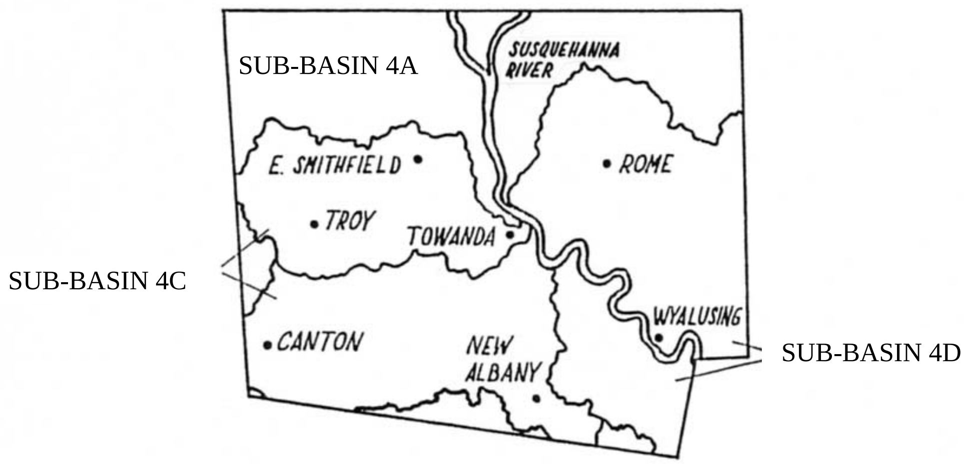
Bradford County



2005
CHESAPEAKE BAY
A FIVE YEAR STRATEGY

APPROVED JANUARY 3, 2005
BRADFORD COUNTY CONSERVATION DISTRICT

EXECUTIVE SUMMARY

The following report was developed as a response to a need to better define and address non-point source pollution in Bradford County, giving particular attention to the nitrogen, phosphorus and sediment reductions needed for Pennsylvania's commitment to the Chesapeake Bay reduction goals.

A local assessment of the major sources of non-point pollution identified the following areas: Agricultural Tillage; Agricultural Nutrient Management; Transportation Systems; Storm-water Run-Off; Commercial Fertilizers; and Stream Channel and Bank Instability. Detailed studies and resulting data were utilized to define and quantify both the sources and the needs to address these sources. Those studies included the following:

- 1989 Chesapeake Bay Watershed Assessment
- 1999-2000 Dirt and Gravel Roads Site Evaluation and Inventory
- USDA Natural Resources Inventory
- Watershed Assessments for Towanda, Sugar, Bentley, Satterlee, Laning, Wysox and Seeley Creeks
- 2004 Bradford County Comprehensive Plan
- County Plan for On-Lot Septage Management

During 1989, the Bradford County Conservation District was given a grant to conduct watershed assessments, through the PA Conservation Commission under the PA Chesapeake Bay Program. The purpose of the grant was to assess the need for assistance in addressing potential non-point sources of pollution from agricultural enterprises in the targeted watersheds.

The watershed studies covered an area of 519,328 acres. This area included the Susquehanna River Sub-Basins 4-C, which included 285,095 acres consisting of Sugar and Towanda Creeks, and 4-D, which included 234,233 acres consisting of Wysox, Wyalusing, Sugar Run and Tuscarora Creeks. Approximately 490 livestock operations were identified in sub-basin 4-C and 350 livestock operations in sub-basin 4-D.

The watershed assessment team assembled detailed sets of maps and compiled data for the purpose of developing a Pollution Potential Index. This index was developed in order to set priorities based on elements directly contributing to potential sources of nutrient runoff associated with livestock and normal farming operations. These elements include information on: sub-watershed delineation; average slopes; amount of land in row crops; amount of land in hay and pasture; amount of land in urban/residential use; amount of area covered by water; amount of land in forest; soil erodibility; animal density; drainage density; and farm density.

Personal interviews were conducted by randomly selecting individuals owning and/or operating agricultural lands in each of the sub-basins, in order to assess the needs and anticipated interest in the area of nutrient management on agricultural operations. In sub-basin 4-C, 60 (12%) individuals were interviewed in person with an additional 36 by phone. In sub-basin 4-D, 48 (13.7%) individuals were interviewed in person with an additional 95 by phone.

Results of the interviews conducted revealed that only 35% of those interviewed had their soil tested in sub-basin 4-C and only 50% in sub-basin 4-D. In the area of manure testing, only 5% tested in sub-basin 4-C and 0% in 4-D. Manure storage was utilized by only 1% in sub-basin 4-C and 4-D. 75% of those interviewed needed new or updated conservation plans in sub-basin 4-C, with 61% needing such in sub-basin 4-D.

A "cooperation expectancy" factor was created for each farmer interviewed. This factor is based on conservation needs expressed by the farmer, past history of government program participation and the attitudes of the farmer concerning the Chesapeake Bay Program. These factors were then averaged for each sub-basin to come up with an expected number of program participants.

A cooperation expectancy of 57% in sub-basin 4-C is estimated for the Chesapeake Bay Program, and 66% in sub-basin 4-D.

This valuable data and cultural information, along with the qualifying and quantifying studies referred to, were utilized in the 2005 strategic plan to develop two sets of options for the Conservation District in addressing non-point sources of pollution that affect local, state and Bay water quality goals. The first option for each of the identified issues was developed with the assumption of securing additional resources that could be utilized with an enhanced local delivery infrastructure. Option 2 considered current staffing and infrastructure with little additional resources.

Educational program needs were demonstrated in the areas of general nutrient management, conservation leasing, addressing special non-resident conditions, and soil testing results follow-up.

The following County Strategy was adopted by the Bradford County Conservation District Board on January 3rd, 2005.

INTRODUCTION

As the length of day grows in Bradford County and the sun begins to warm the earth, the snows of winter slowly begin their transformation into the waters that fill the creeks and, eventually the rivers of Bradford County. At first, these waters travel over frozen soils washing their surface into man made channels and intermittent streams entering perennial waterways that rage in the spring and become dry beds of gravel during the summer. Later on in the spring, as the soils thaw, the abundant moisture rapidly saturates the shallow top layer and is stopped by a hard impermeable layer of hardpan soils created by massive glaciers long ago. The results become very similar, with the surplus moisture rapidly washing down the slopes carrying any soil and related nutrients into the waiting creek beds.

These Creeks in turn fall rapidly from the headlands carrying tremendous loads of soil and gravel cut from the stream-banks and carried from the surrounding lands. As the perennial streams join with the major streams, they enter broad alluvial plains with less extreme slopes and their bed-loads gradually drop out forming large, ever-changing gravel bars which push and twist the stream-bank from side to side. Finally, all that is left of these "flushes" is the fine soil particles that may take days or weeks to settle out, and the rich nutrients from the land. These remaining particles rapidly reach the waiting Susquehanna River which rushes them to the vast Chesapeake Bay.

It's these "fine" sediments that choke the fish and smother the aquatic life at the bottom of the streams, river and bay; and these nutrients which cause massive algae blooms which cloud the waters and have created the concern and common commitment among the states draining into the bay and the Federal Government. In order to assess the full impact of these "non-point" source pollution sources, the State of Pennsylvania and the Federal Environmental Protection Agency has embarked on a massive assessment effort in identified watersheds which culminates in increased technical and financial assistance aimed at the management and control of nutrients entering waters draining into the Susquehanna River. These efforts will in turn, reduce the EPA estimated 60 percent of the total nitrogen loading and 21 percent of the total phosphorus loading to the Chesapeake Bay carried by the Susquehanna.

This report contains findings of the 1989 assessment efforts in Bradford County of two major subbasin areas covering over 535,000 acres. 4-C which contains Sugar and Towanda Creeks located west of the Susquehanna; and 4-D which includes Wysox, Wyalusing, Sugar Run, and Tuscarora Creeks. Not included in this study are the major watersheds of Bentley Creek, Wappasenning Creek, and the Chemung and Susquehanna Rivers in the upper half of the county. Approximately 25% of the county's farms are in the areas not addressed in this report. The report has been updated to reflect the current accomplishments and needs since the publication of the 1989 report.

The 1989 study was authorized and funded through the Department of Environmental Resources, Bureau of Soil and Water Conservation under the Chesapeake Bay Program. The assessments were part of phase IV of the PA

Chesapeake Bay Program. This update report was developed to address the need to refine efforts within Bradford County in addressing the critical needs of the Chesapeake Bay effort in Pennsylvania.

HISTORIC BACKGROUND

To properly "interpret" the significance of any area as vast as the study area covered in this report, it is extremely useful to take a moment to become familiar with its history. This becomes all the more vital when attempting to justify the allocation and utilization of funding and technical resources in addressing management needs. Obviously an area of strong traditional agricultural enterprises will more easily justify a program to support and strengthen their continuation.

BRADFORD COUNTY is a part of the dissected Allegheny Plateau, carved by the eroding forces of the Susquehanna River and its many tributaries. Glaciation occurring nearly twelve thousand years ago also played a prominent role in creating many irregular natural features consisting of flat, stream valleys bordered by steep, rough mountains. The great ice sheet was responsible for leaving ponds and wetlands, huge deposits of sand and gravel and moving the soil and rocks to determine the flow of water in the creek and river watersheds.

Thousands of years before Europeans came to what is now Bradford County, migrant Indian hunters and fishermen roamed the forested hills and valleys. They had little knowledge of agriculture but made primitive stone weapons and tools that aided them in survival as they set up camps where wildlife was most abundant. These stone age people found the streams supporting great numbers of fresh water fish. With no barriers present on the Susquehanna River, there were great spawning migrations of shad, eels, herring and other fish from the Atlantic Ocean and Chesapeake Bay that found their way up the river and its tributaries. Fish were taken with bone or flint spears, bone fishhooks, nets and weirs. The artifacts of this early culture may still be found along the streams, near hillside springs and hunting paths in the hills.

A great transition took place in the life of the Indians when they started to practice agriculture. Their desire and ability to become good gardeners and farmers ranks with contact with white people as the two most significant events in the history of the Indians.

Trees were girdled and seeds were planted beneath the dead branches. Slowly the land was cleared using crude tools. Fires would be built around the base of the trees, controlled by rings of clay and as the flames ate into the wood, grooved stone axes would be used to cut away the charred wood. Fire, when controlled and directed, was a very useful tool, not only in felling trees and cooking food but as a weapon for protection from dangerous animals.

The limbs of the felled tree were burned off and the log trunk rolled or dragged to a place where it could be used later. Wood was used for dugout canoes, dishes, hide stretchers, stockades and wooden poles used to construct dwellings.

The soil was worked with stone hoes attached to a short handle and holes were made in the soft earth for the seeds. Because of the abundance of fish, they were often used for fertilizer. Before the seeds were planted they were soaked in water containing vegetable poisons to discourage grubs, wire worms and crows. The principal garden crops grown were corn, beans, pumpkins, squash, potatoes, sunflowers, melons, gourds and tobacco. The Indians did not use the "broadcast" method of planting seeds but planted in rows and hills so cultivation with the stone hoe was made easier.

Corn was the most important crop grown and the Iroquois grew at least three types. A "flour" or dent type that was ground up for meal; sweet corn that was relished on the cob; and a fluffy, white popcorn completely unknown to the white man at that time.

Vegetables as well as meats were dried and stored for winter's use. Cache or storage pits are found at nearly every village site. Garden food was supplemented by nuts, mushrooms, herbs, roots and wild berries when in season. Hunting and fishing was still important but survival did not depend entirely upon the success of finding game in the forests and fish and mussels in the streams.

The important thing about agriculture was that it brought the nomadic Indians together in small villages where they could work together for mutual protection and plant, tend and harvest the crops that would help them survive the harsh winters. As they cleared more land and tended more crops, living conditions improved. Better living quarters were built, pottery and better implements were developed as the people had more time to devote to the improvement of handicrafts.

The early whites that came to Bradford County found the frontier very dangerous because of unfriendly Indians, hence there were very few settlers that braved the perils before the early 1800s. The Hartley and Sullivan Expeditions were successful in destroying many Indian villages, burning the grain fields and gardens and making the region safe enough for hardy white settlers and their families to homestead. In the Sullivan Expedition in 1779, General George Washington sent one-third of the Continental Army into this region to kill or drive out the hostile Indians.

A number of the soldiers taking part in the expedition against the Indians were so impressed with the fertile soil, beautiful forests of pine, hemlock and hardwoods, and clean streams teeming with fish, that they returned after the war with their families to build homes and start farming the partially cleared lands. The early settlers, who were mostly of English, Irish and Scotch-Irish extraction, settled in the river valley but as the stories about this land of milk and honey spread, the migration increased. Many settlers pushing up the valleys of the Susquehanna tributaries began their life anew along Towanda, Wyalusing, Wysox, Sugar Run, Tuscarora, Tunkhannock, Sugar and other creeks throughout the region.

If soil is the cradle of life, it was also the lifeblood that helped colonize the region. The soil would grow nearly any grain or plant. The first crops grown by the settlers were corn and potatoes. As they cleared more acres, wheat, rye, oats, buckwheat, flax, barley and hops were grown. Hay was an important crop from the time of the first white settlers and remains so today. In addition to field crops, pumpkins, squash, cabbage, beans, peas and other vegetables were grown for home consumption as well as for sale. Maple products, first made by the Indians of the region, were also exported by the county settlers and continue to be part of the economy today.

In 1832, the major commodities exported by the county were grain, flour, whiskey, fruit, salted meat, livestock and lumber. The lumber industry had begun to decline by about 1880 as the forests were used up. By this time, dairy had become the dominant industry. A North Central Railway agent in Troy, on Sugar Creek, reported that over 3 million tons of butter were shipped out by rail in 1880.

For nearly a hundred years, Bradford County claims to have led the nation in the production of buckwheat although it is not grown commercially in the county today. Another successful crop, not grown in the county presently, was tobacco. In the 1900 Bradford County Directory, 340 tobacco growers are listed and 17 cigar manufacturers.

Coal and lumbering industries flourished briefly. Railroads and a canal were built and many mills were established along the fast flowing streams but most all of this development is gone today. There has been a revival of interest in lumber and wood products, partially due to increased knowledge of timber management which makes it possible to utilize forest lands in a more sustainable manner.

However, agriculture - and dairying in particular – has continued to remain the most important activity in the county. Today, Bradford County ranks third in number of milk cows in the state and is one of the major suppliers of fluid milk to the New York - New Jersey area. The Leprino mozzarella plant in Waverly, New York supplies most of the Pizza Hut restaurants in the nation with cheese, much of it produced with milk from Bradford County cows. Several other regional processing facilities also utilize county milk for non-liquid dairy products such as cheese and yogurt.

In the past ten years, Bradford County has become one of the premier veal producing areas in the country. With approximately 100 veal growers scattered around the county, it has become a major supplier to the urban east coast markets. A relatively new industry in America, veal production was pioneered by Walter Newton of New Albany in the 1960s, using techniques from Europe. Newton set up a contract system with a number of farms in the county and his example was followed by several other current leaders in the veal industry, in particular Rathbun Veal and Hickock Veal. The growth of the veal industry has increased the price of bob calves; resulted in an expanded packing and slaughtering industry; and created a network of jobs in trucking both calves and feed.

Bradford County has continued to attract new farmers due to reasonable land prices and an operating infrastructure of services to the agricultural sector. The county boasts two weekly farm papers that help to draw farmers from other parts of the east.

In the early 1970s, a group of Amish farmers moved into the northeast part of the county. While numbers have diminished in recent years, these families have combined the traditional farm enterprises of Bradford County: maple syrup, hay, dairy for cheese production, lumber, and now, veal.

The county continues to maintain a vital agricultural sector but is becoming more and more popular for recreation. It is hoped that the Chesapeake Bay program will help Bradford County remain a strong part of American agriculture, as it has been for many years in the past.

LOCATION AND DESCRIPTION

SETTING

Bradford County is the second largest county in Pennsylvania consisting of 738,800 acres. It is bordered on the east, west and south by Pennsylvania Counties of Susquehanna, Tioga, Sullivan and Wyoming forming, with these counties, the region commonly referred to as the Northern Tier of Pennsylvania. It is bordered on the north by New York State's county of Tioga.

The Susquehanna River forms a north-south axis through the County from a point of entry just above the conjunction with the Chemung River in Athens Township, until it leaves the County just below Laceyville.

Bradford County has the Pennsylvania metropolitan areas of Wilkes-Barre/Scranton situated to the southeast and Williamsport to its southwest, and the New York metropolitan areas of Elmira to its northwestern point and Binghamton to its northeastern point.

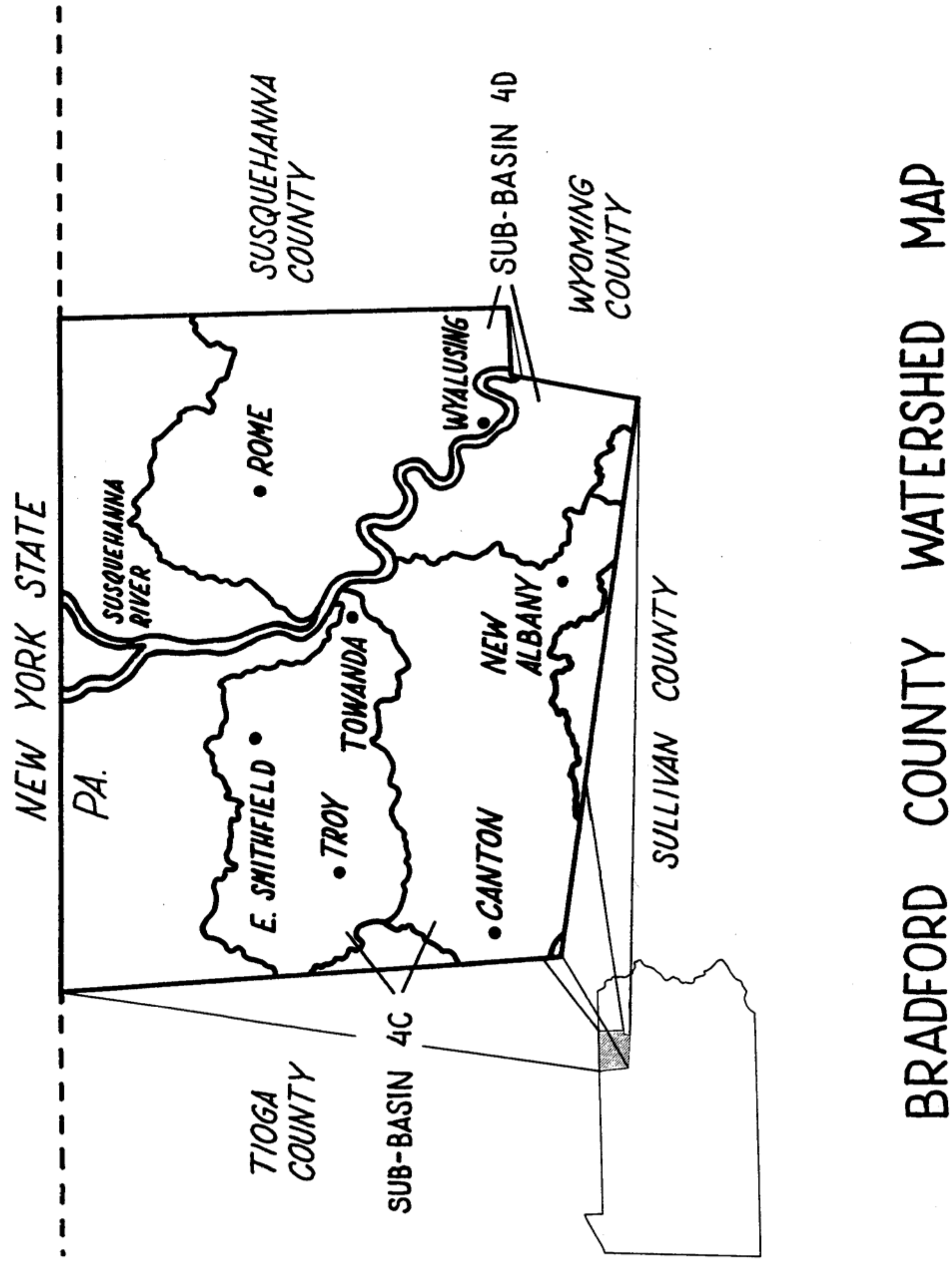
The population of Bradford County is 62,919 by the 1980 census report and 62,761 in the 2000 report and is rural by definition with no true "urban" areas. The Bradford County Comprehensive Plan, published in March of 2004, note some unique aspects of the County:

- ⇨ County residents are choosing suburban and rural living over that found in the County’s boroughs
- ⇨ The number of houses in the County is increasing but at a slower rate than other counties in the region
- ⇨ Private water supply (wells) and sewage disposal systems (on-lot septic) serve the majority of County residents

TOPOGRAPHY

The majority of Bradford County is located within the (glaciated) Low Plateaus Section of Appalachin Plateaus Province. The topography of the area is generally one of flat-topped mountains and hills dissected by steep-sided stream valleys. The area is underlain by generally flat-lying rock strata, which have been only slightly upwarped in some places. This gentle upfolding has given rise to some of the observed relief; however, most of it has been produced by streams cutting down through the flat-lying strata. The amount of land with slopes exceeding 15% is roughly one quarter of the county.

Most of the County was covered by ice during at least one of the glacial stages of the Pleistocene Epoch and deposits of at least three (3) ages are preserved in the County. The latest glaciation left by the Wisconsin ice is of two (2) types; till and outwash. Till is an unstratified deposit of material that has been placed by moving ice or dropped directly by the melting ice and has not been sorted by running water. It usually consists of fine, impure clay containing unsorted stones of all sizes and shapes. Associated in many places with the till are stratified outwash deposits consisting, usually, of clay, sand, "quicksand" and gravel, which have been sorted by running water and deposited by streams or in lakes. The most extensive deposits of glacial outwash occur along the valleys of the Susquehanna River and its major tributaries. Bentley, Sugar, Towanda, Wysox, and Wyalusing creeks, and the Chemung River, are the major tributaries.


NEW YORK STATE
PA.
SUSQUEHANNA COUNTY
SUB-BASIN 4D
WYOMING COUNTY
SUSQUEHANNA RIVER
ROME
WYALUSING
TOWANDA
NEW ALBANY
E. SMITHFIELD
TROY
CANTON
SULLIVAN COUNTY
TIOGA COUNTY
SUB-BASIN 4C
BRADFORD COUNTY WATERSHED MAP

ECONOMY AND LAND USE

Agriculture is by far the largest land use and economic engine for Bradford County. 2002-3 PA Agricultural Statistics cite Bradford County as having 1,655 farms encompassing 329,500 acres. This ranks the County 6th in overall number and 2nd in amount of land actively farmed. Combined income reported from the same source for the same period of time for field and livestock production amounted to $121,000,000.00

Dairy products are the primary industry (often ranked 2nd or 3rd in PA for milk production and cattle and calves). The veal calf industry has become a major source of income in Bradford County, realizing over $70 million annually from the sale of calves and related products.

Forestry and farmlands are the major land uses in the County. The National Resource Inventory, conducted by the USDA Soil Conservation Service in 1982 revealed land use in the county as follows:

SUMMARY OF LAND USE - BRADFORD COUNTY
1982 - NATIONAL RESOURCES INVENTORY

RANK - LAND USE	ACRES (to nearest 1/10)	PERCENTAGE
1 - FORESTLAND	342,800	46.4%
2 – CROPLAND	234,400	31.7%
3 – PASTURELAND	104,200	14.1%
4 - MINOR LAND COVER/USE	27,000	3.7%
5 - RURAL TRANSPORTATION	15,200	2.0%
6 - URBAN AND BUILT UP LAND	9,400	1.3%
7 - SMALL WATER AREAS	5,800	.8%
TOTAL	**738,800 ACRES**	**100%**

Another approach to "land use" data is one presented in the 2004 Bradford County Comprehensive Plan, where the "registered" use of the property is considered in determining land use as opposed to actual cover or physical land use. For example a 100 acre parcel of property that has been purchased for residential may indeed consist of 99 acres of forest and one acre of residence but is listed entirely as residential. This approach is useful in planning for future impact on both the infrastructure needs of the areas in question and also the potential future environmental impact of that entire 100 acre parcel being developed. The summary of registered land use is as follows:

LAND USE BY REGISTERED OR ASSESSED USES
2003 BRADFORD COUNTY COMPREHENSIVE PLAN

USE	PERCENTAGE
1. Forested / Undeveloped Land	30.1
2. Agriculture	52.9
3. Natural Resource Extraction	0.3
4. Residential	15.1
5. Commercial	0.7
6. Industrial	0.3
7. Public	0.3
8. Transportation/Communication/Utility	0.2

WATER QUALITY IMPACTS

To better target current efforts in addressing non-point source water quality impacts related to nitrogen, phosphorus and sediment, the leading sources were identified and quantified in the following sections. These sources or contributors include:

- ⇨ Agricultural Nutrient Management – encompasses all aspects of livestock and crop operations involving manures and commercial fertilizers. Barnyard location and management, manure storage and application, livestock access to waters of the Commonwealth, and sound nutrient management are all part of the issues related to agricultural nutrient management.
- ⇨ Commercial Fertilizer Applications – are part of numerous non-agricultural operations as well as the on farm ones. Improper use on lawns, golf courses, schools and commercial areas can contribute significant amount of “N” and “P” to the surface and ground water.
- ⇨ Agricultural Tillage – includes 32,500 tilled acres for corn alone according to the 2002-3 Ag statistics. The need for current, state of the art conservation planning remains a high priority. Conservation and no-till practices need to be better incorporated into the culture of the County’s agricultural operations.
- ⇨ Stream Channel and Bank Stability – or lack there of contributes literally hundreds of thousands of tons of sediment and their related nutrients on an annual basis according to documented measurements. Studies have shown as much as 25% of these sediments and nutrients are reaching the Chesapeake Bay.
- ⇨ Rural Transportation Systems – contribute sediments and other road related substances directly to surface waters via drainage systems, eroding road banks, and blockages of stream channels and floodplains.
- ⇨ Storm Water – and the change to natural hydrology as a result of land use change contributes considerable amounts of nutrients and sediments to the County’s streams.
- ⇨ On-lot Septic Systems – are the primary source of sewage treatment in the County. Lack of maintenance, failing systems and inadequate construction pollute both the ground water and surface waters of the County.

Each of these potential sources are organized by background information; pollution specific causes; quantification of potential impacts; best management practices available; total County needs; and an annual/5year implementation program.

Potential Pollution Source:

Dirt and Gravel Roads, Driveways and Access Lanes

SOURCE BACKGROUND:

Pennsylvania's roads are a prime example of non-point source pollution. There are hundreds of thousands of miles of road ways in Pennsylvania. Pennsylvania also has the largest network of rivers and streams in the United States with the exception of Alaska. Unfortunately, this network of streams becomes an all too convenient disposal area for road runoff. Traditional thinking in road maintenance has been to get water off of the roads and into streams by the quickest means possible. This practice results in thousands of tons of sediment, not to mention what is being carried with it, being deposited into the state's streams.

The presence of sediment is a natural and necessary part of a healthy stream. The addition of excess sediment, however, can cause great harm to the aquatic ecosystem. Here are some of the effects of excess sediment:

- Disruption of natural stream order and flow
- Damage to fish species through direct abrasion to body and gills
- Loss of fish spawning areas due to the filling in of gaps in streambeds
- A breakdown in the aquatic food chain as sediment suffocates small organisms living in the streambed
- Accelerated filling in of dams and reservoirs
- A change in the water composition in the Chesapeake Bay and other estuaries

POLLUTION SPECIFIC CAUSES:

Roadways and their related drainage systems are often directly connected to streams and wetlands. Due to the topography of the County, most roads have been built on the old trails that followed the creeks and rivers. These trails eventually evolved into the roads and highways of today. The larger, modern roads of today have resulted in many infringements on the natural hydrology of the watersheds by encroaching on floodplains, restricting stream channels with culverts and bridges, and by concentrating flows that reach the stream channels more rapidly. Drainage systems intercept and collect uphill water and concentrate otherwise sheet flows into concentrated flows that can be erosive to both the ditch and road banks. Steep road slopes on the side hills, narrow valleys with steep drop offs and clustered residential areas that do not permit outleting road ditches, all contribute to the problems. These drainage systems also often discharge directly into a stream without any energy dissipation or vegetative filtration.

Sediments from eroding road banks, ditches and the road surfaces themselves have the potential to severely degrade water quality Salts and brines, anti-skid materials, oils, anti-freeze and other materials all bond to the sediments leaving the road system and enter the streams. A survey conducted by the Bradford County

Conservation District as part of a study of the Mill Creek watershed, dramatically demonstrated the effects of road drainage on stream macro-invertebrate populations at the pipe outlets of dirt roads.

Finally, the materials utilized to construct the roads themselves can be a source of water quality degradation.

Many of the maintenance practices utilized by both the local municipalities and the state also contribute to the problems. Removal of vegetative linings of the road ditches, use of polluting anti-skid materials and anti-dust materials, poor drainage system maintenance, improper vegetative control along road banks, poor outlet stabilization, undersized culverts and bridge openings, all have significant impacts on water quality and can contribute large quantities of "fines" that remain suspended in the streams for considerable time.

Other elements that are part of the road drainage system include the numerous private driveways and drainage ditches associated with off-road drainage systems. In summary, impacts stem from:

- ⇨ Improper/Poor Construction of Road, Driveway, and Access Lane
- ⇨ Improper/Poor Maintenance of Road, Driveway, and Access Lane
- ⇨ Improper/Poor Construction and Maintenance of Drainage Best Management Practices
- ⇨ Improper/Poor Location and Layout of Road Network, Driveways, and Access Lanes

AMBIENT CONTRIBUTING CONDITIONS:

Local Soils, Geology, Topography, Waterways Network and Weather

QUANTIFICATION OF POTENTIAL SOURCES:

Bradford County is the second largest county in area in Pennsylvania and is entirely rural in nature. The County is comprised of 51 municipalities that own and maintain 1,592.9 linear miles of road ways and their related drainage systems. Of those miles, 1,302.4 miles are dirt and gravel. The State owns and maintains an additional 902.3 miles. This surfacing gives these roads a higher potential of pollution to Waters of the Commonwealth.

Early in 2000, the Bradford County Conservation District inventoried all 1,302 miles of local, municipality controlled, dirt and gravel roads in the County as part of the State Dirt and Gravel Roads Program. The roads were inspected for sites that contributed directly on water quality of the receiving stream. Sites identified were scored based on: overall visible sedimentation in the stream; overall visible erosion on the road, road banks or road ditch; road surface material; road slope; road ditch stability; road bank stability; distance to stream, outlet/bleeder ditch stability; road bank slope; outlets directly to the stream; average bank slope; average canopy cover; dust potential and road segment shape.

1,522 sites were identified in the inventory, the largest number of any County in the state. These sites average .23 miles (1,214 ft). As of September of 2004, there has been correction to 44 of these sites at an average cost of $17,533.67 per site, including state and local funding.

Driveways and access lanes have the same pollution potential as public roads. Bradford County has approximately 19,400 housing units that can be described as detached single –family dwellings (2004 County Comp Plan), of which approximately 50% of the households have driveways of significant size that could potentially impact on drainage systems related to roadways. That equates to 9,700 total driveways within the county, potentially impacting on water quality. Other sources not captured here are logging roads, recreational trails and other private lanes.

BEST MANAGEMENT PRACTICES

While each site is unique and requires an individual approach, there are many common avenues to take in addressing the issues described above. Foremost in the continued education and training of the maintenance foremen and crews that work with the transportation system. The “Environmental Sensitive Maintenance of Dirt and Gravel Roads” Program needs to be continued and expanded.

On Dirt & Gravel sites the following practices are utilized:

- Road ditch stabilization – by adding outlets, improving the stability of the ditch through vegetative, rock or geotextile armoring, or reducing grades.
- Road bank Stabilization – through vegetative management that encourages bank protection. Grading to stable slopes and seedings are also incorporated.
- Managing off road drainage – by addressing ditches, driveways and other sources of uphill water before it enters the road drainage system and diverting it to a stabile area.
- Stabilization of outlets – through outletting into stabile vegetative areas away from direct discharge into the stream. Other methods such as rock stabilization, geotextile, etc. are utilized.
- Reconnecting stream channels with their floodplains – by adequately sizing culvert and bridge openings and installing floodplain culverts to handle flood flows.
- Shaping and grading roads - to maximize efficiency of water control. Road grade breaks, avoiding berms along the downhill side of the road and good road shape that avoids severe erosion all play a part in this practice.
- Road construction and surface material – can avoid many of the problems cited. By utilizing good base material, promoting internal drainage in wet

areas, and utilizing non-polluting materials for road surfaces, water quality impacts can be dramatically reduced. A table of these and other best management practices are as follows:

Dirt and Gravel Roads, Driveways and Access Lanes
BEST MANAGEMENT PRACTICES

- Roadway design, layout and construction
  - Appropriate Driving Surface Aggregate
  - Proper Shaping and Grading of Roads
  - Stabilized Ingress/Egress
  - Insloping/Outsloping
- Road Drainage System Design
  - Additional Cross-Pipes
  - Ditch Lining
  - Underdrain
  - Managing Off Road Drainage
  - Headwalls/Endwalls
  - Outlet/Inlet Protection
  - Cutouts
  - Vegetative Filter Infiltration
  - Divide Flow Quantity
  - Diversion of Surface Water
  - Level Spreaders
  - Proper Pipe Installation
  - Appropriate Outlet/Inlet Location
  - Sheet Flow
  - Appropriately Sized Pipes
  - Rock Filters
- Road Bank design, layout, construction & maintenance
  - Bank Sloping & Stabilization
  - Vegetative Management
  - Proper berm maintenance
- Stream Stabilization
  - Stream Bank Protection
  - Reconnection of Stream Channels with Floodplains
- Driveway design, layout and construction
  - Additional Cross-Pipes
  - Ditch Lining
  - Underdrain
  - Managing Off Road Drainage
  - Ditch Lining
  - Underdrain
  - Managing Off Road Drainage
  - Headwalls/Endwalls
  - Outlet/Inlet Protection
  - Cutouts
  - Vegetative Filter Infiltration
  - Divide Flow Quantity
  - Diversion of Surface Water
  - Level Spreaders
  - Proper Pipe Installation
  - Appropriate Outlet/Inlet Location
  - Sheet Flow
  - Appropriately Sized Pipes

<u>Proposed Needs to Address All Above Identified Sources by 2010:</u>

Experience has shown that direct contact and assistance is the most effective manner to facilitate site and maintenance improvement. Generations of maintenance behavior can only be modified through training and awareness. This is accomplished by demonstrations and proven performance of best management practices. Technical, informational, educational and cost share assistance is needed.

The 44 sites that have been completed were at an average cost of $17,533.67. This equates to a total of $26,686,245.74 to address all 1522 identified sites. Currently the Dirt and Gravel Roads Program is providing approximately $300,000.00 annually to address these sites. At the current rate of funding it would take 89 years to complete projects at current costs.

1. **Staffing Needs**

- Education
  - 1/4 Man year @ $30,000.00/year X 1/4 = $7,500.00/year X 5 years = **$37,500.00**
- Construction Oversight, Site Design/Layout, and Administration
  - 2 Full-time @ $30,000.00/year X 2 = $60,000.00/year X 5 years = **$300,000.00**
- Project Engineer
  - 1/4 Man year @ $64,000.00/year X 1/4 = $16,000.00/year X 5 years = **$80,000.00**
- Administrative Support
  - 1/2 Man year @ $30,000.00/year X 1/2 = $15,000.00/year X 5 years = **$75,000.00**

2. **Best Management Practices Installation (5 year needs)**

- Dirt and Gravel Roads
  - 40 sites per year X $17,533.67 X 5 years = **$3,506,734.00**
- Driveways
  - 50 X $500 each X 5 years = **$125,000.00**
- Access Lanes (farms)
  - 50 X $1,500.00 each X 5 years = **$375,000.00**

Total Required 5 Year Needs:
$4,499,234.00

<u>DATA SOURCES:</u>

- ⇨ 1999/2000 Bradford County Work Site Inventory
- ⇨ Center For Dirt & Gravel Roads Studies – Bradford County Program Evaluation, 2004
- ⇨

<u>Partners</u>

Center for Dirt & Gravel Roads Studies
State Conservation Commission
Natural Resources Conservation Service

Fish & Boat Commission
PennDOT
Local Municipalities
Homeowners and Farmers

Potential Pollution Source:

On-Lot Septic Systems

SOURCE BACKGROUND

- Failed and non-maintained septic systems in Bradford County present a health and pollution risk to the residents and environment of the County and down stream.
- Local management by the use of storage and land application of the septage materials as a crop amendment has been demonstrated to be the most viable option for disposal in Bradford County.
- Education of the general public and local officials is paramount to reducing the nutrient loss to the environment and securing public health.
- Bradford County has the resources, in the soils and agricultural operations available to manage the utilization of the septage its residents produce.
- Personnel and resources are needed to facilitate the land application of the septage materials.

Issue:

On lot septic systems present challenges on several different levels to the residents of Bradford County. Initially, the soils and climate present problems in finding cost effective, suitable sites in which to install systems for individual homes. Secondly, although the systems can never be considered maintenance free, many home owners only maintain the system when it has failed. So each year, only a fraction of the systems than need pumping are properly maintained. In addition, options to dispose the pumped materials are limited.

On lot septic systems are a method by which the water borne household waste from one home is treated near the dwelling itself. The household water borne wastes from bathing, appliances, kitchen washing, toilets, etc. are sent to a holding septic tank which separates the grey water and solids. The septic tank holds the material while anaerobic biological activity (not requiring Oxygen) and physical action break down the solids. Septage tanks release waters containing dissolved materials and retain suspended and precipitated solids. Grey water then percolates through a piping system for discharge to a leach field. Eventually the solids form septage sludge which builds up in the tank and needs to be removed from the system for further treatment or final disposal.

In order for these on lot systems to function properly, with high efficiency and with longevity, they must be regularly maintained by a pump out cleaning process. The Pennsylvania Department of Environmental Protection states on their application for a septic system that the tanks should be pumped out every 2 to 3 years. If the tank is not pumped regularly, solids will eventually disperse into the leach field sand bed, causing the whole system to fail. Failing systems discharge nutrient rich material which may eventually discharge directly into channels of conveyance and waters of the Commonwealth.

Whether the septage material is in the tank, seeping into the soils, or a by-product to be managed, there are nutrient matters that need to be considered. The material comprises many components, but nitrogen and phosphorous are of prime concern for the Chesapeake Bay watershed.

Pennsylvania Act 101.a5 of 1988 (the Municipal Waste Planning, Recycling, and Waste Reduction Act) found that "it is necessary to give counties the primary responsibility to plan for the processing and disposal of municipal waste generated within their boundaries to insure the timely development of needed processing facilities." Section 303.a states that "each county shall have the power and its duty shall be to insure the availability of adequate permitted processing and disposal capacity for the municipal waste which is generated within its boundaries."

After consideration of all alternatives, on July 11, 1996, the Bradford County Commissioners approved the County position that effluent from on lot home septic systems be utilized, recycled, or reused for the benefit of the soils of Bradford County. This reuse is meant to include direct application for agricultural use, land reclamation, compost utilization, or other beneficial practices. However, the need has not been met yet totally with local solutions.

POLLUTION SPECIFIC CAUSES:

While the DEP recommends that septic tanks should be typically pumped every three years with the average size family, many are never pumped out. The underlying thought of the situation is that due to lack of adequate maintenance and the combination of soil and weather conditions, there are too many of the systems in the County which are seeping or in a failure status.

According to the EPA "National Water Quality Inventory Report", septic systems ranked as the number one contamination source of ground water. Dye tests done for realty transactions prior to 1996 indicated up to 40% of septic systems had some type of failure. Actual failure numbers are difficult to acquire, because many home owners will either not take any action at all hoping the problem will go away or just pumping the systems out only when the problem gets beyond their personal tolerance, thus avoiding the permitting process with the County Sanitation Committee.

When septage sludge is removed from a tank, there is no regulatory specified method of disposal, as long as it is taken to some kind of permitted disposal site or facility. At this time the options available in Bradford County are:

- one permitted site exists for storage and then land application of household septage within the County

- land filling the sludge material after additional dewatering at the County land fill facility
- mixing the septage with sewage, then dewatering; this material may be composted or land filled, depending on the facility
- trucking septage for treatment or land application on permitted sites in other counties or states

To summarize, both the lack of knowledge on the part of the average homeowner as to the maintenance needs of the septic systems they are relying on, and the increased costs of pump out and maintenance due to lack of facilities to accept the materials combine to result in an increase in failed systems in Bradford County.

QUANTIFICATION OF POTENTIAL SOURCES:

Information	Source	Numbers
Population	2003 US Census Bureau (estimate)	62,643 people
Total Housing Units	US Census Bureau, 2002	29,055 individual units [1]
Housing Units with on lot septic systems, including pre-permit systems	Derived from Census numbers and the County Strategic Plan	20,193 systems
On Lot systems installed since 1968	Permitted systems installed or repaired failures with final approval from the Bradford County Sanitation Committee [2]	10,742 systems [3]
Non-Permitted Systems, including out houses, privies and others	Bradford County Sanitation Committee estimate	8,862 [4]
Permitted Land Application Sites	Bradford County Conservation District and DEP, Division of Wastewater Management	1 site
Systems in Need of Normal Annual Pumping	20,193 ÷ 3 DEP recommendation that typically sized families should maintain their system by pumping it out every 3 years	6,731 systems

Annually gallons of septage to be managed under DEP recommended maintenance schedules	6,731 X 1,000 (1,000 gallons is the average size of a septic tank)	6,731,000 gallons
Total potential annual amount of septage produced in Bradford County at any given time	1,000 gallons per tank average	20,193,000 gallons
Potential Nutrients of interest to be managed	N (Nitrogen) [5]	3,372,231 lbs./yr
Potential Nutrients of interest to be managed	P (Phosphorous) [5]	843,058 lbs./yr

[1] In 2000, 9.1% of dwellings in the County were hunting or seasonal residences.
[2]For approximately 10 years during that period, several townships in the County did their own permitting and inspections of septic systems. Those installations are unaccounted for.
[3] The duplication of systems during this time period were insignificant for systems which were permitted for initial installation and then for repair.
[4] With 300 estimated/year installed and or repair of failed existing systems, the number of un-permitted systems should slowly decline in the future.
[5] A guide to the Federal EPA Rule for Land Application of Domestic Septage to Non-Public Contact Sites (Nitrogen as N = 2%, Phosphorous as P = 1% by weight)

PROPOSED NEEDS TO ADDRESS ALL ABOVE IDENTIFIED SOURCES BY 2010:

As the result of the 1996 study done by the Bradford County Conservation District and presented to the County Commissioner's for their consideration, the following options for septage management were considered:

- Land filling the sludges
- Increased trucking the material to further locations
- Changes in the present waste water plants
- A specifically built waste water treatment plant solely for the purpose of septic management
- Composting
- Composting with wetland treatment of the material
- Mine reclamation
- Incineration
- Land application without a storage unit
- Land application with a storage unit
- No change to the current system

Each of the options was considered for short term and long term costs, public acceptance, environmental impact, comprehensiveness and practicality. After evaluating the options within the District, in Committee and in public forums, the option to build a storage and land apply the material for beneficial balanced crop usage was chosen as the best option for Bradford County. In addition, since the regulations were changed in 1998, more soils are available for land application of septage. The report concluded that 12 average sized agricultural operations in the County would have sufficient land area to utilize all nutrients produced in the County's septic systems in a balanced agronomic system.

In 1997, Bradford County initiated a demonstration project on a farm in Terry Township for the disposal of household septage. According to the regulations at the time, suitable soils were identified for the land application of septage. Grant money from DEP was used to submit the permit application, write a nutrient management plan, complete the engineering, and construct a concrete storage facility, including a garbage screening portion and a pumping unit to remove the material for land application. At the same time, one septage hauler was contracted to bring the material he had pumped from residential septic tanks to the facility and pay a tipping fee.

This proved to be beneficial to all the parties involved. Homeowners had a reasonable price for septic tank pumping. The hauler had a reasonable price for tipping his load and a closer location to do so, saving time and money. The farm operator is receiving an income and nutrient benefit for his crops. The District benefited by being able to prove the concept and to show the facility to other interested organizations.

Half the tipping fee was turned back to the Conservation District until the construction cost was repaid. This tipping fee has been set aside by the District awaiting the next agricultural operator who desires to do the same thing. The original farmer now owns the facilities on his property and continues to accept septage from the same hauler.

Commonly, systems are pumped only during a sale of the property or if a problem arises. However, with the present numbers of septic systems 6,731 tanks in the County should be pumped out annually to properly maintain the systems so that seepages do not occur or nutrients are not dispensed into the surface and sub-surface waters of the Commonwealth. Many times the problem is serious enough to label the system a failure, however many homeowners will pump to avoid the costly replacement of the leach field.

The public needs to know why and how to maintain a system long before a failure occurs which can cost from $500 to $10,000 to repair. Financial and social incentives are needed to encourage the maintenance of the systems so as to improve the present situation in which a large amount of unaccounted nutrients are entering the Chesapeake Bay's water systems.

For many homeowners advertising of tank additives is their only education on the matter. Unfortunately, these additives can camouflage serious problems in a septic system. The additives give a homeowner a sense of confidence while the septic system is filling with solids. They may save money in the short term only to have a major repair waiting for them in the future and leaching of nutrients and microorganisms in the meantime.

This education should specifically target homeowners and local government officials. Both need to be aware of the realities that are buried in the tanks and sand mounds on their properties and what can be done to ensure that the systems do function properly.

BEST MANAGEMENT PRACTICES

1. COUNTY-WIDE SEPTAGE MANAGEMENT

Needed for the Future		Total Cost Estimate	Annual Need
Permitted Sites (11 additional sites) *	Each site would include acreage for application and a concrete storage structure of 12' X 65' which would hold 298,000 gallons of material with garbage screen and dumpster	$75,000 per site * X 11 sites $900,000 * estimate	$75,000
Technical and Permitting Assistance and Public Education from the Conservation District	Personnel time, training expenses, and nutrient management planning	$10,000 / year	$10,000
Engineering Assistance for the Permitting process	Personnel time and equipment	$5,000 / year	$5,000
Administration	Contracting and accounting personnel time	$3,750 / year	$3,750

- 12 sites with bi-annual applications of septage would handle 7,152,000 gallons of material per year.

2. HOMEOWNER MANAGEMENT SOLUTIONS:

Incentives		Per Year Cost
Well Testing Grants	Coinciding with the Master Well Program education to demonstrate the need of management or that a septic system is functioning properly. 125 tests each year for fecal coliform @ $20.00/test.	$2,500
1st Time Pumping Discount Coupons	Provided to landowners to encourage the regular scheduled pumping of their on lot septic systems. 100 coupons per year @ $50.00/coupon.	$5,000
Assessment Quantitative Study	Measure the actual loss of nutrients via County evaluation of home on-lot systems.	$10,000

Total Required Annual Monetary Needs
$111,250.00

Partners

Bradford County Commissioners
Bradford County Sanitation Committee
CBP
DEP
Master Well Program (PSE)
Northern Tier Regional Planning & Development Commission
Northern Tier Solid Waste Authority
NRCS
Penn State Extension
Valley Waste Water Authority

DATA SOURCES:

1. PA Act 101 – Nutrient Waste Planning
2. EPA Natural Water Quality Inventory Report
3. 2002-3 US Census
4. EPA – A Guide to Federal EPA Rules for Land Application for Domestic Septage to Non Public Contact Sites
5. 1996 Bradford County Septage Management Options
6. 2004 Bradford County Comprehensive Plan

POTENTIAL POLLUTION SOURCE:

Commercial Fertilizer Use

SOURCE BACKGROUND:

Commercial Fertilizers present challenges to Bradford County in several ways. Most Agricultural operations intentionally minimize their losses to the environment to minimize their economic losses. Loss control would include professional application or dry storage conditions, careful field handling and spill prevention. However, many homeowners and groundskeepers apply their own fertilizers without much training or attention to details.

POLLUTION SPECIFIC CAUSES:

The largest area of concern is not the professional agricultural operators or professional lawn services. The average homeowner has a higher predisposition to over apply fertilizers and other agricultural chemicals to their lawns and gardens. This is due to two patterns of thought:

- ✓ If a little will make the lawn / garden grow, then a little more will make it great.
- ✓ Any remaining fertilizer is used rather than discarded.

Rather than helping the situation, many homeowners make the soils worse by adding more chemicals to make up for the perceived lack of plant health caused by the over application.

QUANTIFICATION OF POTENTIAL SOURCES:

The following table estimates the potential areas of concern, however the situation needs to be studied more to verify the quantities and public needs. The last study in Bradford County was conducted in 1988. Both the agricultural climate and public usage of chemicals has changed since that time and warrants an in-depth look into the situation.

Potential Areas of Concern	Acres	% Fertilized [1]	Total Acres Possible for Fertilizer Application	% Possibly Over Fertilized [1]	Potential Total Acres of Over Application
Golf Courses [1]	200	100	200	100	200
Residential Lawns [1]	121,947	10	12,195	10	1,220
Schools, Parks and Corporate Facilities [1]	10,770	50	5,385	25	1,346
Totals	132,917		17,780		2,766

[1] Source: Bradford County Office of Planning and Grants as stated in the 2004 County Comprehensive Plan

BEST MANAGEMENT PRACTICES

The practices needed to address those outlined above largely center around education, information and outreach efforts to the homeowners and managers of the areas of concern. Many non-agricultural landowners know little of the value of nutrient management. The following best management practices would be valuable to incorporate into an educational/outreach program:

- Targeted workshops for groundskeepers of business, schools, institutional grounds, with a focus on nutrient management
- Series of workshops for homeowners
- Nutrient management planning for groundskeepers and homeowners with a focus on soil fertility and landscaping with nutrient balancing
- Incentives for soil testing
- On-site technical assistance
- Survey of present management practices in order to better target efforts
- Survey of commercial outlets for fertilizer to assess quantities as well as cooperation by dealers for educational outreach

PROPOSED NEEDS TO ADDRESS ALL ABOVE IDENTIFIED SOURCES:

BMP's Needed	Number Anticipated to Fill Need	Individual Item Cost	To Fill The Anticipated Need
Non Agricultural Nutrient Management Plans	100	$250	$25,000
Soil Tests [1]	1,000	$20 / test	$20,000
Survey of fertilizer use & impacts	1	$5,000	$5,000

[1] Soils tests can cover one lawn or 1 test / 10 acres of a residence, park or golf course.
** One time expenditure

Other Needs:

Item		Cost per Year
Educational Outreach	Publications Trainings	$500 $1,000
Technical Assistance	Technical Staff Time	$1,000

5 Year Implementation Needs:

Staffing Needs

- Education
  - 1/4 Man year @ $30,000.00/year X 1/4 = $7,500.00/year X 5 years = **$37,500.00**
- Technical Support
  - 1/4 Man year @ $30,000.00/year X 1/4 = $7,500.00/year X 5 years = **$37,500.00**

Best Management Practices Installation (5 year needs)

- Nutrient Management Plans
  - 20 plans per year X $250 X 5 years = **$25,000.00**
- Soil Tests
  - 50 X $20 each X 5 years = **$5,000.00**
- Workshops
  - 2 X $500 each X 5 years = **$5,000.00**
- Publications
  - $500 each X 5 years = **$2,500.00**
- Survey
  - 1 time = **$5,000.00**

Total Required 5 Year Monetary Needs
$ 117,500.00

DATA SOURCES:

- ⇨ Bradford County Office of Planning and Grants
- ⇨ 2004 Bradford County Comprehensive Plan

Partners:

Bradford County Crop Management Association
Farm Service Agency
NRCS, Towanda
Penn State Extension
Master Gardeners
Pa Department of Agriculture
Various Agricultural Businesses
Various Home Supply Businesses

POTENTIAL POLLUTION SOURCE:

Stream Bank Erosion

SOURCE BACKGROUND:

Pennsylvania's streams are often one of the largest unmeasured source of non-point source pollution. There are hundreds of thousands of miles of streams in Pennsylvania. Pennsylvania has the largest network of rivers and streams in the United States with the exception of Alaska. Unfortunately, due to the extent of this network, we (people) have altered these systems to 'fit' our ideal vision of lifestyle. Such actions that continue to act upon our precious resource include: land cover alterations, riparian vegetation removal, gravel removal, channel alterations, etc. This traditional thinking has led to degraded stream eco-systems and increased bank erosion/channel migration. The results are thousands of tons of sediment, not to mention what is being carried with it, being transported downstream to the Chesapeake Bay.

The presence of sediment is a natural and necessary part of a healthy stream. The addition of excess sediment, however, can cause great harm to the aquatic ecosystem. Here are some of the effects of excess sediment:

- Disruption of natural stream order and flow
- Damage to fish species through direct abrasion to body and gills
- Loss of fish spawning areas due to the filling in of gaps in streambeds
- A breakdown in the aquatic food chain as sediment suffocates small organisms living in the streambed
- Accelerated filling in of dams and reservoirs
- A change in the water composition in the Chesapeake Bay and other estuaries

POLLUTION SPECIFIC CAUSES:

1. **Alteration and Removal of Vegetative Cover**

Riparian vegetation is critical to the maintenance of stable stream banks. Removal of this vegetative buffer leads to destabilized stream conditions due to a number of negative impacts. Riparian vegetation works to intercept a large percentage of rainfall, allowing for evaporation back into the atmosphere. Additionally, the root complexes of riparian trees, shrubs and grasses work to bind the soil together, increasing its erosion resistance. This soil loss is not just important from the standpoint of sedimentation. The ability of soils to absorb rainfall, known as infiltration capacity, is critical in the mitigation of excessive runoff to a stream during a precipitation event. As more soils are forever lost to erosion, the overall infiltration capacity in the watershed decreases. This allows for increases in the volume and rate of water entering a stream as surface runoff as the result of a particular precipitation event. The surface roughness created by a healthy riparian buffer slows the surface flow of water as it reaches the stream, thereby lengthening the time required by the water to reach the stream. This allows for higher infiltration rates, minimizing the amount of water reaching the stream as surface runoff. Lowering the velocity of surface runoff also helps to reduce its erosion potential. When riparian vegetation is altered or removed, all of these buffering benefits are lost. In fact, removal of streamside vegetation leads to a substantial increase in the volume of water reaching the stream as the result of a particular precipitation event. This water also reaches the stream more quickly than if a healthy vegetative buffer were in place.

Conversion of indigenous forest cover to agricultural land also affects watershed hydrology in similar ways. Historically, large portions of the County's watersheds have been cleared first for timber and then for farmland. Today, agriculture (cropland and pastureland) is the dominant land use in the stream valleys, accounting for nearly 66% of the entire land area. Widespread alteration of the dominant vegetative cover types in the watershed has undoubtedly had long-reaching adverse effects throughout the watershed, especially to the stream system therein.

Changes in hydrology as a result of alteration and/or removal of vegetation both along the riparian corridor as well as across the watershed are well documented. Removal of native forest cover in an experimental New Hampshire forest resulted in a 40% annual increase in surface runoff (water reaching the adjacent stream during and just after a particular precipitation event). This increase in surface runoff was even higher during the summer months, with runoff amounts increasing by 400 percent (Likens, 1984). Removal of riparian vegetation along a stream reach is devastating to that reach, and its direct effects are evidenced downstream. When native vegetation is altered on a watershed-wide scale, such as in the conversion of forests to agricultural or residential land, the impacts of that alteration are devastating to the entire watershed. The large-scale changes in hydrology resulting from this watershed-wide change in vegetative cover are well-reflected in the frequency and scope of instability issues evident in a watershed where such changes have taken place. Increased runoff rates and volumes lead to a well-documented increase in the frequency and intensity of bankfull discharges. These more frequent and intense flood events have an egregious effect on the stability of morphological features and processes along a stream or stream reach.

It is critical, wherever possible and practicable, to attempt to re-establish native vegetation as an integral part of any stream restoration, remediation, or stabilization project undertaken in the watershed. The benefits of establishing a healthy native riparian buffer are numerous. Streamside buffers stabilize local hydrology; increase roughness; allow more water to enter the soil (percolation); allow for the establishment of substantial root masses along the banks, provide structural stability to the banks; and increase the amount of quality habitat used by a myriad of birds, amphibians, insects, and mammals. Additionally, woody and leaf material originating from the riparian corridor establishes the very basis of the food chain within the stream. This coarse particulate organic matter (CPOM) provides food for microbes and some benthic macroinvertebrates which then become food for larger stream organisms (Sweeney, 1992; Allan, 1995). All in all, the establishment of a healthy native riparian vegetative stream buffer is extremely beneficial to the physical and ecological integrity of the stream and the stream corridor. Every effort should be made to establish and protect these critical areas as part of any watershed-wide stabilization effort.

2. Channel Encroachment / Floodplain Restriction

Floodplains are areas adjacent to streams which become inundated due to an increase in water surface elevation, namely as a result of precipitation events. Floodplains are critical in the dissipation of flow energy during high water events. As flowing water begins to inundate the floodplain, energy is lost as a result of increased roughness and alteration of the width/depth regime. This in turn reduces velocity and lowers the potential erosive effect of the high water event. Floodplain areas also increase the storage capacity of the basin, helping to maintain channel stability. As with wetlands, vegetated floodplain areas promote storage within the drainage basin, thereby increasing the retention of a greater volume of floodwater. Retention of floodwaters within the floodplain reduces peak discharges by lengthening the time to peak runoff. This helps to reduce flood energy, mitigating stream erosion and runoff hazards. Removal or alteration of floodplain vegetation decreases the storage potential of these floodplain areas, which in turn decreases time to peak discharge and increases runoff volume, thereby increasing the likelihood of downstream flooding (See 'Alteration and Removal of Vegetation').

Floodplain effectiveness is compromised by longitudinal or transverse encroachment. Longitudinal encroachment occurs when roadway fill, buildings, or other structures encroach upon the floodplain parallel to the stream channel. In Bradford County encroachment of roadways upon stream channels is fairly common, and is a significant source of impairment to a number of streams as documented in all watershed assessments conducted in the County. The construction of roadways along streams is common, as many of these roads follow old trails or travel routes, or at least follow the moderate grades that usually parallel streams. Encroachment of roadways upon stream corridors has serious impacts to the channel, however. The proximity of the road usually requires the removal of roadside vegetation as a road maintenance concern. Unfortunately, in situations where the stream and road are adjacent or nearly so, this roadside vegetation is also the streamside vegetation. Typically, streams which are laterally encroached by roads have very poorly vegetated banks, especially on the bank adjacent to the road. Since roads are intended to be permanent, immovable structures, streams which parallel them are unable to laterally migrate along road corridors. Streams which do so are usually straightened and deepened as a road maintenance measure. The banks are hardened with rip-rap or other bank protection structures. Since streams paralleling roads are unable to meander, they tend to down-cut. This causes incision and entrenchment of the stream channel. As this condition worsens, oftentimes being assisted by human road maintenance practices, the channel becomes further disconnected or restricted from the floodplain. This leads to accelerated erosion of the channel bed and banks during high flows, as the inherent energy-dissipation capabilities of the floodplain are non-existent. This excessive scouring of sediment generates extra material, which eventually is deposited somewhere downstream, often creating impaired morphology in those depositional areas and hence translating the impact of the road encroachment some distance downstream.

Transverse encroachment occurs when fill or structures encroach or span the floodplain perpendicular to the stream channel, such as debris jams, beaver dams, bridges or culverts. This type of encroachment eliminates floodplain access during high flow events, and increases scour and degrading of the streambed (in the case of bridges and culverts) by forcing the increased volume of water through a smaller opening, increasing its velocity. This increased velocity leads to a higher erosive potential at the outlet of the obstruction opening. Transverse encroachment may also increase upstream flooding due to backwater effects caused by the channel obstruction. Transverse obstructions also cause excessive deposition of sediment, ultimately leading to lateral migration of the channel (see ‘Debris Jams’).

3. Debris Jams

Debris jams are often serious contributors to the overall instability of a stream reach, particularly in those channel types with flatter slopes. Debris jams primarily work to degrade stream channels in two ways. First, the channel obstruction created by a debris jam can act as a deflector, diverting flow away from the existing channel, and forcing it to create a new channel where one previously did not exist. This scouring of a new channel generates excessive sediment, destabilizing the new banks as well as altering the proper dimension, pattern, and profile of the channel in the area of the debris jam. This additional sediment load generated as the stream creates a new channel is usually deposited somewhere downstream, altering channel morphology in that area. This change then causes new channel adjustments, for instance if this deposited material creates a transverse bar, or a mid-channel bar. These alter existing morphology by diverting flows away from their traditional path, ultimately leading to the generation of more sediment, which will be deposited further downstream. In this method, the process continues to repeat itself, leading to the translation of channel impairment quite a distance downstream of the original impact site. Also, this diversion of water from the old channel into a new channel usually involves the excessive erosion of the receiving bank. If this bank is located in a forested area, the result is often an undermining of streamside trees, which eventually fall into the stream and become the next debris jam.

A second manner in which debris jams affect the morphology of stream channels is through the obstruction of flood waters during high flow events. As discharge increases as a result of a precipitation event, water velocities and energy of the flow both increase. This increasing energy allows for the transport of sediment material through the stream system, with the transport ability of the stream increasing as discharge and energy increase. Simply put, the more energy the flow of water has, the more material, and larger material, it can move. Obstructions in the channel, such as debris jams, slow the flow of water down. As the water slows, it begins to lose energy. When it slows sufficiently to the point where it no longer has the energy required to move the sediment load it was able to carry before reaching the obstruction, it begins to deposit this excess sediment that it can no longer move. This causes an accumulation of excessive sediment just upstream of the obstruction. As this sediment accumulates here over time, the distance from the obstruction at which the deposition of sediment begins to occur migrates upstream.

The ultimate effect of this deposition of sediment is a flattening of the channel slope. As the slope of a stream channel increases, it typically becomes less sinuous, taking on a straightened form. Conversely, as the slope of a stream channel lessens, or flattens, that channel begins to become more sinuous, that is to say it begins to meander more. Taking into account the fact that stable stream reaches develop, over time, a fairly consistent slope, these slopes can be altered in a short period of time by a debris jam and by the processes outlined above. The result is lateral migration of the stream channel. As the slope of a stream reach is flattened by the excessive deposition of sediment, it becomes more sinuous, and begins to meander more significantly. This meandering behavior leads to erosion of the streambanks, which once maintained the straighter channel which previously existed. This accelerated erosion of the streambanks supplies more sediment to the stream system through this quickly degrading reach, accelerating the rate at which the channel slope flattens. As the channel slope decreases more and more, this prompts the channel to become more and more sinuous, further eroding the streambanks. In this manner, the process intensifies, and the impacts become more drastic.

In many instances where debris jams have existed for a long enough period of time as to create significant changes to channel morphology and/or bank stability, the removal of these obstructions may not be sufficient enough to restore channel or bank stability, either at the location of the debris jam or through the stream reach immediately downstream. Careful examination of the site must first assess the immediate and long-term impacts of debris removal before it is attempted.

4. Anthropogenic Channel Alteration

There is considerable documentation of the historic effect that man has had on Bradford County through deliberate alterations. Streams, over geologic time, without man's influence tend to reach a form that is adapted to the geology, slope and climate of an area. Clear-cutting at the turn of the 19^{th} century and the related skidding of logs through the creek channels, changes in hydrology due to growth of the County have all resulted in the instability of our stream channels. With the lack of restoration, local officials and landowners have adopted an approach of stream "maintenance" to address the resultant overwhelming sediment supply. Streams are viewed in many instances as "maintenance liabilities".

Deliberate alteration of stream channels and corridors is widely evident throughout the County. Most common is the straightening of the wetted channel, usually as part of an effort to mitigate flood impacts, or to preserve established property (usually in the form of crop or pastureland). Many of these efforts consisted of digging a straight, deep trench through the channel, oftentimes using the displaced substrate material to construct berms on one or both sides of the creek. The impacts of straightening and berming the channel are devastating to the morphology of the stream, both locally as well as further downstream. As the channel is straightened, its velocities increase due to the loss of sinuosity, which functions as an energy-dissipation mechanism in low slope channels. (These increased velocities lead to excessive scour of the stream bed and banks. As this material is eroded, the channel deepens, and it becomes further detached form the floodplain. The straightening of a stream channel affects not only the straightened segment, but also has lasting impacts downstream. In many instances, the first meander downstream of a straightened reach of stream is accompanied by a severely eroding outside meander bank. Water passing through this straightened reach has a higher velocity than normal, and therefore has a more intense impact on the outside meander bank (higher near bank stress). The accelerated erosion of this outside meander bank generates excess sediment to the stream system, which eventually is deposited somewhere downstream. This sediment deposition usually leads to impaired morphology at these downstream sites.

Anthropogenic channel alteration still occurs frequently throughout the County. Activities such as removal of gravel bars, straightening of stream channels and construction of levees and berms are quite common, especially as part of damage relief as a result of recent flood events in the watershed (autumn of 2004). Unfortunately, execution of these activities without consideration of long-term channel stability impacts, or a lack of understanding as to the cumulative downstream impacts of these localized activities, often leads to a condition where makeshift stabilization efforts are short-lived, and lead to increased impairment of localized as well as downstream channel morphology. Many times, these impairments over time become the very causes of the excessive flood damage these efforts were originally implemented to avert. This issue is indeed a sensitive one, aggravated by existing beliefs in the community, and the personal impact to peoples lives caused by flood damage and other stream-related issues.

5. Transitional Areas

Erosion or impairment of stream banks and stable channel morphology is often evident in areas of stream corridor transition. These impacts are seen in areas where the stream corridor passes from a wooded to a pasture area, or vice versa. Transitional impairment can also occur along stream reaches which undergo a significant change in material size, channel type, or valley type.

Streams flowing through forested areas, or other areas where significant vegetative cover allows for ample stabilization of bank integrity and stable hydrologic parameters, tend to be broad, flat, and somewhat straight compared to streams flowing through pastures or other open areas. Streams flowing through these areas tend to be narrow, incised and/or entrenched, and meander quite significantly. These two generically differentiated stream types usually have different sediment transport regimes. That is to say, these stream types appear to be able to move varying sizes and amounts of sediment at different rates because of their differing channel configurations. In areas where the stream corridor or channel transitions from one type to the other, the capability of the channel to transport material changes, often abruptly. This change is linked directly to the change in channel dimension, pattern, and profile, which in turn affects the amount of energy high flows can potentially achieve. For instance, a stream channel of particular pattern, dimension, and profile carries water with a distinct amount of energy. The energy possessed by this flow is dictated by discharge, and by the dimension, pattern, and profile inherent to the stream channel type. This flow is capable of moving a particular amount of sediment, the amount of which is directly linked to the energy of the flow. This transporting of sediment material acts as a mechanism for energy dissipation. When this stream corridor enters an area where it transitions from one type to another, leading to a transition from one channel type to another (that is to say, a change from a channel of a particular pattern, dimension, and profile to that of another pattern, dimension, and profile), this transition translates to a change in flow energy, which in turn means a change in the amount of sediment able to be moved. In areas where the channel transitions to a type through which the flow can attain more energy, say from a highly sinuous, fairly flat C-type to a straighter and steeper B-type, this can result in disproportionately high flow energy if no excess sediment is present to be moved. This system is then said to be *sediment-starved*. These systems often generate excessive sediment by eroding bank material at an accelerated rate.

In areas where a steep channel transitions into an area with a flatter slope, sediment can be deposited as flow energy decreases. This excessive deposition can lead to alterations in channel morphology by forming detrimental features such as transverse bars or mid-channel bars, sometimes resulting in impairment of the channel.

Throughout the County, the most obvious and widespread type of transitional erosion occurs in areas where streams flow from woodland to pasture areas. This transition is usually accompanied by a transition from a broad, somewhat straight channel to a narrow, deep, sinuous channel. Near bank stress is very high at the point where the somewhat straight channel begins to meander through the beginning of the pasture reach, exerting highly erosive forces on the outside meander banks. This generally leads to accelerated erosion of these banks, as well as the accompanying generation of excessive sediment and the problems associated with it.

Although this type of erosion is directly due to natural hydraulic processes, the conditions in which these transitions occur are typically a result of human activity. The abundance of pastures and open agricultural fields in the water, often interspersed by small woodlots, account for the frequency of these stream corridor transitions. Additionally, channel alteration (straightening, etc…) changes stream slopes and channel types, creating transitions between altered and unaltered reaches. Taking into account the minimal buffering capacity of our existing geology and soils in the watershed (see ‘Geology and Soils’), These anthropogenic alterations to land use cover types, as well as alterations to channel dimension, pattern, and profile, have been devastating to the overall stability of the stream system within the Sugar Creek watershed.

6. Geology and Soils

The geology and soil types present in the County do not lend well to the stabilization of stream channels and banks, especially when exposed to the stressors which exist in the drainage basin. Typically, soils are loose and are largely unconsolidated. Streambanks comprised of these soils, once left unprotected by the removal of vegetative root cover, are very easily eroded. These highly erodible materials do not offer a substantial buffer against the impacts which destabilize stream channels in this watershed. That is to say, these same stream impacts and causes of impairments, located on streams which exist in a watershed comprised of more erosion resistant soils, would cause less channel and bank impairment than is evident in the County's watersheds. This idea of a low 'resistance threshold' does much to explain the frequency and degree to which we see these impacts lead to channel and bank impairment.

A second aspect of watershed soils and geology influencing stream function is the shape of the larger sediment material, of which much of the substrate material in local stream channels is comprised. Most of the gravel- and cobble-sized material is flat and plate-shaped. Sediment material so shaped is highly mobile, and so is less resistant to high flow energy. The high mobility of the material means that, generally speaking, the bed characteristics of stream channels in the watershed are more susceptible to change, and most likely are changing more frequently and drastically than would bed features in a channel where sediment materials are more rounded, with higher densities per unit surface area, and therefore less mobile, all other watershed conditions remaining equal. What this means is that local geologic and soil conditions dictate that streams in the County are more susceptible to change, and are less resistant to negative impacts to channel and/or bank stability.

Much of the surface soil in the watershed is underlain by a fairly shallow (typically @ 12" to 24" below the surface) fragipan. This poorly permeable, lens-like layer often prevents substantial recharge of the underground aquifer. This condition lends a flashy nature to local streams in the watershed. In regions where no fragipan is present, adequate infiltration of rainwater leads to percolation into the ground aquifer. This removes much of the water which would enter the stream immediately as surface runoff (see 'Removal and Alteration of Vegetative Cover'). Instead, this water is slowly injected into the stream through the ground aquifer. The result is a more consistent streamflow regime over time. Stream discharge increases moderately during a normal rain event, and then falls gradually, but not drastically due to the constant influence of water from the ground aquifer. In this fashion, streamflows fluctuate less during periods of high and low precipitation.

This is not the case where a shallow fragipan affects percolation into the ground aquifer. Much of the water which might usually percolate into the ground aquifer, slowly recharging streamflow over an extended period of time, is instead intercepted by this fragipan, and after rapidly saturating the shallow soil layer above is discharged directly to the stream as runoff. Therefore, more water reaches the stream directly as runoff. At the same time, there is significantly less recharge of the groundwater aquifer, meaning that the less water is available for long-term injection to the stream from the aquifer. The end result is a more drastic increase in stream discharge during a rain event, followed by a substantial lowering of discharge after the initial runoff passes through. In this manner, streams in the County are flashy by nature, rising quickly during precipitation events and then lowering drastically shortly after the event has ended. This flashy nature translate into more frequent bankfull flow events, more frequent floods, and lower base flows during periods of low precipitation. The combination of this naturally occurring fragipan effect and the low resistance threshold of local soils, on top of all of the anthropogenic impacts to the streams in the watershed, culminate in the impaired conditions evident throughout the County.

The presence of this impervious subterranean layer also affects streambank stability. In areas where bank slopes have been substantially increased due to accelerated erosion, the fragipan layer is often exposed. When the sandy or silty bank material above the fragipan becomes saturated during a precipitation event or from offsite drainage, this already highly erodible material becomes even more easily moved as it slides across the slick surface of the fragipan layer, which is often comprised mostly of clay.

AMBIENT CONTRIBUTING CONDITIONS:

Local Soils, Geology, Topography, Waterways Network, Weather, and People

QUANTIFICATION OF POTENTIAL SOURCES:

See Attached Supporting Documentation (Excel Spreadsheet)

4346.4 Miles of Total Stream Bank Miles in Bradford County between the Major Sub-Watersheds of Bentley, Laning, Satterlee, Seeley, South, Sugar, Towanda, Wappessening, Wyalusing, and Wysox Creek and the Susquehanna and Chemung Rivers.

It has been estimated that 13.6% of stream banks are eroding. (Data from Sugar Creek Watershed Assessment)

Therefore, 4346.4 miles X 13.6% = ***295.9 Miles of Eroding Banks in Bradford County or 1,562,352 feet.***

Soil loss estimated through the evaluation of site specific data from the Sugar Creek Watershed Assessment and collaborated by data from the Bentley Creek Tributary Assessment indicates an average amount of .623 tons per foot per year. According to a published study by Lloyd A. Reed of the U.S. Geological Survey presented to the American Geophysical Union, Geochemical Society, and Mineralogical Society of America at their 1995 spring meeting, sediments characteristic of those in Bradford County remain in suspension much longer then previously anticipated. In fact, as much as 50% of the fine sediments could reach the Chesapeake Bay or be trapped by the dams on the Susquehanna, from Bradford County. It is also a safe assumption that 50% of the typical soils in the County can be classified as fines.

Therefore the following calculations can be assumed as accurate:
1,562,352 feet of eroding stream bank X .623 tons = 973,345 tons annually are lost directly into Bradford County streams through bank erosion. 50% or 486,672 tons are fines, and of that number, 50% or 243,336 tons potentially reach the Chesapeake Bay.

Additionally, based on average contributions of 2.5 pounds of nitrogen and1 pound of phosphorous (USDA NRCS *Bentley Creek Preliminary Report)* for each ton of sediment of stream bank soil, ***608,340 pounds of nitrogen and 243,336 pounds of phosphorous are delivered to the Bay.***

In summary:
- ⇨ 1,562,352 feet or 295.9 miles of streambanks are eroding in Bradford County
- ⇨ 973,345 tons of sediment are entering Bradford County Streams from streambanks annually.
- ⇨ 243,336 tons of sediment are reaching the Chesapeake Bay from Bradford County streambanks annually.
- ⇨ 243,336 pounds of phosphorous are reaching the Chesapeake Bay from Bradford County streambanks annually.
- ⇨ 608,340 pounds of nitrogen are reaching the Chesapeake Bay from Bradford County streambanks annually.

DEP Tributary Strategy Plan goals target Bradford County to install
8.82 miles of Non-Urban Stream Restoration by 2010

POTENTIAL BEST MANAGEMENT PRACTICES TO ADDRESS SEDIMENT SOURCE STABILIZATION RELATED TO STREAMS:

Natural Stream Channel Design
Riparian Plantings
Riparian Easements
Stormwater Management Planning
Creation of Floodplain Access
Flood Water Detention/Retention
Land Purchasing
Riparian Management Planning
Streambank Stabilization - Structure
Streambank Stabilization - Bioengineering

Stream Channel Stabilization
Landowner Education
Municipal Official Education
Watershed Association Development and Education
Watershed Planning
Contractor Education

PROPOSED NEEDS TO ADDRESS ALL ABOVE IDENTIFIED SOURCES BY 2010:

Staffing Needs

- Education – Municipalities, Watershed Groups, Landowners, Agencies
  - 1/2 Man year @ $30,000/year X ½ = $15,000/year X 5 years = **$75,000**
- Assessment, Design, Construction Oversight and Administration
  - 2 Full-time @ $30,000/year X 2 = $60,000/year X 5 years = **$300,000**
- Project Engineer
  - ¼ Man year @ $64,000/year X ¼ = $16,000/year X 5 years = **$80,000**
- Administrative Support
  - ¼ Man year @ $30,000/year X ¼ = $7,500/year X 5 years = **$37,500**

Best Management Practices Installation

$132,000 - $528,000 per mile X 8.82 miles = **$1,164,240 – $4,656,960**

Total Required Monetary Needs:
$1,656,740 - $5,149,460

DATA SOURCES:

- ⇨ Sugar Creek Triage Report
- ⇨ Bentley Creek Tributary Assessment
- ⇨ Towanda Creek Watershed Assessment
- ⇨ Lloyd A. Reed, U.S. Geological Survey presented to the American Geophysical Union, Geochemical Society, and Mineralogical Society of America at their 1995 spring meeting

Watershed Name	1st Order Streams (miles)	2nd Order Streams (miles)	3rd Order Streams (miles)	4th Order Streams (miles)	5th Order Streams (miles)	6th Order Streams (miles)	0th Order Streams (miles)	Total Stream Mileage in Watershed	Total Stream Bank Length in Watershed	Total Mileage of Eroding Stream Banks*
Bentley Creek Watershed	43.7	20.6	6.5	4.6				75.4	150.8	**10.3**
Chemung River Watershed	41	17.5	9.8	0.6	2.8			71.7	143.4	**9.8**
Laning Creek Watershed	15.4	6.1	8.6					30.1	60.2	**4.1**
Satterlee Creek Watershed	11.6	7.1	1					19.7	39.4	**2.7**
Seeley Creek Watershed	18.8	3.6	4.8					27.2	54.4	**3.7**
South Creek Watershed	30.7	10.6	8.3					49.6	99.2	**6.8**
Sugar Creek Watershed	161.2	70	30.4	23.5				285.1	570.2	**38.8**
Susquehann River Watershed	302.1	131.1	42.5	32.9	6.5	27.3	53.3	595.7	1191.4	**81.1**
Towanda Creek Watershed	303	107.6	45.6	39.7	25.6			521.5	1043	**71.0**
Wappasening Creek Watershed	73	32.6	11.3	13				129.9	259.8	**17.7**
Wyalusing Creek Watershed	87.7	38.8	19.7	1.7	16.9			164.8	329.6	**22.4**
Wysox Creek Watershed	109.7	51.3	29.2	8.2	4.1			202.5	405	**27.6**

Grand Total Stream Bank Mileage in Bradford County
4346.4

Grand Total Eroding Stream Bank Mileage in Bradford County
295.9

Values Generated from BCCD Assessment of Sugar Creek Watershed's 2nd, 3rd, and 4th Order Streams

Total Erosion Sites Identified	166	**Total Erosion Sites Identified**	166
Total Length of Sites (feet)	178161	**Total Length of Sites (mile)**	33.7
Total Area of Sites (square feet)	1208324	**Total Area of Sites (square mile)**	0.043
Average Site Length (feet)	1073	**Average Site Length (mile)**	0.20
Average Site Height (feet)	7.8	**Average Site Height (mile)**	0.0015
Average Site Area (square feet)	7279	**Average Site Area (square mile)**	0.00026

Percentage of Eroding Streams for Sugar Creek Watershed's 2nd, 3rd, and 4th Order Streams **13.6%**

* It is being assumed that 13.6% of total stream banks of each watershed are eroding.

Potential Pollution Source:

Agricultural Nutrient Management

SOURCE BACKGROUND:

Animal manure with its handling and application practices is a leading source of nutrients to the water of Pennsylvania in Bradford County. Agriculture has long been the county's leading revenue generating industry. The dominating cultural management practice has been to collect, and field apply manure daily in the most convenient location. Bradford County is generally land rich, with more than enough crop land to utilize nutrients from animal wastes. However, the majority of hay ground goes under-fertilized. Manure nutrients are concentrated on intensively farmed and conveniently located acres.

Farm infrastructure is often located adjacent to the stream, hailing back to days when proximity to water was an asset. As the industry has grown, adaptation of existing facilities is more common than building new ones in less environmentally sensitive areas. As these facilities are expanded with increased herd sizes the animal and manure concentrations often reach levels that are not sustainable or maintainable in these sensitive areas.

POLLUTION SPECIFIC CAUSES:

Timing and application rate are the primary considerations for manure application. Manure applied during late fall, winter and early spring months when the ground is frozen, snow covered or saturated is extremely susceptible to runoff with snow melt and storm water. Also, most manure nutrients applied in fall and winter are not utilized until the following growing season. Many of these nutrients are lost to surface waters before they can be utilized. Over-application leaves excess nutrients after crop growth susceptible to leaching and runoff.

Most soil on our farmed land has a shallow impermeable layer. Soil is quickly saturated in fall and spring, creating high risk for surface runoff of manure nutrients. Most Bradford County farms contain many hill side fields where slopes create a runoff concern when the ground is frozen or saturated.

Manure handling is often concentrated in environmentally sensitive areas. Outdoor animal confinement allows large amounts of manure nutrients to be transported by storm water runoff. They are often adjacent to streams either because that is where the barn is or the stream is used to water animals. Manure is often not collected in these outdoor lots. Grazing animals have access to many miles of streams. This destabilizes stream banks and directly deposits manure nutrients to the water.

QUANTIFICATION OF POTENTIAL SOURCES:

Bradford County has 75,193 Animal equivalent units according to the USDA 2002 Ag Census ranked as follows: Dairy, Beef, Hogs/pigs, Horses, Poultry, Sheep/Lambs, Other. Approximately 1,200,000 tons of animal manure is produced annually. Total potential loads to the edge of water are 7,158 lb N/farm X 965 livestock farms yet to develop nutrient management plans = 6,907,470 lbs N and 2,769 lbs P/farm X 965 = 2,699,775 lbs P. *(based on calculations from Bradford County Chesapeake Bay Watershed Assessment from values in DEP "Manure Management For Environmental Protection)*.

Local conditions make the period between October – May sensitive for manure application. During this period ground is often saturated, snow covered or frozen. 780,000 tons (65%) of the manure is generated during this sensitive period.

Crop acres able to receive manure total 338,600. If spread evenly, all manure produced in the county could be used at a rate of 3.5 tons/acre. With typical annual application rates at approximately [1]20 T/ac, Manure is applied to only about 18% of available acres.

Of the 1,050 livestock farms (cattle, poultry)[2] approximately 965 have yet to develop approved nutrient management plans. Based on our history with follow-up and review of nutrient management plans approximately one third of plans need to be revised every three years because of operational changes.

BEST MANAGEMENT PRACTICES
Of priority in Bradford County

- Nutrient Management Plans inventory all nutrient sources on a farm and account for how they will be managed. Practices include soil and manure testing.

- Riparian zone fencing excludes cattle from streams to keep from disturbing banks and allows growth of vegetated buffers to filter runoff.

- Barnyard management Systems address outdoor manure concentrations in confined areas. Practices we will consider include relocation to a less sensitive area, diverting clean surface and roof water from manure, collection and filtration of runoff from barnyards, reinforcement to allow manure collection.

- Animal Waste Management Systems address how manure will be handled and field applied. Practices we will consider include planning appropriate areas for winter application, identify proper areas in fields to temporarily stack manure, structures to stack solid manure, structures to contain manure as liquid. Manure

[1] Based on history of manure spreader calibration
[2] 840 livestock farms (1989 assessment) + 25% = 1,050 – 85 approved nmp's to date = 965 nmp's to be prepared

storage facility type and size must be planned to meet the unique needs of each farm's nutrient management plan.

Proposed Needs to Address Identified Sources:

When the Watershed Assessment was completed in 1989, an average of 62% of farmers interviewed said they would potentially work with an agency to address nutrient and sediment issues. This cooperation factor is being applied to estimate the amount of voluntary implementation we can expect for the following BMP's. The 1989 assessment includes real data from watersheds 4-C and 4-D of the Susquehanna River Basin, approximately 75% of the county. All the following numbers have been increased by 25% to account for remaining farm needs in other sub-watersheds.

Nutrient Management Plans

- 566 plans[3] x $2,000/plan = $1,132,000
- 48 NMP revisions required in next 5 years[4] x $1,000/plan = $48,000

Soil Testing

- 2,546 tests needed annually[5] x $20 per sample = $50,920 per year

Manure Testing

- 1,263 tests annually[6] x $30 each = $37,890 per year

Riparian Fencing to exclude animals

- 395,000 feet required[7] x $1.50/ft = $592,500

Barnyard Management Systems

- 101 systems required[8] @ $20,000 each = $2,020,000

Animal Waste Management Systems

- 560 systems required[9] @ $50,000 each = $28,000,000

Total = $31,881,310

Possible Annual Accomplishments (assuming BMP$ provided):

All following data is from Bradford County 1989 Watershed Assessment and assumes 62% cooperation

[3] 840 livestock farms (1989 assessment) + 25% =1,050 livestock farms x 62% cooperation = 651 NMP's – 85 developed to date = 566 farms yet to develop plans.

[4] Estimating one third of nutrient management plans developed by 2007 will need revisions by 2010. 85 plans to date + 30 new plans/year x 2 years = 145 plans by 2007 x 33% = 48 plan revisions.

[5] 493 farms + 25% x 20 tests/farm = 12,320 tests x 62% cooperation = 7,638/3 years = 2,546 tests annually

[6] 815 farms + 25% x 2 tests/farm = 2,038 tests x 62% cooperation = 1,263 tests annually

[7] 316,000 feet possible in 1989 + 25% = 395,000 feet required

[8] 100 units possible in 1989 +25% - 24 completed to date = 101 systems still required.

[9] 504 units possible in 1989 +25% - 70 completed to date = 560 systems still required.

- 30 Nutrient Management Plans
- 600 soil samples (landowner's cost @ $20 each = $12,000)
- 60 manure tests (landowner's cost @ $30 each = $1,800)
- 27,000 feet riparian fencing implemented @ $1.50/ft = $40,500
- 20 barnyard management systems implemented @ $20,000 each = $400,000
- 12 animal waste management systems implemented @ $50,000 each = $600,000

Total BMP Needs - $1,054,300.00

Staffing Needs

- 3 man-years - nutrient management planning @ $30,000/year = **$90,000**
- 1 man-year – construction oversight @ $30,000/year = **$30,000**
- 1 man-year - Engineer @ $64,000/year = **$64,000**
- ½ staff year for administration @ $30,000/year = **$15,000**
- NRCS field office staff

Total Staff Needs - $199,000.00

TOTAL ANNUAL NEEDS - $1,253,300

Nutrients saved for these invested resources: *(based on actual calculated savings Mill Creek Watershed Restoration Project)*

Riparian Fencing – 27,000 feet:
1,116 lb N/1,500 feet average project = 20,088 lb N
428 lb P/1,500 feet average project = 7,704 lb P

Barnyard Management – 20 systems
4,086 lb N/system = 81,720 lb N
1,593 lb P/system = 31,860 lb P

Animal Waste Management Systems – 12 systems
2,470 lb N/system = 29,640 lb N
948 lb P/system = 11,376 lb P

Total Potential Annual Nutrient Savings:
Nitrogen = 131,448 lbs,/yr.
Phosphorous = 43,940 lbs./yr.

Un-met needs assuming these annual accomplishments and resources

- 416 Nutrient Management Plans
- 1,946 soil samples/year
- 1,181 manure tests/year
- 260,000 feet riparian fencing
- 1 barnyard management system
- 500 animal waste management systems

DATA SOURCES:

- ⇨ 1989 Bradford County Chesapeake Bay Watershed Assessment
- ⇨ DEP Manure Management for Environmental Protection
- ⇨ 2002-3 PA Agricultural Statistics
- ⇨ The Agronomy Guide, 2004, PSU

Bardford County Manure Inventory

Animal Numbers from 2002 USDA Ag Census

Animal type	Number animals	Avg weight (lbs)	AEU's	Annual manure	Nutrient Content (lbs/t) N	P	K		Total (lbs) N	P	K
Beef	7,499	1,150	8,624	94,433	11	7	10		1,038,763	661,031	944,330
Dairy - dry (10%)	2,486	1,300	3,232	48,367	9	3	7		435,303	145,101	338,569
Dairy - lactating	22,377	1,300	29,090	562,746	10	4	8		5,627,460	2,250,984	4,501,968
Heifers/calves	47,432	500	23,716	376,551	7	2	7		2,635,857	753,102	2,635,857
Hogs/pigs	30,013	260	7,803	102,531	9	9.5	5		922,779	974,045	512,655
Sheep/lambs	2,489	130	324	2,365	23	8	20		54,395	18,920	47,300
Poultry	300,000	3	1,020	4,877	37	55	31		180,449	268,235	151,187
Horses	1,384	1,000	1,384	11,366	12	5	9		136,392	56,830	102,294
Totals:				**1,203,236**					**11,031,398**	**5,128,248**	**9,234,160**
							Avg/farm =		10506	4884	8794

(1,050 livestock farms - 1989 Bradford County Watershed Assessment +25%)

Actual Calculated Nutrient Savings for farms in the Mill Creek Watershed

Farms	Total N Produced	Total P Produced	N saved w/ NMP	P saved w/ NMP		Manure Mgmt Syst		Baryard mngmt syst		Stream Fencing	
						N	P	N	P	N	P
1			100	50							
2	40923	17756	32779	14223		5179	2247	17176	7453	3638	1579
3	26975	10264	18417	7055		8122	3111	8122	3111	2173	833
4	21820	8728	13354	5341		3405	1362	7665	3066	1135	454
5	21788	10116	11529	5353		6917	3212			2306	1071
6	17959	6922	12643	4873		3654	1408	6182	2383	1972	760
7	24324	8898	14059	5143				9377	3430	3641	1332
8	28123	10722	17656	6731		2860	1090	11458	4368	3367	1272
9	73844	24014	51986	16905		18715	6086	17675	5748	7278	2367
10	16900	6760	11615	4646		3415	1366	7515	3006	685	274
11	4661	3068	3445	2268		668	440	2391	1574	382	252
Totals =	277317	107248	187483	72538		52935	20322	87561	34139	26577	10194
Avg/nmp =	27732	10725	17044	6594	Avg/syst =	5882	2258	9729	3793	2658	1019
			x 42%	*x 42%*		*x 42%*	*x 42%*	*x 42%*	*x 42%*	*x 42%*	*x 42%*
County Average[1] =	10506	4884	**7158**	**2769**	**Co. Avg/syst =**	**2470**	**948**	**4086**	**1593**	**1116**	**428**

[1] From the manure inventory the average Nitorgen produced per farm = 10,506 lbs. Average Phosphorus is 4,884 lbs. These are 37.9% and 45.5% of Mill Creek farm averages respectively. Therefore 42% of average savings on Mill Creek farms will be used as county averages.

Potential Pollution Source

Tillage

Source Background:

Tillage is classified as any land that is cultivated to prepare the soil for seed, as well as maintaining the ground for the proper growth of crops. The objective of soil conservation is to enhance and sustain production of available land. It is also important to maintain an important relationship between land and water cycles to moderate the hazards of flooding. Important principles to consider when controlling the erosion of cropping lands are;

- Use the land in accordance with its suitability
- Protect the soil surface with a growing crop stubble from the previous crop, or pasture
- Control runoff before it is able to concentrate into an erosive force
- Assure runoff entering streams from crop fields does not contain excessive sediments and nutrients

Improving soil quality and sustainability should be a main priority for natural resource conservationists, as well as farmers. The following characteristics are good indicators of soil quality;

- Good bulk density
- Abundant soil pores
- Good infiltration rates and water holding capacity
- Overall tilth
- High levels of organic matter
- Beneficial soil organisms

Soil conservation is an important concept, since any type of frequent tillage can have a negative effect on almost all of the previous characteristics. Cropping fields that are continuously tilled season after season could create more serious soil quality problems. Without a break from tillage a total breakdown of soil structure is possible. Severely degrading the soil structure can cause limitations on water infiltration, which in turn increases surface runoff and the amount of non-point source pollutants entering the waters of the commonwealth.

Even moderate erosion to agricultural fields may cause significant yield setbacks due to the loss of nutrients and organic matter, as well as the damage done to the soil's physical properties. When tillage is sustained over many seasons a hardpan may develop, which can cut off root elongation, crop development, and yield.

Erosion contributes to a loss of inherent soil fertility levels, because nearly all organic matter, plant-available potassium, and plant-available phosphorus are located in the topsoil. The productivity of eroded soils can be restored by adding inputs, but only when favorable subsoil material is present.

Bradford County cropland:

Because of the large economic impact that agriculture has on Bradford County, soil conservation is an important resource. Of the total amount of cultivated cropland in the county the USDA Natural Resources Inventory revealed about 51.9% of the row crops are eroding at a rate of 6.5 tons/acre, which is 3.5 tons/acre above the 3 ton/acre tolerable soil loss rate. Based on actual loss determinations in the 1989 study *(Bradford County Chesapeake Bay Watershed Study)* the following calculations from real data quantify the amount of topsoil and nutrients we are losing annually to erosion in agricultural fields, sub-basin 4-B is estimated data and assumes a 25% increase from sub-basins 4-C and 4-D.

Non-point source pollution ***(Row crops)***

Sub-Basin	Acres	NRI%	Excess loss	Tons lost/year
4-B	9,689	X 51.9%	X 3.5 T/A	17,600 tons
4-C	24,546	X 51.9%	X 3.5 T/A	44,587 tons
4-D	14,210	X 51.9%	X 3.5 T/A	25,812 tons
				Total 87,999 Tons

Given nutrient losses of 5.44lbs of Nitrogen and 2lbs of Phosphorus for each excessive ton of soil lost *(from Animal Waste Utilization on Cropland and Pastureland, US EPA – 600/2-79-059 page 48)* and presumably entering a waterway, total nutrient losses for each sub-basin are as follows:

Sub-Basin	Tons lost/year	N (5.44lbs/T)	P (2lbs/T)
4-B	17,600	95,744lbs/yr	35,200lbs/yr
4-C	44,587	242,553lbs/yr	89,174lbs/yr
4-D	25,812	140,417lbs/yr	51,624lbs/yr
Total	**87,999**	**478,714 lbs/yr**	**175,998 lbs/yr**

Agricultural statistics

There are approximately 1,655 active farms *(2002-3 PA Ag Statistics)* in Bradford County. According to an inventory of the USDA files and data collected in the 1989 study, approximately 75% of these active farms either have an outdated conservation plan or don't have one at all. On average conservation plans should be updated every 5 years to take into account cropping rotations.

Calculations:

1,655 farms x .75 = 1,241 farms with outdated conservation plans

Approximate cost → 1,241 plans x $2,000/plan = $2,482,000

Having a conservation plan for an agricultural operation is crucial. Farmers need conservation plans to meet chapter 102 requirements for earth disturbance. Also conservation plans are needed before the operation is able to receive cost-share money from any conservation program. The new nutrient management regulations require all agricultural operations to have implemented conservation plans. In addition, the calculated soil loss from individual fields is applied to the phosphorus index, which helps interpret the amount of available nutrients that may be applied to a specific field.

Soil Conservation BMP's

Conservation buffers are an easy and cost-effective solution for addressing nutrients lost to the waters of the commonwealth. According to the Bradford County Chesapeake Bay Watershed Assessment within the county there is approximately 395,000 total feet of riparian cropland that is available for implementation, 79,000 total feet in sub-basin 4-B of the Susquehanna River, and 316,000 total feet in sub-basin 4-C and 4-D of the Susquehanna River. The following cost for each associated BMP is based on 2001 East Field Team One (NRCS) cost list.

→ **Riparian Cropland**

395,000 total feet of Riparian Forest buffer with a minimum 35 foot buffer

395,000ft x 35ft = 13,825,000sq ft / 43,560sq ft/acre = 317.4 acres
317.4 acres x $1,600/Acre = $507,840

→ **Contour Strips**

23,375 total acres in sub-basin 4-B, 4-C, and 4-D at a cost of $10/Acre

23,375 acres x $10/Acre = $233,750

→ **Permanent vegetative cover of critical areas**

455 total acres in sub-basin 4-B, 4-C, and 4-D at a cost of $500/Acre

455 Acres x $500/Acre = $227,500

→ **Sediment Retention/ Erosion and Water Control Structures**

630 total structures in sub-basin 4-B, 4-C, and 4-D at a cost of $1,000 each

630 structures x $1,000/ structure = $630,000

→ **Waterway Systems**

4,375 total feet in sub-basin 4-B, 4-C, and 4-D at a cost of $10/foot

4,375ft x $10/ft = $43,750

→ **Diversion Systems**

601,250 total feet in sub-basin 4-B, 4-C, and 4-D at a cost of $2.50/foot

601,250ft x $2.50/ft = $1,503,125

→ **Conservation Tillage Systems**

23,411 total acres in sub-basin 4-B, 4-C, and 4-D at a cost of $25/Acre

23,411 Acres x $25/Acre = $585,275

Total cost to address soil conservation needs with BMP's: $3,731,240

Source: All previous quantity figures taken from Bradford County Chesapeake Bay Watershed Assessment

Benefits of Conservation BMP's

- Slow water runoff and reduce flooding downstream
- Stabilize stream-banks and reduce the water temperature of the stream
- Serve as food source, nesting cover, and shelter for wildlife
- Remove up to 50% or more of nutrients in runoff
- Remove up to 75% or more of sediment in runoff
- Establish natural vegetation
- Provide a setback for agricultural chemical use from watercourses

Existing Program Resources

1) **Agri-Link**
   1. Grassed waterways
   2. Terraces, Diversions

2) **AMA**
   1. Riparian Buffers
   2. Soil Conservation (No-till, Reduced till)

3) **Farm Stewardship Program**
   1. Riparian Buffers

4) **CREP**
   1. Riparian Buffers
   2. Grassed Waterways
   3. Filter Strips
   4. Contour Strips
   5. Cover Crops

5) **EQIP**
   1. Riparian Buffers
   2. Filter Strips
   3. Terraces
   4. Soil Conservation (No-Till, Reduced Till)

6) **Grassland Reserve Program**
   1. Cover Crops

Annual BMP Needs

⇨ 60 Conservation Plans @ $2,000 each = **$120,000**
⇨ 60 Plan implementation @ $2,000 each = **$120,000**

TOTAL BMP = $240,000.00

Staffing Needs (Annual)

2 technicians/planners @ $30,000/technician = **$60,000**

1 construction technician @ $30,000/technician = **$30,000**

1 engineer design assistant @ $30,000/assistant = **$30,000**

¼ administration support @ $30,000/admin. support = **$7,500**

TOTAL STAFFING NEEDS - $127,500.00

Bradford County has approximately 1,655 active farms, of these farms it was figured from USDA files that about 1,241 farms either have outdated conservation plans, or do not have one at all. With the changing nutrient management regulations an active farm will be required to have a current conservation plan to meet the needs of the Act 6 laws. Besides the nutrient management regulations, active farms are required to have current conservation plans to meet chapter 102 requirements for earth disturbance. To keep conservation plans current and to stay ahead, the district could meet these needs by completing 60 conservation plans per year with two technical planners, one construction tech to overlook practice implementation, and one engineer design assistant to layout diversions, terraces, and other BMP's that address soil conservation.

Annual Savings

With two full time technical planners the district could complete 60 conservation plans per year. The completion of these conservation plans would coincide with nutrient management planning and allow us to stay ahead of the demand for yearly nutrient management plans.

→ Sediment, Nitrogen, Phosphorus lost per year

- 87,999 excess tons sediment lost/year
- 478,714 excess lbs Nitrogen lost/year
- 175,998 excess lbs Phosphorus lost/year

→ Sediment, Nitrogen, Phosphorus savings per plan

- **84,999 excess tons sediment/year / 1,241 plans = 68.5 tons/plan**
- **478,714 excess lbs Nitrogen/year / 1,241 plans = 385 lbs N/plan**
- **175,998 excess lbs Phosphorus/year / 1,241 plans = 142 lbs P/plan**

→ Sediment, Nitrogen, Phosphorus savings per year

- **68.5 tons sediment/plan x 60 plans/year = 4,110 tons/year**
- **385 lbs Nitrogen/plan x 60 plans/year = 23,100 lbs N/year**
- **142 lbs Phosphorus/plan x 60 plans/year = 8,520 lbs P/year**

Total BMP money to address all needs for soil conservation came to $3,731,240, or about $3,006 per plan. To address 60 plans/year total BMP money needed yearly would total $180,360.

DATA SOURCES:

⇨ 2002 Ag Census Bradford County
⇨ USDA National Resource Inventory
⇨ 1989 Bradford County Chesapeake Bay Watershed Assessment
⇨ Penn State Extension
⇨ Iowa State Extension
⇨ US EPA – Animal Waste Utilization on Cropland and Pastureland

POTENTIAL POLLUTION SOURCE:

URBAN ISSUES AFFECTING THE CHESAPEAKE BAY

Pollution sources include:	**Proposed needs include:**
• New Development • Geology/Soils • Runoff from impervious surfaces • Roadside Ditches/Catch Basins and Non-point Pollution • Lack of Legislation • Lack of Statistics/Data • Public Resistance	• Proper Project Design • Stormwater Management Act 167 • Coordination of Stormwater Planning • Public Involvement/Education • NPDES Construction Permits • Riparian Buffers • New PADEP Stormwater Policy and Program Practices - BMP's

SOURCE BACKGROUND

Although Towanda, Wysox, Athens, Sayre, Wyalusing, Troy and Canton are the population and employment centers, statistically Bradford County remains a rural county.

Developed uses account for less than 17 percent of Bradford County land. However, development and stormwater issues are significant contributors of nitrogen, phosphorus and sediment nonpoint source pollution to the Chesapeake Bay.

Pollution Specific Causes

New Development

The environmental impacts of new land development are frequently degraded wetlands, riparian zones and habitat, endangered fragile soil types or special geologic features, disturbance of historical and/or archaeological features, and the decline of amphibians, macroinvertebrates, and biodiversity.

Geology/Soils

Even minor land development can cause a dramatic increase in stormwater runoff to a stream, depending on the watershed's geology, soil type, land use, and topography/slope. Bradford County's soils have a high runoff potential due to the thin layer of topsoil and a relatively impervious layer of clay or fragipan, that limits groundwater infiltration. They are highly sensitive to rainfall and snowmelt inputs, which makes streambank erosion and the formation of gravel bars very common during intense storms and spring snowmelt. Unstable stream channels and streambanks contribute literally hundreds of thousands of tons of sediment and their related nutrients on an annual basis according to documented measurements. Studies have shown as much as 25% of these sediments are reaching the Chesapeake Bay.

Impervious surfaces

Development, buildings, roads, and ditches all change the hydrological characteristics of the watersheds by encroaching on floodplains, restricting stream channels with culverts and bridges, and by concentrating flows that reach the stream channels more rapidly. The bankfull flow increases in magnitude, frequency, and duration resulting in channel widening, downcutting, scouring, streambank erosion, the loss of pools and riffles, and creating cumulative downstream flooding issues.

Penn State Department of Agriculture has determined that the impervious area in a watershed increases by 5% for every one person per hectare (2.47 acres) of added population. *(Enhancing the Watershed Forest Conference 11/1/03)*

Roadside Ditches/Catch Basins

The primary stormwater management methods in the region are catch basins or roadside ditches that convey water directly to streams and wetlands without any retention capacity or energy dissipation. Roads, parking lots, and other paved surfaces transport stormwater runoff that contributes and dissolves pollutants such as petroleum hydrocarbons; metals; nutrients (phosphorus and nitrate); organic matter; sediment; and synthetic organics (pesticides, herbicides). These substances are rarely removed through treatment prior to being washed directly into surface waters via drainage systems that erode road banks and contribute to blockages of stream channels and floodplains.

Lack of Legislation

Of Bradford County's 51 municipalities, 50 have floodplain ordinances, 13 have local zoning ordinances, 5 have local subdivision and land development ordinances, and only 1 has a stormwater management plan, although a second stormwater plan is ready for adoption. Only Athens Township regulates development on steep slopes. The ability to understand and enforce existing ordinances varies between municipalities. Enforcement and understanding of existing ordinances varies greatly between municipalities.

The county's Office of Planning and Grants controls peak rate of runoff so it does not exceed predevelopment conditions, but it fails to control volume of runoff, fails to control NPS pollutant loadings, and does not address timed release of water from retention ponds. The stormwater management plan should address these issues.

Lack of Statistics/Data

Municipalities do not currently have a method or incentive to measure their stormwater runoff. The Office of Planning and Grants estimates 240 subdivision requests are processed each year, with approximately 25% involving construction; the Bradford County Assessment Office does not have information readily available of the number of annual building permits issued by the municipalities, nor the type.

Detailed existing land use information is needed for stormwater management assessment, sewerage assessment, economic growth analysis, detailed municipal planning/zoning, evaluating potential development areas, determining conservation opportunities, and monitoring development changes over time.

Public Resistance (excerpts from the Bradford County Comprehensive Plan)

Regional planning hearings identified several mindsets that hinder planning efforts, including strong resistance to zoning/building permits, consolidation of services, building codes, and land use controls.

PROPOSED NEEDS / REMEDIATION

There are a number of ways in which the effects of impervious surfaces upon stream flow characteristics can be corrected, and by which pollutants can be removed from stormwater. The use of retention basins, grassed swales, infiltration areas, and in-line manufactured stormwater treatment devices can moderate flow and allow for settling out and removal of various contaminants.

Importance of project design

Through sometimes innovative project design, impacts from stormwater runoff can be minimized to maintain the natural hydrologic regime, and sustain high water quality, groundwater recharge, stream baseflow and aquatic ecosystems. The most cost effective and environmentally advantageous way to manage storm water runoff is through nonstructural project design, minimizing impervious surfaces and sprawl, avoiding sensitive areas (i.e. buffers, floodplains, steep slopes), and designing to topography and soils to maintain the natural hydrologic regime. (Model Act 167 Stormwater Management Ordinance 12/31/2003)

Stormwater Management Act 167

Act 167 is a watershed-based management strategy to regulate and address the impact of stormwater runoff for existing and future land use and stipulating model ordinance standards for new land development. The purpose of the program is to prevent flooding, maintain hydrologic balance of watersheds, and maintain water quality and ground water recharge.

Stormwater Management Plans incorporate ordinances, zoning laws and best site design plans which are designed to store, carry, and release stormwater in a manner that prevents flooding and water damage throughout the watershed and enhances groundwater recharge. Only Wysox has an Act 167 Stormwater Management Plan in place, although Ridgebury Twp. (Bentley Creek) has prepared but not adopted a plan.

Coordination of Stormwater Planning

The preparation and adoption of a stormwater management plan may require changes by county government's recordkeeping and by local government in how land use is regulated. For those municipalities with little or no land use regulation, a plan will require those municipalities to adopt in its entirety the model stormwater management ordinances produced by the county or adopt separate building, subdivision, land development and building code ordinances to address the standards of a plan. For those already having stormwater ordinances, amendments may be all that is required. Municipalities within a watershed and the county may elect to administer the new stormwater management ordinances collectively rather than each municipality individually through municipal engineers and planning offices.

Successful implementation of stormwater management plans hinges upon local officials, municipal engineers and the community understanding the need for watershed planning, cooperation between municipalities within a watershed and inter-county cooperation. Treatment of non-point pollution before it enters waterways is critical to water quality issues.

The Office of Planning and Grants estimates they process 240 subdivision requests per year, with approximately 25% involving construction, detailed records are not kept; the Bradford County Assessment Office does not have information readily available of the number of annual building permits issued by the municipalities, nor the type.

A study by Bradford County Conservation District personnel to determine what is needed for a smooth implementation of a stormwater management plan would take a technician approximately 6 months.

Public Resistance

Municipalities need to strongly encourage public participation and involvement prior to undertaking a stormwater management strategy or adopting new ordinances, and planning projects.

The Dirt and Gravel Road Program

The Dirt and Gravel Road Program does an excellent job of assisting municipalities address stormwater management of their dirt and gravel roads, although it is rarely applicable in an urban community.

Act 102/105 and NPDES Construction Permits

These permitting processes regulate and educate as earth disturbance projects are undertaken.

Post Construction Stormwater Management Plans:

* Must Accompany the Construction Permit Application
* Must Identify BMP's
* BMP's must be designed and constructed in accordance with a PADEP approved Act 167 Plan; an existing/adopted MS4 Ordinance if there is no Act 167 Plan; or if none of the above are in place, the project must be based on a 2-year storm, pre to post, no increase in runoff volume control standard.

Riparian Buffers

Both urban and rural riparian buffers are an important resource for absorbing and filtering stormwater runoff, nutrient reduction and habitat restoration. Rain and sediment that run off the land can be slowed and filtered in the forest, settling out sediment, nutrients and pesticides before they reach streams. Forest infiltration and water storage can be 10-15 times higher than grass turf and 40 times higher than a plowed field.

Potential reduction of Sediment and Nutrients for Different Buffer Systems

Buffer Width (ft)	Buffer Type	Sediment Reduction %	Nitrogen Reduction %	Phosphorus Reduction %
15	Grass	61.0	4.0	28.5
30	Grass	74.6	00.7	24.2
62	Forest	89.8	74.3	70.0
76	Forest/Grass	96.0	75.3	78.5
95	Forest/Grass	97.4	80.1	77.2

(CBP/TRS 220/00 EPA 903-R-99-002 Riparian Forest Buffers Linking Land and Water)

New PADEP Stormwater Policy and Program Emphasis

Antidegradation	Groundwater Recharge, Infiltration
Construction Permits	NPDES Phase II
Expanded Use of Act 167 Stormwater Planning	PA Best Management Practices Handbook

BEST MANAGEMENT PRACTICES

Pennsylvania for Post Construction Stormwater Management BMP's are in Section 8 of DEP's Comprehensive Stormwater Management Policy. Site specific applications and designs are dependent on local soils, rainfall, land cover, slope, and other relevant information. The three main requirements of the policy are to maintain groundwater recharge, maintain surface water quality and to control the rate and volume of surface flow.

The Center for Watershed Protection provides fact sheets and Performance Criteria on stormwater management, porous pavement, Infiltration Systems, Open Channels, Filtering Systems, Grassed Filter Strips, Ponds, Grassed Filter Strips, Wetlands,

WATER QUALITY BMP's	***GROUNDWATER RECHARGE BMP's***	***RATE AND VOLUME CONTROL BMP's***
Permeable Paving	Permeable Paving	Permeable Paving
Stormwater Infiltration	Stormwater Infiltration	Stormwater Infiltration
Grass Swale	Grass Swale	Grass Swale
Bioretention	Bioretention	Bioretention
Filter Strip	Filter Strip	Dry Pond
Stormwater Wetlands		Stormwater Wetlands
Water Quality Structures		Riparian Corridor Management
Sand Filter		Rooftop Runoff Management
Wet Pond (extended detention pond)		Wet Pond (extended detention pond)
Riparian Corridor Management		
Rooftop Runoff Management		

STRUCTURAL BEST MANAGEMENT PRACTICES

Runoff Volume/Infiltration Oriented	***Initial Design***
<u>Vegetative and soil-based</u>	Locate Stormwater "in the right place"
Rain/recharge gardens/Bioretention	Consider Topography
Vegetated filter strips	Evaluate Soils
Vegetated Swales (Bio-infiltration, Dry, Wet)	Design with a Positive Overflow – no dead ends
Porous pavement with infiltration beds	Consider Geology
Subsurface infiltration beds	Carbonate
Infiltration trenches	Mining
French drains/dry wells	Visual Inspection
Outlet control (level spreaders, etc.)	Limiting Layers
Retentive grading techniques, berms	Water Table
	Bedrock
Runoff Volume/Non-Infiltration Oriented	Past Disturbance – Fill, compaction, debris?
Vegetated roofs	Cation Exchange Capability for Pollutant Removal
Cisterns/Rain Barrels/Capture Reuse	
	Site Infiltration
Runoff Quality/Non-Infiltration	Percolation Test (w/ modifications?)
Constructed wetlands	Double Ring Infiltrometer
Wet ponds/retention basins	Hydraulic Conductivity – Lab Test
Filters	Amoozemeter
Water quality inserts	Constant Head
Detention/Extended Detention	
Special Storage: Parking Lot, Rooftop, etc	***Construction Criteria***
Infiltration basins	Protect soils - Do not compact
Restoration BMPs	Protect infiltration BMPs from sediment until drainage area is completely stabilized
Riparian Corridor Restoration	Sequencing
Revegetation/Reforestation	Staging/stockpiling
Soils Amendment	Use clean aggregate
	Establish/protect dense vegetation
Volume-Reducing BMPs	
Porous Pavement w/ Infiltration	***Soil Testing***
Infiltration Trenches/Beds	Select the right locations for Testing
Bio-Infiltration Swales	Low, Wet areas will not drain
Berms/Retentive Grading	Multiple Testing Locations
Rain Gardens/Bioretention	Importance of Deep Hole for Visual Inspection
Vegetative ("Green") Roofs	Evaluate Soils – Field Infiltration Tests
Cisterns/Capture & Reuse	Test near bottom of proposed bed

Proposed Needs to Address All Above Identified Sources by 2010:

1. ***PROJECT DESIGN***

Engineering Review of Stormwater Plans for Municipalities
1 engineer @ $64,000/year x 25% = $16,000 /year x 5 years = **$80,000.**

2. ***IMPLEMENT STORMWATER MANAGEMENT ACT 167 FOR EACH OF DEP'S WATERSHEDS IN BRADFORD COUNTY***

1.4 plans implemented each year for 5 years = **$140,000 /year** x 5 years = **$700,000**
($100,000* x 7 remaining watersheds based on DEP's breakout of watersheds in Bradford County; Wysox is completed.*)

1) **Chemung River**
   Bentley Creek Watershed
   Seeley Creek Watershed
2) **Sugar Creek Watershed**
   Mill Creek Watershed
3) **Towanda Creek Watershed**
   Schrader Creek Watershed
4) **Wappasening Creek Watershed**
   Satterlee Creek Watershed
5) **Susquehanna River**
   Laning Creek Watershed
6) **East Wyalusing Creek Watershed**
7) **Wyalusing Creek Watershed**
8) **Wysox Creek Watershed**
   *Wysox's 12-yr old plan cost $60,000 ($48,000 for a consultant and $12,000 mapping/field work by Bradford Co. Office of Planning and Grants)

⇨ ***COORDINATION OF STORMWATER PLANNING***

A study by Bradford County Conservation District personnel to determine what is needed for a smooth implementation of stormwater management plans and review each municipal plan would take a technician approximately 6 months.
1 Person @ $30,000/year x **50%** = $15,000/year x 1 year = **$15,000**

⇨ ***102/105 AND NPDES CONSTRUCTION PERMITS***
THIS DOES NOT INCLUDE THE ENGINEERING INSPECTIONS ALREADY MENTIONED UNDER "PROJECT DESIGN"

1 Fulltime Technician @ **$30,000/year** x 5 years = **$150,000**

⇨ ***RIPARIAN BUFFERS***
USE WATERSHED ASSOCIATIONS, VOLUNTEERS, CHESAPEAKE BAY TREE PROGRAMS, ETC. TO SUPPLEMENT USDA AG LAND SET-ASIDE PROGRAMS.

⇨ ***BEST MANAGEMENT PRACTICES FOR STORMWATER MANAGEMENT***
A WORKSHOP PRESENTING VARIOUS ALTERNATIVES TO CONCRETE PAVING COULD BE DEVELOPED. THIS WOULD BE FUNDED THROUGH EDUCATIONAL GRANT.

Develop 15-acre retention wetlands @
$2,500/acre = $37,500/year x 5 years = **$187,500**
1 Design Engineer @ $64,000/year x 25% of time = **$16,000/year** x 5 years = **$80,000**

- ⇨ ***DEMONSTRATION PROJECTS COULD INCLUDE STORMWATER "GREEN STRUCTURES" AND RAIN/STORMWATER GARDENS.***

1 Demo project/year @ $10,000 /year x 5 years = **$50,000**
1 Design Technician @ $30,000/year x 25% of time = **$7,500/year** x 5 years = **$37,500**

TOTAL 5 YEAR MONETARY NEEDS =
$1,300,000.00

POTENTIAL PARTNERS

Bradford County Commissioners
Bradford County Sanitation Committee
Chesapeake Bay Program
DEP
Northern Tier Regional Planning & Development Commission
Penndot
NRCS
Penn State Extension
Pennvest
Environmental Protection Agency
Susquehanna River Basin Commission
DCNR
League of Women Voters of Pa
Local Municipalities, their Planning Commissions and Zoning Boards
Watershed Associations

DATA SOURCES:

- ⇨ Enhancing the Watershed Forest Conference – 2003
- ⇨ Bradford County Office of Planning and Grants
- ⇨ 2004 Bradford County Comprehensive Plan
- ⇨ PA Act 167
- ⇨ Act 167 Model Stormwater Management Ordinances
- ⇨ Borton-Lawson's Stormwater Powerpoint Presentation
- ⇨ Bradford County Assessment Office
- ⇨ Bradford County's Chesapeake Bay Watershed Assessment 1989
- ⇨ Cahill Associate's Stormwater Management Powerpoint
- ⇨ DEP's 3930-PM-WM0035 NPDES Instructions
- ⇨ DEP's map of Bradford County Watersheds
- ⇨ DEP's Model Act 167 Stormwater Management Ordinance 12/31/2003
- ⇨ DEP's Watershed Options
- ⇨ Ducks Unlimited's Wetlands for Water Quality
- ⇨ EPA 903-R-99-002 Riparian Forest Buffers Linking Land and Water CBP/TRS 220/00
- ⇨ Section 8 of DEP's Stormwater Best Management Policy
- ⇨ Soil Survey of Bradford and Sullivan Counties, PA
- ⇨ The Center for Watershed Protection

SUMMARY OF POTENTIAL LOADING BY SOURCE CATEGORY

SOURCE	SEDIMENT	NITROGEN	PHOSPHORUS
Dirt & Gravel Roads **(1522 identified sites)**	?	?	?
Driveways (9,700)	?	?	?
Farm Access Lanes (?)	?	?	?
On-Lot Septic Systems (20,193)	0	3,372,231 lbs./yr.	843,058 lbs./yr
Commercial Fertilizer (75,485 acres)	?	?	?
Stream Banks (295.9 miles)	243,336 tons/yr.	608,340 lbs./yr.	243,336 lbs./yr.
Agricultural Nutrient Management	0	6,907,470 lbs./yr.	2,699,775 lbs./yrs
Agricultural Tillage	87,999 tons/yr.	478,714 lbs./yr.	175,998 lbs./yr.
Urban Stormwater Related	?	?	?
TOTALS	**331,335 tons/yr.**	**11,366,755 lbs./yr.**	**3,962,167 lbs./yr.**

ANNUAL IMPLEMENTATION COSTS

SOURCE ADDRESSSED	BMPs	ENGIN	TECH/ PLANNER	ED	ADMIN.	MISC.
D&G – 40 SITES	$701,347	$16,000	$60,000	$7,500	$15,000	0
Driveways – 50	25,000					
Access Lanes – 50	75,000					
Septage Utilization Site – 1	75,000	5,000	10,000	0	3,750	0
Septage – Homeowners	7,500					10,000
Commercial Fertilizer	6,000	0	7,500	7,500	0	6,500
Stream Banks – 1.8 miles	594,000	16,000	60,000	15,000	7,500	0
Agricultural Nutrient Management	1,054,300	64,000	120,000	0	15,000	
Agricultural Tillage	240,000	0	120,000	0	7,500	
Urban Stormwater Related	187,500	32,000	37,500	0	5,000	15,000
TOTAL $ NEEDS	**$2,765,647**	**$133,000**	**$415,000**	**$30,000**	**$53,750**	**$31,500**
TOTAL PERSONNEL NEEDS		**2.1**	**13.8**	**1**	**1.63**	

ANNUAL BMP SUMMARY

BMP DESCRIPTION	#/YEAR	$/EACH	TOTAL
DIRT & GRAVEL ROADS			
1. IDENTIFIED WORK SITES	40	17,533.67	701,347
2. DRIVEWAYS	50	500.00	25,000
3. ACCESS LANES	50	1,500.00	75,000
ON-LOT SEPTIC SYSTEMS			
1. SEPTAGE STORAGE AND UTILIZATION SITES	1	75,000.00	75,000
2. WELL TESTING FOR COLIFORM	125	20.00	2,500.00
3. SYSTEM PUMPING INCENTIVES	100	50.00	5,000
4. NEEDS ASSESSMENT**	1	10,000.00	10,000
COMMERCIAL FERTILIZER USE			
1. COMMERCIAL/RESIDENTIAL NUTRIENT MANAGEMENT PLANS	20	250.00	5,000
2. SOIL TESTS	50	20.00	1,000
3. PUBLICATION & EDUCATIONAL MATERIALS		500.00	500.00
4. WORKSHOPS	2	500.00	1,000
5. NEEDS ASSESSMENT**	1	5,000.00	5,000.00
STREAM STABILIZATION			
1. ONE MILE STREAM STABILIZATION	1.8	330,000	330,000
AGRICULTURAL NUTRIENT MANAGEMENT			
1. NUTRIENT MANAGEMENT PLANS	30	2,000.00	60,000
2. SOIL SAMPLES	600	20.00	12,000
3. MANURE TESTS	60	30.00	1,800
4. FEET OF RIPARIAN FENCING FOR ANIMAL EXCLUSION	27,000	1.50	40,500
5. BARNYARD MANAGEMENT SYSTEMS	20	20,000.00	400,000
6. ANIMAL WASTE MANAGEMENT SYSTEMS	12	50,000.00	600,000
AGRICULTURAL TILLAGE			
1. CONSERVATION PLANS	60	2,000.00	120,000
2. MISC. BMP SYSTEMS – PER FARM	60	2,000.00	120,000
URBAN STORMWATER RELATED ISSUES			
1. STORMWATER MANAGEMENT PLANS	1.4	100,000.00	140,000
2. RETENTION WETLANDS – PER ACRE	15	2,500.00	37,500
3. DEMONSTRATION STORMWATER BMPs	1	10,000.00	10,000

**** One time implementation**

IMPLEMENTATION STRATEGY

Bradford County has a long history of identifying the needs of the county's natural resources and those of the landowners and managers that control them as a first priority. The next step has been developing plans and strategies to address those needs and finally locating and matching the programs and resources that will implement those plans and strategies. The following strategy will continue that tact. In all seven of the potential impact areas, the first priority is to the completion of areas that need assessing to better target the limited resources. This may include a target group survey such as the operation and maintenance of on-lot septic systems or an individual nutrient or conservation plan. Education and information is a strong component in all areas. And finally, finding and securing incentive resources to address the resource or manager's needs.

As presented, each of the seven *Potential Pollution Sources* were categorized by background descriptions, a description of specific water quality impact sources, a qualification and quantification, a list of total needs to address those qualifications and quantification, and a 5 year resource need.

Two options are presented in each of the areas. *Option 1* – is one that includes enhanced resources that is achievable with the current infrastructure of technical, educational, administrative and physical (housing, equipment, etc.) capabilities within Bradford County. *Option 2* – is one that considers less achievement but is accomplished with current staffing and physical resources with minimum additional monetary inputs. Each area was evaluated as a stand alone estimate in regards to available staffing resources. This creates a potential for over commitment of available staffing and administrative capability if all Option 2 choices were adopted without additional personnel.

Funding for each of these areas is dynamic in that it changes from fiscal year to year. To identify specific sources of funding would be both limiting and dated. The actual funding sources for each described area will be evaluated on an annual basis and appropriate funding sought. Federal sources such as EPA 319, Small Watershed Grants; State Growing Greener, Chesapeake Bay, etc. will all be evaluated as they become available for funding. Landowner contributions have been found to be a considerable historic source of the funding in all cases. The following options analysis therefore does not specifically identify where the funding will be sought but rather it estimates the level of need.

I Dirt & Gravel Roads, Driveways and Access Lanes

Strategy Narrative:
The primary goal is to continue to aggressively address identified water quality impact sites. This will be accomplished through the existing structure of the Dirt & Gravel Roads Program as well as targeted educational efforts with municipal officials. Working with building permit officers, homeowner groups, etc., technical assistance will be directed towards addressing driveway issues. Farm audiences and individual farmers will receive assistance in addressing implement and animal access lanes to address drainage and runoff issues.

OPTION 1

BMP DESCRIPTION	**#/YEAR**	**$/EACH**	**TOTAL**
1. IDENTIFIED WORK SITES	40	17,533.67	701,347
2. DRIVEWAYS	50	500.00	25,000
3. ACCESS LANES	50	1,500.00	75,000
TOTAL			**$801,347**
***CURRENT AVAILABLE FUNDING**			**300,000**
BMP NEEDS			**501,347**

ANNUAL STAFFING NEEDS

1. Educator	.25	$7,500.00
2. Technical	2	60,000.00
3. Engineer	.25	16,000.00
4. Administration	.5	15,000.00
TOTAL		**98,500.00**
*CURRENT AVAILABLE FUNDING		**68,000.00**
STAFFING NEEDS		**30,500.00**

OPTION 1 BMP + STAFFING NEEDS = $531,847.00

OPTION 2

BMP DESCRIPTION	**#/YEAR**	**$/EACH**	**TOTAL**
1. IDENTIFIED WORK SITES	17	17,533.67	298,072
2. DRIVEWAYS	10	500.00	5,000
3. ACCESS LANES	5	1,500.00	7,500
TOTAL			**$310,572**
[1]CURRENT AVAILABLE FUNDING			**298,072**
BMP NEEDS			**12,500**

ANNUAL STAFFING NEEDS

1. Educator	.25	$7,500.00
2. Technical	1.5	45,000.00
3. Engineer	.125	8,000.00
4. Administration	.25	7,500.00
	TOTAL	**68,000.00**
[1]CURRENT AVAILABLE FUNDING		**68,000.00**
STAFFING NEEDS		**0.00**

OPTION 2 BMP + STAFFING NEEDS = $12,500.00

[1]Current Available Funding:
- ✓ PA Dirt & Gravel Roads Program
- ✓ PA Chesapeake Bay Program – Technical Assistance Grants

II On-Lot Septic Systems

Strategy Narrative:
The goal is to continue to develop a self sustaining system to encourage homeowners and communities to better manage their systems. The work done by the Conservation District for the 1995-6 study and demonstration project clearly proved that such a system is viable from a water quality and economic perspective. Completion of the establishment of the 12 septage utilization sites will assure a total utilization of nutrients related to on-lot septic systems. Education and incentives for owners/operators will assure their proper maintenance and avoidance of failures resulting in water quality impacts. Income generated from the tipping fees will continue to be the major source of financial resources for the sites' development.

OPTION 1

BMP DESCRIPTION	**#/YEAR**	**$/EACH**	**TOTAL**
1. SEPTAGE STORAGE AND UTILIZATION SITES	1	75,000.00	75,000
2. WELL TESTING FOR COLIFORM	125	20.00	2,500
3. SYSTEM PUMPING INCENTIVES	100	50.00	5,000
4. NEEDS ASSESSMENT**	1	10,000.00	10,000
TOTAL			**$92,500**
[2]**CURRENT FUNDING AVAILABLE**			**60,000**
BMP NEEDS			**32,500**

** Single year funding only

ANNUAL STAFFING NEEDS

1.	Technical	.33	10,000.00
2.	Engineer	.08	5,000.00
3.	Administration	.125	3,750.00
	TOTAL		**18,750.00**
CURRENT AVAILABLE FUNDING			**0.00**
STAFFING NEEDS			**18,750.00**

OPTION 1 BMP + STAFFING NEEDS = $51,250.00

OPTION 2

BMP DESCRIPTION	**#/YEAR**	**$/EACH**	**TOTAL**
1. SEPTAGE STORAGE AND UTILIZATION SITES	1	75,000.00	75,000
2. WELL TESTING FOR COLIFORM	50	20.00	1,000
3. SYSTEM PUMPING INCENTIVES	50	50.00	2,500
4. NEEDS ASSESSMENT**	0	10,000.00	0
TOTAL			**$78,500**
[2]**CURRENT FUNDING AVAILABLE**			**60,000**
BMP NEEDS			**18,500**

** Single year funding only

ANNUAL STAFFING NEEDS

1.	Technical	.33	10,000.00
2.	Engineer	.08	5,000.00
3.	Administration	.125	3,750.00
	TOTAL		**18,750.00**
[1]CURRENT AVAILABLE FUNDING			**0.00**
STAFFING NEEDS			**18,750.00**

OPTION 2 BMP + STAFFING NEEDS = $37,250.00

[2]Current Available Funding
- ✓ Bradford County Conservation District Septage Revolving Fund
- ✓ PA Chesapeake Bay - Technical Assistance Grant

III **Commercial Fertilizer Use**

Strategy Narrative:
Education, Information and Incentives are the primary focus of addressing the needs described for this potential source of water quality impairment. Workshops on residential nutrient management, trainings for commercial groundskeepers and a template for mini-nutrient management plans are proposed. Minimal technical assistance and education efforts should maximize effectiveness of this strategy.

OPTION 1

BMP DESCRIPTION	**#/YEAR**	**$/EACH**	**TOTAL**
1. COMMERCIAL/RESIDENTIAL NUTRIENT MANAGEMENT PLANS	20	250.00	5,000
2. SOIL TESTS	50	20.00	1,000
3. PUBLICATION & EDUCATIONAL MATERIALS		500.00	500
4. WORKSHOPS	2	500.00	1,000
5. NEEDS ASSESSMENT**	1	5,000.00	5,000
TOTA			**12,500**
CURRENT FUNDING AVAILABL			**0**
BMP NEED			**12,500**

** Single year funding only

ANNUAL STAFFING NEEDS

1. Technical	.25	7,500.00
2. Educator	.25	7,500.00
TOTAL		**15,000.00**
CURRENT AVAILABLE FUNDING		**0.00**
STAFFING NEEDS		**15,000.00**

OPTION 1 BMP + STAFFING NEEDS = $27,500.00

OPTION 2

BMP DESCRIPTION	#/YEAR	$/EACH	TOTAL
1. COMMERCIAL/RESIDENTIAL NUTRIENT MANAGEMENT PLANS	0	250.00	0
2. SOIL TESTS	0	20.00	0
3. PUBLICATION & EDUCATIONAL MATERIALS		500.00	500
4. WORKSHOPS	2	500.00	1,000
5. NEEDS ASSESSMENT**	0	5,000.00	0
TOTA			**1,500**
CURRENT FUNDING AVAILABL			**0**
BMP NEED			**1,500**

** Single year funding only

ANNUAL STAFFING NEEDS

1. Educator	.1	3,000.00
TOTAL		**3,000.00**
CURRENT AVAILABLE FUNDING		**0.00**
STAFFING NEEDS		**3,000.00**

OPTION 2 BMP + STAFFING NEEDS = $4,500.00

IV Stream Erosion

Strategy Narrative:
Consistent with the Bradford County Conservation District's Strategic Plan, the goal of this section of the strategy, focuses on the development and maintenance of the District's technical capability to deliver qualified assessment, planning, design and implementation support to the County's 9 watershed groups. By working with these organizations and the funding they are able to secure, the goals identified in the issue description are achievable. The support of these watershed initiatives in the form of education to our municipal officials, contractors and landowners is essential to facilitate the "cultural change" needed to best protect the County's streams.

OPTION 1

BMP DESCRIPTION	#/YEAR	$/EACH	TOTAL
1. ONE MILE STREAM STABILIZATION	1.8	330,000	594,000
TOTAL			**594,000**
[3]**CURRENT FUNDING AVAILABLE**			**250,000**
BMP NEEDS			**344,000**

ANNUAL STAFFING NEEDS

1. Educator	.5	$15,500.00
2. Technical	2	60,000.00
3. Engineer	.25	16,000.00
4. Administration	.25	7,500.00
TOTAL		**99,000.00**
[3]CURRENT AVAILABLE FUNDING		**62,000.00**
STAFFING NEEDS		**37,000.00**

OPTION 1 BMP + STAFFING NEEDS = $381,000.00

OPTION 2

BMP DESCRIPTION	**#/YEAR**	**$/EACH**	**TOTAL**
1. ONE MILE STREAM STABILIZATION	.75	330,000	250,000
TOTAL			**250,000**
[3]CURRENT FUNDING AVAILABLE			**250,000**
BMP NEEDS			**0**

ANNUAL STAFFING NEEDS

1. Technical	2	60,000.00
2. Engineer	.25	16,000.00
3. Administration	.12	3,750.00
TOTAL		**79,750.00**
[3]CURRENT AVAILABLE FUNDING		**62,000.00**
STAFFING NEEDS		**17,750.00**

OPTION 2 BMP + STAFFING NEEDS = $17,750.00

[3]Current Available Funding
- ✓ Bradford County Conservation District
- ✓ PA Chesapeake Bay - Technical Assistance Grant
- ✓ Sugar Creek Watershed Association
- ✓ Towanda Creek Watershed Association
- ✓ Wysox Creek Watershed Association
- ✓ Laning Creek Watershed Association
- ✓ Satterlee Creek Watershed Association
- ✓ US Fish & Wildlife Service

V Agricultural Nutrient Management

Strategy Narrative:

The foundation of any effective strategy to addressing agricultural nutrient management is the planning tools that enable the individual farmer to manage his or her on-farm nutrients. Conservation and nutrient management plans are essential for the assessment and sound management needed to determine any implementation of other best management practices. These planning tools are dynamic and change and grow with the operations of the farm. The technical support to assist in the planning, needs assessment, design and implementation is the central focus of this area's strategy. Incentives to demonstrate and assist in the implementation of supportive best management practices is also a crucial component of any approach to assuring good water quality protection. The implementation of these BMPs can be facilitated by technical assistance that is knowledgeable in the many agencies, programs and sources of assistance. The Conservation District's history of accomplishment in the Mill Creek Watershed clearly demonstrated the power of coordination and facilitation by a knowledgeable technical delivery team in leveraging considerable resources.

OPTION 1

BMP DESCRIPTION	**#/YEAR**	**$/EACH**	**TOTAL**
1. NUTRIENT MANAGEMENT PLANS	30	2,000.00	60,000
2. SOIL SAMPLES	600	20.00	12,000
3. MANURE TESTS	60	30.00	1,800
4. FEET OF RIPARIAN FENCING FOR ANIMAL EXCLUSION	27,000	1.50	40,500
5. BARNYARD MANAGEMENT SYSTEMS	20	20,000	400,000
6. ANIMAL WASTE MANAGEMENT SYSTEMS	12	50,000.00	600,000
TOTAL			**1,114,300**
[4]**CURRENT FUNDING AVAILABLE**			**600,000**
BMP TOTAL			**514,300**

ANNUAL STAFFING NEEDS

1. Technical	4	120,000.00
2. Engineer	1	64,000.00
3. Administration	.5	15,000.00
TOTAL		**199,000.00**
*CURRENT AVAILABLE FUNDING		**90,000.00**
STAFFING NEEDS		**109,000.00**

OPTION 1 BMP + STAFFING NEEDS = $623,300.00

OPTION 2

BMP DESCRIPTION	**#/YEAR**	**$/EACH**	**TOTAL**
1. NUTRIENT MANAGEMENT PLANS	15	2,000.00	30,000
2. SOIL SAMPLES	300	20.00	6,000
3. MANURE TESTS	30	30.00	900
4. FEET OF RIPARIAN FENCING FOR ANIMAL EXCLUSION	15,000	1.50	22,500
5. BARNYARD MANAGEMENT SYSTEMS	10	20,000	200,000
6. ANIMAL WASTE MANAGEMENT SYSTEMS	6	50,000.00	300,000
TOTAL			**559,400**
[4]CURRENT FUNDING AVAILABLE			**559,400**
BMP TOTAL			**0**

ANNUAL STAFFING NEEDS

1. Technical	2	60,000.00
2. Engineer	.5	32,000.00
3. Administration	.25	7,500.00
TOTAL		**99,000.00**
[4]CURRENT AVAILABLE FUNDING		**90,000.00**
STAFFING NEEDS		**9,000.00**

OPTION 2 BMP + STAFFING NEEDS = $9,000.00

[4]Current Funding Available (will vary depending on Federal and State funding)
- ✓ USDA EQIP
- ✓ USDA CREP
- ✓ Chesapeake Bay Foundation
- ✓ PA Chesapeake Bay Program – Technical Assistance Grant
- ✓ Bradford County Conservation District
- ✓ Landowner Contributions

VI Agricultural Tillage

Strategy Narrative:
The foundation of any effective strategy to addressing agricultural tillage is the planning tools that enable the individual farmer to manage his or her on-farm soil resources. Conservation plans are essential for the assessment and sound management needed to determine any implementation of other best management practices. These planning tools are dynamic and change and grow with the operations of the farm. The technical

support to assist in the planning, needs assessment, design and implementation is the central focus of this area's strategy. Incentives to demonstrate and assist in the implementation of supportive best management practices is also a crucial component of any approach to assuring good water quality protection. The implementation of these BMPs can be facilitated by technical assistance that is knowledgeable in the many agencies, programs and sources of assistance. The Conservation District's history of accomplishment in the Mill Creek Watershed clearly demonstrated the power of coordination and facilitation by a knowledgeable technical delivery team in leveraging considerable resources.

OPTION 1

BMP DESCRIPTION	**#/YEAR**	**$/EACH**	**TOTAL**
1. CONSERVATION PLANS	60	2,000.00	120,000
2. MISC. BMP SYSTEMS – PER FARM	60	2,000.00	120,000
TOTAL			**240,000**
[5]CURRENT FUNDING AVAILABLE			**120,000**
BMP TOTAL			**120,000**

ANNUAL STAFFING NEEDS

1. Technical	3	90,000.00
2. Administration	.5	15,000.00
TOTAL		**105,000.00**
*CURRENT AVAILABLE FUNDING		**90,000.00**
STAFFING NEEDS		**15,000.00**

OPTION 1 BMP + STAFFING NEEDS = $135,000.00

OPTION 2

BMP DESCRIPTION	**#/YEAR**	**$/EACH**	**TOTAL**
1. CONSERVATION PLANS	10	2,000.00	20,000
2. MISC. BMP SYSTEMS – PER FARM	10	2,000.00	20,000
TOTAL			**40,000**
[5]CURRENT FUNDING AVAILABLE			**20,000**
BMP TOTAL			**20,000**

ANNUAL STAFFING NEEDS

1. Technical	1	90,000.00
2. Administration	.1	3,000.00
TOTAL		**93,000.00**
[5]CURRENT AVAILABLE FUNDING		**90,000.00**
STAFFING NEEDS		**3,000.00**

OPTION 2 BMP + STAFFING NEEDS = $23,000.00

[5]Current Funding Available
- ✓ USDA EQIP
- ✓ USDA CREP
- ✓ Chesapeake Bay Foundation
- ✓ PA Chesapeake Bay Program – Technical Assistance Grant
- ✓ Bradford County Conservation District
- ✓ Landowner Contributions

VII Urban Related Stormwater

Strategy Narrative:
To address unregulated stormwater from development, the involvement of municipal officials, developers and homeowners needs to be addressed. Educational outreach efforts, demonstration of effective BMPs and technical planning tools are the main thrust of this area of concern strategy. Providing technical and informational assistance to municipalities to develop and implement stormwater management plans and the related reviews of development plans for consistency is the emphasis of this section of the County's strategy.

OPTION 1

BMP DESCRIPTION	#/YEAR	$/EACH	TOTAL
1. STORMWATER MANAGEMENT PLANS	1.4	100,000.00	140,000
2. RETENTION WETLANDS – PER ACRE	15	2,500.00	37,500
3. DEMONSTRATION STORMWATER BMPs	1	10,000.00	10,000
TOTAL			**187,500**
[6]CURRENT FUNDING AVAILABLE			**105,000**
BMP TOTAL			**82,500**

ANNUAL STAFFING NEEDS

1. Technical	1.25	37,500.00
2. Engineer	.5	32,000.00
3. Administration	.17	5,000.00
TOTAL		**74,500.00**
[6]CURRENT AVAILABLE FUNDING		**16,000.00**
STAFFING NEEDS		**58,500.00**

OPTION 1 BMP + STAFFING NEEDS = $141,000.00

OPTION 2

BMP DESCRIPTION	**#/YEAR**	**$/EACH**	**TOTAL**
1. STORMWATER MANAGEMENT PLANS	1	100,000.00	100,000
2. RETENTION WETLANDS – PER ACRE	0	2,500.00	0
3. DEMONSTRATION STORMWATER BMPs	0	10,000.00	0
TOTAL			**100,000**
[6]CURRENT FUNDING AVAILABLE			**75,000**
BMP TOTAL			**25,000**

ANNUAL STAFFING NEEDS

1. Technical	.5	15,000.00
	TOTAL	**15,000.00**
[6]CURRENT AVAILABLE FUNDING		**15,000.00**
STAFFING NEEDS		**0.00**

OPTION 1 BMP + STAFFING NEEDS = $25,000.00

[6]Current Funding available
- ✓ Act 167 Funding
- ✓ PA Chesapeake Bay Program – Technical Assistance Grant