

Fire Danger Rating:

Lessons learned in NZ



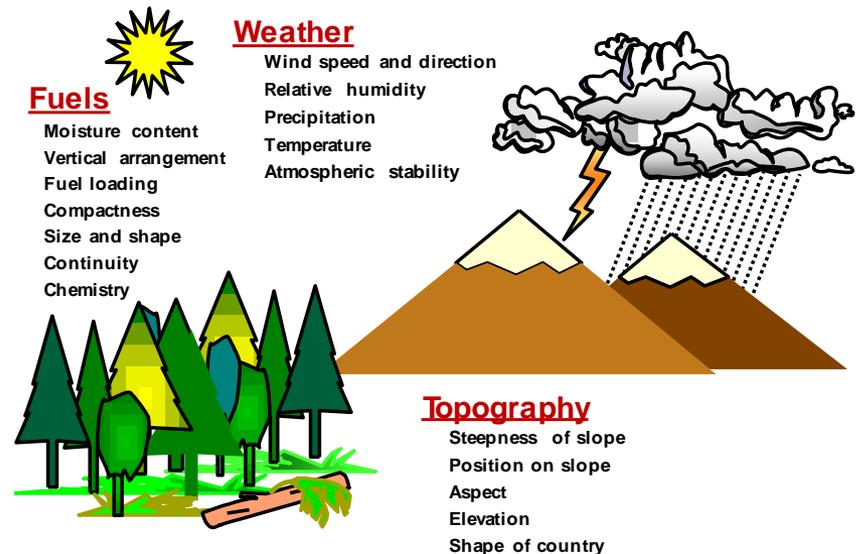
Fire Danger Rating Systems

- Successful wildfire management programs require a reliable “intelligence” system
- Usually in form of a fire danger rating system
- Outputs used to support decision-making



Fire Danger Rating

- Aims to provide a simple measure of assessing the flammability of fuels from day to day
- Integrates the fixed and variable factors of the fire environment
- Provides qualitative and/or numerical indexes of fire potential



Fire Danger Rating Outputs

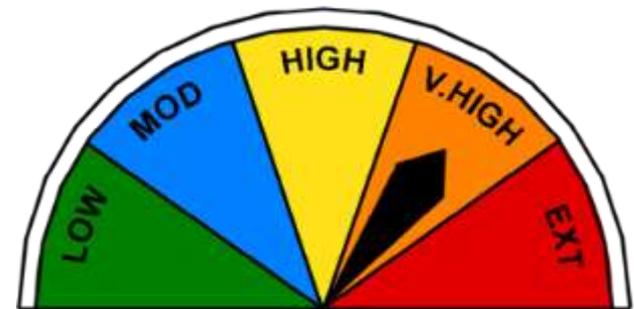
Should answer the question:

“What is the probability of a fire starting, spreading and doing damage today?”

Fire potential:

- Indication of expected burning conditions
 - ease of ignition
 - potential spread rates
 - fire intensity
 - fire size and shape
- Plus potential impact
 - difficulty of control
 - damage potential

Fire Danger Today



Goal of Fire Danger Rating Research

- *“Make an index such that any given value will represent the same fire behaviour, no matter what weather history leads to it.”*



This is a very stiff test... The trouble is one very quickly outruns the available practical knowledge.”

(Van Wagner 1970)

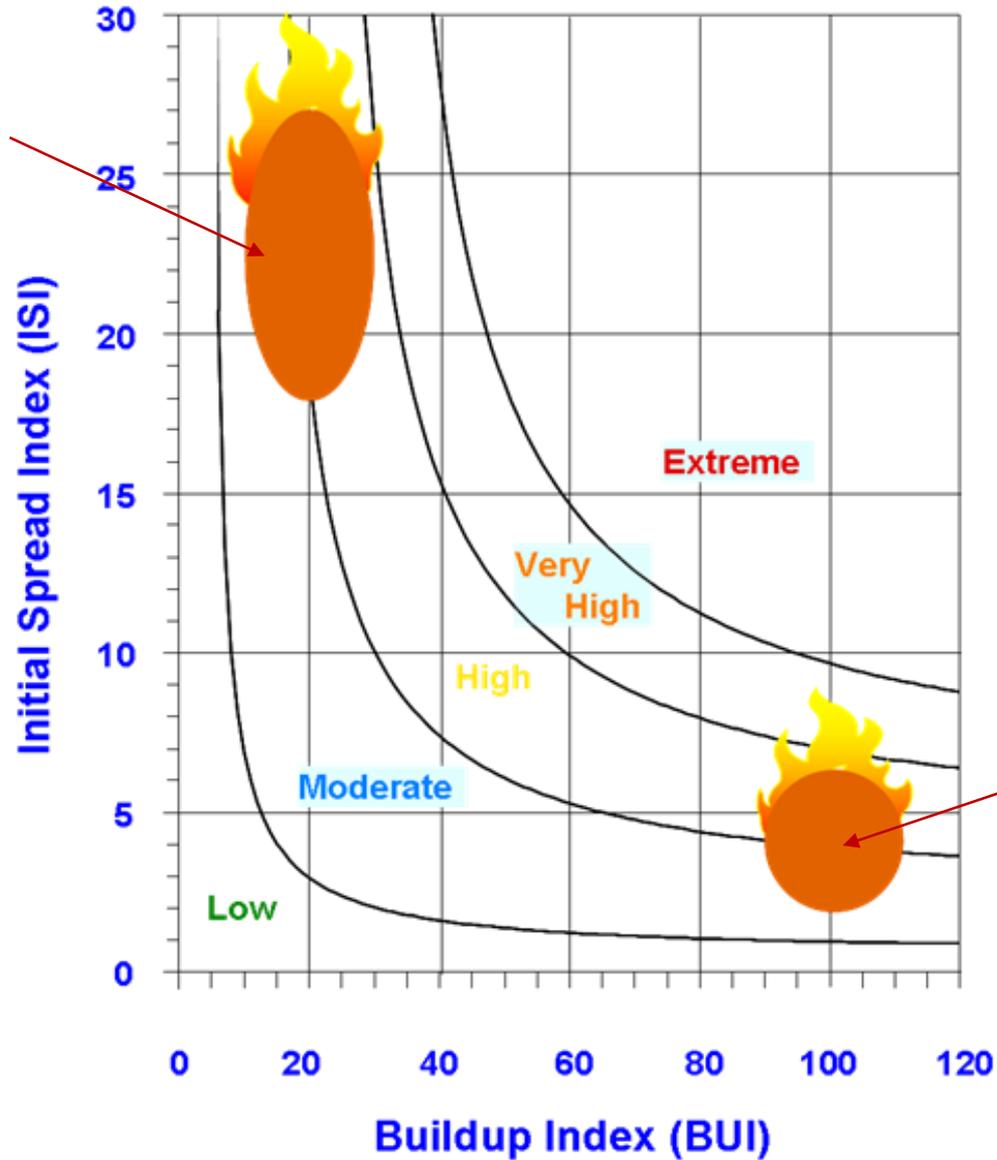
- *“The fact is that it’s difficult to portray all the aspects of fire danger in a single number... One number can’t be expected to cover the full range of fire management needs.”*



(Alexander 1994)

Forest Fire Danger Class Graph

High ISI, Low BUI
= fast spread,
elliptical shape,
more perimeter,
larger area



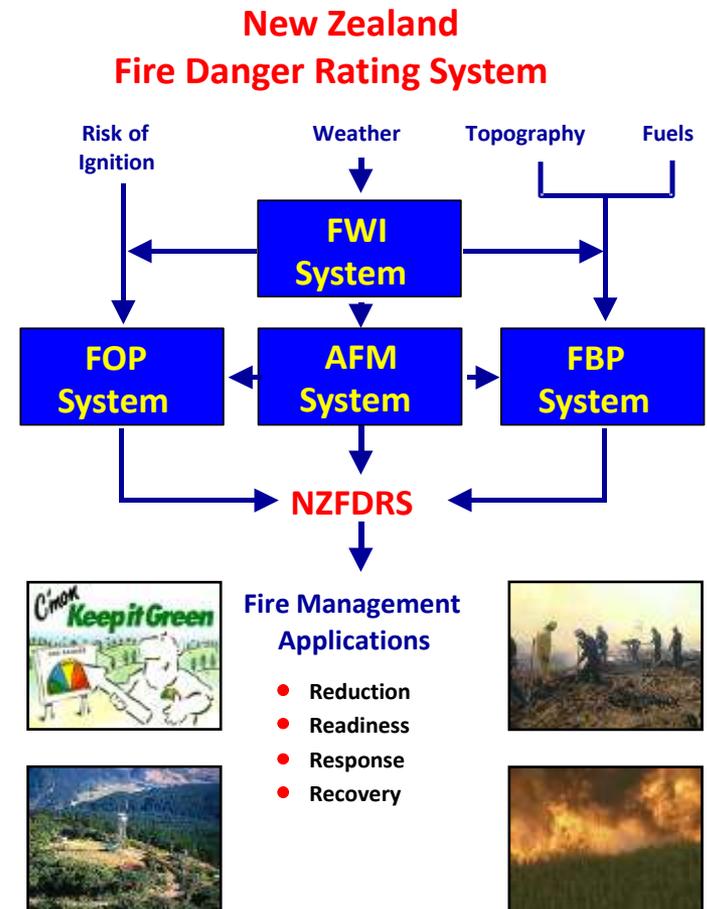
Two fires with
same FWI value

High BUI, Low ISI
= slow spread,
circular shape,
slow growth,
persist in same
area

New Zealand Fire Danger Rating System (NZFDRS)

Derived from Canadian equivalent, the CFFDRS

- Fire Weather Index (FWI) System core component
- Fire behaviour and fire danger classes based on Fire Behaviour Prediction (FBP) System
- Fire Occurrence Prediction (FOP) and Accessory Fuel Moisture (AFM) subsystems still under development
- Provides information to support fire management decision-making



Fire Danger vs Fire Behaviour Prediction systems

FWI System – provides numerical ratings of the **relative fire potential** in a **standard fuel type** (i.e., a mature pine stand) on **level terrain**, based solely on **weather observations** measured **daily at noon** local standard time (1300 DST).



FBP System – provides **quantitative fire behaviour** estimates for major **fuel types** and **topographic** situations based on **FWI System** and **fire weather observations** for the **time of the prediction**.



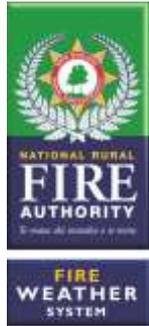
NZ Fire Danger Classes

- Principal use is for notifying the public
- Fire danger classes based on head fire intensity
 - determined from fuel load and potential rate of fire spread
- Related to suppression effectiveness
- Models available for Forest, Grassland and Scrubland fuel types from FBP System



Fire Danger Class	Fire Intensity (kW/m)	Control Requirements	
L	< 10	Ground crews with hand tools	
M	10-500	Ground crews with backpack pumps	
H	500-2000	Water under pressure and/or heavy machinery	
VH	2000-4000	Aircraft using chemical fire retardants	
E	> 4000	Very difficult if not impossible to control	

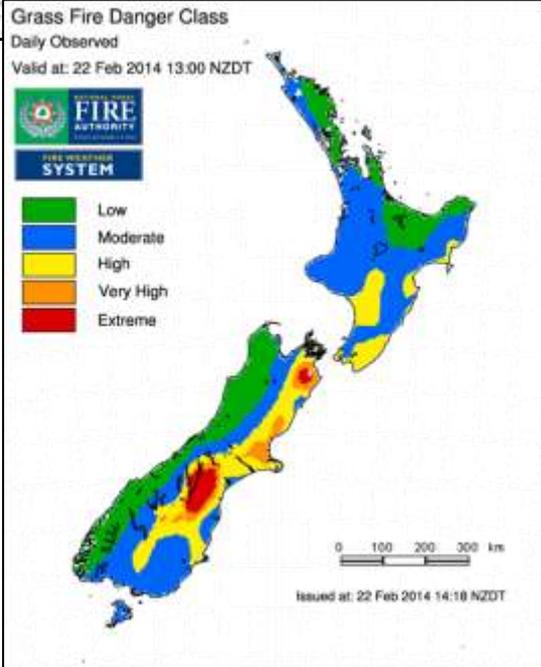
Fire Weather System



NORTH ISLAND DATA																
Saturday, 2 February 2014																
STATION NAME	FOREST	SCRM	GRASS	FFMC	DMC	DC	ISI	RA	FWI	TEMP	RH	WSP	WSPD	DIRN	STAT	
Pukekohe	M	E	L	44	18	142	8.8	24	8.8	21.9	38	330	10	0.0	30	A-8
Ngauruhia	M	E	L	39	21	118	4.8	35	9.2	23.1	38	330	9	0.0	30	A-8
Whangarei	M	E	L	38	20	99	4.7	136	29.9	17.2	94	311	8	0.0	30	A-8
Te Kaha	M	E	L	37	22	143	4.2	34	8.8	23.1	38	331	10	0.0	30	A-8
Whakarewa	M	E	L	37	24	140	5.0	38	11.4	23.0	32	370	11	0.0	30	A-8
Whangarei Head	M	E	L	36	20	103	4.6	36	13.4	25.0	30	310	7	0.0	30	A-8

SOUTH ISLAND DATA																
Saturday, 2 February 2014																
STATION NAME	FOREST	SCRM	GRASS	FFMC	DMC	DC	ISI	RA	FWI	TEMP	RH	WSP	WSPD	DIRN	STAT	
Christchurch Airport	M	E	L	67	22	141	5.0	32	10.3	23.9	57	330	12	0.0	30	A-8
Waima Plains	M	E	L	66	28	147	3.7	38	9.8	20.1	34	329	8	0.0	30	A-8
Wairarapa	M	E	L	65	31	171	6.2	45	14.8	24.4	47	300	12	0.0	30	A-8
Wairarapa	M	E	L	64	23	162	6.9	34	12.1	24.1	52	339	13	0.0	30	A-8
Christchurch	M	E	L	63	32	229	8.8	47	19.8	24.9	58	337	14	0.0	30	A-8
Wairarapa	M	E	L	62	23	160	7.0	34	13.8	25.3	51	336	10	0.0	30	A-8
Wairarapa	M	E	L	61	24	228	9.8	58	24.8	26.2	62	334	9	0.0	30	A-8
Christchurch	M	E	L	60	19	136	3.9	28	7.3	21.9	75	311	6	0.0	30	A-8

SOUTH ISLAND DATA																
Saturday, 2 February 2014																
STATION NAME	FOREST	SCRM	GRASS	FFMC	DMC	DC	ISI	RA	FWI	TEMP	RH	WSP	WSPD	DIRN	STAT	
Wairarapa	M	E	L	67	22	145	5.2	32	10.6	23.0	58	330	12	0.0	30	A-8
Wairarapa	M	E	L	67	48	207	6.8	68	19.3	23.3	53	347	18	0.0	30	A-8
Wairarapa	M	E	L	66	19	136	3.9	28	7.3	21.9	75	311	6	0.0	30	A-8
Wairarapa	M	E	L	64	9	82	2.8	14	4.8	18.9	58	325	12	0.0	30	A-8
Wairarapa	M	E	L	63	29	152	4.5	43	13.8	23.0	57	350	9	0.0	30	A-8
Wairarapa	M	E	L	62	26	163	4.3	38	10.8	24.0	57	310	8	0.0	30	A-8
Wairarapa	M	E	L	61	25	158	8.8	42	18.4	26.0	59	320	19	0.0	30	A-8
Wairarapa	M	E	L	60	22	205	5.4	38	11.8	22.0	71	310	17	0.0	30	A-8



- Current fire weather and fire danger updated daily from network of 200+ weather stations
- Forecasted weather used to calculate hourly (2 days) and daily (6 days) FWI values
- fire manager access via FWSYS software application
- public access via Internet: nrfa.fire.org.nz/fire_weather

Fire management activities

Reduction:

- Public notification of fire danger using fire danger signs
- setting of Restricted and Prohibited Fire Seasons
- permit conditions and burning controls/prescriptions
- public access controls (e.g. forest or recreation area closures, off-road vehicle access)
- activity restrictions (e.g. spark-hazardous activities, forestry operations, roadside mowing)



Readiness:

- readiness levels – stand-by requirements
- pre-determined response – initial attack guidelines



Response:

- fire behaviour prediction and growth modelling
- resource requirements
- trigger points for community warnings and/or evacuations

Recovery:

- lessons learned – fire operational reviews (reduction/readiness preparations, response effectiveness)
- wildfire documentation – fire behaviour case studies





FDRS Users

- Fire managers – rural and urban
- Forestry and land managers
- Rural land owners / farmers
- Residents in rural-urban interface
- General public – visitors to rural areas



⇒ **Essential to know the target audience!**

Adaptation to local environment

- Adoption of existing FDRS most cost-effective option
- Local fuel types unlikely to be the same
- ⇒ **Fire danger ratings need to represent fire behaviour in relevant fuel type(s)**
- ⇒ **Care not to extend system beyond its original intent**
- Program of research needed to adapt FDRS for local fuel types
 - takes time & resources



Conclusions (1)

- Fire Danger Rating systems integrate the fixed and variable factors of the fire environment – terrain, fuels and weather
- FWI System provides assessment of relative fuel dryness and fire behaviour potential – on a broad area basis only, based solely on weather (for a reference fuel type)
- FBP System provides quantitative estimates of fire behaviour – for site-specific fuels, slope & wx/FD
- Must have a good idea of what you intend to use the FDRS for at the outset

Conclusions (2)

- Can't just adopt an existing FDRS – need to adapt it to the local fuels and fire environment
- FDRS outputs need to be related to observed fire behaviour in fuel types of interest
- Know who the key end-users of information from the FDRS will be
- Technology transfer and training in the background and use of the FDRS essential – need to understand the assumptions and limitations
- Need to balance the pressures of operational need against scientific rigour – better to take longer, but get it right