CHAPTER 2

CHARACTERISTICS OF THE FISHING CREEK CEDAR RUN WATERSHED

Hydrologic Features

The Combined Watershed consists of four subwatersheds including Fishing Creek (99.5 square miles), Little Fishing Creek (42.1 square miles), Long Run (24.4 square miles) and Cedar Run (15 square miles). The total drainage area of the Combined Watershed is approximately 181 square miles.

The Fishing Creek watershed originates east of the Borough of Carroll in Union County, flowing first through Sugar Valley and then through the upper portion of Nittany Valley for a total distance of 42 miles. Sinkholes are very prominent throughout the 27 miles of southwestward travel through Sugar Valley. As a result, this section of Fishing Creek experiences intermittent flow during dry months as the water drains underground through the limestone topography. The northwest flowing segment from Tylersville to Lamar exhibits perennial flow except for a small area of intermittent flow upstream of the Fish Hatchery at Tylersville. From Lamar, Fishing Creek flows northeast to Mill Hall where it discharges into Bald Eagle Creek.

Little Fishing Creek, with its Roaring Run and Laurel Run tributaries, emanates near Pleasant Gap in Centre County, flowing a distance of 15.8 miles northeast to its confluence with Fishing Creek at Lamar.

Long Run, including the Cooper Run, Pepper Run, Washburn Run, and Chub Run tributaries, travels 13.3 miles northwest from its origin near Logan Mills in Clinton County to Salona where it discharges into Fishing Creek.

The Cedar Run Watershed, beginning east of Jacksonville, Centre County, travels 8.7 miles northeast and merges with Fishing Creek at Cedar Springs in Clinton County.

Topography & Regional Geology

As a part of the Appalachian Mountains, the Combined Watershed exhibits the classic topography of this mountain system, consisting of three (3) northeast-southwest trending mountain ridge complexes separated by two (2) inter-mountain valleys. The Sugar Valley mountain complex forms the eastern boundary of the watershed succeeded to the northwest by the Big Mountain Complex. The western border of the watershed is delineated by the crestline of Bald Eagle Mountain. These mountain ridges are composed of sedimentary sandstones and

quartzite of the Bald Eagle, Juniata, Tuscarora and Clinton Formations. The Reedsville shale and the shaly limestone Coburn-Nealmont Formations provide the transition between ridge and valley.

Of the two inter-mountain valleys, Sugar Valley is situated on the eastern side of the watershed while the upper portion of Nittany Valley composes the western member of the valley sequence. These valleys are constructed from Ordovician Carbonates of the Bellefonte, Axeman, and Nittany Formations. The Upper Cambrian Gatesburg Formation, the oldest geologic formation in the watershed, is expressed in the western region of Nittany Valley.

Drainage System

The Combined Watershed displays the classic transverse drainage system found almost exclusively within the central and southern Appalachian Mountains of the eastern United States. The mainstem of the Combined Watershed, Fishing Creek, is the dominant consequent stream carving three (3) watergaps through the mountain ridges. The main tributaries flowing on the valley floors compose the subsequent streams of the system, while the streams flowing from the slopes of the mountain ridges form the obsequent and resequent streams and complete the classic drainage pattern of the watershed.

Soil Associations and SCS Hydrologic Soil Groups

The primary soil associations in the Combined Watershed include Dekalb-Clymer-Cookport, Hagerstown-Wiltshire, Murril-Buchanon-Laidig, Pope-Barbour-Sequatchie and Lehew-Ungers-Albrights. Dekalb-Clymer-Cookport soil association makes up the majority of the Combined Watershed. The most common land use associated with these soils is forest land. Hagerstown-Wiltshire soils primarily occur in Nittany and Sugar Valleys. Extensive farming operations dominate these valleys. Murril-Buchanon-Laidig soils occur on the moderately sloping edges of Nittany and Sugar Valleys. Pope-Barbour-Sequatchie soils border Fishing Creek and Long Run in Mackeyville and Rote, respectively. Lastly, Lehew-Ungers-Albrights association occurs primarily on the north facing slope of Rainsares Mountain in Lamar Township. Soil association data (IDRISI-GIS map images) are available for review at the Clinton County Conservation District.

The USDA Natural Resources Conservation Service (formerly SCS) collected and digitized the soil data for the Combined Watershed as a part of the 1995 update of the Clinton County Soil Survey. Towson State University converted these data into IDRISI-GIS. A Hydrological Soil Group (HSG) category was assigned to each soil type according to the HSG inventory in

Appendix A of the SCS Technical Release-55 (TR-55), 1986. The basis for Hydrologic Soil Group classification is the infiltration rate of the bare soil after prolonged wetting. This classification system includes four (4) categories: Hydrologic Soil Groups A, B, C, and D. Table 2-1 lists the infiltration rate, runoff potential, and soil texture for each HSG.

Table 2-1
Runoff Potential, Infiltration Rate and Soil Texture
of the Hydrologic Soil Groups
(from Soil and Water Conservation Technical Guide Pennsylvania, 1991)

Hydrologic Soil Group	Runoff Potential	Infiltration Rate	Soil Texture
A	low	high	sand, or sandy loam
B	moderate	moderate	silt loam or loam
C	moderate to high	low	sandy clay loam
D	high	very low	clay loam or clay

Only hydrologic soil groups B, C, and D occur within the Combined Watershed (Plate 4). Specifically, HSG B soils occupy 28% of the Combined Watershed. HSG B soils occur primarily in the agricultural valleys. The majority (59%) of the soils within the Combined Watershed are classed as HSG C, and are associated with the steeper, forested regions. Hydrologic soil group D soils exist mostly in Centre County just south of Little Fishing Creek and immediately south of Roaring Run. In Clinton County, HSG D soils are common in Mill Hall and Sugar Valley, but occupy only very small areas throughout the remainder of the Clinton County portion of the Combined Watershed. Overall, HSG D soils occupy 8% of the Combined Watershed. The remainder of the Combined Watershed is primarily stony land and quarries (5%).

Existing Land Use and Land Cover

The United States Geological Survey (USGS) derived the land use and land cover data from digital USGS, 1:250,000-scale base maps. Towson State University converted these data into IDRISI GIS. These data identify nine (9) land use types according to an Anderson Level II categorization. Table 2-2 lists the total acreage and percentages of each land use type in the Combined Watershed.

Table 2-2
Land Use Classification for the
Fishing Creek/Cedar Run Watershed

LAND USE TYPE	ACRES	PERCENTAGE
Residential	841	0.72
Comm/Indust	111	0.10
Impervious Surfaces	1421	1.22
Crop, Pasture	35,822	30.79
Orchards, Nurseries	30	0.03
Other Agriculture	66	0.06
Forest	77,624	66.72
Strip Mines	72	0.06
Open Space	354	0.30
Total	116,341	100.00

Existing land use in the Combined Watershed (Plate 1) is primarily forest with agriculture dominating the valleys. Forest land comprises about 67% of the Combined Watershed. A large portion of this forest land is either Bald Eagle State Forest, Tiadaghton State Forest, or State Game Lands 255 and 295. Most of the logging in the Combined Watershed occurs on private land, but some does occur on state lands. Recreationists have private hunting and summer camps dispersed throughout the forest land.

Agriculture is the second most common land use in the Combined Watershed. Most of the farmlands are located in the wide limestone valleys. Major farming enterprises include dairy, beef, poultry, grain, and produce. The most common crops are corn, wheat and hay.

Residential land use is centered around Mackeyville, Lamar, Cedar Springs, Mill Hall, Mingoville, Nittany, Hublersburg, and Loganton. State Routes 880, 64 and 220, and Interstate 80 are major highways. Commercial land in the Combined Watershed is primarily in Mill Hall.

Future Land Use and Land Cover

The future land use data were derived for the Combined Watershed from the existing land use data using IDRISI-GIS. Plate 2 (Future Land Use and Land Cover) contains the primary changes to the existing land use plate.

The future land use changes were determined based on the planning studies, growth rates, and other information that was available as of February 1995. Please note that the parameters of planning studies may change prior to actual plan implementation.

Sub-Area Characteristics

As shown on Plate 4, the Combined Watershed was divided into 118 subareas. Fishing Creek, Little Fishing Creek, Long Run, and Cedar Run subwatersheds contain 58, 33, 15, and 12 subareas, respectively. The original Consultant delineated the subarea boundaries and Towson State University digitized them into IDRISI-GIS. The Consultant determined the subarea boundaries based on drainage and land use characteristics, and adjusted the boundaries of some subareas in order to utilize stream crossings with known flow characteristics as points of interest through which all runoff from that subarea flows. Table A-1 in Appendix A contains a summary of the average hydrologic characteristics for each sub-area and sub-watershed.

SCS Runoff Curve Numbers

SCS runoff curve numbers (CN) were calculated for each sub-area in the Combined Watershed using land use classes in Chapter 2 of SCS TR-55. Geology, land use, hydrologic soil groups, hydrologic connectivity, and time of concentration of runoff were used to determine the curve numbers. The hydrologic connectivity (Figure 6-1) is the flow direction or pattern of runoff from subarea to subarea. The time of concentration for each sub-area is the time for runoff to travel from the hydraulically most distant point within the sub-area to the sub-area outlet. Both the hydrologic connectivity and time of concentration are important in determining the impact of upstream runoff on downstream areas. Average weighted curve numbers were calculated for each sub-area and listed in Table A-1. The table includes both existing and future average weighted CN's.

Precipitation and Design Storms

There are no known rain gauges within the Combined Watershed. In the absence of actual storm rainfall data, "design" storms that have a time distribution as devised by Natural Resource

Conservation Service or Pennsylvania Department of Transportation (PA DOT) are used for hydrologic modeling. The original Consultant obtained the depths of the design storms from the PA DOT Field Manual of Storm Intensity-Duration-Frequency (IDF) Charts, Region 3 (1986). Table 2-3 shows the 24-hour design storm depths for the 2 through 100-year return period storms.

The mean annual precipitation throughout the Combined Watershed averages 40 to 42 inches according to the Water Resources Bulletin No. 16, Pennsylvania Gazetteer of Streams Part II, 1984.

Table 2-3
24-Hour Design Storm Depths
and 24 Hour Duration's
(after PA DOT IDF Charts, 1986)

Return Period (years)	24-Hour Duration (inches)
2	2.60
5	3.10
10	3.70
25	4.60
50	5.10
100	6.00

Stream Flow and Estimated Design Floods

The stream flows utilized in the Flood Insurance Studies within the Combined Watershed were based on approximate statistical methods. These flows, and flows computed from other methods, were compared to estimated streamflows from the hydrologic model during model calibration, as discussed later in this report.

Flood Insurance Studies

Flood Insurance Studies were prepared by the Federal Emergency Management Agency (FEMA) or the Department of Housing and Urban Development (HUD), to aid in the administration of the National Flood Insurance Act of 1968, and the Flood Disaster Protection Act of 1973. Many of these Flood Insurance Studies include detailed delineation studies.

Detailed delineation studies in the Combined Watershed include: Little Fishing Creek from its confluence with Fishing Creek in Porter Township to an access road in Walker Township about 3,000 feet from the Clinton and Centre County boundary, and from Legislative Route 14027 to the old railroad grade in Mingoville; Long Run from its confluence with Fishing Creek to approximately 0.6 mile upstream of Township Route 362 (Wetzel Road) in Lamar Township; Roaring Run from its confluence with Little Fishing Creek to the intersection of T-907 and T-605 in Walker Township; and Fishing Creek from its confluence with Bald Eagle Creek to the Legislative Route 18006 bridge over Fishing Creek in Porter Township. Data from detailed studies include floodplain boundaries, floodways, design storm-flood profiles for the 10-, 50-, 100-, and 500- year storms, and summaries of the drainage area/peak discharge relationships for specific streams. These Flood Insurance Studies are available for review from either the municipality in which the stream is located or from the Clinton and Centre County Conservation Districts.

Existing and Future Floodplain Development

Development within currently urbanizing areas of the Combined Watershed will be primarily regulated by floodplain management regulations enacted by the local municipalities. Act 166 required all municipalities in the Combined Watershed to enact ordinances that regulate the type and extent of development within floodplain areas. Specifically, these ordinances limit future floodplain development to that which would not significantly alter the carrying capacity of the floodplain or be subject to a high damage potential.

The Combined Watershed shall be regulated by the following criteria:

1. Damage potential of existing floodplain development will remain unchanged, for storm events representing the two-year through 100-year return period events, through implementation of the stormwater management criteria included in the Fishing Creek/Cedar Run Watershed Stormwater Management Plan.
2. Damage potential for future floodplain development will be minimized by only permitting specific types of development which are damage resistant consistent with the Floodplain Management Act as implemented through municipal floodplain regulations and the Department of Environmental Protection Chapter 105 - Dam Safety and Waterway Management Regulations, and Chapter 106 - Floodplain Management Regulations.
3. Damage potential of existing and future floodplain development may be reduced with implementation of remedial measures in areas subject to inundation. The effectiveness

and design life of any remedial measures would be enhanced by implementation of the Stormwater Management Plan.