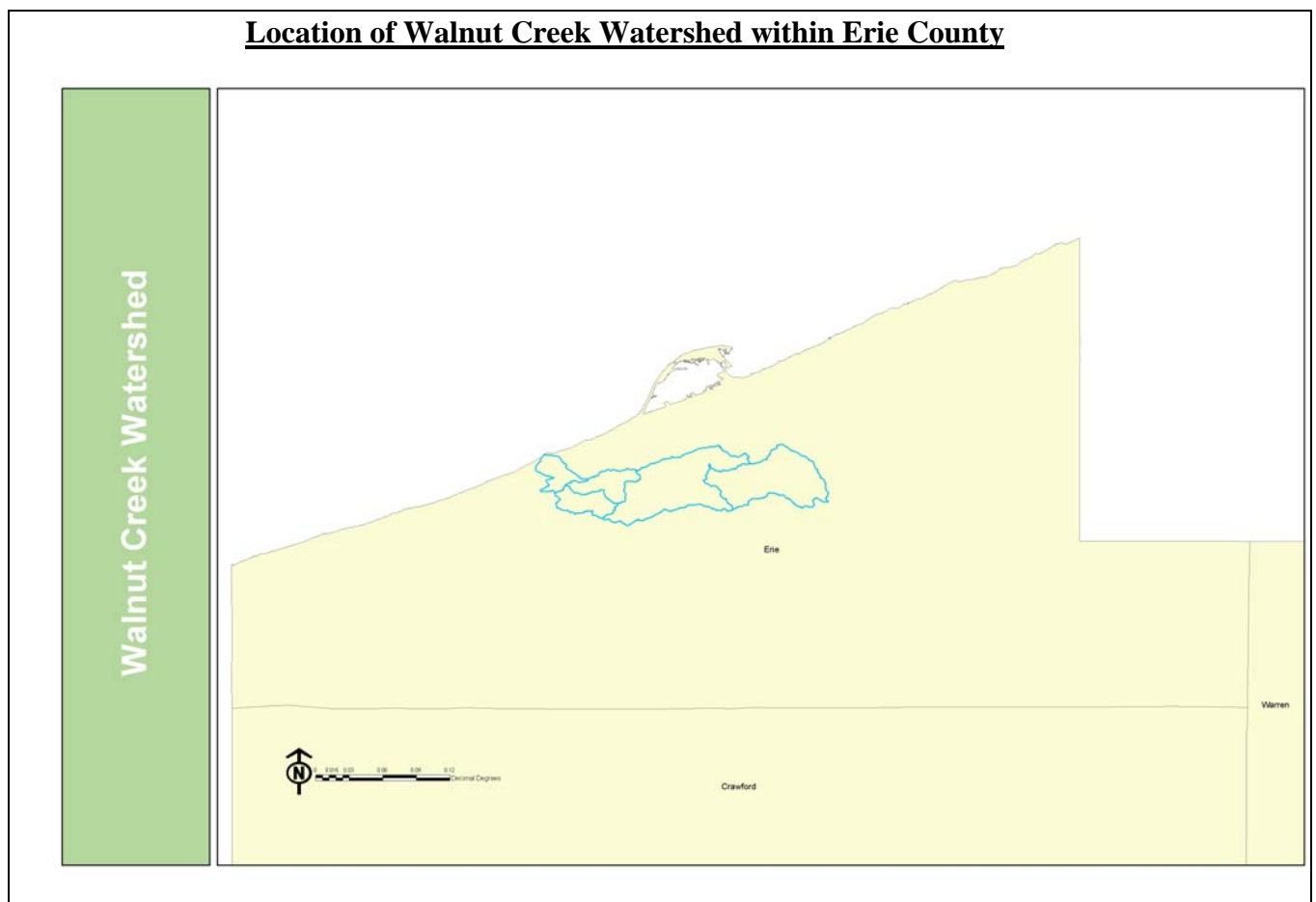


## PART 2--FEATURES AND PHYSICAL CHARACTERISTICS OF THE WATERSHED

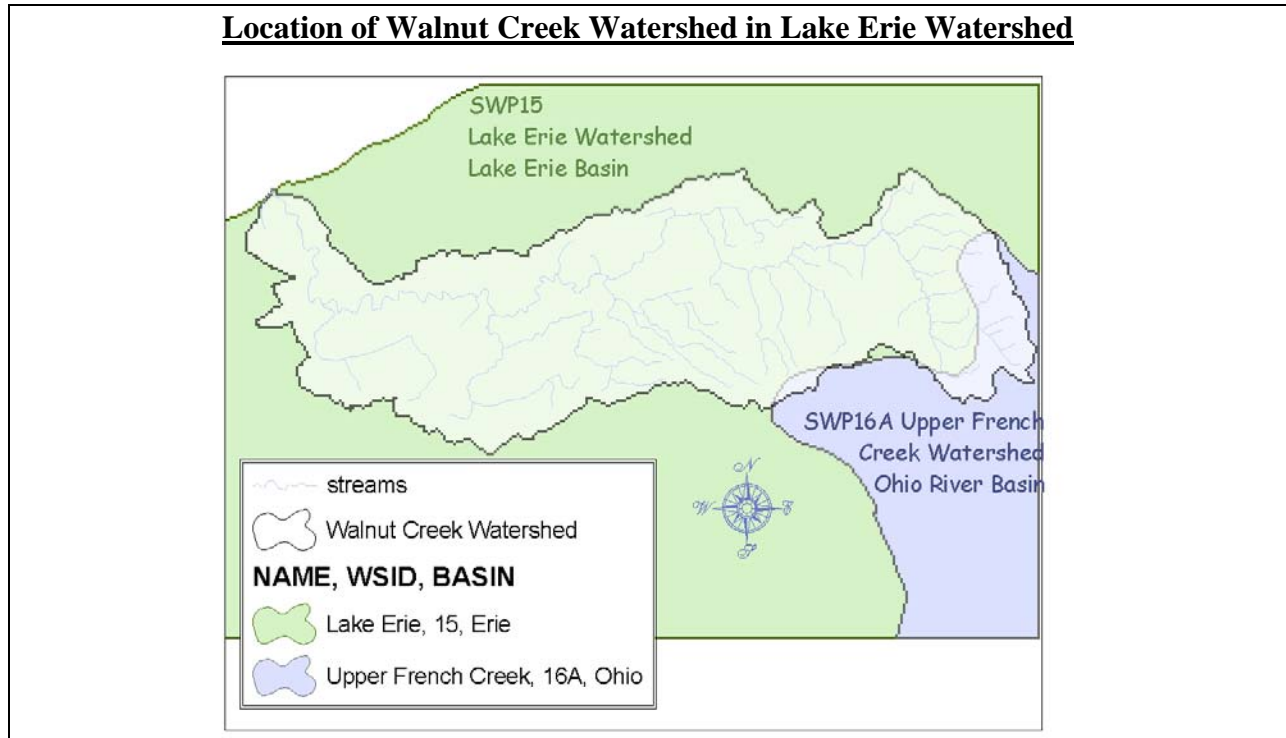
### 2.1 Location

The Walnut Creek Watershed is located in Erie County, Pennsylvania. By traveling north on Interstate Route 79, west on U.S. Route 20, and north on Manchester Road, one can reach the mouth of the watershed at its confluence with Lake Erie. The watershed drains in a northwesterly direction from the headwaters in Greene and Summit Townships, through Millcreek and McKean Townships, to Lake Erie at Manchester Beach, Fairview Township. The figure below depicts the location of the watershed boundary, as well as the boundaries of the five sub-watersheds, described later in this report.



## 2.2 Watershed Boundaries

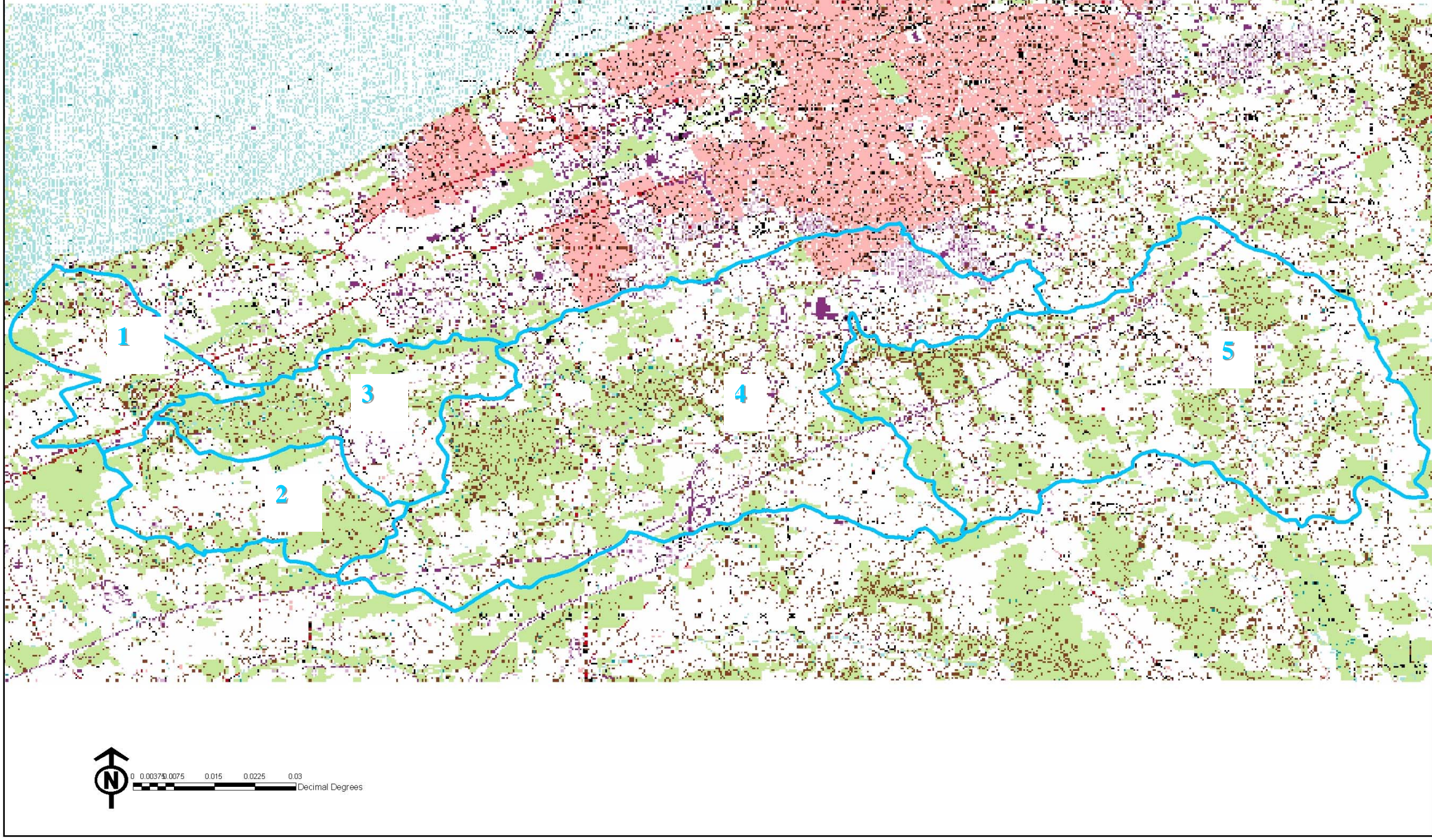
The Walnut Creek watershed includes 83.4 stream miles and drains a 38.2 square mile watershed area. The southeast boundary of the watershed borders the Upper French Creek watershed and constitutes a sub-continental divide between water flow to the Great Lakes and water flow to the Gulf of Mexico.



It is important to recognize that watershed boundaries are established using topographic and hydrologic principles. They often do not accurately reflect ground water flow, particularly at the periphery of a watershed. The two-dimensional representation of a surface water divide is often not an appropriate demarcation of ground water flow. Several more factors must be considered to establish a ground water divide, and these are inherently more difficult to establish, as compared to traditional hydrologic and cartographic techniques used to determine surface watershed boundaries. A more detailed explanation of local ground water conditions is provided further in this report.

For the purposes of this report, the overall Walnut Creek watershed has been further divided in to five sub-watersheds. These sub-watersheds are numbered one (1) through five (5), from West to East with Sub-Watershed two (2) corresponding to the southerly Bear Run drainage. The southwestern tributaries to the main stem of Walnut Creek are named locally as Bear Run and Thomas Run, west to east, respectively. The Bear Run drainage constitutes the southwesterly most of the five sub-watersheds.

# Walnut Creek Sub-Watershed Boundaries



## 2.3 Watershed Floodplain

A *floodplain* is the land adjacent to a stream or river that experiences occasional or periodic flooding. The floodplain is delineated by the maximum area of land that is likely to be flooded by a 100-year flood as shown on floodplain maps produced by the Federal Emergency Management Agency (FEMA). The floodplain includes the *floodway*--the stream channel and adjacent areas that carry flood flows, and the *flood fringe*--the area covered by the flood, but which do not experience strong currents.

DEP regulates the floodway, or more specifically, the channel and portions of the adjoining floodplain that carry the 100-year frequency flood. A 100-year flood is described as the highest level of flooding that, on average, is likely to occur every 100 years. New structures or additions to existing structures, as well as earth moving activities in the floodway often require a permit from DEP. In some circumstances a federal permit may also be necessary.

DEP does not typically regulate private construction activities within the flood fringe (not including E&S controls and stormwater discharges associated with construction activities as required by Chapter 102). Development within the flood fringe is regulated by local ordinances. Chapter 106 of the Department's regulations does; however, require political subdivisions of the Commonwealth to obtain a permit for construction activities in the floodway and flood fringe.

The main purpose of floodway regulation is to protect people and property in floodplains from the dangers and damages of floodwaters and material that may be carried by floodwaters. In addition to the obvious impacts that flooding can have on public safety, there are numerous environmental impacts associated with flooding and floodplain development. Streams with obstructed and developed floodplains often experience severe erosion problems, changes in water temperature and resultant impairment to aquatic life.

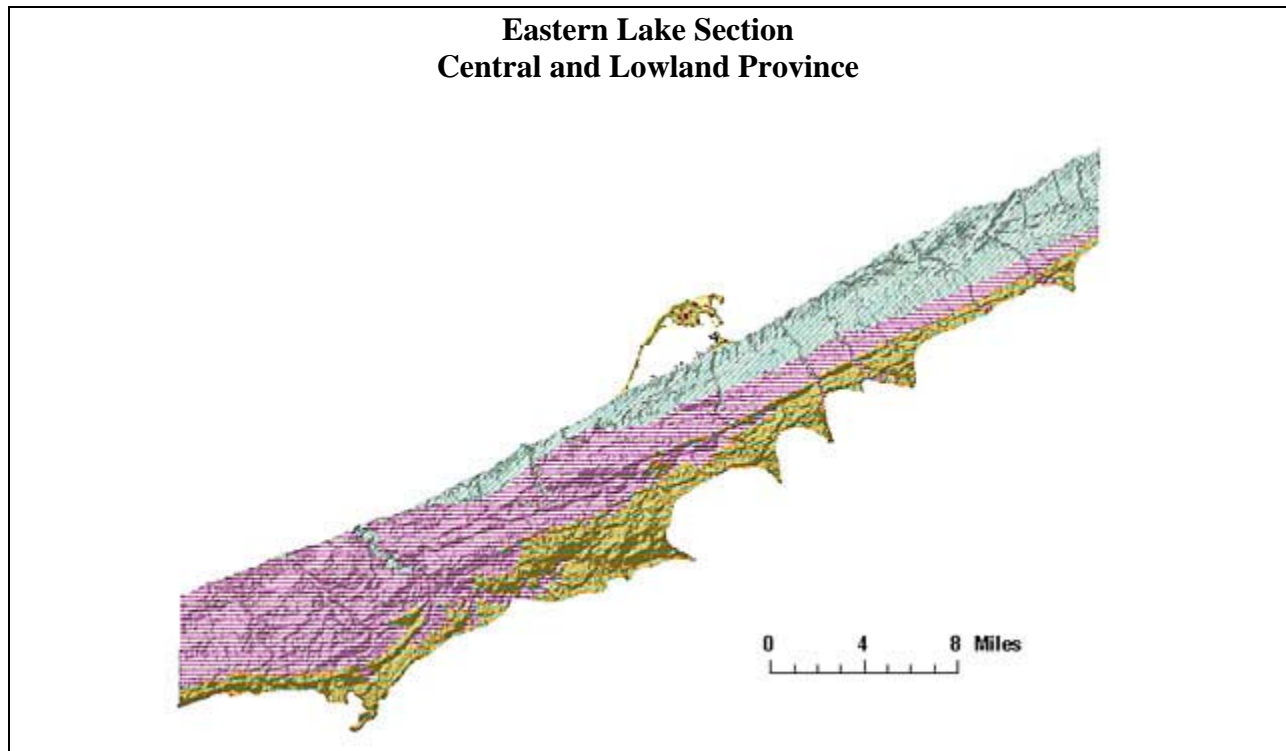
The riparian corridor is very important to the overall health of a stream. As the floodway and flood fringe of Walnut Creek is developed, much of the wetlands and vegetation is removed. When this occurs the natural water storage capacity, filtering properties and stream shading is lost. A lot of the middle and lower reaches of Walnut Creek have been developed and modified. The Stream Corridor Assessment, completed as part of this assessment, documents numerous floodway obstructions, permitted and unpermitted, diminished stream riparian buffer zones and erosion problems.

Floodplains should be carefully considered with respect to land use and development planning, with particular attention to public safety and storm water management. FEMA has completed detailed studies of much of the floodplain of the Walnut Creek watershed. FEMA mapping for Erie County can be found at:

<http://msc.fema.gov/webapp/wcs/stores/servlet/StoreCatalogDisplay?storeID=10001&catalogID=10001&langID=-1&userType=G>. Click on "Flood Insurance Studies".

## 2.4 Physiography

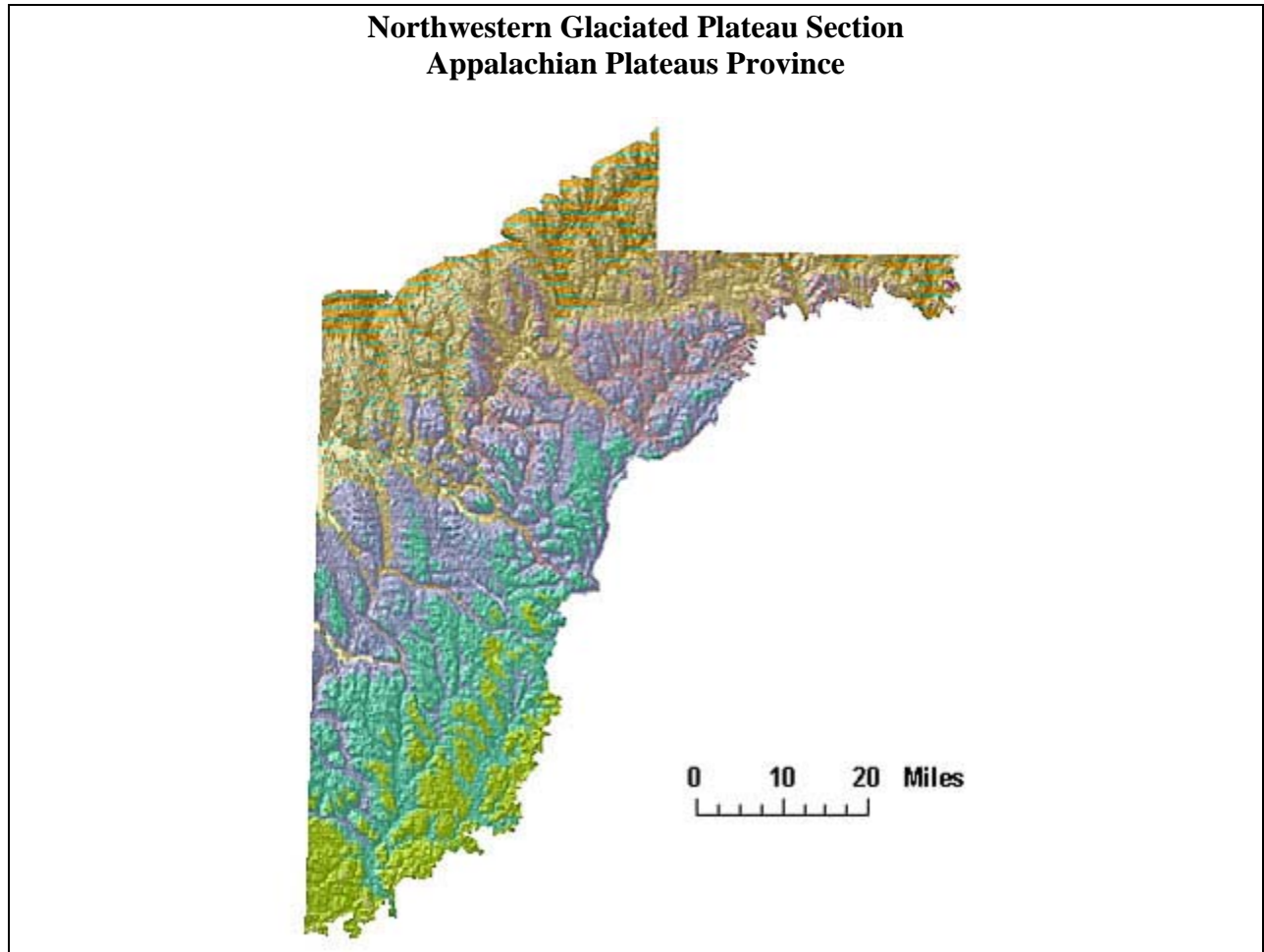
The Walnut Creek watershed is located in the Eastern Lake Section of the Central Lowland Physiographic Province and the Glaciated Plateau Section of the Appalachian Plateau Physiographic Province. The following descriptions are from the Pa. Geological Survey's Map 13 - Physiographic Provinces of Pennsylvania (Sevon, 2000):



The Eastern Lake Section consists of a series of northwest-sloping, lake-parallel, low relief ridges. These ridges are made up of unconsolidated surficial materials, mainly sands and gravels, which were deposited during the most recent deglaciation of the area about 18,000 years ago. Steep-sided, narrow valleys cut through these ridges into the underlying shales and siltstones and flow into Lake Erie.

Originally, the ridge bordering Lake Erie sloped gently into the lake. Erosion of the shoreline has caused the lake-land interface to move southeastward so that today there is a steep bluff adjacent to the lake. Continued erosion of this bluff is a primary environmental problem in the area. Local relief in the section is less than 100 feet and generally half that. Elevation is 570 feet at Lake Erie and rises southward to a high of 1,000 feet. Drainage pattern is parallel and streams are oriented normal to the Lake Erie shoreline.

The Northwestern Glaciated Plateau Section consists of many broad, rounded uplands cut by long, linear valleys. The uplands have a southeast-oriented linearity that is pronounced in eastern Erie and central Crawford Counties. Elsewhere upland linearity is obscure to absent. The uplands are cut by many flat-floored, narrow to wide valleys that are separated from adjacent uplands by steep slopes on one or both sides of the valley.



The valleys are very linear and are oriented northwest southeast for the most part, although some valleys are normal to this orientation. The valley floors are often wetlands. There is frequently a considerable depth of unconsolidated material beneath the valley floor. Local relief between valley floor and the top of an adjacent upland may be up to 600 feet, but is generally less. Local relief on the valley floors and the uplands is less than 100 feet. Elevation ranges from 900 to 2,200 feet. Drainage pattern is dendritic. Bedrock, which is largely covered by glacial deposits, consists of a variety of sandstones, siltstones, shales, as well as some conglomerates and coal. Bedding in the rocks is horizontal. Many of these rocks are relatively soft and were easily eroded into linear landforms by the continental glaciers.

## 2.5 Geology

Local surficial bedrock in the Walnut Creek watershed includes siliciclastic rocks of the Devonian Period of the Paleozoic Era. Rocks of this Period date between 408 and 360 million years before the present. By definition, clastic rocks are derived from the materials of pre-existing rocks, in contrast to nonclastic rocks, which are formed through direct precipitation of minerals from solution or secretion by organisms. Carbonate rocks, such as limestone, are a common example of a nonclastic rock type. This is not to say that the rocks of the Walnut Creek watershed are entirely clastic in nature, rather, that this is the dominant type of rocks to be described.

The rock types of the Walnut Creek watershed consist of approximately 72% interbedded sedimentary rock, and 28% shale. Shale may be defined as a clastic rock, comprised of silt and clay particles, that is fissile in nature – it can be broken in to thin layers.

The universally accepted Wentworth Scale classifies clays and silts of having a particle size between 0.0039 and 0.0625 millimeters (mm). Fine sand particles being larger than silt, and very coarse sand having a maximum particle size of 2.0mm. The northwesterly occurring shales (Northeast and Girard), described below, would fall roughly in this range of clastic particle size, with the other local formations (Venango and Chadakoin) exhibiting a wider ranager of material sizes, including some particles larger than sand.

Primary sedimentary features, such as ripple marks and graded bedding, are evident upon inspection of local outcrops, particularly in exposed rocks in the streambed of Walnut Creek. These features typify a near-shore to shallow marine depositional environment. The rocks exposed in the Walnut Creek watershed today would have been deposited in a coastal, or shallow marine depositional environment, as highlands to the southeast were eroded into the Kaskaskia Sea of that era. Marine fossils are found occasionally in these rocks.

The following descriptions are modified from reports of the Pennsylvania Geological Survey: *Geologic Map of Pennsylvania - Map 1* (Berg, Geyer, Edmunds, and others; 1980), and *Water Resource Report 62 - Groundwater Resources of Erie County* (Richards, McCoy, and Gallaher 1987):

### **Venango Formation**

Map Symbol - Dv

Light-gray siltstone interbedded with some flaggy, gray sandstone and some bluish-gray shale; Panama Conglomerate and Woodcock Sandstone are, respectively, the lower and upper key beds defining the formation; referred to as "Cattaraugus" by some workers; includes some red shales where it interfingers to the east and south with the Catskill Formation; marine fossils present. The Venango Formation is a good aquifer for water supply. The water quantity and quality are generally better than those of the underlying aquifers.

### **Chadakoin Formation**

Map Symbol - Dch

Light-gray or brownish siltstone and some sandstone, interbedded with medium-gray shale; included in Conneaut Group and "Chemung" of earlier workers; marine fossils common; includes "pink rock" of drillers. The Chadakoin Formation is an extensive aquifer, which is marginally acceptable for water supply.

### **Girard Shale**

Map Symbol - Dg

Argillaceous, ashen-gray, flaky shale and siltstone; included in Conneaut Group and "Chemung" of earlier workers; marine fossils rare. The Girard Shale is the poorest aquifer in Erie County, as measured by reported well yields and specific capacity

### **Northeast Shale**

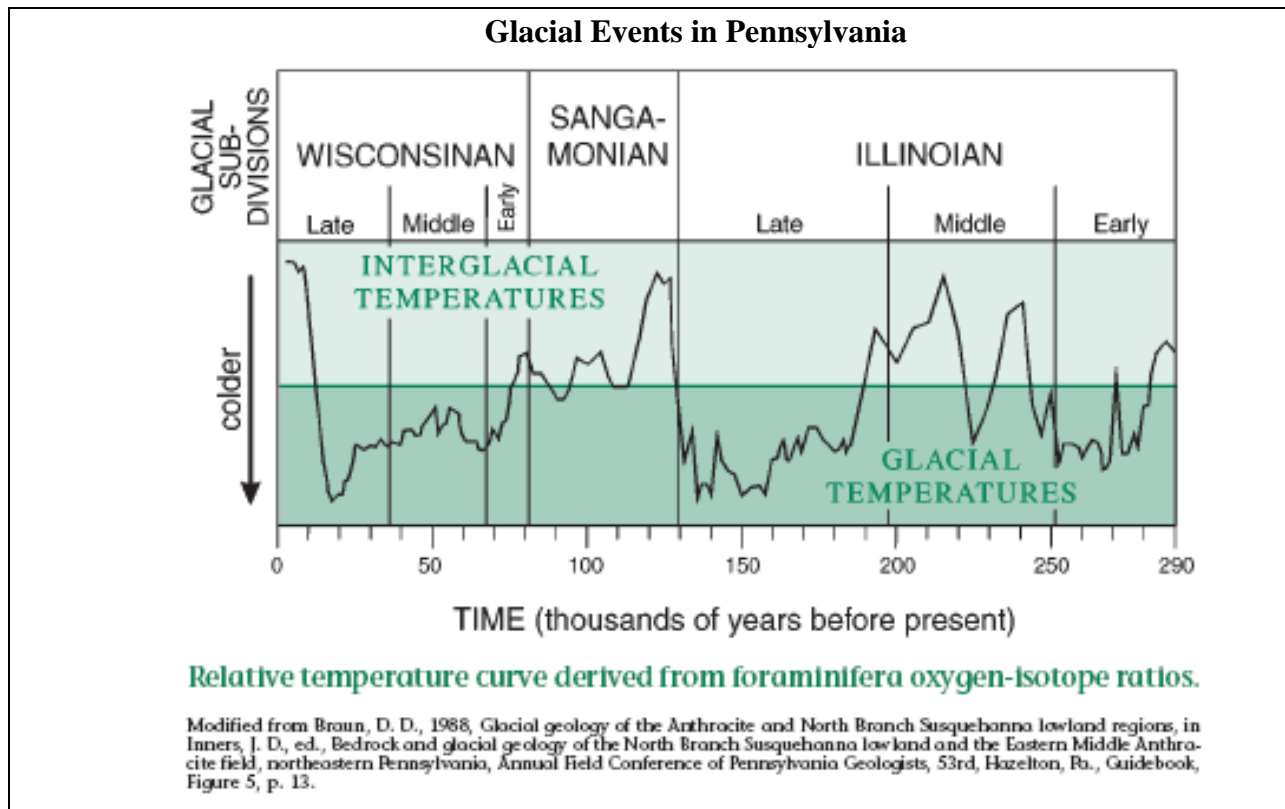
Map Symbol - Dne

Medium-gray shale and some thin light-gray siltstone interbeds; included in Canadaway Formation of New York; included in "Chemung" of earlier workers; contains sparse fossil marine fauna. The Northeast Shale does not have the potential for a good potable water supply due to generally poor water-bearing characteristics and poor water quality.

Unconsolidated glacial materials cover nearly all of the bedrock in the watershed. These materials include till, outwash deposits, and ancestral Lake Erie beach sands. These materials were deposited and eroded, periodically, during the Pleistocene and Holocene Epochs of the Quaternary Period of the Cenozoic Era, beginning about 2 million years ago, and the erosion and re-deposition of these materials is continuing today. During the peak of Pleistocene glaciations, about 30% of the Earth was covered by ice.

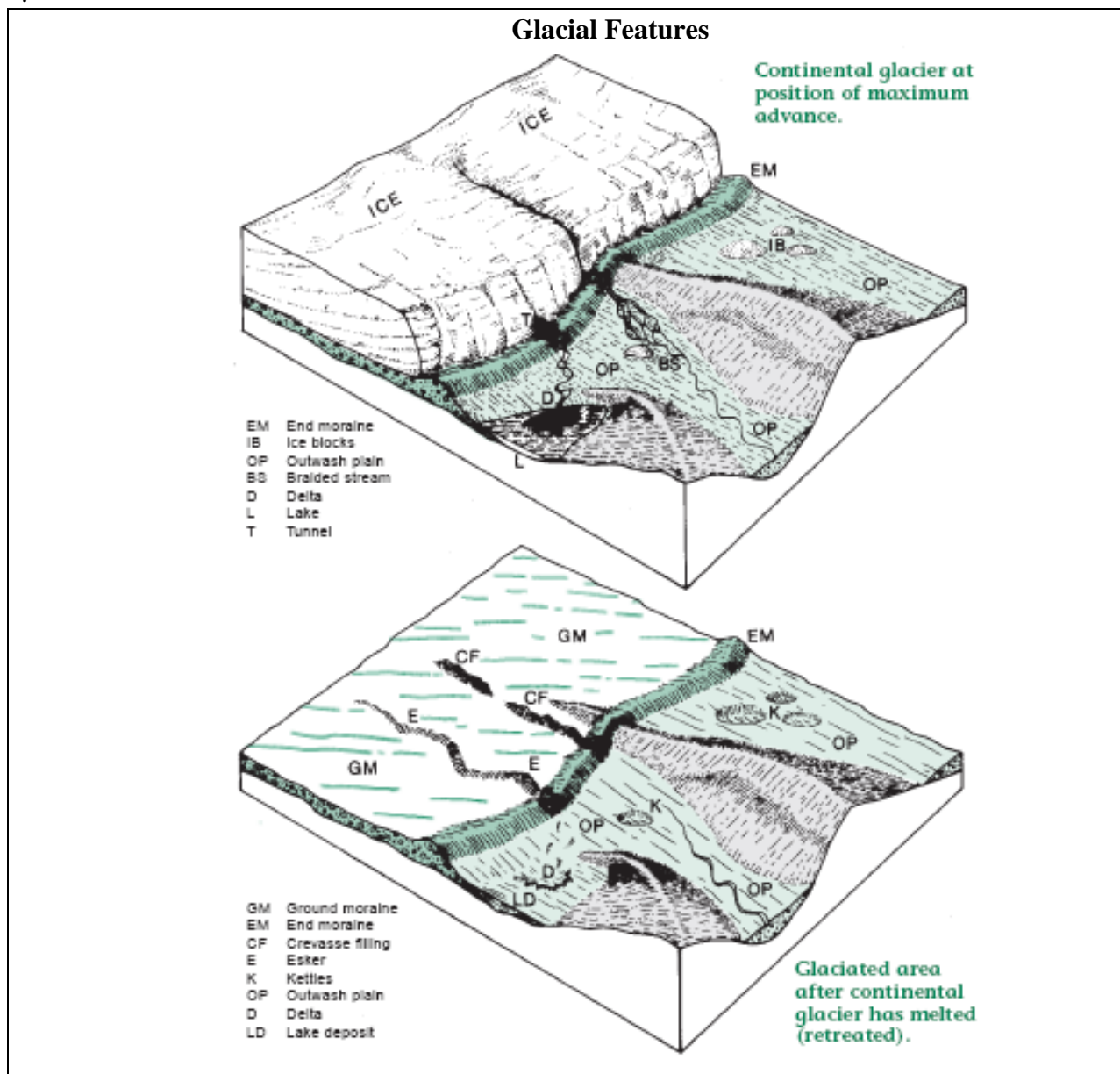
During the Pleistocene, glaciers advanced and receded several times, scouring exposed soils and bedrock, pushing, mixing, grinding and abrading rock particles and sediments over hundreds of miles. The most significant events, that produced glacial deposits in the Walnut Creek watershed, include the Illinoian and Wisconsin events. The following table, reflecting these periods of glacial advance and retreat, is taken from The Pennsylvania Geological Survey's Pennsylvania and the Ice Age (Sevon & Fleeger, 1999).





The glaciofluvial and glaciolacustrine processes of melt water, from ice sheets, re-depositing these materials as lateral and end moraines, kames, eskers, drumlins, and beach sands has resulted in the complex occurrence of unconsolidated glacial materials, evident in the Walnut Creek watershed today. Most significantly, the ancestral occurrences of Lake Erie have produced extensive deposits of sands, locally known as “beach ridges”. These sands are a significant source of ground water supply for drinking water and other uses.

The process of erosion of these materials is continued in the watershed today, as Walnut Creek transports glacial and eroded bedrock materials downstream, and the waves and currents of Lake Erie move, abrade, and re-deposit them. The following figure is taken from the Pennsylvania Geological Survey’s Pennsylvania and the Ice Age, to understand the types and genesis of glacial deposits:



The Pa. Geological Survey General Geology Report 32 - Glacial Geology of Northwestern Pennsylvania (Sheppa, White, Droste, and Sitler, 1959) describes the occurrence, type, and age of unconsolidated glacial materials, in the vicinity of the Walnut Creek watershed.

Maps depicting local bedrock geology and glacial deposits within and around the Walnut Creek watershed are provided in Appendix A. Both are from Pa. Geological Survey sources. Further discussion of glacial deposits, and particularly their significance to ground water occurrence and use in the watershed is provided further in this report.

## 2.6 Soils

The dominant hydrologic soil group or runoff potential in the Walnut Creek watershed is C. Hydrologic soils in Group C have a moderately high runoff potential and are sandy clay loam with low infiltration rates when thoroughly wetted. The average soil erodibility (K) factor in the Walnut Creek watershed is 0.34. The K-factor defines the potential of soil erosion independent of rainfall, slope, vegetation, or management practices; easily eroded soils have a K value between 0.37 and 0.7, and resistant soils have a K value less than 0.37. The Walnut Creek watershed is part of the Lake Erie basin (SWP15).

Soils maps are used to depict soil types within each of the sub-watersheds in the Walnut Creek drainage. Data for these maps was provided by the U.S. Department of Agriculture – Natural Resource Conservation Service (NRCS). The soil maps and descriptions of soil types corresponding to the map symbols are provided in Appendix A of this report, and are also available via the internet at the [USDA-NRCS Official Soil Series Description site](#).

The nature of soil and unconsolidated material erosion within the watershed is a complex consideration. The wide range of land uses, variability in soil types, presence of exposed, unconsolidated glacial materials, with highly variable particle shapes and sizes, as well as the erosional mechanisms present - wind, water, snow, ice, plant and animal activity, human activity, and lacustrine processes, all interact to effect the movement and re-deposition of soil and unconsolidated sediments.

Human activity often increases the rate of soil erosion. Soils, and most importantly the plants and organisms that they support, provide filtration of water entering streams and aquifers. This filtration blocks sediments and contaminants, which may adversely impact water quality and affect aquatic plants, animals, and drinking water supplies. Careful attention to soil management practices should be considered by local communities, as development within the watershed places increasing stress on limited soil resources.

## 2.7 Ground Water Quality

A comprehensive ground water quality evaluation was beyond the scope of this assessment, but general conclusions can be made from existing reports. The U.S. Geological Survey's *Ground-Water Quality Data in Pennsylvania - A Compilation of Computerized [Electronic] Databases*; 1979-2004; Low and Chichester, prepared in cooperation with DEP, is included in Appendix B. Based on the aforementioned, and the Pa. Geological Survey's *Water Resource Report 62 - Groundwater Resources of Erie County* (Richards, McCoy, and Gallaher, 1987), also included in Appendix B, several conclusions may be drawn about local ground water quality in the watershed:

- The Northeast shale and Girard shale bedrock aquifers are of poor or very poor quality with high to very high chloride, iron, and dissolved solids concentrations. These chemicals occur naturally, and are typical of these types of aquifers with low, to very low, permeabilities and transmissivities. Some wells in these formations, exhibit

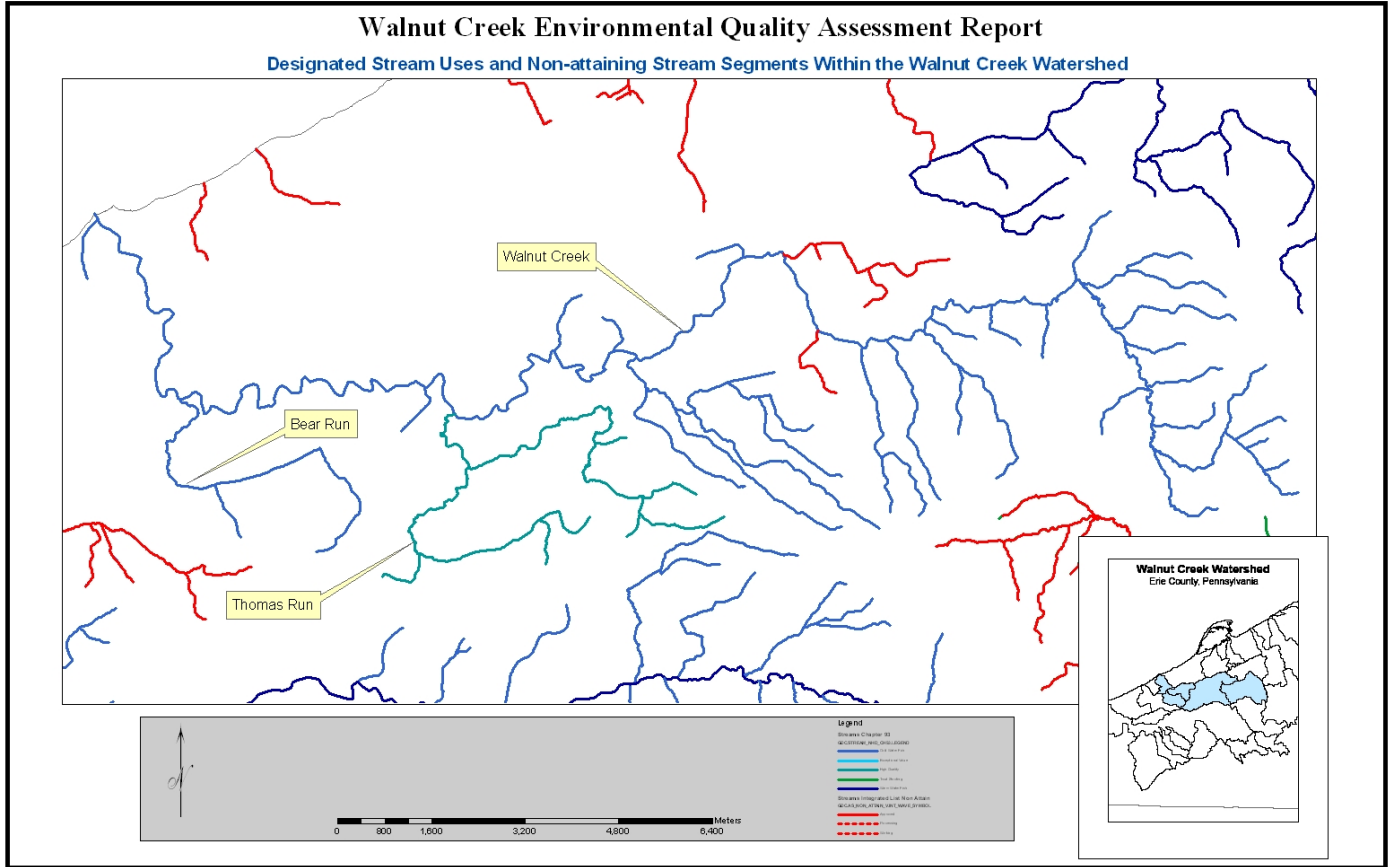
inorganic chemical concentrations in excess of U.S. Environmental Protection Agency Maximum Contaminant Limits for Public Water Supplies.

- The Chadakoin and Venango Formations, in the southeastern area of The Watershed, generally produce better water quality than the local shales, but quality also varies greatly, locally, and relatively high concentrations of chloride occur. As above, the chemicals present are naturally occurring and account for the relatively low quality of these formations, as aquifers for water supply. Some wells in these formations, exhibit inorganic chemical concentrations in excess of U.S. Environmental Protection Agency Maximum Contaminant Limits for Public Water Supplies.
- Shallow, unconsolidated, glacial remnant materials are the predominant aquifer type for private and public water supplies within the watershed. Glacial till, outwash, and ancestral Lake Erie beach sands each vary widely in occurrence and composition, throughout the watershed, with ancestral beach sands generally exhibiting the best water quality. Each of these aquifers, exhibit wide variability in water quality, locally.
- Several wells within, or in proximity to, the watershed exhibit notably elevated nitrate concentrations. Elevated nitrate concentrations may be indicative of human-caused impact and are typically associated with agricultural activities, improperly managed storm water, or areas of poorly functioning septic/sewage systems.

## **2.9 Designated Stream Use and Attainment**

The main stem of Walnut Creek is protected as a Cold Water Fishery and Migratory Fishery under Chapter 93 Water Quality Standards, Drainage List X. There are two major tributaries of Walnut Creek, Thomas Run and Bear Run. Thomas Run is protected as a High Quality - Cold Water Fishery and Migratory Fishery, for its entirety, under Chapter 93 Water Quality Standards, Drainage List X. Bear Run is protected as a Cold Water Fishery and Migratory Fishery as listed within Chapter 93 Water Quality Standards, Drainage List X. Other unnamed tributaries to Walnut Creek, aside from Thomas Run, have the same designation as the main stem.

The Walnut Creek watershed was previously assessed using biological screening protocols during State Surface Water Assessment Program sampling (2001). The 2001 assessments documented stream use impairments within three tributaries of Walnut Creek, as shown on the diagram below. These assessments were cursory in nature and only recognized the “worst of the worst” impairments. Nevertheless, all three of these tributaries were found to be impaired due to non point sources of pollution due to siltation stemming from urban runoff, storm sewers and residential runoff.



These impairments are listed within the 2006 Pennsylvania Integrated Water Quality Monitoring and Assessment Report. The specific impairment data for these three tributaries is as follows:

- Station 20010711-1645-TAS -- 1.2 miles of impairment due to siltation stemming from a combination of urban runoff and storm sewers;
- Station 20010711-0945-TAS -- 3.1 miles of impairment due to siltation coming from a combination of urban runoff and storm sewers;
- Station 20010711-1050-TAS -- 0.6 miles of impairment due to siltation stemming from residential runoff.

Because of the more intensive sampling protocols that were used during this particular watershed assessment, it is expected that additional stream use impairments will be documented.

## 2.10 Land Use Assessment

The *Walnut Creek Watershed Environmental Quality Assessment* included an evaluation of land use within the watershed. The evaluation involved identifying land use data sources in an effort to gain greater understanding of how these factors may influence the water quality and biological health of the Walnut Creek watershed.

Land use, and the resulting affects that land use has on overall health and function of watershed systems, continues to be of greater importance to watersheds that are in or around urban areas. There is often a delicate interaction of several variables such as hydrology, chemistry, and biology that exist in undeveloped watersheds that are free from anthropogenic influence. These variables and their interrelations can change when land use alterations occur within a watershed such as the introduction of urban development corridors.

**2.10.1 Hydrologic Cycle**

Land use influences a watershed most by altering the methods by which land reacts to precipitation, known as the hydrologic cycle. Altering the hydrologic cycle for parcels of land within watershed basins or sub-basins has a direct impact on the receiving streams and rivers. The hydrologic cycle in an undisturbed, natural watershed is a balanced system where precipitation, runoff, evapotranspiration, infiltration, groundwater recharge, and stream base flow all perform important functions.

Precipitation is distributed over the land surface, some of which runs off into a receiving waterway. Another portion of precipitation is held in puddles, ponds and lakes, or on the foliage, and is then evaporated back into the atmosphere. Precipitation also percolates into the soil where a portion is used by vegetation for transpiration and the remainder recharges groundwater and regulates the base flow of streams.

The average annual precipitation total for Erie, Pennsylvania area is approximately 42.7 inches per year (NOAA 2002, Average Annual Precipitation in Pennsylvania, 1971-1990). The following table approximates how the annual precipitation total within the Walnut Creek watershed is distributed for each pathway in the hydrologic cycle on an undisturbed acre of land.

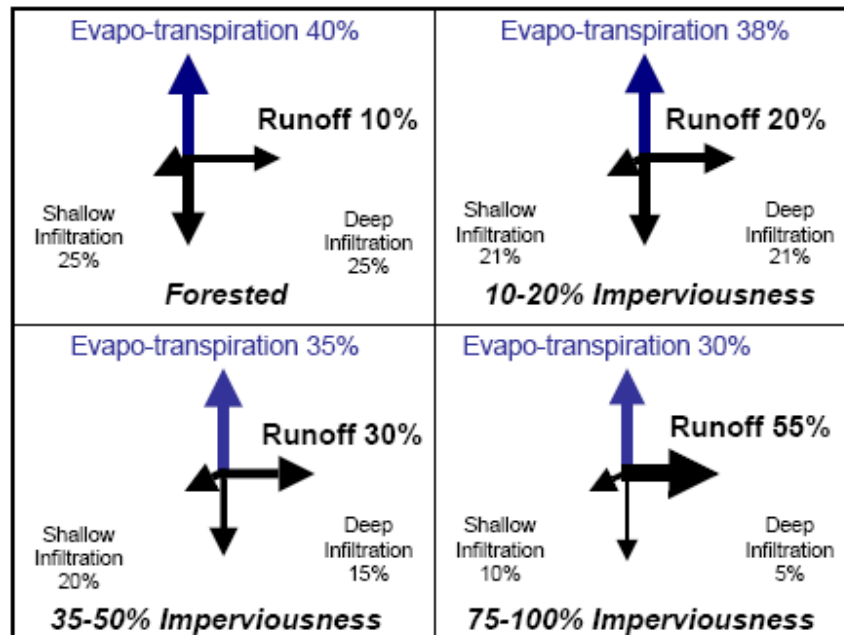
**Distribution of Annual Precipitation Total for an Undisturbed Acre  
In the Walnut Creek Watershed**  
(all depths and percentages approximated)

	<b><i>Depth (inches)</i></b>	<b><i>Percentage of Total</i></b>
<b><i>Annual Total Precipitation</i></b>	<b><i>43 inches</i></b>	<b><i>-----</i></b>
Evapotranspiration	24 inches	55%
Infiltration	11 inches	27%
Runoff	8 inches	18%

(NOAA 2002, Average Annual Precipitation in Pennsylvania, 1971-1990)

The hydrologic response of a land area and receiving waterway is altered when undisturbed areas are developed into urban commercial, industrial, or residential land uses. Watersheds experiencing these types of increases in urban development, such as the Walnut Creek watershed, see increased areas of impervious surface and compacted soils, which eliminate the ability of precipitation to infiltrate into the ground and receiving aquifers. Evaporative rates for impervious surfaces and compacted soils also are reduced from their original capabilities. Depending on soil types and the extent of development impact, the volume of stormwater runoff from a site can contribute significantly higher volumes to a receiving waterway. The figure

below exhibits the hydrologic response of a tract of land as vegetation is removed and impervious and compacted surfaces are introduced (Meyer & Paul, 2001).



*Progressive introduction of impervious surface and resulting affects on the hydrologic cycle  
Streams in the Urban Landscape. Annual Review of Ecology and Systematics*

### **2.10.2 Affects of Impervious Surface Area on Aquatic Biological Diversity**

Numerous studies have addressed declining aquatic biological communities and decreased water quality in response to progressive introduction of urban development and impervious cover (Klein 1979, Booth & Jackson 1997, Roy et al 2003). This negative correlation is perhaps best demonstrated by the Urban Streams Classification Model, which can be viewed at ([www.stormwatercenter.net](http://www.stormwatercenter.net)). The model corresponds impervious surface area within a watershed to the richness, health and diversity of biological community in the waterway. The three categories consist of sensitive (<10%), impacted (10-25%), and non-supporting (>25%). Sensitive watersheds have less than 10% impervious cover and exhibit a fully functioning aquatic community. Watersheds with 10-25% of impervious surface area are designated as impacted and show signs of degradation to the aquatic biology. Watersheds that have greater than 25% impervious surface cover often show very low biodiversity that continues to decrease as imperviousness increases.

There are several reasons why impervious surface areas contribute to declines in biological communities within waterways. The losses in infiltration and evapotranspiration from urbanized land uses translate into substantial increases in runoff volume. These increased volumes are often conveyed into a receiving waterway at discharge rates differing from the undisturbed state of the land. This can lead to altered peak flow timing within a watershed, which can cause flooding and increased intensity of flow within the waterway that contributes to bed and bank erosion and increased sediment loads that affect stream biology.



Introduction of impervious and compacted surfaces within a watershed also can have serious affects on the groundwater table by reducing the quantity of precipitation infiltration. The loss of infiltration capacity reduces replenishment of aquifers that feed the base flow of dependent, localized waterways. Reduction in base flows in these waterways may have the unwanted affect of low water levels, in addition to a host of other unintended consequences. Pollutant loads that may not be impacting the waterway under normal flow conditions can become more concentrated when base flow decrease, and therefore, can have a greater affect on the biology of the stream. Lower base flow in a waterway can also affect the longstanding temperature regimes in the stream, having detrimental affects on biological communities dependent upon certain temperature parameters.

Impervious surfaces can also change the chemistry of precipitation runoff. Depending on the land use, runoff from impervious surfaces and compacted soils can have elevated levels of non-point source pollutants such as sediments, nutrients, petroleum products, polycyclic aromatic hydrocarbons, metals, *E. coli* bacteria, and temperature. These non-point source pollutants can contribute to acute and/or chronic effects in the health of the aquatic biologic community.

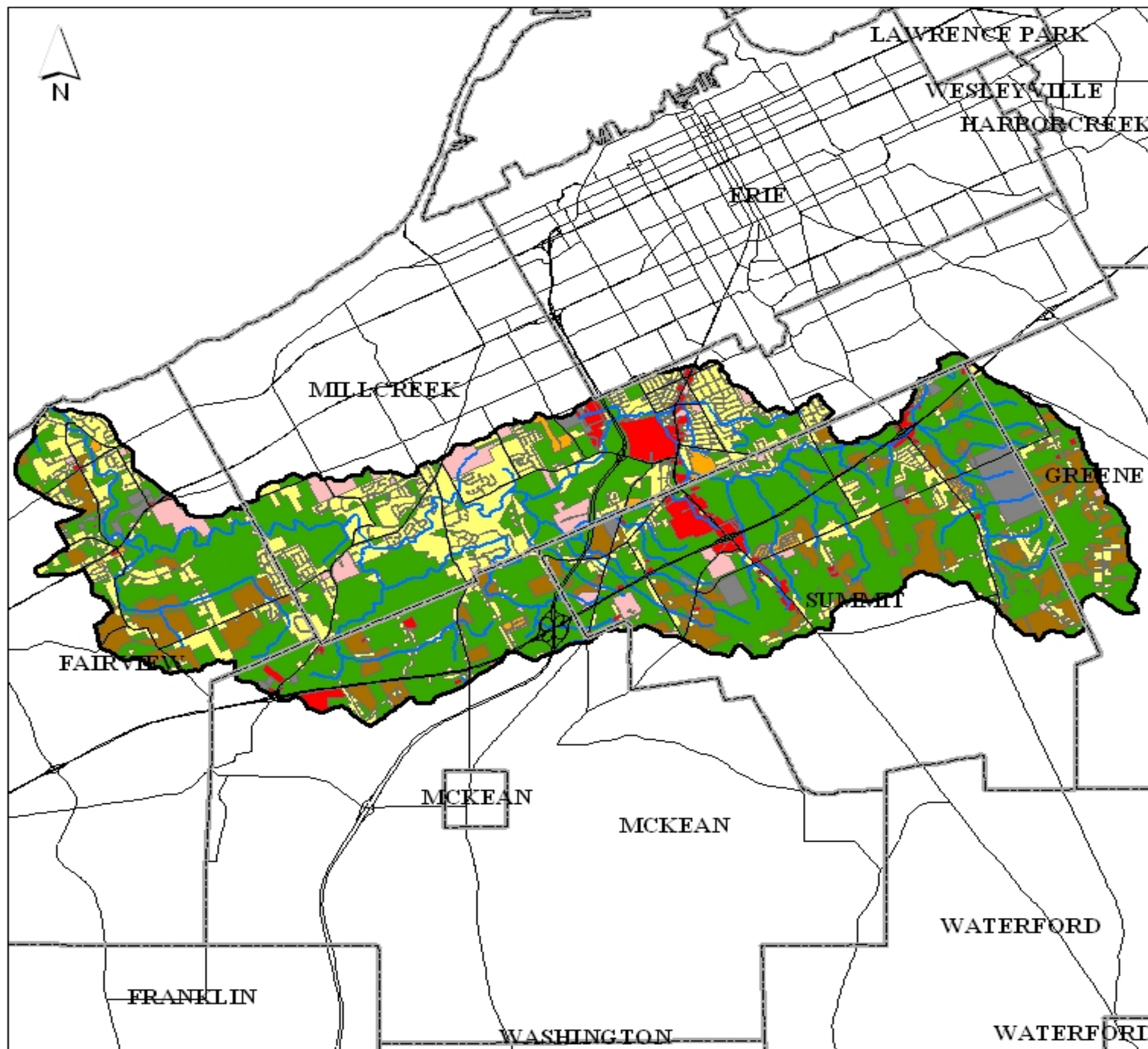
For more specific information regarding the biological status of Walnut Creek, refer to the Part 4 Biological Health and Diversity section of the report.

### ***2.10.3 Current Walnut Creek Land Use***

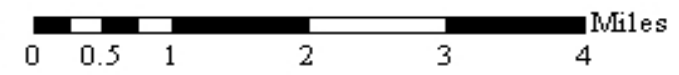
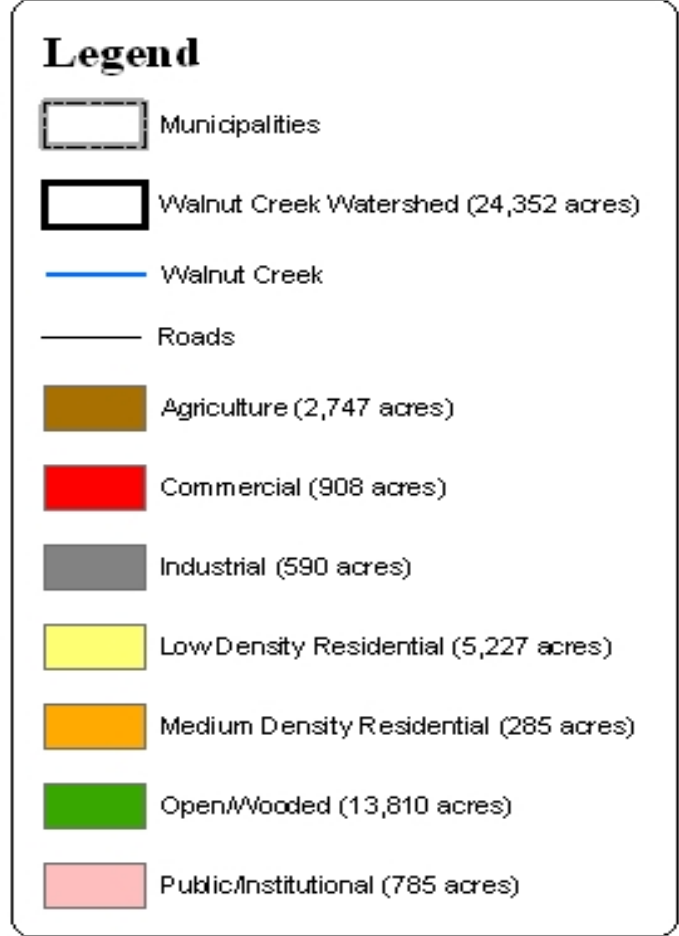
DEP has identified the most current land use statistics within the Walnut Creek watershed with the aid of the Lake Erie Office of Pennsylvania Sea Grant. PA Sea Grant provided geographical information system (GIS) services and materials that were produced for use in their Non-point source Education for Municipal Officials program, funded in part through a DEP Growing Greener grant. The GIS land use data was provided to PA Sea Grant from the Erie County Department of Planning. The following table presents land use distribution within the Walnut Creek watershed, followed by a map that represents the geographic locations of the different land use classifications.

**Land Use Distribution In the Walnut Creek Watershed**

<b><i>Land Use Classification</i></b>	<b><i>Acres</i></b>	<b><i>Percent of Total Acreage</i></b>
Agriculture	2,747	11.28%
Commercial	908	3.73%
Industrial	590	2.42%
Low Density Residential	5,227	21.47%
Medium Density Residential	285	1.18%
Open/Wooded	13,810	56.69%
Public/Institutional	785	3.23%
<b><i>Total</i></b>	<b>24,352</b>	<b>100%</b>



# Walnut Creek Watershed Land Use/ Land Cover



Watershed Land Use/Land Cover

An analysis of land use distribution in the watershed shows that approximately 13,810 acres, or 56.69% of the watershed is currently undisturbed land classified as open/wooded. In addition, agricultural areas cover another 2,747 acres, or 11.28% of the watershed. Most of these areas are on the outer edges of the Erie metropolitan area.

The next largest land use is low density residential development, which is occurring in several areas in Fairview, Millcreek, and Summit Townships. This residential pressure is a result of urban sprawl expanding in a concentric ring from the City of Erie. Access and proximity to Lake Erie at the mouth of the watershed is attracting new residential development along West Lake Road (PA 5) and West Ridge Road (US 20). Residential pressures also are found along the Sterrettania Road corridor, which provides residents with good access to Interstate 90, the City of Erie, and the Kearsarge/Peach Street commercial areas. Of particular interest are the undeveloped areas on Love Road, Zimmerly Road, Grubb Road and Hershey Road that are undergoing significant commercial and residential pressures caused by their potential for future public utilities, proximity to the Millcreek Mall/Upper Peach Street commercial complexes in the Kearsarge area, and the convenient access to Interstate 79 and Interstate 90. Other notable areas experiencing low density residential pressure are those in Summit Township along upper Peach Street, the Perry Highway, and Wattsburg Road with excellent access to Interstate 90. Medium density residential land use currently only consists of 282 acres within the watershed, and is concentrated in the Kearsarge/Upper Peach Street area.

Much of the 908 acres of commercial land use, 3.73% of the watershed area, is located in the Millcreek Mall/Upper Peach Street corridor. This area has experienced intense commercial development during the past 15-20 years and projections show continued development into the foreseeable future. The following are U.S. Geological Survey aerial photographs of the area between Interstates 79 and 90, and US Highway 19 (several tributaries and the main channel of Walnut Creek can be seen running from east to west). Significant development has occurred in this area of the watershed in recent years. It is one example of the real and potential impact of concentrated development in the vicinity of major transportation corridors. It likewise demonstrates the stress this development places on limited, sensitive, source water and riparian/aquatic habitat areas within the watershed.

**September 4, 1987**



**May 4, 2002**

Other areas of commercial land use are the Perry Highway and Wattsburg Road interchanges of Interstate 79. The Wattsburg Road interchange is expected to rapidly develop in the coming years in response to the recent opening of a large horse race track and slots parlor. Industrial and public/institutional land uses consist of 590 acres and 785 acres respectively. These figures are projected to increase much slower than residential and commercial development in the future.