

Cocalico Creek Watershed Restoration Plan

Lancaster County, Pennsylvania

Prepared for: Cocalico Creek Watershed Association

Funded By:
PA DEP Growing Greener
National Fish and Wildlife Foundation

December 2008

Prepared by:

LandStudies

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Section 1

Identification of Critical Restoration Areas for Aquifer Recharge

Groundwater Recharge

The recharge of drinking water aquifers is an important hydrologic function that assures our drinking water supply and provides consistent baseflow to our streams. This recharge occurs from storm events in which precipitation infiltrates the soil and then flows through pores and fractures to reach the underground water table - thereby recharging the aquifer. The infiltration of direct precipitation through vegetated soils reduces nutrients and improves water quality prior to aquifer recharge. The proper functioning and protection of areas of recharge is therefore an important water resources feature of watersheds for both environmental and human need purposes.

Within the Cocalico Creek watershed groundwater is the primary source of water for municipal, domestic, industrial, and agricultural uses. As water usage increases and land use changes due to a growing population, it is important to protect areas that efficiently transport surface water through the soil and underlying rock to the water table. These important groundwater recharge locations are called Critical Aquifer Recharge Areas (CARA).

The Susquehanna River Basin Commission's (SRBC) "Northern Lancaster County Groundwater Study: An Evaluation of the Manheim-Lititz and Ephrata Area Groundwater Basins" is the best source to identify key stream reaches and critical areas for aquifer recharge (Figure 1.1). Restoration opportunities may exist at these CARAs which would enhance infiltration and recharge processes.

Geology and Identification of Critical Aquifer Recharge Areas in the Cocalico Creek Watershed

The Cocalico Creek watershed consists of two distinct geologic areas. The northern region consists of hills and highlands with shale and sandstone geologic features. Shale and sandstone are harder, more erosion resistant rocks and therefore do not play an important role in groundwater recharge. This area is not included in the SRBC groundwater study. The Ephrata groundwater basin is 48.4 square miles and is located within the southern region of the Cocalico Creek Watershed. The Ephrata basin is considered a "carbonate valley" due to the carbonate aquifer located beneath this region (Figure 1.2). The bedrock beneath the valley is limestone. Limestone is a carbonate rock, easily worn and eroded by acidic water, creating openings and conduits along fractures in the bedrock. These geologic features are efficient at transporting water to the water table. Table 1.1 describes the geologic formations shown on Figure 1.2.

The SRBC indentified four types of CARA's within the study area. They are Dry Valley's, Losing Stream Reaches, Siliciclastic to Carbonate Stream Crossings, and Karst Modified Uplands.

- Dry Valleys exist where the high permeability of karst geology has lowered the water table eliminating stream recharge and therefore stream flow within the region. These areas

supplement groundwater recharge through the pooling and infiltration of water of large drainage areas. The water table depth also creates head conditions promoting recharge.

- Losing stream reaches occur where stream flow crosses a conduit caused by karst geology and loses water to the water table. In the Cocalico watershed flow loses range from a few tenths of a cubic foot per second (small streams) to several cubic feet per second (larger streams). A profile view of Indian Run, a losing stream reach, shows the unsaturated zone where the stream is perched. This unsaturated zone is typical of streams impacted by legacy sediment deposits. See Figure 1.3 for an illustration.

- Siliciclastic Crossings refers to areas where Siliciclastic (noncarbonate) geology interfaces with limestone or carbonate geology. Silicilastic bedrock produces acidic water. When the acidic water crosses into the more carbonate geological areas the karst permeability is increased due to the wear of the acidic water on the soluble rock. This process occurs throughout the groundwater basin where the two geological formations meet, however the recharge process is most efficient beneath perennial stream flow.

- Karst modified uplands refers to upland areas between stream valleys with small depressions. These depressions increase permeability in underlying carbonate geology as well as store surface runoff which recharges the groundwater table. Many of these regions can be considered "dormant sinkholes". The SRBC Groundwater Study identified 4511 Surface depressions and 12 sinkholes within the Ephrata Groundwater Basin.

The CARA's located within the study area are mapped on Figure 1.4. Table 1.2 lists the type of CARA, where it is located, and the length of the stream or acreage of drainage area.

CARA Protection Needs

The Northern Lancaster County SRBC Groundwater Study found that the Manheim/Lititz /Ephrata Valley is one of the nine most stressed and water challenged areas in the state. The Ephrata Valley is less stressed than the Manheim/Lititz basin. It is important for the Ephrata region to consider efforts to protect the available recharge areas.

According to the SRBC study, the majority of groundwater withdrawals are located in the southern half of the Ephrata groundwater basin where streamflow is augmented by Ephrata area wastewater treatment plant discharge; however increased growth and groundwater withdrawals, especially in the northern watershed, could negatively impact stream flow and cause withdrawal restrictions.

The SRBC identified four major concerns that must be addressed to protect ground water resources and recharge within CARAs. They are the reduction in infiltration and groundwater

recharge, excess withdrawal of groundwater in potentially stressed areas, increases in water usage, and coordination of municipal ordinances.

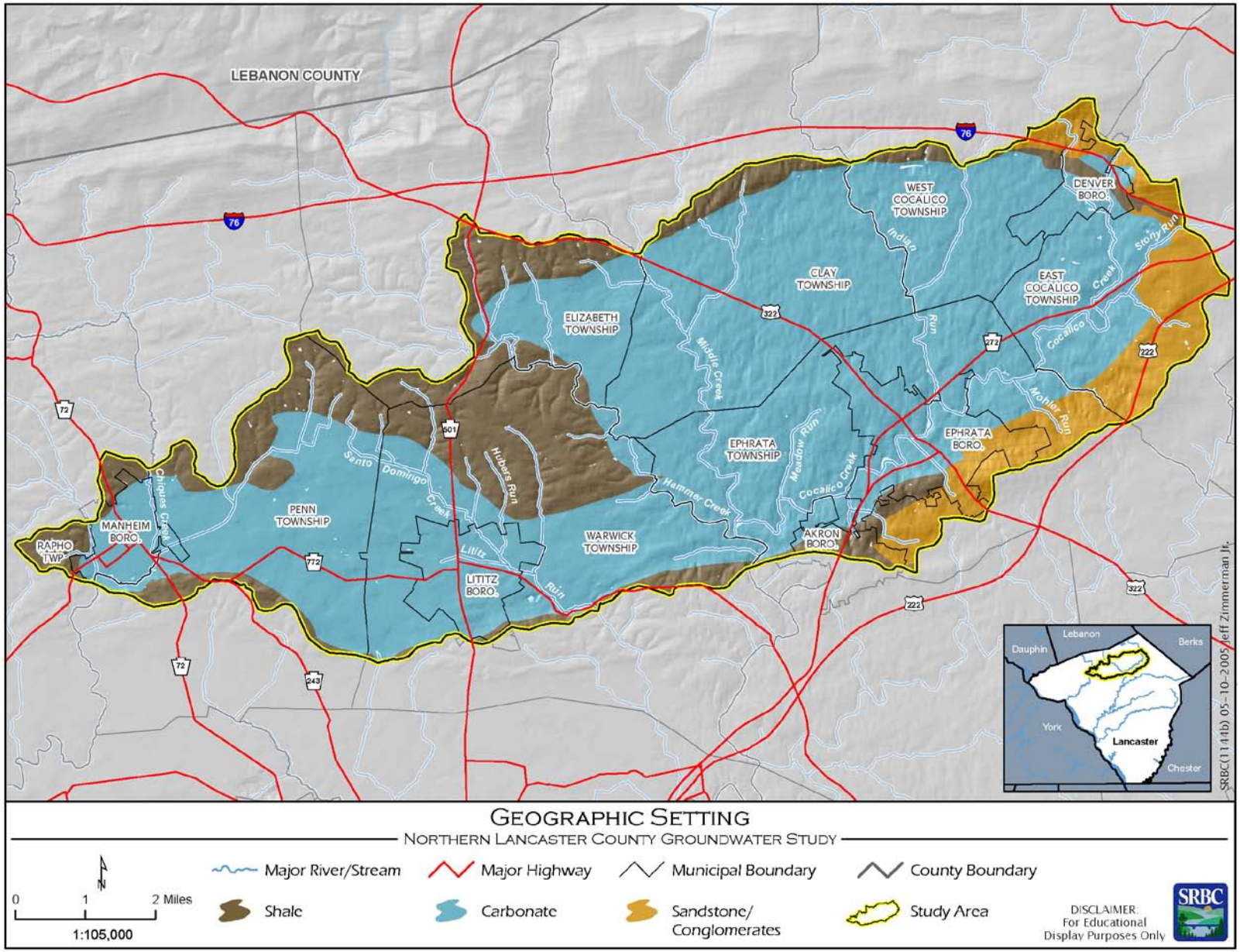
Currently the Ephrata groundwater basin is 8 % impervious. Land use and the resulting cover are important considerations for groundwater recharge. Within CARAs, municipalities should minimize impervious cover, prevent soil compaction and concentrate stormwater to areas where the water can be safely infiltrated using stormwater best management practices and ideally regional stormwater facilities. By protecting CARAs, groundwater recharge is maximized providing the potential for continued future groundwater withdrawals and sustainable growth in the remainder of the watershed.

Legacy sediment, discussed in section 2, also reduces infiltration and groundwater recharge in losing streams and stream crossings. The mill dams and deforestation that occurred historically caused sediment to settle in stream valleys resulting in streams perched on fine sediments. These sediments disconnect the stream from its groundwater system reducing infiltration. Stream reaches considered CARAs that are impacted by legacy sediments can be restored through stream and floodplain restoration and also have the added benefit of providing stormwater management per the PA Stormwater BMP Handbook, 6.5.1 Floodplain Restoration.

See the Municipal Toolbox in Section 8 of this report for a description of recommendations that can be used to address CARAs and other water resource quantitative and qualitative concerns.

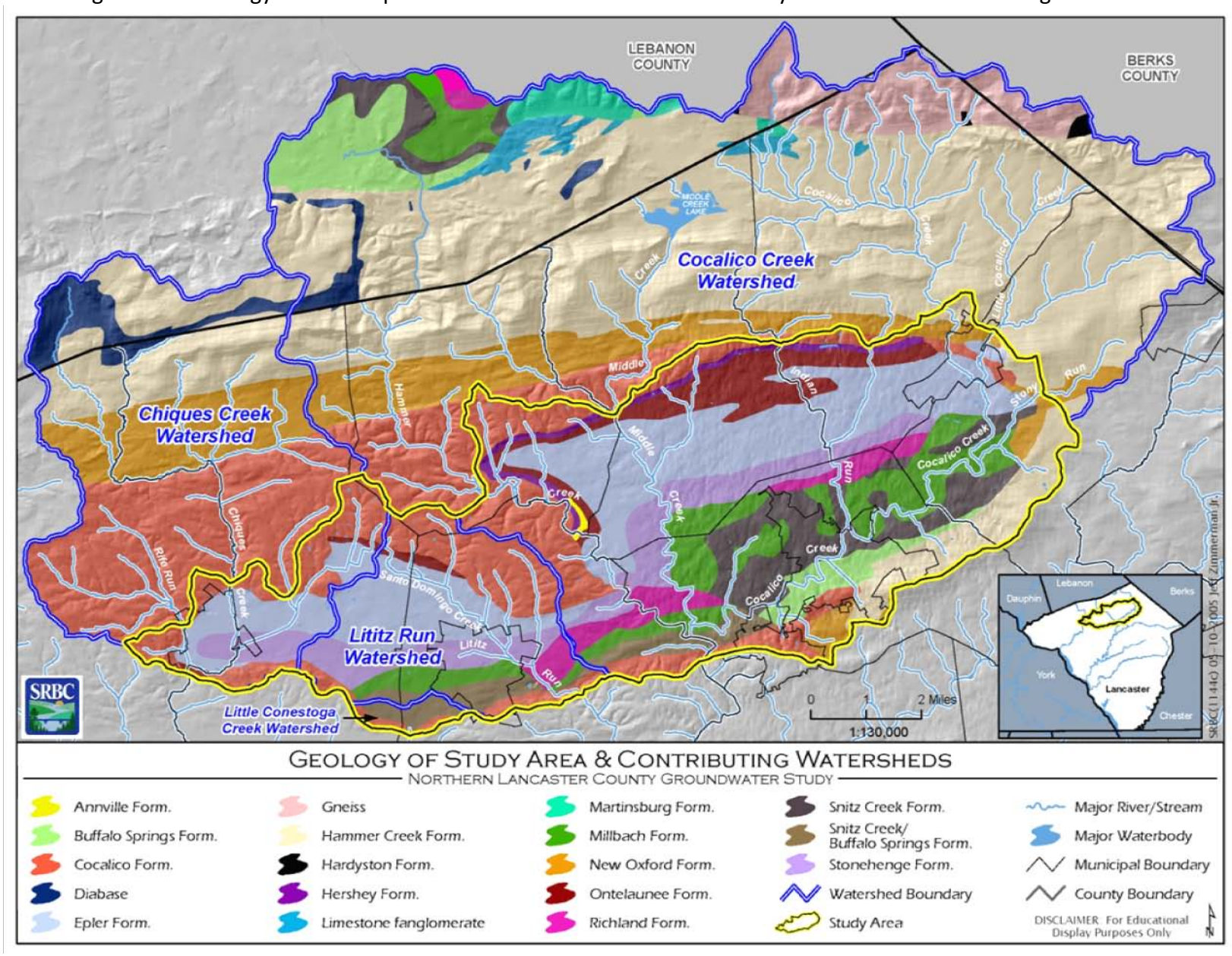
For more detailed information regarding groundwater recharge and availability in relation to the geology of the Cocalico Creek watershed please see the 2005 Susquehanna River Basin Commission's Northern Lancaster County Groundwater Study: A Resource Evaluation of the Manheim – Lititz and Ephrata Area Groundwater Basins.

Figure 1.1 - Geographic Setting of the Susquehanna River Basin Groundwater Study Area



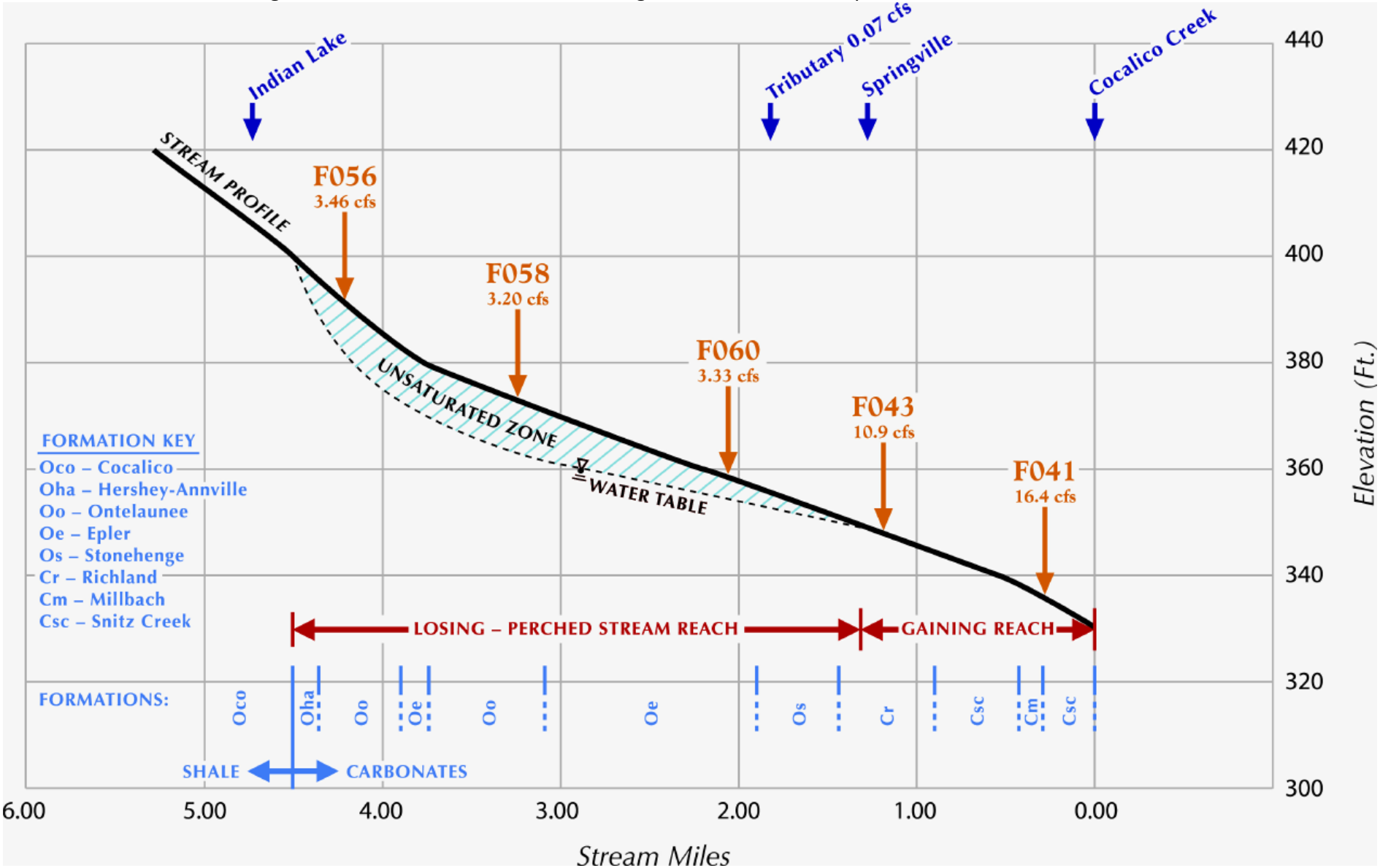
Map Created by the Susquehanna River Basin Commission

Figure 1.2 - Geology of the Susquehanna River Basin Groundwater Study Area and the Contributing Watershed



Map Created by the Susquehanna River Basin Commission

Figure 1.3 - Profile of Indian Run, a Losing Stream, from Shale Upland Area to Cocalico Creek



Created by the Susquehanna River Basin Commission

Figure 1.4

Critical Aquifer Recharge Areas in the Cocalico Creek Watershed

Subwatershed Boundaries

Streams and Lakes

Dry Stream Valleys

Karst Modified Uplands

Stream Crossings

Losing Stream Reaches

* Approximate Locations

LandStudies

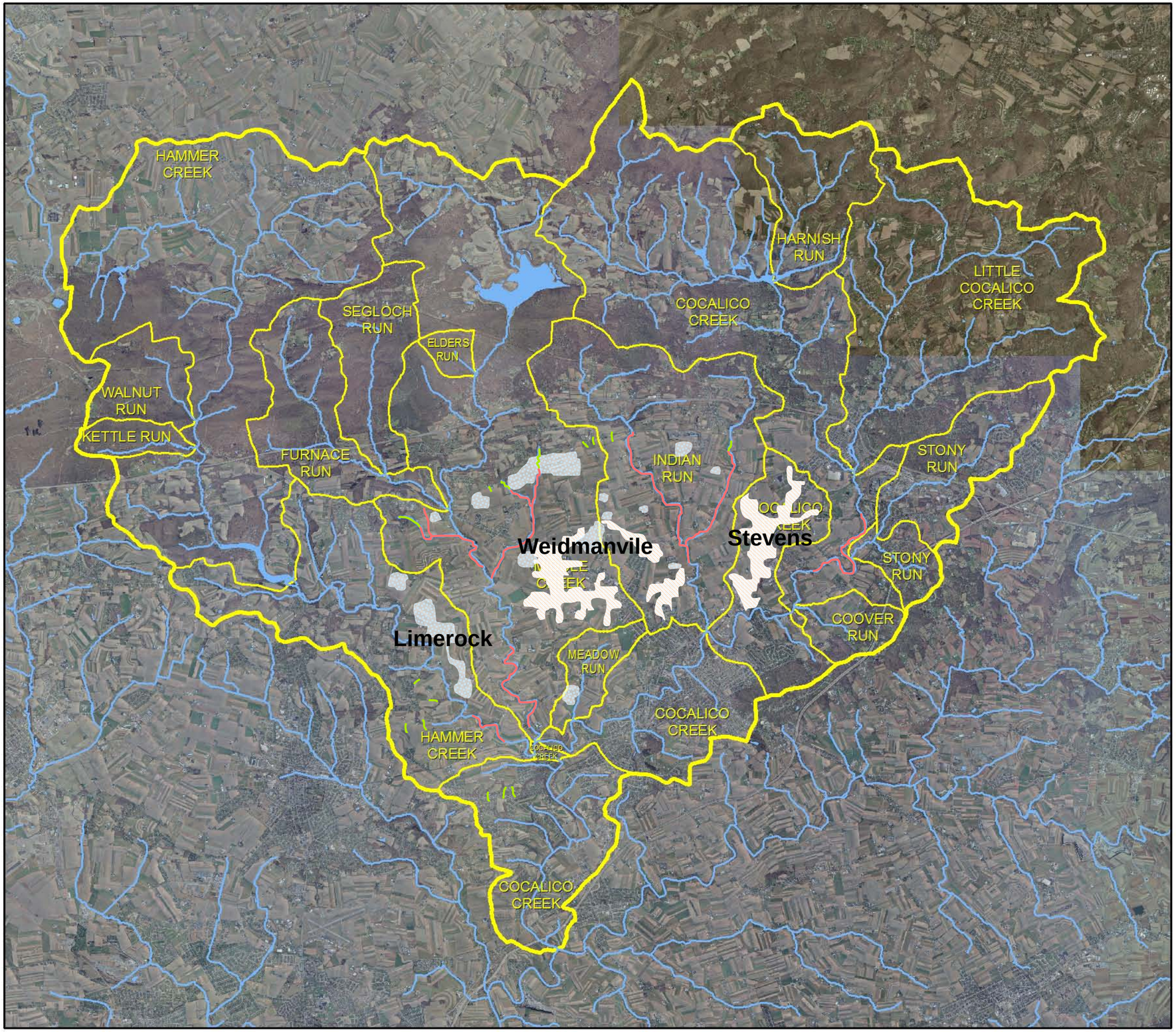


Table 1.1 - Description of Geologic Formation in Figure 1.2

Formation	Map Symbol	Description
Hammer Creek; and Conglomerate	Trh; Trhc	Interbedded red shales, red, brown, gray sandstones, and fine to coarse quartz conglomerates.
New Oxford; and Conglomerate	Tnh; Tnhc	Interbedded red shale, siltstone, fine-grained and arkosic sandstones, some with carbonate cement and conglomerate.
Cocalico	Oco	Bluish-black to dark gray fissile shale; purple and green shale with thin quartzite bed near base.
Hershey	Oh	Dark gray, thin bedded, argillaceous limestone; shaly near top of bed.
Myerstown	Omy	Medium gray, thin bed limestone grading to black at base.
Annville	Oa	Light gray, massive bed limestone.
Ontelaunee	Oo	Medium to dark gray, thick-bedded crystalline dolomite with minor limestone.
Epler	Oe	Medium-light gray, thick-bedded limestone and dolomite.
Stonehenge	Os	Medium-gray, crystalline, cherty limestone and gray shaly calcarenite.
Richland	Cr	Gray, thick-bedded, finely crystalline dolomite.
Millbach	Cs	Pinkish-gray and medium gray, laminated limestone with thin sandstones.
Snitz Creek	Csc	Light to medium gray, thick-bedded, oolitic dolomite with medium gray interbeds.
Buffalo Springs	Cbs	Light gray to pinkish-gray crystalline limestone with alternating light gray crystalline dolomite.

Created by the Susquehanna River Basin Commission

Table 1.2 - Description of CARAs within the Cocalico Creek Watershed

CARA Name/Location	Type of CARA	Amount
Limerock	Dry Valley	3 sq mi drainage area
Weidmanville	Dry Valley	2.5 sq mi drainage area
Stevens	Dry Valley	2.5 sq mi drainage area
Cocalico Creek	Losing Stream	4.08 miles
	Stream Crossing	3
Hammer Creek	Losing Stream	1.65 miles
	Stream Crossing	4
Indian Run	Losing Stream	2.72 miles
UNT to Indian Run	Losing Stream	2.25 miles
Middle Creek	Losing Stream	6.72 miles
	Stream Crossing	4
UNT to Middle Creek	Losing Stream	2.56 miles

Section 2

Identification of Legacy Sediment Stream Segments and Degraded Habitat Areas

Impact of Legacy Sediment

Modern development activities and agricultural practices are often blamed for polluted waterways and unstable streams. However a greater portion of the problem, especially in the Chesapeake Bay region, goes back to the agricultural period of the 18th through the early 20th centuries. During this time erosion from large scale forest clearing and poor farming practices deposited millions of tons of soil into our local streams, valleys, and floodplains.

Concurrently, hundreds of mills and dams were built along Pennsylvania waterways. These dams reduced water velocity in the impounded stream, causing the deposition of tons of sediments behind these dams. These sediments, deposited throughout our stream and river valleys within the past two centuries, are called "Legacy Sediments."

Legacy sediments alter the geomorphology – the processes by which landforms are formed and the materials of which they consist – and the hydrology – the cyclic movement of water over and under landforms – of the valley bottom, producing an array of problems for the streams themselves and for the communities through which they flow. Such problems include increased sediment and unwanted nutrients in the water, bank erosion, debris jams, habitat instability and loss, and flash floods, all of which are common in the small streams of watersheds such as the Susquehanna, Schuylkill, Delaware, and other basins in the Piedmont Province. Many of these problems first surfaced after the onset of urbanization.

Urbanization began in the 1950s, reaching a peak in the 1970s and 1980s, before stormwater management policies were implemented. Stormwater runoff increased dramatically with urbanization, according to models developed by the Lancaster County Office of Engineering and others. Before urbanization, stream channels had been building up – rising in elevation, or "aggrading" – on top of deposited sediments for several centuries. With large-scale sedimentation and erosion halted due to farming conservation practice, these channels began cutting down through the accumulated sediments, due to the flow forces of increased runoff and the removal or crumbling of old dams. Stream channels today are still cutting rapidly through thick stacks of legacy sediments, exposing peats, sands, and gravels of the submerged, pre-settlement valley floors (Figure 2.1).

When the channel eventually cuts down to its historical, pre-settlement floor, the gravels at that elevation erode easily, allowing the stream to begin undercutting the banks of the slightly more cohesive, finer grained legacy sediments. In Lancaster County, Pa., bank collapse and erosion now occur along at least 80 percent of the 644 miles (1036 km) of stream channels in the Conestoga watershed. We estimate that 10 percent of the sediment stored along valley floors since 1710 has been removed by channel incision and widening that closely resembles arroyo cutting in the arid southwest (lateral bank erosion rates of >0.5 m/yr measured at multiple sites). The large volume of sediment trapped in the valley bottoms for several

centuries has become a major source of suspended sediment load in local streams and in their downstream receiving water bodies during the past 35 years, and will remain so unless substantial remediation efforts are made. This same phenomenon of channel incision, channel bank erosion, and bank collapse is occurring throughout the Piedmont region of Pennsylvania and Maryland, and beyond.

The deleterious impacts of legacy sediments on stream systems and their receiving waters are numerous and seriously affect groundwater recharge, flooding, water quality, aquatic environments, and native vegetation. Prehistoric floodplain areas that are naturally intended to store water are now filled with legacy sediments. Streambeds that are perched above their historical gravel levels interrupt the natural interplay between stream flow and groundwater recharge. Clays and sediments built up between the gravels and current, historically formed bank tops (often misnamed "floodplains") prevent flows in the channel or on the surfaces of the legacy sediments from entering into the aquifer. Flow is directed, instead, into the channel and its downstream receiving waters. See Table 2.1 below for a summary of the negative impacts caused by historic mill dams and legacy sediment.

Figure 2.1 – Channel Affected by Legacy Sediment (top) and a Restored Stream Channel (bottom).

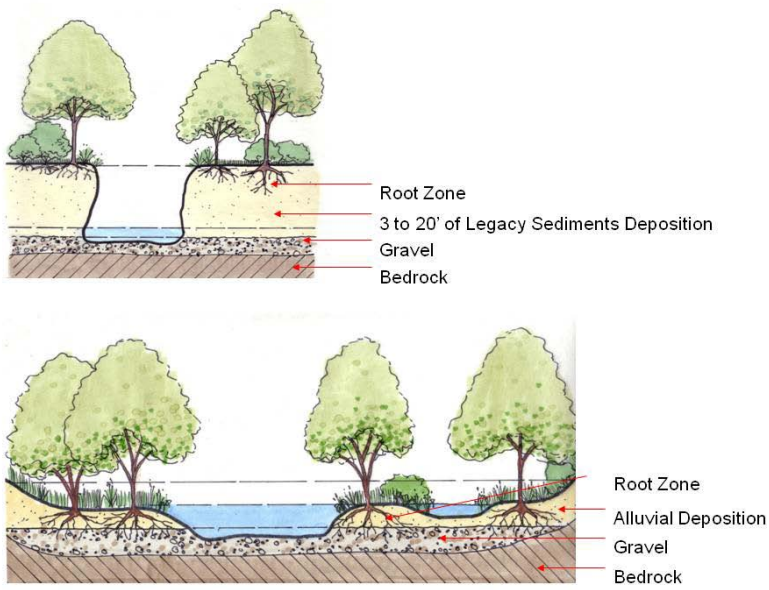


Table 2.1 - Negative Effects of Historical Mill Dams and Legacy Sediment on a Watershed.

Water Quality:	**Riparian Impacts:**
Increased sediment loading	Less denitrification
Increased nitrogen loading	Reduced plant nutrient uptake
Increased phosphorus loading	Reduced flood water retention
Hydrologic Impacts:	**Biological Impacts:**
Less floodplain inundation	Poor stream habitat quality
Greater downstream flooding	Reduced wetlands
Reduced aquifer recharge	Reduced wildlife - no connectivity
Channel migration	

Historic Mill Dams and Legacy Sediments in the Cocalico Creek Watershed

Mill dams within the Cocalico Creek watershed were located using research by Franklin and Marshall faculty on mill dams within Lancaster County. Mill dams within Lebanon County were located by LandStudies using historical maps. A total of 56 mill dams existed in the watershed. The results are shown in Figure 2.2. Table 2.2 breaks down the number of mill dams within each subwatershed.

Table 2.2 - Number of Historic Mill Dams within each Subwatershed

Subwatershed	Number of Historic Mill Dams
Cocalico Creek (Downstream)	0
Cocalico Creek (downstream, middle)	2
Cocalico Creek (upstream, middle)	2
Cocalico Creek (upstream)	7
Coover Run	0
Elders Run	0
Furnace Run	1
Hammer Creek (downstream)	8
Hammer Creek (upstream)	10
Harnish Run	3
Indian Run	3
Kettle Run	0
Little Cocalico Creek	9
Meadow Run	1
Middle Creek	10
Segloch Run	0
Stony Run (downstream)	0
Stony Run (upstream)	0
Walnut Run	0
Total Mill Dams	56

The highest concentrations of mill dams are located on Cocalico Creek, Hammer Creek, and Middle Creek. Many of the mill dam locations on the mid-stream subwatersheds of the Cocalico correspond to the impaired stream segments shown in Figure 3.1 in section 3 of this report. Many of these stream segments are designated as impaired or problem areas due to siltation and flooding. Streambank erosion due to legacy sediment is a one likely cause of the siltation while reduced floodplain efficiency and infiltration may contribute to flooding problems.

Benefits of Floodplain Restoration

The restoration of floodplains by removing legacy sediment and reestablishing a stable stream system has numerous benefits that go far beyond nutrient reductions. The nutrient reduction benefits are described in this report. These and other benefits that could also be realized through this project are described briefly below.

- Sediment and Nutrient Reduction: Legacy sediments generally contain moderate to high concentrations of nitrogen and phosphorus. Because of the unstable conditions described above, the sediment, and nutrients associated with that sediment, erode readily and contribute a significant pollutant load to the stream system and ultimately, in the case of this project, to the Chesapeake Bay. Removing the legacy sediment and establishing a stable stream channel effectively eliminates this pollutant source. The wetland pockets associated with the floodplain restoration also trap incoming sediments, and native vegetation filters incoming nutrients, adding to the long term benefit of sediment and nutrient reduction.
- Groundwater Recharge: The restored stream channel is designed to flood more frequently, allowing smaller storm flows to access a larger floodplain surface area on a regular basis. In addition, the restored floodplain surface has higher infiltration rates due to the removal of the clay in the legacy sediment and the establishment of deeply rooted native vegetation. This combination creates a favorable condition for significantly increased groundwater recharge.
- Stormwater Peak Flow Management and Regional Flood Control: The removal of legacy sediment can provide a tremendous increase in flood storage volume. The results of this additional volume can include the reduction of peak flood elevations and of peak flow rates.
- Wetland Creation: Wetland pockets created along the length of a restoration reach have multiple benefits, including improved water quality, flood control, groundwater recharge, and wildlife habitat. Water from high flows settles in the wetlands, where waterborne sediments can drop out, nutrients can be used by the wetland plants, and nuisance flooding can be abated. Water in the wetlands gradually filters through the ground, recharging

groundwater systems. Well vegetated wetlands are prime habitat for a wide variety of aquatic and terrestrial wildlife.

- Riparian Buffers: Native plants, both herbaceous and woody, provide many benefits to the stream itself and to the water that moves into the floodplain. Trees and shrubs help shade the stream, keeping it cooler and healthier for aquatic wildlife. Leaf litter from these woody plants also provides a source of food for macroinvertebrate life in the stream.
- Wildlife Habitat Improvement: A cleaner stream, wetland pockets, and a variety of native plants create and improve habitat for both in stream and terrestrial wildlife, starting with the macroinvertebrate life in the stream and continuing up the food web to birds and mammals. The newly naturalized site will provide food, cover, and nesting sites for a variety of species.
- Invasive Species Removal: Creating a more natural floodplain and establishing a native plant community results in the elimination of invasive species and helps discourage the return of those species.
- Aesthetic Enhancement: The naturalized landscape produces lush green vegetation, bright flowers, and seeds and nuts that look good and attract a variety of butterflies, birds, and other wildlife species.

The location of historic mill dams was utilized as an important information source to assist in interpreting field observations. The presence of legacy sediment is often correlated with an historic mill dam, and sometimes the remnant foundations of these mill dams are observed in the field. Accumulations of legacy sediments typically result in significant streambank erosion, leading to degraded habitat conditions and large downstream loadings of sediment and nutrients to downstream waters and the Chesapeake Bay.

Figure 2.2.

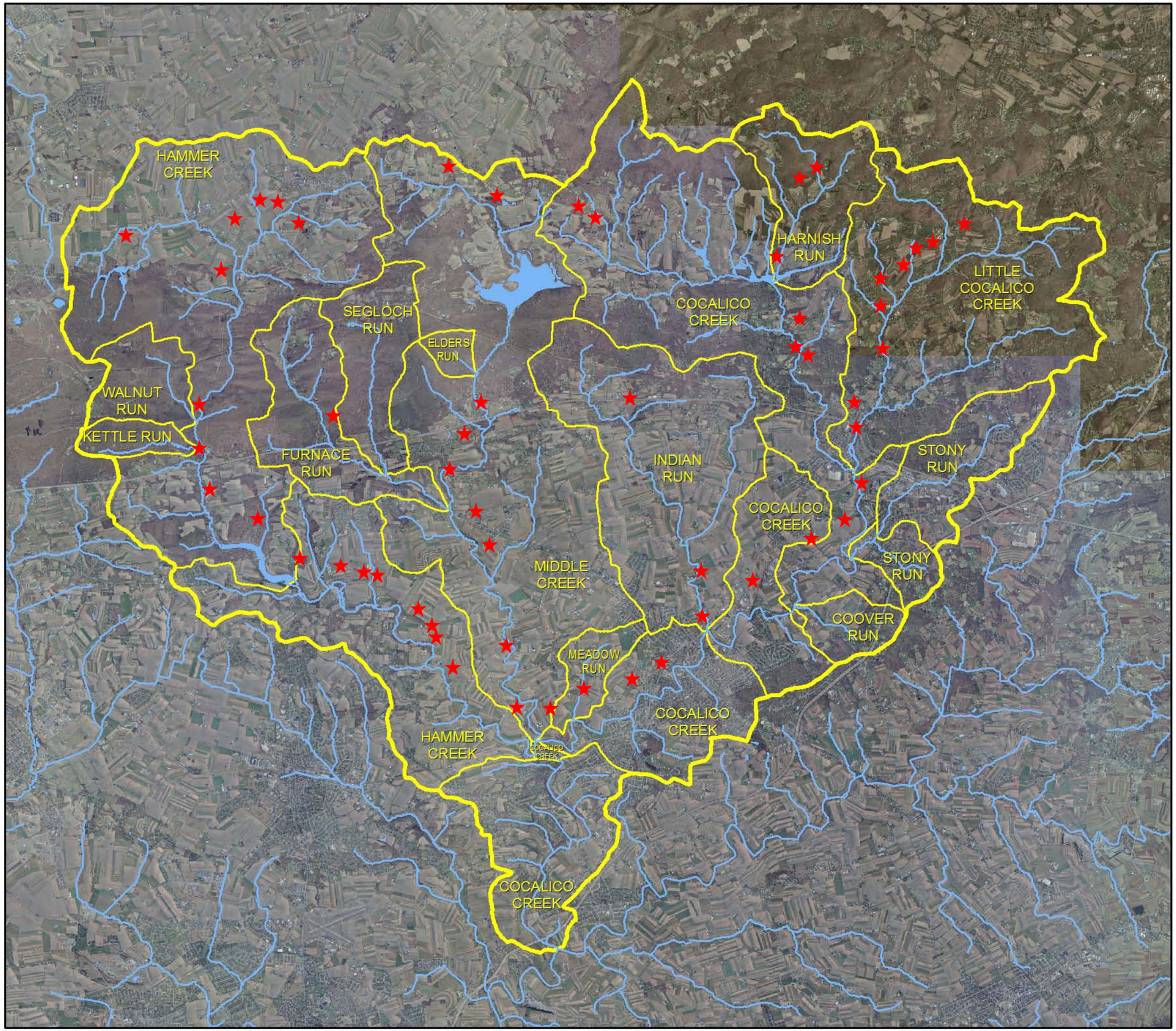
Milldams in the Cocalico Creek Watershed

Subwatershed Boundaries

Streams and Lakes

Mill Dam Locations

LandStudies



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Section 3

Surface and Groundwater Quality Assessment

Impaired Streams

DEP determines, through sampling and analysis, which streams in the state are impaired because they do not meet their designated or existing water use. Uses include aquatic life, fish consumption, recreation, and potable water supply. Numerical and narrative criteria are used to determine whether a stream achieves its designated use and existing use. If a stream is not meeting its designated use and all "required pollution control technologies" have been implemented, it is designated as impaired and added to the 303(d) list of impaired streams. Pollution control technologies include required upgrades to sewage treatment plants. Once placed on the 303(d) list, a total maximum daily load (TMDL) may be required for the stream segment. A TMDL is the allowable amount of a pollutant that can be released into a water body while still meeting water quality standards. TMDL's include pollution from point and non-point sources and a margin for safety.

Within the Cocalico Creek watershed 17 stream segments comprising 40 miles of stream are considered impaired. The majority of the impaired streams are located in the southeastern region of the watershed. DEP listed 35 miles of these streams as impaired due to siltation and nutrients caused by agricultural activities. Urban and residential runoff contributed to 28 miles of impaired stream. Streams can have multiple contributing factors for impairment. Most stream segments were placed on the 303(d) list in 2002 with TMDL effective dates of 2015. Two segments of the Cocalico were placed on the list in 2008 and have TMDL effective dates of 2021. See Figure 3.1 for the locations of impaired streams and Table 3.1 for a complete description of the corresponding stream reaches.

The identified segments of impaired streams in the watershed are a key information source that was utilized to focus field reconnaissance efforts for identifying priority restoration sites.

Groundwater and Surface Water Nitrates

Nitrates, although naturally occurring, can become a pollutant when high concentrations reach surface and ground water. Water polluting nitrates can come from point sources such as sewage treatment facilities and non-point sources such as cropland and residential lawns. The EPA established the safe drinking water level for nitrates at 10mg/l or less. Excess nitrates in groundwater can be detrimental to human health. Infants who intake high nitrate water can develop blue baby syndrome where nitrates affect the cells ability to carry oxygen.

According to the Susquehanna River Basin Commission's Northern Lancaster County Groundwater Study, 47 percent of the 64 groundwater samples tested had nitrate levels exceeding 10mg/L. Stream samples tested for nitrate ranged from 0.7 to 18.25 mg/l with 23 percent exceeding 10mg/l. High nitrates in groundwater were found throughout the study area. The highest concentrations of nitrates in surface water (over 10mg/l) were located on a

tributary to Middle Creek flowing south from Durlach and Indian Run downstream of Springville. The lowest concentrations were along the Cocalico Creek and its tributaries upstream of Ephrata. See Figure 3.2 for tested locations and concentrations of nitrates in groundwater and surface water.

High nitrates in the watershed can result from point source discharges such as sewage treatment plants and non-point source discharges from manure and fertilizer applications on crop fields, un-treated animal heavy use areas, and runoff from lawn and golf course fertilization.

Due to the karst nature of the southern Cocalico Creek watershed it is important to minimize nutrient runoff and leaching. Water can easily transport nitrogen though the underground conduits and affect ground water and drinking water quality. See Figure 3.3 for established wellhead protection areas within the Cocalico Creek watershed where particular efforts are undertaken to minimize nitrate concentrations that could directly affect public water supplies.

See Section 8, the municipal toolbox, for recommendations of how municipalities can better protect groundwater and drinking water resources. Many residences in the watershed rely on private wells for their drinking water, which may have nitrate levels exceeding the EPA safe drinking water standards. It is important the measures be taken to reduce nitrate levels in groundwater, including the implementation of best management practices for the management of manure on agricultural fields and the application of fertilizers on residential lawns.

Figure 3.1

303D Listed Stream Segments in the Cocalico Creek Watershed

Subwatershed Boundaries

Streams and Lakes

303D Listed Streams

1

Indicated segment

LandStudies

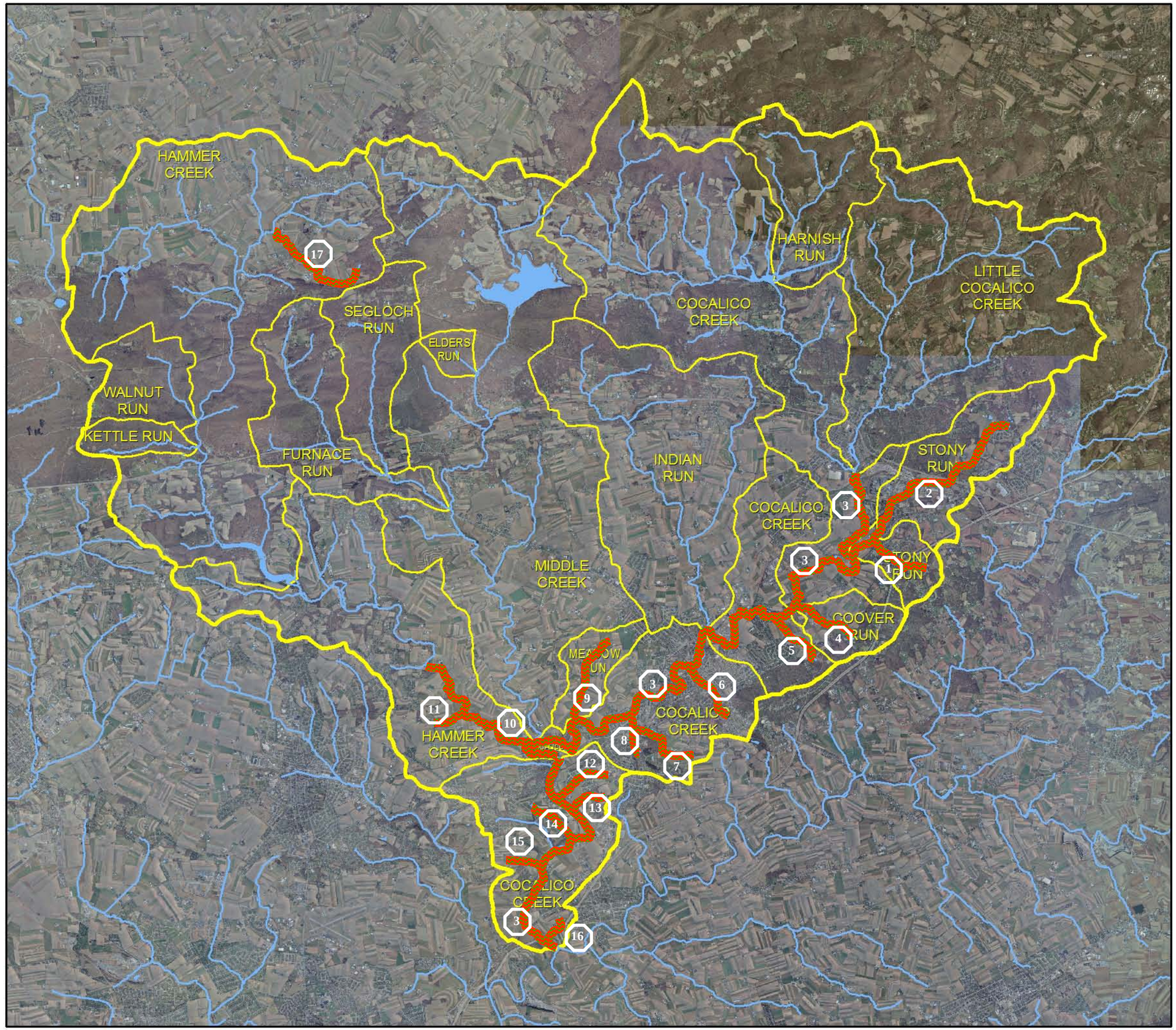

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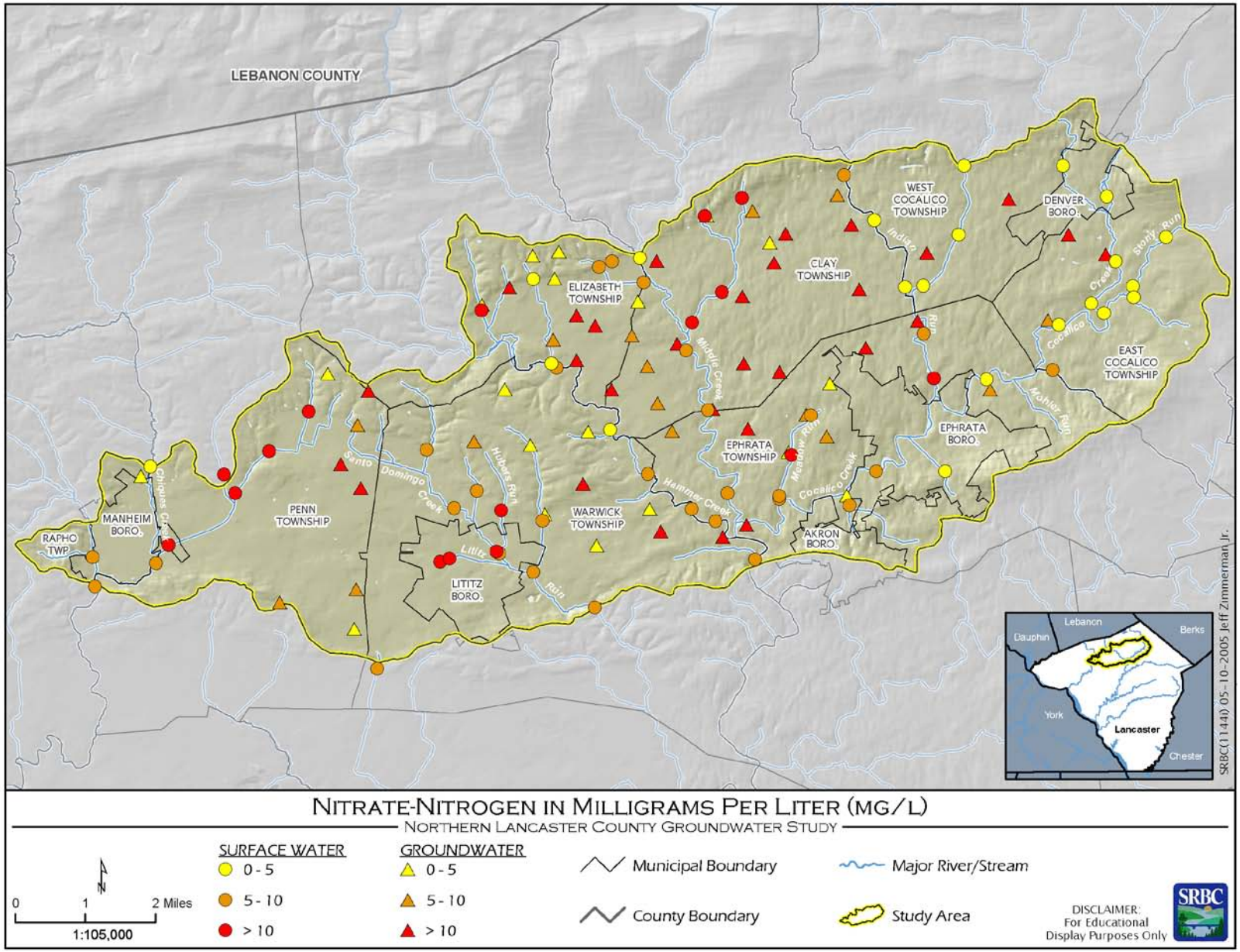
Figure 3.2 Surface and Ground Water Nitrate Testing Results from the SRBC Groundwater Study



Map Created by the Susquehanna River Basin Commission

Figure 3.3

Wellhead Protection Areas and Water Supply in the Cocalico Creek Watershed

Subwatershed Boundaries

Streams and Lakes

Wellhead Protection Areas

Akron Township Proposal Well head Protection Area

Public Water Supply Well

Springs used for Public Water Supply

LandStudies

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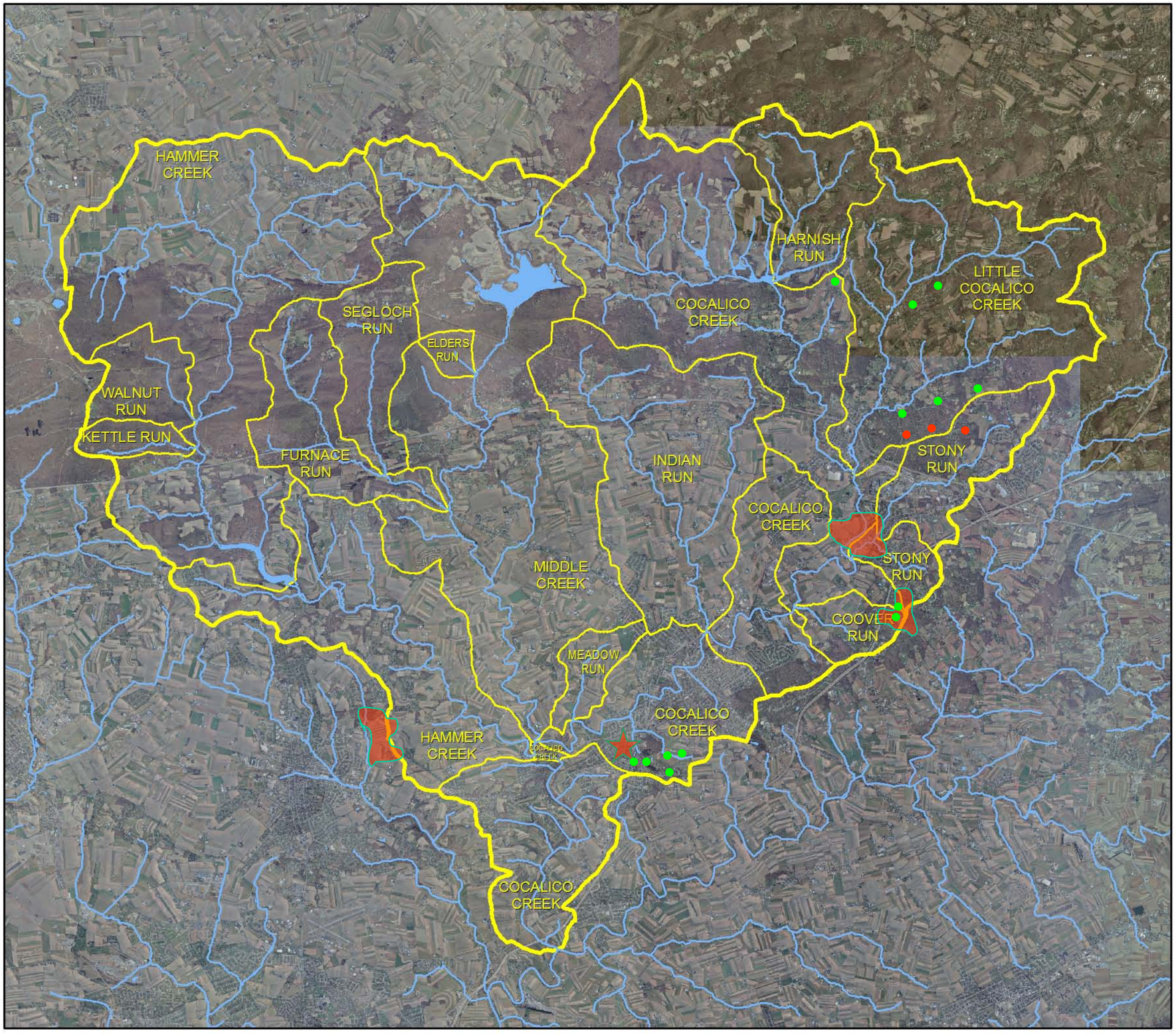


Table 3.1 Key to Numbered Impaired Stream Segments and Stream Segment Description

EXAMPLE:
1.Stream Name
Hydrologic Unit Code (HUC)
Impaired Designated Use
Reasons for Impairment
Date placed on 303d list, TMDL date

1. Stony Run
HUC: 02050306
Aquatic Life (8572) - 4.15 miles
Crop Related Agric Nutrients 2002, 2015
Grazing Related Agric Siltation 2002, 2015
Urban Runoff/Storm Sewers Cause Unknown 2002, 2015

2. Stony Run (Unt 07718)
HUC: 02050306
Aquatic Life (8572) - 1.16 miles
Crop Related Agric Nutrients 2002, 2015
Grazing Related Agric Siltation 2002, 2015
Urban Runoff/Storm Sewers Cause Unknown 2002, 2015

3. CocalicoCreek
HUC:02050306
Aquatic Life (8572) - 16.78 miles
Crop Related Agric Nutrients 2002, 2015
Grazing Related Agric Siltation 2002, 2015
Urban Runoff/Storm Sewers Cause Unknown 2002, 2015

4. Coover Run
HUC: 02050306
Aquatic Life (619) - 1.25 miles
Crop Related Agric Nutrients 2002, 2015
Grazing Related Agric Siltation 2002, 2015

5. Cocalico Creek (Unt 07715)
HUC: 02050306
Aquatic Life (623) - 1.09 miles
Agriculture Nutrients 2002, 2015
Siltation 2002, 2015

6. Cocalico Creek (Unt 64002)
HUC: 02050306
Aquatic Life (13425) - 1.1 miles
Urban Runoff/Storm Sewers Siltation 2008, 2021

7. Cocalico Creek (Unt 07709)
HUC: 02050306
Aquatic Life (626) - 1.5 miles
Road Runoff Siltation 2002, 2015
Urban Runoff/Storm Sewers Nutrients 2002, 2015
Siltation 2002, 2015

8. Cocalico Creek (Unt 07708)
HUC: 02050306
Aquatic Life (626) - 1.92 miles
Road Runoff Siltation 2002, 2015
Urban Runoff/Storm Sewers Nutrients 2002, 2015
Siltation 2002 2015

9. Meadow Run
HUC: 02050306
Aquatic Life (625) - 1.5 miles
Agriculture Nutrients 2002, 2015
Siltation 2002, 2015
Siltation 2002, 2015

10. Hammer Creek
HUC: 02050306
Aquatic Life (8624) - 3.29 miles
Crop Related Agric Nutrients 2002, 2015
Siltation 2002, 2015
Grazing Related Agric Nutrients 2002, 2015
Siltation 2002, 2015

11. Hammer Creek (Unt 07665)
HUC: 02050306
Aquatic Life (8624) - 0.54 miles
Crop Related Agric Nutrients 2002, 2015
Siltation 2002, 2015
Grazing Related Agric Nutrients 2002, 2015
Siltation 2002, 2015

12. Cocalico Creek (Unt 07662)
HUC: 02050306
Aquatic Life (603) - 1.03 miles
Agriculture Nutrients 2002, 2015
Small Residential Runoff 2002, 2015

13. Cocalico Creek (Unt 07661)
HUC: 02050306
Aquatic Life (601) - 0.68 miles
Agriculture Nutrients 2002, 2015

14. Cocalico Creek (Unt 07660)
HUC: 02050306
Aquatic Life (600) - 0.92 miles
Crop Related Agric Nutrients 2002, 2015

15. Cocalico Creek (Unt 07658)
HUC: 02050306
Aquatic Life (598) - 0.62 miles
Agriculture Nutrients 2002, 2015

16. Cocalico Creek (Unt 07657)
HUC: 02050306
Aquatic Life (13421) - 0.49 miles
Urban Runoff/Storm Sewers Siltation 2008, 2021

17. Hammer Creek (Unt 07680)
HUC: 02050306
Aquatic Life (8587) - 2.05 miles
Crop Related Agric Siltation 2002, 2015
Grazing Related Agric 2002, 2015

Section 4

Stormwater and Wastewater Management Analysis

Stormwater Management

Prior to 1978 stormwater management regulations did not exist and streamflows drastically increased due to development and the resulting impervious surface. There are areas in the Cocalico Creek Watershed where flooding occurs, sometimes closing roadways and threatening properties.

Floodplain restoration can assist in stormwater peak flow management and regional flood control. The removal of legacy sediment can provide a significant increase in flood storage volume. The results of this additional volume can reduce peak flood elevations and peak flow rates. Efforts were made in this study to identify stream segments where flooding is an issue. These areas were examined in the field and identified as priority restoration areas when appropriate.

Below is a suggested stormwater management strategy for the Cocalico Creek Watershed. Further information regarding the Cocalico Watershed Stormwater Management (Act 167) Plan can be found in the review of municipal and regional water plans, Section 5 of this report.

Regional Stormwater Management Strategy for Cocalico Creek Watershed

I. Develop Regional Stormwater Management Potential Utilizing Identified Restoration Projects

Goals: Identify how the proposed restoration projects could be used for regional SWM and ACT 167 requirements.

Tasks: Demonstrate watershed effects of floodplain restoration at the proposed restoration sites within the watershed.

- identify portions of the watershed, future development and problem areas, where land development and stormwater requirements can be offset, and to what extent
- coordinate findings with individual municipalities and the Lancaster County Engineer
- prepare conceptual hydrology and hydraulics (H&H) analysis for the proposed sites to quantify the benefits - storage volume, rate reduction, water quality, etc.
- include recommendations to Lancaster County for the Cocalico Watershed Act 167 plan and ordinances currently being updated
- consider ordinance amendments to allow more accurate selection of run-off curve numbers for floodplain restoration projects

II. Implementation

Goal: Design and cost estimates for construction of the regional SWM facilities for use in finding public or private sources for construction.

Tasks:

- background data collection and trenching
- engineering and design
- permit requirements
- cost estimates
- quantitative analysis of additional economic benefits related to credit generation (carbon, nutrient, water, etc.), topsoil generation, etc.

Wastewater Management

In January of 2005, the Pennsylvania Chesapeake Bay Tributary Strategy, developed by the PA DEP and approved by the U.S. Environmental Protection Agency (EPA), mandated reductions in nutrient discharges. This means sewage treatment plants and municipal authorities are facing costly upgrades to meet nutrient removal requirements. Nutrient credit trading is a potential solution that can give treatment facilities additional time to evaluate needed upgrades, or over the long term implement the most cost effective upgrades. The higher levels of nutrient removal can be cost prohibitive per pound of nutrient reduction. Instead of upgrading the facilities to achieve these very high levels of nutrient removal, treatment facilities can purchase nutrient credits to offset discharges that do not meet regulations. A nutrient credit is created when best management practices are implemented that reduce the nutrients polluting the watershed above and beyond what is required by law or baseline conditions.

Four wastewater treatment plans exist in the Cocalico Creek Watershed. See Figure 4.1 for a map of their locations. Nutrient trading is a viable option to help treatment plants reduce nutrient discharges and gain compliance within the Cocalico Creek watershed. Agricultural BMPs such as no-till and cover cropping can generate nutrient credits. Stream buffers and stream and floodplain restoration work, completed in 2005 through the present, can generate nutrient credits as well. Floodplain restoration removes legacy sediments and stabilizes stream banks that would otherwise erode and increase nutrient and sediment pollution within the Cocalico Creek Watershed and the Chesapeake Bay Watershed. The suggested restoration sites in Section 7 of this report could generate nutrient credits. More information regarding the criteria of the nutrient trading program can be found on the PA DEP website.

FIGURE 4.1

Wastewater Treatment Plants in the Cocalico Creek Watershed

Subwatershed Boundaries

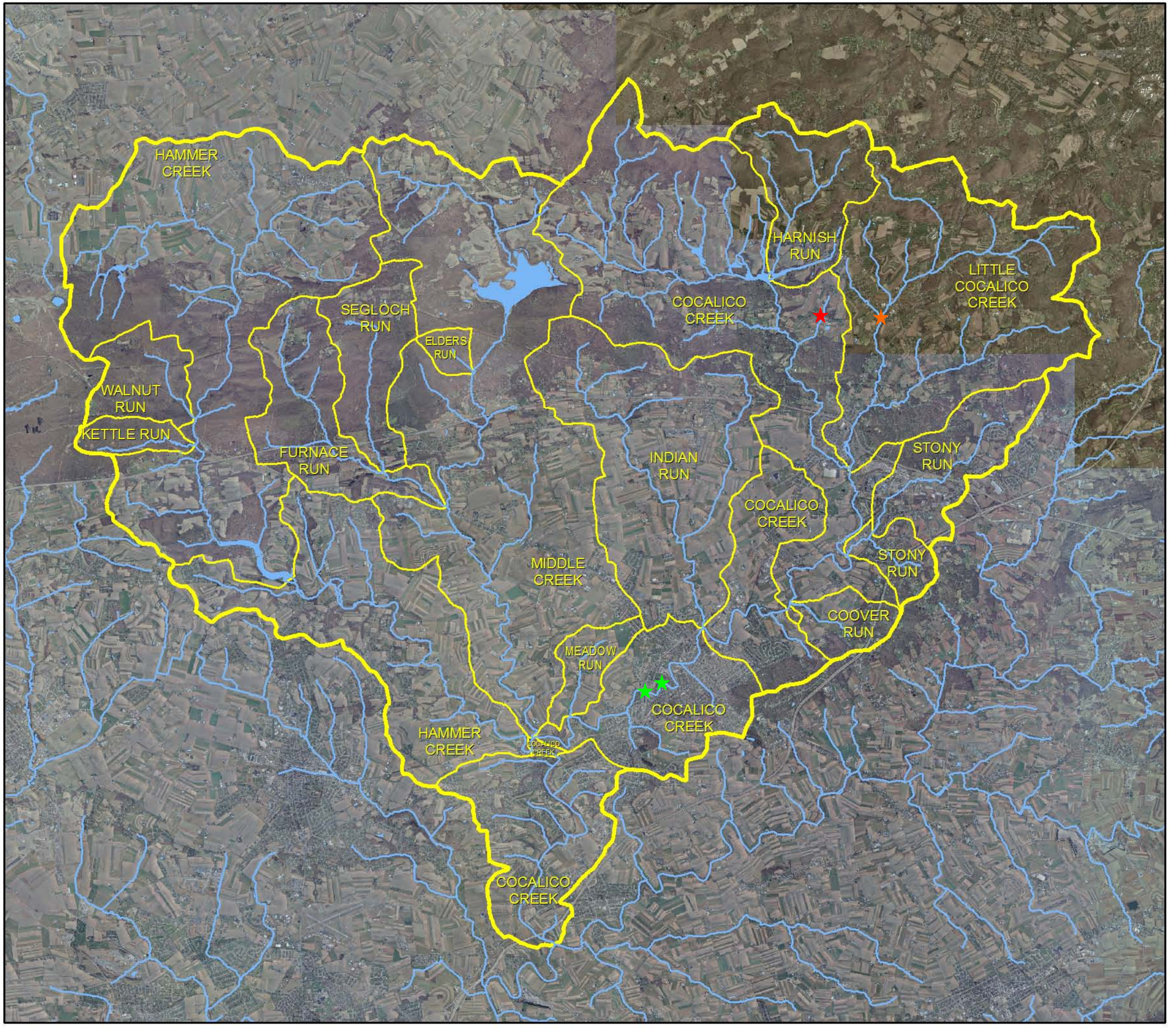
Streams and Lakes

Ephrata Wastewater Treatment Plants

Reinholds Wastewater Treatment Plant

Cocalico Biological Treatment Plant

LandStudies



Section 5

Review of Municipal and Regional Water Resource Plans

Considerations for Municipal and Regional Plan Reviews

Ordinances and Municipal and Regional Plans that address water quantity and quality are important to protect ground and surface water resources. They ensure minimum standards are being met and suggest guidelines and requirements for future growth. An overview of the ordinances in the Cocalico Creek watershed is important for two reasons:

1. The Ordinance Overview provides a baseline to assess what is being done to manage water resources on a local level throughout the northern Lancaster County region.

2. The Ordinance Overview provides a resource for municipalities to identify areas of weakness in various categories or standards. The overview can be used as a resource to determine which other local municipality has successfully implemented a standard that can be used to update or amend current ordinances. For example, a municipality that currently does not have an ordinance in place for a hydrogeologic study may consider reviewing and adopting a similar ordinance from one of the municipalities that has successfully implemented this requirement as part of the land development process.

Meetings were held with municipal leaders to discuss the existing ordinances and determine what additional requirements are needed based on problem areas within the watershed. Attachment 1 documents the outcomes from these discussions and an overview of existing ordinances. Table 5.1 inventories policies for each municipality within the Cocalico Creek watershed and Table 5.2 summarizes specific existing ordinances within each municipality. Watershed restoration planning and implementation has been an ongoing process within the Cocalico Creek watershed. See Table 5.3 for a list and description of subwatershed plans and restoration projects that have been completed within the watershed.

Summaries of the existing municipal, regional, and state plans and how they relate to water quality and quantity with the Cocalico Creek Watershed are given below.

Considerations for the Cocalico Region Strategic Comprehensive Plan

The Cocalico watershed lies within the northeast portion of Lancaster County, adjacent to Berks and Lebanon counties, and encompasses about 50 square miles. The three participating municipalities within the study area include Denver Borough, East Cocalico Township, and West Cocalico Township. The municipalities individually adopted the Cocalico Region Strategic Comprehensive Plan between September and November 2003. The plan is a land-use and growth-management policy plan authorized under Article III of the Pennsylvania Municipalities Planning Code. The plan supersedes any previous comprehensive plans adopted by the participating municipalities.

The Cocalico Region Strategic Comprehensive Plan (CRSCP) encourages the protection and conservation of prime agricultural soils, farming and natural resources, and restoration of degraded ecosystems. The plan also includes objectives for the allocation of future growth areas based upon projected growth and utilizing compact growth areas that can be efficiently served by a wide range of public facilities, services, and utilities.

Future updates to the CRSCP may specifically consider the findings of this study, with the following recommendations. Further descriptions and examples of these strategies and recommendations are included in the Toolbox (see Section 8).

- Include the priority restoration sites, proposed in the Cocalico Creek Watershed plan, as natural resource protection and conservation areas to prevent future development in these locations.
- Encourage regional stormwater management. See Section 4 for the Regional Stormwater Management Strategy for Cocalico Creek Watershed.
- Include Critical Aquifer Recharge Areas (CARAs) where delineated as priority natural resource protection and conservation areas.
- Include strategies to protect and potentially improve the infiltration potential of CARA's.
- Include a build-out scenario strategy with respect to water resource availability. Pay special attention to "potentially stressed" areas where the water supply may not meet future demand.
- The Public Utilities Objectives of this plan should be updated to consider the results of the Cocalico Creek Watershed Plan. The committees addressing regionalization of the water system, wellhead protection, and watershed issues should be represented on the Oversight Committee and Water Planning Teams.
- The Cocalico Region Green Map should be amended to include the priority restoration project locations.

Considerations for Amendments to Floodplain Regulations

The following amendments to allow stream and floodplain restoration activities as permitted uses in floodplains are important because of the multiple benefits derived from stream and floodplain restoration activities. These benefits include flood conveyance and reduction, wetland creation, groundwater recharge, sediment and nutrient reduction in waterways, stormwater management, stabilized riparian buffer establishment and invasive species removal, riparian and in-stream wildlife habitat improvement, topsoil generation, and aesthetic enhancement.

- Permitted Uses

  Stream restoration work, including, but not limited to: efforts to control erosion and sedimentation; floodplain management techniques; efforts to promote groundwater recharge; efforts to lower flood stages; efforts to reduce nutrient loads; and the placement of in-stream habitat structures

  The following uses are permitted when incorporated into design plans. These plans and associated uses shall be subject to approval by the Commission. The plan shall demonstrate that the proposed uses: do not increase the height or frequency of floodplain water; are installed so as to withstand the maximum volume, velocity, and force of floodplain water; are flood- and floatation-proof; do not create unhealthy or unsanitary conditions; and do not degrade the quality of surface water, or the quality of groundwater.

  - ✓ Groundwater recharge and/or nutrient reduction facilities
  - ✓ Ponds and created wetlands
  - ✓ Flood-proofing and flood hazard reduction measures / structures to protect existing buildings or other existing infrastructure
  - ✓ Public and private utility facilities, except buildings
  - ✓ Water oriented uses (excluding buildings), e.g. docks, piers, boat launching ramps, hatcheries
  - ✓ Water monitoring devices
  - ✓ Culverts, bridges, and their approaches for floodplain crossings by streets, access drives and driveways

- Prohibited uses

  Sanitary landfills, dumps, junk and salvage yards, and outdoor storage of vehicles and/or materials, except those materials necessary for the completion of stream restoration work provided for in this Section.

- Design and Performance Standards

  Prior to any proposed stream restoration work, a Water Obstruction & Encroachment Permit, if required, shall be obtained from the Pennsylvania Department of Environmental Protection, Water Management Program, and authorization, if required, shall be gained from the U.S. Army Corp of Engineers.

- Application Procedures

  Within the Floodplain Zone, a zoning permit shall be required for any proposed development, construction, reconstruction, placement, replacement, renovation, extension,

repair or other improvements of uses or structures, including placement of mobile homes, and activities such as mining, dredging, filling, grading, paving or drilling operations, but excepting any proposed stream restoration work permitted, if required, by a Water Obstruction & Encroachment Permit issued by the Pennsylvania Department of Environmental Protection, Water Management Program, and authorized, if required, by the U.S. Army Corps of Engineers. Application for a zoning permit shall be filed with the Zoning Officer who shall make an initial determination on the application.

Considerations for the Cocalico Creek Watershed Act 167 Plan

Act 167 is Pennsylvania's stormwater management act. This Act was developed in 1978 in response to the impacts of accelerated stormwater runoff resulting from land development in the state. It requires counties to prepare and adopt watershed based stormwater management plans. It also requires municipalities to adopt and implement ordinances to regulate development consistent with these plans.

The Act 167 summary found in Attachment 3 is based on a review of the original Cocalico Creek Watershed Act 167 Plan Ordinance. This ordinance is currently being updated by the Lancaster County engineering office. The comments below explain how the proposed restoration projects respond to the requirements of ACT 167 for the watershed.

MS4 Stormwater Management Program

In December 1999 federal regulations (Phase II NPDES Stormwater Regulations) were passed requiring municipalities in urbanized areas to implement a stormwater management program to reduce the negative water quality impacts of stormwater. These regulations affected MS4s (municipal separate storm sewer systems), mandating municipalities to adopt local ordinances to comply with federal regulations and the Department of Environmental Protection permit PAG-13. Six best management practice categories must be satisfied in order to meet NPDES permit requirements for MS4s. They are:

- Public Education and Outreach
- Public Participation and Involvement
- Illicit Discharge Detection and Elimination
- Construction Site Runoff Control
- Post Construction Stormwater Management in New Development and Redevelopment
- Pollution Prevention and Good Housekeeping for Municipal Operations and Maintenance

These BMPs were designed to reduce the discharge of pollutants from MS4s, protect water quality, and meet requirements of the federal clean water act. DEP offers protocols and guidance for meeting these regulations and must approve each municipal stormwater management program.

All townships and boroughs within the Cocalico Creek watershed except Heidelberg Township in Lebanon County have urban areas within their boundaries (see Attachment 4) and therefore must meet these stormwater regulations. Millcreek Township, Lebanon, has a designated urban area, however is not on DEP's list of MS4s so they may have received an exception.

Lancaster County Water Resource Plan

The Lancaster County Comprehensive Plan includes a Water Resource Planning component. Attachment 2 contains a summary of the Water Resources Plan regarding the inconsistencies between water supplier planning and municipal planning of urban growth boundaries and village growth boundaries within the Cocalico Creek watershed. Information regarding current water needs, projected water needs, and system capabilities for each municipal water authority is also included in this attachment. Solutions for coordinating water planning efforts and addressing these water availability concerns can be found within the municipal toolbox in Section 8 of this report.

PA State Water Plan (ACT 220)

In addition to the municipal and regional plans, the State Water Plan (Act 220) requires that the state pinpoint areas where future water availability is a concern. DEP and USGS performed the initial work to indentify these "hot spots." These areas will be reviewed by the regional committees (in this case the Lower Susquehanna Regional Committee and then may be designated as ACT 220 Critical Water Planning Areas (CWPAs). Each CWPA will need to complete a planning study. The process of publicly releasing these CWPAs may not be until late 2008, and even draft versions will not be released for public viewing until the spring of 2009. Several areas in the Cocalico Creek Watershed have been initially identified as having water availability issues by the early stages of the ACT 220 process. Figure 5.1 shows critical water planning area screening locations in the Cocalico Creek Watershed as identified in the Act 220 planning process.

Recommendations and Strategies

Various approaches for local government and water resource planners to consider are included in the municipal toolbox in section 8 of the report. The toolbox has been divided into

categories based on the most relevant issues impacting water quality and quantity in the watershed.

The categories include:

- Impervious Cover - Historical changes in land use have led to increased urbanization and a sharp increase in impervious surfaces – roads, parking lots, driveways, and roofs – replacing meadows and forests. The result is less surface area to provide infiltration and recharge and consequently, an increase in stormwater runoff bypassing the aquifer and flowing directly to streams. The overall reduction in infiltration throughout the region is important, but the loss of infiltration in Critical Aquifer Recharge Areas is particularly significant in the overall sustainability of the water supply.
- Resource Protection - It is important to consider tools for protecting natural resources during the land development process and as part of an overall preservation program. Since direct acquisition of important resource lands is typically cost prohibitive, creative tools such as TDR's and nutrient credit generation through restoration are critical to the long term protection of valuable lands. The proposed resource protection tools can be prioritized based on the importance of the various projects proposed as part of this study.
- Stormwater Management - Encouraging infiltration of stormwater runoff is important to a sustainable water supply, especially within CARAs. It is also important to consider viable and consistent protocols for determining the potential for stormwater management methods that promote infiltration in carbonate geology areas and high-density karst areas. Close to 100 percent of soluble pollutant removal should be considered before infiltration.
- Land Use & Development - Consistency between the various ordinances within the watershed and their approach to protecting water resources within the watershed is key to a sustainable future. Multiple governing bodies, each with their own set of regulations, oversee the land use and development of the watershed region. Lack of consistency in approach and oversight creates an uncoordinated effort that results in adversarial relationships. The water supply is not limited by political boundaries.
- Coordinating Water Supply and Disposal - Stressed recharge areas are those in which demand could potentially exceed supply. An over-withdrawal of groundwater from these areas and the subsequent discharge of treated sewage into streams exiting the watershed (without reuse) would exacerbate this condition. Efforts to protect and improve the quality and supply of water resources within the watershed rely on a coordinated effort between water and sewer authorities. This effort is vital to the sustainability of the regions water supply and sewage disposal infrastructure.

- Agricultural Land Use - Intensive tillage practices, applications of manure and fertilizer, and uncontrolled barnyard runoff are significant concerns in the watershed. Municipalities have various tools available to better manage agricultural practices to protect water resources.

Section 8 of this report is a municipal toolbox to help municipalities identify restoration and protection recommendations and priorities that fit their individual needs. It is also a guide for improving existing ordinances and comprehensive plans to protect water resource management with a focus on regional and watershed approaches.

Figure 5.1 DEP Act 220 State Water Plan Critical Water Planning Area Screening Points

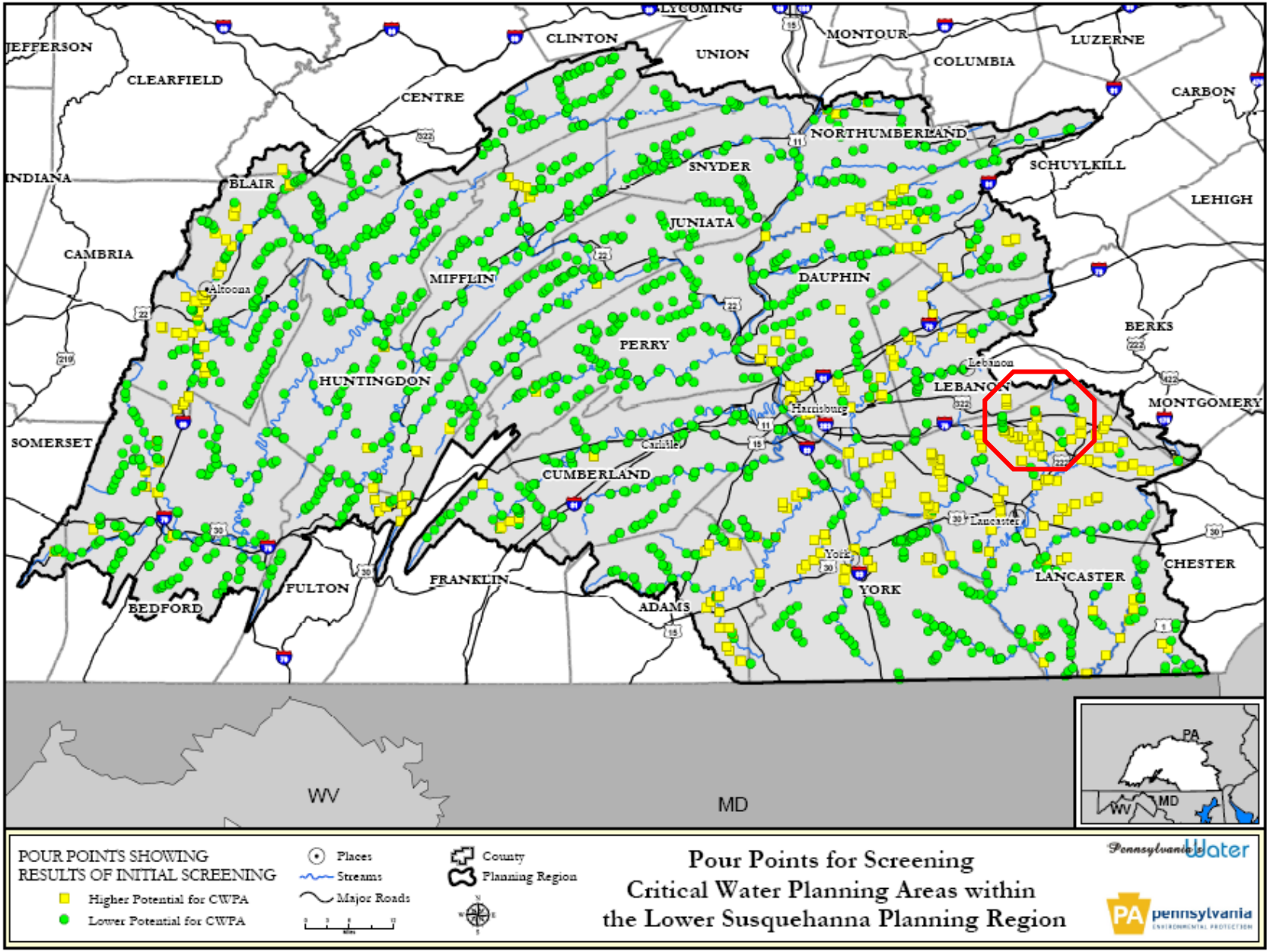


Table 5.1 Municipal Policy Inventory - Cocalico Creek Watershed

Municipality	Zoning	SLDO*	SWM*	537 Plan*	Comp Plan*	Park/Open Plan*	Regional Plan*	Status	Review Status
Lancaster County									
Adamstown Borough	1989**	1997	in SLDO	1987	2003		Cocalico Region Strategic Comprehenisve Plan	2003	Updated 7/24/2007
Akron Borough	1997	2004 Draft	2004 Draft	1995	1991	2001			
Clay Township	2002	1995	in SLDO	1995	1995				
Denver Borough	1992	LCPC*	2004	1995	2003	2002	Cocalico Region Strategic Comprehenisve Plan	2003	
East Cocalico	2003	2003	2003	2007	2003	1993	Cocalico Region Strategic Comprehenisve Plan	2003	
Elizabeth Township	2003	LCPC*	1989	1974	2000	2002			
Ephrata Borough	1996	2000	2004	1995	2001	1989			Updated 8/16/2007
Ephrata Township	2000	1992	1992	1995	1995	1993			
Penn Township	2002	1999	2003	2003 - draft	1993	2002	Manheim Central Regional Comprehensive Plan	2001	
Warwick Township	1997	1997	2006	2009	1999	2002	Lititz/ Warwick Region Strategic Comprehensive Plan - update	2007	Updated 7/10/2007
West Cocalico Township	2002	2004	in SLDO	1987	2003	1993	Cocalico Region Strategic Comprehenisve Plan	2003	Subdivision and stormwater updated 1/8/2008
West Earl Township	1996	1992	2005	2007			Conestoga Valley Regional Comprehensive Plan	2003	Updated 7/24/2007
Lebanon County									
Cornwall Borough	2005	2002	in SLDO	1993	2000				
Heidelberg Township	2007			2001	2000				
Millcreek Township	1977			1990	2000				
South Lebanon Township	2006	1990		1988	2000				
Berks County									
South Heidelberg Township	2004	1992	1989	draft	2002				
Spring Township									

***Abbreviation is defined in Appendix 2: Glossary of Planning and Regulatory Terminology**

**** Adamstown zoning to be updated in 2007**

Table 5.2
Municipal Ordinance Overview of Existing Regulations

REQUIREMENTS	LANCASTER COUNTY BOROUGHS				LANCASTER COUNTY TOWNSHIPS								LEBANON COUNTY				BERKS COUNTY	*
	Adamstown	Akron	Denver	Ephrata	Clay	East Cocalico	Elizabeth	Ephrata	Penn	Warwick	West Cocalico	West Earl	Cornwall	Heidelberg	Mill Creek	South Lebanon	South Heidelberg	Lancaster County SLDO[1]
Category I: Impervious Cover Reduction																		
Streets																		
Street width allowed < 24'			X			X	X				X						X	X
Substitutions for sidewalks allowed										X								
Joint use driveways encouraged										X								
Parking Ratios																		
Min parking for professional office (per 1,000 s.f.)	3.3	5	*	3.3	5	3.3	*	4	3.3	3.3	3.3	2.5	5		5		5	3.5-4.5
Min parking for Retail centers (per 1,000 s.f.)		5	*	4	5	5	*	4	5	5.5	3.3	10	5		1 per 300 feet		5	4-5
Min parking for single family	2	2	*	2-3	2	2	*	2	2	2	2	2	2		2		2	2
Shared parking is encouraged	X	X	X	X	X	X	X	X	X	X	X	X			X		X	X
Ratios reduced with shared/joint parking				X		X			X		X							
Parking Lots																		
Minimum parking stall of < 10' x 20'			X	X				X	X	X							X	
Pervious paving materials permitted	X					X			X	X			X					
Landscape islands and landscaping required within parking lot	X			X	X	X		X	X	X	X	X	X			X	X	

[1] Defined in Appendix 2: Glossary of Planning and Regulatory Terminology

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Category II: Resource Protection																		
Resource Conservation																		
Floodplain protection or district	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Steep slope protection	X	X	X		X	X	X	X	X		X		X	X	X	X	X	
Wetland protection				X		X		X	X	X	X		X	X			X	
Existing tree protection measures	X		X	X		X							X	X	X	X	X	
Forested land protection	X		X	X	X	X	X		X	X	X		X	X	X		X	X
Conservation development standards			X				X		X	X							X	
Resource conservation	X			X			X			X	X		X	X	X		X	
Riparian buffers		X	X	X	X	X			X	X							X	
Growth Limits/ Agricultural Preservation																		
Active farm preservation program						X	X	X	X	X						X		
TDR program[1]										X								
UGB/VGB[1] boundary in place					X			X	X	X		X						
Clean and green enrollment[1]	X				X	X	X	X	X	X	X	X						
Agricultural security[1]					X	X	X	X	X	X	X	X			X			
Prime agricultural soils[1] protection		X			X		X	X		X	X	X		X	X			
Agricultural Preservation[1]										X		X	X	X		X	X	
Sliding scale zoning[1]		X									X							

[1] Defined in Appendix 2: Glossary of Planning and Regulatory Terminology

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Condensed housing or cluster[1] use permitted with open space	X			X		X	X	X	X	X	X						X	
Permitted by right[1]				X													X	
Permitted through Conditional or Special Exception[1]	X					X	X	X	X	X	X	X						
Public Water Supply Protection																		
Wellhead or aquifer recharge area protection										X				X				
Open Space Management																		
Guidelines for establishing native plant communities							X			X								
Enforceable requirements to establish associations to effectively manage open space										X								
Open space may be managed by a third party										X								
Category III: Storm Water Management (SWM)																		
ACT 167 ordinance in place	X			X	X	X		X		X	X	X	X					
Encourages reduction of impervious surfaces	X	X	X			X	X			X	X	X	X					X
SWM/BMP[1] required	X	X	X	X	X	X		X	X	X	X	X	X					
Groundwater recharge encouraged	X			X	X	X		X	X	X		X	X					
Recommends replicating existing drainage patterns	X	X	X	X		X	X	X		X	X	X	X	X		X		
Standards or methods are in place to monitor and maintain SWM BMP's	X				X	X				X		X						
Transition from E&S[1] facilities to retention facilities is monitored to ensure system is working following build-out.						X		X		X		X						

[1] Defined in Appendix 2: Glossary of Planning and Regulatory Terminology

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Category IV: Land Use/ Development																		
Karst Geology Issues																		
Hydrogeologic study req.				X		X		X	X	X		X						
Sinkhole and depression ID req.			X					X	X									X
Sinkhole protection measures						X		X	X	X	X							X
Limitations (blasting, land use, SWM basins, underground storage, tanks, manure storage, etc.)				X		X		X	X	X		X						
Specific Water-Related Uses																		
Car wash facilities required to use public sewer and water system				X			X	X	X	X	X	X						
Car wash facility required to recycle water				X		X	X	X				X						
Swimming pool disposal and filling standards			X			X				X		X						
Ornamental ponds, wading pools, lakes, dams, or impoundments			X			X	X		X	X		X						
Quarry or extractive related use standards						X	X	X	X	X	X		X	X				

[1] Defined in Appendix 2: Glossary of Planning and Regulatory Terminology

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Mushroom operations/comp						X				X							X	
Septage and /or solid waste disposal and processing facilities				X		X	X		X	X								
Cemeteries not permitted in floodplain, flood fringe or areas of high water				X				X		X	X							
Subsurface storage or tanks		X			X													
Manure storage								X			X							
Hospital and medical facilities waste disposal										X								
Stockyard, slaughtering and feedlots										X								
Intensive farming operations											X							
Land Development Review																		
Sketch Plan optional	X	X	X	X	X	X	X	X	X	X	X	X	X			X		X
Sketch Plan required																		
Natural, cultural resources inventory			X			X	X		X	X	X							X
Environmental impact statements									X									
Site meeting with LCCD[1] rep			X			X	X		X	X	X							X

[1] Defined in Appendix 2: Glossary of Planning and Regulatory Terminology

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Category V: Water Supply and Disposal																		
Private Wells																		
Yield and quantity aquifer testing (quantity of water available for proposed use)			X		X	X	X		X	X	X							X
Hydrogeologic impact study or water supply study (impact on adjacent properties)			X	X	X	X	X	X	X	X	X	X						
Well capping requirements or standards									X			X						
Public system required																	X (may be required)	
Sewage Disposal																		
Sewage Enforcement Officer			X		X	X	X	X	X	X	X	X						
Lot size increased to ensure acceptable level of nitrate-nitrogen in adjacent groundwaters							X		X			X						
Alternative on-lot systems permitted						X			X			X						
Public system required																		
Category VI Agricultural Land Use																		
Agricultural Management																		
PA Nutrient Management Plan recommended					X	X	X	X	X	X								
Agricultural Best Management Practices		X						X		X								
Manure Storage regs.					X	X		X		X								
Conservation Plan Requirements								X		X								

[1] Defined in Appendix 2: Glossary of Planning and Regulatory Terminology

Table 5.3 Watershed Restoration History
Cocalico Creek Watershed

Status of Planning Efforts	*Specific Goals of Assessment*	*Watershed Associations*	*Status of Act 167 Planning*
Cocalico Creek Ecological Watershed Management Plan – September 1995- This study was prepared at the request of the Save our Creek (SOC) organization, whose objective is to improve the Cocalico Creek. A two-phase planning process was completed. First, a watershed assessment was performed to evaluate the Cocalico Creek and its tributaries. The second phase involved making recommendations for stream improvements for designated sections of the Cocalico Creek. The study focused primarily on identifying the effects of existing land use practices and providing recommendations and best management practices to improve the Cocalico Creek Watershed.	• Utilizing an ecological watershed planning format for water quality improvement • Providing instream management techniques • Incorporating educational and public awareness	Save Our Creek (SOC) – Ephrata, PA Save Our Creeks is a committed group of community activists dedicated to the clean-up of the Ephrata Borough Section of the Cocalico Creek.	An Act 167 Stormwater Management Plan has been completed for the entire Cocalico Creek Watershed. ACT 167 Stormwater Management Ordinances have been adopted by most of the municipalities within the watershed

Restoration Projects Completed or Planned

Cocalico Creek Stream Restoration – Summer 2003 -This project, located along Church Road in Ephrata, involved the restoration of approximately 2,200 linear feet of stream channel that had eroded downward, detaching itself from its floodplain, and had many high, vertical banks. The channel also had a poor alignment with the bridge opening, creating a backwater effect that increased erosion. The restoration included cutting the floodplain down, relocating a section of the channel, and creating a stable stream corridor. The project improved aquatic habitat, reduced erosion, and integrated the stream with created wetlands, which provide additional sediment and pollutant sinks and filters. The right-bank wetland receives high flow from two upstream cuts in the stream bank. Sediments are deposited here rather than carried downstream. A forested and herbaceous riparian buffer was installed on both banks along the length of the project.

Continued…

Restoration Projects Completed or Planned- Cocalico Creek Watershed

Grater Park Stream Buffer and Wetland Creation - The area in Grater Park was an under-utilized section of the downtown Ephrata Borough Park. The lawn area was often wet and difficult for municipal personnel to maintain with mowing equipment. The Save Our Creek (SOC) organization identified the site as a potential wetland restoration site. The created wetland was designed to filter and treat road runoff before it enters Cocalico Creek. The project also includes 2,500 linear feet of forested riparian buffers.

Cocalico Creek Trail - This proposed 7-mile trail along Cocalico Creek is an important and under-utilized resource through the Borough of Ephrata. The trail was divided into seven reaches; each representing unique characteristics and challenges within this densely populated area. An environmental assessment of the stream corridor identifying Issues and Opportunities associated with each Reach was prepared. The overall approach includes community recreation balanced with the protection and improvement of the environment along the corridor. Stream stability and flooding issues were addressed through strategic and limited stream crossings, created wetlands, and targeted stream improvement projects.

Warm Season Grass Meadow - The Save Our Creek (SOC) organization created an 8-acre warm season grass meadow to improve water quality and wildlife habitat adjacent to the Cocalico Creek.

Bon View Linear Park - Floodplain understory management, wetland restoration and bio-swale creation as part of an ecological park along the Cocalico Creek at 3rd Street in Denver. The project was funded though a grant provided by DCNR.

Haller Mill Environmental Education Center - Restoration of an historic mill and creation of an active recreation park on the Haller Mill site in Ephrata Borough.

Hammer Creek Watershed

Status of Planning Efforts	*Watershed Associations*	*Status of Act 167 Planning*
Hammer Creek Watershed Assessment – 2001 - This assessment for the Hammer Creek Watershed Association, assembled all available information regarding the location and types of impacts of non-point source pollution in the Hammer Creek Watershed downstream of Speedwell Forge Lake. It includes a plan that identifies costs of proposed restoration efforts	Hammer Creek Watershed Association (HCWA) – Lititz, PA	An Act 167 Stormwater Management Plan has been completed for the entire Cocalico Creek Watershed, which includes the Hammer Creek Watershed.

Restoration Projects Completed or Planned

Good Farm Stream Corridor and Floodplain Restoration – 2001 - Design and construction services for the restoration associated with the Good Farm. Agricultural Best Management Practices were installed, including grass swales, a wetland to filter barnyard run-off, and riparian buffer plantings. Approximately 2,000 linear feet of stream were restored using Natural Channel Design techniques, including the installation of rock vanes and cross vanes for streambed and bank protection.

Emory Martin Property – completed in 2001 - The stream had been degraded by storm events, past agricultural activities and scour from the upstream bridge. The existing channel eroded both downward and laterally in several places. The purpose of this restoration project was to adjust the alignment of the channel and grade the banks and floodplain to improve the fish habitat and minimize erosion. The in-stream fish habitat is improved during low flow by providing riffles and deeper faster water. The restoration design incorporated "Natural Channel Design" techniques of using rock structures to establish and maintain a stable stream channel and grading in the floodplain to pass high flows.

Snavely's Mill Property – completed Fall 2003 - This restoration project, involving channel relocation, was a prioritized project of the Hammer Creek Watershed Assessment because of mass wasting of streambanks and degraded aquatic habitat. The restoration restored the stream channel to its former location within the adjacent floodplain. Measurable results include erosion reduced by 85-100 tons/year, 50% increase in the macro-invertebrate community and creation of 3-5 acres of wetlands.

Continued…

Restoration Projects Completed or Planned- Hammer Creek Watershed
Fox/Zimmerman – completed Spring 2005 - This project included approximately 3,200 linear feet of degraded stream channel. The restoration reconnected the stream to its floodplain and included two relocated sections to create stable conditions and improve the stream's alignment with the bridge opening under Carpenter Road. Oberholtzer Property – proposed - As a result of the Hammer Creek Watershed Assessment, the Hammer Creek Watershed Association (HCWA) has prioritized the Oberholtzer project because of accelerated erosion and sedimentation and degraded aquatic habitat along this 3,300-foot reach. The HCWA applied for a Growing Greener Grant in 2005 to provide funding for the design and permitting phases of the proposed project.

Indian Creek Watershed

Status of Planning Efforts		*Watershed Associations*	*Status of Act 167 Planning*
None		There is no current watershed association for the Indian Creek Watershed	An Act 167 Stormwater Management Plan has been completed for the entire Cocalico Creek Watershed, which includes the Indian Creek Watershed.
Restoration Projects Completed or Planned			
None			

Middle Creek Watershed

Status of Planning Efforts		*Watershed Associations*	*Status of Act 167 Planning*
None		There is no current watershed association for the Middle Creek Watershed	An Act 167 Stormwater Management Plan has been completed for the entire Cocalico Creek Watershed, which includes the Middle Creek Watershed.
Restoration Projects Completed or Planned			
None			

Attachment 1: Ordinance Overview and Municipal Meeting Summary

Ordinance Inventory Review and Findings

- Ordinance audits were sent to each of the eighteen (18) municipalities
- Five municipalities responded
- Results from the audit and a review of each municipality's ordinances were compiled and listed in Table 5.2, Municipal Ordinance Overview of Existing Regulations.
- A meeting was held with municipal officials to discuss ordinances affecting water resources.

The following outlines findings from ordinance reviews and summarizes municipal official's comments regarding water resource issues as they relate to land use regulations.

Impervious Cover

Includes streets, cul-de-sacs, parking ratios, and parking lot regulations

Findings:

- Only Warwick Township allows substitutions for sidewalks and the use of joint driveways.
- Less than 50% of municipalities allow street width reductions.
- A majority of the townships require landscape islands and landscaping within parking lots (Akron, Denver, Elizabeth, Heidelberg, Mill Creek do not).
- Few municipalities permit pervious pavement (Adamstown, E. Cocalico, Penn, Warwick Cornwall allow it).
- A majority of municipalities encourage shared parking (except Cornwall, Heidelberg, S. Lebanon).
- Less than 50% of municipalities allow reduced ratios with shared/joint parking.

Response from municipal officials:

Impervious Cover

- Denver Borough has allowed pervious surfaces but does not have an official ordinance.
- Shared parking is working in Denver Borough.
- Most ordinances require 2 off-street parking spaces per household.
- Denver allows joint household parking.
- Areas are experiencing in-fill development (this is not necessarily encouraged).
- Zones of development in West Cocalico are limited.
- Significant changes will occur once regulations are in place for stormwater management on development / impervious cover over 1,000 sq. ft.

Landscaped Islands

- Ephrata has had success utilizing bioswales.
- Overall, pervious surfaces are encouraged but are not in ordinances (maintenance is an issue).

Resource Protection

Includes resource conservation, growth limits / agricultural preservation, public water supply protection and open space management regulations

Findings:

- Majority of townships had floodplain, steep slope, and forested land protected (>80%).
- Approx. 50% protect wetlands, existing trees, and riparian buffers.
- Only 30% employ conservation development standards (Denver, Elizabeth, Penn, Warwick, S. Heidelberg allowed).
- Municipalities with the most agricultural land have an active farm preservation program.
- Only Warwick has a TDR program.
- UGB/VGB boundaries are in place in Clay, Ephrata, Penn, Warwick and W. Earl.
- Only two townships use sliding scale zoning (Akron and W. Cocalico).
- Lebanon County does not allow condensed or cluster use with open space requirements.
- The majority of townships in Lancaster allow resource protection zoning (clustering, condensed, etc.) only through the conditional or special exception process. This deters developers from using these approaches because it is more costly and takes more time.
- Only two townships (Warwick and Heidelberg) have wellhead or aquifer recharge area protection.
- Open space management is nearly completely void of township or borough participation. (Warwick participates in native communities, enforceable requirements, and third party management. Elizabeth provides guidelines for native communities)

Response from municipal officials:

Resource Protection

- Local zoning overrules the Urban Growth Boundary (UGB).
- Typically, the land outside UGBs is purchased for development (lower prices).

TDRs

- East Cocalico has considered the idea of Transfer of Development Rights (TDR's) but has not acted. They are waiting to see if and how other municipalities use this tool.
- Warwick has had success preserving farmland as part of the Township's TDR program tied into the Campus Industrial Zoning District.
- Very few wellhead protection measures are in place throughout the watershed.

Stormwater Management

Includes stormwater management regulations

Findings:

- Approximately 50% employ ACT 167, encourage the reduction of impervious surfaces or encourage groundwater recharge.
- Approximately 70% require SWM BMPs and replication of existing drainage.
- Approximately 30% monitor or maintain SWM BMPs and infiltration facilities and transition E&S facilities used during construction to stormwater retention facilities.
- Most Boroughs do not feel stormwater management is an issue because they do not have room for additional growth (they are already at “build out”).

Response from municipal officials:

Stormwater Management

- Much of the new stormwater management for new development utilizes subsurface systems that are difficult to monitor and maintain.
- Usually stormwater management issues are complaint driven.
- Municipal officials agreed there are advantages to regional vs. site by site approach.
- Developers find they are needing larger pieces of land to deal with infiltration requirements.

Land Use Development

Includes karst geology regulations, specific water-related uses and land development review.

Findings:

- Approx. 30% require hydrogeologic studies or sinkhole protection.
- 15% identify sinkhole and depressions (Denver, Ephrata, Penn indentify these areas)
- Municipalities understand that karst issues are only a concern with areas underlain by limestone geologic features.
- Overall, less than 50% require special limitations on water for specific uses (car wash, swimming pools, ornamental ponds, septage, cemeteries in floodplains).
- Approximately 10% have ordinances in place for subsurface storage, manure storage, hospital waste disposal, stockyard/slaughtering areas, or intensive farm operations.
- Only Penn Township requires an environmental impact statement.
- 35% require a natural, cultural resources inventory and a site meeting with LCCD (Denver, E. Cocalico, Elizabeth, Penn, Warwick, and W. Cocalico).

Response from municipal officials:

Land Use Development

- Hydrogeologic study never seems to affect developments regardless of geologic formation
- The only way to prevent issues relating to karst topography is to not allow development in karst locations
- Municipalities should verify they are not encouraging development in karst areas by overlaying karst areas with UGBs.
- Sketch plans typically go through preliminary plan process
- Municipalities do not agree with ordinance stating that lot size should be larger to improve nitrate concentrations in well water.
- Package sewer systems are an approval and maintenance problem for developers.

Water Supply and Disposal

Includes private wells and sewage disposal regulations.

Findings:

- Approx. 80% of Lancaster County townships require hydrogeologic impact studies or water supply studies while none are required in Lebanon County
- Only two townships had well capping requirements (Penn and W. Earl)

- Approx. 40% require yield and quantity aquifer testing
- 9 of 17 municipalities have a sewage enforcement officer
- Only three municipalities require lot size increase to ensure acceptable nitrate levels (Elizabeth, Penn, and W. Earl)
- Only three municipalities allow alternative on-lot systems (E. Cocalico, Penn, and W. Earl)

Response from municipal officials:

Water Supply and Disposal

- Regulations seem to slow growth
- Schoeneck sewage problems are due to density and placement on both sides of a ridge.

Agricultural Land Use

Includes agricultural management related regulations.

Findings:

- Two have conservation plan requirements (Ephrata and Warwick)
- Four have manure storage requirements (Clay, E. Cocalico, Ephrata, and Warwick)
- Three suggest Agricultural BMPs (Akron, Ephrata, Warwick)
- Six recommend PA nutrient management plans

Response from municipal officials:

High Intensity Agriculture within the Watershed

- Concern lies more with unregulated small farms (no conservation plans)
- East Cocalico requires stormwater controls with exceptions only if a conservation plan is in place.

Attachment 2: Summary and Excerpts from the Lancaster County Water Resources Plan

Lancaster County Water Resources Plan
The Lancaster County Water Resources Plan provides a future direction for the County's water resources to 2010 and beyond. This future direction is reflected in a comprehensive set of objectives and implementation tasks making up a plan of action to safeguard the County's water supply. This plan was updated in 2007. Excerpts from the plan as it relates to water supply in the Cocalico Creek Watershed is outlined below:

Water Service Planning
Future water service areas, as well as franchise areas, usually reflect water supplier planning, while UGBs and VGBs reflect municipal planning. Often, these two planning processes proceed independently resulting in inconsistencies and conflicts which can create unnecessary costs and inefficiencies. As part of the Lancaster County Study, existing and planned future water service areas, as well as franchise areas, were compared to UGBs and VGBs to determine where conflicts exist and where coordination between municipal and supplier planning efforts can be improved.

Table III-8

FUTURE VGB PUBLIC WATER NEEDS				
Village Growth Area	**Projected Water Provider**	**Municipality**	**Population Increase to Use Public Water**	**Projected New Public Water Needs**
2. Reinholds/Blainsport	West Cocalico	West Cocalico Township	1,467	129,180
4. Stevens	East Cocalico	East Cocalico Township (partial)	-[2]	-[2]

[2]Included in UGB figures as water providers serve both VGBs and UGBs.

Existing service areas were, in most cases, identified on the basis of existing water lines. These were then compared to the locations of UGBs and VGBs to determine any inconsistencies. The following conflicts were identified within the Cocalico Creek Watershed study area.

- Denver Borough, East Cocalico Township Authority, Ephrata Area Joint Authority, West Cocalico Township Authority, have existing water service areas that extend beyond UGBs or VGBs, but which are contiguous to them and might be included within them.
- The Ephrata Area Join Authority is a source of public water for neighboring municipalities with no or insufficient public water of their own. A regional water service is recommended as a cost efficient alternative to entirely new water system.
- Akron Municipal Authority, East Cocalico Township Authority, Ephrata Area Join Authority, and West Cocalico Township Authority lack any planned future water service areas. This is because water suppliers in Pennsylvania historically have relied on individual requests for water service to guide planned extensions. Unlike other states which require

concurrency for development and the provision of public utilities, Pennsylvania does not require municipalities to extend such utilities to developing areas.

- Denver Borough Authority has partial planned water service areas indicating immediate planned service areas (generally remedial or in connection with a planned development), or indicating that a municipality which is or could be served by that supplier desires service.
- The Akron Municipal Authority has exclusive franchise areas within which they are permitted by the Pennsylvania Public Utilities Commission (PUC) to provide water service. They are in the process of turning their current extraterritorial service areas over to the Ephrata Area Joint Authority, and for this reason, its franchise area boundary has not been mapped or evaluated. Municipal water suppliers providing direct water service outside their municipal boundaries must have franchise areas and be regulated by the PUC. This discourages municipalities from extending water service outside their boundaries.
- Denver Borough Authority, East Cocalico Township Authority, Ephrata Area Joint Authority, and West Cocalico Township Authority have built water service areas overlapping wellhead recharge areas. This presents a real challenge to these communities in terms of protecting their wellheads from contaminants.
- Akron Municipal Authority and East Cocalico Township Authority have planned growth areas within UGBs which overlay their wellhead recharge areas. This is a serious conflict and could prevent or diminish effective wellhead protection.

<u>Water Supply</u>

The existing water system capabilities of Lancaster County's large community water suppliers was evaluated to determine their ability to meet existing and projected year 2010 water needs. The results for the water suppliers within the Cocalico Watershed are presented in Tables III-2.

The following notes related to water supply areas within the Cocalico Creek Watershed.

- East Cocalico Township Authority and Ephrata Area Join Authority may have inadequate water availability to meet 2010 needs.
- *West Cocalico Township Authority may have more than adequate water for year 2010 needs.* This system has a projected 200,000 GPD or greater in excess water over year 2010 needs and therefore offer the greatest potential for water provision to adjacent or nearby municipalities through bulk sales or direct service.
- Ephrata Area Joint Authority may have insufficient excess filtration plant capacity to meet projected needs
- West Cocalico Township Water Authority has a large residual excess pumping capacity and safe yields which are also high.
- Considering projected new water needs to the year 2010,Denver Borough Authority, and Warwick Township Municipal Authority (Rothsville) are anticipated to have inadequate treated storage capacity.

Table III-2

EXISTING WATER SYSTEM CAPABILITIES								
No.	**Water Utility**	**Residual Water Available GPD**[1]	**Residual Treatment**[2] **/ Pumping**[3] **Capacity GPD**	**Residual Treated Storage Capacity**[4] **(gallons)**	**Projected New Water Needs GPD**[5]	**Year 2010 System Adequacy**		
						Water	**Treatment-/Pumping**	**Storage**
2	Akron Municipal Authority	253,455	/ 1,385,455	950,000	85,463	Y	/Y	Y
7	Denver Borough Authority	219,664	273,162 / 506,182	-330,000	131,572	Y	Y/Y	N
8	East Cocalico Township Authority	162,438	/ 232,438	4,070,000	403,184	N	/N	Y
13	Ephrata Area Joint Authority	531,929	106,589 / 3,245,340	2,628,929	1,024,848	N	Y/Y	Y
31	Warwick Township Municipal Authority (Rothsville)	180,335	/ 180,335	-200,000	43,839	Y	/Y	N
32	West Cocalico Township Authority	358,630	/ 358,630	20,000	157,571	Y	/Y	Y

[1]Safe yield or permit allocation less average daily withdrawal (or, where not available, less average daily water use).
[2]For systems with filtration plants (shown to the left of "/", this is existing treatment capacity (no peaking factor) less average existing daily withdrawal, or, where not available, less average daily water use.
[3]This is generally existing pumping capability for wells, (or, where this is not available, maximum daily yield), less average daily withdrawal. Source: REWAI 1995 System Surveys and 1993 Water Supply Reports.
[4]Existing treated storage capacity less recommended storage capacity (see Table III-3).
[5]See Future Public Water Needs table and analysis.
Y = Yes N = No NA = Not Applicable

Attachment 2: Lancaster County Water Resource Plan

AKRON MUNICIPAL AUTHORITY

SERVICE AREA

Municipalities/Areas Served: Akron Borough & parts of West Earl & Ephrata Townships
Connections to Other Systems: Ephrata Area Joint Authority

Existing Service Area/Urban Growth Boundary Consistency: Yes **Future Service Area/Franchise Area/Urban Growth Boundary Consistency:** No future service area indicated

WATER SUPPLY

Safe Yield of System: 456,000+ GPD[1]

Water Sources: 5 Wells (1 not in use)

Average Daily Withdrawal: 202,545 GPD

Evaluation of Aquifer(s) for New Water Source Development:

Aquifer Name: Epler, Snitz Creek, Buffalo Springs

CURRENT SYSTEM DEMAND

Bulk Water Sales/Purchases: 82,597 GPD purchased 5,129 GPD sold

Population Served: 4,000

Average Daily Water Use: 280,014 GPD[2]

Peak Daily Water Use: 349,320 GPD

Types of Use (GPD):

Residential, Commercial, Institutional, Other: 277,314 GPD

Industrial: 2,700 GPD

2010 PROJECTED SYSTEM DEMAND

Service Area Population Increase: 996

Water Needed to Serve Population Increase: 85,463 GPD

Total Population to be Served: 4,996

Average Daily Water Use: 365,477 GPD

Types of Use (GPD):

Residential, Commercial, Institutional, Other: 349,206 GPD

Industrial: 16,271 GPD

SYSTEM EVALUATION

Projected 2010 Water Excess/Deficit: 90,523 GPD excess
Projected 2010 Pumping/Storage Capacity Excess/Deficit: Adequate pumping capacity; 950,000 gallon storage capacity excess

Water Availability & System Capacity to Serve Build-Out of Service Area Beyond 2010: Adequate water availability; adequate storage capacity

SWIP Susceptibility: Yes **Fire Flow Capability:**

[1]does not include well not in use [2]includes bulk water purchased; excludes bulk water sold

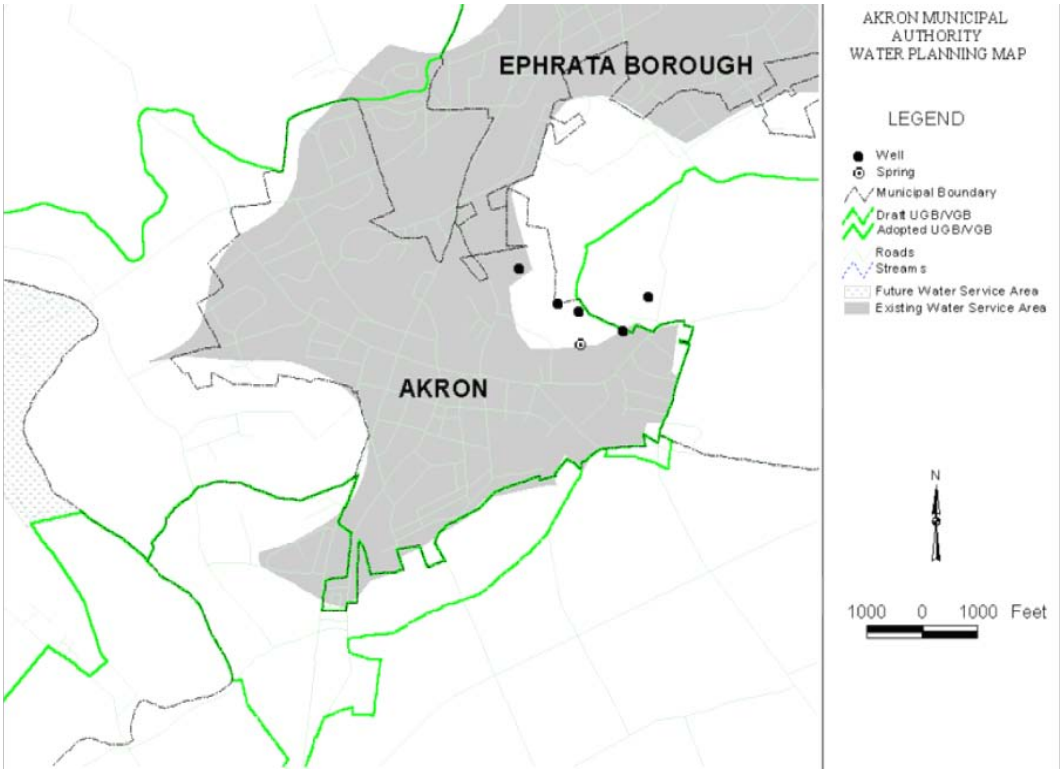
Potential Major Threats to Water Supply: Planned development coincides with wellhead recharge area (urban runoff and reduced recharge); agricultural practices; intensive agriculture; RCRA site

Potential Alternative Sources of Water: Ephrata Area Joint Authority

Priority for Wellhead Protection: High

RECOMMENDATIONS

· Re-evaluate UGB boundary in light of wellhead recharge areas.
· Adopt future service area consistent with UGB.
· Utilize Ephrata Area Joint Authority's treatment plant.
· Adopt wellhead protection program.
· Update contingency planning, Determine fire flow capability.



Attachment 2: Lancaster County Water Resources Plan

DENVER BOROUGH AUTHORITY

SERVICE AREA

Municipalities/Areas Served: Denver Borough
Connections to Other Systems: None

Existing Service Area/Urban Growth Boundary Consistency: No; existing service area extends east into East Cocalico Township & outside UGB
Future Service Area/Urban Growth Boundary Consistency: Yes

WATER SUPPLY

Water Sources: 3 wells, Cocalico Creek (13 springs discontinued)
Safe Yield of System: 500,000 GPD
Average Daily Withdrawal: 280,336 GPD

Evaluation of Aquifer(s) for New Water Source Development:

Aquifer Name: Epler, New Oxford

CURRENT SYSTEM DEMAND

Population Served: 2,853
Bulk Water Sales/Purchases: 0
Average Daily Water Use: 275,336 GPD
Peak Daily Water Use: 516,000 GPD

Types of Use (GPD):
Residential, Commercial, Institutional, Other: 227,771 GPD
Industrial: 47,565 GPD

2010 PROJECTED SYSTEM DEMAND

Service Area Population Increase: 1,372
Total Population to be Served: 4,225
Water Needed to Serve Population Increase: 131,572 GPD
Average Daily Water Use: 406,908 GPD

Types of Use (GPD):
Residential, Commercial, Institutional, Other: 332,123 GPD
Industrial: 74,785 GPD

SYSTEM EVALUATION

Projected 2010 Water Excess/Deficit: 93,092 GPD excess
Projected 2010 Treatment/Storage Capacity Excess/Deficit: 141,590 GPD treatment capacity excess (assuming all sources treated); adequate pumping capacity; -330,000 gallon storage capacity deficit

Water Availability & System Capacity to Serve Build-Out of Service Area Beyond 2010: Close-to-adequate water availability; adequate treatment capacity; inadequate storage capacity

SWIP Susceptibility: Yes
Fire Flow Capability: 11%

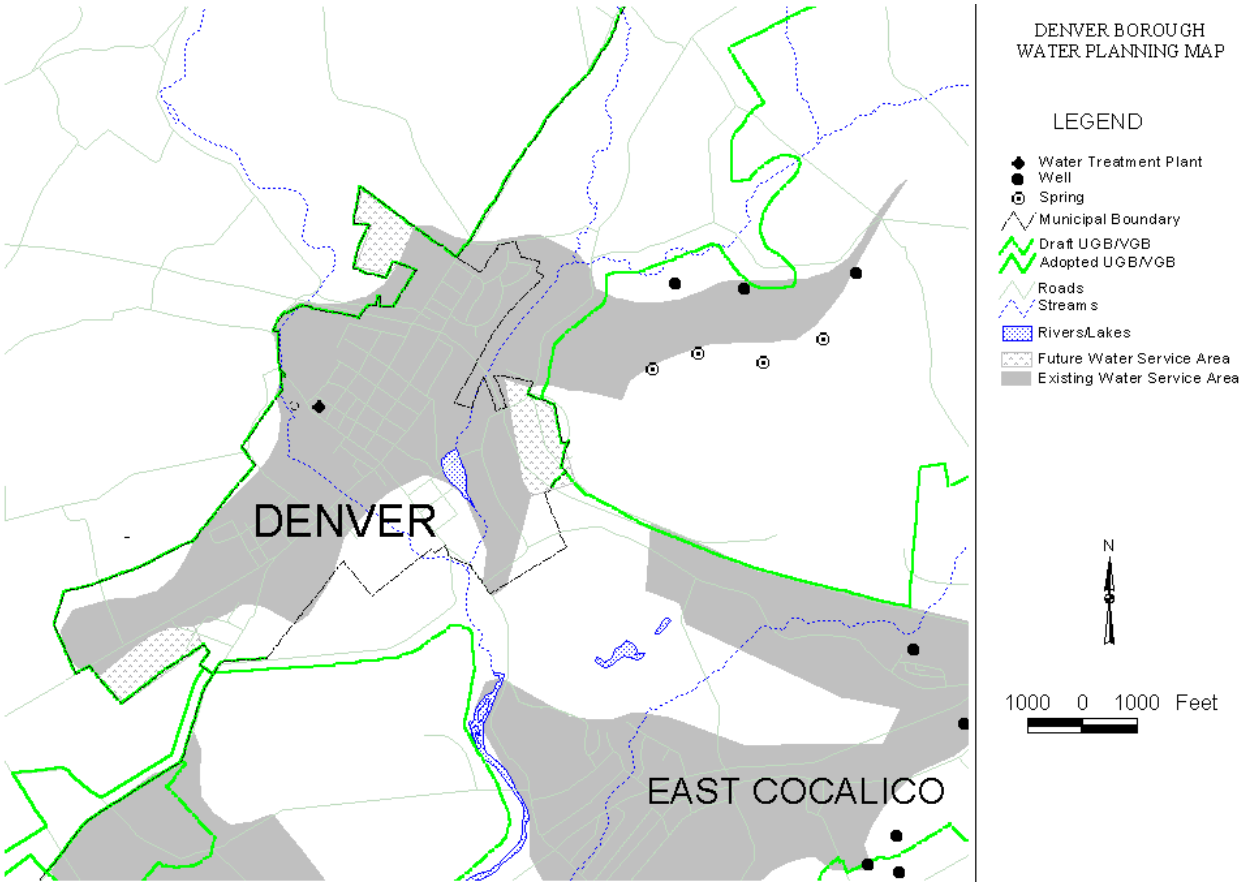
Potential Major Threats to Water Supply: Adjacent development (suburban runoff and reduced recharge); agricultural practices; intensive agriculture; major transportation routes (spills)

Potential Alternative Sources of Water: East Cocalico Township Authority (emergency only)

Priority for Wellhead Protection: High

RECOMMENDATIONS

· Re-evaluate UGB boundary in light of wellhead recharge areas.
· Adopt future service area consistent with UGB.
· Evaluate use of unused water source and establish safe yield.
· Interconnect with East Cocalico Township.
· If West Cocalico's water sources are surface water influenced, provide treatment to it.
· Increase storage capacity.
· Adopt wellhead protection program.
· Update contingency planning.
· Improve fire flow capability.



Attachment 2: Lancaster County Water Resources Plan

EAST COCALICO TOWNSHIP AUTHORITY

SERVICE AREA

Municipalities/Areas Served: East Cocalico Township
Connections to Other Systems: None

Existing Service Area/Urban & Village Growth Boundary Consistency: No; existing service area extends south of Stevens & outside VGB & UGB
Future Service Area/Urban & Village Growth Boundary Consistency: No future service area indicated

WATER SUPPLY

Water Sources: 11 wells

Safe Yield of System: 630,000 GPD
Average Daily Withdrawal: 467,562 GPD

Evaluation of Aquifer(s) for New Water Source Development:

Aquifer Name: Epler, New Oxford

CURRENT SYSTEM DEMAND

Population Served: 7,700

Bulk Water Sales/Purchases: 0
Average Daily Water Use: 467,562 GPD
Peak Daily Water Use: 632,200 GPD

Types of Use (GPD):
Residential, Commercial, Institutional, Other: 363,325 GPD
Industrial: 104,237 GPD

2010 PROJECTED SYSTEM DEMAND

Service Area Population Increase: 6,148
Total Population to be Served: 13,84, 8,

Water Needed to Serve Population Increase: 403,184 GPD
Average Daily Water Use: 870,746 GPD

Types of Use (GPD):
Residential,, Commercial, Institutional, Other: 644,533 GPD
Industrial: 22, , 6,213 GPD

SYSTEM EVALUATION

Projected 2010 Water Excess/Deficit: -240,746 GPD deficit
Projected 2010 Pumping/Storage Capacity Excess/Deficit: Adequate pumping capacity for remaining available water; 3,829,254 gallon storage capacity excess

Water Availability & System Capacity to Serve Build-Out of Service Area Beyond 2010: Inadequate water availability; adequate storage capacity

SWIP Susceptibility: Maybe **Fire Flow Capability:** 80%

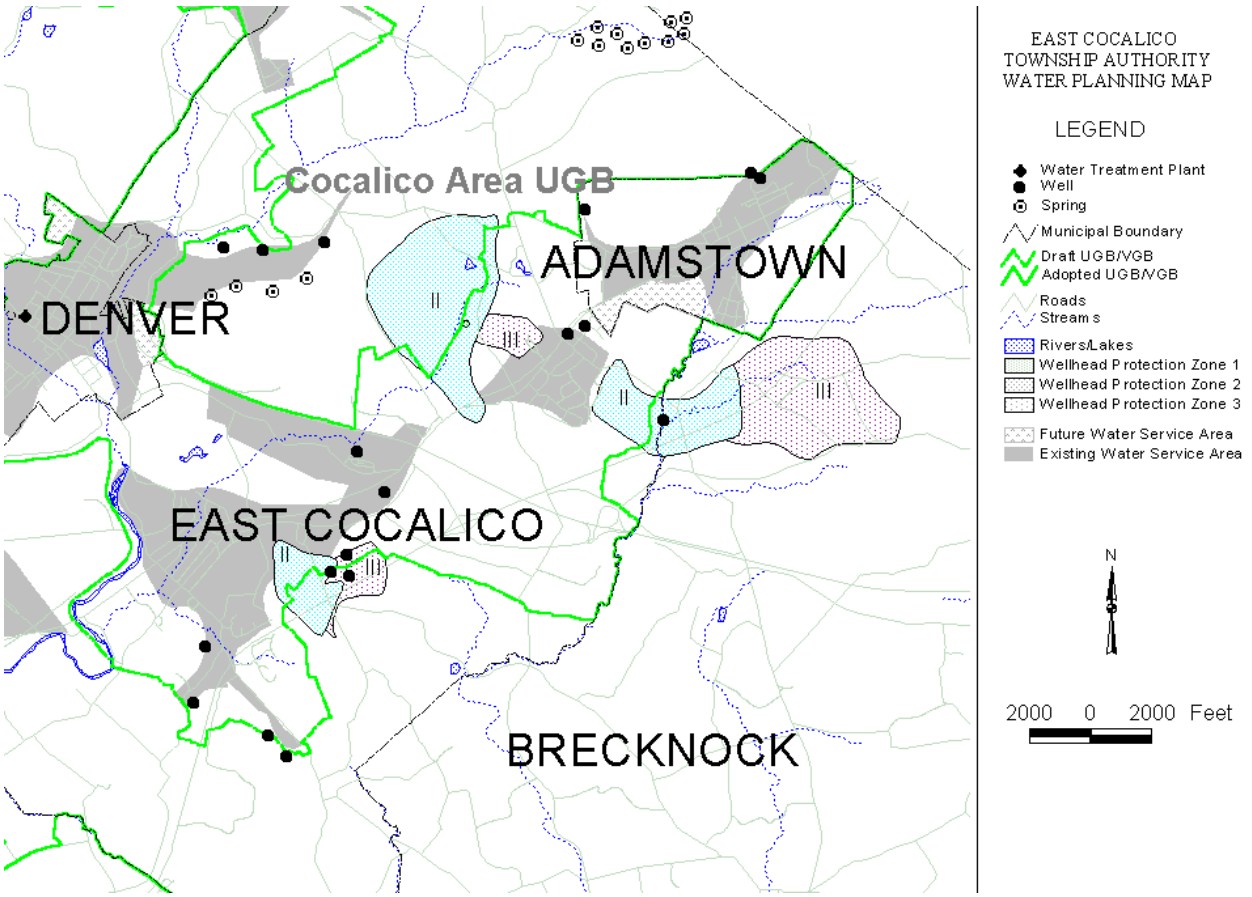
Potential Major Threats to Water Supply: Existing and planned development coincide with delineated wellhead recharge areas (urban runoff and reduced recharge); major transportation routes (spills); industry; agricultural practices; sludge site; cemetery

Potential Alternative Sources of Water: Adamstown Borough Water Department; West Cocalico Township Authority; new wells outside UGB

Priority for Wellhead Protection: High

RECOMMENDATIONS

· Evaluate existing service areas outside UGB and VGB for inclusion within UGB and VGB.
· Re-evaluate UGB boundary in light of wellhead recharge areas for both East Cocalico Township Authority and Adamstown Borough Water Department systems.
· Adopt future service area consistent with UGB and VGB.
· Drill new wells.
· Determine SWIP applicability; if surface water influenced, build treatment plant, possibly in conjunction with Adamstown Borough Water Department.
· Adopt wellhead protection program.
· Update contingency planning.
· Obtain operator certification.



Attachment 2: Lancaster County Water Resources Plan

EPHRATA AREA JOINT AUTHORITY

SERVICE AREA

Municipalities/Areas Served: Ephrata Borough, Ephrata Township, & parts of Clay & West Earl Townships
Connections to Other Systems: Akron Municipal Authority

Existing Service Area/Urban Growth Boundary Consistency: No; existing service area extends west & north into Ephrata Township & outside UGB
Future Service Area/Urban Growth Boundary Consistency: No future service area indicated

WATER SUPPLY

Water Sources: 3 wells, Cocalico Creek

Safe Yield of System: 2,500,000 GPD
Average Daily Withdrawal: 1,968,071 GPD

Evaluation of Aquifer(s) for New Water Source Development:

Aquifer Name: Stonehenge, Richland, Millbach, Snitz Creek, Epler, New Oxford, Hammer Creek

CURRENT SYSTEM DEMAND

Population Served: 15,000

Bulk Water Sales/Purchases: 75,970 GPD sold
5,129 GPD purchased
Average Daily Water Use: 1,962,942 GPD[1]
Peak Daily Water Use: 2,570,000 GPD

Types of Use (GPD):
Residential, Commercial, Institutional, Other: 1,861,254 GPD
Industrial: 101,688 GPD

2010 PROJECTED SYSTEM DEMAND

Service Area Population Increase: 7,712
Total Population to be Served: 22,712

Water Needed to Serve Population Increase: 1,024,848 GPD
Average Daily Water Use: 2,987,790 GPD

Types of Use (GPD):
Residential, Commercial, Institutional, Other: 2,739,286 GPD
Industrial: 248,504 GPD

SYSTEM EVALUATION

Projected 2010 Water Excess/Deficit: -487,790 GPD deficit
Projected 2010 Pumping/Storage Capacity Excess/Deficit: -918,259 GPD deficit (assuming all sources treated); adequate pumping capacity; 1,604,081 gallon storage capacity excess

[1]includes bulk water purchased; excludes bulk water sold

Water Availability & System Capacity to Serve Build-Out of Service Area Beyond 2010: Inadequate water availability and treatment capacity; adequate storage capacity

SWIP Susceptibility: Maybe

Fire Flow Capability:

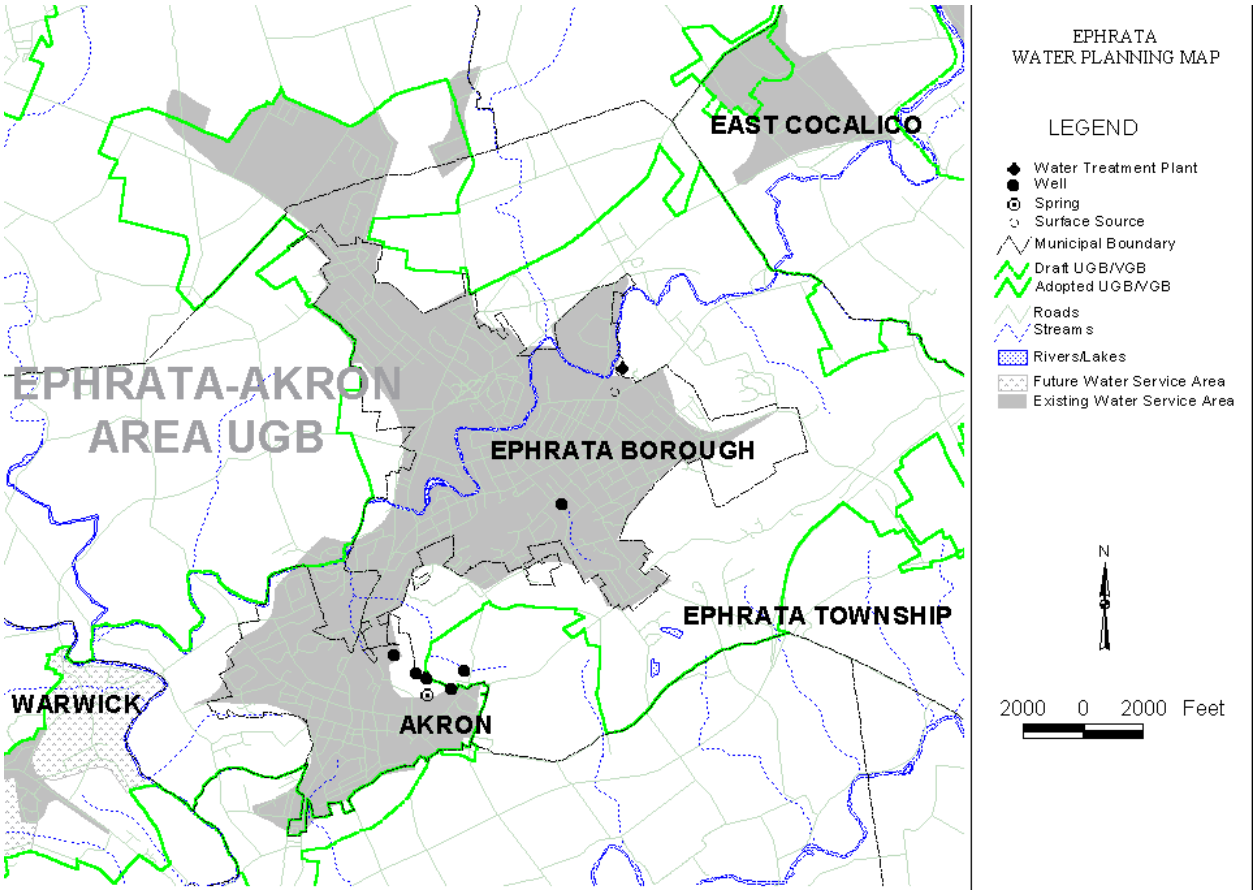
Potential Major Threats to Water Supply: Adjacent development (urban runoff and reduced recharge); industry; storage tank; RCRA site; recycling center; cemetery; agricultural practices; carbonate geology; high system leakage rate

Potential Alternative Sources of Water: New wells outside UGB

Priority for Wellhead Protection: High

RECOMMENDATIONS

· Evaluate existing service areas outside UGB for inclusion within UGB.
· Adopt future service area consistent with UGB.
· Determine SWIP applicability of wells; if surface water influenced, enlarge treatment plant and provide treatment for Akron Municipal Authority.
· Drill new wells.
· Adopt wellhead protection program.
· Expand leak detection program.
· Update contingency planning.
· Improve fire flow capability.



Attachment 2: Lancaster County Water Resources Plan

WARWICK TOWNSHIP MUNICIPAL AUTHORITY (Rothsville)

SERVICE AREA

Municipalities/Areas Served: Rothsville area
Connections to Other Systems: None

Existing Service Area/Urban Growth Boundary Consistency: Yes
Future Service Area/Urban Growth Boundary Consistency: Yes

WATER SUPPLY

Water Sources: 1 well

Safe Yield of System: 288,000 GPD
Average Daily Withdrawal: 107,665 GPD

Evaluation of Aquifer(s) for New Water Source Development:

Aquifer Name: Richland, Epler, Snitz Creek, Stonehenge

CURRENT SYSTEM DEMAND

Population Served: 1,570

Bulk Water Sales/Purchases: 0
Average Daily Water Use: 107,665 GPD
Peak Daily Water Use: 214,200 GPD

Types of Use (GPD):
Residential, Commercial, Institutional, Other: 107,665 GPD
Industrial: 0

2010 PROJECTED SYSTEM DEMAND

Service Area Population Increase: 473
Total Population to be Served: 2,043

Water Needed to Serve Population Increase: 43,839 GPD
Average Daily Water Use: 151,504 GPD

Types of Use (GPD):
Residential, Commercial, Institutional, Other: 142,120 GPD
Industrial: 9,384 GPD

SYSTEM EVALUATION

Projected 2010 Water Excess/Deficit: 136,496 GPD excess
Projected 2010 Pumping/Storage Capacity Excess/Deficit: Residual pumping capacity NA; -200,000 gallon storage capacity deficit

Water Availability & System Capacity to Serve Build-Out of Service Area Beyond 2010: Adequate water availability and inadequate storage capacity

SWIP Susceptibility: Maybe

Fire Flow Capability: 0%

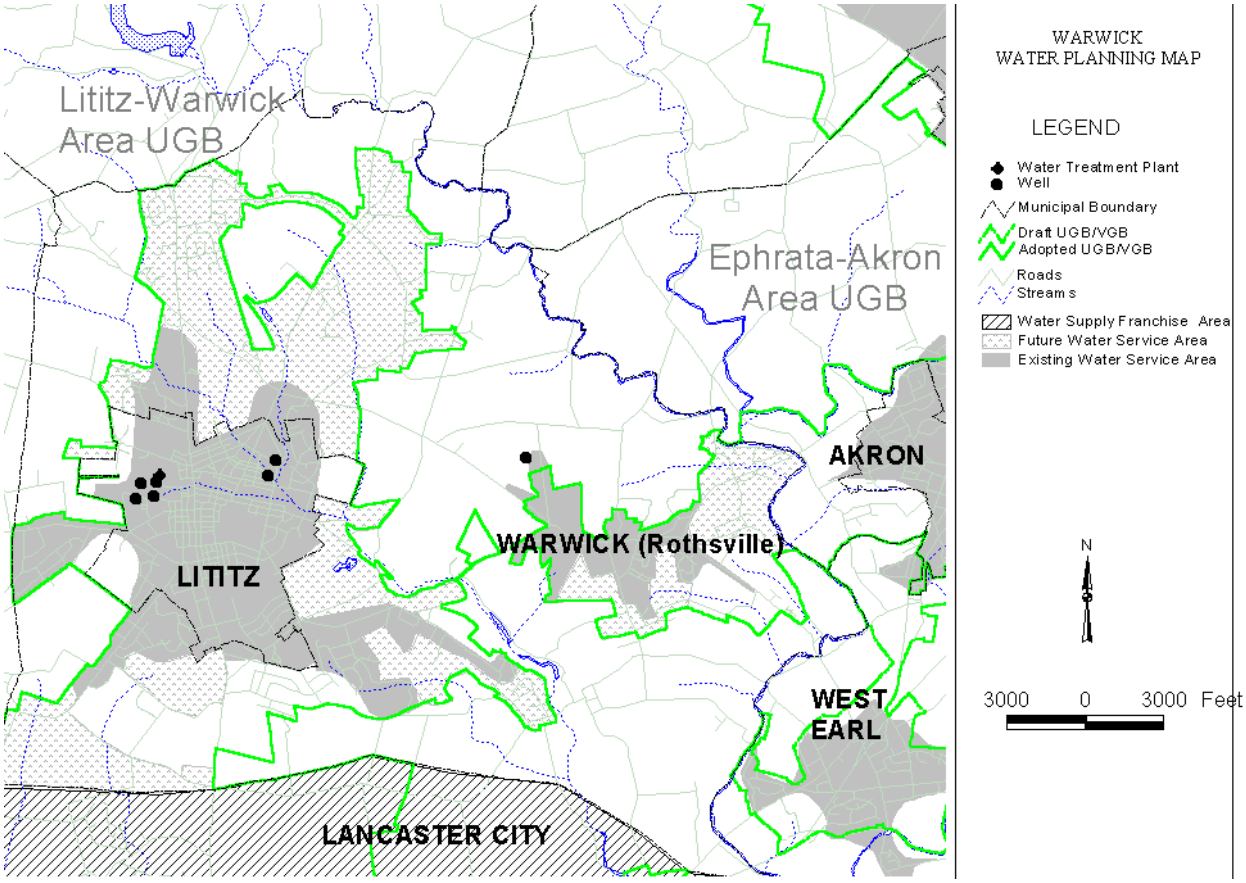
Potential Major Threats to Water Supply: Agricultural practices; intensive agriculture; industry; RCRA sites; cemetery; on-lot septics

Potential Alternative Sources of Water: Warwick Township Municipal Authority (Lititz)

Priority for Wellhead Protection: Medium

RECOMMENDATIONS

· Interconnect with Warwick Township Municipal Authority (Lititz).
· Determine SWIP applicability; if source surface water influenced, abandon source and purchase bulk water from Warwick Township Municpal Authority (Lititz).
· Increase storage capacity, possibly in conjunction with Littiz Borough Waterworks.
· Update contingency planning.
· Improve fire flow capability.



Attachment 2: Lancaster County Water Resources Plan

WEST COCALICO TOWNSHIP AUTHORITY

SERVICE AREA

Municipalities/Areas Served: West Cocalico Township & part of East Cocalico Township
Connections to Other Systems: None

Existing Service Area/Village Growth Boundary Consistency: No; existing service area extends north outside VGB
Future Service Area/Village Growth Boundary Consistency: No future service area indicated

WATER SUPPLY

Water Sources: 2 wells

Safe Yield of System: 500,000 GPD
Average Daily Withdrawal: 141,370 GPD

Evaluation of Aquifer(s) for New Water Source Development:

Aquifer Name: Hammer Creek, New Oxford, Epler

CURRENT SYSTEM DEMAND

Population Served: 2,088

Bulk Water Sales/Purchases: 0
Average Daily Water Use: 141,370 GPD
Peak Daily Water Use: 401,000 GPD

Types of Use (GPD):
Residential, Commercial, Institutional, Other: 398,483 GPD
Industrial: 2,517 GPD

2010 PROJECTED SYSTEM DEMAND

Service Area Population Increase: 1,467
Total Population to be Served: 3,555

Water Needed to Serve Population Increase: 157,571 GPD
Average Daily Water Use: 270,550 GPD

Types of Use (GPD):
Residential, Commercial, Institutional, Other: 238,928 GPD
Industrial: 31,622 GPD

SYSTEM EVALUATION

Projected 2010 Water Excess/Deficit: 201,059 GPD excess
Projected 2010 Pumping/Storage Capacity Excess/Deficit: Adequate pumping capacity; 20,000 gallon storage capacity excess

Water Availability & System Capacity to Serve Build-Out of Service Area Beyond 2010: Adequate water availability and storage capacity

SWIP Susceptibility: Maybe **Fire Flow Capability:** 17%

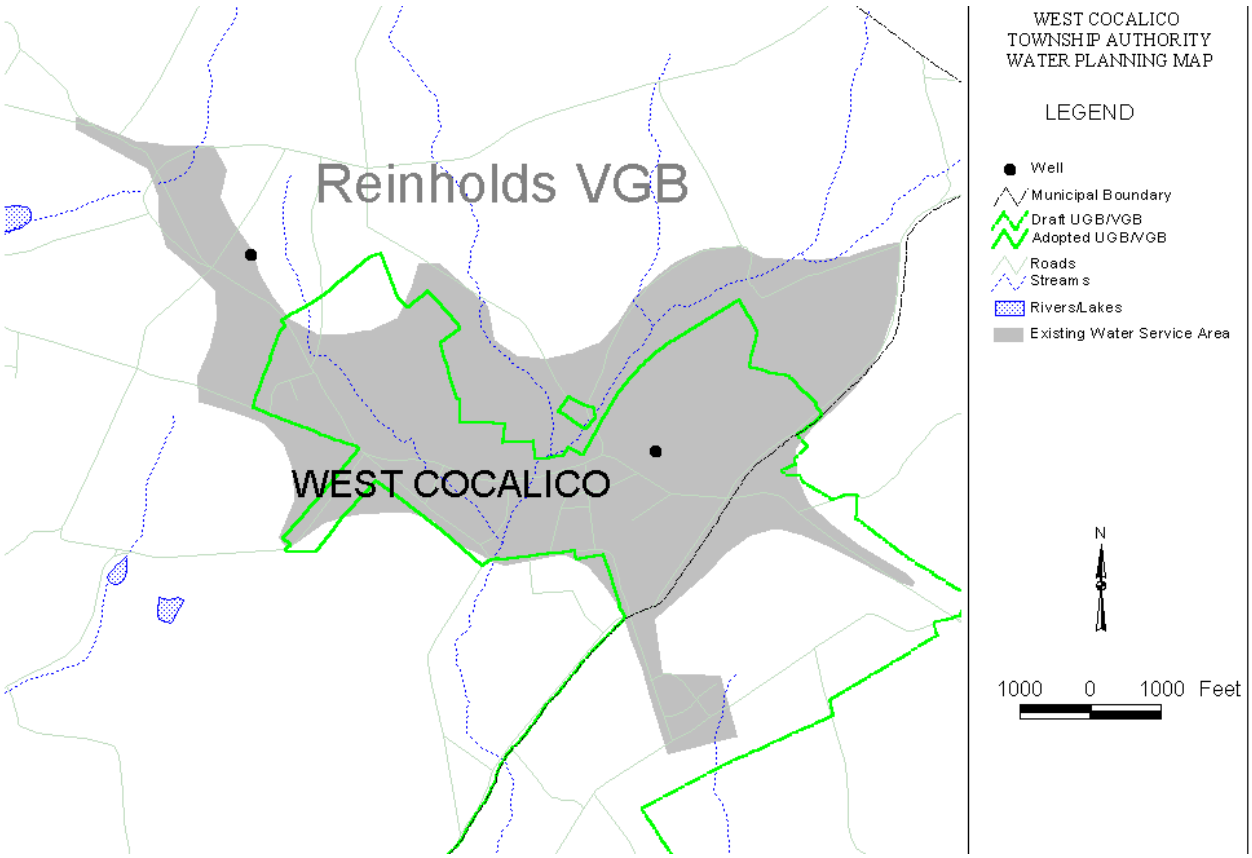
Potential Major Threats to Water Supply: Adjacent development (suburban runoff and reduced recharge); agricultural practices; intensive agriculture; industry; cemetery; on-lot septics; major transportation route (spills)

Potential Alternative Sources of Water: NA

Priority for Wellhead Protection: High

RECOMMENDATIONS

· Evaluate existing service areas outside VGB for inclusion within VGB.
· Adopt future service area consistent with VGB. · Determine SWIP applicability; if sources surface water influenced, interconnect with Denver Borough Authority and utilize its treatment capacity.
· Increase storage capacity, possibly in conjunction with Denver Borough.
· Adopt wellhead protection program.
· Provide direct service to East Cocalico Township.
· Update contingency planning.
· Improve fire flow capability.



Attachment 3. Considerations for the Amendment of the Cocalico Watershed Act 167 Plan in relation to Floodplain Restoration

- **Section 102**: "*Encourage recharge of groundwater…*," "*Maintain existing flows and quality of streams…*," and "*preserve and restore the flood-carrying capacity of streams*." **All of these are accomplished through floodplain restoration more effectively than by more conventional stormwater management BMPs.**
- **Section 302.6**: "*Stormwater management facilities located within or affecting the floodplain or any watercourse shall also be subject to the requirements of Section 306 (Floodplain) of this Ordinance, the [Name of Municipality] Zoning Ordinance…*" **This section implicitly allows for stormwater management facilities in the floodplain. See "Considerations for Amendments to Floodplain Recommendations" in Section 5**
- **Section 306** (referenced below) does not restrict floodplain restoration; however **individual municipal zoning ordinances should also be considered and revised as necessary. See "Considerations for Amendments to Floodplain Recommendations " in Section 5.**
- **Sections 302.C and 302.D and Sections 304.F and 304.G**: These sections refer to Groundwater Recharge and Water Quality volume requirements and calculations. These criteria are oriented towards conventional stormwater BMP's and do not adequately capture the recharge and water quality benefits of floodplain restoration. **A better set of criteria would be the 2006 PA Stormwater BMP Manual (PA BMP Manual), which has additional provisions for quantifying the benefits of various BMPs including floodplain restoration. See Toolbox, Stormwater Management BMP's.**
- **Section 808** allows the Municipality to grant a modification of requirements if "an alternative proposal will allow for equal or better results." A modification citing the Groundwater Recharge and Water Quality criteria given in the PA BMP Manual and referencing the additional benefits of floodplain restoration should be justified. **It is recommended that municipalities adopt additional ordinance provisions that specifically refer to the PA BMP Manual, thereby avoiding the need for modifications to allow its use. See Toolbox, Stormwater Management BMP's.**
- **Section 302.E**: This section refers to riparian corridor preservation and vegetation, with specific goals of reducing thermal impacts and protecting the stream channel. **Floodplain restoration inherently involves establishing sustainable and functioning riparian buffers and can effectively meet the goals stated in this section. See Toolbox, Riparian Buffers.**
- **Section 302.F**: This section permits regional stormwater management by one or more developers, and specifically states that this can be on-site or off-site. Floodplain restoration provides stormwater management benefits on a watershed scale, and these benefits can be realized either on-site or off-site. **Peak attenuation provided by an on-site or off-site floodplain restoration project can be demonstrated by modifying the exiting Act 167 Cocalico Creek Watershed TR-20 model to reflect the additional flood storage provided by the project. Off-site benefits would be most effective when the restoration project site is upstream of the development site. See "Regional Stormwater management Strategy for Cocalico Creek Watershed" in Section 4.**
- **Section 302.G**: "*For any proposed development, the developer has the option of using a less restrictive runoff control if the developer can prove that "no harm" would be caused by discharging at a higher runoff rate than specified by the Plan*." **Sections 302.A and 302.B** specify that, for all

design storm events, the post development runoff hydrograph must either match the pre-development hydrograph at all points or the peak flow rate must be 50% or less of the pre-development peak rate. The "No Harm" option provides a third alternative that requires: 1. matching peak flows from the Cocalico Creek Watershed Act 167 TR-20 model at all points, and 2. Verifying stable conveyance and adequate capacity of the drainage system between the site and the mainstem of the Cocalico Creek. For floodplain restoration projects located on the Cocalico Creek or on a tributary immediately above the confluence with the mainstem, meeting this option requires adding the proposed condition development data and the storage data resulting from the floodplain restoration to the Act 167 TR-20 model to demonstrate that the pre-development peak flow rates are met. For project sites off line of the mainstem, an analysis of the tributary from the project site to the mainstem would also be required to demonstrate stability and flood elevations. Under **Section 303.S**, the developer would have the option to upgrade existing structures to relieve existing deficiencies and accommodate increased flows downstream of the project site if necessary to qualify for the No Harm Option. If an increase in flood elevations in the tributary would result from the project, agreements may need to be secured with downstream property owners. **This provision is favorable with respect to the floodplain restoration BMP, especially for projects sites on the main stem of the Cocalico Creek**. **See "Regional Stormwater management Strategy for Cocalico Creek Watershed" in Section 4.**

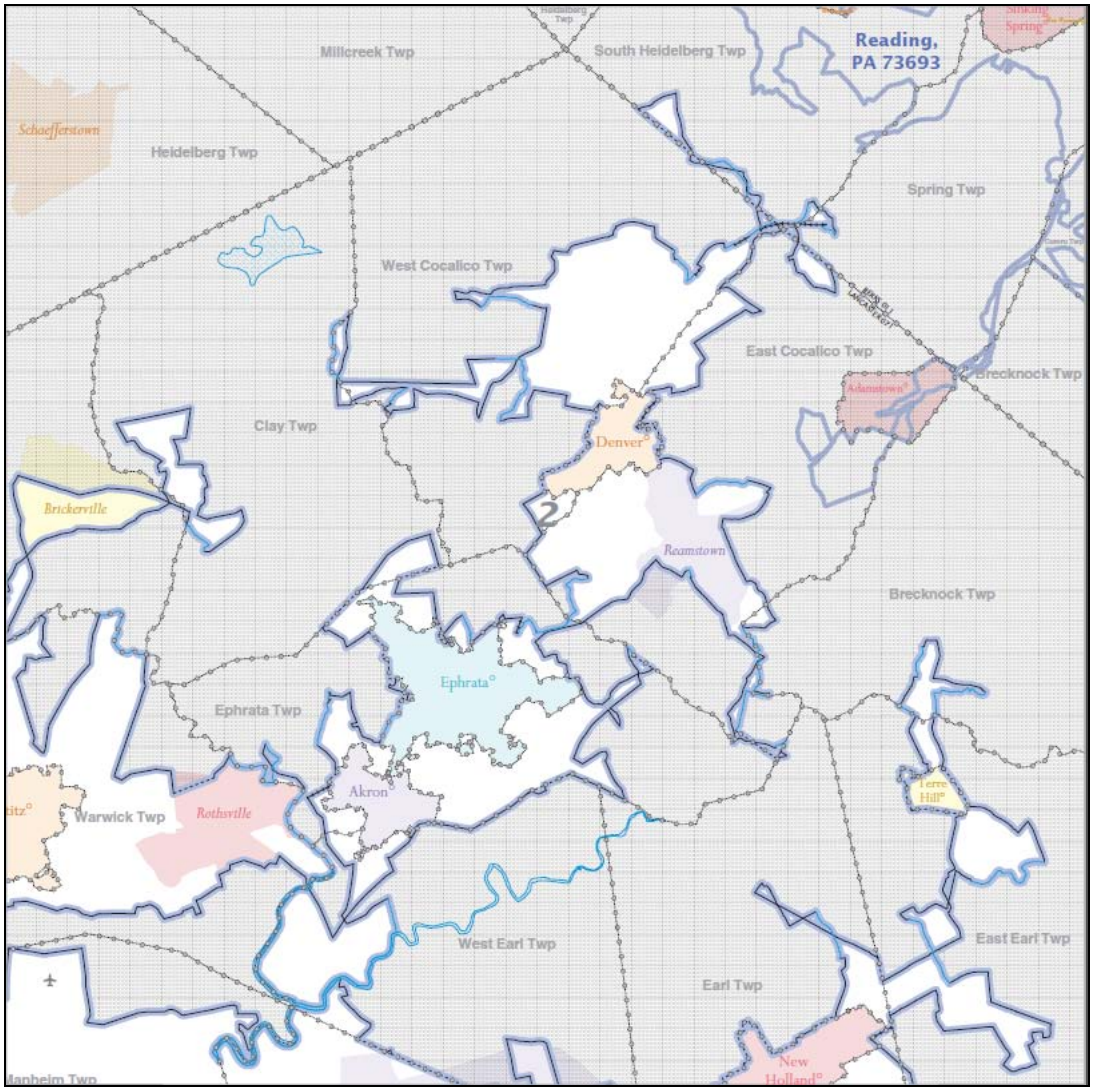
- **Section 304.D and 304.E(1)**: The Ordinance requires runoff coefficients to be "*based on actual land use assuming summer or good land conditions*" and "*be based on the information contained in Appendix B2 and B3…*" These requirements can diminish the observed benefits of floodplain restoration in two ways. In many cases the existing cover condition in floodplain areas is poor. For example, overgrazed pastures tend to have un-vegetated areas and be severely compacted. Accurately assessing the existing land cover condition in the area to be restored will provide a more realistic measure of the benefit. In addition, areas impacted by legacy sediments tend to have low infiltration rates as a result of the compacted fine sediments (clay) that have accumulated. Measurement of infiltration rates at the existing land surface and at the historic floodplain typically shows the potential for significantly higher infiltration in the restored floodplain. Runoff curve numbers are given by hydrologic soil group (HSG), which is determined by soil permeability and classified as A through D. Soils classified as HSG A have higher permeability and HSG D soils have lower permeability rates The HSG is assigned to the soil type based on generalized soil properties. Based on the anticipated increased permeability of the restored floodplain, it is reasonable to adjust the HSG for the restoration area. This would result in the use of a lower runoff curve number for the restoration area based on the adjusted HSG. The requirements of these sections could be modified under **Section 808**; however an ordinance provision for these factors that are specific to floodplain restoration would remove a potential barrier in the review process. **Therefore, it is recommended that the Ordinance be amended to allow more accurate selection of runoff curve numbers for floodplain restoration projects. See "Regional Stormwater management Strategy for Cocalico Creek Watershed" in Section 5.**
- **Section 305.A(2)**: This section specifically states that Groundwater Recharge and Water Quality Volumes should be considered in the post development runoff hydrographs. This allows the runoff model to effectively capture the benefits of the selected stormwater management BMPs, including

floodplain restoration. **While the Act 167 Model Ordinance includes this provision, many municipal stormwater ordinances do not allow Groundwater Recharge and Water Quality Volumes to be considered in the pre-/ post peak flow comparison.**

- **Sections 306.C and 306.D**: These sections allow stormwater management facilities to be located in the floodplain, provided that they meet the listed criteria. **This would permit the use of Floodplain Restoration as a stormwater management BMP.**
- **Section 404.E**: This provision requires that, unless an alternate schedule is approved by the Municipality, stormwater management facilities be constructed and As-Built Plans be submitted within one year of approval or the Stormwater Management plan may be considered disapproved. Due to permitting, seasonal considerations, and construction sequencing, the one-year timeframe may not be adequate for a floodplain restoration project. Although an alternate schedule could be approved, this requirement could become an unnecessary procedural hurdle. **It is recommended that this section be revised to allow two years for the construction of a floodplain restoration project and the submission of As-Built Plans.**
- **Section 501**: This section pertains to construction inspections. Section 803.C(1) requires that a qualified person certify that the stormwater management facilities have been constructed according to the approved plans and specifications. Without having observed the construction of the facilities it would be difficult to make such a certification. In addition stormwater management BMPs, especially Floodplain Restoration, require great care and expertise to be constructed correctly. These facilities will likely fail if proper construction oversight is not provided. **Therefore, it is recommended that a provision be added requiring that a qualified individual oversee the installation of all stormwater management BMPs. See Toolbox, "Stormwater Management BMP Management Authority"**
- **Sections 703 and 704**: These sections require maintenance agreements for stormwater management BMPs. A monitoring and maintenance plan should be established for Floodplain Restoration Projects. **Where the restoration area is located on the development site, the area should be located on a parcel owned by a homeowners association or another organization that has entered into an agreement to maintain the floodplain in accordance with the plan. Where the restoration area is located off-site, an easement should be established and the municipality or another organization should enter into an agreement to maintain the area. The ordinance does reference the possibility of establishing a Municipal Stormwater Maintenance Fund to support ongoing monitoring and maintenance of stormwater management facilities. See Toolbox, "Stormwater Management BMP Management Authority"**

Attachment 4: U.S. Census Bureau Urbanized Areas Outline Map

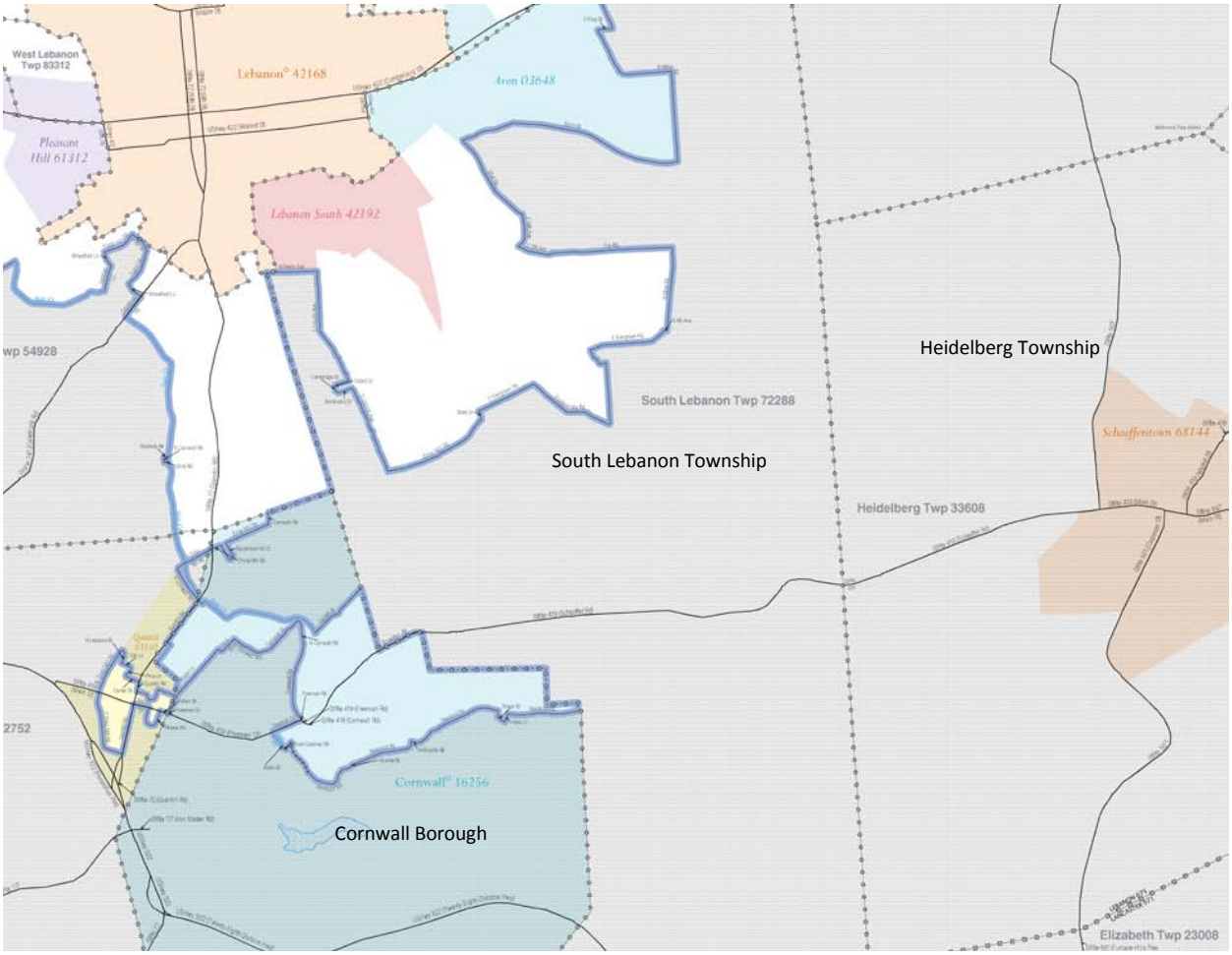
Excerpt from Map of Lancaster, PA



Townships and boroughs that contain urban areas outlined in blue must participate in the MS4 stormwater management regulations.

Attachment 4: U.S. Census Bureau Urbanized Areas Outline Map

Excerpt from Map of Lebanon, PA



Townships and boroughs that contain urban areas outlined in blue must participate in the MS4 stormwater management regulations.

Attachment 4: U.S. Census Bureau Urbanized Areas Outline Map

Excerpt from Map of Reading, PA

Townships and boroughs that contain urban areas outlined in blue must participate in the MS4 stormwater management regulations. Millcreek Township, Lebanon County may have an exception.

Section 6
Integration of Water Resource Needs in the Watershed

The research findings completed and described earlier in this report were utilized to identify the water resource management issues in the basin. Watershed maps were developed to spatially identify areas where there may be water resource concerns that could be addressed via a restoration project.

These findings were presented to the watershed stakeholders at a public meeting in the spring 2008. Municipalities were invited to this meeting, and announcements were placed in the watershed association newsletter as well. The purpose of the public meeting was to solicit input and comments from the watershed stakeholders on the findings regarding water resource issues in the basin.

A table of identified and potential water resource issues (Table 6.1) was developed for the watershed and distributed at the public meeting as a means of both summarizing research findings and soliciting feedback from the stakeholders on the issues. The table and watershed maps developed as part of this study were utilized to engage stakeholders in discussions of water resource issues in the basin.

The feedback from the public meeting was summarized in a watershed map of identified problem areas (Figure 6.1). These problem areas, identified by the stakeholders, were then utilized to assist in identifying priority restoration projects for the watershed (Section 7). The comments from the municipality representatives that attended the meeting were particularly useful. These representatives routinely work on comments and issues raised by their constituents within their jurisdictions, and they know the watershed very well with respect to resource issues.

After discussions following the public meeting on water resource issues in the watershed, we felt that additional input from the municipalities that had not attended any of the public meetings was needed. We recommended that, as part of the identification of priority restoration projects for the watershed, we would solicit one-on-one meetings with interested municipalities at their offices to gather additional input for the restoration plan.

Figure 6.1

Problem Areas in the Cocalico Creek Watershed

Subwatershed Boundaries

Streams and Lakes

- Siltation and Flooding – Harnish Run
- Erosion and Flooding – Denver to Reinhold
- Erosion and Flooding – Denver Borough
- Stormwater runoff and Flooding
- Flooding – Academy Drive
- Siltation – Blue Lake
- Flooding – Akron Borough
- Flooding – Ephrata Borough

LandStudies

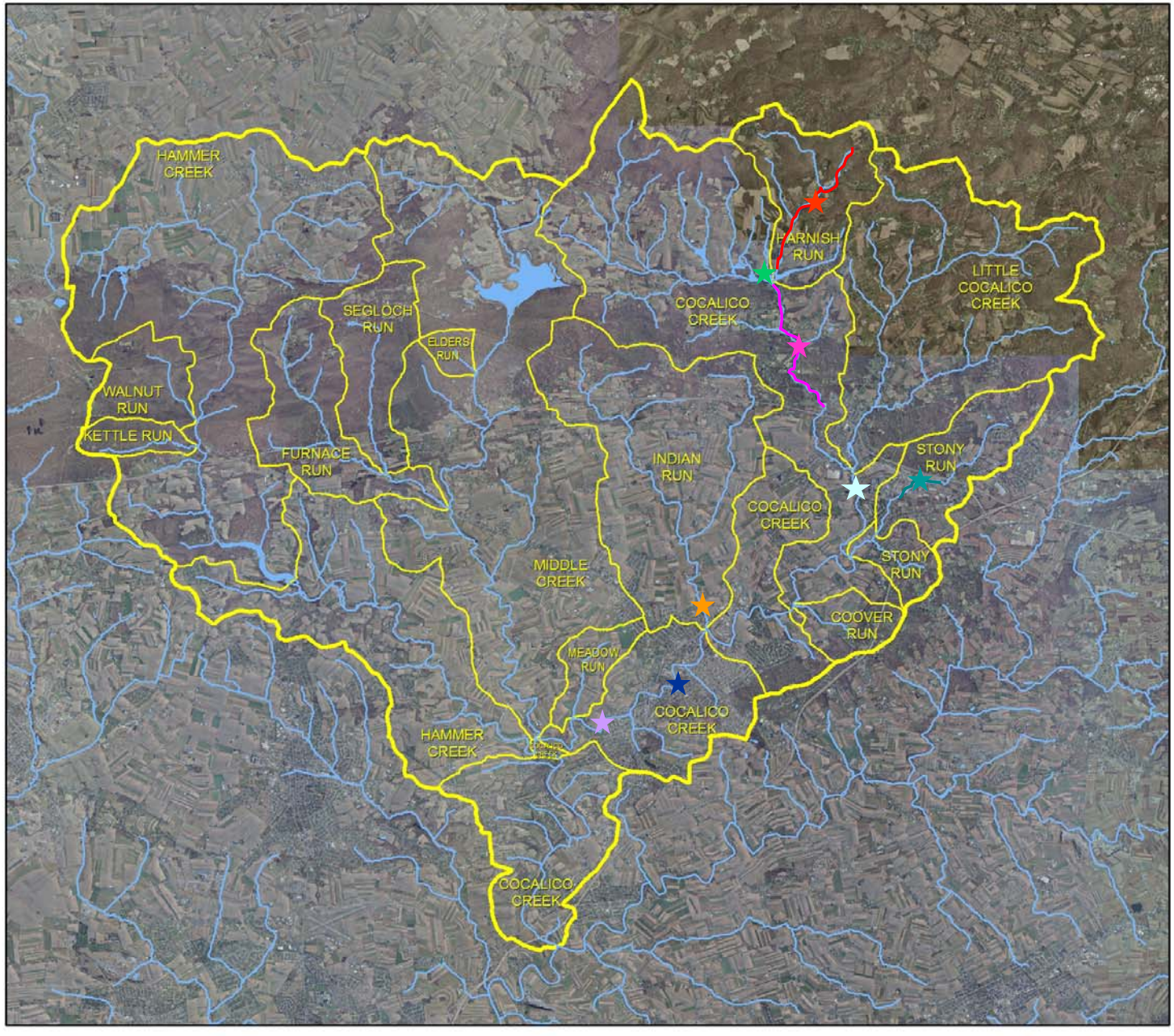


Table 6.1. **Water Resource Issues Matrix - Cocalico Creek Watershed.**

		Management and Restoration Issues, Needs, and Opportunities							
SUBWATERSHEDS	**SUBWATERSHED AREA (sq. mi.)**	**CARA Areas**	**Impaired Stream Segments (303d)**	**Legacy Sediment Areas (Former Mill Dams)**	**Stormwater (Flooding) Problem Areas**	**Wastewater Facilities**	**Wellhead Protection and Water Supply Areas**	**Groundwater Supply Issue Areas**	**Development Pressure Areas (Act 167 Plan)**
Cocalico Creek: 8157 and 8151	**6.1**	**low**	**high**						
Middle Creek	**23.7**	**high**		**10**					**1**
Elders Run	**0.5**								
Furnace Run	**4.7**			**1**					
Segloch Run	**3.4**								
Hammer Creek	**32.1**	**med**	**high**	**18**			**1**		**2**
Kettle Run	**0.9**								
Walnut Run	**2.2**								
Cocalico Creek: 8063	**5.3**		**high**	**2**	**high**	**2**	**6**		
Meadow Run	**1.3**	**low**	**high**	**1**					
Indian Run	**12.0**	**high**		**3**					
Cocalico Creek: 7835	**4.4**	**high**	**high**	**2**					
Coover Run	**1.4**		**high**				**3**		
Cocalico Creek: 7543	**18.4**			**8**	**high**	**1**	**2**		**2**
Harnish Run	**4.2**			**2**	**high**				
Little Cocalico Creek	**14.7**			**9**		**1**	**7**		
Stony Run	**4.7**		**high**		**high**		**2**		**1**

Number of identified areas in each subwatershed, or a general categorization of the issue (high, medium, or low) are utilized in the matrix.

Section 7
Identification of High Priority Sites for Restoration

The research findings and watershed issues matrix, along with the problem areas identified by the stakeholders at the public meeting (spring 2008), were used to plan and conduct field reconnaissance trips to the watershed areas. As discussed in Section 6, we held one-on-one meetings with interested municipal officials that responded to our meeting requests. These meetings were held at the respective municipal offices, and the watershed issue maps were used as a starting point to solicit their input on changes to identified issue areas, and additional issue areas in the watershed where resource problems exist. These one-on-one municipal meetings were extremely beneficial for identifying specific areas in their jurisdictions where we needed to field investigate water resource problems.

As a side note, we strongly recommend that one-on-one meetings with local government representatives, in their offices, be utilized to solicit input. This is a far more fruitful approach than holding "municipal meetings" or watershed meetings where municipal representatives are invited.

Numerous reconnaissance trips were completed to identify priority restoration projects for the watershed. We extensively utilized the impaired waters designations and problem areas as identified by stakeholders as a guide in planning field reconnaissance trips. CARA areas and historic mill dam locations were utilized as well for visits, and were also utilized to assist in interpreting our field observations. Photographs and field notes were taken for each visit, and the findings were summarized and developed into a "Cocalico Creek Priority Sites" table (Table 7.1). Map locations for each site, identified in the table as map page and coordinates, refer to the ADC Street Map Book for Lancaster County (13th edition, Alexandria Drafting Company, Alexandria, VA).

Priority rankings (high, medium and low) were not made until all sites were visited and project summary sheets were developed for each priority restoration site. The priorities reflected in Table 7.1 were subjective and made by the project investigators. A priority ranking was determined relative to all the other priority project sites. Severity of the water resource issues at the site was the primary determinant for a priority ranking, although restoration constraints such as access (either physical access or landowner permission or likely landowner interest in the restoration) also influenced the priority ranking.

A total of 25 priority restoration projects were identified for this plan. Of these 25 sites, 13 were categorized as high priority sites, 7 as medium priority sites, and 5 as low priority sites. These are subjective in nature, and it is recommended that the watershed stakeholders and those soliciting funding for restoration go visit these sites and develop

their own priority ranking. They can then determine which sites they want to emphasize in their endeavors to secure funding.

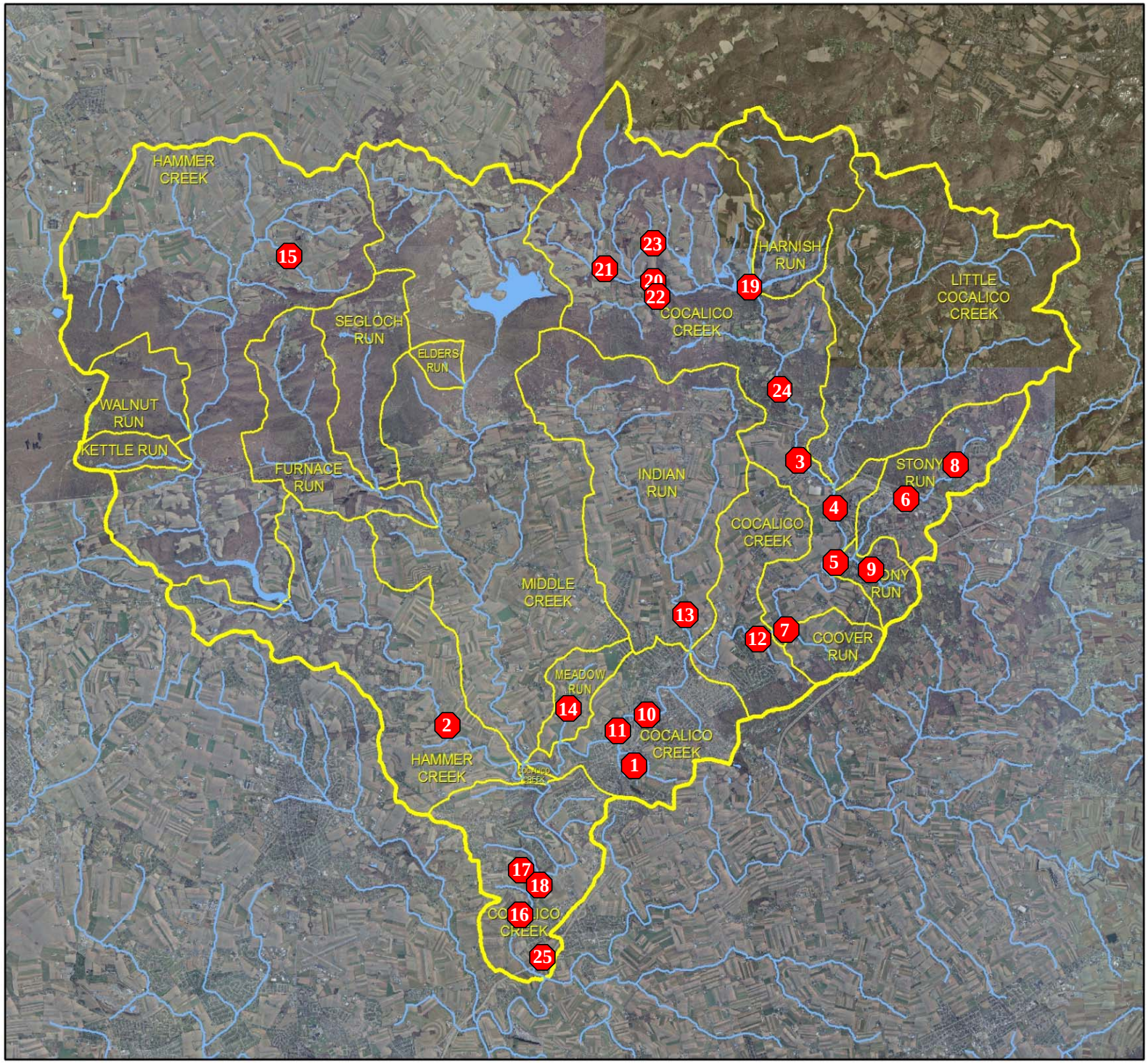
There are undoubtedly many additional sites in the watershed where restoration is needed. Our approach in this plan is to utilize resource research findings and stakeholder input to identify those sites that collectively represent the highest priority sites in the watershed. It would be erroneous to conclude that there are no other high priority restoration sites in the watershed. We did not visit every mile of stream in the watershed, nor could anyone be expected to for this project. That is why three public meetings were held as part of this project to solicit input from those who know the watershed best. It should be well understood that this plan is a document that can and should be updated and appended as continued input is gathered on these and other resource sites in the watershed.

Each of the 25 priority project sites is summarized in a 2-page report for each site, included as Appendix 1 at the end of this report. A watershed map showing the location of these 25 priority project sites is provided in Figure 7.1 These project summaries provide location maps, site summaries, recommended restoration approaches, benefits of the proposed restoration, priority rankings, restoration cost ranges, restoration time frames, potential funding sources for the restoration, and field pictures of the site and restoration issues at the site. The cost ranges provided in these project summaries are generic in nature, with the costs being those that are typical for similar projects. The purpose of the restoration cost ranges is to provide a perspective on the general level of funding that needs to be sought to pursue restoration at the site.

Figure 7.1

Composite Map of Priority Sites

Numbers Refer To Those in Table 7.1



LandStudies

Table 7.1 Priority Restoration Projects in the Cocalico Creek Watershed.

Priority Site	Township	Watershed Map	Priority	Stormwater and/or Flooding	Legacy Sediments	Agricultural	Dams or Channelization	Impairments	Groundwater SWPA
Unnamed Tributary in Akron Borough Park	Akron Borough	1	low		yes	yes	yes		yes
Hammer Creek - Buch Mill Road to Meadow Valley Road	Ephrata Twp. and Warwick Twp.	2	medium		yes	yes		yes	
Cocalico Creek in Denver - Fourth Street to Memorial Park	Denver Borough and West Cocalico Township	3	high	yes	yes				
Cocalico Creek at Fox Chase	East Cocalico Twp.	4	medium	yes	yes	yes	yes	yes	
Stony Run at Church Street in Reamstown	East Cocalico Twp.	5	high	yes	yes	yes	yes	yes	
Stony Run near Stony Run Industrial Park	East Cocalico Twp.	6	high	yes	yes	yes	yes	yes	
Coover Run	East Cocalico Twp.	7	high	yes	yes	yes	yes	yes	
Stony Run near Hill Road	East Cocalico Twp.	8	high	yes	yes	yes		yes	
Unnamed Tributary to Stony Run	East Cocalico Twp.	9	medium	yes			yes	yes	
Cocalico Creek at Haller Dam	Ephrata Borough	10	high	yes	yes		yes	yes	
Cocalico Creek at Niss Avenue	Ephrata Borough	11	low	yes	yes			yes	
Cocalico Creek near Green Dragon	Ephrata Township	12	high	yes	yes	yes		yes	
Indian Run	Ephrata Township	13	low	yes	yes	yes			
Meadow Run	Ephrata Township	14	high		yes	yes		yes	
Unnamed Tributary to Hammer Creek	Heidelberg Twp.	15	high		yes	yes		yes	
Cocalico Creek below Log Cabin Road	Warwick Twp.	16	medium	yes	yes	yes			
Unnamed Tributary to Cocalico Creek at Disston View Drive	Warwick Twp.	17	high		yes	yes		yes	
Unnamed Tributary to Cocalico Creek at Rose Hill Road	Warwick Twp.	18	low		yes	yes	yes		
Blue Lake on Cocalico Creek	West Cocalico Twp.	19	high	yes	yes		yes		
Cocalico Creek at Hickory Road	West Cocalico Twp.	20	high	yes	yes	yes			
Cocalico Creek Shenks Mill Road	West Cocalico Twp.	21	medium		yes	yes			
Indian Run along Hickory Road	West Cocalico Twp.	22	high	yes	yes	yes			
Unnamed Tributaries to Cocalico Creek along Route 897	West Cocalico Twp.	23	medium		yes	yes			
Cocalico Creek along Greenville Road	West Cocalico Twp.	24	medium	yes	yes		yes		
Unnamed Tributary to Cocalico Creek at US 222	West Earl Twp.	25	low			yes	yes	yes	

Table 7.1 Priority Restoration Projects in the Cocalico Creek Watershed.

Priority Site	Township	Map Page	Coordinates
Unnamed Tributary in Akron Borough Park	Akron Borough	3241	J5
Hammer Creek - Buch Mill Road to Meadow Valley Road	Ephrata Twp. and Warwick Twp.	3241	A4
Cocalico Creek in Denver - Fourth Street to Memorial Park	Denver Borough and West Cocalico Township	3130	H3
Cocalico Creek at Fox Chase	East Cocalico Twp.	3130	J5
Stony Run at Church Street in Reamstown	East Cocalico Twp.	3130	K7
Stony Run near Stony Run Industrial Park	East Cocalico Twp.	3131	B5
Coover Run	East Cocalico Twp.	3130	H10
Stony Run near Hill Road	East Cocalico Twp.	3131	F3
Unnamed Tributary to Stony Run	East Cocalico Twp.	3131	A7
Cocalico Creek at Haller Dam	Ephrata Borough	3241	K2
Cocalico Creek at Niss Avenue	Ephrata Borough	3241	H3
Cocalico Creek near Green Dragon	Ephrata Township	3130	E9
Indian Run	Ephrata Township	3130	B9
Meadow Run	Ephrata Township	3241	F2
Unnamed Tributary to Hammer Creek	Heidelberg Twp.	3016	B6
Cocalico Creek below Log Cabin Road	Warwick Twp.	3241	C10
Unnamed Tributary to Cocalico Creek at Disston View Drive	Warwick Twp.	3241	C8
Unnamed Tributary to Cocalico Creek at Rose Hill Road	Warwick Twp.	3241	D9
Blue Lake on Cocalico Creek	West Cocalico Twp.	3018	E7
Cocalico Creek at Hickory Road	West Cocalico Twp.	3018	A7
Cocalico Creek Shenks Mill Road	West Cocalico Twp.	3017	H6
Indian Run along Hickory Road	West Cocalico Twp.	3018	A7
Unnamed Tributaries to Cocalico Creek along Route 897	West Cocalico Twp.	3018	B5
Cocalico Creek along Greenville Road	West Cocalico Twp.	3130	G1
Unnamed Tributary to Cocalico Creek at US 222	West Earl Twp.	3353	D2

Section 8
Municipal Toolbox
and
Plan Summary

The primary tools developed in this plan relate to protection and restoration activities that can be undertaken in the watershed.

The municipal toolbox, attached at the end of this report section and described in Section 5, provides specific tools and measures that can be implemented to protect water resources in the watershed.

The priority restoration projects described in Section 7 identify specific locations in the watershed that are in great need of restoration actions to improve the water resources there.

The involvement of the private sector is an important and necessary component for moving the priority restoration projects forward. Many restoration projects in the past, if not most projects, have been funded by grant programs from state and federal sources. In the long term, this is not a sustainable approach. Financial incentives for the private sector to assist in funding the implementation of these restoration projects are critical elements for restoration sustainability. Nutrient credits, stormwater management capacity (i.e. credits), and tax credits are important incentives for the financial involvement of the private sector. The nutrient trading program and REAP are examples of programs where the private sector can receive financial incentives as a return for their investment in BMP implementations. These innovative approaches need to be promoted and advanced for this restoration plan to move forward into the restoration implementation phase.

The Cocalico Creek Watershed Association will be promoting this Watershed Restoration Plan to municipal representatives. We encourage them to promote it to the private sector as well.

Section 8: Municipal Toolbox

	Tool	Description	Activities	Source	Priority
A	**Regional Recommendations**				
1	**Water Planning Team**	A consortium of groups, individuals and stakeholders to address the broad range of issues with the common goal of a sustainable water supply.	Include representation from wellhead protection, water authorities, sewage treatment, agricultural community, industry, land owners, watershed groups, Lower Susquehanna Regional Committee (ACT 220), county water resources task force, etc. This consortium may provide more efficient guidance, improved communication, and important partnerships needed to protect a common interest....water resources.	State Water Planning Team (ACT 220)	High
2	**Cocalico Region Comprehensive Plan Update**	Integrate protection of priority restoration sites and recommendations of the Cocalico Creek Watershed Plan into existing and future multi-municipal and regional planning efforts.	Update comprehensive plans or include strategies in new regional comprehensive planning efforts that address water resource protection. Consider some of the following tools proposed as part of this watershed plan and recommendations noted in the report. - Include priority restoration sites proposed as part of the Cocalico Creek Watershed plan as priority natural resource protection and conservation areas to prevent development from occurring in these locations. - Encourage regional storm water management. See the Regional Stormwater Management Strategy for Cocalico Creek Watershed in Section 4. - Include Critical Aquifer Recharge Areas (CARAs) where delineated as priority natural resource protection and conservation areas. - Include strategies to protect and potentially improve the infiltration potential of CARA's as important recharge areas. - Include a build-out scenario strategy with respect to water resource availability, with special attention paid to "potentially stressed" areas where the water supply may not meet future demand. - The Public Utilities Objectives of this plan need to be updated in consideration of the results of the Cocalico Creek Watershed Plan. The committees recommended to address regionalization of the water system, wellhead protection, and watershed issues should be represented on the Oversight Committee and Water Planning Teams. - The Cocalico Region Green Map may be amended to include the restoration project locations.	PA Municipalities Planning Code	High
3	**Build-out Zoning Strategy**	Use current zoning districts and GIS data to develop a build-out scenario for future development in relationship to available water supply and wastewater. Use this map as a guide for updating comprehensive plans and re-zoning.	Consider public water supply and water resources for these plans and/or previous studies or on-lot availability. The goal is to protect high recharge areas (CARA's), priority restoration sites and conservation corridors from development, while concentrating development in areas where water and sewage disposal are currently available.	South Coventry Township Chester County, PA	High
4	**Open Space Land Acquisition**	Purchase property using public funds or private land trusts for the purpose of preserving important open space and natural areas.	Use this strategy to prioritize land acquisition for potential future water sources, areas of high groundwater recharge potential, potential regional SWM locations, restoration opportunities identified in the Cocalico Creek Watershed plan and other locations with importance to protecting water quality.	Lancaster County Comprehensive Plan - Growth Management Element Update	Low
5	**Conservation Corridors**	Provide a framework for future growth by prioritizing where open space may be protected and where development could occur using the Cocalico Region Green Map updated with priority restoration sites identified in the Cocalico Creek Watershed Plan.	Using the Cocalico Creek Watershed "Project Map" as a guide, identify locations for conservation lands and corridors in each municipality which may also include wetlands, steep slopes >25%, 100 year floodplain, geologic features (high density karst, sinkholes, caves, etc), and forested lands including wetland buffers, riparian buffers, hedgerows, significant tree stands, etc.		High
6	**Defined Growth Areas**	As applied in Lancaster County, land within defined growth areas is targeted for densities of at least 5.5 units per acre and planned infrastructure (roads, water, sewer) improvements. Current County designations are Urban Growth Areas (UGAs) and Village Growth Areas (VGAs). Outside of these areas, land is planned to remain in predominantly rural and agricultural use.	Growth areas should consider existing and future public water supply and protection of CARA's and proposed restoration sites identified in the Cocalico Creek Watershed Plan. Adjustments to existing growth areas may be necessary in light of the findings of this report. Municipalities without defined growth areas should prioritize establishing them.	Lancaster County Comprehensive Plan - Growth Management Element Update	HIgh
7	**Source Water (or Wellhead) Protection Overlay Districts**	These ordinances are intended to minimize threats to the quality of groundwater and surface water, particularly groundwater supplies, and assist in determining compliance with federal and state environmental regulations that could affect water quality. They protect designated groundwater recharge areas by applying special design standards, such as setbacks, use limitations, signage, and buffers.	Ordinances may be implemented on a municipal level, but because of multi-municipal overlap in zones of influence (a public water source well in one municipality may have a zone of influence in another municipality), a model ordinance for the entire water authority supply area or aquifer should be encouraged.	Mount Joy Borough	Medium

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	Tool	Description	Activities	Source	Priority
8	**Agricultural Nutrient Management Program**	This program is intended to minimize threats to the quality of groundwater and surface water, particularly groundwater supplies, and assists in determining compliance with federal and state environmental regulations that could affect water quality.	Consider a funding source for nutrient management programs and monitoring for farms in vulnerable locations such as groundwater recharge areas, high-density karst areas, and wellhead protection zones 1 and 2, if applicable.	Local Model: Warwick Township Nutrient Management Pilot Project	Medium
9	**Community Land Trusts**	A non-profit trust that owns the land and permits the resident owner to retain title to the house, representing a more affordable approach to home ownership. Regulations place limits on the amount profit that can be earned by a single homeowner over a period of time. In places where housing prices are rising quickly, this program helps keep housing affordable for future buyers.	Easements owned by land trusts should be prioritized for priority restoration sites identified in the Cocalico Creek Watershed Plan. Consider appropriating money to a land trust for the acquisition of open space.	Brandywine Conservancy Natural Lands Trust Heritage Conservancy	Medium
B	**Municipal Recommendations**				
	Impervious Cover				
1	**Streets**	Residential streets are often unnecessarily wide, and these excessive widths contribute to the largest single component of impervious cover in a subdivision (CWP, 1998). By requiring narrower street widths based on a maximum width, the developer must prove why the additional width is necessary.	Revise street requirements to reduce impervious cover and promote infiltration of runoff. Street width ordinances may use standard, consistent street classification definitions and maximum street widths that are the minimum to accommodate safe travel lanes, maintenance, and emergency management. Allow utilities within right-of-way and under paving. Allow grass swales instead of curbs and gutters. Require sidewalks on only one side of the street. Reduce total street length by encouraging efficient use and layout.	Recommended Model Development Principles for East Hempfield, West Hempfield and Manor Townships and Lancaster County, PA, Alliance for the Chesapeake Bay and the Center for Watershed Protection, March 2005	Medium
2	**Cul-de-sacs**	Cul-de-sac turn-arounds provide an opportunity for infiltration of runoff in the middle of the turn-around while reducing the amount of impervious cover and allowing emergency access.	Cul-de-sac turnarounds should incorporate landscaped islands and bioretention in lieu of fully paved turnaround areas.	Recommended Model Development Principles for East Hempfield, West Hempfield and Manor Townships and Lancaster County, PA, Alliance for the Chesapeake Bay and the Center for Watershed Protection, March 2005	Medium
3	**Parking Ratios**	Parking ratios determine the amount of parking allowed for various land uses or activities. Many times municipal parking ratios are based on national or outdated standards requiring too much parking for a particular use. The result is large expanses of unused or rarely used impervious cover.	The municipality should review and revise parking ratios to reflect actual parking demands. Consider setting parking ratios as a maximum instead of a minimum. Any additional parking could be defined as "overflow parking" for which alternative pervious paving surfaces should be considered, depending on the intensity of use.	Recommended Model Development Principles for East Hempfield, West Hempfield and Manor Townships and Lancaster County, PA, Alliance for the Chesapeake Bay and the Center for Watershed Protection, March 2005	Medium
4	**Driveways**	Studies show that 20% of the impervious cover in residential subdivisions can consist of driveways (Schueler, 1995). Consider allowing alternatives and limiting the amount of impervious cover on a lot.	Require a maximum amount of a single family home driveway to be impervious and any additional paving to be porous surface. A 3,000 square-foot maximum may be sufficient for most single family homes on a one-acre lot. Encourage shared driveways, especially on flag lots, and reduce minimum driveway widths to 9' for one way and 18' for double lane.	Recommended Model Development Principles for East Hempfield, West Hempfield and Manor Townships and Lancaster County, PA, Alliance for the Chesapeake Bay and the Center for Watershed Protection, March 2005	Medium

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	Tool	Description	Activities	Source	Priority
5	**Parking Lots**	Parking lots are the largest component of impervious cover in most commercial and industrial zones, but conventional design practices do little to reduce the paved area in parking lots (CSP, 1998).	Reduce the amount of imperviousness associated with parking lots by providing compact car spaces, minimizing stall dimensions, incorporating efficient parking lanes, and using pervious materials in overflow or spillover parking areas. Wherever possible provide treatment for parking lot runoff using bioretention areas or filter strips integrated into landscaped islands.	Recommended Model Development Principles for East Hempfield, West Hempfield and Manor Townships and Lancaster County, PA, Alliance for the Chesapeake Bay and the Center for Watershed Protection, March 2005	Medium
6	**Porous Asphalt / Concrete Paving**	Porous asphalt / concrete paving is being used throughout southeastern Pa. with successful results. These systems provide flexibility in design to accommodate various soil, geologic, and hydrologic conditions while providing infiltration over a broader area. Porous paving surfaces combined with bioretention for overflow provide a reasonable alternative to conventional impervious paving.	Allow alternative porous paving wherever the use permits, especially in low-intensity, infrequent uses or overflow parking areas. Consider porous paving swales in less intensive areas of parking lots that overflow into bioretention facilities.	Cahill Associates, 104 South High Street West Chester, PA 610-696-4150 Harbor Engineering 41 South Main Street Manheim, PA 717-665-9000	High
	Resource Protection				
1	**Floodplain Ordinance Amendment to Allow Floodplain Restoration**	Floodplains and streams are many times the only available open space left in developed urban areas. Typically these systems are stressed by the dramatically altered hydrologic systems. Floodplains must be protected, but at the same time provide excellent opportunities to restore the floodplain and reclaim storage volumes and stream stability. Many municipalities are currently revising their floodplain ordinances to meet new FEMA requirements. When making revisions, consider allowing uses within the floodplain that relate to restoration work while protecting the floodplain from encroachments.	1. Adopt a floodplain ordinance that protects the floodplain from obstructions, while allowing the opportunity for restoration activities that may reduce flooding and improve infiltration and groundwater recharge while creating recreational opportunities and habitat diversity. 2. **See Section 5 for "Floodplain Ordinance Amendment Recommendations'**	LandStudies, Inc. 315 North Street Lititz, PA 17543 717-627-4440	High
2	**Forest Conservation**	A process for urban greenspace protection during the development process. Individual sites proposed for development are assessed and thresholds for clearing, afforestation, and reforestation are established based on the net tract area, land use category, existing forest cover, and proposed clearing area. Long-term protective instruments are required to ensure that the retained area will remain forested.	Use Forest Stand Delineation and preparation of Forest Conservation Plans as a means of identifying existing forest stands on a site and mitigating the impact of removal and development either on the site or within the watershed.	Maryland State Forest Conservation Act	Medium
3	**Hydrogeologic Investigations for Karst Areas**	Municipalities may want to consider these investigations for any land development proposed for sites where high-density karst is located. Special site investigations are recommended to identify vulnerabilities related to karst on and surrounding the site, how the development will influence the karst features, and what will be done to mitigate potential failures in the form of sinkholes. This information will allow the municipality to make informed decisions about the proposed land development and method of SWM.	Preliminary Investigation - Review historical aerial photography and published maps of karst features If visible depressions are observed additional investigation, standard penetration testing (SPT) may be necessary to determine if the observed depressions were past sinkholes that had been filled in, or if they were simply topographic depressions. Detailed Investigation - Electromagnetic (EM) and seismic refraction surface geophysical surveys may be necessary to identify subsurface soil and bedrock anomalies; Cone Penetrometer Technology (CPT) logging of subsurface soil hydrogeologic and geotechnical properties; and GeoProbe® direct push soil sampling to characterize the subsurface with regard to carbonate geology issues. These techniques may be employed on site at the same time to gather information on the subsurface for use in addressing the infiltration of stormwater as part of the NPDES Phase II permitting process.	Lancaster County Conservation District Alternative Environmental Solutions 930 Pointview Avenue, Suite B Ephrata, PA 717-738-7272	High

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	Tool	Description	Activities	Source	Priority
4	**Steep Slope Conservation District**	An overlay of any zoning district with slopes of 20 - 30% and greater. Steep slopes are often adjacent to streams and in wooded areas. Restrictions such as a minimum building envelope or lot size to prevent erosion and removal of vegetation may be warranted if the entire lot is in the Steep Slope District. Provide a list of acceptable slope stabilization plantings that are native and not invasive while providing quick cover.	Designate protection for slopes > 30%. Provide plant list and specifications for planting methods in a guideline format for stabilizing slopes >30% for new construction and any time disturbance eliminates cover. Consider building-envelope or lot-size restrictions if lots are located entirely or partially within the Steep Slope Overlay District.	Natural Resource Protection Standards Section 115-43 Steep Slope Conservation District East Bradford Township, PA	Low
5	**Management of Existing Vegetation**	Native plant communities provide a vital role in infiltration capabilities of surface runoff. For this reason, it is important to consider standards for preserving existing woodland and established native plant communities as well as encouraging the establishment of natural meadows and woodlands in residential areas.	Conserve woodlands, hedgerows, and other naturally occurring established plant systems. Protect vegetation from mechanical injury, excavation, and fill. Establish maintenance standards in residential areas. Selectively control noxious vegetation and manage natural areas that include woodlands, meadows, and sensitive areas such as wetlands and floodplains. Also establish standards for maintenance of vegetation in residential areas that allow for natural meadows while considering proper maintenance to control invasive material.	Natural Resource Protection Standards Section 115-45 Management of Existing Vegetation East Bradford Township, PA	Medium
	Construction in High Density Karst Locations	Site design and construction procedures are important components of sinkhole development. Sinkholes most often form in areas where storm-water runoff is concentrated, where bearing loads are concentrated, and where ground water is pumped in large volumes.	Minimize site disturbance, including cut/fill and drainage alteration. Minimize impervious surface, waterproof pipe-fittings and pipe-to-basin fittings to reduce the potential for leaks. Place foundations on sound bedrock.	Virginia Department of Conservation and Recreation - Hydrologic Modeling and Design in Karst	Medium
	Response and Remediation of Sinkhole Occurrence During Construction	Sinkholes that occur during construction should be repaired immediately to prevent enlargement and associated adverse impacts.	Report the occurrence to the approving authority within 24 hours. Halt construction activities in the immediate area of the sinkhole. Stabilize and secure the area. Direct surface water away from the sinkhole area to a suitable storm drain system. The hydrogeologist who performed the hydrogeologic investigation for the site should be contacted to assist with determining the best method of remediation.	Virginia Department of Conservation and Recreation - Hydrologic Modeling and Design in Karst	Medium
8	**Managing Existing Sinkholes**	Existing sinkholes are a direct connection to groundwater sources. For this reason, landowners need to be educated about the importance of protecting existing sinkholes and what to do in the case one should appear on a property.	If the sinkhole is in the vicinity of or could damage existing structures, it is recommended that a Hydrogeologist, or other professional with experience in sinkhole remediation is hired to assess the situation and make expert recommendations on the remediation technique. If the sinkhole is in an area where it will not damage surrounding property, the best approach is to stabilize the area and protect the sinkhole from intrusion with fencing or planting. If water is draining into the area, re-route the flow away from the sinkhole and protect the sinkhole from any fill or hazardous materials.	Alternative Environmental Solutions 930 Pointview Avenue, Suite B Ephrata, PA 717-738-7272	Medium
9	**Transfer of Development Rights**	Zoning tool that directs growth to preferred locations (see Defined Growth Areas) through the sale and purchase of development rights. Development rights are established for a given piece of land and can be separated from the title of that property. These rights can then be transferred to another location within a defined growth area such as a UGA or VGA.	Consider including Conservation Corridors and CARA's in rural resource areas and prioritized as sending areas for Transfers of Development Rights (TDRs).	Lancaster Farmland Trust *Local Model:* Warwick Township Lancaster County	Medium
	Stormwater Management				
1	**Regional Stormwater Management Strategy for the Cocalico Creek Watershed**	Develop Regional SWM Potential Utilizing Identified Restoration Projects - Identify how the proposed restoration projects could be used for regional SWM and ACT 167 requirements.	Demonstrate watershed affect of floodplain restoration at the proposed restoration sites within the watershed. - Identify portions of the watershed, future development and problem areas, where land development and stormwater requirements can be offset, and to what extent - Coordinate findings with individual municipalities and the Lancaster County Engineer - Prepare conceptual hydrology and hydraulics (H&H) analysis for the proposed sites to quantify the benefits - storage volume, rate reduction, water quality, etc. - Include recommendations to Lancaster County for the Cocalico Watershed Act 167 plan and ordinances currently being updated - Consider ordinance amendments to allow more accurate selection of run-off curve numbers for floodplain restoration projects.		High

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	Tool	Description	Activities	Source	Priority
2	**Implementation of Regional Stormwater Management in the Cocalico Creek Watershed**	Design and cost estimates for construction of the regional SWM facilities for use in finding public or private sources for construction.	Complete design and engineering work for each of the prioritized restoration sites identified for regional SWM potential: -Background data collection and trenching - Engineering and design - Permit requirements - Cost estimates - Quantitative analysis of additional economic benefits related to credit generation (carbon, nutrient, water, etc.), topsoil generation, etc.		High
3	**Stormwater Management BMP Management Authority**	Long-term maintenance and management body that oversees the maintenance of the SWM BMPs in a municipality or for a water resource area.	Responsibility may be municipal or by a watershed group or other conservation group with active and willing membership. These groups are particularly well suited to understand the special maintenance needs of BMPs and associated natural areas. With creative funding sources, these groups could provide technical assistance and implementation. Funding sources include fees from homeowner associations, impact fees from developers, and fees from SWM utilities.	Lancaster County Comprehensive Plan Growth Management Element Update	Medium
4	**In Lieu Fee for on-site Stormwater Management**	In most municipalities, new developments are required to detain the excess stormwater on site. Municipalities, a landowner or a group of developers may consider building a regional stormwater management facility using fees from new development within the drainage area. In-lieu fees are allocated for design, construction and maintenance of regional stormwater management facilities.	- Locations for regional stormwater management facilities (SWM) are identified in Appendix 1 of the Cocalico Creek Watershed report and recommended as part of local ACT 167 plans. These SWM facilities are strategically sited to serve multiple purposes (groundwater recharge, ecological restoration, wildlife habitat, etc.) and function more satisfactorily than smaller, scattered on-site facilities. - Amendments to local Stormwater Management ordinances will be necessary to allow the in-lieu fee alternative and to identify criteria for when it is appropriate.	Stormwater Management Plan City of Tulsa, OK	High
5	**Stormwater Detention in High Density Karst Locations**	A Hydrogeologic Investigation for Karst Areas (see above) is the first step toward stormwater management and erosion and sediment control design in areas designated as high-density karst. The most important considerations during design are to replicate existing drainage patterns as closely as possible and to dissipate overland flows over the largest possible areas. Waterway designs should be shallow, broad and provide maximum bottom width and wetted perimeter to disperse flow over the greatest area.	Consider amendments to stormwater and E&S ordinances to reflect the following points: 1. Minimize modifications to site topography and soil profiles. 2. Where practical, drainage facilities should consist of embankments at or above grade. Temporary and final grading of the site should provide for drainage away from known karst areas. 3. All SWM facilities should be designed to disperse the flows across the broadest channel area possible. 4. Shallow, trapezoidal channel cross-sections are preferred over V or parabolic- shaped channels. 5. Sediment basins and traps should be used as a last resort for sediment control. 6. Basin profiles should be broad and flat to allow maximum dispersion of detained flow. Basin bottoms should be smooth to avoid ponding. 7. Avoid concentrated flows. Inlet / outlet structures should be designed to provide diffuse discharge of water. 8. Use underdrains to encourage gradual discharge of water and to avoid prolonged ponding of water.	Lancaster County Conservation District Virginia Department of Conservation and Recreation - Hydrologic Modeling and Design in Karst Stormwater Management Plan for the Spring Creek Watershed Sweetland Engineering and Assoc. State College, PA 814-237-6518	High
6	**Transfer of Stormwater Rights**	Similar concept to Transfer of Development Rights, but in this case provides preferred locations (regional stormwater receiving areas) through the sale or lease of the development rights for the land. Stormwater rights are established for a given piece of land and can be separated from the title of that property. These rights can then be transferred to another location within the watershed to provide SWM or NPDES requirements for a proposed development in a designated growth area.	Locations for regional stormwater management receiving areas need to be determined as part of a Watershed Assessment. Once areas have been identified within the watersheds of designated growth areas, developers are provided the option to purchase the development rights or rental fee for using the land for SWM for the off-site development.		Low
7	**Minimum Disturbance/ Minimum Maintenance**	Minimum Disturbance/Minimum Maintenance (MD/MM) - also called site fingerprinting or site footprinting - is an approach to site design in which the clearing of vegetation and the disturbance of soil are carefully limited to a prescribed distance from proposed structures and other improvements. MD/MM is especially appropriate for those sites with existing tree cover, although the vegetation to be conserved may include any type of natural vegetative cover.	Consider providing stormwater credits when MD/MM is used in open space for a proposed development.	Cahill Associates, 104 South High Street West Chester, PA 610-696-4150	Low

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	Tool	Description	Activities	Source	Priority
8	**Stormwater BMP Retrofit Strategies**	In many urban or fully developed suburban areas, either there is no infrastructure in place to address stormwater runoff or previously installed structures have not been maintained and no longer serve the purpose for which they were intended.	1. Provide guidelines for voluntary maintenance and for retrofitting existing structures to provide infiltration or water quality benefits. The benefit to land owners is improved aesthetic, lower maintenance, and reduced property damage. 2. Inventory locations where stormwater management facilities have failed and are contributing to urban stream degradation or are no longer functioning. This includes erosion at pipe outflows and runoff damage to private and public property. 3. If the condition is affecting public property or water resources, consider outside funding sources to restore and stabilize the facility or infrastructure. 4. Explore Funding options for a retrofitting program	Center for Watershed Protection, Community Stormwater Retrofitting.	Low
	Land Use Development				
1	**Building Envelope Limitations**	On lots larger than one acre, extensive open space outside of the building envelope is converted to lawn or other ornamental landscaping, which reduces the infiltration potential of each lot.	Consider ordinance language that encourages native meadow or reforestation outside of the building envelope, especially the rear yard if it abuts existing farmland or other natural environment (forest, wetland, pond, stream, etc.) This reduces maintenance, provides buffers, and encourages infiltration.	The Homes at Wyncote Design Guidelines Lower Oxford Township, Chester County, PA Haines Township Subdivision and Land Development Ordinance, Centre County, PA	Medium
2	**Conservation Subdivision Zoning**	Allows subdivision of smaller lot sizes than typically allowed in rural areas with a minimum open space requirement (usually 50%).	Each township should consider an Open Space or Conservation Development Ordinance as a by-right form of development within designated zoning districts. A detailed list of design standards pertaining to the quality, quantity, and configuration of open space is important. Consider a minimum lot size and a net density with a minimum amount of open space.	"Growing Greener Conservation by Design" Natural Lands Trust Hildacy Farm 1031 Palmers Mill Road Media, PA 19063 610-353-5587	High
3	**Dedicated Easements**	Voluntary dedication of open space or agricultural easements to a public entity or qualified private land conservation organization. The landowner still owns the property; however, the land must remain in farming or open space in perpetuity.	To cover their cost in maintaining the land they own or in monitoring the land on which they hold easements, land trusts typically require some endowment funding. When conservation zoning offers a density bonus, developers can donate the proceeds from the additional "endowment lots" to such trusts for maintenance or monitoring. In some situations, a local government might desire to own part of the conservation lands within a new subdivision, such as when that land has been identified in a municipal open space plan as a good location for a park or open space link. Developers can be encouraged to sell or donate certain acreage to municipalities through additional density incentives, although the final decision would remain the developer's.	Brandywine Conservancy PO Box 141 Chadds Ford, PA Natural Lands Trust Hildacy Farm 1031 Palmers Mill Road Media, PA 19063 610-353-5587	Medium
4	**Riparian Buffer Regulations**	Some municipalities incorporate riparian buffers as an Overlay Zoning District, while others provide only guidelines for voluntary establishment. The important consideration is to provide a required setback from a water course, stream, or drainage swale and to discourage locating structures or other man-made features in these areas. These areas should also be set aside for potential future restoration work that may be necessary to stabilize the stream system. Revegetation is only temporary if the stream reach is actively moving and buried in Legacy Sediment.	Consider planting buffers on stable stream reaches identified in the Cocalico Creek Watershed plan. Stable reaches are typically those not impacted by Legacy Sediment. Plant riparian tree species as part of the proposed restoration projects.	Pennsylvania Organization for Watersheds & Rivers 610 North Third St. Harrisburg PA 17101 (717) 234-7910	Medium
5	**Buffer Ordinance**	Create a general buffer ordinance, applicable to various uses, that incorporates native plant material and accommodates multiple objectives, including visual breaks, stormwater management, infiltration, greenways, and trails. Buffers may have various uses (residential and agricultural, for example) adjacent to streams, steep slopes, wetlands, etc. and may also serve as links to other buffers or natural areas.	Determine types of uses and buffers along with minimum widths for each type of buffer. For example, the minimum width for a riparian buffer may vary depending on the size or order of the stream. A list of native plants to be used in each buffer type, along with the required spacing, should be included. Spacing of the material should directly relate to the size of the plants installed. A base groundcover should be established for each buffer type. Maintenance guidelines describing types of invasive plants and their removal are a vital component of this ordinance.	Recommended Model Development Principles for East Hempfield, West Hempfield and Manor Townships and Lancaster County, PA, Alliance for the Chesapeake Bay and the Center for Watershed Protection, March 2005	Low

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	Tool	Description	Activities	Source	Priority
6	**Low Impact Development (LID) Standards**	LID is an ecologically friendly approach to site development and stormwater management that aims to mitigate development impacts to land, water, and air. The approach emphasizes the integration of site design and planning techniques that conserve the natural systems and hydrologic functions of a site.	Incorporate elements of LID into local zoning ordinances.	Governor's Green Government Council www.gggc.state.pa.us www.lowimpactdevelopment.org	High
7	**Green Building Technology**	Environmentally sustainable building design that includes use of energy-efficient materials, recycled materials, solar energy, and structural and mechanical components that save utility costs over the life of the structure and have minimal impact on the environment.	Encourage the U.S. Green Building Council's Leadership in Energy Efficient Design (LEED) program certification based on a rating system for buildings and land development on a municipal level. Review the requirements of LEED and target elements that protect groundwater recharge and promote water recycling and other methods for protecting water resources.	United States Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) www.usgbc.org	Medium
	Water Supply				
1	**Coordinated Water Service Planning**	Future water service areas, as well as franchise areas, usually reflect water supplier planning, while UGBs and VGBs reflect municipal planning. Often, these two planning processes proceed independently resulting in inconsistencies and conflicts which can create unnecessary costs and inefficiencies.	As part of the Lancaster County Study, existing and planned future water service areas, as well as franchise areas, were compared to UGBs and VGBs to determine where conflicts exist and where coordination between municipal and supplier planning efforts can be improved.	Lancaster County Comprehensive Plan Growth Management Element Update, Water Resource Plan	High
2	**Aquifer Test Requirements**	Prior to the installation of any new water system or subdivision of land into lots that would be served by individual wells in the area or in proximity to areas of known groundwater contamination or inadequate yields of potable supplies, aquifer and water quality tests shall be performed. This test should be required in stressed areas (where the demand exceeds the supply).	Include Aquifer Test Requirements for new water systems or the subdivision of land into lots served by individual wells.	Lancaster County Subdivision and Land Development Ordinance Section 609.03	High
3	**Water Needs Analysis / Water Feasibility Analysis**	The applicant shall submit an analysis of raw water needs (groundwater or surface water) from either private or public sources along with a water feasibility analysis to enable the municipality to evaluate the impact of the proposed development on the groundwater supply and on existing wells	Prioritize this analysis for sites with Conservation Corridors	West Cocalico Township Zoning Ordinance Sec 55.q page 153 Mount Joy Borough Code Section 119-16	High
4	**Well Construction Standards**	Pa. is one of only four states that does not have construction standards for private wells. Unlike community water systems, which are permitted and strictly regulated by the state, private water systems are constructed, tested, and treated by the homeowner.	Provide regulations that require new wells to be constructed with a sanitary cap, as well as shock chlorination following construction of the well, and grout seal on new well construction to reduce *E. coli* contamination.	Center for Rural Pennsylvania 717-787-9555 info@ruralpa.org	Medium
5	**Well Capping / Abandonment**	Unsealed or improperly sealed wells may threaten public health and safety and the quality of the groundwater resources. The proper abandonment (decommissioning) of a well is a critical first step in its service life.	1. Eliminate the physical hazard of the well. 2. Eliminate a pathway for migration of contamination. 3. Prevent hydrologic changes in the aquifer system, such as the changes in hydraulic head and the mixing of water between aquifers. The method of decommissioning a well will depend on both the reason for abandonment and the conditions and construction details of the boring or well. Enlist the services of a professional well driller, licensed in Pa., to perform these services.	ACT 610, the Water Well Drillers License Act "Water-well Abandonment Guidelines" Ground Water Monitoring Guidance Manual, PA DEP Mount Joy Township's Capped Sewer Ordinance	Medium
	Agricultural Land Use				
1	**Rural Resource Areas**	Counterpart of Urban Growth Areas - designated areas that are targeted for agricultural and natural resource land preservation, rural economic development policies, and zoning techniques that discourage sprawl development patterns.	Prioritize Conservation Corridor lands as designated Rural Resource Areas.	Lancaster County Comprehensive Plan Growth Management Element Update	HIgh

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	Tool	Description	Activities	Source	Priority
2	**Farmland Preservation**	Focus agricultural preservation through zoning techniques on lands with Conservation Corridors.	Use Conservation Corridors as priority lands for the County's agriculture conservation easements, the State's agricultural security area programs, and local growth management tools (TDRs, UGB/VGBs, etc.).	Lancaster County Agricultural Preservation Board Municipalities	High
	Education				
1	**Environmental Education**	Discuss how school districts in the watershed may want to integrate watershed improvements, projects, concerns, and opportunities into their environmental education curricula.	- Consider involvement with implementing and maintaining projects described in the Cocalico Creek watershed report - Consider a "watershed awareness" outdoor activities day for elementary students. - Consider an ongoing, long-term research or monitoring program for high-school students. - Involve students in creating studies based at outdoor environmental education sites suggested in the Cocalico Creek Watershed report.	PA Environmental Education requirements. LandStudies, Inc.	High
2	**Managing Small Vernal Ponds**	Maintaining a healthy pond is challenging because it contains a complex aquatic ecosystem that can be unbalanced by livestock, waterfowl, or runoff from surrounding lands. Many of the ponds in the study area are maintained for water storage and are perched systems with limited aquifer recharge potential. Although in some cases these ponds, if vernal in nature, may provide recharge, it is important to consider the management and health of these eco-systems.	- Complete a preliminary assessment and monitoring to understand the land uses and drainage area that contribute to the pond. - Maintain dams and standpipes to maintain water levels and prevent erosion. - Establish a riparian buffer to protect the shoreline, prevent erosion and discourage Canada geese. - Create a Pond Management Plan - ID services and resources provided by the pond and its uses and determine a management approach with technical assistance.	"Ecologically Based Small Pond Management" report by West Chester University (Fairchild and Velinsky, 2004)	Low
3	**Natural Landscaping**	Bayscapes are environmentally-sound landscapes benefiting people, wildlife, and the Chesapeake Bay. Bayscaping advocates a holistic approach to landscaping through principles inspired by relationships in the natural environment.	Plant conventional landscapes with low-input landscaping (reduced mowing, fertilizing, and pesticide use) that uses native plant material.	Alliance for the Chesapeake Bay "Bayscapes - PA" Rebecca Wertime (717) 737-8622	Low
4	**Managing Land Adjacent to Streams and Waterways**	Educational information from the USDA Forest Service about the importance and methods for taking care of property adjacent to streams. Of the 83,161 miles of rivers and streams in Pa., approximately 85% are small, headwater streams. Protecting small streams is crucial because they often influence drinking water sources.	Protect the stream and floodplain from fill, obstructions, and structures. Establish a streamside buffer (riparian buffer) consisting of native trees, shrubs, or other plants as a transition area between the stream and upland areas. Don't try to fix the stream without the assistance of a professional water resource engineer with experience in stream system maintenance and geomorphology.	PA DEP USDA Forest Service 814-723-5150	Low
5	**Conservation Reserve Enhancement Program (CREP)**	CREP is a federal/state partnership with a goal of enrolling 100,000 acres of cropland and pasture in conservation plantings to improve water quality and provide wildlife and fisheries habitat. This program provides plant material and installation and rents the non-productive land at a yearly per-acre rate. Planting trees may reduce evapotranspiration and provide root zone conduits for infiltration through impenetrable layers.	Educated landowners adjacent to streams, watercourses and about the benefits of this program.	NRCS Lancaster Office 717-299-1563	Low
6	**Tox-Away Day**	This program is a one- or two-day event that allows residents within the watershed to bring hazardous household waste to a local site for proper disposal. Materials may include dangerous substances that pose a risk to water resources such as paint, oils, cleaning fluids, old computers, herbicides, pesticides, etc.	Planning for a tox-away day must begin very early - as long as 6 to 18 months before the collection date. The following subjects need to be addressed during the planning phase: - Define Roles and Responsibilities of those involved - Create the Planning Committee and begin planning approx. 8 months to 1 year prior to the planned event - Identify the Program Sponsor - Hire the hazardous Waste Contractor (begin by talking with local solid waste authorities to see if they off the service and to determine fees) - Use the opportunity to educate the community about the protection of water resources and proper disposal of hazardous waste.	PA DEP Household Hazardous Waste Disposal Events DEP website Lancaster County Solid Waste Management Authority 1299 Harrisburg Pike PO Box 4425 Lancaster, PA 17604 Phone: 717-397-9968	Low

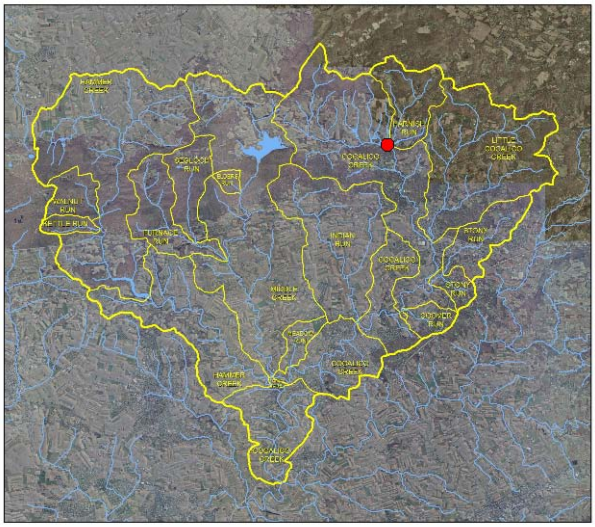
Appendix 1

Priority Restoration
Project Summaries

Priority Site:
BLUE LAKE ON COCALICO CREEK

Blue Lake is located in the headwaters region of the Cocalico Creek watershed. It receives and has historically trapped sediments and nutrients from upstream agricultural lands in the watershed. It is a highly diverse and valuable wildlife habitat with significant wetlands surrounding the lake.

The lake has filled up with sediments over the last few decades, and no longer has any sediment trapping capacity. Water depths in the lake have decreased from 4+ feet to about 0.5 feet in much of the lake. Blue Lake is in dire need of restoration.



Benefits:

- Revitalization of ecologically valuable lake and wetlands complex
- Restoration of sediment storage with dredging of lake
- Reduction of downstream sediment and nutrient loading
- Increased recreational use

Project Restoration Summary:

Priority: High

Cost Range: $150,000

Time Frame: 1.5 yrs

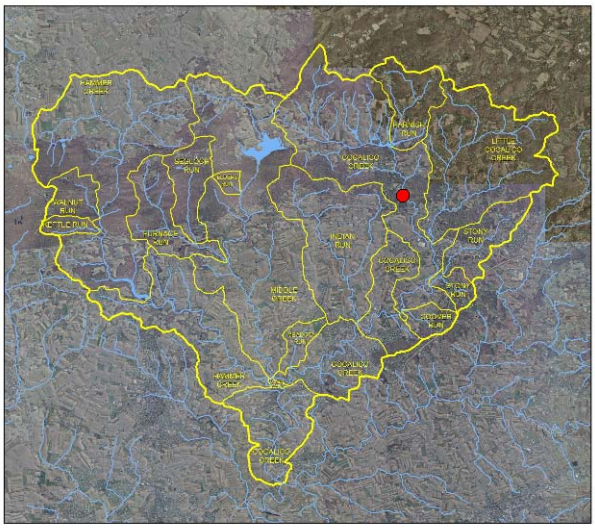
Potential Funding Sources: private, with potential sale of nutrient credits

Priority Site:

COCALICO CREEK ALONG GREENVILLE ROAD

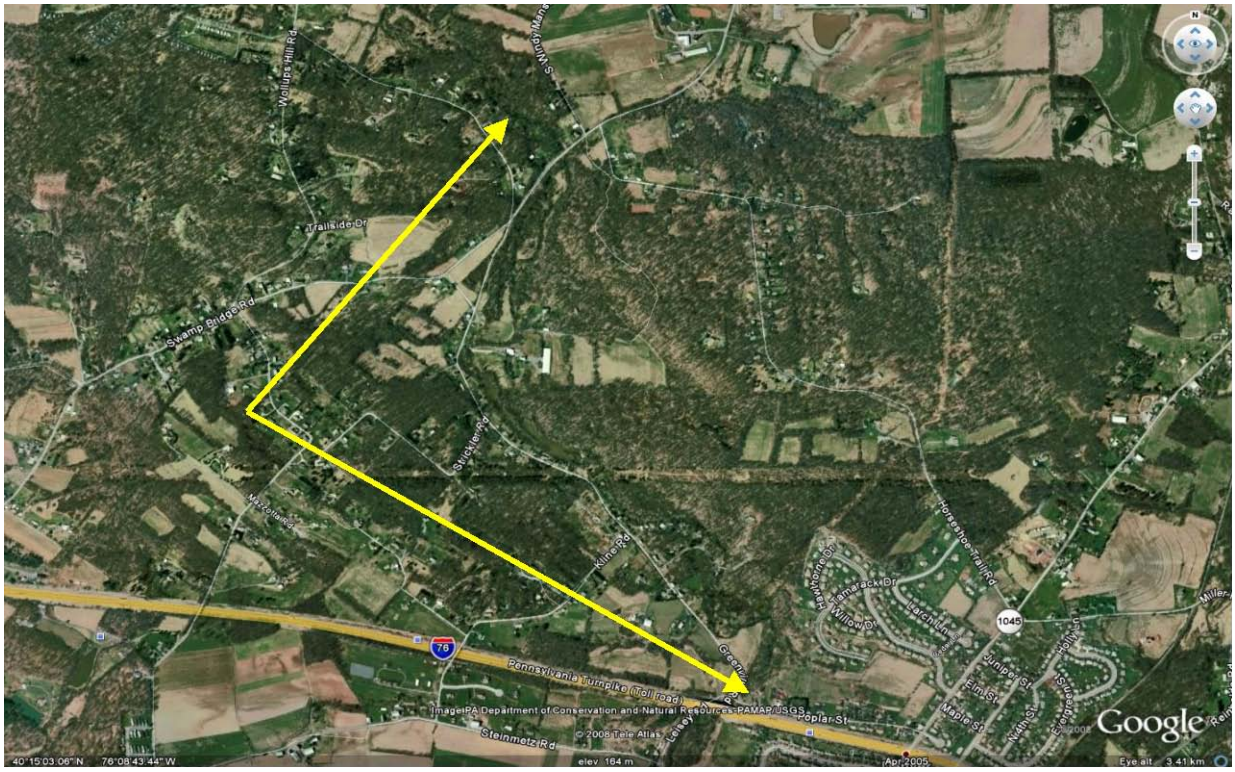
This stretch of Cocalico Creek exhibits areas where localized flooding occurs. The backwater areas in this stretch are created by an existing dam, which significantly reduces the stormwater storage capacity along this stretch of stream. There are areas downstream from this dam and upstream from the existing backwater where streambanks are high. Two historic mill dams occurred in this segment of stream, in addition to the existing dam.

Reductions in sediment and nutrient loading in this stream segment would necessitate dam removal coupled with floodplain restoration to manage the accumulated sediment behind the dam. These restoration approaches would alleviate the flooding issues there, but would require landowner support and consent. There are numerous landowners along this stream segment, and support and consent may be a challenge.



Benefits:

- Reduction in sediment erosion from stream banks with dam removal and floodplain restoration
- Decreased downstream nutrient and sediment loading
- Reduced flooding locally with increased stormwater management capacity
- Increase in stormwater storage, potentially benefiting future development that needs stormwater credits



Priority Site Overview:

Priority: medium

Cost Range: could be significant, up to $800k or more if complications with dam removal

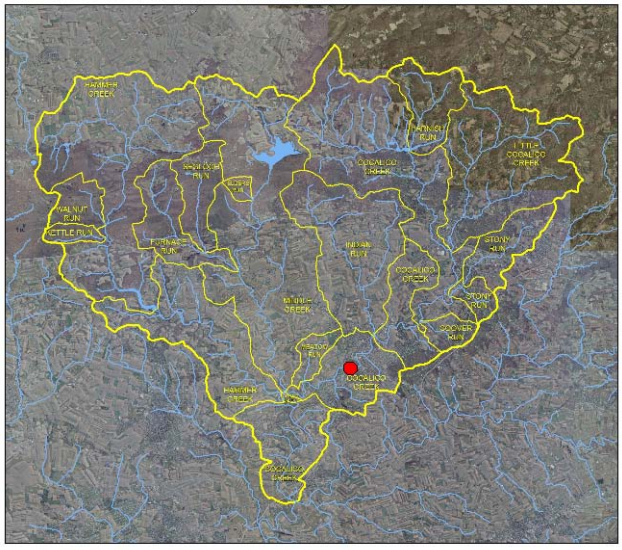
Time Frame: restoration projects of this type take several years between design, permitting, and construction. The time frame for this project would likely be 4 years.

Potential Funding Sources: state or federal grant funding for dam removal and floodplain restoration; private developers needing stormwater credits also provide restoration funding; nutrient credits and trading could provide additional incentives.

Priority Site:
COCALICO CREEK AT HALLER DAM

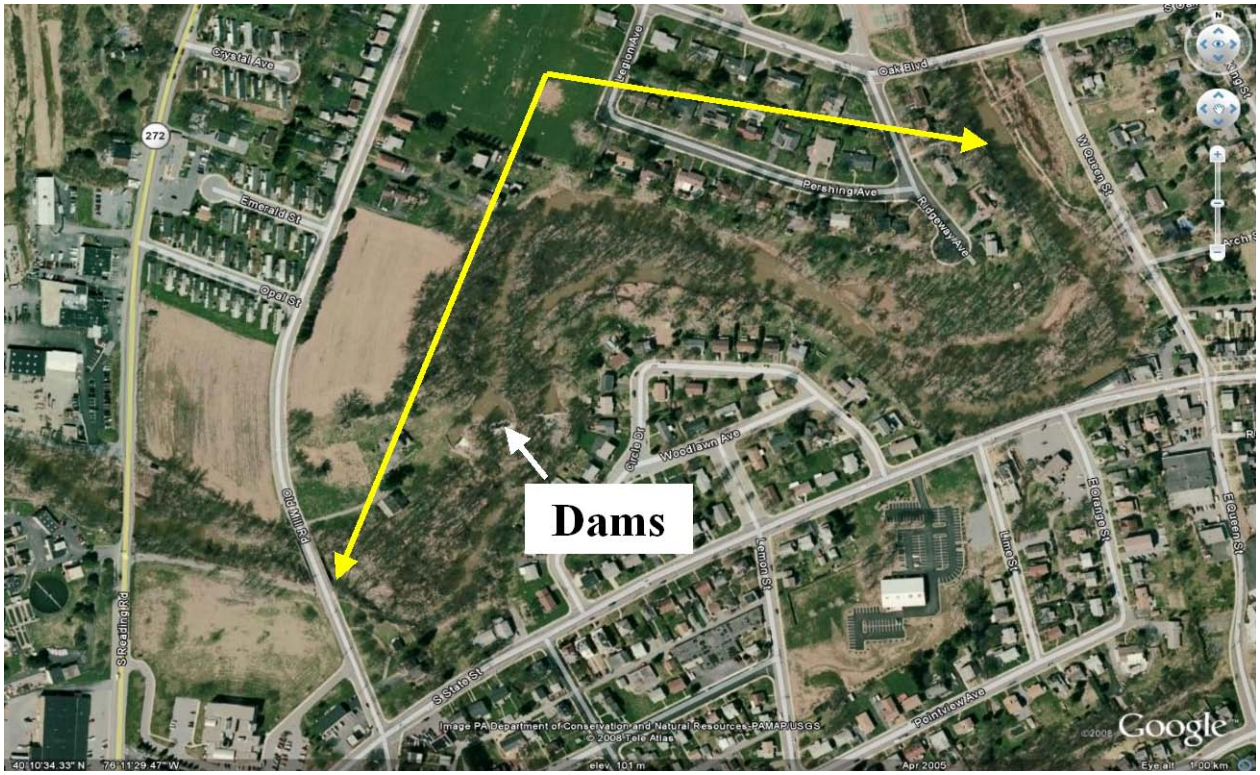
Cocalico Creek at Haller Dam is a site with three dams creating backwater in this braided section of stream. Legacy sediment has accumulated behind these dams, although the extent of accumulation has not yet been investigated.

Dam integrity is always an issue with dams, and particularly in this situation with dams on three channels. There is little stormwater storage capacity with current conditions, and the stream erodes the banks along the nearby residences. This site presents an excellent restoration and environmental education opportunity.



Benefits:

- Increased stormwater storage with dam removal and floodplain restoration
- Decreased loadings of sediment and nutrients downstream
- Elimination of dam safety and dam maintenance issues
- Restoration of a functional floodplain
- Establishment of an environmental education center



Project Restoration Summary:

Priority: high

Cost Range: significant, likely in the $600k range with dam removal and legacy sediment management

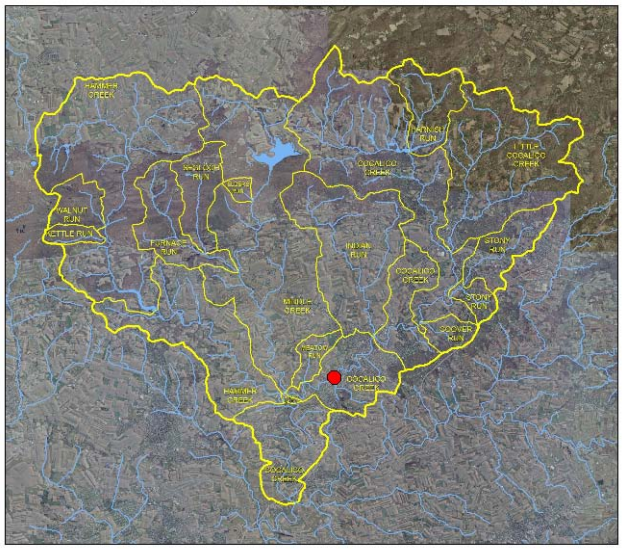
Time Frame: typically a three-year project from design to permitting to restoration

Potential Funding Sources: state and/or federal funding programs, and non-profit grant programs, for dam removal and stream restoration

Priority Site:
COCALICO CREEK AT NISS AVENUE

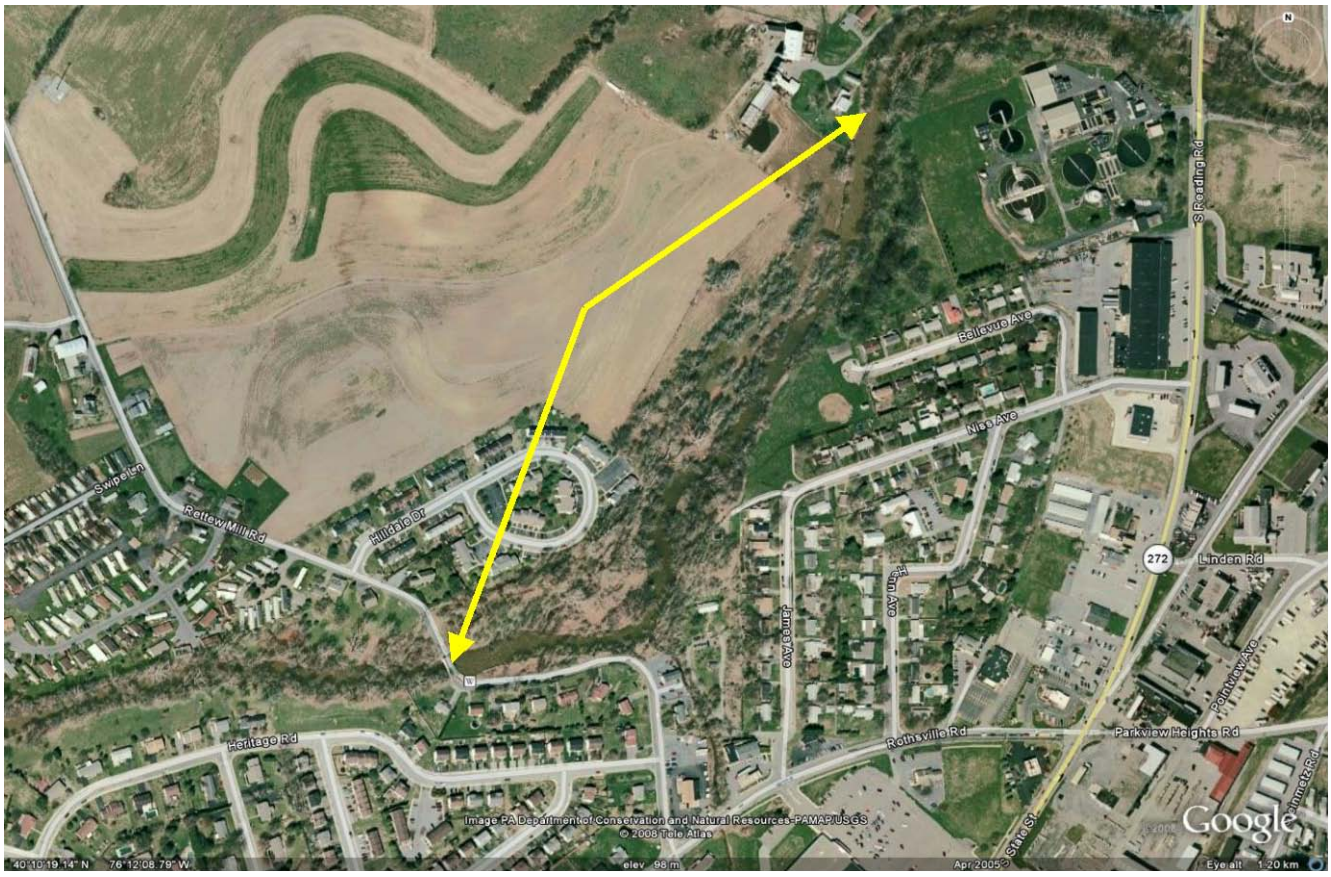
This segment of Cocalico Creek was identified as an area prone to flooding. Field investigations showed significant streambank erosion, with potential for floodplain restoration to gain stormwater management capacity. Streambank erosion is severe in some locations, and the stream is encroaching on Rettew Mill Road. Flooding immediately downstream from this segment is also an issue.

The area available for floodplain restoration is somewhat limited, and the feasibility of this BMP needs to be investigated with field-level data collection. Streambank erosion needs to be controlled in this segment, regardless of the restoration technique.



Benefits:

- Reduce streambank erosion in this stream segment
- Reduce encroachment of the stream on Rettew Mill Road because of streambank erosion
- Provide for reduced flooding benefits as provided by floodplain restoration
- Reduce sediment and nutrient loading by legacy sediment removal and reduction in streambank erosion
- Improve stream and riparian habitat



Project Restoration Summary:

Priority: low

Cost Range: floodplain restoration costs would likely range up to $500k, with alternative remediation approaches costing less but providing fewer benefits and no long-term restoration or stormwater management benefits

Time Frame: likely 3 years for floodplain restoration; likely 1 year or so for alternative remediation approaches

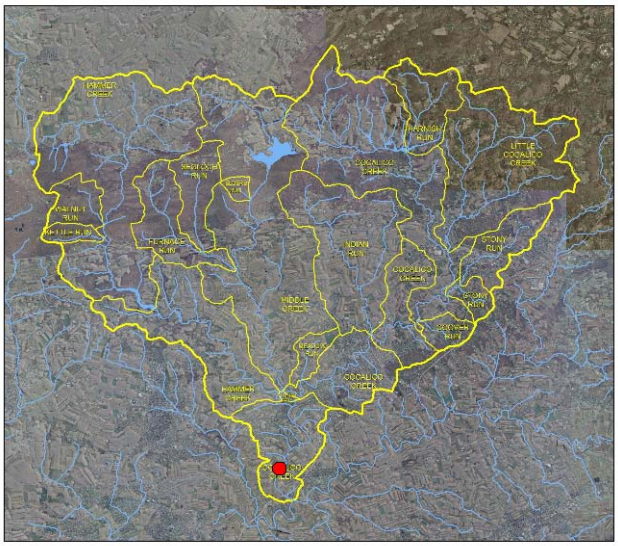
Potential Funding Sources: state and federal grant programs for floodplain restoration or alternative remediation measures; potential for DOT funding to protect Rettew Mill Road from stream encroachment; stormwater and nutrient credits if floodplain restoration is pursued

Priority Site:

COCALICO CREEK BELOW LOG CABIN ROAD

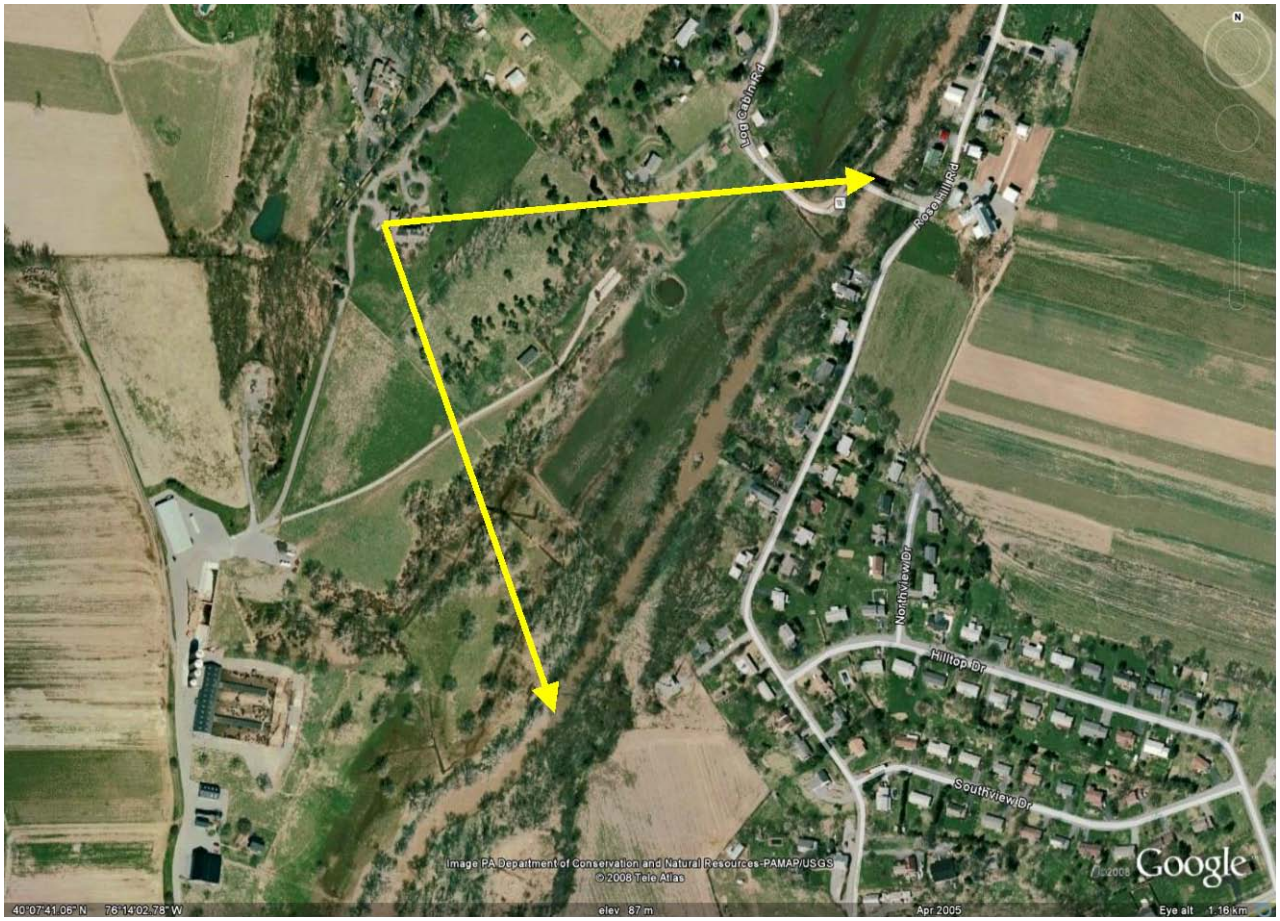
Cocalico Creek in the segment downstream of Log Cabin Road is characterized by streambanks that are 5-6 feet high with deposits of legacy sediments. The stream is actively eroding to the west toward a residence. The active lateral streambank erosion continues to threaten and topple riparian trees.

A floodplain restoration project would significantly reduce this lateral erosion and the resulting sediment and nutrient loading downstream to the Chesapeake Bay. Additional stormwater management capacity would be created as well.



Benefits:

- Significantly reduce sediment and nutrient loading from erosion of legacy sediments
- Restore a functional floodplain that can further reduce nutrient loads to downstream waters
- Increase wetlands with floodplain restoration
- Enhance instream and riparian habitat for wildlife
- Increase stormwater management capacity with a restored floodplain



Project Restoration Summary:

Priority: medium

Cost Range: floodplain restoration costs could range as high at $600k, depending on the length of stream and floodplain that are restored. Riparian buffer plantings are included in this cost.

Time Frame: likely 3 years from design to restoration completion.

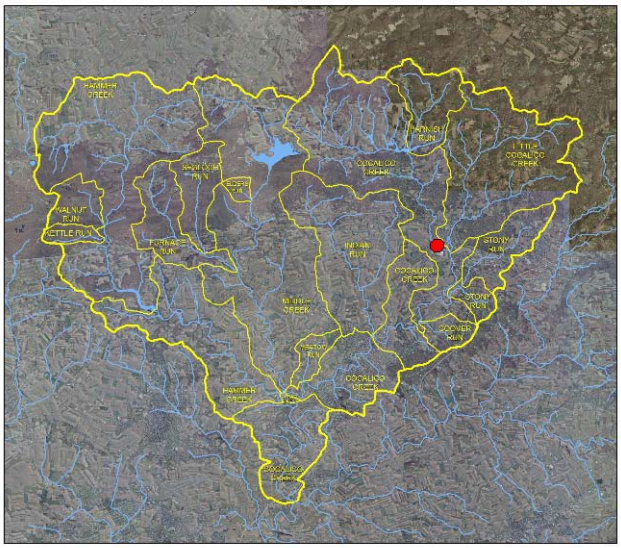
Potential Funding Sources: state and federal grant programs for stream and floodplain restoration, and nutrient credits and trading as an economic incentive.

Priority Site:

COCALICO CREEK IN DENVER – FOURTH STREET TO MEMORIAL PARK

Cocalico Creek in Denver experiences flooding of properties, and the stream segment from Fourth Street to Denver Memorial Park has been targeted as an area where stream restoration and stormwater management can be undertaken to alleviate this flooding, which also occurs along this segment of stream as well.

Significant accumulations of legacy sediment occur along this stream segment. While riparian buffers have been planted in this stream segment, they are growing on 4 to 7 feet of legacy sediment. This reduces their water quality benefits, and streambank erosion threatens tree survival in years to come.



Benefits:

- Significantly reduce sediment and nutrient loading from erosion of legacy sediments in this stream segment
- Provide for significant stormwater management through floodplain restoration along this stream segment, helping to reduce flooding
- Improved instream habitat and water quality, and enhanced riparian habitats for wildlife

Project Restoration Summary:

Priority: high

Cost Range: floodplain restoration costs could range as high as $600k, depending on the length of stream and floodplain that are restored. Replacement of riparian buffer plantings will be necessary and important.

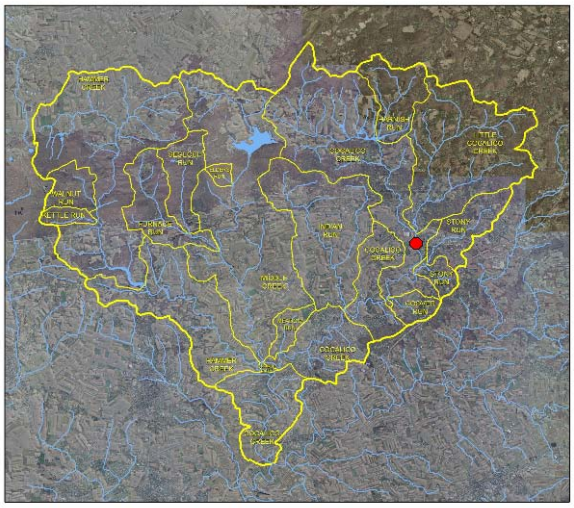
Time Frame: likely 3 years from design to completed restoration.

Potential Funding Sources: state and federal grant programs for stream and floodplain restoration, and nutrient credits and trading as an economic incentive.

Priority Site:
COCALICO CREEK AT FOX CHASE

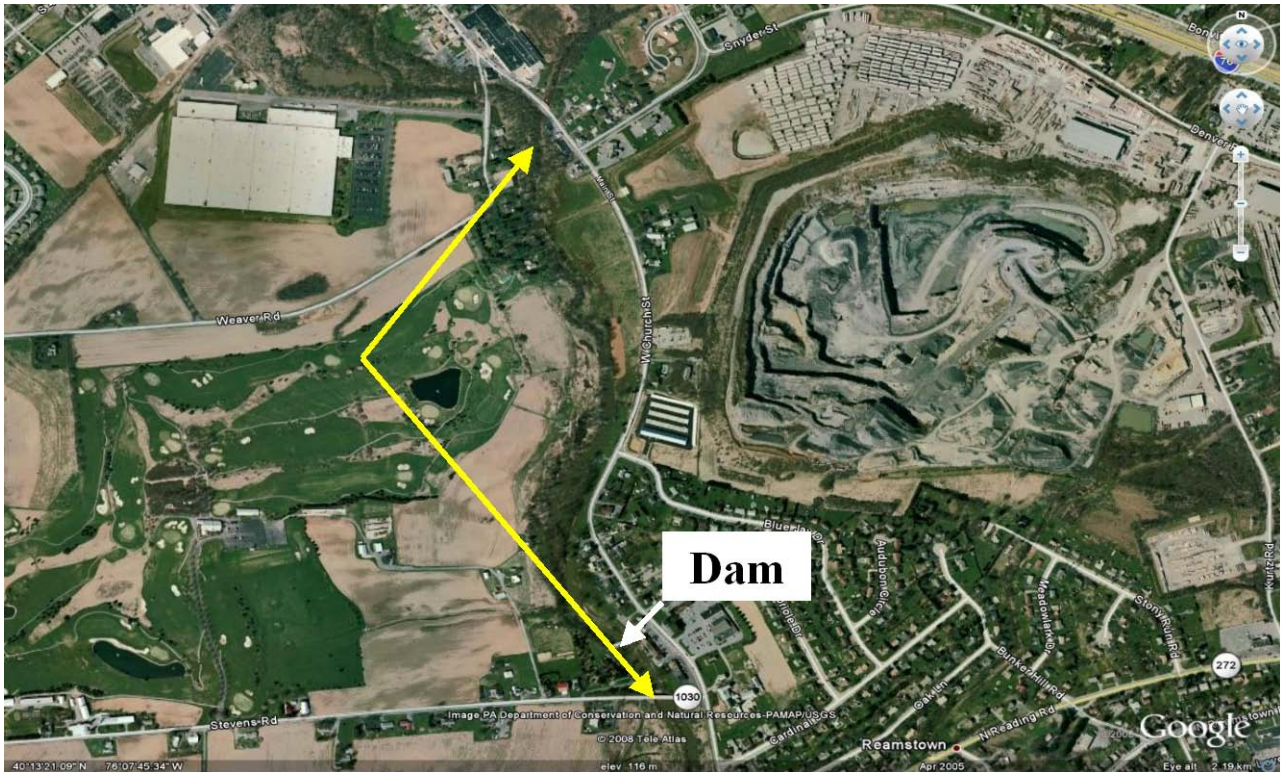
Significant sedimentation has occurred behind the Fox Chase dam, and resident geese are adding nutrients to the stream above the dam. This section of stream is impaired because of upstream agricultural and stormwater sources. Some flooding occurs at this site above the dam, and needs to be alleviated. Stream banks are less than 1 ft high in the impoundment.

Restoration needs to include both dam removal and floodplain restoration. Additional stormwater capacity will be realized with restoration, and flooding will be reduced. The resident geese will likely relocate with the elimination of the impoundment. Implementation of agricultural BMPs in upstream sections of this stream segment will address those sources of impairment to Cocalico Creek. Should dam removal be undertaken, water withdrawals from the creek for golf course irrigation need to be assured in the restoration design.



Benefits:

- Increased stormwater storage in areas with dam removal
- Increased sediment retention and nutrient removal with floodplain restoration
- Reduced input of nutrients from resident geese on impoundment
- Multiple benefits to the stream from floodplain restoration
- Elimination of dam safety upkeep
- Reduced sediment and nutrient loading from upstream agricultural sources



Project Restoration Summary:

Priority: medium

Cost Range: could be significant, up to $0.6M. Need to design the project to provide for continued withdrawals of water for golf course maintenance. Upstream agricultural BMPs would cost around $25k.

Resident Waterfowl Nutrient Loading

Time Frame: restoration projects of this type take several years between design, permitting, and construction

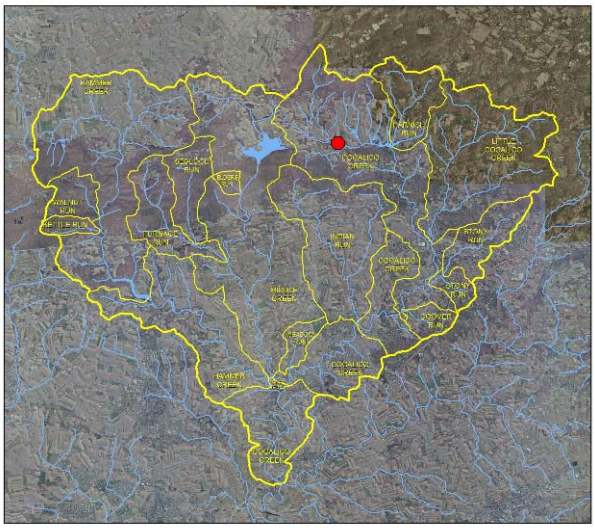
Potential Funding Sources: state or federal grant funding, and private developers needing stormwater credits. State, federal, and local funding sources for agricultural BMPs.

Priority Site:
COCALICO CREEK AT HICKORY ROAD

Significant amounts of sediment have accumulated in Blue Lake because of upstream sources. This site, upstream of Blue Lake, is an important site in which best management practices need to be implemented to reduce sediment loads.

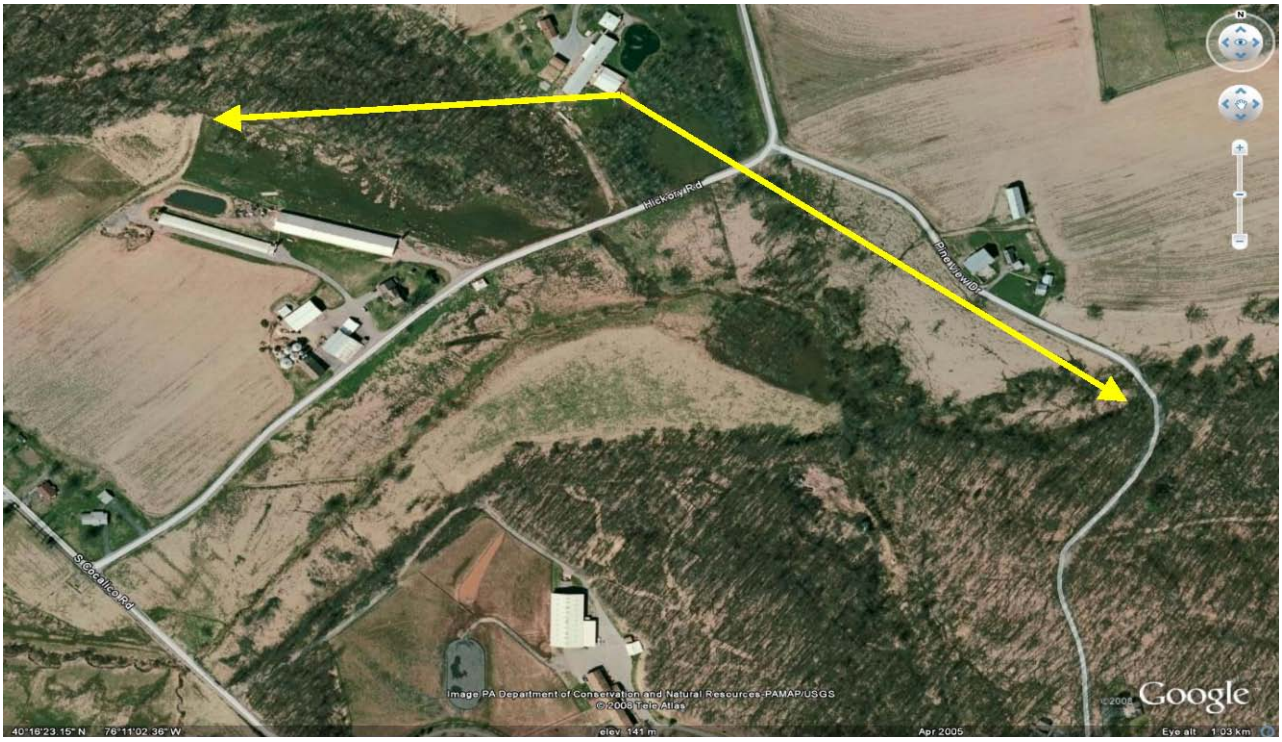
The BMPs needed at this site include streambank fencing, cattle crossing(s), and riparian buffers. Cattle have complete access to the stream, and the erosional damage caused by this access is apparent.

This stream, along with Indian Run, experience flooding that could be alleviated with floodplain restoration. The two stream segments should be restored in tandem.



Benefits:

- Riparian buffer benefits for sediment retention and nutrient removal
- Decreased bank erosion from cattle crossing the stream
- Reduced direct input of nutrients to stream from cattle
- Reestablishment of stream bank vegetation with removal of cattle from riparian zone
- Decreased flooding in the area with floodplain restoration



Project Restoration Summary:

Priority: high

Cost Range: low, likely less than $15k for agricultural BMPs. Floodplain restoration efforts could cost up to $400k.

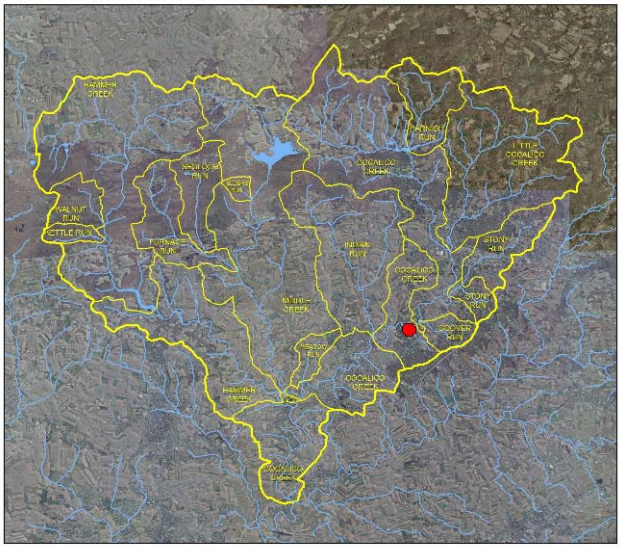
Time Frame: several month period for agricultural BMPs; 2-3 years for floodplain restoration.

Potential Funding Sources: state, local, and/or federal funding programs for agricultural BMPs; state and federal funding programs for floodplain restoration, with the possibility of private funding for nutrient and stormwater credits.

Priority Site:
COCALICO CREEK NEAR GREEN DRAGON

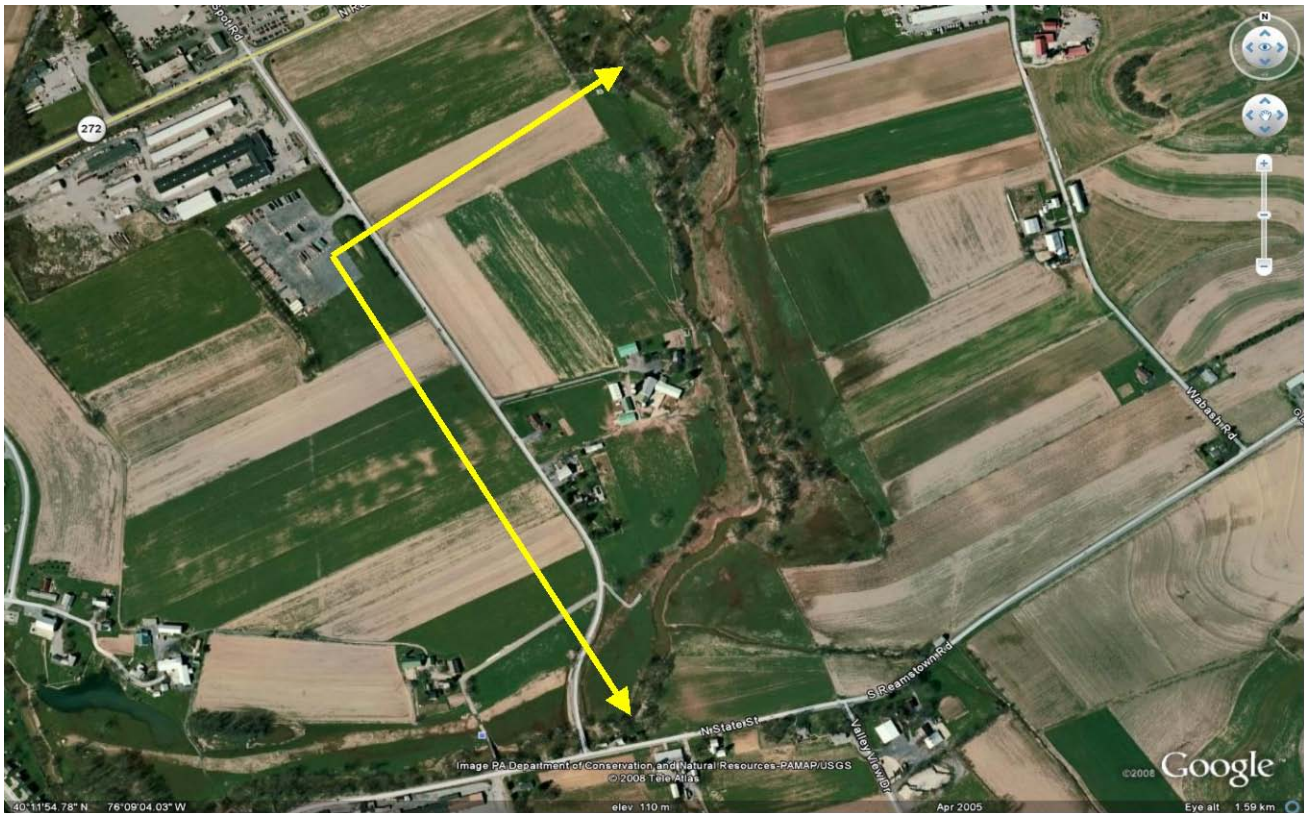
Cocalico Creek is impaired by agricultural impacts through this segment of the stream, and is further impacted by significant streambank erosion. There are no riparian buffers in this stream segment, and dairy cows have free access to the stream.

Agricultural BMPs need to be implemented in this stream segment, and floodplain restoration would significantly reduce sediment and nutrient loading to the Chesapeake Bay from bank erosion in this stream segment. Agricultural BMPs, including riparian buffers, would best be implemented in conjunction with floodplain restoration. Floodplain restoration at this site would ideally be undertaken in conjunction with floodplain restoration on Coover Run, which joins Cocalico Creek in this stream segment.



Benefits:

- Significantly reduce sediment and nutrient loading from agricultural sources, including dairy cow access to the stream
- Significantly reduce streambank erosion, with banks currently 4 to 6 feet high
- Reduce sediment and nutrient inputs to Cocalico Creek by planting riparian buffers
- Enhance instream and riparian habitat with floodplain restoration



Project Restoration Summary:

Priority: high

Cost Range: streambank fencing, with stream crossing and/or offstream watering, could be accomplished relatively inexpensively. Floodplain restoration would likely cost up to $500k, depending on the length of stream restored and sewer line issues.

Time Frame: one year for agricultural BMPS, up to 3 years for floodplain restoration depending on funding availability. Riparian buffers planted with floodplain restoration.

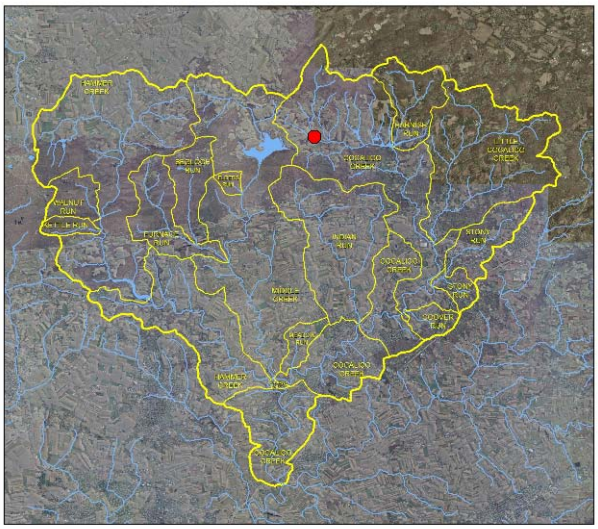
Potential Funding Sources: state, federal, and local agricultural BMP funding programs; state and federal grant programs for floodplain restoration, with nutrient credits and sales a potential financial incentive for floodplain restoration.

Priority Site:

COCALICO CREEK AT SHENKS MILL ROAD

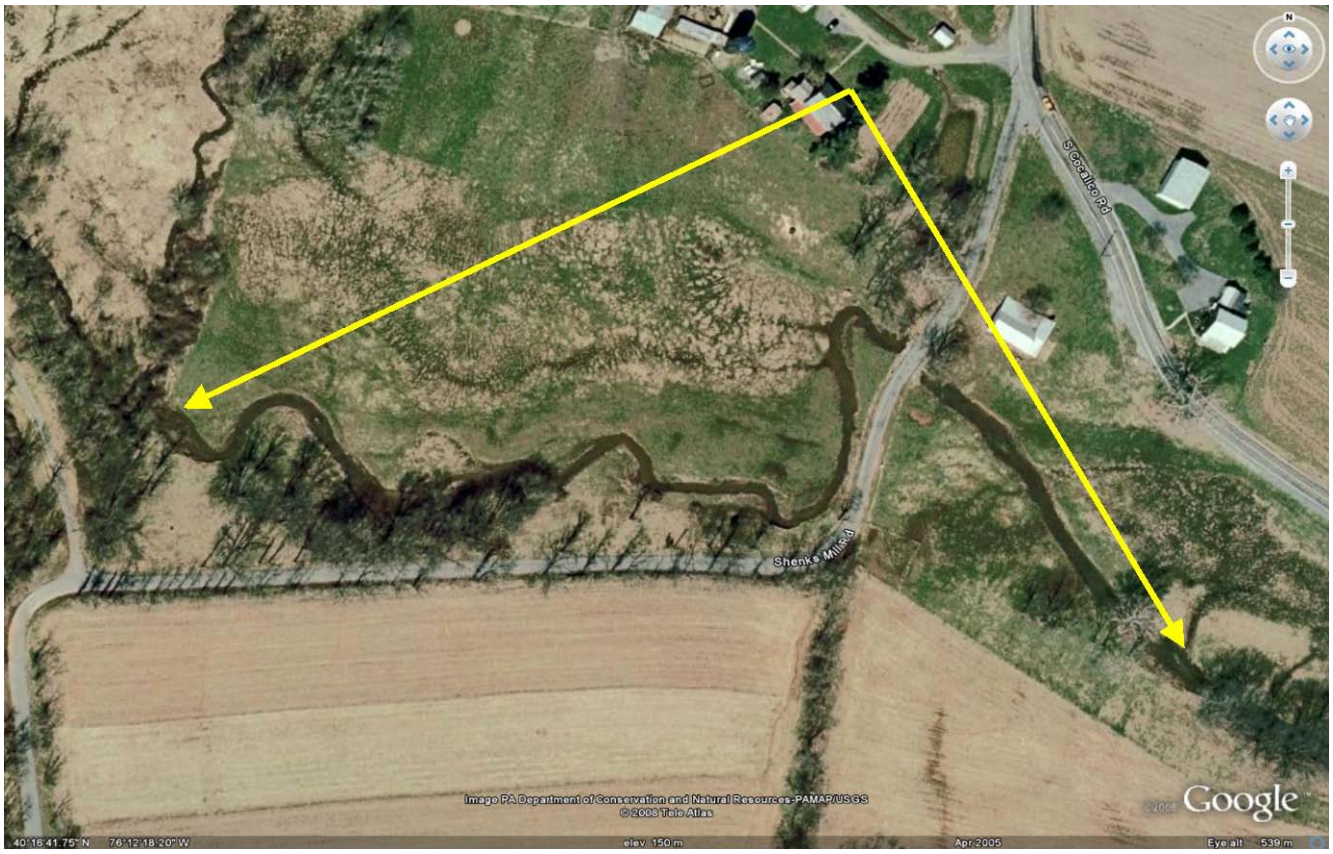
Significant amounts of sediment have accumulated in Blue Lake because of upstream sources. This site, upstream of Blue Lake, is an important site in which best management practices need to be implemented to reduce sediment loads.

The BMPs needed at this site include floodplain restoration, streambank fencing, cattle crossing(s), and riparian buffers. Cattle have complete access to the stream, and the erosional damage caused by this access is apparent. Stream banks are high (1 to 3 ft), vertical and bare soil.



Benefits:

- Reduced erosion of sediments and nutrients during storm events
- Riparian buffer benefits for sediment retention and nutrient removal
- Reduced direct input of nutrients to stream from cattle
- Multiple benefits to the stream from floodplain restoration



Project Restoration Summary:

Priority: medium

Cost Range: low, likely less than $15k for agricultural BMPs with cost-share programs. Floodplain restoration efforts could cost up to $400k.

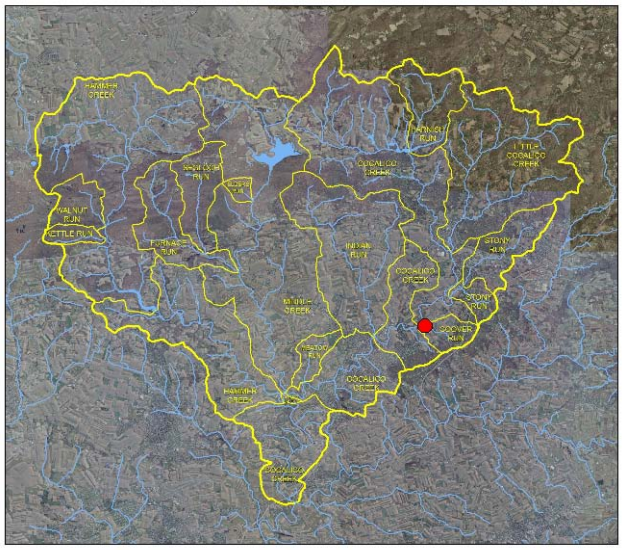
Time Frame: several month period for agricultural BMPs; 2-3 years for floodplain restoration.

Potential Funding Sources: state, local, and/or federal funding programs for agricultural BMPs; state and federal funding programs for floodplain restoration, with the possibility of private funding for nutrient and stormwater credits.

Priority Site:
COOVER RUN

Coover Run is impaired by agricultural impacts, and is also channelized in segments. It flows into Cocalico Creek in a section where that creek is severely impacted by legacy sediments. There is also significant streambank erosion in Coover Run as well.

While legacy sediment issues are significant in Coover Run and should be addressed, the agricultural impacts are severe and need to be addressed as a high priority. There is, however, a part of Coover Run with very high bank erosion that also should be remediated as a high priority.



Benefits:

- Significantly reduced sediment and nutrient loading from agricultural sources
- Significantly reduce bank erosion, particularly in one section where eroding banks are at least 12 ft high
- Reduce sediment and nutrient inputs to Coover Run by planting riparian buffers
- Eliminate channelized stream segments, improving stream and riparian habitat

Project Restoration Summary:

Priority: high

Cost Range: Agricultural BMPs could be expensive, if barnyard management facilities need to be constructed. Stream restoration could be expensive as well, with the removal of channelized segments of Coover Run.

Time Frame: the impacts are severe in this stream, so agricultural BMPs should be addressed immediately. Stream restoration and remediation activities will take more time, up to 3 years or more depending on funding availability.

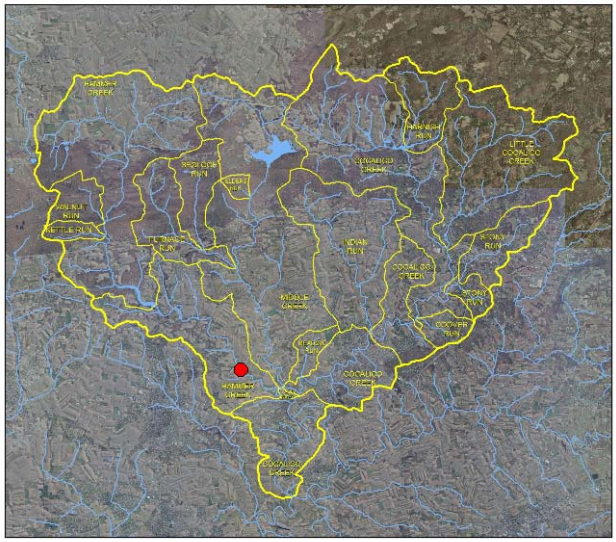
Potential Funding Sources: state, federal, and local agricultural BMP funding programs; state and federal, as well as local, programs for stream remediation and stream restoration.

Priority Site:

HAMMER CREEK FROM BUCH MILL ROAD TO MEADOW VALLEY ROAD

Hammer Creek, from Buch Mill Road downstream to Meadow Valley Road, is impaired along with an unnamed tributary that flows into Hammer Creek within this stream segment. There are several areas where agricultural BMPs could be implemented to significantly reduce sediments and nutrients that enter Hammer Creek.

Both the unnamed tributary and Hammer Creek have significant streambank erosion in this segment, resulting in sediment and nutrient loading to downstream waters and the Chesapeake Bay. Reductions in streambank erosion, coupled with streambank fencing, stream crossings for livestock, and riparian buffers, would reduce this water quality impairment.



Benefits:

- Significantly reduced sediment and nutrient loading from an impaired, unnamed tributary to Hammer Creek
- Improved instream habitat and water quality, and riparian habitats for wildlife along Hammer Creek
- Significantly reduce sediment and nutrient loading from at least one farm in this stream segment
- Significantly reduce sediment and nutrient loading from streambank erosion along Hammer Creek and the unnamed tributary

Project Restoration Summary:

Priority: medium

Cost Range: $20k for agricultural BMPs, and floodplain restoration costs could range up to $600k to address streambank erosion, depending on the length of stream restored.

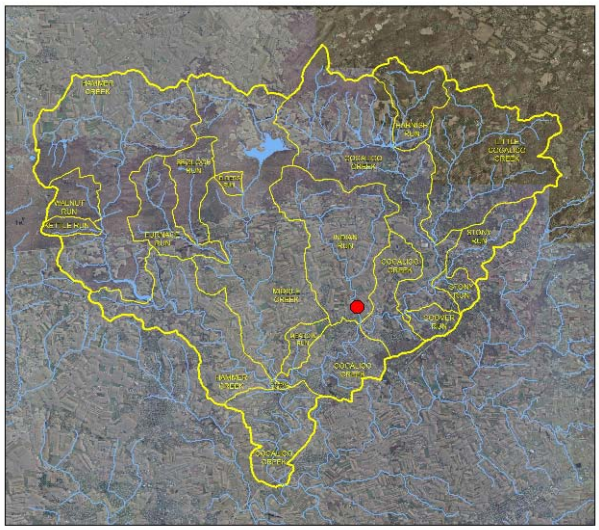
Time Frame: an outreach program should be implemented to solicit farmer/landowner interest in BMPs, including floodplain restoration. Agricultural BMPs could be implemented rather quickly. Floodplain restoration could take 3 years to complete.

Potential Funding Sources: state, federal, and local agricultural BMP funding programs, state and federal grant programs for stream and floodplain restoration, and nutrient credits and trading as an economic incentive.

Priority Site:
INDIAN RUN

Flooding is an issue in this segment of Indian Run. Historically there was a mill dam downstream of this site, but that segment of stream is now channelized with concrete and stone banks. Stream restoration in this lower segment could reduce flooding with a functional floodplain.

Upstream of this site are numerous farming operations where riparian buffers and agricultural BMPs could be implemented. Streambanks in these farming parcels should be investigated, once access permission is granted, to determine the potential for stormwater management benefits from floodplain restoration. Indian Run flows in a relatively straight channel through these farms, so stream restoration with the inclusion of channel meanders and a restored floodplain would better manage stormwater and downstream flooding. At this point, we recommend the implementation of agricultural BMPs on the upstream farms.



Benefits:

- Significantly reduced sediment and nutrient loading from agricultural sources
- Reduce sediment and nutrient inputs by planting riparian buffers
- Enhance instream and riparian habitat for wildlife
- Floodplain and stream restoration in the lower section and through the upstream farms (with channel meanders and a functional floodplain) could improve stormwater management for flood reduction purposes.

Project Restoration Summary:

Priority: low

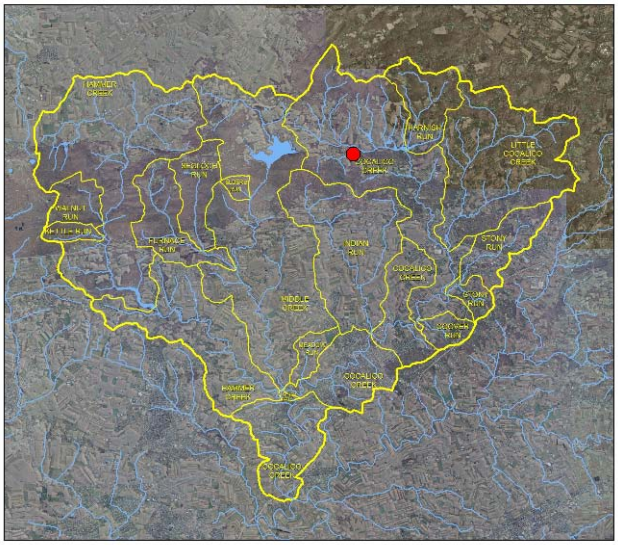
Cost Range: Agricultural BMPs could be implemented on the upstream farms with cost-share programs. Stream restoration with functional floodplain restoration, if implemented on the upstream farms, would be expensive, with costs perhaps ranging up to $1M if much of the stream length were restored.

Time Frame: agricultural BMPs could be implemented over a two-year period on the upstream farms; stream restoration would take 3-4 years to complete.

Potential Funding Sources: state, federal, and local agricultural BMP funding programs; state and federal grants for stream restoration; potential nutrient and stormwater credits as financial incentives for private sector funding interest.

Priority Site:
INDIAN RUN AT HICKORY ROAD

Indian Run, along Hickory Road in West Cocalico Township, experiences frequent flooding along with Cocalico Creek. The confluence of the two streams is also along Hickory Road. There is significant streambank erosion along parts of Indian Run, with substantial opportunity for floodplain restoration. This BMP would significantly reduce erosion and its sediment and nutrient loading, and would greatly increase the stormwater management capacity in this stream segment. Flooding should be reduced with floodplain restoration. Agricultural BMPs should also be implemented in conjunction with floodplain restoration along Indian Run. Restoration activities at Indian Run should be done in conjunction with restoration at Cocalico Creek in the confluence segment.



Benefits:

- Decreased streambank erosion with floodplain restoration
- Increased stormwater management capacity with floodplain restoration
- Reduced flooding with the increased stormwater management capacity
- Reduced sediment and nutrient loading downstream with reduced streambank erosion
- Improved water quality with agricultural BMPs
- Increased instream and riparian habitat for wildlife

Project Restoration Summary:

Priority: high

Cost Range: Floodplain restoration costs could be in the range of $500k or more, depending on the length of stream restored. Agricultural BMP costs should be low with cost-share programs for several upstream farming operations.

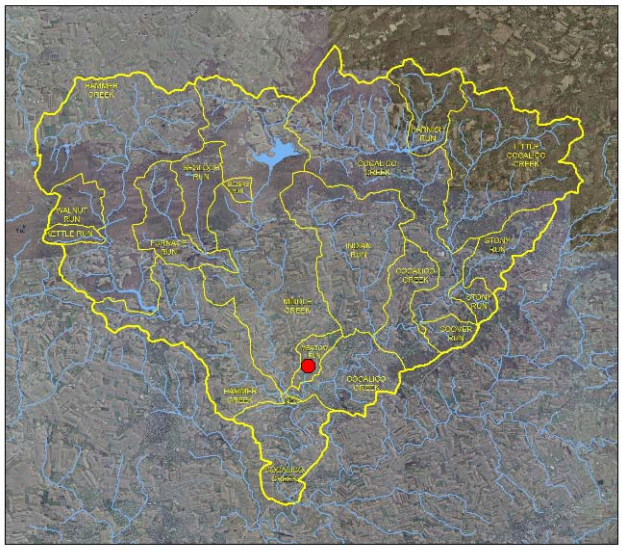
Time Frame: upstream agricultural BMPs could be implemented in 1-2 years, or less with enthusiastic farmers. Floodplain restoration will likely take 3 years from design to completed restoration.

Potential Funding Sources: Federal, state, and local funding programs for agricultural BMPs; state and federal grant programs for floodplain restoration; nutrient credits and trading possible with floodplain restoration and agricultural BMPs above baseline.

Priority Site:
MEADOW RUN

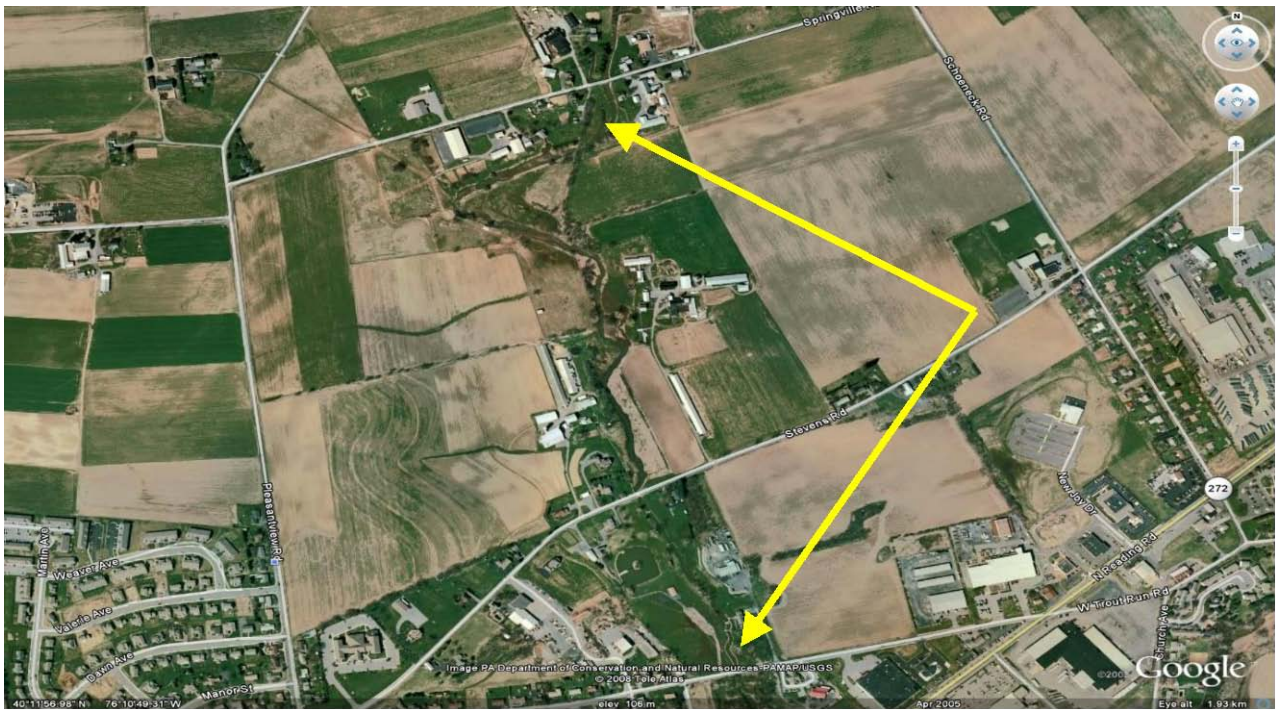
Meadow Run flows through an agricultural watershed, and presents several opportunities to significantly reduce nutrient loads and sediment loads to Cocalico Creek.

A large segment of Meadow Run is identified here as an opportunity to implement several best management practices, including stream crossings or off-stream watering, riparian buffers, and streambank fencing. Solicitation for involvement in BMPs should be sought from other farmers outside of this segment as well, through the Conservation District.



Benefits:

- Significant reductions in nutrient loading and sediment loading to the stream
- Improved water quality in runoff through riparian buffers
- Improved stream habitat quality in this impaired stream.



Project Restoration Summary:

Priority: high

Cost Range: likely in the $30k range, depending on the length of stream in which BMPs will be installed. Cost-share programs would reduce this cost significantly.

Time Frame: several months for installation, will take up to a year or more to get the maximum number of farmers involved.

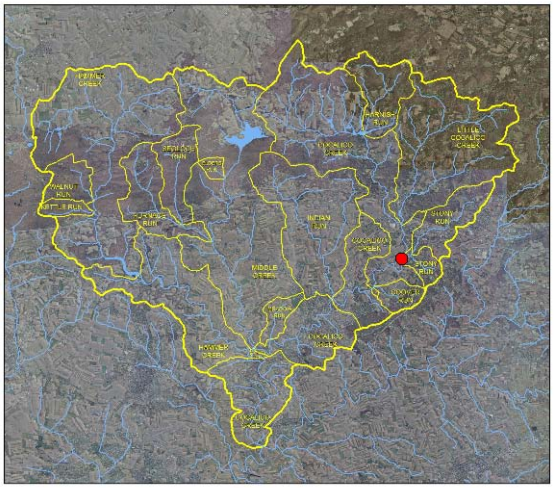
Potential Funding Sources: federal, state and local agricultural BMP funding programs; nutrient credits could be accrued with baseline compliance.

Priority Site:

STONY RUN AT CHURCH STREET IN REAMSTOWN

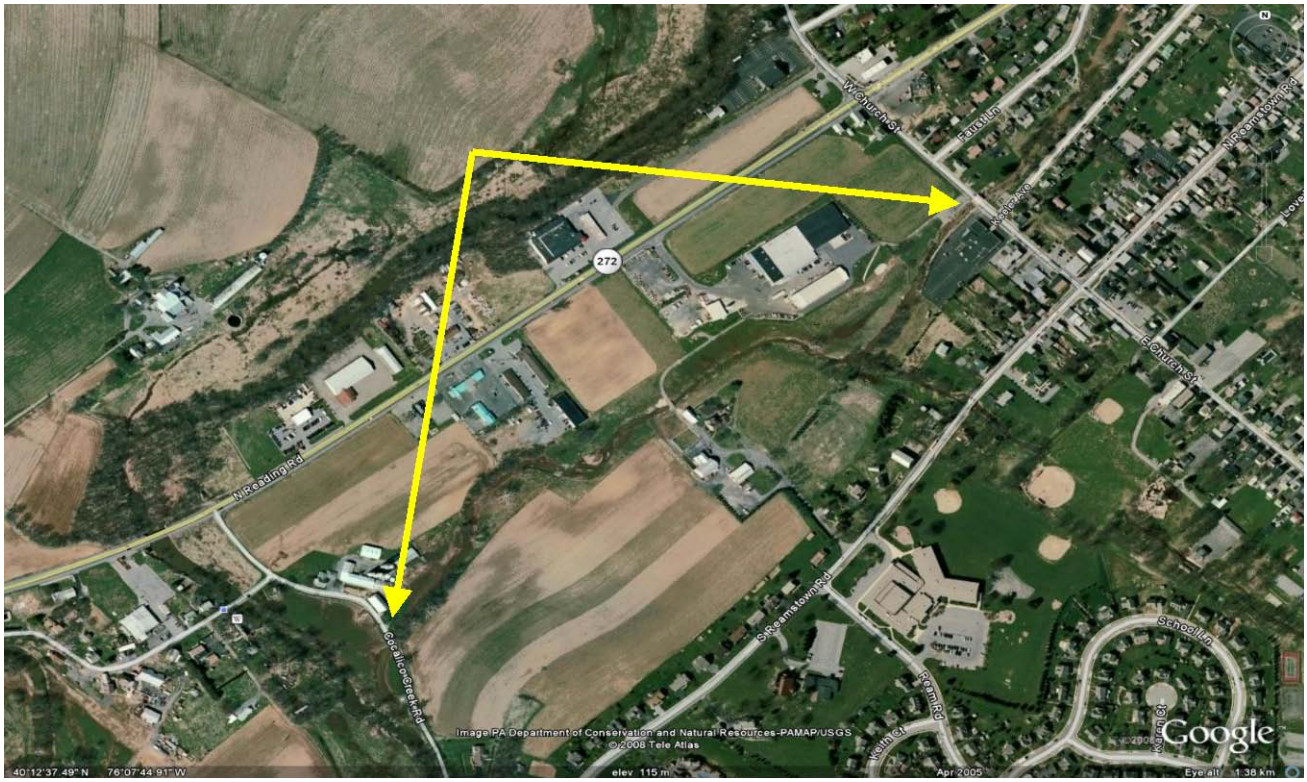
Stony Run at Church Street has been a perennial flooding problem area. Attempts have been made to stabilize the erosion with rock and stone. Erosion of the banks will continue, along with the potential for flooding, until a permanent solution is implemented.

The restoration here should consider allowing floodwaters to flow on a restored floodplain adjacent to and immediately downstream of the area shown in the picture below. Feasibility analysis will determine the extent of area available for restoration, and the degree to which flooding potential could be reduced.



Benefits:

- Alleviate flooding downstream and provide stormwater storage credits
- Alleviate instability and bank erosion; reduce downstream sediment and nutrient loading
- Protect adjacent parking lot at fire station
- Improve in-stream and riparian habitat through floodplain restoration and riparian buffers



Project Restoration Summary:

Priority: high

Cost Range: $15k for agricultural BMPs, and floodplain restoration costs could range up to $400k to address streambank erosion and provide for stormwater management benefits.

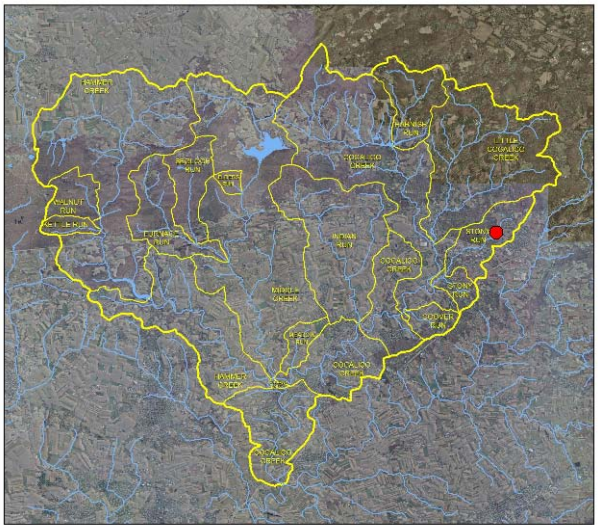
Time Frame: agricultural BMPs could be implemented relatively quickly, but would be most beneficial after floodplain restoration, which would likely 3 years to properly restore the stream and alleviate flooding and erosion.

Potential Funding Sources: state, federal and local agricultural BMP funding programs; state and federal grant programs for floodplain restoration; nutrient credit sales from restoration

Priority Site:
STONY RUN NEAR HILL ROAD

Stony Run is impaired with both agricultural impacts and significant streambank erosion. Floodplain restoration, in combination with riparian buffers and agricultural BMPs, will significantly improve this segment of Stony Run.

About half of this segment of Stony Run is owned by East Cocalico Township, with the lower half next to the Township Offices and the segment immediately upstream in East Cocalico Township Park. Floodplain restoration projects are often more easily facilitated on publicly owned lands. The sediment and nutrient loading from streambank erosion is apparent in this segment of Stony Run.



Benefits:

- Significantly reduce sediment and nutrient loading from streambank erosion in this stream segment
- Eliminate the loss of trees in the Township Park because of streambank erosion
- Improved instream and riparian habitat and water quality, benefiting wildlife
- Reduce agricultural impacts by implementation of BMPs

Project Restoration Summary:

Priority: high

Cost Range: floodplain restoration could range up to $400k, depending on the length of stream that is restored. Agricultural BMP costs were not investigated because access was not secured for a farm site visit. Riparian buffer costs would be part of floodplain restoration.

Time Frame: up to 3 years for floodplain restoration; agricultural BMPs on the upstream farm could be implemented quickly with farmer interest.

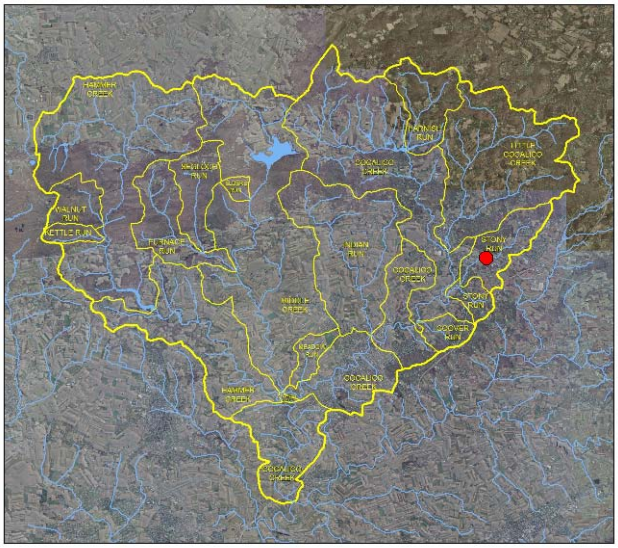
Potential Funding Sources: state and federal grant programs for floodplain restoration, with nutrient credits and stormwater management credits as additional economic incentives; state, federal, and local agricultural BMP funding programs.

Priority Site:

STONY RUN NEAR STONY RUN INDUSTRIAL PARK

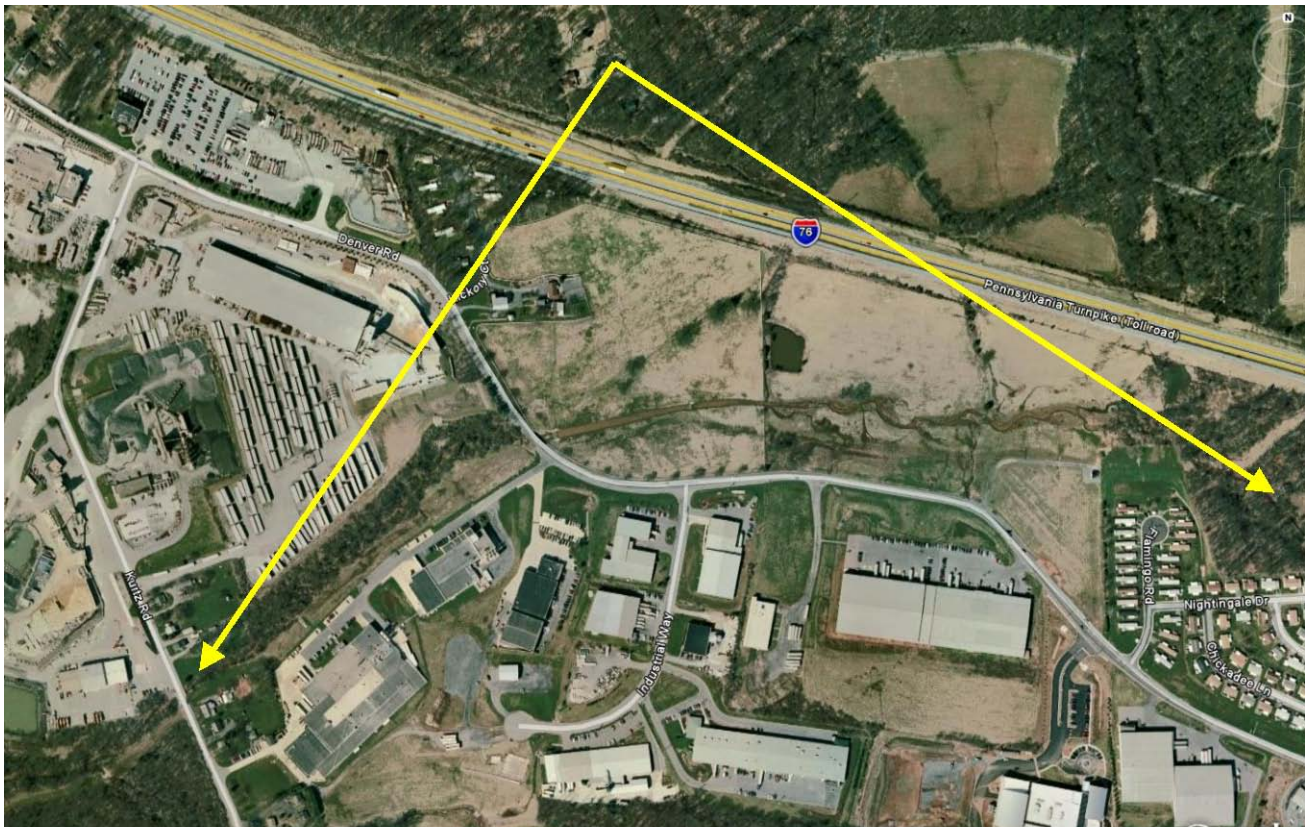
Stony Run is impaired due primarily to urban stormwater, although legacy sediment accumulation in the floodplain is common and significant. Flooding is an issue in downstream areas, so stream and floodplain restoration that can better manage stormwater runoff would be a significant benefit.

Part of Stony Run has been channelized, with small dams constructed as well. These exacerbate the flooding problem, and need to be corrected. There are opportunities in this identified stream segment for floodplain restoration, which will provide significant stormwater management benefits, reduce erosion, and improve water quality.



Benefits:

- Significantly increase the stormwater management capacity in this segment of Stony Run
- Reduce flooding equivalently through increased stormwater management by floodplain restoration
- Significantly reduce sediment and nutrient loading by legacy sediment removal
- Improve stream and riparian habitat by floodplain restoration and riparian buffers



Project Restoration Summary:

Priority: high

Cost Range: floodplain restoration costs would likely range up to $600k, depending on the length of stream that is restored.

Time Frame: likely 3 years from design to completed restoration by floodplain restoration, including riparian buffer planting

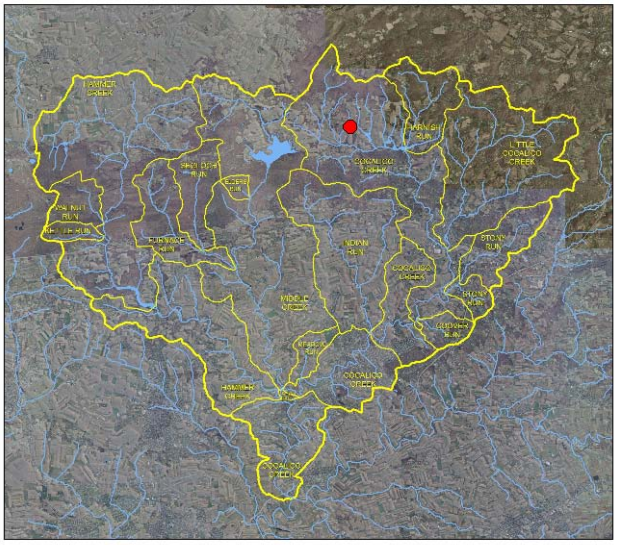
Potential Funding Sources: state and federal grant programs for stream and floodplain restoration; potential for private sector investment in floodplain restoration for the stormwater management credits; nutrient credits and trading an additional financial incentive.

Priority Site:

UNNAMED TRIBUTARIES TO COCALICO CREEK ALONG ROUTE 897

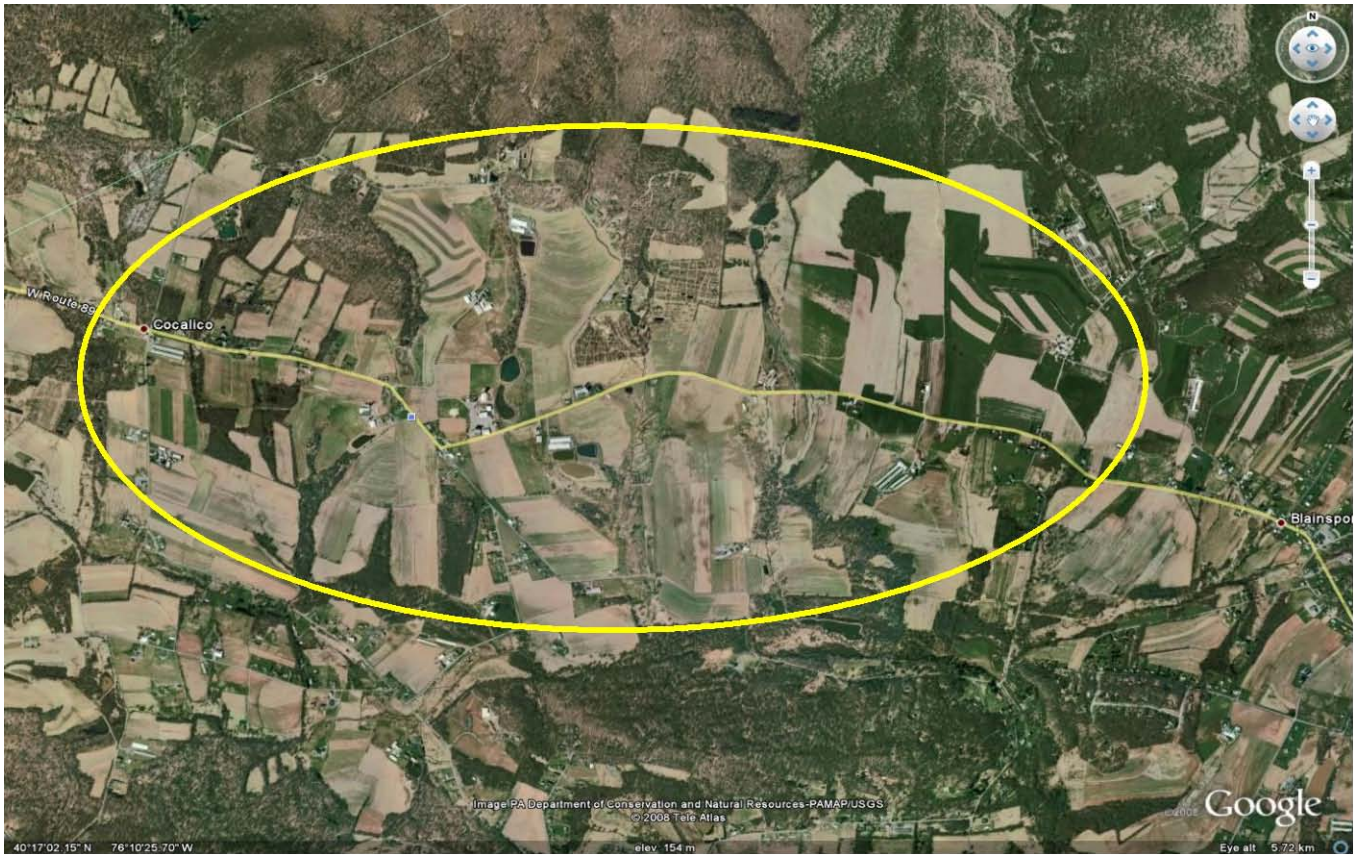
Significant sediment and nutrient loading occurs in the headwater region of Cocalico Creek, in West Cocalico Township. Numerous small first order tributaries, as well as the headwaters of Cocalico Creek, originate on or flow through agricultural lands. There are opportunities to implement agricultural BMPs on these agricultural lands.

Reductions in streambank erosion, the planting of riparian buffers, and the creation of riparian wetlands are present along these first order tributaries. These streams flow through agricultural lands, and stream restoration would likely necessitate streambank fencing, stream crossings and/or offstream watering for dairy operations, and the cooperation and interest of landowners.



Benefits:

- Significantly reduced sediment and nutrient loading from agricultural sources
- Reduced nutrient inputs by planting riparian buffers
- Enhanced instream and riparian habitat for wildlife
- Floodplain and stream restoration through the upstream farms, where streambank erosion is significant, would further decrease sediment and nutrient loading.



Project Restoration Summary:

Priority: medium

Cost Range: Cost-share programs for agricultural BMPs would greatly reduce overall implementation costs. Stream and floodplain restoration to reduce streambank erosion would likely cost $300k for 1000 to 2000 feet of stream to be restored.

Time Frame: agricultural BMPs can be implemented in a year on a farm; the target for these farms should be in the 2-3 year range; floodplain restoration typically takes 2-3 years from design to completed restoration.

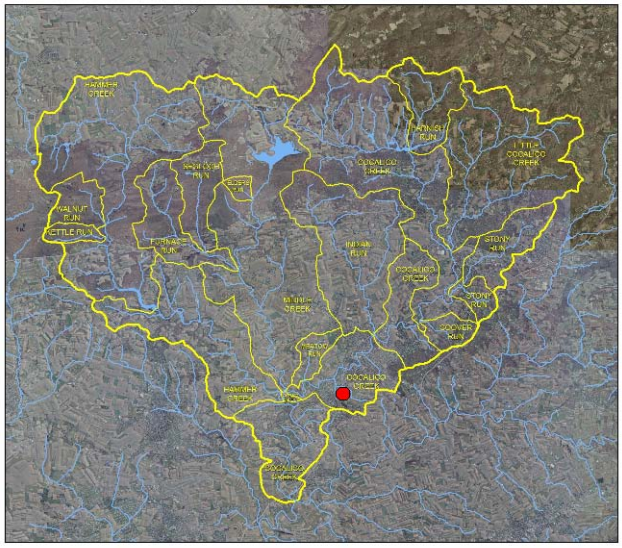
Potential Funding Sources: state, federal, and local agricultural BMP funding programs; state and federal grants for stream restoration, with nutrient credits and trading as additional financial incentives.

Priority Site:

UNNAMED TRIBUTARY IN AKRON BOROUGH PARK

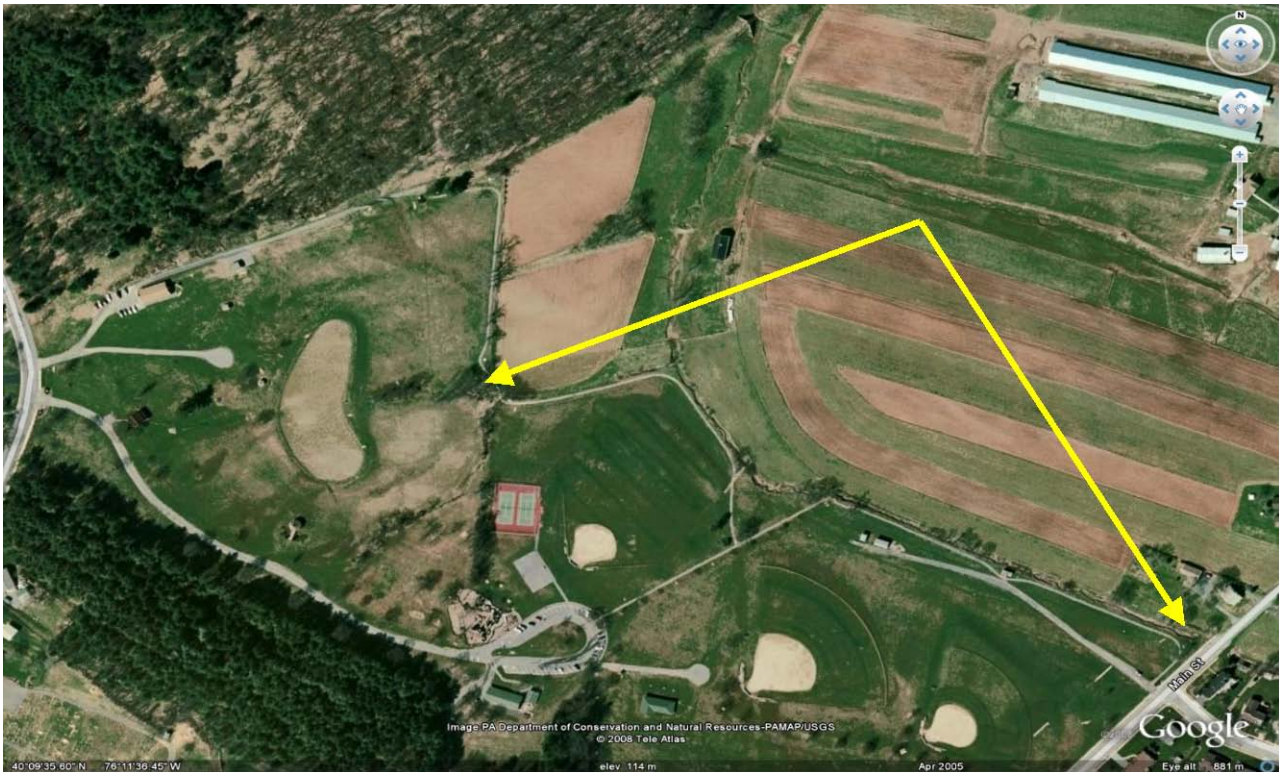
An unnamed tributary in Lloyd Roland Memorial Park, in Akron Borough, has significant erosion of the streambanks caused by legacy sediment deposition. The stream is bordered by row crop agriculture for most of its length, and passes adjacent to public wells for the Borough in the park. Several restoration measures are recommended for this site.

Riparian buffers and perhaps additional agricultural BMPs for the cropland, are recommended to reduce nutrient input to the stream and groundwater, particularly for wellhead protection. Floodplain restoration would reduce sediment and nutrient loadings from this stream, improve wildlife habitat, and provide environmental education opportunities in the park.



Benefits:

- Significantly reduce sediment and nutrient loading from agricultural lands to the unnamed tributary
- Protect the groundwater supply to the public wells located within 100 yards of the unnamed tributary
- Significantly reduce sediment and nutrient loading from streambank erosion along the length of the unnamed tributary
- Enhance riparian habitat and wildlife usage of the unnamed tributary
- Provide potential environmental education opportunities for the park.



Project Restoration Summary:

Priority: low

Cost Range: $10k or less for agricultural BMPs, and floodplain restoration costs could range up to $350k.

Time Frame: agricultural BMPs could be implemented relatively quickly assuming interest from the landowner. Floodplain restoration might take more time to secure funding, and would be a 2-3 year project.

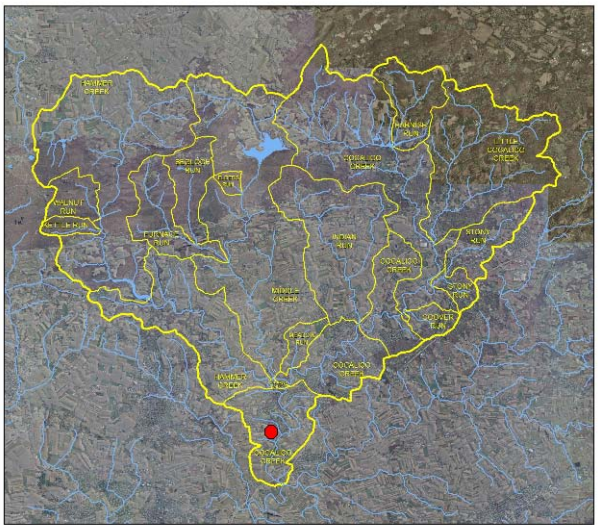
Potential Funding Sources: state, federal, and local agricultural BMP funding programs; state and federal grant programs for floodplain restoration; potential nutrient credit sales to partially offset costs for floodplain restoration and agricultural BMPs.

Priority Site:

UNNAMED TRIBUTARY TO COCALICO CREEK AT DISSTON VIEW DRIVE

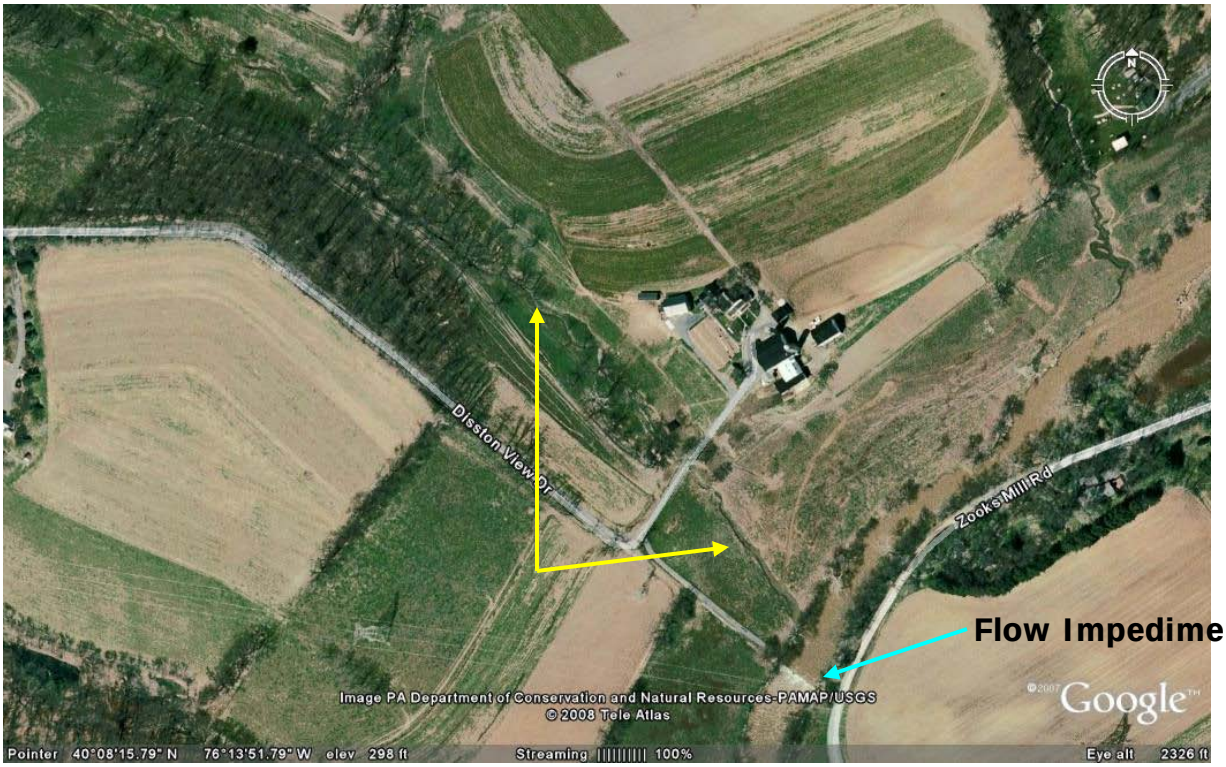
This unnamed tributary to Cocalico Creek, located in the lower part of the watershed, has restoration opportunities for agricultural BMPs along with stream and floodplain restoration. Additionally, there is a flow impediment across Cocalico Creek that needs to be investigated as to its impact on backing up water and increasing sedimentation upstream in the creek.

Barnyard runoff from a dairy farm flows directly into Cocalico Creek via this unnamed tributary. Sediment erosion upstream from the farm is significant and should be controlled as well.



Benefits:

- Reduced nutrient and sediment loading to Cocalico Creek
- Potential decrease in sedimentation in the stream with removal of the flow impediment
- Improved water quality in runoff through riparian buffers



Project Restoration Summary:

Priority: high

Cost Range: relatively low for the agricultural BMPS in the lower segment (likely about $8k); higher costs for stream restoration in the upper stream segment (likely about $350k)

Time Frame: several months for the agricultural BMPs; 2 to 3 years for the stream restoration in the upper segment

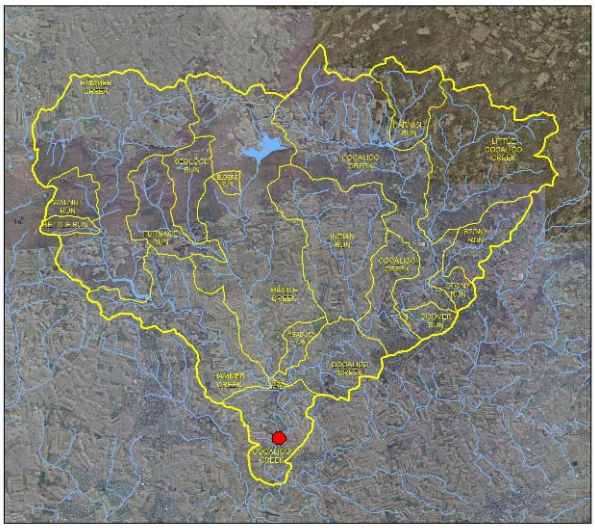
Potential Funding Sources: local, state, and federal agricultural BMP funding sources; state and federal grants for the stream restoration; nutrient credits and trading as a financial incentive.

Priority Site:

UNNAMED TRIBUTARY TO COCALICO CREEK AT ROSE HILL ROAD

An unnamed tributary flows into Cocalico Creek near Rose Hill Road. The tributary does not flow except during surface runoff events. The slope of this drainage is steep, and the surface runoff flows a short distance before discharging into Cocalico Creek.

The surface runoff comes from a farm where agricultural BMPs should be promoted. These BMPs will reduce sediment and nutrient loading to Cocalico Creek from barnyard runoff and adjacent fields. These BMPs will have a direct benefit to Cocalico Creek.



Benefits:

- Reduced sediment and nutrient loading to Cocalico Creek from agricultural sources
- Improved water quality entering Cocalico Creek

Project Restoration Summary:

Priority: low

Cost Range: depending on the extent of agricultural BMPs that may be needed, such as barnyard runoff controls, should be relatively low with cost-share programs.

Time Frame: should be able to implement within one year.

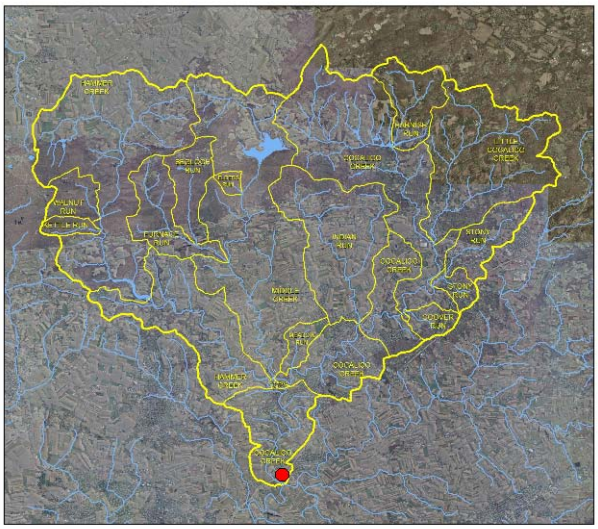
Potential Funding Sources: state, federal, and local agricultural BMP funding programs; possibility for nutrient credits and trading if BMPs are above baseline requirements.

Priority Site:

UNNAMED TRIBUTARY TO COCALICO CREEK US 222

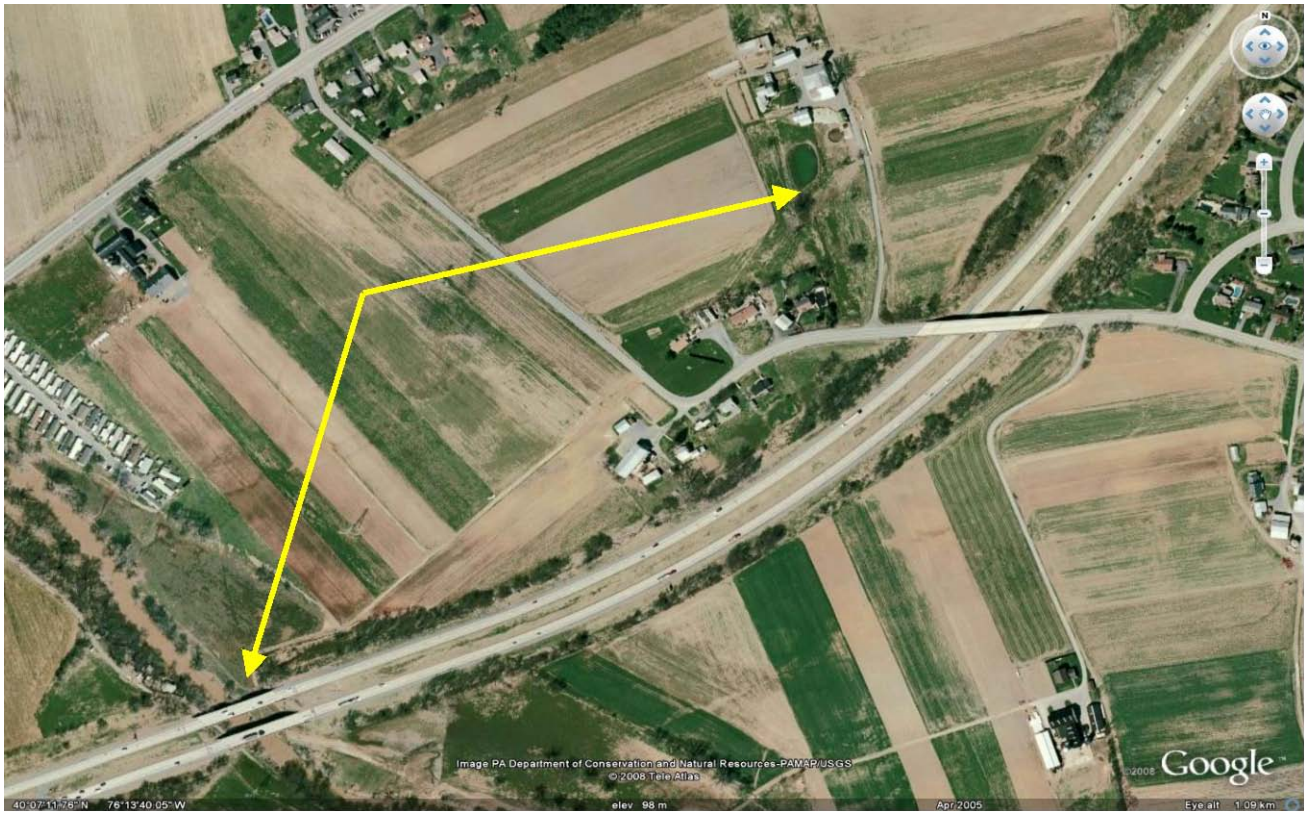
This unnamed tributary to Cocalico Creek runs somewhat parallel to US 222, and is impaired for stormwater runoff. There are two farms on this tributary, and the upstream one contributes some sediment and nutrient runoff to it. It is suspected that stormwater runoff from US 222 contributes pollutants to the tributary as well.

Agricultural BMPs are recommended for the farm contributing sediment and nutrients to the tributary. Enhancement of the roadside vegetation via a bioswale may be successful in reducing the pollutant load to the tributary during runoff events from the roadway.



Benefits:

- Reduced sediment and nutrient loading from agricultural sources with BMPs
- Reduced nutrient inputs with riparian buffer plantings
- Reduced pollutant loadings from US 222 to the tributary with enhanced bioswale techniques along the roadway
- Enhanced instream and riparian habitat for wildlife



Project Restoration Summary:

Priority: low

Cost Range: low costs with cost-share programs for agricultural BMPs; bioswale enhancements may be relatively low cost as well, particularly if partially or fully funded by the federal DOT.

Time Frame: agricultural BMPs could be implemented within a year; bioswale enhancements may take longer to secure funding for implementation.

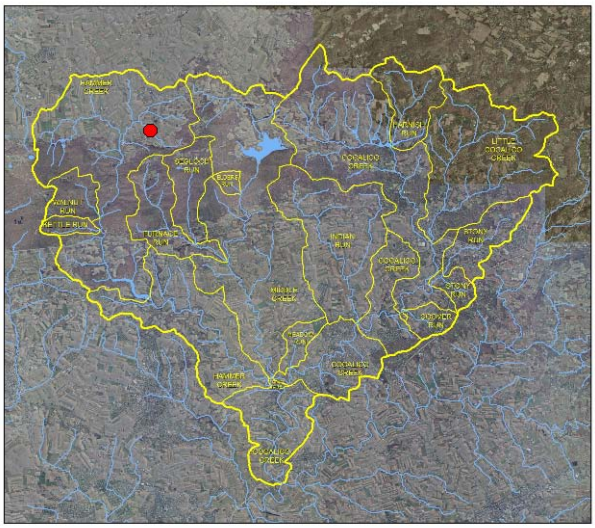
Potential Funding Sources: state, federal, and local agricultural BMP funding programs; federal DOT funding for bioswale enhancements, perhaps with cost share from the state.

Priority Site:

UNNAMED TRIBUTARY TO HAMMER CREEK

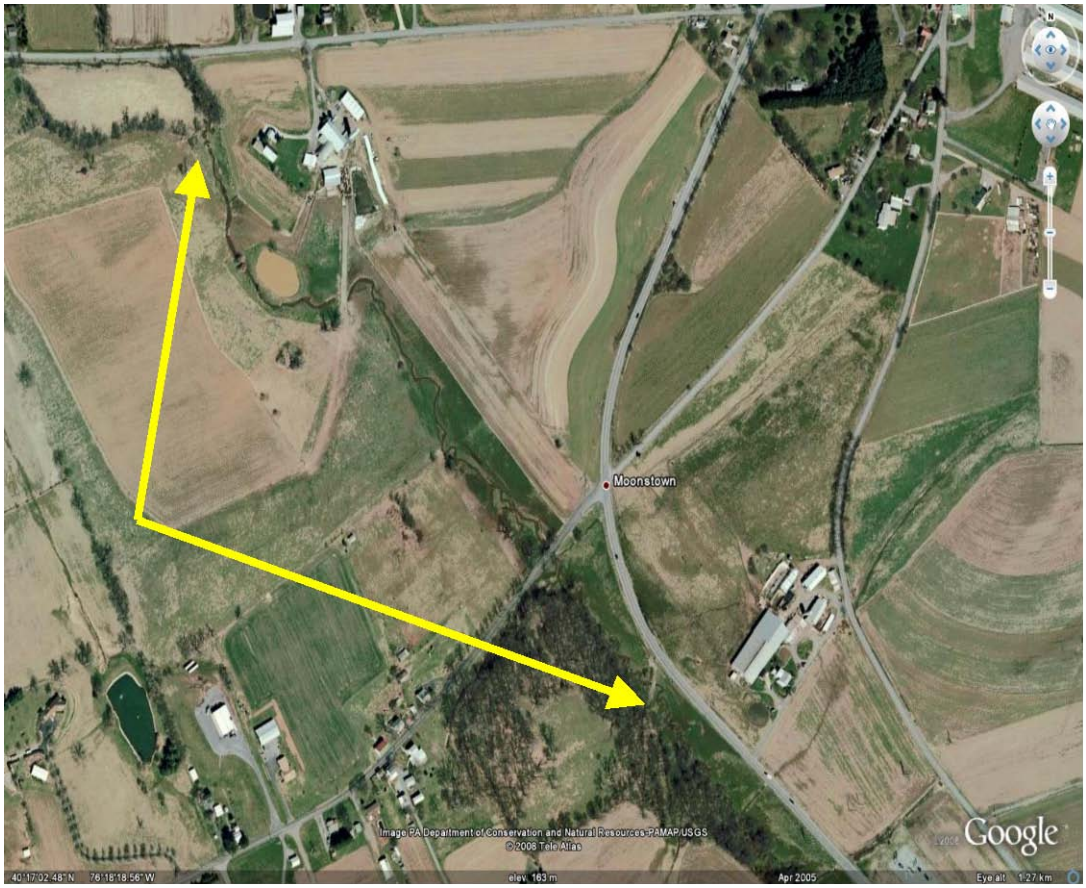
This unnamed tributary to the headwater region of Hammer Creek flows through an agricultural area on which two historic mill dams were located. The accumulation of legacy sediments behind these mill dams is evident with the vertical and bare stream banks with clear evidence of significant erosion.

Agricultural BMPs need to be implemented here as well, including streambank fencing, stream crossings for livestock, and riparian buffers. Ideally these BMPs would be implemented following a stream and floodplain restoration.



Benefits:

- Significantly reduced sediment and nutrient loading to Hammer Creek and downstream
- Improved in-stream habitat and water quality.
- Restored floodplain habitats including created wetlands.
- Benefits to stream and riparian wildlife



Project Restoration Summary:

Priority: high

Cost Range: significant for full restoration, likely in the $400k range with stream and floodplain restoration

Time Frame: likely 3 years for full restoration, ideally with stream and floodplain restoration initially and followed by agricultural and riparian buffer BMPs

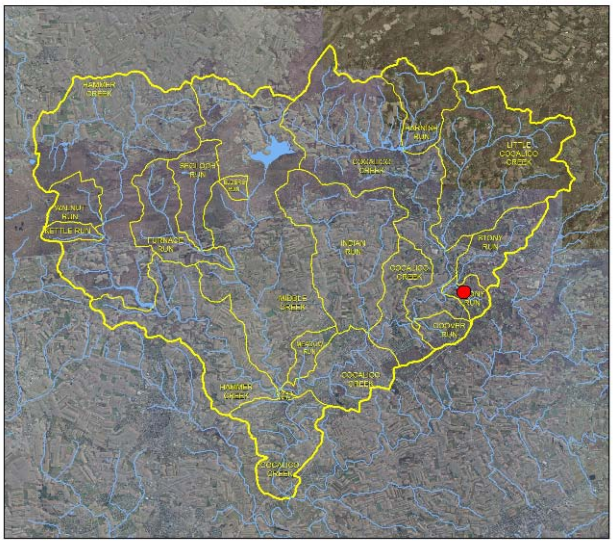
Potential Funding Sources: state and federal funding programs; nutrient credits and trading could partially offset BMP implementation costs

Priority Site:

UNNAMED TRIBUTARY TO STONY RUN

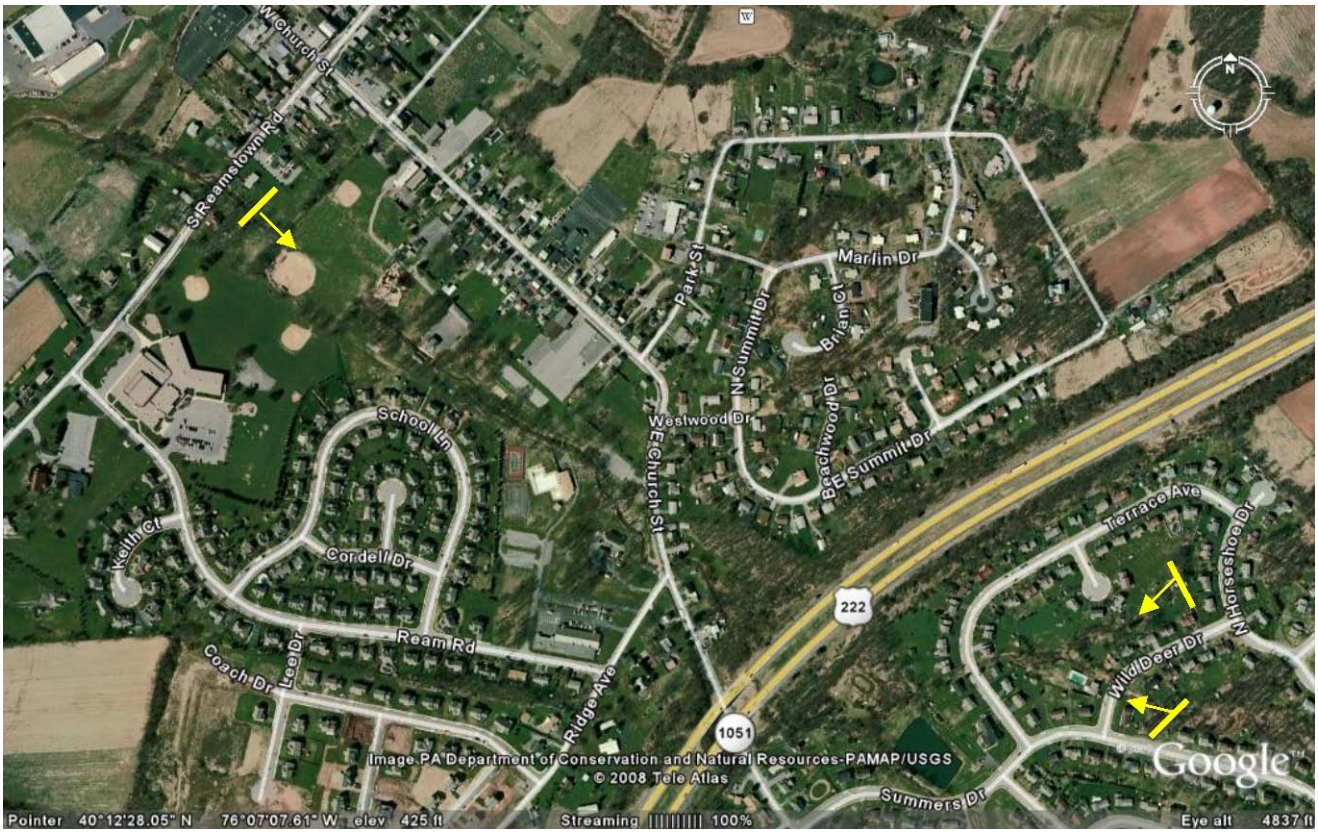
This unnamed tributary to Stony Run, in Reamstown and East Cocalico Township, is impaired due to urban stormwater runoff. The stream also has significant streambank erosion both in the East Cocalico Heights subdivision and downstream through other residential areas and through the Cocalico Recreational Area and Reamstown Memorial Park.

The streambank erosion is causing the loss of trees in the park and threatening infrastructure. Traditional remediation measures have been taken in several areas, but the erosion problem is extensive and requires a more holistic and environmentally sound approach. Restoration is necessary for the park and recreation areas, as well as the residential areas where erosion continues to encroach on residences.



Benefits:

- Significantly increase the stormwater management capacity in this unnamed tributary.
- Significantly reduce streambank erosion and the consequent sediment and nutrient loading downstream
- Greatly reduce the streambank erosion and resultant encroachment in residential yards and structures
- Reduce the loss of trees and infrastructure in the park and recreation area by reducing erosion
- Improve stream and riparian habitat
- Provide educational opportunities in the park and recreation area



Project Restoration Summary:

Priority: medium

Cost Range: floodplain restoration costs could range from $400k to $800k, depending on the length of stream restored and the measures incorporated in residential areas

Time Frame: restoration would likely take 3-4 years, with potentially significant design time and costs for residential areas

Potential Funding Sources: state and federal grant funding programs for stream restoration; potential private sector interest and funding for stormwater credits from floodplain restoration; potential homeowner association funding for benefits from reduced encroachment; nutrient credits and trading an additional financing incentive.

Appendix 2

Glossary of

Planning and Regulatory Terminology

Appendix 2: Glossary of Planning and Regulatory Terminology

Act 537: Act 537 was enacted in 1966 to correct sewage disposal problems. It requires municipalities develop and implement a plan to address current and future wastewater needs.

Agricultural Conservation Easements: Prevent the development or improvement of the land for any purpose other than agricultural production, related agricultural activities.

Agricultural Preservation: The purpose of this program is to protect viable agriculture land by acquiring agricultural conservation easements from landowners who voluntarily apply to the program.

Agriculture Security Area: ASAs are created by local municipalities in cooperation with landowners who collectively establish a minimum of 250 acres to place in an ASA. Land included in ASAs must meet specific requirements. Benefits provided to participants include cooperation with municipalities, limitations on eminent domain, and increased eligibility for conservation easements.

Bioswales: Gently sloped vegetated ditches that slow the flow of rain water into the sewer system.

BMP: Best Management Practice, tools used to address environmental resource management concerns.

Building Envelope: The area within a lot bounded by the building setback lines or a specific sized area as designated in an ordinance within which all building related structures or improvements are located.

Clean and Green: A state program that provides tax benefits to landowners who maintain their land in agricultural or forested use.

Comp Plan: Comprehensive Plan, a document that provides the framework and policy direction for land use decisions. It should be all inclusive, considering issues that impact the future growth of the community.

Condensed or Cluster Use: development which sets aside areas of open space and groups housing or improvements.

Conditional Use: A use permitted in a particular zoning district based upon the location of that use within the district and upon compliance with specific conditions and criteria.

Conservation Development Standards: Examples include "Better Models for Development in Pennsylvania", Edward McMahon and Shelley Mastran, The Conservation Fund in partnership with DCNR, 2005 and "Recommended Model Development Principles - Lancaster County", Builders for the Bay Initiative.

E&S: Erosion and Sedimentation, many earth disturbance activities are required to have an approved erosion and sedimentation control plan that must be implemented during construction.

GPD: Gallons per day

Impervious Cover: Surfaces that do not infiltrate water and produce high runoff rates.

In-fill Development: Promotes higher density use of urban areas and neighborhoods by building on vacant lots, leaving rural areas and open spaces undeveloped.

In-lieu-fee: An agreement between a municipality and a developer. Under an in-lieu-fee agreement, the municipality collects funds from a developer or a number of individuals who are required to meet ordinance regulations.

LCCD: Lancaster County Conservation District

LCPC: Lancaster County Planning Commission

NPDES: National Pollutant Discharge Elimination System, a permit program regulating point source discharge into surface waters.

Overlay Zoning District: A zoning tool that creates a special zoning district placed over an existing base zone which identifies special provisions or has special regulations or incentives attached to promote conservation or guide development.

Park/Open Plan: A park and recreation plan may be a free-standing document or it may be included as a chapter (or chapters) of the larger municipal comprehensive plan.

Permitted by Right: Allowed as of current regulations

Permitted through Conditional or Special Exception: A use permitted in a particular zoning district once specific criteria have been met.

Pervious Cover: Surfaces that infiltrate water.

Prime Agricultural Soil: Soils containing properties that are very well suited for agricultural purposes.

RCRA : Resource Conservation and Recovery Act, gives the Environmental Protection Agency the authority to control the generation, transportation, treatment, storage, and disposal of hazardous waste and address environmental problems resulting from hazardous waste.

Regional Plan: A plan representing the efforts and interests of multiple municipalities cooperating towards common goals.

SLDO: Subdivision and Land Development Ordinance

Sliding Scale Zoning: Limits the number of times a parcel can be split based on its original size at the time of ordinance adoption. A larger minimum parcel size is also established.

SWIP: Surface Water Identification Protocol, monitoring performed if a water supplier uses a groundwater source that could be influenced by surface water.

SWM: Stormwater Management, the construction of roads, building, and developments increases impervious land and water runoff. This water should be managed through stormwater management plans and BMPs.

TDR Program: Transfer of Development Rights, a tool that directs growth to preferred locations through the sale and purchase of development rights. Development rights are established for a piece of land and can be separated from the title of that property for transfer to another location where more intensive development is considered appropriate.

UGB: Urban Growth Boundary, a line defining an area that is designated as appropriate for future development and includes a city or borough as its center, developed portions of townships, and enough development capacity to meet future land use needs over a 25-year period without constraining the development market. (Source of Definition: Lancaster County Comprehensive Plan)

VGB: Village Growth Boundary, a line defining an area that is designated as appropriate for future development and includes a traditional village core, adjacent developed portions of a township, and additional land to absorb a portion of a township's future land use needs while maintaining village scale, character, and a defined edge. (Source of Definition: Lancaster County Comprehensive Plan)