Mississippi
Streamside Landowner's Handbook

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As we enter a new century, the landscape of Mississippi will change. Cities and towns will expand into areas that are now forest, field, and pasture. The agriculture and forestry industries will continue to provide food, building materials, and paper and pulp products for our society. Development and industry will make expanding demands on surface water resources for services such as drinking water, sewage treatment, surface drainage, and water for industrial processes. Our rivers and streams will flow through this increasingly populated and complex landscape. When you consider the multiple uses that we presently demand of our rivers and streams, increased demands on them in the future are a cause for concern.

Streams accommodate our various human activities, but at the same time they support a rich variety of fish, aquatic animals, and plants. Streams, their flood plains, and hardwood bottomlands provide essential wildlife habitat for deer, turkeys, rabbits, squirrels, most of our migratory and native songbirds, and countless other varieties of wildlife.

People have long felt a strong connection to streams and rivers. They run through our history, our literature, and our personal experiences. Whether it is the scenery, the sounds, the cool water on a summer day, the pull of a fish in the current, or the gliding of a canoe, our streams and rivers provide us with diverse pleasures.

Their value to us is not easily measured, but it is great. *"There is an intimate relationship between our streams and the development and conservation of all the other great and permanent sources of wealth,"* said Theodore Roosevelt in 1907. Throughout history streams have provided human society with water, food, transportation for commerce, and power to turn mills and generate electricity. The appreciation of streams for their natural beauty and for the fish and wildlife they sustain is something that we can easily overlook. We in Mississippi recognize that a healthy stream or river has value in itself outside the measure of commerce or human industry. To maintain this value, streams need the consideration and help of landowners and others.

In the Act that created the Scenic Streams Stewardship Program, the drafters wrote that there is a necessity for a "rational balance between the use of these streams and the conservation of the natural beauty along these streams." Conservation is possible through the concern and effort of landowners of property adjoining rivers and streams.

Landowners along streams need to make their land produce income for them. However, their activities along a stream can directly affect it for better or worse. For these select few people, there is tremendous opportunity to be good stewards of the water, land, and wildlife along, and within the stream. Stewardship is " the careful responsible management of something entrusted to one." A steward is a conservator.
The Scenic Streams Stewardship Program was designed to promote voluntary private conservation efforts along Mississippi's best remaining natural rivers and streams. The Scenic Streams Stewardship Program asks that streamside landowners consider voluntarily using Best Management Practices (BMP) along streams, for instance leaving a buffer zone of trees and vegetation along the banks. A stream buffer zone or Streamside Management Zone (SMZ) of an appropriate size and width will keep erosion to a minimum, and will maintain stable stream banks. Recommended appropriate widths are based on slope, and are published in *Best Management Practices for Forestry in Mississippi* by the Mississippi Forestry Commission.

The benefits of keeping stream banks stable through the use of BMPs are numerous. Property values remain strong, soil and nutrients stay in place, and the stream avoids degradation from silt, caving banks and erosion. Also, swimming holes stay deep, and a canopy of trees provides shade which helps keep water temperatures cool.

Owners of timberland can strike a balance between fully utilizing their timber resources and leaving adequate buffer zones for stream conservation. Trees left standing won't be turned into cash in a timber sale, but there is real value in keeping streambanks stable. The legislature made the Stream Program completely voluntary so nobody would feel regulated into leaving uncut trees.

We hope that through learning more about the value of healthy streams and the dependence of natural communities of stream fish and aquatic life on this health, landowners will choose to practice stream conservation on their own by blending conservation techniques with profitable timber harvest and other land uses. To that end, this handbook is written for landowners as an educational guide and resource book about their streams.

Chapter 1. Stream Ecology and Channel and Bank Stability

Physical Processes

Streams are broadly classified according to their bed materials and temperature. Whether a stream is a bedrock or alluvial stream depends on the geology of the basin through which the stream flows. Coldwater streams can support trout and salmon year-round. Warmwater streams, such as ours in Mississippi, cannot support trout and salmon. Classic mountain trout streams that have large boulders, and flow over rocky beds usually fit the bedrock type. The trout streams of the upper south, northeast and west are bedrock streams. Alluvial streams like ours in Mississippi flow through deposits of sand, gravel, silt, and clay and move this material called alluvium downstream and are in a constant process of shaping and reshaping their beds, banks, and floodplains. They deposit some of this material in their beds, and when they overflow their banks, the alluvium gets deposited in their floodplains. The Mississippi River is a big alluvial stream that, over history, has built natural banks and deltas. Over thousands of years it has moved its channel laterally (east to west) hundreds of miles.

All streams, whether alluvial or bedrock, have four basic characters that define them: Slope, discharge, sediment load, and particle size. Slope describes the vertical drop of a stream from its headwaters to its mouth, or to the sea. Slope is the proportion of fall to run. For example: a 1-foot drop in 100 feet of length gives a 1/100 or 1 % slope.

Discharge is the volume of water carried by the stream. It is measured as a rate and given in cubic feet per unit of time, often by cubic feet per second (cfs) or in some other time increment such as thousands or millions of cubic feet per day or year.

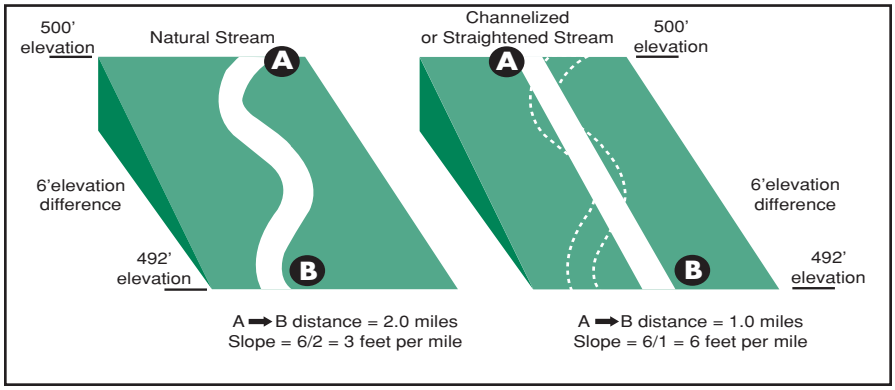

Figure 1. Change in stream slope due to channelization

Sediment load and particle size describe the silt, sand, gravel, rocks, and other substances picked up and moved by flowing water. Slope, discharge, sediment load, and particle size work in equilibrium. For example, a stable stream with a given slope and discharge, can carry a certain amount of material of a certain type. Another way to put this is that a channel will remain in equilibrium if changes in sediment load and particle size are balanced by changes in water discharge and slope.

When this stability is changed, a channel will respond by one of two processes: degradation (picking up sediment or system-wide bed-scour), or aggradation (system-wide deposition of sediment).

A degrading channel cuts into its bed when increased flow energy picks up bed materials and moves them. An aggrading channel has its bed built up as flow energy decreases and drops sediment. For instance, one such variation would be to decrease the discharge of a stream by diverting some of its water, perhaps for irrigation or industrial use. The stream would have less volume, move more slowly, and deposit more of its load of sediment and suspended materials on its bed. Channelizing a stream by straightening(cutting across bends) and deepening a section of it will change its equilibrium in a different way.[1]

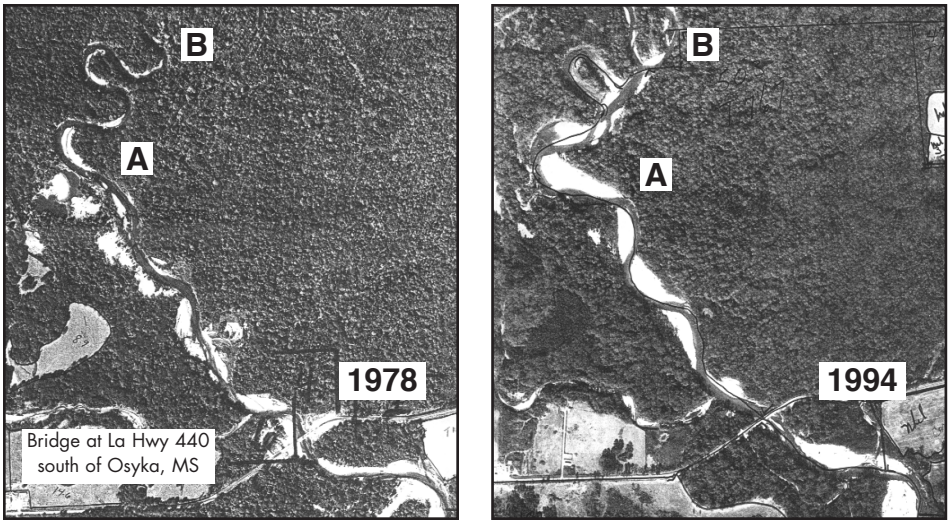

Figure 2. Headcutting on Tangipahoa River between 1978 and 1994. Note "A" widening of sandbars, and "B" loss of forest canopy as headcut migrates upstream leaving new sandbars where the forest once grew.

In a channelized stream section, slope is altered. Water will now fall from the upper elevation to the lower elevation over a shorter distance. If a mile of bends are bypassed through channelizing and straightening, a stream that used to drop 6 feet in 2 miles now drops that same 6 feet in 1 mile (Fig. 1). The water will be moving faster, with increased energy, and can carry more material. This stream will begin cutting a deeper channel where the water runs faster. To reach the equilibrium point, sediment will begin to move or slough from above the deepened, or straightened section. This system wide sloughing is called "accelerated erosion." It is also called "headcutting" because of the tendency for the sloughing to work its way upstream or toward the head-waters of a stream (Fig. 2).

Other activities beside channelization can cause headcutting including natural occurrences such as increased runoff after fires in the watershed. Scooping sand or gravel from a stream bed and trenching across a stream bed to bury a pipe can initiate headcuts. When a hole or trench is dug in the bed of the river, it can create a knickpoint. The increased energy and turbulence caused by the knickpoint results in the upstream migration of the knickpoint. The current will cut away at the upstream lip of the knickpoint, removing these bed materials and carrying them downstream.

As the knickpoint migrates, it can cause the banks along the channel to become unstable and slough down so that the next flood will wash them away. A local term for headcutting is "blowout". The banks above a headcut which once were forested will become unstable as the soil and sand wash out and the trees topple into the stream.

Headcutting is the same process as the formation of gullies on land. Gullies stop migrating upslope in a field when the rainfall stops. Headcuts have a constant source of erosive energy as long as the stream flows.

In Mississippi, Bayou Pierre is sometimes called the "mother of all headcuts". Beginning at its mouth at the Mississippi River, this stream has blown out its banks and those of most of its upstream tributaries across four counties. This headcut began marching upstream in the 1930s and is still active. Some erosion is natural, but this accelerated process is set in motion by man-induced stream-bed disturbance. Headcuts are extreme and destructive example of streams tending to work back to an equilibrium after disturbance of slope, which along with discharge, sediment load, and particle size define the physical nature of flowing water.

This general pattern of headcutting and channel response was described in the channel evolution model (Schumm, 1977). The model breaks the process down into five stages: Stage I: stable channel, Stage II: incision, Stage III: widening, Stage IV: Stabilizing, Stage V: Stable. The stream, over time, cuts down in its bed in response to some change or insult to its equilibrium. Starting with a stable stage I channel, there may be a knickpoint or channelization or increased runoff in the watershed. In stage II the stream excavates a deeper, larger volume channel that can accommodate the increased flows. Stage III brings on a widening of the channel, with bank collapse due to vertical instability. The bed and bank erosion which accompanies a stage III channel means that much sediment is transported and deposited periodically in point bars and then moved during high flows. Stage IV channels show some stabilizing trends as vegetation becomes established on the sediment, and banks are held in place first by grasses, then by shrubs and trees.

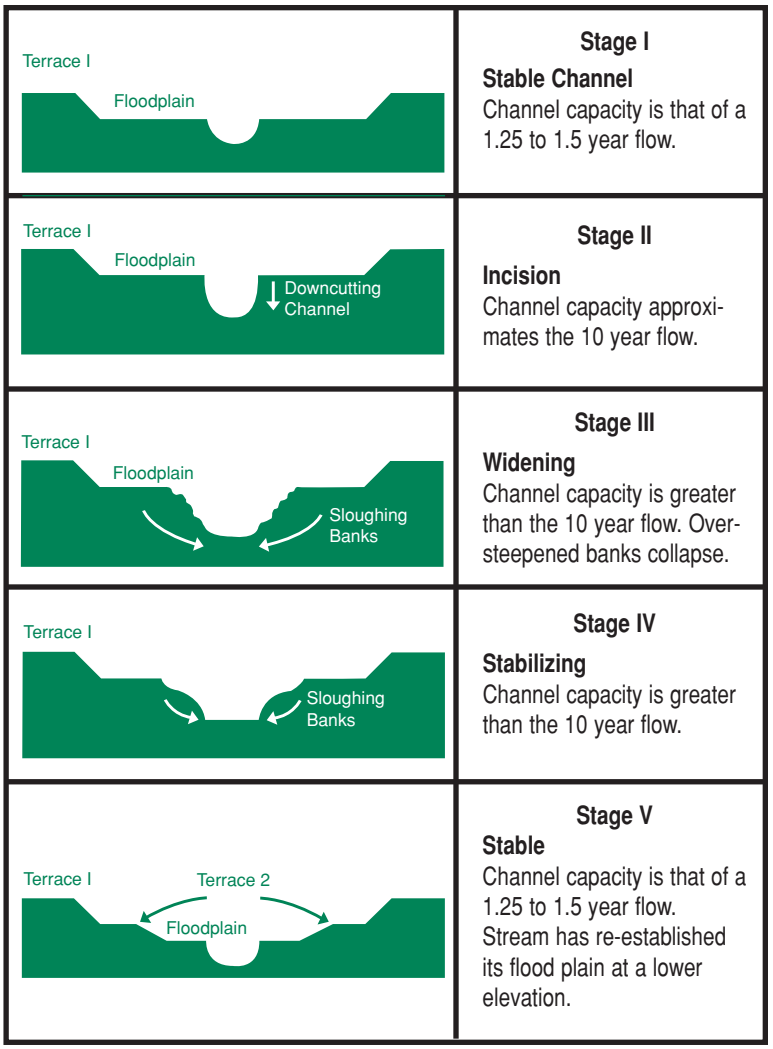

Figure 3. The Channel Evolution Model breaks headcutting into five stages; after Schumm 1977

In stage V the stream regains the stability it had as a stage I channel, but the overall elevation of the streambed is lower, and the former floodplain is now a terrace.[3] (Fig. 3)

Historical Stream Disturbance in Mississippi

In the southeastern United States in general, and in Mississippi in particular, human activity has touched almost every stream, and certainly part of every drainage basin. The land use changes that have taken place in the last two-and-a-half centuries are due to land clearing for agricultural activities, settlement patterns, timber harvest, road and railroad building, and the spread of towns and cities (urbanization and sprawl).

Settlement and development of land by Europeans first followed rivers and Native American trade routes. With the arrival of railroads in Mississippi in the 1830's, settlement followed along their routes. Forests were cut at a much faster pace than in pre-railroad times.

In the seventy years from the end of the Civil War to the Great Depression, a majority of old growth pine and hardwood forests were cut and taken to mill and market by rail. Mississippi's pine and other southern-grown lumber helped build Chicago and countless other 19th century American cities. It was also used to help re-build Europe after both world wars.[4]

The landscape of much of the South changed after these old forests were cleared. The cotton economy was already in place in the rich river bottom-lands before the railroads boomed. After the railroads spread and the forests were cut, much of the former forest lands, whether hilly or flat could be farmed. Most of these lands were planted in cotton. They were farmed intensely in these seventy years (1860-1930), so much so, that natural nutrients were depleted on marginal land, and erosion removed vast amounts of topsoil.

Figure 4.
Virgin Pines in Southern Mississippi.

Due to its nutrient requirements, cotton is very hard on even the best soils, and during these years it was planted almost everywhere regardless of the suitability of the soil. The middle South had an upland cotton economy until the land gave out, about the same time of the Great Depression. In some areas of Mississippi, this economy based on growing cotton on unsuitable soil lasted past the depression years, but even these remnants of this system had ground to a halt by about 1960.[5,6]

When the landscape changed from forest to small farms, the rivers and streams draining these areas showed the effects of land use changes. Over the years, streams that ran clear became muddy as sediment and topsoil from fields and hillsides were washed into them. As farms were abandoned, the forests

reclaimed the poor or marginal land, and the streams became clear again, but some streams still retain massive amounts of sediment from this time that are shifted around as the streams seek an equilibrium in an altered physical state. In portions of Mississippi that receive drainage from poor, hilly land that was farmed in the 19th century, the streams are still affected by these accumulated loads of sediment.

The Loess Hills and the North-Central Hills of Mississippi are the two physiographic regions where streams most notably show the effects of land uses of 100 years ago. Basically, these are the places where the kudzu is the thickest today. This imported exotic vine was planted to fight the enormous forces of erosion, and it remains a telltale sign of this period of agricultural history and land use. Streams in the southern part of the state do not seem to suffer as much from the disruptive farming practices of the upland cotton days. The landscape is a bit flatter, suffered less from erosion, and, generally was less affected by problems rooted in historical land use.

Even our best remaining natural streams have a long history of alteration. There are some streams that hardly show these effects, and these are the streams that people find most attractive and will work hard to conserve.

Modern Era Stream Disturbance

Streams drain the changing landscape of Mississippi and they face the traditional land uses of farming and forestry activities. But they are being stressed by the spread of cities and towns and the construction of roads, streets and parking lots coinciding with development. In a sense, streams and rivers are being sandwiched between traditional land uses and the new pressures development puts on natural drainage systems.

Farming and silviculture have cycles of temporary land use changes. Crops or trees are planted on prepared sites; they grow and are harvested. Farming has an annual cycle from planting to harvest, while the cycle of forestry activities is longer, from 15 to 40 years or more. The land recovers, or at least stabilizes, within these cycles and there is some soil loss in rainwater runoff. Most importantly, the soil still allows water to percolate down and seep into the earth (groundwater infiltration). The soil of a pasture, field, or forest remains permeable and eventually recovers from disturbance.

Development poses a much more difficult problem for ground water infiltration and surface drainage.

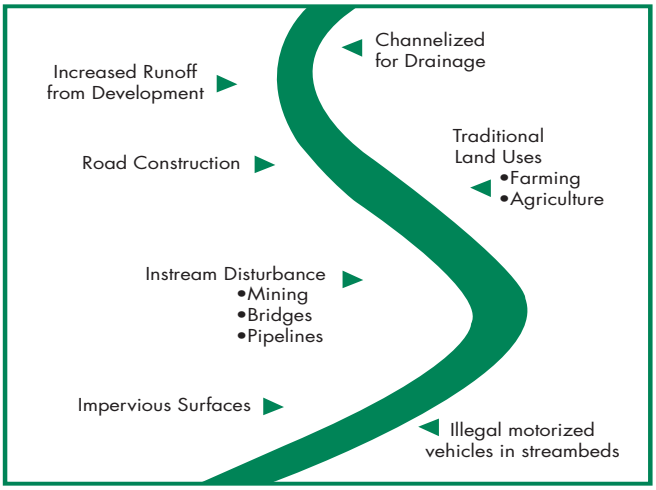

Figure 5.
Physical stresses on streams

Hardened surfaces don't allow water to percolate into the soil. Developed land is permanently changed in its use, and the way the land drains is forever altered. Rainwater quickly runs off roofs, streets, roads, and parking lots. Underground drainage directs stormwater from roads and concrete surfaces to ditches that take the water directly to a stream, creek, or river. On undeveloped land, precipitation ordinarily takes days to percolate down into the shallow ground water and then seep into a stream where it contributes to the stream's base flow. With development, less water seeps into the soil and more rainfall is transmitted as surface runoff which is quickly delivered to the stream. Development is permanent, and there is no cycle over which the land can regain its ability to absorb water through percolation or seepage.

What development does to a natural stream or river is disrupt its equilibrium. Stream discharge is increased as runoff water finds its way to the main channel more quickly. The stream rises much faster than when it drained fields, and forests. Flash floods occur now when they did not prior to development, and the stream channel will adjust to handle the greater, faster, and higher storm water flows. Over time, the stream must carry a greater volume of water and sediment and will adjust its slope by cutting into its bed if its bed materials are soft enough. When water reaches hard clay formations or sandstone and can no longer cut down, it will top the banks and spread out into the floodplain (if the stream channel is not too deeply incised). The stream may also undercut its banks and cause them to fail.

In urbanizing basins, where small streams must carry increased storm water runoff, streams change their character physically and biologically. Fishes and aquatic life that cannot tolerate the radical changes in the altered stream environment simply disappear because their habitat requirements are no longer met. A stream that supported a dozen or more species of fish prior to urbanization, will support two or three species afterward. This is the death of a natural stream and marks its transformation to an urban ditch. There are streams bearing the evidence of this sad course of events at the sprawling edges of Mississippi cities and increasingly on the developing fringes of smaller towns that incorporate adjacent rural communities.

Rural streams safe from urbanization face various impairments to their health from road construction projects, pipeline crossings, and excessive sediment and polluted runoff from farming and forestry activities. All of this is collectively called non-point source pollution. For road construction, agriculture, and forestry, there exist soil conservation measures and water quality improvement practices formulated to reduce the impacts of non-point source pollution on streams. These Best Management Practices (BMPs) are designed to maintain good water quality in streams that may be affected by construction sites, farming and forestry activities.

Any stream impacted by channel or bank disturbance, coupled with increased nonpoint source runoff eventually can show the effects of accelerated erosion. In the earlier discussion of channel stability, accelerated erosion (headcutting) was introduced. BMPs reduce adverse impacts to a stream's water quality, and their use will help fight the effects of accelerated erosion.

Changes to Stream Ecology by Dams and Impoundments

When a dam is constructed on a stream to create a lake or reservoir, there are many changes that take place affecting the physical and biological features of the stream. The stream environment is defined to a great degree by flowing water and is sometimes called a lotic environment by biologists. Lotic comes from the word *lotus* which in Latin means bathing or washing. It signifies moving waters.

Lakes are lentic environments, from the Latin *lentus* meaning slow, calm, or sluggish. A reservoir is a combination of the lentic and lotic environments because some water is constantly coming in from the river, moving through the reservoir and out the dam or spillway. The character of the river is changed to a very slow, almost still condition in which the flow is hardly noticeable. For all practical purposes, the river is changed to a lake.

The biological and physical features of free-flowing rivers and dammed impoundments are very different. Several things stop happening when a river is dammed. Fish reproduction, transport of sediment, and elements of the aquatic food chain are disrupted or re-arranged. Many species adapted to life in flowing water depend on seasonal cues for reproduction, like temperature and water level. Streams are at low flow in the summer and early fall and at peak flows during late winter and spring. Many species of fish follow flood waters out of the banks into the floodplain where they feed. Additionally, some fish spawn as river waters move out onto the floodplain where their young can take advantage of abundant food. The seasonal cues are not as strong in reservoirs as they are in streams.

River-dependent fish species must migrate up and down rivers during their life cycles. American eels live as adults in rivers and migrate to the sea to spawn, while the breeding Gulf sturgeon lays eggs in river-bottom gravel beds and then returns to the waters of brackish bays and estuaries of the Mississippi Sound. The blockage caused by a dam means these basic conditions are not met. These fish will not reproduce and over time will disappear from the river reaches above the dam. In the northeast, and northwest U.S., runs of migrating salmon and shad are stopped by dams. In our southeastern U. S. streams that drain to the Gulf of Mexico, migration and spawning of eels, sturgeon, herring, striped bass, paddlefish, and some species of shad are stopped by dams.

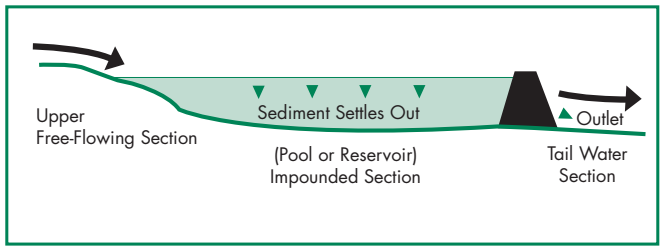

Figure 6. The free-flowing, impounded, and tailwater reaches of a river that has been dammed

When the flowing water of a river slows down in a reservoir it cannot carry its suspended load, so sediment drops out of suspension and goes to the bottom. Reservoirs begin filling with sediment as soon as the dam is closed. They have finite life spans unless dredging keeps the sediment from collecting. If a reservoir is built to control floods or store drinking water, this accumulation of sediment robs its capacity to store water.

As the bottom builds up from sedimentation, the reservoir becomes filled with soil, sand ,and silt and will hold less water. A glass half full of sand will not hold as much water as when it is empty. This analogy holds true for reservoirs as well.

Some things start happening in the reservoir environment that did not happen in the river. The slower water of the reservoir means that populations of free-floating, tiny, green plants or phytoplankton will establish residence in the water column. Rivers have a moderate amount of plankton, but because the water is always moving, large populations usually don't get established. Phytoplankton manufacture their own food from sunlight through photosynthesis. The plankton-based food chain of a reservoir functions like other plankton-based food chains in lakes and in the oceans (Fig. 7). This is fundamentally different from the food chain of the river which depends on washed-in organic material supporting aquatic insects and other invertebrates such as crayfish. A river's source of nutrients is based on the things that wash into it or that are covered by flood waters and are processed by invertebrates. In one respect, rivers and streams are like long, wet, moving compost piles with populations of invertebrate decomposers, shredders, filter feeders and predators forming the base of the food chain for fish. These small organisms are in turn eaten by fish. Leaves and woody debris from stream-side floodplain forests are a very important source of organic or carbon-based nutrients that drive an *allochthonous* system. This Greek word means "other earth" and signifies that the nutrients driving the food chain in a river are washed in from the flood plain of the stream.[7]

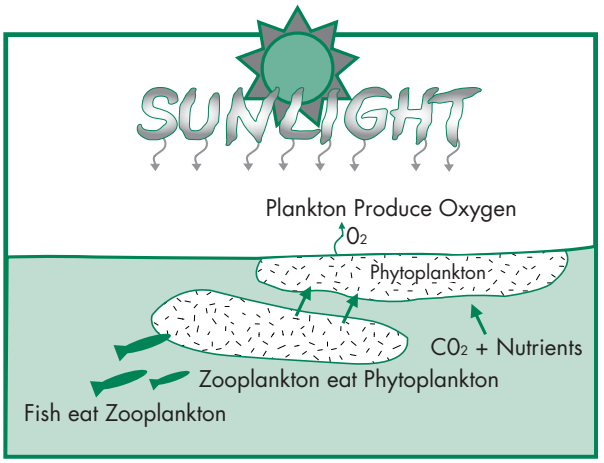

Figure 7. Autochthonous Food Chain of a reservoir. Phytoplankton produce their own food through photosynthesis. Zooplankton feed on Phytoplankton and provide food for fish.

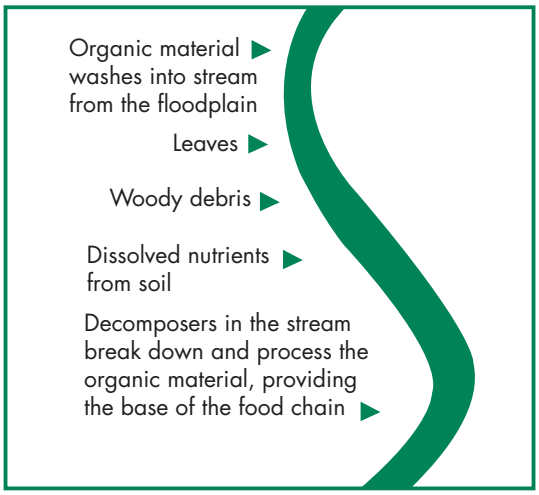

Figure 8. Allochthonous Food Chain of a stream or river. The river receives nutrients from organic material that washes in from the floodplain.

When a population of plankton gets established in a reservoir, the allochthonous system shifts to an *autochthonous* system, another Greek work meaning "own earth". It describes a food chain that to some degree can produce its own food. This refers to the tiny green plants or phytoplankton that use photosynthesis to convert the sun's energy to biological material.

Phytoplankton form the base of a reservoir food chain and are eaten by zooplankton (tiny free floating animals). Zooplankton populations in a reservoir are composed of rotifers and other protozoans, also tiny crustaceans and the drifting larvae of certain insects and fish.

Juvenile crappie and bluegill and some adult fish like shad and paddlefish can filter plankton out of the water using the filaments on their gill arches. Large plankton populations can support enormous populations of filter feeding shad. In turn, the shad feed adult predators such as black bass, crappie, catfish, and others. Sometimes shad become so numerous that no amount of predators can control them. Environmental factors can also cause the plankton population to collapse which can in turn cause a decrease in the filter feeder populations. This can set in motion a cycle of decline in numbers of predator fish.

On the other hand, river food chains are more dependent on the annual cycles of flooding and the annual introductions of organic material, especially leaves, and the organisms that process them. Reservoir food chains are also influenced by seasons, but depend more heavily on the population cycles of the plankton. The stream environment is always richer and more biologically diverse than the reservoir environment that is created by damming the stream. Impounded reaches of rivers and streams decline in biodiversity compared to the free-flowing reaches because the lentic environment is more homogeneous and has fewer habitat types. River dependent species cease to breed, become rare, and eventually are lost from reservoirs.

The tailwater is the section of a river below a dam. The tailwater environment can be similar to, or very different from the natural reach of the river above the dam. This depends upon whether water leaves the dam from the bottom of the reservoir or from the top. Some hydroelectric dams draw water from deep in the reservoir to run through penstocks and turn turbines. During most of the year, water at the bottom or in the middle depths of the reservoir is much cooler than surface water. This stratification effect is common to lakes and reservoirs in the temperate zones. Mississippi's subtropical climate causes its lakes and reservoirs to only partially stratify. Nevertheless, our reservoirs have warmer water at the surface and the coldest water at the bottom. Even in summer, deep parts of a reservoir are cold, hovering around 50 degrees Fahrenheit.

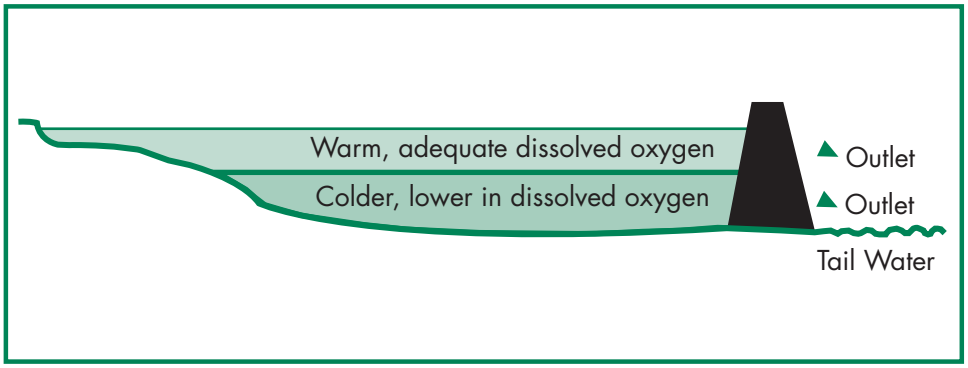

Figure 9. The character of the tailwater environment depends on whether tailwater is withdrawn from upper or lower levels of reservoir at dam.

If cold water is withdrawn and released into the tailwaters, it changes the environment so radically that warmwater fishes are displaced. In this instance, the tailwater temperature profile is essentially changed into that of a trout stream for some distance downstream, until the river warms enough to be considered

a warmwater stream. Indeed, rainbow trout are stocked into these cold tailwaters in many Tennessee Valley Authority (TVA) lakes and deep hydroelectric reservoirs in Arkansas, Tennessee, and elsewhere in the Mid-South. The dominant fish species of a warmwater stream are bass, sunfish, catfish, various suckers, and minnows. These warmwater adapted species are unable to reproduce and sustain their populations in cold tailwaters.

When the water leaving a dam is withdrawn from the warm upper layers of a reservoir, the temperature of this released water is close to what would be considered seasonally normal for the river, and a warmwater stream environment will exist in the tailwater. Reservoir tailwaters usually support abundant fisheries since the water drawn from the upper layers of a reservoir is rich with plankton and small forage fish like shad. Also adult fish such as crappie are continually washed out of the reservoir into the tailwaters, particularly during large discharges. All Mississippi reservoirs have warmwater environments in their tailwaters.

A dam has effects on a natural river that are far reaching. In some parts of the U.S., dams are being removed from rivers when it is economically justifiable. These rivers are returning to a natural condition after a century or more. Fish that could not make spawning migrations because of dams are reinvading their former spawning sites and reproducing. Anglers are seeing these fish again after a long absence. In New England, migratory shad and sea-run trout have returned to their former habitats when dams have been removed. These homecomings are being celebrated as landmark events for the rivers, the towns, and people along them.

Chapter 2.
Soil Conservation in Forestry and Agriculture

Best Management Practices and Sustainable Forestry

From colonial times through the eighteenth century, Mississippi's forests produced timber for building, masts for ships, turpentine, pitch, and charcoal. During this time, lumber mills were located primarily along rivers, and timber was rafted downstream to them. Choice timber along streams was cut first, but vast tracts were undisturbed because there was no practical way to get it to mills. Gradually, the growth of railroads changed this situation, and eventually the railroads began to carry more timber than could be rafted down rivers and streams. Between 1860 and 1930, Mississippi's remaining old growth timber was cut and transported to mills by the railroads. The technology for cutting and removing the timber to a rail head began with human and animal power, but steam-powered skidders and cable draw-works and later internal combustion engines greatly increased production.

Figure 10. Piney woods logging operation in south Mississippi showing ox-drawn log carriages.

At the height of the removal of old-growth forests, especially on railroad spurs or "dummy lines" in the piney woods of the coastal plain, lumber mills produced small communities and towns around them that lasted just as long as the supply of timber. When the mills "cut out" the mill jobs were gone, the mill equipment was dismantled and moved and the towns they supported often disappeared. By 1930 most of the coastal plain pine forests were cut and the land was opened up for development into small farms or pastures. The era of professional forestry in the South began in the late 1940s.[8,9]

The forest products industry has recognized the need to develop and adopt sound soil conservation measures to ensure that neither the soil nor its nutrients are wasted through erosion or storm-water runoff. This became important with the passage of the federal Clean Water Act in 1972, when stream water quality became a concern of timber harvesters and forestry operations. By using sound soil conservation measures, industrial and private forest landowners can ensure good water quality during and after harvest, thus achieving the goals of the Clean Water Act, sustaining commercial forestry, and strengthening the image of the forest products industry. Best Management Practices (BMPs) were developed by the forest products industry specifically to achieve these water quality goals.

Clean Water Act

The Federal Clean Water Act was passed in 1972 under the Nixon administration. It was amended in subsequent years, and provides the basis for water quality standards today. National goals for pollution elimination were set, and the National Pollution Discharge Elimination System (NPDES) was established to make it illegal to discharge pollution to water without a permit. This system first sought to regulate pollution from point sources, which are single, readily identified generators of polluted discharge. Each point source must have a permit which allows monitoring of what is discharged to water. The Clean Water Act is administered in each state by a state agency approved by the U.S. Environmental Protection Agency. In Mississippi the Department of Environmental Quality is the state agency in charge of issuing NPDES permits and enforcing the Clean Water Act.

Much more difficult to address is non-point source pollution, or polluted runoff that reaches streams and watersheds from many different sources. Section 319 of the Clean Water Act instructs states to address this more diffuse type of pollution. Education about Best Management Practices (BMPs) is considered the most practical, economical and effective way to combat nonpoint source pollution from urban storm water, construction, agriculture, forestry, land disposal, surface mining, and hydrological modification.

In 1995, the American Forest and Paper Association (AF&PA) began an industry-wide effort in self-regulation called the Sustainable Forestry Initiative (SFI). Sustainable forest management means practicing a land stewardship ethic that integrates reforesting, managing, growing, nurturing, and harvesting of trees for useful products with the conservation of soil, air, water quality, wildlife and fish habitat, and aesthetics. In short, it means managing forests for timber production and wildlife by means of mixed or integrated practices. The best thing about SFI is that participants must demonstrate adherence to its requirements to be a member of the AF&PA, which represents 250 companies that make up 84 percent of paper production, 50 percent of solid wood production and manage 90 percent of the industrial timberland in the U.S. For instance, AF&PA members must demonstrate that BMPs are being implemented and are effective in maintaining water quality in their timber harvest operations. The AF&PA can expel members who fail to meet SFI goals. SFI will result in environmental as well as economic benefits from forest lands.

BMPs for forestry in Mississippi remain voluntary for all private landowners. They are promoted through landowner education efforts by the Mississippi State University Extension Service, the Mississippi Forestry Commission, the Mississippi Forestry Association, and agencies concerned with forest management and conservation such as The Department of Wildlife, Fisheries, and Parks which sponsors the Scenic Streams Stewardship Program and is concerned with the use of BMPs to protect stream quality. The following is a list of some of the suggested BMPs for Mississippi.

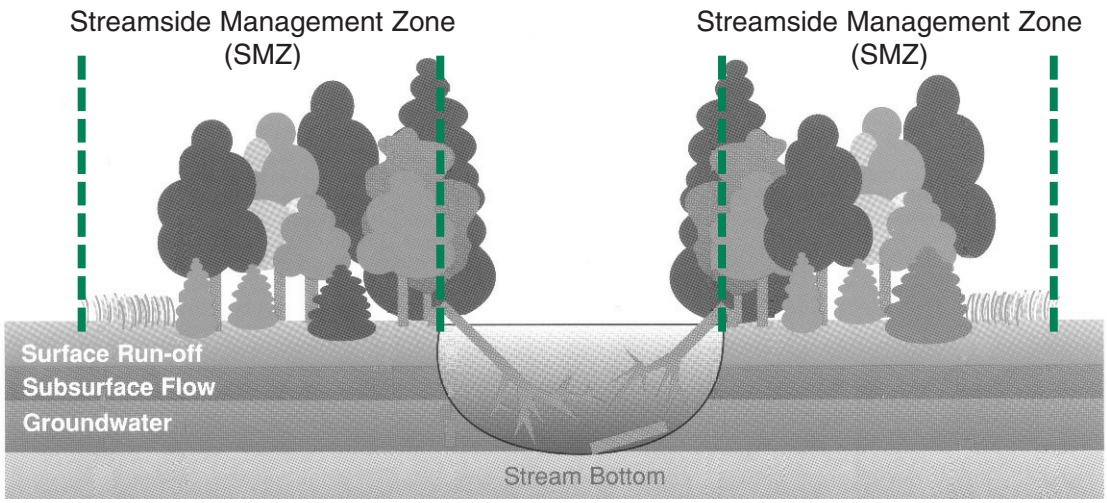

Figure 12. The Streamside Management Zone is the most important BMP for streamside stability. Source: A stakeholder's guide to the Conasauga River of Georgia and Tennessee. Southeast Aquatic Research Institute. Chattanooga, TN.

1) Streamside Management Zones (SMZs) are buffer zones or bands of vegetation and trees, adjacent to streams and rivers left intact during and after timber harvest to prevent erosion and maintain water quality and wildlife habitat. SMZ width depends on slope.

2) Planned and properly installed skid trails and logging roads include water bars and repair of roads after timber harvest. The use of topographic maps or aerial photography can aid in planning and locating roads and trails so that they reduce or eliminate drainage problems and runoff. Logging contractors are also required to keep stream crossings to a minimum and employ culverts and other methods to protect bank stability.

3) Appropriate erosion control measures at loading decks and during site preparation, replanting and re-vegetation operations.

The three recommendations above come from the March 2000 edition of *Best Management Practices for Forestry in Mississippi*.[11] The full manual is published by the Mississippi Forestry Commission (MFC) and is available from a local MFC County or District office. The BMP manual is also provided and explained in training programs conducted throughout the state by the MSU Extension Service.

Recent Analysis of Effectiveness of Forestry Streamside Management Zones

Forest landowners may wonder if the use of Best Management Practices makes a difference in stream water quality. The effectiveness of SMZs has been studied numerous times in different parts of the United States over more than a decade. Researchers usually compare a stream from an unharvested reference forest with a similar stream in another forest where the recommended SMZs have been used. Often, these two sites are compared with a stream on a third site that has been harvested by clearcutting with no SMZs used

at all. The individual site characteristics used for the comparisons are numerous. Some of the characteristics are: water quality (Dissolved oxygen, pH, and water temperature, turbidity, total suspended sediments, and levels of dissolved nitrate, phosphate, and sulphate), mineral soil exposure, net deposition/erosion, stream habitat indicators, and condition of the fish and larger invertebrate populations, (crayfishes and immature life stages of insects that live in streams).[12]

The presence of an SMZ usually makes a positive difference in the before and after harvest condition of the stream as measured by these characteristics. Each stream is different in its character due to its individual slope, discharge and the type of sediment it carries. Each timber harvest site is different too due to its soil type, the time of year of harvest, the vagaries of weather i.e., flood or drought, and the selectivity of harvest, i.e., clearcut, select or thinning. These differences among the studies make it difficult to make any sweeping statement that summarizes SMZ effectiveness for stream water quality over all the studies.

Two of the stream characteristics in the various studies are somewhat predictable with regard to timber harvest: water temperature and sediment introduction to the stream. Water temperature is one factor that almost always changes. Temperature of the water increases if shading vegetation is removed from a stream and the stream receives more hours of full sunlight. This change can cause stress for fish and other cold blooded aquatic life in a stream because water temperature is such a controlling factor in their lives. SMZs help keep streams shaded with vegetation so that stream temperature is not affected by timber harvest.

The movement of large equipment on a timber harvest site will disturb the soil surface. Without BMPs, frequent or heavy rainfall will wash sediment into streams in harvested areas. Sediment is harmful to aquatic life because it covers and kills fertilized eggs of fish and invertebrates, and when it is present in sufficient concentration, it clogs gills of both fish and the invertebrates that dwell in streams.

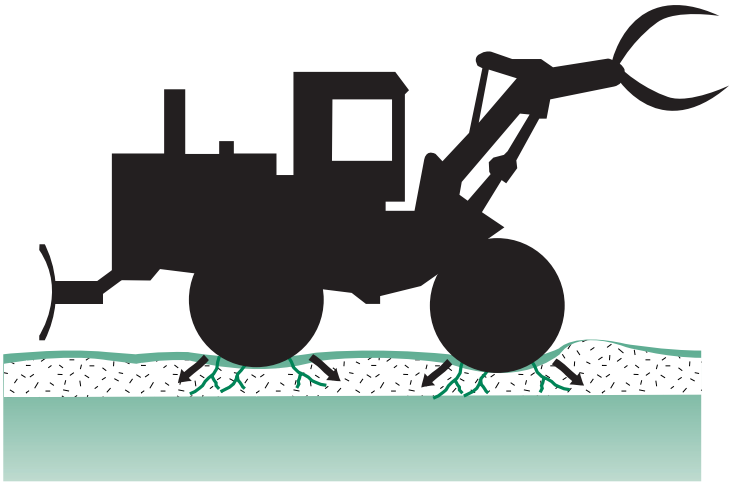

Figure 13. Heavy equipment tires disturb soil during timber harvest. Streambank soils need protection from disturbance, so it is important to keep machinery out of SMZs as much as possible during harvest operations.

The severity of the stress on stream life from either temperature change or sediment input depends on the characteristics of the individual stream such as in-stream cover, the type of stream bed materials, streamside tree canopy and shading, depth, discharge, and on the amount of rainfall. The time of year is also

important because sediment is most harmful to fish and aquatic life during the spawning season which runs during spring and summer in Mississippi.

Using streamside management zones and the entire set of BMPs are practical and desirable ways to reduce the potential damage to streams from timber harvesting operations. Every major forestry industry group, and every business that depends upon timber harvest for its livelihood from loggers to mill operators recognizes that protecting streams is part of sustainable forestry. BMPs, and particularly SMZs, are the best preventive methods for the protection of water quality during timber harvest. Streamside landowners who sell timber should use BMPs to protect the value of their land, particularly to protect their valuable soil so that it stays in place to grow more trees in the future. Productive, well managed forests provide stream protection and a host of other benefits such as good water quality, recreation, aesthetics, and stable habitat for fish, aquatic invertebrates, and wildlife along the stream. Forest landowners manage trees as a growing asset, and at the same time provide habitat for wildlife and fish with the recognition that these two roles are compatible and profitable.

Streamside Management Zones in Mississippi

The Mississippi Forestry Commission's BMP booklet recommends the following widths of stream side management zones along perennial streams (flow year round):

Percent Slope*	SMZ Width
0%-5%	30 feet
6%-20%	40 feet
21%-40%	50 feet
Over 40%	60 feet

Table 1. Streamside Management Zone Widths recommended for different slopes

* Slope is the ratio of rise to run. A 5 percent slope has a 5 foot change in elevation (rise) over 100 feet of distance (run) or 5/100.
Source: Mississippi's BMPs, Best Management Practices for Forestry in Mississippi, Mississippi Forestry Commission. March 2000.

These recommendations provide **minimum** effective widths. A landowner may want wider buffer zones, and may require them in the timber deed or contract when timber is sold. The only way that a landowner can be absolutely sure that BMPs are used on a harvest job is to have this request stated explicitly in the timber deed or contract. Agreements between the seller (landowner) and the buyer of timber (timber company) in a written contract are legally enforceable. A good contract protects the landowner (seller) and the timber buyer. Always demand a written contract for a timber sale. Landowners should protect their soil and land by the inclusion of BMPs in any timber sale and

protect themselves with a good sale contract.

The best way to insure that everything is handled properly is to obtain the services of a registered consulting forester. A forester can select and mark trees, estimate timber volume, solicit bids, negotiate contracts and inspect harvest operations for you. The consulting forester is the landowner's agent in the sale and receives compensation as a commission or percentage of the sale price. In choosing a consulting forester, check with the Board of Registration for foresters at the MSU College of Forest Resources. Phone the Board at 662-325-2772 or on the web; www.cfr.msstate.edu/borf

Harvesting Alternatives

Modern forest harvest methods offer the landowner a variety of ways to cut marketable timber. Types of harvest include: seedtree and shelterwood cuts, selection cuts of groups or individual trees, and total harvests. Total harvests are often referred to as clearcuts. There also exists a variety of stand improvement practices that benefit both the timber and the wildlife. While timber sale economics usually dictate the harvest type and stand manipulation, often wildlife management is a very significant concern. The Mississippi Department of Wildlife, Fisheries and Parks actively manipulates the forest on many of its managed lands across the state for the benefit of wildlife. Large private and commercial hunting lease operations also actively manage forests to benefit wildlife.

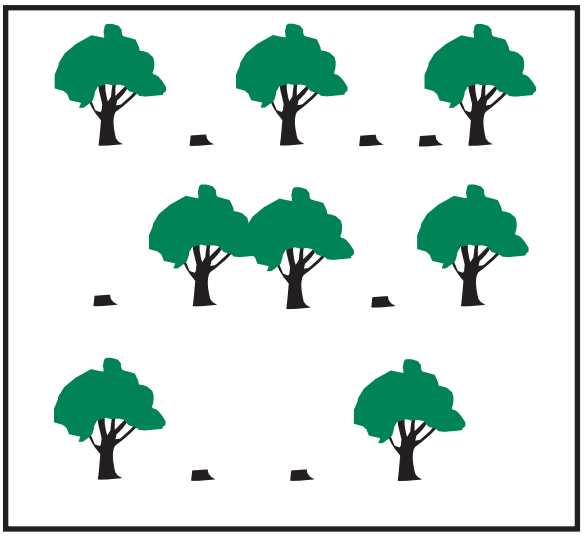

Figure 14. Thinning a Timber Stand

Forest Management Practices *which* Enhance Wildlife Habitat

- **Timber Thinnings**
- **Prescribed Burning**
- **Manage Forest Opening**
- **Forest Corridors**
- **Retain mast Trees and Shrubs as Food for Wildlife**
- **Create and Maintain Snags**
- **Leave Timber Slash in Place**
- **Create Brush Piles**

Logging contractors can thin timber stands or harvest selectively marked trees if there is enough wood volume to justify this economically (Fig. 14). Some tracts are too small to justify thinning. The machinery required for most timber harvest jobs is big and expensive to own and operate. When a timber buyer bids on a job there must be enough timber involved in the sale to make a profit and cover operating expenses. Larger tracts can be harvested in different ways, leaving economically realistic options open to the landowner and the timber buyer. Sometimes, a tract of forest land is of such a small size that potential buyers will only consider harvesting all mature trees.

Another timber harvest option is to select groups of trees to remove while leaving other groups intact (Fig 15). Select removal of trees within the forest can be arranged so that a patchwork of harvest areas is distributed evenly across a piece of land. Such a harvest design allows for regeneration that will mix areas of grasses, herbs, and shrub growth into a mature or older forest. This method is practical for the machinery operators, and it opens up many options to manipulate and improve wildlife habitat for many species.

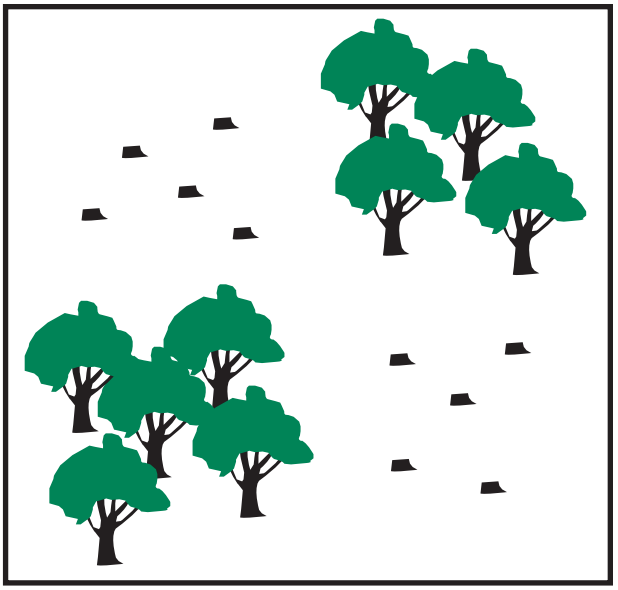

Figure 15. Select Removal of Timber (Group Selection)

The turning radius of most skidders and tree shear machines is so wide that it is difficult to harvest one tree and leave another untouched if the trees are closely spaced (Fig. 16). Damage to remaining trees can be caused by skidder tires and abrasion by felled and dragged trees. For this reason it is important to think of the turning radius of the machine when doing selective removal of trees or groups of trees. If a total harvest is not desired by the landowner, a group selection or patch harvest may be something to consider. A registered forester can help with these decisions.

There are a few logging operators who will use chain saws to cut trees, and small tractors to skid timber. Worker safety and insurance issues have led to greater mechanization so that operators are exposed to fewer chain saws, cables and other dangerous features of logging. Some operators still log using horses or oxen, and there are a few operating in Mississippi.

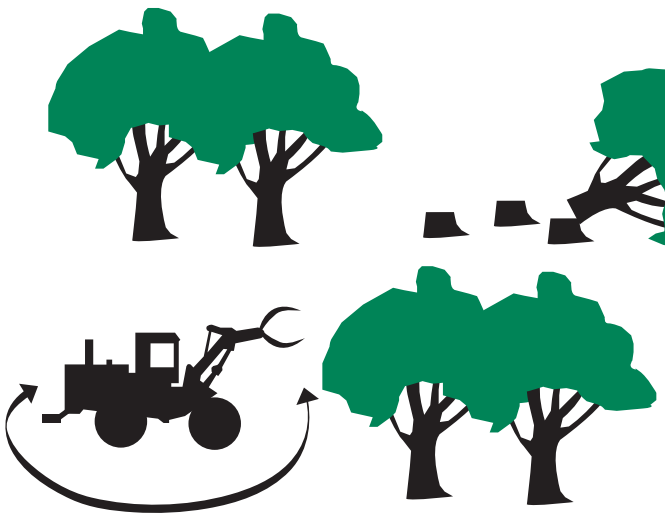

Figure 16. Turning Radius of Large Machinery must be considered in Select Cuts or Thinning

The Mississippi State University Extension Service offers courses and publications to forest landowners. Extension offices in every county insure that information is widely accessible. Phone your local county extension office or look up information on the internet at the **www.msucares.com** web address. The following list of titles and numbers of extension forestry publications is only a brief sample of the available resources.

Short Courses for the Forest Landowner, P2164

Streamside Management Zones & Forest Landowners, P2233

Forest Management Alternatives for Private Landowners P1337

Forestry Terms for Mississippi Landowners, P1250

Marketing Your Timber: The Timber Sales Agreement, P1855

Legal Terms and Concepts for Forest Landowners, P1762

Forestry Income Tax Series: 1. Basics of Basis, P1983

Longleaf Pine in Mississippi, P 2201

Bottomland Hardwood Management, P2004

Attract More Wildlife Through Timber Management, P1446

Natural Regeneration Using Seed Trees, P1816

Figure 17. Selected Mississippi State University Extension Forestry Management Titles

Agricultural Best Management Practices

Along most Mississippi streams, the dominant land uses are forestry and agriculture. Agricultural BMPs are recommendations to farmers on how to reduce soil loss and non-point source pollution (polluted runoff) during row crop planting and cultivation, and cattle and dairy operations. The soil loss per acre can be dramatic for row-crop farming operations - from 18 to 20 tons per acre per year. The loss of an inch per acre over one-two years can result without good soil conservation practices. Production losses can easily cost from $30 to $60 an acre annually, and soil losses reduce yields.[13,14]

Current row crop farming practices include measures that control erosion and soil loss with no-till, or low-till crops. The use of buffer strips, conservation tillage, terraces, and the practice of leaving crop residue in place all help keep soil exposure to a minimum and are good erosion preventatives. Farmers face the prospect of investment in different equipment in order to take advantage of new reduced tillage technology. Some tax incentives exist for the purchase of this equipment. In farm fields already suffering from

erosion, engineered solutions such as drop-pipes, grade stabilization structures, and slotted board risers can repair problems that without attention will only worsen over time.[15,16]

Cattle or dairy operations can fence cattle out of streams where other adequate water sources are available. Cattle can be very hard on the softer soils and sand of stream banks, and the introduction of manure directly into streams is an added problem that should be avoided for the sake of the health of the herd and the health of downstream users. The use of fences to exclude cattle from stream banks solves these problems. Electric fences are particularly good along stream margins because they do not gather much debris during high water events. Multi-strand wire and mesh fences can gather excessive amounts of floating debris during floods which causes them to fail. Single strand electric fences don't snag as much debris, and if they do break are much easier to repair.

Clearing along streams for development, camps and boat ramps.

Land adjacent to streams is scenic and commands consistently high prices in real estate markets. Naturally, when people buy high-priced land along streams, they want to enjoy the natural beauty. This often includes plans for clearing the banks to get a better view. Construction projects may include stairs down the bank to the stream, small docks or bulkheads, and in some cases a concrete, gravel or rip-rap boat ramp. The disturbance to stream bank vegetation and soil during construction projects can be as drastic and harmful as a total forest removal removal and replacement with a lawn, or as minor and benign as cutting away only enough vegetation to create a dirt footpath.

Over time, landowners who least disturb the banks will have fewer "battles" with the stream. Building camps well back from the immediate bank will insure that bank stability is not decreased by earth moving machines and other construction activities. The stems of woody vegetation and the trunks of trees act to slow flowing water down and decrease its erosive power. The living roots of shrubs and trees hold soil in place along streambanks. Clearing for a view of the stream must be balanced with the amount and kind of vegetation that is removed.

The native trees and shrubs that cling to banks are adapted to that place. They thrive because the moisture, soil, nutrients and hours of sunlight per day are right. Selective removal of some branches or light pruning can be a way to balance the desire for a view with the necessity of having adequate vegetation along banks to stabilize them during seasonal high water events.

The worst thing to do along a stream is to clear all the trees and shrubs and plant a grass lawn. This, more often than not, begins a fight with erosion. Likewise, grading banks down and creating boat ramps will usually start a fight with the river that the landowner will lose (Fig. 18).

There are legal and regulatory issues too that may be triggered by construction projects that disturb banks and put fill or sediment into streams. This is especially true in the Coastal Management Zone and along rivers which are navigable. It is best to get competent advice from the proper regulatory agency or

from someone who understands streams before committing to a construction project that disturbs banks. Wetland permits involving stream banks are handled by the U.S. Army Corps of Engineers and by the Mississippi Department of Environmental Quality. Projects within the Coastal Zone are handled by the Department of Marine Resources.

Each county in Mississippi has a United States Department of Agriculture (USDA) office which will provide soil conservation expertise from professionals from the Natural Resources Conservation Service (NRCS). The offices of the Mississippi Soil and Water Conservation Commission are distributed around Mississippi in the various Soil and Water Conservation Districts. Professionals from these federal and state soil conservation agencies are available free of charge to consult with streamside landowners.

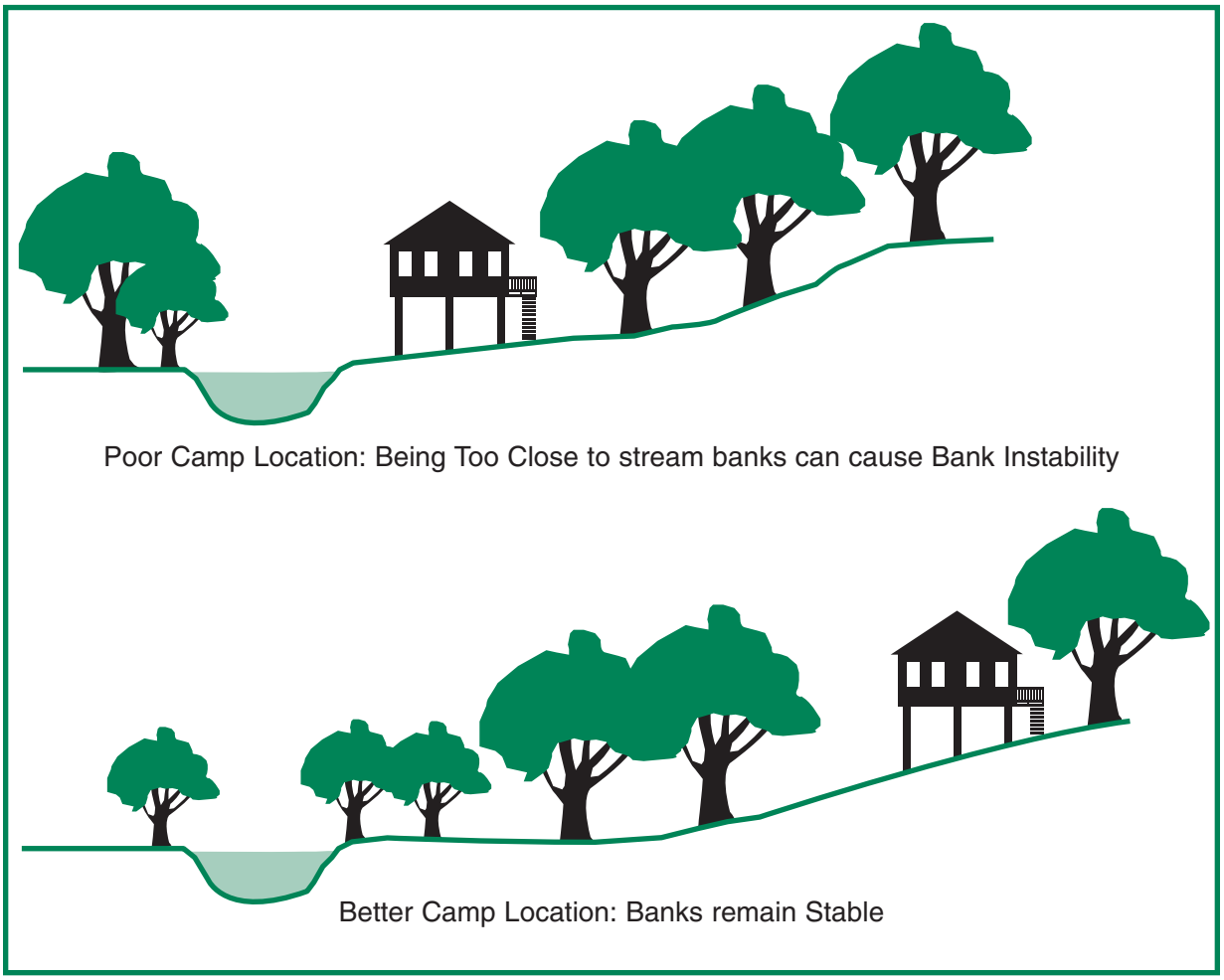

Figure 18. Proper location of stream-side camps and development helps maintain bank stability and prevents problems during high water events.

Chapter 3. Stream Restoration Intervention and Repair

The earlier discussions of accelerated erosion (headcutting) in stream channels provide a background about the physical processes affecting streams after disturbance occurs. As headcuts migrate up river channels and even small tributaries, they cause the banks to slough and channels to change. The lasting effects of headcuts are overwidened, degraded, and possibly incised (down-cut) channels in the knick zone, and transportation of sediment and deposition in the downstream direction. Streams can recover from these disturbances, but typically take decades and even centuries to do so.

Soil movement off agricultural land can be dramatic, as the discussion of soil loss illustrated. Streams that drain agricultural areas receive whatever washes off the surrounding lands. If soil conservation practices are poor or absent, streams deteriorate physically and biologically. The biological effect most often shows up as a decline in the diversity of species living in the stream. Which species show the most dramatic declines will depend upon the particular stream. Some lose diversity of freshwater mussels, in others there is a decline in the number of different fish species.

Stream restoration is the intervention by soil specialists, engineers, and biologists to stop or slow the decline in the physical form and biological functions of the waterway. Stream restoration in agriculture settings is usually to halt fields eroding, or to stop gully or rill erosion from affecting the local drainage network of farm ditches and canals which lead to existing streams or rivers.

Stream restoration also is undertaken when headcuts on streams are collapsing streambanks and taking property by the effects of accelerated erosion. This form of restoration can take the form of bank stabilization by armoring the banks, and/or through deflecting water away from problem areas, and building grade control structures. Usually, this work is accomplished with some application of stone or rock. Increasingly, softer structures and materials are used in streambank restoration. Logs, biodegradable material, live plantings of willow or other tree cuttings can hold banks together while native vegetation becomes established. Stream restoration calls for soil scientists and civil engineers to work with the natural energy of the stream through manipulations that will allow the channel and banks to recover their integrity. With the return of physical integrity comes an increase in the biological health of a stream or waterway.

Books and courses have been produced to teach engineers, natural resource field personnel, farmers and landowners how to tackle stream restoration. Instead of a thorough treatment of the subject in this text, a brief account will suffice along with reference to good information resources on stream restoration methods and practitioners. An assessment of the overall condition of the entire watershed is necessary as a first step in deciding whether stream restoration techniques should be used at all, and in deciding which ones to use. Because a stream is an equilibrium or balanced system of discharge, slope, and sediment load, any man-made alteration in the name of restoration will have a consequence on one or more of these three factors. The trick in restoration is in predicting desired outcomes for these manipulations and in careful consideration of the choices in the planning stages of a project.[17]

In Mississippi, the groups with the most expertise in stream restoration are the state's Soil and Water Conservation Commission, and the county representatives of the Natural Resources Conservation Service (NRCS) which is part of the United States Department of Agriculture (USDA). NRCS biologists and technicians throughout Mississippi can be consulted for stream restoration needs. The Waterways Experiment Station (WES) of the U.S. Army Corps of Engineers has several staff members with expertise and experience in stream restoration as well. Periodically, this group teaches a stream restoration course at WES in Vicksburg.

Mississippi is particularly rich with agencies and institutions that focus on the prevention and repair of erosion. The Mississippi State University Extension Service and the Water Resources Research Institute at the Mississippi State Civil Engineering Department are two good examples. The NRCS has the soil and sedimentation laboratory at the University of Mississippi in Oxford. Also at Oxford is the U.S. Forest Service's Forest Hydrology Laboratory. The Whitten Plant Materials Center at Coffeeville, is part of the NRCS.

Stream Restoration Resource Guides

Stream Restoration Guidebook, cost $35
North Carolina State University Water Quality Group
Box 7637
Raleigh, NC 27695-7637
(919) 515-3723
Free download at: www5.bae.ncsu.edu/programs/extension/wqg/sri

Kansas River and Stream Corridor Management Guide
Kansas State Conservation Commission
109 SW 9th Street, Suite 500
Topeka, KS 66612-1299
(785) 296-3600

Stream Corridor Restoration: Principles, Processes, and Practices, cost $71, paper, $60, CD ROM
NTIS
5285 Port Royal Road
Springfield, VA 22161
1-800-553-6847 / (703) 605-6000

Stream Restoration with bank plantings using native plants

Living roots hold stream banks together. If a bank has been cleared and needs replanting, or if planting is part of a restoration project, contractors need a source of plant materials. It is not practical to generate a listing of all the possible types of plants that may be dominant along rivers and creeks in Mississippi. Probably the best advice is to plant what is well adapted to the growth conditions along the bank. This can be discovered by doing some investigation of the dominant vegetation types at the site.

It makes sense to plant something already proven to be successful at a site. What grows well on a specific zone of a bank or streamside area should be noted and identified, so that a commercial source can be located. If naturally occurring seedlings or daughter plants of native species can be transplanted on the site itself, then the restoration can use perfectly adapted plant material. One caution is to try to avoid invasive or exotic (non-native) plants in your restoration planting.

Agencies, Consultants, and Plant Materials Vendors

Free help is available from your county Mississippi State University Extension specialist or from the NRCS office in your county with its biologists, soil specialists, and technicians. A district forester from the Mississippi Forestry Commission can help as well with plant selection and planting.
The following is a partial listing of sources for plants and advice:
1) Mississippi Planting Guide. June 1999, Jamie Whitten Plant Materials Center, Coffeeville, Miss. Ecological Sciences. Jackson, Miss. United States Dept. of Agriculture, Natural Resources Conservation Service. Available on the internet www.ms.nrcs.usda.gov/planting.htm
2)Mississippi State University Extension Service. Publication MTN 4E, Forest Seedling Availability.

Availability from in-state and regional Nurseries.
Revised July 2001.

Commercial Trees: Pines and Hardwoods.

Bearcreek Nursery, Inc.
1172 Old Yazoo City Rd.
Canton, MS 39046
Contact: Paul Hopping
601-898-8071

International Paper
Super Tree Seedling Sales
301 Humble Ave. #156
Hattiesburg, MS 39401
Contact: Tom Reynolds 1-800-452-3164
Internet: www.supertreeseedlings.com

Mississippi Forestry Commission
Waynesboro Nursery
1063 Buckatunna-Mt.Zion Rd.
Waynesboro, MS 39367
Phone 601-735-9512

Mississippi Forestry Commission
Winona Nursery
90 Highway 51
Winona, MS 38967
Phone 662-283-1456

Hardwood Seedlings LLP
P.O. Box 459
St. Francisville, LA 70775
Contact: Ms. Kellie Daniel
Phone: (225)635-4789
email: info@hardwoodnursery.com

Delta View Nursery
Rt. 1 Box 28
Old Highway 61 S.
Leland, MS
38756
1-800-748-9018 email hardwoods@tecinfo.com
website www.deltaviewnursery.com

Yazoo Hardwood Nursery
P.O. Box 304
Merigold, MS 38759
Contact: Mark Yarborough
Phone 662-748-2652

Circle "C" Ranch Tree Farm
6061 Oak Ridge Rd.
MerRouge, LA 71261
Contact: Louie Crook Jr.
Phone: (318) 647-3518

International Forest Company Inc.
1265 Georgia Hwy 133 N.
Moultrie, GA 31768
Tel. (229) 985-0231
Toll Free 1-800-633-4506
Wayne Bell, Patrick Mobley

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www.barnesbrothersnursery.com

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P.O. Drawer 439
Semmes, AL 36575
Phone (251) 645-2222
Tom Dodd III
www.doddnatives.com

Jenkins Nurseries
(wholesale only to licensed landscapers)
62188 Dummyline Rd.(off Hwy 16 east of Amite)
Amite, LA 70422
(985)748-7746

Rick Webb's Louisiana Growers (wholesale only)
63279 Lowery
Amite, LA 70422
(985) 747-0510
rwebb@i-55.com

Pushepetappa Gardens (John Thornton)
2317 Washington Street
Franklinton, LA 70438 (Nursery is in Pine, LA)
(985) 839-4930 -Dr. Thornton's Veterinary Clinic
(985) 839-4173 Dr. Thornton's Home

Trees by Touliatos (Plato Touliatos)
2020 Brooks Road
Memphis, TN 38116
(901) 345-7361 www.waterplants.net

Crosby Arboretum List of Native Plants Along Southern Mississippi Streams

The following discussion and list were produced by the staff of the Crosby Arboretum, located just south of Picayune. The property contains a remnant of the longleaf pine natural community. The arboretum originally belonged to the Crosby family and was made a living memorial to L. O. Crosby Jr. (1907-1978). It is managed by Mississippi State University as its Coastal Research and Extension Center. Arboretum habitat surveys, such as the following example completed in 1990, list native plants along the creeks on the arboretum property. The inventories are some of the best references for plant life native to stream banks in the Eastern Gulf Coastal Plain region of Mississippi.

Stream Bank Habitat (from arboretum's pinecote habitat species list)

This habitat is a complicated gap type. Due to the permanence of the open water environment (at least in human terms, it is permanent), the edge effect will persist. Plants that would, in a normal forest habitat, be subject to deep shade, are able to grow along the margin in partial shade or even full sun. This distorts their habit-usually resulting in asymmetrical branching and uncharacteristic growth rates. Thus, the oft mentioned (and rarely observed) layering of the mature forest structure is absent from the Stream Bank Habitat. In this case, I assume that the stream is never exposed to fire, hence a self perpetuating hardwood dominated forest would develop. Relict trees from the pioneer forest would persist through time. Gaps formed by their demise and the occasional loss of other trees would allow opportunistic colonizers to invade-particularly along the water's edge. Thus, the two primary environmental gradients are probably light level and soil moisture.

Native plants found along the creeks of the arboretum include:

Acer rubrum Red maple
Aronia arbutifolia red chokeberry
Aralia spinosa devil's walking stick
Berchemia scandens Alabama supplejack
Cephalanthus occidentalis buttonbush
Clematis crispa swamp leatherflower
Clethra alnifolia sweet pepperbush
Cornus alternifolia alt. leaved dogwood
Cornus florida flowering dogwood
Cornus stricta swamp dogwood
Crategus marshalli parsley hawthorn
Crategus crus-galli cockspur hawthorn
Cyrilla racemifolia Titi
Gelsemium sempervirens jasmine
Hypericum spp. St. John's Wort
Ilex decidua deciduous holly
Ilex opaca American Holly
Ilex verticillata common winterberry
Liquidambar styraciflua sweet gum
Liriodendron tulipifera tulip poplar
Lonicera sempervirens coral honeysuckle
Magnolia grandiflora magnolia
Magnolia virginiana sweet bay magnolia
Menisperma caroliniana common moonseed
Myrica cerifera (excl.pusilla) wax myrtle
Nyssa sylvatica var. biflora black gum
Osmanthus americana wild olive
Ostrya virginica hop hornbeam
Persea palustris red bay
Pinus glabra Spruce pine
Bignonia capreolata crossvine
Campsis radicans trumpet creeper
Carpinus caroliniana ironwood
Carya aquatica water hickory
Pinus palustris Longleaf pine
Pinus elliotti Slash pine
Prunus angustifolia Chickasaw plum
Prunus serotina black cherry
Quercus falcata Southern red oak
Quercus laurifolia laurel oak
Quercus michauxii swamp chestnut oak
Quercus alba white oak
Quercus nigra water oak
Quercus phellos willow oak
Quercus virginiana live oak
Rhododendron canescens native azalea
Sabal minor dwarf palmetto
Rhus copallina winged sumac
Sassafras albidum sassafras
Sebastiana fruticosa Gulf sebastiana
Taxodium ascendens pond cypress
Trachelosperma difforme climbing dogbane
Vaccinium arboreum farkleberry
Vaccinium elliotti Elliot's blueberry
Vaccinium staminium deerberry
Viburnum ashei southern arrowwood
Viburnum dentatum arrowwood
Viburnum nudum possum haw
Viburnum rufidulum rusty blackhaw
Vitis rotundifolia wild grape

Vendors supplying native plants are uncommon around the South, but their numbers are on the increase. Even though fewer than half of the above list of plants are available commercially, some may fit your soil type, climate and needs.

Chapter 4. Mississippi's Scenic Streams Stewardship Program
History of Mississippi's Stream Program

Mississippi's first attempt at a stream conservation act was in 1969, following passage by Congress of the National Wild and Scenic Rivers Act in 1968. After six failed attempts at a state regulatory streams act, the project was abandoned in 1978. If nothing else, it was clear that a regulatory program would not work in Mississippi.

Twenty years later, a renewed effort emerged to create a streams program in Mississippi, but one without regulation. The late Richard L. "Dick" Livingston, chairman of the House Game and Fish Committee, and William Y. Quisenberry, of The Department of Wildlife, Fisheries and Parks - a longtime key player in state land acquisition and conservation led the effort. Elizabeth R. Barber, executive director of The Mississippi Wildlife Federation at the time lobbied for the Scenic Stream bill. The Mississippi Scenic Stream Stewardship Act was passed in the 1999 Legislative session and was signed by the Governor on March 16, 1999. This legislation created the Scenic Streams Stewardship Program (SSSP) which began on August 9,1999.

Goal

The goal of the SSSP is to encourage voluntary private conservation efforts by riparian (streamside) landowners. In a non-regulatory framework, landowners are assisted in voluntary management agreements which seek to maintain scenic values without interfering with their property rights or land use.

When a stream or river is nominated to the program, a landowner-based stewardship plan is created. Generally, the goal is to maintain good water quality for recreation and fish and wildlife habitat through promotion of BMPs.

Eligibility Requirements

The SSSP applies to streams that have not been channelized within the past five years and are considered by law to be public waters. Designation as a public waterway depends on the volume of water that flows in the particular section of the stream. The Public Waterway Law, Mississippi Code § 51-1-4, provides that for a stream to be a public waterway, the mean annual flow volume must be at least 100 cubic feet per second (cfs). Small headwater sections of streams generally do not qualify as public waters, and so it is the middle and lower sections of streams that may be qualified for the SSSP.

This program leads landowners to manage timber harvest operations so that streams are protected without mandatory regulations. The program considers one stream at a time, with support originating at the community level. If a stream is evaluated and found eligible, an Advisory Council with a landowner majority is assembled from the communities near the stream. If strong public support for nomination is shown in the community, and if this is reflected by comments at a required public meeting, a bill of nomination is

submitted to the Legislature. If local support is lacking, the stream won't be nominated. This is a joint decision of the Advisory Council and the Department.

Steps in the Nomination Process

There are ***eight*** steps involved in nominating a stream.

1) Eligibility. Any Mississippi organization, resident, state agency or local government may request the Department to evaluate a stream for eligibility.

2) Evaluation. The Department will then evaluate the stream using the following criteria: biological, physical(character of stream channel), human interaction (use by people), and historical.

3) Legislative Determination of Eligibility.

If the stream meets the above criteria, the Department recommends to the Legislature that the stream be listed as eligible. This recommendation takes the form of a bill which the Legislature must adopt before the nomination process advances to step 4.

4) Advisory Council.

The Department, through the executive director appoints an Advisory Council for the stream. This council is composed of members representing the following interests;

a) The Department b) Local Government c) Agriculture d) Forestry
e) Business f) Conservation g) Recreation
h) Riparian (streamside) Landowners (must constitute a majority of the council).

5) Public Notice and Meeting.

Actual notice is mailed to riparian landowners at their current address found in county tax rolls. A public meeting will be held in the vicinity of the stream thirty days after published public notice in newspapers of both local and statewide circulation. Public comments concerning the nomination of the stream will be received at this meeting.

6) Nomination.

After consideration of the public comments received at the meeting, the Advisory Council and the Department will decide whether to request a bill of nomination by the Legislature.

7) Legislative Nomination and Notice.

Nomination of the stream to the SSSP is filed as a bill and must be adopted by the Legislature. Notice of the final designation, including boundaries, will be given by publication in local and statewide newspapers and by mail to riparian landowners and local governments.

8) Stewardship Plan.

The Department and the Advisory Council develop a cooperative, voluntary stewardship plan for the scenic stream. Individual landowner agreements can provide a connected patchwork of protected stream banks along the length of a stream.

Streams included in pilot program by Scenic Streams Act

Sections of six streams were made eligible for consideration when the Scenic Streams Stewardship Act passed in March of 1999. These six are listed as components of a pilot program.

§ 51-4-17. Pilot programs.

(1) The department is authorized to conduct a pilot program for the following streams designated as eligible for inclusion in the SSSP:

(a) Wolf River in Pearl River, Hancock, Stone and Harrison counties beginning at Mississippi Highway 26 in Pearl River County to Bay St. Louis in Harrison County;

(b) Black Creek in Lamar, Forrest, Perry, Stone, George and Jackson counties beginning at Mississippi Highway 589 in Lamar County to the Pascagoula River in Jackson County;

(c) Okatoma Creek in Simpson and Covington counties beginning at the Illinois Central Gulf Railroad in Simpson County to the Bowie River in Covington County;

(d) Strong River in Smith, Rankin and Simpson counties beginning at the confluence of Beech Creek in Smith County to the Pearl River in Simpson County;

(e) Pearl River in Winston and Neshoba counties beginning at the origin, confluence of Nanih Waiya Creek and Bogue Chitto Creek in Winston County to Mississippi Highway 15 in Neshoba County;

(f) Buttahatchee River in Monroe and Lowndes counties beginning at the Mississippi-Alabama state line in Monroe County to U.S. Highway 45 in Lowndes County.

Streams Nominated

Of the streams in this list, the Wolf River was formally nominated to the program in March of 2000. Also, the Tangipahoa River in Pike County joined the program in 2001, Magee's Creek in Walthall County was nominated in 2002, and The Chunky River in Newton and Lauderdale counties joined in 2003. Stewardship Plans are under way for these streams.

Stewardship Plan

A stewardship plan is composed of voluntary agreements by streamside landowners to keep banks stable by using BMPs when they harvest timber or clear along stream banks. BMPs, discussed earlier in detail, are a set of recommended guidelines for planning and conducting timber harvest operations so that adverse effects from soil disturbance do not harm water quality in nearby streams. These practices help maintain the scenic values of the stream. Voluntary participation ensures that the rights of riparian (streamside) landowners will continue in existing agriculture, forestry, water supply, recreational, commercial, and industrial uses, and any other uses identified. This plan is created with the assistance of the Mississippi Soil and Water Conservation Commission, and the Mississippi Forestry Commission. A landowner is not obligated or required to participate in the plan.

Two stewardship options are available to a landowner wishing to participate in the stewardship plan. Landowners can take part through non-binding BMPs, or through binding agreements such as conservation easements. The choice to participate or not is left to the landowner.

Non-binding Conservation Agreements

Basic participation in a stewardship plan is through the non-binding agreement with the Department that the landowner will require Best Management Practices (BMP) when harvesting timber along stream banks. This means that BMPs will be made a requirement in the timber deed or contact of sale with the timber buyer. BMPs call for leaving an area of uncut trees and vegetation of an appropriate width along the stream bank. Foresters call this a Streamside Management Zone or SMZ. The width of the SMZ will generally depend on the grade or slope of the land. Leaving adequate standing trees and vegetation along streams serves to hold bank soils and slow rainwater runoff, and filter and trap sediment before it washes into the stream. This agreement is non-binding and can be canceled with 30 days notice to the Department.

Binding Conservation Agreements

Other stewardship options can include creation of a conservation easement by the landowner. A conservation easement is a legal agreement a property owner makes to restrict the type and amount of development that may take place on his or her property. The landowner still owns the land to which the easement applies. Federal income tax incentives for conservation appeared in 1976, and the 1986 revision of the IRS tax code included conservation easements in section 170 (h). They are a special class of itemized deduction. Conservation easements must be 1) given in perpetuity, 2) to a qualified holder (a non-profit land trust, or state agency), and 3) must be for conservation purposes. A tax deduction of up to 30% of Adjusted Gross Income (AGI) is allowed based on the decrease in the fair market value of the land due to the development restrictions caused by the easement. The restrictions a landowner places on his/her development rights also cause reductions in the estate value for estate planning purposes. Easements provide long term habitat protection and are powerful tools for reducing income and estate taxes. Conservation easements are binding and cannot be terminated with notice.

An example of a significant conservation easement is International Paper Company's agreement to limit disturbance in a 300-foot wide forested buffer on either side of the Wolf River for 15 miles in Harrison County. The Company negotiated the terms of the easement, and was afforded tax relief.

Most landowners choose the non-binding agreement to use BMPs when harvesting timber. This kind of participation in a stewardship plan can be terminated easily. On the other hand, granting of easements and donations of land are not choices that may be terminated by 30 days notice. These conveyances are governed by Mississippi property, and/or federal tax law and should only be undertaken by the landowner after consultation with an attorney. Such legal acts must be in writing and filed in the public record in the appropriate county chancery court. Mississippi passed its own Conservation Easement Act of 1986, which is a statute providing for granting of easements (see Miss. Code §89-19-1). This statute gives a clear method for granting gifts of land or easements which can qualify the donor for tax relief under federal law.

Mississippi Income Tax Credit for Conservation Easements on Scenic Streams

House Bill 701 of the 2003 regular Legislative session (Miss. Code Sec. 27-7-22.21) was enacted to help landowners with the transaction costs involved in creating conservation easements. If conservation easements under section 170(h) of the Internal Revenue Code are created on lands adjacent to nominated scenic streams or on lands considered priority conservation sites by the Mississippi Natural Heritage Program (NHP), a Mississippi income tax credit is available on 50 percent of allowable transaction costs up to a limit of $10,000. Allowable transaction costs are defined as: costs of the appraisal of lands or interests in lands, including conservation easements, that are being donated, of the baseline survey of the natural features, animals and plants present on the site, of engineering and surveying fees, of maintenance and monitoring fees and of legal fees, including the costs of document preparation, title review and title insurance. Landowners may spread the credit over 10 years. This credit was created to encourage long term conservation of high quality habitats along nominated scenic rivers and streams and on NHP priority sites.

Important Features of the SSSP

1) The program is voluntary, non-regulatory, and was created as a framework for stream conservation in which landowners may choose to participate. The Legislature did not want to create a program which would add layers of regulation for landowners.

2) Landowner conservation agreements help maintain the biological integrity and function of streambank property. The benefits of maintaining stable stream banks are many. Bank erosion is decreased, stream channels remain deep and stable, water quality is improved, habitat is maintained for fish and wildlife, and valuable soil and nutrients remain on the land.

3) The program confers no new rights on the public to use or access private lands within the boundary of a designated scenic stream area. The program operates under the Public Waterway Law presently in force and

does not change the law.

4) Any landowner entering into a binding agreement (easements or fee donation) for the management of lands along nominated streams is eligible for a state tax credit of 50% of the transaction costs of creating the easement up to $10,000.

5) With proper notice, landowners may withdraw from non-binding options such as BMP agreements. Other stewardship options such as granting conservation easements along streams, or donating land to the Department are binding and may not be terminated with notice of 30 days.

Frequently Asked Questions about the SSSP.

1) What is the chance that this program will turn into something that is regulatory, and can the Federal Government come in on the heels of this program and take it over?

This program is a creation of the state Legislature. If it changes, the Legislature will have to do it. It would be against stated legislative intent to have a regulatory program. This much can be learned from a reading of the first paragraph of the Act (see appendix B).

The Legislature refused for nearly 30 years to pass regulatory versions of a streams program. The efforts failed six times between 1969 and 1978. In 1999, this voluntary, non-regulatory, landowner outreach program was created and passed into law. The Legislature does not want to regulate landowners with a streams program.

In order for the federal government to come in on the heels of a state program, it must have delegated administrative powers to the state over some subject and provided the state with federal guidelines to follow. And it must be shown that the state failed to follow them.

The Department of Wildlife, Fisheries and Parks has not been delegated any administrative power over streams or waters by the federal government. The SSSP is Mississippi law, not federal law, and there is no basis for the federal government to step in.

2) Will this open my stream to more public use and all the attendant problems, littering, too many people, etc.

No. The important fact is that this does not change public waterway law, nor does it give anyone more legal rights to float, swim or use public waters than they had prior to the program.

This is a landowner outreach program. There is some required public notice about meetings, nominations and designations, but most of the interaction is directed to landowners along the stream or river.

The day-to-day work of the Program, and the vast majority of the correspondence, contact, and transactions are with landowners. This is not a promotional campaign to open up a river to more use. It is a BMP education program, with water quality improvement, and stream bank stability as its goals. It seeks stability or improvement of fish and wildlife habitat, not increased exploitation of streams. Most recreational users of public waters tend to value the same scenic qualities as the landowners in the program. Recreational stream users who litter and break laws are dealt with by law enforcement officers.

3) If all the program really asks is that folks use BMPs voluntarily, what is the difference between this and the way things were before, because BMPs were already voluntary. Why do we need a Scenic Streams Program to do this?

BMPs are voluntary. The importance of leaving buffer zones along streams is hard to oversell or overemphasize. Farmers have had buffer programs such as Conservation Reserve Program and Wetland Reserve Program for some time. When compared with farmers, non-agricultural landowners along streams are less likely to receive the message about improving water quality with buffer zones. This program provides a way to directly reach these people.

Generally, county and local governments do not have the people or resources to do educational programs that reach out to landowners. Since stream conservation is a statewide issue, it is appropriate for a statewide resource agency to undertake the task. This program uniquely fits the expertise of the Department. Streams provide habitat for the fishery and wildlife resources that the Department manages. Healthy in-stream and riverbank habitats help sustain fish and wildlife populations.

A stewardship plan considers an entire section of river and provides a framework in which voluntary, coordinated private conservation efforts can protect this reach. Also, until now concerned landowners have not had a way to be part of an organized effort in stream conservation.

For landowners unfamiliar with BMPs, this program is a way to spread the message that streamside landowners have a substantial effect on the river for better or worse. Their choices matter in the overall condition of the stream. Unity of purpose and the ability to understand how one's efforts relate to similar undertakings along a stream make the difference. Landowners are asked to lend the strength of their agreements to use BMPs to the effort to conserve habitat along the river. In doing this, they may convince upstream and downstream neighbors to do the same.

How will this program affect farmers?

This program does not create another layer of regulation for farmers. The farmers who will have contact with the Program are those who have pastures or fields along the banks of streams that become eligible for the SSSP. They will be contacted by the Department when their parcel is found in the county land ownership maps at the tax assessor's office. They will receive notice of public meetings concerning nomination, and will be invited to comment on the inclusion of their stream in the program. Farmers may already be involved in CRP continuous sign-up buffer programs.

If their river is nominated to the Program, farmers will be contacted by the Department again about being part of a voluntary stewardship plan. They can choose to participate by agreeing to use BMPs bordering the stream, or they can choose not to participate. The program does not single out farmers, but offers the same encouragement and opportunity to them as it does to other landowners.

Private Property Rights and Mississippi's Public Waterways Law

The text of the public waterways law is included so that the reader can digest it by reading the text before reading the background and comments.

Public Waterways Law (text)

§ 51-1-4. What constitutes public waterways; rights thereon.

(1.) Such portions of all natural flowing streams in this state having a mean annual flow of not less than one hundred (100) cubic feet per second as determined and designated on appropriate maps by the Mississippi Department of Environmental Quality shall be public waterways of the state on which the citizens of this state and other states shall have the right of free transport in the stream and its bed and the right to fish and engage in water sports. Such persons exercising the rights herein granted shall do so at their own risk and such persons shall not be entitled to recover any damages against any owner of property along such public waterways or anyone using such property with permission of the owner for any injury to or death of persons or damage to property arising out of the exercise of rights herein granted other than those damages which may be recovered for intentional or malicious torts or for gross or willful negligence against the owner of property or anyone using such property with permission of the owner. Nothing herein contained shall authorize anyone utilizing such public waterways under the authority granted hereby to trespass upon adjacent lands or to launch or land any commercial or pleasure craft along or from the shore of such waterways except at places established by public or private entities for such purposes. Nothing herein contained shall authorize any person utilizing said public waterways under the authority granted hereby to disturb the banks or beds of such waterways or the discharge of any object or substance into such waters or upon or across any lands adjacent thereto or to hunt or fish or go on or across any adjacent lands under floodwaters beyond the natural banks of the bed of the public waterway. Floodwater which has overflowed the banks of a public waterway is not a part of the public waterway.

The right of the public to use public waterways does not include the use of motorized vehicles in the beds of a public waterway without the written permission of the landowner. Any person who uses a motorized vehicle in the bed of a public waterway without the written permission of the landowner may be punished as provided in Section 97-17-93.

Nothing herein contained shall be construed to prohibit the construction of dams and reservoirs by the State of Mississippi or any of its agencies or political subdivisions or riparian owners in the manner now or hereafter authorized by law or in any way to affect the rights of riparian landowners along such waterways except as specifically provided hereinabove or to amend or repeal any law relating to pollution or water conservation or to affect in any manner the title to the banks and beds of any such stream or the title to any minerals thereunder or to restrict the mining or extraction of such minerals or the right of ingress and egress thereto.

The provisions of this section limiting the liability of owners of property along public waterways and persons using such property with permission of the owners shall not be construed to limit any rights of

claimants for damages under federal statutes or acts applying to navigable streams or waterways or any other civil causes of action subject to admiralty or maritime jurisdiction nor shall said provisions be construed to limit the rights of any parties involved in litigation founded upon the commercial or business usage of any navigable streams or waterways.

Any lake hydrologically connected to a natural flowing stream and listed as a public waterway under subsection one on July 1, 2000 and subsequently removed from that list before July 1, 2001 by the Commission on Environmental Quality because the lake did not meet the requirements of subsection one shall be presumed to be a public waterway until a court of competent jurisdiction determines otherwise. Nothing in this subsection shall be construed to determine the property rights in the bed or banks of the lake, the right of ingress or egress across private property to the lake, or mineral interests.

This section shall apply only to natural flowing streams.

SOURCES: Codes 1942 §§ 8413.5 8413.6; Laws 1972 ch. 361 §§ 1 2; 1988 ch. 598 § 1 eff from and after passage (approved May 25 1988).

SOURCES: Laws 1994 ch.

Background and Commentary on the Public Water Law

In 1988 the Legislature clarified certain long-standing public rights of use pertaining to streams when it created the Public Waterways Law. From Mississippi's early territorial days, streams and rivers were used for commerce. In the common law there existed a right to use them for transportation. This right of use was codified in some early Mississippi law books such as *Hutchinson's Code of 1848, Miss. Laws 1896*. This understanding of running surface waters as a common or public thing has its roots in Roman Law that classified running water and air as public things. This was absorbed into English Common Law and became part of the legal system of the American colonies long before Mississippi's statehood. This common law view persists now in the Public Trust Doctrine.

Since territorial days, the nature of the use of streams has changed from commercial to recreational, and the law was changed in 1988 by the Mississippi Legislature to reflect this. Compared to neighboring Southern states which have legislated little about public waters in the last 150 years, Mississippi is very progressive. The change was from the older laws of navigability for commerce to a limited right of use by citizens of this state and other states. This right is limited to free transport on the water and in the bed of streams and the right to fish and engage in water sports. Present waterways law makes direct reference to trespassing in its text and endeavors to protect riparian (streamside) landowners from liability to users of the water while still affording the public a right of reasonable recreational use. The law specifically prohibits disturbance of streambeds or banks.

Only streams with a certain minimum flow are classified as public waters. A stream must have a mean annual flow of 100 cubic feet per second (cfs) to be considered public. This flow rate is a statistical mean based on many years of stream flow data. The practical translation of the flow requirement means that

given Mississippi's average rainfall and topography, in order to have 100 cfs at a given point on a stream, there must be 75 square miles of drainage basin above it. In other words, in Mississippi, the water draining off of 75 square miles of watershed will give a flow volume of 100 cfs.
On streams having at least 100 cfs mean annual flow, the public (literally citizens of this state and other states) have the right to free transport and to fish and engage in water sports.

Rights of Recreational Users

The Public Waterway Law allows citizens to have free transport in the stream and its bed and the right to fish and engage in water sports. What is contemplated here is floating on the stream in canoes, or innertubes, swimming, and fishing. Wading to fish is acceptable on public waters as long as the wader does not venture off the streambed onto adjacent lands.

Prohibited uses of public waterways

Disturbance of the bed or banks or discharge of any object or substance into water or upon adjacent land is prohibited. Trespassing on adjacent lands is prohibited. Strictly speaking, it is trespassing to leave the stream bed and move onto sandbars or banks along the public stream or river. When public waters are out of their usual banks, fishing or hunting in or on flood waters that have spread over adjacent lands is not allowed. Launching recreational or commercial craft (boats) is not allowed from any place other than a public or private boat launch.

Trespassing in Mississippi

Miss. Code § 97-17-93. **Entering lands of another without permission; enforcement; relation to other statutes; dismissal of prosecution.**

> "(1) Any person who knowingly enters the lands of another without the permission of or without being accompanied by the landowner or the lessee of the land, or the agent of such landowner or lessee, shall be guilty of a misdemeanor and, upon conviction, shall be punished for the first offense by a fine of not less than One Hundred Fifty Dollars nor more than Two Hundred Fifty Dollars."".....(2)(a) It shall be the duty of sheriffs, deputy sheriffs, constables, and conservation officers to enforce this section.

A trespasser is one who intentionally and without consent or privilege enters another's property. The trespasser's intent or state of mind is ordinarily inferred from the facts of the incident. In Mississippi, Justice Court judges (Justices of the Peace) have jurisdiction over citations for trespassing. Cases will be brought before them whether the citation has been made by a law enforcement officer or solely by sworn affidavit of the landowner. The public water law directly addresses the situation of recreational users who venture off the streambed and walk onto adjoining private lands. The law clearly states that this sort of activity is

trespassing: **"Nothing herein contained shall authorize anyone utilizing such public waterways, under the authority granted hereby, to trespass upon adjacent lands..."**

Riding off-road vehicles in streams

Many trespassing cases have been heard around Mississippi involving the riding of All Terrain Vehicles (ATVs) or 4-wheelers in streams. Unfortunately, people routinely use streams for recreational riding which is destructive to aquatic habitat and violates the use and quiet enjoyment of landowners whose streambeds they ride upon.

The 2002 session of the state Legislature amended Mississippi's public waterways law, prohibiting riding motorized vehicles in public waterways without the landowner's written permission. Violation of this law is a misdemeanor. A landowner's right to exclude people from his/her property is recognized. Regarding prosecutions by Justice Court judges of trespassing on public waterways, there seems to be confusion over the status of the beds of public waterways.

The easy case is the private (non-public) stream or river flowing over private land. Here, no right of use is granted to citizens, and anyone found along these streams may be excluded. The confusion seems to come with private land that has a public waterway flowing across it. This is a common situation in Mississippi, because most public streams do flow over private land, on which the landowner pays taxes.

Some county officials have called the streambeds and banks public land and have refused to exclude ATV riders from it. Their reasoning seems to be that if the stream is a public waterway, then the streambed underneath is public land. This is wrong. It is the water that has the public right attached to it. But the land beneath the water and on the banks of the stream is private and has always been private.

Contact with the streambed by fishermen, boaters, and swimmers is normal. Wading to fish, or to push or drag one's boat over a log, or wading while swimming are all acceptable ways of exercising the right granted by the public waterway law. Attorney General's opinions have treated wading twice before, stating both times that wading the streambed is allowed on public waters. See Office of the Attorney General, State of Mississippi opinion numbers 3524 of December 6, 1993 and 18086 of December 3, 1976. These opinion letters cover wading, anchoring a boat, and push-poling a boat, all of which are found to be allowable incidental contacts with the bottom of the stream. Attorney General opinions are for guidance, but they are not equivalent to settled case law resolved by a court.

Recreational riding of ATVs, cars, or trucks in streams is not a water sport. It disturbs the bed and banks of the streams and produces sediment which is harmful to aquatic life. The destruction of fish spawning beds, the covering of fish eggs with silt and the disturbance of aquatic life that fish depend on as a food source cannot be allowed under the color of the public waterways law. What is granted by Miss. Code 51-1-4 is the right to use and enjoy natural flowing waters, and any activity that would tend to damage these resources must be excluded.

Landowner Liability Along Public Waterways

The Public Waterways Law defines public waterways as those streams and rivers having 100 cubic feet per second (cfs) mean annual flow. It also gives certain protection to landowners along streams. The Legislature reasoned that if a public right of use was granted to citizens to use streams for recreation, then landowners along them needed certain protections from liability if the citizens using streams for the intended purpose were injured. Since it is only the water that is public, the landowner should not be at risk of being liable for the damages of others simply because he or she owns the land beneath and beside the water.

Liability for injury to those using public waters is covered in Miss. Code 51-1-4. What the law says is :

"Such persons exercising the rights herein granted shall do so at their own risk, and such persons shall not be entitled to recover any damages against any owner of property along such public waterways or anyone using such property with permission of the owner for any injury to or death of persons or damage to property arising out of the exercise of rights herein granted, other than those damages which may be recovered for intentional or malicious torts or for gross or willful negligence against the owner of property, or anyone using such property with permission of the owner."

This language is the product of the 1988 amendment of 51-1-4 of 1972 which was brought on by a lawsuit in United States District Court For the Southern District of Mississippi: Dumas v. Pike County, Mississippi, 642 F.Supp. 131 (S.D. Miss 1986).

Mr. Dumas, a tourist from Alabama, who was floating the river in a rented inner tube, dived head first off a clay bank or bluff along the Bogue Chitto River in Pike County, broke his neck and was rendered a paraplegic. Dumas sued the landowner and the county. The judge in the case denied a summary judgment dismissal requested by Pike County and the landowner, and in doing so allowed the case to continue to trial on the issue of negligence and the corresponding duty of the private landowner who owned the bluff to warn of a dangerous condition.

This case scared landowners, and the Legislature answered this fear two years later in 1988 when it created the language in 51-1-4. The Legislature intended to protect landowners along public waterways by adding language to make it harder for a judge or jury to find a landowner liable for damages to someone who became injured along his section of public water. This amendment "raised the bar" (increased the standard of proof) for plaintiffs in personal injury cases, making it tougher to prove negligence against a streamside landowner on a public waterway.

The statute denies the recovery of damages in a lawsuit against a landowner in all cases except those in which the landowner does something intentional, malicious, or grossly negligent. Landowners can be held liable for damages if they go out of their way to harm or injure a person, or if they do something grossly negligent. Gross negligence is the intentional failure to perform a manifest duty in reckless disregard of the consequences as affecting the life or property of another. This is different from a mere failure to exercise ordinary care which is the definition of ordinary negligence.

Decisions such as this by the Legislature come from a public policy based on reason. Landowners along

public streams share the quiet enjoyment of a part of their land with recreational users of streams. It is reasonable to decrease the liability burden on these landowners by enacting a law (Miss. Code 51-1-4) to give them certain kinds of immunity from liability for damages. This does not mean that these landowners are immune from being sued. Suits are still possible, but what the public waterway law does is make the plaintiff's job of proving the landowner's liability for damage much more difficult.

Appendix A

What You Can Do In The Eligibility And Evaluation Process

A stream's eligibility for the Scenic Streams Stewardship Program (SSSP) is evaluated using four basic criteria. These are (1) biological features, (2) physical features, (3) human interaction, and (4) historical features. The first two are technical and require research and evaluation by the Department. The last two are best researched and reported by people who live in the vicinity of the stream under consideration, and the SSSP Program certainly would benefit from their assistance with this research.

When a request is made for a stream to be considered for eligibility, the Program needs the help of local volunteers who can gather information about how people use and experience the stream. This includes some basic and easily obtained descriptive economic information. Some examples of this type of information are: counting and describing things like boat launches or access points (put-in points for float trips), bait shops, canoe rentals, and camping areas along or close to the stream. Fishermen can readily report on sport and commercial fishing activities along the stream, e.g., how many different kinds of fish are usually caught. Also important are historical sites along the stream, whether they are Native American Indian sites, Civil War sites, old mill sites, or any other significant historical features.

This kind of information is best gathered by knowledgeable local volunteers. The process of research is also a chance to talk to business owners, neighbors, friends, and landowners along the stream and in the community about having the stream included in the SSSP.

The SSSP is rooted in community interest, and must have a local Advisory Council for each stream in the Program. The research process on general economic and historical features can provide the groundwork for choosing the Advisory Council. Landowners and others genuinely interested in the health of a stream will make excellent Advisory Council members. Early interest in having a stream evaluated for eligibility is a positive sign that initial momentum exists. We recognize the value of this and encourage the dedicated assistance of persons interested in advancing the process, including assembling basic information about the stream.

The eligibility process will be greatly aided by the completion of the following checklist, plus the inclusion of any necessary written explanations or comments on the different areas of information:

Economics: How many privately owned recreation-based services are supported by recreational activities along the stream? (Boat launch ramps, tackle stores, canoe rentals, camping areas).

❑More than Four ❑Between Two and Four ❑Less than Two

Please list the names and locations:

Access:

❑•More than three access points which permit launching of small boats (14 feet or less) or canoes. These are access points or ramps which allow easy launching of small boats or canoes from trailers.

❑•Two to three access points which may or may not permit the easy launching of canoes or small boats from trailers. Boaters may have to park their vehicles and carry or drag the boat or canoe down the bank to the water.

❑•Fewer than two access points which may or may not permit the easy launching of canoes or small boats from trailers. Boaters may have to park vehicles and carry or drag boat or canoe as above.

Please list locations for these access points.

Navigability:

❑•Water depth and flow allow year-round use by small boats or canoes and the stream is free from obstructions that completely block the stream channel.

❑•Water depth and flow may restrict year-round use by small boats or canoes and the stream may possess some cross-channel obstructions.

❑•Water depth and flow only permit seasonal use by small boats or canoes and the stream possesses numerous obstructions, many of which completely block the stream channel.

Sensory: **Sight:**

❑•No visible signs of pollution or foreign discharges or materials.

❑•Few locations with visible signs of pollution or foreign discharges or materials.

❑•Generally degraded by visible signs of pollution or foreign discharges or materials.

Please give description:

Sounds:

❑•Only occasional and intermittent noises from residential, recreational or rural roads, settlements, and agricultural/forestry operations.

❑•Occasional highway, railroad, agricultural/forestry operation noises and frequent residential or recreational noises.

❑•Frequent noise of any type or occasional industrial or urban noises.

Please explain:

Smells:

❑•No unnatural odors present.

❑•Occasional unnatural odors present, but they are not strong (e.g. industrial, residential, agricultural).

❑•Unnatural odors occur often or a strong odor occurs at one or more locations.

Please describe:

Fishing:

❑•Populations of sport and commercial fishes support or could support viable fisheries for more than five species. For instance: bass, bluegill, channel catfish, redear sunfish, brown bullhead (mudcat).

❑• Populations of sport and commercial fishes support or could support viable fisheries for two to five species

❑•Populations of sport and commercial fishes support or could support viable fisheries for less than two species.

Please list species caught in stream:

Historical:

❑•Natural history (fossils), prehistoric (Native American) and/or historic Spanish or French exploration, Civil War and 18th century (1700s), or 19th century (1800s) settlement features are known to exist in association with the stream.

❑•There is high to medium probability that natural history, prehistoric and/or historical features exist in association with the stream.

❑•There are no known features and the probability of them existing is low.

Please list names and locations of sites:

When this information is complete, the person, or group making the request for an eligibility evaluation is invited to make a presentation to the Stream Assessment Committee of the SSSP. This group meets periodically in an informal round-table session in Jackson and would welcome presentations on the subject streams. Phone (601) 354-7303 or e-mail andrew.whitehurst@mmns.state.ms.us for more information.

b) Mississippi Scenic Streams Stewardship Act

§ 51-4-1. Title and citation of chapter.

This chapter may be cited as the "Mississippi Scenic Streams Stewardship Act."
SOURCES: Laws, 1999, ch. 381, § 1, eff from and after July 1, 1999.

§ 51-4-3. Definitions.
Except as otherwise required by the context:

(a) "Department" means the Department of Wildlife, Fisheries and Parks.

(b) "Stream" means any free-flowing stream or segment of stream that is a public waterway under Section 51-1-4, Mississippi Code of 1972, and has not been channelized within the last five (5) years.
SOURCES: Laws, 1999, ch. 381, § 2, eff from and after July 1, 1999.

§ 51-4-5. Public policy declared.

The Legislature finds that certain selected streams and stream segments of this state possess unique or outstanding scenic, recreational, geological, botanical, fish, wildlife, historic or cultural values. It is the policy of the Legislature to provide for the protection of these streams and to conserve the state's natural heritage for the benefit and enjoyment of present and future generations, while preserving the private property rights of riparian landowners.

There is a necessity for a rational balance between the use of these streams and the conservation of the natural beauty along these streams. The Legislature finds that this balance will best be achieved through a nonregulatory voluntary stewardship program emphasizing local education, participation and support. The primary goal of the program is to maximize voluntary private conservation efforts and to build and maintain a sense of stewardship among stream users and riparian landowners. To accomplish this goal, the program must provide a nonregulatory framework to obtain cooperative, voluntary management agreements with riparian landowners to maintain scenic values while ensuring the rights of riparian landowners to continue customary uses along the stream.
SOURCES: Laws, 1999, ch. 381, § 3, eff from and after July 1, 1999.

§ 51-4-7. Establishment; administration by Department of Wildlife, Fisheries and Parks; eligibility for designation as scenic stream.

(1) There is hereby created the State Scenic Streams Stewardship Program. The department shall coordinate the program. The department shall establish and publish minimum criteria for assessing a stream's eligibility for the State Scenic Streams Stewardship Program. To qualify as eligible, the stream must possess unique or outstanding scenic, recreational, geological, botanical, fish, wildlife, historic or cultural values. The level of pollution of a stream's waters must be considered in determining eligibility for qualification as a scenic stream. A stream with relatively polluted waters may qualify as eligible as a scenic stream if other values are considered outstanding.

(2) (a) The department shall inventory and evaluate Mississippi streams and identify the streams or stream segments which possess unique or outstanding scenic, recreational, geological, botanical, fish, wildlife, historic or cultural values based on the criteria established under this section.

(b) Any Mississippi organization, resident, state agency or local government may request the department to evaluate a stream.

(3) If the department determines that a stream meets the eligibility criteria, the department may recommend to the Legislature that a stream or stream segment be listed as eligible for nomination to the State Scenic Streams Stewardship Program. In order for a stream to be listed as eligible for nomination to the State Scenic Streams Stewardship Program, the recommendation must be filed as a bill and must be adopted by the Legislature.
SOURCES: Laws, 1999, ch. 381, § 4, eff from and after July 1, 1999.

§ 51-4-9. Nomination and designation as scenic stream.

(1) After the eligibility assessment of a stream is completed by the department, and the Legislature enacts legislation approving the eligibility, the stream may be nominated as provided in this section. The department, through the executive director, shall establish an advisory council for that stream. The advisory council must be appointed as early as possible to assist the work of the department. Each council must consist of members who represent a broad range of interest in the vicinity of the eligible stream and shall include, but not be limited to, at least one (1) member from the department, local government, agricultural interests, forestry interests, business interests, conservation interests, recreational interests and riparian landowners who shall constitute a majority of the council. The advisory council shall elect a chairman. The advisory council shall assist and advise the department concerning the nomination of the stream for the program.

(2) The department shall hold a public meeting in the vicinity of the eligible stream proposed for nomination to the State Scenic Streams Stewardship Program. This public meeting must be conducted before any action by the department to nominate the eligible stream for inclusion in the State Scenic Streams Stewardship Program. The purpose of this meeting is to receive public comments concerning the proposed nomination of the eligible stream. Notice of this meeting must be published at least thirty (30) days before the meeting in a newspaper having general circulation in each county containing or bordering the eligible stream under study and in a newspaper having general circulation in the state. The department shall notify, in writing, the landowners along the eligible stream. The department and the advisory council shall consider the public comments in its decision whether to nominate the stream.

(3) Following the public meeting and after consideration of the public comments, the department and the advisory council may nominate the eligible stream for designation as a scenic stream and inclusion in the program. In order for a stream to be listed as eligible for nomination to the State Scenic Streams Stewardship Program, the nomination must be filed as a bill and adopted by the Legislature. No stream shall be designated as a scenic stream and placed in the program until the Legislature has duly enacted legislation designating the stream as scenic and placing it in the State Scenic Streams Stewardship Program.

SOURCES: Laws, 1999, ch. 381, § 5, eff from and after July 1, 1999.

§ 51-4-11. Notice of designation; development of cooperative voluntary stewardship plan; protection of private property rights.

(1) After the Legislature has designated a stream as a state scenic stream, the department shall publish a notice of the designation and provide written notice to the affected units of local government and landowners. Notice of the designation also must be published in a newspaper of general circulation in the state to apprise interested parties of the opportunities under this chapter. The notice must describe the boundaries of the stream or stream segment.

(2) (a) The department and the advisory council shall develop a cooperative voluntary stewardship plan for the scenic stream. The department shall consult and cooperate with the State Soil and Water Conservation Commission and the State Forestry Commission in developing the stewardship options utilizing current best management practices. Any other affected state agency may also make recommendations to the department. The plan shall identify current and traditional uses along the stream and outline goals, objectives and action strategies to address the management of resources along the stream.

b) The plan shall utilize best management practices to maintain the scenic values of the stream while ensuring the rights of riparian landowners to continue existing agriculture, forestry, water supply, recreational, commercial and industrial uses and any other uses identified in the plan.

(3) (a) The plan shall provide several stewardship options for a landowner. The options shall vary in length of commitment, degree of involvement and enforceability. An option may be modified to meet the needs of a landowner based on the individual attributes of the stream.

(b) Participation in the stewardship plan is voluntary. A landowner is under no obligation to participate in the plan. A participating landowner must give at least thirty (30) days' notice of his intent to terminate a nonbinding option and to withdraw from the program.

(4) (a) The department may receive by gift, devise, grant or dedication, conservation easements or other interest in real property for the State Scenic Streams Stewardship Program.

(b) If any land is donated to the state for the Scenic Streams Stewardship Program and the land ceases to be used in the program, the title to the land reverts to the donor.

(5) Any lands placed in the State Scenic Streams Stewardship Program may be obtained only from private or corporate owners voluntarily. Land placed in the State Scenic Streams Stewardship Program shall not be obtained by eminent domain.

SOURCES: Laws, 1999, ch. 381, § 6, eff from and after July 1, 1999.

§ 51-4-13. Existing or future uses of scenic stream not prohibited.

This chapter shall not be construed to prohibit, restrict or otherwise affect any existing or future lawful use or activity in or related to the scenic streams area. This chapter also shall not be construed to prohibit, restrict or otherwise affect the operation, maintenance or new construction of any facility, road, railroad, bridge, utility, pipeline, crossing or any other structure in or related to the scenic stream area. In the event there is any conflict between this section and any other provision in this chapter, this section shall control.

SOURCES: Laws, 1999, ch. 381, § 7, eff from and after July 1, 1999.

§ 51-4-15. Implementation of policies and practices of chapter.

(1) The department shall administer this chapter and may promulgate regulations for the specific powers granted under this chapter. In the process of administering the Scenic Streams Stewardship Program, the department shall consider, protect and ensure protection of the rights of private ownership and of the voluntary participants in the Scenic Streams Stewardship Programs.

(2) The department may enter into agreements with local, state and federal agencies, and private landowners, for the mutual management of a scenic stream. An agency which has administrative jurisdiction over lands or interests in land along a state scenic stream must assist the department to implement the policies and practices of this chapter.

SOURCES: Laws, 1999, ch. 381, § 8, eff from and after July 1, 1999.

§ 51-4-17. Pilot programs.

(1) The department is authorized to conduct a pilot program for the following streams designated as eligible for inclusion in the State Scenic Streams Stewardship Program:

(a) Wolf River in Pearl River, Hancock, Stone and Harrison Counties beginning at Mississippi Highway 26 in Pearl River County to the Bay of St. Louis in Harrison County;

(b) Black Creek in Lamar, Forrest, Perry, Stone, George and Jackson Counties beginning at Mississippi Highway 589 in Lamar County to the Pascagoula River in Jackson County;

(c) Okatoma Creek in Simpson and Covington Counties beginning at the Illinois Central Gulf Railroad in Simpson County to the Bowie River in Covington County;

(d) Strong River in Smith, Rankin and Simpson Counties beginning at the confluence of Beech Creek in Smith County to the Pearl River in Simpson County;

(e) Pearl River in Winston and Neshoba Counties beginning at the origin, confluence of Nanih Waiya Creek and Bogue Chitto Creek in Winston County to MS Highway 15 in Neshoba County; and

(f) Buttahatchee River in Monroe and Lowndes Counties beginning at the Mississippi-Alabama state line in Monroe County to U.S. Highway 45 in Lowndes County.

(2) The department shall follow the requirements in this chapter for the nomination of these streams to the State Scenic Streams Stewardship Program. The department shall report annually to the Legislature on the status of the pilot program.

(3) Any landowner entering into a binding agreement for the management of lands in a pilot project shall be eligible for any subsequent incentives that are offered for participation in the State Scenic Streams Stewardship Program.

SOURCES: Laws, 1999, ch. 381, § 9, eff from and after July 1, 1999.

§ 51-4-19. No right of public access created by this chapter.

This chapter does not confer upon any member of the public the right to the use of or access to private lands within the boundary of a designated scenic stream area and any unauthorized use is trespass and subject to the penalties provided for trespass offenses.

SOURCES: Laws, 1999, ch. 381, § 10, eff from and after July 1, 1999.

§ 51-4-21. Eligibility of portion of Magee's Creek for nomination to Program.

In accordance with Section 51-4-7, Magee's Creek in Walthall County from the confluence of Varnell Creek to the Bogue Chitto River is designated as eligible for nomination to the State Scenic Streams Stewardship Program.

SOURCES: Laws, 2000, ch. 308, § 1, eff from and after passage (approved Mar. 17, 2000.)

§ 51-4-23. Designation of portion of Wolf River as State Scenic Stream.

The Wolf River in Pearl River, Hancock, Stone and Harrison Counties from Highway 26 in Pearl River County to the Bay of St. Louis in Harrison County, which was initially designated as eligible for inclusion in the scenic stream program under Section 51-4-17, is designated as a state scenic stream and is included in the State Scenic Streams Stewardship Program.
SOURCES: Laws, 2000, ch. 309, § 1, eff from and after passage (approved Mar. 17, 2000.)

Notes about the Act:

1) Section 51-4-5 calls for a rational balance between the use of streams and the conservation of the natural beauty along them, while protecting private property rights and existing uses. To accomplish this goal, the program provides a non-regulatory framework to obtain cooperative, voluntary management agreements with riparian landowners to maintain scenic values while ensuring the rights of riparian landowners to continue customary uses along the stream.

2) Section 51-4-11(5) states that there will be no takings by eminent domain, all participation in this program is voluntary. Likewise 51-4-11 (4)b allows reversion of land grants back to donor if the land ceases to be used in the program.

3) Section 51-4-19 emphasizes the protection of private property rights in stating that this act does not confer a right of use or access to private lands within the boundary of a designated scenic stream area and any unauthorized use is trespass and subject to the penalties provided for trespass offenses.

   Use of public sections of streams is governed by the public water law 51-1-4. See full text and commentary on this law in these materials above.

Appendix C

Glossary of Scientific and Technical Terms
(From: Derrick, D. Glossary of Stream Stabilization Terms. 2001. Engineer Research and Development Center, U.S. Army Corps of Engineers, Vicksburg, MS and From: Waters, T.F. Wildstream: a natural history of the free flowing river. 2000. Riparian Press. St. Paul Minnesota.)

Accelerated erosion: An increase in the rate of removal of soil particles from a bank's slope due to human induced disturbance brought about by land use activities.
Aggradation: The geologic process by which stream beds, flood plains, and the bottoms of other water bodies are raised in elevation by the deposition of material that was eroded or transported form other areas. Typically a stream that is undergoing aggradation over a long section of its length has an excess supply of sediment. Aggradation is the opposite of degradation.
Allochthonous: describing organic matter that is produced on land and then is washed in or otherwise moved to the stream; compare authochthonous.
Alluvial: referring to a stream whose channel boundaries are composed of appreciable quantities of the sediments transported by stream flow. An alluvial stream is free to adjust its dimensions of size, shape, pattern, and slope in response to changes in flow and sediment.
Alluvium: A general term for all material deposited by a modern stream anywhere along its course. Alluvium would include sediments laid down in river beds, floodplains, lakes, fans, and estuaries.
Autochthonous: term applied to organic matter produced by aquatic plants within the stream; compare allochthonous.
Bedrock: The solid rock underlying gravel, sand, and soils and overlying the mantle rock, ranging from surface exposure to depths of several hundred feet. A stream is controlled by bedrock when it has scoured or eroded down to that level, is confined and cannot adjust its dimensions; compare alluvial.
Best Management Practices (BMPs): Are non regulated guidelines for silviculture, agriculture, and construction which when properly applied, will control water pollution from nonpoint source pollutants and maintain site productivity.
Biodiversity: The variety of living organisms considered at all levels of organization, including the genetic, species, and higher taxonomic levels, and the variety of habitats and ecosystems, as well as the processes occurring therein.
Channelization: The straightening of a stream, usually performed to improve conveyance.
Clearcut: An area of forest in which all mature trees have been harvested.
Coldwater: Descriptive of salmonid fishes (salmon, trout); implies they need cold water; stream classification based on the presence of salmon, trout and other cold water adapted fishes and aquatic life; compare warmwater.
Decomposers: Organisms that accomplish the decomposition of organic matter, such as bacteria and fungi.

Degradation: The geologic process by which streambeds, floodplains, and the bottoms of other water bodies are lowered in elevation by the removal of materials by water. A progressive lowering of a channel bed due to scour, usually caused by a shortage of sediment, and/or an increase in discharge.

Delta: A deposit of alluvium, usually flat and fan-shaped, formed where moving water is slowed by a body of standing water. Typical examples are found where a river flows into a bay, where a river flows into a lake or reservoir, or where a tributary flows into a larger stream or river.

Discharge: The quantity of flow passing a channel cross-section in a unit of time, usually measured in cubic feet per second (cfs) or cubic meters per second. The stream discharge can consist of water, dissolved solids, organic sediment and inorganic sediment.

Diversity: see biodiversity.

Equilibrium: A stream channel is in equilibrium if it is both stable and graded. A stable stream has a cross- sectional geometry which remains relatively constant over time. A graded stream has a slope just sufficient to transport all the material delivered to the stream. A stream in equilibrium will neither aggrade nor degrade because changes in sediment load and particle size are in balance with changes in slope and water discharge.

Erosion: The wearing away of the land surface by detachment of soil and rock fragments through the action of moving water, wind, and other geological agents.

Filter-feeders: functional group of organisms that filters fine particles of organic matter or plankton from stream currents; such as many caddisfly and blackfly larvae and some fish species such as shad.

Fishery: An exploitable stock or supply of fish whether for commercial or recreational use.

Floodplain: Low lying areas of land adjacent to the stream that are inundated by water from the stream during floods or whenever the stream overflows its banks.

Headcutting: Channel bottom erosion moving upstream through a basin indicating that a readjustment of the basin slope and its stream discharge and sediment load characteristics is taking place. Headcutting is evidenced by the presence of waterfalls or rapidly moving water through an otherwise placid stream. Headcutting often leaves streambanks in an unstable condition (oversteepened)as it progresses through a reach.

Knickpoint: A location on the stream where there is an abrupt change of elevation and slope, usually referring to a vertical overfall (waterfall or shelf).

Larva, Larvae: Immature life stage of an organism such as an insect or other invertebrate which has several stages of growth through which it must pass before becoming an adult. Fish and frogs also have larval stages.

Lentic: Pertaining to still waters, lakes and ponds; compare lotic

Lotic: Pertaining to flowing waters, streams and rivers; compare lentic.

Non-point source pollution: Pollution from many different sources, usually associated with rainfall runoff moving over and through the ground, carrying natural and man-made pollutants into rivers, streams, lakes, wetlands, estuaries, coastal waters, and underground drinking water; polluted runoff.

Organic carbon: Carbon from a source which was once alive but is broken down by natural processes. Leaves falling into a stream are a source of organic carbon for the stream ecosystem.

Particle size: A linear dimension, usually diameter, used to characterize the size of a particle. The dimension may be determined by sieving, micrometric measurement or direct measurement.

Photosynthesis: Process of transforming water and carbon dioxide with the energy of sunlight into new organic matter; the base of all plant and animal life on earth.

Phytoplankton: Assemblage of free floating algal cells (tiny green plants) common to lentic waters.

Physiographic: A region distinct because of physical geography, relief features or land forms. The Loess Hills and Upper Coastal Plain are two of the many physiographic regions of Mississippi.

Plankton: Free floating small organisms, plants and animals.

Predators: Animal feeding on other animals.

Protozoans: Phylum of eukaryotic single-celled micro-organisms showing a wide variety of forms.

Richness: The number of species present at a particular place and time.

Riparian: Having to do with the edges or banks of flowing waters, e.g., riparian forest, riparian landowner.

Rotifers; Aquatic invertebrates from 1-3mm long known as pseudocoelomates. Rotifers and other zooplankton are eaten by newly hatched fish.

Scour: Erosion due to flowing water; usually considered as being localized as opposed to general bed degradation. Scour pools are found downstream of logs or boulders. If an entire stream section is being scoured, the stream is cutting down into its bed or degrading.

Sediment load: The weight of solid matter being moved through a stream through a cross-section per unit of time.

Silviculture: The science and art of cultivating forests based on the life history and general characteristics of forest trees.

Skid trail: A temporary, non-structural pathway over forest soil for dragging felled trees or logs to a landing for processing.

Slope: Steepness of land. Degree of deviation from horizontal, expressed as a percentage, as a numerical ratio, in degrees or as horizontal rise or fall per foot of linear length. A 25% slope is equal to a 4:1 slope, is equal to a slope of approximately 14 degrees, and 0.25 ft per ft.

Sloughing: Slumping or slope-failure. Shallow movement of a soil mass down a streambank as a result of an unstable condition at or near the surface. Conditions leading to sloughing are: bed degradation, attack at the bank toe, rapid drawdown, and steep slope erosion to an angle greater than the angle of repose of the material.

Stewardship: The careful, responsible management of something entrusted to a person.

Streamside management zone (SMZ): An area adjacent to the bank of a stream or body of open water where extra precaution is necessary to carry out forest practices in order to protect bank edges and water quality.

Suspended load: The part of a stream's total sediment load which is transported within the body of fluid and has very little or no contact with the bed.

Tailwater: The section of a river or stream immediately below the outflow of a dam.

Warmwater: Term roughly defining a stream with warmwater fish species such as sunfish, bass and catfish.

Water bar: A mound or ridge of soil formed across a road or trail for the purpose of deflecting water onto the adjacent area, usually into the forest litter. Water bars prevent forest road beds from conveying water down slopes.

Water quality: The chemical and physical properties of natural water bodies. Poor water quality indicates the presence of pollution or other human-induced degradation.

Upland cotton: Cotton farmed on upland mineral soils that are less fertile and more erodible than the preferred rich bottomland or delta soils. Denotes upland areas which were marginally suitable or unsuited for cotton and which became rapidly depleted and eroded.

Urbanizing: A transition of land use from agriculture or forestry use to urban. A watershed or drainage basin which is urbanizing has its permeable surfaces (soils, fields, forests) replaced by impermeable surfaces (roads, subdivisions, parking lots, roofs). Rivers and streams are physically altered by urbanization due to faster runoff of rainfall as impermeable surfaces replace permeable surfaces.

Zooplankton: Free floating small animals in lakes, ponds, and oceans.

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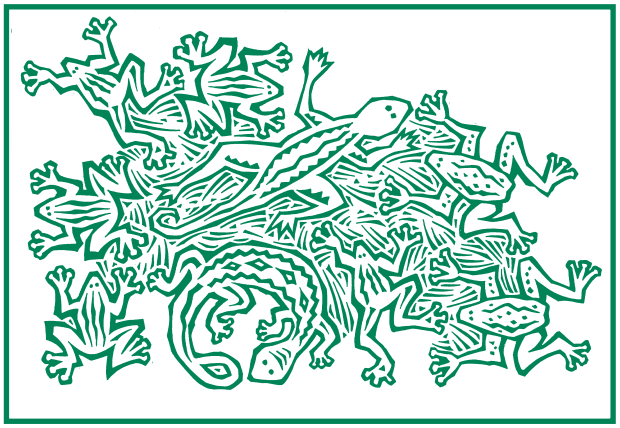

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