

Updated 1/2004

**Watershed Restoration Action Strategy (WRAS)
State Water Plan Subbasin 02E
Pidcock Creek and Mill Creek and
Tributaries to the Delaware River
In Lower Bucks County PA**

Introduction

Subbasin 02E consists of the Delaware River and its tributaries from downstream of the mouth of Tohickon Creek near Lumberville to upstream of the Neshaminy Creek near Bristol. For convenience, the subbasin is named for the two largest tributaries, Pidcock Creek and Mill Creek. All of these Delaware River tributaries drain relatively small land areas; the largest, Mill Creek, drains only 19.8 square miles and the second largest, Pidcock Creek, drains only 12.7 square miles. The subbasin lies entirely within Bucks County. The subbasin drainage area is 134 square miles, the third smallest in PA. A total of 171 streams flow for 254 miles through the subbasin. The subbasin is included in **HUC Area 2040201**, Lower Delaware River/Neshaminy Creek.

Geology/Soils

Two-thirds of the subbasin lies within the Northern Piedmont Ecoregion. Most of this region is within the Triassic Lowlands section (64a), which consists of gray arkose sandstone, and red and brown sandstone, shale, and conglomerate of the Stockton Formation. The Diabase and Conglomerate Uplands section (64b) is interspersed through this area. This portion consists mostly of gray or black argillite of the Lockatong Formation (Trap Rock) and diabase, igneous and metamorphosed rocks which are quarried as building stone and aggregates.

The lower third of the basin adjacent to the Delaware River is in the Middle Atlantic Coastal Plain, Delaware River Terraces and Uplands (63a) consisting of unconsolidated sand and gravel. The coastal plain is interspersed with schist, gneiss and quartzite of Cambrian and Precambrian Age, part of the Piedmont Uplands (64c).

The majority of the subbasin has soils with high runoff potential due to slow infiltration rates and is subject to severe flooding. The diabase-trap rock derived soils have the poorest infiltration rates and highest runoff potential. The upper subbasin area along the Delaware River and a few other isolated areas in the coastal plain have soils with high or medium infiltration rates and are less prone to severe runoff problems. The Stockton Formation is moderately fractured and provides relatively good water well yields. The Trap Rock and diabase areas consist of hard rock with few fractures and low water yield in wells. Problems with on-lot septic systems also develop there because of poor soil infiltration and dispersal of wastewater through drain fields.

Land use

The subbasin is largely rural in the upper 2/3 and highly urbanized in the lower 1/3. This lower third has some of the earliest residential suburbs of Philadelphia, including Levittown, one of the first planned communities in the nation. The lower third also has large industrial parks and commercial tracts in addition to the high intensity village-borough type residential developments. In 1990, forty-one percent of the population of Bucks County lived in 12 municipalities of the Delaware River coastal plain, about two-thirds of which is in subbasin 02E. The subbasin population was 175,000 in 1990 and is projected to increase significantly to 220,000 by 2040. The older, highly urbanized boroughs and townships, such as Bristol Township and Bristol Borough, in the southern end of the subbasin are losing population while the population is growing in the more rural areas to the north and outside the highly urbanized area.

Acres of Land Cover by Type for Subbasin 02E			
Land use Category	Number of Acres	Land use Category	Number of Acres
Water Bodies	5,263.1	Mixed Forest	4,334.2
Low Intensity Development	13,957.6	Deciduous Forest	23,877.8
High Intensity Development	6,502.5	Woody Wetland	3,167.1
Hay/Pasture	4,491.8	Emergent Wetland	574.9
Croplands	16,596.3	Quarry	1,951.2
Coniferous Forest	1,379.3	Transitional/Abandoned Land	1,448.2
		Total Acres	83,543.9

Significant tracts of open, agricultural land and woodlots remain in the upper two-thirds of the subbasin, but suburban areas are expanding around the villages into this desirable area of Bucks County. The land adjacent to the Delaware River north of the coastal plain (Morrisville) has less development than the downstream section. Many large estates and horse farms are located in the upper subbasin.

The coastal plain area within the southeastern bend of the Delaware River has two large lakes, sewage lagoons, sand and gravel operations, and two large landfills.

Natural Resources:

Waterways, tidal creeks and wetlands in Falls and Bristol Townships contain historical sites for several fish, amphibian and reptile species of special concern. The Natural Lands Trust and Morris Arboretum has reported that the Paunacussing Creek watershed contains a diversity of natural habitats for wildlife and unusual species of flora and fauna, including several rare, endangered, and species of special concern.

The Nature Conservancy has protected some remnant coastal plain habitats from development:

- Bristol Marsh is a freshwater tidal marsh along the Delaware River that contains some rare wetland plants. An adjacent 11-acre area of marsh is protected through a long-term conservation management agreement with Bristol Borough. Rohm and Haas Co. also donated a conservation easement on 7 acres of marsh on their adjacent property.
- Silver Lake Nature Center has some endangered amphibian species.
- Delhaas Woods, a 181-acre wooded wetlands managed by the Silver Lake Nature Center has Pennsylvania's best example of an Atlantic coastal plain forest.

Parks:

- Washington's Crossing Historical Park near the Borough of New Hope
- Delaware Canal State Park along the Delaware River, which includes several picnic areas and a PA Fish and Boat Commission boat access to the Delaware River
- Falls of the Delaware Park along the Delaware Canal north of Morrisville
- Bristol Township: Silver Lake County Park, Frosty Hollow County Park along Mill Creek and a tributary, Queen Anne Park, and Black Ditch Park along Black Ditch Creek
- Bowmans Hill Tower and Wildflower Preserve north of Brownsville

Chapter 93 Exceptional Value (EV) and High-Quality (HQ) Stream Classifications:

- No EV streams
- HQ streams:
 - Paunacussing Creek
 - “Cuttalossa Creek” (unnamed tributary #03090 to the Delaware River)
 - Aquetong Creek

Water Quality Impairment

DEP 303d list of Impaired Waters: The lower 20 miles of the Delaware River, was placed on the 303d list in 1998 for a fish consumption advisory due to PCB’s and chlordane. The assessment of the subbasin was completed in 2001. The upper two-thirds of the subbasin is unimpaired. Most of the lower third is impaired due to urban runoff and storm sewers. Many streams in the lower third have had habitat and stream channel modifications that affect stormwater runoff.

Monitoring/Evaluation

The highly developed lower third of the subbasin experiences severe flooding and urban runoff during high intensity storms. Some of this portion experienced severe flooding during Hurricane Floyd in fall 1999 and during an 11-inch localized rainfall in June 1996. Water and flow variability and fluctuations impair many of the streams flowing through the urbanized portion of the watershed.

Most of the upper half of the subbasin has numerous woodlots and a relatively intact riparian corridor. Streams in this portion very likely attain their aquatic uses. This area still has many farms but is receiving development pressure as large estate sized building lots and subdivisions. The retention of woods and riparian cover is crucial to maintaining the aquatic habitat and avoiding impairment and habitat degradation. Three of these streams, Paunacussing Creek, Aquetong Creek, and Cuttalossa Creek, have received recognition of their good water quality through their special protection status classification as High Quality waters in the Department’s Chapter 93, Water Quality Standards.

Urbanization and paving can have a severe effect on stream aquatic life. Studies by the Maryland Department of Natural Resources have shown 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 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.

The Bucks County Planning Commission conducted a study of the nonresidential development properties and parcels zoned for nonresidential use in the county coastal zone, with funding from Section 305 of the coastal Zone Management Act of 1972. Nonresidential development, which includes office, industrial, institutional and commercial development has a higher potential for impact on surface and groundwater quality, wetlands and urban runoff than residential development. This type of development involves massive site grading and removal of vegetation and the construction of large areas of impervious surfaces. This type of development can cause significant pollution of the fragile natural resources of the coastal

zone. The county planning commission identified four goals for future nonresidential development to protect their coastal zone: maintain predevelopment hydrologic conditions, protect sensitive natural features, provide development regulations with greater flexibility, and improve site layout, design, and land use efficiency. Much of these would be implemented through protection of open space areas, reducing unnecessary paving, improving landscape standards, and fitting the site design to the landscape. The study identified a variety of strategies and for municipalities to follow to achieve these goals.

The Bucks County Water Supply Plan and Wellhead Protection Study of 1996 identified a variety of potential contamination sources in the lower portion of the subbasin. In the Mill Creek watershed they identified over 100 DEP regulated storage tanks, 5 facilities regulated by the Bucks County Emergency Services Department, 4 junkyards, one solid waste transfer station, and one EPA regulated industry classified as a “large quantity hazardous waste generator” under RCRA. Since the area is prone to severe flooding, the potential problems may be magnified.

Future threats to water quality

Continued urbanization and paving will increase stormwater runoff potential in the rapidly expanding suburbs of Philadelphia and around the villages of the subbasin. The increased development and paving will also impede infiltration and groundwater recharge, increase the need for public water supplies wells, which could decrease groundwater quantity and stream base flow.

Watershed Restoration Initiatives

Pennsylvania Growing Greener Grants:

- \$20,000 (FY 2003) to Yardley Borough - for storm water runoff best management practices at Buttonwood Park.
- \$7,738 (FY2002) to Bowman’s Hill Wildflower Preserve for organization of the Pidcock Creek Watershed Association.
- \$1.2 million (FY2001) to Middletown Township for Phase 2 of the Otter Creek restoration project, to create wetlands to control stormwater runoff in a highly urbanized area.
- \$30,000 (FY2000) to the Bucks County Planning Commission to conduct an assessment and develop a restoration and protection plan for the “Otter Creek” watershed. Otter Creek is a local name for the combined watersheds of Mill Creek, Queen Anne Creek and an unnamed tributary known as “Black Ditch Creek”. A public education and outreach program will also be developed.
- \$25,000 (FY2000) to the Delaware River Greenway Partnership to address two tasks within Delaware River Greenway Project, creation and implementation of a landowner stewardship program and stabilization of 200 feet of streambank along the Delaware Canal State Park.
- \$60,000 (FY2000) to the American Littoral Society/Delaware Riverkeeper to conduct a hydrogeomorphic survey of Paunacussing Creek, to develop a restoration and protection master plan, and to implement a streambank stabilization project.
- \$48,000 (FY 1999) to the Partnership for Land Use Management to develop a nonpoint source management plan for Paunacussing Creek watershed.
- \$4,875 (FY 1999) to the Partnership for Land Use Management to develop an environmental awareness of Paunacussing Creek watershed to ensure that effective land use practices are adopted to minimize effects of nonpoint source pollution.

U.S. Environmental Protection Agency (EPA) Clean Water Act Section 319 Grants:

- \$60,000 (FY2001) to the Makefield Lakes Community Association for watershed education and restoration, consisting of shoreline restoration, creation of educational signs, sediment removal, and educating the community about related watershed issues.
- \$110,000 (FY2000) to Lower Makefield Township to conduct a comprehensive stream corridor evaluation and to develop a management plan for Brock Creek. A model restoration project will be

completed to demonstrate the effectiveness of new and innovative BMPs for streambank stabilization and channel restoration in an urban setting.

- \$93,940 (FY1999) to the Bucks County Conservation District (CD) to restore the highly urbanized 1.5 square mile Silver Creek watershed. Seven to 10 stormwater catchment basins will be replaced, 100 feet of stream channel will be restored, water quality monitoring will be conducted, and residents will be educated on how to decrease NPS pollution.
- \$66,700 (FY1999) to Bucks County CD to identify sources of NPS pollution and develop a strategy for nonpoint source load reduction in Mill Creek.

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

- \$42,000 (2000) to the Heritage Conservancy to prepare a comprehensive rivers conservation plan for the middle Delaware River from Fork Township in Northampton County, to upper Makefield Township, Bucks County.
- \$23,000 (2000) to Partnership for Land Use Management to prepare a comprehensive rivers conservation plan for Paunacussing Creek watershed.
- \$75,000 (2000) to Bensalem Township to prepare a greenway trail and feasibility study for their township.
- \$65,000 (1996) to the Heritage Conservancy to develop a rivers conservation plan for the lower Delaware River.
- Keystone Land Trust Program Grants:
 - \$750,000 to the Wildlands Conservancy to acquire 22 acres along the east branch of Hough's Creek between the Delaware Canal and Washington's Crossing Historic Park in Upper Makefield Township.

PENNVEST:

- \$787,594 loan to Lower Bucks County Joint Municipal Authority to eliminate wet weather discharges of sewage into Queen Anne Creek.

League of Women Voters (WREN) Mini-grants:

- \$3,000 to Bristol Township School District to produce a video using middle school presentations about water protection issues and to share the information with elected officials, citizens and service groups.

(DEP) Act 167 Stormwater Management Plans:

- Delaware River and tributaries in lower Bucks County

Public 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. 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.

Citizen/Conservation groups

- Paunacussing Watershed Association is a 130-member organization established to work with township, county, state, and regional agencies to assure continued protection of the ecological assets of in the Paunacussing Valley.
- Delaware Riverkeeper Network
- Heritage Conservancy
- Friends of the Delaware Canal
- Honey Hollow Watershed Association

Funding Needs

The total dollars needed for addressing all nonpoint source problems in the watershed is undetermined. Stream assessments have been conducted and TMDLs will be developed for impaired waters in the subbasin. Development of watershed restoration plans for impaired waters will help determine what Best Management Practices (BMPs) are necessary to help reduce pollution sources and should give rough estimates of restoration needs.

Funding sources available to support the development of site-specific implementation plans and remediation projects that address the sources of water quality impairment include the EPA Clean Water Act Section 319 grant program and the Pennsylvania Growing Greener program which target reductions in nonpoint source pollution. Pennsylvania has generally placed more emphasis on funding projects slated for implementation on water bodies where TMDLs have been completed or where water quality impairments have been documented.

Restoration Needs

Otter Creek Watershed:

Otter Creek is a small tributary of the Delaware River in the lower Bucks County townships of Bristol, Falls, and Middletown, Bristol Borough, and small portions of 5 other townships and boroughs. Otter Creek is not the official name of a creek in the Pennsylvania Gazetteer of Streams. Otter Creek is the name given to the lower portion of Mill Creek, and therefore includes Mill Creek, Queen Anne Creek and Black Ditch Creek. A total of 140 residences and 53 nonresidential facilities are located in the 100-year floodplain of the Otter Creek watershed. The June 1996 flood caused about \$6.8 million in damages to residential structures and personal property and \$4 million in damages to nonresidential (commercial and public) facilities in the watershed.

The Otter Creek Watershed Stormwater Management and Flood Control Study of May 1999 indicated a potential for a variety of measures to improve environmental quality. Included were 11 areas potentially suitable for constructing herbaceous wetlands. Other recommendations to reduce flood damage included infrastructure demolition and modification for many structures and bridges within the floodplain. The total estimated construction costs of the recommendation in the study are close to \$12 million. Creating the wetlands is projected to cost \$2.8 million.

The Bucks County Planning Commission plan to pursue a natural means of managing stormwater and reducing erosion in the lower subbasin. Planned measures include restoration of riparian buffers, streambank erosion controls, and constructing wetlands. A partnership with local municipalities, state and federal agencies and environmental groups has been formed to pursue funding to complete the plans.

References/Sources of information

- State Water Plan, Subbasin 2, Central Delaware River. Department of Environmental Protection, July 1983
- USGS Topographic Maps
- 319 project proposals and summaries
- DEP: Watershed Notebooks, Unified Assessment Document, and information from DEP databases and Website.
- 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
- The Nature Conservancy, Pennsylvania Chapter Newsletter
- Bucks County Nonresidential Land Use Study, Bucks County Planning Commission, 1998.
- Information from project proposals submitted to the Growing Greener and 319 grants programs.

- Otter Creek Watershed Stormwater Management and Flood Control Study. 1999. Bucks County Planning Commission, Bucks County, PA. Prepared by Pickering, Corts, & Summerson, Inc. Newtown, PA.
- Environmental Futures Planning, Assessment of Indicators for SWP 02E and 02F. Department of Environmental Protection, Southeast Regional Office. 2001.

Streams in Subbasin 02E: 303d/305b Listings

Stream	Stream Code	Drainage basin (square miles)	Miles Attaining at least one designated use	Miles Impaired	Causes/Sources/ Comments
1-Delaware River	00002		19.44 main stem	4.6 miles of 3 UNTs <u>19.99</u>	Habitat alterations, water/ flow variability & unknown causes from Urban runoff/ storm sewers & Habitat modifications <u>Fish consumption advisory: PCB's, Mercury, Chlordane</u>
2-Delaware Canal	63770				<i>Unassessed</i>
2-Hickory Creek	03109	1.50	All		
2-Paunacussing Creek	03093	7.78	All		<i>HQ-CWF</i>
2- "Cuttalossa" Creek"	03090		All		<i>HQ-CWF</i>
2-Aquetong Creek	03039	8.01	All		<i>HQ-CWF</i>
2-Pidcock Creek	03002	12.7	All		
2-Jericho Creek	02975	9.63	4.82 main stem & all of 23 UNTs	1.4 main stem & 3.2 miles of 3 UNTs	Siltation from AG
2-Houghs Creek	02958	5.19	All	3.0	Unknown causes from Agriculture
2-Dyers Creek	02952	1.20	All		
2-Buck Creek	02944	6.99	All except 0.9 miles	0.9 main stem & one UNT	Urban runoff/ storm sewers; Channelization/ flow alterations
3-Brock Creek	02946	4.29		3.4 main stem	Urban runoff/ storm sewers
2-Martins Creek	02920	6.99		5.5 main stem & 2.7 miles of 3 UNTs	Siltation from Urban runoff/ storm sewers & Channelization/ flow alterations
3-Rock Run	02922	4.87		3.6 main stem & 2 miles of one UNT	Siltation from Urban runoff/ storm sewers & Channelization/ flow alterations
2-Mill Creek/ Otter Creek	02916	19.8		11.6 main stem & 6.5 miles of 6 UNTs	Habitat alterations, water/ flow variability & unknown causes from Urban runoff/ storm sewers & Habitat modifications
3-Queen Anne Creek	63801	6.64		2.9 main stem & 4.1 miles of 3 UNTs	Habitat alterations, water/ flow variability & unknown causes from Urban runoff/ storm sewers & Habitat modifications

Levittown Lake is on the Lake 303d list due to a fish tissue consumption advisory for chlordane.

Streams are listed in order from upstream to downstream. A stream with the number 2 is a tributary to a number 3 stream, 4's are tributaries to 3's, etc. Stream names in parentheses are local or unofficial names for unnamed tributaries.

Chapter 93 information: HQ= High Quality; CWF= coldwater fishes