

# Vegetation – Immediate Postburn Effects

This document describes methods for measuring burn severity on organic substrate and vegetation (above ground plant parts) following fire in grassland, brush or shrubland, woodland, and forest areas. Protocols also include measuring fire effects on individual trees including bark char height, crown scorch height, and crown scorch percent. This protocol was developed for the National Park Service's (NPS) fire monitoring program but may be adapted for other monitoring purposes. For background

information on the fire monitoring program, including the purpose and overview of the program, related policy, and personnel responsibilities, refer to Chapter 1, pages 1-5 of the NPS Fire Monitoring Handbook (FMH, <http://www.nps.gov/fire/fmh/FEMHandbook.pdf>). An overview of management objectives and the process for developing corresponding monitoring program objectives is reviewed in Chapter 3, pages 19-32 of the FMH.



Sampling design, including defining the population of interest, pilot sampling, calculating minimum sample size, and addressing potential design problems, is described in FMH Chapter 4, pages 33-54. Methods for generating and selecting plot locations and installing plots are found in FMH Chapter 5, pages 59-79. The schedule for monitoring prior to and following fire treatment is located in FMH Chapter 5, pages 55-58, although the schedule may be revised for other purposes. For a list of field equipment needs recommended for implementing this protocol, see FMH Appendix E, pages 221-224. Information about monitoring program file maintenance and data storage is found in FMH Chapter 5, pages 112-113. To review data quality procedures, see FMH Chapter 5, pages 114-117.

The field methods for the protocol described below are taken from FMH Chapter 5, pages 108-111 (<http://www.nps.gov/fire/fmh/FEMHandbook.pdf>). Specific forms developed for field data collection follow the protocol description.

# Monitoring Immediate Postburn Vegetation & Fuel Characteristics

## GRASSLAND AND BRUSH PLOTS

After the burned plot has cooled sufficiently (generally within two to three weeks), remeasure the RS variables (see Tables 5 and 6 on page 57). Record postburn conditions that characterize the amount of heat received in the type on the Brush and grassland plot burn severity data sheet (FMH-22). On each form, circle the postburn status code as “01 Post” (within two months of the burn, see tip box below). The first number represents the number of treatment iterations, e.g., 02 Post would indicate that the plot had been burned (or otherwise treated) twice.

## FOREST PLOTS

After the burned plot has cooled sufficiently (generally within two to three weeks), remeasure the RS variables (see Table 7 on page 57) using the preburn monitoring techniques. Record postburn conditions that characterize the amount of heat received in the type on the Forest plot burn severity data sheet (FMH-21). Remeasure the overstory and record data on the Tree postburn assessment data sheet, FMH-20 (optional for pole-size trees). Do not remeasure the diameter of overstory trees for at least one year postburn, but at every visit record whether each tree is alive or dead. On each form, circle the postburn status code as “01 Post” (within two months of the burn). The first number represents the number of treatment iterations, i.e., 02 Post would indicate that the plot had been burned (or otherwise treated) twice.

### Timing Burn Severity Data Collection



You can lose burn severity data by waiting too long to collect it, and having rain or snow mar the data collection. Collect burn severity data as soon as possible after the plot cools, which can be much less time than the recommended two weeks, especially in grasslands.

### Immediate Postburn Vegetation & Fuel Characteristics Accuracy Standards



Accuracy standards for each variable discussed in this section are listed at the end of this section (Table 29, page 111).

## MONITOR POSTBURN CONDITIONS

### Burn Severity—All Plot Types

Visual assessments of burn severity allow managers to broadly predict fire effects upon the monitoring type, from changes in the organic substrate to plant survival (Ryan and Noste 1985). Burn severity is rated and coded separately for organic substrate and vegetation, distinguished by an S or V, respectively. Rate burn severity according to the coding matrix (Table 28, page 110; adapted from Conrad and Poulton 1966; Ryan and Noste 1985; Bradley and others 1992).

#### Example:

In a plant association dominated by shrubs you observe the following conditions at one of the 4 dm<sup>2</sup> burn severity data collection points: the leaf litter has been consumed, leaving a coarse, light colored ash; the duff is deeply charred, but the underlying mineral soil is not visibly altered; foliage and smaller twigs are completely consumed, while shrub branches are mostly intact (40% of the shrub canopy is consumed). Burn severity would be coded as S2 (substrate impacts) and V3 (vegetation impacts) on the Brush and grassland plot burn severity data sheet (FMH-22), or the Forest plot burn severity data sheet (FMH-21).

Where there was no organic substrate present preburn, enter a 0 to indicate that the severity rating is not applicable. Do the same if there was no vegetation present preburn. You can often determine whether there was vegetation or substrate at a point by examining the preburn data sheets.

### Grassland and brush plots

Record burn severity measurements every 5 m, starting at 1 m and ending at the 30P (1 m, 5 m, 10 m, etc.). Record data from a minimum of seven areas per plot. You can choose to rate burn severity at every point sampled (100 data points, optional) along the transect. The additional effort may be minimal since vegetation data may be collected at each of these points anyway. Space has been provided on FMH-22 for this optional data.

---

## Grassland & Brush Plot Burn Severity



In past versions of this handbook, the protocol for collecting burn severity ratings was to collect data every 5 m, starting at the 0P and ending at the 30P. To avoid the influence of the plot rebar, it is now recommended that the first reading be made at 1 m, with all other measurements being the same.

---

At each sample point, evaluate burn severity to the organic substrate and to the above-ground plant parts in a 4 dm<sup>2</sup> area (2 dm × 2 dm) and record the value on FMH-22. Use the burn severity coding matrix for the appropriate plant association (Table 28, page 110) to determine the severity ratings.

### *Forest plots*

Burn severity ratings are determined at the same points on the forest dead and downed fuel inventory transect lines where duff depth is measured: 1, 5, 10, 15, 20, 25, 30, 35, 40, and 45 ft. Alternatively, if the Q4–30 m (the first 30 m of the Q4–Q1 transect) line is used, you can use the same methods used in grassland and brush plots. See the warning box below for another alternative.

Using the dead and downed fuel inventory transect lines you will have 40 points rated per plot. At each sample point, evaluate burn severity to the organic substrate and to above-ground plants in a 4 dm<sup>2</sup> area (2 dm × 2 dm). Use the burn severity code matrix (Table 28, page 110) for the appropriate plant association, and record the value on FMH-21.

---

## Forest Plot Burn Severity



You may now use the herbaceous transects (e.g., Q4–Q1, Q3–Q2) instead of the fuel transects to monitor burn severity in forest plots. The intervals (except for Q4–30 m) are at the 1, 5, 10, 15, 20, 25, 30, 35, 40, and 45 m marks. Only collect this data for the portions of the plot where you have vegetation transects.

---

Table 28. Burn severity coding matrix.

	Forests		Shrublands		Grasslands	
	Substrate (S)	Vegetation (V)	Substrate (S)	Vegetation (V)	Substrate (S)	Vegetation (V)
<b>Unburned (5)</b>	not burned	not burned	not burned	not burned	not burned	not burned
<b>Scorched (4)</b>	litter partially blackened; duff nearly unchanged; wood/leaf structures unchanged	foliage scorched and attached to supporting twigs	litter partially blackened; duff nearly unchanged; wood/leaf structures unchanged	foliage scorched and attached to supporting twigs	litter partially blackened; duff nearly unchanged; leaf structures unchanged	foliage scorched
<b>Lightly Burned (3)</b>	litter charred to partially consumed; upper duff layer may be charred but the duff layer is not altered over the entire depth; surface appears black; woody debris is partially burned; logs are scorched or blackened but not charred; rotten wood is scorched to partially burned	foliage and smaller twigs partially to completely consumed; branches mostly intact	litter charred to partially consumed, some leaf structure undamaged; surface is predominantly black; some gray ash may be present immediately postburn; charring may extend slightly into soil surface where litter is sparse, otherwise soil is not altered	foliage and smaller twigs partially to completely consumed; branches mostly intact; less than 60% of the shrub canopy is commonly consumed	litter charred to partially consumed, but some plant parts are still discernible; charring may extend slightly into soil surface, but soil is not visibly altered; surface appears black (this soon becomes inconspicuous); burns may be spotty to uniform depending on the grass continuity	grasses with approximately two inches of stubble; foliage and smaller twigs of associated species partially to completely consumed; some plant parts may still be standing; bases of plants are not deeply burned and are still recognizable
<b>Moderately Burned (2)</b>	litter mostly to entirely consumed, leaving coarse, light colored ash; duff deeply charred, but underlying mineral soil is not visibly altered; woody debris is mostly consumed; logs are deeply charred, burned-out stump holes are common	foliage, twigs, and small stems consumed; some branches still present	leaf litter consumed, leaving coarse, light colored ash; duff deeply charred, but underlying mineral soil is not visibly altered; woody debris is mostly consumed; logs are deeply charred, burned-out stump holes are common	foliage, twigs, and small stems consumed; some branches (>.6–1 cm in diameter) (0.25–0.50 in) still present; 40–80% of the shrub canopy is commonly consumed.	leaf litter consumed, leaving coarse, light gray or white colored ash immediately after the burn; ash soon disappears leaving bare mineral soil; charring may extend slightly into soil surface	unburned grass stubble usually less than two inches tall, and mostly confined to an outer ring; for other species, foliage completely consumed, plant bases are burned to ground level and obscured in ash immediately after burning; burns tend to be uniform
<b>Heavily Burned (1)</b>	litter and duff completely consumed, leaving fine white ash; mineral soil visibly altered, often reddish; sound logs are deeply charred, and rotten logs are completely consumed. This code generally applies to less than 10% of natural or slash burned areas	all plant parts consumed, leaving some or no major stems or trunks; any left are deeply charred	leaf litter completely consumed, leaving a fluffy fine white ash; all organic material is consumed in mineral soil to a depth of 1–2.5 cm (0.5–1 in), this is underlain by a zone of black organic material; colloidal structure of the surface mineral soil may be altered	all plant parts consumed leaving only stubs greater than 1 cm (0.5 in) in diameter	leaf litter completely consumed, leaving a fluffy fine white ash, this soon disappears leaving bare mineral soil; charring extends to a depth of 1 cm (0.5 in) into the soil; this severity class is usually limited to situations where heavy fuel load on mesic sites has burned under dry conditions and low wind	no unburned grasses above the root crown; for other species, all plant parts consumed leaving some or no major stems or trunks, any left are deeply charred; this severity class is uncommon due to the short burnout time of grasses
<b>Not Applicable (0)</b>	inorganic preburn	none present preburn	inorganic preburn	none present preburn	inorganic preburn	none present preburn

## Scorch Height

Record the tree tag number (Tag), whether the tree is alive (L), dead (D), resprouting (R), consumed/down (C), broken below BH (B) or cut stump (S) (Live Code), maximum scorch height (ScHgt), and the scorched proportion of the crown (ScPer). See Glossary for definitions. Trees that have fallen should be noted, though they will be recorded during the year-1 remeasurement. You may also record char height (Char), an optional variable, on FMH-20.

Estimate the maximum scorch height on each overstory tree two weeks to two months after the fire has burned across the monitoring plot. **Note:** If another time frame (e.g., 3 months or year-1 postburn) exposes scorch patterns more definitively, measure scorch height again at that time and enter the data with the other Post data. Record this information in the Notes section of the FMH-4.

Maximum scorch height is measured from ground level to the highest point in the crown where foliar death is evident (see Figure 35). Some trees will show no signs of scorch, but the surrounding fuels and vegetation will have obviously burned. In this case, you can estimate scorch height by examining adjacent vegetation. It may be useful to produce a graph of scorch heights to show the variation around the average. Managers may want to correlate scorch height with the pre-burn locations of large dead and down fuels; these correlations usually require photographs or maps of fuel pockets.

## Percent Crown Scorched

For each overstory tree, estimate the percent of the entire crown that is scorched. Average percent crown scorched may be calculated, but percent crown scorched is a better indicator of individual tree mortality.

## OPTIONAL MONITORING PROCEDURES

### Char Height

You can often measure char height simultaneously with scorch height. To obtain an average maximum char height, measure the height of the maximum point of char for each overstory tree (see Figure 35). For these data calculate the mean of maximum char heights. It may be useful to note on the data sheet the extent of the cambial damage to the tree and to describe the char on the ground surrounding each tree in the Notes section of FMH-20.

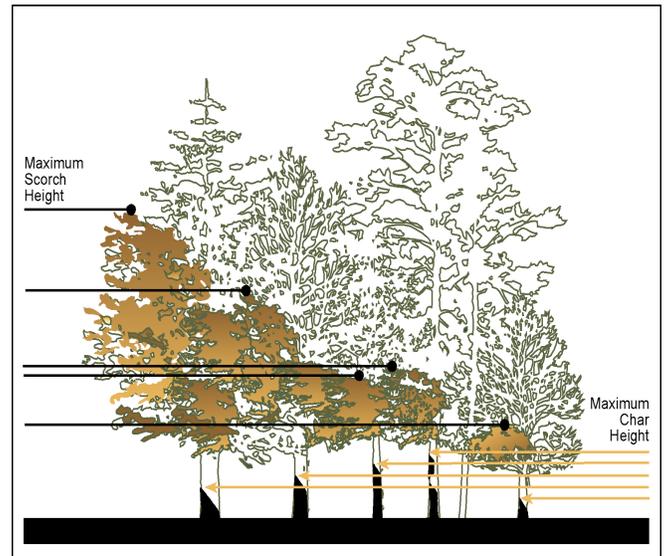


Figure 35. Scorch and char height.

## Scorch and Char for Pole-size Trees (Optional)



You may collect scorch height, percent crown scorch, and char height for pole-size trees if these data are important to resource and/or fire management staff.

Table 29. Accuracy standards for during burn and immediate postburn (RS) variables.

Fire Behavior and Severity		
Flame Length or Depth/ROS	<10 ft	± 1 ft
	>10 ft	± 5 ft
Burn Severity		± 1 Class
Scorch/Char Height	<10 m	± 1 m
	>10 m	± 5 m
Percent Crown Scorch		± 10%





**FMH-21**

**FOREST PLOT BURN SEVERITY DATA SHEET**

Page \_\_\_ of \_\_\_

Plot ID: \_\_\_\_\_

B / C (Circle One)

Date: \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Burn Unit: \_\_\_\_\_

Recorders: \_\_\_\_\_

Burn Status: Circle one and indicate number of times treated, e.g., 01-Post, 02-Post) \_\_\_\_\_ Post

When collecting burn severity on fuel transects, rate each fuel load transect at the duff measurement points using the Coding Matrix below. When collecting burn severity on herbaceous transects, rate each herbaceous transect (Q4–Q1—transect 1, Q3–Q2—transect 2, 0P–50P—transect 3) at the meter measurement points on the tape listed in the tables below (1, 5, 10, etc.) using the same matrix. Collect data only along the transects where you collected preburn data. Note: If you read only herbaceous transect Q4–30 m, use FMH-22.

Each observation is from a 4 dm<sup>2</sup> area.

Transect 1	1	5	10	15	20	25	30	35	40	45
Vegetation										
Substrate										

Transect 2	1	5	10	15	20	25	30	35	40	45
Vegetation										
Substrate										

Transect 3	1	5	10	15	20	25	30	35	40	45
Vegetation										
Substrate										

Transect 4	1	5	10	15	20	25	30	35	40	45
Vegetation										
Substrate										

**Coding Matrix:**

<b>5</b> Unburned	<b>4</b> Scorched	<b>3</b> Lightly Burned	<b>2</b> Moderately Burned	<b>1</b> Heavily Burned	<b>0</b> Not Applicable
-------------------	-------------------	-------------------------	----------------------------	-------------------------	-------------------------

Note: See reverse for detailed definitions.

	Unburned (5)	Scorched (4)	Lightly Burned (3)	Moderately Burned (2)	Heavily Burned (1)	Not Applicable (0)
<b>Substrate (S)</b>	not burned	litter partially blackened; duff nearly unchanged; wood/leaf structures unchanged	litter charred to partially consumed; upper duff layer may be charred but the duff layer is not altered over the entire depth; surface appears black; woody debris is partially burned; logs are scorched or blackened but not charred; rotten wood is scorched to partially burned	litter mostly to entirely consumed, leaving coarse, light colored ash; duff deeply charred, but underlying mineral soil is not visibly altered; woody debris is mostly consumed; logs are deeply charred, burned-out stump holes are common	litter and duff completely consumed, leaving fine white ash; mineral soil visibly altered, often reddish; sound logs are deeply charred, and rotten logs are completely consumed. This code generally applies to less than 10% of natural or slash burned areas	inorganic preburn
<b>Vegetation (V)</b>	not burned	foliage scorched and attached to supporting twigs	foliage and smaller twigs partially to completely consumed; branches mostly intact	foliage, twigs, and small stems consumed; some branches still present	all plant parts consumed, leaving some or no major stems/trunks; any left are deeply charred	none present preburn

**FMH-22 BRUSH AND GRASSLAND PLOT BURN SEVERITY DATA SHEET** Page \_\_\_ of \_\_\_

Plot ID: \_\_\_\_\_ B / C (Circle One) Date: \_\_\_ / \_\_\_ / \_\_\_

Burn Unit: \_\_\_\_\_ Recorders: \_\_\_\_\_

Burn Status: Circle one and indicate number of times treated, e.g., 01-Post, 02-Post) \_\_\_\_\_ Post

Burn severity ratings are made every 5 m using the Coding Matrix below. Each observation is from a 4 dm<sup>2</sup> area (top form). Optionally, you can use the lower form, which will allow you to rate severity at all 100 points. Note: If your herbaceous transect(s) are longer than 30 m, use FMH-21.  
(Circle One) Q4-30 m w 0P-30P

	1 m	5 m	10 m	15 m	20 m	25 m	30 m
<b>Vegetation</b>							
<b>Substrate</b>							

OR

**Substrate and Vegetation Burn Severity at Every Point (Optional)**

0.3 S___ V___	6.3 S___ V___	12.3 S___ V___	18.3 S___ V___	24.3 S___ V___
0.6 S___ V___	6.6 S___ V___	12.6 S___ V___	18.6 S___ V___	24.6 S___ V___
0.9 S___ V___	6.9 S___ V___	12.9 S___ V___	18.9 S___ V___	24.9 S___ V___
1.2 S___ V___	7.2 S___ V___	13.2 S___ V___	19.2 S___ V___	25.2 S___ V___
1.5 S___ V___	7.5 S___ V___	13.5 S___ V___	19.5 S___ V___	25.5 S___ V___
1.8 S___ V___	7.8 S___ V___	13.8 S___ V___	19.8 S___ V___	25.8 S___ V___
2.1 S___ V___	8.1 S___ V___	14.1 S___ V___	20.1 S___ V___	26.1 S___ V___
2.4 S___ V___	8.4 S___ V___	14.4 S___ V___	20.4 S___ V___	26.4 S___ V___
2.7 S___ V___	8.7 S___ V___	14.7 S___ V___	20.7 S___ V___	26.7 S___ V___
3.0 S___ V___	9.0 S___ V___	15.0 S___ V___	21.0 S___ V___	27.0 S___ V___
3.3 S___ V___	9.3 S___ V___	15.3 S___ V___	21.3 S___ V___	27.3 S___ V___
3.6 S___ V___	9.6 S___ V___	15.6 S___ V___	21.6 S___ V___	27.6 S___ V___
3.9 S___ V___	9.9 S___ V___	15.9 S___ V___	21.9 S___ V___	28.9 S___ V___
4.2 S___ V___	10.2 S___ V___	16.2 S___ V___	22.2 S___ V___	28.2 S___ V___
4.5 S___ V___	10.5 S___ V___	16.5 S___ V___	22.5 S___ V___	28.5 S___ V___
4.8 S___ V___	10.8 S___ V___	16.8 S___ V___	22.8 S___ V___	29.8 S___ V___
5.1 S___ V___	11.1 S___ V___	17.1 S___ V___	23.1 S___ V___	29.1 S___ V___
5.4 S___ V___	11.4 S___ V___	17.4 S___ V___	23.4 S___ V___	29.4 S___ V___
5.7 S___ V___	11.7 S___ V___	17.7 S___ V___	23.7 S___ V___	29.7 S___ V___
6.0 S___ V___	12.0 S___ V___	18.0 S___ V___	24.0 S___ V___	30.0 S___ V___

**Coding Matrix:**

**5** Unburned   **4** Scorched   **3** Lightly Burned   **2** Moderately Burned   **1** Heavily Burned   **0** Not Applicable

**Note:** See reverse for detailed definitions.

Date Entered: \_\_\_ / \_\_\_ / \_\_\_

