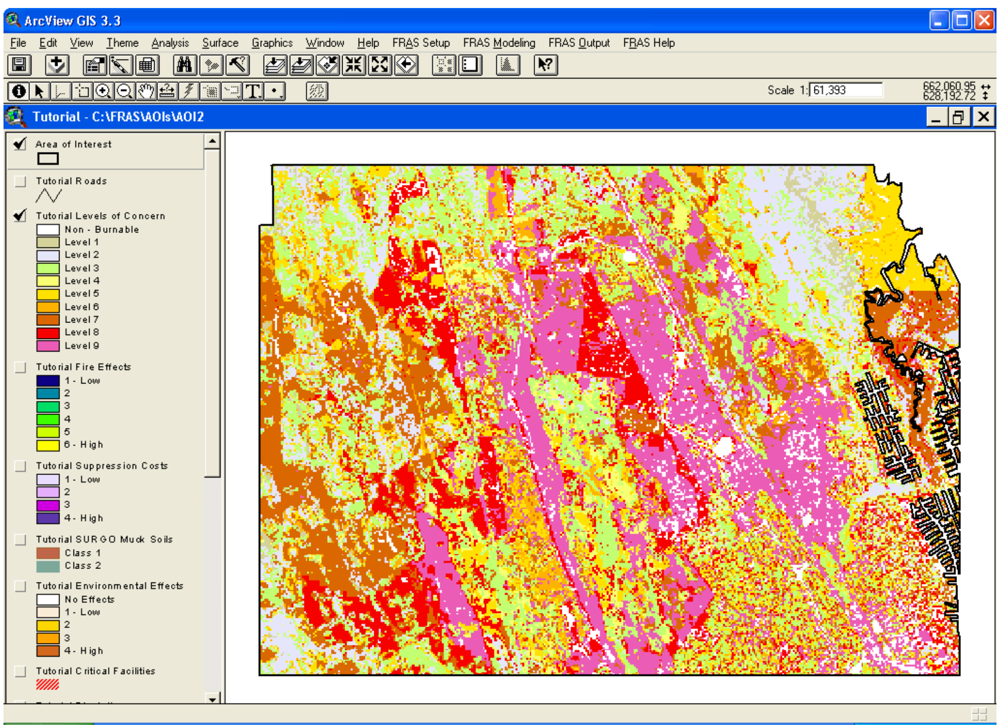
State of Florida
Florida Forest Service

Fire Risk Assessment System (FRAS)
Training Student Reference Text



December 2002

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Student Reference Text for Using the Florida Fire Risk Assessment System

I. Course Introduction

This publication has been prepared as the Student's Reference during training on the Florida Wildfire Risk Assessment and the use of the Florida Wildfire Risk Assessment System.

Course Objectives

This publication has been prepared to help the user:

- Understand the Structure and Outputs of the Florida Wildfire Risk Assessment
- Understand the Structure and Use of the Florida Wildfire Risk Assessment System to Examine the Published Results
- Understand the Structure and Use of the Florida Wildfire Risk Assessment System to Assess the Effectiveness of Mitigation Options

Schedule for the Day

There will be a 10-minute break each hour.

0800 - 0830	Participants Arrive and Prepare for Session
0830 - 0900	Welcome
0900 - 1030	Introduction to the Florida Wildfire Risk Assessment (FRA)
1030 - 1100	Introduction to GIS Concepts
1100 - 1145	Introduction to the Florida Wildfire Risk Assessment System (FRAS)
1145 - 1230	Lunch
1230 - 1330	Using the Florida Wildfire Risk Assessment System: Using Published Results in the FFRA
1330 - 1600	Using the Florida Wildfire Risk Assessment System: Assessment of Effectiveness of Mitigation Measures, Fuels and Fire Prevention
1600 - 1630	Using the Florida Wildfire Risk Assessment System: Assessment of Effectiveness of Mitigation Measures, Changing Resource Locations
1630 - 1645	Installation of the FRAS and Questions
1645 - 1700	Closeout

Computer Logistics

The ArcView, and Spatial Analyst programs and the FRAS extension have been loaded on the computer being using for this training. You will be provided with a CD with the FRAS extension to ArcView which can be installed on a computer back home. Spatial Analyst is not required but without this program installed, the FRAS functionality is limited.

Ground Rules for Successful Computer Training

Expertise levels of trainees frequently ranges based on background and experience. Many parts of this training will utilize examples that need to be completed in a structured order. Coaches are provided to assist you. All trainees can help the training cadre by not proceeding with steps prior to being told to do so. At times, trainees who are quite familiar with ArcView and Spatial Analyst may feel comfortable proceeding at a quicker rate than the instructor is providing. Eventually, this can create problems when the steps taken by the trainee are not correct or consistent with those planned.

Please assist the training cadre by doing the following:

- Do not proceed quicker than the instructor is teaching.
- If you have a question using the software, raise your hand so a coach can come to assist you.
- Liquids and electronic equipment do not mix well so please do not have any containers with liquids at your work area unless the container has a well sealed lid.

Cadre and Coach Introductions

The training cadre will be introduced. Please wear your name tag so then training cadre can address you in a courteous manner.

Uses for the FRA Published Results and the FRA ArcView Extension (FRAS)

The products from the FRA and the analysis of mitigation measures using the FRAS can provide a value set of tools and a process to facilitate the following:

- Communication
- Decision Support
- Program Planning

Communication

The FRAS allows the user to access the FRA Published Results for Districts or a combination of Districts within the State. One of the primary uses of the FRA outputs will be to communicate to others the current wildland fire risk for areas. In addition, the FRA outputs provide intermediate outputs such as Expect Fire Size that can also be of value in communicating with others.

Actions in communicating with the public can generally be separated into three categories:

- Awareness Actions
- Education and Motivational Actions
- Regulatory Actions

<u>Awareness Actions</u>

The first step in communicating with others is to assist them in becoming aware of a problem. Many fire prevention activities including the use if the image of Smoky Bear provide an awareness to someone that there is a need to exercise caution when using fire in any manner.

Education and Motivational Actions

Once a person is aware, then the opportunity exists to provide information and instruction in a manner to promote a desired behavior. Desired behaviors can be the proper disposal of an ignited cigarette or the proper type of clearing around a home. For people to be receptive to these educational messages, they must be aware of the problem and also be aware of the benefits and consequences of their actions. The FRA products and the analyzing of mitigation measures can assist individuals in understanding that in reality, there are only "choices and consequences." In the many areas of Florida where fire dependent ecosystems exist, the question is not will fire visit and area but when. When that time occurs, the effects on the public will most likely depend on the choices. The fire's effects will detail the consequences of their choices.

Regulatory Actions

At times, educational measures are not sufficient to initiate voluntary compliance and statutory rules, regulations and laws are needed. Development, where necessary, of these regulatory measures should not be viewed as negative but as a necessary part of a coordinated fire management program. Examples of regulations include restrictions on open burning and when industrial activities can continue in the wildland.

Using FRA and FRAS Products to Work with Others

FRA and FRAS products can support the ability to work with many groups including:

- The Public
- Elected Officials
- Government Officials including County Planners
- Business

Working with the Public

Through articles in the printed media, brochures and presentations to community groups, the FRA products can communicate to the general public the current wildland fire risk. The highest value in in the use of FRA products to communicate FRA products related to wildland fire risk is most likely the general public. Support for community assessment and the FIREWISE program can be facilitated once the public better understands the likelihood of wildland fire effects.

Working with Elected Officials

Gaining legislative understanding for initiatives and budget requests will facilitate agency to legislator communication and potential support for agency requests. In the short-term, allocation of current or near-term budgets can be based on the likelihood for the highest benefit if products from the FRA and FRAS are utilized.

Working with Government Officials including County Planners

All agencies and organizations perform some sort of programmatic planning to guide the mid-term to long-term goals and objectives of the agency or organization. Communication facilitating analysis of alternatives can be accomplished using the FRA and FRAS.

Development of Land Use Planning Guidelines
Analysis to support land use planning decisions can be also supported by products from the FRA and FRAS. Products from the FRA and FRAS can be used in the development of best management practice measures and of statutory mitigation measures for land use and development.

Data Repository for Use in Fire Management Economic Efficiency Models
The FRA provides a wealth of data and information that can support analysis of:

- Fire Prevention Options
- Fuels Management Options
- Resource Location Options
- Defensible Space Options

Working with Business
Businesses will be better able to structure their activities if they understand the likelihood and potential impacts from wildland fire. For example, insurance companies will be able to develop a more appropriate and actuarially correct rate structure. The tourist industry can better prepare itself to deal with impacts from wildland fires such as smoke.

Using FRA and FRAS Products to Support Decisions in Wildland Fire Suppression
Personnel with wildland fire protection responsibilities make decisions to support initial attack and large fire support. Products from the FRA and FRAS can be utilized to support these decisions.

Initial Attack Decisions
Decisions depend on the information available. Quick access to data can provide information to support decisions on logistics and prioritization. Data layers within the FRA which can provide this support on initial attack decisions include FBPS fuel model, critical facilities, utilities, wildland urban interface (structures) and roads to name a few. The basis for all computer-aided dispatch (CAD) systems are base data layers and the FRA provides many of these.

Large Fire Support Decisions
As with initial attack decisions, large fire support decisions depend on the information available. The data layers mentioned to support initial attack decisions will also be valuable aids to large fire support Incident Management Teams (IMT), particularly if the IMT is from out of the area. As a minimum, the FRA products will provide assess to:

- Values at risk
- Fuels and weather information
- Data for statewide use of the Fire Area Simulator (FARSITE 4.0)

II. Introduction to FRA

Background of FRA Development (Florida Wildfire Risk Assessment (FRA))

Florida possesses a unique set of characteristics that make much of the state highly susceptible to wildfire. The state is blessed with an abundance of wildlands. The state has also experienced an influx of new residents into these wildlands, creating a intermingling of urban settlement within wildlands of the state.

Florida's weather is conducive to starting and spreading numerous, and sometimes large wildfires. Florida's rate of lightning strikes is unequaled in the nation. Lightning, coupled with extended periods of drought, set the stage for catastrophic fire episodes. While lightning accounts for a large proportion of wildfire ignitions, human-caused fires are ever increasing as the population rises.

Florida's wildland vegetation evolved in a fire ecosystem. The vegetation is adapted to burn periodically. Fine fuels, which are easily ignited and spread fire rapidly, are abundant throughout Florida. The lack of managed fire in much of the wildlands has promoted an accumulation of these fuels that will burn with such intensity as to hamper suppression efforts.

To reduce the loss of life and property due to wildfire, communities and fire management organizations should actively manage wildland fire risk. Managing wildland fire risk can be challenging as fuels frequently change across the landscape and through time. Fire behavior can be affected by changes in land development, fuels, weather conditions, and topography. In addition, many social, technical and institutional barriers exist to proactive fire risk management and planning.

Florida's fire managers face a complex problem that is compounded by increasing fire intensities due to accumulation of vegetative materials, continued residential growth into wildland fire-prone areas, and increasing firefighting costs. The Florida Forest Service determined that a process is needed to assess fire hazards and risks, and the values to be protected. The process should provide managers with a strategic view of the state to improve public safety and protect them from property losses like those experienced in 1985, 1989, 1998, and 1999.

The purpose of the Florida Fire Risk Assessment (FRA) is to identify the potential for serious fires within the State of Florida and prioritize areas where mitigation options may be desirable. The FRA can also be used to locate areas within the state where interagency planning may be of value to effectively manage wildland fire risk. The results can be used to complete a more detailed analysis at the local level and communicate wildland fire management issues to the public.

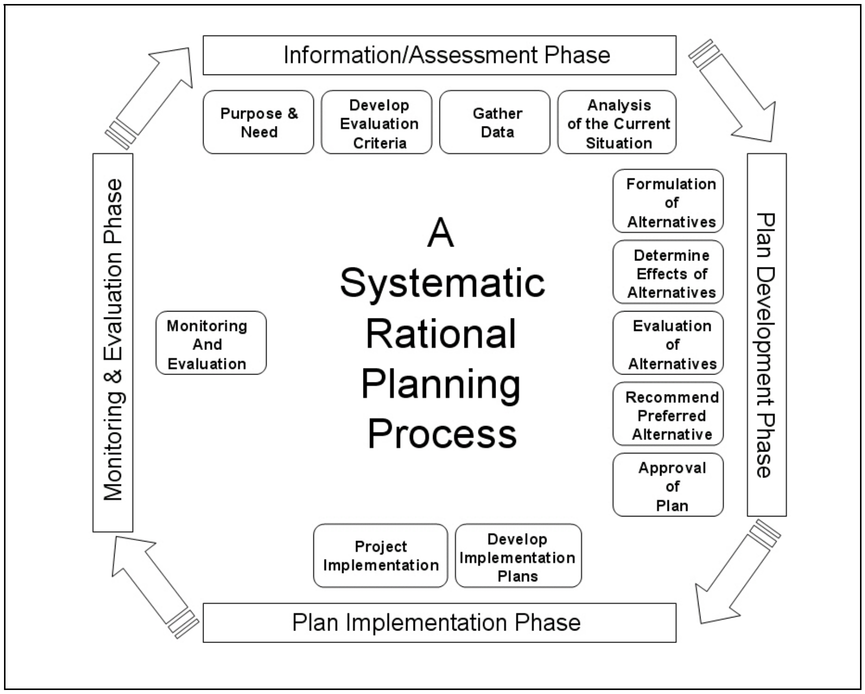
The results of the risk assessment can be used to:

- Identify areas where mitigation measures may be of value
- Facilitate communication among agencies to better define priorities and improve emergency response
- Develop a refined analysis of a complex landscape and fire situations using GIS
- Facilitate communication with local residents to address community priorities and needs

Role of Assessments

In land management planning, four phases are normally encountered. These are:

- Project Assessment
- Alternative Formulation, Evaluation and Selection of Preferred Alternative
- Project Implementation
- Project Monitoring and Evaluation



The purpose of the FRA is to provide information for identification of potential project areas where fire risk mitigation measures may be of value.

Traditionally, assessments of the potential wildland fires have analyzed the following three components:

- Fire Occurrence (frequently called "risk')
- Fuels (frequently called "hazard")
- Values at Risk (effected by a fire)

Mapping and ranking of these components has been done in many ways since the early 1900's. Definition of terms is critical in communicating and understanding have the FRA was completed.

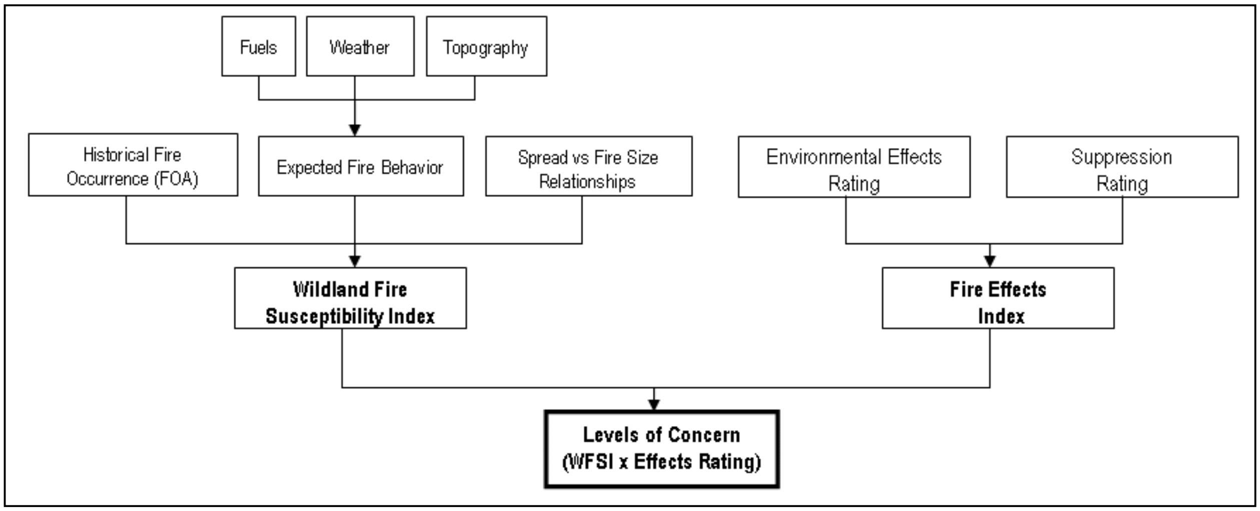
Hot Tip

The Seven "P"s

Proper, Prior, Planning Prevents Pathetic Poor Performance

Wildland Fire Risk

Webster's dictionary defines risk as "The possibility of suffering harm or loss." As one can see, there needs be an "effect of an action" before one can incur a risk from an action. Traditionally, fire management personnel have used the term "risk" to refer to "what starts wildland fires." Within the FRA, the Level of Concern is the best measure of wildland fire risk. The Level of Concern is calculated from the likelihood of an acre burning, called the Wildland Fire Susceptibility Index (WFSI), and the expected effects of the fire (Fire Effects Index). The Level of Concern will be discussed in more detail later in this section.



Fire Occurrence

As has been mentioned, fire management personnel traditionally have used the term "risk" to refer to "what starts wildland fires." In the FRA, Fire Occurrence Areas (FOAs) have been developed. Within each FOA the probability of each acre igniting is the same.

Fuels

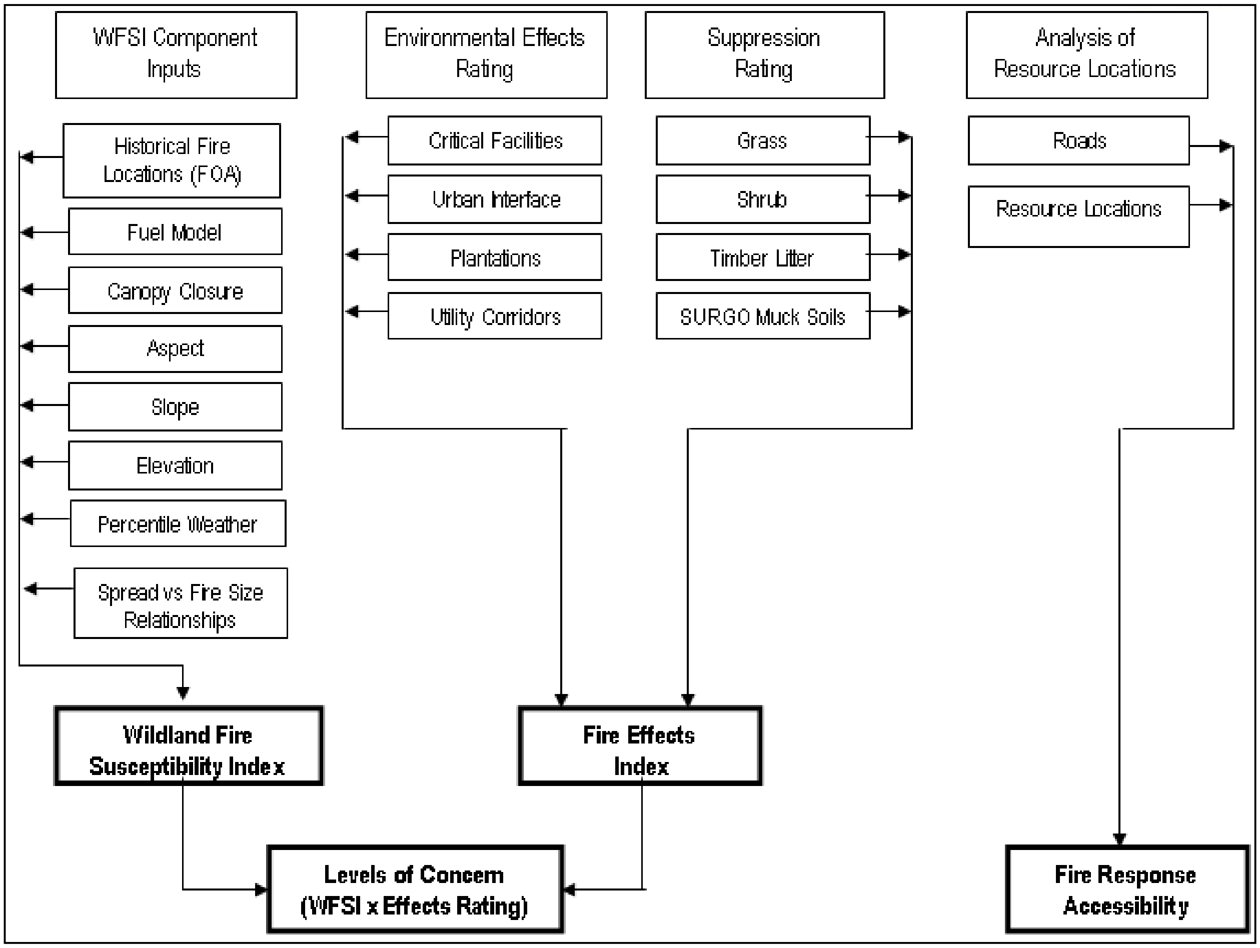
Traditionally, fire management personnel have used the term "hazard" to refer to "what will burn" in a wildland fire. Webster's dictionary defines "hazard" as a "chance or accident or a danger," neither of which apply to the use here. Consequently, in the FRA the surface vegetative matter that will burn in a wildland fire is simply referred to as "fuel" and are categorized using the fuel models in the Fire Behavior Prediction System.

Values (at Risk)

As noted, to define the "risk" of a wildland fire, an effect is needed. For an effect to occur, there must be defined values that will be affected. Within the FRA, there are two sets of values defined: Environmental Effects and Fire Suppression Costs. Collectively, a Fire Effects Index defining the expected effects on each acre is defined. The Fire Effects Index is a combination of an Environmental Effects Rating and a Fire Suppression Rating.

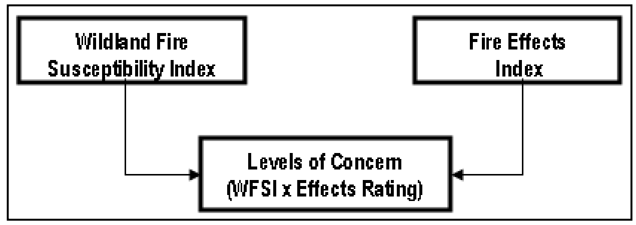
Inputs, Outputs and Process Flow

The two primary indices assigned to each 30 meter x 30 meter cell in the State are the Levels of Concern (LOC) and the Fire Response Accessibility Index (FRAI).



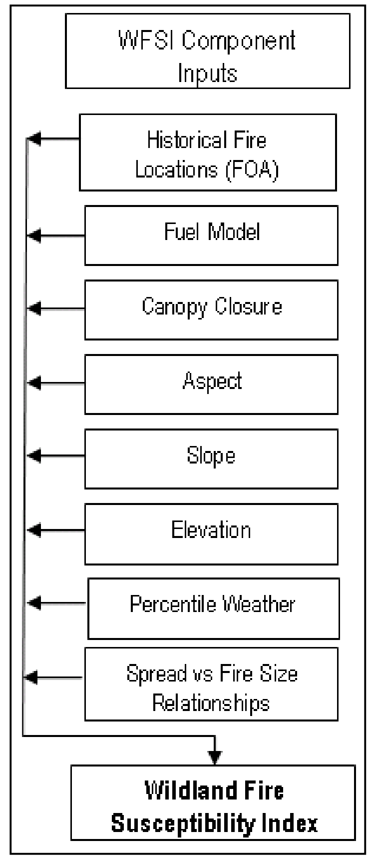
Levels of Concern

The Levels of Concern is calculated as the Wildland Fire Susceptibility Index (WFSI) times the Fire Effects Index (FEI).



<u>Wildland Fire Susceptibility Index</u>

The Wildland Fire Susceptibility Index (WFSI) is a value between 0 and 1. It was developed consistent with the mathematical calculation process for determining the probability of an acre burning. The WFSI integrates the probability of an acre igniting and the expected final fire size based on the rate of spread in four weather percentile categories into a single measure of wildland fire susceptibility. Due to some necessary assumptions, mainly fuel homogeneity, it is not the true probability. But since all areas of the State have this value determined consistently, it allows for comparison and ordination of areas of the state as to the likelihood of an acre burning.



<u>Fire Occurrence (Fire Occurrence Areas)</u>

A Fire Occurrence Area (FOA) is an area where the probability of each acre igniting is the same. The historical fire locations from the past 20 years were used with a few exceptions. Pictorially, if one were to locate the point location for historic ignitions on a map of an FOA, the points would appear to be equally spaced.

<u>Fire Occurrence Data Used</u>

The potential for wildland fire occurrence is based on historic fire ignition data from the Florida Forest Service, the USDA-Forest Service, the US-Department of the Interior (DOI) and the Department of Defense (DOD). Fire occurrence data for the DOI agencies included the National Park Service, the Fish and Wildlife Service and the Bureau of Indian Affairs. Fire occurrence data for the DOD agencies included US Air Force's Eglin Air Force Base. Fire occurrence data was gathered for 20 years. The years 1981-2000 are used for the base period. For some agencies, fire occurrence data was not available for this entire time period and for these agencies, fire occurrence was annualized based on the number of years available.

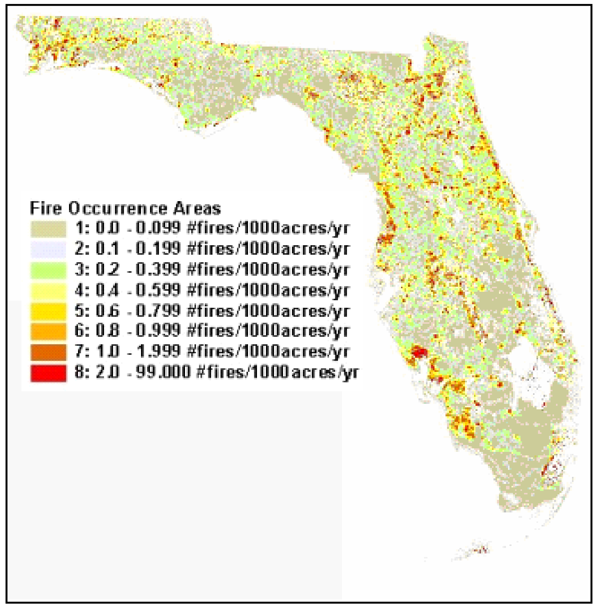
<u>Overview of FOA Development Process</u>

A grid illustrating the probability of a wildfire igniting was developed using ARC/INFO GRID by analyzing the location of historic ignitions. Fire occurrence rates in Fire Occurrence Areas (FOA) were described as the number of fires ignited per 1,000 acres per year. A surface grid with fires per 1,000 acres per year was generated using an Inverse Weighted Difference (IDW) calculation available in ArcInfo GRID. FOAs were developed to identify areas were the probability of a fire igniting was similar. Hence, within an FOA, the probability of each acre igniting is the same.

FOA Classifications and Map

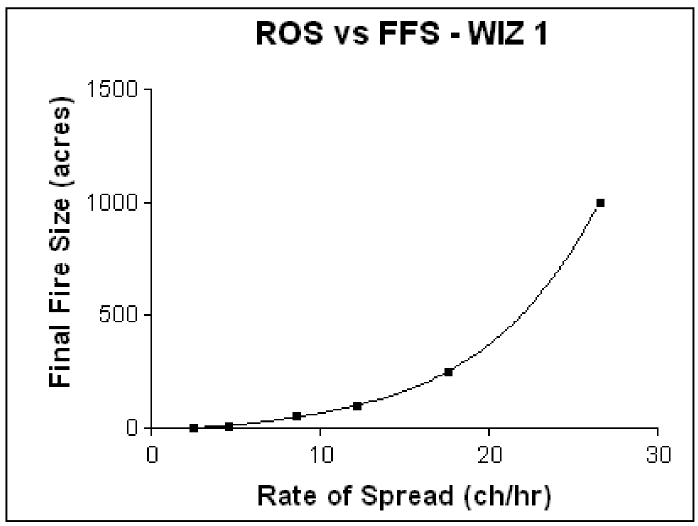
Eight FOA categories were defined. The table below defines the FOA rate in each FOA as well as State-wide acreages and average. As an example, the figure below at the right shows the FOAs for the state. The table summarizes acres and FOA rates by category.

FOA Acres	FOA Rate From	FOA Rate To	Avg FOA Rate (Fires/1000 acres/yr)	Percent of Acres	Cum Percent of Acres
10,567,243	0.000	0.099	0.035	36.5%	36.5%
5,106,232	0.100	0.199	0.146	17.6%	54.1%
5,874,037	0.200	0.399	0.288	20.3%	74.4%
2,978,297	0.400	0.599	0.489	10.3%	84.7%
1,647,387	0.600	0.799	0.691	5.7%	90.3%
983,224	0.800	0.999	0.892	3.4%	93.7%
1,433,696	1.000	1.999	1.326	4.9%	98.7%
381,831	2.000	99.000	3.596	1.3%	100.0%
28,971,947			0.330	100.0%	



Expected Final Fire Size

For a cell, the FOA provides an estimate of the cell igniting. To calculate the WFSI, the expected size of a fire needs to be determined to facilitate estimating the probability of an acre burning. To do this, it was necessary to develop relationships between fire spread rates and the expected final fire size. The inputs to this relationship are the expected fire behavior which depend are fuels, weather and topography and a measure of suppression effectiveness of fire protection forces.



For each Weather Influence Zone, a relationship between the rate of spread and final fire size was developed using the fire report data from the Florida Forest Service for the period 1981-2000. Details of how this relationship was developed are contained in the section titled Rate of Spread vs Final Fire Size Relationships that follows.

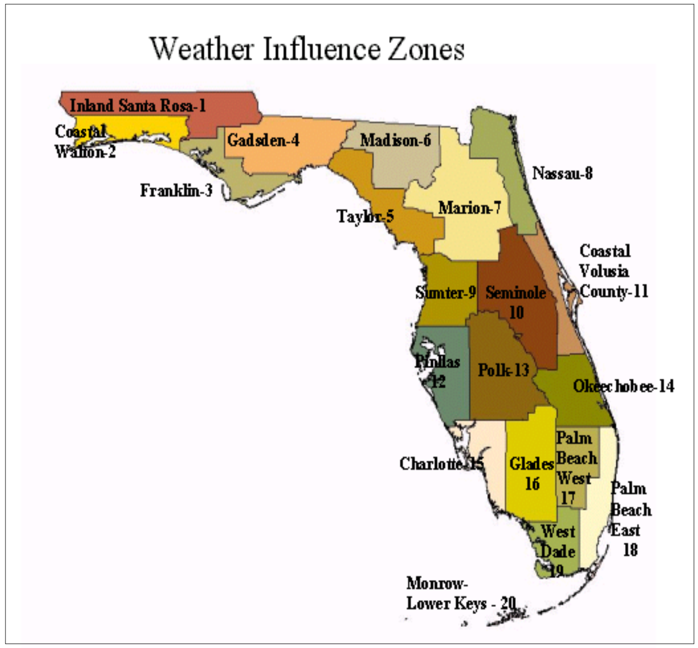
The process used to develop the fire rate of spread follows. Fire behavior prediction requires definition of the weather, fuels and topography.

Weather

Weather in the state of Florida varies geographically. Weather Influence Zones (WIZ) were developed by the Florida Forest Service State Meteorologist. Twenty Weather Influence Zones were developed for the State.

Weather Influence Zones

Within each WIZ, daily weather data was gathered from 1981 - 2000 from land management agency maintained weather stations and from National Oceanographic and Atmospheric Administration (NOAA) maintained weather stations. A computer program was developed by the Florida Forest Service's State Meteorologist to geo-reference the weather observations from the weather stations within a WIZ to the geographical center of the WIZ. Hence, one weather data set was developed with a weather observation for each day from January 1, 1981 through December 31, 2000 for each WIZ. From this weather data set, percentile weather was developed for each WIZ.

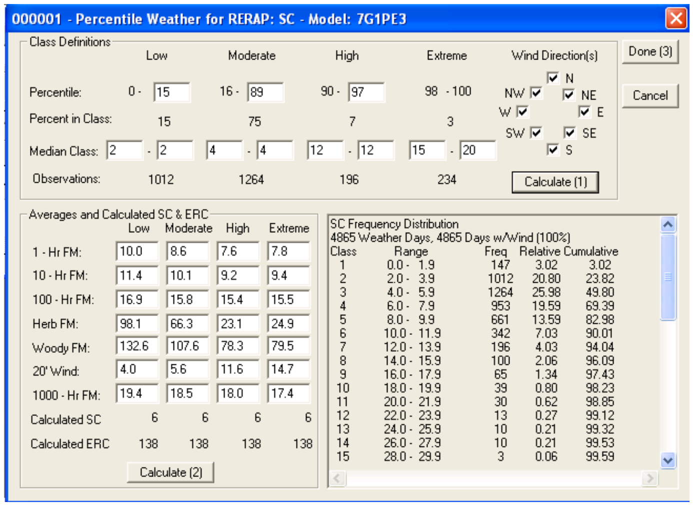


Development of Percentile Weather Values

For each WIZ, one weather data set was developed with a weather observation for each day from January 1, 1981 through December 31, 2000. This data was checked for errors and then imported into the USDA-Forest Service's *FireFamilyPlus* program. The National Fire Danger Rating System (NFDRS) index Spread Component (SC) was calculated for each day. The fire season was assumed to be from October 1 through May 31. The SC was calculated using the NFDRS fuel model G. Though little fuel model G exists within Florida, fuel model G contains fuel loading in all of the dead (1-h, 10-h and 100-h) and live (herbaceous and woody) fuel categories. This allows for the influence in the SC calculation of the fuel moisture values in all of the fuel categories. In addition, climate class 3 (sub-humid / humid) and slope class 1 (0-25%) were used.

Hot Tip

Frequently, localized weather is not available for the initial assessment of an on-going wildland fire. The use of the percentile weather parameters for a WIZ would be a good estimate until more localized parameters are available.



The Spread Component was then divided into four commutative percentile categories Low (0-15%), Moderate (16-90%), High (91-97%) and Extreme (98-100%). The median SC was determined for each category. The environmental values for 1-h, 10-h, 100-h timelag fuel moisture, live herbaceous fuel moisture, live woody fuel moisture and the 20 foot 10 minute average wind speed were determined as the average of the respective values on days when the SC was equal to the median SC. This allowed for the determination of four percentile weather categories with the percent of occurrence of each category and with environmental values to define the weather conditions within each category. Below is an example printout of percentile weather values from FireFamilyPlus for WIZ 1.

```
Station: 000001: Inland Santa Rosa      Variable: SC
 Model: 7G1PE3
         Data Years: 1981 - 2000
         Date Range: October 1 - May 31
Wind Directions: N, NE, E, SE, S, SW, W, NW

Percentiles, Probabilities, and Mid-Points
    Variable/Component Range       Low        Mod        High       Ext
            Percentile Range     0 - 15    16 - 89    90 - 97    98 - 100
       Climatol. Probability       15         75          7          3
          Mid-Point      SC      2 -    2   4 -    4  12 -   12  15 -   20
            Num Observations      1012       1264        196        234
      Calculated Spread Comp.        3          4         12         16
              Calculated ERC        23         28         31         32

Fuel Moistures
        1 Hour Fuel Moisture      10.00       8.60       7.60       7.80
       10 Hour Fuel Moisture      11.40      10.10       9.20       9.40
      100 Hour Fuel Moisture      16.90      15.80      15.40      15.50
    Herbaceous Fuel Moisture      98.10      66.30      23.10      24.90
         Woody Fuel Moisture     132.60     107.60      78.30      79.50
               20' Wind Speed       4.00       5.60      11.60      14.70
     1000 Hour Fuel Moisture      19.40      18.50      18.00      17.40
```

Proportion (Percent) of Fires That Occur Within Each Percentile Weather Category

If 15 percent of the days during the fire season are in the Low Percentile Weather Category, one cannot assume that 15 percent of the fires during the fire season will occur on the days in this Weather Category. For each day from January 1, 1981 through December 31, 2000, the NFDRS Spread Component was calculated using the *FireFamilyPlus* program. Each fire within the fire occurrence database for all agencies within a Weather Influence Zone has a fire start date. Each historic fire was assigned a Spread Component based on the fire's start date. The four percentile weather categories were also developed using the same assumptions for SC and the four categories have SC ranges. Hence, a correlation could be made assigning each historic fire to one of the four percentile weather categories. From these assignments, the proportion of fires that occurred in each percentile weather category by WIZ was determined.

<u>Fire Behavior Prediction</u>

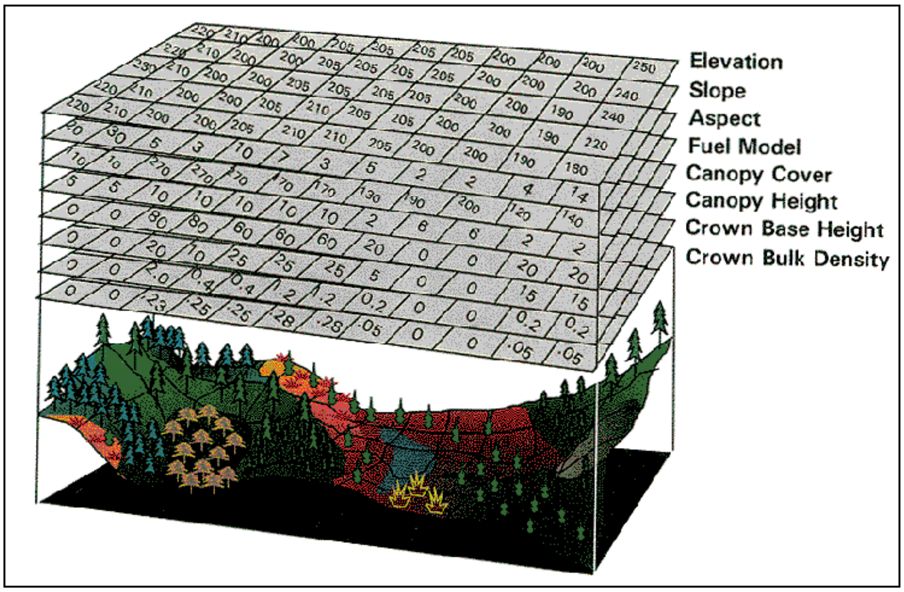
Potential fire behavior was evaluated using the program FlamMap. FlamMap is a GIS-based analytic tool. It uses topographic information, fuel characteristics, and weather to calculate rate-of-spread, flame length, fire type, and other characteristics of fire behavior.

<u>FlamMap</u>

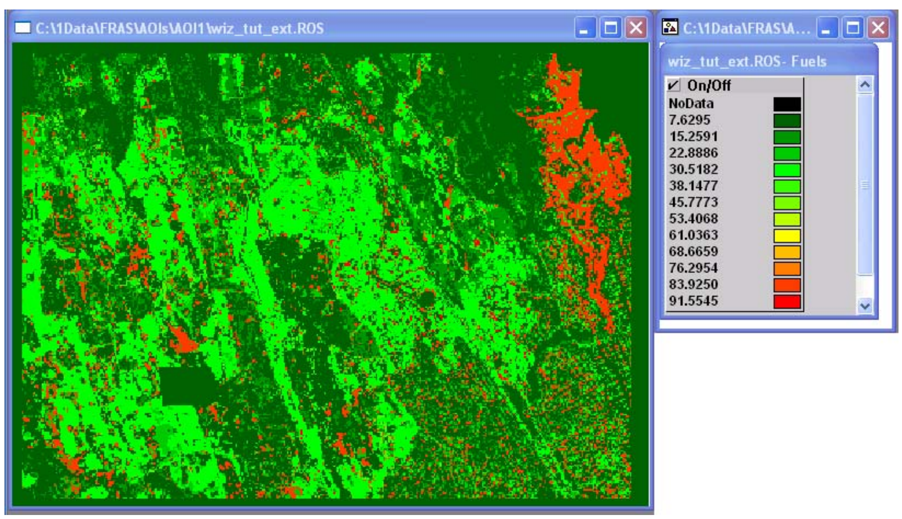
The purpose of using FlamMap is to generate fire behavior data that are comparable across the landscape for a given set of weather, fuels and fuel moisture data inputs. FlamMap is based on the GIS data themes and algorithms used in *Farsite* (Fire Area Simulator) as described by Finney (1998). GIS data are required for 5 data themes and optional for 3 data themes as follows:

Required Themes
- Elevation
- Slope
- Aspect
- Surface fuel model
- Canopy Cover

Optional Themes
- Stand Height
- Canopy Base Height
- Canopy Bulk Density



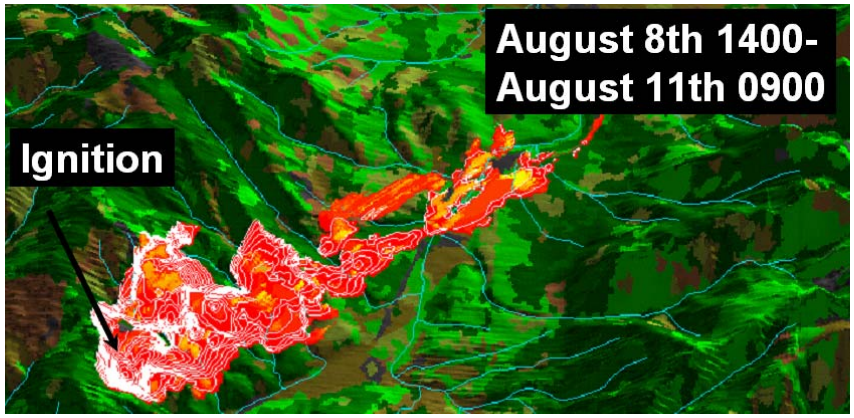
For the FRA, only the required themes were used due to data availability.



The fire behavior variable calculated by FlamMap for the FRAS is fire spread rate. This variable was developed since it can be used to estimate a fire's expected fire size. Additional fire behavior outputs such as fire intensities and flame length are available outputs of the FlamMap program.

FlamMap calculates the behavior of a fire occurring in each 30x30 meter cell under defined weather conditions. Fire behavior is described independently for each individual cell. FlamMap does not account for contagious processes that may affect fire behavior in an adjacent cell. An example using the Extreme Percentile Weather data appears in the figure above. The scale is in meters per minute.

Farsite



The Farsite (Fire Area Simulator) program is a two-dimensional fire behavior prediction tool. It predicts the fire behavior based on GIS data layers. In the FRAS, Farsite was not used but the data layers needed to use Farsite are the same as those needed for FlamMap. Use of Farsite to predict fire behavior and fire growth is facilitated by the data layers developed in the FRA.

The table that follows compares Farsite and FlamMap.

Farsite	FlamMap
• Dynamic – Space and time specific • Needs an ignition point • Needs a simulation start time and stop time • Produces fire behavior only inside the fire perimeter	• Static – Time and condition specific • No ignition point or location • No simulation start time and stop time • Generates fire behavior everywhere

The table that follows compares uses for Farsite and FlamMap.

Uses	Farsite	FlamMap
Model the growth of fires	Yes	No
Support Assessments of Risk	No	Yes
Different Fuel/Weather Scenarios	Yes	Yes
Active Fire Behavior Prediction	Yes	No

The table that follows compares inputs for Farsite and FlamMap.

Inputs	Farsite	FlamMap
GIS Layers for Fuels and Topography	Yes	Yes
Initial Fuel Moisture Values	Yes	Yes
Uses Custom Fuel Models	Yes	Yes
Uses Weather and Wind Files	Yes	No
Fire Start time and Stop Time	Yes	No
Fire Ignition Location	Yes	No
Desired Spread Direction	No	Yes
Constant Wind Speed and Direction	No	Yes

The table that follows compares outputs for Farsite and FlamMap.

Outputs	Farsite	FlamMap
Fire Arrival Time at a Location	Yes	No
Spread Rate	Yes	Yes
Flame Length	Yes	Yes
Fireline Intensity	Yes	Yes
Heat per Unit Area	Yes	Yes
Crown Fire Type	Yes	Yes
Fire Spread Direction	Yes	No
Midflame Windspeed	No	Yes
Solar Irradiance	No	Yes
1-hr Timelag Fuel Moisture	No	Yes
10-hr Timelag Fuel Moisture	No	Yes

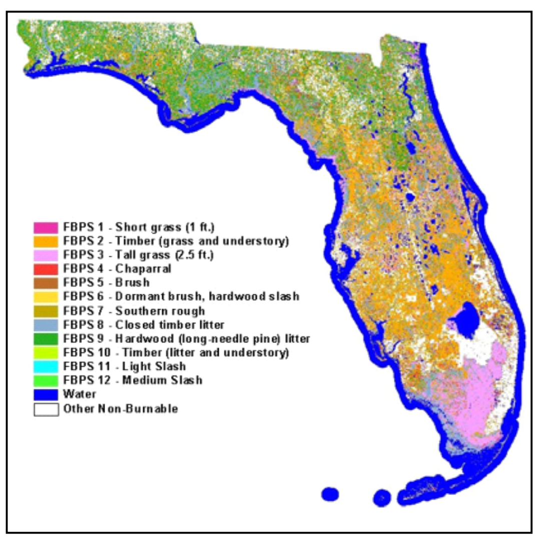
<u>Fuel - Surface Fuel Models</u>

A FRA design requirement was to classify each acre of burnable land in Florida using the fuel models in the Fire Behavior Prediction System (FBPS). The fuel models are in the table at the right.

FBPS Fuel Model	Description
1	Short grass (1 ft.)
2	Timber (grass and understory)
3	Tall grass (2.5 ft.)
4	Chaparral
5	Brush
6	Dormant brush, hardwood slash
7	Southern rough
8	Closed timber litter
9	Hardwood (long-needle pine) litter
10	Timber (litter and understory)
11	Light slash
12	Medium slash
13	Heavy slash

To facilitate classification within the State, a Florida Dichotomous Fuel Model Key was developed. Fifty FFS employees were trained in its use. These employees sampled over 3,000 plots assigning a FBPS fuel model to each. Correlations were made between the spectral characteristics of the plots and the fuel model allowing for a uniform assignment of fuel models throughout the state.

The figure at the right shows the final fuel model map for the state.



To analyze fuel management mitigation measures, custom FBPS derivative fuel models were developed to complement the existing 13 fuel models. A custom FBPS derivative fuel model is a custom fuel model that minimizes, reduces, or increases fuel loading and fuel bed depth for each of the original FBPS fuel models. By altering the fuel loading and fuel bed depth of the existing fuel models in a consistent manner, the characteristic surface area to volume ratio and the relative packing ratio are preserved with the parent FBPS fuel model.

The table below defines the attributes of the FBPS derivative fuel models. The standard 13 FBPS fuel models have an identifier 1-13. The custom derivative fuel models were developed to allow for assignment of a fuel model to post-treatment fuel beds and to also provide fuel models to assign to fuel beds as they change over time following treatment.

Custom and FBPS Fuel Model Attributes Used in FRAS

	Name	1h T/A	10h T/A	100h T/A	Herb T/A	Woody T/A	1h SA/V	Herb SA/V	Woody SA/V	Depth (Feet)	Mx Ex
1A	Short grass (1 ft.) - Low	0.52	0.00	0.00	0.00	0.00	3500	0	0	0.70	12
1	Short grass (1 ft.) - High	0.74	0.00	0.00	0.00	0.00	3500	0	0	1.00	12
1Z	Short grass (1 ft.) - High	0.96	0.00	0.00	0.00	0.00	3500	0	0	1.30	12
2A	Timber (grass and understory) - Low	1.40	0.70	0.35	0.35	0.00	3000	1500	0	0.70	15
2	Timber (grass and understory) - FBPS	2.00	1.00	0.50	0.50	0.00	3000	1500	0	1.00	15
2Z	Timber (grass and understory) - High	2.60	1.30	0.65	0.65	0.00	3000	1500	0	1.30	15
3A	Tall grass (2.5 ft.) - Low	2.10	0.00	0.00	0.00	0.00	1500	0	0	1.75	25
3	Tall grass (2.5 ft.) - FBPS	3.01	0.00	0.00	0.00	0.00	1500	0	0	2.50	25
3Z	Tall grass (2.5 ft.) - High	3.91	0.00	0.00	0.00	0.00	1500	0	0	3.25	25
4A	Chaparral - Low	3.51	2.81	1.40	0.00	3.51	2000	0	1500	4.20	20
4	Chaparral - FBPS	5.01	4.01	2.00	0.00	5.01	2000	0	1500	6.00	20
4Z	Chaparral - High	6.51	5.21	2.60	0.00	6.51	2000	0	1500	7.80	20
5A	Brush - Low	0.70	0.35	0.00	0.00	1.40	2000	0	1500	1.40	20
5	Brush - FBPS	1.00	0.50	0.00	0.00	2.00	2000	0	1500	2.00	20
5Z	Brush - High	1.30	0.65	0.00	0.00	2.60	2000	0	1500	2.60	20
6A	Dormant brush, hardwood slash - Low	1.05	1.75	1.40	0.00	0.00	1750	0	0	1.75	25
6	Dormant brush, hardwood slash - FBPS	1.50	2.50	2.00	0.00	0.00	1750	0	0	2.50	25
6Z	Dormant brush, hardwood slash - High	1.95	3.26	2.60	0.00	0.00	1750	0	0	3.25	25
7A	Southern rough - Low	0.79	1.31	1.05	0.00	0.26	1750	0	1550	1.75	40
7	Southern rough - FBPS	1.13	1.87	1.50	0.00	0.37	1750	0	1550	2.50	40
7Z	Southern rough - High	1.47	2.44	1.95	0.00	0.48	1750	0	1550	3.25	40
8A	Closed timber litter - Low	1.05	0.70	1.75	0.00	0.00	2000	0	0	0.14	30
8	Closed timber litter - FBPS	1.50	1.00	2.50	0.00	0.00	2000	0	0	0.20	30
8Z	Closed timber litter - High	1.95	1.30	3.26	0.00	0.00	2000	0	0	0.26	30
9A	Hardwood (long-needle pine) litter - Low	2.04	0.29	0.11	0.00	0.00	2500	0	0	0.14	25
9	Hardwood (long-needle pine) litter - FBPS	2.92	0.41	0.15	0.00	0.00	2500	0	0	0.20	25
9Z	Hardwood (long-needle pine) litter - High	3.79	0.54	0.20	0.00	0.00	2500	0	0	0.26	25
10A	Timber (litter and understory) - Low	2.10	1.40	3.51	0.00	1.40	2000	0	1500	0.70	25
10	Timber (litter and understory) - FBPS	3.01	2.00	5.01	0.00	2.00	2000	0	1500	1.00	25
10C	Timber (litter and understory) - High	3.91	2.60	6.51	0.00	2.60	2000	0	1500	1.30	25
11A	Light slash - Low	0.85	2.54	3.11	0.00	0.00	1500	0	0	0.56	15
11	Light slash - FBPS	1.50	4.51	5.51	0.00	0.00	1500	0	0	1.00	15
11Z	Light slash - High	2.22	6.65	8.13	0.00	0.00	1500	0	0	1.48	15
12A	Medium slash - Low	3.01	10.55	12.43	0.00	0.00	1500	0	0	1.73	20
12	Medium slash - FBPS	4.01	14.03	16.53	0.00	0.00	1500	0	0	2.30	20
12Z	Medium slash - High	4.64	16.23	19.13	0.00	0.00	1500	0	0	2.66	20
	Low Spread Models										
1N	Short grass (1 ft.) - Low Spread	0.10	0.00	0.00	0.00	0.00	3500	0	0	0.12	12
2N	Timber (grass and understory) - Low Spread	0.14	0.07	0.04	0.04	0.00	3000	1500	0	0.07	15
3N	Tall grass (2.5 ft.) - Low Spread	0.12	0.00	0.00	0.00	0.00	1500	0	0	0.10	25
4N	Chaparral - Low Spread	0.15	0.12	0.06	0.00	0.15	2000	0	1500	0.18	20
5N	Brush - Low Spread	0.09	0.05	0.00	0.00	0.18	2000	0	1500	0.18	20
6N	Dormant brush, hardwood slash - Low Spread	0.14	0.23	0.18	0.00	0.00	1750	0	0	0.23	25
7N	Southern rough - Low Spread	0.10	0.17	0.14	0.00	0.03	1750	0	1550	0.23	40
8N	Closed timber litter - Low Spread	0.75	0.50	1.25	0.00	0.00	2000	0	0	0.10	30
9N	Hardwood (long-needle pine) litter - Low Spread	0.47	0.07	0.02	0.00	0.00	2500	0	0	0.05	25
10N	Timber (litter and understory) - Low Spread	0.30	0.20	0.50	0.00	0.20	2000	0	1500	0.10	25
11N	Light slash - Low Spread	0.29	0.86	1.05	0.00	0.00	1500	0	0	0.19	15
12N	Medium slash - Low Spread	0.28	0.98	1.16	0.00	0.00	1500	0	0	0.16	20

A description of the custom FBPS derivative fuel models follows.

Low Derivatives of the FBPS Fuel Models 1-12
For each FBPS fuel model, a low version was developed by reducing the fuel loading in each category by 30% and by reducing the fuel bed bulk depth by 30%. The consistent reduction in depth and loading maintains the fuel bed bulk density and characteristic (average) surface area to volume ratio for the fuel bed. The low derivative fuel models are designated with the letter A following the standard fuel model number. For example, a 1A is the low loading version of a FBPS fuel model 1.

High Derivatives of the FBPS Fuel Models 1-12
For each FBPS fuel model, a high version was developed by increasing the fuel loading in each category by 30% and by increasing the fuel bed bulk depth by 30%. The high derivative fuel models are designated with the letter Z following the standard fuel model number. For example, a 1Z is the high loading version of a FBPS fuel model 1.

Low Spread Derivatives of the FBPS Fuel Models 1-12
For each FBPS fuel model a low spread version was developed by reducing to a low level the fuel loading and fuel bed depth in each standard fuel model. The rate of spread in these models is approximately 1 ch/hr using the Extreme Percentile weather conditions. It is meant to simulate the expected fire behavior in some fuel bed immediately post-treatment. The low spread fuel models are designated with the letter N following the standard fuel model number. For example, a 1N is the low spread version of a FBPS fuel model 1.

Hot Tip

While the user does have the ability to modify the output fuel profiles, it is strongly recommended the default profiles be used unless the user has extensive knowledge in fuel treatment and assessment.

Weather
Percentile weather values were used within each WIZ.

Topography - Slope, Aspect and Elevation
Within FlamMap, data layers for the State were developed for slope, aspect and elevation for USGS DEM information.

Percent Canopy Cover
A data layer defining the percent canopy cover was developed using satellite imagery and information gathered at the 3,000 sample plots.

<u>*Canopy Fuels*</u> (Canopy Ceiling Height, Canopy Base Height and Canopy Bulk Density)
Due to lack of funding to process the data to develop these three canopy data layers, they were not developed or used.

Hot Tip

Fire behavior predictions from FlamMap are for a surface fire only.

<u>Rate of Spread vs Final Fire Size Relationships</u>
For each Weather Influence Zone, a relationship between the rate of spread and final fire size was developed using the fire report data from the Florida Forest Service for the period 1981-2000. Several fire size classes were used to estimate the amount of time from fire start to fire containment. For all Weather Influence Zones, the time from fire start to fire containment for the benchmark fire sizes of 0.5, 2, 10, 50, 100, 500 and 1,000 acres was determined. Additional fire sizes greater than 1,000 acres were used when fires of these sizes occurred historically within a WIZ.

The average fire rate of spread for each benchmark fire size was estimated by using the double ellipse area model developed by Fons (1946) as documented by Anderson (1983). The model calculates fire size (Area) as: Area = K * D^2 where K is a constant dependent solely on mid-flame wind speed and D is the distance the fire has traveled from its point of origin (D = rate of spread times containment time). Mid-flame windspeed was set at 1, 2, 3, 5, 7, 9, and 12 mph for each of the benchmark sizes of 0.5, 2, 10, 50, 100, 500 and 1,000-acre fires. The mid-flame windspeed was set at a value of 12 mph or larger for fires with final fire sizes greater than 1,000 acres.

A relationship between the fire size and average rate of spread values for the benchmark fire sizes was developed using multi-variable regression. For all fuel models except fuel model 3, a fourth order polynomial was determined to be the best equation form to use. The form is $Y = A + B*X+C*X^2 + D*X^3 + E*X^4$ where X = rate of spread, Y is the expected fire size and A-E are the regression coefficients. In some cases, A was changed so that a 0.5 acre fire was expected when the rate of spread was 1 chain per hour (1.1 feet per minute). For fuel model 3, a power function was used. The form is $Y = A + B*X^C + D*X^E$ where X is the rate of spread.

A			2.0000000
B			-2.9950000
C			1.5890000
D			-0.0975100
E			0.0036050
Max Size			2000
Largest Fire			1080
WIZ-->			1
ROS	Avg	Std Dev	Acres
1	0.5	0.2	0.5
2	1.3	0.4	1.6
3	3.1	1.3	5.0
4	6.6	2.8	10.1
5	12.1	5.0	16.8
6	20.0	8.0	24.8
7	30.8	12.0	34.1
8	45.0	17.2	44.6
9	62.9	24.0	56.3
10	85.1	32.6	69.5
15	276.8	112.3	168.0
20	649.2	278.8	374.4
25	1269.0	569.3	804.9
30	2207.6	1027.5	1629.5
35	3427.5	1770.2	2000.0
40	5003.6	2879.1	2000.0
45	6991.7	4425.4	2000.0
50	9492.6	6459.7	2000.0
55	12570.3	9058.9	2000.0
60	16290.5	12310.7	2000.0
65	19212.3	14298.3	2000.0
70	21849.3	16655.9	2000.0
75	24442.1	19915.0	2000.0
80	27347.0	24205.3	2000.0
85	29947.6	29126.7	2000.0
90	32620.6	34923.8	2000.0
100	36124.3	38901.0	2000.0
120	40031.6	42376.1	2000.0

A maximum expected fire size was set for all Weather Influence Zones to account for physical conditions that would limit fire spread. These values were based on historic fire sizes.

The table on the previous page provides an example using WIZ 1. The equation developed was:

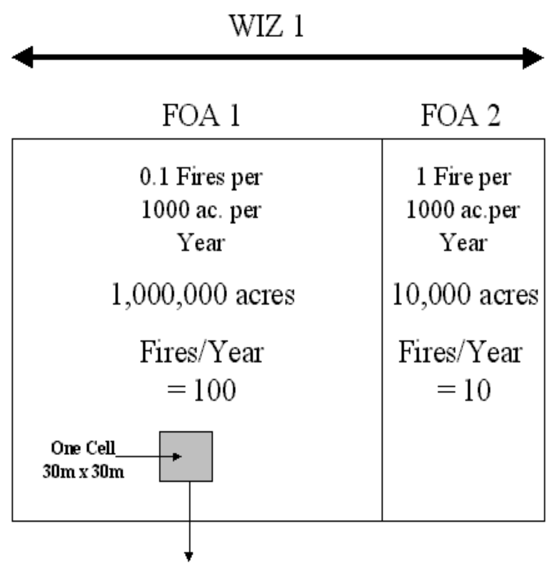
$$FFS = 2.0 - 2.995*X + 1.589*X^2 - 0.09751*X^3 + 0.003605*X^4$$

with a maximum fire size of 2,000 acres. Note that for spread rates greater than 35 ch/hr, the final fire size remains at 2,000 acres.

Columns in the table on the previous page are also provided for the State-wide average for a given rate of spread as well as the standard deviation based on the 20 WIZs in the State.

<u>Example of the Calculation of WFSI</u>

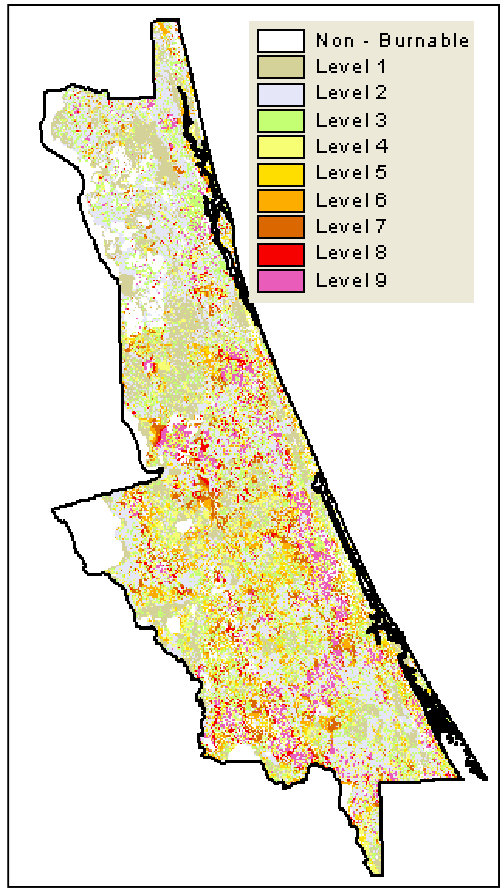
The WFSI is calculated for each percentile weather category for each 30 meter by 30-meter cell on burnable area within the State. The four values from the four Percentile weather Categories are summed to obtain the WFSI for a cell. The calculation is done for cells within a FOA and WIZ intersection. When the calculation is done for a cell, it is assumed that all cells in the FOA and WIZ intersection have the attributes of the cell. In essence, one is asking "what would be the expected probability of an acre burning if all cells in the FOA and WIZ intersection were the same at the selected cell?"



To assist in the understanding of the calculation, an example is presented. Assume that the calculation is being done for a cell in FOA 1, WIZ 1. The data flow is shown via the example in Table below. For the example, assume that the fire occurrence rate in FOA 1 is 0.1 fires / 1000 acres / year and assume there are 1,000,000 acres in the FOA 1, WIZ 1 intersection.

Row	Item	Percentile Weather				Total
		Low	Moderate	High	Extreme	
1	Percent of Fires	10%	80%	8%	2%	100%
2	Number of Fires	10	80	8	2	100
3	Rate of Spread (chains/hr)	2	5	12	24	N/A
4	Final Fire Size (acres)	1	6	98	900	N/A
5	Annual Acres Burned	10	480	784	1800	3074
6	WFSI	0.0001	0.0048	0.0074	0.0180	0.0374

The figure on the previous page shows that within FOA 1 and WIZ 1, there are 100 fires per year. Row 1 gives the Percent of Fires that have historically occurred within each of the Percentile Weather Categories.



Multiplying the Proportion of Fires in each Percentile Weather Category by the total number of fires in the FOA 1 / WIZ 1 intersection (100 fires) allows for determination of the Number of Fires in each Percentile Weather Category, Row 2.

The FlamMap program has calculated a Rate of Spread for each Percentile Weather Category (Row 3) and a Rate of Spread versus expected Final Fire Size Relationship (Row 4) has been determined. This allows for the determination of the expected Final Fire Size within each Percentile Weather Category.

Multiplying the Number of Fires per year in each Percentile Weather Category by the expected Final Fire Size yields the Annual Expected Acres Burned for each Percentile Weather Category (Row 5).

Dividing the Annual Expected Acres Burned for each Percentile Weather Category by the total acres within the FOA1, WIZ 1 intersection (1,000,000 acres) yields the WFSI within each Percentile Weather Category Row 6). The WFSI for the cell is the sum of the four Percentile Weather Category WFSI values.

An example of the WFSI map for the Bunnell District is shown in the figure at the above right.

Hot Tip

The WFSI calculation is based on the logical calculation process for determining the probability of an acre burning; i.e. acres burned per year divided by the total area. The goal of the FRAS is not to estimate via the WFSI the actual probability of an acre burning but to use the WFSI to ordinate the burnable areas in the State into categories representing the likelihood of the cell being impacted by a wildland fire.

Fire Effects

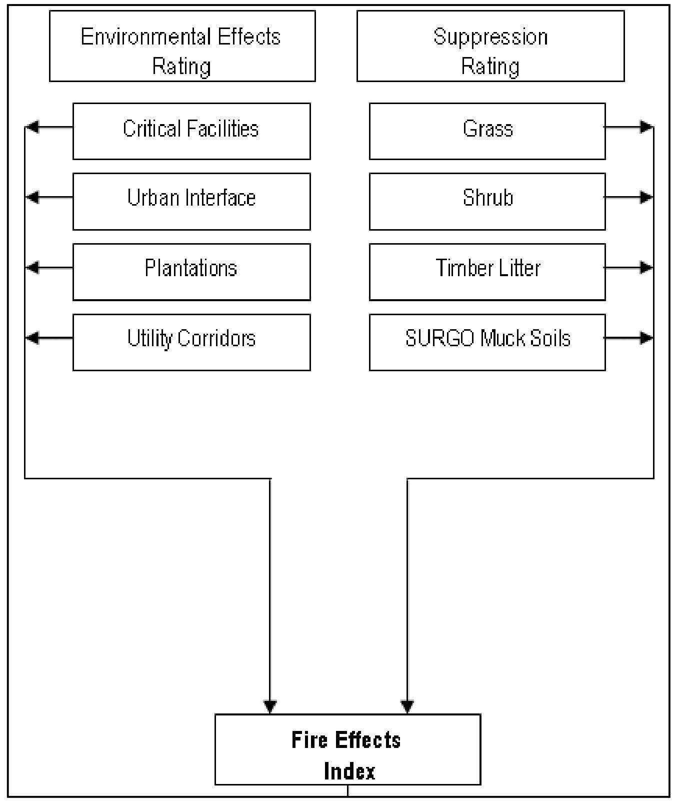
The Fire Effects Index is comprised of two inputs:

1. Environmental Effects Rating

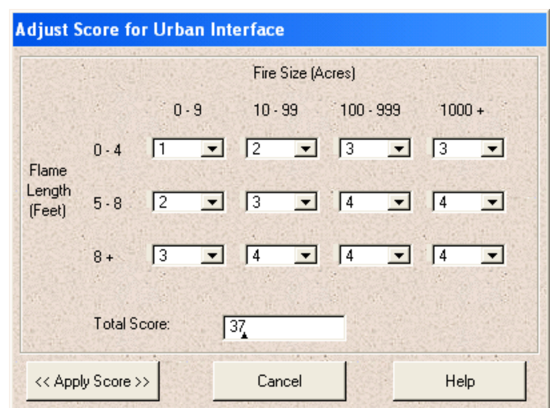
2. Suppression Rating

The purpose of the index is to identify those areas that have environmental values at risk to wildland fire and/or are costly to suppress. The environmental effects that are included in this analysis are:

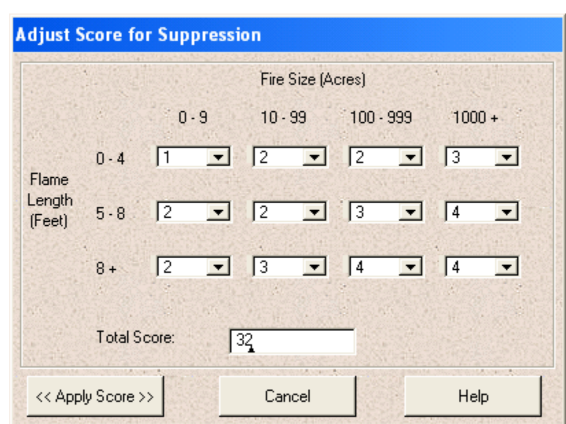
- Urban Interface
- Utility Corridors
- Plantations (natural and planted)
- Critical Facilities (from FFS burn authorization plan)



Each environmental input was assigned an effects score by FFS fire managers using a matrix to assign a value of 1 to 4 (1 being low effect, 4 for high) for 12 flame length vs. fire size scenarios (See figure at right). To arrive at an environmental effects rating, the individual scores for the inputs; critical facilities, urban interface, plantations and utility corridors were summed.



The suppression costs are evaluated by fuel type. Each cell in the state has been assigned a base, grass, shrub, timber litter or muck suppression score. The base score represents fires that are not in grass, shrub, timber litter or muck areas. FFS fire managers used the matrix shown at the right to assign the fire suppression and muck scores. The grass, shrub and timber litter scores were based on suppression billing information provided by the FFS districts for the past five years. Cells with a slash fuel model are assigned a base suppression score. The suppression rating for each cell was assigned based on the fuel type (or muck soil) on the ground.

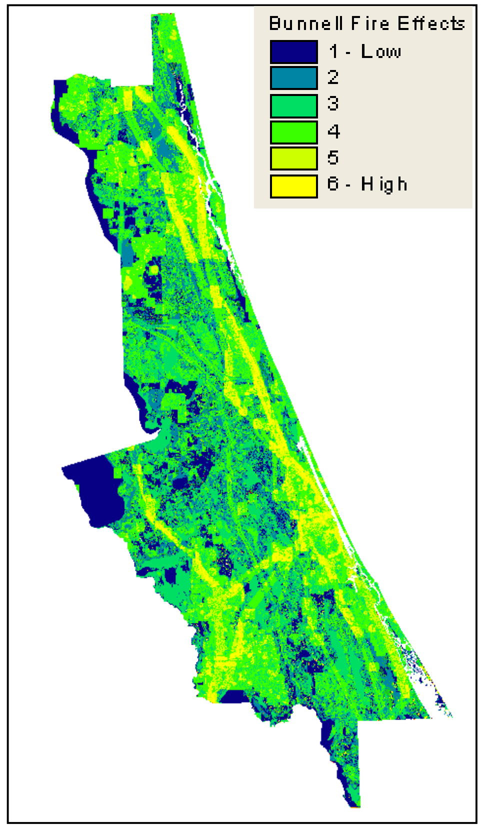


The Fire Effects Index was then calculated by combining the Environmental Effects Rating and the Suppression Rating using the following equation:

Fire Effects = (0.80 * Environmental Effects Rating
+ (0.20 * Suppression Rating)

The final Fire Effects Values can range from 0 – 100.

An example of the Fire Effects map for the Bunnell District is in the figure at the right. A description of how the Environmental Effects Rating and the Suppression Rating were developed follows.

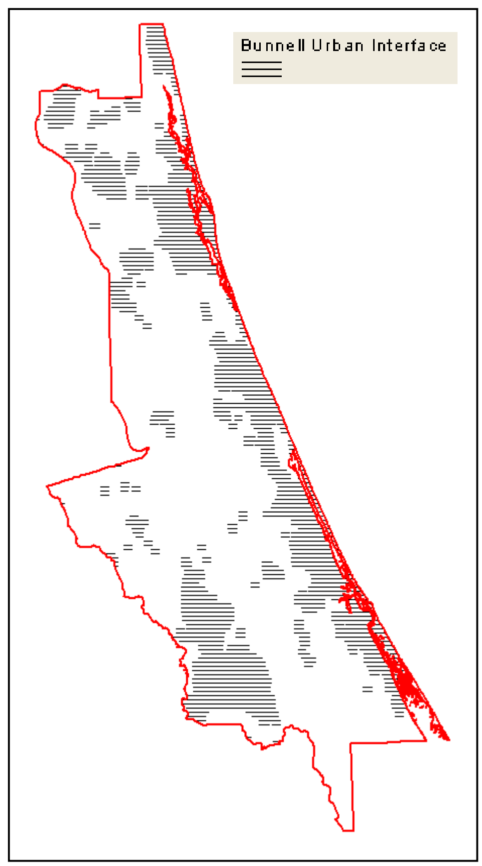


Environmental Effects Elements

The following are the environmental effects elements: Urban Interface, Utility Corridors, Plantations (natural and planted) and Critical Facilities (from FFS burn authorization plan)

Urban Interface

The urban interface was derived from a combination of the urban areas delineated on the fuels map and the 2000 Census Bureau data. This layer highlights key areas for fire prevention based on the human element. The urban interface areas were buffered (990 meters) to sufficiently represent areas of concern (See figure at right).



Urban Interface was created to represent the buffers around the two types of potential interfaces that exist within the state of Florida.

- URBN1: Category 1. Interface Community – exists where structures directly abut wildland fuels. This category was defined as having a population density of 250 or more people per square mile.

- URBN2: Category 2. Intermix Community – The Intermix Community exists where structures are scattered throughout a wildland area. There is no clear line of demarcation; wildland fuels are continuous outside of and within the developed area. This category was defined as having a population density of between 28-250 people per square mile.

Utility Corridors

Generating a 500 meter buffer around transmission lines developed the Utility Corridors layer. Inside the buffer represents areas where smoke and fire can become dangerous.

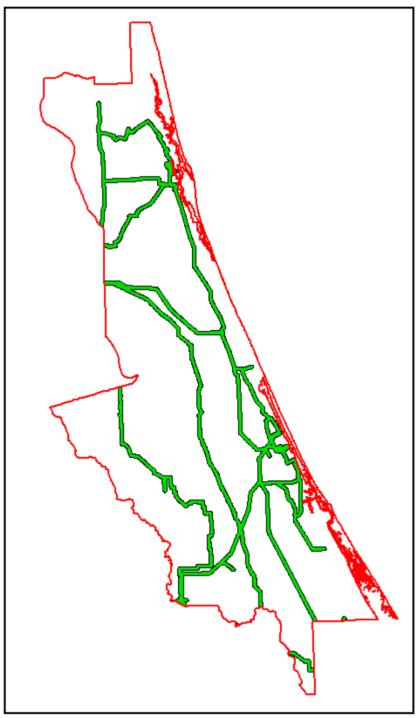
Plantations

Plantations were derived from the Florida Water Management Districts Land Use and Land Cover database and includes the following classes; forest regeneration, mesic flatwoods, pine plantations, longleaf pine, pine flatwoods, sand pine and upland coniferous forest.

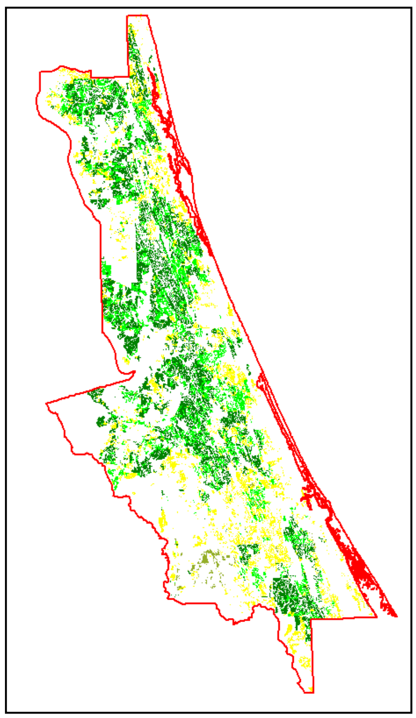
Critical Facilities

Critical facilities information was derived from the FFS burn authorization plan. Buffers were set at 1,000 meters for airports and heliports and 500 meters from any other feature in the critical facilities layer including schools, hospitals, airports, interstates and highways. This layer represents areas that are sensitive to smoke.

Utility Corridors



Plantations



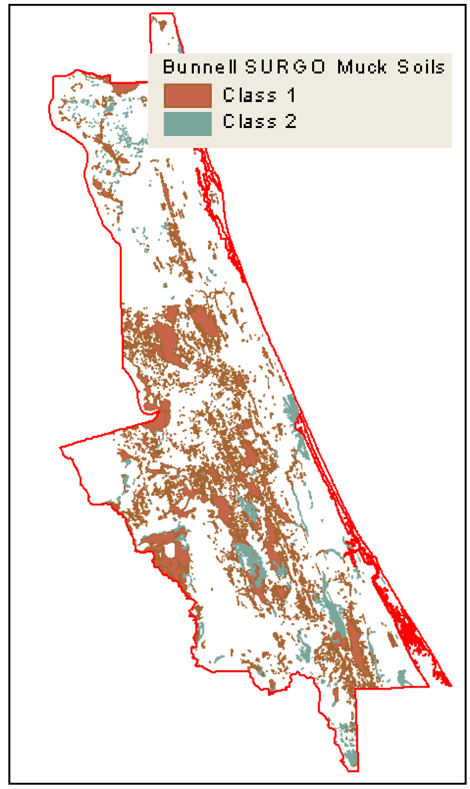
Critical Facilities

Expected Suppression Costs Elements

Fuel Type

The fuels layer was used to assign each cell in the State a fuel type of grass, shrub, timber litter.

Muck Soils

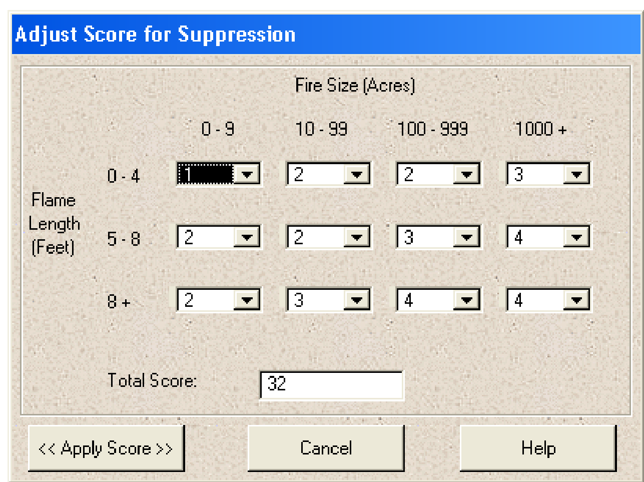


Muck soils were extracted from SURGO data by the FFS. Muck soils constitute areas of concern for fire fighting efforts as fires within these areas tend to be expensive and difficult to extinguish. The muck soils were classified into two groups but combined into one for the analysis.

- CL1 - "Organic Soils" (histosols) are true organic soils with greater than 16" of peat or muck. These soils will present the greatest problem to fire suppression efforts.

- CL2 - Soils that can have a veneer of organic soil typically less that 16". These are important to identify because they may pose some difficulty.

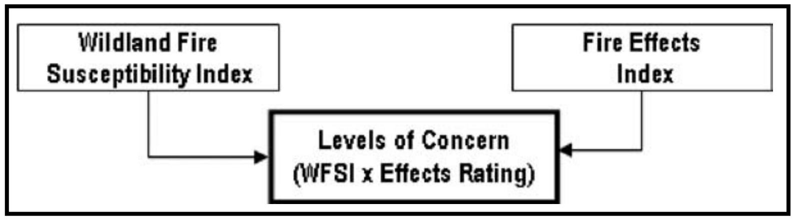
Suppression Rating



A group of FFS managers met and developed a suppression score for an average fire. This average fire was assigned to a "base" fuel type. The figure at the right shows the score for the base fuel type. Then, data was gathered on the suppression costs for fires within the state the fuel types, grass, brush and timber litter. The base fuel type was assigned to the average value, 32. Based on the difference in average fire cost in the fuel types to the base, suppression score was assigned to grass (9), brush (33) and timber litter (40). Slash was assigned the base score (32). The highest possible suppression score is 48 (12 * 4). Areas with muck soils were assigned a suppression score of 48.

Levels of Concern

The Levels of Concern are calculated as the Wildland Fire Susceptibility Index (WFSI) times the Fire Effects Index (FEI).



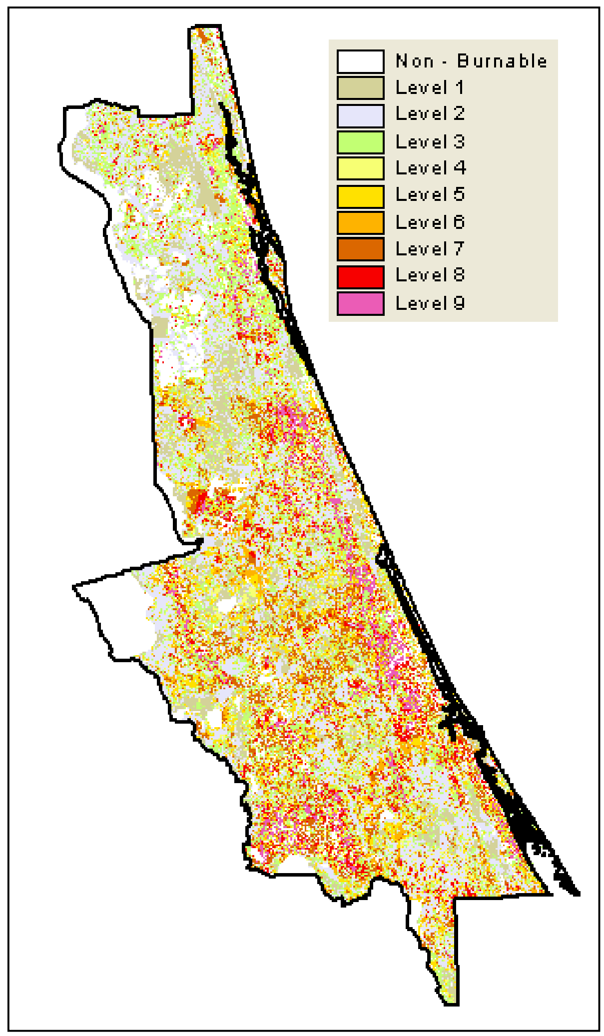
Level of Concern = WFSI * Fire Effects Index

The WFSI is a value between 0 and 1. The Fire Effects Index is a value between 0 and 100. Hence the LOC is a value between 0 and 100.

Classifications and Map

The output values were assigned to nine LOC categories ranging from low concern to high concern. The LOC output can be used to prioritize areas for further analysis. The FRAS allows the capability to modify the fuels, fire occurrence data (modifying WFSI) and Fire Effects to generate new results and compare them to the published data.

An example of the Levels of Concern map for the Bunnell District is in the figure at the right.



The LOC results can be used to complete a more detailed analysis at the local level and communicate wildland fire management concerns.

The LOC results can be used to:

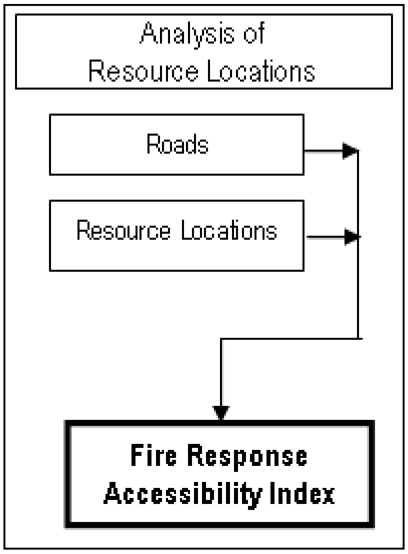
- Identify areas where mitigation options may be of value
- Allow agencies to work together and better define priorities
- Develop a refined analysis of a complex landscape and fire situations using GIS
- Increase communication with local residents to address community priorities and needs

Fire Response Accessibility Index

Definition

The Fire Response Accessibility Index (FRAI) is a relative measure of how long it would take initial attack resources to drive from their resource location to each cell.

Overview of Process



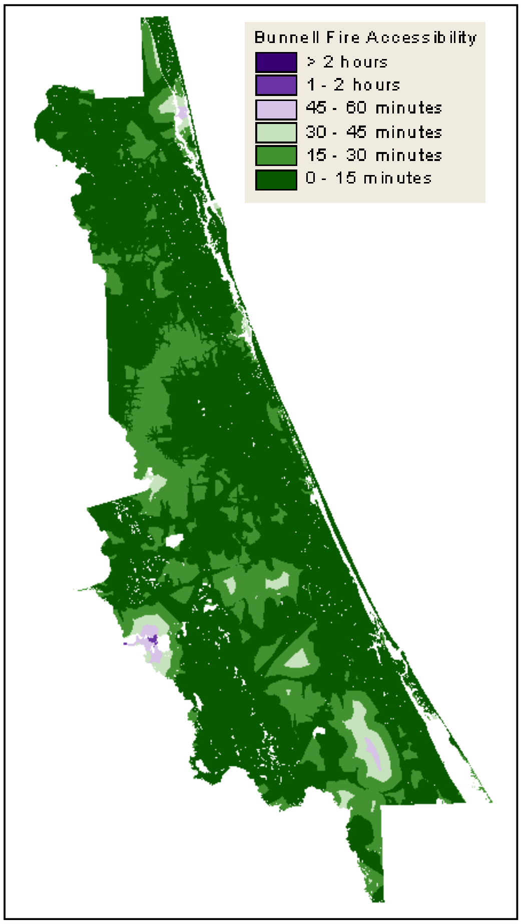
The Fire Response Accessibility Index (FRAI) is calculated based on the distance from resource locations. The speed traveled on roads was estimated at 40 miles per hour. Travel on roads was assumed to be eight times faster than travel off road. Water was coded as "NO DATA," meaning that travel across water could not be done unless there was a road crossing. A cost distance analysis was run allowing Arc/Info to assign an approximate time to reach each cell.

The Fire Response Accessibility Index allows users to identify areas of low accessibility from their resources. Coupled with the Levels of Concern data, this information will highlight areas where accessibility is low and the level of concern is high, providing valuable information for those concerned with the impacts of wildland fire.

Classifications and Map

The FRAI is divided into six categories as follows:

FRAI Class	Estimated Travel Time from Resource Location to Cell
1	> 120 Minutes
2	60-120 Minutes
3	45 – 60 Minutes
4	30 – 45 Minutes
5	15- 30 Minutes
6	0 – 15 Minutes



Define Published Results of the Florida Wildfire Risk Assessment (FRA).

The primary output from the Florida Fire Risk Assessment is the data developed by the project team of experts that describes fire risk across the state. These maps and data define the current situation and are referred to as the Published Results. These outputs provide a data platform for use by operational FFS staff, as well as other fire management collaborators, in mitigation planning and communication activities. These results can be used for identifying areas where more localized analysis (Project Areas) may be appropriate.

A series of spatial map data has been compiled and derived as the key part of the project to support operational staff in the future assessment and management of wildland fire risk across the State. The Published Results reflect the latest and most accurate data describing the wildland fire risk situation in Florida.

Definition of the Florida Wildfire Risk Assessment System (FRAS).

FRAS is an extension to the ArcView program.

- FRAS provides a computer program for FFS staff, as well as other Florida fire specialists, to access and use the Published Results of the Florida Fire Risk Assessment project.

- FRAS provides a communication method to display the existing wildland fire risk situation within the state to managers, officials and legislators, and operational staff.

- FRAS provides modeling capabilities that facilitate FFS staff in modifying key inputs, such as fuel models and fire occurrence, to reflect local knowledge and situations, to derive custom outputs for Wildland Fire Susceptibility Index (WFSI) and Levels of Concern (LOC).

Modeling capabilities extend the use of the Published Results by allowing District staff to model the effectiveness of fire management mitigation measures to determine potential effects of management options. It also identifies areas where the FOA, WFSI or LOC are high candidates for mitigation projects. This allows District staff to leverage local knowledge and expertise while taking advantage of the rich data derived from the assessment process.

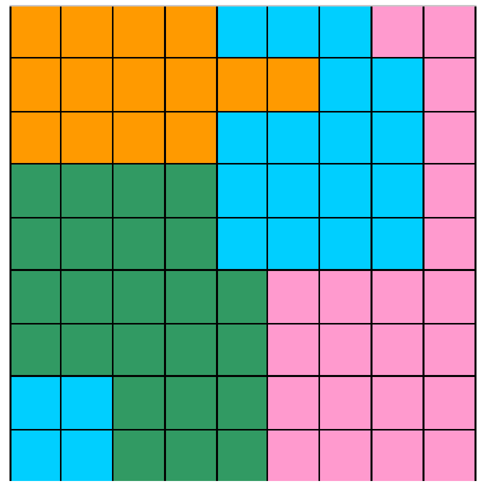
III. Introduction to GIS Concepts

Definition of GIS

A geographic information system (GIS) is "A collection of computer hardware, software, and geographic data for capturing, storing, updating, manipulating, analyzing, and displaying all forms of geographically referenced information" (Kennedy H., 2001). Basically, a Geographic Information System manipulates spatial information. There are two types of spatial data:

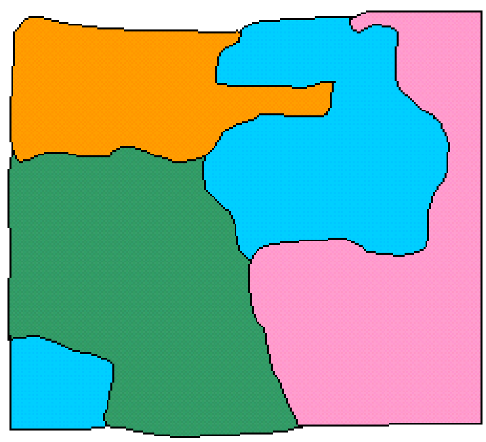
- Grid data is comprised of equally sized square cells arranged in rows and columns. The term raster can be used interchangeable with grid, however raster is usually reserved for satellite imagery. Spatial models most often utilize grid data because of the relative speed in processing time. Accuracy of the grid data is dependent upon the size of the grid cell and the precision in which the original data was captured. The figure at the right shows an example of how a grid land use land cover file would look.

  Each pixel is assigned to one class or object (i.e. Agriculture, forest, urban, wetland, etc.)



- Vector data is represented as polygon, line or point data. Vector data tends to follow reality better than a grid because vector data is not limited by the size of the cell. Instead, accuracy is limited only to the precision of the input data. The figure at the right shows an example of the land use land cover above would look if it were a polygon coverage.

  The two types of spatial data, grid and vector, are interchangeable, however precision is not gained when converting grid to vector and precision is lost when converting from vector to grid.



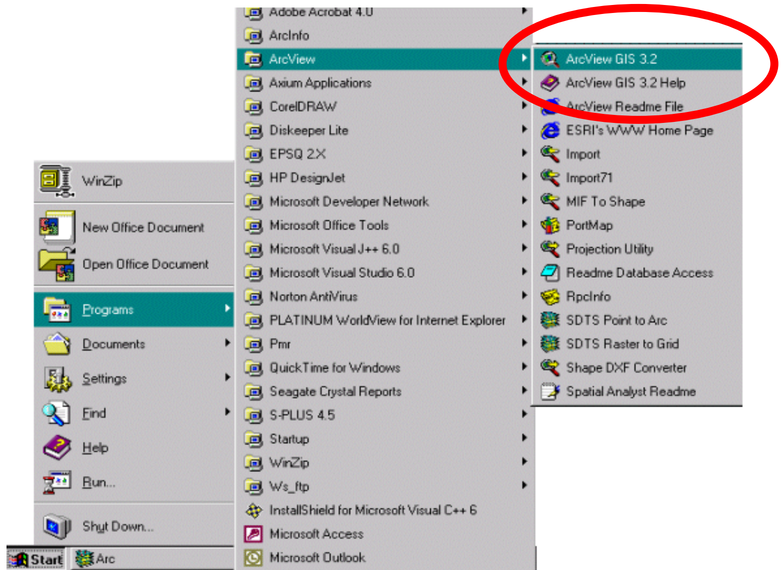
  Each feature, polygon in this case, is assigned to one class or object (i.e. Agriculture, forestry, urban, wetland, etc.)

The Fire Risk Assessment System uses a combination of vector and raster (grid) GIS data. ArcView allows you to view, analyze and create maps and reports with both types of data.

Starting ArcView

If an icon is on the Desktop, then the ArcView program can be initiated by doubling clicking on the icon. Otherwise,

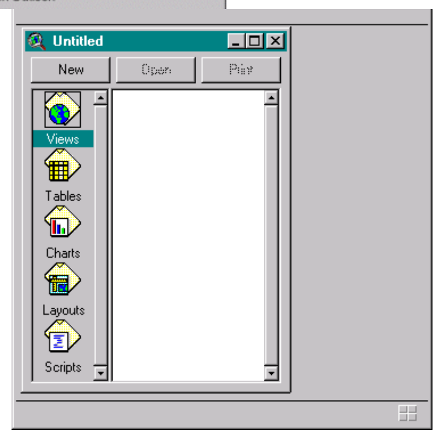
- Click on the **Start Menu**
- Click on **Programs**
- Click on **ArcView**
- Click **on ArcView GIS 3.X** to enter ArcView



The figure at the right shows an example of how to navigate to ArcView through the Start menu.

Description of Opening Screen

The first window that appears is called the **Project Window**. From this window, users can add views, add tables, create charts, develop layouts and write scripts. The figure at the right shows how ArcView looks once the program starts.



Views

Lists available views and allows the creation of new views. Views are windows in which different spatial layers (either grid or vector) geo-referenced to each other can be added to create a map (i.e. a fuels map with roads overlaying). The data that has been provided with the FRAS is already geo-referenced to the Albers projection.

Tables

Lists available tables and allows the user to add existing dBase, text or ArcInfo Info tables to the project. Also allows users to create new tables.

Charts

Lists available charts and allows the user to create new charts based on existing tables within the project.

Layouts

Lists available layouts and allows the user to create new map layouts using existing views, tables, and / or charts.

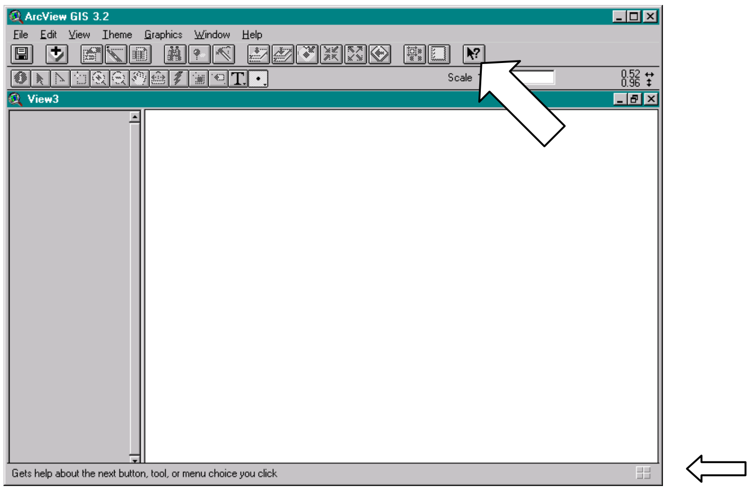
Scripts

Lists available scripts and allows the user to customize ArcView with scripts.

For the purpose of this presentation, the basic functionality associated with the Views, Tables, Charts and Layouts will be highlighted. To create scripts requires advanced knowledge of ArcView and Avenue programming. For more information on scripts, consult either ESRI's ArcView 'Using Avenue' manual or contact ESRI to enroll in their course 'Programming with Avenue'.

Getting Help in ArcView

To find out what a button, tool, or menu choice does, you can move the cursor over it but do not select it. A description called a Tool Tip will appear in ArcView's status bar (the bottom). Below shows where the description appears within the ArcView window.



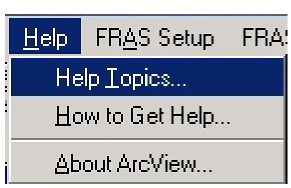
Status Bar where description of button, tool or menu choice appears.

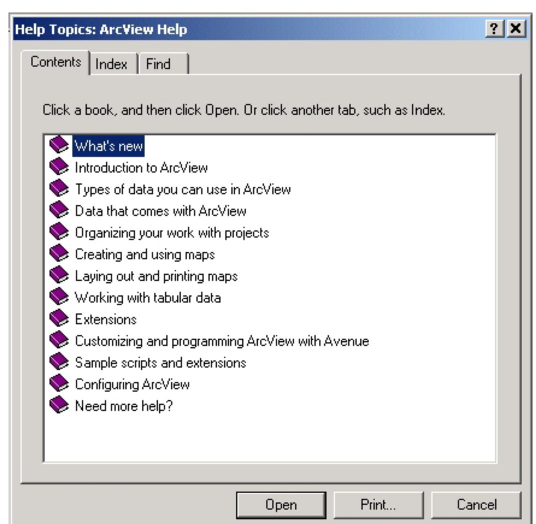
To get more help about a button, tool, or menu choice, click on the **Help Button**  then click on the button, tool, or menu choice you want more information about.

If an ArcView dialog box is open and you would like more information about it, simply press the **F1** key.

Finally, help is available through the **Help Menu**, then selecting '**Help Topics**'. The **Help dialog** allows users to search through help in three ways:

- Browsing the **Contents**,
- Searching the **Index**, and by
- **Find**ing a particular word within the help files.

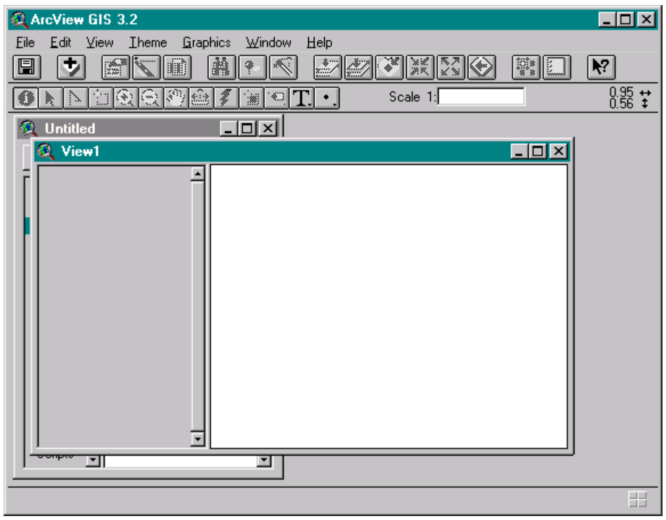




Views

Note that before the functions of FRAS can be accessed, the active window in the ArcView application has to be a view.

To open a new view, double click on the View icon from the **Project Window**. You'll notice the Menu across the top, the ArcView Task Bar, and the Tool Bar have changed. The combination of the Menu, ArcView Task Bar and Tool Bar when the view is open (see figure below) is referred to as the View Graphical User Interface (View GUI).



Menu
ArcView Task Bar
Tool Bar

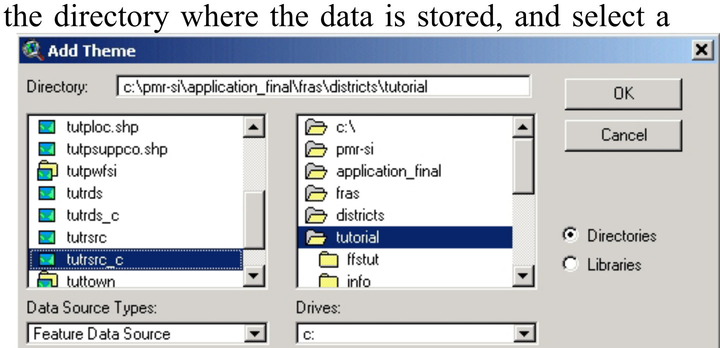
When a view is first opened, most of the buttons, tools and menu choices are gray, meaning you can't use them until you add a theme.

Adding a Theme

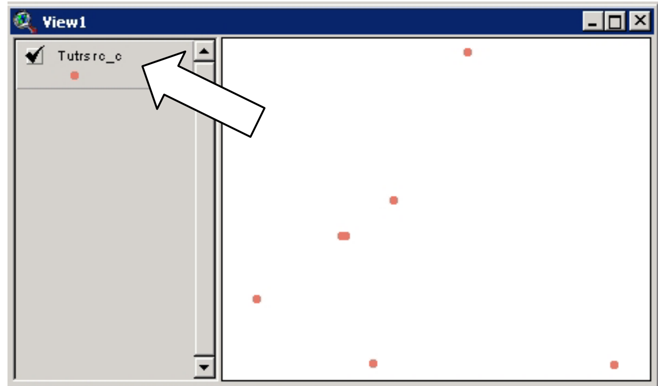
A theme is ArcView's terminology for a vector or grid. Spatial data can be stored as grids or vector files, as seen in the introduction, and can be saved as many types of formats. ArcInfo uses coverages and grids, ERDAS Imagine uses Images, ArcView uses shapefiles, and the list continues.

Click on the **Add Theme** button 

In the Add Theme Dialog Box, navigate to the directory where the data is stored, and select a coverage or shapefile. For the purposes of this example, select the resource locations file. This file has the XXXrsc_c notation where XXX represents a three-letter abbreviation for the district. The figure at the right shows an example of how the dialog box will appear. Note that by holding the shift key down, the user can select more than one theme to add at a time. Click **OK** to add the selected theme(s) to the active view.



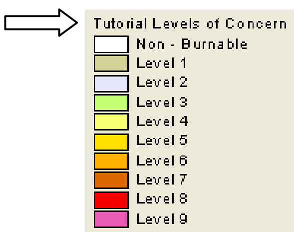
Once the OK is checked, you are returned to the view with the theme active, but not drawn. To draw the theme, click on the little box to the left of the theme name and the theme will draw within the View screen. Click on the button next to the name to have the theme displayed. The figure at the right shows how to draw a theme.

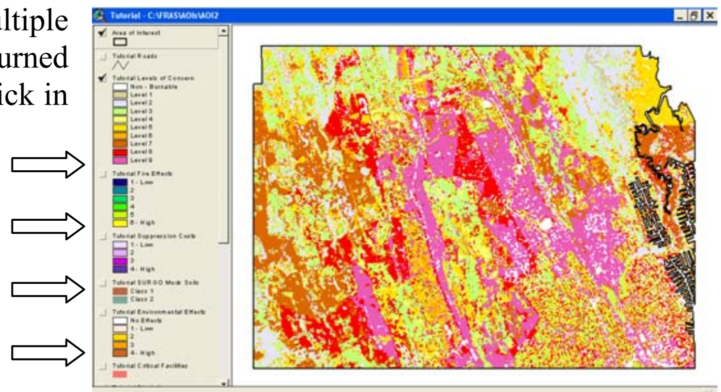


Clicking once on the theme name will activate that theme. A theme needs to be active before any queries or analysis can be done using that theme.

Managing Themes

When the FRAS AOI theme opens, multiple themes appear in the view. Themes can be turned on and off by making a checkmark (left click in the square to the left of the title).

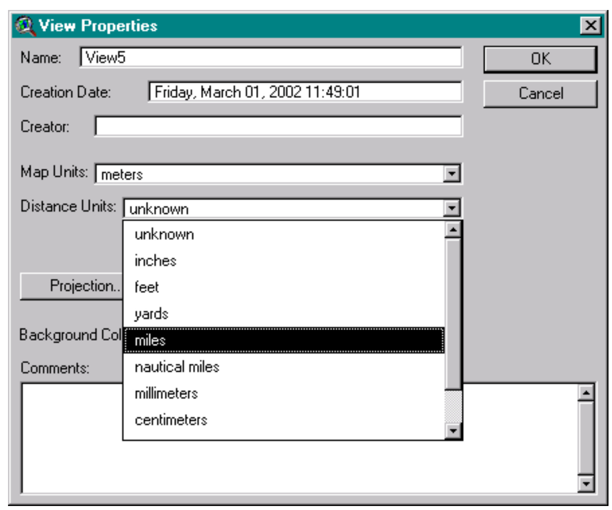




When multiple themes are selected, the theme at the top of the view window will overlay all other themes. To move a theme to the top, left click on the theme and drag and drop it to the top of the view.

Change the Map Units

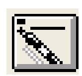
All of the FRA data sets that are provided to the FFS are in the Albers projection with meters as the units. In order to perform any distance calculations or queries, or before a scale bar can be added to a layout, ArcView needs to know that the View contains themes with meters as the units. To set this, on the menu bar, click on **View**, then on **Properties**. A **View Properties Dialog Box** opens. Change the **map units** to meters and the **distance units** to miles by selecting these choices from the pull down list. Figure 9 shows an example of how to change the view properties distance and map units. Click OK to apply the changes to the view.



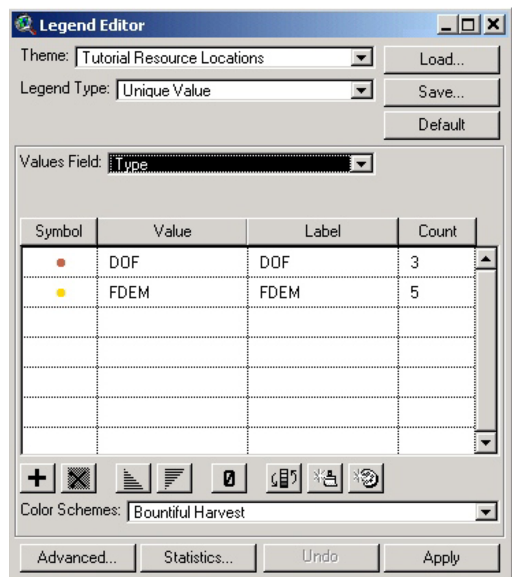
Hot Tip

Note that any themes that are added to the view through the FRAS automatically have the map and distance units correctly set.

Changing a Legend Display

The Theme's Legend Editor Dialog Box allows users to change the appearance of the theme. To open the theme's Legend Editor Dialog Box, double click on the theme name. Alternatively, the user can open the Legend Editor Dialog Box by first making the theme active, then clicking on this button from the ArcView  Tool bar.

When first opened, the legend editor will show that the **Legend Type** is single symbol. Change this to 'Unique Value' and change the **Values Field** to 'TYPE'. Two rows will show up in the legend editor. The figure at the right provides an example of how the legend editor will look.

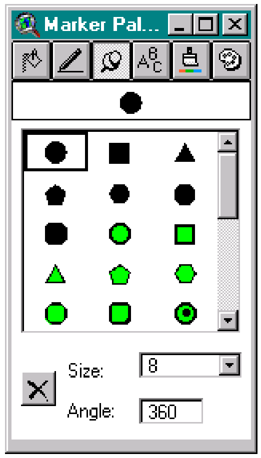


The symbols, or colors and shapes for each point, are automatically assigned for each value within the Type field. To change these, double click on the colored point to bring up the **Symbol Window** where you can change the fill type, line type, marker type, text font and color. You can also enter the Palette manager where you can add new palettes. A palette contains fill types, line types, marker types, text fonts and colors. For a complete list of available palettes, see ESRI's manual "Using ArcView GIS."

The Figure at the right shows the default **Symbol Window** that pops up with a "point" coverage.

To change the symbol a point is drawn with, click on a different shape within the **Marker Palette**. ESRI provides a symbol palette that contains a flame that can be used in our example. To load this symbol palette into the symbol window and have it become available, click on the

Palette Manager icon, . Then click on the '**Load**' button.



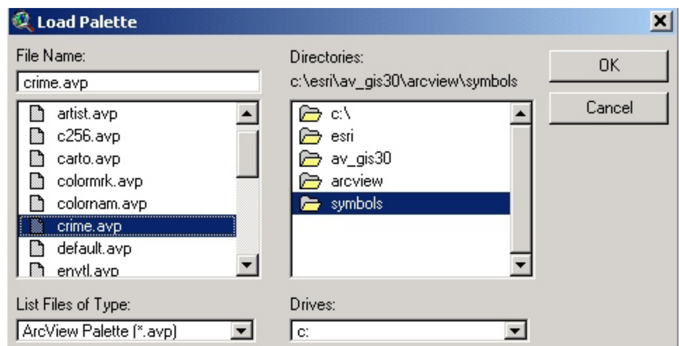
The icons from left to right are:

- **Fill Palette** (for use with polygon vectors),
- **Line Palette** (for use with line vector files),
- **Symbol Palette** (for use with point vector files),
- **Text Palette** (to change appearance of text),
- **Color Palette** (to change the color of a theme or graphic), and the
- **Palette Manager** (to add new palettes to the dialog box).

Navigate to the following directory:

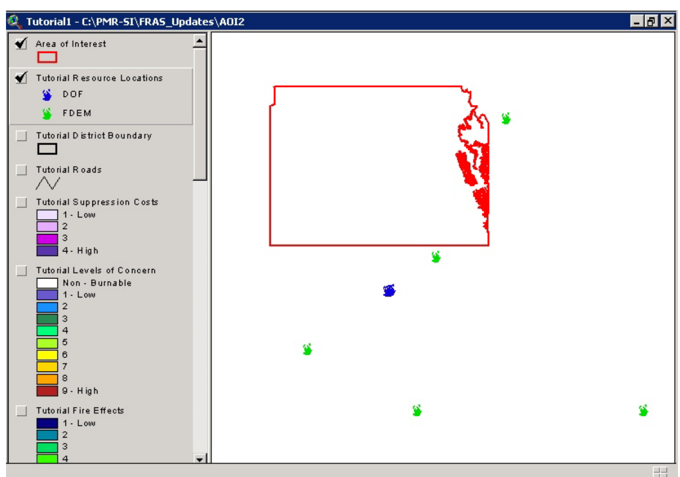
c:\esri\av_gis30\arcview\symbol directory.

If ArcView is stored on a different drive, then substitute that drive for c:. Select **crime.avp** and click **OK**.

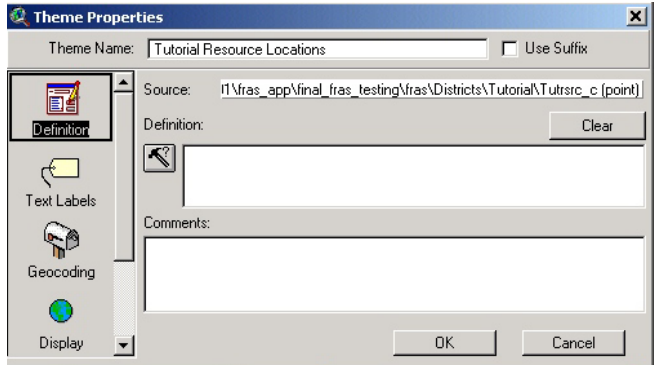


An example of the Load Palette and how it would be filled out is shown at the right.

Click on the **Marker Palette** icon to select the new marker symbol. Scroll down and select the flame picture and set the size to 12. Change the color by selecting the **Color Palette** icon, . Set the color for FFS Resource Locations to blue and change the FDEM resources to the green. The view should now look similar to the figure at the right.



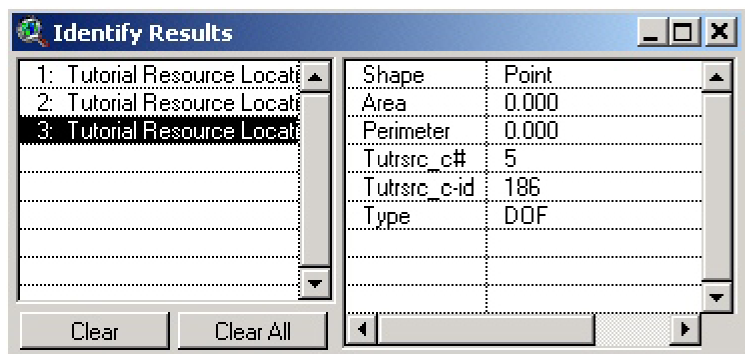
Changing the Theme Properties



The theme properties must be edited if the user wishes to change the name of the theme drawn. To do this, make the theme active by clicking on the name once. Then click on **Theme** from the main menu following by clicking **properties**.

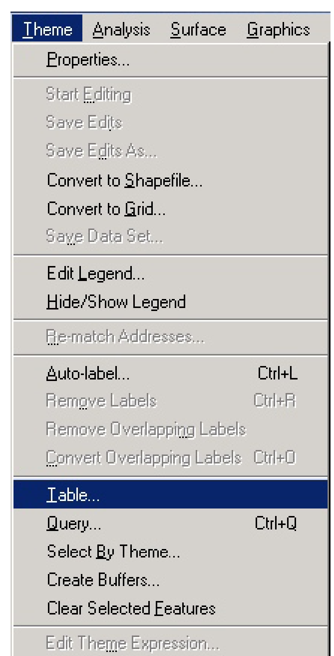
Alternatively, the user can select the button from the ArcView Tool bar. Change the **Theme Name** to "Initial Dispatch Locations" and click **OK**. In the figure at the above right, the Theme Properties Dialog Box is displayed.

Using the Identify Tool to Query a Theme



To query a fire to gain more information quickly, first make the theme active by clicking once on the theme name. You will notice a raised box around the entire theme legend. Next click on the identity tool and then click on a resource location. An 'Identify Results' dialog opens showing you all the information linked to that point, see table to the right. If more than one point is selected, as multiple resources are found in the same area, multiple records will be selected. In the figure above right, three fire points were selected at once as they all appear within the same area.

Tables



Tables can be viewed for any point, polygon or line coverage in the views by selecting "Tables" under the **Theme** menu or by selecting the Table button on the task bar.

To view the table for plantations, click on plantations to make it the active theme. Select the table button above or use the theme menu to display the table for plantations.

Summarize Tables

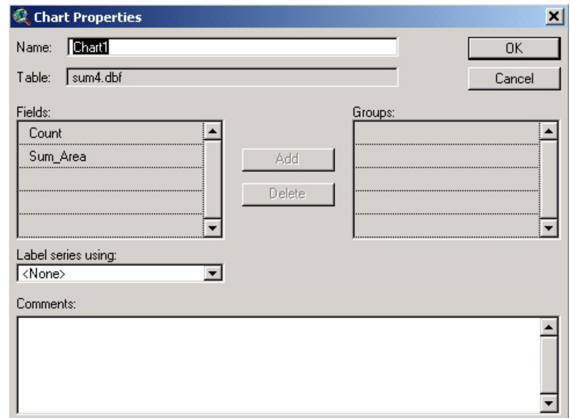
To find out the acreage of plantations by class, the user can summarize the table. To do this, make the Attributes of Plantations table active and select the Description column to make it active. Click on the **Summarize Button** on the ArcView Task Bar bar. Select 'area' for the field and 'Sum' for the Summarize by. Click on the 'Add' button to add this analysis to the table.

Descript	Count	Sum_Area
FOREST REGENERATION	31	8151928.4004
LONGLEAF SANDHILL	1	58662.7109
MESIC FLATWOODS	69	6664863.5703
PINE PLANTATIONS	49	5721188.8223
	226	4932148.5391

Then click OK. The result is a summary of acres by Plantation category.

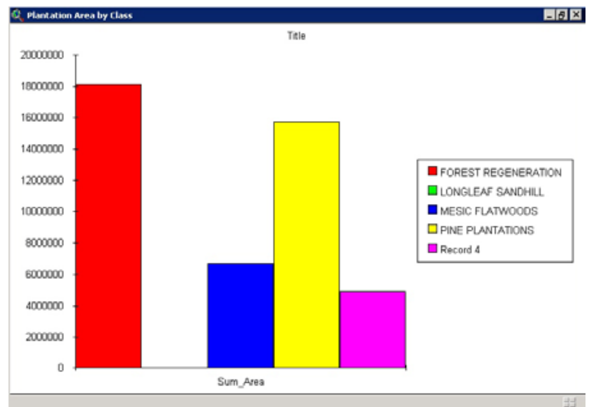
Charts

Charts are used frequently to display data in a clear and concise format. ArcView provides some basic functionality for creating charts.



Create New Chart

Double click on the **Chart** icon in the **Project manager window**. (Plantations Table is active). A **New Chart Dialog Box** opens prompting for a table name in which to create the chart. Select the summary table just created and then click **OK**. The **Chart Properties Dialog Box** opens. Select "Sum_Area" field and click on the '**Add**' button. Then Label Series Using the Description field. Change the chart title to 'Plantation Area by Class' and click on the **OK** button. See figure at the right for an example of how the **Chart Properties** dialog box would look.



A new chart appears similar to the figure at the right. To change any of the chart items, click on the **Chart Element Tool** then click on the element to change, like the Title for instance.

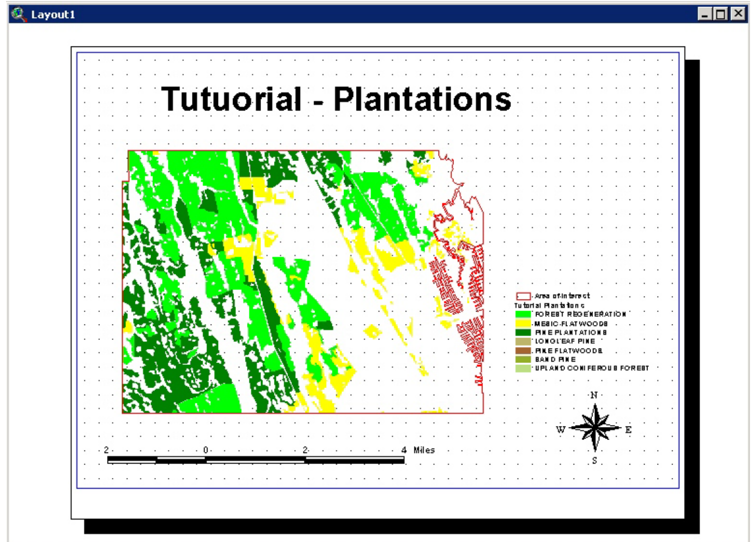
Layout

A layout is a map that lets the user display views, charts, tables, and graphics. The layout is used to prepare a map in ArcView.

Create New Layout

Double click on the **Layout** icon in the **Project Manager Window**. A new layout window opens with a blank layout. ArcView provides a couple of templates that can be used to help organize the layout. To use an existing template, choose the **Layout menu** then **Use Template**. The **Template Manager** opens showing a list of available templates. Select the 'Landscape' template and click the **OK** button. Notice that the layout now has the information contained within the view, a legend, a north arrow, and a scale bar. The layout also has a gray box along the top of the layout. This is for the title.

To add a title, double click on the gray box and add the new title in the text properties dialog box. The figure to the right shows an example of the finished layout.

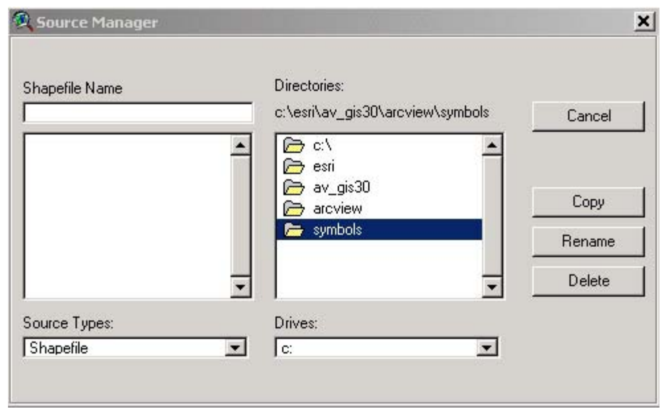


Data Management

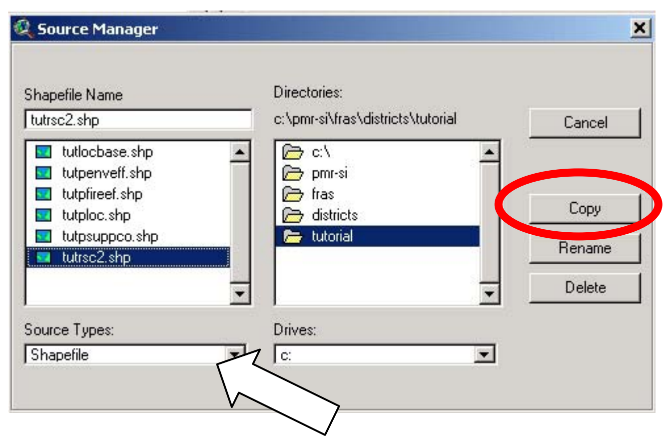
As themes or grids are generated in ArcView, you can save them to specific directories with specific names when they are created. However, there are instances when you need to copy, rename or even delete these themes. This section shows you how to perform common data management tasks by using ArcView's Source Manager Dialog.

Copy a Theme or Grid to a New Location

To copy a theme or grid to a new location, open the Source Manager Dialog Box by clicking on **File**, **Manage Data Sources** menu. The Source Manager Dialog opens.

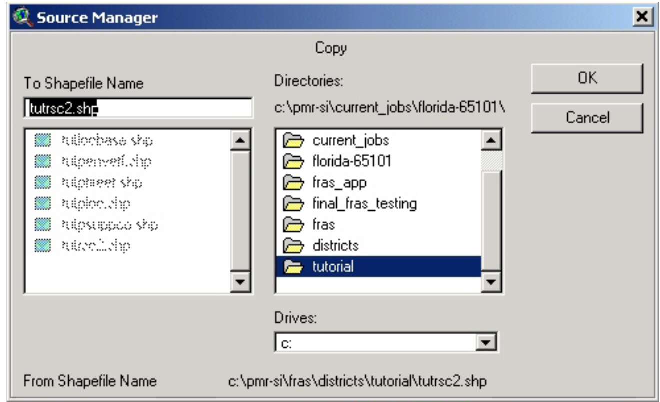


Navigate to where the data is stored and select the desired shapefile or grid to copy (Figure to right). Note that the source manager defaults to searching for shapefiles. If a copy of a grid is needed, change the Source Type in the lower left corner of the dialog to Grid. In order for Grid to be an option, the Spatial Analyst extension must first be loaded.



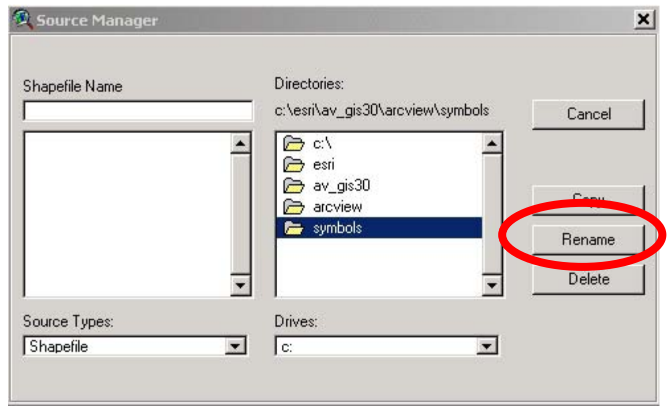
Click on the **Copy** button along the right side of the dialog.

The source manager then prompts for a location and name for the new shapefile. Once specified, click **OK**. The dialog does not close as it returns to the original directory. This behavior is to facilitate moving many shapefiles or grids relatively quickly.



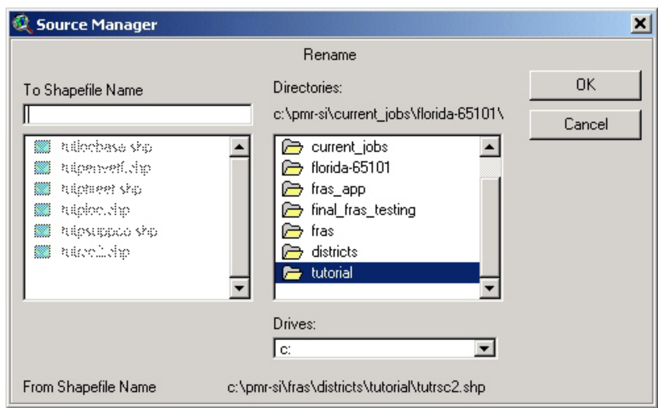
Rename a Theme or Grid

To rename a theme or grid, open the **Source Manager Dialog Box** by clicking on **File**, **Manage Data Sources** menu. The Source Manager Dialog opens in a manner similar to the figure at the right. Navigate to where the data is stored and select the desired shapefile or grid to rename.



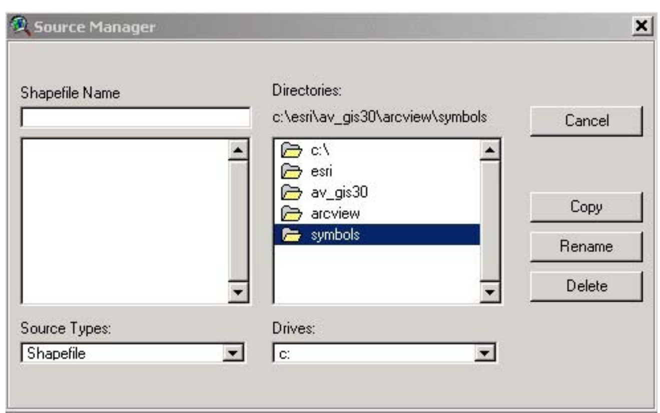
Click on the **Rename** button along the right side of the Dialog.

The source manager then prompts for a location and the new name for the shapefile. Once specified, click **OK**.

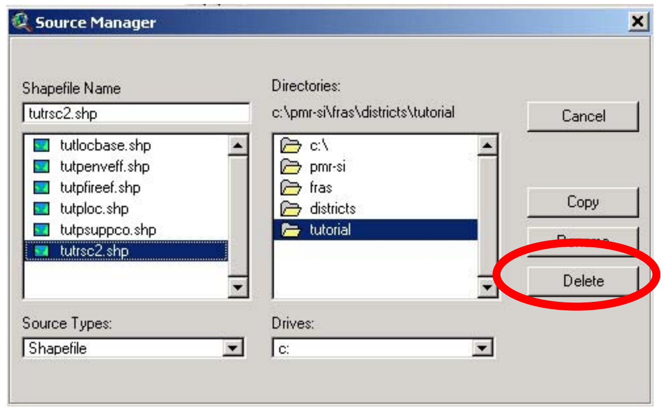


Deleting a Theme or Grid

To delete a theme or grid, open the Source Manager Dialog Box by clicking on **File** from the main view menu, then **Manage Data Sources**. The Source Manager Dialog opens (see figure at right).

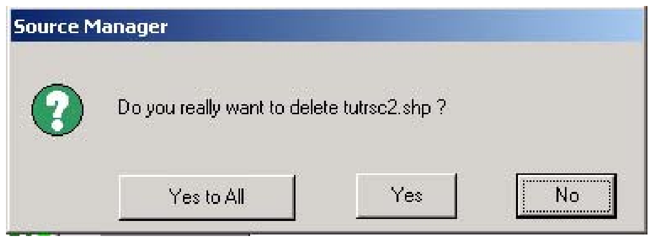


Navigate to where the data is stored and select the desired shapefile or grid to delete (see figure at right). It is important to delete grids and shapefiles using the Source Manager to ensure all related files associated with the data are removed from the system.



Click on the **Delete** button along the right side of the Dialog.

The Source Manager then prompts you to make sure you really want to delete the shapefile or grid. Click either **Yes to All** or **Yes** to delete the data.



IV. Introduction to the Florida Wildfire Risk Assessment System (FRAS)

Goals and Objectives

The purposes of the FRAS are to:

- Provide a computer program for FFS staff, as well as other Florida fire specialists, to access and use the Officially Published Results of the Florida Fire Risk Assessment project.

- Provide a communication method to display the existing wildland fire risk situation within the state to managers, officials and legislators, not only operational staff.

- Provide modeling capabilities that facilitate FFS staff in modifying key inputs, such as fuel models and fire occurrence, to reflect local knowledge and situations, to derive custom outputs for Wildland Fire Susceptibility Index (WFSI) and Levels of Concern (LOC).

A series of spatial map data has been compiled and derived as the key part of the project to support operational staff in the future assessment and management of wildland fire risk across the state. This data has been derived by a team of fire management experts and reflects the latest and most accurate data describing the wildland fire condition within Florida. Tools are provided in the FRAS that support the printing of maps and reports using the published results. The data has been developed to facilitate comparison of areas across the state in this regard.

Modeling capabilities extend the use of the Published Results by allowing District staff to model the effectiveness of fire management mitigation measure to determine potential effects of management options. Areas where the FOA, WFSI or LOC are high are candidates for mitigation projects. This allows District staff to leverage local knowledge and expertise while taking advantage of the rich data derived from the assessment process.

FRAS Design

The FRAS was developed as a standalone application that operates as an extension to the ArcView 3.x GIS software. FRAS was specifically designed to operate on the AcrView 3.x versions of ArcView GIS. The application will not operate on the ArcGIS platform. The application was designed to utilize the FlamMap program in a standalone mode to support the calculation of fire behavior outputs including the seamless conversion of data between the two programs. The integration approach also supports future planned development of the FlamMap program that will continue to occur independently.

The FRAS was also designed to leverage the capabilities found in the ArcView GIS platform. The standard ArcView interface has been used as the framework for the FRAS interface. The FRAS is accessed via a series of custom pulldown menu options within AcrView3.x that provides custom functionality and manages data in the standard ArcView View-Theme data organization.

All other ArcView functions are available while the FRAS options are available. In several instances custom tools have been developed to facilitate easier analysis and review of data. However, none of the core capabilities found within ArcView have been removed. The ArcView GIS platform provides a robust and extensive framework for growth of the application and further analysis by operational staff.

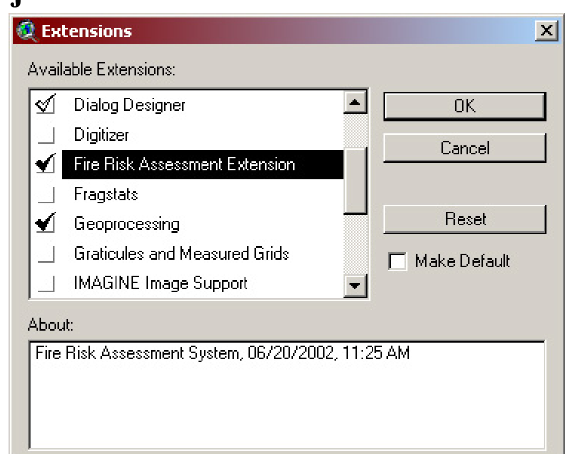
Districts and Weather Influence Zones

The Published Results data is organized and tiled into two separate geo-administrative units, Districts and WIZs. Due to the volume of data for the statewide coverage, base data, mandatory themes and derived data have been broken into coverage layers by FFS District. This approach facilitates better use by the District staff while minimizing the amount of data storage required.

Ensuring District(s) Data Is Available

The FRAS was developed to operate on the District-wide and WIZ-wide Published Results data. Accordingly, it is important that the District and WIZ data for relevant Districts be loaded on to the computer. Be sure to adhere to the data organization protocols.

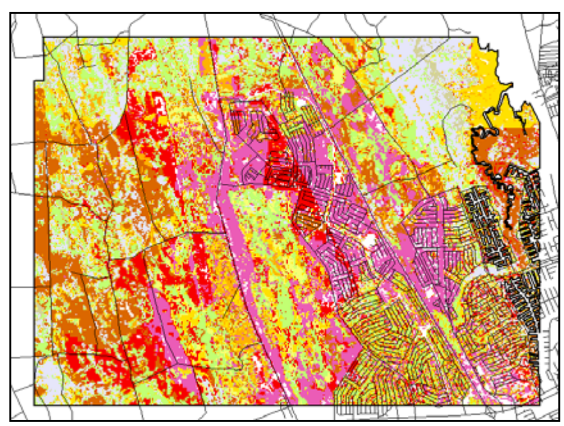
ArcView Extension versus the ArcView Project File



In order to facilitate use of the FRAS, the application was designed as an extension. ArcView extensions can operate independently of a specific project. This allows users to gain access to FRAS capabilities when using their own custom project files.

To load the FRAS extension, select the File-Extensions menu option from the ArcView Project menu. Clicking on the Fire Risk Assessment Extension and clicking on the OK button will add the FRAS menu options to the existing ArcView project.

The Sample Tutorial Data Set



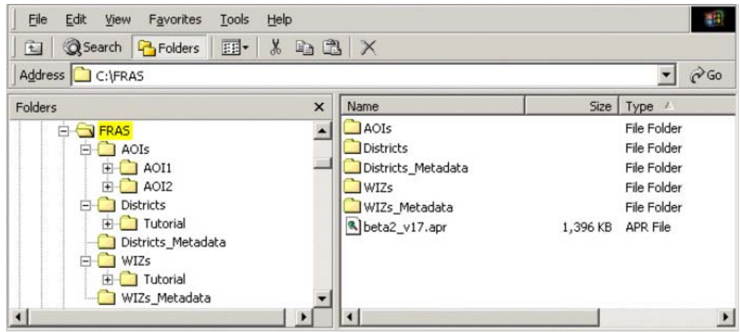
A tutorial data set is provided with the FRAS to facilitate learning and understanding of the capabilities of the software. This data represents a small subset of a single District. This sample data will allow you to understand the capabilities of FRAS.

Data Organization

Data is organized within three primary data folders:

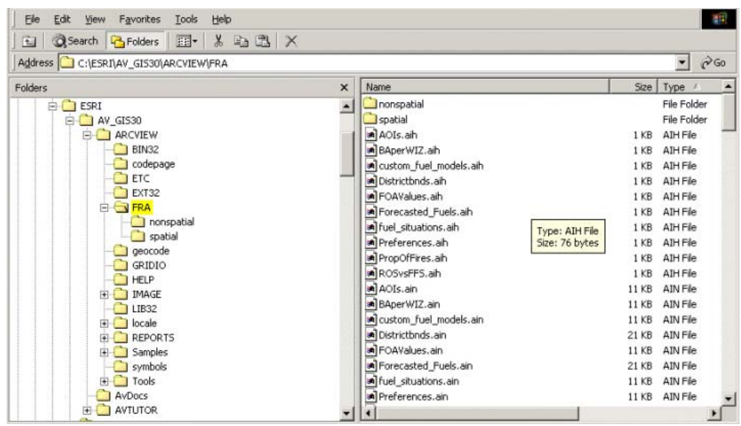
- Published Results data by District,
- Published Results data by Weather Influence Zone
- User defined data based on Area of Interest.

These data folders are all located within the main FRAS folder. The FRAS folder can be located on any path, however the X:\FRAS\Districts, X:\FRAS\Wizs and X:\FRAS\AOIs subdirectories will be imposed and used by the application. The figure at the right presents an example of this data structure where the main FRAS folder is located at root of the C drive (C:\FRAS). AOI data is stored in individual subdirectories created and managed seamlessly by the FRAS in the X:\FRAS\AOIs folder.



AOI subdirectories are created automatically as new AOIs are created. FRAS numbers them sequentially (AOI1, AOI2, etc). For modeling purposes, any modified data, such as fuels, or derived data, such as a new WFSI or LOC, for an AOI is stored in these sequentially numbered AOI folders. Tools are provided to Add or Remove AOIs in the FRAS Modeling menu options.

The FRAS application also utilizes numerous data files to support the management and operation of the application itself. This data is maintained seamlessly by the application in the folder named: X:\\ESRI\AV_GIS30\ArcView\FRA.



Starting ArcView

Start ArcView by clicking on the program icon or from the Start, Programs menu in Windows.

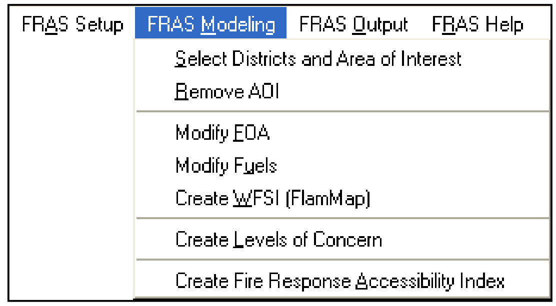
Default ArcView Project

A default ArcView project is provided as an ideal starting point for learning the FRAS application. The default ArcView project has predefined themes and has the FRAS extension loaded. The project file is fras.apr and can be found in the "FRAS" installation directory. Select Open an Existing Project and double click on the file fras.apr file.

Hot Tip

It is recommended that users utilize this project as it has been designed so it can satisfy all requirements and the use of other ArcView project files is not required.

FRAS Process Flow

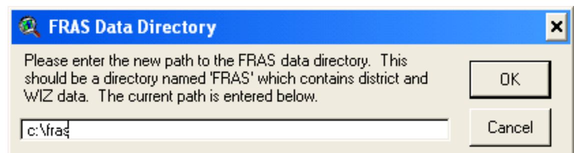


The FRAS extension has been designed as a series of pull down menu options that operate in either the ArcView Project or View interface. The menu options for the Project interface represent a subset of capabilities appropriate for the interface. In particular, the FRAS Modeling options are limited.

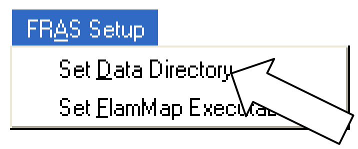
FRAS Setup

This menu item allows the user to set the path to the FRAS data directory and to the FlamMap executable file.

Set Data Directory

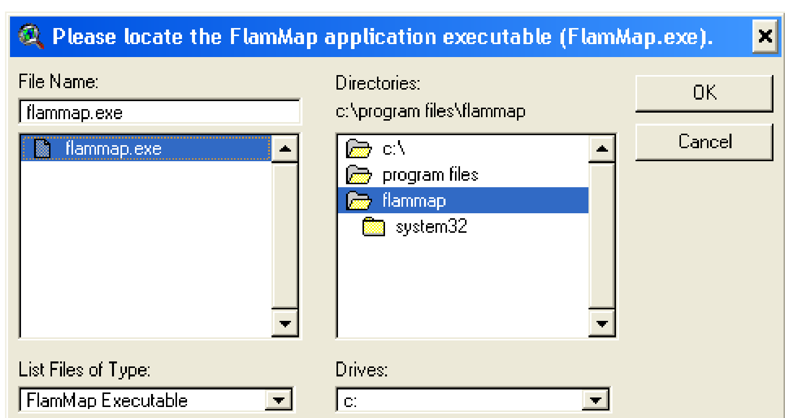


The FRAS requires data to be stored using the following directory structure: X:\FRAS\Districts. The path to where this directory is stored must be specified. When FRAS is opened for the first time, the user will be prompted for the location of this directory. Type in the directory path and click OK.

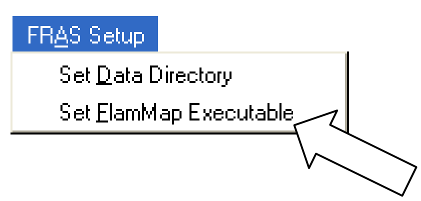


Once specified, the path is stored within the application, it doesn't have to be re-set, even if other new FRAS projects are opened. To change the path, click on the FRAS Setup menu from the project window menu bar or the view window menu bar, and then click on Set Data Directory.

Set FlamMap Executable



If the Spatial Analyst extension is available, it will be loaded into the project. The FRAS will then automatically search the computer for the FlamMap executable. If the executable is not in the registry nor is it in the C:\Program Files\FlamMap directory, the user will be prompted to locate the flammap.exe program file. Once this is defined, the user will not need to set this parameter again unless either FRAS or FlamMap is reinstalled.



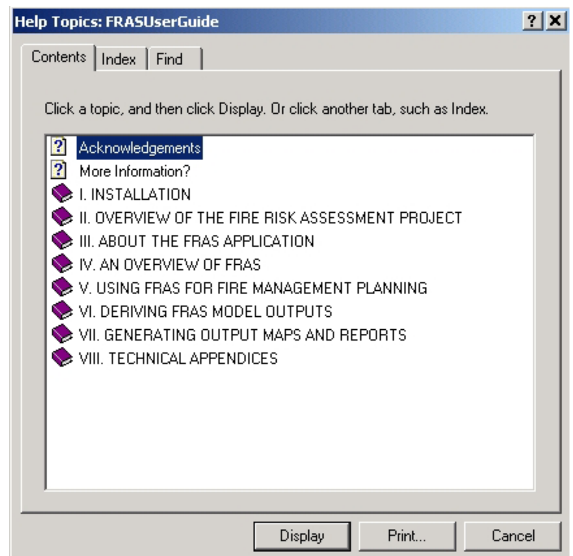
The user can also specify the location of the flammap.exe file using the FRAS Setup, Set FlamMap Directory menu item.

Once specified, the file path locations are stored within the FRAS and they do not need to be reset, even if other new FRAS projects are opened. The path to the program may be changed in the application by clicking on the FRAS Setup menu from the project window menu bar. The user can also use the View Window menu bar and then click on Set FlamMap Executable.

FRAS Analysis Capabilities
AOI selection and modeling capabilities include tools used within Project Areas, including the ability to modify fire occurrence rates and fuels treatment. The users also have the ability to modify Resource Locations within an AOI. Re-mapping of FOAs, WFSIs, LOCs and FRAIs is possible using the analysis tools. Users without Spatial Analyst will have the ability to only adjust the Fire Effects Index input scores and re-map the resulting Levels of Concern.

FRAS Output
Options exist to generate maps or standard reports for the Published Results View or the active AOI View.

FRAS Help
This menu item provide access to the on-line Help system. Selecting **FRAS Help** and clicking on **Review User Guide** will display the FRAS Help dialog which allows users to search by browsing the contents, searching the index and finding a term.

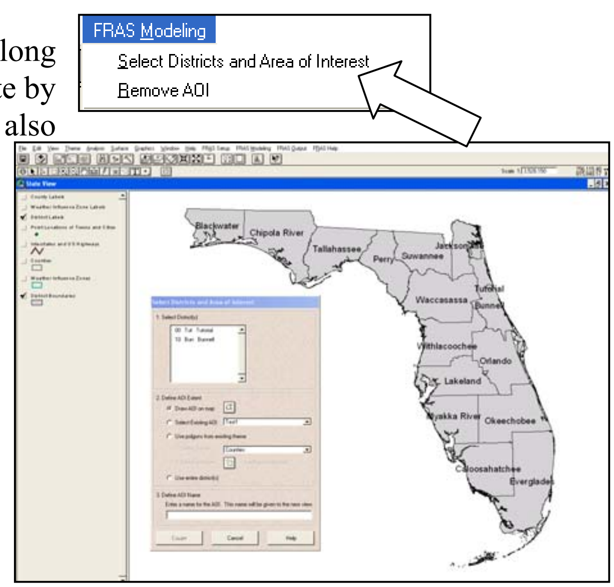


Selecting District(s)

When the FRAS is launched, there are three default views that appear. These are:

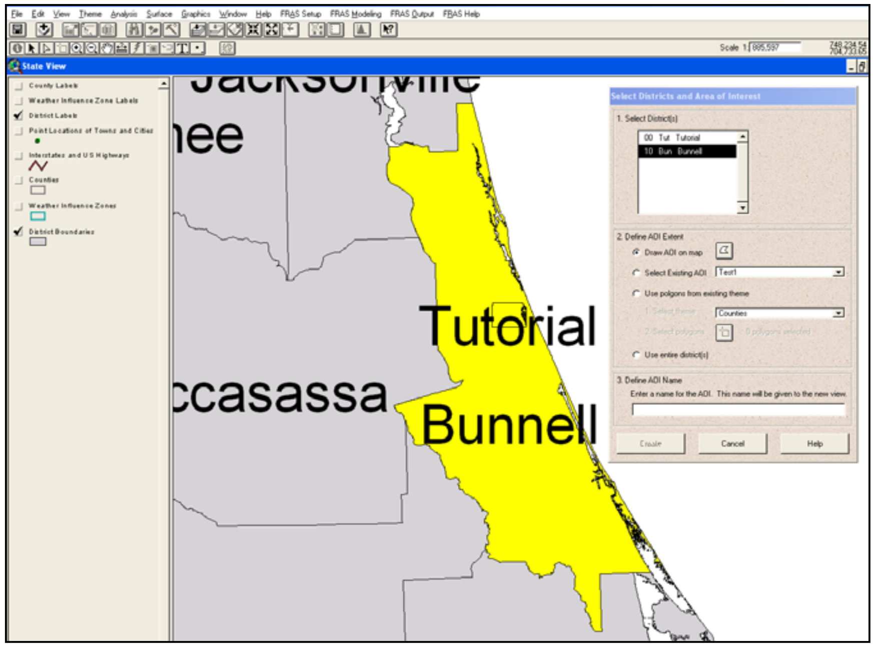
- State View
- FFS Published FRAS Results View
- AOI Data View

State View
When the program first opens, the State View appears along with the District selection tool. This view shows the state by District, County, and Weather Influence Zones. It also provides location landmarks such as point locations of towns and cities, as well as roads to help orient the user. The purpose of this view is to aid the user in selecting a District(s), to be viewed or modeled.



One can also access the **Select Districts and Area of Interest** dialog from the FRAS Modeling, Select Districts and Area of Interest menu.

Once a District(s) is selected, it is highlighted in Yellow on the State View. The user can then depict an Area of Interest using an existing polygon or drawing a new polygon in the view.



Only the Tutorial data set is available for the training.

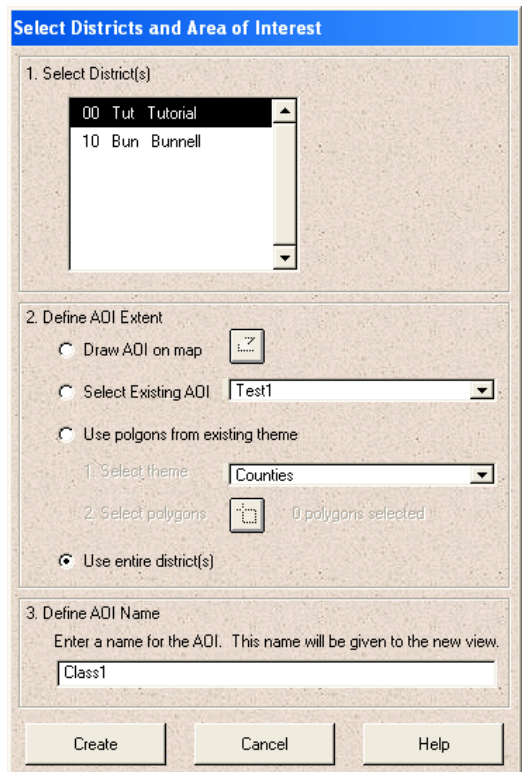
To select the first AOI follow the steps below:

1. Select the Tutorial data set by clicking on it in the top windows in the dialog box.

2. Select the Use Entire District option

3. Enter an AOI name Class1.

4. Click on the Create button.

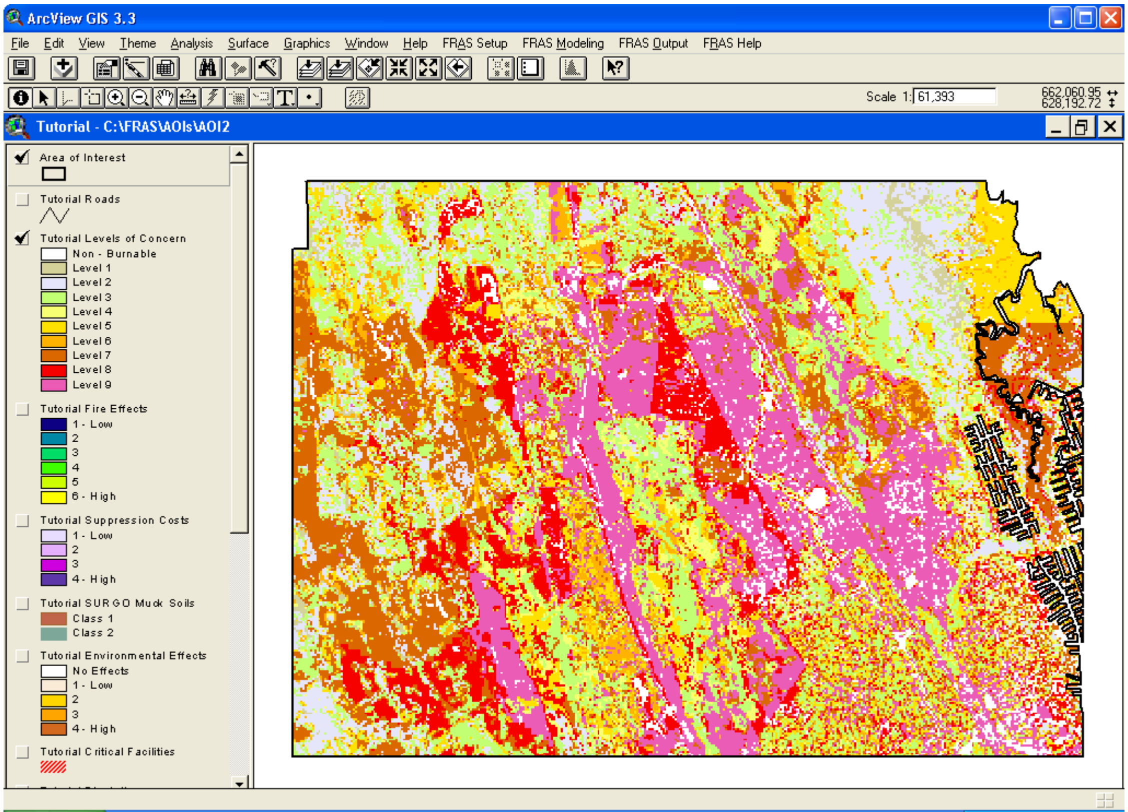


Define the AOI Extent

In Section 2 of this dialog, there are four options that can be used to Define the AOI Extent. The first three will be discussed more in detail Section V, Using FRAS in Fire Management Planning - Published Results in FRA and Section VI, Using the Florida Wildfire Risk Assessment System: Assessment of Effectiveness of Mitigation Measures, Fuels and Fire Prevention.

Selecting the entire District as the Tutorial data set will cause the AOI to be defined as the Tutorial data set.

Once a District(s) and an Area of Interest are defined, two new views are launched. The first is the FFS Published FRAS Results View. This view presents all of the published data themes for the Districts that are selected in the State View.



As new Districts are selected, using the **Select Districts and AOI** function, the Published Results data is added to the view as new themes. Only Districts that are selected are added as themes to the Published Results view.

Using the Published Results

The primary output from the Florida Fire Risk Assessment is the data developed by the project team of experts that describe fire risk across the state. These maps and data define the current situation and are referred to as the Published Results. These outputs provide a data platform for use by operational FFS staff, as well as other fire management collaborators, in mitigation planning and communication activities. These results can be used for identifying areas where more localized analysis (Project Areas) may be appropriate.

A series of spatial map data has been compiled and derived as the key part of the project to support operational staff in the future assessment and management of wildland fire risk across the state. This data has been derived by a team of fire management experts and reflects the latest and most accurate data describing wildland fire risk within Florida.

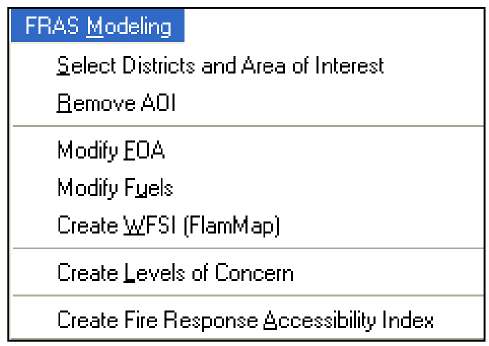
The FRAS has been designed to clearly distinguish between the Published Results, Areas of Interest and the results for Project Areas where mitigation measures have been analyzed. The Published Results data cannot be directly modified with the application. In this regard, the FRAS will allow for analyzing management options for fire risk mitigation. AOI data is maintained in a separate directory structure that facilitates its reuse without impacting the Published Results data.

Maps and reports can be generated for the Published Results data, AOI data or AOI data with Project Areas. Separate ArcView *views* are provided for each AOI data set. The Published Results view will contain only data for the District(s) selected while using the application. Multiple Districts can be selected.

Section V, Using FRAS in Fire Management Planning - Published Results in FRA will cover working with the Published Results.

Working With FRAS to Derive New Indices and Values to Assess Mitigation Measures

The FRAS has been constructed to allow the user to model the effectiveness of certain mitigation measures on the key indices (WFSI, Fire Effects Index, LOC and FRAI) as well as other intermediate values such as fire spread rate or expected final fire size.



Mitigation options are categorized into four groups:

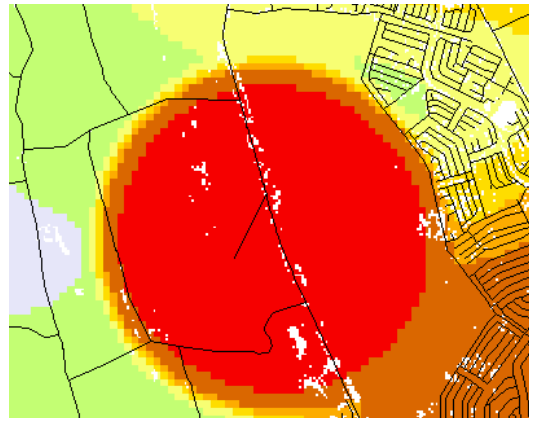
- Fire Prevention Options
- Fuels Management Options
- Preparedness Planning Options
- Creation of Defensible Space Options

Hot Tip

Fire management planning is rich with well developed and valid analytical processes to assess the effectiveness and efficiency of fire management alternatives. Based on the assumptions of the planner, the FRAS can model the effectiveness of some mitigation measures but not all. Since benefit cost is not part of the FRAS modeling system, the FRAS does not provide information on the economic efficiency of mitigation measures.

Fire Prevention Options

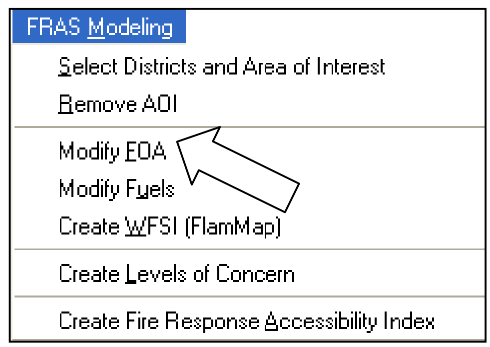
Areas with a high FOA rate are candidates for implementation of fire prevention measures. These measures can be classified into one of three categories:



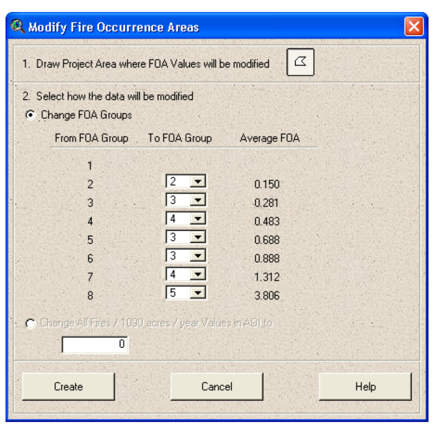
- Awareness Actions
- Education Actions
- Regulatory Actions

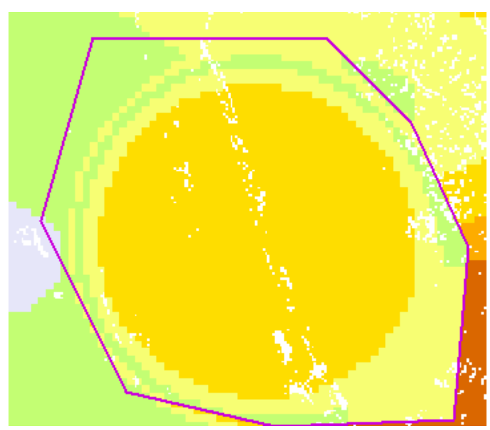
Examples of Awareness Actions include Smoky Bear visits, parade presentations and some types of signing. Once a person is aware of the desire to prevent human caused fires, Education Actions can occur to teach individuals specific actions that will prevent a wildfire from starting. For Education Actions to be effective, the causes for fires must be well understood. Fire cause information is included on fire reports hopefully based on a though fire cause determination. When Education Actions are not sufficient, governments frequently need to resort to implementing Regulatory Actions such as administrative rules or regulations. Examples of these actions include fire use restrictions and industrial activity restrictions.

To analyze the effectiveness of fire prevention measures, the user will need to estimate the change expected in fire occurrence rate from the mitigation measure(s). The WFSI and LOC for a cell are affected by the fire occurrence rate. The fire occurrence rate in the Published Results for a cell is defined by which FOA it resides. The user can modify the FOA rate using the **Modify FOA** menu. Details of this process are contained in Section VI, Using the Florida Wildfire Risk Assessment System: Assessment of Effectiveness of Mitigation Measures, Fuels and Fire Prevention.



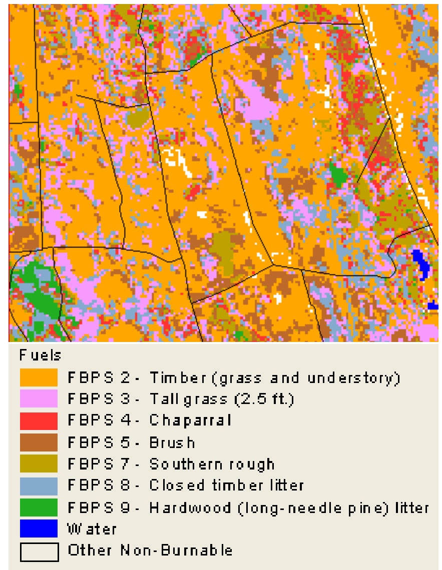
The user will need to estimate the change in FOA rate given a proposed fire prevention activity. The FRAS only provides the resultant change in WFSI and LOC given a user defined change in FOA rate.



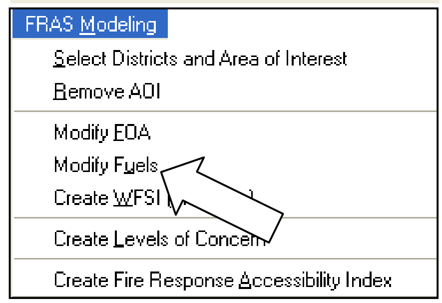


Fuels Management Options

A FRA design requirement was to classify each acre of burnable land in Florida using the fuel models in the Fire Behavior Prediction System (FBPS). Fuel changes will affect expected fire behavior, which in turn effect fire suppression effectiveness. For example, reducing fuel loading can cause a reduction in rate of spread and flame length, which allows for personnel and equipment to work effectively next to a fire.

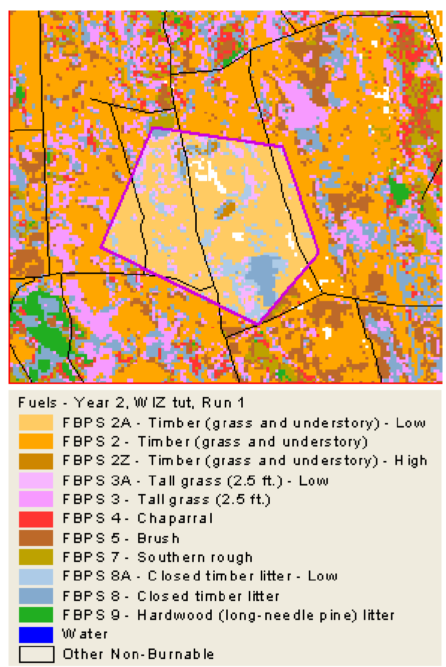


Default changes in fuel models following fuels treatment are included in the FRAS. Changes are provided for each year following treatment for 10 years. Fire behavior changes are modeled using the FlamMap program. Within FRAS, the following fuel treatment methods are defined:



- Chopping and harrowing
- Chopping followed by Rx Fire
- Herbicide Only
- Mastication
- Piling and burning (or chipping) w/machine
- Broadcast Rx fire
- Broadcast Rx fire followed by chopping
- Broadcast Rx fire followed by herbicide
- Thinning

To analyze the effectiveness of fuels treatment measures, the planner will need to estimate the change expected in fuel model following treatment and for each year for the successive 10 years. Fortunately, a workshop was conducted with FFS and other land management personnel who defined default fuel models for each fuel treatment method within each fuel situation.



The WFSI and LOC for a cell are affected by the fuels treatment since expected behavior will be different. Details of the fuels mitigation analysis process are contained in Section VI, Using the Florida Wildfire Risk Assessment System: Assessment of Effectiveness of Mitigation Measures, Fuels and Fire Prevention.

Preparedness Planning Options

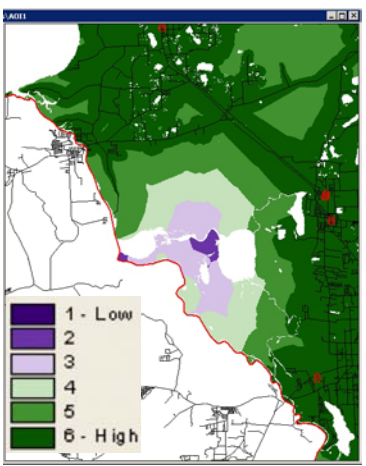
Fire suppression planning is a well-developed science and there are several systems in place that can be used. One item that needs to be defined in all systems is the initial attack time (travel plus other items such as getaway time, etc). Knowing which areas are more accessible by road is one of many items that the fire planner needs to define and consider. The Fire Response Accessibility Index (FRAI) is a measure of accessibility. Keep in mind that there are ways to get to a fire other than by roads such as by air so the FRAI is not a full measure of true accessibility.

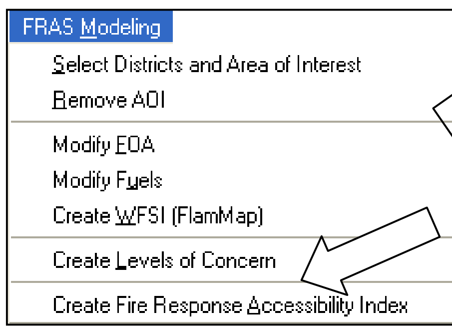
The FRAI is a measure of the change in accessibility by road given a fire dispatch location (station) is changed. Hence, it can be used to address changes in initial attack time, which is one component of a more robust fire planning process.

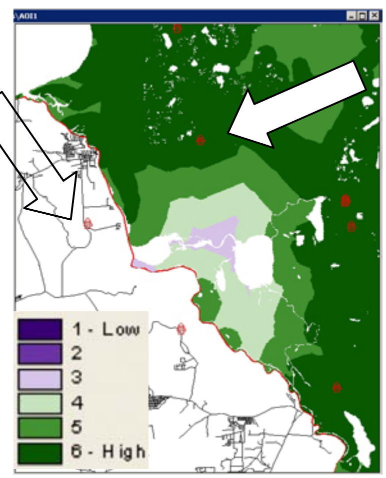
To analyze the effectiveness of changing resource locations for protection resources, a planner can move resource locations and/or can add resource locations.

The distance a cell is from resource locations affects the FRAI for that cell. Details of the FRAI analysis process is contained in Section VII, Using the Florida Wildfire Risk Assessment System: Assessment of Effectiveness of Mitigation Measures, Changing Resource Locations.

<u>Published Results</u> <u>Adding of Two New Stations</u>







Creation of Defensible Space Options

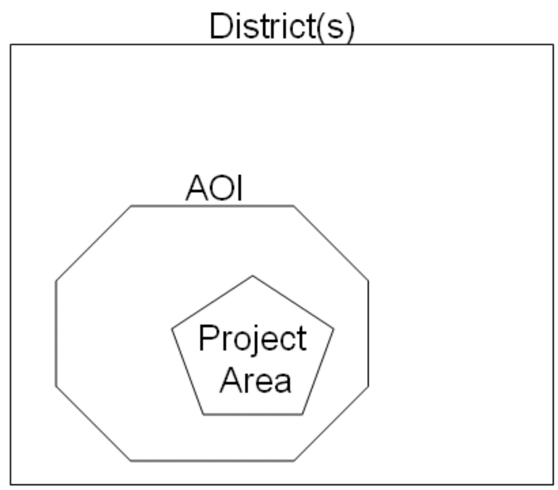
By creating defensible space around a structure, fire suppression personnel can potentially become more effective. This increases the probability a structure will survive in a wildfire. Theoretically, increasing the defensible space will then reduce the Environmental Effect Rating as measured by the Urban Interface element of this Rating. The Urban Interface Effects Score can be changed with the FRAS but there are no strict analytical processes to determine this change.

V. Using FRAS in Fire Management Planning – Published Results in FRA

The outputs from the Florida Fire Risk Assessment that define the current fire situation in Florida are referred to as the Published Results. These outputs provide a data platform for use by operational FFS staff, as well as other fire management collaborators, in mitigation planning and communication activities. These results can be used for identifying areas where more localized analysis (Project Areas) may be appropriate. This section provides an overview of the published results and provides instruction for viewing the results, and creating maps and reports.

FRAS allows for delineation of project areas with the ability to re-create outputs such as WFSI and LOC based on changes in FOA rate and/or fuel model. Changes in accessibility can also be modeled. This functionality supports the comparison of different mitigation efforts.

Selecting a District and Area of Interest



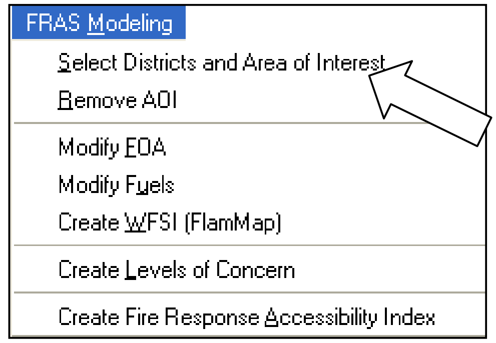
The first step is to select a District, or Districts, and to define an Area of Interest within the District selection. The entire District can also be the Area of Interest. A Project Area is defined as the area where fire prevention and/or fuels treatment measures are analyzed.

This step will result in the loading of data into the Published Results view, and the creation of a new AOI view to support modeling and AOI-based mapping and reporting. The AOI view can contain an entire data set for the selected Districts, however in most cases a smaller Area of Interest will be defined using the tools provided. In this regard, the AOI view will typically contain a small subset of data clipped to the user defined AOI boundary. Within the AOI, Project Areas can be defined to delineate the areas to be impacted by fuel treatment and or fire prevention activities.

Hot Tip

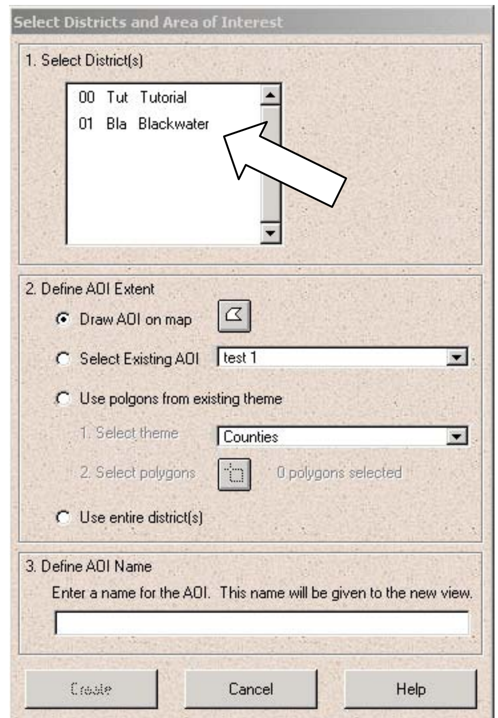
If an entire District is selected as the AOI, the program may take a long time to process the information.

Districts are selected using the Select Districts and Area of Interest under the FRAS Modeling menu. The tool allows the user to select a single District or multiple Districts for analysis.



The **Select Districts and AOI** dialog contains three sections. These are:

- 1. Select Districts
- 2. Define AOI Extent
- 3. Define AOI Name



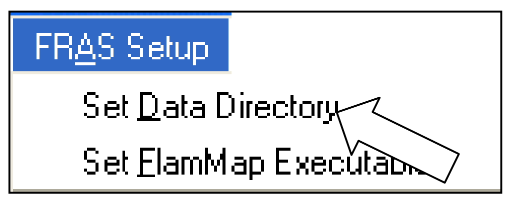
A scroll list of Districts is provided based on data found on the hard drive by FRAS. District data is located using the path location defined by the **Set Data Directory** tool.

Only those Districts located in the defined path that adhere to the standard data organization will be listed. It is possible to use different data locations for the District and Tutorial data (i.e. put District data on different disks). By changing the Set Data Directory, a different list of District data will be displayed in the scroll list. It is recommended that the Tutorial data set be installed in the same location as the published District data.

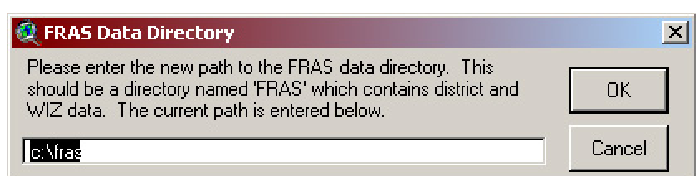
Step-by-step instructions on using this dialog follow:

Step 1: Defining the Path for District Data

Prior to using the selection dialog you must define where your District data is located on your computer or network. Select **Set Data Directory** option from the **FRAS Setup** menu.



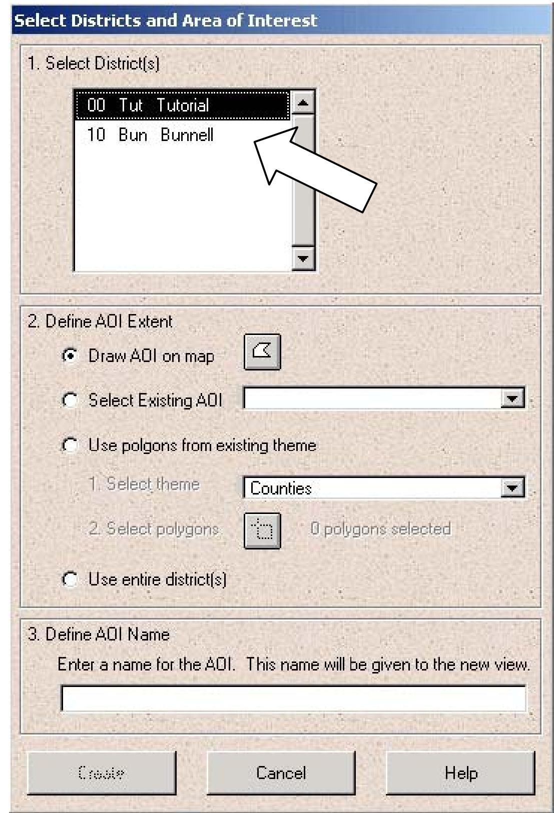
When prompted, type in the FRAS source data folder path. This is shown in the figure at the right. This path is stored by FRAS and used to locate all District data for processing. By changing this location at any time, other locations for District data can be identified (i.e. if data for different Districts is stored on different paths or disks). In most cases, the District data and the Tutorial data set can be stored in the same location to eliminate the need to change this location.



Press **OK** once you have defined the data path.

Step 2: Selecting Districts

Click on the **FRAS Modeling** , **Select Districts and Area of Interest** menu. The selection dialog as shown to the right will appear.

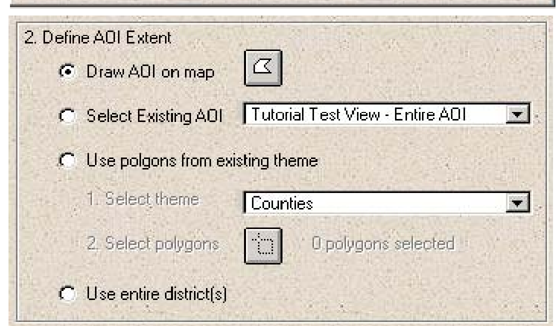


Select Tutorial from the scroll down list. As you select tutorial it will be highlighted in yellow on the State View and FRAS will zoom to the selected District(s).

Multiple Districts can be selected by holding the shift key while selecting Districts. Note the Tutorial data set cannot be selected with other Districts.

Step 3: Defining an Area of Interest (AOI)

Three options are provided for defining or selecting an Area of Interest:

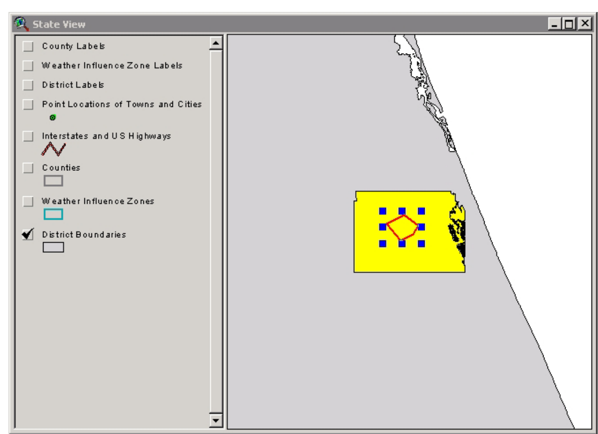


- Drawing a single AOI on the map,
- Selecting an existing AOI that was previously defined,
- Using polygons selected from an existing theme, or
- Defining an AOI to use the entire District.

It is anticipated that in most cases, the user will want to define a smaller AOI that reflects their area of responsibility, or potential mitigation Project Areas.

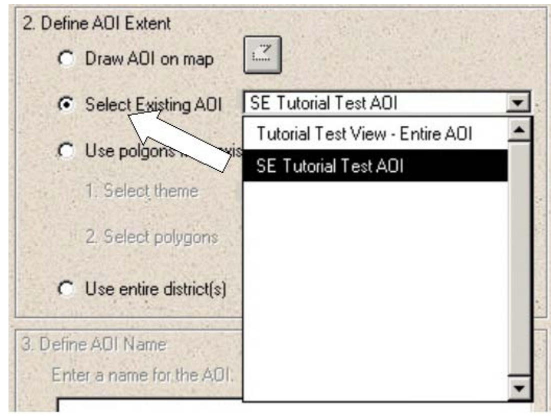
__**Draw AOI On Map**__

The most common method of defining the AOI extent is to digitize the area boundary using your mouse on the State View. Click with the left mouse button to digitize boundary points and double click to end digitizing. If you want to re-digitize, close the first polygon and begin digitizing again only the last polygon defined will be used to define the AOI extent. An example of an AOI shown in the Tutorial Area is presented to the right.



Select Existing AOI

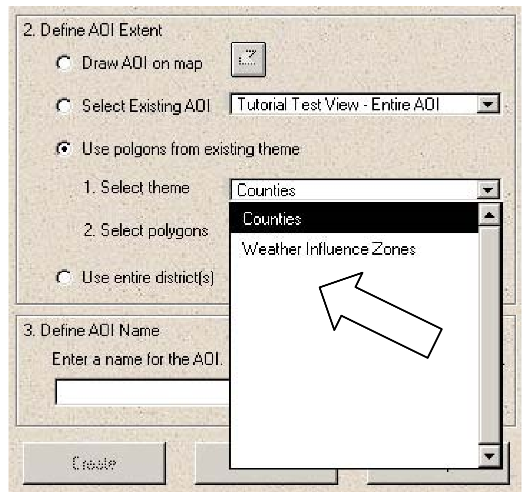
The second method for defining the AOI extent is to select a previously defined (existing) AOI. Select the Select Existing AOI option and pick an AOI shown in the pull-down scroll list. The AOI boundary will be shown on the State View when you select it from the scroll list. Only a single AOI can be selected.



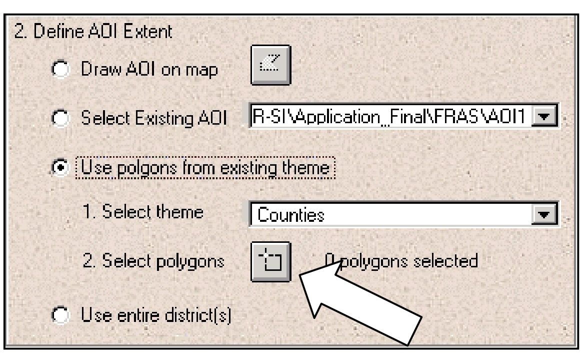
Use Polygons From Existing Theme

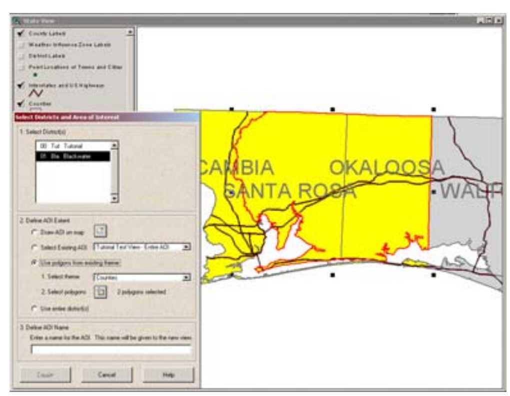
The third method of defining the AOI extent is to select polygons from an existing theme. To use this option the theme must be loaded into the State View.

First, select the theme from the pull-down list of available State View themes. If the theme does not exist in the view, use the general ArcView **Add Theme** tool to add the theme to the State View first. It will then appear in the scroll list. An example of selecting Counties is shown to the right.



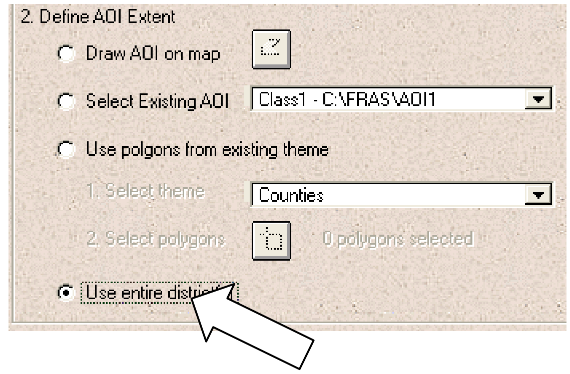
Next, select the **Select Polygons** button from the dialog and select the theme polygons from the State View. Use the standard ArcView zoom and pan tools to set the view map the way you want. Click on the polygon using the left mouse button. To select multiple polygons, hold the SHIFT key and click on the features. The figure below shows an example where two adjoining County polygons have been selected for the Blackwater District. Note that polygons do not need to be adjacent to be selected. This allows the user to select AOIs that are not connected as long as they exist in an existing theme.





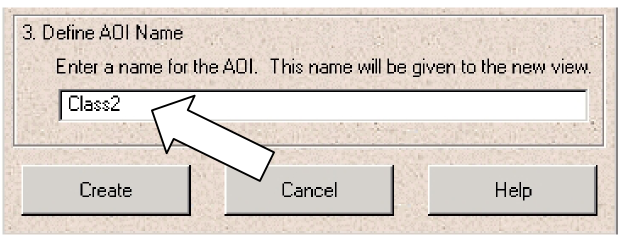
Use Entire District

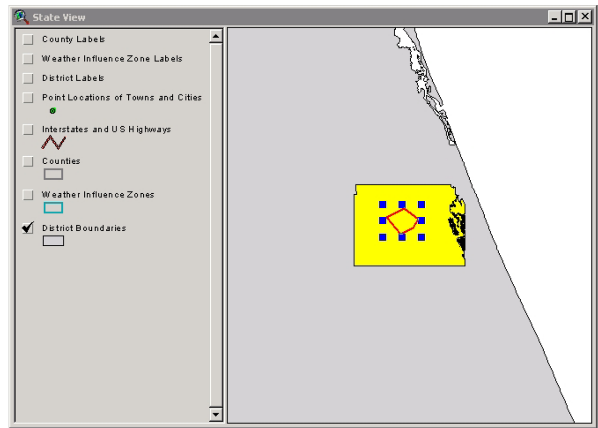
The final method of defining the AOI extent is to select the entire District by toggling the **Use entire District(s) option**.



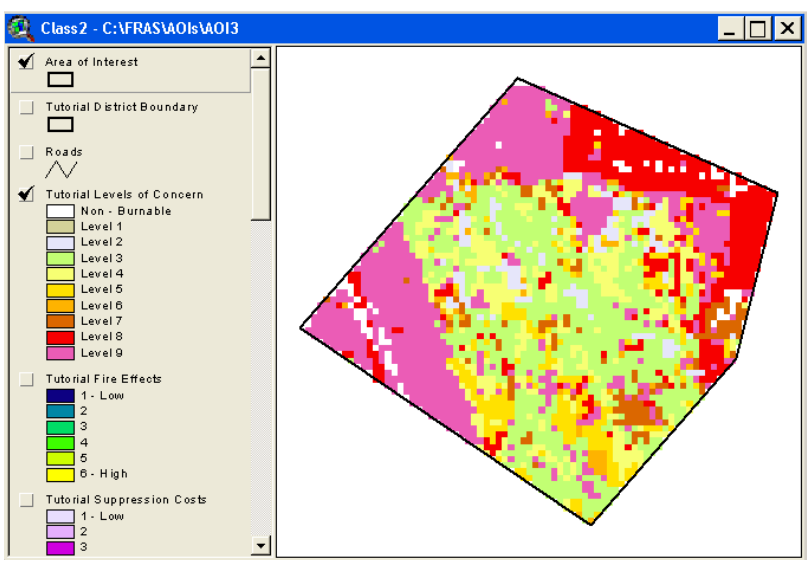
Define AOI Name

Using the **Draw AOI on map** option, digitize an AOI polygon (see right). Once an AOI is defined, a unique name for the AOI must be defined. Type **Class2** into the input field.



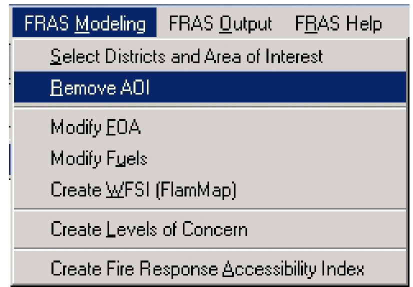


Once the name is entered, press the **Create** button. A new data view will be created for the AOI. Input data themes will be clipped to the AOI boundary and loaded into the view as themes. An example of the AOI Data View that was created by drawing an AOI on the map is displayed below. The layer displayed is the Published Results output for Levels of Concern. The AOI Data View is now available for use with the viewing tools described in this section. Note that an unlimited number of AOIs can be defined and used but only a single AOI can be active at any time.

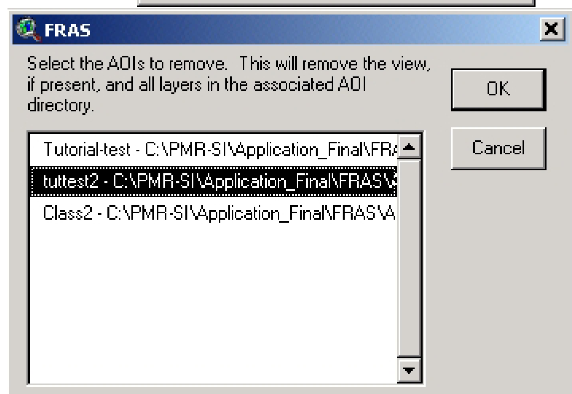


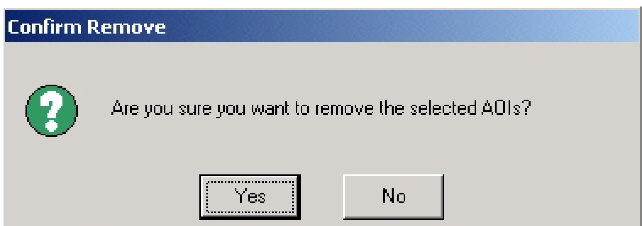
Removing an AOI

The user may want to remove an AOI. This should only be done if you do not intend to undertake any modeling in the future for that AOI, and/or you do not need to generate maps or reports for the AOI. If the user plans access to the AOI results in the future, it should not be removed.



To remove an AOI, select the **FRAS Modeling**, **Remove AOI** menu item. This menu item will remove the AOI view and any internal data derived on disk for that AOI. The figure to the right shows this dialog. Note that more than one AOI can be removed by selecting multiple AOIs from the list. Once the user clicks OK, they are prompted to confirm the delete.





Generating Maps

There are ten standard maps available within FRAS.

The Difference Between Maps of Published Results and AOI Maps

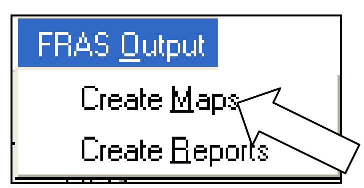
Tools are provided to generate maps and reports for the Published Results and AOI data. The same suite of tools can be used on either data view(s). This section describes how to create maps and reports for the output data.

A series of standard maps are provided in FRAS. Here, users can generate maps quickly and easily using either Published Results data or AOI data. Depending on which view is open, the user can also print maps of the specific AOI or for all the Districts available on disk in the FRAS directory.

Opening the Standard FRAS Map Dialog

Select an active view. This can be either the Published Results View or an AOI Data View.

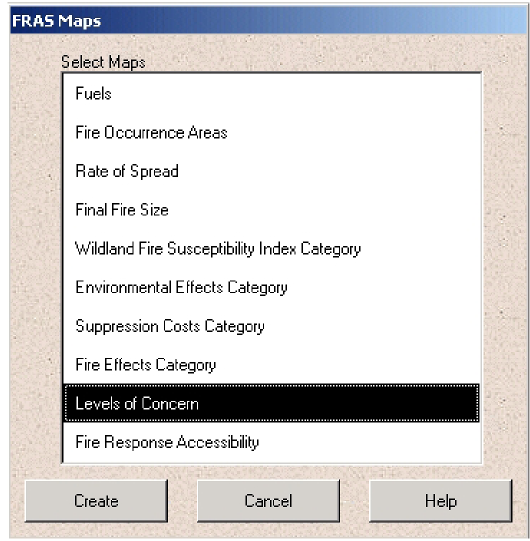
Select the **Create Maps** option from the **FRAS Output** menu.



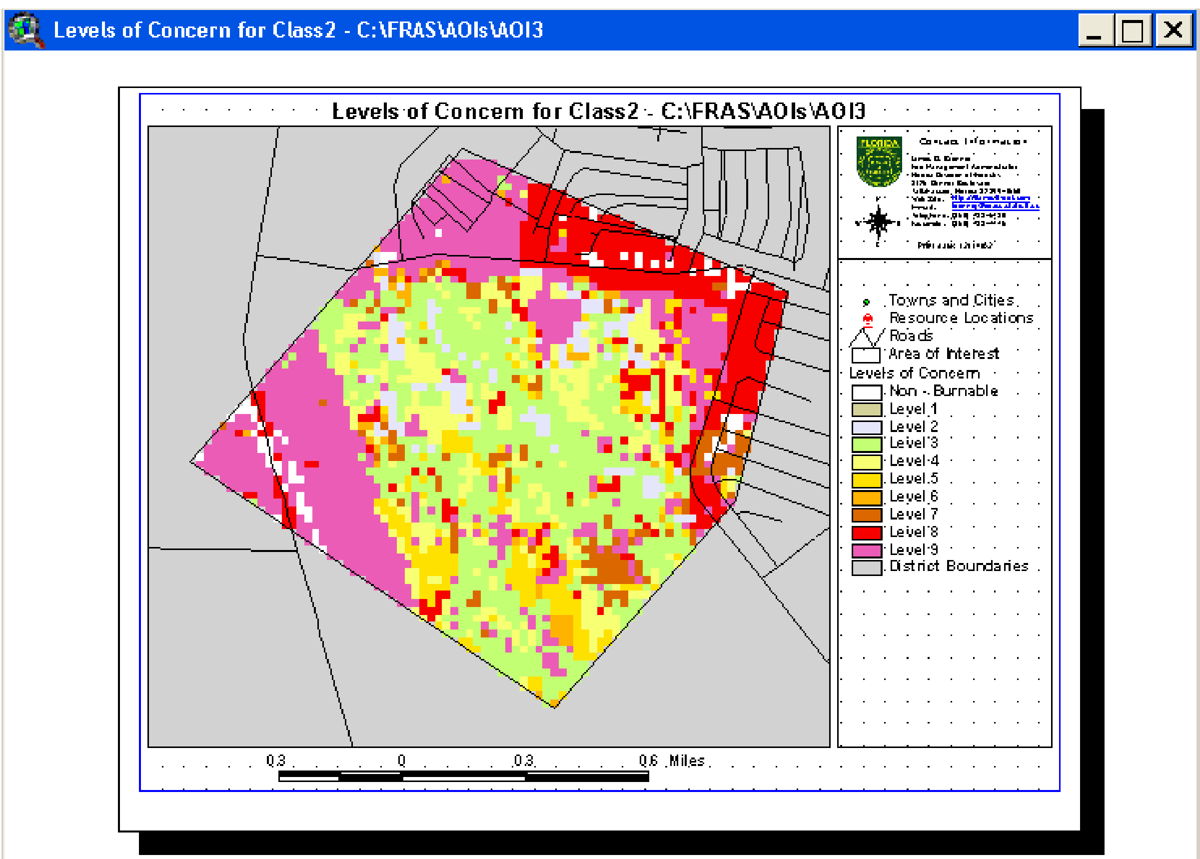
Selecting Which Map to Create

There are 10 standard maps provided with FRAS:

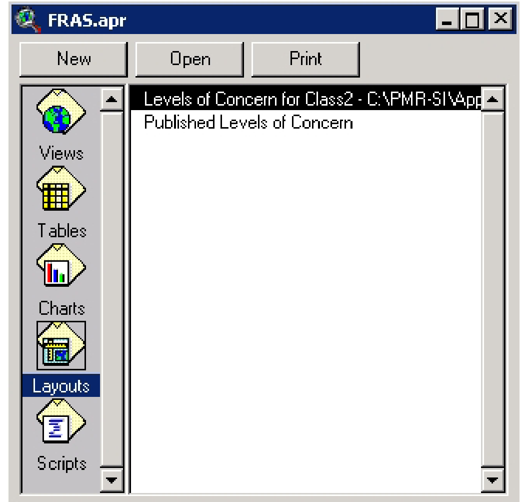
- Fuels
- Fire Occurrence Areas
- Rate of Spread (can choose between low, moderate, high or extreme weather categories)
- Final Fire Size
- Wildland Fire Susceptibility Index Category
- Environmental Effects Category
- Suppression Costs Category
- Fire Effects Category
- Levels of Concern
- Fire Response Accessibility



To create a map using one of these standard map layouts, highlight the map by clicking on the map title and click **Create**. FRAS then adds the relevant themes to the active view and generates the map using a predetermined layout. An example layout of the Levels of Concern for the **Class2** AOI is shown below.



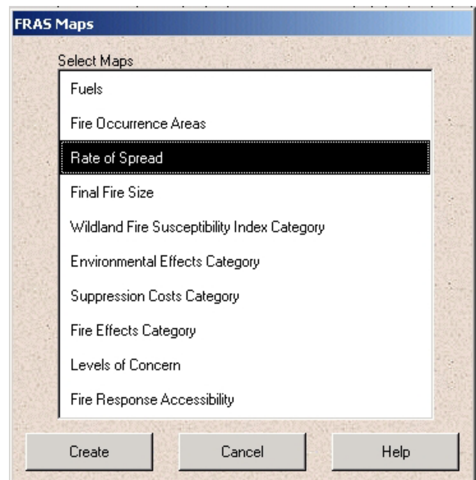
The selected map layout is automatically added to the Project Layouts list. To print the map, select the layout from the Layouts list and press the **Print** button.

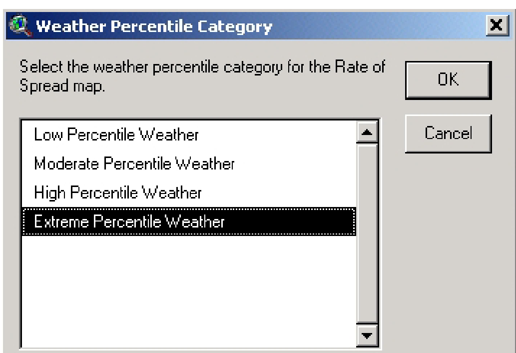


Special Cases Where More Information Is Required Before A Map is Created

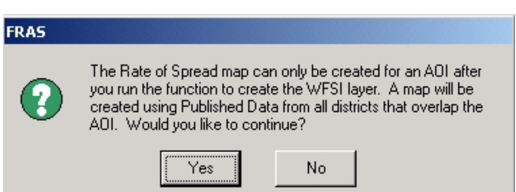
<u>Rate of Spread Weather Percentile Categories</u>

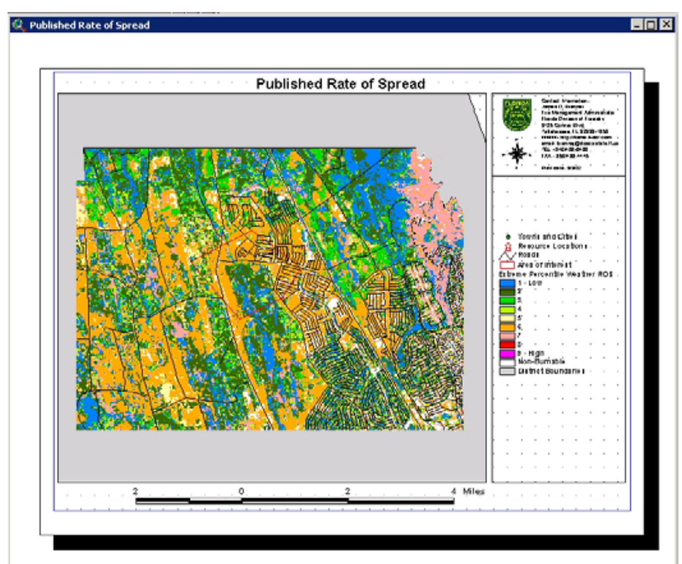
Rate of Spread values are calculated per weather category and are stored as such as attributes in the WIZXX_YYY grid, where XX represents the Weather Influence Zone number and where YYY represents the weather category (i.e. low, moderate, high and extreme). The user must specify which weather category should be mapped, for this example, select Extreme Percentile Weather .



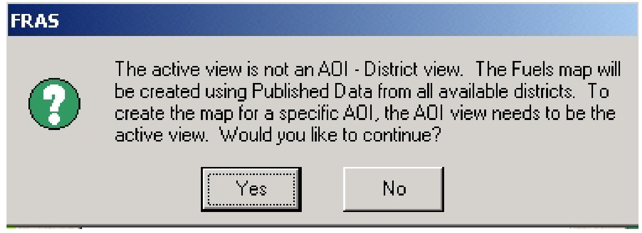


If the AOI data has not been modified from the Published Results, FRAS will ask if you would like to map the Published Results. Select **yes** to create the map. The result is the Published Results map of ROS for extreme weather.

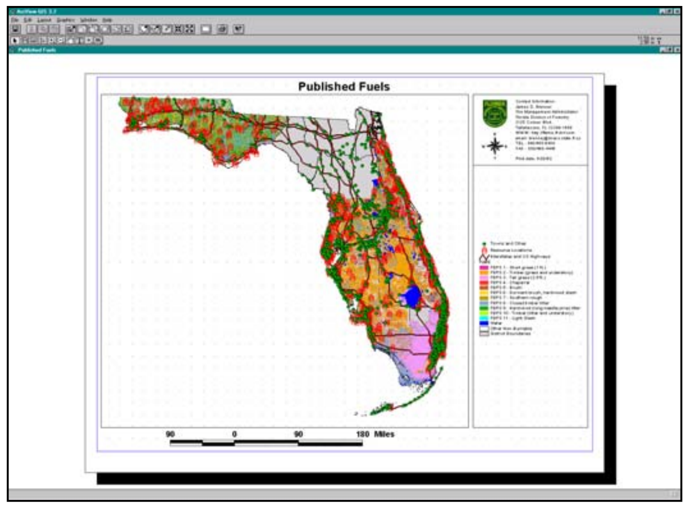




The Difference Between AOI and Published Results Maps



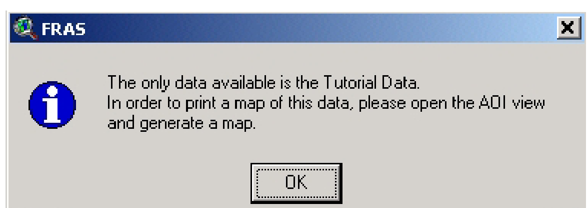
If the active view is the AOI view, then the maps generated will be for only that particular AOI. Note that the AOI view may contain the Published Results or new results if the inputs have been modified. If the active view is the Published Results, then the maps generated will be generated for all available Districts in the FRAS directory. The user is prompted, in advance, so that the user can cancel the action. Be aware that creating a map for the entire state may take some time; therefore the user is asked if they would like to continue.



To generate a map using all available District data, the user would click **Yes**, and would click **No** to cancel the action.

For example, if the user selects 'Yes' and had Blackwater, Bunnell, Caloosahatchee, Chipola River, Everglades, Lakeland Myakka River, Okeechobee, Orlando, Tallahassee, and Withlacoochee data on disk in the FRAS directory, a map would be created using all of the districts data.

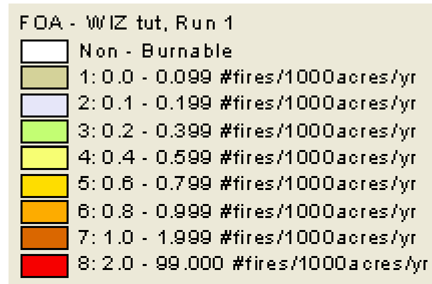
The only exception is if the user only has the tutorial data loaded. Then the user will be prompted with a dialog to inform them that they only have the tutorial data and must create the map from the AOI View. This is done because maps created using all available Districts ignore the tutorial District folder since it overlaps with Bunnell.



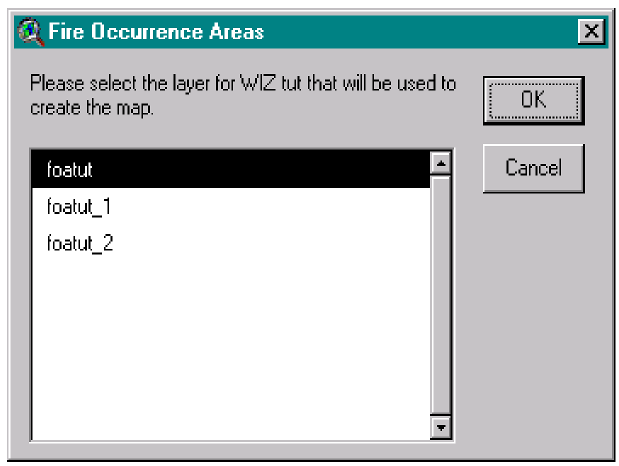
Creating a Map For Data Created Using Multiple Runs

Using the FRAS modeling capabilities, it is possible to create multiple grids within the same AOI Data View of the same theme, such as FOA, Fuels, WFSI. Each time one of these data sets is re-created, it is provided a sequential number referred to as the "model run."

To distinguish between "model runs," the theme is labeled with a **'Run #'** where # represents the run number. When the user selects a modeling function that will re-create a new output map (such as FOA, Fuels, WFSI or LOC) using a newly created data layer, FRAS finds all instances of that data layer and prompts the user to specify which data layer should be used to generate the map. The example to the right shows a WFSI theme that has been re-created using the modeling capabilities. The resulting output theme is added to the AOI data view, and tracked by FRAS using the unique run number; i.e. in this case 1.



The names listed in the prompting dialog have the naming convention **NAME_#** where # represents the run number and NAME is the name stored in the AOI directory. For example, multiple FOA data instances for an active AOI Data View using the Tutorial data set will appear in the dialog (see figure at right). Note the "tut" suffix instead of a District code.



If the title does not contain '_#', then it is the Published Results data. The top item in the list, **foatut**, is the Published Results data coverage for the Tutorial data set. The middle item, foatut_1, is the file name for the AOI FOA data layer created when the first Modify FOA Project Area was defined. The file foatut_2 is the file name for the AOI FOA data layer created when the second Modify FOA Project Area was defined.

Hot Tip

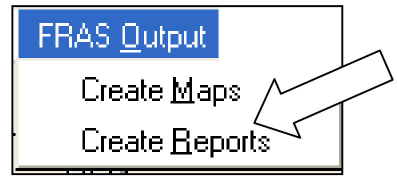
Fuels Analysis and Fire Prevention Analysis Worksheets have been created for the user to record and track Project Area assumptions. Recording on these forms the file names for Project Area data grid layers is essential. This will insure that the correct data grid layer will be selected when the WFSI and LOC are calculated.

Generating Reports

A series of standard reports are provided in the FRAS. Here, users can generate reports using either Published Results or AOI data. The user can also generate reports for the specific AOI or for all the Districts regardless as to whether or not they are on disk.

Opening the FRAS Reports Dialog

Select an active AOI Data View and then select the **Create Reports** option from the **FRAS Output** menu.



Selecting a Report to Create

There are 14 standard reports provided within FRAS. Nine reports are dynamic reports to reflect the current information within the AOI. Five reports are static reports that reflect the Published Results information for the entire state of Florida.

The AOI report titles are preceded by 'AOI –' and the Published Results reports are preceded by 'Published –'.

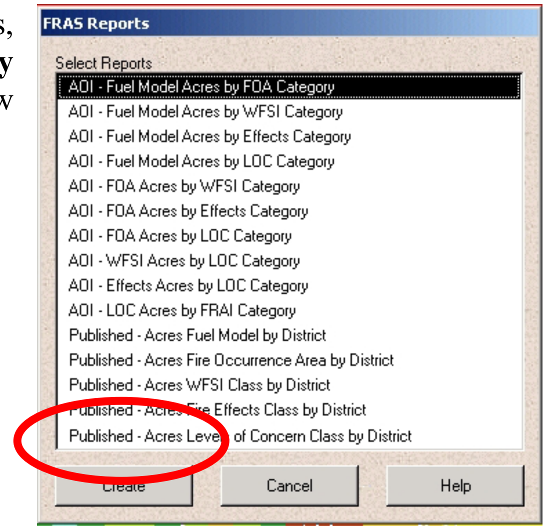
The available AOI reports include the following:

- AOI – Fuel Model Acres by FOA category
- AOI – Fuel Model Acres by WFSI category
- AOI – Fuel Model Acres by Effects category
- AOI – Fuel Model Acres by LOC category
- AOI – FOA acres by WFSI category
- AOI – FOA acres by Effects category
- AOI – FOA acres by LOC category
- AOI – WFSI acres by LOC category
- AOI – Effects acres by LOC category

The available Published Results reports include:

- Published – Acres Fuel Model by District
- Published – Acres Fire Occurrence Area by District
- Published – Acres Wildland Fire Susceptibility Index Class by District
- Published – Acres Fire Effects Class by District
- Published – Acres Levels of Concern Class by District

To create a report using one of these standard formats, select a report, for example **AOI-Fuel Model Acres by FOA Category,** in the reports list activate your AOI view and click on the **Create** button.



Error Message if Active View is not an AOI View

Reports need to have the AOI view active in order to generate AOI reports. The user will be prompted if an AOI view is not the active view and will not generate the report. This message is shown at the right.

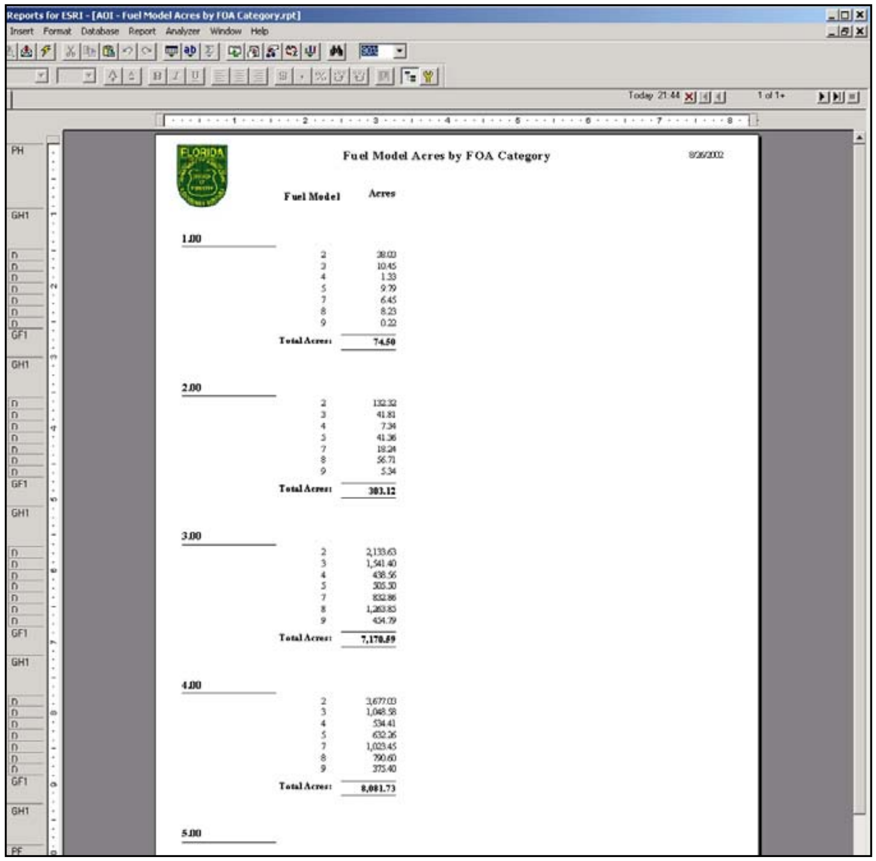
Defining the Report Filename

Once a report is selected, FRAS will query the data layers and prompt the user for an output filename. The file name will be used for the report as well as a dbf file that users can view independently of
Crystal Reports.

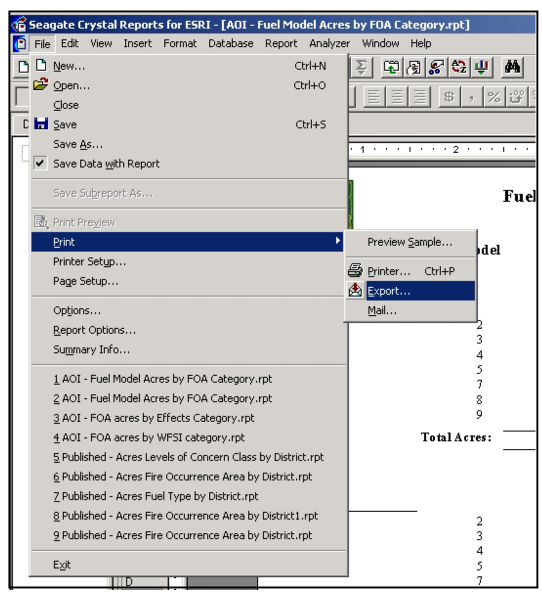
Once the filename has been designated, FRAS generates the report using a predetermined layout in Crystal Reports. A splash screen opens and shows the final filename and location of the file being created.

Output Format for an AOI Report

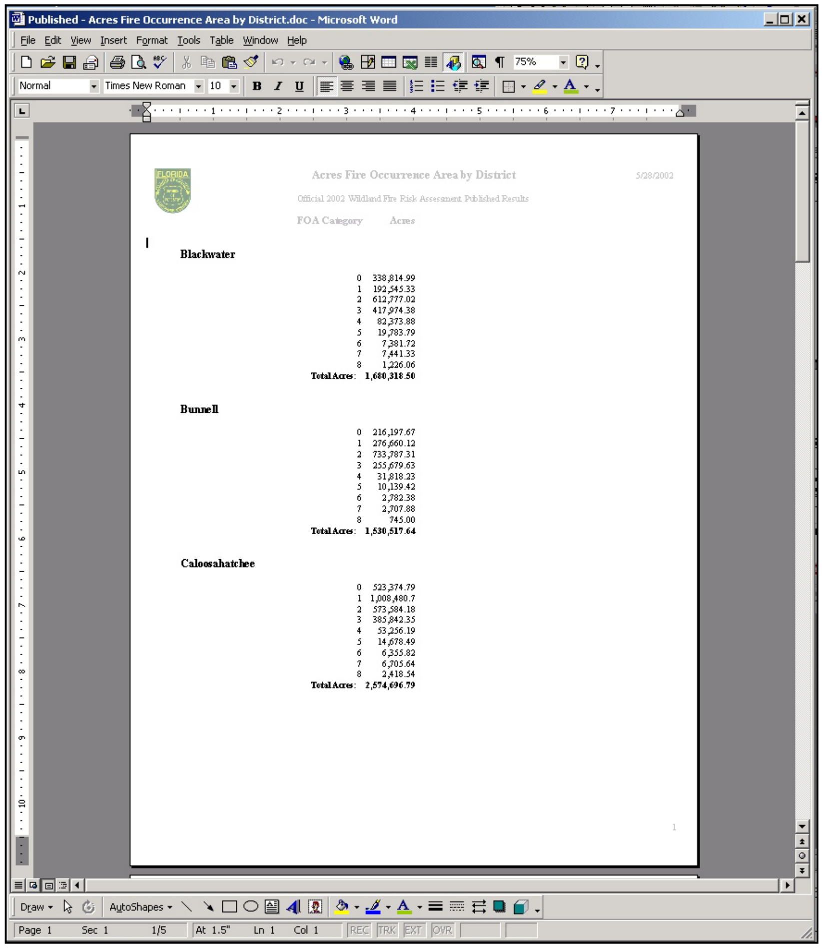
At the right is an example layout for the Tutorial AOI Data using Crystal Reports. The report summarizes fuel model acres by FOA category for the Tutorial, which is the current Area of Interest (AOI)



FRAS creates a Crystal Reports .rpt file and a .dbf file in your AOI directory. The Crystal Report file can also be exported to a MS Word Document by navigating to the **File** menu and selecting **Print** then **Export** and selecting **Word for Windows Document** as the format.



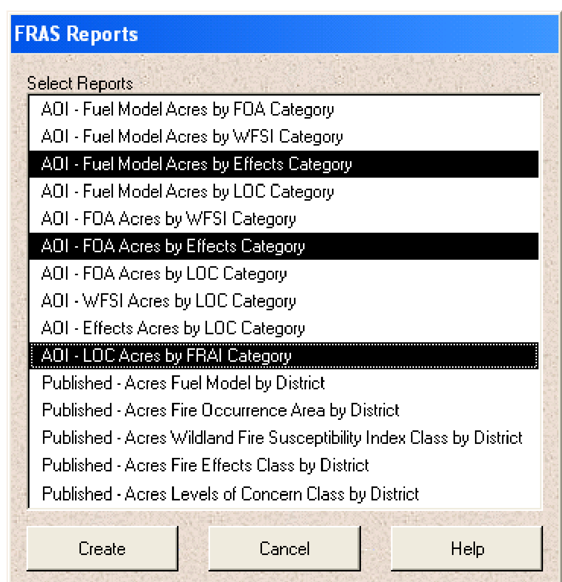
Output Format for a Published Data Report



The Published Results reports are static and contain information for all Districts. These reports were generated in Crystal Reports. The figure at the right is an example layout for the Published Results data using Crystal Reports to develop the layout and Word to display the data. The report details the Fire Occurrence Area (FOA) acres by FOA category by District.

Creating Many Reports at Once

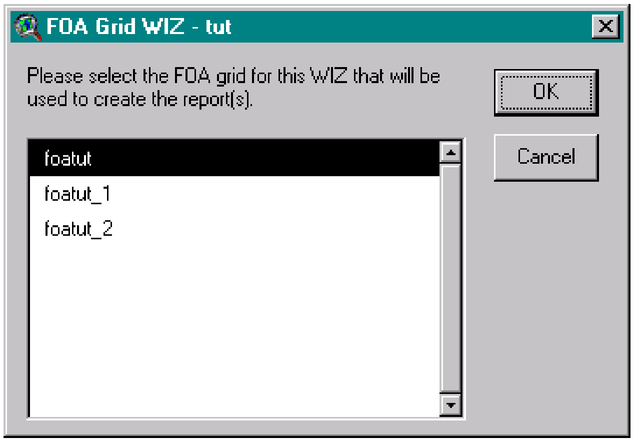
Clicking on the map titles while holding the shift key can select the creation of multiple maps. The figure at the right presents an example of this.



<u>Creating a Report For Data That Has Been Created Using Multiple Runs</u>
The user can model mitigation measures whereby FRAS changes or creates:

- Fuel Models
- Fire Occurrence Areas
- Rate of Spread
- Final Fire Size
- Wildland Fire Susceptibility Index
- Environmental Effects Rating
- Suppression Rating
- Fire Effects Index
- Levels of Concern
- Fire Response Accessibility Index.

Accordingly, as discussed in the previous section, multiple model run versions of a data set, such as FOA, WFSI, etc., may exist in an active AOI Data View. When this occurs, the user will be prompted to select a single layer in order to create the report. At the right is an example of the dialog requesting the user to specify a FOA run to use for the report.



Creating Custom Maps and Reports

There are instances when the standard maps and reports cannot be used to portray the information that is needed. In these cases, the user must generate a custom map or report.

Creating a Custom Map

A "layout" in ArcView is a map that allows the user to display views, charts, tables, and graphics. The layout is used to prepare a map for output from ArcView. The standard tools available within ArcView are available to create custom layouts. A review of these capabilities is provided.

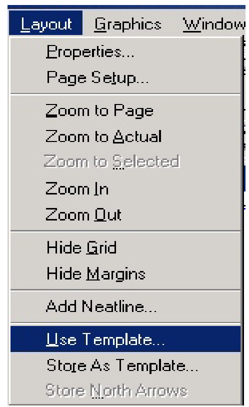
To create a new layout, double click on the **Layout** icon in the **Project manager window**.

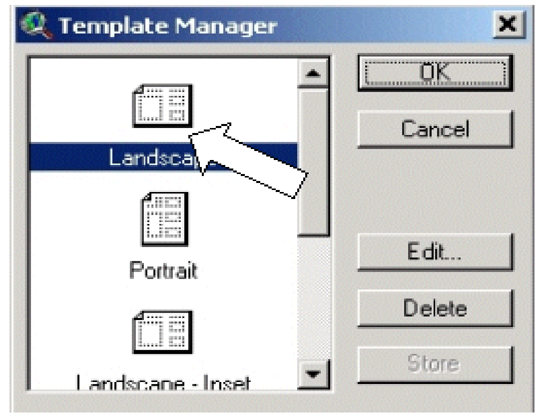
A new layout window opens with a blank layout. ArcView provides a few templates that can be used to help organize the layout. FRAS has customized these templates to be easier and quicker to populate.

To use an existing template, choose the **Layout menu** then **Use Template**.

The **Template Manager** opens showing a list of available templates.

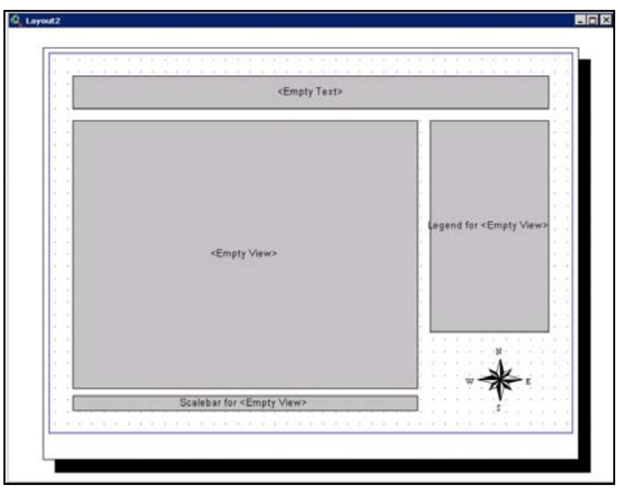
Select the **Landscape** template and click the **OK** button.

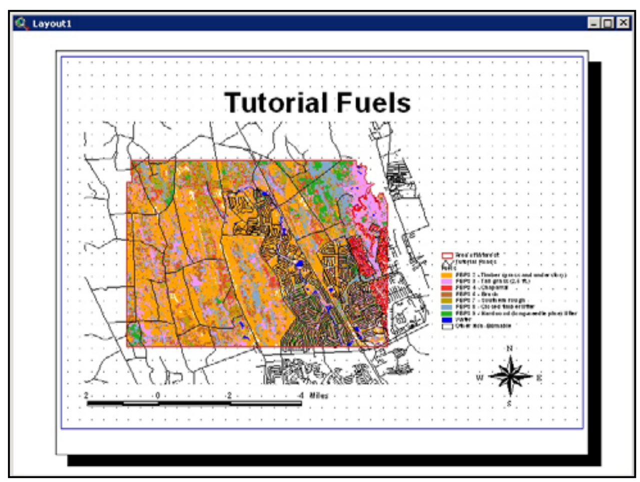




Notice that the layout now has blank boxes. Double click on the 'View' box and select the correct view that should be used to populate the layout. Once the view is selected, the layout is populated with a scale bar, north arrow, the view, and the legend. The remaining gray box that says 'Empty Text' is for the map title. To add a title, double click on the gray box and add the new text in the text properties dialog box.

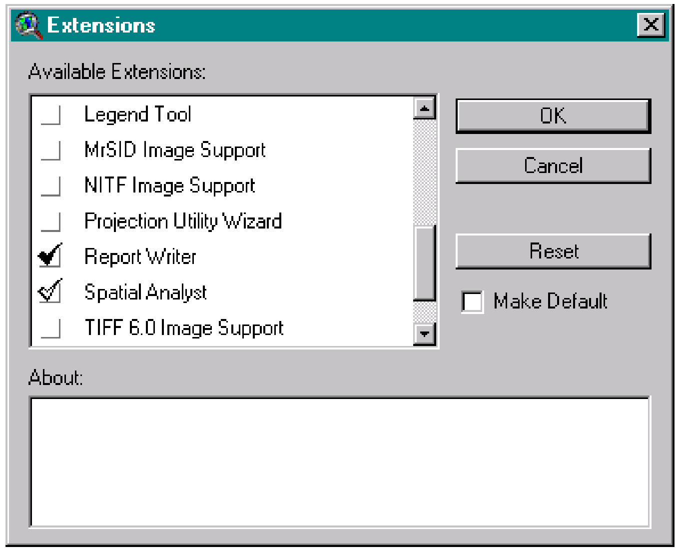
Below is an example of both the empty layout and completed layout using the Tutorial fuels theme.





Creating a Custom Report

In order to generate custom reports in ArcView, the **Report Writer** extension must be loaded. To load this extension, click on the **File – Extensions** menu option. The figure at the right presents the Extensions dialog. Scroll down through the list until Report Writer appears. If Report Writer is not listed, ArcView should be reinstalled to install all extensions. Select **Report Writer** by clicking on the checkbox next to the title.



Press the **OK** button to load the extension.

Reports are generated from information in a data table. Accordingly, a data table must be created or opened in ArcView. To generate a report of the Resource Locations by type (either FFS, USFS, or FDEM) within a District or AOI, follow these steps:

<u>Step 1</u>

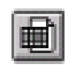
Make the view active – either the AOI Data View or the Published Results View.

<u>Step 2</u>

Activate the Resource Locations theme by clicking on the title until the name is highlighted.

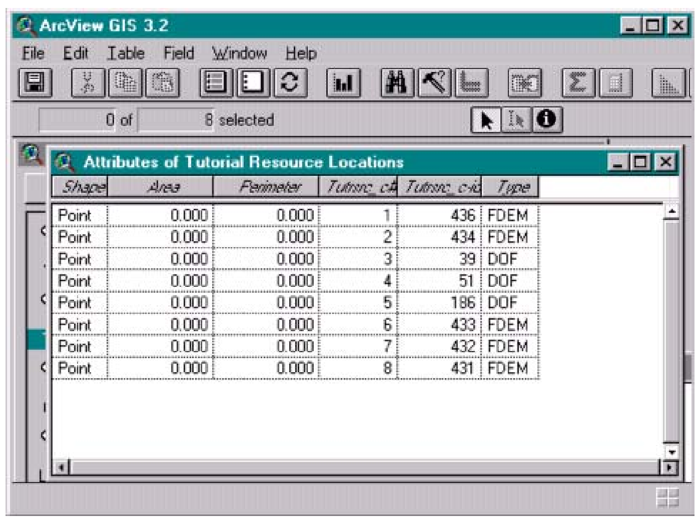
<u>Step 3</u>

Open the resource location table by clicking on the ‘**Open Theme Table**’ button .

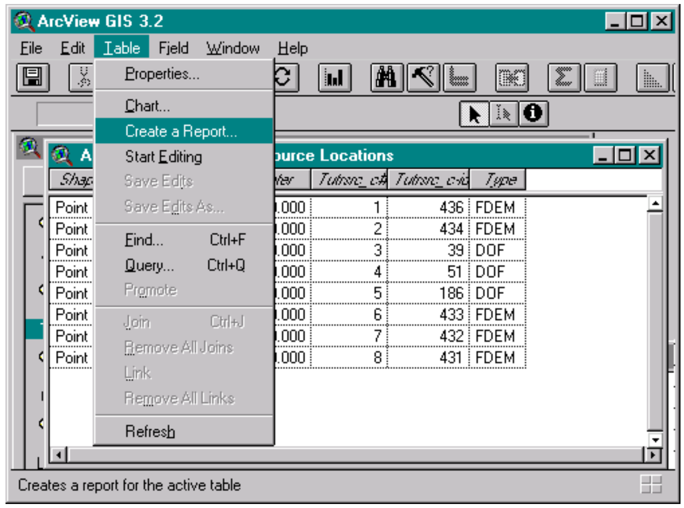


An example of a table for the Resource Locations for the tutorial data is shown at the right.

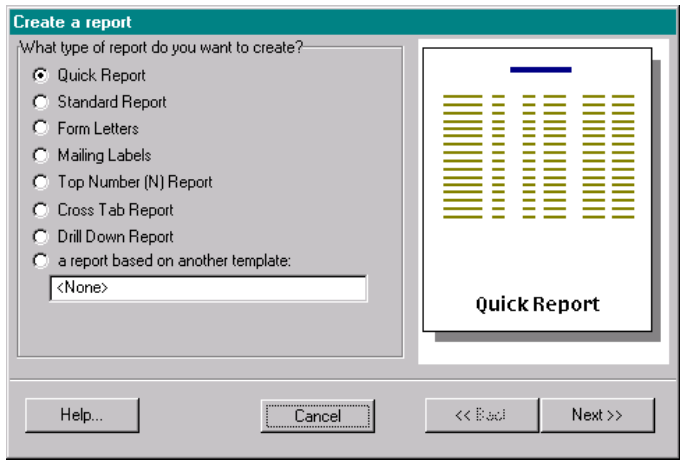
Visual observation of this data set alone shows that there are three FFS Resource Locations and five FDEM Resource Locations in the tutorial data set.



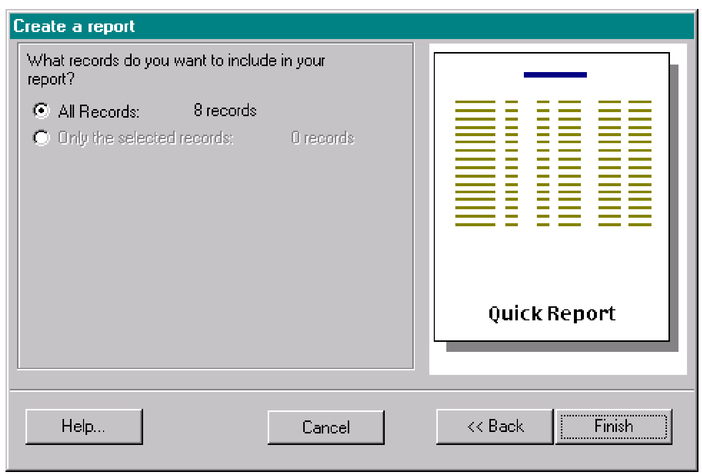
Step 4
To generate a report to show the resource by owner (*Type*), select the **Table – Create a Report** menu option.



Selecting this option will present the user with the **Create a Report** Dialog.



Step 5:
Choose **Quick Report** and press **Next >>**.

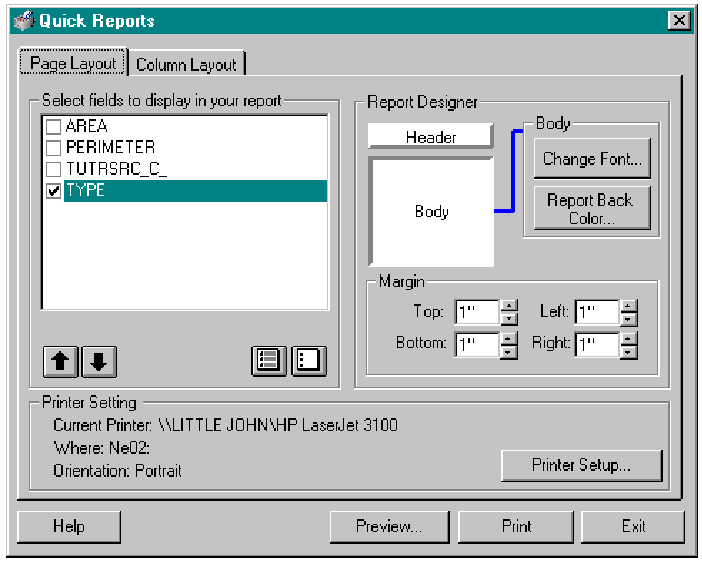


Step 6

Check the **All Records** checkbox and press **Finish**. If specific records were previously selected in the table, then the option 'Only the selected records' would also be available. This allows the user to create a report for selected records only.

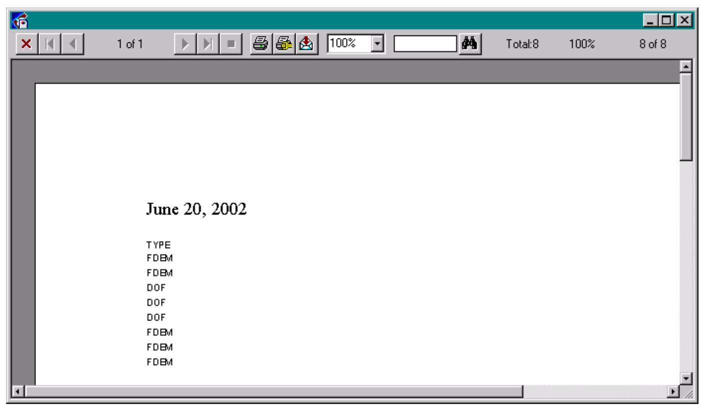
Step 7

The Quick Report dialog will appear. Highlight the field **Type** to be displayed in the report and press either **Preview** to preview the report before printing, or **Print** to send the report directly to the printer.



Step 8

If the Preview button is pressed the following report will be appear.



VI. Using the Florida Wildfire Risk Assessment System: Assessment of Effectiveness of Mitigation Measures - Fuels and Fire Prevention

Introduction

Options for mitigation measures can be classified into the following areas:

- Fuels Management Options
- Fire Prevention Options
- Preparedness Planning Options
- Creation of Defensible Space Options

Fuels Management Options

To analyze the effectiveness of fuels treatment measures, the planner will estimate the change expected in the fuel model following treatment and for each year for the successive 10 years. A workshop was conducted with FFS and other land management personnel who defined default fuel models for each fuel treatment method within each fuel situation. The WFSI and LOC for a cell are affected by the fuels treatment since expected behavior will be different.

Fire Prevention Options

To analyze the effectiveness of fire prevention measures, the planner will estimate the change expected in fire occurrence rate from the mitigation measure(s). The fire occurrence rate in the Published Results for a cell is defined by which FOA it is in. The planner can modify the FOA rate using the Modify FOA menu. The WFSI and LOC for a cell are affected by the fire occurrence rate.

Preparedness Planning Options

The FRAI is a measure of the change in accessibility by road given a fire dispatch location (resource location) is changed. Hence, it can be used to address changes in initial attack time, which is only <u>one</u> component of a more robust fire planning process. To analyze the effectiveness of changing resource locations for protection resources, planner can move resource locations and/or can add resource locations. The FRAI for a cell is affected by changes in resource locations.

Creation of Defensible Space Options

By creating defensible space around a structure, fire suppression personnel can potentially become more effective. This increases the probability a structure will survive in a wildfire. Theoretically, increasing the defensible space will then reduce the Environmental Effect Rating as measured by the Urban Interface element of this Rating. The Urban Interface Effects Score can be changed with the FRAS but there are no strict analytical processes to determine this change. The first three options will be presented in detail. The planner will need to use professional judgment to change the Urban Interface Effects Score. Some research is being done at the Missoula Fire Sciences Laboratory though that can be of value in this judgment.

Project Areas
To analyze mitigation options, the planner will need to define a Project Area.

Definition
A Project Area is a polygon within an AOI where the effectiveness of mitigation measures is to be analyzed. For example, a Project Area for fuels analysis might be an area being considered for fuels treatment.

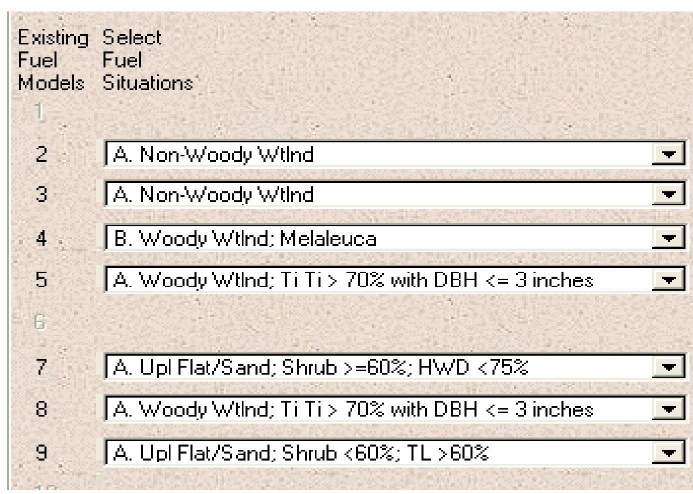
Fuels Management Options - Modifying Fuel Models
This section will show how the to analyze the effectiveness of fuels management options.

The 13 Fire Behavior Prediction Fuel Models
An assessment design requirement was to classify each acre of burnable land in Florida using the fuel models in the Fire Behavior Prediction System (FBPS). The fuel models are in the table at the right.

FBPS Fuel Model	Description
1	Short grass (1 ft.)
2	Timber (grass and understory)
3	Tall grass (2.5 ft.)
4	Chaparral
5	Brush
6	Dormant brush, hardwood slash
7	Southern rough
8	Closed timber litter
9	Hardwood (long-needle pine) litter
10	Timber (litter and understory)
11	Light slash
12	Medium slash
13	Heavy slash

The Florida Dichotomous Fuel Model Key
To facilitate classification of areas in the State, a Florida Dichotomous Fuel Model Key was developed. Fifty FFS employees were trained on its use. These employees sampled over 3000 plots assigning a FBPS fuel model to each. Correlations were made between the spectral reflectance value of the plots and the fuel model allowing for a uniform assignment of fuel models through the state.

Fuel Situations
A fuel situation is a specific vegetative and physical condition that identifies a condition where a specific FBPS fuel model would occur. Within the Florida Fuel Model Dichotomous Key, fuel situations were defined. The same FBPS fuel model can result from different fuel situations. As fuels mitigation measures are defined, the appropriate fuel situation will need to be defined for the fuel models that existing within the Project Area.



The table that follows provides a description of the fuels situation / FBPS fuel model combinations from the Florida Fuel Model Dichotomous Key.

FM 1	A. Non-woody wetlands - Includes freshwater marshes and wet prairies
	C. Uplands - Flatwoods and Sandhills, herb cover 75-100%
	D. Uplands - Flatwoods and Sandhills, shrub cover < 60%, Grass cover >60%
FM2	A. Non-woody wetlands - Includes freshwater marshes and wet prairies
	B. Woody Wetlands - Canopy cover 25-60% & herb cover >60%
	C. Uplands - Flatwoods and Sandhills, herb cover 75-100%
	D. Uplands - Flatwoods and Sandhills, shrub cover < 60%, Grass cover >60%
FM3	A. Non-woody wetlands - Includes freshwater marshes and wet prairies
	B. Woody Wetlands - Canopy cover 25-60% & herb cover >60%
	C. Uplands - Flatwoods and Sandhills, herb cover 75-100%
	D. Uplands - Flatwoods and Sandhills, shrub cover < 60%, Grass cover >60%
FM4	B. Woody Wetlands - canopy cover > 60% and Melaleuca
	C. Uplands - Flatwoods and Sandhills, shrub cover >=60%; Hardwood canopy <75%
FM5	A. Woody Wetlands - ti ti stands/thickets > 70% of cover with DBH >= 3 inches
	B. Woody Wetlands - Canopy cover 25-60% & shrub cover>60%
	C. Uplands - Flatwoods and Sandhills, shrub cover >=60%; Hardwood canopy <75%
FM6	A. Woody Wetlands - Canopy cover 25-60% & shrub cover>60%
FM7	A. Woody Wetlands - Canopy cover 25-60% & shrub cover>60%
	B. Uplands - flatwoods and sandhills, shrub cover >=60%; Hardwood canopy <75%
FM8	A. Woody wetlands - ti ti stands/thickets > 70% of cover with DBH =< 3 inches
	B. Woody wetlands - canopy cover > 60% & not Melaleuca
	C. Uplands - Flatwoods and Sandhills, shrub cover >= 60%; hardwood canopy >= 75%
	D. Uplands - Flatwoods and Sandhills, shrub cover <60%; Timber litter >60%
FM9	A. Woody wetlands - canopy cover > 60% & not Melaleuca
	C. Uplands - Flatwoods and Sandhills, shrub cover <60%; Timber litter >60%
FM10	A. Dead/down material is present and overgrown with live fuel. Slash is from trees, leaves have fallen and cured. Heavy dead component.
	B. Woody wetlands - canopy cover > 60% & not Melaleuca
	C. Uplands - Flatwoods and Sandhills, shrub cover >= 60%; hardwood canopy >= 75%
	D. Uplands - Flatwoods and Sandhills, shrub cover <60%; Timber litter >60%

Custom Fuel Model Definitions

To analyze fuel management mitigation measures, custom FBPS derivative fuel models were developed to complement the existing 13 fuel models. A custom FBPS derivative fuel model is a custom fuel model that minimizes, reduces, or increases fuel loading and fuel bed depth for each of the original FBPS fuel models. By altering the fuel loading and fuel bed depth of the existing fuel models in a consistent manner, the characteristic surface area to volume ratio and the relative packing ratio are preserved with the parent FBPS fuel model.

Custom and FBPS Fuel Model Attributes Used in FRAS

Name	1h T/A	10h T/A	100h T/A	Herb T/A	Woody T/A	1h SA/V	Herb SA/V	Woody SA/V	Depth (Feet)	Mx Ex
1A Short grass (1 ft.) - Low	0.52	0.00	0.00	0.00	0.00	3500	0	0	0.70	12
1 Short grass (1 ft.) - High	0.74	0.00	0.00	0.00	0.00	3500	0	0	1.00	12
1Z Short grass (1 ft.) - High	0.96	0.00	0.00	0.00	0.00	3500	0	0	1.30	12
2A Timber (grass and understory) - Low	1.40	0.70	0.35	0.35	0.00	3000	1500	0	0.70	15
2 Timber (grass and understory) - FBPS	2.00	1.00	0.50	0.50	0.00	3000	1500	0	1.00	15
2Z Timber (grass and understory) - High	2.60	1.30	0.65	0.65	0.00	3000	1500	0	1.30	15
3A Tall grass (2.5 ft.) - Low	2.10	0.00	0.00	0.00	0.00	1500	0	0	1.75	25
3 Tall grass (2.5 ft.) - FBPS	3.01	0.00	0.00	0.00	0.00	1500	0	0	2.50	25
3Z Tall grass (2.5 ft.) - High	3.91	0.00	0.00	0.00	0.00	1500	0	0	3.25	25
4A Chaparral - Low	3.51	2.81	1.40	0.00	3.51	2000	0	1500	4.20	20
4 Chaparral - FBPS	5.01	4.01	2.00	0.00	5.01	2000	0	1500	6.00	20
4Z Chaparral - High	6.51	5.21	2.60	0.00	6.51	2000	0	1500	7.80	20
5A Brush - Low	0.70	0.35	0.00	0.00	1.40	2000	0	1500	1.40	20
5 Brush - FBPS	1.00	0.50	0.00	0.00	2.00	2000	0	1500	2.00	20
5Z Brush - High	1.30	0.65	0.00	0.00	2.60	2000	0	1500	2.60	20
6A Dormant brush, hardwood slash - Low	1.05	1.75	1.40	0.00	0.00	1750	0	0	1.75	25
6 Dormant brush, hardwood slash - FBPS	1.50	2.50	2.00	0.00	0.00	1750	0	0	2.50	25
6Z Dormant brush, hardwood slash - High	1.95	3.26	2.60	0.00	0.00	1750	0	0	3.25	25
7A Southern rough - Low	0.79	1.31	1.05	0.00	0.26	1750	0	1550	1.75	40
7 Southern rough - FBPS	1.13	1.87	1.50	0.00	0.37	1750	0	1550	2.50	40
7Z Southern rough - High	1.47	2.44	1.95	0.00	0.48	1750	0	1550	3.25	40
8A Closed timber litter - Low	1.05	0.70	1.75	0.00	0.00	2000	0	0	0.14	30
8 Closed timber litter - FBPS	1.50	1.00	2.50	0.00	0.00	2000	0	0	0.20	30
8Z Closed timber litter - High	1.95	1.30	3.26	0.00	0.00	2000	0	0	0.26	30
9A Hardwood (long-needle pine) litter - Low	2.04	0.29	0.11	0.00	0.00	2500	0	0	0.14	25
9 Hardwood (long-needle pine) litter - FBPS	2.92	0.41	0.15	0.00	0.00	2500	0	0	0.20	25
9Z Hardwood (long-needle pine) litter - High	3.79	0.54	0.20	0.00	0.00	2500	0	0	0.26	25
10A Timber (litter and understory) - Low	2.10	1.40	3.51	0.00	1.40	2000	0	1500	0.70	25
10 Timber (litter and understory) - FBPS	3.01	2.00	5.01	0.00	2.00	2000	0	1500	1.00	25
10C Timber (litter and understory) - High	3.91	2.60	6.51	0.00	2.60	2000	0	1500	1.30	25
11A Light slash - Low	0.85	2.54	3.11	0.00	0.00	1500	0	0	0.56	15
11 Light slash - FBPS	1.50	4.51	5.51	0.00	0.00	1500	0	0	1.00	15
11Z Light slash - High	2.22	6.65	8.13	0.00	0.00	1500	0	0	1.48	15
12A Medium slash - Low	3.01	10.55	12.43	0.00	0.00	1500	0	0	1.73	20
12 Medium slash - FBPS	4.01	14.03	16.53	0.00	0.00	1500	0	0	2.30	20
12Z Medium slash - High	4.64	16.23	19.13	0.00	0.00	1500	0	0	2.66	20
Low Spread Models										
1N Short grass (1 ft.) - Low Spread	0.10	0.00	0.00	0.00	0.00	3500	0	0	0.12	12
2N Timber (grass and understory) - Low Spread	0.14	0.07	0.04	0.04	0.00	3000	1500	0	0.07	15
3N Tall grass (2.5 ft.) - Low Spread	0.12	0.00	0.00	0.00	0.00	1500	0	0	0.10	25
4N Chaparral - Low Spread	0.15	0.12	0.06	0.00	0.15	2000	0	1500	0.18	20
5N Brush - Low Spread	0.09	0.05	0.00	0.00	0.18	2000	0	1500	0.18	20
6N Dormant brush, hardwood slash - Low Spread	0.14	0.23	0.18	0.00	0.00	1750	0	0	0.23	25
7N Southern rough - Low Spread	0.10	0.17	0.14	0.00	0.03	1750	0	1550	0.23	40
8N Closed timber litter - Low Spread	0.75	0.50	1.25	0.00	0.00	2000	0	0	0.10	30
9N Hardwood (long-needle pine) litter - Low Spread	0.47	0.07	0.02	0.00	0.00	2500	0	0	0.05	25
10N Timber (litter and understory) - Low Spread	0.30	0.20	0.50	0.00	0.20	2000	0	1500	0.10	25
11N Light slash - Low Spread	0.29	0.86	1.05	0.00	0.00	1500	0	0	0.19	15
12N Medium slash - Low Spread	0.28	0.98	1.16	0.00	0.00	1500	0	0	0.16	20

A description of the custom FBPS derivative fuel models follows.

Low Derivatives of the FBPS Fuel Models 1-12

For each FBPS fuel model, a low version was developed by reducing the fuel loading in each category by 30% and by reducing the fuel bed bulk depth by 30%. The consistent reduction in depth and loading maintains the fuel bed bulk density and characteristic (average) surface area to volume ratio for the fuel bed. The low derivative fuel models are designated with the letter A following the standard fuel model number. For example, a 1A is the low loading version of a FBPS fuel model 1.

High Derivatives of the FBPS Fuel Models 1-12

For each FBPS fuel model, a high version was developed by increasing the fuel loading in each category by 30% and by increasing the fuel bed bulk depth by 30%. The high derivative fuel models are designated with the letter Z following the standard fuel model number. For example, a 1Z is the high loading version of a FBPS fuel model 1.

Low Spread Derivatives of the FBPS Fuel Models 1-12

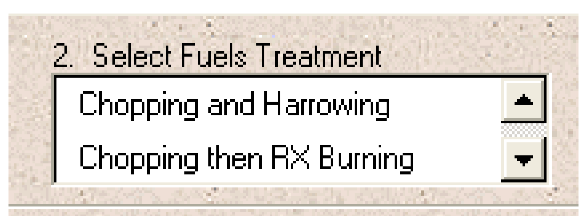
For each FBPS fuel model a low spread version was developed by reducing the fuel loading and fuel bed depth in each category to a very low level. The rate of spread in these models is approximately 1 chain per hour using the Extreme Weather Percentile conditions. It is meant to simulate the expected fire behavior in some fuel bed immediately post-treatment. The low spread fuel models are designated with the letter N following the standard fuel model number. For example, a 1N is the low spread version of a FBPS fuel model 1.

Hot Tip

While the user does have the ability to modify the output fuel profiles, it is strongly recommended the default profiles be used unless the user has extensive knowledge in fuel treatment and assessment.

Fuel Treatment Options

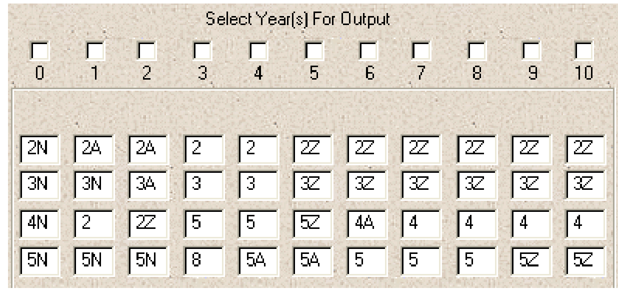
Within FRAS, the following fuel treatment methods are defined:



- Chopping and harrowing
- Chopping followed by Rx Fire
- Herbicide Only
- Mastication
- Piling and burning (or chipping) w/machine
- Broadcast Rx fire
- Broadcast Rx fire followed by chopping
- Broadcast Rx fire followed by herbicide
- Thinning

Fuel Model Assignments Over Time

Default changes in fuel models that result following fuels treatments are included in the FRAS. Changes are provided for each year following treatment for 10 years.



To analyze the effectiveness of fuels treatment measures, the planner will need to estimate the change expected in fuel model following treatment and for each year for the successive 10 years. Fortunately, a workshop was conducted with FFS and other land management personnel who defined default fuel models for each fuel treatment method within each fuel situation.

Using the FRAS to Assess Changes in Fuel Model

All fuels analysis is done within a defined Project Area. A Step-Wise Process is provided to assist the user in completing the analysis of fuels treatments. A summary of the analysis steps follows:

<u>Fuels Analysis Steps</u>

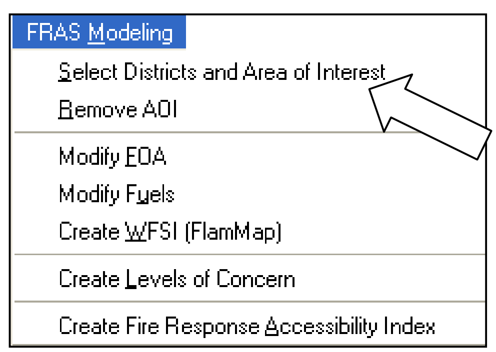
Step 1a: Select the FRAS Modeling Menu
Step 1b: Select the District(s) and AOI
Step 1c: Click on the Modify Fuels Menu
Step 1d: Create the Project Area Polygon
Step 1e: Complete Part 1 of the Fuels Analysis Worksheet
Step 2: Select the Treatment Type
Step 3: Select the Fuels Situations for each Fuel Model
Step 4: Verify the Fuels Profile for First Fuel Model
Step 5: Verify the Fuels Profile for Remaining Fuel Models
Step 6: Select the Year(s) of Interest
Step 7: Generate the Fuel Profiles for the Year(s) of Interest
Step 8: Create the WFSI for the Year(s) of Interest
Step 9: Create the LOC for the Year(s) of Interest

<u>Step 1a: Select the FRAS Modeling Menu</u>

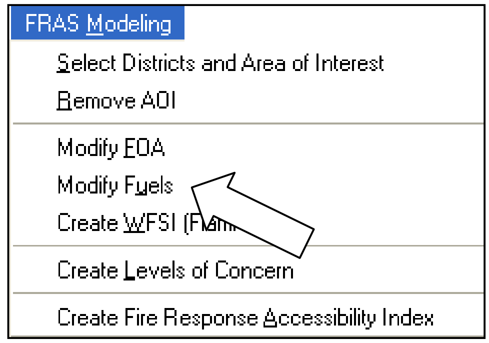
Click on FRAS Modeling on the ArcView FRAS Main Menu.

<u>Step 1b: Select the District(s) and AOI</u>

If the District and AOI to be used are not the current active view, select or define the District(s) and AOI to use by clicking on the FRAS Modeling, Select Districts and AOI Menu. Proceed to select the District(s) and AOI based on the process presented in Section V.



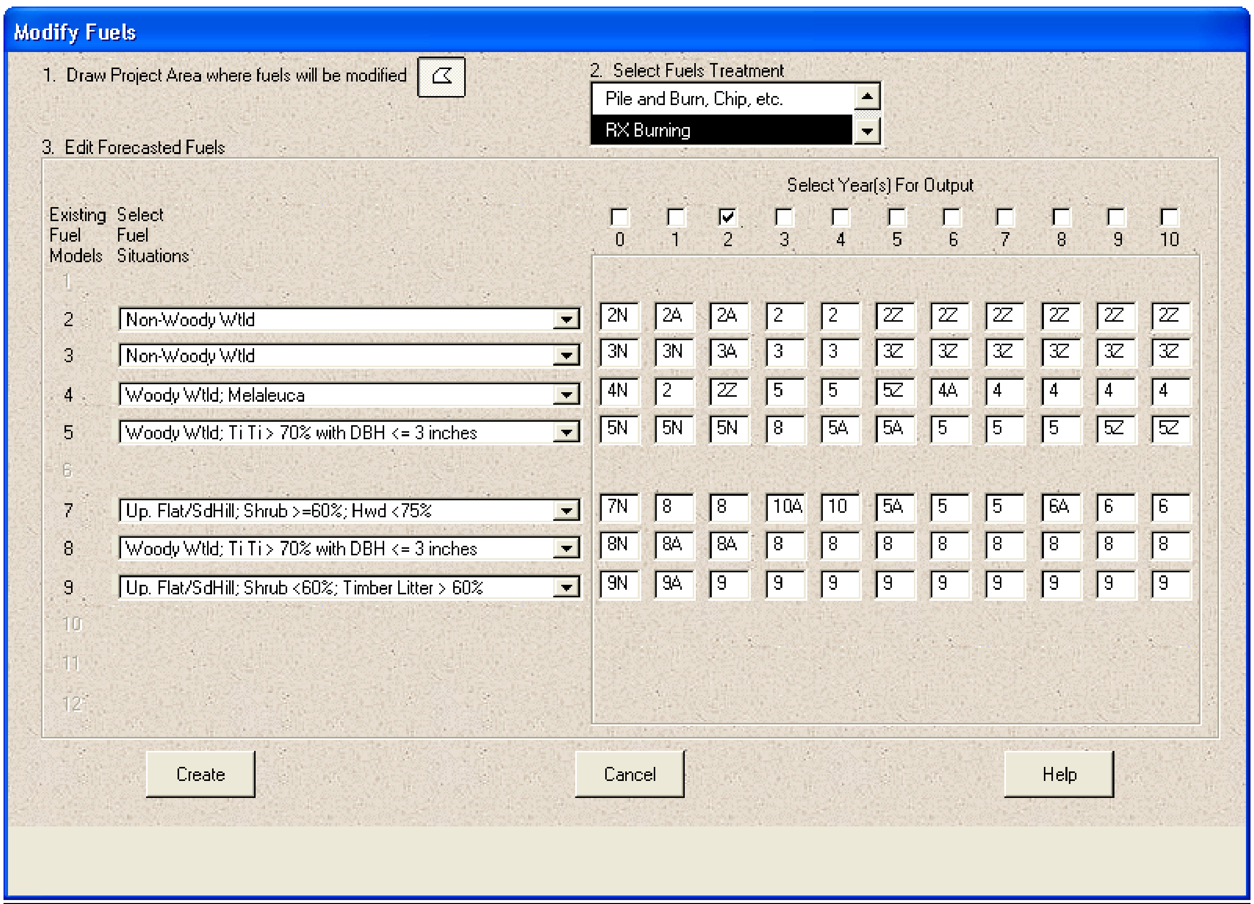
Step 1c: Click on the Modify Fuels Menu Item



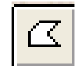
The next step is to select from the FRAS Modeling main menu the Modify Fuels menu item.

A dialog similar to the one below will appear. It contains three sections. These sections will allow the user to:

- Section 1: Step 1d: Create the Project Area Polygon
- Section 2: Step 2: Select the Treatment Type
- Section 3: Step 3: Select the Fuels Situations for each Fuel Model
  - Step 4: Verify the Fuels Profile for First Fuel Model
  - Step 5: Verify the Fuels Profile for Remaining Fuel Models
  - Step 6: Select the Year(s) of Interest

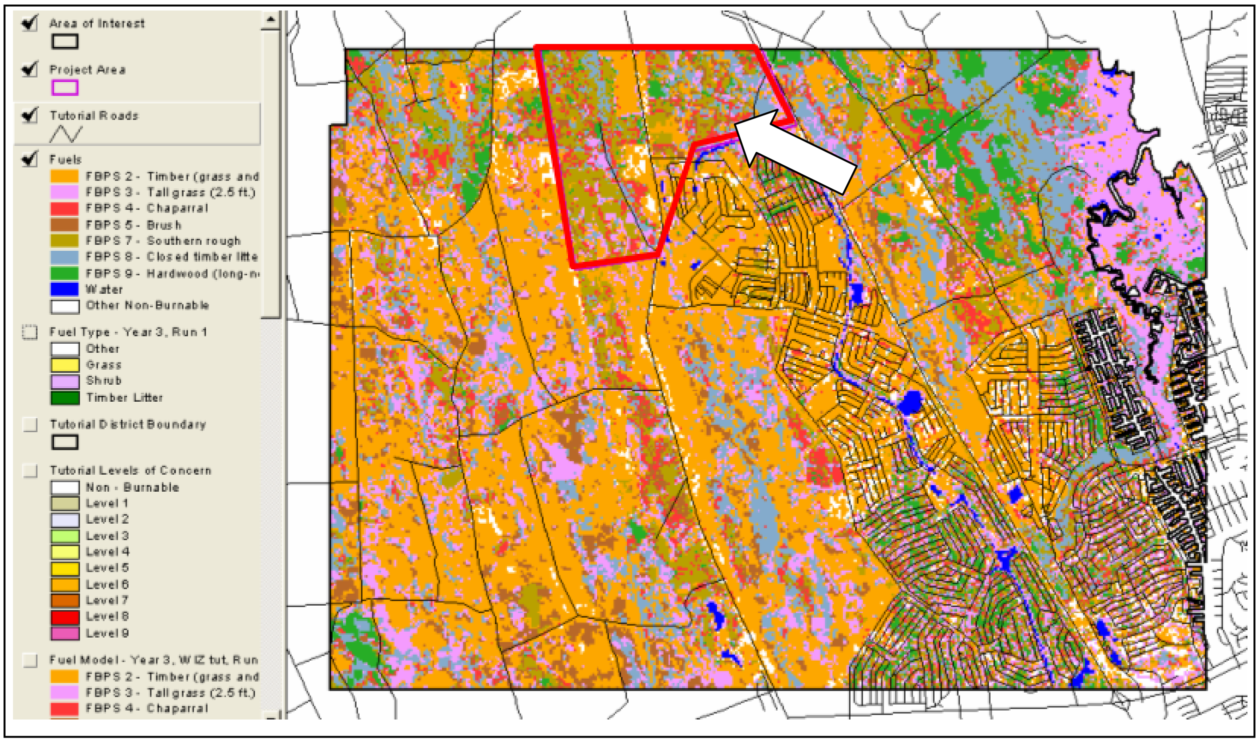


<u>Step 1d: Create the Project Area Polygon</u>



To digitize a Project Area for modifying fuels in the AOI Data View, click on the icon following the label in Section 1: Draw Project Area where fuels will be modified. If no Project Area is defined, the entire AOI will be used for the Project Area. It is highly recommend that Project Areas be used rather than the entire AOI being made the Project Area.

After the Draw Project Area icon is clicked, the dialog will minimize so the Project Area can be digitized. Create the polygon by doing a left single click on each vertex of the polygon. Double click on the last vertex to finish the polygon. The Modify Fuels dialog will reappear. An example of a digitized Project Area is shown below.



<u>*Hot Tip*</u>

Modifying the fuels will change the WFSI data and ultimately the LOC data layer.

Step 1e: Complete Part 1 of the Fuels Analysis Worksheet

Inputs to a Project Area in FRAS are not recorded electronically. Hence, the inputs for a fuels project need to be recorded on a FRAS Fuels Analysis Worksheet. Part 1 provides a place to record Project Identification information. Part 2 provides a section to record file names and information needed to run FlamMap. Part 3 provides a form to record the Fuel Situations and Fuel Models used OR just the modifications to the FRAS default fuel situations and fuel models used. To minimize recording information, it is recommended the second option be used most often. To aid the user, the bottom of the worksheet shows the Fuels Analysis Steps and the FlamMap Process Steps though neither is shown on the example below. A blank copy of the FRAS Fuels Analysis Worksheet can be found in the Appendix.

FRAS Fuels Analysis Worksheet

Part 1: Project Identification

Project: __________________	District: _________________	AOI: ____________________
Planner: _________________	Date: __ / __ / __	Treatment Type: ____________________

Part 2: File Names and FlamMap Information

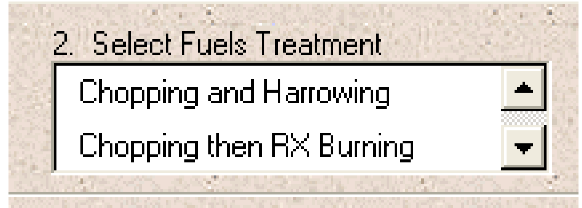
Fuel_Grid File Names: ___________(yr=_2_) ____________(yr=__), ____________(yr=__)	Fuel_Type File Names: ____________(yr=__) _____________(yr=__), ___________(yr=__)
WFSI_Grid File Names: ____________(yr=_2_), ____________(yr=__), ___________(yr=__)	
WIZs in AOI: _______________	Location of LCP & FMS Files: ________________________
ROS File Names: ____	

Part 3: Project Assumptions

___ **Modifications to FRAS Defaults** ___ **Fuel Situations and Fuel Models Used**		Years Since Treatment (Circle to Specify Years of Interest)										
FM	Fuel Situation	0	1	2	3	4	5	6	7	8	9	10
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												

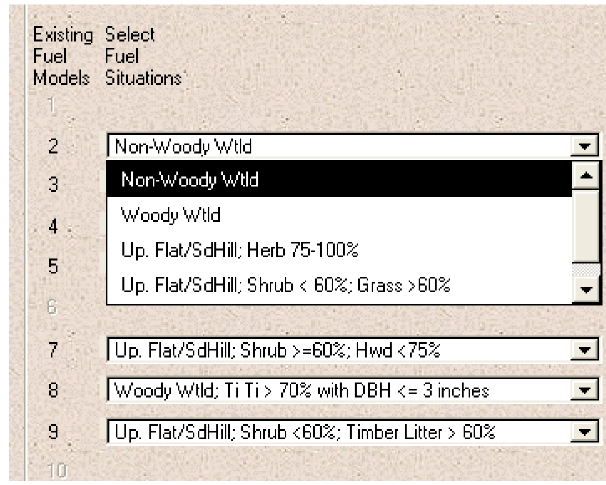
Step 2: Select the Treatment Type

Select the type of fuel treatment for the Project Area by using the scroll list options in Section 2. Select a Fuels Treatment. Once a treatment is selected, the post treatment fuel situations are automatically populated for that fuel treatment for each fuel model in Section 3.



Step 3: Select the Fuels Situations for Each Fuel Model

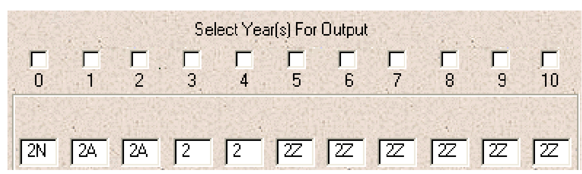
This step involves reviewing the available fuel situations for each fuel model and selecting the appropriate fuel situation from the list for each fuel model. This is illustrated in the figure at the right. Once the fuel situation is selected, the fuel profiles for selected fuel situations will appear within the dialog box.



Be sure to record on the fuel situations for each fuel model on the FRAS Fuels Analysis Worksheet.

Step 4: Verify the Fuels Profile for First Fuel Model

This step allows the user to verify the fuel profiles for each fuel model / fuel situation. Any of the years (0-10) can be modified and are automatically applied to the Project Area. Type in new fuel models for those years where a change from the defaults is desired. Note that a panel of experts has derived the fuel profiles during workshops for the FRAS project. Note that the range of fuel models from year 1-10 represents a scenario. A change in 1 year will require potential changes in subsequent years.

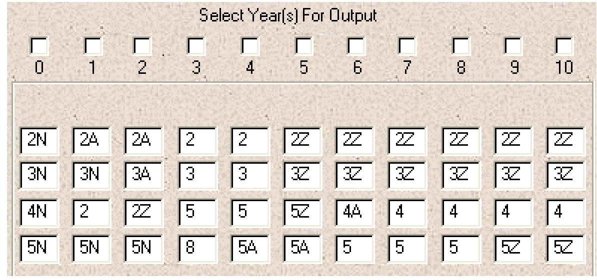


Record the fuel models on the FRAS Fuels Analysis Worksheet.

Hot Tip

While the user does have the ability to modify the output fuel profiles, it is strongly recommended the default profiles be used unless the user has extensive knowledge of fuel changes overtime.

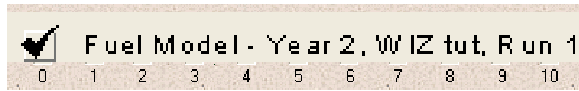
Step 5: Verify the Fuels Profile for Remaining Fuel Models



The next step is for the user to verify the appropriate fuel model / fuel situation for the remaining fuel models found in the Project Area, and to modify the fuel profile for any given year (0-10).

Record on the FRAS Fuels Analysis Worksheet.

Step 6: Select the Year(s) of Interest



Select a single year, or multiple years for which a new fuels map is desired. Note that this will create multiple fuels layers with file names based on the run number. The fuels layer will have the file name fuelXX_Y where XX is the WIZ number and Y is the run number. For the tutorial data set, XX is tut. If the example above right were from the tutorial data set, the fuels layer file name would be fueltut_1. If the example above right were from the Bunnell District, the fuels layer file name would be fuel11_1 if the Project Area were in WIZ 11. The Bunnell District is contained in parts of three Weather Influence Zones.

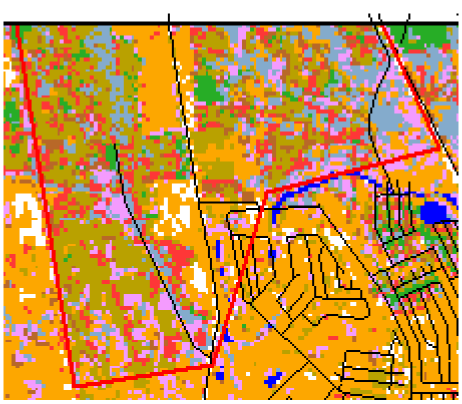
A Fuel Type data layer is created also. The fuel types are Grass, Brush, Timber Litter and Other soils. This Fuel Type layer is used in the calculation of the LOC. The Fuel Type layer will have the file name fcar_Y where Y is the run number. For the example above right, the file name would be fcar_1. *Understanding the file naming convention is critical.* The correct fuels layer must be identified when the WFSI is calculated.

Be sure to record file names in Part 2 of the FRAS Fuels Analysis Worksheet

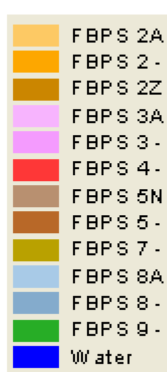
Step 7: Generate the Fuel Profiles for the Year(s) of Interest

This step will allow you to generate a new fuel model output for the fuel treatment Project Area and overlay this modified fuels onto the original fuels map for the AOI. To do this, click on the **Create** button. The new fuel layers for the selected fuel profile years will be generated and displayed in the AOI view. The new fuel layers are then available as inputs into FlamMap to generate a new WFSI.

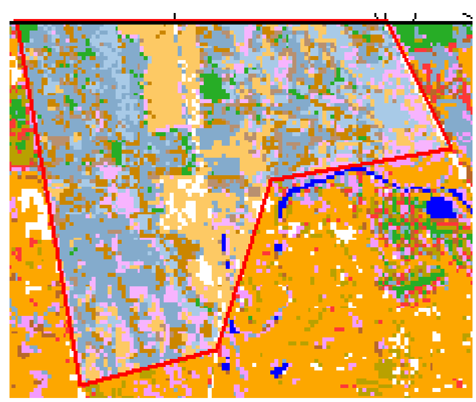
Published Results



Fuel Model



Fuels Modified at Year 2



Step 8: Create the WFSI for the Year(s) of Interest

The Wildland Fire Susceptibility Index integrates the probability of an acre igniting, wildland fire behavior and ROS vs final fire size relationships. It combines the data from the Fire Occurrence Areas, fire behavior data developed by FlamMap and expectant fire size vs. fire spread rate relationships. A Wildland Fire Susceptibility Index (WFSI) was computed for each 30x30 meter cell of burnable vegetation within the State in the Published Results. If fuel models are changed in a Project Area, the WFSI will change for each of the years of interest selected. To obtain the new WFSI values for the Project Area, the user will need to:

- Run FlamMap for the AOI
- Calculate the new WFSI

Running FlamMap

Since FlamMap is an external standalone program, the user must utilize the FlamMap program Windows interface to create the rate of spread (ROS) files. Accordingly, there are a series of processing steps within FlamMap that must be satisfied to create each of the ROS files for each WIZ and Year of Interest and within the Area of Interest. For more information on FlamMap, refer to Section II. The process flow for creating these ROS files with FlamMap follows:

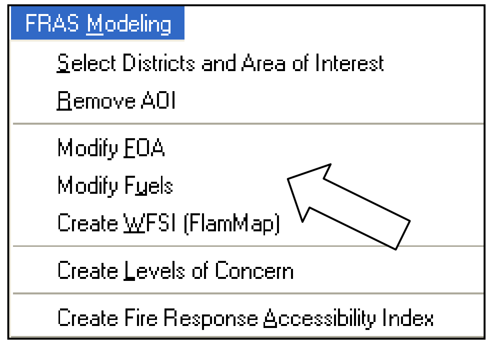
FlamMap Process Steps

Step F-1: Start FlamMap
Step F-2: Define the FlamMap Program Location
Step F-3: Define the Environmental Inputs for First WIZ and Low Percentile Weather Category
Step F-4: Define the Output Data Specs
Step F-5: Generating ROS Output
Step F-6a: Select Environmental Inputs the Next Percentile Weather Category and Complete Steps 3-6 Until All Categories Have Been Run
Step F-6b: Complete Steps 3-6 for the Next WIZ
Step F-7: Exit FlamMap and Creating the WFSI
Step F-8: Re-run FlamMap, if desired, for additional Years of Interest (Go to Step 2).

Hot Tip

Note the iterative processing that is required at the end of each run to ensure that each percentile weather scenario is run for each WIZ within your AOI.

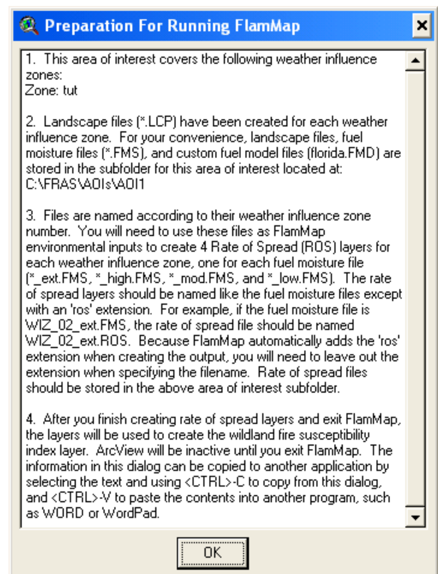
Step F-1: Start FlamMap
To initiate the running of FlamMap, select the **FRAS Modeling, Create WFSI menu.**



Step F-2: Define the FlamMap Program Location
If the path to the flammap.exe program has not yet been set, you will be prompted to set this parameter now. Navigate to the file directory where the flammap.exe file resides and click OK.

Select the fuels layer to use in the FlamMap runs
A dialog will appear where the user can select the fuel data layer(s) to be used. If more than one WIZ exists in the Project Area, the user will be prompted for each. Refer to the fuel data layer file names as recorded in Part 2 of the FRAS Fuels Analysis Worksheet.

Recording WIZs and AOIs
A dialog similar to the one at the right will appear. The report dialog provides important information that you need to know prior to running FlamMap.

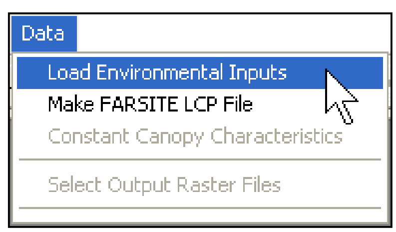


This information includes:

- Item 1 – A list of the weather influence zones (WIZ) within the AOI containing the Project Area
- Item 2 - The location of the *.LCP (landscape) and *.FMS (fuel moisture) files, and
- Item 3 - Naming conventions for output FlamMap ROS files.

Record the names and file locations on the FRAS Fuels Analysis Worksheet.
Press OK to dismiss the dialog and start the FlamMap program interface.

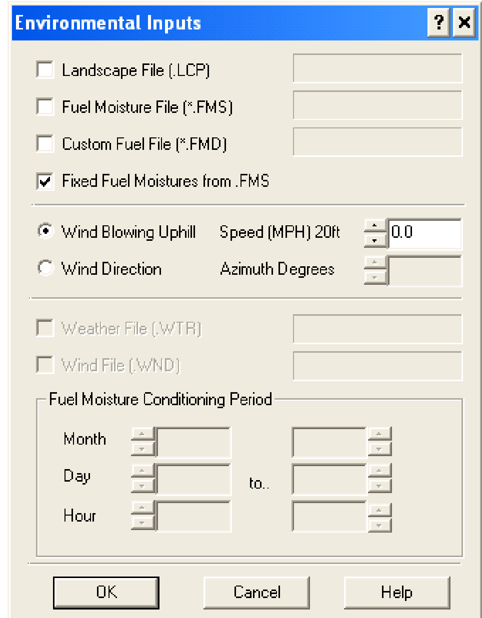
Step F-3: Define the Environmental Inputs for First WIZ and Low Percentile Weather Category
When FlamMap starts, ArcView will present a blank interface.
Select the Data, Load Environmental Inputs menu item.



The environmental inputs for the FlamMap run must be specified per percentile weather category per weather influence zone. Currently, this includes the selection of a fuel moisture file (defined as either Low, Moderate, High or Extreme), and the 20' wind speed. These fuel moisture files represent corporate data and must not be changed by the user. The fuel moisture file has a .FMS extension. Four files have been predefined and are provided for each WIZ. These files are copied to the AOI folder automatically and the directory provided in the **Preparation for Running FlamMap** dialog that opens prior to FlamMap opening.

Define the Landscape File Location

The FlamMap dialog for defining the environmental inputs appears at the right.

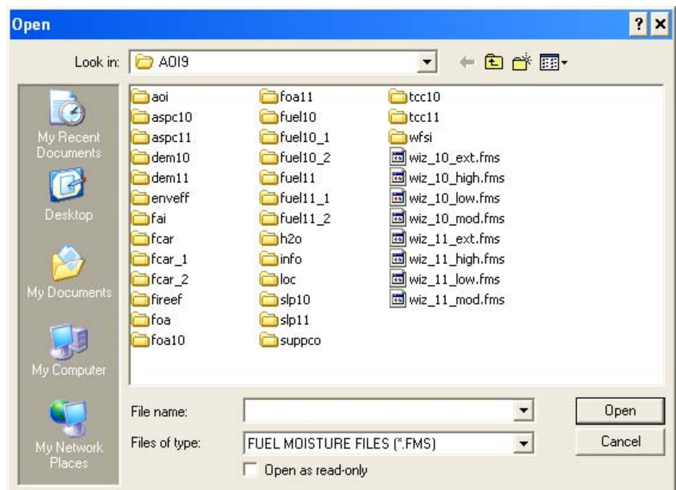


The first step is to define the file location for the landscape (LCP) file. Note that if more than one WIZ exists in the AOI, then a landscape file has been created for each WIZ. Steps 3-6 will need to be performed for each WIZ.

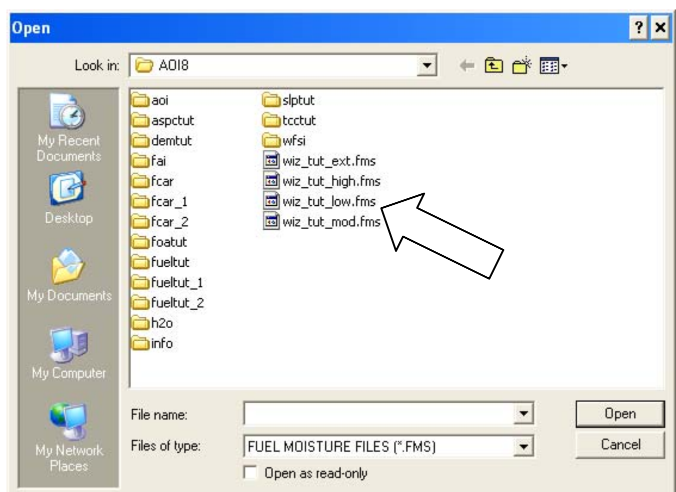
Click on the Landscape File (.LCP) checkbox and navigate to and select the LCP file created by FRAS for the WIZ desired. A standard file browser will appear to support this definition. Note that you may need to navigate to the specific AOI folder for your AOI Data View. The .LCP file is automatically created and placed there by the FRAS.

Define Environmental Conditions for Low Percentile Weather

Click on the Fuel Moisture file (*FMS) box to locate the low percentile fuel moisture data file. The figure at the right presents the FMS file selection dialog. Note that you may need to navigate to the appropriate AOI subdirectory. Each FMS file is automatically created in the AOI folder for the active AOI Data View.



In the figure at the right, note there are fuel moisture files for two WIZs, 10 and 11. This provides an example of what the user will see if there is more than one WIZ in the AOI.

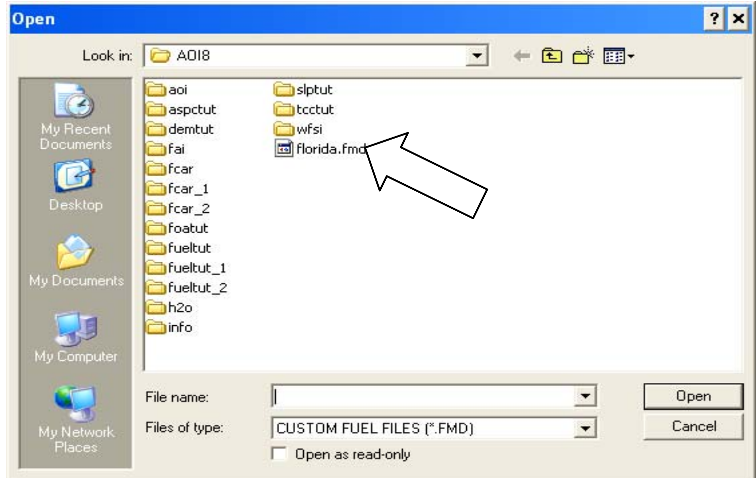


The figure at the right shows the FMS file selection dialog for the tutorial data set. Note the naming convention for the FMS files. The standard naming convention is wiz_XX_YYY.fms where the XX is the WIZ number and the YYY is the percentile weather category.

The low percentile weather FMS file is named: wiz_tut_low.fms. Select this file.

Define the Custom Fuel Model File Location

Custom fuel models most likely appear in cells in the Project Area following fuels treatment. FlamMap needs to know the parameters that define each custom fuel model. The fuel loading and other fuel model parameters for the custom fuel models are located in an ASCII file titled florida.fmd. This file is automatically copied to the AOI folder for the active AOI Data View.



Click on the Custom Fuel File (*FMD) checkbox to locate the florida.fmd data file. If necessary, navigate to the appropriate AOI subdirectory to select this file.

Define the 20-foot Wind Speed for Low Percentile Weather

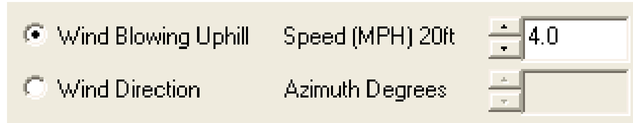
A separate parameter within the definition of the percentile weather data set is the 20-foot, 10-minute average wind speed. In FlamMap, it is entered separately from the fuel moisture conditions.

The wind speeds for each percentile weather category for each WIZ are listed in the table at the right.

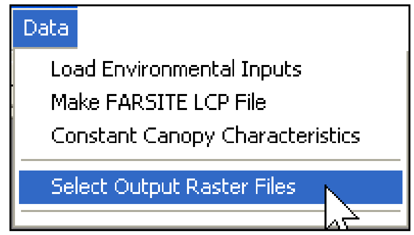
WIZ	20' Wind Speed by Percentile Weather Category			
	Extreme	High	Moderate	Low
1	14.7	11.6	5.6	4.0
2	15.1	11.2	7.2	5.4
3	14.2	10.1	6.6	3.3
4	14.1	10.2	6.3	3.1
5	14.3	10.0	6.2	3.3
6	14.2	9.9	6.3	3.3
7	14.8	9.8	6.9	4.8
8	16.6	11.6	6.4	4.3
9	16.9	11.0	8.0	4.8
10	17.4	11.4	7.0	4.7
11	17.2	11.0	7.0	4.6
12	16.3	11.1	7.9	4.7
13	17.7	12.3	8.2	4.9
14	17.1	12.5	9.1	5.7
15	15.0	11.2	7.2	3.7
16	16.7	12.3	9.2	5.1
17	19.2	13.3	10.0	5.4
18	19.6	14.2	9.6	5.3
19	20	14.0	9.1	5.1
20	22.2	15.6	10.4	5.1
Tutorial	16.6	11.6	6.4	4.3

The WFSI Published Results data layer was calculated using percentile weather wind speed values entered as a decimal to the nearest tenth. To repeat the Published Results, enter the wind speed to the nearest tenth. Since these 20-foot wind speed values are reduced to mid-flame by FlamMap, it is recommended that the user round them off to the nearest tenth when entering them into the FlamMap program.

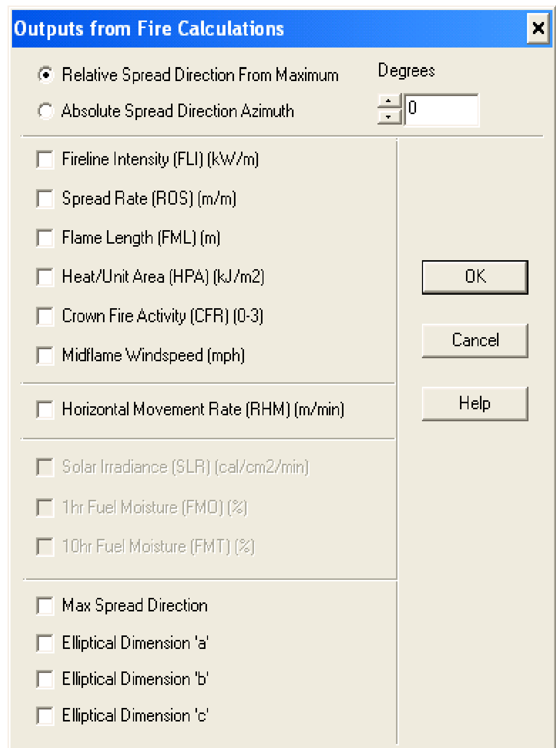
Click on the Wind Blowing Uphill radio button. Enter the 20-foot windspeed value for the low percentile weather in the box provided. Notice that the wind speed value has been rounded to 4.0 from the table value of 4.3.



<u>Step F-4: Defining Output Data Specs</u>
Once the environmental characteristics are defined, the output data layer for ROS must be defined. Select **Data**, **Select Output Raster Files** from the FlamMap menu options.



The dialog at the right will appear. The output data layer that must be created is Rate of Spread. Note that other data layers can be created such as Flame Length. Use of these other data layers will be discussed later.



To generate the ROS output file **for the low percentile weather category, click on the checkbox to the left of the** Rate of Spread title.

The user will be prompted to define the output ROS file name. The naming convention must follow the same format as that of the FMS files. This format is:

WIZ_XX_YYY.ROS

where, XX is the WIZ number and YYY is the percentile weather category (low, mod, high or ext). For the tutorial data set, the file name for the low percentile weather ROS file will be titled as follows: wiz_tut_low.ros. Type in the file name <u>without including the file extension</u> and then click on the Save button. This will return you to the **Outputs from Fire Calculation** dialog; select OK to close the dialog.

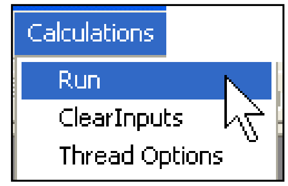
<u>Hot Tip</u>

FlamMap adds the ROS extension automatically. Therefore, the name entered in the dialog box <u>must not</u> contain the ROS extension.

For example, type in wiz_tut_low, not wiz_tut_low.ros.

Step F-5: Generating ROS Output for the Low Percentile Weather Category

Once the output data specifications are defined, FlamMap can create the Rate of Spread (ROS) output data file.



Select **Calculations**, **Run** from the FlamMap menu. An informational message that shows % completed will be presented and it disappears when FlamMap has completed the data layer creation.

Step F-6a: Select Environmental Inputs the Next Percentile Weather Category and Complete Steps 3-6 Until All Categories Have Been Run

The user needs to repeat Steps 3-6 for the moderate, high and extreme percentile categories. Follow the instructions in Steps 3-6 replacing the "low" percentile weather name in the instructions with moderate, high and or extreme. Note the abbreviations in the file naming are as follows:
low for low, mod for moderate, high for high and ext for extreme.

Hot Tip

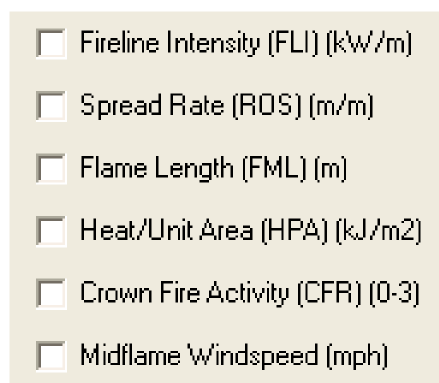
For the same WIZ, you do not need to change the landscape (LCP) file selection or the custom fuel model (FMD) selection in Step 3.

Step F-6b: Complete Steps 3-6 for the Next WIZ

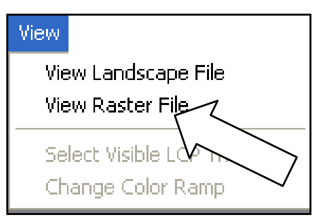
Note that if more than one WIZ exists in the AOI, then a landscape file has been created for each WIZ. Steps 3-6 will need to be performed for each percentile weather category for each WIZ.

Using FlamMap to Create and Display Other Fire Behavior Outputs Besides Rate of Spread

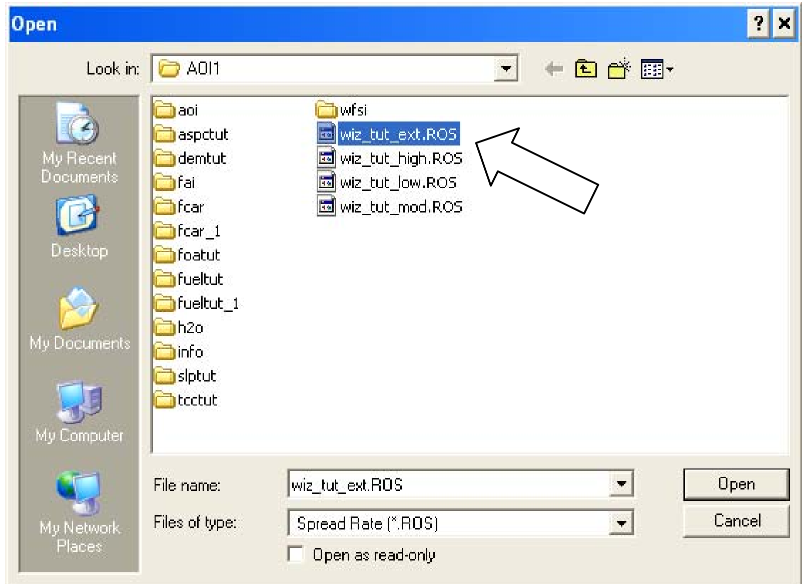
FlamMap has the ability to create data layers for other fire behavior such as flame length. The figure to the right shows the fire behavior layers that can be selected besides rate of spread. The process to create one of these additional fire behavior layers is the same as then process used to create the data layer for rate of spread.



To view either data layers included in the landscape file or the output fire behavior files, select the View menu in FlamMap.



Select the **View Raster File**. The file selection dialog at the right will appear.



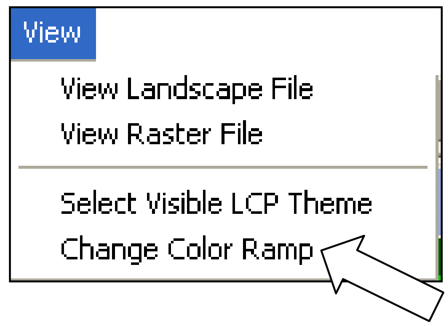
At the bottom of the dialog is a box titled Files of type. Click on the pulldown and select **ROS** files.

When this is done, ROS layer files created by FlamMap will appear.

For this example, select the **wiz_tut_ext.ROS** file.

Click on the **Yes** when asked the question "Yes for Categories."

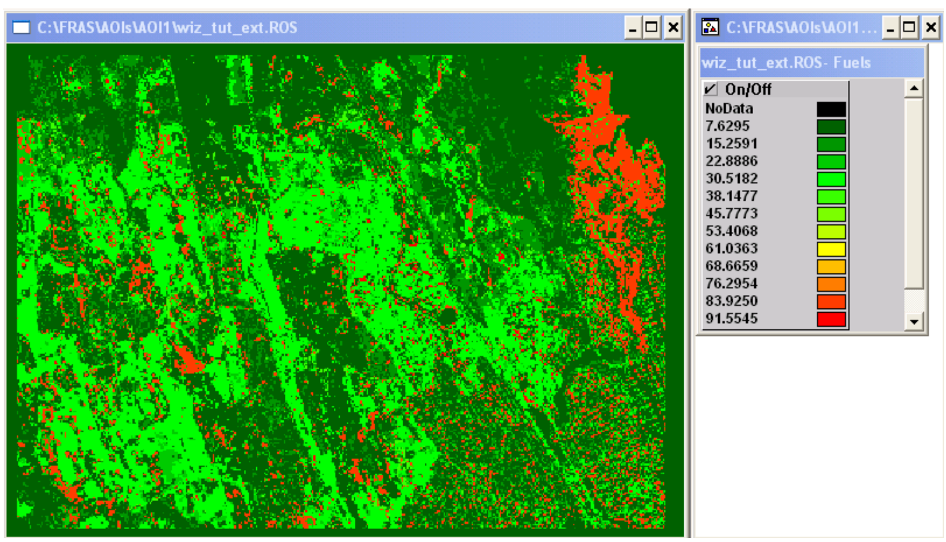
The map that appears will not be very readable.



<u>Next, select the View, Change Color Ramp menu.</u>

From the dialog that appears, select the **Continuous Scale**. In the pull down below that selection, select the Green-Yellow-Red option. Green is the low values with Red the high values.

A map similar to the one at the right will appear. The ROS values in the key are in meters per minute.



One meter/minute is approximately three chains per hour.

If a flame length output data layer had been created, it could be displayed in the same manner.

Rate of Spread maps can be printed from within FRAS using the FRAS Output, Create Maps menu item.

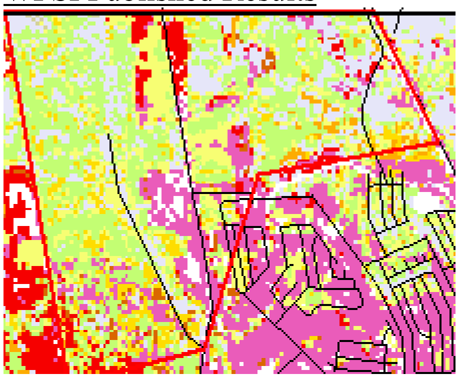
Step F-7: Exit FlamMap and Creating the WFSI

Once all ROS categories have been run for all WIZs in the AOI, FlamMap is closed by selecting the **File**, **Exit** menu. When prompted to confirm the exit, select the **Yes** button. ArcView will not be active until FlamMap has been closed.

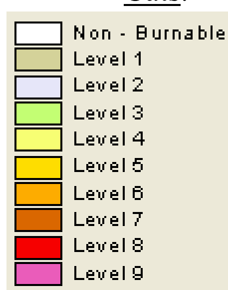
Exiting FlamMap will initiate a process within FRAS that automatically converts the ROS ASCII files into ArcView GRID format. This conversion will occur transparent to the user except for the processing messages in the center of the screen and at the bottom of the ArcView window. FRAS will first check to ensure that all four ROS files exist for each WIZ. If a file is missing, a message will appear and it will be necessary to run FlamMap again to create the missing ROS file(s).

Once the file conversion is completed, the ROS values in the data layers from FlamMap are converted from meters/minute to chains/hour. The final fire size is calculated and the WFSI values are calculated for each percentile weather category. The grids are named according to the following convention WIZXX_YYY where XX is the WIZ number and YYY is the percentile weather category abbreviation. The final WFSI for the WIZ is then calculated by summing the four weather category WFSI values. Upon completion of the WFSI calculations you will be notified.

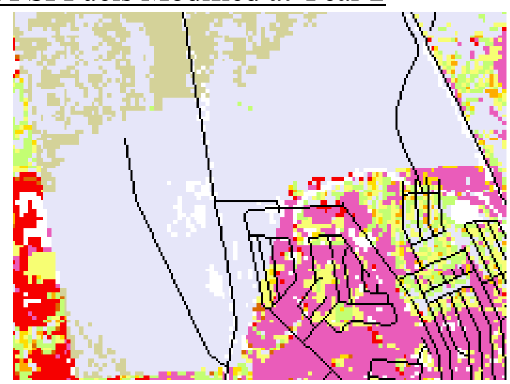
WFSI Published Results



Cats.



WFSI Fuels Modified at Year 2



Note that the areas in white in the WFSI maps are non-burnable fuels.

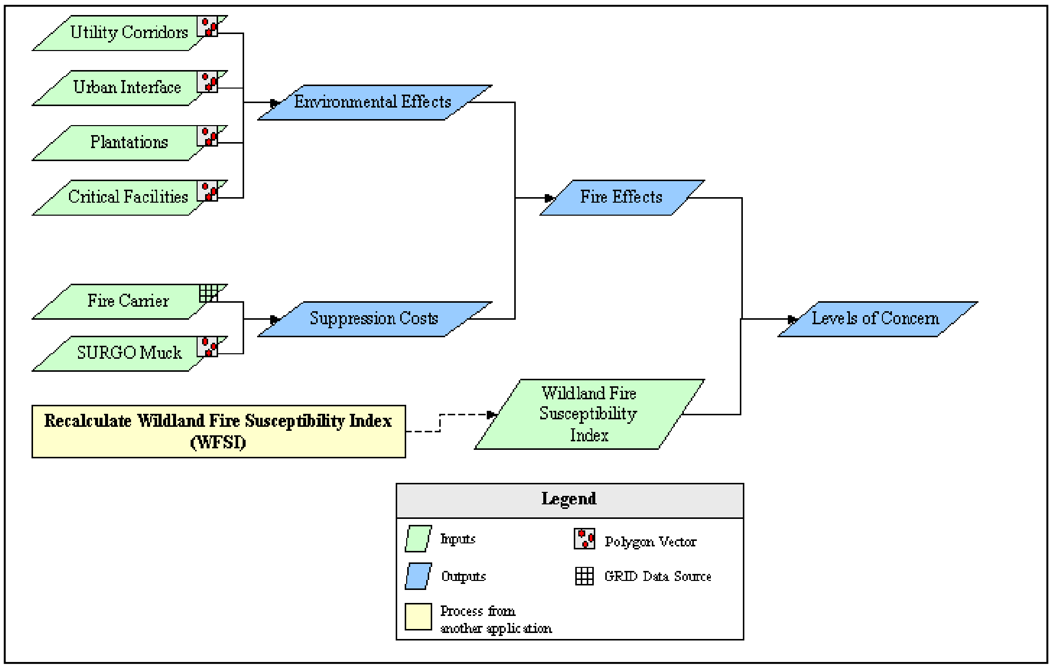
Step F-8: Re-run FlamMap, if desired, for additional Years of Interest (Perform Steps 2-8).

Note that if more than one Year of Interest was selected for fuels in the Project Area following treatment, FlamMap will need to be run again for the additional Years of Interest.

Step 9: Create the LOC for the Year(s) of Interest

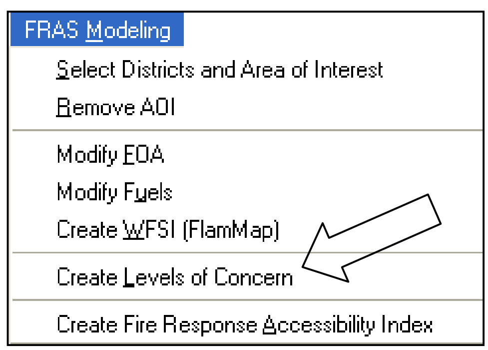
The Levels of Concern (LOC) values were assigned by multiplying the wildland fire susceptibility index by the fire effects index. The figure below presents a data flow of the LOC calculation process. Since the WFSI has changed for the cells within the Project Area, new LOC values need to be calculated. The Recalculate Wildland Fire Susceptibility Index box represents the newly created WFSI values for the Project Area. The LOC values are calculated for the entire AOI. The LOC calculation follows the following 4 steps:

- Step 1 – Initiate LOC dialog
- Step 2 - Select the Fuel Type Map
- Step 3 - Select the WFSI Data Layer Name
- Step 4 - Create WFSI Data Layer



<u>Creating LOC</u>

To create the LOC, follow the steps below:

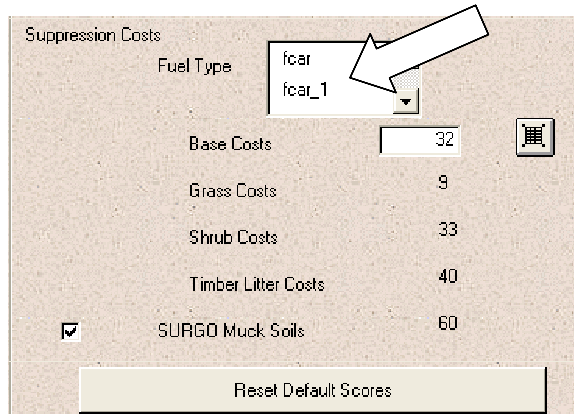


<u>Step 1 – Initiate LOC dialog</u>

To Initiate the LOC dialog, select the **FRAS Modeling**, **Create LOC** menu item.

Step 2 - Select the Fuel Type Map

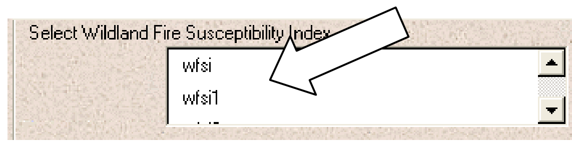
The Create LOC dialog appears at the right. To re-create the LOC, the user needs to identify the Fuel Type map that is associated with the Fuel Model Map that was created for the Year of Interest.



Click on the Fuel Type map name to select it. Note that there are two fuel type maps, fcar, which is the published results and fcar_1, which is the first run created from the fuels modification process.

Step 3 - Select the WFSI Data Layer Name

Click on the WFSI data layer name that has the Run number that is being used. Note, WFSI is the published results, WFSI1 is the new run created using the modified fuels layer.



Step 4 - Create WFSI Data Layer

Click on the Create Button.

Creating Maps and Reports

WFSI, LOC, Rate of Spread and Final Fire Size maps can be created using the FRAS Outputs, Create Maps menu. In addition, reports can be generated using the FRAS Outputs, Create Reports menu.

Prevention Options - Modifying Fire Occurrence Rates

Another option for modifying key input data is to change the Fire Occurrence Classes. To analyze the effectiveness of fire prevention measures, the planner will need to estimate the change expected in fire occurrence rate from the mitigation measure(s). The WFSI and LOC for a cell are affected by the fire occurrence rate. The fire occurrence rate in the Published Results for a cell is defined by which FOA it is in. The planner can modify the FOA rate using the Modify FOA menu.

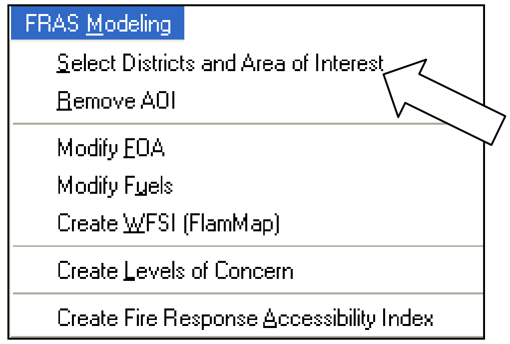
Using the FRAS to Assess Changes in Fire Occurrence Rate

All fire prevention analysis is done within a defined Project Area. A Step-Wise Process is provided to assist the user in completing the effectiveness analysis of fire prevention mitigation options. A summary of the analysis steps follows:

Fire Prevention Analysis Steps

Step 1a: Select the FRAS Modeling Menu
Step 1b: Select the District(s) and AOI
Step 1c: Click on the Modify FOA Menu
Step 1d: Create the Project Area Polygon
Step 1e: Complete Part 1 of the Fire Prevention Analysis Worksheet
Step 2: Change FOA Rate
Step 2a: Changing An FOA Rate to Another Existing FOA Rate
OR

Step 2b: Changing All FOAs to a New User Defined FOA Rate
Step 3: Create the WFSI for the AOI Containing the Project Area
Step 4: Create the LOC for the AOI Containing the Project Area

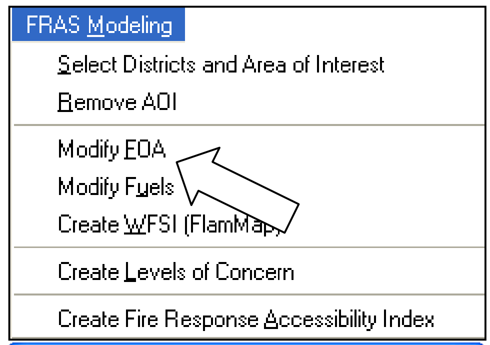


Step 1a: Select the FRAS Modeling Menu

Click on the **FRAS Modeling** menu, on the ArcView FRAS Main Menu.

Step 1b: Select the District(s) and AOI

If the District and AOI to be used are not the current active view, select or define the District(s) and AOI to use by clicking on the FRAS Modeling, **Select Districts and AOI** Menu. Proceed to select the District(s) and AOI based on the process presented in Section V.

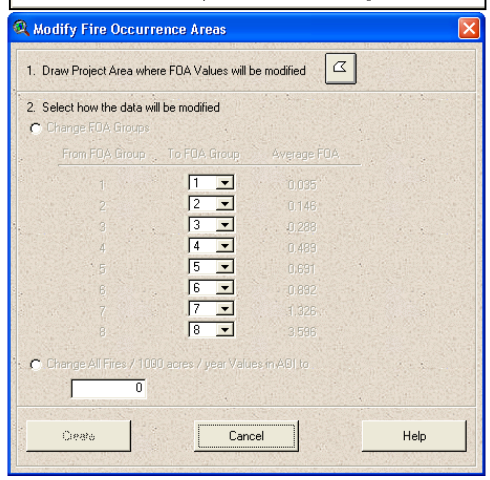


Step 1c: Click on the Modify FOA Menu

The next step is to select from the FRAS Modeling main menu the **Modify FOA** menu item.

A dialog similar to the one at the right will appear. It contains two sections. These sections will allow the user to:

- Section 1: Step 1d: Create the Project Area Polygon
- Section 2: Step 2: Change FOA Rate



Step 1d: Create the Project Area Polygon

To digitize a Project Area for modifying fire occurrence in the AOI Data View, click on the icon to the right of Section 1: **Draw Project Area where FOA Values will be modified**. If no AOI is defined, the entire model view AOI will be used for the Project Area. Since this fire occurrence modification tool is intended to reflect operational treatments, it is highly recommend that Project Areas be used.

After the Draw Project Area where fuels icon is clicked, the dialog will minimize so the Project Area can be digitized. Create the polygon by doing a left single click on each vertex of the polygon. Double click on the last vertex to finish the polygon. The Modify FOA dialog will reappear. An example of a digitized Project Area is shown at the right.

Step 1e: Complete Part 1 of the Fire Prevention Analysis Worksheet

Inputs to a Project Area in FRAS are not recorded electronically. Hence, the inputs for a fire prevention project need to be recorded on a FRAS Fire Prevention Analysis Worksheet. Part 1 provides a place to record Project Identification. Part 2 provides place to record file names for the fuel grid layer, the fuel type grid file name and the FOA grid file name. Part 3 contains a table where assumptions on fire occurrence changes can be recorded. To aid the user, the bottom of the worksheet shows the Fuels Analysis Steps and the FlamMap Process Steps though neither is shown on the example below. A blank copy of the FRAS Fuels Analysis Worksheet can be found in the Appendix.

FRAS Fire Prevention Analysis Worksheet

Part 1: Project Identification

Project: _________________	District: ________________	AOI Name: ______________
Planner: ________________	Date: __ / __ / __	Fire Prevention Action: _____________ ___________________________________

Part 2: File Names

Fuel_Grid File Name: __________________	Fuel_Type File Name: __________________
FOA_Grid File Name: __________________	WFSI_Grid File Name: _________________
ROS File Names: ____	

Part 3: Project Assumptions

Change FOA Categories ___		
From FOA Category	Average FOA Rate (fires/1000 ac/yr)	To FOA Category
1	0.035	
2	0.146	
3	0.288	
4	0.489	
5	0.691	
6	0.892	
7	1.326	
8	3.596	
Change All Fires FOA Rate ___		
Average FOA Rate (fires/1000 ac/yr)		
FOA Rate = ____________		

Fire Prevention Analysis Steps

Step 1a: Select the FRAS Modeling Menu
Step 1b: Select the District(s) and AOI
Step 1c: Click on the Modify FOA Menu
Step 1d: Create the Project Area Polygon
Step 1e: Complete Part 1 of the Fire Prevention Analysis Worksheet
Step 2: Change FOA Rate
Step 2a: Changing to Another Existing FOA Rate
OR
Step 2b: Changing to a New User Defined Rate
Step 3: Create the WFSI for the Year(s) of Interest
Step 4: Create the LOC for the Year(s) of Interest

FlamMap Process Steps

Step F-1: Start FlamMap
Step F-2: Define the FlamMap Program Location
Step F-3: Define Environmental Inputs for First WIZ and Low Percentile Weather Category
Step F-4: Define Output Data Specs
Step F-5: Generating ROS Output
Step F-6: Select Environmental Inputs the Next Percentile Weather Category and Complete Steps 3-6 Until All Categories Have Been Run
Step F-7: Complete Steps 3-6 for the Next WIZ
Step F-8: Exit FlamMap and Creating the WFSI
Step F-9: Re-run FlamMap, if desired, for additional Years of Interest (Perform Steps 2-8).

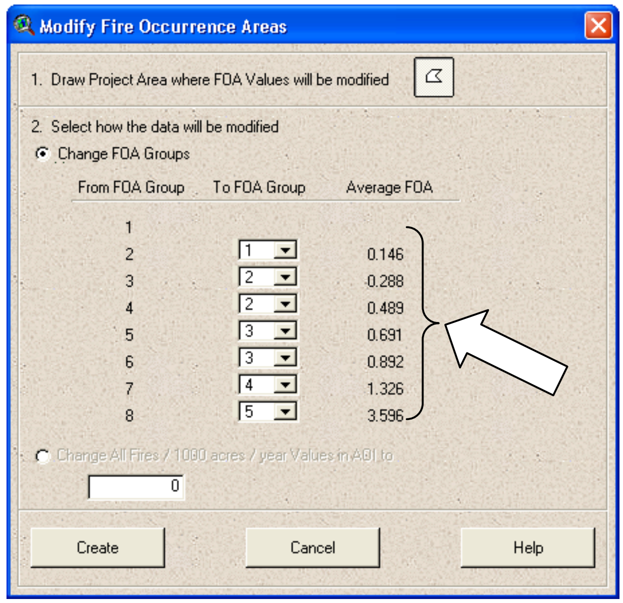
Step 2: Change FOA Rate

Implementing fire prevention actions is expected to reduce the historic fire occurrence rate as shown in the Published Results. FRAS allows the user to change the occurrence rate by:

- Step 2a: Changing An FOA Rate to Another Existing FOA Rate
- Step 2b: Changing All FOAs to a New User Defined FOA Rate

Step 2a: Changing An FOA Rate to Another Existing FOA Rate

Select the **Change FOA Groups** option in Section 2 of the Modify FOA dialog.



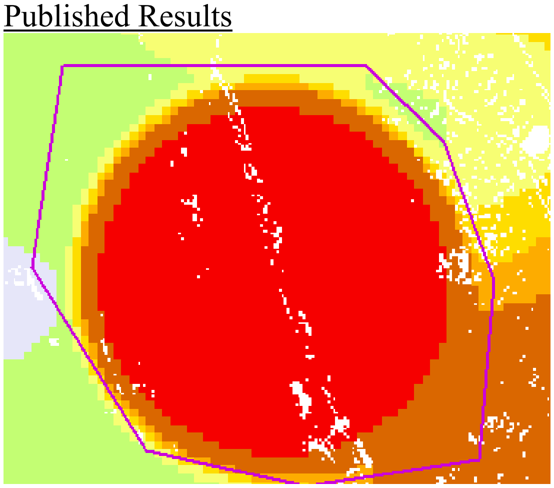
In the To FOA group column, select a new fire occurrence rate to be assigned to each FOA Category that occurs in the Project Area a new FOA Category.

In the example at the right, FOA category 8 has been modified to change to the fire occurrence rate in FOA 5.

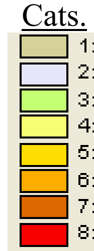
Note that in the example, FOA category 1 does not allow the user to enter a 'To FOA Group'. This is because there are no cells with FOA category 1 within the Project Area.

Once the FOA categories have been changed, press the **Create** button to modify the FOA data. Note that the AOI Data View will be updated with the revised FOA theme.

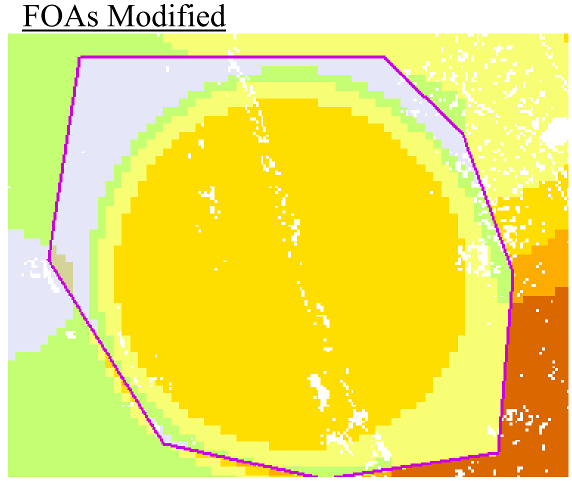
Published Results



Cats.

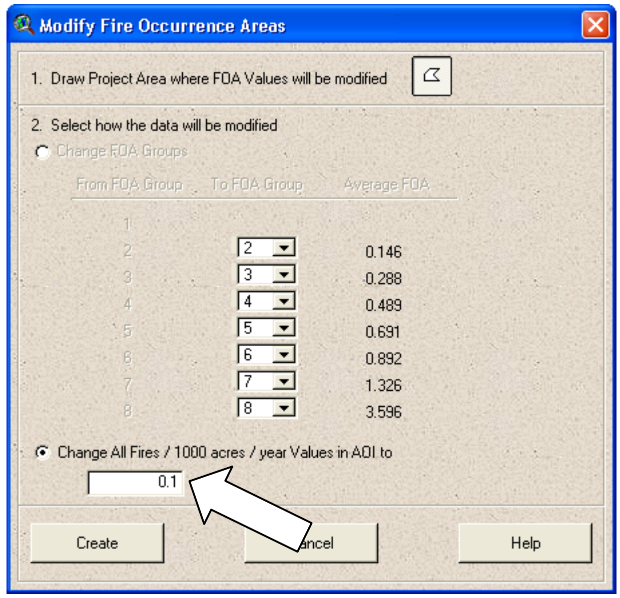


FOAs Modified



Step 2b: Changing All FOAs to a New User Defined FOA Rate

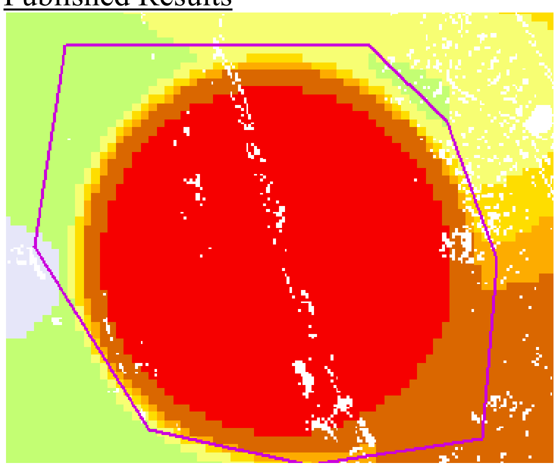
Select **Change All fires/1000 acres/year Values in AOI** in Section 2 of the Modify FOA dialog.



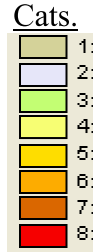
Enter a new fire occurrence rate in fires per 1000 acres per year. All cells in the Project Area will have the fire occurrence rate changed to this rate. By default, the entire Project Area has a new user defined FOA Category.

Below are examples of the FOA categories for the Published Results and FOA modified so that the fire occurrence rates for all cells in the Project Area is 0.1 fires per 1000 acres per year.

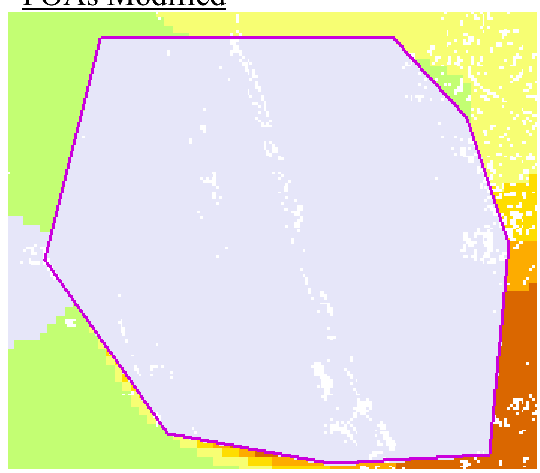
Published Results



Cats.



FOAs Modified



Hot Tip

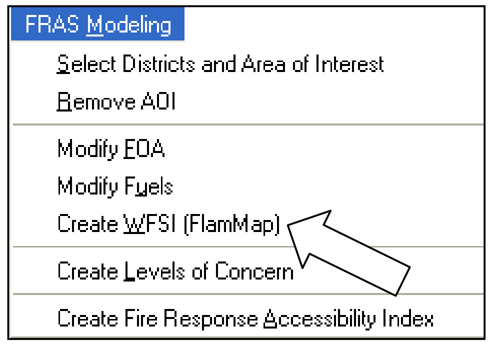
Modifying the fire occurrence will change the WFSI data and ultimately the LOC data layer.

Step 3: Create the WFSI for the AOI Containing the Project Area

The Wildland Fire Susceptibility Index integrates the probability of an acre igniting and wildland fire behavior. It combines the data from the Fire Occurrence Areas, fire behavior data developed by FlamMap and expectant fire size vs. fire spread rate relationships. A Wildland Fire Susceptibility Index (WFSI) was computed for each 30x30 meter cell of burnable vegetation within the State in the Published Results. If the fire occurrences rates are changed within a Project Area and if the user wants to display the WFSI or the LOC for the Project Area, then it will be necessary to recalculate the WFSI.

To obtain the new WFSI values for the Project Area, the user will need to:

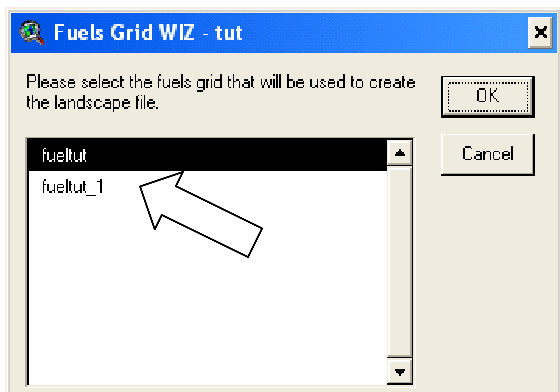
- Select the FRAS Modeling, Create WFSI menu item
- Select the Fuel Grid Layer to Use
- Start and Run FlamMap if Necessary
- Select the FOA Layer
- View the WFSI Data Layers



Select the FRAS Modeling, Create WFSI menu item

Click on the **FRAS Modeling** Menu and then on the **Create WFSI** menu item.

A dialog where the user can select the fuel layer to use is displayed.



Select the Fuel Grid Layer to Use

A dialog similar to the one at the right will appear. If no Project Areas for fuel treatment have been created, the only fuel grid layer that will be displayed is the Published Results fuel grid layer for the AOI. In the example, the Published Results fuels grid layer file name is fueltut. In the example, a Modify Fuels Project Area has been defined and has the file name fueltut1 (Run 1).

If the user wishes to recalculate the WFSI for the Modify FOA Project Area, then the user should select the Published Results fuels grid. If the Modify FOA Project Area overlapped the Modify Fuels Project Area and the user wants to recalculate the WFSI with both fuels and fire occurrence changes, then the user would select the fuel grid layer that is associated with the Modify Fuels Project Area; ie. fueltut_1.

The example that follows assumes that the Published Results fuel grid layer has been selected.

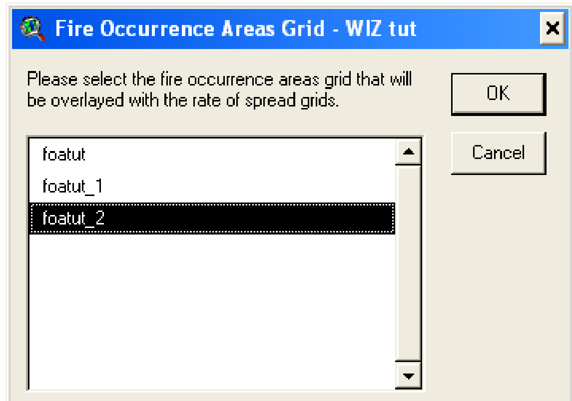
Start and Run FlamMap if Necessary

If the fuels grid that is selected has had rate of spread files previously created using FlamMap, then the user just needs to close FlamMap by selecting the File, Exit menu item. For a newly created AOI, FlamMap will always need to be run since no rate of spread files will exist for any fuel grid layer in the AOI.

Run FlamMap as described in FlamMap Process Steps, Steps F-3 through F-6. These steps are described in the part of this section titled *Using the FRAS to Assess Changes in Fuel Model*.

Select the FOA Layer

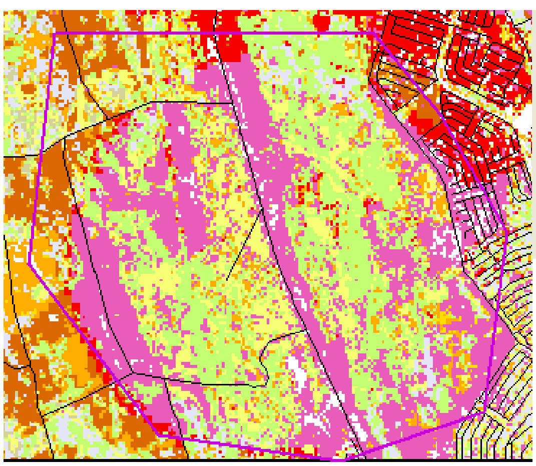
After FlamMap closes, a Fire Occurrence Area dialog similar to the one at the right, will appear. The Published Results FOA grid layer file name will be displayed; ie. foatut. Other FOA grid layers file names that have been created via the Modify FOA dialog will also appear. Refer to the FRAS Fire Prevention Worksheet to determine the FOA grid layer file name for the FOA Project Area where the recreation of the WFSI is desired.



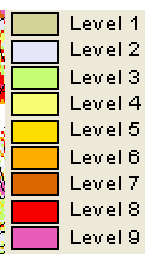
View the WFSI Data Layers

Following selection of the FOA grid layer file name, FRAS will complete the process of recalculating the WFSI for all cells in the AOI.

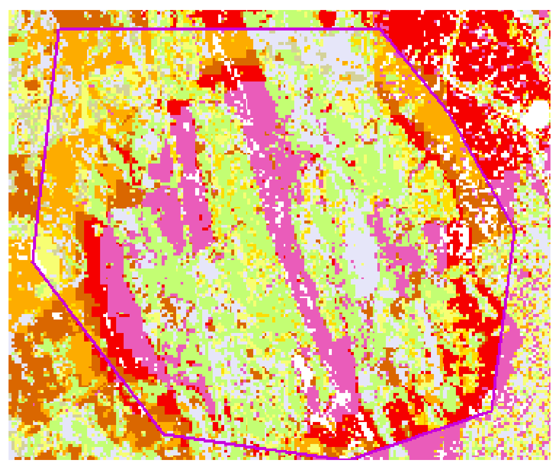
WFSI Published Results



Cats.



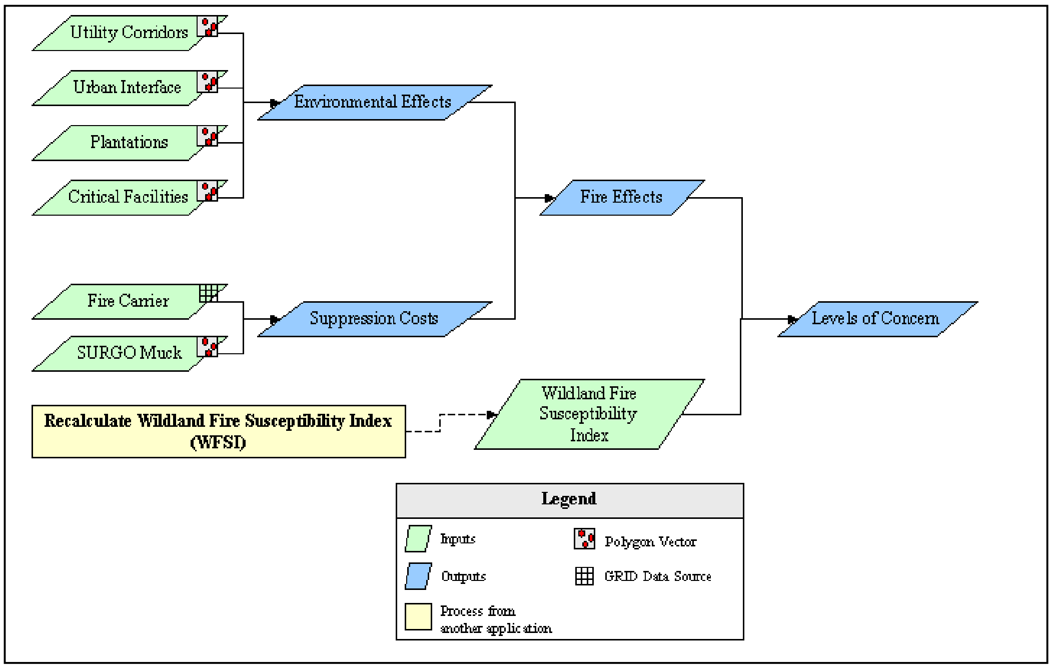
WFSI with FOAs Modified



Step 4: Create the LOC for the Year(s) of Interest

The Levels of Concern (LOC) values were assigned by multiplying the wildland fire susceptibility index by the fire effects index. The figure below presents a data flow of the LOC calculation process. Since the WFSI has changed for the cells within the Project Area, new LOC values need to be calculated if a revised LOC data layer is desired. The Recalculate Wildland Fire Susceptibility Index box represents the newly created WFSI values for the Project Area. The LOC values are calculated for the entire AOI. The LOC calculation follows the following 4 steps:

- Step 1 – Initiate LOC dialog
- Step 2 - Select the Fuel Type Map
- Step 3 - Select the WFSI Data Layer Name
- Step 4 - Create WFSI Data Layer

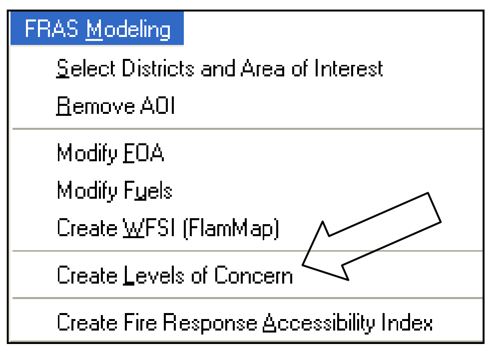


<u>Creating LOC</u>

To create the LOC, follow the steps below:

<u>Step 1 – Initiate LOC dialog</u>

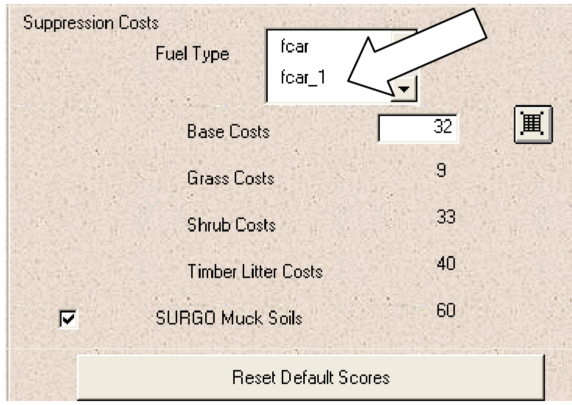
To initiate the LOC dialog, select the FRAS Modeling, Create LOC menu item.



Step 2 - Select the Fuel Type Map

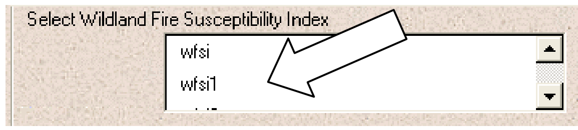
The Create LOC dialog appears at the right. To re-create the LOC, the user needs to identify the Fuel Type map that is associated with the Fuel Model Map that was created for the Year of Interest.

Click on the Fuel Type map name to select it.



Step 3 - Select the WFSI Data Layer Name

Click on the WFSI data layer name that has the Run number that is being used.



Step 4 - Create WFSI Data Layer

Click on the Create Button.

Creating Maps and Reports

WFSI, LOC, Rate of Spread and Final Fire Size maps can be created using the FRAS Outputs, Create Maps menu. In addition, reports can be generated using the FRAS Outputs, Create Reports menu.

VII. Using the Florida Wildfire Risk Assessment System: Assessment of Effectiveness of Mitigation Measures, Changing Resource Locations

Introduction

As discussed in Section VI, options for mitigation measures can be classified into the following areas:

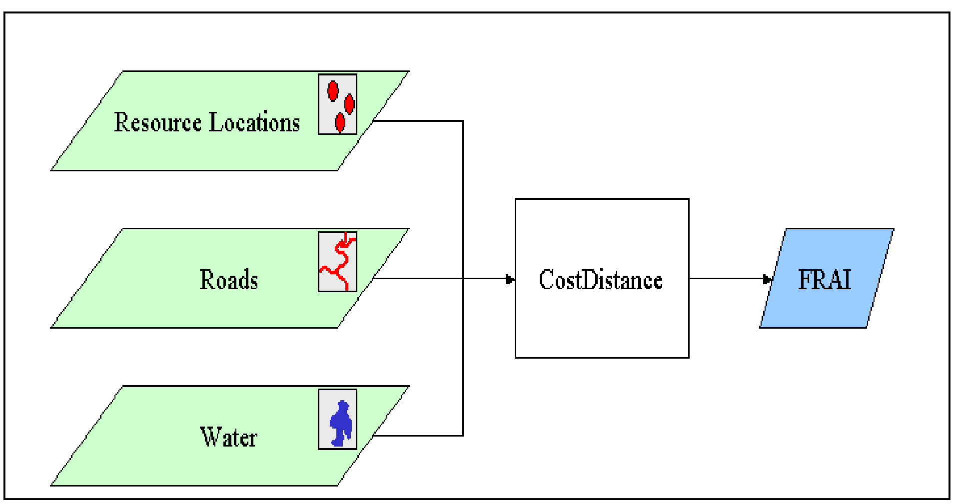
- Fuels Management Options
- Fire Prevention Options
- Preparedness Planning Options
- Creation of Defensible Space Options

This section focuses on assessing Preparedness Planning Options using FRAS tools to analyze accessibility by changing locations where fire protection resources are stationed.

These locations will be referred to as resource locations.

No custom tool is provided to facilitate this capability, as it is readily available using the general ArcView editing functions. Accordingly, this section describes the steps that are required to update resource locations for generating the Fire Response Accessibility Index. The FRAI is a measure of the change in accessibility by road given a resource location (fire station) is changed. It can be used to address changes in initial attack time, which is one component of a more robust fire planning process.

To analyze the effectiveness of changing resource locations for protection resources, the planner can move resource locations and/or can add resource locations. The data processing flow for the FRAI data is illustrated at the right. Updating the resource locations dictates an update to the FRAI layer.



Changing Resource Locations Analysis Steps

The steps to analyze the change in FRAI with changes in resource locations follows:

- Step 1: Ensuring District Resource Locations Data is Loaded into the Active AOI Data View and Saved to the AOI Directory
- Step 2: Selecting the Existing Resource Locations Theme
- Step 3: Converting to a Shapefile
- Step 4: Start Editing
- Step 5: Digitizing New Locations
- Step 6: Moving Existing Locations
- Step 7: Removing a Location
- Step 8: Stop Editing

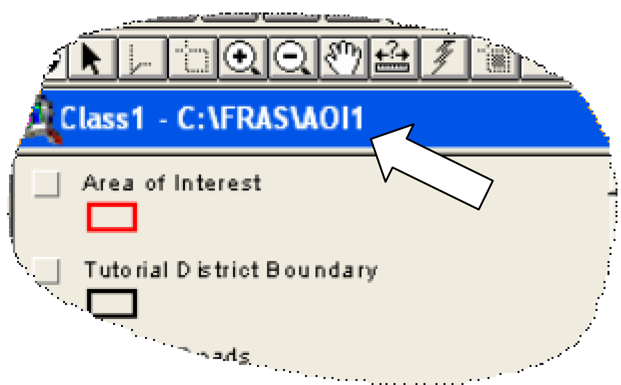
Step 1: Ensuring District Resource Locations Data is Loaded into the Active AOI Data View and Saved to the AOI Directory

Updating the Resource locations must occur in an active AOI Data View. Select the AOI Data View for the area in which the resource locations are to be modified. Ensure the resource locations theme exists. Resource locations are clipped to an 8-mile buffer around the AOI extent during creation of the AOI Data View.

The original source resource locations (resources) data resides as a coverage found in each District folder. For example, for the Blackwater District, the resource locations data file will be "blarsrc". Resource locations always have the "**rsrc**" naming convention. Refer to the metadata provided with the Published Results data distribution found in the "**FRAS\Districts_Metadata**" folder.

When an AOI is created, the resource locations are clipped to the AOI and copied to the AOI folder. Since the AOI folders are managed seamlessly by FRAS, it will be necessary to determine which specific AOI folder is being used for the view since this is required in the next step.

To provide this information to the user, the specific AOI folder is incorporated into the View name. The View Name consists of the AOI name, in this example the name is **Class1**, and full AOI folder path name.



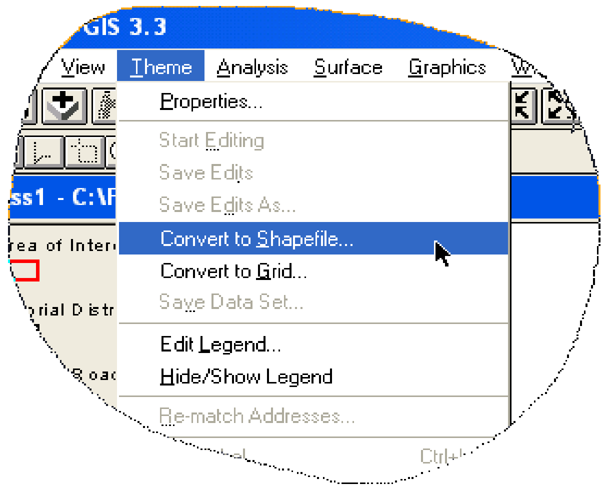
Once the location of the specific AOI folder is known, proceed with creating a copy of the resource locations shapefile and updating it.

Step 2: Selecting the Existing Resources Locations Theme

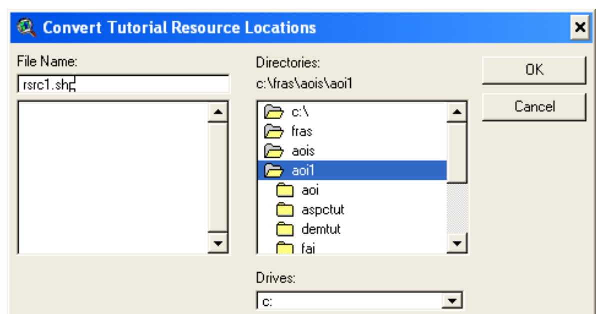
Select the resource locations theme in the view legend by placing the cursor over the name and clicking the left mouse button. The box around the name of the resource location coverage should be raised as shown to the right.

Step 3: Converting to a Shapefile

The theme must be converted to a shapefile to facilitate editing. This will make a copy of your resource locations. To convert the theme to a shapefile, click on the ArcView Theme menu and select **Convert to Shapefile**.

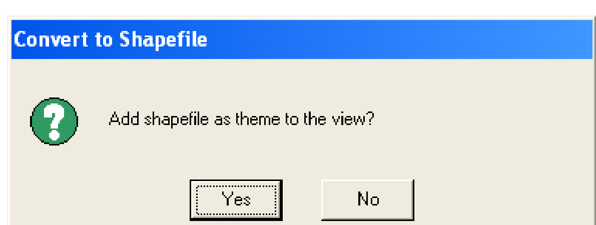


FRAS will prompt for the path to the new shapefile. Navigate to the **specific AOI folder** and save the new shapefile using the "**rsrc#.shp**" naming convention where the # can be a unique sequential number to help you identify other resource location data sets. As long as the string, 'rsrc' exists within the name, FRAS will recognize it as a resource locations data set and will include it in the list of data layers. For this example, the new resource location file is named **rsrc1.shp**.



Using a sequential numbering scheme will allow for the creation of many modified resource location data sets. This would allow for comparison of different scenarios for allocation with respect to the final impact on fire accessibility.

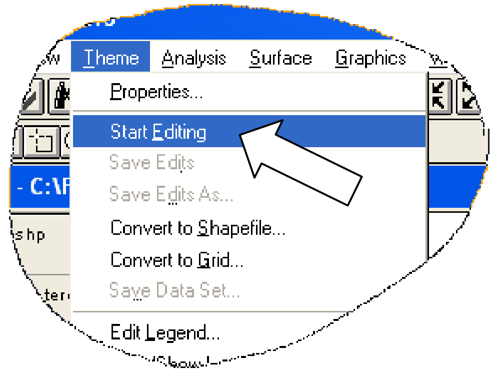
You will then be prompted to "**Add shapefile as a theme to the view**?" Press the **Yes** button to add the new shapefile as a theme to the AOI Data View (see figure at right).



Now one can start editing the resource locations by adding new resource locations, moving existing resource locations, or removing resource locations.

Step 4: Start Editing

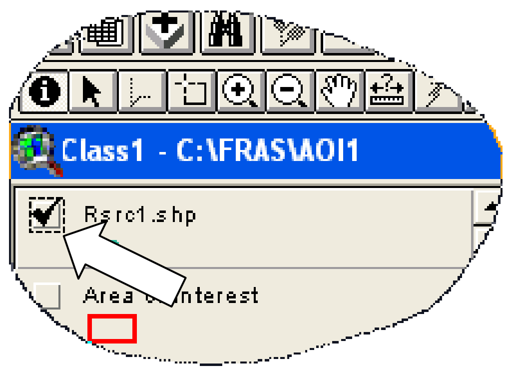
Select the new shapefile theme that has just been added to your AOI view.



Click on the theme title to make the theme the **active theme**.

Now select the ArcView **Theme-Start Editing** menu option.

A dashed line will appear around the check box in the view legend when the theme is ready for editing (see figure at the right).



Step 5: Digitizing New Locations

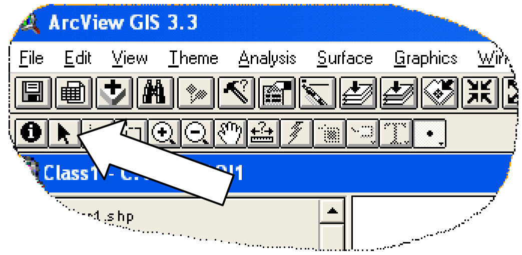
To insert a new resource location, select the point tool from the tool drop-down menu as shown. The cursor should now appear as a crosshair on the screen.

Place the cursor on the map where you would like the new resource location and click the <u>left</u> mouse button once to place the point. The new point will added to the shapefile and become the selected feature .

Many new locations can be added in this manner using this approach.

Step 6: Moving Existing Locations

To move a resource location, the pointer tool must first be selected.



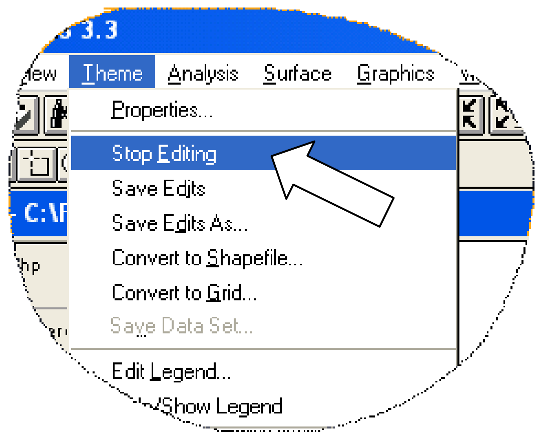
Using this tool, depress and hold the left mouse button until the point is at the desired location in the shapefile. This is a drag-and-drop operation.

Step 7: Removing a Location

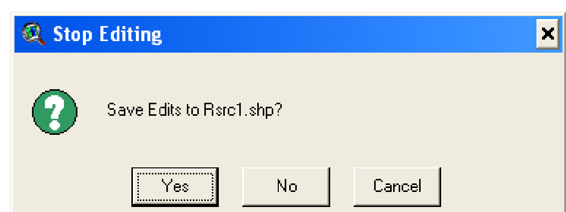
To remove a resource location point from the shapefile, place the pointer tool over the resource location to be removed and click the left mouse button once. The resource location should appear as selected. To delete the selected resource location, press the delete key on the keyboard.

Step 8: Stop Editing

Once editing is complete, select the **Theme-Stop Editing** menu option.



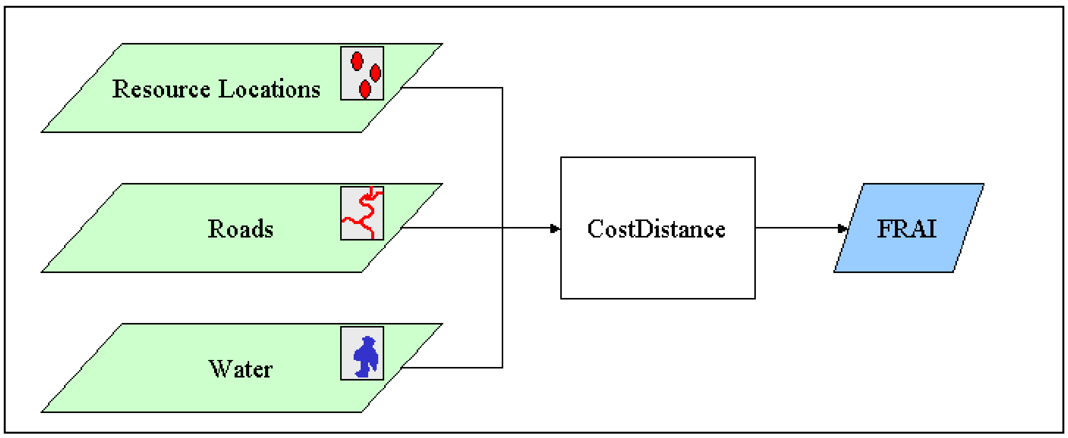
The program will prompt to confirm saving edits. Press **Yes** to save the edits.



Recreating the FRAI

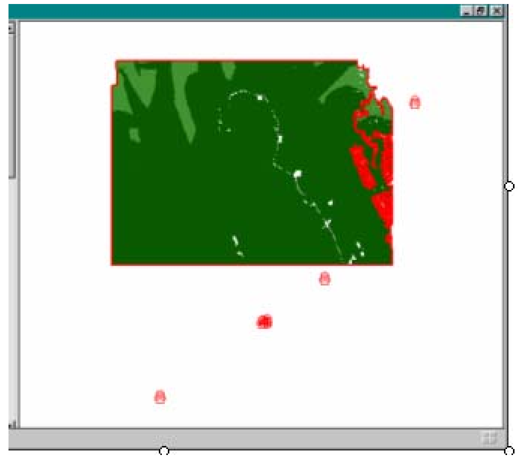
Now that the resource locations have been edited, the FRAI may be re-created using these new locations. The Fire Response Accessibility Index allows users to classify areas based on accessibility by their fire suppression resources. Coupled with the Levels of Concern data, this information will highlight areas where accessibility and the level of concern have combinations that are not desirable.

This function allows the user to input new resource locations, road information, or change the ratio of rate of travel on the road vs. rate of travel off the road. The program utilizes the costdistance raster processing function of ArcView's Spatial Analyst module. This function allows for cell value allocations based on a minimum time distance from a resource location using the estimated time it would take to travel through each cell. The Spatial Analyst software provides raster-processing functions that have been utilized for most modeling capabilities found within the FRAS.

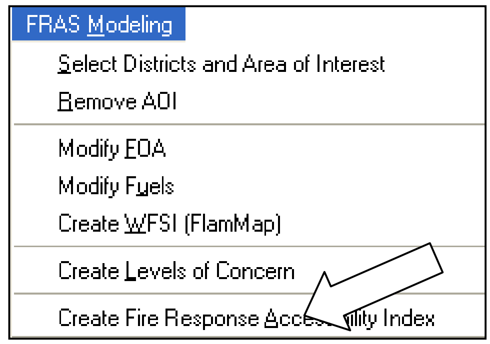


The FRAI model uses the input resource locations as the source grid and the cost grid is developed using the relative time it takes to travel on a road versus a non-road overlaid with water, where time travel is infinite (assuming that resources cannot travel through water). The resource locations are converted to a grid where the locations have a value of 1 and the remaining points have a no-data value. The roads are converted to a grid whereas the value entered under "Estimate how many times faster a road is than a non-road" is used to populate the value where roads exist and a value of one is assigned to every other cell, with the exception of areas covered with water which are assigned a value of "NO DATA." The term NO DATA is used to represent areas on the map where information does not exist (i.e. where there are no resource locations) and hence, no processing is undertaken for these areas.

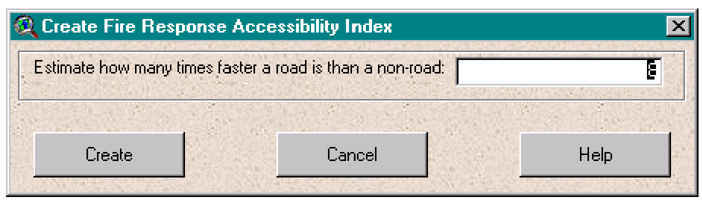
If the resources and roads data layers are clipped to the boundary file, the FRAI model will interpret the edges to be less accessible than the center whereas that may not be the case. Therefore, resources and roads extend eight miles outside the Area of Interest.



To re-create the FRAI select the Create Fire Response Accessibility Index option from the FRAS Modeling menu.

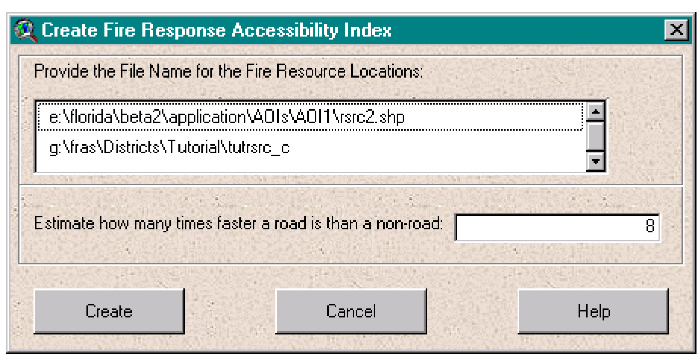


The interface dialog for FRAI has been developed to be interactive with the user based on modifications that may, or may not have previously occurred with the Resource locations data and updates to roads. The figure at the right is the dialog that will appear if no changes to the resource locations or roads have occurred.

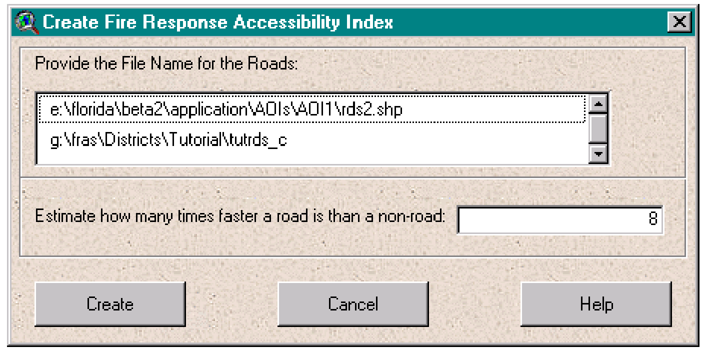


The **Cancel** button can be clicked any time prior to pressing the Create button to cancel the FRAI model.

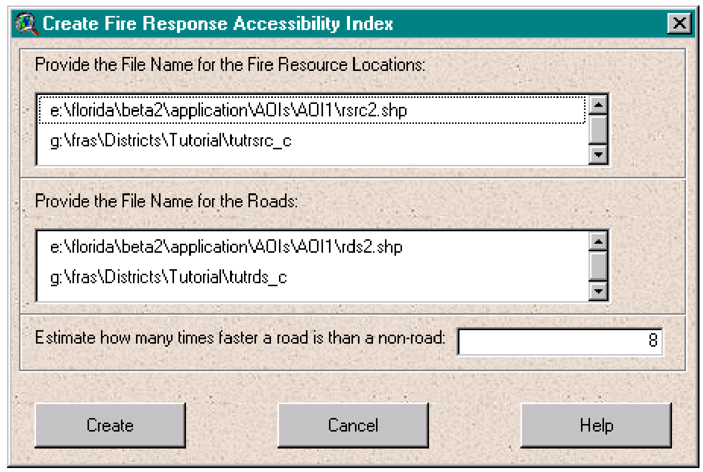
If the resource locations have been updated the dialog will appear as shown at the right. Note that all file naming requirements must be adhered to for this model to utilize the updated data (i.e. rsrc naming convention). The program looks for the point locations. The attributes associated with the points do not affect the modeling procedure.



In addition, if the roads data has been updated and saved in the specific AOI folder (and named according to the '**rds**' naming convention (i.e. rds2, rds3, etc.)), the dialog would appear as shown at the right. The program looks for the line locations. The attributes associated with the roads do not affect the modeling procedure.



If both the resources and the roads were updated, the user would be allowed to choose from a list for both data layers, as shown to the right.



In the three dialogs shown, the user must select the specific file to use to calculate the new FRAI. This can be the updated data or the Published Results data for the District from which your AOI has been defined. In most cases, the user will want to use the updated data if it exists. The examples presented use the Tutorial data set as the default District.

Select the data file in each scroll list that is presented.

Estimating How Many Times Faster A Road Is Than A Non-Road
All dialogs require that you estimate how many times faster a road is than a non-road for accessibility. This is a general estimate of how much faster travel on road is than travel off road. For instance, if general road travel were 40 mph whereas general off-road travel is about 5 mph, then the value that would be entered here would be 40 / 5 = 8 (which is the default value).

Press the **Create** button to re-calculate the FRAI using the parameters specified in the dialog box. The output data is saved to the AOI directory and is titled using **FAI##** notation where ## represents a sequential numbering for the new FRAI output.

VIII. Program and Data Installation and Questions

Technical Requirements

Successful operation of the FRAS requires certain technical prerequisites. These are described below.

User Prerequisites

Each user of the FRAS should have a basic understanding of the operation of the ArcView GIS software. In particular, the user should understand the basic data organization of Views and Themes. An understanding of generic ArcView functions will also provide the ability to use ArcView to enhance the review and analysis of the FRAS data beyond the scope of the application.

System Requirements

Many of the FRAS modeling capabilities require the use of the ArcView Spatial Analyst module. This program is a separate licensed program. It provides analytical modeling capabilities based on raster algebra techniques. These techniques are mandatory to support the advanced modeling that is involved in calculating WFSI and FRAI. Without Spatial Analyst, modeling capabilities are limited in the application and the user will be limited to viewing, mapping and reporting of the Published Results, and recalculating LOC based on changes to the Fire Effects Score.

Due to the processing requirements for the modeling functions, the following minimum computer specifications are recommended.

- Pentium III CPU
- 700 Mhz minimum (1 Ghz or higher preferred)
- SVGA monitor resolution (1024x768) or higher
- 64 Mb RAM (128 or higher preferred)
- Use of the Windows Small Font settings
- Minimum disk space may vary depending on District data requirements but at least 10 gig is recommended

Program(s) Installation

The Fire Risk Assessment System, referred to as FRAS, contains three separate installation steps.

- Installing the ArcView FRAS application,
- Installing the FlamMap program, and
- Ensuring your District and Weather Influence Zone (WIZ) data is copied to disk.

The installation programs have been provided to ensure maximum flexibility for future upgrades of FRAS and the FlamMap program. In addition, the FRAS installation procedures are provided independent of the FRAS project Published Results data since these have been provided separately.

Follow the instructions provided in this section to properly install FRAS. Ensure all other Windows applications are closed that may be active before installing. Note that users, who have ArcView Spatial Analyst and would like to re-create the WFSI layer, will need to install the FlamMap application. This is recommended. The installation for FlamMap is included on the distribution CD. Users who would like to create reports for an Area of Interest will also need Crystal Reports installed. Crystal Reports is an optional install option included with ArcView.

Installation Steps

The first step is to install the ArcView FRAS application.

Installing FRAS

The installation for FRAS is accessed through the setup.exe file located in the FRAS directory provided on the distribution CD.

This program installs the following components for the application:

The Tutorial data set is installed to a location defined by the user.

The user can define where they would like the Tutorial data set to reside. The Tutorial data set is a sample set of layers for a small area within the Bunnell District that is provided as a default District data set with the application to support testing and training. The Tutorial data set can be installed with the Published Results data or in a separate location. The District Published Results data is provided separately from the FRAS application as a deliverable of the Fire Risk Assessment project. It is recommended that the Tutorial data be installed in the same location as the Published Results data.

FRAS provides the flexibility of allowing users to locate District data (including the Tutorial data set) on any path location they choose. This is an important capability when considering the large size of the District datasets. For those users with data for multiple Districts they may choose to store the data on different disk drives.

All District and WIZ data must adhere to a standard subdirectory structure that utilizes a "FRAS\Districts\…" and "FRAS\WIZs\…" organization. All District-wide data must be located *off of* these two subdirectories using the standard District and WIZ naming convention. The FRAS Directory Organization section describes this in detail.

A function is provided in FRAS that allows the user to easily change the data path location. This allows the user to store data for different Districts on different locations, typically due to the large file size and potential disk storage limitations, yet utilize them in the application by simply changing the data directory setting at any time. This is also true for the Tutorial data set.

The FRAS ArcView extension (FireRiskAssessment.avx) is installed to the "Ext32" subdirectory of your ArcView install directory

While a default project file is provided and is recommended for use for training and testing, FRAS have been developed as an ArcView extension that will operate in any ArcView project file.

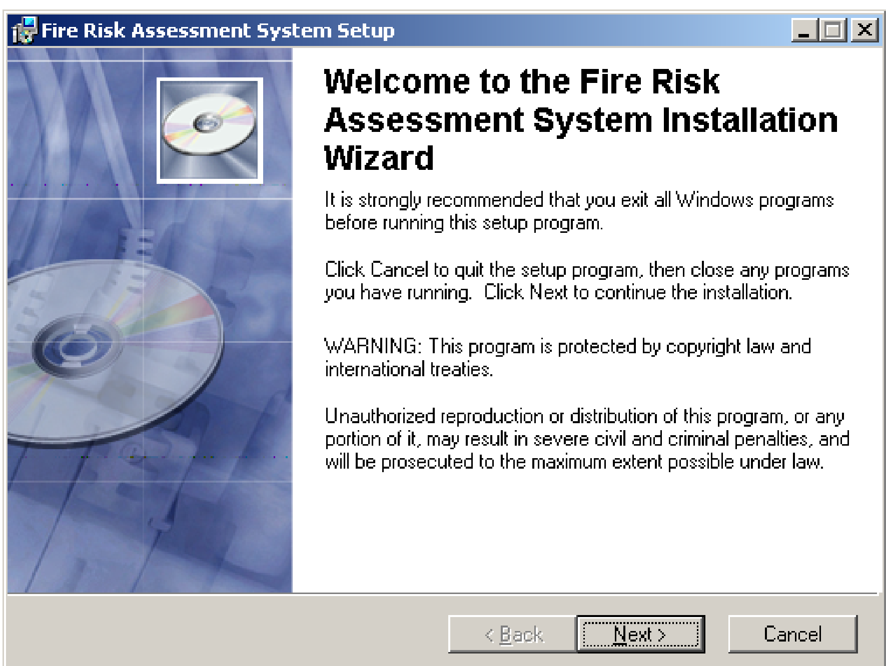
Application files are installed to an "FRA" subdirectory of your ArcView install directory

The core application configuration files are maintained in a subdirectory of the ArcView software. This is typically "c:\ESRI\AV_GIS30\ArcView" but may differ on a specific machine. The installation program automatically determines where ArcView has been installed and installs the "FRA" subdirectory.

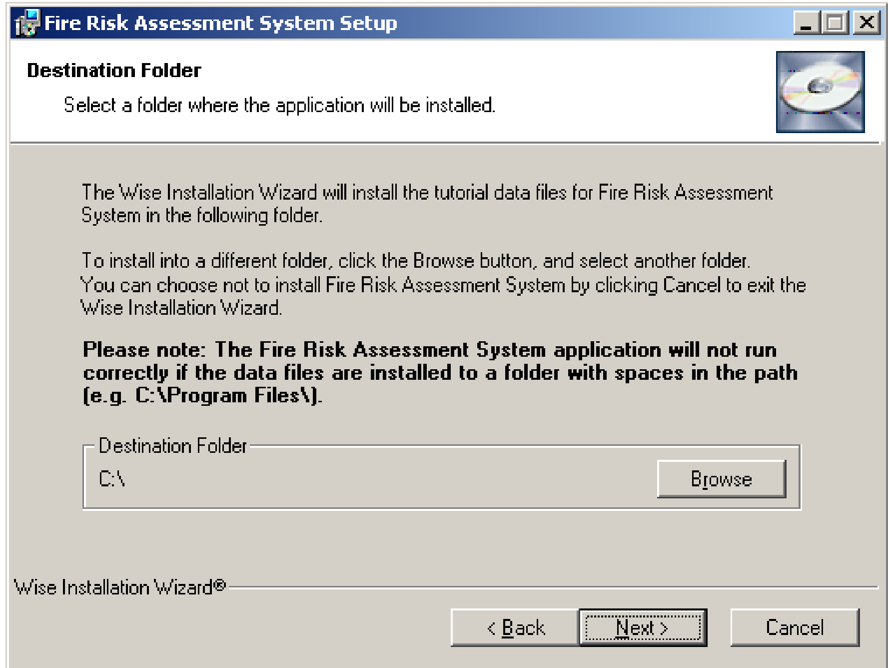
A sample ArcView project that uses the extension is installed to the same location as your tutorial data.

The sample project file (FRAS.apr) is the default for running FRAS. It is recommended that this project file be used until the user has experience with the application. The project file has been designed to lessen the learning curve and aid users during initial usage and training. The default project file is automatically installed in the "FRAS" subdirectory.

To install FRAS, double-click the setup.exe file and follow the instructions in the setup program to choose the tutorial data destination. The dialog below will appear. Click on Next.



The dialog at the right will appear.



By default the "C:" path location is defined. Remember that when installing the Tutorial data, a "FRAS\Districts\Tutorial" and a "FRAS\WIZs\Tutorial" subdirectory will be added to whatever source path selected. It is recommended that the user browse to where you have located your Published Results District data source path. This will allow the user to utilize the District data or the Tutorial data without changing the data directory within the application. If you install the Tutorial data in a different location, you will need to change the data directory whenever you need to use either data set.

After using the Browse button to select the Tutorial data destination, press the Next> button.

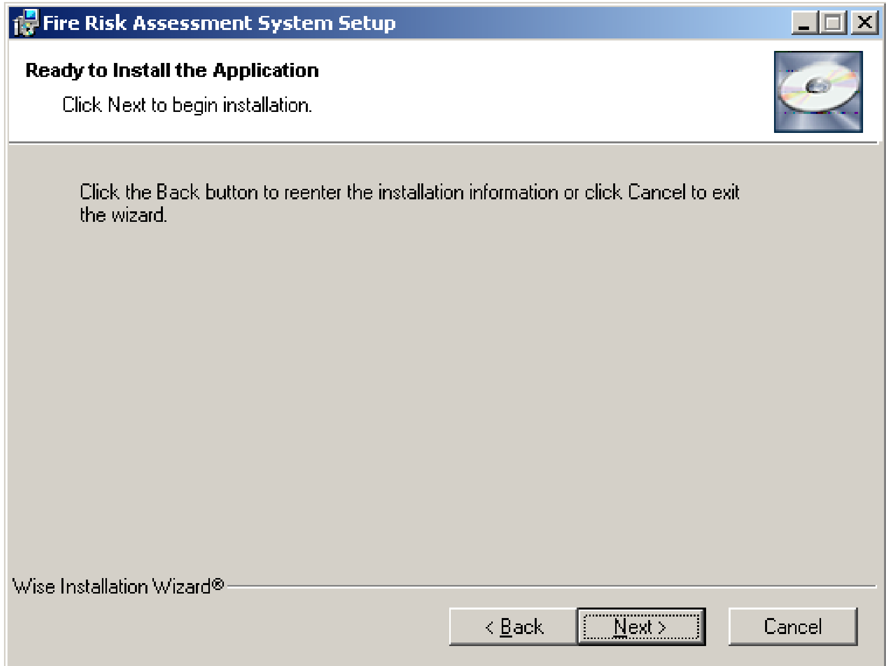
Hot Tip

Note that the Destination Directory you select cannot include spaces in the subdirectory names.

This is a limitation within ArcView. If spaces are included in the subdirectory names an error message will appear.

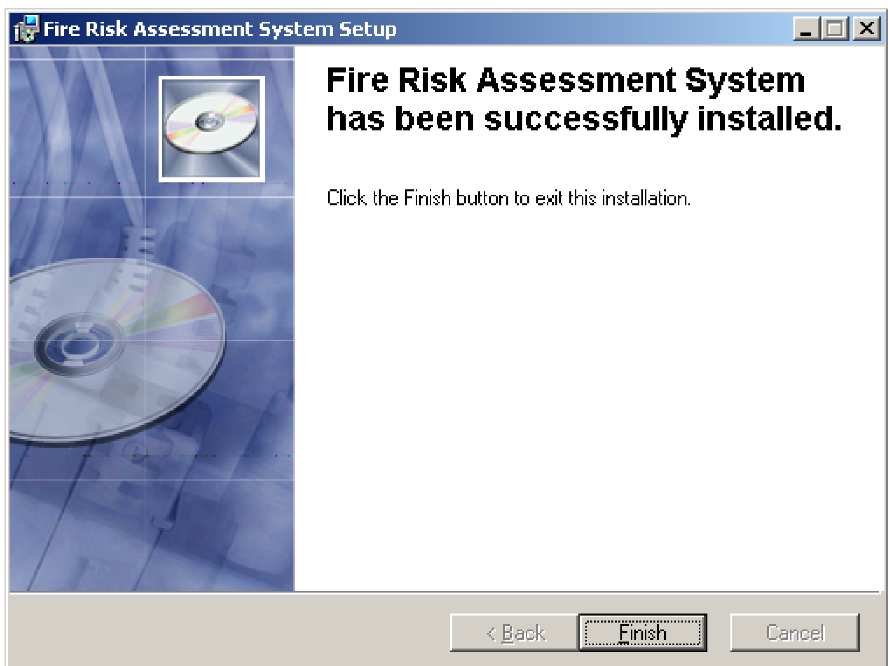
You will then have an opportunity to reenter the installation information or cancel the install (see figure at right).

After pressing the Next> button again the setup will then install the application.



When the installation is complete you will be presented with the completion dialog (see figure at right).

Press Finish to complete the installation.



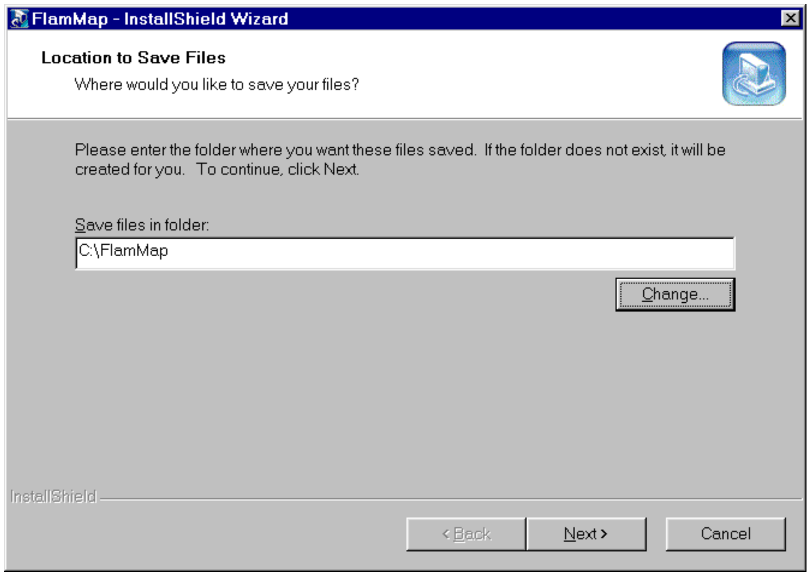
Installing FlamMap

If you will be utilizing the FRAS modeling capabilities to re-create the Wildland Fire Susceptibility Index (WFSI) data, you also need to install the FlamMap program after FRAS installation is complete. The FlamMap installation program is provided on the distribution CD but operates as a separate installation task. Note that due to some recent bug fixes with the FlamMap program, two separate steps are involved for installing FlamMap. These include:

- Installing the latest FlamMap release (v1.05), and
- Updating the FlamMap executable program file (.exe).

Installing the Latest Release

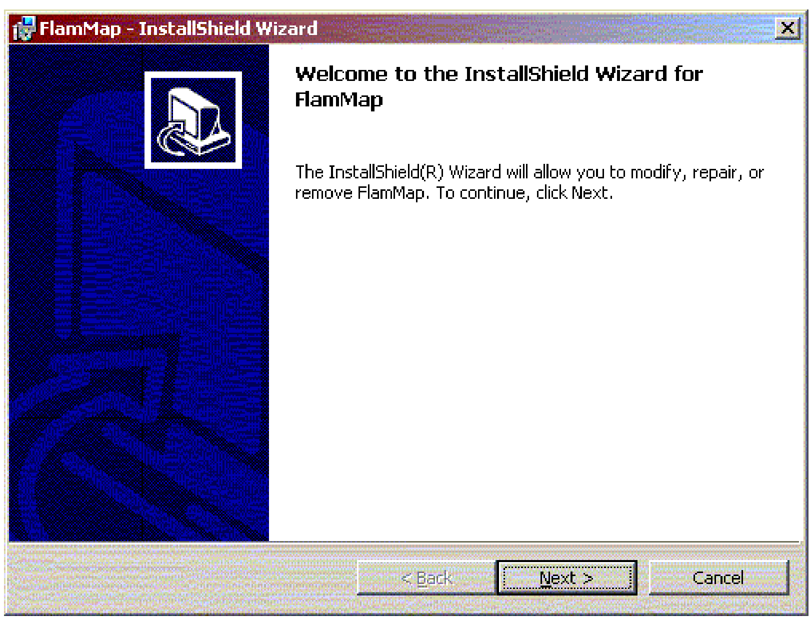
To install the latest distribution of FlamMap, double click on the FlamMap_1.05.exe program found on the FlamMap folder on the CD. This will initiate a series of dialogs that will prompt you through the installation.



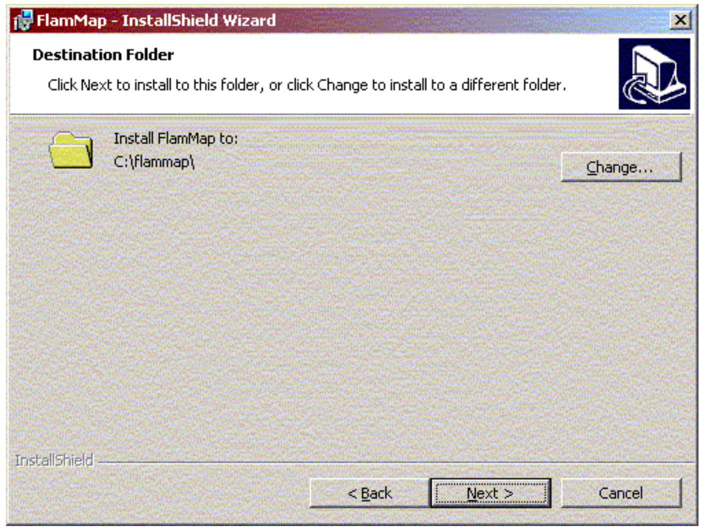
Locate the setup.exe file for the FlamMap install on the FRAS distribution CD. Double click on it and the dialog at the right will appear.

It is recommended that the default path locations be used during the installation.

Once the initial path is defined, the user you will be prompted with the FlamMap install splash screen. Press Next> to proceed.

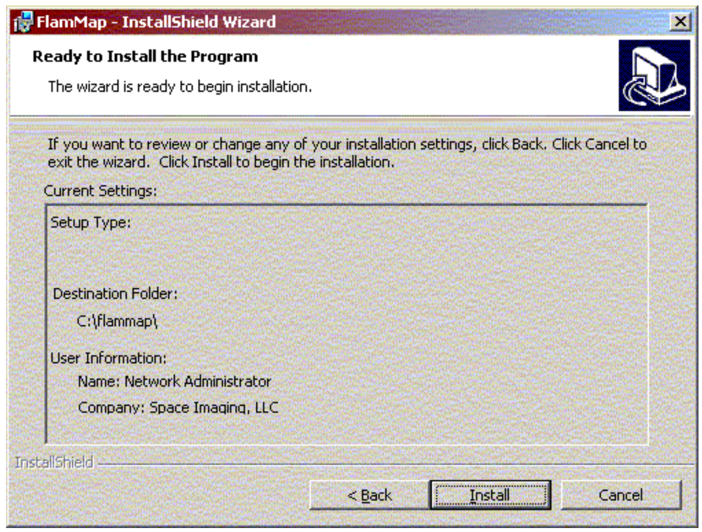


It is recommended that the default path location for the FlamMap program be used. However, if you prefer you can define another path or drive. FRAS will automatically look for the FlamMap program location when it starts. If it does not find the program you will be prompted to locate it. A separate function is also provided from the main FRAS Setup menu to allow you to explicitly define the location at any time. This will facilitate the use of another version if perhaps a new version of FlamMap is installed in the future.



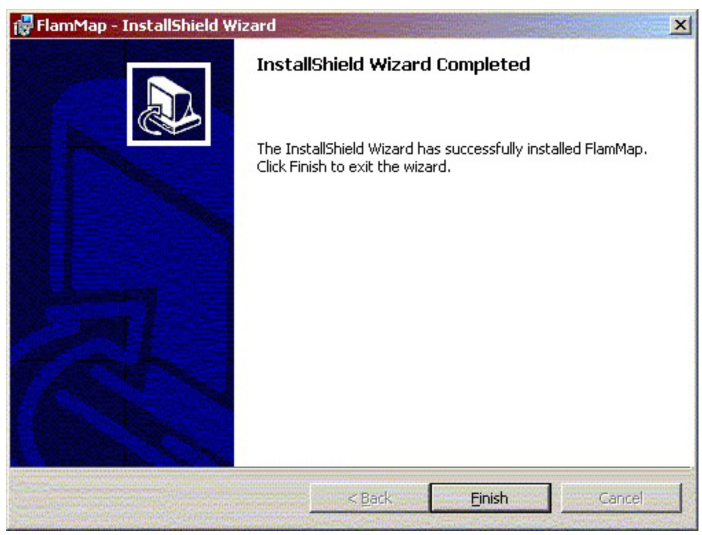
Once the path location is defined, the user will be prompted to begin the actual installation process.

Press the Install button.



Once the installation is complete you will be prompted with a completion dialog.

Press Finish to complete the installation process.

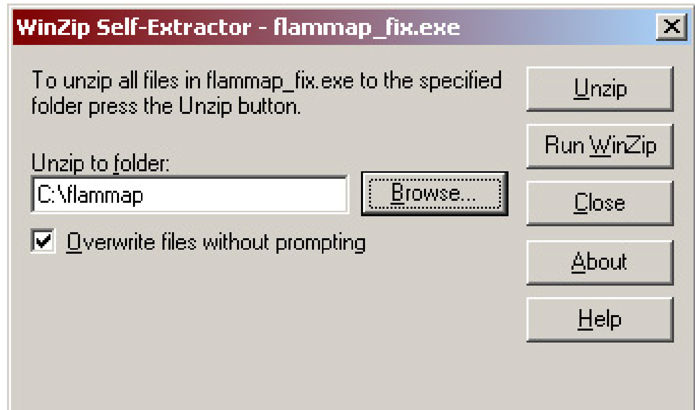


Installing the FlamMap Application Update

During testing of the WFSI modeling components of FRAS, a new version of the executable was released. It is necessary to install this upgrade in order for FRAS to run properly.

The upgrade must be installed separately and simply involves extracting the new FlamMap executable program from the self-extracting zip file (FlamMap_fix.exe) into the FlamMap program location.

This file can be found in the FlamMap folder on the CD. This will replace the FlamMap.exe program.

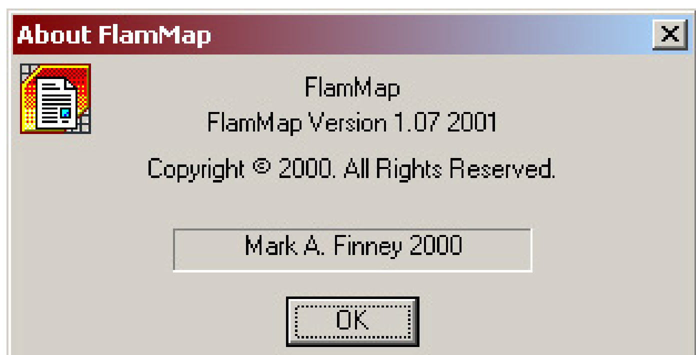


Double click on the FlamMap_fix.exe program. The dialog at the right will appear.

To complete this step press the Browse… button and select the folder where you installed FlamMap. By default this is "C:\FlamMap".

Press Unzip to overwrite the original program exe file with the new program exe file.

Press Close to exit the dialog.



To confirm you have successfully installed the bug fix version of FlamMap, start the FlamMap program by selecting Start-Programs-FlamMap. Once the FlamMap window appears select Help-About. The version information at the right should appear in the About FlamMap dialog.

The installation of FlamMap is now complete.

If the correct version information (v1.07) as shown above is not installed, the most likely cause is the new program was installed into the wrong location. Repeat the installation of the fix and ensure the new .exe file in extracted into the correct installation folder for FlamMap.

Un-Installing the FRAS

As with any Windows installation, you may uninstall either the FRAS or FlamMap application through the Add/Remove Programs dialog in the Windows Control Panel.

Select “FRAS” or “FlamMap” from the list of currently installed programs and click “Remove”.

Installing the District Data

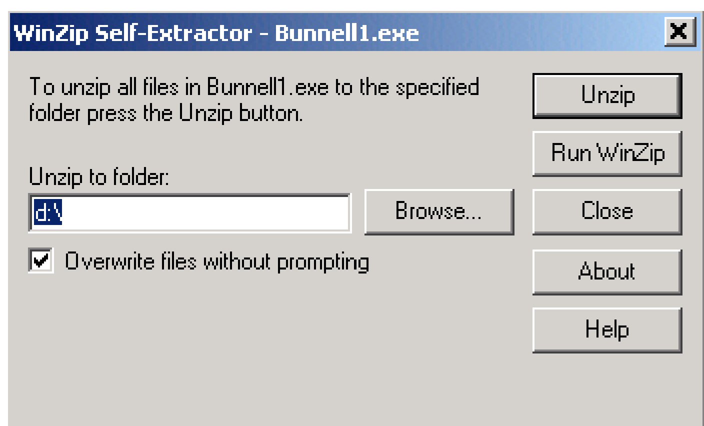
The District Data has been provided to FFS on CDs. The table below summarizes the number of Data CD’s for each district.

District #	District Name	# of CDs
01	**Blackwater**	**1**
02	**Chipola River**	**3**
04	**Tallahassee**	**2**
05	**Perry**	**2**
06	**Suwannee**	**2**
07	**Jacksonville**	**1**
08	**Waccasassa**	**3**
10	**Bunnell**	**2**
11	**Withlacoochee**	**2**
12	**Orlando**	**2**
14	**Lakeland**	**2**
15	**Myakka River**	**2**
16	**Okeechobee**	**2**
17	**Caloosahatchee**	**2**
18	**Everglades**	**2**

The executables on the FRAS Data CDs are labeled by District; and CD number if more than one CD exists.

For example, Bunnell has two CDs; the executable on the first CD is called ‘Bunnell1.exe’ and the second CD contains ‘Bunnell2.exe’.

To begin the install double-click the ‘District#.exe’ file. The dialog at the right will appear.



When installing the District data, a district directory and the associated WIZ directories will be added to the source path you select.

For example, for Bunnell the following subdirectories will be created:

- FRAS\Districts\Bunnell
- FRAS\WIZs\WIZ08
- FRAS\WIZs\WIZ10
- FRAS\WIZs\WIZ11

If the data spans more than one CD, insert the second CD and double-click on the executable. The data should be unzipped to the same folder as CD1. For example, if the Bunnell1 files were unzipped to the "d:\" folder then the bunnell2 data should be unzipped to the "d:\" folder as well. Follow the same instructions for the third CD (Chipola River is the only district with three data CDs).

For easier use within FRAS, it is recommended that data for multiple districts be installed in the same FRAS parent directory. This will allow you to utilize the other District data or the Tutorial data without changing the data directory within the application. If the data is installed into a different location, the data directory will need to be changed each time a different data set is used.

Hot Tip

The names of the data directories and subdirectories must remain unchanged in order for FRAS to run properly.

Questions and Technical Support

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Appendices

Glossary of ArcView and GIS Terms

Accuracy - The degree to which the coordinates match the real world.

ArcView 3.x - The conventional standalone ArcView software is ESRI's desktop GIS commercial software. ArcView is proprietary and utilizes the Avenue language for programming applications. ArcView 3.x is the most robust and universally accepted GIS platform in the GIS industry. ArcView is the development platform for the FRAS.

Avenue - The programming language for the ArcView 3.x software platform. Avenue is a scripting language that is embedded within the ArcView 3.x project file format. Using avenue, custom scripts can be bundled with dialog boxes to create a custom application within ArcView. Avenue is a proprietary programming language and is only supported within ESRI's ArcView 3.x software.

Cell - The smallest unit of information in a raster or grid map. Usually rectangular, cell is often used synonymously with pixel.

Chart - A diagram showing the relation between two or more variables

Coordinates - The x- and y-values that define a location in a 2-D coordinate system; the z-value would define the height in a 3-D coordinate system.

Geocode - A code representing the location of an object, such as an address

Georeferenced - To assign coordinates from a known reference system, such as Albers or latitude/longitude, to the page coordinates of a map.

Graphical User Interface (GUI) - A program interface in which the user clicks on graphic icons and menus with a mouse instead of typing commands with the keyboard.

Grid - Equally sized square cells arranged in rows and columns. Attributes are associated with each cell.

Layout - A window within ArcView where map elements, such as the title, legend, view, north arrow, and scale bar, are arranged for printing a map.

Pixel - The smallest unit of information in a raster or grid map. Usually rectangular, pixel is often used synonymously with cell.

Polygon - A polygon represents areas of homogeneity in the classification. For example, a land cover classification would have a field of grass, a stand of trees, a water body, etc. enclosed in polygons.

Precision - The exactness with or detail in which the coordinates are expressed, the number of significant digits used to store the coordinates.

Project Manager - Window within ArcView that allows users to navigate between Views, Tables, Charts and Layouts. Shows a Table of Contents of the current project.

Raster - Raster data contains pixels organized in a grid of columns and rows representing a geographical area. Attributes are associated with each cell.

Spatial Analyst - Spatial Analyst is a module for the ArcView GIS that facilitates raster data modeling and analysis. Most of the modeling processes within FRAS utilize the Spatial Analyst module to create output data.

Theme - A vector or raster layer of related geographic features, such as streets, rivers, or land cover types

Vector - A data structure used to represent linear geographic features represented by points, lines or polygons. Attributes are associated with each feature.

View - ESRI's definition is "an interactive map that lets you display, explore, query, and analyze geographic data in ArcView."

Glossary of FRA and FRAS Terms

1-h - The one-hour (1-h) timelag dead fuel category includes fuels from 0 to 0.24 inches (0.64 cm) in diameter. This includes needles, leaves, cured herbaceous plants and fine dead stems of plants.

10-h - The ten-hour (10-h) timelag dead fuel category includes fuels from 0.25 to 0.99 inch (0.64 to 2.54 cm) in diameter.

100-h - The hundred-hour (100-h) timelag fuel category includes fuels from 1 to 2.99 inches (2.54 to 7.62 cm) in diameter.

20-foot Wind Speed - The wind speed is frequently taken at a National Fire Danger Rating System weather station. The National Fire Weathers Observers Handbook provides the standards for the gathering of weather at stations designated to provide data for the National Fire Danger Rating System (Deeming et. al, 1972). The wind speed measurement is taken at 20 feet above the vegetation and is measured based on a 10-minute average. Wind speed values used should be average expected values that can be expected to occur during the period of time the projection is for. Enter the 20-foot wind speed in the cell.

AOI – Abbreviation for Area of Influence

Area of Influence – Generally a subset area inside a District or Districts that one wishes to define. An entire Distinct can be defined as an Area of Influence. Within an Area of Influence, Project Areas can be defined for analysis of mitigation measures.

Broadcast Rx fire – The application of fire to the entire Project Area.

Broadcast Rx fire followed by chopping – The application of fire to the entire Project Area followed by the mechanical application of equipment that chops vegetation into smaller pieces.

Broadcast Rx fire followed by herbicide – The application of fire to the entire Project Area – followed by the application of herbicide to the entire Project Area.

Critical Facilities - Critical facilities information was derived from the FFS burn authorization plan. Buffers were set at 1,000 meters for airports and heliports and 500 meters from any other feature in the critical facilities layer including schools, hospitals, airports, interstates and highways. This layer represents areas that are sensitive to smoke.

Chopping and harrowing – Chopping of fuels followed by harrowing.

Chopping followed by Rx Fire – Chopping of wildland fuels followed b

Defensible Space – The area around a structure that when cleared of flammable vegetation increases the ability of firefighters to protect the structure from a wildland fire.

District – A defined organizational area within the Florida Forest Service.

Environmental Effects Rating – The Environmental Effects Rating is the sum of the individual effects scores for critical facilities, urban interface, plantations and utility corridors.

Farsite – A computer program that predicts wildland fire behavior and growth using the models in the Fire Behavior Prediction System applied on 3-dimentional GIS data layers.

FBPS - Abbreviation for the Fire Behavior Prediction System

Final Fire Size – The size of a fire in acres upon containment.

Fire Behavior Prediction System – The Fire Behavior Prediction System includes all of the mathematical models and fuel model that are included in the Behave and BehavePlus computer systems.

Fire Effects Index - The Fire Effects Index was then calculated by adding 80% of the Environmental Effects Rating to 20% of the Suppression Rating. The Fire Effects Index can range from 0 – 100.

Fire Occurrence Area - A Fire Occurrence Area (FOA) is an area where the probability of each acre igniting is the same. The historical fire locations from the past 20 years were used with a few exceptions. Pictorially, if one were to locate the point location for historic ignitions on a map of an FOA, the points would appear to be equally spaced.

Fire Response Accessibility Index - The Fire Response Accessibility Index (FRAI) is a relative measure of how long it would take initial attack resources to drive from their resource location (resource location) to the cell.

Fire Risk Assessment System – A computer application which is an extension to the ArcView 3.x software that allows for the viewing and printing of information in the Published Results as well as a ability to analyze the effectiveness of some mitigation measures.

Fire Risk Assessment – The Fire Risk Assessment includes all of the data layers, indices, outputs, maps and report of the Published Results from the Florida Fire Risk Assessment Project.

FireFamilyPlus – A computer program that utilizes historic daily weather observations and historic fire occurrence information to support analysis of fire danger and staffing requirements.

FlamMap **-** FlamMap is a computer program that generates fire behavior data across the landscape for a given set of weather, fuels and fuel moisture data inputs.

Flame Length - This is the length of the flame in a spreading surface fire within the flaming front. Flame length is measured from midway in the combustion zone to the average tip of the flames.

Florida Dichotomous Fuel Model Key – A dichotomous key based on vegetation and site characteristics that supports the classification of wildland vegetation in Florida to one of the 13 FBPS fuel models, rock, water or urban areas.

FOA - Abbreviation for Fire Occurrence Area

FRA - Abbreviation for Fire Risk Assessment

FRAI - Abbreviation for Fire Response Accessibility Index

FRAS - Abbreviation for Fire Risk Assessment System

Fuel Model – A fuel model is a set of attributes that define fuel bed characteristics. The attributes such as fuel loading, depth and surface area to volume ratio support the fuel inputs to the Rothermel Fire Spread Model.

Fuel Moisture File – An ASCII file that is the input to the Farsite and FlamMap programs defined fuel moistures values by fuel size classes.

Fuel Profile – A description of the fuels in a wildland area over time.

Fuel Situation - A fuel situation is a specific vegetative and physical condition that identifies a condition where a specific FBPS fuel model would occur. Within the Florida Fuel Model Dichotomous Key, fuel situations were defined. The same FBPS fuel model can result from different fuel situations. As fuels mitigation measures are defined, the appropriate fuel situation will need to de defined for the fuel models that exist within the Project Area.

Fuel Type – Fuel types are based on the primary carrier of fire which are grass, brush, timber litter and slash.

Herbaceous - Live herbaceous fuels are grasses and forbs that are living. Herbaceous fuels can be either annual or perennial.

Herbicide Only – The application of herbicide as the sole fuel treatment method.

Initial Dispatch Locations – The same as Resource Location.

Landscape File – A file used by the FlamMap program that integrates all of the data layers needed to run the Farsite or FlamMap programs.

Levels of Concern - The Levels of Concern are calculated as the Wildland Fire Susceptibility Index (WFSI) times the Fire Effects Index (FEI). The Level of Concern is equal to the WFSI * Fire Effects Index. The WFSI is a value between 0 and 1. The Fire Effects Index is a value between 0 and 100. Hence the LOC is a value between 0 and 100.

LOC - Abbreviation for Levels of Concern

Mastication – Use of machinery that used powered rotary mechanical action to change wildland fuels.

Mitigation Options – Methods and projects that are proposed to reduce the effects of the current situation. In FRAS analysis of the effectiveness of fuels treatment projects and fire prevention activities to reduce the effects of wildland fires is stressed.

Muck Soils - Muck soils are organic soils that constitute areas of concern for firefighting efforts as fires within these areas tend to be expensive and difficult to extinguish. Muck soils were extracted from SURGO data by the FFS.

National Fire Danger Rating System – Refers to the 1972, 1978 and 1988 versions of the fire danger rating systems developed for the United States.

Percentile Weather – A set of weather conditions that represent the average conditions that would occur a defined percent of the fire season.

Piling and burning (or chipping) w/machine – A fuel treatment method where fuels are arranged by hand or mechanical means into pile which are then burned or chipped.

Plantations - Plantations were derived from the Florida Water Management Districts Land Use and Land Cover database and includes the following classes; forest regeneration, mesic flatwoods, pine plantations, longleaf pine, pine flatwoods, sand pine and upland coniferous forest.

Project Area - A Project Area is defined as the area where fire prevention and/or fuels treatment measures are to be analyzed.

Published Results - The primary output from the Florida Fire Risk Assessment is the data developed by the project team of experts that describes fire risk across the state. These maps and data define the current situation and are referred to as the Published Results. These outputs provide a data platform for use by operational FFS staff, as well as other fire management collaborators, in mitigation planning and communication activities. These results can be used for identifying areas where more localized analysis (Project Areas) may be appropriate.

Rate of Spread - Rate of spread is the "speed" the fire travels through the surface fuels. The rate of spread is the spread rate of the head fire spreading uphill with the wind blowing straight uphill. The rate of spread prediction uses the Rothermel (1972) surface fire spread model, which assumes the weather, topography and fuels remain uniform for the elapsed time of the projection.

Relative Packing Ratio - This is the fuel model's packing ratio divided by the optimum packing ratio for the fuel model. Vertically oriented fuel beds like grass and brush generally have a relative packing ratio less than one while horizontally oriented fuel beds such as timber litter and slash have a relative packing ratio greater than one.

Resource Locations – Locations where firefighting equipment is located or stationed. In many cases, these are fire station locations for urban/rural fire departments or Florida Forest Service offices.

Risk - The possibility of suffering harm or loss.

ROS - Abbreviation for rate of spread.

Run – The results for a specific FRA input (fuel model, etc.) or output (WFSI, etc.) for the modeling processes with FRAS.

Run Number – The numerical identifier of a run; ie. 1, 2, 3, etc.

SC – Abbreviation for Spread Component.

Spread Component – The Spread Component is a index in the National Fire Danger Rating System. It is calculated using the Rothermel Spread Model with a few minor modification to the model used in the Fire Behavior Prediction System. It is the rate of spread measured in feet per minutes assuming a defined fuel model, slope class, climate class and herbaceous vegetation type with weather conditions from a NFDRS weather station.

Suppression Rating – The suppression costs are evaluated by fuel type. Each cell in the state has been assigned either a base, grass, shrub, timber litter or muck suppression score. Base is the expected average of all non-muck fires. FFS fire managers used the matrix to assign the fire suppression and muck scores. The grass, shrub and timber litter scores were based on suppression billing information provided by the FFS districts for the past five years. Cells with a slash fuel model are assigned a base suppression score. The final suppression score for each cell was assigned based on the fuel type (or muck soil) on the ground.

Surface Area to Volume - The 1-h surface-area-to-volume ratio (1-h SA/V) is the amount of area on the outside of the fuel (surface area) divided by the volume of the fuel. A way to visualize the surface-area-to-volume ratio is the square feet of wrapping paper in would take to wrap a box divided by the volume of the box in cubic feet. The 10-h and 100-h SA/V are set at 109 ft2/ft (358 m2/m3) and 30 (98 m2/m3) for all fire behavior fuel models.

Thinning – The cutting of trees generally in diameters classes that are smaller than the average stand diameter for a timber stand. Thinning reduces the number of trees per acre.

Utility Corridors – This are corridors where electric transmissions lines and gas transmissions lines occur. Some of the lines are underground and are not effected b wildland fire. The corridors. A buffer around transmission lines developed the Utility Corridors layer. Inside the buffer represents areas where smoke and fire can present hazards.

Urban Interface – The area between wildland fuels and defined urban communities and areas. The urban interface was derived from a combination of the urban areas delineated on the fuels map and the Census Bureau data.

Weather Influence Zone – A Weather Influence Zone (WIZ) is an area when the weather conditions are uniform. Within each WIZ, daily weather data was gathered from 1981 - 2000 from land management agency maintained weather stations and from National Oceanographic and Atmospheric Administration (NOAA) maintained weather stations. A computer program was developed by the Florida Forest Service's State Meteorologist to geo-reference the weather observations from the weather stations within a WIZ to the geographical center of the WIZ. Hence, one weather data set was developed with a weather observation for each day from January 1, 1981 through December 31, 2000 for each WIZ. From this weather data set, percentile weather was developed for each WIZ.

WFSI - Abbreviation for Wildland Fire Susceptibility Index

Wildland Fire Susceptibility Index - The Wildland Fire Susceptibility Index (WFSI) is a value between 0 and 1. It was developed consistent with the mathematical calculation process for determining the probability of an acre burning. The WFSI integrates the probability of an acre igniting and the expected final fire size based on the rate of spread in four weather percentile categories into a single measure of wildland fire susceptibility. Due to some necessary assumptions, mainly fuel homogeneity, it is not the true probability. But since all areas of the State have this value determined consistently, it allows for comparison and ordination of areas of the state as to the likelihood of an acre burning.

WIZ - Abbreviation for Weather Influence Zone

Woody - Live woody fuels are shrubs that are living.

Year of Interest – The year since fuels treatment that the fuel models in a Project Area will be displayed for.

FRAS Fire Prevention Analysis Worksheet

Part 1: Project Identification

Project: __________________	District: _________________	AOI Name: _______________
Planner: _________________	Date: __ / __ / __	Fire Prevention Action: ______________ ___________________________________

Part 2: File Names

Fuel_Grid File Name: ___________________	Fuel_Type File Name: ___________________
FOA_Grid File Name: ___________________	WFSI_Grid File Name: __________________
ROS File Names: ____	

Part 3: Project Assumptions

Change FOA Categories		
From FOA Category	Average FOA Rate (fires/1000 ac/yr)	To FOA Category
1	0.035	
2	0.146	
3	0.288	
4	0.489	
5	0.691	
6	0.892	
7	1.326	
8	3.596	

Change All Fires FOA Rate
Average FOA Rate (fires/1000 ac/yr)
FOA Rate = _____________

Fire Prevention Analysis Steps

Step 1a: Select the FRAS Modeling Menu
Step 1b: Select the District(s) and AOI
Step 1c: Click on the Modify FOA Menu
Step 1d: Create the Project Area Polygon
Step 1e: Complete Part 1 of the Fire Prevention Analysis Worksheet
Step 2: Change FOA Rate
 Step 2a: Changing to Another Existing FOA Rate
 OR
 Step 2b: Changing to a New User Defined Rate
Step 3: Create the WFSI for the Year(s) of Interest
Step 4: Create the LOC for the Year(s) of Interest

FlamMap Process Steps

Step F-1: Start FlamMap
Step F-2: Define the FlamMap Program Location
Step F-3: Define the Environmental Inputs for First WIZ and Low Percentile Weather Category
Step F-4: Define the Output Data Specs
Step F-5: Generating ROS Output
Step F-6: Select Environmental Inputs the Next Percentile Weather Category and Complete Steps 3-6 Until All Categories Have Been Run
Step F-7: Complete Steps 3-6 for the Next WIZ
Step F-8: Exit FlamMap and Creating the WFSI
Step F-9: Re-run FlamMap, if desired, for additional Years of Interest (Perform Steps 2-8).

FRAS Fuels Analysis Worksheet

Part 1: Project Identification

Project: _________________	District: ________________	AOI Name: ______________
Planner: ________________	Date: __ / __ / __	Treatment Type: ____________________

Part 2: File Names and FlamMap Information

Fuel_Grid File Names: ___________(yr=__) ____________(yr=__), ___________(yr=__)	Fuel_Type File Names: ___________(yr=__) ____-________(yr=__), ___________(yr=__)
WFSI_Grid File Names: ___________(yr=__), ____________(yr=__), ___________(yr=__)	
WIZs in AOI: ______________	Location of LCP & FMS Files: ________________________
ROS File Names: ____	

Part 3: Project Assumptions

___ Modifications to FRAS Defaults
___ Fuel Situations and Fuel Models Used

Years Since Treatment
(Circle to Specify Years of Interest)

FM	Fuel Situation	0	1	2	3	4	5	6	7	8	9	10
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												

Fuels Analysis Steps

Step 1a: Select the FRAS Modeling Menu
Step 1b: Select the District(s) and AOI
Step 1c: Click on the Modify Fuels Menu
Step 1d: Create the Project Area Polygon
Step 2: Select the Treatment Type
Step 3: Select the Fuels Situations for each Fuel Model
Step 4: Verify the Fuels Profile for First Fuel Model
Step 5: Verify the Fuels Profile for Remaining Fuel Models
Step 6: Select the Year(s) of Interest
Step 7: Generate the Fuel Profiles for the Year(s) of Interest
Step 8: Create the WFSI for the Year(s) of Interest
Step 9: Create the LOC for the Year(s) of Interest

FlamMap Process Steps

Step F-1: Start FlamMap
Step F-2: Define the FlamMap Program Location
Step F-3: Define the Environmental Inputs for First WIZ and Low Percentile Weather Category
Step F-4: Define the Output Data Specs
Step F-5: Generating ROS Output
Step F-6a: Select Environmental Inputs the Next Percentile Weather Category and Complete Steps 3-6 Until All Categories Have Been Run
Step F-6b: Complete Steps 3-6 for the Next WIZ
Step F-7: Exit FlamMap and Creating the WFSI
Step F-8: Re-run FlamMap, if desired, for additional Years of Interest (Perform Steps 2-8).