2.0 Land Resources

2.1 Topography / Geology

Topography

The Cherry Creek watershed lies within the *Blue Mountain* S*ection* of the Valley and Ridge Province, characterized by long, parallel, sharp-crested ridges separated by long, narrow valleys. Elevations range from 1,600 feet along ridge-tops to 300 feet in the valley bottoms. Rapidly-weathering rocks underlie the valleys, while more resistant quartzite and sandstone form the higher ridges. The differential weathering characteristics and upright folds have produced the long valleys and ridges unique to this section. The *Topography* map (Figure 2.1) illustrates the narrow valley and long ridges of the watershed.

Geology

The valley and ridge section of the basin is underlain by primarily shale, siltstone, and minor carbonate units. Fifteen thousand years ago, Wisconsian glaciers covered the entire watershed. Nearly all areas in the watershed, with the exception of hilltops, are now covered with unconsolidated sediments deposited or reshaped during glacial melting. The valley and ridge section is generally covered by thicker glacial deposits. They are typically meltwater-derived and include ice contact, outwash, and lacustrine deposits. Rock fragments in the glacial sediments are generally similar to the composition of the underlying bedrock and are thus assumed to be locally derived. Colluvium – soil and rocks deposited at the base of steep inclines – decreases the topographic slope at the base of most hills throughout the basin. Alluvium (sediment deposited by flowing water) consisting of sand, gravel, and cobbles from eroded till deposits is common to many of the streams.

Bedrock geologic units underlying the watershed include undifferentiated Silurian-Devonian aged rocks that are found in a band across the northern part of the watershed, in the Godfrey Ridge area. The Silurian rocks have been intensely deformed by folding and faulting, resulting in dramatic topography and were formed 408 to 436 million years ago. The first jawed fishes and vascular plants appeared during the Silurian Period. The oldest rocks are found in the southernmost part of the watershed: Bloomsburg Red Beds, and the Shawangunk Formation. See: *Bedrock Geology* map (Figure 2.2).

Glacier Terminal Moraine Geology

Cherry Valley, its ridges and Kittatinny Mountain offer more proof of the existence of a continental ice sheet than perhaps anywhere else in the world. During the Quaternary Period (the geological history connected to the history of our human race) the Pleistocene Wisconsin late Woodfordian Stage glacial deposits and sculpture processes vividly portrayed the most recent major event to shape and form the physiography of Cherry Valley. H. Carvill Lewis, a Professor of the Academy of Natural Sciences of Philadelphia in his early 1880 report – "The Glacial Terminal Moraine in Pennsylvania and Western New York" describes these claims and why Cherry Valley is so beautiful and well known. Somewhere between 12,500 and 18,500 years ago the Wisconsin glacier terminal moraine, a vast ice sheet 1800 feet higher than the valley floor, began to melt and recede northwards leaving in its path all kinds of interesting features such as: kettles, kames, stratified and unstratified drift or till, striae and boulders.

In Saylorsburg the accumulation of till covered with boulders fills the entire valley. Side to side kames (knob-like conical hills) and kettle holes (depressions) cover the entire landscape. Saylor's Lake, formerly called Lake Poponoming, lies on top of the terminal moraine in a kettle hole surrounded by drift and is the most southern moraine lake in all of Pennsylvania.

Kames usually represent ancient watercourses containing stratified water-worn gravel of local origin with fine sand material at the bottom and coarse gravel on the surface. Between Stormville and Delaware Water Gap outstanding sets of kames running parallel with the valley are connected to one another by low gravel ridges on either side of Cherry Creek, which because of the presence of these kames is considered a sub-glacial stream. Joining some of these conical hills on either side are cross kames that appear opposite ravines and depressions whose axes are at right angles to the valley.

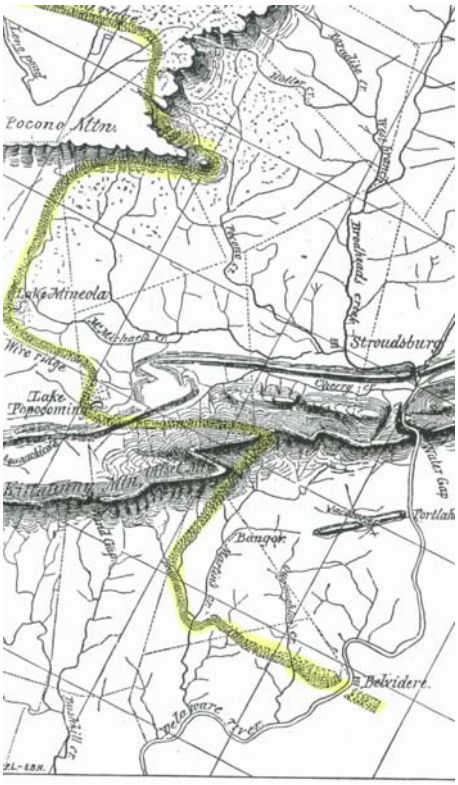
View to Big Pocono across Moraine

Glacial striae (scratches and grooving appearing on large boulders) abound in the valley. Near Kemmererville opposite the old school house striae can be seen upon Clinton red shale. Above this, at the southwest end of a Clinton red shale hill, for a distance of one eighth mile the bare rounded rock prominently displays sharp parallel gouged lines a foot deep. Very large boulders of white Pocono sandstone, also striated, rest atop the red rocks indicating they acted as the carving tools. When looking up the valley South 37 degrees west one can observe a wall of glacial drift extending across the valley, which formed the back portion of the terminal moraine. At Table Rock within a mile of Delaware Water Gap the largest glacial groove in the state of Pennsylvania measures six feet wide and seventy feet

long.

Huge ten to twenty five foot in diameter boulder blocks of Lower Devonium Fossiliferous Upper and Lower Helderburg limestone and fossiliferous Oriskany sandstone sit atop Kittatinny Mountain 1200 feet above the floor of Cherry Valley one and a half miles west of Fox Gap. These same rock Age-Groups also sit on top of the Clinton sandstone and shales of Poplar Valley Ridge (formerly called Red Ridge) at Tott's Gap (formerly called Tatamy's Gap). The Clinton Formation belongs to the Lower Silurian Period, which comprise the oldest rock in the valley. The only logical explanation for these two phenomena, is based on the following reasoning: first, the appearance of younger rock located at an elevation 800 feet higher and two miles south from Godfrey Ridge (the source of the Helderburg limestone and Oriskany Groups) and second, this same rock, also 800 feet higher and one and a half miles south of Godfrey Ridge, is the lifting and transporting force provided by a massive continental glacier.

Much of Cherry Valley's industry today, including farming, vineyards, tree farms, trout hatcheries, quarry operations etc., can be attributed to the great Wisconsin Glacier Terminal Moraine.[1]



Line of Glacial Moraine from Belvidere, NJ to the Pocono Plateau through Cherry Valley

[1] Summary report by Peter F. Steele using: Second Geological Survey of Pennsylvania, Report of Progress, Report on the Terminal Moraine in Pennsylvania and Western New York, by H. Carvill Lewis, Professor of the Academy of Natural Sciences of Philadelphia, published by the Board of Commissioners for the Second Geological Survey, 1884; and The Wisconsin Stage of the First Geological District, Eastern New York, by Donald H. Cadwell, Editor, Bulletin Number 455, New York State Museum, The University of the State of New York, The State Education Department, Albany, New York 12230, June 1986.

Scenic Geologic Features

Outstanding Scenic Geological Features of Pennsylvania are documented in a report by the same name authored by the State Geologist Arthur A. Socolow (Environmental Geology Report 7, Parts 1 & 2, 1979). In the preface, Mr. Socolow notes, *"Scenery has been recognized as a natural resource since 1864, when the first state park, Yosemite Valley, California, was established … Today, society recognizes these geologic features as a valuable environmental resource … Because of their outstanding geologic significance, the geologic features described here become outdoor classrooms, places where you can study the earth's surface in an almost natural condition, relatively undisturbed by human activities."*

The following describes unique geologic sites that occur in the watershed study area, all of which lie in the Valley and Ridge province, Appalachian Mountain section:

Delaware Water Gap - A highly scenic water gap cut by the Delaware River through the Kittatinny Mountain; the most attractive in the United States. Massive gray conglomerate and sandstone of the Shawangunk Formation of Silurian age supports the ridges and forms cliffs.

Lake Lenape Cave Shelter- A large overhanging cliff of quartzite of the Shawangunk Formation (Tammany Member Silurian age) was once used as living quarters by Leni Lenape Indians. This site has recently been excavated for artifacts left behind by the Indians. Excavation sites such as this supply much evidence used to piece together ancient cultures.

Wolf Rocks – Wolf Rocks have been called the most outstanding viewpoint from the Appalachian Trail in eastern Pennsylvania. The rock here is quartzite (Shawangunk Formation, Silurian age). It underlies The Little Offset ridge and crops out in a narrow band of bare rock. Wolf Rocks marks the southernmost point of continental glaciation along the Trail; the effects of the glacial climate extended far to the south, but the ice stopped here.

View from Wolf Rocks

2.2 Soil Characteristics

Soils Types

Like geology, soils play an important role in determining stream chemistry, and are also important for development and land planning purposes. Properties such as thickness, texture, and moisture capacity make some soil associations better suited to certain uses, such as agriculture or development, than others.

Through the center of the valley proximate to Cherry Creek are dominantly deep soils formed in glacial outwash and alluvium mainly on terraces and floodplains. This is the *Wyoming-Chenango-Pope* general soil association. It consists of nearly level to sloping, deep, somewhat excessively drained and well drained soils underlain by glacial outwash and alluvium. Across the southeastern boundary of the watershed along the Kittatinny Ridge lie dominantly shallow and moderately deep soils formed in glacial till mainly in the valley and ridge province. This is the *Dekalb-Hazleton-Laidig* general soil association. It consists of sloping to moderately steep, moderately deep, and deep, well drained soils underlain by brownish glacial till and colluvium. Between the Cherry Creek and the Kittatinny Ridge lie dominantly deep soils formed in glacial till mainly in the Appalachian plateau province. This is the *Lackawanna-Wellsboro-Oquaga* general soil association. It consists of nearly level to sloping, deep and moderately deep, well drained and moderately well drained soils underlain by reddish glacial till. Across the northwestern boundary of the watershed along the Godfrey Ridge lie dominantly shallow and moderately deep soils formed in glacial till mainly in the valley and ridge province. This is the *Benson-Rock outcrop* general soil association. It consists of moderately steep to very steep, shallow, well drained soils and areas of rock outcrop underlain by calcareous and noncalcareous shale, slate, sandstone and quartzite.[2]

Limitations

Benson-Rock outcrop Association – This soil unit extends along the northern edge of the watershed; its steep slopes form the watershed boundary to the north. It consists of moderately steep to very steep bedrock ridges. The soils are mainly steep and hilly, but some rolling and nearly level soils can be found on ridgetops. Benson soils are shallow and well drained. This association is poorly suited to most crops grown in the region because of surface stones, rock ledges, and shallow depth to bedrock. Slope is also a major limitation.

Wyoming-Chenango-Pope – Through the center of the valley proximate to Cherry Creek are dominantly deep soils formed in glacial outwash and alluvium mainly on terraces and floodplains. It consists of nearly level to sloping, deep, somewhat excessively drained and well drained soils underlain by glacial outwash and alluvium. Most of this map unit has been cleared and is used for general crops. Much is presently idle or is in established

[2] General Soil Map and descriptions, Monroe County, Pennsylvania, U.S. Department of Agriculture Soil Conservation Service, compiled 1978.

communities. A few small areas are developed for homesites and recreation. The soils are suited for most crops commonly grown in the county. Most of the soils, however have a very low to moderate available water capacity, and crop yields decrease during dry periods. Management practices that conserve moisture, reduce runoff, and control erosion are essential. The major limitations for most uses are the rapid permeability and flooding.

Lackawanna-Wellsboro-Oquaga – Between the Cherry Creek and the Kittatinny Ridge lie dominantly deep soils formed in glacial till mainly in the Appalachian plateau province. This is the *Lackawanna-Wellsboro-Oquaga* general soil association. It consists of nearly level to sloping, deep and moderately deep, well drained and moderately well drained soils underlain by reddish glacial till. This map unit is mostly wooded. A few areas were cleared for crops, but large portions of these areas are now idle. Some of the wooded areas were cleared for villages, recreation areas, and resorts. Except where cleared, the soils are too stony for cultivation and are better suited to woodland, wildlife habitat, and recreation than to other uses. Cleared soils are suited to most crops commonly grown in the county. Protection of woodland from fire and improved woodland management are needed. Cleared areas need to be protected against runoff and erosion. The major limitations in addition to stoniness are the slow permeability, the seasonal high water table, and the moderate depth to bedrock.

Dekalb-Hazleton-Laidig – Across the southeastern boundary of the watershed along the Kittatinny Ridge lie dominantly shallow and moderately deep soils formed in glacial till mainly in the valley and ridge province. This is the *Dekalb-Hazleton-Laidig* general soil association. It consists of sloping to moderately steep, moderately deep, and deep, well drained soils underlain by brownish glacial till and colluvium. This map unit is mostly wooded. The soils are too stony for cultivation and are better suited to woodland, wildlife habitat, and recreation than to other uses. The main limitations in addition to stoniness are the moderate depth to bedrock, the slope, and the moderately slow permeability. Protection of woodland from fire and improved woodland management are needed.

Limitations for Septic Tank Effluent Absorption

Of particular concern for this watershed plan is the fact that most of the watershed has severe limitations for conventional, in-ground septic tank absorption fields. See the map of *Septic Tank Absorption Limitations* (Figure 2.3). Only a very small percentage of the soils in the watershed are classified as having moderate or slight limitations for septic tank absorption capacities. Thus, many homes in the rural areas of the watershed use alternative systems such as sand mounds for wastewater treatment. Given these limitations and the widespread use of sand mound systems throughout the watershed, it will be critical to the future health of the watershed that these systems are monitored and maintained in proper working order. To that end, the Action Plan recommends that municipalities establish sewage management programs to assure that on-lot systems are properly monitored and maintained.

This plan also encourages the exploration of other alternative systems for wastewater treatment, which would offer improvements over the prevalent technology. One such

alternative system is land application of treated sewage and industrial wastewater. The map of *Soil Suitability for Land Application of Treated Wastewater* (Figure 2.4) shows the location of soils in the watershed suitable for land application. Suitable soils were chosen according to their ranking in a table of suitable soils found in the *Manual for Land Application of Treated Sewage and Industrial Wastewater*, PA DEP, 1981. Soils are represented on the map in three categories:

- "Most Suitable" soils are those with a maximum application rate of 1.5"-2.0" per week. These soils are well drained (wooded or open). Their irrigation season is approximately March to December.
- "Suitable" soils are those with a maximum application rate of 1"-1.5" per week. These soils are shallow well drained to moderately well drained (wooded or open). Their irrigation season is approximately March to December.
- "Less Suitable" soils are those with a maximum application rate of 0.5" per week. They are somewhat poorly drained and have an irrigation season of approximately May to September.

"Not Suitable" soils are those that are poorly drained or slopes in excess of 15 percent.

These systems have not been used in the Cherry Creek watershed to date. However, in the nearby Brodhead watershed, Spruce Lake Retreat, in Barrett Township, uses a spray irrigation system at the headwaters of the Brodhead Creek. This wastewater system sprays into three forested zones totaling five acres. The permitted volume for 2001 was 494,000 gallons per month for the months of March through November. However, the actual volume sprayed during the 2001 nine-month permitted period was 228,000 gallons per month, on average.

Another system is operated by Pleasant Valley School District at their middle school in Brodheadsville.

An interesting nearby project is that of the Pike County Business Center, located in Blooming Grove Township, a 615-acre business park with a projected sewage flow of 10,000 gallons per day. Sewage will be collected from each site, treated, and returned to be recycled as flush water for toilets and urinals. The remaining 20% will be discharged to a spray irrigation field.

2.3 Protected Lands

About 3,688 acres of land, or 28% of the watershed, are publicly owned, including state lands, county lands, and municipal lands. Private protected lands, including private conservation lands, and purchased agricultural easements, total about 1465 acres, or about 11% of the watershed. Therefore about 39% of the watershed is protected through public and private means. Quasi-protected lands, or lands indicating a conservation interest, include agricultural security areas and Pennsylvania Act 319 lands that have not been permanently protected through private or public means total about 4000 acres, or

30% of the watershed. See the *Protected Lands* map (Figure 2.5) for the spatial distribution of these lands. They break out as follows:

Federally Owned Lands

There are approximately 2,208 acres of federally owned lands in the project area. Approximately 337 acres lie within the Mount Minsi subwatershed in Delaware Water Gap Borough and are under the jurisdiction of the Delaware Water Gap National Recreation Area (DWGNRA). See: Section 3.1 for a description of the DWGNRA. Another approximate 518 acres lies primarily in Smithfield Township east of Tott's Gap Road and intersects with the Appalachian Trail along the Kittatinny Ridge. About 80 acres of the eastern most portion of this tract lies in the Caledonia Creek subwatershed. Approximately 30 acres lie in Delaware Water Gap Borough under the jurisdiction of the DWGNRA, which includes a portion of the Appalachian Trail Head located near Lake Lenape that leads to the Mount Minsi overlook. In Hamilton Township there are two large federally owned tracts, one of approximately 582 acres and one of approximately 202 acres. These too intersect with the Appalachian Trail along the Kittatinny Ridge. The remainder of the federal acreage is composed of smaller parcels spread out along the Kittatinny Ridge.

State Owned Lands

There are no State Parks, State Game Lands or State Forests in the Cherry Creek watershed. However, the Commonwealth of Pennsylvania owns approximately 50 acres along the Kittatinny Ridge.

County Owned Lands

There are no county-owned lands in the watershed.

Municipal Lands

There are about 1430 acres of municipal-owned protected lands and parkland in the watershed.

Other Protected and Quasi-Protected Lands

Other protected lands in the watershed include private conservation lands – including those protected by fee acquisition, conservation easement, and purchased agricultural easements. Quasi-protected lands include agricultural security areas, and Pennsylvania Act 319 lands.

- Private conservation lands are those protected by private land trusts and conservancies, such the Nature Conservancy and the Pocono Heritage Land Trust. The Nature Conservancy and Pocono Heritage Land Trust have protected 628 acres of critical habitat, corridor, and buffer lands in

Cherry Valley including the 271-acre Blakeslee Farm, 45-acre Domotor tract, 175-acre Christine farm, and 137-acre Walker Property.

- Purchased Agricultural Easements permanently protect the 271-acre Blakeslee Farm and about 65 acres of additional agricultural lands in the watershed. Conservation easements also protect 70 acres on the Groner Farm in Stroud Township. Another 208 acres of the Fellencer Farm in Hamilton Township is under contract for an Agricultural Easement.

- Agricultural Security Areas are not protected but are areas deemed suitable for protection by purchased agricultural easements. A total of 1,452 acres of Cherry Valley land located in the watershed have been designated as agricultural security areas.

- Pennsylvania Act 319 lands are those protected under the "Clean and Green" program, which provides property tax breaks to owners. These lands are *not* permanently protected – a landowner can simply pay the back-taxes in order to develop the site (examples of this have already occurred in Monroe County). Act 319 lands in the watershed total approximately 4,348 acres and include both agricultural and forested lands.

2.4 Landfills

There are no active landfills located in the watershed.

2.5 Hazard Areas

Waste Sites

"Superfund" sites are listed on the National Priorities List (NPL) [http://www.epa.gov/superfund/sites/npl/pa.htm] No Superfund sites are listed for the watershed. The federal Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) established the Superfund Program. A query on EPA regulated facilities in "Envirofacts" lists two facilities in the watershed:

- HEICO CHEMICALS INC - ROUTE 611, DELAWARE WATER GAP, PA 18327 (no RCRA storage) - PAD003037504
- TRANSISTOR DEVICES INC CIRCUITEK DIV - BROAD ST, DELAWARE WATER GAP, PA 18327 (no RCRA storage) - PAD079164158

There have been no violations in the past 2 years and no current significant violations. At this time, no issues related to either of these companies impact the watershed.

Mines / Quarries

One major mining operation lies adjacent and partially within the Cherry Creek watershed boundary. Hanson Aggregates – Hamilton Township, Cherry Valley Road Located off the western portion of Cherry Valley Road, it is a limestone quarrying operation however the majority of the site is located outside the watershed. Hanson Aggregates is not permitted (does not have a permit) to discharge waste water into area rivers. An EPA Envirofacts query shows there have been no violations in the past 2 years and no current significant violations. At this time, no issues related to this company impact the watershed.

Sinkholes

Cherry Valley lies within the carbonate bedrock region of Eastern and Central Pennsylvania, which is primarily composed of limestone and dolomite. This increases the possible occurrence of sinkholes, a subsidence feature in an area underlain by carbonate bedrock. Though the area may be susceptible, there have been neither instances of nor concern about sinkholes reported in the area. Sources: Pocono Record Online; Archive search 1998-2004; Kochanev, W.E., 1999, Sinkholes in Pennsylvania: Pennsylvania Geological Survey, 4th ser., Educational Series 11, 33 p.

Storage Tanks Sites

According to recent data from the Pennsylvania Department of Environmental Protection eMapPA [http://www.emappa.dep.state.pa.us/emappawebsite], there are ten (10) storage tank locations in the Cherry Creek watershed. Five are located in Delaware Water Gap Borough, one in Smithfield Township, three in Stroud Township, and one in Hamilton Township. A storage tank location is a DEP primary facility type, and its sole sub-facility on eMapPA is the storage tank itself. Storage tanks are aboveground or underground, and are regulated under Chapter 245 pursuant to the Storage Tank and Spill Prevention Act. Storage tanks currently contain, have contained in the past, or will contain in the future, petroleum or a regulated hazardous substance.

[Insert: *Topography* map.]

[Insert: *Bedrock Geology* map.]

[Insert: *Septic Tank Absorption Limitations* map.]

[Insert: *Septic Suitability for Spray Irrigation* map.]

[Insert map of Protected Lands.]