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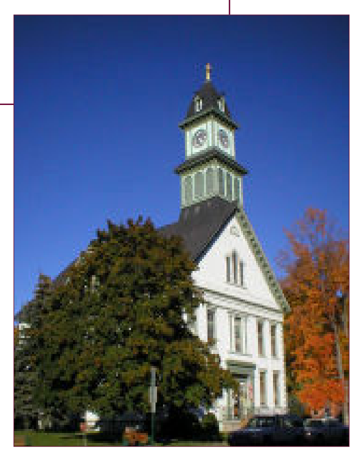
Potter County Planning Commission

Potter County
Act 167 County-Wide
Stormwater Management Plan
Phase II

May 5, 2010



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Section I – Introduction

This stormwater management plan is the product of a collaborative effort between the varied stakeholders within the Act 167 Designated Watersheds in Potter 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). The intent of this document is to present the findings of a two-phased multi-year study of the watersheds within the county. 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. 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 naturally occurs as the infiltrative capacity of the surface is exceeded. 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). However, it is has been observed, and verified, that the cumulative nature of individual land surface changes dramatically influences flooding conditions. This cumulative effect of development in some areas has resulted in flooding of both small and large streams, with substantial financial property damage and endangerment of the public health and welfare. Therefore, given the distributed and cumulative nature of the land alteration process, a comprehensive (i.e., watershed-level) approach should 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. A watershed-based stormwater management plan can minimize inconsistencies to more effectively address the issues which contribute to a watershed's degradation. 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 instable 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.

STORMWATER MANAGEMENT PLANNING

Historically, the approach to stormwater management was to collect the runoff and convey it, via a system of inlets and pipes, as quickly as possible to the nearest receiving waters. The increased volume of stormwater delivered quickly to receiving waters had a detrimental effect on channel morphology. Negative impacts, such as severe channel erosion and significant in-stream sediment deposits resulted. These impacts led to unstable, deepened and widened channels, nuisance flooding, infrastructure damage, increased culvert and bridge maintenance requirements, and had a detrimental affect on the stream quality in terms of habitat for aquatic organisms. In addition, large amounts of rainfall were lost to the watershed and became unavailable for infiltration and groundwater recharge, and contaminants on the land surface entered the stream untreated.

This conveyance approach was later replaced with the stormwater management standards that largely exist today in municipalities. This latter "peak flow" approach required that peak flows from development sites be managed, usually through detention ponds, such that the peak discharge from the site is no greater than 100% of the peak discharge rate from the site prior to development. While this may have helped reduce some stormwater problems, there were two significant failings with this approach.

The first failing of the rate-controlled approach is that it does not consider the watershed as a single interrelated hydrologic unit. Because watersheds are interconnected networks, an integrated watershed management approach is needed. Two points are emphasized regarding the need for watersheds to be regulated as interconnected networks:

7. Stormwater regulatory responsibility, absent arrangements to the contrary, rests with each municipal government in Pennsylvania. Therefore, stormwater management regulations, if applied at all, are implemented by a municipality within the boundaries of its own jurisdiction. There is no guarantee that all municipalities within a given watershed have comparable standards. When standards are implemented by individual municipalities, the problems caused by unmanaged stormwater in areas with poor, or no, regulations are conveyed to municipalities downstream. Upstream municipalities can, and do, cause stormwater problems for downstream neighbors. In these situations, downstream municipalities are forced to deal with problems associated with increased water volume, increased sediment loads, and increased pollutants which originate in areas where they have no control.
8. Each area within a watershed is unique in terms of its contribution to the overall watershed hydrology. However, when the same standards are implemented throughout a broad area, and the overall watershed hydrology is not considered, these standards can result in over-management in some areas and under-management in other areas. In some cases, this type of management could actually exacerbate stormwater problems. Further, this "one-size-fits-all" approach does not take into account conditions such as soil infiltration rates, slopes, or channel conditions, which vary throughout a watershed and municipality.

The second key failing is that the rate-controlled approach does not consider the aspects of water quality, channel protection, or the importance of infiltration in the hydrologic cycle. Simply managing the rate at which stormwater leaves a development site does not maintain the overall watershed hydrology. When implementing a peak rate control strategy as the sole method of controlling stormwater runoff, pollutants are still delivered to surface waters, rainfall is still unavailable to the watershed for recharge, and channel erosion and sedimentation still occur.

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 (HUD, 2003). 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 (Low Impact Development Center, 2007). These concepts are the origin of many of the strategies identified to achieve the goals presented in this Plan.

As a comprehensive technology-based approach to managing stormwater, LID has developed significantly since its inception, in terms of policy implementation and technical knowledge. The goals and principles of LID, as describe in *Low-Impact Development Design Strategies* (Prince George's County, 1999) are defined as follows:

- Provide an improved technology for environmental protection of receiving waters.
- Provide economic incentives that encourage environmentally sensitive development.
- Develop the full potential of environmentally sensitive site planning and design.
- Encourage public education and participation in environmental protection.
- 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.

The overall design concepts and specific design measures for BMPs are derived from the following conceptual framework (Prince George's County, 1999):

1. The site design should be built around and integrate a site's pre-development hydrology;
2. 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);
3. These smaller BMPs should be distributed throughout a site so that stormwater is mitigated at its source;
4. An emphasis should be given to non-structural BMPs; and
5. Landscape features and infrastructure should be multifunctional so that any feature (e.g., roof) incorporates detention, retention, filtration, or runoff use.

The LID process is meant to provide an alternative approach to traditional stormwater management; *Table 1.1* highlights the difference between the two approaches. These concepts, as they apply to stormwater, are the basis for the stormwater management approach presented in this Plan.

LID Approach		Traditional Approach	
Approach	Examples	Approach	Examples
1. Integration of Pre-Development Hydrology	A development built around a drainage way outside of functional floodplain	Elimination of all water features from project site	Redirection and conveyance of drainage; alteration of floodplain to meet site design
2. Emphasis on smaller magnitude, higher frequency storm events	Several small BMPs	Large stormwater ponds and facilities that focuses on 10 and 100-year events	A single stormwater pond
3. Stormwater to be mitigated at source	BMPs located near buildings, within parking lot islands	Stormwater to be conveyed to low point in site	A single stormwater pond
4. Use simple, non-structural BMPs	Narrower drive ways, conservation easements, impervious disconnection	Use of pipe and stormwater ponds	A single stormwater pond
5. Use of multifunctional landscape and infrastructure	Green roofs, rain gardens in parking lot islands	Stormwater and site feature kept as separate as possible	No consideration given

Table 10.1. Comparison of LID Versus Traditional Stormwater Management Approach

When implemented at the site level, LID has been found to have a beneficial impact on water quality and in reducing peak flows for more frequent storm events (Bedan and Clausen, 2009; Hood et. al., 2007). There are numerous case studies and pilot projects that emphasize similar finding about the benefits of site level development and of specific LID BMPs (EPA, 2000; DEP, 2006; Low Impact Development Center, 2009).

When implemented at the watershed level, as proposed in this Plan, there are quantifiable benefits in terms of reduced peak discharges coming from future developments (as discussed in *Section VI*). The approach of considering water quality and existing condition hydrology will help address documented stream impairments (as discussed in *Section IX*). Additionally, adopting a LID approach will help alleviate the economic impact of the additional regulations proposed in the model ordinance (as discussed in *Section VIII*). Several other Act 167 Plans that have been recently prepared or are being prepared concurrently with this Plan further support these findings.

Section II – Goals and Objectives of the Act 167 Stormwater Management Plan

This plan was developed to present the findings of a two-phased multi-year study of the watersheds within the County. Watershed-based planning addresses the full range of hydrologic and hydraulic impacts from cumulative land developments within a watershed rather than simply considering and addressing site-specific peak flows. 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.

The overall objective of this Plan is to provide a plan for comprehensive watershed stormwater management throughout Potter 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 cumulative basin-wide stormwater 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 Potter 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.

These goals provided the focus for the entire planning process. A scope of work was developed in Phase 1 that focused efforts on gathering the necessary data and developing strategies that address the goals. With the general focus of the Plan determined, Phase II further researched county specific information, provided in-depth technical analysis, and developed a model ordinance to achieve these goals. On the following page, *Table 2.1* shows the preferred stategies to address the goals, and where these strategies are addressed in the Plan:

1. Manage stormwater runoff created by new development activities by taking into account the cumulative basin-wide stormwater impacts from peak runoff rates and runoff volume	
Develop models of selected watersheds to determine their response to rainfall	*Section VI, Appendix A*
Determine appropriate stormwater management controls for these basins	*Section VI, Appendix A*
2. Meet the legal water quality requirements under Federal and State laws	
Provide recommendations for improving impaired waters within the county	*Section IX*
Encourage the use of particularly effective stormwater management BMPs	*Section VII*
3. Provide uniform standards throughout Potter County	
Develop a Model Stormwater Management Ordinance with regulations specific to the watersheds within the county	*Model Ordinance*
Adopt and implement the Model Ordinance in every municipality in Potter County	*Model Ordinance*
3. Encourage the management of stormwater to maintain groundwater recharge, to prevent degradation of surface and groundwater quality, and to protect water resources	
Provide education on the correlation between stormwater and other water resources	*Section I, Section X*
Require use of the Design Storm Method or the Simplified Method	*Model Ordinance*
4. Preserve the existing natural drainage ways and water courses	
Provide education on the function and importance of natural drainage ways	*Section I, Section X*
Protect these features through provisions in the Model Ordinance	*Model Ordinance*
5. Ensure that existing stormwater problem areas are not exacerbated by future development and provide recommendations for improving existing problem areas	
Develop an inventory of existing stormwater problem areas	*Section V*
Analyze problem areas and provide conceptual solutions to the problems	*Section V*

Table 2.1. Preferred Strategies to Address Plan Goals

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.

PLAN ADVISORY COMMITTEES

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
3	Phase 2 Start-up Meeting – re-introduce the Phase 2 planning process. Emphasize the importance of full municipal involvement. Present summary of the Phase 1 Report. Reviewed problem areas to solicit input.	1.21.2009
4	Review the project status, update problem area investigations, solicit input from municipalities, provide summary of stormwater problems. Identify areas that require detailed hydrologic modeling. Discuss stormwater management standards and criteria for the Model Ordinance.	6.11.2009
5	With municipal engineers invited to the meeting - Technical issues for detailed models: Review model selection and setup, initial modeling runs, calibration procedures, presentation on LID, solicit input on technical standards, water quality issues. Discussion on Model Ordinance Provisions	10.27.2009
6	With municipal engineers invited to the meeting - Reviewed detailed modeling results, present standards and criteria; presented overview of Model Ordinance and implementation examples of small projects; solicited input on Ordinance provisions. (Draft MODEL ORDINANCE sent to municipalities prior to meeting).	4.22.2010
7	General review of draft Plan: Gather general comments and feedback prior to finalization of the Plan. (Draft Plan sent to municipalities prior to meeting).	TBD
Public Hearing	Conduct the hearing as required by Act 167 to present the Plan to the public.	TBD
8	Municipal Implementation Workshop: Provide assistance to municipalities on implementation of the Plan including adaptation, enactment, and implementation of the ordinances and other action items.	TBD
Public Workshop	Public Implementation Workshop: Provide introduction and overview of the Plan to public.	TBD

Table 2.2. Summary of PAC Meetings

Section III – Potter County Description

Potter County is located in the north central area of Pennsylvania. It is surrounded to the south by Clinton and Cameron Counties, to the west by McKean County, by the New York state line to the north, and by Tioga County to the east. It was created in 1804 from what was originally Lycoming County. It is primarily rural in character with the historic economic activity being closely tied to forestry.

POLITICAL JURISDICTIONS

The county is comprised of 30 municipalities. The political jurisdictions include six (6) boroughs and twenty four (24) second class townships. Summary statistics for the boroughs and municipalities of Potter County are provided in *Tables 3.1* and *3.2*, respectively. Generally, an area is classified as rural when the population density is below 274 people per square mile (Center for Rural Pennsylvania, 2010). With the exception of Coudersport, Galeton, and Shinglehouse Boroughs, Potter County's population density falls far below this threshold with about 15 people per square mile for the entire county. The population has varied somewhat over the last century, peaking in 1900 with over 30,000 inhabitants and decreasing to between 16,000 and 18,000 between 1950 and 2000. In the past decade, the population has decreased by 7.5%. Population projections for the county for the year 2020 vary between 14,500 and 17,600 (Potter County, 2005; Center for Rural Pennsylvania, 2010).

Municipality	2000 Census Population	2008 Estimated Population	Area mi^2	Estimated 2008 Population Density
Austin	623	562	4.0	139
Coudersport	2,650	2,375	5.6	422
Galeton	1,325	1,213	1.3	937
Oswayo	159	140	1.4	101
Shinglehouse	1,250	1,105	2.1	530
Ulysses	684	631	4.1	156
Borough Total	6,691	6,026	18.5	326

Table 3.1. Potter County Municipalities – Boroughs

Municipality	2000 Census Population	2008 Estimated Population	Area mi^2	Estimated 2008 Population Density
Abbott	226	216	70.0	3
Allegany	402	368	40.6	9
Bingham	687	680	35.7	19
Clara	168	172	19.6	9
Eulalia	941	884	31.1	28
Genesee	789	716	35.6	20
Harrison	1,093	1,016	36.4	28
Hebron	622	575	43.7	13
Hector	453	422	41.1	10
Homer	390	390	32.0	12
Keating	307	276	41.5	7
Oswayo	251	244	37.3	7
Pike	292	228	36.7	6
Pleasant Valley	80	74	19.7	4
Portage	223	195	38.1	5
Roulette	1,348	1,220	32.6	37
Sharon	907	859	34.0	25
Stewardson	74	66	74.3	1
Summit	112	111	49.2	2
Sweden	775	715	33.9	21
Sylvania	61	54	29.7	2
Ulysses	691	747	75.4	10
West Branch	392	369	62.2	6
Wharton	91	97	113.3	1
Township Total	11,375	10,694	1,063.8	10
County Total	18,066	16,720	1,082.2	15

Table 3.1. Potter County Municipalities - Townships

LAND USE

Over 95% of the land in Potter County is non-urban (included forested and agricultural areas). The predominant land use is deciduous forests that occupy 83% of the landscape. Less than 4% of the total land use is designated as some type of urban land use, the majority of which are single family dwellings. There has been measurable growth in urban land use due to changes in demographics. Despite the population decline that has occurred since 2000 has been accompanied by an increase in the number of housing units by 3.8% (Center for Rural Pennsylvania, 2010). The majority of future housing growth use is projected to be single family, detached units, although the boroughs are also projected to have some increase in multi-family units (Potter County, 2005).

Land Use	Area (mi²)	Portion of County (%)
Single Family/Residential	33.74	3.16
Multi Family/Residential	0.01	0.00
Mobile Home Park	0.33	0.03
Commercial	1.11	0.10
Junk/Salvage Yard	0.04	0.00
Warehouses and Temporary Storage	0.01	0.00
Industrial	0.28	0.03
Parking Lots	0.06	0.01
Utilities	0.33	0.03
Institutional/Governmental	0.48	0.05
Cemetery	0.03	0.00
Hospital	0.14	0.01
Recreational	0.20	0.02
Urban Total	36.75	3.44
Cropland/ Pasture	127.95	11.97
Idle Fields	3.23	0.30
Orchards/Nurseries/Horticulture	0.30	0.03
Farmsteads and Farm Related Buildings	0.70	0.07
Successional Grassland/Shrub/Brush	4.40	0.41
Deciduous Forest	892.07	83.44
Evergreen Forest	0.11	0.01
Clear-cut	0.43	0.04
Non-Urban Total	1,028.75	96.22
Streams/Waterways/Canals	1.30	0.12
Manmade Reservoirs and Impoundments	0.65	0.06
Wetlands	0.20	0.02
River Banks	0.18	0.02
Mining/ Extraction	0.55	0.05
Unknown	0.33	0.03
Water Features	3.20	0.30

Table 3.2. Potter County Existing Land Use (Adapted from Potter County, 2005)

GENERAL DEVELOPMENT PATTERNS

The future land use pattern in the 2005 Comprehensive Plan designates 11 categories that have varying effects on Stormwater. Between all future projected growth (High Growth, Rural Growth Rural Hamlet, and Village), there is 24 mi² (2.2% of the county) designated for future land use changes. The quantity of additional impervious surface from the future projected growth is likely to be much smaller than 24 mi² since much of the projected future growth is rural in nature and some of which involved redevelopment or improvements to existing impervious areas (e.g., projected building in with Borough boundaries). *Table 3.3* highlights the projected location, the type, and the potential localized stormwater impact of each type of development.

Designation	Description	Area of Focus	Potential Localized Stormwater Impact
1. High Growth Area	Generally consists of low to high density residential; commercial and industrial uses and services	The high growth area is primarily located in Coudersport Borough extending along Route 6 into Eulalia Township and Sweden Township.	Severe
2. Rural Growth Area	Typically smaller in size than a high growth area, but still includes low to high density residential, smaller scale commercial and industrial uses and services, and generally has good to excellent accessibility to local highways	Rural Growth areas include Shinglehouse Borough, Galeton Borough, Ulysses Borough, and Austin Borough.	Minor
3. Village Area	Unincorporated and incorporated boroughs that are developed with low to medium density residential and very small scale commercial and industrial uses	Villages include the following areas Oswayo Borough, Roulette, Genesee/Hickox, Harrison Valley/Mills, Cross Fork, and Wharton.	Minor
4. Rural Hamlet	Clusters of homes and very small scale non-residential uses generally located at major highway crossroads	Rural hamlets include Germania, Millport, Honeoye, North Bingham, Walton/Telescope/West Pike, Conrad, Keating Summit, Gold, West Bingham, Ellisburg, Andrews Settlement, Sunderville, North Fork, and Hebron Center.	Minor
5. Rural Resource Area	Generally consists of all areas outside of high growth, rural growth, historical village, and rural hamlet areas	The rural resource area generally consists of all areas outside of high growth, rural growth, historical village, and rural hamlet areas.	Minor
6. Town Centers	Similar to a central business district, which is defined as an intensively developed, mixed use area within a borough, usually containing retail uses, government offices, service uses, professional uses, cultural and entertainment establishments, restaurants, and hotels, appropriate transportation facilities	Coudersport Borough, Galeton Borough, Shinglehouse Borough, Austin Borough, and Ulysses Borough have been identified as having town centers in the county.	Severe
7. Utility and Utility Corridor Protection Overlay	Power line rights-of-way, natural gas transmission line rights-of-way, natural gas and oil fields, railroad rights-of-way, and buffer areas around abandoned landfills		Moderate to Severe
8. Transportation Enhancement Overlay	Access management, signage, type of development, and appropriate design criteria	The county's major transportation corridor. It is recommended that a corridor improvement/ beautification study be conducted of Route 6.	Minor
9. Historic Overlay	Protect historic resources from being indiscriminately razed without consideration of preservation or incorporation into a development	Throughout the county	Minor
10. Watershed Protection Overlay	Development guidelines such as riparian buffers	Exceptional value and high quality stream basins in the county.	Positive
11. Conservation/ Recreation Overlay	Steep slopes, wetlands, flood plains, streams, ponds, and public lands will be protected from disturbance.	Throughout the county.	Positive

Table 3.3. Potter County Future Land Use (Adapted from Potter County, 2005)

TRANSPORTATION

Transportation in the county has influenced the hydrology of the watersheds. With no Interstate roadways within Potter County, State Route 6 is the most important transportation route through the County. Route 6's east-west path bisects the County connecting Pennsylvania's northern counties together. Other minor transportation routes include State Route 44 running diagonally from the southeast to the northwest and provides a link to Lock Haven and Olean; State Route 49 which links Coudersport to the northeast providing access to Corning, NY; and State Route 449 linking Coudersport to the NY State Southern Tier Expressway.

These major thoroughfares and crossroads provide a critical transportation and commuting link for county residents. However, these routes create an increase of impervious surfaces throughout the watershed. These impervious surfaces create more surface runoff and are non-point source pollution during precipitation events. This increases the stress on the drainage systems in the watershed, reduces water quality, and exacerbates streambank erosion, especially at already-known problem areas.

The County's sole airport is the Cherry Springs Airport located near Galeton. Air service is limited due to the turf runway.

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 assigned the Soil Conservation Service the task of inventorying the prime and unique farmlands and farmlands of state and local importance. This inventory was designed to assist planners and other officials in their decision making to avoid unnecessary, irrevocable conversion of good farmland to other uses. On the USDA's important farmland inventory map, the farmlands are categorized into four classifications: prime farmland, unique farmland, additional farmland of statewide importance, and additional farmland of local importance. According to the USDA, prime farmland soils are usually classified as capability Class I or II. Of Potter County's total land area, 114,000 acres (16 percent) are classified prime farmland soils as identified in NRCS SURRGO Soil Database for Potter County (NRCS, 2008).

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. These soils are usually classified as capability Class II or III. Potter County has about 78,500 acres (11% of the total County) of Farmland soils of statewide importance.

The loss of good farmland is often accompanied by such environmental problems as surface water runoff and interference with the natural recharging of groundwater. Furthermore, when prime agricultural areas are no longer available, farmers will be forced to move to marginal lands, usually on steeper slopes with less fertile soils, which are more apt to erode and less likely to produce.

CLIMATE

Potter County is situated in the Northwest Plateau Division and the climate is classified as humid continental. The area is mostly largely influenced by Lake Erie receiving largest quantities of snow early in the winter and then less when Lake Erie freezes. Potter County's annual precipitation of 40.1 inches. The winters are generally cold with average monthly temperatures below freezing in December, January and February. The coldest month is January, with an average temperature of 21° F. The warmest month is July with an average temperature of 66° F (Weather Channel, 2010). Based on the NOAA Coudersport Gage (Coop ID # 363130), the average snowfall in Coudersport is 55 inches per years, varying between 20 and 106 inches.

RAINFALL

Figures 3.1 and 3.2 show the rainfall statistics for Potter County. The average rainfall, shown in Figure 3.1 portrays the amount of precipitation throughout each year since 1931. Although there can be significant variation in the annual rainfall total (between 27 and 57 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 show 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 Potter County comes from storms low magnitudes. Only 10% of the daily rainfall values between 1931 and 2009 exceeded 0.70 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 2.46 inches was exceeded 24 times in more than 60 years of data. When analyzing only the annual maximum series, the NOAA Atlas 24-hour, 2-year storm was exceeded only 18 times. Thus, viewing only the annual maximum series neglects a substantial number of significant historical rainfall events. The implication for stormwater policy in Potter 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.

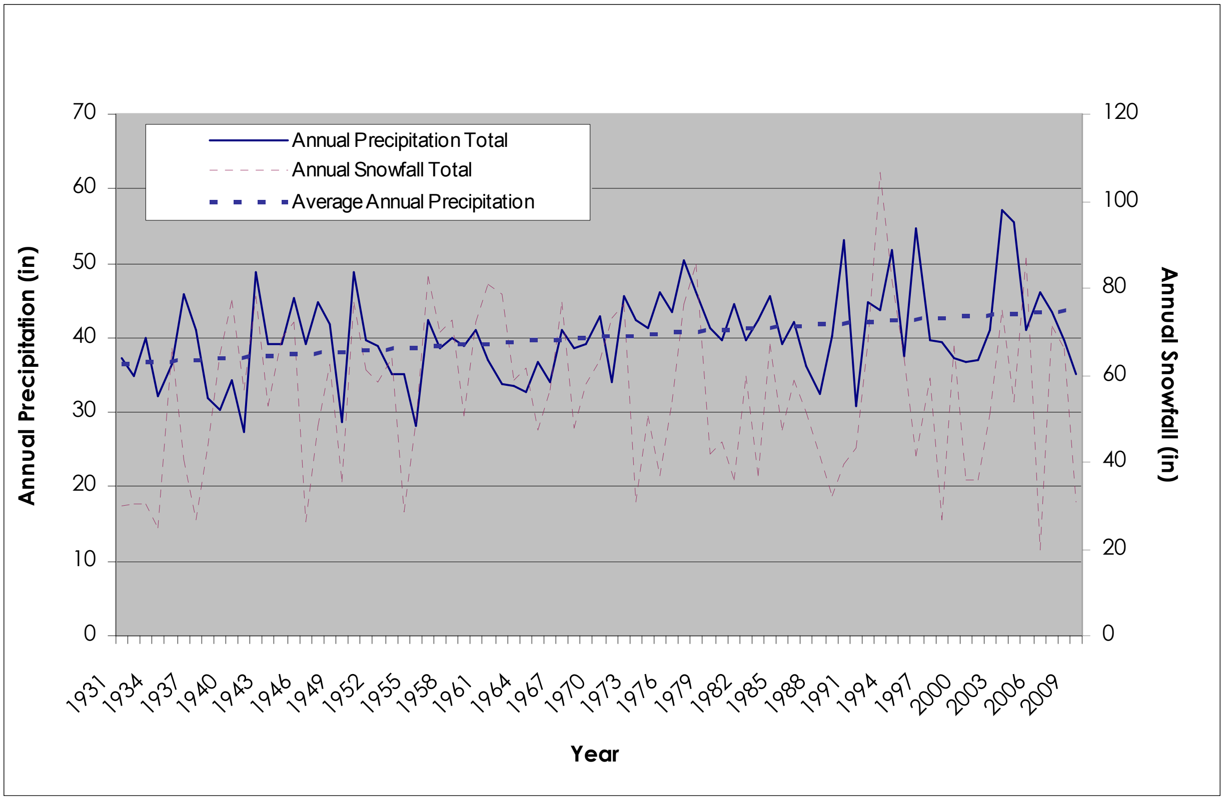


Figure 3.1. Annual Precipitation at Galeton, Pennsylvania (Coop ID # 363130)

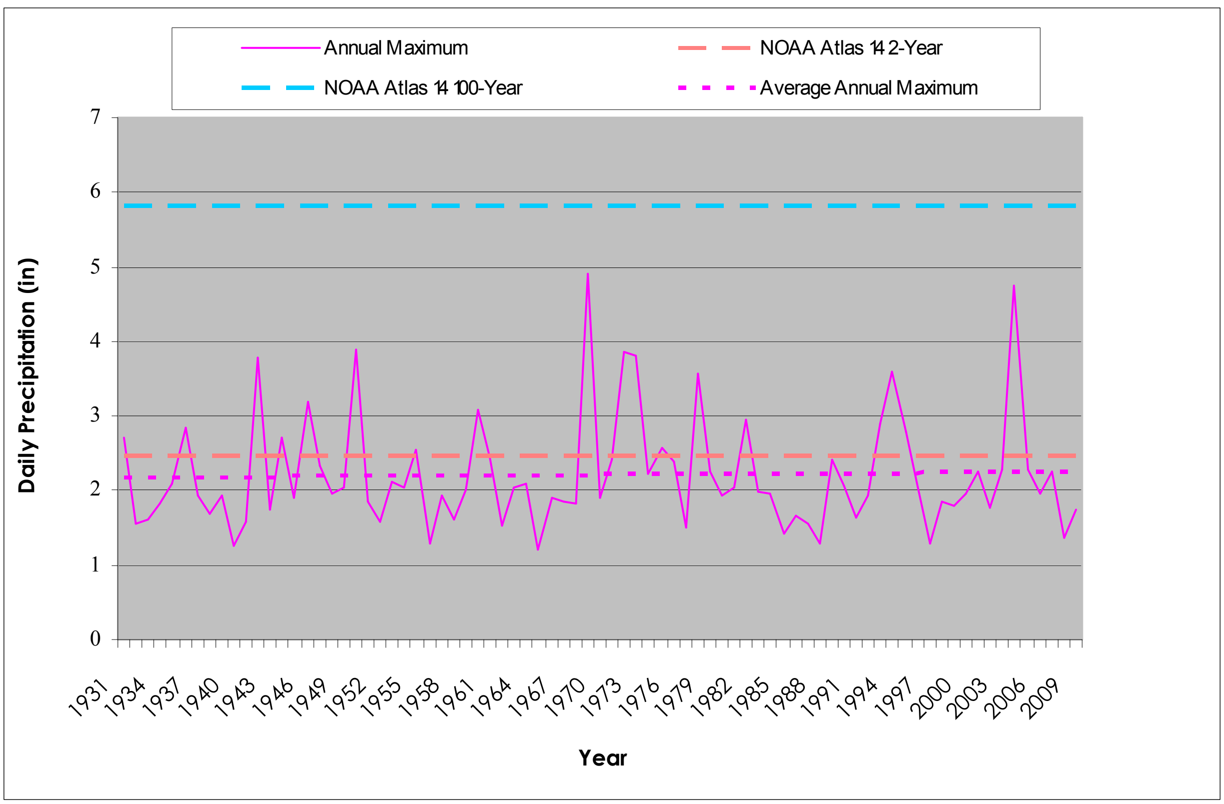


Figure 3.2. Daily Precipitation at Galeton, Pennsylvania (Coop ID # 363130)

GEOLOGY

Approximately 400 million years ago, north central Pennsylvania was inundated by an inland sea. As the levels of this sea were raised and lowered in various climate cycles sand, shale, and organic and calcium were deposited in layers of varying thicknesses and extent. This region was later thrust upward by subterranean pressures and the floor of the ancient basin became an elevated plateau, the Appalachian Plateau. After millions of years of extensive weathering, the plateau was transformed into ravines and canyons that carried large quantities of debris to the Susquehanna River and the Chesapeake Bay. This weathering gave the Appalachian Plateau province it characteristic high, flat-topped divides and steep sided valleys with deeply entrenched streams. During the retreat of glaciers towards the end of Pleistocene epoch, the valleys through which these streams had flowed were blocked and redirected by glacial deposits that form many of the outcrops and rectangular stream patterns that can be observed today (Pine Creek Watershed Council, 2005). Potter County is located within two sections of the Appalachian Plateaus Physiographic Province that reflects this history – the Deep Valleys Section and the Glaciated High Plateau Section (Sevon, 2000).

The Deep Valleys Section in Potter is comprised of several very deep, steep-sloped valleys separated by narrow, sloping uplands. In the deepest valleys such as Pine Creek at the border of Potter and Tioga counties, the stream at the valley bottom is as much as 800’ below the top of an adjacent upland. At the head of a valley (near the headwaters of the each watershed), the valley merges with the upland with only 10’s of feet of elevation difference between the valley bottom and the upland (DCNR, 2010).

In the northern portion of the County is the Glaciated High Plateau Section that is characterized by broad to narrow, rounded to relatively flat, elongate uplands. These uplands are dissected by steep to shallow valleys (DCNR, 2010).

BEDROCK FORMATIONS

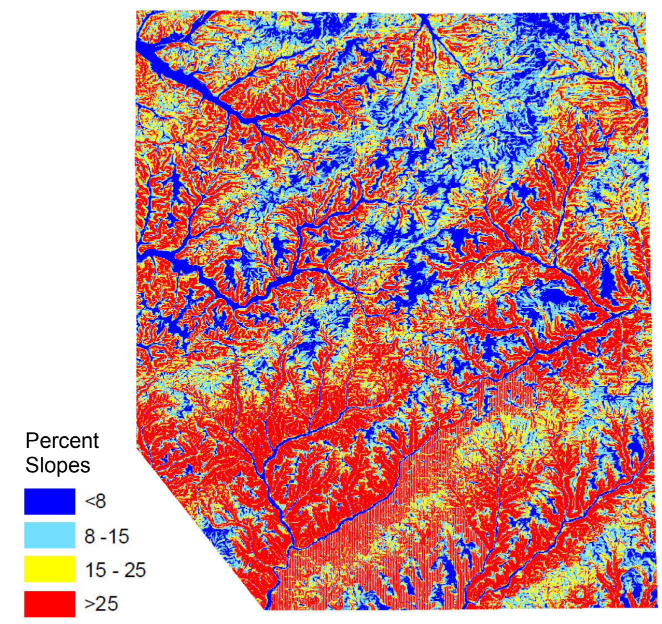
Exposed bedrock in Potter County is sedimentary in origin and includes 7 different geologic formations that range in age from the 320 to 400 million years. The formations consist of mostly of sandstone with some siltstone and mudstone. The formation names are as follows (PA Geological Survey, 2010):

Formation	Dominant Lithology	Age	% of County
Burgoon Sandstone	Sandstone	Mississippian	0.3%
Catskill Formation	Sandstone	Devonian	46.8%
Chadakoin Formation	Siltstone	Mississippian and Devonian	4.9%
Huntley Mountain Formation	Sandstone	Devonian	38.8%
Lock Haven Formation	Mudstone	Devonian	3.1%
Pottsville Formation	Sandstone	Pennsylvanian	4.9%
Shenango Formation through Oswayo Formation, undivided	Sandstone	Mississippian and Devonian	1.2%

Table 3.4. Geologic Formations

SLOPES

Much of the county contains sizeable areas of steep slopes. 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 60% is classified as having slopes of 15% or greater. Slope values are broken into four categories and shown in *Table 3.5* below. Also shown is the total area in Potter 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 (mi²)	Portion of Total Area	Slope Restrictions
Flat to Moderate	0-8%	210.2	19.4	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%	216.6	20.0	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%	231.0	21.3	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%	424.3	39.2	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 3.5. Summary of Slopes in Potter 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 Potter County have variable drainage characteristics and have various restrictions on their ability to drain, promote vegetative growth, and allow infiltration. They are generally moderately to poor drained and have a high runoff potential. The following describes the predominant soil series that occupy Potter County:

Series Name	Map Symbols	Hydrologic Soil Group	% of County	Restrictions
Albrights	AbA, AbB, AbC, AbD, AbF, AcC, AcD, AcF	C	0.7	Fragipan (18-32in.)
Atkins	At	D	0.1	
Barbour	Ba, Bb	B	0.3	Lithic bedrock (60-99in.)
Lackawanna	BKF	C	1.1	Fragipan (21-36in.)
Barbour	Bc	B	0.2	
Basher	Bd, Be, Bf	B	0.5	
Bath	BhB, BhD, BhE, BhF, BkD, BkE	C	2.5	Fragipan (21-38in.)
Braceville	Bn	C	0.1	Fragipan (15-30in.)
Brinkerton	BrB, BrF	D	0.1	Fragipan (11-30in.)
Cookport	CTF	C	<0.1	Lithic bedrock (40-72in.)
Cavode	CaB, CaC, CaD, CbB, CbC, CbD, CdC, CdF	C	0.6	Paralithic bedrock (40-80in.)
Cadosia	CeC, CeE	B	0.2	Lithic bedrock (60-60in.)
Chenango	CfB, CfD, CfF	A	0.5	Lithic bedrock (40-120in.)
Clymer	CgB, ChB, ClB, ClD, ClE, CmC, CmE	B	3.5	Lithic bedrock (40-60in.)
Cookport	CoB, CoC, CoD, CoE, CpB, CpD, CpE	C	4.6	Lithic bedrock (40-72in.)
Craigsville	CrA	B	<0.1	Lithic bedrock (61-120in.)
Chippewa	CvB, CwB	D	0.2	Fragipan (8-20in.)
Dekalb	DfB, DfD, DfE, DkB, DkD, DkE, DxD, DxE	C	1.7	Lithic bedrock (20-40in.)
Freetown	Fr	D	<0.1	Lithic bedrock (61-120in.)
Hartleton	HLF	B	11.1	Lithic bedrock (40-60in.)
Hazleton	Ha	A	0.2	Lithic bedrock (40-60in.)
Hartleton	HaB, HaD, HaE, HaF	B	3	Lithic bedrock (40-60in.)
Holly	Hb	D	0.7	Lithic bedrock (60-99in.)
Hartleton	HbD, HbE	B	0.1	Lithic bedrock (40-60in.)
Hustontown	HuB, HuC, HuD, HuE, HvC, HvD, HvE	C	4.4	Fragipan (18-32in.)
Hazleton	HwF, HxB, HxD, HxE, HyB, HyD, HzD, HzE, HzF	B	6.4	Lithic bedrock (40-68in.)
Lordstown	LPF	C	0.7	Lithic bedrock (20-40in.)
Leetonia	LTC, LTE, LTF	C	7.6	Lithic bedrock (40-60in.)

Table 3.6. Soil Characteristics of Potter County (NRCS, 2008)

Series Name	Map Symbols	Hydrologic Soil Group	% of County	Restrictions
Lackawanna	LaB, LaC, LaD, LaE, LaF, LbD, LbE	C	3.8	Fragipan (17-36in.)
Laidig	LdC, LdD, LdE	C	0.8	Fragipan (28-35in.)
Leck Kill	LkB, LkD, LkE, LkF, LmC, LmD, LmE	B	16.5	Lithic bedrock (40-60in.)
Lordstown	LoB, LoD, LoE, LoF, LpC, LpD	C	0.9	Lithic bedrock (20-40in.)
Leetonia	LsC, LsE	C	1.9	Lithic bedrock (40-60in.)
Lehew	LwB, LwC, LwD, LwE, LwF, LxD, LxE, LxF	C	5.2	Lithic bedrock (20-40in.)
Mardin	MBF, MaB, MaC, MaD, MaE, MbC, MbD, MbE	C	4.7	Fragipan (14-26in.)
Melvin	McA	D	0.1	Lithic bedrock (72-99in.)
Middlebury	Me, Mf, Mg	B	0.5	
Meckesville	MhD	C	<0.1	Lithic bedrock (61-120in.)
Mixed alluvium	Mn	D	1.1	
Morris	MoA, MoB, MoC, MoD, MoF, MsC, MsD, MsF	C	2.7	Fragipan (11-22in.)
Nolo	NoB	D	0.1	Fragipan (16-30in.)
Nolo variant	NsB	D	0.3	Fragipan (16-30in.)
Norwich	NwB, NxB	D	0.3	Fragipan (10-24in.)
Oquaga	OaB, OaD, OaE, OaF, OxC, OxD, OxF	C	1.9	Lithic bedrock (20-40in.)
Red Hook	Rh	C/D	0.2	
Potomac	Rv	A	0.1	Lithic bedrock (61-120in.)
Scio fine sandy loam	ScA	B	0.2	
Solon	SoB, SoD	B	<0.1	Lithic bedrock (20-60in.)
Tioga	TaA, TgA, ThA	B	0.2	
Tunkhannock	TkC, TkE, TkF, TuB, TuD	A	0.9	
Unadilla	UfA	B	<0.1	
Ungers	UmF	B	0.2	Lithic bedrock (40-60in.)
Unadilla	UnA	B	<0.1	
Volusia	VoA, VoB, VoC, VoD, VoE, VsB, VsC, VsD	C	1.8	Fragipan (10-22in.)
Wellsboro	WeB, WeC, WeD, WeE, WfC, WfD, WfE	C	3.5	Fragipan (12-30in.)
Wharton	WgB, WhB, WhD, WhE	C	0.5	Paralithic bedrock (61-72in.)
Other	W, GP	--	0.1	Water, Pits

Table 3.6 (continued). Soil Characteristics of Potter County (NRCS, 2008)

One of the impediments to drainage in the Genesee River watershed of Potter County 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 which is typically 12-36 inches below the surface in Potter County (Ciolkosz and Waltman, 2000; NRCS, 2008). Thus, higher runoff rates and reduced infiltration capacity typically exist in these soils. Additional impediment to subsurface drainage include lithic and paralithic bedrock (i.e., solid and weather or broken layers of bedrock) although the bedrock depths varies between 2'-10'. *Table 3.7* displays the proportion of fragipan and bedrock in the County.

Restrictions	% of County
Fragipan	28.4
Lithic bedrock	64.8
Paralithic bedrock	1.1
None Identified	5.7

Table 3.7. Soil Restrictions in Potter County

An additional indicator of the response to rainfall of the soils in Potter 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 permeability. *Table 3.8* show a summary of the hydrologic soil groups for Potter County. A small percentage of the county's soils have variable runoff potential depending on whether or not they are drained or undrained. For example, agricultural field with tile drainage may decrease the runoff potential from hydrologic soil group D to hydrologic soil group C. Over 95% of the soils in Potter County are hydrologic soil group A, B, or C indicating a moderate runoff potential (Refer to *Plate 4 – Hydrologic Soils*).

Hydrologic Soil Group	Runoff Potential	% of County
A	Low	2.4
B	Low to moderate	42.4
C	Moderate to high	52
C/D		0.2
D	High	2.9
Unidentified		0.1

Table 3.8. Hydrologic Soil Groups in Potter County

HYDRIC SOILS

Hydric soils are important to identify and locate because they provide an approximate location where wet areas may be found. Together, they account for 2.8% of the surface area of Potter 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 now protected by DEP and should be examined before deciding on any type of development activity. According to NRCS, the following table lists the hydric soils found in Potter County:

Atkins	Morris
Brinkerton	Nolo
Chippewa	Nolo variant
Freetown	Norwich
Holly	Red Hook
Melvin	

Table 3.9. Hydric Soils

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 3.4*, 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.

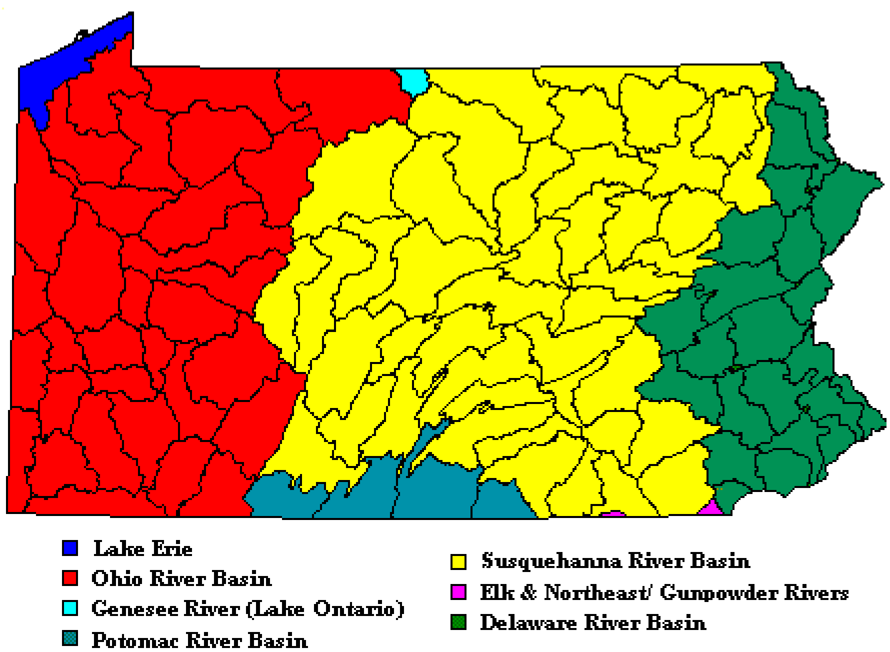


Figure 3.3. Pennsylvania's Major River Basins as Delineated by DEP (DEP, 2009)

For the purpose of this Plan, these are the largest basins within the Commonwealth. The major river basins are further divided into "subbasins" and "Act167 Designated Watersheds" for stormwater management purposes. Act 167 divided the Commonwealth into 29 subbasins and 357 designated watersheds. Potter County is split by the Susquehanna River Basin flowing southeast, Ohio River Basin, and the Genesee River. The county contains at least a portion of twelve different Act 167 Designated Watersheds. This classification of the county's watersheds is summarized in the following table:

Drainage Basin	Act 167 Designated Watershed	Portion of County (%)
Ohio River	Allegheny River (Potter)	15.5
	Allegheny River	1.0
	Oswayo Creek	11.9
Susquehanna River	Cowanesque River	4.3
	First Fork Sinnemahoning Creek	19.3
	Kettle Creek	14.6
	Pine Creek	13.1
	Sinnemahoning Creek	0.3
	Sinnemahoning/Portage Creek	2.2
	West Branch Pine Creek	6.6
	Young Women's Creek	2.5
Genesee River	Genesee River	8.7

Table 3.10. Potter County Watersheds

ACT 167 DESIGNATED WATERSHEDS

The Act 167 designated watersheds in Potter County provide the headwaters to three different major drainage basins. This Plan includes a detailed study of Oswayo Creek and the Genesee River. Additionally, an Act 167 Stormwater Management Plan was prepared and approved in 1992 for the Allegheny River in Potter County. Although the Allegheny River in Potter County is not studied in detail in this Plan, some components from the 1992 Plan will be incorporated into this Plan, as discussed in Section 4. The remaining nine watersheds will be addressed generally through the Plan.

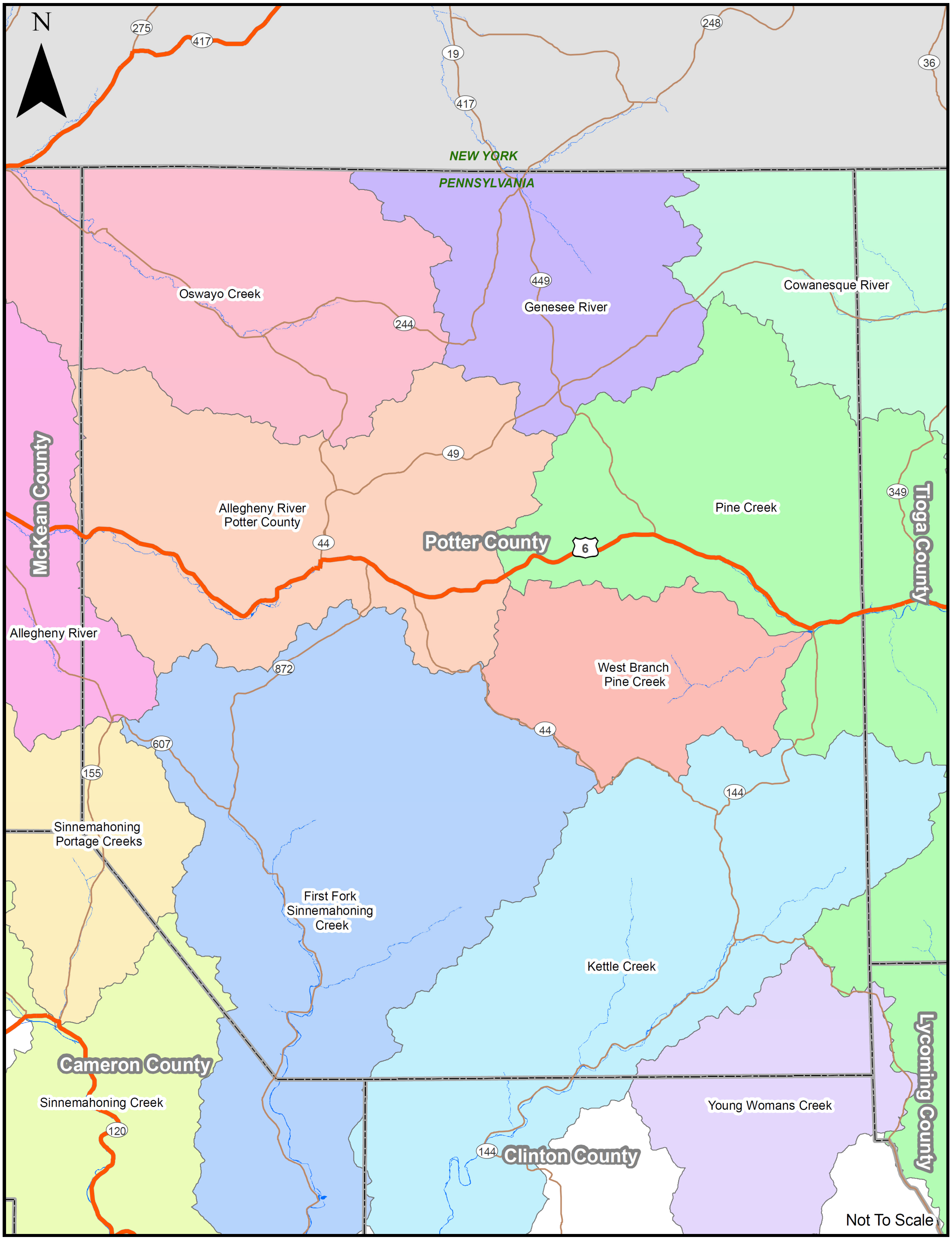


Figure 3.4. Act 167 Designated Watersheds in Potter County

Oswayo Creek Watershed

Oswayo Creek drains northwest before it confluence with the Allegheny River in McKean County. Characteristic of many streams in this geologic region, Oswayo Creek has wide valley with steep hillside slopes making it conducive to rapid runoff and deep channel flows. It is reported to have flooded many times in the past with extreme events reported in September 1967 and June 1972 (FEMA, 1991). Given its rural location and the climate, flooding is increased because of ice and floating debris such as logs, trees, and brush (FEMA (1991).

Watershed	Municipality	Area (mi²)
Oswayo Creek	Allegany Township	4.5
	Clara Township	10.6
	Genesee Township	6.3
	Hebron Township	28.8
	Oswayo Borough	1.4
	Oswayo Township	35.1
	Pleasant Valley Township	6.1
	Sharon Township	34.0
	Shinglehouse Borough	2.1

Table 3.9. Oswayo Creek Watershed

The water quality and biological diversity with the Oswayo Creek watershed is generally excellent. It is designated as a wild trout fishery by the Pennsylvania Fish and boat Commission (PAFBC) and over 200 of the 352 miles of designated stream within the watershed are designated either as Exceptional Value or High Quality Cold Water Fished according to the Pennsylvania Chapter 93 Designation. There are 77 miles of stream designated to support wild trout production (PAFBC, 2009).

Genesee River Watershed

The Genesee River is the only watershed in Pennsylvania within the Lake Ontario watershed. It drains north beginning in Ulysses and Allegany Townships with steep narrow valleys widening out to relatively broad floodplains with mild slopes near the state border. Within the Pennsylvania portion of the watershed, 78% of the soils are underlain by fragipans and an additional 16% are underlain by shallow bedrock ranging between 2.5' to 5.0' in depth below the soil surface (NRCS, 2008). The combination of steep slopes, poorly drained soils, and general climate give the watershed a very high runoff potential.

Watershed	Municipality	Area (mi²)
Genesee River	Allegany Township	12.2
	Bingham Township	32.4
	Genesee Township	29.3
	Harrison Township	0.1
	Hector Township	0.0
	Oswayo Township	2.2
	Ulysses Borough	4.0
	Ulysses Township	14.0

Table 3.10. Genesee River Watershed

The water quality and biological diversity with the Genesee River watershed in Pennsylvania is also generally excellent. It has over 134 of the 234 miles of designated stream within the watershed are designated as High Quality Cold Water Fishes according to the Pennsylvania

Chapter 93 Designation. Throughout the Genesee River watershed in Pennsylvania, there are 44 miles of stream designated to support wild trout production (PAFBC, 2009).

IMPOUNDMENTS

There are only two major water impoundments with significant flood control capability located in Potter County, the North Fork Dam in the Cowanesque watershed and the Lyman Run Dam within the West Branch of Pine Creek watershed. There exist several other dams that are run of the river dams that have only localized effects on the county's watershed hydrology. *Figure 3.4* shows the location of these impoundments.

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 IV – Existing Stormwater Regulations and Related Plans.

Potter County streams are shown with their Chapter 93 protected use classification in Figure 3.5 (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 IV.

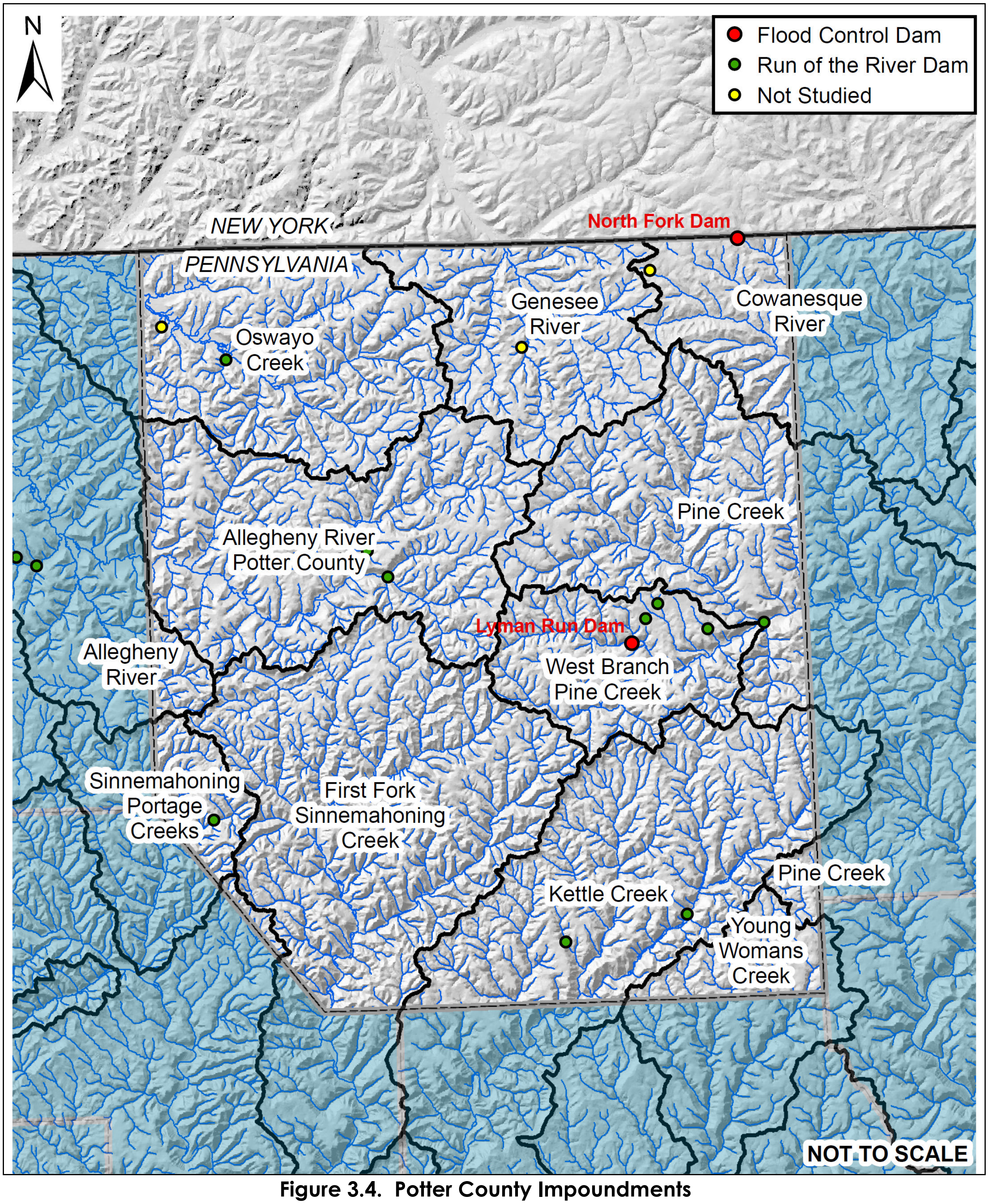


Figure 3.4. Potter County Impoundments

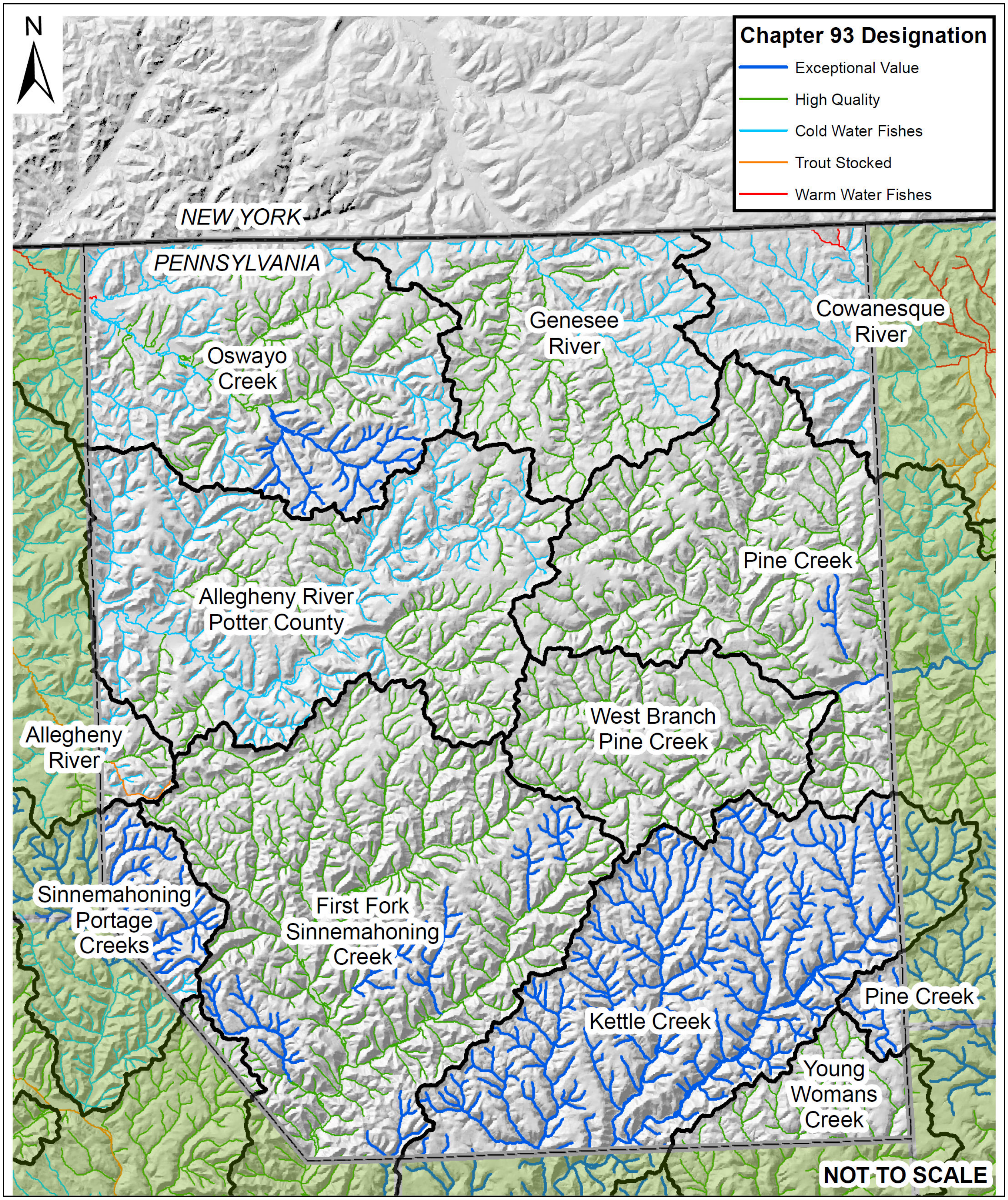


Figure 3.5. Chapter 93 Classification of Potter County Streams

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

GROUNDWATER

Groundwater, the water that fills the underground spaces between rock and soil partictles, is a major water supply source for most of Potter County. It is created as rain, melting snow, or surface water seep into the ground and fill these underground spaces. Surface water that is tranporting harmful contaminants found in stormwater discharges may therefore have an adverse impact on groundwater as the contaminated water reaches the water table. Since the quality of groundwater can be effected by the surface water, effective stormwater management regulations should consider the effects any particular stormwater strategy might have.

Several municipalities throughout the county have prepared source water protection plans and wellhead protection plans that delineate wellhead protection areas (WHPA). WHPAs are defined as area surface and subsurface area surrounding a water well or wellfield supplying a public water system, through which contaminants are reasonably likely to move toward and potentially adversely affect a water well or well field. In the plan, potential sources of contamination are identified along with strategies for addressing high risk development such commercial developments that use toxic and hazardous chemicals.

Although the potential risk from stormwater-related contamination is identified to be relatively low in these plans (e.g., refer to Shinglehouse Borough, 2002), it may be appropriate for certain commericial or industrial establishments that handle toxic and hazardous chemicals (i.e., stormwater "hot spots") to take extra precautions in the design of their stormwater facilities. Such precautions may include the installation of water quality inlets or oil-water separators, or pehaps incorporating the ability to isolate a spilled substance in a tank for lined pond where it can be easily removed. The following areas and jurisdiction have prepared wellhead protection plans that should carefully considered with any proposed development where groundwater may potentially be affected:

Municipality	Pertinent Wellhead Protection Plan(s) (WHP)
Austin Borough	Austin Borough WHP
Bingham Township	Northern Tier Children's Home WHP Ulysses Borough WHP
Coudersport Borough	Coudersport Borough WHP
Galeton Borough	Galeton Borough WHP
Roulet Township	Roulet Township WHP
Shinglehouse Borough	Shinglehouse Borough WHP
Ulysses Borough	Ulysses Borough WHP Northern Tier Children's Home WHP
Ulysses Township	Ulysses Borough WHP Northern Tier Children's Home WHP

Table 3.11. Wellhead Protection Areas in Potter County identified by the Potter County Planning Commission

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 3.12* summarizes the findings from this study.

Storm Event	Number of Buildings at Least Moderately Damage	Total Economic Loss
10	140	$50 million
50	232	$70 million
100	277	$82 million

Table 3.12. Potential Impact Due to Flooding (PEMA, 2009)

Detailed Studies

There are various levels of detail in floodplain mapping. Detailed studies (Zones AE and A1-A30 on the floodmaps) 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 3.6* below for a graphical representation of these terms. 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).

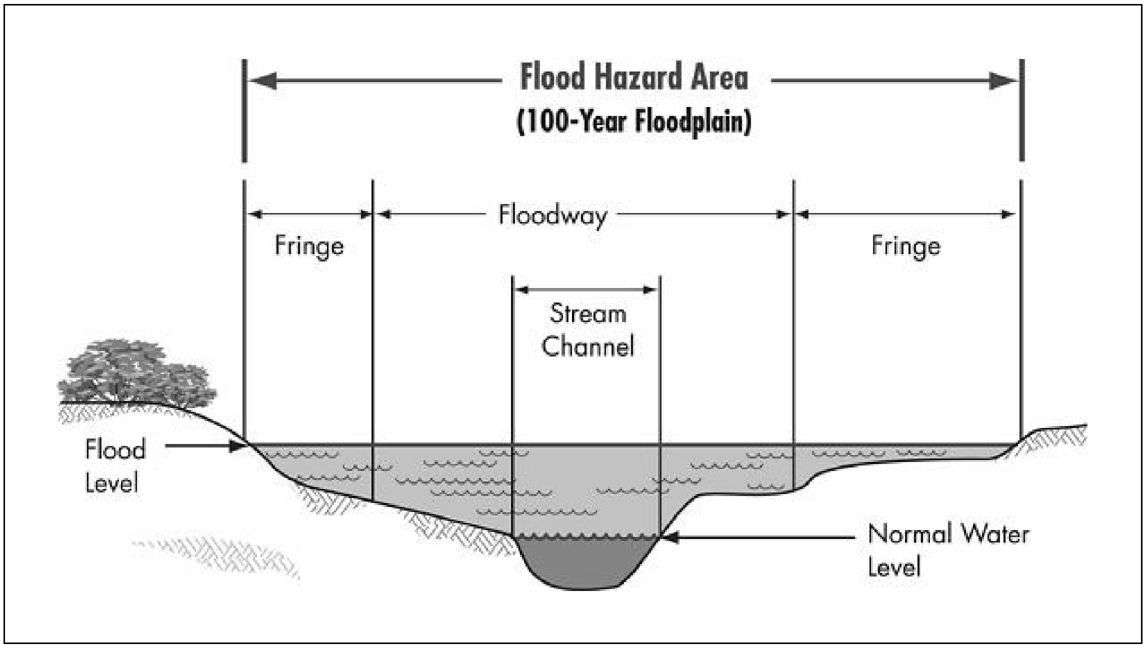


Figure 3.6. Floodplain Cross Section and Flood Fringe (NH Floodplain, 2007)

A review of the FIRMs revealed that several 100-year floodplains exist within Potter County for the main streams draining the County. Detailed studies that clearly define the 100-year flood elevation and the floodway are provided in the locations indicated in *Table 3.13*.

Waterbody
Allegheny River
Dingman Run
Freeman Run
Honeoye Creek
Mill Creek
North Hollow Run
Pine Creek
West Branch of Freeman Run

Table 3.13. Detailed Method Study (FEMA, 2010)

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 find it necessary to have the developer pay for a detailed study at the location in question. All streams with drainage areas of at least 1 square mile that are in the 1:24,000 National Hydrography Dataset had at an approximate study in the most recent FEMA Map Update process (FEMA, 2010).

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.

Levees and other flood control stuructures

As administrator of the National Flood Insurance Program (NFIP), FEMA has a series of policies and guidelines concerning the protection of life and property behind levees. Periodically, FEMA updates the effective FIRMs as new hydrologic and hydraulic data become available and to reflect changes within the community. In the ongoing map update process, FEMA issued Procedure Memorandum 43 (PM 43) – Guidelines for Identifying Provisionally Accredited Levees (PALs) (FEMA, 2007). For communities with levees, PM 43 has potential to substantially impact the communities protected by levees. A PAL is a levee that has previously been accredited with providing 1-percent-annual-chance flood protection on an effective FIRM. After being designated as a PAL, levee owners will have up to 24 months to obtain and submit documentation that the levee will provide adequate protection against a 1-percent-annual-chance flood. If the levee cannot be certified as providing protection from the 1-percent-annual-chance flood, the areas currently being protected by the levees will be mapped and managed as if they were within the floodplain (i.e., in most cases, the residents and businesses currently being protected by the levees would be forced to purchase flood insurance in accordance with the NFIP).

There are at least levee projects in Potter County:

Project (Year Constructed)	Owner	Waterbody	PAL Levee Status
Coudersport (1953)	Borough of Coudersport	Mill Creek	PAL Eligible
Coudersport (1953)	Borough of Coudersport	Allegheny River	PAL Eligible
Galeton (1962)	Borough of Galeton	Pine Creek	PAL Eligible

Table 3.14. Levee Systems in Potter County

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 Potter 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. Potter County is scheduled to have an Effective FIRM update available by January 2011. This will correspond to an effort by DCED to have all municipalities adopt and implement a new floodplain model ordinance that conforms to federal and state requirements.