Clarion County
Stormwater Management Plan

Adopted May 2011
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CLARION COUNTY
STORMWATER MANAGEMENT PLAN

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Section 1
Introduction

This stormwater management plan is the product of a collaborative effort between the varied stakeholders within the Act 167 Designated Watersheds in Clarion County, Pennsylvania. The Plan has been developed based upon the requirements contained within the Pennsylvania Stormwater Management Act, Act 167 of 1978, and guidelines established by the Pennsylvania Department of Environmental Protection (DEP). As described in the Act, a two-phased multi-year watershed specific study was to have been completed of individual watersheds in the County to determine hydrology and develop stormwater management models to base requirements on for each. Funding for the multi-year study was eliminated by DEP at the direction of the state legislature. This preempted the planning process. The Clarion County Commissioners, Clarion County Department of Planning and Development and the Clarion County Conservation District because of their long standing belief in the necessity of stormwater management (as evidenced by the prior inclusion of stormwater management requirements in the Clarion County Subdivision and Land Development Ordinance) decided to use completed elements of the study to update the County's stormwater management requirements to reflect the spirit and intent of Act 167. Generally, the study was undertaken to develop recommendations for improved stormwater management practices, to mitigate potential negative impacts by future land uses, and to improve conditions within impaired waters. Clarion County is very rural in nature with a declining population. The current population is approximately 39,000 persons. Pennsylvania Department of Community and Economic Development (DCED) data shows that the vast majority of the County's total land area, approximately 87% is undeveloped and most of that being forest or farmland. Residential land use is less than 1%. Industrial and commercial land use is also less than 1%. There is little industrial or commercial development beyond the Interstate 80 and State Route 68 corridor. Housing starts are less than 100 per year for new homes. As such, the primary stormwater concern is between adjoining properties or neighbor to neighbor. Pollution from urbanization, industrial or municipal sources accounts for 0.2% of impaired stream miles in Act 167 watersheds in Clarion County and is not a major problem. The specific goals of this plan are discussed in detail in the following section. This section introduces some basic concepts relating the physical elements of stormwater management, the hydrologic concepts, and the planning approach used throughout this study.

RAINFALL AND STORMWATER RUNOFF

Precipitation that falls on a natural landscape flows through a complex system of vegetation, soil, groundwater, surface waterways, and other elements as it moves through the hydrologic cycle. Natural events have shaped these components over time to create a system that can efficiently handle stormwater through evaporation, infiltration, and runoff. The natural system often sustains a dynamic equilibrium, where this hydrologic system evolves due to various ranges of flow, sediment movement, temperature, and other variables. Alterations to the natural landscape change the way the system responds to precipitation events. These changes often involve increasing impervious area, which results in decreased evaporation and infiltration and increased runoff. The increase in stormwater runoff is manifested in runoff quantity, or volume, and runoff rate. These two factors cause the natural system to change beyond its natural dynamic equilibrium, resulting in negative environmental responses such as accelerated erosion, greater or more frequent flooding, increased nonpoint source pollution, and degradation of surface waters. Decreased infiltration means less groundwater recharge which in turn leads to altered dry weather stream flow.

Some level of stormwater runoff occurs as the infiltrative capacity of the surface is exceeded. This occurs even in undisturbed watersheds. However, the volume and rate of runoff are substantially increased as land development occurs. Stormwater management is a general term for practices used to reduce the impacts of this accelerated stormwater runoff. Stormwater management practices such as detention ponds and infiltration areas are designed to mitigate the negative impacts of increased runoff. Volume of

runoff and rate of runoff are often referred to by the term "water quantity". Water quantity controls have been a mainstream part of stormwater management for years. Another aspect of runoff is water quality. This refers to the physical characteristics of the runoff water. Common water quality traits include temperature, total suspended solids, salts, and dissolved nutrients. Water quality is an emerging topic in stormwater management and the general water resources field. Both water quantity and water quality can contribute to degradation of surface waters.

As development has increased, so has the problem of managing the increased quantity of stormwater runoff. Individual land development projects are frequently viewed as separate incidents, and not necessarily as an interconnected hydrologic and hydraulic system. This school of thought is exacerbated when the individual land development projects are scattered throughout a watershed (and in many different municipalities). Therefore, given the distributed and cumulative nature of the land alteration process, a comprehensive (i.e., watershed-level) approach must be taken if a reasonable and practical management and implementation approach or strategy is to be successful.

Watersheds are an interconnected network in which changes to any portion within the watershed carry throughout system. There are a variety of factors that influence how runoff from a particular site will affect the overall watershed. Many of the techniques for managing stormwater within a watershed are unique to each watershed. An effective stormwater management plan must be responsive to the existing characteristics of the watershed and recognize the changing conditions resulting from planned development. In Pennsylvania, stormwater management is generally regulated on the municipal level, with varying degrees of coordination on types and levels of stormwater management required between adjoining municipalities. While land use regulation remains at the municipal level, the framework established within a watershed plan enables municipalities to see the impact of their regulations on the overall system, and coordinate their efforts with other stakeholders within the watershed.

WATERSHED HYDROLOGY

Under natural conditions, watershed hydrology is in dynamic equilibrium. That is, the watershed, its ground and surface water supplies, and resulting stream morphology and water quality evolve and change with the existing rainfall and runoff patterns. This natural state is displayed by stable channels with minimal erosion, relatively infrequent flooding, adequate groundwater recharge, adequate base flows, and relatively high water quality. When all of these conditions are present the streams support comparatively healthy, diverse and stable in-stream biological communities. The following is a brief discussion of the impact of development on these steam characteristics:

1. Channel Stability – In an undisturbed watershed, the channels of the stream network have reached an equilibrium over time to convey the runoff from its contributing area within the channels banks. Typically, the channel will be large enough to accommodate the runoff from a storm, the magnitude of which will occur approximately every 18-24 months. Disturbances, such as development, in the watershed disrupt this equilibrium. As development occurs, additional runoff reaches the streams more frequently. This results in the channel becoming unstable as it attempts to resize itself. The resizing occurs through bed and bank erosion, altered flow patterns, and shifting sediment deposits.
2. Flooding – When a watershed is disturbed and channel instability occurs, it results in increased localized flooding, and other associated problems. Overbank flows will occur more frequently until the channel reaches a new equilibrium. It is important to realize that this equilibrium may take many years to be attained once the new runoff patterns are in place. In watersheds with continuous development, a new equilibrium may not be reached. Additionally, floodplain encroachment and in-stream sediment deposits from channel erosion may exacerbate flooding.
3. Groundwater Recharge – In an undisturbed watershed, runoff is minimal. Natural ground cover, undisturbed soils, and uneven terrain provide the most advantageous conditions for maximum infiltration to occur. When development occurs, these favorable conditions are diminished, or

removed, causing more rainfall to become runoff that flows to receiving streams instead of infiltrating. Less water is retained in the watershed to replenish groundwater supplies.

4. Base Flows – Loss of groundwater recharge, as described above, leads to insufficient groundwater available to replenish stream flow during dry weather. As a result, streams that may have an adequate base flow during dry weather under natural conditions may experience reduced flow, or become completely dry, during periods of low precipitation in developed watersheds. Thermal degradation of the waterbody often accompanies the reduction of base flow originating from groundwater. This source of base flow is generally much cooler than surface water sources. The increase in water temperature can be detrimental to many ecological communities.
5. Water Quality – Stormwater from developed surfaces carries a wide variety of contaminants. Pesticides, herbicides, fertilizers, automotive fluids, hydrocarbons, sediment, detergents, bacteria, increased water temperatures, and other contaminants that are found on land surfaces are carried into streams by runoff. These contaminants affect the receiving streams in different way, but they all have an adverse impact on the quality of the water in the stream.
6. Stream Biology – Biological communities reflect the overall ecological integrity of a stream. The composition and density of organisms in aquatic communities responds proportionately to stressors placed on their habitat. Communities integrate the stresses over time and provide an ecological measure of fluctuating environmental conditions. The adverse impacts of improperly managed runoff and increased pollution are evident in the biological changes in impacted streams. When biological communities within a waterbody degrade the overall ecological integrity of the stream is also diminishing.

It is important to understand that watershed hydrology, rainfall, stormwater runoff, and all of the above characteristics are interconnected. The implications of this concept are far reaching. How we manage our watersheds has a direct impact on the water resources of the watershed. Any decision that affects land use has implications on stormwater management and, in turn, impacts the quality of the available water resources. The quality of water resources has an economic consequence as well as an effect on the quality of life in the surrounding areas. This understanding is at the core of current stormwater management approaches.

The stormwater management philosophy of this Plan is reflected in the technical standards: peak flow management, volume control, channel protection, and water quality management. The philosophy and the standards reflect an attempt to manage stormwater in such a way as to maintain the watershed hydrology as near to existing, or historical, conditions as possible.

- Provide an improved technology for environmental protection of receiving waters.
- Develop the full potential of environmentally sensitive site planning and design.
- Help build communities based on environmental stewardship.
- Reduce construction and maintenance costs of the stormwater infrastructure.
- Introduce new concepts, technologies, and objectives for stormwater management such as micromanagement and multifunctional landscape features (bioretention areas, swales, and conservation areas); mimic or replicate hydrologic functions; and maintain the ecological/biological integrity of receiving streams.
- Encourage flexibility in regulations that allows innovative engineering and site planning to promote smart growth principles.
- Encourage debate on the economic, environmental, and technical viability and applicability of current stormwater practices and alternative approaches.

LOW-IMPACT DEVELOPMENT AND STORMWATER MANAGEMENT

Low-Impact Development (LID) is an approach to land development that uses various land planning and design practices and technologies to simultaneously conserve and protect natural resource systems and reduce infrastructure costs. As the term applies to stormwater management, LID is an approach to managing stormwater in a manner similar to nature by managing rainfall at the source using uniformly distributed, decentralized, micro-scale controls. These concepts are the origin of many of the strategies identified to achieve the goals presented in this Plan.

7. The site design should be built around and integrate a site's pre-development hydrology;
8. The design focus should be on the smaller magnitude, higher frequency storm events and should employ a variety of relatively small, best management practices (BMPs);
9. These smaller BMPs should be distributed throughout a site so that stormwater is mitigated at its source;
10. An emphasis should be given to non-structural BMPs; and
11. Landscape features and infrastructure should be multifunctional so that any feature (e.g., roof) incorporates detention, retention, filtration, or runoff use.

Section 2
Goals and Objectives

Although this plan represents many things to many people, the principal purposes of the Plan are to protect human health and safety by addressing the impacts of future land use on the current levels of stormwater runoff and to recommend measures to control accelerated runoff to prevent increased flood damages or additional water quality degradation.

GOALS OF THIS PLAN

The overall objective of this Plan is to provide a plan for comprehensive watershed stormwater management throughout Clarion County. The Plan is intended to enable every municipality in the County to meet the intent of Act 167 through the following goals:

1. Manage stormwater runoff created by new development activities by taking into account the impacts from peak runoff rates and runoff volume.

2. Meet the legal water quality requirements under Federal and State laws.

3. Provide uniform stormwater management standards throughout Clarion County.

4. Encourage the management of stormwater to maintain groundwater recharge, to prevent degradation of surface and groundwater quality, and to protect water resources.

5. Preserve the existing natural drainage ways and water courses.

6. Ensure that existing stormwater problem areas are not exacerbated by future development and provide recommendations for improving existing problem areas.

STORMWATER PLANNING AND THE ACT 167 PROCESS

Recognizing the increasing need for improved stormwater management, the Pennsylvania legislature enacted the Stormwater Management Act (Act 167 of 1978). Act 167, as it is commonly referred to, enables the regulation of development and activities causing accelerated runoff. It encourages watershed based planning and management of stormwater runoff that is consistent with sound water and land use practices, and authorizes a comprehensive program of stormwater management intended to preserve and restore the Commonwealth's water resources.

The Act designates the Department of Environmental Resources as the public agency empowered to oversee implementation of the regulations and defines specific duties required of the Department. The Department of Environmental Resources was abolished by Act 18 of 1995. Its functions were transferred to the Pennsylvania Department of Conservation and Natural Resources (DCNR) and the Department of Environmental Protection (DEP). Duties related to stormwater management became the responsibility of DEP (Act 18 of 1995).

As described in Act 167, each county must prepare and adopt a watershed stormwater management plan for each watershed located in the county, as designated by the department, in consultation with the municipalities located within each watershed, and shall periodically review and revise such plan at least every five years. Within six months following adoption, and approval, of the watershed stormwater plan, each municipality must adopt or amend, and must implement such ordinances and regulations, including zoning, subdivision and development, building code, and erosion and sedimentation ordinances, as are necessary to regulate development within the municipality in a manner consistent with the applicable watershed stormwater plan and the provisions of the Act.

Section 2 – Goals and Objectives

Section 5 of Act 167 sets forth the Plan contents required for each Stormwater Management Plan. Section 5.b lists thirteen (13) elements to include in the Plan, and Section 5.c lists an additional two (2) elements for inclusion. The following table addresses these elements in Section 5 of Act 167, and presents the necessary information to inventory and address issues with stormwater management in the County.

SECTION 5b

(1) A survey of existing runoff characteristics in small as well as large storms, including the impact of soils, slopes, vegetation and existing development;

Because of the very rural nature of Clarion County, the very low percentages for existing residential (0.73%), industrial (0.18%), and commercial (0.3%) land uses and a continuing population decline (as noted in Section 3 of the Plan), small as well as large storms produce runoff characteristics governed primarily by land in forested or other vegetated states. The "Soil Survey of Clarion County, Pennsylvania", NRCS, 1958, summarizes drainage and runoff characteristics of the soils in the county. The NRCS's "Web Soil Survey" at http://websoilsurvey.nrcs.usda.gov/ provides detailed runoff data including hydrologic soil group designations for the soils within any areas of interest (AOI) of 10,000 acres or smaller within the county.

(2) A survey of existing significant obstructions and their capacities;

In consultations with the Clarion County Department of Planning and Development, the Clarion Conservation District, the municipalities and public meetings, a listing of obstructions was formulated in Section 5 of the Plan along with recommendations. Most of these were pipe culvert or road ditch related issues that are maintenance, sizing or design issues and not related to development. Stream blockage from deposition resulting from past strip mine sites is also a large factor.

(3) An assessment of projected and alternative land development patterns in the watershed, and the potential impact of runoff;

As noted in Section 3, the Clarion County Comprehensive Plan states residential development has been moderate over 31 years averaging only 111 housing units of all types per year, the majority of these are in scattered, very low density developments on large lots. The majority of the County is planned as "Rural Resource" and "Key Conservation" areas. "Rural Resource" areas allow for growth through low intensity land uses. "Key Conservation" areas constrain development in important areas adjacent to rivers and streams. Hence quantity, velocity and quality of runoff will not be significantly altered from the current state. There may be improvement as development takes place on previously surfaced mined land and active erosion is addressed. Present and proposed oil and gas development pose a significant risk to quantity and quality of water.

(4) An analysis of present and projected development in the flood hazard areas, and its sensitivity to damages from future flooding or increased runoff;

Section 3 provides a discussion and an analysis showing damages to existing development due to flood hazard areas caused by increased runoff in the watershed. Recommendations were made with measures to mitigate future damages in Section 6.

(5) Survey of existing drainage problems and proposed solutions;

In Section 5, results of a collection of drainage problems are listed by municipality. The proposed solution to most of them was proper maintenance, design and replacement of existing controls most of which are low cost issues.

(6) A review of existing and proposed stormwater collection systems;

At this time no new storm water collection systems are being proposed. Work is primarily focused on replacing existing infrastructure. As indicated in Section 3 of the Plan, only 10% of the daily rainfall values recorded between 1885 and 2009 exceeded 0.75 inches, which is well below any design standards currently specified in the County.

(7) An assessment of alternative runoff control techniques and their efficiency in the particular watershed;

Section 6 of the Plan identifies a variety of runoff control techniques available for use in all watersheds in the County. It references and expands upon the Pennsylvania Stormwater Best Practices Manual to identify innovative methods of controlling runoff. In addition, traditional engineering solutions such as drainage structure replacement, streambank restoration, etc. were also identified in situations where alternative runoff controls are not applicable.

(8) An identification of existing and proposed state, federal and local flood control projects located in the watershed and their design capacities;

Clarion County has no existing flood control projects and none are proposed.

(9) A designation of those areas to be served by stormwater collection and control facilities within a 10-year period, an estimate of the design capacity and costs of such facilities, a schedule and an identification of the existing or proposed institutional arrangements to implement and operate the facilities;
Because of no proposed significant land use changes and the lack of intense residential, commercial or industrial development, no new storm water collection or control facilities are proposed on a County level.
(10) An identification of flood plains within the watershed;
Flood insurance studies prepared under the National Flood Insurance Program were identified in Section 3.
(11) Criteria and standards for the control of stormwater runoff from existing and new development which are necessary to minimize dangers to property and life and carry out the purposes of this act;
Standards and criteria were developed in Section 6 which is to be implemented through the Model Ordinance.
(12) Priorities for implementation of action within each plan; and
In Section 8 of the Plan implementation is addressed. Three activities are priorities for Plan implementation: 1) Adoption of municipal ordinances that enable application of the Plan's provisions. 2) Review of drainage plans for all activities regulated by the Plan. 3) Enforcement of municipal regulations. Each municipality will need to determine how best to implement provisions of the Plan. In some cases it may be advantageous for multiple municipalities to implement the Plan cooperatively or on a County-wide basis.
(13) Provisions for periodically reviewing, revising and updating the plan.
Section 8 discusses the requirement of Section 5(a) of the Act that each plan must be reviewed and any necessary revisions made at least every five years after its initial adoption.
SECTION 5c
(1) Contain such provisions as are reasonably necessary to manage stormwater such that development or activities in each municipality within the watershed do not adversely affect health, safety and property in other municipalities within the watershed and in basins to which the watershed is tributary; and
With the adoption of the Model Stormwater Management Ordinance provided with this Plan, each municipality must enforce development, redevelopment, and other regulated activities consistent with the standards and criteria contained in the Model Ordinance. These standards and criteria have been developed to ensure regulated activities will not adversely affect health, safety, and property in the County.
(2) Consider and be consistent with other existing municipal, county, regional and State environmental and land-use plans.
Section 3 identifies several planning efforts which the County conducted in the past. These include watershed Act 167 Plans, comprehensive planning including open space planning and land use plans, and hazard mitigation planning.

Table 2.1. Elements of Act 167

PLAN ADVISORY COMMITTEE

Public participation by local stakeholders is an integral part of comprehensive stormwater management planning. Coordination amongst these various groups facilitates a more inclusive Plan, that is able to better address the variety of issues experienced throughout the county. Several Plan Adisory Committee meetings were facilitated throughout the development of this Plan.

A Plan Advisory Committee (PAC) was formed at the beginning of the planning process, as required by the Stormwater Management Act. The purpose of the PAC is to serve as an access for municipal input, assistance, voicing of concerns and questions, and to serve as a mechanism to ensure that inter-municipal coordination and cooperation is secured. The PAC consists of at least one representative from each of the municipalities within the county, the County Conservation District, and other representatives as appropriate. A full list of the PAC members can be found in the Acknowledgements section at the beginning of this Plan.

As per Act 167, the Committee is responsible for advising the county throughout the planning process, evaluating policy and project alternatives, coordinating the watershed stormwater plans with other municipal plans and programs, and reviewing the Plan prior to adoption. **Table 2.2** is a summary of the PAC meetings that were held throughout the planning process.

PAC Meeting	Purpose of Meeting	Meeting Dates
1	Phase 2 Start-up Meeting - Introduce the Phase 2 planning process. Emphasize the importance of full municipal involvement. Present summary of the data collection questionnaire from Phase 1.	6.18.2009
2	General review of draft PLAN: Gather general comments and feedback prior to finalization of the PLAN.	September – October 2010
3	Pre-hearing meeting: Review comments and responses to comments. Summarize implementation.	10.18.2010
Public Hearing	Conduct the hearing as required by Act 167 to present the PLAN to the public.	4.27.2011

Table 2.2. Summary of PAC Meetings

Section 3
Clarion County Description

Clarion County is located in northwest Pennsylvania adjacent to Forest, Jefferson, Armstrong, Butler, and Venango Counties. Redbank Creek forms the southern boundary of the county, and the Allegheny River forms a large portion of the western boundary. The county began settling after 1801 with Pennsylvania born Scots-Irish, Germanic and English heritage by way of the southwestern portion of the State. Clarion County was formed in 1839 from parts of Venango and Armstrong Counties. Settlement began in the southern portion of the county. The iron industry was strong between 1830 and 1860. After the Civil War, oil wells began to appear. Since then, clay mining and coal mining have been the major natural resource industries.

The general character of the surface is hilly -- almost mountainous -- near the water courses, and undulating in the uplands. Here and there on the line of the dividing ridges rise bold, isolated knobs, usually stream sources. Their crests are in most cases cleared and cultivated to the summit. The average elevation of the county is about 1300 feet above sea level. The lowest point in the county is 820 feet at the junction of Redbank Creek and the Allegheny River at the Clarion-Armstrong county line. The highest point, at 1912 feet, is the southern end of McNaughton Hill in Millcreek Township (Socolow, 1973). The summits in the southern portion of the county are typically higher than those in the north.

POLITICAL JURISDICTIONS

Clarion County is classified as a sixth class county and is comprised of 34 municipalities. The political jurisdictions include 12 boroughs and 22 second class townships. The County has a total population of 41,765 according to the 2000 census. Clarion Borough has the largest population with 6,185. Clarion Township and Washington Township are the only other municipalities to exceed 2,000 people (with 3,273 and 2,037, respectively). Brady Township has the smallest population with just 62 residents. Farmington Township is the largest municipality geographically with a total land area of 62.0 square miles which is followed by Porter Township with 44.5 square miles, while Callensburg Borough is the smallest covering just 0.2 square miles. Clarion Borough, located near the geographical center of the county, is the county seat and serves as the administrative headquarters of the County. The 34 Clarion County municipalities are listed with their associated land area in **Table 3.1**:

Townships	Area (mi^2)	Townships	Area (mi^2)	Boroughs	Area (mi^2)
Ashland Township	22.6	Millcreek Township	28.9	Callensburg Borough	0.2
Beaver Township	33.7	Monroe Township	29.5	Clarion Borough	1.5
Brady Township	1.7	Paint Township	20.5	East Brady Borough	0.8
Clarion Township	31.5	Perry Township	29	Foxburg Borough	0.3
Elk Township	31.3	Piney Township	17.8	Hawthorn Borough	1.1
Farmington Township	62	Porter Township	44.5	Knox Borough	0.6
Highland Township	19.1	Redbank Township	30.1	New Bethlehem Borough	0.5
Knox Township	17.5	Richland Township	15.1	Rimersburg Borough	0.4
Licking Township	17.4	Salem Township	16.1	Shippenville Borough	0.4
Limestone Township	37.7	Toby Township	28.9	Sligo Borough	1.4
Madison Township	27.1	Washington Township	32.5	St Petersburg Borough	0.3
				Strattanville Borough	0.5

Table 3.1. Clarion County Municipalities

LAND USE

Land use is a crucial component of stormwater management planning. An analysis of existing land use provides background information for estimating existing stormwater runoff. Existing land use and general development patterns are used to forecast future land use. General growth patterns and future land use is essential information used to develop stormwater management controls that are appropriate for a particular region.

EXISTING LAND USE

In 1980, the county's population was 43,362; by 2000, the population had decreased to 41,765. This represents a population reduction of around four percent (4%) over the 20 year time period. The U.S. Census Bureau Population Estimates Program (PEP) estimates a -5.5% population change from April 1, 2000 to July 1, 2009. However, population trends are not directly correlated with land used patterns. Though the population has declined, new development has continued to take place as residents relocate within the county, as new seasonal residents construct second homes, and as businesses and institutions expand and improve their facilities. The 2004 Clarion County Comprehensive Plan classified all the land uses within the county:

Description	Area (mi^2)	Area (%)
Residential	4.43	0.73%
Industrial	1.06	0.18%
Low Intensity	559.63	92.84%
Commercial	2.27	0.38%
State Lands	35.37	5.87%

Table 3.2. Clarion County Existing Land Use

It is noted that the "Low Intensity" classification includes agriculture, mining areas and low-density rural residential areas outside major corridors. The data shows that the vast majority of the county's land is undeveloped. Pennsylvania Department of Community and Economic Development (DCED) indicates that approximately 86.7% of the county's total land area is undeveloped, with most of this percentage devoted to forest and agricultural uses, while 13.3% of its land is considered developed.

The Comprehensive Plan examined land use in both 1968 and 1999-2000 survey at a county-wide scale which revealed only three areas of major change. Each of these areas is a major corridor connecting I-80 to population centers on the Route 322 corridor. The first area is PA Route 338 from Exit 7 to the Borough of Knox where there are four commercial clusters and one concentration of industrial use. The second area is Route 66, from Exit 8 to Shippenville, that is virtually continual industrial and commercial uses from the interchange to one mile north and from Route 322 south for about three-quarters of a mile. Finally, Exit 9 is now dominated by commercial uses from I-80 to the Clarion Borough line.

Forests and Publicly Owned Lands

Over 62% of the county land is identified as forested. Forested land is the predominant, and single largest, land use category in the county. This category includes publicly-owned forest lands such as state forests, state parks, and state game lands, as well as privately-owned forest lands, including seasonal camps. Of the approximately 375 square miles of forest, publicly owned land makes up a considerable portion of this total. Another significant category of publicly owned land is the 11,758 acres of State Game Lands managed by the Pennsylvania Game Commission. There are three State Game Lands within the County.

State Game Lands	Area (ac)
SGL 63	3,413
SGL 72	2,025
SGL 74	6,320
TOTAL	11,758

In addition, Cook Forest State Park is a Pennsylvania State Park on 7,182 acres in Farmington Township. In total, public lands account for 5% of the entire county.

Farmlands

Prime farmland, as defined by the U.S. Department of Agriculture (USDA) in the National Soil Survey Handbook, is the land that is best suited to producing food, feed, forage, and fiber and oilseed crops. It has the soil quality, growing season, and water supply needed to economically produce a sustained high yield of crops when it is treated and managed using acceptable farming methods (NRCS, 2007). In 1972, the USDA tasked the Soil Conservation Service to inventory the prime and unique farmlands, and farmlands of state and local importance, to assist planners and other officials in their decision making to avoid unnecessary, irrevocable conversion of good farmland to other uses. Of Clarion County's total land area 16.9% (65,690 acres) are classified as prime farmland (NRCS, 2009). According to the USDA, prime farmland soils are usually classified as capability Class I or II.

Farmland soils of statewide importance are soils that are predominantly used for agricultural purposes within a given state, but have some limitations that reduce their productivity or increase the amount of energy and economic resources necessary to obtain productivity levels similar to prime farmland soils. Of Clarion County's total land area, 22.8% (88,719 acres) is classified as farmland of statewide importance (NRCS, 2009). These soils are usually classified as capability Class II or III.

The Comprehensive Plan showed 147 square miles (24.4% of the County) was in agricultural use in 1997. Farmland in the county declined by 18,045 acres between 1968 and 1999 (about 600 acres per year). Throughout Pennsylvania, this land is often lost to development. However, it seems that in many cases in Clarion County the land is simply no longer farmed and is reverting back to forested land.

Transportation

Transportation in the county has influenced the hydrology of the watersheds. Of the 1,406 miles of roadway, the 28 miles of Interstate 80 that crosses the county are the most important. Route 322, which crosses the county east-west, is the second most important. Route 66 is the principal north-south route and is classified as a minor arterial roadway. Route 68 is a minor arterial roadway connecting East Brady to Clarion to the northeast. Route 208 parallels I-80 from Grove City in the west, then heads northeast through Knox ending at Route 36. Route 36 traverses the northeast corner of Clarion County running northwest to southeast. These major thoroughfares and crossroads provide a critical transportation and commuting link for county residents. A review of land use patterns shows development is heavily clustered along these and other transportation networks. There has been a general shift in land-use pattern over time to conform to major roads serving the county and the presence of infrastructure to support intensive growth and development (Clarion County, 2004).

Only one rail line operates in the county (Knox and Kane Railroad) which is used solely for freight traffic and traffic is sporadic. The Clarion County Airport is the only airport in the county. There are no commercial services at the 5,000' field which has 8,000 operations per year, consisting of business and personal (recreational) use.

Industry

The Comprehensive Plan indicates industrial land use appears to have declined over the past several decades because of improvements in the way land-use is identified. It further contends that in reality industrial land use has been growing moderately but changing in character over this time period. Mining-related uses are declining and light industry is growing. Manufacturing industries within Clarion County tend to process natural resources, adding value to local raw materials.

The largest number of employers continues to be the lumber and wood industries. A good proportion of Clarion County's manufacturing employment is in the wood products sector (about 45% of all 1997 employment). The health care, retail and hospitality sectors are also important industries in the county. Perhaps most notably, Clarion University is an important economic force in the county. Its students help keep Clarion Borough vibrant. Also, the staff and faculty contribute greatly to the overall economy.

Residential Development

According to the 2004 Comprehensive Plan, residential development was rather moderate over the prior 31 years, absorbing only 424 acres. "Since 1980, the county has gained 2,226 housing units, or an average of 111 units per year." Major subdivisions of relatively high density are not common in the county. "Housing and demographic changes indicate higher levels of scattered, very low-density residential development." These trends indicate many county residents are choosing large-lot rural areas or small subdivisions.

FUTURE GROWTH PATTERNS

The future growth "core" area of the county is Clarion Borough and the surrounding areas. The 2004 Clarion County Comprehensive Plan identifies "Areas of Interest" which logically follow transportation routes from existing population centers that have public utility services. The core extends into the surrounding Townships of Clarion, Paint, Highland, Limestone and Monroe. Industrial and commercial growth is identified along routes which intersect I-80 creating interchanges. Specifically, industrial growth is planned for Route 68 from I-80 north toward Clarion, Route 338 from I-80 toward Knox, and along Paint Boulevard from I-80 to Route 322.

The majority of the county is planned as "Rural Resource" and "Key Conservation" areas. "Rural Resource Areas" allow for growth through low intensity land uses thereby preserving the rural character of agriculture and forest areas. "Key Conservation Areas" are important areas adjacent to rivers and streams, have steep slopes, and/or other development constraints. Because of these two areas, quantity, velocity and quality of runoff will not be significantly altered from the current state. There may be improvement as development takes place on previously surfaced mined land and active erosion is addressed. Present and proposed oil and gas development which are not regulated by the Plan pose a significant risk to quantity and quality of water.

CLIMATE

Clarion County is situated in the Central Mountain Plateau Climatic Divisions and the climate is classified as continental. As with most of Pennsylvania, the area is mostly affected by weather systems that develop in the Central Plains, or mid-west, and are carried by prevailing westerly winds. Canada is the primary source of cold air and the Gulf of Mexico is the main source of moisture. In general, the winters in Clarion County are cold and the summers are warm and sometimes hot. The average summer temperature is 66°F, while the maximum temperatures experienced in the summer is over 100°F. The county's average winter temperature is about 26°F while the minimum temperatures experienced often dips below 0°F. There are about 130 frost-free days during the year in Clarion County. Annual precipitation is more than 43". The average annual snowfall amounts to about 40" a year with snow covering the surface for an average of 80 days.

RAINFALL

Figures 3.1 and 3.2 show the rainfall statistics for Clarion County. The average rainfall, shown in **Figure 3.1** portrays the amount of precipitation throughout each year since 1885. Although there can be significant variation in the annual rainfall total (between 28 and 60 inches). While this variation can have a significant impact on water supply and vegetative growth, it is the quantity of rain in a relatively short time period (1-hour, 6-hour, 24-hour, 48-hour) that receives the focus of most stormwater regulations.

Figure 3.2 shows the annual maximum rainfall events recorded over the same time period graphed and the NOAA Atlas 14 values for the 2-year and 100-year storm events, derived using partial series data. The annual maximum rainfall for a station is constructed by extracting the highest precipitation amount for a

particular duration in each successive year of record. A partial duration series is a listing of period of record greatest observed precipitation depths for a given duration at a station, regardless of how many occurred in the same year. Thus, a partial data series accounts for various storms that may occur in a single year.

Historical focus on the annual maximum rainfall and the larger magnitude, low frequency storm events as done in previous stormwater planning efforts throughout Pennsylvania has lead to neglect of 1) the majority of storm events that are smaller than the annual maximum and their subsequent value to the landscape in terms of volume and water quality and 2) the fact that inclusion of every storm may increase the 24-hour rainfall total typically used in design.

The majority of rainfall volume in Clarion County comes from storms of low magnitudes. Only 10% of the daily rainfall values recorded between 1885 and 2009 exceeded 0.75 inches, which is below any design standards currently being used in the county. Thus, any stormwater policy should incorporate provisions such as water quality, infiltration, or retention BMPs that account for these small events. It is important to acknowledge that many of these smaller rainfall events lead to larger runoff events as they may be saturating the soils prior to a larger storm or occurring within a short time period that still overwhelm existing conveyance facilities.

For the gage shown in **Figure 3.1** and **3.2**, the NOAA Atlas 24-hour, 2-year storm event total of 2.5 inches was exceeded 66 times in 112 years of data. When analyzing only the annual maximum series, the NOAA Atlas 24-hour, 2-year storm was exceeded only 36 times. Analysis of these datasets results in 55% fewer events exceeding the 2-year storm when using only the annual maximum data. Viewing only the annual maximum series neglects a substantial number of significant historical rainfall events. The implication for stormwater policy in Clarion County is that best management practices should incorporate the NOAA Atlas 14, partial duration data series to ensure the best available data is being used for design purposes.

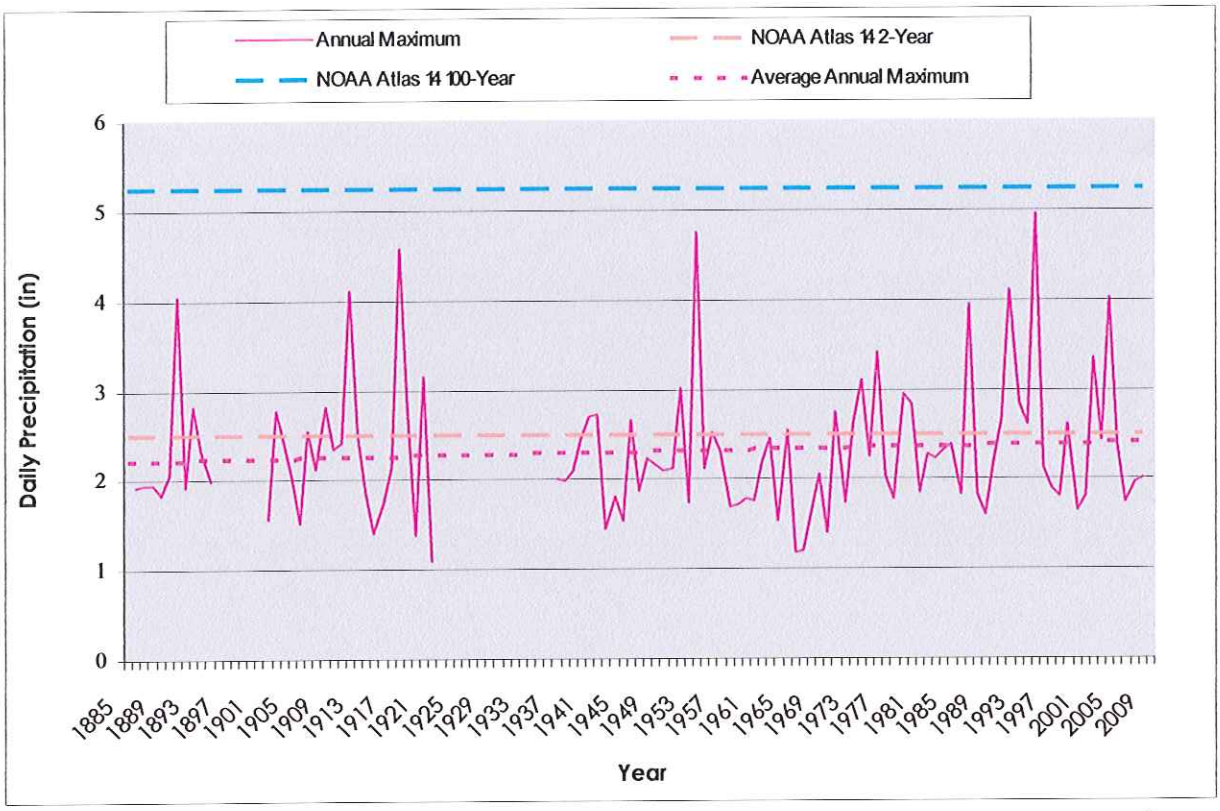


Figure 3.1. Annual Precipitation at Clarion 3 SW, Pennsylvania (Coop ID #361485)

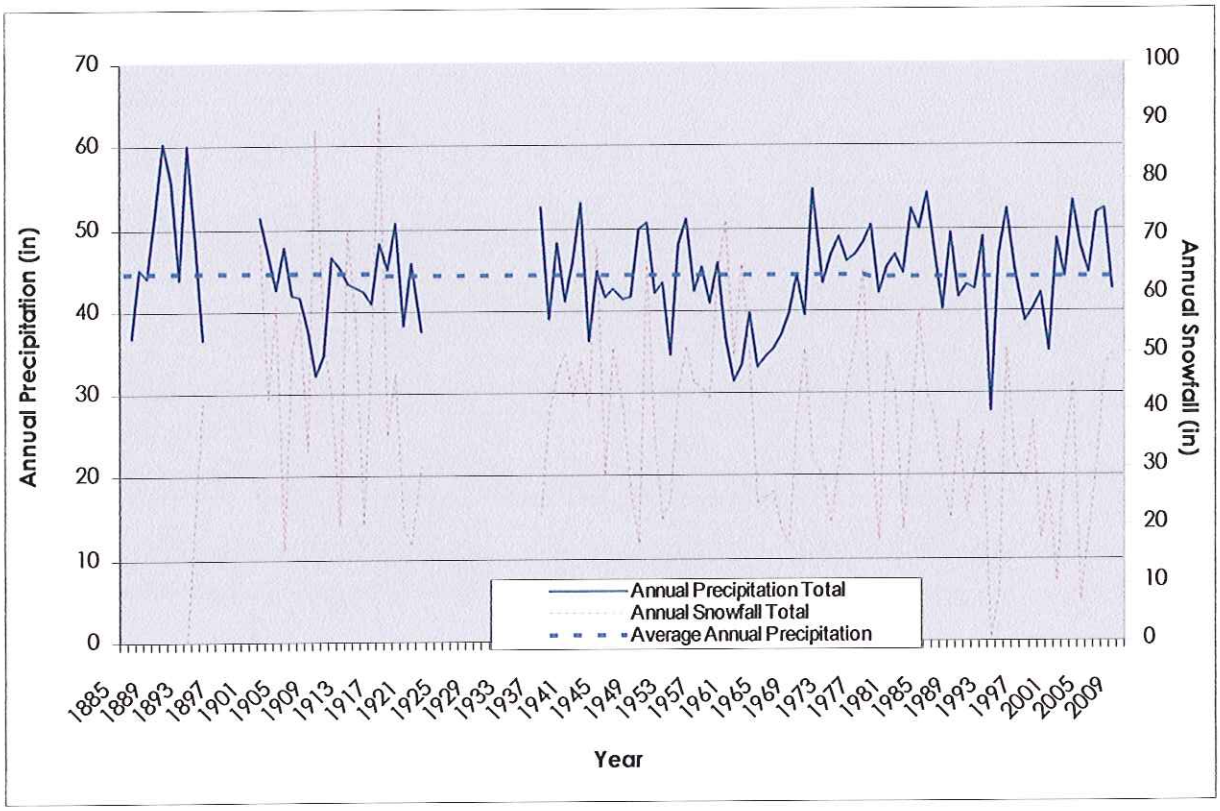


Figure 3.2. Daily Precipitation at Clarion 3 SW, Pennsylvania (Coop ID #361485)

Section 3 – Clarion County Description

GEOLOGY

Clarion County's present day surface forms were created through several geologic forces acting over many thousands of years. The land emerged from a prehistoric inland sea essentially as a plain comprised of water-deposited materials. Through the action of time and pressure, the earlier deposits of sand, clay, silt, and carboniferous (plant) materials were formed into the sandstone, shale, limestone, and coal strata which make up the bedrock stratigraphy of the area.

Clarion County is located almost entirely in the Pittsburgh Low Plateau Section of the Appalachian Plateaus Physiographic Province, with the very northern part of the county in the High Plateau Section of the same Province. The Appalachian Plateaus Physiographic Province is by far the largest province in the state. It contains mostly rock that is not faulted and folded but site relatively flat. Many of the folds that do exist in this province are high amplitude and stretch for miles. The dominant topographic form of the Pittsburgh Low Plateau Section is a smooth to irregular, undulating surface with narrow, relatively shallow, valleys. Strip mines and reclaimed mine land is also common. It has low (101 to 300 feet) to moderate (301 to 600 feet) local relief and a dendritic drainage pattern. The High Plateau Section is characterized by broad, rounded to flat uplands having deep, angular valleys. The local relief is moderate (301 to 600 feet to high (601 to 1,000 feet) with a dendritic drainage pattern (Sevon, 2000). The areas within the Appalachian Plateua Physiographic Province are further described as follows:

High Plateau Section – The small portion of the county lies within this Section toward the southwestern corner. The High Plateau Section consists of broad, rounded to flat uplands cut by deep angular valleys. The uplands are underlain by flat-lying sandstones and conglomerates. Local relief

between valley bottoms and adjacent uplands can be as much as 1,000', but is generally in the area of half that amount. Elevations in the Section range from 980' to 2,360'. The western boundary of the Section is the Late Wisconsinan glacial border. The area between this border and the Allegheny River a few miles to the east was glaciated by pre-Wisconsinan glaciers. A large part of the Section is covered by trees of the Allegheny National Forest.

Pittsburg Low Plateau Section – This section consists of a smooth undulating upland surface cut by numerous, narrow, relatively shallow valleys. The uplands are developed on rocks containing the bulk of the significant bituminous coal in Pennsylvania. The landscape reflects this by the presence of some operating surface mines, many old stripping areas, and many reclaimed stripping areas. The local relief on the uplands is generally less than 200'. Local relief between valley bottoms and upland surfaces may be as much as 600'. Valley sides are usually moderately steep except in the upper reaches of streams where the side slopes are fairly gentle. Elevations range from 660 to 1,700'.

BEDROCK FORMATIONS

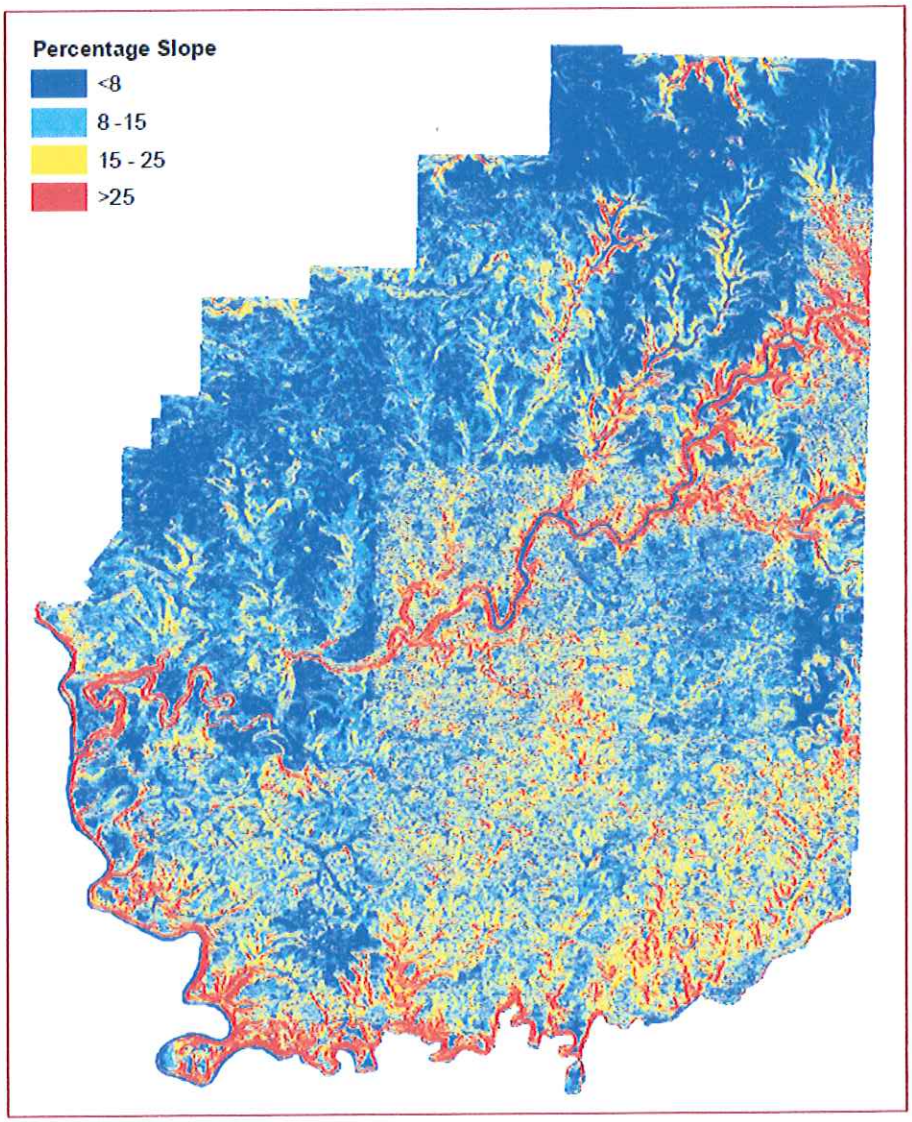
Bedrock in Clarion County includes seven different geologic formations that were formed primarily in the Pennsylvanian geologic period but also the older Mississippian and Devonian periods. The older formations are found mostly in the river valleys. The primary lithology of these formations is sandstone and shale. Less dominant lithologies include conglomerate, shale, siltstone, limestone, clay, coal, and claystone. The vast quantity of coal in the county, and all of Pennsylvania, was formed during the Mississippian and Pennsylvanian periods. The 64 million years of time during these two periods is called the Carboniferous time (Barnes and Sevon, 2002). The bedrock formations in the county are as follows (Berg et al., 1980):

Formation	Dominant Lithology	% of County
Allegheny Formation	Sandstone	48.3%
Burgoon Sandstone through Cuyahoga Group, undifferentiated	Sandstone	3.7%
Glenshaw Formation	Shale	1.9%
Pottsville Formation	Sandstone	43.6%
Shenango Formation	Sandstone	0.1%
Shenango Formation through Cuyahoga Group, undivided	Sandstone	0.3%
Shenango Formation through Oswayo Formation, undivided	Sandstone	2.2%

Table 3.3. Geologic Formations

SLOPES

The slope of the land not only delineates drainage patterns, but it is an indication of suitable land uses and the ability to develop land. Clarion County's land area is comprised of varying degrees of slope, ranging from nearly level plateaus to severe slopes. The general characteristics and development potentials and limitations of each category of slope are described as follows:



Slopes with grades of 15% or greater are considered steep. If disturbed, these areas can yield heavy sediment loads on streams. Very steep slopes, with over 25% grade, produce heavy soil erosion and sediment loading. Of the County's total land area, approximately one-third (36%) is classified as having flat to moderate slopes of 8% or less. This slope range has vey few associated land use restrictions. Slope values are broken into four general categories and shown in **Table 3.4** below. Also shown is the total area in Clarion County within each category, the total area as a percentage of all land in the county, and the general slope restrictions associated with each category.

Slope Classification	Slope Range	Land Area (mi^2)	Portion of Total Area	Slope Restrictions
Flat to Moderate	0-8%	219.0	36.0	Capable of all normal development for residential, commercial, and industrial uses; involves minimum amount of earth moving; suited to row crop agriculture, provided that terracing, contour planting, and other conservation practices are followed
Rolling Terrain and Moderate Slopes	8 - 15%	198.2	32.6	Generally suited only for residential development; site planning requires considerable skill; care is required in street layout to avoid long sustained gradients; drainage structures must be properly designed and installed to avoid erosion damage; generally suited to growing of perennial forage crops and pastures with occasional small grain plantings
Steep slopes	15 - 25%	132.2	21.8	Generally unsuited for most urban development; individual residences may be possible on large lot areas, uneconomical to provide improved streets and utilities; overly expensive to provide public services; foundation problems and erosion usually present; agricultural uses should be limited to pastures and tree farms
Severe and Precipitous Slopes	> 25%	58.1	9.6	No development of an intensive nature should be attempted; land not to be cultivated; permanent tree cover should be established & maintained; adaptable to open space uses (recreation, game farms, & watershed protection)

Table 3.4. Summary of Slopes in Clarion County

SOILS

The behavior of a soil's response to rainfall and infiltration is a critical input to the hydrologic cycle and in the formation of a coherent stormwater policy. The soils within Clarion County have variable drainage characteristics and have various restrictions on their ability to drain, promote vegetative growth, and allow infiltration. The following describes the predominant soil series in Clarion County (NRCS, 2009).

Series Name	Map Symbols	Hydrologic Soil Group	% of County	Restrictions
Aeric Epiaquents	293B	C	0.7	
Bethesda	193F, 93B, 93D	C	9	
Itmann	190D	B	0.1	
Sewell	92B, 92D	C	0.3	
Udorthents	90B	C	<0.1	
Armagh	Aa, Ab, Ac, Ad, Ae	D	1.8	Paralithic bedrock (40-72in.)
Atkins	Af	B/D	1.3	Lithic bedrock (60-99in.)
Brinkerton	Ba, Bb, Bc	D	0.9	Fragipan (0-0in.)
Cavode	Ca, Cb, Cc	C	1	Paralithic bedrock (40-72in.)
Cavode variant	Cd	C	<0.1	Paralithic bedrock (40-72in.)
Cavode	Ce, Cf	C/D	6.8	Paralithic bedrock (40-90in.)
Cavode variant	Cg, Cgc	C	<0.1	Paralithic bedrock (40-72in.)
Cavode	Ch, Ck, Cl	C/D	3.5	Paralithic bedrock (40-90in.)
Cookport	Cla, Clb, Clc, Cld, Cle, Clf, Clg	C	10.6	Fragipan (0-0in.)
Cavode	Cm, Cn, Co, Cp	C	1.5	Paralithic bedrock (40-72in.)
Clymer	Cr, Cs, Ct, Cu, Cv	B	1	Lithic bedrock (40-54in.)
Cookport	Cw, Cx, Cy, Cz	C	2.6	Lithic bedrock (40-72in.)
Hazleton	Da, Db, Dc	B	2.4	Lithic bedrock (40-80in.)

Series Name	Map Symbols	Hydrologic Soil Group	% of County	Restrictions
Dekalb	Dd, De, Df, Dg, Dh, Dk, Dl, Dm, Dn, Do	C	2.5	Lithic bedrock (20-40in.)
Hazleton	Dp, Dr	B	0.2	Lithic bedrock (40-80in.)
Dekalb	Ds, Dt, Du, Dv	C	12	Lithic bedrock (20-40in.)
Ernest	Ea, Eb, Ec, Ed, Ee, Ef, Eg	C	8.6	
Gilpin	Ga, Gb, Gc	C	0.6	Lithic bedrock (20-40in.)
Weikert	Gd	C	<0.1	Paralithic bedrock (10-20in.)
Gilpin	Ge, Gf, Gg	C	2.7	Lithic bedrock (20-40in.)
Weikert	Gh	C	0.1	Paralithic bedrock (10-20in.)
Gilpin	Gk, Gl	C	1	Lithic bedrock (20-40in.)
Chenango	Gla, Glb	A	0.1	
Weikert	Gm, Gn, Go	C	2.3	Paralithic bedrock (10-20in.)
Gilpin	Gp, Gr, Gs, Gt	C	3.1	Lithic bedrock (20-40in.)
Weikert	Gu, Gv, Gw	C	2.7	Paralithic bedrock (10-20in.)
Gilpin	Gx, Gy	C	0.7	Lithic bedrock (20-40in.)
Ginat	Gz	D	0.1	
Allegheny	Ha, Hb, Hc	B	0.3	
Land fill	LF	C	<0.1	
Leetonia	La, Lb	C	0.9	Lithic bedrock (40-60in.)
Cookport	Lc, Ld	C	1.2	
Brinkerton	Le	D	<0.1	Fragipan (0-0in.)
Monongahela	Ma, Mb, Mc, Md	C/D	0.5	Fragipan (25-35in.)
Nolo	Na, Nb, Nc	D	0.8	Lithic bedrock (40-60in.)
Philo	Pa, Pb	B	1.5	Lithic bedrock (40-40in.)
Pope	Pc	B	0.1	
Atkins	Pd	D	<0.1	
Pope	Pe	B	0.1	
Rayne	Ra, Rb, Rc	B	0.5	Lithic bedrock (40-40in.)
Sciotoville	Sa, Sb, Sc	C	0.7	Fragipan (18-38in.)
Shelocta	Sd, Se	B	<0.1	Lithic bedrock (48-99in.)
Tyler	Ta, Tb	D	0.1	Fragipan (18-32in.)
Culleoka	Wa, Wb, Wc	B	<0.1	Paralithic bedrock (20-40in.)
Wharton	We, Wf, Wg, Wh	C	0.6	Paralithic bedrock (40-40in.)
Wharton variant	Wk, Wl, Wm	C	0.2	Paralithic bedrock (40-40in.)
Wheeling	Wn, Wo, Wp, Wr, Ws, Wt	B	0.5	
Pits	GP		<0.1	
Pits	QU		<0.1	Lithic bedrock (0-0in.)
Riverwash	Rv		<0.1	
Water	W		1.3	
Wet spots	193D		10	
Urban land	99B		<0.1	Dense material (10-10in.)

Table 3.5. Soil Characteristics of Clarion County (NRCS, 2009)

A very common impediment to drainage throughout Clarion County is the presence of lithic and paralithic bedrock (i.e., solid and weathered bedrock, respectively) close to the surface. Higher runoff rates and reduced infiltration capacity typically exist in soils underlain by these features. However, if the depth to bedrock is large enough, it may not impede drainage. An additional impediment to subsurface drainage is the presence of fragipan soils, typically a loamy, brittle soil layer that has minimal porosity and organic content and low or moderate in clay but high in silt or very fine sand. With fragipans, upwards of 60% of input water moves laterally above the fragipan layer (Ciolkosz and Waltman, 2000; NRCS, 2008). **Table 3.6** displays the proportion of fragipan and bedrock in Clarion County.

Restrictions	% of County
Dense material	0 %
Paralithic bedrock	20.0 %
Lithic bedrock	36.5 %
Fragipan	12.0 %
None Identified	31.4 %

Table 3.6. Soil Restrictions in Clarion County

An additional indicator of the response to rainfall of the soils in Clarion County is the hydrologic soil group assigned to each soil. This classification varies between A which has very low runoff potential and high permeability and D which typically has very high runoff potential and low impermeability. **Table 3.7** shows a summary of the hydrologic soil groups for Clarion County. Some soils have variable runoff potential depending on whether they are drained or undrained. For example, an agricultural field with tile drainage may decrease the runoff potential from hydrologic soil group D to hydrologic soil group A.

Hydrologic Soil Group	Runoff Potential	% of County
A	Low	0.1 %
B	Low to moderate	6.9 %
B/D		1.3 %
C	Moderate to high	61.6 %
C/D		14.9 %
D	High	3.9 %
Mining, Water, or Urban Land		11.3 %

Table 3.7. Hydrologic Soil Groups in Clarion County

Groundwater recharge rates are variable over time and space. In Pennsylvania, 80% of groundwater recharge occurs from November to May, with March typically having the greatest amount of recharge. Areas that receive the most recharge are typically those that get the most rainfall, have favorable surface conditions, and are less susceptible to the influences of high temperatures and thus evapotranspiration. Across Pennsylvania, mean-annual recharge values range from about 7-22 inches. Reese and Risser (2010) identified ranges for mean-annual recharge value based on Hydrologic Unit Code watershed boundaries. In Clarion County, these values fall into one of four ranges: 10.01-12 in, 12.01-14 in, 14.01-16 in, or 16.01-18 inches. The majority of the county is within either the 12.01-14 inch or 16.01-18 inch category.

HYDRIC SOILS

The analysis of hydric soils has recently become an important consideration when performing almost any kind of development review. These soils are important to identify and locate because they provide an approximate location where wet areas may be found. **Table 3.8**, on the following page, lists the hydric soils, as listed by NRCS, found in Clarion County.

Wetland areas are lands where water resources are the primary controlling environmental factor as reflected in hydrology, vegetation, and soils. Thus, the location of hydric soils is one indication of the potential existence of a wetland area. Wetland areas are protected by state law and should be examined before deciding on any type of development activity.

Bethesda very channery silt loam	Cavode stony silt loam	Nolo stony silt loam
Bethesda soils	Cookport channery silt loam	Philo fine sandy loam
Aeric Epiaquents	Cookport silt loam	Philo silt loam
Armagh silt loam	Cookport stony silt loam	Pope fine sandy loam
Armagh stony silt loam	Ernest silt loam	Pope silt loam
Atkins silt loam	Ginat silt loam	Riverwash
Brinkerton silt loam	Lickdale silt loam	Sciotoville silt loam
Brinkerton stony silt loam	Lickdale stony silt loam	Tyler silt loam
Cavode channery silt loam	Monongahela silt loam	Wharton silt loam
Cavode silt loam	Nolo silt loam	

Table 3.8. Hydric Soils in Clarion County

WATERSHEDS

Surface waters include rivers, streams and ponds, which provide aquatic habitat, carry or hold runoff from storms, and provide recreation and scenic opportunities. Surface water resources are a dynamic and important component of the natural environment. However, ever-present threats such as pollution, construction, clear-cutting, mining, and overuse have required the protection of these valuable resources.

Watersheds are delineated and subdivided for the sake of management and analysis. The physical boundaries of a watershed depend on the purpose of the delineation. Often times a watershed is called a "basin" but is also a "subbasin" to an even larger watershed. This indistinct nature often leads to confusion when trying to categorize watersheds. As show in **Figure 3.3**, DEP has divided Pennsylvania into seven different major river basins, based upon the major waterbody to which they are tributary. These include: Lake Erie Basin, Ohio River Basin, Genesee River Basin, Susquehanna River Basin, Potomac River Basin, Elk & Northeast / Gunpowder Rivers Basin, and Delaware River Basin.

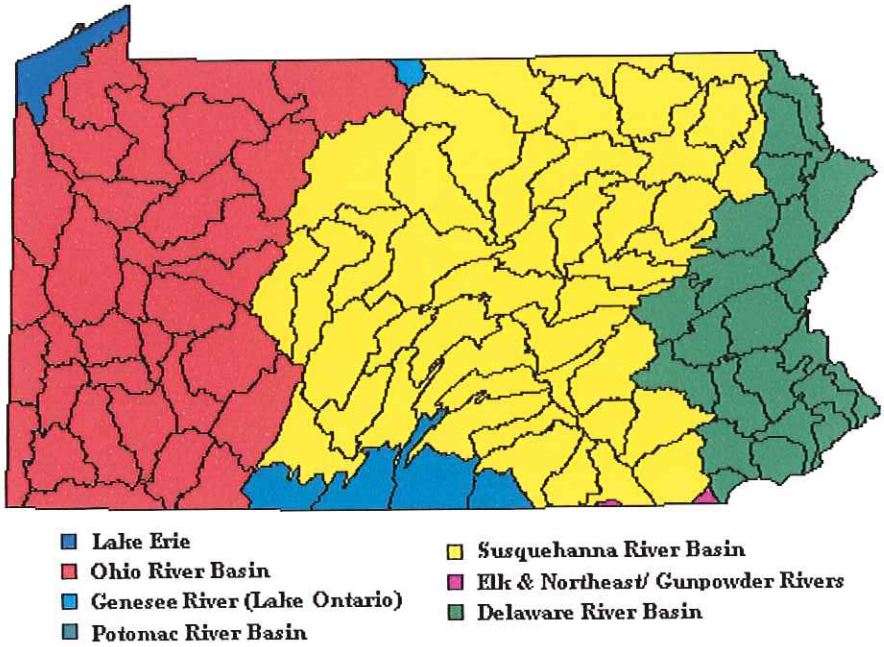


Figure 3.3. Pennsylvania's Major River Basins as Delineated by DEP (DEP, 2009)

For the purpose of this Plan, these are the largest basins within the Commonwealth. The major river basins are further divided into "subbasins" and "Act 167 Designated Watersheds" for stormwater

management purposes. Act 167 divided the Commonwealth into 29 subbasins and 357 designated watersheds. Clarion County lies entirely within the Ohio River Basin. The Ohio River Basin is divided into eleven subbasins (including direct discharges as a unique subbasin). However, the Act 167 Designated Watersheds within Clarion County are within three of these subbasins: Direct Discharges, Allegheny River, and Clarion River subbasins. The Allegheny River subbasin is so expansive that it is classified into several reaches. The county contains at least a portion of nine different Act 167 Designated Watersheds. This classification of the county's watersheds is summarized in **Table 3.9**:

Major River Basin	Subbasin (Reach)	Act 167 Designated Watershed
Ohio River Basin	Direct Discharges	Allegheny River
		Clarion River
	Allegheny River (From New York state line to confluence with Clarion River)	East Sandy Creek
		Tionesta Creek
	Allegheny River (From Clarion River to Kiskiminetas River)	Redbank Creek
	Clarion River	Deer Creek
		Licking Creek
		Piney Creek
		Toms, Cather, Maxwell, Blyson, McCanna Runs

Table 3.9. Classification of Clarion County Watersheds

ACT 167 DESIGNATED WATERSHEDS

All runoff in Clarion County is tributary to one of nine Act 167 Designated Watersheds. Each of these basins drains surface water into the major streams and rivers running through the county. Nearly half of the county (47%) lies within two of these watersheds: Redbank Creek and Clarion River (Direct Discharges). All of the Act 167 Designated Watersheds in the county are listed in **Table 3.10** along with the total area of each watershed (as delineated within Pennsylvania) and the area of the watershed that is within Clarion County. These watersheds are depicted in **Figure 3.4**.

Watershed	Total Area (mi^2)	Area within County (mi^2)
Allegheny River	1556.1	57.1
Clarion River	823.9	187.4
Deer Creek	74.1	74.1
East Sandy Creek	103.2	25.1
Licking Creek	52.1	52.1
Piney Creek	71.4	71.3
Redbank Creek	175.6	97.9
Tionesta Creek	478.6	18.6
Toms, Cather, Maxwell, Blyson, McCanna Runs	40.2	23.8

Table 3.10. Act 167 Watershed Areas in Clarion County

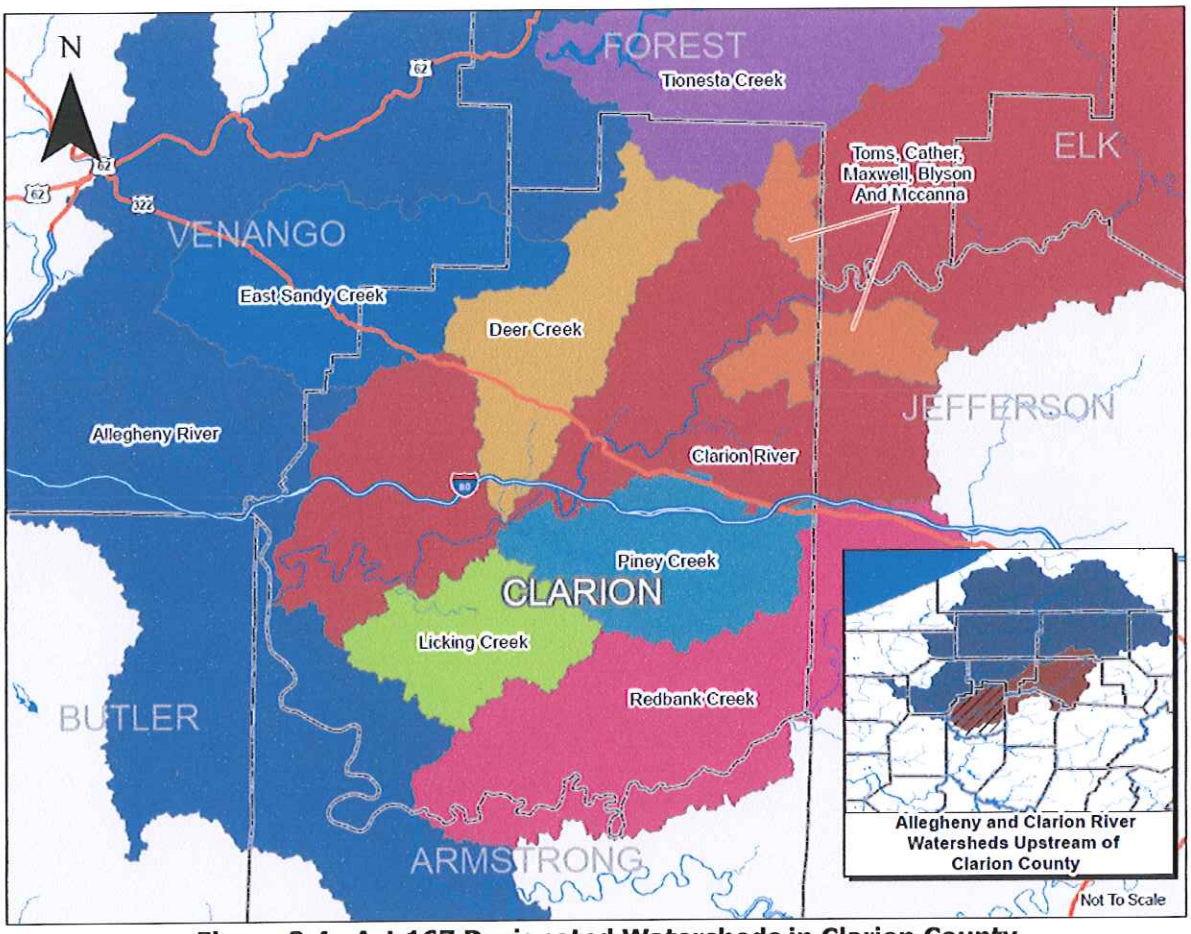


Figure 3.4. Act 167 Designated Watersheds in Clarion County

Clarion River

The Act 167 Designated Clarion River watershed is composed of direct discharges to the Clarion River that are not included in any other Act 167 designated watersheds. This includes the main stem of the Clarion River and various minor tributaries. The Clarion River has 16 major tributaries with a drainage area of greater than 25 square miles. There are six Act 167 Designated Watersheds that are directly tributary to the Clarion River.

This 823.9 square mile watershed stretches across McKean, Elk, Forest, Jefferson, and Clarion Counties. The Clarion River begins in the headwater reaches of East Branch Clarion River and West Branch Clarion River in southern McKean County. These two branches join in Johnsonburg, Elk County and flow southwest towards Ridgway. From the confluence of the East and West Branches, the river flows 101 miles in a generally southwest direction before joining the Allegheny River at the Clarion-Armstrong county border, just north of Parker, PA. Just under one-quarter (i.e. 23%) of the watershed lies within Clarion County. **Table 3.11** lists the municipalities within the watershed and their contributing area.

Watershed	Municipality	Area (mi^2)
Clarion River	Ashland Township	6.4
	Beaver Township	28.4
	Callensburg Borough	0.1
	Clarion Borough	1.6
	Clarion Township	18.2
	Elk Township	2.6
	Farmington Township	25.2
	Highland Township	19.2
	Knox Borough	0.6
	Knox Township	6.0
	Licking Township	11.7
	Millcreek Township	17.1
	Monroe Township	3.0
	Paint Township	11.9
	Perry Township	10.9
	Piney Township	2.8
	Richland Township	10.6
	Salem Township	10.8
	St Petersburg Borough	0.3
	Strattanville Borough	0.1

Table 3.11. Municipalities within the Clarion River Watershed

The landscape of the Clarion River watershed is comprised of irregular wooded hills and winding valleys. The upper part of the basin (above Clarion Borough) has narrow, steep-sided slopes and valleys with high hills. The Clarion River has a picturesque quality with diverse and mature vegetation and a sinuous channel (Clarion River Basin Commission, 1998).

Deer Creek

Deer Creek is one of the major tributaries of the Clarion River. This 74.1 square mile watershed, located in the north central part of the county, is one of only two Act 167 Designated Watersheds entirely within the county boundaries. The watershed begins in Washington and Farmington Townships, at the extreme northern part of the county. Deer Creek flows southwest from its origin, roughly paralleling Route 66, to its confluence with the Clarion River approximately 5.5 miles southwest of Clarion Borough.

Watershed	Municipality	Area (mi^2)
Deer Creek	Ashland Township	0.3
	Beaver Township	5.3
	Elk Township	26.3
	Farmington Township	8.9
	Knox Township	10.7
	Paint Township	8.6
	Shippenville Borough	0.3
	Washington Township	13.7

Table 3.12 Municipalities within the Deer Creek Watershed

Approximately three-quarters of the watershed is forested land, while less than 2% is classified as urban land. The majority of State Game Lands No. 63 is within this watershed as well as the developed areas of Marianne and Shippenville. The watershed has 149 miles in total stream length, giving it a stream density of 2.0 miles of stream per square mile of drainage area. The mean basin elevation is 1470 and the unadjusted basin slope is around 5.8%.

Licking Creek

Licking Creek is one of the major tributaries of the Clarion River. This 52.1 square mile watershed, located in the south central part of the county, is another one of the two Act 167 Designated Watersheds entirely within the county boundaries. Cherry Run joins Licking Creek immediately west of Callensburg Borough, less than a mile upstream from the confluence of Licking Creek and the Clarion River. The Cherry Run subbasin accounts for just over 40% of the total land area in this watershed. The headwaters of Licking Creek are found Monroe and Porter Townships. From there it flows west southwest towards Sligo Borough. Little Licking Creek joins the main stem immediately west of Sligo before continuing west southwest towards Callensburg where the channel turns north and flows into the Clarion River.

Watershed	Municipality	Area (mi^2)
Licking Creek	Callensburg Borough	0.1
	Licking Township	6.5
	Madison Township	0.1
	Monroe Township	7.8
	Perry Township	4.1
	Piney Township	10.0
	Porter Township	2.5
	Rimersburg Borough	0.3
	Sligo Borough	1.4
	Toby Township	19.3

Table 3.13. Municipalities within the Licking Creek Watershed

Just over half (55%) of the watershed is forested land and less than 2% is classified as urban land. The watershed has 95 miles in total stream length, giving it a stream density of 1.8 miles of stream per square mile of drainage area. The mean basin elevation is 1330 and the unadjusted basin slope is around 7.3%.

IMPOUNDMENTS

There are several impoundments located within the County. Piney Hydroelectric Dam operated by Brookfield Power impounds approximately 16 miles of the Clarion River forming Piney Lake, an 800-acre lake with a normal maximum pool elevation of 1093 feet above mean sea level. Completed circa 1924, the dam is constructed of reinforced concrete and has a maximum height and total length of 139 feet and 771 feet, respectively. The maximum depth of Piney Lake at the dam is 89 feet. Kahle Lake, located on the Venango-Clarion County border, is a 251-acre reservoir owned by the Commonwealth of Pennsylvania and managed by the Fish & Boat Commission.

SURFACE WATER QUALITY

Water Quality Standards for the Commonwealth are addressed in The Pennsylvania Code, Title 25, Chapter 93. Within Chapter 93, all surface waters are classified according to their water quality criteria

and protected water uses. According to the antidegradation requirements of §93.4a, "Existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected." Certain waterbodies which exhibit exceptional water quality and other environmental features, as established in §93.4b, are referred to as "Special Protection Waters." These waters are classified as High Quality or Exceptional Value waters and are among the most valuable surface waters within the Commonwealth. Activities that could adversely affect surface water are more stringently regulated in those watersheds than waters of lower protected use classifications. The existing water quality regulations are discussed in more detail in **Section 4 – Existing Stormwater Regulations and Related Plans**.

Clarion County streams are shown with their Chapter 93 protected use classification in **Figure 3.6** below. (This figure is provided for reference only; the official classification may change and should be checked at: http://www.pacode.com/index.html) An explanation of the protected use classifications can be found in **Section 4**.

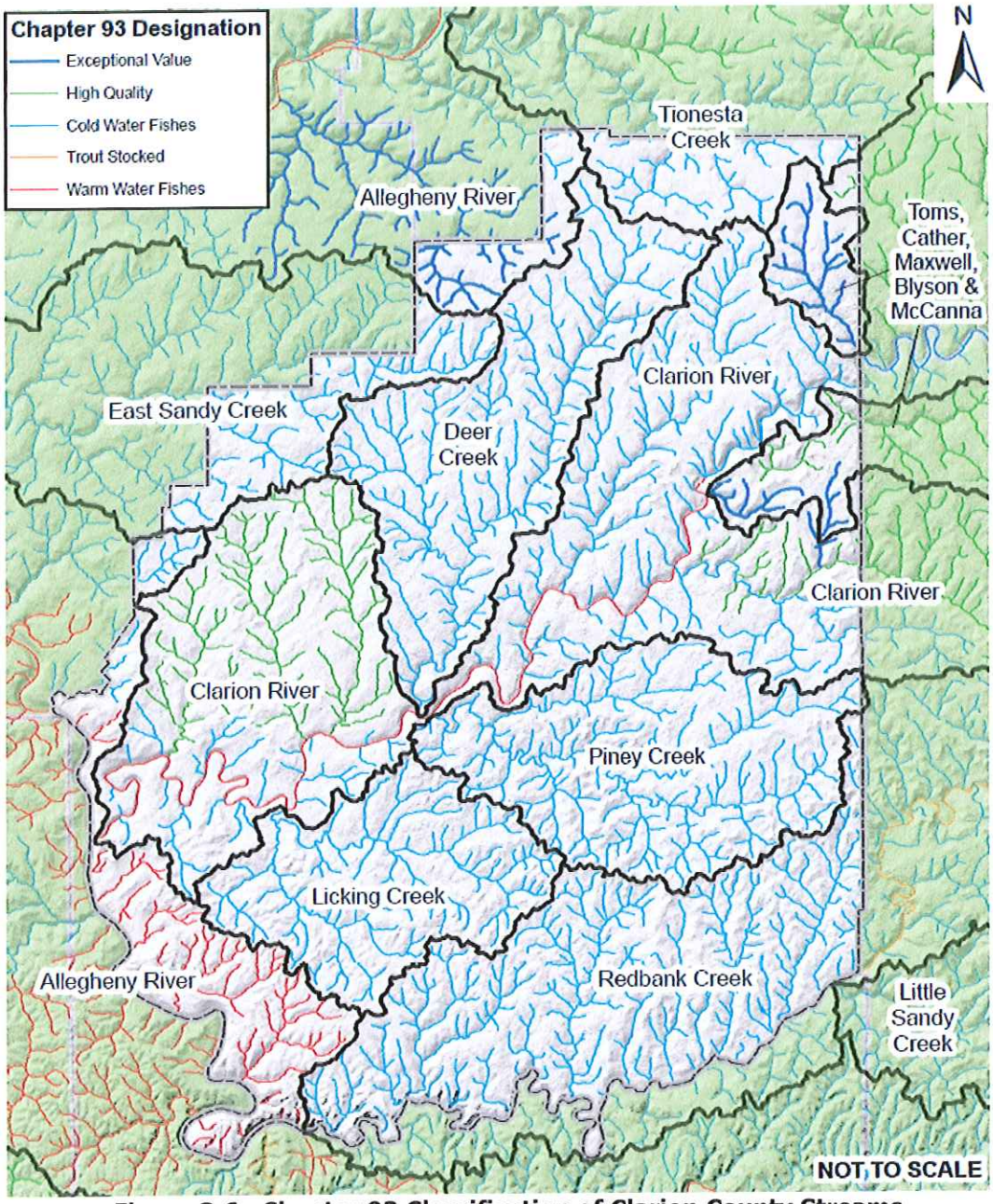


Figure 3.6. Chapter 93 Classification of Clarion County Streams

In Pennsylvania, bodies of water that are not attaining designated and existing uses are classified as "impaired". Water quality impairments are addressed in **Section 7** of this Plan. A summary of the impaired waters within Clarion County is also included in that section.

FLOODPLAIN DATA

A flood occurs when the capacity of a stream channel to convey flow within its banks is exceeded and water flows out of the main channel onto and over adjacent land. This adjacent land is known as the floodplain. For convenience in communication and regulation, floods are characterized in terms of return periods, e.g., the 50-year flood event. In regulating floodplains, the standard is the 100-year floodplain, the flood that is defined as having a 1 percent chance of being equaled or exceeded during any given

year. These floodplain maps, or Flood Insurance Rate Maps (FIRMs), are provided to the public (http://msc.fema.gov/) for floodplain management and insurance purposes.

In 2007, the Pennsylvania Emergency Management Agency (PEMA) completed a statewide study to determine damage estimates for all major flood events. The study computed damages in dollars for total economic loss, building and content damage, and also estimated the number of damaged structures (PEMA, 2009). **Table 3.14** summarizes the findings from this study.

Storm Event	Number of Buildings at Least Moderately Damaged	Total Economic Loss
10	66	$52.3 million
100	118	$64.9 million
500	157	$81.5 million

Table 3.14. Potential Impact Due to Flooding (PEMA, 2009)

According to the Federal Emergency Management Agency (FEMA) Community Status Book Report (FEMA, 2010a), all of the municipalities in Clarion County participate in the National Flood Insurance Program (NFIP) with the exceptions of Brady Township, and the Boroughs of Callensburg, Rimersburg, Shippenville, St. Petersburg and Strattanville. The Boroughs of Knox Rimersburg, Shippenville, St. Petersburg, and Strattanville are non-floodprone communities (FEMA, 2010b).

A Flood Insurance Study (FIS) report investigates the existence and severity of flood hazards for a given study area. A preliminary county-wide FIS for Clarion County was released on March, 31, 2010. According to FEMA Q3 data, 24.3 square miles of the county are within the Special Flood Hazard Area. Of this area, about 5% of the areas are detailed studies and 95% are covered by approximate studies.

Detailed Studies

There are various levels of detail in floodplain mapping. Detailed studies (Zones AE and A1-A30 on the flood maps) are conducted at locations where FEMA and communities have invested in engineering studies that define the base flood elevation and often distinguish sections of the floodplain between the floodway and flood fringe. See **Figure 3.7** on the following page for a graphical representation of these terms. The table to the right lists the streams that were studied by detailed methods (FEMA, 2010b).

Streams Studied by Detailed Methods
Allegheny River
Leisure Run
Licking Creek
Little Licking Creek
Redbank Creek

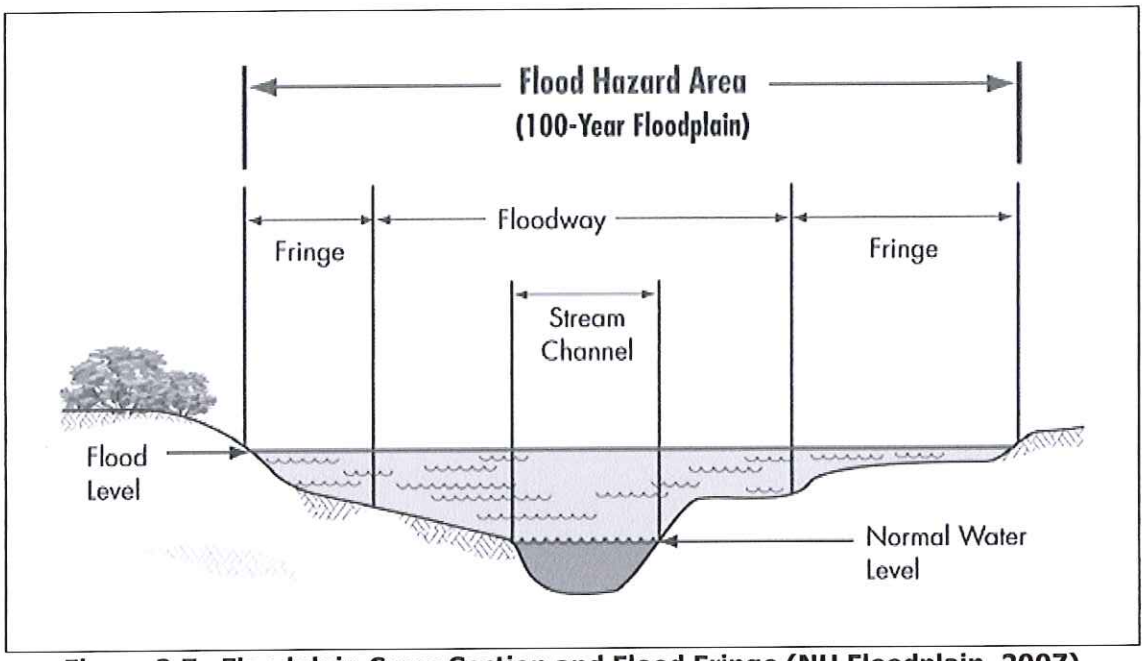


Figure 3.7. Floodplain Cross Section and Flood Fringe (NH Floodplain, 2007)

For a proposed development, most ordinances state that there shall be no increase in flood elevation anywhere within the floodway; the flood fringe is defined so that any development will not cumulatively raise that water surface elevation by more than a designated height (set at a maximum of 1'). Development within the flood fringe is usually allowed but most new construction is required to be designed for flooding (floodproofing, adequate ventilation, etc).

Approximate Studies and Non-delineated Floodplains

Approximate studies (Zone A on the DFIRM) delineate the flood hazard area, but are prepared using approximate methods that result in the delineation of a floodplain without providing base flood elevations or a distinction between floodway and flood fringe. If no detailed study information is available, some ordinances allow the base flood elevation to be determined based on the location of the proposed development relative to the approximated floodplain; at times, a municipality may find it necessary to have the developer pay for a detailed study at the location in question.

One limitation of FIRMs and older Flood Insurance Rate Maps is the false sense of security provided to home owners or developers who are technically not in the floodplain, but are still within an area that has a potential for flooding. Headwater streams, or smaller tributaries located in undeveloped areas, do not normally have FEMA delineated floodplains. This leaves these areas unregulated at the municipal level, and somewhat susceptible to uncontrolled development. Flood conditions, due to natural phenomenon as well as increased stormwater runoff generated by land development, are not restricted only to main channels and large tributaries. In fact, small streams and tributaries may be more susceptible to flooding from increased stormwater runoff due to their limited channel capacities.

Pennsylvania's Chapter 105 regulations partially address the problem of non-delineated floodplains. Chapter 105 regulations prohibit encroachments and obstructions, including structures, in the regulated floodway without first obtaining a state Water Obstruction and Encroachment permit. The floodway is the portion of the floodplain adjoining the stream required to carry the 100-year flood event with no more than a one (1) foot increase in the 100-year flood level due to encroachment in the floodplain outside of the floodway. Chapter 105 defines the floodway as the area identified as such by a detailed FEMA study or, where no FEMA study exists, as the area from the stream to 50-

feet from the top of bank, absent evidence to the contrary. These regulations provide a measure of protection for areas not identified as floodplain by FEMA studies.

Community Rating System (CRS)

To reduce flood risk beyond what is accomplished through the minimum federal standards, the NFIP employs the Community Rating System to give a credit to communities that reduce their community's risk through prudent floodplain management measures. Several of these measures coincide with the goals and objectives of this plan: regulation of stormwater management, preservation of open space, and community outreach for the reduction of flood-related damages.

Flood insurance premiums can be reduced by as much as 45% for communities that obtain the highest rating. Only 28 of the Commonwealth's 2500+ municipalities participate in the CRS. Currently, there are no municipalities within Clarion County participating in the CRS.

FIRM Updates

As new information becomes available, FEMA periodically updates the FIRMs to reflect the best available data and to address any new problem areas. Clarion County is currently in the process of completing a comprehensive FIRM update. All communities within the county will be shown on a single set of countywide FIRMs. Also, the new maps will have an updated base map that will greatly improve the accuracy of floodplain determinations and all floodplain boundaries will be updated. This includes a change to Digital Flood Insurance Rate Maps (DFIRMs) that will be compatible with Geographic Information Systems (GIS). Preliminary updated flood maps were released on March 31, 2010. This process will correspond with an effort by DCED to have all municipalities adopt and implement a new floodplain model ordinance that conforms to federal and state requirements.

Section 4

Existing Stormwater Regulations and Related Plans

It is often helpful to assess the current regulations when undertaking a comprehensive planning effort. An understanding of current and past regulations, what has worked in the past, and what has failed, is a key component of developing a sound plan for the future. Regulations affecting stormwater management exist at the federal, state, and local level. At the federal level the regulations are generally broad in scope, and aimed at protecting health and human welfare, protecting existing water resources and improving impaired waters. Regulations generally become more specific as their jurisdiction becomes smaller. This system enables specific regulations to be developed which are consist with national policy, yet meet the needs of the local community.

EXISTING FEDERAL REGULATIONS

Existing federal regulations affecting stormwater management are very broad in scope and provide a national framework within which all other stormwater management regulations are developed. An overview of these regulations is provided below in **Table 4.1**.

Clean Water Act	Section 303	Requires states to establish Total Maximum Daily Loads for point sources of pollution that are allowable to maintain water quality and protect stream flora and fauna. Other water quality standards (e.g., thermal) are also regulated.
Clean Water Act	Section 404	Regulates permitting of discharge of dredged or fill material into the waters of the United States. Includes regulation of discharge of material into lakes, navigable streams and rivers, and wetlands.
Clean Water Act	Section 401/402	Authorizes the Commonwealth to grant, deny, or condition Water Quality Certification for any licensed activity that may result in a discharge into navigable waters. Established the National Pollutant Discharge Elimination System (NPDES) that regulates any earth disturbance activity of 5 acres (or more) or 1 acre (or more) with a point source discharge.
Rivers and Harbors Act of 1899	Section 10	Regulates activities that obstruct or alter any navigable waters of the United States.
Federal Emergency Management Act		Requires that any proposed structure within the floodplain boundaries of a stream cannot cause a significant increase in the 100-year flood height of the stream.

Table 4.1. Existing Federal Regulations

EXISTING STATE REGULATIONS

Pennsylvania has developed stormwater regulations that meet the federal standards and provide a statewide system for stormwater regulation. State regulations are much more specific than federal regulations. Statewide standards include design criteria and state issued permits. State regulations, found in The Pennsylvania Code, Title 25, cover a variety of stormwater related topics. A brief review of the existing state regulations is provided below in **Table 4.2**.

Chapter 92	Discharge Elimination	Regulates permitting of point source discharges of pollution under the National Pollutant Discharge Elimination System (NPDES). Storm runoff discharges at a point source draining five (5) or more acres of land or one (1) or more acres with a point source discharge are regulated under this provision.
Chapter 93	Water Quality Standards	Establishes the Water Use Protection classification (i.e., water quality standards) for all streams in the state. Stipulates anti-degradation criteria for all streams.
Chapter 96	Water Quality Implementation Standards	Establishes the process for achieving and maintaining water quality standards applicable to point source discharges of pollutants. Authorizes DEP to establish Total Maximum Daily Loads (TMDLs) and Water Quality Based Effluent Limitations (WQBELs) for all point source discharges to waters of the Commonwealth.
Chapter 102	Erosion and Sediment Control	Requires persons proposing or conducting earth disturbance activities to develop, implement and maintain Best Management Practices to minimize the potential for accelerated erosion and sedimentation. Current DEP policy requires preparation and implementation of a post-construction stormwater management (PCSM) plan for disturbed areas of 1 acre or more.
Chapter 105	Dam Safety and Waterway Management	Regulates the construction, operation, and maintenance of dams on streams in the Commonwealth. Also regulates water obstructions and encroachments (e.g., road crossings, walls, etc.) that are located in, along, across or projecting into a watercourse, floodway, wetland, or body of water.
Chapter 106	Floodplain Management	Manages the construction, operation, and maintenance of structures located within the floodplain of a stream if owned by the State, a political subdivision, or a public utility.

Table 4.2. Existing State Regulations

STATE WATER QUALITY STANDARDS

Water Quality Standards for the Commonwealth are addressed in The Pennsylvania Code, Title 25, Chapter 93. Within Chapter 93, all surface waters are classified according to their water quality criteria and protected water uses. The following is an abbreviated explanation of these standards and their respective implications to this Act 167 plan.

General Provisions (§93.1 - §93.4)

The general provisions of Chapter 93 provide definitions, citation of legislative authority (scope), and the definition of protected and statewide water uses. DEP's implementation of Chapter 93 is authorized by the Clean Streams Law, originally passed in 1937 to "preserve and improve the purity of the waters of the Commonwealth for the protection of public health, animal and aquatic life, and for industrial consumption, and recreation," and subsequently amended. **Table 4.3** is a summary of the protected water uses under Chapter 93 that are applicable to Clarion County.

Protected Use	Relative Level of Protection	Description
Aquatic Life		
Warm Water Fishes (WWF)	Lowest	Maintenance and propagation of fish species and additional flora and fauna which are indigenous to a warm water habitat.
Trout Stocking Fishes (TSF)		Maintenance of stocked trout from February 15 to July 31 and maintenance and propagation of fish species and additional flora and fauna which are indigenous to a warm water habitat.
Cold Water Fishes (CWF)		Maintenance or propagation, or both, of fish species including the family Salmonidae and additional flora and fauna which are indigenous to a cold water habitat.
Special Protection		
High Quality Waters (HQ)		A surface water that meets at least one of chemical or biological criteria defined in §93.4b
Exceptional Value Waters (EV)	Highest	A surface water that meets at least one of chemical or biological criteria defined in §93.4b and additional criteria defined in §93.4b.(b)

Table 4.3. Chapter 93 Designations in Clarion County

Antidegradation Requirements (§93.4a - §93.4d)

According to the antidegradation requirements of §93.4a, "Existing in-stream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected." Certain waterbodies which exhibit exceptional water quality and other environmental features, as established in §93.4b and summarized in **Table 4.3**, are referred to as "Special Protection Waters." Activities that could adversely affect surface water are more stringently regulated in those watersheds than waters of lower protected use classifications. For WWF, TSF, or CWF waterbodies, many of the antidegradation requirements can be addressed using guidance provided in this plan and the DEP BMP Manual; for HQ or EV watersheds, the current regulations follow DEP's antidegradation policy.

For a new, or additional, point discharge with a peak flow increase to an HQ or EV water, the developer is required to use a non-discharge alternative that is cost-effective and environmentally sound compared with the costs of the proposed discharge. If a non-discharge alternative is not cost-effective and environmentally sound, the developer must use the best available combination of treatment, pollution prevention, and wastewater reuse technologies and assure that any discharge is non-degrading. In the case where allowing lower water quality discharge is necessary to accommodate important economic or social development in an area, DEP may approve a degrading discharge after satisfying a multitude of intergovernmental coordination and public participation requirements (DEP, 2003).

Water Quality Criteria (§93.6 - §93.8c)

In general, the water discharged form either a point source or a nonpoint source discharge may contain substances in a concentration that would be inimical or harmful to a protected water use. The specific limits for toxic substances, metals, and other chemicals are listed in this section.

Designated Water Uses and Water Quality Criteria (§93.9)

The designated use and water quality criteria for each stream reach or watershed is specified in §93.9. The majority of watersheds within Clarion County have a cold water fisheries designated use. This is also the leading designated use within the county, in terms of total miles, with almost 212 miles of stream designated as cold water fisheries and another 25.7 miles designated as High Quality – Cold Water Fisheries. **Table 4.4** below summarizes the designated uses of all stream uses in Clarion County.

Designated Use	Total Length (mi)	Percentage
Warm Water Fishes (WWF)	34.9	11.7%
Cold Water Fishes (CWF)	211.5	71.1%
High Quality CWF (HQ-CWF)	25.7	8.6%
Trout Stocking Fishes (TSF)	7.2	2.4%
Exceptional Value (EV)	18.3	6.2%

Table 4.4. Summary of Designated Uses for Clarion County Waters

On the following page, **Table 4.5** shows the Chapter 93 designated uses for Clarion County as defined by §93.9. This table was developed from the information contained in the Pennsylvania General Code. This information can be difficult to navigate in list form. A good resource for viewing stream designations graphically is DEP's internet based analytical mapping tool, *eMapPA* which can be accessed at the following website: http://www.emappa.dep.state.pa.us/emappa/viewer.htm

Stream (Zone)	Designated Use
Allegheny River (main stem, Clarion River to Kiskiminetas River)	WWF
Allegheny River (main stem, PA-NY state border to Clarion River)	WWF
Beaver Creek	HQ-CWF
Black Fox Run	WWF
Blyson Run	EV
Canoe Creek	HQ-CWF
Catfish Run	WWF
Cather Run	HQ-CWF
Clarion River (main stem, confluence of East and West Branches to inlet of Piney Lake at RM 37.4)	CWF
Clarion River (main stem, inlet of Piney Lake at RM 37.4 to mouth)	WWF
Courtleys Run	CWF
Deer Creek	CWF
Douglass Run	CWF
Dunlap Creek	WWF
Leatherwood Creek	CWF
Leisure Run	CWF

Stream (Zone)	Designated Use
Licking Creek	CWF
Little Mill Creek	CWF
Long Run	CWF
Mast Run	CWF
Maxwell Run	HQ-CWF
McCanna Run (Pendleton Run)	EV
Middle Run	CWF
Middle Run	CWF
Mill Creek (main stem, Little Mill Creek to mouth)	CWF
Mill Creek (source to Little Mill Creek)	HQ-CWF
Pine Creek	CWF
Piney Creek	CWF
Redbank Creek (main stem, confluence of Sandy Lick Creek and North Fork to mouth)	TSF
Reeds Run	CWF
Richey Run	CWF
Rock Run	CWF
Stroup Run	HQ-CWF
Toby Creek	CWF
Town Run	CWF
Trap Run	HQ-CWF
Trout Run	CWF
Turkey Creek	HQ-CWF
UNT to Allegheny River (RM 106.70 to Clarion River)	WWF
UNT to Clarion River (confluence of East and West Branches to inlet of Piney Lake at RM 37.4)	CWF
UNT to Clarion River (inlet of Piney Lake at RM 37.4 to mouth)	CWF
UNT to Mill Creek (Little Mill Creek to mouth)	HQ-CWF
UNT to Mill Creek (source to Little Mill Creek)	HQ-CWF
UNT to Redbank Creek (confluence of Sandy Lick Creek and North Fork to mouth)	CWF
Whites Run	CWF
Wildcat Run	CWF
Woods Run	HQ-CWF

Table 4.5. Clarion County Designated Water Uses

Water Quality Impairments and Recommendations

Additional to the Chapter 93 regulations, DEP has an ongoing program to assess the qualities of water in Pennsylvania and identify stream and other bodies of water that are not attaining the required water quality standards. These "impaired" streams, their respective designations, and the subsequent recommendations are discussed in Section 7.

EXISTING MUNICIPAL REGULATIONS

In Pennsylvania, stormwater management regulations usually exist at the municipal level. A review of the existing municipal regulations helps us unravel the complex system of local regulation and develop watershed wide policy that both fits local needs and provides regional benefits. **Table 4.6** provides a summary of existing regulations for the 34 municipalities within Clarion County.

Municipality	Zoning	Subdivision & Land Development (SALDO)
Ashland Township	NO	NO
Beaver Township	NO	NO
Brady Township	NO	NO
Callensburg Borough	NO	NO
Clarion Borough	YES	YES
Clarion Township	NO	NO
East Brady Borough	NO	NO
Elk Township	NO	NO
Farmington Township	NO	NO
Foxburg Borough	NO	NO
Hawthorn Borough	NO	NO
Highland Township	NO	NO
Knox Borough	NO	NO
Knox Township	NO	NO
Licking Township	NO	YES
Limestone Township	NO	NO
Madison Township	NO	NO
Millcreek Township	YES	NO
Monroe Township	NO	NO
New Bethlehem Borough	YES	YES
Paint Township	NO	NO
Perry Township	NO	NO
Piney Township	NO	NO
Porter Township	NO	NO
Redbank Township	NO	NO
Richland Township	NO	NO
Rimersburg Borough	YES	NO
Salem Township	NO	NO
Shippenville Borough	NO	NO
Sligo Borough	YES	NO
St Petersburg Borough	NO	NO
Strattanville Borough	NO	NO
Toby Township	NO	NO
Washington Township	NO	NO

Table 4.6. Clarion County Municipal Ordinance Matrix

EXISTING RELATED PLANS

Review of previous planning efforts is another important component of regional planning. An analysis of previous plans, and the results achieved through implementation of recommendations within those plans, provides invaluable information for current and future planning efforts. The following table is a summary of related plans:

Plan Title	Date	Author
Clarion County Comprehensive Plan	November 2004	Graney, Grossman, Colosimo and Associates, Inc. / Clarion County Planning Commission
Act 167 Storm Water Management Scope of Study, Piney Creek Watershed	May 1991	Clarion County Planning Commission

Table 4.7. Related Plans Review

Section 5
Significant Problem Areas and Obstructions

One of the stated goals of this Plan is to "ensure that existing stormwater problem areas are not exacerbated by future development and provide recommendations for improving existing problem areas." The strategy for achieving this goal required identification of the existing significant stormwater problem areas and obstructions, and than evaluation of the identified problem areas and obstructions.

The first task was to identify the location and nature of existing drainage problems within the study area, and where appropriate, gather field data to be used for further analysis of the problem. The geographical location data may be used to plot all of the problem areas and obstructions on a single map. Mapping the location of the sites in this manner enables you to identify isolated problems and determine which problems are part of more systemic problems. Systemic problems are often an indication that larger stormwater management problems exist, which may warrant more restrictive stormwater regulations.

IDENTIFICATION OF PROBLEM AREAS AND OBSTRUCTIONS

Identification and review of existing information concerning the county's stormwater systems, streams, and tributary drainage basins within the project limits was conducted during Phase I and Phase II of this Plan. During Phase I, questionnaires were distributed to all of the municipalities in Clarion County. The questionnaire enabled the municipalities to report all of the known problem areas and obstructions within their municipality. Of the 34 municipalities in Clarion County, 26 participated in the assessment process by returning completed questionnaires. The responses were summarzied and reported in the Phase I report of this Plan.

A total of 127 problem areas and obstructions were identified from the questionnaires. These are distributed among the county's watersheds as shown in **Table 5.1** below:

Act 167 Designated Watershed	Problem Areas	Obstructions	Total	% of Total
Allegheny River	17	1	18	14.2%
Clarion River	29	9	38	29.9%
Deer Creek	13	2	15	11.8%
East Sandy Creek	0	0	0	0.0%
Licking Creek	31	3	34	26.8%
Piney Creek	0	12	12	9.4%
Redbank Creek	4	4	8	6.3%
Tionesta Creek	0	0	0	0.0%
Toms, Cather, Maxwell, Blyson & McCanna Runs	2	0	2	1.6%

Table 5.1. Problem Area and Obstruction Location by Watershed

When plotted on a single map, the problem areas are concentrated mostly in the central and southeastern portions of the county. All of the reported obstructions and problem areas are listed in **Table 5.2** and **5.3**, respectively, on the following pages.

ID	Municipality	Location	Description
O1	ASHLAND TOWNSHIP		3 BRIDGES
O2	HIGHLAND TOWNSHIP	MCCLEARY ROAD	EARTH AND STONE ROADWAY CAUSEWAY
O3	SLIGO BORO	LICKING RUN AND ANDERSON RUN	STREAM DAM
O4	KNOX BORO	HUSTON AVE AND BEATTY AVE	FLOODING
O5	KNOX BORO	N MAIN ST AND WHITE AVE	PONDING
O6	KNOX BORO	JR HIGH SCHOOL	FLOODING
O7	ST PETERSBURG BORO	RAILROAD ST	18" CULVERT CAUSING EROSION
O8	ST PETERSBURG BORO	PUMP STATION RD	FLOODING AND EROSION
O9	PAINT TOWNSHIP	BANNER RD	DAMAGED CULVERT
O10	PAINT TOWNSHIP	HEARST BRIDGE	DEBRIS BUILD UP ON CULVERT
O11	PAINT TOWNSHIP	STEINER ROAD	ADDITIONAL MAINTENANCE
O12	LIMESTONE TOWNSHIP	KEMMER RD	CULVERT
O13	LIMESTONE TOWNSHIP	SPRING RD	CULVERT
O14	LIMESTONE TOWNSHIP	LENWOOD RD	CULVERT
O15	LIMESTONE TOWNSHIP	CURLL RD	CULVERT
O16	LIMESTONE TOWNSHIP	DEER HOLLOW RD	CULVERT
O17	LIMESTONE TOWNSHIP	SUTTON RD	BRIDGE AND PIPE
O18	LIMESTONE TOWNSHIP	CURTAIN BOTTOM RD	CULVERT
O19	LIMESTONE TOWNSHIP	SANDY FLAT RD.	CULVERT
O20	LIMESTONE TOWNSHIP	FENSTERMAKER RD	CULVERT
O21	LIMESTONE TOWNSHIP	LIMESTONE RD	CULVERT
O22	LIMESTONE TOWNSHIP	CEMETERY RD	CULVERT
O23	LIMESTONE TOWNSHIP	SR 2015	CULVERT
O24	NEW BETHLEHEM BORO	LEASURE RUN	BRIDGE - SAND BAR REMOVAL
O25	NEW BETHLEHEM BORO	SR 0028	BRIDGE - SAND BAR REMOVAL
O26	NEW BETHLEHEM BORO	WATER ST	STORM DRAIN
O27	NEW BETHLEHEM BORO	WOOD ST AND PINE ST	STORM DRAIN
O28	PERRY TOWNSHIP	COLLIER RD	EROSION - 3 CULVERTS
O29	PERRY TOWNSHIP	LIME PLANT RD	CULVERT
O30	PERRY TOWNSHIP	MONTEREY RD	EROSION, ROAD DAMAGE
O31	PERRY TOWNSHIP	TERWILLIGER RD	EROSION

Table 5.2. Reported Obstructions

ID	Municipality	Location	Description
P1	ASHLAND TOWNSHIP	VARIOUS THROUGHOUT	252 ROAD CROSSINGS
P2	TOBY TOWNSHIP	SR 3012 / TWP 378	SEVERE FLOODING
P3	TOBY TOWNSHIP	SR 3012 / SR 68	FLOODING
P4	TOBY TOWNSHIP	TWP 448	FLOODING
P5	TOBY TOWNSHIP	TWP 452	FLOODING
P6	TOBY TOWNSHIP	TWP 481	FLOODING
P7	TOBY TOWNSHIP	TWP 376	EROSION / STREAM MIGRATION
P8	TOBY TOWNSHIP	SR 3012 / SR 68	FLOODING
P9	TOBY TOWNSHIP	TWP 373	FLOODING
P10	TOBY TOWNSHIP	TWP 374	ROADWAY DESTRUCTION, MUDSLIDES
P11	TOBY TOWNSHIP	TWP 377	FLOODING, SINKHOLE IN ROAD
P12	TOBY TOWNSHIP	TWP 368	FLOODING, ROADWAY DAMAGE
P13	TOBY TOWNSHIP	TWP 353	FLOODING
P14	TOBY TOWNSHIP	TWP 352	
P15	TOBY TOWNSHIP	TWP 305	
P16	TOBY TOWNSHIP	SR 3012	
P17	CLARION BORO	TROUT RUN	
P18	CLARION BORO	UNIVERSITY MANOR	INADEQUATE STORM SEWER
P19	CLARION BORO	S. 5TH AVE CORRIDOR	FLOODING
P20	CLARION BORO	TROESE ADDITION	FLOODING
P21	CLARION BORO	6TH AVE. AT SOUTH ST. TO BARDER ST	INADEQUATE STORM SEWER
P22	CLARION BORO	7TH AVE SOUTH ST - BARDER ST	NO INLETS
P23	CLARION BORO	PENN AVE - FERN ST.- FRAMPTON ST.	NO STORM SEWERS
P24	CLARION BORO	SHERIDAN RD.	ROADWAY DESTRUCTION, NO DRAINAGE
P25	CLARION BORO	TOBY HILL RT 966	OBSTRUCTION BY DEBRIS
P26	CLARION BORO	SOUTH ST. AT HASKELL PL.	FLOODING
P27	CLARION BORO	CAMPBELL AVE. - E. 8 AVE.	LIMITED STORM SEWER
P28	FOXBURG BORO	SUMMIT AVE	POOR DRAINAGE
P29	HIGHLAND TWP	HIGHLAND DRIVE	EROSION
P30	SLIGO BORO		CHANNEL BACKFILL
P31	SLIGO BORO	FRONT STREET	FLOODING
P32	SLIGO BORO	LICKING CREEK AT BORO LIMITS	STRIP MINE RUNOFF
P33	SLIGO BORO	THROUGHOUT BORO	ACID MINE DRAINAGE
P34	SLIGO BORO	CRAIGS RUN	ACID MINE DRAINAGE
P35	SLIGO BORO	FRONT STREET	ARTISAN SPRING
P36	ST PETERSBURG BORO	MAIN ST.	FLOODING
P37	ST PETERSBURG BORO	MAIN ST.	FLOODING FROM CHESTNUT ST

ID	Municipality	Location	Description
P38	ST PETERSBURG BORO	EMLENTON ST.	FLOODING
P39	ST PETERSBURG BORO	SR 478	FLOODING WATER SUPPLY
P40	PAINT TOWNSHIP	INT OF SYCAMORE AND WOODLAND	PONDING WATER
P41	PAINT TOWNSHIP	SR 322	ROAD FLOODING
P42	PAINT TOWNSHIP	PAINT MILLS RD	OUTFLOW SCOUR
P43	PAINT TOWNSHIP	SR 4029	FLOODING, EROSION, ROADWAY DAMAGE
P44	PAINT TOWNSHIP	MCCLAIN WATSON RD	FLOODING
P45	PAINT TOWNSHIP	MEYERS RD	EROSION
P46	PAINT TOWNSHIP	BRENIMAN RD	EROSION
P47	PAINT TOWNSHIP	OAKWOOD LANE	FLOODING
P48	PAINT TOWNSHIP	MCCLAIN RD, WATSON RD, GLOSSER RD	FLOODING
P49	PAINT TOWNSHIP	MCCLAIN WATSON ROAD	EROSION AND FLOODING
P50	PAINT TOWNSHIP	MEYERS RD	EROSION AND FLOODING
P51	PAINT TOWNSHIP	BANNER ROAD	FLOODING
P52	PAINT TOWNSHIP	MARIANNE	FLOODING
P53	PAINT TOWNSHIP	SR 322 AND DOE RUN	FLOODING
P54	PAINT TOWNSHIP	WILLOW LN	FLOODING
P55	PAINT TOWNSHIP	DOE RUN RD	FLOODING
P56	PAINT TOWNSHIP	SR 0066	FLOODING
P57	PAINT TOWNSHIP	SR 322	FLOODING
P58	PAINT TOWNSHIP	RIDGEWOOD CT	FLOODING
P59	PAINT TOWNSHIP	STEINER RD	EROSION
P60	PAINT TOWNSHIP	AMSLER AVE	POOR DRAINAGE
P61	PAINT TOWNSHIP	SR 0066	FLOODING
P62	PAINT TOWNSHIP	SYCAMORE	FLOODING
P63	PAINT TOWNSHIP	RIDGEWOOD ROAD	FLOODING
P64	NEW BETHLEHEM BORO	LEASURE RUN	FLOODING
P65	NEW BETHLEHEM BORO	MOUTH LEASURE RUN	FLOODING
P66	NEW BETHLEHEM BORO	KECK AVE AND EAST WASHINGTON ST	FLOODING
P67	NEW BETHLEHEM BORO	SR 0066	FLOODING
P68	PERRY TOWNSHIP	STEPHENS RD	FLOODING
P69	PERRY TOWNSHIP	FREEDOM RUN	FLOODING
P70	PERRY TOWNSHIP	STEPHENS RD	EXCESSIVE RUNOFF FROM FARMS
P71	PERRY TOWNSHIP	MONTEREY RD	ALLEGHENY RIVER FLOODING FROM ICE
P72	PERRY TOWNSHIP	BARTOW RD	ROADWAY FLOODING
P73	PERRY TOWNSHIP	BLACK FOX ROAD	STREAM BANK EROSION
P74	PERRY TOWNSHIP	HILLVILLE RD	EROSION / BRIDGE DESTRUCTION
P75	PERRY TOWNSHIP	TERWILLIGER RD	STREAM BANK EROSION
P76	PERRY TOWNSHIP	PINE HOLLOW RD	STREAM BANK EROSION

ID	Municipality	Location	Description
P77	PERRY TOWNSHIP	BARTLEY RD	STREAM BANK EROSION / ROAD DAMAGE
P78	PERRY TOWNSHIP	MATHILDAVILLE RD	EROSION / BRIDGE DESTRUCTION
P79	PERRY TOWNSHIP	TERWILLIGER RD	SWALE EROSION
P80	MILLCREEK TWP	FISHER-SIGEL RD	UNDERSIZED PIPE CAUSES FLOODING
P81	MILLCREEK TWP	SPRING DRIVE	PIPE CAUSES PONDING AND FLOODING
P82	MILLCREEK TWP	OLD ST N	PIPE CAUSES PONDING AND FLOODING
P83	EAST BRADY BORO	5TH & PERDUM STS	DITCH WASHOUTS
P84	EAST BRADY BORO	4TH & PERDUM STS	WASHOUT AT INLET, BROKEN PIPE
P85	EAST BRADY BORO	4TH & PERDUM STS	DITCH WASHOUTS
P86	EAST BRADY BORO	6TH ST & 1ST ST	OUTLET PIPE ON ROADWAY
P87	EAST BRADY BORO	WALLACE & 1ST ST	LARGE HOLE BESIDE INLET
P88	EAST BRADY BORO	BRADY ST	DITCH WASHOUTS; PLUGGED CULVERTS
P89	EAST BRADY BORO	1ST & PROSPECT ST	OVERBANK FLOW ON ROADWAY
P90	EAST BRADY BORO	1ST ST	WATER NOT GETTING TO INLETS
P91	RIMERSBURG BORO	MILL ST	WASHED OUT ROADWAY EDGES
P92	RIMERSBURG BORO	CHERRY ST	WASHED OUT DITCH LINES
P93	HAWTHORN BORO	MAIN ST.	CULVERT
P94	HAWTHORN BORO	MAPLE ST	CULVERT
P95	HAWTHORN BORO	WALNUT ST	CULVERT
P96	HAWTHORN BORO	PINE AVE	FARM FIELD RUNOFF

Table 5.3. Reported Problem Areas

RECOMMENDATIONS

The reported stormwater problems within the study area can be attributed to one, or more, of several principal causes:

1. The existing storm drain system has insufficient capacity.
2. There is an incomplete collection and conveyance system or a lack of a formal/comprehensive system.
3. Maintenance is required on an existing system (e.g. catch basin inlets become plugged and local flooding occurs).
4. Problem areas are located in the floodplain area.

In addition, the problem areas mentioned in this section are more pronounced in the more populated/developed areas. This is most likely due to encroachments into floodplain areas and undersized culverts or bridges. Also, a large number of these stormwater related problems have been traced back to uncontrolled runoff from local and upstream areas, inadequate culverts or bridges, and obstructions in the system that are blocking the natural flow of stormwater. Most of the pipe culvert or road ditch related issues are maintenance, sizing or design issues and not related to development. Stream blockage from deposition resulting from past strip mine sites is also a large factor.

This study has identified some drainage problems that occur on a yearly basis. While a certain amount of flooding is natural in streams during heavy rain, periodic maintenance can prevent some of the identified problems with flooding and erosion. A stormwater facility maintenance program should be developed and implemented as part of the strategy to correct existing problems and alleviate future problem areas.

Continued improper development within the county will amplify these problems. Remedial actions will be necessary to correct existing drainage problems. In the long term, a comprehensive approach is needed to tackle these problems. This approach will have to incorporate regulations and development standards into local zoning, consider both on-site and off-site drainage, provide a consistent approach between communities, use natural elements for the transport and storage of stormwater, consider both quantity and quality of water, and treat the watershed as a whole.

Stormwater master planning is one way to address the needs and potential threats to a watershed. However, implementation of these practices can be difficult and may not be economically feasible for many communities. Looking ahead, it is expected that the status of the current stormwater infrastructure will keep deteriorating with time. In addition to imposing stronger regulations to control new development, increased expenditures for maintenance and other improvements is necessary, or the systems will continue to deteriorate faster than the ability to fix and maintain them.

Because of the very rural nature of Clarion County, the very low percentages for existing residential (0.73%), industrial (0.18%), and commercial (0.3%) land uses and a continuing population decline (as noted in Section 3 of the Plan), small as well as large storms produce runoff characteristics governed primarily by land in forested or other vegetated states. Because of this a more detailed analysis was not undertaken.

Because of no proposed significant land use changes and the lack of intense residential, commercial or industrial development, no new storm water collection or control facilities are proposed on a County level. Work is primarily focused on replacing existing infrastructure. As indicated in Section 3 of the Plan, only 10% of the daily rainfall values recorded between 1885 and 2009 exceeded 0.75 inches, which is well below any design standards currently specified in the County.

Section 6

Technical Standards for Stormwater Management

TECHNICAL STANDARDS FOR STORMWATER MANAGEMENT

The field of stormwater management has evolved rapidly in recent years as additional research has increased our comprehension of how stormwater runoff is interrelated with the rest of our natural environment. Even now this relationship is not completely understood. Stormwater management practices will continue to evolve as additional knowledge becomes available. Effective resource management involves balancing the positive and negative effects of all potential actions. These actions are considered, and the individual management techniques which provide the best known balance are chosen for implementation. The goal of this Plan is to manage stormwater as a valuable resource, and to manage all aspects of this resource as effectively as possible. This Plan contains technical standards that seek to achieve this goal through four different methods. These standards are summarized as follows:

Peak Discharge Rate Standards – Peak discharge rate standards are implemented primarily to protect areas directly downstream of a given discharge by attenuating peak discharges from large storm events. These standards are also intended to attenuate peak flows throughout the watershed during large storm events. Peak discharge rate controls are applied at individual development sites. Controlling peak discharge rates from the sites entails collection, detention, and discharge of the runoff at a prescribed rate. This is an important standard for achieving stable watersheds.

Volume Control Standards – The standards in this Plan that address increased stormwater volume are intended to benefit the overall hydrology of the watershed. The increased volume of runoff generated by development is the primary cause of stormwater related problems. Increased on-site runoff volume commonly results in a sustained discharge at the designed peak discharge rate, as well as an increased volume and duration of flows experienced after the peak discharge rate. Permanently removing a portion of the increased volume from a developed site is key in mitigating these problems and maintaining groundwater recharge levels. Meeting this standard generally involves providing and utilizing infiltration capacity at the development site, although alternative methods may be used.

Channel Protection Standards – Channel protection standards are designed to reduce the erosion potential from stormwater discharges to the channels immediately downstream. Even though peak discharge rate controls are implemented for larger design storms, they do not provide controls for the smaller storms. These storms account for the vast majority of the annual precipitation volume. Past research has shown that channel formation in developed watersheds is largely controlled by these small storm events. The increased volume and rate of stormwater runoff during small storms forces stream channels to change in order to accommodate the increased flows. Channel protection standards will be achieved through implementation of permanent removal of increased volume from discharges during low flow storm events.

Water Quality Standards – The water quality standards contained in this Plan are meant to provide a level of pollutant removal from runoff prior to discharge to receiving streams. Stormwater runoff can deliver a wide range of contaminants to the receiving stream, which leads to a variety of negetive impacts. Water quality standards can be achieved through reducing the source of pollutants and utilizing natural and engineered systems that are capable of removing the pollutants.

Beyond the standards discussed above, other measures may be taken to ensure that stormwater is properly managed.

Stormwater management is an issue that is entwined with land use decisions and has social and economic implications. To maximize the effectiveness of a stormwater management program, a holistic approach is needed. Stormwater management should be a consideration in any ordinance decisions that affect how land is used.

CONTROLS FOR ROADWAY PROJECTS

For purposes of Act 167 Stormwater Management Plans (Plans), design policy pertaining to stormwater management facilities for Pennsylvania Department of Transportation (PennDOT), and Pennsylvania Turnpike Commission (PTC) roadways and associated facilities are provided in Sections 13.7 (Antidegradation and Post Construction Stormwater Management Policy) of *PennDOT Publication No. 13M, Design Manual Part 2* (August 2009), as developed, updated, and amended in consultation with PADEP. As stated in DM-2.13.7.D (Act 167 and Municipal Ordinances), PennDOT and PTC roadways and associated facilities shall be consistent with Act 167 Plans. DM-2.13.7.B (Policy on Antidegradation and Post Construction Stormwater Management) was developed as a cooperative effort between PennDOT and PADEP. DM-2.13.7.C (Project Categories) discusses the anticipated impact on the quality, volume, and rate of stormwater runoff.

Where standards in this Plan are impracticable, PennDOT or PTC may request assistance from DEP, in consultation with the County, to develop an alternative strategy for meeting state water quality requirements and the goals and objectives of the Act 167 Plans.

Municipal roadway projects are regulated by municipal stormwater ordinances but Municipalities are exempt from the requirement to file an Operations and Maintenance (O&M) agreement with themselves.

RECOMMENDED BEST MANAGEMENT PRACTICES

As previously stated, the preferred strategy for achieving the goals of this plan is to reduce, or eliminate, the sources of non-point source pollution. This is an important concept, in that the most effective way to reduce the number of stormwater runoff problems is to reduce the amount of runoff generated. There are a wide variety of non-structural practices that are used to reduce the amount of runoff generated and to minimize the potential negative impacts of runoff that is generated. All of these BMPs are intended to minimize the interruption of the natural hydrologic cycle caused by development. The relative effectiveness of each non-structural BMP are listed in the Pennsylvania Stormwater Best Management Practices Manual. These practices should be used where applicable to decrease the need for less cost effective structural BMPs.

When non-structural practices are unable to achieve the stormwater standards, it may be necessary to employ structural practices. Generally, structural BMPs are chosen to address specific stormwater functions.

IMPLEMENTATION OF STORMWATER MANAGEMENT CONTROLS

From a regulatory perspective, the standards and criteria developed in this Plan will be implemented through municipal adoption of the Model Stormwater Management Ordinance developed as part of the Plan. The Model Ordinance contains provisions to realize the standards and criteria outlined in this section. Providing uniform stormwater management standards throughout the County is one of the stated goals of this Plan. This goal will be achieved through adoption of the Model Ordinance by all of the municipalities in Clarion County.

From the pragmatic development viewpoint, the stormwater management controls will be put into practice through use of comprehensive stormwater management site planning and various stormwater BMPs. Site designs that integrate a combination of source reducing non-structural BMPs and runoff control structural BMPs will be able to achieve the proposed standards.

Section 7
Water Quality Impairments

The Clean Water Act is a series of federal legislative acts that form the foundation for protection of U.S. water resources. These include the Water Quality Act of 1965, Federal Water Pollution Control Act of 1972, Clean Water Act of 1977, and Water Quality Act of 1987. The goal of the Clean Water Act is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters". Section 305(b) of the Federal Clean Water Act requires each state to prepare a Watershed Assessment Report for submission to the United States Environmental Protection Agency (EPA). The reports include a description of the water quality of all waterbodies in the state and an analysis of the extent to which they are meeting their water quality standards. The report must also recommend any additional action necessary to achieve the water quality standards, and for which waters that action is necessary.

Section 303(d) of the Act requires states to list all impaired waters not meeting water quality standards set by the state, even after appropriate and required water pollution control technologies have been applied (EPA, 2008). The law also requires that states establish priority rankings for waters on the list and develop Total Maximum Daily Loads (TMDLs) for these waters. A TMDL is the maximum amount of pollutant that a water body can receive and still safely meet the state's water quality standards for that pollutant. TMDLs are a regulatory tool used by states to meet water quality standards in impaired waterbodies where other water quality restoration strategies have not achieved the necessary corrective results.

IMPAIRED STREAMS

Pursuant to the provisions of the Clean Water Act, DEP has an ongoing program to assess the quality of waters in Pennsylvania and identify streams, and other bodies of water, that are not attaining designated and existing uses as "impaired". Water quality standards are comprised of the uses that waters can support, and goals established to protect those uses. Each waterbody must be assessed for four different uses, as defined in DEP's rules and regulations:

1. Aquatic life,
2. Fish consumption,
3. Potable water supply, and
4. Recreation

The established goals are numerical, or narrative, water quality criteria that express the in-stream levels of substances that must be achieved to support the uses. This assessment effort is used to support water quality reporting required by the Clean Water Act. DEP uses an integrated format for the Clean Water Act Section 305(b) reporting and Section 303(d) listing in a biennial report called the "Pennsylvania Integrated Water Quality Monitoring and Assessment Report". The narrative report contains summaries of various water quality management programs including water quality standards, point source control and nonpoint source control. In addition to the narrative, the water quality status of Pennsylvania's waters is presented using a five-part characterization of use attainment status (DEP, 2008). The listing categories are:

Category 1: Waters attaining all designated uses.

Category 2: Waters where some, but not all, designated uses are met. Attainment status of the remaining designated uses is unknown because data are insufficient to categorize the water.

Category 3: Waters for which there are insufficient or no data and information to determine if designated uses are met.

Category 4: Waters impaired for one or more designated use but not needing a total maximum daily load (TMDL). These waters are placed in one of the following three subcategories:

- Category 4A: TMDL has been completed.
- Category 4B: Expected to meet all designated uses within a reasonable timeframe.
- Category 4C: Not impaired by a pollutant and not requiring a TMDL.

Category 5: Waters impaired for one or more designated uses by any pollutant. Category 5 includes waters shown to be impaired as the result of biological assessments used to evaluate aquatic life use. Category 5 constitutes the Section 303(d) list submitted to EPA for final approval.

CLARION COUNTY IMPAIRMENTS

If a stream segment is not attaining any one of its designated uses, it is then considered to be "impaired". **Figure 7.1** shows the non-attaining stream segments in Clarion County and identifies the primary source of the impairment listing.

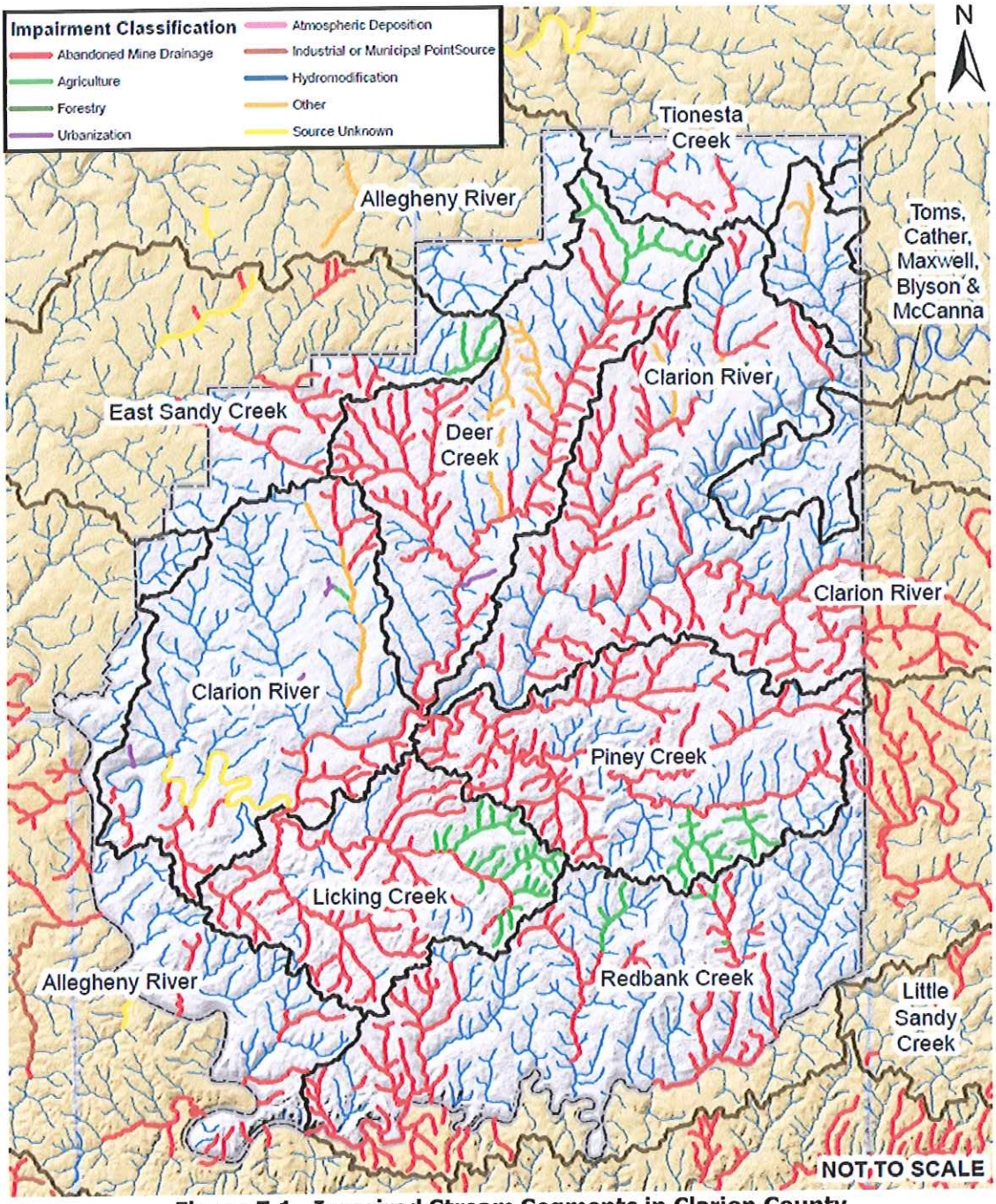


Figure 7.1. Impaired Stream Segments in Clarion County

In Clarion County, the non-attaining streams were primarily listed based on an Aquatic Life use assessment, which is reflective of any component of the biological community (i.e. fish or fish food organisms). The source-cause of impairment varies from stream to stream. Oftentimes, there are multiple source-causes attributed for impairment of a particular stream segment. **Table 7.1** shows a summary of the primary source of impairment in each Act 167 Designated Watershed within the County. This table does not reflect streams that have multiple source-causes of impairment.

Classification	Category	Act 167 Watersheds (stream miles where not indicated)										
		Allegheny River	Clarion River	Deer Creek	East Sandy Creek	Licking Creek	Piney Creek	Redbank Creek	Tionesta Creek	Toms, Cather, Maxwell, Blyson And Mccanna	Entire County	Percent of County
Impaired (miles)	Acid Mine Drainage	15.7	175.1	100.3	18.2	83.0	87.6	82.8	8.0	--	570.7	37.0
	Agriculture	--	1.6	--	5.3	31.3	14.1	4.9	--	--	57.3	3.7
	Atmospheric Deposition	--	--	--	--	--	--	--	--	--	0.0	0.0
	Forestry	--	--	--	--	--	--	--	--	--	0.0	0.0
	Hydromodification	--	--	--	--	--	--	--	--	--	0.0	0.0
	Industrial or Municipal Point Source	--	--	--	--	--	--	--	--	--	0.0	0.0
	Urbanization	--	2.3	1.3	--	--	--	--	--	--	3.7	0.2
	Source Unknown	--	14.0	--	--	--	--	--	--	--	14.0	0.9
	Other	--	--	--	--	--	--	--	--	3.3	3.3	0.2
	Total Impaired	15.7	193.0	101.6	23.6	114.3	101.7	87.7	8.0	3.3	648.9	42.0
	Percent of Total	9.8	44.4	44.1	36.7	145.7	56.8	30.6	20.2	4.7	42.0	42.0

Table 7.1. Summary of Impaired Segments by Watershed

TMDL DISCUSSION

Once a waterbody is listed on the EPA approved 303(d) list, it is required to be scheduled for development of a TMDL. TMDLs are expressed in terms of mass per time, toxicity, or other appropriate measures that relate to a water quality standard. They can be developed to address individual pollutants or groups of pollutants, if it is appropriate for the source of impairment.

A TMDL must identify the link between the use impairment, the cause of the impairment, and the load reductions needed to achieve the applicable water quality standards. However, a precise implementation plan is not part of the approved TMDL. A TMDL is developed by determining how much of the pollutant causing the impairment can enter the waterbody without exceeding the water quality standard for that particular pollutant. The calculated pollutant load is then distributed among all the pollutant sources as follows:

$$TMDL = WLA + LA + MOS$$

Where: TMDL = Total Maximum Daily Load

WLA = Waste Load Allocation; from point sources such as industrial discharges and wastewater treatment plants

LA = Load Allocation; from nonpoint sources such as stormwater, agricultural runoff and natural background levels

MOS = Margin of Safety

TMDL's are developed by the State and submitted to EPA for review and approval. Once a TMDL has been approved, it becomes a tool to implement pollution controls. It does not provide for any new implementation authority. The point source component of the TMDL must be implemented through existing federal programs with enforcement capabilities (e.g. National Pollution Discharge Elimination System, NPDES). Implementation of the Load Allocations for nonpoint sources can happen through a voluntary approach, or by means of existing state or local regulations.

There are currently 17 waterbodies in Clarion County with approved TMDLs. As shown in the table below, all of the approved TMDLs are for Abandoned Mine Drainage (AMD).

Watershed	Category	Cause	Status
Beaver Run	AMD	Other Inorganics, Metals, pH	EPA Approved, 4/9/2003
Brush Run (Clarion)	AMD	Metals, pH	EPA Approved, 4/9/2009
Deer Creek (Clarion)	AMD	Metals, pH	EPA Approved, 4/9/2009
Douglas Run	AMD	Metals, pH	EPA Approved, 4/9/2003
Gathers Run	AMD	Metals, pH	EPA Approved, 4/7/2009
Jones Run	AMD	Metals, pH	EPA Approved, 4/9/2003
Leatherwood Creek	AMD	Metals	EPA Approved, 7/10/2009
Licking Creek	AMD	Metals, pH	EPA Approved, 4/9/2009
Little Mill Creek	AMD	Metals, pH	EPA Approved, 8/16/2006
Lower Clarion River	AMD	Metals, pH	EPA Approved, 4/9/2009
McGourvey Run	AMD	Other Inorganics, Metals, pH	EPA Approved, 12/22/2004
Mill Creek (Clarion)	AMD	Metals, pH	EPA Approved, 5/8/2009
Parks Run	AMD	pH	EPA Approved, 4/9/2001
Redbank Creek	AMD	Metals, pH	EPA Approved, 6/9/2009
Reids Run	AMD	Metals	EPA Approved, 4/7/2009
Town Run	AMD	Metals	EPA Approved, 7/10/2009
Walley Run	AMD	Metals	EPA Approved, 4/4/2007

Table 7.2. Clarion County Total Maximum Daily Loads (TMDLs)

Section 8

Plan Adoption, Implementation and Update Procedures

PLAN REVIEW AND ADOPTION

The opportunity for local review of the draft Stormwater Management Plan is a prerequisite to county adoption of the Plan. Local review of the Plan is composed of several parts, namely the Plan Advisory Committee review (with focused assistance from others including Legal Advisors and Municipal Engineer's review, Municipal review), and County review. Local review of the draft Plan is initiated with the completion of the Plan by the County and distribution to the aforementioned parties. Presented below is a chronological listing and brief narrative of the required local review steps through County adoptions.

1. Plan Advisory Committee Review - This body has been formed to assist in the development of the Clarion County Act 167 Stormwater Management Plan. Municipal members of the Committee have provided input data to the process in the form of storm drainage problem area documentation, storm sewer documentation, proposed solutions to drainage problems, etc. The Committee met on several occasions to review the progress of the Plan. Municipal representatives on the Committee have the responsibility to report on the progress of the Plan to their respective municipalities. Review of the draft Plan by the Plan Advisory Committee will be expedited by the fact that the members are already familiar with the objectives of the Plan, the runoff control strategy employed, and the basic contents of the Plan. The output of the Plan Advisory Committee review will be a revised draft Plan for Municipal and County consideration.

    a. Municipal Engineers Review - This body has been formed to focus on the technical aspects of the Plan and to educate the Municipal Engineers on the ordinance adoption and implementation requirements of the Plan. The group met to solicit input as well as to receive comments and direction in the development of the model ordinance. The result of this is a revised draft model ordinance for Municipal and County consideration.

    b. Legal Advisory Review - This body has been formed to focus on the legal aspects of the Plan and to educate the Municipal solicitors on the ordinance adoption and implementation requirements of the Plan. The group met to provide input as well as to receive comments and direction in the development of the model ordinance. The result of this effort is a revised draft model ordinance for Municipal and County consideration.

2. Municipal Review - Act 167 specifies that prior to adoption of the draft Plan by the County, the planning commission and governing body of each municipality in the study area must review the Plan for consistency with other plans and programs affecting the study area. The Draft Clarion County - Act 167 - Stormwater Management Ordinance that will implement the Plan through municipal adoption is the primary concern during the municipal review. The output of the municipal review will be a letter directed to the County outlining the municipal suggestions, if any, for revising the draft Plan (or Ordinance) prior to adoption by the County.

3. County Review and Adoption - Upon completion of the review by the Plan Advisory Committee, with assistance from the Municipal Engineer and Legal Advisory focus groups, and each municipality, the draft Plan will be submitted to the County Board of Commissioners for their consideration.

The Clarion County review of the draft Plan will include a detailed review by the County Board of Commissioners and an opportunity for public input through the holding of public hearings. Public hearings on the draft Plan must be held with a minimum two-week notice period with copies of the draft Plan available for inspection by the general public. Any modifications to the draft Plan would be made by the County based upon input from the public hearings, comments received from the municipalities in the

study area, or their own review. Adoption of the draft Plan by Clarion County would be by resolution and require an affirmative vote of the majority of the members of the County Board of Commissioners.

The County will then submit the adopted Plan to DEP for their consideration for approval. The review comments of the municipalities will accompany the submission of the adopted Plan to DEP.

IMPLEMENTATION OF THE PLAN

Upon final approval by DEP, each municipality within the county will become responsible for implementation of the Plan. Plan implementation, as used here, is a general term that encompasses the following activities:

- Adoption of municipal ordinances that enable application of the Plans provisions.
- Review of Drainage Plans for all activities regulated by the Plan and the resulting ordinances.
- Enforcement of the municipal regulations.

Each municipality will need to determine how to best implement the provisions of this Plan within their jurisdiction. Three basic models for Plan implementation are presented in **Table 8.1** below. In some cases it may be advantageous for multiple municipalities to implement the Plan cooperatively, or even on a county-wide basis.

Individual Municipal Model	Each municipality passes, implements, and enforces the SWM ordinance individually.
Multi-Municipal Model	Several municipalities cooperate through a new, or existing, service-sharing agreement (COG, Sewage Association, etc.)
County Service Provider Model	County department, or office, (e.g. County Planning Entity or County Conservation District) provides SWM ordinance implementation and enforcement services to municipalities.

Table 8.1. Models for Municipal Plan Implementation

Regardless of what model is used for implementation, each municipality will need to adopt regulations that enable the chosen implementation strategy. For municipalities that choose the Individual Municipal Model, this means municipal adoption of the Model Ordinance or integration of the Plan's provisions into existing municipal regulations. For the other two models, this will require ordinance provisions that designate the regulatory authority and adoption of an inter-municipal agreement or service-sharing agreement.

It is important that the standards and criteria contained in the Plan are implemented correctly, especially if the municipality chooses to integrate the standards and criteria into existing regulations. In either case, it is recommended that the resulting regulatory framework be reviewed by the local planning commission, the municipal solicitor, the Clarion County Department of Planning and/or the Clarion County Conservation District for compliance with the provisions of the Plan and consistency among the various related regulations. Additionally, the adopted regulations may be reviewed by PADEP for compliance with this Plan.

PROCEDURE FOR UPDATING THE PLAN

Any proposed revisions to the Plan would require municipal and public review prior to County adoption consistent with the procedures outlined above. An important aspect of the Plan is a procedure to monitor the implementation of the Plan and initiate review and revisions in a timely manner. The process to be used for the Clarion County Act 167 Stormwater Management Plan will be as outlined below.

1. Monitoring of the Plan Implementation - The Clarion County Planning Commission will be responsible for monitoring the implementation of the Plan by maintaining a record of all development activities

within the study area. Development activities are defined and included in the recommended Municipal Ordinance. Specifically, the CCPC will monitor the following data records:

a. All subdivision and land developments subject to review per the Plan which have been approved within the study area.
b. All building permits subject to review per the Plan which have been approved within the study area.
c. All DEP permits issued under Chapter 105 (Dams and Waterway Management) and Chapter 106 (Floodplain Management) including location and design capacity (if applicable).

2. Review of Adequacy of Plan - The Plan Advisory Committee will be convened periodically to review the Stormwater Management Plan and determine if the Plan is adequate for minimizing the runoff impacts of new development. At a minimum, the information to be reviewed by the Committee will be as follows:

a. Development activity data as monitored by the CCPC.
b. Information regarding additional storm drainage problem areas as provided by the municipal representatives to the Watershed Plan Advisory Committee.
c. Zoning amendments within the study area.
d. Information associated with any regional detention alternatives implemented within the study area.
e. Adequacy of the administrative aspects of regulated activity review.

The Committee will review the above data and make recommendations to the County as to the need for revision to the Clarion County Act 167 Stormwater Management Plan. Clarion County will review the recommendations of the Plan Advisory Committee and determine if revisions are to be made. A revised Plan would be subject to the same rules of adoption as the original Plan preparation.

Section 9
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