9/2003

Watershed Restoration Action Strategy (WRAS)
State Water Plan Subbasin 07J
Conestoga River
(Susquehanna River)
Lancaster, Lebanon, and Berks Counties

Introduction

Subbasin 07J, which consists of the Conestoga River and its tributaries, drains 491 square miles of central Lancaster County and headwater areas in adjacent Lebanon and Berks Counties. Major tributaries are Cocalico Creek, 140 square miles, Little Conestoga Creek, 65.5 square miles, Mill Creek, 56.4 square miles, and Muddy Creek, 51.8 square miles. Cocalico Creek has two major tributaries, Middle Creek, 32.4 square miles and Hammer Creek, 53.2 square miles. The subbasin contains a total of 288 streams flowing for 644 miles. The subbasin is included in **HUC Area 2050306, Lower Susquehanna River**, a Category I, FY99/2000 Priority watershed.

The Susquehanna River and its east shore unnamed tributaries from south of Washington Boro to the mouth of the Conestoga River are also included in this subbasin. The Susquehanna River is impounded in the subbasin behind the Safe Harbor Dam, which is owned and operated by Pennsylvania Power and Light Co. (PPL) as a hydroelectric station to generate electricity.

Geology/Soils

The entire basin is in the Northern Piedmont Ecoregion. The majority of the basin is in the Piedmont Limestone/Dolomite Lowlands (64d) Section. This terrain is nearly level to undulating and contains sinkholes, caverns and disappearing streams. The strata are highly folded and faulted. Numerous faults pass through the subbasin, especially in the middle portion around Lancaster and between Lititz and Ephrata. This portion of the subbasin has very fertile soils and is intensively farmed; virtually all the forest has been removed. Few wetlands remain; many farm fields have been tiled to drain wet spots.

The upper edge of the subbasin is within the Triassic Lowlands (64a) Section, consisting of mostly red sandstone and gray shale. This region has higher slopes than the limestone lowlands and erodible reddish sandy to shaley soils.

The Trap Rock and Conglomerate Uplands Section (64b), with its extensive diabase boulder fields, is located near the northwest boundary of the basin. Because of the widespread boulder fields, this portion of the watershed is unsuitable for agriculture or residential development and is mainly forested and owned by the PA Game Commission.

A narrow band of Wissahickon schist, part of the Piedmont Uplands Section (64c), is located along the Susquehanna River. This is a continuation of the more extensive rugged schist area south of the subbasin known as the “River Hills”.

The limestone soils, low topographic relief and relatively long growing season provide excellent conditions for farming. The solubility of the limestone produces fertile soils and the numerous sinkholes and faults allow surface water to enter the groundwater system with little infiltration or filtering by the soil. These conditions also allow nutrients and chemicals from fertilizers and pesticides spread on farms to readily enter the groundwater and cause drinking water wells to be contain potentially harmful concentrations of nitrates and pesticides. DEP Bureau of Water Supply Management conducted a dye tracer study for Lititz Borough under their wellhead protection program. They found that dye movement through the groundwater was swift, traveling ¼ mile in only 3 hours. Soils in other portions of the subbasin generally have a moderate infiltration rate.

Land Use

The majority of the land use in the subbasin is either agricultural or urban land use. Little or no large forested tracts remain except in the extreme northern portion of the subbasin near the headwaters of Hammer, Segloch, Middle and Cocalico Creeks along the Lebanon County line. Diabase boulder fields make this land unsuitable for farming. These lands are the most densely forested in the subbasin and largely under state ownership. Forested corridors also exist along the lower Conestoga River, the Susquehanna River and along other smaller creeks in the River Hills. Several limestone quarries operate within the subbasin. The Triassic red sandstone and diabase rocks are also quarried for building materials.

The subbasin contains the City of Lancaster and 9 boroughs. The population was 286,000 in 1990 and is projected to increase significantly to 385,000 by the year 2040. The Conestoga River watershed has added approximately 40,000 new residents each decade since 1950; however, land use in the watershed still remains predominantly agricultural. Urbanized and commercial areas are expanding rapidly outward from Lancaster City and many of the boroughs into the prime agricultural areas of the county. The PA Turnpike passes through the northern portion of the subbasin. Several U.S. and Pennsylvania highways connecting with the PA Turnpike provide access through the subbasin. The farms and rural landscape and the many Old Order Amish residents make the subbasin a popular destination for tourists from New York, New Jersey, Maryland and elsewhere in Pennsylvania.

The watershed includes some of the most productive soils and agricultural land in Pennsylvania and the country. The limestone soil area of the upper Conestoga River watershed is one the most intensely farmed areas in Pennsylvania, with approximately 57% in cropland and 37% in pasture, woodland, urban or other lands. Intensive livestock and poultry operations, farm markets, and agricultural businesses dominate the landscape. Lancaster County is a leading dollar volume agricultural producer among non-irrigated counties in the United States. The major crops are corn grain and silage, hay, small grain, tobacco, and potatoes. Dairy cows, heifers, breeding and fattening hogs, fattening cattle, poultry for layers and broilers are the major animal industries. Portions of Lancaster County have more dairy cows per acre than any other locality in the United States. The Mill Creek watershed is home to some of the highest densities of dairy cows found anywhere in Pennsylvania. Row crops also cover a large area of farmland. Old Order Amish and Mennonite families who follow traditional farming methods own many of the farms in the upper Mill Creek watershed. Farms are divided into smaller and smaller pieces as they are passed on to their children. The average farm size is relatively small, only 52 acres.

Natural Resources:

Several Lancaster City parks border the Conestoga River. The Lancaster County Conservancy has purchased several streamside areas for preservation. State Game Lands #46 in Segloch Run and Hammer Creek watersheds and the Middle Creek Wildlife Refuge are located along the Lancaster-Lebanon County line near the northern edge of the watershed.

The Conestoga River and its tributaries and drilled wells provide domestic water supplies for eight municipalities with a total population of 175,000, including the City of Lancaster. Half of the drinking water for Lancaster City is drawn from the Conestoga River.

DEP Chapter 93 Designated Exceptional Value (EV) and High Quality Streams (HQ):

EV:

- Elders Run
- Segloch Run

HQ:

- Wisslers Run
- Rock Run
- Black Creek

- Cocalico Creek, source to Blue Lake
- Hammer Creek, source to Speedwell Forge Lake
- Unnamed tributary to Mill Creek from New Holland Reservoir, source to tailwaters of reservoir
- Grubb Hollow

PA Fish and Boat Commission Class A (highest biomass category) trout streams:

- Segloch Run, from T-596 & T-548 intersection to SR1026 bridge, mixed brook and brown trout (2.2 miles)

Water Quality Impairment

The Conestoga River watershed is subjected to a variety of nonpoint source pollutants including organic enrichment and siltation from agriculture, on-lot septic systems, streambank erosion and lack of stabilization, and unrestricted cattle access along streams. Mill Creek has a point source discharge with high chloride content. Muddy Run has sediment-laden substrate, eroded banks, and excessive aquatic macrophyte growth due to high nutrient and sediment laden runoff from dairy farms.

The upper portions of the Conestoga River, Little Conestoga Creek, Mill Creek, and Cocalico Creek are impaired by nutrients and sediment from agriculture. Excess nitrates, residual pesticides, and bacteria impair surface and groundwater in most of the limestone-based portion of the subbasin. Suspended sediment particles also impair surface waters. The Conestoga River and its tributaries contribute the highest nutrient loads of all the nontidal rivers in the Chesapeake Bay drainage. According to USGS, the Conestoga River at Conestoga ranked first in total nitrogen and total phosphorus yields among surface water sites sampled throughout the Chesapeake Bay from 1994 through 1996. Surface and groundwater use as domestic water is impaired by a variety of point and nonpoint sources that add nutrients, sediment and pesticides. Swimming, fishing, and other recreational uses of surface waters are also impaired.

Soil erosion is a major problem in the subbasin. Unrestricted access of livestock to streams results in trampled streambanks and excessive stream sedimentation and sparse streamside buffers and riparian vegetation. Soil erosion rates in the subbasin were over 10 tons per acre in 1982, almost double the state average. Large areas of row crops and use of conventional tillage as well as unrestricted cattle access to streams combine to leave the soil vulnerable to erosion. Many of the streams in the subbasin are extremely muddy for several days after summer thunderstorms. The resulting high sediment can make water unfit to drink, smother aquatic life and fish eggs, clog fish gills, and block sunlight into the creeks and rivers. Much of the excellent limestone soil is being washed down into the Susquehanna River, where it gathers behind the Holtwood and Conowingo Dams or is carried into the Chesapeake Bay. Most highways and major roads in the subbasin are overcrowded and are being expanded and upgraded. Runoff from road construction can also be an additional although temporary source of stream sedimentation.

Numerous industrial and municipal point sources discharge into subbasin streams. More than 50 percent of Lancaster County's sewage ends up in the Conestoga River. These effluents are normally treated; however, raw sewage may discharge at times when stormwater runoff creates overflow conditions. Heavy industrial and commercial zones located in and around Lancaster City and radiating out along each of the major highways contribute heavy metals and organic metal compounds to sewage discharges. The highways are also sources of oil and grease and metal contaminants. Suburban development is expanding out from Lancaster City and the boroughs, much in the portion of the subbasin underlain by carbonate rocks. Some of the best agricultural soil in the U.S. is being paved over and taken out of production by expanding housing and commercial development. Water supply wells in these formerly farmed areas are vulnerable to excess nutrients, bacteria, and herbicide contamination from agriculture operations. High nitrate concentrations in groundwater have the potential to be harmful to children. If water is removed from groundwater wells for use as drinking water and in industry and returned to the river or smaller streams, groundwater recharge is reduced and a lowering of the water table can occur and more sinkholes can form.

Monitoring/Evaluation:
The subbasin was assessed under the Department's Unassessed Waters Program from 1997to 2000.

Sources of impairment in the Conestoga River watershed were identified as crop and grazing related agriculture, land disposal, habitat modification, construction, small residential development, golf courses, channelization, removal of vegetation, on site wastewater, urban runoff/storm sewers, municipal point sources, upstream impoundments, surface mining and "other". Causes of impairment from agricultural sources were siltation, nutrients and organic enrichment/ low dissolved oxygen (DO); however, DO is not measured directly. Organic enrichment is often determined by the presence of extensive algal blooms, which are assumed to contribute to low DO, and the absence of pollution sensitive aquatic species. Causes of impairment associated with the other sources included flow alterations, siltation, taste and order, chloride, and unknown causes.

DEP biologists use a combination of habitat and biological assessments as the primary mechanism to evaluate Pennsylvania streams under the Unassessed Waters Program. This method requires selecting stream sites that would reflect impacts from surrounding land uses that are representative of the stream segment being assessed. The biologist selects as many sites as necessary to establish an accurate assessment for a stream segment. The length of the stream segment assessed can vary between sites. Several factors are used to determine site location and how long a segment can be, including distinct changes in stream characteristics, surface geology, riparian land use, and the pollutant causing impairment. Habitat surveys and a biological assessment are conducted at each site. Biological surveys include kick screen sampling of benthic macroinvertebrates, which are identified to family in the field, and an evaluation of their tolerances to pollution. Benthic macroinvertebrates are the organisms, mainly aquatic insects, that live on the stream bottom. Since they are short-lived (most have a one-year life cycle) and relatively immobile, they reflect the chemical and physical characteristics of a stream and chronic pollution sources or stresses. Habitat assessments evaluate how deeply the stream substrate is embedded, degree of streambank erosion, condition of riparian vegetation, and amount of sedimentation.

The Conestoga Headwaters Project, Rural Clean Water Program (RCWP) report of 1992 was prepared by the U.S. Department of Agriculture (USDA). The area studied covered 110,000 acres and included sampling locations on the Conestoga River near Terre Hill, Little Conestoga Creek near Churchtown, Muddy Creek near Martindale, and Cocalico Creek near Ephrata. Water quality problems and impaired water uses were reported to affect approximately 132 miles of the Conestoga River and its tributaries in the upper part of the subbasin. Water quality degradation and sources included excessive nitrates and phosphorus originating from animal waste and excess commercial fertilizers, pesticides from farms, sediment from intense cropping, and high coliform bacteria from animal waste.

The 1992 USDA report indicated a need for agricultural best management practices (BMPs) to reduce pollution from high-density livestock operations, maximum row crop production, high soil erosion rates, and high nutrient applications. About 25 tons of manure are produced for every acre of farmland. The average manure application on corn land is about 40 tons per acre, which substantially exceeds crop nutrient requirements. Consequently, nitrates in groundwater exceeded the 10 mg/l drinking water standard in many of the groundwater sampling sites. The highest percentage of exceeded limits was in the area underlain by carbonate rocks. Measurable concentrations of the herbicides atrazine, alachlor, and metolachlor were found almost exclusively in the carbonate rock areas. Densities of fecal coliform bacteria ranging from 1 to 900 colonies per 100 ml were found at about 1/3 of the well samples from the carbonate areas. The report concluded that a significant amount of herbicide remains in the soil and leaches out into the groundwater after the growing season.

The Alliance for the Chesapeake Bay and the U.S. Geological Survey (USGS) conducted a snapshot evaluation of stream quality of the Little Conestoga Creek basin based on macroinvertebrates and chemical

analyses of nitrogen, ammonia, organic and nitrate, and phosphorus in 1997. The upper Little Conestoga Creek watershed upstream of East Petersburg Borough and the lower watershed downstream of Millersville Borough, including the West Branch Little Conestoga Creek watershed, are 80% agricultural land use. About 90% of the watershed is underlain by fractured limestone rock. They found that most of the watershed was impaired by excess nutrients and that the biological communities were also adversely affected. The most stressed stream segments were directly correlated with areas with the highest percentage of agricultural land use. Around 50% of the tested private water wells exceeded EPA standards for drinking water due to nitrate and bacterial pollution. Nitrate concentrations above drinking water standards were measured at the two most impaired sites on the lower West Branch and one on Indian Run. All macroinvertebrates samples had less than three pollution sensitive taxa. Even the least impaired sites on upper Little Conestoga Creek and the West Branch, Brubaker Run, and Swarr Run, showed some signs of environmental stress affecting the aquatic life.

A U.S. EPA biological study of agricultural areas in the Mid-Atlantic region stated that it was impossible to find healthy streams in the Limestone/Dolomite Lowlands Ecoregion of the Piedmont including Mill Creek due to poor farming practices in these watersheds for the past 100 years. Sampling of benthic macroinvertebrates showed severe degradation in Lowland streams including Mill Creek. The most severely impaired sites were on tributaries, especially Muddy Run and unnamed tributaries. Main stem Mill Creek was in slightly better condition than its tributaries. The contributing factor was the percent agricultural cover. Macroinvertebrate richness is reduced if the agricultural land use is more than 15 percent. Traditional agricultural practices contribute to both habitat and water quality and biological impairment. Sedimentation, bank erosion, and lack of adequate riparian zones are the major contributing factors.

Future threats to water quality

As urbanization and paving continues, the most serious threat to water quality may shift from farming and animal waste to stormwater/urban runoff.

Nonresidential development, which includes office, industrial, and commercial development, is booming in the subbasin. This type of development has a high potential for impact on surface and groundwater resources due to the massive site grading, removal of vegetation, and large areas of paving for parking lots. Local land use planning should encourage these developments to maintain open space, reduce unnecessary paving, improve land use standards, and better fit of the design to the landscape contours.

Urbanization and paving can have a severe effect on stream aquatic life. Studies by the Maryland Department of Natural Resources showed that a reduction in stream aquatic species diversity may begin with as little as 2% impervious cover. Maryland streams with above 15% impervious cover were rated fair to poor for aquatic species. When the impervious cover reached 25%, species diversity was significantly reduced. Riparian vegetation removal and paving affect both stream water temperature and habitat for aquatic species. Organisms most affected include many species of reptiles and amphibians, brook trout, and stoneflies. Stormwater runoff from paved areas can also wash out oil and grease and other pollutants into streams. The paved areas also restrict replenishment of groundwater and contribute to flash flooding during storm events and extreme fluctuations in stream water levels. Extreme flow fluctuations cause difficulties in the attachment of bottom dwelling organisms to the stream substrate and also cause a scouring of the substrate. Retention of riparian vegetation in unnamed headwater tributaries, known as first order streams, which may comprise as much as 50% of the streams in a watershed, can be especially critical to the protection of organisms in the downstream watershed.

Restoration/Protection Initiatives:

Pennsylvania Growing Greener Grants:

- $1,500 (FY 2003) to Donegal Chapter of Trout Unlimited to form the Middle Creek Watershed Organization.

- $121,000 Susquehanna River Basin Commission to develop a "water budget" and restoration/protection plan for portions of Lancaster County, including the Conestoga River watershed, and to conduct several public education workshops.
- $19,704 (FY2002) to Lancaster County Career and Technology Center. Vo-tech high school students will plant native buffers to stabilize eroding streambanks on 850 feet of Mill Creek on the school property.
- $135,000 (FY2001) to the Hammer Creek Watershed Association for restoration of Hammer Creek at Snavely's Mill.
- $150,000 (FY2001) to Lititz Run Watershed Alliance for stream and wetland restoration at the Banta site.
- $95,000 (FY2001) to the Little Conestoga Watershed Alliance for development of an assessment and restoration plan for Little Conestoga Creek watershed.
- $4,375 (FY2001) to the Furnace Run/Segloch Run Watershed Alliance for a start-up grant to establish their alliance.
- $115,650 (FY2001) to the Save Our Creek Foundation for terrestrial and structural stream enhancement on Cocalico Creek.
- $9,032 (FY2000) to Manheim Township Commissioners to establish a 500 foot by 100-foot riparian buffer along Landis Run in a township park and to restore beneficial vegetation to an existing wetland. The site will be used as a demonstration area.
- $24,500 (FY2000) to the Little Conestoga Creek Watershed Alliance to demonstrate watershed assessment and stream restoration methods for citizens of the Little Conestoga Creek watershed. The project will focus on an unnamed tributary of Little Conestoga Creek in Manor Township to assess 2.1 miles of stream corridor and restore a 500-foot impaired stretch using streambank stabilization, in-stream structures and establishment of riparian buffers. The project will also include educational signs.
- $11,000 (FY2000) to the Lancaster County Conservation District (CD) to cover start-up costs and support to the Little Conestoga Creek Watershed Alliance. The project will include preparation of a brochure, mass mailing, incorporation of the association, stationery, and purchase of a lap-top computer.
- $75,000 (FY 2000) to the Lititz Run Watershed Alliance to restore 7 acres of riparian buffer, create a 5.26-acre warm season grass meadow, establish 1.25 acres of wetlands, and build a 1.12-acre stormwater management basin. These practices will be centered in a new development in Warwick Township, demonstrating the integration of development and environmental restoration.
- $50,000 (FY1999) to the Lititz Run Watershed Alliance to continue the restoration efforts in Lititz Run and tributaries. The project will use the assistance of local government, private organizations, and citizen volunteers.
- $50,000 (FY1999) to Lancaster County Conservation District to install agricultural BMPs and restore riparian buffers on Hammer Creek.
- $20,325 (FY1999) to the Lebanon County Conservation District to implement agricultural BMPs on a farm identified under the Susquehannock Fly Fishers Association initiatives. The project will eliminate barnlot runoff and establish a filter area to treat feedlot runoff.
- $112,500 (FY1999) to the Lititz Run Watershed Alliance to continue restoration of Lititz Run. Implementation aspects will include streambank stabilization, establishment of riparian buffers, and instream habitat and wetland creation and enhancement.
- $101,102 (FY1999) to the Quittapahilla Creek Watershed Association to stabilize seven miles of Hammer Creek streambanks in Lebanon County. The project will include livestock fencing, cattle crossings, and incorporation of streamside plantings of trees and shrubs.

<u>U.S. EPA Clean Water Act Section 319 Grants:</u>

- $52,125 (FY2003) to Little Conestoga Creek Watershed Alliance for streambank restoration of Bachman Run.
- $210,450 (FY2003) to Hammer Creek Watershed Association for continuation of natural stream design streambank restoration in Hammer Creek.

- $100,000 (FY2003) to Lititz Run watershed Alliance for agricultural best management practices in Lititz Run watershed.
- $300,000 (FY2002) to the Lancaster County Conservation District for installation of agricultural BMPs. Part of this grant money will be spent in the Lititz Run watershed.
- $159,233 (FY2002) to the Little Conestoga Watershed Alliance for design and implementation of phase 1 of the restoration of Millers Run.
- $20,325 (FY2001) to Lebanon County Conservation District for implementation of agricultural BMPs in the Lebanon County portion of Hammer Creek.
- $8,000 (FY2001) to the Manheim Township Commissioners to restore 500 feet of stream channel and establish riparian buffers along a tributary of Little Conestoga Creek in Stonehenge Park.
- $54,000 (FY2001) to Hammer Creek Watershed Association to conduct an assessment of nonpoint source pollution in the Hammer Creek watershed downstream of Speedwell Forge Lake. A plan will be developed that will identify costs of restoration efforts.
- $97,500 (FY2001) to Lancaster County Conservation District to restore a degraded portion of Swarr Run and provide a demonstration/pilot site for the Conestoga River Watershed Initiative. Activities will include installation of streambank fencing, riparian forest buffers, trails, a constructed wetland for wastewater treatment and a manure storage facility.
- $50,000 (FY1999) to Lancaster Conservation District for the Conestoga River Initiative, an effort to coordinate activities by the various groups and agencies in the subbasin and reduce nonpoint pollution in the watershed through development of a restoration plan and demonstration areas for correcting streambank erosion.
- $135,828 (FY1999) to Ducks Unlimited for the Muddy Run Restoration Project for streambank fencing to exclude cattle access to streams in the Muddy Run watershed.
- $112,000 (FY1999) to Lititz Run Restoration to complete restoration of the Millport Conservancy wetland project following removal of an orphan dam.
- $27,400 (FY1999) to F.X. Browne, Inc. to assess the water quality and develop a restoration plan for the PA Fish and Boat Commission owned Speedwell Forge Lake.
- $27,000 (FY1998) to Lancaster Conservation District for the Cocalico Creek Watershed/ Hammer Creek pilot project for wetlands, streambank fencing, barnyard and field erosion control.
- $1,282,022 (FY1995 to 2001) Pequea/Mill Creek National Monitoring Project with the U.S. Geological Survey is an ongoing project to assess the water quality and effects of streambank fencing initiatives.
- $243,000 (FY1998) to Landstudies, Inc. for restoration of Lititz Run through agricultural BMPs, streambank restoration and community education.
- $37,750 (FY1992) to Lancaster Conservation District for Pequea/Mill Creek streambank fencing to exclude cattle. Majority of the money was spent in Mill Creek watershed.
- Conservation District NPS Education Program (1999) to develop a brochure on pasture management and stream fencing practices.

Pennsylvania Watershed Restoration Assistance Program (WRAP):

- $4,868 (FY1999) to Lancaster County Academy to restore a wetland in an urban settling at a shopping center.
- $4,000 (FY1999) to Lancaster County Board of Commissioners to help development of the Hammer Creek Watershed Association, which will assist in implementing agricultural BMPs.
- $26,400 (FY1999) to Save Our Creek Foundation to restore riparian buffers in Ephrata Borough Park along the Cocalico Creek.

(DEP) Act 167 Stormwater Management Plans:

- Approved: Little Conestoga Creek (1998) and Mill Creek (1998)
- Under development: Cocalico Creek

Department of Conservation and Natural Resources (DCNR) Rivers Conservation Grants:

- $25,000 (2000) to Donegal Chapter of Trout Unlimited to restore a stream channel, stabilize streambanks and improve fish habitat along 1000 feet of Lititz Run.

- $25,000 (1996) to Donegal Chapter of Trout Unlimited to develop conservation plans for Lititz Run watershed.

- Land Trust Grants:
  - $220,000 (1997) to The Nature Conservancy for acquisition of 105 acres in West Cocalico Township for expansion of the Acopian Preserve Natural Area.
  - $225,000 to Lancaster County Conservancy to acquire a 234-acre natural area along Stehman Run in Martic Township

Agriculture Initiatives:

- Lancaster County Conservation District and U.S. Fish and Wildlife Service: monitoring continues for evaluation of the streambank fencing project on Mill Creek completed in 1998.
- U.S. Department of Agriculture Natural Resource Conservation Service (NRCS) Programs:
  - Pequea/Mill Project: Started in early 1990's, over 70 miles of stream fenced in both watersheds, over 160 manure storage facilities installed as of mid-2000. About 60% of the work has been in Mill Creek watershed.
- Pennsylvania Agriculture Plan, Section 208 of the Clean Water Act, identified the Conestoga River headwaters as the number one priority watershed for agricultural pollution abatement in Pennsylvania.
- State Conservation Commission grant for $99,000 to the Lancaster CD to help pay for installation of farm conservation practices that will improve water quality in the Chesapeake Bay. The program will pay for 80% of the project costs.
- The Conestoga Headwaters Clean Water Program was implemented from 1977 through 1986. One of their goals was promotion of BMPs on farms such as wise use of manure and fertilizer and tilling and planting techniques to conserve soil. Their goal was to sign up 300 farms in the program. During that period only 71 farms had contracted for help in implementing appropriate BMPs. The low level of participation was in part attributed to the numerous Mennonite farmers who traditionally do not contract with government agencies.
- Chesapeake Bay Program Activities:
  - $1,278,304 total cost share received for 102 bay contracts, average contract was $13,513 for installation of agricultural BMPs.
- Rural Clean Water Program:
  - $1.9 million cost share for BMPs from 1981 to 1990 and extensive USGS water quality monitoring.

PENNVEST:

- $7.9 million loan (1996) to Ephrata Borough to construct a 2.3 million gallons per day sewage treatment plant and an interceptor to provide service to East Cocalico Township and Denver Borough to eliminate overloading of the existing system and to provide 1,00 new jobs in the area.

Sewage Facility Planning Grants:

- Awards in 1995-1996 ranging from $266 to $92,000 to townships: Clay, East Cocalico, East and West Earl, Ephrata, and boroughs: Ephrata, Denver, and Akron.

Wellhead Protection Programs:

- The East Hempfield Municipal Water Authority, which serves 15,000 customers in East and West Hempfield Townships, entered the program in 1996 to protect its nine wells and a spring. The program will emphasize education and voluntary compliance. The high volume wells and springs are located in limestone strata and are vulnerable to toxic spills via movement through sinkholes and fractures. The wells are located in the village of East Hempfield, and the spring along Swarr Run.
- East Cocalico Township has also entered the program
- Wellhead Protection Community-Based Education (DEP) Grant to Lititz Borough for land use and groundwater protection plans to protect the recharge area of the borough's 6 water supply wells.

Chesapeake Bay Small Watershed Grants Program:

- $40,000 to the Lititz Run Alliance to improve 2,700 feet of streambank in Borough of Lititz, conduct restoration activities in the Mill Pond, and to create a wetland to filter stormwater in Santo Domingo Creek

- $9,800 to the Lancaster County Conservation District and NRCS to construct a trout nursery on an Amish farm to provide trout for stocking streams where cattle exclusion fencing has been installed. Mill Creek trout raceway project for trout reintroduction in Mill Creek was completed in 1998 under their Trout Can Save the Bay program. The US Fish and Wildlife Service was also a partner.

Other:

- The Little Conestoga Creek stream environmental snapshot evaluation was paid for by DEP from fines generated in Lancaster County.
- $50,000 from the Resslers Mill Foundation for streambank fencing in Mill Creek.
- The Pennsylvania Game Commission was the first agency to fund streambank fencing to keep out cattle; funding began in 1988 on Muddy Run.
- The Lancaster County Conservation District has ongoing projects to help restore water quality in streams affected by farming and stormwater runoff.

Citizen/Conservation Groups

- Lititz Run Watershed Alliance formed in 1997 has received national recognition for its efforts to restore Lititz Run.
- Save Our Creek watershed activities include on-going stream corridor improvements and clean-up projects.
- The Chesapeake Bay Foundation (CBF) and the Alliance for the Chesapeake Bay (ACB) conduct and contribute to education and awareness, water quality, and stream restoration activities in county streams.
- Hammer Creek Watershed Association, newly formed group in 1999.
- Little Conestoga Creek Watershed Alliance newly formed group in summer 2000.
- Lancaster Healthy Communities is a volunteer organization involved with promoting a healthy community lifestyle. They are one of 15 collaborators for the countywide Lancaster Community Indicator Project tracking water quality and stream health.
- Donegal Chapter Trout Unlimited has assisted other groups in stream restoration activities in the subbasin.

Public Participation/Outreach

Watershed Notebooks

DEP's website has a watershed notebook for each of its 104 State Water Plan watersheds. Each notebook provides a brief description of the watershed with supporting data and information on agency and citizen group activities. Each notebook is organized to allow networking by watershed groups and others by providing access to send and post information about projects and activities underway in the watershed. This WRAS will be posted in the watershed notebook to allow for public comment and update. The notebooks also link to the Department's Watershed Idea Exchange, an open forum to discuss watershed issues. The website is www.dep.state.pa.us. Choose Subjects/Water Management/Watershed Conservation/Watershed and Nonpoint Source Management/Watershed Notebooks.

A variety of federal and local agencies and staff from other Department programs reviewed or provided information for this WRAS. These included NRCS, the Chester and Lancaster County Conservation Districts, and the DEP South Central Regional Office. The public participation process has begun through distribution of this WRAS at various workshops and conferences and by the county conservation districts and DEP Regional Coordinators. Public input has been and will continue to be incorporated into expanding and fine tuning the WRAS for direction on use of 319 grant funds beyond FY2000.

The Lancaster County Conservation District (LCCD) has started a watershed awareness campaign to educate county citizens so that they can improve the water quality in their own watershed. Three public workshops were held as a part of this awareness campaign. LCCD also provides local groups with organizational, technical, and financial procurement assistance. They have also published educational brochures including one titled 'Pasture Management and Stream Fencing-What's in it for me?' for the local farming community

and for statewide use through local County Conservation District and NRCS offices. The conservation districts and NRCS should continue the education of farmers on proper and safe use of pesticides and manure spreading on fields to help reduce groundwater pollution from nitrates and residual pesticides.

Funding Needs
The total needed dollars for addressing all nonpoint source problems in the watershed is undetermined at this time and will be so until stream assessments are conducted and necessary TMDL's are developed for the watershed. Existing programs that address nonpoint source issues in the watershed will continue to move forward until TMDL's are completed. The Draft TMDL for Muddy Run was completed in December 2000.

Pennsylvania has developed a Unified Watershed Assessment to identify priority watersheds needing restoration. Pennsylvania has worked cooperatively with agencies, organizations and the public to define watershed restoration priorities. The Commonwealth initiated a public participation process for the unified assessment and procedures for setting watershed priorities. Pennsylvania's assessment process was published in the *Pennsylvania Bulletin, DEP Update* publication and World Wide Web site. It was sent to the Department's list of watershed groups, monitoring groups, and Nonpoint Source Program mailing list. Department staff engaged in a significant outreach effort which included 23 additional events to solicit public comment. The Department received 23 written comments from a variety of agencies, conservation districts and watershed groups. Pennsylvania is committed to expanding and improving this process in the future.

Total Maximum Daily Loads TMDL's
TMDL's identify the amount of a pollutant that a stream or lake can assimilate without violating its water quality standards. TMDL's are calculated to include a margin of safety to protect against a mathematical or data error. TMDL's are set for each pollutant causing impairment.

Muddy Run Draft TMDL:
A Total Maximum Daily Load (TMDL) was developed for Muddy Run, a tributary of Mill Creek, to address impairments noted on Pennsylvania's 1996 Clean Water Act section 303(d) list. The segment was listed based on surface water quality monitoring in the stream. The impairments were caused by excess nutrients and suspended solids loads from agriculture.

The protected water uses of the Conestoga River basin are water supply, recreation, and aquatic life. The aquatic life use for Muddy Run is warm water fishes. The Muddy Run watershed is primarily in agricultural land use, with 98% in pasture/hay or cropland, with 47.1% in cropland and 49.7% in hay and pastureland.

The Muddy Run watershed is subject to a variety of nonpoint source pollutants including organic enrichment from agriculture and on-site septic systems, streambank erosion and lack of stabilization, and unrestricted cattle access along streams. Agriculture has been identified as the largest contributor of sediment and phosphorus to the Muddy Run watershed. Soil erosion is a major nonpoint source problem in the basin. Soil erosion rates were over 10 tons per acre in 1982, almost double the state average. Large areas of row crops, the use of conventional tillage, and unrestricted cattle access to streams combine to leave the soil vulnerable to erosion. The resulting increased sediment yields can make water unfit to drink, smother aquatic life and fish eggs, clog fish gills, and block sunlight into the creeks and rivers. Much of the soil is washed down into the Susquehanna River, where it gathers behind the hydroelectric dams or is carried into the Chesapeake Bay.

Agricultural runoff from cropland and pasture can often contribute increased pollutant loads to a waterbody when poor farm management practices allow soils rich in nutrients from fertilizers or animal waste to be washed into the stream, increasing in-stream nutrient and sediment levels. The watershed includes some of the finest limestone soils and agricultural land in both Pennsylvania and the United States. Lancaster County is a leading dollar volume agricultural producer among non-irrigated counties in the United States.

Cattle and other agricultural animals deposit manure and, therefore, nutrients on the land surface where it is available for runoff and delivery to receiving waterbodies. Spreading animal manure on agricultural lands also contributes to nutrient runoff. The Pennsylvania Animal Density GIS coverage based on the 1997 Census of Agriculture indicated that 3,401 cattle, 2,813 hogs, 91 sheep, 405 horses, 114,176 chickens, and 257 turkeys were present in the watershed. The livestock densities in Lancaster County were used to calculate the livestock counts in the Muddy Run watershed based on the area of the watershed (5,619 acres). Livestock densities were used to adjust nutrient concentrations from agricultural lands in the watershed modeling and analysis. Unrestricted access of livestock to streams results in trampled stream banks, which in turn results in excessive stream sedimentation, sparse streamside buffers, and minimal riparian vegetation.

Typically in aquatic ecosystems the quantities of trace elements are plentiful; however, nitrogen and phosphorus may be in short supply. The nutrient that is in the shortest supply is called the limiting nutrient because its relative quantity affects the rate of production (growth) of aquatic biomass. If the nutrient load to a waterbody can be reduced, the available pool of nutrients that can be utilized by plants and other organisms will be reduced and, in general, the total biomass can subsequently be decreased as well. In most efforts to control eutrophication processes in waterbodies, emphasis is placed on the limiting nutrient. This is not always the case, however. For example, if nitrogen is the limiting nutrient, it still might be more efficient to control phosphorus loads if the nitrogen originates from sources that are difficult to control, such as nitrates in ground water.

In most freshwater bodies, phosphorus is the limiting nutrient for aquatic growth. In some cases, determination of which nutrient is the most limiting is difficult; therefore, the ratio of the amount of nitrogen to the amount of phosphorus is often used to make this determination. If the nitrogen/ phosphorus ratio is less than 10, nitrogen is limiting; if the nitrogen/phosphorus ratio is greater than 10, phosphorus is the limiting nutrient. In the case of listed stream segment in the Muddy Run watershed, the nitrogen/phosphorus ratio is 10.4, pointing to phosphorus as the limiting nutrient. The nutrient portion of the TMDL's for the impaired watershed, therefore, addresses only phosphorus. Controlling the phosphorus loading to this listed stream segment in the Muddy Run watershed will limit plant growth and reduce eutrophication.

Because Pennsylvania has no numerical in-stream criteria for the pollutants of concern, a reference watershed approach was developed to set allowable loading rates in the impaired watersheds. The reference watershed approach is used to estimate the necessary loading reduction of phosphorus and sediment that would be needed to restore a healthy aquatic community and allow the streams in the watershed to achieve their designated uses. The reference watershed approach is based on determining the current loading rates for the pollutants of interest from a selected non-impaired watershed that has land use characteristics similar to those of the impaired watershed.

The reference watershed approach pairs two watersheds, one attaining its uses and one that is impaired based on biological assessment. Both watersheds must have similar land cover and land use characteristics. Other features such as base geology should be matched to the extent possible. The objective of the process is to reduce the loading rate of nutrients and sediment in the impaired stream segment to a level equivalent to or slightly lower than the loading rate in the non-impaired reference stream segment. Achieving the phosphorus and/or sediment loadings recommended in the TMDL's will ensure that the aquatic life use of the impaired stream is achieved. A portion of the Yellow Breeches Creek, which is located in southern Cumberland County, was used as the reference watershed for comparison with Muddy Run.

Summary of Reference Watershed and TMDL Endpoints					
Reference Watershed	**Impaired Watershed**	**Existing Loads** (Muddy Run Watershed)		**TMDL Endpoint** (Reference Watershed, Yellow Breeches Creek)	
		Phosphorus (lb/ac/yr)	Sediment (lb/ac/yr)	Phosphorus (lb/ac/yr)	Sediment (lb/ac/yr)
Yellow Breeches Creek	Muddy Run	3.05	3,164.24	1.97	786.72

The TMDL was developed using the Generalized Watershed Loading Function (GWLF) model which provides the ability to simulate runoff, sediment, and nutrient (N and P) loadings from a watershed with variable size source loads, e.g., agricultural, forested, and developed land. Septic loads may also be calculated and point sources may be included where applicable. Adjustments were made to the model to compensate for the differences between the impaired and reference watershed. Load allocations were made for the sources of P and sediment from hay/pasture, row crops, coniferous, mixed forest, deciduous, low and high intensity development, quarries, groundwater, and septic systems.

TMDL Computation for the Muddy Run Watershed			
Pollutant	**Unit Area Loading Rate in Yellow Breeches Creek (lbs/ac/yr)**	**Total Watershed Area in Muddy Run (acres)**	**TMDL Value (lb/yr)**
Phosphorus	1.04	5,619	5,819
Sediment	868.15	5,619	4,878,066

TMDLs for the Muddy Run Watershed				
Pollutant	**TMDL (lb/yr)**	**LA (lb/yr)**	**WLA (lb/yr)**	**MOS (lb/yr)**
Phosphorus	5,819	5,237	0	582
Sediment	4,878,066	4,390,259	0	487,807

The TMDL is allocated to the agricultural nonpoint sources, load allocations, or LAs, and 10 percent of the allowable loading is reserved as a margin of safety (MOS). No major point source sediment or phosphorus discharges are located in the Muddy Run watershed; therefore, no point sources (WLAs) were considered in TMDL development for the watershed. The TMDL covers a total of two miles of stream segments in the Muddy Run watershed. The TMDL establishes a total reduction for phosphorus loading of 69 percent from the average yearly loading of 17,147 pounds and a total reduction in sediment loading of 41 percent from the average yearly loading of 7,460,637 pounds in the subwatershed.

Load Allocations for Muddy Run Watershed by Land Use/Source									
		Phosphorus				**Sediment**			
Source	**Area (acres)**	**Unit Area Loading Rate (lbs/ac/yr)**	**Annual Average Load (lbs/yr)**	**LA (annual average) (lbs/yr)**	**% Reduc-tion**	**Unit Area Loading Rate (lbs/ac/yr)**	**Annual Average Load (lbs/yr)**	**LA (annual average) (lbs/yr)**	**% Reduc-tion**
Hay/Past	2792	0.89	2496	1630	34.6%	344.17	960,998	787,850	18%

Cropland	2649	5.33	14118	3076	78.2%	2447.10	6,482,058	3,584,828	44.8%
Coniferous	30	0.01	0	0	0.0%	5.97	177	177	0.0%
Mixed For	20	0.01	0	0	0.0%	4.90	97	97	0.0%
Deciduous	25	0.02	0	0	0.0%	5.08	126	126	0.0%
Lo Int Dev	42	0.10	4	4	0.0%	246.47	10,354	10,354	0.0%
Hi Int Dev	62	1.26	78	78	0.0%	110.53	6,828	6,828	0.0%
Groundwater			425	424					
Point Source			0	0					
Septic Systems			24	24					
Total	**5619**	**3.05**	**17147**	**5237**	**69%**	**1,327.76**	**746,0637**	**4,390,259**	**41%**

Additional information and loadings calculations can be found in the Draft TMDL on the Department's website at http://www.dep.state.pa.us/, choose directLINK, TMDL, Muddy Run.

Restoration Needs

The assessment of the subbasin has been completed. Impaired waters have been placed on the 303d list. Restoration efforts should be directed towards those stream segments on the 303d list. Since the Conestoga River watershed contributes some of the highest nutrient loads to the Chesapeake Bay, remediation of agricultural nonpoint source pollutants in the Conestoga River will also greatly assist the efforts to clean up pollutants and excess sediment in the Bay.

The following stream sections are impaired by agricultural practices and in the greatest need of agricultural best management practices (BMPs) such as cattle exclusion, cropland terraces, contour farming, grass waterways, and manure management, streambank stabilization and restoration of riparian buffers:

- Conestoga River: 30 miles of the upper main stem and 28.26 miles of 17 unnamed tributaries
- East Branch Conestoga River: entire watershed (5.99 miles)
- Black Creek watershed (15.92 miles)
- Little Muddy Creek: lower 2.56 miles of main stem
- Cocalico Creek: lower 16.93 miles of main stem, Stony Run (5.24 miles)
- Hammer Creek: 3.45 miles of the lower main stem, 2 unnamed tributaries (3.54 miles)
- Stauffer Run: entire watershed (5.3 miles)
- Mill Creek: 16.74 miles lower main stem; 2 unnamed tributaries, Groff Run (4.08 miles), Muddy Run (3.41 miles)
- Little Conestoga Creek: 18.11 miles main stem, 16.01 miles unnamed tributaries, Swarr Run (7.9 miles), Millers Run (1.94 miles), Brubaker Run (2.92 miles)
    - West Branch Little Conestoga Creek: 2.45 miles lower main stem, one unnamed tributary (1.97 miles), 2.36 miles main stem Indian Run

Implementation of agricultural BMPs in the affected areas should reduce nutrient and sediment loads. Installation of BMPs is already underway in many of these watersheds. Streambank stabilization and fencing have begun to reduce phosphorus and sediment loads. Stabilizing streambanks will also help reduce instream erosion. Fencing will keep livestock out of the stream and provide a riparian zone along the stream to trap sediment and phosphorus, thus keeping these pollutants from reaching the stream. Contour farming and grass waterways will help reduce sediment runoff during storms.

Restoration efforts in the Conestoga River watershed have been implemented by a variety of agencies and citizens groups. Riparian corridors are being reestablished in many areas throughout the watershed and many farmers in the basin are implementing a variety of agricultural best management practices (BMPs). These efforts need to continue and be coordinated to assure that BMPs are placed in locations that will achieve the highest load reductions.

The removal of several run of the river dams in the subbasin by the Pennsylvania Fish and Boat Commission has improved stream habitat, narrowed the stream channel, and reduced the amount of algae and sediments in sections of the Conestoga River and Lititz Run.

The Conestoga Watershed Initiative being prepared by Lancaster County Conservation District and Landstudies, Inc. will establish the Conestoga Watershed Council to coordinate restoration efforts sponsored by the various citizens groups and will involve state, federal, and local agencies. As part of this initiative, an evaluation of streambank erosion and sedimentation following fluvial geomorphological (FGM) methods was begun in watersheds where public and landowner interest is highest.

The Little Conestoga Creek study identified stressed stream reaches and tributaries in need of attention. Assessments underway in Hammer Creek watershed upstream and downstream of Speedwell Forge Lake will pinpoint restoration needs in that watershed. Groups seeking funding for implementation projects should use these evaluations and plans to direct their restoration efforts.

Lititz Run:
A restoration and management plan has been developed by Landstudies, Inc. for the Lititz Run watershed. The Lititz Run watershed was once largely in agricultural and forested land use. Towns, villages and housing and commercial developments are spreading out from the center of the watershed, Lititz Borough. The Lititz Run restoration plan developed for the watershed recommends a variety of practices to preserve and restore the quality of life in urban and suburban areas and farmland. The plan has broad based community support, including local businesses, Warwick Township, Lititz Borough, and the Donegal Chapter of Trout Unlimited.

Remediation of impairment from urban/stormwater and agricultural practices has begun in the Lititz Run watershed. BMPs installed or planned include streambank restoration, planting of riparian buffers, instream habitat enhancement, contour plowing, grass waterways, and wetland creation and enhancement. The limestone and dolomite geology underlying two-thirds of the watershed provides the spring sources of Lititz Run and other tributaries but also presents challenges to remediation. Sinkholes and solution channels readily transport contaminants to the groundwater. Some streams and groundwater have high nitrate concentrations from spreading of excess fertilizer, improper manure storage and leaky on-lot septic systems.

Update on Lititz Run restoration activities by the Lititz Run Watershed Alliance, Contact person, Daniel Zimmerman (dzimmerman@warwicktwp.org):

- Wynfield Project: The riparian buffers have been completed, wetlands have been established and a maintenance program is underway.
- Weidler Farm project was completed by September 2001. Project exceeded objectives by completing cattle crossing, installation of a milk house pump and irrigation system and Barnyard spouting.
- Millport Conservancy project was completed in October 2001. Objectives met include 1500 linear feet of stream stabilization, wildlife habitat enhancement by improving adjacent pond to Lititz Run.
- Newport Square Ecological Restoration: As of fall 2002, educational signage was installed throughout the project site. The signage provides information on Riparian Buffers and the functions of wetlands. Re-seeding of warm season grasses was completed. Over 20 volunteers replaced all dead trees within the riparian buffer. Warm season grasses were treated to remove invasive weed growth. Seeding of warm season grasses and wetland plants will be completed in Spring 2003.

Mill Creek Watershed:
Mill Creek watershed is impaired by nonpoint source pollution from agricultural sources. The major contributors are high animal densities in areas adjacent to stream channels. Livestock are pastured near streams and are usually allowed direct access to the stream for drinking and cooling. The USGS has been investigating the effects of installation of agricultural BMPs under the Pequea/ Mill Creek National Monitoring Project (NMP) since 1989. The study evaluated trends in nutrient and suspended solids (residue) concentrations and loading. BMPs installed include streambank fencing and crossings, barnyard runoff controls, manure storage facilities, and rotational grazing. As of January 1998, about 12 to 15 miles out of 70 total stream miles in Mill Creek had been fenced and 50 manure storage facilities were installed. About 20 % of the farms with streambank fencing have also implemented barnyard runoff controls. Most of the BMPs were installed in the Muddy Run portion of Mill Creek watershed. Upstream of Muddy Run, 16 farms or 3.5 of 8 total stream miles have been fenced. Five manure storage facilities have been installed in the Muddy Run basin.

Significant trends in reductions in nutrients and residue have been documented after installation of agricultural BMPs. The strongest trends were a greater than 50% reduction in concentrations of total and dissolved phosphorus (P) and residue in base flow in Mill Creek and Muddy Run. Storm flow samples showed a 31% reduction in total P concentrations in Mill Creek and a 54% decrease in nonfilterable residue in Muddy Run; however, a trend of 54% increase in total ammonia nitrogen was noted in Muddy Run during storm flow. The PA Fish and Boat Commission stocked Muddy Run with trout for the first time in spring 2000. This successful stocking was an additional benefit of fencing over 1,000 cows out of the stream.

The USGS study indicated that streambank fencing in connection with other BMPs such as stream crossings, manure storage, and rotational grazing is effective in reducing polluted runoff and improving water quality during both base flow and storm flow events. Many more BMPs are necessary to complete the restoration efforts already underway. Additional improvements in water quality are expected with installation of additional BMPs; however, because of the magnitude of the problem achievement of water quality standards may not be observed for some time.

Hammer Creek
A watershed assessment was conducted that assembled all available information regarding the location and types of impacts of nonpoint source pollution in the Hammer Creek Watershed downstream of Speedwell Forge Lake. A plan was prepared that identified costs of proposed restoration efforts. Specific BMPs identified in the plan will be implemented incorporated into ongoing public education efforts about the watershed.

Project updates by the Hammer Creek Watershed Association, Contact person, Gary Trostle, dgtrost@dejazzd.com:

- As of April 2002, two projects at the Lee Good Farm and Emory Martin Farm incorporating 3/4 miles of Hammer Creek between Carpenter Road and Buch Mill road were completed. The work involved narrowing the channel and regrading the stream banks to allow the creek to access the flood plain more easily. Rock weirs were installed to direct the flow to the center of the channel, a wetland area was created on the Good Farm segment and riparian buffer zones were seeded and planted on the entire segment. Informational Signage was installed.
- The Snavely Project involves relocating the 3000 feet of Hammer Creek into a former stream channel that is now heavily wooded. The mature trees will provide shade to allow the waters to cool to compensate for heat gain from Speedwell Forge Lake and the Snavelys Mill race. An archeological search was conducted by PHMC, who dug search pits and found no prehistoric artifacts. Groundbreaking was expected in late summer or early fall 2002.

References/Sources of information

- State Water Plan, Subbasin 7, Lower Susquehanna River. Department of Environmental Protection, February 1980
- USGS Topographic Maps
- U.S. EPA 319 and Growing Greener grant project proposals and summaries
- DEP: Watershed Notebooks, Unified Assessment Document, and information from files and databases.
- Map of Draft Level III and IV Ecoregions of Pennsylvania and the Blue Ridge Mountains, Ridge and Valley, and Central Appalachians of EPA Regions III
- A Snapshot Evaluation of Stream Environmental Quality in the Little Conestoga Creek Basin, Lancaster County, Pennsylvania. USGS Water Resources Report 98-4173, September 1998.
- Conestoga Headwaters Project Rural Clean Water Program (RCWP) 10-Year Report, 1992, US Department of Agriculture, Agricultural Stabilization and Conservation Service.
- The Conestoga River. A Fact Sheet prepared by the Alliance for the Chesapeake Bay.
- Lititz Run Watershed "A Community Improving Its Water Quality", Landstudies, Inc. 1999.
- Trends in Surface Water Quality during Implementation of Best Management Practices in Mill Creek and Muddy Run Basins, Lancaster County, Pennsylvania. USGS Fact Sheet 168-99, January 2000.
- The Biological Condition of Streams in the Pequea and Mill Creek Watersheds in Pennsylvania. March 1999. U.S. Environmental Protection Agency, Region III, Biology Group, Wheeling, WV.
- Draft TMDL for Muddy Run Watershed. DEP Bureau of Watershed Conservation. December 2000.

Streams in Subbasin 07J: 303d/305b Listings

Stream	Stream Code	Drainage area square miles	Miles Impaired	Miles Attained	Sources/Cause/ *Comments*
1-Susquehanna River	06685				
2-Dry Run	07866	0.50	2.16		Flow alterations from natural sources
2-Witmers Run	07864	1.14	2.49 main stem	0.8 of one UNT	Siltation from AG
2-Wisslers Run	07846	0.83			*HQ-CWF*
2 Manns Run	07834		1.75		Nutrients & siltation from AG
2-Conestoga River	07548	477	30.1, upper main stem; 61.26 of 36 UNTs; 4.84 middle main stem; 8.44 of 8 UNTs; 1.0 main stem	29.38, lower main stem; 8.07, of 8 UNTs	Nutrients, siltation, organic enrichment/low DO from AG grazing & crops and other Siltation from golf courses/ urban/residential development, flow alterations/ channelization, upstream impoundments, vegetation removal & AG. Chlorine from point source
3-East Branch Conestoga River	07815	7.15	3.66, main stem; 2.33 of 6 UNTs		Nutrients, organic enrichment/ low DO from AG & other sources
3-Muddy Creek	07760	51.8	4.53 of 4 UNTs	12.02 main stem; 7.94 of 5 UNTs	
4-"Rock Run"	07781		1.58 main stem; 0.68 of 2 UNTs	8.24 main stem; 1.81of 2 UNTs	Nutrients & siltation from AG grazing *HQ-TSF*
4-Black Creek & 6 UNTs	07774	10.2		15.92	*HQ-WWF*
4-Little Muddy Creek	07765	16.1	2.56 main stem; 2.64 of 2 UNTs	7.11 main stem; 5.96 of 4 UNTs	Siltation from AG grazing
3-Groff Creek	07749	13.2	6.88, main stem; 8.16 of 4 UNTs		Nutrients & siltation from AG-crops & grazing
3-Cocalico Creek	07656	140	16.93, main stem; 5.61 of 6 UNTs	10.25 main stem, 21.41 of 15 UNTs	Nutrients & siltation from AG grazing & crops; Urban-unknown causes *HQ-WWF, upper basin*
4-Harnish Run & 3 UNTs	07732	4.17		7.54	

4-Little Cocalico Creek & 10 UNTs	07719	14.6		20.26	
4-Stony Run	07717	4.71	4.1 main stem; 1.14 of one UNT		Nutrients & siltation from AG grazing & crops; urban/ unknown causes
4-Coover Run	07716	1.35	1.19		Nutrients & siltation from AG grazing & crops
4-Indian Run at Ephrata & 2 UNTs	07710	12.0		9.08	
4-Meadow Run	07707	1.30	1.5		Nutrients & siltation from AG
4-Middle Creek & 7 UNTs	07689	32.4		38.34	
5-Elders Run	07700	0.52		0.54	*EV*
5-Furnace Run & 3 UNTs	07693	8.10		7.91	
6-Segloch Run	07694	3.43		3.09	*EV*
4-Hammer Creek	07664	35.2	3.45 lower main stem, 3.54 of 2 UNTs	16.43 upper main stem, 24.3 of 21 UNTs	Siltation & nutrients from AG/grazing & crops
5-Walnut Run	07676	2.16		1.58	
5-Kettle Run	07675	0.95		1.91	
3-Lititz Run	07646	17.4	5.45 main stem; 2.27 of one UNT	3.1 of 2 UNTs	Suspended solids from Urban runoff/storm sewers Nutrients & siltation from AG
4-Santo Domingo Creek	07652	3.92	0.63 main stem; 1.0 of one UNT	1.54 of one UNT	Suspended solids from Urban runoff/storm sewers
4-Hublers Run	07651	0.77		1.6	
3-Landis Run	07638	3.19	3.05, main stem; 0.86 of one UNT		Flow alterations, siltation from channelization & land development
3-Stauffer Run	07635	5.25	3.1 main stem; 2.2 of 2 UNTs		Nutrients & siltation from AG grazing; Residential development-unknown
3-Mill Creek	07957	56.4	16.74 main stem; 17.22 of 14 UNTs	9.84 main stem; 8.18 of 5 UNTs	Nutrients & siltation from AG/grazing & crops; Road runoff, Land development, One UNT- Industrial point source impairment
4-Groff Run, & one UNT	07620	2.63	4.08		Nutrients & siltation from AG/grazing
4-Muddy Run	07613	8.84	5.6 main stem; 2.86 of 2 UNTs		Nutrients & siltation from AG/grazing

4-Big Spring Run	07599	5.80	2.21 main stem; 7.04 of 6 UNTs		Nutrients & siltation from AG
3-Stehman Run & 2 UNTs	07588	4.95		6.59	
3-Little Conestoga Creek	07559	65.5	18.11 main stem; 16.01 of 12 UNTs	2.87 main stem; 6.99 of 3 UNTs	Nutrients & siltation from AG/grazing; Urban runoff-unknown causes
4-Swarr Run	07576	8.88	4.11 main stem; 3.79 of 3 UNTs		Nutrients & siltation from AG/grazing & crops; Urban-unknown causes
5-Millers Run	07577	1.23	1.94		Nutrients & siltation from AG grazing & crops; Urban runoff-cause unknown
4-Brubaker Run	07572	2.88	2.92		Nutrients & siltation from AG grazing; Urban-unknown cause
4-West Branch Little Conestoga Creek	07562	12.3	2.45 main stem; 1.97 of one UNT	5.85 main stem; 4.96 of 4 UNTs	Nutrients & siltation from AG grazing & crops-
4-Indian Run at Rock Hill	07560	3.20	3.62, main stem; 1.18 of one UNT		Nutrients & siltation from AG crops
3-Witmer Run & 2 UNTs	07553	3.20		3.97	
2-"Grubb Hollow"	07546	1.45			*HQ-WWF*

The subbasin was assessed under the DEP unassessed waters project in 1997, 1999 and 2000.

Streams are listed in order from upstream to downstream. A stream with the number 2 is a tributary to a number 1 stream, 3's are tributaries to 2's, etc.

UNTs= unnamed tributaries; AG= agriculture

Chapter 93 information: EV= Exceptional Value; HQ= High Quality; WWF= warm water fishes; CWF= coldwater fishes; TSF= trout stocked fishes