Strategic Forest Management Plan for the Waynesville Watershed
April 27, 2004

Introduction

The Waynesville Watershed occupies an area of approximately 8600 acres in the Allen Creek area of Haywood County, North Carolina (Figures 1 and 2). The town of Waynesville began acquiring this property around 1913 for the purpose of creating a reservoir that would supply the town with high quality water for residential and commercial needs, and for flood control. Construction on the reservoir began in 1977 and was completed in 1980. While the town continues to acquire additional land, the current property boundary includes all of the private land that drains into the reservoir. There are some public holdings in the very upper reaches of the watershed held by the Blue Ridge Parkway (US Department of the Interior, National Park Service). In addition, the city owns some areas, such as Rocky Branch Creek, that drain into Allen Creek north of the reservoir (outside the watershed for the reservoir).

The Waynesville Watershed is classified by the NC Department of Environment and Natural Resources Division of Water Quality as a WS-I watershed, meaning that waters are used as sources of water supply for drinking, culinary or food processing by users desiring maximum protection for their water supplies. WS-I waters are those within essentially natural and undeveloped watersheds with no permitted point source (wastewater) discharges.

The total reservoir capacity is approximately 1.1 billion gallons (86 acres), though it is typically maintained at around 600 million gallons (50 acres) for flood control. The water treatment process includes flocculation, sedimentation, and dual media filtration. The water treatment plant can treat 8 million gallons per day. Currently, about 3.6 million gallons of treated water are used per day. The minimum release of water to maintain flow in Allen Creek is about 2.5 million gallons per day (3.5 cubic feet per second). The estimated yield of the watershed is 12.8 million gallons per day (19.8 cubic feet per second).

The lands within the current watershed boundary have been subjected to a variety of land use practices in the past. The most intensive of these were probably concentrated around the former mountain farm community of Quinland. The more gentle slopes commonly found adjacent to streams were cleared and cropped, with adjacent steeper or more rocky areas cleared and used for pasture. There has also been a long history of timber harvesting in the watershed, which is evidenced by the approximately 90 miles of roads and trails that are still evident.

This document lays out a strategic plan for the management of forested lands within the Waynesville Watershed. This plan outlines a broad management strategy that will guide management activities in accordance with the terms of a working forest conservation easement. A detailed forest management plan will be required to guide site-specific forest management practices within the watershed.

Forest management objectives

The primary forest management goal is to create and maintain a vigorous, healthy, and diverse forest that will ensure the production of high quality drinking water from the Waynesville Watershed land area. Other objectives for the management of this forest will also be pursued, but only in a manner that is consistent with the primary objective stated above. These other objectives include:

- The preservation and protection of biodiversity and of rare and unique plant and animal species.
- The protection of the visual quality of the watershed, particularly as it is viewed from the Blue Ridge Parkway and other surrounding vistas.
- The generation of income through the sale of timber and non-timber forest products.
- The development of a forestry education resource for the surrounding community.

These management objectives are designed to protect the current high quality of the water rather than altering water yield. While it is possible to manage a forest in a manner that increases water yield, most research suggests that to increase yield significantly would require large and continuous reductions in forest cover. Given the steepness of the topography in the Waynesville Watershed, it is believed that such disturbances would lead to reductions in water quality and fail some of the secondary objectives outlined above. If it is determined that the current water needs for the town are not being met, then it would be more effective to employ water conservation measures rather than to implement large-scale manipulation of the watershed forest.

The greatest threats to water quality in this watershed occur in the form of natural and anthropogenic disturbances that might cause significant increases in sedimentation, water nutrient levels, or water temperature. In the Waynesville Watershed, these impacts might occur following either (i) large-scale disturbances that caused significant amounts of tree mortality and/or reductions in forest cover across large land areas within the watershed, or (ii) smaller scale disturbances that caused reductions in forest cover and/or soil disturbances in areas adjacent to streams and waterways. Large-scale disturbances that might cause significant forest mortality include insect and disease outbreaks, wind and ice storms, wildfire, and air pollution. Small-scale disturbances that might negatively impact streams are most commonly associated with heavy equipment operation that might be associated road construction and some timber harvesting activities.

The forest management objectives for this property can best be achieved through the promotion of vigorous, naturally occurring forest communities throughout the watershed. These communities most often contain healthy individuals of species that are best adapted to conditions within the watershed and are best able to resist and recover from damaging agents or events. The watershed can be further protected by structuring the forest in such a way that there is a balance of age classes represented across the landscape. In summary, the best forest condition for this watershed is one that is made up of diverse, naturally occurring forest types, which are maintained in a

vigorous and healthy condition such that they are actively accumulating both nutrients and biomass.

General Forest Description

Soils – The Waynesville Watershed occupies a primarily north-facing valley and occurs at elevations ranging from about 3200 feet near the reservoir to over 6200 feet at Richland Balsam (Fig. 1). The watershed contains deep, well-drained soils that formed in felsic to mafic, high-grade metamorphic and igneous rocks that occur on gently sloping to very steep topography. The soils have differing productivity potentials, and support a wide range of forest types. The Natural Resource Conservation Service mapped all of the soils in the watershed in 1997. The soil map units are shown in Figure 3, and the major soil properties are presented in Appendix I.

Forest Communities – During the summer of 2002, USFS personnel sampled the vegetation within the watershed. They identified and modeled the potential locations of 9, naturally occurring forest communities in the watershed (Fig. 4, Table 1) (no attempt was made to locate and model the locations of the artificially created white pine plantations that exist in areas around the reservoir). The naturally occurring forest communities are described in greater detail in Appendix II.

Table 1. ***Estimated areas of potential forest cover types within the Waynesville Watershed.***

Covertype	Area (acres)	Percent of Watershed
Modeled types:		
Spruce – Fir	390	5
High Elevation Red Oak	1990	23
Northern Hardwood Slope	1675	19
Northern Hardwood Cove	875	10
Mesic Oak – Hickory	1175	14
Pine – Oak – Heath	36	<1
Oak - Heath	360	4
Poplar Cove	990	11
Acidic Cove	1120	13
Unmodeled types:		
White Pine Plantation	~150	~ 1.5

In the spring and summer of 2002, forestry interns working through the Little Tennessee Sustainable Forestry Project performed a reconnaissance survey of the timber resources in the watershed. The results from this inventory indicated that there

are a number of productive forest stands within the watershed, and that there are currently areas that contain large volumes of valuable timber that would support commercial operations. There are also significant opportunities to increase both the volume and value of the timber throughout the watershed through the application of sound forest management practices.

Access Roads – There are approximately 90 miles of roads and trails within the Waynesville Watershed (Fig. 5). The majority of these roads were constructed during past timber harvesting operations. These roads can be separated into either improved (about 30 miles) or unimproved (about 60 miles) based on their present condition.

For the most part, improved roads have moderate grades, are cleared of vegetation and downed trees, and can be used by SUV's or other 4x4 vehicles. Most of these roads have not been graveled, and have limited trafficability during wet conditions. In areas lower in the watershed, near the reservoir, bridges and culverts have been installed where these roads intersect perennial streams. However, there are frequent occurrences higher in the landscape where the roads ford perennial streams.

Unimproved roads comprise a wide range of conditions. In some cases they were old skid trails and landings that were never constructed to high standards, in other cases they were haul roads or access roads that are no longer maintained. Their single common denominator is that they are not currently accessible to vehicular traffic. In most cases the road grade is still evident, though the amount of work required to make these roads usable varies greatly.

Forest Management:

Silvicultural treatments: In order to achieve the forest management objectives outlined for this property, a number of classical silvicultural treatments will be applied. These can be separated into (i) regeneration treatments, which are designed to replace mature trees in a stand with a new crop of trees, and (ii) intermediate stand treatments, which are designed to influence the growth, composition, and condition of the trees currently present in a stand. Table 2 outlines the preferred regeneration treatments that will be employed in the watershed, and a brief description of the silvicultural objectives of each. Regeneration treatments will primarily rely on natural forms of regeneration to provide the next crop of trees.

Intermediate stand treatments will be employed in stands that are growing satisfactorily, and are not in need of regeneration. These treatments will be applied in order to enhance the health and condition of existing stands by removing less desirable stems. Intermediate stand treatments will be prescribed in order to accomplish the following:

- Improve stand vigor by thinning stands that are overstocked.
- Improve stand health by removing trees that are infected with insects or disease.

- Improve stand condition by removing poorly formed or damaged trees.
- Increase species diversity by removing more common species that are competing with less common species.

Table 2. ***Identification and objectives of preferred regeneration treatments.***

Regeneration treatment	Silvicultural objectives
Even-aged methods: ➢ Patch clearcutting – patch sizes ranging from 1 to 10 acres. Trees greater than 2 inches dbh felled.	• Creation of a truly even-aged stand. • Maximize diversity and density of regeneration. • Promote regeneration of the most intolerant species in the stand.
Two-aged methods: ➢ Shelterwood	• Development of a two-storied stand. • Slight reduction in competition for regeneration. • Promote regeneration of both moderately tolerant and intolerant species in the stand.
Uneven-aged methods: ➢ Single tree selection or Small-group selection (openings less than 0.5 acre)	• Develop or maintain a classically uneven-aged stand that mirrors conditions that would develop following canopy gap disturbances. • Continuously maintain a high percentage of mature trees in the stand. • Promote regeneration of the more tolerant species in the stand.
➢ Large-group selection (openings 0.5 to 1 acre)	Same as small-group except: • Increase the diversity of regeneration. • Promote greater development of understory vegetation. • Promote regeneration of some less tolerant species in the stand.

The forest will be managed on roughly a 20-year cycle. This means that each stand within the watershed will be evaluated for treatment approximately every 20 years. The specific treatment to be prescribed for each stand will be based on the condition of the stand at that time, which will be evaluated in the context of the overall goals and condition of the watershed. Based on these analyses, the treatment for each stand might be to either (i) do nothing, (ii) perform an intermediate stand treatment, or (iii) perform a regeneration treatment. A series of compartments will be delineated that will guide which areas will be considered for treatment during each year.

Harvests of forest products from the watershed, when conducted, will be carefully planned to assure a continuing, renewable and long-term source of forest products consistent with the conservation easement goals and objectives. Harvest projections by species or species group, over the period of the forest management plan, and over reasonable horizons beyond the plan, will be sufficiently detailed to demonstrate sustainable forest management.

Forest area available for treatment must be determined, and current scientific methods and site-specific information used to project harvest volumes. Area regulation or other suitable methods can be employed to ensure that variability in harvest volumes is consistent with the conservation easement goals, silvicultural requirements for maintaining a diverse forest, and principles of sustainable forestry.

Published yield tables will be utilized to provide the initial estimate of harvest volume potential. Such yield tables exist for broad regions and must be carefully interpreted and adjusted for local conditions. Where they exist, variable-density yield tables should be utilized. To the degree feasible, computerized stand growth models will be employed to customize projections of timber growth and harvest. Over time, growth data from stands under similar treatment, including but not limited to stands on this parcel will be utilized to ensure that growth and harvest projections are correct.

Riparian zone management: This plan recognizes the fundamental importance of managing riparian zones in order to protect water quality and other ecological values. As such, riparian zones will be managed to achieve the following:

- Maintain adequate filter strips to protect against sedimentation.
- Develop and maintain riparian forests comprised of naturally occurring species that are resistant to disturbance, healthy, and vigorously growing.
- Develop and maintain adequate canopy cover to moderate water temperatures and provide litter inputs to streams.
- Recruit large, old trees that will provide coarse woody debris to streams upon their death.

The maintenance of such forests will sometimes necessitate carefully planned forest management activities, including timber harvesting. Forest management activities in riparian areas will adhere to the following guidelines:

- All criteria outlined by current North Carolina Forestry Practices Guidelines (Best Management Practices) will be met or exceeded.
- As a general rule, no timber will be felled within 25 feet of intermittent or perennial streams. The only exceptions will be for documented instances where timber cutting is required to protect forest health or water quality. Any trees cut within this 25-foot buffer will be directionally felled so as not to fall into the stream.
- As a general rule, no harvesting equipment will be allowed to operate within 50 feet of intermittent or perennial streams. The only exceptions are for approved stream

crossings or documented cases where there is no prudent alternative, and where such alternative would not be expected to negatively impact water quality. Any trees felled within this 50-foot buffer will be directionally felled so as not to fall into the stream.

Rare and endangered species: This plan recognizes the importance of protecting rare and endangered species within the watershed. An initial examination of the watershed indicates that these occur almost exclusively in rugged, high elevation areas, and in the aquatic communities of some streams. These are areas where forest management activities would already be greatly restricted due to (i) riparian management constraints, (ii) protection of the Blue Ridge Parkway viewshed, (iii) low forest productivity potential, or (iv) limited access and equipment operability. The following strategies will be employed to protect and enhance rare and endangered species within the watershed:

- All state and federal laws regarding timber-harvesting restrictions will be followed when threatened and endangered species are encountered.
- The overall biodiversity within the watershed will be maintained or enhanced by maintaining a complex of vigorous, diverse, naturally occurring, forest communities across the landscape.
- All practical steps will be taken to preclude the use or spread of invasive, exotic species.

Special areas: The town of Waynesville can identify areas within the watershed where active forest management is to be precluded, or that will encompass other special or unique uses. Currently, the only area that falls into this category is that portion of the watershed that was recently acquired with the assistance of the Clean Water Management Trust Fund and Section 319 funds (Fig. 6). This plan recognizes that there will be no active forest management within this area.

Conservation logging practices: In addition to meeting or exceeding all current North Carolina Forestry Practices Guidelines, additional care will be employed in the planning and execution of all timber harvesting operations in order to minimize their negative impacts on soils, vegetation, and other site properties. Timber harvests will be planned in consideration of the silvicultural objectives, current stand condition, soil properties, topography, season, weather, and harvesting technology. Particular emphasis will be placed on employing only skilled operators to perform all harvesting within the watershed. In addition, equipment configurations will be constantly reviewed to ensure that equipment is being used that best matches silvicultural objectives and site conditions.

Forest roads: The current road network provides important access into the watershed for monitoring forest condition, fire protection, law enforcement patrolling, and other

necessary uses. These roads also have the potential to provide access to a significant portion of the property for forest management activities, including timber harvesting. Forest roads and trails, whether used for skidding logs or for truck hauling, can be sites of significant soil erosion and sedimentation, and thus must be managed carefully. The following guidelines will apply to the use of forest roads within the property:

- All roads and trails used during forest management activities will be constructed, utilized, and maintained in a manner to meet or exceed criteria outlined in current North Carolina Forest Practices Guidelines.
- As a rule, every effort will be made to utilize existing roads and trails in all forest management activities rather than constructing new roads. The only exception is when additional road construction is required to achieve the goals of this plan.

Broad silviculture strategies for each stand type:

Figure 4 shows the most recent estimate of the distribution of potential forest cover types within the watershed. Forest cover types are not distributed randomly across the landscape, but instead are distributed in response to soil and topographic factors. Not all forest types will be managed with the same intensity. Certain cover types will be managed more actively than others, particularly where (i) such management is needed to protect water quality, (ii) productivity is highest, (iii) operability is the least restrictive, and (iv) financial returns will be the highest. Table 3 outlines the general level of management that will be utilized in each forest cover type.

Implementation: All specific forest management activities will be conducted in accordance with a plan written by a professional forester.

Table 3. ***Broad forest management strategies for potential forest cover types within the Waynesville Watershed.***

Cover type	Management level[1]	Silvicultural systems	Justification
Spruce – Fir	Minimal	Uneven-aged	• Low productivity • Difficult access • Difficult operability • Protect Parkway viewshed • Protect rare communities • Removed from reservoir and higher order streams • Low commercial value
High elevation red oak	Opportunistic	Uneven-aged, 2-aged	• Low productivity • Moderate to difficult access • Difficult operability • Protect Parkway viewshed • Protect rare communities • Distant from reservoir and higher order streams • Low commercial value
Northern Hardwood (slope)	Active	Uneven-aged, 2-aged	• Moderate to high productivity • Moderate access • Moderate operability • Protect riparian zones • Moderate to high commercial value
Northern Hardwood (cove)	Active	Uneven-aged, 2-aged	• High productivity • Moderate access • Moderate operability • Protect riparian zones • Moderate to high commercial value
Mesic Oak – Hickory	Active	2-aged, even-aged	• Moderate to high productivity • Moderate access • Moderate operability • Protect riparian zones • Moderate to high commercial value
Pine – Oak – Heath	Opportunistic	2- aged, even-aged	• Low productivity • Moderate access • Moderate to difficult operability • Removed from reservoir and higher order streams • Low commercial value
Oak – Heath	Opportunistic	2- aged, even-aged	• Low productivity • Moderate access

Table 3. ***Broad forest management strategies for potential forest cover types within the Waynesville Watershed.***

Cover type	Management level[1]	Silvicultural systems	Justification
			• Moderate to difficult operability • Removed from reservoir and higher order streams • Low commercial value
Poplar Cove	Active	Uneven-aged, 2-aged, Even-aged	• High productivity • Moderate access • Moderate operability • Protect riparian zones • Moderate to high commercial value
Acidic Cove	Active	Uneven-aged, 2-aged, Even-aged	• Moderate to high productivity • Moderate accessibility • Moderate operability • Protect riparian zones • Moderate to high commercial value
White Pine Plantation	Active	Uneven-aged, 2-aged, Even-aged	• Moderate to high productivity • Moderate accessibility • Moderate operability • Adjacent to perennial streams and reservoir • Moderate to high commercial value

[1]**Minimal** implies that little if any active management will occur. **Opportunistic** implies that limited management will occur, and that management treatments will generally only be prescribed where need and/or opportunities present themselves. **Active** implies that more frequent and intensive management activities will occur.

APPENDIX I

Major soils in the Waynesville Watershed, and their properties

Moved to Appendix 1 of the Waynesville Watershed Forest Stewardship Plan

APPENDIX II

Description of Potential Forest Communities in the Waynesville Watershed based on 2002 USFS survey

1. Spruce-Fir Forest Zone: This zone includes the highest elevations, typically above 5400 feet, of the southern Appalachians. The habitat is characterized by highly acidic, organic rich soils that are frequently drenched either from ambient rainfall or fog deposition. The forests are distinguished by the presence of either red spruce or Fraser fir. Due to the balsam wooly adelgid, Fraser fir the species is typically a minor component or only present as relatively young trees. Yellow Birch can be co-dominant within this zone. The shrub layer can be dense within this zone although a more open herb subtype is the most common occurrence within this zone. Bryophytes often dominate within the herb layer. About 5% (390 acres) of the watershed is present within this coniferous dominated zone.

2. High Elevation Red Oak Forest Zone: These sites occur on steep slopes and ridgetops on upper to middle slopes at elevations above 3000 feet. The community is dominated by northern red oak (greater than 50%) within the overstory with a variety of other more mesic hardwood species, such as yellow birch, beech, red maple, white oak or chestnut oak co-occurring. American chestnut formerly dominated or co-dominated within this community. Various understory variants of this community are located across the Blue Ridge Mountains. They differ in the degree of openness of the understory. Ericaceous shrubs such as flame azalea, highbush cranberry, lowbush blueberry, highbush blueberry, bear huckleberry and great laurel dominate the shrub layer of the one variant thus inhibiting any well-developed herbaceous layer. This is particularly prevalent along upper north facing slopes in the Blue Ridge escarpment and often referred as the red oak slope forest. Within the other variant of this high elevation red oak forest, the herbaceous layer is more highly developed and typically dominated by New York fern and Pennsylvania sedge with a scattering of bluets, wood rush, hay-scented fern, purple node Joe-pye-weed and Curtis's goldenrod. Both variants were located within the Waynesville watershed. Approximately 23% (1990 acres) of the watershed occurs within this type.

3. Northern Hardwood (cove) Zone: This community occurs in draws, or flats at high elevations; typically above 4200 feet elevation. The community is particularly prevalent on east or north-facing drains. Dominance in the overstory varies between yellow birch, yellow buckeye, sugar maple, and beech, although black cherry and Canadian hemlock can also be frequent. This community type has an open understory with shrubs being uncommon consisting mainly of hobblebush and gooseberry. Herbs are common within this community with white snakeroot, heartleaf aster, Core's starwort, wood ferns, southern lady fern, hedge-nettle, bluebead lily, rosy twisted-stalk and stinking Willie consisting of characteristic species. Ramps are diagnostic of this community. Approximately 19% (1675 acres) of this community has been modeled within the Waynesville watershed.

4. Northern Hardwood (slope) Forest: This type was separated from the Northern Harwood (cove) Forest to distinguish the landscape position. While many of the same tree dominants as Northern Hardwood Cove Forest tend to occur, it is not as productive as the former nor does it have the herb diversity. It is typically dominated in the herb layer with a dense carpet of Pennsylvania sedge. The zone is the large transition area between Northern Hardwood Cove and High Elevation Red Oak. As such forest types include species components from both other zones. The zone differs from High Elevation Red Oak primarily by the lack of dominance by northern red oak although the species can be present as a minor component. A highly specialized type of this zone is the Beech Gap Forest that tends to occur in high elevation gaps with dominance by stunted wind swept beech trees in the canopy and Pennsylvania sedge in the herb layer. Approximately 10% (875 acres) of the Waynesville watershed has been modeled as this type.

5. Poplar Cove Forest Zone: The Rich Cove Forests occur in the mid elevation areas and are typically dominated in the canopy by yellow poplar, but also contains numerous other deciduous hardwood trees including basswood, yellow buckeye, black birch, green ash, red maple, beech, and hickory. The presence of large amounts of sugar maple typically indicates a higher nutrient content in the soil and can result in higher herbaceous species diversity. A variety of smaller trees may be present in the midstory including silverbell, serviceberry, flowering dogwood, alternate-leaved dogwood, and black locust. Slippery elm occurs with this type and indicates higher nutrient content. Within the open understory, Hydrangea is the most common shrub. The herbaceous layer is diverse. While many of the same plant species that occur within the Northern Hardwood Cove Zone can occur within this zone, the presence of yellow poplar, the greater abundance of ginseng, and the absence of wild leek separate the two. Approximately 11% (990 acres) of the area has been mapped as Poplar Cove Forest.

6. Mesic Oak-Hickory Forest Zone: On the mid to lower elevation broad ridges and convex slopes of the mountains a variety of montane oak forest communities occur. Within many sites hickories also codominate with the oaks. Given that this zone is the most common within the southern Appalachians, a tremendous amount of variation occurs across the landscape in this vegetation type. Typically the variants sort out with variable moisture content and soil nutrient content. In addition, previous land use history shapes the present plant community within this zone. The predominant type seen within the Waynesville watershed is the acidic type, although the basic and white pine type may also occur. The low dry subtype does not occur here. It is unclear how closely these communities have evolved with occasional fire disturbance. Natural fires within this type are thought to have been of low to moderate intensity and confined to the forest surface. In those examples with recent prescribed burns, the herb layer appears more diverse with an increase in legumes, for that particular variant of the montane oak type. Approximately 14% (1175 acres) of the area is mapped as this type.

7. Acidic Cove Forest Zone: This zone includes hemlock and mixed mesophytic forests typically dominated by an evergreen understory. The Acidic Cove Forest

community occurs throughout the watershed on sheltered mesic sites from low to mid elevations. Often these communities occur on steep protected slopes along riparian areas. A mixture of black birch, red maple, Canadian hemlock, tulip poplar and Fraser's magnolia dominate the community. Great rhododendron and dog-hobble almost exclusively dominate the understory excluding almost all herbs except for a scattering of galax, rattlesnake plantain and spotted wintergreen. Occasionally in gaps of the shrub layer more characteristic herbs of rich cove forest can occur within this community. Little is known about the dynamics of this community. The rocky acidic soil is thought to maintain the present structure, although there is some evidence that some examples have resulted from heavy disturbance in rich cove forest. The Canadian Hemlock Forest subtype is a variation within this zone. It occupies the same habitat as and is closely associated with and grades to acidic cove forest. It is dominated by eastern hemlock although may codominate with white pine depending on former disturbance patterns. Great rhododendron can be scattered to dense within the shrub layer with doghobble restricted to streamside zones. Herbaceous diversity varies from extremely sparse in heavy ericad cover to moderate diversity in occasional shrub gaps. Diagnostic herbs are the same as acidic coves. Approximately 13% (1120 acres) has been mapped as this type.

8. Oak Heath Zone: On those sharpest ridge points on southern and southwestern exposures throughout the southern Appalachians this community type occurs. Within the Waynesville watershed this type is given the predominant north facing drainage. It primarily occurs on sharper convex slopes adjacent to the Mesic Oak-Hickory Forest. The Chestnut Oak-Scarlet Oak Forest has dominance by xeric oaks such as chestnut oak and scarlet oak with scattered black oak. Red maple, sourwood, serviceberry, and blackgum are lesser components of the canopy and subcanopy within this community. Generally a dense layer of mountain laurel occurs, although in portions of the landscape bear huckleberry and low bush blueberry also dominate. Other ericaceous shrubs present within this xeric type included deer blueberry, flame azalea, and maleberry. Herbaceous diversity is quite sparse within this zone. This community is thought to be fire dependent and in those sites with recurrent burns, the community has a more open shrub layer and a more diverse herbaceous layer. Approximately 4% (360 acres) of the area occurs as this type.

9. Pine -Oak-Heath Forest Zone: On a few steepest portions of the Waynesville watershed, the previous zone grades to a Pine-oak/heath Forest. Pitch pine is a codominant with the xeric oaks in this community type. Both shrub and herb diversity are strikingly similar in this community to the Chestnut Oak-Scarlet Oak Forest. Within the Waynesville watershed this type is uncommon. This zone is the most fire adapted portion of the landscape and certain species such as pitch pine are believed to be dependent on periodic severe fires which open seedbeds for otherwise shade-intolerant species. Less than 1% (36 acres) of the area is mapped as this type.

Unmodeled Plant Community Types

Some rarer plant community types also occur within the Waynesville watershed. Due to their non-repeatable pattern across the landscape as well as their small size, it is difficult if not impossible to accurately map. Typically this habitat component is defined as occurring within a matrix of various other forested plant communities

Heath or Shrub Bald

Heath balds were located within the upper slopes of Shiny Creek drainage. This type occurs scattered at high-elevations throughout the southern Appalachians, typically on exposed knobs, steep ridges and extremely steep slopes. It has a dense shrub layer, typically evergreen, with a few stunted xeric-loving tree species and very few herbaceous members. The predominate shrubs are members of the heath family; Rhododendrons, azaleas, blueberries, huckleberries, minnie bush, fetter bush and sand myrtle. The shallow soils supporting this community type are subject to extremes in moisture given the high ambient precipitation, frequent fog deposition and desiccating winds. Soils are typically much more acidic and nutrient-poor than those surrounding forested soils.

Boulderfields

Boulderfield Forests occur in high steep, typically north-facing slopes with a cool microclimate. The type is the result of a periglacial climate beyond the periphery of the ice sheet during the last ice age. These forests are typically distinguished by a partially open canopy dominated by yellow birch, but also can contain buckeye, black cherry, beech, and red spruce. The shrub skunk-currant is diagnostic of this habitat. Herbs are sparse here since little soil accumulation occurs between the boulders, although in seepage areas a lush carpet of herbs can persist. Moss generally carpets the boulders. This community is closely associated with northern hardwood forest and is distinguished by the partially open canopy and the numerous boulders

Seeps

Seeps occur on flatter portions of stream channels where there are gaps in the shrub layer or the understory is already open. They can occur from low to high elevation sites. The consistently wet conditions present can maintain a partially open canopy. The size is highly variable but typically less than 0.5 acre. At mid to low elevation sites, they are embedded in rich cove forests, although they can be present in acidic cove or Canadian hemlock forests. These sites typically have a closed canopy and are dominated in the shrub layer by black alder, various willows and deciduous holly. Diagnostic herbs include naked rush, various sedges, cinnamon fern, common muhly grass and fowl mannagrass. Within high elevation sites, the community has been delineated as a high elevation seep. A partially open to closed overstory, consisting primarily of yellow birch and yellow buckeye, occurs within this high elevation type. Shrubs are uncommon within this type, although gooseberries are the most characteristic group of species. Characteristic herbaceous species include bee balm, Ruth's sedge, green-headed coneflower, pink turtlehead, tassel rue, stiff cowbane, trailing wolfsbane, false hellebore and umbrella-leaf.

Montane Acidic Rock Outcrops

A tremendous amount of variation occurs within this heterogeneous vegetation type. Individual types can have great disparity between 2 sites as well as within an individual site. These small outcrops are distinguished by the absence of exfoliating surfaces and may be associated with seepage or not. These communities typically occur on steep to very steep to almost vertical slopes over variable geologies. The soil ranges from bare rock areas with no soil, to shallow soil over rock at edges, to deeper organic or mineral soil in cracks. Elevational variation is also present. A diversity of plant species occupy the different niches available. Lichens and bryophytes dominate the rock faces. Shrubs are rare, more commonly associated with the adjacent plant community. Characteristic herbs are Michaux's saxifrage, mountain spleenwort, poverty grass, false Solomon's seal, Elliott's bluestem, Mountain cynthia, wavy hairgrass, beardtongue, mountain-mints, alumroots and various sedges. At higher elevations, more exposed sites many rare disjunct vascular and nonvascular plants occur separated from their main range much further north.

Pine plantations

In addition to the communities described above, there are a number of white pine plantations that were planted to stabilize areas around the reservoir.