FLAT TOP COMPLEX

Wildfire Science Documentation Report

FINAL REPORT FROM THE WILDFIRE SCIENCE DOCUMENTATION GROUP

MAY 2012

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Notes:

The numbers in this report were based on information available at the time the report was prepared and may be subject to change.

Subsequent to the completion of this report, the wildfire management program in the former department of Sustainable Resource Development was transferred to the department of Agriculture and Forestry.

Acknowledgements

The Wildfire Science Documentation Group would like to thank Sustainable Resource Development staff and those individuals who provided detailed documentation, data, on-site interviews, field work, and reconnaissance assistance. These elements significantly contributed to the development of this report.

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WILDFIRE SCIENCE DOCUMENTATON

Documentation Process

In mid-May 2011, 52 wildfires ignited in the Lesser Slave Area over a two-day period. Three of these wildfires were managed as the Flat Top Complex, two of which resulted in unprecedented impacts on the Town of Slave Lake and surrounding communities.

This event prompted Sustainable Resource Development to establish a Documentation and Technical Support Team to review and document wildfire science behaviour and operations. As well, the Minister of Sustainable Resource Development appointed a four-person independent committee called the Flat Top Complex Wildfire Review Committee. The reports prepared by the Documentation and Technical Support Team were submitted to the Flat Top Complex Wildfire Review Committee to assist them in providing recommendations to the Minister regarding improvements to the department's wildfire management program. This document provides background and historical wildfire information, as well as specific wildfire behaviour and conditions relevant to the Flat Top Complex.

The Documentation and Technical Support Team (Appendix A) focused on two aspects of the wildfires managed through the Flat Top Complex:

1. Wildfire science components related to the influence of fuels, weather, and topography on wildfire behaviour.
2. Operational chronology including wildfire preparedness planning, detection, initial attack, sustained attack, and resources.

The documentation process included on-site interviews, review of all relevant operational logs and records, forest fuel consumption field work, development of a data library, on-site reconnaissance of burned area and wildfire impacts, and the reconstruction of fire weather and danger conditions and subsequent wildfire behaviour.

National and Provincial Wildfire Overview

Canada experienced catastrophic community wildfire events throughout the 1800s and early 1900s. This period was followed by a significant decrease in wildfire impacts until the first decade of the current century. Historical wildfires with significant community impacts in previous centuries have included:

- Miramichi wildfire in New Brunswick (1825)
- Saguenay wildfire in Quebec (1870)
- Fernie wildfire in British Columbia (1908)
- Cochrane wildfire in Ontario (1911)
- Matheson wildfire in Ontario (1916)
- Lac La Biche wildfire in Alberta (1919)

- Haileybury wildfire in Ontario (1922)

There were nine recorded wildfires in Canada between 1825 and 1938 that were associated with over 600 known fatalities. The two wildfires in western Canada occurred in August 1908 (Fernie wildfire—22 fatalities) and May 1919 (Lac La Biche wildfire—14 known fatalities and additional unconfirmed). The Lac La Biche wildfire was estimated to have burned over 2.8 million hectares in Alberta and Saskatchewan.

More recent major wildfire events impacting communities in western Canada include:

- Garnet (Penticton) wildfire in British Columbia (1994)
- Salmon Arm wildfire in British Columbia (1998)
- Chisholm wildfire in Alberta (2001)
- Firestorm, Okanagan Mountain wildfire in British Columbia (2003)
- Lost Creek wildfire in Alberta (2003)
- Flat Top Complex wildfires in Alberta (2011)

The combined wildfire events of May 14 and 15, 2011 in the Lesser Slave Area of central Alberta were unprecedented and resulted in the most significant community destruction in Canadian history (estimated insured losses exceeded CAD$700 million). This overview provides a synopsis of the weather conditions and wildfire behaviour experienced by Sustainable Resource Development wildfire resources and other emergency responders from May 11 to 15, 2011.

BRIEF SYNOPSIS OF THE FLAT TOP COMPLEX ON MAY 14 AND 15

The 2011 wildfire season in central Alberta developed quickly following snowmelt in early May. Within days, 189 wildfires were ignited across the province (Table 1). Strong, sustained winds from the southeast created wildfire suppression challenges. When initial attack and sustained attack resources were fully committed, additional national and international resources were requested. The Lesser Slave Area, one of the 11 Sustainable Resource Development Regional Areas (10 of which are in the Forest Protection Area; Appendix B), was the most active in terms of wildfire activity, with 52 wildfires and over 23 communities/locations (e.g., camps, worksites, parks, and wildfire lookouts) threatened. Three of the wildfires in the Lesser Slave Area were identified as the “Flat Top Complex”.

Area	Number Of Wildfires	Communities/Locations Threatened
Southern Rockies (Calgary)	5	Morley Reserve
Foothills (Edson)	25	Lodgepole
Fort McMurray	6	Fort MacKay, Oilsands camps, Richardson Recreational Backcountry
Smoky (Grande Prairie)	12	None
Footner (High Level)	14	Fox Lake
Lac La Biche	18	Janvier, Chisholm, Long Island Lake
Peace (Peace River)	7	Cadotte Lake
Clearwater (Rocky Mountain House)	22	Crimson Lake Provincial Park
Lesser Slave (Slave Lake)	52	Widewater, Canyon Creek, Poplar Estates, Town of Slave Lake, Faust, East Prairie/Enilda, Gift Lake, Wabasca, Red Earth, House Mountain area
Woodlands (Whitecourt)	28	Pass Creek, Carson Lake Provincial Park
Total	**189**	**Over 23 communities/locations threatened**

Table 1 – Number of wildfires by area and communities and locations threatened between May 11 and May 15.

The three wildfires managed under the Flat Top Complex included SWF-056, SWF-065, and SWF-082 (Figure 1). Two of these wildfires, SWF-056 and SWF-065, were responsible for the combined loss of over 510 structures (including 484 single-family dwellings, 7 multi-family residences, and 19 non-residential buildings) in the Town of Slave Lake and in the nearby communities of Canyon Creek, Widewater, and Poplar Estates. The majority of damage at the community level occurred within 31 hours of ignition of the two wildfires. The third wildfire (SWF-082) did not result in any structure loss.

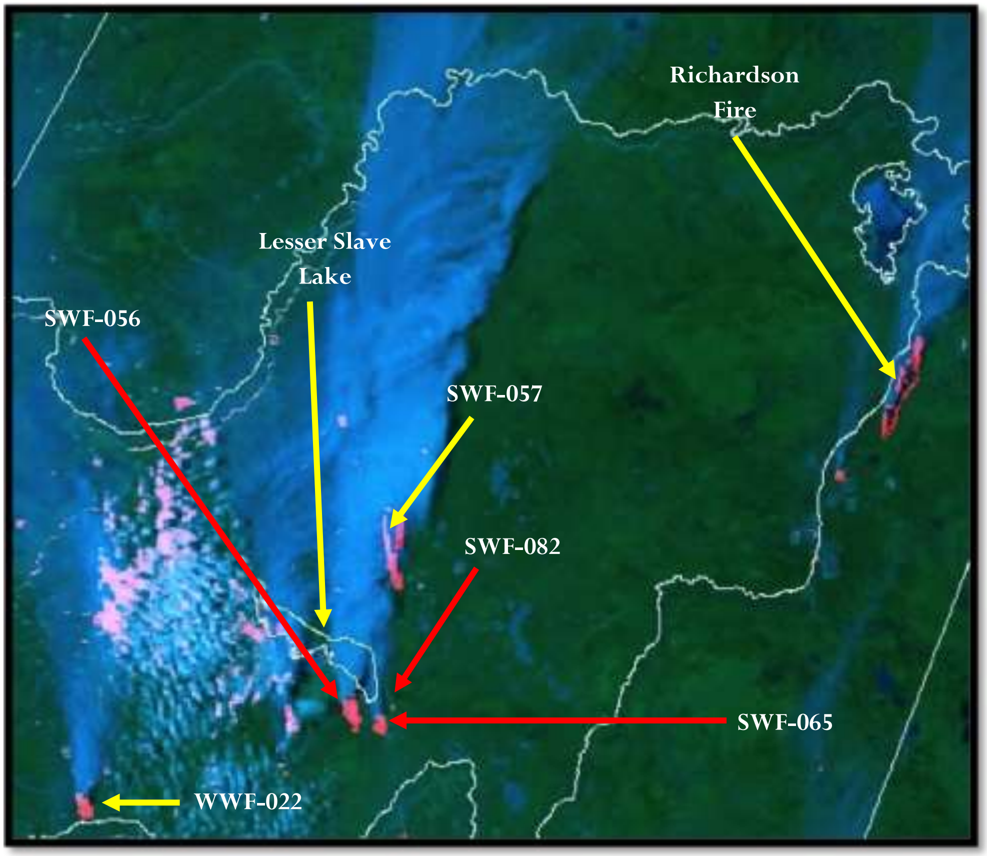


Figure 1 – Imagery of wildfires in the Whitecourt, Slave Lake, and Fort McMurray area on May 15, 2011 at 16:35, approximately one hour before structures were ignited in the Town of Slave Lake. Note the flat, strongly wind-driven smoke columns.

One of the significant factors affecting the extreme wildfire behaviour exhibited on SWF-056 and SWF-065 was the development of sustained, strong winds, often gusting above 80 kilometres per hour. This resulted in flat, wind-driven convection columns that kept smoke at low levels and produced significant downwind ember transport. This extreme spotting was the primary means by which SWF-056 and SWF-065 breached community protection barriers and ignited structures within communities. In addition, the strong winds and low-level smoke curtailed aerial suppression efforts, made monitoring of wildfire progress difficult, and threatened the safety of the public, Sustainable Resource Development wildfire resources, and other emergency responders.

Wildfire SWF-056 was discovered at 13:25 (all times are Mountain Daylight Time unless otherwise noted) on May 14, burning in a recently harvested cutblock about 25 kilometres southeast of the south shore communities (Widewater, Canyon Creek, and Wagner) adjacent to Slave Lake. Initial attack did not contain the wildfire during the afternoon and evening of May 14 because of high winds and spotting. Dozers worked on the eastern flank until 24:00 when erratic wildfire behaviour created unsafe working conditions.

On the morning of May 15, SWF-056 was behaving like a typical high-intensity spring wildfire in boreal mixedwood fuels in central Alberta, propagated by strong winds, extensive spotting, and wicking in leafless deciduous fuel types with a conifer understory. With low relative humidity levels and pre-greenup conditions, the wildfire progressed at approximately two kilometres per hour. Dozer crews with air support worked until 14:30 when conditions became unsafe because of erratic wildfire behaviour, and suppression operations were discontinued. Evacuation orders were issued for the south shore communities at approximately 12:36 and a fire-modelled projection for SWF-056 predicted that it would reach these communities at approximately 19:30. Figures 2 and 3 illustrate the convection column development above SWF-056 on May 15 and the flat, wind-driven nature of the smoke column as it crossed Highway 2.

Figure 2 – SWF-056 at 14:57, May 15 beginning a 10 kilometre run to the south shore communities of Canyon Creek and Widewater.

Figure 3 – Wind-driven convection column of SWF-056 crossing Highway 2 into south shore communities on May 15. Note the ice cap cloud above the smoke indicating violent surface combustion activity.

The rugged topography within the perimeter of SWF-056 (illustrated in Figure 4) also influenced wildfire behaviour and suppression efforts. Figure 5 illustrates how continuity of conifer fuels contributed to the two fire fronts that reached Widewater and Canyon Creek. The wildfire approached Highway 2 at 19:30 on May 15. By 20:23 the eastern front had spotted (long-range ember transport) into Widewater and structures were burning (Figure 6). The wildfire eventually moved into Canyon Creek.

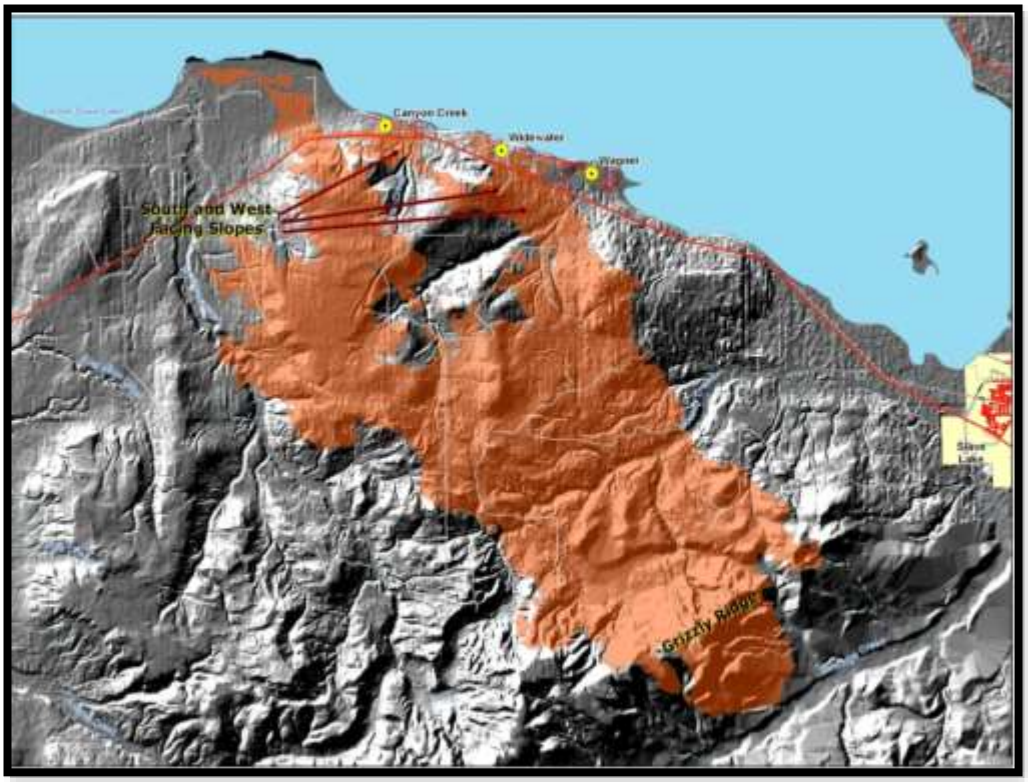


Figure 4 – Topographic map illustration for slope and aspect influence on wildfire behaviour.

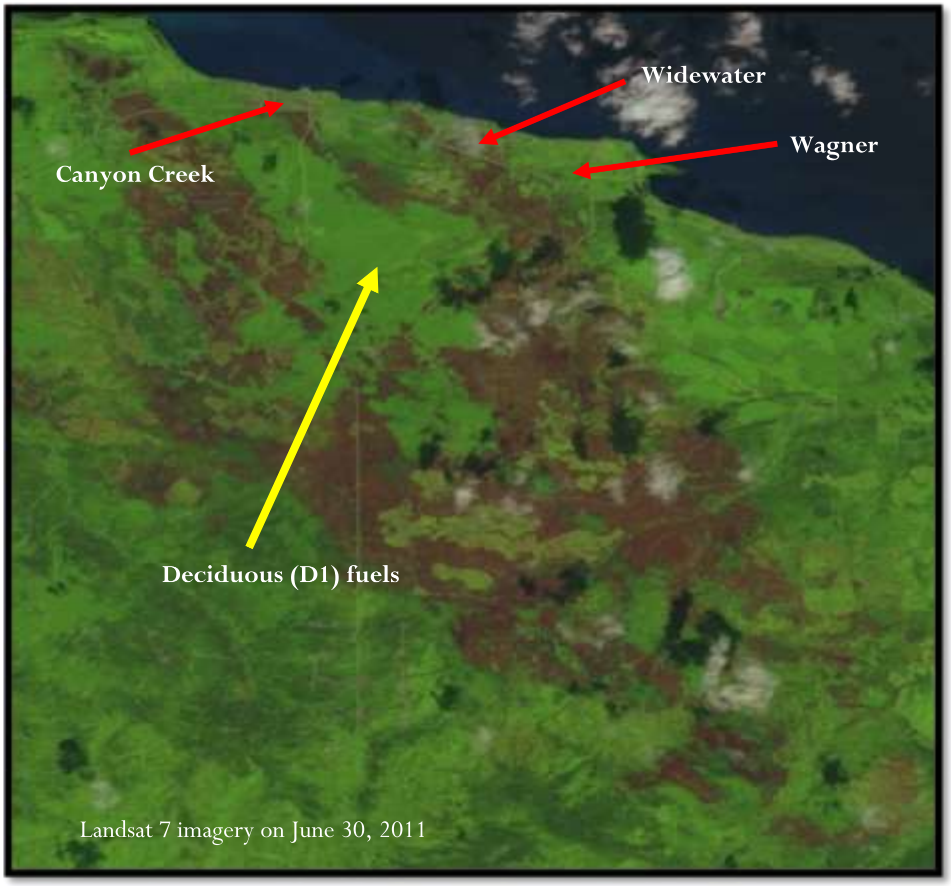


Figure 5 – Post-burn Landsat image of SWF-056 illustrating the landscape pattern of wildfire behaviour in the mixedwood (M1) fuel type as the wildfire front burned around the aspen (D1) fuel type.

Figure 6 – Aerial illustration of the wildfire's path into Widewater which followed a strip of mixedwood fuel type associated with a balsam fir understory.

Wildfire SWF-065 was detected at 17:50 on May 14, burning in mature black spruce, approximately eight kilometres southeast of the Town of Slave Lake. Initial attack began at 18:06. The wildfire crowned almost immediately under the influence of strong southeast winds, spreading quickly to the northwest spotting into Poplar Estates within an hour after ignition. SWF-065 remained active throughout the night, with the Lesser Slave Regional Fire

Service (Fire Department) and Sustainable Resource Development crews working to contain the wildfire. Safety conditions were compromised because of strong winds, unpredictable wildfire behaviour, and large amounts of anthropogenic fuels (combustibles such as structures, machinery associated with petroleum products, hay stacks, scrap piles, vehicles, fuel tanks, holiday trailers, flammable landscaping materials, rubber tires, and wood piles). Throughout the morning of May 15, SWF-065 was relatively quiet, but by early afternoon sustained strong winds generated an increase in wildfire intensity. Two distinct fingers of the wildfire developed and began moving northwest towards the Town of Slave Lake (Figures 7 and 8). The southern finger, spreading in a narrow line along Highway 2, developed more slowly, largely due to heavy airtanker activity. After air support was grounded at approximately 16:00 as a result of dangerous wind conditions, this finger spread quickly through harvesting residue and black spruce. Extremely high winds and downwind spotting resulted in the wildfire approaching the Town of Slave Lake. At approximately 17:25, extreme short-range spotting began igniting structures in the Town of Slave Lake before the wildfire reached Highway 88 (Figure 9).

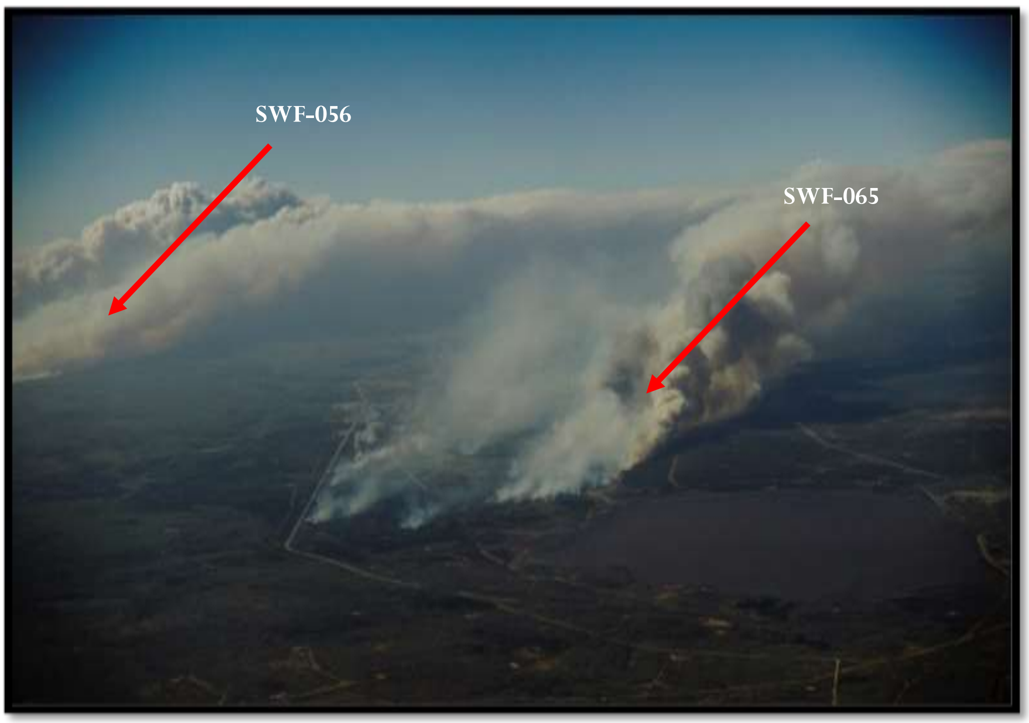


Figure 7 – SWF-056 in the background and SWF-065 in the foreground illustrating extreme wildfire behaviour on the north finger and initiation of a crown fire in black spruce along Highway 2 (May 15 at 15:53).

Figure 8 – The separation of the strongly wind-driven south and north fingers of SWF-065 at 15:57 on May 15.

Figure 9 – SWF-065 approached Highway 88 and extreme short-range spotting ignited multiple structures in the Town of Slave Lake.

A post-burn wildfire behaviour analysis of SWF-065 on May 15 identified the key factors that contributed to the extensive structural damage in Poplar Estates and the Town of Slave Lake. Wind observations at Slave Lake Airport recorded gusts up to 89 kilometres per hour, and the Deer Mountain Lookout, 12 kilometres south of the Town of Slave Lake, recorded gusts of 114 kilometres per hour at 14:00. The role of black spruce stands east of the Town of Slave Lake was significant, particularly the narrow strip east and west of the Visitor Information Centre, adjacent to Highway 2. Figure 10 illustrates the post-fire pattern of the south and north fingers of SWF-065. The north finger exhibited extreme wildfire behaviour and accounted for the majority of the area burned. The south finger ignited structures in the Town of Slave Lake approximately 40 minutes after it reached the Visitor Information Centre.

Figure 10 – Post-burn Landsat image of SWF-065 illustrating the narrow strip of black spruce adjacent to Highway 2 that the wildfire spread through before entering the Town of Slave Lake.

The black spruce strip along Highway 2 east of the Visitor Information Centre is identified in Figures 10, 11 and 12. Figure 13 is a graphic post-fire illustration of extreme wildfire behaviour in the black spruce fuel type that produced short-range spotting into the Town of Slave Lake.

Figure 11 – Post-burn illustration of the narrow strip of black spruce east of the Visitor Information Centre and adjacent to Highway 2.

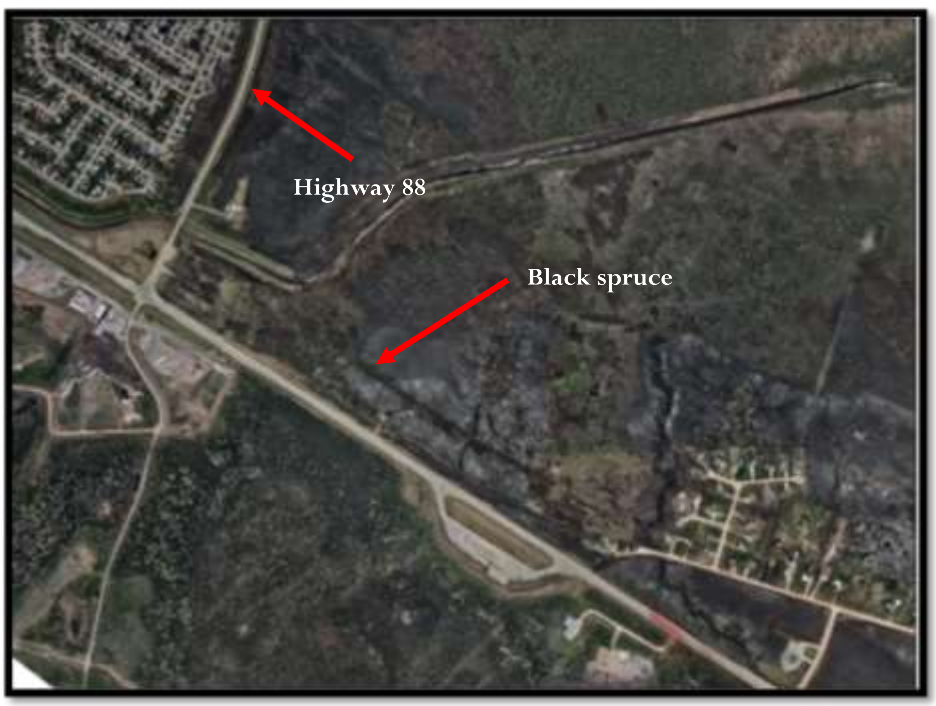


Figure 12 – Post-burn illustration of the black spruce fuel type leading from the Visitor Information Centre to Highway 88.

Figure 13 – Post-burn illustration of burn patterns in black spruce indicating extreme wildfire behaviour adjacent to Highway 88.

A detailed summary of the factors that contributed to the complexity of the wildfire situation of the Flat Top Complex is provided in the ***Wildfire Operations Documentation Report***. The following is a brief synopsis of the key factors influencing the events of May 14 and 15:

1. Wildfire environment
   - Sustained, extremely high wind speeds combined with low relative humidity quickly created receptive fuels, and high intensity crown fires developed. Low, wind-driven smoke columns and prolific downwind spotting resulted in erratic wildfire behaviour that made monitoring wildfire development challenging.
2. Resourcing
   - Alberta experienced a heavy wildfire load (activity) during mid-May which resulted in the provincial resources (manpower, equipment, and aircraft) being fully committed during this time period.
3. Air operations
   - Air operations on the Lesser Slave Area wildfires were impacted by extremely high winds that created safety issues, eventually leading to the suspension of air attack as wildfire SWF-065 advanced on the Town of Slave Lake. There were also airspace congestion issues associated with the large number of aircraft operating in a confined space between the Slave Lake Airtanker Base and the nearby wildfires.

4. **Initial and sustained attack on SWF-056 and SWF-065**
    - Initial and sustained attack operations were complicated when SWF-065 burned into Poplar Estates, resulting in Sustainable Resource Development suppression resources being used in structure protection during night-time operations.
5. **Communications**
    - The extremely high volume of air and ground radio traffic overloaded the communications system at times, which created delays in transferring wildfire behaviour and suppression operations information.

Wildfire Science Background

The behaviour of high intensity wildfires is complex and often unpredictable. Forest fire danger is a general term used to express a variety of factors in the wildfire environment, such as ease of ignition and difficulty of control. Fire danger rating systems produce qualitative and/or numeric indices of wildfire potential that are used as guidelines for a wide variety of wildfire management activities.

CANADIAN FOREST FIRE DANGER RATING SYSTEM (CFFDRS)

Canada has developed a sophisticated fire danger rating system that supports operational suppression activities throughout the wildfire season. This system has been adopted internationally by several countries with wildfire prone environments. A comprehensive description of the CFFDRS is provided in Appendix C.

The CFFDRS is a national system for rating the potential intensity and behaviour of wildfires in Canada.

The CFFDRS consists of two subsystems: the Canadian Forest Fire Weather Index System (released in the early 1970s) and the Canadian Forest Fire Behaviour Prediction System (released in the late 1980s).

1. **Canadian Forest Fire Weather Index (FWI) System**

The FWI System consists of six components that account for the effects of fuel moisture and wind on wildfire behaviour. The first three components (the fuel moisture codes) are numeric ratings of the moisture content of litter and other fine fuels, the average moisture content of loosely compacted organic layers of moderate depth, and the average moisture content of deep, compact organic layers.

- **Fine Fuel Moisture Code (FFMC)**
  The FFMC is a numeric rating of the moisture content of litter and other cured fine fuels. This code is an indicator of the relative ease of ignition and the flammability of fine fuel.

- **Duff Moisture Code (DMC)**
  The DMC is a numeric rating of the average moisture content of loosely compacted organic layers of moderate depth. This code gives an indication of fuel consumption in moderate duff layers and medium-sized woody material.
- **Drought Code (DC)**
  The DC is a numeric rating of the average moisture content of deep, compact organic layers. This code is a useful indicator of seasonal drought effects on forest fuels and the amount of smouldering in deep duff layers and large logs.

The remaining three components are fire behaviour indices, which represent the rate of fire spread, fuel available for combustion, and frontal fire intensity. The values increase as wildfire danger increases.

- **Initial Spread Index (ISI)**
  The ISI is a numeric rating of the expected rate of fire spread. It combines the effects of wind and the FFMC on rate of spread without the influence of variable quantities of fuel.
- **Buildup Index (BUI)**
  The BUI is a numeric rating of the total amount of fuel available for combustion. It combines the DMC and the DC.
- **Fire Weather Index (FWI)**
  The FWI is a numeric rating of fire intensity. It combines the ISI and BUI. It is a general index of fire danger throughout the forested areas of Canada.

Alberta adopted the FWI System in 1971 and it has been used as a decision aid in a variety of wildfire management planning and operational activities. Calculation of FWI System values commences on the third day after snow is gone at the particular recording station.

Values for the FWI System are calculated for each weather station daily at 13:00. Combined with spatial modelling of forecast wildfire behaviour, these values form the basis of wildfire preparedness planning in Alberta.

2. Canadian Forest Fire Behaviour Prediction (FBP) System

The FBP System provides quantitative estimates of potential head fire spread rate, fuel consumption, and fire intensity, as well as fire descriptions. With the aid of an elliptical wildfire growth model, it gives estimates of fire area, perimeter, perimeter growth rate, flank, and backfire behaviour. Alberta began using the FBP System operationally in the late 1980s as a decision aid in a variety of wildfire management planning and operational activities.

2011 WILDFIRE SEASON IN NORTH AMERICA

United States

The trend towards more costly and destructive wildfire seasons in the United States continued in 2011. More than 62,000 wildfires burned over 3.3 million hectares, exceeding the 10-year (2002–2011) average of 1.5 million hectares. Federal wildfire suppression costs alone, excluding state and local government costs, approached US$1.5 billion. Large areas burned in Alaska, California, Colorado, Oregon, and Utah, but the most destructive wildfires occurred in the south-central area of the country. Exceptional and prolonged drought conditions in this area resulted in record wildfire activity, particularly in Texas, Arizona, and New Mexico.

Several of the spring wildfires in the southern United States resulted in extensive evacuations and home losses, and created air quality and health issues over large areas (Figure 14).

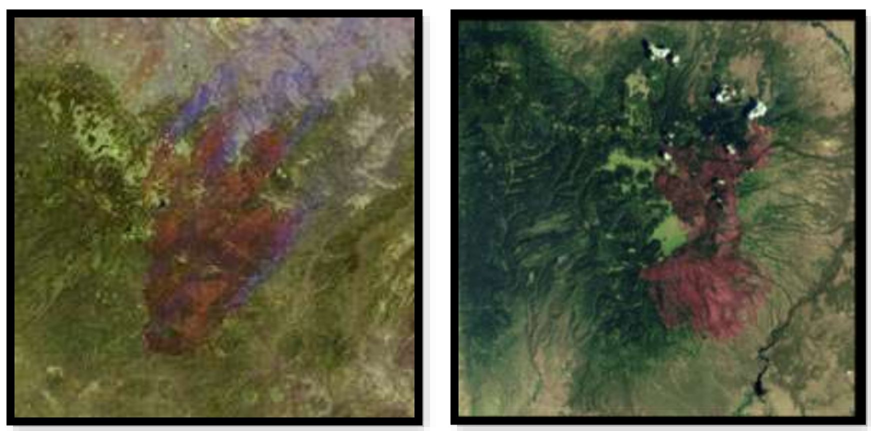


Figure 14 – Post-burn Landsat images of the Wallow wildfire (left) and the Las Conchas wildfire (right).

- The Wallow wildfire in northeastern Arizona began in late May 2011, and at that time was the largest wildfire ever recorded in Arizona. The wildfire grew rapidly and steadily over the next two weeks. It eventually burned close to 218,000 hectares across mixed forest and the wildland–urban interface landscapes, resulting in the evacuation of 6,000 people and the loss of 32 homes. Estimated suppression costs totalled approximately US$109 million.
- The Las Conchas wildfire in New Mexico started in late June 2011 and spread 20 kilometres (covering more than 17,000 hectares) in the first six hours. This wildfire eventually burned over 63,000 hectares in a mixed forest and wildland–urban interface landscape. This wildfire threatened the Los Alamos National Laboratory, burned 63 homes, and forced widespread evacuations. This became the largest wildfire in New Mexico history, costing more than US$47 million to suppress.
- Wildfires in Texas burned a record 1.01 million hectares in 2011, accounting for about 33% of the area burned in the country. Major wildfire activity in April and May was followed by even more disastrous wildfires in September. The Bastrop County

wildfire near Austin, Texas (Figure 15), destroyed close to 1,400 homes in early September. The estimated value of the timber burned by the Texas wildfires was more than US$500 million.

Figure 15 – Bastrop, Texas, wildfire burned into interface developments destroying over 1,400 homes and forcing evacuations of adjacent communities.

Canada

From a national perspective, the 2011 wildfire season was above average compared with the previous decade. The total area burned was 2.56 million hectares compared with the most recent 10-year average of approximately 1.9 million hectares. Canadian wildfire statistics are strongly influenced by the fact that about 50% of the area burned occurs in remote, northern areas where wildfires in some jurisdictions may be monitored rather than suppressed when communities are not threatened. Alberta has a full suppression policy, which involves the organization responding to all wildfires.

In 2011, area-burned statistics were dominated by the explosion of wildfire activity in northern Alberta in the spring, followed by increasing summer wildfire activity in other jurisdictions, most notably the Northwest Territories, Saskatchewan, and Ontario. This is illustrated in Table 2, which compares wildfire statistics in late May and early September 2011. Over the last 25 years, Alberta recorded the third-highest average number of wildfires nationally; however, Alberta's area burned was the seventh-highest average (Appendix D). These statistics are indicative of Sustainable Resource Development's aggressive initial attack and sustained attack programs, and the extensive limited action, monitor, and observation zones in other provinces.

	May 31, 2011 Wildfire Statistics		September 8, 2011 Wildfire Statistics	
Province	Wildfires	Hectares	Wildfires	Hectares
BC	109	372.00	537	11,943.00
YT	21	5,806.82	53	39,746.33
AB	531	442,020.29	1019	940,045.30
NT	10	9.52	205	431,926.07
SK	154	3,638.38	261	339,956.40
MB	42	93.00	269	84,309.00
ON	165	1,460.70	1116	627,083.70
QC	64	949.00	273	12,422.80
NL	17	65.60	47	402.80
NB	47	29.60	71	38.80
NS	90	128.40	115	133.22
PE	1	1.30	1	1.30
PC	12	16,650.00	61	84,663.70
Total	**1263**	**471,224.61**	**4028**	**2,572,672.42**

Table 2 – Canadian wildfire statistics by province for May 31, 2011 and September 8, 2011. Alberta's statistics are highlighted in orange. PC = Parks Canada.

The wildfire activity across Canada was below normal during the month of May (with the exception of the province of Alberta). The potential for extreme spring wildfire behaviour, however, did exist in the Northwest Territories and northern Saskatchewan where similar fire weather conditions persisted into the early summer. As Alberta's wildfire load increased and additional resources were required, the provinces of British Columbia and Ontario were able to provide assistance based on below-normal wildfire activity in those areas. Later in the summer, wildfire activity escalated in northwestern Ontario, resulting in evacuations from numerous Aboriginal communities. At that time, Alberta was able to send firefighting resources to Ontario to assist with wildfire suppression.

Recent Historical Wildfire Trends in the Lesser Slave Area

Threats to communities in the Lesser Slave Area have been relatively common over the past five decades. Both the 2001 Chisholm wildfire and the 1968 Vega wildfire occurred when forest fuels were very dry, particularly medium to heavy fuels represented by the Buildup Index (BUI). These wildfires, while occurring under high winds, were also strongly influenced by high levels of fuel consumption, resulting in strong vertically developed convection columns. In comparison, BUI and fuel consumption levels on the 2011 Flat Top Complex wildfires were much lower, but wind speeds were higher. These sustained strong winds caused extreme downwind spotting and horizontal, wind-driven columns.

The wildfire history of Alberta also indicates spring is the most volatile season in the boreal forest. The majority of the province's largest wildfires and extreme wildfire behaviour events have occurred in April and May. Large wildfires in the month of May have dominated area burned statistics in recent years in Alberta. Figure 16 shows average monthly area burned for the past 20 years, along with monthly area-burned numbers for 2011. From this figure it is evident that the large area burned in May 2011 is consistent with the 20-year trend.

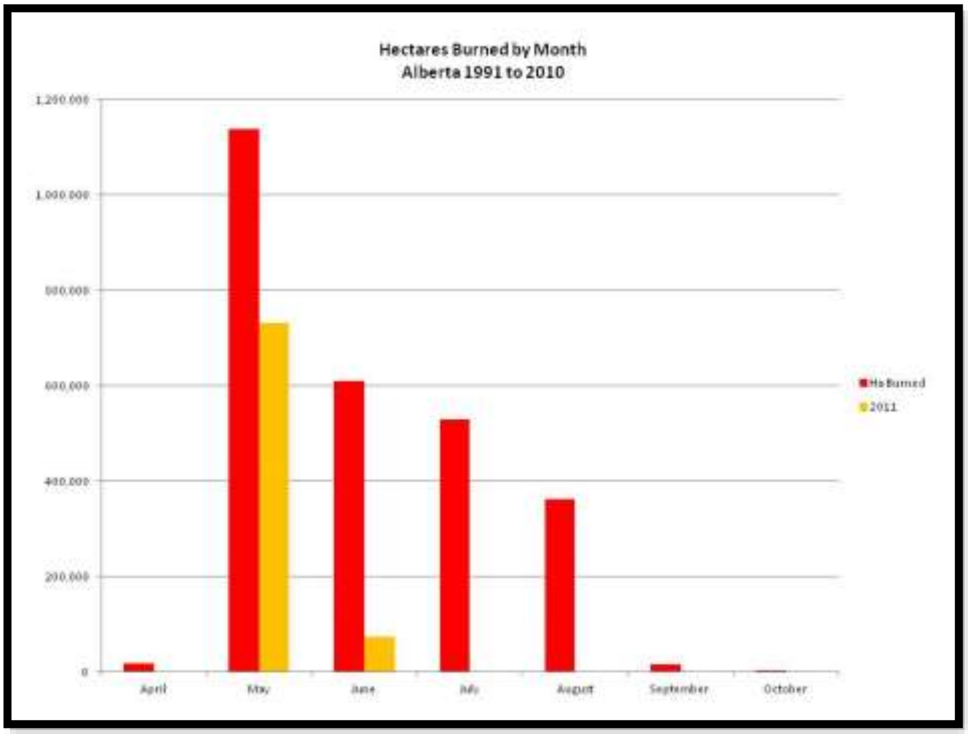


Figure 16 – Monthly wildfire area burned in Alberta from 1991 to 2010 (red) and for May and June 2011 (yellow).

A review of the wildfire weather and wildfire danger data associated with the spring events highlights the following:

- A large proportion of the total area burned occurs during a small number of burning periods (typically one to three days).
- The previous winter's precipitation is not a reliable indicator of the following spring's wildfire activity. Extreme wildfire behaviour events have occurred after winters with both below- and above-normal precipitation. Drought conditions are not a prerequisite for extreme wildfire behaviour in spring.
- Intrusion of modified arctic air masses results in very low relative humidity values frequently accompanied by significant wind speeds. These conditions may affect large-scale areas of the province, particularly in the boreal forest. These air masses often produce atypical burning periods with active wildfire behaviour outside the normal daily cycle.
- Very low relative humidity values can generate extreme flammability in fine fuels under relatively low temperature conditions, especially prior to vegetation greenup. Major wildfires have occurred under well-below normal temperatures. The 2002 House River wildfire is the second largest in recent history. This wildfire spread during the coldest spring on record in central Alberta (major spread in mid-May occurred

with a temperature of 13 ◦C and 13% relative humidity), demonstrating that temperature is not always an essential factor in wildfire growth.

- Long-term data from weather stations in the boreal forest show average wind speeds are generally highest in spring. Greater contrasts between air masses typically occur in April and May. Strong wind events under low relative humidity conditions provide a wildfire environment supportive of extreme wildfire behaviour when concurrent with a lack of recent precipitation.
- Long periods of daylight are observed at high latitudes in the spring. For example, the length of daylight was about 16 hours on May 15 at Slave Lake.

Several of these factors occurred during the Flat Top Complex during May 14 and May 15.

Over the past four decades there have been a number of significant wildfires in close proximity to communities in the Lesser Slave Area (Figure 17). The following provides a brief summary of the most notable characteristics of these wildfires, illustrating the extreme wildfire conditions that have occurred in this area.

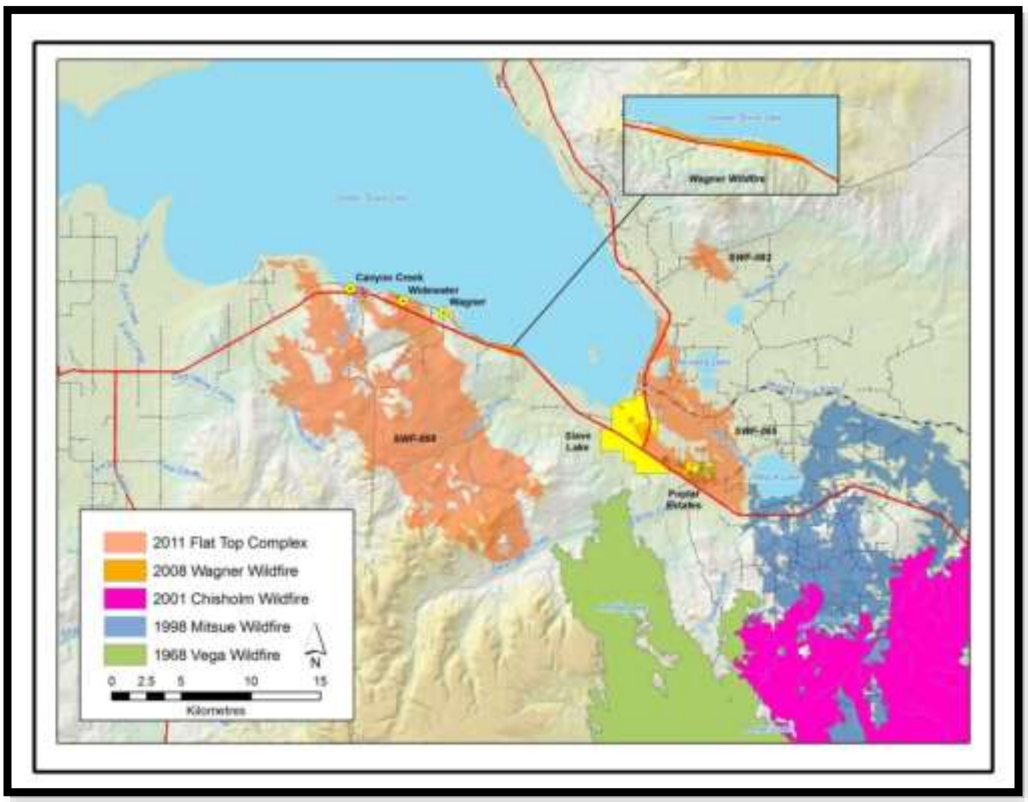


Figure 17 – Historic wildfire activity in the Lesser Slave Area from 1960 to 2011.

1968 VEGA WILDFIRE

In the third week of May 1968, a large outbreak of wildfires in central Alberta burned over 364,000 hectares. These wildfires followed a dry fall, below-normal overwinter precipitation, a period of low relative humidity, above-normal temperatures, and strong, persistent southerly winds. Wildfire danger conditions were elevated across the Lesser Slave Area during this period, with the BUI, Initial Spread Index (ISI), and Fire Weather Index (FWI) components of the FWI System all at extreme levels (Table 3). The human-caused Vega wildfire burned over 133,550 hectares (Figure 18) and ran 60 kilometres towards Slave Lake during the afternoon and evening of May 23, 1968, with an unprecedented average spread rate of six kilometres per hour. Upper air measurements showed the presence of a low-level jet in the wildfire area, a factor which contributed to the extremely fast growth on May 23. The wildfire stopped just south of the Town of Slave Lake as a result of lower overnight winds and an influx of cool moist air the following day.

Station	Temp. (°C)	RH (%)	Wind Direction	Wind Speed (km/hr)	FFMC	DMC	DC	ISI	BUI	FWI
Flat Top	16	19	SE	28	93	41	116	27	43	40

Table 3 – Weather and Fire Weather Index System values for the Flat Top Lookout on May 23, 1968.

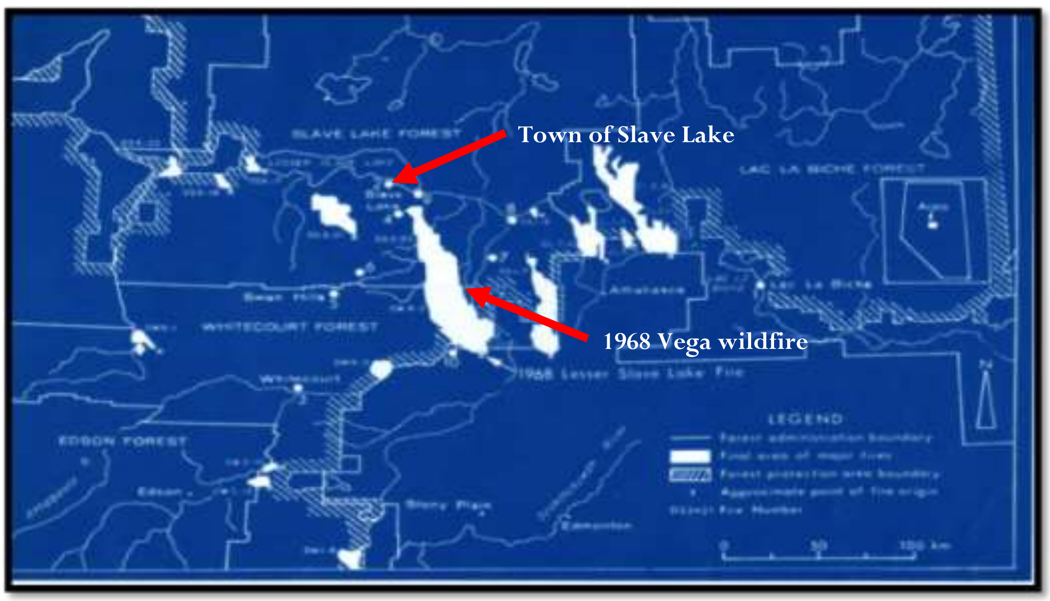


Figure 18 – Location and final area of the 1968 Vega wildfire and of other major wildfires in central Alberta during May 1968.

1998 MITSUE WILDFIRE

Following normal fall and overwinter precipitation in 1997/98, the human-caused Mitsue wildfire (east of Slave Lake) started on May 2 and burned over 49,670 hectares south of Mitsue Lake. Warm temperatures and low humidity levels, combined with strong winds of 20–30 kilometres per hour, created significant dryness in fine fuels, with high wildfire danger conditions overall (Table 4). The combination of suppression efforts by Alberta Environment and the wind direction from the northwest prevented the wildfire from threatening communities around Slave Lake. A number of log decks in the Mitsue industrial section were burned during the wildfire event and mill facilities were threatened.

Station	Temp. (ºC)	RH (%)	Wind Direction	Wind Speed (km/hr)	FFMC	DMC	DC	ISI	BUI	FWI
Flat Top	22	22	NW	20	93	27	53	8.6	27	14

Table 4 – Weather and Fire Weather Index System values for the Flat Top Lookout on May 2, 1998.

2001 CHISHOLM WILDFIRE

Following a winter with below-normal precipitation and an early and warm spring, forest fuels in the Lesser Slave Area were exceptionally dry in the spring of 2001. The human-caused Chisholm wildfire started on May 23, 2001 and eventually burned over 116,000 hectares destroying ten homes and numerous outbuildings in the hamlet of Chisholm (Figure 19). On May 27 and 28, this wildfire ran 35 kilometres northwest towards the Town of Slave Lake and by May 31 was within eight kilometres of the town. Extreme wildfire danger conditions (Table 5), along with very dry fuel conditions, resulted in unprecedented wildfire behaviour with rapid rates of spread, continuous crown fire activity, medium- to long-range spotting, and the development of major fire whirl. The wildfire intensity levels resulted in the development of a towering convection column reaching 15 kilometres in height that injected smoke particulates into the lower stratosphere. The wildfire stopped short of the Town of Slave Lake due to a combination of suppression efforts by Sustainable Resource Development (previously Alberta Environment), changing weather conditions, and burning into younger fuel types created by the 1968 Vega and 1998 Mitsue wildfires (Figure 20).

Figure 19 – Chisholm community looking north after May 28.

Figure 20 – Map of historical wildfire activity in the area including the 2001 Chisholm wildfire

Station	Temp (ºC)	RH (%)	Wind Direction	Wind Speed (km/hr)	FFMC	DMC	DC	ISI	BUI	FWI
Flat Top	26	26	SE	49 Gusting to 77	93	48	228	72	63	87

Table 5 – Weather and Fire Weather Index System values for the Flat Top Lookout on May 28, 2000.

2008 WAGNER WILDFIRE

Spring conditions in 2008 were similar to those in 1998. The human-caused Wagner wildfire started on May 15. Strong winds pushed the wildfire into the communities of Widewater and Wagner leading to the evacuation of residents. Temperatures were seasonal, with relatively high humidity levels and wind speeds of 30–40 kilometres per hour. Fine fuels were dry but BUI levels were still low, resulting in generally high wildfire danger conditions (Table 6). Forest fuels were primarily mixedwood stands dominated by older poplar, heavy grass, and herbaceous plants that were 100% cured. The wildfire burned a total of 143 hectares and was stopped primarily as a result of the suppression efforts of Sustainable Resource Development and the Municipal District of Lesser Slave River.

Station	Temp. (^{o}C)	RH (%)	Wind Direction	Wind Speed (km/hr)	FFMC	DMC	DC	ISI	BUI	FWI
Flat Top	19	48	NW	29 Gusting 53	87	18	57	12.8	21	17

Table 6 – Weather and Fire Weather Index System values for the Flat Top Lookout on May 15, 2008.

2011 FLAT TOP COMPLEX

On May 15, 2011 a wildfire (SWF-065) driven by an extreme wind event ran eight kilometres and created an urban fire storm that eventually destroyed one quarter of the Town of Slave Lake in addition to impacting the adjacent residential development in Poplar Estates. A second wildfire (SWF-056) ran 12 kilometres and burned west of the Town of Slave Lake impacting the communities of Widewater and Canyon Creek. A third wildfire (SWF-082) occurred 14 kilometres north of Slave Lake. These three wildfires were managed as the Flat Top Complex.

Unlike the 1968 Vega and 2001 Chisholm wildfires that followed extended dry periods with below-normal precipitation amounts and early, warm springs (Table 7), the 2011 wildfires in the Lesser Slave Area followed normal- to above-normal overwinter precipitation amounts and occurred within a week of snowmelt, when medium-to-heavy fuels were still relatively wet. Starting spring Drought Code (DC) values indicated long-term moisture conditions were not at drought levels. With the exception of January, temperatures through the winter and spring were well below normal.

Unprecedented sustained southeast winds and low relative humidity levels during the second week of May created optimum conditions for firebrand spotting.

Downwind spotting was one of the major contributing factors to wildfires SWF-056 and SWF-065 burning into communities (Canyon Creek, Widewater, Poplar Estates, and the Town of Slave Lake) (Figure 21).

Figure 21 – Wildfire burned into Widewater and Canyon Creek on May 15, 2011 driven by strong southeast winds.

The Flat Top Lookout weather station commenced fire weather calculations on May 12, following the disappearance of snow cover. Sustained average wind values for this station were unprecedented for a five-day period prior to SWF-056 and SWF-065 burning into community developments. These strong, dry, southeast winds supported extreme wildfire behaviour on May 15 with the highest wind speeds recorded (114 kilometres per hour at the Deer Mountain Lookout) at 14:00. During the major wildfire run, temperatures were normal for mid-May; however, minimum relative humidity values were in the 15–20% range.

Station	Temp. (°C)	RH (%)	Wind Direction	Wind Speed (km/hr)	FFMC	DMC	DC	ISI	BUI	FWI
Flat Top	14	29	SE	58 Gusting 84	90	15	193	80	26	64

Table 7 – Weather and Fire Weather Index System values for the Flat Top Lookout on May 15, 2011.

Medium-to-heavy fuels were drier during the Vega and Chisholm wildfires. A higher level of fuel consumption, along with higher rates of spread, contributed to extremely high intensity levels and the development of towering convection columns. By comparison, the 2011 Flat Top Complex included wind-driven wildfires with lower fuel consumption levels, resulting in relatively flat convection columns and prolific downwind spotting (Table 8).

Values	Flat Top Wildfire	Chisholm Wildfire	Vega Wildfire
ISI	80	72	27
Rate of Spread (km/hr)	2	4.5–6	6
Head Fire Intensity (kW/m)	30,000	225,000	137,000

Table 8 – 2011 Initial Spread Index (ISI), Rate of Spread, and Head Fire Intensity values comparing two of the Flat Top Complex wildfires (SWF-056 and SWF-065) with the 2001 Chisholm wildfire and 1968 Vega wildfire.

2011 RICHARDSON WILDFIRE

The Richardson wildfire in northeastern Alberta started about the same time as the wildfires in the Flat Top Complex, under similar environmental factors. The Richardson wildfire became the largest Alberta wildfire in modern history, burning approximately 577,647 hectares.

A brief discussion of the Richardson wildfire is included in the *Flat Top Complex Wildfire Operations Documentation Report*.

WEATHER CONDITIONS FOR THE FLAT TOP COMPLEX

2010–2011 Fall and Winter Weather Conditions

Alberta experienced a generally cold winter with normal to well-above-normal snowfall recorded in much of the province. Average monthly temperatures in central Alberta and the Lesser Slave Area (Table 9) were mostly below normal, with the exception of January.

Month	Climatic Normal Temperature (°C)	Mean Temperature (2010/11) (°C)	Temperature Anomaly (°C)
November	-6.1	-6.5	-0.4
December	-12.9	-15.9	-3.0
January	-14.5	-13.6	0.9
February	-11.7	-12.3	-0.6
March	-4.7	-9.4	-4.7
April	3.3	1.6	-1.7

Table 9 – Lesser Slave Area monthly temperature anomaly from November 2010 to April 2011. The climatic normal monthly temperature is the average monthly temperature for 1971–2000 (average of the maximum and minimum temperatures for each day in that month).

The Flat Top Lookout showed precipitation was well distributed temporally throughout the winter with normal precipitation totals recorded in the Lesser Slave Area (Figures 22); several stations in the Swan Hills forecast zone recorded over 200% of normal winter precipitation.

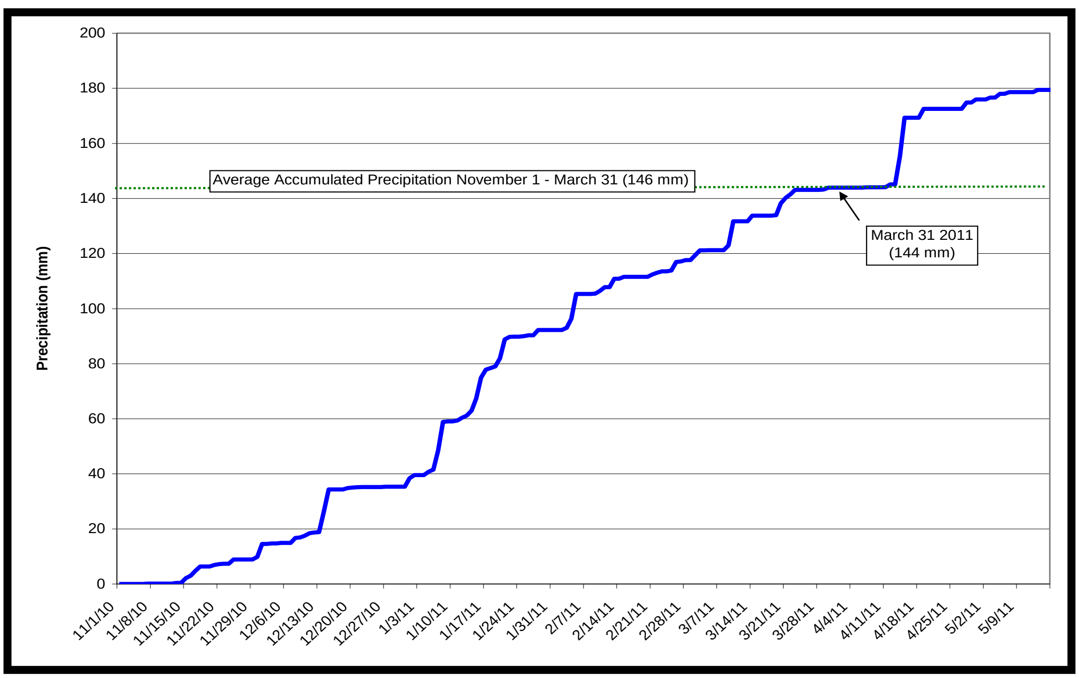


Figure 22 – Total accumulated precipitation for Flat Top Lookout from November 1, 2010 to May 15, 2011 from the Alberta Environment and Water Monitoring station.

Early May 2011 Spring Moisture Conditions

Starting DC values in the spring are determined by adjusting the final calculated values from the previous fall, according to the amount of effective overwinter precipitation. The 2010 fall DC values in the Lesser Slave Area were well below normal indicating no significant seasonal moisture deficit was evident at the end of the 2010 wildfire season.

The starting DC values for April 1, 2011 generally reflected the moist fall conditions and normal to above-normal overwinter precipitation in the Lesser Slave Area (Figure 23). On May 13, BUI and DC values remained low (Figure 24) while ISI and FFMC values were trending high to extreme as a result of strong, dry winds.

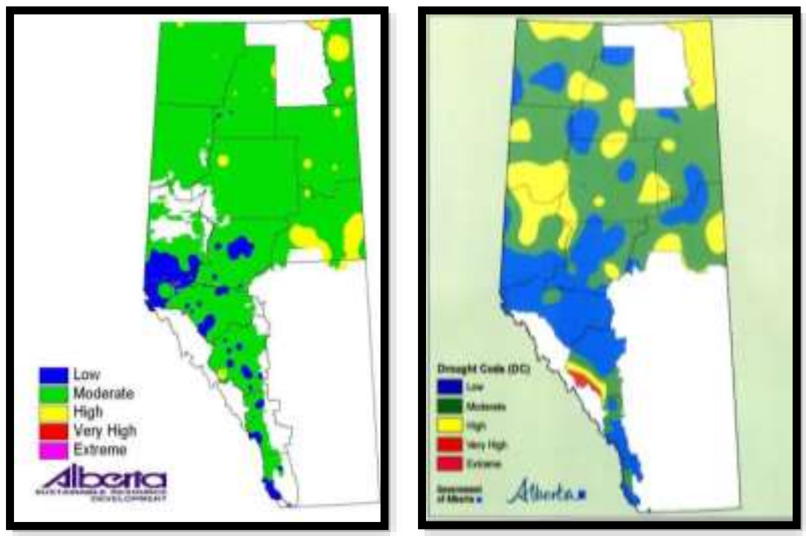


Figure 23 – Long-term average starting Drought Code values (left), starting Drought Code values for April 1, 2011 (right).

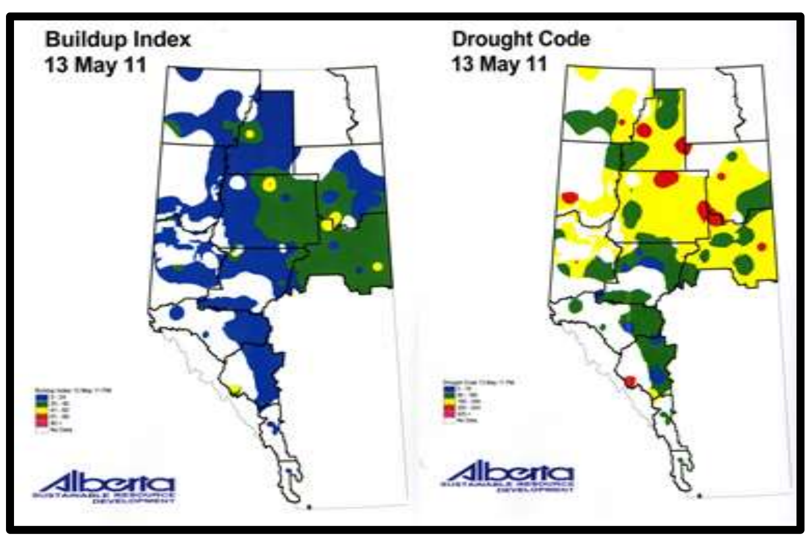


Figure 24 – Buildup Index (left) and Drought Code values (right) for May 13, 2011.

Given the lower-than-normal temperatures in April that persisted into early May, as well as the deep snowpacks over central and northern boreal areas of the province, this area experienced a slower-than-typical snowmelt (Figure 25). Consequently, many areas were not required to calculate wildfire danger codes and index values until the second week of May when snow cover disappeared. An extensive area of northern Alberta remained snow-covered until mid-May. Flat Top Lookout reported snow-free conditions on May 9 and began wildfire danger calculations three days later (May 12).

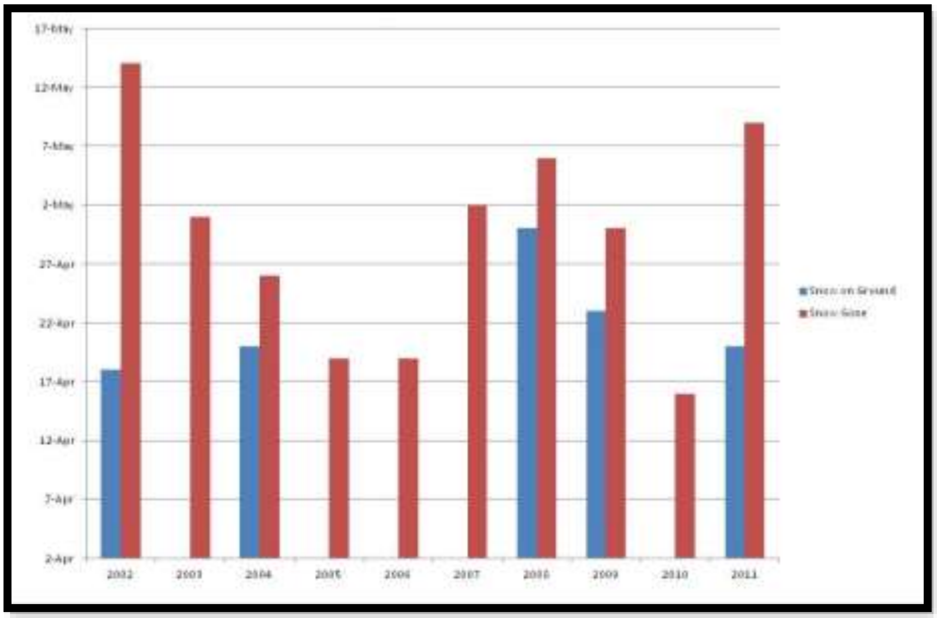


Figure 25 – Reported snow conditions for Flat Top Lookout from 2002 to 2011. The transition from snow on ground to snow gone (no snow patches observed within a 1 kilometre radius around a weather station) is the melting period.

FOLIAR MOISTURE CONTENT

Foliar moisture content has an important influence on wildfire behaviour in coniferous fuel types and reaches its lowest point in mid- to late-spring due to the phenological state of the trees (seasonal phases of tree development). The dates of minimum foliar moisture content are dependent on latitude, elevation, and weather conditions. Low foliar moisture content increases the potential for crown fire development and rapid rates of spread.

Foliar moisture measurements were not taken during the Flat Top Complex; however, latitude and elevation models from the CFFDRS suggests the dates for minimum foliar moisture content in conifers is approximately June 10 for Slave Lake and June 19 for Marten Hills Lookout.

GREENUP

Greenup stages (in which fuels move from dry, brown, and cured to green and lush) are important indicators of ignition and wildfire behaviour potential. The following greenup stages are reported as part of the wildfire weather observation process:

- Grass greenup stage
- Deciduous leaf-out
- Coniferous needle flush

Sustainable Resource Development weather observers noted the grass was 90% cured in the Flat Top Complex area, indicating easy ignition from any source and rapid rates of spread (Figure 26). Rate of spread and wildfire intensity are closely related to the percentage of cured in grass fuels. Significant wildfire spread in grass is generally not supported at less than 50% cured. The grass greenup stage was typical for the location and time of year (Figure 27).

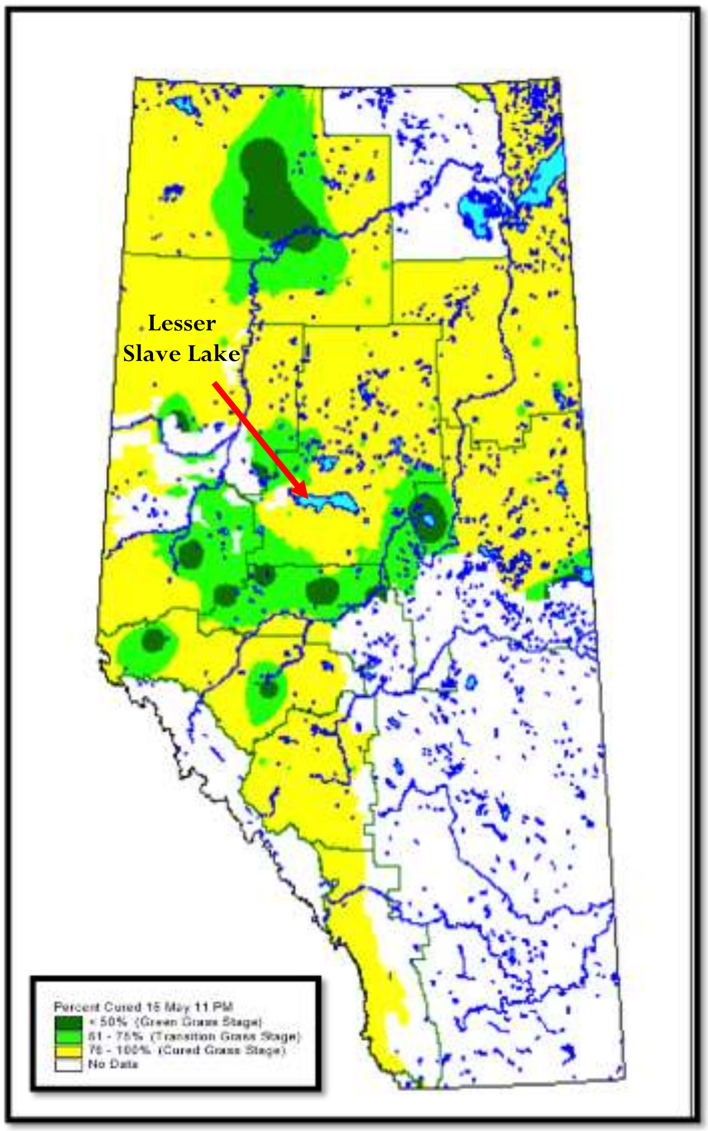


Figure 26 – Grass greenup stage in Alberta on May 16.

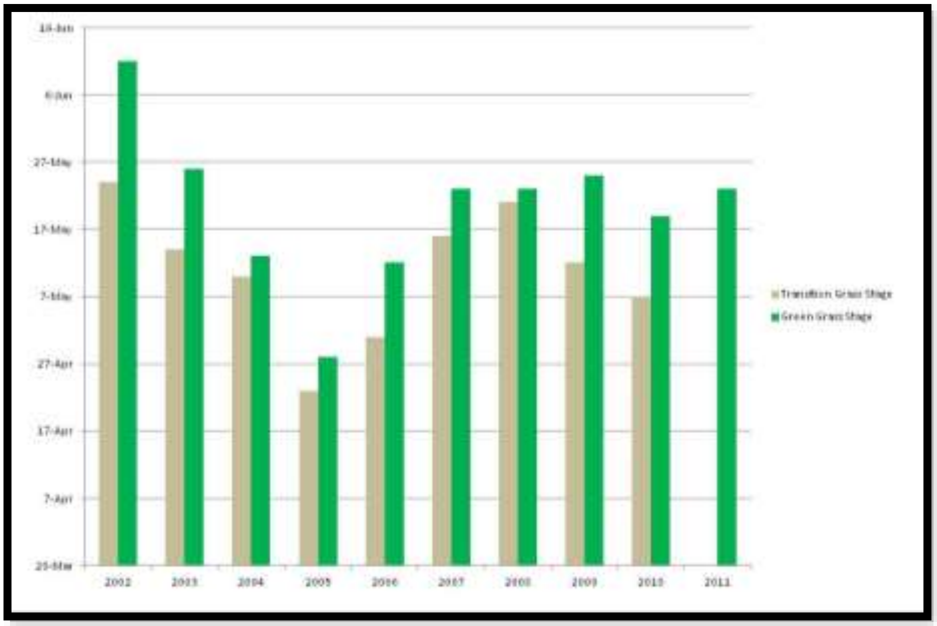


Figure 27 – Historical grass greenup stage dates for Flat Top Lookout from 2002 to 2011. Note the transition grass stage includes 51–75% cured grass, and the green grass stage includes less than 50% cured grass.

Deciduous leaf-out had just commenced during the Flat Top Complex wildfire events. Varying with elevation, deciduous species were between the open bud and leaf-out stages. These stages were typical for the location and time of year (Figure 28). Surface fuels, grasses, and other vegetation (herbs and forbs) were exposed to sunlight and wind, making them more susceptible to ignition and rapid wildfire spread.

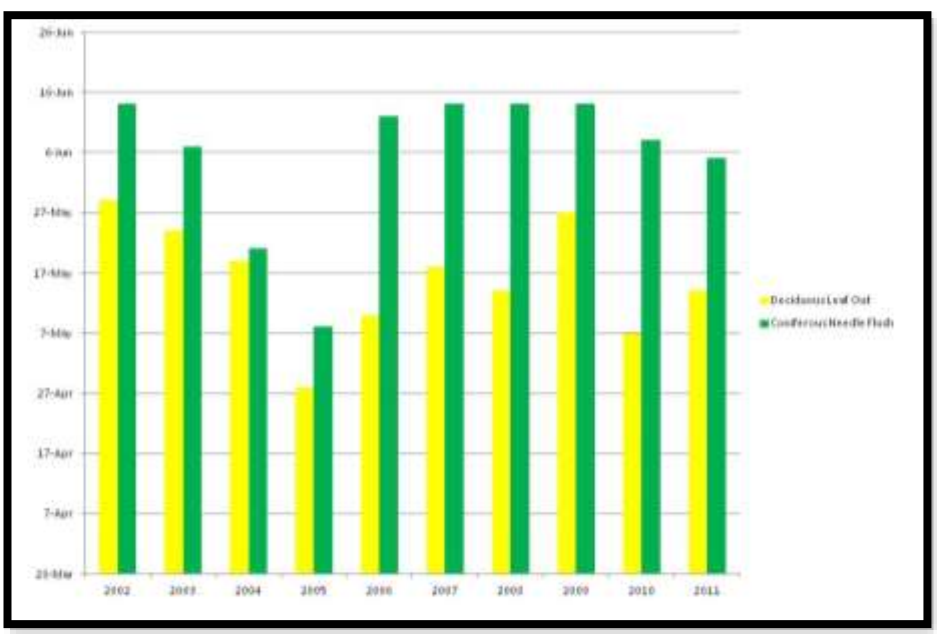


Figure 28 – Reported leaf-out and needle flush at Flat Top Lookout from 2002 to 2011.

Weather Conditions from May 10 to May 13

The start of the weather conditions that led to the wildfire outbreak and extreme wildfire behaviour events of May 14 and May 15 coincided with the development of an upper and surface ridge over eastern Alberta and Saskatchewan on May 10. The ridge continued to build over the next two days and by May 12 had acquired the characteristics of a closed blocking or quasi-stationary upper level high pressure system. A deep and very cold upper low also became anchored along the coast of British Columbia, generating a strong temperature and pressure gradient through a deep layer of the atmosphere across eastern British Columbia and western Alberta. This upper level pattern is generally conducive to the development of deep surface low pressure systems over the interior of British Columbia and strong surface pressure gradients across Alberta (Figure 29). The Provincial Forest Fire Centre's Weather Section (Appendix E) created forecast surface weather maps during the entire Flat Top Complex wildfire event (Appendix F)

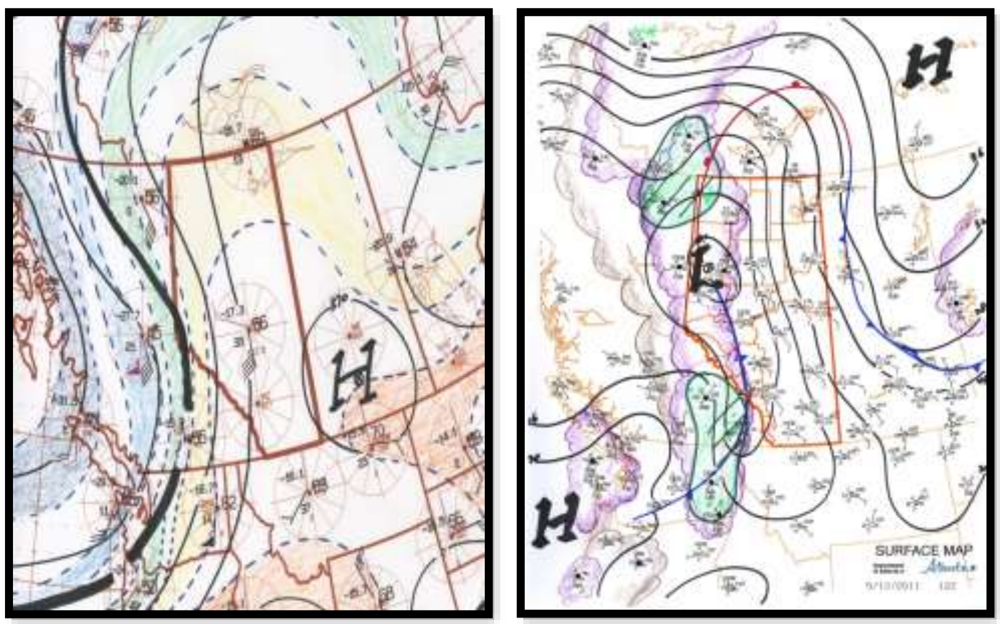


Figure 29 – Sustainable Resource Development 500 hectoPascals (left) and surface analyses at 06:00 on May 12, 2011 (right).

From May 11 to May 13, temperatures began to recover to near-normal values (Appendices G, H, I, and J) and snowmelt progressed rapidly in central Alberta. Relative humidity values in the 30% range increased drying of fine- and medium-weight fuels. Strong southeast winds of 30 kilometres per hour, with gusts of 50 to 60 kilometres per hour, affected central and eastern areas of the province.

One of the critical wildfire weather aspects of this upper level pattern is the potential intrusion of modified arctic air southward along the eastern flank of the upper ridge into the southern Prairies. These air masses are generally very dry in early spring with dew point values below the freezing mark. As this arctic air travels south it begins to warm and relative humidity values fall significantly. This dry and very stable air can then be drawn northward into Alberta as low pressure systems develop in eastern British Columbia. The presence of very low dew point temperatures (-8 °C to -11 °C) over northern Saskatchewan and Manitoba were evident on May 11. By May 13 the evolving circulation across the Prairies indicated the potential for an influx of this type of air mass into the province, triggering the development of an even drier and stronger southeasterly flow over most of Alberta. Consequently, a Fire Weather Advisory was issued by Sustainable Resource Development on the morning of May 13 for provincial forecast zones east of the fifth meridian (100 kilometres east of the Town of Slave Lake) for the May 14 and May 15 burning periods (Figure 30).

Government of Alberta

Wildfire Management Branch Forecast Issued:

Date: Friday, May 13, 2011

AM Forecast - 1100

Fire Weather

Fire Weather Advisory

Exceptionally low relative humidity values and strong southeast winds will give very easy burning conditions for zones east of the fifth during Saturday and Sunday's burning period. Caution is advised in all operations. Flashy fuels will become extremely flammable.

The cold front that moved into the western boreal section through yesterday has now weakened and lies from High Level to western Fort McMurray. Southeast winds (20 gusting 40 kilometres per hour) will persist across the eastern boreal sections today but winds will diminish to light southeast elsewhere. Relative humidity values will continue in the 25-30% range over the eastern boreal sections and the Grande Prairie zone. Relative humidity values between 35-40% elsewhere.

Very strong southeast winds will develop during Saturday's burning period as extremely low relative humidity values develop over zones east of the fifth. Cross over conditions are forecast as Initial Spread Index/Fine Fuel Moisture Code values trend into the extreme range. Caution is advised near flashy fuels. The airmass will remain stable across all zones.

Figure 30 – Sustainable Resource Development Fire Weather Advisory and forecast issued at 11:00 on May 13, 2011.

Weather Conditions on May 14 and May 15

The Fire Weather Advisory forecast for May 14 and 15 provided initial indications that the low pressure system and cold front near the border between Alberta and British Columbia was beginning to push slowly eastward. This eastward drift of the low pressure system maintained or increased the pressure gradient supporting strong southeast winds over Alberta during May 14 and 15 (Figure 31).

The influx of very dry modified arctic air into central and eastern Alberta during May 14 and 15 (Appendix F) in conjunction with strong southeast winds, generated FFMC conditions highly conducive to wildfire ignition and very high rates of spread.

The communities around Slave Lake are located between the northeastern edge of Swan Hills and the southern edge of the Marten Hills forecast zones. The Flat Top Lookout elevation is 1030 metres; the Marten Hills Lookout elevation is 1000 metres, and the Slave Lake Airport elevation is 583 metres. The association of the Swan Hills, Marten Hills, and the large lake adjacent to communities, influences both wind speed and direction. A valley effect from the Athabasca River to Slave Lake deflects easterly winds into the southeast quadrant and also amplifies wind velocities (Figure 32). Three weather stations (S1-Salteaux, S2-Marten Hills, and S4-Kinuso) in close proximity to the Flat Top Complex and the Slave Lake Airport automatic weather station provided detailed hourly records of the fire weather environment during the event.

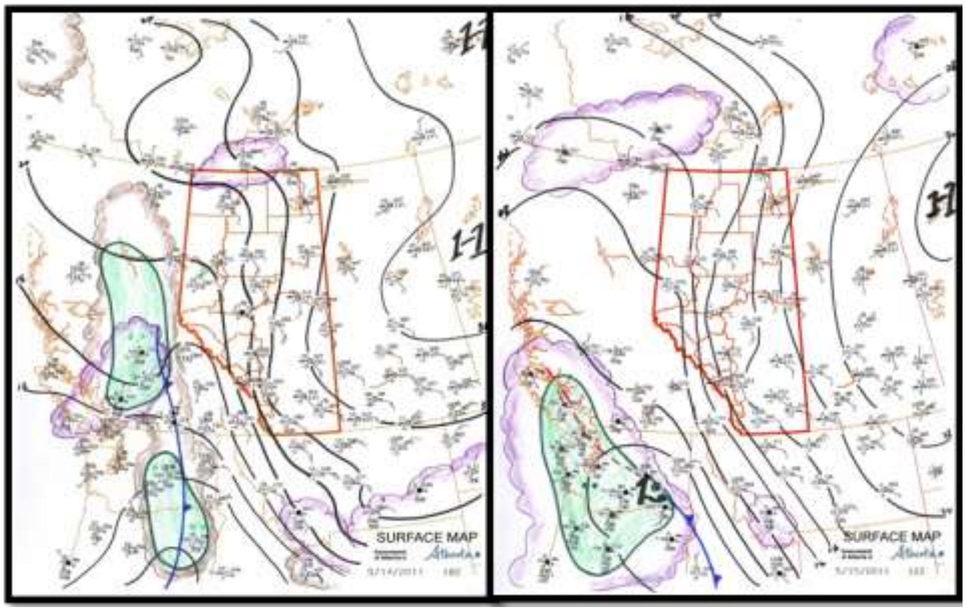


Figure 31 – Surface weather maps for 12:00 on May 14 (left) and 06:00 on May 15 (right).

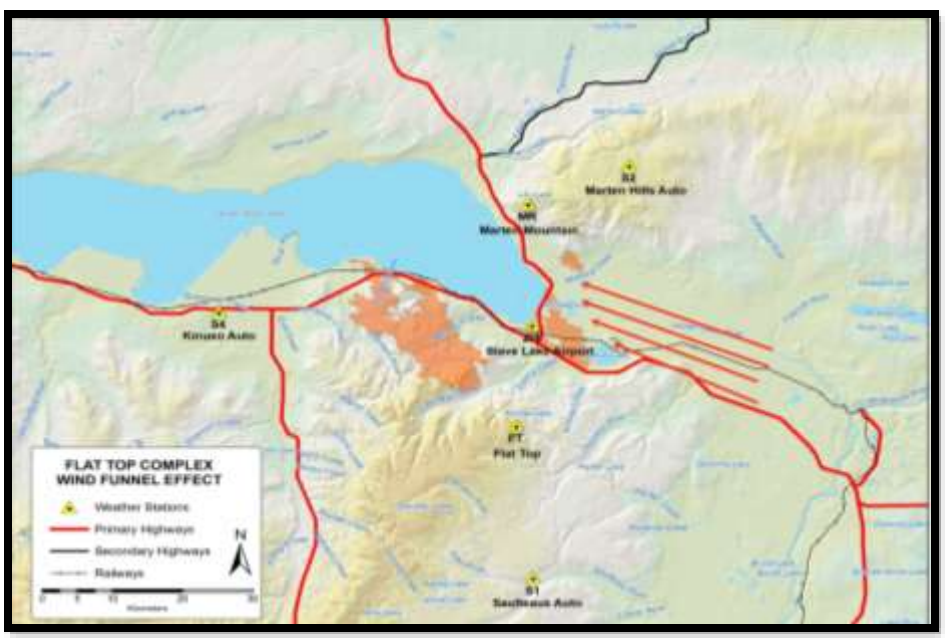


Figure 32 – Weather station locations and topographical wind "funnel" effect illustrated at Slave Lake Airport and Flat Top Lookout.

Wind gusts are common at Slave Lake, with the majority being from the west or northwest. Twelve cases of wind gusts over 80 kilometres per hour have been recorded since 1971; of those, five events were from the southeast. Wind direction during periods of high wildfire danger in spring at Slave Lake is predominantly southeast or northwest. Figures 33 and 34 illustrate the sustained wind speeds at the Flat Top Lookout for May 11 to May 15, 2011 compared with historical observations of high wind speeds over consecutive days since 1974. The previous record for high sustained winds occurred in 2008 on May 26 (19 kilometres per hour), May 27 (33 kilometres per hour), and May 28 (31 kilometres per hour). Sustained wind speeds in 2011 exceeded these values on four of five consecutive days:

- May 11 (39 kilometres per hour)
- May 12 (34 kilometres per hour)
- May 13 (9 kilometres per hour)
- May 14 (47 kilometres per hour)
- May 15 (58 kilometres per hour)

The channelling influence of the local topography in the Slave Lake area is reflected in the comparison of wind rose data (a chart that shows predominant wind direction and speed) for the Slave Lake Airport and the Kinuso weather station (Figure 35). Additional wind rose data for Salteaux, Marten Hills, and Kinuso weather stations, and the Marten Mountain and Flat Top lookouts can be found in Appendix K.

During the afternoon of May 15, the combination of the topographic effect and the influence of the large surface area of Lesser Slave Lake were evident from satellite imagery. The wind velocities in the Mitsue/Slave Lake “valley” were higher than in surrounding areas. The smoke was drifting from the southeast until influenced by the lake surface west of the Town of Slave Lake. The smoke columns from SWF-056, SWF-057 (south of Red Earth), SWF-065, and SWF-082 seemed to merge and move in a more northerly direction, possibly as a result of the topography and lake location.

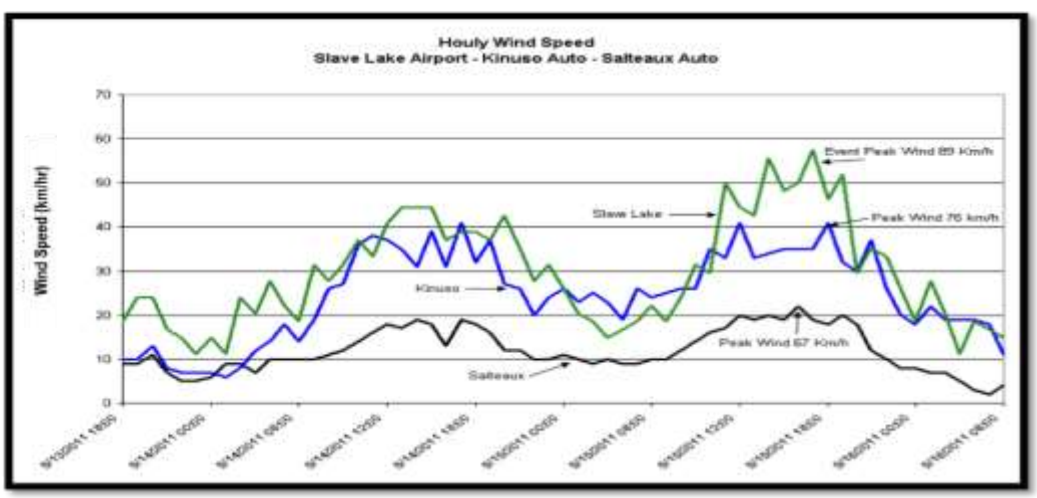


Figure 33 – Hourly wind speeds with peak gusts for Slave Lake Airport, as well as Salteaux and Kinuso weather stations.

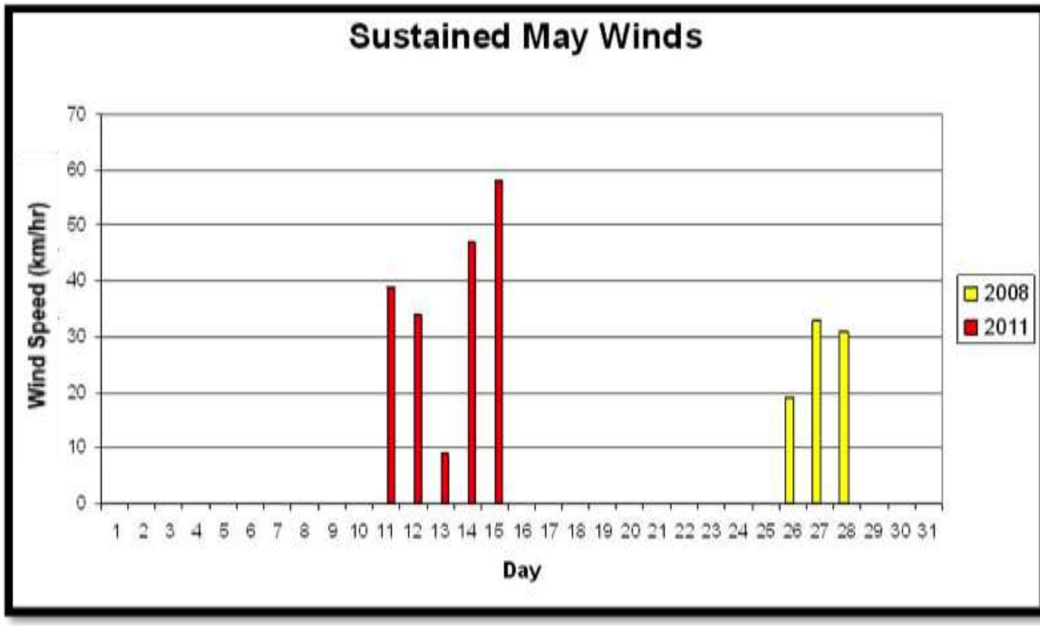


Figure 34 – An illustration of sustained May wind speeds at the Flat Top Lookout for May 11–15, 2011; from 1974 to 2010 only one year (2008) had two consecutive days over 30 kilometres per hour.

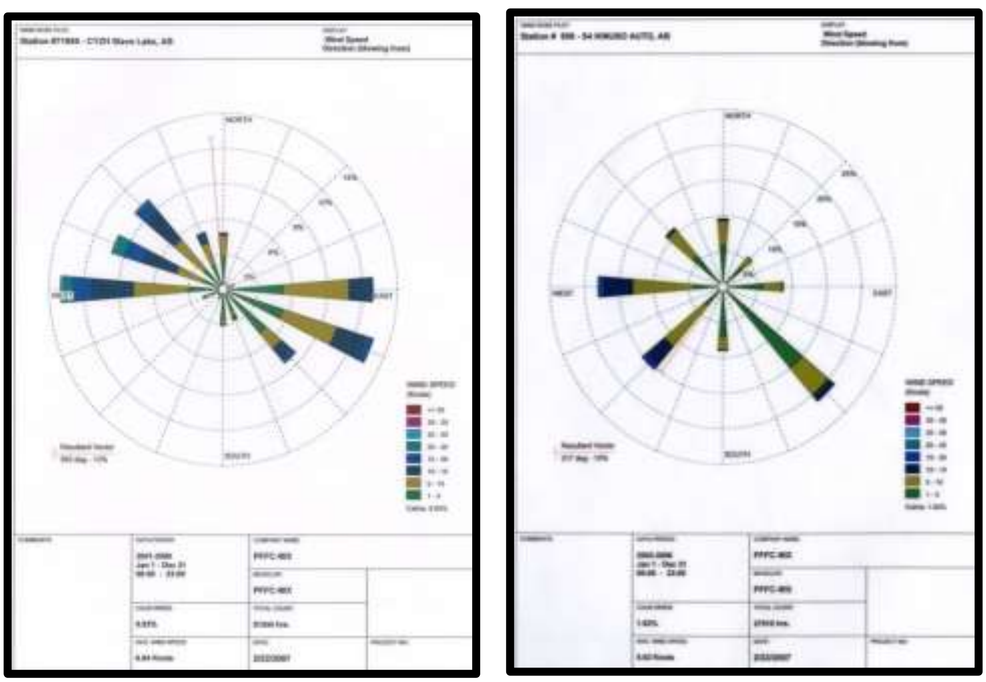


Figure 35– Wind rose for Kinuso between 00:00 and 23:00 from January 1 to December 31, 2003–2006 (left) and Slave Lake Airport between 00:00 and 23:00 from January 1 to December 31, 2001– 2006 (right). The average hourly wind speed at the airport weather station was calculated at 12.8 knots (~24 kilometres per hour), and predominant wind direction was westerly and southeasterly.

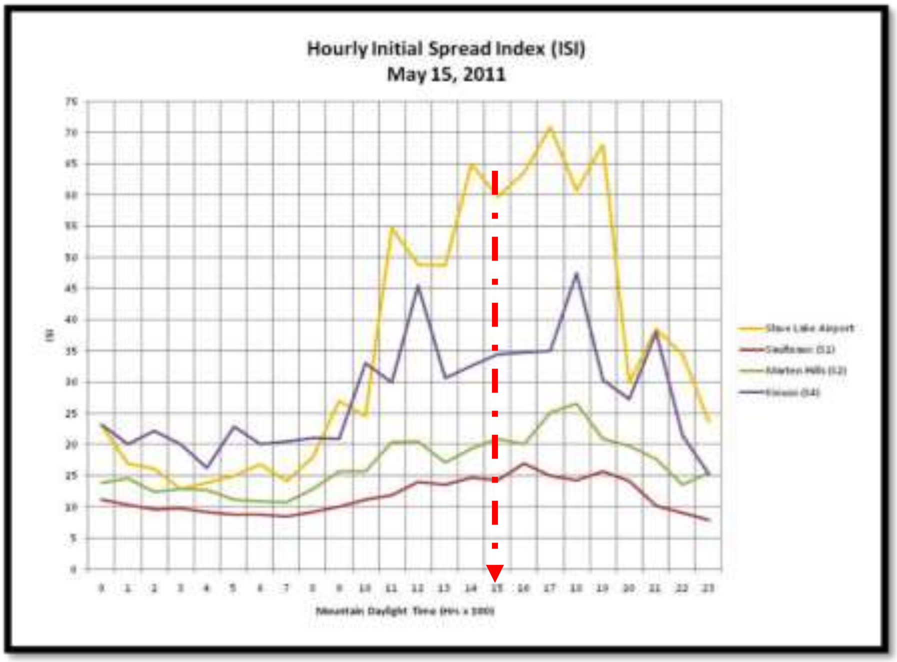


Figure 36 – Hourly Initial Spread Indices for May 15.

Hourly ISI values for May 15 are illustrated in Figure 36. This chart shows persistently high ISI values through each day because of sustained strong winds and poor overnight relative humidity recovery. The ISI values reached extremely high peaks during the afternoon of May 15, which contributed to very high rates of spread and spotting on SWF-056 and SWF-065.

The relative humidity and wind speed data for the May 14 and 15 burning periods obtained from the Alberta Sustainable Resource Development weather stations and the station at Slave Lake Airport are notable in several aspects:

- Minimum relative humidity values reached 15% on May 14 with temperatures of 20 °C. These conditions generated extreme dryness in light and flashy fuels (Figure 37).
- Poor relative humidity recovery occurred overnight on May 14 as a result of the very low dew point temperatures and persistent wind speeds, in the 20 kilometres per hour range.
- Minimum relative humidity values were similar at all surrounding stations indicating a well-mixed atmosphere during both burning periods.
- Slave Lake Airport wind speeds (Figures 32, 33, and 38) were generally 10–15% higher than at the surrounding stations reflecting a distinct topographic channelling effect in the east–southeast and west–northwest wind directions.

Figure 38 illustrates limited rain on May 13, high relative humidity, and low wind speed. Wind speeds recovered to 50 kilometres per hour and a cross-over of relative humidity and temperature occurred by May 15. Charts for May 11 to May 16 for other surrounding weather stations can be found in Appendix I. The FWI values (Appendix L) at the Flat Top Lookout and

Slave Lake Airport (Figure 39) were at extreme levels on May 15, largely due to the influence of high wind speeds.

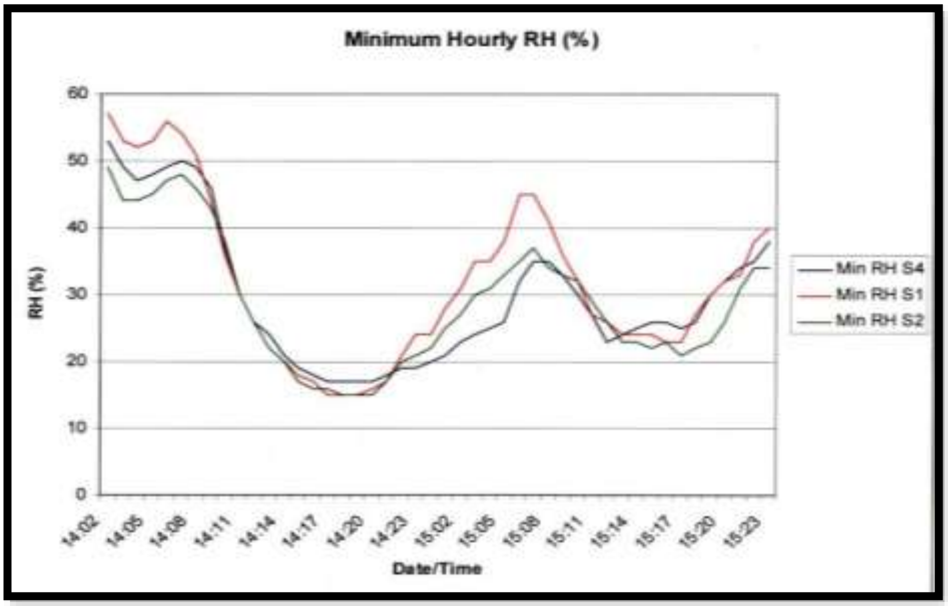


Figure 37 – Minimum hourly relative humidity values at Kinuso (S4), Marten Hillls (S2) and Salteaux (S1) weather stations for May 14 and May 15.

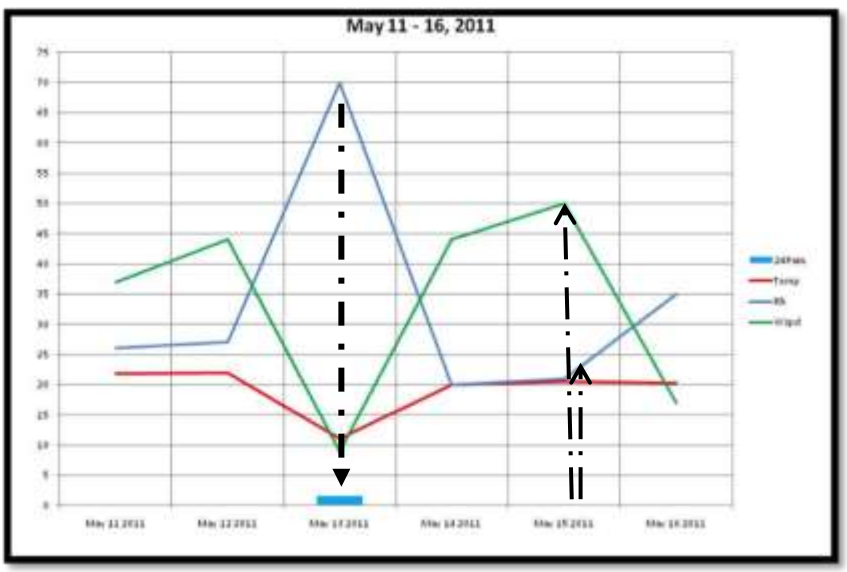


Figure 38 – Example of noon weather observation chart for Slave Lake Airport, May 11 to May 16. Note the peaks on May 14 and 15. 24-hour rainfall in millimetres, temperature in degrees Celsius, relative humidity in percent, and wind speed in kilometres per hour.

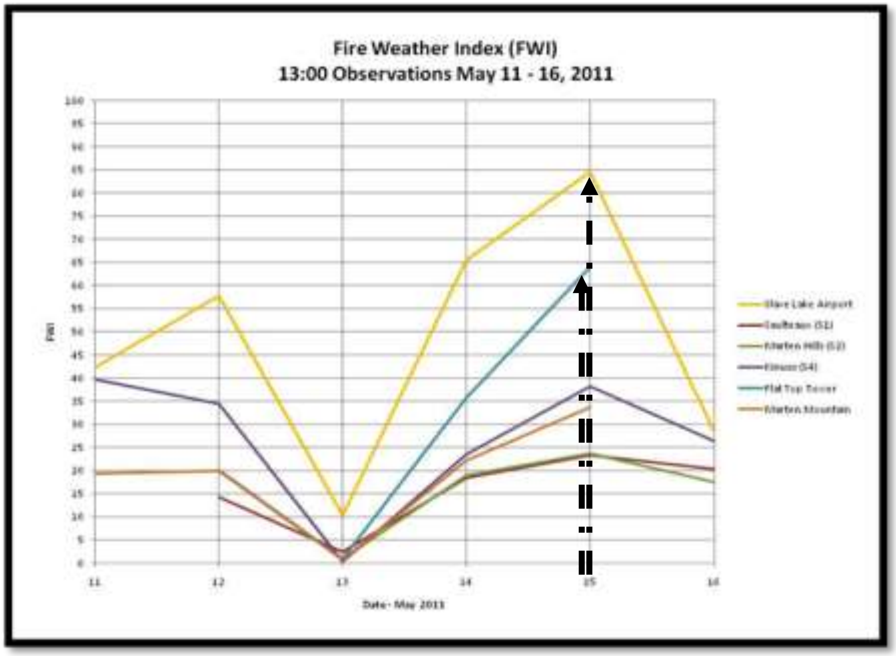


Figure 39 – Fire Weather Index observations for May 11 to May 16. Note the extreme Fire Weather Index (FWI) value for Slave Lake Airport.

Upper Air Analysis on May 14 and May 15

The conditions in the troposphere, lower atmosphere extending ~10–12 kilometres above the Earth's surface, influences wildfire in two ways:

1. The weather observed at the Earth's surface is the result of what is happening in the three-dimensional atmosphere. The air temperature, wind speed and direction, precipitation, and relative humidity the wildfire experiences at the Earth's surface depends largely on the vertical structure of the atmosphere. The strength, location, and movement of surface highs and lows, as well as associated warm and cold fronts, are a result of what is happening in the lower atmosphere.
2. Active wildfires are not constrained to the surface. They are three-dimensional with a convection column that may extend many kilometres into the atmosphere. The interaction between the convection column and the vertical structure of the atmosphere can have a significant impact on wildfire behaviour and growth.

The vertical profiles of wind speed and air temperature are of particular importance for wildfire management. Wind profiles shown in Figures 40 and 41 are from the Stony Plain, Alberta, upper air station operated by Environment Canada. The station releases weather balloons equipped with radiosondes (data recording units) that record the pressure, temperature, moisture, and wind speed as they rise through the atmosphere. These radiosondes are released twice daily at 06:00 and 18:00. No vertical profiles of wind speed for May 14 and 15 at 18:00 were available from the Stony Plain upper air station. However, there are observations of wind speed recorded by aircraft landing at and taking off from Edmonton International Airport. Wind speed observations from an aircraft taking off from the

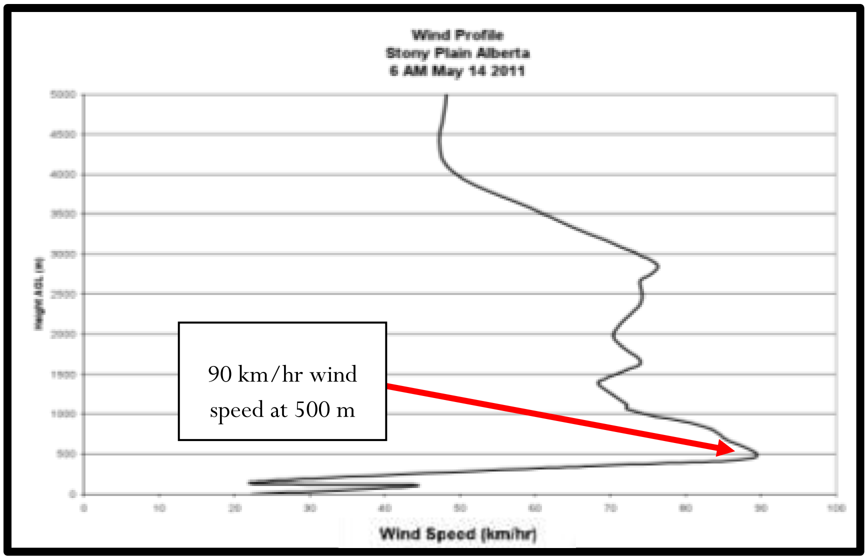


Figure 40 – Vertical wind profile at Stony Plain, Alberta, at 06:00 May 14, 2011.

Edmonton International Airport at approximately 15:30 on May 15 are shown in Figure 42. The wind speed observations from times close to 18:00 were selected. All the vertical wind speed profiles show strong wind speeds at or near the surface. The stronger winds aloft can be mixed down to the surface when the atmosphere is unstable, as was the case on May 14 and 15. The wildfire can also generate winds due to in-drafts to the combustion zone. Wildfires can also bring down these higher winds aloft through various interactions with a convection column. The result is extremely strong and gusty winds at the surface, as was observed by all the weather stations in the Lesser Slave Area. The 18:00 wind profiles on the Flat Top Complex are similar to those observed for many historical wildfires. However, the May 14 and 15 profiles near Slave Lake are more extreme in that the strong winds are at or very near the surface.

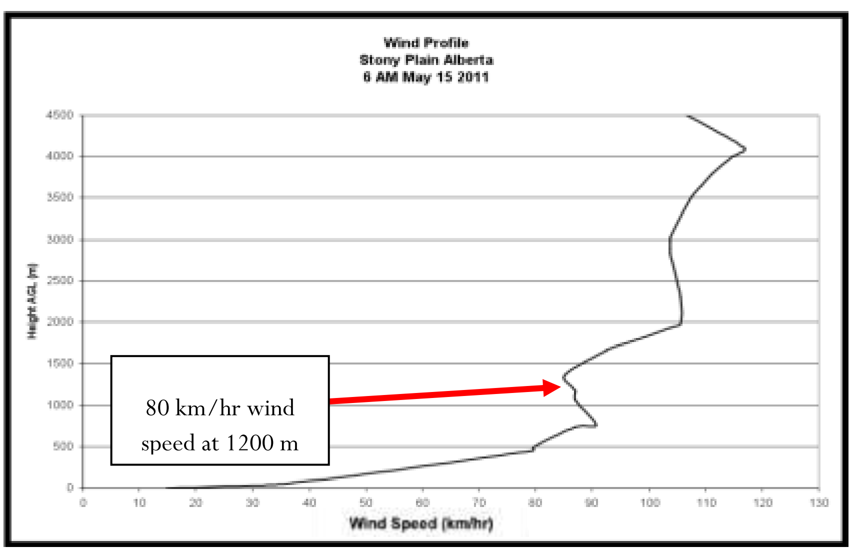


Figure 41 – Vertical wind profile at Stony Plain, Alberta, at 06:00 on May 15, 2011.

Figures 43 and 44 show the Stony Plain vertical temperature and moisture profiles for May 14 and 15 at 18:00. The lower atmosphere was unstable on May 14 and extremely unstable on May 15. This instability facilitated the mixing of the lower atmosphere and allowed the higher wind speeds above ground to be brought down to the surface. Given the wind and temperature profiles observed on May 14 and 15, 2011 strong and gusty southeast winds would be expected at the surface.

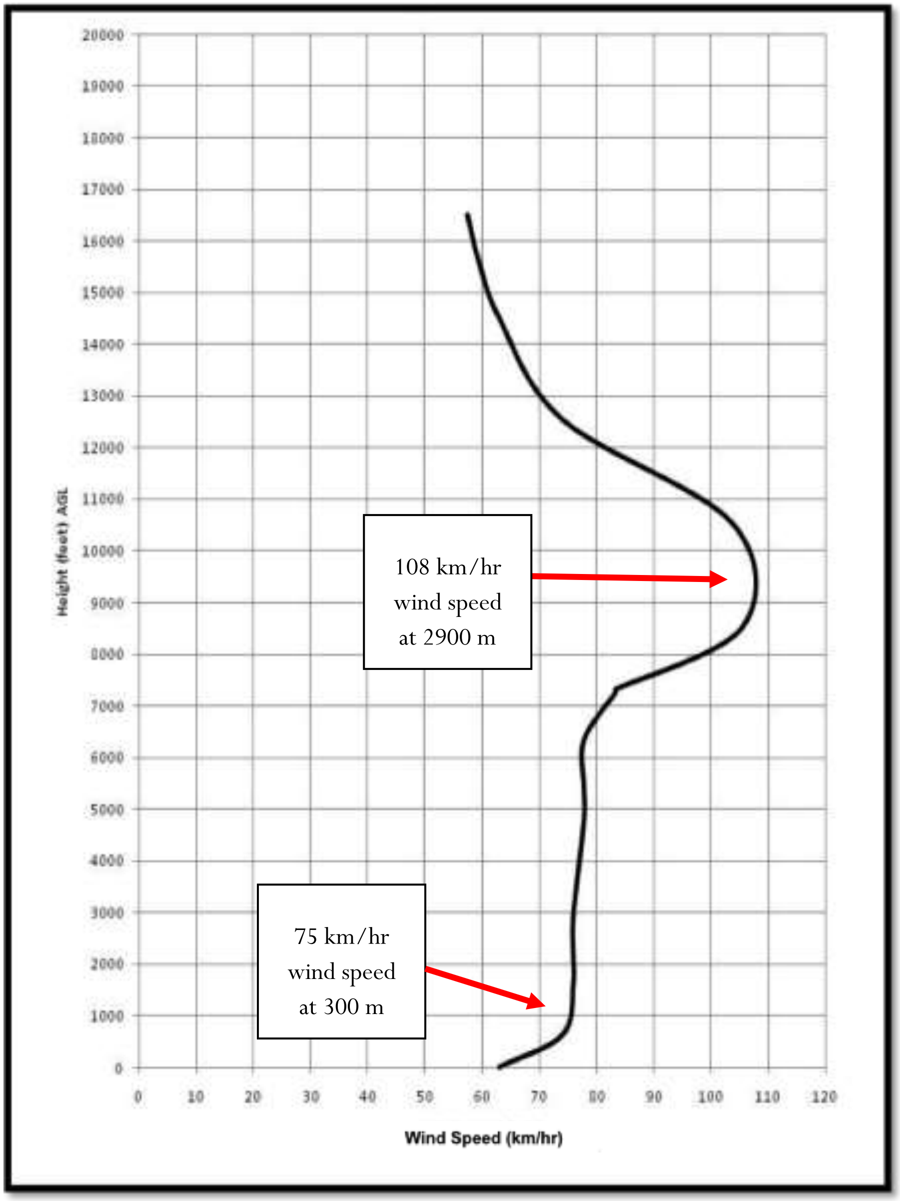


Figure 42 – Vertical wind profile from an aircraft flying into Edmonton International Airport at 15:30 May 15, 2011.

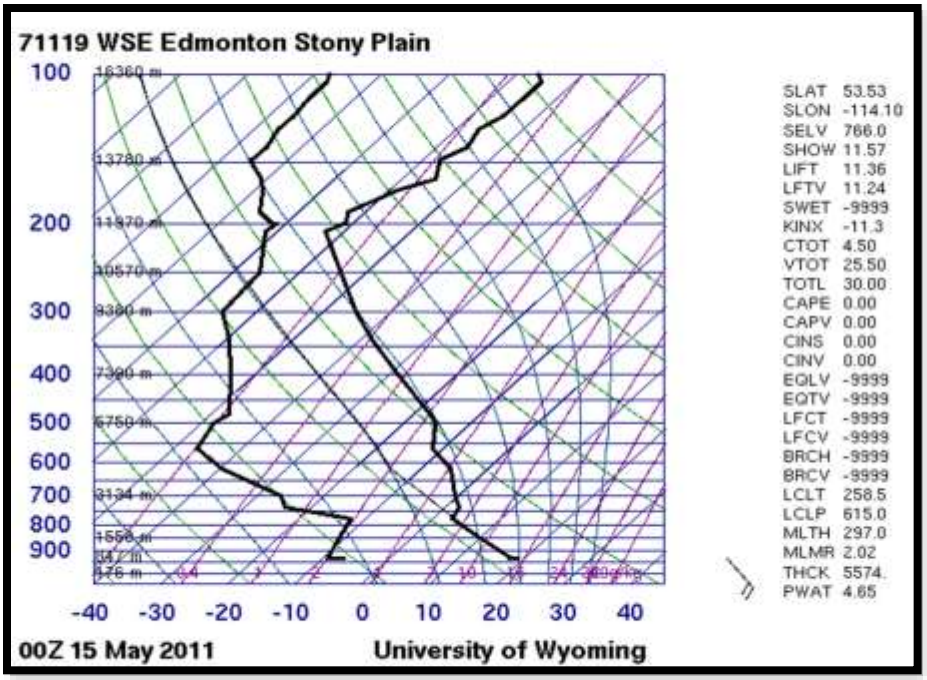


Figure 43 – Vertical profile of temperature and moisture at Stony Plain, Alberta, at 18:00 May 14, 2011.

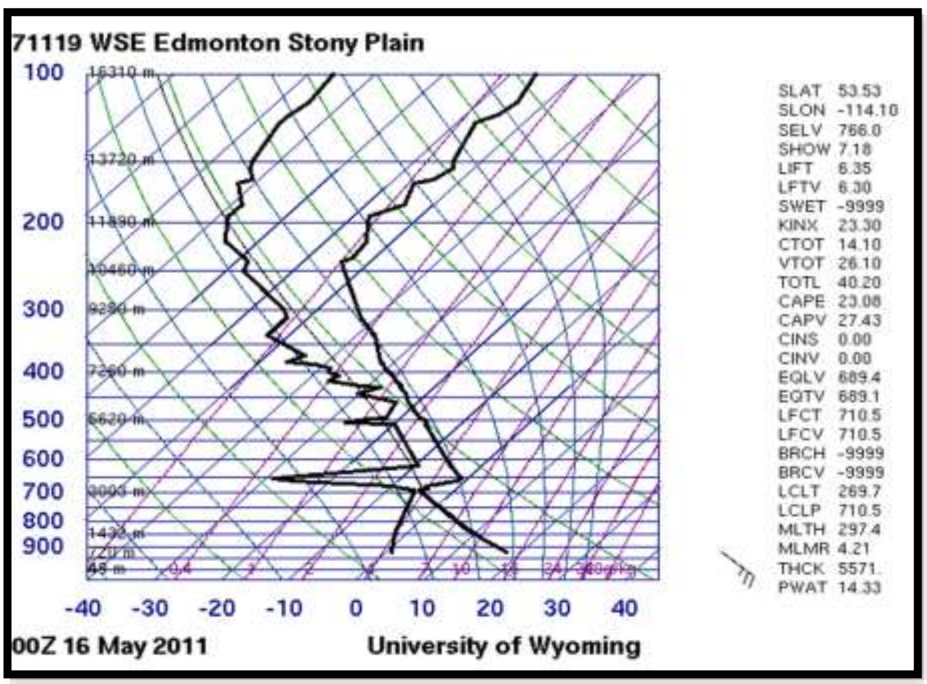


Figure 44 – Vertical profile of temperature and moisture at Stony Plain, Alberta, at 18:00 May 15, 2011.

Large, high-intensity wildfires are generally described as wind-driven or convection column–driven. If the rate at which thermal energy above the wildfire (energy released from the combustion of the wildfire) is converted to kinetic energy (mechanical energy created by wind) is greater than the kinetic energy of the wind field, a convection column will develop. If the reverse occurs, a wind-driven wildfire will result. Heated gases above wildfires rise and trap surrounding cool air, which reacts with vaporized fuel to form additional combustion products. Buoyancy is the driving force through which the thermal energy of the wildfire is converted to kinetic energy of motion in the convection column. Once established, the height and dynamics of a convection column are a function of the atmospheric lapse rate and the size and intensity of the wildfire. If wind speeds are light and decrease or remain constant with height above a wildfire, it is easier for convection columns to attain their full potential. If winds are strong or wind speed increases with height above ground, then vertical convection is often restricted and the column is sheared off.

Figure 45 – Towering convection column of the Chisholm wildfire that reached 15 kilometres.

Towering convection columns, often reaching the height of the tropopause (10–12 kilometres), are commonly associated with high-intensity wildfires in boreal and temperate forests. High fuel consumption, combined with moderate to high sustained rates of spread, permits strong vertical column development. Both the 1968 Vega wildfire and the 2001 Chisholm wildfire are examples of typical high-intensity boreal wildfires with well-developed convection columns reaching into the upper troposphere and lower stratosphere (Figure 45). The wind profiles the Vega and Chisholm wildfires showed speeds increasing with height (Figures 46 and 47), but because of the significant intensities, especially in the case of the Chisholm wildfire, convection columns were able to develop. In contrast, the wildfires burning in the Lesser Slave Area in May of 2011 were driven by sustained strong winds that, when combined with lower levels of fuel consumption (due to the short interval after snowmelt), resulted in relatively flat convection columns very close to the ground. These were typical wind-driven wildfires, with extreme short- and long-range spotting ahead of the flaming wildfire fronts (Figure 48).

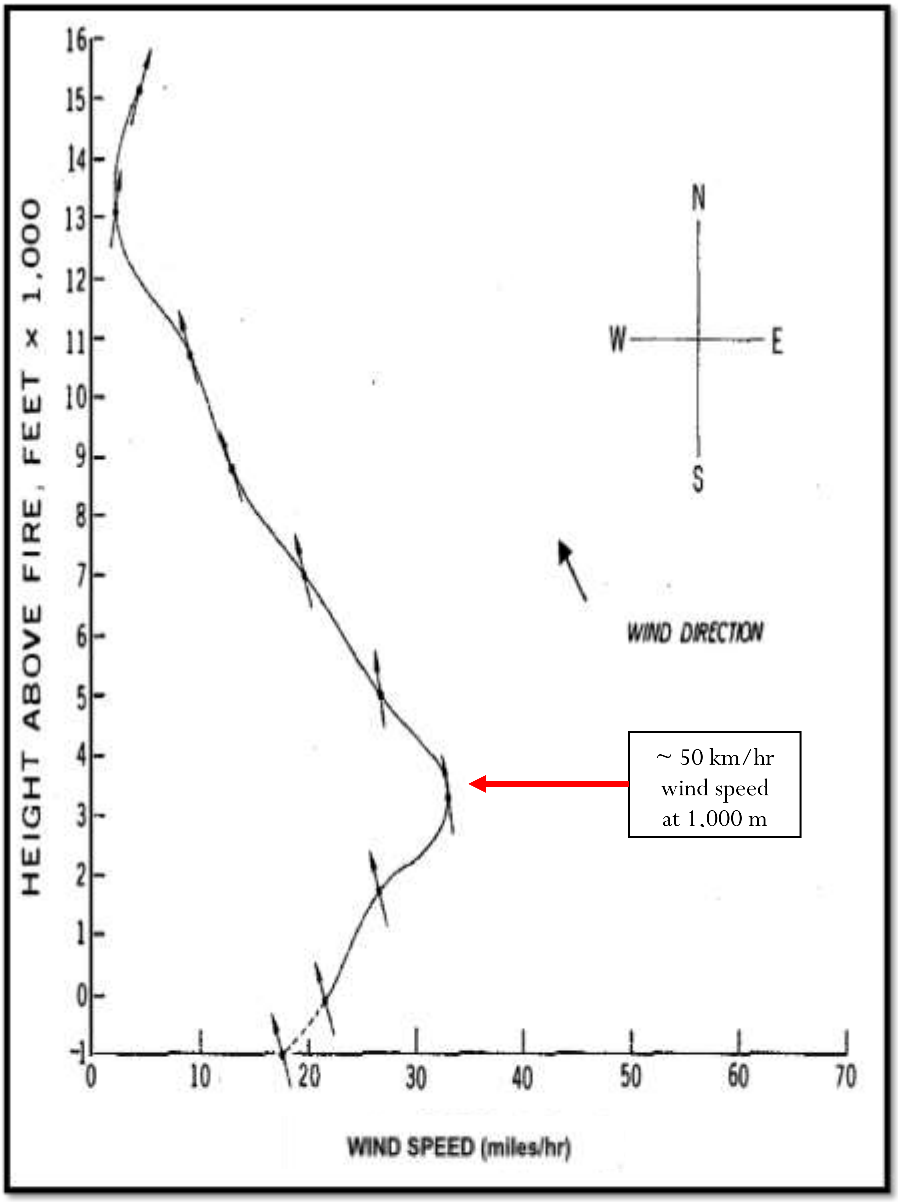


Figure 46 – Wind profile over Stony Plain, Alberta, for 17:00 May 19, 1968.

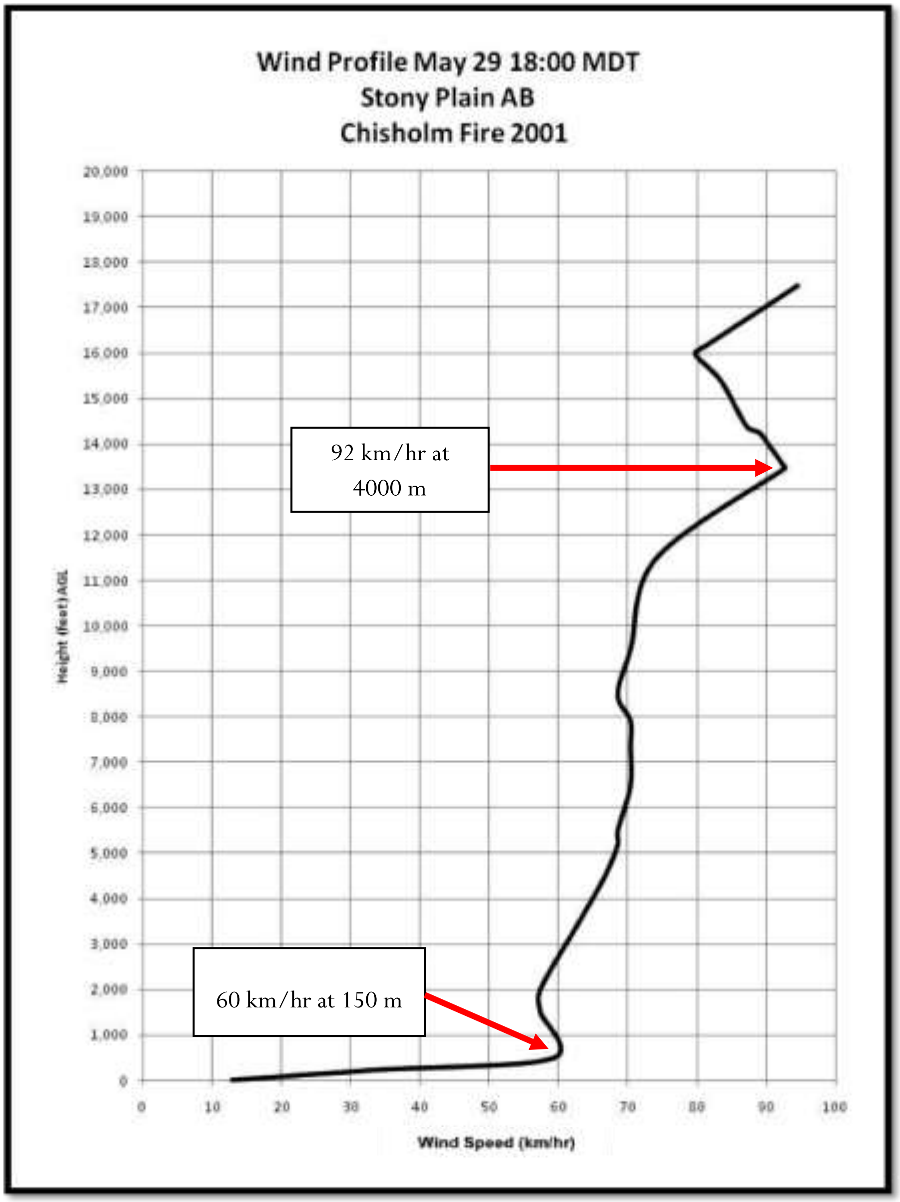


Figure 47 – Vertical wind profile at Stony Plain, Alberta, at 18:00 May 28, 2001 during the Chisholm wildfire event.

Figure 48 – Illustration of a typical wind-driven wildfire with short-range spotting and low smoke drift directly ahead of the fire front.

FOREST FUELS IN THE FLAT TOP COMPLEX AREA

The most common forest types in central Alberta include pure stands of aspen (*Populus tremuloides*) and balsam poplar (*Populus balsamifera*), along with mixedwood stands of aspen, balsam poplar, and white spruce (*Picea glauca*) on well-drained uplands. Lodgepole pine (*Pinus contorta*) and jack pine (*Pinus banksiana*) occur in pure stands or are mixed with black spruce (*Picea mariana*) or white spruce (*Picea glauca*).

The Canadian Forest Fire Danger Rating System (CFFDRS) identifies 16 discrete benchmark wildland fuel types in Canada. Each fuel type has unique characteristics of tree species, understory, ground vegetation, and forest stand structure that define how the fuel type will burn under given wildfire danger conditions. Fuel type descriptions can be found in Appendix M.

Fuel Types

Fuel Type Code	Vegetation Type
C1	Spruce-Lichen Woodland
C2	Boreal Spruce
C3	Mature Jack of Lodgepole Pine
D1/D2	Leafless/Green Aspen
M1/M2	Leafless/Green Boreal Mixedwood
O1	Grass
S1/S1	Pine/Spruce Slash

Table 10 – Fuel types present in the Flat Top Complex wildfire area.

Table 10 illustrates the wildland fuel types present in the Flat Top Complex area and are typical for the boreal forest environment. In the Flat Top Complex area, highly volatile stands of black spruce (identified as the C2 fuel type within the Canadian FBP System) are common and are present near communities and other values-at-risk (Figure 49).

Fuel Types and Spatial Distribution

Wildland fuel types are determined using algorithms within computer programs applied to various sources of spatial vegetation data (Appendices N):

- Alberta Vegetation Inventory ((AVI) various versions)
- Alberta Ground Cover Classification (AGCC)
- Alberta Phase 3 Inventory
- Cut-over updates
- Wildfire updates
- Other agency inventory
- Field verifications

Figure 49 – C2 (Boreal Spruce) fuel type adjacent to the Visitor Information Centre.

For operational purposes, a spatial geographic information system (GIS)-based grid at 100-metre resolution has been developed for Alberta. A 25-metre grid was recently developed that covers the entire province and will enhance planning activities. Examples for the Slave Lake area are shown in Figures 50, 51, and 52.

Many leafless aspen fuel types (D1 within the FBP System) contain considerable quantities of cured grass and dead and downed woody material, which contribute to higher rate of spread and intensity levels than would normally be predicted using the standard D1 fuel type in the model (Figure 50).

Many leafless mixedwood stands (M1) in the Slave Lake area contained varying amounts of dead balsam fir (*Abies balsamifera*), which contributed greatly to increased wildfire intensity and spotting. The vegetation inventory from which the fuel type grids were derived did not identify a dead balsam fir component in the understory; therefore, these fuel types were not correctly described in the fuel type grids. The CFFDRS has two specific fuel type descriptions for varying amounts of dead balsam fir (M3: dead balsam fir/mixedwood leafless, 100% dead fir and M4: dead balsam fir/mixedwood green, 30% dead fir).

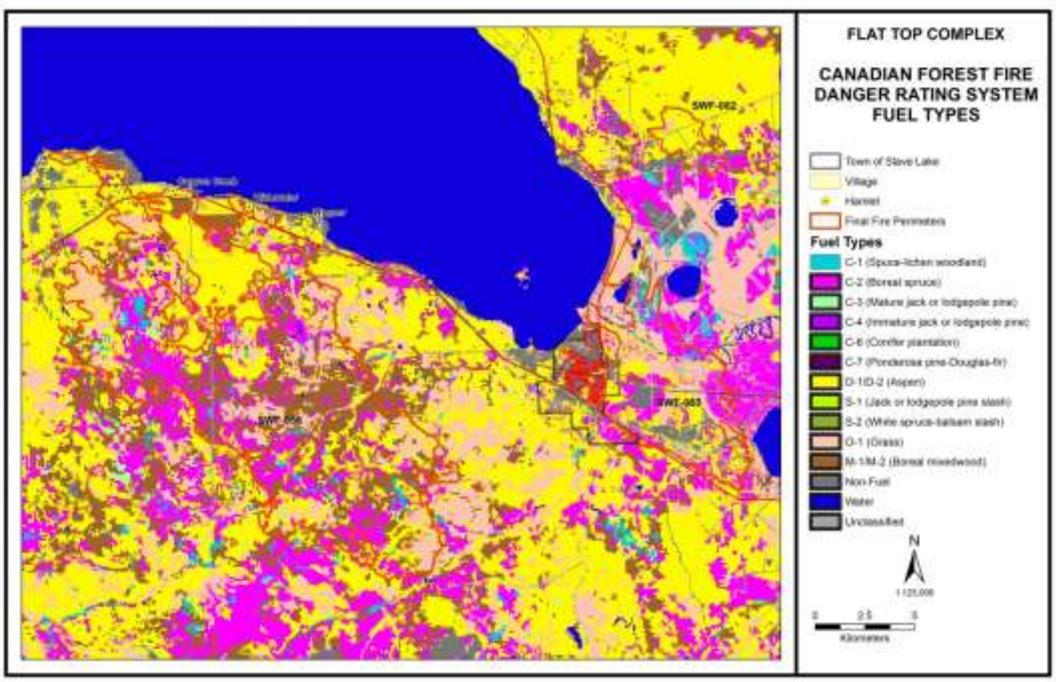


Figure 50 – Composite of 100-metre and 25-metre fuel grids.

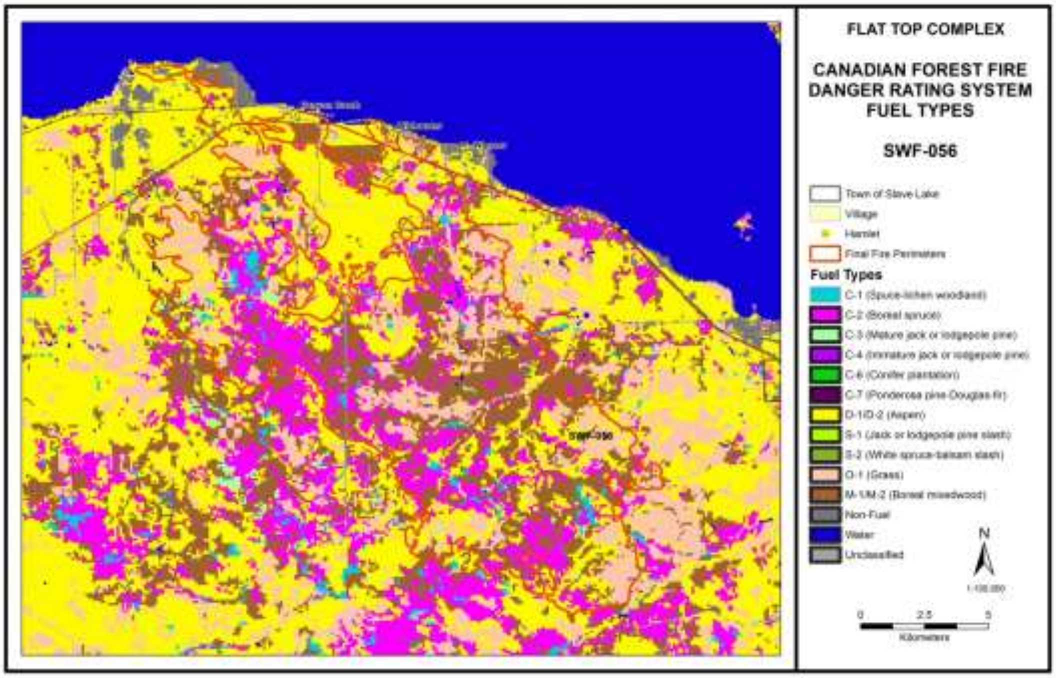


Figure 51 – Boreal spruce (C2), mixedwood (M1), and aspen (D1) fuel types all associated with SWF-056. The M1 fuel type had a balsam fir understory that was dying out as a result of previous droughts.

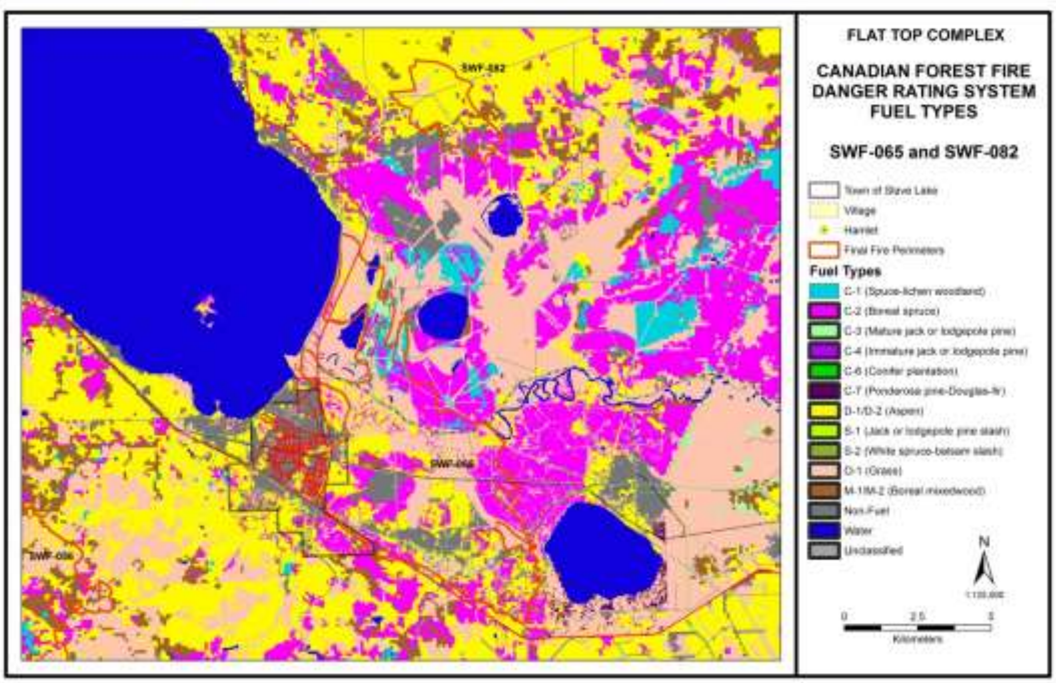


Figure 52 – Spatial illustration of fuel types associated with SWF-065. The patchwork of boreal spruce (C2), mixedwood (M1), grass (01), and aspen (D1) fuels throughout the wildfire perimeter.

ANTHROPOGENIC FUELS

Within the wildland urban interface of both SWF-056 and SWF-065, combustibles such as structures, vehicles, holiday trailers, all-terrain and off-highway vehicles, fuel tanks, wood piles, discarded machinery, old tires, and any number of other items that are prone to ignition from falling embers or radiant heat, were intermixed with forest fuel types (Figure 53).

Figure 53 – Illustration of anthropogenic fuels.

Anthropogenic fuels have a yet-to-be quantified influence on ignition potential, wildfire intensity, and rates of spread and are often in close proximity to values at risk. These fuels contribute to ember transport in urban environments and can profoundly affect wildfire suppression efforts.

FUEL LOADING

Sustainable Resource Development established a number of sample plots in both SWF-056 and SWF-065 to determine pre-burn and post-burn fuel loadings. A total of 33 sampling plots (13 post-fire plots in burned areas and 20 control plots in unburned areas were established). Because pre-burn and post-burn sampling was not possible on the same plots, an attempt was made to locate stands that were similar in composition for both pre-burn and post-burn sampling. Plots were located in three general FBP fuel types: C2 (boreal spruce), D1/D2 (leafless/green aspen), and M1/M2 (boreal mixedwood leafless/green).

Various sampling techniques were employed within each plot to determine fuel loadings for the forest floor duff and litter layers, surface fuels (including downed woody debris), herbaceous material, and standing tree biomass. Figures 54 and 55 illustrate typical forest floor, surface, and crown fuel consumption from SWF-056 and SWF-065 in pre-burn and post-burn plots in C2 (boreal spruce) and M1/M2 (boreal mixedwood leafless/green) fuel types. A map showing the location of plots on SWF-056 and SWF-065 and a table summarizing pre-burn and post-burn fuel weights are provided in Appendix O.

Figure 54 – Typical fuel consumption in boreal spruce (C2) fuels.

Figure 55 – Typical fuel consumption in mixedwood (M1/M2) fuels.

PREDICTING WILDFIRE BEHAVIOUR

Four commonly used fire behaviour prediction tools are available to wildfire managers in Alberta (Appendix P):

1. Spatial Fire Management System (SFMS)
2. Prometheus (Canadian Wildfire Growth Model)
3. *Behave* by Remsoft®
4. *Field Guide to the Canadian Forest Fire Behaviour Prediction (FBP) System*

<u>Spatial Fire Management System (SFMS)</u>

The SFMS is an advanced wildfire management information system that integrates wildfire science models and decision support planning modules into a geographic information system (GIS). It is designed to be used by wildfire management agencies for daily operational planning purposes at the strategic, tactical, and landscape levels. The system incorporates a full implementation of the Canadian Forest Fire Danger Rating System (CFFDRS), providing assessments of wildfire ignition and growth potential and predicted wildfire behaviour. It also includes tools for resource allocation planning and wildfire threat rating. Alberta adopted SFMS operationally in the mid-1990s and the program is used throughout the wildfire season.

In 2011, daily SFMS outputs were generated as early as May 11. Managers have the opportunity to update afternoon forecast outputs for the following morning based on revised forecasts or actual overnight precipitation values. A second revision can be done in the early afternoon based on actual weather observations. Adjustments in resource requirements or deployment can be made, if necessary, to meet operational guidelines and policies.

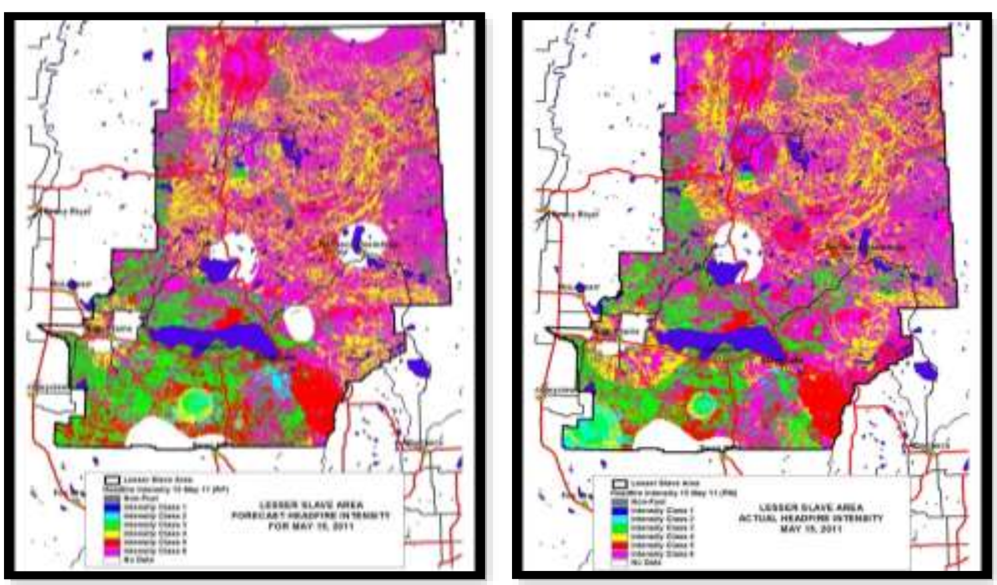


Figure 56 – Forecast Head Fire Intensity for May 15, 2011 based on the revised morning weather forecast (left) and actual Head Fire Intensity for May 15, 2011 based on 13:00 weather observations (right).

Forecast Head Fire Intensities (HFI) on May 14 and 15 (Figures 56, 57, and 58; Appendix Q) were exceeded during the wildfire spread on SWF-056, SWF-065, and likely on SWF-082 when compared with Prometheus simulations. The HFI intensity class descriptions and typical wildfire behaviour images are presented in Appendix C.

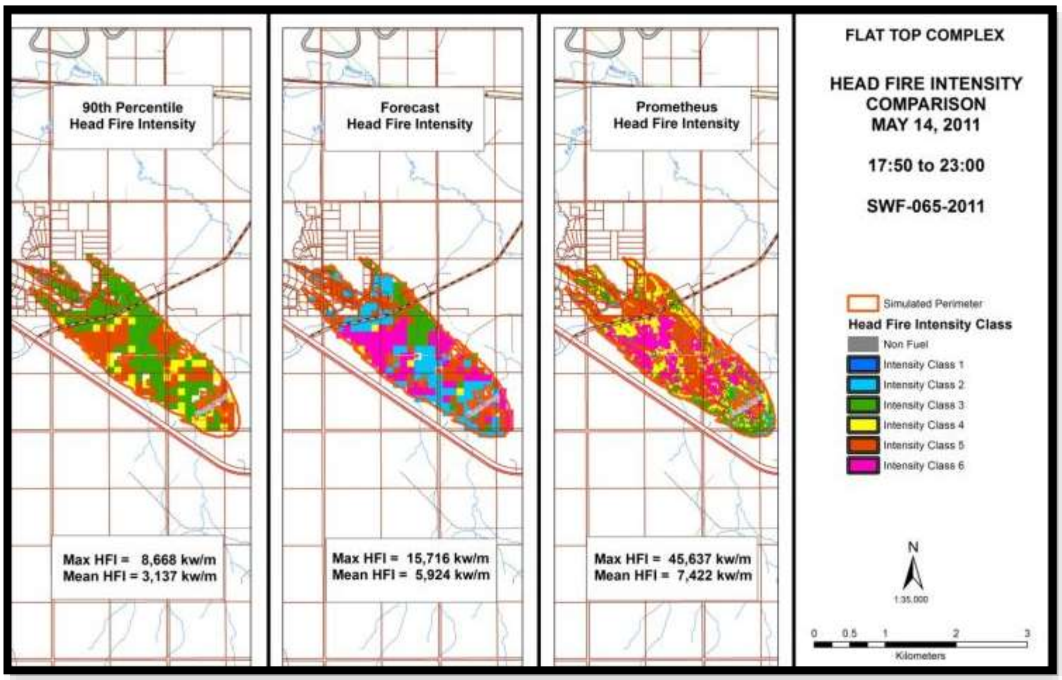


Figure 57– Spatial representation of differences in Head Fire Intensity (90th percentile) versus forecast versus Prometheus Head Fire Intensity.

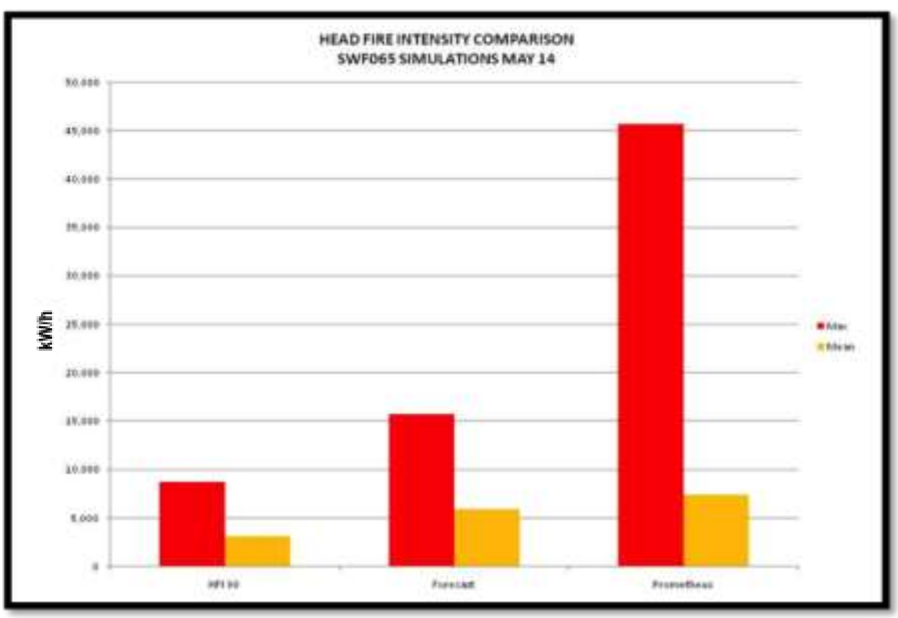


Figure 58 – Graphical representation of differences in Head Fire Intensity (90th percentile) versus forecast versus Prometheus Head Fire Intensity.

Discrepancies between forecast, actual, and Prometheus HFIs may be attributed to the difference between forecasted wind speeds (Appendices Q and R), higher actual local wind speeds, and gusts created by topographic influences. An additional contributing factor may have been the use of reclassified fuel grids for the Prometheus simulations instead of the standard provincial 100-metre fuel grid used to calculate forecast HFIs.

Prometheus (Canadian Wildland Fire Growth Model)

Prometheus is a deterministic wildland fire growth simulation model based on the FWI and FBP sub-systems of the CFFDRS. The model computes spatially-explicit fire behaviour and spread outputs given fuel, topography, and weather conditions. Prometheus was developed by an integrated, multi-disciplinary team of Canadian researchers and wildfire managers. Sustainable Resource Development is the lead agency in ongoing refinement and development of the model. Operational versions of Prometheus have been available since 2001.

This state-of-the-art model allows for operational and strategic assessments of spatial wildfire behaviour on the landscape. Uses of this model in wildfire and forest management include the following:

- Assessing the effectiveness of various forest and wildfire management strategies aimed at reducing the threat of large wildfires.
- Evaluating the wildfire behaviour potential or burn probability of landscapes created by different forest management strategies and practices.
- Evaluating the potential threat wildfires could pose to communities, recreational facilities, forest management units, and other values-at-risk.
- Predicting the growth and intensity of wildfires that have escaped initial attack.

Various Prometheus simulations were completed after the May 15 wildfire runs to quantify and support rate of spread and wildfire intensity observations by ground personnel and to determine potential for wildfire spread in the absence of effective suppression.

The initial simulations used existing 100-metre fuel grids and hourly weather from the station at Slave Lake Airport. Subsequent simulations for SWF-065 used a newly created 25-metre fuel grid, corrected by field inspection of areas where fuel typing from vegetation data was inaccurate.

SWF-056 Simulations

Prometheus simulations on SWF-056 overestimated wildfire spread on May 14 (Figure 59). The overestimation may, in part, be a result of suppression efforts limiting wildfire spread. Hourly weather observations from Slave Lake Airport were used in the simulations. Wind speeds over SWF-056 may have been lower because the area is outside the “funnel effect” present on SWF-065. Inaccuracies in the 100-metre fuel grid may also have contributed to the overestimation of wildfire spread. The new Alberta Vegetation Inventory to Fire Behaviour

Prediction (AVI2FBP) conversion program is expected to address some of the fuel-typing issues.

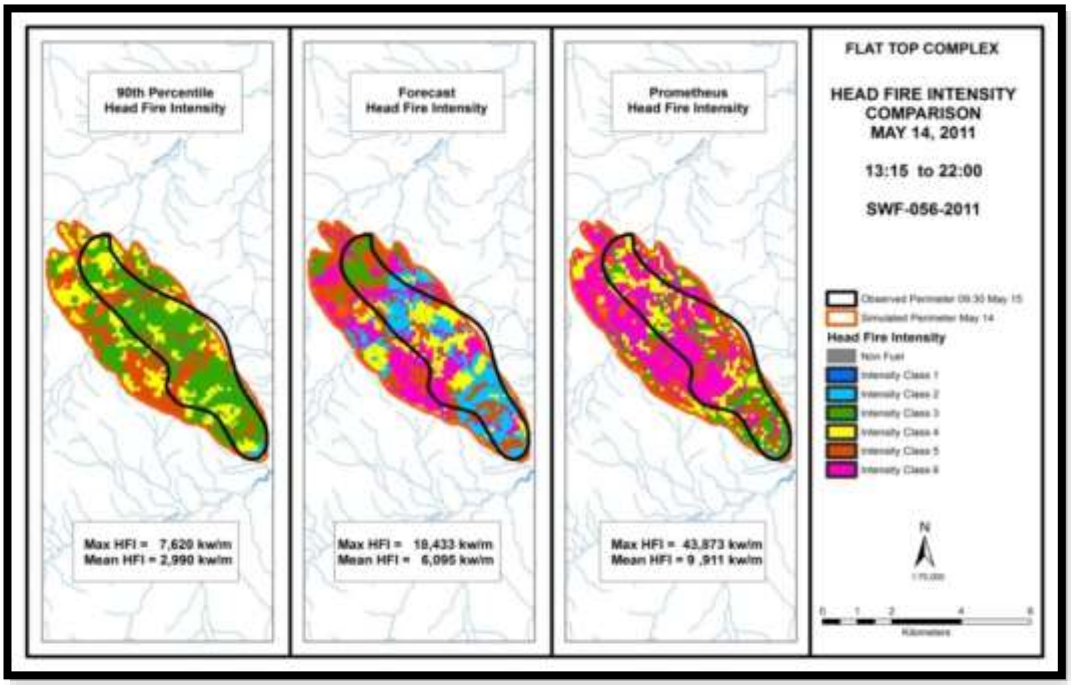


Figure 59 – Comparison of documented and simulated wildfire spread and Head Fire Intensity on May 14, 2011.

Simulations for May 15 accurately predicted extreme Head Fire Intensity (HFI; Figure 60). It also predicted the time the wildfire would reach Highway 2, Canyon Creek, and Widewater (Figures 61 and 62). Although the 100-metre fuel grid used in the simulations did not account for coniferous understory in some aspen (D1) fuel types or for dead balsam fir in some mixedwood (M1) fuel types, it did not appear to affect the accuracy of the simulations for May 15.

Figure 60 – Wildfire behaviour on SWF- 056 at 13:54 confirming extreme Prometheus Head Fire Intensity predictions (May 15).

SWF-065 Simulations

In contrast to Prometheus simulations on SWF-056, simulations on SWF-065 underestimated wildfire spread distance for May 14. The underestimated spread distance was primarily due to the fuel grid which classified residential and agricultural areas as non-fuel areas. In reality, most of these areas were grass covered or contained other fuel sources that contributed to wildfire spread.

Simulations for May 15 appeared to overestimate rates of spread in grass fuel types. In addition, the actual spread direction on the "north finger" of the wildfire did not appear to correspond to the wind direction recorded at the Slave Lake Airport. Additional simulations were completed for May 14 and 15 as shown in Figures 63 and 64.

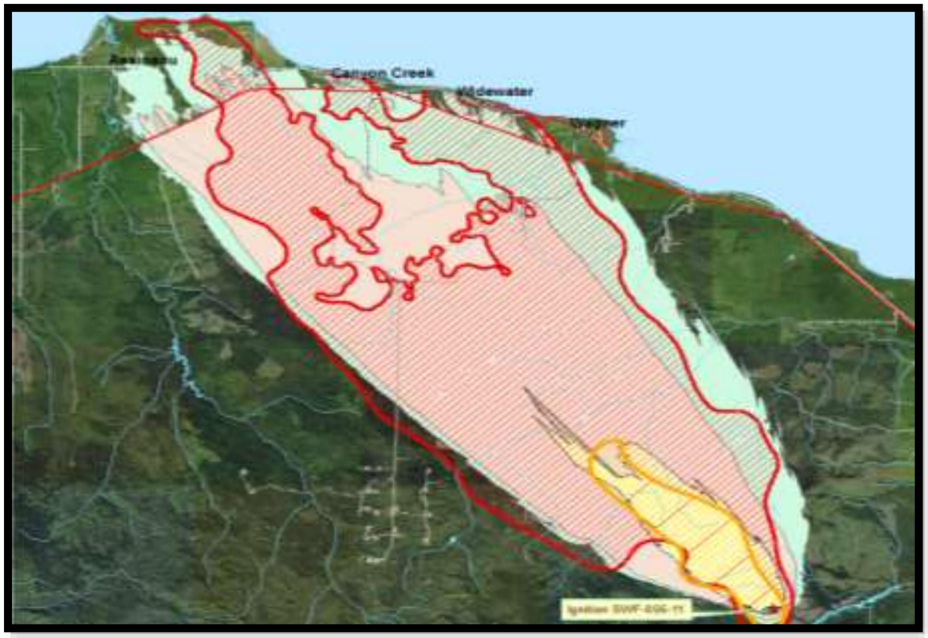


Figure 61 – Actual perimeter on SWF-056. Note the orange perimeter as of May 15, 2011 at 08:00 and the red perimeter as of May 16 at 08:30.

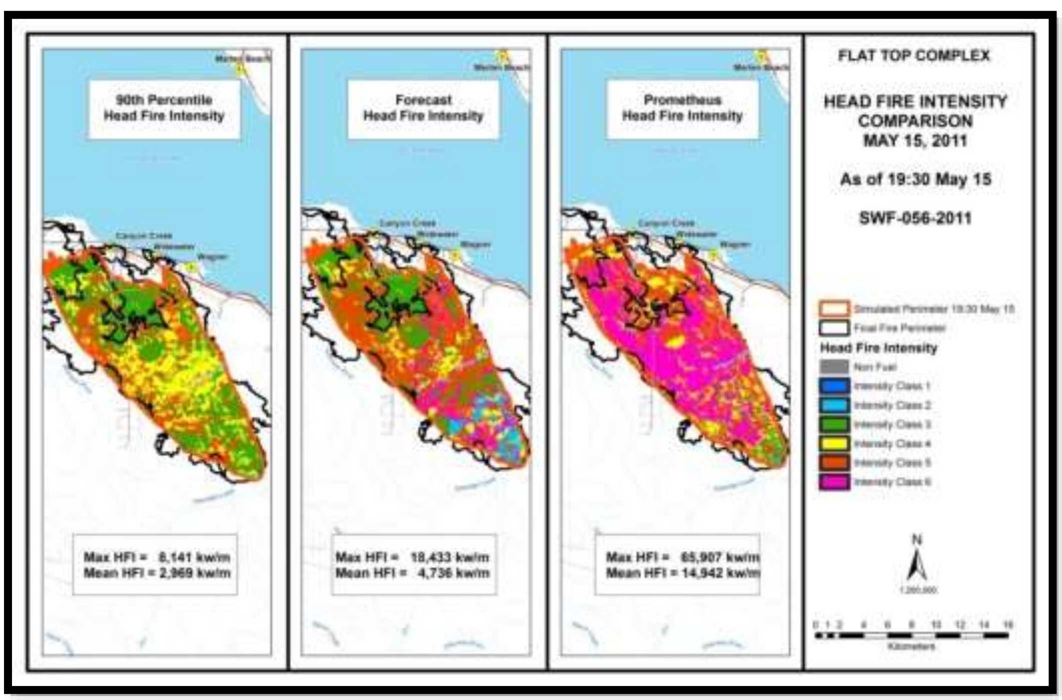


Figure 62 – Comparison of documented and simulated wildfire spread and Head Fire Intensity on May 15, 2011.

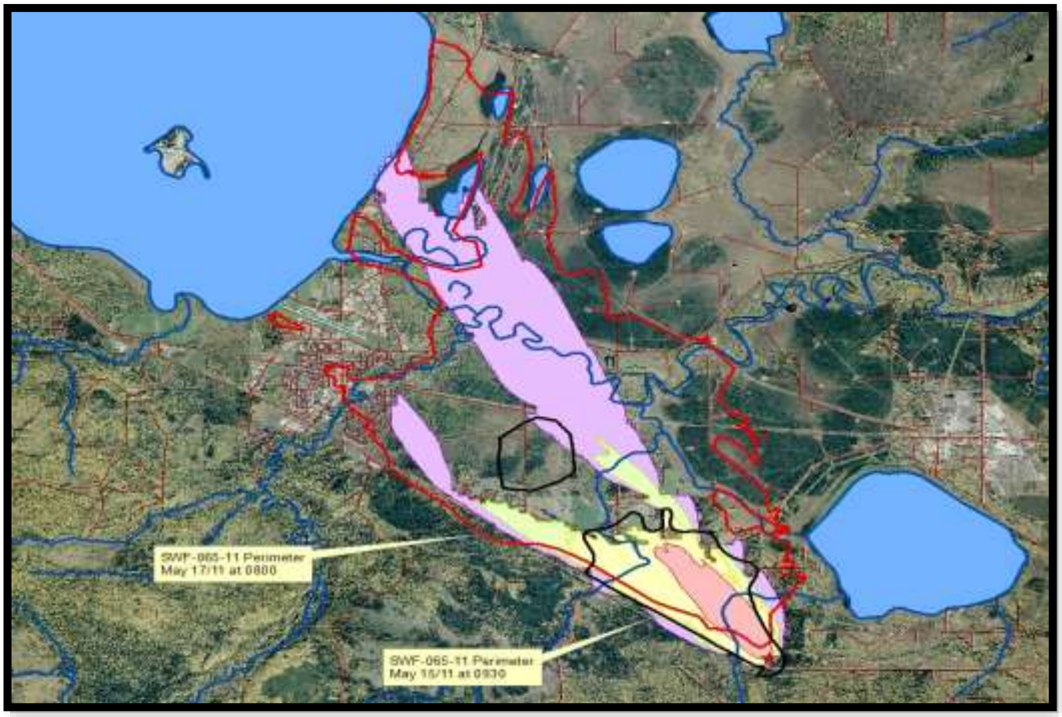


Figure 63 – Prometheus simulations on SWF-065 on May 15 at 18:00. Note the projection shows the wildfire reached Highway 88 and the edge of town at approximately 17:30. Prometheus projected the maximum rates of spread would be 75 metres per minute with a wind speed of 46 kilometres per hour between 15:00 and 18:00.

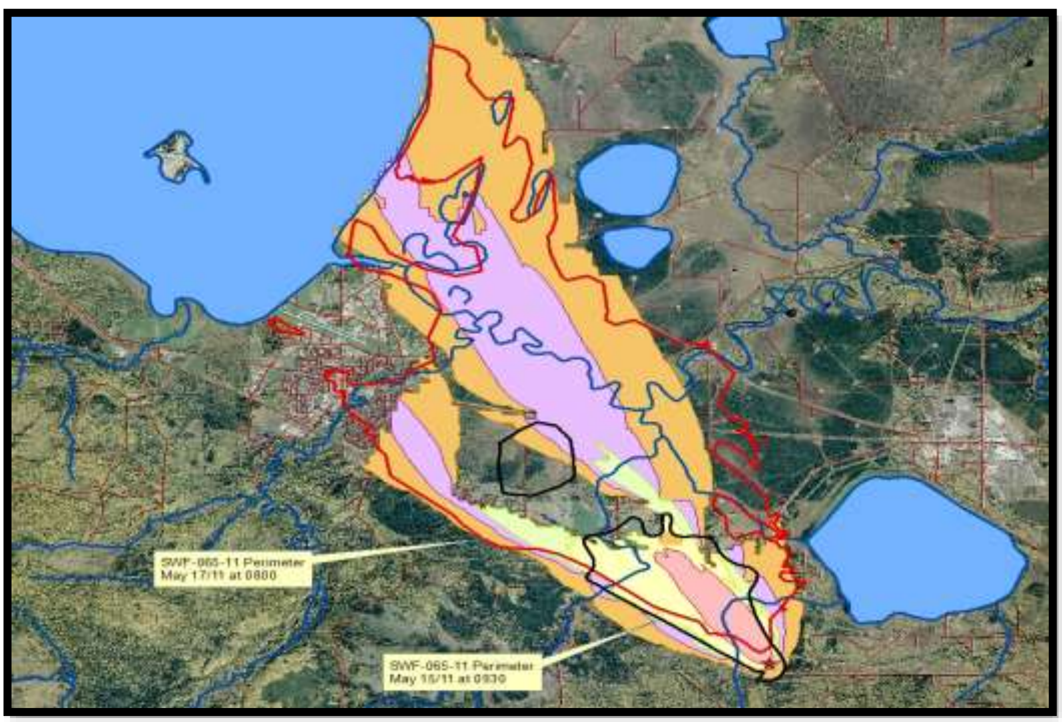


Figure 64 – Prometheus simulations on SWF-065 on May 15 at 23:00. Prometheus projected the maximum rates of spread would be 37 metres per minute with a wind speed of 26 kilometres per hour. The wildfire did not spread outside the burning period set from 13:00 to 23:00.

<u>May 14 from 17:50 to 23:00</u>

A Prometheus simulation was conducted for the initial wildfire run into Poplar Estates using a "new" 25-metre fuel grid and Slave Lake Airport hourly weather observations. Although wildfire spread distance was underestimated, calculated HFI closely matched firefighter observations (Figure 65).

<u>May 15 from 15:57 to 17:37</u>

A Prometheus simulation was conducted for potential spread into the Town of Slave Lake using a new 25-metre fuel grid and hourly weather observations from Slave Lake Airport. There was no effective suppression activity during this time frame that would have produced a discrepancy between documented and simulated wildfire spread (airtanker operations at Slave Lake Airport were grounded at approximately 16:00). Wildfire growth was modeled from the point where air attack was suspended. This simulation closely matched observations from various sources as well as documented wildfire spread reaching Highway 88 at 17:30 (Figure 66). Extremely high HFIs also support reported spotting distances. A third simulation was conducted to determine the potential wildfire spread south of Highway 2 had suppression efforts not been successful in containing the spot fire spread. This simulation was inconclusive as fuels were typed as non-fuel in significant areas within the corporate boundaries of Slave Lake. The simulation did identify extremely high HFIs on the night of May 14 and morning of 15.

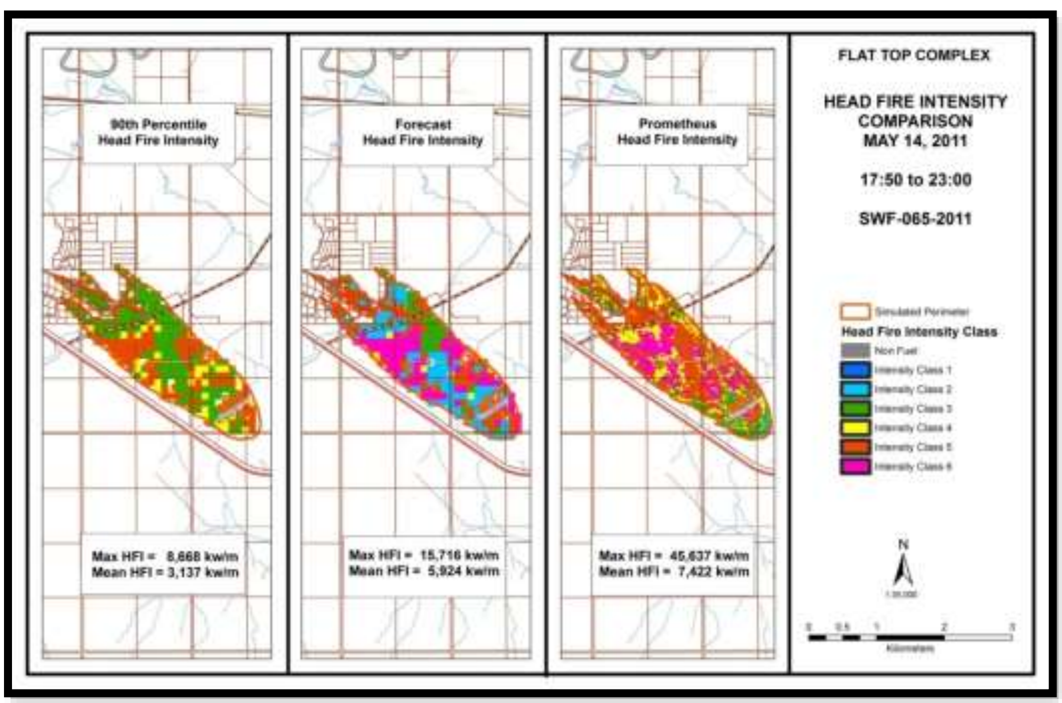


Figure 65 – May 14, 2011 simulated wildfire spread, comparing 90th percentile, forecast, and Prometheus Head Fire Intensity for SWF-065.

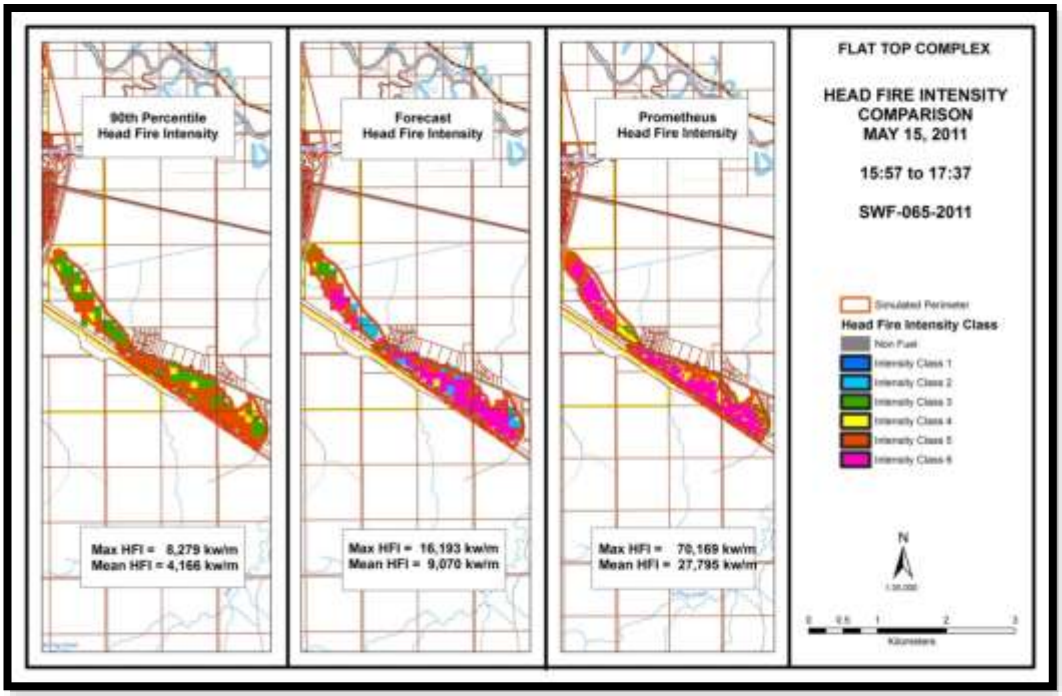


Figure 66 – May 15, 2011 wildfire run into the Town of Slave Lake for SWF-065.

Behave by Remsoft®

Behave is a commercial software package that calculates FWI System and FBP System values based on user inputs of applicable variables.

The program uses equations from the CFFDRS. The most common outputs used are Rate of Spread (ROS), Head Fire Intensity (HFI), Crown Fraction Burned (CFB), and Fuel Consumption (FC). Projected elliptical wildfire perimeter and area burned are also calculated. The outputs are presented numerically in tables rather than in a GIS-tagged spatial display. A wildfire behaviour projection was done for SWF-056 on May 15 using *Behave* (Figure 67).

	Fuel type	Percent ground slope (%)	Aspect of slope (°)	Distance (m)	Elapsed Time (DD:HH:MM)	Total Time (DD:HH:MM)	Rate of spread (m/min)	Total fire Intensity (kW/m)
1	M1-Pc(50)	2	NW	10000	0:05:22	0:05:22	25 - 34	9,649 - 13,236

	Date	Time	Fuel Type	Percent ground slope (%)	Aspect of slope (°)	Distance (m)	Time (mins)	Rate of spread (m/min)	Head fire total intensity (kW/m)	Fine fuel moisture code	Buildup index	10 metre wind speed (kph)	Cardinal wind direction (°)
1	May 15 2011	14:00 - 15:00	M1-Pc(50)	2	NW	1791.2	60	29.854	11,644	89	25.2	58	SE
1	May 15 2011	15:00 - 16:00	M1-Pc(50)	2	NW	1921.4	60	32.023	12,513	89.6	25.2	58	SE
1	May 15 2011	16:00 - 17:00	M1-Pc(50)	2	NW	2030.5	60	33.842	13,236	90.1	25.2	58	SE
1	May 15 2011	17:00 - 18:00	M1-Pc(50)	2	NW	1921.4	60	32.023	12,513	89.6	25.2	58	SE
1	May 15 2011	18:00 - 19:00	M1-Pc(50)	2	NW	1791.2	60	29.854	11,644	89	25.2	58	SE
1	May 15 2011	19:00 - 19:22	M1-Pc(50)	2	NW	544.3	21.8	24.974	9,649	87.6	25.2	58	SE

Figure 67 – *Behave*® projection for May 15, 2011.

- The projection was made from a known point at 14:00 during the May 15 wildfire run.
- The intent was to determine an approximate time the wildfire would reach Highway 2, Canyon Creek, and Widewater.

- Constant wind speed, wind direction, and mixedwood (M1 with 50% conifer) fuel types were used in the projection.
- Similar to Prometheus, the projection predicted when the wildfire reached Highway 2.

<u>Field Guide to the Canadian Forest Fire Behaviour Prediction System</u>

The *Field Guide to the Canadian Forest Fire Behaviour Prediction (FBP) System*, also known as the "Red Book" (Figure 68), was prepared to allow approximations of the FBP System outputs when computer-based applications are not available. It is intended mainly to be used as a field reference.

Certain simplifications were made so important wildfire behaviour characteristics could be presented in tabular form.

The Field Guide was used to estimate ROS and HFI levels in the boreal spruce (C2) fuel type for SWF-065 on May 15. The predicted spread rate was 80 metres per minute or 4.8 kilometres per hour with Intensity Class 6 wildfire behaviour. This spread rate is higher than observed, but the prediction of Intensity Class 6 wildfire behaviour proved valid.

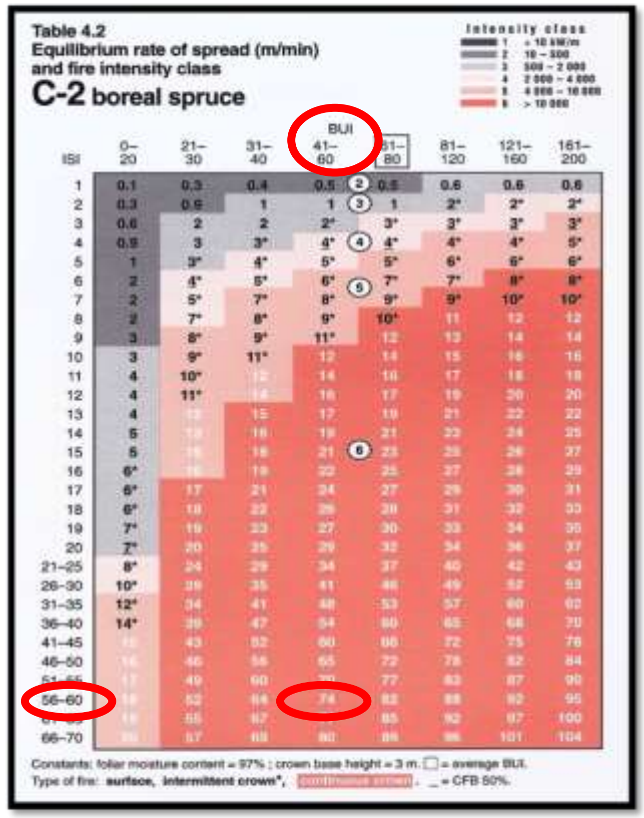


Figure 68 – Slave Lake Airport ISI and BUI values applied to boreal spruce (C2) fuel type to give an approximate rate of spread of 80 metres per minute and Intensity Class 6 wildfire behaviour.

Head Fire Intensity Calculations

A variety of methods were used to estimate HFIs for SWF-065 as it quickly burned through boreal spruce the hour before entering the Town of Slave Lake.

1. **Relationship between Flame Length and Fire Intensity (**courtesy of the Canadian Forest Service*)*

In the wildfire science literature, theoretical relationships have been developed between flame lengths and fire intensity. While not perfect, these relationships have been used to estimate frontal fire intensity levels. This technique was employed to obtain estimates of HFI for SWF-065 using flame lengths estimated from photographs, post-burn char heights, and focusing on the most intense wildfire behaviour period between 16:30 and 17:30 on May 15.

During this period, SWF-065 burned in continuous black spruce as it approached and burned past the Visitor Information Centre moving toward the Town of Slave Lake.

The relationship between flame length (*L*) and intensity (I_B) is defined by the following equation:

$I_B = 230L^{1.5}$, where *L* is in metres and I_B is in kilowatts per metre.

Flame lengths were difficult to observe during the major run of SWF-065 on May 15 because the strong winds caused the column to be almost flat. However, ground photography from the area of the Visitor Information Centre and around the Town of Slave Lake indicates flame lengths in the range of 10 to 30 metres:

- For a flame length of approximately 10 m, I_B=7,300 kilowatts per metre.
- For a flame length of approximately 30 m, I_B=38,000 kilowatts per metre.

Therefore, based on the flame length technique, frontal fire intensity levels would be in the range of 7,300 to 38,000 kilowatts per metre.

2. **Canadian Fire Effects Model** (courtesy of the Canadian Forest Service)

The Canadian Fire Effects Model (CanFIRE) is a stand-level model that integrates wildfire behaviour and wildfire ecology to simulate physical and ecological wildfire effects in Canadian forests. Wildfire behaviour simulation is driven by FWI System parameters, fuel type, and fuel load information. Rate of fire spread is calculated using the FBP System. The CanFIRE model uses new fuel consumption algorithms and calculates wildfire intensity using Byram's model.

The CanFIRE model was used with the forest inventory plot data gathered by Sustainable Resource Development to estimate fuel consumption and wildfire intensity levels for the Flat Top Complex, and it was designed to calculate fuel consumption and remaining post-fire fuel load by inputting pre-fire fuel load and FWI parameters. In this case, the model was run in a trial-and-error method using the FWI data from May 15 and by repeatedly adjusting input fuel loads (forest floor, dead woody debris, and total tree biomass) until the post-fire fuel remaining was the same as Sustainable Resource Development's field data. The fuel consumption of all three fuel components at that point was summed for total fuel consumption. An ROS of two kilometres per hour and three kilometres per hour were used to represent the range of conditions measured on that day. The HFI was calculated using the rate of spread and fuel consumption values, and the latter were adjusted to account for fuel consumption loss during flaming combustion only. In this way, the calculated wildfire intensity would most accurately represent conditions at the head of the fire. Fuel consumption in the flame front was estimated as 20% of total forest floor fuel consumption, 20% of total dead woody debris fuel consumption, and 95% of total tree biomass consumption.

Results from the CanFIRE analysis, based on total fuel consumption of 6.19 kilograms per square metre for the boreal spruce (C2) fuel type, 3.35 kilograms per square metre for the aspen (D1/D2) fuel type, and 5.04 kilograms per square metre for the mixedwood (M1/M2) fuel type (50% conifer and 50% deciduous), gave the HFI estimates for rates of spread of both 2 and 3 kilometres per hour represented in Table 11.

CanFIRE Head Fire Intensity Estimates

Fuel Type	2 km/hr Rate of Spread	3 km/hr Rate of Spread
Boreal Spruce (C2)	22,500 kW/m	38,800 kW/m
Aspen (D1/D2)	6,600 kW/m	10,000 kW/m
Mixedwood (M1/M2)	16,600 kW/m	28,100 kW/m

Table 11 – CanFIRE Head Fire Intensity estimates for two different rates of spread (CanFIRE analysis courtesy of the Canadian Forest Service).

3. *Field Guide to the Canadian Forest Fire Behaviour Prediction (FBP)* System

Based on the weather measurements from Slave Lake Airport for May 15, which result in a Buildup Index (BUI) of 48 and an Initial Spread Index (ISI) of 83, the Red Book estimates the following rates of spread in Table 12.

Red Book Estimates for Rate of Spread

Fuel Type	Rate of Spread
Boreal Spruce (C2)	80 metres per minute (4.8 km/hr)
50% Mixedwood (M1/M2)	54 metres per minute (3.24 km/hr)

Table 12 – Estimates of rates of spread in both boreal spruce and mixedwood fuel types using the Red Book (*Field Guide to the Canadian Forest Fire Behaviour Prediction (FBP) System*).

4. Prometheus (Canadian Wildland Fire Growth Model)

The Prometheus model was used to estimate HFI levels for SWF-056 and SWF-065 on both May 14 and 15. During the critical runs of both wildfires on the afternoon of May 15, this model predicted Intensity Class 6 wildfire behaviour (>10,000 kilowatts per metre) for both. Mean HFI levels of 14,942 kilowatts per metre and 27,795 kilowatts per metre were calculated for SWF-056 and SWF-065, respectively.

HFI calculations summary

Although the intensity values are estimates, they provide an indication of the severe wildfire conditions experienced. All the methods used above reflect agreement on the significant wildfire intensity levels reached by the Flat Top Complex wildfires, particularly on the afternoon of May 15. Even without significant levels of fuel consumption and given the short period after snowmelt, the strong winds created high rates of spread and prolific downwind spotting.

OBSERVED WILDFIRE BEHAVIOUR FOR THE FLAT TOP COMPLEX AREA

Historical spring wildfire patterns in the Lesser Slave Area illustrate the flammability of the forest fuels during the month of May and the potential for community impact, such as smoke drift, health and safety issues, and structural damage.

Observed Wildfire Behaviour for SWF-056

Wildfire behaviour characteristics of SWF-056 were influenced by sustained southeast winds at the time of detection (May 14 at 13:25) and initial attack. The wildfire originated in a cutblock that was harvested in late 2009. Fine slash and grass fuels in the cutblock supported rapid wildfire spread during the first burning period. Spread direction was upslope to the northwest towards Grizzly Ridge. On May 14, approximately 1,000 hectares burned in a wind-driven elliptical pattern (Figure 69). The wildfire behaviour characteristics on May 15 were dominated by strong southeast winds. Both short- and long-range spotting were observed throughout the burning period.

The wildfire eventually breached Highway 2 and prolific ember transport ignited multiple structures in Canyon Creek and Widewater. A detailed description of the wildfire behaviour on May 14 and 15 is provided as follows:

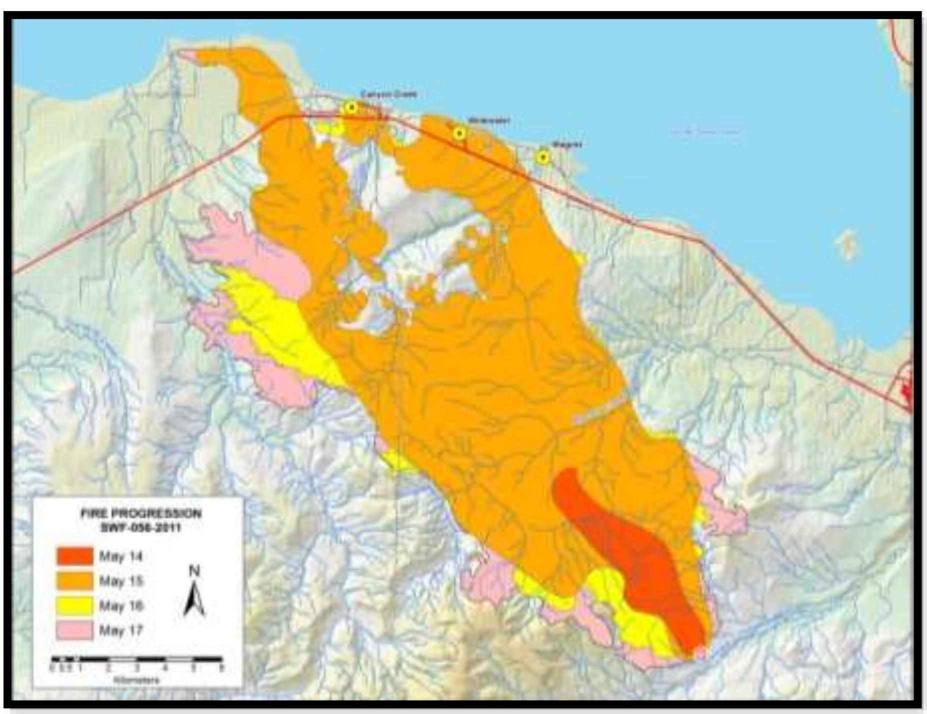


Figure 69 – Wildfire progression on SWF-056 from May 14 to May 17, 2011.

May 14

SWF-056 was detected at 13:25 on May 14, approximately 20 kilometres south of Wagner (Figures 70 and 71). Grass fuels and strong winds supported rapid fire growth to the northwest throughout the afternoon and evening burning period. By 16:34, SWF-056 had grown to approximately 30 hectares in size, exhibiting Intensity Class 4 in slash and grass fuels, and burning upslope towards Grizzly Ridge. By the end of the burning period on May 14, SWF-056 had spread approximately eight kilometres to the northwest.

Figure 70 – SWF-056 origin in a recent cutblock spreading northwest on May 14. Note the Town of Slave Lake in the upper left corner (see red arrow).

May 15

By mid-morning on May 15 (Figure 72), an active wind-driven column was developing on SWF-056. Combined airtanker and ground operations were not able to contain the wildfire because of extreme spotting. At 13:15, the Group 2 Air Attack Officer indicated the wildfire had crested a hill to the northwest at close to the midway point to the head. There was no longer a solid perimeter, rather a collection of spot fires that were independently growing with several patches of unburned fuel within. The winds were steady at approximately 60 kilometres per hour. The wildfire length-to-breadth ratio was 6:1 at that time, and the size was confirmed at 1,000 hectares. Rates of spread in the cutblocks were approximately five metres per minute and the Air Attack Officer observed the dozer guard was beginning to fail by about 12:30. At the right flank in the grass (01) fuel understory, rates of spread were between five and ten metres per minute. Towards the head, rates of spread were estimated using low-lying (horizontal) smoke drift and the lack of an organized fire front. The main concern was multiple spot fires at the head. By 13:27, the eastern flank of the wildfire was Intensity Class 5/6, with a large convergence of spot fires identified approximately four kilometres from the morning perimeter (Figure 73). At 14:39 the east flank was burning into mixedwood (M1) fuel type with a balsam fir understory (Figure 74). At 16:25, spot fires were observed 1–1.5 kilometres ahead of the main wildfire front (Figure 75). Helicopter bucketing

Figure 71 – SWF-056 at 16:22 on May 14 illustrating an elliptical wind-driven burning pattern in slash fuels with a grass component.

was not effective on these spot fires. SWF-056 continued to spread rapidly northward, splitting into two flame fronts while moving around a large area of leafed-out aspen. The wildfire approached Highway 2 at 19:30. By 20:23 the eastern front had spotted, with long range ember transport, into Widewater and structures were burning (Figure 76). The wildfire eventually spread into Canyon Creek.

Figure 72 – SWF-056 at 10:30 on May 15 being driven by strong southeast winds.

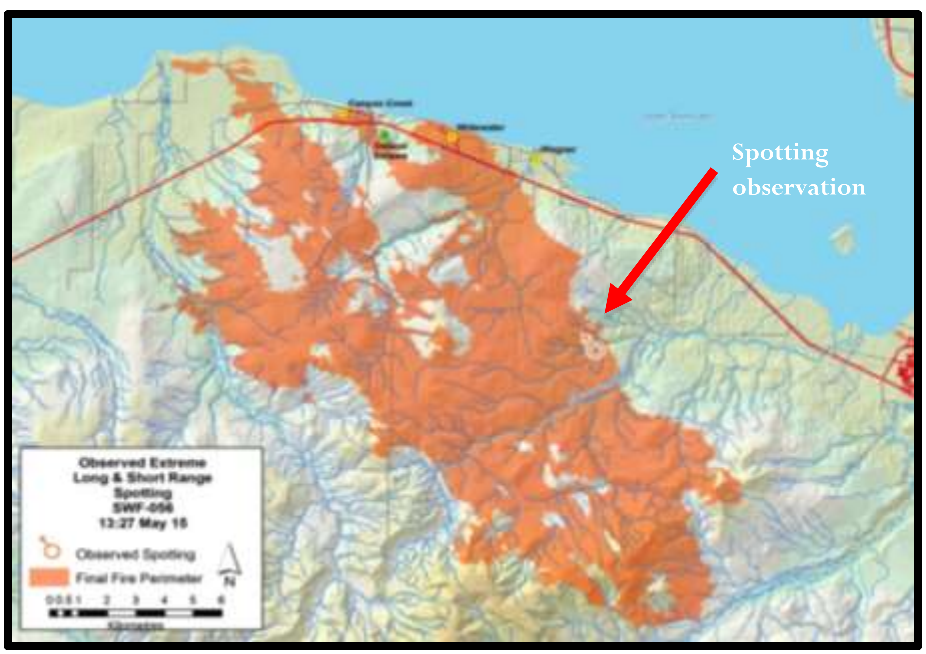


Figure 73 – Fire front and long-range spotting observation at 13:27 on the east side of SWF-056.

Figure 74 – East flank of SWF-056 burning in the mixedwood (M1) fuel type with a balsam fir understory at 14:39.

Figure 75 – Looking southeast from Osland Estates at a spot fire between the main fire (1.5 kilometres ahead) and Osland Estates at 16:25.

Figure 77 shows the essentially flat nature of the wind-driven column on SWF-056 at 18:21. The horizontal layer of cloud above the column is a pileus ice cloud; usually an indicator of violent updrafts which push convective heat above the smoke column forming short-lived ice clouds.

Figure 76 – Structure loss in Widewater on May 19.

Figure 77 – Looking east at 18:21 on May 15 as the wind-driven convection column smokes in south shore communities.

INFLUENCE OF INTERFACE FUELS ON WILDFIRE BEHAVIOUR FOR SWF-056

SWF-056 spotted across Highway 2 into the Hamlets of Canyon Creek and Widewater (Figures 78, 79, and 80) on the evening of May 15. A variety of wildland fuels within and adjacent to the hamlets contributed to spot fires, multiple ignitions, and rapid fire spread to structures, creating challenges for Sustainable Resource Development wildfire resources and other emergency responders.

Fuels were continuous adjacent to the developed portions of the hamlets. Within the hamlets, wildland fuels were interrupted by roads, driveways, maintained lawns, and various forms of infrastructure (Figures 79, 80, 81, and 82).

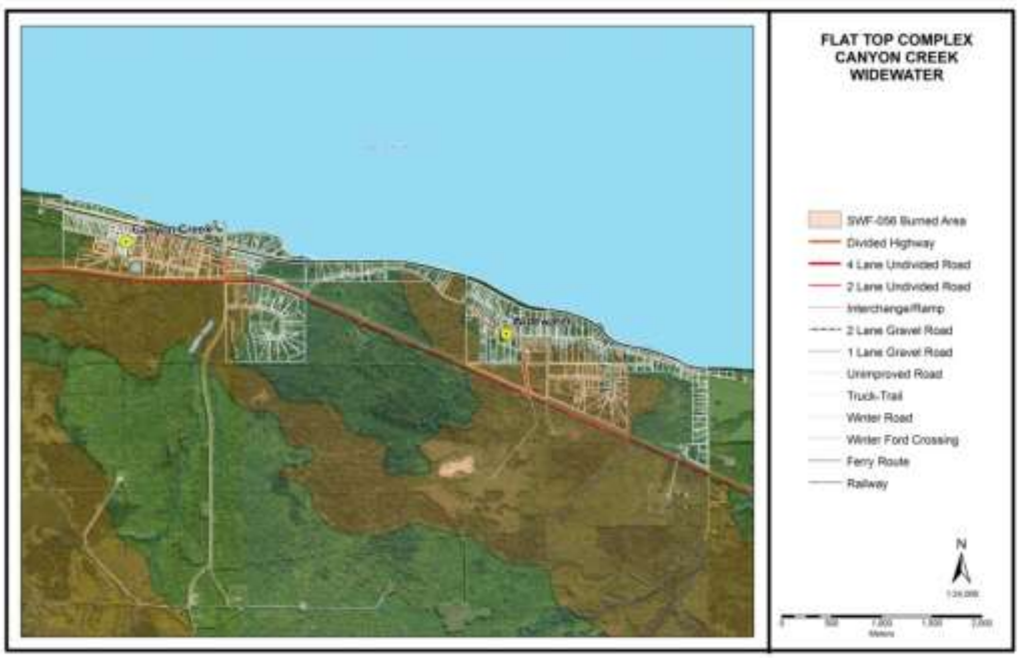


Figure 78 – The Hamlets of Canyon Creek and Widewater were located amongst flammable forest fuels. Note the wildfire perimeter that follows the mixedwood fuel type into the communities.

SWF-056 approached the communities from the southeast spreading quickly and intensely through strips of mixedwood fuels (Figures 83 and 84) and the conifer understory in deciduous stands. The wildfire eventually spotted across Highway 2 into residential developments.

Cured grass in unmaintained open areas, varying amounts of dead and downed woody fuel in aspen (D1), and mixedwood (M1) stands supported immediate ignition from falling embers and rapid wildfire spread on May 15. For the most part, maintained lawns did not sustain ignition or appreciable wildfire spread; however, grass accumulations along fence lines, ditches, railway rights-of-way, and in rows of trees between properties allowed the wildfire to wick between larger areas of forest fuels (Figure 85). In many cases these fuels were in close proximity to homes and other structures, resulting in ignition from flame contact (Figures 86, 87, and 88).

Figure 79 – Canyon Creek in the lower right corner. Highway 2, and a new subdivision (on the left).

Figure 80 – Widewater developments illustrating defensible areas (areas that include a structure and immediate surroundings where the chance of ignition by wildfire or flaming embers is reduced).

In contrast to SWF-065 and the Poplar Estates subdivision, there were very few black spruce (C2) stands in the vicinity of Canyon Creek and Widewater. The fuel types of most concern were the aspen (D1) stands with dense coniferous understory and the mixedwood (M1) stands with a high coniferous percentage and a dead balsam fir understory. These fuels contributed to high wildfire intensity and long-range spotting into the communities.

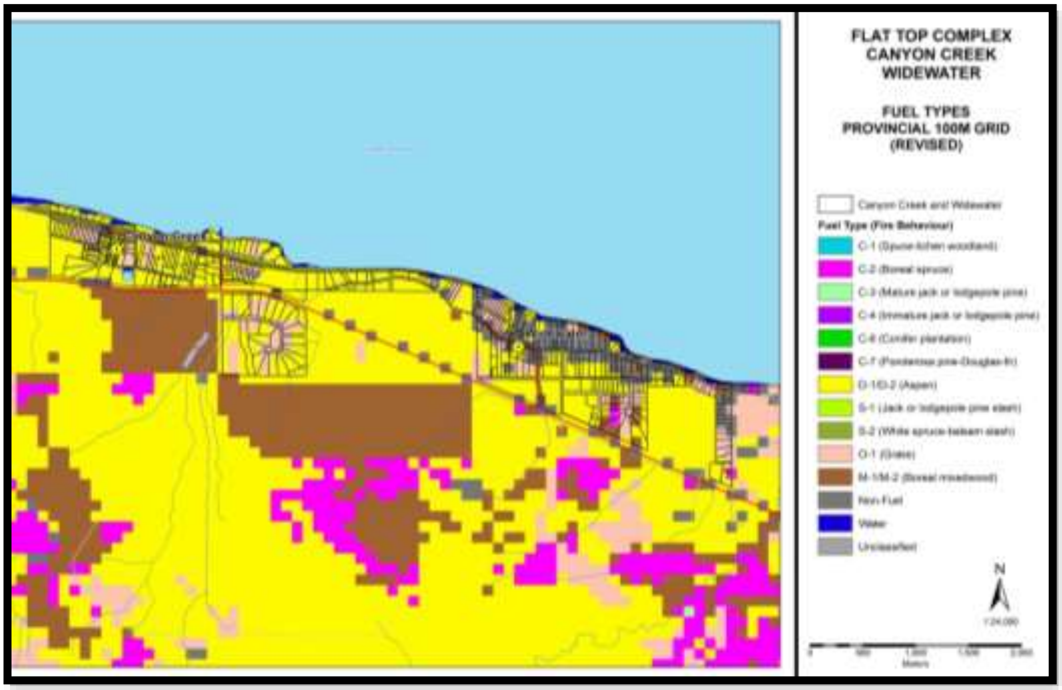


Figure 81 – Revised 100-metre provincial fuel grid for Canyon Creek and Widewater.

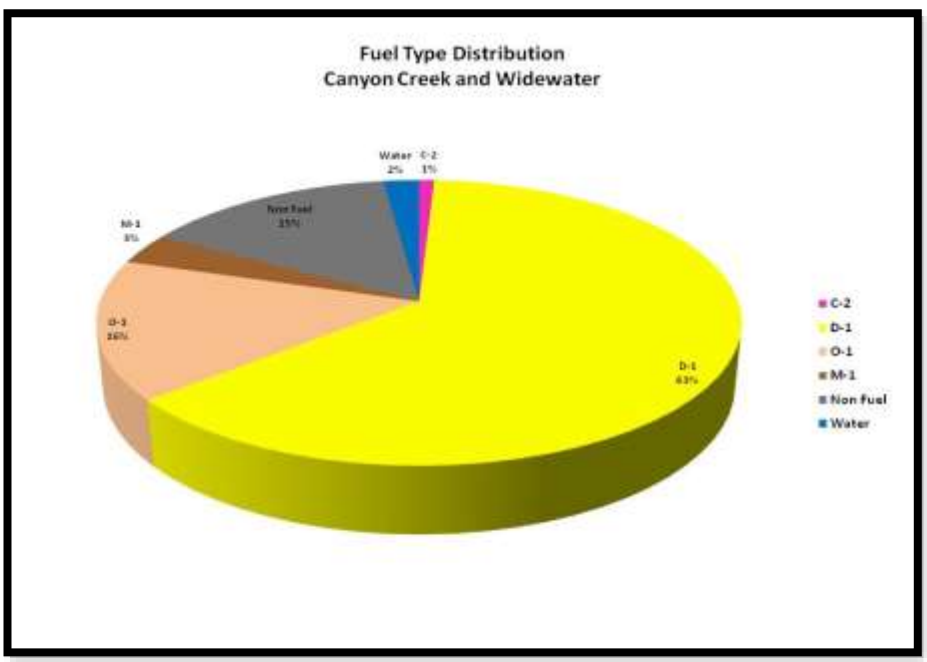


Figure 82 – Fuel type distribution for Canyon Creek and Widewater. Non-fuel and water proportions are over-represented and D1 (aspen) fuel types contained a significant conifer understory.

Figure 83 – Strip of high coniferous content mixedwood (M1) fuels between Highway 2 and the west end of Widewater.

Figure 84 – Strip of high coniferous content mixedwood (M1) fuels south of Highway 2 and Canyon Creek.

Figure 85 – Open areas of grass where fuel loading was reduced did not sustain wildfire spread. Evidence of wicking in grass accumulation along right-of-way (Canyon Creek) was noted.

Figure 86 – Structures in close proximity to mixedwood (M1) fuels ignited by flame contact (Widewater).

Figure 87 – Wildfire followed fuel accumulations along tree lines and ignited structures (Canyon Creek).

Figure 88 – Mixedwood (M1) fuel type with high amounts of dead and downed woody material and unmaintained grass areas.

Observed Wildfire Behaviour for SWF-065

The origin of SWF-065 in flammable coniferous fuels dominated by black spruce and strong southeast winds supported a crown fire that immediately escaped initial attack. The wildfire spread quickly into residential developments on the east and west sides of Mitsue Road with suppression efforts continuing throughout the night in the Poplar Estates subdivision. On May

15, this wildfire was the number one priority in the Lesser Slave Area and aggressive suppression continued until extreme wildfire behaviour and wind velocities created unsafe conditions for emergency responders. The following sections provide a detailed description of the wildfire behaviour on May 14 and 15.

<u>May 14</u>

SWF-065 (Figure 89) was detected at 17:50 (Figure 90) on May 14, burning in mature black spruce approximately two kilometres southwest of Mitsue Lake. Initial attack began at 18:06. Under the influence of strong southeast winds, the wildfire crowned immediately, exhibiting extreme wildfire behaviour, and quickly spread west into private land developments east of Mitsue Road. By approximately 18:45, the wildfire reached and jumped Mitsue Road (a distance of approximately three kilometres), spreading into Poplar Estates (Figures 91, 92, and 93). This wildfire remained active throughout the night as suppression efforts continued in the residential area. Wildfire suppression efforts were complicated by the large amounts of anthropogenic fuels in this area.

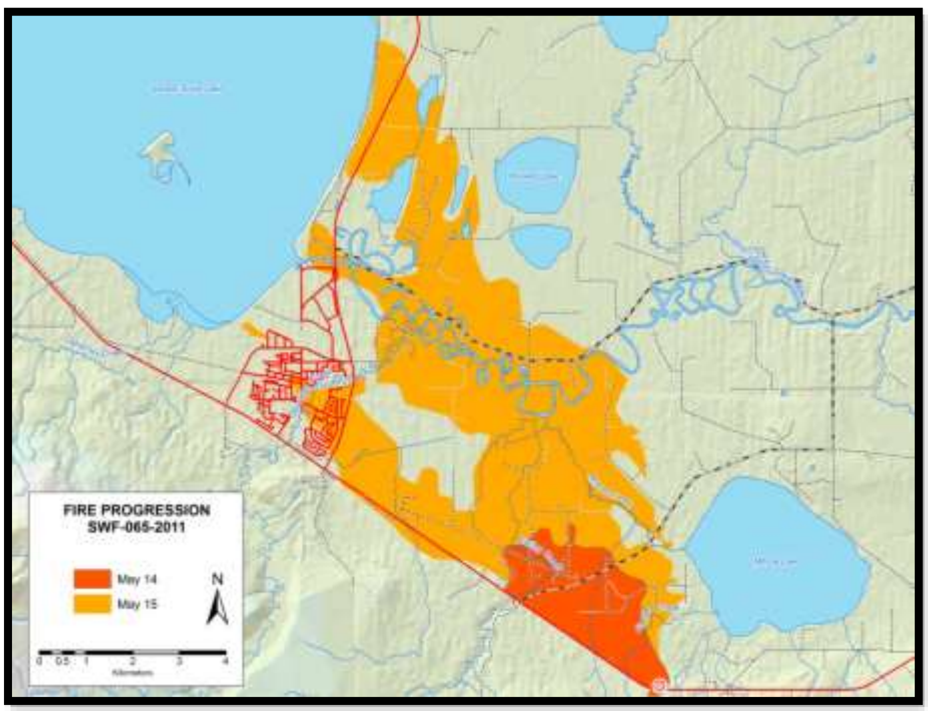


Figure 89 – SWF-065 progression map on May 14 and May 15 illustrating the south and north fingers of the wildfire.

Figure 90 – SWF-065 shortly after detection at 17:50 on May 14.

Figure 91 – SWF-065 at 18:54 on May 14 after spotting into Poplar Estates, close to Mitsue Highway. The low-lying smoke column created operational and safety challenges.

Figure 92 – SWF-065 at 19:07 on May 14 illustrating the extensive spotting ahead of the fire front.

Figure 93 – SWF-065 at 22:13 on May 14 driven by strong southeast winds that continued on May 15.

May 15

SWF-065 was relatively quiet throughout the morning of May 15 (Figure 94) while both SWF-056 and SWF-057 (north of the Town of Slave Lake) were developing convection columns. Shortly before 15:00, wind gusts began to increase wildfire intensity, and two fingers of the wildfire developed and spread towards the Town of Slave Lake (Figures 95 and 96). The north finger was more vigorous at this time because it was free burning, while the south finger was receiving active air attack along Highway 2 (Figure 97). The wildfire continued to burn in black spruce and in harvest residue on private land (slash) along the highway. Retardant drops succeeded in lowering wildfire intensity for a short period. When air attack was shut down because of winds, the south finger gained momentum in black spruce fuels, reaching the Visitor Information Centre road at 16:45 (Figure 98). After slowing slightly while burning around the Visitor Information Centre, the south finger then gained momentum spreading directly towards the Town of Slave Lake (Figure 99). At approximately 17:25, extreme short-range spotting began igniting structures in the Town of Slave Lake before the wildfire reached Highway 88 (Figures 100 and 101). SWF-065 began progressing towards the business district at 17:42. By 19:54, SWF-065 had become a structural fire storm in the eastern portion of the Town of Slave Lake (Figures 102 and 103). During a 90-minute period (between approximately 16:00, when air attack was discontinued from Slave Lake Airport, and 17:30), the wildfire travelled about 3.3 kilometres. This translated to an average spread rate of 2.2 kilometres per hour. The wildfire spread from the Visitor Information Centre (16:45) to Highway 88 (17:30) at 3.2 kilometres per hour (a distance of 2.4 kilometres).

Figure 94 – Looking northwest from Mitsue Lake to the Town of Slave Lake at 11:52 on May 15 showing minimum wildfire activity on SWF-065 (white arrow). Early wildfire intensity development on SWF-056 is visible in the upper left corner (red arrow).

Figure 95 – SWF-065 in the foreground beginning to exhibit increasing wildfire intensity, and SWF-056 in the background illustrating extreme wildfire behaviour at 14:21 on May 15.

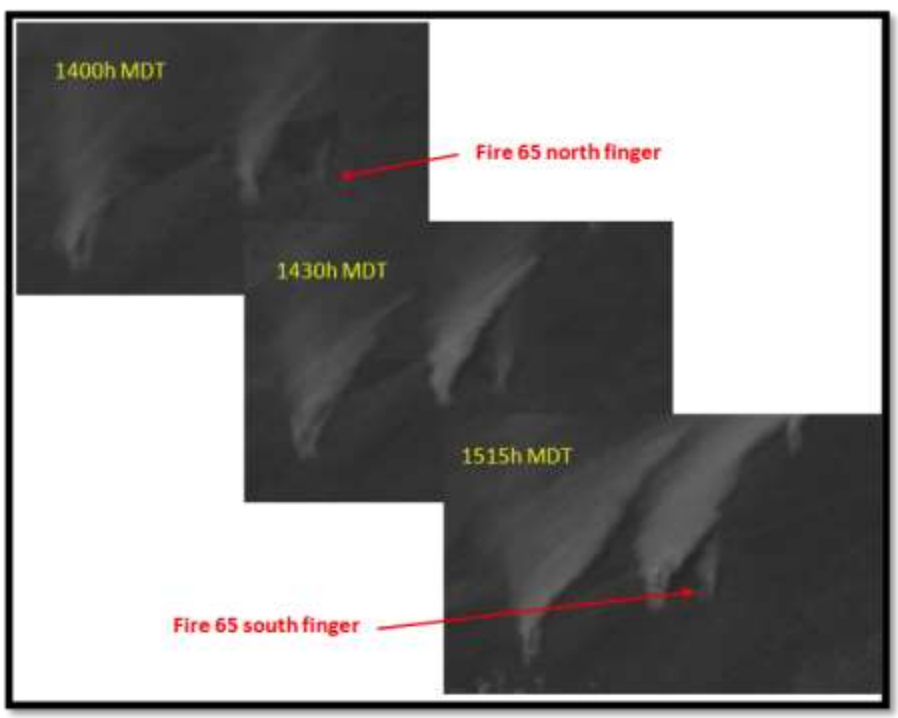


Figure 96 – Geostationary Operational Environmental Satellite (GOES) image illustrating the rapid development of SWF-065 on the afternoon of May 15 including the formation of two distinct fingers.

Figure 97 – Electra airtanker retardant drop at 14:25 along Highway 2 on the south finger of SWF-065 (May 15).

Figure 98 – SWF-065 breaches the Visitor Information Centre access road at 16:45, two kilometres east of the Town of Slave Lake (May 15).

Figure 99 – SWF-065 progressing towards the business district of the Town of Slave Lake as a result of spotting and structure-to-structure radiation heat transfer at 17:42 (May 15).

Figure 100 – SWF-065 adjacent to Highway 2, one kilometre from the Town of Slave Lake (May 15).

Figure 101 – SWF-065 approaches Highway 88 and the Town of Slave Lake at 17:09 (May 15).

Many responders noted the significant short-range spotting ahead of the wind-driven fire front. The combination of forest fuels and anthropogenic fuels from residential developments produced unprecedented ember transport. Figure 104 illustrates the spotting density recorded on a boat tarp just across Highway 88. Burn holes translated to approximately 900,000 embers per hectare. Presumably the burn holes were a total of both the first wave of forest fuel spots from east of Highway 88 and some additional spots resulting from the burning of the first row of structures.

Figures 105 and 106 provide a perspective on the progress of SWF-065 on the afternoon of May 15. Figure 105 focuses on the area of black spruce and slash fuels between Highway 2 and the Poplar Estates residences when the wildfire began to exhibit increasingly intense wildfire behaviour at about 14:30. Figure 106 shows black spruce fuels in the area between the Visitor Information Centre and Highway 88 where the wildfire gained momentum and crossed the drainage ditch south of Highway 88 before burning to the highway and spotting into the Town of Slave Lake. Both figures provide visual evidence of the intense wildfire behaviour exhibited in fuel types dominated by black spruce.

Figure 107 is a post-burn Landsat image that provides a broader perspective on the development of SWF-065. It shows the small, seemingly less significant size of the southern finger of SWF-065 compared with the northern finger. It also illustrates the narrow path followed by the wildfire into the Town of Slave Lake.

Both short-range and long-range spotting is a common outcome of high-intensity crown fires. Although longer-range spotting creates wildfire control challenges, short-range spotting is a significant factor in wildfire spread because a large number of firebrands are deposited just ahead of the flaming front. These new wildfires quickly join and are drawn into the fire front, creating a pulsing influence on spread.

Figure 102 – SWF-065 became a structural fire storm at 19:54 in the eastern portion of the Town of Slave Lake on May 15.

Figure 103 – Fire storm in the Town of Slave Lake at 22:13 with sustained winds over 80 kilometres per hour on May 15.

As a result of extreme sustained wind velocities and associated wind gusts on May 15, extreme short-range spotting played a major role in wildfire spread and likely extended the wildfire further downwind than would be the case if the fire were driven by a convection column. The flat smoke column on SWF-065 made it difficult to identify the position of the fire front, particularly as the wildfire approached the Town of Slave Lake. Extreme downwind spotting with a high percentage of relatively large firebrands ignited structures in the Town of Slave Lake, while the fire front was still approximately 0.5 kilometres upwind.

Figure 104 – Spotting density on a boat tarp in the eastern subdivision of Slave Lake converts to 900,000 firebrands per hectare (left) and extreme spotting characteristics of coniferous crown fires and the production of embers (right).

Figure 105 – Post-burn illustration of the narrow strip of black spruce east of the Visitor Information Centre and adjacent to Highway 2 that carried the wildfire towards the Visitor Information Centre. Note the red remnants of retardant from airtanker drops.

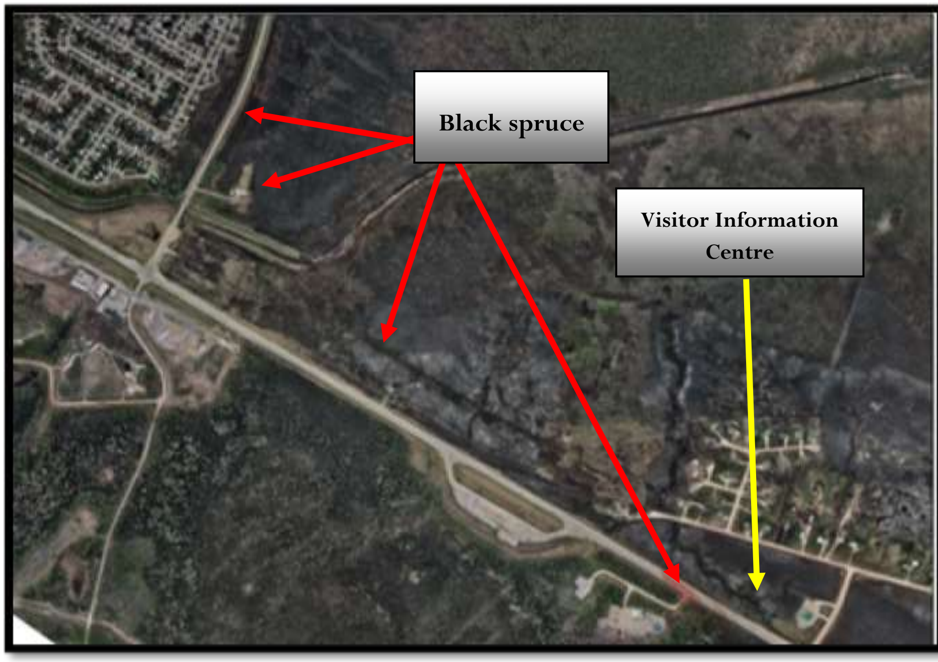


Figure 106 – Post-burn illustration of the black spruce fuel type leading from the Visitor Information Centre to Highway 88.

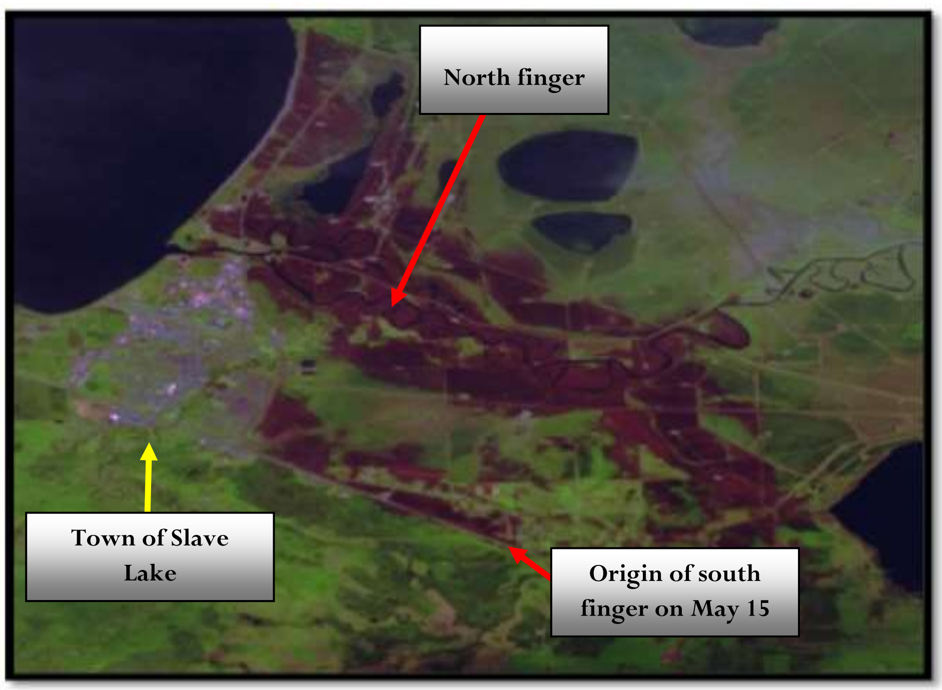


Figure 107 – Post-burn Landsat image of SWF-065 illustrating the narrow strip of black spruce adjacent to Highway 2 that carried the wildfire towards the Town of Slave Lake on May 15.

<u>May 17</u>

Post-burn aerial photographs of SWF-065 clearly reflect varying degrees of wildfire intensity within the perimeter (Figures 108 and 109). The most intense burning occurred in the black spruce stands on the afternoon of May 15, including the area east of the Visitor Information Centre and the area between the Visitor Information Centre and Highway 88. Very patchy burning was evident in Poplar Estates and the acreages south of the Town of Slave Lake.

Figure 108 – Pattern of the north finger illustrating the wildfire selectively burning the boreal spruce (C2) fuel type (photo taken on May 17).

Figure 109 – Looking northwest from the origin of SWF-065 towards Poplar Estates and the Town of Slave Lake. Note the patchwork of fuel types and the division of the south and north fingers, in addition to retardant lines (photo taken May 17).

INFLUENCE OF INTERFACE FUELS ON WILDFIRE BEHAVIOUR FOR SWF-065

SWF-065 ignited on the east side of Mitsue Road on the afternoon of May 14 and, by the evening of May 15, residential and industrial structures were destroyed in Poplar Estates and the Town of Slave Lake. The wildfire behaviour was primarily influenced by a significant wind event that began on May 11 and continued through to May 15. The fine forest fuels (cured grass and other minor surface vegetation) had extremely low moisture content values. In contrast, medium and heavy fuel moisture content values were fairly high, and the soil horizon was still frozen in some areas. This section focuses on the initial wildfire behaviour and impact in Poplar Estates, as well as the factors contributing to the initiation of the fires run into the Town of Slave Lake on May 15.

SWF-065 spotted into Poplar Estates (Figures 110, 111, and 112) on the evening of May 14. A variety of wildland fuels within the community (Figures 113 and 114) contributed to spot fires spreading to structures. Multiple ignitions and rapid spread to structures in Poplar Estates challenged both Sustainable Resource Development wildfire crews and Lesser Slave Regional Fire Service crews. Anthropogenic fuels contributed to random fire spread that ultimately reached the black spruce fuel type east of the Visitor Information Centre and then ran into the Town of Slave Lake.

Fuels were continuous in the undeveloped portions of Poplar Estates; however, in the developed area, wildland fuels were interrupted by roads, driveways, maintained lawns, and various forms of infrastructure (Figures 110 to 119).

Cured grass in unmaintained open areas, as well as varying amounts of dead and downed woody fuel in aspen (D1) (Figure 115) and mixedwood (M1) stands (Figures 116, 117, and 118) allowed immediate ignition from falling embers and rapid, fairly high-intensity wildfire spread on May 14. For the most part, maintained lawns and fields where agricultural activities had taken place had reduced fuels and did not sustain ignition or appreciable wildfire spread. Unmaintained grass along fence lines, ditches, and in rows of trees between properties allowed fire to wick between larger areas of forest fuels. In many cases, these fuels were in close proximity to homes and other structures resulting in ignition from radiant heat (Figure 117).

Of most concern were the black spruce (C2) stands (Figures 110 and 119) that extended from the middle of Poplar Estates parallel to Highway 2, past the Visitor Information Centre towards the Town of Slave Lake. The extreme wind conditions contributed to the wildfire spotting into the west end of Poplar Estates and its continued spread into the Town of Slave Lake. Spread rates of over two kilometres per hour and Intensity Class 6 wildfire behaviour were documented throughout the event.

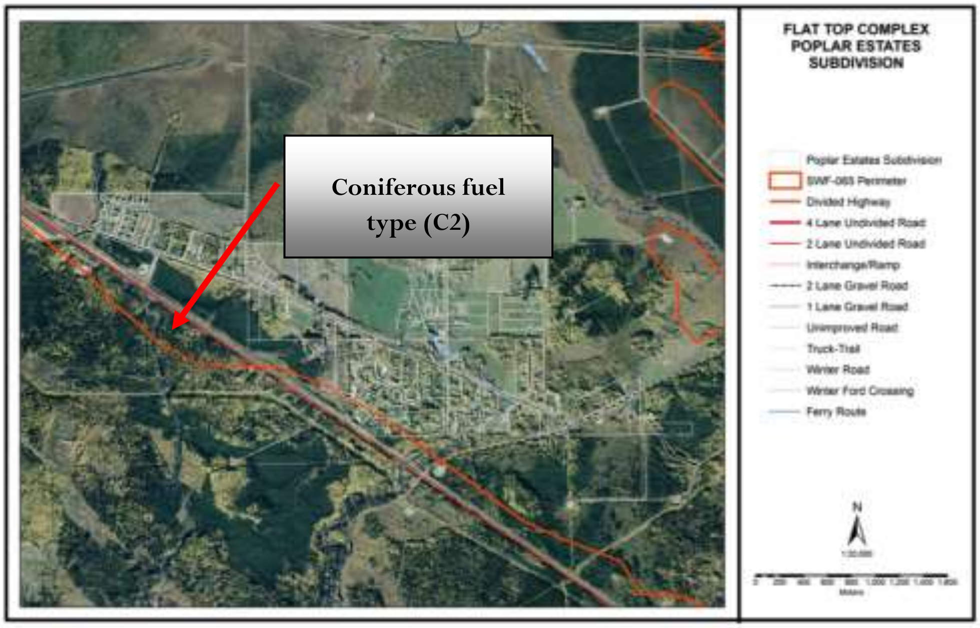


Figure 110 –Image of Poplar Estates. Note the coniferous (C2) fuel type adjacent to Highway 2, directly east of the Town of Slave Lake.

Figure 111 – The west end of Poplar Estates in the background with the Visitor Information Centre and Highway 2 in the foreground.

Figure 112 – The east end of Poplar Estates near the origin of the wildfire run on May 15 (adjacent to Highway 2).

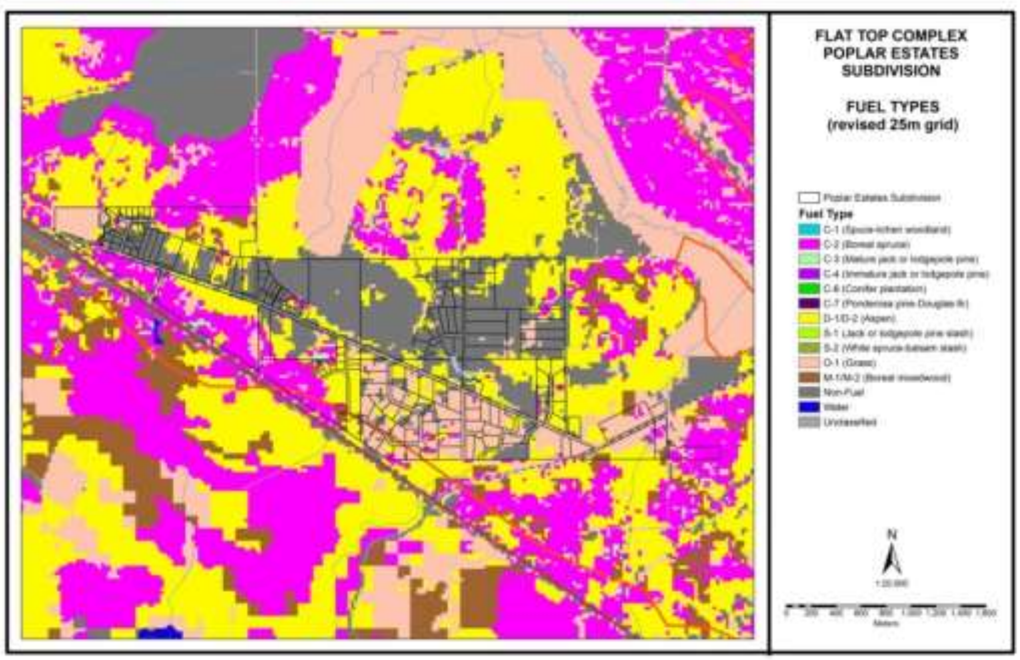


Figure 113 – The revised 25-metre fuel grid for Poplar Estates. The area north of Poplar Estates was classified as non-fuel; however, it contained cured grass.

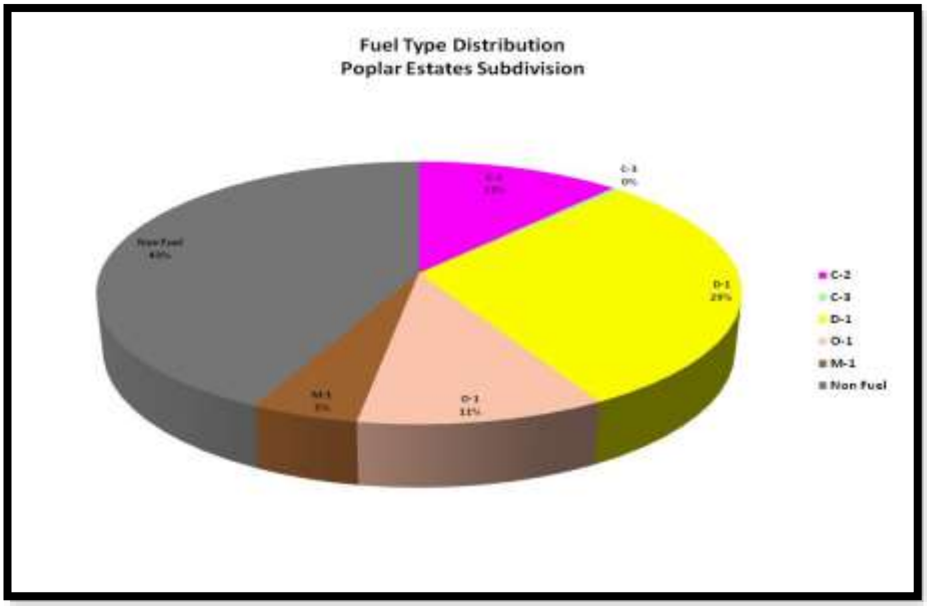


Figure 114 – The fuel type distribution in Poplar Estates; the non-fuel proportion is over-represented.

Figure 115 – Typical aspen (D1) fuels within Poplar Estates that provided opportunity for fire to spread from property to property (left). Accumulation of grass under aspen allowed easy ignition and rapid fire spread (right).

Figure 116 – Open areas of grass where fuel loading was reduced did not sustain fire spread. However, there is evidence of wicking in grass accumulations along the fence line (left) and in typical mixedwood (M1) fuels within Poplar Estates, providing both wildfire spread and spotting opportunities (right).

Figure 117 – Common combustible fuels associated with residential developments were responsible for wicking wildfire into structures (left). Wicking adjacent to Highway 2 towards the Visitor Information Centre (right).

Figure 118 – Mixedwood fuel type (burned over) with high amounts of dead and downed woody material that contributed to wicking into a FireSmart residence.

Figure 119 – Typical black spruce (C2) fuels within Poplar Estates.

INFLUENCE OF INTERFACE FUELS IN THE POPLAR ESTATES

Rural residential communities are developing near larger communities in the forested areas of Alberta. Poplar Estates is an example of a wildland–urban interface area (Figure 120) where wildland fuels support wildfire ignition and spread. Wildfire behaviour in these wildland fuels can be predicted and measures taken to mitigate the effect of these fuels. However, anthropogenic development activities add a new and unpredictable dimension to wildfire behaviour.

Communities also contain anthropogenic fuels (Figure 121). Once ignited by either direct flame contact or firebrands, these fuels can have a profound effect on wildfire behaviour in the form of radiant heat, direct flame contact, or creation and transport of firebrands to adjacent structures and other anthropogenic fuels. Their presence can complicate wildfire suppression efforts.

Rural communities can contain industrial or commercial facilities associated with servicing local industries. These areas may also have large amounts of flammable products (e.g., petroleum).

In Poplar Estates, common examples of anthropogenic fuels included outbuildings with flammable exteriors, recreational equipment (boats, all-terrain vehicles, and trailers), vehicles, and machinery. Burning homes and outbuildings produced firebrands that ignited other anthropogenic and wildland fuels within Poplar Estates. Burning shingles, siding, and other materials were spread by the strong southeast winds to neighboring structures (Figure 122).

Figure 120 – Homes, garages, outbuildings, and vehicles common to rural residential communities.

Figure 121 – Machinery and other combustible items that contributed to random fire spread.

Figure 122 – Melted vinyl siding illustrating the potential for it to be blown away by the wind if ignited, thus spreading fire downwind.

WILDFIRE BEHAVIOUR CHARACTERISTICS IN POPLAR ESTATES

SWF-065 escaped initial attack efforts on May 14 as a result of strong, dry southeast winds and immediate crowning in the black spruce (C2) fuel type east of Poplar Estates. Despite aggressive wildfire suppression efforts during the night of May 14 and throughout the burning period on May 15, the strong winds and prolific short-range spotting contributed to the wildfire spreading westward to Highway 88. The strip of black spruce adjacent to Highway 2 east of the Visitor Information Centre began active crowning at approximately 16:00. The fire front that developed ran past the Visitor Information Centre and into the Town of Slave Lake. Strong winds collapsed the convection column east of the Visitor Information Centre and extreme wildfire behaviour commenced, causing wildfire responders to be pulled back to safe areas. The airtanker fleet was also grounded because of high wind speeds. This section of the report focuses on the wildfire behaviour characteristics on May 14 and 15 that contributed to the ignition of the eastern section of the Town of Slave Lake.

Figure 123 – Typical black spruce (C2) fuel type in the Lesser Slave Lake Area illustrating vertical crown continuity.

Black Spruce Fuel Type

Black spruce (C2) stands (aged 75 to 110 years) are a common fuel type in the Lesser Slave Area. Stand density averages about 2,000 stems per hectare. The fuel type understories are usually Labrador tea, *Cladonia*, feather moss, and sphagnum moss. An important feature of a black spruce forest is the continuous and flammable crown layer that extends to the surface allowing rapid ignition (Figure 123). The C2 fuel type was associated with the early wildfire behaviour of SWF-065, initial attack escape on May 14, and the initiation of extreme wildfire behaviour at approximately 16:00 on May 15. This fuel type was also associated with prolific short-range spotting that ignited structures immediately west of Highway 88. The presence of C2 fuel type within two kilometres of communities in Alberta's forested area can affect the success of wildfire suppression.

In 1982, an experimental burning project was carried out at Porter Lake in the Northwest Territories. This study produced wildfire behaviour data for black spruce and woodland lichen fuel type (C1), including measurements for high-intensity crown fires. Although the C1 fuel type is somewhat different from the classic C2 black spruce fuel type in the Slave Lake area, the wildfire behaviour measured in 1982 was very similar to SWF-065 in terms of fuel consumption, rates of spread, and overall Head Fire Intensities (HFI; Figures 124 and 125).

Wicking in cured grass and other fine fuels

Cured grass and other fine fuels were common throughout Poplar Estates, particularly along fence lines, driveways, and property boundaries (Figure 126). Given the strong winds and minimum relative humidity, these linear fuel corridors supported the spread of relatively low intensity surface fire between structural developments. Once surface fires reached anthropogenic fuels, the wildfire intensity increased significantly and short-range spotting was initiated. The exceptional growing season in 2010, resulting from abundant rainfall and above-average temperatures, enhanced the growth of grass fuels contributing to wicking.

Figure 124 – Aerial view of Porter Lake experimental burn (1982) illustrating the black spruce/woodland lichen fuel type (C1).

Figure 125 – Ground view of Porter Lake experimental burn (1982) illustrating wildfire behaviour in black spruce/woodland lichen (C1) fuel type.

Figure 126 – Wildfire wicks along fence lines and unmaintained areas associated with cured grass.

<u>Spotting</u>

The amount of short-range spotting associated with SWF-065 is unprecedented in Alberta and was ultimately responsible for the wildfire breaching Highway 88. Extreme spotting was a function of low fuel moisture, strong winds, a collapsed convection column, fuel types that created embers, and fuels that were susceptible to ignition from those embers (Figures 127 and 128).

Figure 127 – Black spruce east of Highway 88 produced extreme ember showers (spotting) that ultimately ignited structures in the Town of Slave Lake.

Figure 128 – Ember transport (spotting) ignited homes independent of surface fire spread.

<u>Wind-driven convection column</u>

Historically, wildfires in Alberta are defined as convectively driven even though they are associated with strong wind events. A wildfire is said to be convectively driven when the thermal energy of the convection column exceeded the kinetic energy of the wind field. As a result of extreme winds during the Flat Top Complex, the convection column's thermal energy could not overcome the wind field energy. This contributed to smoke issues ahead of the fire front and prolific short-range spotting (Figures 129 to 134).

<u>Initial impact of wildfire spread and operational priorities</u>

Wildfire progression within Poplar Estates influenced suppression strategies and tactics as the following examples show:

- Additional spotting as a result of anthropogenic fuels created multiple fire heads that needed to be controlled to prevent the wildfire from spreading to other structures and homes causing further destruction.
- Several residential sites had other materials that created wicking along unmaintained driveways, fence lines, and property lines and added to the complexity for suppression resources.
- Diversion of firefighting resources from the wildfire perimeter to scattered locations within the subdivision (multiple fire fronts).

Figure 129 – Strong southeast winds with collapsed convection columns on SWF-056 in the background and SWF-065 in the foreground at 15:53 on May 15.

Figure 130 – The location of the initiation of extreme wildfire behaviour on May 15 (left) and during extreme wildfire behaviour (right).

Figure 131 – High-resolution photo of the south finger illustrating the location of the initiation of extreme wildfire behaviour on May 15 (red box).

Figure 132 – Wildfire crowned in black spruce at 15:57 on May 15, east of the Visitor Information Centre, and began a 1.5-hour run into the Town of Slave Lake.

Figure 133 – View of the south finger crowning in black spruce east of the Visitor Information Centre at 15:57. The north finger intensity increased as the black spruce fuel type became involved.

Figure 134 – Structure-to-structure firebrand transport ignited homes in conjunction with surface fire spread.

Observed Wildfire Behaviour for SWF-082

SWF-082 was discovered at 15:50 on May 15, during the critical period when SWF-065 was moving quickly towards the Town of Slave Lake. At 16:35 on May 15, the wind-driven columns from SWF-056, SWF-065, and SWF-082 were converging.

Because of the sustained attack on higher-priority wildfires in the Lesser Slave Area and limited resources, no airtankers were committed to SWF-082 for initial attack. Dozer guard construction commenced on May 16 but was suspended because of excessive smoke and erratic wildfire behaviour. Wildfire suppression actions resumed on May 18.

SWF-082 was mostly a light-burning surface fire in leafless aspen (D1). The wildfire exhibited minimal spread during the May 16–18 period.

CONCLUSIONS

This report describes the behaviour of the Flat Top Complex in May 2011, including the environmental factors and suppression impacts that influenced wildfire spread and intensity. The 2011 fire season in central Alberta developed quickly following snowmelt in early May. Within days, 189 human-caused wildfires ignited across the province and threatened over 23 communities and locations. The Lesser Slave Area was the most active in terms of wildfire activity, with 52 wildfires and several communities threatened. A week before the wildfires of the Flat Top Complex started, the fire danger rating was low; however, the level increased as the week progressed.

Two of the three Flat Top Complex wildfires (SWF-056 and SWF-065) ignited on May 14, and SWF-082 was detected on May 15. During the morning of May 15, the wildfire behaviour of SWF-056 and SWF-082 contrasted with the behaviour of SWF-065. Both SWF-056 and SWF-082 exhibited early morning buildup of wildfire intensity as a result of continuous forest fuels, whereas SWF-065 (which had an overnight fire suppression operation) remained quiet until 14:00. Although strong winds developed early resulting in intense fire fronts on SWF-056 and SWF-082. The non-continuous fuel types and aggressive wildfire suppression operation modified the behaviour of SWF-065 until the fire reached black spruce stands and began to crown on both the south and north fingers. Consequently, the wildfire spotted and ignited structures in the Town of Slave Lake. SWF-056 and SWF-065 were responsible for the combined loss of over 500 structures in the Town of Slave Lake and in the nearby communities of Canyon Creek, Widewater, and Poplar Estates. Key factors that influenced the events of May 14 and 15 included the following:

- Wildfire environment
    - Sustained, extremely high wind speeds from the southeast, combined with low relative humidity
    - Low, wind-driven smoke columns
    - Prolific down-wind spotting
    - Extreme wildfire behaviour
- Resourcing
    - Significant wildfire activity throughout the province
    - Fully committed provincial air and ground resources
- Air operations and initial attack
    - High winds affecting air and ground operations
    - Air space congestion
    - Wildland–urban interface complexities
- Communications
    - High volume of ground and air radio traffic

The 2011 wildfire season across North America demonstrated how destructive and dangerous wildfires can be when they are adjacent to community developments. Despite above-average snowfall in 2010, short-term extreme weather conditions in the middle of May in Alberta resulted in two wildfires that entered communities. This wildfire event was the second most costly natural disaster in Canada's history, with over $700 million in insurable losses. The area burned in the 2011 wildfire season in Alberta was approximately 10 times the five-year average (2006–2010).

At the landscape scale in Alberta, extensive industrial and community growth in a fire-prone environment has created a mosaic of values-at-risk requiring aggressive wildfire protection. The 2011 Flat Top Complex and Richardson wildfires demonstrate fire regimes and impacts are shifting and that Alberta's wildfire management program must adapt to meet these dynamic changes in order to achieve community and industrial development safety and sustainability.

The extent and number of people living and working in wildland–urban interface areas are adding a new dimension to future wildfire management programs. As climate change and aging forests combine to increase wildfire risk, proactive FireSmart prevention planning and funding, public and responder safety initiatives, and timely evacuations will become more critical. The documentation of the wildfire events associated with the Flat Top Complex will be used to enhance wildfire management programs.

APPENDIX A - DOCUMENTATION AND TECHNICAL SUPPORT TEAM

DENNIS QUINTILIO

Dennis worked as a Fire Behaviour Specialist in Alberta for 24 years prior to assuming management positions in 1990.

- From 1967-1974, he was stationed at the Northern Forestry Centre as study leader and worked on early design and implementation of the Canadian Forest Fire Danger Rating System.
- He was appointed Project Leader in 1975 and continued to refine fire behaviour prediction elements of the system through study of large-scale experimental burns.
- From 1980 to 1990, he taught at the Environmental Training Centre which offers a two- year diploma in Forestry, and coordinated all in-service fire management training in Alberta.
- In addition to his teaching responsibilities, Dennis was also a practicing Fire Behaviour Officer and served on the Alberta Forest Service Fire Investigation Team.
- Dennis moved into his role as Director of the Environmental Training Centre in the fall of 1990.
- In 1995, he assumed the position of Executive Director, Forest Management Division, Alberta Lands and Forest Service
- In 1999 Dennis was appointed Executive Director of the Integrated Resource Management (IRM) Division responsible for implementation of IRM in Alberta.

Dennis retired from the government of Alberta in June of 2001 after 34 years of forestry practice and currently provides consulting services (Dennis Quintilio and Associates Ltd.) across Canada with a primary focus on policy level wildfire reviews (Saskatchewan, Yukon, Northwest Territories, British Columbia, Alberta) and FireSmart planning.

He has a B.Sc.F and a M.Sc. degree from the University of Montana and is a member of the Alberta Registered Professional Foresters Association.

GARY MANDRUSIAK

Gary Mandrusiak has been involved with most aspects of wildfire management during his 36 years with the Government of Alberta. His career took him from Forest Officer in a small Ranger District to Wildfire Prevention Officer in the Clearwater Forest Area.

Wildfire Management related activities included:

- Type 1 Incident Command Team Member
- Extended periods as Area and Regional Duty Officer
- Fire Management Training Course Instructor

- Field representative during development of Decision Support Systems
- Steering Committee member – Canadian Wildland Fire Growth Model
- Prescribed fire planning and implementation
- Wildland-urban interface planning and implementation
- Fire management input into Forest Management Plans
- Wildfire investigations and cost recovery
- Crown Officer on civil litigation cases
- Alberta Environment Achievement Award, 2001, Dickson Dam Regional Emergency Operations Team Concept and Implementation
- Premier's Bronze Award, 2003, Conklin Evacuation Team – House River Fire
- Deputy Minister's Award, 2007, R11 Forest Management Planning Team

Upon retirement from ASRD in January 2007, he formed G. Mandrusiak & Associates Ltd., providing a range of wildfire management planning and support services to the Government of Alberta, municipalities and other agencies.

Projects have included:

- Several Prescribed Burn Plans for Clearwater Area
- Monitoring, documentation and post-burn reports
- Wildfire Threat Ranking and Wildfire Preparedness Guides for over 50 multi-residence subdivisions
- Provided various inputs into FireSmart Community Plans for several communities in the Foothills Area
- Completed six FireSmart Community Plans in the Clearwater Area
- Mentoring ASRD staff in FireSmart planning process
- Participated in development of the Southern Rockies Landscape Fire Strategy
- Participated in the 2009 Government of Saskatchewan Fire Program Review
- Currently working with ASRD staff developing a Landscape Fire Strategy for Clearwater Area

MIKE FLANNIGAN

Dr. Mike Flannigan is a professor with the Department of Renewable Resources at the University of Alberta and a senior Research Scientist with the Canadian Forest Service. He received his B.Sc. (Physics) from the University of Manitoba, his MS (Atmospheric Science) from Colorado State University and his PhD (Plant Sciences) from Cambridge University. Mike also completed Meteorologist course MT35 with Environment Canada and worked as a meteorologist for a few years. Dr. Flannigan's primary research interests are fire and weather /climate interactions including:

- Potential impact of climatic change
- Lightning-ignited forest fires
- Landscape fire modelling

- Interactions between vegetation (peat in particular), fire and weather

He was the Editor-in-Chief of the International Journal of Wildland Fire (2002-2008) and has taken on leadership roles with the US National Assessment on Global Change, IPCC, IGBP Fire Fast Track Initiative and Global Change Terrestrial Ecosystems (GCTE) efforts on the global impacts of wildfire. Mike is the director of the recently formed Western Partnership for Wildland Fire Science located at the University of Alberta.

NICK NIMCHUK

Nick Nimchuk has been employed by the Government of Alberta at the Provincial Forest Fire Centre (PFFC) since 1979 as a Fire Weather Meteorologist and assumed his current role as Fire Weather Section Head in 1990. Nick is a 1977 meteorology graduate of the University of Alberta. He also has an extensive background in aviation as a former Royal Canadian Air Cadet Warrant Officer and holds a commercial pilot license.

Nick's service with PFFC commenced during a number of milestone fire seasons in Alberta. He rapidly gained experience in weather forecasting for major wildfire events and in the development and implementation of advanced technology in Alberta's fire management program such as automatic weather station and electronic lightning detection networks. Nick also played a significant role in the development of Alberta's Pre-suppression and Preparedness System (PPS) through extensive training of fire management staff in the Canadian Forest Fire Danger Rating System (CFFDRS) and Canadian Forest Fire Behaviour Prediction (FBP) System. His role in the education and training of fire personnel continued to expand into national level fire behaviour courses with the preparation and delivery of fire weather/behaviour training modules in Alberta and several other provinces and territories.

Nick has authored and co-authored a number of published papers documenting fire weather/behaviour cases studies and lightning detection network performance.

BOB MAZURIK

Bob Mazurik graduated with a Forest Technology Diploma from the Northern Alberta Institute of Technology (NAIT) in 1978. His career with the Alberta Forest Service started in 1977 cruising timber. Over the next few years Bob worked as a Forest Officer in High Level, Kinuso and Peace River.

In 1995, as part of the Land and Forest Regionalization initiative, Bob was appointed to the District Superintendent position of the East Peace District. In May, 1996 he was then appointed to the Position of Regional Forest Protection Officer for the Northwest Boreal Region. This new position was responsible for the Forest Protection program in the Northwest Region from this time until 2008. He continued to work full time in Forest Protection, working as a Wildfire Operation officer and Wildfire Technologist in the Peace Wildfire Management Area with duties including FireSmart Community Protection and Fire and Landscape Planning. In January 2008, Bob took on the role of Provincial Fire Behaviour Specialist with the

Provincial Forest Fire Centre (PFFC) in Edmonton and presently works in that position. The primary duties of this position are:

- Managing and providing support for the Spatial Fire Management System (SFMS) including maintaining the fire behaviour prediction system fuel grid (one of the key elements of SFMS)
- Administration of the Provincial Aerial Ignition Program
- Training and mentoring field staff in the use of fire behaviour models and decision support tools, including becoming the program lead in 2010 of Prometheus the Canadian Wildfire Growth Model,
- Actively participating in prescribed burning and wildfire suppression operations as a Fire Behaviour Analyst (FBAN)

Bob took the Advanced Wildfire Behaviour Course in 1986 and then the Wildfire Specialist Course in 1997. He has been an FBAN on a number of prescribed fires including Mt Nestor, Mt Buller near Banff and Archer Lake north of Fort McMurray which was completed to study the effects of Mountain Pine Beetle on fire behaviour. He has worked extensively as an FBAN at the Fire Centre level assisting the Area Duty Officer during pre-suppression and suppression operations. Bob was assigned the role of the FBAN on the Flat Top Complex in May 2011. Presently he is a faculty member for the Western Cadre of the Advanced Wildfire Behaviour Course, the Advanced Wildfire Behaviour Specialist course, and is the Primary Instructor in Alberta for (SFMS) Alberta's Pre-Suppression planning tool. In 2010 he became the Chair for the Prometheus Wildfire Growth Model course.

Bob is an active member of the College of Alberta Professional Forest Technologists.

BRIAN J. STOCKS

Brian worked in forest fire research for the Canadian Forest Service in Sault Ste. Marie, Ontario for 35 years between 1967 and 2002:

- During the 1970s and 1980s, as a study leader and project leader, his research focused primarily on field investigations of fire behaviour, through the conducting of experimental burning programs in major Canadian fuel types that contributed directly to the development of the Canadian Forest Fire Behaviour Prediction System.
- Beginning in the late 1980s he became increasingly involved, as a senior fire scientist, in international, inter-disciplinary research in the area of forest fires and global change, with emphasis on the impacts of climate change on boreal fire regimes.
- During this period he led Canadian scientific delegations on experimental burning projects in Alaska, Siberia, South Africa, and Kenya, and co-coordinated international, multidisciplinary experiments in Canada (e.g., the International Crown Fire Modelling Experiment in Canada's Northwest Territories, and the Ontario Mass Fire Experiment).

- He is the author or co-author of 190 scientific papers covering many aspects of forest fire and global change research, and is an Adjunct Professor of Fire Science in the Faculty of Forestry, University of Toronto.

In 2002 Brian retired as a senior research scientist, and formed a small company to provide consulting services. In this role he has worked on the development of the Canadian Wildland Fire Strategy and many current fire management issues across Canada. During his career he has conducted investigations on numerous serious wildfires, including fires involving substantial loss of life and property. He has a BScF degree from the University of Toronto and an MScF degree from the University of California.

BRUCE MACGREGOR

Bruce spent 41 years with Sustainable Resource Development throughout Central and Northern Alberta and has gained extensive experience in Resource and Wildfire Management.

He has been directly involved in the development of the Alberta Forest Protection Program from 1991 to 2007 as a Forest Protection Officer and as Senior Manager for the Lac La Biche Wildfire Management Area and Provincial Forest Fire Centre. Wildfire management related activities include:

- Negotiated Wildfire Agreements
- Completed a settlement strategy for three large wildfire billing agreements
- Dealt extensively with Aboriginal wildfire contractors, Aboriginal firefighters and Aboriginal administrations
- Investigated wildfires and reviewed contractor investigations
- Participated in the development of the SRD Debris Management Policy
- Expert Panel Member for SRD on five individual reviews of the Forest Protection Branch chaired by Gerry DeSorcy from 2003 to 2007
- Task Team Member for the Review of Alberta's Wildfire Crew Program during the winter of 2006/07
- Wildfire Management training course instructor at the Hinton Training Centre
- Type 1 Incident Management Team Member

He retired from Sustainable Resource Development at the end of March 2007 and now operates MacGregor Forestry Ltd.; a wildfire and forest consulting company operated out of Lac La Biche, Alberta. He is a Registered Professional Forest Technologist and is past President of the College of Alberta Professional Forest Technologists. Projects include:

- Review Team Member for the 2009 Government of Saskatchewan Fire Program Review
- Developed the 2010 Waterways Containment Strategies Pilot Project
- Developed 11 Wildfire Preparedness Plans (involving 17 communities) and 3 Wildfire Mitigation Plans for the Foothills Area
- Provide environmental and regulatory consulting services for oil & gas industry

- Provide wildfire training services for oil & gas industry
- Provide prescribed fire planning and implementation services to SRD
- Developing FireSmart plans for upstream oil and gas industry across the province
- Developing various community based Wildfire Preparedness Plans and Wildfire Mitigation Plans across the province

ROB THORBURN

Rob began his 35 year career in forestry with the Alberta Government in 1972, undertaking in those early years, a number of seasonal forestry and fire control positions.

From 1977 to 1981, Rob served as a Forest Officer in northern Alberta, working with both the public and industry in forest land use, environmental protection, and wildfire suppression.

From 1981-1984, Rob assumed the new position of Air Attack Program Coordinator for the Footner Lake Forest, managing several air tanker bases and specializing as a Provincial Air Attack Officer with airtankers, a role he remained active in until the mid-1990s.

1984 saw Rob switching direction, becoming the Assistant Chief Ranger to the High Level Ranger District.

In 1986 he accepted a position as a Wildland Fire Instructor at the Forest Technology School in Hinton. There, Rob taught forestry diploma students and provincial staff, courses on wildland fire prevention, detection, pre-suppression, suppression, wildfire science and management. During that period he led the development of Canada's first computer based wildland fire simulator and interactive multimedia training courses. In 2002 he was appointed as Head of the Provincial Wildfire Management Training program.

In 2003, Rob was appointed as the Director of the Hinton Training Centre. He continued on as Director until his retirement in May of 2010.

During Rob's career, he always maintained a "foot in the ashes" approach with regard to gaining knowledge in wildfire by keeping actively involved in suppression on Alberta's large wildland fire fronts. He seized the opportunity to do so on a number of occasions as a Type 1 Incident Commander, Incident Operations Chief, Air Operations Branch Director, and as an Air Attack Officer.

Rob currently provides consulting services in wildfire research, safety and training. He has a Forest Technology Diploma from the Northern Alberta Institute of Technology (NAIT) and is a Registered Professional Forest Technologist with the College of Alberta Professional Forest Technologists.

TERRY VAN NEST

Terry's career in forestry began in 1965 when he accepted a position with Alberta Lands and Forests. From 1965 to 1976, he worked in a number of ranger districts in Alberta and from 1976 to 1982, he worked in the Peace River Forest as a forest protection technician.

In 1982, Terry became Alberta's first provincial fire behaviour officer; a position which he held until 1991. During this period Terry was actively involved in operational fire behaviour duties with the Province as well as on a national and international scale. Other activities included technology transfer, fuels inventory, prescribed burning, wildfire investigation, fire behaviour training, co-operation in fire research projects and the development of operational fire information systems such as Alberta's Pre-Suppression and Preparedness Planning System, and in co-operation with Forestry Canada, the development of the Intelligent Fire Management Information System.

In February 1991, Terry transferred to the Forest Technology School (now called the Hinton Training Centre) at Hinton as Senior Fire Control Instructor. During the 1990s, Terry was involved in the initiation and development of National Fire Management training and the establishment of the CIFFC National Training Working Group. Also, during this period Terry participated in international training missions to Belarus, Spain, New Zealand and the United States. In March 1999, Terry accepted the position of Training Operations Manager at the Hinton Training Centre.

In October 2002, Terry retired from the Government of Alberta. In 2002 and 2003 Terry worked as a Canadian Forest Service Training Advisor, Foreign Programs, on the Canadian International Development Agency Fire Danger Rating System project in Southeast Asia. Terry was responsible for developing a training strategy for the project and assisted with the development and delivery of the initial training program in Indonesia and Malaysia. Since 2003 Terry’s wildland fire related activities have been primarily in the area of fire investigation.

Terry has a Forest Technician Diploma and has attended several fire behaviour courses at NARTC (National Advanced Resource Technologies in Marana, Arizona). Terry has co-authored several papers.

Awards received

- 1990 - Certificate of Appreciation from the Alaska Department of Natural Resources for assistance provided on The Canadian Forest Fire Danger Rating System
- 1990 - Alberta Forestry Innovation Award (Honorable Mention) for the development of the Intelligent Fire Management Information System
- 1992 - Forestry Canada Merit Award for Technology Transfer of the Intelligent Fire Management Information System
- 1995 - North American Forestry Commission Fire Management Study Group award in recognition of dedication in wildland fire suppression
- 2002 - National Wildfire Coordinating Group in recognition of contributions to wildland fire investigation (Fire Investigation Working Team 2002)
- 2004 - Canadian Forest Service Merit Award for exemplary contribution to the Southeast Asia Fire Danger Rating System Project.

RICK ARTHUR

Rick graduated from the Northern Alberta Institute of Technology (NAIT) Forest Technology Program in 1975 and has worked in a wide variety of forestry related positions across the province since then. In the last 37 years, he has worked on the fire line in positions ranging from "the guy at the end of a fire hose" to a Type 1 Incident Commander. He has been on major fire operations from Ontario to British Columbia and from Yellowstone to the Yukon. He is a Past President for "Partners in Protection" and was extensively involved in the development of FireSmart, a program focused on reducing the risk of wildfire to communities. Partners in Protection have received numerous Provincial and National awards for the development of the FireSmart program components which have been adopted by all provinces across Canada as the model for their wildland-interface programs.

Through Rick's experience base, he has developed an extensive background in:

- Fire history
- Fire regime analysis
- Fire behaviour sciences

He was included in the cadre for the National Fire Behaviour Specialist program. Rick has been nominated for, and been successful recipient of, a number of awards including the Deputy Ministers Award. He attributes much of his success to being a strong believer in partnerships and actively seeking to create and nurture those opportunities in his daily regime.

Today, he leads the Wildfire Prevention Program for the Southern Rockies Area which is noted for its extensive FireSmart programs, numerous municipal partnerships, as well as being leaders in the provincial prescribed fire program.

MORGAN KEHR

In 1981, Morgan began his 30 year career in forestry with Alberta Sustainable Resource Development. He held various positions related to wildfire management and suppression operations throughout the province including:

- Forest Protection Technologist in Edson
- Wildfire Operations Officer in Whitecourt
- Alberta Provincial Prescribed Fire Program Lead
- Program Manager for Alberta Provincial Wildfire Operations

In addition to numerous Incident Command Team assignments on large fires across Alberta (including notable fires such as Virginia Hills, Agnes Lake, Chisholm, House River, Lost Creek), Morgan`s operational experience and certification as Planning Section Chief 1, Operations Section Chief 1, and Incident Commander 1 have been provided to the Yukon, Northwest Territories and the United States.

While in the Provincial Wildfire Operations position, Morgan represented the Province of Alberta on National and International initiatives such as the Canadian Forest Fire Centre Resource Management Working Group, the Northwest Compact Working Group, as well as the Jalisco (Mexico) Resource Sharing Agreement Working Group.

Morgan has also been heavily involved in Policy and Standard Operating Procedure development for the Province, as well as actively involved with various wildfire training courses as chair or instructor at the Hinton Training Centre.

Morgan is currently the Forestry Program Manager for the Southern Rockies area. He has a Forestry diploma from the Northern Alberta Institute of Technology (NAIT) and is a Registered Professional Forest Technologist with the College of Alberta Professional Forest Technologists.

DEANNA MCCULLOUGH

Deanna is the Director of Business Relations and Strategic Initiatives in the Wildfire Management Branch of Sustainable Resource Development. She was the project manager for the Flat Top Complex wildfire review.

Deanna graduated from the University of Alberta with a Bachelor of Science Degree in Forestry, She has over 25 years of experience working for the government of Alberta in forest and wildfire management positions. Over the last 8 years, Deanna has been involved in business planning, and the evaluation and refinement of various wildfire management strategies, standards, procedures and policies through internal and external reviews. She is a Registered Professional Forester with the College of Alberta Professional Foresters.

SHERRA MULDOON

In 1995, Sherra began her career with Alberta Sustainable Resource Development as a wildland firefighter where she completed five seasons in the initial attack program (Helitack and Rapattack). Sherra graduated with a Bachelor of Science Degree in Forestry from the University of Alberta. Sherra then took on various roles over an eight year period which evolved into the FireSmart Program Coordinator, including initiatives such as community protection, integration of fire, forest and land management and prescribed fire.

Sherra then became a wildfire consultant for Dennis Quintilio and Associates in 2009 and continues to work on various initiatives covering western Canada, with a primary focus on policy level wildfire reviews and FireSmart planning.

Highlights as a wildfire consultant include:

- Wildfire management program reviews, documentation reports, and landscape-level pilot projects across Western Canada
- Wildfire Preparedness Guides and Wildfire Mitigation Strategies (involving various communities across Alberta)

- FireSmart publications (FireSmart Guidebook for Upstream Oil and Gas Industry, FireSmart Field Guide for Upstream Oil and Gas Industry, Wildfire Prevention Best Management Practices for Oil and Gas Industry)
- Wildfire Preparedness Plans for Oil and Gas Industry
- Wildfire training (Atco, Oil and Gas Industry, Hinton Training Centre)

Sherra is a Registered Professional Forester with the College of Alberta Professional Foresters and holds various wildfire management certifications. She has been awarded the SRD Bright Idea Award and the Deputy Minister Award.

APPENDIX B - FOREST PROTECTION AREA

Alberta's Forest Protection Area (show in pink) was created based on municipal considerations, ecological considerations, timber management, and practical fire control considerations.

APPENDIX C - CANADIAN FOREST FIRE DANGER RATING SYSTEM (CFFDRS)

The Canadian Forest Fire Danger Rating System (CFFDRS) is a national system for rating the potential intensity and behaviour of wildfires in Canada.

Forest fire danger is a general term used to express a variety of factors in the wildland fire environment, such as ease of ignition and difficulty of control. Fire danger rating systems produce qualitative and/or numeric indices of wildfire potential, which are used as guides in a wide variety of wildfire management activities.

The CFFDRS has been under development since 1968. Currently, two subsystems–the Canadian Forest Fire Weather Index (FWI) System (released in the early 1970s) and the Canadian Forest Fire Behaviour Prediction (FBP) System (released in the late 1980s)–are being used extensively in Canada and internationally.

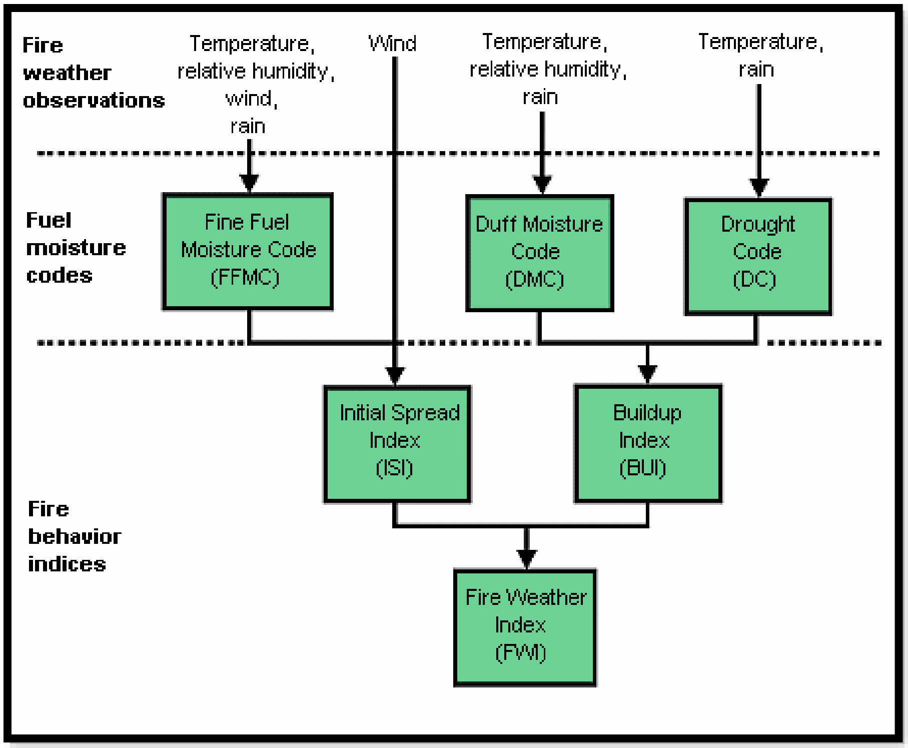
Canadian Forest Fire Weather Index (FWI) System

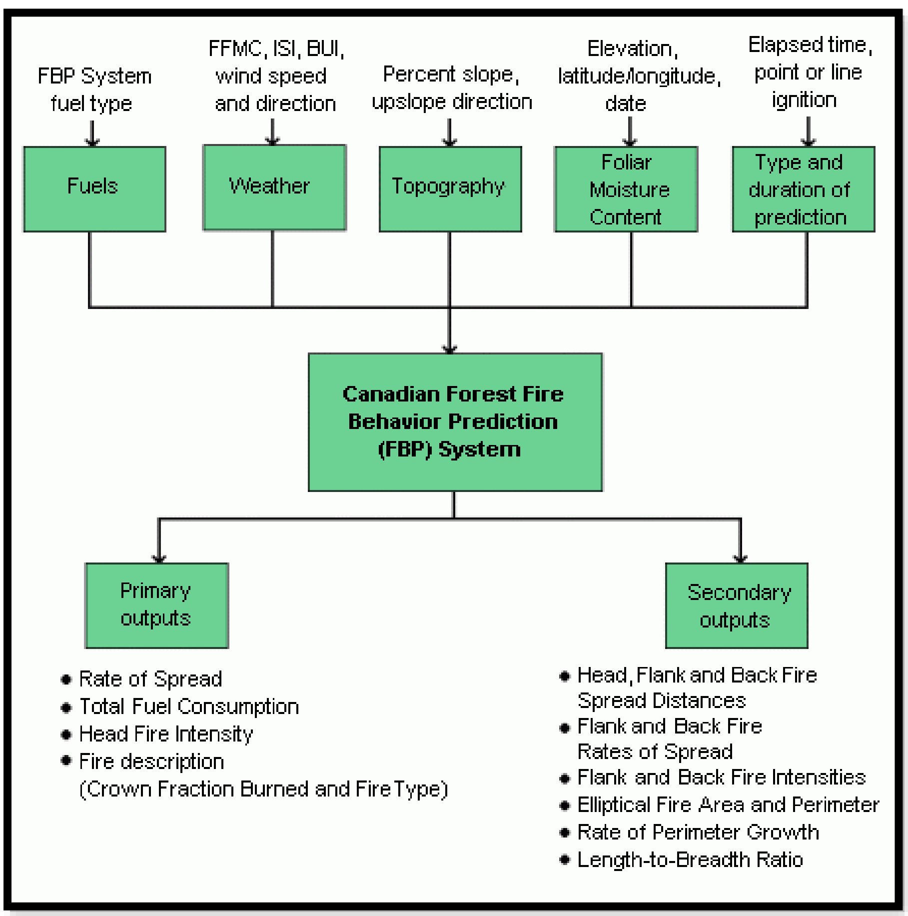
- The FWI System consists of six components that account for the effects of fuel moisture and wind on wildfire behaviour.
- The first three components, the fuel moisture codes, are numeric ratings of the moisture content of litter and other fine fuels, the average moisture content of loosely compacted organic layers of moderate depth, and the average moisture content of deep, compact organic layers.
- The remaining three components are fire behaviour indices, which represent the rate of fire spread, fuel available for combustion, and frontal fire intensity. The values rise as wildfire danger increases.
- Alberta adopted the FWI System in 1971 and it has been used as a decision aid in a variety of wildfire management planning and operational activities.
- Calculation of FWI System values commences on the third day after snow is gone at the particular recording station.

Canadian Forest Fire Behaviour Prediction (FBP) System

- The FBP System provides quantitative estimates of potential head fire spread rate, fuel consumption, and fire intensity, as well as fire descriptions. With the aid of an elliptical wildfire growth model, it gives estimates of fire area, perimeter, perimeter growth rate, and flank and back fire behaviour.
- Alberta began using the FBP System operationally in the late 1980s as a decision aid in a variety of wildfire management planning and operational activities.

CFFDRS FWI System values are calculated for each weather station daily at 13:00 MDT. Combined with spatial modelling of forecast wildfire behaviour, these values form the basis of wildfire preparedness planning in Alberta.


Fire weather observations
Temperature, relative humidity, wind, rain
Wind
Temperature, relative humidity, rain
Temperature, rain
Fuel moisture codes
Fine Fuel Moisture Code (FFMC)
Duff Moisture Code (DMC)
Drought Code (DC)
Initial Spread Index (ISI)
Buildup Index (BUI)
Fire behavior indices
Fire Weather Index (FWI)


FBP System fuel type
FFMC, ISI, BUI, wind speed and direction
Percent slope, upslope direction
Elevation, latitude/longitude, date
Elapsed time, point or line ignition
Fuels
Weather
Topography
Foliar Moisture Content
Type and duration of prediction
Canadian Forest Fire Behavior Prediction (FBP) System
Primary outputs
Secondary outputs
• Rate of Spread
• Total Fuel Consumption
• Head Fire Intensity
• Fire description (Crown Fraction Burned and Fire Type)
• Head, Flank and Back Fire Spread Distances
• Flank and Back Fire Rates of Spread
• Flank and Back Fire Intensities
• Elliptical Fire Area and Perimeter
• Rate of Perimeter Growth
• Length-to-Breadth Ratio

Definitions:

Fine Fuel Moisture Code (FFMC) The FFMC is a numeric rating of the moisture content of litter and other cured fine fuels. This code is an indicator of the relative ease of ignition and the flammability of fine fuel.

Duff Moisture Code (DMC) The DMC is a numeric rating of the average moisture content of loosely compacted organic layers of moderate depth. This code gives an indication of fuel consumption in moderate duff layers and medium-size woody material.

Drought Code (DC) The DC is a numeric rating of the average moisture content of deep, compact organic layers. This code is a useful indicator of seasonal drought effects on forest fuels and the amount of smoldering in deep duff layers and large logs.

Initial Spread Index (IS) The ISI is a numeric rating of the expected rate of fire spread. It combines the effects of wind and the FFMC on rate of spread without the influence of variable quantities of fuel.

Buildup Index (BUI) The BUI is a numeric rating of the total amount of fuel available for combustion. It combines the DMC and the DC.

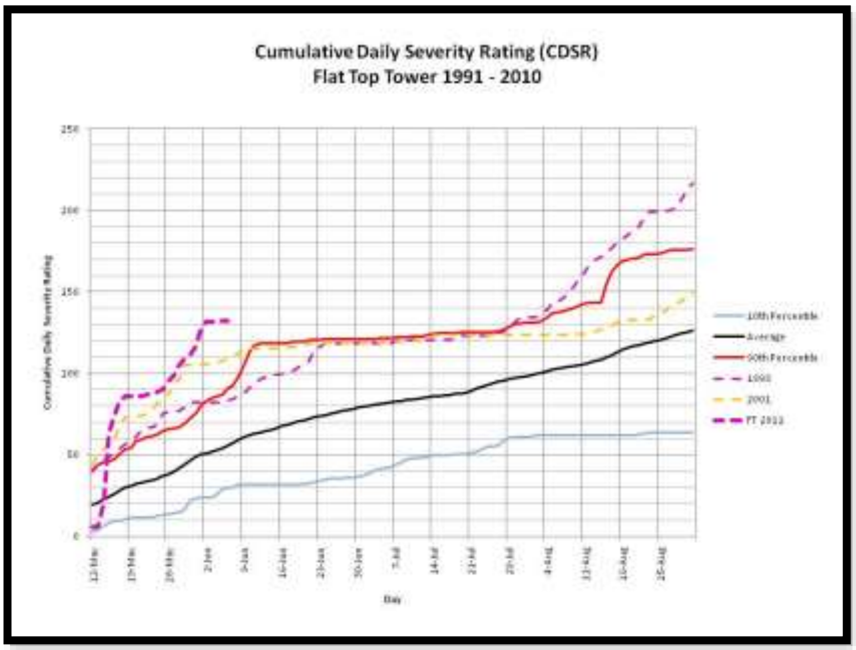
Fire Weather Index (FWI) The FWI is a numeric rating of fire intensity. It combines the ISI and the BUI. It is suitable as a general index of fire danger throughout the forested areas of Canada.

Daily Severity Rating (DSR) The DSR is a numeric rating of the difficulty of controlling wildfires.

Hazard Rating	FFMC Fine Fuel Moisture Code	DMC Duff Moisture Code	DC Drought Code	ISI Initial Spread Index	BUI Build Up Index	FWI Fire Weather Index	HFI Intensity Class
Low	0-76	0-21	0-79	0-1.5	0-24	0-4.5	1-2
Moderate	77-84	22-27	80-189	2-4	25-40	4.5-10.5	3
High	85-88	28-40	190-299	5-8	41-60	10.5-18.5	4
Very High	89-91	41-60	300-424	9-15	61-89	18.5-29.5	5
Extreme	92+	61+	425+	16+	90+	29.5+	6

The DRS is a function of the FWI but more accurately reflects the expected efforts required for wildfire suppression by giving greater weight to higher values than lower ones. Daily DSR values can be summed to obtain a cumulative value and averaged over any desired period such as a week, month, or season. Individual DSR's can also be summed up to a given date to provide Cumulative Daily Severity Rating (CDSR). CDSR curves show at any given time during the wildfire season the level of wildfire weather severity reached up to that date and provide an effective measure of potential wildfire intensity.

CDSR for an individual wildfire season can also be charted against long-term average CDSR, percentiles (e.g., 10th Percentile, 90th Percentile) or benchmark severe wildfire seasons.



Rate of Spread (ROS) ROS is the predicted speed of the wildfire at the front or head of the fire (where the fire moves fastest) and takes into account both crowning and spotting. It is measured in metres per minute and is based on the Fuel Type, Initial Spread Index, Build-up Index, and several fuel-specific parameters such as phenological state (leafless or green) in deciduous trees, crown base height in coniferous trees, and percent curing in grasses.

Total Fuel Consumption (TFC) TFC is the predicted weight of fuel consumed by the wildfire both on the forest floor and in the crowns of the trees. It is measured in kilograms per square metre of ground surface and is based on Foliar Moisture Content, Surface Fuel Consumption, and Rate of Spread.

Head Fire Intensity (HFI) HFI is the predicted intensity, or energy output, of the wildfire at the front or head of the fire. It has become one of the standard gauges by which fire managers estimate the difficulty of controlling a wildfire and select appropriate suppression methods. It is measured in kilowatts per metre of fire front and is based on the Rate of Spread and the Total Fuel Consumption. For operational purposes, Head

Fire Intensity is expressed and spatially displayed as six Intensity Classes.

Crown Fraction Burned (CFB) CFB is the predicted fraction of the tree crowns consumed by the wildfire. It is based on Buildup Index, Foliar Moisture Content, Surface Fuel Consumption, and Rate of Spread.

Fire Type (FT) FT provides a general description of the wildfire. It is based on the CFB. If the CFB is less than 0.1 (10%), then the wildfire is a surface fire. If the CFB is 0.9 (90%) or more, then the wildfire is a continuous crown fire. If the CFB is between 0.1 and 0.9, then the wildfire is an intermittent crown fire.

Snow Gone Snow gone is typically declared when all snow cover that is visible from the observation site has melted. Wildfire danger calculations are normally started three days after snow gone has been reported.

Descriptions of Head Fire Intensity Classes 1 Through 6

APPENDIX D - 25-YEAR AVERAGE NUMBER OF WILDFIRES AND AREA BURNED

25-year average number of wildfires and area burned by province/territory (CIFFC data).

Province/ Territory	25 Year Average (Number of Wildfires)	25 Year Average (Area Burned)
BC	1,248	37,837
YT	89	149,295
AB	697	102,291
NT	177	411,821
SK	412	287,437
MB	338	162,650
ON	911	119,271
QC	563	208,238
NL	97	24,500
NB	259	631
NS	219	506
PE	14	34
PC	61	35,623
Total	**5,086**	**1,540,133**

APPENDIX E - PFFC WEATHER FORECASTING

Sustainable Resource Development operates a network of 191 weather stations at lookout towers and remote automatic locations. Observations from these stations are used to calculate forecasts, wildfire danger, and for planning wildfire preparedness and suppression activities.

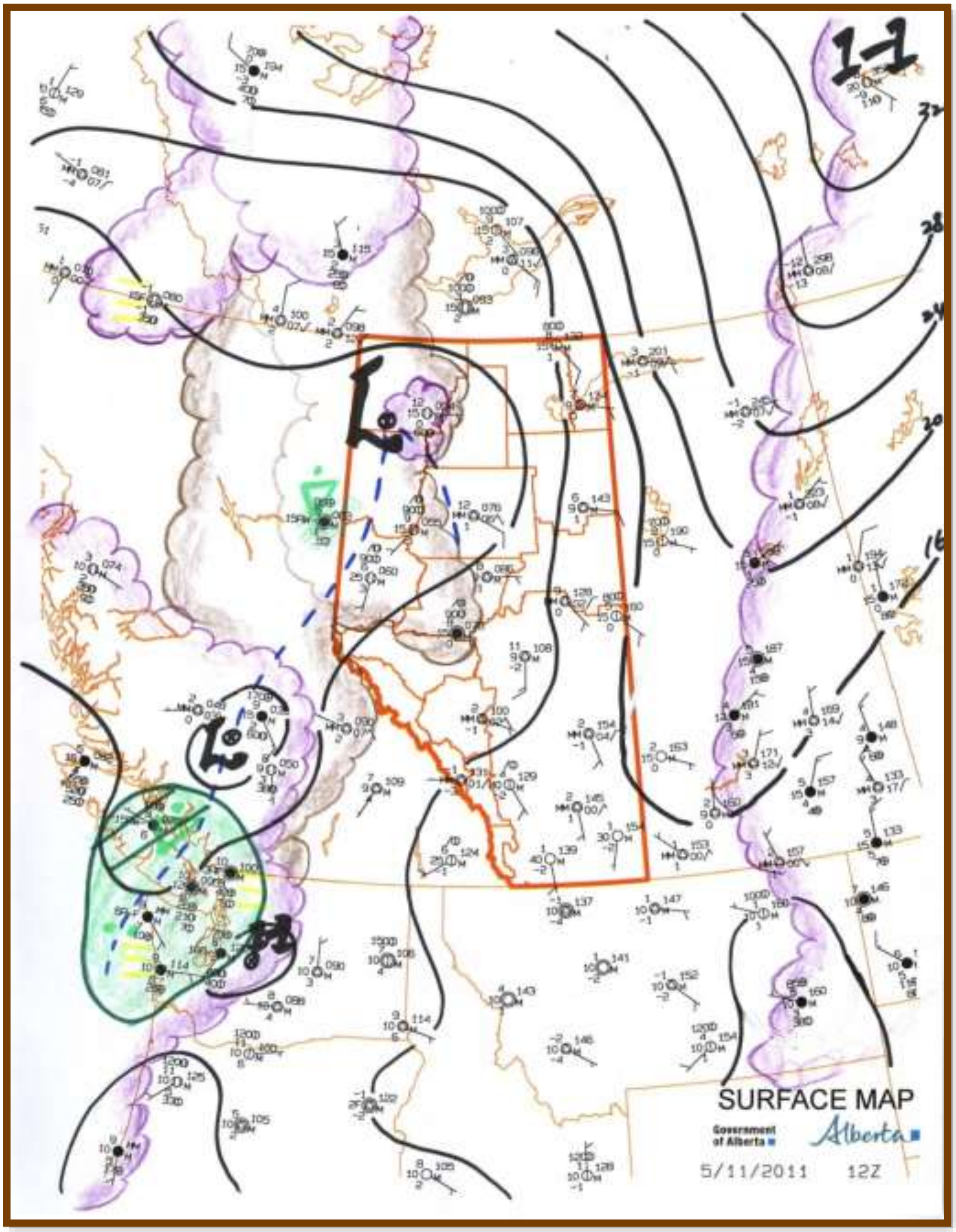
Sustainable Resource Development maintains year-round weather forecast staff (four wildfire weather meteorologists and two seasonal technicians) at the Provincial Forest Fire Centre. The staff monitor changes in weather conditions that influence the wildfire environment and are responsible for:

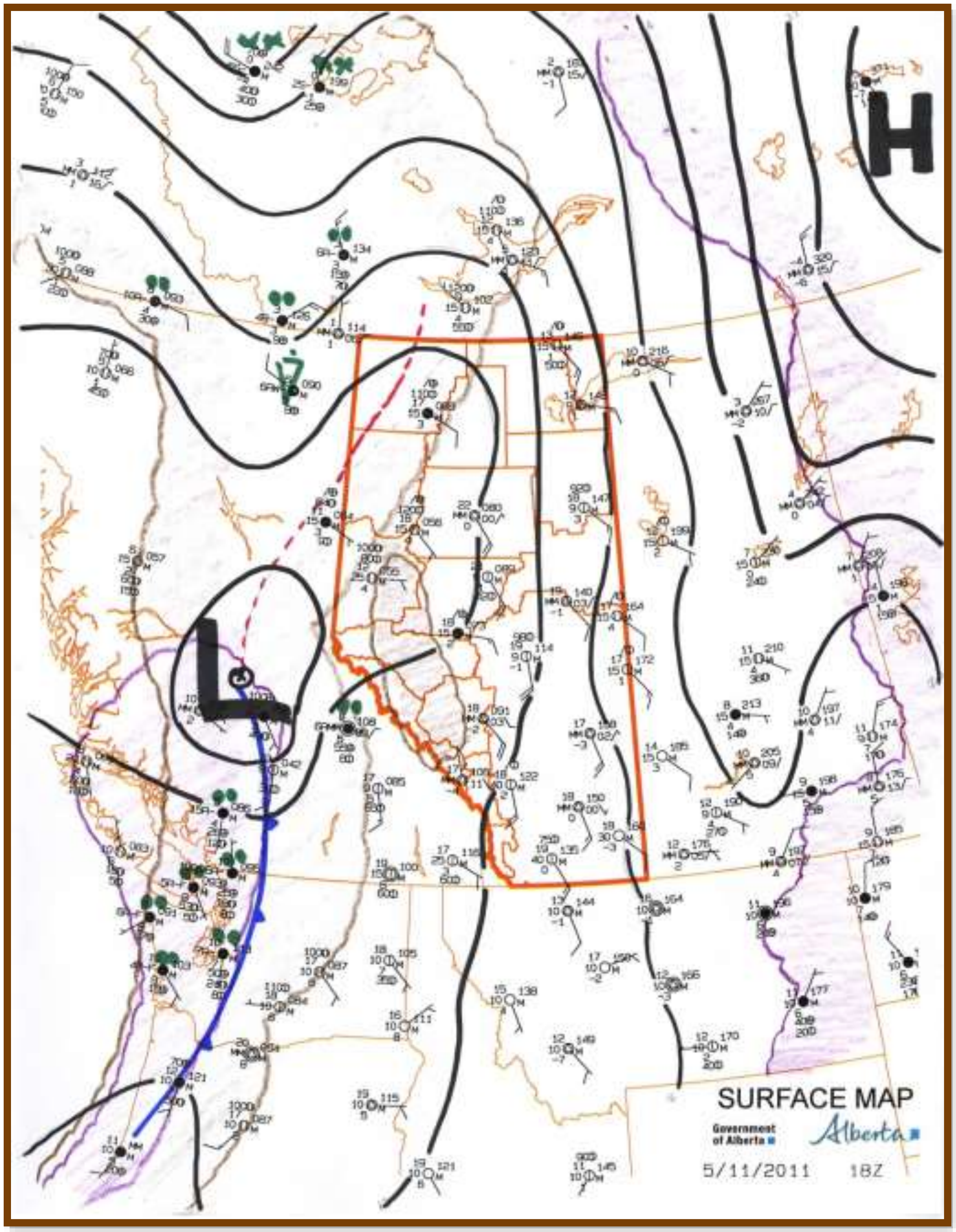
1. Producing two wildfire weather forecasts and briefings per day during the wildfire season (April 1 to October 31). Early and late season forecasts may be limited to one per day depending on wildfire danger.
2. Providing weather expertise for wildfire management activities including wildfire suppression, prescribed burns, forest health programs, pre-suppression planning, and resource deployment.
3. Supplying weather forecasts and updates to other provincial agencies, such as the Alberta Environment River Flow Forecast Team and Alberta Emergency Management Agency, as well as Environment Canada.
4. Managing and archiving wildfire weather and lightning data from the remote sensing network.
5. Providing support to wildfire management training courses, related to weather and wildfire behaviour.

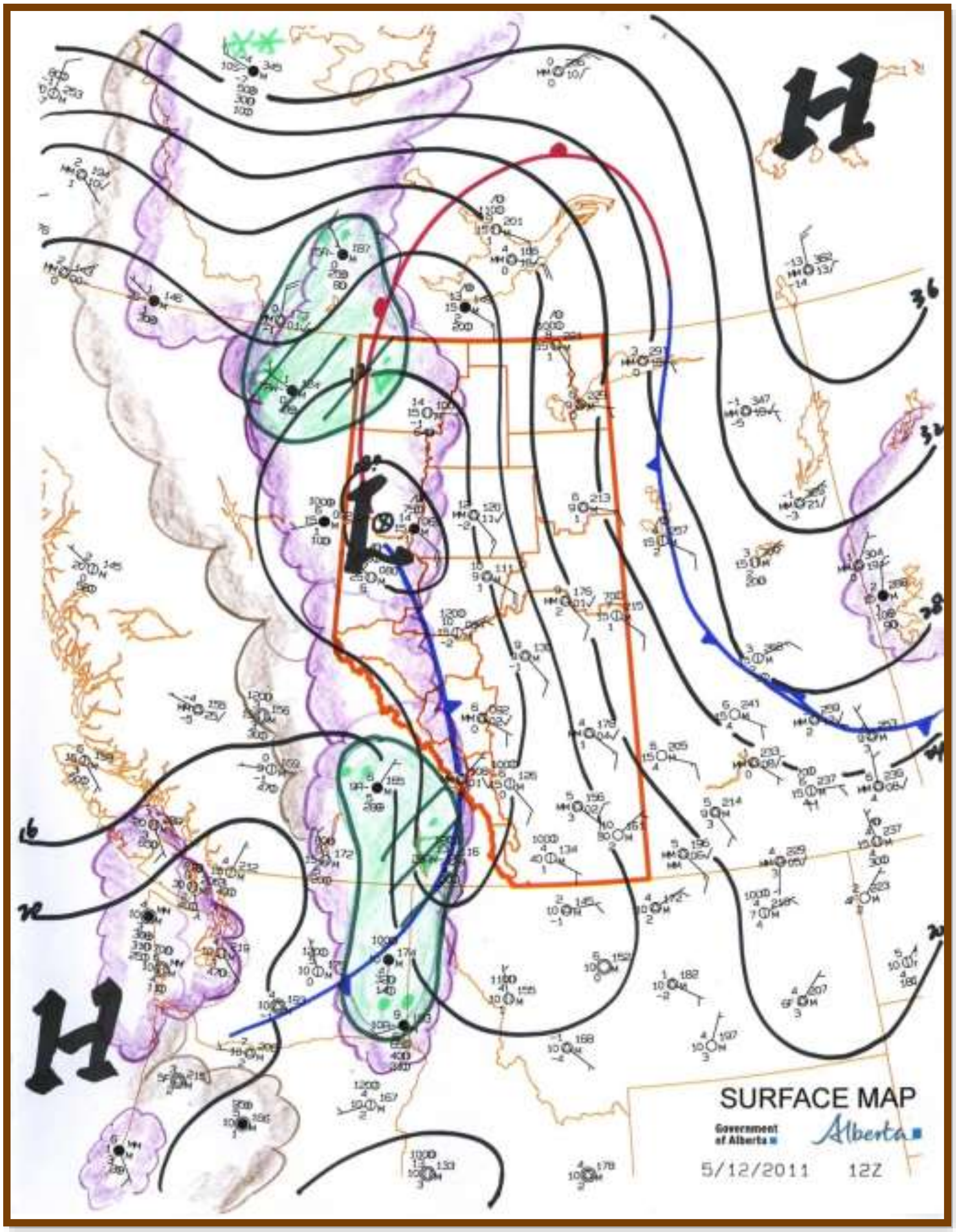
Regular forecasts include morning (10:00 hrs MDT) and afternoon (15:00 hrs MDT) synopses, three day outlook (PM forecast only), temperature, relative humidity, winds, lightning, and precipitation forecasts (by forecast zone) that are geared to wildfire weather and wildfire behaviour. “Fire Weather Advisories” are rare, but are included in the forecasts when deemed necessary. Surface weather maps are issued along with the forecasts at 12:00 Zulu (06:00 MDT) and 18:00 Zulu (12:00 MDT).

APPENDIX F - FORECAST SURFACE WEATHER MAPS

Forecast surface weather maps generated by the Wildfire Management Branch Provincial Forest Fire Centre Weather Section for May 11 to 16, 2011.




SURFACE MAP
Government of Alberta
Alberta
5/11/2011 18Z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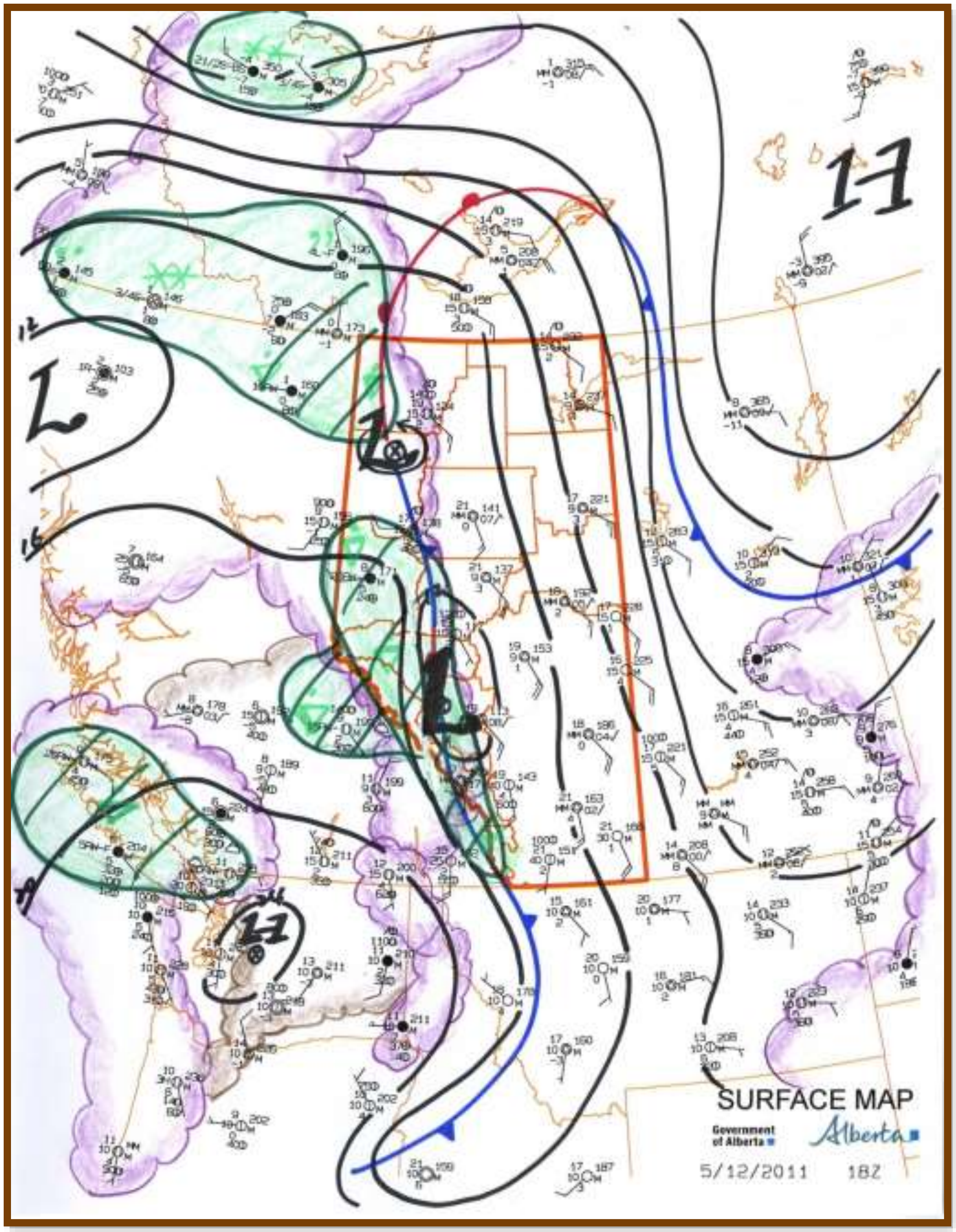
Government of Alberta
Alberta
5/12/2011 12Z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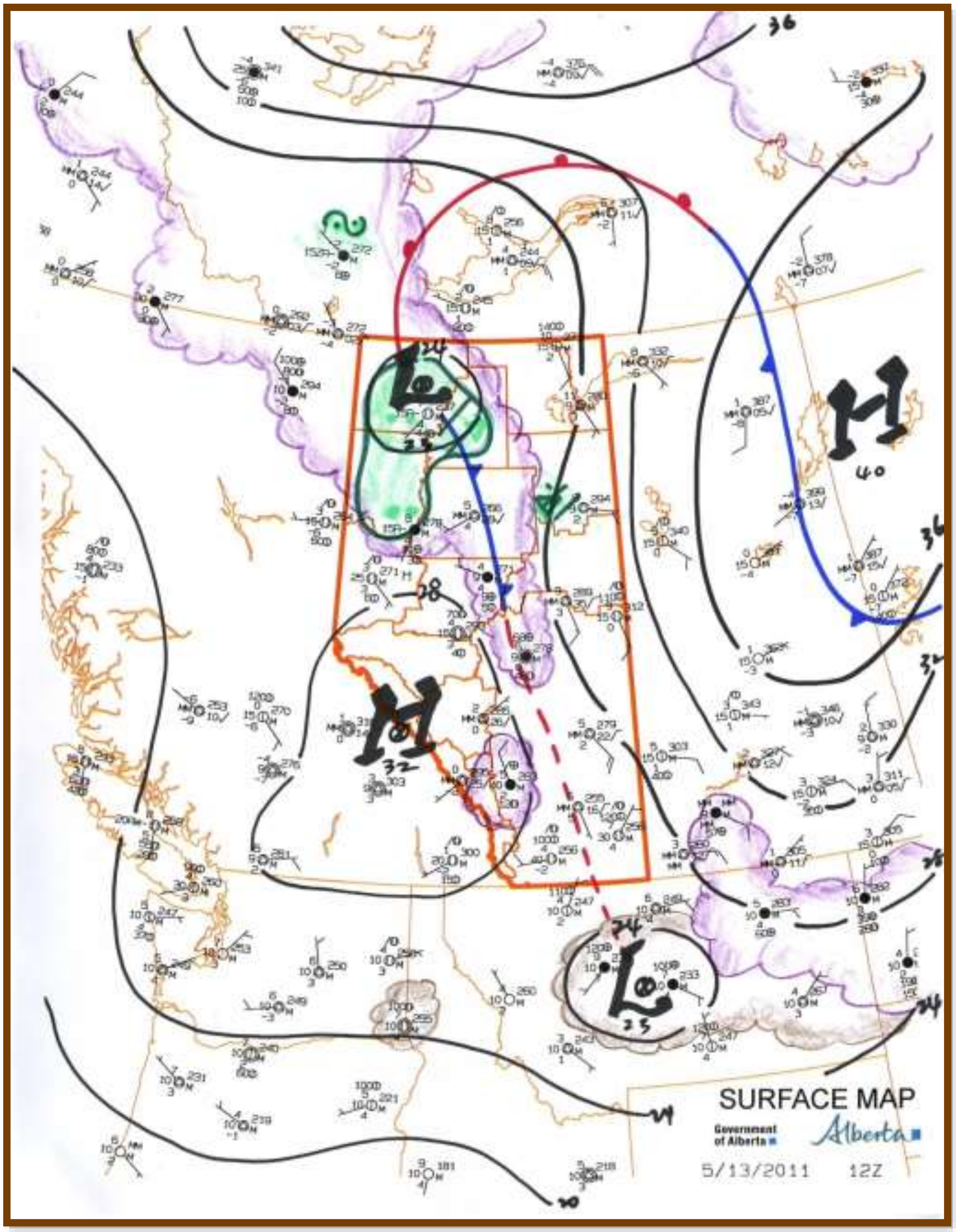
Government of Alberta
Alberta
5/12/2011 18Z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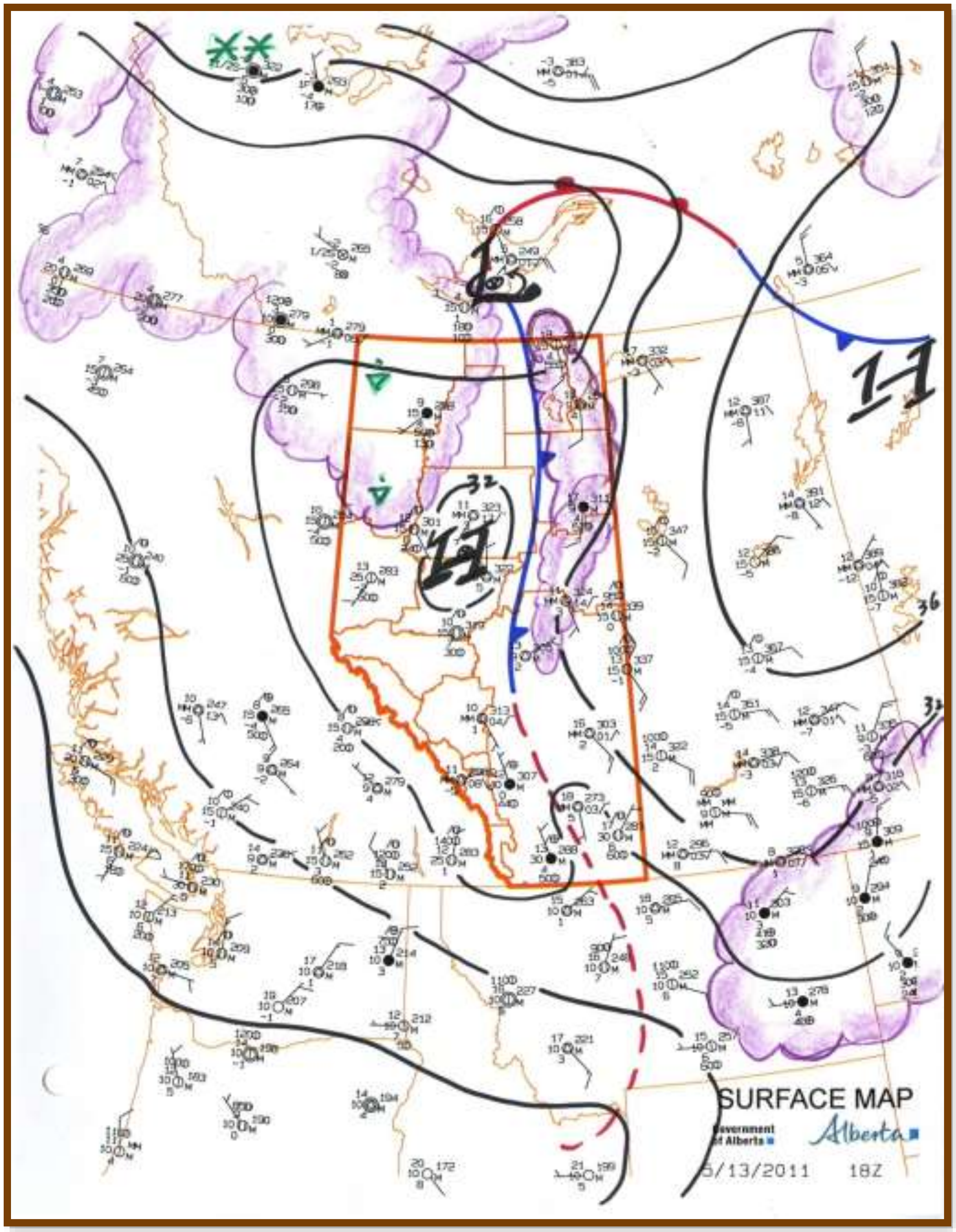
Government of Alberta
Alberta
5/13/2011 12Z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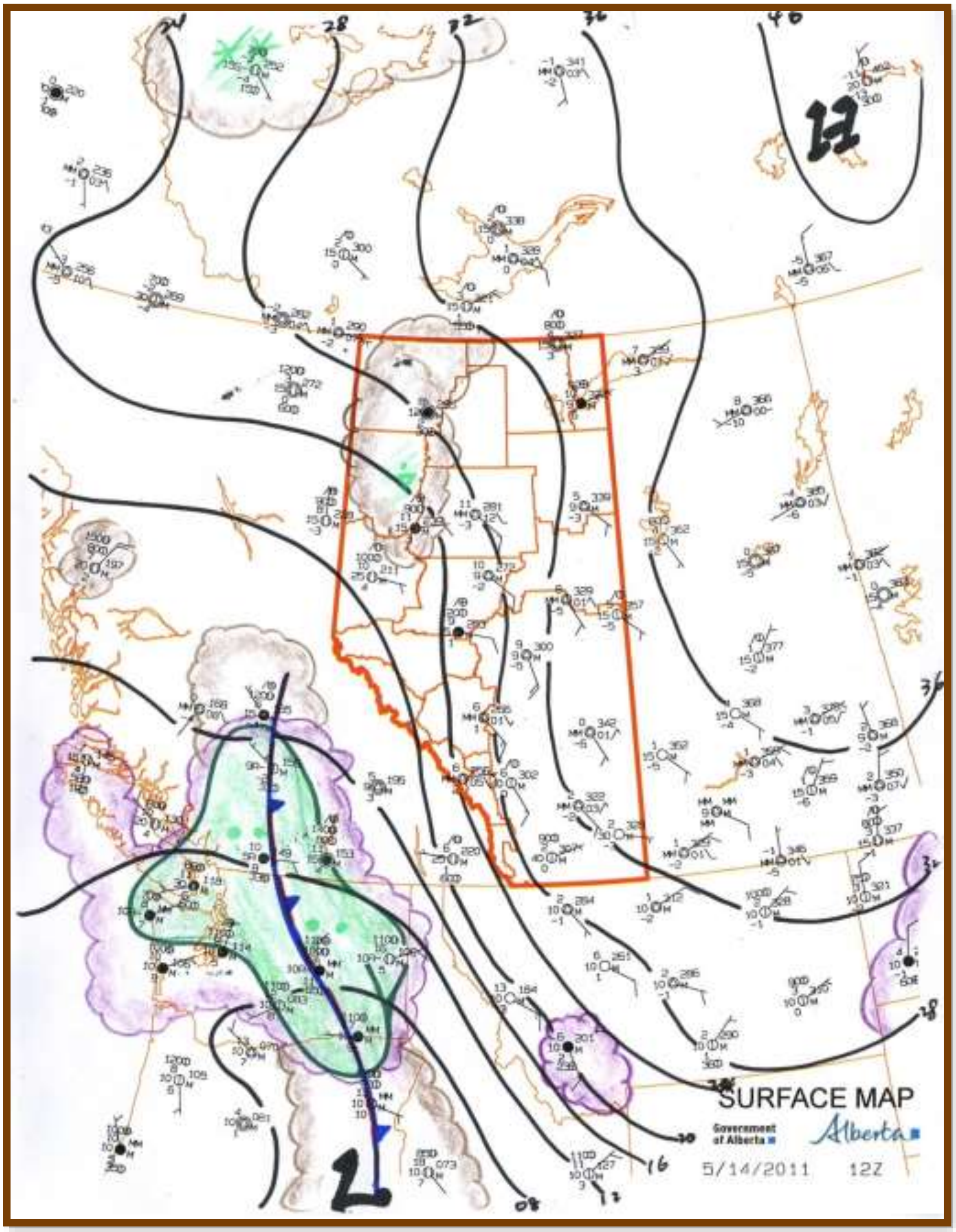
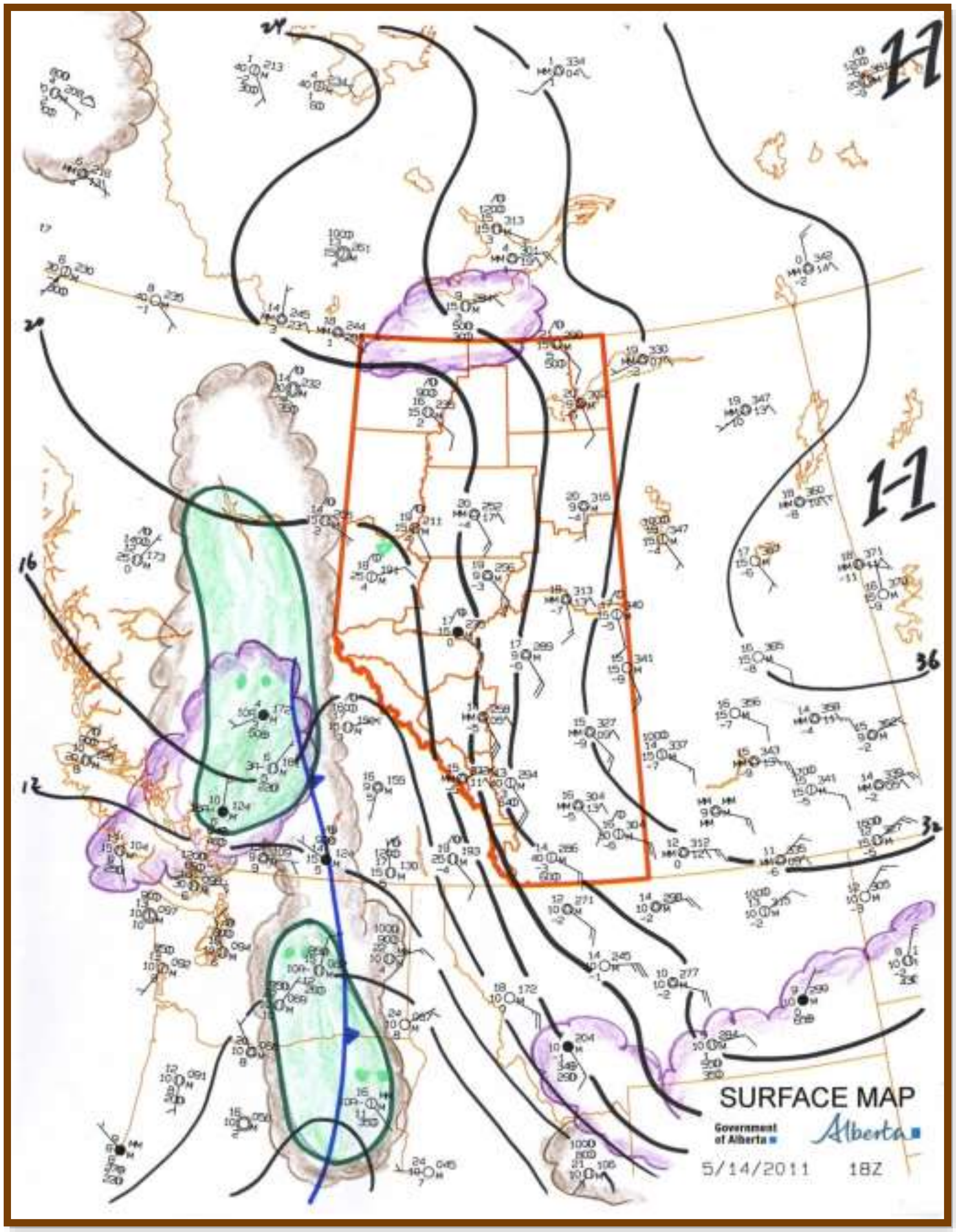
Government of Alberta
Alberta
5/13/2011 18Z



SURFACE MAP
Government of Alberta
Alberta
5/14/2011 12Z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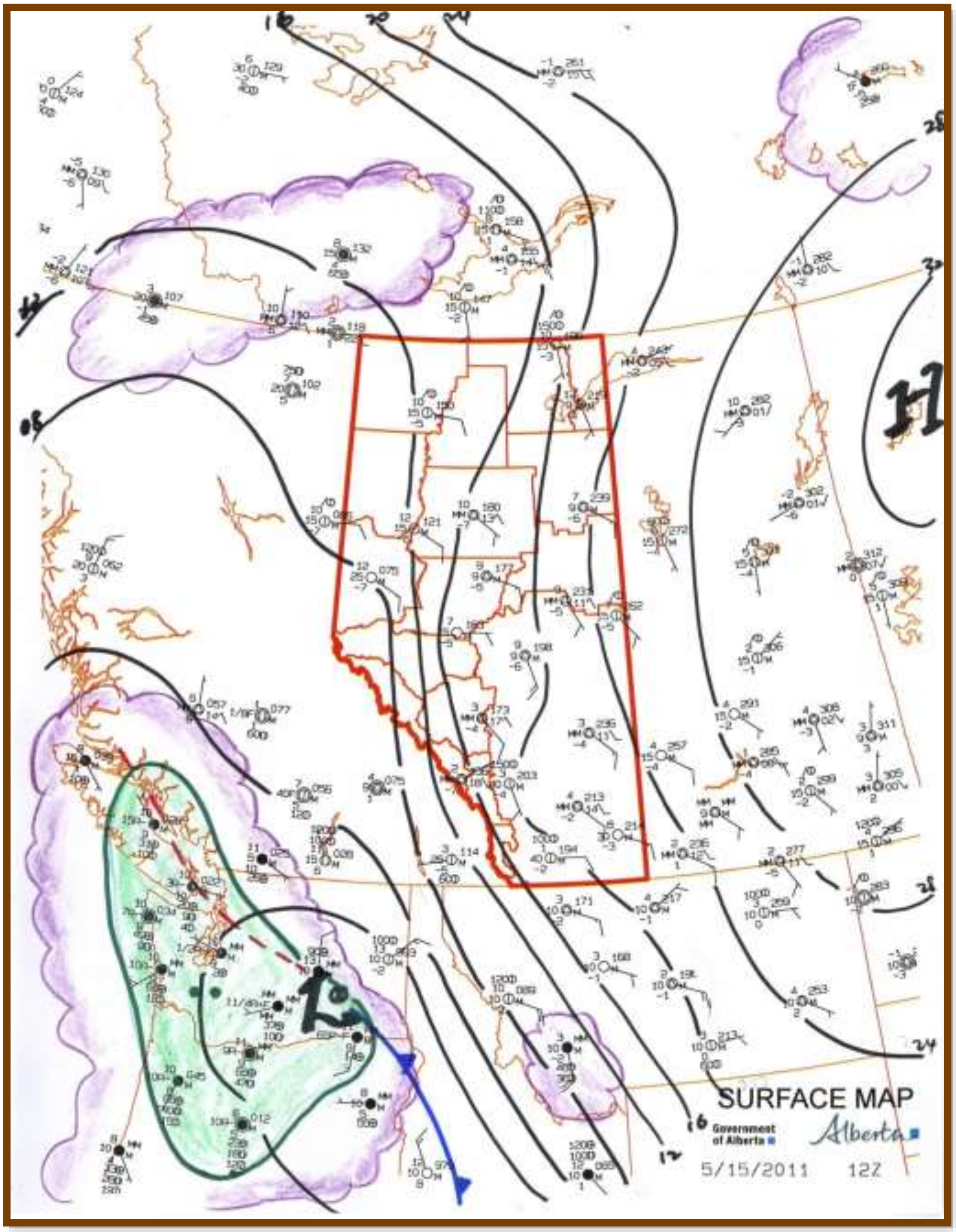
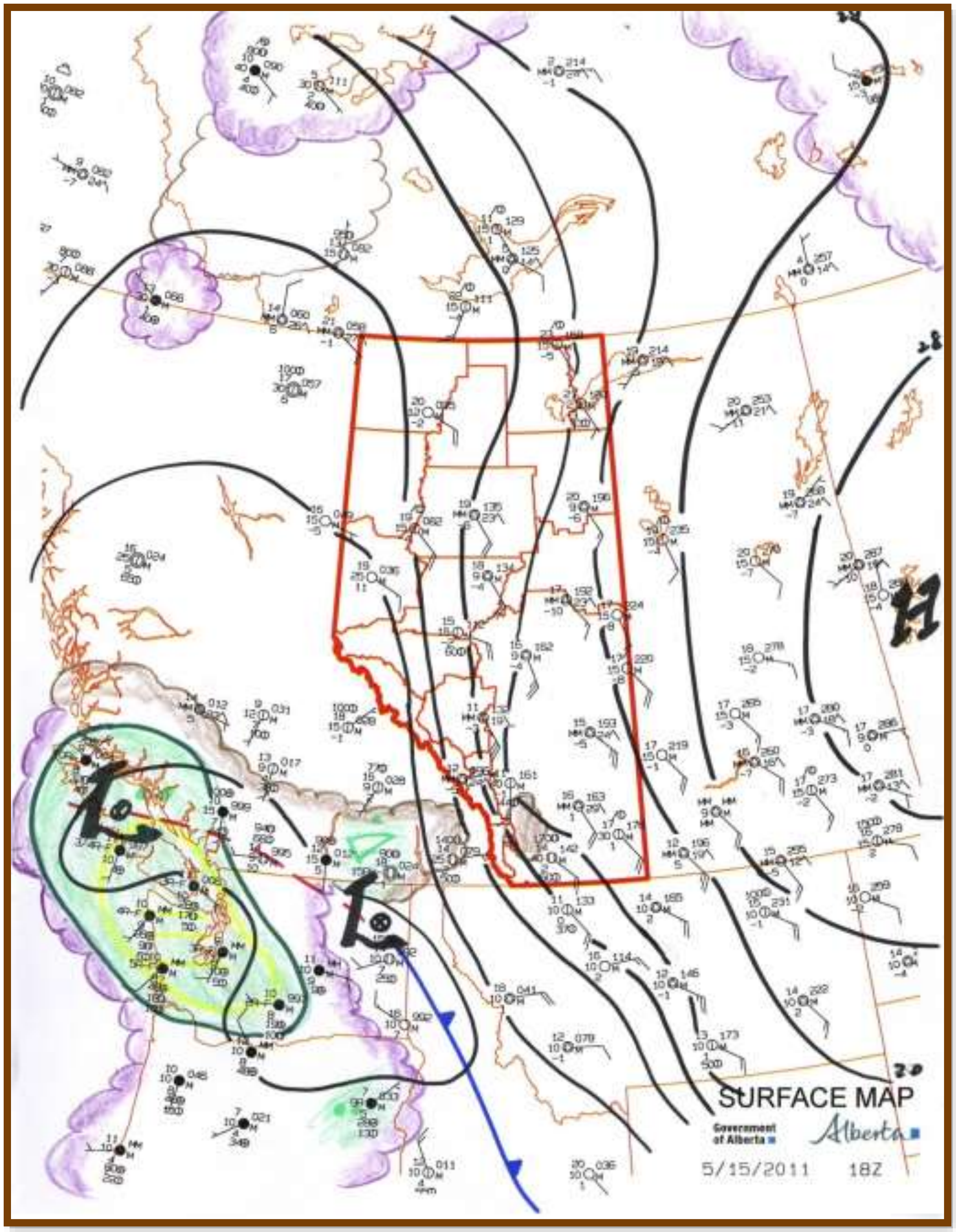
Government of Alberta
Alberta
5/14/2011 18Z


SURFACE MAP
Government of Alberta
Alberta
5/15/2011 12Z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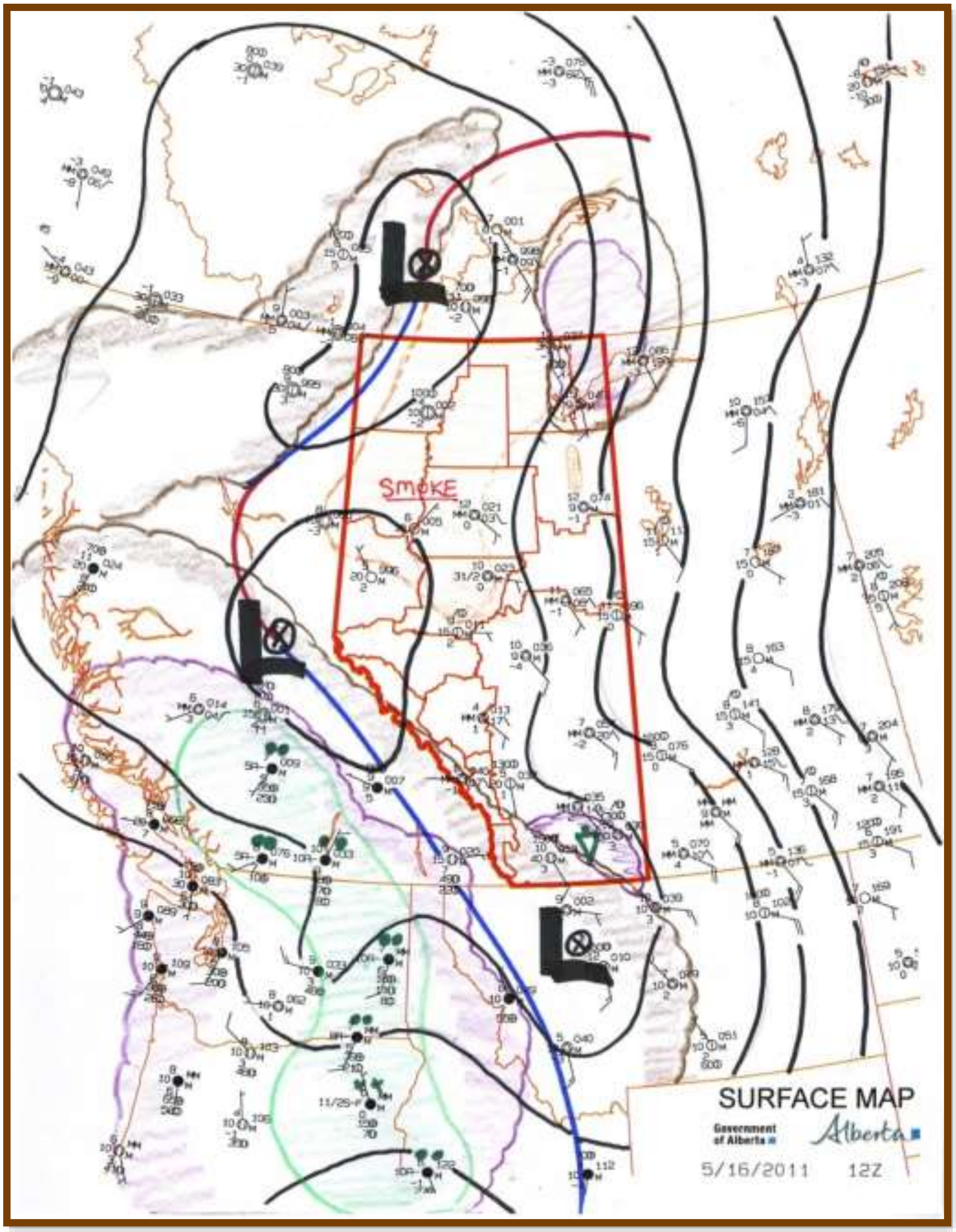
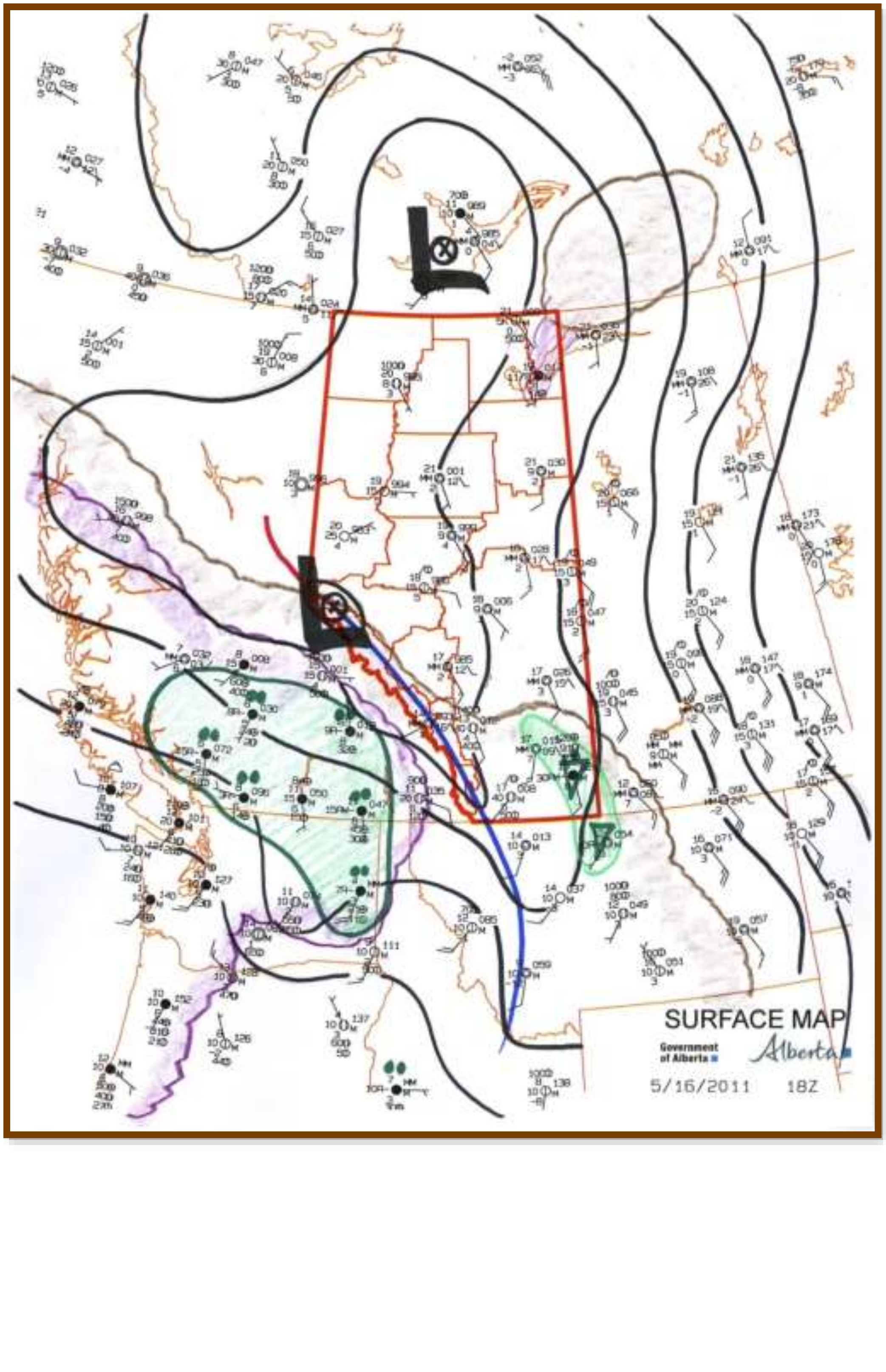
Government of Alberta
Alberta
5/15/2011 18Z


SMOKE
SURFACE MAP
Government of Alberta
Alberta
5/16/2011 12Z


SURFACE MAP
Government of Alberta
Alberta
5/16/2011 18Z

APPENDIX G - ENVIRONMENT CANADA FORECASTS (SLAVE LAKE)

FPCN16 CWWG 111032
FORECASTS FOR CENTRAL AND NORTHERN ALBERTA ISSUED BY ENVIRONMENT CANADA AT **5.00 AM MDT WEDNESDAY 11 MAY 2011** FOR TODAY AND THURSDAY.
THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 11.00 AM.

SLAVE LAKE.

TODAY..A MIX OF SUN AND CLOUD. WIND BECOMING SOUTHEAST 30 KM/H GUSTING TO 50 THIS MORNING. HIGH 21. UV INDEX 5 OR MODERATE.

TONIGHT..CLOUDY PERIODS. WIND SOUTHEAST 30 KM/H GUSTING TO 50. LOW 11.

THURSDAY..A MIX OF SUN AND CLOUD. WIND SOUTHEAST 30 KM/H. HIGH 22.

FPCN16 CWWG 111630
FORECASTS FOR CENTRAL AND NORTHERN ALBERTA ISSUED BY ENVIRONMENT CANADA AT **11.00 AM MDT WEDNESDAY 11 MAY 2011** FOR TODAY AND THURSDAY.
THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 4.00 PM.

SLAVE LAKE.

TODAY..A MIX OF SUN AND CLOUD. WIND SOUTHEAST 30 KM/H GUSTING TO 50. HIGH 21. UV INDEX 5 OR MODERATE.

TONIGHT..CLOUDY PERIODS. WIND SOUTHEAST 30 KM/H GUSTING TO 50. LOW 11.

THURSDAY..A MIX OF SUN AND CLOUD. WIND SOUTHEAST 30 KM/H. HIGH 22.

FPCN16 CWWG 112134
FORECASTS FOR CENTRAL AND NORTHERN ALBERTA ISSUED BY ENVIRONMENT CANADA AT **4.00 PM MDT WEDNESDAY 11 MAY 2011** FOR TONIGHT THURSDAY AND
THURSDAY NIGHT.
THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 5.00 AM THURSDAY.

SLAVE LAKE.

TONIGHT..CLEAR. WIND SOUTHEAST 30 KM/H GUSTING TO 50. LOW 11.

THURSDAY..SUNNY. INCREASING CLOUDINESS IN THE AFTERNOON. WIND SOUTHEAST 30 KM/H. HIGH 20. UV INDEX 5 OR MODERATE.

THURSDAY NIGHT..CLOUDY. RAIN BEGINNING IN THE EVENING. AMOUNT 10 TO 20 MM. WIND SOUTHEAST 20 KM/H BECOMING LIGHT NEAR MIDNIGHT. LOW
PLUS 3.

FPCN16 CWWG 121030
FORECASTS FOR CENTRAL AND NORTHERN ALBERTA ISSUED BY ENVIRONMENT CANADA AT **5.00 AM MDT THURSDAY 12 MAY 2011** FOR TODAY AND FRIDAY.
THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 11.00 AM.

SLAVE LAKE.

TODAY..A MIX OF SUN AND CLOUD. 40 PERCENT CHANCE OF SHOWERS OVER WESTERN SECTIONS LATE THIS AFTERNOON. WIND SOUTHEAST 30 KM/H. HIGH 20. UV INDEX 5 OR MODERATE.

TONIGHT..CLOUDY. 40 PERCENT CHANCE OF SHOWERS THIS EVENING. RAIN BEGINNING NEAR MIDNIGHT. AMOUNT 5 TO 10 MM. WIND SOUTHEAST 20 KM/H. LOW PLUS 3.

FRIDAY..CLEARING IN THE MORNING. HIGH 15.

FPCN16 CWWG 121631
FORECASTS FOR CENTRAL AND NORTHERN ALBERTA ISSUED BY ENVIRONMENT CANADA AT **11.00 AM MDT THURSDAY 12 MAY 2011** FOR TODAY AND FRIDAY.
THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 4.00 PM.

SLAVE LAKE.

TODAY..A MIX OF SUN AND CLOUD. 40 PERCENT CHANCE OF SHOWERS OVER WESTERN SECTIONS LATE THIS AFTERNOON. WIND SOUTHEAST 30 KM/H. HIGH 20. UV INDEX 5 OR MODERATE.

TONIGHT..BECOMING CLOUDY THIS EVENING THEN RAIN. SHOWERS OVER WESTERN SECTIONS THIS EVENING. AMOUNT 5 TO 10 MM. WIND SOUTHEAST 20 KM/H. LOW PLUS 3.

FRIDAY..CLEARING IN THE MORNING. HIGH 15.

FPCN16 CWWG 122131
FORECASTS FOR CENTRAL AND NORTHERN ALBERTA ISSUED BY ENVIRONMENT CANADA AT **4.00 PM MDT THURSDAY 12 MAY 2011** FOR TONIGHT FRIDAY AND FRIDAY NIGHT.
THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 5.00 AM FRIDAY.

SLAVE LAKE.

TONIGHT..INCREASING CLOUDINESS. SHOWERS OVER WESTERN SECTIONS THIS EVENING. SHOWERS BEGINNING NEAR MIDNIGHT. AMOUNT 10 TO 15 MM. WIND SOUTHEAST 40 KM/H GUSTING TO 60 BECOMING LIGHT THIS EVENING. LOW
PLUS 4.

FRIDAY..CLEARING IN THE MORNING. HIGH 16. UV INDEX 5 OR MODERATE.

FRIDAY NIGHT..CLEAR. WIND BECOMING SOUTHEAST 20 KM/H OVERNIGHT.LOW 9.

FPCN16 CWWG 131030
FORECASTS FOR CENTRAL AND NORTHERN ALBERTA ISSUED BY ENVIRONMENT CANADA AT **5.00 AM MDT FRIDAY 13 MAY 2011** FOR TODAY AND SATURDAY.
THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 11.00 AM.

SLAVE LAKE.

TODAY..RAIN ENDING EARLY THIS MORNING THEN A MIX OF SUN AND CLOUD. HIGH 16. UV INDEX 5 OR MODERATE.

TONIGHT..CLEARING LATE THIS EVENING. LOW 8.

SATURDAY..SUNNY WITH CLOUDY PERIODS. 40 PERCENT CHANCE OF SHOWERS IN THE AFTERNOON. WIND SOUTHEAST 30 KM/H. HIGH 19.

FPCN16 CWWG 131630
FORECASTS FOR CENTRAL AND NORTHERN ALBERTA ISSUED BY ENVIRONMENT CANADA AT **11.00 AM MDT FRIDAY 13 MAY 2011** FOR TODAY AND SATURDAY.
THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 4.00 PM.

SLAVE LAKE.

TODAY..SUNNY. BECOMING A MIX OF SUN AND CLOUD THIS AFTERNOON. HIGH 16. UV INDEX 5 OR MODERATE.

TONIGHT..CLOUDY PERIODS. LOW 8.

SATURDAY..SUNNY WITH CLOUDY PERIODS. 40 PERCENT CHANCE OF SHOWERS IN THE AFTERNOON. WIND SOUTHEAST 30 KM/H. HIGH 19.

FPCN16 CWWG 132141
FORECASTS FOR CENTRAL AND NORTHERN ALBERTA ISSUED BY ENVIRONMENT CANADA AT **4.00 PM MDT FRIDAY 13 MAY 2011** FOR TONIGHT SATURDAY AND SATURDAY NIGHT.
THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 5.00 AM SATURDAY.

SLAVE LAKE.

TONIGHT..CLOUDY PERIODS. WIND BECOMING EAST 20 KM/H NEAR MIDNIGHT. LOW 8.

SATURDAY..SUNNY. WIND SOUTHEAST 20 KM/H GUSTING TO 40 INCREASING TO 40 GUSTING TO 60 NEAR NOON. HIGH 18. UV INDEX 6 OR HIGH.

SATURDAY NIGHT..CLEAR. WIND SOUTHEAST 40 KM/H GUSTING TO 60 BECOMING EAST 20 IN THE EVENING. LOW 8.

FPCN16 CWWG 141030
FORECASTS FOR CENTRAL AND NORTHERN ALBERTA ISSUED BY ENVIRONMENT CANADA AT **5.00 AM MDT SATURDAY 14 MAY 2011** FOR TODAY AND SUNDAY.
THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 11.00 AM.

SLAVE LAKE.

TODAY..CLEARING. WIND SOUTHEAST 40 KM/H GUSTING TO 60. HIGH 18. UV INDEX 5 OR MODERATE.

TONIGHT..CLEAR. WIND SOUTHEAST 40 KM/H GUSTING TO 60. LOW 8.

SUNDAY..SUNNY. WIND SOUTHEAST 40 KM/H GUSTING TO 60 DIMINISHING TO 20 IN THE EVENING. HIGH 18.

FPCN16 CWWG 141631
FORECASTS FOR CENTRAL AND NORTHERN ALBERTA ISSUED BY ENVIRONMENT CANADA AT **11.00 AM MDT SATURDAY 14 MAY 2011** FOR TODAY AND SUNDAY.
THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 4.00 PM.

SLAVE LAKE.

TODAY..CLEARING EARLY THIS AFTERNOON. WIND SOUTHEAST 40 KM/H GUSTING TO 70. HIGH 20. UV INDEX 5 OR MODERATE.

TONIGHT..CLEAR. WIND SOUTHEAST 40 KM/H GUSTING TO 70. LOW 8.

SUNDAY..SUNNY. WIND SOUTHEAST 40 KM/H GUSTING TO 60 DIMINISHING TO 20 IN THE EVENING. HIGH 18.

FPCN16 CWWG 142130
FORECASTS FOR CENTRAL AND NORTHERN ALBERTA ISSUED BY ENVIRONMENT CANADA AT **4.00 PM MDT SATURDAY 14 MAY 2011** FOR TONIGHT SUNDAY AND SUNDAY NIGHT.
THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 5.00 AM SUNDAY.

SLAVE LAKE.

TONIGHT..CLEAR. WIND SOUTHEAST 40 KM/H GUSTING TO 60 DIMINISHING TO 20 GUSTING TO 40 NEAR MIDNIGHT. LOW 10.

SUNDAY..SUNNY. WIND SOUTHEAST 20 KM/H GUSTING TO 40 INCREASING TO 40 GUSTING TO 70 IN THE MORNING. HIGH 22. UV INDEX 5 OR MODERATE.

SUNDAY NIGHT..CLEAR. WIND SOUTHEAST 40 KM/H GUSTING TO 70 DIMINISHING TO 20 IN THE EVENING. LOW 11.

FPCN16 CWWG 150405 AAA
UPDATED FORECASTS FOR CENTRAL AND NORTHERN ALBERTA ISSUED BY ENVIRONMENT CANADA AT **10.05 PM MDT SATURDAY 14 MAY 2011** FOR TONIGHT
SUNDAY AND SUNDAY NIGHT.
THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 5.00 AM SUNDAY.

SLAVE LAKE.

TONIGHT..CLEAR. LOCAL SMOKE. WIND SOUTHEAST 30 KM/H GUSTING TO 50. LOW 10.

SUNDAY..SUNNY. WIND SOUTHEAST 20 KM/H GUSTING TO 40 INCREASING TO 40 GUSTING TO 70 IN THE MORNING. HIGH 22. UV INDEX 5 OR MODERATE.

SUNDAY NIGHT..CLEAR. WIND SOUTHEAST 40 KM/H GUSTING TO 70 DIMINISHING TO 20 IN THE EVENING. LOW 11.

FPCN16 CWWG 151030
FORECASTS FOR CENTRAL AND NORTHERN ALBERTA ISSUED BY ENVIRONMENT CANADA AT **5.00 AM MDT SUNDAY 15 MAY 2011** FOR TODAY AND MONDAY.
THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 11.00 AM.

SLAVE LAKE.

TODAY..SUNNY. WIND SOUTHEAST 20 KM/H INCREASING TO 40 GUSTING TO 70 THIS MORNING. HIGH 20. UV INDEX 5 OR MODERATE.

TONIGHT..CLEAR. WIND SOUTHEAST 40 KM/H GUSTING TO 70. LOW 11.

MONDAY..SUNNY. INCREASING CLOUDINESS IN THE EVENING. WIND SOUTHEAST 20 KM/H BECOMING LIGHT IN THE EVENING. HIGH 21.

FPCN16 CWWG 151630
FORECASTS FOR CENTRAL AND NORTHERN ALBERTA ISSUED BY ENVIRONMENT CANADA AT **11.00 AM MDT SUNDAY 15 MAY 2011** FOR TODAY AND MONDAY.
THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 4.00 PM.

SLAVE LAKE.

TODAY..SUNNY. WIND SOUTHEAST 40 KM/H GUSTING TO 70. HIGH 20. UV INDEX 5 OR MODERATE.

TONIGHT..CLEAR. WIND SOUTHEAST 40 KM/H GUSTING TO 70. LOW 11.

MONDAY..SUNNY. INCREASING CLOUDINESS IN THE EVENING. WIND SOUTHEAST 20 KM/H BECOMING LIGHT IN THE EVENING. HIGH 21.

FPCN16 CWWG 152130
FORECASTS FOR CENTRAL AND NORTHERN ALBERTA ISSUED BY ENVIRONMENT CANADA AT **4.00 PM MDT SUNDAY 15 MAY 2011** FOR TONIGHT MONDAY AND MONDAY NIGHT.
THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 5.00 AM MONDAY.

SLAVE LAKE.

TONIGHT..CLEAR. WIND SOUTHEAST 50 KM/H GUSTING TO 70 BECOMING EAST 30 GUSTING TO 50 LATE THIS EVENING. LOW 11.

MONDAY..SUNNY. WIND SOUTHEAST 30 KM/H GUSTING TO 50. HIGH 23. UV INDEX 6 OR HIGH.

MONDAY NIGHT..CLEAR. WIND SOUTHEAST 30 KM/H GUSTING TO 50 BECOMING LIGHT EARLY IN THE EVENING. LOW 9.

FPCN16 CWWG 152347 AAA
UPDATED FORECASTS FOR CENTRAL AND NORTHERN ALBERTA ISSUED BY ENVIRONMENT CANADA AT **5.44 PM MDT SUNDAY 15 MAY 2011** FOR TONIGHT MONDAY AND MONDAY NIGHT.
THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 5.00 AM MONDAY.

SLAVE LAKE.

TONIGHT..CLEAR. LOCAL SMOKE. WIND SOUTHEAST 50 KM/H GUSTING TO 70 BECOMING EAST 30 GUSTING TO 50 LATE THIS EVENING. LOW 11.

MONDAY..SUNNY. LOCAL SMOKE. WIND SOUTHEAST 30 KM/H GUSTING TO 50. HIGH 23. UV INDEX 6 OR HIGH.

MONDAY NIGHT..CLEAR. WIND SOUTHEAST 30 KM/H GUSTING TO 50 BECOMING LIGHT EARLY IN THE EVENING. LOW 9.

FPCN16 CWWG 161030
FORECASTS FOR CENTRAL AND NORTHERN ALBERTA ISSUED BY ENVIRONMENT CANADA AT **5.00 AM MDT MONDAY 16 MAY 2011** FOR TODAY AND TUESDAY.
THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 11.00 AM.

SLAVE LAKE.

TODAY..SUNNY. LOCAL SMOKE. WIND BECOMING SOUTHEAST 20 KM/H GUSTING TO 40 THIS MORNING. HIGH 22. UV INDEX 5 OR MODERATE.

TONIGHT..CLEAR. WIND SOUTHEAST 20 KM/H GUSTING TO 40 BECOMING LIGHT THIS EVENING. LOW 10.

TUESDAY..SUNNY. BECOMING A MIX OF SUN AND CLOUD IN THE MORNING. WIND BECOMING SOUTHEAST 20 KM/H EARLY IN THE EVENING. HIGH 17.

FPCN16 CWWG 161633
FORECASTS FOR CENTRAL AND NORTHERN ALBERTA ISSUED BY ENVIRONMENT CANADA AT **11.00 AM MDT MONDAY 16 MAY 2011** FOR TODAY AND TUESDAY.
THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 4.00 PM.

SLAVE LAKE.

TODAY..SUNNY. LOCAL SMOKE. WIND SOUTHEAST 20 KM/H GUSTING TO 40. HIGH 22. UV INDEX 5 OR MODERATE.

TONIGHT..CLEAR. WIND SOUTHEAST 20 KM/H GUSTING TO 40 BECOMING LIGHT THIS EVENING. LOW 10.

TUESDAY..SUNNY. BECOMING A MIX OF SUN AND CLOUD IN THE MORNING. WIND BECOMING SOUTHEAST 20 KM/H EARLY IN THE EVENING. HIGH 17.

FPCN16 CWWG 162134
FORECASTS FOR CENTRAL AND NORTHERN ALBERTA ISSUED BY ENVIRONMENT CANADA AT **4.00 PM MDT MONDAY 16 MAY 2011** FOR TONIGHT TUESDAY AND TUESDAY NIGHT.
THE NEXT SCHEDULED FORECAST WILL BE ISSUED AT 5.00 AM TUESDAY.

SLAVE LAKE.

TONIGHT..CLEAR. LOCAL SMOKE. WIND SOUTHEAST 20 KM/H GUSTING TO 40 BECOMING LIGHT THIS EVENING. LOW 12.

TUESDAY..A MIX OF SUN AND CLOUD. 30 PERCENT CHANCE OF SHOWERS IN THE AFTERNOON WITH RISK OF A THUNDERSTORM. LOCAL SMOKE. WIND BECOMING EAST 20 KM/H GUSTING TO 50 NEAR NOON. HIGH 20. UV INDEX 5 OR
MODERATE.

TUESDAY NIGHT..CLEAR. WIND EAST 20 KM/H GUSTING TO 50 BECOMING LIGHT IN THE EVENING. LOW 7.

APPENDIX H - MORNING AND AFTERNOON FORECASTS WITH ADVISORIES

Once-daily forecasts were issued May 11 to 13 with regular twice-daily forecasts commencing on May 14, 2011.

Government of Alberta

Wildfire Management Branch Forecast Issued:
Date: Wednesday May 11 2011

Fire Weather

ISI/FFMC values will trend into the very high/extreme range today over the eastern boreal sections with max temps in the low 20's. Near cross-over conditions over the LB/MM zones today can support active fire behaviour in the cured fine fuels. Winds increasing to SE30G50-60 km/h today for zones east of the fifth giving high ISI values....

Stable conditions across the eastern boreal zones today under the influence of an upper ridge. The ridge will begin to slide slightly eastwards as a low pressure centre develops over southern BC and strengthens the pressure gradient. Winds will increase to SE30-40G60km/h over the eastern boreal with gusts to 80km/h over higher terrain. Some RW/TRW activity will develop over the NW boreal section late this aft as the upper ridge edges eastwards.

On Thursday, the upper ridge moves into the eastern boreal sections while an unstable southerly upper flow develops over the western boreal sections. Widespread RW/TRW activity will develop along a cold front moving into the western boreal sections. Strong SE winds 30-40G60km/h will develop over the eastern boreal sections giving extreme ISI/FFMC values and near cross-over conditions. Winds will diminish to W/NW15-20km/h with the passage of the cold front with max temps trending lower..

Outlook for Friday: The cold front moves into the central boreal zones/SE slopes and weakens. Some TRW activity will redevelop along this old frontal boundary in the aft. A much lighter pressure gradient will exist across the province giving SE 15-20km/h winds. Max temps 17-19 deg C with RH values 30-35% over the eastern boreal sections; moderate elsewhere. No precip is forecast for the eastern boreal sections over the next period.

Outlook for Saturday: The upper ridge over the eastern boreal sections rebuilds while an unstable southerly flow develops over the western boreal/NE slopes. SE winds will strengthen to SE 25-30G40-50km/h over the eastern boreal sections. Max temps 18-22 deg C with RH values 25-30%. Expect high FFMC/ISI values over eastern boreal sections...Easy burning conditions are expected in cured fine fuels.

Forecast of Temp, RH, and wind for tomorrow afternoon; precipitation for next 24 hours

Fcst Zone	Max T	Low RH	Pcpn Covg	Pcpn Type	Ltg today	Ltg tom	Trend	Large Fire Potential	Wind Tomorrow Afternoon
OJ	20	40	40L-M	RW TRW	L-M	H	LC	L	SE30/NW30
FV	22	25	-	-	L	H	UP	L	SE30G55
MA	16	40	40L	RW TRW	L-M	H	LC	L	SE20G40/W20G40
RE	22	30	-	-	L	H	UP	L	SE35G55
GP	16	40	-	-	L	H	LC	L	NW20
SH	21	25	-	-	L	H	UP	L	SE40G60
PY	21	25	-	-	L	L	UP	L	SE35G55
MM	22	25	-	-	L	L	UP	M	SE40G60
LB	23	25	-	-	L	L	UP	M	SE40G60
ED	17	40	30L	RW	L	H	LC	L	NW15-20
RM	17	40	-	-	L	H	LC	L	NW15-20
BO	18	35	-	-	L	H	LC	L	SE25G50/NW20G40
CR	16	35	-	-	L	M	LC	L	SW30G60
JA	13	50	40L	RW	L	M	LC	L	NW15-20
BA	13	50	-	-	L	M	LC	L	NW15-20
WA	17	35	-	-	L	M	LC	L	SW30G60

Government of Alberta

Wildfire Management Branch Forecast Issued:
Date: Thursday, May 12 2011

Fire Weather

Very high to extreme ISI/FFMC values continue across zones east of the fifth today and will give very easy burning conditions in the fine fuels. Cross-over conditions are forecast with RH values between 20-25%. Winds SE40G60km/h will persist throughout today's burning period…

Upper ridge over the eastern boreal sections is giving stable conditions and strong SE winds. Max temps continue in the low 20 deg range. No precip activity is forecast for zones east of the fifth over the next few burning periods. Over western sections, an unstable southerly flow moving in from BC with a cold front moving eastwards into the western boreal will trigger widespread RW/TRW activity today. Good coverage expected with winds shifting from SE20G40km/h to NW15-20km/h with the frontal passage. RH values will trend higher across the western sections this aft with the frontal passage.

On Friday, the cold front will weaken as it moves into the central boreal. Winds will become light SE across all zones. An upper trough will move into the NW boreal sections in the aft/eve and trigger widespread RW/TRW activity. Stable conditions elsewhere.

Outlook for Saturday: The upper ridge over the eastern boreal sections rebuilds and gives warm/stable conditions. SE winds will increase to 20G40km/h in the afternoon. Max temps in the 19-21 deg range with RH values near 25% giving near cross-over conditions. FFMC/ISI values will trend into the very high/extreme range.

Outlook for Sunday: Very high ISI/FFMC values are forecast with strong SE winds continuing. Max temps between 20-22 deg with RH values 20-25% giving cross over conditions. An upper trough will approach the SE slopes in the aft/eve and trigger some RW/TRW activity.

Forecast of Temp, RH, and wind for tomorrow afternoon; precipitation for next 24 hours

Fcst Zone	Max T	Low RH	Pcpn Covg	Pcpn Type	Ltg today	Ltg tom	Trend	Large Fire Potential	Wind Tomorrow Afternoon
OJ	13	40	70	RW TRW	H	M	DN	L	SE10
FV	15	40	50	RW TRW	M	L	DN	L	SE10
MA	15	25	70	RW TRW	H	L	DN	L	SE10
RE	16	35	60	RW TRW	H	L	DN	L	SE10
GP	15	25	60	RW TRW	M	L	DN	L	SE10
SH	15	30	80	RW TRW	H	L	DN	L	SE15
PY	20	30	-	-	L	L	UP	L	S15
MM	19	30	-	-	L	L	UP	L	SE15
LB	19	30	-	-	L	L	UP	L	SE15
ED	15	30	60	RW TRW	M	L	DN	L	SE10
RM	15	30	60	RW TRW	M	L	DN	L	SE15
BO	16	30	20	RW	L- M	L	LC	L	SE15
CR	16	30	20	RW	L -M	L	LC	L	E20
JA	14	40	70	RW TRW	M	L	DN	L	E15
BA	15	40	30	RW	L-M	L	LC	L	E15
WA	16	30	20	RW	L-M	L	LC	L	E20

Government of Alberta

Wildfire Management Branch Forecast Issued:
Date: Friday, May 13 2011

Fire Weather

Fire Weather Advisory

Exceptionally low RH values and strong SE winds will give very easy burning conditions for zones east of the fifth during Saturday and Sunday's burning period. Caution is advised in all operations. Flashy fuels will become extremely flammable.

The cold front that moved into the western boreal section through yesterday has now weakened and lies from High Level to western MM. SE winds 20G40km/h will persist across the eastern boreal sections today but winds will diminish to light SE elsewhere. RH values will continue in the 25-30% range over the eastern boreal sections and the GP zone. RH values between 35-40% elsewhere.

Very strong SE winds will develop during Saturday's burning period as extremely low RH values develop over zones east of the fifth. Cross over conditions are forecast as ISI/FFMC values trend into the extreme range. Caution is advised near flashy fuels. The airmass will remain stable across all zones.

Outlook for Sunday: SE winds 30G50km/h will persist through Sunday's burning period as RH values lower to the 15-20% range for the boreal zones. Extreme FFMC/ISI values are forecast.....RH values will trend into the 25-30% range over the SE slopes ahead of an approaching upper trough over the pacific northwest.

Outlook for Monday: Winds will diminish to moderate over the eastern boreal sections as the ridge shifts eastwards. RH values continue in the near the 20% range across all boreal zones with max temps between 20-22deg C. Crossover conditions will redevelop. Scattered RW activity will develop over the SE slopes ahead of an approaching upper low near Vancouver Island.

Forecast of Temp, RH, and wind for tomorrow afternoon; precipitation for next 24 hours

Fcst Zone	Max T	Low RH	Pcpn Covg	Pcpn Type	Ltg today	Ltg tom	Trend	Large Fire Potential	Wind Tomorrow Afternoon
OJ	18	30	40L	RW	L	L	LC	L	SE25G40
FV	20	25	30L	RW	L	L	UP	L	SE30G50
MA	19	25	-	-	L	L	UP	L	SE25G40
RE	20	20	30L	RW	L	L	UP	M	SE40G50
GP	20	25	-	-	L	L	UP	L	SE30G50
SH	20	25	-	-	L	L	UP	L	SE40G60
PY	20	25	-	-	L	L	UP	L	SE25G40
MM	20	20	-	-	L	L	UP	M	SE30G50
LB	21	15	-	-	L	L	UP	M	SE30G50
ED	17	25	-	-	L	L	UP	L	SE30G50
RM	16	20	-	-	L	L	UP	L	SE30G50
BO	15	20	-	-	L	L	UP	L	SE30G50
CR	15	30	-	-	L	L	UP	L	E30G50
JA	12	40	-	-	L	L	UP	L	SE20G40
BA	12	40	-	-	L	L	UP	L	SE25G50
WA	15	30	-	-	L	L	UP	L	E30G50

Government of Alberta

Wildfire Management Branch AM Forecast
Issued:
Saturday May 14 2011

Fire Weather

FIRE WEATHER ADVISORY REMAINS IN EFFECT FOR BOREAL ZONES EAST OF THE FIFTH FOR TODAY AND SUNDAY'S BURNING PERIOD .....Flashy fuels extremely flammable in these zones....caution advised in all operations in the advisory area as FFMC/ISI values reach well into the extreme range...

RH values falling into the 15% range in the eastern boreal zones this burning period under gusty SE winds generating extreme FFMC/ISI values..strong SE winds across the province today including the southern east slopes...gusty winds persisting overnight with poor RH recovery in most areas...

A strong upper level and surface ridge of high pressure building into the province from Sask is driving dewpoint values well below freezing in the eastern boreal zones – as temps approach the 20 deg mark, RH values will fall into the 15% range in these areas with a risk of even lower values at some stations. The pressure gradient has also increased significantly overnight in all areas and very gusty SE winds are forecast in most areas of the province. RH values remain more moderate in the western zones however the southern foothills and grasslands will see 20-25% producing crossover conditions accompanied by strong SE winds.

Similar conditions are expected in most areas Sunday as the very strong SE pressure gradient persists over Alberta - winds may increase in the eastern boreal areas Sunday with gusts to 60km/h – the fire weather advisory will remain in affect for these areas for Sunday's burning period....

Forecast for Today and Tonight

Forecast Zone	Maximum Temp	Low RH	Pcpn Coverage	Pcpn Type	Ltg Prob	Afternoon Wind
OJ	18	35	20L	RW	L	SE25G40
FV	20	30	20L	RW	L	SE30G50
MA	18	35	-	-	L	SE25G40
RE	20	20	-	-	L	SE35G50
GP	20	25	-	-	L	SE30G50
SH	19	25	-	-	L	SE40G60
PY	20	25	-	-	L	SE20G40
MM	20	15	-	-	L	SE30G45
LB	20	15	-	-	L	SE30G45
ED	18	25	-	-	L	SE30G50
RM	16	25	-	-	L	SE30G50
BO	15	30	-	-	L	SE30G50
CR	15	30	-	-	L	E30G50
JA	12	40	-	-	L	SE20G40
BA	12	40	-	-	L	SE25G50
WA	15	30	-	-	L	E30G50

Government of Alberta

Wildfire Management Branch PM Forecast
Issued: Saturday May 14 2011

Fire Weather

FIRE WEATHER ADVISORY REMAINS IN EFFECT FOR BOREAL ZONES EAST OF THE FIFTH FOR TODAY AND SUNDAY'S BURNING PERIOD .....Flashy fuels extremely flammable in these zones....caution advised in all operations in the advisory area as FFMC/ISI values reach well into the extreme range...

Pressure gradient increasing over zones east of the fifth Sunday generating very gusty wind conditions and driving ISI values higher in most areas..RH values at some stations in the LB/eastern RE/MM zones falling into the 10-15% range...low RH values also extending further NW into the eastern MA and FV zones..

Very easy burning conditions will continue Sunday in zones east of the fifth as FFMC/ISI values also trend higher in western zones. Very low dewpoints will drive RH values into the 15% range at several stations in the eastern MA/RE /MM/LB zones - some stations will likely fall into the 10-15% range. The strong SE winds along the foothills will help maintain moderate RH values in the east slopes/mtn parks

Outlook for Monday : Upper ridge weakens significantly and drifts east of the province – southerly flow aloft establishes over Alberta. Much lower wind speeds and ISI values most forecast zones as surface trough develops over the province. RH values recover slightly in the eastern boreal areas under SE winds of 20 km/h. Max temps generally in 18-21 deg range most areas – RH values east of the fifth 25-30% and 35-45% elsewhere. Sct TRW RW developing east slopes areas.

Outlook for Tuesday : RH values continue to trend higher all areas with light winds suppressing FFMC/ISI values. Surface trough deepens over the province as a significant upper disturbance tracks northward along the Sask border into central Alberta in southerly flow aloft – widespread RW/TRW developing into periods of rain overnight in the southern east slopes/SH/ED/southern LB/RE zones.

Forecast of Temp, RH, and wind for tomorrow afternoon; precipitation for next 24 hours

Fcst Zone	Max T	Low RH	Pcpn Covg	Pcpn Type	Ltg today	Ltg tom	Trend	Large Fire Potential	Wind Tomorrow Afternoon
OJ	21	20	-	-	L	L	UP	L	SE25G45
FV	22	20	-	-	L	L	UP	L	SE30G50
MA	19	20	-	-	L	L	UP	L	SE30G50
RE	20	15	-	-	L	L	UP	M-H	SE35G60
GP	18	25	-	-	L	L	UP	L	SE25G45
SH	18	25	-	-	L	L	UP	L	SE35G60
PY	22	15	-	-	L	L	UP	M	SE25G45
MM	22	15	-	-	L	L	UP	M-H	SE30G50
LB	20	15	-	-	L	L	UP	M-H	SE35G50
ED	17	30	-	-	L	L	UP	L	SE30G50
RM	16	35	-	-	L	L	UP	L	SE30G50
BO	16	35	-	-	L	L	P	L	SE30G50
CR	16	35	-	-	L	L	UP	L	SE30G50
JA	15	45	-	-	L	L	UP	L	SE20
BA	15	40	-	-	L	L	UP	L	SE20G40
WA	16	35	-	-	L	L	UP	L	SE25G40

Government of Alberta

Wildfire Management Branch AM Forecast
Issued:
Sunday May 15 2011

Fire Weather

FIRE WEATHER ADVISORY REMAINS IN EFFECT FOR BOREAL AREAS EAST OF THE SIXTH FOR TODAY .....Flashy fuels extremely flammable in these zones....caution advised in all operations in the advisory area as FFMC/ISI values reach well into the extreme range...

Poor RH recovery last night as gusty SE winds persisted during the overnight hours allowing active behaviour well outside the typical burning period....strong SE winds expected to continue this burning period particularly in the SH/RE/LB/MM zones ...gusty SE winds in the east slopes as well with a slight increase in RH values...

Little change in the overall weather picture is expected this burning period as a very strong SE pressure gradient and very dry air remain over most forecast zones. The high pressure system over southern Sask generating these conditions continues to drift SE into Manitoba and will gradually lose it's grip on Alberta – dewpoints have begun to increase over southern Alberta and will produce slightly higher RH values in most zones south of Slave Lake today however no sig change in the extreme FFMC/ISI conditions is expected. The area of strongest winds will begin to drift eastward this evening into the LB/MM zones as a new low pressure system begins to develop over the ED/GP zones – a cold front will develop with this system over southern BC and will be supported by an upper disturbance in Montana. Colder and humid air will push northward into the east slopes/mtn parks Mon aftn with gusty SW winds and sct RW activity.

Mon aftn in the boreal zones east of the fifth winds of SE20G40 km/h are expected - west of the fifth E-SE winds of 15km/h are forecast. RH values will continue to persist in the 20-25 % range in most boreal zones and the SH zone. Max temps in most boreal areas will remain in the 21-24 deg range. No sig reduction in FFMC values in the boreal and SH zones is expected Mon...

Forecast for Today and Tonight

Forecast Zone	Maximum Temp	Low RH	Pcpn Coverage	Pcpn Type	Ltg Prob	Afternoon Wind
OJ	23	15	-	-	L	SE25G45
FV	23	15	-	-	L	SE30G50
MA	20	15	-	-	L	SE30G50
RE	20	15	-	-	L	SE35G60
GP	18	20	-	-	L	SE25G45
SH	18	20	-	-	L	SE40G70
PY	23	15	-	-	L	SE25G45
MM	22	15	-	-	L	SE35G50
LB	20	15	-	-	L	SE35G50
ED	17	30	-	-	L	SE30G50
RM	16	30	-	-	L	SE30G50
BO	16	35	-	-	L	SE30G50
CR	16	35	-	-	L	SE30G50
JA	15	45	-	-	L	SE20
BA	15	40	-	-	L	SE20G40
WA	16	35	-	-	L	SE25G40

Government of Alberta

Wildfire Management Branch AM Forecast
Issued:
Monday May 16 2011

Fire Weather

FIRE WEATHER ADVISORY REMAINS IN EFFECT FOR BOREAL AREAS EAST OF THE FIFTH FOR TODAY .....Flashy fuels extremely flammable in these zones....caution advised in all operations in the advisory area as FFMC/ISI values reach well into the extreme range...

Gusty SE winds expected to continue in boreal zones east of the fifth this burning period as low pressure system develops over west-central Alberta...widespread crossover conditions in the boreal zones...lower windspeeds expected by late aftn in central Alberta...RW activity spreading into the southern east slopes as cold front pushes northward through the Rockies...BUI uptrend continuing particularly in the eastern boreal regions...

The pressure gradient over Alberta has weakened overnight in western Alberta with the area of strongest winds shifting east into the LB/MM/eastern RE zones. Extreme FFMC/ISI values will affect these areas. Very high to extreme FFMC values will continue in most boreal areas despite a modest increase in RH values .

A cold front is pushing across the divide and will drive northward into central Alberta by Tues AM. This weak front will generate more unstable conditions and a risk of TRW RW activity in most areas from Red Earth to the Rocky zone. Winds behind the front will be generally S-SE 15-20 km/h in central boreal areas and NE 20-25 km/h in areas along the NWT border with SW15 km/h along the east slopes. Max temps in central and southern zones will be in the 16-18 deg range while 23-25 deg is seen for zones north of Red Earth.

Currently no significant organised precipitation event is in the outlook for the province....

Forecast for Today and Tonight

Forecast Zone	Maximum Temp	Low RH	Pcpn Coverage	Pcpn Type	Ltg Prob	Afternoon Wind
OJ	24	20	-	-	L	NE10-15
FV	24	20	-	-	L	SE15
MA	23	25	-	-	L	E15
RE	24	20	-	-	L	SE20G40
GP	22	25	-	-	L	SE15/SW15
SH	22	25	-	-	L	SE25G40
PY	24	20	-	-	L	S20
MM	24	20	-	-	L	SE25G45
LB	22	20	-	-	L	SE30G50
ED	20	30	20L	RW TRW	M	SE20
RM	18	35	20L	RW TRW	M	SE15/SW20
BO	16	35	20L	RW TRW	M	SW30G50
CR	16	40	20L	RW	L	SW40G60
JA	17	50	20L	RW	L-M	SE10
BA	16	50	20L	RW	L-M	SW25G45
WA	16	40	20L	RW	L	SW40G60

Government of Alberta

Wildfire Management Branch PM Forecast
Issued: Monday May 16 2011

Fire Weather

FIRE WEATHER ADVISORY REMAINS IN EFFECT FOR BOREAL AREAS EAST OF THE FIFTH FOR TODAY'S BURNING PERIOD .....Flashy fuels extremely flammable in these zones....caution advised in all operations in the advisory area as FFMC/ISI values reach well into the extreme range...

Gusty S-SE winds continue to generate extreme FFMC/ISI values in areas east of the fifth this burning period...winds decreasing in western boreal zones and the SH zone as gradient continues to weaken under a broad low pressure area....cold front pushes across the Rockies and will push northward into the central boreal zones Tue AM..widely sct RW with some TRW activity expected in the east slopes/SH and GP zones Tues...excellent RH recovery expected overnight under a much improved dewpoint picture in most forecast zones ..

Very easy burning conditions continue this aftn/eve in the eastern boreal zones as stronger SE winds persist well into the evening. A broad low pressure area south of the GP zone is pulling a cold front northward from southern Alberta into the boreal zones over the next 24 hours. The front will bring cooler and more humid conditions to the east slopes and SH zones. Some widely sct TRW RW activity will also affect these areas...lighter winds are also forecast for zones east of the fifth Tue aftn...

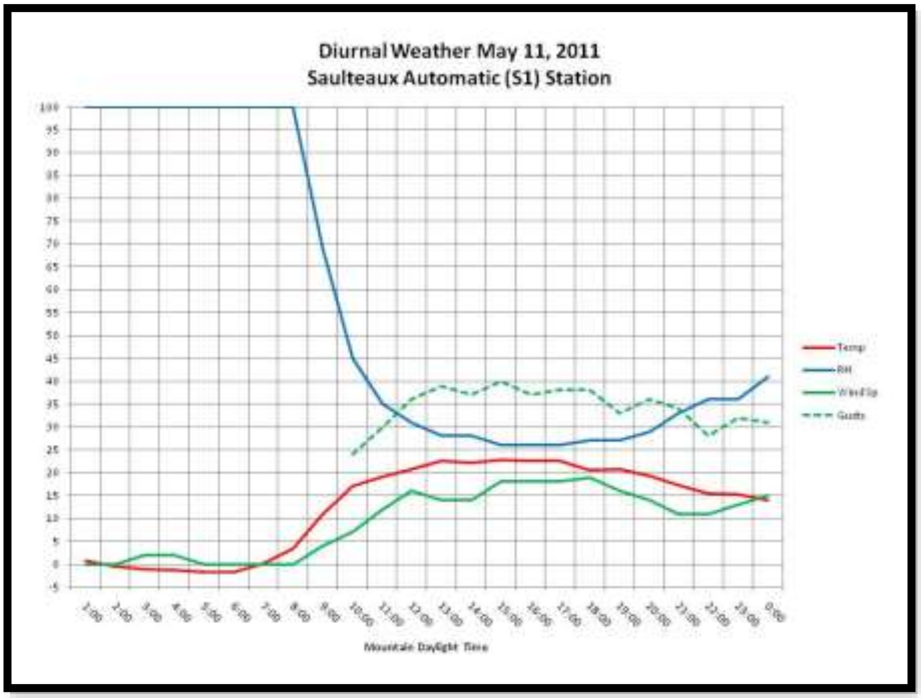
Outlook for Wednesday: Generally unstable airmass over the province under a southerly flow aloft. Widely sct TRW RW activity most boreal zones Weak pressure gradient all zones resulting in generally light winds all areas. RH values in 30-40% range with 40-50% in most zones west of the fifth. Excellent RH recovery overnight all zones. Max temps in 19-22 deg range boreal zones – 17-19 east slopes .

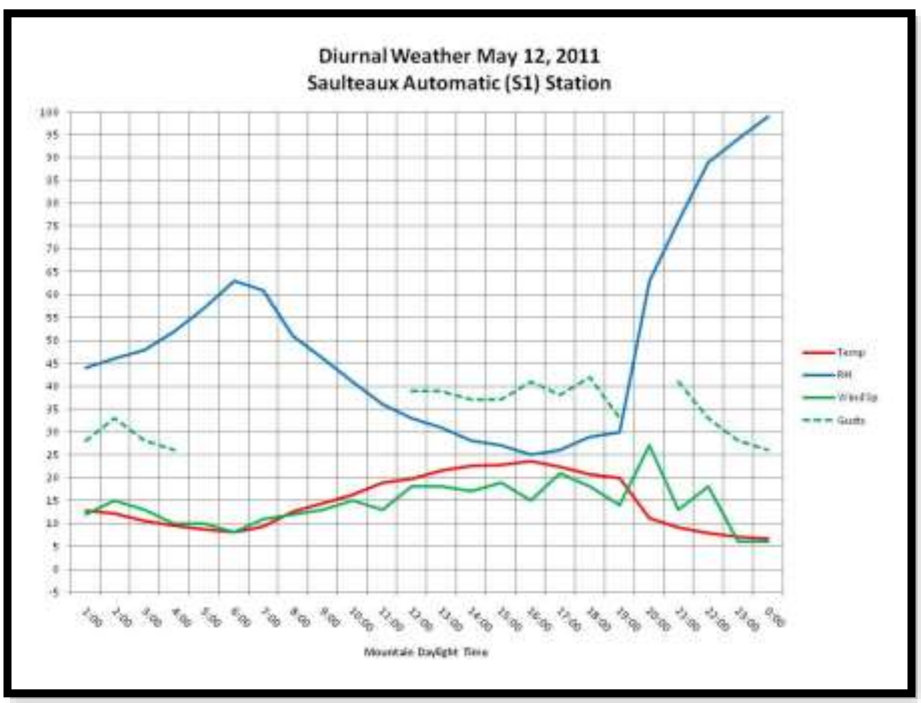
Outlook for Thursday: Weak pressure gradient remains over the province maintaining light and variable winds most areas. Temps generally in 20-23 deg range boreal zones and 17-19 southern east slopes/mtn parks. Sct TRW RW east slopes. RH values 35-45% boreal zones and 40-50% east slopes. Excellent RH recovery most areas.

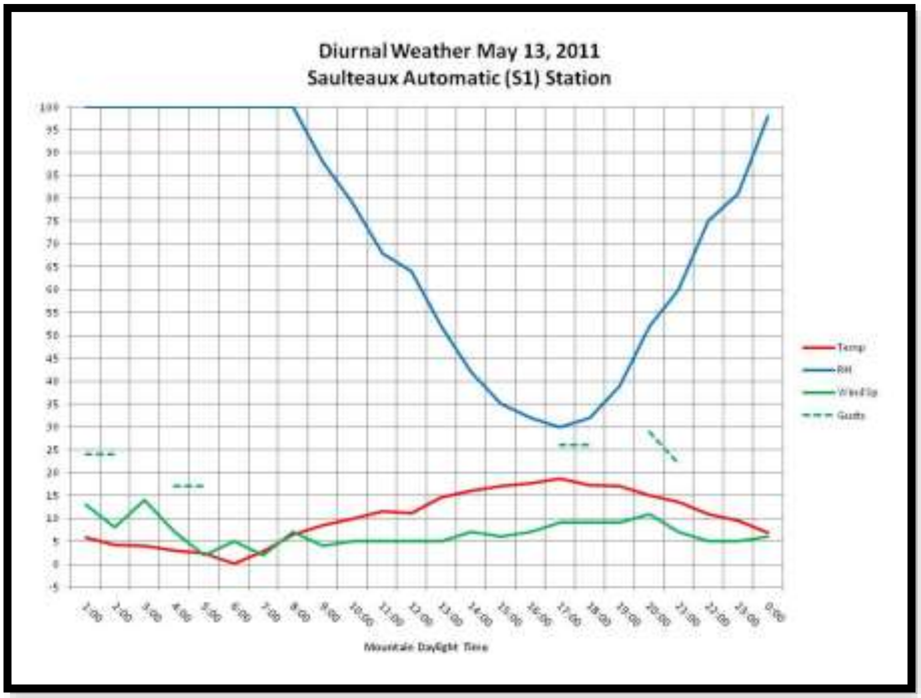
Forecast of Temp, RH, and wind for tomorrow afternoon; precipitation for next 24 hours

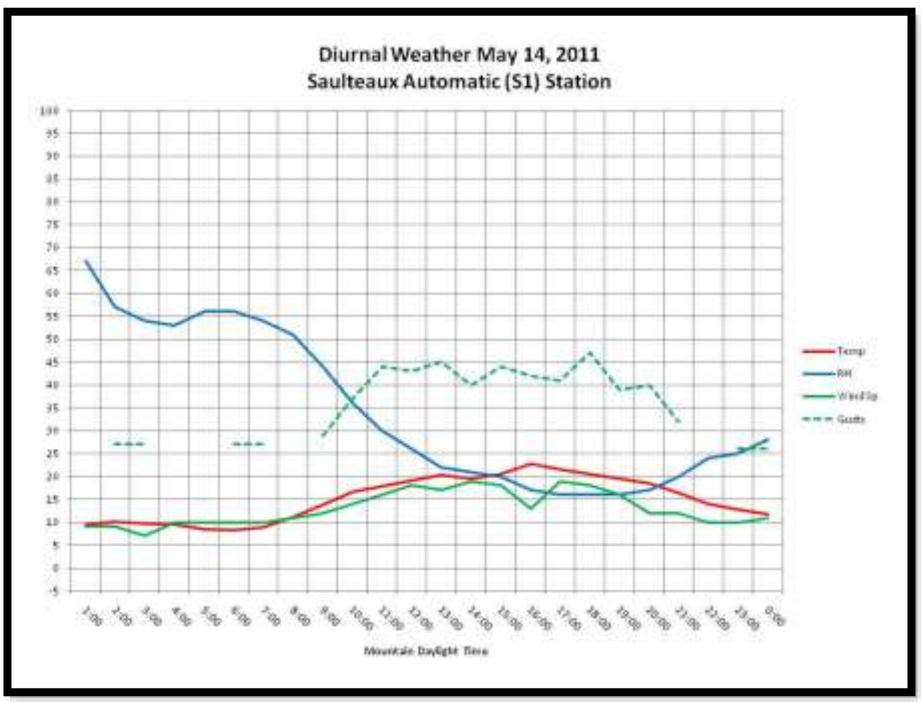
Fcst Zone	Max T	Low RH	Pcpn Covg	Pcpn Type	Ltg today	Ltg tom	Trend	Large Fire Potential	Wind Tomorrow Afternoon
OJ	23	25	-	-	L	L	UP	L-M	NE20G40
FV	25	20	-	-	L	L	UP	L-M	NE20G40
MA	20	35	-	-	L	M	LC	L	E15
RE	22	30	-	-	L	M	LC	M	E15
GP	15	50	40L	RW	L	M	LC	L	W20
SH	18	35	-	-	L	M	LC	L	SE15/SW15
PY	25	20	-	-	L	L	UP	M	NE20
MM	25	25	-	-	L	L-M	UP	M	SE20
LB	22	20	-	-	L	L-M	UP	M	SE20
ED	15	40	30L	RW	L-M	M	LC	L	SW15
RM	14	35	40L	RW	L-M	M	LC	L	SW15
BO	14	35	40L	RW	L-M	M	LC	L	SW20
CR	14	35	-	-	L	L	LC	L	SW20
JA	13	55	40L	RW	L-M	L	LC	L	SW10
BA	13	45	40L	RW	L	M	LC	L	SW15
WA	14	35	-	-	L	L	LC	L	SW20

APPENDIX I - DIURNAL WEATHER






Diurnal Weather May 13, 2011
Saulteaux Automatic (S1) Station
Temp
RH
Wind Sp
Gusts
Mountain Daylight Time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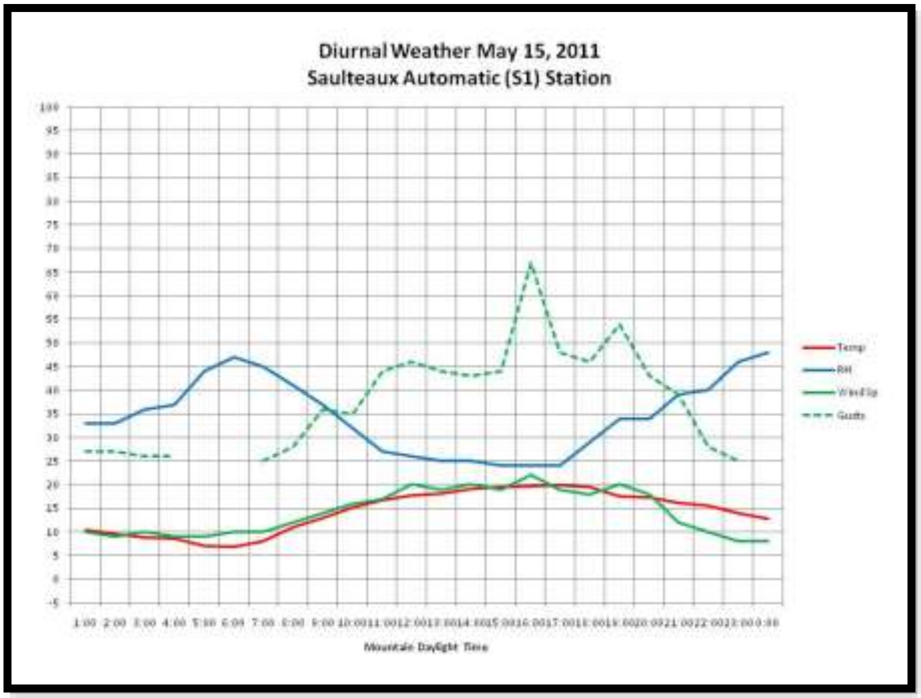
Saulteaux Automatic (S1) Station
Temp
RH
Wind Sp
Gusts
Mountain Daylight Time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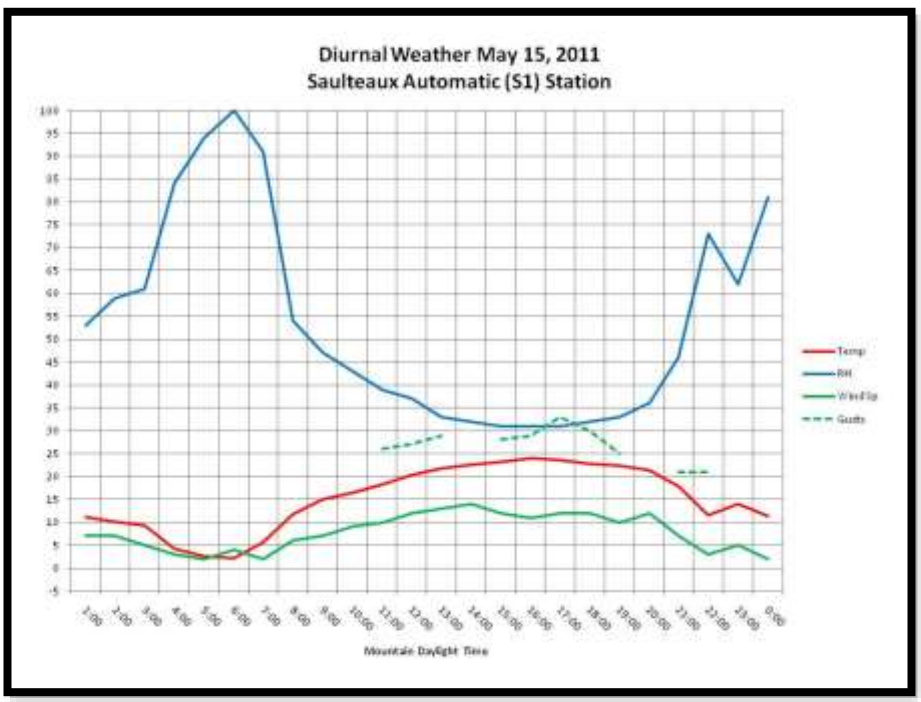
Saulteaux Automatic (S1) Station
Temp
RH
Wind Sp
Gusts
Mountain Daylight Time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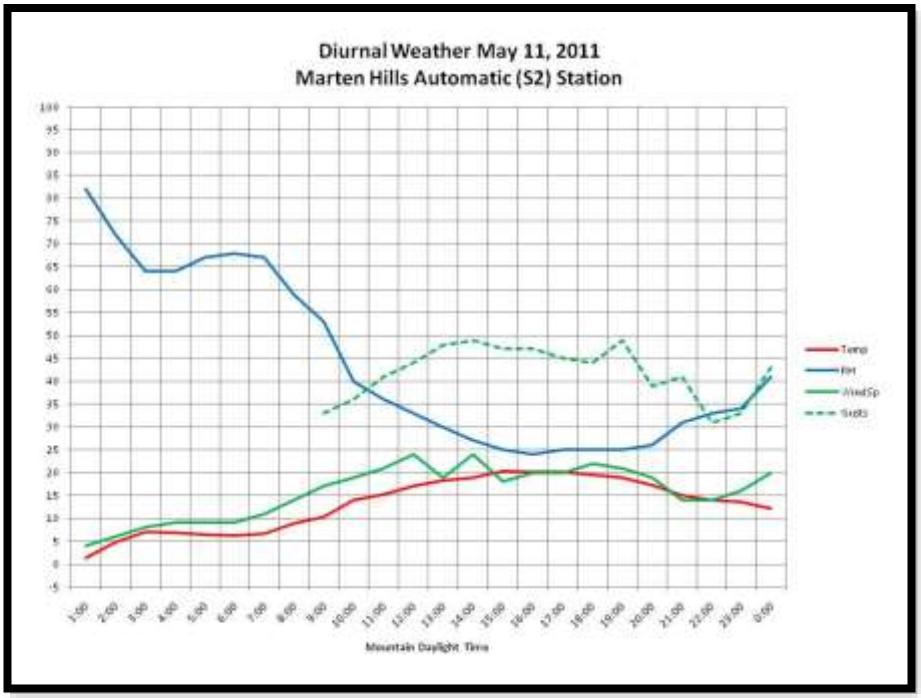
Saulteaux Automatic (S1) Station
Temp
RH
Wind Sp
Gusts
Mountain Daylight Time


Diurnal Weather May 11, 2011
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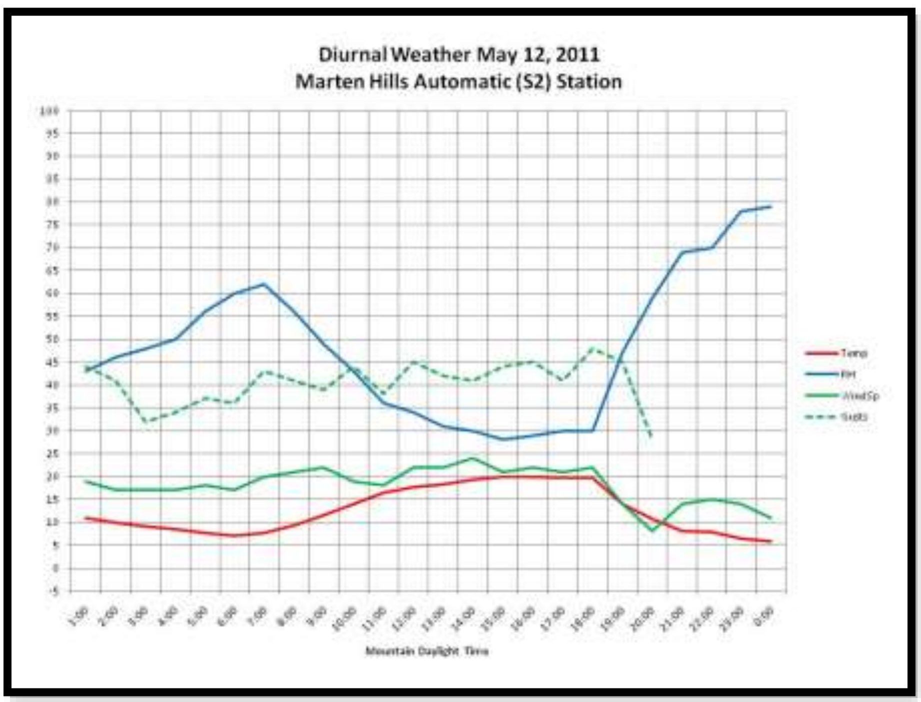
Mountain Daylight Time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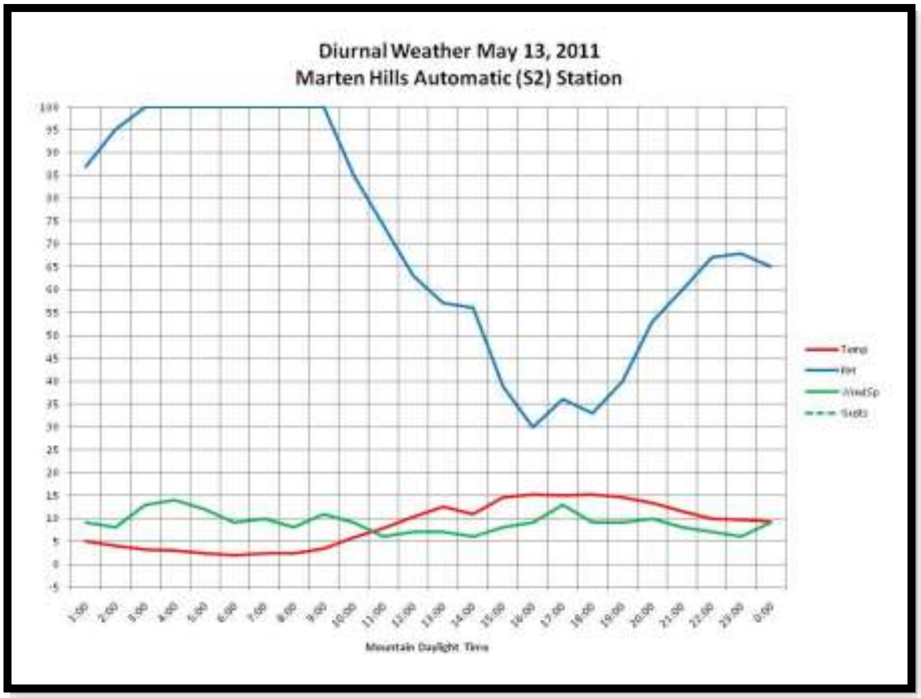
Marten Hills Automatic (S2) Station
Mountain Daylight Time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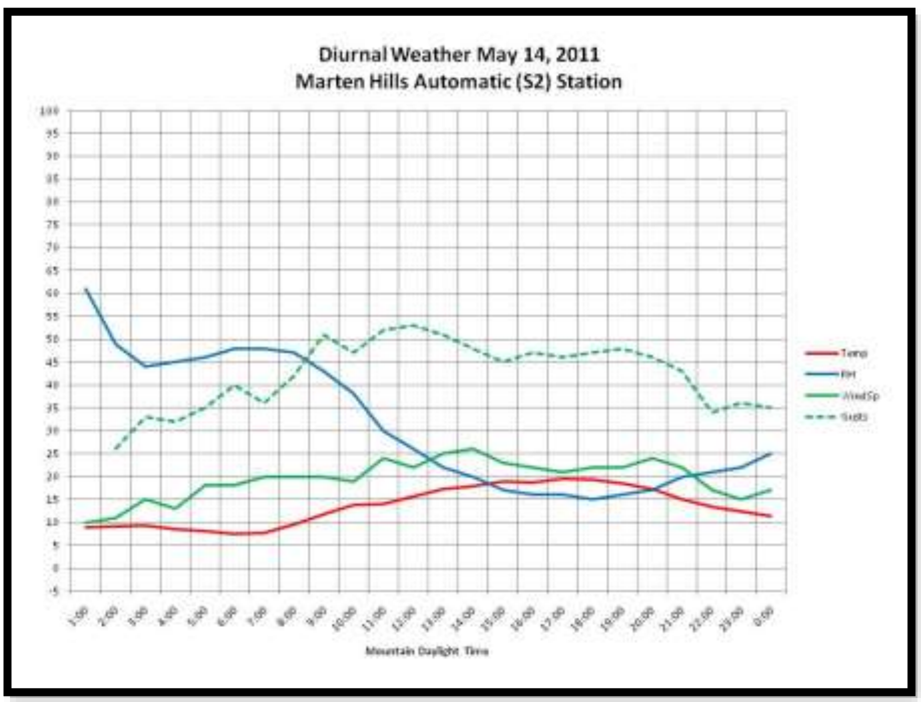
Mountain Daylight Time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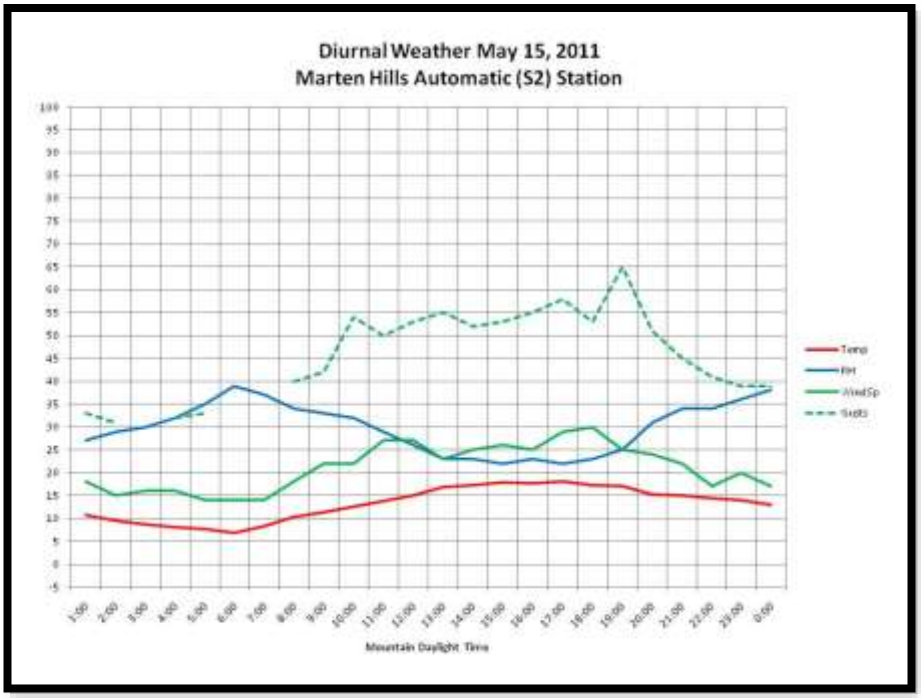
Marten Hills Automatic (S2) Station
Mountain Daylight Time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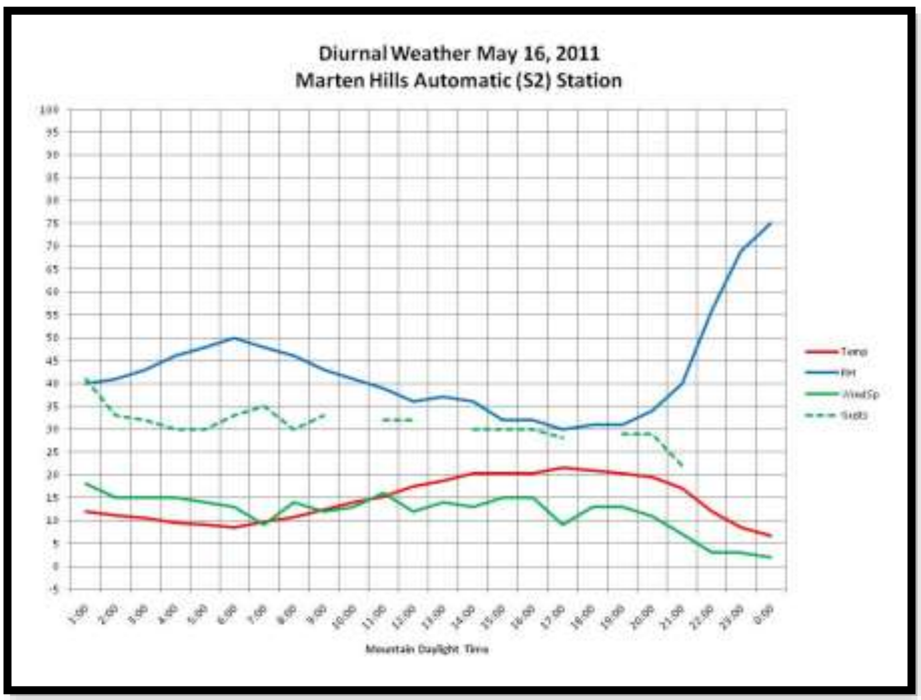
Mountain Daylight Time


Diurnal Weather May 16, 2011
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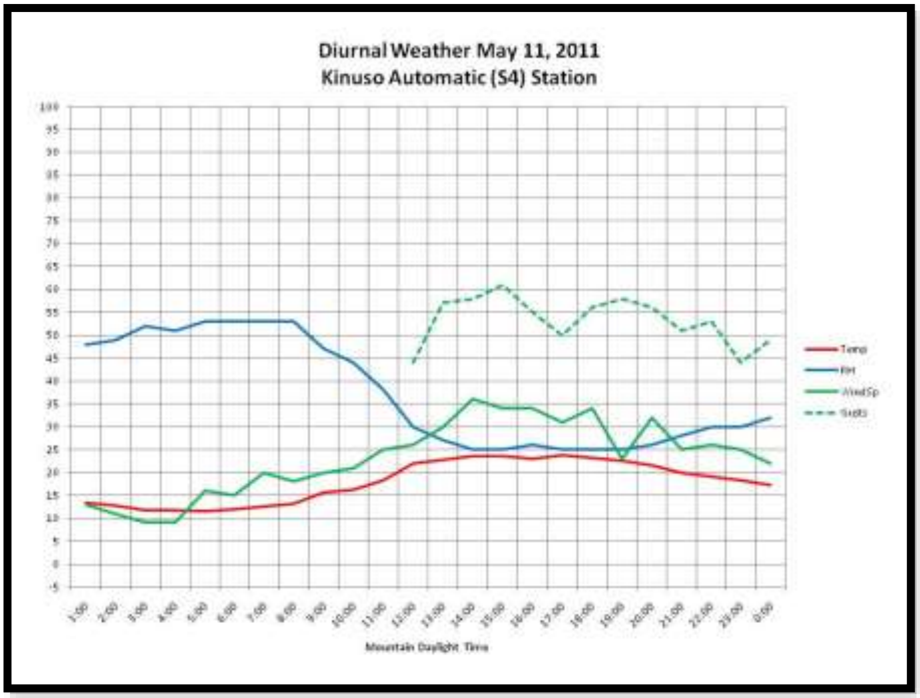
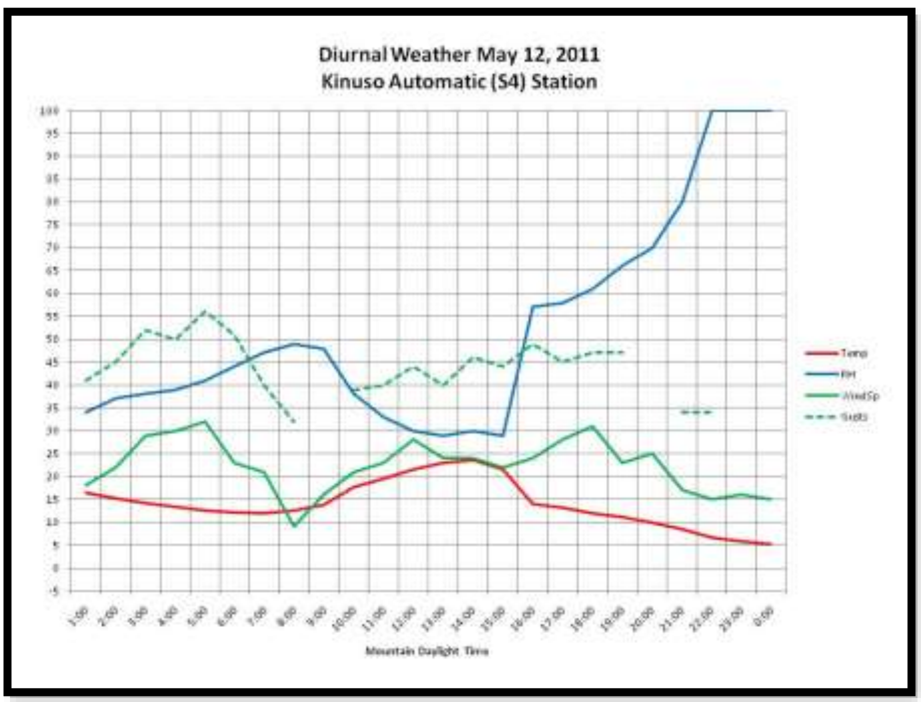
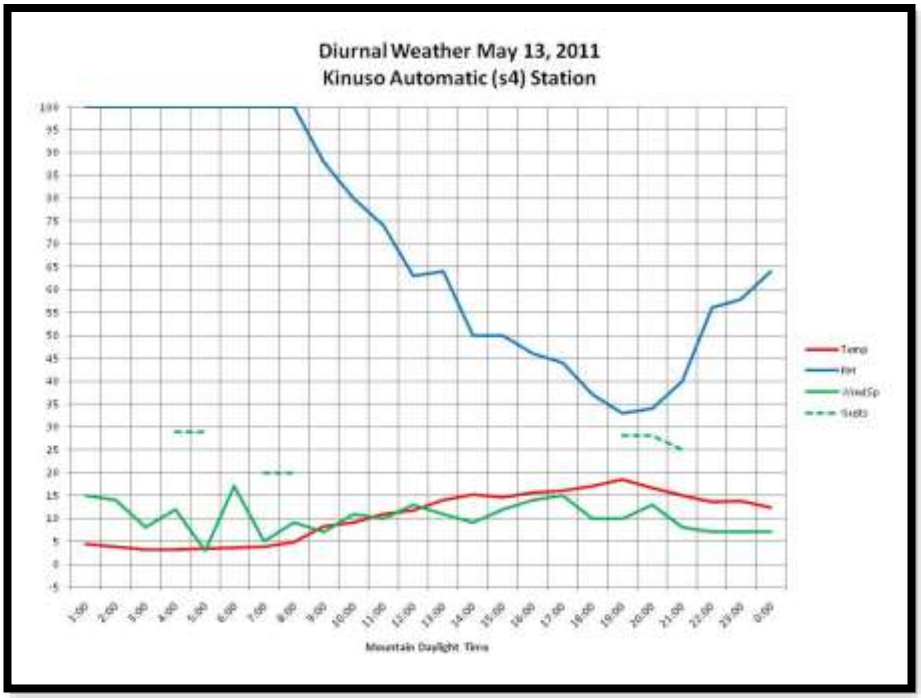
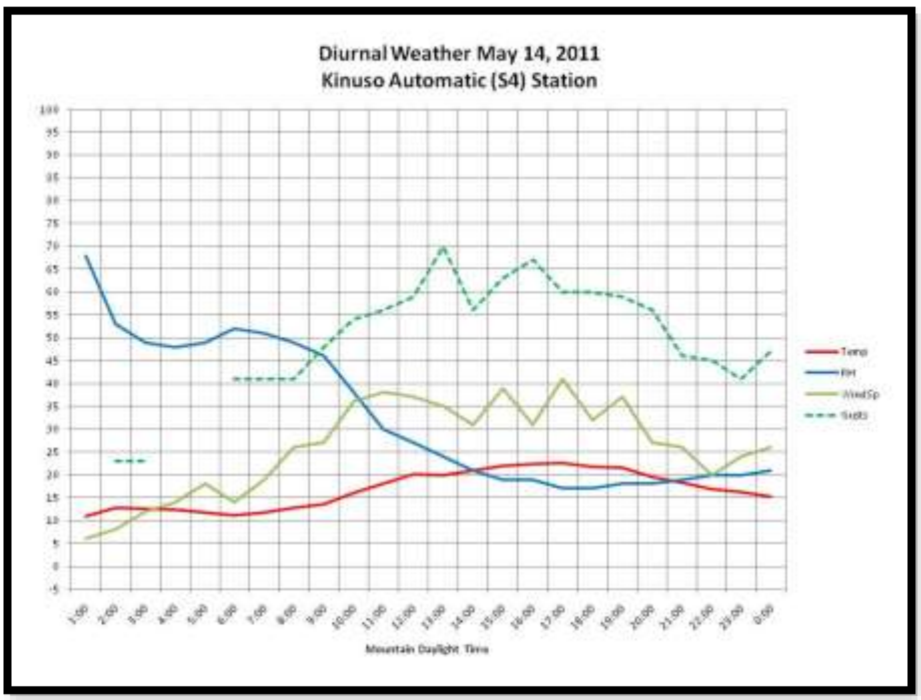
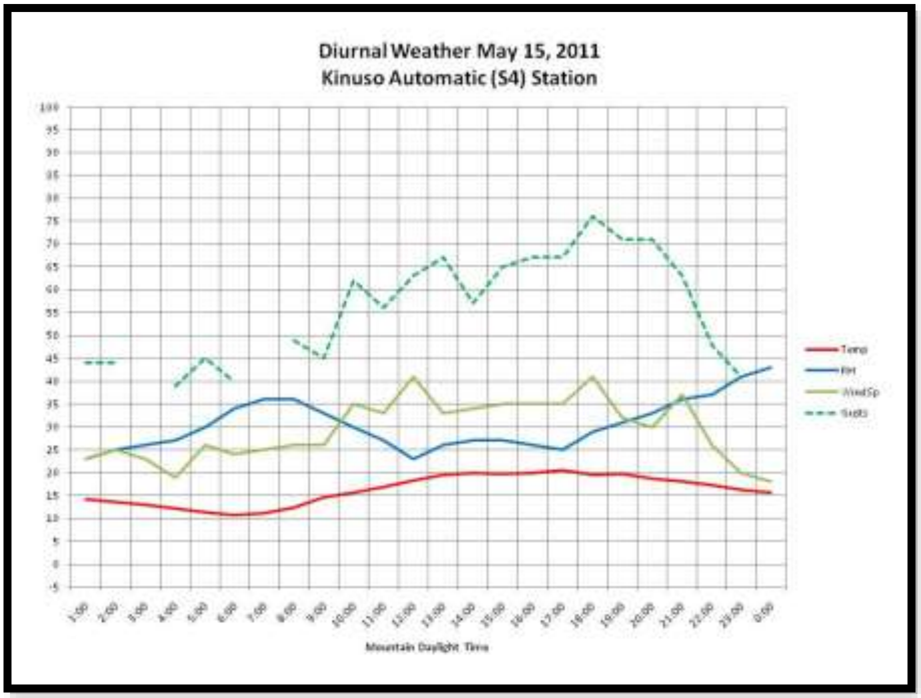
Mountain Daylight Time

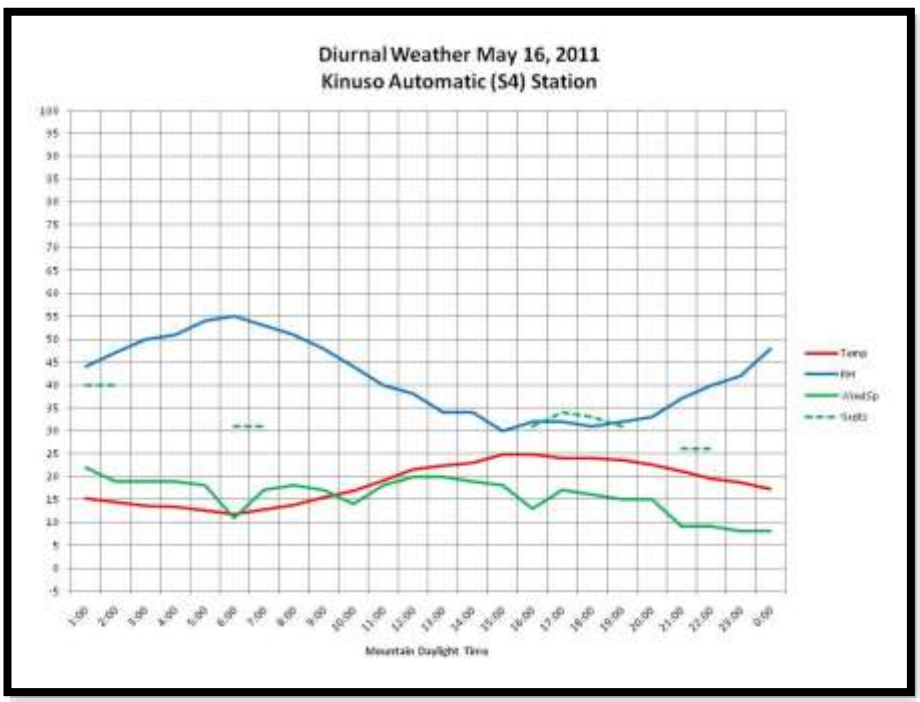

Diurnal Weather May 11, 2011
Kinuso Automatic (S4) Station
Mountain Daylight Time

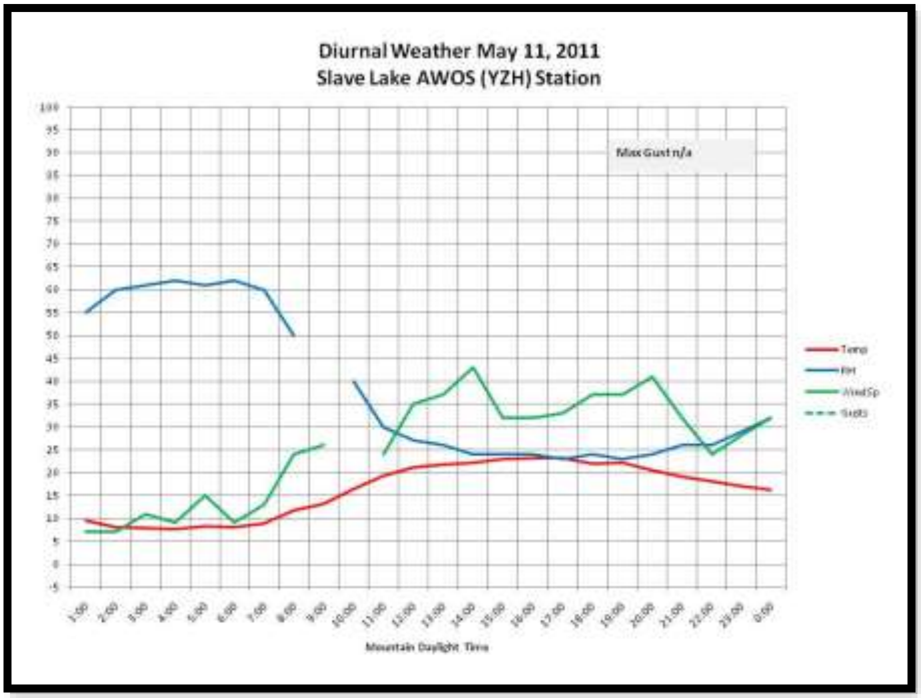

Diurnal Weather May 12, 2011
Kinuso Automatic (S4) Station
Mountain Daylight Time

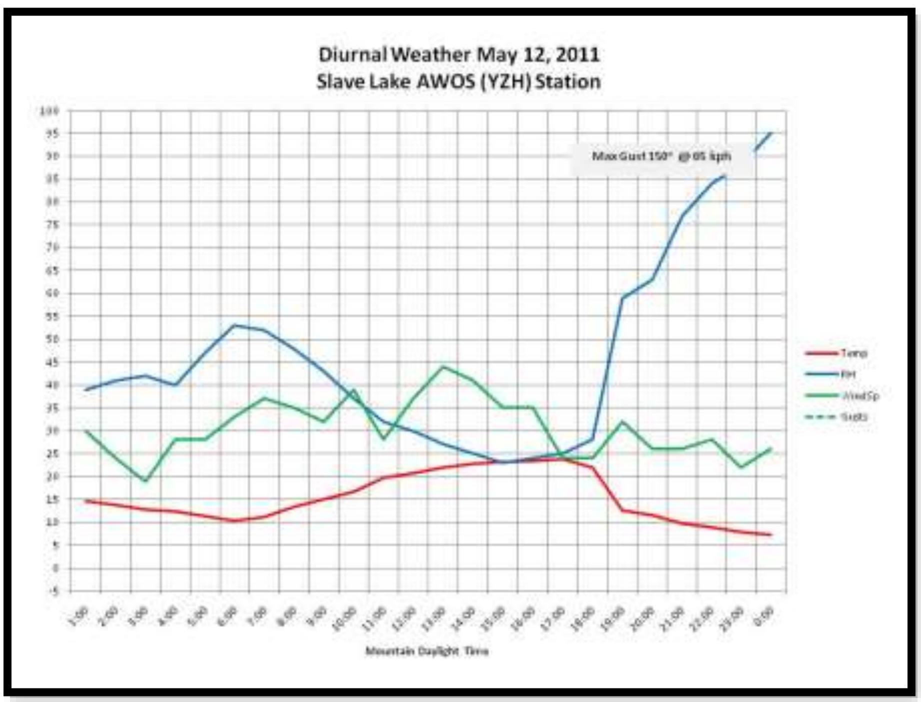

Diurnal Weather May 13, 2011
Kinuso Automatic (s4) Station
Temp
RH
Mountain Daylight Time

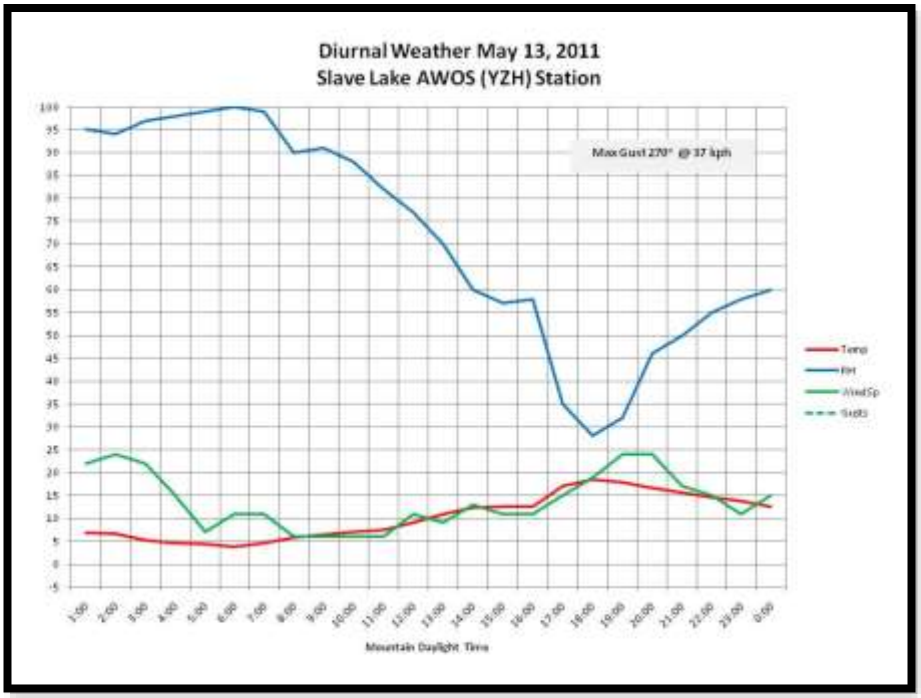

Diurnal Weather May 14, 2011
Kinuso Automatic (S4) Station
Temp
RH
Mountain Daylight Time

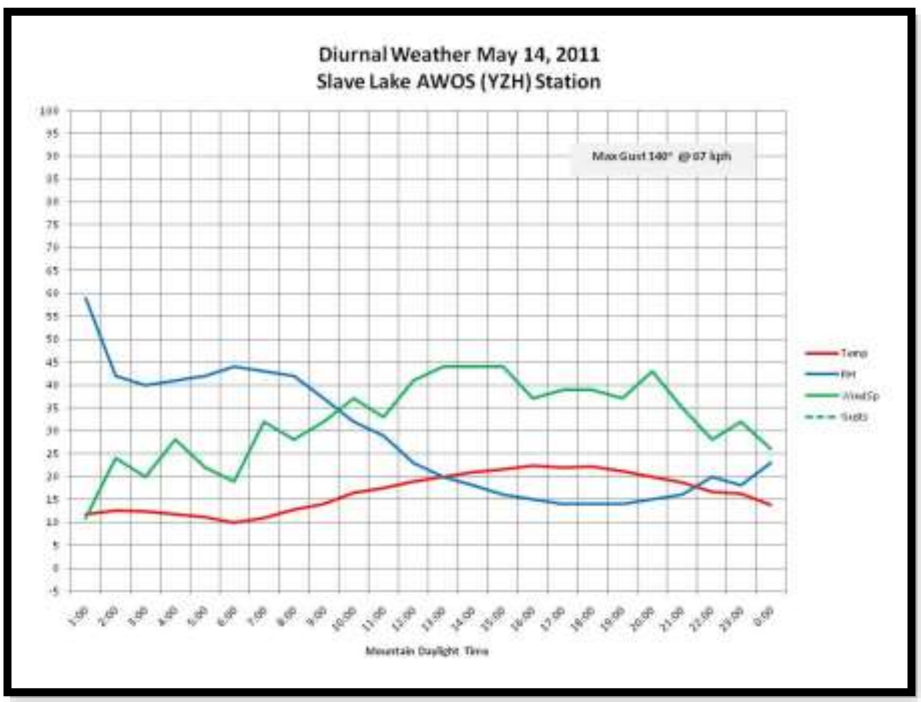

Diurnal Weather May 15, 2011
Kinuso Automatic (S4) Station
Mountain Daylight Time

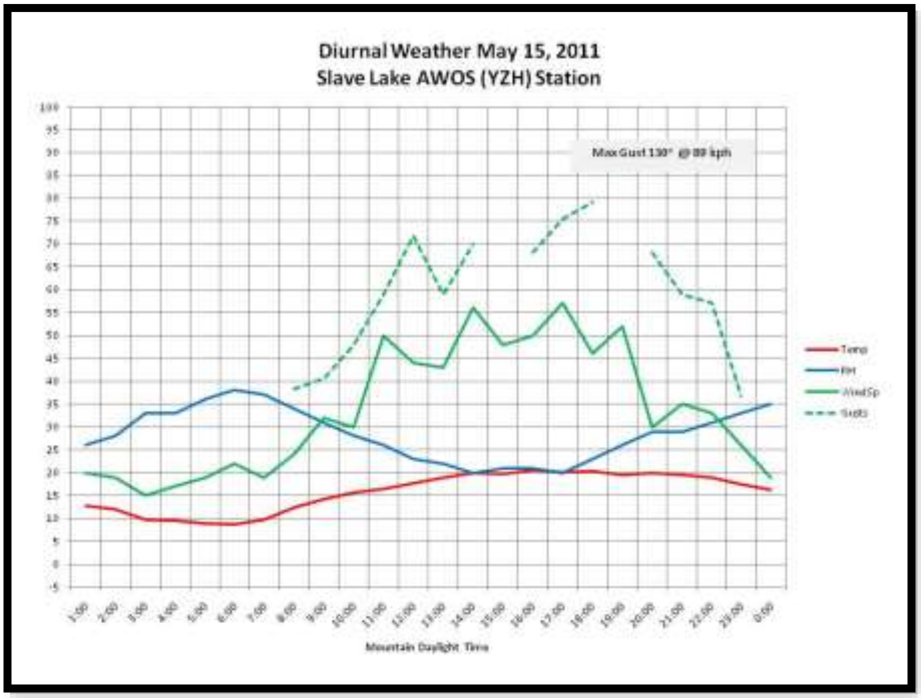

Diurnal Weather May 16, 2011
Kinuso Automatic (S4) Station
Mountain Daylight Time

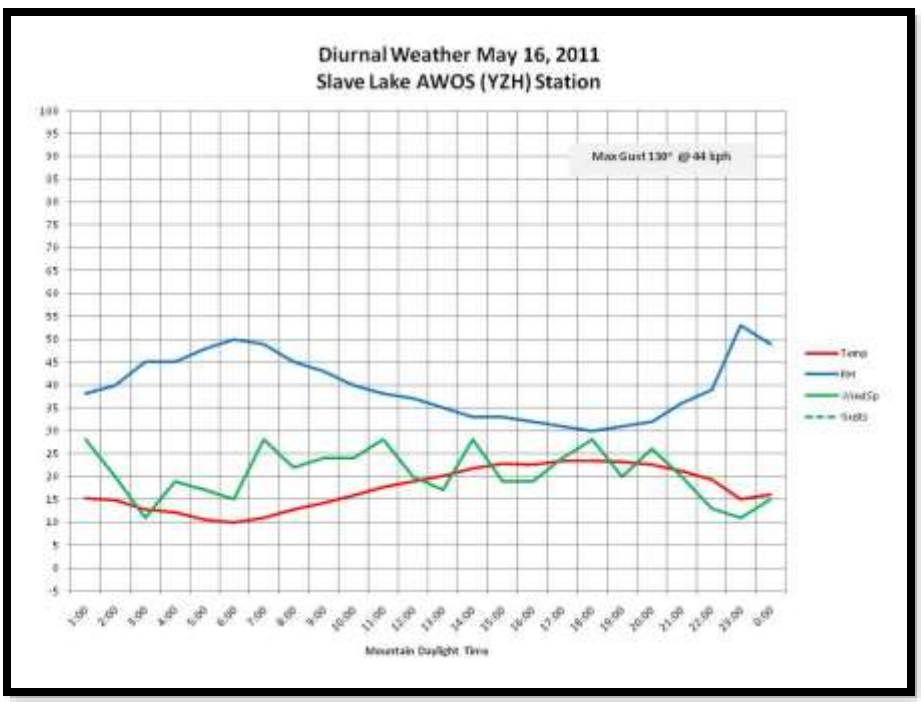

Diurnal Weather May 11, 2011
Slave Lake AWOS (YZH) Station
Max Gust n/a
Temp
RH
WindSp
Gusts
Mountain Daylight Time


Diurnal Weather May 12, 2011
Slave Lake AWOS (YZH) Station
Max Gust 150° @ 65 kph
Temp
RH
WindSp
Gusts
Mountain Daylight Time


Diurnal Weather May 13, 2011
Slave Lake AWOS (YZH) Station
Max Gust 270° @ 37 kph
Temp
RH
WindSp
Gusts
Mountain Daylight Time


Diurnal Weather May 14, 2011
Slave Lake AWOS (YZH) Station
Max Gust 140°
Temp
RH
WindSp
Gusts
Mountain Daylight Time


Diurnal Weather May 15, 2011
Slave Lake AWOS (YZH) Station
Max Gust 130° @ 89 kph
Temp
RH
Mountain Daylight Time


Diurnal Weather May 16, 2011
Slave Lake AWOS (YZH) Station
Max Gust 130° @ 44 kph
Temp
RH
Mountain Daylight Time

APPENDIX J - PERCENTILE WILDFIRE WEATHER ANALYSIS

An analysis was completed on the historical weather parameters and Fire Weather Index (FWI) System values for the weather stations in closest proximity to the Flat Top Complex Wildfires. The intent was to compare weather variables and FWI System components on May 14 and 15 with historical records.

The percentile tables show wind speeds at the Slave Lake Airport and Flat Top Lookout equaled or exceeded previously recorded maximums on May 15, 2011. Fire Weather Index (FWI), Initial Spread Index (ISI), and Daily Severity Rating (DSR) values also exceeded previously recorded maximums at these stations.

Note: Values include (from left to right) percentile, temperature, relative humidity, wind speed, fine fuel moisture code, initial spread index, duff moisture code, build-up index, drought code, daily severity rating, and fire weather index. Relative humidity MAX will be a *minimum* value rather than maximum.

Kinuso Automatic – 2003 to 2010 - Spring (April & May)

Percentile	Temp	RH	WindSpeed	FFMC	ISI	DMC	BUI	DC	DSR	FWI
70	16.6	35.0	17	88.9	8.1	33.3	44.0	294.5	4.0	16.8
80	18.7	31.0	19	90.2	9.7	40.9	54.7	364.1	5.8	20.7
90	21.2	27.3	24	91.6	13.5	52.4	73.3	397.5	9.6	27.5
95	22.7	25.0	27	91.9	16.4	61.2	83.4	422.9	13.7	33.6
MAX	26.6	10.0	36	95.4	34.9	91.4	124.9	492.2	48.7	68.8
15-May	19.5	26.0	33	91.2	26.8	25.5	38.4	194.4	17.29	38.3

Flat Top Lookout – 1991 to 2010 - Spring (April & May)

Percentile	Temp	RH	WindSpeed	FFMC	ISI	DMC	BUI	DC	DSR	FWI
70	14.0	38.8	18	87.1	6.0	19.0	25.0	143.1	1.7	10.3
80	15.5	35.1	20	88.6	7.8	24.0	30.7	172.3	2.6	13.0
90	18.0	30.0	25	89.9	10.0	31.0	39.0	204.3	3.7	16.0
95	19.5	26.4	29	90.8	12.5	38.3	48.4	225.3	4.8	18.5
MAX	26.0	18.0	46	94.0	26.5	67.5	69.3	293.3	10.5	29.0
15-May	14.0	29.1	58	90.0	80.3	15.3	25.6	193.0	42.97	64.1

Marten Mountain Lookout – 1991 to 2010 - Spring (April & May)

Percentile	Temp	RH	WindSpeed	FFMC	ISI	DMC	BUI	DC	DSR	FWI
70	15.6	51.0	22	84.9	4.5	12.2	17.4	87.9	0.7	6.2
80	17.0	46.0	25	86.5	5.9	16.0	22.4	97.3	1.3	9.0
90	19.0	40.0	29	87.4	7.9	26.3	31.1	134.5	2.7	13.3
95	20.8	34.0	34	88.2	12.0	33.0	42.4	188.9	4.5	18.0
MAX	26.7	15.0	48	90.5	23.1	65.8	78.3	241.9	21.4	43.3
15-May	14.5	22.8	33	91.0	26.0	19.5	29.9	162.1	13.7	33.6

Slave Lake Airport – 1983 to 1996 - Spring (April & May)

Percentile	Temp	RH	WindSpeed	FFMC	ISI	DMC	BUI	DC	DSR	FWI
70	14.0	41.0	20	87.0	6.0	26.0	38.0	217.3	2.6	13.0
80	16.0	35.0	22	88.0	8.0	31.0	44.0	230.0	4.1	17.0
90	19.0	29.0	28	90.0	12.0	41.0	55.2	251.0	6.4	21.8
95	21.0	25.4	32	91.0	16.0	46.2	63.0	274.5	9.5	27.3
MAX	29.0	13.0	50	94.0	47.9	61.5	76.0	345.0	32.8	55.1
15-May	20.5	21	50	93.2	83.1	35.5	47.8	183.5	70.15	84.6

Saulteaux Automatic – 1987 to 2010 - Spring (April & May)

Percentile	Temp	RH	WindSpeed	FFMC	ISI	DMC	BUI	DC	DSR	FWI
70	17.7	32.0	13	90.0	7.8	35.6	50.0	278.9	4.1	17.0
80	19.6	28.0	15	91.0	9.2	43.0	59.5	297.9	5.6	20.4
90	22.0	24.0	18	92.3	11.4	54.2	72.4	332.8	8.1	25.1
95	23.4	21.2	21	93.0	13.0	63.1	80.4	360.6	9.9	28.0
MAX	30.0	12.0	31	96.1	25.6	90.2	111.8	445.7	25.0	47.2
15-May	19.3	24.0	9	92.8	10	43.7	69.2	416.1	8.79	26.2

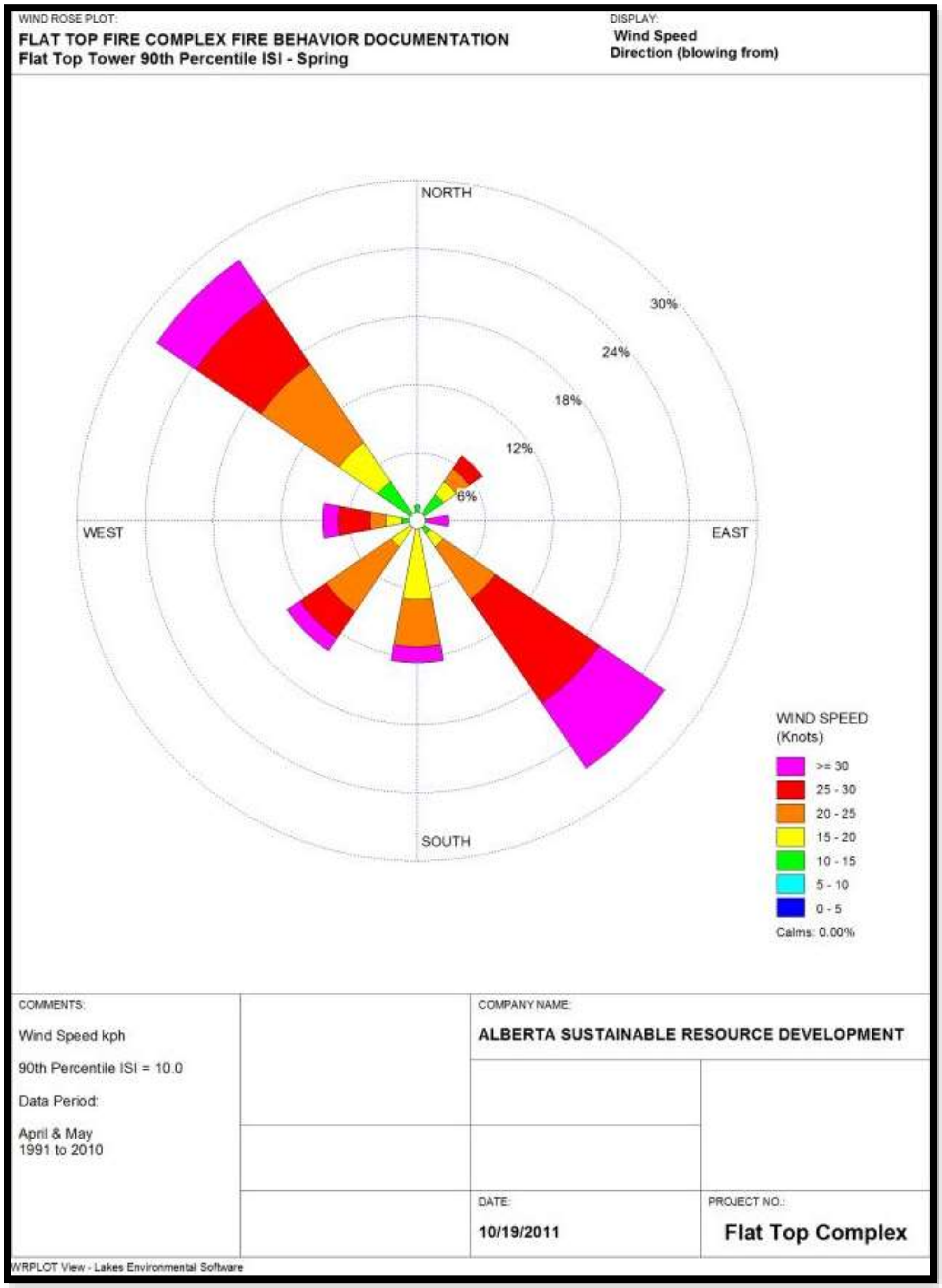
Marten Hills Automatic – 1988 to 2010 - Spring (April & May)

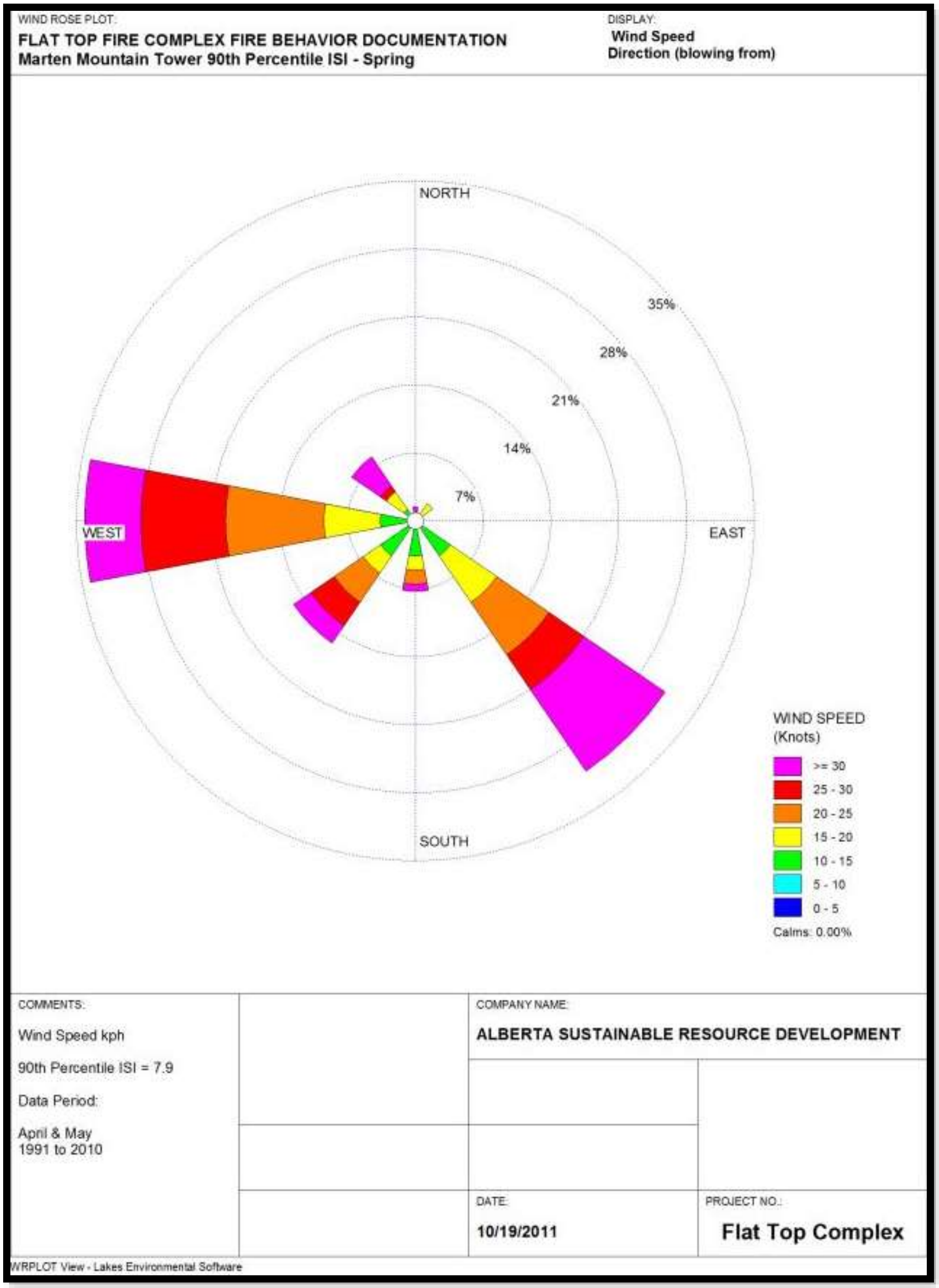
Percentile	Temp	RH	WindSpeed	FFMC	ISI	DMC	BUI	DC	DSR	FWI
70	14.5	36.7	17	88.1	6.9	23.3	32.1	203.8	2.4	12.5
80	16.7	32.0	20	89.2	8.8	27.6	38.0	224.3	3.8	16.3
90	19.0	27.0	23	90.8	11.3	34.0	46.6	250.2	6.1	21.3
95	20.7	24.0	27	91.4	14.5	40.9	55.1	264.3	7.7	24.3
MAX	27.0	15.0	41	94.1	25.9	81.8	81.6	329.5	24.4	46.6
15-May	18.7	37.0	14	91.2	10.4	18.2	29.5	196.4	4.32	17.5

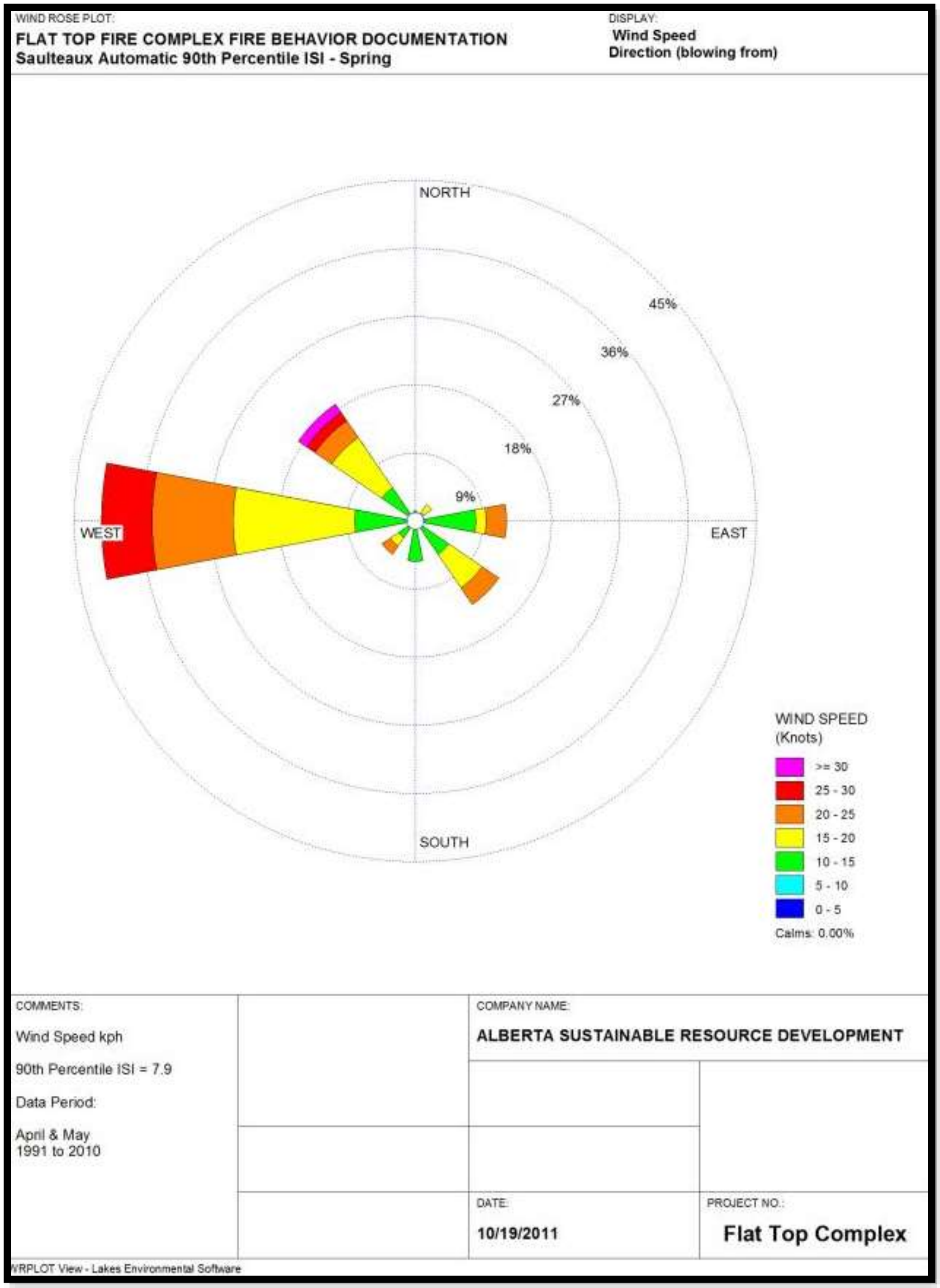
Kinuso Automatic – 2003 to 2010 - Spring (April & May)

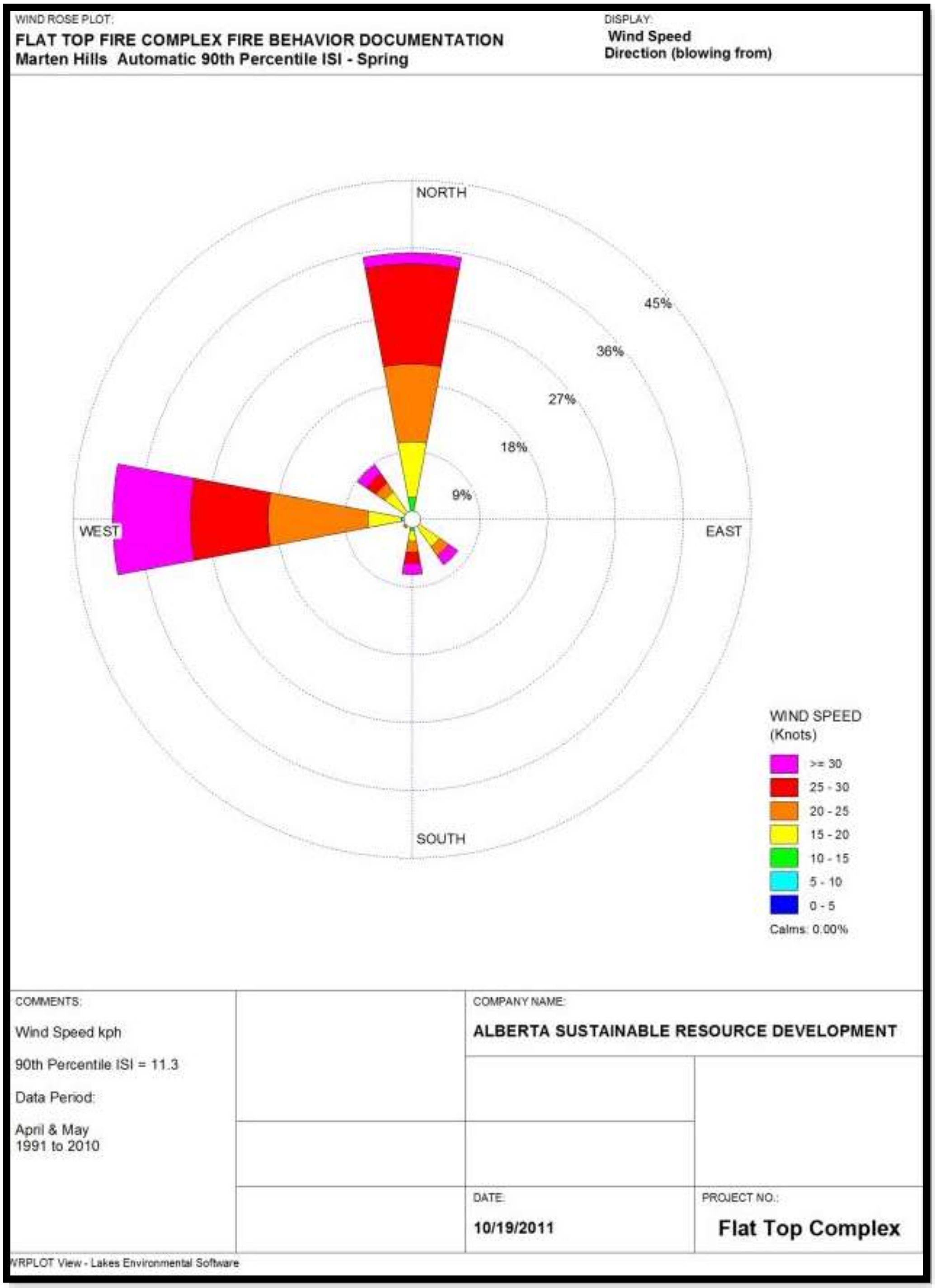
Percentile	Temp	RH	WindSpeed	FFMC	ISI	DMC	BUI	DC	DSR	FWI
70	16.6	35.0	17	88.9	8.1	33.3	44.0	294.5	4.0	16.8
80	18.7	31.0	19	90.2	9.7	40.9	54.7	364.1	5.8	20.7
90	21.2	27.3	24	91.6	13.5	52.4	73.3	397.5	9.6	27.5
95	22.7	25.0	27	91.9	16.4	61.2	83.4	422.9	13.7	33.6
MAX	26.6	10.0	36	95.4	34.9	91.4	124.9	492.2	48.7	68.8
15-May	19.5	26.0	33	91.2	26.8	25.5	38.4	194.4	17.29	38.3

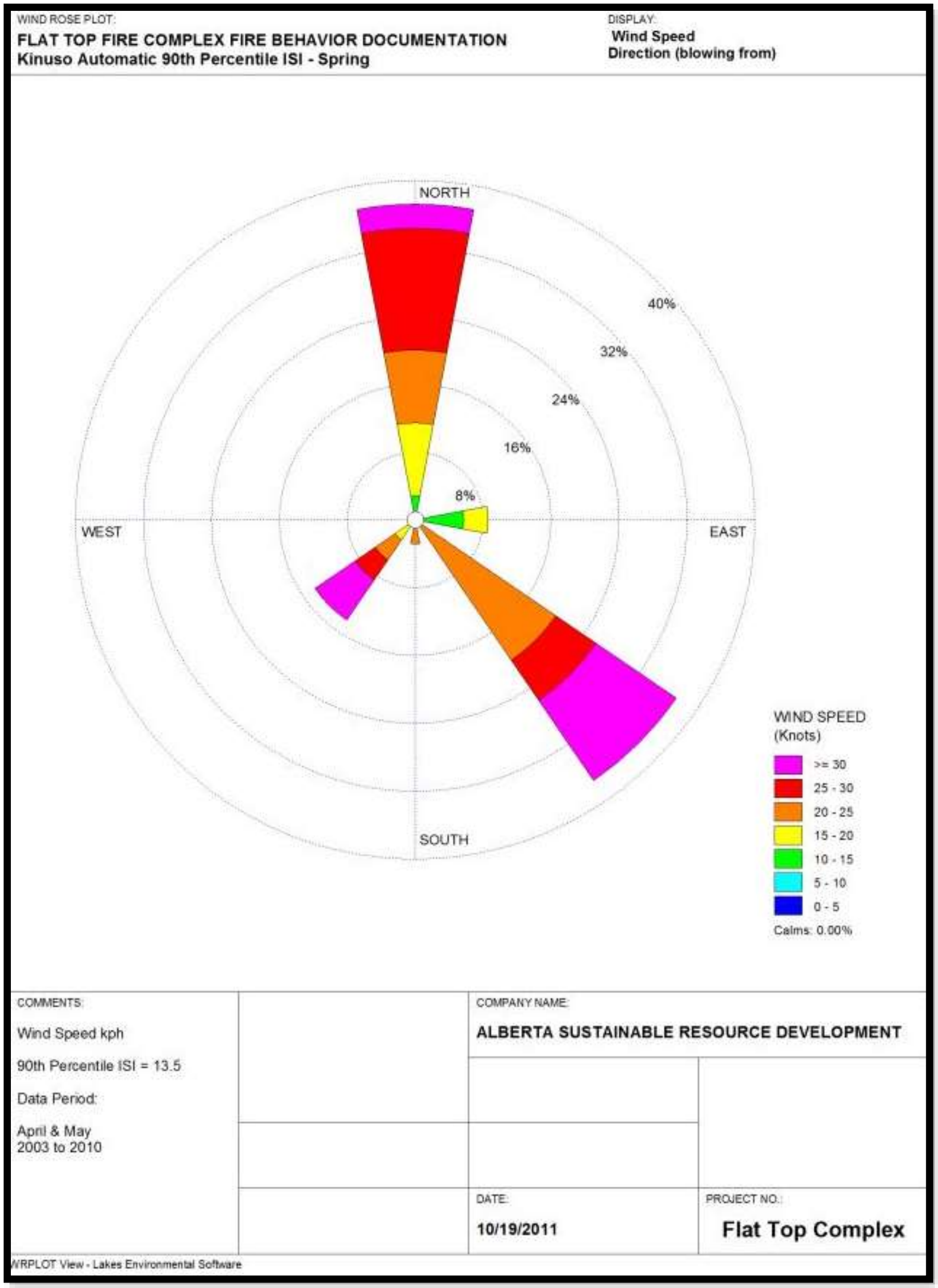
APPENDIX K - WIND ROSE DATA

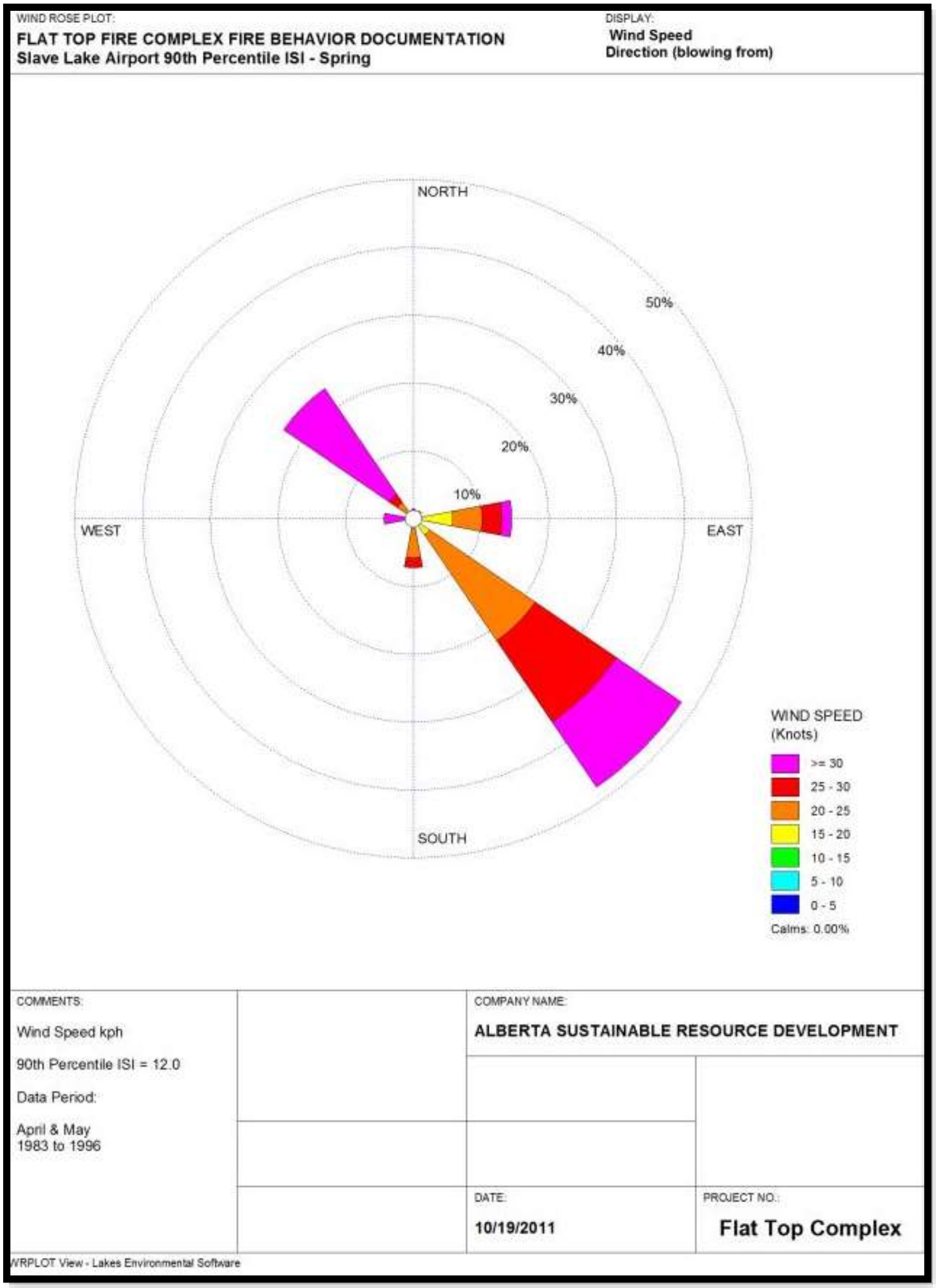



WIND ROSE PLOT:
FLAT TOP FIRE COMPLEX FIRE BEHAVIOR DOCUMENTATION
Marten Mountain Tower 90th Percentile ISI - Spring
DISPLAY:
Wind Speed
Direction (blowing from)
NORTH
WEST
EAST
SOUTH
7%
14%
21%
28%
35%
WIND SPEED
(Knots)
>= 30
25 - 30
20 - 25
15 - 20
10 - 15
5 - 10
0 - 5
Calms: 0.00%
COMMENTS:
Wind Speed kph
90th Percentile ISI = 7.9
Data Period:
April & May
1991 to 2010
COMPANY NAME:
ALBERTA SUSTAINABLE RESOURCE DEVELOPMENT
DATE:
10/19/2011
PROJECT NO.:
Flat Top Complex
WRPLOT View - Lakes Environmental Software


WIND ROSE PLOT:
FLAT TOP FIRE COMPLEX FIRE BEHAVIOR DOCUMENTATION
Saulteaux Automatic 90th Percentile ISI - Spring
DISPLAY:
Wind Speed
Direction (blowing from)
NORTH
45%
36%
27%
18%
9%
WEST
EAST
SOUTH
WIND SPEED
(Knots)
>= 30
25 - 30
20 - 25
15 - 20
10 - 15
5 - 10
0 - 5
Calms: 0.00%
COMMENTS:
Wind Speed kph
90th Percentile ISI = 7.9
Data Period:
April & May
1991 to 2010
COMPANY NAME:
ALBERTA SUSTAINABLE RESOURCE DEVELOPMENT
DATE:
10/19/2011
PROJECT NO.:
Flat Top Complex
WRPLOT View - Lakes Environmental Software


WIND ROSE PLOT:
FLAT TOP FIRE COMPLEX FIRE BEHAVIOR DOCUMENTATION
Marten Hills Automatic 90th Percentile ISI - Spring
DISPLAY:
Wind Speed
Direction (blowing from)
NORTH
WEST
EAST
SOUTH
9%
18%
27%
36%
45%
WIND SPEED
(Knots)
>= 30
25 - 30
20 - 25
15 - 20
10 - 15
5 - 10
0 - 5
Calms: 0.00%
COMMENTS:
Wind Speed kph
90th Percentile ISI = 11.3
Data Period:
April & May
1991 to 2010
COMPANY NAME:
ALBERTA SUSTAINABLE RESOURCE DEVELOPMENT
DATE:
10/19/2011
PROJECT NO.:
Flat Top Complex
WRPLOT View - Lakes Environmental Software


WIND ROSE PLOT:
FLAT TOP FIRE COMPLEX FIRE BEHAVIOR DOCUMENTATION
Kinuso Automatic 90th Percentile ISI - Spring
DISPLAY:
Wind Speed
Direction (blowing from)
NORTH
WEST
EAST
SOUTH
8%
16%
24%
32%
40%
WIND SPEED
(Knots)
>= 30
25 - 30
20 - 25
15 - 20
10 - 15
5 - 10
0 - 5
Calms: 0.00%
COMMENTS:
Wind Speed kph
90th Percentile ISI = 13.5
Data Period:
April & May
2003 to 2010
COMPANY NAME:
ALBERTA SUSTAINABLE RESOURCE DEVELOPMENT
DATE:
10/19/2011
PROJECT NO.:
Flat Top Complex
WRPLOT View - Lakes Environmental Software


WIND ROSE PLOT:
FLAT TOP FIRE COMPLEX FIRE BEHAVIOR DOCUMENTATION
Slave Lake Airport 90th Percentile ISI - Spring
DISPLAY:
Wind Speed
Direction (blowing from)
NORTH
SOUTH
WEST
EAST
10%
20%
30%
40%
50%
WIND SPEED
(Knots)
>= 30
25 - 30
20 - 25
15 - 20
10 - 15
5 - 10
0 - 5
Calms: 0.00%
COMMENTS:
Wind Speed kph
90th Percentile ISI = 12.0
Data Period:
April & May
1983 to 1996
COMPANY NAME:
ALBERTA SUSTAINABLE RESOURCE DEVELOPMENT
DATE:
10/19/2011
PROJECT NO.:
Flat Top Complex
WRPLOT View - Lakes Environmental Software

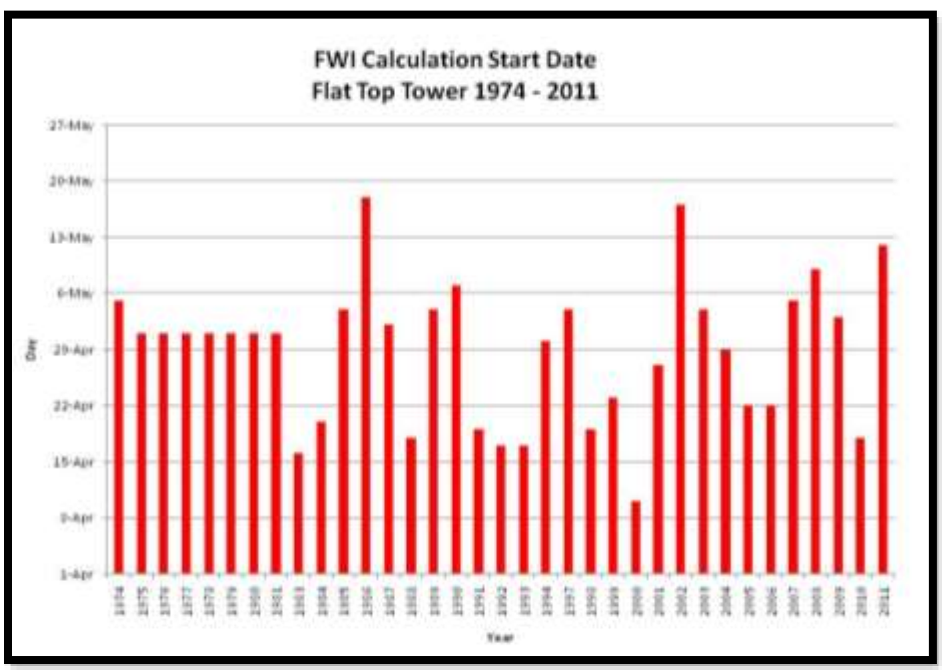
APPENDIX L - FIRE WEATHER INDEX (FWI) SYSTEM CALCULATIONS

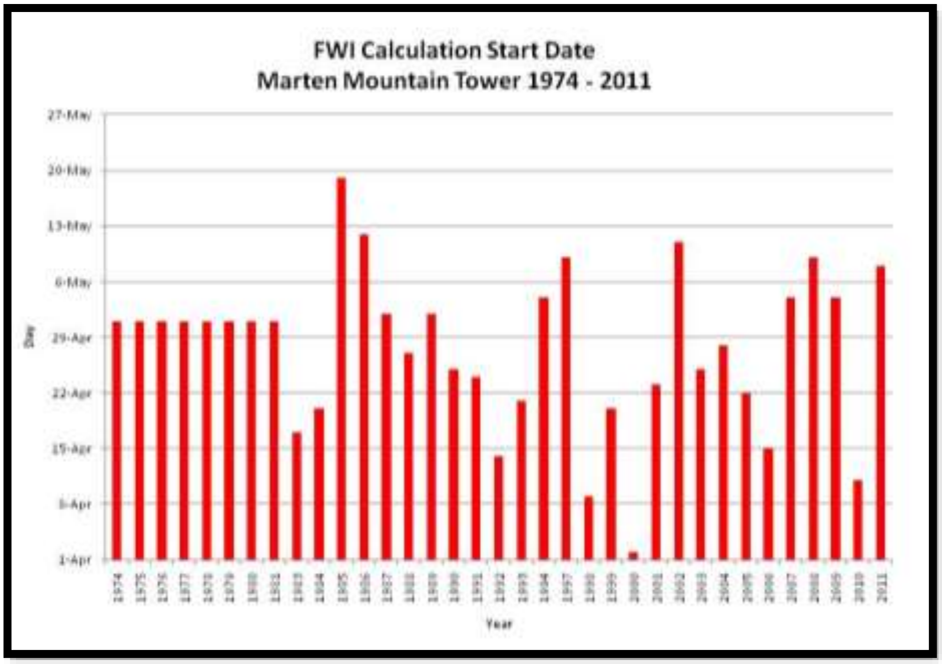
For the purposes of wildfire danger and wildfire behaviour analysis included in this report, 2011 observations from the Slave Lake Airport weather station were obtained from Environment Canada archived records. The analysis also examined historical and 2011 observations from the six Sustainable Resource Development weather stations in closest proximity to the Flat Top Complex Wildfires.

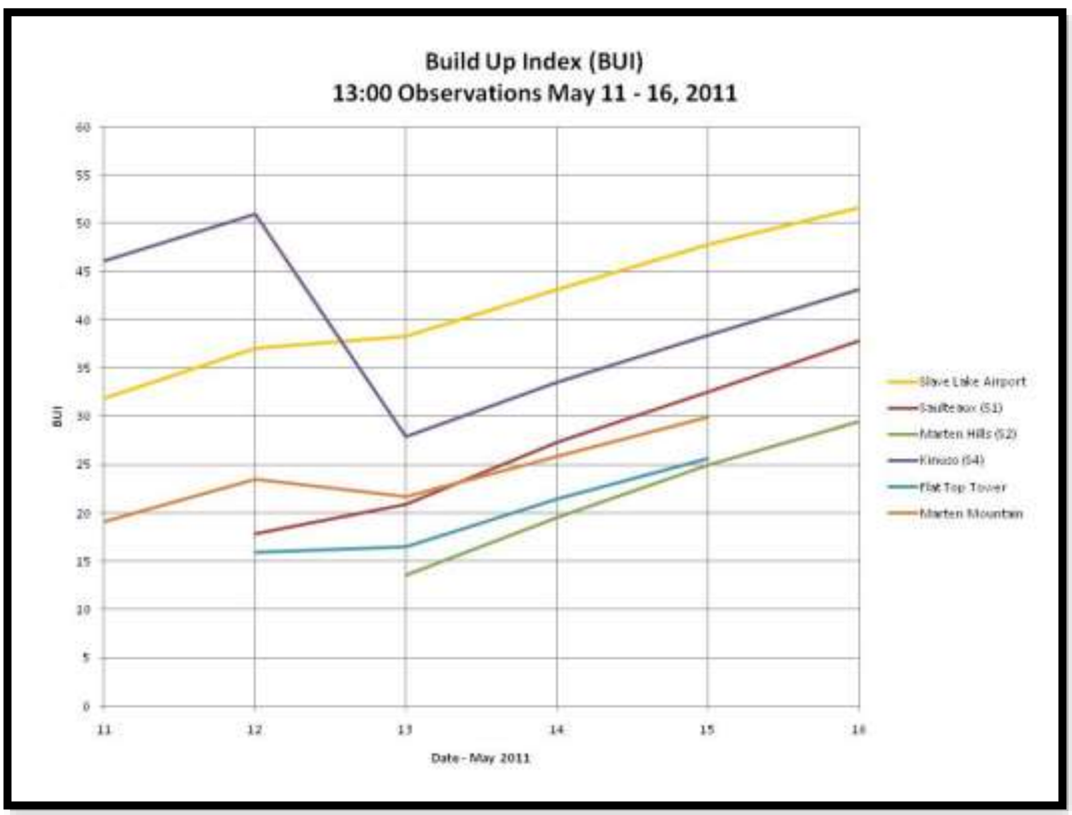
Key elements of the weather analysis included:

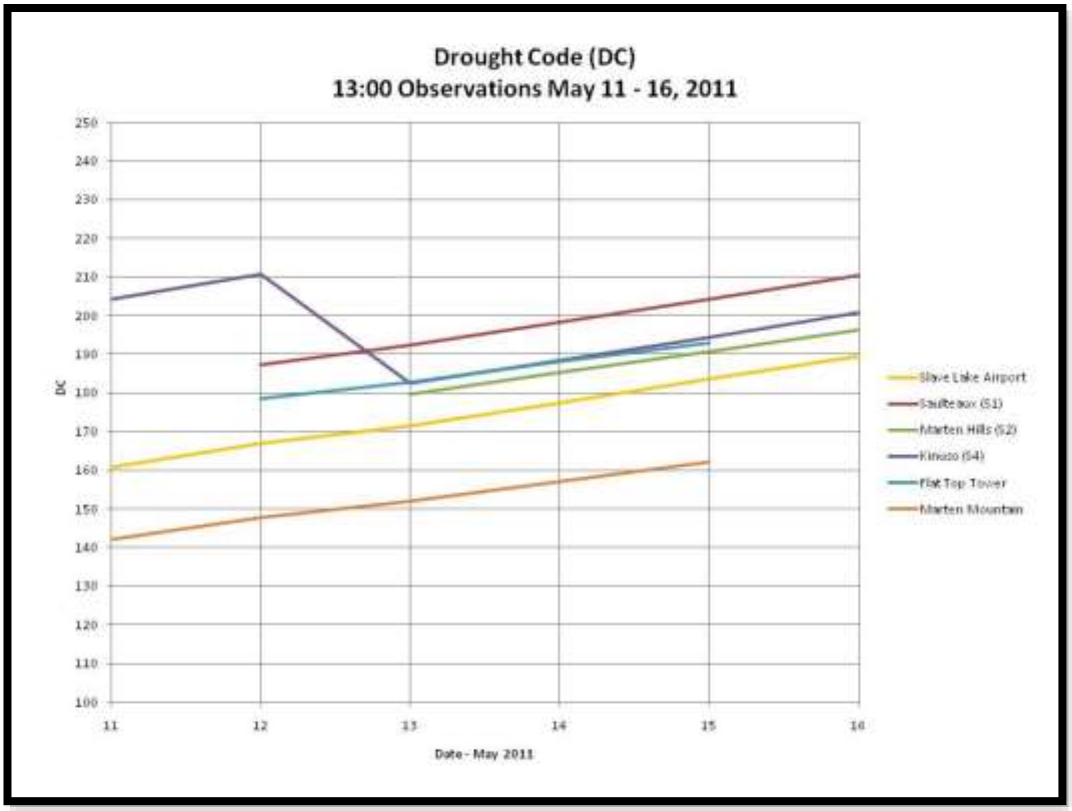
- Daily FWI System values for local weather stations for the period of May 11 to May 16.
- Hourly observations of temperature, relative humidity, wind speed and wind gusts for automatic stations.
- Hourly calculations of Fine Fuel Moisture Code and Initial Spread Index values at automatic stations for the period of May 11 to May 16.
- Determination of predominant wind direction during periods of high wildfire danger using the 90th percentile Initial Spread Index.

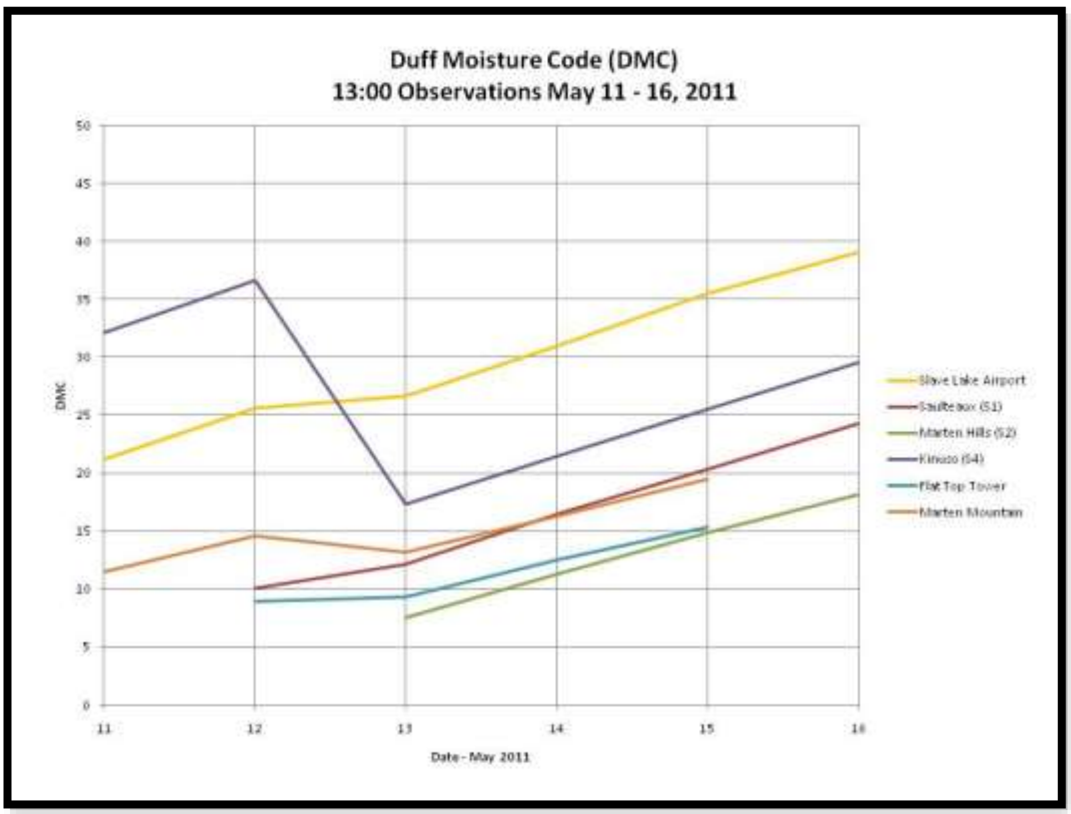
Weather observations are taken and recorded at 07:00 and 13:00 MDT at SRD lookout towers. Hourly weather is recorded at the automatic stations. Temperature, relative humidity, wind direction, wind speed, precipitation, and other weather variables are recorded and incorporated into the FWI System to provide continuous wildfire danger records through the wildfire season.

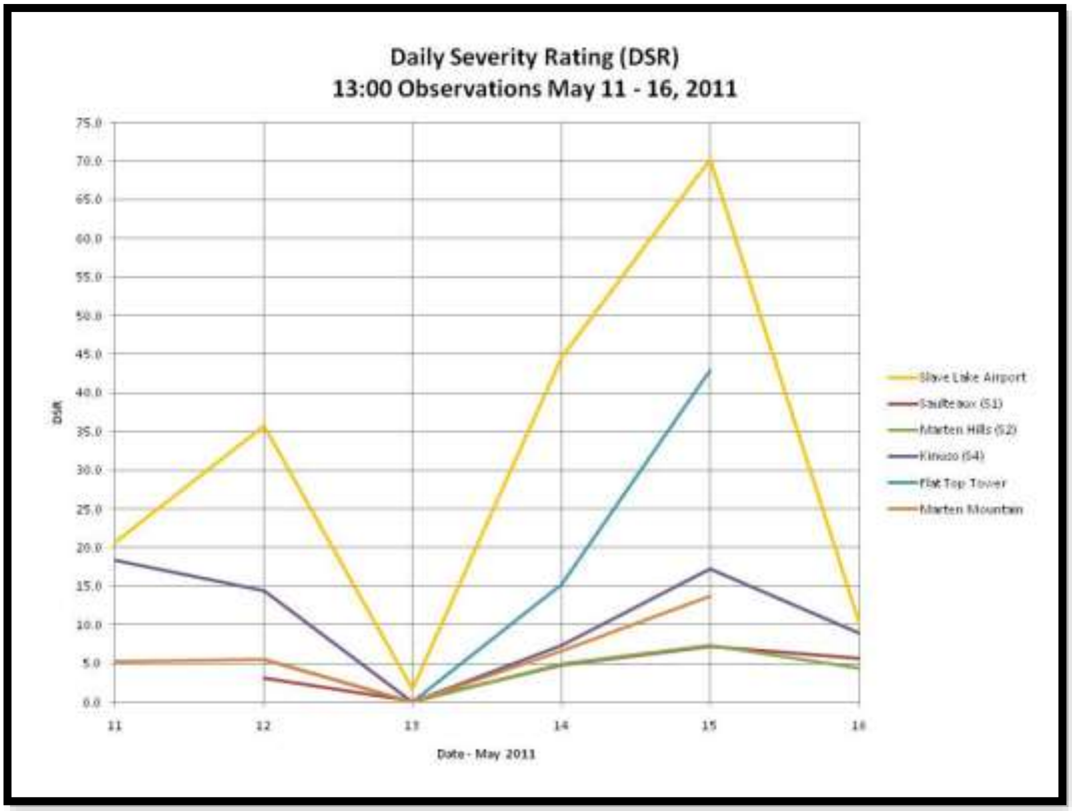


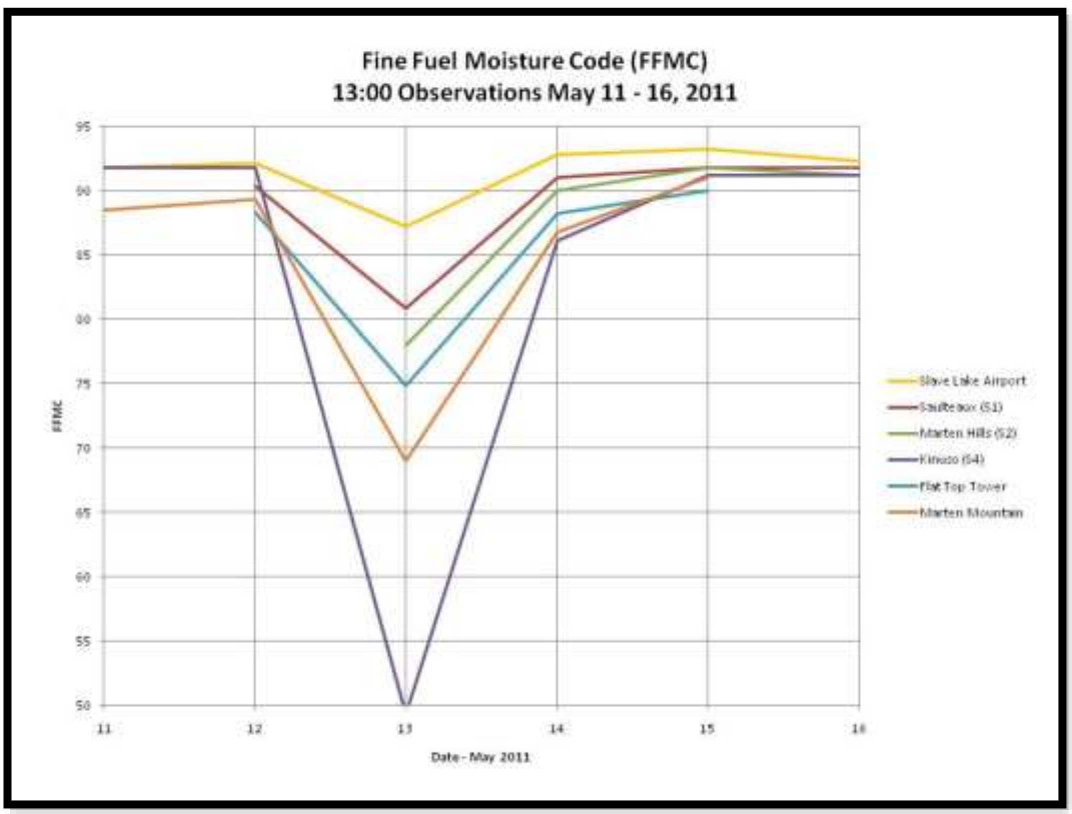

FWI Calculation Start Date
Marten Mountain Tower 1974 - 2011
Day
Year

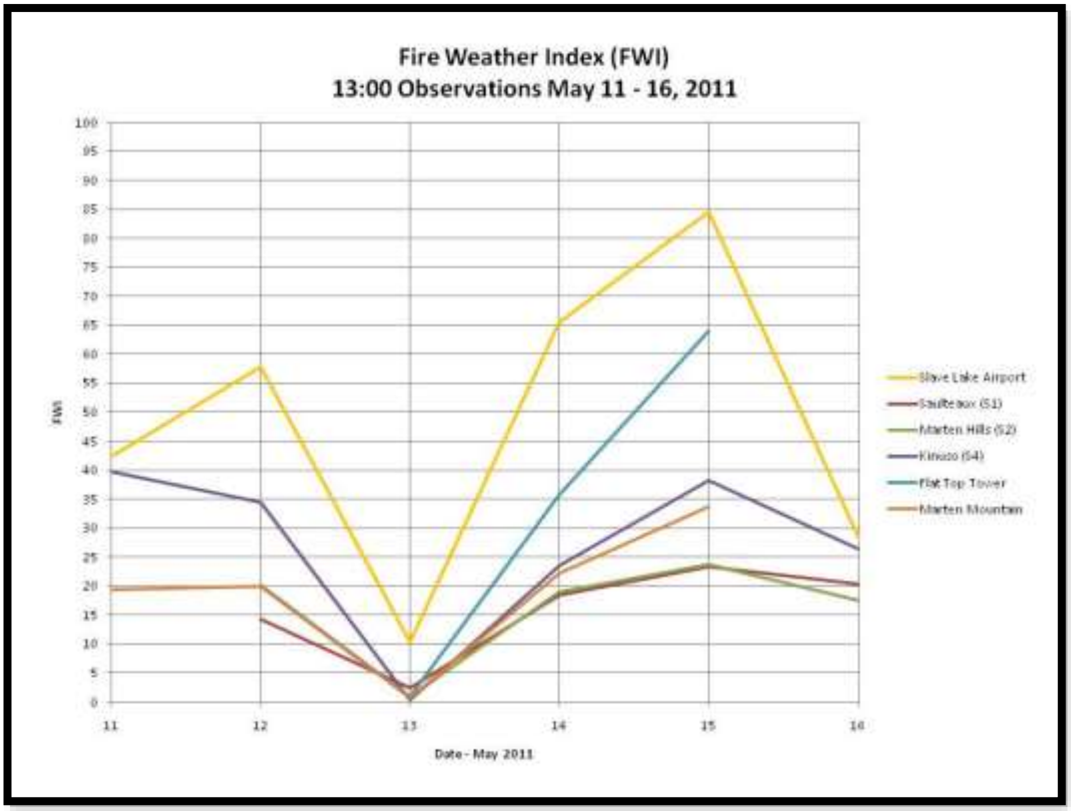

Build Up Index (BUI)
13:00 Observations May 11 - 16, 2011
BUI
Date - May 2011
Slave Lake Airport
Saulteaux (S1)
Marten Hills (S2)
Kinuso (S4)
Flat Top Tower
Marten Mountain

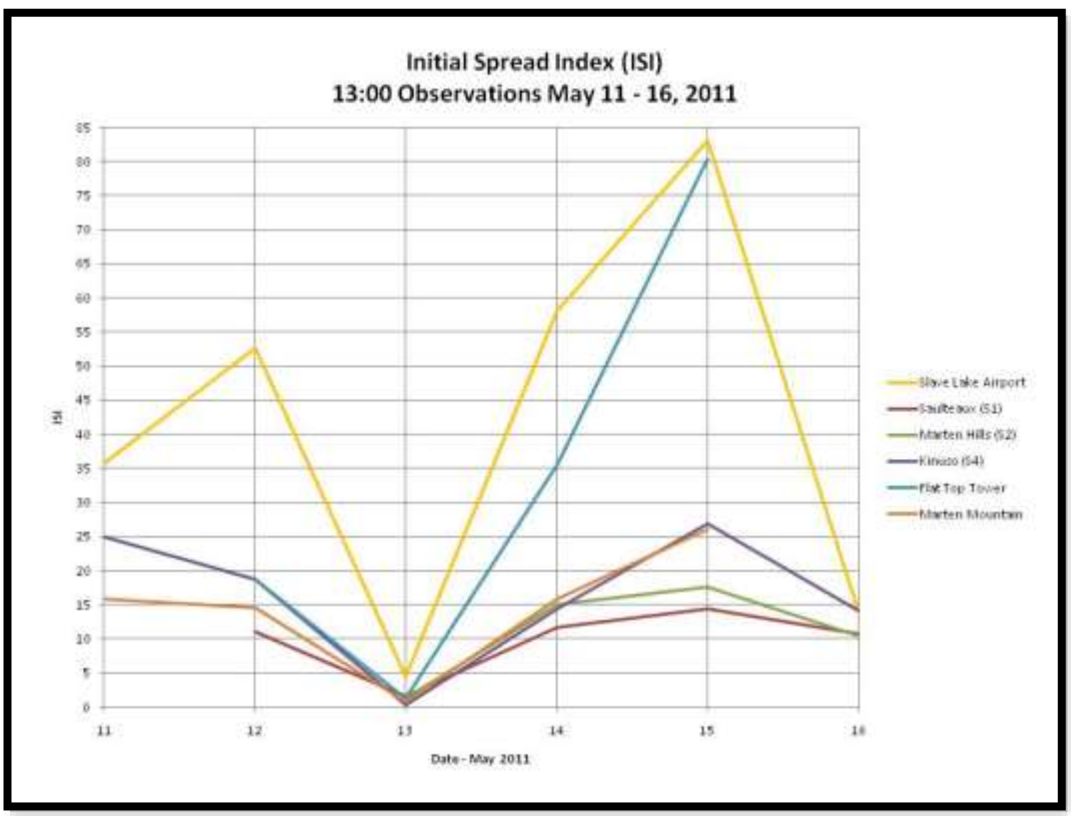

Drought Code (DC)
13:00 Observations May 11 - 16, 2011
DC
Date - May 2011
Slave Lake Airport
Saulteaux (S1)
Marten Hills (S2)
Kinuso (S4)
Flat Top Tower
Marten Mountain

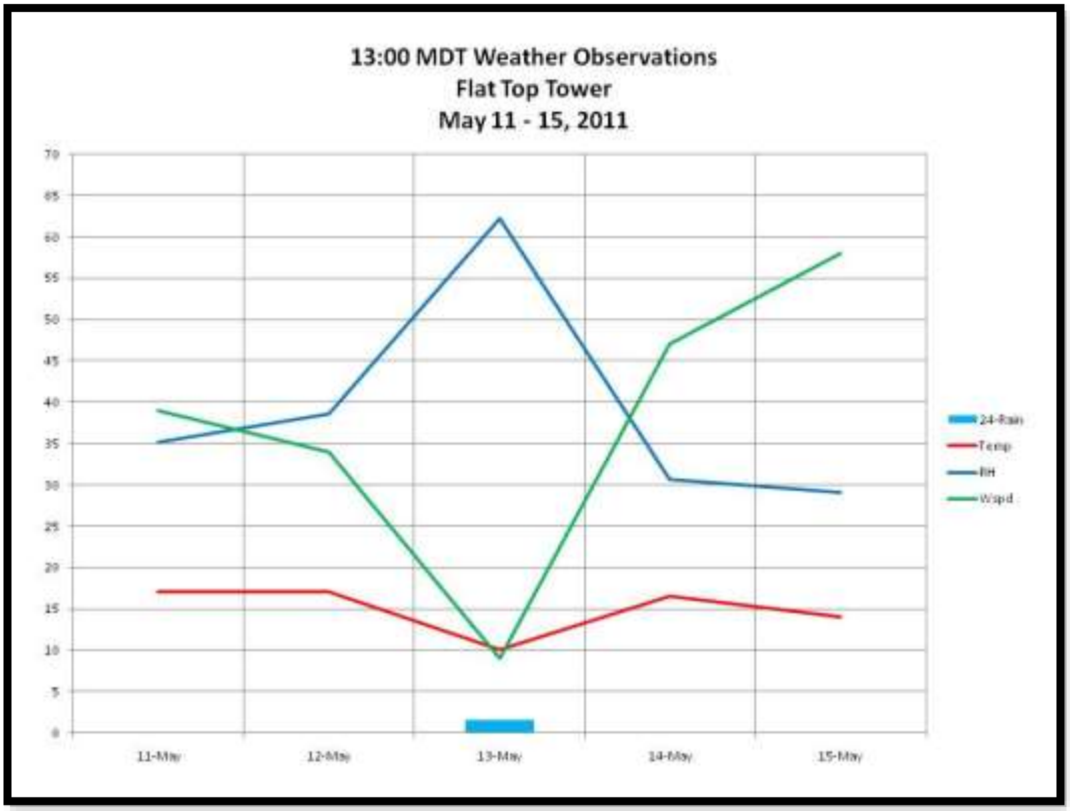

Duff Moisture Code (DMC)
13:00 Observations May 11 - 16, 2011
DMC
Date - May 2011
Slave Lake Airport
Saulteaux (S1)
Marten Hills (S2)
Kinuso (S4)
Flat Top Tower
Marten Mountain

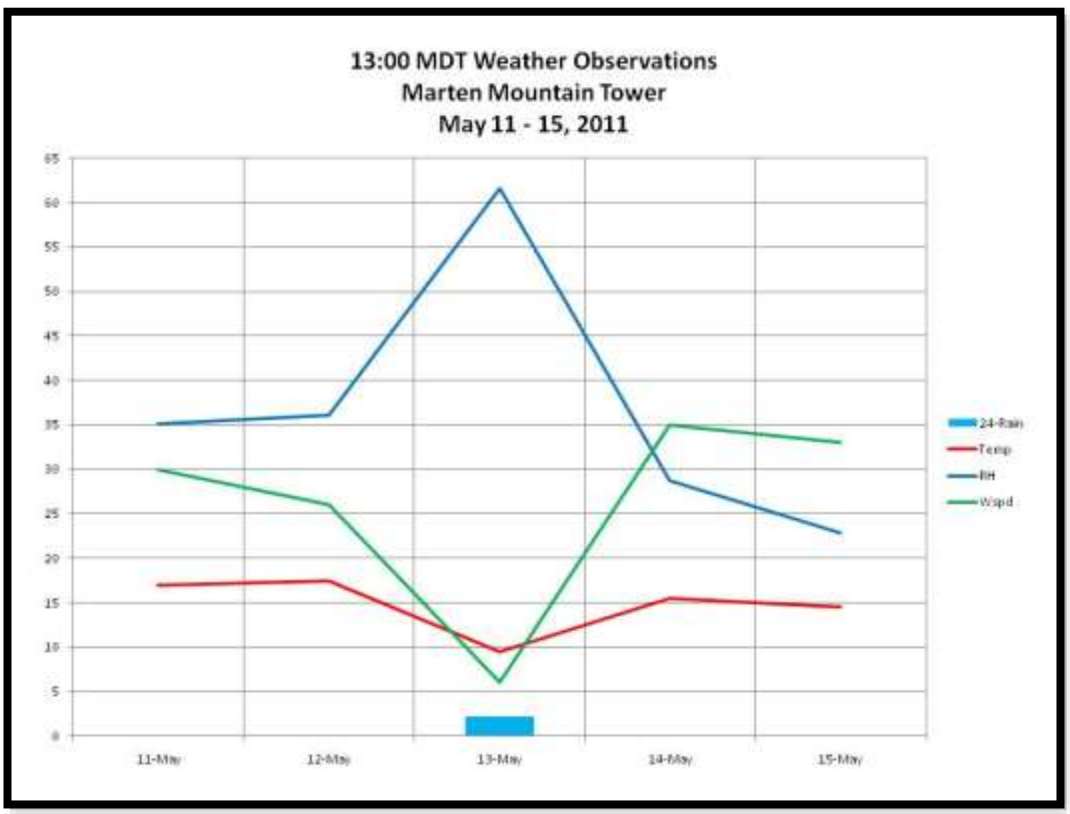

Daily Severity Rating (DSR)
13:00 Observations May 11 - 16, 2011
DSR
Date - May 2011
Slave Lake Airport
Saulteaux (S1)
Marten Hills (S2)
Kinuso (S4)
Flat Top Tower
Marten Mountain

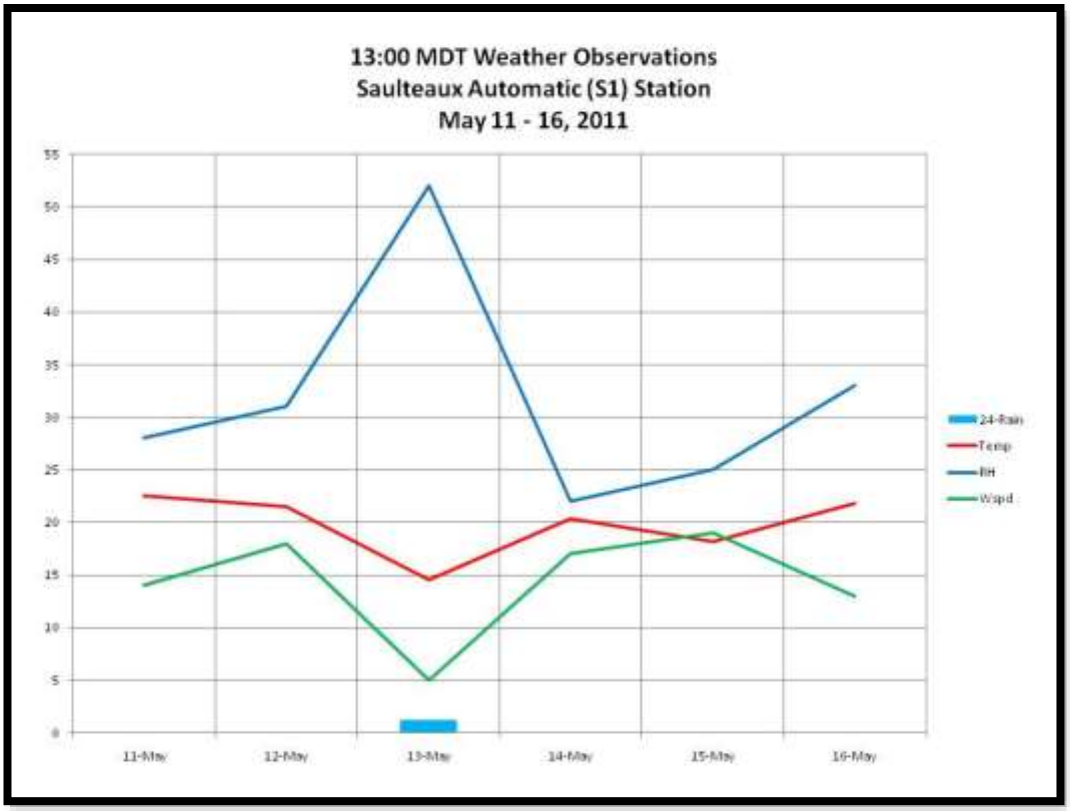

Fine Fuel Moisture Code (FFMC)
13:00 Observations May 11 - 16, 2011
FFMC
Date - May 2011
Slave Lake Airport
Saulteaux (S1)
Marten Hills (S2)
Kinuso (S4)
Flat Top Tower
Marten Mountain

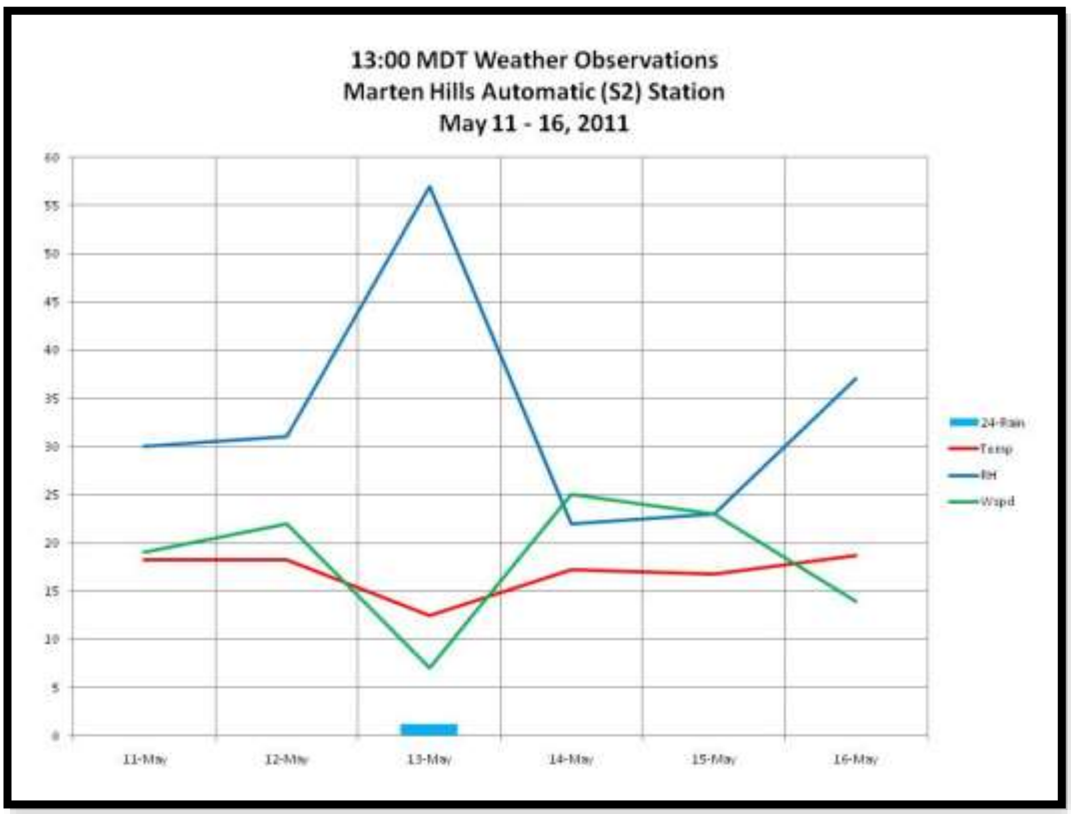

Fire Weather Index (FWI)
13:00 Observations May 11 - 16, 2011
FWI
Date - May 2011
Slave Lake Airport
Saulteaux (S1)
Marten Hills (S2)
Kinuso (S4)
Flat Top Tower
Marten Mountain

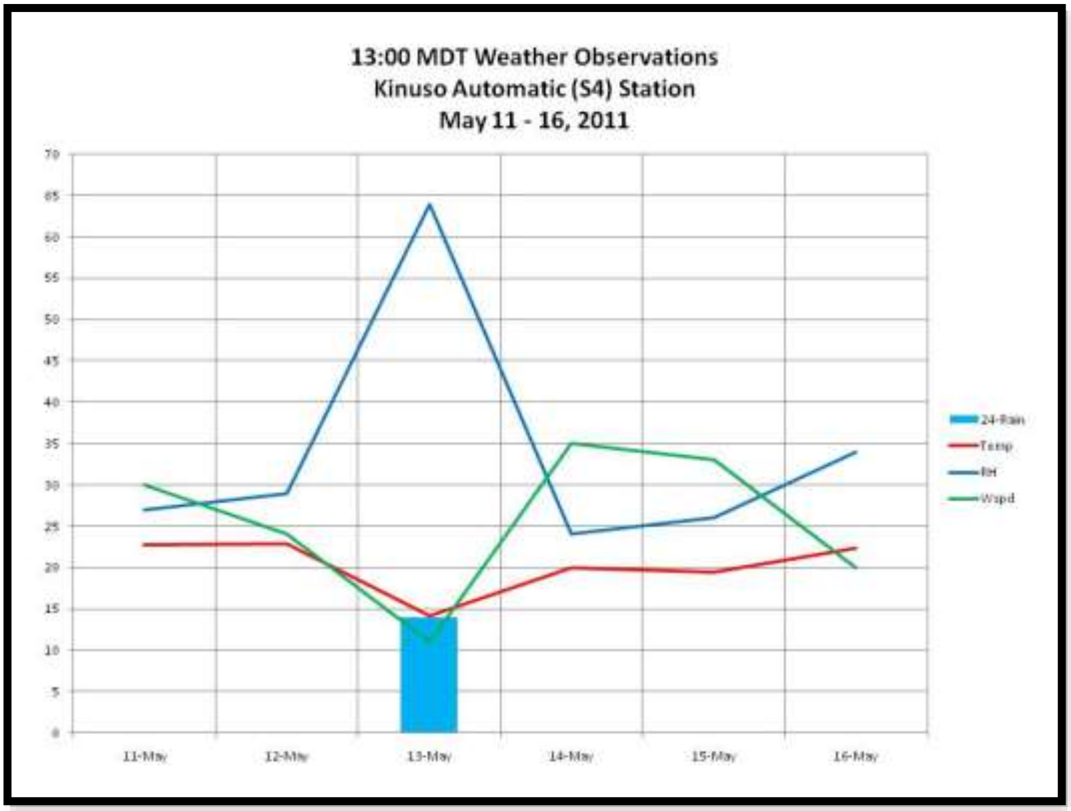

Initial Spread Index (ISI)
13:00 Observations May 11 - 16, 2011
ISI
Date - May 2011
Slave Lake Airport
Saulteaux (S1)
Marten Hills (S2)
Kinuso (S4)
Flat Top Tower
Marten Mountain


13:00 MDT Weather Observations
Flat Top Tower
May 11 - 15, 2011
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
11-May
12-May
13-May
14-May
15-May
24-Rain
Temp
RH
Wspd


13:00 MDT Weather Observations
Marten Mountain Tower
May 11 - 15, 2011
65
60
55
50
45
40
35
30
25
20
15
10
5
0
11-May
12-May
13-May
14-May
15-May
24-Rain
Temp
RH
Wspd


13:00 MDT Weather Observations
Saulteaux Automatic (S1) Station
May 11 - 16, 2011
55
50
45
40
35
30
25
20
15
10
5
0
11-May
12-May
13-May
14-May
15-May
16-May
24-Rain
Temp
RH
Wspd


13:00 MDT Weather Observations
Marten Hills Automatic (S2) Station
May 11 - 16, 2011
60
55
50
45
40
35
30
25
20
15
10
5
0
11-May
12-May
13-May
14-May
15-May
16-May
24-Rain
Temp
RH
Wspd


13:00 MDT Weather Observations
Kinuso Automatic (S4) Station
May 11 - 16, 2011
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
11-May
12-May
13-May
14-May
15-May
16-May
24-Rain
Temp
RH
Wspd

APPENDIX M - FOREST FUEL TYPES

The Canadian Forest Fire Danger Rating System defines 18 primary forest fuel types in Canada. Each fuel type has a unique composition of species, stand structure and burning characteristics at a given fire danger level. Deciduous, Mixedwood, and Mixedwood with Dead Balsam Fir fuel types are further differentiated by phenological state (leafless or leafed out). Percent conifer or dead balsam fir can also be factored into the mixedwood fuel types. Forest fuel types common to the Flat Top Complex are illustrated below:

C1 - Spruce Lichen Woodland

The C1 fuel type is characterized by open, parklike black spruce (*Picea mariana* (Mill.) B.S.P.) stands occupying well-drained uplands in the subarctic zone of western and northern Canada. Jack pine (*Pinus banksiana* Lamb.) and white birch (*Betula papyrifera* Marsh.) are minor associates in the overstory. Forest cover occurs as widely spaced individuals and dense clumps. Tree heights vary considerably, but bole branches (live and dead) uniformly extend to the forest floor and layering development is extensive. Accumulation of woody surface fuel is very light and scattered. Shrub cover is exceedingly sparse. The ground surface is fully exposed to the sun and covered by a nearly continuous mat of reindeer lichens (*Cladonia* spp.), averaging 3 to 4 cm in depth above mineral soil. Fire behaviour under high fire danger conditions: surface fire with torching and crowning.

C2 - Boreal Spruce

The C2 fuel type is characterized by pure, moderately well-stocked black spruce stands on lowland (excluding *Sphagnum* bogs) and upland sites. Tree crowns extend to or near the ground, and dead branches are typically draped with bearded lichens (*Usnea* spp.). The flaky nature of the bark on the lower portion of stem boles is pronounced. Low to moderate volumes of down woody material are present. Labrador tea (*Ledum groenlandicum* Oeder) is often the major shrub component. The forest floor is dominated by a carpet of feather mosses and/or ground-dwelling lichens (chiefly *Cladonia*). *Sphagnum* mosses may occasionally be present, but they are of little hindrance to surface fire spread. A compacted organic layer commonly exceeds a depth of 20 to 30 cm. Fire behaviour under high fire danger conditions: almost always a crown fire.

C3 -Mature Jack or Lodgepole Pine

C4 - Immature Jack or Lodgepole Pine

D1 – Leafless Aspen

The C3 fuel type is characterized by pure, fully stocked (1000 to 2000 stems/ha) jack pine or lodgepole pine (*Pinus contorta* Dougl. ex Loud.) stands that have matured at least to the stage of complete crown closure. The base of live crown is well above the ground. Dead surface fuels are light and scattered. Ground cover is feather moss (*Pleurozium schreberi*) over a moderately deep (approximately 10 cm), compacted organic layer. A sparse conifer understory may be present. Fire behaviour under high fire danger conditions: surface and crown fire.

The C4 fuel type is characterized by pure, dense jack pine or lodgepole pine stands (10,000 to 30,000 stems/ha) in which natural thinning mortality results in a large quantity of standing dead stems and dead downed woody fuel. Vertical and horizontal fuel continuity is characteristic of this fuel type. Surface fuel loadings are greater than in fuel type C3, and organic layers are shallower and less compact. Ground cover is mainly needle litter suspended within a low shrub layer (*Vaccinium* spp.). Fire behaviour under high fire danger conditions: almost always a crown fire.

The D1 fuel type is characterized by pure, semimature trembling aspen (*Populus tremuloides* Michx.) stands before bud break in the spring or following leaf fall and curing of the lesser vegetation in the autumn. A conifer understory is noticeably absent, but a well-developed medium to tall shrub layer is typically present. Dead and down roundwood fuels are a minor component of the fuel complex. The principal fire-carrying surface fuel consists chiefly of deciduous leaf litter and cured herbaceous material that is directly exposed to wind and solar radiation. In the spring the duff mantle (F and H horizons) seldom contributes to the available combustion fuel because of its high moisture content. Fire behaviour under high fire danger conditions: always a surface fire in younger stands; intense surface fire in overmature collapsing stands; some anecdotal evidence of intermittent crown fire after leaf-out under extreme fire danger conditions.

The M1 fuel type (and its "green" counterpart, M2) is characterized by stand mixtures consisting of the following coniferous and deciduous tree species in varying proportions: black spruce, white spruce (*Picea glauca* (Moench) Voss), balsam fir (*Abies balsamea* (L.) Mill.), subalpine fir (*Abies lasiocarpa* (Hook.) Nutt.), trembling aspen, and white birch. On any specific site, individual species can be present or absent from the mixture. In addition to the diversity in species composition, stands exhibit wide variability in structure and development, but are generally confined to moderately well-drained upland sites. M1, the first phase of seasonal variation in flammability, occurs during the spring and fall. The rate of spread is weighted according to the proportion (expressed as a percentage) of softwood and hardwood components. Fire behaviour under high fire danger conditions: surface fire, torching, and crown fire, dependent on percent conifer content in the stand.

M1- Boreal Mixedwood (Leafless)

O1 - Grass

The O1 fuel type is characterized by continuous grass cover, with no more than occasional trees or shrub clumps that do not appreciably affect fire behaviour. Two subtype designations are available for grasslands; one for the matted grass condition common after snowmelt or in the spring (O1-a) and the other for standing dead grass common in late summer to early fall (O1-b). The proportion of cured or dead material in grasslands has a pronounced effect on fire spread there and must be estimated with care. Fire behaviour under high fire danger conditions: intense surface fire in matted grass (O1-a) and rapid spreading, intense surface fire in standing grass (O1-b). Does not usually support fire spread after greenup.

APPENDIX N - QUALIFIERS FOR FUEL TYPE MAPPING

For the most part, the current state of converting vegetation data to wildland fuel types is satisfactory for planning use at a landscape scale (e.g., Provincial or Area level). Accuracy and detail for planning at the Community Zone level is less than ideal.

There are several limitations that must be recognized when using current fuels data:

- Fuel typing is subject to the accuracy of the vegetation inventory source, and algorithms/processes used to convert the inventory to Canadian Forest Fire Danger Rating System fuel types.
- Fuel types shown as aspen (D1/D2) assume classic younger age class aspen with surface fuels consisting of dried herbaceous material and leaf litter, and little or no downed woody material. Many of the aspen stands designated as D1 are decadent and collapsing, with a high component of grass and heavy loading of dead and downed woody material that result in high-intensity wildfire.
- Aspen stands may contain a conifer understory that was not identified in the vegetation inventory, resulting in fire behaviour similar to that in mixedwood (M1/M2) stands.
- Coniferous component in mixedwood (M1/M2) stands may not be accurate and are usually underestimated. A dead balsam fir component may not have been identified.
- Areas of “non-fuel” may be overestimated. Agricultural lands, rights-of-way, and “urban” areas are often classified as non-fuel, but may actually be grass covered. There may be negative implications on landscape-level fire management planning where non-fuel types are more common. This issue is being addressed by the new Alberta Vegetation Inventory to Fire Behaviour Prediction (AVI2FBP) conversion program which more accurately classifies grass fuel type areas.
- Fuel types within recently burned areas may not be up to date. Typically, these areas are designated non-fuel immediately after the wildfire, but may not be updated frequently enough to reflect natural vegetation succession.
- Fuel typing of harvested areas may not be up to date. Modern harvesting and reforestation methods – tree length skidding, roadside processing, debris disposal, and scarification – result in true slash fuel types (S1 and S2) being less common. In many cases these fuel types are balanced by varying amounts of unmerchantable wood being knocked down and flattened in the harvesting process. Vegetation succession on cut over areas may not be accounted for in all cases.
- Current cut to length practices leaves more surface fuels in cutblocks post harvest.

APPENDIX O - FUEL LOADING PLOT INFORMATION

Table 1: Average fuel load by plot for Slave Lake data for SWF-056-11 and SWF-065-11. C01= Control Plot; P01= Post-fire plot.

Plot ID	FBP Fuel Type	Sample Type	Stand Origin	Stand Density (sph)	Average Fuel Load by Plot (t/ha)				
					Duff	Litter	Down Woody Debris	Herbaceous (Forb & Grass)	Tree
SL-1386-4063	C2	C01	1914	1901	73.29	6.63	11.90	0.36	375.05
SL-1389-4069	C2	C01	1928	2802	80.27	9.38	4.64	0.28	307.02
SL-1562-3910	C2	C01	1949	225	36.71	8.80	0.94	0.07	11.89
SL-1564-3919	C2	C01	1949	150	0.00	23.37	0.94	0.14	8.25
SL-1566-3919	C2	C01	1933	450	45.50	6.59	2.13	0.16	22.48
SL-1567-0400	C2	C01	1964	525	94.76	11.51	6.12	0.28	127.82
SL-1569-4571	C2	C01	1896	2001	171.30	12.93	2.13	0.09	438.35
SL-1679-2423	C2	C01	1921	2001	45.27	7.23	6.74	0.05	155.36
SL-1679-2428	C2	C01	1934	2802	79.87	6.21	10.82	0.12	283.48
SL-1684-2426	C2	C01	1939	2602	51.86	7.74	7.01	0.13	202.58
SL-1392-4047	C2	P01	1919	1450	49.18	5.36	1.29	0.00	91.34
SL-1393-4050	C2	P01	1911	1550	82.97	4.14	4.85	0.00	90.16
SL-1557-3928	C2	P01	1925	475	92.88	1.00	0.69	0.00	19.42
SL-1560-3930	C2	P01	1927	650	69.58	15.69	1.03	0.00	32.79
SL-1605-4539	C2	P01	1920	1150	268.69	0.00	10.62	0.00	68.58
SL-1606-4548	C2	P01	1981	1650	174.64	4.51	25.34	0.00	115.35
SL-1880-0555	D1/D2	C01	1949	2101	63.33	9.25	14.44	0.13	381.28
SL-2030-0520	D1/D2	C01	1933	1050	63.82	11.60	16.79	0.19	253.65
SL-2034-0512	D1/D2	C01	1963	2001	66.29	10.42	12.61	0.11	390.98
SL-2013-0505	D1/D2	P01	1960	1500	79.67	9.56	16.99	0.00	270.84
SL-2014-0510	D1/D2	P01	1952	1801	25.70	14.14	19.26	0.00	303.64
SL-1557-0391	M1/M2	C01	1969	2099	46.92	7.92	6.56	0.11	339.06
SL-1565-0386	M1/M2	C01	1939	1450	51.05	6.64	17.14	0.41	340.02
SL-1573-4558	M1/M2	C01	1878	600	175.66	12.83	25.34	0.13	225.07
SL-1578-4551	M1/M2	C01	1864	1000	112.25	14.55	66.02	0.20	258.99
SL-1876-0550	M1/M2	C01	1960	2201	62.70	7.67	9.56	0.18	368.66
SL-1879-0545	M1/M2	C01	1928	2602	59.17	5.93	11.42	0.51	876.81
SL-2031-0515	M1/M2	C01	1967	500	34.74	7.73	28.48	0.26	100.18
SL-1561-0411	M1/M2	P01	1913	1000	65.48	11.39	80.47	0.00	143.40
SL-1561-0414	M1/M2	P01	1909	1150	28.31	24.80	60.12	0.00	163.79
SL-1687-4362	M1/M2	P01	1943	1300	164.21	14.54	18.24	0.00	182.18
SL-1871-0576	M1/M2	P01	1947	2299	30.24	8.42	12.59	0.00	167.87
SL-1873-0575	M1/M2	P01	1950	2101	54.41	9.90	15.05	0.00	280.72

Table 2: Average fuel load by FBP fuel type for Slave Lake data for SWF-056-11 and SWF-065-11. C01= Control Plot; P01= Post-fire plot.

FBP Fuel Type	Sample Type	Sample Size (n)	Average Fuel Load by Fuel Type (t/ha)				
			Duff	Litter	Down Woody Debris	Herbaceous (Forb & Grass)	Tree
C2	C01	10	67.88	10.04	5.34	0.17	193.23
C2	P01	6	122.99	5.12	7.27	0.00	69.61
D1/D2	C01	3	64.48	10.42	14.61	0.14	341.97
D1/D2	P01	2	52.68	11.85	18.12	0.00	287.24
M1/M2	C01	7	77.50	9.04	23.50	0.26	358.40
M1/M2	P01	5	68.53	13.81	37.30	0.00	114.72

APPENDIX P - WILDFIRE BEHAVIOUR PREDICTION TOOLS

<u>Spatial Fire Management System (SFMS)</u>

The Spatial Fire Management System (SFMS) is an advanced wildfire management information system that integrates wildfire science models and decision support planning modules into a geographic information system. It is designed to be used by wildfire management agencies for daily operational planning purposes at the strategic, tactical, and landscape levels.

The system incorporates a full implementation of the Canadian Forest Fire Danger Rating System, providing assessments of fire ignition and growth potential, and predicted fire behaviour. It also includes tools for resource allocation planning and wildfire threat rating. Alberta adopted SFMS operationally in the mid-1990s and is used everyday during the wildfire season.

<u>Prometheus (Canadian Wildland Fire Growth Model)</u>

Prometheus is a deterministic wildland fire growth simulation model based on the FWI and FBP sub-systems of the CFFDRS. The model computes spatially-explicit fire behaviour and spread outputs given fuel, topography, and weather conditions. Prometheus was developed by an integrated, multi-disciplinary team of Canadian researchers and wildfire managers. Sustainable Resource Development is the lead agency in on-going refinement and development of the model. Operational versions of Prometheus have been available since 2001.

This state-of-the-art model allows for operational and strategic assessments of spatial fire behaviour on the landscape. Uses of this model in wildfire and forest management include:

- Assessing the effectiveness of various forest and wildfire management strategies aimed at reducing the threat of large wildfires
- Evaluating the fire behaviour potential or burn probability of landscapes created by different forest management strategies and practices
- Evaluating the potential threat wildfires could pose to communities, recreational facilities, forest management units and other values-at-risk
- predicting the growth and intensity of wildfires that have escaped initial attack

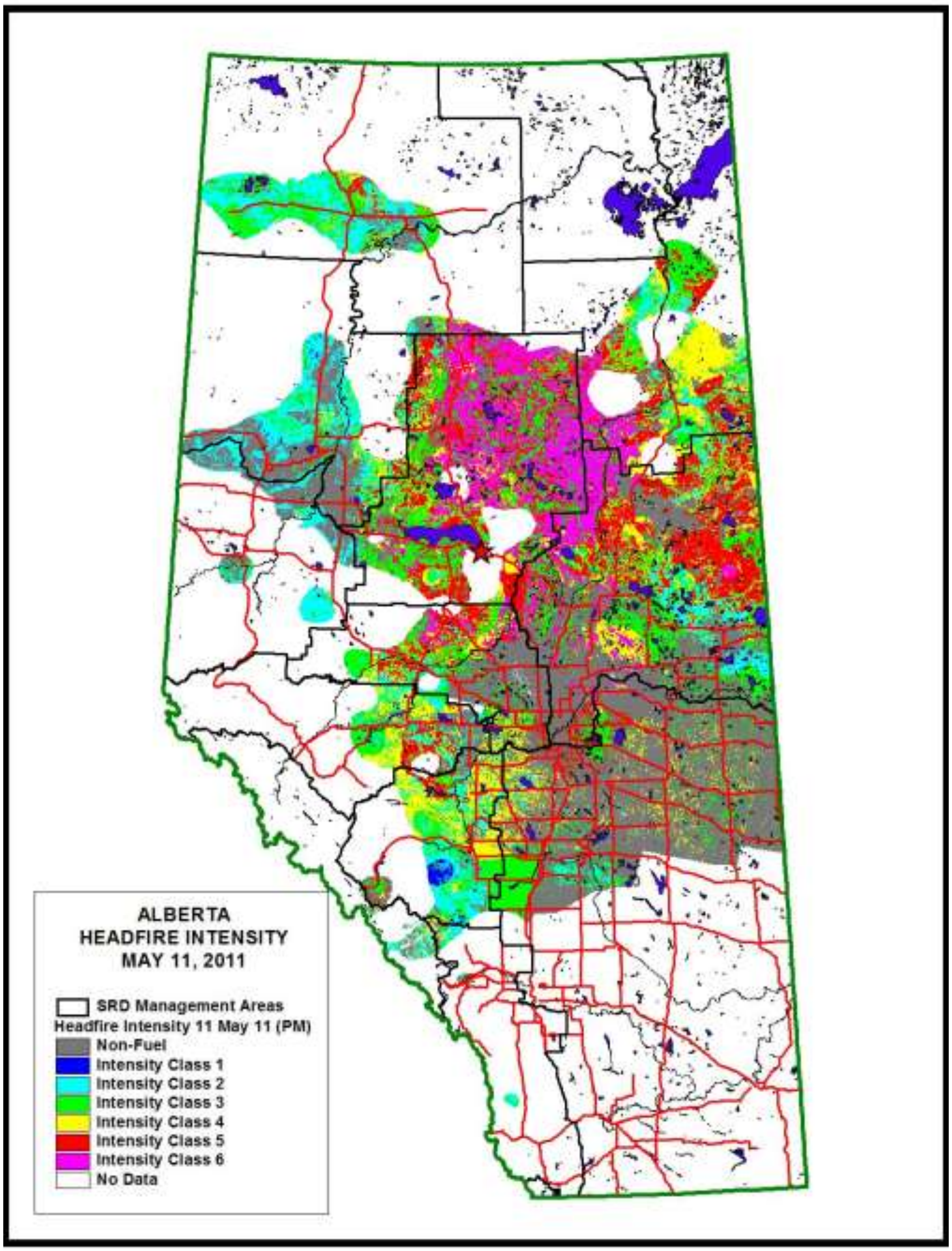
<u>*Behave* by Remsoft</u>

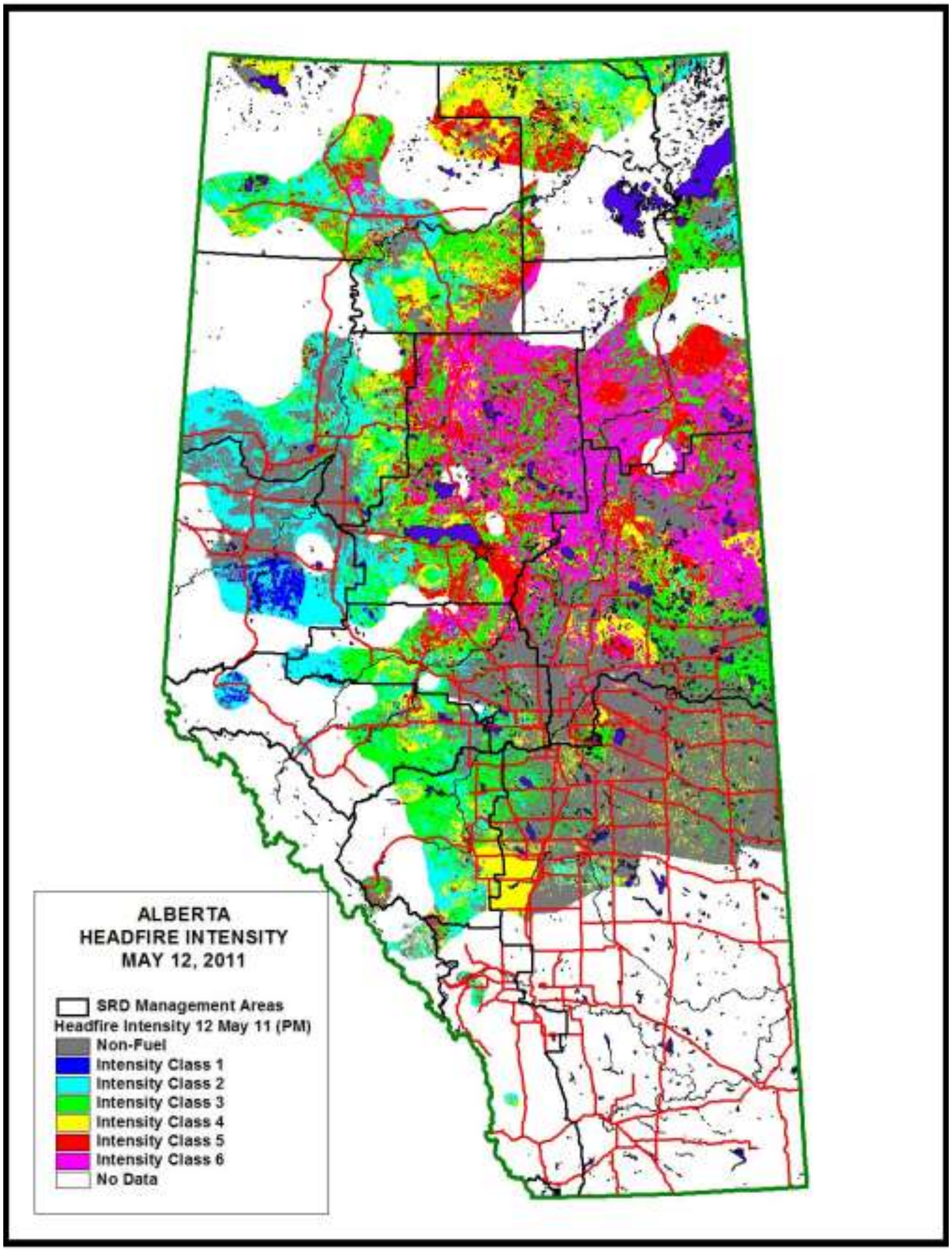
Behave is a commercial software package introduced several years ago. It calculates Fire Weather Index System and Fire Behaviour Prediction System values based on user inputs of applicable variables.

The program uses the equations of the Canadian Forest Fire Danger Rating System. Most common outputs used are Rate of Spread, Head Fire Intensity, Crown Fraction Burned, and Fuel Consumption. Projected wildfire perimeter and area burned are also calculated. The outputs are numerical (tabular) rather than spatially displayed (on a geographic information system).

APPENDIX Q - FORECASTED AND ACTUAL HEAD FIRE INTENSITIES

Provincial head fire intensity forecast maps for May 11 to 16, 2011.

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HEADFIRE INTENSITY
MAY 12, 2011
SRD Management Areas
Headfire Intensity 12 May 11 (PM)
Non-Fuel
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Intensity Class 4
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Intensity Class 6
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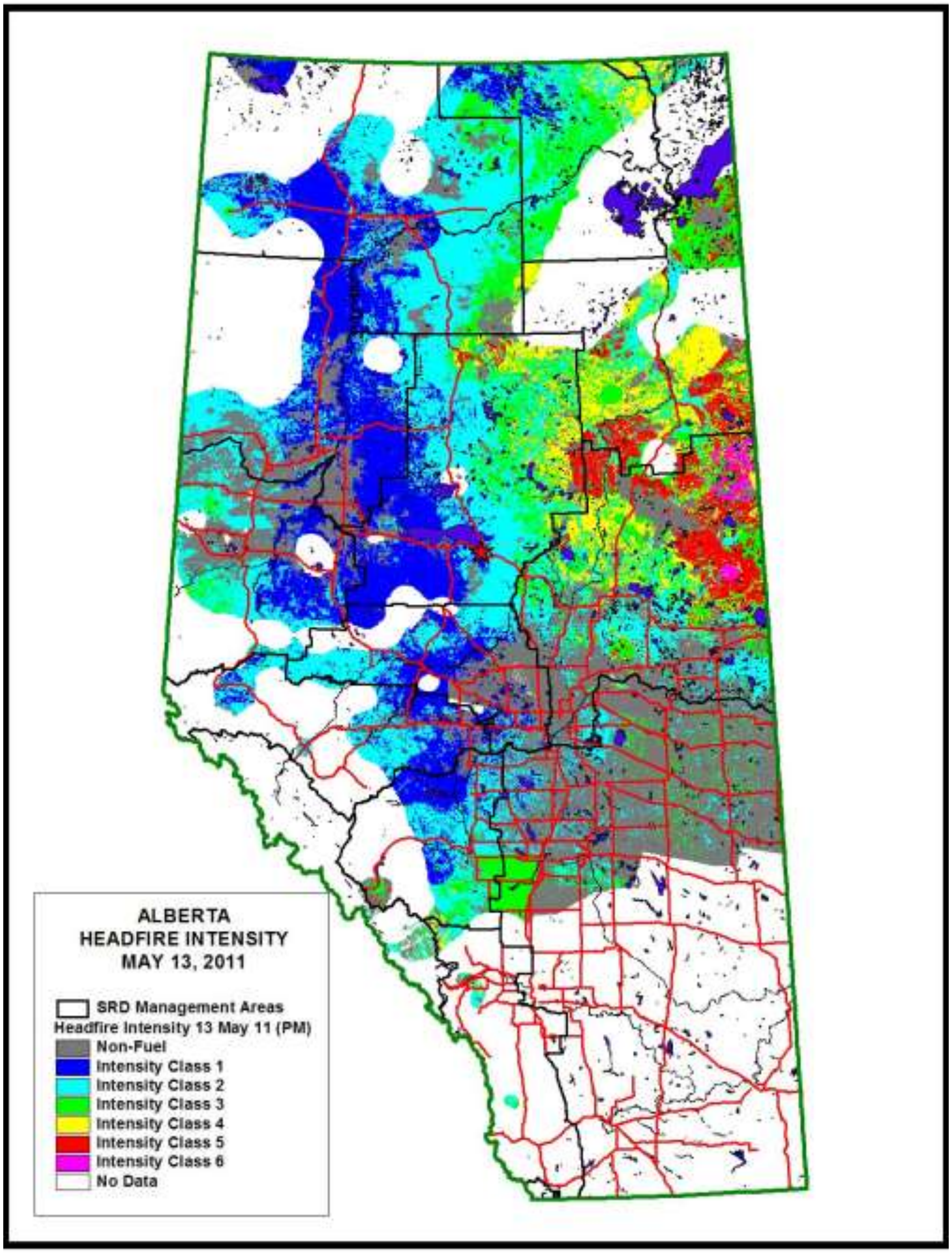
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HEADFIRE INTENSITY
MAY 13, 2011
SRD Management Areas
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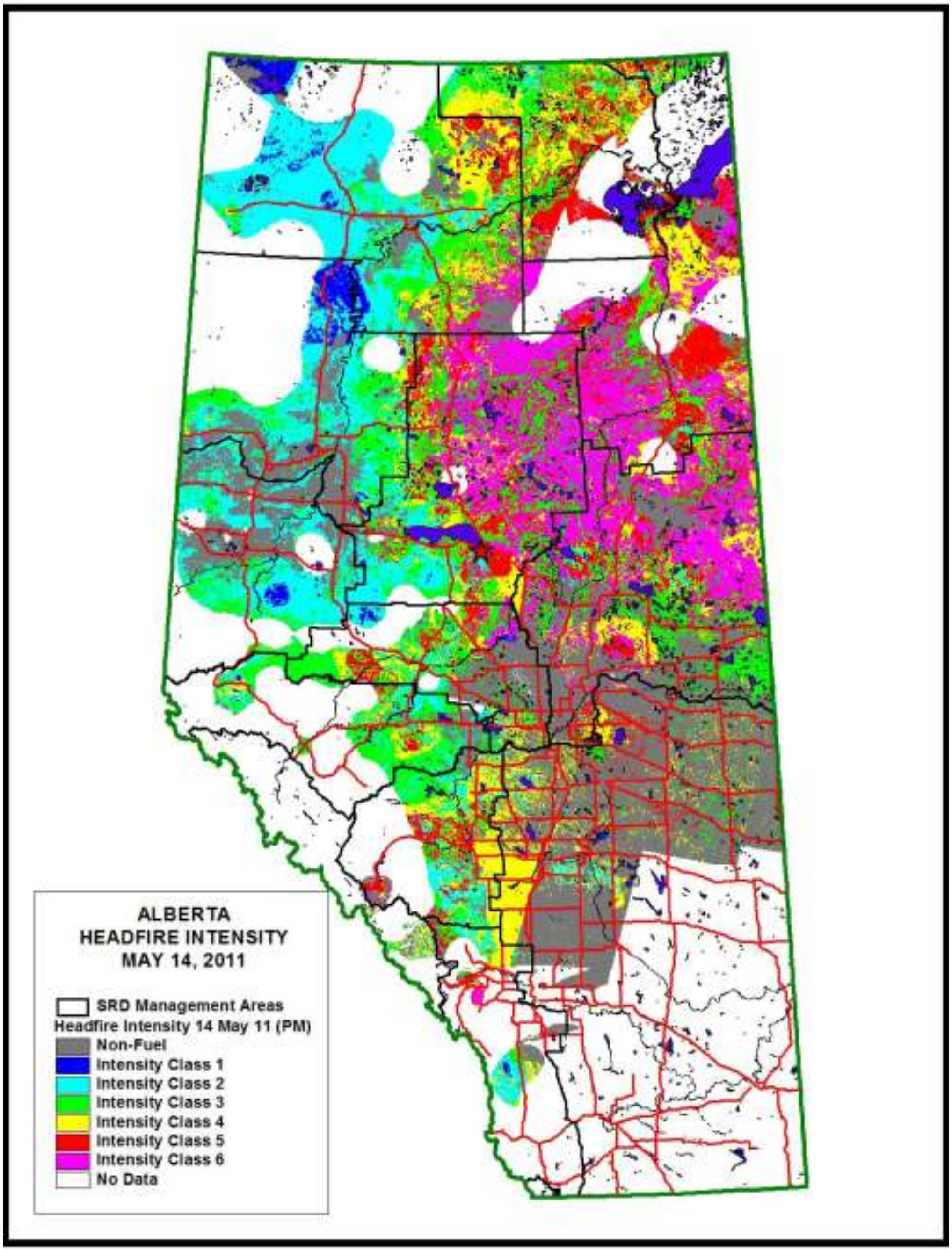
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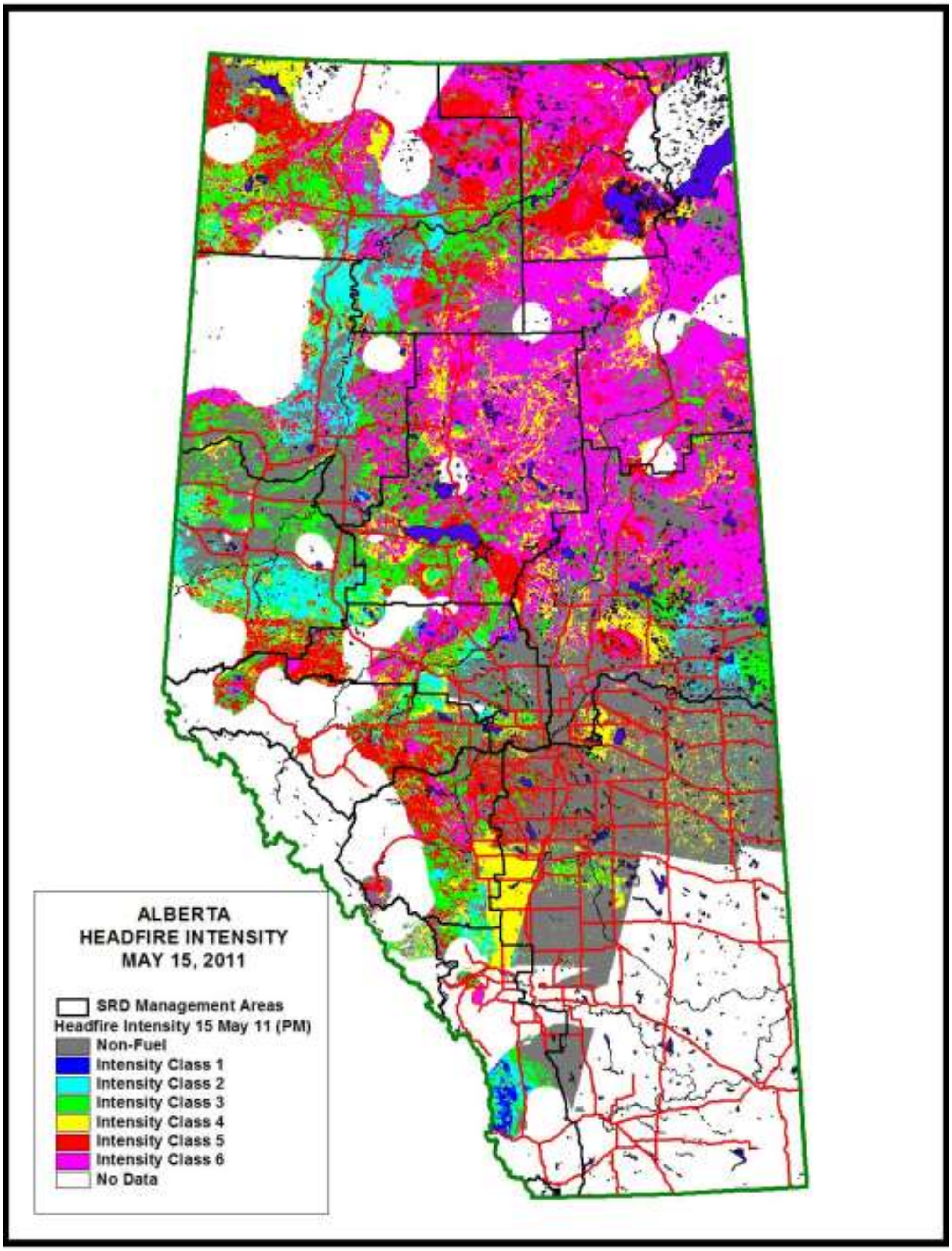
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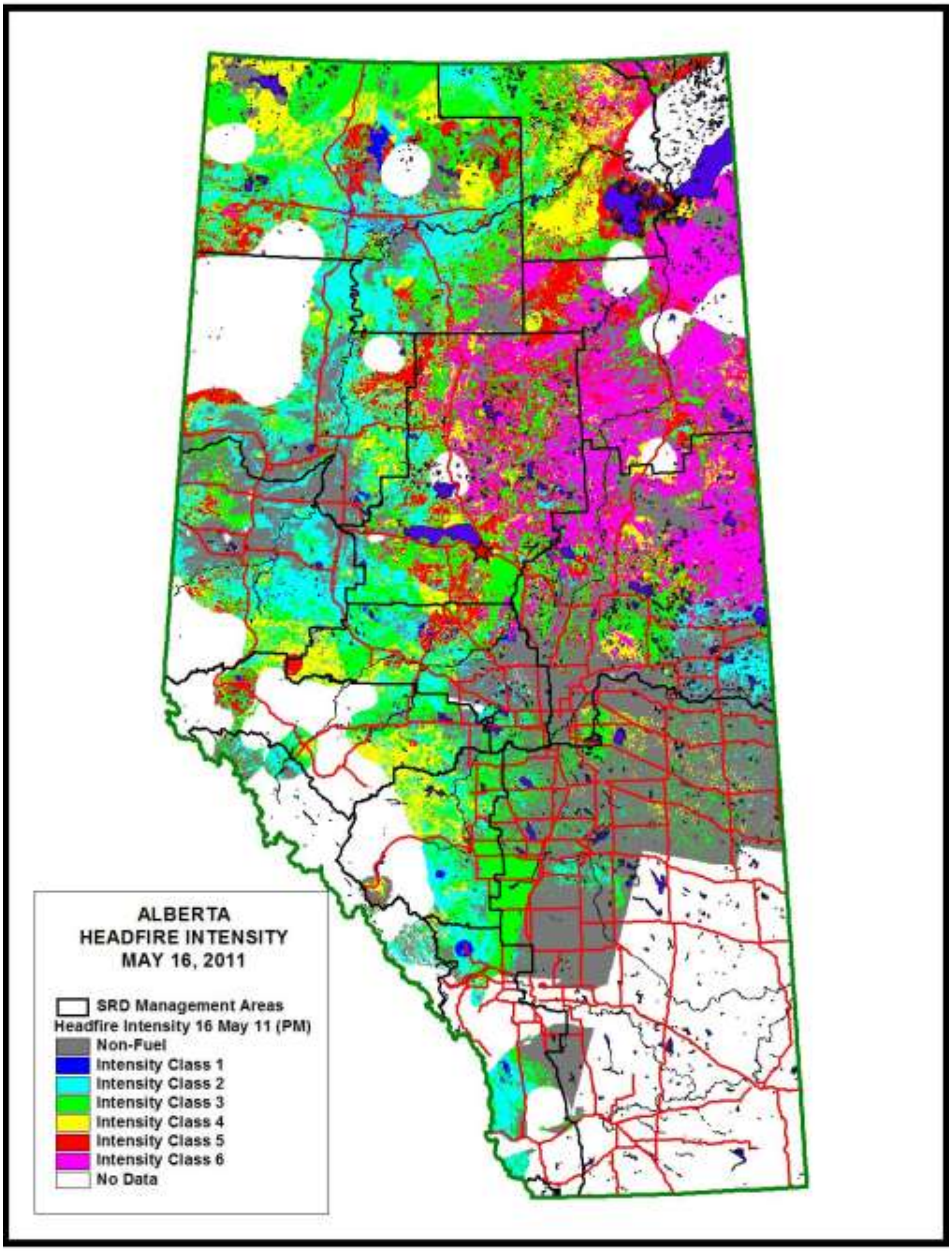
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Headfire Intensity 16 May 11 (PM)
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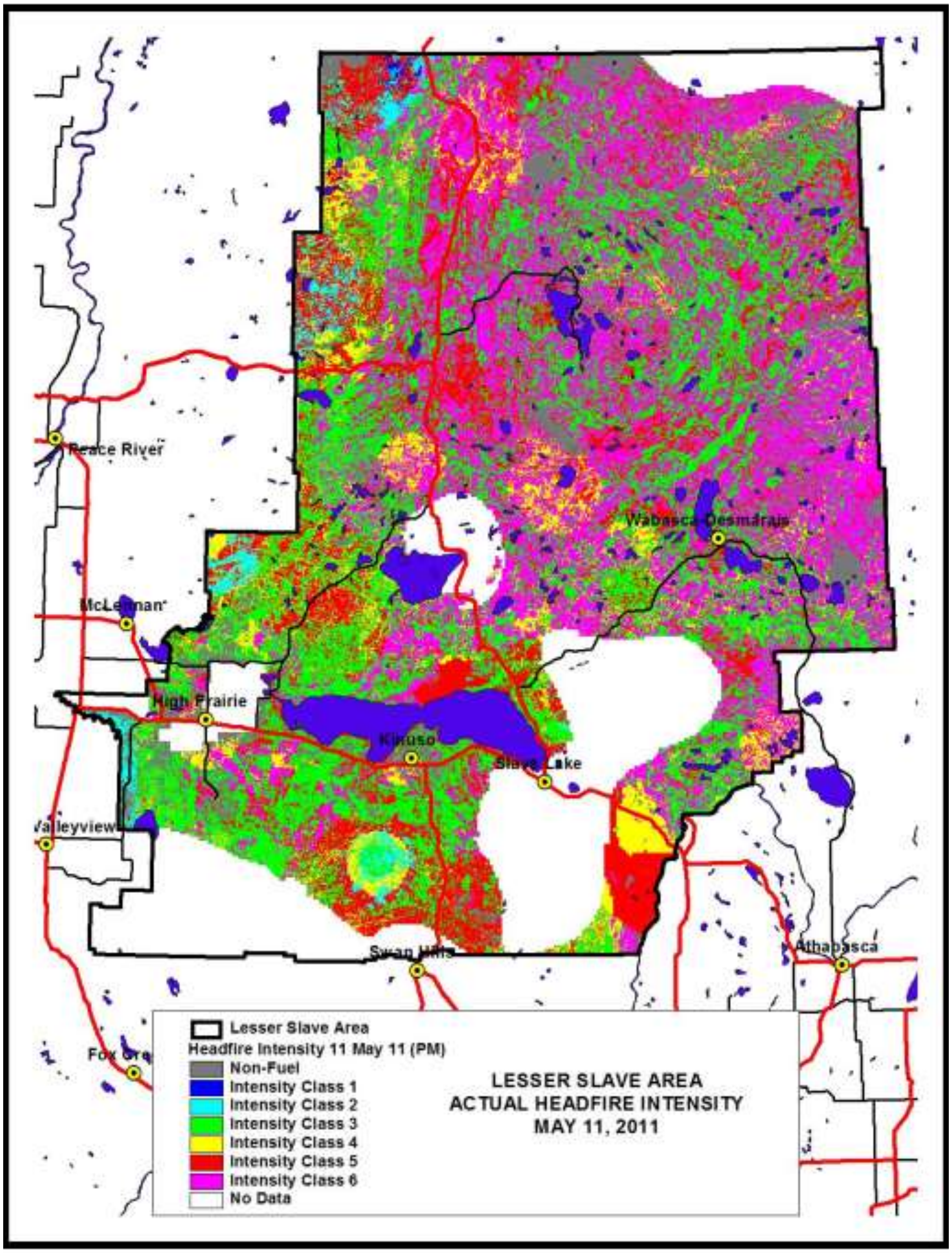
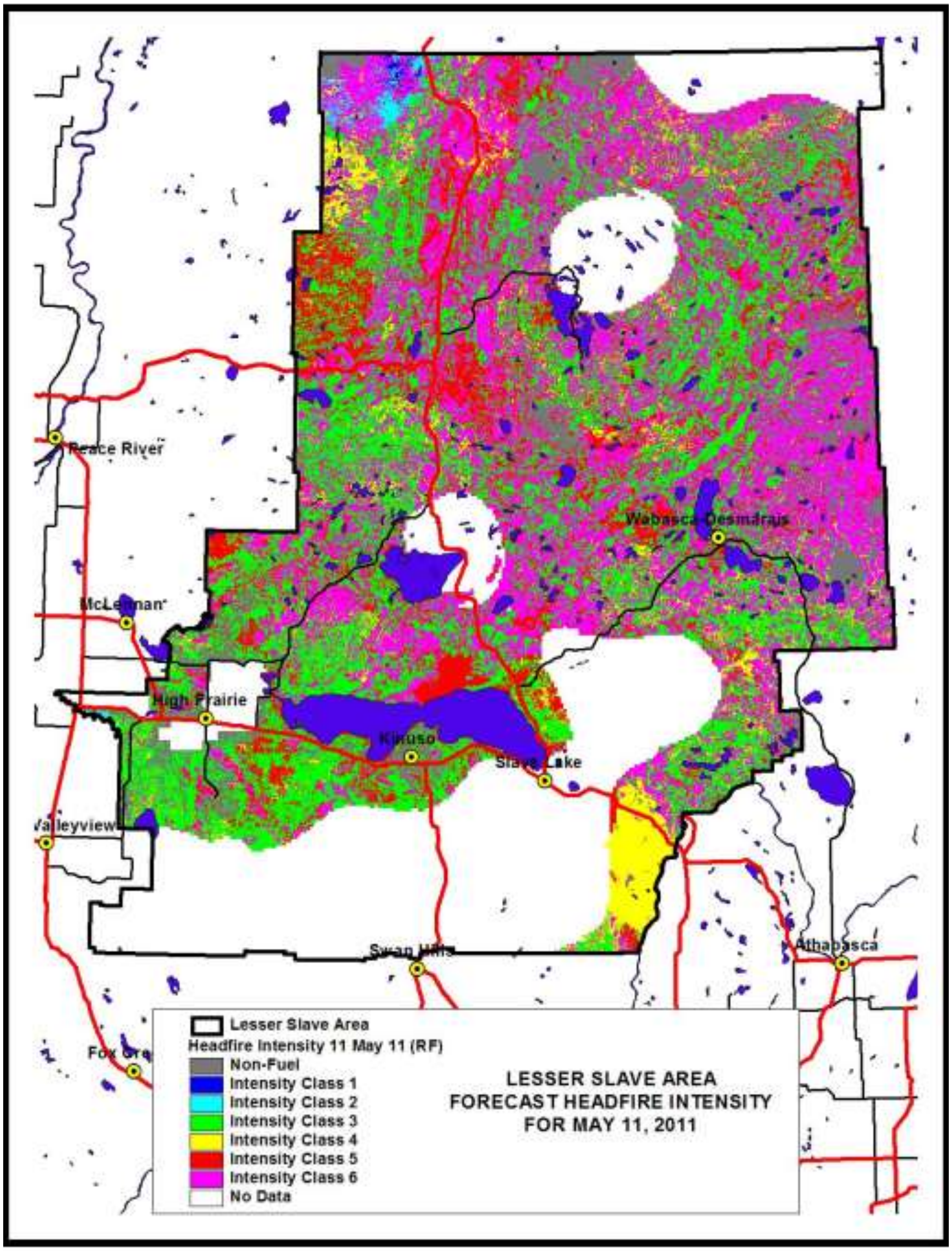
Lesser Slave Area actual and forecasted head fire intensity maps for May 11 to 16, 2011.

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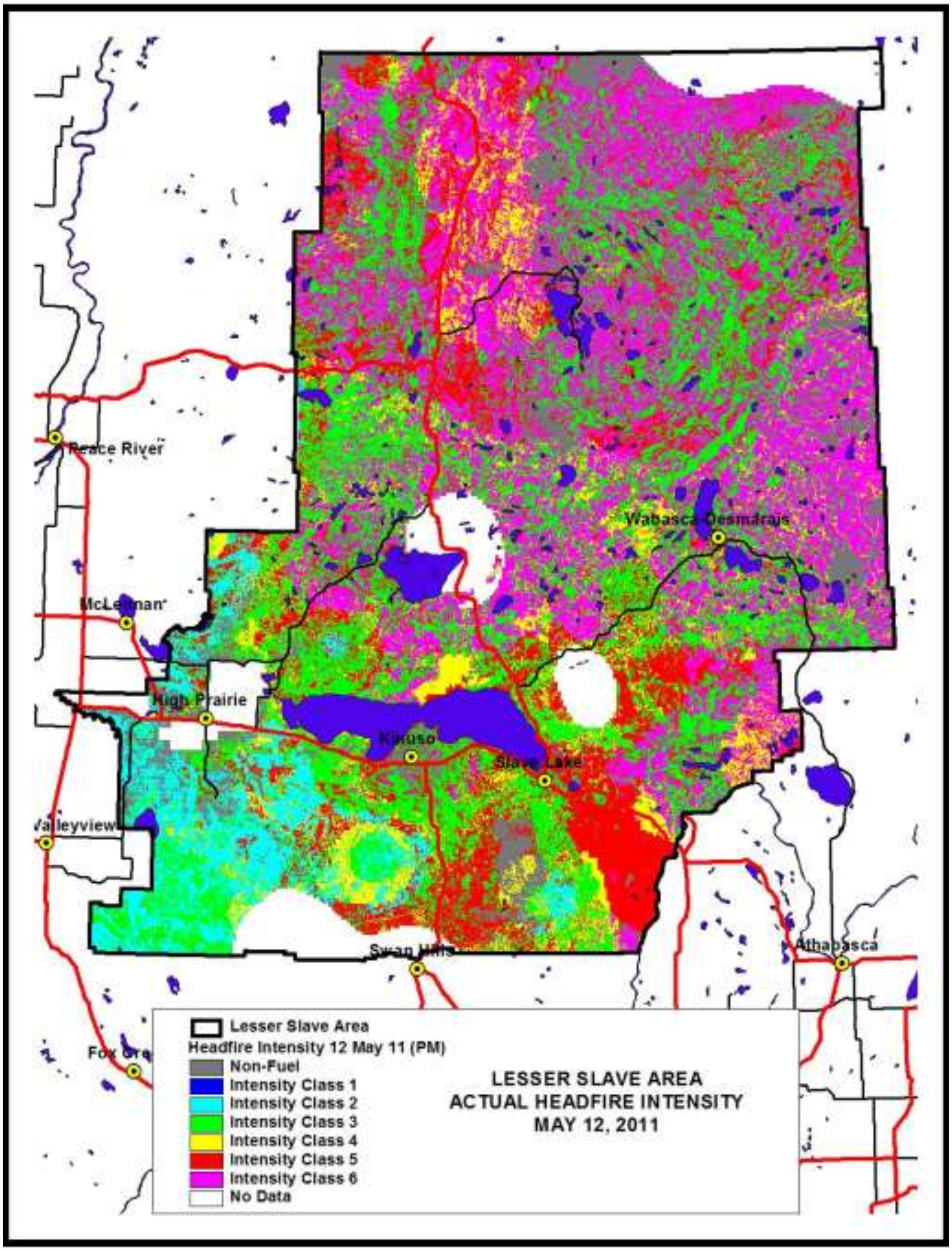
FORECAST HEADFIRE INTENSITY
FOR MAY 11, 2011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Non-Fuel
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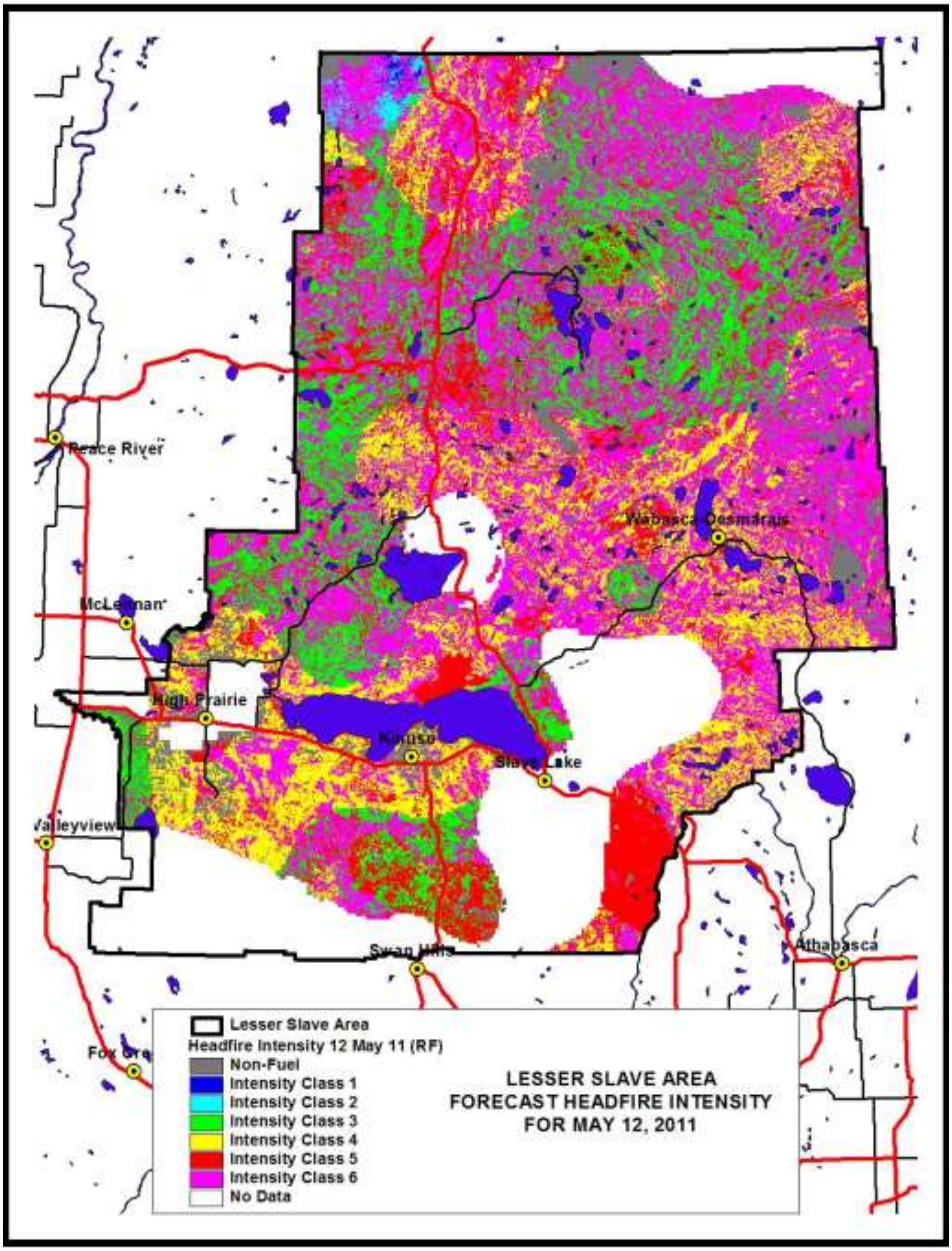
ACTUAL HEADFIRE INTENSITY
MAY 12, 2011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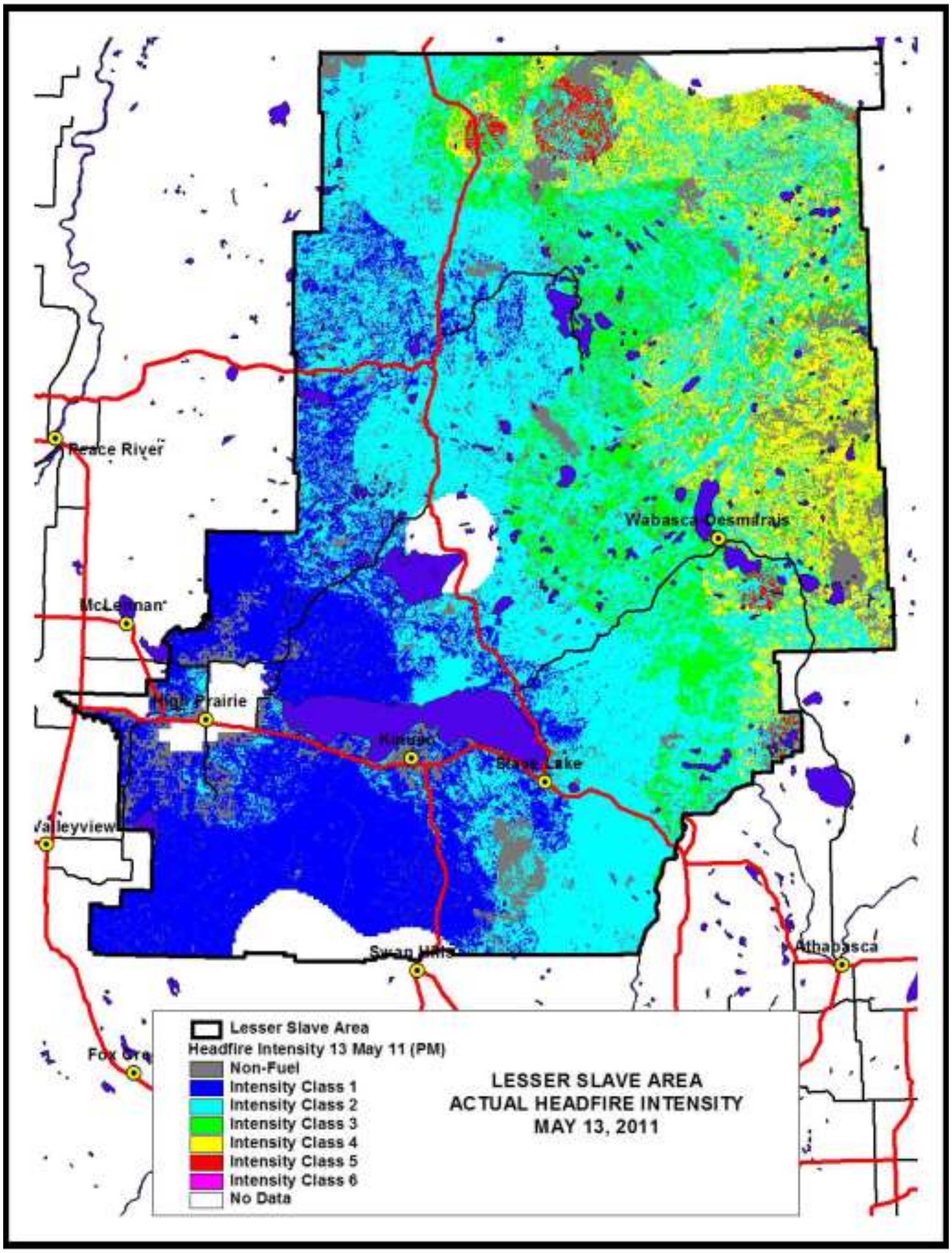
FORECAST HEADFIRE INTENSITY
FOR MAY 12, 2011



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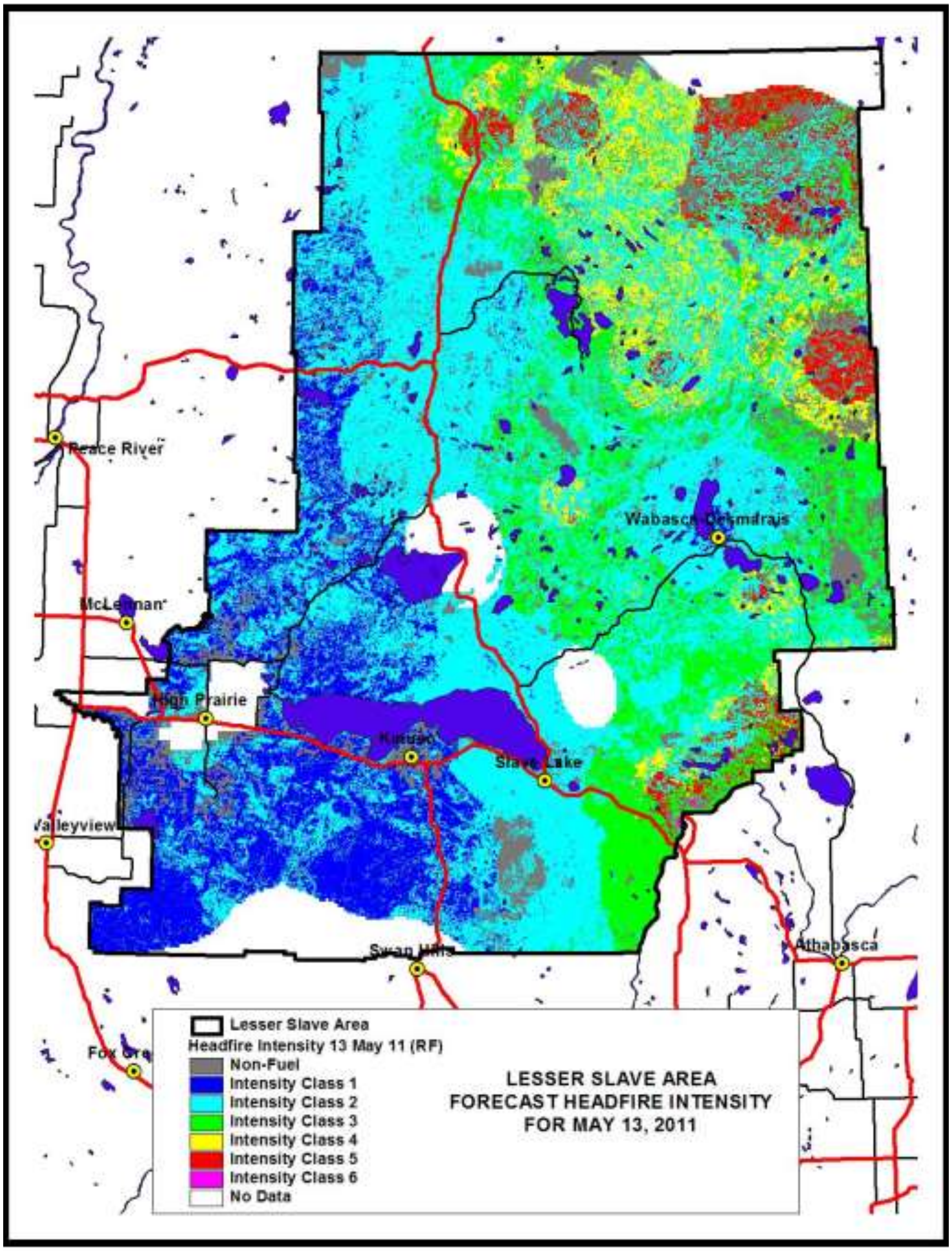
ACTUAL HEADFIRE INTENSITY
MAY 13, 2011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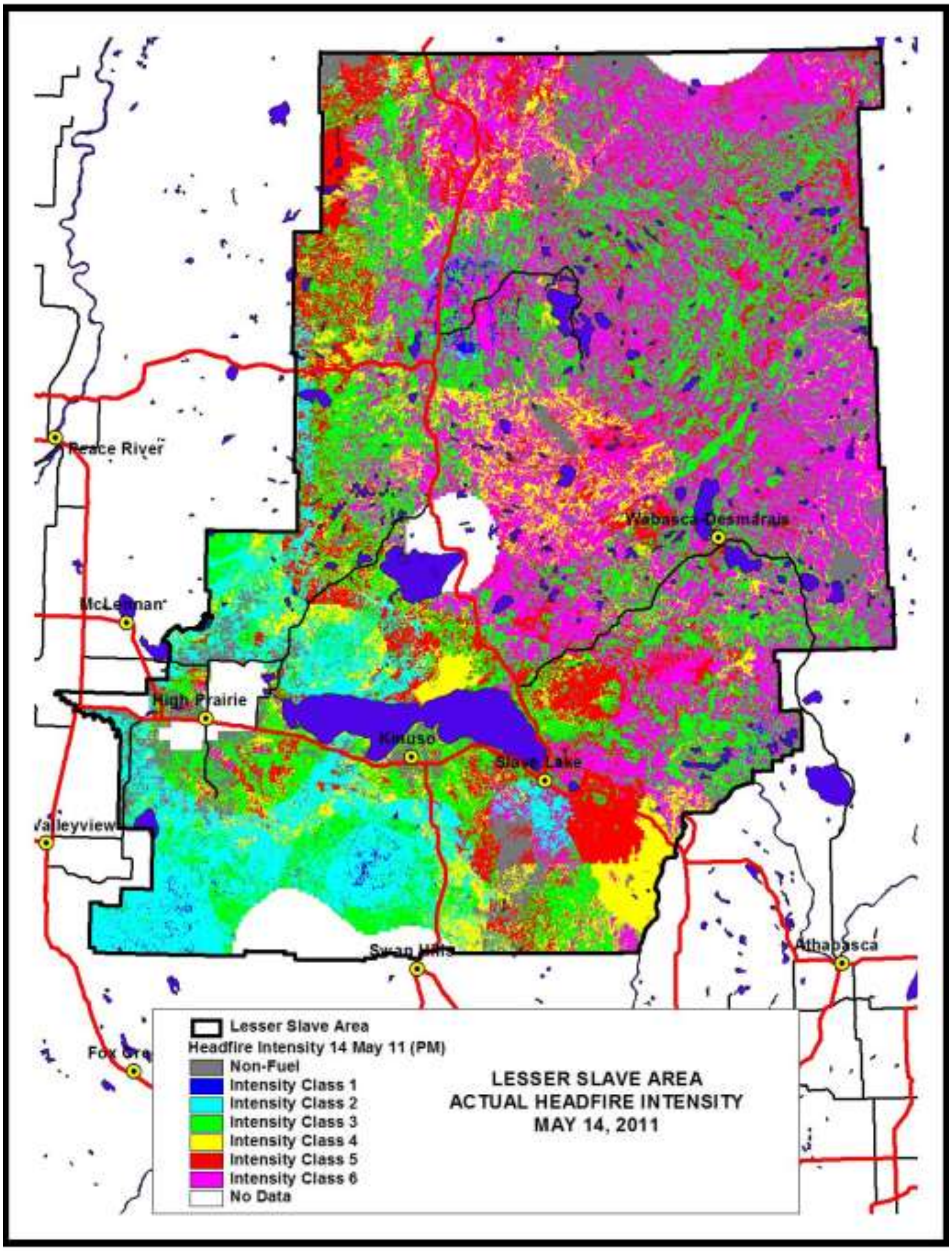
FOR MAY 13, 2011



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Non-Fuel
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ACTUAL HEADFIRE INTENSITY
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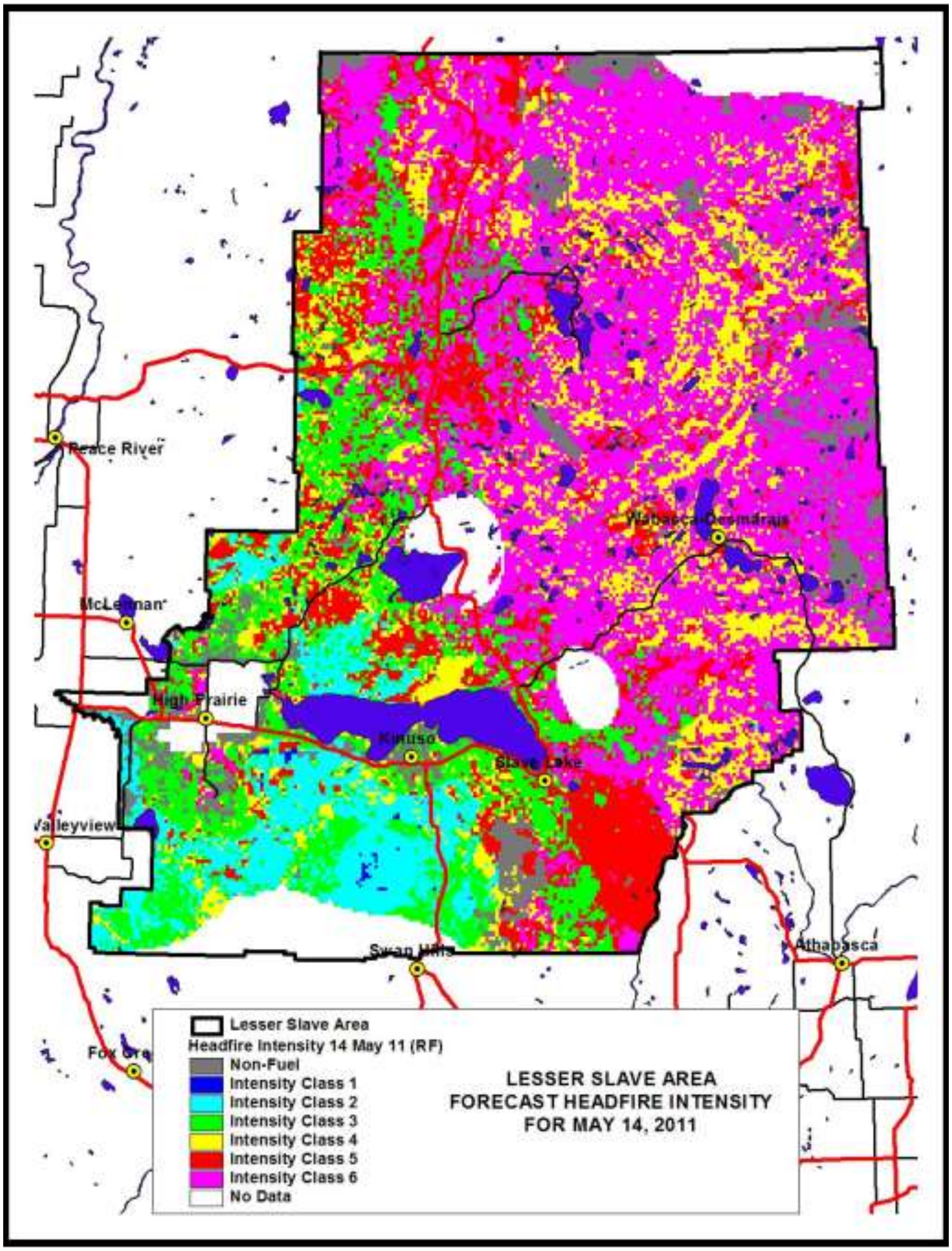
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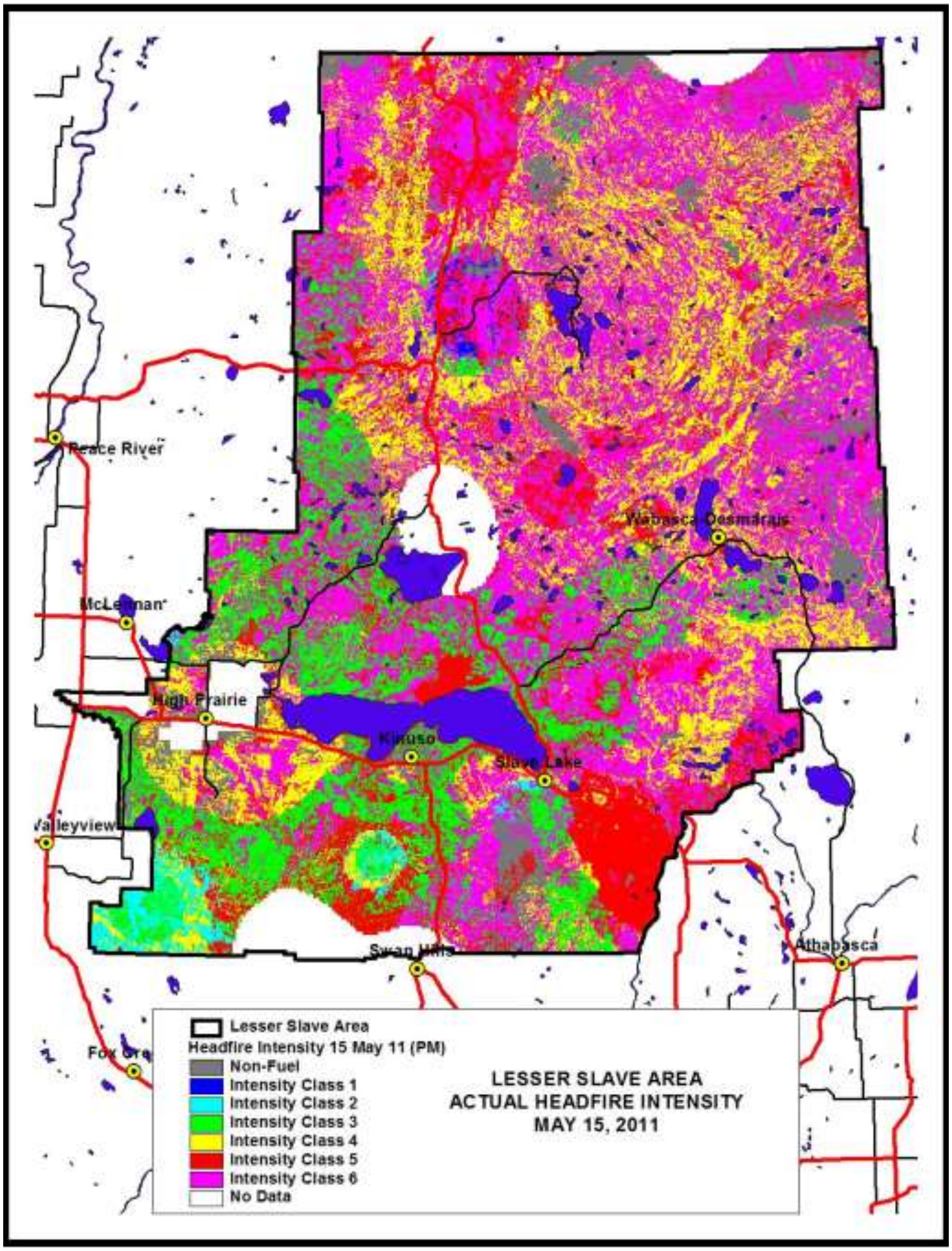
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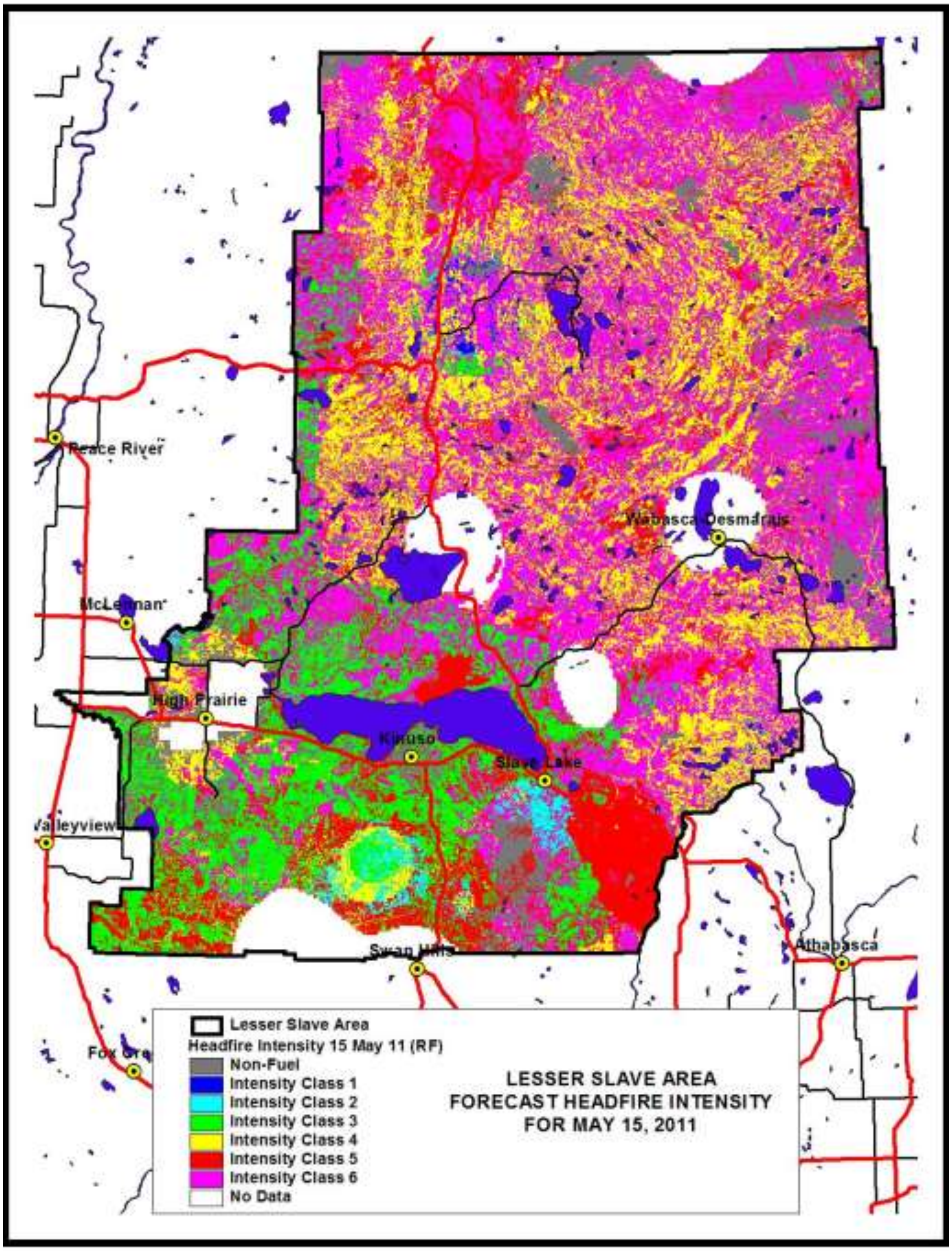
ACTUAL HEADFIRE INTENSITY
MAY 15, 2011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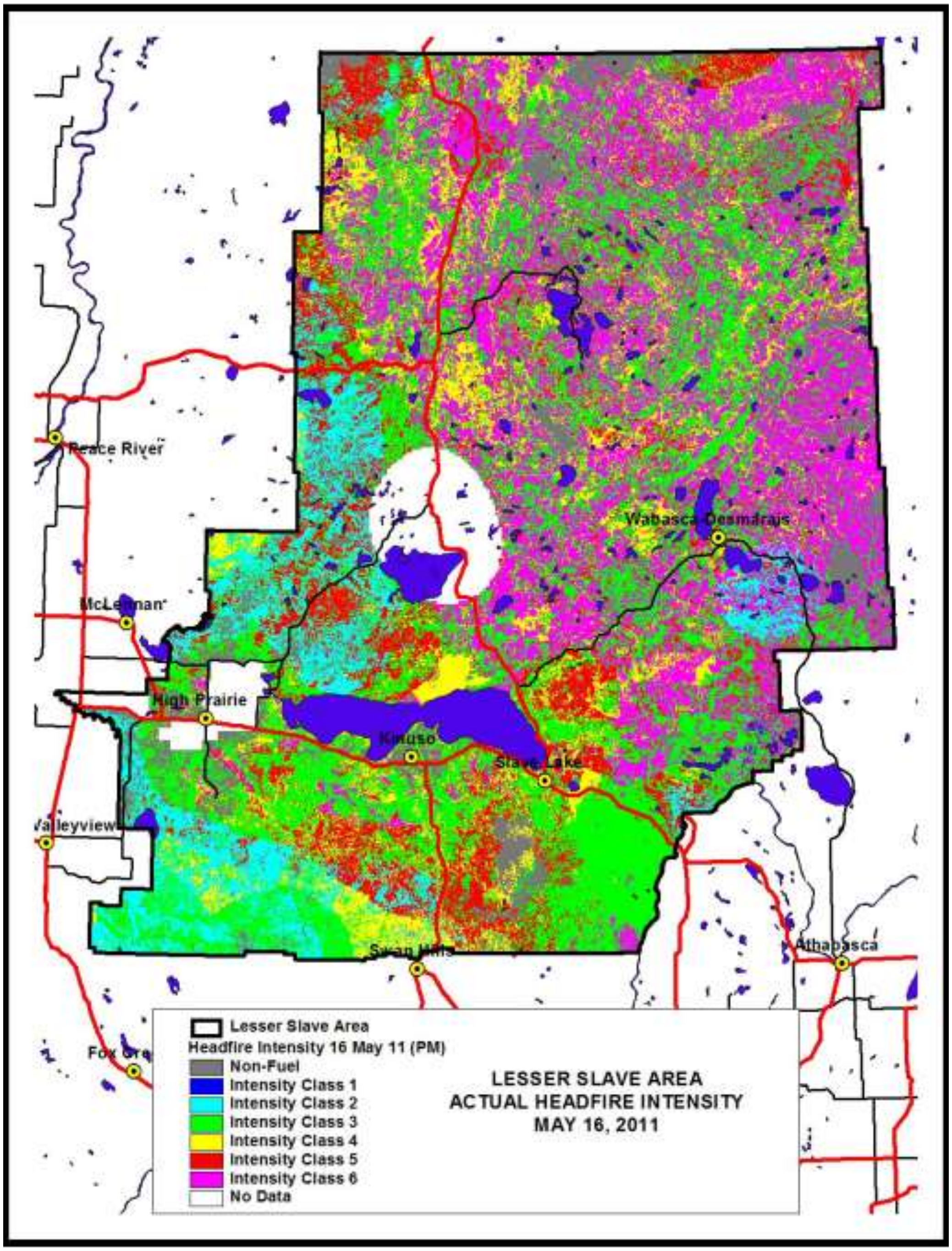
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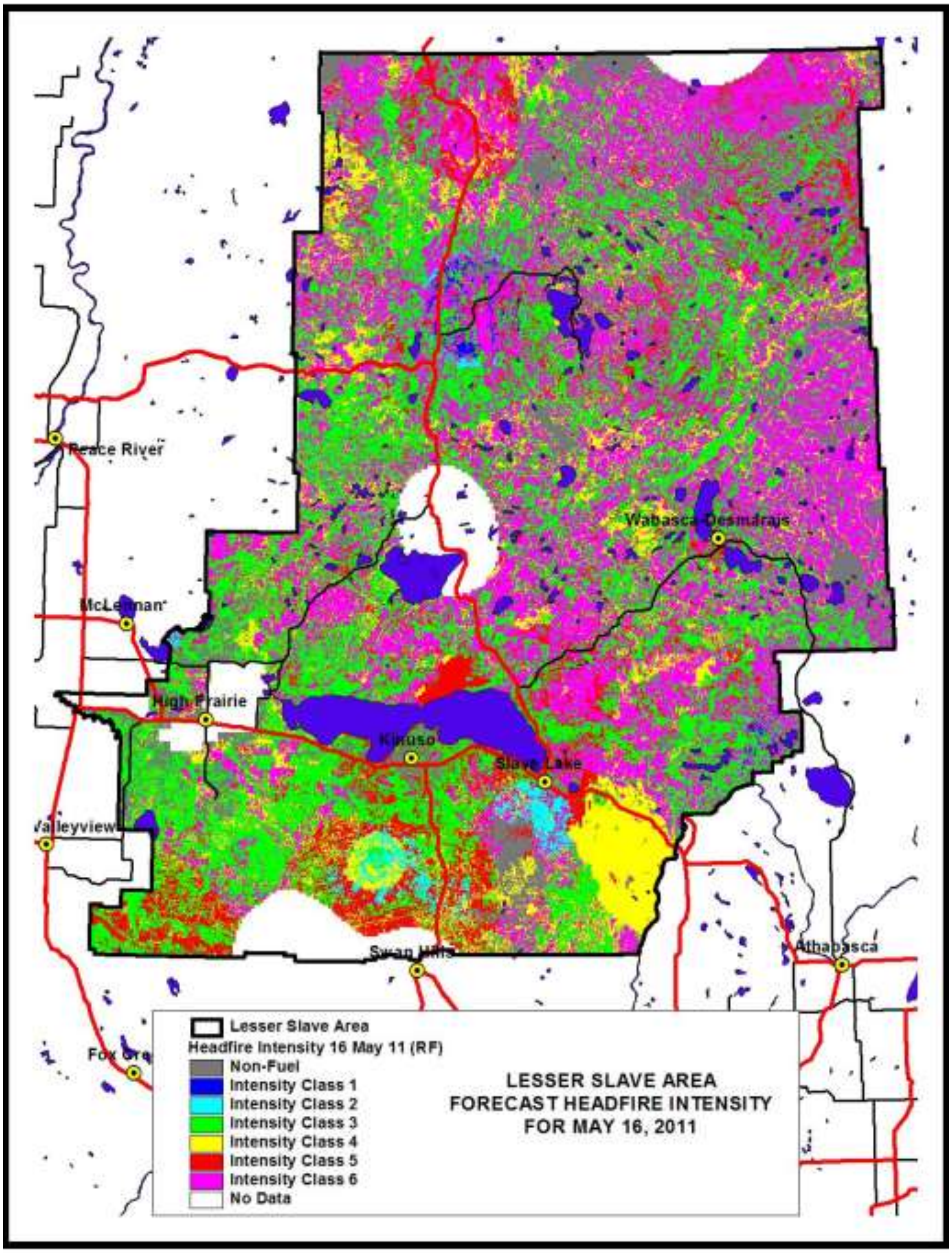
ACTUAL HEADFIRE INTENSITY
MAY 16, 2011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Athabasca
Lesser Slave Area
Headfire Intensity 16 May 11 (RF)
Non-Fuel
Intensity Class 1
Intensity Class 2
Intensity Class 3
Intensity Class 4
Intensity Class 5
Intensity Class 6
No Data
LESSER SLAVE AREA
FORECAST HEADFIRE INTENSITY
FOR MAY 16, 2011

APPENDIX R - WIND FORECAST SUMMARY

Alberta Sustainable Resource Development (ASRD) forecasts of wind speed and wind direction for the Swan Hills Forecast Zone (which includes Slave Lake) are compared to those issued by Environment Canada (EC) for Slave Lake for the period May 11 – 16. No evening forecasts were issues by ASRD pasts day one. In all cases, forecast wind speed and direction were consistent between both agencies.

Date Time	Forecast Today		Forecast Tonight	Forecast Tomorrow		Forecast Tomorrow Night
	EC	ASRD	EC	EC	ASRD	EC
May 11						
05:00	SE30G50	-	SE30G50	SE30	-	-
11:00	SE30G50	-	SE30G50	SE30	-	-
12:00	-	SE30G60	-	-	SE40G60	-
16:00	-	-	SE30G50	SE30	-	SE20
May 12						
05:00	SE30	-	SE20	n/a	-	-
11:00	SE30	-	SE20	n/a	-	-
12:00	-	SE40G60	-	-	SE15	-
16:00	-	-	SE40G60	n/a	-	SE20
May 13						
05:00	n/a	-	n/a	SE30	-	-
11:00	n/a	-	n/a	SE30	-	-
12:00	-	SE20G40	-	-	SE40G60	-
16:00	-	-	E20	SE40G60	-	SE40G60
May 14						
05:00	SE40G60	-	SE40G60	SE40G60	-	-
10:00	-	SE40G60	-	-	SE--G60	-
11:00	SE40G70	-	SE40G70	SE40G60	-	-
15:00	-	-	-	-	SE35G60	-
16:00	-	-	SE40G60	SE40G70	-	SE40G70
22:05	-	-	SE30G50	SE40G70	-	SE40G70
May 15						
05:00	SE40G70	-	SE40G70	SE20	-	-
10:00	-	SE40G70	-	-	SE20G40	-
11:00	SE40G70	-	SE40G70	SE20	-	-
15:00	-	-	-	-	SE25G40	-
16:00	-	-	SE50G70	SE30G50	-	SE30G50
27:44	-	-	SE50G70	SE30G50	-	SE30G50
May 16						
05:00	SE20G40	-	SE20G40	SE20	-	-
10:00	-	SE25G40	-	-	SE15-20	-
11:00	SE20G40	-	SE20G40	SE20	-	-
15:00	-	-	-	-	SE/SW15	-
16:00	-	-	SE20G40	E20G50	-	E20G50