COURSE: Prescribed Fire Planning and Implementation

TOPIC: Contingency Planning (Unit 7)

I. Objectives

1. Discuss the importance of the contingency plan and what elements are required in the plan.

2. Use BEHAVE PLUS to calculate maximum spotting distance, probability of ignition, and containment parameters for spot fires outside a prescribed fire unit.

3. Define the conditions under which a prescribed fire is reclassified as an unwanted wildland fire.

4. Assure that fire severity (drought) is adequately addressed in prescribed fire plans, and that the Burn Boss can recognize when these conditions exist.

II. Contingency Planning

Define what contingency actions constitute a significant departure from what was planned or expected and where conversion to a wildland fire is appropriate.

Include procedures to be followed and actions to be taken if the fire exceeds the abilities of the holding crew to keep it within prescribed parameters and/or unit boundaries.

Fuels both inside and outside the burn unit should be considered. Contingency planning needs to address not only the fuels and values to be protected near the unit, but also the problems posed if initial attack fails (i.e., Los Alamos example).

Who is to declare the fire a wildland fire?

Who will be the Incident Commander after escape is declared?

Define the number and type of contingency forces to be used as initial action.

Who is to be notified of the escape?

What role will the holding crew take?

Should they remain on the burn or suppress the escape? Account for every person as either reassigned or released from the fire and identify who is to supervise those who are reassigned.

How do you assure the availability of contingency forces?

This can best be achieved by:

1. Defining the number and type of contingency forces needed in the prescribed fire plan.

2. Validating their potential availability immediately before committing to the prescribed fire. This is a critical element of the GO/NO/GO checklist.

3. Maintain communications concerning any change in the availability of contingency forces throughout prescribed fire plan implementation and prepare to modify plan implementation if necessary.

III. Fire Behavior Prediction Outside the Burn Unit

The earlier we incorporate the probability of escape in the planning process, the better.

No one likes to plan for a disaster, but in any project where the risk of a system failure exists, planning may reduce the consequences of the failure.

Contingency planning answers the question: "Are there enough forces available to provide an appropriate response if the holding forces cannot contain spots outside the burn perimeter"? If the answer to the question is no, the plan needs to be reviewed, especially the prescription portion of the plan.

Look at some of the work we did in the prescription development unit. Assume for the purposes of this unit, that fuels on the predicted downwind side of the unit are the same as those used in the prescription. Therefore, the NFFL fuel model 2 BEHAVE PLUS run will help predict fire behavior outside the unit.

Modules: SURFACE

Description		Unit 7

Fuel/Vegetation

Fuel Model		2

Fuel Moisture

1-h Moisture	%	3, 5, 7, 9, 11, 13, 15
10-h Moisture	%	10
100-h Moisture	%	15
Live Herbaceous Moisture	%	100
Live Woody Moisture	%	

Weather

Midflame Wind Speed	mi/h	2.0, 4.0, 6.0, 8.0, 10.0,
Direction of Wind Vector (from upslope)	deg	0

Terrain

Slope Steepness	%	0

Run Options

Calculations are only for the direction of maximum spread.

Fireline intensity, flame length, and spread distance are always for the direction of the spread calculations.

Wind and spread directions are degrees clockwise from upslope.

Wind direction is the direction the wind is pushing the fire.

Output Variables

Rate of Spread (maximum) (ch/h)

Fireline Intensity (Btu/ft/s)

Flame Length (ft)

Maximum Wind Exceeded?

Notes

BehavePlus 2.0.2 Mon, Dec 22, 2003 at 14:25:52 Page 2

Unit 7-1

Rate of Spread (maximum) (ch/h)

1-h Moisture %	Midflame Wind Speed mi/h 2.0	4.0	6.0	8.0	10.0	12.0
3	10.3	29.5	59.0	98.0	146.1	202.9
5	8.8	25.4	50.7	84.3	125.6	174.4
7	8.1	23.2	46.3	76.9	114.5	159.1
9	7.4	21.1	42.2	70.2	104.6	145.2
11	6.2	17.9	35.8	59.5	88.6	123.1
13	4.3	12.4	24.7	41.1	61.2	85.0
15	0.1	0.1	0.1	0.1	0.1	0.1

BehavePlus 2.0.2 Mon, Dec 22, 2003 at 14:25:52 Page 3

Unit 7-1

Rate of Spread (maximum) (ch/h)

1-h Moisture %	Midflame Wind Speed mi/h 14.0
3	268.2
5	230.5
7	210.2
9	191.9
11	162.6
13	112.3
15	0.1

BehavePlus 2.0.2 Mon, Dec 22, 2003 at 14:25:52 Page 4

Unit 7-1

Fireline Intensity (Btu/ft/s)

1-h Moisture %	Midflame Wind Speed mi/h 2.0	4.0	6.0	8.0	10.0	12.0 >
3	102	292	584	971	1447	2009
5	79	227	453	753	1122	1558
7	69	198	395	656	977	1357
9	60	172	344	571	852	1183
11	45	129	258	428	638	886
13	22	64	128	213	317	440
15	0	0	0	0	0	0

BehavePlus 2.0.2 Mon, Dec 22, 2003 at 14:25:52 Page 5

Unit 7-1

Fireline Intensity (Btu/ft/s)

< 1-h Moisture %	Midflame Wind Speed mi/h 14.0
3	2655
5	2059
7	1794
9	1563
11	1171
13	582
15	0

BehavePlus 2.0.2 Mon, Dec 22, 2003 at 14:25:52 Page 6

Unit 7-1

Flame Length (ft)

1-h Moisture %	Midflame Wind Speed mi/h 2.0	4.0	6.0	8.0	10.0	12.0 >
3	3.8	6.1	8.4	10.6	12.8	14.9
5	3.4	5.5	7.5	9.5	11.4	13.2
7	3.2	5.1	7.0	8.9	10.7	12.4
9	3.0	4.8	6.6	8.3	10.0	11.7
11	2.6	4.2	5.8	7.3	8.8	10.2
13	1.9	3.1	4.2	5.3	6.4	7.4
15	0.1	0.1	0.1	0.1	0.1	0.1

BehavePlus 2.0.2 Mon, Dec 22, 2003 at 14:25:52 Page 7

Unit 7-1

Flame Length (ft)

< 1-h Moisture %	Midflame Wind Speed mi/h 14.0
3	16.9
5	15.0
7	14.1
9	13.3
11	11.6
13	8.4
15	0.1

By linking the DIRECT run with SIZE, you obtain area and perimeter for a free burning fire at a selected time frame. Look at size and perimeter at 0.5 hours after ignition.

Now look at what containment efforts you need to apply to initial attack a spot outside the unit. For the purposes of the exercise, assume that you have set a burned area target of 50 acres.

Modules: SURFACE, SIZE, CONTAIN

Description		Unit 7-1

Fuel/Vegetation

Fuel Model		2

Fuel Moisture

1-h Moisture	%	3, 5, 7, 9, 11, 13, 15
10-h Moisture	%	10
100-h Moisture	%	15
Live Herbaceous Moisture	%	100
Live Woody Moisture	%	

Weather

Midflame Wind Speed	mi/h	2.0, 4.0, 6.0, 8.0, 10.0,
Direction of Wind Vector (from upslope)	deg	0

Terrain

Slope Steepness	%	0

Fire

Elapsed Time	h	.5

Suppression

Suppression Tactic		Rear
Line Construction Offset	ch	1
Resource Name		Crew
Resource Line Production Rate	ch/h	24
Resource Arrival Time	h	.5
Resource Duration	h	8

Run Options

Calculations are only for the direction of maximum spread.

Fireline intensity, flame length, and spread distance are always for the direction of the spread calculations.

Wind and spread directions are degrees clockwise from upslope.

Wind direction is the direction the wind is pushing the fire.

Unit 7-1
Area (ac)

1-h Moisture %	Midflame Wind Speed mi/h 2.0	4.0	6.0	8.0	10.0	12.0
3	1.8	9.8	29.8	66.7	124.9	208.7
5	1.3	7.3	22.0	49.3	92.3	154.2
7	1.1	6.0	18.3	41.0	76.8	128.2
9	0.9	5.0	15.3	34.2	64.0	106.9
11	0.7	3.6	11.0	24.5	45.9	76.8
13	0.3	1.7	5.2	11.7	21.9	36.6
15	0.0	0.0	0.0	0.0	0.0	0.0

Unit 7-1
Area (ac)

1-h Moisture %	Midflame Wind Speed mi/h 14.0
3	321.8
5	237.7
7	197.7
9	164.8
11	118.3
13	56.5
15	0.0

BehavePlus 2.0.2 Mon, Dec 22, 2003 at 14:28:57 Page 11

Unit 7-1

Perimeter (ch)

1-h Moisture %	Midflame Wind Speed mi/h 2.0	4.0	6.0	8.0	10.0	12.0	14.0
3	16	38	71	112	163	221	288
5	13	33	61	97	140	190	247
7	12	30	56	88	127	173	226
9	11	27	51	80	116	158	206
11	9	23	43	68	99	134	175
13	7	16	30	47	68	93	121
15	0	0	0	0	0	0	0

VI. SPOT Module

The SPOT module helps you predict how far downwind spotting may occur. SPOT does not predict the probability of spotting, nor does it predict where spots may occur. Remember, the most spots will probably occur near the line and the least number of spots far away.

Modules: SURFACE, SPOT

Description		Unit 7

Fuel/Vegetation

Fuel Model		2
Mean Cover Height	ft	0

Fuel Moisture

1-h Moisture	%	3, 5, 7, 9, 11, 13, 15
10-h Moisture	%	10
100-h Moisture	%	15
Live Herbaceous Moisture	%	100
Live Woody Moisture	%	

Weather

20-ft Wind Speed	mi/h	5, 10, 15, 20, 25, 30, 35
Wind Adjustment Factor		.4
Direction of Wind Vector (from upslope)	deg	0

Terrain

Slope Steepness	%	0
Ridge-to-Valley Elevation Difference	ft	0
Ridge-to-Valley Horizontal Distance	mi	
Spotting Source Location		

Run Options

Calculations are only for the direction of maximum spread.

Fireline intensity, flame length, and spread distance are always for the direction of the spread calculations.

Wind and spread directions are degrees clockwise from upslope.

Wind direction is the direction the wind is pushing the fire.

Output Variables

Flame Length (ft)

Midflame Wind Speed (mi/h)

Spotting Distance from a Wind Driven Surface Fire (mi)

(continued on next page)

BehavePlus 2.0.2 Mon, Dec 29, 2003 at 10:58:25 Page 7

Unit 7

Spotting Distance from a Wind Driven Surface Fire (mi)

1-h Moisture %	20-ft Wind Speed mi/h 5	10	15	20	25	30	35
3	0.1	0.2	0.3	0.5	0.6	0.8	1.0
5	0.1	0.2	0.3	0.4	0.6	0.7	0.9
7	0.1	0.2	0.3	0.4	0.6	0.7	0.9
9	0.1	0.2	0.3	0.4	0.5	0.7	0.8
11	0.1	0.2	0.3	0.4	0.5	0.6	0.7
13	0.1	0.1	0.2	0.3	0.4	0.5	0.6

If the 20 foot windspeed is 20 mph and the 1-hour fuel moisture is 7%, you could expect spots to occur up to 0.4 miles downwind of your prescribed fire. This is helpful in calculations of how to deploy your holding forces. Once again, remember, the most spots will occur near the line.

V. Probability of Ignition Module

Probability of Ignition describes, as a percent, the chance that if an "appropriate" firebrand lands on an "appropriate" fuelbed, a sustainable ignition will result.

Modules: IGNITE

Description		Unit 7

Fuel Moisture

1-h Moisture	%	3, 5, 7, 9, 11, 13

Weather

Air Temperature	oF	60, 65, 70, 75, 80, 85, 90

Terrain

Fuel Shading from the Sun	%	50

Run Options

No run options selected.

Output Variables

Probability of Ignition from a Firebrand (%)

Notes

BehavePlus 2.0.2 Mon, Dec 29, 2003 at 10:49:30 Page 2

Unit 7
Probability of Ignition from a Firebrand (%)

Air Temp oF	1-h Moisture % 3	5	7	9	11	13
60	81	61	45	34	25	18
65	81	61	45	34	25	18
70	83	63	47	35	26	19
75	83	63	47	35	26	19
80	86	65	49	37	28	20
85	86	65	49	37	28	20
90	89	68	52	39	29	22

It is evident that dry bulb temperature makes little effect on P(I). As a planning tool, P(I) is useful in alerting holding forces to the chances that one of those firebrands 0.4 miles from the line is or is not likely to start a spot fire.

VI. ***When does a prescribed burn become an unwanted wildland fire?***

The answer to the question is simple in theory. A prescribed fire becomes an unwanted wildland fire when the fire "escapes the planned fire area (other than minor slopovers) or burns outside the written prescription (i.e. environmental conditions or fire behavior not listed in the written prescription or inability to meet objectives)" (621 FW 3.8.)

1. The prescribed burn "breaks" through the unit boundary and due to ROS, I_B, and flame length, the holding crew cannot suppress the "slopover" at the designated burned area target.

2. A spot fire outside the unit boundary cannot be suppressed at the burned area target.

3. Multiple spot fires cannot be suppressed in an appropriate time frame. The number of spot fires exceeds the capabilities of the holding crew.

4. Critical prescription elements such as air quality/smoke management, historical or archeological discoveries, etc. require termination of the burn.

5. Unforeseen circumstances create a situation in which burn personnel cannot complete the prescribed fire within the allotted budget. This is a very delicate situation. Instances in which a prescribed fire requires more mop up than planned could result in excessive costs. However, the prescribed fire planning process should take into consideration all factors in the completion of the prescribed fire. Running out of money is not a good management practice.

Each individual prescribed fire plan should clearly define what contingency actions constitute a significant departure from what was planned or expected and where conversion to a wildland fire is appropriate.

In addition to recognizing when conditions exceed or are anticipated to exceed planned limits, it is important to alert others to this situation. Informal communication should work effectively on a local basis. Establishing a formal interagency process at the State or Geographic Area Coordination Group level would assure broadening the communications network.

Altering the perception that a "successful burn" is one that achieves the target acreage to one that successfully executed the plan would remove the stigma of "losing a fire" and improve communications of important information. Successful implementation of the contingency portion of the prescribed fire plan should be rewarded.

VII. Assessing Fire Severity (Drought) or the Cumulative Effects of Weather on Fire Behavior

In a prescribed burn plan, you need to address what effects prolonged drought will have on your prescribed burning. How are you going to tell if you are in unusually dry conditions, and what are you going to do if conditions are dry? There are very few cases where you may have to burn under drought conditions in order to obtain your objectives, and the ways you would deal with these conditions would be part of your normal planning process. For example, in order to open up areas in some wetlands, you may need to wait until water levels are very low and the organic material is dry enough to burn. Usually however, burning under these conditions is undesirable, and some Burn Bosses have had escapes because they did not recognize that conditions were much drier than normal, and the fire behavior turned out much higher than they expected. In most situations, implementing prescribed burning in these kind of conditions is usually beyond the skill and experience level of a Type 3 Burn Boss. This determination will need to be made on a case-by-case basis.

Prolonged drought will cause drying of larger fuels and possibly litter, duff, and soil layers that do not normally burn. Fuel models do not account for these fuels burning, so BEHAVE PLUS will not predict this. As a result, THESE FUELS WILL BURN AND ADD TO THE INTENSITY OF THE FIRE! If you are in a drought situation, you can expect higher flame lengths, highly increased fireline intensity, resistance to control efforts, prolonged smoldering of large logs and duff layers, difficult mop-up, and lingering smoke problems. A fire of this intensity may cause you to exceed your objectives or cause undesired effects.

Prolonged drought may affect live fuel moisture. Under normal conditions, live vegetation such as tree trunks and limbs may have a high enough moisture content so that they do not contribute to fire behavior. In drought conditions, live fuel moisture may be abnormally low, which will lead to more extreme burning conditions than you would expect.

The Fire Behavior Prediction System (FBPS), Northern Forest Fire Laboratory (NFFL), and National Fire Danger Rating System (NFDRS) fuel models which contain 100-hour, 1000-hour, and live fuels will be more affected by cumulative drought. Drought will not have as much effect on grasses (FBPS fuel models 1 and 3) since fuels are composed mostly of 1-hour fuels and are more affected by temperature and relative humidity than prolonged drought.

Drought may have a profound effect on marsh-type fuels since the organic soils may add to the intensity, mop-up problem, and smoke production if they are dry! You may wind up with something resembling a peat fire. If soils are not organic, cumulative drought will not cause them to contribute to additional fire intensity although the duff on top of the soils may.

In severe cases, vegetation such as grasses and herbs may not even green up or may cure out earlier than expected, so the green fuels you thought you were going to have as a barrier when you wrote the burn plan may be dry and able to carry fire. The altered phenology caused by a drought may also prevent the regrowth of vegetation on your burn unit which may be the desired objective of the burn.

Wet areas that you were counting on as a barrier may be much lower than necessary to conduct a safe burn. Water sources may be dried up. Fuels affected by drought near the perimeter may create high intensity that will cause control problems (either intensity or spotting) if extremely dry.

The Burn Boss may face constraints on burning due to other fire activity. If conditions are unusually dry, there may be wildland fires occurring in the area. Counting on these resources to respond to an escape you may have is not realistic, and it may strain your interagency relationships with your cooperators. Your cooperators may be questioning why you are lighting fires when they are fighting fires. Common sense must be your guide in this area. Ensure that you are aware of what the local, Geographic Area, and National Preparedness Levels are to determine if additional approvals are necessary to conduct prescribed burning. Burning under these kind of conditions is generally beyond the scope of a Burn Boss Type 3, although each situation needs to be looked at on a case-by-case basis. Some states impose burn bans when certain levels of drought or burning conditions develop. Be sure you know if this applies to you before you light the match.

HOW DO YOU KNOW IF YOU ARE EXPERIENCING UNUSUALLY DRY CONDITIONS?

Each station, area, or Region will have to determine which of the following drought indicators is appropriate for their fuels and conditions. You should build a file relating fire behavior and fire effects to drought indicators based on your experiences with prescribed fire and wildland fire. Historic (baseline) drought indices should be developed on all refuges where drought effects have been identified as a concern.

The most common way to monitor drought conditions is to follow whether precipitation is below normal at your station. But be careful, as precipitation can be above normal for the year, but BELOW normal for the last 4 or 5 months, leading to abnormally dry conditions. If possible, use one of the other indices rather than relying on average precipitation.

The National Fire Danger Rating System (NFDRS) is the most common method of tracking burning conditions. The ERC (energy release component) is a good indicator of how much drying has occurred and when burning conditions are getting severe. The Keetch-Byram Drought Index (KBDI) is another output of the NFDRS that specifically tracks drought conditions. The Burning Index (BI) will fluctuate more than the ERC, and is therefore, not as good at tracking long-term trends.

The Canadian Forest Fire Danger Rating System (CFFDRS) was designed to track cumulative drying, especially in deep duff and organic soils. Although it was developed for northern forest types, some areas have found that some of the indices work well for them.

Nearby automated weather stations will probably calculate dead and live fuel moisture and NFDRS indices that indicate what the burning conditions are for their area. Some weather stations will calculate fire danger based on either the U.S. or Canadian system. If you do not have direct access to the weather station outputs or to the NFDRS indices found in WIMS (Weather Information Management System), the nearest dispatch office should be able to give you information on conditions around the area. The farther you are from a weather station, the less accurate the indices may be for your station.

The KBDI, Palmer Drought Index, and Departure from Average Greenness are indicators that can be accessed for information on regional conditions, sometimes at the county level. This data and other useful information on fire danger can be found at the Wildland Fire Assessment System (WFAS) on the Internet (http://www.fs.fed.us/land/wfas/welcome/htm).

The KBDI can be calculated at any station using a rain gauge and simple mathematical calculations. Since they are simple, they are often made and kept by field offices that do not have access to RAWS stations and NFDRS calculations, and will be more accurate than the broad-scale indicators found on the Internet. These calculations will also provide a much better indicator of drought conditions than relying on whether precipitation for the year to date is above or below normal.

The Resource Conservation Service in your area may have current local soil moisture data that can be used to build a local reference for burning conditions. Some states issue range fire indices daily. Consult with the National Weather Service, as they are often available on the Internet.

If you are in drought conditions, remember that burning under these conditions means that most likely, a Type 3 Burn Boss is not appropriate for this assignment. The Unit Fire Management Officer must also mitigate the effects, such as doing the following:

1. Postpone the burn.

2. Have additional holding forces on site.

3. Have additional water sources available.

4. Burn under less severe conditions.

5. Spend greater effort on mop-up.

6. Monitor the fire more thoroughly to make sure it’s really out.

Don’t be fooled! If only a light rain occurs after a prolonged dry spell, the interior of large woody fuels and deep organic layers will still be dry. You could make the mistake of thinking that because you just got rain, conditions are back to normal. It would only take a slight amount of drying to put you right back in severe conditions.

Spring burning is often done when larger woody fuels are wet from winter precipitation. If winter precipitation has been below average for the area, consider postponing burning for the season or until after a significant rainfall (2" plus). The Burn Boss is responsible for consulting with your Fire Management Officer if the nearest weather station is showing below normal precipitation or your observations indicate that conditions are drier than normal.