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TECHNOLOGY TRANSFER NOTE

A-008

A DECISION AID FOR CHARACTERIZING FIRE BEHAVIOR AND DETERMINING FIRE SUPPRESSION NEEDS

Alexander and De Groot (1988) recently produced a wall poster which included a simple guide to assist in determining or analyzing fire behavior characteristics and interpreting fire suppression requirements, in the form of a graph and a table, based on the Canadian Forest Fire Weather Index System. The use of color and the physical size of the graph is not particularly convenient in such daily operational applications as:

- initial attack preparedness assessment
- dispatching of suppression resources
- escaped fire situation analysis
- strategies & tactics on campaign fires
- prescribed fire planning

Specific examples of these uses in fire management, either directly or indirectly, can be found elsewhere (e.g., De Groot and Alexander 1986; Murphy and Tymstra 1986; Alberta Forest Service 1988; McAlpine and Alexander 1988; Lanoville and Mawdsley 1989). Several fire management agencies have already incorporated prototype versions of the graph and table in their field handbooks and training manuals (e.g., Ontario Ministry of Natural Resources 1984, 1985; Lieskovsky et al. 1987; B.C. Ministry of Forests and Lands 1987). The purpose of this note is to present enlargements of both illustrations that would be suitable as "masters" for reproducing black and white photocopies (Fig. 1 and Table 1).

To determine the Fire Intensity Class from the graph, simply find the point where the Buildup Index (BUI) and the Initial Spread Index (ISI) intersect, then refer to the associated table for a descriptive explanation based on the appropriate numerical rating between 1 and 5. For example, if the BUI were 40 and the ISI 10, the Fire Intensity Class would be 3.

The fire intensity class graph and accompanying table were initially distributed at the 1986 Annual Meeting of the Canadian Committee on Forest Fire Management. This unpublished prototype version, which can be found in print in several places (e.g., De Groot and Alexander 1986; Murphy and Tymstra 1986; B.C. Ministry of Forests and Lands 1987; Lieskovsky et al. 1987), included six fire intensity classes or ranks rather than five. The criteria for the sixth class was revised by the first author in December 1987 (MEA) from 8 000 kW/m to 10 000 kW/m (see Alberta Forest Service 1988; McAlpine and Alexander 1988). However, for the purposes of the Alexander and De Groot (1988) poster publication, only five classes were used because of the lack of data beyond a frontal fire intensity of 7 460 kW/m.

Readers should note that the graph and table are most applicable to the kind of jack pine fuel type depicted in the Alexander and De Groot (1988) poster.

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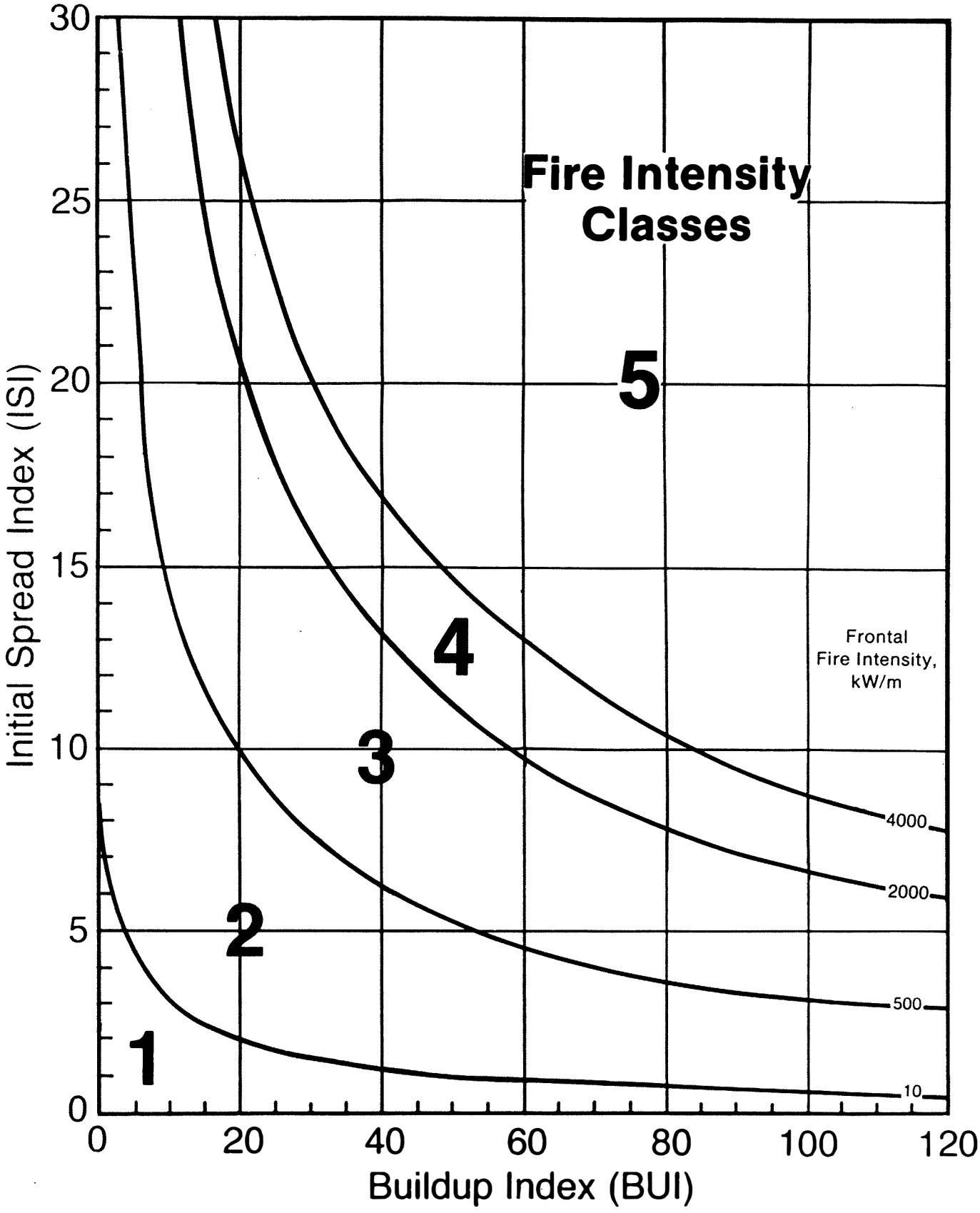

Figure 1. Fire intensity classes for the jack pine fuel type depicted in the Alexander and De Groot (1988) poster as a function of the Initial Spread Index and Buildup Index components of the Canadian Forest Fire Weather Index System. Refer to Table 1 for the fire control implications.

Table 1. Fire behavior characteristics and fire suppression interpretations associated with the fire intensity classes in Figure 1 for the jack pine fuel type depicted in the Alexander and De Groot (1988) poster.

Fire Intensity Class	Frontal fire intensity (kW/m)	Surface head fire[1] Flame length (m)	Surface head fire[1] Flame height (m)	Type of fire and fire suppression difficulty	Fire Weather Index[2] (FWI)
1	<10	<0.2	<0.1	Firebrands that cause an ignition to occur are self-extinguishing (i.e., fire fails to spread). Going fires remain of the smouldering ground or subsurface variety, provided there is a forest floor layer of significant depth and a general level of dryness[3]. Extensive mop-up is generally required.	0-3
2	10-500	0.2-1.4	0.1-1.0	Creeping or gentle surface fire. Direct manual attack at fire's head or flanks by firefighters with hand tools and water is possible. Constructed fireguard should hold.	4-13
3	500-2000	1.4-2.6	1.0-1.9	Low vigor to moderately or highly vigorous surface fire. Hand-constructed fireguards likely to be challenged. Heavy equipment (bulldozers, pumpers, retardant aircraft, skimmers, helicopter with bucket) generally successful in controlling fire.	14-23
4	2000-4000	2.6-3.5	1.9-2.5	Very vigorous or extremely intense surface fire (torching common). Control efforts at fire's head may fail.	24-28
5	>4000	>3.5	>2.5	Intermittent crown fire[4] to active crown fire development (at >10 000 kW/m)[5]. Very difficult to control. Suppression action must be restricted to fire's flanks. Indirect attack with aerial ignition (i.e., helitorch and/or A.I.D. dispenser) may be effective.	>29

[1] Flame length based on relationship with fire intensity according to Byram (1959). Flame height based on flame length and a 45° flame angle (Alexander 1982).

[2] Based on the second equation given in Alexander and De Groot (1988) except the upper and lower FWI values for Fire Intensity Classes 1 and 2 were determined from Van Wagner (1987) since none of the Darwin Lake fires were conducted at the very low end of the frontal fire intensity scale.

[3] Drought Code (DC) >300 and/or Buildup Index (BUI) >40.

[4] Synonymous with passive crown fire as described by Van Wagner (1977) (Merrill and Alexander 1987).

[5] Violent physical behavior probable at frontal fire intensities greater than 30 000 kW/m (i.e., blow-up or conflagration type fire run); suppression actions should not be attempted until burning conditions ameliorate.

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