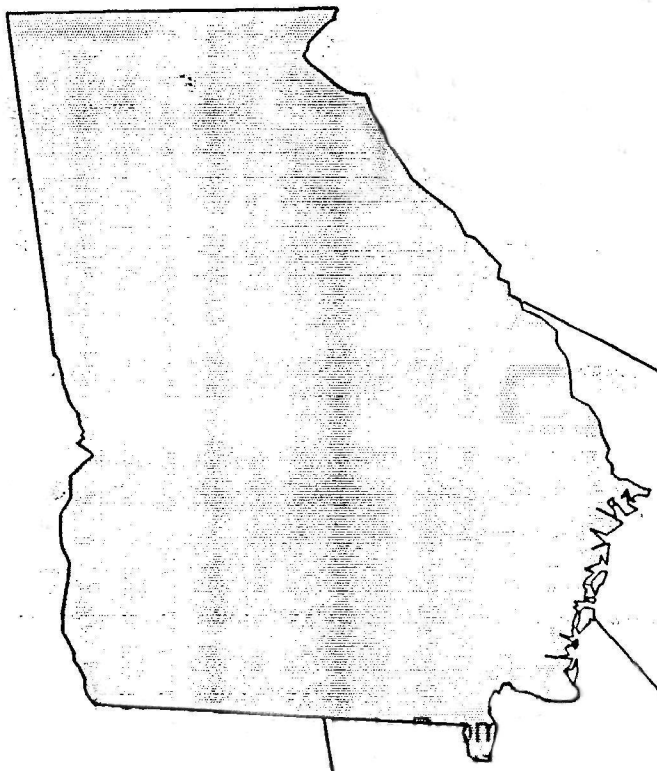
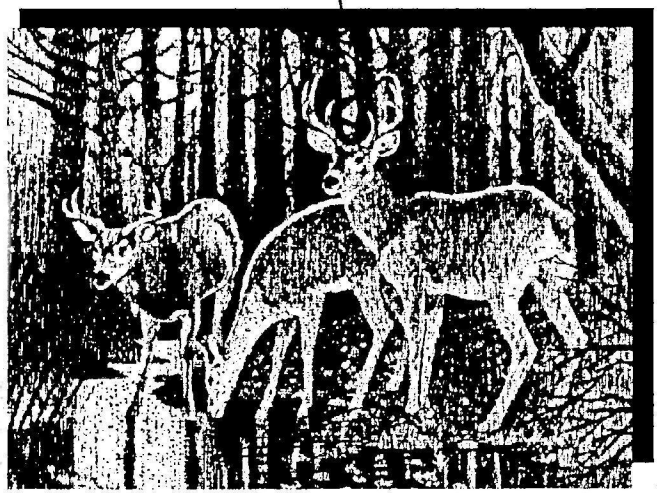
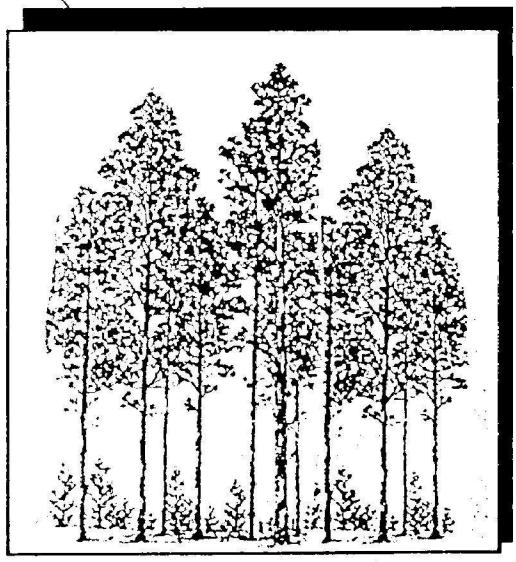
Best Management Practices

For Forested Wetlands In Georgia







Georgia Forestry Association
Wetlands Committee

Revised April, 1993

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Technical Criteria for Jurisdictional Identification.

The legal definition of wetlands, as enacted by Section 404 of the Clean Water Act and unanimously adopted by the EPA, U S Army Corps of Engineers, the Soil Conservation Service, and the U S Fish and Wildlife Service is "***Those areas that are inundated or saturated by surface or groundwater at a frequency or duration sufficient to support and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.***"

The methodology used for identifying and delineating jurisdictional wetlands is found in the 1987 U S Army Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87-1 **Wetlands possess three essential characteristics: (1) hydrophytic vegetation, (2) hydric soils, and (3) wetland hydrology. All three must be present under normal circumstances for an area to be identified as a wetland.** Each characteristic is described in the following text

Hydrophytic Vegetation. Defined as macrophytic plant life growing in water, soil or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content A national interagency panel has developed a "National List of Plant Species That Occur in Wetlands" which has been subdivided into a regional list The list separates vascular plants into five basic groups commonly called "wetland indicator status" based on a plant species' frequency of occurrence in wetlands They are (1) obligate wetland, (2) facultative wetland, (3) facultative, (4) facultative upland, and (5) obligate upland An area has met the hydric vegetation criteria when, under normal circumstances, more than 50 percent of the composition of the dominant species from all strata (trees, shrubs, grasses) are obligate wetland (OBL), facultative wetland (FACW), and/or facultative (FAC) species

Examples of trees for each indication group are

OBL - bald cypress, overcup oak, water tupelo
FACW - slash pine, sweet bay, green ash, swamp chestnut oak, willow oak, sugarberry
FAC - loblolly pine, black gum, sweetgum, red maple, yellow poplar
FACU - white oak, longleaf pine, southern red oak

Hydric Soils. Defined as soils that are saturated at least 15 consecutive days or inundated at least 7 consecutive days during the growing season in most years The National Technical Committee or Hydric Soils (NTCHS) has developed a list of the nation's hydric soils which has been subdivided into a state list based on the physical characteristics of organic and mineral soils Local lists have been compiled and are available from county SCS offices

Wetland Hydrology. Defined as areas which are seasonally inundated and/or saturated to the soil surface for a consecutive number of days and/or more than 12 5 percent of the growing season Indicators may include, but are not limited to drainage patterns, drift lines, sediment deposition, watermarks, stream gauge data and flood predictions, historic records, visual observation of saturated soils and visual observation of inundation Areas wet between 5 percent and 12 5 percent of the growing season may or may not be wetlands Areas saturated to the surface for less than 5 percent of the growing season are non-wetlands

Note For the purpose of better defining hydric soils and wetland hydrology, the growing season is usually the period between the last freezing temperature in the spring and the first freezing temperature in the fall Most SCS county soil surveys contain tables showing when these dates occur (usually in table 2 or 3 of modern surveys) In Georgia the COE Savannah District uses the 28 degree Fahrenheit or lower temperature threshold at the frequency of "5 years in 10 probability Therefore the growing season for Camden County is between February 2 and December 22

Landowners with questions concerning delineation or application of specific silvicultural practices should contact:

U.S. Army Corps of Engineers	**1-800-448-2402**
U.S. Environmental Protection Agency	**1-404-347-4015**
USDA Soil Conservation Service	**1-706-546-2115**
Georgia Forestry Commission	**1-800-GA-TREES**
UGA Cooperative Extension Service	**1-706-542-3447**
Georgia Forestry Association	**1-404-416-7621**

IDENTIFICATION OF FORESTED WETLANDS BY PHYSIOGRAPHIC CLASS

Forested wetlands occur in all three major physiographic regions of Georgia (Mountains, Piedmont, and Coastal Plain). Both large and small areas of wetlands are found in streambeds, low-lying level to concave stream terraces, and flood plains of these regions. Because wetland characteristics such as vegetation, soil, and hydrology differ within the same region, different wetland types are recognized and described in this publication. The Forested Wetlands identified in this document are not necessarily classified as jurisdictional wetlands as defined and regulated under the Clean Water Act. However, the wetlands types described here encompass certain soil, site conditions, and timber types in which jurisdictional wetlands are likely to be found (see page 2).

Floodplains, Terraces And Bottomland - flat areas bordering major and minor water courses. Formed by deposits in times of flooding.

Black River Bottoms.

Flood plains of major river systems generally originating in the Coastal Plain. Characterized by sandy sediments and slow movement of surface water. The floodplains of the streams are on a modest scale and have not developed a clean division of natural levees, backswamps, sloughs, and terraces.

Hydrology and Soils. Significant ground-water movement occurs throughout the year. The flood plain is inundated during the spring season in the North and sometimes during the summer season in the South. The frequency of flooding is associated with storm events. Soils are usually poorly drained with very poorly drained soils in sloughs and oxbows. Common soil series are: Bibb, Levy, Nawney, Bladen, Rains, and Meggett.

Vegetation. Forest tree species include bald cypress, blackgum, water tupelo, green ash, sweetgum, water hickory, water oaks, and red maple. Loblolly, slash, spruce and pond pines are common. In the southernmost areas cabbage palm is prevalent.

Red River Bottoms.

Flood plains of major river systems originating in the Piedmont or Mountains. Characterized by sandy and silty sediments. Sloughs and oxbow swamps are commonly interspersed and if large enough may be classified separately as muck swamps. Levees of the river bottom and first terraces are somewhat higher but flood periodically from seasonal rains. Second terraces nearest to the uplands flood infrequently.

Hydrology and Soils. Significant ground-water movement occurs throughout the year. The floodplain is characterized by turbid sediment bearing water flowing in well-defined channels and sloughs with overland flow occurring periodically. The duration of flooding is seasonal and

typically during the winter and early spring or after main storm events. Soils are well drained to very poorly drained. Common soil series in the oxbow and sloughs are: Chastian and Wehadkee. First terraces are dominated by: Congaree, Tawcaw, Chewacla, Wehadkee, and Roanoke. Chewacla, Congaree and Riverview are found on second terraces.

Vegetation. Forest tree species in the oxbows and sloughs include bald and pond cypress, blackgum and water tupelo. Water hickory, laurel oaks, willow oaks, red maple, cottonwood, ash, riverbirch, spruce pine and pond pine are found in the first terrace. The second terraces are dominated by ash, red maple, sweetgum, water oak, hickory, sycamore, yellow poplar, loblolly and slash pines.

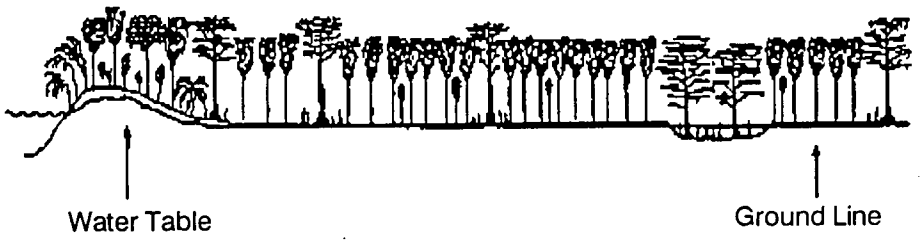
Branch Bottoms.

Relatively flat, alluvial land located near the headwaters and in floodplains of minor drainages. They are dominated by constant seepage of spring-fed water with minor flooding during the wet seasons.

Hydrology and Soils. Surface water flows year round in well defined channels except during extremely dry periods. Channels are fed by significant groundwater movement and seepage and are subject to minor overflow after main storm events. Soils are poorly to very poorly drained. Common soil types are Bibb, Surrency, Bladen, Pelham and Rutledge.

Vegetation. Forest tree species include black gum and cypress near the channels, sweetgum, water oak, sycamore, red maple, yellow poplar, ash and loblolly pine. In the southern most areas slash pine and cabbage palms are common.

Muck Swamps.



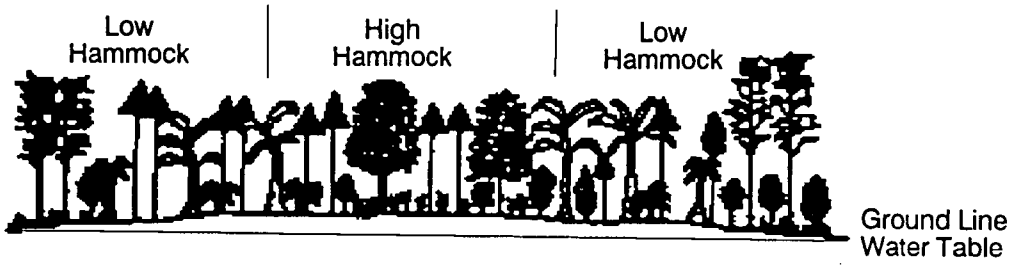
Large areas adjoining drainages near the coast and large sloughs and oxbow depressions of major river floodplains. Muck swamps are usually found at the lowest elevations and are characterized by slow moving to standing water.

Hydrology and Soils. Semi-permanently to seasonally flooded through a combination of precipitation and overland flow. These sites are usually inundated year-round. Soils are poorly to very poorly drained. Common soils are: Muckalee, Johnston, Satilla, Chastain and Rutledge.

Vegetation. Forest tree species are dominated by bald and pond cypress, water tupelo and black gum. Swamps associated with redwater rivers are dominated by water tupelo and bald cypress Those associated with blackwater rivers are dominated by blackgum and both cypress species. The more stagnant the water the more likely that pond cypress and blackgum will dominate.

Wet Flats - expanses of shallow or low-lying land located between well defined natural drainage systems. Wet flats are inundated or saturated for varying periods of time during the growing season.

Pine Hammocks & Pine Savannas.

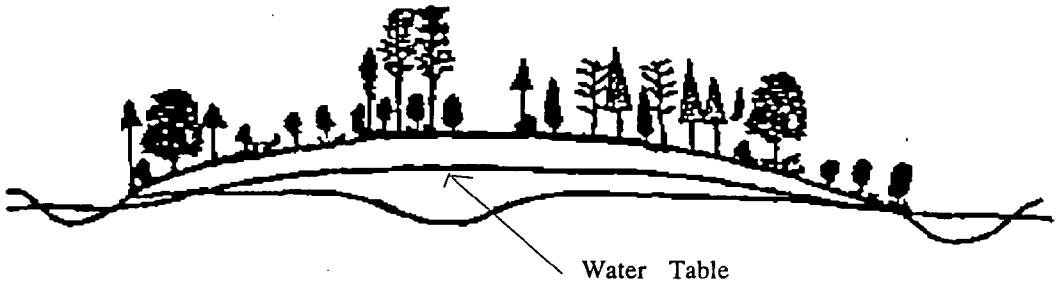


Broad interstream flats generally underlain by clays where drainage systems are poorly developed. Sites are characterized by weak overland flow and constant seepage. Commonly found in the flatwoods of the Coastal Plain.

Hydrology and Soils. Seasonably saturated by high or perched water tables from precipitation. Standing water and shallow overland sheet flow are common during the wet seasons. Soils are somewhat poorly to very poorly drained. Common soils are: Leon, Pelham, Bladen, Meggett, Wahee and Ocilla.

Vegetation. Forest tree species include open canopies of longleaf pine with laurel oak, some loblolly, slash and pond pines. The wetter portions are dominated by sweetgum, willow oak, red maple, loblolly pine and cypress.

Pocosins.



Broad shrub bogs with elevated centers where drainage is restricted due to elevated rims, sluggish outlets and impermeable soils located in the northern portion of the lower Coastal Plain. Pocosins consist of organic soils which accumulate due to the poor drainage. Pocosins are characterized by continuous wetness.

Hydrology and Soils. Pocosins are saturated for most of the year by high or perched water tables from precipitation. Standing water is common during the wet season. Soils in the center are very poorly drained grading to poorly drained at the edges. Pocosin soils include: Ponzer, Belhaven, Pungo and Pamlico.

Vegetation. Vegetation is dominated by pond pine and evergreen shrubs. Forest tree species common to pocosins include pond pine, cypress, Atlantic white cedar with scattered sweetgum, willow oak and red maple. Dense understories are of titi, red bay, sweet bay, loblolly bay, wax myrtle, sweet gallberry and blueberry are common.

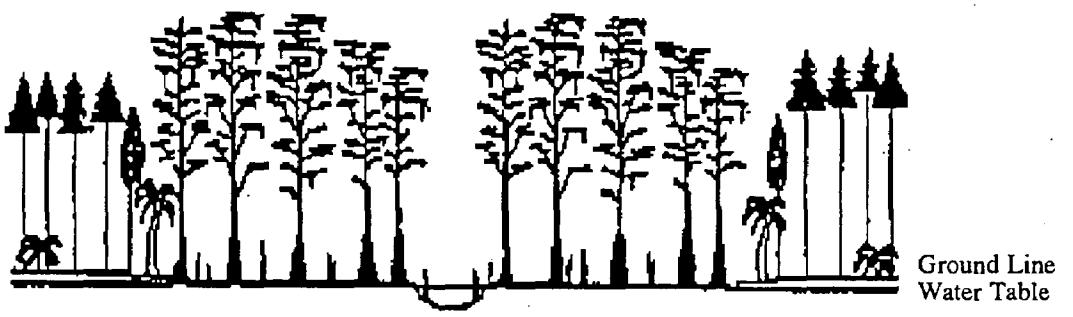
Carolina Bays.

Geomorphologically distinct, elliptical depressions with either saturated organic or mineral soils located in the middle and lower Coastal Plain, primarily in North Carolina. Carolina Bays usually have a northwestern-southeastern orientation and a sandy rim on the southeastern side. Carolina bays are characterized by poor surface drainage and restricted outflow.

Hydrology and Soils. Seasonally saturated by water tables from precipitation. Standing water and weak overland flow are common during the wet season. Most soils are poorly to very poorly drained, however, soils formed on the sandy rims are well drained. Common, poorly drained mineral soils are: Coxville, Rutledge, and Rains; mineral soils on the sandy rim are Norfolk, Lakeland and Kureb; common organic soils are Kingsland, Croatan and Pamlico.

Vegetation. Vegetation varies from herbaceous marshes to evergreen shrubs to swamp forests. Forests are dominated by a combination of red, sweet and loblolly bay. Pond pine, loblolly, red maple, blackgum and yellow poplar are sometimes present. Dense understories of titi, fetter-bush and gallberry are common.

Cypress Strands - Cypress Stringer.

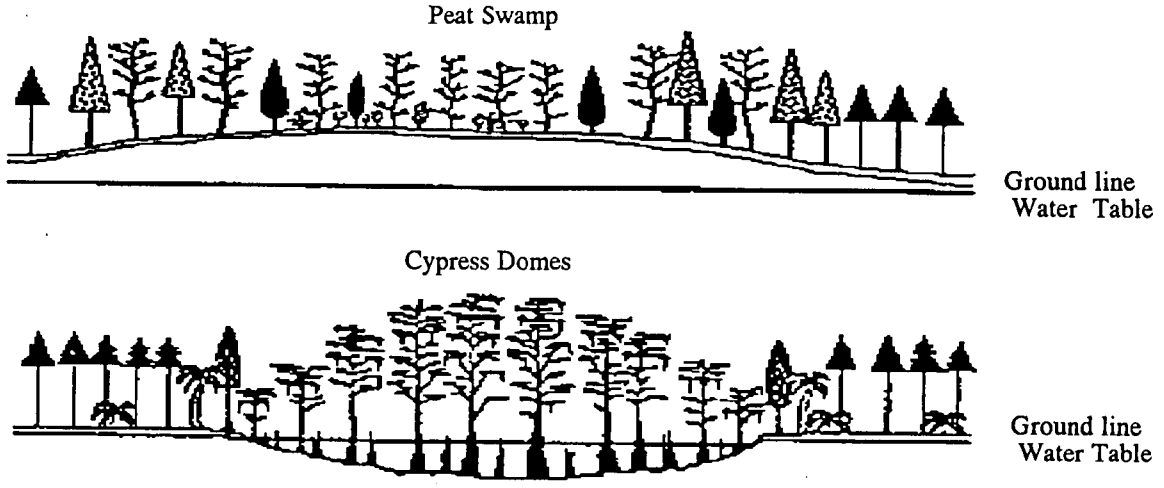


Elongated or linear depressions in the flatwoods landscape following subsurface clay and limerock topography characterized by drainage through multiple braided channels or sheetflow into the blackwater rivers. Cypress stringers are narrow strands and occur frequently.

Hydrology and Soils. Semi-permanently to permanently flooded during the growing season with surface water usually flowing in braided channels. The organic rich soil grades into a sandy humus rich hardpan underlain by gleyed and somewhat mottled sandy soil over limerock. The soil drainage class is very poorly drained. Common soils are: Ellabelle, Surrency, Rutledge, Bayboro, and Cape Fear.

Vegetation. The forest vegetation is dominated by bald cypress interspersed with sweetbay and red bay, swamp black gum and sometimes cabbage palm.

Peat Swamps, Cypress Domes

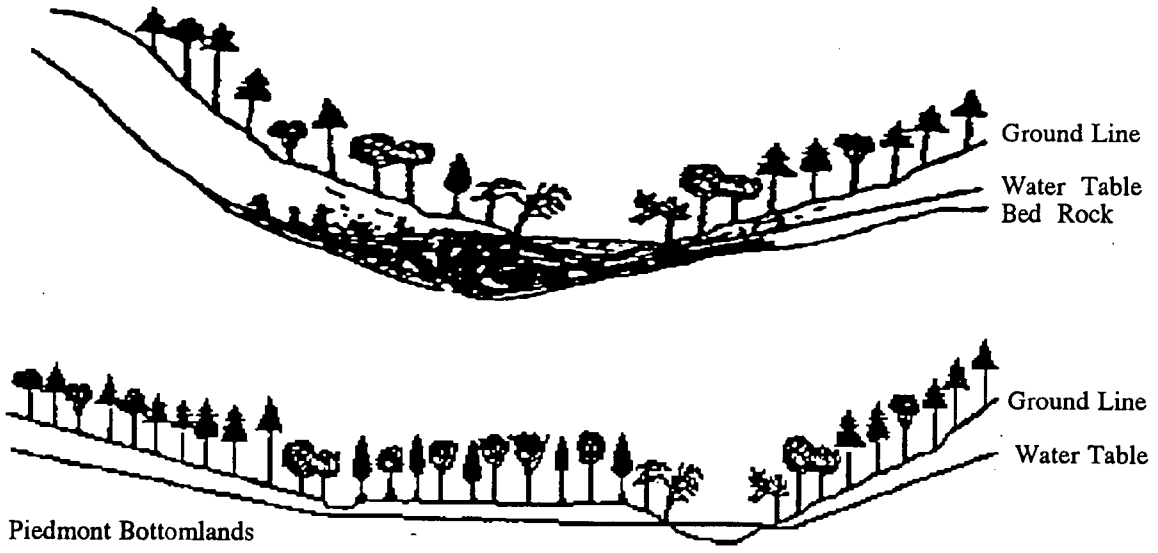


Upland flats and shallow organic depressions occurring in the lower Coastal Plain located in broad interstream areas from which blackwater rivers and branch bottoms originate. Sites are characterized by standing water and constant seepage. Cypress domes are generally much smaller than peat swamps and are dominated by cypress and black gum.

Hydrology and Soils. Seasonally saturated by high or perched water table from storm precipitation. Standing water is common with very slow surface flow to an outlet occurring during the wet season. Soils are poorly to very poorly drained. Common soils are: Belhaven, Pungo, Kingsland, Surrency, Ellabelle and Emory.

Vegetation. Forest tree species include bald and pond cypress, loblolly, slash and pond pine, blackgum and red maple. Understory vegetation includes sweet bay, red bay, fetter-bush, blueberry, titi, and greenbriar. Cypress domes are predominantly cypress and black gum with little understory in the interior.

Gulfs, Coves, Lower Slopes Adjacent to Streams and Piedmont Bottomlands.



Non-eroded fertile mineral upland flats, side slopes and stream bottoms located in the Piedmont and Mountains. Sites are characterized by poor internal drainage and lateral water movement.

Hydrology and Soils. Water input by overland flow, precipitation and seepage. Sites may be seasonally or intermittently flooded or saturated. Soils are well to poorly drained. Common soils are: Enon, Iredell, Chastain, Roanoke, Chewacla and Congaree.

Vegetation. Forest tree species include river birch, box elder, sweetgum, sycamore, ash, northern red oak, water and willow oak, loblolly pine, black cherry, red maple, black gum, and black walnut.

MULTIPLE USE GUIDELINES

A key aspect of proper management of the forested wetland ecosystem is the minimization of site impacts associated with silvicultural practices including timber harvesting. These impacts are not limited to the physical site but include other values inherent to the wetland environment. **Forest managers operate within the social and political environment as well as the biological!**

In addition to timber production, management strategies should include provisions for other benefits from forested wetlands. **Good forest wetlands management practices and multiple-use are not mutually exclusive.** Within the framework of these guidelines it is possible to carryout harvesting and regeneration practices, provide for recreation, wildlife habitat, and maintain the primary hydrological functions of wetlands as natural filters and reservoirs of clean water. Some sites may, by their characteristics accommodate more uses than others.

Much attention has been paid to the "multiple-use" concept. Nature is a multiple-use concept practitioner. Wetlands perform multiple functions for multiple "users". Wetlands provide habitat for numerous species of flora and fauna, maintain the local hydrologic balance and recharge groundwater, and provide an "outdoor classroom" for education and research. Intelligent, judicious use of the wetland resource can successfully involve multiple uses and maintain a healthy balance. The key to success is an understanding of the wetland ecosystem and a stewardship approach for its management.

Suggested Best Management Practices are intended to protect, maintain, and improve the various wetland "functions" and potential uses. Each of the potential multiple uses of wetlands should be examined individually:

Timber Production - Irregular shaped or patch clearcuts provide increased "edge effect" habitat for wildlife species. Refer to the specific BMPs for harvest, regeneration, road building, etc.

Hydrologic Functions - Forested wetlands help dissipate flood waters and improve water quality by filtration and sediment trapping. See the separate discussion of streamside management zones for further information.

Fisheries - Follow BMP guidelines for timber-related activities to protect surface waters from turbidity, siltation, temperature changes, pollution/contamination from fuels, lubricants, herbicides, pesticides or other substances.

Wildlife - Most wildlife management techniques are acceptable on wetlands sites. These include establishment of food plots, cover and nesting areas for game and non-game species as well as maintaining mast producing trees. Some timber harvesting practices improve habitat for numerous wildlife species. For more information refer to Cooperative Extension Service Publication "Selective Practices and Plantings for Wildlife", 1987.

Grazing - Livestock grazing is not recommended on most forest wetlands because of soil compaction, water pollution and destruction of regeneration and wildlife habitat.

Aesthetics - Many people base their opinions on what they see. Minimize the visual impact of silvicultural practices when and wherever feasible. For example, moderate- size clearcuts, streamside and roadside management, buffer zones, and other responsible management practices help minimize adverse public reaction.

Recreation - Hunting, fishing, boating, hiking, camping, birdwatching, photography, etc. are valuable activities which can be successfully coordinated with silvicultural management strategies. All uses should be conducted to minimize impacts to the wetlands ecosystem.

Education and Research - Well managed forested wetlands serve as examples of how sound silvicultural practices minimize damage and can, in fact, enhance the wetland environment. All BMPs are recommended with this in mind.

Forested wetlands, especially bottomland hardwoods, are very productive ecosystems with multiple functions and values. It is not possible for any policy to maximize each multiple use. These guidelines, suggestions, and recommendations are intended to address multiple-use issues and provide a balance that best combines various uses. With proper management, wetlands can be used for commercial timber production without compromising environmental quality. It is imperative that the forestry community comply with both the letter and spirit of all existing regulations in implementing Best Management Practices.

STREAMSIDE MANAGEMENT ZONES

Introduction

Forestry BMPs are designed to protect water quality from road construction, timber harvesting, site preparation, and other silvicultural practices that may cause non-point source pollution. In addition to the protection provided by BMPs, **streamside management zones** (SMZs) are areas adjacent to flowing or standing water which require more specific or more stringent management considerations to protect water resources. Management practices are recommended for both primary and secondary SMZs (Figure 1).

SMZs may have beneficial impacts such as regulating stream temperatures, ameliorating upslope discharges of pollutants and water to adjacent watercourses, and serving as a buffer or screen to minimize the visual impact of silvicultural activities. The exact role that SMZs play is, however, not readily predictable due to each site's unique physical and biological characteristics and how they are integrated with the adjacent watercourse characteristics.

Definition of Wetland SMZs

Streamside management zones are land areas adjacent to natural perennial streams and natural lakes, ponds, and other standing water that require specific management considerations to provide the water and streambank with special protection from land-use activities. These zones may be partly or completely in jurisdictional wetlands.

Perennial streams are defined as flowing throughout the year (except during extremely dry periods) in well-defined channels, and should be quite obvious. Intermittent and ephemeral streams are characterized as having seasonally flowing water. These streams may be more difficult to recognize, but can be protected with existing forestry BMPs.

Purpose of the SMZ

The purpose of an SMZ is to protect the natural water system from adjacent land-use activities. Areas on both sides of watercourses or around standing bodies of water should be delineated and given special consideration to protect streambank integrity and avoid water pollution.

SMZs are not intended to clean-up the results of poor upstream, upslope or adjacent practices. The SMZ does provide a generally undisturbed buffer area so vegetation and the forest floor slow surface flow and physically trap and filter out suspended sediments before these particles reach the stream channel or open water. The SMZ can also act as a sink of limited capacity for essential elements, nutrients and other chemicals via hydrologic, biologic, and physical processes, both on the surface and subsurface. Adequately vegetated SMZs also provide wildlife corridors and shade which may regulate stream water temperatures. This can be an important consideration in trout streams and wildlife management.

Determination of SMZ Width

There is no uniform formula for the determination of SMZ width because of their highly site-specific nature. The width of the SMZ necessary to ensure protection of water quality and quantity has not been demonstrated by specific studies. No scientific means are currently available for exactly defining optimal SMZ width.

If shading to control temperature in the watercourse were the only management concern, only a relatively narrow SMZ would be necessary for protection. Other conditions that must be factored into determination of SMZ width, however, include slope, depth to water table, vigor of riparian vegetation, nature of the hydraulic connectivity between the SMZ and the watercourse, degree of management (e.g., harvesting) within the SMZ, the potential for windthrow or blowdown of residuals into the watercourse, and other local conditions.

The width of an SMZ should be determined by on-site evaluation. Variation in topography or other conditions along a watercourse or surrounding a body of standing water may require changes in the SMZ width. Generally, the steeper the slope the wider the SMZ, and the more gentle the slope the narrower the SMZ. A similar rule-of-thumb applies for erodible soils: the more erodible the soil the wider the SMZ, and the less erodible the soil, the narrower the SMZ needed.

For the majority of conditions in Georgia, the width of an SMZ should range from at least 20 feet on each side of streambeds in slightly erodible soils to 50 feet in severely erodible soils where slopes perpendicular to the stream are less than 5 percent, such as in the Lower Coastal Plain. In areas such as the Upper Coastal Plain, where slopes vary greatly, SMZs should range from at least 40 feet in slightly erodible soils and 5 percent slopes to 160 feet in severely erodible soils and 20 percent slopes. In areas where slopes exceed 20 percent, such as in the Piedmont and Mountain regions, the SMZ should range from at least 80 feet wide in slightly erodible soils to a minimum of 160 feet in severely erodible soils. Refer to Figure 1. for generalized width recommendations based on slope and erosion hazard. Managers should be aware of the site conditions that would require a change in the width of the SMZ from what is generally recommended.

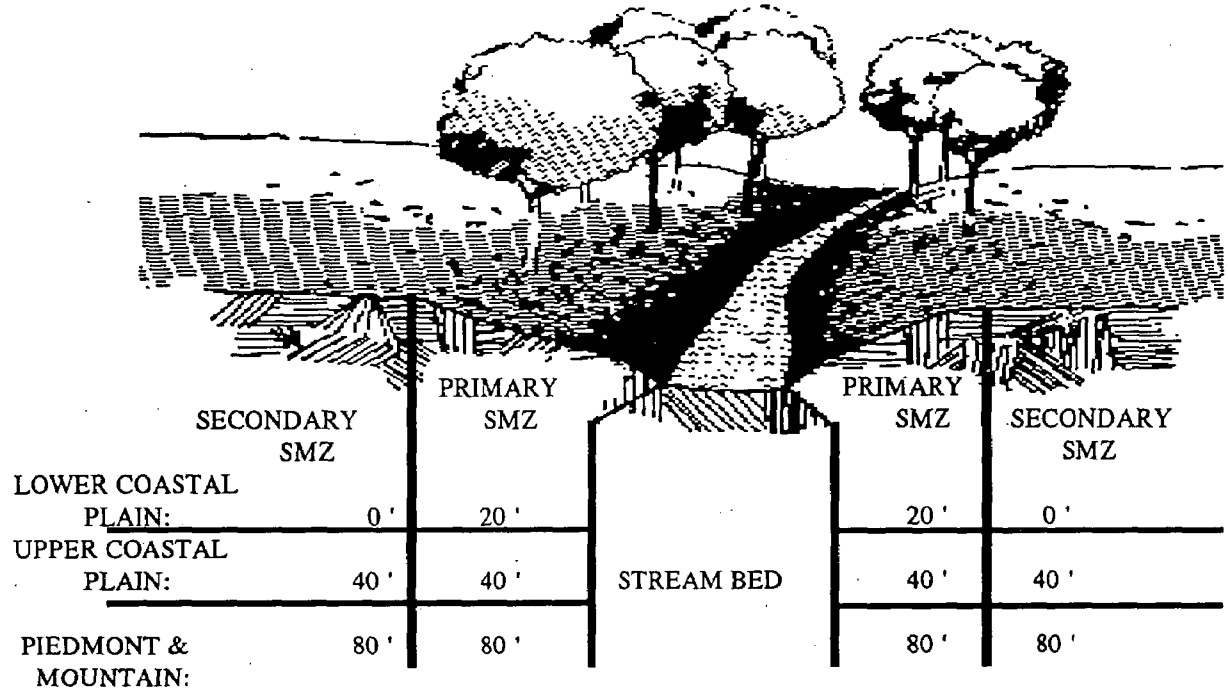


Figure 1. Generalized streamside management zones and their widths by region

Specific Recommendations Within The Wetland SMZ

Timber Harvest. For any harvest within the SMZ, all standard BMPs apply. In additon:

BMP Recommendations

1. Consider SMZs in the preharvest planning.
2. Determine the SMZ width.
3. Locate log decks and sawmills on well-drained sites at least 50 feet outside the primary SMZ.
4. Stabilize roads, stream crossings and monitor conditions at crossings, bridges, culverts, etc. See Section II, Stream Crossings in Recommended Best Management Practices for Forestry in Georgia for specific guidelines.
5. If no harvest is to occur within the SMZ, it should remain as undisturbed as possible, including limited access, etc. to protect site integrity and productivity.

6. Harvesting within an SMZ, including patch clearcuts and selective harvests, should leave the forest floor as undisturbed as possible.
7. Selective harvests should leave a residual stand with diverse species composition and ``leave'' trees of various heights.

Practices to be Avoided

1. With the exception of stream crossings, placing roads or skid trails within an SMZ.
2. Unnecessary stream crossings.
3. Locating landings, staging areas, or log decks within the SMZ.
4. Contamination of soil and water by refueling, servicing or repairing equipment.
5. Felling trees into the streambed. Debris such as tops and limbs should be kept out of the stream. If such materials enter streams or sloughs, they should be removed. Water flow should not be restricted or impeded in any way.
6. Avoid rutting and soil compaction by limiting logging equipment use within the SMZ. Use harvesting systems which minimize soil disturbance. Avoid activity on saturated soils.

Access. The SMZ should remain as undisturbed as possible to protect site integrity and productivity. Therefore, limit access through the SMZ.

Timber Stand Improvement. Timber management objectives may be best met by removal of undesirable species by mechanical or chemical methods on individual stems.

Wildlife. Selective timber harvest plans should include provisions for leaving trees essential for wildlife. Residual trees should include various height classes and species diversity, providing both food and suitable habitat. SMZs also serve as travel lanes for some species. More specific recommendations are dependent upon the species involved. State and federal regulations pertaining to wildlife, such as endangered species, must be observed.

Fire. Use of fire should be restricted within the SMZ when managing for hardwoods. Fire can be detrimental to hardwood regeneration and productivity. Wetland SMZs should be protected from fire, especially during dry periods because riparian vegetation may be necessary for the stability and integrity of the streambank and the periphery of open bodies of water. Uncontrolled fire can destroy the litter, duff, and humus layers of the forest floor and expose mineral soil to erosion altering conditions.

Chemicals. Pesticide and fertilizer use should be limited within the SMZ because of their pollution potential. Pesticide treatment should be made by injection or directed application. Forest fertilizer should be applied in such a manner (rate, time, frequency of application, etc.) to prevent soil or water pollution. If state and federal laws regarding the proper use of silvicultural chemicals are adhered to, and manufacturer's label directions followed; the judicious use of chemicals should not jeopardize the SMZ or the water it protects. Care should also be taken in areas adjacent to the SMZ to prevent the drift, spill, seepage, or wash of silvicultural chemicals into the SMZ or watercourse.

Site Preparation. Mechanical site preparation is prohibited within the primary SMZ.

Reforestation. Natural regeneration, hand planting, or direct seeding are generally acceptable within the SMZ. Refer to the regeneration recommendations for specific guidelines.

Summary

BMPs Recommended

1. Consider SMZs in planning.
2. On-site evaluation to determine SMZ width.
3. Harvest systems which minimize forest floor disturbance.
4. Any type of cutting practice, including patch clearcutting, except where it will affect water temperatures to the detriment of trout.
5. Natural regeneration, hand planting, or direct seeding.

Practices to be Avoided

1. Crossing streams or wet sites.
2. Use of wheeled or tracked vehicles.
3. Leaving trees, tops, or anything in the water.
4. Placement of anything in the streambed that would impede water flow.
5. Roads or trails or any kind, unless absolutely necessary.
6. Fire.
7. Mechanical site preparation or machine planting.
8. Sawmills, log decks, landings, or staging areas.
9. Aerial or broadcast application of silvicultural chemicals.

WETLAND ACCESS SYSTEMS

Properly constructed and maintained access systems are an essential element in the management of Georgia's forested wetlands. Access systems (roads of permanent or temporary nature) are required for routine management, timber removal, fire suppression, and fire protection.

Properly constructed roads provide a means to access and conduct normal silvicultural operations without site degradation. Roads that are improperly located, constructed, or maintained have the potential to adversely affect water quality, water quantity, and aesthetics. They also accelerate erosion, and reduce or degrade wildlife and/or fishing habitat. Access roads should not significantly alter the hydrologic make-up of the forested wetland. Access roads and stream crossings should comply with guidelines established in the ``Manual for Erosion and Sediment Control in Georgia.''

Forested Wetlands Access Guidelines

Permanent roads provide all season access for silvicultural operations. Permanent roads should only be constructed to: (a) serve as access for large and frequently used areas, (b) serve as approaches to watercourse crossings, (c) serve as access for fire protection or property protection

Temporary roads are constructed to provide access into a specific area for a specific operation. Properly constructed, these temporary roads have less effect on the hydrology of forested wetlands than permanent roads and should be used whenever practical (see guidelines for closing, page 16)

Low water, hard surface crossings are a viable alternative to culvert or bridge crossings. Such crossings must be designed to create a stable foundation in shallow streams. These types of crossings should not be designed to serve as a dam and should limit the placement of rock or stabilization material to 6" above the streambed.

Wetland access roads and crossings should be made at right angles to the main stream channels and constructed to allow normal water flow under seasonal fluctuations and storms. An example of these types of crossings are bridges, culverts, or low water, hard surface crossings. Care must be taken to prescribe the correct size and/or frequency to assure normal water flow (Table 1).

Table 1. Drainage for 2½- inches per hour rainfall*

		Cross-Section Area of Pipe Required (in sq ft.) for:			
Acres in Watershed	Impervious Soils	Steep Slopes Heavy Soils 25%+	Mod. Slopes Mod. Soils 15-25%	Gentle Slopes Light Soils 0-15%	Flatland Sandy Soils
10	3.4	2.6	1.9	1.2	0.7
20	5.8	4.3	3.2	2.0	1.2
30	8.0	5.9	4.4	2.8	1.6
40	9.9	7.3	5.4	3.5	2.0
50	11.6	9.7	6.4	4.1	2.3
60	13.4	10.1	7.4	4.7	2.7
70	15.0	11.2	8.3	5.3	3.0
80	16.6	12.4	9.2	6.3	3.3
90	18.2	13.6	10.1	6.3	3.6
100	19.7	14.7	10.8	6.8	3.9
200	33.2	24.9	18.4	11.7	6.6
300	45.7	33.6	27.1	15.8	9.0
400	56.0	42.0	30.5	19.5	11.2
500	66.8	49.4	36.6	23.2	13.2
1,000	113.0	88.9	62.1	39.4	22.4

*(Modified from Talbot's Formula for a 2½-inch per hour rainfall)

To use the tables in selecting a culvert:

1. From Table 1, for the given watershed (Drainage) area, soil and cover conditions, read the required pipe cross-section area for 2-inches of rainfall per hour.

2. Select a culvert from Table 2 that has at least the required area determined above.

3. For watersheds that require more than 44.2 square feet of pipe (a 90-inch pipe), multiple pipe combinations should be used to meet the pipe area requirements. It is generally preferable to use multiple pipes of the same size and the pipes should be spaced leaving a distance of 1/2 the pipe diameter between the pipes. For example, if two 72-inch pipes are required, the pipes should be spaced 36-inches apart.

TABLE 2*

Diameters of Round Pipe Needed for Pipe Cross-Section Areas Listed in Table 1

Pipe Cross-Section Area (sq. ft.)	Diameter (inch)
0.55	10
0.79	12
1.25	15
1.80	18
3.10	24
4.90	30
7.10	36
9.60	42
12.60	48
15.90	54
19.60	60
23.80	66
28.30	72
33.20	78
38.50	84
44.20	90

*King's Handbook on Hydraulics, modified by Forestry BMP Handbook Technical Advisory Committee.

When constructing access systems such as stream crossings, isolated wetland crossings, fill roads, or low water hard surface crossings; the access system should be stabilized to prevent erosion and/or stream sedimentation. For areas that will not stabilize quickly, grass seeding or other stabilizing methods or materials must be used to prevent erosion or sedimentation.

After the activities on a temporary road have ceased, the removal of culverts and/or bridges is recommended. Allowing temporary roads to revegetate reduces potential erosion and allows the road bed to return to its natural state. Recommendations for seeding and mulching roads and disturbed areas are found in Table 3. Landowners may inquire with the Game and Fish Division for preferred plant mixtures which will improve wildlife habitat.

Table 3. Recommendations for Seeding, Mulching and Fertilizing Roads, Skid Trails and Disturbed Areas in Georgia

UPPER & LOWER COASTAL PLAINS REGIONS			PIEDMONT REGION			MOUNTAIN REGION		
Dates	Species for planting	Rates/Acre	Dates	Species for Planting	Rates/Acre	Dates	Species for Planting	Rates/Acre
Sept. 1 to Nov 15	Tall fescue or "Pensacola" bahiagrass and rye grass	23-35 lb 23-35 lb 15 lb	Sept. 1 to Nov 1	Tall fescue and unhulled sencea or "Ambro" virgata lespedeza	23-35 lb 50-60 lb	Mar 15 to June 1 and June 1 to Aug 15[2]	Tall Fescue and sencea or "ambro" virgata lespedeza Weeping lovegrass and scarified sencea or "Ambro" virgata lespedeza Browntop or "Dove" proso millet[3]	25-35 lb 40-50 lb 4 lb 40-50 lb 20-30 lb
Nov 15 to Feb 15	Tall fescue or "Pensacola" bahiagrass and Abruzzi rye	25-35 lb 20-25 lb 1 bu	Nov 1 to Mar 1[2]	Tall fescue and unhulled sencea or "Ambro" virgata lespedeza and Abruzzi rye	25-35 lb 50-60 lb 1 bu			
Feb 15 to June 15	Pensacola Bahiagrass or bermuda grass and scarified sericea or "ambro" virgata lespedeza	20-25 lb 6 lb 30-40 lb	Mar 1 to Apr 15	Tall fescue and scarified sencea or "Ambro" virgata lespedeza	25-35 lb 30-40 lb	Aug 15 to Oct. 15	Tall fescue and Unhulled sericea or "Ambro" virgata lespedeza or red clover	40 lb 40-60 lb 40 lb
			Apr 15 to July 1	Pensacola bahiagrass and scarified sencea or "Ambro" virgata lespedeza or common bermuda grass and scarified sencea or "Ambro" virgata lespedeza	25-35 lb 40-60 lb 6 lb 40-50 lb	Oct. 15 to Mar 15	Tall fescue and unhulled sericea or "Ambro" virgata lespedeza and Abruzzi rye (for nurse crop)	25-35 lb 40-60 lb 1 bu

[1]Inoculate legume seed
[2]Planting during this period is hazardous and may have to be repeated
[3]Can be used for temporary cover, June to August.
NOTE Fertilize with 800 to 1,000 lb per acre of 8-12-12 Mulch slopes with 4,000 lb small grain straw or 5,000 lb hay per acre

Fill roads should be constructed only when absolutely necessary for access. This is especially important in wetlands with flowing water systems; fill roads always have the potential to restrict natural flow patterns. Cross drains may be needed to ensure adequate surface water flow consistent with pre-existing conditions. When possible, roads should be constructed at natural ground level because they are less likely to restrict flowing water. If fill roads are necessary for access, they should be constructed parallel to the flow of the main channel and outside the SMZ except when the road is built for the purpose of crossing the main channel.

Since all fill roads have the potential to restrict the flow patterns or volumes of water movement through forested wetlands, water conveyance structures such as culverts, bridges, and fords must be installed with care to assure the conveyance of water through fill roads to provide for flood control, erosion control, and control potential damage to site productivity. Care must also be taken to size such structures to accommodate water volumes experienced during wet seasons or storms.

To prevent excessive rutting during adverse weather, traffic should be restricted and roads regraded. Gravel, mats, and fabric can be used to improve drainage and bearing capacity of road. Broad based drainage dips, water bars, and turnouts are effective means of minimizing erosion losses for access crossings and roads which have significant topography changes. Refer to the publication, "Recommended Best Management Practices for Forestry in Georgia" for guidelines.

Access systems should be constructed only after sufficient planning has been performed. As with all silvicultural activities, access systems should be constructed with emphasis placed on systems which will maintain or enhance existing wetlands functions.

Recommended BMPs for Access Systems

1. Properly plan the access system.
2. Follow recognized and approved construction methods.
3. Construct stream crossings at right angles to the channel.
4. Use properly sized culverts and cross drains.
5. Stabilize soils around bridges and culverts.
6. Use temporary culverts and crossings where practical.
7. Restrict traffic on wet roads.

HARVESTING WETLAND SITES

Timber harvesting is necessary to achieve most management objectives in forest wetlands. Planning the harvest and selecting the right harvesting system can achieve management objectives such as timber production, ensuring stand establishment, and improving wildlife habitat, while avoiding the risks of detrimental impacts.

Planning the Harvest

Several factors should be considered before logging is initiated. Plan all access roads and major skid trails. Avoid locating major roads or trails in areas where rutting or soil puddling may occur. Structure road and trail drainage systems to allow continuous natural drainage. Estimate the amount of harvested timber that must be removed from the tract and the routes used to haul timber. Balance the road system to avoid over-using a particular haul road or skid trail. Plan the access system to minimize traffic over unstable soils or highly sensitive areas.

Schedule the harvest to take advantage of dry weather when the site would be least degraded. Also consider the impact of harvest timing on regeneration. If coppicing is used for regeneration, plan the harvest in late fall or early winter to increase reproductive vigor of the stump sprouts.

Determine the type of system best suited for harvesting in terms of system impact on site quality. Most harvesting systems can be used to log wetland sites, although some modification to the equipment may be required. At least three different harvest systems are suitable for wetland logging.

Conventional harvesting systems currently log most of the wetland sites in the South. These systems are commonly comprised of a chainsaw crew, several skidders, a loader, and haul trucks (Fig. 2). Some mechanized operations use rubber tired feller-bunchers, rather than a chainsaw crew for felling. Others use tracked feller-bunchers which create less impact on the site than rubber-tired units. Logging with a conventional system can be used successfully on wetland sites, if access is planned and movement across the site is rigidly controlled.

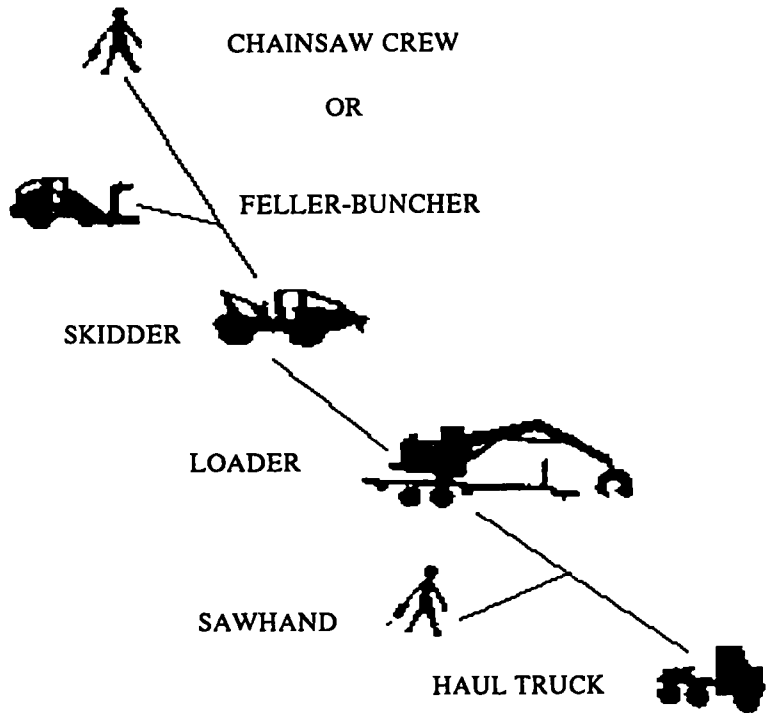


Figure 2. Components of a conventional harvesting system used for wetland logging

Cable yarder and aerial harvesting systems have been used in the South at different times to log wetlands inaccessible to conventional harvesting systems (Fig. 3). These systems are expensive to operate and not widely available. In most cases, a conventional harvesting system with controlled access to the site is as effective as either an aerial or cable system.

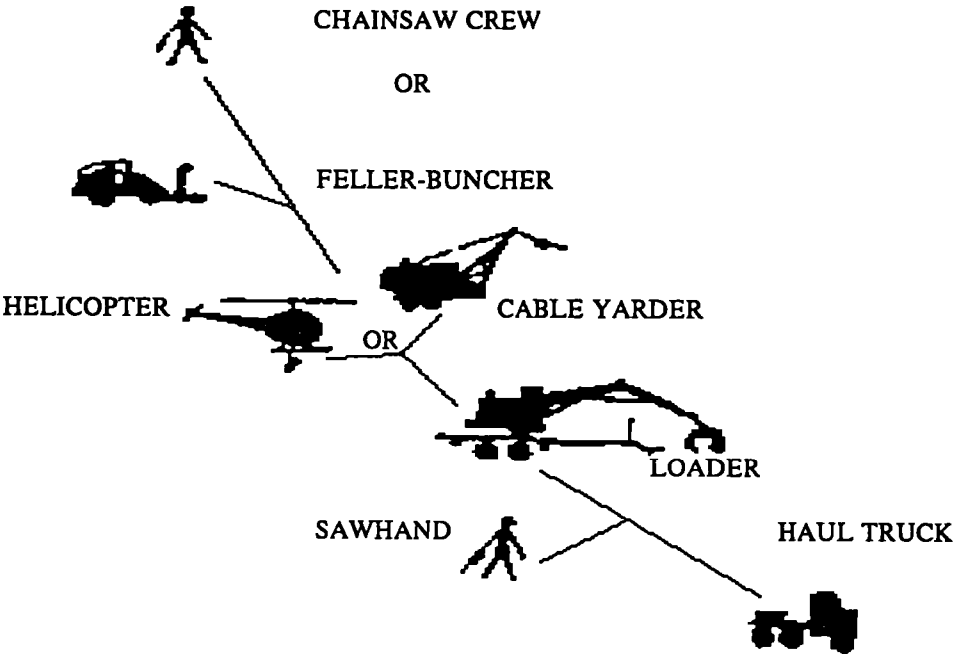


Figure 3. Components of a cable and aerial harvesting system for wetland logging.

Harvesting Constraints

During the harvest, constraints should be placed on equipment to minimize site disturbance, particularly in the SMZs. Encourage the use of low ground pressure tire or track configurations on all equipment, especially on all skidding equipment. Locate skid trails along the contour to reduce erosion and improve vegetative reproduction.

Trees should not be felled into the streambed and debris, such as tree tops and limbs, should be kept out of the stream. If trees are felled into the stream, remove the material from the stream prior to completing the harvest. All equipment should be refueled, serviced and repaired well away from the stream. Trash, such as discarded oil and hydraulic fluid containers, should be removed from the site to avoid soil and stream contamination. Landings should be maintained during operation and cleaned up prior to moving. Landing size should be kept to a minimum and located on high ground where possible.

Special effort should be made to keep the SMZ areas intact during the harvest. Avoid stream crossings whenever possible to minimize stream contamination by leaking diesel fuel or oil. Do not place landings or log decks in an SMZ. Avoid placing roads or skid trails in the SMZ. If a road is required, be sure to stabilize the crossing area prior to use. **Keep disturbance from logging equipment to a minimum.**

Harvest Supervision

Supervision is required to ensure that any forest operation proceeds in a correct manner. Make sure the logging crew understands what is expected during harvest. **Logging operations on wetland sites should be closely supervised to avoid environmental problems.** Areas that require detailed supervision include timber transport and skidding operations. Limit the operations on sensitive sites during periods of abnormally wet conditions to avoid site damage. Monitor road and culvert conditions to prevent problems before they occur.

Recommended Best Management Practices for Harvesting Wetland Sites

Recommended BMPs for wetland harvesting operations differ slightly from those provided for other harvesting situations, as detailed in the Georgia Forestry Commission pamphlet ``Recommended Best Management Practices for Forestry in Georgia''. The following practices are recommended when harvesting most wetland sites:

Recommended BMPs

1. Areas on both sides of a water course should be given special consideration to protect stream bank integrity.
2. Limit the operations on sensitive sites during periods of abnormally wet conditions to avoid site damage.
3. Locate all major skid trails outside the SMZ.
4. Approaches to water crossings should be as near to a right angle as possible.
5. Keep skidder loads light and use high flotation tires or wide tracks to improve flotation.
6. Concentrate skid trails when ground is saturated to minimize compaction and soil disturbance.
7. When ground is dry, alternate skid trails to minimize soil disturbance.
8. Locate landings (log decks, docks, etc) before establishing the road system.
9. Keep the number and size of landings to a minimum. Where possible, place decks and landings on sites that are well drained and slightly sloped to ensure rapid drying during wet periods.
10. Place landings outside the SMZ. When servicing equipment at the landing do not allow waste oil or fuel to drain onto the ground. Remove all garbage and trash from the landing prior to abandonment and seed-in the site to reduce erosion potential.
11. Keep all roads and ditches free of logging debris.

Proper planning, recommended harvest practices, and adequate supervision during the harvest will help protect and maintain our forested wetlands for future use and enjoyment.

REGENERATING WETLAND FORESTS

Successful regeneration begins with a forest management plan which evaluates regeneration options prior to harvest. Repeated selective harvesting without regard for regeneration usually results in a decline of stocking and value of desirable species. The choice of regeneration method is dependent on timber species present, age, stocking, soils, other site and stand characteristics, and the landowner's primary management objectives. Successful regeneration may be natural or artificial.

Concepts of Natural Regeneration

Forested wetlands can be extremely productive and many have the capacity to naturally regenerate themselves. Natural regeneration utilizes the normal cycle of species succession. Landowner objectives determine whether the regeneration cycle will focus on early or climax species. Two types of silvicultural systems, even age and uneven age, are available. Their application will depend on fundamental management decisions and the silvicultural characteristics of desired tree species. Well-stocked young to middle-aged stands provide more management and regeneration options than understocked or over-mature stands.

Hardwood Regeneration. Clearcutting, properly applied, has the greatest application of any management system for natural regeneration of quality southern hardwoods. Coppice regeneration from stumps and roots of young vigorous stands is generally more successful than those from mature or climax species. Schedule the harvest in late fall or early winter to increase reproductive vigor of the stump sprouts. Hardwood regeneration which relies on seed production and dissemination from seed trees is generally impractical and unnecessary. Shelterwood systems may have application for regeneration of late successional species and are frequently recommended for wildlife management or aesthetic considerations.

Pine Regeneration. A regeneration harvest is required. This may include intermediate or shelterwood systems or leaving evenly spaced seed trees to provide adequate seed fall. Once seedlings are established the seed trees should be removed. Clearcuts timed to coincide with natural seed fall may result in adequate regeneration on some sites.

Concepts of Artificial Regeneration

Some wetland sites are not conducive to site preparation and planting equipment. However, during dry periods many of these sites can be artificially regenerated with pine or hardwood species with varying degrees of success. Artificial hardwood regeneration is usually more expensive due to seed or seedling costs, availability, and the extra protection needed from herbaceous and woody competition. Sites that can be artificially regenerated tend to have greater rates of success when planted or seeded to pines.

Artificial regeneration includes but is not limited to the use of prescribed fire, chemical, or mechanical site preparation treatments such as chopping, shearing, piling, raking, disking, bedding and fertilization. (Minor drainage for removal of surface water may be recommended and is widely practiced). Minor drainage does not include drainage associated with the immediate or gradual conversion of a wetland to a non-wetland. Stand establishment may be accomplished by broadcast seeding, or by hand or machine planting seed or seedlings. Species choice is a management option.

Recommended Regeneration Practices by Wetlands Groups

Regeneration systems commonly used in forested wetlands include: patch or clearcut followed by natural or artificial regeneration, shelterwood, seed tree, and group selection. Single tree selection systems may be recommended for sensitive areas such as streamside management zones. Definitions of these systems are found in the appendix.

Care must be exercised during intermediate cuts to avoid soil puddling and compaction and prevent residual stand damage. Regeneration systems that require repeated stand entry are less effective for forest wetlands types with high organic soils. These types may include black river bottoms, branch bottoms, muck swamps, peat swamps and cypress domes.

Complete overstory felling is the preferred site preparation method for obtaining natural regeneration of bottomland hardwoods. Site preparation practices that significantly till surface soil should be minimized on areas that are subject to flooding or where surface runoff may result in increased turbidity of adjacent waters.

FLOOD PLAINS, TERRACES AND BOTTOMLAND

Natural Regeneration: From seed, seedlings in place prior to and from coppice following a harvest cut. Harvest may be stand clearcutting, patch cutting or group selection. Clearcutting is most effective for hardwood regeneration. Natural regeneration of pine requires seed or seedlings in place prior to harvest or the implementation of a regeneration type harvest. Regeneration of desired species may be encouraged by removing understory stems.

Artificial Regeneration: Not normally recommended in bottomland, first terrace, or muck swamps. Regeneration of second terraces may be accomplished by a wide array of site preparation techniques. These may include various combinations of shearing, disking, bedding,burning, herbicides, and fertilization. Planting of seed or seedlings may be by hand or machine. The choice of method and species is a management option.

WET FLATS

Natural Regeneration: From seed, seedlings in place and coppice development following clearcutting, patch cutting or group selection. Broadcast burning for pine regeneration should be conducted when soil moisture is acceptably high.

Artificial Regeneration: Accomplished by a wide array of site preparation and stand establishment techniques including mechanical, chemical, burning and fertilization. Bedding is recommended and widely practiced. The choice of method and species is a management option. Broadcast burning should be conducted when soil moisture is acceptably high.

PEAT SWAMPS, CYPRESS DOMES

Natural Regeneration: From seed, seedlings in place and coppice development following clearcutting.

Artificial Regeneration: May be accomplished by direct seeding.

GULFS, COVES, LOWER SLOPES ADJACENT TO STREAMS, PIEDMONT BOTTOMLANDS

Natural Regeneration: From seed, seedlings in place and coppice development following clearcutting, patch or group selection.

Artificial Regeneration: Accomplished by a wide array of site preparation and stand establishment techniques including both mechanical and chemical. Mechanical site preparation should be avoided within the primary SMZ.

Recommended Regeneration Systems By Forested Wetland Type

	NATURAL REGENERATION				ARTIFICIAL REGENERATION		
Type	Clearcut	Group Selection	Shelter Wood	Seed[1] Tree	Mechanical Site Prep	Plant	Direct Seed
FLOOD PLAINS, TERRACES, BOTTOMLAND							
Black River	A	B	B	C	D	C	C
Red River	A	B	B	C	D	B	B
Branch Bottoms	A	B	B	C	D	C	C
Piedmont Bottoms	A	B	B	C	D	B	B
Muck Swamps	A	C	C	C	D	C	C
WET FLATS							
Pine Hammocks & Savannas	A	B	B	B	A	A	B
Pocosins or Bays	A	C	B	B	B	B	B
Cypress Strands	A	C	C	C	D	C	C
CYPRESS DOMES· PEAT SWAMPS							
Peat Swamps	A	C	C	C	C	C	C
Cypress Domes	A	C	C	C	D	C	C
GULFS, COVES, LOWER SLOPES	A	B	B	C	C	B	C

[1]Seed tree cuts are not recommended on first terraces of flood plains, terraces and bottomland.

A - Highly effective
B - Effective
C - Less effective
D - Not recommended

Recommended BMPs for Regeneration Systems

1. Evaluate regeneration options prior to harvest.
2. Minimize soil degradation from harvest and site preparation by limiting operations on saturated soils.
3. Construct beds and plant on the contour.
4. Avoid mechanical site preparation and planting in the SMZ.

For Natural Regeneration

5. Harvest during dormant seasons to take advantage of current seed sources and favorable coppice growth.
6. Harvest the present stand as completely as possible to allow maximum light for shade intolerant species.
7. Harvest trees at a stump height of less than 12" to promote vigorous coppice.
8. Control residual stems larger than 1.5" DBH by shearing, felling girdling or herbicides within 6 months of harvest.

Summary of Recommended BMPs For Forested Wetlands

SMZs

1. Consider SMZs in planning.
2. Determine and mark SMZ width on site.
3. Harvest systems which minimize forest floor disturbance.
4. Any type of cutting practice, including patch clearcutting, except where it will affect water temperatures to the detriment of trout.
5. Natural regeneration, hand planting, or direct seeding.

Practices to be Avoided

1. Crossing streams or wet sites.
2. Use of wheeled or tracked vehicles.
3. Leaving trees, tops, or anything in the water.
4. Placement of anything in the streambed that would impede water flow.
5. Roads or trails or any kind, unless absolutely necessary.
6. Fire.
7. Mechanical site preparation or machine planting.
8. Sawmills, log decks, landings, or staging areas.
9. Aerial or broadcast application of silvicultural chemicals.

Access Systems

1. Properly plan the access system.
2. Follow approved construction methods.
3. Construct stream crossings at right angles to the channel.
4. Use properly sized culverts and cross drains.
5. Stabilize soils around bridges and culverts.
6. Use temporary culverts and crossings where practical.
7. Restrict skidder and truck traffic on wet roads.

Harvesting Wetland Sites

1. Protect stream bank integrity.
2. Limit the operations on sensitive sites during periods of abnormally wet conditions to avoid site damage.
3. Locate all major skid trails outside the SMZ.
4. Approaches to water crossings should be at right angles.
5. Keep skidder loads light and use high flotation tires or wide tracks to improve flotation.
6. Concentrate skid trails when ground is saturated to minimize compaction and soil disturbance.
7. When ground is dry, alternate skid trails to minimize soil disturbance.
8. Locate landings (log decks, docks, etc) before establishing the road system.
9. Keep the number and size of landings to a minimum. Where possible, place decks and landings on sites that are well drained and slightly sloped to ensure rapid drying during wet periods.
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11. Keep all roads and ditches free of logging debris.

Regeneration Systems

1. Evaluate regeneration options prior to harvest.
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APPENDIX

Clearcutting. Strictly speaking, the removal of the entire standing crop. A silvicultural system in which the old crop is cleared over a considerable area at one time; conifer regeneration is generally artificial, natural regeneration possible by seeding from adjacent stands or from seed and/or advanced growth already on the ground. Hardwood regeneration from coppice.

Group Selection. A modification of the selection system in which trees are removed in small groups at a time. The canopy is opened by group cuttings to create evenly distributed gaps that are enlarged by subsequent cuttings as regeneration develops.

Patch Cutting. A modification of the clearcutting system developed in the Pacific Coast, whereby patches of 40-200 acres are logged as single settings, separated for as long as practicable by living forests. In the Southeast the sizes are generally smaller.

Seed Tree. A tree selected and retained following harvest to provide seed for natural regeneration.

Seed Tree Cutting. Removal in one cut of the mature timber from an area, save for a small number of seed bearers left singly or in small groups. The objective is to create an even-age stand.

Selection Cutting. The annual or periodic removal of trees, individually or in small groups, from an uneven-age forest. The improvement of the forest is a primary consideration.

Shelterwood Cutting. Any regeneration cutting in a more or less regular and mature crop, designed to establish a new crop under the protection of the old.

Shelterwood Systems. Even-aged silvicultural systems in which in order to provide a source of seed and/or protection for regeneration, the old crop is removed in two or more successive shelterwood cuttings, the first of which is ordinarily the seed cutting and the last is the final cutting, any intervening cuttings being termed removal cuttings.

Single Tree Selection. The removal of single, mature, individual or exceedingly small clumps of several such trees. This system is used in situations that preclude complete overstory removal such as streamside management zones, recreation areas, and locations where aesthetics are a prime consideration.

Silviculture. The science and art of cultivating forest crops. The theory and practice of controlling the establishment, composition, constitutional growth of forests.

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