CHAPTER X

PLANNING AND EVALUATION

OBJECTIVES

1) Identify the key elements to be addressed in every burn plan.
2) Write clear and measurable objectives for specific burns.
3) Describe the contingency plan elements for an escaped prescribed fire in Florida.
4) Develop a prescription which meets legal requirements, landowner directives, and best management practices for Florida.
5) Execute an evaluation for a prescribed burn.

INTRODUCTION

Good planning has always been an essential ingredient for successful prescribed burning. In present day Florida, planning is more important than ever. Successful prescribed burners follow a formal planning process that demands extensive preparation and follow up evaluations for each burn. The preceding chapters deal with basic subjects and topics that are integral features of every successful prescribed burning program. The remaining chapters deal with the actual process of conducting a prescribed burn. Planning and Evaluation is so important that it is considered to be one of the four operational phases for all prescribed burns. The remaining phases (Ignition/Suppression, Mop Up and Declaring the Fire Out) occur within fairly well defined time segments but good planning is a continual process. During each operational phase fire behavior, weather, equipment failures, and the evolving dynamics of wildland fire management dictate constant evaluation and adjustments to the plan. During a well planned burn the casual observer may be unaware of these adjustments and experienced crews often incorporate these changes with minimal verbal communication. After ignition, it's far too late to ***begin*** thinking about key elements that may have been overlooked or things that may go wrong during the burn. A successful prescribed fire is one that safely and efficiently achieves the land management objective(s) for which it was conducted.

Land management planning encompasses a broad range of topics. Both long and short term consequences must be considered. Furthermore, land management plans must consider the interaction between onsite and off site activities. Fire is a primary force and management plans should address both wild and prescribed fire. While it is beyond the scope of this chapter, prescribed burners should be familiar with overall management plans and how prescribed fires have been incorporated into these plans. In many cases the same topics are addressed in these other planning processes. On an annual basis, planning should commence well before the upcoming season. For area managers with multiple burn units the first task is to identify which units to burn. Criteria, such as fuel loads, burn history, known problem areas, desired fire return interval and other factors, should be used to develop a list. The list includes all areas that ***should*** be burned. Don't worry about actual capabilities at this point since this list is a simple inventory. Divide large areas into one-day burning blocks and prioritize. Prepare prescriptions for all of the units that you expect to burn in the current cycle. If your initial list far exceeds your capability, prioritize and prepare plans for those units you expect to burn but add an additional 15 to 20 percent. This will allow more flexibility if burning conditions are more favorable than expected,

if wildfires burn some of the units or if priorities change. Prescriptions prepared ahead of time also make it easier to adapt plans and priorities to unexpected weather patterns.

PRESCRIPTIONS FOR INDIVIDUAL BURN UNITS

A burn prescription is a written document that details the purpose and objectives, weather parameters, environmental conditions, precautionary measures, ignition plan, personnel, equipment, and other factors that will allow a fire to be set and burn a predetermined area. A Florida Certified Burn Manager should prepare or review these prescriptions. Each prescription must meet the requirements outlined in FS 590.125 and FAC Ch 5I-2.

A PRESCRIPTION IS:

A written statement defining the range of conditions of temperature, humidity, wind direction and speed, fuel moisture, atmospheric stability, soil moisture and geographical area under which a fire will be <u>ignited</u> and/or <u>allowed to burn</u> in order to obtain given objectives.

A written prescription should be prepared for every burn. Certified burn managers ***must*** prepare a written prescription for each burn and have a copy of the prescription onsite during the burn. The written prescription and evaluation provides a record of the burn. Area managers and landowners should maintain a log book that includes prescriptions and evaluations for all burns conducted on the area. Notes taken during the burn and any post burn evaluations must be included in the log book. Make sure any changes are recorded on the plan so that when the burn is completed you have an accurate description of what transpired. Weather records, observation forms, and major activities should also be included.

Some plans will be simple; others will be complex. There is no single required format for a prescription. Likewise, existing plans and formats are updated and modified when local conditions or specific requirements change. Even 'simple' plans contain a wealth of information and detail. In Florida all prescriptions should include specific information and details about the proposed burn. These details have been divided into fourteen components. Examples and discussion of plans can be found in "Smoke Management Guide For Prescribed and Wildland Fire 2001 Edition" (Appendix C; Hardy et al, 2001) and "A Guide for Prescribed Fire in Southern Forests" (Appendix D; Wade and Lunsford 1989). Most state and federal agencies and large industrial land owners that use fire have burn plan forms they are glad to share. If the objective(s) of a specific burn can be met under a variety of conditions, the plan should be flexible enough to accommodate these conditions.

Major components of Florida prescriptions:

1) ***Purpose and Objectives***
2) ***Description of Burn Unit***
3) ***Map Of burn Unit***
4) ***Weather Factors***
5) ***Safety***
6) ***Fuel Conditions***
7) ***Season and Time of Day***
8) ***Smoke Screening***
9) ***Publicity***

10) Legal Requirements
11) Firing Plan
12) Equipment and Personnel
13) Contingencies, Control and MopUp, Declaring Fire Out
14) Evaluation/Monitoring

DISCUSSION

Items which should receive special attention or suggested parameters are discussed for each category. **NOTE** Not all required information for each prescription parameter is addressed in this chapter. Refer to the appropriate chapters for more detailed information on individual parameters. For example, Smoke management is covered in Chapter VI and safety is discussed in Chapter V.

Purpose and Objectives
A successful prescribed burn depends upon the skilled application of fire following a comprehensive prescription developed for a defined area to accomplish specific objectives.

The first step in the planning process should identify the purpose of the proposed burn. In Chapter II the reasons for conducting prescribed burns in Florida were discussed. The landowner is ultimately responsible for establishing the purpose of each prescribed burn. While identification of a primary purpose is important, it is often advantageous to identify additional reasons for burning. A private landowner may be most interested in enhancing forage production for livestock or managing a forest to produce wood products while public land managers are often concerned with ecological functions and values. Many burns in Florida should be designed to meet more than one purpose. Most prescribed burns in Florida provide some ecological benefits, some hazard fuel reduction, and some wildlife benefits. When appropriate these additional benefits should be recognized and stated as additional reasons for burning.

Once the purposes have been established specific objectives should be developed. Objectives are benchmarks which serve as indicators of the results of each prescribed burn. Objectives should be ***measurable***. For example an objective to reduce hazard fuel should include the desired percent reduction and or an estimate of fuel loading before and after the burn. If a mosaic of burned and unburned areas is desired then an acceptable range should be listed. For example a burn which covers 50-70% may be desirable for one burn unit while it may be desirable to burn at least 90% of the unit when an extreme fire hazard exists. Finally, the actual fire results must be evaluated in order to measure and improve performance.

Successful prescribed burning requires clearly defined objectives, carefully prepared plans to meet these objectives, and proper application of fire. Objectives should not be weakly or loosely stated but should imply how the success of the burn will be measured. Some examples of poorly stated burn objectives are:

1. To see what fire will do in a mixed conifer stand. (It just might go over the hill.)

2. To try fire as a tool in managing timber stands.

3. To remove fuel loading.

Better statements of objectives are:

1. Increase runner oak fruiting for quail and turkey habitat improvement.

2. Increase native grasses for forage.

3. Reduce logging debris by 80%-90%. (Measurable)

4. To kill 90% or more of all hardwoods less than l0 feet tall.

5. Keep crown scorch to less than 50% of the overstory pines.

6. Reduce the palmetto/gallberry understory by 70%. (Measurable)

When the purpose(s) and objectives have been clearly defined everyone will have a better understanding of the value and role of prescribed fire. The person writing the plan will have a clear picture of how the prescribed burn should be executed and evaluated and will be able to communicate these ideas to others. Burn team members, cooperators, and support personnel will have the opportunity to perform their duties in a manner consistent with these clearly defined expectations. The general public will also have the opportunity to get precise and accurate information from anyone associated with the burn.

Description of Burn Unit

Before any operational plan is developed the burn unit must be described. There are seven basic categories that are commonly used to describe burn units.

1. **Location and size**
2. **Burn History**
3. **Soils**
4. **Plant Communities (Overstory & Understory)**
5. **Topography**
6. **Special Features**
7. **Fuels**

LOCATION AND SIZE

The location of the unit should be described in general terms by stating the approximate distance and direction to the nearest major landmark (e. g. Approx, 3 miles SE of Palmdale). Also if the burn unit is part of a larger parcel the name of the larger area should be included. The legal description including Section(s), Township and Range is required. It is also a good idea to

record the Latitude and Longitude of the burn unit. By recording all of these descriptions in the plan the chance of confusion or mistakes is minimized. Furthermore, if assistance is required during the burn different responders may require a specific description. Aircraft equipped with GPS may respond quickly with Latitude and Longitude coordinates while ground units may respond better to a general location description with the Section, Township and Range included. The size of the burn unit should also be included as well as the size of any significant features within the unit which are not part of the burn. Thus if the legal description was all of Section 16, T45S, R36E the unit size would be 640 acres. If this section also includes a 340 acre lake with open water then the area to be burned would be approximately 300 acres.

BURN HISTORY

If the area has been under prescribed fire management the unit records should detail the burn history of the unit and this information should be included. If this information is non-existent the area should be examined closely to determine as much as possible regarding the burn history. Persons with local knowledge may also be interviewed regarding wildfire history. Be sure to describe the reliability of any estimates or information.

SOILS

Describe soils in general terms with emphasis on listing any organic soils or significant duff buildup. County 'Soil Surveys' are an excellent reference source and they should be available through the local county extension office. Sandy well drained soils will influence fuels differently than marl soils located close to the water table. The actual depth to the water table is of vital importance especially in Florida. Most plant communities in Florida are determined by the depth to the water and fire frequency. When dealing with prescribed fire it is also important to know if the water table is above or below normal for the current conditions. Drought, drainage, local conditions, and a variety of other factors can lower water tables and cause dramatic changes in fire behavior and severity. In some cases, small changes amounting to 'just a few inches' may be critical. All of the above items describing the burn unit determine which fuels will burn and how they burn.

PLANT COMMUNITIES

Divide plant community discussions into two parts. The overstory includes the trees and other vegetation which comprise the canopy layer. Include the age, species composition, %cover, basal area, density and other important fuel characteristics. If vines, air plants or other ladder fuels are present be sure to include these items. The height to the bottom of the crown is also important since that will determine the fire's impact to the crown. For most prescribed fires, the understory contains the target fuels. Species composition, density, diversity, height, and general condition will affect fire behavior.

FUELS

The fuels which normally carry a prescribed fire are not the living parts of the plants. The carrier fuels are already dead plant tissue which may be still attached to the live plant or it may be on the ground surface or tangled in with living tissue elevated above the surface. Pine needles, leaves, palmetto fronds, grasses and small branches are typical 'carrier' fuels in Florida. First, list those fuels that are likely to carry the fire. Fuel types, loading, continuity, arrangement and exposure should be recorded. Second, look at non target fuels which may also burn. This should include non-target surface fuels, duff, and ladder fuels which may cause problems if they burn. While it is sometimes done deliberately burning the duff layer or a portion of the duff layer is a complex operation even for experienced burners.

TOPOGRAPHY

In addition to fuels the burn unit also includes a second major component of the fire environment, ***Topography.*** In Chapter VIII topography in Florida fire was discussed. Because much of Florida is relatively flat, topography affects fire behavior in more subtle ways. Where slope is significant it has the same impact it does in other regions. Maximum local relief (slope) is greatest in the Florida panhandle and the central Florida ridge. The area around Sugarloaf 'Mountain' (elevation 302 feet) in the central Florida highlands contains numerous areas where slope is significant. In addition other natural (sandhills and river bluffs) or man-made (levees and canal banks) features throughout Florida may have significant slope. Finally, minor changes in elevation can have dramatic impacts on vegetation, fire behavior, and smoke. Drainages although not apparent may funnel smoke to a major highway or organic soil on one end of a burn unit may be dry enough to burn while the other end of the unit is under water.

SPECIAL FEATURES

Special features include a variety of man-made and natural resources. Buildings, towers, fences, power lines, communications equipment, trails, roads and other man-made features may require protection. Archaeological sites and endangered species may dictate special precautions. Other human activities both on the burn unit and adjacent areas should be assessed and described.

Map of Burn Unit

The burn unit map should serve as a guide for burn team members and other interested parties. The unit boundaries should be well defined along with adjacent or nearby property owners. Access to the unit should also be shown on this map or if required on a second area map. Include access for reinforcements such as the Division of Forestry if they are called. A Division of Forestry transport loaded with a tractor plow has more restricted access than other equipment used on prescribed burns. Also consider access for other emergency equipment including medical rescue and local fire departments. In emergencies it may be necessary to meet certain equipment at designated points. This may include designating landing spots for helicopters as well as locations for meeting medical rescue units. Identify key locations outside the burn unit where and additional fire lines are located as well as natural firebreaks, trails, and other features which may affect the fire. Improved structures or natural features which should be protected should also be identified. Special hazards, areas of fuel buildup, dead end roads and other problem areas should be highlighted. The map should include a verified scale, directional arrow for proper orientation and the date prepared.

Weather Factors

Weather is a major component of the *fire environment.* Three major components (fuel, weather, and topography) determine how each fire will burn. Weather during the burn is a primary concern but pre-burn weather and environmental conditions also affect fire behavior. Post-burn weather can affect mop-up and has a major impact on floral and faunal responses. Using available weather forecasts and measuring on site weather conditions are essential components of all successful prescribed burns. The Division of Forestry web site and NOAA weather offices located throughout Florida are excellent resources for fire weather information including spot forecasts for exact locations. An example of a fire weather forecast is included in Chapter VII. Wind and relative humidity are the two most important weather factors which directly impact how the fuels burn. Wind direction determines how and in which direction the fire will spread

and wind speed will determine how quickly a fire will move. Relative humidity will directly impact fuel moisture and fuel moisture determines how rapidly or if a given fuel will burn. Other weather factors are discussed in the sections fuel conditions, smoke management, and season of burn. Desired forecast wind speeds should generally fall in the range of 5-15 MPH and relative humidity should be between 40-65%. Specific objectives, site conditions, anticipated fire behavior and ignition patterns may dictate more restrictive conditions.

Safety

Both public and crew safety should be addressed in this prescription. Crew training, general safety standards and other policies are discussed in a later section. All personnel should have and use standard Personal Protective Equipment (PPE), be in proper physical condition for their assigned duties and be advised of special hazards on each burn. Heat exhaustion and dehydration are frequent problems on Florida prescribed burns especially when higher ambient temperatures are encountered.

A crew briefing and preburn checklist should be used immediately prior to the burn. This briefing provides everyone the opportunity to review and understand the entire burn plan including contingencies such as escape routes, safety zones, emergency contacts and crew assignments during extended operations.

Public safety is a growing concern in Florida. Smoke management issues dominate public safety issues associated with prescribed burns. While heath issues associated with breathing smoke filled air are always a concern it has been reduced visibility and impacts to transportation that have caused most problems. Smoke management and smoke screening can limit these impacts to acceptable levels but prescribed burners need to develop contingencies for regulating traffic if smoke reduces visibility on roads to unacceptable levels. Warning signs and contact with the Florida Highway Patrol and local police before problems arise are proactive steps which should taken on every prescribed fire.

Fuel Conditions

The fuels which will carry the fire and those fuels that are consumed during a burn determine how a fire burns and the difficulty of control. Fuel characteristics including arrangement, the volume or loading, the size of each fuel particle, continuity, density and chemical characteristics can play major roles in fire behavior. For fine fuels such as grasses and pine needles fuel moisture is critical. Exposure to sun and wind can quickly change fine fuel moistures while fuels in contact with wet surfaces or standing water may retain high fuel moistures. Desired fine fuel moistures will depend upon burn objectives, ignition techniques, fuel loads and site specific circumstances. In general dead fine fuel moistures between 8 and 20 percent are desirable.

Peat soils and duff layers should be excluded as available fuels. Prescription criteria that address the KBDI (Keech-Byram Drought Index), days since significant rain, and the depth to the water table can all serve as indicators of duff and peat conditions. A KBDI index above 500 indicates that peat or duff layers may be at risk. Little or no rain for the prior 10 days results in an extremely hot fire with complete fuel consumption. KBDI estimates are available on the DOF website (Appendix J). Water tables at or near ground level generally indicate that duff or peat has sufficient moisture to prevent ignition. All of these parameters can serve as indicators but local experience will ultimately reveal their accuracy.

Season and Time of Day

From an ecological perspective most lightning fires occurred in May and June at the beginning of the thunderstorm/rainy season. Plant communities are still relatively dry and fires have a greater chance to burn significant acreage. Lightning strikes are frequent during the rest of the rainy season but generally wetter conditions reduce the likelihood of ignition and hinder the spread of any fires that are started. Lightning strikes during the dry season are less frequent so there are fewer fires at this time. During dryer years these less frequent strikes were likely to start fires early in the dry season and these fires might burn until the arrival of the rainy season. Historical prescribed burns were conducted mostly in the winter. The approach and passage of cold fronts produce predictable weather patterns that are conducive to prescribed burning. Successful burn programs often rely on a combination of burning strategies to accomplish multiple objectives. Burn units which have not burned on a consistent rotation should first be burned under safe conservative conditions at the beginning of the dry season (December-January). Once a consistent rotation has been established some burns should be conducted during the early growing season. When woody vegetation is a valuable resource prescribed fire should not be conducted during periods of high potential mortality (Fall for Pine Trees and Spring for Hardwoods). Early growing season burns coincide with the peak wildfire season and in some years little or no prescribed burning is possible at this time. For this reason prescribed burners should set annual plans which actually begin in April or May. Thus in years when growing season burns are restricted the burn manager can make a decision to shift the season of burn to winter or delay the burn for at least one year.

Smoke Screening

Florida's population is rapidly approaching 1 person for every 2 acres of land. Smoke from any wildland fire has the potential to impact thousands of people. **Smoke management is a plan of action to conduct prescribed fires in such a way that the smoke produced is dispersed without causing a health or safety hazard.**

The objectives of smoke management are to:

1) Reduce the emissions produced,
2) Identify and avoid smoke-sensitive areas (SSA's) such as airports, hospitals, schools and public roads, and
3) Burn only when atmospheric conditions assure good smoke transport and dispersion

The combustion processes is comprised of four phases, each producing different types and amounts of combustion products. Understanding these phases is a prerequisite to estimating the total amount of smoke. The total area and amount of time a fire remains in the smoldering phase will significantly impact total smoke production. Smaller, lighter fuels (e.g., grasses) will smolder for a relatively short time compared to larger fuels (e.g. logs, limbs stumps and organic soils like muck).

The smoke associated with fast-moving intense fires is black because of incomplete combustion. Head fires produce the most particulate and backing fires the least. Head fires result in more smoldering for a longer time than backing fires. In a typical heading fire, about half the fuel is consumed during the smoldering phase. In backing fires, most fuel consumption takes place in the flaming zones so little smoldering occurs behind the flaming front.

Combustion Products

Water vapor and carbon dioxide (CO2) comprise about 90% of the combustion products of wildland fuels but are not considered pollutants. Water vapor can, however, drastically reduce visibility.

Pollutants The most important pollutants of forest fires are particulate matter and carbon monoxide (CO). Current smoke management systems are all based on particulate matter. Particulate matter is defined as any solid or liquid particle suspended in the atmosphere. Most are too small to be seen with the naked eye and can stay suspended in the atmosphere for months. Particulate matter is largely responsible for reduced visibility in smoke, most being in the size class range that causes the maximum reduction of light. CO is rapidly diluted but it is very toxic and can cause headaches and disorientation with continued exposure near the combustion zone.

Smoke Management Guidelines

1) Follow a smoke screening process for each burn.
2) Choose wind directions which direct smoke away from sensitive areas.
3) Choose dispersion index values which will allow for safe and proper smoke dispersion.
4) Choose ignition methods which minimize smoke production
5) Communicate and provide advance information to everyone who may be impacted or concerned about smoke.
6) Be prepared to respond promptly and effectively to any problems.
7) Conduct more extensive mop up when smoke sensitive areas may be impacted.
8) Use ignition techniques and weather parameters that favor the flaming phase and minimize the smoldering.
9) Specific burns may require more stringent guidelines but the following minimum values should be met:

Mixing Height	1700 ft
Transport Wind	9 MPH
Daytime Dispersion	35
Night Dispersion	3

10) Reduce the number of acres to be burned by splitting units into smaller blocks.
11) Isolate problem fuels within the burn unit or develop alternate treatment of these fuels.
12) Rotate crew members to minimize exposure to heavy smoke/carbon monoxide.
13) Incorporate experience and lessons learned from other burns both onsite and within the vicinity of the proposed burn.

Publicity

Each plan should include a Public Relations element which identifies the individuals and agencies which should be notified just prior to the burn. A wide variety of methods may be included in this process and include: Distribution of pamphlets or flyers, large posters or notices at strategic locations, public meetings, civic organizations, internet notifications and postings, and media outlets. The public should be notified well in advance and again within a few days of proposed burns. In addition a list should be developed for required contacts on the day of the burn. This list along with telephone numbers should be included in the plan for each individual unit.

Perhaps more than any other environmental program, prescribed fire requires public support. Publicity and education regarding prescribed fire will inform people before they see smoke that this particular fire will be beneficial. Their actions and cooperation both during and after the fire can help minimize any problems or adverse impacts which may arise. Public support and demand for prescribed fire will only be achieved when an effective program has been developed and when the public is informed. Individual crew members should be encouraged to maintain a professional demeanor whenever they are involved in any facet of prescribed fire and to provide positive proactive responses to public inquiries.

Legal Requirements

Legal requirements associated with prescribed burns include laws, rules, and policies administered by the Florida Division of Forestry, Environmental Laws and Endangered Species Laws and Rules. An authorization from the Division of Forestry is required for each burn. All burns that qualify should be conducted under the Certified Prescribed Burn Act and meet all statutory requirements. This act requires that a certified burn manager review and sign the prescription, that a certified burn manager be present during the burn and that established criteria are followed for the entire process (refer to Chapter III and current laws and rules). In addition to other requirements a written prescription must be on site and available for inspection during the burn. In some cases the authorization may be secured after 4:00 PM the day before the burn but in most cases it is obtained after 8:00 AM the day of the burn. It is the responsibility of the Burn Manager to:

1) Notify DOF at the time the authorization is secured that the burn is being conducted under the provisions of the Certified Prescribed Burn Act.
2) Inspect the burn unit prior to ignition to ensure that endangered species will not be adversely impacted by the burn and to ensure that improved property and structures will be protected.
3) Provide a reliable communication link with DOF during the burn.
4) Notify DOF if any problems arise on the burn. If the fire escapes from the designated burn unit ***notification*** and a request for help ***must*** be requested ***immediately***.
5) Be prepared to extinguish the prescribed burn within two hours after notification by the DOF.
6) Be prepared to enact contingency plans for other problems which may arise.

Firing Plan

Selection of the proper firing technique or combination of techniques and ignition pattern should be based on the burning objective(s), fuels, weather, smoke management guidelines, and manpower and equipment available. A complete ignition plan should include both a narrative and a map depicting the ignition sequence. All ignition plans are based on the location and type of control lines. Fire lines which are constructed to bare mineral soil are preferred because these are the most reliable type of line. All fire lines should be completed prior to the scheduled burn date but they should also be inspected immediately prior to the burn.

Every prescribed burn should be preceded by a test fire within representative fuels in the burn unit. The test fire should be located near the downwind side of the burn unit near the anchor point. The test fire is a final check to verify that fire behavior will be within acceptable limits

and that the objectives of the burn can be accomplished. After the test fire has been evaluated a decision is made to either extinguish the fire or to proceed. For cancelled burns the test fire site should be closely monitored for an extended time period to insure the fire is out. After the test fire is complete a blackline should be established on the downwind side of the unit. An anchor point should be established which secures the test fire area and from which the blackline can be established. The baseline is always established on the downwind side of the area to be burned and should be wide enough to stop a headfire. This is normally done in conjunction with burning the whole area but it can be done several weeks prior to the actual burn.

Once the blackline is established the actual ignition of the unit begins. The ignition pattern may be a single technique or a combination of four techniques. These four techniques can be grouped into two broad categories: linefires which are specifically set to back, head, or flank; and spot fires which combine all 3 components at the same time. The need for a secure perimeter line around the area to be burned is common to all firing techniques, as is a secure baseline.

Personnel and Equipment

The complexity, site conditions and size of each burn will determine personnel and equipment requirements. Many agencies have established standards and or guidelines for crew and equipment on prescribed fires. It is the responsibility of the burn manager to make sure that these standards and guidelines are met but, ultimately, the burn manager must also determine that crew members have the combined knowledge, skills, and experience to conduct the prescribed burn. It is also his responsibility to make sure that the available equipment and PPE meets the required standards.

Actual personnel and equipment needs will be determined for each burn. When setting standards it is important to include proper equipment to suppress any escaped fire which is outside the unit. In addition equipment and personnel should have the capability to put out the prescribed fire in a timely fashion if it is causing an unacceptable problem. Site preparation should be accomplished prior to the burn. A standard farm tractor, assorted discs, and a bush hog can do complete site preparation for many burns. Likewise many burns are conducted with 4-10 crew members, a tractor-plow, transportation, a nearby water source, a water buffalo (500 gallon minimum), one type VI Engine (or comparable equipment), assorted hand tools, and PPE for each crew member. Communications equipment should include portable radios and at least one cell phone. When conditions warrant (e.g. heavy rough in surrounding units) a tractor plow should be either on site or nearby. *Urban Interface, other complications, or larger burns will require additional equipment and personnel.*

Contingencies, Control and MopUp, Declaring the Fire Out

Each prescribed fire plan must address specific details concerning contingencies, mop up and declaring the fire out.

Contingency plans should be developed for each proposed burn. They must address procedures and actions for escaped fire. Contingency plans should also address medical emergencies, equipment breakdowns, smoke management problems, and failure to meet prescription criteria. Good contingency planning is based on common sense and good communications. It will increase the likelihood that all personnel will remain calm during the crisis and that correct decisions will be made on a timely basis. Contingency plans and action decisions should provide

for both public and crew safety. Contingency plans should include resources to manage the original prescribed fire as well as the escaped fire or other emergency action. If the fire has escaped the burn manager should be prepared to turn the fire over to the Division of Forestry or their designee upon arrival. The prescribed burn crew should remain on site and perform duties consistent with their training and skill levels. Contingency plans should also contain provisions for extended operations and provide for personnel replacements and shift work for extended operations.

Mop up standards and protocol should be clearly established in the burn plan. Special precautions should be taken on fires which are near smoke sensitive areas or which are near private property. When conducting burns near public roads smoke signs should be onsite or readily available. Snags, unburned fuels, residual smoke, burning peat or duff, or other problems may dictate more extensive mop up. Written guidelines and standards let everyone know what must be done before it is safe to release the crew.

Declaring the fire out is the final step in declaring the burn unit safe. Normally a fire is not declared out until the burn manager is certain that all combustion including smoldering and glowing phases has ceased. This determination is usually made several days after the burn has been completed but in some cases it may be several weeks.

Evaluation

Monitoring and evaluation of the burn are essential tasks for all prescribed burns. For each burn unit the evaluation process is a continual process. When the unit is burned again the process continues through a renewed cycle. Protocols for monitoring fire effects on soil, water, air, vegetation, and wildlife should be included in the burn unit plan. Monitoring should be conducted before, during and after the burn. Fuel loads, wildlife observations, wildlife surveys, vegetation surveys, soil and duff conditions must be recorded before the burn (pre treatment condition, during the burn to determine direct impacts, and after the burn to determine responses to the prescribed fire).

During the burn onsite weather observations should be recorded at specified intervals. Observations of fire behavior should be recorded throughout the entire burn cycle. While it is important to record abnormal or unexpected fire behavior it is also important to record fire behavior and responses that are consistent with predictions and expectations. Rate of spread, residence time, flame length, intensity, and other fire behavior observations should be recorded. While a single individual is often tasked with recording weather and other observations it is a good idea to encourage everyone to carry a small notepad and pencil for recording significant observations as soon as their duties allow. The time of the observation should also be recorded.

A comprehensive evaluation of every burn should be mandatory. This process should ***begin*** with the crew debriefing held as soon as possible after the fire. Review the burn plan to make sure it is an accurate rendition of what occurred. The primary recorder should incorporate team member observations and other pertinent information at this time. Describe the fire behavior produced by the combination of fuels, weather, topography, firing technique(s), and ignition pattern used, and the resulting fire effects so this knowledge can be utilized in planning the next burn. Were weather conditions, fuel conditions and fire behavior within the planned limits? Were the objectives met? Were there any accidents or near accidents? Was the fire confined to its intended area? Were there any escapes? Were the burning technique and ignition pattern correct? What would you do differently next time? Were costs compatible with benefits derived? Describe the effects on air, vegetation, soil, water, and aesthetics. Did the smoke

behave as predicted? Were there any residual smoke concerns? Were they caused by smoldering combustion? The crew debriefing should conclude with a short summary discussion on 'What went Right?', 'What went Wrong?', and 'What would be done Differently?'.

Conduct the first monitoring/field evaluation within 2 weeks after completion of the burn so any crown scorch can be recorded before the needles fall. Southern pines can withstand complete crown scorch during all seasons except the early fall (September and October) **providing** the buds are not killed. Severe crown scorch does, however, stress trees making them more susceptible to post-fire problems such as drought or insect attack. Conduct a second evaluation after the 1st growing season to get a better assessment of the vegetative response. If any older un-scorched pine died while adjacent younger ones survived, it is a sure sign of root damage resulting from dry conditions. Effects on soil, water and wildlife generally take at least several months to show up. Consider taking "before" and "after" photos as part of your documentation.

Evaluation should be a never-ending process; it should not stop with the second evaluation. Not only is evaluation a prerequisite to assessing how close a burn comes to meeting its objectives, but it should also serve as a quantitative statement of the effects of the burn. For example, fire evaluations can provide information useful in answering questions that might arise in the future regarding the impact of the fire program on understory composition and stature, herbaceous species, or changes in overstory growth and yield.

A comprehensive evaluation will look at and address ecological results, operational issues, and problems or close calls. Was the burn completed economically and were problems dealt with in a timely manner. Are the benefits consistent with economic cost? The completed burn plan, field notes and written evaluation should be retained as part of the permanent records for the burn unit.

Post Burn Evaluation Sample Format

PRESCRIBED BURN EVALUATION

1. **ACCOMPLISHMENT**. State in precise terms the actual accomplishment of the fire. For example, 3 inches of duff removed; 20 percent of area bare to mineral soil. Relate this to the desired accomplishment in the fire prescription. Timing of fire effects evaluation is important. Some effects are apparent immediately after the fire and should be evaluated within a week. Other effects might not be apparent until the start of the subsequent growing season. In such situations, the report should be revised to include the longer-term effects after they have been evaluated.

2. **FIRE BEHAVIOR**. State actual fire behavior that occurred. Relate this to desired fire behavior in the fire prescription. Quantify using flame length estimates.

3. **ENVIRONMENTAL CONDITIONS**. State the actual fuel moisture, weather conditions, and other designated environmental factors that preceded the fire and that occurred during the fire. Relate to those specified in the fire prescription.

4. **COST**. State actual costs incurred. Explain any differences from estimated costs.

5. **OBSERVATIONS AND RECOMMENDATIONS**. Summarize significant aspects of the fire in relation to expectations. Relate what actually happens. Indicate knowledge gained that should be considered when planning subsequent prescribed fires. For example (Norum, 1975):

> *Experience gained during this fire indicates a need to modify the ignition procedure for future hazard reduction burns in this fuel type. Because of the concentrated and discontinuous nature of the fuels, fires ignited across the lower edge of a plot often burned vigorously until a fuel discontinuity was reached, whereupon the fire went out. The result was a very ragged burn with hazardous fuel left in the center of the unit. Control and containment difficulties were experienced when ground fuels were sufficiently dry to carry fire between concentrations. Crown fires began to increase in frequency, and spotting outside of the prescribed area required alert patrol and vigorous suppression. Based on the results of this experience, I suggest ignition of strips of fuel, beginning at the perimeter and progressing to the bottom of the plot. Permit each strip of ignited fuel to burn until the level of maximum intensity passes, then ignite the adjacent strip. This procedure should assure ignition of all fuels and minimize control problems.*

PRESCRIBED BURN EVALUATION

No prescribed burn action is complete until an evaluation of the fire is conducted and the results documented in writing. The evaluation should consider how closely the actual fire conformed to that which was planned, any unusual characteristics on the fire, unanticipated difficulties encourage during the action and how well the fire accomplished the desired results.

Evaluation of the burn considers:

- Were pre-burn preparations made?
- Were objectives met?
- Adherence to burning plan?
- Were conditions of weather, fuel conditions, and fire behavior within planned limits?
- Environmental effects on soil, air, vegetation, water, and wildlife?
- Any accidents or near accidents?
- Was fire confined to area? Any escape?
- Was burning techniques correct?
- Were costs comparable with benefits derived?

You, as a member of the prescribed burning crew, may be involved in field measurements as part of the prescribed burn evaluation job. As a member of the burn crew you will play a part in how well the burn operation succeeded and how well the management objectives were met.

All participants in a burning project should be alert to what is happening. Observations should be recorded in a field notebook for future reference. Management people should inquire about events noticed by people on the project.

CONSTRAINTS

Constraints include a variety of factors or issues that place limits on how a prescribed burn may be executed. The successful prescribed burner identifies these constraints during the initial planning stage and develops strategies that overcome these constraints whenever practical. In some cases these constraints will dictate that alternative management strategies should be implemented. The wise and successful prescribed burner recognizes these situations and act accordingly.

1) Environmental

Prescribed fires cause significant changes to the environment. The combustion process converts a large volume of complex organic compounds into a variety of basic molecules and particulate matter. The major products are water and carbon dioxide both of which are abundant in the natural environment. Major pollutants include carbon monoxide and particulates.

Excessive soil erosion, unintended mortality to wildlife, trees, or plants, smoke management problems, and proliferation of exotics are all examples of potential adverse environmental impacts.

2) Multiple Use

As Florida's population continues to increase the demands placed on every acre of land also increase. Only in rare circumstances is land managed for a single purpose. This is especially true for the private landowner but it is also true for government agencies and others who manage land for the benefit of the public. Recreational activities, water supply considerations, major events, transportation requirements, and other conflicts may hinder prescribed burn plans.

3) Economic

The cost of using prescribed fire as a management tool continues to escalate. The constraints listed herein add to this cost. Smaller burn units, larger crew sizes, additional training, more equipment, cancelled burns, and other requirements all contribute to higher costs.

4) Operational

Operational constraints include a wide variety of actions and circumstances that directly impact the local management team. Access to a particular burn unit may be a problem. Some burn units are isolated and difficult to reach. Sometimes they can only be accessed with special equipment. When special equipment is required the burn team may not have priority use further delaying action. Burn team members often have other duties which limit their availability. Meetings, time critical assignments, personal time off, and higher priority jobs often interfere with burn plans. When burn teams are already at marginal levels the loss of one or two members is serious. When specific training and local experience are required there may be no substitutes.

5) Administrative

Administrative constraints place further restrictions on prescribed burning. Administrative issues may hinder or prohibit the use of equipment or personnel from

an adjacent area. Administrative issues may make it difficult to work extended hours on a certain day (e.g. the last day of the pay period). Administrative issues often encourage mid-week burns. Under extreme circumstances administrative constraints can cripple a burn program.

6) Legal

Florida recognizes the importance and benefits of prescribed fire. In fact this important management tool is protected as a landowner right. However, fire is also dangerous. Legal constraints already restrict the use of prescribed fire in ways unimagined even a few years ago. Public health and safety require that these constraints remain in place.

7) Social

Public acceptance is essential to the continued use of prescribed fire. Prescribed burners must consider public responses regarding aesthetics, compatible land uses and timing associated with special events. Nearby schools, major sporting events, holiday travelers, and historical events shape public perception and acceptance of prescribed fire. Even a properly executed burn at the wrong place or time can cause adverse consequences for all prescribed burners. Mistakes, that would be minor under other circumstances, can be catastrophic when social constraints are ignored or forgotten.

SUMMARY

History has repeatedly shown that those who fail to learn from the mistakes of the past are destined to repeat those mistakes. A formal Planning and Evaluation process is essential for the continuation of prescribed burning in Florida. The planning process can help prevent needless repetition of mistakes and it can be instrumental in making sure those successful strategies and techniques are passed on and repeated. The best Planning and Evaluation program only has value when the 'lessons learned' are communicated to those who 'need to know.'

"Good judgment comes from experience, and a lot of that comes from bad judgment." (Will Rogers)

"You can no more get to where you don't know where you're going than you got to where you think you are from where you don't know where you've been." (John Bethea)

Planning the Prescribed Burn
Lesson Notes

Learning Objectives: *Enable trainee to assemble all necessary components into a complete burning prescription, develop defendable objectives, and relate to various constraints associated with prescribed burning.*

Introduction: *Prescription burning is a highly technical job requiring knowledge of fire behavior, suppression techniques, and the environmental effects of fire.*

The written prescription: *is a statement defining the range of conditions of temperature, humidity, wind direction and speed, fuel moisture, soil moisture and geographical area under which a fire will be allowed to burn, or be ignited to obtain given objectives.*

Elements of a prescription are:

Purpose and objectives
2. Description of burning unit
Map of burning unit
4. Weather factors
Fuel conditions
6. Season and time of day
7. Smoke screening plan
Publicity
9. Legal requirements
Firing plan
11. Control and mop-up
Evaluation
Personnel Equipment
Safety

Purpose and Objectives

- *Reasons*
- *Expectations*
- *Fire Behavior*

Description of the Burning Unit

- *Location and # of Acres*
- *Record of previous burning*
- *Complete description, including*
  - *Overstory: type, density and size*
  - *Understory: type, density and size*
  - *Fuels: type, density and size*
  - *Soils type and topography*

Map of the burning unit.

1. *Unit boundaries*
2. *Land ownerships*
3. *Topography*
4. *Fire lines to be established*
5. *Firing, holding details*
6. *Protect structures and reproduction*
7. *One day burning blocks*

Weather Factors

1. *Wind*
2. *Relative Humidity*
3. *Fine Fuel Moisture*
4. *Temperature*
5. *Stability*
6. *Mixing height*
7. *Transport wind speed*
8. *Dispersion index*
9. *Fire danger indices*

- ***Mixing Height*** *of less than 500 meters or 1640 feet is often associated with air pollution episodes.*

- ***Transport wind*** *speeds of less than 4 meters per second (9 mph) are indicators of stagnant conditions which are often result in air pollution episodes.*

- ***Fuel Conditions*** *- combined with weather conditions and topography will determine fire behavior.*

Season and time of day *- determines vegetative response and fire behavior.*

Smoke Screening Plan *- see smoke screening*

Publicity *- see public relations*

Legal requirements

- ***590.026 F.S.*** - *Prescribed Fire Act*
- ***590.12 F.S.*** - *Basic for all burners*
- ***5I-2 F.A.C.*** - *Open burning rules*
- ***Local rules*** - *County or municipality*
- ***Federal Rules***

Firing Plan *- Narrative and map*

1. *Planned time of day*
2. *Firing method, sequence, alternatives*
3. *Lines to establish and fire*
4. *Personnel and equipment*
5. *Location and number of reinforcements*
6. *Instructions and assignments*

Control and Mop-up

1. *Measures for confinement*
2. *Mop-up prompt and complete*
3. *Escape plan is vital*
4. *Plan for smoke problems*
5. *Plan for sudden weather changes*

- ***A successful prescribed burn depends upon skilled application of fire from a carefully developed prescription for a definite area to accomplish specific objectives.***

- ***Objectives should be measurable in order to evaluate the effects of the treatment and to improve future treatments.***

Poor Objectives:

1. *To see what fire will do in a mixed conifer stand*
2. *To try fire as a tool in managing timber stands*
3. *To reduce fuel loading*

Better Objectives:

1. *Increase runner oak fruiting for quail and turkey habitat improvement by 70 percent.*
2. *Increase native grasses for forage by 20 percent.*
3. *Reduce logging debris by 90%.*
4. *To kill 90% or more of all hardwoods less than 10 feet tall.*
5. *Reduce the palmetto/gallberry understory by 70%.*

Objectives are also used for:

1. *Making clear to everyone what is expected on a particular burn*
   Burners
   b. Cooperators
   a. Overhead
2. *The individual writing the prescription*
   1. Evaluating the project

Constraints:

1. *Environmental*
2. *Multiple-Use*
3. *Economic*
4. *Operational*
5. *Administrative*
6. *Legal*

Evaluation:

1. *Were pre-burn preparations made?*
2. *Were objectives met?*
3. *Adherence to burning plan*
4. *Were conditions of weather, fuel, and fire behavior within planned limits?*
5. *Environmental effects on soil, water, air, vegetation and wildlife.*
6. *Any accidents or near accidents?*
7. *Fire confined to prescribed area?*
8. *Was burning technique correct?*
9. *Were costs comparable to benefits?*