CHAPTER 2. LAND RESOURCES

Geology

A scenic view of the Redbank Creek watershed

When studying land resources, a good place to begin is with the region's geology, which can provide information about the land's history, composition, and structure.

From a geological standpoint, land areas are divided into physiographic provinces. These provinces are regions where landforms are similar in geologic structure. Pennsylvania is divided into six physiographic provinces. The project area is entirely within the Appalachian Plateau Physiographic Province (Sevon, 2000), which stretches from Alabama to New York, and encompasses a significant portion of western Pennsylvania.

The Appalachian Plateau Province is further divided into 10 physiographic sections. Located entirely within the Pittsburgh Low Plateau Section, the area is characterized by a smooth to irregular, undulating surface, with narrow, relatively shallow valleys. The underlying rock in this section is typically comprised of shale, siltstone, sandstone, limestone, and coal, all of which are present in the region (Sevon, 2000). A significant amount of coal mining has occurred because of the abundance of coal found in this section, which in most cases has altered the natural geology.

Beyond physiographic provinces, an area also can be categorized by formations. Geologic formations of a region are continuous rock units with a distinctive set of characteristics that make it possible to recognize and map. There are seven geologic formations present. These formations are listed in Table 2-1 and can be seen in Figure 2-1. The most prevalent formation is the Allegheny Formation, which contains significant amounts of coal, and is the focus of much of the watershed's coal mining activities. The formation also contains significant amounts of sandstone and shale. The Pottsville Group is the other most common geologic formation. The Pottsville Group is dominated by sandstone, and also contains discontinuous layers of coal. Because of the discontinuous nature of the coal in the region, mining is not a common practice within the Pottsville Group.

Table 2-1. Geologic Formations

Allegheny Formation
Burgoon Sandstone through Cuyahoga Group
Casselman Formation
Glenshaw Foundation
Huntley Mountain Formation
Pottsville Group
Shenango Formation through Oswayo Formation

Soils

According to the Soil Society of America, soil is "The unconsolidated mineral or organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants." There are over 20,000 soils in the United States alone. Soils are named and classified on the basis of physical and chemical properties.

Soil Associations

Soil associations are comprised of two or three major soils and a few minor soils. There are 20 soil associations present. Descriptions of the soil associations follow, with brief overviews found in Table 2-2

(Hallowich, Topalanchik, Jensen, Braker, & Ellenberger, 1988; Martin & Haagan, 1977; Loughry et al., 1958; NRCS, 2006; Zarichansky et al., 1964).

1. **Rayne-Gilpin-Ernest** soil association contains well drained and moderately well drained, deep and moderately deep, gently sloping to very steep soils on hilltops, ridges, hillsides, and foot slopes. Land uses associated with these soils are primarily forested, mostly mixed hardwoods. Some areas on hillsides are used for pasture and hay, and some hilltops and benches are used for cultivated crops, hay, and pasture. Use limitations include steep slopes, erosion, and a seasonal high water table.

2. **Cookport-Hazleton-Clymer** soil association consists of moderately well drained and well drained, deep, nearly level to moderately steep soils on broad uplands, ridges, and on hillsides. Land uses associated with these soils are typically forested, mixed hardwoods. Use limitations are slope, erosion, surface stones, and a seasonal high water table.

3. **Udorthents-Gilpin-Rayne** soil association includes well drained to somewhat poorly drained, shallow to deep, nearly level to very steep soils on hilltops, ridges, benches, and foot slopes. Land uses associated with these soils in the watershed are mostly areas disturbed during surface mining. Most unmined areas are forested, with some areas used for pasture and hay. The land is typically suited for farming. Use limitations include slope, erosion, and a seasonal high water table.

4. **Atkins-Philo-Monongahela** soil association can be found in areas of poorly drained to moderately well-drained, deep, nearly level and gently sloping soils on floodplains and terraces. Land uses associated with these soils are forested areas or areas of urban development. Some agricultural uses, such as crops, hay, and pasture are present. Use limitations mainly are the high seasonal water table and flooding.

5. **Cavode-Brinkerton-Armagh** soil association contains poorly drained and somewhat poorly drained soils, moderately deep or deep, nearly level or gently sloping areas on uplands. Strip mining is common in this association, as is dairy farming, pasture, cultivated crops and hay. Small wetlands are common, and artificial drainage is often needed before development can occur.

6. **Cookport-Hartsells-Dekald** soil association consists of moderately drained or well drained, moderately deep or deep, and found on ridgetops and slopes. Much of the association is forested while dairy and beef cattle farms are also present. Use limitations include large boulders that are often present at the surface and the coarse nature of the soils.

7. **Dekalb-Leetonia** soil association includes well drained soils found along steep slopes and is rare in the area. The vast majority of the association is forested. Use limitations include large boulders that are often present at the surface and very steep slopes that make agricultural operations nearly impossible.

8. **Gilpin-Montevallo-Ernest** soil association can be found in shallow to moderately deep areas on rolling uplands, steep hillsides, and lower slopes. It is often found within floodplains as well. Strip mining is extensive within this association. Dairy farms, pastures, and Christmas tree farms are also found within the association. Use limitations include possible flood impacts.

9. **Gilpin-Wellston-Ernest** soil association contains well drained and moderately well drained, shallow to deep soils and is found on rolling plateaus, long slopes, and the lower parts of slopes. Coal mining is extensive within this association. Dairy farms and some pasture also can be found within the association.

10. **Guernsey-Westmoreland** soil association contains moderately well drained and well drained soils, and is generally sloping and moderately steep. Typically found in uplands, dairy and beef cattle farms are a common use within this association. Other farming does occur, but artificial draining is sometimes needed. Another use limitation is land slippage that is somewhat common in this association.

11. **Monongahela-Holston** soil association contains moderately well drained and well drained, deep soils, and often is found along stream terraces. This association is common along Redbank Creek. About half of this association within the watershed is farmed, whereas the rest is forested or in urban development. Gravel is common in this association, and some gravel mining does occur.

12. **Purdy-Tyler-Zoar** soil association includes soils that are poorly drained to moderately well drained, and found along stream terraces of waterbodies such as Sandy Lick Creek. Some farming can be found in this association, with the main crop being hay. Much of the association remains forested.

13. **Weikert-Gilpin** soil association contains well drained, shallow to moderately deep soils found on steep and very steep upland areas. Most of this association is forested, with much of it having been logged in the past. Coal mining is a use often found within this soil association. A use limitation includes very steep slopes.

14. **Rainsboro-Melvin-Steff** soil association contains moderately well drained to poorly drained deep soils found in nearly level to gently sloping areas on terraces and floodplains. Urban development is a major land use within this association, as towns such as South Bethlehem are situated within this association. Use limitations include a seasonal high water table.

15. **Rayne-Ernest-Hazelton** soil association consists of well drained to moderately well drained, deep, gently sloping to moderately steep soils found in low-lying areas on ridgetops, and on hillsides. Agriculture is the main land use; however, urban development is often found within this association. Use limitations include a seasonal high water table.

16. **Wharton-Rayne-Cavode** soil association includes well drained to somewhat poorly drained, deep, nearly level to moderately steep soils, found on ridges, benches, and hillsides. Agriculture is common within this association, as it is well suited for crops. Pooling water during wet periods and a seasonal high water table are use limitations within this association. In some parts of the association, artificial drainage is needed for agricultural and urban development.

17. **Dekalb** soil association consists of moderately deep, well drained, moderately steep to very steep, stony soils. The vast majority of the association is forested. The major use limitations in this association are steepness, depth to bedrock, and surface stones. Residential development and agricultural operations are very rare within this association.

18. **Gilpin-Ernest** soil association contains poor to moderately well drained, sloping to steep soils. Agriculture, particularly dairy farms, is common within this association. The majority

of the non-farmed portions of this soil are forested. Timber cutting has been conducted through portions of this association, and erosion is often moderate to severe within the cleared areas.

19. **Gilpin-Rayne-Ernest** soil association consists of well drained, fairly deep, sloping to steep soils found on uplands. Dairy farms and coal mining, typically strip mining, are common land uses within the association. With good drainage and gentle, moderate slopes, there are few natural use-limitations within the soil. Disturbances from past mining practices are one of the few limitations found within the association.

20. **Wheeling-Sciotoville** soil association consists of poorly drained to well drained, nearly level soils. With few use limitations, this association is accustomed to seeing more development than many other associations. Farming and urban development are common, and the association is less forested than most.

Table 2-2. Brief Soil Association Descriptions

Soil Association	Description
Rayne-Gilpin-Ernest	Originates from shale, siltstone, and sandstone. Well drained to moderately drained soils. Found on hills and ridges.
Cookport-Hazleton-Clymer	Originates from sandstone. Moderately drained and well drained soils. Found on uplands, ridges, and hillsides.
Udorthents-Gilpin-Rayne	Originates from shale, siltstone, and sandstone. Well drained to poorly drained soils. Found on hills and ridges.
Atkins-Philo-Monongahela	Originates from sandstone, siltstone, and shale. Poorly to moderately well drained soils. Found on floodplains and terraces.
Cavode-Brinkerton-Armagh	Originates from shale. Somewhat poorly drained and poorly drained soils. Found on broad uplands and gentle slopes.
Cookport-Hartsells-Dekalb	Originates from sandstone. Moderately well drained. Found on broad ridgetops and on slopes.
Dekalb-Leetonia	Originates from sandstone. Well drained soils. Mainly found on steep slopes.
Gilpin-Montevallo-Ernest	Originates from shale, siltstone, and sandstone. Mainly well drained soils. Found on rolling uplands and steep hillsides.
Gilpin-Wellston-Ernest	Originates from siltstone, shale, and sandstone. Well drained and moderately well drained soils. Found on rolling plateaus and long slopes.
Guernsey-Westmoreland	Soils that contain some lime. Moderately well drained and well drained. Found on uplands.
Monongahela-Holston	Moderately well drained and well drained soils. Found along Redbank Creek.
Purdy-Tyler-Zoar	Poorly drained to moderately well drained soils. Mainly found on terraces along older and larger streams. Common along Sandy Lick Creek.
Weikert-Gilpin	Originates from shale, siltstone, and limestone. Well drained soils. Typically found on uplands in close proximity to rivers and creeks.
Rainsboro-Melvin-Steff	Moderately well drained to poorly drained soils. Mainly found on terraces and within floodplains. The soils are typically underlain by stream sediment.
Rayne-Ernest-Hazelton	Originates from shale and sandstone. Well drained and moderately well drained soils. Found in low-lying areas on ridgetops and hillsides.

Table 2-2. Brief Soil Association Descriptions (continued)

Soil Association	Description
Wharton-Rayne-Cavode	Originates from clay, shale, siltstone, and sandstone. Well drained to somewhat poorly drained soils. Found on uplands that are bisected by small streams.
Dekalb	Originates from sandstone and quartzite. Well drained soils. Only a small area within the watershed, found along Redbank Creek.
Gilpin-Ernest	Originates from shale and sandstone. Poor to moderately well drained soils. Prevalent along the bank of Redbank Creek in Clarion County.
Gilpin-Rayne-Ernest	Originate from shale and sandstone. Well drained soils. The dominant association in the Clarion portion of the watershed, located just off the river.
Wheeling-Sciotoville	Originates from sandstone. Poorly drained to well drained soils. The association can be found on gravelly benches along a small portion of Redbank Creek.

Prime Agricultural Soils

Soils that meet certain physical, chemical, and slope characteristics are identified as prime agricultural soils or prime farmland soils. Based upon a predetermined set of criteria, they are designated by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) in each county. These soils are important in meeting the country's short-term and long-term needs for food. Ultimately, these soils will produce the highest yields with minimal input of energy and economic resources (Hallowich et al., 1988). The criteria typically include level to near-level slopes, a well drained structure, deep horizons, an acceptable level of alkaline or acid components, and the capacity for producing food or crops. Figure 2-2 depicts the areas that have prime agricultural soils. As shown on the map, the soils are scattered throughout the watershed. The soils are typically found close to waterbodies. These soils are often closely associated with established urban areas, signifying the importance of farming to the earliest settlements in the area.

The majority of prime agricultural soils are located in Jefferson County. There are 28 soils within Jefferson County that qualify as prime agricultural soils (Zarichansky et al., 1964). As displayed on Figure 2-2, these soils are spread throughout the entire county, with a significant presence along the mainstem of Redbank Creek, North Fork Redbank Creek, and Sandy Lick Creek.

A small portion of the watershed within Clearfield County contains nine soils that qualify as prime farmland. As shown on Figure 2-2, some of the most dense areas of prime agricultural soils within the project area are found within Clearfield County. They are found within Rayne-Gilpin-Ernest, Cookport-Hazleton-Clymer, and Udorthents-Gilpin-Rayne soil associations. Despite the dense presence of prime farmland, the continued loss of soils to surface mining and urban development has resulted in less than 17 percent of the entire Clearfield County land area now meeting the requirements for prime farmland (Hallowich et al., 1988).

Within the Armstrong County portion, six soils qualify as prime farmland (Martin & Haagen, 1977). Only a small percentage of the land is currently in active agriculture. The majority of the prime agricultural soils are found in the eastern portion of the county near South Bethlehem.

Just across Redbank Creek, in Clarion County, there are 25 prime farmland soils scattered throughout a relatively small portion of the project area (Loughry et al., 1958). This area also contains

large reserves of coal, and much of the prime farmland soils are intermingled with both active and abandoned mines. The majority of the prime farmland soils in the county are found in two locations, along the river near New Bethlehem and Hawthorn, and towards the mouth of the river where Redbank Creek empties into the Allegheny River.

Within the small portion that stretches into Elk County, there is one area of prime agricultural soils, as shown on Figure 2-2. This small area stretches into the southern part of Elk County from Clearfield County.

Farmland of Statewide Importance

Soils important to agriculture also can be designated as farmland of statewide importance. These soils, in addition to prime agricultural soils, are critical to the region's agriculture. They are designated by the State Rural Development Committee as being of statewide importance for the production of food, feed, fiber, and forage. Typically, farmlands of statewide importance include those that do not meet the requirements to be designated prime farmland, but produce economically profitable, high yields of crops when treated and managed according to acceptable farming methods. Some may produce yields as high as prime farmlands if conditions are favorable.

Significant pockets of farmland of statewide importance are present. These areas are identified by soils within each county. Eighteen soils classified as farmland of statewide importance are present within Clearfield County, 15 within Armstrong County, 38 within Jefferson County, and 23 in Clarion County (Hallowich et al., 1988; Martin & Haagen, 1977; Zarichansky et al., 1964; Loughry et al., 1958). Throughout the project area, these soils are relatively evenly scattered, with no one geographic area containing a dominant amount of farmland with this designation.

Land Use

Observing the land use of a specific region can reveal a significant amount about that region. Land uses can provide clues about the major economic catalysts in a region, and offer a glimpse into its past. Looking at a region's land use can even identify trends that are not seen from everyday observation, such as insights into possible sources of environmental degradation. It is important to continually monitor land-use changes in a region in order to inform decision makers regarding planning and natural resource protection.

Open space dominates the landscape, while just over three percent of the land area is occupied by urban development. Most of this development is located in the few population centers, including DuBois, Treasure Lake, Brookville, Summerville, and New Bethlehem. Forested lands and agriculture are the two major land uses; combined, they comprise over 78 percent of the total land area. Barren lands, primarily comprised of mined area, make up over 17 percent, and small patches of wetlands and open water are also found. Table 2-3 and Figure 2-3 depict the existing land use.

Forestry

In 1630, an estimated 95 percent of Pennsylvania was covered with forest. Harvesting the timber to support a growing nation reduced the forest coverage of Pennsylvania to an amazing 30 percent by 1907. Over the past century, the number has rebounded, and today 58 percent of the land area in Pennsylvania is forested. Among the forests throughout the state, private interests hold 69 percent, while 31 percent are owned by public agencies (DCNR, 2004b).

Throughout western Pennsylvania, forestry is a key component to both the history and future of many communities. Before the region was settled, nearly the entire Redbank Creek valley was forested. As displayed in Table 2-3, the amount of forestland has dramatically declined, but still represents over half of the project area. The majority of forest, 85 percent, is deciduous, while 11 percent is coniferous forest, and four percent is mixed forest. The most dense forests can be found along North Fork Redbank Creek. Around the mainstem of Redbank Creek and Sandy Lick Creek, the forested areas are interspersed with large expanses of coal-mined land, hay and row crop agricultural operations, and regional population centers, including Brookville, DuBois, and Reynoldsville. Most of the region has been logged at least once in the past, so the vast majority of forests are second- or third-growth forests. Forest stands are comprised of species of oak, maple, hickory, pine, and hemlock (Zarichansky et al., 1964).

Table 2-3. Current Land Use

Land-Use Type	Square Miles	% of Land Area
Water	**1.35**	**0.23**
Open Water	1.35	0.23
Development	**18.86**	**3.26**
Low-Density Urban	16.59	2.87
High-Density Urban	2.27	0.39
Agriculture	**159.53**	**27.64**
Hay Pasture	64.00	11.09
Row Crops	95.53	16.55
Forest	**293.06**	**50.78**
Coniferous Forest	30.99	5.37
Mixed Forest	13.68	2.37
Deciduous Forest	248.39	43.04
Wetlands	**2.42**	**0.41**
Woody Wetland	2.07	0.35
Emergent Wetland	0.35	0.06
Barren	**101.77**	**17.62**
Quarries	4.76	0.82
Coal Mined Areas	65.28	11.31
Transitional	31.73	5.49
Total	**577**	**100**

Historically, timber was sent by raft to Pittsburgh via the Allegheny River. Rafting timber began out of DuBois in the 1850s (Gilmore, personal communication, 2006). The slow and sinuous nature of the creek made the trip a slow journey; it took a week to raft from DuBois to Reynoldsville, just a few miles downstream.

Today, the lumber industry, while scaled back from its height of production over 100 years ago, is still a major component of the local economy. According to a Penn State University study using data from 1997, Jefferson County had the highest timber harvest (most timber harvested) of any county in Pennsylvania for that year. The county also has the tenth-highest amount of standing timber in the commonwealth (Jacobson & Seyler, 2004). Brookville Wood Products Hardwoods, Inc. (BWP Hardwoods, Inc.), a local lumber company produces 80,000-100,000 board feet per day at their mill (Theisen, personal communication, 2007). BWP Hardwoods, Inc. is a supporter of the Sustainable Forestry Initiative, Inc., which means that they strive to develop efforts that combine harvesting of trees with the protection of wildlife and water quality.

BWP Hardwoods, Inc., located in Jefferson County

The region's forestry history has been recognized through its inclusion in the Pennsylvania Lumber Heritage Region (LHR). The LHR is one of 11 heritage regions covering much of the Pennsylvania landscape. The designation recognizes the forested landscapes that dominate much of the project area.

One of the many farms in the Redbank Creek watershed

Agriculture

Like the forestry industry, many livelihoods are based on the agricultural industry. As mentioned previously in this chapter, agriculture is the other major land use within the watershed. Eleven percent of the region is currently in pasture, and 16 percent is currently under row crop agriculture production. Chief crops include hay, corn, oats, and wheat. Livestock operations include dairy cattle and beef cattle. The agricultural areas are fairly evenly spread, with many agricultural operations located adjacent to major waterbodies.

Due to surface mining and residential development, much of the agricultural lands are under threat. The various pressures facing agricultural lands have led to a reduction in the number of farms and the acreage of land farmed. When the region was first settled, agriculture grew rapidly. In 1880, there were 2,576 farms working 154,636 acres in Jefferson County alone. By 1959, those numbers had dropped to 1,203 farms and 138,415 acres. They have continued to decrease, and the trend is moving towards fewer farms working larger acreages (Zarichansky et al., 1964). Opportunities for preserving agricultural lands are available, but the available programs could be greatly expanded. The vast majority of townships do not have farmland preservation ordinances, but should adopt them to preserve this occupation and land use.

There are two farm management types within the watershed—family farms and factory farms. **Family farms** are typically smaller farms that have been in operation for several generations. For the most part, owners of family farms manage and work on their farms following sustainable agricultural practices. The majority of the farms in the Redbank Creek valley are locally owned family farms.

Factory farms are larger, corporate-based industries. Many of these farms control production from animal breeding, processing, and to the market shelf. Factory farms emphasize high volume and profit. Several different types of farming operations are considered factory farms, including concentrated animal feeding operations (CAFO), confined animal feeding operations, conventional farming, industrial agricultural operations, and industrial livestock operations.

Scene from a family farm in the Redbank Creek watershed

Several programs are offered to farmers to promote the protection of natural resources on agricultural lands. The Pennsylvania Department of Agriculture (PDA) promotes the sound use of pesticides through integrated pest management (IPM) efforts. Through the PDA, all licensed pesticide applicators are educated about the safe and effective use of pesticides.

New to western Pennsylvania is the Conservation Reserve Enhancement Program (CREP), an incentive-based program, which pays farmers to implement best management practices (BMPs) on their land. BMPs are methods, structures, and practices, which prevent or reduce water pollution in an economical manner. CREP is administered through the USDA and is available throughout the project area.

Oil and Gas Exploration

For over a century, oil and gas exploration has been a common fixture in the region. As the demand for oil and natural gas grows around the world, exploration for these resources expands as well. In 2005,

the Pennsylvania Department of Environmental Protection (DEP) issued 6,046 oil and gas well-drilling permits throughout the state, a 32.4 percent increase over the record 4,567 permits that were issued in 2004 (DEP, 2006d).

Significant oil and gas fields can be found throughout the project area. The Jefferson County portion is home to several large fields that contain dozens of wells, mostly producing natural gas. There are also some wells scattered throughout the county in areas where large fields are not present. The northwest Clearfield County portion of the project area has several natural gas fields. Much of the gas comes from deep reservoirs (Hallowich et al., 1988).

Permits for 9,681 wells have been issued in the region since 1890. A total of 7,000 gas wells make up a vast majority of these wells. Approximately 100 wells have been producing oil or a combination of oil and gas. The remaining wells fall into a range of categories, including uncompleted wells, dry wells, and storage wells (Harper, personal communication, 2006). Drilling in the region was a fairly consistent practice between 1900 and 1989, as displayed in Table 2-4. Over the past couple of decades, drilling has greatly accelerated, and based upon statewide data, drilling activity is predicted to continue to increase. Between 2000 and 2006, in just six years, more wells were permitted than in any previous decade.

There are some impacts associated with oil and gas drilling. The actual construction of wells and the access roads developed to reach the well sites can cause increased erosion and siltation to occur. This problem is most prevalent among the wells that have been drilled closest to waterbodies. Another problem associated with oil and gas well development is fragmentation of forestlands. As more wells are developed, important forests that serve as critical habitat to many species will be further fragmented by the well sites and by roads used to access the sites. Wildlife is impacted by the loss of habitat through forest fragmentation, when interior habitats are reduced and the amount of edge habitat increases. Fragmented forests make some wildlife more susceptible to predators, and can put wildlife at risk while traveling, as they become temporarily vulnerable when they leave the protection of the forest.

Table 2-4. Oil and Gas Wells Permitted by Decade

Decade	Number of Wells Drilled
1890–1899	29
1900–1909	608
1910–1919	286
1920–1929	640
1930–1939	234
1940–1949	461
1950–1959	506
1960–1969	408
1970–1979	709
1980–1989	789
1990–1999	1,127
2000–2006	1,286

Abandoned wells also pose a threat to natural resources. To address the issue of abandoned oil and gas wells, the commonwealth has several options available to aid in remediation. Through the state's Growing Greener program, funding is available to seal abandoned wells to ensure that they do not pollute local waterways. During the 2005 round of Growing Greener grants, two awards were given to projects addressing abandoned well plugging. In previous years (1999–2004), a total of 15 grants were awarded throughout the state to address abandoned wells.

Active Mines

As was mentioned in the geology section of this chapter, significant reserves of coal are prevalent here. Due to this abundance, there is a long history of coal mining that continues today. Abandoned mines have left behind a legacy of water quality problems that many are striving to correct. A number of active mining operations also are present. These operations work under stricter regulations than those preceding them, but still raise concerns among area residents.

According to permits received through the DEP, currently there are 92 active coal mines. Of those, five are underground mines, while 87 are surface mines. As shown on Figure 2-4, coal mines are scattered over most of the project area. All areas, with the exception of the area around North Fork Redbank Creek, have a significant amount of mining activity. Associated with the active coal mines are 72 discharge points, which also can be seen on Figure 2-4.

Mining remnants: coal bony piles

While coal is the major mineral commodity throughout the Redbank Creek valley, other mining operations exist, including clay, shale, sandstone, and limestone mines (Hallowich et al., 1988).

Industrial/Commercial

Excluding active mining operations and timber operations, there are only limited areas of industrial and commercial development. The majority of which is closely associated with areas of residential development. One of the largest industries in the region is glass manufacturing, which is centered around Brookville. For many generations, glass manufacturing has been a significant part of the local economy. The presence of limestone and sandstone, both used in glass processing, makes this area a suitable location for glass manufacturing plants.

Waste Disposal

Waste disposal, while often a small percentage of land use, can be a major issue because of the controversy that often surrounds the practice. Waste-disposal sites are often situated in areas away from population centers, which can push the sites into areas that are environmentally critical. Proper waste disposal must be approached in a way that balances the desires of a community with the protection of its watershed's natural resources.

Landfills

While recognizing the need for the proper disposal of waste, landfills are typically on the bottom of the list of land uses that residents would want to see on nearby property. According to the DEP, there are currently no active landfills within the project area. The closest landfill is located in southern Elk County, within the Clarion River watershed (DEP, 2006b).

One municipal waste transfer facility is located in the project area in Falls Creek, Jefferson County. A transfer facility is a place where waste is collected and stored until it is transferred to its final destination, such as a landfill (DEP, 2006b).

Sign at the Brookville recycling site

Recycling

One practice that can limit the need for municipal landfills is recycling. There are multiple opportunities for recycling. Voluntary curbside recycling programs are required within Pennsylvania communities with populations that exceed 5,000 people, as mandated by the state legislature in 1988 (DEP, 2006e). DuBois, with a population of over 7,000 residents, is the only community within the watershed that qualifies for this mandate, and the borough currently has a curbside recycling program.

Smaller communities rely on drop-off locations for residents to utilize. Presently, there are 14 drop-off locations within the Jefferson County portion, two within the Clarion County portion, and two within the Clearfield County portion. County solid waste departments administer drop-off recycling programs. The various locations accept a variety of items to be recycled, ranging from everyday household items, such as cans and bottles, to potentially hazardous items, such as batteries and used motor oil (DEP, 2006e). It is essential to inform residents within these smaller communities of this resource that is available to them, and how and where to utilize it.

Agricultural interests have also started participating in recycle/reuse opportunities. Many local farmers are now collecting and shredding old newspapers, and using them for animal bedding. This practice keeps newspapers from ending up in the landfill and saves farmers money. Currently, there are 10 newspaper collection locations throughout Jefferson County.

Agricultural Land Preservation

As described earlier, agriculture is a major land use and economic component. But, similar to many areas, agricultural uses are under increasing pressure to convert to residential development and other land uses. According to the USDA's Natural Resources Inventory, conducted between 1992 and 1997, more than 11 million rural acres in the country were converted to a developed use, and over half of that acreage was agricultural land (NRCS, 1997). That conversion translates to a loss of over one million acres of agricultural lands each year, or more than 3,250 acres every day.

Pennsylvania has been aggressively pursuing farmland preservation since 1988 when the Farmland Protection Program was formed by the state legislature. Since its inception, the program has preserved over 300,000 acres through more than 2,500 conservation easements. With these impressive numbers, Pennsylvania leads the nation in both acres and number of farms preserved. Through the passage of the Growing Greener II referendum in 2005, an additional $80 million was made available through the program. To qualify for the Farmland Protection Program, farms must first be designated in Agriculture Security Areas (PDA, 2006).

Agricultural Security Areas

The Agriculture Security Area (ASA) program was created by the Pennsylvania legislature, and is administered at the township level. ASAs are rural, agricultural areas that are targeted for protection from urban development. They receive special consideration regarding local ordinances affecting normal farming practices, state agency rules and regulations, and in eminent domain condemnation proceedings. To be eligible for an ASA designation, at least 250 acres must be nominated. The 250 acres do not have to be contiguous, but individual parcels must be no less than 10 acres. Lands eligible for the program include pasture, hayland, woodland, or cropland (PDA, 2006).

Through the ASA program, farmers are eligible for the Purchase Agricultural Conservation Easement (PACE) program. This program authorizes the state to purchase conservation easements from willing farmers who are already within an ASA, allowing agricultural operations to continue. Farmers who participate in this program receive economic benefits in return for the conservation easement. The PACE program has not been active in the region.

To date, the ASA program has not been heavily utilized in the project area. While surrounding townships have been able to reap the benefits of this program, there are only four ASAs within the boundaries of the project area. One is located in Jefferson County, while the other three are located in Clearfield County.

Clean and Green Program

Pennsylvania administers the Clean and Green Program, which provides incentives to landowners for the preservation of agricultural lands and forestland. The program provides real estate tax benefits by taxing land based on its "use value," rather than its market value. The program is available to landowners who either own 10 or more acres of qualifying land or earn an annual gross income of more than $2,000 from farming.

Land Ownership

The majority of land is privately owned. Of the 575 square miles, only about 41 square miles (7.4 percent) is held in public ownership as conservation lands. This public land consists of state games lands, state forestland, and municipal parks. There are no federal conservation lands within project area. Acreages of the public lands are displayed in Table 2-5 and Figure 2-5. Public lands are concentrated on state game lands, as over 88 percent of the conservation lands are within the Pennsylvania state game lands system.

Table 2-5. Public Lands

Public Land	Acreage	% of Public Lands
State Game Lands	**23,461.4**	**88.6**
State Game Lands 244	4,826.8	18.2
State Game Lands 54	9,663.5	36.5
State Game Lands 77	2,528.3	9.5
State Game Lands 93	109.8	0.4
State Game Lands 31	5,168.7	19.5
State Game Lands 137	1,164.3	4.4
State Forest	**2,464.7**	**9.3**
Clear Creek State Forest	2,464.7	9.3
Municipal Parks	**558.0**	**2.1**
Total	**26,484.1**	**100**

Public lands are managed by different agencies with various management goals and regulations. The mix of public lands allows for a variety of uses for both visitors and residents of the Redbank Creek valley.

Critical Areas

Various areas deserve increased attention and recognition. Some of these areas are naturally formed, while others are critical areas because of human impact. The areas outlined can fall into several categories, some of which pose threats to humans and wildlife. Others are critical to human and natural populations within the watershed, and deserve increased attention and protection.

Landslides

Western Pennsylvania is the area of the state most susceptible to landslides. The entire region has a high to moderate risk of landslides. The hilly terrain found here is under the biggest landslide threat. Landslides occur most often in areas with loose soils or where old landslide debris is found on steep slopes. Landslides cause damage to transportation routes, utilities, and buildings. They can create travel delays and other side effects. The threat of landslides should always be assessed while planning any development project. Proactively avoiding a landslide is much cheaper in the long run than the clean up and repair that is required after a landslide. If development within a landslide-prone area is ultimately chosen, additional precautionary measures during development, such as additional drainage features and proper site planning, are essential to minimize the risk of a landslide (DCNR, 2006b).

Erosion and Sedimentation

Erosion and sedimentation is a very serious issue with the potential to cause significant degradation to an area's waterbodies. Streambank erosion occurs when the banks of a creek or river erode and deposit sediment into a waterway. Typically, the erosion is caused by improper land uses and a lack of vegetation along the streambank. Vegetation anchors soil in place, preventing it from washing away during high stream levels or heavy rains. However, if the vegetation is removed, the soil is easily washed into the waterbody. A lack of vegetation also leaves soils vulnerable to high winds, which can induce erosion.

Eroding streambank along Redbank Creek

An increase in sediment in the waterbody itself is a cause for concern, as it alters native aquatic habitats. Excessive sedimentation clouds the water, which reduces the amount of sunlight reaching aquatic plants. It covers fish spawning areas and food supplies, and may clog their gills. Other pollutants attach to soil particles and are deposited in waterbodies with the sediment. Downstream, the sediment settles out of the water and is deposited in a new location, which can significantly alter the channel and flow of the stream.

Erosion occurring through the terrestrial portion of a watershed can also have a negative impact on the region's waterbodies. Soil eroded off of construction sites, timber operations, or agricultural operations eventually reaches nearby streams, further exacerbating sedimentation problems. In an effort to combat this problem in the state of Pennsylvania, any disturbance over 5,000 square feet must have a soil and erosion control plan on site. It is critical that these plans are implemented and monitored to ensure their effectiveness.

Floodplains

Floodplains are land areas that lie adjacent to waterbodies, such as Redbank Creek and its tributaries. Floodplains are delineated by the frequency of flooding events that cover them with water. For example, an area that is covered during a 100-year flood, a flood of such magnitude that it usually occurs only once every 100 years, encompasses the 100-year floodplain. Floodplains often contain rich sediments, as occasional flooding leaves behind nutrients from the floodwaters. As can be seen in Figure 2-3, the majority of prime agricultural soils present are found adjacent to Redbank Creek and its tributaries. Floodplains are also inhabited by unique plants and wildlife accustomed to the periodic inundation. Many species found within floodplains are seldom seen in other areas.

The steep slopes along the banks of many waterbodies limit the size of floodplains (Figure 2-6). These limited floodplains are especially prone to flooding during storm events. Floodplains are critical areas that absorb stormwater during intense storm events. Building within the floodplains not only places the built structures in the path of future storm events, but also lessens the floodplain's ability to dissipate large amounts of stormwater, and actually increases the harm realized downstream. The loss of a floodplain's ability to dissipate floodwaters forces the water into a smaller area, thereby increasing the velocity of the waterbody during storm events. This increased velocity can further impact downstream areas by increasing erosion along the streambank and sedimentation within the waterbody.

Wetlands

Wetlands play an important role in maintaining a healthy watershed, because they filter pollutants from water before it reaches rivers or streams and minimize flooding impacts by absorbing excess flow during storm events. Wetlands provide important habitat for a multitude of fish and wildlife species throughout various stages of growth and development.

Wetlands at the headwaters of North Fork Redbank Creek

Wetlands are mostly small, isolated areas scattered throughout the project area (Figure 2-6). Some larger wetlands are associated with Redbank Creek and its tributaries. These larger wetlands can be found around Falls Creek, straddling the Jefferson County and Clearfield County line, and just outside of DuBois. Both wetland areas are along Sandy Lick Creek. A few other larger wetland areas can be found in the upper reaches of North Fork Redbank Creek and along its tributaries. Unfortunately, particularly in the past, wetlands were seen as useless areas because of the lack of understanding of their important functions. Therefore, wetlands were often sacrificed during development projects ranging from mining operations to residential development. Wetlands still become degraded through various land-development practices that continue today. The cumulative loss of wetlands and their functions can cause long-term problems that are not easily corrected. See the Biological Resources and Water Resources chapters for more information about the characteristics of wetlands.

Fish and Wildlife Habitat

Large areas of undeveloped land provide habitat for a diverse array of species. From large expanses of forested areas to isolated riparian wetlands, large areas of open space are available for fish and wildlife. There are several protected species that are currently present within the area. Habitat degradation is typically the biggest threat to protected species; therefore, it is critical that key areas of habitat are protected. The presence of protected species will be discussed in greater detail in the Biological Resources chapter.

Hazardous Areas

Hazardous areas can have profound impacts on land resources and land use. The areas can significantly degrade resources, while excluding many of the most desirable land uses from a region. Next is an overview of the various hazardous areas that can be found throughout the project area.

Old tires are commonly found at illegal dumpsites along roads and streams

Illegal Dumpsites

The problem of illegal dumping is evident in several areas. The practice of illegally dumping waste, rather than properly disposing of it, is a major concern among many stakeholders. The impact of illegal dumps on the scenic value is obvious, but these dumps can also severely degrade habitat in the area, and can cause water quality degradation.

Some steps have been taken to reduce and eliminate the practice of illegal dumping. PA CleanWays, a non-profit organization dedicated to fighting illegal dumping and littering, is active within Jefferson, Clarion, and Clearfield counties. Although Armstrong County is currently not covered by a chapter of PA CleanWays, the group has had some activity in that county as well. They strive to clean up and prevent illegal dumping. Through the end of 2003, PA CleanWays had removed over 508 tons of trash and collected over 12,000 tires to be recycled at various events

(Jefferson County, 2005). The struggle for PA CleanWays is that they depend on local sources to fund their valuable work. Currently, the PA CleanWays effort around the region is not adequately funded.

Industrial Waste Sites

There are two main types of hazardous waste sites that persist after former industrial practices, and they can cause significant long-term environmental degradation if not remediated. The first is Comprehensive Environmental Response Compensation and Liability Act, or Superfund sites. The Superfund program is a federal program that was created in 1980 to locate, investigate, and clean up the worst hazardous waste sites in the nation. Potential Superfund sites are reviewed using the Environmental Protection Agency's (EPA) Hazard Ranking System (HRS). Through this process, limited investigations are conducted to determine if a potential site poses a hazard to humans or the natural environment. Sites that are determined to be hazardous are then listed on the National Priorities List (NPL). Once sites are listed on the NPL, plans are developed to address remediation of the site.

One site from this study area is listed on the NPL. The Jackson Ceramix, Inc. site in Falls Creek is listed due to lead-contaminated wastewater that was discharged onsite while the plant produced china from 1917 to 1985. China waste piles, waste drums, and contaminated soils have been removed from the site, but approximately 20 acres of contaminated wetlands remain.

The second, more common type of hazardous waste site is brownfields. Brownfields are more general sites that have their expansion, redevelopment, or reuse complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant.

To address brownfield issues in the state, DEP has created a Brownfield Action Team. The DEP also developed a joint program with the EPA called the "One Cleanup Program" in 2004. The purpose of the program is to ensure that brownfields recovered under the Pennsylvania brownfields program also satisfy requirements under federal regulations (DEP, 2004a). According to the DEP (2005a), there are only two brownfields in the project area where remediation is either complete or in progress (Table 2-6). Since many areas comparable in size to the project area have more brownfields sites, it should be determined whether additional brownfields exist that have not yet been detected or reported.

Table 2-6. DEP Recognized Brownfields

Site Name	County	Municipality	Subwatershed	Cleanup Standard	Status
Equimeter Rockwell PLT 2	Clearfield	DuBois	Sandy Lick Creek	Site-specific	Completed
Equimeter Rockwell PLT 1	Clearfield	DuBois	Sandy Lick Creek		In Progress

In addition to hazardous waste sites left behind by former industrial practices, there are 148 locations regulated by the Resource Conservation and Recovery Act (RCRA). This act is a federal statute that regulates the transportation, handling, storage, and disposal of solid and hazardous waste materials. Federal facilities may control regulatory responsibilities, including permitting, identifying and listing hazardous waste, adhering to proper procedures when transporting or disposing of waste, developing risk management plans, and maintaining records (EPA, 2002). Requirements for underground storage tanks, including cover tank design, operation, cleanup, and closure, are also contained in RCRA. Sites within the project area are identified in Appendix E.

Abandoned Mines

Once the economically recoverable coal is removed from a mine, the mine is shut down, and the mine operator moves on to another site. However, the story and effects of the coal mine often live on long past its closing. Abandoned coal mines pose a significant hazard throughout western Pennsylvania. Prior to 1971, reclamation of closed coal mines was not required. As shown on Figure 2-4, significant coal mining has occurred throughout the region. Only the north-central portion of the project area, around North Fork Redbank Creek, has not experienced extensive mining activities. Of the 575 square mile watershed, 64.77 square miles have been surface mined for coal.

In total, there are 338 inactive surface mines, and 163 abandoned mines. As shown in Figure 2-4, the mines are scattered throughout the project area. Also illustrated are the 258 discharge points associated with these inactive mines. According to DEP, only two mines are categorized as having their reclamation completed. Some of the most potent legacies of abandoned mines are the discharges of polluted water that significantly degrade nearby waterways. The discharges can contain heavy metals, sulfates, and/or acids. Abandoned mine discharges are located throughout Clearfield, Jefferson, Clarion, and Armstrong counties.

Early coal mining operators gave little thought to the long-term environmental impacts that would occur from the practice, but as awareness increased of the environmental harm that was caused by the mining, regulations to address the issue improved. In 1971, the Pennsylvania legislature enacted the Surface Mining Conservation and Reclamation Act; and in 1977 the federal government passed the Surface Mining Control and Reclamation Act, which closely modeled the Pennsylvania regulation. With the creation of these regulations, mining activities had guidelines and standards to follow and state and federal oversight (DEP, 2005b).

To address the abandoned mine problem, the state created its Reclaim PA initiative. The four objectives of the initiative are:

- To encourage private and public participation in abandoned mine reclamation efforts;
- To improve reclamation efficiency through better communication between reclamation partners;
- To increase reclamation by reducing re-mining risks; and
- To maximize reclamation funding by expanding existing sources and exploring new sources.

To accomplish these goals, Reclaim PA includes a set of policy, management, and legislative initiatives geared toward erasing the abandoned mine problem within the state. With more than a quarter-million acres of abandoned mine lands throughout the state, the initiative is ambitious and necessary (DEP, 2005b).

In 2003, DEP completed the reclamation of 42 acres of abandoned mine lands in Beaver Township, Jefferson County. The mine was abandoned in 1980, and spent nearly 20 years as a hazard to both the people and the natural environment surrounding it. The project consisted of regrading the area to eliminate a dangerous highwall and replanting the site with natural vegetation.

Overall, Pennsylvania and the federal government have created numerous programs to address all types of abandoned mine problems, including the following: Operation Scarlift, the 10% Set-Aside Program, the United States Department of Interior-Office of Surface Mining (OSM) Emergency Reclamation Program, the Bond Forfeiture Program, the Mine Subsidence Insurance Fund, reclamation in lieu of civil penalties, surety reclamation, the Landowner Reclamation Program, EPA Section 319 grants, and the Government-Financed Construction Contract Program (GFCC).

Earthquakes

Although rare, earthquakes do occasionally occur in Pennsylvania. The majority of earthquakes within the state occur in the Reading/Lancaster area in eastern Pennsylvania, and the strongest earthquake in Pennsylvania occurred in 1998 near Jamestown, Crawford County, close to the Ohio border. The Redbank Creek valley is within the area of the state with the lowest risk of earthquake activity (DCNR, 2006c).

Management Recommendations

Goal 2-1. Preserve agricultural lands and lifestyles while encouraging sustainable practices.

Encourage additional townships to participate in the Agricultural Security Area Program, to protect the dwindling acreage of agriculture remaining within the watershed.	High
Encourage agricultural landowners to enroll in land preservation programs to protect lands and maintain agricultural uses on the land.	Medium
Encourage landowners to enroll in cost-incentive programs, such as the Environmental Quality Incentives Program and Conservation Reserve Enhancement Program.	Medium
Develop new methods to support land resource conservation.	Medium
Increase technical and financial assistance to the agricultural communities for implementation of best management practices.	Medium
Lobby for additional funding for the Environmental Quality Incentives Program and Conservation Reserve Enhancement Program.	Medium

Goal 2-2. Protect forest resources.

Enforce existing erosion and sedimentation regulations placed on the logging industry.	High
Encourage the development and use of forest stewardship or forest management plans and participation in the Pennsylvania Forest Stewardship Program and/or the Tree Farm Program.	High
Maintain the natural beauty of the region by encouraging forestland owners to protect their land from development through the purchase of conservation easements.	High
Educate forestland owners by providing them with accurate information regarding sound silviculture practices, forest management plan development, and insect and disease problems that can affect forest health.	Medium
Decrease forest fragmentation by maintaining contiguous forest tracts and/or by maintaining travel corridors between existing non-contiguous forest tracts.	Medium

Goal 2-3. Minimize impacts from commercial and industrial sources.

Encourage tree plantings as one method to reclaim abandoned mine lands, and support the DEP/OSM Reforestation Initiative on active mine sites.	High
Conduct a demonstration project to determine the effect land liming of agricultural, forest, and strip-mined lands has on water quality through neutralization of acidic waters.	Medium
Inventory abandoned wells and mines and plan for remediation.	Medium
Establish better government oversight on gas-well exploration, including impacts to the natural resources.	Medium
Complete remediation of the Jackson Ceramix Superfund site by addressing lead pollution in the 20-acre contaminated wetland located on the site.	Medium

Goal 2-4. Decrease the amount of illegal dumping.

Increase enforcement and penalties for individuals caught dumping illegally.	High
Encourage increased participation in recycling programs through education and incentives for citizens, regular receptacle maintenance and collection by service providers.	High
Host annual cleanups to eliminate illegal dump sites and establish surveillance, and monitoring to decrease the re-occurrence of dumping.	High
Local private and public interests should work together to ensure that PA CleanWays efforts to identify and remove illegal dumpsites are adequately funded.	High
Conduct an illegal dump inventory, locating and documenting dump locations, and develop a remediation plan to cleanup and eliminate dumpsites.	High
Educate residents about the impacts illegal dumping has on water quality, aesthetics, health and safety, and the economy.	Medium
Increase funding to assist groups in hosting cleanup events, educating residents about illegal dumping, and expanding recycling programs.	Medium

Goal 2-5. Decrease erosion and sedimentation issues through the utilization of land-use ordinances and best management practices.

Strictly enforce current regulations designed to prevent erosion and sedimentation problems.	High
Establish and/or strengthen land-use planning tools limiting development in floodplains and other critical areas subject to erosion and sedimentation problems.	Medium

Goal 2-6. Improve herd health and decrease sedimentation through the implementation of best management practices.

Encourage agricultural landowners to develop and implement nutrient management plans.	High
Implement a streambank fencing program to fence cattle out of streams, provide stabilized crossings, alternative watering sources, and riparian corridors.	Medium
Stabilize and properly manage barnyard runoff and livestock areas.	Medium

Goal 2-7. Reduce the number of unlicensed vehicles in residential areas.

Encourage residents to dispose of unlicensed vehicles by educating them about the impacts on safety, human health, and the environment.	Low
Remove unlicensed vehicles from abandoned properties.	Low
Encourage municipalities to establish and enforce land-use ordinances regarding the maintenance of unlicensed vehicles at residential properties.	Low