downstream from Willamette's 002 discharge and upstream from the Johnsonburg STP outfall.

Station 3: Clarion River - approximately 1000 feet downstream from Powers Run and below the Johnsonburg STP outfall.

Station 4: Clarion River - approximately 1000 feet upstream from the PA route 948 bridge in Ridgway (above Elk Creek).

Water Quality Standards: Source- Title 25 Environmental Resources; Department of Environmental Resources: Chapter 93. Water Quality Standards for Aquatic Life

Results = mg/l, unless otherwise specififed CR = Clarion River
* insufficient sample for analysis
** analysis missed by the lab

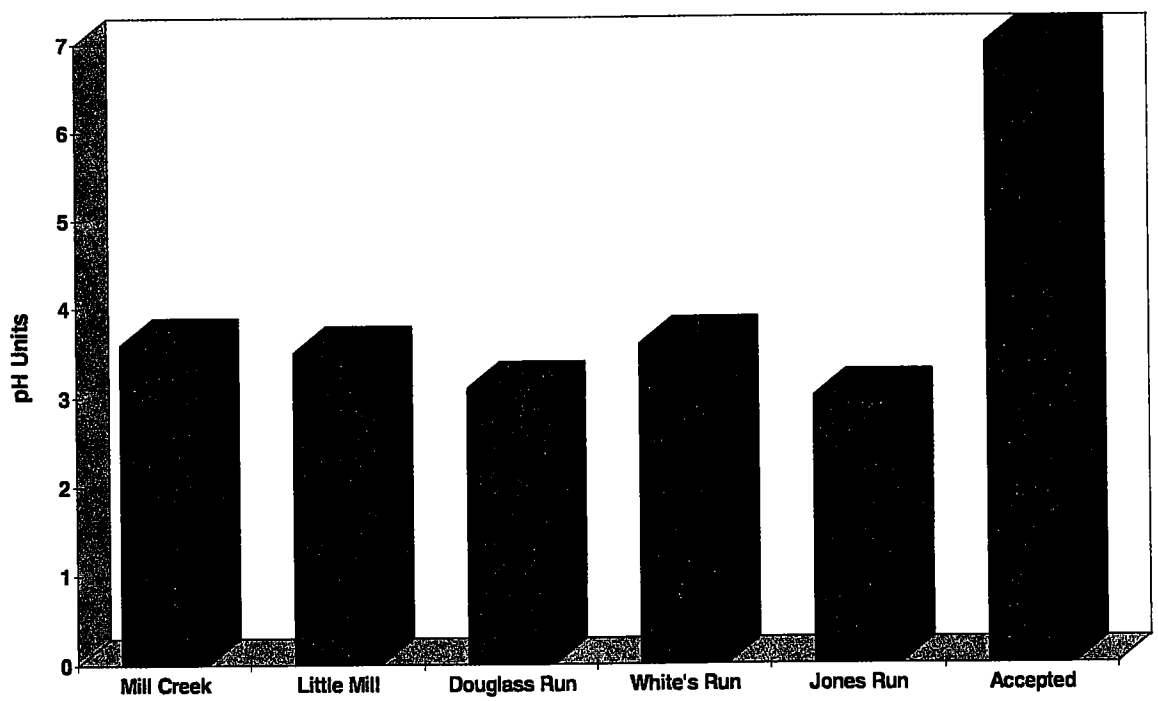
Reclamation Projects

Mill Creek Watershed

The 1981 Corp's study identified the Mill Creek watershed as a major contributor of AMD into the Clarion River basin, Strip mines were considered the major source of AMD in the Mill Creek watershed, with other sources including deep mine, springs, and gas wells, contributing only 10% of the recorded acid loads. Principal AMD-contributing tributaries include Jones Run, Douglass Run, Little Mill Creek, and Whites Run. Stream quality data indicated that the Mill Creeks watershed was desperately in need of reclamation. A non-profit organization , Mill Creek Coalition, developed in the late 1980's has taken an aggressive role in securing funds to remediate the watershed. A combination of well-plugging efforts, and constructed wetland passive treatment projects have been developed and/or proposed for the future remediation goals of the Mill Creek watershed. (Appendix pg.A68-71) The first chart displays the average pH readings in the tributaries within the Mill Creek watershed. Chart 2 identifies the iron readings, Chart 3 is used to display the acidity levels found within the watershed and Chart 4 displays the sulfate levels. All parameters follow the guidelines previously described in this section. The sulfate reading is an indicator that the streams are present in a high area of strip mining activityl Sulfates are cycled through the atmosphere and sedimentary formations. A maximum of 250 mg/l is recommended by the PA Water Quality Standards. Waters which contain sulfates in large concentrations have a cathartic effect on humans and form hard scales in boilers and heat exchanges.

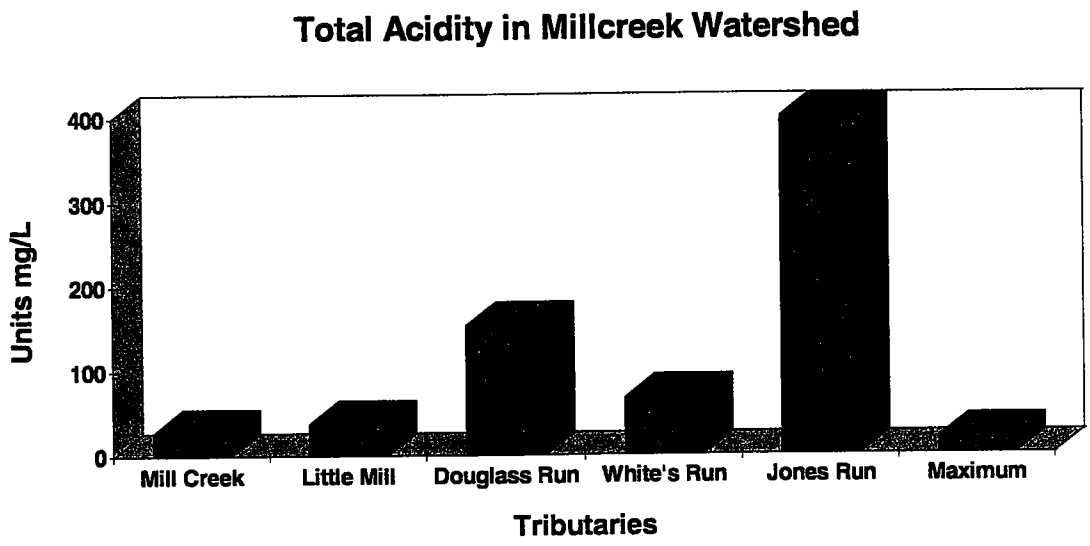
	Mill Creek	Little Mill	Douglass Run	White's Run	Jones Run	Accepted
pH Reading	3.6	3.5	3.1	3.6	3	7

pH Readings in Millcreek Watershed

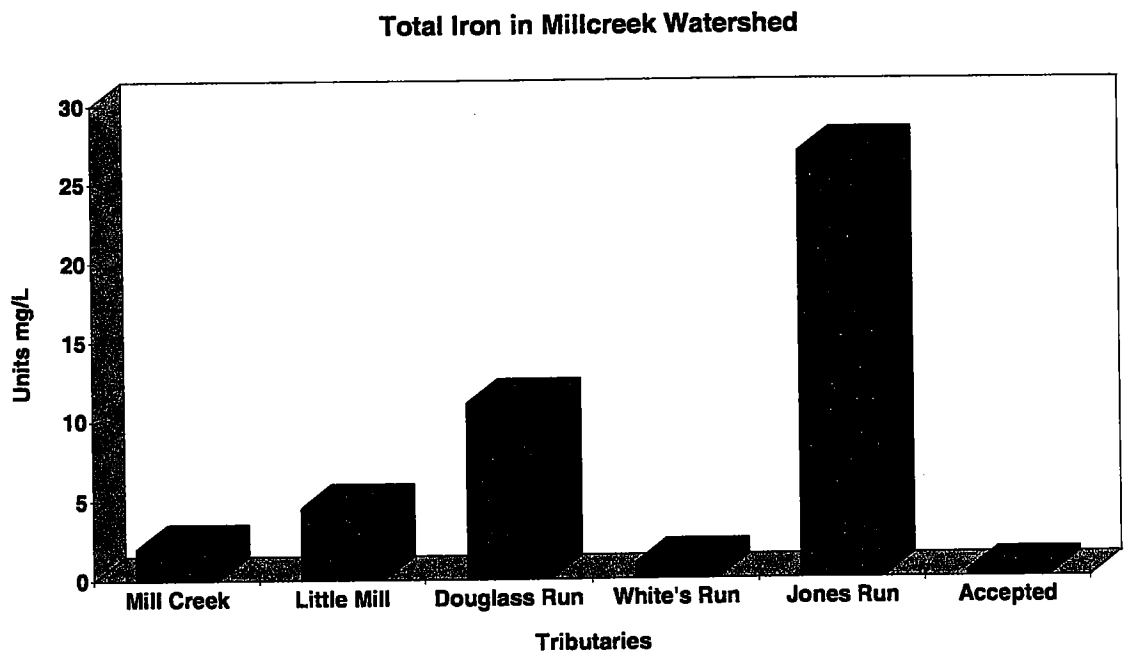


Reclamation Projects

	Mill Creek	Little Mill	Douglass Run	White's Run	Jones Run	Standard
Total Acidity mg/L	28	38	154	68	400	20

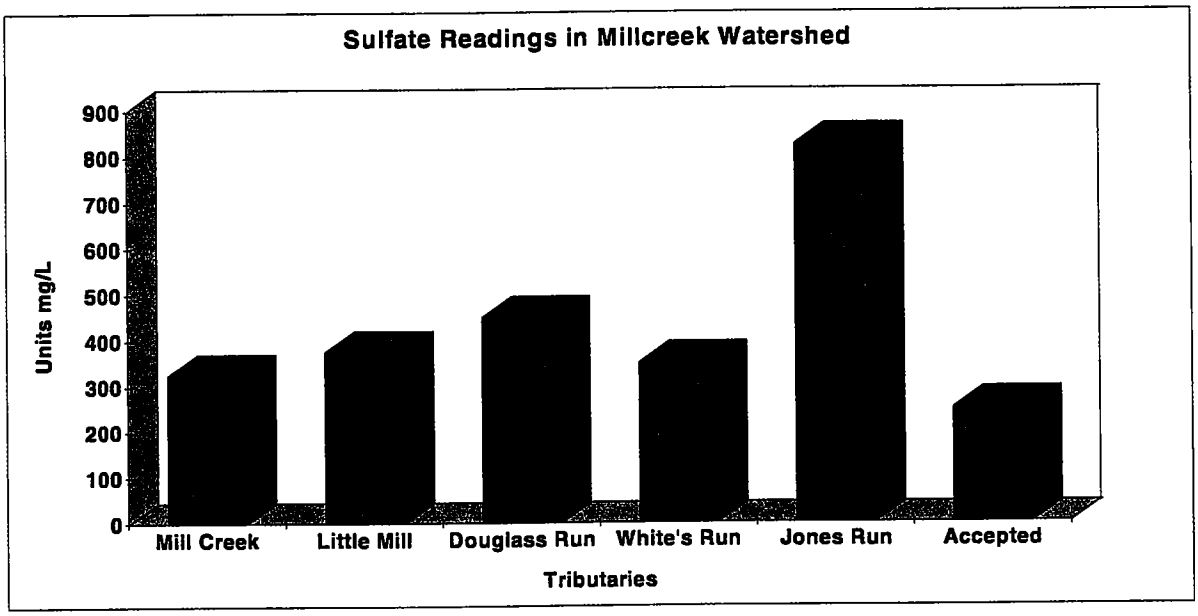


	Mill Creek	Little Mill	Douglass Run	White's Run	Jones Run	Standard
Total Fe mg/L	2	4.5	11.1	1	26.9	0.3



Reclamation Projects

	Mill Creek	Little Mill	Douglass Run	White's Run	Jones Run	Accepted
Sulfate mg/L	325	375	450	350	825	250



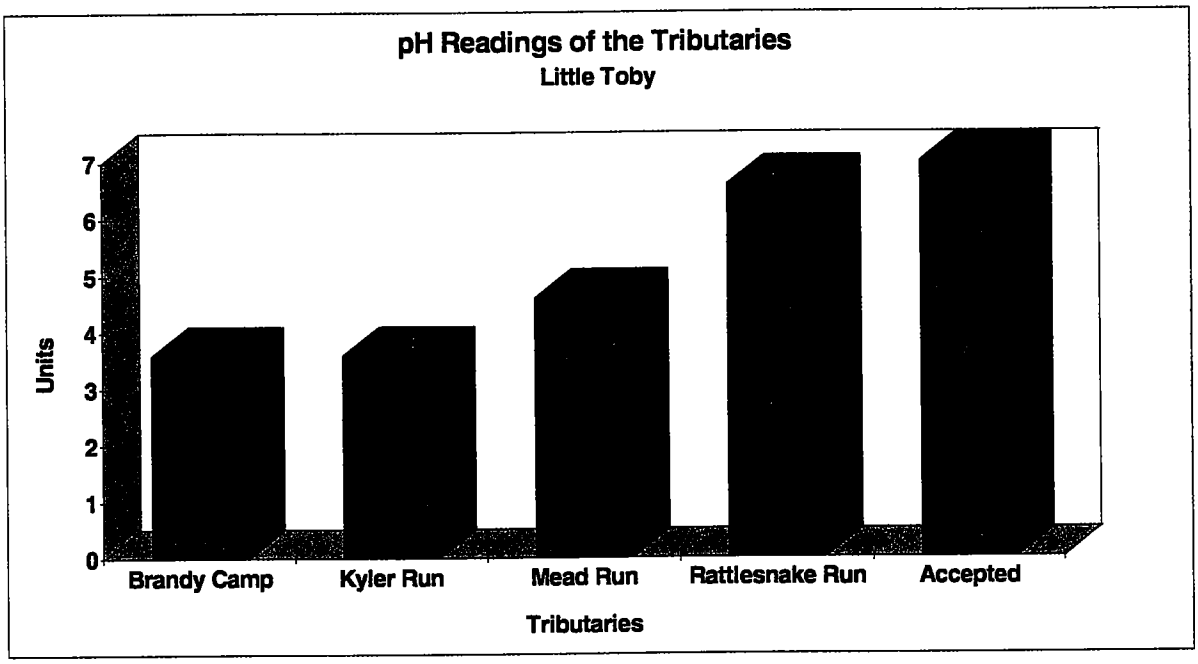
In 1981 the U.S.Army Corp evaluated the Clarion River Basin and determined that the Little Toby Creek Watershed was a major contributor of Acid Mine Drainage (AMD) to the Clarion River Watershed. Although AMD remediation work began over twenty years ago the Little Toby Creek Watershed is still unable to support a reproducing trout fishery. A limestone treatment plant is existence at the headwaters of Little Toby (Reference Appendix pg.A68-71) and this is able to address a percentage of the acid loading. Seven additional sites have been identified for treatment within the watershed. The proposed project will utilize the passive, constructed wetland treatment technology . Below is an overview of sampling points found within the watershed.

Each graph provides the result of a tested parameter. Chart 1 displays the pH readings. Most fish can tolerate pH values of about 5.0 to 9.0. When waters with low pH come in contact with certain chemicals and metals, they often make them more toxic. Chart 2 indicates the total amount of iron in the stream. The World Health Organization recommends that drinking water contain no more than .3 mg/ l of iron and an excessive amount is 1.0 mg/L. High iron concentrations make drinking water look and taste undesirable and may cause pipes to clog.

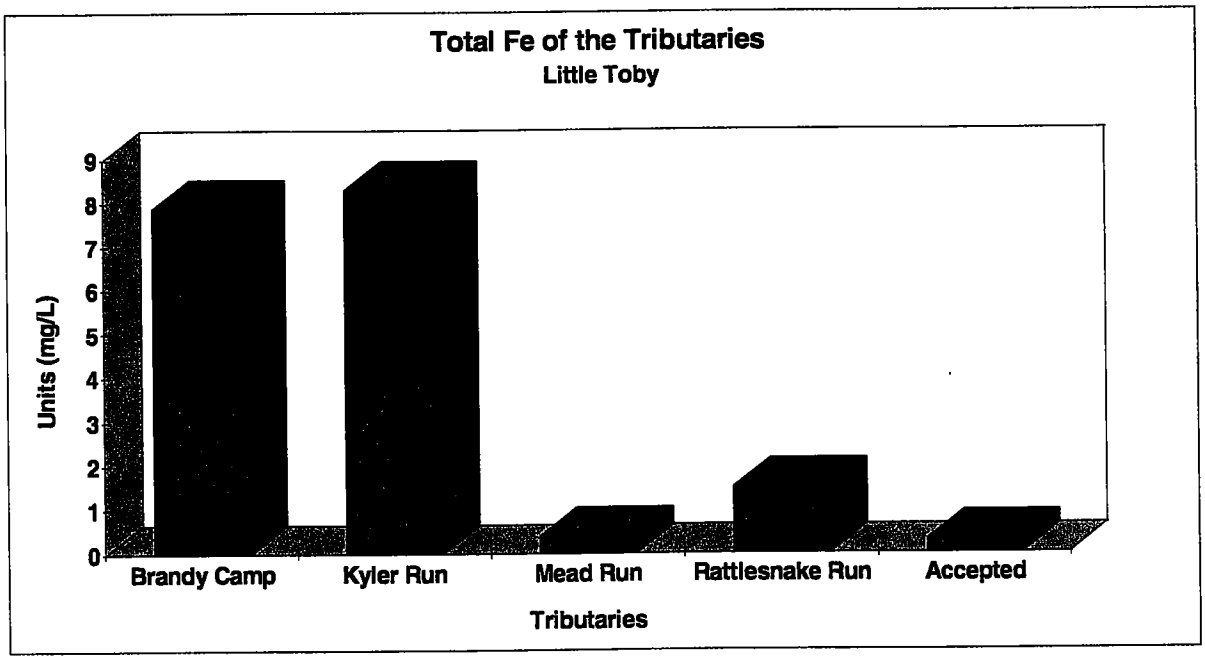
Chart 3 has been used to display the amount of Aluminum found in each sampling point. AL is considered to be a heavy metal and was caused by the mining activities which redistributed the existence of the metal and concentrated it in the environment. Below a pH reading of 5.5, aluminum levels may become a threat to aquatic life. Chart 4 is used to illustrate the amount of acidity found commonly in the Little Toby Creek Watershed. Very acidic water can cause heavy metals such as aluminum to be released into the water. Heavy metals can accumulate on the gills of fish or cause deformities in young fish, reducing their chance of survival.

Reclamation Projects

	Brandy Camp	Kyler Run	Mead Run	Rattlesnake Run	Accepted
pH Reading	3.6	3.6	4.6	6.6	7

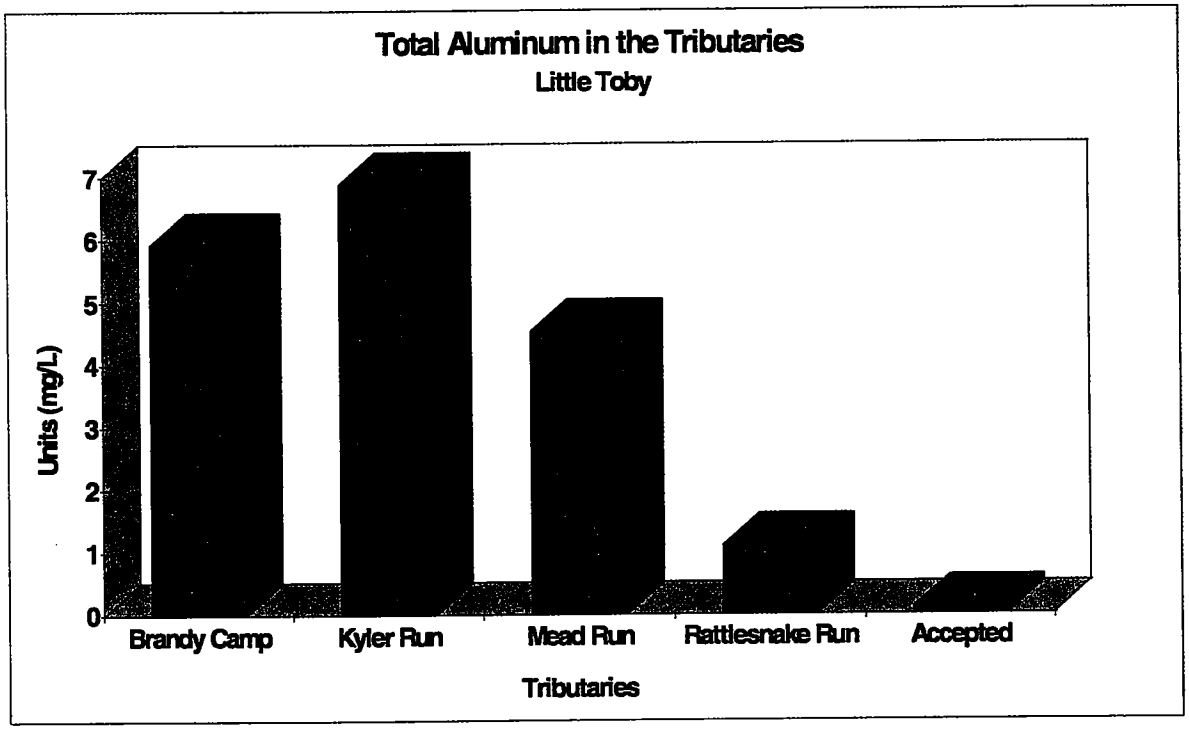


	Brandy Camp	Kyler Run	Mead Run	Rattlesnake Run	Accepted
Total Iron mg/L	7.89	8.31	0.39	1.5	0.3

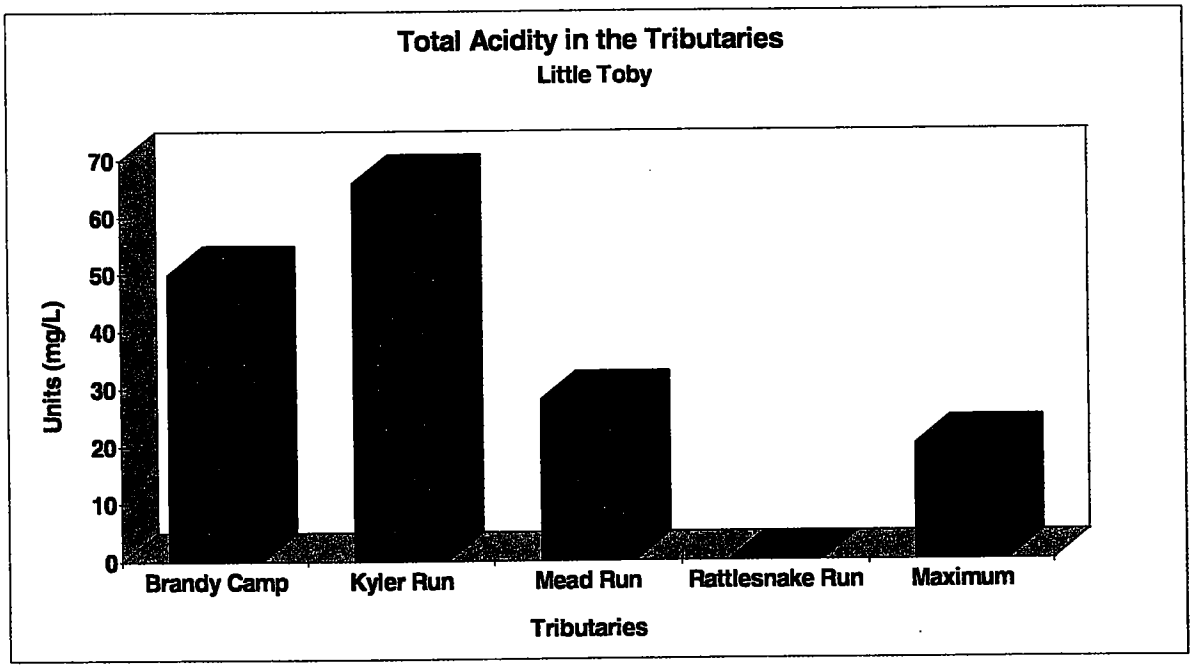


Reclamation Projects

	Brandy Camp	Kyler Run	Mead Run	Rattlesnake Run	Accepted
Total Al mg/L	5.93	6.88	4.53	1.1	0.1



	Brandy Camp	Kyler Run	Mead Run	Rattlesnake Run	Maximum
Total Acidity mg/L	50	66	28	0	20



Passive Treatment System

Manmade wetlands are one way to remove dissolved metals and reduce the acidity of polluted water discharged from abandoned mines. Each passive treatment system must be individually designed to address the kind and concentration of pollutants washing out of a mine and the volume of the flow. There are some basic components if the mine drainage is acidic, which is common in Pennsylvania. The flow is first channeled through a buried trench of limestone to reduce its acidity. The limestone is alkaline and buffers the water, raising its pH. The water exits the trench, is aerated usually be a created waterfall, and flows into one or more wetland areas where the iron oxides and settles out. Aluminum may also precipitate if the water's acidity level isn't too high.

The precipitation process produces acid and a second treatment pond is needed to re-buffer the water and provide additional filtration. Aquatic plants such as cattails help. This wetland may also contain a layer of compost to remove oxygen from the water and layer of limestone, which buffers the acid and improve the pH. A third wetland or settling basin is sometimes needed and/or is optional to increase treatment before the water is discharged into a stream. Seven passive treatment systems are already in place on the Mill Creek and Little Mill Creek watersheds in Clarion and Jefferson counties with approximately 20 or more planned. Little Mill Creek is a tributary of Mill Creek, which flows into the Clarion River.

Alkaline Addition

Research is being conducted into the introduction of limestone to selected streambeds for neutralization of acid flows originating from mine drainage, acid deposition, and poorly buffered soils. Annual dosages of commercially produced limestone sand is added directly into the receiving stream. As the limestone sand is placed into the streams high flows will distribute the material downstream into the streambed where it will be dissolved by acid flows. The purpose of the work is to buffer the stream water and increase its alkalinity before it enters the East Branch Lake or parts of the Clarion River in an effort to improve the water quality and improve and/or restore the brook trout fisheries. Depending on the physical characteristics of each stream, the full annual dosage may have to be administered periodically over several months. Water quality of each stream is monitored periodically downstream of the dump sites to evaluate the effectiveness of each dosage and to indicate a need to adjust the dosage.

In the Fall 1996, alkaline addition began on a group of streams which were tributaries to the East Branch Lake. Water quality, physical description, benthic invertebrate, and fish survey information on each stream and selected tributaries were compiled into a report The targeted tributaries are: Borgardy Run, Instanter Run, Seven Mile Run, the West Fork of Smith's Run, Smith's Run, Gumboot Run, Buck Run, Countyline Run, and Straight Creek. At the time of this written report results of the alkaline addition were still unknown.

Toby Creek, (another research alkaline addition project) which drains into the Clarion Reservoir at Piney Dam, has been the subject of intense mineral resource recovery operations for the past one hundred and fifty years. These operations have ended and this heavily wooded watershed is beginning to heal. D.E.P. has set up well plugging efforts in the watershed, but AMD production from seep lines on hillsides still remain a problem. A project has begun to use limestone sand addition on selected tributaries of Toby Creek. The purpose of the work is to treat the stream water sufficiently to establish fish populations where they have been eliminated .The alkaline addition is being made on : Toby Creek, Engle Run, Little Toby Creek, Step Creek, Rapp Run, Tarkilin Run, Cherry Run, and Barlett Run.

Limestone Treatment Facilities

Acid mine water neutralization as constructed at the Little Toby Creek Watershed was designed for the most economical method of treatment using limestone as the chemical agent. Two limestone systems provide the contact between the stone and the acid water. These are limestone filled static downflow beds and rotating tumbling drums filled with limestone. The downflow beds cause the CaCo3 to dissolve with the flow of acid water through the bed and neutralization is a result. Abrasion of the stone also takes place and mineral fines can accumulate in the bed. Frequent backwashing will clean the stone and remove the solids sludge from the system.

The rotating tumbling drums causes a continuous abrasion of the limestone and acid water is neutralized by the fines produced. Treatment of the entire AMD sources can be achieved by the use of tumbling drums alone, however, metals (Al and Fe) cannot be removed unless extensive settling ponds or other clarification facilities are provided. The combination of the two systems provides a physical advantage to provide complete treatment of the acid water.

The primary treatment facility and wetlands mitigation site is located approximately one mile notheast of the Villiage of Kyler's Corners along Coal Hollow Toad (State Road 2005) in Fox Township.. A second, smaller facility is located 1 1/2 miles northeast of the primary facility along Coal Hollow Road.

*Source: GEO-Technical Services, Inc.
Limestone Treatment Facilities
Little Toby Creek
Elk County, PA

State Regulatory Authorities

Clean Streams Law Clean Water Act

Authority

Clean Streams Law, Clean Water Act, Act of June 22, 1937, P.L. 1987, as amended, 25 PA Code, Chapter 25, National Pollutant Discharge Elimination System; Chapter 93, Water Quality Standards, Chapter 102, Erosion Control.

Functions:

A. Provides regulations to control discharges of sewage or industrial waste into streams and lakes. Exclusively enforced by DEP, Bureau of Water Quality. Use regulated through a permit system.

Two types of NPDES permits

(1). Industrial

(2). Construction activities

B. Basis for State's Chapter 102, Erosion Control Rules and Regulations and the Federal NPDES permits for storm water discharges from construction activities.

1. Controls pollutants from storm water discharges associated with construction activities.

2. All earthmoving activities involving timber harvesting, must have an erosion and sedimentation (E&S) control plan.

C. Subject to valid existing rights as they are defined under 522 of the Surface Mining Control and Reclamation Act of 1977, no mining operations except those which exist on Aug. 3~ 1977~ shall be permitted:

On any lands within the boundaries of units of the National Wilderness Preservation and Wild and Scenic River System, including study rivers designated under Section 5(a) of the Wild and Scenic Rivers Act and National Recreation Areas designated by Act of Congress

Dam Safety and Encroachments Act

Authority

Dam Safety and Encroachments Act, the Act of November 26, 1978, P.L. 1375, No. 325 as amended, 25 PA Code, Chapter 105.

Purposes:

(1) Provide for the comprehensive regulation and supervision of dams, reservoirs, water obstructions and encroachments in the Commonwealth in order to protect the health, safety, welfare, and property of the people.

State Regulatory Authorities

(2) Assure proper planning, design, construction, maintenance, monitoring and supervision of dams, and reservoirs.

(3) Assure proper planning, design, construction, maintenance and monitoring of water obstructions and encroachments, in order to prevent unreasonable interference with water flow and to protect navigation.

(4) Protect the natural resources, environmental rights and values secured by Pa. Const. art.I, 27 and conserve and protect the water quality, natural regime and carrying capacity of watercourses.

Contact for Permit Applications

Northwest Regional Office
190 Adams Road
Jamestown, PA 16134

Endangered and Threatened Species
Fish, Amphibians, Reptiles, and Aquatic Organisms

Authority

Title 30 Chapter 75, Fish and Boat Code, revised February 9, 1991, PA Fish Commission

Provisions

Protect Fish, Amphibians, Reptiles and Aquatic Organism of special concern.

Classification categories contained within state regulations or used by state agencies.

PE Pennsylvania Endangered-All species declared by : 1) the Secretary of the U.S. Department of the Interior to be threatened with extinction and appear on the Endangered Species or the Native Endangered Species List published in the Federal Register; or 2) have been declared by the PA Fish Commission, Executive Director to be threatened with extinction and appear on the PA Endangered Species List published in the PA Bulletin.

PT Pennsylvania Threatened- All species declared by: 1) The Secretary of the U.S. Department of the Interior to be in such small numbers throughout their range that they may become endangered if the environment worsens, and appear on a Threatened Species List published in the Federal Register; or 2) have been declared by the PA Fish Commission Executive Director to be in such small numbers

throughout their range that they may become endangered if ht their environment worsens and appear on the PA Threatened Species List published in the PA Bulletin.

PC Pennsylvania Candidate- Animals that could become endangered or threatened in the future. All of these are uncommon-have restricted, distribution or are at risk because of certain aspects of their biology.

N None-No current legal status exist, but is under review for future listing.

Endangered and Threatened Species: Plant Species

Authority

Conservation of Pennsylvania native Wild Plants, Title 25 Chapter 82, January 1, 988, DEP

Provisions

Protect native wild plant species of special concern

Classification categories contained within state regulations or used by state agencies.

PE Pennsylvania Endangered-A classification of plant species which are in danger of extinction throughout most of their natural range within this Commonwealth, if critical habitat is not maintained or of the species is greatly exploited by man. this classification shall also include any populations of plant species that have been classified as PA Extirpated, but which subsequently are found to exist in the Commonwealth.

PT Pennsylvania Threatened- A classification of plant species which may become endangered throughout most or all of their natural range within this Commonwealth, if critical habitat is not maintained to prevent their future decline, or if the species is greatly exploited by man.

PR Pennsylvania Rare-A classification of plant species which uncommon within this Commonwealth as they may be found in restricted geographic areas or in the existence outside the Commonwealth.

PX Pennsylvania Extirpated-A classification of plant species believed by the Department to be extinct within this Commonwealth. These plants may or may not be in existence outside the Commonwealth.

PV Pennsylvania Vulnerable- A classification of plant species which are in danger of population decline within this Commonwealth because of their beauty economic

value, use as a cultivator, or other factors which indicate that persons may seek to remove these species form their native habitats.

TU Tentatively Undetermined-A classification of plant species which are believed to be in danger of population decline, but which cannot presently be included within another classification due to taxonomic uncertainties, limited evidence within historical records, or insufficiency.

N None-No current legal status exist, but is under review for future listing.

Endangered and Threatened Species: Wild Birds and Mammals

Authority

Title 34 Chapter 133, Game and Wildlife Code, revised December 1, 1990, PA Game Commission.

Provisions

Protect wild birds and mammals species of special concern

Classification categories contained within State regulators or used by State agencies

PE Pennsylvania Endangered-Species in imminent danger of extinction or extirpation throughout their range in PA if the deleterious factors affecting them continue to operate.
These are: 1) species whose numbers have already been reduced to a critically low level or whose habitat has been so drastically reduced or degraded that immediate action is required to prevent their extirpation from the Commonwealth; or 2) species whose extreme rarity or peripherally places them in potential danger of precipitous declines or sudden extirpation throughout their range in PA; or 3) species that have been classified as "Pennsylvania Extirpated", but which are subsequently found to exist in PA as long as the above conditions 1 or 2 are met; or 4) species determined to be "Endangered" pursuant to the Endangered Species Act of 1973, Public Law 93-205 as amended.

PT Pennsylvania Threatened-Species that maybe become endangered within the foreseeable future throughout their range in PA unless the casual factors affecting the organism are abated. These are 1) species whose populations within the Commonwealth are decreasing or have been heavily depleted by adverse factors and while not actually endangered-are still in critical condition; 2) species whose populations may be relatively abundant in the Commonwealth but are under severe threat from serious adverse factors that have been identified and documented; or 3) species whose populations are rare or peripheral and in possible danger of severe

decline throughout their range in PA; or 4) species determined to be "Threatened" pursuant to the Endangered Species Act of 1973, Public Law 93-205 as amended, that are not listed as "Pennsylvania Endangered".

N None-No current legal status exist, but is under review for future listing.

Fish and Boat Code

Regulatory Authority

Commonwealth of Pennsylvania, Fish and Boat Code, Act 1980-175, Title 30, Pa. Consolidated Statues

Commonwealth of Pennsylvania,
fishing and Boating Regulations 1993, Pennsylvania fish and Boat Commission

Purpose

To provide direction and guidance to the Commission in executing its mission of providing fishing and boating opportunities through the protection and management of aquatic resources,

Provisions

As apply to all Commonwealth waterways, "No person shall alter or disturb and stream, steam bed, fish habitat, water or watershed in any manner which might cause damage to or loss of such without permit." The Fish and Boat Code further states that no person, regardless of intent shall alter any substances deleterious (to fish life) to run, flow, wash or be emptied into the waters of the Commonwealth of Pennsylvania.

Floodplain Management Act

Authority

Floodplain Management Act (Act 166) October 4, 1978, P.L., No. 166, regulations, 16 Pa. Code 38 . 1 et seq.

Provisions
Encourage the proper management of floodplain areas

Requires every local municipality recognized as having an area or area subject to flooding, to participate in the National Flood Insurance Program (NFIP)

State Regulatory Authorities

Requires municipalities to enact floodplain management regulations which, at least, comply with the minimum requirements of that program and with the regulations adopted by the Pennsylvania Department of Community Affairs (DCA)

If uses within the floodplain are permitted, a special permit must be obtained prior to construction.

Act only affects development within the one hundred year floodplain.

High Quality and Exceptional Value Waters

Authority

Clean Streams Law-P.L. 1987, 25 Pa. Code Chapters 93 and 95, (93.3, 93.9, 95.1)

Provisions

A. High Quality waters shall be maintained and protected at their existing quality ore enhanced~unless proposed new, additional or increased discharge of pollutants is justified as a result of necessary economic or social development which is of significant public value and the proposed discharge, alone or in combination with other anticipate discharges, will not violate applicable water quality standards.

Exceptional Value waters shall be maintained and protected, at a minimum, at their existing quality.

Provides special water quality protection to waterbodies that persons: 1) water quality better than applicable standards (or are in a natural state); and 2) additional environmental or other features requiring special protection.

B. Any activity that can satisfy the requirements to maintain existing water quality can be permitted in special protection waters. In High Quality, some activities that would degrade water quality could be permitted providing social or economic justification.

Historic Preservation Act

Authority

Act of 37 Pa. C.S. Sec 500 et. seq,

Provisions

A. The conservation of Pennsylvania's historic and natural heritage and the preservation of public records, historic documents and objectives of historic interest, and the identification, restoration and preservation of architecturally and historically

significant sites and structures are duties vested primarily in the PA Historical and Museum Commission.

B. The irreplaceable historical, architectural, archaeological and cultural heritage of the Commonwealth should be preserved and protected for the benefit of all of the people, including future generations.

Oil and Gas Development

Authority

The Oil and Gas Act; the Oil and Gas Conservation Law; the Clean Streams Law; Solid Waste Management Act, the Dam Safety and Encroachment Act; the Coal and Gas Resources Coordination Act; the Administrative Code; and 25 Pa. Code Chapters 78,79,91,92,93,95,97,101,102, and 105.

Purpose

The Oil and Gas Act is the basic law governing oil and gas wells. In addition, the Oil and Gas Conservation Law applies to conservation well. The Clean Streams Law provides the Department of Environmental resources with the basic legal authority to prevent and abate water pollution in PA, and establishes permit requirements for the discharge of industrial wastes. The Solid Waste Management Act and Oil and Gas Act both establish the framework for the on-site disposal of residual waste. The Dam Safety and Encroachments Act contains the permit requirements for encroachments and water obstructions.

Provisions

The Oil and Gas Act sets forth permitting, drilling, casing, operating, plugging, financial responsibility and site restoration requirements. Before drilling or altering and oil or gas well, a well permit must be obtained from the Department. The well site may not be within 100 ft. of a stream, spring or body of water as identified on the 71/2 minute topographic map or within 100 ft. of any wetland greater than one acre in size unless the Department grants a waiver for a lesser distance. The Act also requires consideration of the impact of the well on public resources such as:

1). Publicly owned parks, forest, gamelands and wildlife areas;
2). National or State scenic rivers;
3). National natural landmarks;
4). Habitats or rare and endangered flora and fauna and other communities;
5). Historical and archaeological sites listed on the Federal or State list of historic places.

State Regulatory Authorities

Wells must be plugged in accordance with 25 Pa. Code Chapter 78 upon abandonment of the well. Site restoration must occur within nine months of completion of drilling a well or plugging a well.

Pennsylvania Sewage Facilities Act

Authority

Pennsylvania Sewage Facilities Act of January 1966 P.L. (1965) 1531, as amended, Regulations 25 Pa. Code, 71.1 et seq.

Provisions

Requires individuals to obtain a sewage permit for on-lot sewage disposal systems. Generally administered by either township or county. Sewage permits are normally required prior to obtaining building permit.

Sewage permit is required of all residences with or without water. Criteria reviewed:

- Is proposal in flood plain soils?--if yes, then no permit is issued.
- Must pass percolation test.
- Maximum slope for field is 25%

Chapter 73-Technical aspects of system construction

% Slope	Sewage system Requirements
0 - 8	Regular sewage seeping bed
9 - 15	Trench-type system approved by local sewage officer
16 - 20	Detailed engineering designed Trench-type system
21 - 25	Professional engineer designed system

Solid Waste Management

Authority

The Solid Waste Management Act-Act 97 of 1980 and the residual and municipal waste regulations promulgated there under.

Provisions

To regulate the ongoing generation, transportation, treatment, storage, and disposal of residual, municipal and hazardous waste.

Regulation is carried out through the issuing of permits.

State Regulatory Authorities

Storm Water Management

Authority
Pennsylvania Storm Water Management Act of October 1978 (No. 167, P.L. 864) 32 P.S. 680 et seq.

Purpose
Planning and Management of Storm Water to address increased rates and volumes of runoff due to land development including Forest Management activities.

Provisions

A. Requires each county to develop management plans to deal with stormwater runoff within each watershed with flood potential.

B. Requires any person engaged in the alteration or development of land which may affect storm water runoff.

C. Requirements of county plans are implemented via existing Floodplain and Erosion and Sedimentation Control Regulations as well as DEP Dam Safety and Waterway Management Regulations.

Surface Mining Conservation and Reclamation Act

Authority
Pennsylvania Surface Mining Conservation and Reclamation Act of May 31, 1945

Provisions
To regulate surface mining of coal resources in PA
Permits are required for coal surface mining activities.

Water Rights Act

Authority
Water Rights Act of June 24, 1939, 32 P.S. Sections 631-641.

Provisions
The Act provides for the permitting of surface waster withdrawals by public supply agencies vested with the power, authority, right or franchise to sell water to the public. A water allocation permits is issued by the Department.

Any public water supply agency must obtain a water allocation permit from the appropriate regional office prior to commencing a surface water withdrawal.

Federal Regulatory Authorities

Section 404 of the Clean Water Act

Authority
Section 404 of the Clean Water Act, enacted by Congress in 1972

Provisions
This gives the Corps of Engineers jurisdiction over " all waters of the United States", this includes the Clarion River, its tributaries, adjacent and isolated wetland area.

Regulated activities include all activities which involve a discharge of dredge or fill material into "all waters of the United States:. An individual Department of the Army Permit must be obtained prior to the discharge of fill.

Projects which involve wetland areas need to have the wetland boundaries accurately delineated, and every effort should be made to avoid impacts to wetland areas, minimize project impacts, and lastly mitigate for the impacts.

In PA a Joint Permit application can be filed with the PA DEP to apply for an individual Department of Army Permit. This application also applies for Section 401 Water Quality Certification, which must be obtained from the state, and is a Federal requirement.

Federal Endangered Species Act

Authority
Act of December 28, 1973, P.L.. 93-205, 87 Stat. 884 as amended, 16 U.S.C. 50 CFR Part 17

Provisions
Gives federal protection to the Northern riffleshell mussel and Clubshell mussel.

Federal Wilderness Act

Authority
Act of September 3, 1964, P.L. 88-577,

Provisions
Protects certain public lands which have been designated as a component of the "National Wilderness Preservation System."

Charges administering agency with preserving the wilderness character of the area.

Prohibits the use of motor vehicles, motorized equipment and prohibits the installation of structures within any wilderness area.

Glossary

acidity- the capacity of water for neutralizing a basic solution

alkalinity- buffering capacity of the water, the ability of the water to resist pH change

AMD- Acid Mine Drainage, polluted water discharged from abandoned mines

ANF- Allegheny National Forest

bethnic- bottom dwelling and refers to organisms that live in crawl upon, or attach themselves to the bottom of a stream or river.

carrying capacity- The maximum number of animals that a habitat can sustain while maintaining the ecosystem in a healthy, vigorous condition.

cfs-cubic feet per second

Clarion River Basin- All the land drained by the Clarion River and the streams that flow into the river.

Clarion River Watershed- The region drained by the Clarion River.

COE- Corp of Engineers

CRBC- Clarion River Basin Commission

DCNR -Department of Conservation and Natural Resources

DEP- Department of Environmental Protection , a Pennsylvania State Agency

DER- Department of Environmental Resources, previous name to DEP

ecosystem- The system formed by the interaction of groups of organisms and their environment.

endangered species- Species listed a nationally in danger of extinction throughout all or a significant portion of their ranges by current Federal Register Final Rule-making.

EPA- Environmental Protection Agency

erosion- The wearing away of the land's surface by running water, wind, ice, and other geological agents. It includes detachment and movement of soil or rock fragments by water, wind, ice or gravity.

fecal coliform- bacteria found in the feces of human and other warm-blooded animals Fecal Coliform by themselves are not pathogenic.

FERC-Federal Energy Regulatory Commission

floodplain- Low land and relatively flat areas bordering a river or stream subject to flooding. The minimum area included is that subject to a one percent (100 - year recurrence) or greater chance of flooding in any given year.

geology- the study of the structure of the earth

hydrology- the study of the properties, distribution, and effects of water on the earth's surface, in the soil and underlying rocks

impoundment- to accumulate water in a reservoir

invertebrate- an animal without a backbone. Common aquatic examples include worms, insects, snails, and crayfish

leachate -Liquid substance created as a result of ground water seeping from a porous, perforated vessel that holds material. Leachate is usually associated with the water seeping from a landfill or abandoned mine.

macroinvertebrates- Invertebrates seen with the unaided eye.

mg/L-milligrams per liter

non-point source pollution- Pollution caused as a result from the runoff of water over an area and which picks up pollutants and carries them into local streams and rivers.

parameter- a fixed limit or boundary: In this particular document parameter is used as a general description of the specific water quality criteria.

pathogenic organisms- bacteria, viruses, and parasites that cause disease and illnesses.

perennial stream- streams that flow throughout the year.

PFBC-Pennsylvania Fish and Boat Commission

pH- A measure of the acidity or alkalinity of a solution, numerically equal to 7 for neutral solutions, increasing with increasing alkalinity and decreasing will increasing acidity.

PNDI- Pennsylvania Natural Diversity Index, Classification of natural ecological communities in Pennsylvania.

point-source pollution- waste that comes from a specific outflow pipe

revegetation- the re-establishment of a plant cover.

riparian area- pertaining to the bank of a natural course of water

sewage- liquid and solid waste carried off with ground water in sewers and drains.

standard value- The accepted value of water quality criteria based upon water uses which are to be protected and will be considered by the Pennsylvania Department is in its regulation of discharges.

STORET- maintained by the U.S. Environmental Protection Agency, STORET contains data relating to the quality of surface and ground water in the waterways. STORET stands for STOrage and RETrieval was developed as a uniform data collection and reporting system.

threatened species- species listed as threatened nationally by current Federal Register

taxa- A group of organisms characterized by common characteristics in varying degrees of distinction.

Wild and Scenic Rivers- A free-flowing river, or river segment, having outstanding scenic, recreational, geologic, fish and wildlife, historic, archeologic, or other similar values which has been designated by Congress or the Secretary of Interior as a part of the National Wild and Scenic River System to be protected and managed under provisions of the Wild and Scenic River Act of 1968- (Public Law 90-542, as amended).

wetlands- An area that is saturated some part of most years causing unique chemical changes in the soil and established certain water-tolerant plant communities.

Public Meeting, August 7, 1996 at the Clarion County Courthouse

The Clarion River Basin presented the first of two public meetings on Wednesday, Aug. 07, 1996 at 7:00pm. Over 300 public notices were mailed to individuals, corporations, and political figures living in the Clarion River Basin. Twenty people and two newspaper reporters attended the two hour meeting. Each attendee received a copy of the agenda, a Clarion River Basin factsheet, and a description of the watershed.

The agenda for the meeting was as followed:

1. Introduction by Keith Martin, Clarion Co. Commissioner
2. History of the Clarion River Basin Commission by Bernie Spozio
   - Establishment Date
   - Creators
   - Members-Types of membership
3. Purpose by Bernie Spozio
   - Mission--Provide leadership and action to restore the quality of the River
     - --Preserve and protect the Basin from further degradation
     - --Implement the solutions to correct existing pollution problems
     - --Provide educational support
     - --Cooperate and assist with all similar watershed restoration efforts
4. Geographical information by Pam Zahoran
   - Maps--Display the Watershed Area
   - Distribute "Factsheet"
5. Financing
   - Explanation of the PA Rivers Conservation Program
   - Future funding
6. Slide Show Presentation
7. Public Comment conducted by Andy Redmond and David Strong
   - Encourage public participation
   - Identify River Related Problems/Not Solutions
     - --Tourism/Recreation
     - --Water Quality
     - --Water Supply
     - --Socio-Economic
     - --Transportation
     - --Historic Landmarks
     - --General comments and/ or complaints

The comment period lasted approximately 90 minutes with a high percentage of participation from the audience. The group concentrated on existing problems found within the Clarion River Basin. A few comments were made in conjunction with the proposal to designate portions of the Clarion River under the National

Public Meeting, August 7, 1996 at the Clarion County Courthouse

Wild and Scenic Rivers Act. Those comments were addressed at the end of the meeting by Mr. Lionel Lemry representative of the Allegheny National Forest Service.

The following considerations were raised by the meeting's participants:

Educational Opportunities--Perhaps the Clarion River Basin Commission (CRBC) could utilize the schools as an avenue to educate the public. Would the Clarion River Basin Commission be able to present programs to the schools and involve the students with water monitoring and stream clean-up?

Acid Mine Drainage--Is information available stating the number of streams from Piney Dam towards the East Branch Dam have bee affected by Acid Mine Drainage. The participant knew that it was an extremely high percentage but wanted to know what improvements have been made in these streams in recent years and what future plans are being proposed.

Another audience member wanted to know if technology has improved and are there different approaches that can be taken to remediate the acid mine drainage problem prevalent in our area. A discussion followed explaining a variety of technology that is available and economically suitable; however, the success of the program depends on volunteers and something needs to done to ensure a volunteer list for the duration of the project.

Economic Opportunity--Do the citizens realize that the quality of the Clarion River will determine the economic benefits? The designation of the Wild and Scenic River will create an economic opportunity for the communities.

Non-Point Source Pollution--Millcreek township is using oil and gas brine to contain the dust on the township roads. A series of regulations are not being followed. A participant requested that the township supervisors become more educated on environmental issues to prevent situations like this from occurring.

Research--The audience wanted to know what recourses were being used and if enough studies were being evaluated to create a thorough document. It was suggested that the Commission use a few graduate students from Clarion University to review existing studies and research studies completed but not published within each department. The group of participants unanimously agreed that if there is efficient data to complete a watershed report that more monies should not be used to initiate another study.

Studies that may not be found and may need to be completed involve issues such as PCB's, the effect of the East Liverpool Toxic Waste Incinerator on

our area, and a sedimentation problem found in the river created by the dirt roads. The CRBC will continue its research to find existing studies, and the participants offered to provide data available to them.

Public Participation--One member of the audience praised the regional approach taken by the CRBC. This participant reinforced a previous comment made that private citizens can and will do more work on environmental issues if the citizens work together. A further comment was made that the CRBC must prioritize existing problems and create solutions regardless of county lines. The citizens must accept the idea of helping the neighboring communities even if this means placing their own problems on hold until enough funds or solutions can be found.

The audience commented that more public participation is needed. A few suggestions were made concerning the public's involvement and agreed that the slide show and individual contact with organizations are necessary. A suggestion was made to convert the slide show to a video tape and several copies should be made available to local communities.

Tourism--A number of participants questioned if the river is being used by too many people and if the river is capable of handling more people. Infrastructure was discussed and a lack of adequate sewage facilities, especially near the boat launch sites, was mentioned.

Boaters appeared to be satisfied with the number of people on the river; however, the launch ramps and exit ramps for the boats need some immediate attention. The ramps should be dredged and debris needs to be removed. The Millcreek launch area especially needs attention as more and more boaters use the river.

A comment was made that unlimited tourism without proper guidelines will cause further degradation to the river. Rules and or regulations concerning tourists' use of the river need to be established.

Tourism will create a need for stream and river clean-up. Trash is found in all areas and this will increase as the number of people increase. There are no public dumping facilities and people are throwing their trash on the banks. A suggestion was made to create a river float once a year to clean-up the trash.

A citizen unable to attend the meeting had informed a CRBC member that he had observed hillsides used for unpermitted landfills.

A boater's guide is needed to point out the natural scenic values of the river. Perhaps there are unique geological formations found along the river or identification of old growth of trees or virgin timber that can be identified to the boaters or canoeist to encourage the appreciation of the river.

Public Meeting, August 7, 1996 at the Clarion County Courthouse

Sewage Treatment Facilities-- A comment was made that the facilities found within the Basin are old and unable to properly treat excess sewage. Stormwater and heavy rains may cause a by-pass of the sewage.

Feeder streams found in pastures are not being evaluated and may be creating problems for the watershed.

Communities within the watershed ,such as Wilcox, doe not have sewage treatment and this problem needs to be addressed.

Point-Source Pollution-- Open Strip Mine Pits exist since 1968 near Shippenville towards Beaver Creek. The pits can be seen from I-80. A participant commented that nobody is addressing this problem. The strip-mining companies have left the area, and the community is left with the problem.

Ferns--Samples from the Millcreek stream in Elk County were taken and evaluated. The water samples from the heavily infested fern area had a pH reading of 4.5-4.7. The non-infested areas had a pH reading of 6.6. A participant wanted to know if the ferns rather than acid rain contributed to the difference in the pH reading and if there are any other streams where the ferns may be causing this problem? The participant has taken numerous water samples within the stream and will supply the information to the CRBC.

Aesthetic Value of the River -- Historical evaluation needs to be addressed below Piney Dam. Acknowledgments of the historical significance of Blyson Run and the State Road Ripple needs to be made. Archaeological sites need to be identified. Perhaps further recognition, not studies, are needed.

The highlights of the river can be printed in a boater's guide or established some way on the river.

A private landowner approach a CRBC member after the meeting and stated that this idea may not be good for the private landowner. The acknowledgment of historical sites and/ or archaeological sites may encourage boaters to approach the property with the hopes of finding a souvenir.

The Clarion River Basin Commission concluded the meeting by reinforcing the idea that comments and information will be accepted throughout the Clarion River Watershed Study. The CRBC wants to encourage public participation and if anyone knows of an organization that would like a presentation, they should contact our office. The CRBC's address and phone number are located on the factsheet and the agenda. The CRBC will present a draft copy of the study to interested parties and request comments before a final draft is sent to the state for approval.

Attendance: 43 people
Meeting Adjouned at 9:15

Public Meeting August 14, 1996
Elk County's Courthouse

The Clarion River Basin presented the second public meetings on Wednesday, Aug. 14, 1996 at 7:05 pm. Over 300 public notices were mailed to individuals, corporations, and political figures living in the Clarion River Basin. Thirty-five people attended the two hour meeting. Each attendee received a copy of the agenda, a Clarion River Basin factsheet, and a description of the watershed.

The agenda for the meeting was as followed:

1. Introduction by Andy Redmond, President of the Clarion River basin Commission
2. History of the Clarion River Basin Commission by Bernie Spozio
   - Establishment Date
   - Creators
   - Members-Types of membership
3. Purpose by Bernie Spozio
   - Mission--Provide leadership and action to restore the quality of the River
     - --Preserve and protect the Basin from further degradation
     - --Implement the solutions to correct existing pollution problems
     - --Provide educational support
     - --Cooperate and assist with all similar watershed restoration efforts
4. Geographical information by Pam Zahoran
   - Maps--Display the Watershed Area
   - Distribute "Factsheet"
5. Financing
   - Explanation of the PA Rivers Conservation Program
   - Future funding
6. Slide Show Presentation
7. Public Comment conducted by Andy Redmond and David Strong
   - Encourage public participation
   - Identify River Related Problems/Not Solutions
     - --Tourism/Recreation
     - --Water Quality
     - --Water Supply
     - --Socio-Economic
     - --Transportation
     - --Historic Landmarks
     - --General comments and/ or complaints

The comment period lasted approximately 90 minutes with a high percentage of participation from the audience. This group also concentrated on existing problems found within the Clarion River Basin, and were very specific about certain pollution problems found within the immediate area. A few comments were made in conjunction with the proposal to designate portions of the Clarion River under the National Wild and Scenic Rivers Act. Those comments were

addressed at the end of the meeting by Mr. Lionel Lemry representative of the Allegheny National Forest Service.

The following considerations were raised by the meeting's participants:

Acid Mine Drainage--Along Elk Creek near Washington St., the AMD problem has seemed to increase during the past year. If the water table remains high, the appearance of the water is fine. Once the water table begins to drop, the appearance of the water is almost orange. A homeowner commented that the problem is much worse than in past years, and questioned if the timbering activity along the hillside around Elk Creek and Dry Run could be the cause. He also asked if the Clarion River Basin Commission (CRBC) could investigate the problem.

A coal company recently received a permit to strip mine nearly 100 acres along the Little Mill Creek. The residents fear that this may create an AMD problem and requested water quality monitoring of the site. The residents realize that the mining will occur and cannot be stopped unless the water quality of the stream begins to indicate an acid mine drainage problem.

Research--A further explanation of the research methods used by the CRBC was requested. An audience member wanted to know if past studies provided water data on certain "trouble spots" because he river changes weekly. He wished to know if the past studies have frequent data and if there are any regular monitoring points established on the river to identify problems as soon as possible.

Inquiries were made about available funding to organize and support volunteers to conduct weekly or daily monitoring.

Fish Population--In 1985-86 the river presented an offensive appearance. There existed a nasty odor, rocks covered with sediment and a discoloration of the river. The river steadily improved since that time until May, 1995. During the improvements there were confirmed sightings of ospreys, river otters, and king fishers. People were catching 15" brown trout and "hundreds" of brook trout. Since May, 1995 the river has again deteriorated. There seems to be fewer fish. During May 1996 an audience member had noticed a pipe discharging a"tea color" or "chocolate milk color" substance directly into the river. This person questioned if the pipe could be a direct cause to the decrease in the fish population. This pipe is one of a series of 12-14 pipes embedded along the complete width of the river's channel. Willamette's representative acknowledged the pipes and reported that these effluent pipe have been in existence since May 1992. The pipes continuously discharge unless the mill shuts down, and a complete shut down has never occurred since the installation of these pipes. ***The CRBC and Willamette's representatives explained that*** biological conditions are improving in the upper Clarion River since Penntech Papers installed a new activated sludge treatment plan. The CRBC committee recalled a study completed earlier this year indicating that the water quality of the Clarion

River is improving. Minnows, small brown trout, and bass were confirmed. This is evidenced by the increased invertebrate diversity and presence of several pollution sensitive taxa. Members of the audience agreed that more people are fishing and one audience member indicated that the river is better than it has been for the past 50 years.

Thermal Pollution--Many people in the audience commented on the drastic change in the Clarion River's water temperature above Johnsonburg compared to the temperature of the water below the paper mill's effluent pipes. During the summer months the water temperature above Johnsonburg averages near 64° F. Below the pipes the water temperature averages near 93° F. Understanding that the quality of Willamette Industries discharge is less harmful than a years past, the audience asked if something could be done about the temperature of the discharge and if the "hot water" is more detrimental to the fish than the unheated effluent material.
Willamette's representative and CRBC steering committee was able to explain many of the questions concerning Thermal Pollution--The water temperature of the effluent is high, but the stream temperature only increased by one degree Celsius. According to the DEP regulations Willamette must create a temperature of 93-95oF in order to properly remove the bacteria. At one time Dill Hill was used to absorb the heat, but did not create such an efficient discharge and is no longer in use. Once the discharge is mixed with the stream the water temperatures quickly adjust and matches the temperature of the water found above the effluent. Willamette, DEP, and individuals have continuously monitored the stream below the effluent recording a constant pH reading of 7.0-7.5, indicating good water. Discussion about the East Branch Dam followed, and the question was asked if the dam is releasing unnaturally cold water, or if the dam is releasing enough water to needed to maintain the biodiversity of the Clarion River.

River Appearance--Some audience members have noticed a bacteria growth floating down the Clarion River from Willamette's discharge pipes. The bacteria was in "links and resembled a strand of toilet paper."

A picture shown to the audience members indicated that Toby Creek, once known for its profuse amount of AMD, now appears to be cleaner than the river.

Unrecorded sightings of a black color seen in the river water was discussed by the audience. The audience wanted this black color identified and questioned if it threatened the health and safety of the fish and other aquatic life.

Fish Consumption--Are there any recent studies completed along the river on the health of the fish? Are the fish good for human consumption? Some audience members reported that bass and trout have been caught and appear to have "red sucker" marks, open sores, and black sores. One person sighted an extremely large area of dead crayfish. The audience questioned the causes of the disfigured fish and dead crayfish and if the fish should be eaten by humans.

Public Meeting August 14, 1996
Elk County's Courthouse

The CRBC explained that many of the markings described by the members of the audience could be caused by a variety of reasons. Sewage in the water is a main contributor to red sores found on the fish. Some markings are caused by fish attacking one another, or rubbing against the river's bottom.

Fish Management--Who is in charge of enforcing the regulations? Many people have been seen carrying a large number of caught fish. Are they within the legal limits and size? The audience members could not recall sighting a fish enforcement officer.

Due to the "thermal pollution" many members of the audience felt that the fish traveled upstream to escape the warm water. Now the upper portion of the river appears to be "over fished" and this is creating damage to the aquatic life of the river.

Does the fish commission track the success rate of stream stocking, and are they aware of the fact that perhaps the conditions are not suitable for the type of trout that is being stocked?

Sewage--The West Branch of the Clarion River has an obnoxious odor created by the sewage flowing into the river. As of now the community of Wilcox does not have a municipal sewage treatment plant. The community hopes to hook into Johnsonburg in the near future, and this should help with the sewage problem..

Municipalities are permitted to by- pass their systems during heavy rainfall, and the by-pass is noticeable in many areas. What can be done? Financial assistance to small towns to correct the sewage problems has been greatly reduced despite the need for such assistance.

Tourism is welcomed into the area, but there are not adequate restroom facilities to handle the extra population. The audience members suggested that more "infrastructure" is needed as soon as possible. The river is becoming busier, and the canoeists need restroom and lodging facilities.

East Branch Dam--One member of the CRBC technical committee commented on the laws governing the dam. As an example he stated that Piney Dam is in a "catch 22" scenario because the dam must maintain a certain flow, and also maintain enough water in the reservoir for the boaters. Sometimes summer weather conditions prevent this from occurring.

The CRBC committee reinforced the idea to tour Willamette's treatment center and review the written reports. The CRBC encourages participation and hopes that members of the audience would become more involved. The CRBC is hoping that the next steering committee meeting could be held in Ridgway to further encourage involvement.

Attendance: 38 people
Meeting Adjourned: 9:20

Seneca Rocks Audubon Meeting
September 9, 1996

The following considerations were raised by the meeting's participants:

River Appearance- A member of the audience questioned the color of the river during low flow each summer. An amber or tea color was observed between Gravellick and Blyson Run. This person also questioned the appearance of green algae similar to "horsetails." A discussion by the audience followed and suggestions were made that this may be an organic problem. Further testing would be needed before the problem could be identified.

Trash does not seem to be a major problem along the river in Clarion County. There are a few known spots where recreationalists continue to dump their trash. A spring clean-up of the river and the tributaries would be enough to maintain the area. A suggestion was made that the canoe liveries present educational brochures on the importance of "carry-in/carry-out" disposal of the litter. This procedure is common out West, and it appears to be working well.

Timbering - There seemed to be a confusion on the rules and regulations concerning this industry. The audience questioned the erosion and sedimentation plan that needs to submitted to the Conservation District. A particular area near Cather's Run is in the process of being timbered and causing damage to the stream. The stream has lost its clarity due to the sediment caused by the timbering. Fishing in the area has become non-existent. This is a major concern since Cather's Run is considered a high quality stream. The CRBC presenter offered to assist with this matter and the proper regulators will be contacted.

Sewage- A planning department member of Millcreek Twp., Clarion was present and expressed concern about the lack of sewage facilities along the river's corridor. He noted that Millcreek Twp. has a large amount of seasonal cabins and the owners are not required to install sewage treatment or disposal. The planning department is researching the use and location of a public restroom . He noted that the township is in the process of passing a zoning ordinance which will specify land use along the corridor. Millcreek Twp. will appreciate and accept assistance from the Clarion River Basin Commission.

An audience member noted that the "old 322" bridge is quite frequently used as an area by recreationalist as a "restroom". There are no facilities and this member was concerned about the spring located nearby which is used frequently by the area residents as drinking water.

Socio-Economics- Is the public receiving enough balanced education on landowner's rights? Is there a misunderstanding as to what the private owner needs to fear when the river becomes more regulated or considered "Wild and Scenic"? The audience was concerned that many private owners will not appreciate conservation of the river due to the fact that they may lose control of their own property. Letters written by a few key members of the Private Land Owners Association, have appeared in the local newspaper but rebuttals are not

being written. Could the CRBC publish a factual document educating the private owner on his rights?

The river below Piney Dam is rarely mentioned. What about that area? Are there concerns about water quality? Is there anything being done to remediate this area? Most of this area is privately owned. Are the owners interested in conservation of the river?

Abandoned Landfills-The audience was aware of many dumpsites on private lands. Are these illegal, and can something be done? Municipal landfills that have been closed and forgotten need to be identified and tested to see if the leachate is leaking into a nearby stream.

River Usage- There were mixed emotions on this topic. Part of the audience felt that the river is overcrowded. They wondered if there are written limits to the number of boaters, canoeists and campers. This particular group felt that there is enough access to the river. The other part of the audience was glad to hear that tourism has improved. With increased tourism, though, proper facilities need to be built. The river will soon be used by canoeists planning overnight trips and something needs to be established along the corridor to assist these canoeists. The audience agreed that river usage has increased and will continue to increase. The preservation of the river will be easier if the area is properly prepared to handle the recreationalists.

Blue Heron Sanctuary-Blue Herons are returning to the river in a particular area. An audience member will identify this location with the CRBC presenter to see if the commission can offer some assistance to protect this area .*Further info. is coming.*

The Clarion River Basin Commission concluded the meeting by reinforcing the idea that comments and information will be accepted throughout the Clarion River Watershed Study. If anyone knows of an organization that would like a presentation, they should contact our office.

Attendance: 18 people
Meeting Adjourned: 7:45 pm

Minutes from the discussion at the Millcreek Coalition (October, 09, 1996)

What is the status of the agreement between Penelec and the CRBC? Penelec in the past had agreed to provide materials for alkaline addition to compensate for low flow. Has this occurred recently? Could Penelec be persuaded to provide matching funds for a particular seep rather than alkaline addition . The coalition commented that the streams have adjusted in that area and are able to support some aquatic life. Would Penelec's donation of supplies or funds be better used if the donatin went towards a certain seep reclamation?

Could Penelec donate an annual cash sum to the CRBC (perhaps $5000.00)? The CRBC steering committee would determine how the money would be spent.

Has a study been completed on the effects of acidic water on the structure of the dam?

Trout unlimited is involved in a study being completed by PennDot on the dirt and gravel roads. The study is researching the effects the run-off is having on the trout streams. The study is supposed to lead to an education program for township supervisors on grading techniques, bank seeding, use of filter fabrics, and better knowledge of gravel material. The coalition suggested that the CRBC investigate this program and perhaps could beome involved or provid suggestions.

Are zoning ordinances in place providing guidance for private owners? Are floodplains, riparian forests, and bank vegetation protected?

Are educational programs available in the school districts? Can the school districts become more involved or aware of in stream clean-ups ?

Attendance: 9 people

Meeting Adjourned : 8:15 pm

Informational Meetings

In October, 1996 an informational meeting was arraigned by St. Mary's Borough Council. Dave Strong and Pam Zahoran attended the meeting. The meeting was announced in the local newspaper and to each council member. A slide show was presented and Pam explained the purpose of the CRBC and the PA Rivers Conservation Program. Dave Strong answered many of the questions and provided comments are some of the concerns presented at the meeting. The following comments were made:

1. St. Mary's public water supply may be adversely effected by an "abandoned" landfill once used by the municipality. The residents attending the meeting felt that the landfill was not properly sealed or lined due to the lack of regulations at the time of closure. Could this landfill be creating a "toxic leachate' that may be seeping into the water supply?
2. Stackpole Carbon Company which no longer operates in St. Mary's may be responsible for continued contamination of the watershed. Stackpole is responsible for a number of sites that have not been sealed properly, or properly cleaned up and may be creating a leachate which may be seeping into the groundwater of St. Mary's.
3. Land Management- St. Mary's in the past has allowed floodplain development. However, since 1985 an ordinance was passed to discourage new developments or expansion of existing development within the floodplain.
4. Past strip mining projects continue to add mine drainage into the watershed. Abandoned gas wells exist and nothing appears to be done with them.
5. Is Elk Creek able to handle the industrial waste stream effluent produced by the St. Mary's area?

An informational meeting was held on request by the Barnett Township Supervisors in Forest County. The Clarion River Basin Commission was placed on the agenda of November's township's regularly scheduled meeting. Pam Zahoran attended the meeting and briefly explained the purpose of the Clarion River Basin Commission and the Pennsylvania Rivers Conservation Program. The meeting was well attended by individuals residing in the area and all township supervisors. Barnett Township's residents are cautiously accepting the increased tourism in the area, and would like to become better prepared. The area lies between Clear Creek State Park and Cook's Forest State Park. The residents expressed an interest in becoming more involved with the commission and accepting advice on options available in the area to increased proper use of the river. Barnett Township had been pursuing a public canoe launch. As a result of this meeting the supervisors agreed that public restroom facilities also needed to be provided with the canoe launch. Barnett Township proceeded to apply for a "Small Community" grant to be used for the canoe access and a public facility.

An informational meeting was also held in January, 1997 for the Jefferson County Planning Department. Pam Zahoran attended this meeting, presented a slide show, and provided an explanation and purpose of the CRBC and the Pennsylvania Rivers Conservation Program. The Jefferson County's planning department provided comments on "dump sites" within their jurisdiction, and historical sites within the area. All information has been incorporated into the study. Overall, the planning department seemed pleased with the CRBC and encouraged continued endeavors.

Preliminary Findings Public Meeting
Thursday, April 17th, 1997
Peirce Science Auditorium
Clarion University, Clarion, PA

The meeting was called to order at 7:15 p.m. by Bernie Spozio, Conservationist with the Natural Resource Conservation Services, and an Executive Board representative of the Clarion River Basin Commission (CRBC).

Mission Statement Explanation: The mission of the Clarion River Basin Commission (CRBC) is to enhance the river quality both from a community and a water quality standpoint. The group was formed to unite the five (Mckean, Elk, Forest, Jefferson and Clarion) counties to work together on the problems of the river through out the entire basin.

Grant Explanation: PA Rivers Conservation Program : Bernie Spozio explained that the study is being funded by the Keystone Recreation, Park and Conservation Fund Act authorized by the Department of Conservation and Natural Resources (DCNR). The study is being completed by the CRBC's study team and the technical assistant hired by the commission.

Process of identifying issues: Bernie Spozio stated that the public meetings were held from August, 1996 through January 15th, 1997 to gather comments. Based on the issues stated by the public the CRBC identified and collected resource data to substantiate the issue.

Study Team: Each member of the CRBC's study team was introduced by Bernie Spozio. The CRBC is a non-regulatory body . The CRBC should not be viewed as an environmental group, but rather a group working together equally with industrial leaders, community residents, and public officials to enhance the quality of the basin.

Comment Period Explanation: Bernie Spozio explained that the comment period for the preliminary document will end May 17th, 1997 (30 days). Comments can be mailed to the CRBC in care of the Clarion Conservation Office. Changes in the report will be made and presented at the next public meeting in early June, 1997 at Ridgway (Elk Co. Courthouse) Once again there will be a 30 day comment period. A final document will be presented to the public at a meeting in Brockway during the month of August, 1997. After each public meeting each county's planning department will have a copy of the presented material for residents to review and make comments.

Explanation of the Executive Summary : Pam Zahoran provided a brief explanation of what is found in the entire document that will presented to the state as a result of this study. The executive summary explains the PA Rivers

Conservation Plan, the study area, relationship to other plans, study methodology, and elements of the plan.

Elements of the Plan: Pam Zahoran explained that Chapters I through IV contains a description and background information of the study area. It was stressed that the public understands that the entire watershed rather than the corridor of the Clarion River is included in this study completed by the CRBC. Chapter V contain areas of concerns directly related to the issues identified by the public during the initial meetings held by the CRBC. Chapters VI and VII identify the issues and possible management options. These two chapters was the focus of the discussion for this meeting.

Issues: The study team emphasized that these are concerns and issues raised by the public and they are not the result of a scientific or environmental studies. Issues can still be raised by the public and added to this document. Each study team member added comments and explanation to each issue as needed.

1. Sewage Treatment-- Identified at each public meeting. The CRBC was unable to locate available data except at the PA American Water Supply located in Clarion, PA. The only data indicates that there may be a problem, but more data is needed before a problem can be identified. This was one point along the river, not a clear indication of the entire river.

2. Tourism-- Mentioned at almost every public meeting. Fifty percent of the people wanted more, fifty percent stated that the area has too many tourist. Both groups have identified that the tourist are going to come, and the area needs to be properly prepared. The "Carrying Capacity" of the river has never been identified to the knowledge of the CRBC. A recreational study of Piney Dam is in progress and will be completed by August, 1997. Preliminary findings indicate that the area is able to handle the amount of docks permitted by Piney Dam.

3. Landfills-- Dave Strong explained that old, once permitted municipal and industrial landfills that were closed before the new regulations were in place. Concerned that there is a possibility that a toxic leachate is seeping into the groundwater.

Illegal dumps found along the hillside of many tributaries creating an aesthetic problem and a water quality problem. Jefferson Co. will offer financial assistance to any township providing volunteers to clean up illegal dump sites. This program is offered through the Jefferson Co. Solid Waste Authority.

4. Roads-- Three thousand miles of roads within the watershed. Trout Unlimited is involved a program surveying roads within close proximity of high quality roads to identify road conditions and sedimentation problems. Purpose is to provide an educational training program to township supervisor on treatment and dust control measures that can be completed without interfering with the quality of the streams. Material is available now by the DEP for township supervisors on proper care of the roads.

5. Water Quality-- Lack of Water Quality Monitoring Programs. Sample charts were provided to the audience comparing historical data. East Branch Lake,(currently being treated with alkaline addition) Johnsonburg, Ridgway, Cooksburg, and the 322 Bridge analysis indicating an improvement in the quality of the river but not a dramatic change.

-- Andy Redmond provided details about the impact of Willamette Industry's effluent discharge, The old mill has modernized. Independent surveys has indicated that the macro-invertebrate studies show great improvements. Color and temperature is still an issue and a thermal impact study will need to be completed.

6. Impoundment: Bernie Spozio explained that East Branch Dam has an influence the downstream water quality. East Branch Dam has a cold water discharge but recently has been impacted by recreational boaters wanting to maintain higher reservoir for boating. The cold water discharge has been reduced causing Willamette's discharge to have a greater impact on the river. Each issue is interrelated. One item cannot be blamed

Piney Dam- Bob Kaufman provided a detail explanation of the permit to release 100 cubic feet per second (cfs) consistently to dilute the mine drainage below the dam and to maintain the aquatic life. However, to maintain the recreational needs of the dam Piney Dam is not always able to consistently release 100 cfs. and could be causing biological problems below the dam. Power generating needs are subservient to the needs of the recreational dam.

7. Fisheries-- Bernie Spozio identified the concern of safety of fish for human consumption.. Limited tissue analysis indicates some identification of PCB's. Further studies are needed an accurate evaluation is completed.

The CRBC was unable to locate good studies completed on macro invertebrates to indicate while there is a difference in the quantity of fish among areas of the basin. Issues concerning fisheries was primarily identified in the Johnsonburg area. Studies have indicated an improvement in the quantity of fish

8. Land Use- CRBC is a non-regulatory body. The commission feels that this is an issue to be handled by the individual townships and counties.

Flood control was mentioned and Ridgway did complete a reconnaissance study . Janie French from Headwaters Charitable Trust explained that the cost sharing with Army Corps of Engineers was approximately 3 million dollars to increase vegetation and improve levies built in the area .

The state does not have a floodplain management program and is considering a voluntary buy out program for resident living in the floodplain.

Comments:

Education was a comment presented at each meeting . The study teams felt that this should be a component of each issue rather than an issue by itself.

Issues identified as a result of this meeting:

1. Volunteer program for citizens to become more involved with water quality testing. However, the programs do not always test the proper parameters needed to identify the problems of the stream. Perhaps the community members could at least collect water samples and bring them to the lab for further testing.

2. Land Application of Fly Ash on the Glacial Minerals site owned by six individuals located in the Millcreek watershed . Abandoned Strip Mine Site that was used as a dump for Glacial's washing material and is leaching into White's Run. The CRBC stated that there is a need to look at the analysis of the fly ash, identify the source, identify the application procedure and the monitoring program. The CRBC will try to get a copy of the construction plan and any hydrology test results completed on the site.

3. Has anything been done to identify abandoned oil and gas wells? The commission knows of a variety of old sources that may contain maps that identify the oil and gas wells. However, one main source does not exist. Plugging may be an option, but major problems with old wells have not been an issue.

4. Land Use - An audience member wanted to know why the CRBC was not writing management options on land use/ management and aesthetics of the river. The commission explained that the committee would like to remain focused on water quality issues and though land use ultimately effects water quality this issue should be addressed at the municipality level. The member of the audience suggested that the CRBC clarify this matter in the document or consider offering management options for the issue of land use.

Attendance; 42 people
Meeting was adjourned at 8:45 p.m.

"Draft Document Presentation"
Elk County Courthouse
Wednesday, June 11, 1997

Introduction by Ms. June Sorg: Elk county Commissioner and a representative of the Clarion River Basin Executive Committee.

Grant Explanation: PA Rivers Conservation Program : by Andy Redmond, President of the Clarion River Basin Commission. This document contains data from a variety of agencies and issues that were stated at meetings held in the fall of 1996. The issues and management options will become a part of the final document. Once placed on the Pa Registry, the issues will qualify for further funding.

Mission Statement: by Andy Redmond. To maintain and improve the Clarion River quality. Membership is comprised of individual citizens, agencies, officials and industries along the river corridor. The purpose of this meeting is to present the draft document. This is the second step in the comment period. The final plan will be presented in August in Brockway.

Clarion River Basin "Draft Document" : A large document because it contains information pertaining to the issues that were brought up by the public from August, 1996 until January, 1997.. The issues were used as a base for the research because the CRBC felt that this was the information that the public wanted. The first 36 pages of the document identifies the study. The 72 page appendix provides research for the statements made in the narrative.

Comment Period: Each planning commission has a complete copy of the "draft document". The CRBC encourages the citizens to review the study and make comments. There will be a 30 day comment period for individuals to make comments. The CRBC will edit the document and the final copy of the document will illustrate the comments and changes..

Executive Summary: Presented by Pam Zahoran Lists all the issues that were stated by individuals. The issues were placed into management categories and suggested options were written . The executive copy may go home with each individual.

PA Rivers Conservation Plan: The purpose of the program is to complete a study and have the river placed on the PA Registry. When the river is placed on the PA Registry any individual, municipality, township, or county will be permitted to apply for further grant monies within the watershed.

Elements of the Plan

Identified the Watershed : Overhead map presentation of the area and complete watershed. Emphasized that not just the corridor is being study.

1. Road Map: Overhead map of all the roads within the area. Majority of the roads are under the ownership of local municipalities. The Clarion River Basin has over 3,000 miles of roads.

2. Sewage Treatment: Identified at each public meeting. Sewage was broken into categories for a distinct clarification. Inadequate sewage treatment is a concern in all areas of the watershed during a high amount of precipitation. The CRBC was unable to locate available data aside from the PA American Water Supply located in Clarion, PA. This data indicates that there may be a problem, but more data is needed before any problem can be identified. The water sampling point is one location along the river, and not a clear indication of the entire river. The CRBC does not want to make people feel that there is a sewage problem in the area, but there is a need for a further study to be completed within the watershed area.

3. Aesthetic and Natural Resources Extraction: Mine drainage is still a prevalent problem in the area. However, there are organizations established within the watershed area that are addressing the mine drainage problem. The CRBC will work closely with other organizations and assist them with their projects and funding. The CRBC was involved with gathering federal funds to remediate the mine drainage and assisted with the efforts by the different coalitions. The management options identify the different organizations and possible funding sources

Abandoned gas wells have been mentioned at meetings; identifying the location of these wells will be an enormous task.

4. Tourism: Infrastructure could be insufficient if tourist attractions increase without the addition of roads, restrooms, and other facilities. As far as the CRBC knows, The "Carrying Capacity" of the river has never been determined. Historical markers and viewsheds were suggested at one meeting to create additional tourist attractions while preserving the land.

RAT--Residents Against Tourism . A representative of the group expressed his concerned about the inflow of tourist to the area. Especially in the little Toby Creek area, there are signs of graffiti on the rocks, destroyed vegetation on game lands, crowded streams and diminished tranquillity. The "RAT" group is not against all tourism. The group agrees that the area has been used for many years by the hunters and fisherman, but now RAT believes the number of tourists is getting out of hand, and if something does not happen now to control the number of tourists the area will become abused and ruined.

*Citizen comment---Tourism and Recreation may be the salvation of Ridgway and the opportunities should exist and be promoted with the cooperation of other agencies in the area, especially the "Rails-to-Trails" program.

A conclusion was drawn by the group that there is a difference in opinion on the number of tourists that should be in the area. Ultimately, the decision is a political one that falls on the shoulders of the community. Once again, the basin's "Carrying Capacity" needs to be determined before tourism decisions can be accurately made.

5. Landfills--Landfills that have been abandoned by municipalities and communities, have not been properly closed and sealed, and may be leaking into the groundwater. A common occurrence in every community. Locating the landfills is not a problems; identifying what is in the landfill does present a problem.

Illegal dumps--Located in close proximity to a stream. Volunteer programs to remove the debris and the counties assist with proper disposal of the material.

6. Roads-- Three thousand miles of roads are within the watershed. A majority of the roads belong to townships that do not always have the money to pave the roads. Trout Unlimited is involved a program surveying roads within close proximity of high quality streams to identify road conditions and sedimentation problems. The last gas tax increase will assist municipality on the sedimentation and dust control on unapproved roads. The money is only available to roads within close proximity to high quality streams. This is just a start, and there is hope that the program will continue.

7. Water Quality-- Lack of Water Quality Monitoring Programs- Sample charts were provided to the audience comparing historical data. East Branch Lake,(currently being treated with alkaline addition) Johnsonburg, Ridgway, Cooksburg, 322 Bridge, and St. Petersburg analysis indicating an improvement in the quality of the river but not a dramatic change.

A member of the audience stated that Ron Leas, (Fish Commission), is now conducting a thorough water analysis of Elk Creek. Elk Creek is a concern because of the lack of data available, this analysis will be sought out by the CRBC. St. Mary's is a highly industrialized center within the watershed and there is a concern stated by the residents. Elk Creek is used by many industries.

St. Mary's waste treatment plant was questioned as to the consistency of proper treatment as with all sewage treatment systems. Heavy rains inundate the treatment system the is a problem that is becoming more critical in all municipalities. Ultimately, the correction of this problem falls directly on the residents of the areas. Planning departments need to become more involved

St. Mary's Wastewater Treatment representative stated that it is in compliance with DEP's regulations. The treatment plant is still waiting for a final permit from DEP. Bypassing is a common problem in all areas, and the plant does not deliberately flush its gates to cause problems. This problem is not unique to St. Mary's, and the representative wanted to make sure that the audience understood the situation. The treatment plant is meeting the NPDES permit. The problem is over 60 years old, and the problem will not be solved over night.

Willamette received special attention within the document because of the comments raised at the August, 1996 public meeting held in Ridgway. Research on and a visit to Willamette was independently done. Research indicates that a study was completed on the effluent in June 1996. The results supplied a comparison analysis of the effluent and the ultimate effect it has on the corridor

of the river (overhead shown to the audience). The effluent's appearance is not pleasing, but the chemistry of the water is acceptable by DEP's standards. The temperature of the water is a concern, but the higher temperature is needed in order to properly treat the mill's discharge. Willamette is aware that thermal pollution is a concern of the public. A fish study result which was presented to the audience is found in the document.

*Citizen comment- The water is much better than it was 25 years ago. Willamette is improving its method of treatment.

*Citizen comment- This person would like to go on record saying that "I think that there is a lot more that needs to be done, and I hope that this plan will concur and will look down the road towards the possibility of helping the residents. The job is not done and I understand that Willamette needs a certain temperature to complete the job. I believe that the water is better than it was 25 years ago. I don't believe that the water is better than it was 5 years ago. The thermal issue is a big problem, and I hope nobody wants to sweep it under the rug. The problem needs to be looked at not just one or two time a year, but on a regular basis." The water should be cooled down reasonably, and you cannot expect fish to have part of stream heated to 93^0 F and not have an impact; it does not work that way.

-- Andy Redmond provided details about the impact of Willamette Industry's effluent discharge, The old mill has modernized. Independent surveys has indicated that the macro-invertebrate studies show great improvements. Color and temperature is still an issue and a thermal impact study will need to be completed.

8. Impoundments : Bernie Spozio explained that East Branch Dam and Piney Dam influence the water quality. Water release is an issue with impoundments, as each dam needs to maintain enough water for recreational use and yet sustain water quality of the river. East Branch Dam has a cold water discharge, and this could cause as much effect as Willamette's discharge. Both temperatures are unnatural for the Clarion River, but with a better management release, perhaps the cold water could assist Willamette with its warm water discharge. The cold water discharge has been reduced, causing Willamette's discharge to have a greater impact on the river. Each issue is interrelated. One factor alone cannot be blamed.

9. Fisheries-- Bernie Spozio identified the concern of safety of the human consumption of fish. Limited tissue analysis indicates some existence of PCB's. Further studies must be completed to produce an accurate evaluation.

No management plans on fisheries have ever developed. Recently the fish commission has initiated the process of gathering data.

10. Land Use- - CRBC is a non-regulatory body. The commission feels that this is an issue to be handled by the individual townships and counties. The CRBC will provided assistance with grants but will not be involved with township zoning and ordinances.

Study Team was introduced and explained that this team is just a part of the CRBC. This is not the Executive Board and this committee was formed to complete this study.

Management Options-The process was explained as was the necessity of the different organizations. Each option is just a suggestion and the CRBC encourages the citizens to review the issues and management options. Once stated in this plan, the issue would receive a higher priority for funding by a municipality.

New Issue: Vacated transmission lines, the old gas lines, and sewer lines, that were not sealed once they became abandoned, Utility companies abandoned them and now they are transmitting the water through the area with out the source or destination identification. The person knows of some of the lines in his immediate area but is asking for assistance with a way of identifying the lines.

Comments:

The CRBC would like to draw participation from the people. Many people attend the meetings, but do not become actually involved.

Is Ridgway represented by the "Study Team"? Ridgway is represented by the Elk County representatives.

Tourism was brought up once again. Each side spoke one more time.

The last meeting will be publicized in the newspaper, and there will be notification mailed to all members, supervisors, representatives, and past participants.

The purpose of this document is to bring together all the issues of the watershed. The CRBC would like to be able to form committees within each region to deal with specific issues.

The CRBC is not formed for economic development, but rather for the purpose of maintaining or enhancing the quality of the Clarion River.

Meeting adjourned at 9:15 PM.
Attendance: 16 people

WORKS CITED

Alerich, Carol L (1993) *Forest Statistics for Pennsylvania--1978 and 1989.* Resource Bulletin NE-126 United States Department of Agriculture 157 pp.

Allegheny River Basin Reginal Plan. Ohio River Basin Commission. Cincinnati, Ohio, 1979 178 pp.

Bolles, W. and Geyer A. (1979) *Outstanding Scenic Geological Features,* Commonwealth of Pennsylvania, Department of Environmnetal Resources, Bureau of Topographic and Geologic Survey.

Buckwalter, T., Dodge, C., Schiner, G., and Koester, H. *Water Resources of the Clarion River and Redbank Creek Basins, Northwestern Pennsylvania,* Pennsylvania Department of Environmental Resources, U.S. Geological Survey 111 pp.

Caldwell, J. A. (1877). *Caldwell's Illustrated Historical Combination Atlas of Clarion Co Pennsylvania.* West Virginia: Walsworth Publishing Company

Campbell, G. and Wildberger, S. (1992). *The Monitor's Handbook.* Maryland, LaMotte Company 71 pp.

Clarion River and Mill Creek Wild and Scenic River Eligibility Report Allegheny National Forest Warren Pennsylvania, 1996 30pp.

Clarion River Basin, Pennsylvania Acid Mine Drainage Abatement Program : Stage 1 Reconnaissance Report . U.S. Army Engineer District, Pittsburgh Corps of Engineers , 1980.

Coll, M. Jr. and Siwicki, R. (1996) *Water Resources Data Pennsylvania Water Year 1995. Volume 3. Ohio River and St. Lawerence River Basins,* U.S. Geological Survey Water-Data Report PA-95-3, Pennsylvania Department of Environmental Protection and the U.S. Army Corps of Engineers, U.S. Department of the Interior 200 pp.

Davis, A.J. (1887), History of Clarion County of PA. D. Mason and Co. Publishers

Elk County of Pennsylvania Brochure Elk County Planning Department, 1994

Hydrology of Area 2, Eastern Coal Province, Pennsylvania and New York. United States Department of the Interior Geological Survey. Harrisburg, Pennsylvania, 1983 93 pp.

Jefferson County Comprehensive Plan. Mullin & Lonergan Associates, Inc. Pittsburgh-Philadelphia, 1991

Koester, H. and Lescinsky, J. (1976) *Selected Hydrologic Data, Clarion River and Redbank Creek Basins, Northwestern Pennsylvania,* Pennsylvania Department of Environmental Resources, U.S. Geological Survey 164 pp.

Land and Resource Management Plan, Allegheny National Forest. United States Department of Agriculture, 1986 .306pp

Local Protection of High Quality Streams. Deptartment of Environmental Resources Report No. 6. Commonwealth of Pennsylvania, 1981

Mitchell, M. and Stapp, W. (1993). *Field Manual for Water Qualtiy Monitoring.* Michigan: Thomson-Shore Printer 240 pp.

Pennsylvania Code : Title 25. Environmental Resoures Chater 93. Water Quality Standards (1992), Department of Environmental Resources, Bureau of Water Wuality Management, Harrisburg, PA. 212 pp.

Palmer, T. (1980). *Rivers of Pennsylvania.* Pennsylvania: University of Pennsylvania State Park , University Press 229 pp.

Statewide Floods in Pennsylvania, January 1996. Fact Sheet 103-96 U.S. Department of the Interior, U.S. Geological Survey.

Soil Survey of Cameron & Elk Counties, 1964; Soil Survey of Clarion County, 1958; Soil Survey of Jefferson County, 1972; Soil Survey of Warren County, 1958, U.S. Government Printing Office, United States Department of Agriculture Soil Conservation Service.

Water Resources Bulletin. U.S. Department of the Interior Geological Survey Bulletin No. 12. Low Flow Characteristics of Pennsylvania Streams. Commonwealth of Pennsylvania, 1977 441 pp.

Water Resources Bulletin. U.S. Department of the Interior Geological Survey Bulletin No. 16. Pennsylvania Gazetteer of Streams. Commonwealth of Pennsylvania, 1984 418 pp.

Widmann, Richard H. (1995) *Forest Resources of Pennsylvania* Resource Bulletin NE-131 United States Department of Agriculture

Williams, C.E. (1994). *Inventory of Special Concern Plants and Unique Natural Communities: Clarion River and Mill Creek Corridors, Northwestern, Pennsylvania.* Department of Biology, Clarion University of Pennsylvania, Clarion PA.

Williams, Charles E.. (1995, Volume XVI, No. 1). "A Clean Slate for the Clarion" *Pennsylvania Wildlife Pg. 27-29.*

STUDIES CITED

Hasse, R. (1996). *Clarion River Survey Ridgway Township, Elk County June 25-28, 1996* Department of Environmental Protection: Northwest Regional Office

Hasse, R. (1992). *Clarion River Survey(Penntech Papers) Ridgway Township, Elk County September 9-10, 1992* Commonwealth of Pennsylvania: Field Operations-Northwest Regional Office

Young, Leroy (1995). *Biological Monitoring of the Clarion River to Assess Impacts of Piney Dam Releases.* Survey Date: 10-11 July 1995 Report Date: 8 December 1995 Commonwealth of Pennsylvania Pennsylvania Fish & Boat Commission, Division of Environmental Services.

Aquatic Ecology of Toms Run, Clarion County, Pennsylvania (The), 1991 Department of Environmental Resources

Listing of Waters Having Wild Trout (1992). Pennsylvania Fish & Boat Commission, Division of fisheries Management.

National Study of Chemical Residues in Fish: Volume II (1995), Office of Science and Technology, Standards and Applied Science Division, U.S. Environmental Protection Agency, Washington, DC

Proposed Limestone Sand Treatment of East Branch Clarion River Lake Tributaries (1996) , Elk County Federation of Sporstman Clubs and Seneca Resources Corportation.

Pennsylvania Natural Diversity Inventory (1996). Pennsylvania Department of Conservation and Natural Resources. Nature Conservancy and Western Pennsylvania Conservancy

Profile of Northwestern and Northcentral Pennsylvania Counties (1996). Center for Rural Pennsylvania, Harrisburg, PA.

Water Quality Ratings for Pennsylvania Streams (1992), Department of Environmental Resources, Bureau of Water Quality Management.

ACKNOWLEDGMENTS

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Clarion, Jefferson, Elk, Forest, and McKean County Conservation Districts
Clarion, Jefferson, Elk, Forest, and McKean County Planning Departments
Clarion River Basin Commission's Executive Board
Department of Environmental Protection
- Bureau of Water Quality Management
- Bureau of Water Supply and Community Health
- Bureau of Waste Management
- Bureau of Dams, Waterways , and Wetlands
- Division of Water Planning and Allocation

Elk County Federation of Sportsman Clubs
Headwaters Resource Conservation and Development, Clearfield , PA
Millcreek Coalition, Clarion and Jefferson County
Natural Resource Conservation Service
Northwest Regional Planning and Development Commission
Pennsylvania Department of Conservation and Natural Resources
Pennsylvania Department of Transportation
Pennsylvania Fish and Boat Commission
Pennsylvania Game Commission
Pennsylvania Historical and Museum Commission
Pennyslvania Trouts Unlimited
Pittsburg Division of the U.S. Army Corps of Engineers
Toby Creek Watershed Association, Elk and Jefferson County
United States Department of the Interior Geological Survey
United States Forest Service : Allegheny National Forest

Abbreviations

CRBC	Clarion River Basin Commission
PFBC	PA Fish & Boat Commission
PADEP	PA Department of Environmental Protection
ERI	Ecological Restoration, Inc.
NORM	Normandeau Associates, Inc.
USACE	US Army Corps of Engineers
DCNR	Department of Conservation and Natural Resources
EPA	Environmental Protection Agency
CR	Clarion River
mg/l	milligrams per liter
ug/l	micrograms per liter
EPT	Ephemeroptera, Plecoptera, and Trichoptera
su	standard units
PCB	Polychlorinated biphenyls
J-burg	Johnsonburg
STA	Station
RM	River Mile
CWF	Cold Water Fishery
HQ-CWF	High Quality Cold Water Fishery
WWF	Warm Water Fishery
CPUE	Catch per Unit Effort
AMD	Acid Mine Drainage

Appendix E

Charts

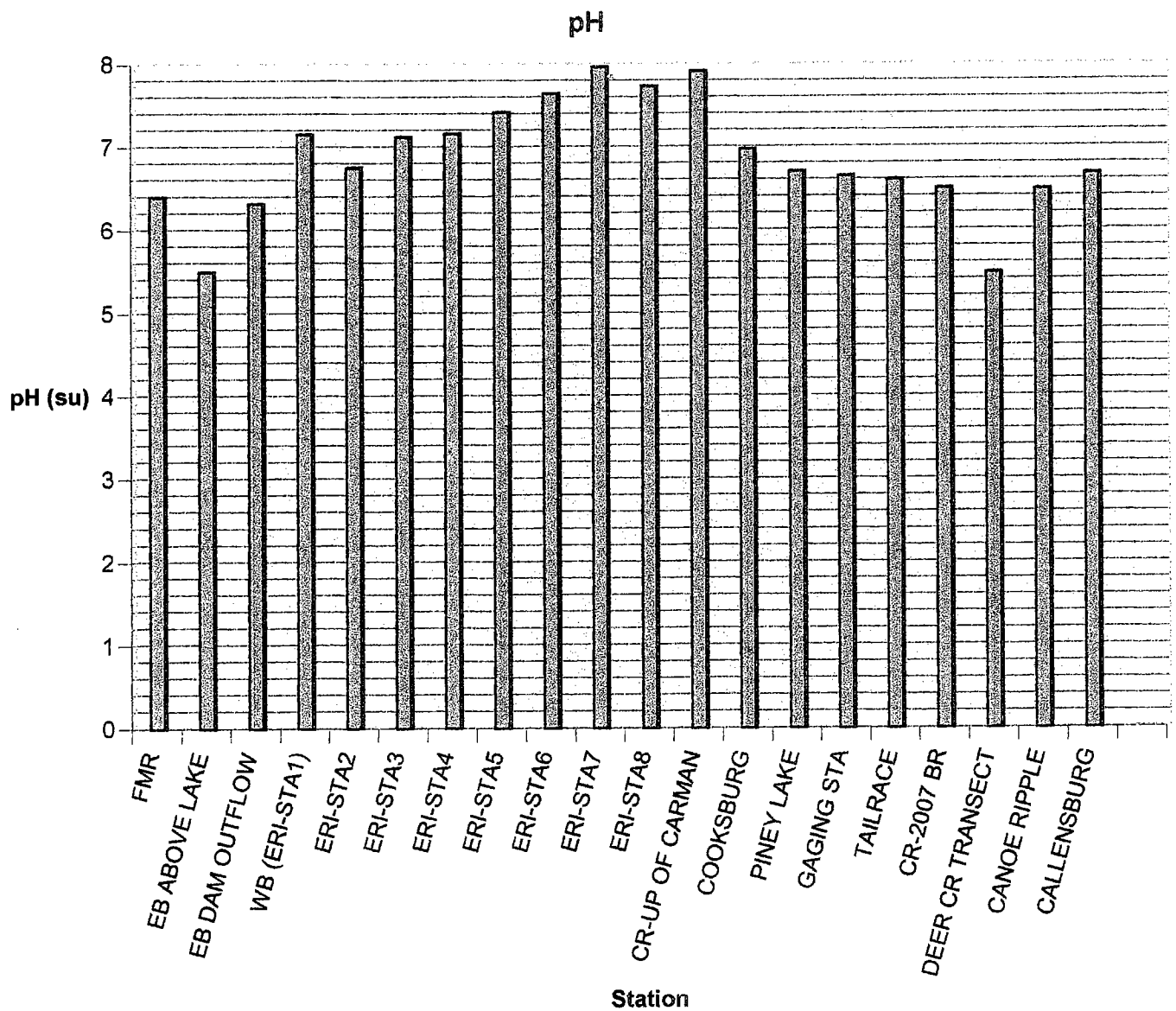

pH
pH (su)
0
1
2
3
4
5
6
7
8
FMR
EB ABOVE LAKE
EB DAM OUTFLOW
WB (ERI-STA1)
ERI-STA2
ERI-STA3
ERI-STA4
ERI-STA5
ERI-STA6
ERI-STA7
ERI-STA8
CR-UP OF CARMAN
COOKSBURG
PINEY LAKE
GAGING STA
TAILRACE
CR-2007 BR
DEER CR TRANSECT
CANOE RIPPLE
CALLENSBURG
Station

Chart E-1

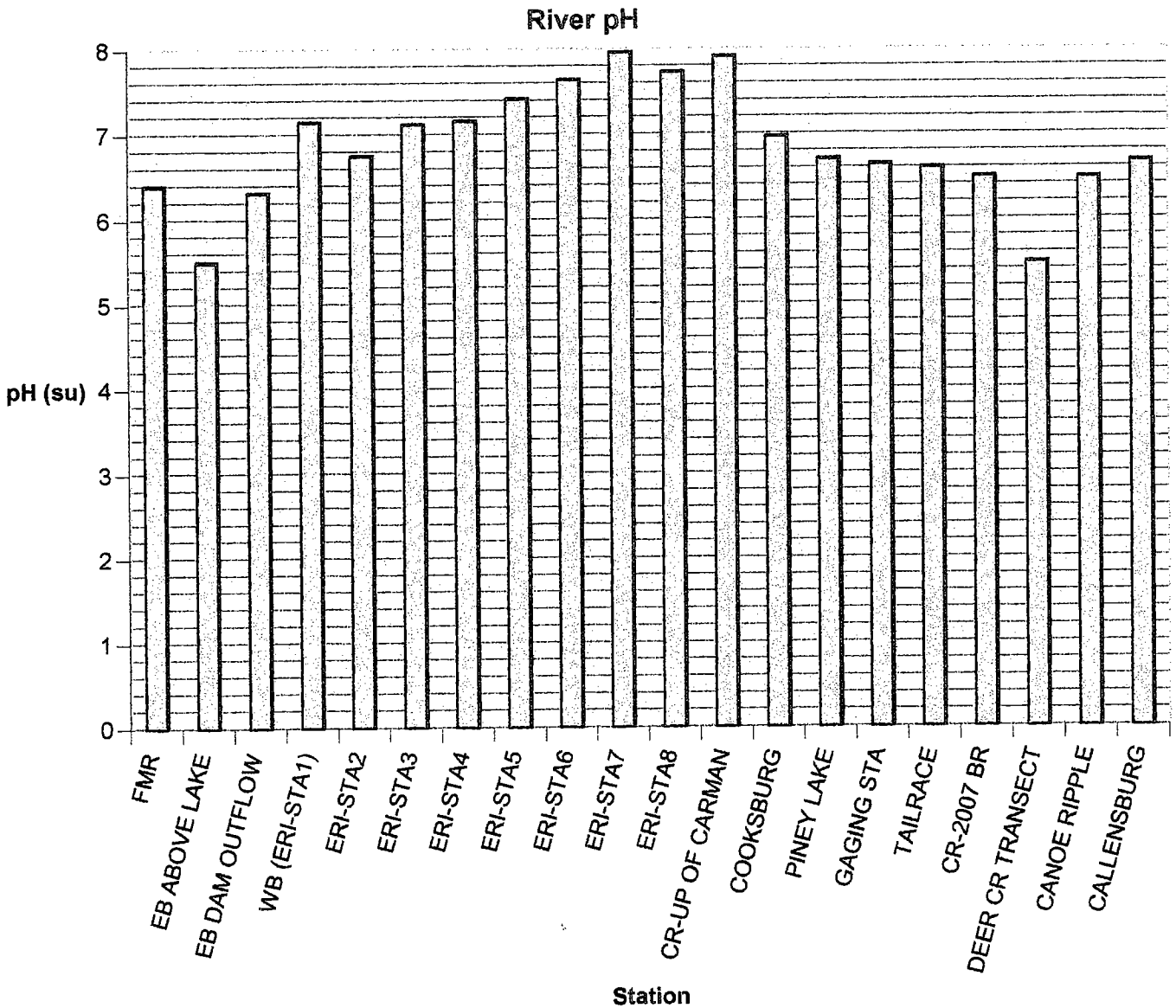

River pH
pH (su)
0
1
2
3
4
5
6
7
8
FMR
EB ABOVE LAKE
EB DAM OUTFLOW
WB (ERI-STA1)
ERI-STA2
ERI-STA3
ERI-STA4
ERI-STA5
ERI-STA6
ERI-STA7
ERI-STA8
CR-UP OF CARMAN
COOKSBURG
PINEY LAKE
GAGING STA
TAILRACE
CR-2007 BR
DEER CR TRANSECT
CANOE RIPPLE
CALLENSBURG
Station

Chart E-2

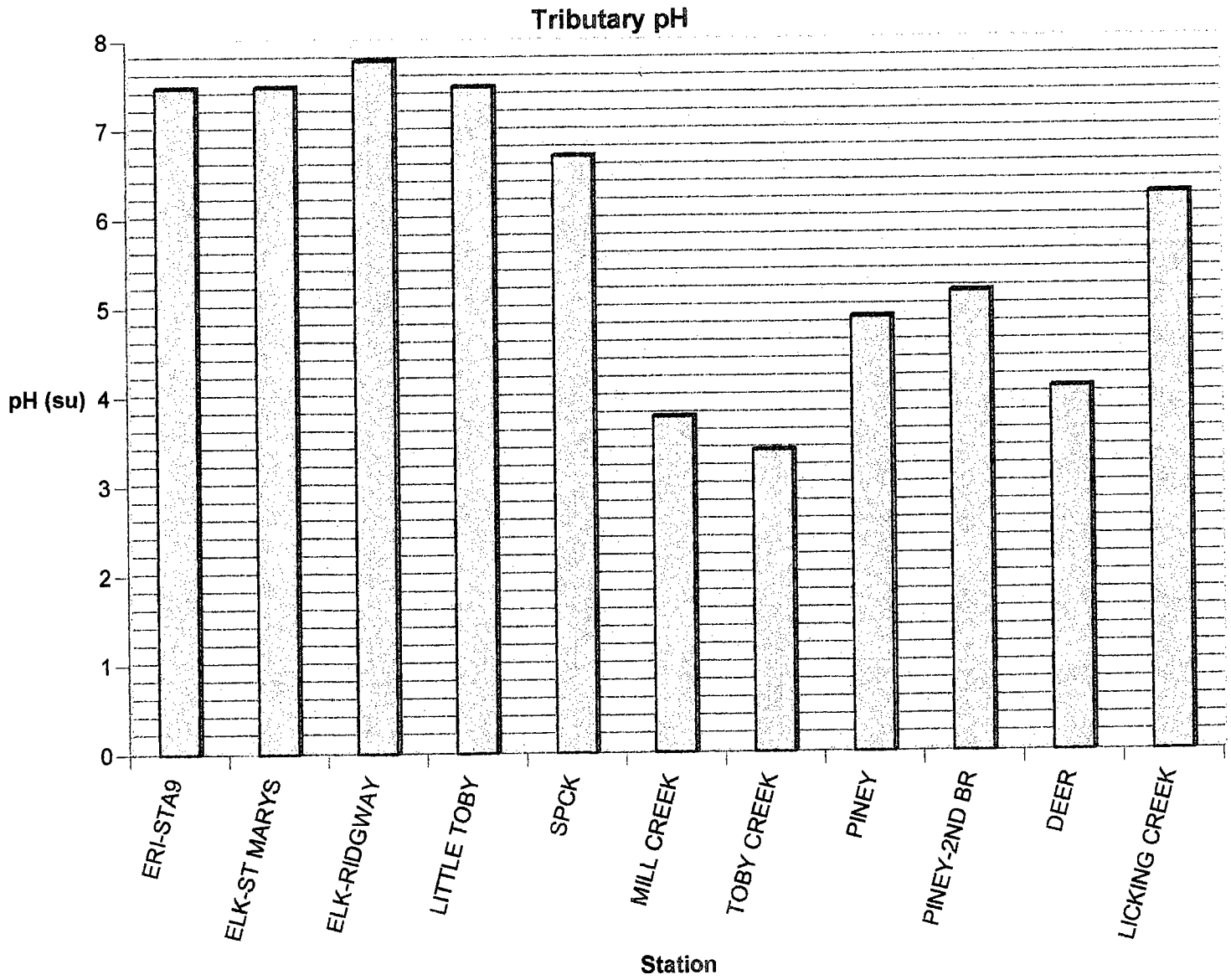
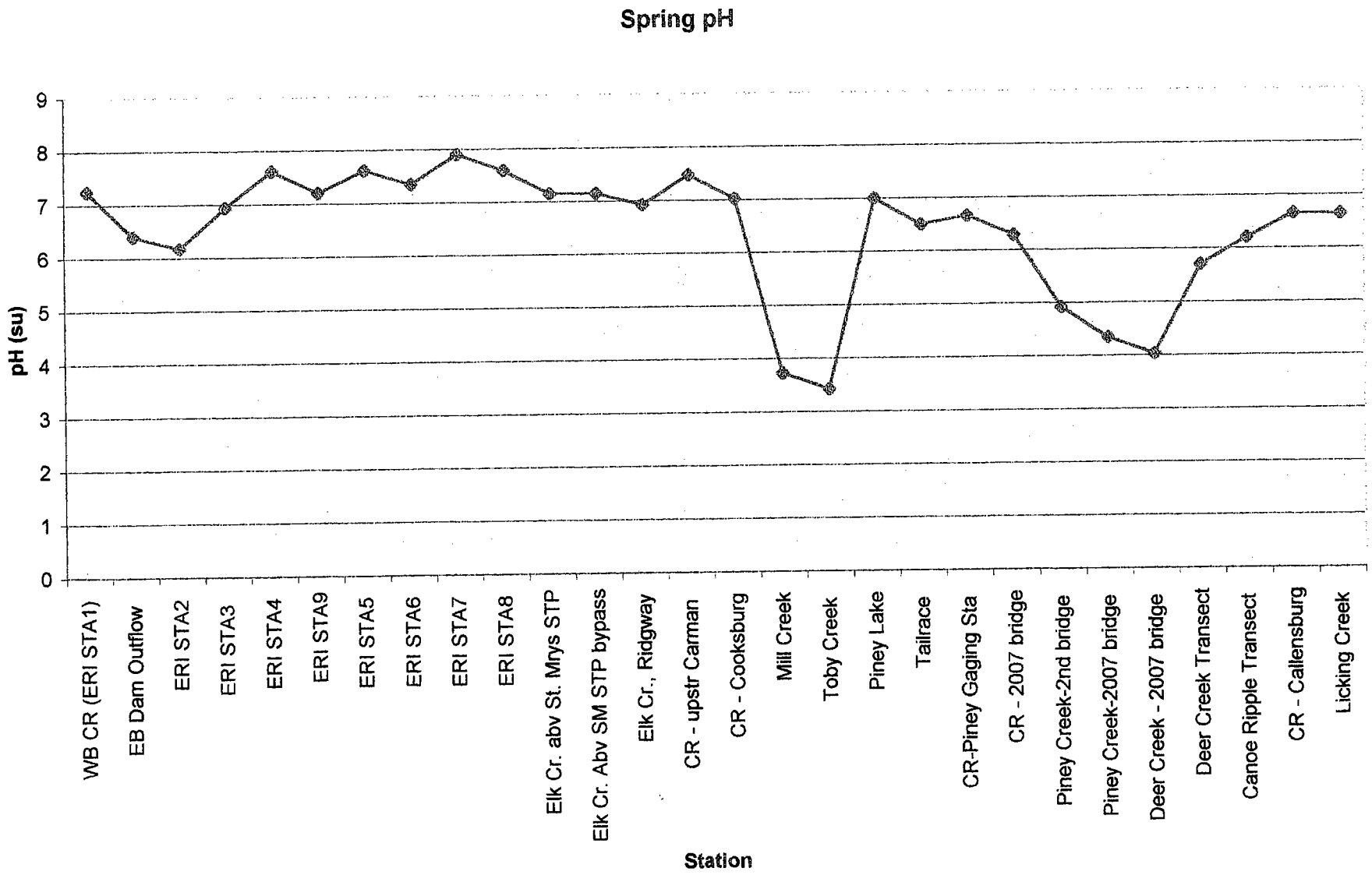

Tributary pH
pH (su)
8
7
6
5
4
3
2
1
0
ERI-STA9
ELK-ST MARYS
ELK-RIDGWAY
LITTLE TOBY
SPCK
MILL CREEK
TOBY CREEK
PINEY
PINEY-2ND BR
DEER
LICKING CREEK
Station

Chart E-3


Spring pH
pH (su)
9
8
7
6
5
4
3
2
1
0
WB CR (ERI STA1)
EB Dam Outflow
ERI STA2
ERI STA3
ERI STA4
ERI STA9
ERI STA5
ERI STA6
ERI STA7
ERI STA8
Elk Cr. abv St. Mrys STP
Elk Cr. Abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
CR - Cooksburg
Mill Creek
Toby Creek
Piney Lake
Tailrace
CR-Piney Gaging Sta
CR - 2007 bridge
Piney Creek-2nd bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
Deer Creek Transect
Canoe Ripple Transect
CR - Callensburg
Licking Creek
Station

Chart

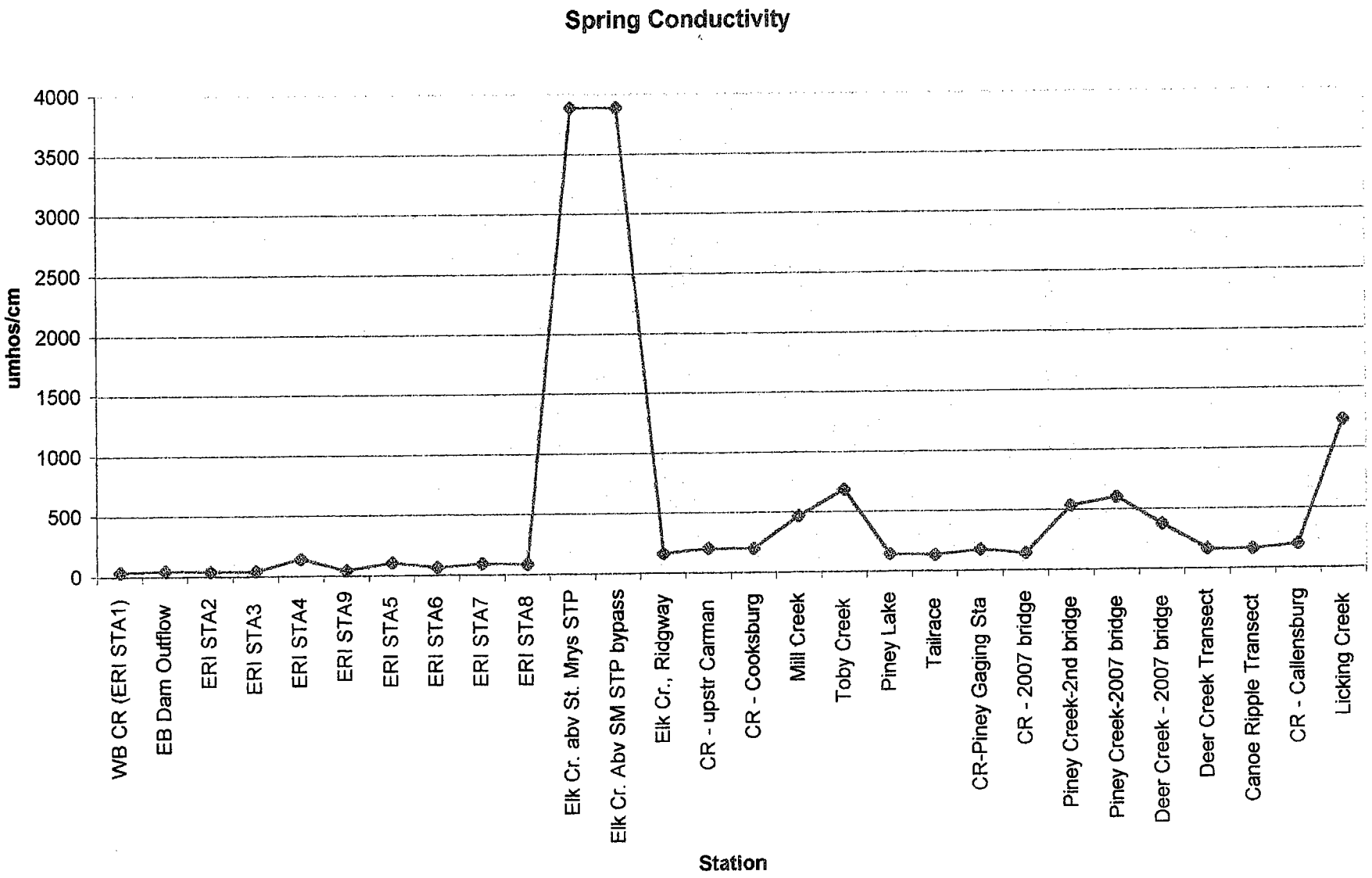

Spring Conductivity
umhos/cm
4000
3500
3000
2500
2000
1500
1000
500
0
WB CR (ERI STA1)
EB Dam Outflow
ERI STA2
ERI STA3
ERI STA4
ERI STA9
ERI STA5
ERI STA6
ERI STA7
ERI STA8
Elk Cr. abv St. Mrys STP
Elk Cr. Abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
CR - Cooksburg
Mill Creek
Toby Creek
Piney Lake
Tailrace
CR-Piney Gaging Sta
CR - 2007 bridge
Piney Creek-2nd bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
Deer Creek Transect
Canoe Ripple Transect
CR - Callensburg
Licking Creek
Station

Chart E-5

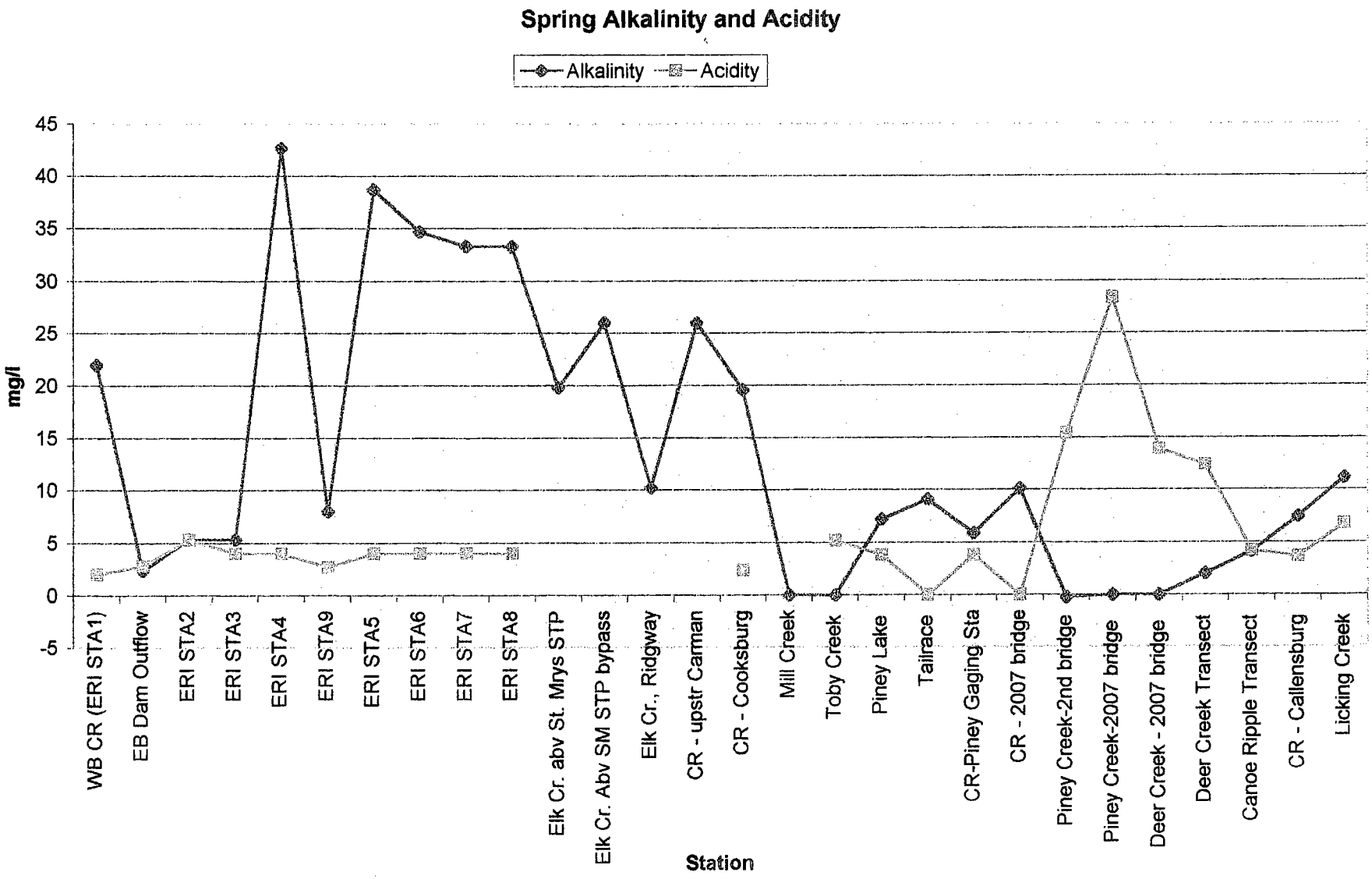

Spring Alkalinity and Acidity
Alkalinity
Acidity
mg/l
45
40
35
30
25
20
15
10
5
0
-5
WB CR (ERI STA1)
EB Dam Outflow
ERI STA2
ERI STA3
ERI STA4
ERI STA9
ERI STA5
ERI STA6
ERI STA7
ERI STA8
Elk Cr. abv St. Mrys STP
Elk Cr. Abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
CR - Cooksburg
Mill Creek
Toby Creek
Piney Lake
Tailrace
CR-Piney Gaging Sta
CR - 2007 bridge
Piney Creek-2nd bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
Deer Creek Transect
Canoe Ripple Transect
CR - Callensburg
Licking Creek
Station

Chart E-6

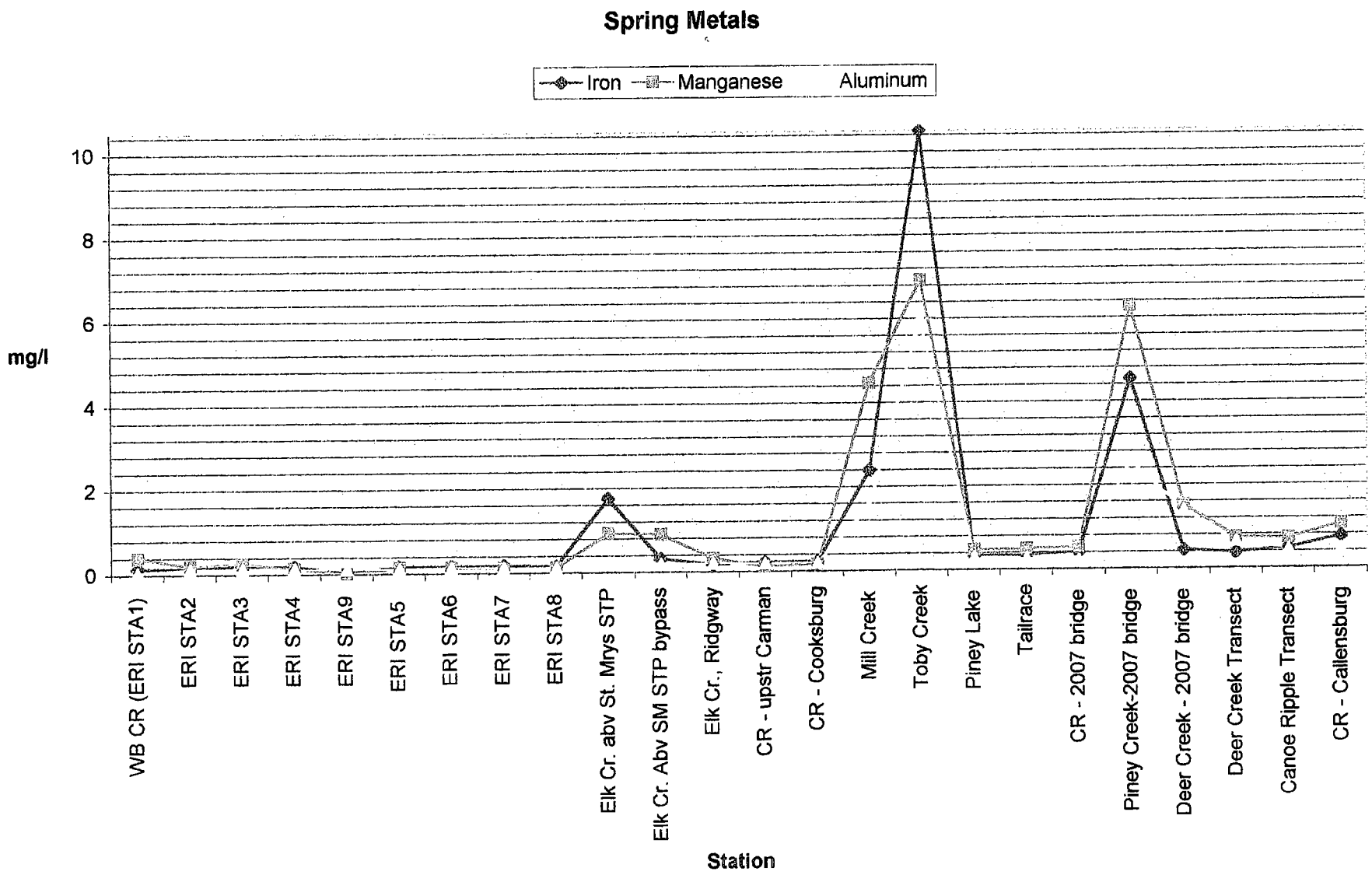

Spring Metals
Iron
Manganese
Aluminum
mg/l
10
8
6
4
2
0
WB CR (ERI STA1)
ERI STA2
ERI STA3
ERI STA4
ERI STA9
ERI STA5
ERI STA6
ERI STA7
ERI STA8
Elk Cr. abv St. Mrys STP
Elk Cr. Abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
CR - Cooksburg
Mill Creek
Toby Creek
Piney Lake
Tailrace
CR - 2007 bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
Deer Creek Transect
Canoe Ripple Transect
CR - Callensburg
Station

Chart E-7

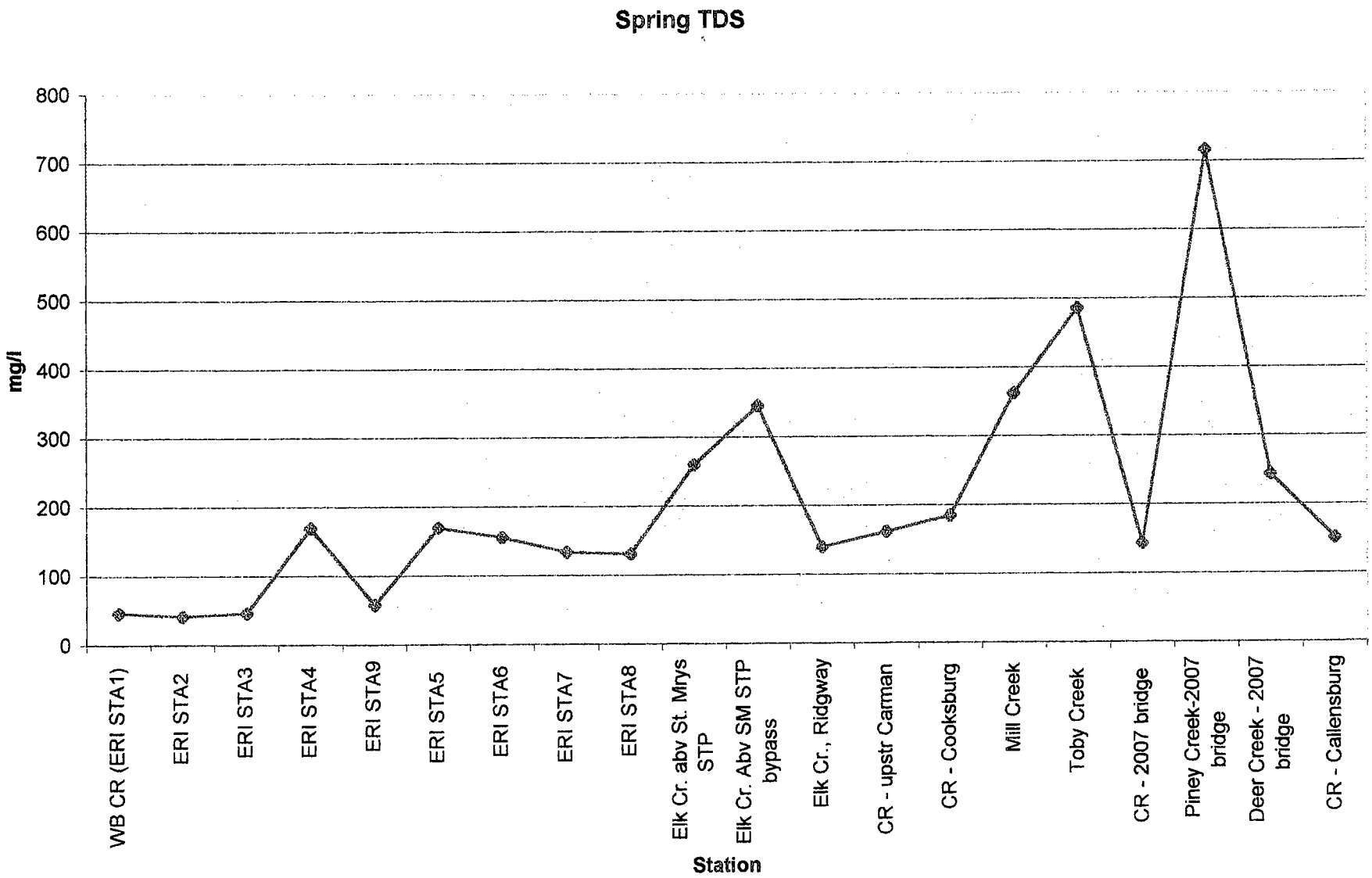

Spring TDS
mg/l
800
700
600
500
400
300
200
100
0
WB CR (ERI STA1)
ERI STA2
ERI STA3
ERI STA4
ERI STA9
ERI STA5
ERI STA6
ERI STA7
ERI STA8
Elk Cr. abv St. Mrys STP
Elk Cr. Abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
CR - Cooksburg
Mill Creek
Toby Creek
CR - 2007 bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
CR - Callensburg
Station

Chart E-8

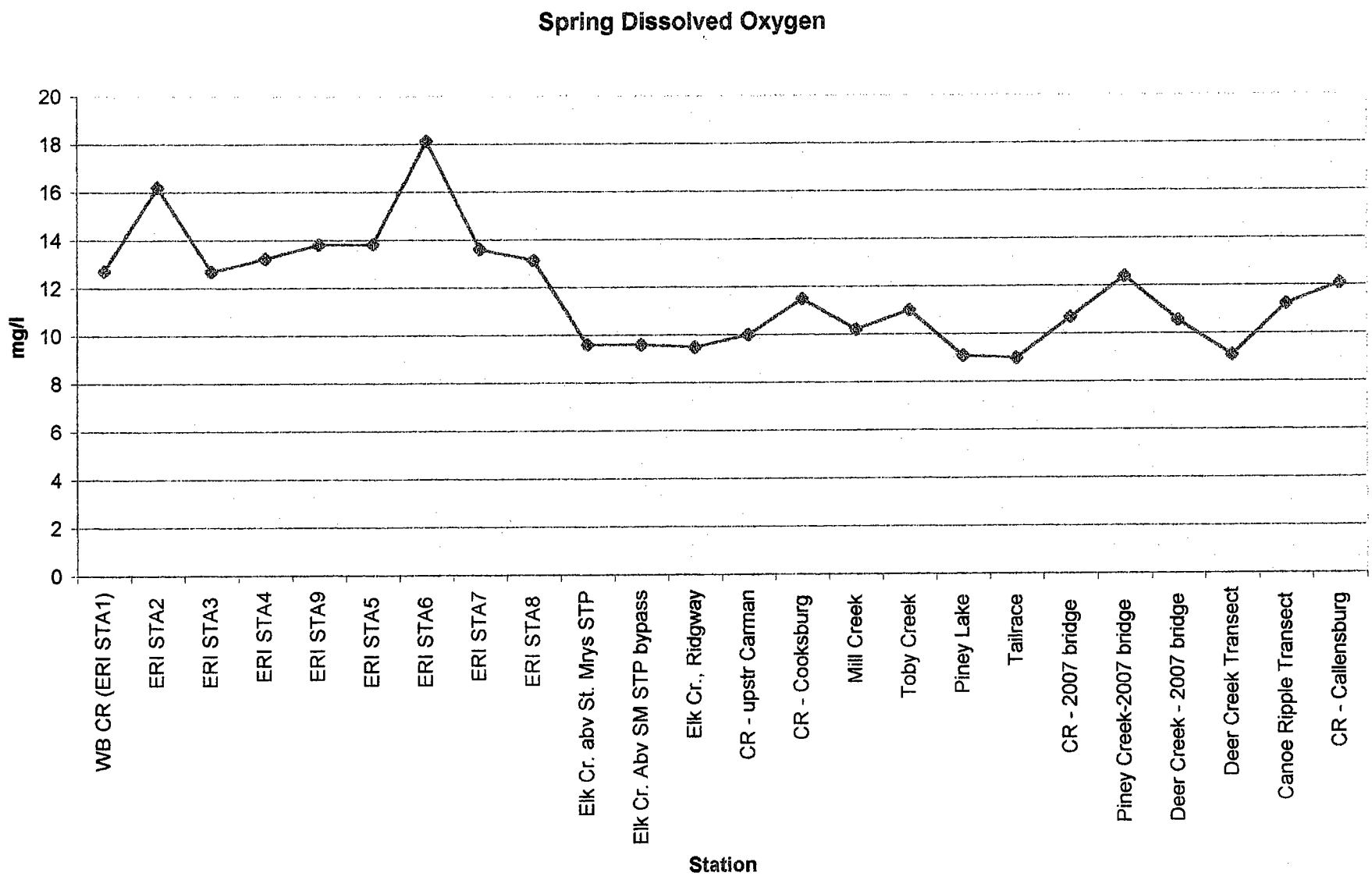

Spring Dissolved Oxygen
mg/l
20
18
16
14
12
10
8
6
4
2
0
WB CR (ERI STA1)
ERI STA2
ERI STA3
ERI STA4
ERI STA9
ERI STA5
ERI STA6
ERI STA7
ERI STA8
Elk Cr. abv St. Mrys STP
Elk Cr. Abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
CR - Cooksburg
Mill Creek
Toby Creek
Piney Lake
Tailrace
CR - 2007 bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
Deer Creek Transect
Canoe Ripple Transect
CR - Callensburg
Station

Chart F-9

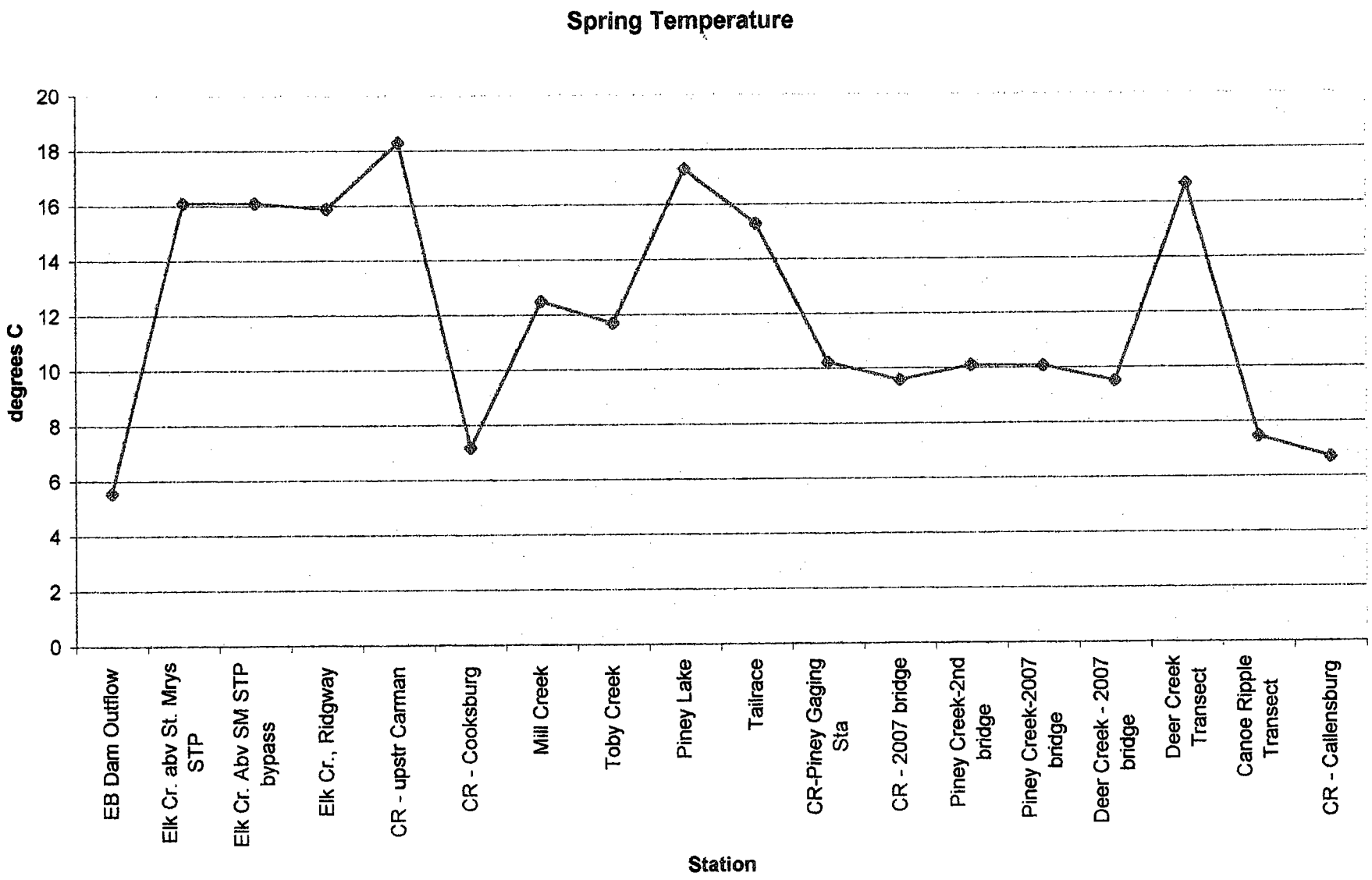

Spring Temperature
degrees C
20
18
16
14
12
10
8
6
4
2
0
EB Dam Outflow
Elk Cr. abv St. Mrys STP
Elk Cr. Abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
CR - Cooksburg
Mill Creek
Toby Creek
Piney Lake
Tailrace
CR-Piney Gaging Sta
CR - 2007 bridge
Piney Creek-2nd bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
Deer Creek Transect
Canoe Ripple Transect
CR - Callensburg
Station

Chart E-10

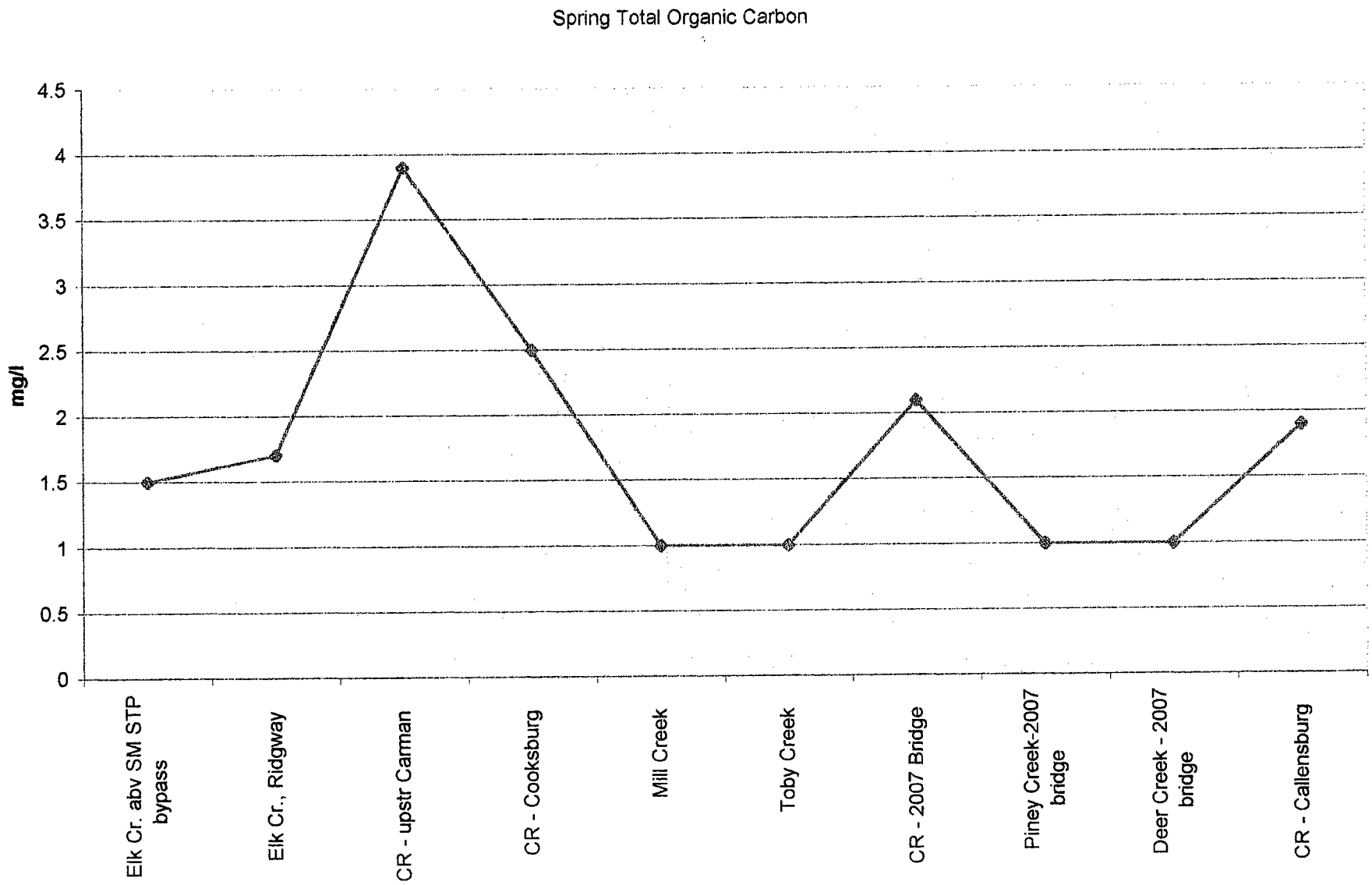

Spring Total Organic Carbon
mg/l
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Elk Cr. abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
CR - Cooksburg
Mill Creek
Toby Creek
CR - 2007 Bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
CR - Callensburg

Chart E-11

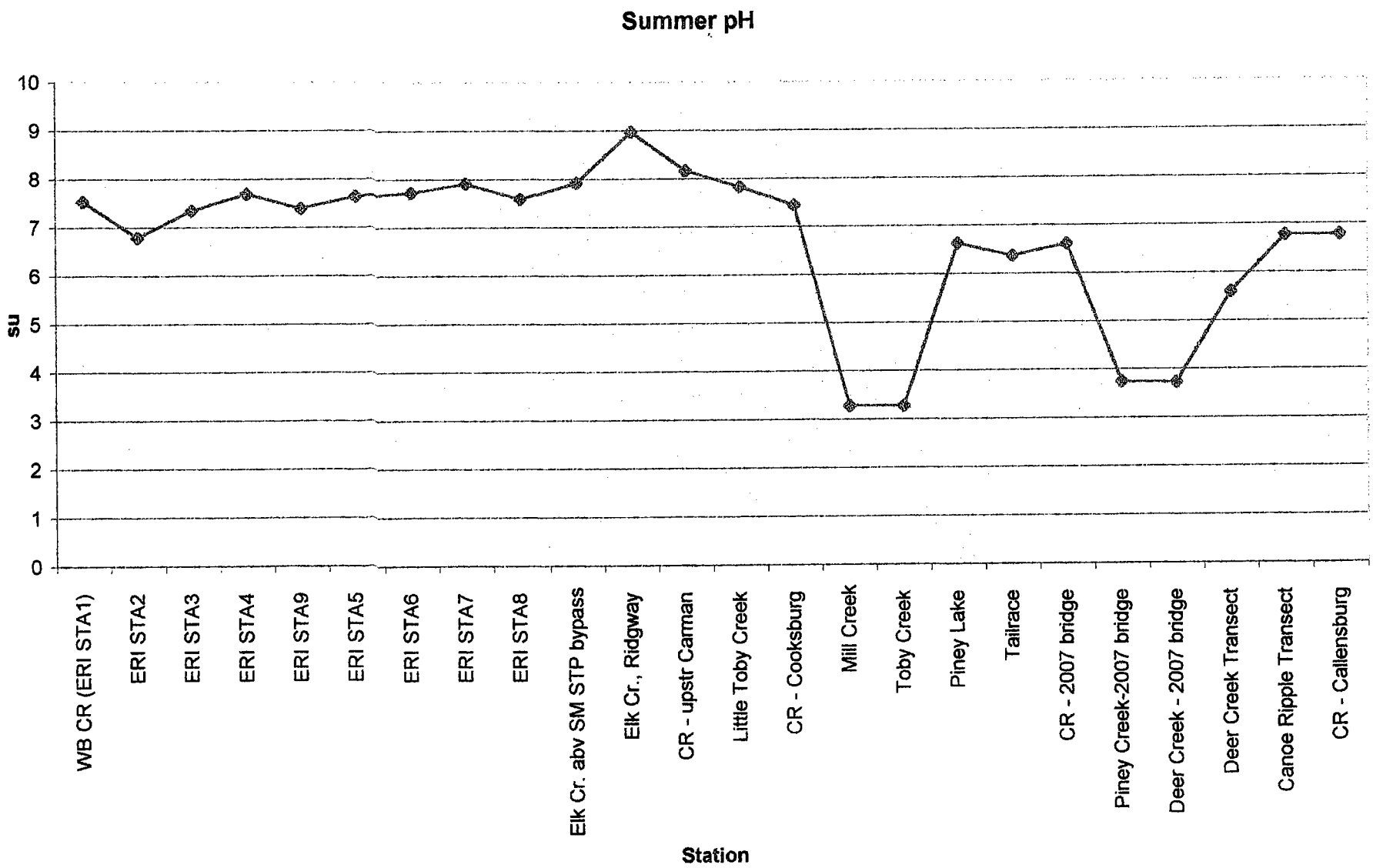

Summer pH
su
10
9
8
7
6
5
4
3
2
1
0
WB CR (ERI STA1)
ERI STA2
ERI STA3
ERI STA4
ERI STA9
ERI STA5
ERI STA6
ERI STA7
ERI STA8
Elk Cr. abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
Little Toby Creek
CR - Cooksburg
Mill Creek
Toby Creek
Piney Lake
Tailrace
CR - 2007 bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
Deer Creek Transect
Canoe Ripple Transect
CR - Callensburg
Station

Chart E-12

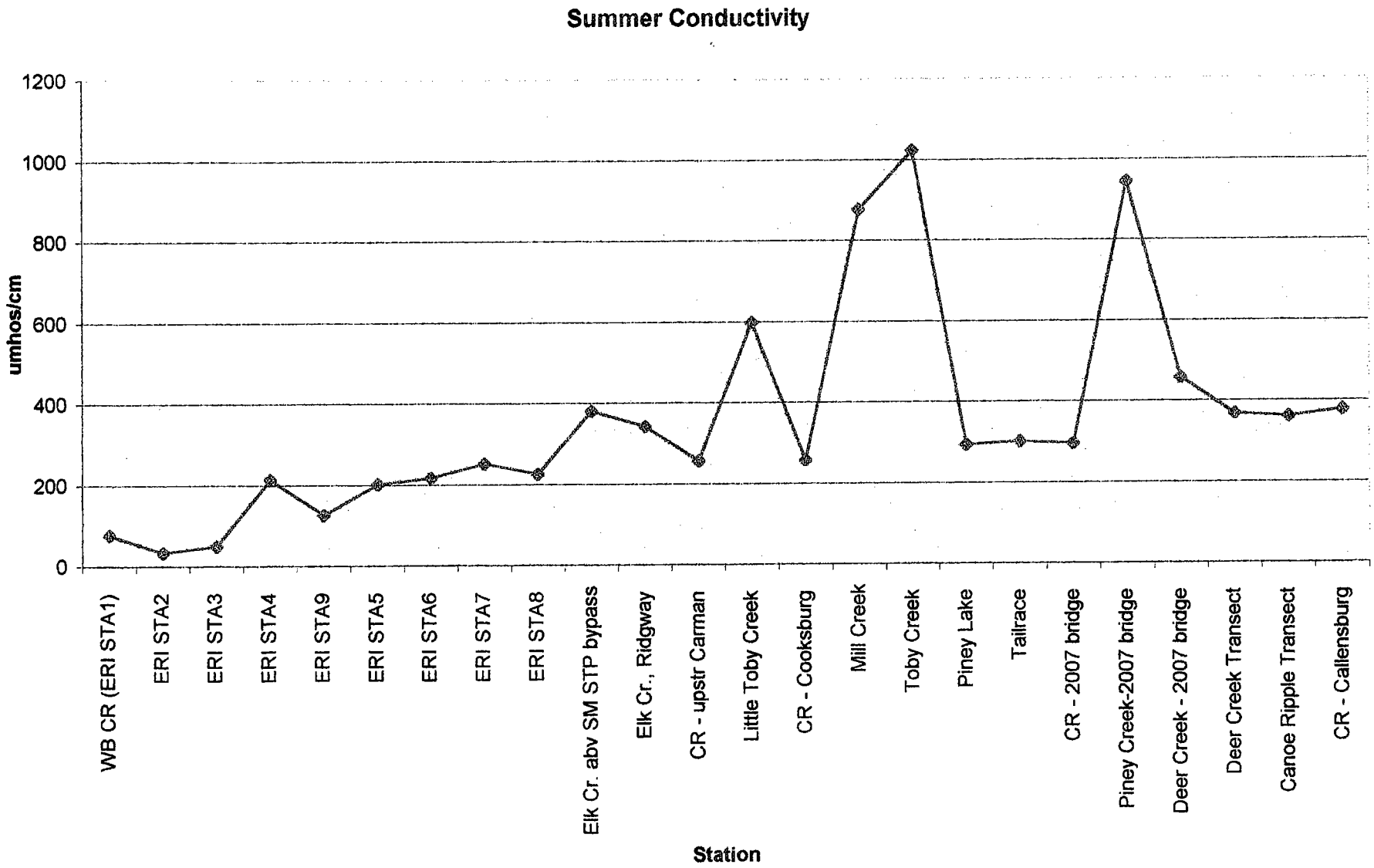

Summer Conductivity
umhos/cm
1200
1000
800
600
400
200
0
WB CR (ERI STA1)
ERI STA2
ERI STA3
ERI STA4
ERI STA9
ERI STA5
ERI STA6
ERI STA7
ERI STA8
Elk Cr. abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
Little Toby Creek
CR - Cooksburg
Mill Creek
Toby Creek
Piney Lake
Tailrace
CR - 2007 bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
Deer Creek Transect
Canoe Ripple Transect
CR - Callensburg
Station

Chart E-13

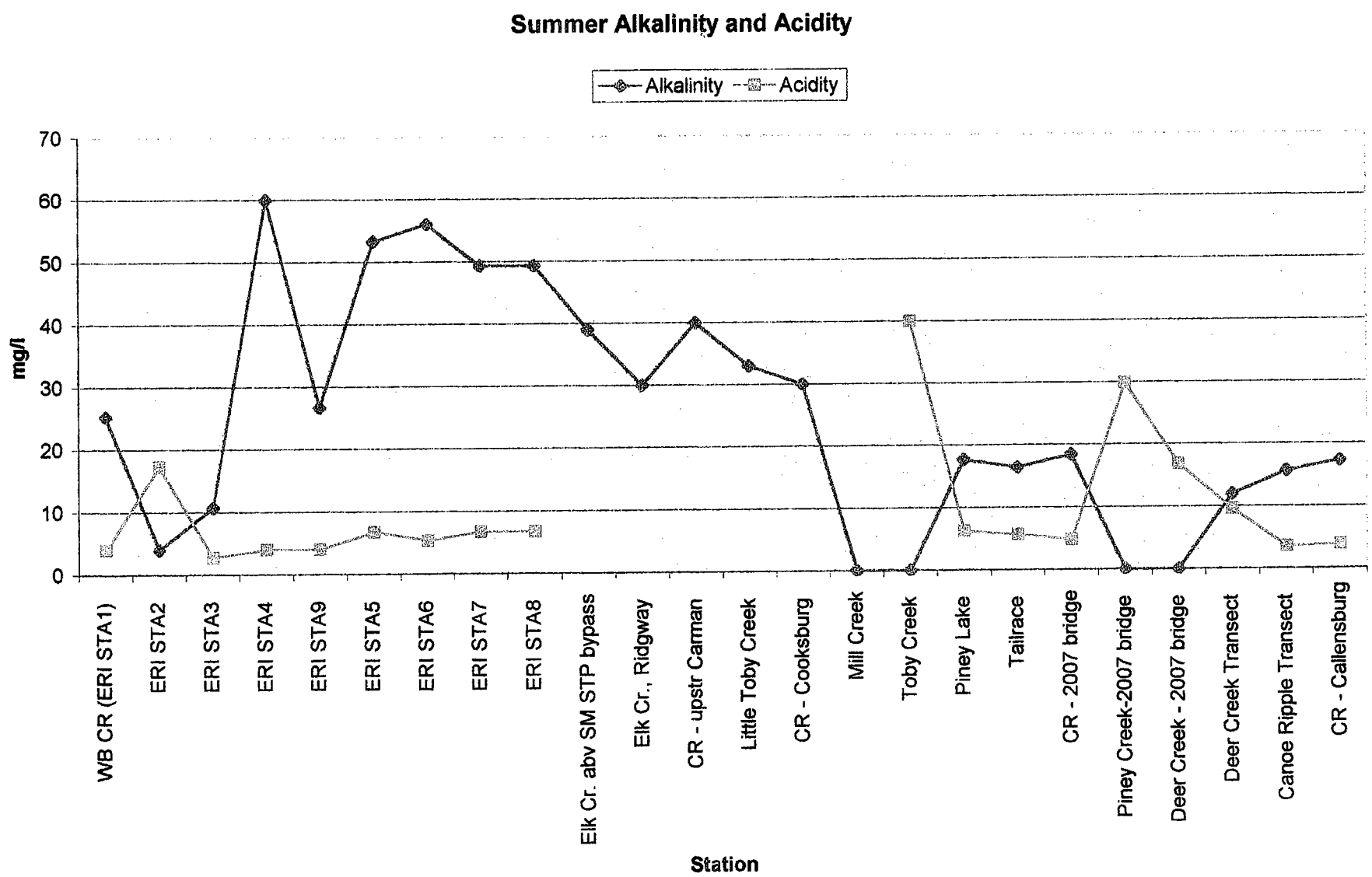

Summer Alkalinity and Acidity
Alkalinity
Acidity
mg/l
70
60
50
40
30
20
10
0
WB CR (ERI STA1)
ERI STA2
ERI STA3
ERI STA4
ERI STA9
ERI STA5
ERI STA6
ERI STA7
ERI STA8
Elk Cr. abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
Little Toby Creek
CR - Cooksburg
Mill Creek
Toby Creek
Piney Lake
Tailrace
CR - 2007 bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
Deer Creek Transect
Canoe Ripple Transect
CR - Callensburg
Station

Chart 5-14

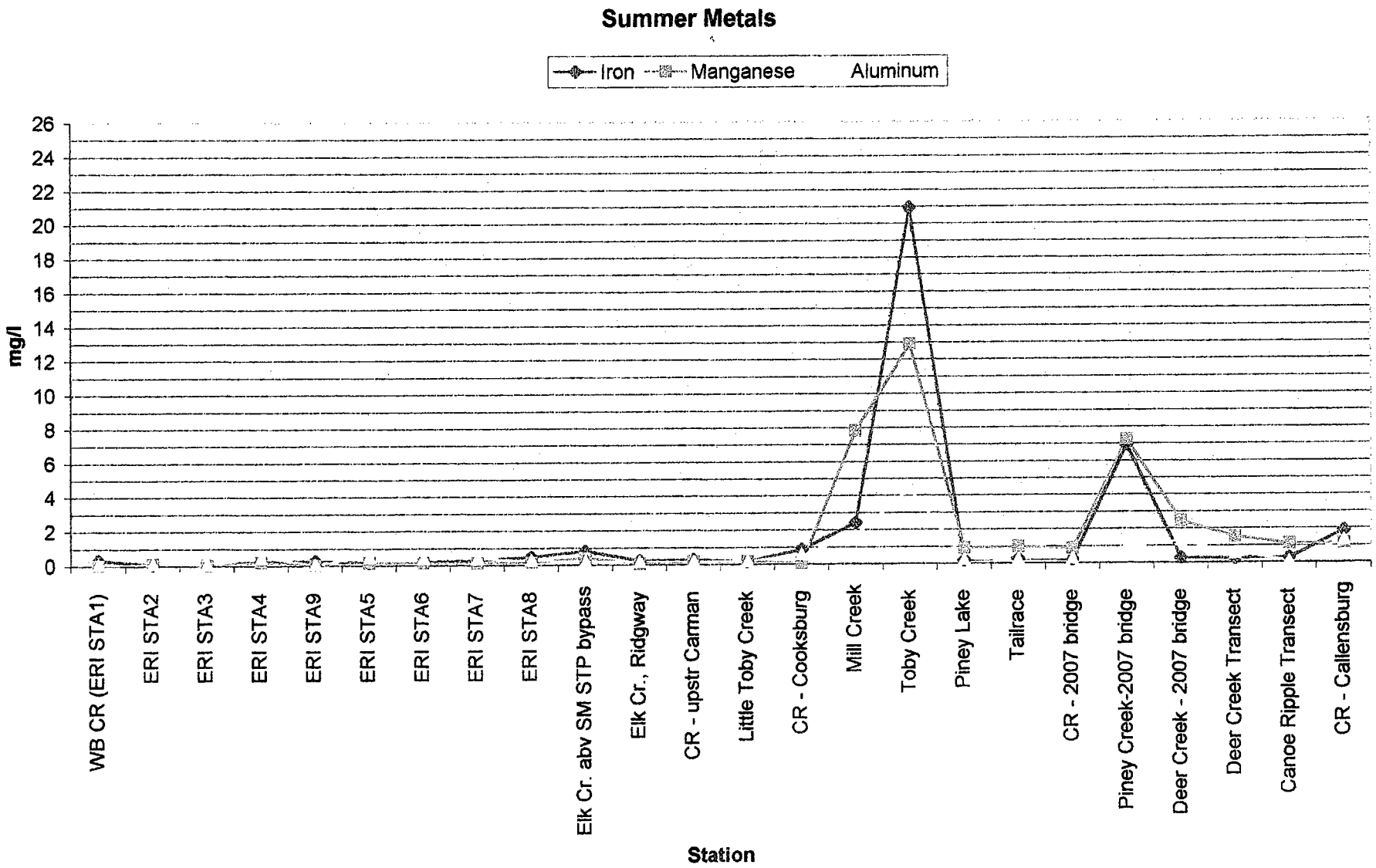

Summer Metals
Iron
Manganese
Aluminum
mg/l
26
24
22
20
18
16
14
12
10
8
6
4
2
0
WB CR (ERI STA1)
ERI STA2
ERI STA3
ERI STA4
ERI STA9
ERI STA5
ERI STA6
ERI STA7
ERI STA8
Elk Cr. abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
Little Toby Creek
CR - Cooksburg
Mill Creek
Toby Creek
Piney Lake
Tailrace
CR - 2007 bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
Deer Creek Transect
Canoe Ripple Transect
CR - Callensburg
Station

Chart E-15

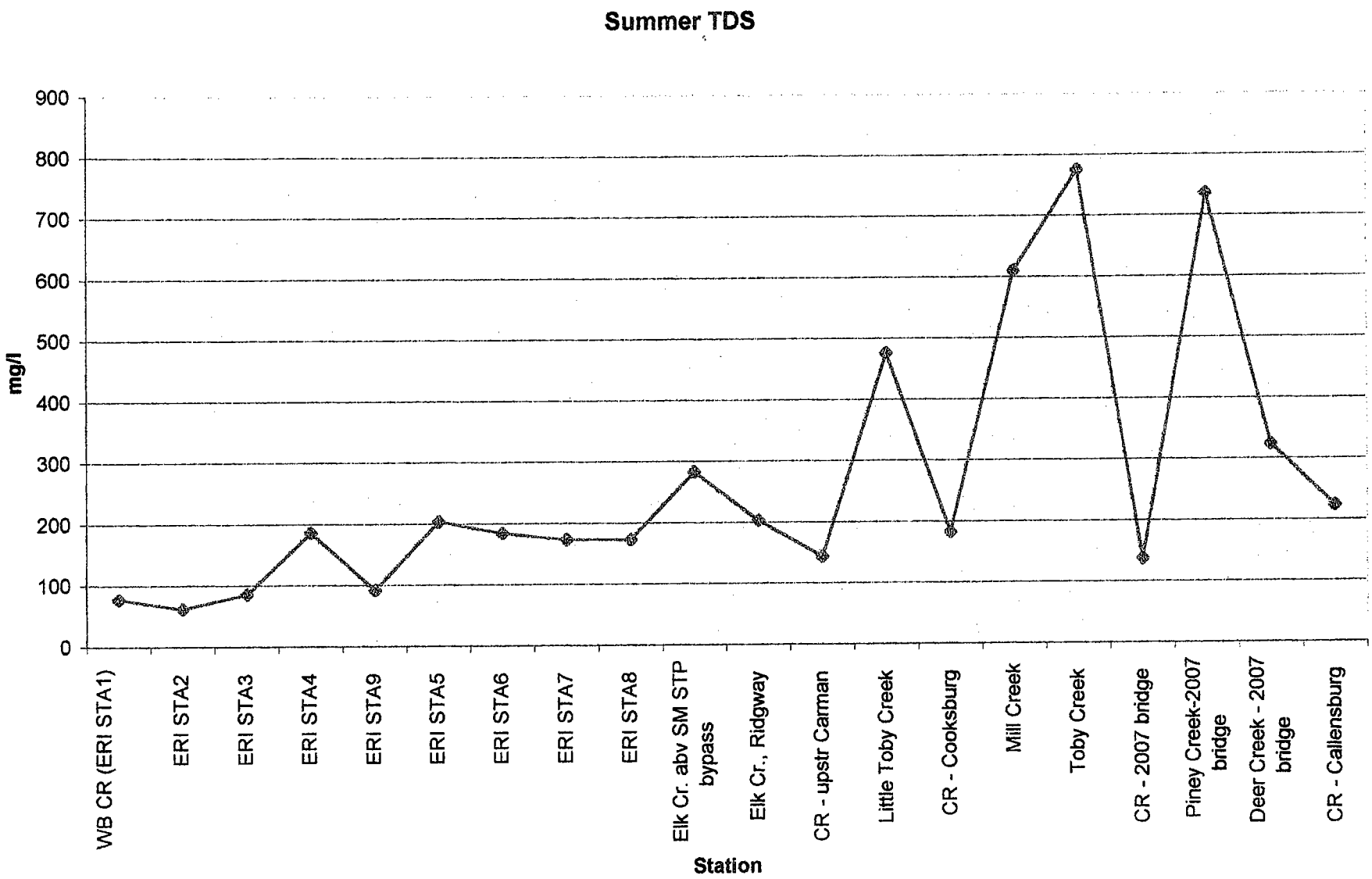

Summer TDS
mg/l
900
800
700
600
500
400
300
200
100
0
WB CR (ERI STA1)
ERI STA2
ERI STA3
ERI STA4
ERI STA9
ERI STA5
ERI STA6
ERI STA7
ERI STA8
Elk Cr. abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
Little Toby Creek
CR - Cooksburg
Mill Creek
Toby Creek
CR - 2007 bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
CR - Callensburg
Station

Chart F-16

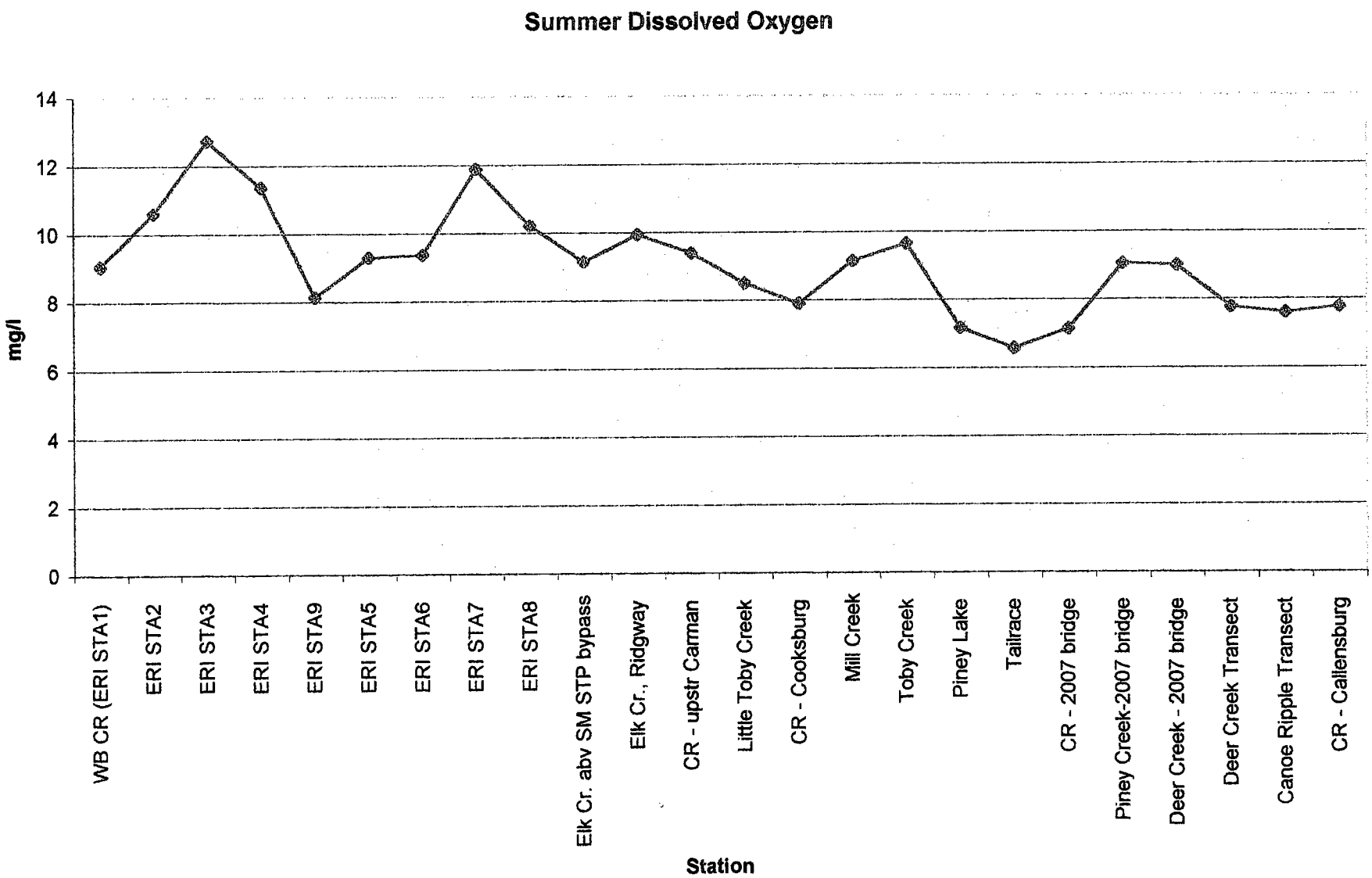

Summer Dissolved Oxygen
mg/l
14
12
10
8
6
4
2
0
WB CR (ERI STA1)
ERI STA2
ERI STA3
ERI STA4
ERI STA9
ERI STA5
ERI STA6
ERI STA7
ERI STA8
Elk Cr. abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
Little Toby Creek
CR - Cooksburg
Mill Creek
Toby Creek
Piney Lake
Tailrace
CR - 2007 bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
Deer Creek Transect
Canoe Ripple Transect
CR - Callensburg
Station

Chart F-17

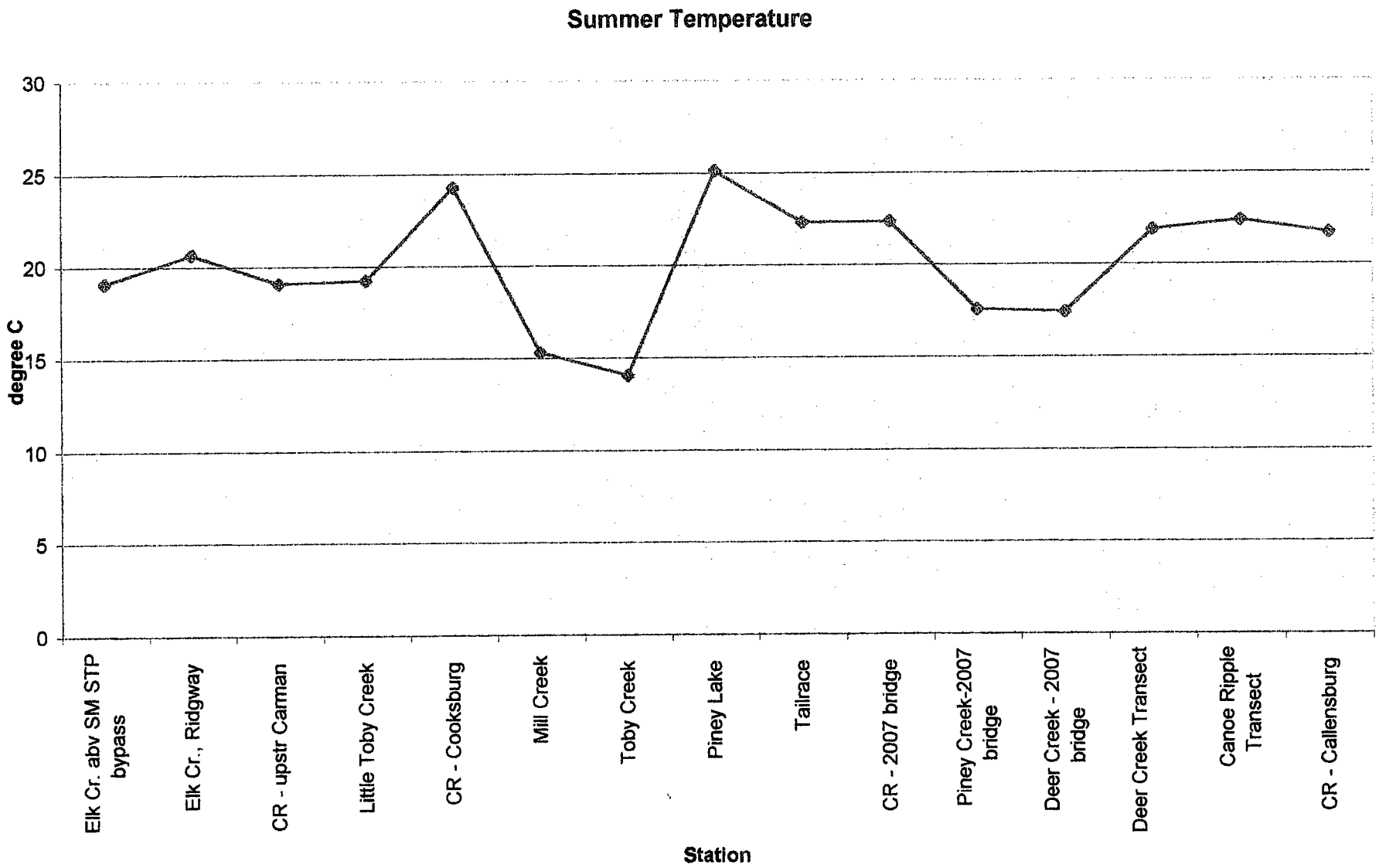

Summer Temperature
degree C
30
25
20
15
10
5
0
Elk Cr. abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
Little Toby Creek
CR - Cooksburg
Mill Creek
Toby Creek
Piney Lake
Tailrace
CR - 2007 bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
Deer Creek Transect
Canoe Ripple Transect
CR - Callensburg
Station

Chart F 18

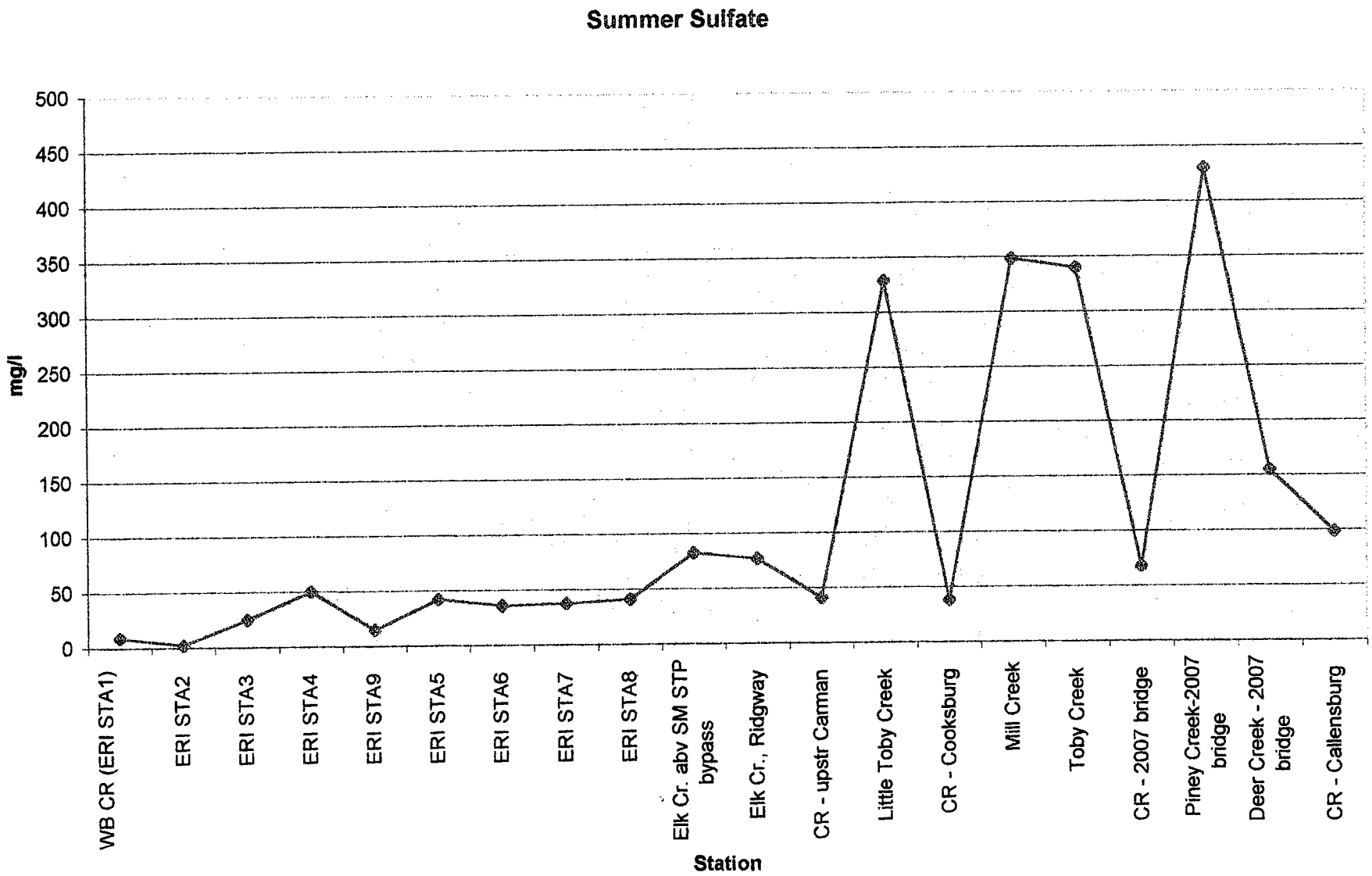

Summer Sulfate
mg/l
500
450
400
350
300
250
200
150
100
50
0
WB CR (ERI STA1)
ERI STA2
ERI STA3
ERI STA4
ERI STA9
ERI STA5
ERI STA6
ERI STA7
ERI STA8
Elk Cr. abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
Little Toby Creek
CR - Cooksburg
Mill Creek
Toby Creek
CR - 2007 bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
CR - Callensburg
Station

Chart 9

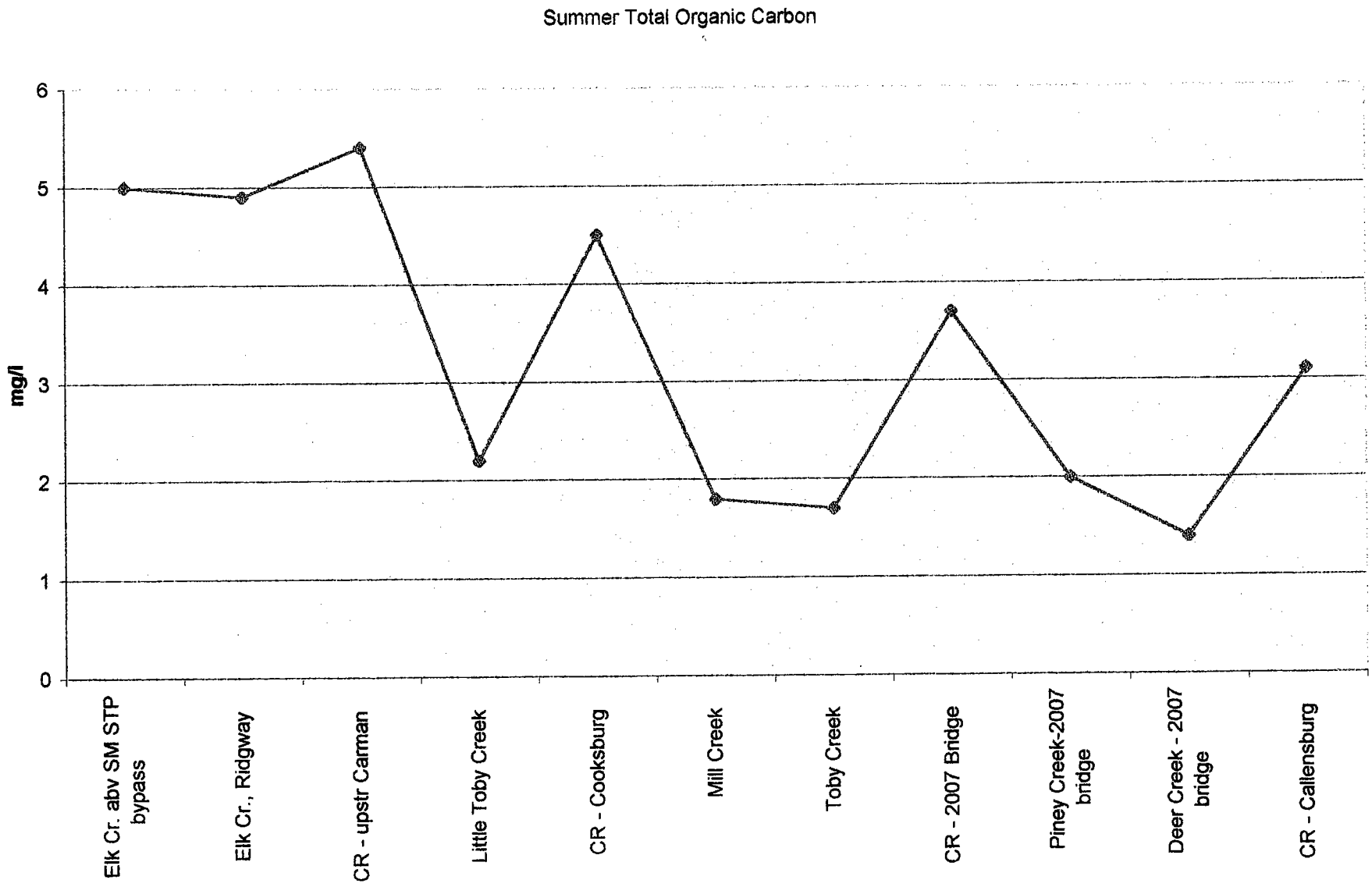

Summer Total Organic Carbon
mg/l
0
1
2
3
4
5
6
Elk Cr. abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
Little Toby Creek
CR - Cooksburg
Mill Creek
Toby Creek
CR - 2007 Bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
CR - Callensburg

Chart E-20

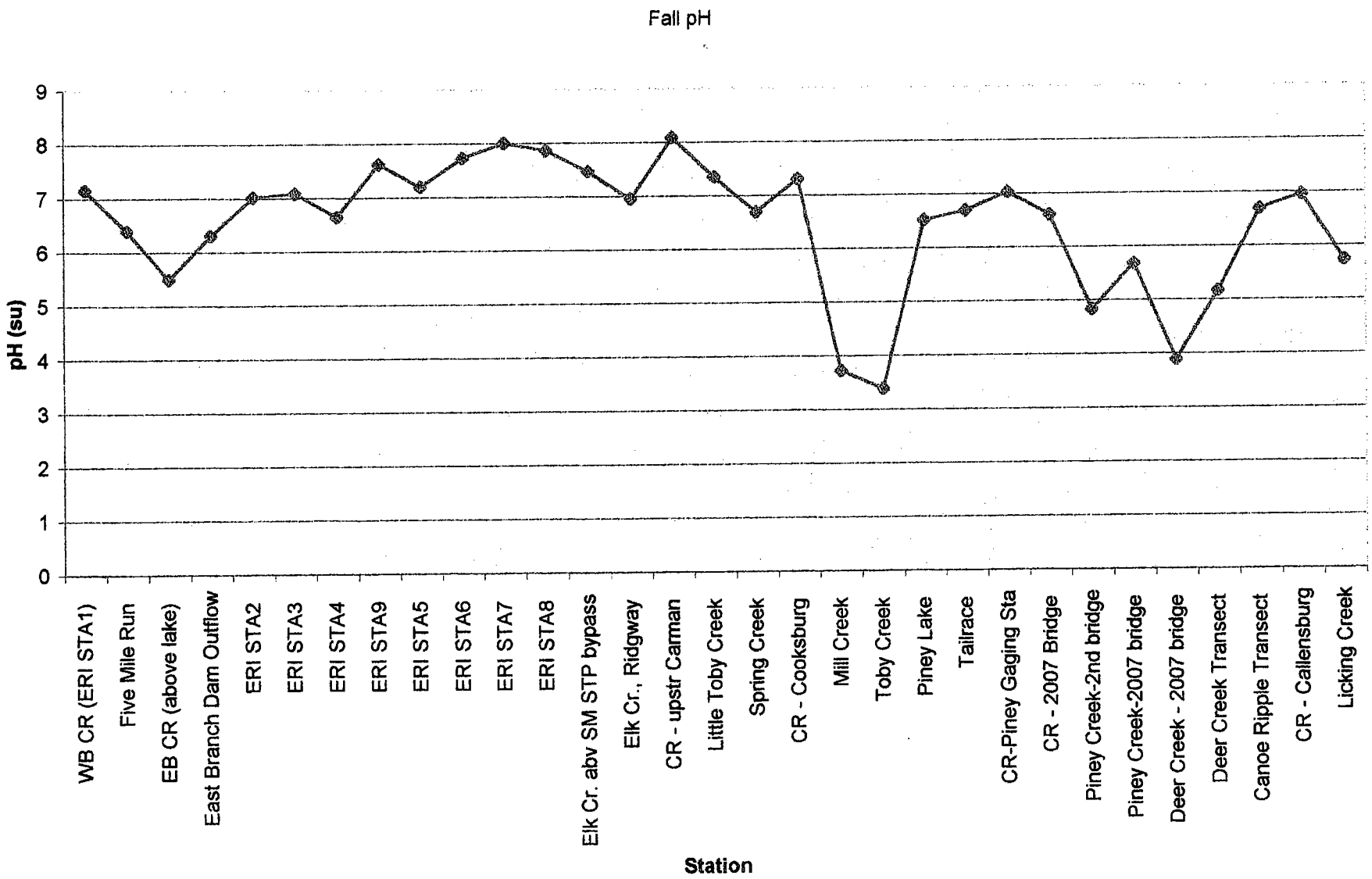

Fall pH
pH (su)
9
8
7
6
5
4
3
2
1
0
WB CR (ERI STA1)
Five Mile Run
EB CR (above lake)
East Branch Dam Outflow
ERI STA2
ERI STA3
ERI STA4
ERI STA9
ERI STA5
ERI STA6
ERI STA7
ERI STA8
Elk Cr. abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
Little Toby Creek
Spring Creek
CR - Cooksburg
Mill Creek
Toby Creek
Piney Lake
Tailrace
CR-Piney Gaging Sta
CR - 2007 Bridge
Piney Creek-2nd bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
Deer Creek Transect
Canoe Ripple Transect
CR - Callensburg
Licking Creek
Station

Chart E-21

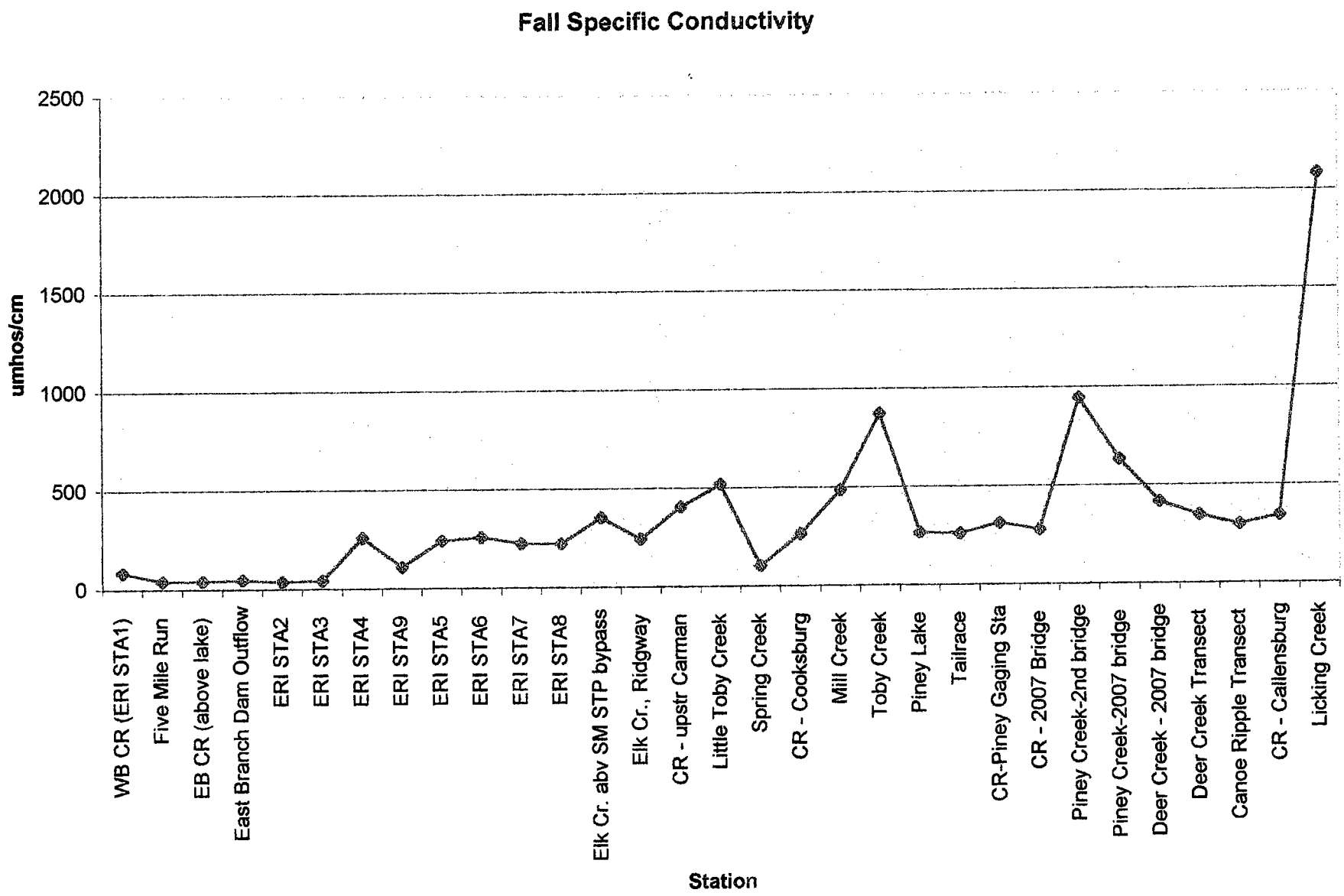

Fall Specific Conductivity
umhos/cm
2500
2000
1500
1000
500
0
WB CR (ERI STA1)
Five Mile Run
EB CR (above lake)
East Branch Dam Outflow
ERI STA2
ERI STA3
ERI STA4
ERI STA9
ERI STA5
ERI STA6
ERI STA7
ERI STA8
Elk Cr. abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
Little Toby Creek
Spring Creek
CR - Cooksburg
Mill Creek
Toby Creek
Piney Lake
Tailrace
CR-Piney Gaging Sta
CR - 2007 Bridge
Piney Creek-2nd bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
Deer Creek Transect
Canoe Ripple Transect
CR - Callensburg
Licking Creek
Station

Chart E-22

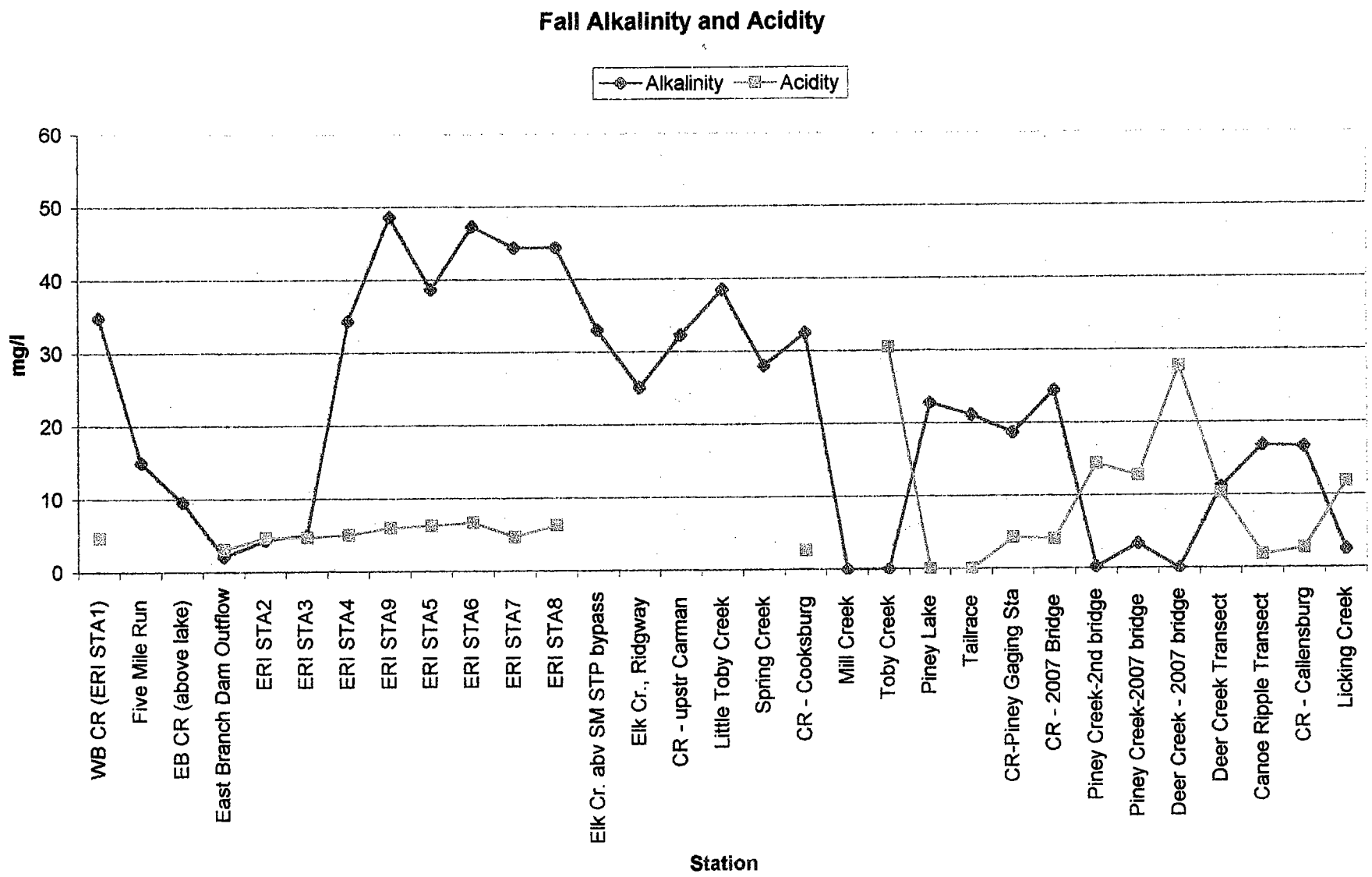

Fall Alkalinity and Acidity
Alkalinity
Acidity
mg/l
60
50
40
30
20
10
0
WB CR (ERI STA1)
Five Mile Run
EB CR (above lake)
East Branch Dam Outflow
ERI STA2
ERI STA3
ERI STA4
ERI STA9
ERI STA5
ERI STA6
ERI STA7
ERI STA8
Elk Cr. abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
Little Toby Creek
Spring Creek
CR - Cooksburg
Mill Creek
Toby Creek
Piney Lake
Tailrace
CR-Piney Gaging Sta
CR - 2007 Bridge
Piney Creek-2nd bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
Deer Creek Transect
Canoe Ripple Transect
CR - Callensburg
Licking Creek
Station

Chart E-23

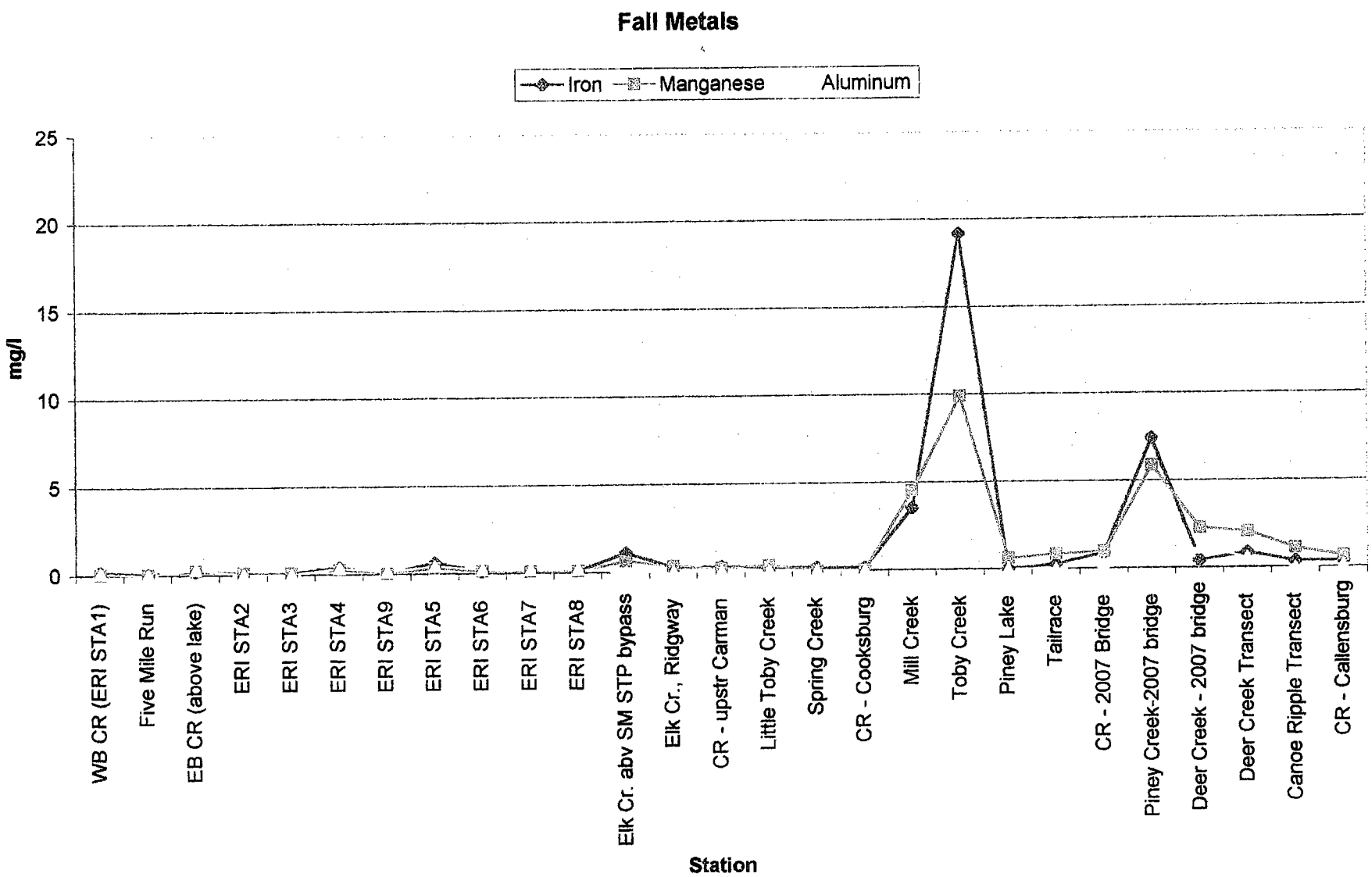

Fall Metals
Iron
Manganese
Aluminum
mg/l
25
20
15
10
5
0
WB CR (ERI STA1)
Five Mile Run
EB CR (above lake)
ERI STA2
ERI STA3
ERI STA4
ERI STA9
ERI STA5
ERI STA6
ERI STA7
ERI STA8
Elk Cr. abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
Little Toby Creek
Spring Creek
CR - Cooksburg
Mill Creek
Toby Creek
Piney Lake
Tailrace
CR - 2007 Bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
Deer Creek Transect
Canoe Ripple Transect
CR - Callensburg
Station

Chart E-24

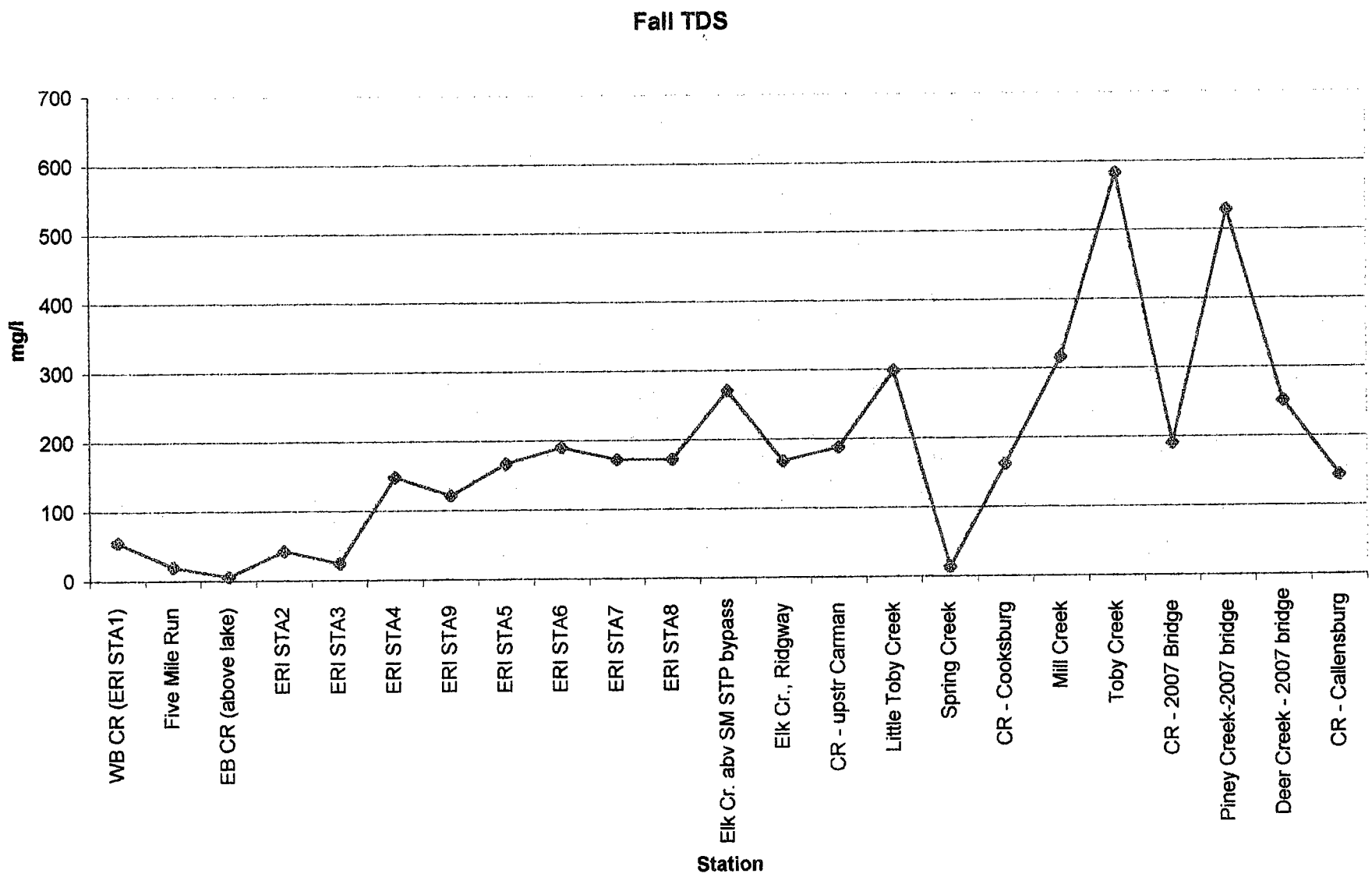

Fall TDS
mg/l
700
600
500
400
300
200
100
0
WB CR (ERI STA1)
Five Mile Run
EB CR (above lake)
ERI STA2
ERI STA3
ERI STA4
ERI STA9
ERI STA5
ERI STA6
ERI STA7
ERI STA8
Elk Cr. abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
Little Toby Creek
Spring Creek
CR - Cooksburg
Mill Creek
Toby Creek
CR - 2007 Bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
CR - Callensburg
Station

Chart E-25

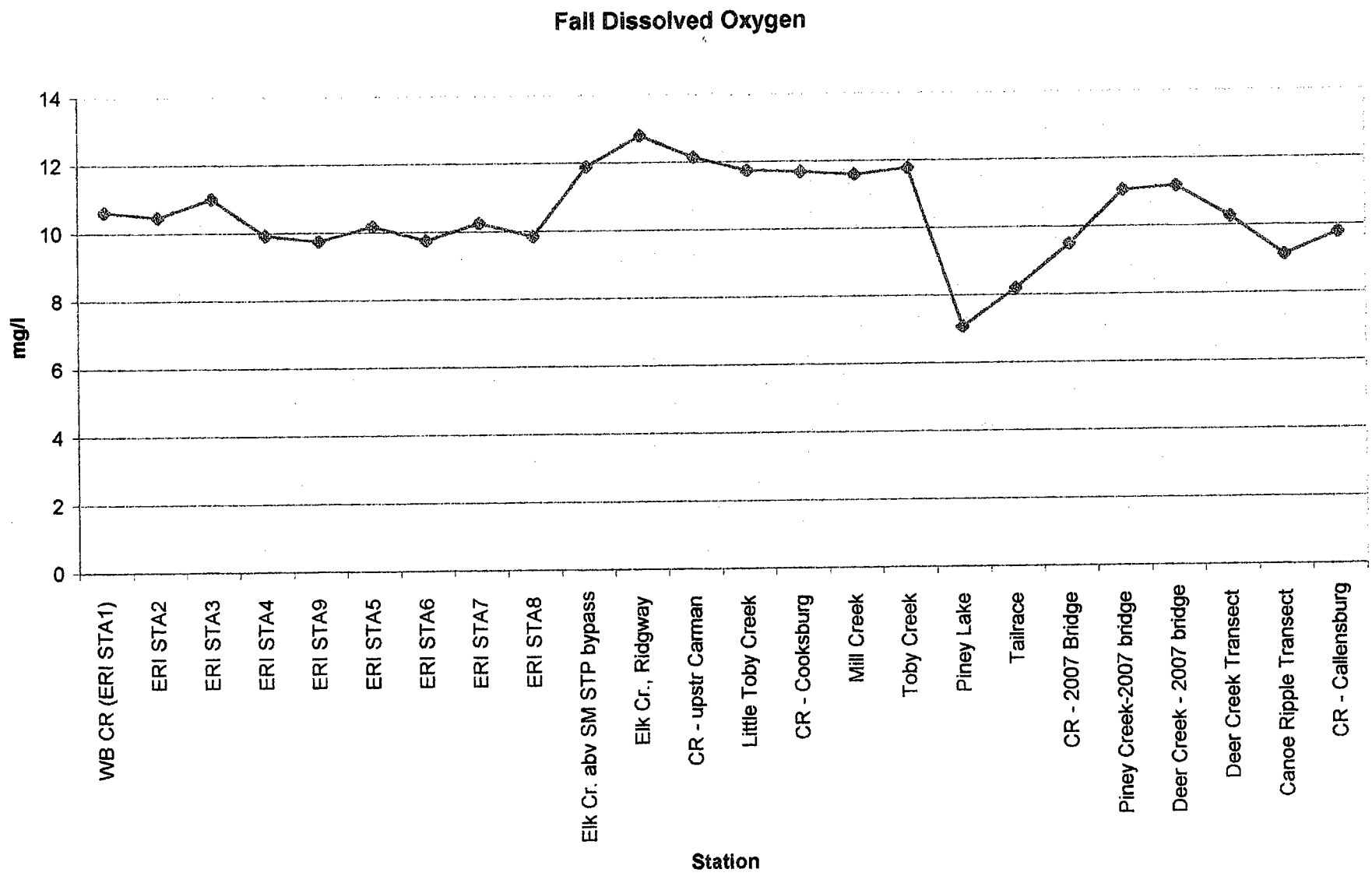

Fall Dissolved Oxygen
mg/l
14
12
10
8
6
4
2
0
WB CR (ERI STA1)
ERI STA2
ERI STA3
ERI STA4
ERI STA9
ERI STA5
ERI STA6
ERI STA7
ERI STA8
Elk Cr. abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
Little Toby Creek
CR - Cooksburg
Mill Creek
Toby Creek
Piney Lake
Tailrace
CR - 2007 Bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
Deer Creek Transect
Canoe Ripple Transect
CR - Callensburg
Station

Chart E-26

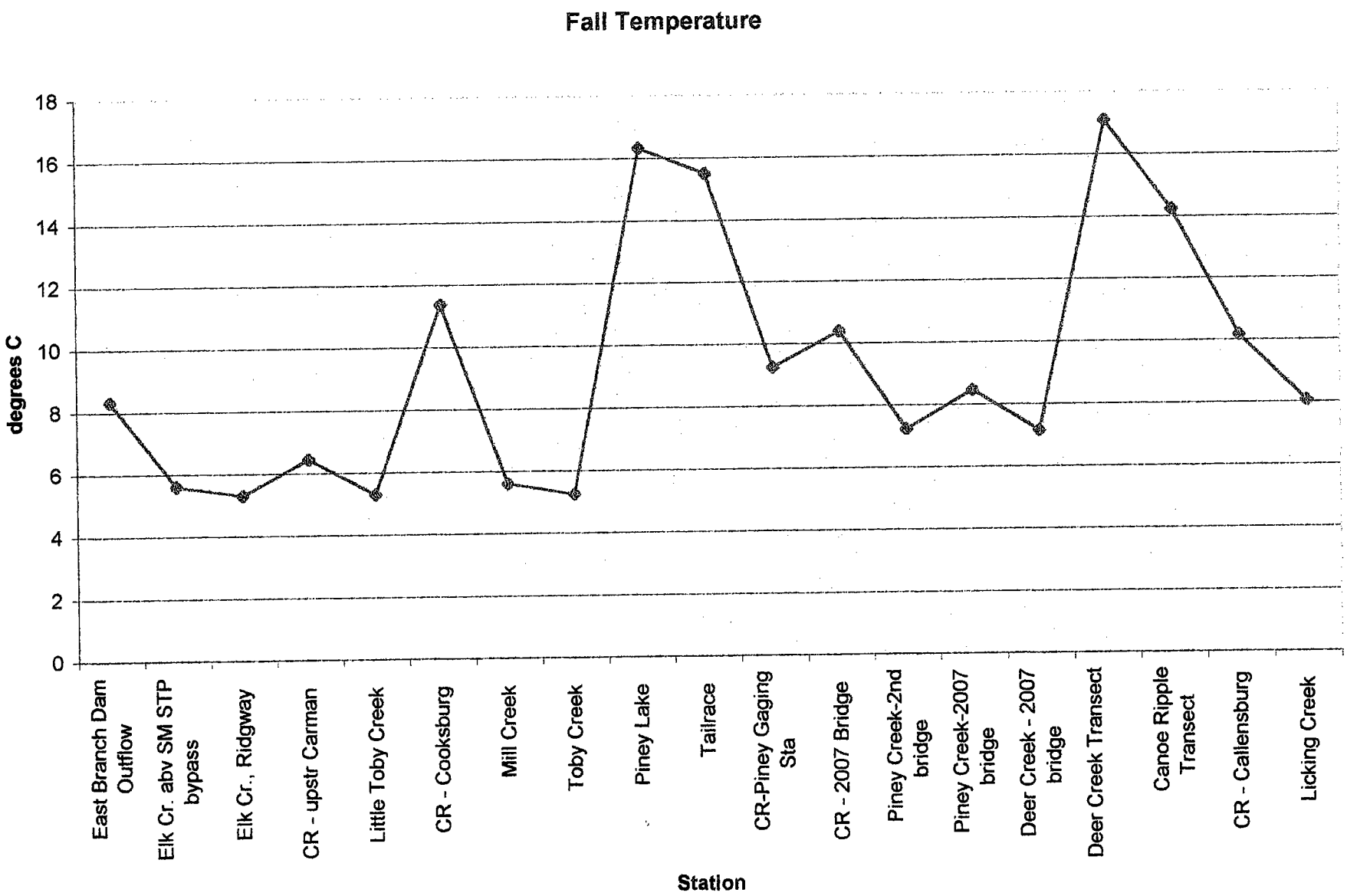

Fall Temperature
degrees C
18
16
14
12
10
8
6
4
2
0
East Branch Dam Outflow
Elk Cr. abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
Little Toby Creek
CR - Cooksburg
Mill Creek
Toby Creek
Piney Lake
Tailrace
CR-Piney Gaging Sta
CR - 2007 Bridge
Piney Creek-2nd bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
Deer Creek Transect
Canoe Ripple Transect
CR - Callensburg
Licking Creek
Station

Chart 27

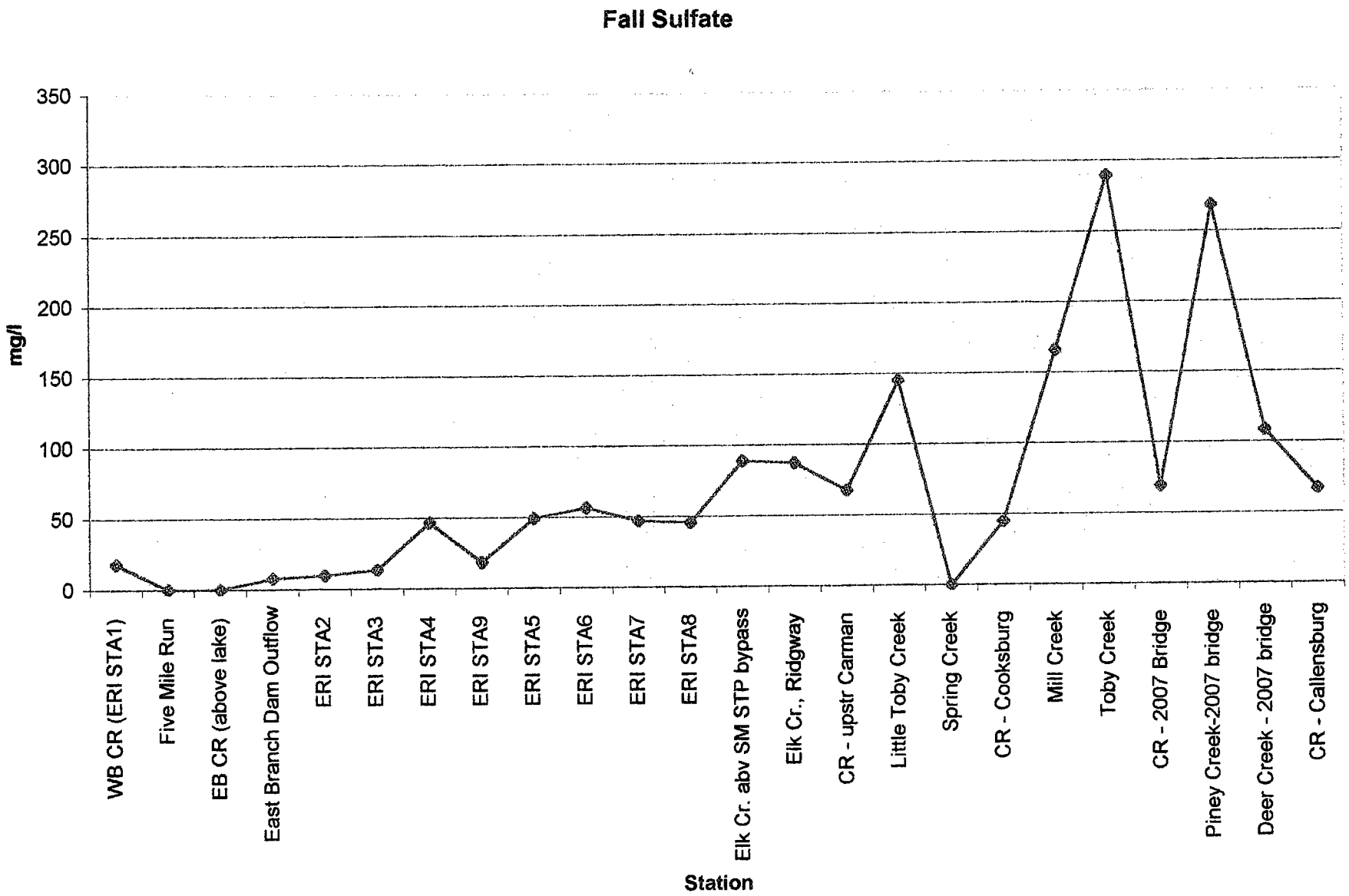

Fall Sulfate
mg/l
350
300
250
200
150
100
50
0
WB CR (ERI STA1)
Five Mile Run
EB CR (above lake)
East Branch Dam Outflow
ERI STA2
ERI STA3
ERI STA4
ERI STA9
ERI STA5
ERI STA6
ERI STA7
ERI STA8
Elk Cr. abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
Little Toby Creek
Spring Creek
CR - Cooksburg
Mill Creek
Toby Creek
CR - 2007 Bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
CR - Callensburg
Station

Chart E-28

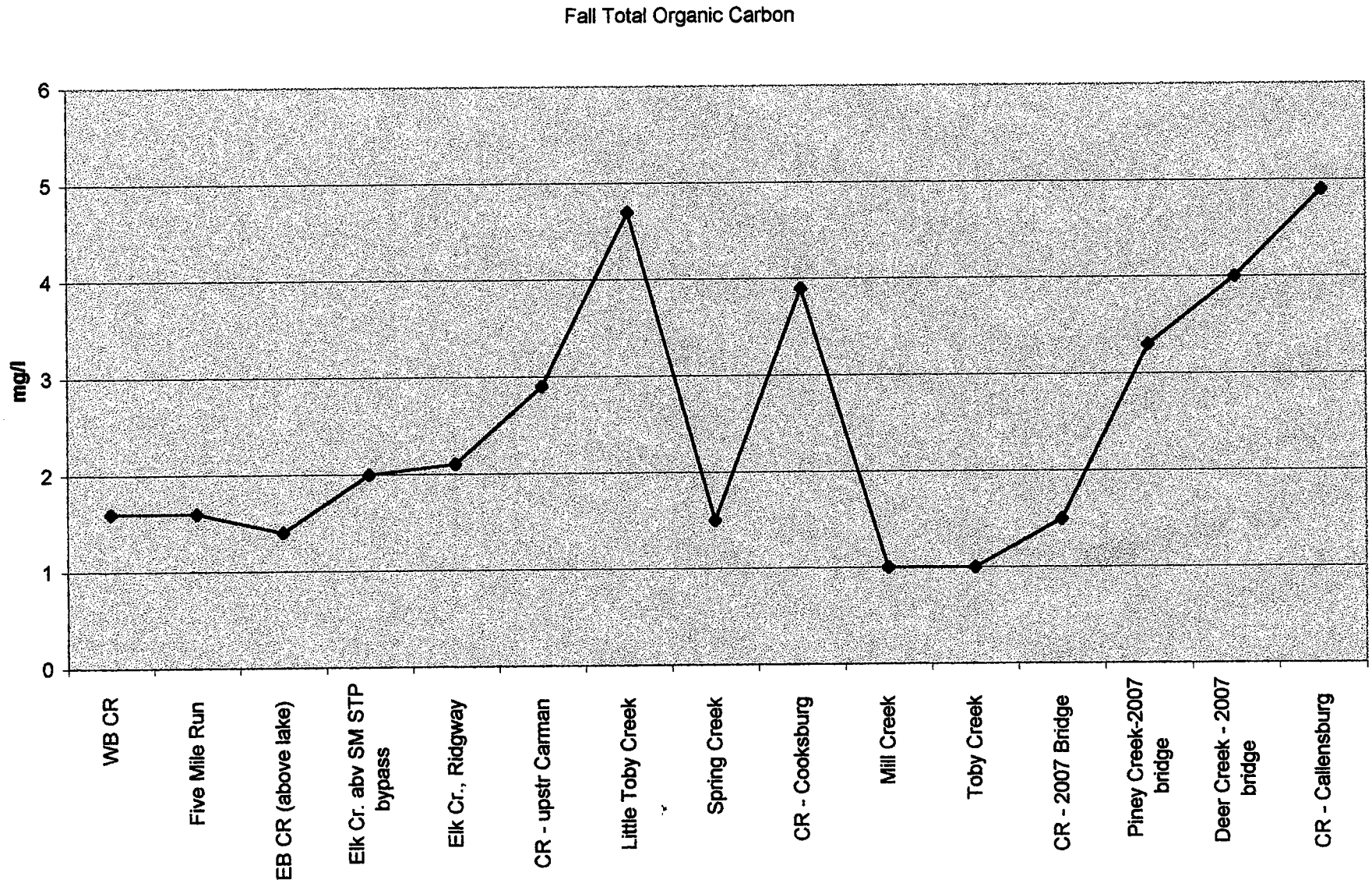

Fall Total Organic Carbon
mg/l
0
1
2
3
4
5
6
WB CR
Five Mile Run
EB CR (above lake)
Elk Cr. abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
Little Toby Creek
Spring Creek
CR - Cooksburg
Mill Creek
Toby Creek
CR - 2007 Bridge
Piney Creek-2007 bridge
Deer Creek - 2007 bridge
CR - Callensburg

Chart E-29

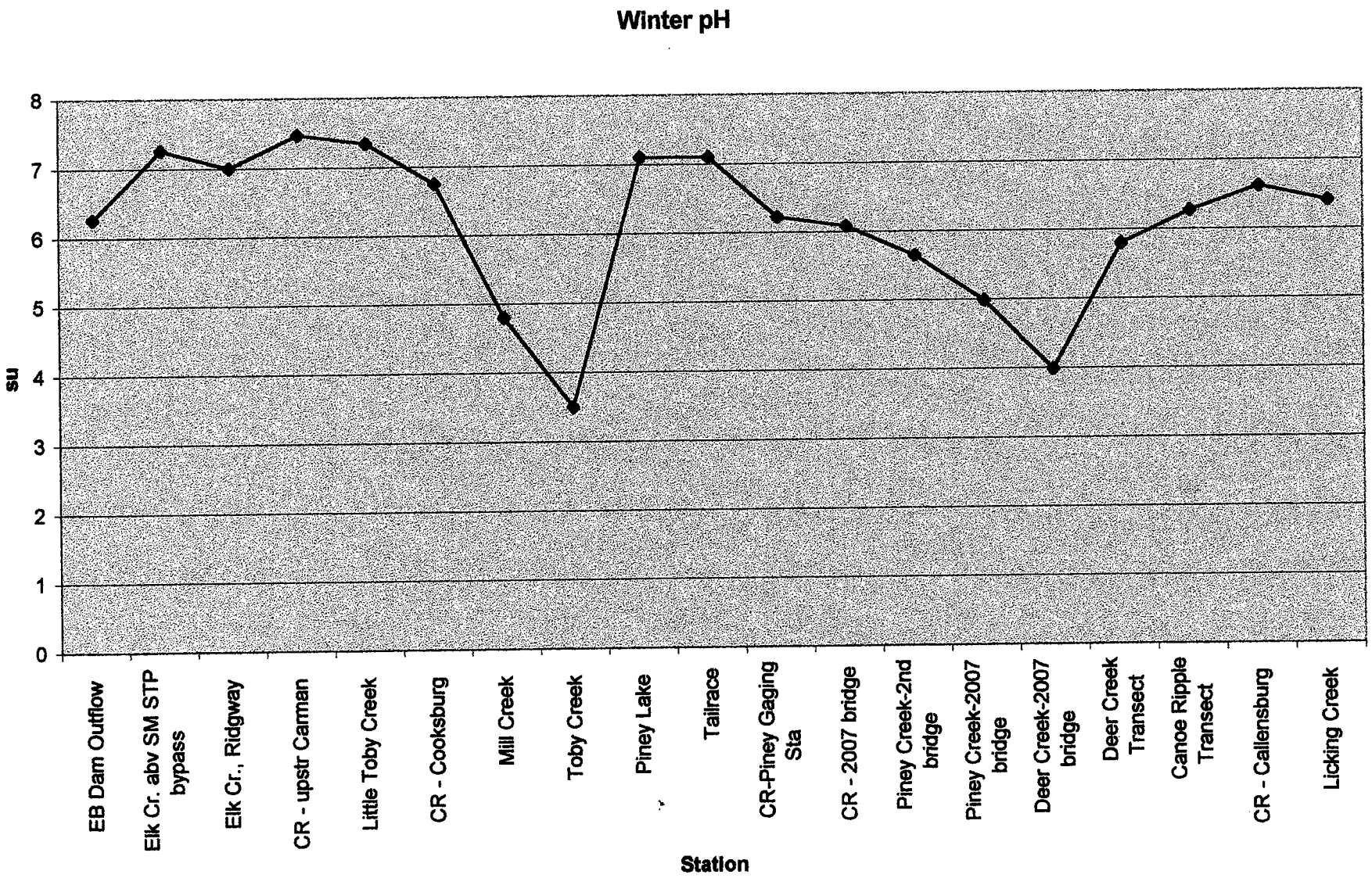

Winter pH
su
0
1
2
3
4
5
6
7
8
EB Dam Outflow
Elk Cr. abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
Little Toby Creek
CR - Cooksburg
Mill Creek
Toby Creek
Piney Lake
Tailrace
CR-Piney Gaging Sta
CR - 2007 bridge
Piney Creek-2nd bridge
Piney Creek-2007 bridge
Deer Creek-2007 bridge
Deer Creek Transect
Canoe Ripple Transect
CR - Callensburg
Licking Creek
Station

Chart F-20

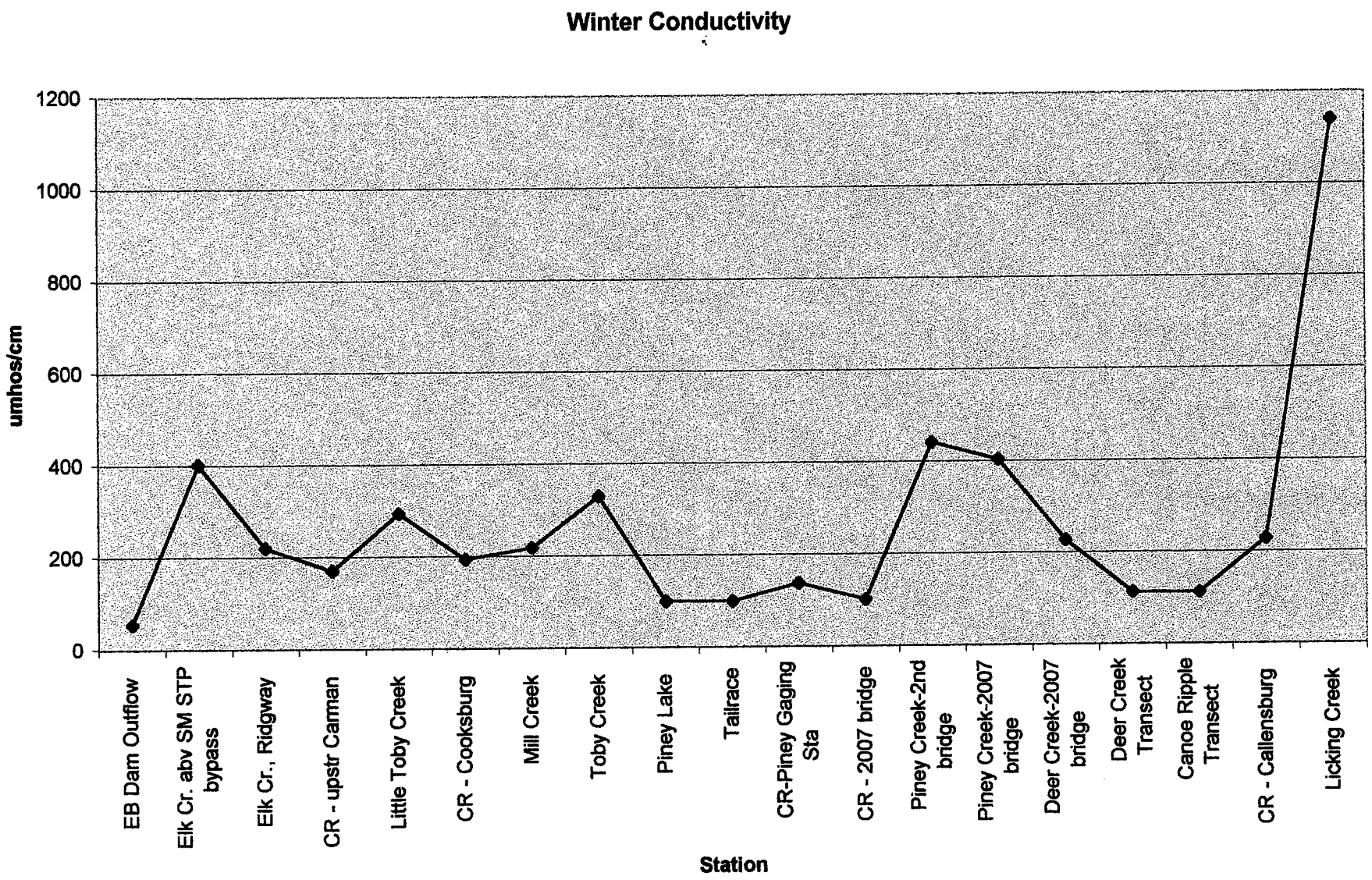
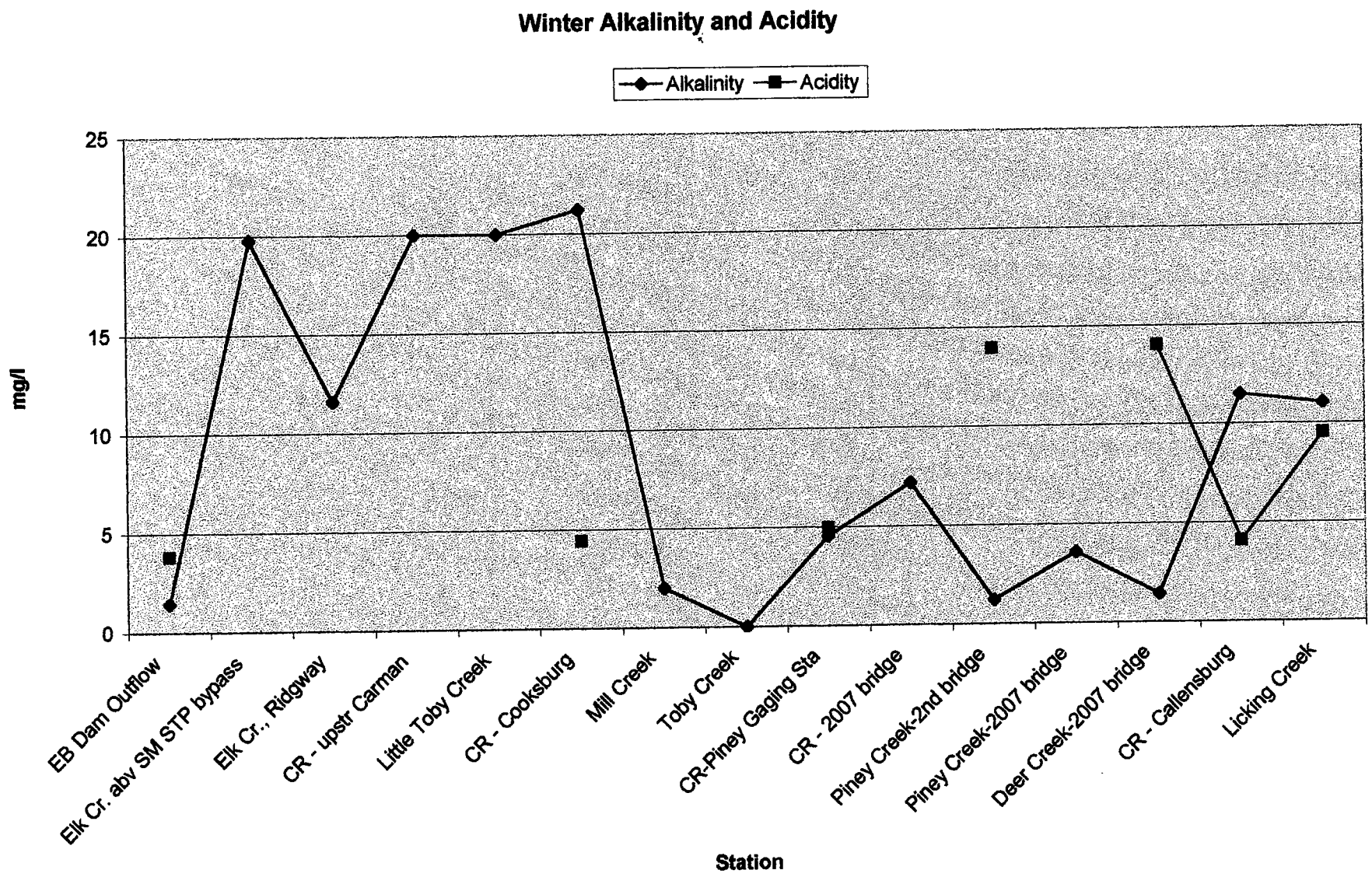

Winter Conductivity
umhos/cm
1200
1000
800
600
400
200
0
EB Dam Outflow
Elk Cr. abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
Little Toby Creek
CR - Cooksburg
Mill Creek
Toby Creek
Piney Lake
Tailrace
CR-Piney Gaging Sta
CR - 2007 bridge
Piney Creek-2nd bridge
Piney Creek-2007 bridge
Deer Creek-2007 bridge
Deer Creek Transect
Canoe Ripple Transect
CR - Callensburg
Licking Creek
Station

Chart E-31


Winter Alkalinity and Acidity
Alkalinity
Acidity
mg/l
25
20
15
10
5
0
EB Dam Outflow
Elk Cr. abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
Little Toby Creek
CR - Cooksburg
Mill Creek
Toby Creek
CR-Piney Gaging Sta
CR - 2007 bridge
Piney Creek-2nd bridge
Piney Creek-2007 bridge
Deer Creek-2007 bridge
CR - Callensburg
Licking Creek
Station

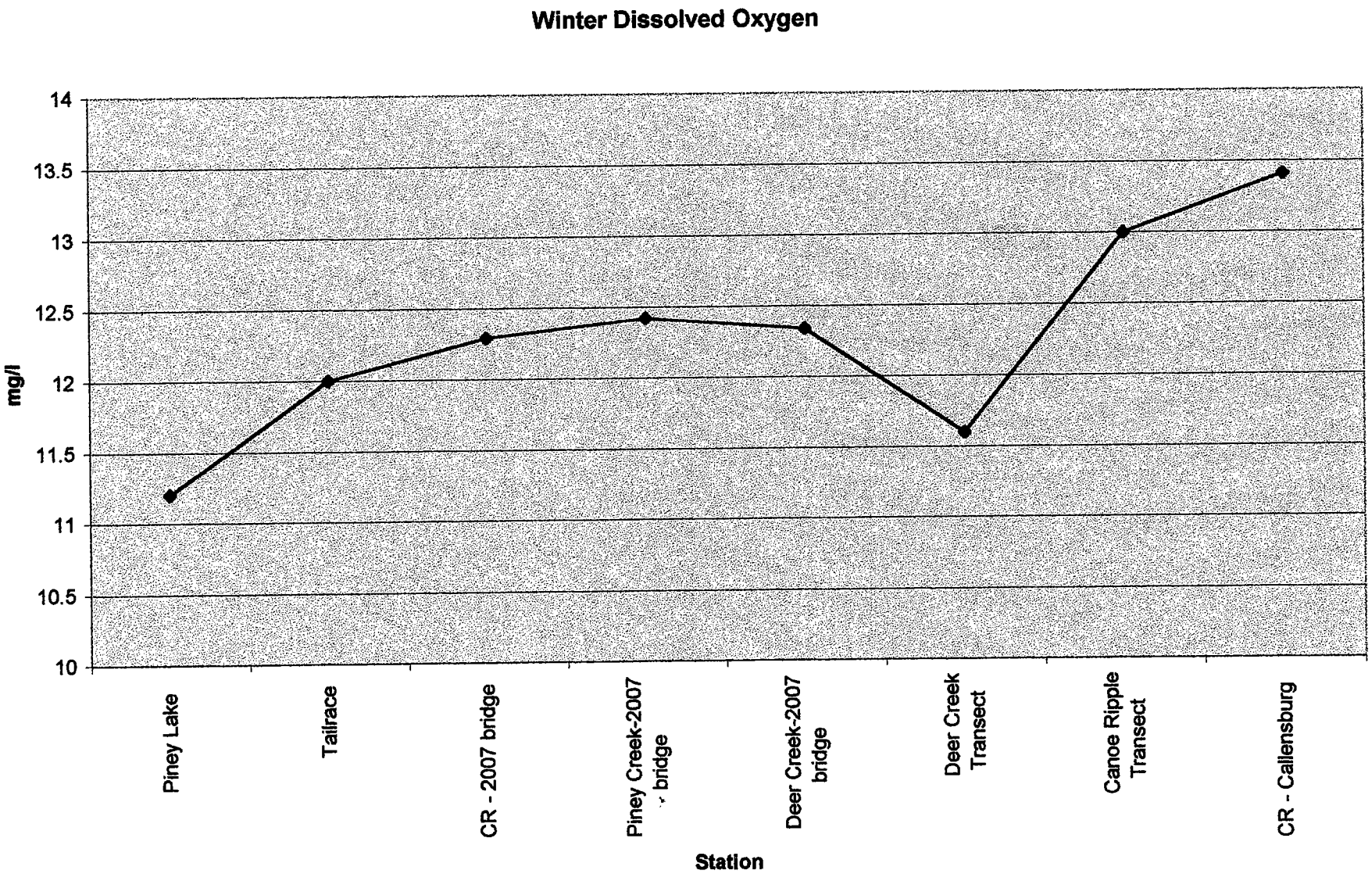

Winter Dissolved Oxygen
mg/l
14
13.5
13
12.5
12
11.5
11
10.5
10
Piney Lake
Tailrace
CR - 2007 bridge
Piney Creek-2007 bridge
Deer Creek-2007 bridge
Deer Creek Transect
Canoe Ripple Transect
CR - Callensburg
Station

Chart F-23

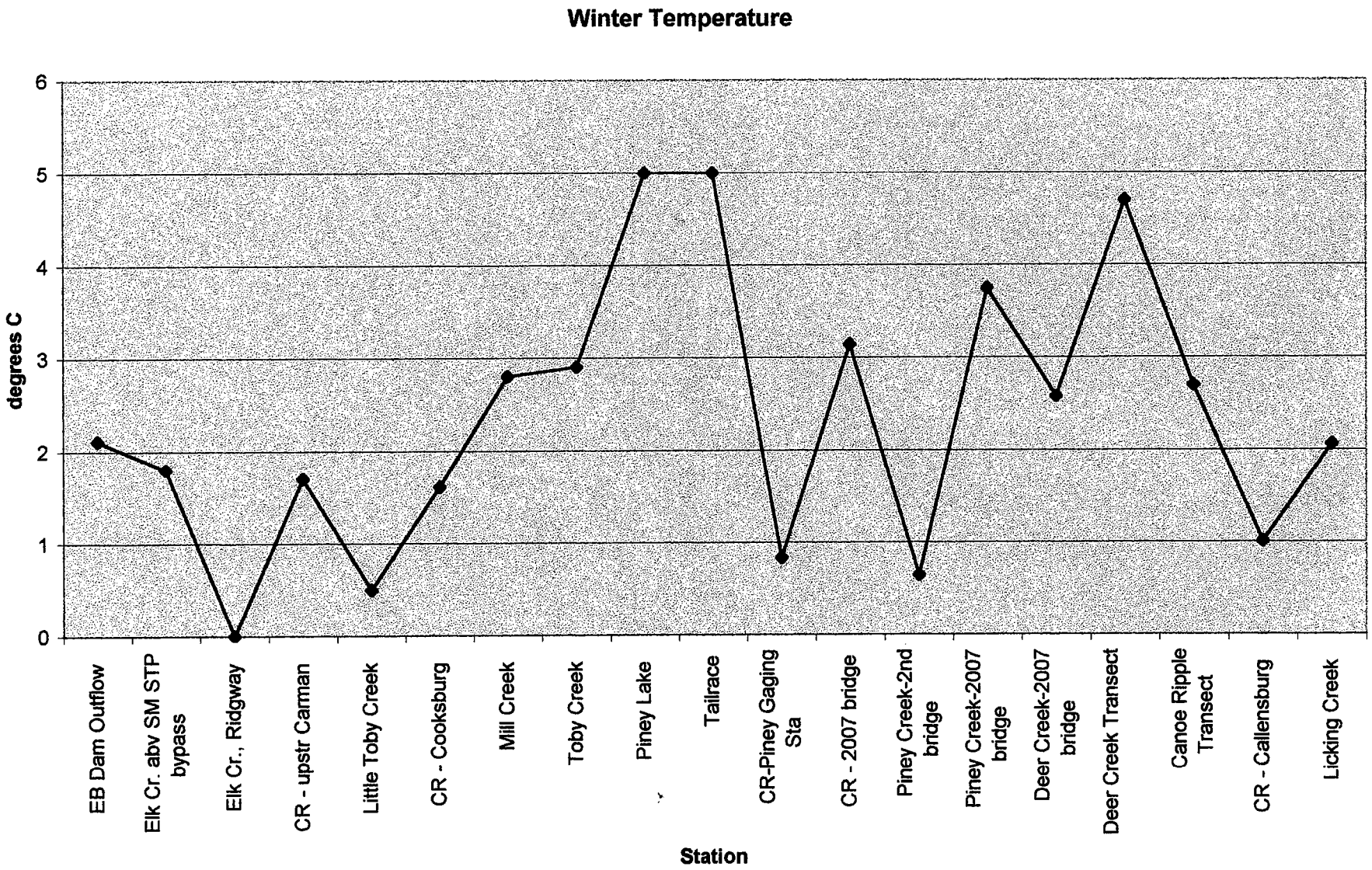
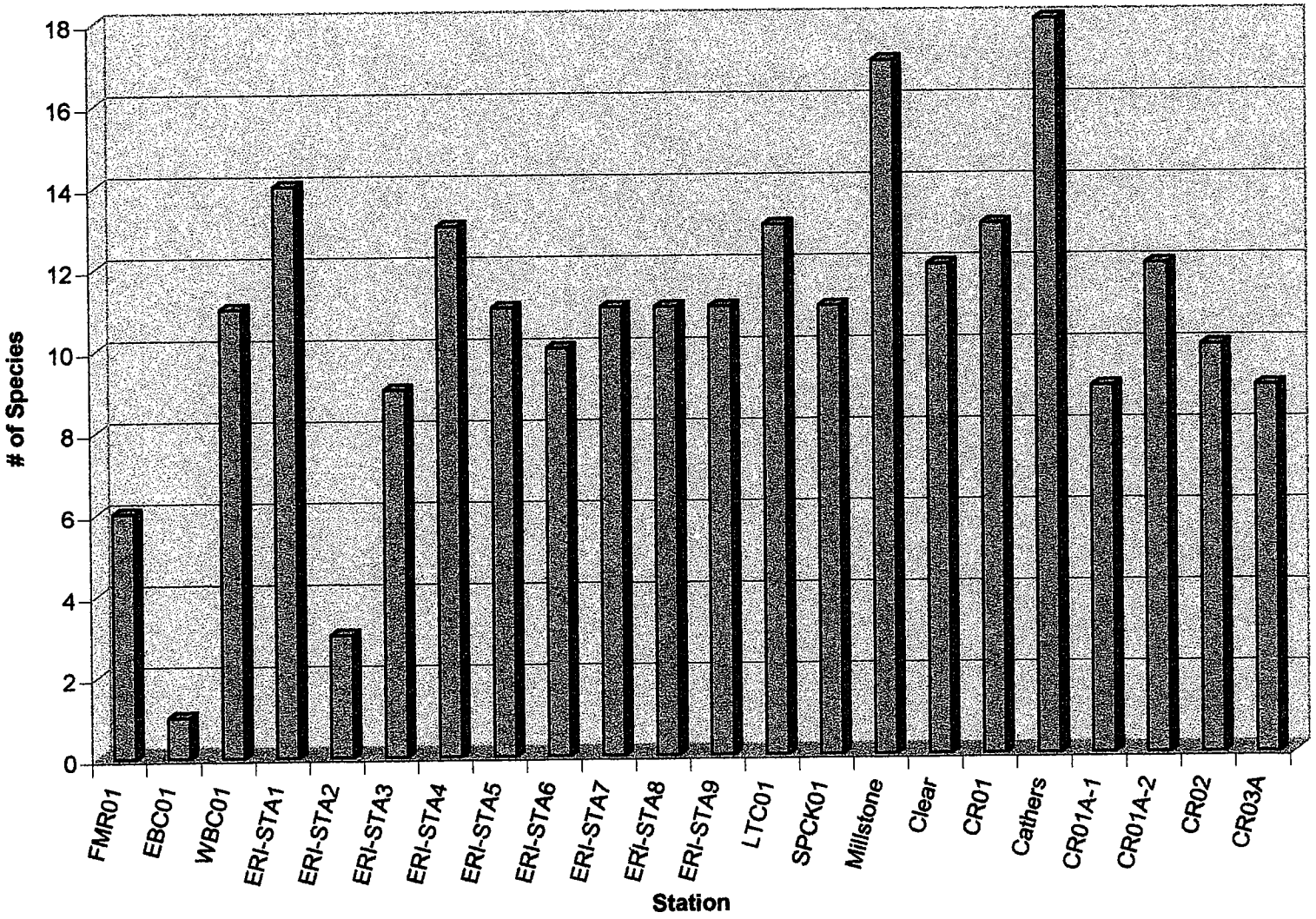

Winter Temperature
degrees C
0
1
2
3
4
5
6
EB Dam Outflow
Elk Cr. abv SM STP bypass
Elk Cr., Ridgway
CR - upstr Carman
Little Toby Creek
CR - Cooksburg
Mill Creek
Toby Creek
Piney Lake
Tailrace
CR-Piney Gaging Sta
CR - 2007 bridge
Piney Creek-2nd bridge
Piney Creek-2007 bridge
Deer Creek-2007 bridge
Deer Creek Transect
Canoe Ripple Transect
CR - Callensburg
Licking Creek
Station

Chart E-34

Fish Species 1998



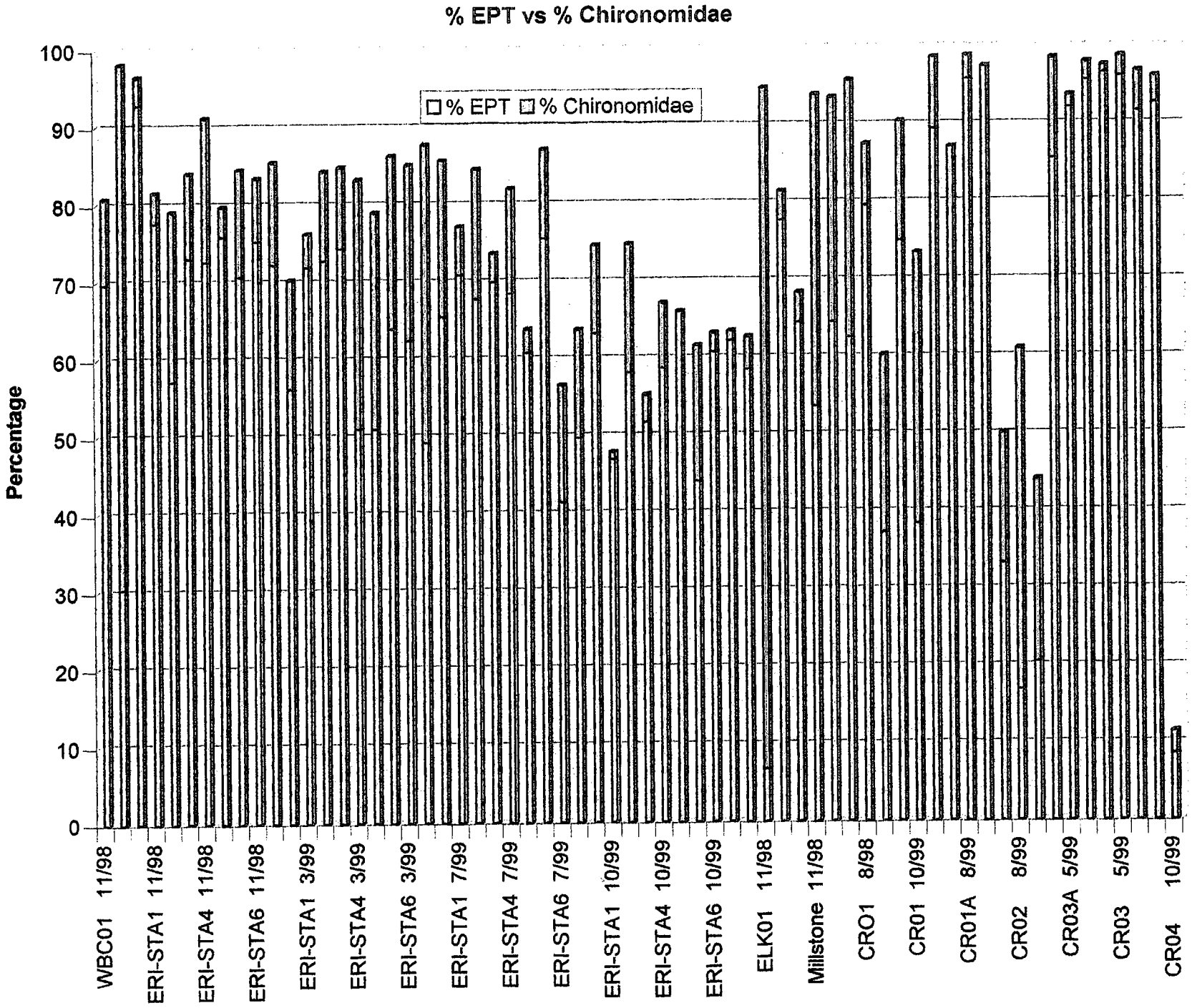

% EPT vs % Chironomidae
% EPT
% Chironomidae
Percentage
100
90
80
70
60
50
40
30
20
10
0
WBC01 11/98
ERI-STA1 11/98
ERI-STA4 11/98
ERI-STA6 11/98
ERI-STA1 3/99
ERI-STA4 3/99
ERI-STA6 3/99
ERI-STA1 7/99
ERI-STA4 7/99
ERI-STA6 7/99
ERI-STA1 10/99
ERI-STA4 10/99
ERI-STA6 10/99
ELK01 11/98
Millstone 11/98
CRO1 8/98
CR01 10/99
CR01A 8/99
CR02 8/99
CR03A 5/99
CR03 5/99
CR04 10/99

Chart 19

Appendix A

Water Chemistry Data

East Branch Clarion River - above lake (EBC01)

PARAMETER	DATE SAMPLED 11/17/98
pH	5.5
Total Organic Carbon (mg/l)	1.4
Hot Acidity (mg/l)	3.2
Alkalinity (mg/l)	9.6
Calcium T (mg/l)	2.92
Magnesium T (mg/l)	1.23
Sodium T (mg/l)	1.36
Potassium T (mg/l)	<1.00
Iron T (ug/l)	222
Manganese T (ug/l)	237
Zinc T (ug/l)	59
Aluminum T (ug/l)	319
Sp Conductivity (umhos/cm)	40.9
Chloride (mg/l)	1
Residue, Tot (mg/l)	36
TDS @105 C (mg/l)	6
T Susp Solid (mg/l)	30
Sulfate T (mg/l)	<20.0

Five Mile Run (FMR01)

PARAMETER	DATE SAMPLED 11/17/98
pH	6.4
Total Organic Carbon (mg/l)	1.6
Hot Acidity (mg/l)	0
Alkalinity (mg/l)	15
Calcium T (mg/l)	3.73
Magnesium T (mg/l)	1.18
Sodium T (mg/l)	1.76
Potassium T (mg/l)	<1.00
Iron T (ug/l)	58
Manganese T (ug/l)	13
Zinc T (ug/l)	<10.0
Aluminum T (ug/l)	<200.0
Sp Conductivity (umhos/cm)	41.7
Chloride (mg/l)	2
Residue, Tot (mg/l)	32
TDS @105 C (mg/l)	20
T Susp Solid (mg/l)	12
Sulfate T (mg/l)	<20.0

East Branch Dam Outflow (1201)

Parameter	Date-Time					
	10/13/98 1700	10/13/98 0830	11/9/98 0930	11/23/98 0800	12/15/98 0930	1/11/99 0830
Sp Conductivity @25 C (um/cm)	50.6	47.4	47.2	45.9	45.9	45.3
ORP (MV)	17.53247	17.88079	16.45161	16	16.55844	15.7377
Total Alkalinity as CaCO3 (mg/l)	2.658135	1.7882	2.250842	1.80934	2.141133	2.474959
Total Acidity as CaCO3 (mg/l)	2.914976	1.974661	2.508791	3.954638	3.981431	3.986833
Laboratory pH	6.65	6.3	6.37	5.93	6.3	6.68
Turbidity (NTU)	1.5	1.5	0.44	0.9	1.5	1.4
Color (PT-CO Units)	12.5	7.5	5	8	15	10
Water Temp (Deg C)	**********	14.44444	6.111111	**********	4.444444	2.222222
Total Sus Solids 105 C (mg/l)	1.47	**********	**********	**********	**********	**********
Sulfate (mg/l)	7.8598	**********	**********	**********	**********	**********
H. Perox. Acid CaCO3 (mg/l)	-2.83413	-18.0516	5.369214	3.809239	1.52648	3.657653
Total NH3-N as N (mg/l)	**********	**********	**********	**********	**********	**********
Total Phosphorus as P (mg/l)	**********	**********	**********	**********	**********	**********
Total NO3+Nitrite as N (mg/l)	**********	**********	**********	**********	**********	**********
Total Kjeldahl Nitrogen (mg/l)	**********	**********	**********	**********	**********	**********

Parameter	1/25/99 0830	2/8/99 0930	2/22/99 0930	3/8/99 0930	3/22/99 0930	4/26/99 0930
Sp Conductivity @25 C (um/cm)	46.2	47.5	51	82	56.4	44.3
ORP (MV)	16.66667	16.55844	17.41935	20.72368	21.8543	14.95017
Total Alkalinity as CaCO3 (mg/l)	2.470486	0.975573	1.689512	1.974067	2.400956	0.806252
Total Acidity as CaCO3 (mg/l)	5.00391	3.986833	2.154176	4.003128	3.073531	2.978002
Laboratory pH	6.24	5.7	6.03	6.64	6.6	6.21
Turbidity (NTU)	1.6	1	1.9	2.6	1.8	1.1
Color (PT-CO Units)	5	15	15	15	12.5	7.5
Water Temp (Deg C)	3.333333	1.111111	2.222222	1.666667	3.333333	6.111111
Total Sus Solids 105 C (mg/l)	**********	**********	**********	**********	**********	**********
Sulfate (mg/l)	**********	**********	**********	**********	**********	**********
H. Perox. Acid CaCO3 (mg/l)	2.079758	6.647778	10.94005	7.083668	3.475549	40.95878
Total NH3-N as N (mg/l)	**********	**********	**********	**********	**********	**********
Total Phosphorus as P (mg/l)	**********	**********	**********	**********	**********	**********
Total NO3+Nitrite as N (mg/l)	**********	**********	**********	**********	**********	**********
Total Kjeldahl Nitrogen (mg/l)	**********	**********	**********	**********	**********	**********

US Army Corps of Engineers, Water Quality Data, 98-99.

East Branch Dam Outflow (1201) continued

Parameter	5/3/99 0800	5/10/99 0800	5/24/99 0800	7/21/99 1240		
Sp Conductivity @25 C (um/cm)	42.2	46.8	60.8	**********		
ORP (MV)	14.80263	13.90728	21.71053	**********		
Total Alkalinity as CaCO3 (mg/l)	1.110168	1.157894	6.266282	**********		
Total Acidity as CaCO3 (mg/l)	1.988022	2.973984	2.982032	**********		
Laboratory pH	6.27	6.19	6.71	**********		
Turbidity (NTU)	1	1.2	1.1	**********		
Color (PT-CO Units)	10	10	15	**********		
Water Temp (Deg C)	**********	7.222222	**********	**********		
Total Sus Solids 105 C (mg/l)	**********	**********	**********	**********		
Sulfate (mg/l)	**********	**********	**********	**********		
H. Perox. Acid CaCO3 (mg/l)	3.377118	2.10677	0.395086	**********		
Total NH3-N as N (mg/l)	**********	**********	**********	0.057		
Total Phosphorus as P (mg/l)	**********	**********	**********	0.01		
Total NO3+Nitrite as N (mg/l)	**********	**********	**********	0.25		
Total Kjeldahl Nitrogen (mg/l)	**********	**********	**********	1		

West Branch Clarion River (WBC01, ERI-STA1)

PARAMETER	DATE SAMPLED 11/17/98
pH	6.7
Total Organic Carbon (mg/l)	1.6
Hot Acidity (mg/l)	0
Alkalinity (mg/l)	32
Calcium T (mg/l)	9.53
Magnesium T (mg/l)	2
Sodium T (mg/l)	4.83
Potassium T (mg/l)	<1.00
Iron T (ug/l)	243
Manganese T (ug/l)	38
Zinc T (ug/l)	<10.0
Aluminum T (ug/l)	<200.0
Specific Conductivity (umhos/cm)	97.5
Chloride (mg/l)	6
Residue, Tot (mg/l)	82
TDS @105 C (mg/l)	56
T Susp Solid (mg/l)	26
Sulfate T (mg/l)	40

PARAMETER	DATE SAMPLED Nov-98	Mar-99	Jul-99	Oct-99
pH	6.566667	7.25	7.54	7.69
Conductivity	61.1	38.66667	77.2	90.7
Dissolved Oxygen	12.72	13.59	9.06	8.56
Acidity (mg/l)	2	4	4	7.3
Alkalinity (mg/l)	22	13.3	25.3	42.7
Aluminum (mg/l)	0.11	0.06	<.1	0.1
Ammonia (mg/l)	0.13	<1.0	<.1	0.1
BOD (mg/l)	<1.0	<1.0	<1.0	1
Chloride (mg/l)	8.2	12.8	10.5	9.5
Chloroform (ug/l)	<1	<1	4.2	0.005
Dioxin	*	*	*	*
Furan	**	**	**	**
Iron (mg/l)	0.32	0.16	0.35	0.27
Manganese (mg/l)	0.02	0.4	0.03	0.05
Nitrate (mg/l)	<0.10	<0.10	<0.10	0.1
Phenol (mg/l)	<0.005	<0.005	<0.005	<0.005
Phosphorous (mg/l)	<0.01	<0.01	<0.01	0.01
Sodium (mg/l)	6.9	4.81	9.33	7.1
Sulfate (mg/l)	7.5	13	8.7	7.1
Sulfide (mg/l)	<0.4	<0.4	<0.4	0.4
Total Dissolved Solids (mg/l)	24	47	78	71
Total Kjeldahl Nitrogen (mg/l)	0.68	0.5	2.17	1.27
Total Residual Chlorine (mg/l)	<0.20	<0.20	0.24	0.2
Total Suspended Solids (mg/l)	<1.0	1	8	4

* = no characteristic ions for dioxin

** = no characteristic ions for furan

Table A-4

Aquatic Biological Survey, 1999.
Ecological Restoration, Inc., 98-99.

East Branch at Bendigo State Park (ERI-STA2)

PARAMETER	DATE SAMPLED			
	Nov-98	Mar-99	Jul-99	Oct-99
pH	7.366667	6.16667	6.79	6.68
Conductivity	32.33333	42.03333	33.5	40.5
Dissolved Oxygen	12.86	16.22333	10.61	8.1
Acidity (mg/l)	4	5.3	17.3	5.3
Alkalinity (mg/l)	4	5.33	4	4.7
Aluminum (mg/l)	<0.10	0.14	<0.10	0.03
Ammonia (mg/l)	<0.10	<0.10	<0.10	0.1
BOD (mg/l)	<1.0	<1.0	<1.0	1
Chloride (mg/l)	1.47	3.3	4	0.7
Chloroform (ug/l)	<1	<1	<1	0.005
Dioxin	*	*	*	*
Furan	**	**	**	**
Iron (mg/l)	0.2	0.15	0.08	0.01
Manganese (mg/l)	0.17	0.21	0.11	0.05
Nitrate (mg/l)	<0.1	<0.1	<0.1	0.1
Phenol (mg/l)	<0.005	<0.005	<0.005	<0.005
Phosphorous (mg/l)	0.07	<0.01	<0.01	0.01
Sodium (mg/l)	1.2	1.71	1.76	1
Sulfate (mg/l)	10.2	20.5	1.8	9.8
Sulfide (mg/l)	<0.4	<0.4	<0.4	0.4
Total Dissolved Solids (mg/l)	15	42	62	71
Total Kjeldahl Nitrogen (mg/l)	0.57	0.43	1.78	1.43
Total Residual Chlorine (mg/l)	<0.20	<0.20	<0.20	0.2
Total Suspended Solids (mg/l)	<1.0	7	2	3

* = no characteristic ions for dioxin

** = no characteristic ions for furan

Table A-5

Ecological Restoration, Inc., 98-99.

Mouth of Powers Run (ERI-STA9)

PARAMETER	DATE SAMPLED			
	Nov-98	Mar-99	Jul-99	Oct-99
pH	7.533333	7.203333	7.4	7.73
Conductivity	63.96667	46.3	126.6	155.8
Dissolved Oxygen	12.04	13.81667	8.14	7.46
Acidity (mg/l)	4	2.7	4	8
Alkalinity (mg/l)	20	8	26.7	77.3
Aluminum (mg/l)	0.17	0.12	<0.1	0.13
Ammonia (mg/l)	<0.1	0.14	<0.1	0.1
BOD (mg/l)	1.6	2.2	<1.0	1
Chloride (mg/l)	10.3	14.1	20.8	57
Chloroform (ug/l)	<1	<1	<1	0.005
Dioxin	*	*	*	*
Furan	**	**	**	**
Iron (mg/l)	0.09	0.04	0.29	0.01
Manganese (mg/l)	0.01	0.01	0.02	0.02
Nitrate (mg/l)	<0.1	<0.1	<0.1	0.1
Phenol (mg/l)	<0.005	<0.005	<0.005	<0.005
Phosphorous (mg/l)	<0.01	<0.01	<0.01	<1.01
Sodium (mg/l)	4.4	7.42	17	32.7
Sulfate (mg/l)	12.9	18.8	14.5	24.1
Sulfide (mg/l)	<0.4	<0.4	<0.4	<0.4
Total Dissolved Solids (mg/l)	51	58	92	192
Total Kjeldahl Nitrogen (mg/l)	0.42	0.98	1.35	0.77
Total Residual Chlorine (mg/l)	<0.2	<0.2	<0.2	0.2
Total Suspended Solids (mg/l)	<1.0	1	11	31

* = no characteristic ions for dioxin

** = no characteristic ions for furan

Upstream of Willamette Discharge - on Main Stem of Clarion River (ERI-STA3)

PARAMETER	DATE SAMPLED			
	Nov-98	Mar-99	Jul-99	Oct-99
pH	6.766667	6.936667	7.35	7.41
Conductivity	38.6	46.2	49.8	47.3
Dissolved Oxygen	13.55333	12.69	12.74	8.46
Acidity (mg/l)	4	4	2.7	5.3
Alkalinity (mg/l)	6	5.33	10.7	4
Aluminum (mg/l)	<0.10	0.14	<0.10	0.04
Ammonia (mg/l)	0.12	<0.10	<0.10	0.1
BOD (mg/l)	<1.0	1	<1.0	1.1
Chloride (mg/l)	1.75	4.22	2	0.9
Chloroform (ug/l)	<1	<1	<1	0.005
Dioxin	*	*	*	*
Furan	**	**	**	**
Iron (mg/l)	0.16	0.22	0.09	0.02
Manganese (mg/l)	0.14	0.26	0.06	0.06
Nitrate (mg/l)	0.12	<0.1	<0.10	0.1
Phenol (mg/l)	<0.005	<0.005	<0.005	<0.005
Phosphorous (mg/l)	<0.01	<0.01	<0.01	0.01
Sodium (mg/l)	2.1	3.74	5.29	1.6
Sulfate (mg/l)	15	24.7	24.5	12.4
Sulfide (mg/l)	<0.4	<0.4	<0.4	0.4
Total Dissolved Solids (mg/l)	13	47	86	37
Total Kjeldahl Nitrogen (mg/l)	0.44	0.33	1.93	0.73
Total Residual Chlorine (mg/l)	<0.20	<0.20	<0.20	0.2
Total Suspended Solids (mg/l)	12	4	<1.0	4

* = no characteristic ions for dioxin

** = no characteristic ions for furan

Table A-7

Ecological Restoration, Inc., 98-99.

Downstream of Willamette Discharge - on Main Stem of Clarion River (ERI-STA4)

PARAMETER	DATE SAMPLED			
	Nov-98	Mar-99	Jul-99	Oct-99
pH	5.466667	7.623333	7.69	7.84
Conductivity	255.6667	142.9667	213.3	261.3
Dissolved Oxygen	12.27	13.23333	11.37	7.58
Acidity (mg/l)	6	4	4	4
Alkalinity (mg/l)	54	42.7	60	14.7
Aluminum (mg/l)	0.29	0.13	0.47	0.43
Ammonia (mg/l)	0.16	0.14	0.26	0.1
BOD (mg/l)	1.2	1.9	5	2.1
Chloride (mg/l)	52	43	54.5	10.2
Chloroform (ug/l)	<1	<1	<1	0.005
Dioxin	*	*	*	*
Furan	**	**	**	**
Iron (mg/l)	0.2	0.19	0.24	0.62
Manganese (mg/l)	0.11	0.15	0.21	0.44
Nitrate (mg/l)	0.41	0.13	<0.10	0.01
Phenol (mg/l)	<0.005	<0.005	<0.005	<0.005
Phosphorous (mg/l)	<0.01	<0.01	<0.01	0.01
Sodium (mg/l)	44.5	34.5	59.9	11.5
Sulfate (mg/l)	59.2	53.1	40.6	34
Sulfide (mg/l)	<0.4	<0.4	<0.4	0.4
Total Dissolved Solids (mg/l)	215	170	186	82
Total Kjeldahl Nitrogen (mg/l)	0.97	0.37	4.5	1.88
Total Residual Chlorine (mg/l)	<0.20	<0.20	0.23	0.2
Total Suspended Solids (mg/l)	6	12	36	21

* = no characteristic ions for dioxin

** = no characteristic ions for furan

CR-Upstream of Johnsonburg's Municipal Wastewater Treatment Plant (ERI-STA5)

PARAMETER	DATE SAMPLED			
	Nov-98	Mar-99	Jul-99	Oct-99
pH	6.5	7.623333	7.64	7.9
Conductivity	246.8667	106	201.3	237.5
Dissolved Oxygen	12.41	13.83667	9.3	7.95
Acidity (mg/l)	6	4	6.7	6.6
Alkalinity (mg/l)	58	38.7	53.3	19.3
Aluminum (mg/l)	0.31	0.12	0.49	0.59
Ammonia (mg/l)	<0.10	<0.10	<0.10	0.1
BOD (mg/l)	1.7	1.6	1.9	1
Chloride (mg/l)	59.5	43	67.8	10.7
Chloroform (ug/l)	<1	<1	3.9	0.005
Dioxin	*	*	*	*
Furan	**	**	**	**
Iron (mg/l)	0.19	0.17	0.18	1.07
Manganese (mg/l)	0.11	0.15	0.17	0.55
Nitrate (mg/l)	0.63	0.1	<0.10	0.1
Phenol (mg/l)	<0.005	<0.005	<0.005	<0.005
Phosphorous (mg/l)	<0.01	<0.01	<0.01	0.23
Sodium (mg/l)	56.6	36.1	70.5	14.2
Sulfate (mg/l)	62.5	54.8	41.5	36.2
Sulfide (mg/l)	<0.4	<0.4	<0.4	<0.4
Total Dissolved Solids (mg/l)	234	170	204	101
Total Kjeldahl Nitrogen (mg/l)	0.7	0.7	1.5	1.1
Total Residual Chlorine (mg/l)	0.2	<0.20	<0.20	0.2
Total Suspended Solids (mg/l)	1	7	5	46

* = no characteristic ions for dioxin

** = no characteristic ions for furan

Ecological Restoration, Inc., 98-99.

Table A-9

CR-Downstream of Johnsonburg's Municipal Wastewater Treatment Plant (ERI-STA6)

PARAMETER	DATE SAMPLED			
	Nov-98	Mar-99	Jul-99	Oct-99
pH	7.6	7.346667	7.73	7.88
Conductivity	300.6667	67	217.3	217.5
Dissolved Oxygen	11.48667	18.14667	9.38	8.01
Acidity (mg/l)	4	4	5.3	9.3
Alkalinity (mg/l)	60	34.7	56	34.7
Aluminum (mg/l)	0.32	0.14	0.42	0.1
Ammonia (mg/l)	<0.10	<0.10	0.26	0.1
BOD (mg/l)	<1.0	1.5	4.4	1
Chloride (mg/l)	57	40.8	62	39.6
Chloroform (ug/l)	<1	<1	<1	0.005
Dioxin	*	*	*	*
Furan	**	**	**	**
Iron (mg/l)	0.2	0.17	0.2	0.05
Manganese (mg/l)	0.12	0.14	0.18	0.17
Nitrate (mg/l)	0.71	0.11	<0.10	0.1
Phenol (mg/l)	<0.005	<0.005	<0.005	<0.005
Phosphorous (mg/l)	<0.01	<0.01	<0.01	<0.01
Sodium (mg/l)	54.2	33.2	67.9	38.8
Sulfate (mg/l)	64.8	52	35.5	48.5
Sulfide (mg/l)	<0.4	<0.4	0.4	<0.4
Total Dissolved Solids (mg/l)	216	156	184	165
Total Kjeldahl Nitrogen (mg/l)	0.72	1.34	3.82	1.17
Total Residual Chlorine (mg/l)	0.29	<0.2	0.22	0.2
Total Suspended Solids (mg/l)	2	16	28	4

* = no characteristic ions for dioxin

** = no characteristic ions for furan

Ecological Restoration, Inc., 98-99

Table A-10

CR-Above Confluence of Riley Run (ERI-STA7)

PARAMETER	DATE SAMPLED			
	Nov-98	Mar-99	Jul-99	Oct-99
pH	7.8	7.913333	7.91	8.21
Conductivity	220.3	94.4	251.9	232.8
Dissolved Oxygen	12.22333	13.60667	11.9	8.28
Acidity (mg/l)	4	4	6.7	5.3
Alkalinity (mg/l)	52	33.3	49.3	36.7
Aluminum (mg/l)	0.29	0.14	0.38	0.1
Ammonia (mg/l)	0.14	0.1	0.13	0.1
BOD (mg/l)	1.1	1.9	2.6	1.4
Chloride (mg/l)	54.5	45	54.5	39.6
Chloroform (ug/l)	<1	<1	6.2	0.005
Dioxin	*	*	*	*
Furan	**	**	**	**
Iron (mg/l)	0.22	0.19	0.28	0.08
Manganese (mg/l)	0.05	0.13	0.15	0.14
Nitrate (mg/l)	0.41	0.1	<0.10	0.1
Phenol (mg/l)	<0.005	<0.005	<0.005	<0.005
Phosphorous (mg/l)	<0.01	<0.01	<0.01	<0.01
Sodium (mg/l)	50.8	31.7	63.4	36.4
Sulfate (mg/l)	52.2	46.8	37	41.9
Sulfide (mg/l)	<0.4	<0.4	<.4	<0.4
Total Dissolved Solids (mg/l)	193	134	173	151
Total Kjeldahl Nitrogen (mg/l)	0.75	0.52	1.83	1.18
Total Residual Chlorine (mg/l)	0.23	<0.20	<0.20	0.2
Total Suspended Solids (mg/l)	2	7	23	8

* = no characteristic ions for dioxin

** = no characteristic ions for furan

Ecologial Restoration, Inc., 98-99.

Table A-11

CR- North of Ridgway (ERI-STA8)

PARAMETER	DATE SAMPLED			
	Nov-98	Mar-99	Jul-99	Oct-99
pH	7.466667	7.593333	7.59	8.27
Conductivity	220	88.36667	225.9	229.4
Dissolved Oxygen	12.09333	13.14	10.22	7.61
Acidity (mg/l)	6	4	6.7	6.6
Alkalinity (mg/l)	54	33.3	49.3	34.7
Aluminum (mg/l)	0.3	0.12	0.28	0.07
Ammonia (mg/l)	<0.1	<0.1	0.13	0.1
BOD (mg/l)	2.3	2.7	2	1
Chloride (mg/l)	54.5	40.8	54.5	37.8
Chloroform (ug/l)	<1	<1	4.4	0.005
Dioxin	*	*	*	*
Furan	**	**	**	**
Iron (mg/l)	0.17	0.16	0.48	0.08
Manganese (mg/l)	0.05	0.13	0.16	0.12
Nitrate (mg/l)	0.5	0.1	<0.10	0.1
Phenol (mg/l)	<0.005	<0.005	<0.005	<0.005
Phosphorous (mg/l)	<0.01	<0.01	<0.01	<0.01
Sodium (mg/l)	50.8	29.8	67.4	34.4
Sulfate (mg/l)	50	45.7	40.7	41.1
Sulfide (mg/l)	<0.4	<0.4	0.4	<0.4
Total Dissolved Solids (mg/l)	197	131	173	147
Total Kjeldahl Nitrogen (mg/l)	0.77	0.57	2.22	0.77
Total Residual Chlorine (mg/l)	<0.2	<0.2	<0.2	0.2
Total Suspended Solids (mg/l)	3	6	32	6

* = no characteristic ions for dioxin

** = no characteristic ions for furan

Elk Creek above bridge at Alpine Metals, Ridgway Boro (ELK01)

PARAMETER	DATE SAMPLED 5/17/99	8/9/99	11/18/99	8/21/00	11/13/00	2/5/01
Temperature (deg. C)	15.9	19.4	4.3	21.9	6.3	0
Sp. Conductance (umhos/cm)	162	350	287	334	217	220
Dissolved Oxygen (mg/l)	9.5	10	13.5	9.9	12.1	14.7
pH	6.92	9.05	8.37	8.88	7.45	7
Nitrite Tot. (mg/l)	<.01	<.01	<.01	<.01	<.01	<.01
Nitrate Tot. (mg/l)	0.86	2.16	0.33	1.56	0.57	1.15
Arsenic T (ug/l)	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0
Lead T (ug/l)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity (mg/l)	10.2	36	34	24	19.2	11.6
Hardness T (mg/l)	46.862	82.4888	245.436	83.6068	58.8912	48.1532
Calcium T (mg/l)	12.4	22.3	60.6	22.5	15.3	12.9
Magnesium T (mg/l)	3.85	6.49	22.8	6.64	5.01	3.86
Copper T (ug/l)	<10.0	<10.0	21	<10.0	<10.0	<10.0
Iron T (ug/l)	180	207	174	255	276	446
Manganese T (ug/l)	317	60	730	57	202	416
Zinc T (ug/l)	14	<10.0	<10.0	<10.0	<10.0	21
Aluminum T (ug/l)	<200.0	<200.0	<200.0	<200.0	<200.0	<200.0
TDS @105C (mg/l)	140	170	376	236	148	216
T Susp Solid (mg/l)	<2	8	6	18	14	<2
Hot Acidity (mg/l)	0	0	0	0	0	0
Ammonia-N T (mg/l)	<.02	<.02	<.02	<.02	<.02	0.11
Phosphorus T (mg/l)	0.03	0.09	0.03	0.02	0.04	0.03
Sulfate T (mg/l)	39	58	181	96	60	31
T Org Carbon (mg/l)	1.7	4.9	1.3	3	2.6	1.6

PARAMETER	DATE SAMPLED 11/17/98
pH	6.8
Total Organic Carbon (mg/l)	2.8
Hot Acidity (mg/l)	0
Alkalinity (mg/l)	28
Calcium T (mg/l)	18.3
Magnesium T (mg/l)	5.77
Sodium T (mg/l)	16.8
Potassium T (mg/l)	2.84
Iron T (ug/l)	253
Manganese T (ug/l)	209
Zinc T (ug/l)	47
Aluminum T (ug/l)	259
Specific Conductivity (umhos/cm)	259
Chloride (mg/l)	23
Residue, Tot (mg/l)	162
TDS @105 C (mg/l)	2
T Susp Solid (mg/l)	28
Sulfate T (mg/l)	49

PA DEP, Water Quality Data, 1999-2001.
Aquatic Biological Survey, 1999.

Table A-13

Elk Creek just above St. Marys STP

PARAMETER	DATE SAMPLED 5/17/99
Temperature (deg. C)	16.1
Sp. Conductance (umhos/cm)	3890
Dissolved Oxygen (mg/l)	9.6
pH	7.15
Nitrite Tot. (mg/l)	<.01
Nitrate Tot. (mg/l)	0.33
Arsenic T (ug/l)	<4.0
Lead T (ug/l)	<1.0
Alkalinity (mg/l)	19.8
Hardness T (mg/l)	131.394
Calcium T (mg/l)	34.1
Magnesium T (mg/l)	11.2
Copper T (ug/l)	<10.0
Iron T (ug/l)	1760.0
Manganese T (ug/l)	928.0
Zinc T (ug/l)	27.0
Aluminum T (ug/l)	<200.0
TDS @105C (mg/l)	260
T Susp Solid (mg/l)	8
Hot Acidity (mg/l)	0.0
Ammonia-N T (mg/l)	0.07
Phosphorus T (mg/l)	0.03
Sulfate T (mg/l)	82.0
T Org Carbon (mg/l)	1.8

Elk Creek just above St. Marys STP bypass

PARAMETER	DATE SAMPLED 5/17/99	8/9/99	11/18/99	8/21/00	11/13/00	2/5/01
Temperature (deg. C)	16.1	19.6	4.7	18.6	6.5	1.8
Sp. Conductance (umhos/cm)	3890	377	351	385	356	402
Dissolved Oxygen (mg/l)	9.6	9	12.5	9.3	11.3	13.6
pH	7.15	7.99	7.49	7.85	7.44	7.26
Nitrite Tot. (mg/l)	<.01	<.01	<.01	<.01	<.01	0.01
Nitrate Tot. (mg/l)	0.23	0.28	0.39	0.22	0.33	0.91
Arsenic T (ug/l)	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0
Lead T (ug/l)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity (mg/l)	26	46	32	32	34	19.8
Hardness T (mg/l)	206.428	143.978	130.2608	252.884	110.0584	86.2772
Calcium T (mg/l)	50.6	42.1	36.3	38.2	29.9	23.7
Magnesium T (mg/l)	19.4	9.4	9.59	38.2	8.57	6.56
Copper T (ug/l)	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0
Iron T (ug/l)	313	1180	1100	458	1130	1630
Manganese T (ug/l)	905	298	737	537	570	546
Zinc T (ug/l)	12	10	20	<10.0	15	26
Aluminum T (ug/l)	<200.0	<200.0	<200.0	<200.0	<200.0	267
TDS @105C (mg/l)	346	222	316	344	226	140
T Susp Solid (mg/l)	8	<2.0	<2.0	16	8	<2.0
Hot Acidity (mg/l)	0	0	0	0	0	0
Ammonia-N T (mg/l)	0.04	0.03	0.12	0.03	0.04	0.17
Phosphorus T (mg/l)	0.02	0.03	0.04	0.02	0.03	0.03
Sulfate T (mg/l)	173	72	78	93	100	66
T Org Carbon (mg/l)	1.1	5	2	2.2	2.5	2.1

PA DEP, Water Quality Data, 1999-2001.

Table A-14

Spring Creek (SPCK01)

PARAMETER	DATE SAMPLED 11/17/98
pH	6.7
Total Organic Carbon (mg/l)	1.5
Hot Acidity (mg/l)	0
Alkalinity (mg/l)	28
Calcium T (mg/l)	6.41
Magnesium T (mg/l)	1.94
Sodium T (mg/l)	7.61
Potassium T (mg/l)	<1.00
Iron T (ug/l)	198
Manganese T (ug/l)	34
Zinc T (ug/l)	11
Aluminum T (ug/l)	<200.0
Sp Conductivity (umhos/cm)	104.1
Chloride (mg/l)	12
Residue, Tot (mg/l)	34
TDS @105 C (mg/l)	14
T Susp Solid (mg/l)	14
Sulfate T (mg/l)	<20.0

Clarion River - RR trestle upstream of Carman, Spring Creek Twp.

PARAMETER	DATE SAMPLED					
	5/17/99	8/9/99	11/18/99	8/21/00	11/13/00	2/5/01
Temperature (deg. C)	18.3	18.2	5.3	20	7.6	1.7
Sp. Conductance (umhos/cm)	205	236	440	276	373	170
Dissolved Oxygen (mg/l)	10	8.3	13.5	10.5	10.8	14.4
pH	7.48	7.65	8.49	8.68	7.69	7.47
Nitrite Tot. (mg/l)	<.01	<.01	0.02	<.01	<.01	0.01
Nitrate Tot. (mg/l)	0.34	0.56	2.18	0.32	0.21	0.5
Arsenic T (ug/l)	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0
Lead T (ug/l)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity (mg/l)	26	36	18.6	44	46	20
Hardness T (mg/l)	29.0766	36.3552	70.5832	29.2396	45.55	34.0052
Calcium T (mg/l)	8.45	10.9	19.4	8.68	14.1	9.96
Magnesium T (mg/l)	1.93	2.21	5.36	1.83	2.5	2.21
Copper T (ug/l)	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0
Iron T (ug/l)	227	306	306	303	279	198
Manganese T (ug/l)	119	105	329	56	60	120
Zinc T (ug/l)	<10.0	91	10	11	<10.0	12
Aluminum T (ug/l)	<200.0	<200.0	<200.0	<200.0	<200.0	<200.0
TDS @105C (mg/l)	162	98	174	190	202	102
T Susp Solid (mg/l)	6	12	8	6	4	<2
Hot Acidity (mg/l)	0	0	0	0	0	0
Ammonia-N T (mg/l)	0.03	0.02	<.02	<.02	<.02	<.02
Phosphorus T (mg/l)	0.03	0.06	0.12	0.05	0.05	0.03
Sulfate T (mg/l)	39	31	52	51	83	38
T Org Carbon (mg/l)	3.9	5.4	2.9	4.7	6.3	2.7

PA DEP, Water Quality Data, 1999-2000.

Table A-16

Little Toby Creek - at RR trestle at Carman (LTC01)

PARAMETER	DATE SAMPLED 8/9/99	11/18/99	8/21/00	11/13/00	2/5/01
Temperature (deg. C)	18.5	4	20	6.6	0.5
Sp. Conductance (umhos/cm)	625	548	572	456	294
Dissolved Oxygen (mg/l)	8.5	12.5	8.5	11	14.1
pH	7.71	7.5	7.94	7.57	7.34
Nitrite Tot. (mg/l)	<.01	<.01	<.01	<.01	<.01
Nitrate Tot. (mg/l)	0.37	0.29	0.25	0.2	0.43
Arsenic T (ug/l)	<4.0	<4.0	<4.0	<4.0	<4.0
Lead T (ug/l)	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity (mg/l)	32	56	34	30	20
Hardness T (mg/l)	305.61	46.9788	278.338	202.368	124.908
Calcium T (mg/l)	76.1	15.1	70.3	49.8	32
Magnesium T (mg/l)	28	2.24	24.9	18.9	10.9
Copper T (ug/l)	<10.0	<10.0	<10.0	<10.0	<10.0
Iron T (ug/l)	131	234	212	188	1400
Manganese T (ug/l)	70	121	284	480	759
Zinc T (ug/l)	<10.0	<10.0	<10.0	<10.0	24
Aluminum T (ug/l)	<200.0	<200.0	<200.0	<200.0	638
TDS @105C (mg/l)	486	238	466	294	140
T Susp Solid (mg/l)	14	8	4	10	4
Hot Acidity (mg/l)	0	0	0	0	0
Ammonia-N T (mg/l)	<.02	<.02	<.02	<.02	0.07
Phosphorus T (mg/l)	<0.02	0.04	<.01	<.01	0.02
Sulfate T (mg/l)	254	71	403	148	108
T Org Carbon (mg/l)	2.2	7.8	1.4	1.6	1.1

PARAMETER	DATE SAMPLED 11/17/98
pH	6.8
Total Organic Carbon (mg/l)	1.5
Hot Acidity (mg/l)	0
Alkalinity (mg/l)	38
Calcium T (mg/l)	69.7
Magnesium T (mg/l)	24.9
Sodium T (mg/l)	9.33
Potassium T (mg/l)	2.66
Iron T (ug/l)	164
Manganese T (ug/l)	159
Zinc T (ug/l)	29
Aluminum T (ug/l)	<200.0
Specific Conductivity (umhos/cm)	617
Chloride (mg/l)	11
Residue, Tot (mg/l)	384
TDS @105 C (mg/l)	370
T Susp Solid (mg/l)	<2.0
Sulfate T (mg/l)	215

PA DEP, Water Quality Data, 1999-2001.
Aquatic Biological Survey, 1999.

Table A-17

Cooksburg - Rt. 36 Bridge

Parameter	5/13/99	7/7/99	9/9/99	11/16/99	12/7/00	1/25/01	3/12/01
Temperature (deg. C)	14.8	26.7	21.9	5.2	0.2	0.3	0.8
Sp. Conductance (umhos/cm)	126	256	260	262	216	200	232
Dissolved Oxygen (mg/l)	9	7.6	8.2	11.7	13.7	13.6	14
pH	6.44	7.55	7.35	7.33	6.6	6.99	7.1
Nitrite Tot. (mg/l)	<.01	<.01	0.01	<.01	<.01	<.01	<.04
Nitrate Tot. (mg/l)	0.15	0.19	0.25	0.14	0.35	0.41	0.28
Arsenic T (ug/l)	-----	-----	-----	-----	-----	-----	-----
Lead T (ug/l)	<1.0	<1.0	<1.0	<1.0	1.7	<1.0	7.7
Alkalinity (mg/l)	14.2	28	32	32	26	22	22
Hardness T (mg/l)	37.5562	62.0296	45.6372	50.5736	53.6392	47.3892	63.394
Calcium T (mg/l)	9.65	18.5	12.8	14	14.6	12.1	17.2
Magnesium T (mg/l)	3.26	3.83	3.31	3.78	4.16	4.16	4.95
Copper T (ug/l)	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0
Iron T (ug/l)	243	1550	199	178	202	125	207
Manganese T (ug/l)	139	76	77	42	102	71	199
Zinc T (ug/l)	491	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0
Aluminum T (ug/l)	<200.0	946	<200.0	<200.0	<200	<200.0	<200.0
TDS @105C (mg/l)	224	194	172	162	180	130	146
T Susp Solid (mg/l)	10	<2	<2	<2	<2	<2	6
Hot Acidity (mg/l)	-----	-----	-----	-----	-----	-----	-----
Ammonia-N T (mg/l)	0.06	0.05	0.02	<.02	<.02	<.02	<.02
Phosphorus T (mg/l)	0.02	0.02	0.04	0.03	0.01	0.01	0.02
Sulfate T (mg/l)	25	50.81	26	45	58	54	46.8
T Org Carbon (mg/l)	2.5	5.1	3.8	3.9	2.8	2	2.6

PA DEP, Water Quality Data, 1999-2001.

Table A-18

Route 36 Bridge - Cooksburg (3049)

Parameter	Date-Time					
	10/13/98 1500	10/27/98 1400	11/10/98 1400	11/23/98 1100	12/21/98 0800	1/5/99 1300
Sp Conductivity @25 C (um/cm)	174	321	299	268	240	194.9
ORP (MV)	48.6755	59.01639	61.93548	60.98361	61.36364	49.34211
Total Alkalinity as CaCO3 (mg/l)	16.62543	35.88059	40.22156	37.84321	34.01482	22.32316
Total Acidity as CaCO3 (mg/l)	2.961992	0.989992	2.508791	3.959967	5.972146	4.025063
Laboratory pH	7.06	7.46	7.46	7.25	6.92	6.98
Turbidity (NTU)	3.5	3.5	1.5	6	3.1	1.5
Color (PT-CO Units)	25	20	10	40	15	20
Water Temp (Deg C)	16.66667	14.44444	10.55556	10	**********	4.444444
H. Perox. Acid CaCO3 (mg/l)	-19.0389	-26.7406	-31.7609	-30.7006	-28.3342	-19.4987

Parameter	1/11/99 0800	1/25/99 1100	2/8/99 1400	2/22/99 1400	3/8/99 1500	3/22/99 1400
Sp Conductivity @25 C (um/cm)	261	71.2	107.8	137	143	128
ORP (MV)	51.31579	22.54902	35.06494	41.44737	39.34426	34.31373
Total Alkalinity as CaCO3 (mg/l)	28.826	2.272847	6.058822	8.571607	7.399849	7.997933
Total Acidity as CaCO3 (mg/l)	7.04386	4.003128	2.990125	3.002346	4.047239	3.031254
Laboratory pH	6.74	6.1	6.4	6.75	6.66	6.89
Turbidity (NTU)	2.4	15	1.6	1.7	2.4	2.2
Color (PT-CO Units)	30	50	20	20	15	15
Water Temp (Deg C)	**********	5	5	4.444444	2.777778	4.444444
H. Perox. Acid CaCO3 (mg/l)	-31.5739	4.081322	1.664237	0.078194	0.169175	-6.03112

Parameter	4/6/99 1400	6/14/99 1600
Sp Conductivity @25 C (um/cm)	102.7	327
ORP (MV)	30.69307	65.43624
Total Alkalinity as CaCO3 (mg/l)	6.100389	40.22911
Total Acidity as CaCO3 (mg/l)	3.03543	0.982051
Laboratory pH	6.83	7.61
Turbidity (NTU)	2	1.6
Color (PT-CO Units)	10	30
Water Temp (Deg C)	11.66667	23.33333
H. Perox. Acid CaCO3 (mg/l)	7.251844	-35.1847

US Army Corps of Engineers, Water Quality Data, 98-99.

Table A-19

Mill Creek - SR 1001 Bridge

PARAMETER	DATE SAMPLED					
	5/17/99	8/9/99	11/15/99	8/21/00	11/13/00	2/20/01
Temperature (deg. C)	12.5	17.1	5.9	13.5	5.3	2.8
Sp. Conductance (umhos/cm)	468	1019	569	736	407	218
Dissolved Oxygen (mg/l)	10.2	8.7	11.4	9.6	11.8	13.6
pH	3.73	3.21	3.71	3.35	3.74	4.8
Nitrite Tot. (mg/l)	<.01	<.01	<.01	<.01	<.01	<.04
Nitrate Tot. (mg/l)	0.22	0.2	0.29	0.19	0.23	0.5
Arsenic T (ug/l)	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0
Lead T (ug/l)	<1.0	3.3	<1.0	1	<1.0	<1.0
Alkalinity (mg/l)	0	0	0	0	0	2
Hardness T (mg/l)	180.376	438.888	180.108	249.128	150.896	72.696
Calcium T (mg/l)	35.4	89.2	37.6	51.2	30.2	15.4
Magnesium T (mg/l)	22.3	52.4	20.9	29.4	18.3	8.3
Copper T (ug/l)	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0
Iron T (ug/l)	2400	2430	3490	2410	3580	2320
Manganese T (ug/l)	4470	8770	4740	6880	4270	1760
Zinc T (ug/l)	124	122	76	111	75	60
Aluminum T (ug/l)	1540	1850	1050	1480	948	866
TDS @105C (mg/l)	362	622	354	598	280	170
T Susp Solid (mg/l)	<2	66	<2	<2	10	12
Hot Acidity (mg/l)	38	68	26	46	20	13.6
Ammonia-N T (mg/l)	0.04	0.09	0.06	0.05	0.07	0.03
Phosphorus T (mg/l)	<0.02	<0.02	<0.02	<.01	<.01	<.01
Sulfate T (mg/l)	191	382	195	315	137	70
T Org Carbon (mg/l)	<1.00	1.8	1	<1.00	1.6	<1.00
Acidity (mg/l)	-----	-----	-----	9.8	-----	-----

Toby Creek - T573 bridge site

PARAMETER	DATE SAMPLED					
	5/17/99	8/9/99	11/15/99	8/21/00	11/13/00	2/20/01
Temperature (deg. C)	11.7	15.2	5.7	12.9	4.8	2.9
Sp. Conductance (umhos/cm)	689	1216	1064	830	681	329
Dissolved Oxygen (mg/l)	11	9.4	11.3	9.9	12.25	12.4
pH	3.42	3.22	3.42	3.34	3.36	3.5
Nitrite Tot. (mg/l)	<.01	<.01	<.01	<.01	<.01	<.04
Nitrate Tot. (mg/l)	0.41	0.24	0.39	0.53	0.54	0.98
Arsenic T (ug/l)	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0
Lead T (ug/l)	1.4	3.7	2	1.5	1.4	<1.0
Alkalinity (mg/l)	0	0	0	0	0	0
Hardness T (mg/l)	255.562	491.624	351.646	279.316	232.128	103.486
Calcium T (mg/l)	48.5	89.2	69.3	55.2	44.4	20.3
Magnesium T (mg/l)	32.6	65.2	43.3	34.3	29.4	12.8
Copper T (ug/l)	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0
Iron T (ug/l)	10500	26000	24400	15900	14000	5030
Manganese T (ug/l)	6920	16800	12200	9010	7580	2830
Zinc T (ug/l)	264	221	225	226	193	125
Aluminum T (ug/l)	5990	4450	4180	4380	3860	2500
TDS @105C (mg/l)	486	882	684	668	482	210
T Susp Solid (mg/l)	<2	68	4	10	14	18
Hot Acidity (mg/l)	92	130	100	96	66	34
Ammonia-N T (mg/l)	0.07	0.13	0.12	0.13	0.10	0.06
Phosphorus T (mg/l)	<0.02	<.02	<.02	<.01	<.01	<.01
Sulfate T (mg/l)	163	399	377	280	202	110
T Org Carbon (mg/l)	<1.00	1.7	<1.00	<1.00	1.3	<1.00
Acidity (mg/l)	5.2	56	46	24	15	-----

Table A-21

PA DEP, Water Quality Data, 1999-2001.

Gaging Station - downstream of Piney Dam (3626)

	Date-Time					
Parameter	10/5/98 0800	10/13/98 1620	10/26/98 0800	11/9/98 0800	11/23/98 0800	12/17/98 0800
Sp Conductivity @25 C (um/cm)	328	323	254	289	346	333
ORP (MV)	80.26756	77.96053	71	77.22772	82.62295	85.57377
Total Alkalinity as CaCO3 (mg/l)	16.4512	19.54414	13.74442	17.76208	21.63907	23.21183
Total Acidity as CaCO3 (mg/l)	2.961992	4.997102	2.914976	5.017582	3.959967	5.972146
Laboratory pH	7.44	7.02	6.75	7	6.9	7.12
Turbidity (NTU)	2	1.6	2.5	3.1	3.5	**********
Color (PT-CO Units)	20	20	40	40	60	30
Water Temp (Deg C)	15.55556	10	11.11111	8.888889	5.555556	4.444444
H. Perox. Acid CaCO3 (mg/l)	-16.4718	-18.0475	-12.5507	-11.6906	-26.7406	-19.376

Parameter	12/28/98 0800	1/11/99 0800	1/25/99 0800	2/8/99 0800	2/22/99 0800	3/8/99 0800
Sp Conductivity @25 C (um/cm)	151.4	169	84.4	119.3	136	166
ORP (MV)	47.57282	49.34211	23.45277	37.98701	43.85382	50.16393
Total Alkalinity as CaCO3 (mg/l)	6.782694	7.279292	0.905821	1.591724	5.652303	5.068389
Total Acidity as CaCO3 (mg/l)	5.988375	5.031328	6.865177	3.986833	3.965311	3.03543
Laboratory pH	6.47	6.26	5.47	6.13	6.54	6.43
Turbidity (NTU)	5	2.5	34	2.6	3.6	6.5
Color (PT-CO Units)	25	25	60	20	20	35
Water Temp (Deg C)	1.111111	0	1.666667	2.222222	0	0
H. Perox. Acid CaCO3 (mg/l)	-1.19182	1.632834	4.939135	4.654362	0.124114	4.216414

Parameter	3/22/99 0800	4/6/99 0800	4/27/99 0800	5/10/99 0800	6/14/99 0800	
Sp Conductivity @25 C (um/cm)	182	122	137	209	229	
ORP (MV)	54.63576	36.27451	40.46053	64.56954	71.47651	
Total Alkalinity as CaCO3 (mg/l)	6.957874	4.072567	4.29265	6.553188	7.530323	
Total Acidity as CaCO3 (mg/l)	3.073531	2.020836	3.976043	5.947967	3.965311	
Laboratory pH	6.71	6.73	6.61	6.56	6.67	
Turbidity (NTU)	3.4	0.8	4.5	3.9	1	
Color (PT-CO Units)	20	15	25	25	20	
Water Temp (Deg C)	2.222222	8.888889	7.777778	13.33333	18.88889	
H. Perox. Acid CaCO3 (mg/l)	-0.62249	-2.99986	2.383108	-15.7371	2.10677	

Table A-22

US Army Corps of Engineers, Water Quality Data, 98-99.

Tailrace

PARAMETER	Date Sampled											
	Jan-99	Feb-99	Mar-99	Apr-99	May-99*	Jun-99*	Jul-99*	Aug-99*	Sep-99*	Oct-99*	Nov-99	Dec-99
Temperature (°C) (m mean)	--	--	--	--	15.3	19.3	24	23.6	20.2	15.5	10.8	5
Dissolved Oxygen (mg/l) (m mean	--	--	--	--	9	7.4	6.3	6	6.8	8.5	9.3	12
pH (m mean)	--	--	--	--	6.5	6.2	6.3	6.6	6.6	6.8	6.7	7.1
Conductivity (umhos) (m mean)	--	--	--	--	135	250	320	335	323	320	140	100
Total Aluminum (mg/l)	--	--	--	--	0.28	0.26	**	**	**	**	--	--
Total Iron (mg/l)	--	--	--	--	0.35	0.44	0.23	0.16	0.17	0.36	--	--
Total Manganese (mg/l)	--	--	--	--	0.5	0.9	1.12	0.97	0.79	0.86	--	--
Total Alkalinity (mg/l as CaCO3)	--	--	--	--	9.1	8.9	21.3	19.1	19.1	23.2	--	--
Total Hardness (mg/las CaCO3)	--	--	--	--	47	67	85	87	84	80	--	--
Total Acidity (mg/l as CaCO3)	--	--	--	--	**	3.8	9.2	4	**	4.4	--	--

* Value shown is the location/transect mean of biweekly survey measurements
** Parameter value was less than the limit of quantification (LQ) of the analytical method.
m mean = monthly mean

Table A-23

Normandeau Associates, Inc., Report on Water Quality, 2000.

Piney Lake (Surface)

PARAMETER	Date Sampled											
	Jan-99	Feb-99	Mar-99	Apr-99	May-99*	Jun-99*	Jul-99*	Aug-99*	Sep-99*	Oct-99*	Nov-99	Dec-99
Temperature (°C) (m mean)	--	--	--	--	17.3	23.4	26.4	25.6	22.8	16.2	10	5
Dissolved Oxygen (mg/l) (m mean)	--	--	--	--	9.1	8.5	7.3	5.7	6	6.8	8.4	11.2
pH (m mean)	--	--	--	--	7	6.5	6.6	6.8	6.7	6.4	6.5	7.1
Conductivity (umhos) (m mean)	--	--	--	--	145	237	310	335	335	300	170	100
Total Aluminum (mg/l)	--	--	--	--	0.31	0.23	**	**	**	**	--	--
Total Iron (mg/l)	--	--	--	--	0.34	0.26	0.13	0.16	**	0.46	--	--
Total Manganese (mg/l)	--	--	--	--	0.48	1.02	0.72	1.01	0.29	0.94	--	--
Total Alkalinity (mg/l as CaCO3)	--	--	--	--	7.2	9	24.1	20	21.8	23.8	--	--
Total Hardness (mg/las CaCO3)	--	--	--	--	47	72	78	87	82	79	--	--
Total Acidity (mg/l as CaCO3)	--	--	--	--	3.8	3.5	6.6	8.7	**	4.4	--	--

* Value shown is the location/transect mean of biweekly survey measurements
** Parameter value was less than the limit of quantification (LQ) of the analytical method.
m mean = monthly mean

Piney Creek - 2nd Bridge upstream of confl. w/ Clarion River (2222)

	Date-Time					
Parameter	10/5/98 1628	10/13/98 0800	10/26/98 1620	11/10/98 0800	11/23/98 1620	12/14/98 1620
Sp Conductivity @25 C (um/cm)	902	891	955	991	970	965
ORP (MV)	395.7191	382.8947	418	429.6774	393.4426	426.0586
Total Alkalinity as CaCO3 (mg/l)	0.922044	0	0	0	0.447815	-0.04761
Total Acidity as CaCO3 (mg/l)	7.898645	12.99246	14.57488	17.05978	17.94075	15.81855
Laboratory pH	5.95	4.5	4.3	4.28	4.89	5.13
Turbidity (NTU)	17	25	26	55	4.7	61
Color (PT-CO Units)	50	100	100	130	25	350
Water Temp (Deg C)	11.11111	13.33333	8.333333	**********	3.333333	0
H. Perox. Acid CaCO3 (mg/l)	5.644371	12.9345	12.7124	20.42196	11.63132	18.63913
Mineral Acidity as CaCO3 (mg/l)	**********	**********	0.971659	2.007033	**********	**********

Parameter	12/28/98 2020	1/11/99 1620	1/25/99 1626	2/8/99 1620	2/22/99 1620	3/8/99 1620
Sp Conductivity @25 C (um/cm)	929	167	238	360	525	429
ORP (MV)	370.5882	50.32895	89.21569	142.5249	214.8387	164.2623
Total Alkalinity as CaCO3 (mg/l)	0	7.862714	-0.09882	0.454203	0	-0.93508
Total Acidity as CaCO3 (mg/l)	29.1817	8.050125	6.004692	6.939295	20.46467	13.01017
Laboratory pH	3.86	6.16	5.16	9.6	4.47	4.66
Turbidity (NTU)	37	2	23	5	16	20
Color (PT-CO Units)	130	20	80	45	90	120
Water Temp (Deg C)	0	0	1.666667	2.222222	0	0
H. Perox. Acid CaCO3 (mg/l)	34.21303	0.626568	9.085232	8.054737	31.40472	17.09149
Mineral Acidity as CaCO3 (mg/l)	12.07519	**********	**********	**********	1.077088	**********

Parameter	3/22/99 1620	4/6/99 1620	4/27/99 1620	5/10/99 1620	6/14/99 1600
Sp Conductivity @25 C (um/cm)	377	408	428	652	808
ORP (MV)	144.1176	162.7451	170.4319	281.0631	386.5772
Total Alkalinity as CaCO3 (mg/l)	0.539738	0.343469	-0.65142	-1.50329	0
Total Acidity as CaCO3 (mg/l)	7.072927	7.072927	14.36585	21.06992	27.49742
Laboratory pH	5.57	5.53	4.95	4.58	3.99
Turbidity (NTU)	14	3	8.6	9.3	26
Color (PT-CO Units)	65	17.5	45	55	110
Water Temp (Deg C)	2.222222	8.888889	7.777778	11.11111	20.55556
H. Perox. Acid CaCO3 (mg/l)	8.114735	8.114735	18.37463	18.75772	27.49742
Mineral Acidity as CaCO3 (mg/l)	**********	**********	**********	**********	4.910254

Table A-25

US Army Corps of Engineers, Water Quality Data 98-99.

Deer Creek Transect

PARAMETER	Date Sampled											
	Jan-99	Feb-99	Mar-99	Apr-99	May-99*	Jun-99*	Jul-99*	Aug-99*	Sep-99*	Oct-99*	Nov-99	Dec-99
Temperature (°C) (m mean)	--	--	--	--	16.7	19.5	24.5	21.6	18.5	12.9	9.6	4.7
Dissolved Oxygen (mg/l) (m mean	--	--	--	--	9.1	8.5	7.2	7.6	8.3	9.7	10.1	11.6
pH (m mean)	--	--	--	--	5.7	5.4	6	5.4	5.4	5.4	4.7	5.8
Conductivity (umhos) (m mean)	--	--	--	--	167	311	380	413	422	405	213	113
Total Aluminum (mg/l)	--	--	--	--	0.64	0.47	**	1.13	0.6	0.57	--	--
Total Iron (mg/l)	--	--	--	--	0.38	0.33	0.18	0.19	0.26	1.45	--	--
Total Manganese (mg/l)	--	--	--	--	0.74	1.01	0.97	2.57	1.85	2.25	--	--
Total Alkalinity (mg/l as CaCO3)	--	--	--	--	2	8.2	21.2	6.6	11.6	10.6	--	--
Total Hardness (mg/las CaCO3)	--	--	--	--	58	70	85	158	128	134	--	--
Total Acidity (mg/l as CaCO3)	--	--	--	--	12.4	6.9	4.6	17.3	10.3	10.3	--	--

* Value shown is the location/transect mean of biweekly survey measurements.
** Parameter value was less than the limit of quantification (LQ) of the analytical method.
m mean = monthly mean

Deer Creek - 2007 Bridge

Parameter	5/17/99	8/9/99	11/15/99	8/21/00	11/14/00	2/20/01
Temperature (deg. C)	14.7	19.5	6.3	14.8	6.4	3.5
Sp. Conductance (umhos/cm)	340	601	453	401	281	181
Dissolved Oxygen (mg/l)	9.6	8.5	11.2	9.5	12	12.2
pH	3.49	3.8	3.8	3.9	4.03	3.6
Nitrite Tot. (mg/l)	<.01	<.01	<.01	<.01	<.01	<.04
Nitrate Tot. (mg/l)	0.56	0.44	0.94	0.8	0.59	1.22
Arsenic T (ug/l)	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0
Lead T (ug/l)	<1.0	3.2	1.1	<1.0	<1.0	<1.0
Alkalinity (mg/l)	0	0	0	0	0	1.8
Hardness T (mg/l)	118.944	233.292	131.166	102.334	87.8188	52.6188
Calcium T (mg/l)	25	53.6	28.9	23.3	19.9	12
Magnesium T (mg/l)	13.7	24.1	14.3	10.7	9.24	5.49
Copper T (ug/l)	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0
Iron T (ug/l)	428	251	636	388	465	1360
Manganese T (ug/l)	1870	3490	2500	1940	1700	806
Zinc T (ug/l)	81	77	68	66	52	64
Aluminum T (ug/l)	1560	1900	1090	1060	920	938
TDS @105C (mg/l)	244	386	296	262	208	138
T Susp Solid (mg/l)	<2	58	<2	<2	16	<2
Hot Acidity (mg/l)	24	28	19	18.2	16.8	15.2
Ammonia-N T (mg/l)	<.02	0.02	0.09	0.02	<.02	0.06
Phosphorus T (mg/l)	<.02	<0.02	<0.02	<.01	<.01	<.01
Sulfate T (mg/l)	105	216	131	94	86	61
T Org Carbon (mg/l)	<1.00	1.4	4	<1.00	1	1
Acidity (mg/l)	-----	0.4	-----	-----	-----	-----

Table A-27

PA DEP, Water Quality Data, 1999-2001.

Deer Creek - 2007 Bridge (2220)

	Date-Time					
Parameter	10/5/98 1630	10/13/98 1630	10/26/98 1630	11/9/98 1630	11/23/98 0430	12/17/98 1630
Sp Conductivity @25 C (um/cm)	655	493	615	697	669	682
ORP (MV)	228.1967	150	214	243.9344	228.1967	237.6623
Total Alkalinity as CaCO3 (mg/l)	0	0	0	0	0	0
Total Acidity as CaCO3 (mg/l)	26.72978	22.34815	26.23478	33.11604	39.59967	34.83752
Laboratory pH	3.78	3.98	3.9	3.85	3.58	3.58
Turbidity (NTU)	1	0.41	0.45	2.1	3.9	2.1
Color (PT-CO Units)	5	7.5	5	10	17.5	15
Water Temp (Deg C)	11.11111	10	8.333333	4.444444	3.333333	0
H. Perox. Acid CaCO3 (mg/l)	39.59967	20.40483	27.20644	36.12659	32.66973	30.85609
Mineral Acidity as CaCO3 (mg/l)	6.929943	5.829952	7.773269	12.0422	9.899918	11.94429

Parameter	12/28/98 1630	1/11/99 1630	1/25/99 1630	2/8/99 1630	2/22/99 1638	3/8/99 1630
Sp Conductivity @25 C (um/cm)	913	169	129.2	185	232	219
ORP (MV)	355.3398	49.34211	39.21569	32.89037	66.77419	59.01639
Total Alkalinity as CaCO3 (mg/l)	0	7.376349	-1.08701	0	0	0
Total Acidity as CaCO3 (mg/l)	28.94381	3.965311	10.00782	10.90461	17.23341	13.15353
Laboratory pH	3.77	6.14	4.74	4.29	4.1	4.12
Turbidity (NTU)	46	4.9	19	5.2	2.8	3.9
Color (PT-CO Units)	200	20	80	27	10	15
Water Temp (Deg C)	0	0	1.111111	2.222222	0	0
H. Perox. Acid CaCO3 (mg/l)	29.94187	0.1224114	12.08758	14.99403	31.40472	17.20077
Mineral Acidity as CaCO3 (mg/l)	11.97675	**********	**********	1.982656	3.231264	2.02362

Parameter	3/22/99 1630	4/6/99 1630	5/23/99 1630	6/14/99 1630
Sp Conductivity @25 C (um/cm)	194	214	194	378
ORP (MV)	54.90196	64.35644	62.17105	132.8859
Total Alkalinity as CaCO3 (mg/l)	0	0	0	0
Total Acidity as CaCO3 (mg/l)	11.1146	11.12991	10.93412	18.65896
Laboratory pH	4.47	4.38	4.47	3.83
Turbidity (NTU)	4.4	1.7	3.4	0.7
Color (PT-CO Units)	25	12.5	10	10
Water Temp (Deg C)	1.666667	7.777778	10.55556	18.33333
H. Perox. Acid CaCO3 (mg/l)	16.19808	17.36994	21.26931	17.67691
Mineral Acidity as CaCO3 (mg/l)	1.010418	3.03543	0.994011	6.874355

Table A-28

US Army Corps of Engineers, Water Quality Data. 98-99.

Deer Creek

PARAMETER	Date Sampled											
	Jan-99	Feb-99	Mar-99	Apr-99	May-99*	Jun-99*	Jul-99*	Aug-99*	Sep-99*	Oct-99*	Nov-99	Dec-99
Temperature (°C) (m mean)	3.5	1	0.5	7	15.6	19	21.7	20.2	16.1	11.4	8.2	7
Dissolved Oxygen (mg/l) (m mean	12.6	13.4	11.8	11.6	9.2	8.7	8.4	8.3	9.4	10.1	10.8	11.4
pH (m mean)	4.5	4.3	4	3.9	3.7	3.5	3.4	3.5	3.6	3.6	3.8	3.4
Conductivity (umhos) (m mean)	140	180	230	160	265	373	550	535	537	485	250	290
Total Aluminum (mg/l)	--	--	--	--	1.23	0.9	1.61	1.81	1.32	1.35	--	--
Total Iron (mg/l)	--	--	--	--	0.44	0.22	0.18	0.18	0.21	0.29	--	--
Total Manganese (mg/l)	--	--	--	--	1.17	1.27	3.38	3.7	3.12	2.96	--	--
Total Alkalinity (mg/l as CaCO3)	--	--	--	--	**	**	**	**	**	**	--	--
Total Hardness (mg/las CaCO3)	--	--	--	--	78	79	1.72	217	171	152	--	--
Total Acidity (mg/l as CaCO3)	--	--	--	--	17.7	14.9	24.6	27.4	19.3	20.1	--	--

* Value shown is the location/transect mean of biweekly survey measurements.
** Parameter value was less than the limit of quantification (LQ) of the analytical method.
m mean = monthly mean

Clarion River - SR 2007 Bridge

PARAMETER	DATE SAMPLED				
	5/17/99	8/9/99	11/15/99	11/14/00	2/20/01
Temperature (deg. C)	16.6	23	7.1	8.1	3.7
Sp. Conductance (umhos/cm)	158	307	194	316	105
Dissolved Oxygen (mg/l)	8.7	7	11	10.2	11.8
pH	6.27	6.66	6.76	6.64	6.1
Nitrite Tot. (mg/l)	<.01	0.02	<.01	0.01	<.04
Nitrate Tot. (mg/l)	0.19	0.22	0.22	<.04	0.4
Arsenic T (ug/l)	<4.0	<4.0	<4.0	<4.0	<4.0
Lead T (ug/l)	1.7	<1.0	<1.0	<1.0	<1.0
Alkalinity (mg/l)	10.2	19.4	13.6	30	7.2
Hardness T (mg/l)	52.32	91.59	50.952	91.9432	31.342
Calcium T (mg/l)	13.1	25.1	12.8	23	7.84
Magnesium T (mg/l)	4.75	7	4.6	8.36	2.85
Copper T (ug/l)	<10.0	<10.0	<10.0	<10.0	<10.0
Iron T (ug/l)	477	120	666	1410	423
Manganese T (ug/l)	581	688	602	1240	334
Zinc T (ug/l)	14	<10.0	11	13	27
Aluminum T (ug/l)	<200.0	<200.0	282	253	324
TDS @105C (mg/l)	144	138	136	246	54
T Susp Solid (mg/l)	6	54	<2	16	18
Hot Acidity (mg/l)	2.2	0	0	0	0.4
Ammonia-N T (mg/l)	0.04	0.07	0.04	0.25	<.02
Phosphorus T (mg/l)	0.02	<0.02	0.02	0.01	<.01
Sulfate T (mg/l)	36	68	44	95	38
T Org Carbon (mg/l)	2.1	3.7	1.5	2.7	1.7

Piney Bridge Transect

PARAMETER	Date Sampled											
	Jan-99	Feb-99	Mar-99	Apr-99	May-99*	Jun-99*	Jul-99*	Aug-99*	Sep-99*	Oct-99*	Nov-99	Dec-99
Temperature (°C) (m mean)	0.7	2	0	7	14.7	19.3	24.1	23	19.2	14.2	10.3	5
Dissolved Oxygen (mg/l) (m mean	14	12.7	13.5	11.3	9.3	8.1	6.7	6.8	6.4	8.6	9.2	11.6
pH (m mean)	5.8	6.3	6.1	6.2	6.6	6.5	6.6	6.7	6.5	6.7	6.3	--
Conductivity (umhos) (m mean)	70	120	160	120	127	244	321	312	311	305	140	103
Total Aluminum (mg/l)	--	--	--	--	0.23	0.36	**	**	**	**	--	--
Total Iron (mg/l)	--	--	--	--	0.34	0.41	0.2	0.15	0.19	0.32	--	--
Total Manganese (mg/l)	--	--	--	--	0.47	0.9	1.01	0.88	0.88	0.69	--	--
Total Alkalinity (mg/l as CaCO3)	--	--	--	--	10.1	14.2	21.6	18.5	19.8	23.2	--	--
Total Hardness (mg/las CaCO3)	--	--	--	--	44	66	84	88	80	76	--	--
Total Acidity (mg/l as CaCO3)	--	--	--	--	**	5.9	5	3.5	3.3	4.8	--	--

* Value shown is the location/transect mean of biweekly survey measurements
** Parameter value was less than the limit of quantification (LQ) of the analytical method.
m mean = monthly mean

Piney Creek - 2007 Bridge

Parameter	5/17/99	8/9/99	11/15/99	8/21/00	11/14/00	2/20/01
Temperature (deg. C)	15.3	19	6.3	15.2	6.6	3.5
Sp. Conductance (umhos/cm)	841	1031	784	899	546	393
Dissolved Oxygen (mg/l)	12.4	8.6	11.3	9.5	11.7	12.2
pH	3.85	3.66	6.11	4.1	6.28	5.2
Nitrite Tot. (mg/l)	<.01	<.01	<.01	<.01	<.01	<.04
Nitrate Tot. (mg/l)	0.24	0.26	0.43	0.35	0.42	0.72
Arsenic T (ug/l)	<4.0	<4.0	<4.0	<4.0	<4.0	<4.0
Lead T (ug/l)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity (mg/l)	0	0	3.8	0	5.4	3.6
Hardness T (mg/l)	340.828	483.164	303.654	347.666	240.61	150.79
Calcium T (mg/l)	71.4	99	65.1	74.3	50.1	32.3
Magnesium T (mg/l)	39.4	57.2	34.2	39.3	28	17
Copper T (ug/l)	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0
Iron T (ug/l)	5390	4670	9710	8680	5930	3820
Manganese T (ug/l)	7270	7210	5980	7160	4610	2940
Zinc T (ug/l)	179	101	90	110	88	85
Aluminum T (ug/l)	2660	1250	800	578	1160	1580
TDS @105C (mg/l)	716	792	562	680	496	294
T Susp Solid (mg/l)	10	68	<2	4	10	34
Hot Acidity (mg/l)	50	44	19.4	36	14.4	13
Ammonia-N T (mg/l)	0.06	0.08	0.1	0.07	0.13	0.07
Phosphorus T (mg/l)	<0.02	0.02	<0.02	<.01	<.01	<.01
Sulfate T (mg/l)	309	429	296	431	241	161
T Org Carbon (mg/l)	<1.00	2	3.3	1.2	1.5	<1.00
Acidity (mg/l)	-----	9.8	-----	-----	-----	-----

PA DEP, Water Quality Data, 1999-2001.

Table A-32

Piney Creek

PARAMETER	Date Sampled											
	Jan-99	Feb-99	Mar-99	Apr-99	May-99*	Jun-99*	Jul-99*	Aug-99*	Sep-99*	Oct-99*	Nov-99	Dec-99
Temperature (°C) (m mean)	3	1	2	7	16	19.4	20.8	20.5	16	10.8	8.2	8
Dissolved Oxygen (mg/l) (m mean	13	13.6	13.1	11.6	8.9	8.8	8.4	8.6	9.3	10.5	10.6	11.3
pH (m mean)	4.6	5	5.1	4.5	3.9	3.4	3.2	3.3	4.2	4.7	5.4	4.7
Conductivity (umhos) (m mean)	280	420	470	400	700	903	1015	1015	897	765	430	540
Total Aluminum (mg/l)	--	--	--	--	2.47	1.71	1.44	0.58	1.38	0.76	--	--
Total Iron (mg/l)	--	--	--	--	3.68	4.21	6.35	5.75	6.32	10.6	--	--
Total Manganese (mg/l)	--	--	--	--	5.29	5.87	9.41	6.86	8.31	7.05	--	--
Total Alkalinity (mg/l as CaCO3)	--	--	--	--	**	**	**	**	**	**	--	--
Total Hardness (mg/las CaCO3)	--	--	--	--	264	310	405	382	412	339	--	--
Total Acidity (mg/l as CaCO3)	--	--	--	--	28.4	31.4	40.6	37.8	***	25.4	--	--

* Value shown is the location/transect mean of biweekly survey measurements
** Parameter value was less than the limit of quantification (LQ) of the analytical method.
*** The total acidity value, which was 138 mg/l, was considered spurious.
m mean = monthly mean

Canoe Ripple Transect

PARAMETER	Date Sampled											
	Jan-99	Feb-99	Mar-99	Apr-99	May-99*	Jun-99*	Jul-99*	Aug-99*	Sep-99*	Oct-99*	Nov-99	Dec-99
Temperature (°C) (m mean)	1.3	2	0.3	7	15.1	19.8	24.8	22.5	18.3	14.2	10.2	4.8
Dissolved Oxygen (mg/l) (m mean	13.5	13.6	13.2	11.2	9.3	8.4	7.2	7.2	8.1	9.8	9.5	11.9
pH (m mean)	5.9	6.3	6	6.1	6.5	6.3	7.1	6.9	6.7	6.8	6.6	6.6
Conductivity (umhos) (m mean)	83	123	213	130	150	327	385	373	382	340	173	130
Total Aluminum (mg/l)	--	--	--	--	0.46	0.36	**	**	**	**	--	--
Total Iron (mg/l)	--	--	--	--	0.48	0.49	0.21	0.15	0.17	0.55	--	--
Total Manganese (mg/l)	--	--	--	--	0.71	0.95	1.12	1.3	0.65	1.52	--	--
Total Alkalinity (mg/l as CaCO3)	--	--	--	--	4.1	10.8	19.4	16.7	15.2	18.5	--	--
Total Hardness (mg/las CaCO3)	--	--	--	--	58	68	94	107	96	109	--	--
Total Acidity (mg/l as CaCO3)	--	--	--	--	4.2	3.1	3.1	4.3	**	3.6	--	--

* Value shown is the location/transect mean of biweekly survey measurements.
** Parameter value was less than the limit of quantification (LQ) of the analytical method.
m mean = monthly mean

Table A-34

Normandeau Associates, Inc., Report on Water Quality, 2000.

Rt. 58 Bridge - Callensburg

Parameter	5/10/99	7/13/99	9/7/99	11/8/99	8/10/00	12/6/00	1/8/01	3/8/01
Temperature (deg. C)	15.3	22.3	22.9	7.8	20.9	0.3	1.4	1.9
Sp. Conductance (umhos/cm)	240	370	388	259	390	287	238	213
Dissolved Oxygen (mg/l)	11	7.5	7.5	11.5	7.6	14.2	13.4	13.3
pH	6.34	6.67	6.5	6.72	6.86	6.73	6.83	6.77
Nitrite Tot. (mg/l)	<.01	<.01	0.03	0.01	0.03	0.01	<.01	<.04
Nitrate Tot. (mg/l)	0.24	0.28	0.26	0.31	0.45	0.48	0.5	0.44
Arsenic T (ug/l)	-----	-----	-----	-----	-----	-----	-----	-----
Lead T (ug/l)	1.2	<1.0	<1.0	<1.0	2.5	<1.0	1.4	3
Alkalinity (mg/l)	6.8	22	15	17.8	18.4	20	10.4	9.8
Hardness T (mg/l)	85.754	91.652	118.426	68.162	75.9392	86.8084	77.2212	69.1312
Calcium T (mg/l)	21.2	22.9	27.1	16.8	19.4	20.6	18.1	16.1
Magnesium T (mg/l)	7.95	8.35	12.3	6.35	6.66	8.57	7.76	7.01
Copper T (ug/l)	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0
Iron T (ug/l)	837	215	1210	789	3210	1380	1170	642
Manganese T (ug/l)	1220	1020	1580	695	1070	1100	1030	847
Zinc T (ug/l)	42	12	31	15	23	29	42	31
Aluminum T (ug/l)	627	<200.0	433	348	2290	436	413	215
TDS @105C (mg/l)	146	242	300	144	176	152	152	156
T Susp Solid (mg/l)	10	28	8	4	78	8	<2	<2
Hot Acidity (mg/l)	-----	-----	-----	-----	-----	-----	-----	-----
Ammonia-N T (mg/l)	0.14	0.1	0.02	<.02	0.12	0.05	0.06	0.03
Phosphorus T (mg/l)	<0.02	0.02	0.03	0.04	0.07	<.01	<.01	<.01
Sulfate T (mg/l)	84	-----	127	67	70	91	86	63.3
T Org Carbon (mg/l)	1.9	3.3	2.8	4.9	4.7	2.4	1.4	1.3

Table A-35

PA DEP, Water Quality Data, 1999-2001.

Route 58 Bridge - Callensburg (3016)

	Date-Time					
Parameter	10/5/98 1428	10/13/98 1500	10/19/98 1417	10/26/98 0259	11/2/98 1455	11/8/98 1533
Sp Conductivity @25 C (um/cm)	453	345	249	389	311	324
ORP (MV)	144.4816	87	69	128.8525	91.39073	86.12903
Total Alkalinity as CaCO3 (mg/l)	6.551363	19.16475	13.35725	7.296895	12.46357	15.31551
Total Acidity as CaCO3 (mg/l)	2.961992	2.914976	3.886635	0.989992	4.003128	4.014065
Laboratory pH	7.29	7.22	7.02	6.82	6.79	6.95
Turbidity (NTU)	1.8	2	3.5	2.9	3.2	3.3
Color (PT-CO Units)	17.5	17.5	30	25	55	25
Water Temp (Deg C)	15.55556	16.66667	14.44444	13.33333	10.55556	8.888889
H. Perox. Acid CaCO3 (mg/l)	-5.21626	-22.2673	-6.72077	6.919119	-7.92806	-9.68353

Parameter	11/16/98 1438	11/24/98 0800	12/1/98 1442	12/7/98 1534	12/14/98 1500	12/21/98 1450
Sp Conductivity @25 C (um/cm)	380	352	377	377	380	391
ORP (MV)	106.4516	93.75	105.5921	108.5526	108.8235	109.8039
Total Alkalinity as CaCO3 (mg/l)	19.96399	18.37909	16.63374	20.87804	20.60009	21.4216
Total Acidity as CaCO3 (mg/l)	2.007033	5.010736	4.008589	3.006442	2.012531	3.018797
Laboratory pH	6.98	7.13	7.2	7.36	7.07	7.13
Turbidity (NTU)	2.4	3.1	4.6	3.1	2.5	2.6
Color (PT-CO Units)	15	30	30	25	17.5	18
Water Temp (Deg C)	7.777778	**********	7.777778	7.777778	4.444444	5.555556
H. Perox. Acid CaCO3 (mg/l)	-10.687	-12.8132	-9.80675	-14.8175	-14.4674	-16.4799

Parameter	12/28/98 1437	1/4/99 1425	1/11/99 1500	1/19/99 1440	1/25/99 1450	2/1/99 1439
Sp Conductivity @25 C (um/cm)	155.2	175	193	257	102	138.3
ORP (MV)	47.05882	55.33981	58.03279	65.68627	29.41176	46.75325
Total Alkalinity as CaCO3 (mg/l)	8.147068	5.148016	7.137087	8.605303	0.201294	2.310568
Total Acidity as CaCO3 (mg/l)	2.012531	4.014065	5.00391	5.916032	5.916032	2.990125
Laboratory pH	6.67	6.39	6.23	6.42	5.52	6.13
Turbidity (NTU)	2.7	1.6	2.2	4	38	7
Color (PT-CO Units)	13	20	18	35	120	25
Water Temp (Deg C)	1.666667	0	0	0	0.555556	2.222222
H. Perox. Acid CaCO3 (mg/l)	1.632834	3.362181	-0.92259	-3.37148	6.488572	2.660945

Route 58 Bridge - Callensburg (3016) continued

Parameter	2/8/99 0800	2/16/99 1420	2/22/99 1448	3/1/99 1502	3/8/99 1450	3/15/99 1435
Sp Conductivity @25 C (um/cm)	139	142.1	199.1	171	181	190
ORP (MV)	46.84385	45.2459	70.06579	59.21053	57.04918	59.01639
Total Alkalinity as CaCO3 (mg/l)	2.826151	3.614853	0.716763	3.428643	4.156079	2.838298
Total Acidity as CaCO3 (mg/l)	3.965311	3.917728	3.231364	5.00391	3.03543	4.047239
Laboratory pH	6.45	6.34	5.56	6.22	6.45	6.5
Turbidity (NTU)	5.4	5.8	10	8.4	9	9.3
Color (PT-CO Units)	30	30	35	35	45	40
Water Temp (Deg C)	**********	2.777778	1.111111	1.111111	0.555556	1.666667
H. Perox. Acid CaCO3 (mg/l)	2.10677	2.840353	17.40258	6.082886	4.216414	6.240034

Parameter	3/22/99 1450	3/29/99 1433	4/5/99 1453	4/12/99 1427	5/3/99 1442	5/12/99 0800
Sp Conductivity @25 C (um/cm)	191	150	145	152	172	141
ORP (MV)	56.86275	48.03922	45.09804	44.8505	52.82392	38.87043
Total Alkalinity as CaCO3 (mg/l)	5.381345	4.710439	4.612305	3.60643	4.259314	8.769175
Total Acidity as CaCO3 (mg/l)	3.031254	2.020836	3.031254	3.97067	3.850977	2.873171
Laboratory pH	6.52	6.96	6.79	6.42	6.49	6.75
Turbidity (NTU)	6.3	1.7	2	11	1.8	2.9
Color (PT-CO Units)	35	12.5	15	60	10	12.5
Water Temp (Deg C)	2.777778	5.555556	8.888889	8.888889	14.44444	**********
H. Perox. Acid CaCO3 (mg/l)	3.062645	1.041808	0.03139	4.230087	0.125413	-4.70651

Parameter	5/17/99 1500	5/24/99 1500	6/7/99 1500
Sp Conductivity @25 C (um/cm)	208	215	310
ORP (MV)	65.13158	72.03947	101.6447
Total Alkalinity as CaCO3 (mg/l)	5.180785	8.363267	3.823913
Total Acidity as CaCO3 (mg/l)	2.982032	4.7757603	3.976043
Laboratory pH	6.79	6.62	6.68
Turbidity (NTU)	1.5	26	1.2
Color (PT-CO Units)	15	100	10
Water Temp (Deg C)	18.88889	15.55556	23.88889
H. Perox. Acid CaCO3 (mg/l)	5.36514	-5.22854	1.389097

Callensburg Transect

PARAMETER	Date Sampled											
	Jan-99	Feb-99	Mar-99	Apr-99	May-99*	Jun-99*	Jul-99*	Aug-99*	Sep-99*	Oct-99*	Nov-99	Dec-99
Temperature (°C) (m mean)	1.5	2	0.7	7.5	15.7	20.4	23.8	23.1	18	13.7	10.4	5
Dissolved Oxygen (mg/l) (m mean	13.2	12.9	12.5	11.3	8.7	8.7	8.1	7.9	8.2	9.5	9.9	11.8
pH (m mean)	6.4	6.3	6.7	6.2	5.9	6.5	6.9	6.9	6.7	6.7	6.2	6.9
Conductivity (umhos) (m mean)	80	130	183	137	192	334	387	343	373	333	220	123
Total Aluminum (mg/l)	--	--	--	--	0.89	0.8	**	**	**	**	--	--
Total Iron (mg/l)	--	--	--	--	0.86	1.03	0.21	0.11	**	0.26	--	--
Total Manganese (mg/l)	--	--	--	--	1.27	1.42	1.07	0.97	0.35	0.89	--	--
Total Alkalinity (mg/l as CaCO3)	--	--	--	--	**	8.2	19	17.1	16.5	23.7	--	--
Total Hardness (mg/las CaCO3)	--	--	--	--	84	95	93	96	103	87	--	--
Total Acidity (mg/l as CaCO3)	--	--	--	--	5.7	5.2	3.1	3.3	**	**	--	--

* Value shown is the location/transect mean of biweekly survey measurements
** Parameter value was less than the limit of quantification (LQ) of the analytical method.
m mean = monthly mean

Licking Creek - two bridges upstream of confluence w/ Clarion River (2210)

	Date-Time					
Parameter	10/5/98 1446	10/13/98 1510	10/19/98 1428	10/26/98 0800	11/2/98 1509	11/8/98 1542
Sp Conductivity @25 C (um/cm)	2150	2020	2030	2150	2160	2210
ORP (MV)	1210.234	1241.722	1250	1315	1340	1316.129
Total Alkalinity as CaCO3 (mg/l)	5.677848	2.0229848	6.097876	0.967917	0.435563	1.46794
Total Acidity as CaCO3 (mg/l)	5.923983	7.773269	7.773269	8.744928	8.744928	13.04571
Laboratory pH	5.55	5.86	6.37	5.56	5.75	5.64
Turbidity (NTU)	40	75	44	59	60	75
Color (PT-CO Units)	80	200	120	160	160	200
Water Temp (Deg C)	13.33333	12.22222	13.33333	**********	7.777778	5
H. Perox. Acid CaCO3 (mg/l)	-2.25427	4.939135	-0.89082	7.854111	4.939135	18.41493

Parameter	11/16/98 1447	11/23/98 1500	12/1/98 1442	12/7/98 1542	12/14/98 1512	12/21/98 0800
Sp Conductivity @25 C (um/cm)	2100	2080	2020	2060	2070	1962
ORP (MV)	1248.387	1255.7	1243.421	1223.684	1280.13	1128.664
Total Alkalinity as CaCO3 (mg/l)	1.859391	3.285381	1.079476	1.570146	-0.3333	5.904162
Total Acidity as CaCO3 (mg/l)	15.05274	12.85257	10.97869	12.02577	29.65978	9.056391
Laboratory pH	5.91	5.78	5.69	5.69	4.93	6.12
Turbidity (NTU)	97	67	52	36	70	67
Color (PT-CO Units)	220	400	180	120	400	400
Water Temp (Deg C)	4.444444	6.111111	7.777778	10	0.555556	
H. Perox. Acid CaCO3 (mg/l)	17.41141	4.797898	15.77524	20.25767	16.66181	6.664162

Parameter	12/28/98 1446	1/19/99 0800	1/27/99 0800	2/1/99 1451	2/8/99 1507	2/16/99 1431
Sp Conductivity @25 C (um/cm)	1631	717	622	1137	918	1281
ORP (MV)	1004.854	320.5882	292.1569	617.5325	473.3766	693.4426
Total Alkalinity as CaCO3 (mg/l)	6.904684	10.36662	8.300833	12.27168	11.65553	14.96549
Total Acidity as CaCO3 (mg/l)	10.03516	7.888042	4.003128	8.970374	7.973666	10.77375
Laboratory pH	6.1	6.72	6.53	6.26	6.35	6.49
Turbidity (NTU)	94	36	20	67	35	68
Color (PT-CO Units)	450	150	80	300	110	340
Water Temp (Deg C)	0	**********	**********	1.111111	2.222222	4.444444
H. Perox. Acid CaCO3 (mg/l)	9.383279	-2.38548	-0.92259	-4.31601	-5.31272	-4.01567

Licking Creek - (2210) continued

Parameter	2/22/99 0800	3/1/99 1511	3/8/99 1500	3/15/99 1453	3/22/99 1500	3/29/99 1443
Sp Conductivity @25 C (um/cm)	1657	987	1120	1321	1053	967
ORP (MV)	1006.579	546.7105	782.1782	745.0331	580.1325	382.3529
Total Alkalinity as CaCO3 (mg/l)	11.42881	8.623556	10.44088	15.28772	11.2453	11.65958
Total Acidity as CaCO3 (mg/l)	12.14172	8.006256	13.15353	12.29412	10.2451	4.943297
Laboratory pH	6.31	6.55	6.25	6.55	6.65	6.92
Turbidity (NTU)	110	47	79	45	42	28
Color (PT-CO Units)	500	200	275	240	220	120
Water Temp (Deg C)	**********	1.666667	0	5	3.333333	4.444444
H. Perox. Acid CaCO3 (mg/l)	1.180984	-2.92415	1.180984	-0.62249	-0.62249	-10.032

Parameter	4/5/99 1503	4/12/99 1437	4/19/99 1459	4/26/99 1507	5/3/99 0800	5/10/99 1440
Sp Conductivity @25 C (um/cm)	812	653	1092	1191	1504	1700
ORP (MV)	421.3592	310.9635	580.0664	580.225	839.404	1011.628
Total Alkalinity as CaCO3 (mg/l)	13.18076	10.50035	11.67796	11.71844	10.96304	13.52958
Total Acidity as CaCO3 (mg/l)	8.094479	3.97067	4.963337	6.958075	9.913279	10.53496
Laboratory pH	6.7	6.67	6.69	6.55	6.6	6.52
Turbidity (NTU)	21	3.6	33	40	13	55
Color (PT-CO Units)	100	20	180	200	60	250
Water Temp (Deg C)	11.11111	8.888889	7.777778	13.33333	**********	17.22222
H. Perox. Acid CaCO3 (mg/l)	-6.91349	2.244752	-6.68926	2.383108	-5.82385	-8.05854

Parameter	5/24/99 1513	6/1/99 1520	6/7/99 1510
Sp Conductivity @25 C (um/cm)	1094	1651	1896
ORP (MV)	491.4474	952.3026	1134.868
Total Alkalinity as CaCO3 (mg/l)	13.93878	13.98812	10.87965
Total Acidity as CaCO3 (mg/l)	8.982562	5.988375	7.952086
Laboratory pH	6.48	6.64	6.62
Turbidity (NTU)	90	5.6	20
Color (PT-CO Units)	210	20	55
Water Temp (Deg C)	13.88889	18.33333	22.77778
H. Perox. Acid CaCO3 (mg/l)	-7.18019	-1.19182	0.395086

Appendix G

Evaluations/Comments

EVALUATION OF THE WATER QUALITY, BENTHIC MACROINVERTEBRATE AND FISH DATA PRESENTED IN THE CLARION RIVER BASIN ASSESSMENT (OCTOBER 1998 TO MARCH 2000)

Prepared For:

Clarion River Basin Commission

OCTOBER 2001

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Attachment 1 – PADEP List of Benthic Macroinvertebrates in PA with tolerance value ratings.

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1.0 INTRODUCTION

This report presents an evaluation of the data compiled and summarized on water quality, benthic macroinvertebrates and fish in the "Clarion River Basin Assessment". That "Report", completed by the Headwaters RC&D Council in cooperation with the Clarion River Basin Commission, contained select aquatic surveys in the watershed completed during 1998 and 1999 by environmental consulting firms, government conservation agencies and Clarion University of Pennsylvania.

The "Report" included surveys at six stations on the main stem in the lower reach of the Clarion River (below Piney Dam) for benthic macroinvertebrates and fish (aquatic biota). Water quality was secured at ten stations that included the main stem stations and select tributaries (Deer Creek and Piney Creek).

A total of nine stations for benthic macroinvertebrates and fish were included in the middle reach of the Clarion River (Piney Dam to Ridgway) and only one of these stations occurred on the main stem at Cooksburg. The other stations occurred on major tributaries that included Cathers Run (two stations), Clear Creek (two stations), Millstone Creek (two stations), Spring Creek, Little Toby Creek and Elk Creek. Extensive water quality data was secured from ten stations that did not strictly correspond to aquatic biota stations.

A total of 12 stations for both aquatic biota and water sampling occurred in the upper reach of the Clarion River (Ridgway to the source of the West and East Branches of the Clarion River). Again, the water quality sampling locations were not all at the exact locations of aquatic biota sampling. For aquatic biota, a total of six stations were located on the main stem between Johnsonburg and Ridgway with additional stations on the West Branch (2), East Branch (2), Five Mile Run and Powers Run.

Based on the "Report", the best way to interpret and analyze the data is to segregate the Clarion River into segments, the lower reach (mouth to Piney Dam), the middle reach (Piney Dam to Ridgway) and the upper reach (Ridgway to the sources of the West and East Branches). The East and West Branches of the Clarion River are large streams. Below their confluence at Johnsonburg, the Clarion River is a small river in its upper reach grading to a medium-sized river in its middle reach below Ridgway. The Clarion River continues as a medium-sized river in its lower reach to the mouth at the Allegheny River near Parker.

The segregation of the Clarion River to the reach level in interpreting and analyzing results in the "Report" provides a basis for comparisons that consider natural effects that are inherent from longitudinal gradients in a particular watershed from its headwaters to downstream areas.

2.0 BACKGROUND

Innate regional differences exist in the prevailing geology, topography, soils, vegetative (climax) cover, agricultural potential and water bodies. A particular watershed highly reflects the lands that it drains. These conditions for a specific area are usually described (similarly) on a broader scale by using the ecoregion concept and physiographic province on a smaller scale.

The following brief discussion describes these characteristics for the Clarion River Watershed.

2.1 Ecoregion – Physiographic Concept

The lower portion of the watershed lies within the Western Allegheny Plateau Ecoregion that extends from western Pennsylvania through western Kentucky. The upper portion of the watershed lies within the North Central Appalachians Ecoregion that extends from northwestern Pennsylvania through southeastern New York.

These broader ecoregions are similar to the physiographic provinces described for Pennsylvania where the entire watershed lies within the Appalachian Plateaus Province. The Province is segregated into sections based on glaciation and topography. The lower reach and portions of the middle reach of the Clarion River are situated within the Pittsburgh Low Plateau Section. The upper reach of the watershed is situated within the High Plateau Section.

2.2 Geology and Topography

The underlying rock strata of the Pittsburgh Low Plateau Section consists of shale, siltstone, sandstone and coal with some limestone. The dominant landform consists of a smooth undulating surface having numerous narrow, relatively shallow valleys with some high level terraces. The local relief is low (100 to 300 feet) to moderate (301 to 600 feet). Streams dissect the plateau in a dendritic drainage pattern. The approximate minimum elevation is 600 feet (m.s.l.) and the maximum elevation is 1,700 feet (m.s.l.).

The underlying rock strata of the High Plateau Section consists of sandstone, siltstone and shale with some coal and no limestone. The dominant landform is broad, rounded to flat uplands having deep, angular valleys. The local relief is moderate to high (601 to 1,000 feet). Streams also dissect the plateau in a dendritic drainage pattern. The approximate minimum elevation is 1,080 feet (m.s.l.) and the maximum elevation is 2,500 feet (m.s.l.).

The Clarion River watershed is located in the extreme northeastern edge of the main bituminous coal field that also delineates the Western Allegheny Plateau (often referred to as "Appalachia"). The benefits (employment) and problems (acid-mine drainage) associated with coal mining and its related industries (steel making) in mining this high volatile bituminous coal (high sulfur) is well known by many natives of the region.

The Western Allegheny Plateau also contains some shallow oil fields (to the west of the watershed) and more extensive areas of shallow gas fields. Limestone (carbonate rocks) is not extensive in the watershed. The southern portion of Clarion County, southwestern portion of Jefferson County and the southern portion of Elk County are underlain by the generally flat-lying Vanport Limestone (a high-calcium limestone) which is generally overlain by less than 100 feet of sedimentary (shale, siltstone and sandstone) rock.

2.3 Soils

The soil building process in the unglaciated Clarion River watershed results in surficial materials that represent residuum, colluvium and alluvium.

Residuum is a surface accumulation of unconsolidated rock debris developed in place by the processes of physical and chemical weathering operating on the underlying bedrock. Colluvium is a hillside (slope) deposit of unconsolidated, poorly sorted material that has been transported downslope by gravity-driven processes. Alluvium comprises unconsolidated, well to poorly defined layers of clay, silt, sand, gravel and some boulders. The alluvium is a flat-surfaced deposit on valley bottoms that is deposited by flowing water in the stream channels and adjacent flood plains.

The surficial material in the lower reach and the majority of the middle reach of the Clarion River is categorized as mixed topography and rocks where mixed topography developed on mixed rock types with moderately thick residuum on upland surfaces and thin to moderately thick colluvium on hillsides. Thin to moderately thick alluvium occurs in the valley bottoms. The surficial material in the upper reach is categorized as plateaus and deep valleys where flat-surfaced to gently sloping upland developed on mixed rock types and are generally covered with thick (>5 feet) residuum. The uplands are dissected by steep-sloped valleys which have some colluvium on the hillsides and thin (<3 feet) alluvium in narrow valley bottoms.

Generally, soil types in the Clarion River watershed are acidic (soil reaction – pH 3.6 to 5.5), low in fertility (especially phosphorus) and low in organic matter.

2.4 Vegetation and Land Use

The dominant vegetation cover (climax community) in the Clarion River watershed is forestland. The forest layer type in the lower reach and the majority of the middle reach is Appalachian Oak Forest with the Northern Hardwood Forest type in the upper reach.

The Appalachian Oak Forest is dominated by oaks (*Quercus* spp.) that include red, white, black, chestnut, shingle and scarlet oaks along with hickories (*Carya* spp.), elms (*Ulmus* spp.), white ash (*Fraxinus americana*), tuliptree (*Liriodendron tulipifera*), black gum (*Nyssa sylvatica*) and bigtooth aspen (*Populus grandidentata*). The Northern Hardwood Forest type contains many of the tree species in the Appalachian Oak Forest type and vice versa, with a greater dominance of sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*) and American basswood (*Tilia americana*) along with birches (*Betula* spp.), Cucumber-Tree (*Magnolia acuminata*) and Quaking Aspen (*Populus tremuloides*). Several tree species are co-dominant in both forest layer types that include the black cherry (*Prunus serotina*), red maple (*Acer rubrum*), Canada hemlock (*Tsuga canadensis*) and Eastern white pine (*Pine strobus*).

The forest layer is more intact in the moderate to high local relief in the upper reach of the watershed with more open/agricultural land uses in the low to moderate local relief in the lower and middle reaches of the watershed. Agriculture activity consists of limited areas in row crops (corn and small grains) with the majority in active pasture or hayland (tame cool-season grasses). Much of the hayland is reverting to old field habitat, shrubland or early successional forest. Large areas in the lower and middle reach of the watershed contain reclaimed strip-mined areas that have been graded and planted to herbaceous cover (cool-season grasses and introduced legumes).

2.5 Impoundments

The great dam building era of the middle of the last century resulted in two significant manmade impoundments in the watershed. The Piney Dam and Reservoir that delineates the lower and middle reach and the East Branch Dam and Reservoir in the upper reach are impoundments that extol the multi-purpose benefits of these types of river alterations. These benefits include flood control, recreation and sometimes hydropower.

Although the true benefits of these impoundments have been debated for years, many feel the permanent inundation of upstream areas to protect downstream areas from seasonal flooding is not wise in the long-term. In areas of moderate to high relief, these deepwater impoundments often develop large portions of their water volume that are seasonally or permanently devoid of oxygen. This

stratified condition often modifies downstream temperature regimens, oxygen levels and natural sediment loads (based on the level of water release) and reduces recreational use of the impoundment (except for boating and water skiing).

The major affect of the two impoundments on the Clarion River and East Branch is that both of the dams totally restrict fish movements in the major reaches of the stream, which is essential for a recovering riverine ecosystem.

3.0 WATER QUALITY

This section will summarize the results (seasonal) of select water quality parameters based on the established reach levels in the Clarion River watershed.

3.1 Temperature

The entire Clarion River watershed has a PA DEP (Chapter 93) protected use for Cold Water Fishes (CWF) with many tributaries having special protection as High Quality Waters (HQ-CWF). This protected use, upon which the development of water quality criteria is based, is predicated on the undefined maintenance and/or propagation of fish species including the family Salmonidae (trout) and additional flora and fauna which are indigenous to a cold water habitat.

Cold water habitat is usually defined as aquatic habitat that does not exceed a maximum water temperature of 16° C (60° F) for a sufficient duration, and is certainly warm water habitat when the maximum water temperature exceeds 21°C (70°F) for a sufficient duration. At the latitude of the Clarion River watershed, air temperature can exceed 32°C (90°F) during the summer months.

The warmer months, especially in larger streams and lakes because of heat budgets, are the critical period for the maintenance of water temperatures that are conducive to cold water habitat. Temperature readings, including several thermal variance studies completed at Johnsonburg in the upper reach and Piney Dam in the lower reach, have demonstrated that water temperatures exceed 21°C (70°F) for a sufficient duration in the main stem of the Clarion River. The effects of the two impoundments (East Branch and Piney Lake) tend to alter natural stream temperatures by depressing warmer temperatures in the spring and elevating temperatures in the fall.

The lower and middle reaches of the Clarion River exhibit annual, minimum and maximum water temperatures that are more descriptive of warm water habitat in the region. The upper reach is more consistent of a transition zone between cold water and warm water habitat and may best be described as cool water habitat. Smaller tributaries in the watershed do exhibit (temperature regimens) characteristics of cold water habitat.

3.2 Dissolved Oxygen

The concentration of dissolved oxygen in aquatic environments is essential for the maintenance of a healthy and diverse aquatic biota. Levels less than 6.0 mg/l (ppm) indicate potential stress based on the duration of low levels. Dissolved oxygen tensions fluctuate (naturally) seasonally because warmer water and higher elevations have lower saturation levels for oxygen.

Dissolved oxygen readings throughout the watershed reveal that levels of this parameter are sufficient (>6.0 mg/l) in the main stem and tributaries during all seasons (including critical summer months). Dissolved oxygen readings below several industrial and municipal wastewater discharges revealed that these facilities are not depressing dissolved oxygen levels in the main stem.

Impoundments often alter dissolved oxygen levels in streams below their discharge because of thermal stratification. Thermal stratification reduces water mixing to deeper depths (thermocline), and the bottom layer becomes devoid of oxygen (anoxic). Piney Lake thermally stratifies but does not appear to be significantly depressing dissolved oxygen in the lower reach of the Clarion River. East Branch Lake in the upper reach does not exhibit significant thermal stratification and maintains adequate oxygen levels at all depths.

3.3 pH (Acid Base Reaction)

The measurement of pH (hydrogen ion activity) determines the reaction of water (acidic-basic and the production of salts or precipitates). Most productive aquatic communities require a pH of circumneutral to slightly basic (6.8 to 8.0 standard units). Levels below 6.0 su and above 9.0 su indicate increasing acidic and basic reactions that stress aquatic biota.

Measurement of pH in the main stem of the Clarion River show readings that are generally in the acceptable range of 6.0 su to 8.0 su. Several major tributaries in the upper (East Branch drainage area) and the lower and middle reaches (Deer Creek, Piney Creek, Toby Creek and Mill Creek) exhibit pH readings less than 5.0 su with consistent readings of less than 4.0 su. These tributaries drain extensive areas that have been strip mined for coal.

A pH of less than 5.0 su indicates severe water quality degradation from acid mine drainage (AMD). A pH of less than 4.0 su eliminates all fish life and the majority of lesser life forms, except for a few types of highly specialized algae and bacteria. Readings for pH are depressed in the Clarion River for short distances below the confluence with AMD tributaries.

The tributaries degraded by AMD are impacted by unreclaimed and reclaimed strip-mined areas where high sulfur coal wastes exposed by mining react with air and water to produce sulfuric acid in runoff and seepage from these areas. This mineral acidity causes metals (primarily iron, manganese and aluminum) to be more soluble in receiving waters. This increased solubility of metals can produce dissolved concentrations (especially of manganese and aluminum) that are highly toxic to aquatic biota.

Several public and private entities in the watershed have projects (on-going or planned) that utilize passive treatment systems to treat acid mine seeps, or use limestone sand applied to impacted stream channels to abate acid mine drainage.

3.4 Conductivity and Total Dissolved Solids (TDS)

Water is the universal solvent that will dissolve any substance over a period of time. Conductivity and Total Dissolved Solids (TDS) measurements are similar and determine the amounts of dissolved substances in a volume of water, as opposed to suspended substances. TDS provides a measurement of concentration and can reach levels of 500 mg/l in natural waters. TDS concentrations greater than this level and conductivities above 700 umhos/cm often indicate water quality degradation from acid mine drainage, industrial wastes or municipal wastes.

Conductivities range from less than 50 to 200 umhos/cm throughout the main stem of the Clarion River, but are slightly elevated and approach 500 umhos/cm in the river below some of the inflows of tributaries that are impacted by acid mine drainage.

TDS concentrations are low (<100 mg/l) in the East Branch and West Branch and range between 200 and 300 mg/l throughout the length of the main stem.

Unusually high conductivities (>3,500 umhos/cm) were measured in Elk Creek near St. Marys, which require further examination. High conductivities (>1,000 umhos/cm) and high TDS concentrations (>500 mg/l) were recorded in Deer Creek, Piney Creek, Mill Creek and Toby Creek which is the result of acid mine drainage in these tributaries.

3.5 Alkalintiv - Acidity

Because of the lack of carbonate rocks (limestone and dolomite) in the Clarion River Watershed, the natural, total alkalinity (calcium carbonate) is often less than 20 mg/l. These types of streams are often referred to as "freestone" streams and lack aquatic productivity (reduced numbers of aquatic biota). Increased productivity is usually associated with streams that have a range of 50 to 300 mg/l of total alkalinity. Concentrations of >300 mg/l are often indicative of water quality degradation from nutrient enrichment caused by organic wastes.

Total acidity is related to pH, but provides a concentration measurement for hydrogen ion activity. Total acidity is naturally very low in surface waters in the region. When total acidity exceeds total alkalinity, aquatic production is severely reduced, and a water body approaches sterility (few aquatic life forms).

The naturally low levels of total alkalinity in the Clarion River provide low buffering capacity for conditions that increase total acidity such as acid mine drainage and acid rain. Portions of the Clarion River Watershed receive the highest acid precipitation (low pH rainfall) readings recorded in North America.

Portions of the watershed, where total acidity concentrations exceed total alkalinity concentrations have been recorded in the East Branch drainage in the upper portion of the watershed, and in the lower and middle reaches in tributaries that have been impacted by acid mine drainage (Deer Creek, Piney Creek, Toby Creek and Mill Creek). Total Acidity readings that exceed 50 mg/l, which is very high, were recorded in Toby Creek.

3.6 Metals (Iron, Manganese and Aluminum) and Sulfates

Total metals (iron – Fe, Manganese – Mn and Aluminum – Al) is a measure of both the dissolved and suspended amounts of each metal in a water body. The dissolved concentration of a metal can be very deleterious (acute toxicity) to aquatic biota. Although Fe is not particularly toxic at lower concentrations (except for odor and staining in drinking water supplies), concentrations (ranging from 0.2 mg/l to 0.5 mg/l for Mn and Al) can be toxic to fish and benthic macroinvertebrates.

It is not clear in the study whether or not water samples for metal determinations were total metals or dissolved metals. In the future, determinations should be made for both total and dissolved metals.

Sulfates are not particularly toxic to aquatic biota at concentrations less than 250 mg/l. The most deleterious effect of high metals and sulfate concentrations in a water body is the formation of precipitates (metal sulfates). Low pH waters increase the solubility of metals (dissolved form). When the pH increases these metals precipitate to form sediments on the stream bottom (known as "yellow boy"). These precipitates often plate the stream bottom reducing the habitat for benthic macroinvertebrates. The characteristic yellow precipitate from Fe, black precipitate from Mn and white precipitate from Al in many streams is a familiar sight to many Western Pennsylvanians.

Metal concentrations and sulfate concentrations are the highest in the tributary streams that are impacted by acid mine drainage that include Mill Creek, Toby Creek and Piney Creek. Metal and sulfate concentrations are generally low throughout the main stem of the Clarion River at each reach level.

4.0 BENTHIC MACROINVERTEBRATES

The benthic macroinvertebrate community of a stream provides an assemblage of aquatic organisms that contain groupings whose presence, absence and abundance can define the overall water quality and habitat condition of a water body. The advantages of using benthic macroinvertebrates for bioassessment are the following:

- Macroinvertebrate assemblages are good indicators of localized conditions. Because many benthic macroinvertebrates have limited migration patterns or a sessile mode of life, they are particularly well suited for assessing site-specific impacts (upstream-downstream studies);

- Macroinvertebrates integrate the effects of short-term environmental variations. Most taxon (types) have a complex life cycle of approximately one year or more;

- Degraded conditions can often be detected with only a cursory examination of the benthic macroinvertebrate assemblage. Macroinvertebrates can be easily identified to the family level and many "intolerant" taxa can be identified to lower taxonomic levels (genus or species);

- Benthic macroinvertebrate assemblages are made up of taxa that constitute a broad range of trophic (feeding habits) levels and pollution tolerances, thus providing strong information for interpreting cumulative effects of water quality or habitat degradation;

- Sampling is relatively easy, requires few people and inexpensive gear and has minimal detrimental effect on the resident aquatic biota;

- Benthic macroinvertebrates serve as a primary food source for fish, including many recreationally and commercially important species;

- Benthic macroinvertebrates are abundant and diverse in clean streams providing an assemblage of aquatic worms (Oligochaeta), crustaceans (aquatic sowbugs, scuds and crayfish), mollusks (freshwater mussels, clams and snails) and aquatic insects. The aquatic insect orders common in streams include mayflies (Ephemeroptera), stoneflies (Plecoptera), caddisflies (Trichoptera), dragonflies and damselflies (Odonata), semi-aquatic bugs (Hemiptera), fish flies and alderflies (Megaloptera), aquatic beetles (Coleoptera) and true files – midges (Diptera – Chironomidae);

- Most state water agencies that routinely collect biosurvey data focus on macroinvertebrates. Many states have background macroinvertebrate data, and have more expertise with invertebrates than fish. The PA DEP, Bureau of Water Quality Management has produced a list of all benthic macroinvertebrates found in Pennsylvania waters. This list provides taxonomy for each order to the genus level and includes a tolerance rating for each macroinvertebrate listed. The tolerance rating is adapted from the Hilsenhoff Index where tolerance values range from 0 to 10, where 0 being the most intolerant and 10 being the most tolerant. The PA DEP list is included as Attachment 1.

4.1 Benthic Macroinvertebrate Sampling

Standard benthic macroinvertebrate sampling gear types for streams includes the following:

- Kick Net: Dimensions of net are 1 meter (3.28 feet) x 1 meter (3.28 feet) attached to two poles and functions similarly to a fish kick seine. It is most efficient for sampling cobble substrate in riffles and runs where velocity of current will transport dislodged organisms into the net. Designed to sample 1 m^2 (10.76 s.f.) of substrate at a time and can be used in any depth from a few centimeters (inches) to just below 1 m (3.28 feet) – depths greater than 1 m or greater are difficult to sample with any gear.

- D-frame Dip Net: Dimensions of frame are 0.3 meter (0.98 feet) width and 0.3 meter height, and the net is shaped as a "D" where frame attaches to long pole. Net is cone or bag-shaped for capture of organisms. Can be used in a variety of habitat types and used as a kick net or for jabbing, dipping or sweeping.

- Rectangular Dip Net: Dimensions of frame are 0.5 meter (1.64 feet) width and 0.3 meter (0.98 feet) height and attached to a long pole. Net is cone or bag-shaped. Sampling is conducted similarly to a D-frame net.

- Surber Sampler: Dimensions of frame are 0.3 meter (0.98 feet) x 0.3 meter, which is horizontally placed on cobble substance to delineate 0.09 meter square (0.96 s.f.) area. A vertical section of the frame has the net attached and captures the dislodged organisms from the sampling area. It is restricted to depths of less than 0.3 m (0.98 feet).

The various sampling gear types are used to generate qualitative, semi-quantitative and quantitative data on a benthic macroinvertebrate community. Qualitative sampling is conducted using a kick net or D-frame or rectangular dip nets. Results are reported based on the number of distinct taxon collected with a relative abundance determination (i.e. – rare, present, common, abundant). Semi-quantitative sampling uses the same type of sampling gear with results including

the number of distinct taxon collected along with the number of each taxon identified. Quantitative sampling uses the Surber sampler as the primary sampling gear with results reported as the number of distinct taxon collected along with a density determination of density of organisms per square area (~1 s.f.) of representative stream bottom habitat.

Comparisons of benthic macroinvertebrate sampling data must be evaluated with caution. Precise quantitative sampling is difficult to attain because the Surber sampler provides a small sampling area, and the need to ensure that sampling is conducted in representative habitat introduces inherent bias. The minimum number of Surber samples required is set at 3 to 5 which may not be adequate to provide accurate data on benthic macroinvertebrate density (number per area). The Surber sampler is more suited to smaller streams where the device can be more efficiently utilized in shallow water (less than one-foot depth).

Recent efforts at benthic macroinvertebrate sampling have de-emphasized quantitative sampling, especially in larger streams where use of the Surber sampler is inappropriate because of depth limitations. Semi-quantitative sampling using the D-frame dip net or rectangular dip-net (often referred to as "Surber on a stick") provides highly accurate and precise results where channel units (riffles, runs and pools) are less defined in larger streams. Sampling efforts using a minimum of 5 and up to 10 dip net samples per station provide comparable results and can also be used to generate acceptable organism per unit area (density) data. For example, the benthic macroinvertebrate sampling survey in the upper Clarion River, as part of the Willamette Plant thermal study, used the D-frame dip net to secure 7 samples per station (semi-quantitative) along with 3 additional samples of coarse particulate organic matter (CPOM-organic debris such as leaves and twigs) at each station (qualitative).

4.2 Results of Benthic Macroinvertebrate Sampling in Clarion River Watershed

Benthic macroinvertebrate sampling was conducted on the main stem at five stations in the lower reach below Piney Dam (CRO1A, CR02, CR03A, CR03 and CR04) by a consulting firm and the PA Fish and Boat Commission (PA FBC). A total 10 stations were sampled for benthic macroinvertebrates in the middle reach, with one station located on the main stem at Cooksburg (CR01) and the remaining stations located on tributaries that included Cathers Run (2 stations), Clear Creek (2 stations), Millstone Creek (2 stations) conducted by Clarion University and Spring Creek, Little Toby Creek and Elk Creek conducted by the PA FBC. Benthic macroinvertebrate sampling on the upper reach consisted of six stations on the main stem, two stations on the West Branch, two stations on the East Branch and one station each in Five Mile Run and Powers Run. This sampling was conducted by an environmental consulting firm and the PA FBC.

Sampling conducted by the consulting firms on the lower reach (three sampling events – spring, summer, fall) and the upper reach (four sampling events – spring, summer, fall and winter) consisted of multiple sampling events at the same station that provided invaluable data on seasonal changes in the benthic macroinvertebrate community in these reaches.

Recent evaluations of benthic macroinvertebrate assemblages have emphasized "Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers" developed by the EPA (1999). This protocol uses metrics to predict the response of benthic macroinvertebrate assemblages to increasing perturbation of the aquatic environment. The use of density estimations and species diversity indices is no longer emphasized.

The "Report" correctly emphasizes five metrics for assessing the condition of the benthic macroinvertebrate assemblage in each reach of the Clarion River. These metrics include the following:

1. Total Number of Taxa – this is a taxa diversity or richness measure that measures the overall variety of the assemblage;

2. Percent EPT Taxa - this is an assemblage composition measure that determines the percent of mayfly (Epheneroptera), stonefly (Plecoptera) and caddisfly (Trichoptera) larvae that compose the assemblage;

3. Number of Intolerant Taxa – this is an intolerance/tolerance measure that computes the taxa richness of those organisms considered to be sensitive to pollution, based on an assigned tolerance value of 0 (most intolerant) to 10 (most tolerant);

4. Percent Dominant Taxon – this is an additional intolerance/tolerance measure that determines the dominance of the single most abundant taxon and usually includes the calculation of the 2nd, 3rd, 4th and 5th dominant taxa;

5. Ratio of EPT and Chironomidae Abundances – this metric measures the relative abundance of these indicator groups as a measure of community balance. Good biotic condition is reflected in communities having a fairly even distribution among all four major groups with substantial representation by the more intolerant mayflies, stoneflies and caddisflies compared to the more tolerant midge fly larvae (Chironomidae). Assemblages having a disproportionate number of midge fly larvae types compared to EPT types can indicate environmental stress. Many type of midge fly larvae are very tolerant to many types of water pollution from heavy metals to nutrient enrichment (municipal wastes).

4.2.1 Benthic Macroinvertebrate Assemblage – Lower Reach

A medium-sized river in the region should support a benthic macroinvertebrate assemblage that exceeds a species richness of greater than 50 taxa, and assemblages with less than 30 taxa are indicative of environmental stress.

Seasonal benthic macroinvertebrate sampling on the Clarion River below Piney Dam show consistent results of less than 30 taxa at all stations. The number of individuals of each taxon collected is also low except for some taxa collected in the summer.

The EPT taxa contain few mayflies and stoneflies being dominated by somewhat tolerant caddisflies. The dominant caddisfly taxa include hydropsychids that consist of *Hydropsyche* (tolerance rating = 5), *Cheumatopsyche* (tolerance rating = 6) and *Macrostemum* (tolerance rating = 3). The % EPT taxa exceeds 50% at all stations except for station CR02 which is located near the SR2007 bridge upstream of the Piney Creek confluence. The % EPT taxa ranges from 17% to 34% at this station.

The Ratio of EPT and Chironomidae Abundances in the lower reach is very favorable at all stations except for Station CR02. The ratio favors midge fly larvae during the summer and fall seasons at this location. The midge fly larvae dominant at this station include Orthocladinae, Tanypodinae, Chironomini and Tanytarsini. These midges have not been assigned a tolerance rating by the PA DEP.

Generally, the lower reach of the Clarion River supports a depauperate benthic macroinvertebrate community. The reach is exhibiting some recovery as evidenced by the dominance of hydropsychid caddisflies, especially *Macrostemum*. This caddisfly has a tolerance rating of 3 and is a major component of clean rivers in the region.

The dominance of the scud (*Crangonyx*) in the lower reach at several stations is encouraging. Extremely large populations of amiphipods often develop below impoundments in temperate waters and provide a major food source for fishes. This scud is somewhat intolerant with a tolerance rating of 4.

4.2.2 Benthic Macroinvertebrate Assemblage – Middle Reach

Benthic macroinvertebrate sampling in this reach included only one sampling station on the main stem (CR01) with emphasis on larger tributary streams (Cathers Run, Clear Creek, Millstone Creek, Spring Creek, Little Toby Creek and Elk Creek).

The total number of taxa collected at Cooksburg shows improvement on the main stem compared to the lower reach, but the assemblage is depauperate with less than 30 total taxa (19 to 26 total taxa range).

The EPT taxa contianed several taxa of mayflies and stoneflies. The % EPT taxa flucuated seasonally and exceeded 50% only during the summer season.

The Ratio of EPT and Chironomidae Abundances were even in the spring and fall seasons. The low ratio is the result of dominance of midge fly larvae (Orthocladinae and Chironomini) and aquatic earthworms (Lumbriculidae).

Midge fly larvae (Chironomidae) are a large and diverse group of aquatic insects that are difficult to identify below the subfamily level. They are often associated with degraded water quality. They do contain some of the most tolerant taxa, and their increasing abundance in the absence of other aquatic insect groups (EPT) is often indicative of poor water quality. The midges are an important component of the benthic macroinvertebrate assemblage of all aquatic environments (group contains many intolerant taxa) and they are a major food source for many species of fish.

The benthic macroinvertebrate community in the middle reach of the Clarion River indicates recovery, but water quality remains a problem. The dominance of midge fly larvae, especially Chironomini, which includes bloodworms that indicate low dissolved oxygen concentrations, and the highly tolerant aquatic earthworm (Lumbriculidae), which has a tolerance rating of 8, support this assessment.

Signs of encouragement that support a recovering stream are the dominance of the intolerant caddisfly, *Brachycentrus*, in the summer season (tolerance rating of 1), and the appearance of several intolerant to somewhat intolerant mayflies and stoneflies. Although collected in low numbers, the presence of the large stonefly, *Acroneuria*, with a tolerance rating of 0, and the burrowing mayfly, *Ephemera*, with a tolerance rating of 2, deserve noting. Burrowing mayflies are an important component of clean river systems.

4.2.3 Benthic Macroinvertebrate Assemblage – Middle Reach - Tributaries

The total number of taxa collected in Cathers Run, Clear Creek and Millstone Creek represent a taxa richness that approaches reference conditions for tributary streams in the watershed. Both Cathers Run and Clear Creek drain large tracts of public lands (State Game Land and State Forest). Cathers Run (48 total taxa) and Clear Creek (59 total taxa) contain an abundance of a diverse array of mayflies, stoneflies, caddisflies, crane flies (Tipulidae), riffle beetles (Elmidae) and fish flies – hellgrammites (Megaloptera).

Clear Creek and Cathers Run present an excellent example where the somewhat tolerant hydropsychid caddisflies do not dominate the EPT taxa. The streams contain highly intolerant mayflies (*Epeorus, Ameletus, Ephemerella and Serratella*) that have tolerant values that range from 0 to 2; small (winter) stoneflies (*Paracapnia, Leuctra and Taeniopterx*) and large stoneflies (Perlidae and Perlodidae) that have tolerance values that range from 0 to 2. Several very intolerant caddisflies are also present that include, *Dolophilodes*, and saddlecase makers (*Glosssoma*) that both have tolerance ratings of 0 (most sensitive).

Millstone Creek with a total taxa of 35 is more indicative of impaired streams in the watershed. Intolerant taxa are rare (lower abundance of stoneflies). All three of the streams contain a % EPT that exceeds 50 percent.

Little Toby Creek, Spring Creek and Elk Creek, similar to Millstone Creek show depauperate benthic macroinvertebrate communities for streams of their size in the region. Spring Creek contains an acceptable taxa richness at 31, but mayflies are rare, stoneflies are almost absent, and the Trichoptera are dominated by hydropsychid caddisflies. Little Toby Creek has a low taxa richness (13), but does contain several intolerant to somewhat tolerant mayflies and caddisflies (no stoneflies). This stream does receive AMD in the headwater areas, and may be generally indicative of the low aquatic productivity (limited nutrients) of many streams in the watershed.

Elk Creek drains the urban areas of St. Marys and Ridgway. This is the only monitored stream where moderate to severe impairment is indicated. The total taxa richness is 17, and the Ratio of EPT Abundance to Chironomidae Abundance is very low (88% Chironomidae).

4.2.4 Benthic Macroinvertebrate Assemblage – Upper Reach

Benthic macroinvertebrate sampling in the main stem of the Clarion River in the upper reach consisted of six stations (ERI stations 3 through 8) from Johnsonburg to Ridgway as part of the thermal variance study for the Willamette paper mill.

The benthic macroinvertebrate assemblage in the upper reach of the Clarion River has shown a phenomenal recovery in the last decade. A compilation of the four, seasonal sampling events (11/98, 3/99, 7/99 and 11/99) show a total taxa richness at each station on the main stem ranging from 14 to 47. Winter sampling (3/99) was difficult because of high flows in the river.

Percent EPT taxa ranged from 36.8 to 62.5% and EPT taxa were dominated by intolerant to somewhat intolerant mayflies (*Serratella and Ephemerella*), caddisflies (*Hydropschye and Cheumatopsyche*), riffle beetles (*Optioservus and Stenelmis*) and crane flies (*Antocha and Tipula*). Several intolerant stoneflies were also present in the assemblage that include the medium-sized stonefly, *Isoperla*, and the large stonefly, *Pteronarcys*.

The Ratio of EPT Abundance and Chironomidae Abundance was favorable at all stations on the main stem. The thermal variance study painstakingly identified midge fly larva (Chironomidae) to the genus level. This level of identification revealed that the dominant midges were *Parametriocnemus, Diamesa, Cricotopus/Orthocladius and Pagastia.* These midge fly larvae have tolerance values ranging from 5 to 7, and they are indicative of clean, cool, gravel-bottomed streams (sprawlers and burrowers).

4.2.5 Benthic Macroinvertebrate Assemblage – Upper Reach - Tributaries

Benthic macroinvertebrate sampling in tributaries in the upper reach was conducted on the West Branch, East Branch, Five Mile Run and Powers Run. Seasonal sampling was completed in the West Branch, East Branch and Powers Run by ERI (11/98, 3/99, 7/99 and 10/99) with a single sampling event (11/98) in the West Branch, East Branch and Five Mile run conducted by the PFBC.

Five Mile Run drains into the East Branch Reservoir in the extreme upper end of the watershed. This stream had a total taxa richness of 26. The % EPT taxa was 30 percent but contained a diverse mix of sensitive mayflies (*Ephemerella, Epeorus, Heptagenia*) and stoneflies (*Paracapnia, Leuctra, Taeniopteryx, Acroneuria and Sweltsa*) along with several sensitive caddisflies (*Brachycentrus, Dolophilodes* and the free-living *Rhyacophila).* The abundance of Chironomidae is indicative of the infertile nature (freestone) of headwater streams in the watershed.

The benthic macroinvertebrate assemblage shows a diverse community with a total taxa (seasonal composite) of 89 taxa (ERI) in the West Branch, and seasonal taxa totals that range from 28 to 47 taxa. The % EPT taxa ranges well above 60% and is composed of a high diversity of mayflies, stoneflies and caddisflies. The Ratio EPT Abundance to Chironomidae Abundance is also very favorable. Dominant taxa are mayflies (*Serratella and* Heptageniidae), riffle beetles (*Optioservus*), caddisflies (*Hydropsyche*) and crane flies (*Antocha*). Of particular note, the intolerant caddis fly, *Helicopsyche*, which is abundant in the more productive (limestone) streams to the west-southwest of the Clarion River watershed was common in the West Branch.

Water quality problems in the East Branch have been known for decades (AMD, logging and acid rain) which further reduces the aquatic production in this stream (classic freestone stream). The total taxa (seasonal composite) of 71 in the stream and seasonal taxa totals that range from 13 to 38 taxa are testament to the recent AMD abatement activities currently being conducted on tributaries of the East Branch.

The % EPT Taxa and Ratio of EPT Abundance to Chironomidae Abundance in the East Branch is highly favorable. Dominant taxon include sensitive stoneflies

(*Leuctra and Isoperla*), sensitive mayflies (*Serratella and Epeorus*) and somewhat intolerant caddisflies (*Hydropsyche and Cheumatopsyche*). The density of benthic macroinvertebrates in the East Branch is significantly lower than the West Branch and Clarion River main stem in the upper reach.

Powers Run enters the Clarion River at the southern limits of Johnsonburg. This small tributary drains mostly forestland. Seasonal benthic macroinvertebrate sampling (composite of four events) resulted in a total taxa number of 67 with total taxa from single sampling events ranging from 16 to 22 taxa.

The % EPT Taxa and Ratio of EPT Abundance and Chironomidae Abundance are favorable. Dominant taxa include sensitive stoneflies (*Leuctra*, *Allocapnia* and *Isoperla*) and the mayfly, *Serratella* along with somewhat tolerant caddisflies (*Hydropsyche*) and riffle beetles (*Stenelmis*). The somewhat tolerant midge fly larva, *Parametriocnemus*, was dominant in the winter (3/99) sampling event.

5.0 FISH

The fish community of a stream provides the apex assemblage that characterizes the total aquatic ecosystem. The fish community is primarily a function (fish diversity and abundance of individuals of each species) of the water quality and benthic macroinvertebrate community in a stream and its watershed. The advantages of using the fish community for bioassessment are the following:

- Fish are good indicators of long-term (several years) effects and broad habitat conditions because they are relatively long-lived and mobile;

- Fish assemblages generally include a range of species that represent a variety of feeding habits (trophic levels) that include generalists = omnivores, herbivores, invertivores, filter feeders and piscivores. They tend to integrate effects of lower trophic levels; thus, fish assemblage structure is reflective of integrated environmental health;

- Fish are at the top of the aquatic food web and are consumed by humans, making them important for assessing contamination;

- Fish are relatively easy to collect and identify to the species level. Most specimens can be sorted and identified in the field by experienced fisheries professionals, and subsequently released unharmed;

- Environmental requirements of most fish are comparatively well known. Life history information is extensive for many species, and information on fish distribution is commonly available;

- Protected aquatic life uses (water quality standards) are typically characterized in terms of fisheries (cold water, cool water, warm water). Monitoring fish provides direct evaluation of "fishability" and "fish propagation", which emphasizes the importance of fish to anglers and commercial fisherman;

- Fish account for nearly half of the endangered vertebrate species and subspecies in the United States.

5.1 Biogeography of Fishes in the Upper Ohio River Basin

The Clarion River is a major tributary to the lower Allegheny River. The pre-glacial drainage pattern of the lower Allegheny River (>100,000 years ago) was a river system that included the Allegheny, Monongahela, and upper Ohio River that had confluences near present day Pittsburgh. This system then flowed north along what is now the Beaver-Shenango River system to the Erian River (what is now Lake Erie). The Erian River was part of a large river system that drained what is now The Great Lakes area. This large drainage area then entered the St. Lawrence River that emptied into the North Atlantic Ocean. The upper Allegheny River was disjunct from the lower and flowed directly to the Erian River.

The advance and retreat of the glacial stages greatly altered this drainage pattern. As the last glacial stage, Wisconsin, retreated some 15,000 years ago. The ancient drainage pattern was directed to the south and west. The Allegheny River segments combined and along with the Monongahela River and Beaver-Shenango Rivers reversed flow in the upper Ohio River. The upper Ohio River combined with the lower Ohio River near Louisville, Kentucky, and the whole system now flowed to the Mississippi River drainage.

This large drainage area that included western Pennsylvania also drained most of West Virginia, northeast Kentucky and eastern Ohio and basically defined the Western Allegheny Plateau Ecoregion. The post-glacial drainage pattern of the upper Ohio drainage served as a refuguim for northern fishes that moved south in advance of the glaciers. The connection of the upper and lower Ohio River drainages facilitated an eastern movement of the rich and highly diverse fish fauna of the Mississippi River Basin into western Pennsylvania.

The upper Ohio River Basin is blessed with a multitude of streams that drain glaciated and unglaciated terrain with varied gradients that range from big river habitat to small, mountain (cold water) streams. The fish fauna includes a total of 24 families with 123 species (see Table 1 in Attachment 2). This fish assemblage is dominated by 39 species of carps and minnows (chubs, shiners, daces and minnows), 20 species of perches (darters, walleye, yellow perch and sauger), 14 species of suckers (redhorses, carpsuckers, buffalo, white sucker, northern hog sucker), 11 species of sunfish (rock bass, smallmouth bass, largemouth bass, spotted bass, bluegill, green sunfish, pumpkinseed, warmmouth, black and white

crappie) and 10 species of catfish (channel catfish, flathead catfish and madtoms). Only four species of exotic or non-native species have achieved success in the upper Ohio drainage because of either repeated stockings or high adaptability (brown trout, rainbow trout, common carp, goldfish).

5.2 Fish Distribution in the Clarion River Watershed

A comprehensive list of fishes that were collected as part of the "Clarion River Basin Assessment" in 1997-1999 is included as Table 2 in Attachment 2. This list contains the number of families along with the common and scientific names for each fish species.

This list can not be considered as complete because several fishes known to inhabit the Clarion River were not collected in the studies conducted, such as the silverjaw minnow (*Notropis buccatus*) and spotfin shiner (*Cyprinella spilopterus*). Both of these species are somewhat tolerant to acid-mine drainage (AMD).

A total of 47 species representing eight fish families were collected from the Clarion River. This represents less than half of the fish species (123) and families (24) known to exist in the upper Ohio drainage. Although many of these fish species have only been recorded in the extreme northwestern portion of the upper Ohio River drainage (glaciated Erie-Ontario Lake plain ecoregion), and the headwaters of the Allegheny River such as the longear sunfish (*Lepomis megalotis*), warmouth (*Lepomis gulosus*), central mudminnow (*Umbra limi*), hornyhead chub (*Nocomis biguttatus*), tonguetied minnow (*Exoglossum laurae*), bigmouth shiner (*Notropis dorsalis*), blackchin shiner (*Notropis heterodon*), spotted sucker (*Minytrema melanops*), burbot (*Lota lota*) and Iowa darter (*Etheostoma exile*), the existing fish assemblage of the Clarion River watershed represents a significantly reduced fish community than was found in the watershed in pre-settlement times.

The fact that the watershed once shared a comparable diversity to that which now exists in its receiving waters (primarily the Allegheny River) can be evidenced by records that the paddlefish (*Polyodon spathula*), a keystone big river species, was found in the Clarion River as late as 1919. The loss of at least 25 fish species that once inhabited the watershed can be attributed to the numerous water quality insults that have occurred in the past, and various habitat alterations, especially dams.

The Piney Dam appears to be an effective barrier for movement and recolonization of fishes from the Allegheny River and lower portions of the Ohio River Basin in Pennsylvania as water quality improves in the Clarion River main stem. Several big river species that are becoming more common in the Allegheny, Monongahela and Ohio Rivers in Pennsylvania include the carp-suckers (*Carpiodes*), smallmouth buffalo (*Ictiobus bubalus*), skipjack herring (*Alosa chrysochloris*), mooneye (*Hiodon tergisus*), silver chub (*Macrhybopsis*

storeiana), flathead catfish (*Pylodictis olivaris*), white bass (*Morone chrysops*), spotted bass (*Micropterus punctulatus*), sauger (*Stizostedion canadense*) and freshwater drum (*Aplodinotus grunniens*).

Table 3 in Attachment 2 presents a list of the 47 fish species found in the Clarion River watershed denoting its occurrence by reach level (lower, middle, upper) and its relative abundance in the reach(es) where it was recorded.

Table 4 in Attachment 2 contains a list of species recorded in the watershed along with select Index of Biotic Integrity (IBI) assignments developed by the PFBC for tolerance, feeding guild, spawning guild and origin.

5.2.1 Fish Assemblage – Lower Reach

Of the 47 total fish species recorded in the watershed, 33 species occurred in the lower reach. This assemblage included 11 species that were collected only in this reach (see Table 3).

The intolerant streamline chub, stonecat and rainbow darter are characteristic species of moderate-sized to large, clean streams in the region. The local range of the streamline chub has been reduced to the Allegheny River and French Creek, as this species is very intolerant to aquatic habitat degradation. All three of these species should be common throughout the Clarion River, and definitely represent a loss of species in the upper reaches.

All of the other fish species recorded in the lower reach are common to abundant in the Allegheny River. The lower reach has unimpeded flow to the Allegheny River, and the occurrence of some species may be transient, such as the mountain brook lamprey, as none of the species recorded only in the lower reach are abundant.

The walleye, black crappie, bluegill and golden shiner prefer standing water habitat and often become abundant in impoundments. These species may represent downstream movement from Piney Reservoir. The green sunfish is a highly tolerant species that has been increasing in streams of all sizes the in the upper Ohio River Basin in recent years. The yellow bullhead is tolerant, but is often a common component of fish assemblages in both streams and reservoirs in the region. The silver redhorse is a common component of the round-bodied sucker group in larger streams in the upper Ohio River Basin. This fish is very abundant in the Allegheny River and French Creek, and its numbers are increasing in the Ohio and Monongahela Rivers as water quality has improved.

Reproducing populations of walleye and golden shiner have been documented in East Branch Lake (Army Corps of Engineers) in the upper reach, as well as a reproducing population of yellow perch (*Perca flavescens*). It is surprising that

no yellow perch were collected in any of the studies referenced in the "Report". The yellow perch should currently occur in the lower reach and Piney Reservoir in the middle reach.

5.2.2 Fish Assemblage – Middle Reach

Of the 47 total fish species recorded in the watershed, 30 species occurred in the middle reach. This assemblage included five species that were collected only in this reach (see Table 3), which creates an interesting situation.

The herbivorous, central stoneroller often reaches very high abundance in clean to moderately clean, productive streams in the region. This species was present to common in the larger tributaries of the middle reach (Cathers Run, Clear Creek, Millstone Creek, Little Toby Creek and Spring Creek). Its absence from the lower and upper reaches is unusual.

The intermediate tolerant, sand shiner is one of the most widely occurring and abundant minnows (invertivore) in the upper Ohio River Basin in Pennsylvania. The species was collected only in Little Toby Creek and Spring Creek. Its absence at the main stem sampling station at Cooksburg is puzzling.

The intermediate tolerant, golden redhorse was collected only in Elk Creek in the upper portion of the middle reach. This fish along with the other round-bodied suckers (silver redhorse, shorthead redhorse, black redhorse, northern hog sucker, river redhorse and blue sucker) generally makeup the greatest biomass (weight) of fish groups in clean, upland, warm water streams in the entire Mississippi River Basin. The golden redhorse should be much more abundant than its current status in the Clarion River and its larger tributaries.

The emerald shiner (intermediate tolerance) was only collected in Cathers Run. This species is closely related to the silver shiner and rosyface shiner, and is often confused with the latter. The emerald shiner is one of the most abundant minnows in big river habitat in the upper Ohio Basin and often develops large populations in large reservoirs.

The emerald shiner, silver shiner and rosyface shiner often occur together and provide a major contribution to the forage base for predator (piscivorous) fish in a stream system. The common to abundant status of the intolerant silver and rosyface shiners in the lower and middle reaches of the watershed is encouraging.

The striped shiner is very closely related to the common shiner. Many ichthyologists think that these two intermediate tolerant minnows are subspecies. The striped shiner is more common in the southern portion, and the common shiner is more common in the northern portion of the Ohio River Basin in Pennsylvania. These two species have a high rate of hybridization in the central portion of the Basin.

The striped shiner was collected only in Millstone Creek. The common shiner is one of the most abundant minnows in the middle and upper reaches of the Clarion River watershed. The absence of the common shiner in the lower reach is unusual.

5.2.3 Fish Assemblage – Upper Reach

Of the 47 total fish species recorded in the watershed, 24 species occurred in the upper reach. This fish assemblage included only two species that were collected only in this reach (see Table 3).

The highly tolerant, fathead minnow is rare throughout the upper Ohio River Basin in Pennsylvania. It does not maintain large populations in most waters, and its sporadic distribution is usually augmented by bait introductions.

The occurrence of the intolerant, redside dace (especially in the East Branch) is very encouraging. This distinctive and attractive minnow prefers pool habitat in smaller streams. This fish appears to be decreasing in many streams throughout the upper Ohio Basin, where it was once common.

5.2.4 Fish Assemblage – Entire Watershed

The fish assemblage in the watershed has shown a marked improvement in the last few decades with an increase in fish diversity as efforts to improve water quality and aquatic habitat have proceeded. Although these efforts are commendable, the job is far from over, and much work needs to be done.

The "Report" identified a total of 47 fish species that now inhabit the Clarion River watershed. Four additional fish species not collected during this assessment are also known to inhabit the watershed. These include the silverjaw minnow, spotfin shiner and yellow perch which were discussed earlier, and the pearl dace (*Margariscus margarita*). The pearl dace (intermediate tolerance) has a northern distribution and is a headwater species that occurs in small, clear streams and is adapted to bogs, ponds and lakes. This fish has been collected in the headwaters of the West Branch in the upper reach (PFBC).

Of the 47 fish species collected, 18 occur within only one reach, 18 occur within two reaches and only 11 species recorded occur within all three reaches.

The fish species that inhabit all three reaches of the watershed include the intermediate tolerant river chub, northern hog sucker and three species of darters (greenside, johnny and blackside). These fishes are characteristic components of fish assemblages in small to large streams in the upper Ohio River Basin. The rock bass and smallmouth bass are close associates that comprise the dominant game fish component of larger, warm water streams throughout the eastern

portion of the Mississippi River Basin. Both of these species adapt well to impoundments and provide an attractive quarry for the angler that is not totally focused on catching trout.

The intolerant mottled sculpin (benthic invertivore) occurs from the extreme headwaters of cool, clean streams to large rivers. The mottled sculpin is highly intolerant of AMD. Its abundance in the upper reach is a positive sign of improving water quality.

The tolerant white sucker, creek chub and bluntnose minnow are ubiquitous components of fish assemblages in the smallest headwater streams to larger streams in the upper Ohio River Basin in Pennsylvania. The white sucker and bluntnose minnow adapt to impoundments. These three species, along with the blacknose dace, prefer smaller streams and do not compete well in larger streams when competition with other fishes can occur. Because these species are highly tolerant to degraded water quality and habitat conditions, they often replace other less tolerant species in streams. The abundance of these associate species in larger streams where they replace less tolerant species, such as river chubs, silver shiners, rosyface shiners, mottled sculpin and round-bodied suckers, and vice versa, is an excellent indication of prevailing stream conditions.

The fish species that occur within two reaches (18 total species) include some keystone species that indicate improving conditions in the Clarion River main stem. As the water quality in the Clarion River reached its lowest quality, several tributaries probably served as refugia for many fish species. Many of the intolerant and intermediate tolerant species that occur in the middle reach and upper reach could not have recolonized the Clarion River because of Piney Dam. The higher quality streams that have maintained acceptable water quality such as Clear Creek, Cathers Run, Millstone Creek, Spring Creek and the West Branch, have probably provided sources for many species to reoccupy the Clarion River main stem.

These keystone species that are common to abundant now in the Clarion River main stem include the variegate darter, rosyface shiner and silver shiner. Presence of the mimic shiner, banded darter and logperch is also very encouraging. The logperch often adapts to impounded conditions, and the mimic shiner is often one of the most abundant minnows, along with the emerald shiner, in larger streams in the region.

The collection of the channel catfish above Piney Reservoir indicates that a population of this species may have become established in the impoundment and middle reach (probably from stocking). The channel catfish is an esteemed game fish in impoundments and large, warm water streams throughout the Mississippi River Basin. In the Midwest where it is too warm for trout, the channel catfish is often referred to as the "barbed trout".

Other fish species that were collected in the middle and upper reaches include the common shiner, longnose dace and blacknose dace and the three species of trout. The common shiner is a characteristic minnow of small to medium-sized streams in the region. The blacknose dace is a ubiquitous minnow in small streams in the region. This species along with its close associates (creek chub and white sucker) often represent the entire fish assemblage in degraded streams. The blacknose dace is the most abundant fish in the entire upper reach of the Clarion River. Its replacement by the mottled sculpin and common shiner appears to be occurring below Johnsonburg, as water quality improves in this reach.

The longnose dace is an intermediate tolerant minnow that prefers high gradient, cool water to cold water streams of the region. It is a close associate of the mottled sculpin and native brook trout in smaller headwater streams in the middle and upper reaches. These types of streams are the stronghold of the brook trout.

The brook trout in the Appalachian Range from New York to Georgia is thought by many ichthyologists to be a race or races (possibly even a separate species) of the brook trout from eastern Canada. The northern form grows larger and is an inhabitant of larger streams and lakes. The southern form native to the watershed, is a much smaller fish that inhabits headwater creeks. This species is considered intolerant and occupies high status because of its beauty, preference by anglers and ones' association of this fish as defining high quality, wilderness streams.

Seasonal sampling in the upper reach indicated that many brook trout are diadromous in the upper reach and move from smaller streams to the main stem during winter. Several streams in the upper reach have been documented as areas of natural brook trout reproduction.

The brown trout and rainbow trout, along with the brook trout, are the most prized game fish in the watershed. The brown trout and rainbow trout are maintained by stocking and brown trout natural reproduction has been documented in larger tributaries to the main stem in the upper reach.

The pumpkinseed is primarily a stream sunfish but adapts well to impoundments. This fish and the common carp, brown bullhead and largemouth bass are mobile fish and rare in the watershed. Many of these species, except the common carp, are often periodically stocked in ponds and larger impoundments, and often inhabit stretches of streams above and below impoundments in varying numbers.

6.0 SUMMARY AND RECOMMENDATIONS

6.1 Water Quality

- The Clarion River main stem has shown marked improvements in water quality over the past few decades through forestry best management practices (BMP), acid-mine drainage (AMD) abatement and treatment of industrial and municipal discharges.

- The geology and soils of the watershed lack carbonate rocks (limestone) and fertility which dampens the buffering capacity for AMD and acid rain and generally creates low aquatic productivity conditions (low standing crops) for benthic macroinvertebrates and fish.

- Classification of the entire Watershed for cold water fishes (CWF) overemphasizes the Basin's fisheries for introduced trout and de-emphasizes the Basin's capabilities for providing quality cool water and warm water fisheries.

- AMD remains a serious problem in many tributaries, especially in the lower reach, where the pH is below 4.0 s.u. These levels often severely limit or completely remove aquatic biota from effected streams and cause cumulative problems in downstream areas.

- High metal concentrations, especially Manganese and Aluminum, are acutely toxic to fish. High iron concentrations cause precipitates that degrade stream bottom habitat as pH levels increase. Water quality determinations should include dissolved amounts, as well as, total concentrations for the metals monitored.

- Industrial and municipal discharges can cause localized and downstream water quality problems by reducing oxygen tensions, increasing nutrient enrichment, increasing total dissolved solids and salinity. NPDES (National Pollution Discharge Elimination System) discharges should be monitored to ensure that best technology treatment techniques are being utilized or planned.

- Because accelerated sedimentation is probably the number one pollutant for all stream systems, coordination with various resource agencies should be emphasized to ensure that erosion control practices are enforced and implemented for forestry, farming activities and building development.

- The attractiveness of the Watershed for recreational activity could cause increased organic enrichment from inadequate or improperly designed septic facilities in high use areas. Increased monitoring of these areas should be implemented, and corrective actions for identified problem areas should be formulated.

- Coordination between various entities that have implemented or plan to implement AMD abatement projects (reclamation, passive treatment and limestone sand) should be emphasized. Providing a clearinghouse of information, funding sources and progress made could improve individual projects that are planned.

6.2 Benthic Macroinvertebrates

- Benthic macroinvertebrate assemblages provide a good indicator of stream health. Benthic macroinvertebrate assemblages throughout the main stem show improving conditions, especially in the upper reach.

- Coordination with state resource agencies must be maintained to ensure that benthic macroinvertebrate sampling occurs annually, and the results are used to monitor changes in stream conditions.

- Sampling procedures should be standardized for sampling in the main stem and larger tributaries to promote consistency in analyzing the results.

6.3 Fish

- The sampling effort for fish, as well as benthic macroinvertebrates, included only one station (Cooksburg) on the main stem in the middle reach. Future sampling efforts should include more sampling in this portion of the Clarion River.

- Monitoring of the fish community provides the most efficient procedure to monitor the health of the Watershed (fish are the apex of the aquatic environment that directly reflect the condition of the water quality and benthic macroinvertebrate assemblage).

- The Clarion River Watershed contains 51 species of fish (includes four species not collected as part of "Assessment" sampling report). This is less than half of the species reported from the Upper Ohio River Basin (123 species) in Pennsylvania.

- Many intermediate intolerant and intolerant fishes, that probably sought refuge in some larger tributaries, now appear to be increasing in the main stem in the middle and upper reaches (variegate darter, silver shiner, rosyface shiner, sand shiner, mimic shiner, river chub, Northern hog sucker, mottled sculpin, golden redhorse, redside dace).

- Other intermediate intolerant to intolerant species appear to be recolonizing the lower reach below Piney Dam (mountain brook lamprey, streamline chub, silver redhorse and rainbow darter).

- Warm water gamefish, such as the smallmouth bass and rock bass, appear to be increasing in the upper reach which will augment the creel for anglers.

- Of the 47 species collected in the Clarion River, 33 species occur in the lower reach, 30 species occur in the middle reach and 24 species occur in the upper reach. Eleven of these species are restricted to the lower reach, five restricted to the middle reach and only two restricted to the upper reach.

- Of the 47 species collected in the Watershed, nine are considered intolerant, 27 are considered as intermediate intolerant and 11 species are considered tolerant. This fish assemblage, although most tolerant fish are more abundant than intolerant species, fits the assumed central tendency (bell curve) where a stream or watershed should contain 10% of the assemblage as intolerant and tolerant species with the remaining 80% as intermediate intolerant species (20-60-20 in this case).

- The Clarion River Watershed is a classic representative stream of the Western Allegheny Plateau Ecoregion. Several rare fishes that are inhabitants of larger streams in the Ecoregion have been extirpated from the Clarion River. Their recolonization of the Clarion River Watershed is unlikely because of Piney Dam. These rare and intolerant fishes include the bluebreast darter (*Etheostoma camurum*), spotted darter (*Etheostoma maculatum*), Tippecanoe darter (*Etheostoma tippecanoe*), gilt darter (*Percina evides*), longhead darter (*Percina macrocephala*) and channel darter (*Percina copelandi*).

- Recent efforts at stream restoration have included reintroduction of fish species that have been extirpated from a stream system (e.g. paddlefish reintroduction by PFBC in Ohio and Allegheny Rivers). The re-establishment of some of these highly intolerant fish species that have been extirpated from the Clarion River would certainly certify that the River is back. This reintroduction may be considered in the future.

ATTACHMENT 1

PA DEP List of Benthic Macroinvertebrates in Pennsylvania with Tolerance Value Ratings

PADEP List of Benthic Macroinvertebrates in PA with Tolerance Value Ratings

CODE	TAXA	HILST	IDLEVEL	HILSID
1E+09	Insecta			
1.01E+09	Collembola	9	Collembola	9
1.01E+09	Onychiuridae	9	Onychiuridae	9
1.01E+09	Onychiurus	9	Onychiurus	9
1.01E+09	Poduridae	9	Poduridae	9
1.01E+09	Podura	9	Podura	9
1.02E+09	Ephemeroptera		Ephemeroptera	
1.02E+09	Ameletidae	0	Ameletidae	0
1.02E+09	Ameletus	0	Ameletus	0
1.02E+09	Siphlonuridae	7	Siphlonuridae	7
1.02E+09	Siphlonisca	7	Siphlonisca	7
1.02E+09	Siphlonurus	7	Siphlonurus	7
1.02E+09	Metretopodidae	2	Metretopodidae	2
1.02E+09	Metrotopus	2	Metrotopus	2
1.02E+09	Baetidae	6	Baetidae	6
1.02E+09	Acentrella	4	Acentrella	4
1.02E+09	Acerpenna	6	Acerpenna	6
1.02E+09	Baetis	6	Baetis	6
1.02E+09	Barbaetis	6	Barbaetis	6
1.02E+09	Callibaetis	9	Callibaetis	9
1.02E+09	Centroptilum	2	Centroptilum	2
1.02E+09	Cloeon	4	Cloeon	4
1.02E+09	Diphetor	6	Diphetor	6
1.02E+09	Fallceon	6	Fallceon	6
1.02E+09	Labiobaetis	2	Labiobaetis	2
1.02E+09	Procloeon	6	Procloeon	6
1.02E+09	Heterocloeon	2	Heterocloeon	2
1.02E+09	Isonychiidae	3	Isonychiidae	3
1.02E+09	Isonychia	3	Isonychia	3
1.02E+09	Heptageniidae	3	Heptageniidae	3
1.02E+09	Epeorus	0	Epeorus	0
1.02E+09	Heptagenia	4	Heptagenia	4
1.02E+09	Leucrocuta	1	Leucrocuta	1
1.02E+09	Nixe	2	Nixe	2
1.02E+09	Rhithrogena	0	Rhithrogena	0
1.02E+09	Stenacron	4	Stenacron	4
1.02E+09	Stenonema	3	Stenonema	3
1.02E+09	Cinygmula	1	Cinygmula	1
1.02E+09	Arthropleidae	3	Arthropleidae	3
1.02E+09	Arthroplea	3	Arthroplea	3
1.02E+09	Ephemerellidae	2	Ephemerellidae	2
1.02E+09	Attenella	2	Attenella	2
1.02E+09	Drunella	1	Drunella	1
1.02E+09	Ephemerella	1	Ephemerella	1
1.02E+09	Eurylophella	4	Eurylophella	4
1.02E+09	Serratella	2	Serratella	2
1.02E+09	Timpanoga	2	Timpanoga	2
1.02E+09	Neoephemeridae	3	Neoephemeridae	3
1.02E+09	Neoephemera	3	Neoephemera	3

1.02E+09	Caenidae	7	Caenidae	7
1.02E+09	Brachycercus	3	Brachycercus	3
1.02E+09	Caenis	7	Caenis	7
1.02E+09	Baetiscidae	3	Baetiscidae	3
1.02E+09	Baetisca	4	Baetisca	4
1.02E+09	Leptophlebiidae	4	Leptophlebiidae	4
1.02E+09	Choroterpes	2	Choroterpes	2
1.02E+09	Habrophlebia	4	Habrophlebia	4
1.02E+09	Habrophlebiodes	6	Habrophlebiodes	6
1.02E+09	Leptophlebia	4	Leptophlebia	4
1.02E+09	Paraleptophlebia	1	Paraleptophlebia	1
1.02E+09	Potamanthidae	4	Potamanthidae	4
1.02E+09	Anthopotamus	4	Anthopotamus	4
1.02E+09	Ephemeridae	4	Ephemeridae	4
1.02E+09	Ephemera	2	Ephemera	2
1.02E+09	Hexagenia	6	Hexagenia	6
1.02E+09	Litobrancha	6	Litobrancha	6
1.02E+09	Pentagenia	4	Pentagenia	4
1.02E+09	Polymitarcyidae	2	Polymitarcyidae	2
1.02E+09	Ephoron	2	Ephoron	2
1.02E+09	Tricorythidae	4	Tricorythidae	4
1.02E+09	Tricorythodes	4	Tricorythodes	4
1.02E+09	Leptohyphes	4	Leptohyphes	4
1.03E+09	Odonata		Odonata	
1.03E+09	Petaluridae	5	Petaluridae	5
1.03E+09	Tachopteryx	5	Tachopteryx	5
1.03E+09	Gomphidae	4	Gomphidae	4
1.03E+09	Aphylla	4	Aphylla	4
1.03E+09	Arigomphus	4	Arigomphus	4
1.03E+09	Dromogomphus	4	Dromogomphus	4
1.03E+09	Erpetogomphus	5	Erpetogomphus	5
1.03E+09	Gomphus	5	Gomphus	5
1.03E+09	Hagenius	3	Hagenius	3
1.03E+09	Lanthus	5	Lanthus	5
1.03E+09	Ophiogomphus	1	Ophiogomphus	1
1.03E+09	Progomphus	5	Progomphus	5
1.03E+09	Stylogomphus	4	Stylogomphus	4
1.03E+09	Stylurus	4	Stylurus	4
1.03E+09	Aeshnidae	3	Aeshnidae	3
1.03E+09	Aeshna	5	Aeshna	5
1.03E+09	Anax	5	Anax	5
1.03E+09	Basiaeschna	2	Basiaeschna	2
1.03E+09	Boyeria	2	Boyeria	2
1.03E+09	Epiaeschna	1	Epiaeschna	2
1.03E+09	Gomphaeschna	2	Gomphaeschna	2
1.03E+09	Nasiaeschna	2	Nasiaeschna	2
1.03E+09	Cordulegastridae	3	Cordulegastridae	3
1.03E+09	Cordulegaster	3	Cordulegaster	3
1.03E+09	Corduliidae	5	Corduliidae	5
1.03E+09	Didymops	4	Didymops	4

1.03E+09	Cordulia	4	Cordulia	4
1.03E+09	Dorocordulia	4	Dorocordulia	4
1.03E+09	Epitheca	4	Epitheca	4
1.03E+09	Helocordulia	2	Helocordulia	2
1.03E+09	Somatochlora	1	Somatochlora	1
1.03E+09	Williamsonia	4	Williamsonia	4
1.03E+09	Macromia	2	Macromia	2
1.03E+09	Neurocordulia	3	Neurocordulia	3
1.03E+09	Libellulidae	9	Libellulidae	9
1.03E+09	Celithemis	2	Celithemis	2
1.03E+09	Erythemis	5	Erythemis	5
1.03E+09	Erythrodiplax	5	Erythrodiplax	5
1.03E+09	Ladona	6	Ladona	6
1.03E+09	Leucorrhinia	6	Leucorrhinia	6
1.03E+09	Libellula	8	Libellula	8
1.03E+09	Nannothemis	6	Nannothemis	6
1.03E+09	Pachydiplax	8	Pachydiplax	8
1.03E+09	Pantala	7	Pantala	7
1.03E+09	Perithemis	4	Perithemis	4
1.03E+09	Plathemis	3	Plathemis	3
1.03E+09	Sympetrum	4	Sympetrum	4
1.03E+09	Tramea	4	Tramea	4
1.03E+09	Calopterygidae	5	Calopterygidae	5
1.03E+09	Calopteryx	6	Calopteryx	6
1.03E+09	Hetaerina	6	Hetaerina	6
1.03E+09	Lestes	9	Lestes	9
1.03E+09	Coenagrionidae	8	Coenagrionidae	8
1.03E+09	Amphiagrion	5	Amphiagrion	5
1.03E+09	Argia	6	Argia	6
1.03E+09	Chromagrion	4	Chromagrion	4
1.03E+09	Coenagrion	8	Coenagrion	8
1.03E+09	Enallagma	8	Enallagma	8
1.03E+09	Ischnura	9	Ischnura	9
1.03E+09	Nehalennia	7	Nehalennia	7
1.04E+09	Plecoptera		Plecoptera	
1.04E+09	Pteronarcyidae	0	Pteronarcyidae	0
1.04E+09	Pteronarcys	0	Pteronarcys	0
1.04E+09	Peltoperlidae	2	Peltoperlidae	2
1.04E+09	Peltoperla	2	Peltoperla	2
1.04E+09	Tallaperla	0	Tallaperla	0
1.04E+09	Viehoperla	2	Viehoperla	2
1.04E+09	Taeniopterygidae	2	Taeniopterygidae	2
1.04E+09	Taeniopteryx	2	Taeniopteryx	2
1.04E+09	Bolotoperla	3	Bolotoperla	2
1.04E+09	Oemopteryx	3	Oemopteryx	3
1.04E+09	Strophopteryx	3	Strophopteryx	3
1.04E+09	Taenionema	3	Taenionema	3
1.04E+09	Nemouridae	2	Nemouridae	2
1.04E+09	Amphinemura	3	Amphinemura	3
1.04E+09	Ostrocerca	2	Ostrocerca	2

1.04E+09	Paranemoura	2	Paranemoura	2
1.04E+09	Podmosta	2	Podmosta	2
1.04E+09	Prostoia	2	Prostoia	2
1.04E+09	Shipsa	2	Shipsa	2
1.04E+09	Soyedina	0	Soyedina	0
1.04E+09	Zapada	2	Zapada	2
1.04E+09	Nemoura	1	Nemoura	1
1.04E+09	Leuctridae	0	Leuctridae	0
1.04E+09	Megaleuctra	0	Megaleuctra	0
1.04E+09	Leuctra	0	Leuctra	0
1.04E+09	Paraleuctra	0	Paraleuctra	0
1.04E+09	Zealeuctra	0	Zealeuctra	0
1.04E+09	Capniidae	3	Capniidae	3
1.04E+09	Allocapnia	3	Allocapnia	3
1.04E+09	Capnia	1	Capnia	1
1.04E+09	Nemocapnia	1	Nemocapnia	1
1.04E+09	Paracapnia	1	Paracapnia	1
1.04E+09	Utacapnia	1	Utacapnia	1
1.04E+09	Capnura	1	Capnura	1
1.04E+09	Perlidae	3	Perlidae	3
1.04E+09	Agnetina	2	Agnetina	2
1.04E+09	Hansonoperla	3	Hansonoperla	3
1.04E+09	Neoperla	3	Neoperla	3
1.04E+09	Paragnetina	1	Paragnetina	1
1.04E+09	Acroneuria	0	Acroneuria	0
1.04E+09	Attaneuria	3	Attaneuria	3
1.04E+09	Eccoptura	2	Eccoptura	2
1.04E+09	Perlesta	4	Perlesta	4
1.04E+09	Beloneuria	3	Beloneuria	3
1.04E+09	Perlinella	2	Perlinella	2
1.04E+09	Perlodidae	2	Perlodidae	2
1.04E+09	Cultus	2	Cultus	2
1.04E+09	Diploperla	2	Diploperla	2
1.04E+09	Diura	2	Diura	2
1.04E+09	Helopicus	2	Helopicus	2
1.04E+09	Hydroperla	1	Hydroperla	1
1.04E+09	Isogenoides	0	Isogenoides	0
1.04E+09	Malirekus	2	Malirekus	2
1.04E+09	Oconoperla	2	Oconoperla	2
1.04E+09	Remenus	2	Remenus	2
1.04E+09	Yugus	2	Yugus	2
1.04E+09	Clioperla	2	Clioperla	2
1.04E+09	Isoperla	2	Isoperla	2
1.04E+09	Arcynopteryx	2	Arcynopteryx	2
1.04E+09	Chloroperlidae	0	Chloroperlidae	0
1.04E+09	Utaperla	0	Utaperla	0
1.04E+09	Alloperla	0	Alloperla	0
1.04E+09	Haploperla	0	Haploperla	0
1.04E+09	Rasvena	0	Rasvena	0
1.04E+09	Suwallia	0	Suwallia	0

1.04E+09	Sweltsa	0	Sweltsa	0
1.05E+09	Hemiptera		Hemiptera	
1.05E+09	Hydrometridae	9	Hydrometridae	9
1.05E+09	Hydrometra	9	Hydrometridae	9
1.05E+09	Veliidae	8	Veliidae	8
1.05E+09	Microvelia	9	Microvelia	9
1.05E+09	Rhagovelia	9	Rhagovelia	9
1.05E+09	Steinovelia	9	Steinovelia	9
1.05E+09	Ceratocombidae	9	Ceratocombidae	9
1.05E+09	Ceratocombus	9	Ceratocombus	9
1.05E+09	Gerridae	9	Gerridae	9
1.05E+09	Aquarius	9	Aquarius	9
1.05E+09	Gerris	9	Gerris	9
1.05E+09	Halobates	9	Halobates	9
1.05E+09	Rheumatobates	9	Rheumatobates	9
1.05E+09	Metrobates	9	Metrobates	9
1.05E+09	Trepobates	9	Trepobates	9
1.05E+09	Limnoporus	9	Limnoporus	9
1.05E+09	Belostomatidae	9	Belostomatidae	9
1.05E+09	Belostoma	9	Belostoma	9
1.05E+09	Lethocerus	9	Lethocerus	9
1.05E+09	Nepidae	8	Nepidae	8
1.05E+09	Nepa	8	Nepa	8
1.05E+09	Ranatra	8	Ranatra	8
1.05E+09	Pleidae	8	Pleidae	8
1.05E+09	Neoplea	8	Neoplea	8
1.05E+09	Naucoridae	8	Naucoridae	8
1.05E+09	Pelocoris	8	Pelocoris	8
1.05E+09	Corixidae	8	Corixidae	8
1.05E+09	Hesperocorixa	5	Hesperocorixa	5
1.05E+09	Palmacorixa	8	Palmacorixa	8
1.05E+09	Ramphocorixa	8	Ramphocorixa	8
1.05E+09	Sigara	8	Sigara	8
1.05E+09	Trichocorixa	8	Trichocorixa	8
1.05E+09	Notonectidae	8	Notonectidae	8
1.05E+09	Buenoa	8	Buenoa	8
1.05E+09	Notonecta	8	Notonecta	8
1.05E+09	Mesoveliidae	9	Mesoveliidae	9
1.05E+09	Mesovelia	9	Mesovelia	9
1.05E+09	Hebridae	8	Hebridae	8
1.05E+09	Hebrus	8	Hebrus	8
1.05E+09	Merragata	8	Merragata	8
1.05E+09	Saldidae	8	Saldidae	8
1.05E+09	Micracanthia	8	Micracanthia	8
1.05E+09	Pentacora	8	Pentacora	8
1.05E+09	Salda	8	Salda	8
1.05E+09	Saldula	8	Saldula	8
1.05E+09	Gelastocoridae	8	Gelastocoridae	8
1.05E+09	Gelastocoris	8	Gelastocoris	8
1.05E+09	Ochteridae	8	Ochteridae	8

1.05E+09	Ochterus	8	Ochterus	8
1.06E+09	Megaloptera	8	Megaloptera	8
1.06E+09	Sialidae	6	Sialidae	6
1.06E+09	Sialis	6	Sialis	6
1.06E+09	Corydalidae	3	Corydalidae	3
1.06E+09	Corydalus	4	Corydalus	4
1.06E+09	Chauliodes	4	Chauliodes	4
1.06E+09	Neohermes	2	Neohermes	2
1.06E+09	Nigronia	2	Nigronia	2
1.07E+09	Neuroptera	3	Neuroptera	3
1.07E+09	Sisyridae	1	Sisyridae	1
1.07E+09	Climacia	1	Climacia	1
1.07E+09	Sisyra	1	Sisyra	1
1.08E+09	Trichoptera		Trichoptera	
1.08E+09	Philopotamidae	3	Philopotamidae	3
1.08E+09	Chimarra	4	Chimarra	4
1.08E+09	Dolophilodes	0	Dolophilodes	0
1.08E+09	Wormaldia	0	Wormaldia	0
1.08E+09	Psychomyiidae	2	Psychomyiidae	2
1.08E+09	Lype	2	Lype	2
1.08E+09	Psychomyia	2	Psychomyia	2
1.08E+09	Polycentropodidae	6	Polycentropodidae	6
1.08E+09	Cernotina	6	Cernotina	6
1.08E+09	Cyrnellus	8	Cyrnellus	8
1.08E+09	Neureclipsis	7	Neureclipsis	7
1.08E+09	Paranyctiophylax	5	Paranyctiophylax	7
1.08E+09	Polycentropus	6	Polycentropus	6
1.08E+09	Phylocentropus	5	Phylocentropus	5
1.08E+09	Hydropsychidae	5	Hydropsychidae	5
1.08E+09	Arctopsyche	1	Arctopsyche	1
1.08E+09	Parapsyche	0	Parapsyche	0
1.08E+09	Diplectrona	0	Diplectrona	0
1.08E+09	Homoplectra	5	Homoplectra	5
1.08E+09	Ceratopsyche	5	Ceratopsyche	5
1.08E+09	Cheumatopsyche	6	Cheumatopsyche	6
1.08E+09	Hydropsyche	5	Hydropsyche	5
1.08E+09	Potamyia	5	Potamyia	5
1.08E+09	Macrostemum	3	Macrostemum	3
1.08E+09	Rhyacophilidae	1	Rhyacophilidae	1
1.08E+09	Rhyacophila	1	Rhyacophila	1
1.08E+09	Glossosomatidae	0	Glossosomatidae	0
1.08E+09	Glossosoma	0	Glossosoma	0
1.08E+09	Agapetus	0	Agapetus	0
1.08E+09	Culoptila	1	Culoptila	1
1.08E+09	Protoptila	1	Protoptila	1
1.08E+09	Hydroptilidae	4	Hydroptilidae	4
1.08E+09	Palaeagapetus	1	Palaeagapetus	1
1.08E+09	Agraylea	8	Agraylea	8
1.08E+09	Dibusa	4	Dibusa	4
1.08E+09	Hydroptila	6	Hydroptila	6

1.08E+09	Ochrotrichia	4	Ochrotrichia	4
1.08E+09	Oxyethira	3	Oxyethira	3
1.08E+09	Stactobiella	2	Stactobiella	2
1.08E+09	Leucotrichia	6	Leucotrichia	6
1.08E+09	Ithytrichia	6	Ithytrichia	6
1.08E+09	Orthotrichia	6	Orthotrichia	6
1.08E+09	Neotrichia	2	Neotrichia	2
1.08E+09	Mayatrichia	4	Mayatrichia	4
1.08E+09	Phryganeidae	4	Phryganeidae	4
1.08E+09	Agrypnia	7	Agrypnia	7
1.08E+09	Banksiola	2	Banksiola	2
1.08E+09	Beothukus	2	Banksiola	2
1.08E+09	Fabria	4	Fabria	4
1.08E+09	Hagenella	5	Hagenella	5
1.08E+09	Oligostomis	5	Oligostomis	5
1.08E+09	Phryganea	8	Phryganea	8
1.08E+09	Ptilostomis	5	Ptilostomis	5
1.08E+09	Brachycentridae	1	Brachycentridae	1
1.08E+09	Adicrophleps	2	Adicrophleps	2
1.08E+09	Brachycentrus	1	Brachycentrus	1
1.08E+09	Micrasema	2	Micrasema	2
1.08E+09	Lepidostomatidae	1	Lepidostomatidae	1
1.08E+09	Lepidostoma	1	Lepidostoma	1
1.08E+09	Theliopsyche	1	Theliopsyche	1
1.08E+09	Limnephilidae	4	Limnephilidae	4
1.08E+09	Ironoquia	3	Ironoquia	3
1.08E+09	Onocosmoecus	3	Onocosmoecus	3
1.08E+09	Apatania	3	Apatania	3
1.08E+09	Pseudostenophylax	0	Pseudostenophylax	0
1.08E+09	Anabolia	5	Anabolia	5
1.08E+09	Arctopora	5	Arctopora	5
1.08E+09	Clostoeca	5	Clostoeca	5
1.08E+09	Frenesia	4	Frenesia	4
1.08E+09	Hesperophylax	4	Hesperophylax	4
1.08E+09	Hydatophylax	2	Hydatophylax	2
1.08E+09	Leptophylax	2	Leptophylax	2
1.08E+09	Limnephilus	3	Limnephilus	3
1.08E+09	Philarctus	3	Philarctus	3
1.08E+09	Platycentropus	4	Platycentropus	4
1.08E+09	Pycnopsyche	4	Pycnopsyche	4
1.08E+09	Goera	0	Goera	0
1.08E+09	Madeophylax	4	Madeophylax	4
1.08E+09	Uenoidae	3	Uenoidae	3
1.08E+09	Neophylax	3	Neophylax	3
1.08E+09	Beraeidae	3	Beraeidae	3
1.08E+09	Beraea	3	Beraea	3
1.08E+09	Sericostomatidae	3	Sericostomatidae	3
1.08E+09	Agarodes	3	Agarodes	3
1.08E+09	Psilotreta	0	Psilotreta	0
1.08E+09	Molannidae	6	Molannidae	6

1.08E+09	Molanna	6	Molanna	6
1.08E+09	Helicopsychidae	3	Helicopsychidae	3
1.08E+09	Helicopsyche	3	Helicopsyche	3
1.08E+09	Calamoceratidae	5	Calamoceratidae	5
1.08E+09	Heteroplectron	5	Heteroplectron	5
1.08E+09	Leptoceridae	4	Leptoceridae	4
1.08E+09	Ceraclea	3	Ceraclea	3
1.08E+09	Leptocerus	3	Leptocerus	3
1.08E+09	Mystacides	4	Mystacides	4
1.08E+09	Nectopsyche	3	Nectopsyche	3
1.08E+09	Oecetis	8	Oecetis	8
1.08E+09	Setodes	2	Setodes	2
1.08E+09	Triaenodes	6	Triaenodes	6
1.08E+09	Odontoceridae	0	Odontoceridae	0
1.09E+09	Lepidoptera	5	Lepidoptera	5
1.09E+09	Pyralidae	5	Pyralidae	5
1.09E+09	Langessa	5	Langessa	5
1.09E+09	Munroessa	5	Munroessa	5
1.09E+09	Neocataclysta	5	Neocataclysta	5
1.09E+09	Nymphula	7	Nymphula	7
1.09E+09	Nymphuliella	5	Nymphuliella	5
1.09E+09	Parapoynx	5	Parapoynx	5
1.09E+09	Synclita	5	Synclita	5
1.09E+09	Eoparargyractis	5	Eoparargyractis	5
1.09E+09	Petrophila	5	Petrophila	5
1.09E+09	Acentria	5	Acentria	5
1.09E+09	Schoenobius	5	Schoenobius	5
1.09E+09	Chilo	5	Chilo	5
1.09E+09	Acigona	5	Acigona	5
1.09E+09	Ostrinia	5	Ostrinia	5
1.09E+09	Nepticulidae	5	Nepticulidae	5
1.09E+09	Stigmella	5	Stigmella	5
1.09E+09	Cosmopterigidae	5	Cosmopterigidae	5
1.09E+09	Cosmopteryx	5	Cosmopteryx	5
1.09E+09	Lymnaecia	5	Lymnaecia	5
1.09E+09	Noctuidae	5	Noctuidae	5
1.09E+09	Archanara	5	Archanara	5
1.09E+09	Bellura	5	Bellura	5
1.09E+09	Simyra	5	Simyra	5
1.09E+09	Tortricidae	5	Tortricidae	5
1.09E+09	Archips	5	Archips	5
1.09E+09	Coleophoridae	6	Coleophoridae	6
1.09E+09	Colephora	6	Colephora	6
1.1E+09	Coleoptera		Coleoptera	
1.1E+09	Gyrinidae	4	Gyrinidae	4
1.1E+09	Dineutus	4	Dineutus	4
1.1E+09	Gyrinus	4	Gyrinus	4
1.1E+09	Spanglerogyrus	4	Spanglerogyrus	4
1.1E+09	Haliplidae	5	Haliplidae	5
1.1E+09	Haliplus	5	Haliplus	5

1.1E+09	Peltodytes	5	Peltodytes	5
1.1E+09	Dytiscidae	5	Dytiscidae	5
1.1E+09	Acilius	5	Acilius	5
1.1E+09	Agabetes	5	Agabetes	5
1.1E+09	Agabus	5	Agabus	5
1.1E+09	Bidessonotus	5	Bidessonotus	5
1.1E+09	Brachyvatus	5	Brachyvatus	5
1.1E+09	Celina	5	Celina	5
1.1E+09	Copelatus	5	Copelatus	5
1.1E+09	Colymbetes	5	Colymbetes	5
1.1E+09	Coptotomus	5	Coptotomus	5
1.1E+09	Cybister	5	Cybister	5
1.1E+09	Desmopachria	5	Desmopachria	5
1.1E+09	Dytiscus	5	Dytiscus	5
1.1E+09	Graphoderus	5	Graphoderus	5
1.1E+09	Hydaticus	5	Hydaticus	5
1.1E+09	Hydrovatus	5	Hydrovatus	5
1.1E+09	Hygrotus	5	Hygrotus	5
1.1E+09	Ilybius	5	Ilybius	5
1.1E+09	Laccophilus	5	Laccophilus	5
1.1E+09	Laccornis	5	Laccornis	5
1.1E+09	Liodessus	5	Liodessus	5
1.1E+09	Lioporius	5	Lioporius	5
1.1E+09	Matus	5	Matus	5
1.1E+09	Nebrioporus	5	Nebrioporus	5
1.1E+09	Oreodytes	5	Oreodytes	5
1.1E+09	Rhantus	5	Rhantus	5
1.1E+09	Stictotarsus	5	Stictotarsus	5
1.1E+09	Uvarus	5	Uvarus	5
1.1E+09	Noteridae	5	Noteridae	5
1.1E+09	Hydrocanthus	5	Hydrocanthus	5
1.1E+09	Pronoterus	5	Pronoterus	5
1.1E+09	Suphis	5	Suphis	5
1.1E+09	Suphisellus	5	Suphisellus	5
1.1E+09	Helophoridae	5	Helophoridae	5
1.1E+09	Helophorus	5	Helophorus	5
1.1E+09	Hydrochidae	5	Hydrochidae	5
1.1E+09	Hydrochus	5	Hydrochus	5
1.1E+09	Hydrophilidae	5	Hydrophilidae	5
1.1E+09	Anacaena	5	Anacaena	5
1.1E+09	Berosus	5	Berosus	5
1.1E+09	Chaetarthria	5	Chaetarthria	5
1.1E+09	Crenitis	5	Crenitis	5
1.1E+09	Cymbiodyta	5	Cymbiodyta	5
1.1E+09	Derallus	5	Derallus	5
1.1E+09	Dibolocelus	5	Dibolocelus	5
1.1E+09	Enochrus	5	Enochrus	5
1.1E+09	Helochares	5	Helochares	5
1.1E+09	Helocombus	5	Helocombus	5
1.1E+09	Hydrobius	5	Hydrobius	5

1.1E+09	Hydrochara	5	Hydrochara	5
1.1E+09	Hydrophilus	5	Hydrophilus	5
1.1E+09	Lacobius	5	Lacobius	5
1.1E+09	Paracymus	5	Paracymus	5
1.1E+09	Sperchopsis	5	Sperchopsis	5
1.1E+09	Tropisternus	5	Tropisternus	5
1.1E+09	Staphylinidae	5	Staphylinidae	5
1.1E+09	Bledius	5	Bledius	5
1.1E+09	Carpelimus	5	Carpelimus	5
1.1E+09	Psephidonus	5	Psephidonus	5
1.1E+09	Thinobius	5	Thinobius	5
1.1E+09	Stenus	5	Stenus	5
1.1E+09	Hydraenidae	6	Hydraenidae	6
1.1E+09	Hydraena	6	Hydraena	6
1.1E+09	Limnebius	6	Limnebius	6
1.1E+09	Ochthebius	6	Ochthebius	6
1.1E+09	Psephenidae	4	Psephenidae	4
1.1E+09	Eubrianax	4	Eubrianax	4
1.1E+09	Psephenus	4	Psephenus	4
1.1E+09	Dicranopselaphus	4	Dicranopselaphus	4
1.1E+09	Ectopria	5	Ectopria	5
1.1E+09	Dryopidae	5	Dryopidae	5
1.1E+09	Dryops	5	Dryops	5
1.1E+09	Helichus	5	Helichus	5
1.1E+09	Scirtidae	8	Scirtidae	8
1.1E+09	Cyphon	8	Cyphon	8
1.1E+09	Elodes	8	Elodes	8
1.1E+09	Flavohelodes	8	Flavohelodes	8
1.1E+09	Scirtes	8	Scirtes	8
1.1E+09	Elmidae	5	Elmidae	5
1.1E+09	Ancyronyx	2	Ancyronyx	2
1.1E+09	Dubiraphia	6	Dubiraphia	6
1.1E+09	Gonielmis	5	Gonielmis	5
1.1E+09	Macronychus	2	Macronychus	2
1.1E+09	Microcylloepus	2	Microcylloepus	2
1.1E+09	Optioservus	4	Optioservus	4
1.1E+09	Ordobrevia	5	Ordobrevia	5
1.1E+09	Oulimnius	5	Oulimnius	5
1.1E+09	Promoresia	2	Promoresia	2
1.1E+09	Stenelmis	5	Stenelmis	5
1.1E+09	Ptilodactylidae	4	Ptilodactylidae	5
1.1E+09	Anchytarsus	4	Anchytarsus	5
1.1E+09	Lutrochidae	6	Lutrochidae	6
1.1E+09	Lutrochus	6	Lutrochus	6
1.1E+09	Chrysomelidae	5	Chrysomelidae	5
1.1E+09	Disonycha	5	Disonycha	5
1.1E+09	Donacia	5	Donacia	5
1.1E+09	Hydrothassa	5	Hydrothassa	5
1.1E+09	Neohaemonia	5	Neohaemonia	5
1.1E+09	Prasocuris	5	Prasocuris	5

1.1E+09	Pyrrhalta	5	Pyrrhalta	5
1.1E+09	Curculionidae	6	Curculionidae	6
1.1E+09	Auleutes	6	Auleutes	6
1.1E+09	Bagous	6	Bagous	6
1.1E+09	Brachybamus	6	Brachybamus	6
1.1E+09	Euhrychiopsis	6	Euhrychiopsis	6
1.1E+09	Lissorhoptrus	6	Lissorhoptrus	6
1.1E+09	Listronotus	6	Listronotus	6
1.1E+09	Lixellus	6	Lixellus	6
1.1E+09	Lixus	6	Lixus	6
1.1E+09	Notiodes	6	Notiodes	6
1.1E+09	Onychylis	6	Onychylis	6
1.1E+09	Perenthis	6	Perenthis	6
1.1E+09	Pelenomus	6	Pelenomus	6
1.1E+09	Phytobius	6	Phytobius	6
1.1E+09	Stenopelmus	6	Stenopelmus	6
1.1E+09	Steremnius	6	Steremnius	6
1.1E+09	Tanysphyrus	6	Tanysphyrus	6
1.1E+09	Histeridae	5	Histeridae	5
1.11E+09	Hymenoptera			
1.11E+09	Pompilidae	5	Pompilidae	5
1.11E+09	Anoplius	5	Anoplius	5
1.11E+09	Scelionidae	5	Scelionidae	5
1.11E+09	Pseudanteris	5	Pseudanteris	5
1.11E+09	Telenomus	5	Telenomus	5
1.11E+09	Thoron	5	Thoron	5
1.11E+09	Tiphodytes	5	Tiphodytes	5
1.11E+09	Diapriidae	5	Diapriidae	5
1.11E+09	Trichopria	5	Trichopria	5
1.11E+09	Ichneumonidae	5	Ichneumonidae	5
1.11E+09	Apsilops	5	Apsilops	5
1.11E+09	Cremastus	5	Cremastus	5
1.11E+09	Medophron	5	Medophron	5
1.11E+09	Mesoleptus	5	Mesoleptus	5
1.11E+09	Phygadeuon	5	Phygadeuon	5
1.11E+09	Braconidae	5	Braconidae	5
1.11E+09	Ademon	5	Ademon	5
1.11E+09	Aphanta	5	Aphanta	5
1.11E+09	Asobara	5	Asobara	5
1.11E+09	Bracon	5	Bracon	5
1.11E+09	Chaenusa	5	Chaenusa	5
1.11E+09	Chorebidella	5	Chorebidella	5
1.11E+09	Chorebus	5	Chorebus	5
1.11E+09	Dacnusa	5	Dacnusa	5
1.11E+09	Opius	5	Opius	5
1.11E+09	Phaenocarpa	5	Phaenocarpa	5
1.11E+09	Mymaridae	5	Mymaridae	5
1.11E+09	Caraphractus	5	Caraphractus	5
1.11E+09	Trichogrammatida	5	Trichogrammatida	5
1.11E+09	Hydrophylita	5	Hydrophylita	5

1.11E+09	Lathromeroidea	5	Lathromeroidea	5
1.11E+09	Paracentrobia	5	Paracentrobia	5
1.11E+09	Trichogramma	5	Trichogramma	5
1.11E+09	Eulophidae	5	Eulophidae	5
1.11E+09	Aprostocetus	5	Aprostocetus	5
1.11E+09	Mestocharis	5	Mestocharis	5
1.11E+09	Tetrastichus	5	Tetrastichus	5
1.11E+09	Pteromalidae	5	Pteromalidae	5
1.11E+09	Gyrinophagus	5	Gyrinophagus	5
1.11E+09	Sisridivora	5	Sisridivora	5
1.11E+09	Eucoilidae	5	Eucoilidae	5
1.11E+09	Hexacola	5	Hexacola	5
1.12E+09	Diptera		Diptera	
1.12E+09	Blephariceridae	0	Blephariceridae	0
1.12E+09	Blepharicera	0	Blepharicera	0
1.12E+09	Ceratopogonidae	6	Ceratopogonidae	6
1.12E+09	Dasyhelea	6	Dasyhelea	6
1.12E+09	Atrichopogon	2	Atrichopogon	2
1.12E+09	Forcipomyia	6	Forcipomyia	6
1.12E+09	Alluaudomyia	6	Alluaudomyia	6
1.12E+09	Bezzia	6	Bezzia	6
1.12E+09	Brachypogon	6	Brachypogon	6
1.12E+09	Ceratopogon	6	Ceratopogon	6
1.12E+09	Clinohelea	6	Clinohelea	6
1.12E+09	Culicoides	10	Culicoides	10
1.12E+09	Johannsenomyia	6	Johannsenomyia	6
1.12E+09	Mallochohelea	6	Mallochohelea	6
1.12E+09	Monohelea	6	Monohelea	6
1.12E+09	Nilobezzia	6	Nilobezzia	6
1.12E+09	Palpomyia	6	Palpomyia	6
1.12E+09	Probezzia	6	Probezzia	6
1.12E+09	Serromyia	6	Serromyia	6
1.12E+09	Sphaeromias	6	Sphaeromias	6
1.12E+09	Stilobezzia	6	Stilobezzia	6
1.12E+09	Leptoconops	6	Leptoconops	6
1.12E+09	Chaoboridae	8	Chaoboridae	8
1.12E+09	Chaoborus	8	Chaoborus	8
1.12E+09	Mochlonyx	8	Mochlonyx	8
1.12E+09	Dixidae	1	Dixidae	1
1.12E+09	Dixa	1	Dixa	1
1.12E+09	Dixella	1	Dixella	1
1.12E+09	Nymphomyiidae	6	Nymphomyiidae	6
1.12E+09	Nymphomyia	6	Nymphomyia	6
1.12E+09	Psychodidae	10	Psychodidae	10
1.12E+09	Pericoma	4	Pericoma	4
1.12E+09	Philosepedon	10	Philosepedon	10
1.12E+09	Psychoda	10	Psychoda	10
1.12E+09	Telmatoscopus	10	Telmatoscopus	10
1.12E+09	Threticus	10	Threticus	10
1.12E+09	Ptychopteridae	8	Ptychopteridae	8

1.12E+09	Bittacomorpha	8	Bittacomorpha	8
1.12E+09	Bittacomorphella	8	Bittacomorphella	8
1.12E+09	Ptychoptera	8	Ptychoptera	8
1.12E+09	Tanyderidae	6	Tanyderidae	6
1.12E+09	Protoplasa	6	Protoplasa	6
1.12E+09	Thaumalea	6	Thaumalea	6
1.12E+09	Trichothaumalea	6	Trichothaumalea	6
1.12E+09	Athericidae	2	Athericidae	2
1.12E+09	Atherix	2	Atherix	2
1.12E+09	Pelecorhynchidae	5	Pelecorhynchidae	5
1.12E+09	Glutops	5	Glutops	5
1.12E+09	Dolichopodidae	4	Dolichopodidae	4
1.12E+09	Argyra	4	Argyra	4
1.12E+09	Asyndetus	4	Asyndetus	4
1.12E+09	Campsicnemus	4	Campsicnemus	4
1.12E+09	Dolichopus	4	Dolichopus	4
1.12E+09	Hercostomus	4	Hercostomus	4
1.12E+09	Hydrophorus	4	Hydrophorus	4
1.12E+09	Hypocharassus	4	Hypocharassus	4
1.12E+09	Liancalus	4	Liancalus	4
1.12E+09	Pelastoneurus	4	Pelastoneurus	4
1.12E+09	Sympycnus	4	Sympycnus	4
1.12E+09	Tachytrechus	4	Tachytrechus	4
1.12E+09	Telmaturgus	4	Telmaturgus	4
1.12E+09	Thinophilus	4	Thinophilus	4
1.12E+09	Empididae	6	Empididae	6
1.12E+09	Chelifera	6	Chelifera	6
1.12E+09	Chelipoda	6	Chelipoda	6
1.12E+09	Clinocera	6	Clinocera	6
1.12E+09	Dolichocephala	5	Dolichocephala	5
1.12E+09	Hemerodromia	6	Hemerodromia	6
1.12E+09	Metachela	6	Metachela	6
1.12E+09	Neoplasta	6	Neoplasta	6
1.12E+09	Oreothalia	6	Oreothalia	6
1.12E+09	Proclinopyga	6	Proclinopyga	6
1.12E+09	Rhamphomyia	6	Rhamphomyia	6
1.12E+09	Roederiodes	6	Roederiodes	6
1.12E+09	Stilpon	6	Stilpon	6
1.12E+09	Trichoclinocera	6	Trichoclinocera	6
1.12E+09	Stratiomyidae	8	Stratiomyidae	8
1.12E+09	Caloparyphus	8	Caloparyphus	8
1.12E+09	Euparyphus	8	Euparyphus	8
1.12E+09	Hedriodiscus	8	Hedriodiscus	8
1.12E+09	Labostigmina	8	Labostigmina	8
1.12E+09	Nemotelus	8	Nemotelus	8
1.12E+09	Odontomyia	8	Odontomyia	8
1.12E+09	Oxycera	8	Oxycera	8
1.12E+09	Sargus	8	Sargus	8
1.12E+09	Stratiomys	5	Stratiomys	5
1.12E+09	Tabanidae	6	Tabanidae	6

1.12E+09	Atylotus	6	Atylotus	6
1.12E+09	Chrysops	7	Chrysops	7
1.12E+09	Haematopota	6	Haematopota	6
1.12E+09	Hybomitra	6	Hybomitra	6
1.12E+09	Merycomyia	6	Merycomyia	6
1.12E+09	Tabanus	5	Tabanus	5
1.12E+09	Diachlorus	6	Diachlorus	6
1.12E+09	Ephydridae	6	Ephydridae	6
1.12E+09	Leptopsilopa	6	Leptopsilopa	6
1.12E+09	Psilopa	6	Psilopa	6
1.12E+09	Rhysophora	6	Rhysophora	6
1.12E+09	Muscidae	6	Muscidae	6
1.12E+09	Caricea	6	Caricea	6
1.12E+09	Limnophora	6	Limnophora	6
1.12E+09	Lispe	6	Lispe	6
1.12E+09	Lispoides	6	Lispoides	6
1.12E+09	Phaonia	6	Phaonia	6
1.12E+09	Spilogona	6	Spilogona	6
1.12E+09	Phoridae	6	Phoridae	6
1.12E+09	Dohrniphora	6	Dohrniphora	6
1.12E+09	Megaselia	6	Megaselia	6
1.12E+09	Scathophagidae	7	Scathophagidae	6
1.12E+09	Acanthocnema	7	Acanthocnema	6
1.12E+09	Cordilura	7	Cordilura	6
1.12E+09	Hydromyza	7	Hydromyza	6
1.12E+09	Orthacheta	7	Orthacheta	6
1.12E+09	Spaziphora	7	Spaziphora	6
1.12E+09	Syrphidae	10	Syrphidae	10
1.12E+09	Blera	10	Blera	10
1.12E+09	Callicera	10	Callicera	10
1.12E+09	Ceriana	10	Ceriana	10
1.12E+09	Chalcosyrphus	10	Chalcosyrphus	10
1.12E+09	Chrysogaster	10	Chrysogaster	10
1.12E+09	Eristalinus	10	Eristalinus	10
1.12E+09	Helophilus	10	Helophilus	10
1.12E+09	Mallota	10	Mallota	10
1.12E+09	Myolepta	10	Myolepta	10
1.12E+09	Neoascia	10	Neoascia	10
1.12E+09	Sericomyia	10	Sericomyia	10
1.12E+09	Spilomyia	10	Spilomyia	10
1.12E+09	Tipulidae	4	Tipulidae	4
1.12E+09	Brachypremna	4	Brachypremna	4
1.12E+09	Leptotarsus	4	Leptotarsus	4
1.12E+09	Prionocera	4	Prionocera	4
1.12E+09	Tipula	4	Tipula	4
1.12E+09	Phalacrocera	4	Phalacrocera	4
1.12E+09	Triogma	4	Triogma	4
1.12E+09	Antocha	3	Antocha	3
1.12E+09	Arctoconopa	4	Arctoconopa	4
1.12E+09	Cryptolabis	4	Cryptolabis	4

1.12E+09	Dactylolabis	4	Dactylolabis	4
1.12E+09	Dicranota	3	Dicranota	3
1.12E+09	Elliptera	4	Elliptera	4
1.12E+09	Gonomyia	4	Gonomyia	4
1.12E+09	Helius	4	Helius	4
1.12E+09	Hexatoma	2	Hexatoma	2
1.12E+09	Limnophila	3	Limnophila	3
1.12E+09	Limonia	6	Limonia	6
1.12E+09	Molophilus	4	Molophilus	4
1.12E+09	Ormosia	6	Ormosia	6
1.12E+09	Paradelphomyia	4	Paradelphomyia	4
1.12E+09	Pedicia	6	Pedicia	6
1.12E+09	Pilaria	7	Pilaria	7
1.12E+09	Pseudolimnophila	2	Pseudolimnolophila	2
1.12E+09	Rhabdomastix	4	Rhabdomastix	4
1.12E+09	Ulomorpha	4	Ulomorpha	4
1.12E+09	Erioptera	7	Erioptera	7
1.12E+09	Lipsothrix	4	Lipsothrix	4
1.12E+09	Culicidae	8	Culicidae	8
1.12E+09	Aedes	8	Aedes	8
1.12E+09	Anopheles	8	Anopheles	8
1.12E+09	Culex	8	Culex	8
1.12E+09	Culiseta	8	Culiseta	8
1.12E+09	Mansonia	8	Mansonia	8
1.12E+09	Orthopodomyia	8	Orthopodomyia	8
1.12E+09	Psorophora	8	Psorophora	8
1.12E+09	Toxorhynchites	8	Toxorhynchites	
1.12E+09	Uranotaenia	8	Uranotaenia	8
1.12E+09	Wyeomyia	8	Wyeomyia	8
1.12E+09	Simuliidae	6	Simuliidae	6
1.12E+09	Cnephia	4	Cnephia	4
1.12E+09	Ectemnia	1	Ectemnia	1
1.12E+09	Greniera	6	Greniera	6
1.12E+09	Prosimulium	2	Prosimulium	2
1.12E+09	Simulium	6	Simulium	6
1.12E+09	Stegopterna	6	Stegopterna	6
1.12E+09	Twinnia	6	Twinnia	6
1.12E+09	Chironomidae	6	Chironomidae	6
1.12E+09	Tanypodinae		Chironomidae	6
1.12E+09	Clinotanypus		Chironomidae	6
1.12E+09	Coelotanypus	4	Chironomidae	6
1.12E+09	Alotanypus		Chironomidae	6
1.12E+09	Apsectrotanypus		Chironomidae	6
1.12E+09	Brundiniella	9	Chironomidae	6
1.12E+09	Psectrotanypus	10	Chironomidae	6
1.12E+09	Djalmabatista		Chironomidae	6
1.12E+09	Procladius	9	Chironomidae	6
1.12E+09	Natarsia	8	Chironomidae	6
1.12E+09	Ablabesmyia	8	Chironomidae	6
1.12E+09	Cantopelopia		Chironomidae	6

1.12E+09	Conchapelopia	6	Chironomidae	6
1.12E+09	Guttipelopia		Chironomidae	6
1.12E+09	Hayesomyia	5	Chironomidae	6
1.12E+09	Helopelopia	6	Chironomidae	6
1.12E+09	Hudsonimyia		Chironomidae	6
1.12E+09	Labrundinia	7	Chironomidae	6
1.12E+09	Larsia	6	Chironomidae	6
1.12E+09	Meropelopia	6	Chironomidae	6
1.12E+09	Monopelopia		Chironomidae	6
1.12E+09	Nilotanypus	6	Chironomidae	6
1.12E+09	Paramerina	6	Chironomidae	6
1.12E+09	Pentaneura	6	Chironomidae	6
1.12E+09	Rheopelopia	4	Chironomidae	6
1.12E+09	Thienemannimyia	6	Chironomidae	6
1.12E+09	Trissopelopia	6	Chironomidae	6
1.12E+09	Zavrelimyia	8	Chironomidae	6
1.12E+09	Tanypus		Chironomidae	6
1.12E+09	Boreochlus		Chironomidae	6
1.12E+09	Trichotanypus		Chironomidae	6
1.12E+09	Parochlus		Chironomidae	6
1.12E+09	Boreoheptagyia		Chironomidae	6
1.12E+09	Diamesa	5	Chironomidae	6
1.12E+09	Potthastia	2	Chironomidae	6
1.12E+09	Pseudodiamesa	1	Chironomidae	6
1.12E+09	Sympotthastia	2	Chironomidae	6
1.12E+09	Syndiamesa		Chironomidae	6
1.12E+09	Protanypus		Chironomidae	6
1.12E+09	Monodiamesa		Chironomidae	6
1.12E+09	Odontomesa		Chironomidae	6
1.12E+09	Prodiamesa	3	Chironomidae	6
1.12E+09	Orthocladiinae		Chironomidae	6
1.12E+09	Clunio		Chironomidae	6
1.12E+09	Corynoneura	4	Chironomidae	6
1.12E+09	Thienemanniella	6	Chironomidae	6
1.12E+09	Antillocladius		Chironomidae	6
1.12E+09	Brillia	5	Chironomidae	6
1.12E+09	Bryophaenocladius		Chironomidae	6
1.12E+09	Cardiocladius	5	Chironomidae	6
1.12E+09	Chaetocladius	6	Chironomidae	6
1.12E+09	Cricotopus	7	Chironomidae	6
1.12E+09	Diplocladius	8	Chironomidae	6
1.12E+09	Doithrix	4	Chironomidae	6
1.12E+09	Epoicocladius	4	Chironomidae	6
1.12E+09	Eukiefferiella	8	Chironomidae	6
1.12E+09	Georthocladius	6	Chironomidae	6
1.12E+09	Gymnometriocnemus		Chironomidae	6
1.12E+09	Heleniella		Chironomidae	6
1.12E+09	Heterotanytarsus		Chironomidae	6
1.12E+09	Heterotrissocladius	0	Chironomidae	6
1.12E+09	Hydrobaenus	8	Chironomidae	6

1.12E+09	Krenosmittia		Chironomidae	6
1.12E+09	Limnophyes	8	Chironomidae	6
1.12E+09	Lopescladius	6	Chironomidae	6
1.12E+09	Mesosmittia		Chironomidae	6
1.12E+09	Metriocnemus	6	Chironomidae	6
1.12E+09	Nanocladius	3	Chironomidae	6
1.12E+09	Orthocladius	6	Chironomidae	6
1.12E+09	Parachaetocladius	2	Chironomidae	6
1.12E+09	Paracricotopus	6	Chironomidae	6
1.12E+09	Parakiefferiella	4	Chironomidae	6
1.12E+09	Parametriocnemus	5	Chironomidae	6
1.12E+09	Paraphaenocladius	4	Chironomidae	6
1.12E+09	Parasmittia		Chironomidae	6
1.12E+09	Paratrichocladius	6	Chironomidae	6
1.12E+09	Paratrissocladius		Chironomidae	6
1.12E+09	Plhudsonia		Chironomidae	6
1.12E+09	Psectrocladius	8	Chironomidae	6
1.12E+09	Pseudorthocladius	0	Chironomidae	6
1.12E+09	Pseudosmittia		Chironomidae	6
1.12E+09	Psilometriocnemus	6	Chironomidae	6
1.12E+09	Rheocricotopus	6	Chironomidae	6
1.12E+09	Rheosmittia	6	Chironomidae	6
1.12E+09	Smittia		Chironomidae	6
1.12E+09	Stilocladius		Chironomidae	6
1.12E+09	Symbiocladius		Chironomidae	6
1.12E+09	Synorthocladius	2	Chironomidae	6
1.12E+09	Tokunagaia	6	Chironomidae	6
1.12E+09	Trichochilus		Chironomidae	6
1.12E+09	Tvetenia	5	Chironomidae	6
1.12E+09	Unniella		Chironomidae	6
1.12E+09	Xylotopus		Chironomidae	6
1.12E+09	Chironominae		Chironomidae	6
1.12E+09	Chironomini		Chironomidae	6
1.12E+09	Acalcarella		Chironomidae	6
1.12E+09	Apedilum		Chironomidae	6
1.12E+09	Axarus		Chironomidae	6
1.12E+09	Chernovskiia		Chironomidae	6
1.12E+09	Chironomus	10	Chironomidae	6
1.12E+09	Cladopelma	9	Chironomidae	6
1.12E+09	Cryptochironomus	8	Chironomidae	6
1.12E+09	Cryptotendipes	6	Chironomidae	6
1.12E+09	Cyphomella		Chironomidae	6
1.12E+09	Demijerea		Chironomidae	6
1.12E+09	Demicryptochironomus	8	Chironomidae	6
1.12E+09	Dicrotendipes	8	Chironomidae	6
1.12E+09	Einfeldia		Chironomidae	6
1.12E+09	Endochironomus	10	Chironomidae	6
1.12E+09	Glyptotendipes	10	Chironomidae	6
1.12E+09	Goeldichironomus		Chironomidae	6
1.12E+09	Harnischia	8	Chironomidae	6

1.12E+09	Kiefferulus		Chironomidae	6
1.12E+09	Lauterborniella	6	Chironomidae	6
1.12E+09	Microtendipes	6	Chironomidae	6
1.12E+09	Microchironomus		Chironomidae	6
1.12E+09	Nilothauma	2	Chironomidae	6
1.12E+09	Omisus		Chironomidae	6
1.12E+09	Pagastiella		Chironomidae	6
1.12E+09	Parachironomus	8	Chironomidae	6
1.12E+09	Paracladopelma	7	Chironomidae	6
1.12E+09	Paralauterborniella	8	Chironomidae	6
1.12E+09	Paratendipes	8	Chironomidae	6
1.12E+09	Phaenopsectra	7	Chironomidae	6
1.12E+09	Polypedilum	6	Chironomidae	6
1.12E+09	Robackia		Chironomidae	6
1.12E+09	Saetheria	4	Chironomidae	6
1.12E+09	Sergentia		Chironomidae	6
1.12E+09	Stelechomyia		Chironomidae	6
1.12E+09	Stenochironomus	5	Chironomidae	6
1.12E+09	Stictochironomus	9	Chironomidae	6
1.12E+09	Tribelos	5	Chironomidae	6
1.12E+09	Xenochironomus	0	Chironomidae	6
1.12E+09	Zavreliella		Chironomidae	6
1.12E+09	Pseudochironomus	5	Chironomidae	6
1.12E+09	Tanytarsini		Chironomidae	
1.12E+09	Cladotanytarsus	7	Chironomidae	6
1.12E+09	Constempellina	4	Chironomidae	6
1.12E+09	Micropsectra	7	Chironomidae	6
1.12E+09	Neozavrelia		Chironomidae	6
1.12E+09	Parapsectra		Chironomidae	6
1.12E+09	Paratanytarsus	6	Chironomidae	6
1.12E+09	Rheotanytarsus	6	Chironomidae	6
1.12E+09	Stempellina	2	Chironomidae	6
1.12E+09	Sublettea	6	Chironomidae	6
1.12E+09	Tanytarsus	6	Chironomidae	6
1.12E+09	Zavrelia	4	Chironomidae	6
1.12E+09	Stempellinella	4	Chironomidae	6
2E+09	Demosongea		Chironomidae	6
2.01E+09	Haploscleriana			
2.01E+09	Spongillidae		Spongillidae	4
2.01E+09	Anheteromeyenia		Spongillidae	4
2.01E+09	Corvospongilla		Spongillidae	4
2.01E+09	Dosilia		Spongillidae	4
2.01E+09	Ephydatia		Spongillidae	4
2.01E+09	Eunapius		Spongillidae	4
2.01E+09	Heteromeyenia		Spongillidae	4
2.01E+09	Radiospongilla		Spongillidae	4
2.01E+09	Spongilla		Spongillidae	4
2.01E+09	Trochospongilla		Spongillidae	4
3E+09	Hydrozoa			
3.01E+09	Hydroida			

3.01E+09	Hydridae		Hydridae	4
3.01E+09	Hydra		Hydridae	4
3.01E+09	Cavidae		Cavidae	4
3.01E+09	Cordylophora		Cavidae	4
3.02E+09	Trachylina			
3.02E+09	Petasidae		Petasidae	4
3.02E+09	Craspedacusta		Petasidae	4
4E+09	Turbellaria	9	Turbellaria	9
4.01E+09	Tricladida			
4.01E+09	Planariidae	9	Turbellaria	9
4.01E+09	Cura	7	Turbellaria	9
4.01E+09	Dugesia	7	Turbellaria	9
4.01E+09	Phagocata	7	Turbellaria	9
4.01E+09	Planaria	9	Turbellaria	9
4.01E+09	Dendrocoelidae		Turbellaria	8
4.01E+09	Procotyla		Turbellaria	8
4.02E+09	Catenulida		Turbellaria	8
4.02E+09	Stenostomidae		Turbellaria	8
4.02E+09	Stenostomum		Turbellaria	8
4.03E+09	Mastrostomida		Turbellaria	8
4.03E+09	Macrostomidae		Turbellaria	8
4.03E+09	Macrostomum		Turbellaria	8
4.03E+09	Microstomidae		Turbellaria	8
4.03E+09	Microstomum		Turbellaria	8
4.04E+09	Dalyellioida		Turbellaria	8
4.04E+09	Dalyelliidae		Turbellaria	8
4.04E+09	Castrella		Turbellaria	8
4.04E+09	Typhloplanidae		Turbellaria	8
4.04E+09	Bothromesostoma		Turbellaria	8
4.04E+09	Gyratricidae		Turbellaria	8
4.04E+09	Gyratrix		Turbellaria	8
4.04E+09	Plagiostomidae		Turbellaria	8
4.04E+09	Hydrolimax		Turbellaria	8
5E+09	Nemertea		Nemertea	6
5E+09	Hoplonemertea		Nemertea	6
5.01E+09	Hoplonemertea		Nemertea	6
5.01E+09	Prostomidae		Nemertea	6
5.01E+09	Prostoma		Nemertea	6
6E+09	Nematoda		Nematoda	9
6E+09	Adenophorea		Nematoda	9
6.01E+09	Araeolaimida		Nematoda	9
6.01E+09	Leptolaimidae		Nematoda	9
6.01E+09	Rhabdolaimus		Nematoda	9
6.02E+09	Monhysterida		Nematoda	9
6.02E+09	Monhysteridae		Nematoda	9
6.02E+09	Prismatolaimus		Nematoda	9
6.02E+09	Cyatholaimidae		Nematoda	9
6.02E+09	Achromadora		Nematoda	9
6.02E+09	Ethmolaimus		Nematoda	9
6.03E+09	Enoplida		Nematoda	9

6.03E+09	Tripylidae		Nematoda	9
6.03E+09	Tripyla		Nematoda	9
6.03E+09	Ironidae		Nematoda	9
6.03E+09	Ironus		Nematoda	9
6.04E+09	Dorylaimida		Nematoda	9
6.04E+09	Dorylaimidae		Nematoda	9
6.04E+09	Actinolaimus		Nematoda	9
6.04E+09	Dorylaimus		Nematoda	9
6.04E+09	Mesodorylaimus		Nematoda	9
7E+09	Secernentea		Nematoda	9
7.01E+09	Aphelenchida		Nematoda	9
7.01E+09	Aphelenchoididae		Nematoda	9
7.01E+09	Aphelenchoides		Nematoda	9
7.02E+09	Rhabditida		Nematoda	9
7.02E+09	Diplogasteridae		Nematoda	9
7.02E+09	Rhabditolaimus		Nematoda	9
8E+09	Gastropoda		Gastropoda	
8.02E+09	Mesogastropoda			
8.02E+09	Valvatidae	2	Valvatidae	2
8.02E+09	Valvata	2	Valvatidae	2
8.02E+09	Viviparidae	7	Viviparidae	7
8.02E+09	Tulotoma		Viviparidae	7
8.02E+09	Viviparus	1	Viviparidae	8
8.02E+09	Cipangopaludina		Viviparidae	7
8.02E+09	Campeloma	7	Viviparidae	8
8.02E+09	Lioplax	7	Viviparidae	7
8.02E+09	Ampullaridae	7	Ampullaridae	7
8.02E+09	Marisa		Ampullaridae	7
8.02E+09	Pomacea		Ampullaridae	7
8.02E+09	Bithyniidae		Bithyniidae	7
8.02E+09	Bithynia		Bithyniidae	7
8.02E+09	Micromelaniidae		Micromelaniidae	7
8.02E+09	Antroselates		Micromelaniidae	7
8.02E+09	Hydrobiidae	8	Hydrobiidae	8
8.02E+09	Aphaostracon		Hydrobiidae	8
8.02E+09	Hoyia		Hydrobiidae	8
8.02E+09	Hyalopyrgus		Hydrobiidae	8
8.02E+09	Littoridinops		Hydrobiidae	8
8.02E+09	Probythinella		Hydrobiidae	8
8.02E+09	Pyrogophorus		Hydrobiidae	8
8.02E+09	Tryonia		Hydrobiidae	8
8.02E+09	Antrobia		Hydrobiidae	8
8.02E+09	Clappia		Hydrobiidae	8
8.02E+09	Cochliopina		Hydrobiidae	8
8.02E+09	Fluminicola		Hydrobiidae	8
8.02E+09	Gillia		Hydrobiidae	8
8.02E+09	Lepyrium		Hydrobiidae	8
8.02E+09	Somatogyrus		Hydrobiidae	8
8.02E+09	Birgella		Hydrobiidae	8
8.02E+09	Cincinnatia		Hydrobiidae	8

8.02E+09	Fontelicella		Hydrobiidae	8
8.02E+09	Marstonia		Hydrobiidae	8
8.02E+09	Notogillia		Hydrobiidae	8
8.02E+09	Orygocerus		Hydrobiidae	8
8.02E+09	Pyrgulopsis		Hydrobiidae	8
8.02E+09	Rhapinema		Hydrobiidae	8
8.02E+09	Spilochlamys		Hydrobiidae	8
8.02E+09	Striobia		Hydrobiidae	8
8.02E+09	Amnicola	8	Hydrobiidae	8
8.02E+09	Hauffenia		Hydrobiidae	8
8.02E+09	Horatia		Hydrobiidae	8
8.02E+09	Fontigens		Hydrobiidae	8
8.02E+09	Pyrgophorus		Hydrobiidae	8
8.02E+09	Pomatiopsidae		Pomatiopsidae	8
8.02E+09	Pomatiopsis		Pomatiopsidae	8
8.02E+09	Thiaridae		Pomatiopsidae	8
8.02E+09	Melanoides		Pomatiopsidae	8
8.02E+09	Thiara		Pomatiopsidae	8
8.02E+09	Pleuroceridae	7	Pleuroceridae	7
8.02E+09	Elimia	7	Pleuroceridae	7
8.02E+09	Gyrotoma		Pleuroceridae	7
8.02E+09	Io		Pleuroceridae	7
8.02E+09	Juga		Pleuroceridae	7
8.02E+09	Leptoxis	7	Pleuroceridae	7
8.02E+09	Lithasia		Pleuroceridae	7
8.02E+09	Pleurocera	7	Pleuroceridae	7
8.03E+09	Basommatophora		Pleuroceridae	7
8.03E+09	Acroloxidae		Pleuroceridae	7
8.03E+09	Acroloxus		Pleuroceridae	7
8.03E+09	Lymnaeidae	7	Lymnaeidae	7
8.03E+09	Acella		Lymnaeidae	7
8.03E+09	Bulimnea		Lymnaeidae	7
8.03E+09	Fossaria	7	Lymnaeidae	7
8.03E+09	Lymnaea	7	Lymnaeidae	7
8.03E+09	Pseudosuccinea	7	Lymnaeidae	7
8.03E+09	Radix		Lymnaeidae	7
8.03E+09	Stagnicola	7	Lymnaeidae	7
8.03E+09	Hinkleyia		Lymnaeidae	7
8.03E+09	Fisherola		Lymnaeidae	7
8.03E+09	Lanx		Lymnaeidae	7
8.03E+09	Physidae	8	Physidae	8
8.03E+09	Physa	8	Physidae	8
8.03E+09	Physella	8	Physidae	8
8.03E+09	Aplexa		Physidae	8
8.03E+09	Stenophysa		Physidae	8
8.03E+09	Planorbidae	6	Planorbidae	6
8.03E+09	Gyraulus	6	Planorbidae	6
8.03E+09	Drepanotrema		Planorbidae	6
8.03E+09	Biomphalaria		Planorbidae	6
8.03E+09	Helisoma	7	Planorbidae	6

8.03E+09	Menetus	6	Planorbidae	6
8.03E+09	Planorbella		Planorbidae	6
8.03E+09	Planorbula	7	Planorbidae	6
8.03E+09	Promenetus		Planorbidae	6
8.03E+09	Vorticifex		Planorbidae	6
8.03E+09	Amphigyra		Planorbidae	6
8.03E+09	Neoplanorbis		Planorbidae	6
8.03E+09	Ancylidae	7	Ancylidae	7
8.03E+09	Rhodacmea		Ancylidae	7
8.03E+09	Ferrissia	7	Ancylidae	7
8.03E+09	Hebetancylus		Ancylidae	7
8.03E+09	Laevapex	7	Ancylidae	7
9E+09	Bivalvia			
9.01E+09	Unionoida			
9.01E+09	Margaritiferidae		Margaritiferidae	5
9.01E+09	Margaritifera		Margaritiferidae	5
9.01E+09	Unionidae	4	Unionidae	4
9.01E+09	Actinonaias		Unionidae	4
9.01E+09	Alasmidonta		Unionidae	4
9.01E+09	Amblema		Unionidae	4
9.01E+09	Anodonta		Unionidae	4
9.01E+09	Anodontoides		Unionidae	4
9.01E+09	Carunculina		Unionidae	4
9.01E+09	Cyclonaias		Unionidae	4
9.01E+09	Dysnomia		Unionidae	4
9.01E+09	Elliptio		Unionidae	4
9.01E+09	Fusconaia		Unionidae	4
9.01E+09	Lampsilis		Unionidae	4
9.01E+09	Lasmigona		Unionidae	4
9.01E+09	Leptodea		Unionidae	4
9.01E+09	Ligumia		Unionidae	4
9.01E+09	Obovaria		Unionidae	4
9.01E+09	Pleurobema		Unionidae	4
9.01E+09	Proptera		Unionidae	4
9.01E+09	Ptychobranchus		Unionidae	4
9.01E+09	Quadrula		Unionidae	4
9.01E+09	Simpsoniconcha		Unionidae	4
9.01E+09	Strophitus	4	Unionidae	4
9.01E+09	Truncilla		Unionidae	4
9.01E+09	Utterbackia		Unionidae	4
9.01E+09	Villosa		Unionidae	4
9.01E+09	Tritigonia		Unionidae	4
9.01E+09	Pyganodon		Unionidae	4
9.01E+09	Simpsonaias		Unionidae	4
9.01E+09	Obliquaria		Unionidae	4
9.01E+09	Plethobasus		Unionidae	4
9.01E+09	Megalonaias		Unionidae	4
9.01E+09	Ellipsaria		Unionidae	4
9.01E+09	Arcidens		Unionidae	4
9.01E+09	Epioblasma		Unionidae	4

9.02E+09	Veneroida		Unionidae	4
9.02E+09	Sphaeriidae	8	Sphaeriidae	8
9.02E+09	Pisidium	8	Sphaeriidae	8
9.02E+09	Musculium	5	Sphaeriidae	8
9.02E+09	Sphaerium	8	Sphaeriidae	8
9.02E+09	Corbiculidae	4	Corbiculidae	4
9.02E+09	Corbicula	4	Corbiculidae	4
9.02E+09	Dreissenidae		Dreissenidae	5
9.02E+09	Dreissena		Dreissenidae	5
9.02E+09	Mytilopsis		Dreissenidae	5
1E+10	Hirudinea	8	Hirudinea	8
1E+10	Arhynchobdellid		Hirudinea	8
1E+10	Haemopidae		Hirudinea	8
1E+10	Haemopis		Hirudinea	8
1E+10	Hirudinidae		Hirudinea	8
1E+10	Macrobdella		Hirudinea	8
1E+10	Erpobdellidae		Hirudinea	8
1E+10	Erpobdella	8	Hirudinea	8
1E+10	Mooreobdella	8	Hirudinea	8
1E+10	Nephelopsis		Hirudinea	8
1E+10	Rhynchobdellida		Hirudinea	8
1E+10	Glossiphoniidae		Hirudinea	8
1E+10	Actinobdella		Hirudinea	8
1E+10	Alboglossiphonia		Hirudinea	8
1E+10	Batracobdella		Hirudinea	8
1E+10	Gloiobdella		Hirudinea	8
1E+10	Glossiphonia	8	Hirudinea	8
1E+10	Helobdella	8	Hirudinea	8
1E+10	Marvinmeyeria		Hirudinea	8
1E+10	Placobdella	8	Hirudinea	8
1E+10	Theromyzon		Hirudinea	8
1E+10	Piscicolidae		Hirudinea	8
1E+10	Cystobranchus		Hirudinea	8
1E+10	Myzobdella		Hirudinea	8
1E+10	Piscicola		Hirudinea	8
1E+10	Piscicolaria		Hirudinea	8
1.1E+10	Oligochaeta	10	Oligochaeta	10
1.1E+10	Haplotaxida		Oligochaeta	10
1.1E+10	Haplotaxidae		Oligochaeta	10
1.1E+10	Haplotaxis		Oligochaeta	10
1.1E+10	Lumbricidae	8	Oligochaeta	10
1.1E+10	Lumbriculida		Oligochaeta	10
1.1E+10	Lumbriculidae	8	Oligochaeta	10
1.1E+10	Eclipidrilus		Oligochaeta	10
1.1E+10	Lumbriculus	8	Oligochaeta	10
1.1E+10	Stylodrilus	10	Oligochaeta	10
1.1E+10	Tubificida		Oligochaeta	
1.1E+10	Naididae	8	Oligochaeta	10
1.1E+10	Allonais		Oligochaeta	10
1.1E+10	Amphichaeta		Oligochaeta	10

1.1E+10	Arcteonais		Oligochaeta	10
1.1E+10	Bratislavia		Oligochaeta	10
1.1E+10	Chaetogaster	6	Oligochaeta	10
1.1E+10	Dero		Oligochaeta	10
1.1E+10	Haemonais		Oligochaeta	10
1.1E+10	Nais	8	Oligochaeta	10
1.1E+10	Ophidonais	9	Oligochaeta	10
1.1E+10	Paranais		Oligochaeta	10
1.1E+10	Piguetiella		Oligochaeta	10
1.1E+10	Pristina		Oligochaeta	10
1.1E+10	Ripistes		Oligochaeta	10
1.1E+10	Slavina	9	Oligochaeta	10
1.1E+10	Specaria	9	Oligochaeta	10
1.1E+10	Stephensoniana		Oligochaeta	10
1.1E+10	Stylaria		Oligochaeta	10
1.1E+10	Uncinais		Oligochaeta	10
1.1E+10	Vejdovskyella		Oligochaeta	10
1.1E+10	Tubificidae	10	Tubificidae	10
1.1E+10	Aulodrilus	10	Tubificidae	10
1.1E+10	Bothrioneurum		Tubificidae	10
1.1E+10	Branchiura		Tubificidae	10
1.1E+10	Haber		Tubificidae	10
1.1E+10	Hyodrilus		Tubificidae	10
1.1E+10	Isochaetides	10	Tubificidae	10
1.1E+10	Limnodrilus	10	Tubificidae	10
1.1E+10	Phallodrilus		Tubificidae	10
1.1E+10	Potamothrix		Tubificidae	10
1.1E+10	Psammoryctides		Tubificidae	10
1.1E+10	Quistadrilus		Tubificidae	10
1.1E+10	Rhyacodrilus	10	Tubificidae	10
1.1E+10	Spirosperma	10	Tubificidae	10
1.1E+10	Tasserkidrilus		Tubificidae	10
1.1E+10	Tubifex		Tubificidae	10
1.2E+10	Polychaeta		Polychaeta	10
1.2E+10	Sabellida		Polychaeta	10
1.2E+10	Sabellidae		Polychaeta	10
1.2E+10	Manayunkia		Polychaeta	10
1.3E+10	Crustacea			
1.3E+10	Amphipoda	6	Amphipoda	6
1.3E+10	Crangonyctidae	4	Crangonyctidae	4
1.3E+10	Crangonyx	4	Crangonyx	4
1.3E+10	Stygonectes	6	Stygonectes	4
1.3E+10	Gammaridae	4	Gammaridae	4
1.3E+10	Gammarus	4	Gammarus	4
1.3E+10	Haustoriidae	5	Haustoriidae	5
1.3E+10	Monoporeia	5	Monoporeia	5
1.3E+10	Pontoporeiidae	5	Pontoporeiidae	5
1.3E+10	Talitridae	8	Talitridae	8
1.3E+10	Hyalella	8	Hyalella	8
1.3E+10	Decapoda		Decapoda	

1.3E+10	Cambaridae	6	Cambaridae	6
1.3E+10	Cambarus	6	Cambarus	6
1.3E+10	Fallicambarus	6	Fallicambarus	6
1.3E+10	Orconectes	6	Orconectes	6
1.3E+10	Procambarus	6	Procambarus	6
1.31E+10	Isopoda	8	Isopoda	8
1.31E+10	Asellidae	8	Asellidae	8
1.31E+10	Caecidotea	6	Caecidotea	6
1.31E+10	Lirceus	8	Lirceus	8
1.31E+10	Cladocera	5	Cladocera	5
1.4E+10	Bryozoa	4	Bryozoa	4
1.5E+10	Hydracarina	7	Hydracarina	7
1.6E+10	Nematomorpha	9	Nematomorpha	9

Attachment 2

Fish Tables

TABLE 1
LIST OF FISH FAMILIES AND NUMBER OF SPECIES IN EACH FAMILY RECORDED FOR THE OHIO RIVER BASIN IN PENNSYLVANIA

Lampreys (Petromyzontidae)	4
Sturgeons (Acipenseridae)	2
Paddlefish (Polyodontidae)	1
Gars (Lepisosteidae)	1
Bowfins (Amiidae)	1
Freshwater Eels (Anguillidae)	1
Herrings (Clupeidae)	2
Mooneyes (Hiodontidae)	2
Trouts (Salmonidae)	3
Mudminnows (Umbridae)	1
Pikes (Esocidae)	3
Carps and Minnows (Cyrpinidae)	39
Suckers (Catostomidae)	14
Bullhead Catfishes (Ictaluridae)	10
Trout-perches (Percopsidae)	1
Cods (Gadidae)	1
Killifishes (Cyprinodontidae)	1
Silversides (Atherinidae)	1
Sticklebacks (Gasterosteidae)	1
Temperature Basses (Percichthyidae)	1
Sunfishes (Centrarchidae)	11
Perches (Percidae)	20
Drums (Sciaenidae)	1
Sculpins (Cottidae)	1
Total Number of Families **24**	
Total Number of Species	**123**

TABLE 2
COMPREHENSIVE LIST OF FISH SPECIES
COLLECTED IN THE CLARION RIVER WATERSHED
1997 – 1999

Common Name	**Scientific Name**
PETROMYZONTIDAE (Lampreys)	
Mountain Brook Lamprey	Ichthyomyzon greeleyi
CYPRINIDAE (Carps and Minnows)	
Central Stoneroller	Campostoma anomalum
Redside Dace	*Clinostomus elongatus*
Common Carp	*Cyrpinus carpio*
Streamline Chub	*Erimystax dissimilis*
Striped Shiner	*Luxilus chrysocephalus*
Common Shiner	*Luxilus cornutus*
River Chub	*Nocomis micropogon*
Golden Shiner	*Notemigonus crysoleucas*
Emerald Shiner	*Notropis atherinoides*
Sand Shiner	*Notropis ludibundus*
Silver Shiner	*Notropis photogenis*
Rosyface Shiner	*Notropis rubellus*
Mimic Shiner	*Notropis volucellus*
Bluntnose Minnow	*Pimephales notatus*
Fathead Minnow	*Pimephales promelas*
Longnose Dace	*Rhinichthys cataractae*
Blacknose Dace	*Rhinichthys atratulus*
Creek Chub	*Semotilus atromaculatus*
CATOSTOMIDAE (Suckers)	
White Sucker	Catostomus commersoni
Northern Hog Sucker	*Hypentelium nigricans*
Silver Redhorse	*Moxostoma anisurum*
Golden Redhorse	*Moxostoma erythrurum*
ICTALURIDAE (Bullhead Catfishes)	
Yellow Bullhead	Ameiurus natalis
Brown Bullhead	*Ameriurus nebulosus*
Channel Catfish	*Ictalurus punctatus*
Stonecat	*Noturus flavus*
SALMONIDAE (Trouts)	
Rainbow Trout	Oncorhynchus mykiss
Brown Trout	*Salmo trutta*
Brook Trout	*Salvelinus fontinalis*
COTTIDAE (Sculpins)	
Mottled Sculpin	Cottus bairdi
CENTRARCHIDAE (Sunfishes)	
Rock Bass	Ambloplites rupestris

TABLE 2 (CONT'D.)
COMPREHENSIVE LIST OF FISH SPECIES
COLLECTED IN THE CLARION RIVER WATERSHED
1997 – 1999

Green Sunfish	*Lepomis cyanellus*
Pumpkinseed	*Lepomis gibbosus*
Bluegill	*Lepomis macrochirus*
Smallmouth Bass	Micropterus dolomieu
Largemouth Bass	*Micropterus salmoides*
Black Crappie	*Pomoxis nigromaculatus*
PERCIDAE (Perches)	
Greenside Darter	Etheostoma blennioides
Rainbow Darter	*Etheostoma caeruleum*
Fantail Darter	*Etheostoma flabellare*
Johnny Darter	*Etheostoma nigrum*
Variegate Darter	*Etheostoma variatum*
Banded Darter	*Etheostoma zonale*
Logperch	*Percina caprodes*
Blackside Darter	*Percina maculata*
Walleye	*Strizostedion vitreum*

Nomenclature from: Robins, C.R., et. al. 1991. Common and Scientific Names of Fishes from the United States and Canada (5th Ed.). American Fisheries Society Special Publ. 20. Bethesda, MD. 183 pp.

TABLE 3
OCCURRENCE OF INDIVIDUAL FISH SPECIES AT THE REACH LEVEL IN THE CLARION RIVER WATERSHED WITH RELATIVE ABUNDANCES*

Fish Species	Lower Reach	Middle Reach	Upper Reach
River Chub	Abundant	Common	Common
Bluntnose Minnow	Abundant	Present	Abundant
Creek Chub	Rare	Common	Common
White Sucker	Present	Common	Abundant
Northern Hog Sucker	Common	Common	Present
Mottled Scuplin	Rare	Abundant	Abundant
Rock Bass	Abundant	Rare	Present
Smallmouth Bass	Present	Common	Present
Greenside Darter	Common	Common	Common
Johnny Darter	Abundant	Present	Present
Blackside Darter	Common	Present	Present
Silver Shiner	Common	Common	-------
Rosyface Shiner	Common	Abundant	-------
Mimic Shiner	Common	Rare	-------
Channel Catfish	Rare	Rare	-------
Variegate Darter	Abundant	Common	-------
Banded Darter	Common	Rare	-------
Logperch	Abundant	Rare	-------
Common Carp	Rare	-------	Rare
Brown Bullhead	Present	-------	Present
Pumpkinseed	Common	-------	Present
Largemouth Bass	Common	-------	Present
Fantail Darter	-------	Common	Common
Common Shiner	-------	Present	Abundant
Longnose Dace	-------	Present	Present
Blacknose Dace	-------	Abundant	Abundant
Rainbow Trout	-------	Present	Present
Brown Trout	-------	Present	Common
Brook Trout	-------	Present	Common
Mountain Brook Lamprey	Rare	-------	-------
Streamline Chub	Rare	-------	-------
Golden Shiner	Rare	-------	-------
Silver Redhorse	Rare	-------	-------
Yellow Bullhead	Common	-------	-------
Stonecat	Rare	-------	-------
Green Sunfish	Rare	-------	-------
Bluegill	Present	-------	-------
Black Crappie	Present	-------	-------

TABLE 3 (CONT'D.)
OCCURRENCE OF INDIVIDUAL FISH SPECIES AT THE REACH LEVEL IN THE CLARION RIVER WATERSHED WITH RELATIVE ABUNDANCES*

Rainbow Darter	Present	-------	-------
Walleye	Rare	-------	-------
Central Stoneroller	-------	Common	-------
Striped Shiner	-------	Rare	-------
Emerald Shiner	-------	Rare	-------
Sand Shiner	-------	Rare	-------
Golden Redhorse	-------	Rare	-------
Redside Dace	-------	-------	Present
Fathead Minnow	-------	-------	Rare
Total Number of Species In Reach	**33**	**30**	**24**

**Relative Abundance – Rare, Present, Common, Abundant*

TABLE 4
FISH SPECIES COLLECTED IN CLARION RIVER WATERSHED (1997 – 1999)
WITH SELECT INDEX OF BIOTIC INTEGRITY (IBI) ASSIGNMENTS

Species [1]	Tolerance [2]	Trophic Guild [3]	Spawning Guild [4]	Origin [5]
River Chub	intermediate	invertivore	SL	N
Bluntnose Minnow	tolerant	generalist	NSL	N
Creek Chub	tolerant	generalist	SL	N
White Sucker	tolerant	generalist	SL	N
Northern Hog Sucker	intermediate	invertivore	SL	N
Mottled Sculpin	intolerant	invertivore	SL	N
Rock Bass	intermediate	piscivore	SL	N
Smallmouth Bass	intermediate	piscivore	SL	N
Greenside Darter	intermediate	invertivore	NSL	N
Johnny Darter	intermediate	invertivore	SL	N
Blackside Darter	intermediate	invertivore	SL	N
Silver Shiner	intolerant	invertivore	SL	N
Rosyface Shiner	intolerant	invertivore	SL	N
Mimic Shiner	intermediate	invertivore	NSL	N
Channel Catfish	intermediate	piscivore	NSL	N
Variegate Darter	intolerant	invertivore	SL	N
Banded Darter	intermediate	invertivore	NSL	N
Logperch	intermediate	invertivore	SL	N
Common Carp	tolerant	generalist	NSL	E
Brown Bullhead	tolerant	invertivore	NSL	N
Pumpkinseed	intermediate	invertivore	SL	N
Largemouth Bass	intermediate	piscivore	NSL	N
Fantail Darter	intermediate	invertivore	SL	N
Common Shiner	intermediate	invertivore	SL	N
Longnose Dace	intermediate	invertivore	SL	N
Blacknose Dace	tolerant	generalist	SL	N
Rainbow Trout	intermediate	invertivore/piscivore	SL	E
Brown Trout	intermediate	invertivore/piscivore	SL	E

TABLE 4 (CONT'D.)
FISH SPECIES COLLECTED IN CALRION RIVER WATERSHED (1997 – 1999)
WITH SELECT INDEX OF BIOTIC INTEGRITY (IBI) ASSIGNMENTS

Brook Trout	intolerant	invertivore/piscivore	SL	N
Creek Chub	tolerant	generalist	SL	N
Mountain Brook Lamprey	intolerant	filter feeder	SL	N
Streamline Chub	intolerant	invertivore	SL	N
Golden Shiner	tolerant	generalist	NSL	N
Silver Redhorse	intermediate	invertivore	SL	N
Yellow Bullhead	tolerant	invertivore	NSL	N
Stonecat	intolerant	invertivore	NSL	N
Green Sunfish	tolerant	invertivore	NSL	N
Bluegill	intermediate	invertivore	NSL	N
Black Crappie	intermediate	piscivore	NSL	N
Rainbow Darter	intolerant	invertivore	SL	N
Walleye	intermediate	piscivore	SL	N
Central Stoneroller	intermediate	herbivore	SL	N
Striped Shiner	intermediate	invetivore	SL	N
Emerald Shiner	intermediate	invertivore	NSL	N
Sand Shiner	intermediate	invertivore	SL	N
Golden Redhorse	intermediate	invertivore	SL	N
Redside Dace	intolerant	invertivore	SL	N
Fathead Minnow	tolerant	generalist	NSL	N

1 Total Number of Species Collected in Watershed – 47
2 Tolerance to Aquatic Habitat Degradation – tolerant, intermediate, intolerant.
3 Trophic Guild or Feeding Behavior – filter feeder (plankton), generalist (omnivore), herbivore (plant eater), invertivore (aquatic insect and non-insect macroinvertebrates), piscivore (fish eater).
4 Spawning Guild – SL, simple lithophilic (rock and gravel) spawner; NSL, nonsimple lithophilic spawner.
5 Origin – Native (not introduced – indigenous), Exotic (introduced – not native).

Bibliography

Angelo, Daniel J., Jennifer McDonald and Jared Dressler. Aquatic Biological Survey. Administered by Headwaters Charitable Trust in cooperation with Clarion River Basin Commission, Headwaters RC&D Council, Inc., PA Fish & Boat Commission, and PA DEP. March 2, 1999.

Bonislawsky, Patrick S. Evaluation of the Water Quality, Benthic Macroinvertebrate, and Fish Data Presented in the Clarion River Basin Assessment (October 1998-March 2001). October 2001.

Clarion University. Fish and Invertebrate Data Collected November/December 1998.

DEP Chapter 93 Water Quality Standards. Pennsylvania Code. Title 25 Environmental Protection. August 14, 1999.

Ecological Restoration, Inc. 316(a) Thermal Variance Study Round #1 Sampling Event, November 1998.

Ecological Restoration, Inc. 316(a) Thermal Variance Study Round #2 Sampling Event, March 1999.

Ecological Restoration, Inc. 316(a) Thermal Variance Study Round #3 Sampling Event, July 1999.

Ecological Restoration, Inc. 316(a) Thermal Variance Study Round #4 Sampling Event, October 1999.

Normandeau Associates, Inc. Report on Water Quality Studies of the Clarion River Relative to Relicensing of Piney Hydroelectric Project, FERC Project No. 309-PA. February 2000.

Normandeau Associates, Inc. Report on Fish and Aquatic Macroinvertebrate Communities of Piney Lake and the Clarion River, Clarion County, Pennsylvania. February 2000.

PA Department of Environmental Protection. Clarion River and Tributaries Water Quality Data. May 1999 - March 2001.

PA Fish & Boat Commission. Clarion River Fish and Benthic Macroinvertebrate Data. 1998.

US Army Corps of Engineers. Clarion River and Tributaries Water Quality Data. Oct. 1998-June 1999.

Appendix B

Fish Data

	Cathers Run			Clear Creek			Millstone Creek		
Species	**Downstream**	**Upstream**	**Combined***	**Downstream**	**Upstream**	**Combined***	**Downstream**	**Upstream**	**Combined***
banded darter							19		9.5
blacknose dace	1	44	22.5	71	39	55	6	6	6
blackside darter	2		1	1		0.5	3	8	5.5
bluntnose minnow	7		3.5						
brook trout	1	2	1.5	8	9	8.5			
brown trout		4	2	8	2	5			
common shiner	11		5.5						
creek chub	8	4	6	5	1	3	16	34	25
emerald shiner	19		9.5						
fantail darter							4		2
greenside darter	7	3	5	3	2	2.5	9	6	7.5
hog sucker	11	1	6	6	3	4.5	20	23	21.5
johnny darter				2		1	7	1	4
longnose darter							1		0.5
mottled sculpin	14	68	41	55	46	50.5	36	6	21
river chub	2		1				60	5	32.5
rosyface shiner	150		75				176	3	89.5
sand shiner	5		2.5				1		0.5
smallmouth bass	3		1.5						
stoneroller	13		6.5	2		1	29		14.5
striped shiner							29	5	17
varigate darter	2		1	16		8	21		10.5
white sucker	2	9	5.5	16		8	17	4	10.5
Tot. # indiv/100m	258	135	196.5	193	102	147.5	454	101	277.5
Species Richness	17	8	18	12	7	12	17	11	17
Shannon diversity	0.7429	0.5573	0.8849	0.7781	0.5403	0.7261	0.9301	0.8612	0.9957
Shannon evenness	0.6037	0.6171	0.705	0.721	0.6394	0.6728	0.7559	0.827	0.8092
Game Species									
Tolerant Species									
Intolerant Species	* Combined data is a composite of upstream and downstream data and is adjusted for 100m.								

Table F-1

Clarion University, Fish Data 1998.

PA Fish and Boat Commission Fish Data

Species	WBC01 11/98	FMR01 11/98	EBC01 11/98	LTC01 11/98	SPCK01 11/98
blacknose dace	27	--	--	1	--
bluntnose minnow	--	--	--	--	9
brook trout	--	10	--	--	--
brown trout	10	--	7	1	--
central stoneroller	--	--	--	4	11
common shiner	--	--	--	98	--
creek chub	3	--	--	--	--
fantail darter	6	26	--	6	3
greenside darter	9	--	--	37	10
hog sucker	26	22	--	49	35
johnny darter	2	--	--	14	12
longnose dace	2	--	--	44	--
mottled sculpin	300	92	--	18	53
pumpkinseed	--	1	--	--	--
rainbow trout	--	--	--	--	2
river chub	1	--	--	56	18
sand shiner	--	--	--	2	126
varigate darter	--	--	--	142	67
white sucker	9	9	--	--	--
# of Species	11	6	1	13	11
Density per 100 m	395	160	7	472	346
Trout per hectare	98	192	200	4	16
Game Species					
Tolerant Species					
Intolerant Species	*based on Electrofishing by backpack for 100 meters				

PA Fish and Boat Commission Fish Data

Species	CR01 8/98	CR01A-1 8/98	CR01A-2 8/98	CR02 8/98	CR03A 8/98
banded darter	3	--	6	--	--
black crappie	--	1	1	--	--
blackside darter	--	--	--	2	16
bluegill	--	7	3	--	1
bluntnose minnow	--	--	--	7	--
brown bullhead	--	--	--	3	--
channel catfish	1	--	--	--	--
common carp	--	--	--	--	1
golden redhorse	2	--	--	--	--
green sunfish	--	6	--	--	--
greenside darter	9	2	1	--	--
hog sucker	19	--	1	2	--
hybrid sunfish	--	1	--	--	--
johnny darter	--	--	--	1	3
largemouth bass	--	--	--	--	1
logperch	2	8	28	8	--
mimic shiner	4	--	--	1	--
mottled sculpin	1	--	--	--	--
pumpkinseed	--	13	6	24	11
redhorse sp	--	--	--	--	2
river chub	36	--	4	2	--
rock bass	1	--	1	--	--
silver shiner	64	--	--	--	--
smallmouth bass	18	2	3	--	1
varigate darter	3	--	14	--	--
walleye	--	2	--	--	--
white sucker	--	--	--	3	9
yellow bullhead	--	--	4	--	--
Total # of Species	13	9	12	10	9
Density	163	42	72	53	45
Fish per hour	217	89	94	76	60
Game Species					
Tolerant Species					
Intolerant Species					

Table B-3

PA Fish Boat Commission, 1998.

Ecological Restoration, Inc. Fish Data

Species	ERI-STA1 11/98	ERI-STA2 11/98	ERI-STA3 11/98	ERI-STA4 11/98	ERI-STA5 11/98	ERI-STA6 11/98	ERI-STA7 11/98	ERI-STA8 11/98	ERI-STA9 11/98
blacknose dace	71	17	28	160	252	132	39	149	63
blackside darter	7	--	1	1	6	--	2	3	--
bluntnose minnow	18	--	1	27	--	36	--	2	--
brook trout	--	--	--	--	--	--	1	--	3
brown trout	4	--	--	--	2	1	--	2	2
common shiner	8	--	19	404	188	82	27	94	3
creek chub	4	--	2	18	13	1	--	1	2
fantail darter	3	--	--	6	2	--	--	--	2
greenside darter	9	--	--	1	--	--	7	2	--
hog sucker	19	--	--	1	--	2	1	--	2
johnny darter	11	13	2	9	19	12	5	3	2
largemouth bass	1	--	--	--	--	--	--	--	--
mottled sculpin	76	5	59	78	119	90	94	76	35
pumpkinseed	--	--	--	6	--	--	--	--	--
redside dace	--	--	--	--	3	--	--	--	2
river chub	4	--	2	4	7	7	16	12	--
smallmouth bass	--	--	--	--	--	--	1	--	--
white sucker	12	--	7	50	47	21	7	14	21
# OF SPECIES	14	3	9	13	11	10	11	11	11
Density	247	35	121	765	658	384	200	358	137
Game Species									
Tolerant Species									
Intolerant Species	** based on electrofishing per sample date. Area and/or time is unknown.								

Ecological Restoration, Inc. Fish Data

Species	ERI-STA1 3/99	ERI-STA2 3/99	ERI-STA3 3/99	ERI-STA4 3/99	ERI-STA5 3/99	ERI-STA6 3/99	ERI-STA7 3/99	ERI-STA8 3/99	ERI-STA9 3/99
blacknose dace	31	42	52	140	62	52	15	33	74
blackside darter	--	--	--	3	--	3	--	--	1
bluntnose minnow	--	--	--	22	64	60	--	--	--
brook trout	1	12	--	2	--	1	--	--	1
brown bullhead	--	1	--	--	--	--	--	--	--
brown trout	1	4	--	--	1	--	1	1	2
common shiner	1	--	3	35	584	19	9	--	--
creek chub	1	7	1	5	3	3	2	--	1
fantail darter	--	--	--	--	--	3	--	--	4
greenside darter	--	--	1	--	--	1	--	--	--
hog sucker	4	--	1	--	--	1	--	--	--
johnny darter	--	2	3	--	1	2	1	--	3
largemouth bass	1	--	--	--	--	--	--	--	--
mottled sculpin	9	10	32	19	37	48	7	5	52
pumpkinseed	--	--	--	1	--	--	--	--	--
redside dace	--	--	--	--	2	--	--	--	--
river chub	--	--	1	1	2	--	5	--	--
white sucker	5	6	4	10	10	6	5	4	6
# OF SPECIES	9	8	9	10	10	12	8	4	9
Density	54	84	98	238	766	199	45	43	144
Game Species									
Tolerant Species									
Intolerant Species	** based on electrofishing per sample date. Area and/or time is unknown.								

Ecological Restoration, Inc. Fish Data

Species	ERI-STA1 7/99	ERI-STA2 7/99	ERI-STA3 7/99	ERI-STA4 7/99	ERI-STA5 7/99	ERI-STA6 7/99	ERI-STA7 7/99	ERI-STA8 7/99	ERI-STA9 7/99
blacknose dace	148	16	108	130	352	149	83	188	158
blackside darter	2	--	4	5	--	--	6	2	--
bluntnose minnow	8	--	5	59	58	20	--	5	6
brook trout	--	--	--	--	--	--	--	--	3
brown bullhead	--	--	--	1	--	--	--	--	1
brown trout	5	1	6	8	25	15	3	3	10
common carp	--	--	--	--	--	--	--	1	--
common shiner	11	--	7	107	81	9	46	49	4
creek chub	8	2	1	48	23	--	7	11	13
fantail darter	1	--	--	10	4	--	--	--	4
fathead minnow	--	--	--	--	--	--	3	--	--
greenside darter	10	--	1	1	2	--	--	2	--
hog sucker	8	--	--	1	--	--	--	2	--
johnny darter	4	--	9	10	8	3	7	1	1
largemouth bass	--	--	2	1	--	--	--	1	--
mottled sculpin	141	35	200	182	134	70	127	151	23
pumpkinseed	1	--	--	7	4	--	--	--	--
redside dace	--	3	--	--	1	--	--	--	3
river chub	4	--	4	6	12	6	16	23	--
smallmouth bass	--	--	1	1	3	--	--	--	--
white sucker	8	--	4	57	76	24	22	75	13
# OF SPECIES	14	5	13	17	14	8	10	14	12
Density	359	57	352	634	783	296	320	514	239
Game Species									
Tolerant Species									
Intolerant Species	** based on electrofishing per sample date. Area and/or time is unknown.								

Ecological Restoration, Inc. Fish Data

Species	ERI-STA1 10/99	ERI-STA2 10/99	ERI-STA3 10/99	ERI-STA4 10/99	ERI-STA5 10/99	ERI-STA6 10/99	ERI-STA7 10/99	ERI-STA8 10/99	ERI-STA9 10/99
blacknose dace	53	47	206	621	540	345	125	288	227
blackside darter	5	--	1	3	1	--	7	10	--
bluntnose minnow	98	--	--	164	31	27	3	12	1
brook trout	--	1	--	--	--	--	--	--	1
brown trout	2	3	--	3	6	6	1	3	3
common shiner	27	2	38	446	153	142	70	95	29
creek chub	5	5	2	75	31	25	10	44	12
fantail darter	--	--	2	5	3	1	1	2	--
fathead minnow	--	1	--	--	--	--	--	--	--
greenside darter	5	--	--	3	2	5	5	14	--
hog sucker	13	--	--	1	--	1	1	--	--
johnny darter	3	--	22	35	32	9	7	54	--
largemouth bass	1	--	--	--	--	--	--	--	--
mottled sculpin	139	54	77	182	72	132	410	427	32
pumpkinseed	1	--	1	1	--	--	--	--	--
redside dace	--	25	--	6	3	2	--	--	9
river chub	11	--	2	19	9	8	66	145	--
rock bass	2	--	--	3	1	2	--	--	--
smallmouth bass	4	--	1	5	--	--	3	4	--
white sucker	15	11	2	78	56	55	14	60	9
# OF SPECIES	16	9	11	17	14	14	14	13	9
Density	384	149	354	1650	940	760	723	1158	323
Game Species									
Tolerant Species									
Intolerant Species	** based on electrofishing per sample date. Area and/or time is unknown.								

Normandeau Fish Data

Species	CR01A 5/99	CR02 5/99	CR03A 5/99	CR03 5/99	CR04 5/99
banded darter	7	7	6	14	1
black crappie	1		2		
blackside darter	1	3	2	4	1
bluegill	2		2		
bluntnose minnow	4	4	87	5	
channel catfish	1				
common carp			1		
creek chub	1				
golden shiner			2		
green sunfish		1	1		
greenside darter	1	1	1	8	2
hog sucker	5	5	4	1	
johnny darter	1	4	15	3	
largemouth bass	1	3	4	1	
logperch	22	7	4	4	
mimic shiner		14	2	3	
mottled sculpin	2				
mountain brook lamprey					1
pumpkinseed	1	20	14		
rainbow darter				6	2
river chub	32	48	5	11	2
rock bass	2	19	8	3	5
rosyface shiner	1		13	18	9
silver redhorse			1		
silver shiner	3		13	7	
smallmouth bass	2		1	1	6
stonecat		1		4	
streamline chub			1	1	1
varigate darter	52	1	11	11	
white sucker	3		2		
yellow bullhead	10	1	6	2	
Total # of Species	22	16	25	19	10
Density	155	139	208	107	30
CPUE	51.7	46.3	69.3	35.7	30

Game Species
Tolerant Species
Intolerant Species

**Data shown represents three rounds of sampling (spring, summer, and fall)
CPUE=Catch per Unit Effort (catch per run)

Normandeau Fish Data

Species	Spring	Summer	Fall
banded darter	7	6	22
black crappie	2		1
blackside darter	2	4	5
bluegill		3	1
bluntnose minnow	11	22	67
channel catfish		1	
common carp		1	
creek chub	1		
golden shiner			2
green sunfish		2	
greenside darter	4	3	6
hog sucker	5	3	7
johnny darter	4	11	8
largemouth bass	1	4	4
logperch	12	11	14
mimic shiner	14	2	3
mottled sculpin	1		1
mountain brook lamprey			1
pumpkinseed	1	18	16
rainbow darter	1		7
river chub	4	38	56
rock bass	2	15	20
rosyface shiner	7	7	27
silver redhorse	1		
silver shiner	1	19	3
smallmouth bass	1	3	6
stonecat	1	1	3
streamline chub			3
varigate darter	22	17	36
white sucker	4		1
yellow bullhead	3	16	
Total # of Species	24	22	25
Density	112	207	320
CPUE	28	51.8	64
Game Species	**Data shown represents all 5 stations that were		
Tolerant Species	sampled below Piney Dam collectively, 1999.		
Intolerant Species	CPUE=Catch per Unit Effort (catch per run)		

Appendix C

Benthic Macroinvertebrate Data

Clarion University Macro Data based on 5 Surber and 2 Kicknet samples

	Cathers Run			Clear Creek			Millstone Creek		
	Kicknet	**Surber**	**Total**	**Kicknet**	**Surber**	**Total**	**Kicknet**	**Surber**	**Total**
DIPTERA (true flies)									
Diptera sp.					1	1			
Athericidae									
Atherix								2	2
Ceratopogonidae sp.					1	1			
Chironomidae sp.	125	343	468	9	351	360	19	178	197
Empididae									
Chelifera		1	1						
Simulidae sp.									
Simulium	2	2	4						
Tipulidae									
Antocha		32	32	1	9	10		9	9
Cryptolabis					1	1			
Dicranota		1	1	3		3			
Hexatoma	2	2	4	5	18	23			
Pseudolimmphilia					1	1			
Tipula	1		1						
EPHEMEROPTERA (mayflies)									
Baetidae sp									
Acentrella/Pseudocloen	11	14	25		20	20			
Baetis				4	44	48			
Centroptilum				7		7			
Diphetor				8	1	9			
Baetiscidae									
Baetisca		2	2					3	3
Caenidae									
Caenis								1	1
Ephemerellidae									
Dannella					92	92			
Drunella				2	1	3			
Ephemerella	42	64	106	6	21	27	1	10	11
Eurylophella								1	1

Clarion University Macro Data based on 5 Surber and 2 Kicknet samples

Serratella	63	155	218	7	65	72	3	6	9
Ephemeridae									
Ephemera				2		2	6	27	33
Heptageniidae sp.									
Epeorus	36	86	122	19	153	172		1	1
Stenacron	2	2	4		1	1	14	64	78
Stenonema	32	70	102	32	37	69	19	64	83
Macdunnoa				2	1	3			
Isonychiidae									
Isonychia	21	24	45		11	11	5	5	10
Leptophlebiidae sp.									
Habrophlebia		1	1		1	1		2	2
Leptophlebia		6	6					1	1
Paraleptophlebia	5	12	17	3	19	22		2	2
Polymitarcyidae									
Ephoron				1		1			
Siphlonuridae sp.									
Ameletus				1	3	4			
PLECOPTERA (stoneflies)									
Capniidae sp									
Allocapnia		6	6	1	49	50			
Paracapnia		45	45	4	21	25			
Chloroperlidae sp									
Alloperla		2	2		2	2			
Haploperla		11	11	5	9	14			
Rasvena					3	3			
Sweltsa									
Utaperla	2	1	3	2	3	5		1	1
Leuctridae sp									
Leuctra	1	3	4		34	34			
Paraleuctra				2		2		4	4
Nemouridae sp									
Paranemoura				1	3	4			
Perlidae sp.									
Acroneuria	2	3	5	3	1	4		1	1
Eccoptura		1	1				1		1
Neoperla	1		1						
Perlodidae sp.									

Clarion University Macro Data based on 5 Surber and 2 Kicknet samples

Arcynopteryx		2	2					1	1
Diploperla		2	2		1	1		1	1
Hydroperla	2		2		2	2			
Rasvena				1		1			
Remenus		2	2						
Taeniopterygidae									
Taeniopteryx	3	2	5		3	3		1	1
TRICHOPTERA (caddisflies)									
Trichoptera sp.					1	1			
Brachycentridae sp									
Micrasema								1	1
Glossosomatidae sp									
Glossosoma	4	3	7	2	2	4			
Hydropsychidae									
Cheumatopsyche					2	2			
Diplectrona				1		1			
Hydropsyche	60	33	93	3	5	8	4	3	7
Potamyia		7	7	4	2	6	5	2	7
Hydroptilidae									
Hydroptila		1	1		1	1			
Ochrotrichia	1		1						
Leptoceridae									
Oecetis								1	1
Limnephilidae sp									
Pycnopsyche					1	1			
Odontoceridae									
Psilotreta								1	1
Philopotamidae									
Dolophilodes	17	5	22		2	2		1	1
Wormaldia				1		1			
Polycentropodidae									
Polycentropus		1	1		7	7			
Psychomyiidae									
Psychomyia					2	2			
Rhyacophilidae									
Rhyacophila		2	2		1	1			
Uenoidae									
Neophylax					9	9			

Clarion University Macro Data based on 5 Surber and 2 Kicknet samples

ODONATA (dragonflies & damselflies)									
Gomphidae sp									
Arigomphus							2		2
COLEOPTERA (beetles)									
Elmidae sp.									
Optioservus		4	4	1	11	12		8	8
Oulimnius	1		1		29	29		1	1
Promoresia	3	2	5		1	1			
Stenelmis	1		1						
Gyrinidae									
Dineutus	2		2					1	1
Gyrinus					1	1			
MEGALOPTERA (fishflies, alderflies)									
Corydalidae									
Chauliodes		2	2				3	1	4
Nigronia	1		1						
Sialidae									
Sialis								3	3
OTHER									
Astacidae	1		1						
Tubificidae (tube worms)					1	1			
Tot. # individuals	444	957	1401	143	1061	1204	82	408	490
Taxa richness	28	39	48	31	51	59	12	33	35
% EPT	68.69	59.35	62.49	86.71	59.81	59.23	70.73	50.25	53.67
% Diptera	29.28	39.81	36.58	12.59	36.13	31.02	23.17	46.32	42.04
% Chironomidae	28.15	35.84	33.5	6.29	33.21	28.06	23.17	43.63	40.2
Shannon Div (10)	1.0085	0.9964		1.2579	1.1083		0.9117	0.8619	
Shannon evenness	0.6969	0.6263		0.8435	0.6491		0.8448	0.5676	
Density per surber sample		191			212			82	

Fish and Boat Tributary Macro Data based on 6 surber samples

	WBC01 11/98	FMR01 11/98	EBC01 11/98	LTC01 11/98	SPCK01 11/98	ELK01 11/98
DIPTERA (true flies)						
Athericidae						
Atherix	7					
Chironomidae sp.	69	256	2	15	13	1675
Empididae						
Hemerodromia					1	
Simulidae sp.						
Prosimulium	1	1			1	
Tipulidae						
Antocha	25				12	93
Dicranota		2	1			
Hexatoma	11	2				
Pedicia		1				
EPHEMEROPTERA (mayflies)						
Baetidae sp						
Baetis	4		1			
Baetiscidae						
Baetisca						37
Caenidae						
Caenis	1				2	
Ephemerellidae						
Attenella					1	
Drunella						
Ephemerella	32	1				2
Eurylophella					2	3
Serratella	4				2	6
Ephemeridae						
Ephemera	4					15
Heptageniidae sp.						
Epeorus	21	7				
Stenacron					7	3
Stenonema	58	7		13	46	5
Heptagenia		4			1	
Isonychiidae						
Isonychia	30			27	37	
Leptophlebiidae sp.						
Leptophlebia	8					
PLECOPTERA (stoneflies)						
Capniidae sp						
Allocapnia			1			
Paracapnia		5	3			
Chloroperlidae sp						
Haploperla					1	
Sweltsa	1	4				

Leuctridae sp						
Leuctra		6	6			
Nemouridae sp						
Amphinemura		1				
Soyedina		1				
Peltoperlidae						
Tallaperla			1			
Perlidae sp.						
Acroneuria		1			3	
Agnetina	1					
Attaneuria	3					
Perlodidae sp.						
Diploperla			1			
Isoperla	7	1	1			
Taeniopterygidae						
Oemopteryx					1	
Taeniopteryx		12	1		1	
TRICHOPTERA (caddisflies)						
Trichoptera sp.						
Brachycentridae sp						
Brachycentrus		1		175	25	
Micrasema						2
Glossosomatidae sp						
Glossosoma	14	1		1		
Hydropsychidae						
Cheumatopsyche	50			34	38	11
Diplectrona		16	35			
Hydropsyche	177	20		62	32	39
H. morosa						
Macronema				1	8	
Limnephilidae sp						
Goera					1	
Hydatophylax	9					
Odontoceridae						
Psilotreta		3				
Philopotamidae						
Chimarra					8	
Dolophilodes		13			3	
Polycentropodidae						
Cyrnellus				1		
Neureclipsis	3				1	
Paranyctiophylax						2
Polycentropus		1			1	
Rhyacophilidae						
Rhyacophila	6	10	2			3
Uenoidae						
Neophylax	6					1
ODONATA (dragonflies & damselflies)						

Gomphidae sp						
Dromogomphus				4		
Gomphus						3
Ophiogomphus				3	5	
Stylogomphus					3	
COLEOPTERA (beetles)						
Elmidae sp.	62	1		67	57	
Psephenidae						
Psephenus	1		1			
MEGALOPTERA (fishflies, alderflies)						
Corydalidae						
Chauliodes				1		
Nigronia	6				4	
BIVALVIA (clams)						
Bivalvia sp.	1				9	4
DECAPODA (crayfish)						
Cambaridae sp	1					
OTHER						
Oligochaeta (earthworms)	6				16	
TOTAL TAXA	31	26	13	13	31	17
DENSITY	629	378	56	404	342	1904
# EPT individuals	439	115	52	314	221	129
% EPT	69.79	30.42	92.86	77.72	64.62	6.78
% Chironomidae	10.97	67.72	3.57	3.71	3.80	87.97
Density per surber sample (.1m^2)	105	63	9	67	57	317
Density per m^2	1050	631	94	675	571	3180
Diversity (d)	3.434	3.219	2.565	2.485	3.401	2.833

Fish and Boat River Macro Data based on 6 Surber samples

	CRO1 8/98	CRO1A 8/98	CR03A 8/98
DIPTERA (true flies)			
Athericidae			
Atherix			1
Chironomidae sp.	36	34	26
Empididae			
Hemerodromia		4	
Simulidae sp.	1		
Tipulidae			
Antocha	7		
EPHEMEROPTERA (mayflies)			
Baetidae sp			
Acentrella/Pseudocloen		2	
Heptageniidae sp.			
Stenonema	24	1	
Isonychiidae			
Isonychia	31		
PLECOPTERA (stoneflies)			
Pteronarcyidae			
Pternoarcys	1		
Taeniopterygidae			
Taeniopteryx	1		
TRICHOPTERA (caddisflies)			
Brachycentridae sp			
Brachycentrus	264		
Glossosomatidae sp			
Glossosoma	1		
Hydropsychidae			
Cheumatopsyche	27	80	23
Hydropsyche	5	76	130
Macrostemum	8	170	16
Leptoceridae			
Ceraclea	1		
Polycentropodidae			
Neureclipsis		1	3
ODONATA (dragonflies & damselflies)			
Gomphidae sp	1		
COLEOPTERA (beetles)			
Elmidae sp.			
Optioservus	44		2
MEGALOPTERA (fishflies, alderflies)			

Fish and Boat River Macro Data based on 6 Surber samples

Corydalidae			
Nigronia	1		
BIVALVIA (clams)			
Sphaeriidae sp.	1		
DECAPODA (crayfish)			
Cambaridae sp	1		
ISOPODA (sowbugs)			
Asellidae sp			
Lirceus		1	
OTHER			
Oligochaeta (earthworms)	1		
TOTAL TAXA	19	9	7
DENSITY	456	369	201
# EPT individuals	363	330	172
% EPT	79.61	89.43	85.57
% Chironomidae	7.89	9.21	12.94
Density per surber sample (.1m^2)	76	62	34

Round 1 ERI Macro Data based on 10 subsamples

	ERI-STA1 11/98	ERI-STA2 11/98	ERI-STA3 11/98	ERI-STA4 11/98	ERI-STA5 11/98	ERI-STA6 11/98	ERI-STA7 11/98	ERI-STA8 11/98	ERI-STA9 11/98
DIPTERA (true flies)									
Athericidae									
Atherix	63					1		11	
Ceratopogonidae sp.									
Probezzia sp.		13							11
Chironomidae sp.									
Acricotopus sp.								10	
Brillia sp.	11					1			
Cardiocladius sp.				31	15	1	12	16	
Chironomidae g. sp (pupae)					11	22			
Chironomus sp.			6		75				
Cricotopus elegans								12	
Cricotopus gr. Trifascia			11				13	22	
Cricotopus/orthocladius	33	66	27	178	231	307	32	328	
Cryptochironomus sp.			6				6		
Diamesinae g. sp.						10		22	
Dicrotendipes sp.		6			3				
E. potthasta								30	
Eukiefferiella devonica								10	
Eukiefferiella sp.			12						
Krenopelopia sp.				10	10				
Limnophyes sp.				60		16			
Microtendipes sp.	24	15	12		14	48		66	11
Nilotanypus sp.			11						
Orthocladiinae		10		31	10	14		3	
Pagastia sp.				86	43	36		13	10
Parakiefferiella sp.			36	16	34				
Paralimnophyes sp.		11			10	1			
Parametriocnemus sp.	10	10	61	190	103	32	40	38	
Paraphaenocladius sp.							10		
Paratanytarsus sp.				9	3		11	2	
Phaenopsectra sp.			21						
Polypedilum			20	12	11	9	64	45	
Potthastia sp.							24		
Procladius sp.			9		45				

Round 1 ERI Macro Data based on 10 subsamples

Stictochironomus sp.	27	96		15	69		36		
Tanytarsus sp.				15					
Thienemannimyia gr.	21	190	250	200	120	207	206	17	
Tvetenia sp.				12			1		
Empididae									
Hemerodromia				31	22	1	14	22	
Tabanidae									
Chrysops	3	3							
Tipulidae									
Antocha		27	11	92	143	857	36	226	11
Hexatoma	14		234			1			13
Limnophila							3		
Tipula				3					
EPHEMEROPTERA (mayflies)									
Baetidae sp				8					
Acentrella/Pseudocloen			30	9	8	45	39	15	
Callibaetis					3				
Baetiscidae									
Baetisca		30	9	29	10	14	1		
Ephemerellidae									
Attenella									12
Drunella				3		1	1		
Ephemerella	278	21	170	204	463	456		41	94
Eurylophella		57	3	263	12				3
Serratella		48	322	2041	1196	1014	342	429	298
Ephemeridae									
Ephemera	6			40		18	10	18	
Heptageniidae sp.									
Epeorus			18						
Stenacron		6	25	9	11	14	153	127	
Stenonema	229	248	183	144	141	108	761	509	99
Isonychiidae									
Isonychia	230	38					91	90	
Leptophlebiidae sp.									
Paraleptophlebia	9	14	21	19					73
PLECOPTERA (stoneflies)									
Capniidae sp							4		4

Round 1 ERI Macro Data based on 10 subsamples

Paracapnia									2
Leuctridae sp						3			
Leuctra		9						4	
Perlidae sp.	7								
Acroneuria	41	21							8
Paragnetina	61	5						21	
Perlodidae sp.	22		21						
Cultus		42	26						
Pteronarcyidae									
Pternoarcys	7	2		9					8
Taeniopterygidae									
Taeniopteryx	78	11	10				12		8
TRICHOPTERA (caddisflies)									
Brachycentridae sp									
Brachycentrus								1	
Glossosomatidae sp									
Agapetus								9	
Glossosoma	25		95		44	13			
Helicopsychidae									
Helicopsyche sp (empty cases)	90								
Hydropsychidae									
Cheumatopsyche	261	140	99	45	190	234	693	947	9
Diplectrona	30								
Hydropsyche	194	121	14	100	143	282	53	2	9
H. morosa	843	177	2092	427	1916	4261	264	257	10
H. slossonae	13								
H. sparna	11		30			2		23	
Lepidostomatidae									
Lepidostoma					6				
Limnephilidae sp									
Hydatophylax				15				9	
Limnephilus					3				
Pycnopsyche	45	24			3		31		
Philopotamidae									
Chimarra							44	11	
Polycentropodidae									
Polycentropus		3				1		1	4
Psychomyiidae									

Round 1 ERI Macro Data based on 10 subsamples

Lype diversa		3							
Psychomyia				11		63			
Rhyacophilidae									
R. carolina	10								
R. invaria subgroup		23							
R. mainensis		14	76		9	46		20	
R. manistee				18					
R. minora		3							
ODONATA (dragonflies & damselflies)									
Aeshnidae									
Boyeria				21					
Calopterygidae									
Calopteryx				6	3				
Gomphidae sp			22		7	2		1	1
Gomphus				1					
Lanthus	11						9		
Ophiogomphus			8					2	
COLEOPTERA (beetles)									
Elmidae sp.									
D. vittata	3		3	3	6				
Optioservus	381	211	183	60	181	270	64	724	37
Oulimnius									23
Promoresia		103			12	28	23	26	1
Stenelmis	73		32	10	23	13	76	25	
Psephenidae									
Psephenus						1			
MEGALOPTERA (fishflies, alderflies)									
Corydalidae									
Nigronia	30	30					10		
Sialidae									
Sialis					9		10		
GASTROPODA (snails)									
Ancylidae									
Ferrissia	10		50		340	207		45	
Planorbidae									

Round 1 ERI Macro Data based on 10 subsamples

Helisoma				3	21				
Physidae									
Physella				21	3	4		3	
BIVALVIA (clams)									
Sphaeriidae sp.									
Pisidium	3		6			4		6	
ISOPODA (sowbugs)									
Asellidae sp									
Caecidotea				151	31	15	210	222	
HEMIPTERA (true water bugs)									
Corixidae sp					19				
OTHER									
Hydracarina (water mites)			11						
Nematoda (flat worms)					20	4			
Oligochaeta (earthworms)			152	10	71	44	48	26	85
TOTAL TAXA	37	37	42	45	49	45	38	47	25
DENSITY	3207	1851	4438	4671	5876	8731	3457	4507	844
# EPT individuals	2490	1060	3244	3394	4158	6575	2499	2534	641
% EPT	77.64	57.27	73.10	72.66	70.76	75.31	72.29	56.22	75.95
% Chironomidae	3.93	21.83	10.86	18.52	13.73	8.06	13.16	14.07	3.79
Density per subsample	321	185	444	467	588	873	346	451	84

Round 2 ERI Macro Data based on 10 subsamples

	ERI-STA1 3/99	ERI-STA2 3/99	ERI-STA3 3/99	ERI-STA4 3/99	ERI-STA5 3/99	ERI-STA6 3/99	ERI-STA7 3/99	ERI-STA8 3/99	ERI-STA9 3/99
DIPTERA (true flies)									
Athericidae									
Atherix	30		21				21	7	
Ceratopogonidae sp.									
Probezzia sp.		1							
Chironomidae sp.									
Cardiocladius sp.		63		70	7		120		
Chironomidae g. sp (pupae)					27	2	61		
Coryneura sp.		3							
Cricotopus/orthocladius	42	35		105	7	112	539	517	
Cryptochironomus sp.	3								
Diamesa sp.				161	469				
Diamesinae g. sp.							6		
Diplocladius sp.				20					13
Eukiefferiella sp.	29	1	1	56	5		14	133	31
Krenopelopia sp.				4	5				
Larisa sp.							27		
Limnophyes sp.		7	35	76	77	4			1
Microtendipes sp.		29		5	13		42	7	
Orthocladiinae		1					22		
Pagastia sp.	9	11	41	28	350	77	875	98	
Parakiefferiella sp.								1	
Parametriocnemus sp.		144	70	35	42	9	1267	448	97
Paratanytarsus sp.						1	63	14	
Polypedilum					6				
Potthastia sp.		1							
Synorthocladius sp.				6	40		4		
Thienemannimyia gr.	15	93	31	35	197	4	28	182	1
Zavrelimyia sp.								1	
Dolichopodidae sp.	1								
Empididae									
Hemerodromia				6			49		

Round 2 ERI Macro Data based on 10 subsamples

Simulidae sp.	69	164		2			1	6	15
Tipulidae									
Antocha	126	13	74	129	609	56	28	449	35
Hexatoma	35	42	22					8	
Tipula	6								
EPHEMEROPTERA (mayflies)									
Baetidae sp	7	1	1	3	6		35	1	7
Acerpenna								329	
Callibaetis	84								
Baetiscidae									
Baetisca	21	8			35			1	
Caenidae									
Caenis				3	12				
Ephemerellidae									
Ephemerella					1		2670	2342	
Eurylophella	33	104	33	30	203	27	13	36	1
Serratella	513	1001	634	626	2261	288	120	76	85
Ephemeridae									
Ephemera	56		20	23	294		8	13	
Heptageniidae sp.	140	170	28		114				
Epeorus	37		56					35	1
Stenacron				4				112	
Stenonema							21	63	
Isonychiidae									
Isonychia	91		6					14	
Leptophlebiidae sp.									
Paraleptophlebia	14			3		14	5		
Thraulodes *	42			3	1			6	
Siphlonuridae sp.									
Ameletus			1	2					
PLECOPTERA (stoneflies)									
Capniidae sp	14	63							
Chloroperlidae sp		125				28			1
Alloperla			1						

Round 2 ERI Macro Data based on 10 subsamples

Hastaperla			1						
Utaperla	1							13	35
Leuctridae sp									
Leuctra	56	68					2		
Nemouridae sp			1						
Peltoperlidae									
Peltoperla	14	3	1			1			
Perlidae sp.							13	14	
Acroneuria	61								
Agnetina							12		
Paragnetina								21	
Perlodidae sp.	84		9						
Isoperla		215	63	44	19	40	1	36	42
Pteronarcyidae									
Pternoarcys		6							35
Taeniopterygidae									
Oemopteryx								1	
Taeniopteryx	49	42					35		
TRICHOPTERA (caddisflies)									
Brachycentridae sp	6			27				1	2
Brachycentrus	7	66	56			46			
Micrasema		8					1		
Glossosomatidae sp									
Glossosoma			33						
Helicopsychidae									
Helicopsyche sp (empty cases)							2		
Hydropsychidae									
Cheumatopsyche	96	126		14	119		833	1214	
Hydropsyche	105	379	308	150	497	126	47	59	10
H. morosa							80	42	
H. sparna							2	18	
Macronema					6				
Hydroptilidae		66			6				42
Lepidostomatidae									
Lepidostoma	7		6				1		

Round 2 ERI Macro Data based on 10 subsamples

Leptoceridae									
Oecetis	49								
Limnephilidae sp	30								
Goera								12	
Limnephilus		9	7	18		3		21	
Pycnopsyche	44					3			
Odontoceridae									
Psilotreta	1								
Philopotamidae									
Chimarra							1	28	
Polycentropodidae									
Polycentropus								13	
Psychomyiidae									
Psychomyia						1			
Rhyacophilidae									
Rhyacophila			2	2			1	6	
R. mainensis							28	46	
ODONATA (dragonflies & damselflies)									
Gomphidae sp			1						
Gomphus		1			20				
Lanthus	7								3
Ophiogomphus								14	
COLEOPTERA (beetles)									
Elmidae sp.									
D. vittata								1	
Optioservus	217	227			49		826	392	
Promoresia							1		
Stenelmis	9	69	41	160	8	77	15	35	49
Psephenidae									
Acneus *	1								
Psephenus	7				21			2	
MEGALOPTERA (fishflies, alderflies)									
Corydalidae									

Round 2 ERI Macro Data based on 10 subsamples

Nigronia	42	5			6		3	4	
Sialidae									
Sialis		7			5			1	
GASTROPODA (snails)									
Planorbidae									
Helisoma			1						
BIVALVIA (clams)									
Sphaeriidae sp.									
Pisidium		2			3		13	4	
DECAPODA (crayfish)									
Cambaridae sp				15					
ISOPODA (sowbugs)									
Asellidae sp									
Caecidotea					42		4	78	
OTHER									
Hydracarina (water mites)					1	5			
Oligochaeta (earthworms)			98		6		27	6	6
TOTAL TAXA	44	39	33	33	38	21	47	51	21
DENSITY	2310	3379	1704	1867	5589	924	7987	6981	512
# EPT individuals	1662	2460	1267	952	3574	577	3931	4573	261
% EPT	71.95	72.80	74.35	50.99	63.95	62.45	49.22	65.51	50.98
% Chironomidae	4.24	11.48	10.45	32.19	22.28	22.62	38.41	20.07	27.93
Density per subsample	231	338	170	187	559	92	799	698	51

Round 3 ERI Macro Data based on 10 subsamples

	ERI-STA1 7/99	ERI-STA2 7/99	ERI-STA3 7/99	ERI-STA4 7/99	ERI-STA5 7/99	ERI-STA6 7/99	ERI-STA7 7/99	ERI-STA8 7/99	ERI-STA9 7/99
DIPTERA (true flies)									
Diptera sp.			42		90	41			1
Athericidae									
Atherix	15		7		13		23	27	4
Ceratopogonidae sp.								1	
Probezzia sp.							1		
Chironomidae sp.									
Anthomyiidae g. sp.									1
Cardiocladius sp.		2		68			20	10	1
Chironomidae g. sp (pupae)					7	4	8	12	2
Cricotopus/orthocladius	55	2		56		101	91	133	
Cryptochironomus sp.	6								
Diamesa sp.				41	40				
Diamesinae g. sp.							1		
Diplocladius sp.				10					2
Eukiefferiella sp.	37			43	3		3	76	19
Krenopelopia sp.				1	1				
Limnophyes sp.			21	49	48	1			12
Microtendipes sp.					3		8	3	
Orthocladiinae							36		
Pagastia sp.	18	29	20	18	229	39	47	31	
Parametriocnemus sp.	3	331	17	6	18	17	102	35	40
Paratanytarsus sp.							31	3	
Polypedilum					1		1		
Synorthocladius sp.					2		1		
Thienemannimyia gr.	10		3	71	96	1	8	105	
Dolichopodidae sp.	12								
Hemerodromia							6		
Simulidae sp.	53	91					14	6	
Tabanidae									
Chrysops			1			2	2		
Tipulidae									
Antocha	67	29	38	63	28	37	55	112	77
Hexatoma	40	8	14		20			11	133
Tipula	3	2	35		14	119	3		56

Round 3 ERI Macro Data based on 10 subsamples

EPHEMEROPTERA (mayflies)									
Baetidae sp	13	2	42	1	40	8		55	1
Acerpenna								71	
Callibaetis	61								27
Baetisca	10	11		82	14		63	1	56
Caenis	5				12				
Ephemerellidae									
Ephemerella	3						18	111	
Eurylophella	7	7	32	100	16	10	30	144	19
Serratella	503	56	217	912	643	190	637	567	214
Ephemeridae									
Ephemera	13		7	84	259		21	70	
Heptageniidae sp.	121	66	178	35	56	2	154	147	2
Epeorus	3	133	21		14		14	2	14
Stenacron				1				3	
Stenonema	1								
Isonychiidae									
Isonychia	32		1				1	8	12
Leptophlebiidae sp.			245		42				
Choroterpes									36
Paraleptophlebia	11	77	84	21	6	1			
Thraulodes *	39			14					
Siphlonuridae sp.			1		2	1		28	
Ameletus	1			1					
PLECOPTERA (stoneflies)									
Capniidae sp	13	71	35		6				119
Allocapnia								12	259
Capnia			1		2				
Nemocapnia								2	13
Paracapnia				51			22		
Chloroperlidae sp		28			1	11		6	
Utaperla									7
Leuctridae sp					13				
Leuctra	71	521			56	49		13	322
Peltoperlidae									
Peltoperla	10	1			9				
Perlidae sp.							1		

Round 3 ERI Macro Data based on 10 subsamples

Acroneuria	50	74	14		6		6	14	21
Atoperla ephyre									14
Perlodidae sp.	91								
Cultus		1							
Isoperla		80	28	11	4	13		12	12
Pteronarcyidae									
Pternoarcys		2							
Taeniopterygidae									
Taeniopteryx	41	7					3		20
TRICHOPTERA (caddisflies)									
Brachycentridae sp	5	14	4	20			77	77	102
Brachycentrus	10	21		2					
Micrasema							1		
Glossosomatidae sp					134			56	
Glossosoma	5					76	7	42	
Helicopsychidae									
Helicopsyche borealis	1		21		1	3			
Hydropsychidae									
Cheumatopsyche	77	192	42	20	49	6	51	371	21
Diplectrona								119	
Hydropsyche	107	87	175	494	1467	71	105	300	266
H. morosa	77						7		
H. sparna							1		
Potamyia					48			28	
Hydroptilidae		11							
Neotrichia					1				
Lepidostomatidae									
Lepidostoma	5						20		
Leptoceridae									
Oecetis	38								
Limnephilidae sp									
Hydatophylax						1			
Pycnopsyche	40	13	7		1				13
Odontoceridae									
Psilotreta	7								
Polycentropodidae									
Polycentropus	7				13				
Psychomyiidae									

Round 3 ERI Macro Data based on 10 subsamples

Psychomyia							20		
Rhyacophilidae									
Rhyacophila			14		41	5		14	
R. mainensis							14		
ODONATA (dragonflies & damselflies)									
Aeshnidae									
Boyeria	2						13		5
Cordulegastridae sp	1								
Cordulegaster	6								
Gomphidae sp									
Gomphus						1			
Lanthus	7								13
Ophiogomphus	28		21					13	
COLEOPTERA (beetles)									
Dytiscidae sp		1		1					
Elmidae sp.									
Cyloepus *			1						
D. vittata							1		
Neoelmis *			1			1			
Optioservus	185	133	154	161	190	185	123	308	483
Promoresia					23		2		
Stenelmis		56	82	115	77	70	101	175	154
Hydrophilidae sp						1			
Psephenidae									
Ectopria								5	
Psephenus	3		7	28	14				
MEGALOPTERA (fishflies, alderflies)									
Corydalidae									
Nigronia	51	7	22	7			28	41	5
Sialidae									
Sialis		1	6					21	
GASTROPODA (snails)									
Planorbidae									
Helisoma					3	1			
Physidae									

Round 3 ERI Macro Data based on 10 subsamples

Physella					1	6			
BIVALVIA (clams)									
Sphaeriidae sp.									
Pisidium		1	1		3		9		
DECAPODA (crayfish)									
Cambaridae sp	5	7						21	
Decapoda sp								1	
ISOPODA (sowbugs)									
Asellidae sp					31	4			
Caecidotea				112	2	1	528	159	
HEMIPTERA (true water bugs)									
Corixidae sp								14	
OTHER									
Oligochaeta (earthworms)		2	9				15		3
TOTAL TAXA	54	38	40	33	53	34	52	51	40
DENSITY	2085	2177	1671	2699	3913	1079	2557	3596	2581
# EPT individuals	1478	1475	1169	1849	2956	447	1273	2273	1570
% EPT	70.89	67.75	69.96	68.51	75.54	41.43	49.78	63.21	60.83
% Chironomidae	6.19	16.72	3.65	13.45	11.45	15.11	13.96	11.35	2.98
Density per subsample	209	218	167	270	391	108	256	360	258

Round 4 ERI Macro Data based on 10 subsamples

	ERI-STA1 10/99	ERI-STA2 10/99	ERI-STA3 10/99	ERI-STA4 10/99	ERI-STA5 10/99	ERI-STA6 10/99	ERI-STA7 10/99	ERI-STA8 10/99	ERI-STA9 10/99
DIPTERA (true flies)									
Diptera sp.									
Athericidae									
Atherix	280					7	22	21	
Ceratopogonidae sp.			13					3	
Probezzia sp.									
Chironomidae sp.	60	177	138	164	178	181	99	135	
Anthomyiidae g. sp.									
Cardiocladius sp.									
Chironomidae g. sp (pupae)									
Cricotopus/orthocladius									
Cryptochironomus sp.									
Diamesa sp.									
Diamesinae g. sp.									
Diplocladius sp.									
Eukiefferiella sp.									
Krenopelopia sp.									
Limnophyes sp.									
Microtendipes sp.									
Orthocladiinae									
Pagastia sp.									
Parametriocnemus sp.									
Paratanytarsus sp.									
Polypedilum									
Synorthocladius sp.									
Thienemannimyia gr.									
Dolichopodidae sp.									
Hemerodromia		1	14				63		1
Simulidae sp.		2	70			6	128	9	
Tabanidae									
Chrysops			16			28		64	
Tipulidae	1		2			12			
Antocha	13	2		414	49	57	6	12	21
Hexatoma	37	5	205			21		8	112
Pedicia	9								

Round 4 ERI Macro Data based on 10 subsamples

Tipula	61	6	140		3	7		7	161
EPHEMEROPTERA (mayflies)									
Baetidae sp						14			
Acerpenna									
Baetis	15	17	22	2	5		65	13	
Baetisca	27	13						13	48
Callibaetis									
Caenis	29			3	1	20	14	3	
Ephemerellidae									
Ephemerella	2		5		99	784	98	418	
Eurylophella		1	48			48		6	77
Serratella	11	8	50	140	32	96	94	16	168
Ephemeridae									
Ephemera									
Heptageniidae sp.	201		168		48	427	437	35	105
Epeorus									
Stenacron									
Stenonema	259	105	16	20	2		399	63	147
Isonychiidae									
Isonychia	763		154						
Leptophlebiidae sp.									
Choroterpes									
Paraleptophlebia	1		1			1			7
Thraulodes *									
Siphlonuridae sp.		13	17		3	7	392	72	42
Ameletus							56	20	
PLECOPTERA (stoneflies)									
Capniidae sp			1				1		
Allocapnia									
Capnia									
Nemocapnia									
Paracapnia									
Chloroperlidae sp	14	14							7
Haploperla			21						
Utaperla									
Leuctridae sp									
Leuctra	21								

Round 4 ERI Macro Data based on 10 subsamples

Peltoperlidae									
Peltoperla									
Perlidae sp.	1								133
Acroneuria	61	63	47				36	7	
Agnetina	1								13
Atoperla ephyre									
Paragnetina	42								
Perlodidae sp.									
Cultus									
Isoperla									
Pteronarcyidae									
Pternoarcys	6							8	
Taeniopterygidae									
Taeniopteryx									
TRICHOPTERA (caddisflies)									
Brachycentridae sp									
Brachycentrus									
Micrasema									
Glossosomatidae sp									
Agapetus					1				
Glossosoma	13	2	10	3		21	1	12	2
Helicopsychidae									
Helicopsyche borealis	4								
Hydropsychidae									
Cheumatopsyche	469	49	56	31	49	455	635	418	49
Diplectrona									
Hydropsyche	1085	281	1337	853	200	2556	2163	600	1113
H. morosa									
H. sparna									
Homoplecta	2								
Potamyia	1					35			
Hydroptilidae									
Leucotrichia							42		
Neotrichia									
Lepidostomatidae									
Lepidostoma		1						1	
Leptoceridae									
Leptocerus						1			

Round 4 ERI Macro Data based on 10 subsamples

Oecetis									
Limnephilidae sp	1		7						
Hydatophylax									
Limnephilus		15						12	
Pycnopsyche			3			3	13	14	1
Odontoceridae									6
Psilotreta	20								12
Philopotamidae									
Chimarra	12		48			1	616	145	20
Dolophilodes distinctus	70								
Polycentropodidae									
Nyctiophylax	1								
Polycentropus	1	40	3	47	8	35	21		20
Psychomyiidae									
Lype									1
Psychomyia	20			48		14	63		
Rhyacophilidae			20						
Rhyacophila				1		27			
R. mainensis									
ODONATA (dragonflies & damselflies)									
Aeshnidae									
Boyeria	4					1	24	12	3
Calopterygidae									
Calopteryx						21		12	1
Hetaerina	22								
Cordulegastridae sp									
Cordulegaster									
Gomphidae sp			1					7	
Gomphus									
Lanthus		1							
Ophiogomphus	259					6		1	21
COLEOPTERA (beetles)									
Dryopidae (long-toed water beetles)									
Helichus					1	12			
Dytiscidae sp									
Oreodytes						1			
Elmidae sp.	60		125			14		1	

Round 4 ERI Macro Data based on 10 subsamples

Cyloepus *									
D. vittata									
Neoelmis *									
Optioservus	2429	81	861	196	140	1414	1197	729	637
Promoresia	27	160				20	126	3	
Stenelmis	140		280	15		448	455	59	
Hydrophilidae sp					1	28			
Psephenidae									
Ectopria									
Psephenus	84		13		6		6	14	
MEGALOPTERA (fishflies, alderflies)									
Corydalidae									
Nigronia	58	6				11	40	49	49
Sialidae									
Sialis	13	5				10	42	6	6
GASTROPODA (snails)									
Ancylidae									
Ferrissia				14	3	6			
Planorbidae									
Helisoma					27	34			
Physidae									
Physella									
Physa	1			4	21	127		5	
BIVALVIA (clams)									
Sphaeriidae sp.									
Pisidium									
DECAPODA (crayfish)									
Cambaridae sp	4								
Decapoda sp									
ISOPODA (sowbugs)									
Asellidae sp		1			52	357	889	166	
Caecidotea									
HEMIPTERA (true water bugs)									

Round 4 ERI Macro Data based on 10 subsamples

Corixidae sp	1				51	90			
Ramphocorixa					15				
Notonectidae g. sp.					21			6	
Notonecta							6		
Veliidae g.sp. (broad-shouldered water striders)	1								
OTHER									
Oligochaeta (earthworms)			14			14	21		
Arachnoidea									
Hydracarina g.sp. (water mites)			1						
TOTAL TAXA	50	26	35	16	25	44	33	41	29
DENSITY	6717	1069	3927	1955	1016	7478	8270	3205	2983
# EPT individuals	3153	622	2034	1148	448	4545	5146	1876	1971
% EPT	46.94	58.18	51.79	58.72	44.09	60.78	62.22	58.53	66.07
% Chironomidae	0.89	16.56	3.51	8.39	17.52	2.42	1.20	4.21	0.00
Density per subsample	672	107	393	196	102	748	827	321	298

Round 1 Normandeau Macro Data based on 6 Surber samples

	CR01 5/99	CR01A 5/99	CR02 5/99	CR03A 5/99	CR03 5/99
DIPTERA (true flies)					
Athericidae					
Atherix				1	
Chironomidae sp.					
Chironamini	4			1	
Orthocladiinae	81		2	1	2
Tanytarsini	10				
Simulidae sp.					
Prosimulium	1				
Simulium	1				
Tipulidae					
Antocha	17				
Dicranota	1				
EPHEMEROPTERA (mayflies)					
Baetidae sp					
Acentrella/Pseudocloen	15				
Caenidae					
Caenis	14				
Ephemerellidae					
Ephemerella	10			1	
Serratella	2				
Ephemeridae					
Ephemera	2				
Heptageniidae sp.					
Stenacron	2				
Stenonema	64				
Isonychiidae					
Isonychia	9				
PLECOPTERA (stoneflies)					
Nemouridae sp					
Amphinemura					1
Perlidae sp.					
Acroneuria	7				
TRICHOPTERA (caddisflies)					
Brachycentridae sp					
Micrasema	1				
Hydropsychidae					
Ceratopsyche	15			7	15
Cheumatopsyche	10	20	2	21	16
Hydropsyche		49	2	79	16
Macrostemum	4	99		9	26
Lepidostomatidae					
Lepidostoma					1

Round 1 Normandeau Macro Data based on 6 Surber samples

Polycentropodidae					
Polycentropus					1
COLEOPTERA (beetles)					
Elmidae sp.					
Optioservus	5				
Psephenidae					
Psephenus	2				
MEGALOPTERA (fishflies, alderflies)					
Corydalidae					
Nigronia	2	1		2	1
GASTROPODA (snails)					
Ancylidae					
Ferrissia	3				
BIVALVIA (clams)					
Sphaeriidae sp.					
Pisidium	57				
DECAPODA (crayfish)					
Cambaridae sp					
Orconectes			1		
ISOPODA (sowbugs)					
Asellidae sp					
Caecidotea		1	1		
OTHER					
Amphipoda					
Crangonyx		13			
Lumbriculidae	75	7	4	5	
Lumbricidae		1			
Tricladida					
Dugesia		2			
TOTAL TAXA	26	9	6	10	9
DENSITY	415	193	12	127	79
# EPT individuals	155	168	4	117	76
% EPT	37.35	87.05	33.33	92.13	96.2
% Chironomidae	22.89	0.00	16.67	1.57	2.53
Density per surber sample (.1m^2)	69	32	2	21	13
Shannon Diversity (base e)	2.46	1.36	1.68	1.29	1.64
Evenness	0.76	0.62	0.93	0.56	0.75
Hilsenhoff Index (water quality rating)	5.48 (good)	4.15 (very good)	6.50 (fair)	5.06 (good)	4.52 (good)

Round 2 Normandeau Macro Data based on 6 Surber samples

	CR01 8/99	CR01A 8/99	CR02 8/99	CR03A 8/99	CR03 8/99
DIPTERA (true flies)					
Athericidae					
Atherix				5	
Ceratopogonidae sp.					
Probezzia sp.			1		
Chaoboridae					
Chaoborus		1			
Chironomidae sp.					
Chironamini	18	8	6	4	6
Orthocladiinae	31	56	43	6	12
Pseudochironomini	52				
Tanypodinae		1	23		
Tanytarsini	22	5	50	13	12
Simulidae sp.					
Prosimulium					4
Tipulidae					
Antocha	49				
EPHEMEROPTERA (mayflies)					
Baetidae sp					
Acentrella/Pseudocloen		8		5	11
Baetis		6		8	1
Caenidae					
Caenis	1				
Ephemeridae					
Ephemera	5				
Heptageniidae sp.					
Stenonema	9	2	37		1
Isonychiidae					
Isonychia	10				
TRICHOPTERA (caddisflies)					
Brachycentridae sp					
Brachycentrus	495				
Hydropsychidae					
Ceratopsyche	30	24		133	107
Cheumatopsyche	3	103	4	88	19
Hydropsyche	2	1258	2	564	59
Macrostemum	28	831		126	339
Hydroptilidae					
Hydroptila	3				
Philopotamidae					
Chimarra		1		1	1
Polycentropodidae					
Neureclipsis	15				

Round 2 Normandeau Macro Data based on 6 Surber samples

Polycentropus			4	13	1
ODONATA (dragonflies & damselflies)					
Coenagrionidae					
Argia			3		
Libellulidae					
Libellula			2		
COLEOPTERA (beetles)					
Elmidae sp.					
Macronychus	1				
Optioservus	2	1		1	
Stenelmis	1			2	3
Dineutus		1		2	
MEGALOPTERA (fishflies, alderflies)					
Corydalidae					
Corydalus		1		2	10
Nigronia	4	1	1	7	2
Sialidae					
Sialis	1		3		
GASTROPODA (snails)					
Ancylidae					
Ferrissia	6				
Planorbidae					
Planorbella			1		
BIVALVIA (clams)					
Sphaeriidae sp.					
Pisidium	10		4		
DECAPODA (crayfish)					
Cambaridae sp					
Orconectes			1	1	
ISOPODA (sowbugs)					
Asellidae sp					
Caecidotea		5	17		
OTHER					
Amphipoda					
Crangonyx		7	55		
Hydracarina (water mites)	1				
Oligochaeta (earthworms)					
Lumbriculidae	2	4	8		
Lumbricidae		2	11		
Tricladida					
Dugesia		1			
Tubificidae (tube worms)		3	1		

Round 2 Normandeau Macro Data based on 6 Surber samples

TOTAL TAXA	25	23	21	18	16
DENSITY	801	2330	277	981	588
# EPT individuals	601	2233	47	938	539
% EPT	75.03	95.84	16.97	95.62	91.67
% Chironomidae	15.36	3.00	44.04	2.34	5.1
Density per surber sample (.1m^2)	134	388	46	164	98
Shannon Diversity (base e)	1.65	1.13	2.33	1.42	1.44
Evenness	0.51	0.36	0.77	0.49	0.52
Hilsenhoff Index (water quality rating)	2.51 (excellent)	4.37 (v good)	5.39 (good)	4.83 (good)	3.89 (v good)

Round 3 Normandeau Macro Data based on 6 Surber samples

	CR01 10/99	CR01A 10/99	CR02 10/99	CR03A 10/99	CR03 10/99	CR04 10/99
DIPTERA (true flies)						
Ceratopogonidae sp.						
Probezzia sp.			1			
Chironomidae sp.						
Chironamini	109		12			
Orthocladiinae	44		1	3	5	1
Tanypodinae			3			
Tanytarsini	46				2	
Empididae						
Hemerodromia					1	
Tipulidae						
Antocha	13			1		
EPHEMEROPTERA (mayflies)						
Baetidae sp						
Acentrella/Pseudocloen					5	
Baetis			1			
Caenidae						
Caenis	38					
Ephemerellidae						
Dannella	2					
Ephemeridae						
Ephemera	1					
Heptageniidae sp.						
Stenacron	15		11			
Stenonema	41				3	
Isonychiidae						
Isonychia	93				1	
TRICHOPTERA (caddisflies)						
Brachycentridae sp						
Brachycentrus	1					
Hydropsychidae						
Ceratopsyche				77	74	1
Cheumatopsyche	16	78		50	6	
Hydropsyche		78	1	173	11	
Macrostemum		113		14	88	1
Hydroptilidae						
Hydroptila	3					
Philopotamidae						
Chimarra	1				1	
Polycentropodidae						
Neureclipsis	7		1	1	2	
Polycentropus		1				1
Psychomyiidae						
Psychomyia	1					

Round 3 Normandeau Macro Data based on 6 Surber samples

ODONATA (dragonflies & damselflies)						
Coenagrionidae						
Argia			7	1		1
Enallagma			1			
Libellulidae						
Libellula						1
COLEOPTERA (beetles)						
Elmidae sp.						
Optioservus	12			1	3	
Stenelmis	2					
MEGALOPTERA (fishflies, alderflies)						
Corydalidae						
Corydalus				2	1	
Nigronia	2	4			2	
Sialidae						
Sialis	2		1			2
GASTROPODA (snails)						
Ancylidae						
Ferrissia	32					
BIVALVIA (clams)						
Sphaeriidae sp.						
Pisidium	60					
ISOPODA (sowbugs)						
Asellidae sp						
Caecidotea						2
OTHER						
Amphipoda						
Crangonyx		2	23			1
Hydracarina (water mites)	1			1	1	
Oligochaeta (earthworms)						
Lumbriculidae	26		5	2		18
Tricladida						
Dugesia	1	1				
Tubificidae (tube worms)						6
TOTAL TAXA	26	7	13	12	16	11
DENSITY	569	277	68	326	206	35
# EPT individuals	219	270	14	315	191	3
% EPT	38.49	97.47	20.59	96.63	92.72	8.57
% Chironomidae	34.97	0.00	23.53	0.92	3.40	2.86
Density per surber sample (.1m^2)	95	46	11	54	34	6
Shannon Diversity (base e)	2.52	1.22	1.96	1.29	1.56	1.68
Evenness	0.78	0.63	0.76	0.52	0.56	0.7

Round 3 Normandeau Macro Data based on 6 Surber samples

Hilsenhoff Index (water quality rating)	5.34 (good)	5.40 (good)	5.18 (good)	5.10 (good)	4.13 (v good)	7.63 (poor)

FISH SAMPLING METHODS AND RESULTS

Clarion University

Fish Methods

Fish community data was collected at two sites (1site at least 5 km from the mouth and 1 site 100-500m from the mouth) within each stream. Not surprisingly the upstream and downstream sites harboring greater numbers of individuals and being much more species rich. Therefore these data were combined in order to assess the fish community of the specific stream in question. The shocking effort was performed by measuring out a 100 m transect at each site, and making a single pass with a pulsed DC backpack unit. Shocking time was as follows:

Cathers Run, downstream site:	930 sec
Cathers Run, upstream site:	1474 sec
Millstone, downstream site:	2641 sec
Millstone, upstream site:	1652 sec
Clear Creek, downstream site:	2003 sec
Clear Creek, upstream site:	1752 sec

Fish Results

Cathers Run harbored the most species (18) of any of the streams sampled. It also showed a respectable number of individuals per 100 meters (196.5), species diversity (.8849), and species evenness (.705). Rosyface shiners (38.17%) had the highest relative abundance value followed by Mottled sculpin (20.87%) and Blacknose dace (11.45%).

Of the three streams sampled, Clear Creek showed the least amount of biota. Species richness (12), total number of individuals per 100 meters (147.5), species diversity (.7261), and species evenness (.6728) values were the lowest for any of the streams sampled but overall were still respectable. The fish community was dominated by two species: Blacknose dace (37.29%) and Mottled sculpin (34.24%).

Millstone Creek had the highest values for diversity (.9957), evenness (.8092), and total number of individuals per 100 meters (277.5) of all the streams sampled. Of these species, Rosyface shiners, dominated in terms of relative abundance (32.25%). River chub (11.71%), Creek Chub (9.01%), and Northern hogsucker (7.75%) were the other most abundant species.

All of the fish data collected by Clarion University can be found in Table B-1.

PA Fish & Boat Commission

Fish Methods (Aquatic Biological Survey, 1999)

Electrofishing was conducted on five of the six stations. Sites were selected in reference to the closest stream and previous surveys identified within the PFBC Fisheries Management Database, Pleasant Gap, PA. The electrofishing unit consisted of a Coffelt

Model BP-1C variable voltage pulsating electroshocker (Coffelt Electronics Company, Inc.) combined with a model QEG-300 portable AC generator (Tanaka Kogyo Company) mounted on a modified backpack frame with probes attached to the unit. All fish captured were counted and identified to species; length measurements were taken for all game fish. One hundred meters were electrofished at each sampling location.

Fish Results (Aquatic Biological Survey, 1999)

Station 01: West Branch of the Clarion River Station 01 (WBC01)

The West Branch of the Clarion River is classified as a cold water fishery (CWF) by the Commonwealth of Pennsylvania, Pennsylvania Code, Title 25 Environmental Protection, Department of Environmental Protection Chapter 93 Water Quality Standards.

A variety of non-game fish were captured in the fish survey, including mottled sculpin, blacknose dace, greenside darter, johnny darter, fantail darter, river chub, creek chub, northern hog sucker, and white sucker. Game fish captured included brown trout. The West Branch of the Clarion River Station 01 brown trout population was calculated at 81 trout per hectare. The fish survey data for WBC01 can be found in Table B-2.

Station 02: Five Mile Run Station 01 (FMR01)

Five Mile Run is classified as a high quality cold water fishery (HQ-CWF) in the Commonwealth of Pennsylvania, Pennsylvania Code, Title 25 Environmental Protection, Department of Environmental Protection Chapter 93 Water Quality Standards.

A variety of non-game fish were captured in the fish survey, including mottled sculpin, fantail darter, northern hog sucker, and white sucker. Game fish captured included brook trout and pumpkinseed. The Five Mile Run Station 01 brook trout population was calculated at 192 brook trout per hectare. The fish survey results for FMR01 can be found in Table B-2.

Station 03: East Branch of the Clarion River Station 01 (EBC01)

The East Branch of the Clarion River is classified as a high quality cold water fishery (HQ-CWF) by the Commonwealth of Pennsylvania, Pennsylvania Code, Title 25 Environmental Protection, Department of Environmental Protection Chapter 93 Water Quality Standards.

No species of non-game fish were captured in the fish survey. Game fish captured included brown trout. The brown trout population at the East Branch of the Clarion River Station 01 was calculated at 200 brown trout per hectare. The fish survey results for EBC01 can be found in Table B-2. At the time of the survey, limestone sand was applied immediately upstream of the sampling site, making visibility extremely poor on the stream bottom.

Station 04: Elk Creek Station 01 (ELK01)

Elk Creek is classified as a cold water fishery (CWF) by the Commonwealth of Pennsylvania, Pennsylvania code, Title 25 Environmental Protection, Department of Environmental Protection Chapter 93 Water Quality Standards.

A fish survey was not conducted on Elk Creek in 1998. However, a survey was conducted on 11 June 1997 approximately 5.3 km (3.3 mi) upstream from the benthic macroinvertebrate sampling location. Exact numbers of fish surveyed were not available. A variety of non-game fish were captured in the fish survey, including mottled sculpin, fantail darter, banded darter, blackside darter, common shiner, greenside darter, Johnny darter, river chub, blacknose dace, central stoneroller, creek chub, golden redhorse, variegate darter, northern hog sucker and white sucker. No game fish were captured during this survey.

Station 05: Little Toby Creek Station 01 (LT01)

Little Toby Creek is classified as a cold water fishery (CWF) by the Commonwealth of Pennsylvania, Pennsylvania Code, Title 25 Environmental Protection, Department of Environmental Protection Chapter 93 Water Quality Standards.

A variety of non-game fish were captured in the fish survey, including mottled sculpin, central stoneroller, variegate darter, greenside darter, fantail darter, Johnny darter, sand shiner, common shiner, river chub, longnose dace, blacknose dace and northern hog sucker. Game fish captured included brown trout. The Little Toby Creek Station 01 brown trout population was calculated at 4 trout per hectare. The fish survey results for LT01 can be found in Table B-2.

Station 06: Spring Creek Station 01 (SPCK01)

Spring Creek is classified as a high quality cold water fishery (HQ-CWF) by the Commonwealth of Pennsylvania, Pennsylvania Code, Title 25 Environmental Protection, Department of Environmental Protection Chapter 93 Water Quality Standards.

A variety of non-game fish were captured in the fish survey, including mottled sculpin, central stoneroller, variegate darter, greenside darter, fantail darter, johnny darter, sand shiner, common shiner, bluntnose minnow, river chub, northern hog sucker, and white sucker. Game fish captured included stocked rainbow trout. The Spring Creek Station01 trout population was calculated at 16 rainbow trout per hectare. The fish survey results for SPCK01 can be found in Table B-2.

Discussion (Aquatic Biological Survey, 1999)

Results of the fish survey revealed a diverse fish population, typical of streams such as these. Trout species were identified at all locations with the exception of ELK01 (Aquatic Biological Survey, 1999).

Fish Methods (PA Fish & Boat Commission, 1998)

The Piney Hydroelectric Project results for 1998 are included in this report. The stations sampled were CR01, CR02, CR03A, and CR01A. Sample location descriptions can be found in Table 4. Boat electrofishing was the sampling method used to gather fish at CR01, CR01A, and CR03A. Towboat electrofishing was conducted at CR01A and CR02.

Fish Results

The fish collected from the Clarion River at Cooksburg (CR01) in 45 minutes of boat electrofishing (AC) on August 27, 1998 yielded 18 game fish, all of which were smallmouth bass. The panfish numbered 20 and represented hogsuckers (19) and rock bass (1).

The sampling done at the pool of the tailwaters of the Piney Dam (CR01A-1) yielded 4 game fish including 2 smallmouth bass and 2 walleye. Also caught here were 27 panfish representing 4 species (1 black crappie, 7 bluegill, 6 green sunfish, and 13 pumpkinseed).

The electrofishing performed from the USGS Piney gage upstream to the tailwaters (CR01A-2) produced 72 individuals representing 12 species, 1 of which was a game species (3 smallmouth bass) and 5 of which were pan fish (1 black crappie, 3 bluegill, 1 hogsucker, 6 pumpkinseed, and 1 rock bass).

The fish collected from the Clarion River upstream of Piney Creek at the SR 2007 bridge (CR02) totaled 53 individuals representing 10 species. No game fish were collected, but 3 species of panfish were caught totaling 29 individuals (2 hogsuckers, 24 pumpkinseed, and 3 white suckers).

Fish collected form the Clarion River downstream of the SR 3007 bridge at Canoe Ripple (CR03A) yielded 45 individuals representing 9 species. Two species of game fish were caught (1 largemouth bass and 1 smallmouth bass) and 3 species of panfish were collected totaling 21 fish (1 bluegill, 11 pumpkinseed, and 9 white sucker).

The fish data from these stations can be found in Table B-3.

<u>Ecological Restoration, Inc.</u>

Methods (Ecological Restoration, Inc., 1998)

Ecological Restoration, Inc. prepared a four-part thermal variance study for Willamette Industries, Inc., which is relevant to this study and will be used for comparison. Nine stations were sampled including East Branch, West Branch, and 7 stations below Johnsonburg.

Fish Results

The fish data from all 4 rounds of sampling at the nine stations can be found in Table B-4.

At Station 1, upstream on the West Branch Clarion River, approximately 5 miles north of Willamette's Paper Mill, a total of 247 fish were caught in November 1998 representing 14 species. Among those caught were 5 game fish (4 brown trout and 1 largemouth bass) and 31 panfish (19 hogsuckers and 12 white suckers). At the same station in March 1999, a total of 54 fish were caught representing 9 species. Among those were 3 game fish (1 brook trout, 1 brown trout, and 1 largemouth bass) and 9 panfish (4 hogsuckers and 5 white suckers). This station was sampled for a third time in July 1999 and the fish catch yielded 359 fish representing 14 species. Among those caught were 5 game fish (5 brown trout) and 17 panfish (8 hogsuckers, 1 pumpkinseed, and 8 white suckers). The October 1999 sampling event yielded a total of 384 fish including 7 game fish (2 brown trout, 1 largemouth bass, and 4 smallmouth bass) and 31 panfish (13 hogsuckers, 1 pumpkinseed, 2 rock bass, and 15 white suckers).

Station 2, located upstream on the East Branch Clarion River at Bendigo State Park, a few miles downstream from the East Branch Dam yielded 35 fish representing 3 species when sampled in November 1998. There were no game fish or pan fish caught at this time. In March 1999, the fish catch yielded 84 individuals representing 8 species. Among those were 16 game fish (12 brook trout and 4 brown trout) and 6 panfish (6 white suckers). The sample taken in July 1999 yielded 57 fish representing 5 species. Among those captured was 1 game fish (1 brown trout). The October 1999 sampling event yielded a total of 149 fish including 4 game fish (1 brook trout, 3 brown trout) and 11 panfish (all white suckers).

Station 3, located on the main stem of the Clarion River just below the confluence of the East and West Branches and upstream of Willamette's discharge, yielded a total of 121 fish representing 9 species when sampled in November 1998. Among those caught were 7 panfish (7 white suckers). No game fish were caught. In March 1999, a total of 98 fish representing 9 species were caught. Five of the fish were pan fish (1 hogsucker and 4 white suckers). Again, no game fish were caught. When sampled in July 1999, this station yielded a total of 352 fish representing 13 species. Among those species caught were 9 game fish (6 brown trout, 2 largemouth bass, and 1 smallmouth bass) and 4 panfish (4 white suckers). The October 1999 sampling event yielded a total of 354 fish including 1 game fish (smallmouth bass) and 3 panfish (1 pumpkinseed, 2 white suckers).

Station 4, located on the main stem of the Clarion River just below the discharge from Willamette's Treatment Plant, yielded a catch of 765 fish representing 13 species in November 1998. Among the species caught were 57 panfish (1 hogsucker, 6 pumpkinseed, and 50 white suckers). No game fish were caught at this time. In March 1999, 238 fish were caught representing 10 species. Among those species were 2 game fish (2 brook trout) and 11 panfish (1 pumpkinseed and 10 white suckers). In July 1999, 634 fish were caught representing 17 species. Among those caught were 10 game fish (8 brown trout, 1 largemouth bass, and 1 smallmouth bass) and 65 panfish (1 hogsucker, 7 pumpkinseed, and 57 white suckers). The October 1999 sampling event yielded a total of 1650 fish including 8 game fish (3 brown trout, 5 smallmouth bass) and 83 panfish (1 hogsucker, 1 pumpkinseed, 3 river chubs, 78 white suckers).

Station 5, located on the main stem of the Clarion River just above the discharge from Johnsonburg's Municipal Wastewater Treatment Plant, yielded a total of 658 fish representing 11 species in November 1998. Among the fish caught were 2 game fish (2 brown trout) and 47 panfish (47 white suckers). When the same station was sampled in March 1999, 766 fish were caught representing 10 species. Among those caught were 1 game fish (1 brown trout) and 10 panfish (10 white suckers). In July 1999, this station yielded a total of 783 fish representing 14 species. Among those caught were 28 game fish (25 brown trout and 3 smallmouth bass) and 80 panfish (4 pumpkinseed and 76 white suckers). The October 1999 sampling event yielded a total of 940 fish including 6 game fish (brown trout) and 57 panfish (1 rock bass, 56 white suckers).

Station 6, located on the main stem of the Clarion River below Johnsonburg's Municipal Wastewater Treatment Plant discharge, yielded a total of 384 fish representing 10 species in November 1998. Among those caught were 1 game fish (1 brown trout) and 23 panfish (2 hogsuckers and 21 white suckers). In March 1999, a total of 199 fish representing 12 species were caught. Among those were 1 game fish (1 brook trout) and 7 panfish (1 hogsucker and 6 white suckers). In July 1999, a total of 296 fish representing 8 species were caught. Among those were 15 game fish (15 brown trout) and 24 panfish (24 white suckers). The October 1999 sampling event yielded a total of 760 fish including 6 game fish (brown trout) and 58 panfish (1 hog sucker, 2 rock bass, 55 white suckers).

Station 7, located on the main stem of the Clarion River above the confluence of Riley Run, yielded a total of 200 fish representing 11 species in November 1998. Among those caught were 2 game fish (1 brook trout and 1 smallmouth bass) and 8 panfish (1 hogsucker and 7 white suckers). In March 1999, this station yielded 45 fish representing 8 species. Among those caught were 1 game fish (1 brown trout) and 5 panfish (5 white suckers). In July 1999, 320 fish representing 10 species were caught. Among those were 3 game fish (3 brown trout) and 22 panfish (22 white suckers). The October 1999 sampling event yielded a total of 723 fish including 4 game fish (1 brown trout, 3 smallmouth bass) and 15 panfish (1 hog sucker, 14 white suckers).

Station 8, located on the main stem of the Clarion River just north of the Ridgway City limits, yielded 358 fish representing 11 species in November 1998. Among those caught were 2 game fish (2 brown trout) and 14 panfish (14 white suckers). In March 1999, 43 fish representing 4 species were caught. Among those were 1 game fish (1 brown trout) and 4 panfish (4 white suckers). In July 1999, this station yielded 514 fish representing 14 species. Among those caught were 4 game fish (3 brown trout and 1 largemouth bass) and 77 panfish (2 hogsuckers and 75 white suckers). The October 1999 sampling event yielded a total of 1158 fish including 7 game fish (3 brown trout, 4 smallmouth bass) and 60 panfish (white suckers).

Station 9, located at the mouth of Powers Run, yielded a total of 137 fish representing 11 species in November 1998. Among those caught were 5 game fish (3 brook trout and 2 brown trout) and 23 panfish (2 hogsuckers and 21 white suckers). In March 1999, this station yielded a total of 144 fish representing 9 species. Among those caught were 3 game fish (1 brook trout and 2 brown trout) and 6 panfish (6 white suckers). In July 1999, a total of 239 fish representing 12 species were caught. Among those were 13 game fish (3 brook trout and 10 brown trout) and 13 panfish (13 white suckers). The October 1999 sampling event yielded a total of 323 fish including 4 game fish (1 brook trout, 3 brown trout) and 9 panfish (white suckers).

Normandeau Associates, Environmental Consultants

In support of the relicensing of Piney Hydroelectric Project, Normandeau Associates prepared a report on water quality studies of the Clarion River as well as fish and aquatic macroinvertebrate communities of Piney Lake and the Clarion River. For practicality purposes, the Piney Lake data addressed in this report will be limited to water quality data, but the river data will include fish and macros as well as water quality.

Fish Methods (Normandeau Associates, Inc., Report on Fish..., 2000)

Electrofishing and benthic macroinvertebrate stations in the Clarion River below Piney Dam were established at five locations. The four stations between the dam and Callensburg corresponded to sites sampled by the PFBC/USACE at least once during 1995 to 1998. The station at the abandoned bridge site near St. Petersburg, according to current knowledge, has never been sampled for fish or benthic macroinvertebrates.

A pram electrofisher with pulsed DC current was towed in daylight hours throughout sampling locations in the Clarion River below Piney Dam. All river electrofishing occurred at minimum flow (100cfs). Sampling time at river sites ranged from 53 to 74 min. An effort was made to sample all habitat types (fast, slow, shallow, deep, cover, etc.) accessible by

wading at a site. Most captured fishes were preserved for later identification and processing. Some fishes were identified, measured, weighed and released in the field.

Electrofishing catches in the Clarion River were expressed as relative abundance and CPUE (number per run).

Fish Results (Normandeau Associates, Inc., Report on Fish..., 2000)

The fish data from all of the stations sampled in this report can be found in Table B-5.

The fish communities below Piney Dam were determined by pram electrofishing. The site at St. Petersburg was sampled only in the fall. Overall, the Clarion River below Piney Dam supported 31 species. Five species, including river chub, rock bass, and greenside, banded, and blackside darters, were found at all sampling sites. Additionally, bluntnose minnow, northern hogsucker, yellow bullhead, largemouth bass, johnny darter, variegate darter, and logperch were captured at each of the four sites nearest Piney Dam. Canoe Ripple yielded the most specimens and taxa, and also offered the most habitat complexity of all the sampling sites.

Cyprinids represented by 9 species formed 44% of the catch, while 7 species of darters comprised an additional 32% of all fishes below the dam. Bluntnose minnow, river chub, and variegate darter were the three most abundant species overall. Bluntnose minnow achieved highest abundance at Canoe Ripple and also was the most abundant species overall at that site. River chub abundance was highest in the tailrace, where 69% of all variegate darters were caught. Sunfishes were a relatively minor component of the riverine fauna, and were abundant only at the Piney Bridge and Canoe Ripple sites. The predominant sunfishes below Piney Dam were rock bass and pumpkinseed.

The electrofishing catch aggregated by season showed that 50% of the individuals and the highest CPUE occurred in the fall. The three most numerous fishes below Piney Dam (bluntnose minnow, river chub, and variegate darter) were similarly most abundant in fall. Among other species, only logperch CPUE was comparable in each season.

River chub CPUE was highest at the tailrace and Piney Bridge either in summer or fall. The overall high abundance of bluntnose minnow was due to the high CPUE at Canoe Ripple in the fall. Variegate darter CPUE was high in each season in the tailrace. However, the most consistent catch of darters occurred at Callensburg, where four species (greenside darter, johnny darter, banded darter, and logperch) were taken during each season.

The CPUE at the St. Petersburg site in fall was substantially lower than the other sites, and likely reflected the greater difficulty encountered when sampling this site. Total flow volume at this station was greater, the riffles deeper and faster, and the substrate (large submerged boulders) presented more difficult wading. All contributed to less efficient sampling at this site relative to all others.

Other than minnows and darters, most fishes were young-of-year or older juveniles. Adults of suckers, catfishes, and sunfishes were scarce, likely due to their inaccessibility in deeper pool habitats.

The fish communities at stations below Piney Dam were dissimilar to each other overall and in each season. The Index of Percent Similarity among electrofishing sites was less than 50% for all comparisons except between Callensburg and Canoe Ripple in the spring. Due to the generally uneven distribution and low abundance of fishes, a single species in high proportion had greater weight in index calculations. For example, variegate

darter, river chub, and bluntnose minnow achieved highest abundance consistently only at the tailrace, Piney Bridge, and Canoe Ripple sites, respectively, and usually nowhere else.

Discussion (Normandeau Associates, Inc., Report on Fish..., 2000)

The fish communities of the Clarion River below Piney Dam were generally similar in composition to those documented previously by PFBC/USACE sampling. Minnow species, darters, and pumpkinseed were typically the most abundant and widely distributed fishes. Poor representation or absence of yellow perch, white sucker, walleye, and golden redhorse in 1999 samples, particularly large individuals, may have been due to the inability of the gear to sample in the deeper pools. Large specimens of each of these species were reported by the PFBC in boat electrofishing samples that included deeper portions of pools during 1995-1998.

The total taxa collected by PFBC/USACE sampling in the Clarion River below Piney Dam during 1995-1998 numbered at least 30. Sampling in 1999 yielded seven additional species not collected previously, including mountain brook lamprey, streamline chub, silver shiner, channel catfish, stonecat, mottled sculpin, and rainbow darter. Thus, the documented fish community below Piney Dam currently comprises at least 37 taxa. Although somewhat similar at least in taxonomic composition to that found in the Clarion River above the Project at Cooksburg, the larger number of species found below Piney Dam is the result of composite samples from several habitat types and the presence of Piney Lake immediately upstream.

The increase in fish use of the Clarion River below Piney Dam shown by sampling since 1980 is substantial. The effects of upper river basin water quality improvement projects were largely responsible for improved species richness (from 3 taxa in 1980 to more than 15) through 1995. Continued improvements in the water quality of project inflows, plus initiation of minimum flows in the summer of 1995, have yielded further enrichment of the fish community.

Tailrace electrofishing samples included substantial numbers of variegate darter. This species prefers rapid currents and hard, clean substrates generally devoid of silt. Tailrace substrates were primarily large boulders and bedrock slabs kept clean of silt by daily generation. Variegate darter attained highest abundance in the cleaner substrates of the Piney Dam tailrace relative to other riffle areas sampled downstream that were more affected by siltation and/or AMD products.

Young-of-year and juveniles of many species were taken in 1999 river samples, although other than for darters that likely spawned in the riffles below Piney Dam, it was not clear where reproduction occurred. Most juveniles, especially of game fish and panfish species, inhabited stream or pool margins or backwaters that afforded reduced current and abundant woody debris for cover. The riffle/run/pool complex below the Canoe Ripple Bridge supported the highest species richness as well as the most habitat diversity, including a substantial soft-bottomed backwater with limited SAV and woody debris. It was also the only sample site close to a pH-neutral tributary stream. The Canoe Creek confluence is located about 0.5 mi upstream and may also be a source of recruitment of fishes to the Clarion River.

Additional Fish Results

The Index of Biotic Integrity is also a useful tool by which to compare fish populations. Tolerant species are defined as the 10% most tolerant of all species found in Pennsylvania. Likewise, intolerant species are defined as the 10% most intolerant of all species found in Pennsylvania. All other species that are not classified as tolerant or intolerant express intermediate tolerance to polluted waters. The tolerances presented below are according to station from the headwaters downstream. The number in parenthesis represents the percent of the population that is represented by the tolerant or intolerant species at that station.

The West Branch (WBC01) showed 3 tolerant species (10%) and 1 intolerant species (76%). This same station was also sampled by Ecological Restoration on three occasions. The fall sample showed 4 tolerant (43%) and 1 intolerant (31%) species. The spring sample showed 3 tolerant (69%) and 2 intolerant (19%) species. Finally, the summer samples showed 4 tolerant (48%) and 1 intolerant (39%) species.

Five Mile Run (FMR01) showed 1 tolerant (6%) and 2 intolerant (64%) species.

East Branch (EBC01) showed no tolerant or intolerant species. At Bendigo State Park (ERI-STA2), the fall sample showed 1 tolerant (49%) and 1 intolerant (14%) species, the spring sample showed 4 tolerant (67%) and 2 intolerant (26%) species, and the summer sample showed 2 tolerant (32%) and 2 intolerant (67%) species.

Upstream of Willamette's discharge (ERI-STA3), the sample in the fall showed 4 tolerant (31%) and 1 intolerant (49%) species. The spring samples showed 3 tolerant (58%) and 1 intolerant (33%) species, and the summer sample showed 4 tolerant (34%) and 1 intolerant (57%) species.

Just downstream of Willamette's discharge (ERI-STA4), the fall sample showed 4 tolerant (33%) and 1 intolerant (10%) species, the spring sample showed 4 tolerant (74%) and 2 intolerant (9%) species, and the summer sample showed 5 tolerant (47%) and 1 intolerant (29%) species.

Powers Run (ERI-STA9) showed 3 tolerant (63%) and 3 intolerant (29%) species in the fall, the spring sample showed 3 tolerant (56%) and 2 intolerant (37%) species, and the summer sample showed 5 tolerant (80%) and 3 intolerant (12%) species.

The station above Johnsonburg's Wastewater Treatment Plant (ERI-STA5), showed 3 tolerant (47%) and 2 intolerant (19%) species in the fall, the spring sample showed 4 tolerant (18%) and 2 intolerant (5%) species, and the summer sample showed 4 tolerant (65%) and 2 intolerant (17%) species.

The station below Johnsonburg's Wastewater Treatment Plant (ERI-STA6), showed 4 tolerant (49%) and 1 intolerant (14%) in the fall, the spring sample showed 4 tolerant (61%) and 2 intolerant (25%) species, and the summer sample showed 3 tolerant (65%) and 1 intolerant (24%) species.

The station on the main stem of the Clarion River above the confluence of Riley Run (ERI-STA7) showed 2 tolerant (23%) and 2 intolerant (48%) species in the fall. The same station showed 3 tolerant (49%) and 1 intolerant (16%) species in the spring, and the summer sample showed 4 tolerant (36%) and 1 intolerant (40%) species.

The station on the main stem of the Clarion River just north of Ridgway (ERI-STA8) showed 4 tolerant (46%) and 1 intolerant (21%) species in the fall. The spring sample showed 2 tolerant (86%) and 1 intolerant (12%) species, while the summer sample showed 5 tolerant (54%) and 1 intolerant (29%) species.

Little Toby Creek (LTC01) showed only 1 tolerant (0%) and 2 intolerant (34%) species.

Spring Creek (SPCK01) showed similar results to Little Toby Creek with 1 intolerant (3%) and 2 intolerant (35%) species.

Millstone Creek showed an equal number of both tolerant and intolerant species, 3. The tolerant species represented 15% of the population while the intolerant species represented 44% of the population.

Clear Creek also showed equal numbers of tolerant and intolerant species as well, 3. Here, each represented 45% of the population.

The Cooksburg station (CR01) showed no tolerant species and 2 intolerant (2%) species.

Cathers Run had equal numbers of tolerant and intolerant species, 4. The tolerant species represented 19% of the population and the intolerant species represented 60% of the population.

The area below Piney Dam (Tailrace, CR01A) was sampled by Normandeau and the Fish and Boat Commission. The Fish and Boat Commission sampled two areas below the dam, CR01A-1 and CR01A-2. CR01A-1 showed 1 tolerant (14%) and no intolerant species. CR01A-2 showed 1 tolerant (6%) and 1 intolerant (19%) species. Normandeau found 4 tolerant (12%) and 3 intolerant (35%) species at this location.

Where the SR2007 bridge crosses the Clarion River (CR02), Fish and Boat Commission found 3 tolerant (25%) and no intolerant species. Normandeau found 3 tolerant (4%) and 2 intolerant (1%) species.

The Canoe Ripple site (CR03A) showed 2 tolerant (22%) species and no intolerant species when sampled by the Fish and Boat Commission, but 6 tolerant (48%) and 3 intolerant (12%) species were found when sampled by Normandeau.

The Callensburg station (CR03) showed 2 tolerant (7%) and 5 intolerant (37%) species.

The St. Petersburg station (CR04) showed no tolerant species and 4 intolerant (43%) species.

HABITAT ASSESSMENT

Habitat assessment was not implemented in the project, however, the Fish and Boat Commission in the Aquatic Biological Survey as well as Normandeau Associates performed habitat evaluations for the stations at which they sampled fish and macroinvertebrates. Habitat is an important aspect of fish/invertebrate communities and should definitely be considered when determining the species composition of an area of stream. It is important to keep in mind that some of the electrofishing and/or surber sampling could have been done in an area of poor habitat, yielding less fish/macros than expected according to the quality of the water. The habitat assessments are as follows:

Methods (Aquatic Biological Survey, 1999)

Stream habitat at all of the locations was scored and compared using the habitat assessment field data sheet, an updated version of the EPA Rapid Bioassessment Protocol. Existing habitat was evaluated at each site using 10 habitat parameters including epifaunal substrate/available cover, riffle quality, embeddedness, channel alteration, sediment deposition, frequency of riffles/and riparian vegetative zone. Habitat parameters were rated for deposition, frequency of riffles, and riparian vegetative zone on a scale of 0 to 20 (lowest to highest respectively) for specific criteria. Total habitat scores generally reflect habitat quality. The range for the protocol is as follows: 0-59 poor, 60-99 marginal, 100-159 suboptimal, and 160-200 optimal.

Results (Aquatic Biological Survey, 1999)

Habitat Evaluation for Station 01 on WBC01 scored in the high suboptimal range with a value of 153. Areas of concern include riparian vegetative zone width, scoring 12 out of 20, and channel alteration, scoring 14 out of 20. The riparian zone had a width of approximately 12 to 18 meters and human activities have impacted the zone slightly due to a bridge crossing at the upper reaches of the sample station. Some evidence of channelization was present near the bridge abutment.

Habitat Evaluation for FMR01 scored in the suboptimal range with a value of 134. Areas of concern include bank stability, scoring 10 out of 20, sediment deposition, scoring 12 out of 20, and frequency of riffles, scoring 12 out of 20. Bank stability was moderately unstable with 30 to 60% of the bank in the station reach having areas of erosion. Sediment deposition resulted in an increase in bar formation, mostly from gravel, sand and fine sediment and a moderate deposition was noted in the low gradient stream sections. Frequency of riffles included only two of the four required velocity/depth patterns and the distance between the two riffles was relatively large as per the EPA Rapid Bioassessment Protocol.

Habitat Evaluation for EBC01 scored in the suboptimal range with a value of 145. Areas of concern include bank stability, scoring 10 out of 20, sediment deposition, scoring 12 out of 20, and embeddedness, scoring 13 out of 20. Bank stability was moderately unstable with 30 to 60% of the bank in the station reach having areas of erosion and high potential for erosion during floods. Sediment deposition resulted in an increase in bar formation, mostly from gravel, sand and fine sediment and a moderate deposition was noted in the lower gradient areas of the stream. Gravel, cobble and boulder particles were estimated at 25-50% and surrounded by fine sediment.

Habitat Evaluation for ELK01 scored in the suboptimal range with a value of 125. Areas of concern include channel alteration, scoring 10 out of 20, embeddedness, scoring 13 out of 20 and riparian vegetative zone width, scoring 4 out of 20. Channelization was extensive with the station reach being affected. Gravel, cobble and boulder particles were partially (25-50%) surrounded by fine sediment as per the EPA Rapid Bioassessment Protocol for the embeddedness parameter. The width of the riparian zone was less than six meters and there were little signs of riparian vegetation due to the channelization of the stream section.

Habitat Evaluation for LT01 scored in the suboptimal range with a value of 147. Areas of concern include sediment deposition, scoring 12 out of 20, channel flow status, scoring 12 out of 20 and epifaunal substrate/available cover, scoring 12 out of 20. Sediment deposition resulted in an increase in bar formation, mostly from gravel, sand and fine sediment and a moderate deposition was noted in the slower moving areas of the stream. Channel flow was noted as having less than 75% of the available channel. Available cover had 30-50% mix of stable habitat that would be suitable for full colonization potential as per the EPA Rapid bioassessment Protocol for the embeddedness parameter.

Habitat Evaluation for SPCK01 scored in the suboptimal range with a value of 154. Areas of concern include channel flow, scoring 13 out of 20, sediment deposition, scoring 14 out of 20, and riparian vegetative zone width, scoring 14 out of 20. Channel flow was noted as having greater than 25% of the channel substrate exposed. Sediment deposition resulted in an increase in bar formation, mostly from gravel, sand and fine sediment and a moderate deposition was noted in the slower moving areas of the stream. The width of the riparian zone was approximately 12-18 meters and the zone has been minimally impacted by humans.

Discussion (Aquatic Biological Survey, 1999)

Results of the habitat assessment indicated scores ranging from 125 (ELK01) to 154 (SPCK01). Elk Creek and Five Mile Run were noted as being in the low suboptimal range, while the other four stations scored in the mid to high suboptimal range. Elk Creek scored the lowest of all station samples due to the locations in the town of Ridgway, PA. Various habitat improvement projects could be beneficial at all sampling locations for fish, macroinvertebrates and habitat improvement purposes such as random boulder placement and bottom scouring devices.

<u>Normandeau Associates, Inc.</u>

Habitat Assessment Methods (Normandeau Associates, Inc., Report on Fish, 2000)

The quality of instream and riparian habitat influences the composition of aquatic communities. Physical habitat forms a template upon which biological communities are superimposed and, when poor, constrains biotic potential. Habitat assessment is defined as the evaluation of the structure of the surrounding physical habitat. At the Clarion River a general assessment is defined as the evaluation of the structure of the surrounding physical habitat. At the Clarion River a general assessment approach was used based on visual observation and scoring of 10 habitat parameters (US EPA 1997). Two basic approaches are used, one for low gradient streams and another for high gradient streams

(Clarion River). Some parameters are used for both high and low gradient streams and others are specific for one stream type. The habitat parameters are as follows:

1. Epifaunal Substrate/Available Cover – This parameter measures the amount and variety of natural structures (rocks, logs, fallen trees, branches, undercuts) in the channel available for colonization. A wide variety of substrate and cover types is optimal.
2. Riffle Quality – In high gradient streams this parameter refers to the amount of high quality substrate (cobble and gravel) available in riffle areas (microhabitat diversity).
3. Embeddedness – In streams, embeddedness refers to the extent to which rocks are covered with silt. As rocks become embedded, interstitial surface area available for colonization is reduced.
4. Channel Alteration – This parameter is a measure of man-made changes in the shape of the stream channel due to the construction of culverts, dams, and bridges or due to flood control and irrigation projects. As a stream becomes altered fewer natural habitats are available.
5. Sediment Deposition – Sediment deposition measures the amount of silt and clay that has accumulated in pools and the resulting changes in the stream bottom. Silted stream bottoms are unstable and less suitable for colonization.
6. Frequency of Riffles (or bends)/Velocity-Depth Combinations – This parameter measures the heterogeneity of a stream system. Riffles and bends are a source of high quality habitat so a large number of them is preferred in high gradient streams.
7. Channel Flow Status – The degree to which a channel is filled with water determines its' flow status. When flow is low, rocks and logs that provide habitat are exposed, limiting habitat quantity.
8. Bank Vegetative Protection – Stream banks well covered with vegetation are held in place by root systems. Riparian plants also provide shading and cover for aquatic communities.
9. Bank Stability – This parameter measures whether the stream banks are eroded. Steep banks are more prone to erosion.
10. Riparian Vegetative Zone Width – This parameter measures the width of the vegetative belt on the stream banks. Streams with a wide riparian buffer are less prone to erosion and nutrient input due to runoff.

In the field, each parameter was given a score ranging between 0 and 20 and the scores are then summed. Scores for individual parameters were interpreted as follows: 0-5 (poor); 6-10 (marginal); 11-15 (suboptimal); and 16-20 (optimal). The highest possible total score for a site is 200. Site scores were interpreted as: 0-47 (poor); 60-100 (marginal); 116-150 (suboptimal); and 160-200 (optimal). Scores falling between these ranges were given two descriptors (e.g., marginal/suboptimal for a score of 110).

In the Clarion River scores for the downstream sites were compared to a control location in order to determine if habitat differences (rather than differences in water quality) produced changes in the benthic macroinvertebrate communities upstream versus downstream from Piney Dam. Therefore, in addition to the descriptors listed above describing habitat quality, an additional descriptor was given to each downstream station based on their degree of habitat similarity to the upstream control. Descriptors are simply based on the percent of the downstream scores to the control score and are as follows (US

EPA 1989); 0-58 percent (non-supporting); 60-73 percent (partially supporting); 75-88 percent (supporting); and 90-100 percent (comparable).

Habitat Assessment Results (Normandeau Associates, Inc., Report on Fish, 2000)

The best habitat was observed at the control location at Cooksburg and was assigned a site score of 164 (optimal). Scores at the downstream stations ranged from 118 (suboptimal) at Piney Bridge to 153 and 154 (suboptimal/optimal) at Canoe Ripple and Callensburg, respectively. Relative to the control site, the Canoe Ripple and Callensburg stations were determined to have comparable habitat (>90% of the control score). The other stations were either supporting (75 to 88%) or partially supporting (60 to 73%).

Most of the stream bottom in the Clarion River included a large component of cobble and boulder that armored the substrate and provided refuge. Other cover types such as fallen trees and undercuts were less prevalent. At Cooksburg a suboptimal score was given for the parameter "epifaunal substrate/available cover". Downstream scores for this parameter were all assigned within the marginal range. Because the riffle substrates at all stations were comprised almost entirely of stable boulder, cobble, and gravel, site scores for "riffle quality" were assigned to the optimal range at all stations except Piney Bridge. "Riffle quality" at Piney Bridge was considered to be marginal.

The scores describing "embeddedness" illustrated the most obvious discrepancy between the control site and downstream stations. A rust colored deposit, typically seen in streams impacted by AMD, inundated virtually the entire stream bottom at the downstream stations but was not observed at Cooksburg. Thus, the "embeddedness" parameter was given a score in the excellent range at Cooksburg. All downstream scores for "embeddedness" were assigned to the poor range. It appeared that differences in the invertebrate communities, upstream versus downstream from Piney Dam, would be largely attributable to the presence of this deposit.

Other than for some bridge crossings, the stream channel throughout the length of the study area was unaltered. The parameter assessing "channel alteration" was given a score in the optimal range at all stations. Except for the rust colored deposit noted above, the stream channel was largely free of the type of sedimentation (bed load) that, through transport, results in the formation of islands or point bars. Thus, the parameter termed "sediment deposition" was scored in the optimal or suboptimal range at all stations. Much of the habitat throughout the study area consisted of a sequence of swiftly flowing riffles. This was the case at all stations except Piney Bridge. The parameter termed "frequency of riffles/velocity-depth combination" was given a score in the optimal or suboptimal range at all stations except Piney Bridge. Piney Bridge was scored in the poor range. A minimum flow release of 100 cfs from Piney Dam augmented contributions from groundwater and tributary sources throughout the study area. Thus, the stream channel remained well watered at all stations except Tailrace, nearest Piney Dam. "Channel flow status" was rated as marginal at Tailrace and optimal at the other stations.

All parameters used to evaluate the amount of vegetative cover and the general condition of the stream banks were rated in the suboptimal or optimal ranges at all stations. Both banks were well-vegetated, mostly with trees and/or herbaceous plants, throughout the study area. As a result, the banks were relatively free of erosion. At most locations the width of the riparian zone ranged between 6 and 14 m (20 to 46 ft). At a few locations riparian zones were slightly impacted by residential development. Consequently, the

parameter evaluating "riparian vegetative zone width" was given a score in either the suboptimal or marginal ranges.

Discussion (Normandeau Associates, Inc., Report on Fish, 2000)

The results given for most of the habitat parameters indicated that a healthy and robust invertebrate community should be colonizing the Clarion River both above and below Piney Dam. In general, the physical habitat attributes within the river channel are very good. The Clarion River is at present free of sedimentation caused by an extensive history of deforestation that can be dated back to the 1880's. However, it cannot be de-emphasized that the section of the study area downstream from Piney Dam still shows obvious impact (the substrate remains embedded with rust colored sediment) from the areas' legacy of strip mining. It appeared likely that this condition would produce a repressed invertebrate community in the lower Clarion River.

MACRO SAMPLING METHODS AND RESULTS

Pollution sensitive taxa include the Ephemeroptera, Plecoptera and Trichoptera (EPT) orders. Chironomidae are generally considered pollution tolerant because they inhabit a wide range of chemical and physical water quality conditions. A skewed population having more Chironomidae relative to the number of EPT may indicate environmental stress. Generally, EPT taxa are more abundant in streams with good water quality. It is important, however, to keep in mind that the habitat conditions also determine the species composition at any given location.

Clarion University

Macro Methods

The invertebrate sampling was done using two kick net samples per stream (60 seconds of kicking, 1m x 1m area) and five surber samples per stream (1 square foot of bottom area for each). Invertebrates were sampled at a station 100-500 m from the mouth of the tributary. Both kicknets and surber samples were utilized to assess the invertebrate communities. Numbers for total kicknet samples are a composite of the two samples taken at each site. Five surber samples were taken at each site and the data was combined to calculate the metrics.

Macro Results

The data show that each stream has a healthy invertebrate population. Combined taxa richness values were very promising for each stream (range=35-59). Each stream also showed relatively high values for the % EPT metric (range=50.25%-86.71%), which is an indication of the amount of pollution sensitive taxa within the sample. The percent Chironomidae (pollution tolerant taxa) was less than the percent EPT taxa in all samples. All of the macro data collected by Clarion University can be found in Table C-1.

PA Fish & Boat Commission

Macro Methods (Aquatic Biological Survey, 1999)

Benthic macroinvertebrates were sampled quantitatively and qualitatively. Six quantitative samples were taken with a surber 1 ft^2 ($0.1m^2$) sampler (mesh size 1024 u) in riffle areas. One qualitative sample was collected using a $1m^2$ kick screen in different stream habitats (pool, run, and riffle). Each individual sample was placed in a labeled plastic bag and preserved in ethanol. The samples were taken to the laboratory, separated from debris, counted and identified to the lowest taxonomic level (genus where possible) using available taxonomic keys. The Shannon-Weaver diversity index (d) takes into account the number of taxa encountered and the abundance of different taxa affected by pollution in a stream system. Diversity values (d) from 0-1 are indicative of severely degraded systems, values of 1-3 indicate moderate impacts and values of 3-4 show a relatively unpolluted system. Numbers of benthic macroinvertebrates for each individual

surber sample will be on file with the PFBC if they are needed for future statistical calculations.

Macro Results (Aquatic Biological Survey, 1999)

Station 01: West Branch of the Clarion River Station 01 (WBC01)

The West Branch of the Clarion River is classified as a cold water fishery (CWF) by the Commonwealth of Pennsylvania, Pennsylvania Code, Title 25 Environmental Protection, Department of Environmental Protection Chapter 93 Water Quality Standards.

Benthic macroinvertebrates at WBC01 revealed 31 taxa, a density of 723 EPT/m2, and a diversity (d) of 3.434. These results suggest a relatively unimpacted system. WBC01 revealed an EPT percentage of 68.8% compared to a Chironomidae percentage of 11.0%. This station contained 20 taxa being of the pollution sensitive type (Ephemeroptera, Plecoptera and Trichoptera). Appendix C shows the total numbers of all the individuals collected at all sampling locations. This table also shows the calculated percentages of EPT and Chironomids at the sample locations. Results of the qualitative sampling had 23 taxa and 363 individuals being counted. Pollution sensitive organisms (EPT) comprised 60.9% of the results with 14 taxa being identified. Macro data for this station can be found in Table C-2.

Station 02: Five Mile Run Station 01 (FMR01)

Five Mile Run is classified as a high quality cold water fishery (HQ-CWF) in the Commonwealth of Pennsylvania, Pennsylvania Code, Title 25 Environmental Protection, Department of Environmental Protection Chapter 93 Water Quality Standards.

Benthic macroinvertebrates at FMR01 revealed 25 taxa, a density of 631 individuals/m^2, and a diversity (d) of 3.22. These results suggest a relatively unimpacted system. FMR01 revealed an EPT percentage of 30.4% compared to a Chironomidae percentage of 67.7%. This station contained 20 taxa being of the pollution sensitive type (Ephemeroptera, Plecoptera and Trichoptera). Appendix C shows the total numbers of all the individuals collected at all sampling locations. The table also shows the calculated percentages of EPT and Chironomids at the sample locations. Results of the qualitative sampling had 10 taxa and 76 individuals being counted. Pollution sensitive organisms (EPT) comprised 70.0% of the results with 7 taxa being identified. Macro data for this station can be found in Table C-2.

Station 03: East Branch of the Clarion River Station 01 (EBC01)

The East Branch of the Clarion River is classified as a high quality cold water fishery (HQ-CWF) by the Commonwealth of Pennsylvania, Pennsylvania Code, Title 25 Environmental Protection, Department of Environmental Protection Chapter 93 Water Quality Standards.

Benthic macroinvertebrates at EBC01 revealed 13 taxa, a density of 94 individuals/m^2, and a diversity (d) of 2.57. These results suggest a moderately impacted system. EBC01 revealed an EPT percentage of 92.9% compared to a Chironomidae percentage of 3.6%. This station contained 10 taxa of the pollution sensitive type (Ephemeroptera, Plecoptera and Trichoptera). Appendix C shows the total numbers of all

the individuals collected at all sampling locations. The table also shows the calculated percentages of EPT and Chironomids at the sample locations. Results of the qualitative sampling had 12 taxa and 97 individuals. Pollution sensitive organisms (EPT) comprised 66.7% of the results with 8 taxa. Macro data for this station can be found in Table C-2.

Station 04: Elk Creek Station 01 (ELK01)

Elk Creek is classified as a cold water fishery (CWF) by the Commonwealth of Pennsylvania, Pennsylvania code, Title 25 Environmental Protection, Department of Environmental Protection Chapter 93 Water Quality Standards.

Benthic macroinvertebrates at ELK01 revealed 17 taxa, a density of 3180 individuals/m^2, and a diversity (d) of 2.833. These results suggest a system that has been impacted slightly by pollution. ELK01 revealed an EPT percentage of 6.7% compared to a Chironomidae percentage of 88.0%. This station contained 13 taxa of the pollution sensitive type (Ephemeroptera, Plecoptera and Trichoptera). Appendix C shows the total numbers of all the individuals collected at all sampling locations. The table also shows the calculated percentages of EPT and Chironomids at the sample locations. Results of the qualitative sampling had 14 taxa and 888 individuals. Pollution sensitive organisms (EPT) comprised 64.3% of the results with 9 taxa. Macro data for this station can be found in Table C-2.

Station 05: Little Toby Creek Station 01 (LT01)

Little Toby Creek is classified as a cold water fishery (CWF) by the Commonwealth of Pennsylvania, Pennsylvania Code, Title 25 Environmental Protection, Department of Environmental Protection Chapter 93 Water Quality Standards.

Benthic macroinvertebrates at LT01 revealed 13 taxa, a density of 94 individuals/m^2, and a diversity (d) of 2.57. These results suggest a system that is moderately impacted even though LT01 revealed an EPT percentage of 77.7% compared to a Chironomidae percentage of 3.6%. This station contained 10 taxa of the pollution sensitive type (Ephemeroptera, Plecoptera, and Trichoptera) yet the majority of the species were contained within the order Trichoptera, which indicates some environmental stress. Appendix C shows the total numbers of all the individuals collected at all sampling location. This table also shows the calculated percentages of EPT and Chironomids at the sample locations. Results of the qualitative sampling had 10 taxa and 612 individuals. Pollution sensitive organisms (EPT) comprised 60.0% of the results with 6 taxa. Once again the qualitative samples shows that the majority of the individuals collected at sampling location were within the order of Trichoptera. Macro data for this station can be found in Table C-2.

Station 06: Spring Creek Station 01 (SPCK01)

Spring Creek is classified as a high quality cold water fishery (HQ-CWF) by the Commonwealth of Pennsylvania, Pennsylvania Code, Title 25 Environmental Protection, Department of Environmental Protection Chapter 93 Water Quality Standards.

Benthic macroinvertebrates at SPCK01 revealed 30 taxa, a density of 571 individuals/m^2, and a diversity (d) of 3.40. These results suggest a relatively unimpacted system. SPCK01 revealed an EPT percentage of 62.4% compared to a Chironomidae percentage of 3.8%. This station contained 21 taxa of the pollution sensitive type

(Ephemeroptera, Plecoptera and Trichoptera). Appendix C shows the total numbers of all the individuals collected at all sampling locations. The table also shows the calculated percentages of EPT and Chironomids at the sample locations. Results of the qualitative sampling had 25 taxa and 231 individuals. Pollution sensitive organisms (EPT) comprised 68.0% of the results with 17 taxa. Macro data for this station can be found in Table C-2.

Discussion (Aquatic Biological Survey, 1999)

Diversities for three of the six benthic macroinvertebrate monitoring sites indicated an impaired aquatic system. Station 01 located on Little Toby Creek had the lowest diversity of all stations with a value of 2.49. The East Branch of the Clarion River and Elk Creek also scored in the 2.50 to 2.90 range suggesting a moderately impacted system. This could be due to mine drainage in the upper reaches of Little Toby Creek and East Branch of the Clarion River watersheds. Elk Creek results could be from a lack of habitat and water quality (high metal concentrations).

Macro Methods (Fish & Boat Commission Data, 1998)

Benthic macroinvertebrates were sampled at CR01, CR01A, and CR03A in 1998. Six surber net samples were collected at each site. The samples were preserved in isopropyl alcohol and returned to the laboratory for sorting and identification.

Macro Results

Based on six Surber net samples, macro results yielded a total of 19 taxa captured at Cooksburg (CR01) on August 27, 1998. A total of 456 individuals were collected, 362 of which were EPT taxa representing 79.4% and 9 of the 19 taxa. The number of Chironomidae collected was considerably less with 37 individuals representing 8.1% of the total captured.

Benthic macroinvertebrates collected in six Surber net samples from the Clarion River in the vicinity of the USGS gaging station downstream of Piney Dam (CR01A) on August 26, 1998 yielded a total of 369 individuals representing 9 taxa. EPT taxa comprised 6 of the 9 total taxa with 330 individuals comprising 89.4% of the population. Chironomidae comprised 9.2% of the population with 34 individuals.

At the SR 3007 bridge at Canoe Ripple (CR03A), six Surber net samples yielded a total of 201 individuals representing 7 taxa. EPT taxa comprised 85.6% of the population with 172 individuals representing 4 taxa. However, all of the EPT taxa belonged to the Trichoptera order. Chironomidae taxa comprised 12.9% of the total captured with 26 individuals. All of the macro data collected for this study can be found in Table C-3.

<u>Ecological Restoration, Inc.</u>

Macro Methods (Ecological Restoration, Inc., 1998)

Ecological Restoration, Inc. prepared a four-part thermal variance study for Willamette Industries, Inc., which is relevant to this study and will be used for comparison. Nine stations were sampled including East Branch, West Branch, and 7 stations below Johnsonburg.

Benthic macroinvertebrates were collected and analyzed from each sampling point during the sampling event. Organisms were identified to lowest practical taxa. At each station, the combined riffle and CPOM samples consisted of 10 subsamples.

Macro Results

Sampling occurred at all nine stations in November 1998 (Fall), March 1999 (Spring), July 1999 (Summer), and October 1999 (Fall). The results will be presented according to season in order to show the pattern of invertebrates as you move downstream. The data is based on 10 subsamples per station.

The sampling that was done in November 1998 and October 1999 (Fall) yielded the following combined results and the data can be found in Tables C-4 and C-7.

At all stations sampled in the Fall, % EPT (pollution sensitive taxa = Ephemeroptera, Plecoptera, Trichoptera) taxa was greater than % Chironomidae (pollution tolerant taxa). Also, the % EPT at all stations was greater than 50%.

Station 1, located on the West Branch of the Clarion River, yielded a total of 70 taxa representing 9924 individuals. EPT taxa (pollution sensitive) represented 56.9% of the population. The Chironomidae (pollution tolerant) taxa represented 1.9% of the population. Density per subsample was 496 individuals/.1m^2.

Station 2, located on the East Branch at Bendigo State Park, yielded a total of 51 taxa representing 2920 individuals. EPT taxa represented 57.6% of the population compared to the Chironomidae taxa, which represented 19.9% of the population. Density per subsample was 146 individuals/.1m^2.

Station 3, located just below the confluence of the East and West Branches yet upstream of Willamette's discharge, yielded a total of 63 taxa representing 8365 individuals. EPT taxa represented 63.1% of the population compared to the Chironomidae taxa, which represented 7.4% of the population. Density per subsample was 418 individuals/.1m^2.

Station 4, located just below Willamette's discharge, yielded a total of 53 taxa representing 6626 individuals. EPT taxa represented 68.5% of the population compared to the Chironomidae taxa, which represented 15.5% of the population. Density per subsample was 331 individuals/.1m^2.

Station 5, located just above the discharge from Johnsonburg's Municipal Wastewater Treatment Plant discharge, yielded a total of 64 taxa representing 6892 individuals. EPT taxa represented 66.8% of the population compared to the Chironomidae taxa, which represented 14.3% of the population. Density per subsample was 345 individuals/.1m^2.

Station 6, located below Johnsonburg's Municipal Wastewater Treatment Plant discharge, yielded a total of 74 taxa representing 16,209 individuals. EPT taxa represented 68.6% of the population compared to the Chironomidae taxa, which represented 5.5% of the population. Density per subsample was 810 individuals/.1m^2.

Station 7, located above the confluence of Riley Run, yielded a total of 57 taxa representing 11,727 individuals. EPT taxa represented 65.2% of the population compared to the Chironomidae taxa, which represented 4.7% of the population. Density per subsample was 586 individuals/.1m^2.

Station 8, located on the main stem of the river just north of the Ridgway City limits, yielded a total of 75 taxa representing 7712 individuals. EPT taxa represented 57.2% of the population compared to the Chironomidae taxa, which represented 10.0% of the population. Density per subsample was 386 individuals/.1m^2.

Station 9, located at the mouth of Powers Run, yielded a total of 44 taxa representing 3827 individuals. EPT taxa represented 68.3% of the population compared to the Chironomidae taxa, which represented <1.0% of the population. Density per subsample was 191 individuals/.1m^2. The density at this location is considerably less than the other stations due to the fact that the sample was taken in the tributary as opposed to the other samples that were taken in the river.

The sampling that was done in March 1999 yielded the following results (data can be found in Table C-5):

Station 1 yielded a total of 44 taxa representing 2310 individuals. 27 of the taxa were EPT taxa representing 71.95% of the population compared to the Chironomidae taxa, which represented 4.24% of the population. Density per subsample was 231 individuals/.1m^2.

Station 2 yielded a total of 39 taxa representing 3379 individuals. 18 of the taxa were EPT taxa representing 72.80% of the population compared to the Chironomidae taxa, which represented 11.48% of the population. Density per subsample was 338 individuals/.1m^2.

Station 3 yielded a total of 33 taxa representing 1704 individuals. 20 of the taxa were EPT taxa representing 74.35% of the population compared to the Chironomidae taxa, which represented 10.45% of the population. Density per subsample was 170 individuals/.1m^2.

Station 4 yielded a total of 33 taxa representing 1867 individuals. 15 of the taxa were EPT taxa representing 50.99% of the population compared to the Chironomidae taxa, which represented 32.19% of the population. Density per subsample was 187 individuals/.1m^2.

Station 5 yielded a total of 38 taxa representing 5589 individuals. 14 of the taxa were EPT taxa representing 63.95% of the population compared to the Chironomidae taxa, which represented 22.28% of the population. Density per subsample was 559 individuals/.1m^2.

Station 6 yielded a total of 21 taxa representing 924 individuals. 11 of the taxa were EPT taxa representing 62.45% of the population compared to the Chironomidae taxa, which represented 22.62% of the population. Density per subsample was 92 individuals/.1m^2.

Station 7 yielded a total of 47 taxa representing 7987 individuals. 22 of the taxa were EPT taxa representing 49.22% of the population compared to the Chironomidae taxa, which represented 38.41% of the population. Density per subsample was 799 individuals/.1m^2.

Station 8 yielded a total of 51 taxa representing 6981 individuals. 28 of the taxa were EPT taxa representing 65.51% of the population compared to the Chironomidae taxa, which represented 20.07% of the population. Density per subsample was 698 individuals/.1m^2.

Station 9 yielded a total of 21 taxa representing 512 individuals. 11 of the taxa were EPT taxa representing 50.98% of the population compared to the Chironomidae taxa, which represented 27.93% of the population. Density per subsample was 51 individuals/.1m^2.

The sampling that was done in July 1999 yielded the following results (data can be found in Table C-6):

Station 1 yielded a total of 54 taxa representing 2085 individuals. 33 of the taxa were EPT taxa representing 70.89% of the population compared to the Chironomidae taxa, which represented 6.19% of the population. Density per subsample was 209 individuals/.1m^2.

Station 2 yielded a total of 38 taxa representing 2177 individuals. 22 of the taxa were EPT taxa representing 67.75% of the population compared to the Chironomidae taxa, which represented 16.72% of the population. Density per subsample was 218 individuals/.1m^2.

Station 3 yielded a total of 40 taxa representing 1671 individuals. 20 of the taxa were EPT taxa representing 69.96% of the population compared to the Chironomidae taxa, which represented 3.65% of the population. Density per subsample was 167 individuals/.1m^2.

Station 4 yielded a total of 33 taxa representing 2699 individuals. 16 of the taxa were EPT taxa representing 68.51% of the population compared to the Chironomidae taxa, which represented 13.45% of the population. Density per subsample was 270 individuals/.1m^2.

Station 5 yielded a total of 53 taxa representing 3913 individuals. 28 of the taxa were EPT taxa representing 75.54% of the population compared to the Chironomidae taxa, which represented 11.45% of the population. Density per subsample was 391 individuals/.1m^2.

Station 6 yielded a total of 34 taxa representing 1079 individuals. 15 of the taxa were EPT taxa representing 41.43% of the population compared to the Chironomidae taxa, which represented 15.11% of the population. Density per subsample was 108 individuals/.1m^2.

Station 7 yielded a total of 52 taxa representing 2557 individuals. 22 of the taxa were EPT taxa representing 49.78% of the population compared to the Chironomidae taxa, which represented 13.96% of the population. Density per subsample was 256 individuals/.1m^2.

Station 8 yielded a total of 51 taxa representing 3596 individuals. 26 of the taxa were EPT taxa representing 63.21% of the population compared to the Chironomidae taxa, which represented 11.35% of the population. Density per subsample was 360 individuals/.1m^2.

Station 9 yielded a total of 40 taxa representing 2581 individuals. 22 of the taxa were EPT taxa representing 60.83% of the population compared to the Chironomidae taxa, which represented 2.98% of the population. Density per subsample was 258 individuals/.1m^2.

Normandeau Associates, Environmental Consultants

In support of the relicensing of Piney Hydroelectric Project, Normandeau Associates prepared a report on water quality studies of the Clarion River as well as fish and aquatic macroinvertebrate communities of Piney Lake and the Clarion River.

Macro Methods

Benthic samples in the Clarion River were obtained in riffle areas with a square-foot Surber sampler (0.0929 m^2). After positioning the sampler, the bottom material was disturbed to a depth of 4 in (10 cm) allowing the current to wash all dislodged organisms into the net. Six replicates were taken at each sampling site. Replicate contents were preserved in 70 % isopropanol in labeled containers, and subsequently sorted, identified, and enumerated in the same fashion as for the Ponar samples.

Macroinvertebrate sample data were reduced to six ecological parameters described in US EPA (1989) and Brower and Zar (1977), to facilitate spatial/temporal analyses. These parameters are: 1) community density and total number of taxa (richness), 2) the number of pollution sensitive (EPT) taxa, 3) the percent contribution of the dominant taxon, 4) Shannon's measures of diversity and evenness, 5) Morisita's index of community similarity, and 6) Hilsenhoff's index of water quality.

The density and total number of taxa observed in a sample provides an estimate of the size of a community. Here, density is expressed as the number of specimens per m^2. Samples with large numbers of taxa are considered to be rich. The number of EPT taxa is determined by totaling the taxa within the mayfly (Ephemeroptera), stonefly (Plecoptera), and caddisfly (Trichoptera) insect orders. Taxa within these orders generally are considered intolerant of most forms of pollution and are poorly represented in samples from physically or chemically stressed environments. The percent contribution of the dominant taxon to the total number of organisms uses the abundance of the dominant taxon as an indication of community balance. A community dominated by relatively few taxa would indicate environmental stress. Typically riverine environments with diverse boulder/cobble/gravel substrates and swifter current velocity produce denser, richer, and more balanced communities than lakes do, where substrates tend to be more homogenous.

Brillouin's diversity and evenness are descriptive statistics that compare the distribution of individuals among all taxa observed in a sample. Maximum diversity is obtained when the numbers of individuals among the taxa in a sample are evenly distributed. Diversity values tend to vary according to how samples are processed. However, for this collection values less than 1.50 (base e) will be considered low, whereas diverse communities should exhibit values greater than 2.00. Evenness provides a comparison between a sample's actual diversity with the maximum diversity attainable by that sample if the number of individuals in each taxon was the same (relative diversity). Values range between 0.00 and 1.00. Samples with values close to 1.00 represent a community in which the individual taxa are optimally distributed. Diversity indices and evenness values can be used to evaluate a community's ability to continue as a functional entity in the presence of pollution stress and to recover once pollution problems are corrected. Morisita's index was used to compare invertebrate communities at the upstream control location at Cooksburg in the Clarion River with the five locations established

downstream from Piney Dam. The index measures the degree of similarity between sample pairs. It compares the presence and relative abundance among taxa in discrete samples and also produces a value between 0.00 and 1.00. Samples that generate values close to 1.00 are considered to be nearly identical.

Hilsenhoff's water quality index is a summary measure of water quality. To calculate the index each taxon is given a tolerance value ranging between 0 and 10 that increases as water (and in many cases sediment) quality degrades. The tolerance value is then multiplied by the number of individuals for each taxon and the products summed. This sum is divided by the total number of specimens in the sample to produce the index. Index values range from 0.00 to 10.00 and are interpreted as follows (Hilsenhoff 1987):

Biotic Index	Water Quality
0.00-3.50	Excellent
3.51-4.50	Very Good
4.51-5.50	Good
5.51-6.50	Fair
6.51-7.50	Fairly Poor
7.51-8.50	Poor
8.51-10.0	Very Poor

Macro Results (Normandeau Associates, Inc., Report on Fish..., 2000)

Totals of 7,284 specimens and 60 taxa were analyzed from 96 surber replicates taken from the Clarion River. Mean density for all collections from the upstream control site at Cooksburg was 1,066 per m^2 (SE=201) (six replicates combined). At the five sampling locations downstream from Piney Dam standing crop density averaged 758 (SE=314) per m^2, slightly lower than that at Cooksburg.

At Cooksburg the identity of the dominant taxon changed from season to season. In the spring midges within the subfamily Orthocladinae were most abundant representing 19.6% of the sample total. Orthoclads are a large and diverse group of midges that occupy a variety of lentic and lotic habitats and are usually common in rivers where they form an important food item for young fishes. As a group they tend to prefer areas with swifter current and cobble/gravel substrate to a greater extent than do members of other midge subfamilies. The summer collection was dominated by a particularly dense "bloom" of caddisflies in the genus *Brachycentrus* that represented 61.8% of the cumulative total. *Brachycentrus* is a pollution sensitive caddisfly (tolerance index = 1) that are often locally abundant in large rivers. They are a case building form, restricted to running waters. They feed by orienting their case in an upstream direction and intercepting food items (diatoms, filamentous algae, fine detritus, and smaller invertebrates) by "sweeping" them inward with their legs. Thus, functionally *Brachycentrus* are active filterers but are also known to graze on periphytic algae. In the autumn, midges in the tribe Chironomini were the dominant taxon and comprised 19.2% of the collection. Chironomini are also a diverse group of midges, adapted to a variety of habitats.

An abrupt change in community composition occurred downstream from Piney Dam where net-spinning caddisflies in the genera *Hydropsyche* and *Macrostemum* were most frequently the dominant taxon. *Hydropsyche* and *Macrostemum* were the dominants at the Tailrace, Canoe Ripple, and Callensburg stations for all nine seasonal collections, where

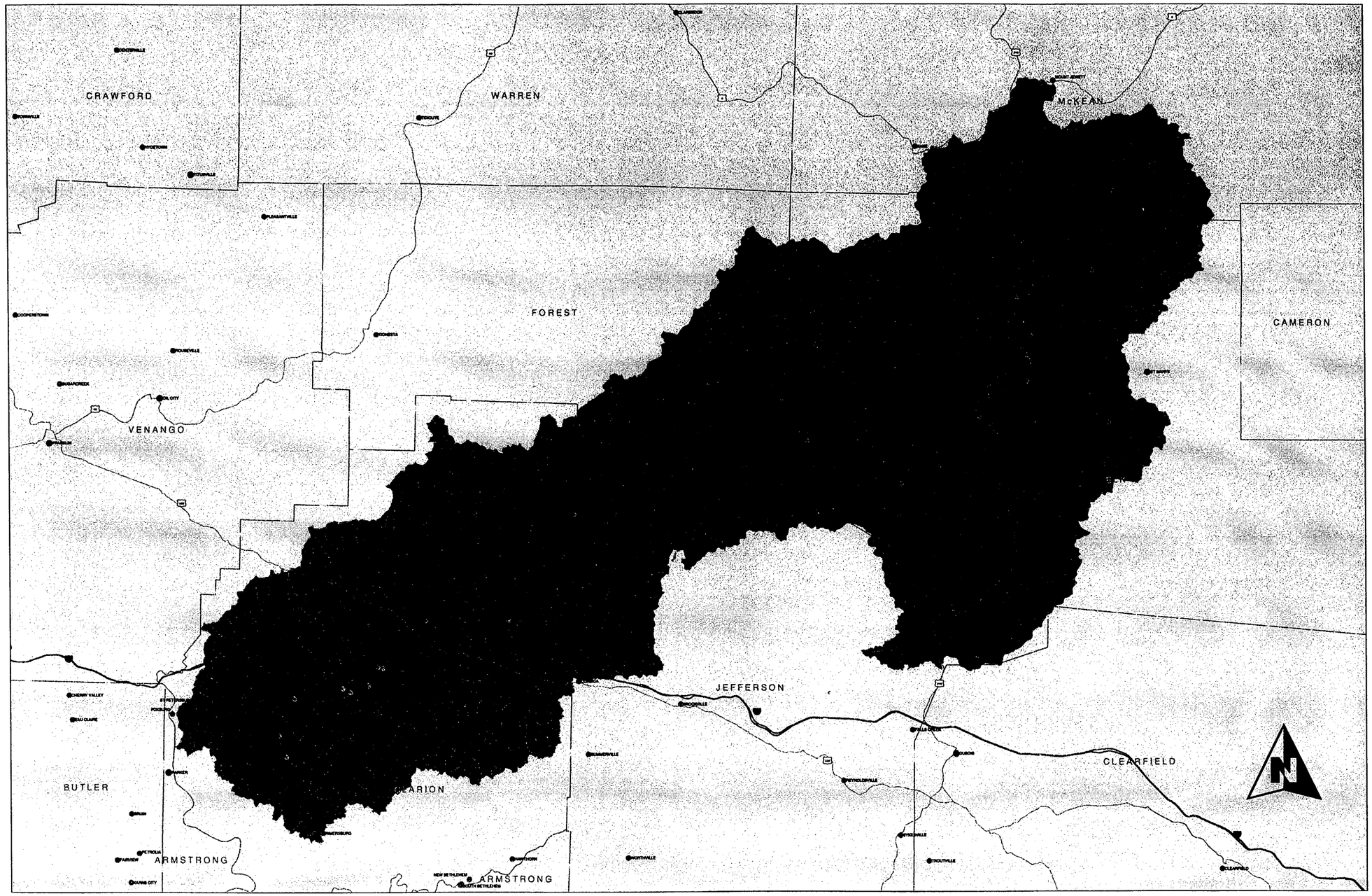
they represented from 32.9% to 62.2% of the sample totals. At the Piney Bridge station aquatic earthworms in the family Lumbriculidae were most common in the spring (33.3%) and sideswimmers or scuds in the genus *Crangonyx* were dominant in summer (19.9%) and autumn (33.8%) collections. Lumbriculids were dominant (51.4%) in the single collection taken from the St. Petersburg station in the autumn. Note that in instances where Lumbriculidae was the dominant taxon, standing crop densities were particularly low.

The epibenthic taxa *Hydropsyche* and *Macrostemum* are passive filtering collectors that construct fine-mesh silken capture nets on the surface of coarse substrate particles in areas of swift current. Food items washed into the net adhere to the silk strands where they are harvested by the insect. From a functional perspective the two genera are essentially the same although it is likely that there is some degree of resource partitioning among them. *Hydropsyche* are omnivores. *Macrostemum* build nets with a much smaller mesh size and feed upon fine particulate matter, phytoplankton, and bacteria. Notably, *Macrostemum* are pollution sensitive with a tolerance index of 3. *Crangonyx*, common at the Piney Bridge station, are omnivores with a tolerance index of 4 and require well-oxygenated water. They also prefer waters with low carbonate concentrations.

Table C-7 shows data collected in round 1 (spring), Table C-8 shows data collected in round 2 (summer), and Table C-9 shows data collected in round 3 (fall).

Clarion River Basin

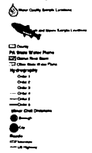
Assessment Map

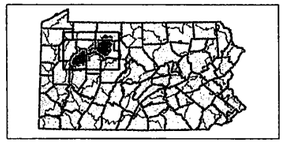


Project funded by Pennsylvania Department of Conservation and Natural Resources

1:12,000

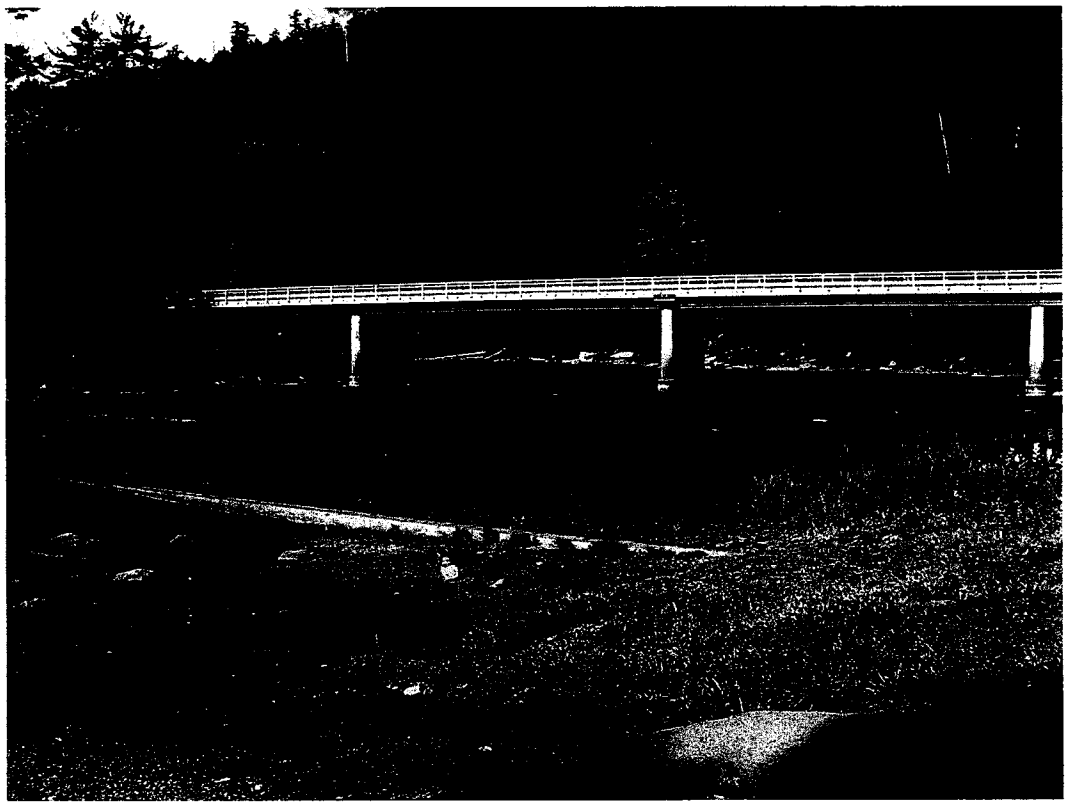
0 2.5 5 10 15 20 Miles



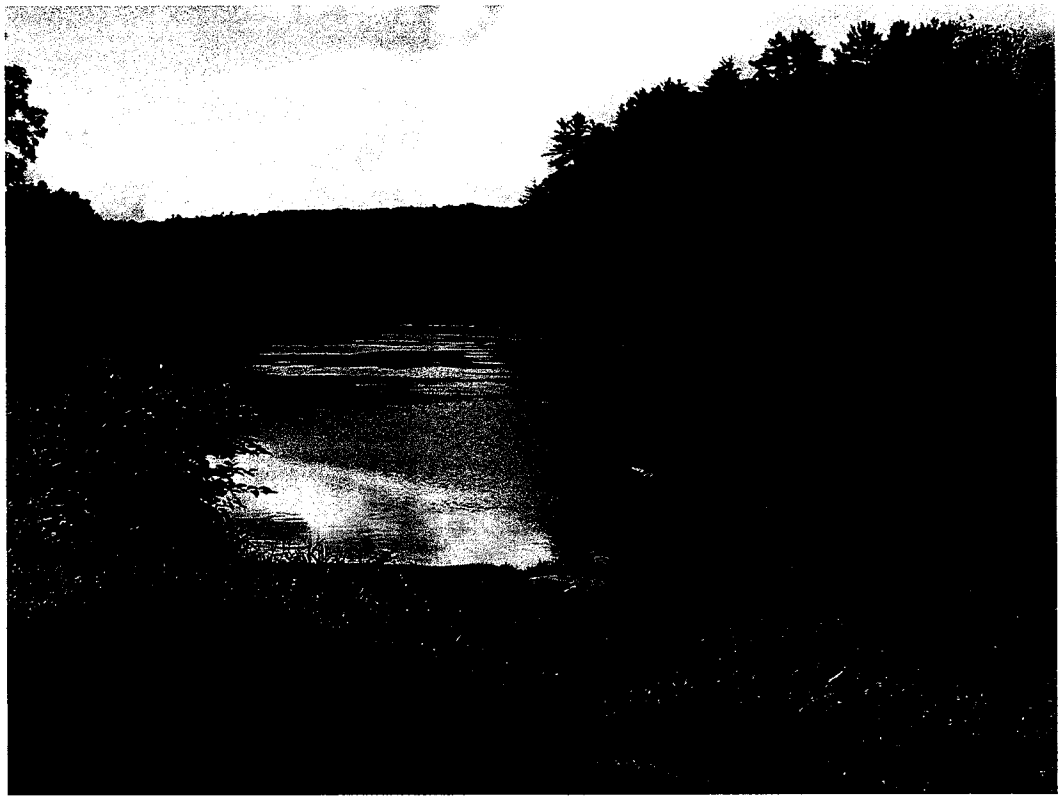


Appendix F

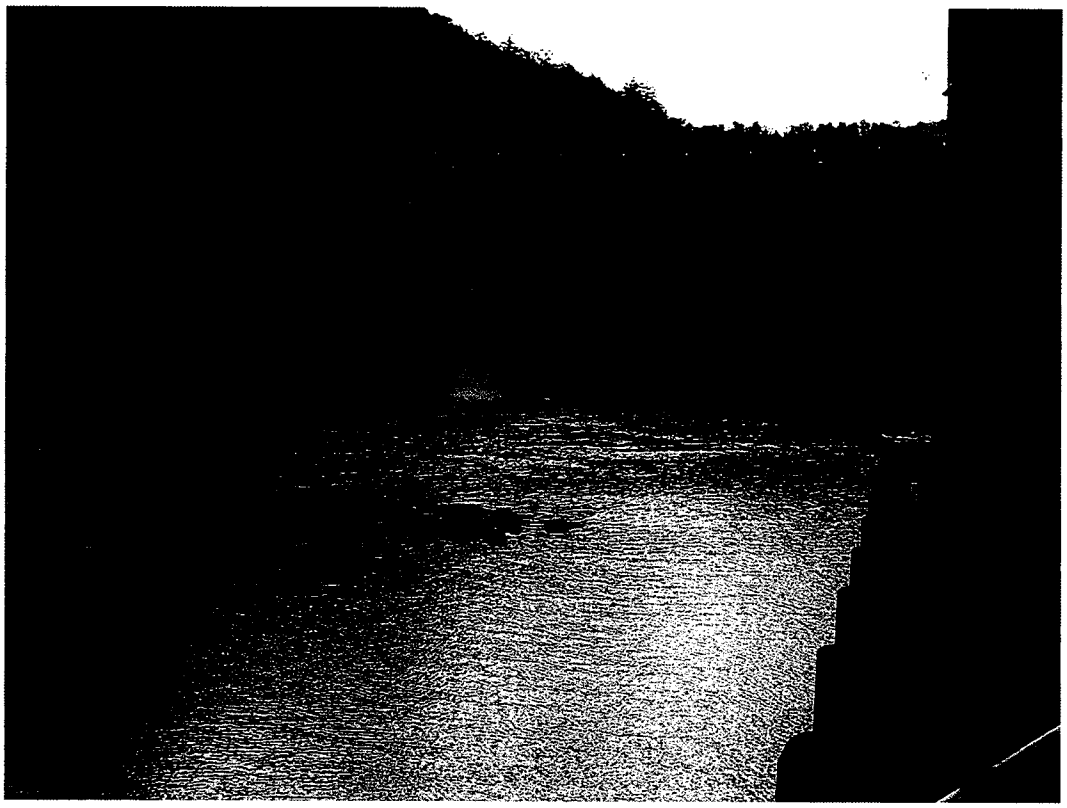
Photos



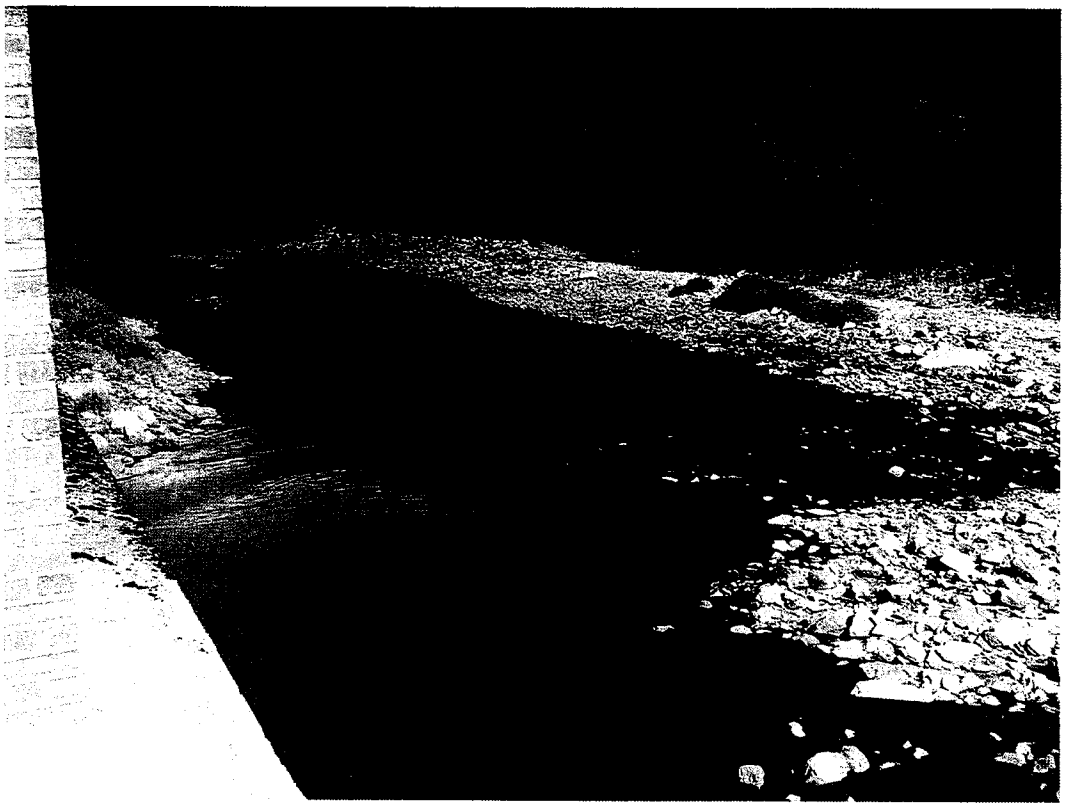
Route 36 bridge looking upstream (above) and downstream (below)



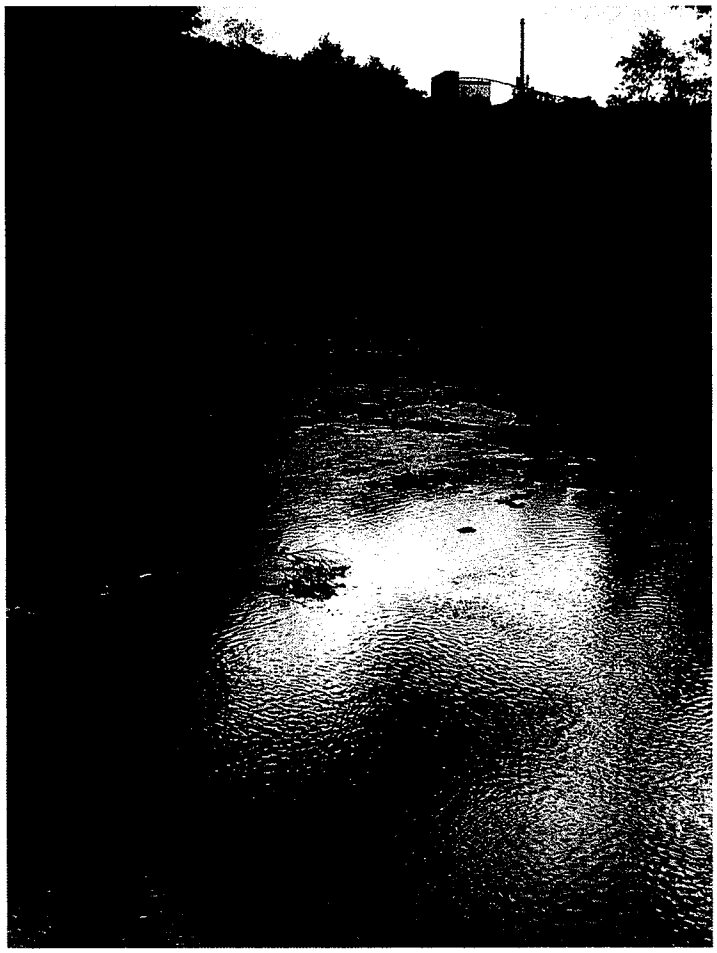
Clarion River at SR 1005 Bridge – Toby Creek enters from the valley in the distance



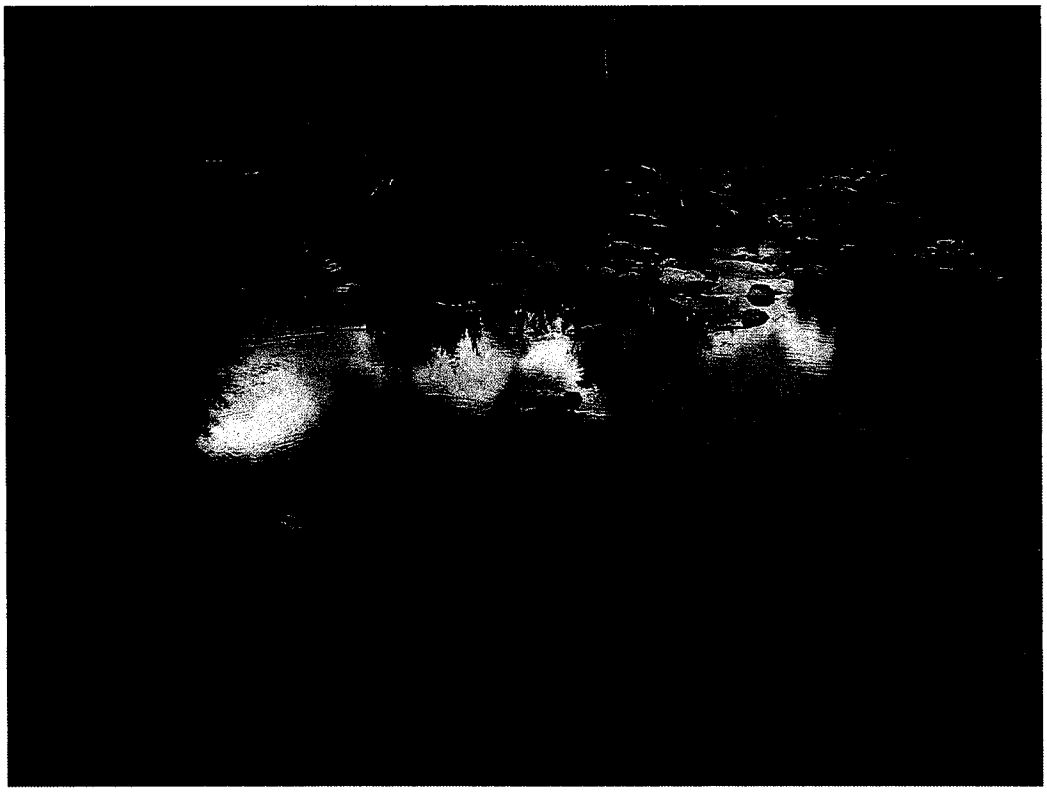
Piney Dam (above) and Piney Dam spillway (below)

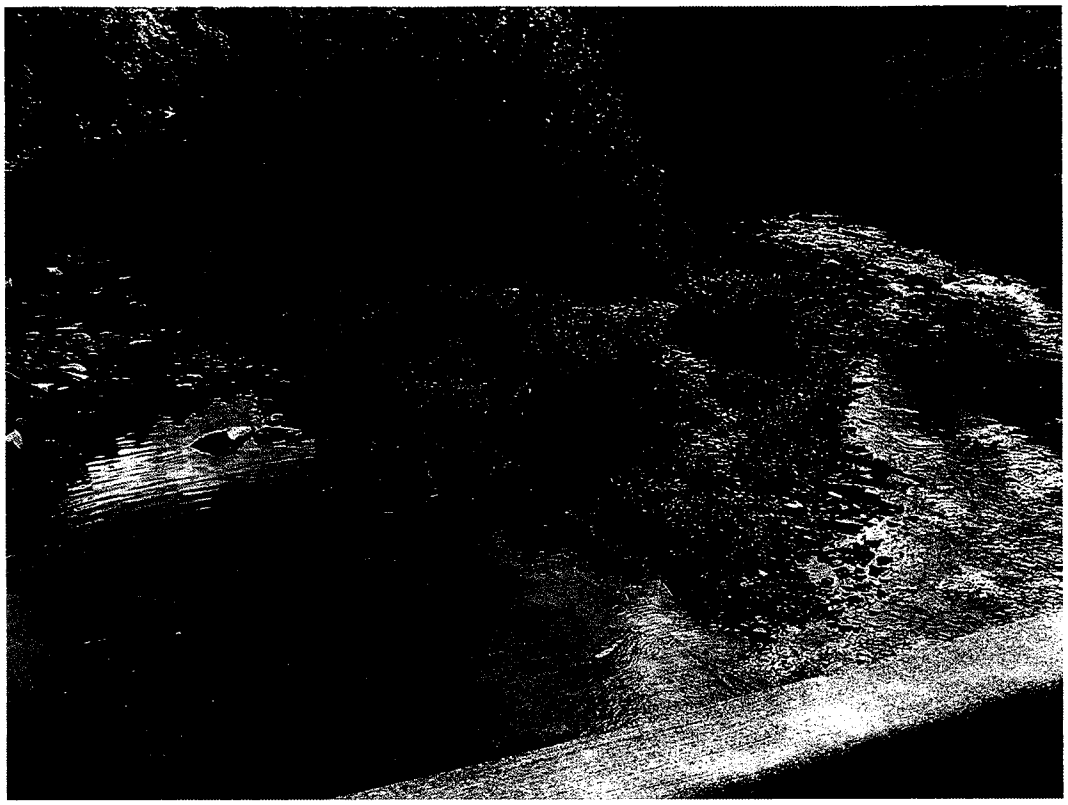


Some wildlife along the way



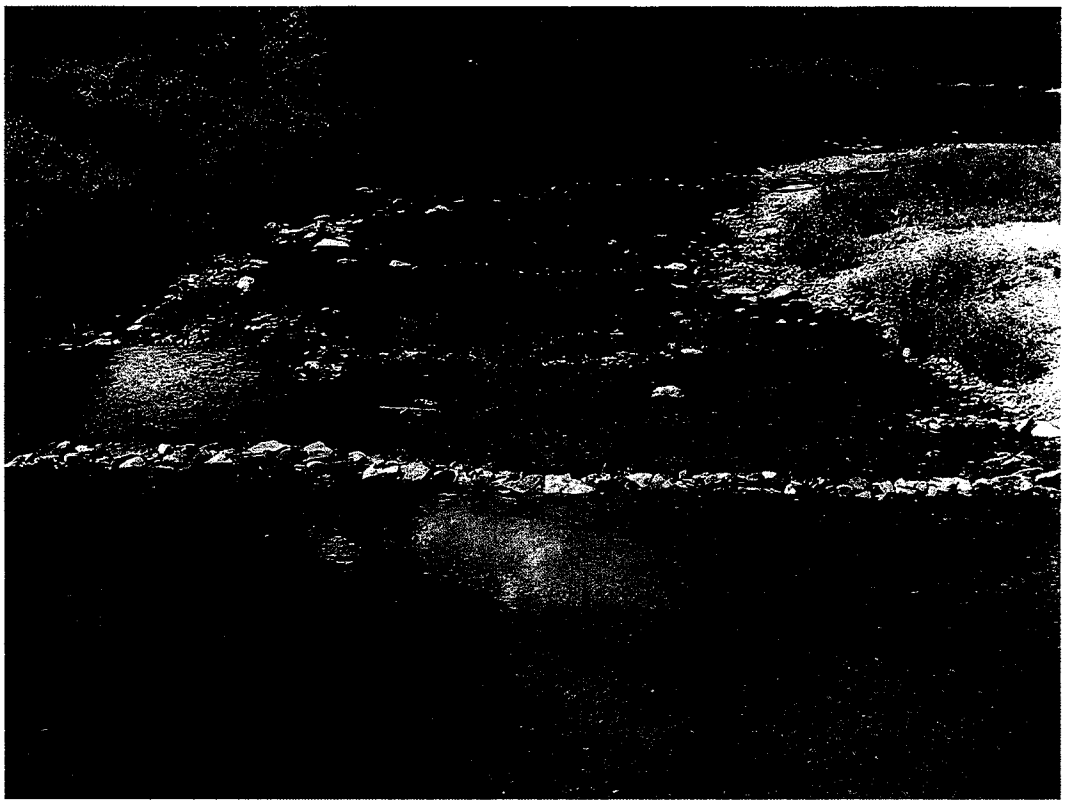
Piney Creek looking upstream (above) and downstream (below)





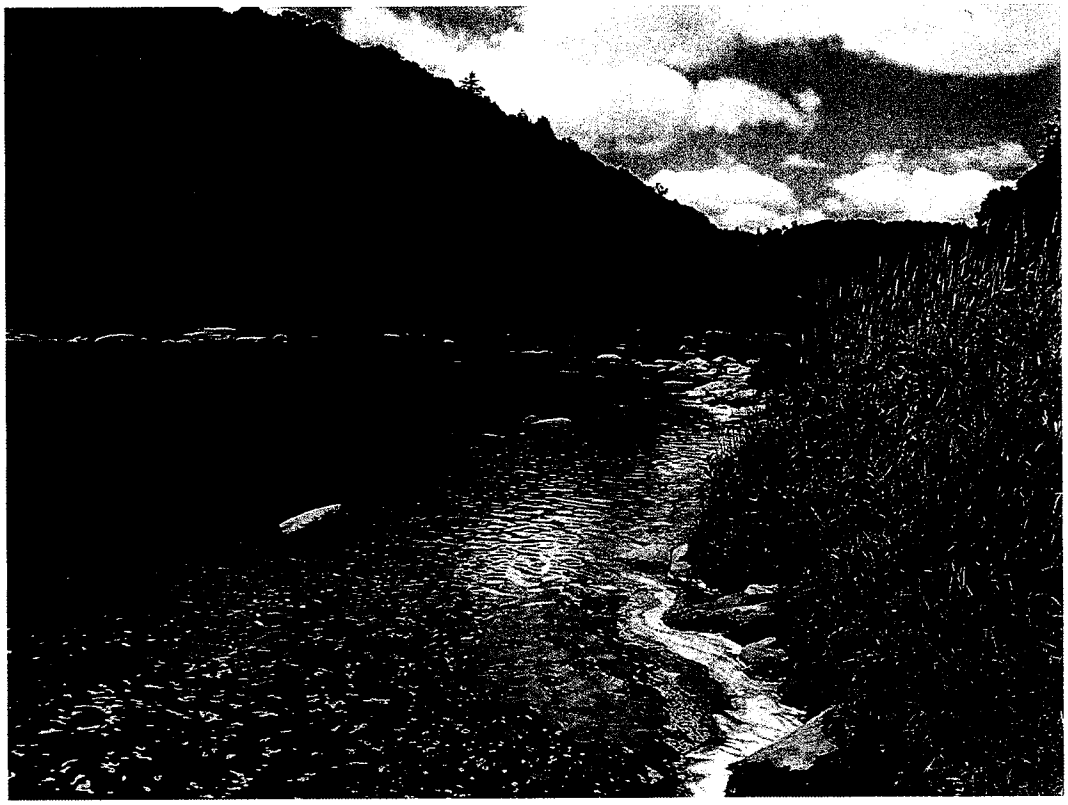
Piney Creek at SR 2007 bridge looking upstream (above) and downstream (below)

Clarion River at SR 2007 bridge looking upstream (above) and downstream (below) notice where Piney Creek enters



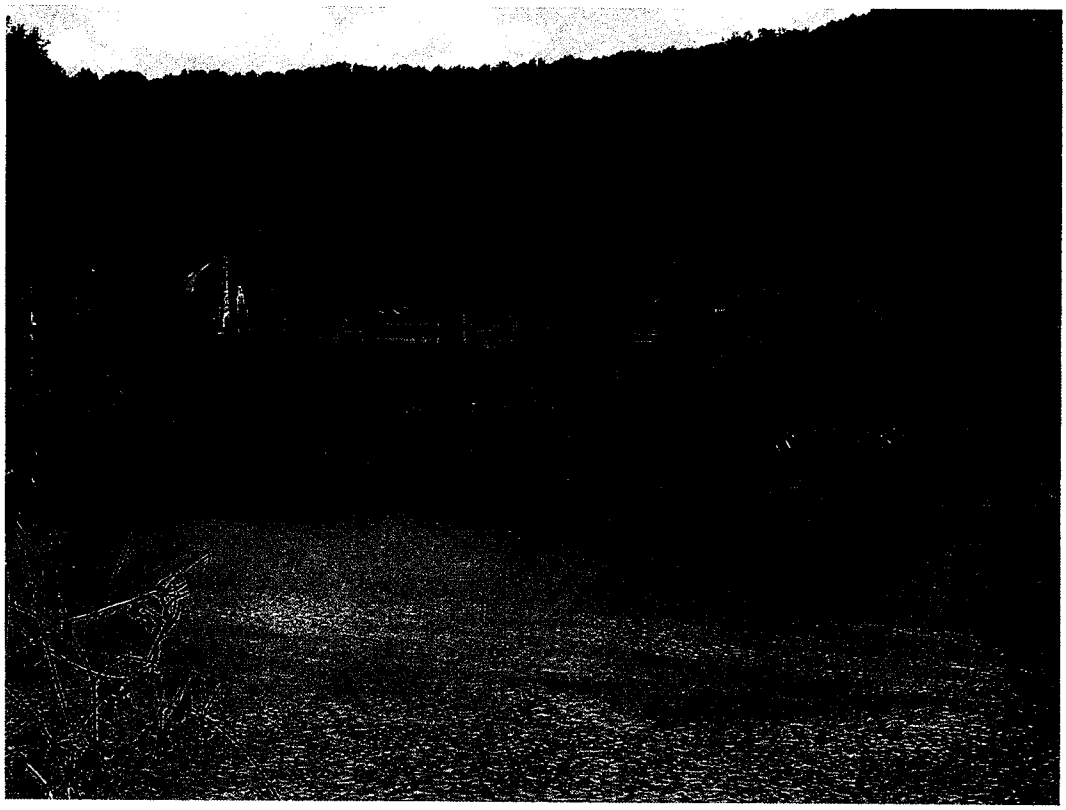
Deer Creek at 2007 bridge looking downstream (above) and upstream (below)

Clarion River at Canoe Ripple bridge looking upstream (above) and downstream (below)



Clarion River at St. Petersburg looking downstream (above) and upstream (below)

Allegheny River – mouth of Clarion River in background



Appendix D

Toxic Fish Tissue Data

Analytical Report: Pennsylvania Fish and Boat Commission Headwaters RC&D

Case Narrative: Pesticide/PCB Data

1.0 Introduction

The pesticide /PCB concentrations in ng/g dry weight are reported for 4 fish tissue samples (SDG93805). These samples were received frozen on 3/4/99. These samples were analyzed in one analytical batch (M2025).

2.0 Analytical Results/Methodology

The sample receipt, preparation, extraction and analyses were conducted in accordance with GERG standard operating procedures. The Pesticide/PCB procedures are those used for analyses for the NOAA's National Status and Trends Program and EPA EMAP-E programs by GERG. The pesticide/PCB data are reported as ng/g on a dry weight basis. The results of the analyses including QA/QC samples are enclosed. All data was reviewed by the respective analyst and met the project quality assurance objectives. Measurements that are outside of QA limits are qualified with a "Q".

3.0 QA/QC Variances: Pesticide/PCB Analyses

The blanks, matrix spike and matrix spike duplicates (MS/MSD) results related to acceptable range for accuracy and precision of the analytical method are discussed below. The analyte concentrations in the blanks were all less than 3 times the method detection limit (<3xMDL), below the method detection limit (J) or not detected (ND). The QC requirements for the MS/MSD were acceptable with the following exceptions. The MSD recovery (133.9%) for PCB 180 was above the acceptanc criteria of 120%. The MS surrogate recoveries were slightly below the 50% acceptance criteria.

4.0 Discussion

The pesticide/PCB concentrations seemed reasonable for fish tissue samples. The blanks showed that the samples were not contaminated during the laboratory analyses. The MS/MSD analyses indicate that the method was operating in a state of control for this sample batch for most analytes. The minor variances of the QC criteria do not effect the overall quality of this data.

Reviewed and Approved:

Terry L. Wade 4/23/99

Terry L. Wade Ph.D. Date
Deputy Director

Pennsylvania Fish & Boat Commission

Client Sample ID	5 Perch		5 Northern Hog Suckers		5 W.S.		5 Smallmouth Bass	
Sample Descriptor								
Original Sample								
GERG ID	C31798		C31799		C31800		C31801	
Sample Type	SAMP		SAMP		SAMP		SAMP	
SDG	93805		93805		93805		93805	
Pesticides	**Concentration**		**Concentration**		**Concentration**		**Concentration**	
Other Chlorinated Pesticides								
Pentachloroanisole	0.97		0.52	J	4.48		0.25	J
Chlorpyrifos	0.38	J		ND	0.72	J		ND
Mirex		ND		ND	0.08	J		ND
Endosulfan II		ND		ND		ND		ND
DDTs and Related Compounds								
2,4' DDE		ND	6.38			ND	4.31	
4,4' DDE	1.11		0.17	J	5.37		1.00	
2,4' DDD	0.48	J		ND	2.24		0.38	J
4,4' DDD	1.16			ND	6.12			ND
2,4' DDT	0.74			ND	0.33	J	0.62	
4,4' DDT		ND	0.42	J	0.79	J	0.36	J
Individual PCBs	**Concentration**		**Concentration**		**Concentration**		**Concentration**	
PCB8/5		ND		ND	0.38	J		ND
PCB18/17	0.11	J		ND	0.80	J		ND
PCB28		ND		ND	2.12			ND
PCB52	2.48		1.31	J	6.12		2.26	
PCB44	1.06	J		ND	5.30			ND
PCB66		ND		ND		ND		ND
PCB101/90	4.04		9.29		10.66		7.36	
PCB118	2.85		1.64		13.79		2.98	
PCB153/132	8.53		4.06		20.07		8.92	
PCB105	0.61	J	0.26	J	2.88		1.75	
PCB138 /160	6.33		3.26		16.52		7.49	
PCB187	3.15		1.06		7.21		3.27	
PCB128	0.53	J		ND	1.99	J	0.32	J
PCB180	15.06	I	3.10		143.20	I	7.21	
PCB170/190	2.13		0.37	J	5.19		2.39	
PCB195/208	0.44	J	0.21	J	2.22		0.37	J
PCB206	0.45	J		ND	1.33		0.36	J
PCB209	1.31	J	0.16	J	2.21		0.24	J

ND Not Detected
J <MDL
NA Not Applicable
Q Results Outside QC
I Interference
B Blank Contamination >3xMDL
d Dilution
EC Exceeds Calibration

Pennsylvania Fish & Boat Commission

Client Sample ID	
Sample Descriptor	Proc Blank
Original Sample	
GERG ID	Q17563
Sample Type	BLANK
SDG	

Pesticides		ND
Other Chlorinated Pesticides	**Concentration**	
Pentachloroanisole	0.15	J
Chlorpyrifos		ND
Mirex		ND
Endosulfan II		ND
DDTs and Related Compounds		
2,4' DDE		ND
4,4' DDE	0.05	J
2,4' DDD		ND
4,4' DDD		ND
2,4' DDT		ND
4,4' DDT	0.06	J

Individual PCBs	**Concentration**	
PCB8/5		ND
PCB18/17		ND
PCB28		ND
PCB52	0.59	J
PCB44	0.25	J
PCB66		ND
PCB101/90	0.74	<3xMDL
PCB118		ND
PCB153/132	1.40	<3xMDL
PCB105		ND
PCB138 /160	1.42	<3xMDL
PCB187	0.65	J
PCB128		ND
PCB180	0.93	<3xMDL
PCB170/190		ND
PCB195/208		ND
PCB206		ND
PCB209	0.10	J

ND Not Detected
J <MDL
NA Not Applicable
Q Results Outside QC
I Interference
B Blank Contamination >3xMDL
d Dilution
EC Exceeds Calibration

Pennsylvania Fish & Boat Commission

Client Sample ID	5 Perch					
Sample Descriptor			Matrix Spike	Matrix Spike Dup		
Original Sample			C31798	C31798		
GERG ID	C31798		Q17564	Q17565		
Sample Type	SAMP		MS	MSD		MSDRPD
SDG	93805		93805	93805		
Pesticides						
Other Chlorinated Pesticides	**Concentration**		**% Recovery**	**% Recovery**		**%RPD**
Pentachloroanisole	0.97		101.1	95.8		5.3
Chlorpyrifos	0.38	J	103.9	100.5		3.3
Mirex		ND	84.2	90.3		7.0
Endosulfan II		ND	101.1	96.3		4.9
DDTs and Related Compounds						
2,4' DDE		ND	88.9	92.1		3.5
4,4' DDE	1.11		79.2	83.9		5.9
2,4' DDD	0.48	J	98.4	92.9		5.8
4,4' DDD	1.16		98.5	102.8		4.3
2,4' DDT	0.74		85.1	78.7		7.9
4,4' DDT		ND	86.6	85.8		1.0
Individual PCBs	**Concentration**		**% Recovery**	**% Recovery**		**%RPD**
PCB8/5		ND	106.1	100.0		5.9
PCB18/17	0.11	J	93.1	96.4		3.5
PCB28		ND	96.2	93.5		2.8
PCB52	2.48		101.1	88.4		13.4
PCB44	1.06	J	92.9	95.3		2.5
PCB66		ND	98.9	105.2		6.2
PCB101/90	4.04		92.5	97.4		5.1
PCB118	2.85		96.5	105.6		9.0
PCB153/132	8.53		93.0	117.8		23.5
PCB105	0.61	J	93.5	96.6		3.2
PCB138 /160	6.33		96.7	110.7		13.5
PCB187	3.15		89.9	100.2		10.9
PCB128	0.53	J	97.1	102.1		5.0
PCB180	15.06	I	111.8	133.9	Q	18.0
PCB170/190	2.13		90.1	102.3		12.6
PCB195/208	0.44	J	86.8	94.0		8.0
PCB206	0.45	J	84.8	95.4		11.8
PCB209	1.31	J	80.9	92.0		12.8
	Avg %Recovery		**94.5**	**94.5**		**7.7** **Avg %RPD**

ND Not Detected
J <MDL
NA Not Applicable
Q Results Outside QC
I Interference
B Blank Contamination >3xMDL
d Dilution
EC Exceeds Calibration

Pennsylvania Fish & Boat Commission

Client Sample ID	
Sample Descriptor	APAC
Original Sample	
GERG ID	Q17566
Sample Type	APAC
SDG	

Pesticides

Other Chlorinated Pesticides	**% Recovery**
Pentachloroanisole	98.9
Chlorpyrifos	109.2
Mirex	104.5
Endosulfan II	102.4
DDTs and Related Compounds	
2,4' DDE	103.5
4,4' DDE	101.1
2,4' DDD	100.1
4,4' DDD	101.4
2,4' DDT	101.2
4,4' DDT	100.2

Individual PCBs	**% Recovery**
PCB8/5	99.3
PCB18/17	101.8
PCB28	108.4
PCB52	107.2
PCB44	103.9
PCB66	104.5
PCB101/90	104.4
PCB118	109.1
PCB153/132	106.4
PCB105	106.2
PCB138 /160	106.0
PCB187	103.4
PCB128	106.0
PCB180	103.9
PCB170/190	104.4
PCB195/208	103.9
PCB206	105.6
PCB209	102.2
Average %Recovery	**102.1**

ND Not Detected
J <MDL
NA Not Applicable
Q Results Outside QC
I Interference
B Blank Contamination >3xMDL
d Dilution
EC Exceeds Calibration

Headwaters RC D Tissue

Client Sample ID	5 Perch	5 Northern Hog	5 W.S.	5 Smallmouth
Sample Descriptor	Clarion River-	Clarion River-	Piney Dam-	Clarion River-
Original Sample				
GERG ID	C31798	C31799	C31800	C31801
Sample Type	SAMP	SAMP	SAMP	SAMP
SDG	93805	93805	93805	93805
Dry Weight	1.09	1.16	1.03	1.22
Wet Weight	6.03	6.18	6.12	6.08
Sample Size Units	Grams	Grams	Grams	Grams
Matrix	Tissue	Tissue	Tissue	Tissue
% solid	18.1	18.9	16.8	20.1
% Lipid	0.5	0.3	2.6	0.5
Reporting Units	pg/g	pg/g	pg/g	pg/g
Calculation Basis (dry/wet)	Dry	Dry	Dry	Dry
QC Batch ID	DX0360	DX0360	DX0360	DX0360
Method	GC/HRMS	GC/HRMS	GC/HRMS	GC/HRMS
Collection Date	12/10/98	11/12/98		11/12/98
Receive Date	3/4/99	3/4/99	3/4/99	3/4/99
Extraction Date	3/31/99	3/31/99	3/31/99	3/31/99
Analysis Date	4/22/99	4/22/99	4/21/99	4/21/99
Surrogate Compounds	%Recovery	%Recovery	%Recovery	%Recovery
13C-2,3,7,8-TCDF	100.2	97.3	94.6	91.5
13C-1,2,3,7,8-PeCDF	106.1	123.8	119.0	121.7
13C-2,3,4,7,8-PeCDF	110.6	107.8	101.9	104.2
13C-1,2,3,4,7,8-HxCDF	95.8	91.8	92.2	88.1
13C-1,2,3,6,7,8-HxCDF	83.7	83.5	85.4	78.9
13C-2,3,4,6,7,8-HxCDF	99.8	97.8	98.4	93.4
13C-1,2,3,7,8,9-HxCDF	109.7	112.1	106.4	104.6
13C-1,2,3,4,6,7,8-HpCDF	108.0	102.3	94.5	94.3
13C-1,2,3,4,7,8,9-HpCDF	124.8	123.9	110.2	111.1
13C-2,3,7,8-TCDD	95.0	91.0	89.1	86.9
37Cl-2,3,7,8-TCDD				
13C-1,2,3,7,8-PeCDD	119.8	114.4	106.2	104.7
13C-1,2,3,4,7,8-HxCDD	101.1	101.0	98.9	91.7
13C-1,2,3,6,7,8-HxCDD	87.1	86.7	81.8	81.9
13C-1,2,3,4,6,7,8-HpCDD	117.1	107.0	100.9	106.8
13C-OCDD	125.5	112.0	100.6	107.4

ND Not Detected
L <LOQ
NA Not Applicable
Q Results Outside QC
I Interference
B Blank Contamination >3xLOQ
D Dilution

Headwaters RC D Tissue - QC

Client Sample ID	
Sample Descriptor	
Original Sample	
GERG ID	Q31229
Sample Type	BLANK
SDG	
Dry Weight	1.00
Wet Weight	
Sample Size Units	Grams
Matrix	
% solid	
% Lipid	
Reporting Units	pg/g
Calculation Basis (dry/wet)	Dry
QC Batch ID	DX0360
Method	GC/HRMS
Collection Date	
Receive Date	
Extraction Date	3/31/99
Analysis Date	04/21/99

Surrogate Compounds	% Recovery
13C-2,3,7,8-TCDF	90.4
13C-1,2,3,7,8-PeCDF	96.1
13C-2,3,4,7,8-PeCDF	94.6
13C-1,2,3,4,7,8-HxCDF	105.1
13C-1,2,3,6,7,8-HxCDF	93.4
13C-2,3,4,6,7,8-HxCDF	106.5
13C-1,2,3,7,8,9-HxCDF	111.2
13C-1,2,3,4,6,7,8-HpCDF	104.2
13C-1,2,3,4,7,8,9-HpCDF	107.7
13C-2,3,7,8-TCDD	85.2
37Cl-2,3,7,8-TCDD	
13C-1,2,3,7,8-PeCDD	99.0
13C-1,2,3,4,7,8-HxCDD	98.2
13C-1,2,3,6,7,8-HxCDD	96.8
13C-1,2,3,4,6,7,8-HpCDD	105.6
13C-OCDD	96.5

ND Not Detected
L <LOQ
NA Not Applicable
Q Results Outside QC
I Interference
B Blank Contamination >3xLOQ
D Dilution

Headwaters RC D Tissue - QC

Client Sample ID	5 W.S.				
Sample Descriptor	Piney Dam-Toby Access	Piney Dam-Toby Access	Piney Dam-Toby Access		
Original Sample		C31800	C31800		
GERG ID	C31800	Q31230	Q31231	Q31230	
Sample Type	SAMP	MS	MSD	MSDRPD	
SDG	93805				
Dry Weight	1.03	1.03	1.04		
Wet Weight	6.12	6.04	6.06		
Sample Size Units	Grams	Grams	Grams		
Matrix	Tissue			%RPD	
% solid	16.8	17.1	17.1		
% Lipid	2.6	0.7	1.2	49.2	Q
Reporting Units	pg/g	%	%		
Calculation Basis (dry/wet)	Dry	Dry	Dry		
QC Batch ID	DX0360	DX0360	DX0360		
Method	GC/HRMS	GC/HRMS	GC/HRMS		
Collection Date					
Receive Date	3/4/99				
Extraction Date	3/31/99	3/31/99	3/31/99		
Analysis Date	04/21/99	04/21/99	04/21/99		
Surrogate Compounds	% Recovery	% Recovery	% Recovery		
13C-2,3,7,8-TCDF	94.6	84.4	92.6		
13C-1,2,3,7,8-PeCDF	119.0	104.8	119.3		
13C-2,3,4,7,8-PeCDF	101.9	91.0	101.5		
13C-1,2,3,4,7,8-HxCDF	92.2	81.5	87.6		
13C-1,2,3,6,7,8-HxCDF	85.4	73.7	80.1		
13C-2,3,4,6,7,8-HxCDF	98.4	85.9	92.9		
13C-1,2,3,7,8,9-HxCDF	106.4	95.6	103.7		
13C-1,2,3,4,6,7,8-HpCDF	94.5	81.4	91.0		
13C-1,2,3,4,7,8,9-HpCDF	110.2	94.1	111.0		
13C-2,3,7,8-TCDD	89.1	79.3	88.8		
37Cl-2,3,7,8-TCDD					
13C-1,2,3,7,8-PeCDD	106.2	96.7	103.9		
13C-1,2,3,4,7,8-HxCDD	98.9	86.3	94.1		
13C-1,2,3,6,7,8-HxCDD	81.8	75.1	85.5		
13C-1,2,3,4,6,7,8-HpCDD	100.9	88.4	99.6		
13C-OCDD	100.6	87.8	97.8		

ND Not Detected
L <LOQ
NA Not Applicable
Q Results Outside QC
I Interference
B Blank Contamination >3xLOQ
D Dilution

Headwaters RC D Tissue - QC

Client Sample ID	
Sample Descriptor	
Original Sample	
GERG ID	Q31232
Sample Type	APAC
SDG	
Dry Weight	1.00
Wet Weight	
Sample Size Units	Grams
Matrix	
% solid	
% Lipid	
Reporting Units	%
Calculation Basis (dry/wet)	Dry
QC Batch ID	DX0360
Method	GC/HRMS
Collection Date	
Receive Date	
Extraction Date	3/31/99
Analysis Date	04/21/99

Surrogate Compounds	% Recovery
13C-2,3,7,8-TCDF	98.8
13C-1,2,3,7,8-PeCDF	100.1
13C-2,3,4,7,8-PeCDF	98.9
13C-1,2,3,4,7,8-HxCDF	93.0
13C-1,2,3,6,7,8-HxCDF	81.4
13C-2,3,4,6,7,8-HxCDF	98.1
13C-1,2,3,7,8,9-HxCDF	108.5
13C-1,2,3,4,6,7,8-HpCDF	95.9
13C-1,2,3,4,7,8,9-HpCDF	112.2
13C-2,3,7,8-TCDD	93.7
37Cl-2,3,7,8-TCDD	
13C-1,2,3,7,8-PeCDD	108.8
13C-1,2,3,4,7,8-HxCDD	94.3
13C-1,2,3,6,7,8-HxCDD	89.9
13C-1,2,3,4,6,7,8-HpCDD	101.8
13C-OCDD	103.4

ND Not Detected
L <LOQ
NA Not Applicable
Q Results Outside QC
I Interference
B Blank Contamination >3xLOQ
D Dilution

Headwaters RC D Tissue

Client Sample ID	5 Perch	5 Northern Hog	5 W.S.	5 Smallmouth
Sample Descriptor	Clarion River-	Clarion River-	Piney Dam-	Clarion River-
Original Sample				
GERG ID	C31798	C31799	C31800	C31801
Sample Type	SAMP	SAMP	SAMP	SAMP
SDG	93805	93805	93805	93805
Dry Weight	1.09	1.16	1.03	1.22
Wet Weight	6.03	6.18	6.12	6.08
Sample Size Units	Grams	Grams	Grams	Grams
Matrix	Tissue	Tissue	Tissue	Tissue
% solid	18.1	18.9	16.8	20.1
% Lipid	0.5	0.3	2.6	0.5
Reporting Units	pg/g	pg/g	pg/g	pg/g
Calculation Basis (dry/wet)	Dry	Dry	Dry	Dry
QC Batch ID	DX0360	DX0360	DX0360	DX0360
Method	GC/HRMS	GC/HRMS	GC/HRMS	GC/HRMS
Collection Date	12/10/98	11/12/98		11/12/98
Receive Date	3/4/99	3/4/99	3/4/99	3/4/99
Extraction Date	3/31/99	3/31/99	3/31/99	3/31/99
Analysis Date	4/24/99	4/24/99	4/23/99	4/24/99
Surrogate Compounds	**%Recovery**	**%Recovery**	**%Recovery**	**%Recovery**
13C-PCB77	92.1	114.2	104.7	90.6
13C-PCB126	98.7	118.2	110.5	94.6
13C-PCB169	86.7	114.9	103.1	94.7
Planar PCB Compounds	**Concentration**	**Concentration**	**Concentration**	**Concentration**
PCB77	280.9	410.8	444.3	974.9
PCB126	42.3	43.4	33.6	77.4
PCB169	ND	ND	ND	8.4 L

ND Not Detected
L <LOQ
NA Not Applicable
Q Results Outside QC
I Interference
B Blank Contamination >3xLOQ
D Dilution

Headwaters RC D Tissue - QC

Client Sample ID	5 W.S.			
Sample Descriptor	Piney Dam-Toby Access	Piney Dam-Toby Access	Piney Dam-Toby Access	
Original Sample		C31800	C31800	
GERG ID	C31800	Q31230	Q31231	Q31230
Sample Type	SAMP	MS	MSD	MSDRPD
SDG	93805			
Dry Weight	1.03	1.03	1.04	
Wet Weight	6.12	6.04	6.06	
Sample Size Units	Grams	Grams	Grams	
Matrix	Tissue			%RPD
% solid	16.8	17.1	17.1	
% Lipid	2.6	0.7	1.2	49.2 Q
Reporting Units	pg/g	%	%	
Calculation Basis (dry/wet)	Dry	Dry	Dry	
QC Batch ID	DX0360	DX0360	DX0360	
Method	GC/HRMS	GC/HRMS	GC/HRMS	
Collection Date				
Receive Date	3/4/99			
Extraction Date	3/31/99	3/31/99	3/31/99	
Analysis Date	04/23/99	04/23/99	04/23/99	
Surrogate Compounds	% Recovery	% Recovery	% Recovery	
13C-PCB77	104.7	89.1	99.9	
13C-PCB126	110.5	96.8	103.8	
13C-PCB169	103.1	92.8	101.1	
PCDD/PCDF Compounds	Concentration	% Recovery	% Recovery	%RPD
PCB77	444.3	112.9	82.9	30.6 Q
PCB126	33.6	111.3	104.0	6.8
PCB169	ND	105.3	96.7	8.6
	Average % Recovery	109.8	94.5	15.3

ND Not Detected
L <LOQ
NA Not Applicable
Q Results Outside QC
I Interference
B Blank Contamination >3xLOQ
D Dilution

TEXAS A&M UNIVERSITY
Geochemical and Environmental Research Group
College of Geosciences and Maritime Studies

Analytical Report: Pennsylvania Fish and Boat Commission and Headwaters RC&D

Fish Analyses (SDG 93805)

Final Report (Trace Organic Analyses)

April 27, 1999
GERG TECHNICAL REPORT 99-007

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DEPARTMENT OF HEALTH
... in pursuit of good health

January 25, 2001

Andrew Redmond, President
Clarion River Basin Commission
Willamette Industries, Inc.
Johnsonburg Paper Mill
100 Center Street
Johnsonburg, PA 15845

Dear Mr. Redmond:

Thank you for your January 2, 2001 letter requesting me to review Texas A & M University's April 27, 1999 Fish Analyses-GERD Technical Report 99-007 and comment on chemical concentrations in fish tissues exceeding fish consumption advisory levels. Upon review of the report, I note the following:

- Currently, fish consumption advisories have only been established for some of the chemicals (PCBs, DDT, chlordane, dioxins, etc.) that were analyzed in the tissue samples. Presently, advisories do not exist for some of the other chemicals (eg. chlorinated benzenes, hexachlorocyclohexanes, etc.) documented in the report.

- The concentrations of all chemicals analyzed in the fish tissue samples were reported on a dry-weight basis and not on a wet-weight basis. Our fish advisories are issued on a wet-weight basis; therefore, levels cannot be directly compared. However, based on the information provided in the report, dry-weight concentrations can be adjusted to a wet-basis for direct comparison. Specifically, as stated in the report, the concentrations would be about five times lower on a wet-weight bases.

Based on my evaluation of the levels of the chemicals that were detected in the fish tissue samples and after adjustment of the contaminant concentrations for direct comparison with fish consumption advisories, it is my determination that the concentrations of all the chemicals in the fish tissue samples are either below advisory levels or below the level of public health concern. Therefore, normal consumption of these fish should not harm the health of the people eating them.

I trust that this addresses your needs.

Sincerely,

Kandiah Sivarajah, Ph.D., DABFM,
State Toxicologist

cc: Dr. Logue

WATER QUALITY METHODS AND RESULTS

PA Fish & Boat Commission

Water Quality Methods (Aquatic Biological Survey, 1999)

The Aquatic Biological Survey done on 28, 29 October and 4, 17 November 1998 was performed by the PA Fish & Boat Commission in cooperation with the Clarion River Basin Commission, Headwaters RC&D Council, Inc., and the PA Department of Environmental Protection. The stations included in this study were the West Branch Clarion River, Five Mile Run, East Branch Clarion River, Elk Creek, Little Toby Creek, and Spring Creek. Station location descriptions can be found on page 2. Samples were taken for benthic macroinvertebrates, fish, and water quality parameters.

Water samples were collected on the tributaries sampled for this study and two sites on the Clarion River. Samples were collected by representatives from Headwaters and transported to the PADEP Bureau of Laboratories and analyzed for standard mine drainage analysis. Water quality parameters analyzed include pH, alkalinity, total acidity, sulfates, iron (Fe), manganese (Mn) and aluminum (Al).

Water Quality Results (Aquatic Biological Survey, 1999)

The water quality measurements for WBC01 revealed a pH of 6.7, an alkalinity of 32 mg/l, and an acidity of 0.00 mg/l with all other parameters within the limits set by Chapter 93. Water quality data for this station can be found in Table A-4.

The water quality measurements for FMR01 revealed a pH of 6.4, an alkalinity of 15 mg/l, and an acidity of 0.00 mg/l with all other parameters within the limits set by Chapter 93. Water quality data for this station can be found in Table A-2.

The water quality measurements for EBC01 revealed a pH of 5.5, an alkalinity of 9.6 mg/l, and an acidity of 3.20 mg/l with all other parameters within the limits set by Chapter 93. Acid precipitation could be the cause of the elevated acidity readings. In order to increase pH, the U.S. Forest Service is applying limestone sand to neutralize the pH. Water quality data for this station can be found in Table A-1.

The water quality measurements for ELK01 revealed a pH of 6.8, an alkalinity of 28 mg/l, and an acidity of 0.00 mg/l with all other parameters within the limits set by Chapter 93. Water quality data for this station can be found in Table A-13.

The water quality measurements for LT01 revealed a pH of 6.8, an alkalinity of 38 mg/l, and acidity of 0.00 mg/l with all other parameters within the limits set by Chapter 93. Water quality data for this station can be found in Table A-17.

The water quality measurements for SPCK01 revealed a pH of 6.7, an alkalinity of 38 mg/l, and an acidity of 0.00 mg/l with all other parameters within the limits set by Chapter 93. Water quality data for this station can be found in Table A-15.

Discussion (Aquatic Biological Survey, 1999)

Results from the water sampling indicate that EBC01 had the low pH at 5.5. In order to raise the pH in the stream, limestone sand was added prior to the electrofishing survey conducted on 04 November 1998. Although EBC01 also had one of the higher Iron

readings at 222.0 ug/l, it is still within the limits set by Chapter 93. The remaining stations had results that would be typical for a watershed impacted by mining activity.

Army Corps of Engineers

Water Quality Results

A total of 15 samples were taken at the East Branch Dam Outflow between October 1998 and May 1999. This station had a consistently low alkalinity and an acidity that was nearly always higher than the alkalinity. Except for 2 of the 15 samples (11/23/98 5.93su, 2/8/99 5.7su), the pH was within the limits set by DEP Chapter 93 Water Quality Standards. Water quality data for this station can be found in Table A-3.

A total of 33 samples were taken at the Callensburg (Rt. 58 Br) station between October 1998 and June 1999. This station also had a consistently low alkalinity with the exception of three samples taken in December 1998. In 9 of the 33 samples, the acidity was higher than the alkalinity. The pH was below the standard in only 2 of the samples, 1/25/99 5.52su, and 2/22/99 5.56su. Water quality data for this station can be found in Table A-36.

A total of 14 samples were taken at the Cooksburg (Rt. 36 Br) station between October 1998 and June 1999. This station showed a low alkalinity in 7 of the 14 samples, six of which occurred consecutively from 25 January through 6 April and were considerably lower than the others (2.3-8.5 mg/l). The other drop in alkalinity occurred on 13 October and was 16.6 mg/l. Acidity was only higher than the alkalinity in one sample, which occurred on 25 January. Water quality data for this station can be found in Table A-19.

A total of 17 samples were taken at the Gaging Station downstream of Piney Dam between October 1998 and June 1999. This station showed a low alkalinity in all but 2 samples. A severe drop in alkalinity occurred on 28 December and remained quite low through June. The acidity exceeded the alkalinity only twice on 25 January and 8 February. The pH was within the standard except on 25 January when it was 5.47su. Water quality data for this station can be found in Table A-22.

A total of 17 samples were taken at Piney Creek (2nd bridge upstream) between October 1998 and June 1999. This station showed a very low alkalinity, below zero at times and the acidity was always in excess of the alkalinity. The pH was consistently low except for 2 rare occasions. On 11 January, the pH was 6.16su, then it dropped to 5.16su on 25 January, and jumped to 9.6su on 8 February. On 22 February, the pH had dropped back down to 4.47su and remained below the standard for the remaining samples. The color was high (>50 PT-CO units) in 11 of the samples. The turbidity was high (>40 NTU) in two of the samples. Water quality data for this station can be found in Table A-25.

A total of 16 samples were taken at Deer Creek (2007 Br) between October 1998 and June 1999. This station showed very low alkalinity, which only got above zero in one sample and was still well below the standard. The acidity well exceeded the alkalinity in all of the samples except for one sample on 11 January. The pH was below the standard in all but one sample on the same date as above. The color was high (>50 PT-CO units) in 2 of the samples. Water quality data for this station can be found in Table A-28.

A total of 33 samples were taken at Licking Creek (2nd bridge upstream) between October 1998 and June 1999. This station showed a low alkalinity in every sample and in 15 of the samples the acidity exceeded the alkalinity. The pH was low between 5 October and 14 December with the exception of 19 October where it was >6su. The remaining

samples after that date were within the standard. Color and Turbidity were often above the standard as well. Water quality data for this station can be found in Table A-38.

Ecological Restoration, Inc.

Methods (Ecological Restoration, Inc., 1998)

Chemical testing was performed on surface water grab samples taken from each station. All stations were sampled on four occasions, November 1998, March 1999, June 1999, and October 1999

Results

Station 1, located on the West Branch showed low alkalinity in the March sample (13.3 mg/l). The iron content was high in November and June, 0.32 mg/l and 0.35 mg/l, respectively. Water quality data for this station can be found in Table A-4.

Station 2, located on the East Branch at Bendigo State Park, showed low alkalinity in all samples (range 4.0-5.33 mg/l). The acidity exceeded the alkalinity in all samples as well (range 4.0-17.3 mg/l). Water quality data for this station can be found in Table A-5.

Station 3, located on the main stem of the river upstream of Willamette's discharge showed alkalinities lower than the standard in all samples (range 5.33-10.7 mg/l). The acidity however remained lower than the alkalinity in all but the October sample. Water quality data for this station can be found in Table A-7.

Station 4, located on the main stem of the river downstream of Willamette's discharge showed a low pH in the November sample (5.47su) but >7su in the other samples. Alkalinity and Acidity were well within the standards. Aluminum was slightly high in three of the samples, November 0.29 mg/l, June 0.47 mg/l, and October 0.43 mg/l. The October sample also showed a high iron content of 0.62 mg/l. Water quality data for this station can be found in Table A-8.

Station 5, located on the main stem of the river upstream of Johnsonburg's Municipal Wastewater Treatment Plant, showed good alkalinity and pH. The aluminum however, exceeded the standard in three of the samples, November 0.31 mg/l, June 0.49 mg/l, and October 0.59 mg/l. The October sample also showed a high iron content of 1.07 mg/l. Water quality data for this station can be found in Table A-9.

Station 6, located on the main stem of the river downstream of Johnsonburg's Municipal Wastewater Treatment Plant, showed good alkalinity and pH as well. The aluminum content, however, again exceeded the standard in two of the samples, November 0.32 mg/l and June 0.42 mg/l. Water quality data for this station can be found in Table A-10.

Station 7, located on the main stem of the river above the confluence of Riley Run, showed similar results as stations 5 and 6. Aluminum exceeded the standard in November (0.29 mg/l) and June (0.38 mg/l). Water quality data for this station can be found in Table A-11.

Station 8, located on the main stem of the river just north of Ridgway City limits, once again showed similar results to stations 5, 6, and 7. Aluminum exceeded the standard in November (0.3 mg/l) and June (0.28 mg/l). Also, the iron content exceeded the standard in June (0.48 mg/l). Water quality data for this station can be found in Table A-12.

Station 9, located at the mouth of Powers Run, showed only low alkalinity on one occasion in March (8 mg/l). All other parameters were within the standards. Water quality data for this station can be found in Table A-6.

PA DEP

Water Quality Results

A total of 8 samples were taken at the Callensburg (Rt. 58 Br) station on between May 1999 and March 2001. The alkalinity was below the standard set by DEP Chapter 93 Water Quality Standards in six of the samples (range 6.8-18.4 mg/l). Iron was also high in the August 2000 sample (3.210 mg/l). Manganese exceeded the standard in six of the eight samples ranging from 1.02 mg/l to 1.58 mg/l. Water quality data for this station can be found in Table A-35.

Three stations were sampled on Elk Creek, one above St. Mary's STP (one sample), one above St. Mary's STP bypass (6 samples), and one in Ridgway Boro above the bridge at Alpine Metals (6 samples). Starting with the sample above St. Mary's STP, sampled on 17 May, conductance was rather high at 3890 umhos/cm, alkalinity was slightly low at 19.8 mg/l, and iron content was high with a value of 1.760 mg/l. The station above St. Mary's STP bypass, sampled in May, August, and November 1999, August and November 2000, and February 2001. Conductivity was rather high in the May 1999 sample as well (3890 umhos/cm). Iron content was slightly high in the February 2001 at 1.63 mg/l. The station located in Ridgway was sampled on the same dates as the previous station. The August 1999 sample showed a slightly high pH of 9.05su. Alkalinity was slightly low in 3 of the 6 samples, the lowest being 10.2 mg/l in May 1999. Water quality for these stations can be found in Tables A-13, 14.

The station located on Little Toby Creek, at the RR trestle at Carman, was sampled five times between August 1999 and February 2001. Sulfates exceeded the standard of 250 mg/l on two occasions, August 1999 – 254 mg/l, and August 2000 – 403 mg/l. Water quality data for this station can be found in Table A-17.

The station located on the main stem of the river at the RR trestle upstream of Carman was sampled on six dates from May 1999 and February 2001. No exceedance of water quality standards was recorded. Water quality data for this station can be found in Table A-16.

The Mill Creek station, located at the SR 1001 Bridge, was sampled six times between May 1999 and February 2001. This station showed typical results of a stream impacted by acid mine drainage. Those parameters exceeding standards were pH (3.21-4.8su), Alkalinity (0-2mg/l), Iron (2.32-3.58 mg/l), Manganese (1.76-8.77 mg/l), TDS (170-598 mg/l), Hot Acidity (13.6-68 mg/l), Aluminum (0.866-1.85 mgl) and Sulfates (70-382 mg/l). Most of the aforementioned parameters exceeded the standard in every sample. Water quality data for this station can be found in Table A-20.

The Cooksburg station, located at the Rt. 36 Bridge, was sampled on seven times between May 1999 and March 2001. The results showed a slightly low alkalinity of 14.2 mg/l in May 1999 and an Iron content of 1.55 mg/l in July 1999. Water quality data for this station can be found in Table A-18.

The Toby Creek station is located at the T573 bridge site and was sampled six times between May 1999 and February 2001. The results were typical of a stream impacted by acid mine drainage. Those parameters exceeding standards were pH (3.22-3.5su),

Alkalinity (0mg/l), Iron (5.03-26 mg/l), Manganese (2.83-16.8 mg/l), Aluminum (2.5-5.99 mgk/l), TDS (210-882 mg/), Acidity (5.2-56 mg/l), Hot Acidity (34-130 mg/l), and Sulfates (110-399 mgl/). Also, Lead content ranged from 1-3.7 ug/l. Most of the aforementioned parameters exceeded the standard in every sample. Water quality data for this station can be found in Table A-21.

The station on the river at SR 2007 Bridge was sampled five times between May 1999 and February 2001. Results from this station showed low alkalinity in four of the five samples, however, on all occasions the alkalinity exceeded the acidity. Also, Manganese was 1.24 mg/l in the November 2000 sample. Water quality data for this station can be found in Table A-30.

The Piney Creek station (SR 2007 bridge) was sampled on six dates between May 1999 and February 2001. The results were typical of a stream impacted by acid mine drainage. The following parameters exceeded standards: pH (3.66-6.28su), Alkalinity (0-5.4 mg/l), Iron (3.82-9.71 mg/l), Manganese (2.94-7.27 mg/l), Aluminum (0.578-2.66 mg/l), TDS (294-792 mg/l), Hot Acidity (13-50 mg/l), and Sulfates (161-431 mg/l) Many of the parameters exceeded the standard in the majority of samples. Water quality data for this station can be found in Table A-32.

The Deer Creek station (SR 2007 bridge) was sampled six times between May 1999 and February 2001. The results were typical of a stream impacted by acid mine drainage. The following parameters exceeded standards: pH (3.49-4.03su), Alkalinity (0-1.8 mg/l), Manganese (0.806-3.49 mg/l), Aluminum (0.938-1.9 mg/l), TDS (138-386 mg/l), and Hot Acidity (15.2-28 mg/l). Water quality data for this station can be found in Table A-27.

Normandeau Associates, Environmental Consultants

Water Quality Methods (Normandeau Associates, Inc., Report on Water Quality, 2000)

The surveys were conducted (meteorological and hydrological conditions permitting) monthly at selected locations in November-April and biweekly at all locations in May-October. During these surveys, field measurements of water temperature, dissolved oxygen (DO), pH, and conductivity were taken at each sampled location. Parameter measurements were determined in surface grab samples taken at each riverine and tributary location. DO and water temperatures were measured using YSI (Model 57) instrumentation equipped with a submersible stirrer. Conductivity and pH were determined using Cole-Parmer portable instruments (Testr2 meter for pH and TDSTestr3 meter for conductivity). All instruments were calibrated initially each survey day with subsequent calibration checks at each transect location: (1) DO against the solubility of oxygen in air saturated distilled water, corrected for altitude, (2) pH against two buffers (4.0 and 7.0) initially, with subsequent checks at one buffer closest to the expected source water pH, and (3) conductivity against a 360 umhos/cm KC1 standard. Parameter measurements and calibration data were recorded by date, time, location and depth (as applicable) on project specific field sheets along with Station operational information, meteorological conditions, and other pertinent observations.

Water Quality Results (Normandeau Associates, Inc., Report on Water Quality, 2000)

Water quality in the vicinity of the Piney Project was characterized from measurements of selected physicochemical parameters taken during routine monthly

and/or biweekly surveys in January-December 1999. The primary water quality parameters sampled in the field included water temperature, dissolved oxygen (DO), pH, and conductivity. In addition, total aluminum, iron, manganese, alkalinity, acidity, and hardness were analyzed from grab water samples taken monthly (May-October) in the Project Lake, Tailrace, and selected locations downstream to Callensburg. The surveys were conducted under prevailing flow releases at Piney Station, with most surveys in May-October conducted under the 100 cfs minimum flow release. Water quality data for the stations sampled in this report can be found in Tables A-23, 24, 26, 29, 31, 33, 34, and 37.

Water temperatures in the Piney Project area displayed a seasonal pattern of variation typical for temperate waters, which generally follows that for ambient air temperature. Overall, monthly water temperatures increased from seasonal lows (<1°C) in mid to late winter (February-March), through spring, reaching summer highs (25-26°C) in July, and then declined thereafter.

Surface water temperatures, particularly in summer to fall differed between lake, riverine, and tributary locations. Overall, most monthly mean water temperatures in Piney Lake were 1 to 4°C higher than corresponding values at downstream river locations. The lower temperatures at river locations (i.e., Tailrace) most likely reflected the mix of the warmer lake surface release (~70 cfs) with cooler Station leakage (~30 cfs) during minimum flow release, which was surveyed most often in summer and fall. Monthly water temperatures in Piney and Deer creeks were up to 5°C and 3°C lower than corresponding values in the Lake and at river locations, respectively, in spring to fall. Although monthly mean temperatures between the tributaries and river stations differed, variations between most locations in the river, as well as that between the tributary creeks, were usually less than 2°C, indicating relatively uniform temperature conditions throughout the downstream river reach.

Dissolved Oxygen in the Piney Project area displayed a general pattern of seasonal variation in contrast to that for water temperature. Although fluctuations in DO occurred, the overall trend was for DO to decrease from a seasonal high of 12-14 mg/l in winter through spring, to the seasonal lows (6-8 mg/l) in summer, and then increase thereafter. This seasonal trend was typical of that observed in most temperate lakes and rivers.

In most months, surface DO values usually differed between locations, with the magnitude of difference generally greater in summer through fall. Although DO differed by as much as 1.5 mg/l between sampled locations in winter, values typically were at or near 100% saturation; noted differences were attributed primarily to differences in corresponding water temperatures. In spring, differences between locations usually were <1.0 mg/l with saturation values greater than 90% at most locations. In June-November, differences in monthly mean values of 2-3 mg/l were common, with the highest values occurring in Piney and/or Deer creeks and the lowest values in the Lake. During this period, mean DO in the river below Piney Dam ranged from a low of 6.0 mg/l (Tailrace in August) to 10.1 mg/l (Deer Creek Transect in November), with values in the lower river reach (Deer Creek Transect to Callensburg) usually 0.5-1.5 mg/l higher than corresponding values in the upper river reach (Tailrace to Piney Bridge). In August-October (months in which all surveys were conducted under the 100 minimum flow release), mean DO in the Tailrace was higher than corresponding Lake surface values, reflecting aeration of Lake surface water released via gated spill.

On a seasonal basis, pH values at most river stations generally were lower (<6.3 su) in winter-spring and higher (>6.3 su) in summer months, while the reverse trend was the case in the acidic tributaries, Piney and Deer creeks.

Surface pH values in Piney Lake were ≥ 6.4 su (6.4-7.0 su) in all sampled months. At river locations downstream of Piney Dam, monthly values ranged from 4.7 su at Deer Creek Transect in November to 7.1 su at Canoe Ripple in July. Overall, surface values in the Lake and at river locations (excluding Deer Creek Transect) were near 6.5 su in most months. Although values between these locations varied in a given month, differences rarely exceeded 0.5 su and usually were ≤ 0.3 su. At Deer Creek Transect, monthly pH values ranged from 4.7 to 6.0 su and were consistently lower than corresponding values at all other river locations. The lower mean values at Deer Creek Transect were attributed to acidic inflows from Deer Creek (about 0.1 mile upstream), the pH of which was consistently <4.0 su in May-December. The effect of this acidic inflow on pH at Deer Creek Transect was most evident at the right (north) bank sampling location, which was under the direct influence of creek flow. Except on two survey dates (18 May and 13 July), pH values at this location were ≤ 5.0 su with most survey values < 4.0 su. On 18 May and 13 July pH was higher (5.7 and 6.7 su, respectively) reflecting the influence/mixing of higher pH in releases (3600 and 600 cfs, respectively) at Piney Station. During other surveys, the Station released 100 cfs (minimum flow) in May-October and ~30 cfs (leakage flow) in November and December.

The influence of Deer Creek was less evident at the mid-stream location on Deer Creek Transect. Except on two surveys when pH was <5.0 su, values at this location were ≥ 5.7 su. Deer Creek had no apparent effect on pH at the left (south) bank location. Survey values at this location were ≥ 5.8 su with most in the range of 6.3-6.8 su. The pH at this location also appeared unaffected by acidic inflows from Piney Creek (located 0.5 miles upstream from Deer Creek Transect). The low pH in Piney Creek inflows, which was similar to Deer Creek in May-August and <5.0 su in most other months, was assimilated in the river within a relatively small area (less than 0.5 mile) upstream of Deer Creek Transect, corresponding pH values downstream at Canoe Ripple Transect were similar to or higher than values at Piney Bridge Transect, located upstream of the tributary influences. This and results of special release surveys indicated that the affects of acidic tributary inflows on river pH were localized in 1999.

The pH values observed in the river reach below Piney Dam in May-October generally reflected the high levels in Piney Lake. Overall, Lake profiles indicated that pH remained relatively high throughout the water column. All values at depth were ≥ 6.0 su with most depths at or near 6.5 su during the study period. Although variations between depths occurred, no distinct stratification was evident, including periods when the water column experienced anoxic or near anoxic conditions. Difference in pH between the surface and bottom ranged from 0.0 to 0.7 su with most less than 0.3 su.

On a seasonal basis, conductivity values in the project area generally were lower in winter to mid-spring and late fall, while higher in summer and early fall. The pattern of seasonal variation in conductivity was in contrast to that described for river inflows reflecting the dilutional effect of runoff following high and/or sustained flow events on ionic/dissolved salt concentrations in the river and tributary creeks.

On a monthly basis, surface conductivity values in the lake and at downstream river locations ranged from 70 umhos at Piney Bridge in January to 422 umhos at Deer Creek Transect in September. Overall, values at these locations were lowest (<100 umhos) in January, highest (≥ 335 umhos) in one or more summer months (July-September), with values 120-220 umhos in most other months. In all sampled months conductivity values were consistently higher in the lower river reach (Deer Creek Transect to Callensburg) than corresponding values at locations in the upper reach (Tailrace to Piney Bridge) and lake. In

the lower river, monthly values were highest at Callensburg or Deer Creek Transect, with values at Deer Creek Transect generally higher during the primary period of low inflow in late June-early October. The higher values at Deer Creek Transect generally reflected the influence of acidic inflow (high in ionic strength) from Piney and Deer creeks. During surveys in May-Dec, conductivity values in Deer Creek ranged from 210-640 umhos with values in late June-early October consistently >400 umhos. Values in Piney Creek were 2-3 times higher than those in Deer Creek, ranging from 430-1130 umhos with most survey values >900 umhos.

The effect of tributary inflows on conductivity at the Deer Creek Transect sampling stations was most evident at the left (south) bank, followed by the right (north) bank, and least evident at the mid-stream location. This indicated that inflows from Piney Creek, unlike that described above for pH, had substantial influence on resultant conductivity levels at Deer Creek Transect. Also, the general influence of tributary inflows on downstream conductivity was not localized as noted for pH. In all months, conductivity values at downstream locations (Canoe Ripple and Callensburg) were similar to those at Deer Creek Transect and higher than corresponding values upstream (Piney Bridge) of the tributary inflows.

Overall, concentrations of parameters in Piney and Deer creeks (except for total alkalinity in both and iron in Deer Creek) were substantially higher than values at other locations (lake and river) throughout the survey period. The general lack of any buffering capacity (no alkalinity detected), high concentrations of metals (aluminum, iron, and manganese), hardness and acidity reflected the impact of acid mine inputs in the drainages of these tributaries. Although both creeks are recipients of acid mine drainage (AMD), variations in parameter concentrations indicated that the impact of AMD is more severe in Piney Creek. Concentrations of parameters (except for aluminum) in Piney Creek typically were 2 to 4 times higher, while total aluminum values were similar to or slightly lower, than values in Deer Creek. Except for aluminum in Piney Creek and iron in both creeks, parameter values in these tributaries were highest in one or more summer months (July-August) and lowest in May. The reverse trend was the case for aluminum in Piney Creek and iron in Deer Creek, while the iron concentration in Piney Creek was highest in October.

Compared to values in the upstream river reach (Piney Lake, Tailrace, and Piney Bridge), the influence of Piney and Deer creek inflows on parameter concentrations in the river was most evident at Deer Creek Transect, with minimal to no discernable effect evident at lower river locations (Canoe Ripple and Callensburg). Based on the differences in parameter values between Piney Bridge and Deer Creek Transect, total manganese, alkalinity, and acidity appeared to be the parameters most affected at Deer Creek Transect, while iron was least affected. At Canoe Ripple and Callensburg, concentrations of aluminum, iron, manganese, alkalinity, and acidity remained unaffected or showed no consistent trend. Total hardness values at these locations generally were similar (May-July) or slightly higher (August-October) than values in the upper reach.

Parameter concentrations in the Piney Tailrace generally reflected values at surface and mid-depth in Piney Lake. In the lake, concentrations of most parameters varied with depth, particularly during July-October when the lake was stratified with respect to temperature and DO. In most months, bottom values for iron, manganese, and acidity were higher than corresponding surface values, while lower for alkalinity and hardness. The differences in parameter concentrations between these depths were attributed to the reduced environment in association with anoxic/near anoxic conditions in bottom waters.

The concentrations of the chemical parameters and survey measurements for the field parameters were examined in reference to applicable state standards. The Pennsylvania water quality standards for the Clarion River (PADER 1994) provide for the protection of aquatic life with specific criteria for the protection of cold water fish (CWF). However, based on reviews of seasonal water temperature conditions and the existing fish community, the PADEP and PFBC have recommended that the specific criteria for the lower portion of the Clarion River (including Piney Project waters) be changed from CWF to WWF (warm water fish). As a result, the water quality parameters surveyed in 1999 were examined with respect to both CWF and WWF criteria. Parameter specific criteria are listed for 7 of the 10 surveyed parameters, including water temperature, dissolved oxygen (DO), pH, alkalinity, aluminum, iron, and manganese. Except for water temperature and DO, parameter specific criteria for CWF and WWF are the same.

Based on individual field measurements taken in May-October, water temperatures in the Piney Tailrace exceeded the CWF criteria on all survey dates, while all values fell within the WWF criteria. The same trend was evident at downstream locations, indicating the warm water nature of the lower Clarion River. DO values in the Piney Tailrace and at downstream locations (except at Piney Bridge on 7 September) were within the criteria for CWF, with values at all locations within the WWF criteria. Except on one survey (15 June), pH values in the Tailrace also were within the State criteria. At downstream river locations, excluding Deer Creek Transect, pH values on nearly all dates were $\geq$ 6.0 su. In most surveys, pH values at one or more Deer Creek Transect locations were less than the State criteria, reflecting the acidic inflow from Deer Creek. On all surveys, pH values in Piney and Deer creeks were consistently less than the State standard. Concentrations of total aluminum, manganese (except in July), and iron in the Tailrace were within the respective criteria in all surveyed months. The Tailrace value for manganese in July was 1.12 mg/l versus the State standard of $\leq$ 1.0 mg/l. Concentrations of iron at downstream locations, including Deer Creek and Deer Creek Transect, usually fell within respective criteria. Aluminum and manganese levels in both creeks and at one or more locations on Deer Creek Transect exceeded the State criteria. At downstream locations (Canoe Ripple and Callensburg) aluminum concentrations generally were within the criteria, while manganese values were at or near to the 1.0 mg/l standard. Although total alkalinity values <20 mg/l (the minimum numeric criteria) occurred in the Tailrace and at downriver locations, the values were considered natural conditions in the drainage.