LeTort Spring Run Watershed Conservation Plan

I. Introduction

For hundreds of years man has been drawn to the banks of the LeTort Spring Run. From the earliest Native Americans through the times of European Settlers to the present day inhabitants, the LeTort Spring Run has served as a means of food, water, work and more recently recreation. As life around it has changed, the LeTort has remained essentially unchanged to become revered as one of the finest limestone trout streams in the nation. It is with this in mind that the LeTort Regional Authority was formed to continue the preservation of this unique stream .

Since its incorporation in 1974, The LeTort Regional Authority has made the preservation and protection of LeTort Spring Run its goal. During these 25 years the Authority has created a nature trail along a section of stream, initiated a conservation easement program, jointly monitored the water quality with the U.S. Geological Survey on a weekly basis and was instrumental in having the LeTort Spring Run designated a component of the Pennsylvania Scenic Rivers system in 1988.

In continuing preservation and protection efforts, the LeTort Regional Authority recently initiated the preparation of this comprehensive plan detailing past and present conditions and management options for future conservation concerns about the LeTort Spring Run and its watershed. Plan information was obtained through previous reports and observations, a detailed stream and watershed field evaluation and map study and landowner comments from a distributed survey.

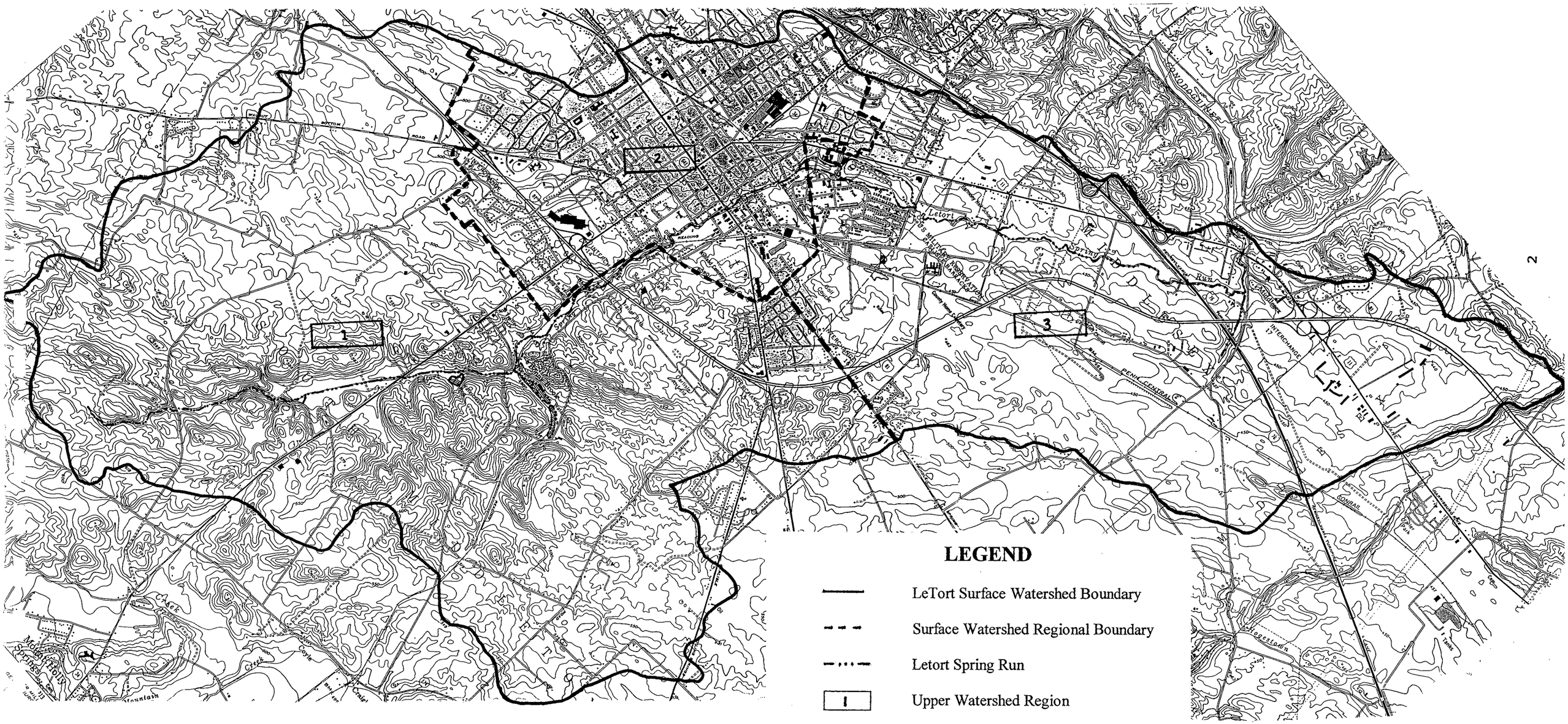
This plan was prepared under contract by Walter N. Heine Associates Inc. with assistance from Natural Lands Trust, the LeTort Regional Authority, the Authority's Executive Director and the Rivers Conservation Plan Steering Committee Members. Base mapping, was prepared by the Department of Public Works at the Carlisle Barracks. Funding for the plans preparation was provided by a Department of Conservation and Natural Resources Rivers Conservation Grant with matching funds provided by the LeTort Regional Authority and Carlisle Barracks.

II. Project Area Characteristics

The project plan focuses on the characteristics of the watershed, separating it into three parts, (upper, middle and lower), discernable by unique and disparate qualities and environments. The map on page 2 shows the approximate areas of these three surface watersheds.

SURFACE WATERSHED MAP

Carlisle and Mechanicsburg Quadrangles
1" = 3100'



LEGEND

- LeTort Surface Watershed Boundary
- Surface Watershed Regional Boundary
- Letort Spring Run
- 1 — Upper Watershed Region
- 2 — Middle Watershed Region
- 3 — Lower Watershed Region

Data from the Act 167 Model Watershed Stormwater Management Plan, DER, July 1983

A. Watershed

The LeTort Spring Run watershed is located in central Cumberland County, Pennsylvania. It is a part of the limestone region of the Valley and Ridge Physiographic Province. Its topography is characterized by rolling, gentle hills of low relief. The highest point in the watershed has an approximate elevation of 677 feet above sea level, while the lowest point has an elevation of about 385 feet. The watershed drains an area of approximately 13,700 acres or 21.4 square miles and is fed by an estimated 21 natural limestone springs. The stream channel slopes in a general southwest to northeast direction at an average of approximately 0.027 feet per foot. The watershed possesses a width to length ratio of approximately 2 to 5 and a drainage density of 0.43 miles of stream per square mile of drainage area. The total length of the LeTort Spring Run, including intermittent sections, is approximately 9.2 miles.

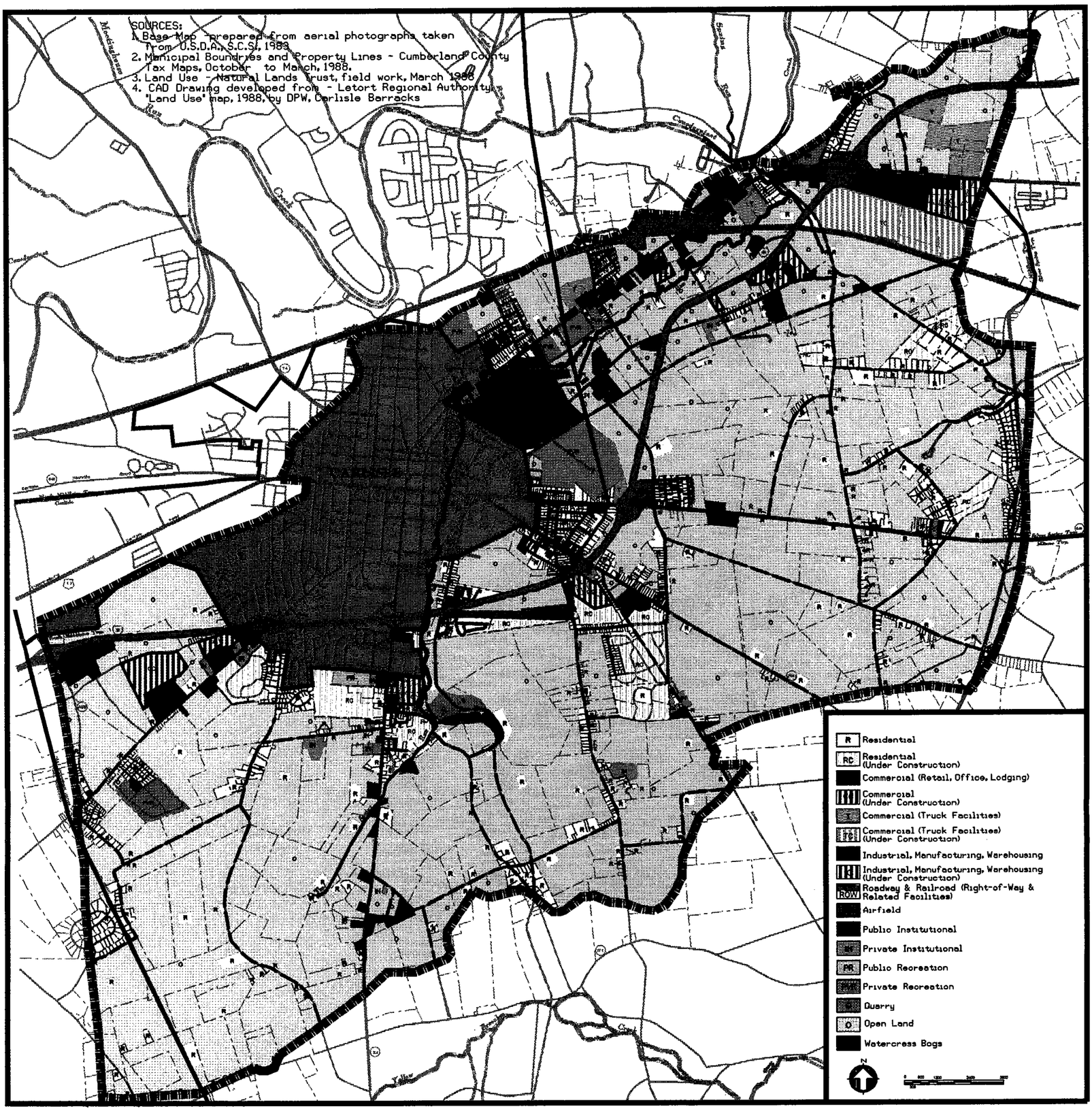
The stream can be divided into upper, middle and lower watersheds based upon topography and surrounding land uses. These watersheds are further described as follows. For Land Use see the map on page 4.

1. Upper Watershed

The upper watershed includes the portion of LeTort Spring Run that lies south of Interstate 81. The main channel in this section is approximately 5.1 miles in length. Most of this region is located in South Middleton Township. The remaining portion of the region consists of small areas located in Dickinson Township and the Borough of Carlisle. Roughly 50% of the LeTort Spring Run watershed area is located in this region. Because it is the least developed portion of the watershed, it has most closely retained the natural runoff quantity, velocity, and quality.

Typical stream channel view in the Upper Watershed

Most of the upper watershed has no direct surface drainage paths leading to the main stream. However, there are small tributaries located just south of the Carlisle Borough line and at Bonny Brook Road. The topography consists of gently rolling hills and depressions that collect rainfall, allowing it to infiltrate into the groundwater system. It then reappears in the form of springs that feed the LeTort Spring Run with a steady base flow all year round. At the present time, most of the upper watershed, except for the Borough of Carlisle, is used for agriculture. The Dickinson Township portion consists of approximately 60 acres of farmland while the Borough of Carlisle portion, which is also small, has been developed as a light and medium density residential and commercial area.



LETORT SPRING RUN

CUMBERLAND COUNTY, PENNSYLVANIA

LAND USE

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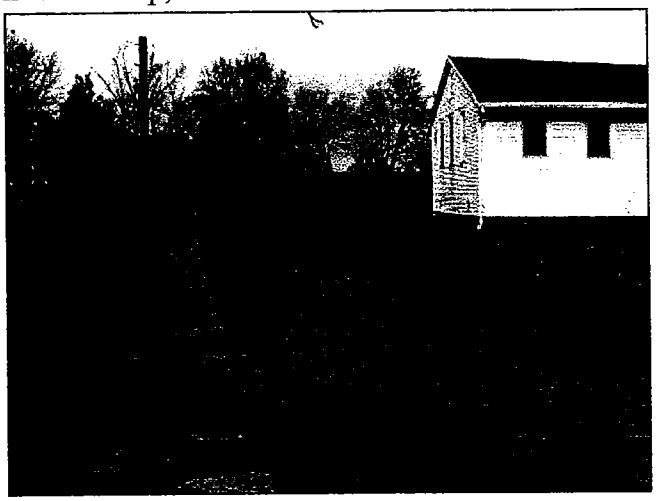
South Middleton Township, which makes up 95 percent of this region, has a high potential for development in its residential, commercial, and industrial zones.

2. Middle Watershed

This area is the highly developed central region of the watershed including downtown Carlisle, portions of South Middleton Township, and a southern section of North Middleton Township. The main channel in this section is approximately 1.6 miles in length. The Borough of Carlisle is zoned residential, commercial, industrial, and institutional, and makes up 60 percent of the middle watershed region. There is little potential for further development.



Typical Stream Channel View in the Middle Watershed

North Middleton Township, which covers 20 percent of the middle watershed and 5 percent of the entire watershed, is also highly developed. The majority is zoned residential but also includes a golf course, part of the Carlisle Fairgrounds, the administrative and vehicular maintenance buildings for a Pennsylvania National Guard unit and the United States Army War College and Carlisle Barracks. The remaining area consists of small commercial and industrial zones with development potential. The LeTort Spring Run divides into a main channel and the Mill Race Run, both of which flow through the grounds of the Carlisle Barracks. The main channel through the Carlisle Barracks has well maintained limestone walls and both portions have adequate flood plain areas.

3. Lower Watershed

Typical Stream Channel View in the Lower Watershed

The Middlesex Township portion of the watershed is designated as the lower watershed region. The main channel in this section is approximately 2.5 miles in length. The zoning is for diversified land uses and is moderately to highly developed. There are three major highways which cross the region: The Pennsylvania Turnpike, Interstate 81, and U.S. Route 11. Because of the excellent transportation network, there is an increasing demand for development in the lower watershed especially for the

trucking and warehousing industries. Though the slopes are not as steep as in the upper watershed, hills and depressions with a few well-defined drainage paths also characterize this region.

B. Stream Corridor

The LeTort Spring Run is an internationally renowned wild brown trout stream. The headwaters of the LeTort, located in South Middleton Township, drain lands which are primarily agricultural with small amounts of residential, commercial and industrial uses interspersed along the major roadways. The Bonny Brook area, with its spring-fed tributaries and wetlands, is the primary source of groundwater flow into the LeTort. It is at this location where the "Left Branch" joins the main channel. The Left Branch begins from springs near the Spring Garden Street Extension.

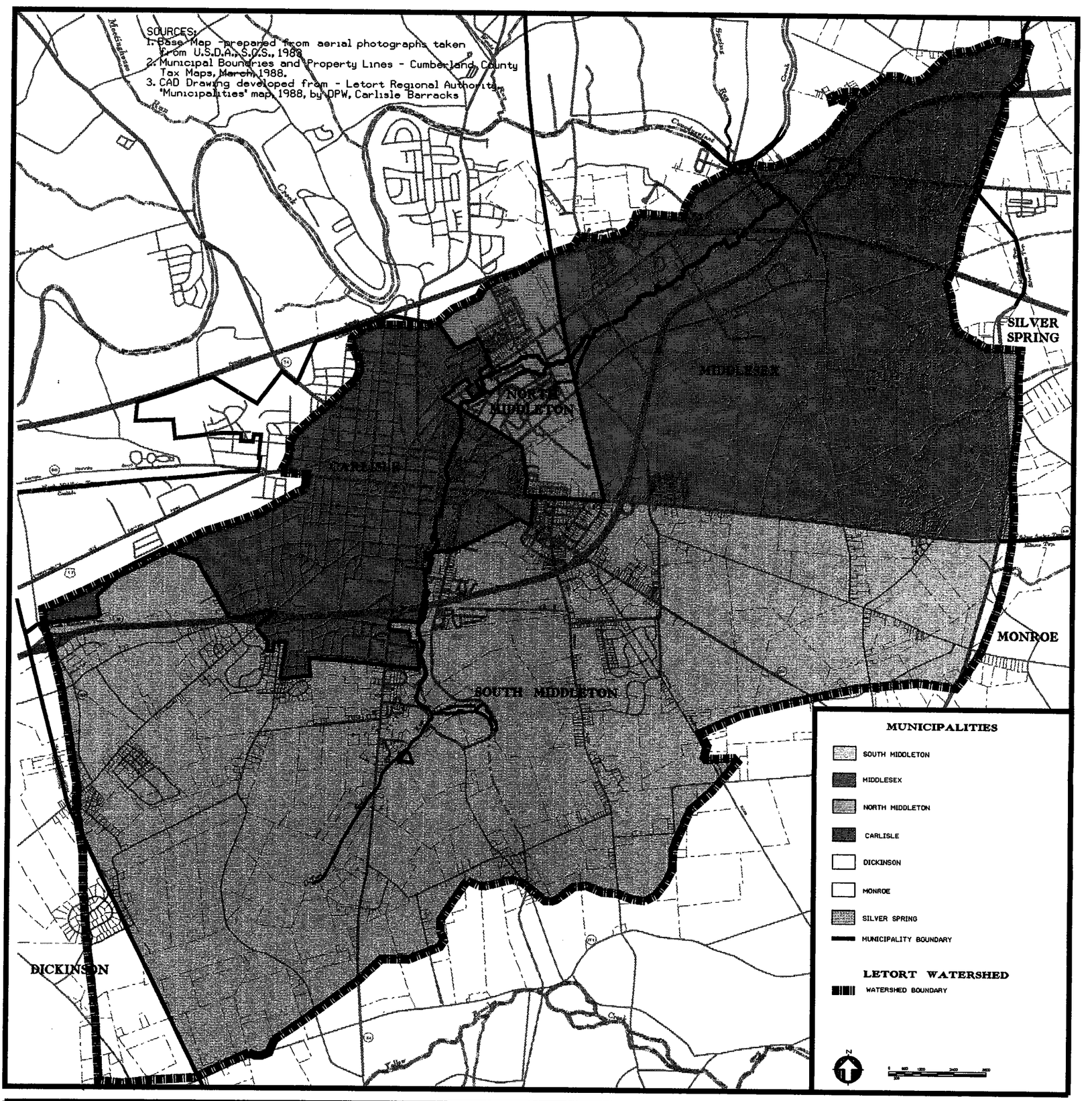
The springs in the Bonny Brook area are also the main source of water for the commercial production of watercress. B&W Quality Growers, Inc. has been growing watercress at this location since 1885. The stream flows from South Middleton Township in a northeasterly direction past the Union Quarries stone quarry, paralleling the abandoned Reading Railroad line, through the Borough of Carlisle and Carlisle Barracks and on towards its confluence with the Conodoguinet Creek in Middlesex Township, where the LeTort is characterized by rapids and a small waterfall which creates turbulent flow.

The stream flows for a total length of 9.2 miles with about 1.5 miles being intermittent according to the U.S.G.S. topographic mapping. During the inspection of the stream in October 1999, however, there was no flow in the channel upstream of State Route 34 indicating the intermittent section may be larger. The vertical fall in elevation from the headwaters (550 feet) to the mouth (385 feet) is approximately 165 feet.

About 1.9 miles of the LeTort Spring Run flows through the Borough of Carlisle. The natural stream banks of this portion have been replaced with a stone retaining wall built in the 1930's as a Municipal Works Project to control floodwater. Development has encroached to within several feet of this wall. The last 2.7 miles of the LeTort meanders through the continually developing rural areas of North Middleton and Middlesex Townships and finally through the heavily developed trucking area along U.S. Route 11 known locally as the "Miracle Mile".

C. Social and Economic Profile

The LeTort Spring Run Watershed comprises areas of the Borough of Carlisle, Middlesex Township, North Middleton Township, South Middleton Township and a small unpopulated portion of Dickinson Township, all of which are located in central Cumberland County. See the Municipalities Map on page 7. Population and housing data for each of these municipalities, except for Dickinson Township, are shown on Table II-1.



LETORT SPRING RUN

CUMBERLAND COUNTY, PENNSYLVANIA

MUNICIPALITIES

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TABLE II-1
LOCAL DEMOGRAPHIC PROFILES*

Municipality	Population	Households
Carlisle Borough	18,419	7,253
Middlesex Township	5,780	1,945
North Middleton Township	9,833	3,596
South Middleton Township	10,340	3,811
TOTAL	**44,372**	**16,605**

* Data received from the Pennsylvania State Data Center. Based on 1990 Census.

From this table it can be seen that over 44,000 people live within or very near the watershed. The majority of the population is centered in and around the Borough of Carlisle and in developments located along or near Routes 34 and 11. Residential development within the watershed appears to be random, although each of the municipalities has attempted to control this through the use of zoning, subdivision and land development ordinances. Since 1990 residential development has progressed throughout the watershed with Middlesex and South Middleton Townships realizing most of the growth.

Many roadways of various types pass through the watershed. Interstate 81, U.S. Route 11 and the Pennsylvania Turnpike all cross over the LeTort Spring Run within a mile of each other. People traveling through or to the LeTort area can do so by either traveling on I-81, U.S. Route 11, Pennsylvania Route 34 or the Pennsylvania Turnpike. The existence of this major highway network has enhanced industrial and commercial development, which has contributed to the economic growth in the watershed.

The majority of the commercial and industrial growth has occurred along US. Route 11 in Middlesex Township, the Borough of Carlisle and along Walnut Bottom Road in South Middleton Township. The continued expansion of public water and sewer facilities within the watershed will likely spur both residential and commercial growth in the future.

D. Outstanding or Unique Features

The outstanding features of the stream and its great popularity among outdoors writers, environmentalists and area citizens have resulted in formal governmental actions to protect the stream's watershed and water quality.

1. Wild Trout Population

Because of the spring fed nature of the stream and the relatively undisturbed watershed, the LeTort is one of the premiere wild trout streams within Pennsylvania and the nation. The LeTort produces almost twenty times more life per acre than typical streams outside

limestone areas. The insects and crustaceans are the primary food for the world famous brown trout that live in the Run. These trout are celebrated for their wiliness and finicky eating habits. Many articles and books have been written celebrating the unique and valuable characteristics of the stream. Artificial fishing flies have been developed specifically for use on the LeTort.

2. Pennsylvania Scenic River Program

Designated a component of the State Scenic River system in 1988, the LeTort Spring Run is now part of a program that recognizes outstanding natural waterways and guides state agencies in decisions involving permitting and land management issues in the riparian corridors along designated streams.

The LeTort Spring Run's scenic corridor runs north from its source in South Middleton Township along Route 34 to its confluence with the Conodoguinet Creek in Middlesex Township. The corridor essentially follows the width of the 100-year flood plain, which is nearly 1,000 feet across at its widest.

Although the Scenic River program does not establish a separate permitting process, it does require that state agencies refer to guidelines developed in the designation study when reviewing permit applications. These guidelines are designed to preserve the rural, pastoral nature of the scenic corridor and limit encroachments by new roads, quarries, earthmoving and landfills. The guidelines have no impact on activities outside state influence.

3. Exceptional Value Status

The LeTort Spring Run has been designated as an Exceptional Value Waters (EV) by the Pennsylvania Department of Environmental Protection. This designation applies to the section of the stream which lies between the State Route 34 bridge downstream to the foot bridge at LeTort park. EV Waters are designated because of outstanding national, State, regional or local resources. This resource can include the waters being situated within a national, State or local park or forest and the use of the waters as a potable water supply. For this section of the LeTort the designation stemmed from South Middleton Township's adoption of a Subdivision and Land Development Ordinance that designates the LeTort, from State Route 34 to the borough line, as a Scenic River District. The EV status provides for additional protection to the stream from potential point source discharges above and beyond the standard statewide limits.

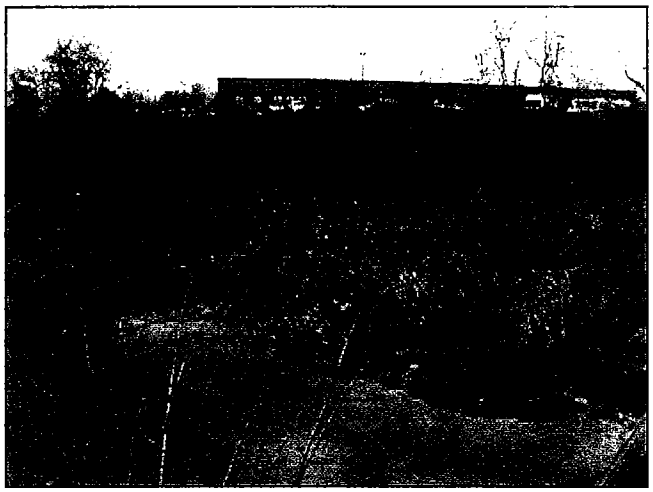
III. Issues, Concerns, Constraints, and Opportunities

Throughout the LeTort watershed there are an assorted number of issues related to the stream's overall health and visual aesthetics. The following subsections deal with the main issues on an overall watershed basis, specifically for the upper, middle and lower sections. A complete listing of the issues observed during the stream inspection is included in Table A. Discussion of conservation practices and remediation measures are included in Section VIII.

A. Overall Watershed

Issues of concern for the overall watershed include the residential and commercial development of the stream corridor stormwater management stormwater management and the appearance of sink holes within or adjacent to the streambed.

The upper and lower, and to a limited extent the middle, portions of the watershed have a high potential for development. This development poses not only an impact on the stream from an aesthetic point of view but also from increases in stormwater runoff and sediment loads. The main issues, therefore, include the proximity of development to the stream, type and density of development, and the stormwater and runoff control facilities associated with these developments.



Development Encroachment - Upper Watershed

Development adjacent to the stream is generally controlled by the individual municipality. Restrictions normally include prohibiting structures within the floodway area. This prevents development directly adjacent to the LeTort. Restrictions for the floodplain areas are less stringent and are only partially effective in preventing development in these areas. Protection of the stream through its Scenic River designation is also limited. The Scenic River corridor for the LeTort generally follows the 100 year floodplain. There are few restrictions on development under this program, but only guidance as to what type of development should take place in the corridor area.

1. Zoning Ordinances

Zoning ordinances help to control the type and density of development within a municipality. Zoning in all the municipalities was established, after appropriate public meetings and comments, largely on the basis of historical use of the land, the location of existing roads and other infrastructure and any current information the planners had about possible and pending development. All of the Townships' zoning ordinances, commendably, recognize the need and encourage the preservation of open space by designating conservation districts.

North Middleton Township has a Scenic River Zone designation, that creates a Conditional Use overlay area which may be applied to lands within the floodplain zone. The purpose is to implement the goals of the LeTort Spring Run Scenic River designation. This area, in North Middleton Township, is principally situated near and within the property of the Carlisle Barracks. The Scenic River Zone designation creates a

desirable segment of "Greenway" along the stream. South Middleton's Ordinance delineates an area five hundred (500) feet from the centerline of the stream as a Scenic River District. Middlesex Township has a few conservation districts within the watershed, yet does not appear to have any immediately around the stream itself.

In regard to the "Existing Zoning" map within this report, it should be noted that some of the Townships' zoning designations have been grouped for ease of depiction on the map. For example, Middlesex Township has three Residential designations, which have been grouped as R-1 and R-2. Also, various named designations of the three townships (open space, floodplain, Scenic Rivers, woodland) are grouped on the map as a "Conservation" zone. The reader is directed to the detailed zoning maps and ordinances of those townships for more exacting site-specific information. Refer to the Existing Zoning map on page 12 for more details.

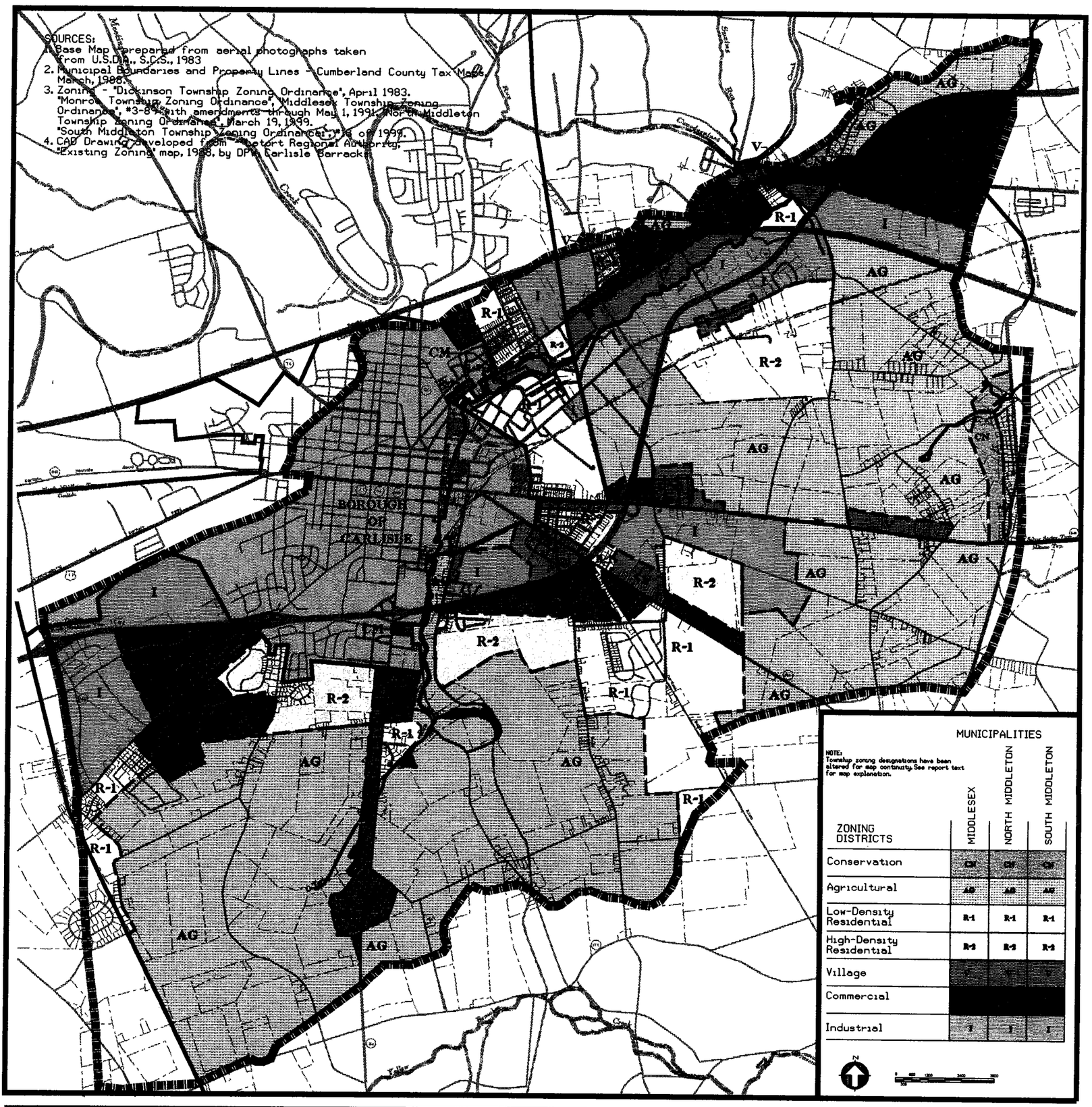
2. Subdivision Ordinances

Subdivision and Land Development Ordinances, which are in effect for all municipalities on the watershed, describe the planning procedures and technical requirements for the legal separation of tracts of land and their development. Included in the technical requirements are engineering designs for the control of stormwater from the developed sites and the mitigation of erosion, during and after construction.

Stormwater ordinances enacted by the municipalities prevent post-development increases in peak storm flows from subdivisions and land development. Such stormwater management, which is relatively new to the watershed, is crucial to the health of the LeTort. The stream is adversely affected by the older, established areas, especially Carlisle Borough, where pre-ordinance stormwater collection systems discharge unimpeded. This absence of stormwater control causes stress to aquatic organisms from increased water velocity and sediment loads. One manifestation of uncontrolled storm sewer flushing is the sparcity of benthic vegetation within the channelized sections of the borough.

Former Sinkhole Location-Upper Watershed

Sinkhole development, the third, but lesser concern, is generally sporadic and unpredictable. These types of geologic features have impacted the stream in the past by diverting significant stream flow into the groundwater regime. Only through direct intervention has the stream flow been retained. The intentional pumping of groundwater near the stream can promote the development of sinkholes. The pictured area developed a sinkhole in the mid-1990's and was filled soon after its discovery.



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CUMBERLAND COUNTY, PENNSYLVANIA

EXISTING ZONING

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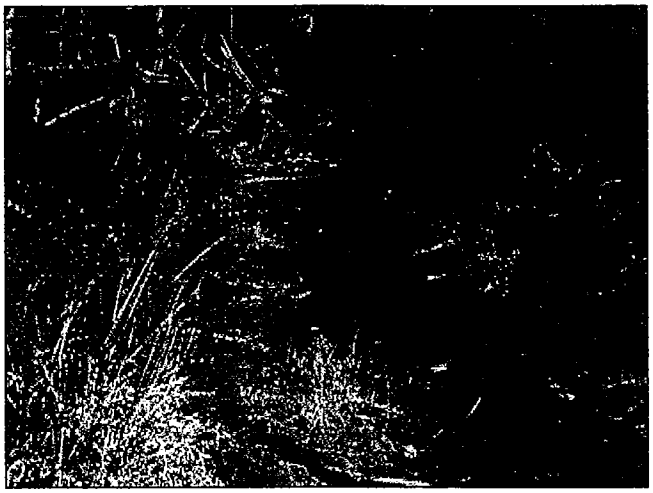
B. Upper Watershed

Within the upper watershed, erosion and agricultural issues constitute the major concerns. Past agricultural activities may have significantly changed the character of the upper portions of the stream. According to a local resident, a section of the stream approximately 0.6 of a mile west of Route 34 was diverted and deepened back in the 1960's. This activity was reportedly undertaken to drain the surrounding wetlands and agricultural fields. This along with the existing field ditches and possible farm tiles promotes rapid runoff and drainage. These in turn may cause the flow in these areas to dissipate more rapidly leaving this area uninhabitable by aquatic species and decreasing the average baseflow in the stream.

Sediment runoff from the agricultural fields is of concern mainly during large storm events. This transported sediment can impact downstream aquatic animal and plant species. For the most part, however, a buffer zone of trees, shrubs and grasses are located along almost all of the stream where agricultural fields are located. This helps to trap sediment prior to its entering the stream. The ditches which drain the fields and are directly connected to the stream are typically stabilized with grass cover.



Intermittent Section of Upper Watershed

There are two dairy cattle access points to the stream west of Route 34. The upstream access is well developed and utilizes best management practices to minimize stream degradation. These practices include stoned paths directly adjacent to the stream and fencing which prohibits animals from lingering or bedding down in the stream bed. Access by cattle to the stream at the second location, however, is unrestricted and considerable disturbance along with deposition of manure within the stream bed was noted. Since these areas are located within the intermittent portion of the stream, stormwater runoff will tend to transport these materials to the lower portions of the stream. Although these storm events are sporadic, the sediment and organic matter can negatively impact the downstream animal and plant species.

Within the upper watershed several types of manmade dams exist. Two dams, one of cinderblock, and the other of tin roof and wood, are located in areas where dairy cattle pasture surrounds the LeTort. These are most likely attempts by local farmers to prevent manure from going downstream or to create cattle drinking areas. An earthen and plastic dam is located just east of the Route 34 bridge but its purpose is unknown. These dams may present a potential erosion problem but may also help pool water and lessen the

sediment loads on the stream. To prevent erosion and retain any benefit from sediment removal, these dams must be sustained by continued and proper maintenance.

Two industrial activities within the upper watershed have the potential for impacting the stream. These include the commercial watercress and quarrying operations. The issues relating to these industries are included in the Critical Areas portion of the next section.

There are also sections of the upper watershed where erosion and stone wall failure has occurred. Further discussion of these issues are included in the middle watershed section.

C. Middle Watershed

Debris at High Street Bridge

The major issues concerning the middle watershed are generally associated with the heavily developed nature of this area. The issues concern trash accumulation within the stream, stormwater runoff from developed areas, and deterioration of the stone walls along the stream.

Trash and debris can be found to varying amounts throughout the stream, however, certain sections and types of areas were noted as having a higher than normal volume. Tires, shopping carts, drums, and plastic containers were noted in the area immediately upstream of LeTort Park. Other sections of concentrated trash included the area behind Weis Markets and an apartment building near the downstream borough line. Many of these areas have similar characteristics which include: unrestricted access to the stream; trees, structures or other obstructions which conceal activities; and easy access to trash or debris (i.e. community dumpsters nearby, market shopping carts, etc.). The majority of the trash consists of paper, plastic, rubber or metal and therefore is mainly of an aesthetic concern.

Stormwater Discharge Pipe in Carlisle

Because of the lack of detention structures within the borough stormwater system, runoff to the stream is generally direct and uncontrolled. This type of runoff leads to erosion problems, such as within the Mully Grub and near bridge piers, and the influx of organic and other contaminants from roadways and parking lots.

The most common and widespread problem associated with the stream within the borough is the deterioration of the retaining walls. Because of the age of the walls and direct action by humans, many sections of the walls are collapsed or completely missing. A collapsed wall can lead to erosion problems within the streambed and banks.

Collapsed Section of Wall in LeTort Park

D. Lower Watershed

As with the upper watershed, agricultural operations are of concern in the lower watershed. Existing and continued encroachment of development near the stream poses the greatest threat.

Several agricultural operations are located within the lower watershed adjacent to the stream. They include a horse farm, dairy operations and agricultural fields. Buffer strips are generally located between these operations and the stream. The majority of the buffer, however, consists of wetlands only, with little or no upland barrier.

Agricultural Fields and Buffer in Lower Watershed

The Carlisle Campground, located along Route 11, directly adjoins the stream. The close proximity of the recreational vehicles presents the possibility of accidental or intentional releases of sewage or engine lubricants/fuel from these vehicles. These types of releases, although likely isolated, could cause periodic impacts to the stream.

Development within the lower watershed has affected the stream from a physical and aesthetic standpoint, especially in the area of Route 81 and the Turnpike. Impacts include modifications to the channel alignment and continued maintenance on residential yards which adjoin the stream. Potential threats to the stream due to uncontrolled development are not unlike those for other sections of the stream previously discussed in III A and C.

Please refer to the October 2000, LeTort Spring Run Watershed Assessment by Skelly and Loy Inc. for additional stream mapping and observations. An abbreviated version of the Skelly and Loy document is located in the Appendix of this report.

IV. Land Resources

The professionals retained by the Authority to prepare this comprehensive plan looked carefully at the natural and human factors which affected the health of the stream. Those factors included the watershed's limestone dominated geology, the characteristics of the various soils and the interests and visions of those persons controlling land use by virtue of land ownership and their access to the watershed's resources.

A. Geology

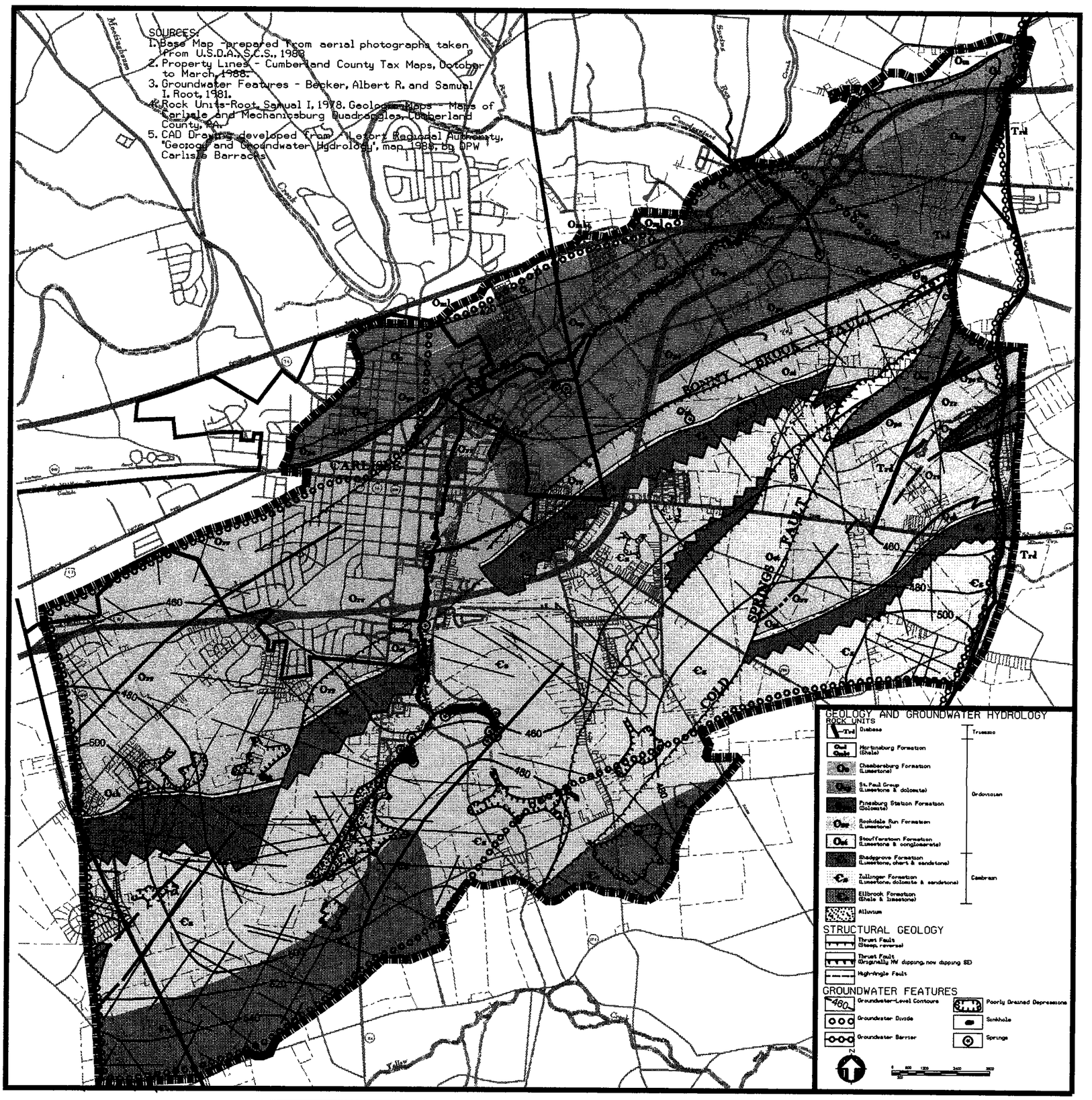
The LeTort Spring Run watershed lies within the Great Valley Section (locally known as the Cumberland Valley) of the Valley and Ridge Physiographic Province. The valley is bounded in the southeast by the steep forested ridges of resistant quartzite in South Mountain and the quartzitic sandstone in Blue Mountain to the northwest. Most of the valley is underlain by the Cumberland Valley sequence of rocks which is tilted to the northeast so that the eroded edges of successively younger rocks are exposed from southeast to northwest. Limestone is the dominate rock type in this sequence and because carbonate rocks are more susceptible to weathering than most other sedimentary rocks, maximum relief rarely exceeds 325 feet.

The LeTort Spring Run watershed is underlain predominately by limestone with minor shale outcropping along its northern edge. Geologic formations that outcrop include the Elbrook, the Conococheague, the Beekmantown Group, the Saint Paul Group, the Chambersburg, and the Martinsburg formations. These are shown on the following Geology and Groundwater Hydrology Map and are described in Table IV-1.

The major structural features found within the watershed are a series of folds, all which are terminated by a fault. The faults are asymmetrical toward the northeast. A number of large northeast trending faults, many of them thrust faults, cross the area. One of the most prominent features is the Bonny Brook fault, which runs parallel to the valley and is crossed by the LeTort just south of the Interstate 81 bridge.

The most important mineral commodity found in the study area is limestone. Potential areas for limestone quarrying exist throughout the LeTort Spring Run watershed. Type A aggregate stone has been produced through the Cumberland Valley from the St. Paul, Conococheague, Rockdale Run and Stonehenge units. Also, by controlled mixing of shale and additives, the Zullinger, Shadygrove, Stoufferstown, Stonehenge and Rockdale Run Formations are suitable as a limestone source for Portland Cement. Limestone is presently being extracted at the Union Quarry.

The rock units that provide the best source of fresh water in the watershed is the upper part of the Beekmantown Group, namely the Rockdale Run Formation. The Shadygrove and Zullinger Formations also provide adequate supplies for domestic use.



LETORT SPRING RUN

CUMBERLAND COUNTY, PENNSYLVANIA

GEOLOGY AND GROUNDWATER HYDROLOGY

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TABLE IV-1
GEOLOGIC UNITS IN THE LETORT SPRING RUN WATERSHED

Geologic Period	Geologic Unit	Lithology	Thickness (feet)
Upper Ordovician	Martinsburg Formation	Dark gray argillaceous shale and interbedded course arkosic sandstone; closely folded but with little cleavage	unknown
	Chambersburg Formation	Coarsely crystalline, dark limestone, in part graphitic with many irregular shale partings and beds of black dense calcareous shale; generally weathers cobbly, highly fossiliferous.	600±
Middle Ordovician	Saint Paul Group	Light-gray, thick bedded, high calcium, "birdseye" micritic limestone with beds of chert bearing limestone.	600-900
Lower Ordovician	Beekmantown Group	Main part is thick-bedded, well-bedded blue calcite limestone' white weathering, fine-grained magnesium limestone in upper part, contains fossils visible in cross section. At base is the Stonehenge member, containing many sandy beds, with round glossy quartz grains and beds of edgewise conglomerate.	3,000±
Upper Cambrian	Conococheague Group	Thick-bedded blue limestone with siliceous bands and thin beds of calcareous sandstone, dark dolomite, and calcitic limestone containing cryptozoon heads.	3,500±
Middle Cambrian	Elbrook Formation	Fine-grained, thin laminated, earthy or shaley limestone. Local calcareous sandstone and siltstone beds form hills of moderate relief.	3,500±

NOTE: Unit thickness varies greatly throughout the valley, above thicknesses are approximate.

Limestone bedrock has the distinction of being one of the few rocks that water, especially slightly acidic rainwater, can fairly rapidly dissolve. In most landscapes, rainwater percolates through the upper layers of soil and accumulates in the pore spaces of lower layers and small cracks in the uppermost bedrock. This water slowly diffuses through the ground along paths that generally follow the dips and falls of the surface. In contrast, groundwater in limestone areas dissolves and enlarges small cracks in the bedrock, eventually creating an underground network of channels and passageways. These networks can hold great quantities of water and rapidly transfer it from one area to another.

Two common features can be seen where underground channels intercept the surface: sinkholes and springs. Springs rise where an underground channel of groundwater meets the surface. The water in the LeTort Spring Run is almost totally a product of springs along its course. It is nearly impossible to tell exactly where the water comes from, or

the route it has followed in reaching the spring. The system of channels does not always flow in the same direction as water would on the surface.

Sinkholes are the natural drains of limestone topography. They are low places where surface water enters the groundwater channel system with little percolation through the soil. They occur where the underlying bedrock has been undermined by the collapse of an underground channel, or where it has been dissolved by concentrated percolation from the surface. The loss of support causes the soil above to collapse. New sinkholes may also form more rapidly where human activity concentrates surface water.

B. Soils

1. Types

The LeTort Spring Run watershed is comprised of soils that originated from sedimentary rock such as limestone and shale. The majority of the soils have developed from residuum weathered from the underlying limestone mantle of much of the drainage basin. Table IV-2 lists the soil series found in the watershed as given by the Interim Soil Survey Report for Cumberland and Perry Counties.

Most of the soils found in the LeTort watershed belong to the Hagerstown-Duffield Association. The majority of the soils in this Association developed from residuum derived from high purity limestones including some materials from dolomites.

The Hagerstown soil is the predominant soil series within the Hagerstown-Duffield Association in the watershed. This series consists of deep, well drained, and moderately permeable soils, with slopes that generally range from three to eight percent. Frequent limestone outcrops appear in these soils.

The second most frequently occurring soil in the Hagerstown-Duffield Association is the Duffield series. This series is found in the southernmost sectors of the basin. It has developed from residuum weathered from Elbrook limestone that, in turn, has produced the present Duffield loams. The Duffield soil series has well-drained, deep and moderately permeable soils. Because these soils are deep, they have less frequent limestone outcrop occurrences than do Hagerstown soils.

TABLE IV-2
SOILS TYPES IN LETORT SPRING RUN WATERSHED

Mapping Symbol*	Association	Series	Permeability	Hydrologic Soil Group
44 B-2	Berks-Weikert	Berks	MR	C (1)
49 A-1	Berks-Weikert	Blairton	MS-M	C
80 A-1	Hagerstown-Duffield	Duffield	M	B
117 A-1 8 A-1	Hagerstown-Duffield	Melvin	M	D (2)
38 D-2	Hagerstown-Duffield	Edom	M-MR	C
34, 35, 36, 37	Hagerstown-Duffield	Hagerstown	M	C
116 A-1	Berks-Weikert	Huntington	M-MR	B
105 A-1	Hagerstown-Duffield	Penlaw	S-MS	C
10 A-1	Hagerstown-Duffield	Lindside	MS-MR	C
25 A-1	Berks-Weikert	Monongahela	MS-M	C
12 A-1	Hagerstown-Duffield	Warners	MS-M	C
47 D-2	Berks-Weikert	Weikert	MR	C/D (1)
86, 87	Hagerstown-Duffield	Clarksburg	MS-MR	C

Permeability

R	Rapid	-	6.0 to 20.0 inches per hour
MR	Mod. Rapid	-	2.0 to 6.0 inches per hour
M	Moderate	-	0.6 to 2.0 inches per hour
MS	Mod. Slow	-	0.2 to 0.6 inches per hour
S	Slow	-	0.06 to 0.2 inches per hour

Hydrologic Groups

A	Low Runoff Potential (High Infiltration)
B&C	Moderate Runoff Potential (Moderate Infiltration)
D	High Runoff Potential (Low Infiltration)

* These symbols are used on the USDA Soil Conservation soils map of Cumberland County

(1) Hydrologic soil group determined by shallow depth to shale bedrock.

(2) Hydrologic soil group determined by shallow depth to water table.

Large amounts of alluvial soils are also present in the watershed. On floodplains of the LeTort Spring Run can be found several minor soil series that are also components of the Hagerstown-Duffield Association. In general, the floodplains of the middle and lower reaches of the stream are comprised of soils in the Warner series, while the floodplains of the upper reach are comprised of soils in the Melvin series. Widely scattered trace amounts of Lindside soils are found near the Warner soils. In general, these alluvial soils are well-to-poorly drained; slowly permeable; have a high seasonal water table; and are subject to some degree of flooding.

There are also trace amounts of soils from the Berks-Weikert Association found in the far northern tip of the watershed. Although the Berks series is the major soil of the Association in this area, small amounts of Weikert and Monongahela soils are also present. The Berks soil is found in the areas near the Carlisle Interchange of the Pennsylvania Turnpike as well as in the vicinity of the Carlisle Country Club. The Weikert and Monongahela soils are found in the area immediately north of U.S. Route 11 near the stream. These soils developed from materials derived from the dark colored Martinsburg shales. They are fairly deep, well drained, and quite permeable as indicated by the permeability ratings shown in Table IV-2.

Most of the soils in the watershed are moderately permeable. As a result of this characteristic, the soils will tend to allow a moderate amount of incident precipitation to infiltrate into the natural subsurface drainage networks of the basin.

According to the conventional USDA Soil Conservation Service hydrologic groupings(See Table IV-2), 29 percent of the soils in the watershed are group B soils, 70 percent are group C, and 1 percent are group D. There are no group A soils in the watershed. .

The very small percentage of group D soils with high runoff potential fall directly along the stream starting on the west branch immediately above the bridge on Bonny Brook Road and extending into the headwaters portion of the LeTort. These soils could be a significant problem if not for their infrequent appearance.

2. Prime Agricultural Soils

Highly productive agricultural land is a non-renewable natural resource which contains deep, well drained and fertile soil. All new development on the watershed represents consumption of the agricultural potential of the area. Although agricultural production is of importance in raising of the nation's food products, the use of the land for agricultural purposes harbors other important natural and cultural values. The preservation of agricultural land also represents the preservation of open space, groundwater recharge areas, and wildlife habitats.

The value of prime agricultural soils has led to its official designation throughout the State. The designation that was used to map the prime production soils was Class I and II soils as categorized by the U.S.D.A. Soil Conservation Service. These soils represent the areas that contain the highest natural soil quality. The LeTort Spring Run watershed is

blessed with an abundance of prime agricultural land, some of which has already been developed for other uses.

C. Ownership

Land within the watershed is primarily privately owned by citizens and various companies. The Borough of Carlisle, the Carlisle School District, Dickinson College and the LeTort Regional Authority own a number of parcels along the LeTort. Also, the federal government owns two parcels principally comprising the War College and the Carlisle Barracks.

Within the watershed, approximately 800 acres or 1.25 square miles are publicly owned by federal, county or municipal entities, which equates to about 6% of the watershed area being publicly owned. This total, however, does not include road rights-of-way which could comprise significant areas.

The LeTort Regional Authority has identified those property owners who adjoin the stream and a property Ownership Atlas has been compiled. This atlas contains public inquires of the properties within the area known as the LeTort Spring Run Conservation Corridor. The Corridor essentially includes all properties that adjoin the stream. Property Ownership Maps were then created to correspond with the Atlas with properties identified and included in the atlas. A Landowner Survey was sent to these land owners for the purposes of soliciting input and ideas for various management actions needed to preserve water quality and improve recreational access to the LeTort Spring Run. The Landowner Surveys were tabulated in early April. Of the 160 that were sent, 42 were returned completed for a 26% return rate. Exhibit A is the Landowner Survey with the number in the blank representing how many times respondents checked that blank. Exhibit B has additional landowner comments taken from the surveys.

D. Landfills

There are two areas along the LeTort Spring Run which are known to have been local dumping grounds. The first area is in the upper watershed, on the western stream bank, located partially under the existing Borough of Carlisle vehicle maintenance garage. This dump was primarily used by the Borough of Carlisle from the 30's through the 60's but is now closed.

The second area is in the lower watershed, on the western bank, and located just downstream of where Post Road crosses the LeTort. This dump was situated on lands formerly part of the Carlisle Barracks but is now owned by Dickinson College.

A privately operated disposal area is located on lands owned by Frog & Switch within the Borough of Carlisle. This property does not abut any portion of the LeTort Spring Run, but stormwater does leave this site as normal runoff. This disposal area was permitted by The Pennsylvania Department of Environmental Resources in 1977 and operated until 1994. In 1997 the permit was modified to "mine" the waste material. This mining is now complete but remediation of soils is still needed.

E. Critical Areas

Two existing operations have been identified as important issues. These are the B & W Growers Inc. watercress operation located along Bonny Brook Road and South Spring Garden Street and the Union Quarries quarrying operation along South Spring Garden Street.

Watercress Operations

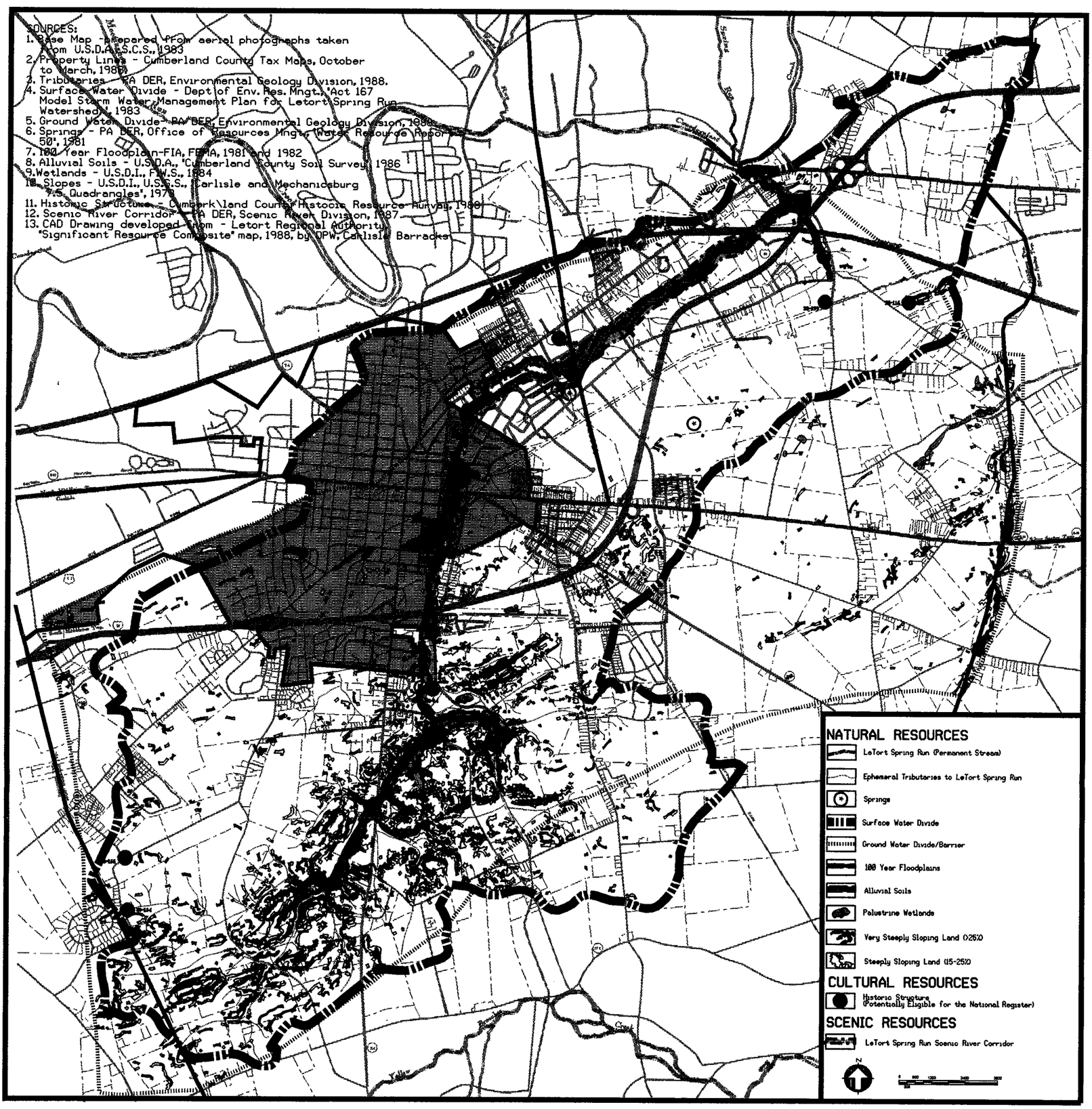
The watercress operation is of concern due to the types and amounts of chemicals permitted for use by B & W Growers Inc. An excessive release of chemicals from this operation resulted in a major fish and vegetation kill in 1981.

The Union Quarries quarrying operation is of concern for several reasons. The pumping of groundwater from the quarry lowers the water table directly beneath the stream bed thereby promoting the possibility of sinkholes developing within the bed of the stream. Another potential concern is from sediment laden runoff to the stream. During the field review some sediment was noted outside the berm/sediment control structures of the quarry although it was uncertain as to the magnitude of this problem. In addition, a large amount of quarry gravel was noted in the stream near the bridges. As with the sediment runoff, it is unclear whether stone deposition in the stream is an ongoing problem.

Pumped Quarry Water Enters the LeTort

V. Water Resources

Foremost in the study design was a comprehensive identification and evaluation of LeTort Spring Run's water resources, including its tributaries, origination of springs, location of lakes, ponds and wetlands as well as identification of some of the principal uses of the water resource. A Significant Resources Composite Map showing many of the features discussed in this section in located on the following page.



LETORT SPRING RUN

CUMBERLAND COUNTY, PENNSYLVANIA

SIGNIFICANT RESOURCES COMPOSITE

LETORT REGIONAL AUTHORITY

Community Center
415 Franklin Street
Carlisle, PA 17013
245-2295

A. Springs

As previously mentioned, there are at least 21 springs which feed the LeTort Spring Run throughout its course. Seventeen of these springs are valuable constituents of the environmental framework of the headwaters of the LeTort, while the remaining four springs feed the three main tributaries discussed later in this section. Many of the springs located in the Bonny Brook Road Area provide the fresh, cold, slow moving water required and used by the B&W Growers Inc. watercress farms.

Spring on Lower Watershed

The cold, fresh water is necessary to maintain the entire waterway environment. Water temperatures in the LeTort fluctuate very little. They normally measure 50° F but have been measured as high as 65° F during extremely hot summer weather. The stream is rarely ice covered in winter. The springs and the aquifers which charge the stream are sensitive to impacts caused by man's use of the land. The water quality may be changed by the leakage of any contaminant within the watershed such as on-lot sewage disposal systems and petroleum constituents from parking lots and service stations. Seepage of contaminants may increase the potential for environmental degradation of water quality throughout the surface hydrologic system. Water quantity coming from springs may also be impacted by future development by increases in withdrawal by private and public water supply wells. Increasing surface runoff through construction of impervious surfacing on the watershed will gradually reduce the aquifer recharge area.

B. Major Tributaries

Besides the Left Branch, which starts at springs on Spring Garden Street Extended, there are three other small, spring-fed tributaries that discharge into the LeTort Spring Run. The first of which is commonly referred to as the Mully Grub. The Mully Grub begins at a spring, now underground, near the intersection of Walnut Bottom Road and South College Street. It makes its way through the Borough of

The Mully Grub as seen from Bedford Street

Carlisle stormwater system until it reaches daylight on the east side of Hanover Street between a Wendy's restaurant and an Exxon gas station. From this point it flows for a length of over 1600 feet east toward Bedford Street, turns north and runs parallel to Bedford Street, before making a right turn and flowing through a culvert under Bedford Street. From there it makes its way to the LeTort Spring Run by dissecting the LeTort Elementary School grounds and the Carlisle Borough Teener League Baseball field. The Mully Grub enters the main channel at LeTort Park.

The second tributary is a spring fed stream known as Parker Spring. It enters the main channel of LeTort Spring Run just downstream of Post Road where the LeTort is classified as a cold water fishery. This spring serves as the water supply for Carlisle Barracks.

The third main tributary is located about 3,000 feet upstream from the LeTort Spring Run's convergence with the Conodoguinet Creek. This unnamed tributary begins from a spring on private property located at the corner of South Middlesex Road and Claremont Road. It enters the LeTort Spring Run at the point where the main stream channel turns toward Route 11 and parallels South Middlesex Road. This portion of the LeTort is also classified as a cold water fishery.

C. Wetlands

The wetlands within the LeTort Spring Run watershed and especially those along the stream itself serve to recharge or discharge groundwater, store floodwaters, trap sediment, retain and remove nutrients and pollutants, support fisheries and wildlife, anchor the streams shoreline and dissipate the erosive forces of the water.

Upper Stream and Associated Wetlands

Wetlands can serve to recharge or discharge the groundwater system. Wetlands located above the water table tend to recharge the groundwater system, while those in contact with the water table will serve to discharge the groundwater to the surface, in much the same way as a spring does. The wetlands along the LeTort are tied very closely to groundwater fluctuations, therefore, raising or lowering the groundwater table directly influences these wetland areas.

The wetlands along the stream serve to temporarily store and slowly dissipate the flow of water after rain events. This helps reduce the flows during flood events and assists in releasing the flood waters over a longer time period. This process also allows wetland plants to filter sediment from turbid waters by slowing the velocity of the water.

Wetlands tend to serve as buffers between upland areas and the stream, thereby intercepting runoff containing nutrients such as nitrogen and phosphorous and as well as various contaminants. They provide environmental variation and a contrast in habitat type along the LeTort.

Since the wetland areas are accessible by foot, they are a scenic asset for hikers, especially those who utilize the LeTort Regional Authority's Nature Trail. In addition, the wetlands offer research areas for the educational institutions in the local municipalities. They are already a valuable site for bird watching.

D. Floodplain

The LeTort Spring Run features a 100-year floodplain along nearly its entire length. The Federal Government offers subsidized flood insurance to property owners within the floodplain if their municipality limits the amount of filling, requires flood proofing of flood-prone structures, and restricts the types of uses in the floodplain. All municipalities within the watershed include these requirements in their ordinances.

Four municipalities: Carlisle Borough, Middlesex and North and South Middleton Townships, have zoning and subdivision/land development floodplain ordinances which directly apply to the LeTort Spring Run. The basis of the flood hazard area in all four of these ordinances is from the Flood Insurance Study and accompanying maps prepared by the Federal Emergency Management Agency (FEMA). These ordinances identify a (1) Floodway Area, a (2) Flood-Fringe Area and (3) General Floodplain Area and areas with (4) Prohibited Uses Within the Floodplain.

1. Floodway Area

All four ordinances are strictest in the Floodway Area. The Floodway Area is delineated using the criteria that a certain area within the floodplain must be capable of carrying the waters of the 100-year flood without increasing the water surface elevation of that flood more than one foot(1') at any point. In this area all development is prohibited except where the effect of such development on flood heights is fully offset by accompanying improvements which have been approved by all appropriate local and state authorities. Permitted uses in this area are general farming/agriculture, outdoor plant nurseries, public and private recreational uses and accessory residential and commercial uses. All four ordinances do allow for special exceptions in this area upon approval by the Zoning Hearing Boards of those municipalities.

2. Flood-Fringe Area

The Flood-Fringe Area is delineated as the land of the 100-year floodplain not included in the Floodway Area. The boundary is the 100-year flood elevations contained in the FEMA mapping. Elevation, rather than location is the determining factor. In this Flood-Fringe Area the development and use of land can only be permitted in accordance with the regulations of the underlying zone, provided that all such uses, activities or development are undertaken in strict compliance with the flood-proofing and related

provisions contained in all other applicable codes and ordinances. Mobile homes are not permitted in the Flood-Fringe Area. Additionally, North Middleton Township allows no new construction or development to be located within the area measured fifty feet (50') landward from the top-of-bank of any watercourse.

3. General Floodplain Area

The General Floodplain Area has essentially the same limitations as the Flood-Fringe Area with the exception of North and South Middleton which have no mobile home restrictions in this area.

4. Prohibited Uses Within the Floodplain

All four zoning ordinances have prohibited the construction of hospitals, nursing homes, jails and prisons within the floodplain, except for Middlesex Township which requires a special permit for such construction. New or substantially improved manufactured home parks or any new or substantially improved structure to be used in the production or storage of dangerous substances are also regulated. In all four municipalities Special Exceptions and Variances may be considered by their Zoning Hearing Boards.

Development in flood-prone areas under these ordinances is strictly regulated but not necessarily prohibited. This increasing development in the floodplain, although regulated, can still lead to more frequent and intense floods and lowered water quality due to greater sediments and pollutant loads.

LeTort Floodplain in Upper Watershed

The LeTort Spring Run cannot be preserved without protecting its floodplain. The floodplain is the protective buffer of the stream and must remain open and stable. It must carry floodwaters and accommodate the continuing natural stream cleaning process of sediment alluviation during high water periods. The floodplain also provides an area for wildlife to live and roam, passive recreation potential, and certainly, aesthetic beauty for people to enjoy.

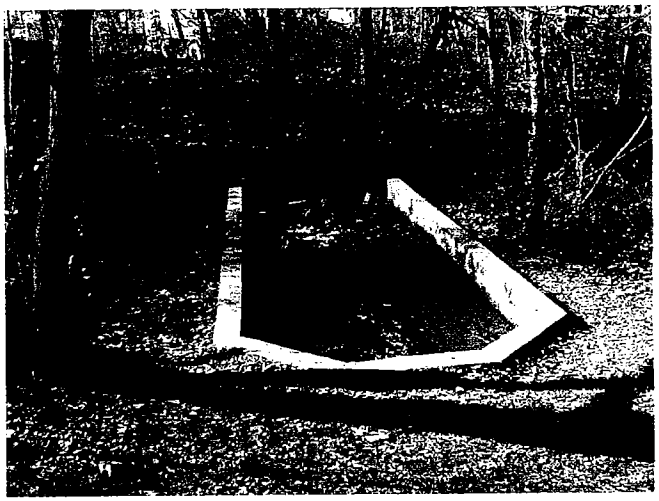
E. Lakes and Ponds

There are no natural lakes or ponds of significant size found within the LeTort Spring Run watershed. There is, however, a man-made wet retention pond serving the All-American Truck stop in Middlesex Township. Some development now under consideration will include either retention or detention ponds as well.

F. Water Quality

1. Point Sources

The federal Clean Water Act established the National Pollution Discharge Elimination System (NPDES) as a permitting process for the discharge of any pollutant from a point source into the waters of the United States. A point source is any discernible, confined or discrete conveyance from which pollutants are or may be discharged. The State's Clean Streams Law gives Pennsylvania primacy to implement the permitting program by giving the Department of Environmental Protection the authority to adopt and enforce water quality regulations.



Union Quarries mine water discharge point.

Point source discharges which are permitted by the State are at three locations along the LeTort Spring Run. The first of which is from the B & W Quality Growers, Inc. watercress operation in South Middleton Township. The second point source discharge is from the Union Quarries facility also in South Middleton Township. The third site is the back-wash flow from the Carlisle Barracks water treatment plant facility in North Middleton Township.

2. Non-Point Sources

Non-point source discharges occur primarily from those areas where stormwater runoff enters the stream. Agricultural runoff along the banks of the LeTort is present within the upper and lower watersheds where cultivated fields and pastures drain directly to LeTort. Except for the areas of concern mentioned earlier in Section III, there does not appear to be any severe erosion along the LeTort. A requirement for stream vegetative barriers, or preferably, a designated greenway would provide significant protection to the stream.

In the middle watershed, Carlisle streets and parking lots drain to the LeTort via storm drains. Oil, gasoline and, probably, hazardous household products leaking from trash areas inevitably make their way into the LeTort with little or no filtering. Areas of concern in this watershed have been previously mentioned in Section III.

3. Monitoring

a) Water Quality

The LeTort Regional Authority has conducted a water quality monitoring program on the LeTort since September of 1991. For monitoring purposes the recorded observations and results are divided into the upper watershed and the lower watershed.

Water samples are collected from ten monitoring sites on a monthly basis and are analyzed for nitrate nitrogen, phosphates and turbidity. Water temperature, dissolved oxygen, pH, and total dissolved solids measurements are taken at each site. Field observations are made in regard to weather, water surface, water color, and submerged aquatic vegetation. Detailed monitoring data can be obtained from the LeTort Regional Authority.

In addition to the LeTort Regional Authority's program, the Environmental Studies Department at Dickinson College has conducted numerous water quality studies on the LeTort over the years. Many of these studies are tools the LeTort Regional Authority uses to urge responsible development in the watershed.

b) Flow Data

In a joint venture between the LeTort Regional Authority and the U.S. Geological Survey, stream flow data has been recorded since 1976. A gauging station is located on the right bank, 320 feet downstream from the bridge on U.S. Highway 11 and 0.2 miles upstream from the LeTorts' confluence with the Conodoguinet Creek. The station consists of a Water-Stage recorder and a Crest-Stage gage. The elevation of the gage is 410 feet above sea level.

Discharge data from this station are available online for study and scientific research through the U.S.G.S. National Water and Data Exchange. According to the data for the Calendar Year 1998, the mean flow was 59.0 cfs. The maximum daily discharge was 180 cfs recorded on March 21, 1998. The minimum daily discharge was recorded on December 30, 1998, when the flow dropped to 23 cfs.

Through 1998 and based on twenty-two years of records, the annual mean flow is 45.3 cfs, while the minimum and maximum annual flows have been 28.3 cfs in 1992 and 62.4 cfs in 1998 respectively. The lowest daily mean flow of 10 cfs occurred August 14, 1976, while the highest daily mean flow of 452 cfs occurred on January 24, 1979. Statistics from the U.S. Geological Survey show that the average annual runoff from the watershed is 2.01 cfs per square mile or 28.5 inches per year. Flow data is presented graphically in Exhibit C .

The average annual rainfall on the watershed is approximately 42 inches and is distributed somewhat uniformly throughout the year. The precipitation in the spring normally exceeds the average rate and the precipitation in the fall is usually less that the average rate. A maximum monthly precipitation of 18.51 inches, over 14 inches above normal, was recorded during June 1972, with 12.5 inches of this amount being associated

with Hurricane Agnes. According to local residents the flooding associated with Hurricane Agnes reached a stage of 8.4 feet. The discharge with this flood was not determined.

4. Stream Classifications

a) Water Quality Standards

Title 25, Chapter 93 of the Pennsylvania Code classifies the LeTort Spring Run as a Cold Water Fishery Protected Use. Sections of the stream have also been designated Special Protection status. The Department of Environmental Protection has listed these sections as follows:

- High Quality - From the headwaters to the Route 34 bridge; and
- Exceptional Value - From the Route 34 Bridge to the railroad bridge at LeTort Park.

The Department of Environmental Protection defines a High Quality Water as a stream or watershed which has excellent quality waters and environmental or other features that require special water quality protection. Exceptional Value Waters constitute an outstanding national, state, regional or local resource, such as waters of national, state or county parks or forests, or waters which are used as a source of unfiltered potable water supply. They also include waters of wildlife refuges or state game lands, or waters which have been characterized by the Fish & Boat Commission as "Wilderness Trout Streams," and other waters of substantial recreational or ecological significance.

b) Special Fishing Regulations

The Pennsylvania Fish & Boat Commission has recognized the quality of the LeTort Spring Run. It lists 1.5 miles of the LeTort, from 300 yards above the bridge on Township. Rt. 481 downstream to the Reading Railroad bridge at the southern end of LeTort Park as a Heritage Trout Angling Area. This area of the LeTort is open to fisherman year round but is limited to fly casting/catch and release fishing only. Wading is permitted unless posted otherwise. More information on this topic can be found in the annual Pennsylvania summary of Fishing Regulations and Laws.

G. Water Supply and Wastewater Treatment

The municipal utilities providing water supply and wastewater disposal are significant municipal services which help determine the overall ability of a community to expand from a rural nature into a suburban or urban community. Communities tend to depend on these municipal utilities as populations increase. In turn, it takes a concentration of population to make the water distribution and wastewater collection systems economically feasible to operate. The fringe areas of suburbanization around Carlisle are attractive areas for extending existing facilities as they become economically feasible or environmentally needed.

1. Private Water Sources

There are several private community, transient non-community and non-transient non-community water systems within the LeTort Spring Run watershed. These sources were identified by means of the Department of Environmental Protection's Pennsylvania Drinking Water Information System(PADWIS) database. See Exhibit D for information from this database for the LeTort Spring Run watershed.

The U.S. Army Carlisle Barracks provides its own water and distribution system. The source of water for this community system is a spring located on the Barracks' property. Water treatment capacity is 1 million gallons per day, of which current use averages between 250,000 and 350,000 gallons per day. The water treatment facility is located directly adjacent to the spring.

2. Public Water Sources

There are three municipal water systems which serve the population of the LeTort Spring Run watershed. The Carlisle water supply system currently draws its supply from the Conodoguinet Creek. The Carlisle system supplies the entire Borough through the Carlisle Borough Water Authority. Some minor extensions of the water distribution system have been installed in South Middleton and North Middleton Townships. The extensions occur along the populated sections of Routes 641, 74, 465, Spring Garden Street and the Cavalry Road area.

The South Middleton Township municipal water supply system draws its supply from the plentiful groundwater reservoir of the limestone valley floor. The system is fed by three wells. One is located just south of the LeTort watershed near Mt. Holly Springs. A second water supply well was constructed just west of Boiling Springs a few miles outside of the watershed. A third well was constructed within the LeTort's watershed and is located on Strayer Drive just outside the Borough of Carlisle. This third well is located within a mile of the stream's main channel. The South Middleton Township Municipal Authority supplies water to Middlesex Township, North Middleton Township and to the Borough of Carlisle in emergency situations.

The Carlisle Suburban Authority (CSA) provides public water service to North Middleton Township. The CSA's present water filtration plant is located outside the watershed of the LeTort Spring Run and draws its supply from the Conodoguinet Creek. The CSA also purchases water from the Carlisle Borough Water Authority to serve accounts located in the Cavalry and Trindle Road areas.

Middlesex Township is currently in the process of identifying potential well locations in order to lessen its reliance on South Middleton Township. It is likely that Middlesex Township, through its Municipal Authority, will develop a well within the watershed of the LeTort Spring Run.

3. Wellhead Protection Areas

Well head protection areas (WHPA) are geographic regions designated by local governing bodies to safeguard the groundwater within the recharge zone of a municipal production well. Typically, several zones are created consisting of concentric circles with the production well at the center. The regulations or ordinances which govern the WHPA restrict certain land uses and activities. Activities which are regulated include, but are not limited to, use and storage of hazardous materials, quarry activities, land application of sewage sludge, above and underground storage tanks, etc.. The regulations also promote groundwater recharge and enhancement of surface and groundwater quality.

South Middleton Township has established an ordinance concerning WHPA for its production wells. The well, which is closest to the LeTort and within the LeTort watershed, is located on Strayer Drive just outside of the Borough of Carlisle. The well itself is just over one mile from the upper reaches of the stream while the WHPA comes within approximately one-half a mile of the stream.

4. Private On-Lot Disposal Systems

On-lot septic systems can be found mainly within the upper and lower reaches of the LeTort watershed. Of main concern is the concentration or volume of sewage disposal, such as at the mobile home parks along Bonny Brook Road, and the proximity of systems to the stream. A few on-lot systems still remain in the Borough of Carlisle. These systems are allowed to remain as long as they pass yearly inspections by the Borough Sewage Enforcement Officer.

On-lot systems utilize the soils natural cleansing ability to break down the sewages's organic constituents and destroy harmful bacteria and pathogens. Many systems, however, were installed prior to the Department of Environmental Protection's full understanding of soil rejuvenation capabilities. Because of this, many on-lot systems fail to fully treat the sewage prior to contact with the regional water table. This is of particular concern within the LeTort watershed because of the relatively shallow water tables which supply the springs within the watershed. Contamination from malfunctioning septic systems include increases in organic loads and bacterial / viral agents.

5. Public Wastewater Treatment Systems

Much of the developed portions of the watershed are served by public wastewater collection and treatment systems, however, none of the treatment plants fall within the limits of the watershed.

In North Middleton Township, public sewage collection, treatment and disposal are performed primarily by the Carlisle Suburban Authority. A small area of North Middleton Township is served by the Carlisle Borough Sewer System. The Carlisle Suburban Authority's wastewater treatment plant is located near Clearwater Drive and adjacent to the Conodoguinet Creek, just west of the Middlesex Township boundary. After treatment and disinfection, wastewater is discharged into the Conodoguinet Creek.

The sludge is trucked and land-applied to nearby farms in Middlesex and North Middleton Townships, or dewatered and landfilled.

VI. Biological Resources

The waterway's alkaline water quality, moderated temperatures and variety of flow conditions have created habitats which encourage the establishment and proliferation of living organisms.

A. Wildlife & Vegetation

Aquatic Vegetation

The waterway and banks of the LeTort Spring Run support the distinct flora and fauna of a Pennsylvania limestone stream. A profusion of aquatic plants create floating mats of vegetation in the waterway sometimes thick enough to kneel on. Large populations of aquatic insects such as mayflies and midges, and crustaceans such as isopods and scuds live and feed on the vegetation. The LeTort Spring Run produces almost twenty times more life per acre than typical streams outside limestone areas. The insects and crustaceans are the primary food for the world famous brown trout that live in the LeTort.

The vegetation found in the vicinity of the LeTort Spring Run is typical of Cumberland County. The area surrounding the LeTort is a mixture of deciduous trees, cropland, abandoned land and manicured lawns. Oak species are dominant since the American Chestnut was logged out in the eastern forests at the turn of the century. The oaks are encroached upon by willow, maple and locust species along the banks. All species make up small wooded areas found along the stream.

These remnant woodland areas are significant environmental sanctuaries. The mixed hardwood tree stands are of value as green contrast to cleared open spaces, as wildlife habitats, natural and wild areas, and potential recreational areas. Because of their high environmental and aesthetic quality the remnant woodlands are being converted in increasing numbers from their wild state to sites for new home construction and commercial developments. The associated high environmental quality and the limited occurrence and desirability of these unique environments for residential development make their place within the LeTort Spring Run watershed extremely important.

In many areas along the stream, land that was once cropland or otherwise intensely managed is now at the stage of the abandoned field in the ecosystem succession. This is a stage where nature is in the beginning process of establishing a climax community. It is characterized by dense growth of vines, herbaceous vegetation and tree seedlings. The predominant tree species during this stage are the boxelder and the black locust. This type of landscape becomes an ideal habitat for various wildlife species that can coexist with man and development but still prefer a wild habitat.

Ducks in LeTort Park, Carlisle

The wetland fringe of the LeTort Spring Run can be quite wide. The cattails, wetland grasses, and reeds in these wetlands provide food and shelter for muskrat, waterfowl, and amphibians. Plants and animals in the LeTort watershed are typical residents of the fragmented ecosystems resulting from development in the region. The common plants and animals of the area are those most able to adapt to a landscape much more open than the original forest cover of the 1700's. Mammals such as red and grey fox, raccoon, opossum, grey and flying squirrels, white-tailed deer, meadow vole, minks and others, live in the patchwork of fields, woods, and neighborhoods. Birds migrating through and breeding in the region include Canada geese, ducks, egrets, and herons.

B. Pennsylvania Natural Diversity Inventory Species

The Pennsylvania Natural Diversity Inventory (PNDI) is a site specific information system that describes significant resources of Pennsylvania. This system includes data descriptive of plant and animal species of special concern, exemplary natural communities and unique geological features.

A data request submitted to the Pennsylvania Natural Diversity Inventory for the LeTort Spring Run watershed revealed that no occurrences of species of special concern are found within the watershed and potential impacts to endangered, threatened, or rare species would not be anticipated.

One species that is listed as endangered by the Pennsylvania Fish and Boat Commission has a historical range within Cumberland County. This specie is the bog turtle. Even though there has been no recent documented sitings within the LeTort Spring Run area, the habitat found along the LeTort is ideal for the bog turtle.

C. *Important Habitats*

The most important features of the LeTort Spring Run is its upper waterway and its population of wild brown trout. These trout are found mainly in the upper reaches of the stream between the Route 34 bridge and the Railroad Bridge at LeTort Park.

The productive aquatic life found in the upper portion of the LeTort is the most diverse found in the entire stream. The aquatic plants serve as a food supply, habitat and as a natural conditioner of the water chemistry. As a food supply the thick populations of aquatic plants provide surplus amounts of energy to aquatic herbivores. Besides the energy available in its own green leaves for higher forms of life, the vegetation harbors dense populations of aquatic insects, insect larve and crustaceans. The invertebrates in turn are excellent suppliers of food for the brown trout.

Sculpin

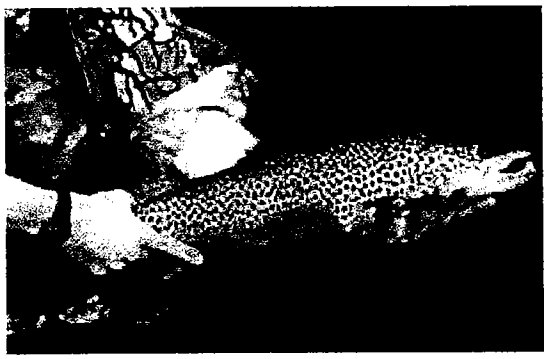
Trout spawning areas have been artificially enhanced along selected portions of the upper section of the stream. Without these beds the natural reproduction of the brown trout would be severely limited. There is a constant effort being made to ensure that a spawning habitat of gravel is maintained for the brown trout in the midst of the sediment introduced to the stream by human activity within the watershed. The wetlands which border much of the stream not only serve an important function for the aquatic wildlife but also for terrestrial wildlife. Since the majority of terrestrial species rely on this type of habitat during their life. In this capacity the wetlands serve as a food and water source, cover and nesting and reproduction areas.

VII. Cultural and Recreational Resources

It is the intent of the affected municipalities and various state agencies, largely working through the LeTort authority, to retain and even broaden the use of the stream and its watershed for public enjoyment. Although fishing has, historically, been its principle attraction, the establishment of nature trails and a park has opened up a variety of enjoyable opportunities.

A. Fishing

The LeTort Spring Run is a unique trout stream that has been immortalized in numerous writings. Articles about the LeTort have appeared in national magazines such as Outdoor Life, Sports Afield, Esquire and numerous fishing magazines. Local fisherman and world-renowned authors such as Vince Marinaro and Charlie K. Fox have written books about the stream. To many avid fishermen, the LeTort has become a Mecca for light tackle and minute dry fly fishing. Some of the articles written have compared the LeTort to the trout streams found in southern England.

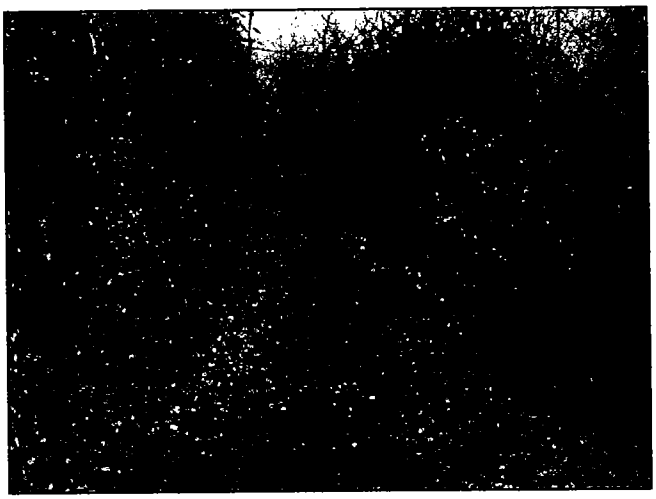


Brown Trout

The combination of constant volume of flow, the small and limited aquatic species and the importance of tiny land bred terrestrial insects' plays a major role in LeTort fishing restrictions. Because of the uniqueness of the LeTort, traditional flies were and still are ineffective in catching the trout. In order to remedy this situation, new trout flies were created. Two of the flies that were created just for the LeTort are the LeTort Hopper and the LeTort Beetle. However, the most important discovery was the jassid. In response to the aloof brown trout, the jassid was developed, which opened the previously unheard of practice of using replicas of land based insects as flies. A jassid is a fly that resembles winged ants and other terrestrial insects.

A unique achievement in fishing occurred along the LeTort, when in 1961, Charlie Fox, along with other local landowners and fisherman, joined together to establish certain fishing regulations. This was done by posting signs that allowed access for the purpose of fishing as long as the angler followed certain rules. The rules were designed to allow immediate enjoyment of the stream while leaving enough trout to reproduce and grow for future enjoyment. Then in 1974, the Pennsylvania Fish Commission aided them by adopting state regulations to enforce and control fishing along the LeTort. Currently special regulations apply to the upper reaches of the LeTort Spring Run concerning "No Harvest Fly-Fishing Only". This section of the LeTort is marked along the stream by small green and white plastic signs and larger cardboard signs. The restrictions are published annually in the Pennsylvania Fish Commission pamphlet: "Summary of Fishing Regulations and Laws".

B. Nature Trail



LeTort Spring Run Nature Trail

In 1978, the LeTort Regional Authority established the LeTort Spring Run Nature Trail after the Reading Railroad line was abandoned in the wake of Hurricane Agnes in 1972. The 1.4-mile nature trail runs from LeTort Park in the Borough of Carlisle to the Bonny Brook Road Bridge, within the abandoned railroad right-of-way. The trail runs parallel to the LeTort Spring Run through woods, meadows and marshes. Although the old right-of-way extends further into Carlisle and south into South Middleton Township towards Mount Holly Gap, ownership has been questioned and has prevented the utilization of the entire abandoned railroad as a nature trail. The trail is open all year to walkers, anglers, bird watchers, and cross-country skiers. Biking, horseback riding, all terrain vehicles, motorcycles, and snowmobiles are not allowed on the trail. The LeTort Regional Authority and other volunteer organizations maintain the trail on a routine basis.

LeTort Park

Besides the nature trail, additional access to the LeTort is provided on public park property, such as, LeTort Park and Biddle Mission Park in the Borough of Carlisle and school grounds at LeTort Elementary School in Carlisle and on Dickinson College property in North Middleton Township. Willing private property owners also provide access on an informal basis. The Carlisle Area School District and Dickinson College use the trail and stream for science classes and as a science laboratory. Historically, the U.S. Army has permitted limited, controlled public access to the LeTort Spring Run at Carlisle Barracks.

C. Historical and Archaeological Importance

The LeTort Spring Run and it's watershed are rich in history. American Indians are known to have lived along the LeTort and Conodoguinet banks due to their location and abundance of food and water. Later, in 1720, the first documented European settler, James LeTort, a French trader, trapper, Indian interpreter and government messenger, also built his home along the stream.

The LeTort's ideal location and resources for westward travel resulted in the construction of a fort (Fort Lowther) in 1753. At the same time Lieutenant Governor James Hamilton, chose the LeTort's vicinity as an ideal site for the Cumberland County seat. In 1753, five dwellings, including a temporary log courthouse, formed a new town. By 1782, this town was incorporated as the Borough of Carlisle.

Today, several historic areas reside within the LeTort watershed. In the Borough of Carlisle a historic district was established in 1976. In this district, which extends to the LeTort banks on Louther and High Streets and nearly to it on Pomfret and South Streets, a Historical Architectural Review Board regulates changes. This district is contained entirely within the watershed but should have no direct effect on the LeTort or it's watershed.

On the Middle/Lower reaches of the LeTort are the Carlisle Barracks, one of the oldest U.S. military installations. The first permanent settlement in the Barracks was established in 1757 by Col. John Stanwix. The Carlisle Barracks served as a military training and educational center throughout the years, including the Revolutionary War, at which time it was known as Washingtonburg. In 1879, the War Department passed control of the post to the Department of the Interior. During the next 39 years the Carlisle Barracks became home to the Carlisle Indian School. This school was well known for several Olympic football and track and field stars, the best known being the legendary Jim Thorpe. Today this area is well manicured with the majority of the LeTort contained within well maintained stone walls.

Neither of these historic areas have any known adverse affects on the LeTort watershed, but merely increase the amount of visitors to its banks each year.

VIII. Management Options

The following sections outline management options for the LeTort Spring Run and the LeTort watershed. The options were developed from information gathered at meetings with municipal representatives, during the field reconnaissance of the stream and watershed, research in preparation of the plan, input from the LeTort Regional Authority, the Authority's Executive Director, the Steering Committee, the public and from The Landowner Survey.

These options merely represent potential projects and not policy. The LeTort Regional Authority may decide to implement any of these options during future meetings. Many of these options must be examined more completely to determine their feasibility.

The management options are in list format and grouped into Restoration, Maintenance and Enhancement sections. It should be noted the options are not listed in order of priority.

A. Restoration

1. Repair damaged sections of wall from LeTort Park to Carlisle Barracks within the Borough of Carlisle. Wall restoration should attempt, when possible, to increase mean velocities within the channel and to incorporate fish habitat structures.

2. Contract with a consultant for the design of a stream restoration project in the Shady Lane section of the stream. If successful, the restoration techniques developed could be utilized on future projects on other sections of the stream.

3. Implement a public education initiative for identified agricultural operations within the watershed. Promote Best Management Practices including limiting access of livestock to the stream, the establishment, enlarging and / or enhancement of buffer zones and improving erosion controls.

4. Evaluate the feasibility of restoration of previously drained wetlands within the watershed (drained wetlands identified on upper watershed).

5. Promote plantings along the riparian zone, primarily within the borough, to minimize increases in stream temperature.

6. Removal of trash and other debris from stream. Limit access to stream in remote areas where dumping is a problem(See Table A).

7. Remove dams(mostly in the upper watershed) and other obstructions which are detrimental to the stream.(See Table A).

B. Maintenance

1. Updating all municipal stormwater management ordinances to require implementation of Best Management Practices to reduce stormwater peak runoff and to improve water quality of the runoff and to promote the concept of Transfer of Development Rights and Clustering.

2. Contract with a consultant to conduct a study of groundwater additions and subtractions along the stream in order to analyze the impacts that the quarrying operation may have on the stream and to possibly identify sinkholes and springs.

3. Contract with a consultant to conduct an analysis of the on-lot disposal systems / community systems within the mobile home parks along Bonny Brook Road to determine the presence and impact of contamination, biologic and nutrient, on the stream.

4. Contract with a consultant to conduct a feasibility study to determine the options and costs of connecting the mobile home park to the South Middleton Township sewer system.

5. Contract with a consultant to conduct an analysis of local sewer systems to determine availability / existence of emergency backup power and automated notification devices.

6. Update all municipal ordinances to protect natural springs that feed to the LeTort. Protection should include limiting water withdrawal and development near the spring or within its recharge zone.

7. Contract with a consultant for the preparation of a Natural Resource Valuation Report. This report should identify the monetary and aesthetic value of the stream to the local area.

8. Survey the Nature Trail and map all easements, properties and rights-of-ways along trail.

9. Purchase land in full or interest free in order to retain land in open space or developed for recreation. e.g: for the Nature Trail extension projects.

10. Purchase conservation easements, when necessary, for the purpose of acquiring development rights.

11. Petition DEP for High Quality designation for section downstream of the Carlisle Barracks.

12. Review the PADEP permit issued to the composting facility on Post Road to determine if it provides adequate protection of the stream. Recommend necessary site improvements and Best Management Practices.

13. Conduct a study of area bridges to determine potential for exacerbating stream flooding.

14. Continue participating in the USGS stream flow monitoring program.

15. Evaluate storm drains within borough near major outfalls to determine if trash netting and/or water quality inlets are warranted.

16. Post information signs in areas with public access to stream (i.e. Public Parks, Camp Grounds, Residential Areas, etc.) describing sensitive nature of stream and watershed and promoting conservation practice.

C. Enhancement

1. Installation of Water Quality Inlets on stormwater systems near all pipe discharge locations.

2. Contract with consultant for the design of the remaining restoration plans for the Mully Grub tributary.

3. Contract for the construction of the remaining restoration plans for the Mully Grub tributary.

4. Extension of the Nature Trail south in South Middleton Township to connect with existing trails in South Middleton Township. The LeTort Spring Run Hiker/Biker Trail is consistent with the recently adopted Cumberland County Greenway Plan. The Greenway Plan identified the LeTort Nature Trail as a high priority for expansion.

5. Extension of the Nature Trail north through the Borough of Carlisle, Carlisle Barracks, North Middleton Township and Middlesex Township to potentially connect with the Appalachian Trail.

6. Creation of an access and parking lot on the Dickinson College tract along Post Road in North Middleton Township.

7. Design and construction of rerouting the Nature Trail across the stream in order to avoid Highland Avenue.

8. Contract for design and construction of improvements to parking area along Bonny Brook Road for access to the Nature Trail.

9. Contract with a consultant to promote a conservation easement program and the concept of a conservation corridor for the stream.

10. Promote a greenway corridor as a potential conservation zone through revision to municipal ordinances.

11. Review Erosion and Sedimentation measures at Union Quarry and suggest any needed implementation measures.

12. Continue to promote and participate in public education programs and field trips to the LeTort.

13. Conduct a study of the local municipalities and PennDOT's winter road maintenance procedures. Explore possibility of lessening or eliminating use of harmful de-icing agents.

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