Fort Bedford
Trout Unlimited

Shobers Run Coldwater Conservation Plan

Prepared by Fort Bedford Trout Unlimited Volunteers
August 2006

Coldwater Heritage Partnership

The Coldwater Heritage Partnership (CHP) exists to provide leadership, coordination, technical assistance, and funding support for the evaluation, conservation, conservation and protection of Pennsylvania's coldwater streams. The CHP is composed of Pennsylvania Trout (PATU), the PA Department of Conservation and Natural Resources DCNR), and the PA Fish and Boat Commission (PFBC). The CHP grant program is administered by PATU under contract with DCNR and receives funding assistance from DCNR, PFBC, and the Western PA Watershed Program (WPWP).

Coldwater Conservation Grants

The Coldwater Heritage Partnership administers a grant program to develop Coldwater Conservation Plans to conserve and protect our coldwater streams. These plans are useful in building awareness and support for the long-term stewardship of coldwater streams and their surrounding watersheds. The plans are meant to identify potential problems and opportunities for stream conservation and may lead to more detailed watershed studies or projects to improve watershed health.

The Western Pennsylvania Watershed Program

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Introduction

Purpose of Study

The Fort Bedford chapter of Trout Unlimited chose to develop an informal assessment and a plan for conserving the Shobers Run watershed for several reasons. For anyone who grew up around Bedford Borough, Shobers Run was the local stream for play and usually their first trout fishing venue. Students at Bedford High School, and later the middle school as well, are likely to have used the stream as an outdoor classroom since the athletic fields at both schools are adjacent to the lower reaches of the stream. Despite the familiarity that many local residents have with Shobers Run, an appreciation of the quality and value of the stream is not widespread. Many landowners not only mow their chemically-attained green lawns to the water's edge, but some will dump their grass clippings and other yard waste over the stream bank without concern. More isolated sections and areas on Bedford Springs property are frequently used as dump sites by landowners and landscapers discarding unwanted yard items and waste.

For several years in the 1990's, Fort Bedford Trout Unlimited stocked cooperative nursery trout in sections of Shobers Run that are convenient and accessible to youth anglers. Litter cleanups, in partnership with 4-H clubs, high school groups, PA CleanWays and others, have been FBTU projects for many years. FBTU has also partnered with high school groups and others in tree-planting projects at two sites along Shobers Run.

Figure 1 Mrs. Jackson's class sampling macroinvertebrates

Local anglers, including some FBTU members, have anecdotally provided evidence of wild trout, both brown and brook, encountered in Shobers Run. The possible presence of wild trout and the potential for development in this small watershed are prime factors in the decision to look closer at current conditions of the watershed and its future.

Bedford County

Bedford County is located in south central Pennsylvania covering an expanse of 1,018 square miles. Somerset and Cambria Counties border to the west, Blair and Huntingdon Counties lie to the north, Fulton County sets on the eastern border, and to the south is

Allegany County, Maryland. Situated very near the geographic center of the county, the Borough of Bedford is both the largest town and the county seat.

Before Europeans arrived in the area around 1630, the lands to become Bedford County were a hunting ground for various Indian nations. In 1750, Robert MacRay built a trading post that grew to be known as Raystown, present day Bedford. A fort was built in 1758 to support British and colonial troops during the French and Indian War. Bedford County was established in 1771 incorporating a region of central and western Pennsylvania that would later become 26 of the present counties. Predominant among early settlers were Scotch-Irish, Welsh, Germans, and Huguenots. In addition to agriculture, early enterprises in Bedford County included timbering, iron furnaces, transportation, and resort spas.

By 1820, the population of the county was over 20,000 though growth was slow over the next few decades. In 1835, the Underground Railroad began operations in Bedford County. In 1840, the population was 29,335 but with the eastern portion of the county being separated in 1850 to form Fulton County, the population was 23,502 for the remaining area. Ten years later, as the country was poised for civil war, the county population was 26,736. After the war, Bedford County experienced some of its fastest growth, with 34,929 residents in 1880 and 38,644 by 1890. Growth slowed in the new century, the population in 1930 was just barely 40,000 and, 30 years later, only 42,451 in 1960. County population decreased over the next decade to just 42,353 in 1970 but slow, steady growth since has brought the county to 49,984 in the 2000 census.

The Watershed

Physical Description of Shobers Run Watershed

Shobers Run is located in central Bedford County; flowing northeasterly through a narrow valley to its confluence with the Raystown Branch of the Juniata River just east of the Borough of Bedford. Most of the watershed is within Bedford Township with the southern portion in Cumberland Valley Township. To the east, the watershed boundary is defined by the ridgeline of Evitts Mountain. The western boundary in the northern portion of the watershed is the ridgeline of a smaller, lower ridge separating Shobers Run from the Cumberland Valley Run watershed to the west. This ridge begins in the southern part of Bedford Borough and is known as Juliana Heights in this area. Approximately four miles southwest of the borough, this dividing ridge is pierced by a tributary of Shobers that drains from the eastern flank of Wills Mountain. Two miles farther to the southwest, another tributary pierces the lower valley-floor ridge to drain water from Wills Mountain near the village of Burning Bush just north of the township line separating Bedford and Cumberland Valley Townships. South of this tributary, the remaining upstream portion of the Shobers Run watershed (approximately two miles of stream length) is contained to the east of the dividing minor ridge.

The watershed encompasses some 16.3 square miles with the main stem flowing for slightly over eleven miles in the syncline of the narrow valley. The tributary drainage follows the 'trellis' pattern typical of streams in the folded topography of the Valley and Ridge province. While main stem drops in elevation some 520 feet over its length; much of this drop is in the headwater section of the main creek. Over nine miles from the upstream tributary near Browns Road to the mouth, Shobers Run only falls about 200 feet.

The designated water use for the Shobers Run watershed, as listed by PA Code Title 25, Chapter 93, is as *High Quality – Cold Water Fishery*. High Quality waters are those "surface waters having quality which exceeds levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water…" Water chemistry requirements must exceed designated levels for a number of parameters at least 99% of the time and a biological assessment must score at least 83% based on Rapid Bioassessment Protocol for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish (EPA/444/4-89-001).

History of the Shobers Run Watershed

With the establishment of Raystown, later to become Bedford, during the 1750's, it can be surmised that Shobers Run (also found as Schobers Run, Shovers Run and Shavers Run; a source for the name remains unknown) was 'discovered' in mid-18th century. Perhaps the cold, clean waters of Shobers Run were a source for drinking water and fish for food in preference to the nearby 'river', which early maps and accounts note was border by extensive wetlands. Much of what is known of the early history of human settlement in the Shobers Run watershed is tied to the history of the Bedford Springs hotel and resort.

It is claimed that in 1796, Nicholas Schouffler, an eccentric gold hunter, became the first European to come upon the springs along Shobers Run. He was particularly excited about the nearby sulphur spring and rocks he found that led him to build a crude furnace and attempt to melt these stones. In 1798, Jacob Fletcher, a trout fisherman enjoying his sport on Shobers Run, drank water from a mineral spring; later telling his friend Dr. Foulke of the purgative and sudorific effect. Soon Drs. Foulke and Anderson of Bedford were recommending the waters to patients. Frederick Naugel, Sr. who operated a mill, originally owned the land around the springs. Jacob Wirtz briefly owned the property but Dr. Anderson bought the property in 1803 and development of a hotel at the site began in 1804. During "the summer of 1805 many valetudinarians came in carriages and encamped in the valley.' The first building that was to become the hotel, the Stone Building, was finished in 1806 with the Crockford House following in 1811. Dr. Anderson died in 1840 but his sons assumed development and management of the property with significant additions in the 1840's including the Colonial Building and the colonnades, and the Swiss and Evitt buildings.

An interesting side story concerns a Henry Wertz, Jr. who, according to court records, was the defendant in a public nuisance case involving construction of a dam of stone,

earth, and gravel he placed across Shobers Run. The structure was reportedly about 50 feet long, 16 to 17 feet deep and 6 feet high and backed up water to the vicinity of the mineral springs creating a nuisance for visitors to the hotel. There is no record of the disposition of the case but this seems the earliest mention of a dam on Shobers. A mill house still stands along the creek downstream from the hotel. Though not well documented, there is circumstantial evidence of the existence of several dams on Shobers Run.

There are seven noted springs near Shobers Run on the hotel property. The mineral or Magnesia Spring, across Shobers from the hotel buildings, was most significant medicinally as a diuretic and cathartic. The Sulphur Spring was important for use in hot baths. The Black spring, named for its discoverer, was a limestone spring and the Sweet Spring flowing from the base of Federal Hill behind the hotel was a drinking water source. The others include the Crystal Spring, the Iron Spring and another limestone spring. The hotel became famous and fashionable during the 1820's. Attractions in addition to the spa waters included walking trails such as the "zigzag" trail up Constitution Hill across the stream from the hotel and the large millpond with an artificial island upon which small boats were floated.

Figure 2 Shobers Run view looking downstream from colonnade

Bedford Springs was well known as the summer home of President James Buchanan and many other chief executives enjoyed the resort; including William Henry Harrison, Zachary Taylor, James Polk and James Garfield. Thaddeus Stevens, Daniel Webster, John C. Calhoun, and Henry Clay also visited the resort. During the Civil War, many generals and other high officers in the Union military encamped their families at the hotel during their duties in Washington or in battle. Additional construction occurred in the 1880's and in 1895 the first golf course opened; a 6000-yard, 18 hole course designed by Spencer Oldham. By 1910, the popularity of the resort was waning, as spa hotel were losing some of their allure. The renowned A.W. Tillinghast redesigned the golf course for nine holes in 1912. In 1923, master golf course architect Donald Ross expanded the course again to 18 holes. With golf the primary attraction, many of the games greats played the Ross course over the next half-century including Walter Hagen, Gene Sarazen, and, later, Arnold Palmer. Through all the incarnations of the golf course, the waters of Shobers Run flowed through as a 'natural' water feature.

During World War Two, the resort served as a US Navy radio training school from 1942 until late 1944 and, during the last months of the war, was an internment center for Japanese diplomats captured in Europe as Nazi Germany fell to the Allies. After the war, modern improvements by the owner Gardner Moore, an experienced hotelier who purchased the resort on 1940, added more than 100 rooms and restored the hotel to popularity during the 1950's. Twice in the decade the Glidden Tour of vintage autos stopped at the Springs; in 1952 drawing 10,000 visitors to Bedford. Former President Eisenhower visited at least twice in the Sixties, a yet-to-be-president Ronald Reagan made an overnight stop in 1975; but by the late 1970's the decline was evident. Occupancy rates dropped to 30 percent as tastes changed and the quaint, pricey resort lost its appeal. Moore sold the hotel in 1980 and so began a 25-year period of partnerships and lawsuits, bankruptcies and defaults, politics and frustration.

A short distance south of the main springs around which the Springs resort grew, a Scottish immigrant, William McDermott, built a house in 1783 and an early steel mill that he operated for nine years before eventually moving to Spruce Creek to build a new mill. Others operated the works after McDermott as an 1807 report of the "tilt-hammer at the Caledonian Steel Works" attests. The house, mill and an impoundment at the site east of Shobers Run were named Caledonia for many years until the mid-20th century when the name Red Oak Lake was adopted. This pond intercepts a tributary to Shobers Run.

North of the Bedford Springs, along Shobers Run, a competitor to the Bedford Springs hotel emerged in late 19th century. Never rivaling the Springs in size of reputation, the former Arandale Hotel lives on, in part, as the Bedford Elks Lodge and nine-hole golf course. These two resorts were not alone in Bedford County. A short distance across the Raystown Branch along Dunning Creek, the Chalybeate Springs Hotel, opened in 1867, was a popular resort in the late 1900's, especially among families though it too hosted presidents and other notables. About nine miles to the southwest, in a small valley near Manns Choice, White Sulphur Springs Resort also attracted summer visitors, beginning operations in 1894.

For the watershed south of the Bedford Springs-Caledonia area, the history of human habitation and development is poorly documented. By reviewing old maps of the county, including those in the appendices, we found that the valley was dotted with homesteads by mid-19th century. The 1939 aerial photographs, also in the appendices, show a number of small farms throughout the valley. Also apparent on the photographs is the logging of the slopes in may parts of the watershed. In areas where fields are cleared along the stream, severe braiding of the channel can be noted. It could be surmised that this is a result of destruction of the riparian vegetated zone and of heavy sediment loads due to upland erosion from land-clearing as well as stream bank erosion. In other parts of the county, the aerial photographs even more clearly illustrate the effects of clear-cut logging on the valley slopes. On the north side of the Raystown Branch on the western side of Evitts Mountain, severe gully erosion is very apparent on the denuded slopes.

Shobers Run is susceptible to flash flooding from heavy downpours and has erupted over its banks a number of times in the last 50 years. The high waters of the flood of 1983 did significant damage to the Bedford Springs golf course and clubhouse and high water in 1991 reached improperly stored pesticides in an outbuilding resulting in a devastating fish kill and destruction of aquatic life in the lower reaches of Shobers Run.

During 2005, it was announced that investors for the Bedford Springs resort development project had been secured and restoration of the golf course and hotel is beginning as we finish this report. FBTU was able to briefly review the application for permits and the plans for the golf course restoration. Most of the concerns and recommendations in reference to the Springs golf course that came about from this study are addressed in the proposed work. FBTU looks forward to the approved restoration plan and the completion of the needed bank and channel stabilization.

Geology and Soils

Bedford County is primarily in the Valley and Ridge Physiographic Province with characteristic long, narrow ridges and valleys oriented northeast to southwest. Rocks that were formed during the Cambrian through Carboniferous periods were compressed from the southeast during the Permian Period, intensely folding and faulting the sediments producing the valleys and ridges. Weathering of the ridges formed our present landscape with the higher ridges of quartzite and sandstone that resist erosion. Lower ridges and slopes consist of shale and siltstone; many valleys are limestone.

Within the Shobers Run watershed, the USDA NRCS Soil Survey of Bedford County notes Lobdell loam, Holly silt loam, Atkins, and Brinkerton soils composing much of the floodplain through which Shobers Run flows, particularly in upstream areas. All of these soils exhibit moderate permeability, high water capacity, slow runoff, and seasonably, at least, a high water table. The erosion hazard is slight for these soils but the threat of flooding and ponding limit most agricultural uses other than pastureland. In upstream areas, stream bank soils include Bedington-berks complex and Buchanan cobbly loams with moderate permeability, water capacity and runoff but with moderate to severe erosion hazard. These soils are more suitable for farming, including cropland.

The lower slopes of the ridges containing the Shobers Run watershed include significant components of Elliber loams and Opequon-Hagerstown complex soils with moderate permeability, low to high water capacity, very rapid runoff and severe erosion potential. These areas are not well suited for farming due to slope and rock outcrops.

Higher on the ridges are found Laidig cobbly loams, Ungers-Lehew, Hazelton-Clymer, and Dystrochrepts-Rock Outcrop complexes with rapid permeability, low water capacity, very rapid runoff, and severe erosion hazard. Slope and large stones limit uses to woodland for timbering, wildlife or recreation.

Appendix D of this report includes portions of Map 61 of the PA Geological Survey as well as detailed soil maps created from the Web Soil Survey site of USAD, NRCS

National Cooperative Soil Survey which include summaries of the soils within each area of interest. Those with an interest in a more detailed treatment of the soils within the watershed are referred to these pages, to the Bedford County Soil Survey, and to the local NRCS office for assistance.

Legacy Sediments

Sediments that accumulated behind dams built for millponds and other uses through the colonial, pre-industrial, and early industrial eras have become important considerations in recent years as old low-head dams are removed and watershed rehabilitation projects are implemented. These highly erodable, unconsolidated sediments present problems when attempting to restore streams to natural, historic channels.

As mentioned in the history section, dams were a feature on Shobers Run. The number and location of the dam(s) has not been determined within the scope of our study to this time. It has also been noted previously that the effects of logging and farming apparent on aerial photographs would indicate that significant sedimentation could have occurred in the valley floor where the main stem flows at fairly low gradient.

In many sites on Shobers Run, especially in the lower stream reaches, areas associated with significant stream bank erosion often reveal several feet of accumulated fine grain sediments layered over a more mixed textured soil. Some of these sites are found within sections that have riparian zones with healthy vegetation, at least currently, but more often these sites are located within areas of modified riparian zones, such as the golf courses and other mowed areas.

Legacy sediments were significantly mentioned in a Growing Greener grant application submitted in 2006 by the Bedford County Development Association that proposed funding for a stream restoration project on Bedford Springs property (Shobers Run, Inc.) downstream from the hotel. Legacy sediments were identified as a priority for grant funding by the PA Department of Environmental Protection during the 2006 grant round. If this project is funded, FBTU will be very interested in some level of participation, perhaps in monitoring.

Climate

Total annual precipitation in Bedford County averages 35.88 inches with about 20 inches (55%) falling from April through September. During the summer, daytime highs generally reach into the lower 80s with nighttime lows in the pleasantly cool upper 50s. There are only an average of 16 warm humid days in the summer, when temperatures reach 90 degrees or higher. During the winter season, daytime highs average in the upper 30s with nighttime lows near 20. The average growing season is 154 days.

Recreation

Shobers Run is a stocked with trout each year by the PA Fish and Boat Commission and, during the early part of the trout season, is popular with anglers, particularly younger fisherman who can walk or bicycle to the stream. As the weather warms, angling pressure on Shobers Run diminishes but occasional fishermen will seek out holdover and wild trout. Wild trout, both brook and brown, have been known from Shobers Run for many years though during the course of this study no wild trout were located.

The lands of the Bedford Springs property have many trails that have been used for hiking and hunting. In the past, posting of this property has been inconsistent. In more recent years, mountain biking and ATV four-wheeling have become popular, and illegal use of trails around the Bedford Springs has caused significant damage to trails and erosion has increased sedimentation in tributaries to Shobers Run.

Though most of the wooded slopes of the watershed are private property, hunting is widely enjoyed throughout the watershed. Near the mouth, athletic fields of the Bedford High School and Middle School border the stream. Relatively light traffic on the roads within the watershed, and the proximity to Bedford, mean that road bicyclist and runners are frequently scene on Business 220 and Sweet Root Road.

Natural Heritage Inventory

There are no natural heritage citations within the Shobers Run watershed listed in the Bedford County Natural Heritage Inventory prepared by the Western Pennsylvania Conservancy in 1998.

Invasive Plants

Surveying for invasive, exotic plants was not a designated component of the habitat survey (visual stream assessment) undertaken by FBTU volunteers. Some participants did, however, note the presence or absence of typical riparian invasive plants on the assessment forms. Purple loosestrife (*Lythrum salicaria*) was reported (and confirmed) at two locations in the watershed. A small colony (<20 in 2006) of *L. salicaria* was observed on the stream banks immediately upstream of the Route 30 bridge. The presence of these plants is obviously related to the very large colony in and along the streambed of the Raystown Branch upstream and downstream of the mouth of Shobers Run. One volunteer noted the possible presence of Japanese knotweed (*Fallopia japonicus*) but investigation of the site did not result in a positive finding.

Land Use

Despite the close proximity to Bedford Borough and being located within perhaps the fastest developing township in the county, the Shobers Run watershed remains approximately 63% wooded. Developed areas account for a bit more than 5 % with about 2.5% impervious surfaces. The remaining approximately 30% includes a small

amount of cropland (mostly hay and some corn), pastureland, and open fields reverting to forest.

Near the mouth of Shobers Run, on the eastern side of the stream along Donahue Road, recent development has increased stormwater runoff. During construction, improper implementation of erosion and sedimentation best-management practices resulted in several pollution events. The county conservation district and PA DEP have been diligent in responding to these and other events in the watershed.

Figure 3 Runoff from unsatbilized construction site along Shobers Run during a light rain

Existing land use in the lower half mile of Shobers Run includes a residential area on the lower slopes of Evitts Mountain (Meadowbrook Terrace), municipal infrastructure in the Bedford Area Municipal Authority wastewater treatment plant on the west side of the stream, and two schools. Upstream, the Bedford Elks golf course contains Shobers Run.

Construction and restoration activities at the Bedford Springs Hotel and golf course will begin soon. Monitoring of these activities will hopefully avoid sediment pollution to Shobers Run. Associated with this development project is a relocation of Business Route 220 from between the hotel complex and Shobers run to the back of the hotel. This will move a large amount of the motor traffic away from the stream but the original road will be retained as a township road providing access to Sweet Root Road. Of most concern with this relocation is the runoff potential from the new, steeper roadway.

There is only one known industrial entity in the watershed, Platt & Sons, Inc., on Teaberry Road near the junction with Browns Road. This is a manufacturer of wire cables and harnesses. At the headwaters, there is a commercial tree farm and orchard, with several ponds that impound the waters of one of three headwater tributary branches.

Today, agriculture is a less significant activity in the watershed than in the past. There are just a few farms along the main stem with little or no pasturing immediately adjacent to the stream. Nor are there significant crop fields adjacent to the main stem. The two tributaries that enter from the west have farming operations located along portions of the streams.

As mentioned above in the history section, there is evidence of much more extensive agricultural land use in the past as well as logging operations that contributed to the sedimentation still evident in the valley. The practices of one hundred years ago and more must be considered when considering how land use has influenced the stream as we

see it today. Additional observations of current conditions and the effects of past use will be found in the *Visual Assessment* section.

Current efforts at land use planning include an underway update of both the county and Bedford Township comprehensive plans. It is expected that these plans will be completed in late 2006 and FBTU looks forward to reviewing final drafts. A stormwater management plan for the Shobers Run watershed was begun several years ago by the Bedford County Planning Commission. The Bedford Township Act 537 Sewage Facilities Plan anticipates adding additional sewage lines to approximately one mile south of the Bedford Springs.

Watershed Stakeholders

Property Owners

From the mouth of Shobers Run upstream past the Bedford Elks, there are a limited number of property owners with stream frontage, especially along the western bank. The Bedford Borough Municipal Authority, the Bedford Area School District, and Cessna Communications, Inc. own the streamside property between the Route 30 bridge and the Bedford Elks. On the opposite side of the stream, Donahoe Manor road parallels Shobers Run for several hundred yards and for many years only the Bedford Rural Electric Coop, the Bedford Church of the Brethren and Bedford Nursing Home, Inc.'s Donahoe Manor existed along this road. In recent years, the Church of Jesus Christ of Latter Day Saints built here and several assisted-living facilities (Colonial Courtyard, Graystone Court, et al) have located here along with a few new homes with stream frontage. To the south, Donahoe Manor Road enters the residential development Meadowbrook Terrace that includes about 130 homes.

Upstream from Meadowbrook Terrace and the open field where Cessna Communications has place a radio transmitter/tower, Shobers Run flows through the golf course and past the buildings of the Bedford Elks, the former site of the Arandale Hotel. Above the Elks property, lands of the Bedford Springs begin. The Bedford Springs properties include about 2100 acres, mostly wooded in upland areas, but the golf course and hotel complex occupy significant acreage near the stream. South of the Springs, there are no truly large property holdings in the watershed other than the Bussard orchards and tree farm at the headwaters of the main stem. There are about ninety-four homes in the valley of the main stem. Along the two tributaries entering from the west, about 30 homes are located in the catchment to the north, with nearly 20 homes in the southern near Brown Road.

Others

Municipalities concerned with the Shobers Run watershed include Bedford Borough and the two townships, Bedford and Cumberland Valley. The Bedford Valley Rod and Gun Club is a sportsman group with a facility along Sweet Root Road. The Bedford Elks annually conducts a "fishing rodeo" on the Elks' portion of Shobers Run; stocking trout

for a youth outing and contest. While this event is the most visible evidence of young people using the fishery resource, during the early part of the trout season the lower two miles of Shobers Run receives considerable angling pressure from young and old.

In addition to Fort Bedford Trout Unlimited, other groups have undertaken projects and activities within the watershed. PA CleanWays of Bedford County has sponsored litter cleanups along stream banks and roads, and the Bedford Rotary Club has conducted cleanups along Business Route 220 through PA DOT's Adopt-A-Highway program for many years

Issues and Concerns

Shobers Run Coldwater Conservation Plan Public Meeting

A public meeting was held at the Bedford Middle School on May 18, 2004 for concerned parties to learn about the process for the Coldwater Conservation Plan and to voice concerns about Shobers Run and activities within the watershed. The following is a list of items of concern mentioned by the participants at that meeting.

Issues and Concerns

- Illegal dumping
- Residential and commercial development
- Logging
- Stormwater management
- Water withdrawals
- Stream bank erosion
- Earthmoving
- Nutrient pollution
- Gravel bar/island formation
- Sewage/malfunctioning septic systems
- Invasive plants (purple loosestrife)
- Golf course pollution
- Lack of riparian buffers
- Pesticide spills
- Bedford Springs development
- Yard care/lawn maintenance
- Sources of tributaries/springs
- Retaining walls causing problems

Watershed Health

Visual Assessment

The Fort Bedford Trout Unlimited chapter held a stream visual assessment training seminar on June 18, 2004 at the Bedford Middle School. Western Pennsylvania Conservancy conducted the training. The protocol for the training came from USDA National Water and Climate Center Technical Note 99-1, Stream Visual Assessment Protocol. This document presents an easy to use assessment tool to evaluate the condition of aquatic ecosystems associated with streams.

During the summer and early autumn of 2004 and again in the summer of 2005, FBTU volunteers conducted visual assessment stream walks in small teams of two or three. Approximately 60 % of the main stem and 50 % of the larger tributaries were covered. Rather than present the raw survey forms, this assessment is presented in narrative form with reference to scores from the SVAP where relevant.

Mouth to Bedford Elks

At the mouth of Shobers Run, US Route 30 crosses the stream and sediment deposits and other influences of the Raystown Branch mark the area of the confluence. During low to moderate stream stages, current flow from the upstream side of the crossing to the junction is very slow. Stream bottom in this area is composed of finer sediments and there is poor habitat for a diversity of benthic organisms. There is evidence of channel straightening and widening, probably associated with bridge and road construction. Longitudinal gravel bars have developed and the stream above the bridge has begun to restore natural meanders. In addition to poor macroinvertebrate habitat, this lowest portion of Shobers Run has poor fish habitat, little shading from streamside trees, and runoff and litter problems from the adjacent roadway and nearby paved business lots.

Figure 4 Route 30 bridge at mouth of Shobers

Across Donahoe Manor Road, which intersects US 30 near the Shobers Run bridge, the Bedford Rural Electric Coop facility includes a small pond. In the past, someone stocked a variety of fish species (including largemouth bass and bluegill) in this pond, though it is

prominently posted against trespassing. Upslope from the pond, there is a fenced but unroofed area where transformers have been stored for many years. There is some concern that contaminants may have entered this pond, and surrounding soil, from this unprotected storage though there is no evidence of such contamination.

Figure 5 Pond at REC facility near junction of Shobers Run and Ravstown Branch

As noted previously, the land on the west bank of the stream, from the mouth to the Watson Street bridge is property of the municipal authority and the Bedford Area School District. Throughout this section, there is minimal shading from streamside trees and there is evidence of past channel straightening. The eastern bank has more natural vegetation but the buffer is very narrow in places. The municipal authority land includes a wastewater treatment plant and a portion of the adjacent field is used by the PA DOT to park some equipment and stockpile materials. In exchange for this use, the PA DOT maintains the property by mowing. Over the last ten years, the municipal authority granted permission to groups such as FBTU, PA CleanWays, and students from the high school to plant trees toward establishing a buffer of about 20 feet in the sections where mowing was occur to the water's edge. While some earlier plantings failed to establish, seedlings planted about five years ago were growing until the early summer of 2006 when it was noted that mowing to the stream edge had again occurred. FBTU contacted both the municipal authority and the office of the borough manager concerning this and a solution will be worked out with PA DOT. Replanting of the buffer by FBTU and others is planned for spring of 2007.

Figure 6 Streambank adjacent to Bedford Borough sewage treatment plant

On the other bank, opposite the above-described reach, there is a narrow, mostly steep, vegetated buffer between the stream and Donahoe Manor Road. The development that has occurred, and is planned, includes several storm water outfalls that enter Shobers Run. These sites were permitted before the most recent changes to PA stormwater management statutes. These outfalls are from stormwater detention basins and appear adequately designed and constructed to minimize sediment pollution but this

could lead to higher stream temperatures after summer rains. The stream through this section alternates between pools and riffles with a cobble-gravel bottom dominating in most riffles and gravel-sand-silt bottom in the pools. There is fair macroinvertebrate habitat, fair fish habitat, poor shading, and poor-to-fair riparian vegetation.

Figure 8 View downstream from Watson Street bridge

Within the Meadowbrook Terrace housing development, there is no extensive stormwater management system. Since part of the development is within Bedford Borough and part in Bedford Township, and because the houses were built over a period of 30 years or more, management of stormwater is varied. Only where the roads converge near the Watson Street bridge is there significant runoff that can enter the stream with heavy downpours. Throughout the remainder, the few catch basins, the concrete ditches and grassy swales deliver runoff the grassy areas that either retain and infiltrate or, in large part, modify the runoff to sheet flow. Surprisingly, lack of planning seems to have resulted in a storm water system that is not perfect but better than others with a similar lineage. On the negative side, the landowners with stream frontage in this area have not maintained natural stream vegetation and in some spots mow to the bank. Downstream from the Watson Street bridge, the stream has narrow vegetative buffers on each side. Within this section, there are several rock-and-log tip deflectors that were installed as part of an Eagle Scout project in the early 1990's. The section has fair to good habitat for macroinvertebrates and fair fish habitat. The bottom is gravel and cobble with an excess of fine sediment in the slower glides. Immediately downstream of the bridge, there was formerly a low head dam that carried a sewer main across Shobers Run from Meadowbrook Terrace. This was removed during sewer line replacement work in 2002, with a new buried line crossing downstream nearer the treatment plant. A mid-channel, longitudinal gravel bar has developed where this dam crossed, partially seen in above photograph. Upstream from the bridge, a similar mid-channel bar has developed over a long time and now is large enough to support small trees. These

Figure 7 View upstream from Watson Street bridge

bars have forced bank-full, channel-forming flows to move laterally and, with inadequate bank stabilization have caused the stream to widen, becoming shallower and slower. Shobers Run in this section is nearly twice as wide as it was 30 to 40 years ago. The former dam and the bridge design are probably responsible for the establishment of the gravel bar grown into a vegetated island. Replacement of the bridge (a wooden deck, single lane span) is planned soon and it is anticipated that restoration of a stable, midstream channel can be accomplished at that time. FBTU has been granted permission by the school district to establish a minimal buffer along the west bank; this work awaits completion of the bridge project.

The remaining stream segments downstream from the Bedford Elks are characterized by minimal streamside vegetation on the western bank, inconsistent vegetation on the eastern bank (controlled by individual residential property owners), and sites with eroding banks as the stream reestablishes meanders eliminating by past channel straightening. Shading is poor to fair and habitat is fair to good for macroinvertebrates and fish. In a few spots, bedrock forms part of the stream bottom but gravel and smaller cobble predominates. There are several deeper pools and some riffle areas with deeper, faster flows. Between the property owned by the school district and that of Cessna Communications, there is a channel that carries storm water from the residential area to the west. This may be a remnant of the channel noted on the 1939 aerial photographs and associated with the millrace marked on the 1877 maps.

Bedford Elks

Shobers Run flows for approximately six tenths of a mile through the property of the Bedford Elks that includes a nine-hole golf course. On the northern half of this section, the stream forms the eastern "out-of-bounds" of the golf course. On the course side, vegetation is expectedly sparse but there are many large trees along the stream edge; some that are undercut. On the opposite bank, the vegetated buffer is wider but in some places modified by landowners. In this stretch also is found a broader area of buffer into which some of the stormwater runoff from the southern part of Meadowbrook Terrace is diverted. Though shading is fair through this stream segment, habitat for fish and benthic organisms is better than downstream, and the bottom has a greater proportion of larger cobble. A footbridge crosses the stream in this section. Midway through the golf course, there is a vehicular

Figure 9 View looking east from Bedford Elks parking lot

bridge that provides access to a residence on the eastern side of the stream. Near this bridge, there is a spring seep (not shown on topographic maps) that enters the stream from the east. Upstream from the access bridge, there is a section mown to the water's edge that transverses several fairways. Here, despite the lack of buffer, the stream banks have remained stable (though channel straightening surely occurred in the past) through some use of riprap and bank shaping that allows the stream access to its floodplain during high-water events. Two additional bridges for walking golfers and carts span Shobers Run in this section that crosses the course. There is little diversity in habitat for aquatic life in this transverse reach and the bottom contains fine sediment deposits in many spots. There is some aquatic vegetation and a deeper channel in part of the segment, but the stream is largely too wide and too shallow.

The upstream portion of the stream on the golf course lies at the base of a steep slope to the west, paralleling Business Route 220. There are some minor riffle areas and few deep pools; channel straightening and dredging have produced a 'ditch' with little habitat diversity. Stream banks exhibit signs of severe erosion and slumping in the past, resulting in a too-wide stream channel. This section has some midstream boulders and some bedrock bottom.

FBTU has been encouraged in recent years with the Bedford Elks golf course management decisions to leave a larger unmown section along the stream edge and to allow volunteer groups to plant riparian trees and shrubs. While these riparian enhancements cannot be implemented everywhere on the golf course without affecting play, additional stabilization and shading of any degree is welcome.

Figure 10 View upstream (south) from Bedford Elks parking lot

Bedford Springs

Upstream from the Bedford Elks, Shobers Run flows for over two miles through property of the Bedford Springs hotel-resort. Near the Elks-Springs boundary, a small seasonal tributary enters from the east off the flank of Evitts Mountain. The next upstream quarter mile is well-shaded with a mixed buffer to the west that includes large trees and a broad vegetated zone continuous with the forested slopes at the base of Evitts Mountain to the west. The stream follows a broad bend away from Business Route 220 and the stream banks are largely stable with a bottom of predominantly gravel and cobble. There is good habitat for macroinvertebrates and fish with wood debris and a riffle-pool sequence. In this section, within the last ten years, FBTU members have caught and released brown trout of less than 10 cm, and other similar brown trout, atypical in appearance to concurrently caught stocked trout, up to 25 cm. These trout are assumed to be 'wild', stream-bred fish. At the upstream end of this stream section, as Shobers Run nears the

Figure 11 View of eroding stream bank (legacy sediments) on Bedford Springs' property

road, there is an old log house and outbuilding sited between the stream and the road. A large pool at a meander of Shobers Run in this area exposes an eroding bank of 1 – 2 meters in height that reveals the overlay of legacy sediments. Could this site be part of Henry Wertz's millpond that was so controversial two centuries ago; or another undocumented milldam?

Upstream from this meander pool, at the site of a former footbridge used by hotel guests, the stream for 100 yards or so is entrenched in a wide straight section that appears to be man-made. The bottom here is of gravel and finer sediments with poor habitat, though fairly well shaded. Above this, Shobers flows in a short, narrow section at the base of a steep slope below Business route 220. This section moderately shaded and the bottom is largely cobble, with good current velocity and habitat. Probable stream-bred brown trout have been caught and released in this area in recent years. At the upstream end of this 'run', a slow-moving pool is found adjacent to the historic Naugel's (Nawgel's) Mill building. Another footbridge was formerly sited at the upstream end of this pool and a municipal sewer main crosses the stream here. Activities involved in the construction and maintenance of the bridge and sewer pipe probably had an influence on the character of the pool and its stream banks and channel. Over the last ten years, it could be observed that a longitudinal gravel bar developed along the east bank in this pool; eventually to merge with the east bank as vegetation established, effectively narrowing the stream and beginning to create a meander. This pool does not provide good macroinvertebrate habitat, shading is only fair, and sedimentation is an expected problem. This site has been a very popular angling spot for many years and the PA Fish and Boat Commission stockings pre-season and in-season create a predictable fishery.

Figure 12 Storm water outfall at Bedford Springs hotel

Above the pool, Shobers Run flows through a brief section of bedrock bottom and for a couple hundred yards farther is moderately well shaded with good habitat. From the east, a near-perennial tributary enters draining the small wooded basin containing the locally noted 'Davey Lewis' Cave, part of Bedford County folklore. On this stream section, too, the first of the named 'Bedford Springs' contribute their flow along with associated and unnamed seeps along the steam banks. The eastern bank is steep and densely wooded with large hemlocks on Constitution Hill. Immediately in front of the main entrance to the hotel, where the colonnade once crossed road and stream to access the Magnesia Spring, the stream bank adjacent to the road has long been armored with a stonewall that in recent years has deteriorated. Here, with less shading and a more manipulated stream channel, habitat is fair, though stream temperature and flow are adequate. Near the intersection of Business Route 220 and Sweet Root Road, Shobers Run turns where it flows under the bridge carrying Sweet Root Road. Here, surface flow and seepage from the Crystal Spring, located a few hundred feet south along Sweet Root Road enters the stream. Crystal Spring, flowing from a pipe emerging roadside from the bank below Constitution Hill, remains a popular water source, with area residents stopping to fill jugs on a near constant basis. A storm water outfall is located a short distance downstream from the Sweet Root Road access bridge. This carries water from the hotel area, and the seeps and springs behind the hotel on Federal Hill, to the stream.

Above the Sweet Root Road bridge, Shobers Run flows through the Bedford Springs golf course. The stream segment(s) on this golf course scored well below any other sections during the Visual Assessment Survey, as might be expected. Shading and the riparian vegetation zone are nearly non-existent; throughout the course, mowing occurs to stream bank top or water edge. Habitat for all forms of life is poor, banks are unstable and eroding, stream bottom is heavily silted, and the stream is entrenched and disconnected from the floodplain. Four tributaries enter Shobers Run on the golf course; three from the east including the northern run that drains from Red Oak Lake fed by the Black Spring. These tributaries, within the course, have similar habitat deficiencies; although all but the northern tributary from the 'lake' are seasonal or temporary. In addition to the natural drainage from the west, storm water runoff from Business Route 220 flows in an unstabilized ditch toward the golf course, and Shobers Run, through a wooded area. There are numerous bridges for golfer access on the course and management of the course drainage, a problem in wet years, has resulted in many ditches, often poorly stabilized, being used.

There are residences along the eastern side of Sweet Root Road to the north and south of Red Oak Lake. These are either now connected or will soon be connected to the Bedford Township Municipal Authority sewer system. There is no municipally-integrated storm water management in this area.

Beyond the golf course to the south, the Bedford Springs property encompasses nearly another one half mile of Shobers Run. In this section a tributary enters from the east and here is also found numerous eroding trails cut by trespassing ATV riders that deliver sediment to the tributary. This section is wooded throughout and shading is very good.

Stream bank stability is fair to good with some banks eroding and revealing likely legacy sediments as the channel seeks its natural meander structure. There is a problem with illegal dumping on the Springs' property in this section but little trash is found within the stream itself.

Springs to TR408 Bridge

The next two and a half miles upstream is largely wooded with little residential development or roadways near the stream. Business Route 220 and Sweet Root Road both parallel Shobers Run at a distance of between 1000 and 2200 feet for most of the length of this stream section. Over the last 4000 feet of stream north of the TR408 bridge, Shobers Run approaches Sweet Root Road and the last 1200 feet before flowing under the Sweet Root Road bridge are within 100 feet of the roadway. At a few points the top of the stream bank is within the right-of-way. Four minor tributaries enter from the flank of Evitts Mountain to the east. These are mostly seasonal streams, with surface water flow after snowmelt and during wet periods. At the southern end of the section, a more significant tributary enters from the west, passing through a gap in the mid-valley ridge that borders the main stem watershed on the northwest. This tributary adds greatly to the volume of water; in drier seasons contributing 30% to 50% of the downstream flow volume.

Residential development in this section is greatest in the middle to southern portion, somewhat clustered around the eastern tributaries. In the southern part of the section, where Shobers Run bends in a large meander close to Sweet Root Road, there are several houses close to the stream flowing through yards. Even farther south, residences are all on the east side of the road. Throughout these 'developed' parts of the watershed, yard management adjacent to the tributaries as well as Shobers Run typically includes lawns mowed to the stream bank; and runoff, where managed at all, is directed into natural stream channels. There are also pipes emptying into stream channels that might carry runoff or 'gray' water from washers and sumps. On-lot septage systems are a potential source of non-point source pollution of nutrients and fecal bacteria but no definitive evidence of failing or inadequate systems was detected during the survey. In these limited residential areas, stream shading is poor and bank erosion evident. Embeddedness of bottom gravel and cobble is significant and instream habitat is poor to fair. Throughout the greater wooded portion of this section, habitat diversity is good for benthic organisms and fish, shading is good to excellent, and steam bank stability is fair to good, with some channel migration and anastomising

Figure 13 View upstream from Sweet Root Road bridge

channels probably due to legacy sediments and past land use practices. In some sites, due to the same influences, bottom gravel and cobble is significantly embedded in finer sediments.

The TR408 bridge is located where Sweet Root Road (TR408) turns west across Shobers Run and connects to Teaberry Road which parallels the stream on the west in the next stream section to the south. At the bridge, Shobers Run is very narrow and in mid-summer nearly completely canopied by both stream bank shrubs and an over-story of larger trees. Within the last five years, there was a timber harvest on a small tract downstream from the bridge in the vicinity of the junction with the tributary from the west. This was not a 'clear-cut' type of harvest and was not a land-clearing operation as a preclude to construction.

Over the last five years, several illegal dumping of trash incidents have occurred along the stretch of Sweet Root Road that closely parallels Shobers Run near the bridge.

Northern Tributary

This tributary drains a small portion of land (~1400 acres) both north and south of the gap in the ridge. The upper parts of the streams are ephemeral or intermittent with no surface water during much of the year. These begin in wooded sections and then pass onto residential parcels where the banks are typically mowed as lawn. Channel and bottom stability varies. As both the northern and southern branches approach the gap, due to topography and stream elevation they become effluent (gaining) reaches, with water 'incoming' to the stream channel from groundwater. A beef operation is located along the southern branch near the gap and here the stream is entrenched in high, unstable eroding banks with little vegetative cover. Manure laden runoff often flows to the stream from this farm. On the northern branch, there is some riparian vegetation but we have not closely surveyed the habitat on these stream sections. On the eastern bank, a wooded hillside borders the branch, and to the west, beyond a narrow buffer with stream bank trees, lie horse pastures. In the gap there are multiple springs that greatly amplify the flow, as well as cool the stream water temperature. Habitat in the gap has not yet been assessed but from a distance, stream shading is poor to fair and eroding banks are visible in spots. As the stream leaves the gap to the east, it passes under Teaberry Road between its intersections with Sweet Root Road and Business Route 220. Immediately upstream from the crossing, Shobers Run flows through a residential property

Figure 14 Clear cold water and macrophytes (watercress) in northern tributary at Teaberry Road

with an absence of vegetative buffers and poor shading. Stream banks are fairly stable, though and the bottom is composed primarily of gravel. Along the stream margins and in slower current areas, aquatic plant growth (watercress, etc.) is substantial. Habitat diversity for benthic organisms and fish is fair.

On the downstream side of the Teaberry Road crossing, this northern tributary flows through a mixed vegetation riparian zone with large black locust trees along the watercourse. Residential development is beginning to encroach from the north. To the south, the buffer between TR 408 and the tributary varies from 1bout 150 feet to more than 500 feet. The stream in this section is well shaded and the banks have fair to good stability. Habitat for fish and macroinvertebrates is good with a bottom of gravel and some cobble, with low embeddedness. As this tributary nears Shobers Run, there is some channel braiding.

Sweet Root Road (TR408 Bridge) to Shobers Run Lane

Figure 15 Hayfields along Teaberry Road above Shobers Run

Upstream from the TR408 bridge, Shobers Run flows for two miles through a largely wooded section. There are no roads adjacent to or crossing the stream in this segment and the residences along Teaberry Road are mostly 1000 feet or more from the stream. There is one small cattle operation along Teaberry Road with minimal stream impacts and pasturage and hay fields are mostly along the road somewhat removed from the stream course. In the southern portion of this segment, residential development along lanes descending from Teaberry Road (approximately 150 above the stream) is closer to Shobers Run. Near the Browns Road and Shobers Run Lane junctions with Teaberry Road, two ponds that are shown on topographic maps are largely dewatered. Sources for these ponds were likely springs in the area of the gap at Browns Road and possibly water diversions from the tributary that bisects the gap.

The area around Shobers Run Lane and Flying Dutchman Road (both private) has some residential development and a large, constructed wetland pond. Formerly a harness racing track (still drawn as such on USGS topographic maps and others), the pond was an USDA-NRCS designed project. Water levels in this pond are maintained by a naturally high water table in the Brinkerton soils of the area, by spring seep at the base of the low rise to the west, and by storm water runoff. A diversion from Shobers Run, a six-inch pipe, is sited to only divert water

Figure 16 Constructed wetland pond near Shobers Run Lane

during higher stream stages.

Figure 17 Shobers Run Lane crossing and sediment-laden stream channel

Shobers Run Lane crosses the stream that is carried below in a stack of seven corrugated metal pipes. The road in this section is unpaved and exhibits maintenance problems associated with high flows in Shobers Run. Conversely, the road negatively impacts the stream, evident in sediment and stream bank stability problems.

Over the course of this stream section, five seasonal tributaries enter from the east off the flank of Evitts Mountain; and from the west, a single perennial tributary that cuts through the ridge from the west, draining a small area (~1100 acres) of the neighboring valley. Over the length of this section, Shobers Run is much narrower than the preceding section. With the exception of the area around the roads described above, the riparian zone has minimal present-day disturbance and vegetation is intact and varied. The stream is well shaded but bank and channel condition bear evidence of past disturbance. Probable channel dredging and straightening, and legacy sediments, have yielded a stream with sediment problems and unstable, migrating stream banks. Fish habitat is limited by the rarity of deeper pools. Habitat for macroinvertebrates is fair to good, somewhat impaired by fine sediments in some areas.

Southern Tributary Near Browns Road

The southern tributary that enters Shobers Run from the valley to the west through the cut at Browns Road (near map location labeled as Burning Bush) is very similar to the northern tributary already described above. The steeper, upstream portions of this small sub-watershed are ephemeral or seasonal with surface flow only after spring snow melt or rain events. In many areas, summer flows are completely subsurface. There are seeps and springs that add flow where channels coalesce in the valley floor. As these combined drainages reach the cut through the ridge that separates the two valleys, several springs add significant volumes of colder alkaline water. A small beef operation is located along the stream in the ridge cut along Browns Road and one of the feeder springs has been dammed to form a pond. On the southern face of the cut, the wooded slope has degraded

Figure 18 Pasture along southern tributary near Browns Road

understory and ground cover due to cattle grazing and the stream banks and riparian zone are also impacted. To the west of Teaberry Road, the tributary has little diversity of habitat for macroinvertebrates or fish but the bottom sediments, mostly gravel, remain relatively free of fine silts and embeddedness is less than in other sections of the watershed. Canopy cover on the western portion of the drainage is poor to fair.

Figure 19 Former water diversion along southern tributary near Teaberry Road crossing. (stream flow is from left to right)

Downstream (east) of the Teaberry Road crossing, the tributary flows about 0.3 mile through a scrub and forested area before joining the main stem of Shobers Run a short distance below the 7 pipe crossing on Shobers Run Lane described in the preceding section. Formerly, two ponds were situated on either side of the tributary (and Shobers Run Lane) and these are still noted on topographic maps of the area. The northern, larger pond still exists as an impounded depression but holds little if any water during most of the year (reportedly there is a breach in the dam wall). A high water diversion of flow, not in use, from the tributary to this pond is still found a few yards downstream from Teaberry Road.

In this eastern, downstream portion of the tributary, canopy cover is improved and the immediate riparian zone has little recent impact from development or agriculture, appearing to be naturalizing former pasture or cropland. There is greater diversity of instream habitat though deep pools are lacking.

Headwaters

Upstream from the constructed wetland near Shobers Run Lane, the creek flows for about 1.9 miles through a forested area with very little residential or other development. No roads cross the creek in this section and the few houses along this stretch are near the road (Teaberry Road to the west) and not close to the stream. This is a stream section that had minimal direct observation during the Visual Assessment. This stream section spans the border between Bedford and Cumberland Valley Townships Two seasonal/ephemeral tributaries enter Shobers Run from the ridge to the east in this section. A private, unpaved road that accesses a small poultry farm crosses the southernmost of these tributaries

About two miles upstream of Shobers Run Lane, near Buck Falls Road, Shobers Run main stem bifurcates with an eastern branch that follows Buck Falls Road and a western branch that continues along Teaberry Road. Stream gradient increases significantly along each of these headwater tributaries. Over a few hundred yards, the branch paralleling Teaberry Road becomes a seasonal stream carrying snow melt and storm water and

resembles a roadside ditch passing a few residences along the road. The eastern branch carries water throughout more of the year and its source is on a tree farm with three ponds. The tree farm property includes the saddle that marks the divide between the Shobers Run (Susquehanna) watershed and the Evitts Creek (Potomac) watershed.

The downstream portion of this section (below Buck Falls Road) has good canopy cover and a diversely vegetated riparian zone. Stream banks are moderately stable overall but there is poor habitat diversity for fish and fair habitat for macroinvertebrates. Embeddedness of coarse bottom gravel and cobble in the riffle areas is evident. Upstream from Buck Falls Road, canopy cover is poor and the riparian zone is impaired by close proximity of road, clearing and mowing and the large constructed ponds. Habitat is poor and there are sediment impacts.

Water Chemistry

Parameters

High Quality Waters in Pennsylvania are so designated when meeting various water quality criteria at least 99% of the time. These criteria include: dissolved oxygen, aluminum, iron, dissolved nickel, dissolved copper, dissolved cadmium, dissolved arsenic, dissolved lead, dissolved zinc, ammonia nitrogen, pH, and temperature. For a High Quality Cold Water Fishery designation, additional specific limits for alkalinity (minimum of 20 mg/L as $CaCO_3$), dissolved oxygen (minimum of 7.0 mg/L), iron (1.5 mg/L 30-day average), osmotic pressure (maximum of 50 milliosmoles/kg), pH (6.0 to 9.0, inclusive), and total residual chlorine (0.011 mg/L 4-day average, 0.019 mg/L 1-hour average).

FBTU chose to examine temperature, pH, dissolved oxygen, nitrate-N, orthophosphate, and alkalinity for this project. This selection was made considering that temperature, pH, alkalinity and dissolved oxygen are all vital for a coldwater fishery and that the two nutrient parameters (nitrates and phosphates) could indicate impacts from agriculture or residential septic systems. Also important for the selection of specific test kits was the ease of use by volunteer monitors.

Previous Sampling Efforts

When first organized the Dickinson College ALLARM project targeted acid rain (the acronym was Alliance for Acid Rain Monitoring at the time, today its Alliance for Aquatic Resource Monitoring) and simple kits for measuring pH and alkalinity were distributed to volunteers. During 1989, five sampling events by ALLARM volunteers occurred between 4/13/89 and 6/21/89 at a site identified as 165a. The minimum pH was found to be 6.0, the maximum was 8.0, and a reported mean of 7.4. Alkalinity ranged from 35 to 95 with a mean of 64. Conditions under which these measurements were made are unknown.

Bedford High School students participating in the Envirothon Club of teacher Ms. Laura Jackson have collected water samples for analysis of basic parameters. The students use LaMotte kits for their chemistry monitoring and collect their samples near the school, a few hundred yards from the mouth.. Through personal correspondence, Mrs. Jackson states that the results obtained by her students continue to indicate that Shobers Run water quality remains within acceptable limits for all parameters monitored but that there has been an increase in nitrate concentrations.

Shobers Run was one of 101 sites in the Juniata River subbasin that Susquehanna River Basin Commission (SRBC) visited and collected samples during the summer and fall of 2004. The water sampling on Shobers Run occurred on the afternoon of October 6, 2004, after flooding due to Hurricanes Frances and Ivan, at a site described as along Business Route 220 downstream of the Bedford Springs. The water chemistry results of that study are summarized below. (PBQ is reported for "parameter below quantification" when a test determines the concentration is below the detection limit.

SRBC Water Chemistry Data

Parameter	Results	Levels of Concern
Alkalinity (lab)	101.4 mg/L	<20 mg/L
Aluminum, total	PBQ	>200 μg/L
Calcium, total	42.1 mg/L	>100 mg/L
Chloride	4.94 mg/L	>250 mg/L
Hardness, total	140 mg/L	>300 mg/L
Iron, total	150 μg/L	>1,500 μg/L
Magnesium, total	8.5 mg/L	>35 mg/L
Manganese, total	11 μg/L	>1,000 μg/L
Nitrate-N	0.54 mg/L	>1.0 mg/L
Nitrite-N	PBQ	>0.06 mg/L
Nitrogen, total	0.65 mg/L	>1.0 mg/L
Orthophosphate, total	PBQ	>0.05 mg/L
Phosphorus, total	0.01 mg/L	>0.1 mg/L
Sodium, total	3.35 mg/L	>20 mg/L
Sulfate	39.9 mg/L	>250 mg/L
TOC	2.2 mg/L	>10 mg/L
TSS	PBQ	>25 mg/L
Turbidity	1.62 NTU	>150 NTU
Acidity (field)	0 mg/L	>20 mg/L
Alkalinity (field)	102 mg/L	<20 mg/L
Dissolved oxygen (field)	9.28 mg/L	<4 mg/L
Flow	14.162 cfs	
pH (field)	8.35	<5.0
Conductivity (field)	303 μmhos	>800 μmhos
Temp (field)	13.9ºC	>25ºC

FBTU Monitoring

For this report, FBTU undertook to conduct water quality monitoring at six sites in the watershed. While the intent was to sample on a monthly basis, logistics prevented this and samples were collected on an approximate quarterly schedule. The data collected is presented in Appendix D. FBTU used LaMotte and HACH kits as indicated in the data tables. A final sampling effort in August 2006 in partnership with the Bedford County Conservation District used other test methods including HACH LDO oxygen meter, HACH sensION pH meter, HACH portable turbidimeter, and HACH DR890 colorimeter.

While the results obtained by FBTU were generally similar to those from the SRBC study, the orthophosphate results, especially during the last collection in August 2006 where the colorimeter was used, were significantly higher. Likewise, there was considerable difference between the volunteer orthophosphate results and that obtained during the August 2006 sampling. Both used similar test chemistry (HACH) with the primary difference being the color wheel used with volunteer monitor kits and the programmable colorimeter during August 2006. The high readings from August 2006 prompted an immediate return to two sites where samples were collected directly into the glass vials used with the colorimeter and the test conducted streamside. No bias from the previous collection in Nalgene sampling bottles was noted. The disparity between the test results and the high orthophosphate readings from the August 2006 have not been resolved and continued phosphorus monitoring is planned to determine if these results were an anomaly or are an indication of an actual water quality concern.

Summary of Water Quality Monitoring
(complete data tables in Appendix E)

Site	(Site ShoMS125 - not used during volunteer monitoring; data for 1 date)	
ShoMS001	Temperature Range:	1.5 – 22.1 C
	Dissolved Oxygen Range:	7.8 – 10.2 mg/L
	pH Range:	7.0 – 7.86
	NO3-N Range:	0.10 – 0.35 mg/L
	PO4 Range:	0.08 – 0.44 mg/L
	Alkalinity Range:	120 – 128 mg /L
	Turbidity Range:	<5 – 10
ShoMS064	Temperature Range:	1.5 – 21.7 C
	Dissolved Oxygen Range:	7.7 – 10.0 mg/L
	pH Range:	7.0 – 7.75
	NO3-N Range:	0.10 – 0.37 mg/L
	PO4 Range:	ND – 0.26 mg/L
	Alkalinity Range:	94 - 120 mg /L
	Turbidity Range:	<5 – 10

ShoMS125	Temperature Range:	23.0 C
	Dissolved Oxygen Range:	9.2 mg/L
	pH Range:	8.05
	NO3-N Range:	0.20 mg/L
	PO4 Range:	0.13mg/L
	Alkalinity Range:	116 mg /L
	Turbidity Range:	4.89
ShoMS270	Temperature Range:	2.0 – 24.8 C
	Dissolved Oxygen Range:	6.4 – 8.0 mg/L
	pH Range:	7.0 – 7.5
	NO3-N Range:	0.05 – 0.22 mg/L
	PO4 Range:	ND – 0.10 mg/L
	Alkalinity Range:	96 - 116 mg /L
	Turbidity Range:	<5 - 15
ShoMS702	Temperature Range:	1.0 – 20.7 C
	Dissolved Oxygen Range:	6.8 – 7.5 mg/L
	pH Range:	7.5 – 7.74
	NO3-N Range:	0.13 – 0.35 mg/L
	PO4 Range:	ND – 0.20 mg/L
	Alkalinity Range:	112 – 140.8 mg /L
	Turbidity Range:	<5 (all dates)
ShoHwe	Temperature Range:	17.0 – 20.5 C
	Dissolved Oxygen Range:	6.6 – 7.0 mg/L
	pH Range:	6.5 – 7.40
	NO3-N Range:	0.08 – 0.15 mg/L
	PO4 Range:	0.02 – 0.08 mg/L
	Alkalinity Range:	64 – 76.8 mg /L
	Turbidity Range:	<5 (all dates)
ShoUNT70	Temperature Range:	16.2 - 17 C
	Dissolved Oxygen Range:	7.3 – 7.8 mg/L
	pH Range:	7.5 – 7.75
	NO3-N Range:	0.38 – 0.58 mg/L
	PO4 Range:	0.04 – 0.46 mg/L
	Alkalinity Range:	146.8 - 160 mg /L
	Turbidity Range:	<5 (all dates)
ShoUNT90	Temperature Range:	14.0 – 15.5 C
	Dissolved Oxygen Range:	7.3 – 7.8 mg/L
	pH Range:	7.5 – 7.58
	NO3-N Range:	0.08 – 0.20 mg/L
	PO4 Range:	0.06 – 0.10 mg/L
	Alkalinity Range:	164 - 180 mg /L
	Turbidity Range:	<5 (all dates)

Macroinvertebrate Sampling

An examination of benthic macroinvertebrates is a valuable tool for assessing the long-term health of an aquatic system. For many aquatic macroinvertebrates, pollutant tolerance scores have been generally accepted and the relative abundance of variously sensitive taxa can be used to calculate several metrics and indices that qualify stream health.

The Susquehanna River Basin Commission conducted macroinvertebrate sampling at the same time as the water chemistry sampling noted above. Their results are listed below.

Order	**Family**	**Genus**	***# in sample***
Coleoptera	Elmidae	*Optioservus*	42
		Stenelmia	2
	Psephenidae	*Psephenus*	5
		Ectopria	1
Diptera	Athericidae	*Atherix*	2
	Chironomidae		28
	Tipulidae	*Antocha*	1
	Simulidae	*Simulium*	28
Ephemeroptera	Baetidae	*Acentrella*	1
	Ephemerellidae	*Ephemerella*	3
	Heptageniidae	*Stenacron*	6
		Stenonema	24
	Isonychidae	*Isonychia*	23
	Leptophlebia	*Paraleptophlebia*	1
Megaloptera	Corydalidae	*Corydalus*	3
		Nigronia	3
Trichoptera	Hydropsychidae	*Ceratopsyche*	6
		Cheumatopsyche	17
	Philopotamidae	*Chimarra*	8
Amphipoda	Gammaridae	*Gammarus*	1

FBTU Macroinvertebrate Sampling

FBTU volunteers collected macroinvertebrates from three sites during early spring in 2005. At each site, three kick seine samples were taken within a 100-meter section and the individual samples were combined for each site. Samples were collected from riffle/run reaches. Volunteers sorted the samples to taxonomic order (in some cases family) and preserved voucher samples in 70% alcohol. Identification to the taxa listed was completed during the next few days with the assistance of the Watershed Specialist at the Bedford County Conservation District.

At the time the collections were being made, subimago mayflies, probably *Baetis*, were emerging, occasionally in the seine.

ShoMacro 1:

Order	**Family**	**Genus**	**# in sample**
Coleoptera	Elmidae	*Optioservus*	14
		Stenelmia	2
	Psephenidae	*Psephenus*	1
Diptera	Athericidae	*Atherix*	4
	Chironomidae		14
	Tipulidae	*Antocha*	3
	Simulidae	*Simulium*	9
Ephemeroptera	Baetidae	*Acentrella*	7
		Baetis	5
	Ephemerellidae	*Ephemerella*	3
		Drunella	12
	Heptageniidae	*Stenacron*	5
		Stenonema	9
	Isonychidae	*Isonychia*	14
	Leptophlebia	*Paraleptophlebia*	3
Megaloptera	Corydalidae	*Corydalus*	1
		Nigronia	2
Trichoptera	Hydropsychidae	*Ceratopsyche*	6
		Cheumatopsyche	11
	Philopotamidae	*Chimarra*	4
Amphipoda	Gammaridae	*Gammarus*	68

ShoMacro 2:

Coleoptera	Elmidae	*Optioservus*	19
		Stenelmia	3
	Psephenidae	*Psephenus*	1
		Ectopria	1
Diptera	Athericidae	*Atherix*	2
	Chironomidae		7
	Tipulidae	*Antocha*	3
	Simulidae	*Simulium*	5
Ephemeroptera	Baetidae	*Acentrella*	1
		Baetis	8
	Ephemerellidae	*Ephemerella*	3
		Drunella	6
	Heptageniidae	*Stenacron*	12
		Stenonema	9
	Isonychidae	*Isonychia*	17
Megaloptera	Corydalidae	*Nigronia*	4
Trichoptera	Glossosomatidae	*Glossosoma*	2
	Hydropsychidae	*Ceratopsyche*	6
		Cheumatopsyche	17
	Philopotamidae	*Chimarra*	8
	Rhyacophilidae	*Rhyacohlila*	1
Amphipoda	Gammaridae	*Gammarus*	21

ShoMacro 3:

Coleoptera	Elmidae	*Optioservus*	8
	Psephenidae	*Psephenus*	1
Diptera	Athericidae	*Atherix*	2
	Chironomidae		12
	Tipulidae	*Antocha*	2
	Simulidae	*Simulium*	5
Ephemeroptera	Baetidae	*Acentrella*	1
	Ephemerellidae	*Ephemerella*	3
	Heptageniidae	*Stenacron*	2
		Stenonema	7
	Isonychidae	*Isonychia*	9
	Leptophlebia	*Paraleptophlebia*	1
Megaloptera	Corydalidae	*Nigronia*	5
Trichoptera	Hydropsychidae	*Ceratopsyche*	2
		Cheumatopsyche	10
	Philopotamidae	*Chimarra*	2

Macroinvertebrate collections for stream assessment can be analyzed using a variety of metrics and indices. We chose to look at: 1) number of taxa, 2) number of EPT taxa (EPT = Ephemeroptera, Plecoptera, and Trichoptera or mayflies, stoneflies and caddisflies), 3) percent dominance of the most abundant family, and 4) Sensitive taxa Index, a score developed by using the Hilsenhoff scale of pollution tolerance for each taxa aggregated for all the sample taxa. These metrics can be used to calculate a 'stream health score' as outlined in the *EPA's Volunteer Stream Monitoring: A Methods Manual.* Please refer to Appendix E for a table of Hilsenhoff pollution tolerance scores and the calculation worksheets for each sample.

Site	#taxa	#EPT taxa	% dominance	Biotic Index (RBP-II)
SRBC	20	9	21.5	4.10
ShoMacro 1	21	11	34.5	4.23
ShoMacro 2	22	12	14.7	3.82
ShoMacro 3	16	9	17.0	3.92

Biotic Index is calculated as below:

$$BI = \Sigma (X_i \cdot T_i)/ n$$

Where $\mathbf{X_i}$ is the number of individuals in each taxon, $\mathbf{T_i}$ is the tolerance value for each taxon, and **n** is total sample size.

The Biotic Index calculated above is from the Rapid BioAssessment Protocol II (RBP-II), which uses family-level tolerance values as assigned from a table that is included in Appendix E Monitoring Data. Biotic index values are interpreted as follows in the chart below (adapted from Stroud Water Research center website).

Biotic Index Value	Water Quality	Degree of Organic Pollution
0 - 3.75	Excellent	Organic Pollution Unlikely
3.76 – 5.00	Good	Some Organic Pollution
5.01 – 6.50	Fair	Substantial Pollution Likely
6.51 – 10.0	Poor	Severe Organic Pollution Likely

The scores obtaining by examining the diversity and composition of each of the macroinvertebrate samples (three by FBTU and one by SRBC) yield scores that are in the lower part of the "Good" range, with two approaching the "Excellent" borderline.

Conclusions and Recommendations

Summary of Findings

The first conclusion and recommendation of this study is the recognized need for a rather immediate addendum to the study in reference to the redevelopment of the Bedford Springs property and the two stream restoration projects planned for the same property, activities getting underway as this study is concluding. The description of conditions in this study will be valuable for comparison to the completed projects but for future planning a currently updated study is necessary. FBTU intends to complete this work in a timely manner and distribute the update addendums to all who are provided a copy of the original study.

Throughout the watershed there are many locations where the stream bank, most often on the outside bank of a meander, illustrates moderate to severe erosion with root structure of the bank vegetation stabilizing a small portion of the 'cut' bank, perched atop one to three feet or more of fine sediments. With some historical references to milldams, and the map evidence from the 1877 Atlas and the 1939 aerial photographs, it is apparent that past land use practices resulted in the legacy sediment issues we note today. These sediments must be considered when planning any restoration projects along the stream and should be a consideration in all land development and infrastructure projects.

In addition to the orthophosphate test results that indicate a potential phosphorus-loading problem on Shobers Run that will require an examination of methods and re-sampling, FBTU was concerned about dissolved oxygen levels low enough to approach the minimal levels needed by trout and other coldwater species. These low-levels were associated with the warmest months of the year and with sites that were most severely impacted by channel alterations and reduced flow. Monitoring of stream temperatures and dissolved oxygen, particularly at the ShoMS270 site at the lower end of the Springs golf course, will be a priority for the continued monitoring efforts.

While agriculture now comprises a small part of the land usage in the watershed, the operations near and along the two western tributaries are of concern due to the lack of some basic Best Management Practices that could easily address the apparent impacts and also the importance of the cold, alkaline waters from the springs near the ridge gaps of both of these streams. These tributaries are vital parts of any effort to protect, manage, or restore wild trout in Shobers Run.

During most of the last 30 years, development in the watershed has been slow but steady. Most residential construction has occurred along Sweet Root Road and has been single unit development with no large subdivisions. More recently, commercial development along Donahoe Manor Road near the mouth of Shobers Run has included managed-living facilities and a small subdivision on the lower flank of Evitts Mountain. The watershed, as most of Bedford County, lacks a storm water management plan though one has been in progress for a few years. With increasing development pressure on the watershed likely in the near future, storm water management planning and local ordinances are vital.

In the course of this study, no evidence of wild trout or reproduction was found but this was not specifically focused upon with the planned and executed investigations. The numerous anecdotal citings of the recent past are hopeful signs wild trout continue to be a feature of the stream. There are few locations where optimal spawning habitat was found, however. Clean gravel riffle areas are not numerous, though the two western tributaries have some potential sites. Creating and restoring habitat for trout would be a desirable feature for any restoration planning.

Goal 1: Promote stewardship of resources throughout the watershed.

Objective 1: Foster a local watershed group.

- Action Step 1 – Hold public meeting to present Coldwater Conservation Plan, initiate a watershed group planning process and recruit watershed group members.
    - Partners: Landowners, Conservation District, FBTU, Bedford Township, and Bedford Borough

- Action Step 2 – Explore possibility of public tour of stream restoration project on Bedford Springs golf course stream restoration project.
    - Partners: Bedford Springs Resort and Hotel, PA DEP

Objective 2: Develop an outreach campaign.

- Action Step 1 – Create a Shobers Run brochure/fact sheet
    - Partners – Bedford County Conservation District, FBTU
- Action Step 2 – Develop a watershed landowner mailing list and initiate a annual Shobers Run newsletter/health report for distribution to stakeholders
    - Partners – Bedford County Conservation District, FBTU

Objective 3: Assist local teachers in developing curricula/lesson plans using Shobers Run as learning tool

- Action Step 1 – Identify teachers at Bedford High School and Bedford Middle School who use/plan to use Shobers Run as resource for teaching about water conservation, aquatic biology, etc.
    - Partners – Bedford Area School District, FBTU
- Action Step 2: Examine "Environment and Ecology Standards' and identify three activities/lesson plans that FBTU for which FBTU could provide assistance
    - Partners - Bedford Area School District, FBTU, Bedford County Conservation district

Goal 2: Continue developing conservation plan and monitoring.

Objective 1: Determine presence/size of wild trout population in Shobers Run

- Action Step 1 – Conduct informal creel survey
    - Partners - FBTU
- Action Step 2 – Request electro-shocking survey by PA Fish & Boat Commission
    - Partners - FBTU, PAFBC

Objective 2: Survey watershed for invasive exotic plants

- Action Step 1 - Train volunteers in identification of invasive plant species likely to be found in watershed
    - FBTU, Bedford County Conservation District
- Action Step 2 – Conduct survey with volunteers
    - FBTU, Shobers Run watershed group
- Action Step 3 – Map sites where invasive plants found in GIS database, share survey findings with Raystown Riparian Vegetation project
    - FBTU, Bedford County Conservation District

Objective 3: Identify critical resource areas for protection

- Action Step 1 – Contact landowners along two major tributaries from west for permission to conduct further assessment and monitoring
    - FBTU
- Action Step 2 – Identify specific sites for restoration and/or protection
    - FBTU, Bedford County Conservation District
- Action Step 3 – Map location of all spring feeding into main stem and larger tributaries
    - Partners - FBTU, Bedford County Conservation District
- Action Step 4 – Create fact sheet/brochure about critical protection areas and distribute along with information on conservation easements, ag BMPs, etc. to targeted landowners
    - Partners - FBTU, Bedford County Conservation District

Objective 4: Develop and implement a long-range aquatic monitoring study design

- Action Step 1 – Create study design for monitoring
    - FBTU, Bedford County Conservation District
- Action Step 2 – Implement water quality monitoring plan
    - FBTU

Objective 5: Supplement this conservation plan with an update addendum that addresses current projects underway

- Action Step 1 – Survey and photograph Bedford Springs golf course stream restoration area
    - FBTU, Bedford Springs Hotel & Resort
- Action Step 2 – Survey other recent construction projects in lower watershed in reference to storm water management practices and any water quality concerns
    - FBTU
- Action Step 3 – Prepare and distribute addendum update to plan
    - FBTU, Bedford County Conservation District

Goal 3:Promote Improved Land Management Practices.

Objective 1: Agriculture

- Action Step 1 – Create contact list for all agricultural producers in watershed
    - Partners - FBTU
- Action Step 2 – Identify BMPs that address high priority sites
    - Partners – FBTU, Bedford County Conservation District
- Action Step 3 – Promote water quality protection and BMPs through targeted mailings using existing materials referencing stream bank fencing, nutrient management, etc.
    - Partners – FBTU, Bedford County Conservation District

Objective 2: Timber harvesting

- Action Step 1 – Create mailing list of all watershed landowners with forested tracts
    - Partners - FBTU
- Action Step 2 – Coordinate informational mailing on timber harvesting to be sent to forest landowners
    - Partners - FBTU, Woodland Owners of Southern Alleghenies, Bedford County Conservation District
- Action Step 3 – Plan and implement a timber harvesting meeting
    - Partners - FBTU, Woodland Owners of Southern Alleghenies, Bedford County Conservation District

Objective 3: Stormwater management

- Action Step 1 – meet with Bedford County Planning Commission, Bedford Borough Manager and Bedford Township Supervisors to learn about current state of stormwater planning and management in watershed
    - Partners – FBTU, Bedford County Planning Commission, Bedford Borough Manager and Bedford Township Supervisors
- Action Step 2 – plan and implement a mailing or hangtag program that promotes homeowner stewardship practices to reduce runoff volume and eliminate pollutants in runoff
    - Partners – FBTU, Bedford County Conservation District
- Action Step 3 – Monitor water quality after storm events to characterize pollutant levels and flow
    - Partners – FBTU, Bedford County Conservation District

Objective 4: Enhance riparian habitat at problem sites as identified during Stream Visual Assessment Protocols.

- Action Step 1 – Work with affected landowners to remove invasive plant species and promote growth of native riparian vegetation
    - Partners – landowners, FBTU, Bedford County Conservation District

- Action Step 2 – Meet with landowner of private road (Shobers Run Lane?) to discuss replacement of multiple pipe crossing that acts as a fish barrier
    - Partners - landowners, FBTU
- Action Step 3 – Obtain permission to install plantings to enhance riparian vegetation at sites where adequate buffer is lacking
    - Partners - landowners, FBTU, Bedford County Conservation District

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Juniata Clean Water Partnership. September 2000. Juniata Watershed Management Plan. Pennsylvania Rivers Conservation Program

United States Department of Agriculture, Natural Resources Conservation Service. 1998. Soil Survey of Bedford County.

United States Department of Agriculture, Natural Resources Conservation Service. December, 1998. Stream Visual Assessment Protocol. National Water and Climate Center Technical Note 99-1.

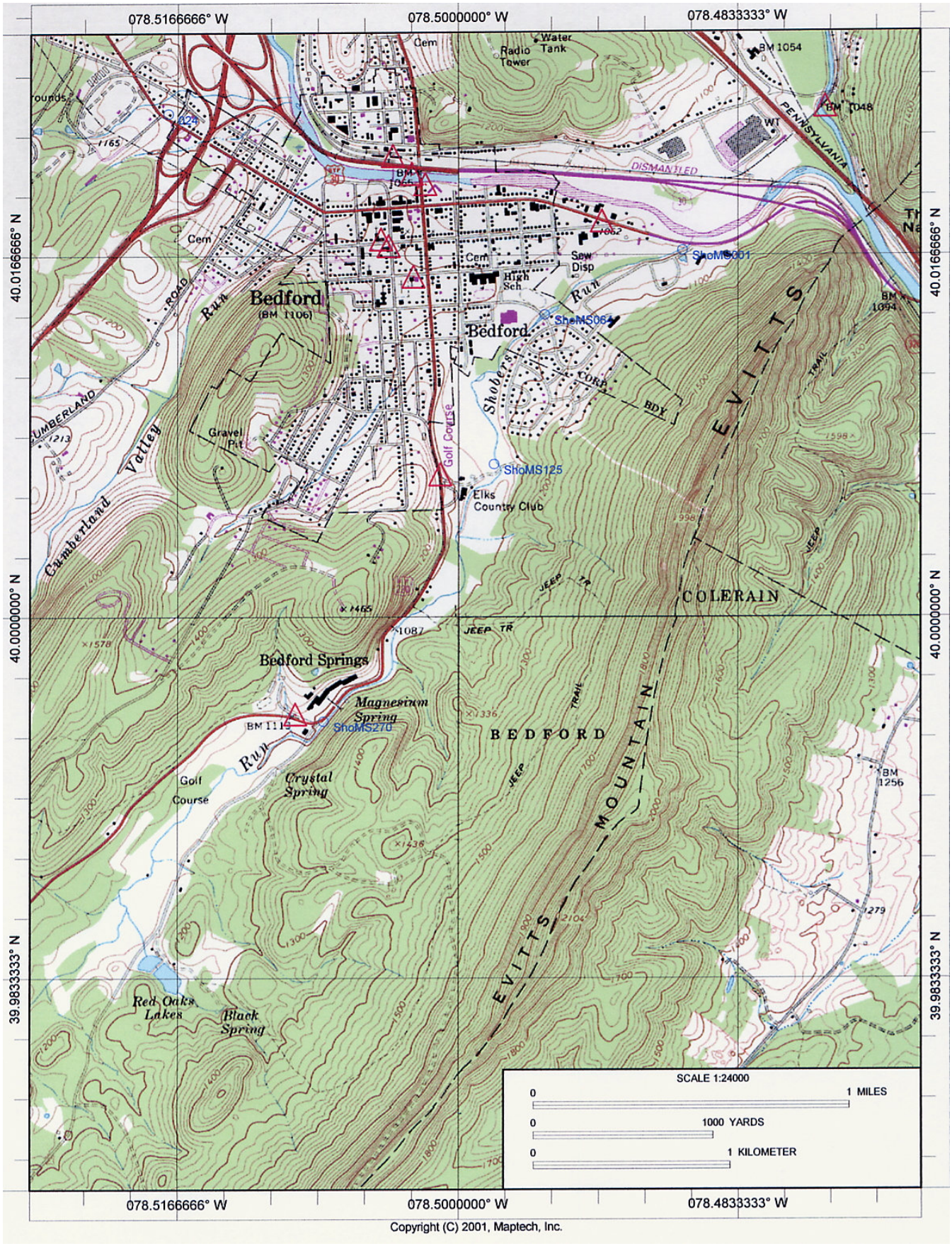
Pennsylvania Department of Conservation and Natural Resources, Bureau of State Parks, Environmental Education and Information Division. 2002. Watershed Education Teacher Manual.

Western Pennsylvania Conservancy. 1998. Bedford County Natural Heritage Inventory.

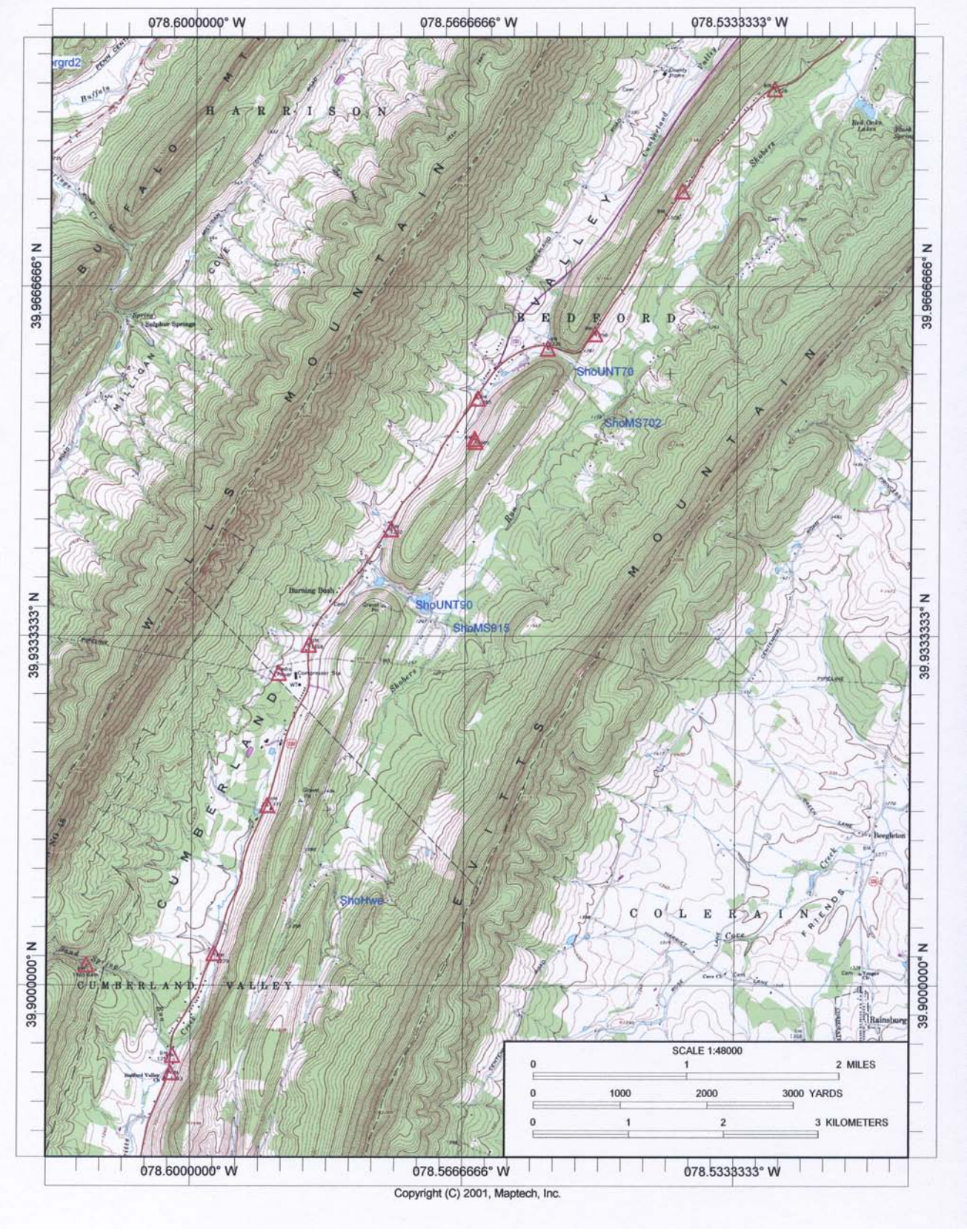
Appendix A - Topographic Maps

Topographic Map of Shobers Run watershed area from mouth to Bedford Springs (1:24000)

Topographic Map of Shobers Run watershed area from Bedford Springs to headwaters (1:48000)



Topographic map of northern portion of Shobers Run watershed with monitoring sites marked.



Topographic map of southern portion of Shobers Run watershed with monitoring sites marked.

Appendix B - Historic Maps

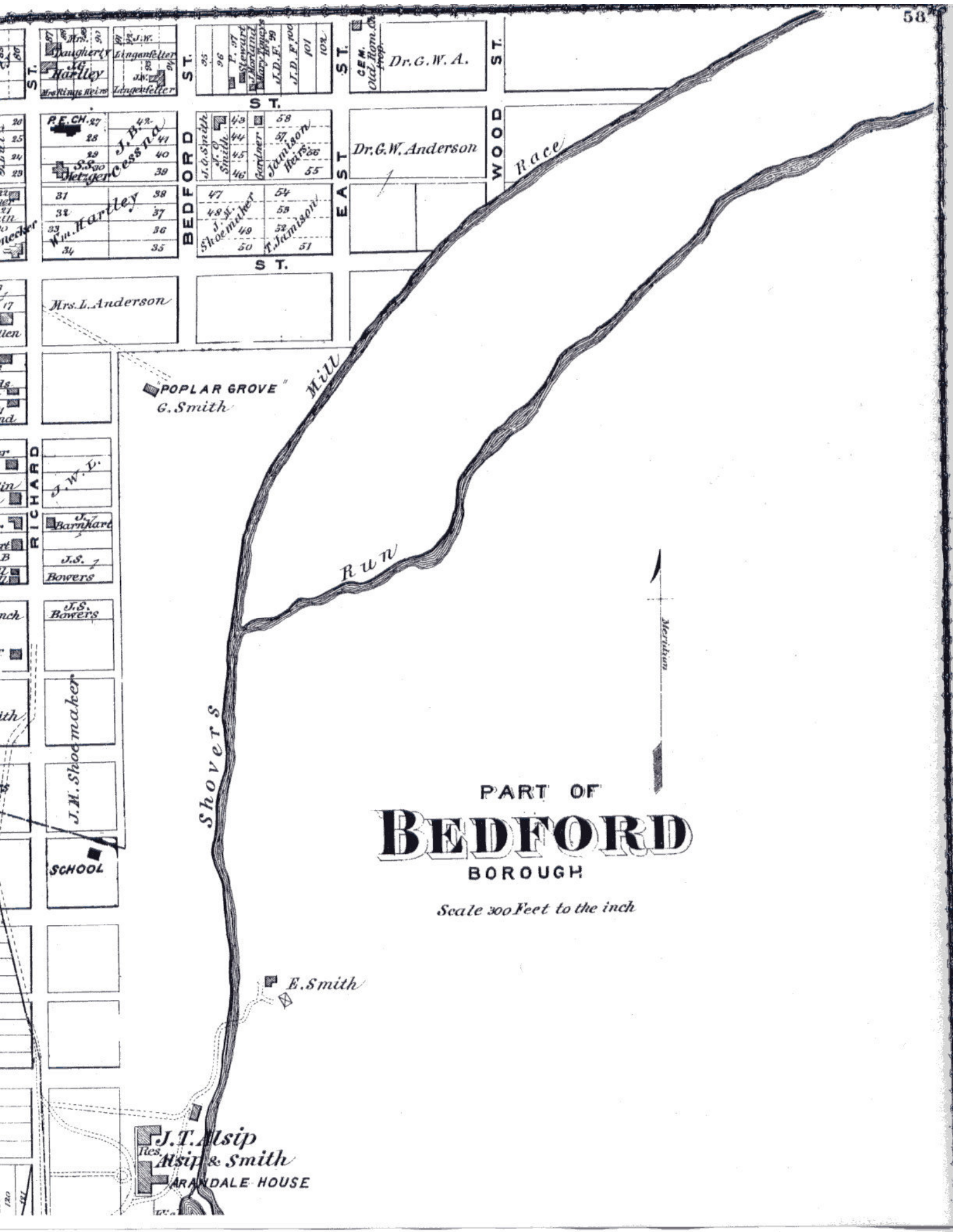
These maps are from the *1877Atlas of Bedford County*

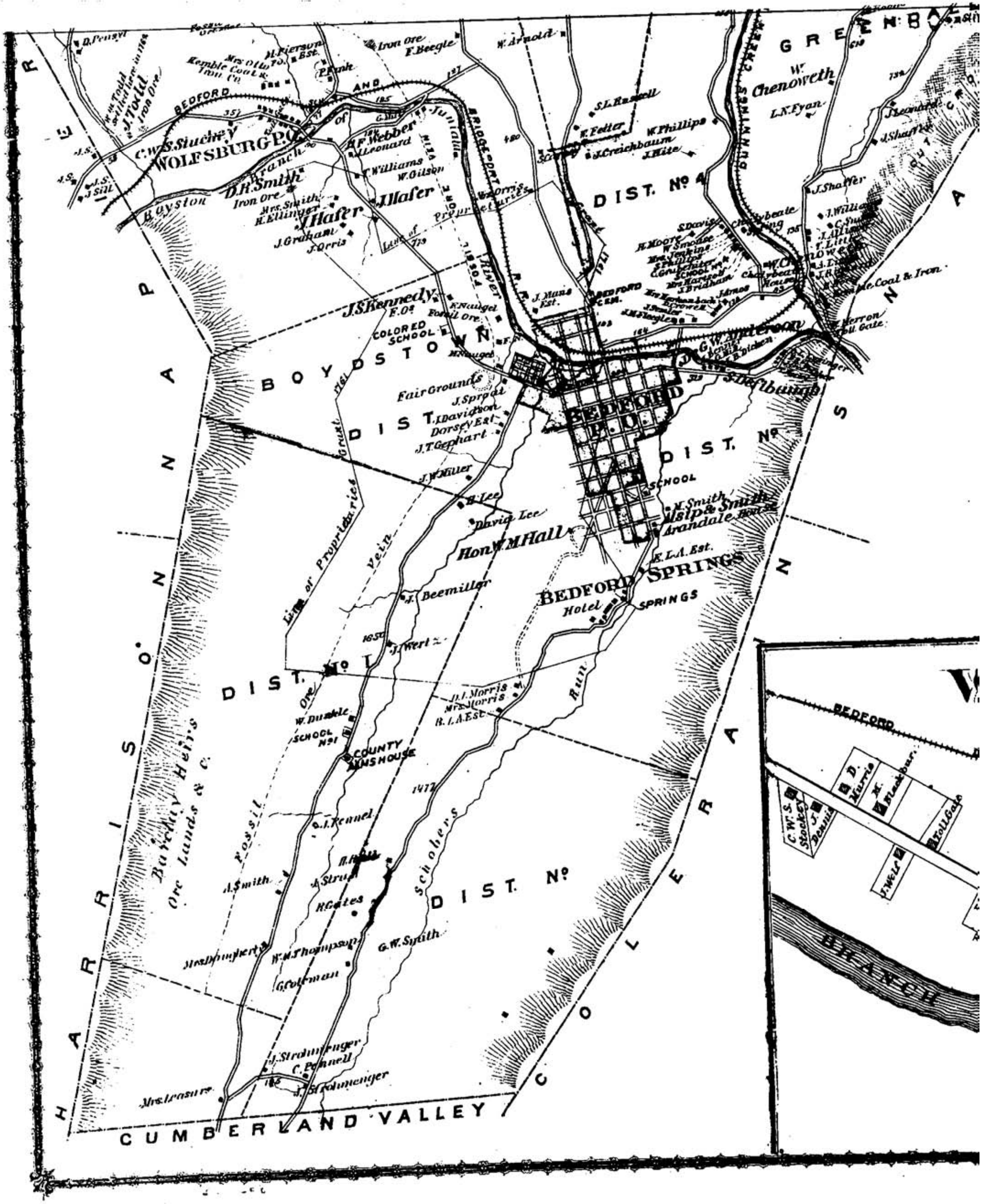
Part of Bedford Borough – showing Shobers Run from area of present-day Elks Lodge (Arandale House) and golf course to near present-day Bedford Middle School

Bedford Township (southern part)

Bedford Springs

Cumberland Valley Township

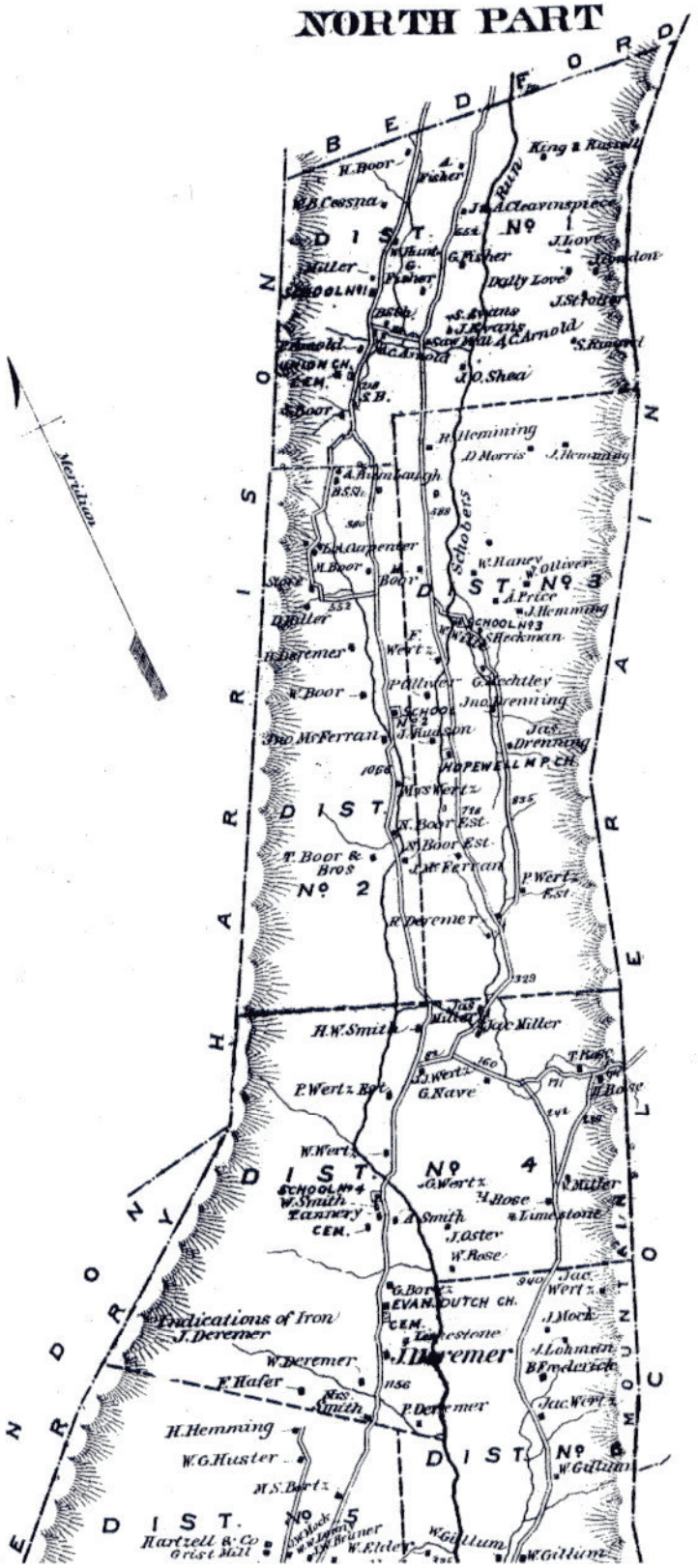

ST.
Mrs. Daugherty
J.W. Langenfelter
H. Hartley
Mrs Kings Heirs
J.W. Langenfelter
F. 97
Stewart
J. Moreland
Mary Rogers
J.D.F. 99
J.D.F. 100
101
102
CEM. Old Rom. Cath.
Dr. G. W. A.
P.E.CH. 27
28
29
S.S. 30
Dietzgen
J. B. Cessna
42
41
40
39
43
44
45
46
J.C. Smith
J.C. Smith
Gardner
58
57
Jamison Heirs 56
55
Dr. G. W. Anderson
BEDFORD
EAST
WOOD
Race
31
32
33
34
Wm. Hartley
38
37
36
35
47
48
J. Y. Shoemaker
49
50
54
53
52
T. Jamison
51
Mrs. L. Anderson
"POPLAR GROVE"
G. Smith
Mill
RICHARD
J.W.V.
J.T. Barnhart
J.S. Bowers
J.S. Bowers
Run
Shovers
J.M. Shoemaker
SCHOOL
Meridian
PART OF
BEDFORD
BOROUGH
Scale 300 Feet to the inch
E. Smith
J.T. Alsip
Res.
Alsip & Smith
ARANDALE HOUSE


BOYDSTOWN
DIST. Nº 4
DIST. Nº 1
DIST. Nº
BEDFORD P.O.
WOLFSBURG P.O.
BEDFORD SPRINGS
Hotel
SPRINGS
Fair Grounds
COLORED SCHOOL
COUNTY ALMSHOUSE
SCHOOL Nº 1
SCHOOL
Arandale House
Hon. W. M. Hall
J. S. Kennedy
G. W. Anderson
D. H. Smith
J. Hafer
W. Chenoweth
Line of Proprietaries
Fossil Ore Vein
Barclay Heirs Ore Lands & Co.
Schobers Run
DUNNINGS CREEK
HARRISON
NAPIER
SNAKE SPRING
COLERAIN
CUMBERLAND VALLEY
BEDFORD
BRANCH

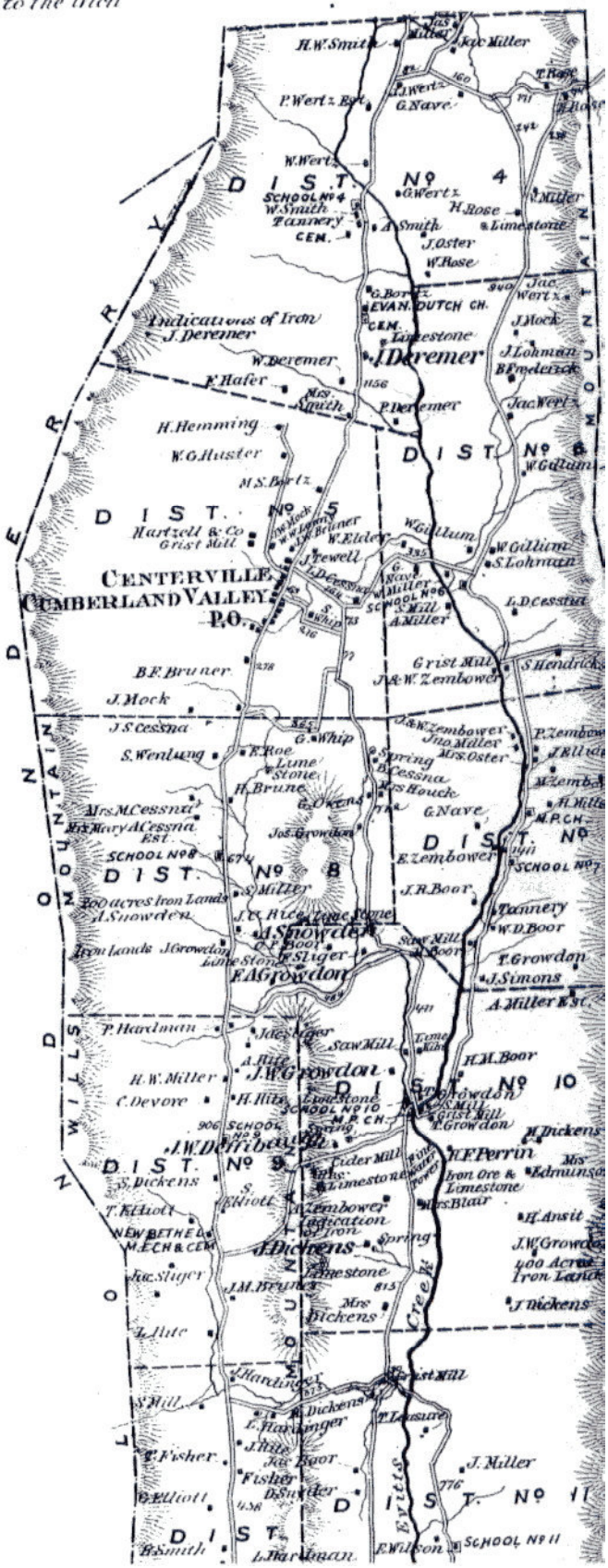
CUMBERLAND VALLEY

Scale 300 Rods to the inch

NORTH PART



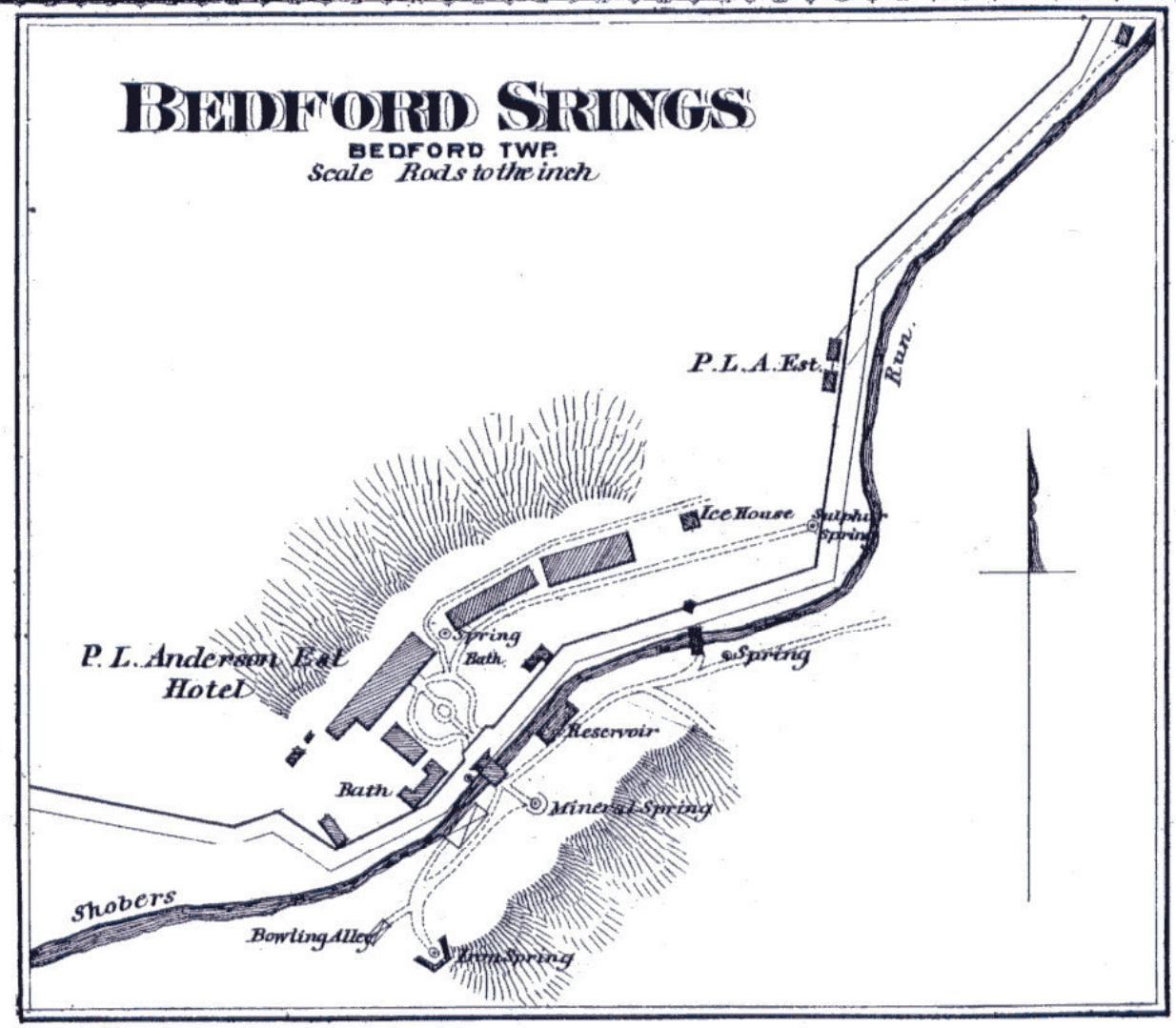
SOUTH PART



BEDFORD SRINGS

BEDFORD TWP.

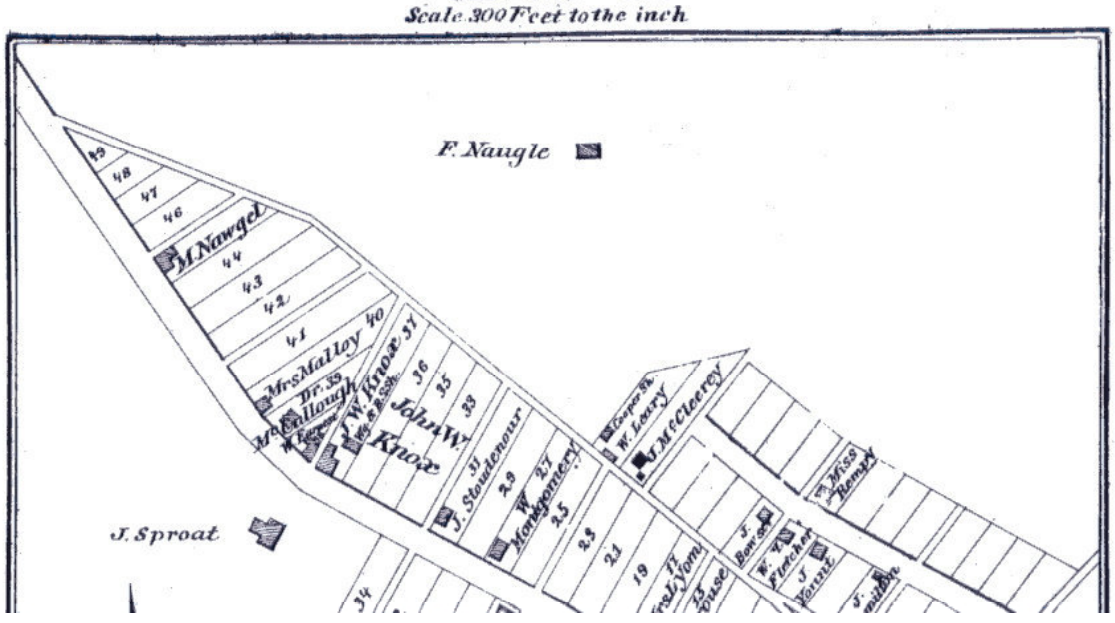
Scale Rods to the inch



BOYDSTOWN

BEDFORD TWP.

Scale 300 Feet to the inch



Appendix C - 1939 Aerial Photographs

Following pages are copied from aerial phographs of Bedford County taken in April 1939

Shobers Run from mouth to Elks

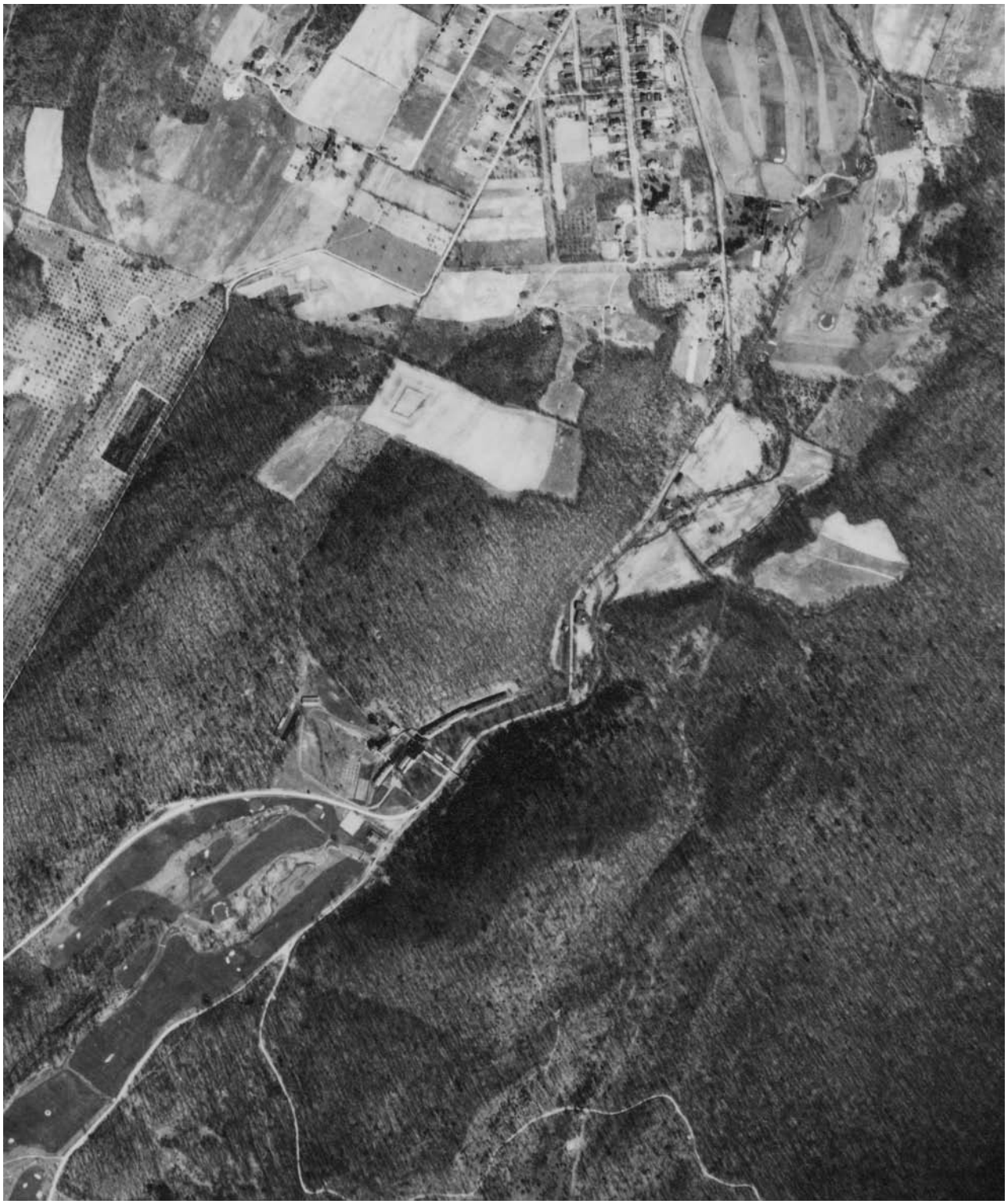
Shobers Run from Elks to Bedford Springs

Shobers Run from Bedford Springs, south

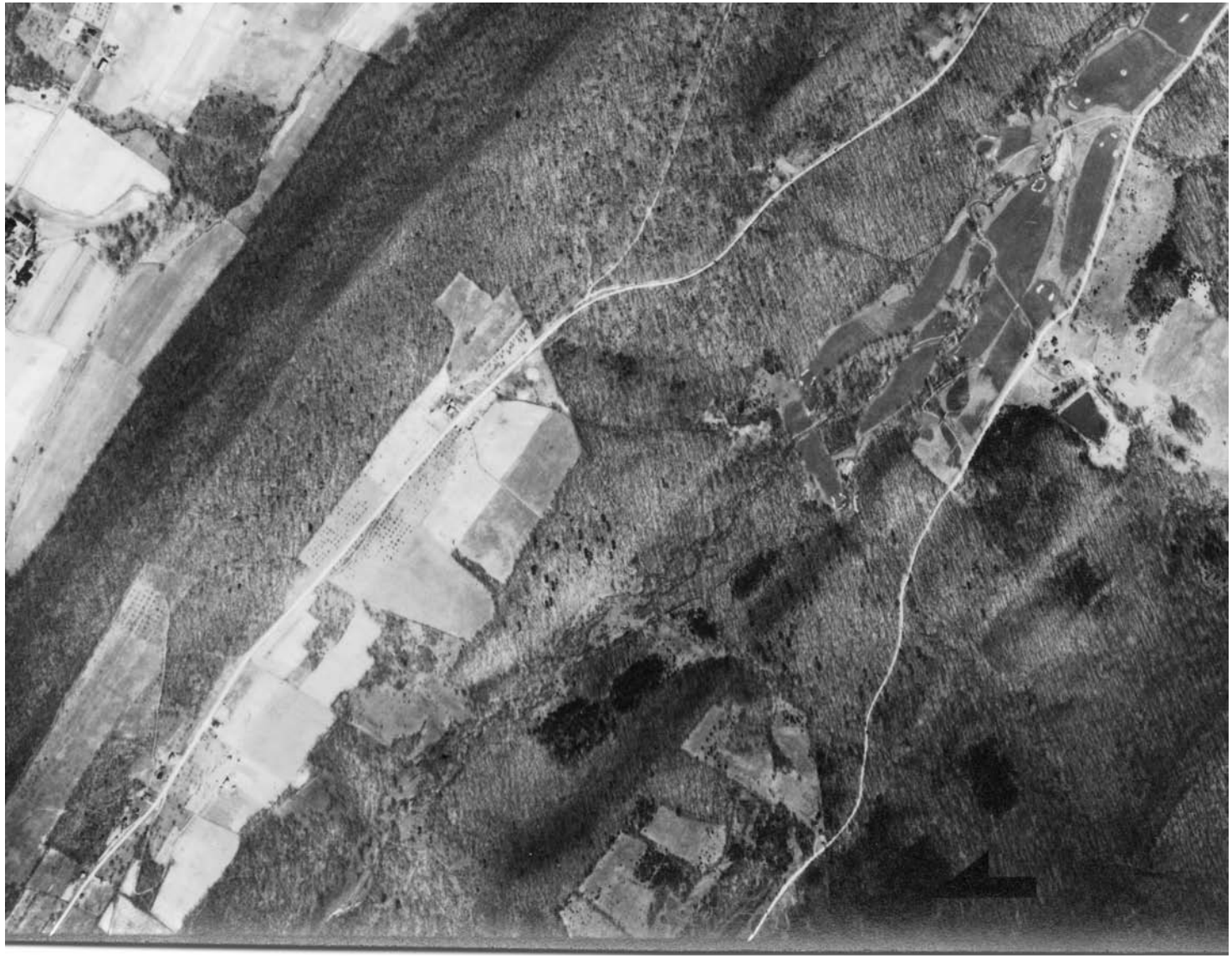
Shobers Run at junction of Sweet Root Road and Teaberry Road including the northern tributary, north

Shobers Run at junction of Sweet Root Road and Teaberry Road, south

Aerial photograph from April 1939 of Shobers Run watershed from mouth to Bedford Elks

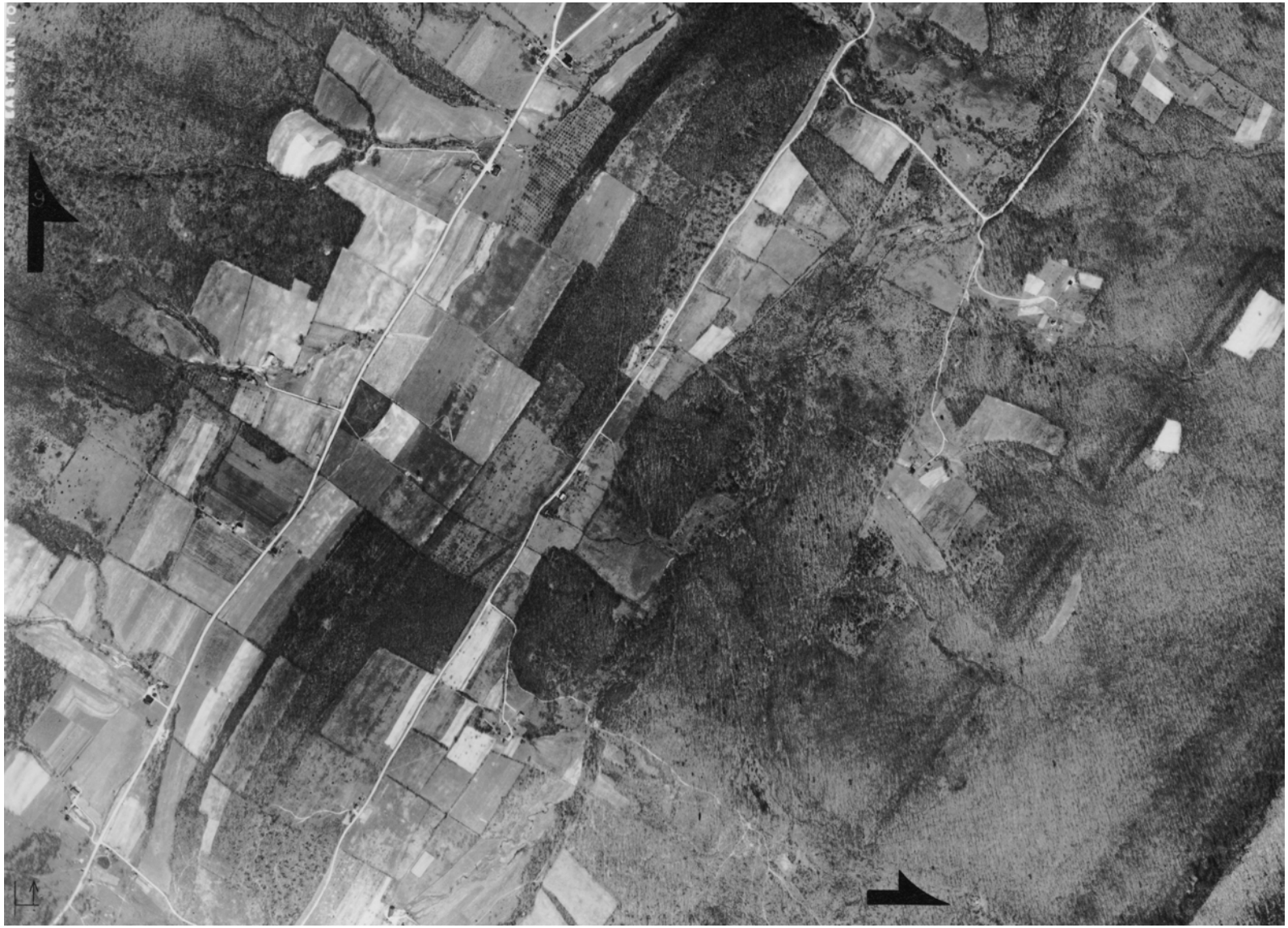


Aerial photograph from April 1939 of Shobers Run watershed from Bedford Elks to Bedford Springs



Aerial photograph from April 1939 of Shobers Run watershed, Bedford Springs south

Aerial photograph from April 1939 of Shobers Run watershed, junction of Sweet Root and Teaberry roads north



Aerial photograph from April 1939 of Shobers Run watershed, junction of Sweet Root and Teaberry Roads south

Appendix D - Soil Survey Maps

General soil maps from Map 61 – Preliminary Geologic Quadrangle Maps of Pa, 1981

Everett West Quadrangle

Rainsburg Quadrangle

Web Soil Survey Maps generated from USDA/NRCS National Cooperative Soil Survey website. In order, north to south, these are:

Mouth/Bedford

Springs – north

Springs – south

North tributary

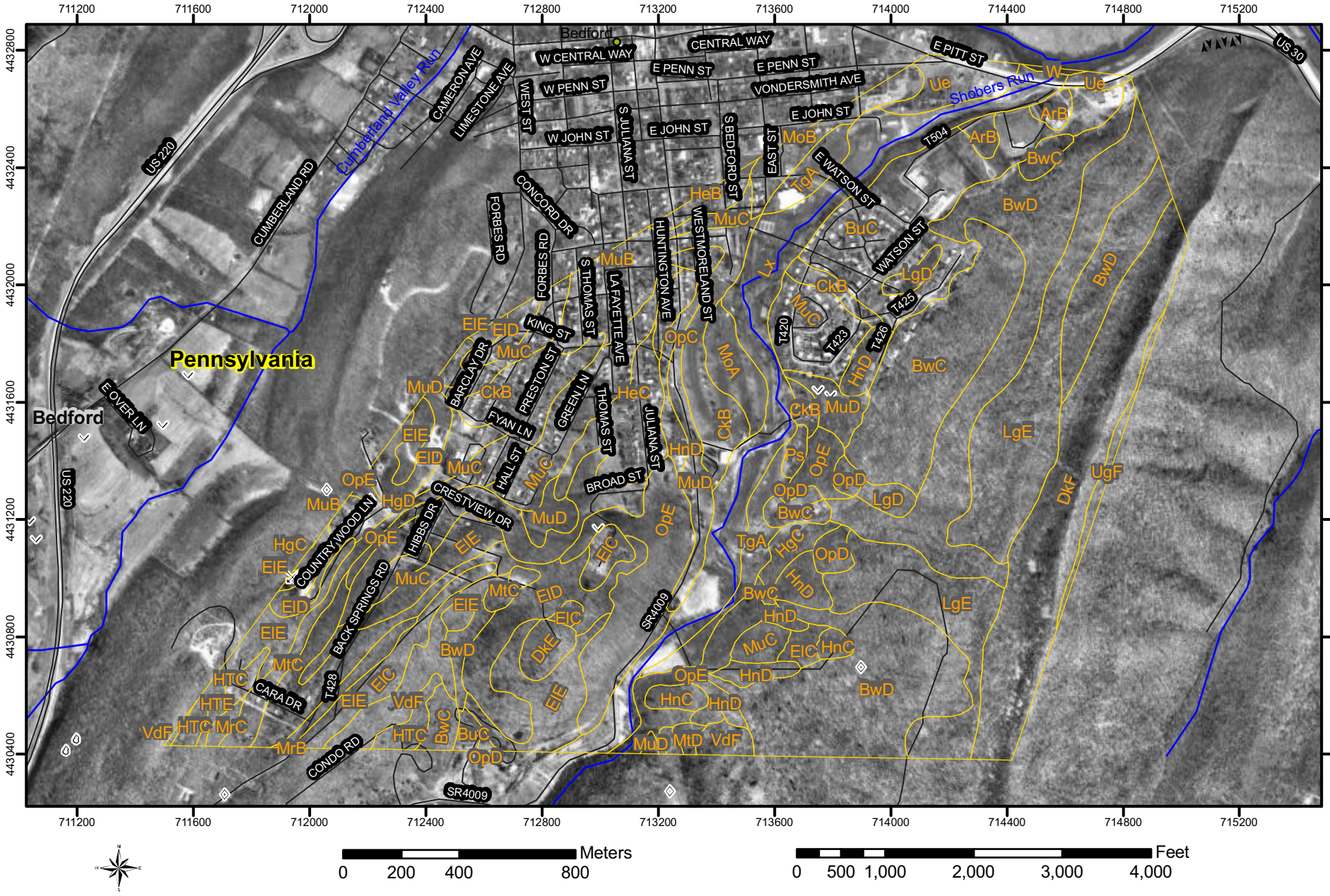
Sweet Root Road to Browns Road

Browns Road south

Headwaters

SOIL SURVEY OF BEDFORD COUNTY, PENNSYLVANIA

Shobers Run-mouth/Bedford



Shobers Run-mouth/Bedford

MAP LEGEND

- Soil Map Units
- Cities
- Detailed Counties
- Detailed States
- Interstate Highways
- Roads
- Rails
- Water
- Hydrography
- Oceans
- Escarpment, bedrock
- Escarpment, non-bedrock
- Gulley
- Levee
- Slope
- Blowout
- Borrow Pit
- Clay Spot
- Depression, closed
- Eroded Spot
- Gravel Pit
- Gravelly Spot
- Gulley
- Lava Flow
- Landfill
- Marsh or Swamp
- Miscellaneous Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Slide or Slip
- Sinkhole
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Perennial Water
- Wet Spot

MAP INFORMATION

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov

Coordinate System: UTM Zone 17

Soil Survey Area: Bedford County, Pennsylvania
Spatial Version of Data: 1
Soil Map Compilation Scale: 1:24000

Map comprised of aerial images photographed on these dates:
4/8/1993; 4/27/1993; 4/20/1994

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend Summary

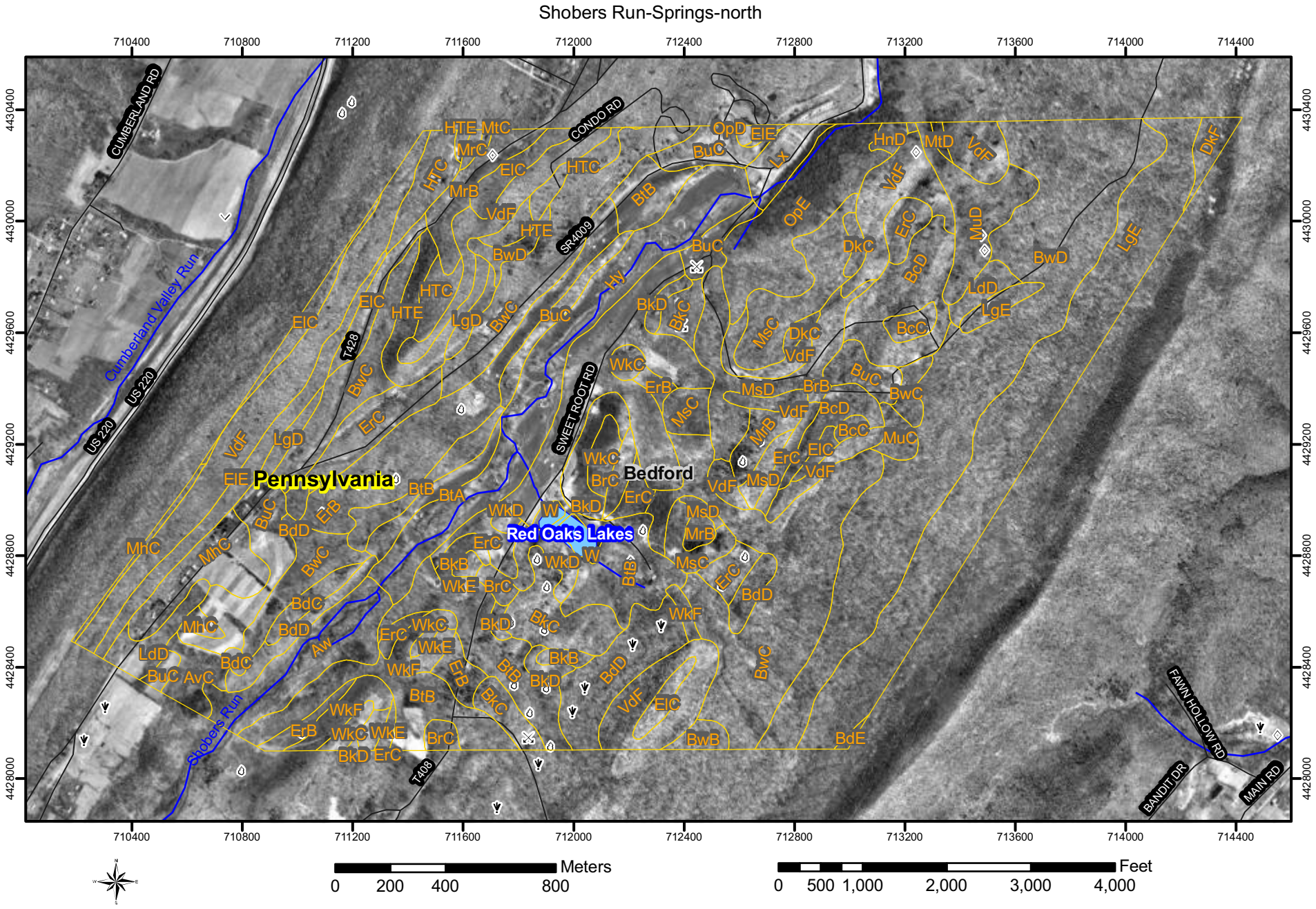
Bedford County, Pennsylvania

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
ArB	Andover cobbly loam, 3 to 8 percent slopes	6.5	0.5
BuC	Buchanan cobbly loam, 8 to 15 percent slopes	70.9	5.4
BwC	Buchanan cobbly loam, 8 to 15 percent slopes, extremely stony	75.4	5.7
BwD	Buchanan cobbly loam, 15 to 25 percent slopes, extremely stony	179.2	13.6
CkB	Clarksburg silt loam, 3 to 8 percent slopes	62.2	4.7
DkE	Dystrocrepts-Rock outcrop complex, 15 to 35 percent slopes	6.9	0.5
DkF	Dystrocrepts-Rock outcrop complex, 35 to 70 percent slopes	88.7	6.7
ElC	Elliber very channery loam, 8 to 15 percent slopes	26.5	2.0
ElD	Elliber very channery loam, 15 to 25 percent slopes	76.1	5.8
ElE	Elliber very channery loam, 25 to 45 percent slopes	66.1	5.0
HeB	Hagerstown silt loam, 3 to 8 percent slopes	6.2	0.5
HeC	Hagerstown silt loam, 8 to 15 percent slopes	22.9	1.7
HgC	Hagerstown silty clay loam, 8 to 15 percent slopes	8.4	0.6
HgD	Hagerstown silty clay loam, 15 to 25 percent slopes	31.7	2.4
HnC	Hagerstown silty clay loam, 8 to 15 percent slopes, very rocky	6.7	0.5
HnD	Hagerstown silty clay loam, 15 to 25 percent slopes, very rocky	29.7	2.3
HTC	Hazleton-Clymer association, 8 to 25 percent slopes, extremely stony	11.1	0.8
HTE	Hazleton-Clymer association, 25 to 45 percent slopes, extremely stony	2.6	0.2
LgD	Laidig cobbly loam, 15 to 25 percent slopes, extremely stony	7.6	0.6
LgE	Laidig cobbly loam, 25 to 35 percent slopes, extremely stony	106.5	8.1

Bedford County, Pennsylvania

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Lx	Lobdell loam	88.3	6.7
MoA	Monongahela silt loam, 0 to 3 percent slopes	12.5	1.0
MoB	Monongahela silt loam, 3 to 8 percent slopes	14.4	1.1
MrB	Morrison channery sandy loam, 3 to 8 percent slopes	0.0	0.0
MrC	Morrison channery sandy loam, 8 to 15 percent slopes	2.3	0.2
MtC	Morrison-Murrill complex, 8 to 15 percent slopes, very stony	14.2	1.1
MtD	Morrison-Murrill complex, 15 to 25 percent slopes, very stony	1.9	0.1
MuB	Murrill channery loam, 3 to 8 percent slopes	29.6	2.2
MuC	Murrill channery loam, 8 to 15 percent slopes	86.7	6.6
MuD	Murrill channery loam, 15 to 25 percent slopes	27.9	2.1
OpC	Opequon-Hagerstown complex, 8 to 15 percent slopes, very rocky	5.4	0.4
OpD	Opequon-Hagerstown complex, 15 to 25 percent slopes, very rocky	8.9	0.7
OpE	Opequon-Hagerstown complex, 25 to 45 percent slopes, very rocky	65.9	5.0
Ps	Purdy silty clay loam, 0 to 3 percent slopes	2.6	0.2
TgA	Tyler silt loam, 0 to 3 percent slopes	22.8	1.7
Ue	Udorthents, loamy	16.2	1.2
UgF	Ungers-Lehew complex, 35 to 60 percent slopes, very stony	5.7	0.4
VdF	Vanderlip-Rock outcrop complex, 35 to 60 percent slopes	20.4	1.5
W	Water	0.7	0.1

SOIL SURVEY OF BEDFORD COUNTY, PENNSYLVANIA



Shobers Run-Springs-north

MAP LEGEND

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- Interstate Highways
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- Rails
- Water
- Hydrography
- Oceans
- Escarpment, bedrock
- Escarpment, non-bedrock
- Gulley
- Levee
- Slope
- Blowout
- Borrow Pit
- Clay Spot
- Depression, closed
- Eroded Spot
- Gravel Pit
- Gravelly Spot
- Gulley
- Lava Flow
- Landfill
- Marsh or Swamp
- Miscellaneous Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Slide or Slip
- Sinkhole
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Perennial Water
- Wet Spot

MAP INFORMATION

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov

Coordinate System: UTM Zone 17

Soil Survey Area: Bedford County, Pennsylvania
Spatial Version of Data: 1
Soil Map Compilation Scale: 1:24000

Map comprised of aerial images photographed on these dates:
4/8/1993; 4/20/1994

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Map Unit Legend Summary

Bedford County, Pennsylvania

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AvC	Andover cobbly sandy loam, 8 to 15 percent slopes, very stony	9.8	0.6
Aw	Atkins silt loam	31.6	1.9
BcC	Bedington-Berks complex, 8 to 15 percent slopes	6.2	0.4
BcD	Bedington-Berks complex, 15 to 25 percent slopes	38.5	2.4
BdC	Bedington-Berks complex, 8 to 15 percent slopes, very stony	7.6	0.5
BdD	Bedington-Berks complex, 15 to 25 percent slopes, very stony	42.6	2.6
BdE	Bedington-Berks complex, 25 to 35 percent slopes, very stony	0.8	0.1
BkB	Berks channery silt loam, 3 to 8 percent slopes	4.3	0.3
BkC	Berks channery silt loam, 8 to 15 percent slopes	33.6	2.1
BkD	Berks channery silt loam, 15 to 25 percent slopes	18.3	1.1
BrB	Blairton channery silt loam, 3 to 8 percent slopes	1.4	0.1
BrC	Blairton channery silt loam, 8 to 15 percent slopes	10.6	0.6
BtA	Brinkerton silt loam, 0 to 3 percent slopes	9.1	0.6
BtB	Brinkerton silt loam, 3 to 8 percent slopes	163.6	10.0
BuC	Buchanan cobbly loam, 8 to 15 percent slopes	59.5	3.6
BwB	Buchanan cobbly loam, 3 to 8 percent slopes, extremely stony	4.3	0.3
BwC	Buchanan cobbly loam, 8 to 15 percent slopes, extremely stony	176.3	10.8
BwD	Buchanan cobbly loam, 15 to 25 percent slopes, extremely stony	162.7	10.0
DkC	Dystrocrepts-Rock outcrop complex, 3 to 15 percent slopes	5.1	0.3
DkF	Dystrocrepts-Rock outcrop complex, 35 to 70 percent slopes	6.0	0.4

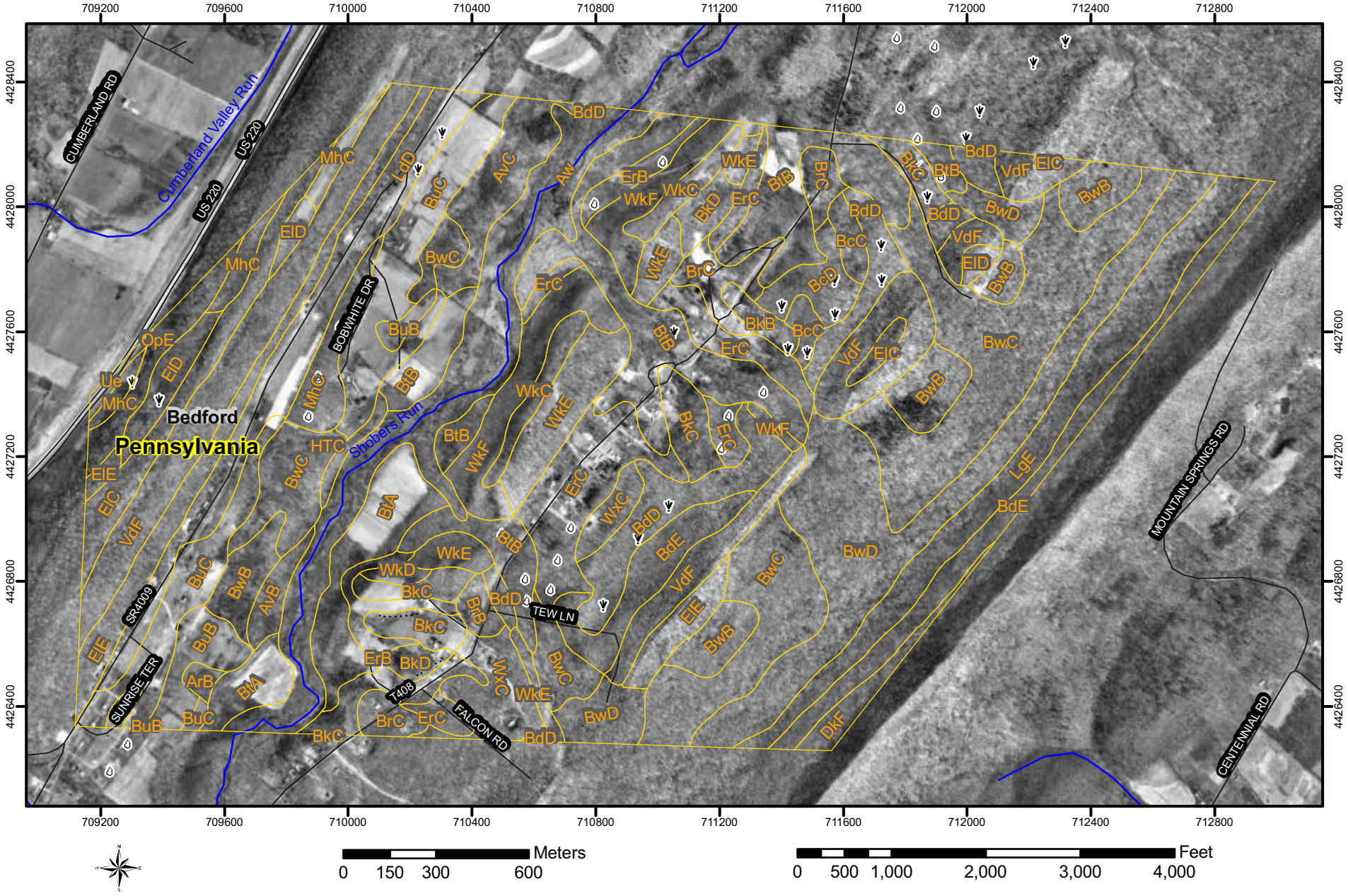
Bedford County, Pennsylvania

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
ElC	Elliber very channery loam, 8 to 15 percent slopes	31.3	1.9
ElE	Elliber very channery loam, 25 to 45 percent slopes	22.4	1.4
ErB	Ernest silt loam, 0 to 8 percent slopes	60.2	3.7
ErC	Ernest silt loam, 8 to 15 percent slopes	50.6	3.1
HnD	Hagerstown silty clay loam, 15 to 25 percent slopes, very rocky	2.6	0.2
HTC	Hazleton-Clymer association, 8 to 25 percent slopes, extremely stony	24.8	1.5
HTE	Hazleton-Clymer association, 25 to 45 percent slopes, extremely stony	20.2	1.2
Hy	Holly silt loam	71.2	4.4
LdD	Laidig cobbly loam, 15 to 25 percent slopes	15.5	1.0
LgD	Laidig cobbly loam, 15 to 25 percent slopes, extremely stony	8.0	0.5
LgE	Laidig cobbly loam, 25 to 35 percent slopes, extremely stony	122.3	7.5
Lx	Lobdell loam	10.9	0.7
MhC	Mertz channery silt loam, 8 to 15 percent slopes	26.9	1.6
MrB	Morrison channery sandy loam, 3 to 8 percent slopes	25.2	1.5
MrC	Morrison channery sandy loam, 8 to 15 percent slopes	1.6	0.1
MsC	Morrison channery sandy loam, 8 to 15 percent slopes, very stony	38.3	2.3
MsD	Morrison channery sandy loam, 15 to 25 percent slopes, very stony	34.0	2.1
MtC	Morrison-Murrill complex, 8 to 15 percent slopes, very stony	0.6	0.0
MtD	Morrison-Murrill complex, 15 to 25 percent slopes, very stony	1.2	0.1
MuC	Murrill channery loam, 8 to 15 percent slopes	5.0	0.3
MuD	Murrill channery loam, 15 to 25 percent slopes	23.2	1.4
OpD	Opequon-Hagerstown complex, 15 to 25 percent slopes, very rocky	1.1	0.1

Bedford County, Pennsylvania

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
OpE	Opequon-Hagerstown complex, 25 to 45 percent slopes, very rocky	43.2	2.6
VdF	Vanderlip-Rock outcrop complex, 35 to 60 percent slopes	145.4	8.9
W	Water	5.9	0.4
WkC	Weikert channery silt loam, 8 to 15 percent slopes	13.5	0.8
WkD	Weikert channery silt loam, 15 to 25 percent slopes	10.4	0.6
WkE	Weikert channery silt loam, 25 to 35 percent slopes	10.7	0.7
WkF	Weikert channery silt loam, 35 to 65 percent slopes	15.9	1.0

Shobers Run-Springs-south



Meters
0 150 300 600

Feet
0 500 1,000 2,000 3,000 4,000

Shobers Run-Springs-south

MAP LEGEND

- Soil Map Units
- Cities
- Detailed Counties
- Detailed States
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- Rails
- Water
- Hydrography
- Oceans
- Escarpment, bedrock
- Escarpment, non-bedrock
- Gulley
- Levee
- Slope
- Blowout
- Borrow Pit
- Clay Spot
- Depression, closed
- Eroded Spot
- Gravel Pit
- Gravelly Spot
- Gulley
- Lava Flow
- Landfill
- Marsh or Swamp
- Miscellaneous Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Slide or Slip
- Sinkhole
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Perennial Water
- Wet Spot

MAP INFORMATION

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov

Coordinate System: UTM Zone 17

Soil Survey Area: Bedford County, Pennsylvania
Spatial Version of Data: 1
Soil Map Compilation Scale: 1:24000

Map comprised of aerial images photographed on these dates:
4/8/1993; 4/20/1994

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Map Unit Legend Summary

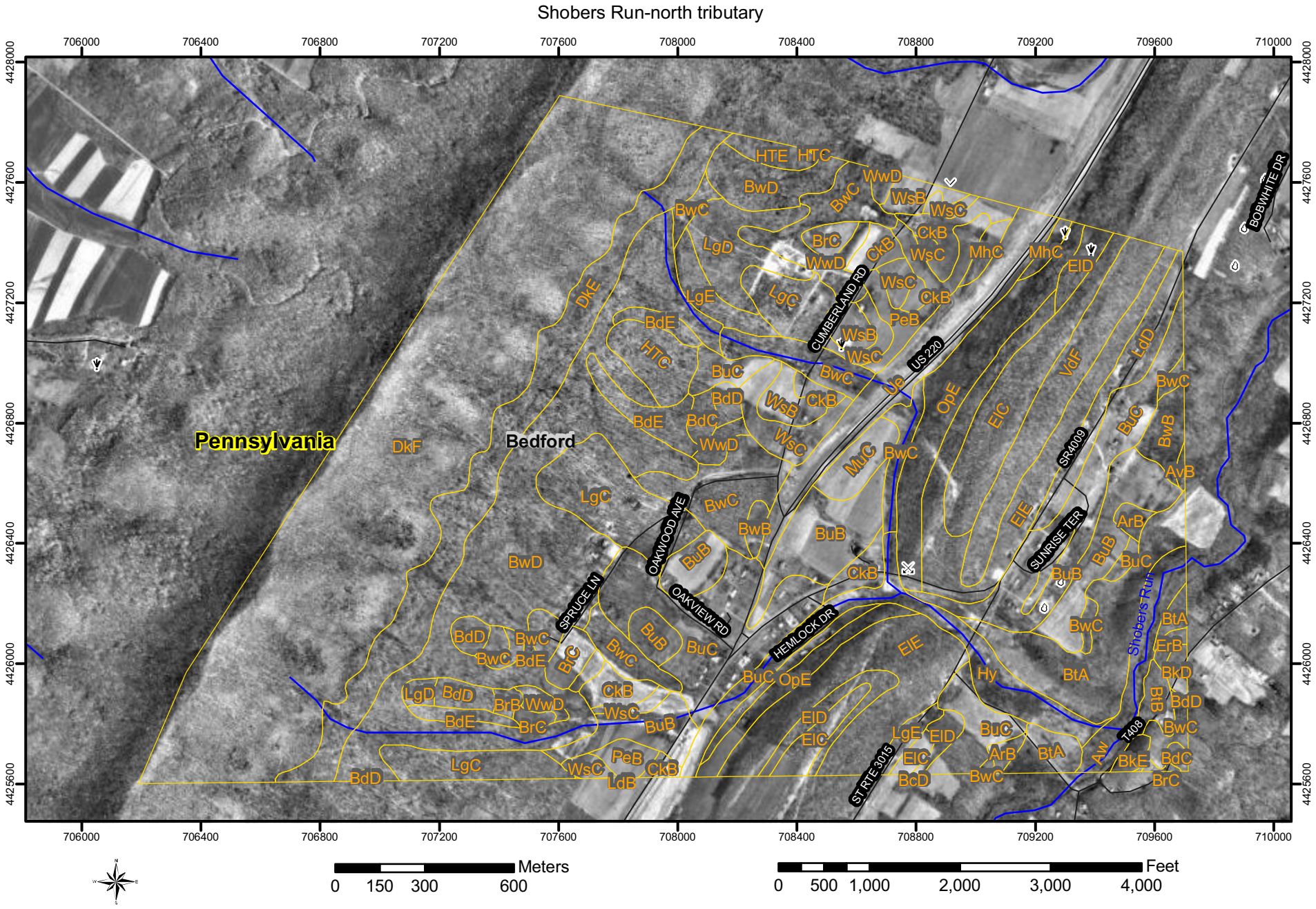
Bedford County, Pennsylvania

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
ArB	Andover cobbly loam, 3 to 8 percent slopes	2.4	0.2
AvB	Andover cobbly sandy loam, 0 to 8 percent slopes, very stony	7.0	0.5
AvC	Andover cobbly sandy loam, 8 to 15 percent slopes, very stony	24.2	1.6
Aw	Atkins silt loam	84.2	5.7
BcC	Bedington-Berks complex, 8 to 15 percent slopes	9.3	0.6
BcD	Bedington-Berks complex, 15 to 25 percent slopes	12.5	0.9
BdD	Bedington-Berks complex, 15 to 25 percent slopes, very stony	52.3	3.6
BdE	Bedington-Berks complex, 25 to 35 percent slopes, very stony	53.3	3.6
BkB	Berks channery silt loam, 3 to 8 percent slopes	5.5	0.4
BkC	Berks channery silt loam, 8 to 15 percent slopes	31.5	2.1
BkD	Berks channery silt loam, 15 to 25 percent slopes	11.3	0.8
BrB	Blairton channery silt loam, 3 to 8 percent slopes	4.9	0.3
BrC	Blairton channery silt loam, 8 to 15 percent slopes	23.5	1.6
BtA	Brinkerton silt loam, 0 to 3 percent slopes	40.7	2.8
BtB	Brinkerton silt loam, 3 to 8 percent slopes	119.2	8.1
BuB	Buchanan cobbly loam, 3 to 8 percent slopes	19.5	1.3
BuC	Buchanan cobbly loam, 8 to 15 percent slopes	68.5	4.7
BwB	Buchanan cobbly loam, 3 to 8 percent slopes, extremely stony	47.7	3.2
BwC	Buchanan cobbly loam, 8 to 15 percent slopes, extremely stony	165.3	11.3
BwD	Buchanan cobbly loam, 15 to 25 percent slopes, extremely stony	112.3	7.6

Bedford County, Pennsylvania

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
DkF	Dystrocrepts-Rock outcrop complex, 35 to 70 percent slopes	8.8	0.6
ElC	Elliber very channery loam, 8 to 15 percent slopes	28.6	2.0
ElD	Elliber very channery loam, 15 to 25 percent slopes	16.4	1.1
ElE	Elliber very channery loam, 25 to 45 percent slopes	42.6	2.9
ErB	Ernest silt loam, 0 to 8 percent slopes	27.7	1.9
ErC	Ernest silt loam, 8 to 15 percent slopes	64.2	4.4
HTC	Hazleton-Clymer association, 8 to 25 percent slopes, extremely stony	3.7	0.3
LdD	Laidig cobbly loam, 15 to 25 percent slopes	53.4	3.6
LgE	Laidig cobbly loam, 25 to 35 percent slopes, extremely stony	54.8	3.7
MhC	Mertz channery silt loam, 8 to 15 percent slopes	26.9	1.8
OpE	Opequon-Hagerstown complex, 25 to 45 percent slopes, very rocky	13.8	0.9
Ue	Udorthents, loamy	2.5	0.2
VdF	Vanderlip-Rock outcrop complex, 35 to 60 percent slopes	101.0	6.9
WkC	Weikert channery silt loam, 8 to 15 percent slopes	16.3	1.1
WkD	Weikert channery silt loam, 15 to 25 percent slopes	2.6	0.2
WkE	Weikert channery silt loam, 25 to 35 percent slopes	40.8	2.8
WkF	Weikert channery silt loam, 35 to 65 percent slopes	43.0	2.9
WxC	Wharton channery silt loam, 8 to 15 percent slopes, very stony	26.2	1.8

SOIL SURVEY OF BEDFORD COUNTY, PENNSYLVANIA



Shobers Run-north tributary

MAP LEGEND

- Soil Map Units
- Cities
- Detailed Counties
- Detailed States
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- Roads
- Rails
- Water
- Hydrography
- Oceans
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- Rock Outcrop
- Saline Spot
- Sandy Spot
- Slide or Slip
- Sinkhole
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
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- Wet Spot

MAP INFORMATION

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov

Coordinate System: UTM Zone 17

Soil Survey Area: Bedford County, Pennsylvania
Spatial Version of Data: 1
Soil Map Compilation Scale: 1:24000

Map comprised of aerial images photographed on these dates:
4/8/1993; 4/20/1994

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Map Unit Legend Summary

Bedford County, Pennsylvania

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
ArB	Andover cobbly loam, 3 to 8 percent slopes	4.6	0.3
AvB	Andover cobbly sandy loam, 0 to 8 percent slopes, very stony	0.8	0.1
Aw	Atkins silt loam	17.4	1.2
BcC	Bedington-Berks complex, 8 to 15 percent slopes	0.0	0.0
BcD	Bedington-Berks complex, 15 to 25 percent slopes	0.0	0.0
BdC	Bedington-Berks complex, 8 to 15 percent slopes, very stony	4.8	0.3
BdD	Bedington-Berks complex, 15 to 25 percent slopes, very stony	10.8	0.7
BdE	Bedington-Berks complex, 25 to 35 percent slopes, very stony	18.3	1.2
BkB	Berks channery silt loam, 3 to 8 percent slopes	0.0	0.0
BkD	Berks channery silt loam, 15 to 25 percent slopes	2.5	0.2
BkE	Berks channery silt loam, 25 to 35 percent slopes	2.5	0.2
BrB	Blairton channery silt loam, 3 to 8 percent slopes	1.9	0.1
BrC	Blairton channery silt loam, 8 to 15 percent slopes	11.8	0.8
BrD	Blairton channery silt loam, 15 to 25 percent slopes	0.1	0.0
BtA	Brinkerton silt loam, 0 to 3 percent slopes	48.6	3.3
BtB	Brinkerton silt loam, 3 to 8 percent slopes	5.1	0.3
BuB	Buchanan cobbly loam, 3 to 8 percent slopes	76.1	5.2
BuC	Buchanan cobbly loam, 8 to 15 percent slopes	112.6	7.6
BwB	Buchanan cobbly loam, 3 to 8 percent slopes, extremely stony	10.2	0.7
BwC	Buchanan cobbly loam, 8 to 15 percent slopes, extremely stony	85.4	5.8

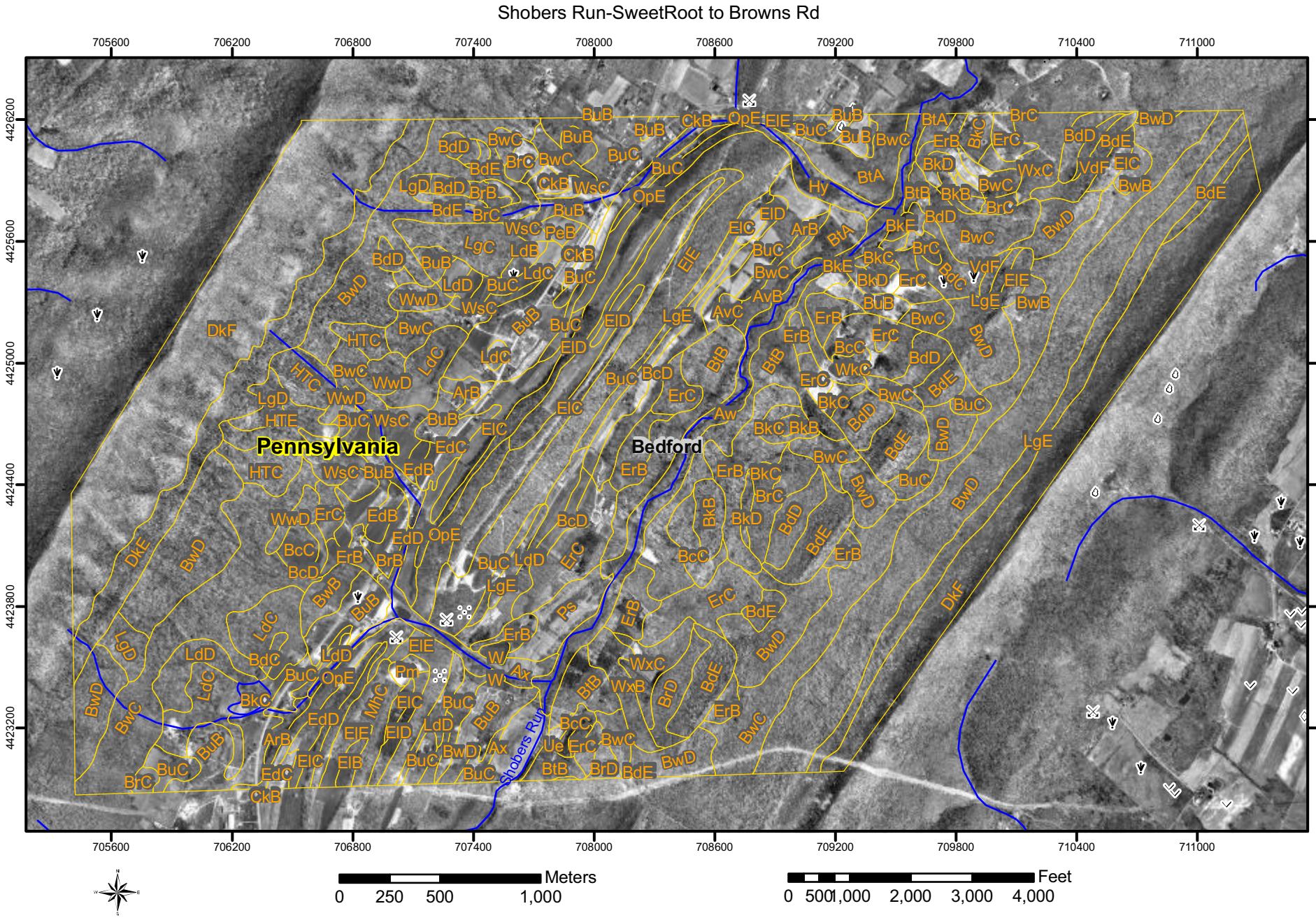
Bedford County, Pennsylvania

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BwD	Buchanan cobbly loam, 15 to 25 percent slopes, extremely stony	154.2	10.5
CkB	Clarksburg silt loam, 3 to 8 percent slopes	29.5	2.0
DkE	Dystrocrepts-Rock outcrop complex, 15 to 35 percent slopes	68.8	4.7
DkF	Dystrocrepts-Rock outcrop complex, 35 to 70 percent slopes	288.8	19.6
ElC	Elliber very channery loam, 8 to 15 percent slopes	41.1	2.8
ElD	Elliber very channery loam, 15 to 25 percent slopes	17.1	1.2
ElE	Elliber very channery loam, 25 to 45 percent slopes	90.9	6.2
ErB	Ernest silt loam, 0 to 8 percent slopes	1.9	0.1
HTC	Hazleton-Clymer association, 8 to 25 percent slopes, extremely stony	13.5	0.9
HTE	Hazleton-Clymer association, 25 to 45 percent slopes, extremely stony	5.3	0.4
Hy	Holly silt loam	33.8	2.3
LdB	Laidig cobbly loam, 3 to 8 percent slopes	0.0	0.0
LdC	Laidig cobbly loam, 8 to 15 percent slopes	0.0	0.0
LdD	Laidig cobbly loam, 15 to 25 percent slopes	18.1	1.2
LgC	Laidig cobbly loam, 8 to 15 percent slopes, extremely stony	56.9	3.9
LgD	Laidig cobbly loam, 15 to 25 percent slopes, extremely stony	21.6	1.5
LgE	Laidig cobbly loam, 25 to 35 percent slopes, extremely stony	13.1	0.9
MhC	Mertz channery silt loam, 8 to 15 percent slopes	5.8	0.4
MuC	Murrill channery loam, 8 to 15 percent slopes	9.4	0.6
OpE	Opequon-Hagerstown complex, 25 to 45 percent slopes, very rocky	44.8	3.0
PeB	Penlaw silt loam, 0 to 8 percent slopes	19.7	1.3
Ue	Udorthents, loamy	39.2	2.7

Bedford County, Pennsylvania

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
VdF	Vanderlip-Rock outcrop complex, 35 to 60 percent slopes	32.4	2.2
WsB	Westmoreland channery silt loam, 3 to 8 percent slopes	16.7	1.1
WsC	Westmoreland channery silt loam, 8 to 15 percent slopes	27.3	1.9
WwD	Westmoreland-Klinesville complex, 15 to 25 percent slopes	11.2	0.8

SOIL SURVEY OF BEDFORD COUNTY, PENNSYLVANIA



Shobers Run-SweetRoot to Browns Rd

MAP LEGEND

- Soil Map Units
- Cities
- Detailed Counties
- Detailed States
- Interstate Highways
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- Rails
- Water
- Hydrography
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MAP INFORMATION

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov

Coordinate System: UTM Zone 17

Soil Survey Area: Bedford County, Pennsylvania
Spatial Version of Data: 1
Soil Map Compilation Scale: 1:24000

Map comprised of aerial images photographed on these dates:
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Map Unit Legend Summary

Bedford County, Pennsylvania

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
ArB	Andover cobbly loam, 3 to 8 percent slopes	16.7	0.4
AvB	Andover cobbly sandy loam, 0 to 8 percent slopes, very stony	10.2	0.3
AvC	Andover cobbly sandy loam, 8 to 15 percent slopes, very stony	3.6	0.1
Aw	Atkins silt loam	75.9	2.0
Ax	Atkins-Ernest complex, 0 to 8 percent slopes	47.3	1.2
BcC	Bedington-Berks complex, 8 to 15 percent slopes	49.0	1.3
BcD	Bedington-Berks complex, 15 to 25 percent slopes	34.9	0.9
BdC	Bedington-Berks complex, 8 to 15 percent slopes, very stony	18.9	0.5
BdD	Bedington-Berks complex, 15 to 25 percent slopes, very stony	62.4	1.6
BdE	Bedington-Berks complex, 25 to 35 percent slopes, very stony	97.9	2.6
BkB	Berks channery silt loam, 3 to 8 percent slopes	20.0	0.5
BkC	Berks channery silt loam, 8 to 15 percent slopes	34.4	0.9
BkD	Berks channery silt loam, 15 to 25 percent slopes	13.7	0.4
BkE	Berks channery silt loam, 25 to 35 percent slopes	5.2	0.1
BrB	Blairton channery silt loam, 3 to 8 percent slopes	11.1	0.3
BrC	Blairton channery silt loam, 8 to 15 percent slopes	36.3	1.0
BrD	Blairton channery silt loam, 15 to 25 percent slopes	24.5	0.6
BtA	Brinkerton silt loam, 0 to 3 percent slopes	48.3	1.3
BtB	Brinkerton silt loam, 3 to 8 percent slopes	140.0	3.7
BuB	Buchanan cobbly loam, 3 to 8 percent slopes	182.4	4.8

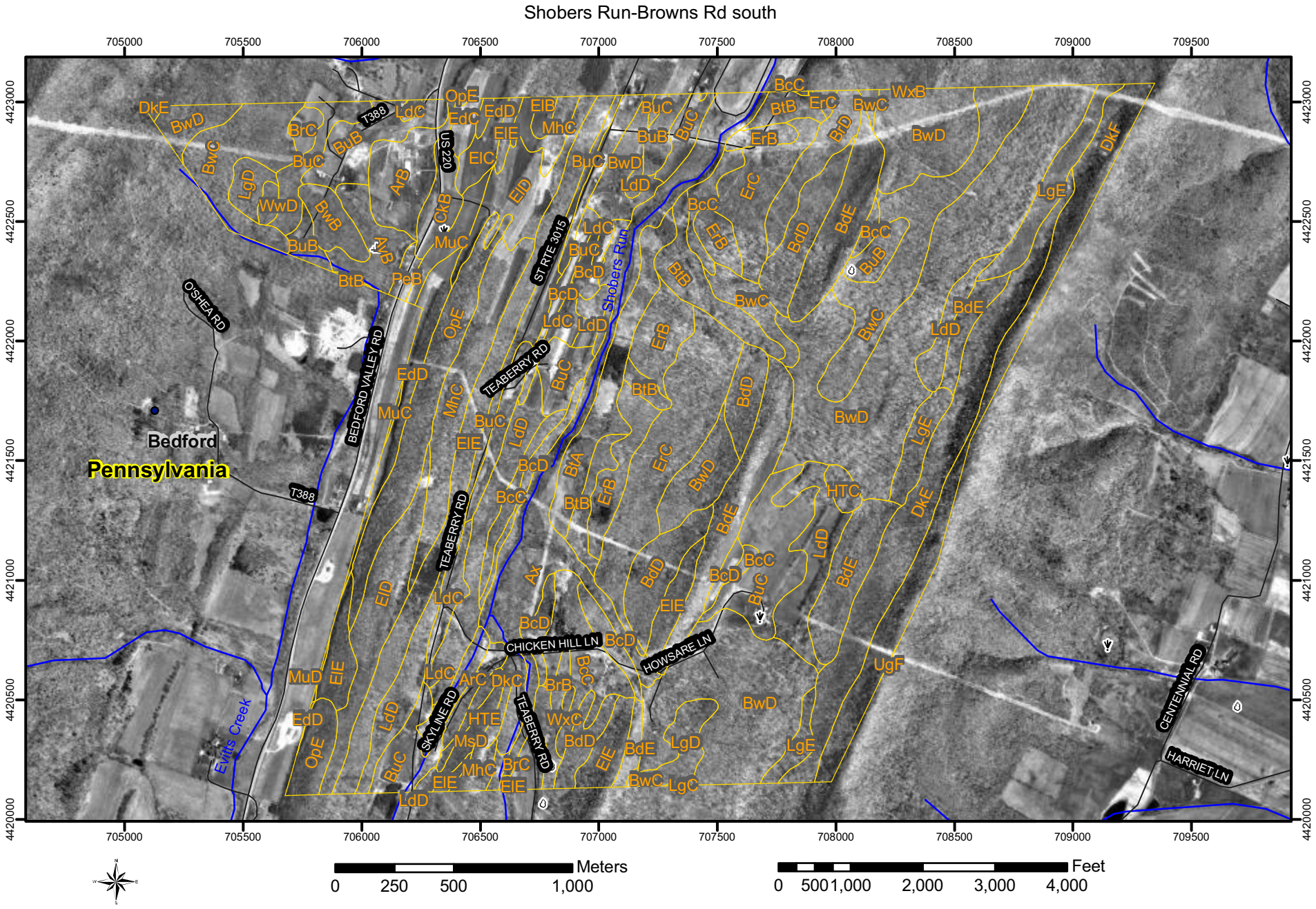
Bedford County, Pennsylvania

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
BuC	Buchanan cobbly loam, 8 to 15 percent slopes	165.2	4.3
BwB	Buchanan cobbly loam, 3 to 8 percent slopes, extremely stony	22.9	0.6
BwC	Buchanan cobbly loam, 8 to 15 percent slopes, extremely stony	371.1	9.7
BwD	Buchanan cobbly loam, 15 to 25 percent slopes, extremely stony	497.6	13.1
CkB	Clarksburg silt loam, 3 to 8 percent slopes	9.6	0.3
DkE	Dystrocrepts-Rock outcrop complex, 15 to 35 percent slopes	96.2	2.5
DkF	Dystrocrepts-Rock outcrop complex, 35 to 70 percent slopes	410.8	10.8
EdB	Edom silty clay loam, 3 to 8 percent slopes	9.1	0.2
EdC	Edom silty clay loam, 8 to 15 percent slopes	17.5	0.5
EdD	Edom silty clay loam, 15 to 25 percent slopes	24.8	0.7
ElB	Elliber very channery loam, 3 to 8 percent slopes	4.8	0.1
ElC	Elliber very channery loam, 8 to 15 percent slopes	98.8	2.6
ElD	Elliber very channery loam, 15 to 25 percent slopes	45.9	1.2
ElE	Elliber very channery loam, 25 to 45 percent slopes	190.5	5.0
ErB	Ernest silt loam, 0 to 8 percent slopes	106.5	2.8
ErC	Ernest silt loam, 8 to 15 percent slopes	111.9	2.9
HTC	Hazleton-Clymer association, 8 to 25 percent slopes, extremely stony	43.7	1.1
HTE	Hazleton-Clymer association, 25 to 45 percent slopes, extremely stony	15.5	0.4
Hy	Holly silt loam	35.8	0.9
LdB	Laidig cobbly loam, 3 to 8 percent slopes	5.3	0.1
LdC	Laidig cobbly loam, 8 to 15 percent slopes	87.0	2.3
LdD	Laidig cobbly loam, 15 to 25 percent slopes	59.7	1.6

Bedford County, Pennsylvania

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
LgC	Laidig cobbly loam, 8 to 15 percent slopes, extremely stony	26.3	0.7
LgD	Laidig cobbly loam, 15 to 25 percent slopes, extremely stony	24.2	0.6
LgE	Laidig cobbly loam, 25 to 35 percent slopes, extremely stony	103.2	2.7
MhC	Mertz channery silt loam, 8 to 15 percent slopes	25.9	0.7
OpE	Opequon-Hagerstown complex, 25 to 45 percent slopes, very rocky	56.4	1.5
PeB	Penlaw silt loam, 0 to 8 percent slopes	4.8	0.1
Pm	Pits and Quarries	4.6	0.1
Ps	Purdy silty clay loam, 0 to 3 percent slopes	23.6	0.6
Ue	Udorthents, loamy	2.4	0.1
VdF	Vanderlip-Rock outcrop complex, 35 to 60 percent slopes	16.3	0.4
W	Water	3.7	0.1
WkC	Weikert channery silt loam, 8 to 15 percent slopes	4.0	0.1
WkE	Weikert channery silt loam, 25 to 35 percent slopes	2.3	0.1
WsB	Westmoreland channery silt loam, 3 to 8 percent slopes	8.1	0.2
WsC	Westmoreland channery silt loam, 8 to 15 percent slopes	44.8	1.2
WwD	Westmoreland-Klinesville complex, 15 to 25 percent slopes	32.7	0.9
WxB	Wharton channery silt loam, 3 to 8 percent slopes, very stony	18.1	0.5
WxC	Wharton channery silt loam, 8 to 15 percent slopes, very stony	43.1	1.1

SOIL SURVEY OF BEDFORD COUNTY, PENNSYLVANIA



Shobers Run-Browns Rd south

MAP LEGEND

- Soil Map Units
- Cities
- Detailed Counties
- Detailed States
- Interstate Highways
- Roads
- Rails
- Water
- Hydrography
- Oceans
- Escarpment, bedrock
- Escarpment, non-bedrock
- Gulley
- Levee
- Slope
- Blowout
- Borrow Pit
- Clay Spot
- Depression, closed
- Eroded Spot
- Gravel Pit
- Gravelly Spot
- Gulley
- Lava Flow
- Landfill
- Marsh or Swamp
- Miscellaneous Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Slide or Slip
- Sinkhole
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Perennial Water
- Wet Spot

MAP INFORMATION

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov

Coordinate System: UTM Zone 17

Soil Survey Area: Bedford County, Pennsylvania
Spatial Version of Data: 1
Soil Map Compilation Scale: 1:24000

Map comprised of aerial images photographed on these dates:
4/8/1993; 4/20/1994

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend Summary

Bedford County, Pennsylvania

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
ArB	Andover cobbly loam, 3 to 8 percent slopes	26.0	1.3
ArC	Andover cobbly loam, 8 to 15 percent slopes	10.1	0.5
AvB	Andover cobbly sandy loam, 0 to 8 percent slopes, very stony	19.1	0.9
Ax	Atkins-Ernest complex, 0 to 8 percent slopes	89.3	4.4
BcC	Bedington-Berks complex, 8 to 15 percent slopes	52.6	2.6
BcD	Bedington-Berks complex, 15 to 25 percent slopes	41.3	2.0
BdD	Bedington-Berks complex, 15 to 25 percent slopes, very stony	67.8	3.3
BdE	Bedington-Berks complex, 25 to 35 percent slopes, very stony	111.7	5.5
BkC	Berks channery silt loam, 8 to 15 percent slopes	0.1	0.0
BrB	Blairton channery silt loam, 3 to 8 percent slopes	3.6	0.2
BrC	Blairton channery silt loam, 8 to 15 percent slopes	11.9	0.6
BrD	Blairton channery silt loam, 15 to 25 percent slopes	19.5	1.0
BtA	Brinkerton silt loam, 0 to 3 percent slopes	34.9	1.7
BtB	Brinkerton silt loam, 3 to 8 percent slopes	43.9	2.2
BuB	Buchanan cobbly loam, 3 to 8 percent slopes	47.5	2.3
BuC	Buchanan cobbly loam, 8 to 15 percent slopes	118.2	5.8
BwB	Buchanan cobbly loam, 3 to 8 percent slopes, extremely stony	12.6	0.6
BwC	Buchanan cobbly loam, 8 to 15 percent slopes, extremely stony	111.0	5.5
BwD	Buchanan cobbly loam, 15 to 25 percent slopes, extremely stony	316.6	15.6
CkB	Clarksburg silt loam, 3 to 8 percent slopes	13.4	0.7

Bedford County, Pennsylvania

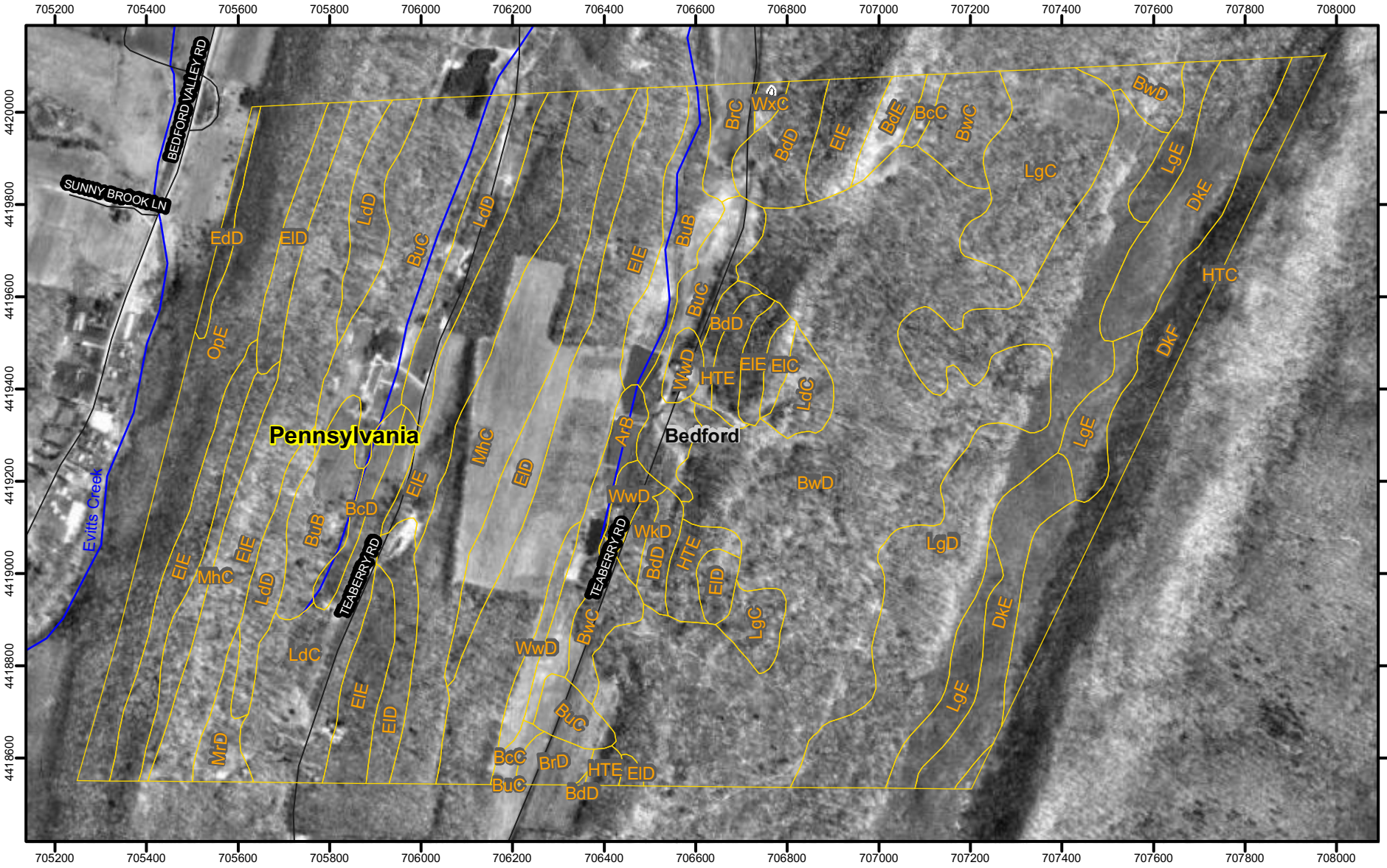
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
DkC	Dystrocrepts-Rock outcrop complex, 3 to 15 percent slopes	3.1	0.2
DkE	Dystrocrepts-Rock outcrop complex, 15 to 35 percent slopes	80.6	4.0
DkF	Dystrocrepts-Rock outcrop complex, 35 to 70 percent slopes	67.2	3.3
EdC	Edom silty clay loam, 8 to 15 percent slopes	5.4	0.3
EdD	Edom silty clay loam, 15 to 25 percent slopes	21.8	1.1
ElB	Elliber very channery loam, 3 to 8 percent slopes	3.2	0.2
ElC	Elliber very channery loam, 8 to 15 percent slopes	9.5	0.5
ElD	Elliber very channery loam, 15 to 25 percent slopes	65.6	3.2
ElE	Elliber very channery loam, 25 to 45 percent slopes	104.0	5.1
ErB	Ernest silt loam, 0 to 8 percent slopes	49.8	2.5
ErC	Ernest silt loam, 8 to 15 percent slopes	94.6	4.7
HTC	Hazleton-Clymer association, 8 to 25 percent slopes, extremely stony	5.1	0.2
HTE	Hazleton-Clymer association, 25 to 45 percent slopes, extremely stony	15.2	0.7
LdC	Laidig cobbly loam, 8 to 15 percent slopes	26.8	1.3
LdD	Laidig cobbly loam, 15 to 25 percent slopes	120.6	5.9
LgC	Laidig cobbly loam, 8 to 15 percent slopes, extremely stony	0.5	0.0
LgD	Laidig cobbly loam, 15 to 25 percent slopes, extremely stony	20.4	1.0
LgE	Laidig cobbly loam, 25 to 35 percent slopes, extremely stony	39.4	1.9
MhC	Mertz channery silt loam, 8 to 15 percent slopes	57.7	2.8
MsD	Morrison channery sandy loam, 15 to 25 percent slopes, very stony	4.4	0.2
MuC	Murrill channery loam, 8 to 15 percent slopes	10.9	0.5
MuD	Murrill channery loam, 15 to 25 percent slopes	0.5	0.0

Bedford County, Pennsylvania

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
OpE	Opequon-Hagerstown complex, 25 to 45 percent slopes, very rocky	59.1	2.9
PeB	Penlaw silt loam, 0 to 8 percent slopes	4.0	0.2
UgF	Ungers-Lehew complex, 35 to 60 percent slopes, very stony	0.0	0.0
WwD	Westmoreland-Klinesville complex, 15 to 25 percent slopes	3.1	0.2
WxB	Wharton channery silt loam, 3 to 8 percent slopes, very stony	0.0	0.0
WxC	Wharton channery silt loam, 8 to 15 percent slopes, very stony	8.3	0.4

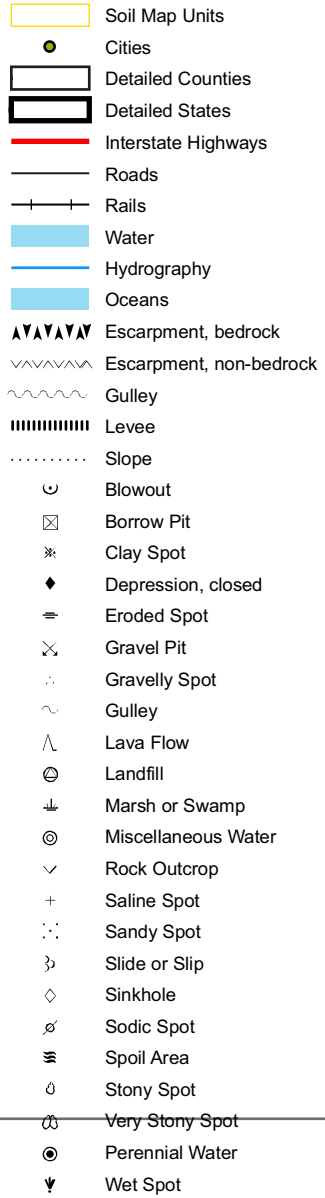
SOIL SURVEY OF BEDFORD COUNTY, PENNSYLVANIA

Shobers Run-headwaters



Shobers Run-headwaters

MAP LEGEND



MAP INFORMATION

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov

Coordinate System: UTM Zone 17

Soil Survey Area: Bedford County, Pennsylvania
Spatial Version of Data: 1
Soil Map Compilation Scale: 1:24000

Map comprised of aerial images photographed on these dates:
4/8/1993; 4/20/1994

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Map Unit Legend Summary

Bedford County, Pennsylvania

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
ArB	Andover cobbly loam, 3 to 8 percent slopes	9.8	1.2
BcC	Bedington-Berks complex, 8 to 15 percent slopes	3.1	0.4
BcD	Bedington-Berks complex, 15 to 25 percent slopes	4.3	0.5
BdD	Bedington-Berks complex, 15 to 25 percent slopes, very stony	15.5	1.9
BdE	Bedington-Berks complex, 25 to 35 percent slopes, very stony	4.1	0.5
BrC	Blairton channery silt loam, 8 to 15 percent slopes	5.1	0.6
BrD	Blairton channery silt loam, 15 to 25 percent slopes	3.6	0.4
BuB	Buchanan cobbly loam, 3 to 8 percent slopes	24.5	3.0
BuC	Buchanan cobbly loam, 8 to 15 percent slopes	48.2	6.0
BwC	Buchanan cobbly loam, 8 to 15 percent slopes, extremely stony	14.7	1.8
BwD	Buchanan cobbly loam, 15 to 25 percent slopes, extremely stony	152.2	18.8
DkE	Dystrocrepts-Rock outcrop complex, 15 to 35 percent slopes	35.1	4.3
DkF	Dystrocrepts-Rock outcrop complex, 35 to 70 percent slopes	28.0	3.5
EdD	Edom silty clay loam, 15 to 25 percent slopes	3.1	0.4
ElC	Elliber very channery loam, 8 to 15 percent slopes	2.2	0.3
ElD	Elliber very channery loam, 15 to 25 percent slopes	37.7	4.7
ElE	Elliber very channery loam, 25 to 45 percent slopes	131.6	16.3
HTC	Hazleton-Clymer association, 8 to 25 percent slopes, extremely stony	0.0	0.0
HTE	Hazleton-Clymer association, 25 to 45 percent slopes, extremely stony	9.9	1.2
LdC	Laidig cobbly loam, 8 to 15 percent slopes	28.9	3.6

Bedford County, Pennsylvania

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
LdD	Laidig cobbly loam, 15 to 25 percent slopes	29.7	3.7
LgC	Laidig cobbly loam, 8 to 15 percent slopes, extremely stony	28.9	3.6
LgD	Laidig cobbly loam, 15 to 25 percent slopes, extremely stony	67.0	8.3
LgE	Laidig cobbly loam, 25 to 35 percent slopes, extremely stony	19.8	2.4
MhC	Mertz channery silt loam, 8 to 15 percent slopes	50.7	6.3
MrD	Morrison channery sandy loam, 15 to 25 percent slopes	4.9	0.6
OpE	Opequon-Hagerstown complex, 25 to 45 percent slopes, very rocky	33.9	4.2
WkD	Weikert channery silt loam, 15 to 25 percent slopes	2.0	0.2
WwD	Westmoreland-Klinesville complex, 15 to 25 percent slopes	9.6	1.2
WxC	Wharton channery silt loam, 8 to 15 percent slopes, very stony	1.3	0.2

Appendix E – Monitoring Data

Summary of Visual Assessment Parameter Scores

Locations Of Monitoring Sites

Shobers Run Water Quality Monitoring Data

Macroinvertebrate Sampling Data

Summary of Visual Assessment Parameter Scores for Larger Stream Sections

Parameter	CC	HA	RZ	BS	WA	NE	FB	FH	PL	IH	CN	RE	MP	Overall
Stream Section														
Mouth to Elks	6	8	3	7	7	8	10	10	7	10	3	8		7.3
Elks	6	8	3	7	7	7	10	8	5	7	3	8		6.6
Elks to Springs Golf Course	7	8	8	5	7	8	10	10	3	8	7	8		7.4
Springs Golf Course	2	6	1	1	7	5	10	1	3	2	1	3		3.5
Springs property upstream of golf course	7	7	5	5	7	7	10	5	3	7	3	5		5.9
Springs property line to Sweet Root Rd bridge	8	8	9	7	7	8	10	5	3	7	10	5		7.3
Northern trib - mouth to Teaberry Rd	8	8	8	7	7	8	10	5	2	5	7	5		6.7
Northern trib - gap	6	6	3	5	7	8	10	3	2	3	2	7	5	5.2
Northern trib - upstream from gap	5	6	1	3	7	7	10	1	1	1	1	3	3	3.8
Sweet Root Rd bridge to Shobers Run Lane	7	8	9	7	7	8	5	5	3	7	7	5		6.5
Southern trib - mouth to Teaberry Rd	8	8	8	7	7	8	10	5	2	7	7	5		6.8
Southern trib - gap	5	6	5	3	7	7	10	6	2	3	3	7	5	5.3
Southern trib - upstream from gap	6	5	1	3	7	7	10	3	1	1	1	3	3	3.9
Shobers Run Lane to Buck Fallls Rd.	7	8	8	7	7	8	10	1	3	7	7	3		6.3
Headwaters	6	7	6	7	7	8	8	3	2	3	2	3		5.2
UNT's from Evitts Mt (east)	7	7	8	7	7	8	8	3	1	3	7	5		5.9
													Mean score of all stream sections	5.8

Overall score is sum of all parameter scores for section divided by numbers of parameters scored

Assessment Parameter	
Channel condition	CC
Hydrologic alteration	HA
Riparian zone	RZ
Bank stability	BS
Water appearance	WA
Nutrient enrichment	NE
Barriers to fish movement	FB
Instream fish cover	FH
Pools	PL
Invertebrate habitat	IH
Canopy cover	CN
Riffle embeddedness	RE
Manure presence	MP

Scores for each assessment parameter range from 1 - 10 with 10 being the optimal condition

Locations of Water Quality Monitoring sites

Site	Lat	Long	Description of Site
ShoMS001	40.0169214	78.4865146	15 meters upstream of Rt 30 bridge
ShoMS064	40.0139514	78.4947294	4 meters downstream of Watson Street brdige
ShoMS125	40.0070636	78.4977649	5 meters downstream of Stroup bridge on Elks golf course
ShoMS270	39.9950742	78.5078256	5 meters downstream of Sweet Root Rd bridge at Bedford Springs
ShoMS702	39.9542983	78.5502052	20 meters upstream of Sweet Root Rd bridge near Big Pine Drive
ShoUNT70	39.9591573	78.5536858	2 meters upstream of Teaberry Rd bridge near Sweet Root Rd. crossover
ShoMS915	39.9346526	78.5688060	10 m downstream from Shobers Run Ln xing below wetland near Flying Dutchman Rd
ShoHwe	39.9086333	78.5823663	3 meters downstream from Buck Falls Rd. culvert
ShoUNT90	39.9368588	78.5734028	10 meters downstream from Teaberry Rd bridge near Browns Rd
ShoMacro1	40.0168302	78.4870072	upstream short distance from ShoMS001
ShoMacro2	39.9993747	78.5074640	downstream from Naugle's Mill on Bedford Springs property
ShoMacro3	39.9542983	78.5502052	same location as ShoMS702

Shobers Run Water Quality Monitoring Data

August 2006 Water Quality Data - Bedford County Conservation District

Site	Lat	Long	Date	Temp	DO conc	DO % sat	pH	Turb	NO3-N	PO4	Alk
ShoMS001	40.0169214	78.4865146	8/28/2006	22.1	7.8		7.86	4.69	0.20	0.44	126.4
ShoMS064	40.0139514	78.4947294	8/28/2006	21.7	7.9		7.75	4.71	0.24	0.26	116.0
ShoMS125	40.0070636	78.4977649	8/28/2006	23.0	9.2		8.05	4.89	0.20	0.13	116.0
ShoMS270	39.9950742	78.5078256	8/28/2006	24.8	6.4		7.29	11.30	0.06	0.08	100.8
ShoMS702	39.9542983	78.5502052	8/28/2006	20.7	7.2		7.74	2.11	0.13	0.20	140.8
ShoUNT70	39.9591573	78.5536858	8/28/2006	16.2	7.5	79.7	7.75	0.68	0.47	0.46	146.8
ShoMS915	39.9346526	78.5688060	8/28/2006	20.2	7.4	85.2	7.64	2.28	0.11	0.19	144.0
ShoHwe	39.9086333	78.5823663	8/28/2006	20.3	6.6	75.7	7.40	2.39	0.08	0.26	76.8
ShoUNT90	39.9368588	78.5734028	8/28/2006	14.9	7.7	79.8	7.58	2.20	0.08	0.26	180.0

Volunteer Monitoring Data

ND - not detected

ShoMS001	40.0169214	78.4865146	8/21/2004	21.5	8.1		7.5	<5	0.15	0.10	118
ShoMS001	40.0169214	78.4865146	2/26/2005	1.5	10.2		7.5	<5	0.10	0.08	128
ShoMS001	40.0169214	78.4865146	5/14/2005	16.5	9.8		7.5	5	0.27	0.20	120
ShoMS001	40.0169214	78.4865146	10/8/2005	16.0	9.7		7.0	10	0.35	0.10	130
ShoMS001	40.0169214	78.4865146	4/22/2006	12.5	9.4		7.5	10	0.23	0.12	108
ShoMS064	40.0139514	78.4947294	8/21/2004	21.0	8.1		7.5	<5	0.10	0.10	110
ShoMS064	40.0139514	78.4947294	2/26/2005	1.5	10.0		7.5	<5	0.10	0.08	104
ShoMS064	40.0139514	78.4947294	5/14/2005	16.0	9.2		7.5	<5	0.30	0.04	106
ShoMS064	40.0139514	78.4947294	8/12/2005	20.0	8.5		7.5	<5	0.17	ND	120
ShoMS064	40.0139514	78.4947294	10/8/2005	15.5	8.6		7.0	<5	0.37	0.08	112
ShoMS064	40.0139514	78.4947294	4/22/2006	12.0	7.7		7.5	10	0.20	0.04	94
ShoMS270	39.9950742	78.5078256	8/21/2004	23.0	6.5		7.5	<5	0.05	ND	90
ShoMS270	39.9950742	78.5078256	2/26/2005	2.0	8.0		7.5	<5	0.10	ND	116
ShoMS270	39.9950742	78.5078256	5/14/2005	17.5	7.2		7.5	<5	0.18	ND	112
ShoMS270	39.9950742	78.5078256	10/8/2005	18.0	7.4		7.0	5	0.22	0.10	102
ShoMS270	39.9950742	78.5078256	4/22/2006	14.5	7.8		7.0	15	0.10	ND	96
ShoMS702	39.9542983	78.5502052	8/21/2004	20.5	6.8		7.5	<5	0.35	0.04	128
ShoMS702	39.9542983	78.5502052	2/26/2005	1.0	7.5		7.5	<5	0.25	0.10	138
ShoMS702	39.9542983	78.5502052	5/14/2005	18.0	7.3		7.5	<5	0.28	0.12	112
ShoMS702	39.9542983	78.5502052	8/12/2005	20.0	7.0		7.5	<5	0.18	ND	124
ShoMS702	39.9542983	78.5502052	10/8/2005	18.5	7.4		7.5	<5	0.15	ND	130
ShoMS702	39.9542983	78.5502052	4/22/2006	14.0	7.4		7.5	<5	0.22	0.16	116
ShoHwe	39.9086333	78.5823663	8/21/2004	20.5	6.8		7.0	<5	0.12	0.04	76
ShoHwe	39.9086333	78.5823663	5/14/2005	17.0	7.0		7.0	<5	0.15	0.02	68
ShoHwe	39.9086333	78.5823663	10/8/2005	18.5	6.7		6.5	<5	0.16	0.02	64
ShoUNT70	39.9591573	78.5536858	8/21/2004	17.0	7.5		7.5	<5	0.44	0.12	160
ShoUNT70	39.9591573	78.5536858	5/14/2005	16.5	7.5		7.5	<5	0.58	0.08	150
ShoUNT70	39.9591573	78.5536858	10/8/2005	16.3	7.6		7.5	<5	0.38	0.04	156
ShoUNT90	39.9368588	78.5734028	8/21/2004	15.5	7.3		7.5	<5	0.14	0.10	172
ShoUNT90	39.9368588	78.5734028	5/14/2005	14.5	7.7		7.5	<5	0.20	0.06	164
ShoUNT90	39.9368588	78.5734028	10/8/2005	14.0	7.8		7.5	<5	0.18	0.08	164

Order	Family	Genus	# in sample	Tolerance Value		
Site - ShoMacro1			(X_i)	(T_i)	(X_i)(T_i)	(X_i)(T_i)/n
Coleoptera	Elmidae	*Optioservus*	14	4	56	0.335329
		Stenelmia	2	4	8	0.047904
	Psephenidae	*Psephenus*	1	4	4	0.023952
Diptera	Athericidae	*Atherix*	4	4	16	0.095808
	Chironomidae		14	6	84	0.502994
	Tipulidae	*Antocha*	3	3	9	0.053892
	Simuliidae	*Simulium*	9	6	54	0.323353
Ephemeroptera	Baetidae	*Acentrella*	7	5	35	0.209581
		Baetis	5	5	25	0.149701
	Ephemerellidae	*Ephemerella*	3	1	3	0.017964
		Drunella	12	1	12	0.071856
	Heptageniidae	*Stenacron*	5	3	15	0.08982
		Stenonema	9	3	27	0.161677
	Isonychidae	*Isonychia*	14	2	28	0.167665
	Leptophlebia	*Paraleptophlebia*	3	4	12	0.071856
Megaloptera	Corydalidae	*Corydalus*	1	4	4	0.023952
		Nigronia	2	4	8	0.047904
Trichoptera	Hydropsychidae	*Ceratopsyche*	6	4	24	0.143713
		Cheumatopsyche	11	4	44	0.263473
	Philopotamidae	*Chimarra*	4	3	12	0.071856
Amphipoda	Gammaridae	*Gammarus*	38	6	228	1.365269
			n=	167	Σ(Xi)(Ti)/n=	4.2395

Site - ShoMacro2

Coleoptera	Elmidae	*Optioservus*	16	4	64	0.418301
		Stenelmia	3	4	12	0.078431
	Psephenidae	*Psephenus*	1	4	4	0.026144
		Ectopria	1	4	4	0.026144
Diptera	Athericidae	*Atherix*	2	4	8	0.052288
	Chironomidae		7	6	42	0.27451
	Tipulidae	*Antocha*	3	3	9	0.058824
	Simulidae	*Simulium*	5	6	30	0.196078
Ephemeroptera	Baetidae	*Acentrella*	1	5	5	0.03268
		Baetis	8	5	40	0.261438
	Ephemerellidae	*Ephemerella*	3	1	3	0.019608
		Drunella	6	1	6	0.039216
	Heptageniidae	*Stenacron*	12	3	36	0.235294
		Stenonema	9	3	27	0.176471
	Isonychidae	*Isonychia*	17	2	34	0.222222
Megaloptera	Corydalidae	*Nigronia*	4	4	16	0.104575
Trichoptera	Glossosomatidae	*Glossosoma*	2	1	2	0.013072
	Hydropsychidae	*Ceratopsyche*	6	4	24	0.156863
		Cheumatopsyche	17	4	68	0.444444
	Philopotamidae	*Chimarra*	8	3	24	0.156863
	Rhyacophilidae	*Rhyacohlila*	1	1	1	0.006536
Amphipoda	Gammaridae	*Gammarus*	21	6	126	0.823529
			n=	153	Σ(Xi)(Ti)/n=	3.8235

Site - ShoMacro3

Coleoptera	Elmidae	*Optioservus*	8	4	32	0.444444
	Psephenidae	*Psephenus*	1	4	4	0.055556
Diptera	Athericidae	*Atherix*	2	4	8	0.111111
	Chironomidae		12	6	72	1
	Tipulidae	*Antocha*	2	3	6	0.083333
Simulidae	Simulium		5	6	30	0.416667
Ephemeroptera	Baetidae	*Acentrella*	1	5	5	0.069444
	Ephemerellidae	*Ephemerella*	3	1	3	0.041667
	Heptageniidae	*Stenacron*	2	3	6	0.083333
		Stenonema	7	3	21	0.291667
	Isonychidae	*Isonychia*	9	2	18	0.25
	Leptophlebia	*Paraleptophlebia*	1	3	3	0.041667
Megaloptera	Corydalidae	*Nigronia*	5	4	20	0.277778
Trichoptera	Hydropsychidae	*Ceratopsyche*	2	4	8	0.111111
		Cheumatopsyche	10	4	40	0.555556
	Philopotamidae	*Chimarra*	2	3	6	0.083333
		n=	72		Σ(Xi)(Ti)/n=	3.9167

Site - SRBC

Coleoptera	Elmidae	*Optioservus*	42	4	168	0.819512
		Stenelmia	2	4	8	0.039024
	Psephenidae	*Psephenus*	5	4	20	0.097561
		Ectopria	1	4	4	0.019512
Diptera	Athericidae	*Atherix*	2	4	8	0.039024
	Chironomidae		28	6	168	0.819512
	Tipulidae	*Antocha*	1	3	3	0.014634
	Simulidae	*Simulium*	28	6	168	0.819512
Ephemeroptera	Baetidae	*Acentrella*	1	5	5	0.02439
	Ephemerellidae	*Ephemerella*	3	1	3	0.014634
	Heptageniidae	*Stenacron*	6	3	18	0.087805
		Stenonema	24	3	72	0.35122
	Isonychidae	*Isonychia*	23	2	46	0.22439
	Leptophlebia	*Paraleptophlebia*	1	3	3	0.014634
Megaloptera	Corydalidae	*Corydalus*	3	4	12	0.058537
		Nigronia	3	4	12	0.058537
Trichoptera	Hydropsychidae	*Ceratopsyche*	6	4	24	0.117073
		Cheumatopsyche	17	4	68	0.331707
	Philopotamidae	*Chimarra*	8	3	24	0.117073
Amphipoda	Gammaridae	*Gammarus*	1	6	6	0.029268
			n= 205		Σ(Xi)(Ti)/n=	4.0976