AQUATIC RESOURCE ANALYSIS (AQUA)

UNITED STATES FOREST SERVICE
NATIONAL FORESTS IN NORTH CAROLINA

PISGAH NATIONAL FOREST
APPALACHIAN RANGER DISTRICT

Northside Timber Sale
Yancey County

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I. INTRODUCTION

The proposed project is a timber sale and associated management activities in Compartments 53,55, and 56, located in the Flattop Mountain area of Yancey County, North Carolina.

A more complete description of the project proposal can be found in the environmental assessment (EA). Activities that do not have the potential to directly, indirectly, or cumulatively affect aquatic resources or have aquatic resources within or adjacent to them will not be considered in this AQUA. Table 1 summarizes proposed activities considered in this AQUA. Since the three action alternatives considered in this AQUA are the same in terms of potential to affect aquatic resources, the discussion of potential effects is relevant to either action alternative. Potential effects of the no action alternative will be discussed separately.

TABLE 1. Proposed activities for the Flat Top Timber Sale included in this AQUA.

Activity	Alt. 1	Alt. 2	Alt. 3	Alt.4
Unit #1 Stand 56/1				
Unit #2 Stand 55/11		X	X	X
Unit #3a Stand 53/2		X	X	X
Unit #3b Stand 53/2		X	X	X
Unit #4 Stand 53/2		X		
Unit #5 Stand 53/11		X	X	X
Site Prep (manual)	X	X	X	
Site Prep (herbicide)	X			X
Prescribed burn			X	X

The proposed project lies within the Big Creek and Spivey drainage basins (LRMP watershed #s 47 and 19). Attachment 1 shows these sub-basins in relation to the local aquatic environment. Table 2 lists water bodies (streams, rivers, ponds, lakes, and reservoirs) involved with the project proposal and approximate mileage (or acreage) within the aquatic project and analysis areas. Only headwater reaches of Big Creek, Little Spivey Creek, and Spivey Creek are within the aquatic project and analysis areas. Attachment 1 highlights the aquatic project and analysis areas.

TABLE 2. Aquatic resources included in this AQUA.

Water Body	Within Project Area	Within Analysis Area
Big Creek	0 miles	0.95 miles
UT #1 Big Creek	0 miles	0.19 miles
UT #2 Big Creek	0 miles	0.19 miles
Little Spivey Creek	0 miles	1.14 miles
UT #1 Little Spivey Creek	0 miles	0.19 miles
UT #2 Little Spivey Creek	0 miles	0.19 miles

UT #3 Little Spivey Creek	0.09 miles	0.09 miles
UT #4 Little Spivey Creek	0.09 miles	0.37 miles
Spivey Creek	0 miles	1.14 miles
UT #1 Spivey Creek	0.19 miles	0.38 miles
UT #2 Spivey Creek	0.19 miles	0.38 miles
TOTAL	**0.56 miles**	**5.21 miles**

Aquatic Project Area

The aquatic project area is defined as the area of potential site-specific impacts on aquatic habitat and populations and contains approximately 0.56 miles of streams within the Northside Timber Sale. It is important to note that the aquatic project area includes headwater reaches of unnamed tributaries to Little Spivey and Spivey Creeks. Because of recent weather patterns, it is difficult to determine if these areas are intermittent or perennial channels. There is evidence of high flow and associated stream channel movements (such as downcutting and braiding); however, there is no aquatic habitat suitable for fish populations. There is limited aquatic habitat suitable for aquatic invertebrate populations within the aquatic project area given the apparent unstable nature of flow regimes and channel form.

Aquatic Analysis Area

The aquatic analysis area, or area of this effects analysis, includes the aquatic project area and downstream reaches to the confluence of Little Spivey and Spivey Creeks. It also includes two unnamed headwater tributaries to Big Creek from approximately 300 yards above old Forest Service road 278 downstream to Highway 19-W and Big Creek from Spivey Gap downstream to the entrance to the old hunt camp. The aquatic analysis area includes approximately 5.21 miles of intermittent and perennial streams within the Big Creek and Spivey Creek watersheds.

II. **AQUATIC SPECIES CONSIDERED AND SPECIES EVALUATED**

National Forests in North Carolina recognize three types of rare species during a NEPA analysis, which are described below. Species meeting these criteria that occur or potentially occur on the Forests are listed in Attachment 2.

A **proposed, threatened, or endangered species (T, E, PT, and PE)** is a species that has been formally listed or is proposed for listing by the United States Fish and Wildlife Service. These species are included in every AQUA conducted for projects within a watershed where the species is known to, likely to, or may occur. These species are also included in AQUAs for watersheds where the species occurred historically but haven't been found during recent surveys.

A **sensitive species (S)** is a species appearing on the Regional Forester's Sensitive Species list for the Southern Region. These species may or may not have a Federal or State status, but generally have a global rank of G1, G2, or G3 and a State rank of S1 or S2. These species are included in every AQUA conducted for projects within a watershed where the species is known to, likely to, or may occur.

A **<u>Forest concern species (FC)</u>** is a species which National Forests in North Carolina considers to be generally rare, and an important part of the biodiversity across the Forests that do not fall within one of the above categories. These species may or may not have a Federal or State status, and generally have a global rank of G3 or lower and a State rank of S1 or lower. These species are included in every AQUA conducted for projects within a watershed where the species is known to or is likely to occur. The large group of Forest concern species, which may occur within the aquatic analysis area, but are not known to or are not likely to occur within this area are addressed collectively as the aquatic insect community.

A **<u>management indicator species (MIS)</u>** is a species that the National Forests in North Carolina selected for emphasis in planning and will be monitored during Forest plan implementation to assess the effects of management on their conditions and trends and the effects on diversity and population viability of all native and desirable non-native plants and animals.

Brook (*Salvelinus fontinalis*) and rainbow trout (*Oncorhynchus mykiss*) are known to occur within the aquatic analysis area. Longnose (*Rhinichthys cataractae*) and blacknose dace (*Rhinichthys atratulus*) and mottled sculpin (*Cottus bairdi*) may occur within the aquatic analysis area in Tennessee. Brook and rainbow trout were chosen as project-level management indicator species since they are sensitive to changes in water quality and habitat condition and occur or may occur in streams within the aquatic analysis area where suitable habitat exists. Blacknose dace (*R. atratulus*) and mottled sculpin (*C. bairdi*) were not chosen as project-level MIS because of their limited distribution within the aquatic analysis area.

Thirty-five rare aquatic species have been listed by the NCWRC, USFWS or NCNHP as occurring or potentially occurring in Yancey County. These species are listed in Attachment 3. Of the thirty-five aquatic species included on the original list for analysis, sixteen were dropped as a result of a likelihood of occurrence evaluation based on preferred habitat elements and field survey results. Species that do not occur (based on survey results) or are not likely to occur (based on a lack of suitable habitat) are removed from the list of species considered. This process is summarized in Attachment 3.

The hellbender (*Cryptobranchus alleganiensis*), sharphead darter (*Etheostoma acuticeps*), and tangerine darter (*Percina aurantiaca*) are known to occur within Unicoi County, Tennessee (Carter, pers. comm. 1998). The hellbender and tangerine darter are listed as locally rare (i.e. Forest Concern species) in Tennessee while the sharphead darter is listed as regionally sensitive by the Forest Service (i.e. Sensitive species). These species are included in the list for Yancey County, North Carolina.

The snubnose darter (*Etheostoma simoterum*) is known to occur in Spivey Creek well downstream of the aquatic analysis area in Tennessee, but not in North Carolina portions of the stream, or anywhere in Yancey County. This species is considered rare in North Carolina (Forest Concern) but not in Tennessee. Therefore, *E. simoterum* is not included in this analysis.

Another fish species, banded sculpin (*Cottus carolinae*) is considered rare in North Carolina and not in Tennessee, and could occur in Yancey County streams. Because of a similarity of appearance, it is difficult to discern *C. carolinae* from the mottled sculpin (*Cottus bairdi*), which is common throughout the Tennessee River basin. Usually, *C. carolinae* is included in aquatic resource analyses for areas where *C. bairdi* is known to occur because of their similarity in appearance and difficult field identification; however, in this case, taxonomic experts have identified the sculpin found in Spivey Creek as *C. bairdi* (TNDOT 1995). Therefore, *C. carolinae* is not included in this analysis.

Therefore, potential effects of the proposed project on two aquatic MIS and nineteen rare aquatic species will be analyzed in this report. These species are listed in Table 3.

Table 3. Known and potential threatened and endangered species, sensitive species, Forest concern species, and MIS evaluated for this project.

SPECIES	TYPE	HABITAT	OCCURRENCE
Federally Threatened and Endangered Species			
NONE			
2002 Region 8 Regional Forester's Sensitive Species List			
NONE			
Forest Concern Species			
Agapetus jocassee (a caddisfly)	Caddisfly	Lotic- erosional	May occur in both project and analysis areas.
Ceraclea species 1 (Lenat's ceraclea)	Caddisfly	Lotic and Lentic	May occur in both project and analysis areas.
Madeophylax altus (Mount Mitchell caddisfly)	Caddisfly	Lotic	May occur in both project and analysis areas.
Cordulegaster erronea (tiger spiketail)	Dragonfly	Lotic – Depostional (headwater streams, sand, silt, and detritus)	May occur in both the project and analysis areas.
Gomphus abbreviatus (spine-crowned clubtail)	Dragonfly	Lotic- depostional Lentic- littoral (sediments, primarily silt)	May occur in both project and analysis areas.
Gomphus adelphus (moustached clubtail)	Dragonfly	Lotic- depositional Lentic- littoral (sediments, primarily silt)	May occur in both project and analysis areas.
Gomphus borealis (beaverpond clubtail)	Dragonfly	Lotic – Depositional Lentic - Littoral	May occur in both project and analysis areas.
Gomphus consanguis (Cherokee clubtail)	Dragonfly	Lotic – Depositional Lentic - Littoral	May occur in both project and analysis areas.

Gomphus descriptus (harpoon clubtail)	Dragonfly	Lotic- depositional Lentic- littoral (sediments, primarily silt)	May occur in both project and analysis areas.
Gomphus lineatifrons (splendid clubtail)	Dragonfly	Lotic- depositional Lentic- littoral (sediments, primarily silt)	May occur in both project and analysis areas.
Gomphus parvidens parvidens (piedmont clubtail)	Dragonfly	Lotic – Depositional Lentic - Littoral	May occur in both project and analysis areas.
Gomphus ventricosus (skillet clubtail)	Dragonfly	Lotic- depositional Lentic- littoral (sediments, primarily silt)	May occur in both project and analysis areas.
Gomphus viridifrons (green-faced clubtail)	Dragonfly	Lotic- depositional Lentic- littoral (sediments, primarily silt)	May occur in both project and analysis areas.
Lanthus parvulus (Northern pygmy clubtail)	Dragonfly	Lotic – Erosional and Depositional (sand and detritus in spring streams)	May occur in both the project and analysis areas.
Ophiogomphus asperses (brook snaketail)	Dragonfly	Lotic- Erosional and depositional (sand) of small cold streams. (running water riffles, pools, and margins)	May occur in both project and analysis areas.
Ophiogomphus mainensis (Maine snaketail)	Dragonfly	Lotic- Erosional and depositional (sand) of small cold streams. (running water riffles, pools, and margins)	May occur in both project and analysis areas.
Stylurus amnicola (riverine clubtail)	Dragonfly	Lotic- depositional Lentic- littoral (sediments, primarily silt)	May occur in both project and analysis areas.
Stylurus scudderi (zebra clubtail)	Dragonfly	Lotic- depositional Lentic- littoral (sediments, primarily silt)	May occur in both project and analysis areas.
Serratella spicilosa (spicilose serratellan mayfly)	Mayfly	Lotic – Erosional and Depositional	May occur in both project and analysis areas.

Management Indicator Species			
Salvelinus fontinalis (Brook trout)	Fish	Mountain Streams	Known to occur in the analysis area.
Oncorhynchus mykiss (Rainbow trout)	Fish	Mountain Streams	Known to occur in the analysis area.

Definitions for the various types of likelihood of occurrence are as follows:

"Known to occur" – those species of which there is documentation that the species exists within a specified area, or it was found in the area during surveys.

"Likely to occur" – those species of which there is no documentation of the species occurring in a specified area but are expected to occur based on documentation of very similar habitat to known populations. For purposes of the AQUA, it should be assumed that the species does occur in a specified area until presence/absence of the species is verified.

"May occur" – the species probably occurs in a specified area in the broadest sense. Only very general habitat preferences and species distribution are used to determine if a species may occur. This does not imply their existence in an area, but that their general habitat description is found in the area, so therefore the species may occur.

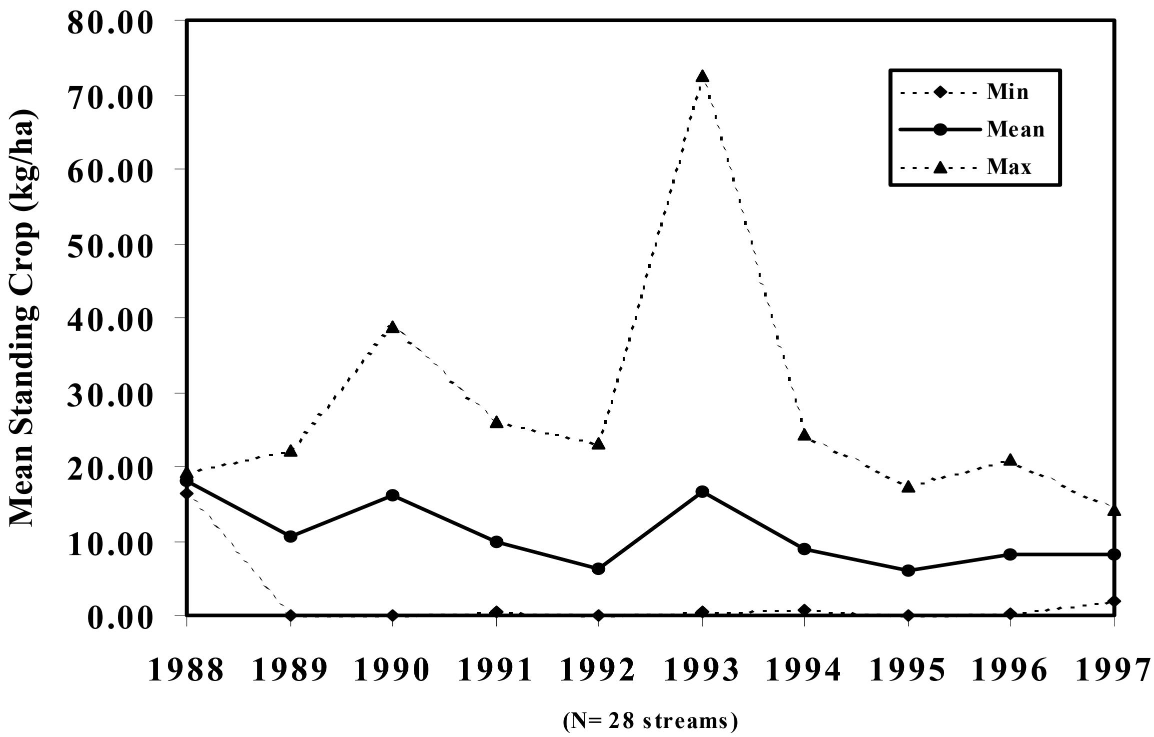
"Not likely to occur" – Suitable habitat for a species may exist in a specified area, but there is other information known about the area and/or the species to determine that it is not likely to occur. These species are not included in the analysis.

"Does not occur" – exhaustive surveys (existing and ours) have not found the species in the project and/or analysis areas. These species are not included in the analysis.

Aquatic MIS population monitoring results

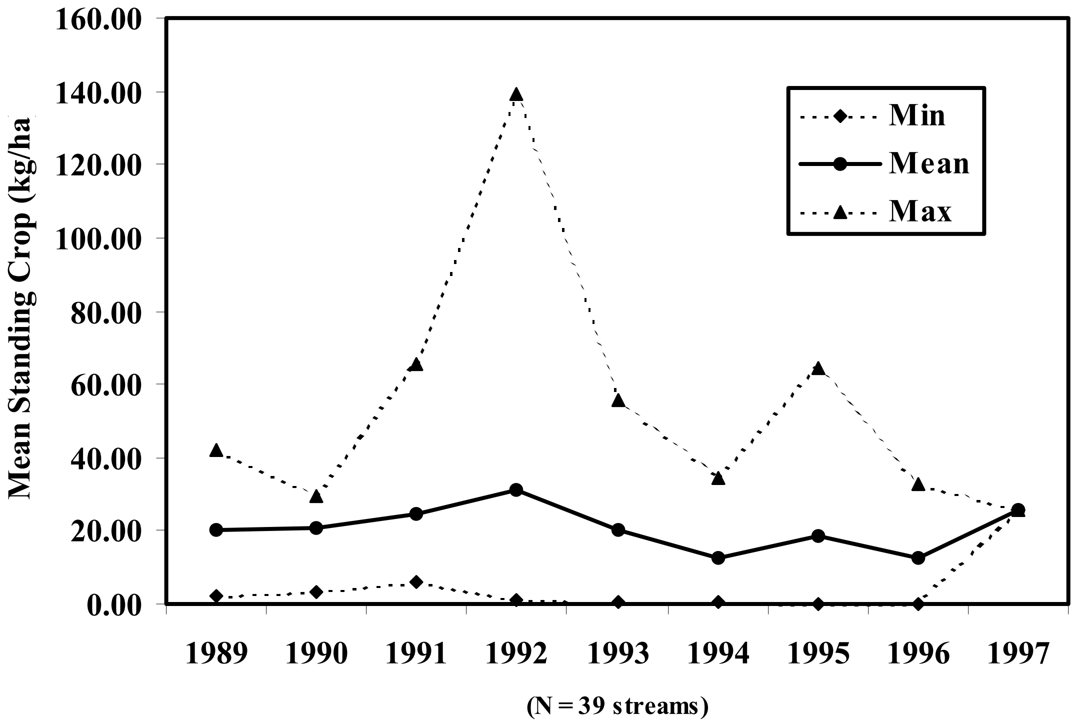
Since 1988, brook trout populations in 28 streams across the Nantahala and Pisgah National Forests have been monitored by the USFS and NCWRC. Figure 1 summarizes a preliminary analysis of this data. Brook trout mean standing crop (the amount of fish flesh per unit of area) has ranged from 5.98 kg/ha to 18.15 kg/ha, with a mean standing crop over this time period of 10.89 kg/ha. Sixty percent of annual estimates of mean standing crop are within one standard deviation of the mean standing crop over the monitoring period (i.e. between 6.40 kg/ha and 15.38 kg/ha). This indicates that there is perhaps not as much variability in total brook trout populations over time as once thought. Brook trout population age-class structure does exhibit considerable variability over time and is discussed below.

Figure 1. Brook trout (*Salvelinus fontinalis*) population trends across the Nantahala and Pisgah National Forests, 1988-2000.



Since 1989, rainbow trout populations in 39 streams across the Nantahala and Pisgah National Forests have been monitored by the USFS and NCWRC. Figure 2 summarizes a preliminary analysis of this data. Rainbow trout mean standing crop has ranged from 12.48 kg/ha to 30.94 kg/ha, with a mean standing crop over this time period of 20.69 kg/ha. Sixty-seven percent of the annual estimates are within one standard deviation of the mean standing crop over the monitoring period (i.e. between 14.80 kg/ha and 26.58 kg/ha). This indicates that there is perhaps not as much variability in rainbow trout populations over time as once thought. Rainbow trout population age-class structure does exhibit considerable variability over time and is discussed below.

Figure 2. Rainbow trout (*Oncorhynchus mykiss*) population trends across the Nantahala and Pisgah National Forests, 1989-2000.



Monitoring data shows that fish populations are not static over time, but rather that a range of population levels oscillate around some mean value, with some species or age classes supporting higher standing crops when environmental conditions are suitable or lower standing crops when conditions are adverse. Aquatic community structure is opportunistic in that as standing crops of one species or age class decline, standing crops of other species or age classes increase relative to their habitat requirements and the new habitat available from the declining stock. This give and take has proven to be cyclic, and that in the absence of catastrophic events (e.g. prolonged drought, successive floods, long-term sedimentation), fish communities will exhibit this cyclic pattern.

Based on a preliminary analysis of the monitoring data, there appears to be no difference in population dynamics across the Forests. It is important to remember that different streams have the inherent capability to support varying population levels, and that ultimately habitat quality and quantity and environmental variables control the fate of fish populations. Forest management activities, as well as natural events such as droughts and floods, have the potential to affect part of a fish population (e.g. spawning success may be affected by sedimentation), and that these effects may be long- or short-term, depending on the duration and magnitude of the event. It is possible to lose a year class of blacknose dace if spawning habitat is temporarily reduced during a poorly timed culvert installation, as well as during a spring flood. Very rarely does the loss of one year class affect long-term population viability. The successive loss of year classes, however, can result in long-term declines in fish standing crops. It is important to note that environmental variables, man-induced land uses, or both can cause successive year class failures.

Based on monitoring efforts since 1988, it does not appear that any stream or its populations have suffered long-term effects of land management or of natural forces. A closer look at the data reveals single year-class failures for brook trout and rainbow trout in one stream or another at some point, but successive year class failures were not found on any stream for any of these species during the monitoring period.

III. ENVIRONMENTAL BASELINE FOR SPECIES EVALUATED

EXISTING CONDITION

Existing Threats to Aquatic Habitat and Populations

Currently, runoff from Highway 19-W and riparian disturbances along power line rights-of-ways are affecting aquatic habitat and populations within Big Creek. It is reasonable to assume that sedimentation of pool habitats and thermol pollution from increased solar radiation within the power line corridors is occurring. In addition, chemical runoff from vehicle traffic and road maintenance (e.g. right-of-way maintenance using herbicides and snow and ice control using salt and other chemicals) is likely affecting aquatic communities within Big Creek since Highway 19-W parallels (and is adjacent to) the stream for most of its length.

Culverts along the Forest Service Road, the road itself, and existing old roads and skid trails are the existing threats to the headwaters of Spivey and Little Spivey Creeks. Impacts from these sources are limited to downslope movement of sediment from road runoff and culvert fills. It is suspected that sediments from these sources are deposited in the natural vegetative filters before they reach areas of perennial water since the road is closed to all but administrative and fire control traffic (i.e. road disturbance is limited). There is an area adjacent to Unit 3 where a very old skid trail is within one branch of a headwater stream. This has resulted in the widening and braiding of the channel. Most sediment movement from this area appears to be deposited above the culvert at the system road. This is one case where a potentially undersized culvert (it stays partially blocked) may have helped downstream water quality by creating a filter and depositional area for runoff sediments.

IV. EVALUATED SPECIES SURVEY INFORMATION

Existing data for aquatic resources within an aquatic analysis area is used to the extent it is relevant to the project proposal. This data exists in two forms: general inventory and monitoring of Forest aquatic resources, and data provided by cooperating resource agencies from aquatic resources on or flowing through the Forest. Both of these sources are accurate back to approximately 1980 and are used regularly in project analyses. Data collected prior to 1980 is used sparingly (mostly as a historical reference). Project-specific surveys are conducted to obtain reliable data where none exists.

Aquatic Habitat

Sheryl A. Bryan, Forest Service Fisheries Biologist conducted aquatic habitat surveys of the proposed aquatic project and analysis areas on March 23 1998. Mrs. Bryan revisited these areas in July 1998 while conducting aquatic invertebrate monitoring for the Big Creek Timber Sale. On September 1, 2000, Kelly Howell, Forest Service Fisheries Biologist, went back to the aquatic project and analysis areas to survey and see if there had been any change in habitat since Mrs. Bryan's last visit. The surveys consisted of examining streams within the aquatic project area, noting habitat quality, quantity, and suitability for rare aquatic and management indicator species, as well as existing impacts and their source.

The site descriptions were taken in part from Fisheries Biologist, Sheryl Bryan's, field notes dated 3/23/98.

Unit #1. Has been dropped from harvest consideration.

Unit #2. This unit is dry but borders a small stream on the west side. The channel is well defined but steep. The substrate is composed of cobble and small boulders with very little sediment in the stream channel. Small pools were present above the road, but too small to harbor fish. Aquatic invertebrates were present. Riparian vegetation composed of rhododendron, poplar and white pine.

Unit #3a. Contains an unnamed tributary to Little Spivey Creek that appears to be intermittent. The channel is wide and not well-defined showing braiding. There is a spring located at the head approximately 350 feet above the road. This fork doesn't contain fish habitat. There were some wet areas in the vicinity along with some ephemeral and intermittent channels.

Unit #3b. Contains an unnamed tributary to Little Spivey Creek that is possibly a perennial. There was evidence of high flows and the channel is well defined. The stream is approximately 1 meter wide. Substrate is composed of gravel and small cobble. This fork doesn't contain fish habitat. There is an old skid road paralleling the channel that should not be used during the proposed sale.

Unit #4. No aquatics concern.

Unit #5. There were three springs at or near the road within the unit. Riparian areas were designated. There were two unnamed tributaries to Spivey Creek in the unit. Channel characteristics were well defined.

Little Spivey Creek at the NC/TN line. This is a relatively flat, meandering channel. The channel is braided in many places with poorly defined pools that are shallow and sedimented. The substrate is mostly gravel and small cobble.

Spivey Creek at TN. The channel is approximately 3-4 meters wide with numerous pools. The substrate is composed of cobble, boulders, and bedrock.

Aquatic Populations

Fish population surveys of streams within the aquatic analysis area were conducted during the summers of 1990 and 1993-95 (not all streams were sampled in each of these years) by U.S. Forest Service (USFS) and North Carolina Wildlife Resources Commission (NCWRC) personnel and by representatives for the Tennessee Wildlife Resources Agency (TWRA) and Tennessee Department of Transportation (TNDOT) using standard backpack electrofishing techniques. Invertebrate samples were taken using a modified kicknet or a Surber sampler.

It is important to note that the types of surveys used are intended to provide information on what fish and invertebrate species are present in the stream at the time of the survey, and may not reflect the seasonal dynamics of many species. Generally, these surveys are conducted at the time of year when the project is expected to be implemented (e.g. summer) to more accurately determine what species could be present during project implementation. It is also important to note that the techniques used do not sample the entire population, but rather what is present at the sample site. It is possible to miss species due to habitat distribution and the natural patchiness of aquatic populations, and to equipment efficiency. However, if there is reason to believe that a species occurs that was not sampled during the surveys (e.g. the existence of historic records or presence suitable habitat and nearby records), it is included in the analysis.

Table 4 describes existing fish populations within the aquatic analysis area. Figure 3 and Table 5 describe the fish community within lower Spivey Creek in Tennessee (downstream of the aquatic analysis area). This information was included to set bounds on fish species potentially occurring within the aquatic analysis area. Although highly unlikely based on survey data, local topography, and species habitat requirements, it would be possible to find any of the species listed in Table * within the aquatic analysis area supporting fish.

Table 4. Fish species distribution within the aquatic analysis area for the Northside Timber Sale,
based on 1990 and 1993 surveys of area streams (USFS 1990 and 1993, NCWRC 1993).

Stream	Site	Brook Trout	Rainbow Trout
Big Creek	Headwaters; above falls	X	
UT (2) Big Creek	Below Spivey Gap	NO FISH PRESENT	
Little Spivey Creek	TN line		X
Little Spivey Creek	Headwaters; along 19-W	NO FISH PRESENT	

Spivey Creek	TN line	X
Spivey Creek (RFk)	Forks in stream	X
Spivey Creek (LFk)	Forks in stream	X
Spivey Creek	Headwaters; Whistling Gap	NO FISH PRESENT

Figure 3. Fish community summary for Spivey Creek, Unicoi County, Tennessee (TNDOT 1995).

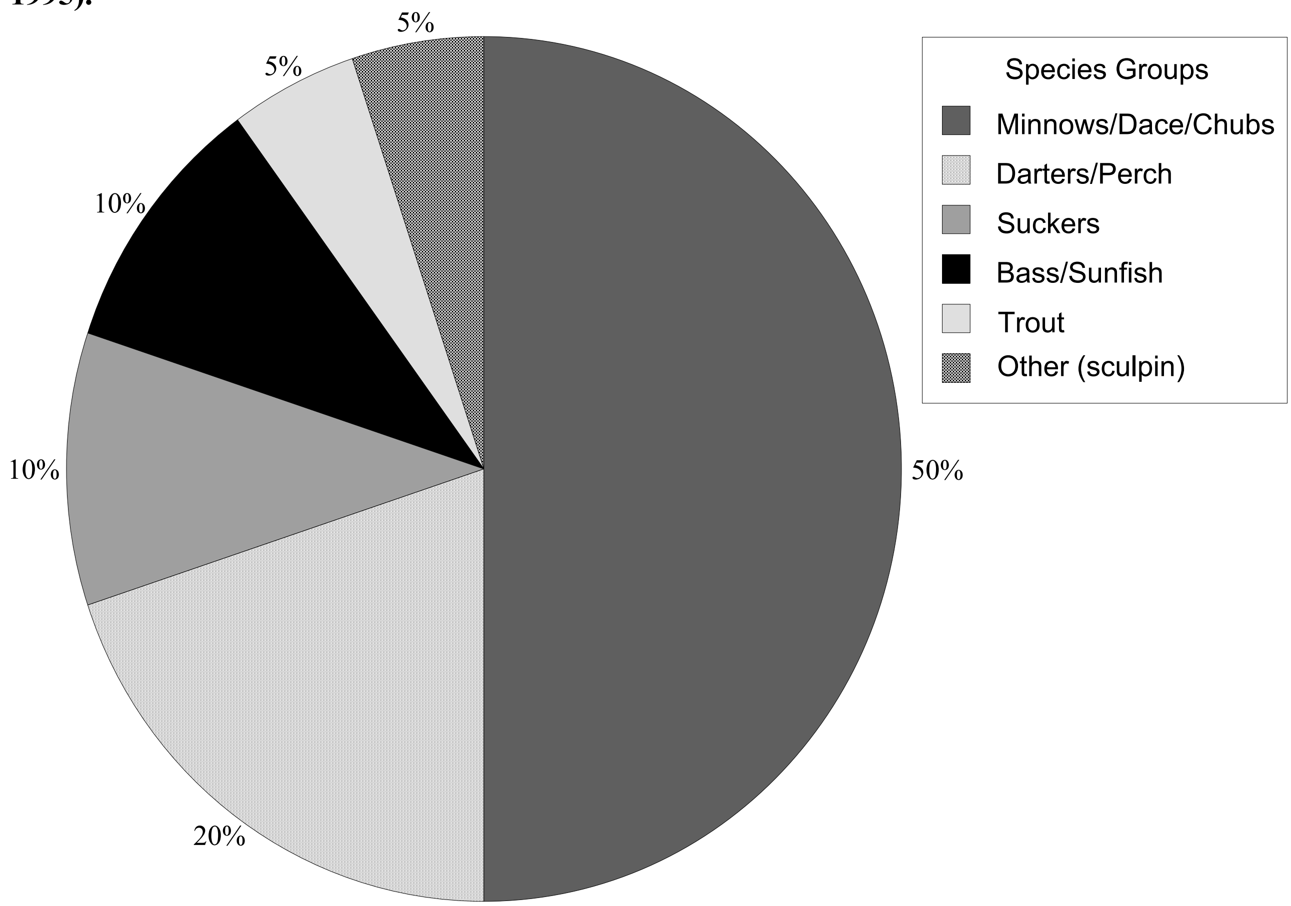


Table 5. Fish species occurring within Spivey Creek, Unicoi County, Tennessee (TNDOT 1995).

Numbers in parentheses indicate species density (#/ha, seasonal average).

Common Name	Scientific Name	Species Group
Central stoneroller	*Campostoma anomalum* (244)	Minnow
striped shiner	*Luxilus chrysocephalus* (2)	Minnow
warpaint shiner	*Luxilus coccogenis* (68)	Minnow
river chub	*Nocomis micropogon* (91)	Chub
Tennessee shiner	*Notropis leuciodus* (2)	Minnow
saffron shiner	*Notropis rubricroceus* (232)	Minnow
telescope shiner	*Notropis telescopus* (15)	Minnow
whitetail shiner	*Cyprinella galactura* (10)	Minnow
fatlips minnow	*Phenacobius crassilabrum* (1)	Minnow

blacknose dace	*Rhinichthys atratulus* (6)	Dace
longnose dace	*Rhinichthys cataractae* (27)	Dace
white sucker	*Catostomus commersoni* (<1)	Sucker
Northern hogsucker	*Hypentelium nigricans* (19)	Sucker
rainbow trout	*Oncorhynchus mykiss* (9)	Trout
mottled sculpin	*Cottus bairdi* (147)	Other
rock bass	*Ambloplites rupestris* (13)	Sunfish
smallmouth bass	*Micropterus dolomieu* (5)	Bass
greenside darter	*Etheostoma blennoides* (11)	Darter
greenfin darter	*Etheostoma chlorobranchium* (29)	Darter
snubnose darter	*Etheostoma simoterum* (31)	Darter
Swannanoa darter	*Etheostoma swannanoa* (5)	Darter

No nongame fish species were sampled from analysis area reaches, which is likely due to physical barriers (e.g. waterfalls, road culverts) downstream of the aquatic analysis area. The nongame species known to occur downstream in Big Creek and Spivey Creek are small and thus have limited upstream mobility.

V. DISCUSSION

Please refer to the Environmental Assessment for a complete list of project issues and a detailed description of each alternative. Mitigation measures will be stated where such actions are necessary to comply with local, State, and Federal environmental regulations. Management recommendations to protect or enhance aquatic resources are made where practical.

GENERAL EFFECTS

Direct Effects

Examples of direct effects of a proposed action on aquatic species include (but are not limited to) things such as crushing individual insects, fish, or redds during stream crossing installation. Such effects are more likely to occur to less mobile aquatic organisms (e.g. aquatic insects, freshwater mussels, and fish eggs and larvae). Whereas, more mobile species such as crayfish, aquatic salamanders, and juvenile and adult fish are often able to escape direct effects by simply leaving the area (emigration).

Examples of direct effects on aquatic habitat include, but are not limited to, things such as changes in the quality, quantity, or diversity of habitat available resulting from sedimentation (or a reduction thereof). It is important to note that effects on aquatic habitats from management activities can be positive or negative, depending on the nature of the proposed actions and site-specific conditions.

Indirect Effects

Examples of indirect effects of a proposed action on aquatic species include (but are not limited to) altered reproductive or foraging success and increased disease as a result of sedimentation and degraded water quality and altered community structure as a result of migration (see above).

Examples of indirect effects on aquatic habitat include, but are not limited to, things such as changes in the quality, quantity, or diversity of habitat available resulting from changes in riparian vegetation. Specifically, the transport of large woody debris (LWD), an integral component of aquatic habitat diversity, to stream channels is a function of riparian vegetation structure and composition. It is important to note here that the Forest Plan does not allow vegetation management within 100 feet of perennial streams unless it is specifically for the enhancement of riparian values. This standard was designed to allow vegetation along streams to become old and decadent and to serve as a long-term source of LWD to stream channels. However, areas exist across the Forests where vegetation can be managed within designated riparian areas to facilitate LWD transport and serve as a short-term source of habitat improvement.

Cumulative Effects

Cumulative effects on aquatic species and habitat are the integration of any direct or indirect effects discussed above into the existing condition. Most often, we think of cumulative effects as a degradation or improvement of an already impacted situation, but they can also be the first step in the degradation or improvement process. It is important to note that cumulative effects on aquatic habitats and populations from management activities can be positive or negative, depending on the nature of the proposed actions and site-specific conditions.

Potential Effects of the No Action Alternative (Alternative 1)

Implementation of the no action alternative would perpetuate the existing condition described above. Aquatic habitat quality and quantity and populations would continue in their natural dynamic patterns. It is important to note that natural processes include aspects such as extinction of species and loss of habitat types. There would be no impacts upon the nineteen Forest Concern species or the two MIS species from implementation of this alternative.

Cumulative Effects: Please refer to the section of this analysis titled "Existing Threats to Aquatic Habitat and Populations".

In addition, the Big Creek Timber Sale area is adjacent to the aquatic resource analysis area for this project. Please refer to the Big Creek Timber Sale AQUA, pages 11-15 (Bryan 1997) for a description of potential effects this forest management on Big Creek. The Big Creek Timber Sale AQUA found that implementation of that project would have no negative effects on aquatic habitat or populations within Big Creek. In fact, that project proposed aquatic habitat improvement within Pit Branch (a tributary to Big Creek) that will improve aquatic habitat condition and population stability within the area.

Angling pressure within the aquatic analysis area for this proposal is not an issue since the streams involved do not support significant fish populations. Trout fishing pressure is affecting Big and Spivey Creeks downstream of the aquatic analysis area where the streams are accessible from the road right-of-way and support catchable-sized fish.

Potential Effects Common to Alternatives 2, 3, and 4

Direct Effects

Access to the proposed units is already in place except for skid trails. Riparian areas have been identified as 100 feet on either side of perennial channels. No activity, except for stream crossings can occur within this area.

There is the possibility that as trees are cut, they will cross a stream channel or spring. While large woody debris in and adjacent to stream channels is desirable for aquatic habitat diversity, it needs to be of the same scale as the channel size and type. Streams within the aquatic analysis area are small and support limited fish populations. The scales of the trees and stream channels do not match, and it is possible that leaving large tree boles in the channels and across springs could result in flow obstruction, which can lead to accelerated bank scouring and failure, and subsequently, sedimentation of local and downstream channels.

Sedimentation of aquatic habitats within the aquatic analysis area could result in the loss of clear-flowing spring habitats and valuable headwater stream origins. Aquatic species utilizing these areas (such as the dragonflies) could be locally lost. Spawning areas for fishes occupying downstream reaches (brook and rainbow trout) could also be reduced or lost to sedimentation. Stream gradients and flow regimes within the analysis areas may not be dynamic enough to rely on natural flushing to occur. Therefore, any losses have the potential to be permanent. To avoid the potential for this habitat loss, trees accidentally felled across stream channels or springs should be removed. "Drag lanes" should not be designated for the removal of these trees to avoid severe bank disturbance. Rather, trees should be removed individually, from where they fell. It is unlikely that pulling individual trees across will result in permanent stream bank damage. Any damage done to the stream banks will most likely be temporary, as there is an abundance of herbaceous vegetation along the banks that will quickly recolonize bare soil.

Indirect Effects

The potential loss of clear-flowing springs and spawning habitats would result in decreased diversity of aquatic species and reduced trout spawning success. Given the very nature of these types of habitats (i.e. they naturally support a low diversity of aquatic species), and the situation that little is known about aquatic insect communities within these areas, any decreases in diversity could indicate the loss of individual species or groups of species. Within a defined area such as the aquatic analysis area, it is not known how communities relate or compare from one spring to another. A species or group of species could be lost from an impacted spring, affecting species viability locally (i.e. within that particular spring), but this may not translate into a decrease in the overall viability of the species at the larger analysis area and landscape scales. In effect, each spring is an island of suitable habitat for the associated insect and fish communities, with island biogeography principles operating at this small scale. Because so little is known about the function and composition of this type of aquatic habitat, it is extremely important to protect these "islands".

Cumulative Effects

Please refer to the cumulative effects discussion above. It is very unlikely that, given the location and types of management proposed, any effects on aquatic resources will be measurable, and therefore contribute to cumulative effects. There has been a tremendous amount of planning and resource specialist involvement in the planning and design of the units proposed for the Northside Timber Sale. Critical aquatic resource areas were dropped from the overall proposal.

Examples of indirect effects on aquatic habitat include, but are not limited to, things such as changes in the quality, quantity, or diversity of habitat available resulting from changes in riparian vegetation. Specifically, the transport of large woody debris (LWD), an integral component of aquatic habitat diversity, to stream channels is a function of riparian vegetation structure and composition. It is important to note here that the Forest Plan does not allow vegetation management within 100 feet of perennial streams unless it is specifically for the enhancement of riparian values. This standard was designed to allow vegetation along streams to become old and decadent and to serve as a long-term source of LWD to stream channels. However, areas exist across the Forests where vegetation can be managed within designated riparian areas to facilitate LWD transport and serve as a short-term source of habitat improvement.

Research has shown that low level and low intensity burns have no effect on water or aquatic habitat quality. Generally, riparian areas retain enough moisture to reduce flame height and intensity to essentially put the fire out. It has been the Appalachian Ranger District's experience that flame heights on low intensity spring burns rarely exceed three inches throughout the burn area. Riparian areas, seeps, and other wet areas do not burn because of higher moisture content. This type of burning, unlike high level and high intensity prescribed burning and wildfires, poses very little risk to aquatic resources, and may in fact, serve as a nutrient source to area streams. The low probability that there will be direct or indirect effects to aquatic habitat and populations leads to the conclusion that there will be an equally low probability of the proposed prescribed burning contributing to cumulative effects on area streams.

The proposed burning would leave nutrients (ash) on top of the ground. Should a rain event occur immediately following the prescribed burn, there could be a nutrient influx into the adjacent streams. These nutrients will temporarily improve water quality; however, measurable changes in water chemistry are unlikely since most runoff will be filtered through live vegetation before entering local stream channels.

In the unlikely event that the fire would burn into a riparian area and expose soil adjacent to the stream, some sedimentation could enter the stream. However, even with a rain event that could produce nutrient and sedimentation influxes, stream gradient would assure rapid flushing. Due to higher moisture levels in riparian areas, there would be a negligible amount, if any, stream cover lost.

In Alternative 4 the use of herbicide methods for silvicultural treatments is analyzed in detail in the Vegetation Management Environmental Impact Statement for the Southern Appalachians. Included in this document is a detailed analysis of the effects of silvicultural treatments on aquatic resources. Please refer to this document for a description of such effects.

Implementation of Alternatives 2, 3, or 4 would not impact the nineteen Forest concern species or the two MIS species or habitat for those species should they occur in the project or analysis areas. Species viability would not be affected by implementation of either alternative. Herbicide use is strictly controlled and would have no effects upon aquatic resources in the project and analysis areas.

VI. MITIGATION MEASURES

Mitigation measures are management actions that are required to maintain compliance with environmental laws and regulations: NEPA, NFMA, and the LRMP EIS. These measures are required in any action alternative to achieve the determination of effect below. Use of the mitigation measures will protect aquatic habitat in the project area for the nineteen Forest Concern species. Aquatic habitat in the analysis area and further downstream (including MIS habitat) would also be protected.

1. Perennial springs and seeps will be marked during unit marking. Spring and seep perimeters will be clearly marked and logging equipment will not be permitted to cross these areas. These areas will join stream riparian areas if there is less than 100 feet between the two areas to protect intermittent reaches.

2. Intermittent springs and seeps will be mapped during unit marking. No equipment will be allowed to cross these areas when they are wet.

3. Trees accidentally felled across stream channels or springs will be lifted (when possible) away from the water. If this is not possible, each tree will be pulled away from the water where it fell and temporary decking will be used to support the weight of the tree as it is pulled across the channel. These removals will be perpendicular to the stream channel whenever possible to minimize stream bank disturbance. Bare soil will be seeded and mulched if native vegetation does not start to recolonize the area by the time timber removal from the unit is complete.

VII. MANAGEMENT RECOMMENDATIONS AND RATIONALE

Management recommendations, while not legally required, are actions that, when implemented, will result in improved resource condition or minimize potential effects.

1. Skid road layout should avoid stream crossings and paralleling perennial channels within designated riparian areas.

2. Landings and skid trails should be vegetated as soon as possible after use to avoid off-site soil movement.

3. Temporary roads (if needed) should be constructed to avoid runoff into area streams. In addition, silt fence, straw bales, or brush barriers should be placed along the length of the road where it parallels or crosses a stream as needed to control runoff and stream sedimentation.

VIII. DETERMINATION OF EFFECT

Implementation of any alternative considered under the current proposal for the Northside Timber Sale will not affect threatened, endangered, or proposed aquatic species, nor will suitable habitat be affected. Consultation with the U.S. Fish and Wildlife Service is not required.

Implementation of any alternative proposed for the Northside Timber Sale project will not have **negative** impacts on aquatic sensitive or Forest concern species, nor will project implementation result in a trend toward listing for any species. No new permanent access is required and **mitigation measures** have been designated to protect sensitive aquatic habitats. Ranger District staff has agreed that these **mitigation measures** are reasonable and can be implemented.

IX. PERSONS CONTACTED

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X. DATA SOURCES AND SURVEY PROTOCOL

Table 5 lists survey methods used for aquatic resource parameters and references to descriptions of the methods. All data used in this AQUA (existing or project-specific) was collected using an appropriate survey method. Full citations of listed references can be found on page*.

TABLE 5. Data collection methods for aquatic resource parameters used in AQUAs.

Parameter	Method	Reference(s)
Fish populations (streams)	backpack electrofishing	Murphy and Willis 1996
		Schreck and Moyle 1990
		SD-AFS 1992
	visual (snorkel)	Dolloff et al. 1993
		Hankin and Reeves 1988
Fish populations (rivers)	IBI	Karr et al. 1986
		Lyons 1992
	boat electrofishing	Murphy and Willis 1996
		Schreck and Moyle 1990
	visual (snorkel, SCUBA)	Murphy and Willis 1996
		Schreck and Moyle 1990
Fish populations (ponds, reservoirs, rivers)	nets/traps	Murphy and Willis 1996
		Schreck and Moyle 1990
Aquatic insects and crayfish	net samplers (Surber, kick, drift)	Brigham et al. 1982
		Hauer and Resh 1996
		Hawkins et al. 1998
		Hobbs 1972
		Merritt et al. 1996
		Rosenburg and Resh 1993
		USEPA 1989
Freshwater mussels	visual (snorkel, SCUBA)	Athearn 1969
		Cummings et al. 1993
Aquatic salamanders	backpack electrofishing	Williams and Hocutt 1981
	visual (snorkel, SCUBA)	Williams and Hocutt 1981
Habitat	BVET	Dolloff et al. 1993
		Hankin and Reeves 1988
		Harrelson et al. 1994
Substrate composition	pebble count	Bevenger and King 1995

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