

Southeast

Revised February 2001

SOUTHEAST FUELS

I. INTRODUCTION

Fire problems in the southeast are due to population shifts in the region.

The population, is becoming more urban, and has adopted a different land ethic. At one time the southeast burned yearly. Forestland and its accompanying values were of little concern to the rural person. In some mountain areas this is still the case but circumstances are changing due to increased emphasis on fire prevention and as ownership patterns change.

Today, people are generally more fire conscious. Urban populations are buying rural land as an investment or as a place to retreat. With the increase in forestland values the general population is more interested in what you do (or don't do) in forest fire suppression. So the urban interface is in the southeast also.

The forest problems in the southeast are still formidable: There are millions of acres of protected forestland in this geographical area and about 1.1 million acres of it burn during an average year. Over 1½ million acres burned in 1993. Of these fires 56 percent are arson caused. Some areas have a higher percentage, as in Kentucky, with 96 percent of the fires caused by arson.

II. GENERAL

- A. Forest fires in the southeast quite often involve both public and private land. Further, the public land may be under the jurisdiction of more than one federal agency as well as a state agency.

Generally, the agency that establishes the original Incident Command on fires involving more than one agency remains in control of that fire. Most states have cooperative agreements with federal agencies within their boundaries to this effect. There are provisions in these cooperative agreements allowing a different agency to assume command of a fire that is burning within their jurisdiction or, more often, to establish a joint command.

The incident management team or overhead resource should be aware of any **cooperative agreements** in effect. The agreements spell out pay rates for manpower and equipment and areas of responsibility.

- B. The small private landowner and forest industries own most of the land area in the southeast. Generally speaking, state forestry organizations are responsible for all fires burning on private land. In situations involving industrial forestlands, state and industrial personnel cooperate closely, but state personnel still have ultimate responsibility. If you are assigned to a team managing an incident you will often see forest industry personnel and equipment working under state direction on fires not on industry land.
- C. You should be aware of a basic difference in philosophy between state fire organizations and most federal agencies. State organizations are generally more cost conscious; they just don't have the money!

- D. Most southeastern and south central compact states have adopted ICS, but their personnel are at different stages of acceptance and knowledge. When working with some state agencies they may not be aware of who a line officer is and you will probably not get a WFSA. You will probably have to write the delegations of authority for them. Help them out, they may not be up to standard in all areas, but work with them. They are a valuable resource.
- E. Personnel available to the Incident Team assigned to the southeast may be a mixed bag indeed. While few state organizations handle all fire responsibilities, most depend heavily on volunteer fire departments, a system of part-time forest wardens, and pick up firefighters to supplement their forces.
- F. Federal Excess Property Program (FEPP) - the southeast has more excess property than the rest of the United States put together.
- Aircraft
 - Large Engines
 - Small Engines

Equipment rental agreements with Volunteer Fire Departments using FEPP cannot charge us for use of that property. They can charge for equipment they have placed on the property. (i.e. tank, pump, etc.)

- G. There are no caterer or showers on national contract in the south. Some have pre-positioned in the past, so logistics folks need to check and see what is available. Most of the time you will have to be innovative. The local people and forest dispatchers can be a big help. Don't be afraid to ask for help or suggestions. The regional cache is located in London, KY. This can cause some delay in getting supplies, so plan ahead.
- H. Over the past couple of years, teams have been called in on fires that affect state lands, under FEMA grants. Finance personnel need to track costs of each fire separately. FEMA may give declarations on some fires and not others. If this happens the state has to pay the total cost. If FEMA is involved there will be someone assigned to cover ESF 4 (Emergency Support Function). These people can be a big help to you in getting the necessary information the team needs to track costs.
- I. Most of the states in the south have County Commissioners and County Judges, who run the activities of the county. However, Louisiana has Parishes and a different political structure. It is best to check with the locals for details, on how the local political government operates.

The southeastern section of the United States can be divided, for fire suppression purposes, into three geographical regions:

- Appalachian Mountains
- Piedmont Plateau

- Coastal Plains

Note that there are other unique geographical regions in the southeastern United States, such as the Everglade Swamp in Florida and the Pocosins in North Carolina that have unique problems. These areas will be covered separately, even though most occur in the coastal plains.

There are two separate fire seasons in all the geographical regions, fall and spring. Fall fire season usually begins in October with leaf fall and ends when the winter rains and snow begin in December. The spring fire season usually begins around March 1 and extends into May when vegetation begins to grow. Warm, windy days and cool nights characterize spring fire season, and this is usually when we have our most severe fires.

Each geographical region has unique fire suppression problems. Four major factors affect strategy and tactics in these regions: topography, weather, fuels and the degree of mechanization of fire suppression forces.

Topography is the most important factor affecting fire behavior in mountainous regions but is a minor concern in the Piedmont and Coastal Plains, where **weather and fuels** are the major elements affecting fire behavior.

In the flat woods of the coastal plains and rolling topography in the Piedmont the key word is **mechanization**. Dozers, range in size from a Type VI equipped with a fire plow to a type I using a blade. They can construct more fireline in a given time than 25 to 100 line personnel. Crews to patrol burnout and backfire are needed. Some fires with a heavy tractor operation will have more tractor personnel than firefighters. Some fires can have from 20-30 tractor plows working at one time.

Let's talk about the separate regions.

J. Mountains: Approximately 50 million acres of forest.

1. Fuels

Fuel Model 9 - mixed upland hardwoods - pine; 10+ tons per acre;
Fuel Model 7 - heavy Laurel and Rhododendron under upland hardwoods and pine; 15-20 tons per acre.

Fuels in the mountain region consist of upland hardwoods and hardwood litter interspersed with pine on the drier sites. Most of the upper slopes have Mountain Laurel in the hardwoods. Rhododendron grows in thickets in the more moist areas. Ozark and Ouachita mountains will not have Laurel or Rhododendron.

2. Topography

The Appalachians vary in height up to 6,684 feet in elevation (Mt. Mitchell, North Carolina). Land is often steep and rocky with large outcroppings of granite, sandstone, limestone, or shale, depending on where you are. Much of this area is inaccessible except by foot. You can be within a few miles of a fire and have to travel 15 or 20 miles to get to the base of the mountain on which the fire is burning. The west doesn't have a monopoly on rough, steep mountains.

3. Weather

During winters of light snowfall the hardwood leaf litter and dead herbaceous material are fluffier (not packed by heavy snowfall) and fire will spread at a rapid rate. Also, in high winds, the fire danger may be underrated because rolling and blowing leaves are not considered. There may be a leaf fall after a burn and reburn will occur if you don't do a good job of mop up.

4. Tactics and Strategy

Upslope runs and sustained rates of spread are more common in the mountains than the other geographical regions.

Fires may burn for several days but usually make their main run on the first or second day. Heavy ground fuels and cull trees make it difficult to mop up.

- a. Generally speaking, when we fight fires in the mountains we try to **get to the top**, with our major suppression efforts.

Reasons:

- (1) When a fire makes a run we do not usually catch it until it reaches the top.
- (2) If we can use equipment many times the only place we can often use it is on the ridge tops.

Tactically, attack the fire indirectly and backfire the line to construct a sufficiently wide break to hold the fire.

- b. If a fire is making a fast run and is very hot you may have to make a flanking attack. If you must flank a fire remember:

Your major suppression effort, all other factors being equal, should be on the east flank first. This is especially true in the fall season. Dry, cold weather fronts can cause a 90-degree wind direction change in a short time, creating a new front along the east flank.

5. Safety

- a. Appalachian ridges and slopes often have shallow soil and loose rock. Tractor operation can be hazardous. Ledges and cliffs

created naturally, or by strip mining, can be a problem to people at night, as well as to equipment.

- b. Backfires are often started by local people from steams, trails, etc. to protect their own property or, in some cases, by arsonists, who use the confusion to start additional fires.
- c. Heavy vegetation can hamper fire suppression and movement of personnel.
- d. May need Law Enforcement folks to go with crews.

6. Resources Available

States in the southeast have some type of aerial support in times of emergencies. Tactics used are usually concerned with helicopters with water buckets or L.A. Tanks making multiple drops in support of ground forces rather than attacking the fire in a direct suppression effort. Federal lands generally have both helicopters and aerial tankers available. Due to cost of large air tankers, states may not opt to use this resource. A new tool recently introduced is a “scoop” tanker where large bodies of water are available. The state of North Carolina has one CL-415 that is very effective.

The helicopter with a bucket or L.A. tanks is a very effective tool in the southeast due to the close proximity of water sources. In much of the mountain region a turn around time of 5 to 6 minutes isn't unusual. Use of Class A foam is on the increase.

Of course, Type VI tractor/plows and communications are widely available. Hand labor with hand tools is effective. In some places this is the first line of defense. At times it is not necessary to get mineral soil to stop a running fire in the first attack. Removal of the loose-leaf litter is often enough and that can be accomplished with leaf blowers and hand tools. Another important tool is the ATV, which makes accessibility easier and helps move supplies and equipment.

7. Special Considerations

Strip mines and haul roads for timber or coal are numerous in some areas, which will allow you access and act as a firebreak. They are not on any map but local forestry personnel will know about them.

Caution: It is easy to get trapped on steep slopes created by overburden pushed off the strip benches. Stay on the benches and construct indirect attack line. Post Lookouts if needed.

- 8. Usually no problem with density altitude: Most of southeast is less than 5000' MSL; 80% less than 1000' MSL.

K. Piedmont: Approximately 50 million acres forest.

1. Fuels

Fuel Model 9 – mixed hardwoods – pine.

Fuel Model 1 – open southern pine plantation.

Fuel Model 9 – closed pine stands.

Most of this region is covered with mixed hardwood pine forest. Fuel continuity is frequently broken by open spaces where land has been cleared from agricultural purposes.

There is a wide range of fuel sizes and densities. Many areas have hardwood fuel types not unlike the mountain regions. There are other extensive areas of loblolly and slash pine plantation ranging from seedlings to pole and saw log size timber.

The wide range of fuels in pine plantations make fire suppression difficult and hazardous. The younger plantations have large amounts of light fuels (Herbaceous materials, pine litter, seedlings, hardwood debris). The sapling size plantations will easily crown given proper conditions and their density hampers working with equipment.

Fuel types near streams and wet bottoms consist of mixed bottomland hardwoods but with less leaf litter than the upland sites. Also, there is often heavy cover of Japanese honeysuckle, which is usually not as flammable as loose-leaf litter. This cover is not usually a “Fuel Ladder” since it is shaded out in pine fuels where crown fires occur.

2. Topography

Approximately 2/3 of the Piedmont is forestland. The rolling topography consists of deep, clay soils and numerous small streams. Except in local situations such as river bluffs, slope generally has little effect on fire behavior.

This area historically has been the center of agriculture in the southeast. The region has been burned repeatedly by local residents and only in recent years have fire prevention activities shown results. People still cause most of the fires in this region, either through debris burning or arson. Railroads also cause serious problems in some areas. Claims personnel need to be aware of how the fire started.

3. Weather

As in mountains, fires in the Piedmont area usually burn the most acreage during the first day. Fires tend to die down nightly and the rolling terrain allows much suppression activity to be done at night when the humidity recovery is high. There are exceptions to this and weather forecasts are important.

4. Tactics and Strategy

- a. Fire burning in **mixed pine-hardwood fuel types** are fought differently than pine plantation fires:

- (1) Slow moving fires are attacked directly and at the head. This is perfect terrain to use dozers in conjunction with burnout and the tactic is used extensively.
- (2) Fast moving fires are attacked at natural breaks or by flanking the fire with mechanized equipment with burnout.

In most cases where natural fuel types prevail there will be breaks in the fuel continuity by roads, agricultural land or streams. These are excellent breaks from which to make a stand against the fire and should be used where possible. Again, backfiring is mandatory if these lines are to be effective.

- b. **Young pine plantations** create a totally different situation than natural fuel types. When conditions are such that **major fires** are possible it is usually not practical to try a frontal attack on a plantation fire.

In some parts of the Piedmont and Coastal Plains extensive reforestation programs have created literally miles of different aged plantations, broken only occasionally by natural forest types.

The situation is not as bleak as it sounds. All plantations of any size have a system of firebreaks and/or roads. Also, streams, branches, and wet drainages remain in hardwoods with little ground cover, thereby creating a natural avenue for equipment and a good break in fuel continuity.

- (1) Fires in intermediate and young pine plantations are usually attacked on the flanks by mechanized equipment and burned out and, if natural breaks are available, at the head with backfiring.

Caution is the watchword and you must have an experienced person handling the frontal attack.

Important: Effective burning out is necessary in this situation. The burnout must be set in close coordination with line construction. The burnout must be set at that specific time when the wildfire is "drawing" the air toward the fire from the line, preventing the burnout from spotting over the line.

- (2) On extremely fast moving plantation fires it is unlikely that a frontal attack will be successful. In this situation about all you can do is to keep the width of the fire at a minimum by flanking attack and make your main stand after the fire moves out of the plantation and is burning in other fuel types.

5. Safety

Due to the rolling terrain and ease of equipment operation it is easy to take fires for granted in the Piedmont.

Special caution should be taken when dry, cold fronts move through the area and when working in the dense fuels of pine plantations. Backfiring and burnout, while commonly used, must be assigned to experienced personnel and coordinated directly by the Operations Chief or Incident Commander. Escape Routes for personnel and equipment are extremely important! It is easy to become careless when on a dozer.

6. Special Considerations

- a. Plantation fires burn swiftly and cover much land in a relatively short time. However, they usually burn most of their acreage in the first burning period.
- b. Fire behavior in the Piedmont is often influenced by weather systems that produce extreme behavior.
- c. People from nearby urban areas are building summer and full time residences in heavily wooded areas of the Piedmont. Property values can be high and are usually given high priority for protection if threatened by wildfire.
- d. There are not a lot of good places to set up a camp. This may require the logistics people to house crews in hotels. You may need a hotel coordinator.

L. Coastal Plains: Approximately 100 million acres.

Fuels

Fuel types in the coastal plains region are determined to a large degree by drainage patterns and relative soil moisture. The predominant fuel types are:

- **Sandhills**
- **Flatwoods**
- **Pocosins (High & Low)**
- **Swamps and Wetlands**

a. **Sandhills** – Fuel model 1, 2-8 tons/acre

- Fuel model 7, 3-10 tons/acre
- Fuel model 9, 2-4 tons per/acre
- Fuel model 4, 10-30 tons/acre

1. Fuels

Fuels in the sandhills are most often grass and brush underneath an overstory of slash, longleaf and loblolly pine. Pine

predominates but mixed hardwood stands similar to the Piedmont regions also occur. Primary grasses in the sandhills region are wiregrass east of the Mississippi River and bluestem west of the Mississippi River.

Soils are well-drained sand and the ground litter consists of pine needles, scrub oak leaves, palmetto, grasses and herbaceous materials.

Wide expanses of young pine plantations are found in the sandhills creating the same hazard areas as those in the Piedmont. Coastal Plain sandhills fuels will normally be a little sparser than the Piedmont.

In addition to the dead fuels, most sandhills sites will contain some live fuels that contribute to fire activity. Saw palmetto commonly occurs and can burn intensely even though green year-round.

One sandhills fuel type deserves special attention, the sand pine/oak scrub of central Florida. This ecosystem occurs on the Lake Wales ridge in central Florida and covers less than 1 million acres. The most continuous block of sand pine scrub occurs in a 280,000-acre block in the Ocala National Forest. Sand pine/scrub is normally considered fuel model 4. Sand pine is a fire dependant species, naturally burning on a 15-50 year cycle. It has serotinous cones and when fires do occur they are usually of stand replacement intensity. The many species of scrub oak are very flammable at certain times of the year, and readily carry fire into the crowns of the sand pine overstory. The key determinant of whether sand pine/scrub will readily burn is live fuel moisture. When the live fuel moisture of the scrub oak and palmetto understory drops to 120% or lower, rapidly spreading crown fires are possible. One of the fastest moving fires on record occurred in the Ocala NF sand pine/ scrub, advancing 36 miles in 5 hours.

2. Topography

Sandhill sites can be very flat or have some rolling hills. Elevation changes may be 5 to 100 feet in sandhills regions of the coastal plains.

3. Weather

Fires in the coastal plains are most influenced by wind. Fast moving, dry cold fronts are associated with many of the larger coastal plains fires. Due to the high nighttime RH recovery almost every night, fires tend to die down nightly. Burnout is very difficult at night.

In all the coastal plains fuels, long range spotting is usually associated with high mixing heights. Mixing heights greater than 6500 feet or a daytime dispersion index higher than 55 are good indicators of potential long range spotting.

Severe thunderstorms can occur year-round. High wind gusts and dangerous lightning accompany the frequent summer storms.

Sea breezes are an important weather consideration in all the various coastal plains fuels, particularly in the warmer months. The distance the sea breeze reaches inland can vary greatly from day to day. Specific spot weather forecasts and local expertise are needed when sea breeze situations are encountered.

Many of the larger fires will occur during warm months. Temperatures along the southeastern coastal plains can reach the 90's from March through October. The 90+ temperatures all summer joined with 40-90% RH every day can cause an extreme heat index much of the summer.

A safety factor throughout the coastal plains of the southeast is the number of people you will encounter. There are many roads, many residences and most are accustomed to fire and will attempt to go about their business ignoring you and your suppression efforts.

4. Tactics and Strategy

Tractor-plow units are the most popular tool. Using engines along with burnout from the many roads in the region is becoming a more accepted tactic as emphasis on keeping fires small decreases due to resource considerations.

In very light sandhills fuels, hand crews can be used, but tractor-plows are usually more efficient and more readily available.

In sandpine/scrub fuels that are actively burning, tractor-plow units are a necessity. The heavy scrub oak and palmetto understory makes handline construction or progressive hose-lays very difficult.

Helicopter bucket drops can be effective in the lighter fuels. Type II ships are needed in heavier fuels.

5. Safety

Sandhill sites tend to have an abundance of flashy fuels that dry out quickly. Intense burning can take place hours after a 0.5 to 1-inch rain. The most severe sand sites in the coastal plains can percolate 12 inches of rain per hour.

Frontal attack with dozers is common in sandhill sites. Single dozers are also used. Working dozers in tandem and ensuring burnout takes place closely behind plowline construction greatly increases safety.

Rattlesnakes and copperheads are common in sandhill sites across the coastal plains. Ground nesting yellow jackets are also common, and burnout crews following dozers must beware of plowed up nests. Some other critters that could cause problems are chiggers, ticks, and fire ants. The locals will be more than happy to inform you on how to cope with these problems.

Heat stress is a major concern much of the year due to high temperatures combined with high humidities. Adequate water intake is a must. Un-acclimated western crews will suffer greatly from the humidity the first few days of an assignment.

A major danger in the southeast is underestimating fuel volatility. Most grasses and brush appear so green that firefighters from other parts of the country do not expect the flashy burning and rapid spread.

6. Resources Available

Tractor-plow units are the tool of choice and the state forestry agencies as well as federal agencies will have many.

Contract dozers with blades and/or fire plows are usually available. They may come wet or dry (with or without fuel). You will need to review contracts and equipment rental agreements. Volunteer fire department engines and specialized foam engines are readily available. Strike teams of engines are not normally used but may be assembled on an incident.

Again, helicopters with buckets or LA tanks are both effective tools because of frequent water sources. Unless on a large park or national forest, water sources will most likely be on private land without any prior agreements.

State of North Carolina has some agricultural airtankers (SEATS) that can carry 800 gallons of retardant.

Type III CWN helicopters are common around the region. Several type II CWN helicopters are available, particularly near the gulf coast oil fields of Texas and Louisiana. Florida State and North Carolina State have a few type II helicopters. One type I helicopter is available within the region, a civilian Blackhawk helicopter, in Florida.

4-wheel ATV's equipped with a power drip torch can be found throughout the coastal plains and are an ideal tool for burnout in the sandhills and flatwoods.

Most federal units and states will have multiple plastic sphere dispenser machines available for burnout from helicopters. Heli-torches in the region have become very rare.

b. **Flatwoods** – Fuel model 7, 5-20 tons/acre

1. Fuels

Flatwoods are lower and wetter sites than sandhills, often transitioning into swamps. Vegetation is predominantly palmetto and gallberry, the classic fuel model 7. A rich diversity of grasses occur, however wiregrass, bluestem and broomsage again dominate in most areas.

Regrowth after a fire or prescribed burn in flatwoods sites is very rapid, and fires can re-occur after only 2 or 3 years.

Flatwoods are characterized by an overstory of slash pine, although loblolly, longleaf pine and some pond pine also occur. Flatwoods almost always require dozer or tractor-plow units for line construction due to heavy brushy vegetation. Hand line construction is ineffective! Flatwoods present several special hazards. Hardened "fatwood" or "lightered" stumps are common throughout and can hang-up a dozer easily. The poorly drained soils also present a constant risk of bogging a dozer down. Fuels are often such that a firefighter on foot will be walking in 6 inches of water and yet the fuels above will support a rapidly spreading fire with 6-foot flames.

2. Topography

Flatwoods are dominated by nearly flat topography with a very slight gradient up to sandhills or down to swamps. The elevation difference between flatwoods and swamps is usually only a few feet and may occasionally be only a few inches.

3. Weather

The same as sandhills.

4. Tactics and Strategy

Tactics are very similar to sandhills. Tractor plow units are the most common tool. Tractor-plows are more likely to be used in tandem in flatwoods due to increased risk of getting stuck. Burnout immediately behind flanking plowlines is very effective.

On rapidly moving fires, indirect attack and burnout from multiple plowlines or roads is most common.

5. Safety

Safety considerations are also similar to sandhills. The biggest concern is sticking a tractor-plow unit in mud or on a stump before a rapidly moving fire or with shifting winds. Ensure tractor-plow units working alone are equipped with a winch. Work tractors in tandem whenever possible.

Flatwoods contain some additional critters that are not as much a concern as in sandhills. Cottonmouths are poisonous snakes that prefer wetter areas. Unlike most snakes, cottonmouths will sometimes seem very aggressive, moving directly toward a person instead of fleeing. Alligators are also more likely to be encountered in wetland bordering flatwoods.

As in sandhills, remember in southeastern coastal plains, green live fuels can and do burn rather fiercely.

6. Resources Available

The resources available are about the same as in the sandhills.

c. **Pocosins (high and low)** – Fuel model 6, 10-20 tons/acre

- Fuel model 4, 30-40 tons/acre

1. Fuels

Most of the pocosin fuels in the southeast occur along the coastal areas of the Carolinas.

High Pocosin – Mixed hardwood and evergreen brush from 6-20 feet tall. The leaves of the brush species are high in oil content and are highly volatile during fire seasons. Some areas have pine overstory. There is usually heavy ground litter on shallow organic to deep peat soils. Fuels are often as much as 40 tons/acre. Heavy understory of shrubs, vines, seedlings and young trees make up much of the fuel complex.

Low Pocosin – Consists of mixed hardwood brush, generally less than six feet tall. Evergreen brush is high in oil content and very flammable. Low pocosin generally has less ground litter and stand of shrub pond pine and Atlantic white cedar are occasionally found, although generally there is no overstory. Soils are shallow organic soils to deep peat like the high pocosins.

2. Topography

Topography in the pocosin region of the Carolinas is very similar to Flatwoods areas in the remainder of the coastal plain. Elevation differences of a few inches to a couple feet greatly influence the vegetation.

3. Weather

Same as sandhills. Most pocosin sites are very close to the coast, so sea breezes are almost always a factor.

4. Tactics and Strategy

There may be a need for a bridging crew to even get equipment into the pocosin areas.

Indirect attack is almost always necessary in pocosins to allow sufficient number of dozer lines to be constructed. Multiple lines (4 to 8 or more) are effective with backfiring of the line closest to the fire. Spotting is always a problem in these fuels, particularly when the backfire and main fire meet.

Head attacks can be and are used in some situations but require extra caution. Head attack may be a practical strategy when natural or man-made breaks occur in the fuels, such as roads or canals.

Another method of head attack is to construct two parallel lines at the head of the fire and burn out between the two lines. These provide the needed break in fuels, while minimizing the spotting potential of a head fire and backfire coming together.

Lines may need to be constructed farther than usual from flanks due to the wet soils and potential for getting equipment stuck. It is not unusual to have 3 or 4 dozers stuck simultaneously while trying to get the first one out!

Air tankers can be effective in pocosin fuels, particularly in the low pocosins.

Equipment lines should be as straight as possible to minimize turns. Sharp turns increase the likelihood of dozers bogging down.

Fires burning in peat and organic soils will burn down to the water table. In periods of drought it may be necessary to irrigate fire lines with high volume pumps to completely extinguish the fire. Sprinkler systems can also be effective for mop up, but must often be maintained for long periods of time, even weeks.

5. Safety

Safety must be emphasized in all the coastal plains fuels, but especially the pocosins. These areas have very hazardous fuel types and are difficult if not impossible to traverse on foot. Drainage ditches and canals fill with water and are difficult for equipment and personnel to cross. In addition, during drought periods, cottonmouths and alligators will congregate in these canals as the last source of open water to dry up.

Heat and humidity concerns will be even more important in pocosin fuels and swamp fuels.

All the other safety concerns of sandhills and flatwoods still apply.

6. Resources Available

Resources available will be about the same as in other coastal plains fuels. One exception is pocosin fuels require high flotation dozers. Narrow track dozers will not work! Most state and federal agencies near these fuels will have some low ground pressure (LGP) dozers available. Timber companies can also be a source for these specialized pieces of equipment.

Several of the southern states and also the National Park Service and US Fish & Wildlife Service also have some specialized tracked swamp equipment such as bombardiers or large tired high clearance swamp buggies. Although available around the southeast it may take considerable time to get these to your fire.

Several terra-torches are located around the southeast and are effective for burnout from roads in pocosin fuels.

c. **Swamps and Wetlands** – Fuel model 1, 3-10 tons/acre

- Fuel model 3, 5-15 tons/acre
- Fuel model 4, 20-30 tons/acre
- Fuel model 6, 10-20 tons/acre

Swamp and wetland fuels can generally be placed in 2 categories:

- Grass marshes, savannahs and prairies
- Swamp hardwood brush species such as titi, wax myrtle, yaupon, and bitterbush

1. Fuels

The savannahs and grassy prairies of the southeast coastal plains are generally classed as fuel model 1, short grasses. Coastal marsh grasses and the sawgrass of the Everglades are classed as fuel model three, tall grasses. Tall sawgrass in the Everglades can be 12 feet high. Rates of spread in all the wetland grass types can be extremely rapid.

Swamp hardwood brush species can become particularly volatile during drought cycles. Late spring and late summer are the most common drought times in the coastal plains. True swamps such as Okefenokee Wildlife refuge in southeast Georgia burned on a natural cycle of every 30-50 years. With disturbance to the water table by man, that cycle appears to be becoming more frequent.

The fringes of swamp areas or stingers of swamp intermixed with flatwoods can burn on a much more frequent cycle.

Titi is a particularly bad fuel for long range spotting. Even with the flat coastal plains terrain and moderate winds, spot fires

will consistently occur $\frac{1}{2}$ to $\frac{3}{4}$ of a mile in front of the main fire. One and $\frac{1}{2}$ mile spot fires have been documented. Rate of spread in swamp fuels is not very high, but the long range spotting drastically increases the overall spread.

During extreme drought, cypress swamps and cypress ponds can also burn. This usually results in total mortality to the overstory. In addition 2 to 4 feet of duff and peat can also be burned from the dry pond bottoms.

2. Topography

Swamp areas are even flatter than the rest of the coastal plains. The highest point in the 2 million acres of the everglades is 10 feet.

3. Weather

Same as the other areas of the coastal plains. Like pocosins, sea breezes are a particular concern in the Everglades and grass marshes of several wildlife refuges

Because of the long range spotting potential of several of the brushy swamp hardwood species, mixing height should be watched closely.

Unlike sandhills and flatwoods fuels, swamp fuels do not burn out quickly and cleanly. Fires may persist in large swamps like Okefenokee for months, so long range forecasts become more important than usual for the southeast.

4. Tactics and Strategy

Tactics differ significantly in wetland grasses and swamps from other coastal plains areas.

In the wetlands grasses, dozers may not be allowed for environmental reasons. Bombardiers and swamp buggies may be allowed. These can be effective for direct attack along the flank using the track to walk down the grasses and then burning out or controlling the flank with water carried on the units.

In Everglades NP, no equipment is allowed, and the normal tactic is direct attack on the flanks with flaps (swatters). The tactic is basically to start at the rear and swat and rotate and gradually pinch off the head. In areas of tall sawgrass there are usually some pockets of spike rush that are intermingled in with the sawgrass. Weed eaters with cutting brush blades can be used to cut a fireline and connect the spike rush flats or to tie into burned areas. Burnout can be effective from these cut lines. Spotting is generally short range due to rapid

consumption of fuels. Helicopters are used to support ground crews with water. Type II ships are more effective than type III in the tall sawgrass. SEATS are also very effective in these fuels.

The most effective time to work in tall sawgrass is when the RH is high, primarily between daylight and 0900. Burnouts are effective with RH's between 70 and 90%, but are difficult to hold when the RH drops below this.

Short grasses can be effectively worked during the day, except with high winds. Engines and bombardiers are effective for flanking attacks if allowed. If not crews and flaps along with helicopter water support are most effective.

In many cases the best strategy for grass fuels in the southeast is to locate a barrier and burn out using the plastic sphere dispenser.

Strategy for brushy hardwood swamp fuels is vastly different from wetland grasses. Heavy equipment is a necessity to construct control lines. Again LGP dozers are usually needed. Several dozers working together are most effective. It often takes 3 to 4 dozers to clear a single line through swamp fuels. The first two walk the vegetation down and clear a path with their blades. The third dozer uses a plow to break the swamp root mat to mineral soil. The fourth dozer then clears this plowline. Again straight lines are preferred.

In most cases lines are pushed through swamps only to tie upland pine areas where the fire can be held together. You normally do not go into a true swamp after the fire, but establish control lines along the perimeter and let the fire come to you.

Burnout is difficult in swamp fuels and almost impossible at night. A terra-torch can help, but in most cases a burnout will have to be conducted just before or just after the peak burning period.

As with pocosins, high volume pumps and sprinkler systems can be effective for mopup. Swamp fires can persist for several months even through rain events of 1 to 2 inches.

5. Safety

Safety considerations are basically the same as in the other coastal plains fuels.

In grassy savannahs or wetlands, caution needs to be exercised due to the potential for very rapid spread.

In both grassy wetlands and swamp brush fuels, the risk of getting equipment stuck is very real. Control lines must be planned far enough away from the main fire to allow time to extricate equipment that becomes bogged down.

In brushy swamp fuels, aerial observers are needed to detect long-range spots that have the potential to entrap personnel and equipment. Unless a state fire tower is nearby, ground lookouts are impractical.

Time of year influences safety zones. During winter months swamps will not usually burn and they can provide a safety zone for personnel. During summer months and drought periods, the opposite is true and swamps may be the worst place to be.

As in flatwoods and pocosins, snakes and alligators are a concern especially when there is limited open water.

Crews in Everglades NP may be tempted to seek shade in hardwood hammocks that occur sporadically throughout the glades. Again, these are the worst place to be as most of the nasty critters will also be there.

Many roads throughout the coastal plains are a "ball bearing" sand that requires large tires and four-wheel drive to travel.

Tall sawgrass and swamp areas are almost impenetrable and once in these areas visibility is very limited. A compass is a must to keep oriented.

When working in grass fires always carry fuses or strike anywhere matches. Should you get trapped, you can quickly burn out a safety island. Do not try and outrun a southern grass fire on foot.

6. Resources Available

Resources available will be about the same as in other coastal plains fuels.

7. Special considerations

Some areas of the coastal plains have good locations for camps. Many agencies have agreements in affect with 4-H camps, youth camps, church camps, etc. Other areas will have no facilities available and camping crews out may be impractical. Nighttime heat, humidity and mosquitoes and biting flies make camping out in the Everglades or Okefenokee Swamp very miserable for crews. In these situations you may want to use motels. A hotel coordinator may be needed as part of your logistics staff.