Glady Watershed Assessment

Glady Fork Sub basin #05020004050

Cheat and Greenbrier Ranger Districts
of the

MONONGAHELA NATIONAL FOREST

May 2001

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Chapter 1 – Characterization

Intent of Watershed analysis

A watershed analysis, as applied on the Monongahela National Forest, is a procedure used to characterize the processes and interactions within a watershed. By analyzing the entire watershed, the focus is on the interrelationships of the various resources. The intent is to develop a scientifically based document that identifies existing problems and recommends options for the continued management and restoration of the specified watershed.

This watershed analysis report sets the stage for future analyses; it does not result in a decision. It is designed to allow for future changes based on new information and data that become available or as other issues develop. The report covers six basic steps:

- Characteristics of the watershed - the dominant physical, biological, and human processes
- Issue identification with key questions - the main resource concerns, conditions, and activities
- Current condition description - the health of identified resources as they relate to the issues
- Reference condition description - establishes the historic health of the identified resource and serves as a comparison to the current condition
- Interpretation of the changed conditions and probable causes - summarizes the main findings of the previous steps and explains the significance of any changes
- Management activity recommendations - outlines potential projects to maintain or restore the health of the identified resources within the framework of the Monongahela National Forest Land and Resource Management Plan (Forest Plan) management prescriptions

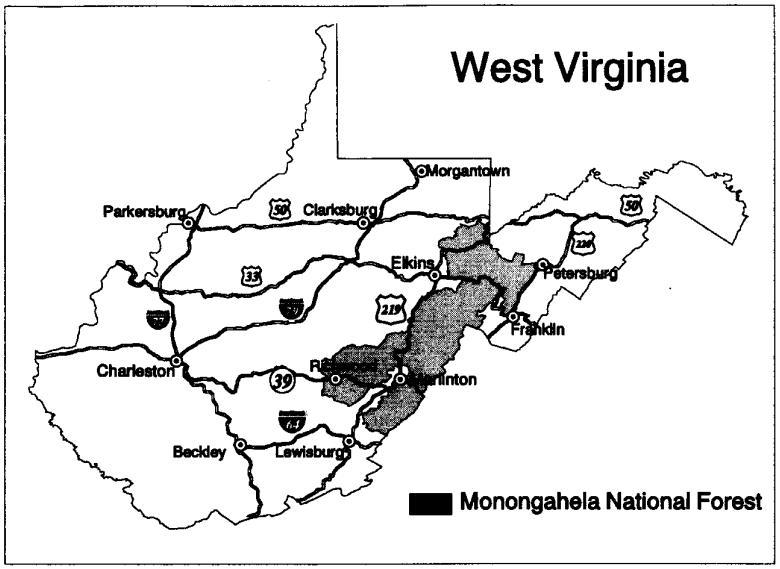
The findings within this document serve as a foundation to develop site-specific project proposals and associated effects analysis and decision documents.

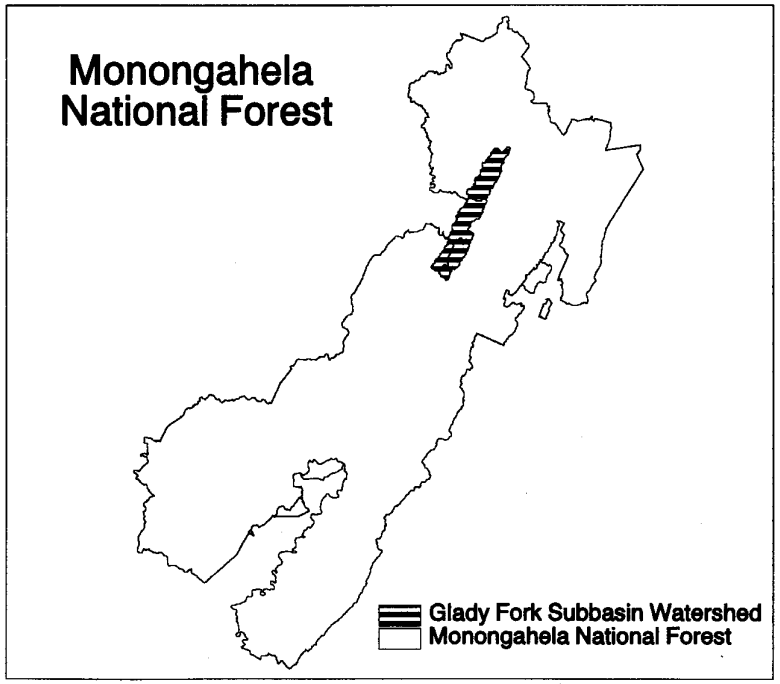
Characterization of Watershed

Location

The Glady watershed is in Randolph and Tucker Counties, West Virginia (Map 1). The area under assessment as documented in this report is a fifth order watershed (#05020004050, using Natural Resource Conservation Service system) and includes four, sixth order sub-watersheds. The headwater of the watershed is the line between Randolph and Pocahontas Counties and the watershed continues to the confluence with Dry Fork near Gladwin. Glady is a tributary to the Dry Fork, which flows to the Black Fork, which flows to the Cheat River at Parsons.

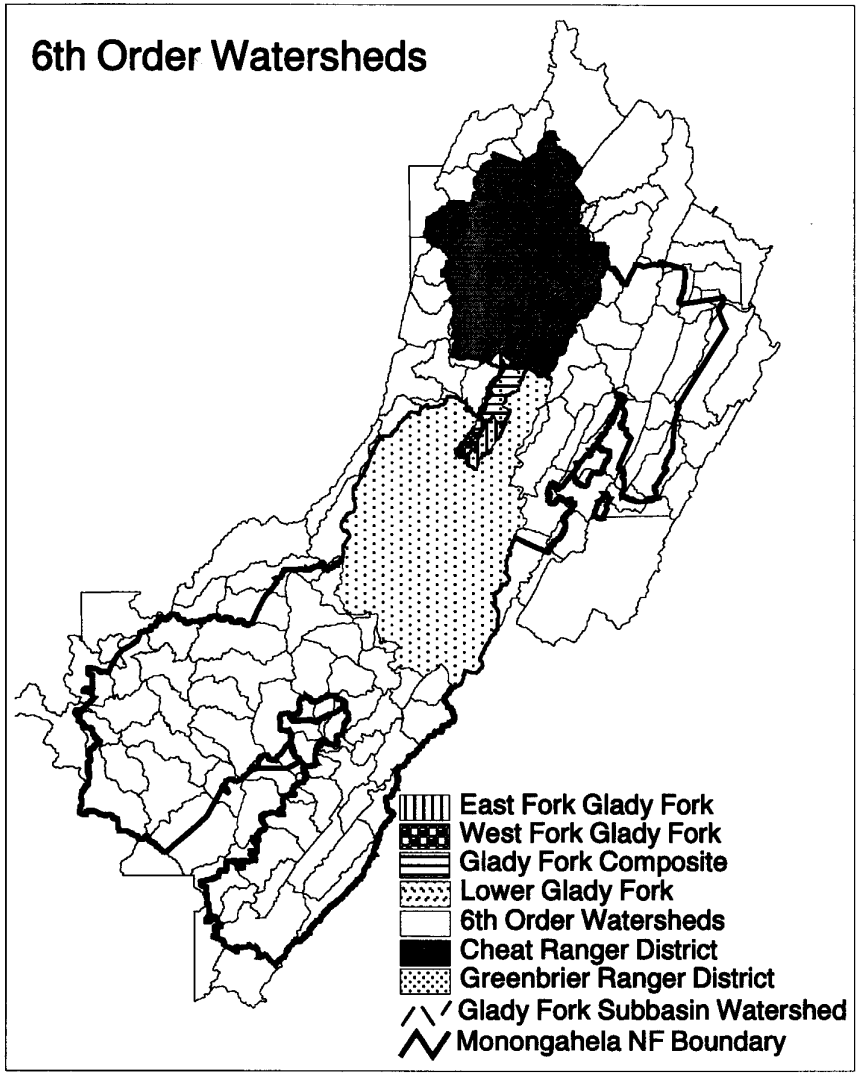
The four sub-watersheds that make up the Glady sixth order watershed are the East Fork, West Fork, Glady Composite, and Lower Glady. The Glady watershed covers approximately 40,623 acres or 63.3 square miles. The watershed is in the Greenbrier and Cheat Ranger Districts, of the Monongahela National Forest, and encompasses approximately 27,300 acres of national forest land. Private land in the Glady watershed comprises about 13,323 acres of the total acreage. Maps 2a and 2b show the watershed and ownership patterns.





Monongahela NF
Glady Fork Subbasin
Watershed
#05020004050
Location Map

Map 1



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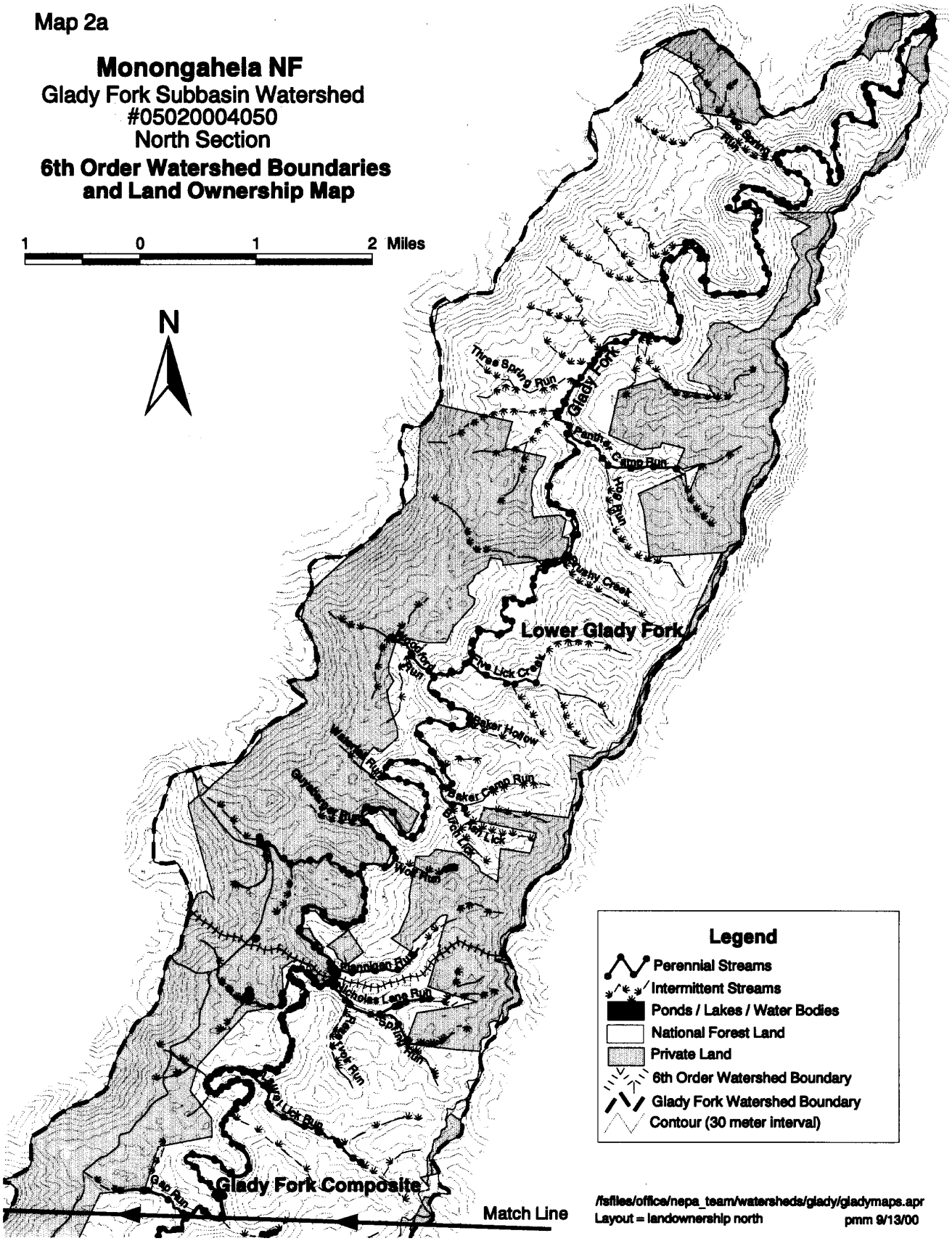
Map 2a
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
North Section
6th Order Watershed Boundaries
and Land Ownership Map
1 0 1 2 Miles
N
Three Spring Run
Glady Fork
Panther Camp Run
Hay Run
Rushy Creek
Lower Glady Fork
Five Lick Creek
Beaver Hollow
Baker Camp Run
Wolf Run
Bennison Run
Nicholas Lane Run
Spring Run
Beaver Lick Run
Gap Run
Glady Fork Composite
Match Line
Legend
Perennial Streams
Intermittent Streams
Ponds / Lakes / Water Bodies
National Forest Land
Private Land
6th Order Watershed Boundary
Glady Fork Watershed Boundary
Contour (30 meter interval)
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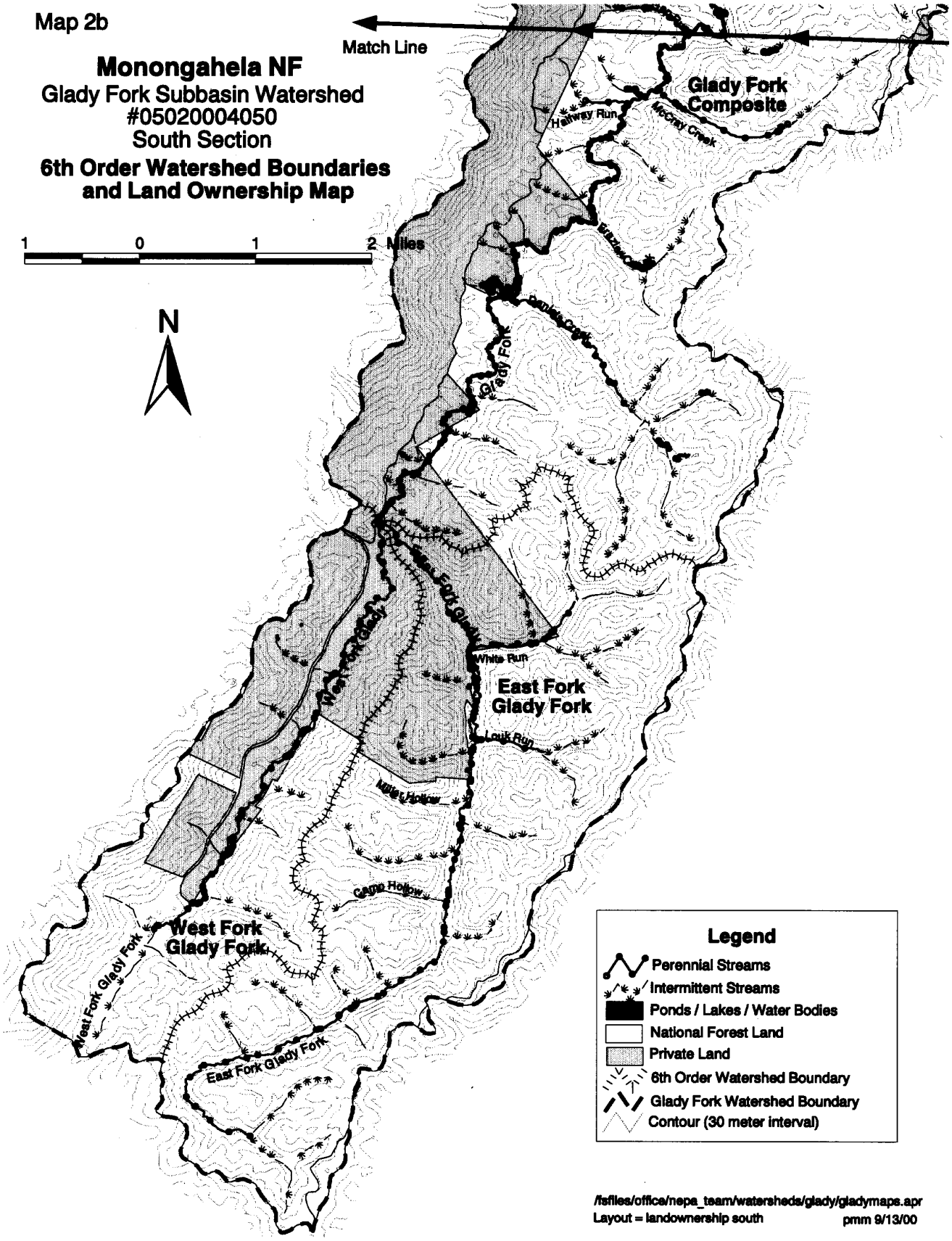
Map 2b
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
South Section
6th Order Watershed Boundaries
and Land Ownership Map
Match Line
1 0 1 2 Miles
N
Glady Fork Composite
Halfway Run
McCray Creek
Glady Fork
Daniels Camp
White Run
East Fork Glady Fork
West Fork Glady
Louk Run
Indian Hollow
Camp Hollow
West Fork Glady Fork
East Fork Glady Fork
Legend
Perennial Streams
Intermittent Streams
Ponds / Lakes / Water Bodies
National Forest Land
Private Land
6th Order Watershed Boundary
Glady Fork Watershed Boundary
Contour (30 meter interval)
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All or parts of the following opportunity areas are included in this watershed: Daniels Creek #36.102, Little Beech Mountain #36.103, McCray Ridge #36.101, Big Knob #33.001, Upper Glady #16.107, and Lower Glady #16.106. These opportunity areas form the core of the watershed and are generally contiguous. All opportunity areas except Big Knob are designated as management prescription 6.1 as described in the Monongahela National Forest Land and Resource Management Plan (Forest Plan). Big Knob is designated a 3.0 management prescription, also described in the Forest plan. Minor amounts of land with 5.0 and 6.2 management prescriptions lie within the watershed boundary. Table 1 shows the acreage and percent of national forest land in the watershed by management prescription. Maps 3a and 3b display the locations of these areas.

Table 1 – Distribution of Management Prescriptions and Opportunity Areas

Management Prescription	**Acres**	**Percent of National Forest Land in Watershed**
6.2	5.0	0.01
5.0	287	1.0
3.0	333.4	1.2
6.1	26,563.5	97.7
Opportunity Area		
36.103 Little Beech Mountain	6,958.9	25
36.101 McCray Ridge	5,634.0	21
36.102 Daniels Creek	5,225.0	19
16.106 Lower Glady	4,634.5	17
16.107 Upper Glady	4,054.3	15
33.001 Big Knob	194.7	0.7
35.002 Laurel Fork South Wilderness	126.0	0.5
15.001 Otter Creek Wilderness	109.6	<0.5
33.002 Beaverdam	100.3	<0.5
36.104 East Shavers Fork	52.0	<0.5
35.001 Laurel Fork South Wilderness	51.4	<0.5
13.011 Bear Heaven	38.2	<0.5
16.201 Laurel Fork	5.0	<0.5
36.108 Fox Run	4.8	<0.5
33.004 Rich Mountain	0.2	0
Total	27,188.9	

The emphasis of the 6.1 management prescription is remote habitat for wildlife species intolerant of disturbance. Secondarily these areas emphasize a semi-primitive and non-motorized type of recreation environment (most roads are closed to public traffic), the removal of a mix of forest products, and management of hardwood forest types.

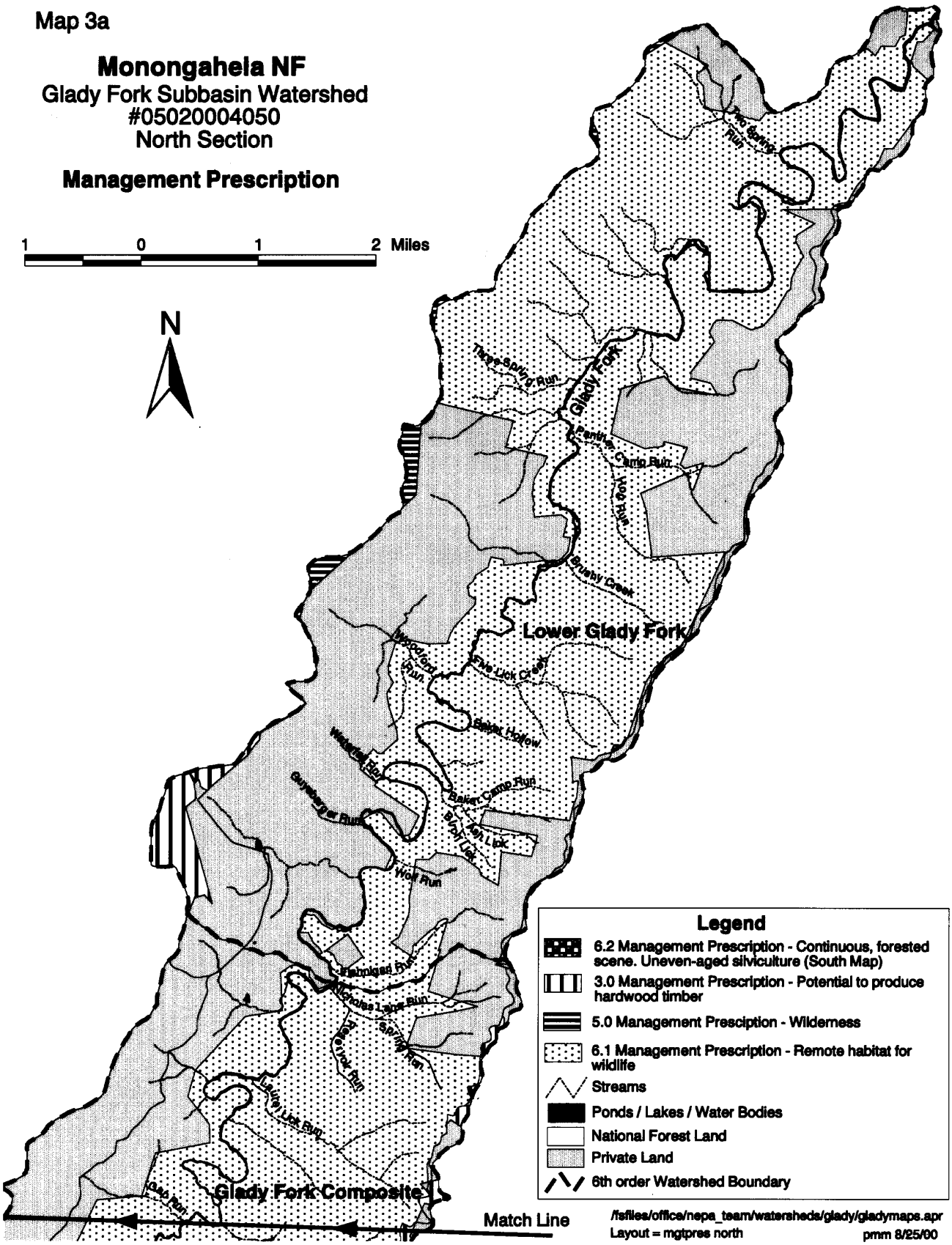
The emphasis for areas with the 3.0 management prescription is production of large, high quality hardwood trees for commodity outputs, hard mast production, and scenic attributes. These areas also emphasize a variety of forest views, wildlife species tolerant of disturbances, and a primarily motorized recreation environment.

The emphasis of areas with the 6.2 management prescription is a largely undisturbed environment suitable for semi-primitive, non-motorized dispersed recreation activities. These areas also emphasize wildlife habitat for species requiring low levels of disturbance and soil and watershed protection.

Management prescription 5.0 is given to congressionally designated wilderness areas. The areas of 6.2 and 5.0 management prescriptions in the watershed are generally not contiguous and are found on the margins. The 5.0 acres in 6.2 designation will not be discussed in any detail in this document.

The watershed also includes a Research Natural Area under study and an ongoing research study plot. Stand 35, compartment 44, Greenbrier District is the Black Cherry Research Natural Area. This 219 acre stand is still considered part of the Daniel's Creek opportunity area, but may be treated differently due to research needs and concerns. The Kraft's Ridge Research area, located on the Cheat Ranger District was created for the study of oak regeneration. The study sites are located in stand 4 compartment 44 off FR 229.

The Lower Glady opportunity area, about 2,935 acres, is a former RARE II area, now called an inventoried roadless area. See Map 14a for location. System roads FR162 and FR229 are in this area, supporting the Kuntzville timber sale of 1982 – 1990 where 834 acres were harvested. This part of the watershed is affected by the roadless rule made final 5 January 2001 and covered in the Roadless Area Conservation EIS. Future management of the area is uncertain. The roads will continue to be maintained for access and to protect water quality, however timber harvest is restricted.


Map 3a
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
North Section
Management Prescription
1 0 1 2 Miles
N
Lower Glady Fork
Glady Fork Composite
Match Line
Legend
6.2 Management Prescription - Continuous, forested scene. Uneven-aged silviculture (South Map)
3.0 Management Prescription - Potential to produce hardwood timber
5.0 Management Presciption - Wilderness
6.1 Management Prescription - Remote habitat for wildlife
Streams
Ponds / Lakes / Water Bodies
National Forest Land
Private Land
6th order Watershed Boundary
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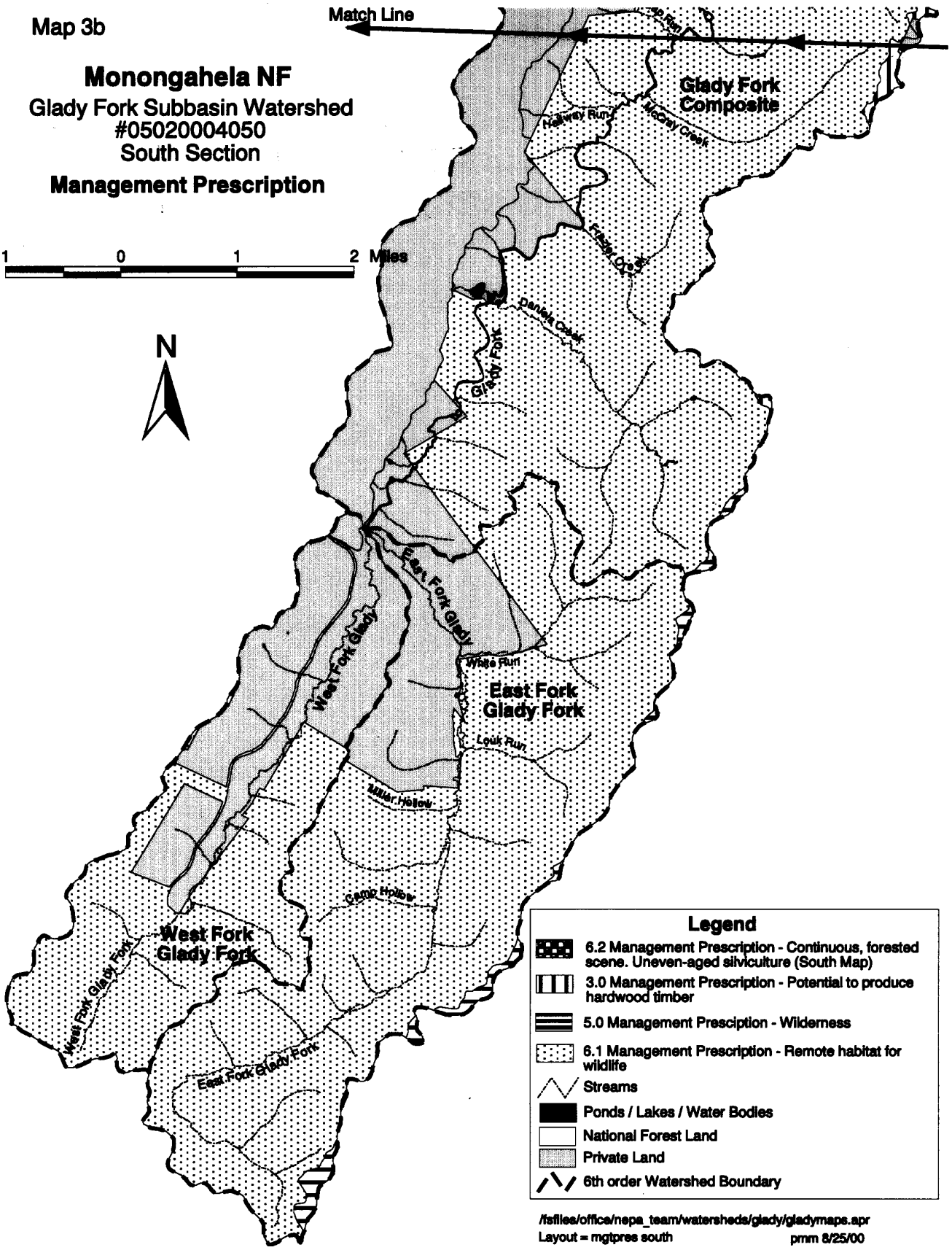
Map 3b
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
South Section
Management Prescription
Match Line
1 0 1 2 Miles
N
Glady Fork Composite
Halfway Run
Mccoy Creek
Frisbe Creek
Daniels Creek
Glady Fork
East Fork Glady
West Fork Glady
White Run
East Fork Glady Fork
Louk Run
Miller Hollow
Camp Hollow
West Fork Glady Fork
West Fork Glady Fork
East Fork Glady Fork
Legend
6.2 Management Prescription - Continuous, forested scene. Uneven-aged silviculture (South Map)
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Dominant Features of Physical Environment

The Glady Fork watershed (not the river itself) is approximately 21 miles long and ranges from 2½ to 3 miles wide. Water flows northeast from the headwaters of the East Fork and West Fork of Glady starting at an elevation of about 3,700 feet. At its confluence with the Dry Fork near Gladwin, West Virginia, the elevation is 1,940 feet. Slopes range from 30 to 40 percent in the upper half of the drainage to 40 to 50 percent in the lower half. Slopes are very steep (65 percent and greater) along the Glady Fork near Panther Camp Ridge, Kraft's Ridge, and Two Spring Run, down to the town of Gladwin located at the extreme northern end of the drainage. The Glady watershed is almost completely forested with northern hardwood forest types located at the higher elevations and oak and hickory types at the lower elevations. Red spruce is found scattered at high elevations and hemlock is found along stream and riparian areas. Vegetation composition and distribution reflects changes in temperature and moisture regimes (precipitation ranges from 45 inches to 51 inches per year) associated with changes in elevations.

Geology and Caves

The most important geologic feature in the watershed is the Greenbrier Group limestone formation. Caves are typically found in this limestone band and provide habitat for various threatened and endangered species including the Virginia Big-eared bat, Indiana bat, and running buffalo clover. This particular limestone band is narrow and most of it is found on private land (along the West Fork, south of the town of Glady). Federal ownership of the limestone occurs mostly from Three Spring Run to Two Spring Run. The most prominent cave system in the area, Cave Hollow - Arbogast, lies just to the north of this watershed and is home for both species of endangered bats. The main entrances to this cave system are gated to prevent human disturbance year around. Caves on private land that are located outside the watershed are also known to contain wintering Indiana bats. Portions of the Glady watershed occur within five miles of some of these caves. Forests within the five-mile radius of these caves are important in the life cycle of the Indiana bat. Refer to the Maps 9a and 9b of this assessment for areas within five miles of bat hibernacula. Numerous smaller caves, sinkholes, and blowholes are found both on federal and private land. The Monongahela National Forest maintains information on caves that occur on federal lands and Medville and Medville (1995) contains detailed information on caves in this watershed in Randolph County, specifically maps 5, 9, 21, and 22 of the publication. The Region 9 Sensitive Species list identifies certain organisms that could exist in these cave ecosystems.

Soils

Three soil groups make up the majority of the upland soils in the watershed, Calvin-Belmont-Meckesville, Dekalb-Berks-Calvin, and Dekalb-Buchanan. These soils are gently sloping to moderately steep, well-drained, acid and lime-influenced soils. Calvin soils range up to 70 percent slope and have high potential for growing trees. Extremely steep slopes are an erosion hazard and plant cover needs to be maintained. Belmont soils range up to 70 percent slope, developed primarily over limestone, and have moderately high potential for growing trees. Less sloping lands are suitable for hay and pasture. Erosion on logging roads and skid trails is a major concern. Meckesville soils occur primarily on a bench in the northern portion of the watershed between Three Spring Run and Two Spring Run. The steeper slopes in this series and the stony layer restricts cultivated crops and hay, but it is suitable for pasture. Erosion potential on logging roads and skid trails, especially on 15 to 35 percent slopes is a major concern. A seasonal high water table occurs at about 2-1/2 to 3-1/2 feet below the surface, restricting root development. Soil permeability is moderate to slow depending on the depth. Frost heaving is a concern in this soil type. Available water for plant growth ranges from low to moderate and associated runoff ranges from medium to rapid. Soil fertility is naturally low for Berks and Dekalb and high for Calvin. Berks and Calvin soils are slope sensitive, meaning they are more susceptible to

erosion on slopes exceeding 55 percent. All soils have moderate to high potential for growing trees. The more gentle slopes are suitable for growing crops, hay and as pasture. The limiting factor for these soils are slope steepness and the limited depth to bedrock.

Water

Thirty-two named perennial and numerous unnamed intermittent streams provide water flow to Glady Fork. Most of the streams have their origins on federal lands and occur in a mostly closed forest environment. The limestone geology strongly influences resurgence and insurgence of water as well as providing chemical buffering capacity. Glady Fork is a free flowing river with only small water impoundments on private land for livestock use. Water quality concerns are usually associated with sedimentation of streams and the river. Primary human use factors causing sedimentation are home sites, agriculture, grazing, timbering, and the associated network of private, state and federal roads and railroads that provide current and past access to the area.

Dominant Features of Biological Environment

The forests of the watershed are largely deciduous in composition, with scattered hemlock and red spruce. Linear openings from gas pipelines and roads cross the forest. This watershed has been impacted for approximately the last 100 years by commercial logging. Most of the timber harvested at the turn of the 20th century was removed via railroads. In general, these harvests were large-scale clearcuts, often with large, hot fires after slash dried out. Selection harvesting during the 1950's left stands of trees where the highest quality, largest diameter trees were removed leaving the smaller and poorer quality trees. To correct this high grading and regenerate shade intolerant species, clearcutting was again used on National Forest land in the 1960s and early 70s.

The West Virginia Division of Environmental Protection (WVDEP) has described this watershed in its Watershed Atlas Project. The numbers from this project are for all ownerships. The watershed has no areas of high intensity development and only 0.03% of the area is in low intensity development. A small portion of the watershed is in pasture or crops with 1.17% in hay or grass, 1.41% in crops, and 2.18% is likely cropland. Nearly 1% (0.73) of the watershed is made-up of wetlands. According to WVDEP records, there have been no toxic releases in the watershed between 1987-1996, and no surface or underground mining permits for minerals.

Laurel Fork South, Laurel Fork North, and Otter Creek wilderness areas bound the upper and lower portions of the watershed.

The Glady Fork watershed assessment includes the entire Glady Fork river main stem and tributaries. The main stem begins at the confluence of the East and West Forks, and flows approximately 32 miles, essentially due north, to its confluence with the Dry Fork. Major drainages within the assessment area include, from north to south, Two Springs Run, Three Springs Run, Panther Camp Run, Five Lick Creek, Nichols Lane Run, McCray Run, Daniels Creek, East Fork Glady and West Fork Glady. There are also numerous smaller perennial, intermittent and ephemeral tributaries to the Glady Fork.

Terrestrial Species and Habitat

Many biological processes or features span areas much larger than a watershed. To appropriately characterize and analyze specific ecosystem components of the Glady watershed, the watershed needs to be placed in a logical setting with respect to these larger scales. Because of mobility, migratory nature, and distribution of certain wildlife species, they too are best characterized and analyzed at larger scales. Approximately 542 species (68 mammals, 230 birds, 160 fish, 42 reptiles, and 42 amphibians) may

utilize the Forest's diverse vegetative and stream habitats during their lives. Glady watershed provides habitat for a number of these wildlife species. All species specifically occupying the Glady watershed are not known.

Some of the more common small mammal species that inhabit the Glady watershed area include red, gray and fox squirrels, chipmunks, skunk, opossum, various species of bats, voles, shrews and mice, and rabbits. These species play important functional roles such as pollination, seed dispersal and linkages within the food web. Important game species within the watershed include whitetail deer and turkey. Black bear and bobcats are likely present in limited numbers. All these species are considered habitat generalists, with the exception of some bat species. They can be found throughout West Virginia, the Monongahela National Forest and the Glady watershed area. With the exception of limestone caves found in the northern section of the watershed, there is no specific habitat unique to the Glady watershed.

Amphibians require water or moist environments and are associated with specific substrates such as down wood or rocky areas rather than with specific vegetation types or stages. Amphibians transfer nutrients from aquatic to terrestrial environments, are prey for predators, and contribute major biomass in forest ecosystems. Amphibians expected to occur within the watershed include a variety of salamanders, toads, tree frogs and true frogs. Reptile distribution is also more closely associated with elevation, aspect, and substrate than with vegetation. Reptiles are susceptible to ground barriers (board-walks on trails), road construction, and human predation. Reptiles inhabiting the Glady area include eastern box turtle, five-lined skink, timber rattlesnake, garter snake, and black rat snake. Similar to mammals found in this area, the majority of amphibians and reptiles found in the watershed are those expected to occur there. With the exception of Cheat Mountain salamander habitat located along the western boundary of the watershed, this area does not contain any unique features not found elsewhere on the Monongahela National Forest.

Game birds found in the area include turkey, ruffed grouse and mourning dove. Waterfowl species are also present in limited numbers, mostly as individual pairs or during migration periods. Numerous non-game bird species also use the diverse vegetation found within the watershed. Numerous neo-tropical migrants use the area along with year-round residents. The watershed area provides important breeding, nesting and/or foraging habitat for a variety of raptors such as the Great horned owl, American kestrel, sharp-shinned and Coopers hawk, Red-tailed hawk and other birds of prey.

Invertebrate species are critical components of many ecosystem functions. They aid in the breakdown of matter, nutrient cycling, maintaining soil structure, chemistry and productivity, wood decomposition, pathogenic effects on other organisms as well as control of disease-causing organisms. Invertebrates can be excellent bio-indicators of soil, water and vegetation health and are found throughout the Glady area. Sensitive cave invertebrates can be found in the same limestone derived caves as many of the bat species. These cave invertebrates are unique to a very few cave systems, making the Glady watershed area critical for their continued existence.

Brown, rainbow and golden trout are annually stocked in the main stem of Glady by the WVDNR. Native brook trout is also present in streams within the Glady watershed. These fish provide for the majority of recreational game fishing along reaches of the Glady. Other nongame fish and aquatic invertebrates also inhabit streams within the watershed. Stream survey and macro invertebrate information has been collected in the past and some stream structures have been constructed within the Glady watershed. More information on Glady's fisheries resources can be found in the **Aquatic Habitat** section, Chapter 3.

The Monongahela National Forest Land Management Plan contains a list of Management Indicator species (MIS) for use in monitoring the impacts of management on area wildlife and fish and their habitats. Management Indicator species for the Forest include the Virginia big-eared bat, Indiana bat, Cheat Mountain salamander, wild trout, black bear, wild turkey, white-tailed deer, gray squirrel, varying (snowshoe) hare and West Virginia Northern flying squirrel. Appendix L in the Forest plan also lists population objectives for each species, along with wildlife species commonly associated with habitat conditions. Each MIS species listed in Appendix L, or their habitat is known to occur within or adjacent to the Glady watershed.

There are currently eleven threatened or endangered species that occur on the Monongahela National Forest, however, the gray wolf and eastern cougar are considered extirpated from WV. Six of the remaining nine threatened or endangered species, or their habitat, can be found within the Glady watershed. These include West Virginia Northern Flying Squirrel, Indiana and Virginia big-eared bats, Cheat Mountain salamander, small whorled pogonia and running buffalo clover

The Monongahela National Forest's sensitive species list currently includes 46 fauna and 43 flora species. This list is designed to be dynamic and will change over time based on new information and monitoring. The current list was updated in 1999 and includes modifications from the previous list. Appendix D contains the Likelihood of Occurrence table for the Glady watershed. This table was designed as a cursory review of areas based upon known populations and habitat descriptions of the Forests current sensitive species. The initial review of the watershed predicts the occurrence of 12 fauna and 15 flora species. The current GIS layer relative to TES species located three known sensitive plant species and four known vertebrate species within the watershed boundaries.

Dominant Features of Social Environment

The small community of Glady is within the Glady watershed. Near Glady is a gas compressor station, the source of most of the traffic through that section of the watershed. US Route 33 crosses through the watershed near Alpena. Private land in the watershed is used for production of timber, cattle, and natural gas. Natural gas is also produced from national forest land.

Many seasonally occupied houses (i.e. hunting camps) are found throughout the watershed, particularly near Gladwin. Permanent residences are mainly along the county roads in the watershed.

National Forest land used for gas storage and production is south of US Route 33 and includes cleared well pads, cleared pipeline rights of way, and access roads. These roads, unlike general forest roads, are used year round and all-terrain vehicles are used for access to maintain the pipeline rights of way.

Chapter 2 - Issues

Issue Identification Process

The development of high priority issues is critical to focus the scope of a watershed assessment. Key questions that address the issues further refine the assessment.

The following chapter lists current, high priority issues and key questions identified within the Glady watershed by internal review of the area. The issues and key questions are organized by core topics.

Erosion Processes/Sedimentation

Road and pipeline development in the upper half of the watershed has resulted in many opportunities for erosion to increase over background levels. Sediment movement into streams needs to be quantified, monitored, and controlled. Soils of the Mauch Chunk geologic formation are found in the watershed.

- What erosion processes are dominant within the watershed (i.e. Surface erosion, mass wasting)?
- Where have they occurred or are they likely to occur?

Hydrology/Stream Channels

Road construction and maintenance, timber harvesting, and grazing have reduced channel complexity through the addition of sediment and reduction of large woody debris to the stream channel. Some of these effects are a result of turn of the century logging and streams are still in recovery from that large-scale logging.

- What are the causes of current, unstable hydrologic process within the watershed?
- What are the sources of accelerated erosion/deposition processes, and what aquatic resource effects are they having?
- What aquatic and riparian resource restoration is needed within the watershed?
- What are the dominant hydrologic characteristics (total discharge, peak flows, minimum flows) and other notable hydrologic features and processes in the watershed (cold water seeps, ground-water re-charge areas)?
- What are the basic morphological characteristics of streams and the general sediment transport and deposition processes in the watershed?
- What activities will occur in the Glady watershed that may correct existing sediment sources or create additional ground disturbance and exacerbate the problem?
- What activities might occur that degrade riparian habitat conditions and reduce the potential for recruitment of large woody debris and fish habitat improvement?
- How are current riparian conditions contributing to existing channel conditions?

Water Quality

The Glady watershed provides important habitat to fish and aquatic invertebrates. Recreation use on the main Glady channel is heavy in places and high water quality is desired. Most streams within the assessment area have levels of fine sediment (sediment <4mm in size) that are detrimental to the native brook trout populations and aquatic communities. Timber harvest activities around the turn of the century affected riparian areas throughout the Glady Fork watershed and today most stream systems lack sufficient levels of large woody debris to provide quality fish habitat. Native brook trout require cold clear water.

- What beneficial uses dependent on aquatic resources occur in the watershed?
- Which water quality parameters are critical?
- What is the current water quality and are there problem areas?
- What could be done to improve riparian and fish habitat conditions?
- Are current riparian conditions affecting stream shading and water temperatures?
- What activities will occur in the Glady Fork watershed that may correct existing sediment sources and/or create additional ground disturbance and exacerbate the problem?
- What activities might occur that reduce riparian habitat conditions and reduce the potential for recruitment of large wood debris and fish habitat improvement?

Vegetation

Management activities such as timber harvest, road building, gas well development, and the introduction of exotic insects and diseases and invasive plants may have changed species composition or altered the biological diversity of the watershed.

- What is the array and landscape pattern of plant communities and seral stages in the watershed?
- What processes caused these patterns (fire, wind, mass wasting, insects, diseases, timber harvesting, grazing)?
- How does the current condition compare with the historic range of variability?
- How does the current condition affect future land management objectives?
- Have botany surveys been completed? Have any threatened, endangered or sensitive plants been found in the watershed?

Wildlife

Fragmentation of the forest by roads, gas pipelines, and gas well pads exists. Some private land is also non-forested. This may be a limiting factor in the diversity of the area.

Threatened, endangered, and sensitive plant and animal species and their habitats are found in the Glady watershed.

There is a lack of variety in the vertical structure of the forest in the Glady watershed. Variety in the landscape from permanent grassy openings is hampered by concern with long-term access to these areas. Some of these openings are in riparian areas and may be adding sediment to streams. Higher elevations lack water sources.

- How fragmented is the Glady watershed, in terms of percent open land and percent forested land? Is the area too fragmented for some species?

- What is the relative abundance and distribution of species of concern in the watershed (threatened, endangered, and sensitive species, featured species, or management indicator species)?
- What is the distribution of individuals or the habitats of the species of concern (threatened and endangered)?
- Will certain types of management affect threatened, endangered, or sensitive species negatively? Are there key areas in the watershed management activities might benefit or harm listed species?
- Are there opportunities to improve the habitat for any threatened, endangered, sensitive or management indicator species?
- Is there a conflict between timber harvest goals and habitat requirements for Indiana bats, Cheat Mountain salamanders, West Virginia Northern flying squirrel or other species within the watershed?
- Are we meeting the population objectives for management indicator species? Are the population objectives for game species appropriate?
- Are we meeting recovery plan objectives for threatened or endangered species?
- Are current riparian areas in suitable condition to support riparian species?
- Are human recreation pressures more than the system can handle?
- Are we monitoring threatened or endangered populations based upon the Forest Biological Assessment and Biological Opinion given by the USDI Fish and Wildlife Service?

Human Uses

The use of the watershed for recreation, timber harvest, natural gas production, and associated roads and trails, contributes to the economic health of local communities. Many roads used to access the gas well developments pre-date the Forest Plan and are below standards used currently.

- What are the major human uses of the Glady watershed?
- Where are these uses found in the watershed?
- Have heritage resources surveys been completed to locate pre-historic and historic cultural sites?
- What measures or actions can be used to upgrade roads used to access gas well developments?

Private Land

Approximately one-third of the Glady watershed is in private land holdings. Characterization of the uses and impacts on private land will help in the determination of cumulative effects in future analyses.

- What management actions are occurring on this portion of the watershed?

Chapter 3 – Current and Reference Conditions

Physical Environment

Soil Types

Three soil groups make up the majority of the upland soils in the watershed, Calvin-Belmont-Meckesville, (also known as Cateache soils), Dekalb-Berks-Calvin, and Dekalb-Buchanan. All of the upland soils are silt loams, with varying amounts of rock. Bottomland soil types include; Atkins, Kanawha, Philo, Pope-Atkins complex, Pope-Linden complex, Pope Variant, and Fluvaquents-Udifluvents complex. These soil types range from silt loam, to sandy loam, to loam. These soils are listed as soils subject to flooding in Table 2. The soils are delineated within the general mapping unit by ranges of slope percentages. Table 2 gives the acres for each general soil mapping unit found in the watershed; see Maps 4a and 4b for locations.

More detailed listing of soils types in the watershed is in the project file for this watershed assessment and the GIS products created for this assessment. Table 3 lists all soil types, ungrouped, found in the watershed.

Table 2 – General Soil Types

General Soil Mapping Unit	Acres	Percent of Watershed
Calvin-Belmont-Meckesville	5,363	13
Dekalb-Berks-Calvin	19,025	47
Dekalb-Buchannan	8,431	21
Soils subject to flooding	1,719	4
Soils not assigned	5,419	13

Table 3 – Soils in the Glady watershed

Name	Total Acres	% of Land Area
Atkins	59.3	0.1
Belmont	1,372.2	3.4
Berks	14,623.8	36.2
Berks-Weikert	3.4	0.0
Blago	22.9	0.1
Brinkerton	6.3	0.0
Buchanan-Ernest	746.7	1.8
Calvin	6,479.0	16.0
Dekalb	6,928.7	17.2
Ernest	2,742.1	6.8
Fluvaquents-Udifluvents	524.5	1.3
Gilpin	546.6	1.3
Gilpin-Dekalb	272.4	0.7
Kanawha	56.2	0.1
Mandy	1,114.4	2.8
Meckesville	1,048.5	2.6
Medihemists	8.8	0.0
Monongahela	3.5	0.0
Philo	47.3	0.1
Pope-Atkins	396.4	1.0
Pope & Linden	8.1	0.0
Pope	8.7	0.0
Purdy	16.5	0.0
Shouns	1,042.2	2.6
Tygart	2.7	0.0
Udorthents	7.1	0.0
Udifluvents	163.4	0.4
Alluvial land	50.2	0.1
Made land	369.5	0.9
Hazelton-Dekalb	294.7	0.7
Potomac	453.5	1.1
Very stony Dekalb	572.5	1.4
Very stony wet land	117.5	0.3
Very stony Brinkerton-Lickdale	18.8	0.1
Very stony Leetonia	11.0	0.0
Lickdale	5.3	0.0
Total	40,144.7	
Acres with no type	262.4	
Acres of land	40,407.1	

An understanding of soil characteristics and a knowledge of which soils are derived from the Mauch Chunk geologic formation and sensitive to disturbance is necessary for making land management decisions. Soils

rated as sensitive require mitigation measures beyond those in the Forest Plan that are routinely applied during project implementation.

The Mandy, Meckesville, and Shouns soils series derived primarily from Mauch Chunk geologic formations comprise about 7.9% of the land area in the Glady watershed. Meckesville and Shouns soils are classed as sensitive due to the potential for slippage if disturbed.

Sensitive soils are also considered to be all soil types over 55% slope, types prone to flooding, types prone to extended periods of saturation, and types with the potential to slip. All the bottomland soil types listed above are considered sensitive due to their potential for flooding. Buchanan and Ernst soils on 15 to 35% slopes, Calvin silt loam soils on 25 to 35% slopes, and 35 to 70 % slopes, and Calvin stony silt loams on slopes 25 to 35% and 35 to 70% slopes are also classed as sensitive due to potential for slippage.

Soil slippage is defined as dislodgement and down slope transport of soil and rock material as a unit in response to gravitational stress. The process, also called mass movement, includes slow displacement such as creep and solifluction, and rapid movements such as landslides, rockslides and falls, earthflows, and avalanches. Water, ice, and air may play an important, if subordinate role in the process. Mass movement can result from the disturbance of soils identified with the potential for slippage. Soil types include: Buchanan and Ernst, Calvin, Meckesville, and Shouns.

Soils on very steep slopes (>55%) are considered sensitive for management due to limitations on equipment. Road or skid trail construction in these areas includes larger and longer cuts than on lesser slopes. Depending on the soil/rock complex, some of these areas are subject to mass movement and/or accelerated soil erosion. In addition to following Forest Plan standards and guidelines, management actions on slopes greater than 55% require site-specific mitigations. Soil types include: Belmont, Berks, Berks-Weikert, Calvin, Dekalb, and Gilpin-Dekalb.

Soils determined sensitive due to wetness or flooding are those with a high water table (at or near the surface) for extended periods. These areas may support different plant communities than surrounding soils. Low weight bearing strength is the limiting factor for management actions in these areas. These areas require larger sized gravel and ditching to provide a stable roadbed. These soils do not have anaerobic conditions in the upper soil layers and do not meet criteria for hydric soils. Soil types include: Atkins, Blago, Brinkerton variant, Medihemists, Purdy, Fluvaquents-Udifluvents Complex, Kanawha, Philo, Brinkerton variant, and Tygart variant.

Belmont soils developed over limestone are considered sensitive to management actions because of the potential for low bearing strength. Stone may be required to provide a stable roadbed. Sinkholes may be found in these areas and the potential to pollute ground water may increase.

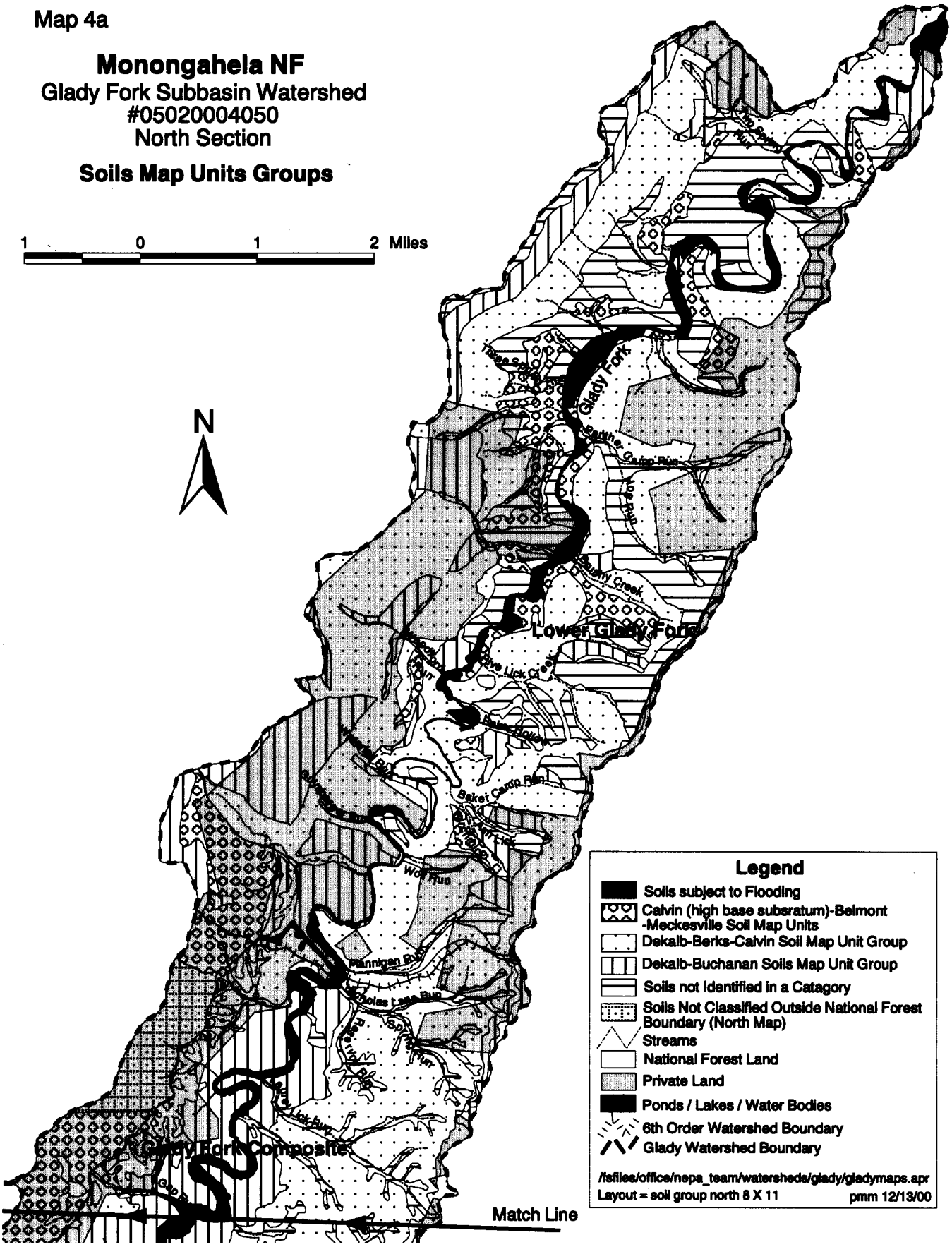
Sensitive soils comprise about 52% of the Glady watershed combined area. Non-sensitive soils make up about 47%, or 18,944 acres. This watershed includes land outside the forest proclamation boundary, about 380 acres, which were not included in soil calculations, however other private land was included. Table 4 shows the acres of sensitive soils by sensitivity class.

The Cheat District soil map is not yet available in GIS format. Soil types for that portion of the watershed for GIS maps and analyses were taken from the ecological landtype (ELT) GIS maps and database. ELT soil codes were based on the 1967 soil survey of Tucker and Northern Randolph counties. As the soil data are updated in the forest GIS, the maps and table will be updated.

Table 4 – Acres and Classes of Sensitive Soils in Glady Watershed

Sensitivity	Acres	Percent of Watershed
Flooding and /or wetness	1,595.1	3.9
Steep slopes	14,365.7	35.4
Potential for slip	1,938.8	4.8
Soils over limestone	652.4	1.6
Steep slopes and potential for slip	1,818.7	4.5
Soils over limestone with steep slopes	641.8	1.6
Total Sensitive Soils	21,012.5	51.8

Maps 5a and 5b show the location and distribution of soils considered sensitive.


Map 4a
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
North Section
Soils Map Units Groups
1 0 1 2 Miles
N
Glady Fork
Lower Glady Fork
Glady Fork Composite
Match Line
Legend
Soils subject to Flooding
Calvin (high base subsratum)-Belmont -Meckesville Soil Map Units
Dekalb-Berks-Calvin Soil Map Unit Group
Dekalb-Buchanan Soils Map Unit Group
Soils not Identified in a Catagory
Soils Not Classified Outside National Forest Boundary (North Map)
Streams
National Forest Land
Private Land
Ponds / Lakes / Water Bodies
6th Order Watershed Boundary
Glady Watershed Boundary
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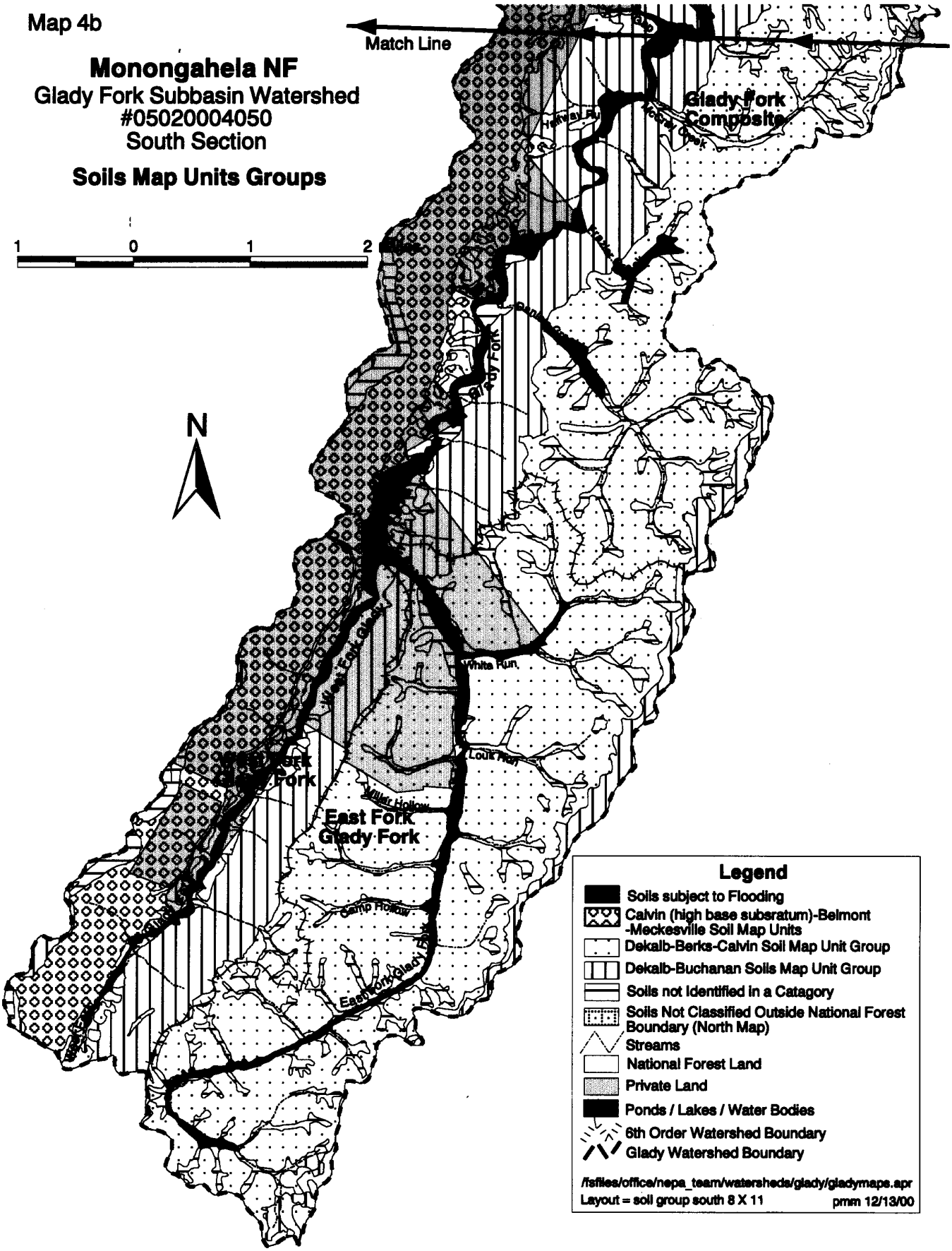
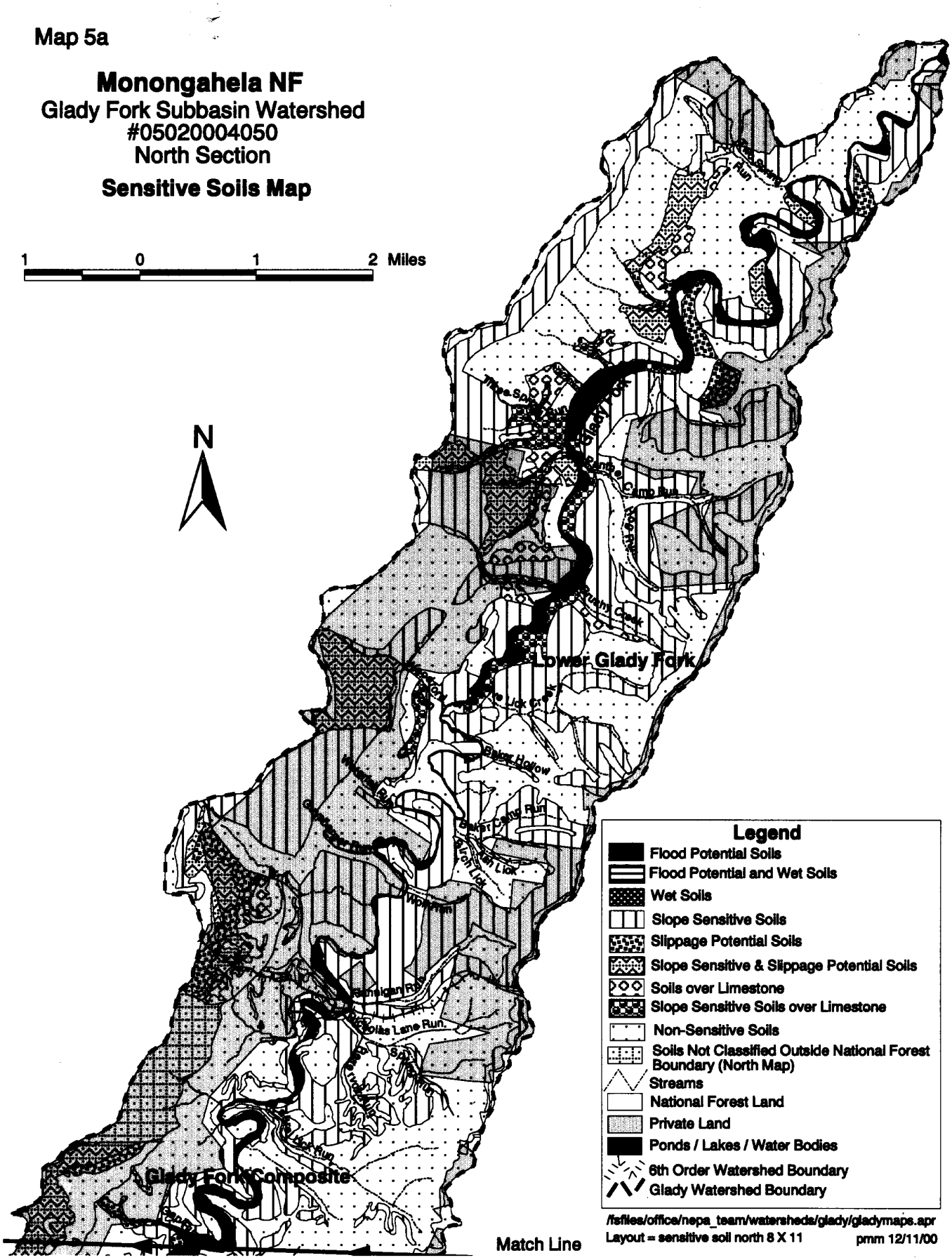
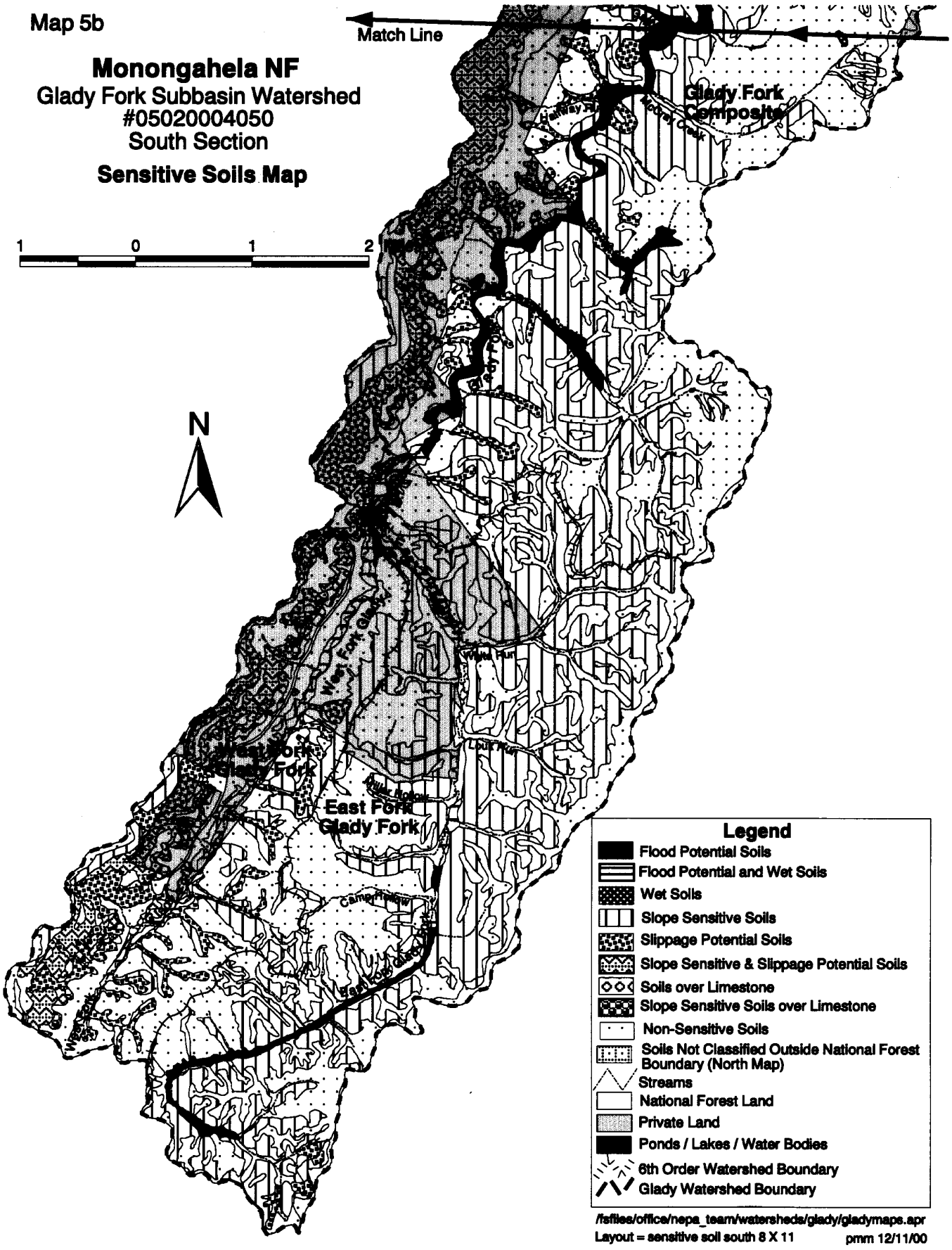
Layout = soil group north 8 X 11
pmm 12/13/00


Map 4b
Match Line
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
South Section
Soils Map Units Groups
1 0 1 2
N
Glady Fork Composite
Big Run
Big Boy Fork
White Run
Louk Run
East Fork Glady Fork
Camp Hollow
Legend
Soils subject to Flooding
Calvin (high base subsratum)-Belmont -Meckesville Soil Map Units
Dekalb-Berks-Calvin Soil Map Unit Group
Dekalb-Buchanan Soils Map Unit Group
Soils not Identified in a Catagory
Soils Not Classified Outside National Forest Boundary (North Map)
Streams
National Forest Land
Private Land
Ponds / Lakes / Water Bodies
6th Order Watershed Boundary
Glady Watershed Boundary
/fsfiles/office/nepa_team/watersheds/glady/gladymaps.apr
Layout = soil group south 8 X 11
pmm 12/13/00


Map 5a
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
North Section
Sensitive Soils Map
1 0 1 2 Miles
N
Lower Glady Fork
Glady Fork Composite
Match Line
Legend
Flood Potential Soils
Flood Potential and Wet Soils
Wet Soils
Slope Sensitive Soils
Slippage Potential Soils
Slope Sensitive & Slippage Potential Soils
Soils over Limestone
Slope Sensitive Soils over Limestone
Non-Sensitive Soils
Soils Not Classified Outside National Forest Boundary (North Map)
Streams
National Forest Land
Private Land
Ponds / Lakes / Water Bodies
6th Order Watershed Boundary
Glady Watershed Boundary
/fsfiles/office/nepa_team/watersheds/glady/gladymaps.apr
Layout = sensitive soil north 8 X 11
pmm 12/11/00


Map 5b
Match Line
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
South Section
Sensitive Soils Map
1 0 1 2
N
Glady Fork Composite
East Fork Glady Fork
Legend
Flood Potential Soils
Flood Potential and Wet Soils
Wet Soils
Slope Sensitive Soils
Slippage Potential Soils
Slope Sensitive & Slippage Potential Soils
Soils over Limestone
Slope Sensitive Soils over Limestone
Non-Sensitive Soils
Soils Not Classified Outside National Forest Boundary (North Map)
Streams
National Forest Land
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6th Order Watershed Boundary
Glady Watershed Boundary
/fsfiles/office/nepa_team/watersheds/glady/gladymaps.apr
Layout = sensitive soil south 8 X 11
pmm 12/11/00

Erosion Processes

Erosion processes vary within the watershed due to the relationships between geology, soils, landscape position (including aspect), and climate. During times of wetter climate, some soils experience more mass wasting than other areas based on differences in geology and landscape position. Present-day erosion processes are primarily streambank, sheet, rill, and gully erosion in some areas. Minor mass wasting in the form of landslides (mainly found on cut and fill slopes on roads), soil humps (from root wads of tree blow down), and soil creep are found within the watershed.

Hydrology

Reference conditions within the Glady Fork watershed can only be speculated upon. All the sub-watersheds, and the streams that drain them, have been substantially impacted by past and to a lesser extent present-day land use. The dominant land use that has affected how streams and watersheds look today is the early 1900's logging and access development. In addition, clearing for livestock grazing, hay production, and agriculture in some sub-watersheds has modified riparian and aquatic conditions. Some of the present day transportation system, and older access roads and trails, also are having effects within the assessment area.

Two streams in the watershed are used by the West Virginia Division of Environmental Protection as regional reference points. The main stem of Glady at its confluence with Dry Fork and Hog Run of Panther Camp Run are monitored for water quality for comparison to other streams. While actions on private and national forest land may affect both reference streams, most of the Hog Run watershed is national forest land.

Stream Morphology

Streams within the assessment area have evolved in soils formed from sedimentary rocks, predominantly sandstone, shales and siltstones, within topography of moderate to high relief. The elevation difference within the watershed is a maximum of approximately 2,000 feet. Generally, slopes are moderate to steep (up to 60% and more) within portions of the watershed, particularly in the northern half of the area. However, some areas with gentle slopes and flatter ridge tops do occur, primarily in the southern portion of the assessment area. Much of the lower valley slopes along the Glady Fork are more gentle terrain, and the river has developed a narrow floodplain. Precipitation is high within the area, averaging 50 to 55 inches annually, but streamflow is somewhat flashy due to the topography and soil/geologic characteristics. Intense summer storms and large frontal system storms are common, as are periodic drought conditions, adding to the wide range of flow conditions in these streams.

Stream channel classification data for Rosgen channel typing were not collected for this assessment. The smaller non-perennial and perennial channels within the assessment area are expected to be primarily "A" channel types, which are entrenched streams with low sinuosity, low width to depth ratios, and steep to moderately steep gradient; and "B" channel types which are moderate entrenchment, sinuosity and width/depth ratios, and moderate gradient (Rosgen 1996). The larger perennial tributaries to the Glady Fork are likely a mixture of stream types, mainly "A" and "B" channels, and "G" channels (entrenched with moderate sinuosity, low width/depth ratio and moderate gradient). Some sections of "C" channels also occur, which tend to be stable channels with low entrenchment and gradient and higher sinuosity.

The Glady Fork main stem covers approximately 32 miles within the assessment area, and includes several stream channel types, mostly "B" and "C" channels. There are likely some areas of "F" channel as well, which is a wide channel but entrenched, with moderate sinuosity.

Streams exhibit a combination of stable and unstable forms, which reflects the influence of natural stream processes and the effects of certain land uses within the sub-watersheds. Natural processes such as bank erosion and channel deposition are part of the "dynamic equilibrium" of streams. However, increased channel erosion and decreased channel stability can result from land use activities such as roads, clearing riparian areas, and in-channel modifications from removing large woody debris.

Most streams within the assessment area exhibit reaches with accelerated channel bank erosion including East Fork Glady, Louk Run, Daniels Creek, Five Lick Creek, Panther Camp Run, Three Spring Run and Low Gap Run. In addition, the main stem of Glady Fork has eroded and unstable channel segments, and channel morphology has changed to less stable forms in some reaches, due to a variety of influences. Those influences include increased runoff from portions of the road system (old and present day), riparian area clearing for pasture and agriculture, channel modifications in response to flood effects, and loss of large woody debris from the channel system.

The morphological effects of these changed conditions is that in some cases stream channels may become more entrenched, reducing the ability of the floodplain to store water during times of flood. However, in other channel reaches sediment deposition occurs, and channel widening can result. Sometimes split channels can develop when high bedload and channel widening is a problem. These processes are affecting portions of the channels within the assessment area.

Stream channel morphology in the late 1800's, before the extensive timber harvesting occurred, is expected to be different from the channel shape and condition of today. In general, channels would have been more stable, with narrower widths and more high quality habitat features. There would have been considerably more large woody debris in the channels, contributing to long-term morphological stability, habitat quality, channel complexity, and greater channel roughness to dissipate energy. Non-perennial headwater channels and small perennial channels would have exhibited more of a step-pool profile. Less channel incision would exist, and floodplain function would have been improved. Channels would have been better "connected" to their floodplains, and floodplains would have performed their natural function of storing floodwaters more efficiently than in some present day locations. This would reduce flood energy within the channels, reducing the amount of bank erosion and instability. Overall, channels would tend to be narrower, and baseflows deeper.

Flow Rates

Streamflow within the various sub-watersheds tends to be highly variable, dependent on season and precipitation patterns. There are no local or nearby streamflow gauging data to quantify flow characteristics. The nearest known stream gauge with a lengthy period of record is on the Dry Fork at Hendricks, about 8 miles downstream from the mouth of Glady Fork, and with a watershed area of 349 square miles (more than five times the watershed area of this assessment). While data from this gauge location may not be particularly accurate for predicting flows in the Glady Fork, they do indicate the magnitude and range of flow conditions that occur within the larger watershed. Annual runoff at the Hendricks gauging station over the past 58 years has averaged 2.24 cubic feet per second per square mile (cfsm) of drainage area. The data also reflects the great variability in flows with the highest daily mean flow of 34,000 cubic feet per second (cfs), observed in November 1985, and an annual 7-day minimum flow of 3.5 cfs observed in 1993. The Hendricks gauging station data indicate that March is typically the month of highest average flow at 4.5 cfsm, and September is the month of lowest average flow at 0.7 cfsm.

These data, and what is known about the watersheds, indicate that streamflows are highly variable by season and precipitation characteristics. The seasonal variation is largely due to the type of precipitation (snow or rain), and the influence of vegetation during the growing season. Evapotranspiration losses in the vegetative growing season contribute most to the lower streamflows. In addition, snowmelt in the late winter and early spring contributes to the higher streamflows. Streamflow tends to be not only variable, but also flashy, responding quickly to the influence of topography and soils, soil moisture conditions at the time of precipitation, rainfall amounts and intensity, and land uses. Some increased runoff occurs in certain portions of the streams where land clearing has taken place. Land clearing occurs in small to large blocks throughout the assessment area, such as in and around the town of Glady, along much of the east flank of Shavers Mountain, north of Alpena, and in the head of Panther Camp Run. In addition, clearing and road access within the gas storage field has likely had some small effect of reducing evapotranspiration and creating small increases in annual runoff.

Runoff rates are also affected by compaction within the watershed, such as in grazing areas, roads and highways, and other uses that substantially disturb and compact soils. The extensive transportation system of state and forest roads, private and old woods roads, old railroad grades, etc., is a major watershed disturbance which collectively intercept surface and shallow groundwater, modify and compact soils, and concentrate and speed runoff, particularly during storm conditions. In turn, less water is available for soil storage and floodplain recharge. This is likely having some effect of increasing flows during storm runoff and snowmelt situations, as well as reducing baseflows and low flows. The magnitude of this effect could be substantial in some localized areas, but its overall effect within the watershed is less clear.

These changes in flow conditions are likely having an effect on the morphology of the upper, non-perennial streams, and to some extent, the perennial reaches downstream. Altered flows also increase the fine sediment supply to aquatic habitats, and during low flows the available aquatic habitat is reduced, putting an even greater stress on aquatic biota.

Reference conditions for stream flows would be somewhat different from flows, as they exist today. The primary factors that control these differences are the amount of present day roads, skid roads, old woods roads and railroad grades, compaction, and land clearing. Streamflow would have been somewhat less flashy in the reference condition, because there would have been less channel extension from the transportation network, and less compaction associated with various land uses. It is likely that baseflows and low flows would have been somewhat greater than the present day condition, because the effective drainage density (length of channel per unit area) would have been less, and soil infiltration would have been greater.

Reference conditions would have been a nearly intact forest throughout most of the watershed area. Primarily small openings would have existed as part of the natural forest condition, caused by infrequent and small mass wasting events, fire, wind-throw and flood damage, and some other naturally occurring influences. These small forest openings would likely have had less effect on streamflow than the larger openings that occur on some private lands today. Areas where conversion to hay and grazing has occurred likely yield more water to streamflow in the growing season, because evapotranspiration losses are less from the cleared lands. In the reference condition, an intact forest would have existed, and evapotranspiration losses would have been greater, so streamflow in those sub-watersheds may have been less during the growing season. The amount of this effect would have been relatively small. However, greater infiltration and soil storage would have existed in the reference condition, because roads and compaction from grazing would have been absent. To some extent, there would have been offsetting factors in those localized areas where openings now exist.

Timber harvesting would not have existed in the reference condition. Timber harvesting in the east has been found to increase the annual water yield from the harvested area, with the majority of those increases occurring in the growing season and mostly as increased baseflows and low flows. However, those water yield increases are relatively small and short term, with streamflow returning to pre-harvest levels in about 10 years or less. In the reference condition, streamflow would have been unaffected by harvesting, so yield increases would not have occurred. However, the truck road and skid road transportation system and old railroad grades did not exist, so precipitation would have infiltrated and been detained more efficiently.

Overall, streamflow in the reference condition was likely to have been more evenly distributed and not as flashy. Soil moisture storage was greater and release to the stream channels was slower. Baseflows were likely greater than the current condition, as well as low flows. However, the magnitude of this difference is difficult to predict. Greater baseflows, and especially low flows under the reference condition, combined with narrower channels and more large woody debris, would have maintained better quality habitat in the streams.

Storm Flows

Stormflow within the assessment area is characterized as intense and frequent. Streams are somewhat flashy in their response to larger storms, especially the more intense storms. Streamflow tends to rise rapidly under those conditions, and will fall rapidly as well, returning to baseflow conditions rather quickly. Major frontal weather systems and tropical storms from the south can carry very substantial quantities of rainfall. On average, the largest annual rainfall event in a 24-hour period is about 2.5 inches. However, major storm events can be frequent, and generally occur during the dormant season of the year (November through mid-May), when evapotranspiration losses are minimal. Examples of recent dormant season precipitation events include the November 1985 flood, and the January and May 1996 floods.

Land use activities and roads within the watersheds can further influence stormflows, but the magnitude of the effects depends on a number of variables. Certain land uses that reduce the soil infiltration and water holding capacity, and reduce riparian vegetation, contribute to increased stormflow and stormflow effects on stream channels. Road development can act to extend the channel system within the watershed, concentrating flows and speeding runoff to downstream areas. Ground-based timber harvest activities can have similar effects through skid-road development. Grazing and agriculture frequently has detrimental effects on streams through soil compaction and reduced infiltration, and loss of healthy riparian vegetation.

The magnitude of the stormflow effects depends on the type of land use, and its relative extent within the sub-watersheds. Normal forest management practices in the eastern United States generally have a small to modest effect on stormflow volume, but a less clear effect on storm peakflows (Reinhart et al 1963; Kochenderfer et al 1997; Edwards and Wood 1994; Hornbeck 1973; Hornbeck et al 1997; Hewlett and Helvey 1970.) Most studies documented stormflow increases for small mountain watersheds (less than 100 acres or so), where the entire small watershed area was harvested, and in some cases included using herbicides after logging to keep the watershed from revegetating quickly. The documented effects are only for the treated watersheds, not for downstream areas, and stormflow increases are usually small. Stormflow increases are usually of relatively short duration, usually only 6 to 10 years or less, and most of the increase occurs during the growing season, not during the dormant season. Within the Glady Fork watershed, timber harvest activities have been relatively limited on the National Forest in recent years. Approximately 1,130 acres, less than 3% of the watershed, has been regenerated on the Forest in the last 29 years.

In addition to timber harvesting, activities that change the land use for a longer period would likely extend the duration of a stormflow effect, particularly if compaction occurred. Grazing impacts would likely

produce longer term stormflow increases. Roads and highways that concentrate flows and reduce soil water storage would speed stormflow runoff, increase stormflow volume, and increase peakflows under some situations, and those effects would persist for the long term.

The cumulative effect of land use activities occurring on and off-Forest are influencing storm flows in the Glady Fork watershed. It is not possible to quantify the effect because of the scattered nature of the roads and land uses throughout the sub-watersheds. The combination of private and old woods roads, the gas storage field access roads, state roads and highways, and Forest Service system roads are all increasing rates of runoff and stormflow to the Glady Fork main stem and tributaries. Storm flow increases would tend to destabilize channels, increase channel bank erosion, increase deposition of sediment in some reaches of the channels, and increase fine sediment over the long-term. (Over the short-term, higher stormflows can flush fine sediment out of the smaller, higher gradient streams.)

Stormflows in the reference conditions would have been slightly to moderately less in volume because of the undisturbed nature of the sub-watersheds. Without the influence of roads and soil compaction, storm runoff would have been less concentrated and slower, with a greater percentage of the precipitation being detained in the soil for slower release. The greatest difference between the current and reference conditions would likely have been for the smaller to moderate sized storm events. In addition, floodplain function would have been less impaired in the reference condition, and a greater proportion of flood flows would have occupied the floodplain, reducing the erosive energy within the stream channels.

Storm peakflows in the reference condition may not have been substantially different, compared to the current condition, for the major, flood-producing storms, particularly during the dormant season when most floods occur. The exceptions may be the sub-watersheds affected by extensive clearing and conversion to grazing and other agriculture. In those sub-watersheds, the reference condition likely was not only smaller stormflow volume, but slightly lower peakflows as well.

Overall, smaller stormflows or longer stormflow duration, and greater floodplain storage in the reference condition would have meant less erosive energy within the stream channels. In general, stream channels would likely have been more stable, with less channel bank erosion and sediment deposition within the channel. Aquatic habitat would have been of higher quality because of the greater bank stability, less sediment deposition, lower fine sediment, and other habitat features.

Sediment

Streams within the sub-watersheds are impacted by sediment, as documented in the inventory of fine sediment conditions. Generally, fine sediment levels are high in these streams and would impair native trout reproduction, although some streams fall below the threshold value of 20 percent. Refer to the **Aquatic Habitat** section of this analysis, and fine sediment sampling results in Table 16. Sediment is delivered to these streams through channel bank erosion, and through sheet and rill erosion of upland slopes, disturbed areas and roads. Some gully erosion occurs below roads where flow concentration has altered drainage patterns, substantially increasing the sediment supply to channels. Examples include some road related drainage problems along portions of FR 183, 187, 422 and 229, the access roads to the gas storage field, and many old woods roads and railroad grades. State roads typically exhibit road runoff and flow concentration problems that contribute large amounts of sediment. Riparian management practices, such as roads along streams, and grazing within the riparian area contribute to de-stabilized stream banks, accelerated channel bank erosion, and channel widening. Numerous sediment sources exist within the sub-watersheds.

Much of the existing channel and erosion conditions are features of the land use that occurred in the early 1900's, when timber was harvested from nearly the entire watershed. Increased stormflows resulting from

such drastic harvesting had substantial channel stability effects, further compounded by removal of most of the riparian vegetation, and the removal of large wood from the channels themselves. Recovery from the impacts around the turn of the century is a very long-term process.

Despite these sediment related problems, and increased water temperatures in the main stem of Glady Fork, all of these streams are considered by the State of West Virginia to meet water quality standards. Designated uses of the surface waters within the watershed include propagation and maintenance of fish and other aquatic life (Category B), and water contact recreation (Category C). In addition, Glady Fork, East Fork Glady, and Three Spring Run are all on the State list of designated trout waters (designated use Category B2). In fact, most perennial streams within the Glady Fork watershed support native trout populations. None of the streams within the assessment area are listed in the State's 1998 303(d) List of "water quality limited waters", indicating general compliance with state standards and designated uses.

Water Chemistry

Water samples taken in early May 2000 from a representative sample of the sub-watershed streams indicate moderate to good chemistry in all streams sampled. Sampled streams fell within 6.6 to 7.3 pH units. Refer to Table 5 for water quality results in these streams. Alkalinity values were low to adequate, but indicating marginal to moderately buffered systems that would generally sustain the aquatic communities. The USEPA sampled two sites on Glady Fork in May 1993, downstream of highway 33, and reported pH values above 7.7 and good water quality.

Table 5 - Water Quality Summary for Glady Watershed

Site (Water Source Name)	pH	Conductivity (uS/Cm)	Alkalinity (mg CaCO3/L)
Three Spring Run	7.30	78.7	28.85
Panther Camp Run	7.08	35.7	7.79
East Fork Glady	6.57	21.8	3.23
West Fork Glady	6.87	39.6	12.77
Glady Fork at Route 33	7.02	32.2	8.37
Glady Fork at State Route 26	7.03	38.8	11.50
McCray Creek	6.90	23.1	2.85
Five Lick Creek	6.73	26.6	3.50
Louk Run	6.79	27.9	5.55
Daniels Creek	6.74	20.5	2.32
Nicholas Lane Run	6.63	31.1	3.19

West Virginia DEP reported Stream Condition Index (WVSCI) values for seven streams within the analysis area. Index values may range between 0 and 100+, with scores above 70 indicating a non-impaired condition. All seven streams sampled scored WVSCI values between 83 and 100+, indicating "good water quality with little or no significant pollution impacts." Although this index indicates good water quality within the watershed, the index may not be very sensitive to stream sediment conditions, since most streams were found to be fine sediment impaired. It is also likely that some of the less buffered streams in the assessment area may experience brief periods of acid shock during rapid snowmelt in the late winter and early spring, but none are currently listed as impaired by acid deposition and water quality is generally adequate to support aquatic communities. The greatest risk of acid runoff would be due to atmospheric deposition. There has been limited strip mining in the watershed (a few acres) and the site is not creating an acid mine drainage problem.

Temperature

No temperature data were collected for this assessment; however, water temperatures are generally considered good throughout the assessment area and suitable for supporting trout. None of the streams within the watershed are listed by the State as temperature impaired. Thermal concerns do exist for in reaches of the Glady Fork main stem and tributaries where riparian areas have been reduced and impacted by grazing, other clearing activities, and beaver dams in certain headwater streams.

Reference conditions for water quality would have reflected the undisturbed condition of the sub-watersheds. Sediment conditions in streams would have been governed by natural watershed processes, and would not have been influenced by the variety of land clearing and disturbance activities that exist today. Riparian areas would have remained intact, leading to improved channel stability and increased stream shading in areas that are now cleared. Overall, bedload sediment and fine sediment would have been at moderately to substantially lower levels, and suspended sediment during stormflow conditions would have been lower. Aquatic habitats throughout the Glady Fork watershed would have exhibited a higher quality because of the reduced sediment conditions. The aquatic community in general would benefit, and trout reproduction would have been maintained at a higher level.

Although streams in the area are considered to be meeting water quality standards for acidity, acid deposition is likely having some effect on water chemistry in some of these streams, at least on an episodic basis. Stream acidity under reference conditions would have been governed by the natural buffering capacity of the soils and bedrock, and by the natural acidity of precipitation and the influence of vegetation. In general, the more poorly buffered streams may have had slightly higher average pH values, or were not subjected to acid shock events from some summer storms and snowmelt runoff. The effect on the aquatic community in most of the sub-watershed streams may not have been large, because most maintain some buffering capacity.

Stream temperatures under the reference condition would have remained lower during summer low flows. This would be due to the combined effect of a more intact riparian forest in those watersheds where extensive clearing has occurred, generally narrower channel width in some stream reaches, and maintaining greater baseflows. Lower summer stream temperatures would have benefited the native aquatic community.

Comparison of Reference Condition to Current Condition

The difference between the undisturbed reference condition and the current condition in the sub-watersheds of the Glady Fork is fairly distinct. Watersheds have been impacted and impaired by a variety of facilities, land uses and conversion, and possibly in some sub-watersheds by the influence of acid deposition. Much of the current condition in these sub-watersheds can be attributed to the early 1900's timber harvesting, and to a lesser extent contemporary land uses such as roads, grazing, agriculture and gas development.

Natural watershed processes are in an impaired state within most of the sub-watersheds, and watershed condition is below its potential. An example is the East Fork Glady Fork, with numerous erosion sources and high fine sediment in the channel. Much of the stream channel system within the assessment area has been impaired through altered flow conditions and sedimentation effects, portions of channels are unstable, and aquatic habitat is impaired. The Glady Fork main stem incorporates all these uses, impacts and effects.

Watershed restoration measures are needed to improve watershed function and begin the process of moving watershed condition toward the reference condition. Watershed restoration is needed on both public and private lands. Restoration measures should consider erosion processes, hydrologic function, riparian and channel conditions, aquatic and riparian community needs, facilities, land use needs and limitations. Restoration projects should focus on old and existing roads and railroad grades, riparian vegetation

recovery, and channel restoration opportunities. Priority should be given to road drainage improvements, road closure or obliteration, and riparian area restoration. Future projects, such as vegetation management, should consider the best methods for achieving management objectives and improving watershed and aquatic condition. In some cases, alternative timber harvest methods should be considered, such as helicopter yarding, to reduce watershed effects.

Biological Environment

Pre-European settlement forests of the Monongahela National Forest

Abrams and McCay (1996) tallied witness trees used as corner markers for warrant maps from 1780 to 1856 by species, physiographic unit, and topographic position from maps contained in the present day Monongahela National Forest. The two physiographic units represented are Allegheny Mountains and Ridge and Valley. The topographic positions used were ridgetop, 0-8% slope; north or south slope, 8-80% slope; cove; or valley, 0-8% slope. Species frequency was calculated by physiographic province and topographic position and compared to present-day forest composition in those areas.

The Glady watershed analysis area is in the Allegheny Mountain province, Northern High Allegheny Subsection, and the Middle Mountain System, Cheat-Shaver's-Back Allegheny Mountain, Cheat Mountain Slopes, Middle Mountain, Allegheny Plateau Red Spruce Frigid Soils, and Allegheny Front Sideslope, landtype associations. Abrams and McCay found that the pre-settlement forests of the Allegheny Mountains were dominated by beech, pine, and hemlock on the mountaintops. Forests on the southeast facing slopes were comprised mainly of pine, birch, red and sugar maple, chestnut, and beech with lesser amounts of basswood, hemlock, cucumber tree, chestnut oak, and yellow poplar. Northwest facing slopes were dominated by sugar maple, beech, and basswood, with moderate amounts of chestnut, cucumber tree, pine, birch, scarlet oak, and black cherry. Species found in the cove forests were primarily birch, beech, red maple, basswood, and hemlock. Valley floor sites were dominated by hemlock, sugar maple, and birch, with considerable amounts of scarlet oak, red oak, and red spruce.

When compared to present day forests, Abrams and McCay found that pine species and basswood were less abundant and red maple, black cherry, and birch increased after European settlement. The species that increased in abundance are early seral or pioneer species. American chestnut is now absent from the overstory due to the chestnut blight. Curiously, red spruce was not a large percentage of either province in the warrant map records. Red spruce has been called yew pine by West Virginians, it is possible that surveyors used this common name and may explain the low numbers of red spruce tallied.

Although hardwoods dominated more than 90% of the original Appalachian forest (Carvell 1986), the red spruce/fir forest was a major forest type, at higher elevations, prior to settlement by people of European origin. It is estimated over 1.5 million acres of spruce/fir forest covered the higher elevations of the Southern Appalachian Mountains in West Virginia, North Carolina, and Tennessee prior to European settlement. By 1860 this area was reduced by half. At the turn of the 20th century, only 225,000 acres of the spruce/fir forest remained and by 1920, the number of acres had been reduced even further, to about 100,000 (USDA Forest Service 1975).

Most of the land now in federal ownership in the Glady watershed was purchased between 1914 and 1939, with some smaller tracts purchased later. Tract descriptions of the land before purchase by the federal government describe forests where the best hardwood trees and most of the hemlock were harvested. One 6,000 acre tract was described as hardwood-hemlock forest type with large hemlocks, and mixtures of poplar, ash, cherry, red oak, white oak, basswood, cucumber, chestnut, beech, birch, and maple. In areas harvested around 1902, a good stand of poplar and ash poles was found. The current East Fork Trail

follows the old railroad grade used in logging before federal ownership. There were areas in the watershed noted for fires caused by the operation of the rail line. In one tract, 300 acres were described as burned over land with new growth coming in. The fires are described as severe and repeating. Reproduction of black locust, birch, maple, and poplar (all early successional species) was noted in the tracts before purchase.

Past Timber Harvests

The distribution of age classes gives a general picture of past timber harvesting in the watershed on National Forest land. There have been numerous timber sales on federal lands that were awarded from 1985 to 1993 and closed between 1990 and 1998. These dates determine the start and end of quiet time in compartments under 6.1 management prescription.

Table 6 below gives the recent sales on the Greenbrier and Cheat Districts within the Glady watershed.

Table 6. – Recent Timber Harvests in Glady Watershed

District/ Compartment	Sale	Year Awarded	Acres Cut	Acres cut by treatment		Year Sale Closed	End of Quiet Time
				Regen	Thin		
3/37	Laurel Lick	1992	120	59	61	1998	2008
3/37	Nichols Lane	1993	46	0	46	1994	2004
3/38	Laurel Lick	1992	145	24	121	1998	2008
3/38	McCray N.	1992	139	42	97	1995	2005
3/39	McCray I	1989	9	9	0	1992	2002
3/39	McCray II	1989	9	9	0	1990	2000
3/39	McCray N.	1992	84	49	35	1995	2005
3/39	McCray S.	1992	78	37	41	1995	2005
3/40	McCray S.	1992	24	24	0	1995	2005
3/40	Lame Duck	1992	178	40	138	1995	2005
3/41	Daniels Creek I	1985	351	150	201	1991	2001
3/41	Daniels Creek II	1987	98	72	26	1991	2001
3/46	Beulah	1990	69	64	5	1994	2004
3/46	Little Beech Mtn.	1991	382	65	317	1997	2007
3/46	Olive II	1988	46	0	46	1991	2001
1/44	Kuntzville	1982	834	157	675	1990	2000
1/53	Five Lick		182	112	80	1997	2007

In 1992, a state law made the registration of timber harvest jobs mandatory. Timber harvests on private land must be conducted by a certified logger and be registered at the state forester's (WVDOF) office in each county. Information collected by the state forester includes names and addresses of purchaser, logger, and landowner, and the number of acres to be harvested, the type of harvest, and the duration of the harvest. In addition, a map and description of the property location is included.

From a review of the records on file at the state forester's office in Elkins, an estimate of past and present timber harvest on private land was made. Records were available only from 1997 to the present. In 1997 there were no timber harvests registered on private land. In 1998 there were 5 jobs registered with a total of 526 acres. Four of these harvests were listed as diameter limit/logger's choice harvests, and one as selection harvest. In 1999, eight jobs were registered in the watershed for a total of 621.5 acres. Four of these were

listed as diameter limit/logger's choice, three as selection harvest, and one as a regeneration harvest. In 2000, four jobs were registered in the watershed. Three of these are listed as selection harvest and one as diameter limit/logger's choice. A total of 1,364.5 acres of private land has been registered as having timber harvest within the watershed over the past 4 years.

Diameter limit/logger's choice timber harvesting is generally done without input from a forester. A diameter limit is set and all trees greater than or equal to this diameter are removed. The choice of species to take may be left to the logger. Select harvest may have included advice or marking of individual trees for removal by a forester. These harvests may also include thinnings. The regeneration harvest was likely a clearcut, however non-commercial trees and shrubs were likely left. A tract of land was noticed to have been listed as two separate logging jobs, not a continuation. This often occurs on land harvested by diameter limit/logger's choice methods as markets change and different species or sizes of trees become marketable.

Age Class Distribution

Forested stands in the Glady watershed are grouped by 15-year age classes for management. The age of a stand is determined during stand exam from increment borings of dominant trees or from timber harvest records. The age class interval is based on a 10-year entry cycle for areas with a management prescription of 6.1 plus 5 years for project development and implementation. Differences in stand structure are generally noticed at intervals of greater than 15 years, however 15 years is used for determining a balanced age class.

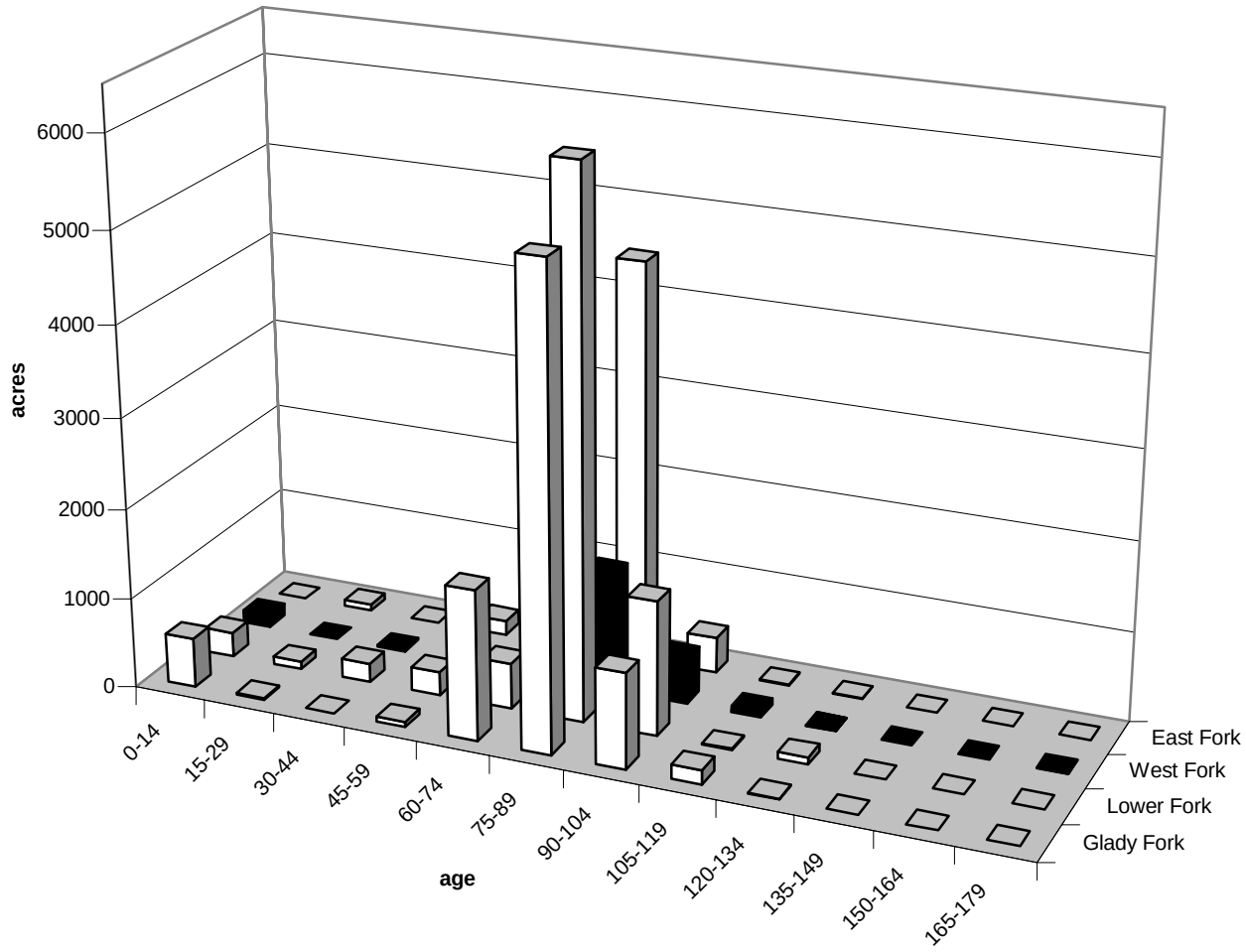
Forest structure differs at different ages. The 0-14 year old stands range from regenerating areas with tree seedling and herbaceous growth to stands of small saplings. Large residual trees may exist in these stands depending on the regeneration method used. This age class can also be called the stand initiation stage. The 15 to 44 year old stands are generally dominated by tree species 4-10 inches in dbh. These stands may be very thick with high numbers of stems per acre. All stems are about the same height and there is little understory or herbaceous growth due to shading. This stage is when trees are competing most for sunlight and stems that cannot grow fast enough start to die off. This age can also be called the understory suppression and stand differentiation stages. Dominant and codominant stems in stands between the ages of 45 and 90 years old are generally increasing mainly in diameter growth. Competition has sorted out the trees into dominant, codominant, suppressed and understory stems. Shade tolerant trees start to become part of the understory in the early part of this stage. In the oldest age classes, gaps begin to form as dominant trees die and the understory is released. This is the understory re-initiation stage. These four stages are based on Oliver and Larson (1990). These structural conditions not only vary with age, but also with forest type, associated species, diseases, and site conditions.

Table 7 and Figure 1 show acres of forest in each age class by sub-watershed. The ages are as of the year 2000.

Table 7 - Age Class Distribution by Sub-watershed

Age	Glady Fork	Lower Fork	West Fork	East Fork	Total	% of total NF land
0-14	546	269	139	1	955	4
15-29	20	85	0	67	172	1
30-44	0	209	22	0	231	1
45-59	59	258	4	160	482	2
60-74	1,665	509	110	1,422	3,706	14
75-89	5,250	5,982	1,319	4,450	16,998	63
90-104	1,058	1,491	514	400	3,706	13
105-119	154	16	69	15	253	1
120-134	9	80	5	6	100	0
135-149	0	0	0	0	0	0
150-164	0	0	0	0	0	0
165-179	0	0	6	0	6	0
Open and brush	299	145	236	116	796	3
Private	4,325	6,083	1,782	1,137	13,327	
Total	13,386	15,129	4,206	7,773	40,491	
Total NF land					26,164	

Figure 1 - Age Class Distribution by Sub-watershed

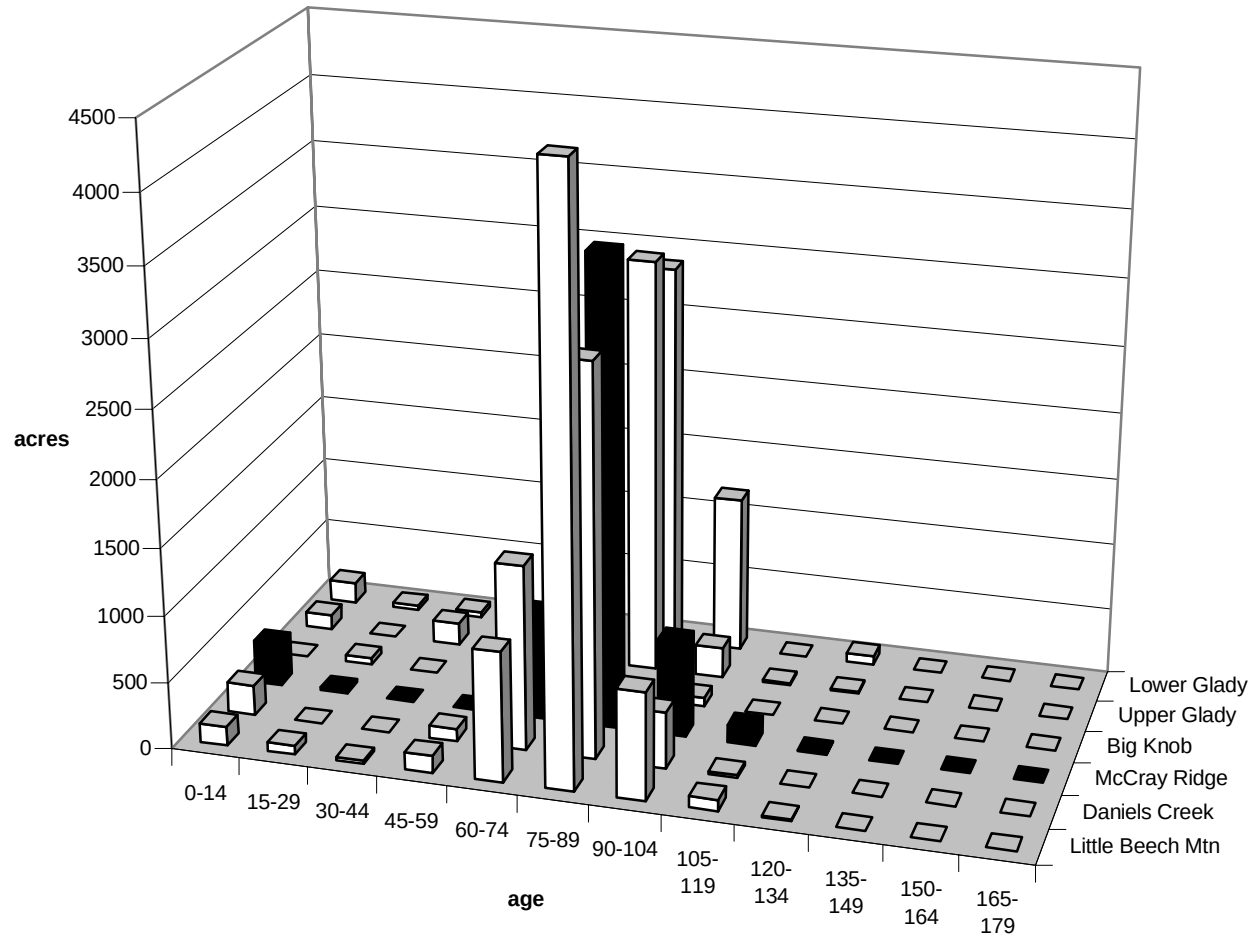


	0-14	15-29	30-44	45-59	60-74	75-89	90-104	105-119	120-134	135-149	150-164	165-179
Glady Fork	546	20	0	59	1665	5250	1058	154	9	0	0	0
Lower Fork	269	85	209	258	509	5982	1491	16	80	0	0	0
West Fork	139	0	22	4	110	1319	514	69	5	0	0	6
East Fork	1	67	0	160	1422	4450	400	15	6	0	0	0

Table 8 - Age Class Distribution by Opportunity Area

Age	Lower Glady	Upper Glady	Big Knob	McCray Ridge	Daniels Creek	Little Beech Mtn.	Total	% of total NF land
0-14	157	112	0	321	223	142	957	4
15-29	34	0	50	20	0	67	172	1
30-44	41	168	0	0	0	22	231	1
45-59	37	143	0	0	91	128	322	1
60-74	137	241	57	801	1,381	968	3,585	13
75-89	2,882	3,099	23	3,479	2,903	4,433	16,817	63
90-104	1,174	227	64	718	421	806	3,411	13
105-119	0	16	0	132	22	83	253	1
120-134	67	13	0	9	0	11	100	0
135-149	0	0	0	0	0	0	0	0
150-164	0	0	0	0	0	0	0	0
165-179	0	0	0	0	0	0	0	0
Open and brush	104	36	0	155	183	298	776	3
Total NF land	4,634	4,053	195	5,634	5,225	6,959	26,699	

Figure 2 - Age Class Distribution by Opportunity Area



	0-14	15-29	30-44	45-59	60-74	75-89	90-104	105-119	120-134	135-149	150-164	165-179
Little Beech Mtn	142	67	22	128	968	4433	806	83	11	0	0	0
Daniels Creek	223	0	0	91	1381	2903	421	22	0	0	0	0
McCray Ridge	321	20	0	0	801	3479	718	132	9	0	0	0
Big Knob	0	50	0	0	57	23	64	0	0	0	0	0
Upper Glady	112	0	168	143	241	3099	227	16	13	0	0	0
Lower Glady	157	34	41	37	137	2882	1174	0	67	0	0	0

In 2000, 63% of forested acres are in the 75-89 year age class. This represents the large-scale forest harvesting in the early 1900's. Three middle age classes, 60-74, 75-89, and 90-104 years, contain 90% of the acres of forested stands in the Glady watershed. If the Forest Plan goal of a balance of acres across the age classes is desired, some young stands will need to be created and some stands will need to be allowed to mature. The formation of natural gaps in the watershed will be accelerated by the impacts of beech bark disease.

The age class distribution by opportunity area shows only the major opportunity areas in the watershed, therefore the totals for the sub-watershed distribution do not match these totals. These six opportunity areas cover the majority of the watershed. The minor opportunity areas are found along the edge of the watershed with the majority outside the Glady watershed. Age class distribution charts and tables for stands in this watershed and in these opportunity areas would be misleading. However, the 6 acres of the oldest stand in

the watershed is in one of these minor opportunity areas. The minor opportunity areas are; Otter Creek Wilderness (15.001), Laurel Fork (16.201), Laurel Fork North Wilderness (35.001), Laurel Fork South Wilderness (3.5002), Bear Heaven (1.3011), Rich Mountain (3.3004), Fox Run (3.6108), and Beaverdam Ridge (3.3002) for a total of 488 acres of national forest land in the Glady watershed.

Forest Type Distribution

Forest stands in the Glady watershed were typed during stand exam based mainly on overstory species. The Forest uses its own guidelines on forest types, based generally on types used by the Society of American Foresters. The Forest Plan goal for MP6.1 areas is for a diversity of forest types, within the existing range of tree species. Rare or unusual forest types may be an indicator for rare or unusual plants or animals.

Forest type also influences forest succession and stand structure. Forest stands of the same age but differing in tree species will create differences in stand structure expected at certain ages. For example, stands with shade tolerant tree species will begin to develop an understory before stands with mainly shade intolerant tree species because of the ability of the shade tolerant tree species to regenerate under shade.

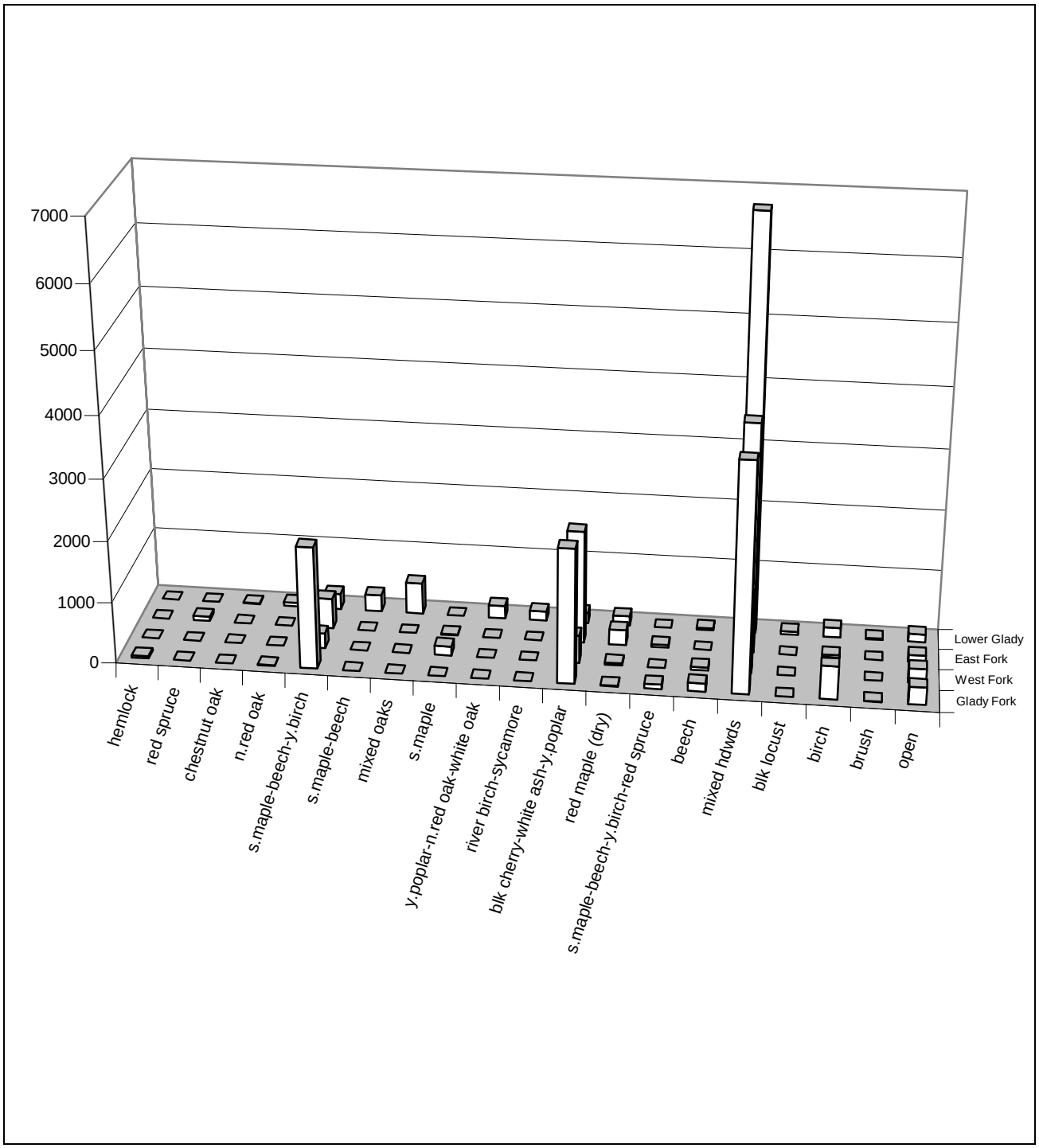
Table 9 and Figure 3 below show the current (2000) distribution of acres in forest types by sub-watershed.

Table 9 - Forest Type Distribution by Sub-watershed

FOREST TYPE	Glady Fork	West Fork	East Fork	Lower Glady	Total	% of total NF land
private land	4429	1782	1,176	6,285	13,672	NA
hemlock	35 (0)	1 (0)	0	0	36	0
red spruce	5 (0)	0	73 (1)	16	94	0
chestnut oak	0	0	0	14 (0)	14	0
Northern red oak	9 (0)	0	0	60 (1)	69	0
sugar maple-beech-yellow birch	1,995 (22)	243 (10)	499 (8)	256 (3)	2,993	11
sugar maple-beech	0	0	0	269 (3)	269	1
mixed oaks	0	0	0	514 (6)	514	2
sugar maple	0	149 (6)	17 (0)	0	166	1
Yellow poplar-northern red oak-white oak	0	0	0	208 (2)	208	1
river birch-sycamore	0	0	0	154 (2)	154	1
black cherry-white ash-yellow poplar	2,204 (24)	454 (19)	1,812 (28)	178 (2)	4,648	17
red maple (dry)	10 (0)	36 (1)	153 (2)	158 (2)	357	1
sugar maple-beech-yellow birch-red spruce	74 (1)	0	42 (1)	0	116	0
beech	135 (1)	53 (2)	1 (0)	30 (0)	219	1
mixed hardwoods	3,740 (41)	1,256(52)	3,750 (58)	6,693 (75)	15,439	57
black locust	0	0	0	54 (1)	54	0
birch	537(6)	0	39 (0)	157 (2)	733	3
brush	12 (0)	0	0	20 (0)	32	0
open	287 (3)	236 (10)	118 (2)	128 (1)	769	3
Total	1,3472	4,210	7,680	15,164	40,557	
Total NF land	9,043	2,428	6,505	8,879	26,884	

Percent of total sub-watershed is given in parentheses

Figure 3 - Forest Type Distribution by Sub-watershed



Because of the diversity in tree species found in the Glady watershed, 57% of the forested acres are classified as mixed hardwood type forests. In these forests, sugar maple, basswood, white ash, birches, northern red oak, yellow poplar and black cherry are present but no one tree species forms the majority of the overstory. The forest type with the next largest percentage of the total watershed is the black cherry-white ash-yellow poplar forest type. In these forests one or a combination of the three species comprises the majority of the overstory. While forest types such as hemlock and red spruce form a small percentage of the entire watershed, these types are very important to individual animal species and may require management to maintain or increase their coverage.

In each sub-watershed, the same general pattern of forest type distribution is present with the mixed hardwood forest type predominant. With the exception of the Glady Fork composite sub-watershed, the mixed hardwood forest type comprises at least 50% of all other sub-watersheds. The Glady Fork composite is comprised of 41% mixed hardwoods, and sugar maple-beech-yellow birch and black cherry-white ash-yellow poplar forest types make up 22% and 24% respectively. While a small number of acres are typed as conifer forest types, it does not mean that there are no spruce or hemlock trees in these sub-watersheds, however it is unlikely that they are in the overstory in large numbers.

Landtype Associations

Land Type associations (LTA) are a description of an area at the landscape scale in the national hierarchical ecological classification and are smaller than subsections, but larger than ecological landtypes. LTAs are differentiated primarily by broad geomorphology, but strongly influenced by climate. LTAs contain repeatable patterns of soil and vegetation groupings that are delineated at the ecological landtype scale.

The Glady watershed includes land classified in five different LTAs, plus unclassified land outside the National Forest proclamation boundary. Table 10 displays the LTAs and the amount of land of each in the Glady watershed. Maps 6a and 6b display this information as well.

Table 10 – Distribution of LTAs in Glady watershed

Landtype Association	Acres	% of total watershed
Cheat-Shaver's-Back Allegheny Mountain – Ba01	1008	2.5
Cheat Mountain Slopes – Ba02	709	1.8
Middle Mountain – Ba05	24,958	61.4
Allegheny Plateau Red Spruce Frigid Soils – Ba08	186	0.5
Allegheny Front Sideslope – Ba10	11,413	28
Unclassified	2,349	5.8
Total	40,623	

All LTAs in the Glady watershed fall under the Northern High Allegheny Subsection. Surface erosion is the primary geomorphic process in all LTAs.

The Cheat-Shaver's-Back Allegheny Mountain LTA is described as a dissected plateau with a moist climate, elevations above 4,000 feet, with red spruce possible in higher elevations. Across the entire LTA, (72,586 acres) the annual precipitation is 52 inches, with a mean temperature of 58.4°F April through September and 24.5°F October through March. Pennsylvanian era sandstone and shale, with some coal deposits, underlie the LTA. Vegetation associations found across the LTA include red spruce, red spruce – eastern hemlock, yellow birch, and sugar maple-beech. This LTA is not suited for prescribed burning to manipulate tree species regeneration.

The Cheat Mountain Slopes LTA (7,005 acres across the Forest) is distinguished by its productive mixed mesophytic sites on soil of the Mauch Chunk formation. This LTA includes the steep side slopes of Cheat, Shaver's, and Back Allegheny Mountains with elevations from 3,000-4,000 feet. In the Glady watershed, this LTA is on the side slope of Shaver's Mountain. Across the entire LTA, the annual precipitation is 45 inches, with a mean temperature of 61.5°F April through September and 35.1°F October through March. Red and green shales of the Mississippian age (Mauch Chunk formation) underlie the LTA. Vegetation associations found in the LTA include red oak, red oak – sugar maple, and sugar maple – basswood. This

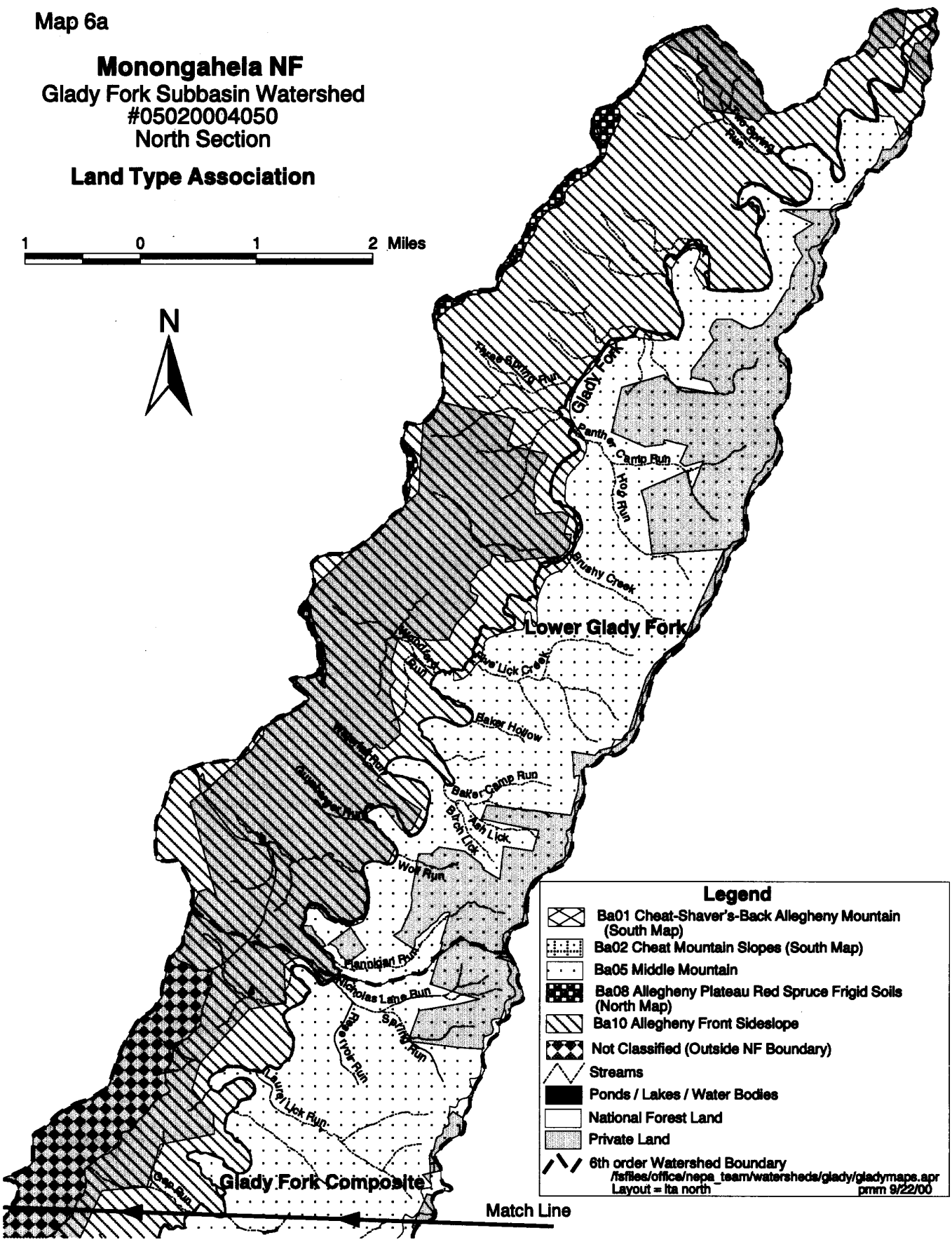
LTA is susceptible to surface erosion if soils are disturbed, but the sites are very productive for vegetation. In general, this LTA has high forest songbird abundance and diversity, high herbaceous diversity, and moderate value for bats.

LTA Ba05 – Middle Mountain System (28,022 acres across the forest) is distinguished by middle elevation (2,500 – 3,500 feet), northern hardwood cover, and soils that retain moisture. Most of this LTA is within the Glady watershed. Across this LTA, the annual precipitation is 45 inches, with mean temperatures of 61.5°F from April through September and 35.1°F from October through March. Devonian sandstones and shales underlie this LTA. Vegetation associations found in the LTA include sugar maple - beech, beech, and sugar maple – basswood. This LTA is a classic northern hardwood forest of sugar maple, beech, and black cherry with some better than average productivity sites. Tree regeneration may be a problem in some areas because of fern expansion following logging.

A small portion of the watershed is classed as Ba08 – Allegheny Plateau Red Spruce, Frigid Soils LTA. In the Glady watershed, this LTA is confined to the northwest edge. This LTA is distinguished by high elevation plateau topography, with red spruce cover, and frigid soils. Across this LTA, the annual precipitation is 52 inches, with mean temperatures of 58.4°F from April through September and 34.4°F from October through March. Pennsylvanian sandstone, siltstone, shale, and conglomerates underlie this LTA. Vegetation associations found in the LTA include red spruce, beech, and yellow birch.

The Allegheny Front Slope LTA (99,623 acres across the Forest) is distinguished by productive sites on sideslopes of plateau blocks with mixed mesophytic vegetation. Across this LTA, the annual precipitation is 52 inches, with mean temperatures of 61.5°F from April through September and 35.1°F from October through March. A variety of rock types underlies the LTA including Mississippian Mauch Chunk and Greenbrier limestone. Vegetation associations found in the LTA include red oak, and red oak – sugar maple, sugar maple – basswood. Some of the best examples of mixed mesophytic forests are found in this LTA.

The unclassified area is adjacent to the Allegheny Front Sideslopes LTA and Cheat-Shaver’s-Back Allegheny Mountain LTA.


Map 6a
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
North Section
Land Type Association
1 0 1 2 Miles
N
Glady Fork
Lower Glady Fork
Glady Fork Composite
Match Line
Legend
Ba01 Cheat-Shaver's-Back Allegheny Mountain (South Map)
Ba02 Cheat Mountain Slopes (South Map)
Ba05 Middle Mountain
Ba08 Allegheny Plateau Red Spruce Frigid Soils (North Map)
Ba10 Allegheny Front Sideslope
Not Classified (Outside NF Boundary)
Streams
Ponds / Lakes / Water Bodies
National Forest Land
Private Land
6th order Watershed Boundary
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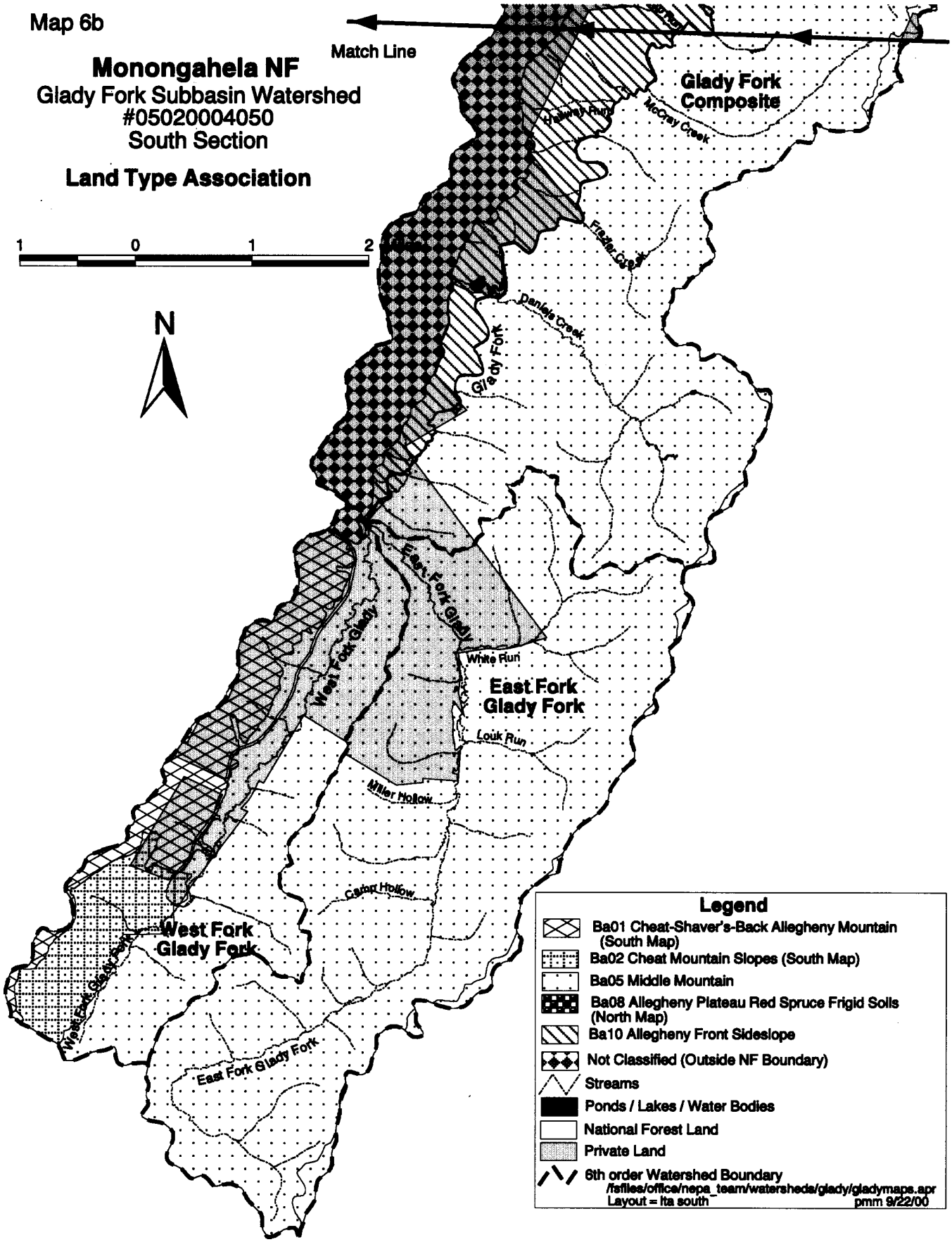
Layout = lta north
pmm 9/22/00


Map 6b
Match Line
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
South Section
Land Type Association
1 0 1 2
N
Glady Fork Composite
McCray Creek
Halfway Run
Frazier Creek
Danley Creek
Glady Fork
East Fork Glady
West Fork Glady
White Run
East Fork Glady Fork
Louk Run
Miller Hollow
Cabin Hollow
West Fork Glady Fork
West Fork Glady Fork
East Fork Glady Fork
Legend
Ba01 Cheat-Shaver's-Back Allegheny Mountain (South Map)
Ba02 Cheat Mountain Slopes (South Map)
Ba05 Middle Mountain
Ba08 Allegheny Plateau Red Spruce Frigid Soils (North Map)
Ba10 Allegheny Front Sideslope
Not Classified (Outside NF Boundary)
Streams
Ponds / Lakes / Water Bodies
National Forest Land
Private Land
6th order Watershed Boundary
/fsfiles/office/nepa_team/watersheds/glady/gladymaps.apr
Layout = lta south
pmm 9/22/00

Ecological Landtypes

To move beyond describing the Monongahela National Forest in terms of just overstory tree species, the forest was mapped using ecological land type associations (ELT). The ELTs incorporate vegetation, degree of slope, soil type, landform, and aspect. This classification system can tell us more about the existing forest, the potential forest and plant communities in an area than forest type alone.

The ELTs were defined for all land within the proclamation boundary, both private and federal ownership. Currently, the ELT coding and mapping is being updated in the GIS database. The ELT codes are being changed to incorporate LTA and other background information. Plant association codes that describe the potential forest based on present over- and understory species are being corrected for the Glady watershed. An analysis of the ELTs and plant associations would be useful in determining rare and sensitive plant and animal habitat.

Disturbance Regimes

As described in previous sections, human use of the land for agriculture and timber harvest has been the major disturbance in the watershed. Based on soil types, elevation, and precipitation small gap formation by the death of a few trees is likely to have been the disturbance regime before human impacts. There are soils with the potential for mass wasting in the watershed and larger openings may have formed on these areas.

With the introduction of the beech scale and the subsequent beech bark disease, a new disturbance has entered the watershed. This disease is killing beech trees in the watershed now. This disease is described in greater detail in the next section.

The role of Native Americans as a disturbance element is unknown in the area. Only four pre-historic sites have been found in the Glady watershed. Turn of the century logging, floods, and lack of surveys may explain why more sites or artifacts have not been found. It is generally understood that the upland forests of West Virginia were used as hunting grounds by Native Americans with larger, more permanent settlements along large river valleys (Lesser, in Stephenson 1993).

The Cheat-Shaver's- Back Allegheny Mountain System and Allegheny Plateau landtype associations are described as unsuited for prescribed burning in the 1998 descriptions. The Allegheny Front Sideslopes landtype association is described as possibly suited for prescribed burning on some sites with careful planning. Landtype associations are large-scale groupings of similar conditions; therefore there may be individual sites at a smaller scale that are suited for prescribed burning in any LTA. Prescribed burning may be an option to herbicides in order to control beech regeneration in some stands. In stands with oaks in the overstory it is likely that oak regeneration will be difficult due to low numbers of advanced regeneration and competing vegetation. Prescribed burning can be used to favor oaks in the understory. This tool should be considered for use in future analyses.

Insects and Diseases

The role of non-native insects, diseases, and invasive plants as disturbance factors has increased in the past century as these have been introduced and their numbers increased. Species known to affect the structure and pattern of vegetation are discussed.

Gypsy Moth The gypsy moth (*Lymantria dispar*) was introduced from France to the United States in 1869. This first defoliation outbreak occurred in 1889 (McManus, Schneeberger, Reardon, and Mason 1989). The insect has steadily moved south and west of the introduction site in New England.

A population crash, caused by the fungus *Entomophagia maimaiga*, has kept the population under control for the past few years. High humidity, frequent rains, and constant temperatures between 14C to 26C are needed for the fungus to germinate and spread (Reardon and Hajeck 1998).

In 2000, southeastern Pocahontas County (adjacent county south of the assessment area) had spots of severe defoliation due to the gypsy moth larva. Here, the conditions for the growth of the fungus apparently came late in the year, large-scale defoliation was visible, and large numbers of egg masses were observed.

Species of oak (especially of the white oak group) are the preferred host for the gypsy moth. Less than 5% of the Glady watershed is in oak forest types. This area is not considered high risk for large-scale defoliation by gypsy moth caterpillars.

Hemlock Wooly Adelgid (*Adelgis tsugae*) This sap sucking insect was introduced from Asia in 1924, and was detected on hemlock in Grant, Pendleton, Hardy and Hampshire Counties in 1992 and in Mineral, Morgan, and Pocahontas Counties in 1993 (Hutchinson 1995). Grant, Pendleton, and Pocahontas Counties border Randolph and Tucker Counties containing the Glady watershed. The insect feeds on twigs causing the foliage to discolor and drop prematurely. Defoliation and death usually occur about 4 years after a tree is infested. Eastern and Carolina hemlocks are highly susceptible and no resistant trees have been located to date. Several common predators (including the Japanese ladybug) of the adelgid have been released and may prove an effective control (Kajawski 1998, Montgomery and Lyon 1996). Severe cold weather also seems to control the hemlock woody adelgid and limit the spread. Researchers have shown that severe cold weather in January 1985 and the winter of 1993-1994 greatly reduced hemlock woody adelgid populations (Souto, Luther, and Chianese 1995).

Less than 1% of the stands in Glady watershed are typed as hemlock, however hemlock is a component of many stands of other forest types and is often in riparian areas. Continued monitoring for the species is needed.

Beech Bark Disease Beech bark disease has the greatest potential to impact the trees and forest structure of the Glady watershed. Beech bark disease is present in the watershed and mortality is occurring. The disease is a complex of interactions between an exotic scale insect, *Crytococcus fagisuga* and native *Nectria* spp. fungi. The scale insect feeds on the phloem of the tree, creating tiny holes in the bark. The feeding sites allow for *Nectria* spp. fungi, not normally fatal to beech trees, to girdle the tree or severely weaken it depending on the level of scale infestation. The scale insect is native to Europe, arrived in Nova Scotia around 1890, and by 1932 trees in Maine were dying from the disease. The scale insect was first noted in West Virginia in 1981 on American beech trees at the Gaudineer Scenic Area in the Monongahela National Forest, however the infestation was estimated to be 20 years old (Mielke and Houston 1983).

Trees of 8 inches dbh and greater are more severely affected than smaller trees. About 30% of infected trees die because of the scale and fungus. Up to 90% of the remaining beech trees are severely injured and do not produce quality wood (Leak and Smith 1995).

Increases in beech mortality are expected in the watershed. Beech readily suckers from roots and stumps and thickets of beech sprouts have been noted in the watershed. American beech is a valuable wildlife food source.

Chestnut Blight (*Cryphonectria parasitica*) This fungus (probably brought to the United States on chestnut trees from Asia) was first reported in the United States in 1904. Within 50 years, the fungus occupied the entire range of American chestnut, its only host, and killed 80% of American chestnut trees (Kuhlman 1978). Nearly all the remaining live trees were infected and dying. Prior to infestation, the American chestnut was a major component of the eastern hardwood forest comprising 25% of all tree species on over 200 million acres from New England to Georgia (MacDonald, Cech, Luchok, and Smith 1978 , Schlarbaum 1989). The species now persists as stump sprouts, reaching about 6-inch dbh and about 30 feet in height before the fungus kills the stem and the stump sprouts. A few resistant trees have been found throughout the range. The Glady watershed is within the historic range of American chestnut.

Noxious Weeds

An older clearing in the watershed, Beulah grazing area, has been maintained by prescribed burning for the past three years. This opening is very patchy with shrub and tree regeneration. St. John's-Wort (*Hypericum* spp.) dominates the forb layer. St. John's-Wort is not a federal or state listed noxious weed, but is undesirable for wildlife food. *Hypericum perforatum,* or common St. John's-Wort, introduced from Europe, is found throughout the state in fields and waste places. Other widespread species of this same genus are found in the state; it is not known which species is in the Beulah opening.

Autumn olive (*Elaeagnus umbellata*) is considered a noxious weed by the state of West Virginia. This shrub has been planted in numerous openings for its berries. There are no plans for eradication at this time, but this species should not be planted in the watershed.

Wildlife Habitat

The majority of the watershed provides forested habitat for wildlife species. As shown in tables 7 and 8 the majority of the forest is 75-89 years old and has mixed hardwood forest type. Since the majority of the forest is still relatively young to middle aged and still maturing, there is little variety in the forest structure. Gaps, other than from timber harvest, are small and not common except for areas of beech bark disease or wind throw, and large standing dead or down trees are not common. There is variety in the vertical structure in many stands as the understory of beech and maple stems develop. Young stands in the watershed are generally in the closed canopy, stem exclusion stage and there is little vertical structural diversity as the stems are generally all the same age and size. These young stands contribute to horizontal, or landscape, diversity across the watershed.

There are openings and apple trees currently maintained by the WV DNR in the watershed. Long-term access to some of these may be a problem if woods roads or old trails are eroding or allowing for illegal access. The need for the open habitat and apple trees may be less important than the need to close old travel ways and reduce sediment delivery to streams. There are options for creating openings on upland sites. Upland openings usually lack a water source and may be less desirable than openings in the riparian area. A sliver of compartment 48, stands 8, 9, and 10 in the watershed is in Forest Service pasture. This area is on the outer boundary of the watershed, with the majority of the open land in the Laurel Fork watershed. About 800 acres of open or brushy land exists in the watershed now, some natural meadows along streams created by beavers and others human made.

Forest Plan standards and guidelines for 6.1 MP areas include a guideline of providing four water sources per square mile if possible. To determine the need for water sources, existing water sources in the GIS layer were mapped with a 1/4-mile radius area surrounding them (see Maps 7 a and 7b). This area covers about

55% (22,394.2 acres) of the total watershed, and about 45% (18,229.2 acres) of the watershed is not within 1/4 mile of a permanent water source within the watershed. Obviously, animals may, and do depending on species, travel beyond the boundaries of this watershed. This map can be used to determine placement and need for water sources in the upland, side slope portion of the watershed.

Terrestrial Species

A variety of habitats supporting terrestrial mammals is present throughout the Glady watershed. Specific mammal sampling has occurred for bat species within the watershed. However, an overall species sampling and analysis has not been conducted within the watershed or adjacent areas so population levels and distribution are unknown. Sampling is a challenge as mammals are generally secretive and difficult to observe. Their populations are dynamic, changing in abundance and distribution as either man or nature alters habitats. Within recent history, there are 67 native mammals known to occur in West Virginia. Four species, the elk, bison, mountain lion and timber wolf, have been extirpated. Others, including the beaver, river otter, fisher, and white-tailed deer were extirpated or on the verge of elimination but have since been reestablished. The coyote, on the other hand, is naturally extending its range into WV.

Based on forest types, soils, geology and LTA designations within the Glady watershed, it is safe to assume that general mammal populations in this area are stable. Many small mammals found throughout Glady watershed are considered habitat generalists with little threat to the species overall viability. Small game harvest information is available from the WV DNR, however, it is difficult to provide small game harvest information usable at the watershed level and the last Small Game Bulletin was published in 1990. The Glady watershed is almost equally split between the WV DNR's Otter Creek and Beaverdam Wildlife Management Areas (WMA). Annual Big Game bulletins published by the WV DNR display deer, turkey and bear harvest information by county and WMA's. This information is more readily available and more suited for population estimates based on harvests within specific areas. Current populations of these species appear to be stable, but are also dependant upon environmental conditions not controlled thru harvest. Population fluctuations are attributed to mast failures and harsh winter weather conditions.

Winter bat surveys have been conducted in many of the state's hibernacula. Overall, populations are stable or increasing for species wintering on the Monongahela. Population declines can be attributed to human disturbance during hibernation, and to a lesser degree, environmental factors (flooding within caves, ceiling collapse, or changes in microclimates due to changes in airflow). Population decreases due to human disturbance are declining as important hibernacula are permanently gated to prevent uncontrolled human entry. Summer bat surveys have also been conducted in and around the Monongahela National Forest since 1998, including areas within the watershed. Information from these surveys has shown that bat species, previously considered rare, are actually more widespread within the forest than originally thought. The surveys have also led to a better understanding of the reproductive timing and activity for different bat species, bat community assemblages and habitat segregation, and identification of critical data gaps and information needs. One need is to determine the relationship between roosting and foraging habitats of bat species. Knowledge gaps are present in precise cave locations, and current and past inventories found within these caves.

No population surveys for amphibians and reptiles were conducted as part of this assessment. Information does exist from surveys related to specific species. The only comprehensive book regarding WV amphibians and reptiles lists 43 different amphibians and 42 reptiles (Green and Pauley 1987).

Although long-term historical data are lacking, salamander populations have declined since European colonization. Deforestation, habitat fragmentation, timber harvesting, urban growth and stream pollution are reasons for this decline. Many salamanders are sensitive to intensive timber practices that greatly modify soil moisture and temperature. Numerous studies document the decline in salamander populations immediately following timber harvesting.

Surveys specifically to identify Cheat Mountain salamander (CMS) presence and population boundaries have been completed across the Forest and including many areas in the Glady watershed. An entire Forest survey has not been completed, due to budget constraints, however this information is critical to meet Recovery Plan objectives for this species. Because the CMS is a habitat specialist, caution must be used when applying specific population locations to other reptile and amphibian species. Cheat Mountain salamanders do not compete well with other more common and widespread species. Their habitats are much more specialized and they are more susceptible to disturbance and less likely to repopulate an area than more common, widespread amphibian species that are habitat generalists.

General invertebrate sampling and analysis have not been conducted within the watershed or adjoining areas so population levels or trends are unknown. The exception to this are limited cave surveys and inventories conducted by the WV DNR. These inventories may be outdated however, and new invertebrate information is needed.

The study of birds in WV extends back into the early 19th century. Birds vary in number and distribution as their habitats change. These changes may occur rather quickly and are often not unnoticed by the hundreds of active birdwatchers in WV today. In 1983, West Virginia Birds: Distribution and Ecology (Hall) brought together all known information on bird distribution on the state.

Several specific bird projects have recently occurred on the Monongahela National Forest. Breeding bird transects have been run throughout the Monongahela and within the Glady watershed. A Forest songbird abundance and viability study was also conducted in the late 1990's. Results of these studies suggest that the Monongahela National Forest is providing abundant habitat for Neotropical migrants and interior species. Forest fragmentation effects are evident only at the local scale, and distinct only within 25 m of edges. With the exception of a few species, bird abundance and species richness in riparian zones investigated were little different from those on upland sites (Demeo 1999).

Recently, Partners in Flight (PIF) has developed priority bird species and habitats for physiographic areas across the U.S. In general, the Monongahela lies in the Mid-Atlantic Ridge and Valley Physiographic area 12, (Rosenberg 2000). The priority bird species and habitats for this region include Bewick's wren, golden-winged warbler, prairie warbler and whippoorwill, that all require early successional shrub habitat. Cerulean warbler, worm-eating warbler, Louisiana waterthrush, and wood thrush all require a more mature deciduous forest habitat. Grassland areas are required for Henslow's sparrow, whereas the Black-throated blue warbler and blackburnian warbler require a northern hardwood/spruce-fir forest. A cursory review of the WV Breeding Bird Atlas (Buckellew and Hall 1994) shows that some of these birds do breed within the Glady watershed.

Recent information is beginning to note that mid-successional stands do not provide optimum conditions for many neotropical migratory birds. Because of past large scale clear-cutting, these stands are not providing the structural diversity to provide optimum nesting and foraging cover. Some experts in the avian research field are recommending forestry practices that restore vegetation structural layers to stands where mid and understory cover is lacking (Hunter undated). The PIF physiographic area summaries identify conservation

recommendations including ensuring adequate tree-species composition and structural diversity where needed.

Fragmentation

Digital orthographic quadrangle (DOQ) photos were examined and open and regenerating areas digitized in ArcInfo for private land in the Glady watershed. Stand data were used to determine cover and age on national forest ownership. Calculations of open, forested, and regenerating land are used to determine existing forest fragmentation in the watershed. The totals are given in Table 11; see also Maps 8a and 8b.

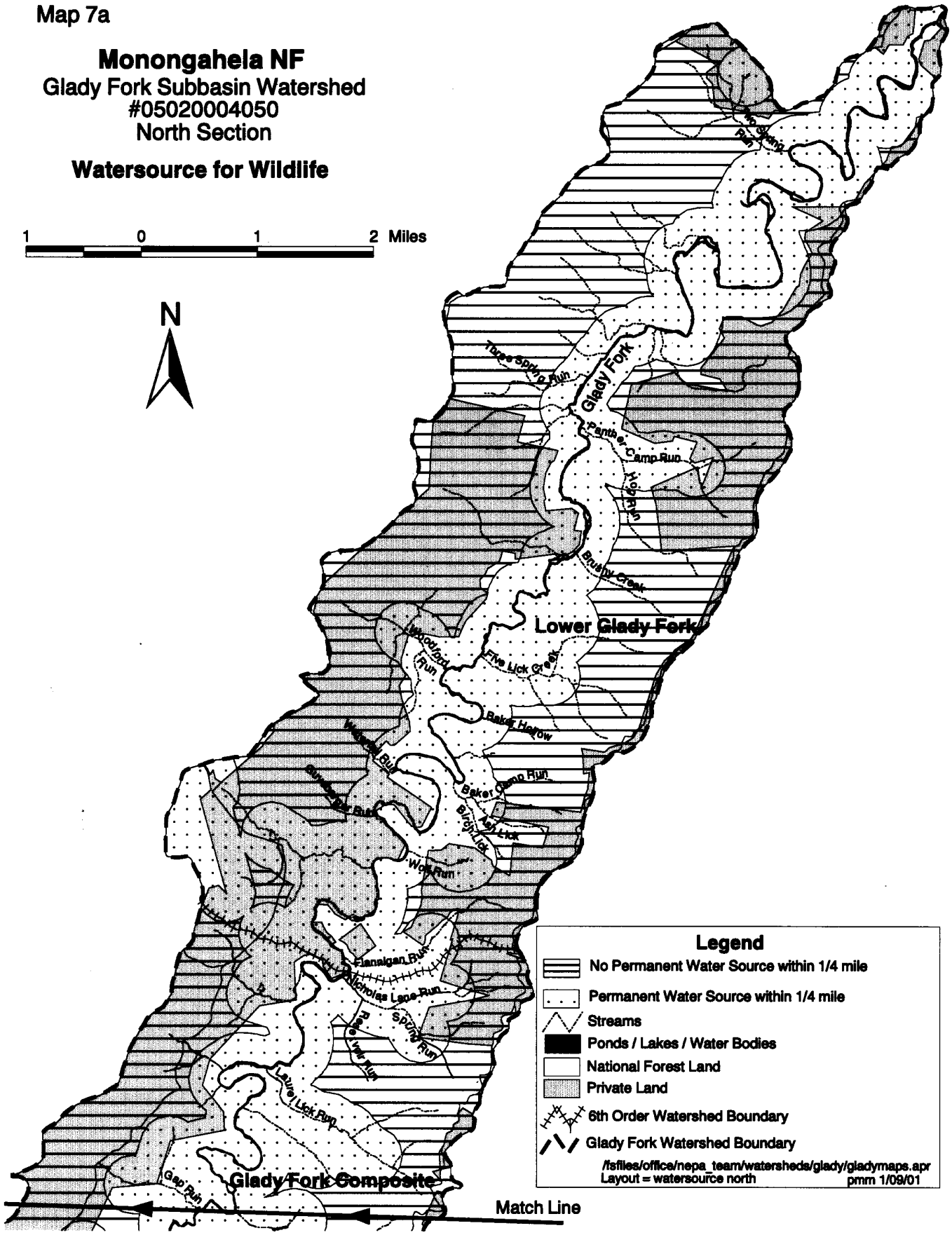
Table 11 – Summary of Open and Forested Land in the Glady watershed

Land Cover Type	Private Ownership	National Forest Ownership	Watershed Total (excluding water)	Percent of Total
Open	2,874.2	805.4	3,679.6	9.1
Forested	10,160.2	25,375.1	35,535.3	87.7
Regenerating forest	268.2	1,023.4	1,291.6	3.2
Total	13,323.8	27,299.4	40,506.5	

The term regenerating forest is given to forest stands known to be less than 25 years old (national forest ownership) and to areas on private land where evidence of timber harvest was apparent. These areas represent a temporary fragmentation of the forest as it re-grows.

The ratio of open land to forested land is more meaningful than percent of the total watershed for either cover type. From this exercise, the fragmentation ratio is estimated as 1:9.6 open to forested land. The ratio for open land plus regenerating land to forest is estimated at 1:7. This means that for every 1 acre of open land there are 7 to 10 acres of forested land.

This watershed is 87.7% forested, with most of the open land in private ownership and mainly in pasture.


Map 7a
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
North Section
Watersource for Wildlife
1 0 1 2 Miles
N
Lower Glady Fork
Glady Fork Composite
Match Line
Legend
No Permanent Water Source within 1/4 mile
Permanent Water Source within 1/4 mile
Streams
Ponds / Lakes / Water Bodies
National Forest Land
Private Land
6th Order Watershed Boundary
Glady Fork Watershed Boundary
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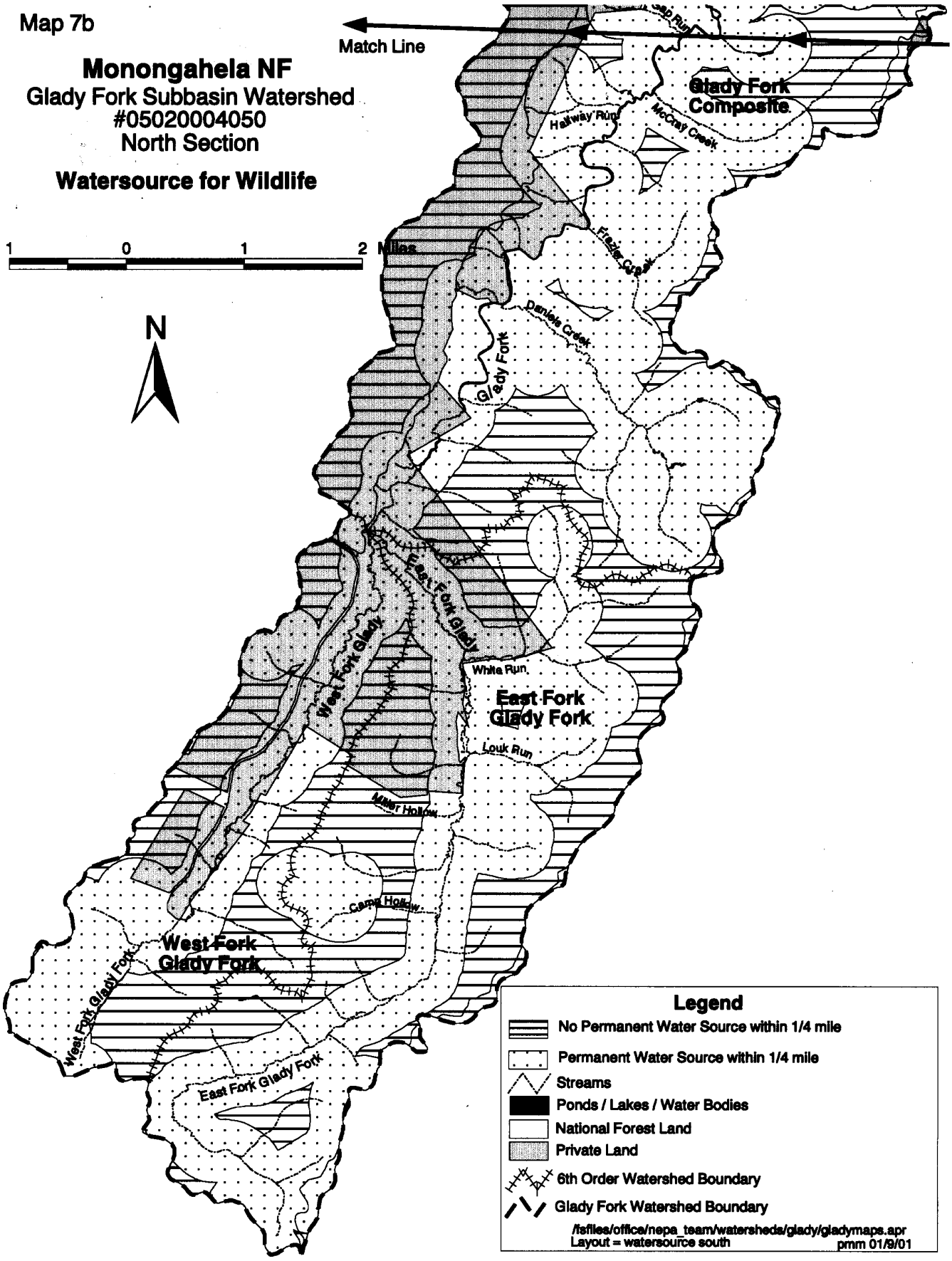
Map 7b
Match Line
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
North Section
Watersource for Wildlife
1 0 1 2 Miles
N
Glady Fork Composite
Hallway Run
McCrary Creek
Frazier Creek
Daniels Creek
Glady Fork
East Fork Glady
West Fork Glady
White Run
East Fork Glady Fork
Louk Run
Miller Hollow
Camp Hollow
West Fork Glady Fork
West Fork Glady Fork
East Fork Glady Fork
Legend
No Permanent Water Source within 1/4 mile
Permanent Water Source within 1/4 mile
Streams
Ponds / Lakes / Water Bodies
National Forest Land
Private Land
6th Order Watershed Boundary
Glady Fork Watershed Boundary
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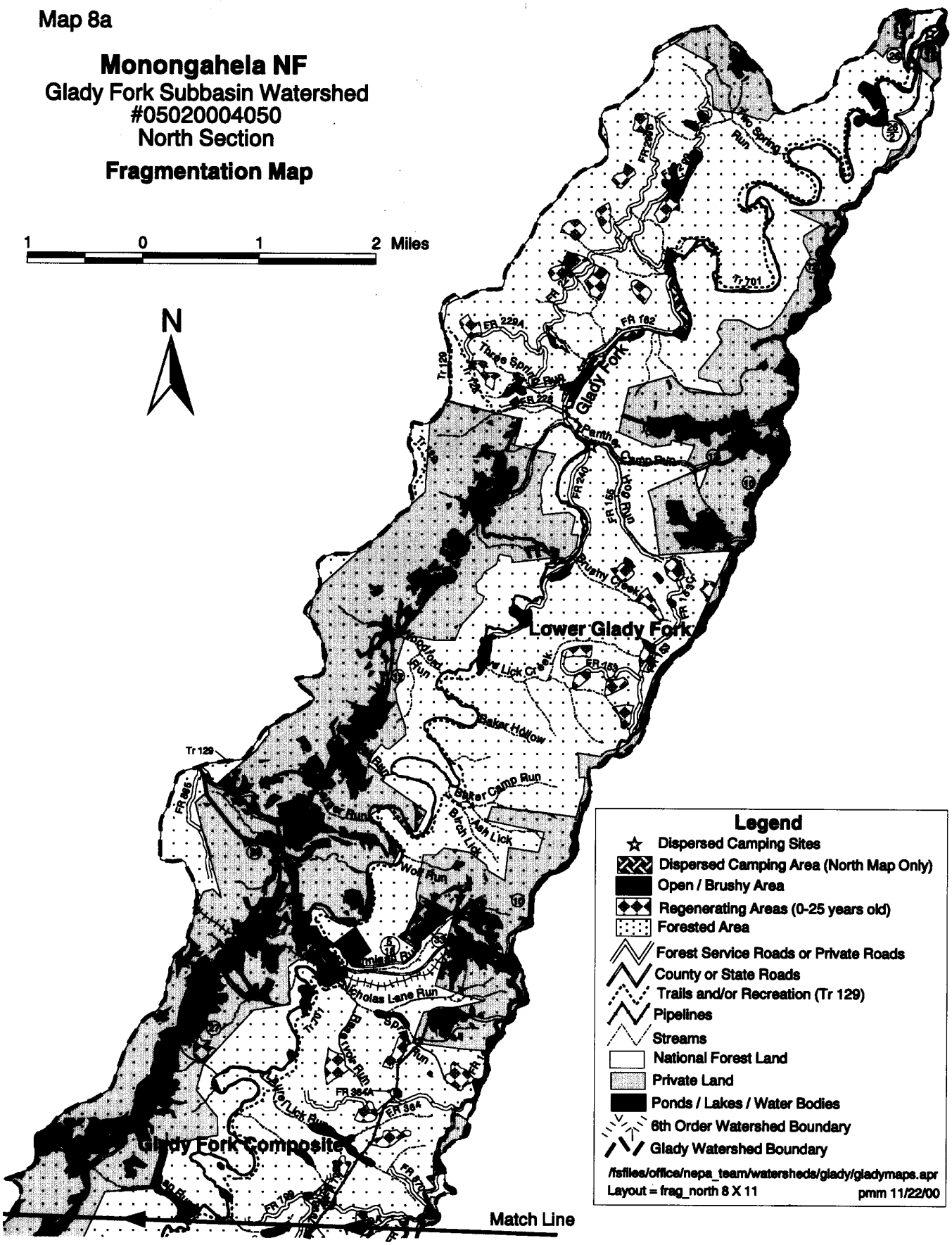
pmm 01/9/01


Map 8a
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
North Section
Fragmentation Map
1 0 1 2 Miles
N
Lower Glady Fork
Glady Fork Composite
Match Line
Glady Fork
Tr 129
Tr 701
FR 229A
FR 182
FR 229
FR 240
FR 189
FR 364
FR 364A
FR 708
Three Spring Run
Thicket Spring Run
Panther Camp Run
Hog Run
Brushy Creek
Lick Creek
Baker Hollow
Baker Camp Run
Birch Lick
Ash Lick
Wolf Run
Nicholas Lane Run
Beech Lick Run
Spring Run
Legend
Dispersed Camping Sites
Dispersed Camping Area (North Map Only)
Open / Brushy Area
Regenerating Areas (0-25 years old)
Forested Area
Forest Service Roads or Private Roads
County or State Roads
Trails and/or Recreation (Tr 129)
Pipelines
Streams
National Forest Land
Private Land
Ponds / Lakes / Water Bodies
6th Order Watershed Boundary
Glady Watershed Boundary
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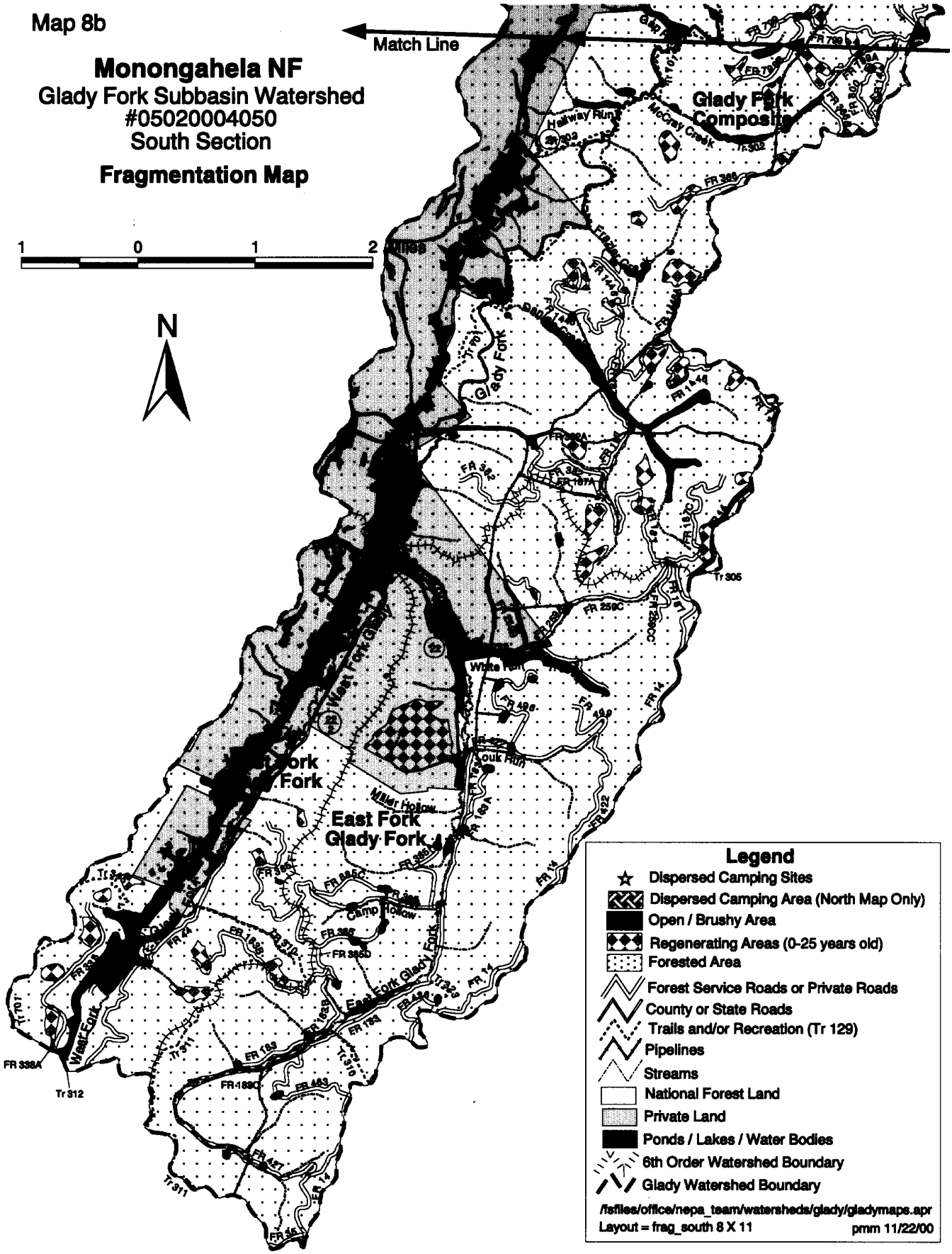
Map 8b
Match Line
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
South Section
Fragmentation Map
1 0 1 2 Miles
N
Glady Fork Composite
East Fork Glady Fork
West Fork
Legend
Dispersed Camping Sites
Dispersed Camping Area (North Map Only)
Open / Brushy Area
Regenerating Areas (0-25 years old)
Forested Area
Forest Service Roads or Private Roads
County or State Roads
Trails and/or Recreation (Tr 129)
Pipelines
Streams
National Forest Land
Private Land
Ponds / Lakes / Water Bodies
6th Order Watershed Boundary
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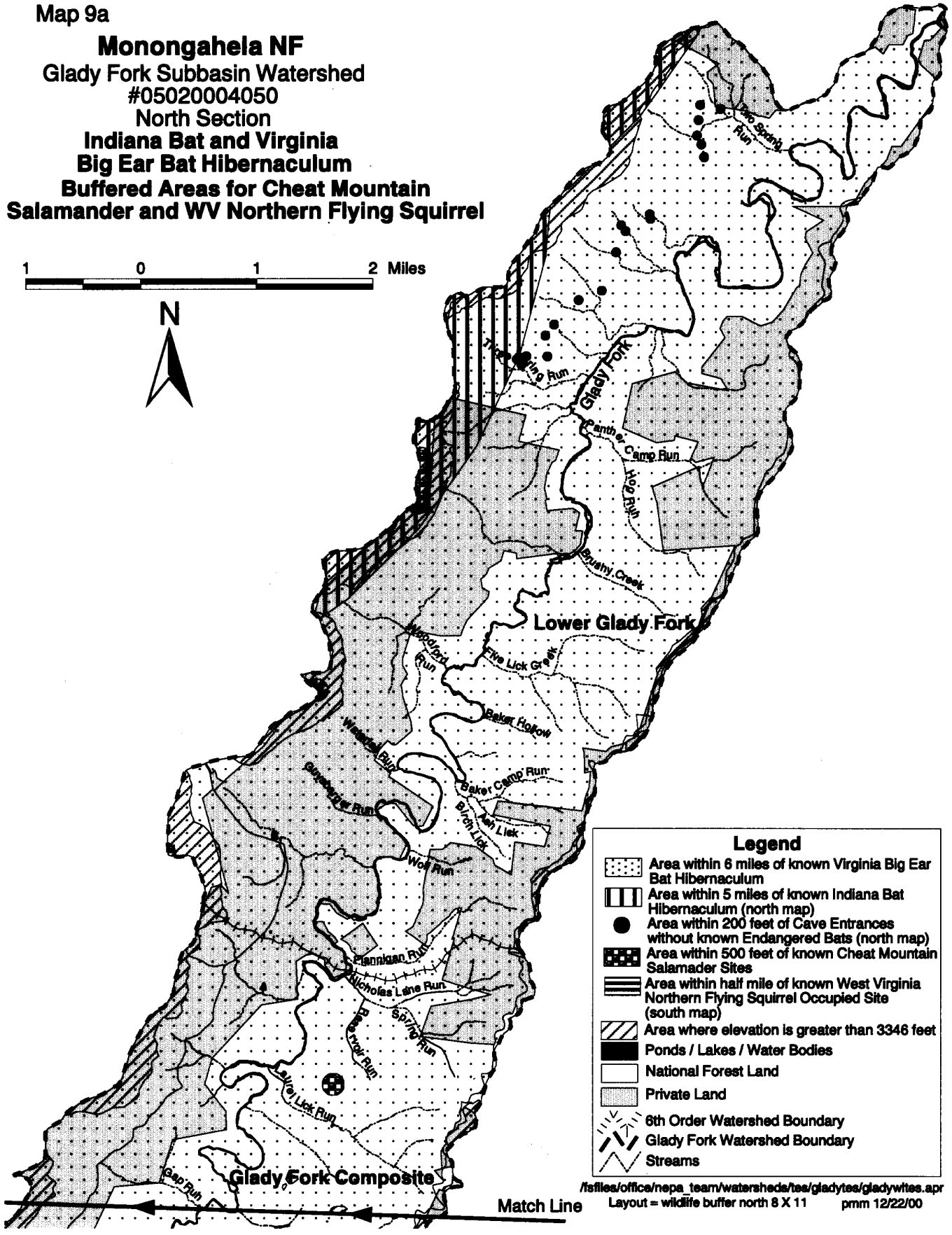
Map 9a
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
North Section
Indiana Bat and Virginia
Big Ear Bat Hibernaculum
Buffered Areas for Cheat Mountain
Salamander and WV Northern Flying Squirrel
1 0 1 2 Miles
N
Glady Fork
Lower Glady Fork
Glady Fork Composite
Match Line
Legend
Area within 6 miles of known Virginia Big Ear Bat Hibernaculum
Area within 5 miles of known Indiana Bat Hibernaculum (north map)
Area within 200 feet of Cave Entrances without known Endangered Bats (north map)
Area within 500 feet of known Cheat Mountain Salamander Sites
Area within half mile of known West Virginia Northern Flying Squirrel Occupied Site (south map)
Area where elevation is greater than 3346 feet
Ponds / Lakes / Water Bodies
National Forest Land
Private Land
6th Order Watershed Boundary
Glady Fork Watershed Boundary
Streams
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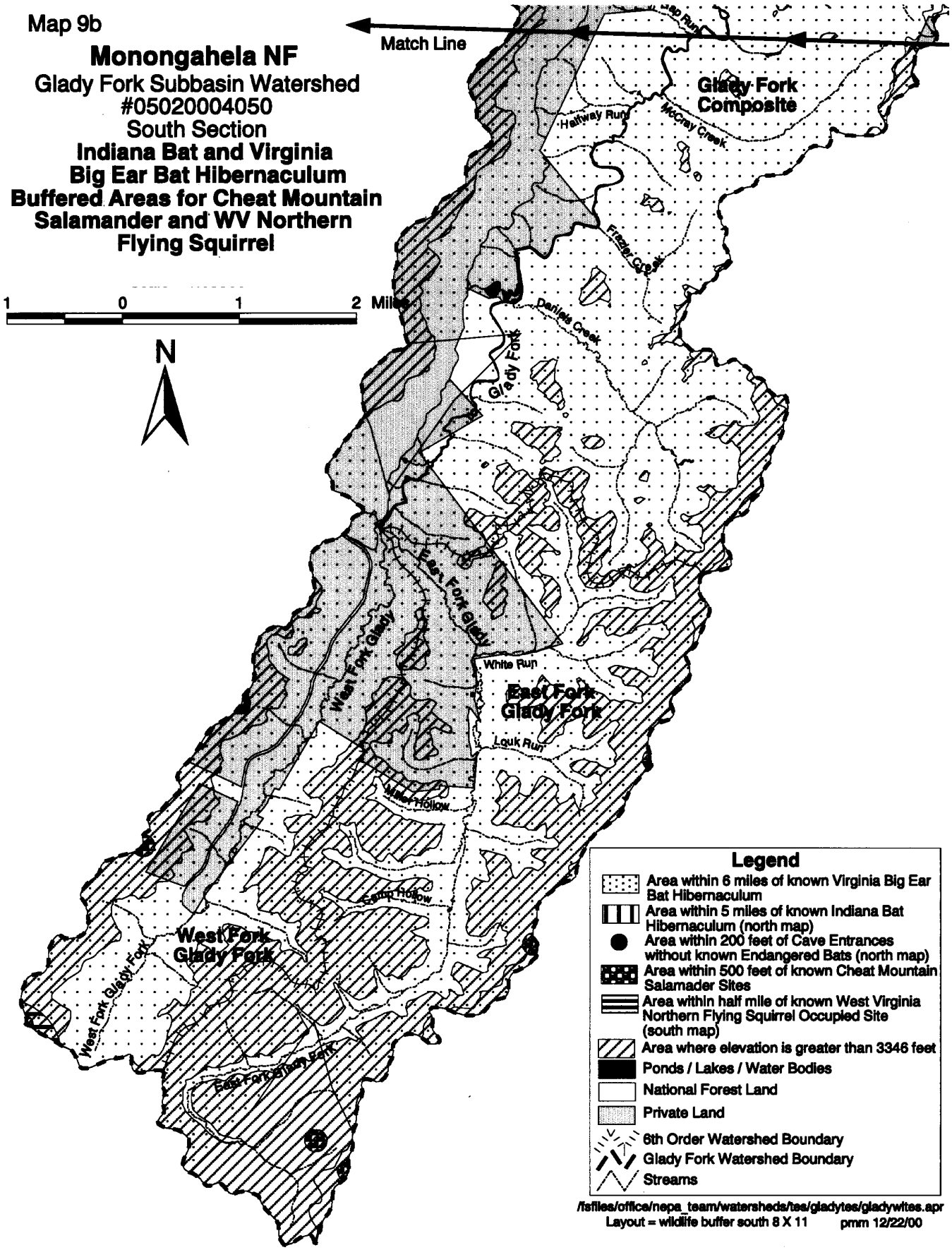
Map 9b
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
South Section
Indiana Bat and Virginia
Big Ear Bat Hibernaculum
Buffered Areas for Cheat Mountain
Salamander and WV Northern
Flying Squirrel
Match Line
1 0 1 2 Miles
N
Glady Fork Composite
Hathway Run
McCray Creek
Freezer Creek
Daniels Creek
Glady Fork
East Fork Glady
West Fork Glady
White Run
East Fork Glady Fork
Louk Run
Miller Hollow
Camp Hollow
West Fork Glady Fork
West Fork Glady Fork
East Fork Glady Fork
Legend
Area within 6 miles of known Virginia Big Ear Bat Hibernaculum
Area within 5 miles of known Indiana Bat Hibernaculum (north map)
Area within 200 feet of Cave Entrances without known Endangered Bats (north map)
Area within 500 feet of known Cheat Mountain Salamader Sites
Area within half mile of known West Virginia Northern Flying Squirrel Occupied Site (south map)
Area where elevation is greater than 3346 feet
Ponds / Lakes / Water Bodies
National Forest Land
Private Land
6th Order Watershed Boundary
Glady Fork Watershed Boundary
Streams
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Management Indicator Species

The Monongahela National Forest Plan lists management indicator species (MIS) that were selected to represent important game, T&E, unique interest, and species to represent other habitats. The objects are to maintain viable population levels (for TES), or to reach desired population objectives for other species (Forest Plan, L-1). Population objectives found in the Forest Plan (L-4), are extremely high. Conversations with WVDNR personnel affirm this. It would be unrealistic to believe that any area could support populations as large as called for in the Forest Plan.

The Virginia big eared bat (VBEB) is known to be present within the watershed. There are also caves within 6 miles of the watershed boundary that contain summer and winter colonies of VBEB. Specific population objectives for this species are to meet recovery plan objectives

Indiana bat – There is no record of summer use by female bats within the watershed. A juvenile male bat was caught in the watershed in August of 1999. There are caves, on both private and Forest Service land within a 5-mile radius of the watershed boundary that serve as hibernacula for Indiana bats. Specific population objectives for this species are to meet recovery plan objectives

Cheat Mountain salamander is known to be present within the watershed. Surveys have been conducted at various locations throughout the watershed. Population objectives for this species are to meet recovery plan standards that include 10 salamanders per acre in occupied range with no loss of isolated populations.

Wild trout have been collected in most of the sub-watershed streams. Population objectives found in the Forest Plan are extremely high, at 250-2,500 trout/acre. Conversations with Mike Shingleton, WVDNR, have confirmed that these population objectives are not realistic, based on available spawning habitat.

Black Bear – Based on harvest information (WVDNR) and sightings by both FS and WVDNR personnel, black bear is present throughout this watershed. Good habitat is provided by vegetative diversity of oak, beech, rhododendron and mountain laurel cover. Estimates of bear populations throughout the state in the early 1970's ranged as low as 500 individuals according the WVDNR and the 1979 bear harvest was just 68. However by 1989, a bear harvest of 510 was reported which exceeded the total estimated population less than 20 years earlier. According to the 1998 Big Game bulletin, WV's bear populations were computed to be approximately 2,900 bears in the mountainous regions and 1,100 in the remaining areas. The Glady watershed lies almost entirely within Randolph County, and is almost equally split between the WV DNR's Otter Creek and Beaverdam Wildlife Management Areas. It is difficult to determine population estimates within the watershed boundary, as bear populations and yearly kills are identified on a county basis. This makes it especially hard to compare existing populations with the population objectives in the Forest Plan as those are based on vegetative types and Forest Plan Management Areas. However, with bear harvests continuing to increase almost yearly, populations appear to be stable or increasing.

Wild Turkey – The Glady watershed encompasses approximately 63 square miles. Forest Plan population objectives for this area suggest 31.7 turkey per square mile is optimal. This objective will be met where turkey populations within the watershed reach approximately 2000 individuals. According to Shawn Head, WVDNR, these numbers are too high and not realistic. Wildlife personnel on the National Forest have conducted habitat improvements and maintenance that benefit wild turkey. Stocking with wild-trapped turkeys has occurred throughout the state with the 1997 estimated total turkey population to be around 140,000. This increase in wild turkey populations has paralleled not only the WV DNR's wild turkey

restoration program, but has correlated with the increased maturity of the state's forests. Wild turkey habitat needs to include a relative mature mast-producing forest and good brood habitat.

White-tailed deer are present within the watershed and are WV's most valuable big game species in terms of recreational and economic importance. Prior to European settlement an estimated 23-40 million whitetails occupied a range similar to that of today. However massive commercial and food exploitation by settlers resulted in the whitetail's near extinction. Harvest regulations, intense management, reintroduction and environmental changes have resulted in an increase in deer numbers. Deer populations are monitored annually through the WV DNR annual harvest reports. Deer harvests continue to increase almost yearly. However, there are natural limits to the number of deer the land can support. When natural limits are exceeded over time, a long-term reduction in the natural limit of deer the land can support occurs. To avoid these problems, the DNR uses the number of bucks killed per square mile in the 2-week bucks only season as an indirect measure of the deer population. Therefore, harvest objectives are based on the number of bucks killed per square mile of deer range (Big game bulletin). Based on buck harvest figures over the past years, it is estimated that the population in this area is approximately 32 deer/square mile. This falls within the population objectives for 6.1 management prescription area of mixed hardwood forest, which would be approximately 50.5 deer per square mile.

Gray squirrel – (population objective of 640 squirrels/square mile) Squirrels are the most popular game animals in WV. Annual harvest may approach 2 million. Annual fluctuations in squirrel populations are normal and occur primarily in response to the abundance of hard mast the preceding year. Predators and sport hunting seem to have little impact on overall squirrel populations, although intensive hunting may reduce squirrel abundance in localized areas. Good habitat is the most important factor in producing abundant squirrel populations. Mature oak-hickory forests provide excellent habitat. Red, black and scarlet oak are more reliable mast producers than white or chestnut oak and these species should be favored if squirrel production is desired.

Existing varying (snowshoe) hare (population objective of 12.9 hares/square mile) habitat is limited to the higher elevations in this watershed. It is not known if snowshoe hare occupy this area in any numbers.

West Virginia Northern flying squirrel is present within ½ mile of the watershed boundary. See the TES section for details of habitat availability and management options.

Mature Habitat

The Forest Plan uses the term old growth in assigning standards for management prescription 6.1 and 3.0 areas. As given in the Forest Plan, five percent of National Forest lands should ultimately be in old growth stands in any area with 6.1 and 3.0 management prescriptions. The Plan further directs that these stands be small, irregularly shaped, and dispersed throughout the opportunity area. Currently, the 6.1 areas in the Glady watershed do not meet old growth conditions. As shown in Figure 1 and Table 7, the oldest age class represented is the 165-179 year old range, with only 6 acres of this age. In some environmental assessments on the forest, 5% of an area was designated as future old growth and removed from the stands considered for timber harvest. In more recent environmental assessments, a pool of potential mature habitat is identified and impacts to this pool by timber harvest and road construction are described as effects to the resource. This pool concept allows for flexibility in determining the best habitat to protect. The pool is generally larger than 5% of the area. Stands were designated as old growth in compartments 41, 42, 43, 36, 37, 38, 39, and 40 on the Greenbrier District. These compartments are in the Daniels Creek (36.102) and McCray Ridge (36.101) opportunity areas. These stands need to be reviewed to see if they are the best

choices for mature habitat/old growth and if the designations should be kept. The stand characteristics are listed in Table 12.

Table 12 – Stands Currently Designated as Old Growth

District	Compartment	Stand	Acres	Year of Origin	Forest Type
3	41	34	27	1922	mixed hardwoods
3	41	35	32	1910	sugar maple-beech-y. birch
3	41	37	11	1910	mixed hardwoods
3	41	64	17	1911	mixed hardwoods
3	41	66	12	1920	birch
3	41	76	8	1897	mixed hardwoods
3	41	78	13	1900	sugar maple-beech-y. birch
3	42	2	6	1906	blk. cherry-w.ash-y.poplar
3	42	4	17	1910	mixed hardwoods
3	42	5	14	1900	mixed hardwoods
3	42	20	10	1920	mixed hardwoods
3	42	23	6	1914	hemlock
3	43	8	14	1920	mixed hardwoods
3	43	9	3	1929	mixed hardwoods
3	43	12	19	1922	mixed hardwoods
3	43	40	16	1918	mixed hardwoods
3	43	51	17	1918	blk. cherry-w.ash-y.poplar
3	43	60	17	1913	mixed hardwoods
3	36	5	38	1911	sugar maple-beech-y. birch
3	36	25	15	1885	sugar maple-beech-y. birch
3	36	35	11	1888	sugar maple-beech-y. birch
3	36	36	6	1888	birch
3	37	11	18	1919	mixed hardwoods
3	37	14	17	1889	mixed hardwoods
3	37	36	12	1914	sugar maple-beech-y. birch
3	38	13	21	1919	mixed hardwoods
3	38	41	39	1924	mixed hardwoods
3	38	42	25	1924	birch
3	39	24	26	1919	sugar maple-beech-y. birch
3	39	50	10	1907	birch
3	40	9	32	1928	mixed hardwoods
3	40	35	45	1910	mixed hardwoods
3	52	16	41	1915	mixed hardwoods
Total			615		

Acres listed in the table above are from the CDS database and may be different from acres calculated from GIS layers.

Threatened and Endangered Species

Threatened and endangered species that are known to occur in this watershed include Indiana and Virginia big-eared bats, Cheat Mountain salamander and running buffalo clover. There is also habitat for the West Virginia Northern flying squirrel and potential habitat for the bald eagle and small whorled pogonia.

West Virginia Northern flying squirrel (VNFS) (*Glaucomys sabrinus fuscus*) **-** The preferred habitat of the VNFS in the southern Appalachians is conifer/northern hardwood ecotones or mosaics consisting of red spruce and fir associated with beech, yellow birch, sugar maple/red maple, hemlock and black cherry (USDI 1990). Until the late 19th century, spruce forests covered more than 200,000 hectares of the state, but these forests were almost completely eliminated by logging from 1880 to 1920 (Millspaugh 1891; Clarkson 1964). Currently spruce forests occupy about 24,000 hectares in the state (Stephenson and Clovis 1983). Recent studies indicate that red spruce has been declining since the 1960's. The exact cause is unknown, although acid deposition is considered as a contributing factor (Stephenson 1993).

Although the vast majority of the watershed consists of mixed hardwood forests (97%), a small spruce component exists at the higher elevations along with a sugar maple/beech/yellow birch/red spruce forest type. Table 9 lists the acres by forest type in each sub-watershed. Suitable VNFS habitat is found on the watershed's southwest side. No specific trapping for squirrels has been accomplished for this assessment; however, efforts should be made where possible to manage this suitable habitat. This is an important objective within the West Virginia Northern flying squirrel recovery plan (USDI 1990). Because little research has been done on the effects of silvicultural management on the VNFS, opportunities exist to study effects of management in this area. However, overall, the Glady watershed does not provide a large quantity of high quality VNFS habitat.

Indiana Bat (IB) (*Myotis sodalis*) - The Indiana bat is distributed throughout the eastern US, from Oklahoma, Iowa, and Wisconsin, east to Vermont and south to northwestern Florida (Romme et al. 1995). In winter, these bats restrict themselves primarily to karst areas of east-central U.S. Hibernacula monitoring shows IB populations are decreasing in portions of their core range (USDI 1996), but not in West Virginia, where estimated populations have been increasing since the early 80's (Endangered Species Federal Assistance Performance Reports, WVDNR 1981-99). Most significant caves are gated or fenced, which has protected IB populations and likely responsible for their increases (Wallace 1999). In the last decade, WV has seen a 45% increase in the number of hibernating IB (Wallace pers. comm. 1999) with the total IB in the state at approximately 10,658 (Stihler and Wallace pers. comm. 1999). This represents 3% of the entire hibernating IB population range-wide. In most years, approximately 26 West Virginia caves provide adequate IB winter hibernacula; five of those caves are on the MNF.

This watershed contains an important limestone formation and cave systems associated with that formation. Indiana bats have been noted to use habitat as far as 5 miles from a hibernacula as swarming areas before returning to the hibernacula for winter. Some males can remain near the hibernacula in the summer (Stihler 1996). Because of this, trees are not to be felled for timber harvesting within 5 miles from hibernacula from April 1 through November 15 (MNF Biological Assessment)**.** Maps 9a and 9b show the area of the watershed within 5 miles of IB hibernacula affected by this restriction.

Table 13 shows the results of winter surveys for IB in West Virginia caves. The Cave Hollow/Arbogast cave is just outside the northern boundary of the Glady watershed and is the only cave listed in the table near the watershed.

Table 13 - Indiana Bat Winter Surveys in the Six Caves with the Highest Populations in West Virginia

Year	Hellhole	Big Springs	Martha's	Cave Hollow Arbogast	Snedegar's	Cornwell
1980			23			
1981						41
1982		150		2		
1983						
1984	210	77	74	3		
1985						
1986	3,330		100			
1987		82	126	24		9 [4]
1988				138		
1989	5,143	77				
1990			130			95
1991	5,470	112		86		
1992			210			90
1993	5,618	176		84		
1994			241		113	115
1995	6,808	254		135		
1996		183	285		120	101
1997	10,437 [1]	200		142		
1998			154 [3]		107	80
1999	8,548[2]	210		124		

[1] WVDNR personnel feel that the number of IB was over-estimated in 1997. Although IB and little brown bats (*Myotis lucifugus*) usually form species-specific clusters, they cluster together in the Bat Room making it easy to over-estimate the number of IB. The count in the Bat Room for 1999 was lower than noted in 1997 survey, but it does not indicate a decline (Stihler and Wallace 1999)

[2] The area known as Tina Hall, a site containing approximately 500 IB in 1997, was not surveyed in 1999 (Stihler and Wallace 1999).

[3] Decline attributed to flooding in the cave.

[4] Not a complete survey

Indiana bats are known to forage and roost in upland areas. As of summer 2000, no confirmed maternity colonies have been found on the MNF; however, potential habitat exists within this project area. Stands of mixed hardwoods greater than 70 years old could provide maternity and foraging habitat.

Data gaps regarding Indiana bats are numerous. Additional monitoring will be identified and required in the USF&WL Biological Opinion for the Monongahela National Forest.

Virginia Big-eared bat (VBEB) (*Corynorhinus townsendii*) - The Virginia Big-eared bat is a geographically isolated and sporadically distributed cave obligate species. While it is known from karst areas in eastern Kentucky, eastern West Virginia, extreme western Virginia, and western North Carolina (Clark and Lee 1987), West Virginia holds its largest populations, particularly Pendleton County (Barbour and Davis 1969, Stihler pers. comm. 2000). West Virginia's Cave Mountain Cave, Hellhole, Hoffman School Cave, Sinnit Cave, and Cave Hollow/Arbogast Cave are designated as "Critical Habitat" for this species based on the precise physical structure, temperature, and humidity conditions required for its continued survival, as well as the significant number of VBEB that occur there. Cave Mountain and Cave Hollow/Arbogast are on the MNF just outside the Glady watershed boundary.

Table 14a - Results of WVDNR VBEB Summer Census in West Virginia

Year	Cave Hollow/ Arbogast	Cave Mountain	Cliff	Hoffman School	Lambert	Mill Run
	Forest Service, critical habitat, gated	Forest Service, critical habitat, gated	Private, outside Proc. Bound, signed	Private, outside Proc. Bound, gated	Private, within Proc. Bound, gated	Private, within Proc. Bound, signed
1983	650	808	-	755		
1984	800	728	-	755	209	
1985	739	812	-	771	230	
1986	1,080	703	-	739	277	
1987	1,015	861	-	780	96	
1988	1,137	773	-	930	58	
1989	286	931	-	753	49	
1990	325	881	-	711	65	
1991	420	826	-	777	116	
1992	423	805	1,350	906	112	
1993	454	762	1,292	942	134	114
1994	491	796	1,350	857	132	153
1995	559	742	1,350	849	122	204
1996	513	768	1,243	980	126	167
1997	454	736	1,004	970	123	231
1998	538	637	1,179	828	131	293
1999	620	568	1,250	850	106	335

Table 14b - Results of WVDNR VBEB Summer Census in West Virginia

Year	Minor Rexrode	Mystic	Peacock	Schoolhouse	Sinnitt/Thorne	Total
	Private, outside Proc. Bound, gated	Private, within Proc. Bound, signed	Forest Service	Private, within Proc. Bound, gated	Private, outside Proc. Bound, gated	
1983	95	254	160	338	153	3,213
1984	171	250	183	378	216	2,890
1985	147	209	207	368	238	3,721
1986	161	239	239	547	338	4,323
1987	206	267	254	548	426	4,453
1988	151	283	326	515	454	4,627
1989	132	274	396	537	560	3,918
1990	133	287	466	449	538	3,855
1991	287	253	497	719	560	4,455
1992	194	338	573	612	466	5,779
1993	356	357	635	629	168	5,843
1994	504	319	652	673	304	6,231
1995	398	367	730	649	418	6,388
1996	377	377	772	701	344	6,368
1997	412	397	800	815	279	6,221
1998	482	406	862	732	187	6,275
1999	534	488	827	655	183	6,416

Table 15 - Results of WVDNR VBEB winter census in WV (Stihler 1988-1999)

Year	C.Hollow Arbogast	Cave Mountain	Cliff Cave	Minor Rexrode	Peacock	School house	Sinnit Thorne	Hellhole	Harper Trail
1988	163	7							4
1989				225	26	343	47	4,664	
1990		2							1
1991	319	1[1]		293	49	473	21	6,188	
1992		2							1
1993	397		69	197	22	575	2	4,965	
1994		15							1
1995	287	0	284	184	20	393	3	6,378	
1996									0
1997	348[2]	28	143	256	108	1323	17	3,862	
1998									0
1999	296[3]		186	187	16	642	3	9,597	

[1] Surveyed upper and lower section to little brown room
[2] Surveyed only front portion of this cave this season
[3] Did not survey passage parallel to Cave Hollow passage.

Cheat Mountain salamander (CMS) (*Plethodon nettingi*) **-** This species is a relict species of 59 disjunct (Pauley and Pauley 1997) and genetically isolated populations (Kramer et al. 1993). It is geographically restricted to high elevation forests containing a red spruce component (Highton 1971, Pauley and Pauley 1997) and mixed deciduous forests with a *Bizzania*-dominated forest floor (Pauley and Pauley 1997). The highest elevation at which CMS has been recorded is 1482 m (4860 ft), on top of Spruce Knob (Pauley pers. comm 1999). Their range is a 700 square mile area exclusively within West Virginia (Pauley 1991), with 88.2 percent of the known populations located within the MNF. Seventy-five percent of the known populations have less than 10 individuals (Pauley 1991). Historically, the range of CMS was likely more extensive than it is today. In colonial times, the first settlers began converting this habitat to other uses almost immediately in the Virginia territory. As of today, natural events and extensive logging eliminated over 93 percent of the original spruce acreage by 1920 (Clarkson 1964).

New Cheat Mountain salamander population findings and delineations are occurring annually, primarily through efforts by Dr. Tom Pauley, Marshal University. Population boundaries are difficult, time consuming and extremely costly to determine and monitor, however, this must be done to meet Recovery Plan objectives. A more concerted effort must be established on the Forest to meet Recovery Plan objectives.

Running Buffalo clover (RBC) (*Trifolium stoloniferum*) **-** This clover formerly grew over a broad area of West Virginia, Ohio, Kentucky, Indiana, Illinois, Missouri, Kansas, Nebraska, and Arkansas (Cusick 1989). Once widespread and commonly found along streams and bison trails, the species range is now restricted to West Virginia, Kentucky, Indiana and Ohio (Ostlie 1990). The species is considered extirpated from much of its historical range (Ostlie 1990). RBC populations range from 1 to 100,000 individuals. In West Virginia, eighteen wild populations, eleven of which are on the Monongahela National Forest, are monitored annually (Harmon and Mitchell 1999).

Disturbance studies of existing RBC populations are underway on the Fernow Experimental Forest. Results from this study are expected show to what extent RBC can be disturbed and if timing of disturbances prevents population declines.

Specific RBC surveys will be required in the Glady Watershed project areas, prior to any ground disturbing activity.

Bald Eagle *(Haliaeetus leucocephalus)* **-** There are known bald eagle nests within the state of West Virginia and on the Monongahela National Forest. Because the Glady watershed does not contain any large lakes or rivers to provide sufficient long-term foraging opportunities, it does not provide optimum habitat for summer breeding use by bald eagles. Migratory routes, however, traverse areas of the MNF. The higher ridges of this watershed could provide stopping points for eagles as they migrate across this area. Maintaining snags and forested areas along ridge tops would maintain the potential for use as migration stopping points.

Small Whorled Pogonia (SWP) – (*Isotria medeoloides)* is a federally threatened species first found on the Monongahela National Forest in 1997. Although sparse, this member of the orchid family is widely distributed, with a primary range extending from southern Maine and New Hampshire through the Atlantic seaboard states to northern Georgia and southeastern Tennessee. Populations consist of plants that may be in any of four different states: vegetative, with an abortive flower bud, flowering, or dormant (SWP Recovery plan). Because of it's potential dormancy, finding this plant can be extremely challenging. To date, the length of dormancy has not been substantiated. Based upon habitat requirements, this plant could

exist throughout the forest and the Glady watershed, however only 1 population on the White Sulphur district has been found.

Specific small whorled pogonia surveys will be required in the Glady Watershed project areas, prior to any ground disturbance activity.

Sensitive species

Species on the R9 sensitive species list that have confirmed occurrence within the project area include small footed bat (*Myotis leibii*), Cheat minnow (*Rhinichthys bowersi*), Cheat Valley cave isopod (*Caecidotea cannulus*), WV blind cave millipede (*Trichopetalum krekeleri*), white monkshood (*Aconitum reclinatum*), butternut (*Juglans cinerea*), and Jacob's ladder (*Polemonium vanbruntiae*). Other sensitive species that may occur within this watershed include the southern rock vole (*Microtus chrotorrhinus carolinensis*) Allegheny woodrat (*Neotoma magister*), Appalachian water shrew (*Sorex palustris punctulatus*), northern goshawk (*Accipiter gentilis*), loggerhead shrike (*Lanius ludovicianus migrans*), timber rattlesnake (*Crotalus horridus)*, green salamander (*Aenides aeneus*), and hellbender (*Cryptobranchus alleghaniensis*). Goshawk surveys using taped calls were made in this watershed during June/July 2000. No goshawks were observed in response to these calls. Specific sensitive species surveys for species other than the goshawk have not been done within the watershed area.

In the summers of 1997 and 1998, a survey was made of selected stands in the Lower Glady opportunity area for threatened, endangered, and sensitive plant species. Four species were found, white monkshood running buffalo clover, butternut, and Appalachian violet (*Viola appalachiensis*). In the late summer/early fall of 2000, other portions of the watershed were surveyed for threatened, endangered, and sensitive plants. No species meeting these criteria were found, however due to the late start of the survey, the area will be re-surveyed in the spring of 2001 for species that may have been missed because of early flowering.

Aquatic Habitat

The current condition of aquatic habitats is characterized as simplified stream channels due to the loss of large woody debris, and elevated levels of fine sediment related to natural events and human activities on sensitive soils. Stream shading is limited in a number of areas due to agricultural practices and beaver activity. No water temperature data were available for the assessment, but the predominance of non-game fishes in some stream systems are likely a reflection of increased water temperatures due to reduced stream shading.

A number of native fish species, primarily non-game species, inhabit these waters. No fish sampling was conducted specific to this assessment, but a review of existing fish sampling data show the following species have been collected within the assessment area: longnose dace, mottled sculpin, blacknose dace, rainbow trout, bluntnose minnow, river chub, brook trout, rosy face shiner, brown trout, rosy side dace, central stoneroller, hog sucker, Cheat minnow, banded darter, silver shiner, small mouth bass, common shiner, striped shiner, creek chub, white sucker, greenside darter, yellow perch, and green sunfish. The list may or may not reflect the current species composition with the watershed assessment area.

No federally listed threatened or endangered fish species are found with the Glady Fork watershed. Cheat minnow have been collected in the main stem and are listed as a sensitive species by the Forest Service.

Species diversity is generally greatest in the main stem and the lower reaches of the larger tributaries. Communities in smaller, colder headwater streams are typically comprised of 2-4 species, predominantly

native brook trout, mottled sculpin and blacknose dace. Fishing pressure is greatest on the main stem, and the West Virginia Division of Natural Resources (WVDNR) stocks the main stem with catchable trout primarily from Highway 33 downstream several miles.

Fish habitat conditions within the Glady Fork and its tributaries still reflect the impacts associated with logging activities from around the turn of the century and the influence of contemporary land use activities such as roads, gas development, and recreation. Streams in the assessment area generally lack large woody debris (LWD), have limited pool habitat, cover and channel complexity, and high levels of fine sediment.

No habitat surveys were conducted specifically for the watershed assessment. Stream surveys conducted in the early 1990's on a number of the larger tributaries in the Glady Fork watershed were reviewed. We can speculate that conditions have not improved significantly within the past 10 years, especially given the impacts of floods in 1996. The stream surveys generally characterized the tributaries as riffle dominated, with few high quality pools and less than 1 piece of large woody debris per 100 feet of stream. One exception was White's Run, which was characterized as being pool dominated, but pool quality was poor.

Sediment samples were collected on nine tributaries and within the Glady Fork main stem during the watershed assessment (Table 16). Only one sample was taken at each stream and sampling was done only once. Fine sediment, less than 4 mm in size, can impair trout production and aquatic health when it exceeds 20% of potential spawning gravels by weight. Of the 10 samples collected, seven were at or above the 20% fine sediment level. Three Springs Run had the highest level with 48.3%. Five Lick Run had the lowest level of fine sediment with 11.9%.

Table 16 - Levels of Fine Sediment in Potential Spawning Gravels in Selected Streams

	Glady Fork	**Three Springs**	**Panther Camp**	**Five Lick**	**Nichols Lane**	**McCray Run**	**Daniels Creek**	**Louck Run**	**East Fork**	**West Fork**
% Fine Sediment (2000)	19.6%	48.3%	19.2%	11.9%	20.4%	29.9%	38.3%	33.9%	31.9%	21.2%

No temperature data were collected during the assessment, but concerns exist due to reduced riparian vegetation and decreased stream shading associated with agricultural activities, beaver activity and the wide channel width of the main stem. The presence of fish species more tolerant of higher water temperatures also indicates conditions that may limit the recovery of native brook trout and coldwater communities.

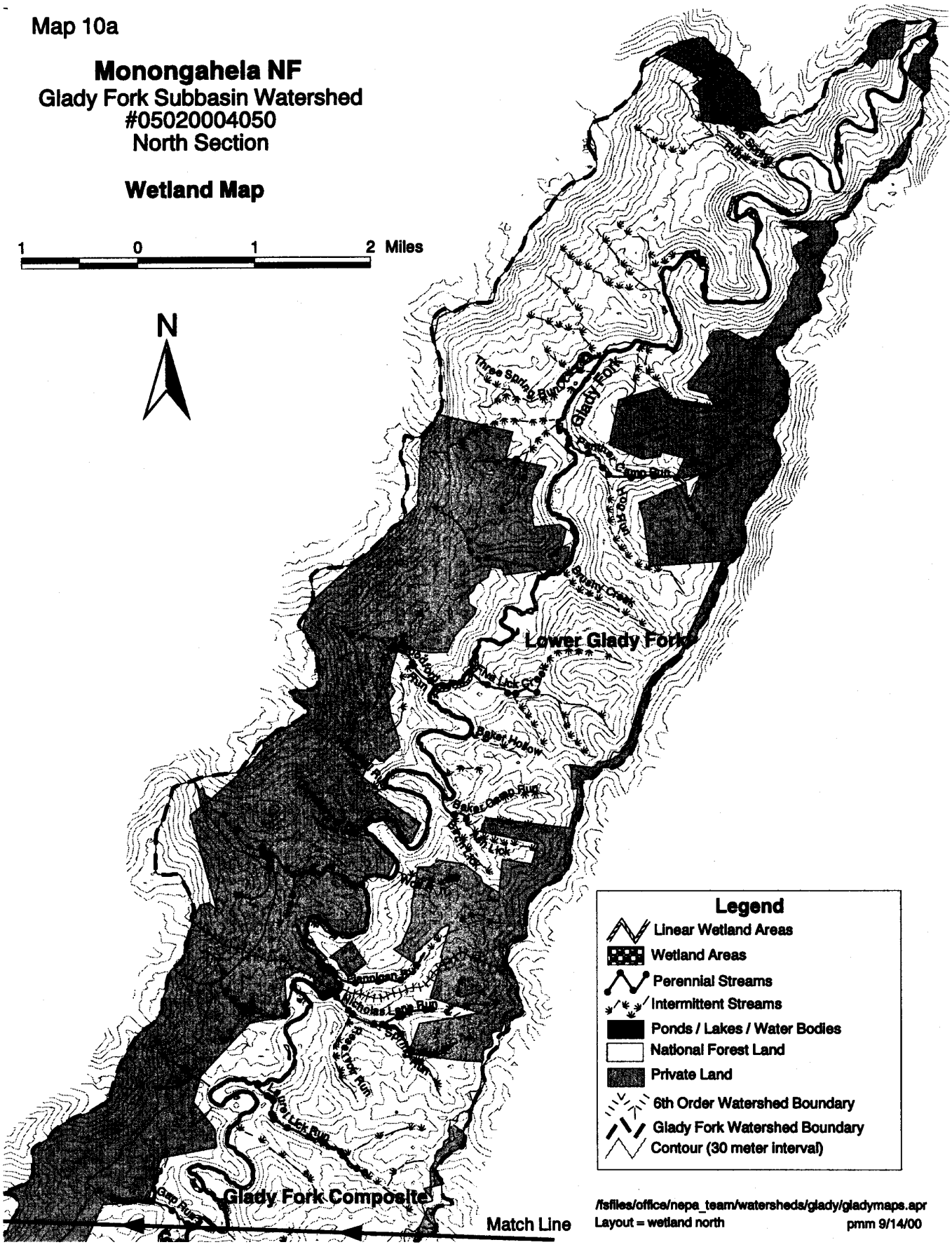
Fish habitat within the Glady Fork watershed assessment area is still greatly influenced by historic impacts associated with agricultural development and logging in the watershed. Simplified channel conditions and elevated levels of fine sediment are a legacy of past land use activities, and contemporary disturbances such as roads, gas development, and agricultural practices exacerbate the problems. Improved aquatic health is largely dependent upon the continued recovery and aging of riparian forests to restore large woody debris that was an important component of these systems. Protecting riparian areas and timber stands along active channels will be an important element in restoring the components for a healthy watershed. Rehabilitation of existing sources of sediment will also help to reduce the amount of fine sediment influencing streams within the assessment area.

No reference, or undisturbed, watershed conditions exist within the Glady Fork drainage with which to compare and contrast the existing conditions. We can speculate that prior to disturbances associated with creating agricultural openings and the logging that occurred around the turn of the century, streams primarily flowed through forested riparian areas. The large woody debris that would fall into the stream

channels from these riparian forests was probably older and larger in diameter than the stands comprising the riparian areas today. Larger trees are generally more stable within stream channels and last longer than smaller diameter trees. With the natural recruitment of LWD, channels were more stable, had greater habitat complexity, pool development and cover. Streams probably had a greater pool to riffle ratio than we observe today. Stream shading was likely greater in the forested riparian areas resulting in cooler water temperatures. Native brook trout were probably in greater abundance and non-game species were likely reduced in range and abundance.

Erosion in an undisturbed watershed would have been less due to the lack of roads and other ground disturbing activities. Fine sediment levels within the stream channels in turn would likely be lower than observed today.

The National Wetland Inventory maps were used to determine areas and amounts of wetlands in the watershed. Wetlands are mainly found along the Glady River and major tributaries. Maps 10a and 10b display wetlands, and perennial and intermittent streams in the watershed.


Map 10a
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
North Section
Wetland Map
1 0 1 2 Miles
N
Three Springs Run
Glady Fork
Cranberry Camp Run
Hoop Run
Bushy Creek
Lower Glady Fork
Baker Hollow
Baker Camp Run
Nicholas Laurel Run
Spruce Run
Bear Den Run
Laurel Lick Run
Gap Run
Glady Fork Composite
Match Line
Legend
Linear Wetland Areas
Wetland Areas
Perennial Streams
Intermittent Streams
Ponds / Lakes / Water Bodies
National Forest Land
Private Land
6th Order Watershed Boundary
Glady Fork Watershed Boundary
Contour (30 meter interval)
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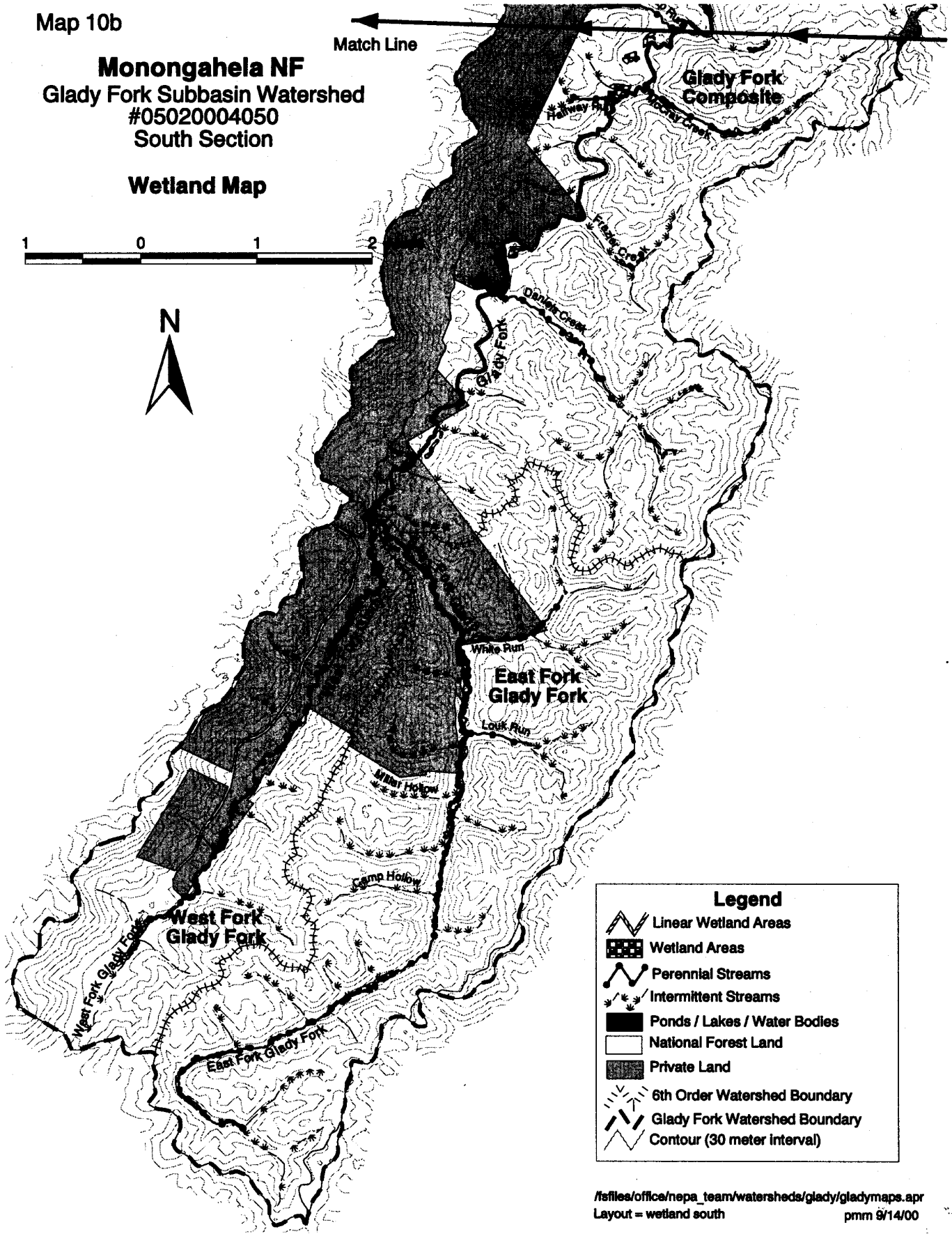
Layout = wetland north
pmm 9/14/00


Map 10b
Match Line
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
South Section
Wetland Map
1 0 1 2
N
Glady Fork Composite
Halfway Run
Frazier Creek
Daniels Creek
Glady Fork
White Run
East Fork Glady Fork
Louk Run
Miller Hollow
Camp Hollow
West Fork Glady Fork
West Fork Glady Fork
East Fork Glady Fork
Legend
Linear Wetland Areas
Wetland Areas
Perennial Streams
Intermittent Streams
Ponds / Lakes / Water Bodies
National Forest Land
Private Land
6th Order Watershed Boundary
Glady Fork Watershed Boundary
Contour (30 meter interval)
/fsfiles/office/nepa_team/watersheds/glady/gladymaps.apr
Layout = wetland south
pmm 9/14/00

Social Environment

Population

Estimates of the human population in the Glady watershed are not available. There are estimates of the population in the entire Cheat watershed from the EPA assessment of the Mid-Atlantic region (Jones et al 1997). The Glady watershed is part of the Cheat watershed. From the 1990 census data, the EPA estimated that 38.85 people per square kilometer resided in the Cheat watershed, an area of about 3,426 km square. This includes the towns of Parsons, Thomas, Davis, Kingwood, and Bruceton Mills.

The assessment also includes an index of human use in the watersheds based on the proportion of the watershed that is urbanized or used for agriculture. The human use index for the entire Cheat watershed is 11.12% with a road density (state, interstate, county, and private) of 0.98 km per square km. Again, these data are for the entire Cheat watershed.

Lower population and road densities are expected in the Glady watershed considering the percentage of National Forest ownership compared to private ownership. Human population and use increases in the Glady watershed from south to north (or downstream) as the amount of private land increases.

The unemployment rate in Randolph County as a whole was 7.5% in 1999. In 1995, 22% of the population in the county had incomes less than the federal poverty level. Per capita income in 1998 was $18,035. The largest industries in Randolph County in 1998 were services, sate and local governments, and durable goods manufacturing. The number of farms increased in the county as a whole from 383 to 396 from 1987-1997, though total farm acres dropped. This countywide information comes from the County Data Profile for Randolph County published by West Virginia University, Bureau of Business and Economic Research (Condon, Childs, and Bogdan 2000).

Heritage Resources

Many Heritage Resource surveys have been made in the Glady Fork Watershed. Between 1984 and 1999, the following surveys displayed in Table 17, were completed on National Forest land in the Glady Fork Watershed.

Table 17 – Previous Heritage Resource Surveys in Glady Watershed

Project Name	Acres
Beulah Sale	424.5
Laurel Lick Timber Sale	434
Nichols Lane Thinning	99
Glady Fork Flood Damage Trail Survey	20
Gene Smith Special Use	1
Lower Glady OA	5,390
Harper Cemetery Sale	200
Berea Oil and Gas Well	5
Monongahela Power Linear RoW, G	1
Monongahela Power Linear RoW, P	1
Kimbleton Road Special Use	1
Glady Septic Tank	1
Kuntzville Timber Sale & Road Construction	876
Berea Gas Well Federal #4	1
Zinn Ridge	642
Little Beech Mountain Timber Sale	956.5
1993 Blowdown Sale	100
Fansler RoW Road	5
Little Beech Mountain Spec. Roads	84
E. Glady Fork Logging Demonstration Area	25
Columbia Gas Wells	5
Camp Hollow	1
Cities Service Gas Well & Road	4
Daniels Creek #1 Timber Sale	420
Daniels Creek Addition	22
Daniels Creek #2 Timber Sale	374
Small Sales FY 91	9
McCray Small Sales 2	40
Laurel Creek Lane Timber Sale	41
Small Sales	45
Beulah Sale Add On	35
Total	10,264

An additional 6,495 acres were surveyed by Forest staff in FY 2000, for a grand total of 16,759 acres surveyed. The survey findings are documented in heritage resource reports numbers 09-21-01-178 and 09-21-03-164. This leaves 10,537, about 40%, needing to be surveyed.

As can be seen from the above list, most of the Heritage Resource surveys were project driven with work related to timber sales, trails, gas developments, and rights of ways (RoW), and many were small in area. Two thirds of the surveys covered less than 100 acres.

Heritage surveys through 2000 located 69 historic sites and 4 prehistoric sites in the Glady watershed. Of the 73 sites, 46 are previously known sites and 27 were newly recorded in 2000. The Heritage Resources Report for this watershed includes one monitored site outside the watershed boundary. The historic sites are identified in the following table.

Table 18 – Known Heritage Resource Sites

Site Type	Number
Homestead/unidentifiable structure	21
Lumber camps	17
Railroad grades	13
Culverts	6
Prehistoric sites	4
Lumber mills	2
Towns	2
Incline	1
Stone quarry	1
Tunnel	1
Cemetery	1
Reservoir	1
School	1
Church	1
CCC camp	1

Except for the railroad grades and culverts, all other resources are ruins. Evaluations for eligibility to the National Register of Historic Places were conducted on 14 of the 54 known sites, and one site was determined eligible. The eligible site is a portion of the former Western Maryland Railroad grade that extended from Durbin to Elkins. The 40 remaining historic and prehistoric sites have not been evaluated.

The extreme southern portion of the watershed, south of FR422, north of the county line, encompassing the headwaters of both branches of the Glady Fork was surveyed in 2000. Our methods were the same as those used to complete other surveys with one exception. The land was identified as high, medium, or low probability for heritage resources. High probability lands were shovel tested, and medium probability areas were examined visually. Much of the area with a high probability for heritage resources is along the two forks of Glady Fork. This area was not surveyed, because it is in a riparian area protected from project impacts (i.e., not likely to have road or timber harvest in the area). Previously known sites in this riparian area were monitored.

There remains 10,535 acres that have not been surveyed for heritage resources. Of these, 354 acres are riparian areas, and have a high probability for heritage resources. This work cannot be completed in FY 2000, and it will take a substantial commitment to complete it in FY 2001.

Previous surveys included riparian areas and many sites were found in this area. For example, the Lower Glady OA survey covered about 4,000 acres in the watershed and 16 sites in the watershed were recorded or monitored. Ten of these, or 62%, are in the riparian area (Map 23). Had the riparian areas been included in this project, we conservatively estimate 20 additional new sites would have been recorded.

Of the 73 sites recorded, 55 remain unevaluated, 5 were determined eligible, and 13 are not eligible for listing on the National Register. Flooding and wildlife opening construction have destroyed most of the 13 sites found not eligible. The eligible sites include 3 culverts, one railroad grade, and one railroad tunnel.

This survey was designed to provide information for planning future Forest projects in non-riparian areas of the watershed. By excluding the riparian area, we did not assess areas of high probability for heritage resources. Consequently, we did not locate all sites in the watershed. The riparian area of the Glady Fork watershed should be surveyed for heritage resources in the future. Future Forest projects should be designed to avoid eligible or unevaluated sites or these sites will be evaluated before any possible impacts.

The difficulty in preserving, protecting, or avoiding sites may occur when roads with CCC era culverts are upgraded or obliterated. Special design standards and protection will be needed if road work occurs near these culverts. All sites should be accurately depicted on the appropriate GIS layer so that these sites can be avoided and protected.

Research Study

Stand 4, compartment 44 on the Cheat District is the site of a 10 year research study of oak regeneration. Exclosures are in place to keep deer from browsing regeneration. In 1999, plots were treated by herbicide (glyphosate) application to the mid story and control plots were left untreated. Target stems for treatment include beech, sugar maple, striped maple, red maple, birch, magnolia, yellow poplar, serviceberry, black gum, white ash, and witch hazel. No oak, cherry or hickory stems were treated with herbicide. The study hopes to show conditions best for regenerating oak species, focusing on light conditions, vegetation dynamics, soil moisture, and soil nutrient status. The Oak Research Study Environmental Assessment was prepared for the study and signed in May of 1999. A shelterwood harvest is possible in 2008 for the study area.

Roads

The Glady watershed is crossed by forest service system roads, roads on private land, old railroad grades or logging roads (called woods roads), state roads, and county roads. Road conditions range from two lane, paved highways to single lane, dirt surface. Table 19 below shows the summary of roads miles by type for the watershed; see also Maps 11a and 11b.

Table 19 – Total Road Miles in the Glady Watershed

Road Type	Miles
Forest Service System – collector	12.0
Forest Service system – local	68.5
Private	8.2
Woods roads	29.9
State/County	39.5
Total	158.1

Forest System Roads

Using information gathered for the determination of maintenance needs across the forest, Table 20 shows the needed work for each system road in the watershed. Some system roads were not surveyed for maintenance needs but were added to the road density calculations. A few of these are segments of a road that cross watershed boundaries. Some older roads are no longer in use, but are still considered system roads since no obliteration or other permanent closure has been done. FR 870 and FR 240 fit in this category. FR 870 begins on private land and is used by the WVDNR to maintain an opening. FR 240 is located on an old railroad grade up the Glady Fork River to the Five Lick area. This road is used to stock the Glady Fork, but only a short section is driven. The road is passable to Brushy Creek.

FR14 is also county road 10. Usually, county and state roads are not included in the road density calculations. However, in this case, the Forest service does maintain this road in cooperation with the county, and it will be added to the road density calculations.

Mileage listed in tables 20 and 21 is derived from GIS. Roads do cross in and out of the watershed boundary, and only short segments of a longer road may be counted in this report.

Table 20 – Road Maintenance Needs

Road Number and Name	Maintenance Level	Miles in Glady Watershed	Notes
14 Middle Mtn.	4	9.29	Outlet pads need to be added, new pipes needed to decrease distance between pipes
44 Durbin-Glady	4	2.66	Outlet pads need to be added to all pipes, new pipes needed to decrease distance between pipes
183 East Fork Glady	3	3.9	Need 102 new pipes with outlet pads; replace 24 existing pipes and add 24 outlet pads; 8 existing pipes need outlet pads
183A East Fork Glady	3	0.66	13 new pipes with outlet pads needed; replace 7 existing pipes and add 7 outlet pads; cleat the pocket of 1 existing pipe and add outlet pad
183B East Fork Glady	3	2.84	Need 33 new pipes with outlet pads: replace 13 existing pipes and add 13 outlet pads; clean pocket of 3 existing pipes and add outlet pads
183C East Fork Glady	3	0.45	Replace 2 existing pipes and add 2 outlet pads; add 9 new pipes with outlet pads
385 Camp Hollow	3	2.79	Add 3,675 tons of stone surfacing; add 61 new pipes with outlet pads; replace 14 existing pipes and add 14 outlet pads; add outlet pads to 5 existing pipes
385A Camp Hollow	3	0.79	Add 970 tons stone surfacing; add 10 new pipes with outlet pads; replace 4 existing pipes and add outlet pads; add outlet pads to 5 existing pipes; clean 3 pockets of existing pipes
385B Camp Hollow	3	0.12	Add 2 new pipes with outlet pads
385C Camp Hollow	3	0.70	Add 890 tons of stone surfacing; add 12 new pipes with outlet pads; replace 1 existing pipe and add outlet pad
385D Camp Hollow	3	0.23	Add 4 new pipes with outlet pads; replace 1 existing pipe and add outlet pad; clean pockets and add outlet pads to 3 existing pipes
385F Camp Hollow	1	1.49	No survey
427 Little Beech Mtn.	3	0.98	Add 11 new pipes with outlet pads; replace 6 existing pipes and add outlet pads; clean pockets of 4 existing pipes and add outlet pads
422	3	2.43	No survey
496 Louk Run	3	1.38	Add 1,803 tons of stone surfacing; add 29 new pipes with outlet pads; replace 7 existing pipes and add outlet pads; clean pockets of 8 existing pipes and add 11 outlet pads to existing pipes
259 White Run	3	0.74	No survey; entire road on private land

Table 20 – Road Maintenance Needs, continued

259A White Run	3	0.47	No survey
259B White Run	3	1.12	No survey
259C White Run	2 or 3	1.05	New road built by gas company. Need 1500 tons surface stone; 14 new pipes with outlet pads; 9 outlet pads on existing pipes; at mile point 1.034 replace 4 – 24" pipes with bridge or other drainage structure
259CC White Run	1	0.67	This was FR 259C. Road built to access gas well. Rework dips and add outlet pads; add 8 new dips and pads; add 9 new pipes with pads; add 1 large pipe or drainage structure; install new lead off ditch.
259D White Run	3	0.85	No survey
423	4	0.04	No survey
187 Daniel's Run	3	3.27	Add 4,190 tons of stone surfacing; add 54 new pipes with outlet pads; clean pockets of 24 existing pipe and add outlet pads.
187A Daniel's Run	3	0.11	Add 3 new pipes with outlet pads
187B Daniel's Run	3	0.44	Clean pockets and add outlet pads to 5 existing pipes; add 9 new pipes with outlet pads; replace 1 existing pipe and add outlet pad.
1446 Zinn Ridge	3	3.8	Add 79 new pipes with outlet pads; replace 8 existing pipes and add 8 outlet pads; clean pockets and add outlet pads to 4 existing pipes
1446A Zinn Ridge	3	0.64	Add 11 new pipes with outlet pads; replace 1 existing pipe and add outlet pad; clean pockets and add outlet pads to 5 existing pipes
1446C Zinn Ridge	1	0.75	No survey
382 Daniels Run	3	2.03	Add 1,013 tons of stone surfacing; add 10 new pipes with outlet pads; clean pockets and add outlet pads to 2 existing pipes; replace 2 existing pipes and add outlet pads.
382A Daniels Run	3	0.25	Add 5 new pipes with outlet pads; clean pocket, flush pipe barrel, and add outlet pad to 1 existing pipe; replace 1 existing pipe and add outlet pad.
799 McCray Ridge	3	1.71	Add 17 new pipes with outlet pads; replace 3 existing pipes and add outlet pads; clean pipe pockets and add outlet pads for 5 existing pipes.
799A McCray Ridge	2	0.82	Redo 12 dips and add flumes; add 5 new pipes with outlet pads
799B McCray Ridge	2	1.01	Redo 14 dips and add flumes; add 3 pipes with outlet pads; clean 2 existing pipe pockets and add outlet pads
799C McCray Ridge	2	0.23	No survey
800	1	0.46	No survey

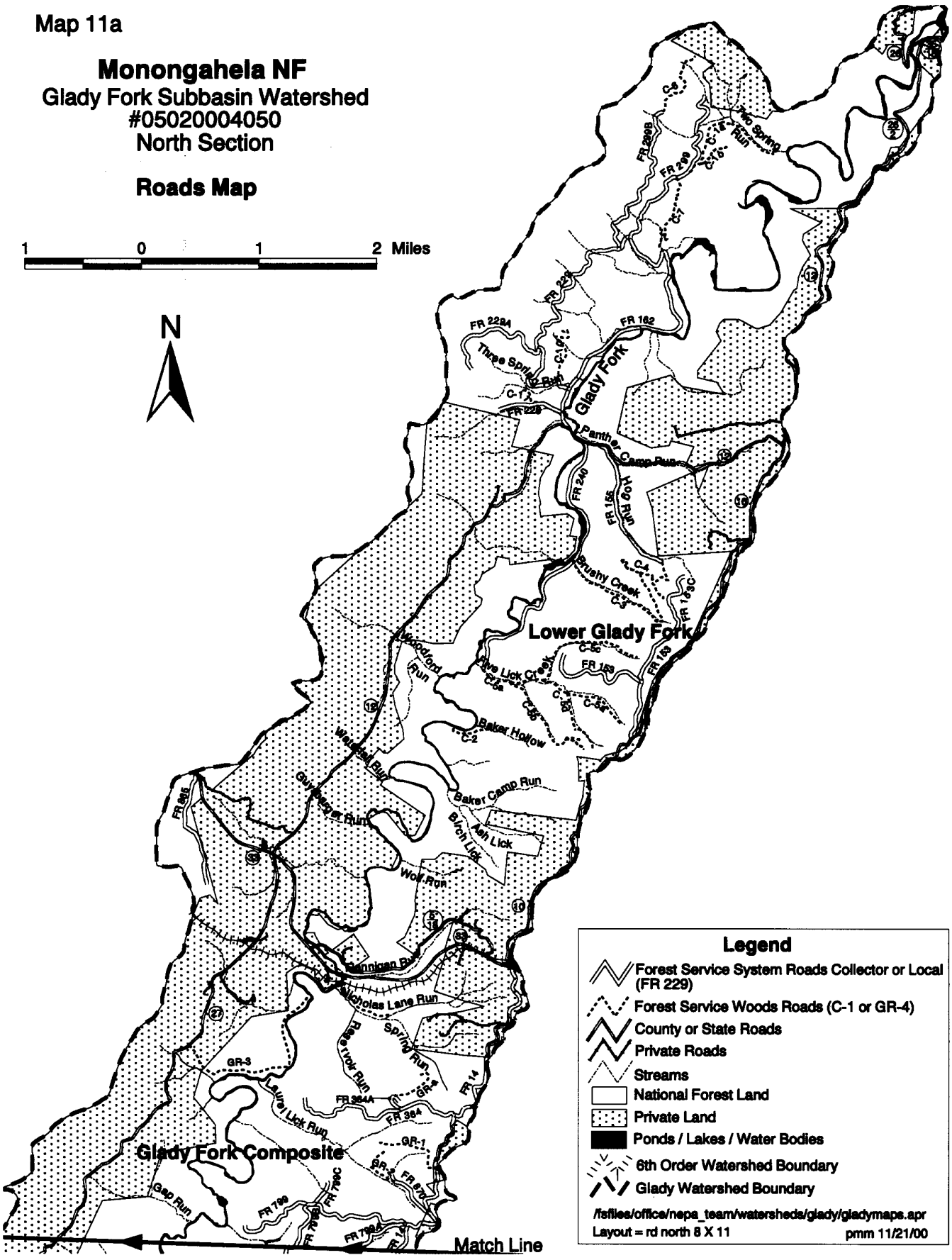
Table 20 – Road Maintenance Needs, continued

865	1	1.04	No survey
364 Spring Run	3	1.59	Add 1,555 tons stone on road surface; clean pockets of 6 existing pipes and add outlet pads; add 9 new pipes and outlet pads; redo 2 dips and add stone; replace 3 existing pipes and add outlet pads.
364ASpring Run	3	0.23	Add 6 new pipes with outlet pads; replace 1 existing pipe and add outlet ditch and pad.
489	2	0.08	No survey
499	3	0.72	Add one 24” pipe with outlet pad at mile 0.131; add one 36” pipe with outlet pad at mile 0.072; add1 new dip with flume; redo 16 existing dips and add flumes.
153		1.27	Redo 24 existing dips and add flumes; add outlet pads to 2 existing pipes and repair and flush.
153A		1.0	Redo 21 dips and add flumes; clean pocket and add pad to one existing pipe; add 1 new dip; add 2 new pipes with outlet pads.
153C		0.40	Redo 5 dips and add flumes; add outlet pad to 1 existing pipe
162	4 to gate, 0.6 miles level 2 to FR229	2.77	Add 23 new pipes with outlet pads; replace 18 existing pipes and add outlet pads; add outlet pads to 5 existing pipes.
228	2	0.59	No survey
229	3 (to game Plot), 2 (to end, no survey)	4.27	Add 4,377 tons of stone surfacing; add 20 new pipes with outlet pads; replace 3 existing pipes and add outlet pads; clean 56 pockets and add 70 outlet pads to existing pipes.
229A	0.73 miles level 3 0.32 miles level 2	1.10	No survey
229B	3	1.52	Add 4 new pipes with outlet pads; clean 6 pockets and add 8 outlet pads to 8 existing pipes.
155	2	1.24	No survey
1447		0.02	short segment of road in this watershed, needs addressed elsewhere
187C		1.46	No survey
240		2.61	Drivable to Brushy Run, used by DNR, also is TR701
338		1.66	No survey
338A		0.05	Short segment of road in this watershed, needs addressed elsewhere
35		0.34	Short segment of road in this watershed, needs addressed elsewhere
366		1.06	No survey
366B		0.38	No survey
426		0.51	No survey

Table 20 – Road Maintenance Needs, continued

463		1.36	No survey
491		1.13	No survey
870		0.49	Short segment of road in this watershed, needs addressed elsewhere
91		0.01	Short segment of road in this watershed, needs addressed elsewhere

The density of the road system was figured in two ways for both local and collector roads. Woods roads were not included in these calculations. The density, expressed as miles of forest service system road per square mile of watershed area in national forest ownership, is given by opportunity area and by sub-watershed. The Forest Plan outlines a guideline for road density by management prescription, and opportunity areas are not delineated on watershed boundaries. The density of roads in a sub-watershed may be more useful for determining cumulative impacts of a project in a sub-watershed. Road densities were calculated using only the national forest acres and road lengths in the Glady watershed. The Glady watershed includes small portions of some opportunity areas with only small segments of roads falling in the watershed. Densities for these minor opportunity areas are not given, only miles of road by class are a listed. The amount of acres from each opportunity area found in the Glady watershed is listed in Table 1.


Map 11a
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
North Section
Roads Map
1 0 1 2 Miles
N
Lower Glady Fork
Glady Fork Composite
Glady Fork
Three Spring Run
Panther Camp Run
Hoo Run
Brushy Creek
Five Lick Creek
Baker Hollow
Baker Camp Run
Ash Lick
Birch Lick
Wolf Run
Bannigan Run
Nicholas Lane Run
Spring Run
Laurel Lick Run
Gap Run
Match Line
Legend
Forest Service System Roads Collector or Local (FR 229)
Forest Service Woods Roads (C-1 or GR-4)
County or State Roads
Private Roads
Streams
National Forest Land
Private Land
Ponds / Lakes / Water Bodies
6th Order Watershed Boundary
Glady Watershed Boundary
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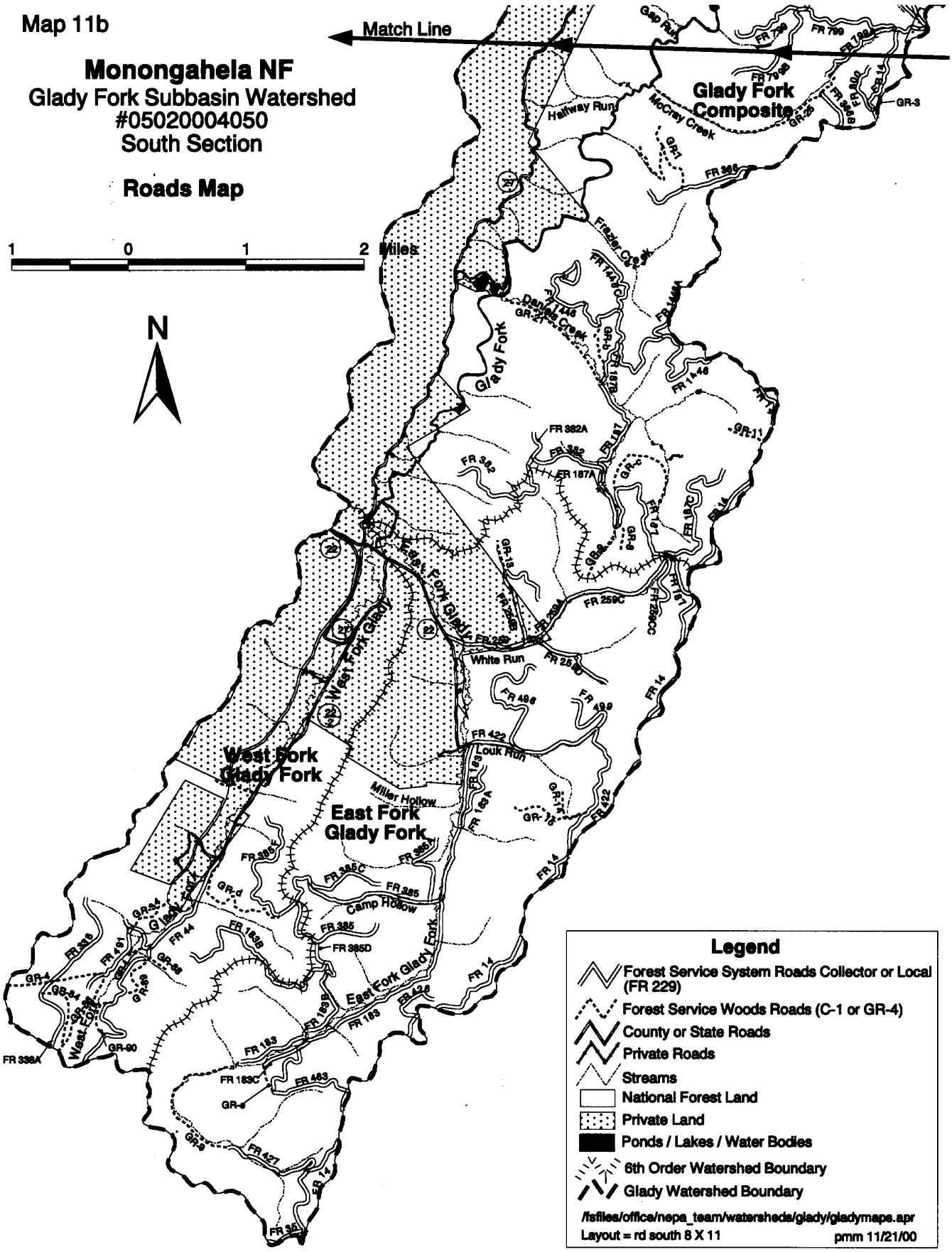
Map 11b
Match Line
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
South Section
Roads Map
1 0 1 2 Miles
N
Glady Fork Composite
West Fork Glady Fork
East Fork Glady Fork
Hallway Run
McCray Creek
Gap Run
Frazier Creek
Dance Creek
White Run
Louk Run
Miller Hollow
Camp Hollow
West Fork Glady
East Fork Glady Fork
Glady Fork
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Legend
Forest Service System Roads Collector or Local (FR 229)
Forest Service Woods Roads (C-1 or GR-4)
County or State Roads
Private Roads
Streams
National Forest Land
Private Land
Ponds / Lakes / Water Bodies
6th Order Watershed Boundary
Glady Watershed Boundary
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Layout = rd south 8 X 11
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Table 21 – Road Density by Opportunity Area

Opportunity Area	Road Class	Miles	Density (miles/square mile)
Major			
16.106 Lower Glady	Local	9.9	1.4
16.107 Upper Glady	Local	6.9	1.1
33.001 Big Knob	Local	1.0	3.4
36.101 McCray Ridge	Collector	1.9	0.2
	Local	9.3	1.0
36.102 Daniels Creek	Collector	2.2	0.3
	Local	19.7	2.4
36.103 Little Beech Mountain	Collector	5.6	0.5
	Local	21.0	1.9
Minor			
15.001 Otter Creek Wilderness		0	0
16.201 Laurel Fork		0	0
35.001 Laurel Fork North Wilderness		0	0
35.002 Laurel Fork South Wilderness		0	0
36.104 East Shavers Fork		0	0
13.011 Bear Heaven	Local	0.01	NA
33.004 Rich Mountain	Collector	0.04	NA
	Local	0.04	NA
36.108 Fox Run	Collector	0.1	NA
	Local	0.2	NA
33.002 Beaverdam Ridge	Collector	2.1	NA
	Local	0.1	NA

Forest Plan guidelines for management prescription 6.1 call for 1.0 mile of collector roads and 1.5 miles of local roads per square mile of area averaged over all opportunity areas with this management prescription. For management prescription 3.0, the guidelines are 1.0 mile of collector roads per square mile and 1 to 3 miles of local roads per square mile of area.

Currently, the 6.1 prescription areas in the watershed have an average density of 1.6 miles per square mile for local roads and 0.3 miles per square mile of collector roads. Daniels Creek and Little Beech Mountain opportunity areas have road densities for local roads greater than the Forest Plan standard. The 3.0 prescription area has an average density of 3.4 miles per square mile of local roads, however this opportunity area is split between watersheds. Again, these densities include the area of land within the Glady watershed and do not represent the entire road density for the minor opportunity areas.

Most, 97.7%, of the watershed is in 6.1 management prescription and most of the watershed is contained in the first six opportunity areas in Table 21.

For determining cumulative effects, the density of roads by sub-watershed is more useful. Table 22 displays the road densities by road class, for the four sub-watersheds in the Glady watershed. These numbers also include those short segments of roads that start in the watershed and run into the adjacent watershed.

Table 22 – Road Density by Sub-Watershed

Sub-watershed	Road Class	Miles	Density (miles/square mile)
East Fork Glady	Collector	4.4	0.4
	Local	24.4	2.4
Glady Fork Composite	Collector	5.0	0.4
	Local	20.1	1.4
Lower Glady Composite	Local	18.2	1.3
West Fork Glady	Collector	2.7	0.7
	Local	5.8	1.5

Access Problem

The existing FR259 system in White Run on the Greenbrier District, the main road and its spurs, is mainly accessible though private land. Columbia Gas Transmission Corporation has access across private land, but the Monongahela National Forest does not. The government can access FR259D from FR259CC as FR259CC begins off FR187 on National Forest land, but not FR259, 259A, and 259B. A road built by Columbia has been named FR259C, and FR259C was renamed FR259CC.

The inability of the Forest Service to gain a right-of-way to this road system limits actions we can take to reduce sediment movement to streams and ensure that existing road systems are designed to meet needs and protect resources.

Woods Roads

Woods roads on the Cheat district were located by GPS mapping. Woods roads maps for the Greenbrier District were used to digitize road locations. These roads all need reviewed on the ground for determination of closure, upgrade, abandonment, or conversion to trail.

Woods roads in the Glady watershed are listed in Table 23. Here, roads that start with the letter C are on the Cheat District, and those that start with GR are on the Greenbrier District.

Table 23 – Woods Roads in Glady Watershed

Number	Miles	Number	Miles
C-1a	1.15	GR-3	1.84
C-1b	0.32	GR-34	0.44
C-2	0.34	GR-4	1.45
C-3	1.45	GR-7	1.32
C-4	0.63	GR-8	0.23
C-4a	0.34	GR-84	0.64
C-5a	1.36	GR-86	0.78
C-5b	1.14	GR-88	0.18
C-5c	1.06	GR-89	0.43
C-5d	0.57	GR-9	1.92
C-6	0.68	GR-90	0.41
C-7	0.94	GR-92	0.06
GR-1	0.66	GR-no number	0.47
GR-10	0.01	GR-no number	0.04
GR-11	0.33	GR-no number	1.00
GR-13	0.28	GR-no number spur off FR 1446	0.25
GR-14	0.42	spur off FR 228	0.54
GR-15	0.60	spur off FR 229	0.19
GR-2	0.42	spur off FR 385F	0.64
GR-21	1.18	spur off FR 44	0.14
GR-23	0.38	spur off FR 491	1.01
GR-25	1.91		0.16
Total			30.31

State, County, and Private Roads

There are 39.5 miles of state and county roads in the Glady watershed. County roads 22, 27, 12, and 26/2 are one-lane paved roads with permanent residences. State road 5/18 runs along Flannigan run and parallels US Route 33. County road 10, also known as the Middle Mountain road or FR14, is a gravel road north of US Route 33 and is paved to the south to federal ownership where gravel surface starts again.

Locations and lengths of other roads on private land were determined from topographic maps and may not reflect current conditions. There are about 8.2 miles of roads on private land in the watershed.

Natural Gas Production

The area south of U.S. 33 and east of the Glady Fork River contains approximately 50% of the roughly 50,000-acre Glady Gas Storage field, a production pipeline, and a well and pipeline used under special use permit. Thirty-two storage and observation well sites (30 on NFS land, 2 on private land), access roads, and gas pipelines (about 23 miles) occur in the Glady Fork watershed (see Maps 12a and 12b). In some instances the pipeline was pl;ace din the road clearing and does not appear separate from the road on Maps 12a and 12b. Only observation wells are not connected to a pipeline.

The Gas Storage field agreement, currently held by Columbia Gas Transmission Corporation, was authorized in 1964 and has a 50-year term, thus is valid until 2013. The Storage agreement grants the operator the right to use and occupy National Forest System land within the bounds of the storage field to construct, operate, maintain, replace, abandon and remove wells, pipelines and roads for the purposes of gas storage. The storage agreement requires the operator to obtain Forest Service approval of plans for gas storage facilities on National Forest land.

Columbia Gas Transmission Corporation's foreseeable activities in the Glady Fork watershed include maintenance of existing storage field facilities. Examples of typical maintenance activities include replacing worn gas pipeline, well cleanout, road maintenance completed under the terms and conditions of a Forest-Service issued road use permit, and mowing well site, pipeline and road rights-of-way. No new storage wells, road or pipeline proposals are foreseen by Columbia Gas at this time.

To access these developments, Columbia Gas Transmission has a road use permit with the Monongahela National Forest. The permit covers approximately 60 miles of roads and road segments to be maintained by Columbia yearly, of this about 27 miles are within the Glady watershed. These roads can be used for other means, such as timber hauling, as needed by the Monongahela. This permit is reviewed annually and outlines the maintenance techniques for different road types.

Currently, the roads listed in Table 24 are used to access gas well developments in the Glady watershed.

Table 24 - Roads Under Permit with Columbia Gas Transmission

Road Number	Road Name	Miles	Gate
183A	East Fork Glady Spur	0.8	No
183B	East Fork Glady Spur	2.0	Yes
183C	East Fork Glady Spur	0.3	No
187	Daniel's Run	3.5	Yes
187A	Daniel's Run Spur	0.1	Yes
187B	Daniel's Run Spur	0.4	Yes
259	White Run	1.4	Yes
259A	White Run Spur	0.7	Yes
259B	White Run Spur	0.6	Yes
259D	White Run Spur	0.7	Yes
364	Spring Run	0.9	Yes
382	Daniel's Run	0.8	Yes
382A	Daniel's Run Spur	0.2	Yes
385	Camp Hollow	3.1	Yes
385A	Camp Hollow Spur	0.8	Yes
385B	Camp Hollow Spur	0.1	Yes
385C	Camp Hollow Spur	0.7	Yes
426	East Fork I	0.5	Yes
427	Little Beech Mtn	1.0	Yes
463	East Fork Ridge	0.7	Yes
496	Louk Run	1.3	Yes
799	McCray Ridge Spur	1.1	Yes
1446	Zinn Ridge	3.8	Yes
1446A	Zinn Ridge Spur	0.8	Yes
Total		26.3	

A review of the roads under permit in October 1999 by Forest Engineering personnel identified that a number of these roads had not been maintained in 1999. In the Glady watershed, maintenance was not done on roads 187, 187A, 187B, 364, 382, 382A, 427, and 496 in 1999. Roads 259, 259A, and 259B were not reviewed for compliance because of access problems. These roads, plus two others outside the Glady watershed, cross private property and are locked.

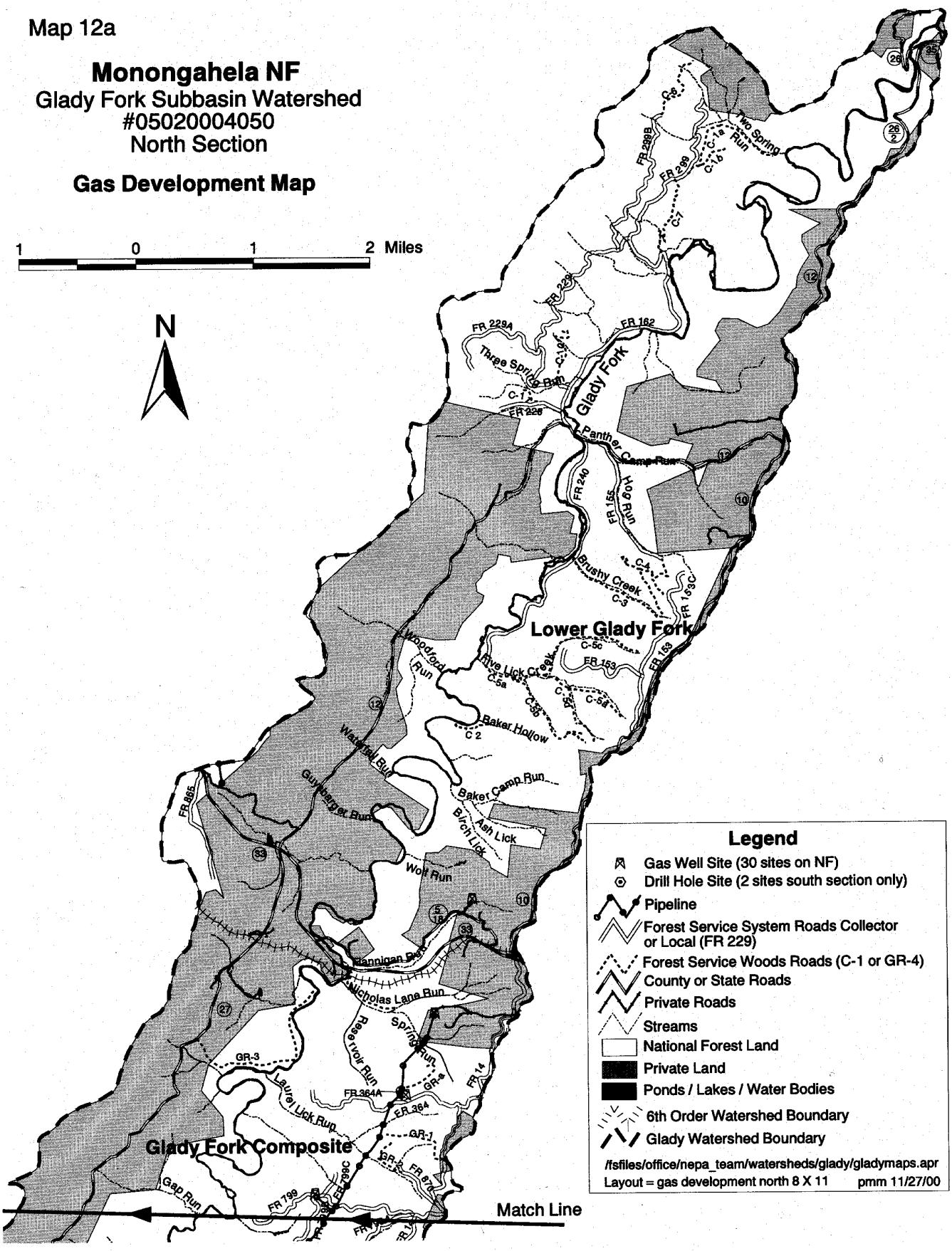
Forest roads 183B, 259D, 364, 799, 1446, and 1446A access observation wells. Observation wells are those no longer producing gas and will eventually be sealed. These roads are generally used just once a month by 4-wheel truck to check wells for leakage. These roads no longer require blading of the roadbed because of stable grass cover. Ditch line and pipe maintenance is still needed on these roads. This maintenance was not done in fiscal year 1999. This would be a change in the road use permit responsibilities.

Forest road 426 has been converted to a foot trail. This conversion needs to be made in the road system database.

The Forest requested that Columbia Gas Transmission prioritize roads used to access their developments as high, moderate, and low priority. All roads in the Glady watershed used were ranked as high priority, with some segments listed both high and moderate priority indicating low use, but single access to some developments.

A single gas producing well occurs on private land between the storage field's northern boundary and U.S. route 33. A pipeline takes gas from this well to the south toward Glady.

Past underground (drift) and strip coal mining occurred on Shaver Mountain north of Glady on privately owned land. A few acres of the strip mining extended into the upper Glady Fork watershed, with nearly all of the strip mining and the drift mine entrances in the Shavers Fork watershed. Given the location of the drift mine entrances in the Shavers Fork and the general rock dip direction toward the west-northwest, it is unlikely that drift mines are discharging significant amounts, if any, of mine water into the Glady Fork watershed.


Map 12a
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
North Section
Gas Development Map
1 0 1 2 Miles
N
Glady Fork
Lower Glady Fork
Glady Fork Composite
Match Line
Two Spring Run
Three Spring Run
Panther Camp Run
Hog Run
Brushy Creek
Five Lick Creek
Woodford Run
Baker Hollow
Baker Camp Run
Ash Lick
Birch Lick
Wolf Run
Gunpowder Run
Hannigan Run
Nicholas Lane Run
Spring Run
Reservoir Run
Laurel Lick Run
Gap Run
FR 229A
FR 162
FR 229
FR 240
FR 155
FR 159C
FR 153
FR 865
FR 364A
FR 364
FR 14
FR 799
FR 799C
FR 870
GR-1
GR-2
GR-3
GR-4
C-1
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C-1b
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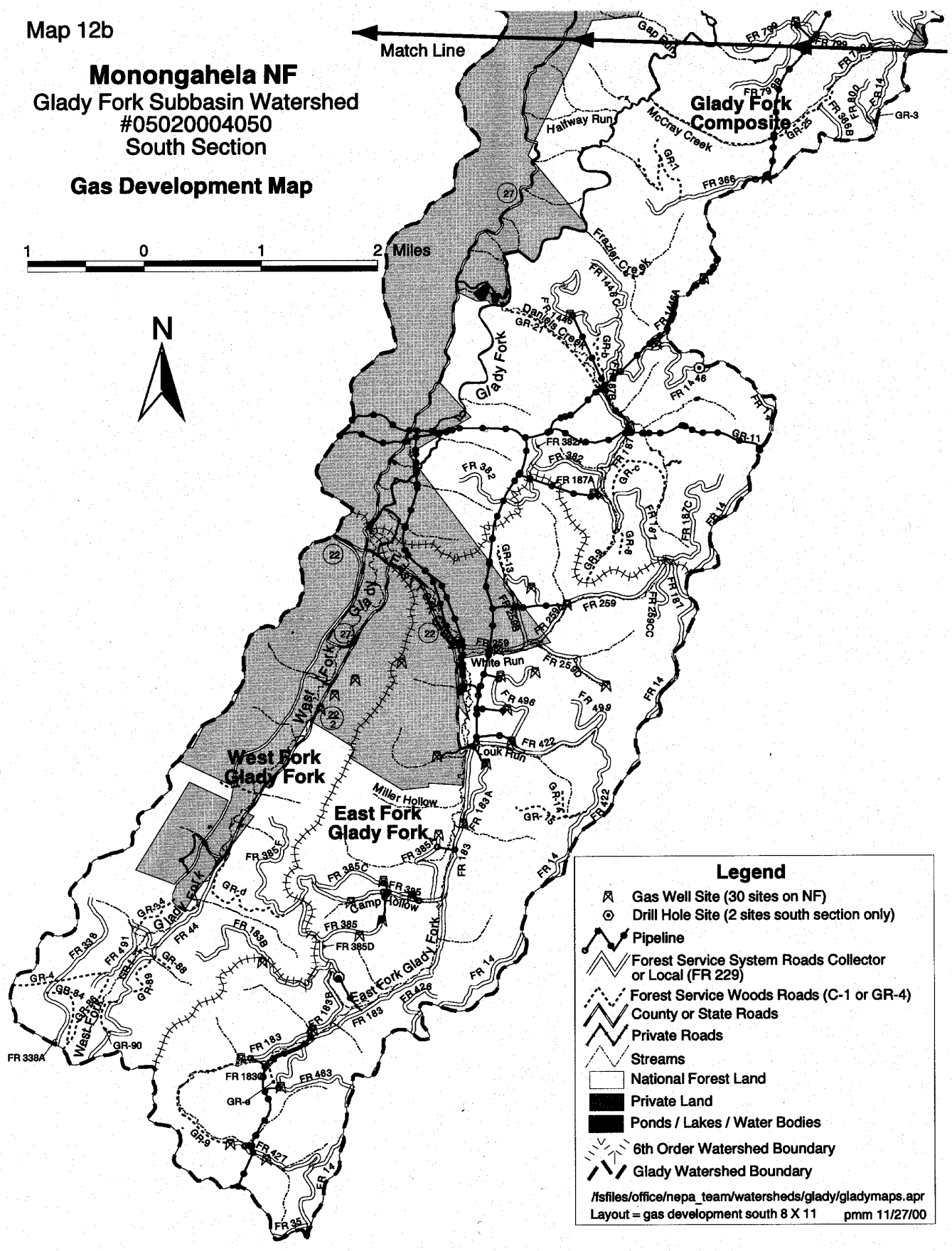
C-5b
C-5c
C-7
C-8
Legend
Gas Well Site (30 sites on NF)
Drill Hole Site (2 sites south section only)
Pipeline
Forest Service System Roads Collector or Local (FR 229)
Forest Service Woods Roads (C-1 or GR-4)
County or State Roads
Private Roads
Streams
National Forest Land
Private Land
Ponds / Lakes / Water Bodies
6th Order Watershed Boundary
Glady Watershed Boundary
/fsfiles/office/nepa_team/watersheds/glady/gladymaps.apr
Layout = gas development north 8 X 11 pmm 11/27/00


Map 12b
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
South Section
Gas Development Map
Match Line
1 0 1 2 Miles
N
Glady Fork Composite
West Fork Glady Fork
East Fork Glady Fork
Legend
Gas Well Site (30 sites on NF)
Drill Hole Site (2 sites south section only)
Pipeline
Forest Service System Roads Collector or Local (FR 229)
Forest Service Woods Roads (C-1 or GR-4)
County or State Roads
Private Roads
Streams
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Private Land
Ponds / Lakes / Water Bodies
6th Order Watershed Boundary
Glady Watershed Boundary
/fsfiles/office/nepa_team/watersheds/glady/gladymaps.apr
Layout = gas development south 8 X 11 pmm 11/27/00

Scenic Quality

Visual Quality Objective mapping of the project area is available at the Greenbrier and Cheat District Offices.

The Glady Fork assessment area lies within the Northern Hardwood and Red Oak/Sugar Maple Land Type Associations of the Monongahela National Forest. Landforms in the northern hardwood zone are rolling to steeply sloped mountains with narrow, winding valleys. Northern hardwood forests are the rule across the zone; pastures are also common throughout. Temporary openings of less than 25 acres, due to timber harvests are common, as are changes in vegetative texture brought about by partial harvests, two-age management for instance. Mountainsides within the zone typically have an even-textured appearance, often punctuated by temporary openings. The line introduced by road construction on mountainsides is most evident during leaf-off periods. Streams in the zone have steep gradients, are swift flowing, clear, and normally have horizontally fractured, dark brown rock beds. The placement of gray, round limestone boulders in the streams as fish habitat has seriously detracted from the scenic character of brown, horizontally fractured streambeds. Glady Fork is an outstanding water form that draws anglers and sightseers to visit the area.

Gas wells and pipelines have had only minimal effect on the overall quality of the scenery.

Visitors will find small recreation areas including rental cabins, campgrounds, observation sites, and picnic areas in openings in the forest. Trails are common across the zone. No communities are found within the northern hardwood zone. High altitude pastures provide outstanding scenic variety. Dispersed camping takes place along all streams in the zone. Wider valley areas are commonly in pasture. Pastures and woodlots on private land are welcome variety to the generally forested zone.

Visitors may chose from a wide variety of recreation opportunities within the northern hardwood zone. Within the Glady Fork assessment area, there are many trail opportunities, but no developed recreation sites.

The landforms of the red oak/sugar maple zone vary from gently rolling, highly dissected low hills to steep sided, massive mountains. Valleys are narrow to very narrow and winding. Visitors encounter enclosed landscapes with foreground detail views. Views of the near middle ground are common, but background vistas are rare. In the northern portion of the forest, the red oak/sugar maple zone is generally found on the mid to lower slopes. Mixed mesophytic vegetation is interspersed with northern hardwoods. Oaks are present. This zone contains the most productive sites on the forest. Valleys are often in open farm or pasture. High altitude openings are rare. Temporary openings, of less than 25 acres, due to timber harvests are common, as are changes in texture where partial harvests have been implemented. The overall appearance is of an even textured forest with scattered openings, either permanent or temporary.

Streams have steep gradients and are swift flowing over rock beds within this zone. Natural rock forms are relatively visually unimportant.

The scattered ownership pattern of intermingled private and public lands reduces the opportunity for the visitor to sense an undisturbed expanse of forested land. Dispersed camping along many of the streams is common.

Valued cultural features include pastures and woodlots in the valleys and lower slopes.

The Allegheny Trail, a major north-south hiking facility, traverses the majority of the Glady Fork assessment area, closely following the Glady Fork stream. This trail is an important recreation facility, though use is light. Portions have been damaged by floods and are in need of reconstruction. A trailhead along FR 44 provides access to the trail to the popular High Falls of Cheat, to the west. This trail and trailhead are not well marked. Trails and trailheads within the Glady Fork area provide access to the Otter Creek Wilderness to the northwest and the Laurel Fork North and South Wildernesses to the east.

The dispersed camping area along the Glady Fork near the wildlife manager's cabin north of Alpena is a locally important and sensitive area. This site is very popular with a group of people and has been the subject of several studies to determine if sanitation facilities and user amenities are adequate. Current thinking is that no further facilities are needed.

The views of travelers on the Middle Mountain Road are limited to the foreground by the largely unbroken forest cover and canopy along the road. Additional variety of views is needed.

Maintenance of the attractive mixture of open and forested landscape scenes is desired. Additional open vistas off the Middle Mountain Road could be made to add variety. Repair of the flood damage to the Allegheny Trail is needed. Better directional trail signing is needed to lead visitors to the High Falls Trail.

The Forest Landscape Architect should layout any vista clearing projects, if they are to be done by volunteers. Consult with the Forest Landscape Architect on any proposed timber harvests.

Recreation

Recreational activities within the watershed assessment area consist mostly of dispersed recreation including hunting, fishing, hiking, site seeing, nature studies and some dispersed camping. Much of the use seems focused on the river and activities associated with the river. Use in general is low with the exception of the dispersed camping in the lower Glady area, hunting season, and fishing season. See Maps 13a and 13b for locations.

A small portion of the congressionally designated Otter Creek, Laurel Fork North and Laurel Fork South Wilderness areas are contained within the watershed area. These areas are to be managed in a way that protects the wilderness attributes for future generations, provides a wilderness experience, and preserves natural ecosystems.

Developed Recreation Sites

The Alpena Gap information site, located along Highway 33 on the western edge of the analysis area, serves as a point of information and as a trailhead for the Shaver's Mountain Trail. Motorists who plan to drive Stuart Memorial Drive use the site, those who access the trailhead, and those motorists traveling Highway 33 who wish to pull off the road. The information signs need to be upgraded.

Trails and Trailheads

The Allegheny Trail (TR701) is a north/south trail that crosses much of the Glady Watershed. This trail follows the Glady river corridor in the northern part of the watershed, follows mountain ridges south of Highway 33 and follows along the Glady river in the area just south of the town of Glady. It again moves to the ridge top and it goes south through the upper part of the watershed. A catwalk type bridge is needed near Gladwin and a bridge is also needed near Five Lick. Trailheads consist of limited signing and parking.

Shavers Mountain Trail (TR 129) mostly follows along the top of Shavers Mountain weaving in and out of the eastern boundary of the Otter Creek Wilderness Area. The trailhead coincides with the Alpena Gap Information Site on the edge of the analysis area.

The Mylius Trail (TR 128) provides access to the Otter Creek Wilderness area from the Glady watershed. The trail climbs to the top of Shavers Mountain, crosses the Shavers Mountain Trail, and descends into the wilderness. The trailhead is located off FR162 and is repeatedly damaged by heavy rains. The trailhead is signed and holds approximately five cars.

The McCray Trail (TR 302) provides access to the Allegheny Trail from State Route (SR) 27 and FR 14. The trail consists of old roads, railroad grades and trails that are placed along an unnamed creek, the Glady Fork River, and McCray Creek. Where McCray Trail joins the Allegheny Trail, the Glady Fork river must be crossed. This crossing could use a substantial bridge, however, the trail has little use and the bridge probably could not be justified. The western trailhead is signed and holds 4-6 cars.

The West Fork Trail (TR312) is an old railroad grade, partially within the watershed, highly used by hikers, mountain bikers, horseback riders and cross-country skiers. It follows along the West fork of the Glady Fork River within the watershed and along the West Fork of the Greenbrier River once it leaves the watershed. This trail is sometimes used as part of a loop in conjunction with the High Falls of Cheat Trail. The high point of the trail is at the Lynn Divide, the southern boundary of the watershed. There is a tunnel just outside the watershed at the northern end of the trail. A trailhead is located approximately 0.5 miles south of Glady off SR 27 and is across from private homes.

Beulah Trail (TR 310) connects the High Falls of Cheat Trail to the Laurel Fork South Wilderness. It follows trails and gas well access roads. It needs blazed and cut out or could be abandoned, as there is little evidence of use. The trail has some drainage problems that need corrected. Signage could be improved. If trail is not abandoned, parking could be improved.

The High Falls Trail (TR 345) is only partially within the watershed, but it is heavily used, especially during summer weekends. The trail crosses a relatively flat area, crosses a couple of streams, and then become steeper as it climbs up onto Shaver's Mountain and leaves the watershed. This trail is popular with hikers and horseback riders.

A trailhead parking lot for Stone Camp Run Trail (TR 305) is located within the watershed on FR14. The trail is within the Laurel Fork North Wilderness and provides access to Laurel Fork River. The trailhead parking lot could use gravel and road improvements. FR 14 is ditched in a way that forces the water to flow directly down the trail.

A trailhead for the Middle Mountain Trail (TR 307) is located within the watershed on FR14. The trail provides access to the Laurel Fork North Wilderness and is located within the Laurel Fork drainage area. The trailhead is steep and not very well marked.

Trail 323, Forks Trail, provides access to the Laurel Fork South Wilderness from either FR 183 or FR 14. Most use occurs from FR 14. The trailhead is signed and there is limited parking. The trailhead sign could be replaced.

Trail 311, County Line Trail, is located behind locked gates. Both ends of the trail follow gas well roads. The trail has little use and is currently hard to find. Much of it follows along the ridge. The trail needs

blazed and cut out or should be considered for abandonment. Trailhead parking is sufficient. Signage could be improved.

Table 25 – Forest Service System Trails in Glady Watershed

Trail Name	Trail No.	Total Miles	Miles in Watershed (on FS)
Mylius Trail	TR 128	3.5	0.95
Shavers Mountain Trail	TR 129	2.5	1.22
McCray Trail	TR 302	4.7	2.36
Stone Camp Run Trail	TR 305	1.5	0.02
Beulah Trail	TR 310	4.2	1.77
County Line Trail	TR 311	4.1	2.78
West Fork Trail	TR 312	25.5	5.52
Forks Trail	TR 323	1.1	0.43
High Falls of Cheat Trail	TR 345	2.9	1.46
Allegheny Trail	TR 701	247 [1]	20.53

[1] – This includes the portions of the trail on ownership other than National Forest.

All trails serve multiple uses such as hikers, mountain bikes, and horse riders. Mylius, Shavers Mountain, Beulah, and Forks trails all access wilderness areas and on wilderness segments mountain bikes are not allowed.

Calculating trail densities presents the same troubles as calculating road densities. The densities shown here are based on miles of trail in the watershed and acres of national forest in the watershed and therefore may not make sense at the opportunity area level. Trail densities are given in Tables 26 and 27.

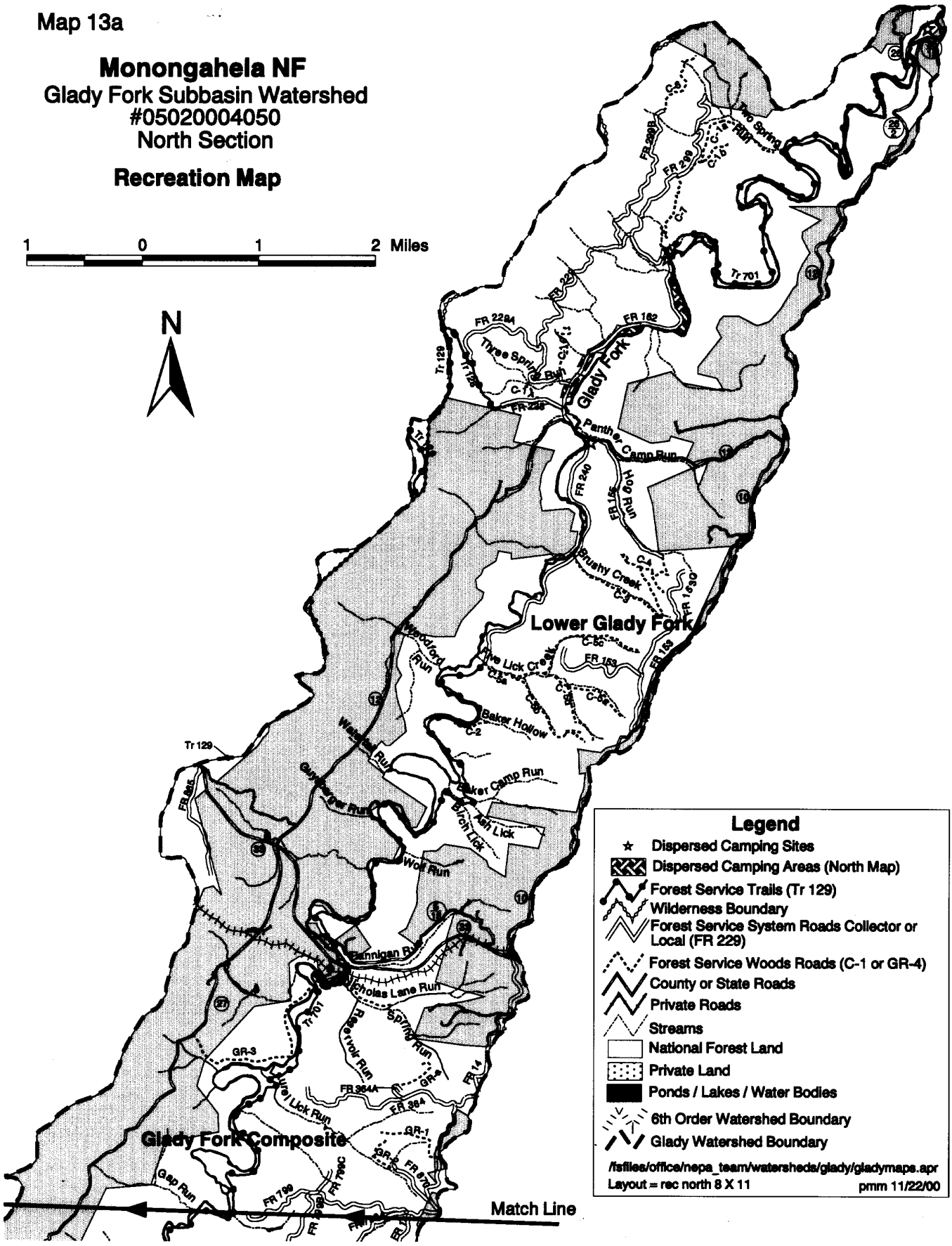
There are segments of trail that are also roads. In these instances, the segment of road that is also a trail was not used to calculate trail densities, as this mileage is already included in the road density calculation. Where trails form the boundary between sub-watersheds or opportunity areas, the mileage was split with half going to each area.

Table 26 – Trail Density by Opportunity Area

Opportunity Area	Miles	Trail Density (miles/square mile)
13.011 Bear Heaven	0.1	1.3
15.001 Otter Creek Wilderness	0.6	3.7
16.106 Lower Glady	7.4	1.0
16.107 Upper Glady	5.4	0.9
16.201 Laurel Fork	0	0
33.001 Big Knob	0	0
33.002 Beaverdam	0	0
33.004 Rich Mountain	0	0
35.001 Laurel Fork North Wilderness	0.02	0.2
35.002 Laurel Fork South Wilderness	0	0
36.101 McCray Ridge	8.8	1.0
36.102 Daniels Creek	2.1	0.3
36.103 Little Beech Mountain	12.2	1.1
36.104 East Shavers Fork	0.3	3.0
36.108 Fox Run	0	0

Table 27 – Trail Density by Sub-watershed

Sub-watershed	Miles	Trail Density (miles/square mile)
East Fork Glady	3.1	0.3
Glady Fork Composite	10.8	0.8
Lower Glady Composite	13.6	1.0
West Fork Glady	9.4	2.5


Map 13a
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
North Section
Recreation Map
1 0 1 2 Miles
N
Glady Fork
Lower Glady Fork
Glady Fork Composite
Match Line
Panther Camp Run
Hog Run
Brushy Creek
Three Springs Run
Baker Hollow
Baker Camp Run
Wolf Run
Flannigan Run
Nicholas Lane Run
Reservoir Run
Spring Run
Gap Run
Legend
Dispersed Camping Sites
Dispersed Camping Areas (North Map)
Forest Service Trails (Tr 129)
Wilderness Boundary
Forest Service System Roads Collector or Local (FR 229)
Forest Service Woods Roads (C-1 or GR-4)
County or State Roads
Private Roads
Streams
National Forest Land
Private Land
Ponds / Lakes / Water Bodies
6th Order Watershed Boundary
Glady Watershed Boundary
/fsfiles/office/nepa_team/watersheds/glady/gladymaps.apr
Layout = rec north 8 X 11
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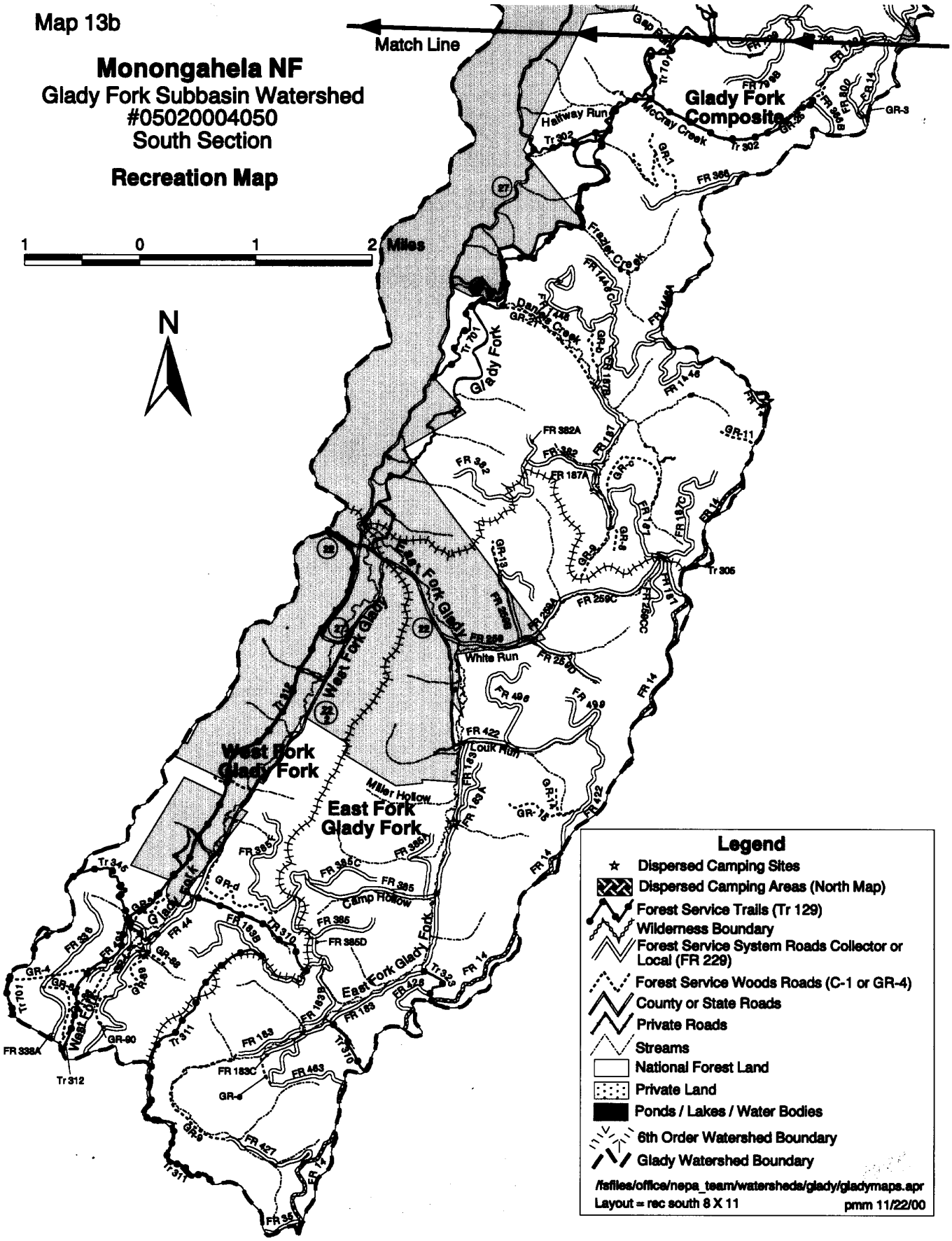
Map 13b
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
South Section
Recreation Map
Match Line
1 0 1 2 Miles
N
Glady Fork Composite
West Fork Glady Fork
East Fork Glady Fork
Legend
Dispersed Camping Sites
Dispersed Camping Areas (North Map)
Forest Service Trails (Tr 129)
Wilderness Boundary
Forest Service System Roads Collector or Local (FR 229)
Forest Service Woods Roads (C-1 or GR-4)
County or State Roads
Private Roads
Streams
National Forest Land
Private Land
Ponds / Lakes / Water Bodies
6th Order Watershed Boundary
Glady Watershed Boundary
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Layout = rec south 8 X 11
pmm 11/22/00

Public Access Roads
Three forest roads are used as disabled hunter access (class Q permits), FR 183 along the east fork of the Glady Fork, FR385 along the Glady Fork, and FR 153 in Five Lick. These roads are open to use by holders of class Q permits from the first week of October (opening of squirrel season) through the end of the calendar year. ATV's are getting around the gate at FR 385.

Dispersed Camping
Dispersed camping in Lower Glady is located along FR 162 and east of the Otter Creek Wilderness area. The area is heavily used during hunting season and during the summer. During holiday weekends, the area is crowded. Some efforts were made in 1997 to harden sites and limit use in the area, without changing the character of the area. Several campsites were eliminated and access roads were closed. We continue to see soil and riparian impacts in the area and further controls are needed. Sites could be further hardened, numbered, and camping limited to the numbered sites. A Forest Supervisor's order would be needed to help control use in the area.

In Gladwin, there are two areas where dispersed camping occurs, one at the old church site and one between Route 26 and the Glady Fork River. The Gladwin site is often used for family reunions and we receive complaints from neighbors about litter and parties. Use occurs during hunting season and during the summer months. Heritage resource sites are also found here.

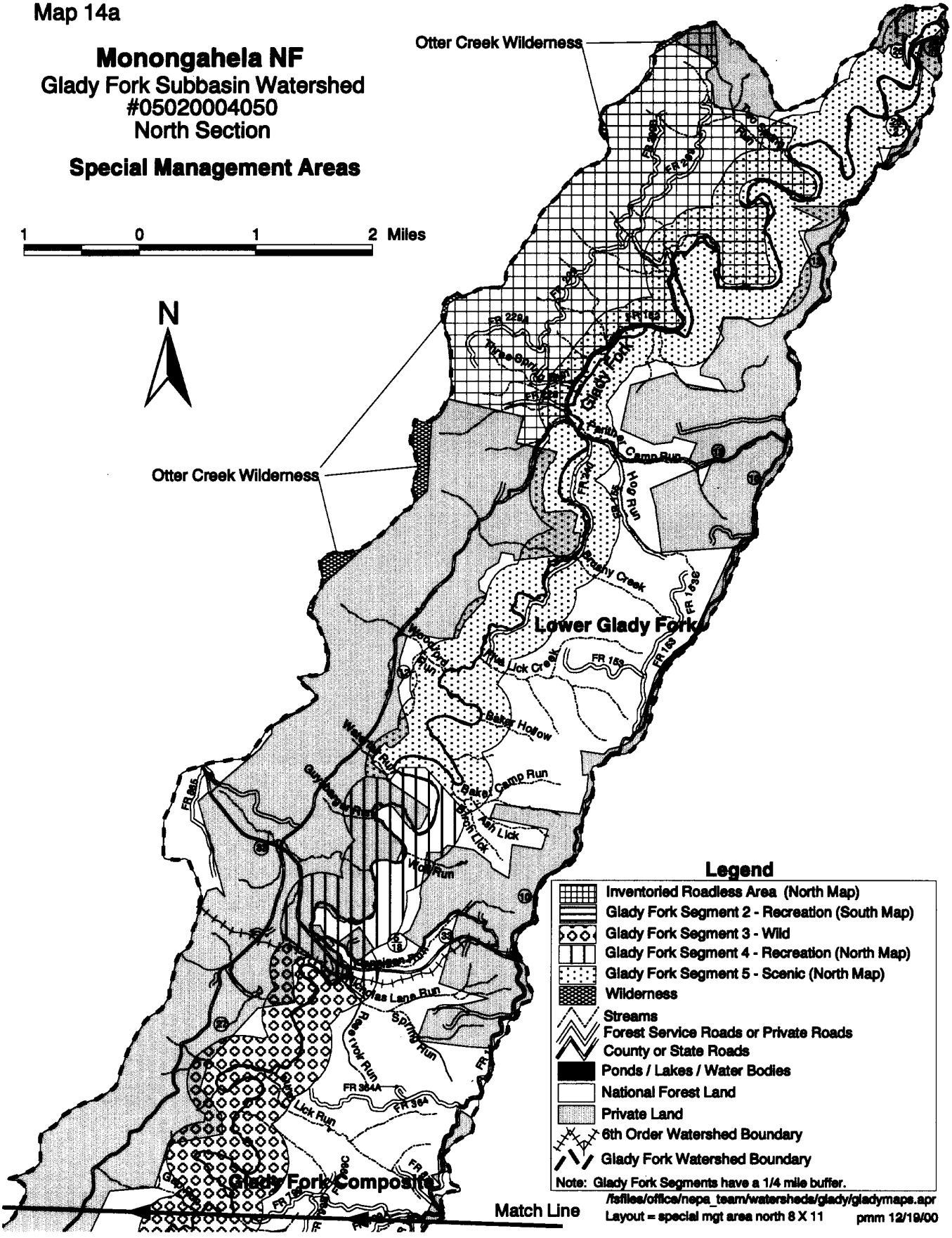
There are a few other small, dispersed campsites along FR 14 (between FR 1446 and 1447), FR 183A, on FR 44 (just south of FR 336), and near the middle mountain overlook on FR 14. These sites are not presenting any problems.

There are no Forest Service developed campgrounds within the watershed area.

Special Uses
The largest special use of the Glady watershed is the gas storage and transmission use by Columbia Gas Transmission Corporation described earlier. Other uses by private individuals, groups, and state offices need to be considered when actions are considered in the Glady watershed. Currently, two spring boxes and waterlines, a WV DNR cabin, a state secondary route (#12), a state low water bridge on Route #26, two outfitter guide permits, and a right-of-way to reach privately owned land are active in the Glady watershed on the Cheat District. Currently on the Greenbrier District there are two permits for the gas pipeline, one for a telecommunications tower, two road rights-of-way, and seven outfitter guide permits include one for the entire Forest.

Wild and Scenic River Study
The Wild and Scenic River Study completed by the Monongahela identified two segments of the Glady Fork for designation as a recreation river, one segment as a wild river, and one as a scenic river. Segment 1, upstream from Glady, was determined to be ineligible as wild, scenic, or recreation status. Segments 2 and 4, from the town of Glady to Frazier's Creek and Nicholas Run to Waterfall Run respectively, are recommended for designation as recreation river segments. Segment 3, from Frazier's Creek to one-half mile above US route 33, is recommended for wild river designation. The segment from Waterfall Run to the confluence with Dry Fork, segment 5, is recommended for scenic river designation. See Maps 14a and 14b for locations.

These recommendations have not been acted on. Until designations are made, no projects that could change the eligibility of a segment should occur within the river corridor and for one-quarter mile beyond. We need to protect the outstanding river values that were the basis for the determination of eligibility. In the segment recommended for wild river designation, this means essentially no major actions such as timber harvests, road construction, or large campground development are to be taken within one-quarter mile of the river. For recreation and scenic designations, some management actions may be approved within the one-quarter mile buffer, as documented through NEPA analysis for significance of effects.


Map 14a
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
North Section
Special Management Areas
1 0 1 2 Miles
N
Otter Creek Wilderness
Otter Creek Wilderness
Lower Glady Fork
Glady Fork Composite
Match Line
Legend
Inventoried Roadless Area (North Map)
Glady Fork Segment 2 - Recreation (South Map)
Glady Fork Segment 3 - Wild
Glady Fork Segment 4 - Recreation (North Map)
Glady Fork Segment 5 - Scenic (North Map)
Wilderness
Streams
Forest Service Roads or Private Roads
County or State Roads
Ponds / Lakes / Water Bodies
National Forest Land
Private Land
6th Order Watershed Boundary
Glady Fork Watershed Boundary
Note: Glady Fork Segments have a 1/4 mile buffer.
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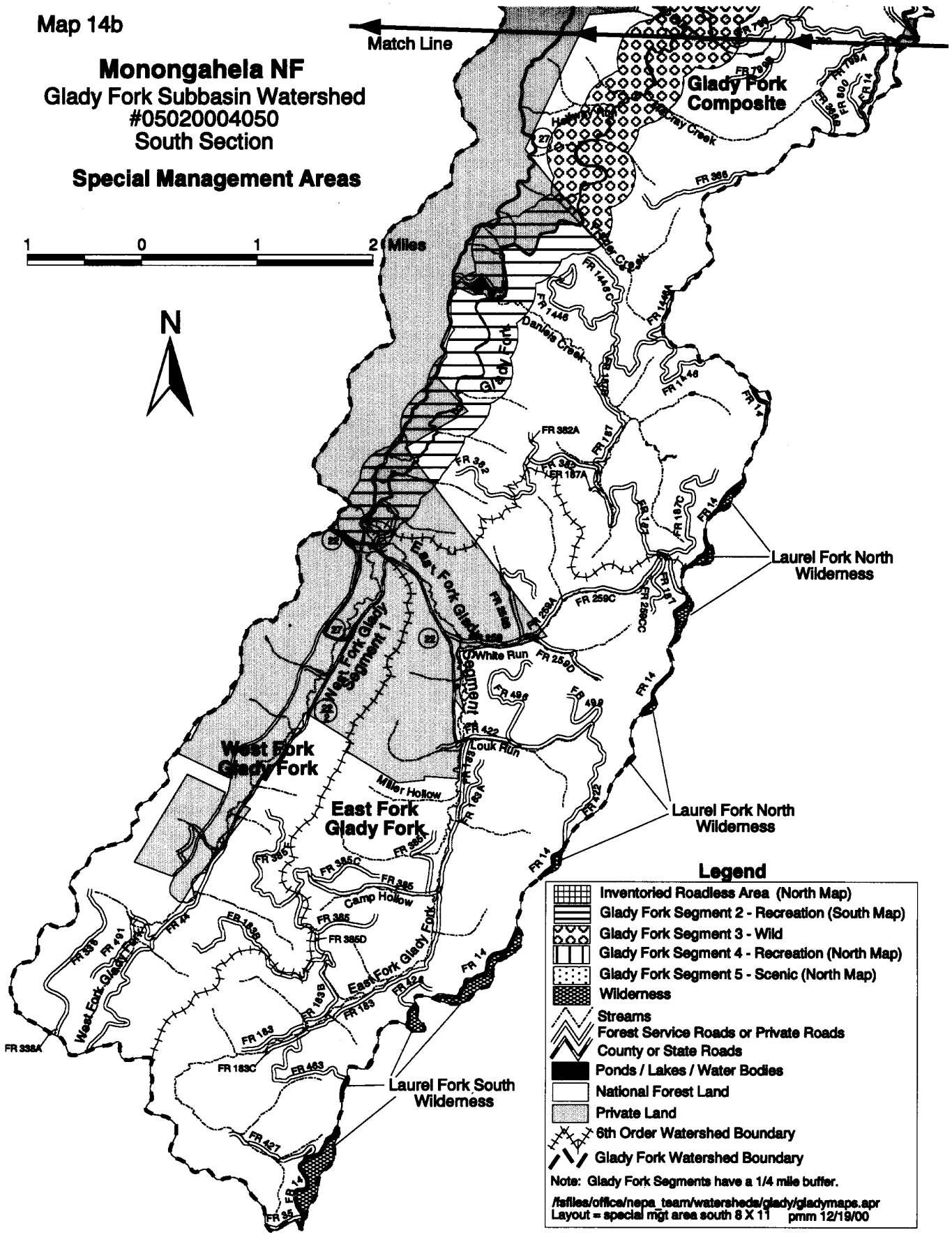
Map 14b
Match Line
Monongahela NF
Glady Fork Subbasin Watershed
#05020004050
South Section
Special Management Areas
1 0 1 2 Miles
N
Glady Fork Composite
Laurel Fork North Wilderness
Laurel Fork North Wilderness
Laurel Fork South Wilderness
West Fork Glady Fork
East Fork Glady Fork
Legend
Inventoried Roadless Area (North Map)
Glady Fork Segment 2 - Recreation (South Map)
Glady Fork Segment 3 - Wild
Glady Fork Segment 4 - Recreation (North Map)
Glady Fork Segment 5 - Scenic (North Map)
Wilderness
Streams
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County or State Roads
Ponds / Lakes / Water Bodies
National Forest Land
Private Land
6th Order Watershed Boundary
Glady Fork Watershed Boundary
Note: Glady Fork Segments have a 1/4 mile buffer.
/isfiles/office/nepa_team/watersheds/glady/gladymaps.apr
Layout = special mgt area south 8 X 11 pmm 12/19/00

Private Land

Throughout the document, land use on private land has been mentioned. Currently, there are croplands, pasturelands, home sites, small communities, light industry, and timber harvest activities on private land. These land uses also include the associated road or trails for access. Private land in the Glady watershed comprises about 13,326 acres of the total acreage, about 33% of the watershed. Timber harvest on private land is described in the **Past Timber Harvests** section above.

Law Enforcement

Illegal ATV use is occurring from many points across the watershed. On the East side of Middle Mountain road, at the head of Laurel Lick, an ATV trail has developed from private land to FR 870. Use appears to be mainly during fall hunting season and is not constant. A large amount of ATV traffic is entering the National Forest from a trail off a private road northeast of the town of Glady. Year round, illegal use is causing some erosion on the trail and ATVs are connecting to FR187, FR382, and the pipeline from this point. A spur off FR385 (marked private on old topographic maps) that connects to private land in the west Fork of Glady, is allowing illegal access generally from August through the hunting season.

Chapter 4 – Recommendations and Data Gaps

Recommendations for actions are from the watershed assessment team members and from review and discussion of the assessment area with staff on the two ranger districts. From this list, various proposed action statements can be developed.

Data Gaps

As mentioned in the document, no stream temperature data were taken specifically for this assessment. Stream data are needed for temperature and sediment; sediment levels reported here are from one grab sample.

As of January 2001, a contract for the collection of forest stand data has not been fulfilled. The age of the stand exam data for the watershed is as old as 20 years for some compartments. New stand exam data are needed. Field reviews of many stands are being made to determine possible timber management actions, but no systematic sampling is underway.

The GIS layers for the Cheat ranger district have not been finalized as of January 2001. Soil type data were gathered from the ELT layer for that district. When the soil type polygon layer and associated data table are available, the analysis of sensitive soils presented in this document should be recalculated and corrected as needed.

There are discrepancies in the calculation of parameters such as acres of a certain forest type in the watershed and acres of open land. Some of this difference can be attributed to rounding errors, but there are missing data in the GIS attribute tables from the addition of the CDS table data. This data table needs to be corrected to be able to use GIS to calculate area and use CDS as attribute source.

Similarly, depending on what GIS layer is chosen, the area of the watershed in surface water differs from layer to layer. The most correct layer needs to be determined.

Inventories for specific wildlife species listed in the **Management Indicator Species**, **Threatened and Endangered Species**, and **Sensitive Species** sections are needed to fill gaps in our knowledge of species use and trends in the area.

Recommendations

Resource	Project	NEPA Documentation
Recreation	Trail bridges on Allegheny Trail (701) – 3 needed, 1 low priority. One bridge needed over wash-out area on D1, one needed near Five Lick, and one needed below Halfway Run where trail comes down to Glady Fork (low priority)	EA
Recreation	Harden dispersed recreation sites along FR162 (D1) to protect resource and control/limit use	CE
Road System	Review all woods roads to determine need. Convert to trails, obliterate, or upgrade to system road as needed.	EA
Minerals	Obtain administrative access to FR 259, 259A, and 259B so road conditions can be monitored and the road use permit enforced	EA
Wildlife Habitat	Continue to use controlled burning to reduce/remove St. John's Wort in the Beulah grazing area	CE/Burn Plan
Wildlife Habitat	Determine long-term needs and access for maintaining apple trees in compartment 38 stand 6, 8, and 24, and compartment 42, stand 19, Greenbrier District.	None, unless work needed to close existing access
Wildlife habitat	Determine access to and need for opening in red pine in compartment 36, stand 3, Greenbrier District.	None, unless action needed to close existing access
Wildlife Habitat	Develop upland openings in watershed. Possible sites are: compartment 43, stand 43, compartment 41, stand 53 (expand existing), compartment 44, stand 30/33, unnamed road off of 422 (linear opening?), compartment 38, stand 58 (expand existing), compartment 43, stand 43, compartment 45, stand 33, all Greenbrier District.	EA
Wildlife Habitat	Consider changing utilization standards in some timber sale units to allow for the retention of more large woody debris on the forest floor.	
Wildlife Habitat	Identify areas/stands for non-commercial methods to add large woody debris to the forest floor (i.e., drop and leave pulpwood size trees)	EA/CE
Wildlife Habitat	Review any patches of aspen found in the watershed for potential to regenerate aspen by harvest or prescribed burning.	EA
Soil and Water	Identify and mitigate sediment sources on FR499, old grade running up Daniel's Creek, bottom section of McCray trail (#302), and old grade running along Laurel Lick.	EA
Road System	Control access from private on FR870, FR382 and FR187 (from the west), FR 385 from old road leading to FR44, and from FR259CC to private land either by placement of Forest Service gates and locks or earth berms..	None?

Aquatic Habitat	Protect existing riparian stands and restore impaired riparian areas to protect the potential source of LWD recruitment, stream shading and channel stability. Retain no-harvest buffer strips along active channels, work with landowners to restore riparian communities on private lands, encourage the WVDNR to relocate wildlife openings out of riparian. Inventory and correct existing sediment sources when possible. Relocate valley bottom roads to ridge-tops, utilize helicopter-logging methods, improve road drainage and gravel surfacing.	EA/EIS
Riparian/Water quality	Restore riparian areas that are substantially degraded on U.S. Government lands, through planting. Areas where riparian planting is needed include portions of the Glady Fork main stem.	EA
Riparian/Water Quality	Work with private landowners, the State and other partners to restore riparian areas on private lands. Focus efforts on grazing and crop production in riparian areas, where opportunities exist.	
Road System	Improve road conditions on old roads and grades, and Forest Service system roads where possible, to correct numerous road drainage and flow concentration problems. Take on action on needed maintenance outlined in previous chapter as funds allow. Close and obliterate portions of old roads, railroad grades, skid roads, and existing system roads that are no longer needed as part of the long-term transportation system. Improve drainage, close or obliterate, and stabilize erosion on many old roads and grades, particularly those in filterstrips and closely following streams, such as the extensive old road system in the Five Lick Creek watershed.	EA
Road System	Restore and improve drainage on portions of FR 183, 187, 229, 229A, 229B, 385, 422 and others. Investigate drainage improvement opportunities on trail 701.	EA
Road System	Investigate opportunities to cooperate with the State to improve state road and highway drainage conditions on numerous state travelways. Some areas to focus on include SR 22, 22/2, 12 and 27, and highway 33.	
Road System	Work with private landowners, when opportunities exist, to encourage road system improvements and improved road maintenance on private lands.	
Aquatic habitat/Water Quality	Restore large woody debris to channels where opportunities exist and benefits warrant.	EA
Aquatic Habitat/Water Quality	Investigate stream channel restoration, on a limited scale, through methods of natural stream channel restoration design, soil bioengineering techniques, Rosgen structures and fish habitat improvements. The Glady Fork main stem is high priority.	EA

Aquatic Habitat/Water Quality	Conduct further stream sampling for sediment amounts and fish population estimates.	
Vegetation Management	Plan vegetation management activities and associated transportation facilities to protect watershed and riparian conditions and functions. Minimize or avoid soil disturbance on steep slopes and sensitive soils. Utilize harvesting techniques that reduce watershed disturbance and sediment source areas, in particular helicopter harvesting, in highly sensitive areas and to reduce new road construction. Helicopter harvesting may be particularly applicable in some areas of steep slopes in the northern portion of the assessment area, and in Mauch Chunk soils. Use Appendix C – Possible silvicultural Actions to help determine harvest units.	Incorporate into EIS
Road system/watershed restoration	Permanently close and remove FR 870 and FR240 from the road system. Erosion control structure and stream crossing work may be necessary. Part of FR240 may be converted to TR701.	EA/EIS
Heritage Resources	Survey riparian areas for new heritage resource sites. Protect and avoid known sites during any project.	EA
Threatened and Endangered Species Management / Vegetation Management	Trees are not to be felled for timber harvesting within 5 miles from hibernacula from April 1 through November 15.	
Threatened and Endangered Species Management	Specific running buffalo clover and small whorled pagonia surveys will be required in the Glady Watershed project areas, prior to any ground disturbing activity.	
Threatened and Endangered Species Management	Determine if trail 701 is a barrier to Cheat Mountain salamander populations in the southwest edge of the watershed.	
Threatened and Endangered Species Management	Select areas to add down woody debris to the forest floor to enhance salamander habitat.	
Threatened and Endangered Species Management	Consider leaving ephemeral pools in closed roads and skid trails if located where they contribute to bat habitat.	
Threatened and Endangered Species Management	Find areas where underplanting with red spruce seedlings would be possible. Underplant red pine stands with red spruce.	

Chapter 5 – Team Composition

The core interdisciplinary team for the Glady Watershed Analysis Report consisted of the following:

Tom Cain – Fisheries Biologist
Barry Edgerton – Hydrologist
Melissa Thomas-Van Gundy – Silviculturist
Jim Knibbs – NEPA Coordinator
Patty McClure – GIS Technician
Ron Polgar – Forestry Technician
Terry Evans– Wildlife Biologist

The extended interdisciplinary team included:

Ruth Brinker – Archaeologist
Carol Rucker – North Zone Recreation Leader
Bill Kerr – Landscape Architect
Karen Stevens – South Zone Wildlife Biologist
Linda Tracy – Geologist
Linton Wright – Soil Scientist