

Appendix A. Burn decision summary.

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Table A1. July burn decisions—northern Idaho.

		Burn Decisions by Smoke Management Area -Northern Idaho						
Date		Boundary SMA (County)	Kootenai SMA (County)	Central SMA	Clearwater County	Idaho County	Latah County	Nez Perce County
July 1, 2012	Weekend							
July 2, 2012		NR	NR	NR	NR	NR	NR	NR
July 3, 2012		NR	NR	NR	NR	NR	NR	NR
July 4, 2012	Holiday							
July 5, 2012		NR	NR	NR	NR	NR	NR	NR
July 6, 2012		NR	NR	NR	NR	NR	NR	NR
July 7, 2012	Weekend							
July 8, 2012	Weekend							
July 9, 2012		NR	NR	NR	NR	NR	NR	NR
July 10, 2012		NR	NR	Moisture	NR	Moisture	NR	NR
July 11, 2012		NR	NR	Burn	NR	Burn	NR	NR
July 12, 2012		NR	NR	NR	NR	NR	NR	NR
July 13, 2012		NR	NR	Burn	NR	Burn	NR	NR
July 14, 2012	Weekend							
July 15, 2012	Weekend							
July 16, 2012		NR	NR	Moisture	NR	NR	Moisture	NR
July 17, 2012		NR	NR	NR	NR	NR	NR	NR
July 18, 2012		NR	NR	NR	NR	NR	NR	NR
July 19, 2012		NR	NR	NR	NR	NR	NR	NR
July 20, 2012		NR	NR	NR	NR	NR	NR	NR
July 21, 2012	Weekend							
July 22, 2012	Weekend							
July 23, 2012		NR	NR	NR	NR	NR	NR	NR
July 24, 2012		NR	NR	NR	NR	NR	Burn	NR
July 25, 2012		NR	NR	NR	NR	NR	NR	NR
July 26, 2012		NR	NR	Burn	NR	Burn	Burn	NR
July 27, 2012		NR	NR	NR	NR	NR	NR	NR
July 28, 2012	Weekend							
July 29, 2012	Weekend							
July 30, 2012		NR	NR	Burn	NR	Burn	NR	NR
July 31, 2012		NR	NR	Burn	NR	Burn	NR	Burn

Note: NR = no requests to burn or a fire-safety burn ban was in place that prohibited crop residue burning
 Ozone = ambient ozone concentrations were above, or were forecasted to be above, allowable limits”
 Red Flag = the National Weather Service issued a red-flag warning for high fire risk

Table A2. August burn decisions—northern Idaho.

		Burn Decisions by Smoke Management Area -Northern Idaho						
		Boundary	Kootenai	Central	Clearwater	Idaho	Latah	Nez Perce
Date		SMA (County)	SMA (County)	SMA	County	County	County	County
August 1, 2012		NR	NR	Burn	NR	NR	Burn	Burn
August 2, 2012		NR	NR	NR	NR	NR	NR	NR
August 3, 2012		NR	NR	NR	NR	NR	NR	NR
August 4, 2012	Weekend							
August 5, 2012	Weekend							
August 6, 2012		Red Flag	Red Flag	Red Flag	Red Flag	Red Flag	Red Flag	Red Flag
August 7, 2012		NR	NR	Burn	NR	Burn	Burn	NR
August 8, 2012		NR	NR	Burn	NR	NR	Burn	NR
August 9, 2012		NR	NR	Poor Ventilation	NR	NR	Poor Ventilation	NR
August 10, 2012		NR	NR	Burn	NR	NR	Burn	NR
August 11, 2012	Weekend							
August 12, 2012	Weekend							
August 13, 2012		NR	Poor Ventilation	NR	NR	NR	NR	NR
August 14, 2012		NR	Poor Ventilation	NR	NR	NR	NR	NR
August 15, 2012		NR	Wind	NR	NR	NR	NR	NR
August 16, 2012		Burn	Poor Ventilation	NR	NR	NR	NR	NR
August 17, 2012		Poor Ventilation	Poor Ventilation	NR	NR	NR	NR	NR
August 18, 2012	Weekend							
August 19, 2012	Weekend							
August 20, 2012		Burn	Poor Ventilation	NR	NR	NR	NR	NR
August 21, 2012		Red Flag	Red Flag	Red Flag	NR	Red Flag	Red Flag	NR
August 22, 2012		Moisture	Moisture	NR	NR	Burn	NR	NR
August 23, 2012		Wind	Wind	NR	NR	NR	NR	NR
August 24, 2012		Wind	Wind	NR	NR	NR	NR	NR
August 25, 2012	Weekend							
August 26, 2012	Weekend							
August 27, 2012		Smoke	Smoke	Poor Ventilation	NR	Poor Ventilation	Poor Ventilation	Poor Ventilation
August 28, 2012		Burn	Burn	Smoke	NR	Smoke	Smoke	Smoke
August 29, 2012		Poor Ventilation	Smoke	Burn	NR	Burn	Burn	Burn
August 30, 2012		Poor Ventilation	Smoke	Poor Ventilation	NR	Poor Ventilation	Poor Ventilation	Poor Ventilation
August 31, 2012		Poor Ventilation	Poor Ventilation	Smoke	NR	Smoke	Poor Ventilation	Burn

Note: NR = no requests to burn or a fire-safety burn ban was in place that prohibited crop residue burning
 Ozone = ambient ozone concentrations were above, or were forecasted to be above, allowable limits”
 Red Flag = the National Weather Service issued a red-flag warning for high fire risk
 Smoke/Ozone = both wildfire smoke and ambient ozone concentrations led to a no-burn decision
 Smoke = wildfire smoke led to a no-burn decision

Table A3. September burn decisions—northern Idaho.

		Burn Decisions by Smoke Management Area -Northern Idaho						
Date		Boundary SMA (County)	Kootenai SMA (County)	Central SMA	Clearwater County	Idaho County	Latah County	Nez Perce County
September 1, 2012	Weekend							
September 2, 2012	Weekend							
September 3, 2012	Holiday							
September 4, 2012		Burn	Wind	Burn	NR	Burn	Burn	Burn
September 5, 2012		Burn	Burn	Burn	Burn	Burn	Poor Ventilation	Burn
September 6, 2012		Burn	Poor Ventilation	Burn	Burn	Burn	Burn	NR
September 7, 2012		Wind	Poor Ventilation	Burn	Poor Ventilation	Burn	Poor Ventilation	Poor Ventilation
September 8, 2012	Weekend							
September 9, 2012	Weekend							
September 10, 2012		Red Flag	Red Flag	Red Flag	Red Flag	Red Flag	Red Flag	Red Flag
September 11, 2012		Burn	Poor Ventilation	Burn	NR	Burn	Burn	Burn
September 12, 2012		Burn	Poor Ventilation	Smoke	Poor Ventilation	Smoke	Poor Ventilation	Poor Ventilation
September 13, 2012		Burn	Poor Ventilation	Smoke	Poor Ventilation	Smoke	Poor Ventilation	Poor Ventilation
September 14, 2012		Burn	Poor Ventilation	Smoke	Smoke	Smoke	Smoke	Smoke
September 15, 2012	Weekend							
September 16, 2012	Weekend							
September 17, 2012		Poor Ventilation	Poor Ventilation	Smoke	Smoke	Smoke	Smoke	Smoke
September 18, 2012		Burn	Poor Ventilation	Smoke	Smoke	Smoke	Poor Ventilation	Poor Ventilation
September 19, 2012		Poor Ventilation	Poor Ventilation	Smoke	Smoke	Smoke	Smoke	Smoke
September 20, 2012		Poor Ventilation	Poor Ventilation	Smoke	Smoke	Smoke	Smoke	Smoke
September 21, 2012		Poor Ventilation	Poor Ventilation	Smoke	Smoke	Smoke	Smoke	Smoke
September 22, 2012	Weekend							
September 23, 2012	Weekend							
September 24, 2012		Smoke	Smoke	Smoke	Smoke	Smoke	Smoke	Smoke
September 25, 2012		Smoke	Smoke	Smoke	Smoke	Smoke	Smoke	Smoke
September 26, 2012		Smoke	Smoke	Smoke	Smoke	Smoke	Smoke	Smoke
September 27, 2012		Smoke	Smoke	Smoke	Smoke	Smoke	Smoke	Smoke
September 28, 2012		Smoke	Smoke	Smoke	Smoke	Smoke	Smoke	Smoke
September 29, 2012	Weekend							
September 30, 2012	Weekend							

Note: NR = no requests to burn or a fire-safety burn ban was in place that prohibited crop residue burning
 Ozone = ambient ozone concentrations were above, or were forecasted to be above, allowable limits”
 Red Flag = the National Weather Service issued a red-flag warning for high fire risk
 Wind = wind velocity was too high for good smoke dispersion but red-flag criteria were not met
 Smoke/Ozone = both wildfire smoke and ambient ozone concentrations led to a no-burn decision
 Smoke = wildfire smoke led to a no-burn decision

Table A4. October burn decisions—northern Idaho.

		Burn Decisions by Smoke Management Area -Northern Idaho						
Date		Boundary SMA (County)	Kootenai SMA (County)	Central SMA	Clearwater County	Idaho County	Latah County	Nez Perce County
October 1, 2012		Burn	Poor Ventilation	Poor Ventilation	Poor Ventilation	Poor Ventilation	Poor Ventilation	Poor Ventilation
October 2, 2012		Red Flag	Red Flag	Burn	Burn	Burn	Burn	Burn
October 3, 2012		Burn	Poor Ventilation	Burn	Burn	Burn	Burn	Burn
October 4, 2012		Burn	Poor Ventilation	Smoke	Smoke	Smoke	Smoke	Burn
October 5, 2012		Burn	Poor Ventilation	Smoke	Smoke	Smoke	Smoke	Burn
October 6, 2012	Weekend							
October 7, 2012	Weekend							
October 8, 2012	Holiday							
October 9, 2012		Poor Ventilation	Poor Ventilation	Smoke	Smoke	Smoke	Smoke	Smoke
October 10, 2012		Burn	Burn	Smoke	Smoke	Smoke	Smoke	Smoke
October 11, 2012		Poor Ventilation	Wind	Smoke	Smoke	Smoke	Smoke	Smoke
October 12, 2012		Burn	Burn	Smoke	Smoke	Smoke	Smoke	Smoke
October 13, 2012	Weekend							
October 14, 2012	Weekend							
October 15, 2012		Moisture	NR	Moisture	Moisture	Moisture	Moisture	Moisture
October 16, 2012		NR	NR	Moisture	Moisture	Moisture	Moisture	Moisture
October 17, 2012		NR	NR	Burn	Burn	Burn	Burn	Burn
October 18, 2012		NR	NR	Burn	Burn	Burn	Burn	Smoke
October 19, 2012		NR	NR	Moisture	NR	NR	Moisture	Moisture
October 20, 2012	Weekend							
October 21, 2012	Weekend							
October 22, 2012		NR	NR	Burn	NR	NR	Burn	Burn
October 23, 2012		NR	NR	Moisture	NR	NR	Moisture	Moisture
October 24, 2012		NR	NR	Moisture	NR	NR	Moisture	Moisture
October 25, 2012		NR	NR	Moisture	NR	NR	Moisture	Moisture
October 26, 2012		NR	NR	Moisture	NR	NR	Moisture	Moisture
October 27, 2012	Weekend							
October 28, 2012	Weekend							
October 29, 2012		NR	NR	Moisture	NR	NR	Moisture	Moisture
October 30, 2012		NR	NR	Moisture	NR	NR	Moisture	Moisture
October 31, 2012		NR	NR	Burn	NR	NR	Burn	Burn

Note: NR = no requests to burn or a fire-safety burn ban was in place that prohibited crop residue burning
 Ozone = ambient ozone concentrations were above, or were forecasted to be above, allowable limits”
 Red Flag = the National Weather Service issued a red-flag warning for high fire risk
 Wind = wind velocity was too high for good smoke dispersion but red-flag criteria were not met
 Smoke/Ozone = both wildfire smoke and ambient ozone concentrations led to a no-burn decision
 Smoke = wildfire smoke led to a no-burn decision
 Moisture = fuel or soil moisture levels were too high for good smoke dispersion

Table A5. July burn decisions—southern Idaho.

		Burn Decisions by Smoke Management Area - Southern Idaho						
		Southwest	Southern	Northern	Southeast	Eastern	Weiser and	Blaine and
		Idaho	Magic Valley	Magic Valley	Idaho	Idaho	Lower Payette	Camas
Date		Idaho	Magic Valley	Magic Valley	Idaho	Idaho	Valleys	Counties
July 1, 2012	Weekend							
July 2, 2012		NR	NR	NR	NR	NR	NR	NR
July 3, 2012		NR	NR	NR	NR	NR	NR	NR
July 4, 2012	Holiday							
July 5, 2012		NR	NR	NR	NR	NR	NR	NR
July 6, 2012		NR	NR	NR	NR	NR	NR	NR
July 7, 2012	Weekend							
July 8, 2012	Weekend							
July 9, 2012		NR	NR	NR	Ozone	NR	NR	NR
July 10, 2012		NR	NR	NR	Red Flag	Red Flag	NR	NR
July 11, 2012		NR	NR	NR	Red Flag	Red Flag	NR	NR
July 12, 2012		NR	NR	NR	Red Flag	Ozone	NR	NR
July 13, 2012		NR	NR	NR	Burn	Burn	NR	NR
July 14, 2012	Weekend							
July 15, 2012	Weekend							
July 16, 2012		NR	NR	NR	Burn	Burn	NR	NR
July 17, 2012		NR	NR	NR	Burn	NR	NR	NR
July 18, 2012		NR	NR	NR	Ozone	NR	NR	NR
July 19, 2012		NR	NR	NR	Ozone	NR	NR	NR
July 20, 2012		NR	NR	NR	Ozone	NR	NR	NR
July 21, 2012	Weekend							
July 22, 2012	Weekend							
July 23, 2012		NR	NR	NR	Red Flag	NR	NR	NR
July 24, 2012		NR	NR	NR	Burn	NR	NR	NR
July 25, 2012		NR	NR	NR	Burn	NR	NR	NR
July 26, 2012		NR	NR	NR	Burn	NR	NR	NR
July 27, 2012		NR	NR	NR	Red Flag	NR	NR	NR
July 28, 2012	Weekend							
July 29, 2012	Weekend							
July 30, 2012		NR	NR	NR	Ozone	NR	NR	NR
July 31, 2012		NR	NR	NR	Burn	NR	Burn	NR

Note: NR = no requests to burn or a fire-safety burn ban was in place that prohibited crop residue burning
 Ozone = ambient ozone concentrations were above, or were forecasted to be above, allowable limits”
 Red Flag = the National Weather Service issued a red-flag warning for high fire risk.

Table A6. August burn decisions—southern Idaho.

		Burn Decisions by Smoke Management Area -Southern Idaho						
		Southwest	Southern	Northern	Southeast	Eastern	Weiser and	Blaine and
Date		Idaho	Magic Valley	Magic Valley	Idaho	Idaho	Lower Payette	Camas
							Valleys	Counties
August 1, 2012		Burn	NR	NR	Burn	NR	NR	NR
August 2, 2012		Burn	NR	Red Flag	Red Flag	NR	NR	NR
August 3, 2012		NR	Burn	Burn	NR	NR	NR	NR
August 4, 2012	Weekend							
August 5, 2012	Weekend							
August 6, 2012		Dust Storm/Ozone	Ozone	NR	NR	NR	NR	NR
August 7, 2012		Smoke/Ozone	Smoke/Ozone	NR	NR	NR	Smoke/Ozone	NR
August 8, 2012		Red Flag	Red Flag	Red Flag	NR	Red Flag	Red Flag	NR
August 9, 2012		Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	NR
August 10, 2012		Red Flag	Red Flag	Red Flag	Red Flag	Red Flag	Red Flag	Red Flag
August 11, 2012	Weekend							
August 12, 2012	Weekend							
August 13, 2012		Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	Smoke/Ozone
August 14, 2012		Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	NR
August 15, 2012		Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	NR
August 16, 2012		Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	NR
August 17, 2012		Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	Smoke/Ozone	NR
August 18, 2012	Weekend							
August 19, 2012	Weekend							
August 20, 2012		Smoke	Smoke	Smoke	Smoke	Smoke	Smoke	NR
August 21, 2012		Smoke	Smoke	Smoke	Smoke	Smoke	Smoke	NR
August 22, 2012		Smoke	Smoke	Smoke	Smoke	Smoke	Smoke	NR
August 23, 2012		Smoke	Smoke	Smoke	Smoke	Smoke	Smoke	NR
August 24, 2012		Red Flag	Red flag	Red flag	Red flag	Red flag	Red flag	NR
August 25, 2012	Weekend							
August 26, 2012	Weekend							
August 27, 2012		Smoke	Burn	Burn	Burn	Burn	Smoke	NR
August 28, 2012		Smoke	Burn	Burn	Burn	Burn	Smoke	NR
August 29, 2012		Smoke	NR	Red Flag	Red Flag	Red Flag	NR	NR
August 30, 2012		Smoke	Smoke	Smoke	Burn	Smoke	NR	NR
August 31, 2012		Smoke	Red Flag	Red Flag	Red Flag	Red Flag	Red Flag	NR

Note: NR = no requests to burn or a fire-safety burn ban was in place that prohibited crop residue burning
 Ozone = ambient ozone concentrations were above, or were forecasted to be above, allowable limits”
 Red Flag = the National Weather Service issued a red-flag warning for high fire risk
 Smoke/Ozone = both wildfire smoke and ambient ozone concentrations led to a no-burn decision
 Smoke = wildfire smoke led to a no-burn decision

Table A7. September burn decisions—southern Idaho.

		Burn Decisions by Smoke Management Area - Southern Idaho						
		Southwest	Southern	Northern	Southeast	Eastern	Weiser and	Blaine and
Date		Idaho	Magic Valley	Magic Valley	Idaho	Idaho	Lower Payette	Camas
							Valleys	Counties
September 1, 2012	Weekend							
September 2, 2012	Weekend							
September 3, 2012	Holiday							
September 4, 2012		Burn	Burn	Burn	Burn	Burn	NR	NR
September 5, 2012		Burn	Burn	Burn	Burn	Burn	NR	NR
September 6, 2012		NR	Burn	Burn	Burn	Burn	NR	NR
September 7, 2012		NR	Burn	NR	Burn	Burn	NR	NR
September 8, 2012	Weekend							
September 9, 2012	Weekend							
September 10, 2012		Red Flag	Red Flag	Red Flag	Red Flag	Red Flag	NR	NR
September 11, 2012		Burn	Burn	Burn	Wind	Burn	Burn	NR
September 12, 2012		Burn	Burn	Burn	Burn	Burn	NR	NR
September 13, 2012		Smoke	Burn	Burn	Burn	Smoke	NR	NR
September 14, 2012		Smoke	Burn	Burn	Burn	Burn	NR	NR
September 15, 2012	Weekend							
September 16, 2012	Weekend							
September 17, 2012		Smoke	Smoke	NR	Smoke	Smoke	NR	NR
September 18, 2012		Smoke	Smoke	NR	Smoke	Smoke	NR	NR
September 19, 2012		Smoke	Smoke	NR	Smoke	Smoke	NR	NR
September 20, 2012		Smoke	Smoke	NR	Smoke	Smoke	NR	NR
September 21, 2012		Smoke	Smoke	NR	Smoke	Smoke	NR	NR
September 22, 2012	Weekend							
September 23, 2012	Weekend							
September 24, 2012		Burn	NR	NR	NR	Burn	NR	NR
September 25, 2012		Burn	Burn	NR	Burn	Burn	NR	NR
September 26, 2012		Smoke	Smoke	Burn	Burn	Burn	NR	NR
September 27, 2012		Smoke	Smoke	NR	Burn	Burn	NR	NR
September 28, 2012		Smoke	Smoke	Burn	NR	Burn	NR	NR
September 29, 2012	Weekend							
September 30, 2012	Weekend							

Note: NR = no requests to burn or a fire-safety burn ban was in place that prohibited crop residue burning
 Ozone = ambient ozone concentrations were above, or were forecasted to be above, allowable limits”
 Red Flag = the National Weather Service issued a red-flag warning for high fire risk
 Wind = wind velocity was too high for good smoke dispersion but red-flag criteria were not met
 Smoke/Ozone = both wildfire smoke and ambient ozone concentrations led to a no-burn decision
 Smoke = wildfire smoke led to a no-burn decision

Table A8. October burn decisions—southern Idaho.

		Burn Decisions by Smoke Management Area - Southern Idaho						
		Southwest	Southern	Northern	Southeast	Eastern	Weiser and	Blaine and
		Idaho	Magic Valley	Magic Valley	Idaho	Idaho	Lower Payette	Camas
Date		Idaho	Magic Valley	Magic Valley	Idaho	Idaho	Valleys	Counties
October 1, 2012		Burn	Burn	NR	Burn	Burn	NR	NR
October 2, 2012		Burn	Wind	Red Flag	NR	Red Flag	NR	Wind
October 3, 2012		NR	Wind	Wind	NR	Burn	NR	Wind
October 4, 2012		Burn	Burn	Burn	NR	Burn	NR	NR
October 5, 2012		NR	Burn	NR	Burn	Burn	NR	Burn
October 6, 2012	Weekend							
October 7, 2012	Weekend							
October 8, 2012	Holiday							
October 9, 2012		NR	Burn	NR	Burn	Burn	NR	Burn
October 10, 2012		NR	Burn	NR	NR	Burn	NR	Burn
October 11, 2012		NR	Burn	NR	Burn	Burn	NR	Burn
October 12, 2012		NR	Burn	NR	Burn	Burn	NR	Burn
October 13, 2012	Weekend							
October 14, 2012	Weekend							
October 15, 2012		Moisture	Wind	NR	NR	Wind	Moisture	NR
October 16, 2012		Moisture	Moisture	NR	Moisture	Moisture	Moisture	NR
October 17, 2012		Moisture	Moisture	NR	Moisture	Moisture	Moisture	NR
October 18, 2012		NR	Burn	Burn	Burn	Burn	Moisture	NR
October 19, 2012		Burn	Burn	Burn	Burn	Burn	Moisture	NR
October 20, 2012	Weekend							
October 21, 2012	Weekend							
October 22, 2012		NR	Burn	NR	Burn	NR	NR	Burn
October 23, 2012		NR	Moisture	Moisture	Moisture	Moisture	Moisture	Moisture
October 24, 2012		NR	Moisture	Moisture	Moisture	Moisture	Moisture	Moisture
October 25, 2012		NR	Moisture	Moisture	Moisture	Moisture	Moisture	Moisture
October 26, 2012		NR	Burn	Moisture	Moisture	Moisture	NR	Moisture
October 27, 2012	Weekend							
October 28, 2012	Weekend							
October 29, 2012		NR	Burn	Burn	Moisture	Moisture	NR	Moisture
October 30, 2012		NR	Burn	Moisture	Burn	Moisture	NR	Moisture
October 31, 2012		Burn	Burn	NR	Burn	Moisture	NR	Burn

Note: NR = no requests to burn or a fire-safety burn ban was in place that prohibited crop residue burning
 Ozone = ambient ozone concentrations were above, or were forecasted to be above, allowable limits”
 Red Flag = the National Weather Service issued a red-flag warning for high fire risk
 Wind = wind velocity was too high for good smoke dispersion but red-flag criteria were not met
 Smoke/Ozone = both wildfire smoke and ambient ozone concentrations led to a no-burn decision
 Smoke = wildfire smoke led to a no-burn decision
 Moisture = fuel or soil moisture levels were too high for good smoke dispersion

Appendix B. Meteorological Summary for the Fall Burn Season

Introduction

This meteorological summary was provided by Gary Bennett of Bennett Fire Weather Services. Many of the images used to illustrate meteorological conditions represent conditions either near the surface (ground level) or some distance above the surface. Height above the surface is expressed in millibars of atmospheric pressure. Many of the images were produced using a computer-based modeling system known as MM5 (the full name of MM5 is Fifth-Generation NCAR/Penn State Mesoscale Model).

A limited pre-season fire weather training was held in Lewiston and included burning techniques and meteorology for burn coordinators and management staff and a tour of Latah County and the Camas Prairie to view problem burn areas. Contractor visits are used to aid coordinators with problem spots and discuss optimum weather for burning some of the more difficult fields. This is an important part of the meteorological contract services program to make sure all coordinators and operational personnel, including farmers, are on the same page meteorologically.

A second fire weather training was held in Boise after the end of the fall burn season. This comprehensive training session was attended by DEQ personnel involved with the CRB program. Many facets of weather forecasting for agricultural burning were covered. This annual training was very useful to smoke managers and field staff.

The fall 2012 CRB season began on July 27 with full operational forecasts. Smoke dispersion forecasts were sent by e-mail to DEQ analysts and field personnel by 8:00 a.m. and 3:00 p.m. each day. The delivery of forecasts via e-mail was followed by conference calls at 8:30 a.m. and 3:30 p.m. each day. The morning conference calls were used to discuss the weather forecast for that day and the conference call in the afternoon was used to discuss the preliminary forecast for the next business day as well as to discuss the events of the current day.

Springtime weather across the state was dry, and an early summer cured wildland fuels quickly. The weather pattern leading up to the start of the fall burn season moved from a La Nina pattern into a neutral weather pattern. When the dry lightning storms began in late June and early July, fuel was very receptive to ignition and wildfires broke out throughout the Pacific Northwest. The abundance of wildfire activity was the single biggest obstacle for crop residue burning this past burn season. The 2012 CRB season was slowed as smoky days lead to poor air quality, which curtailed burn approvals. Temperatures were above average most of the summer and into early fall. Precipitation, except for Boundary County, was nonexistent during the height of the burn season in August and September.

Northern Idaho

July

July was a “wetter” month than average for Boundary County, thereby limiting burning into August, however warm temperatures and generally dry conditions across the Pacific Northwest, especially over mountainous regions, led to lightning storms, which produced wildfires in south, east, and west Idaho. Lingering smoke from the large wildfires was a problem by the end of July.

The background smoke in the valley areas of northern Idaho would remain throughout the month of July and most of the CRB season (Figure 1).

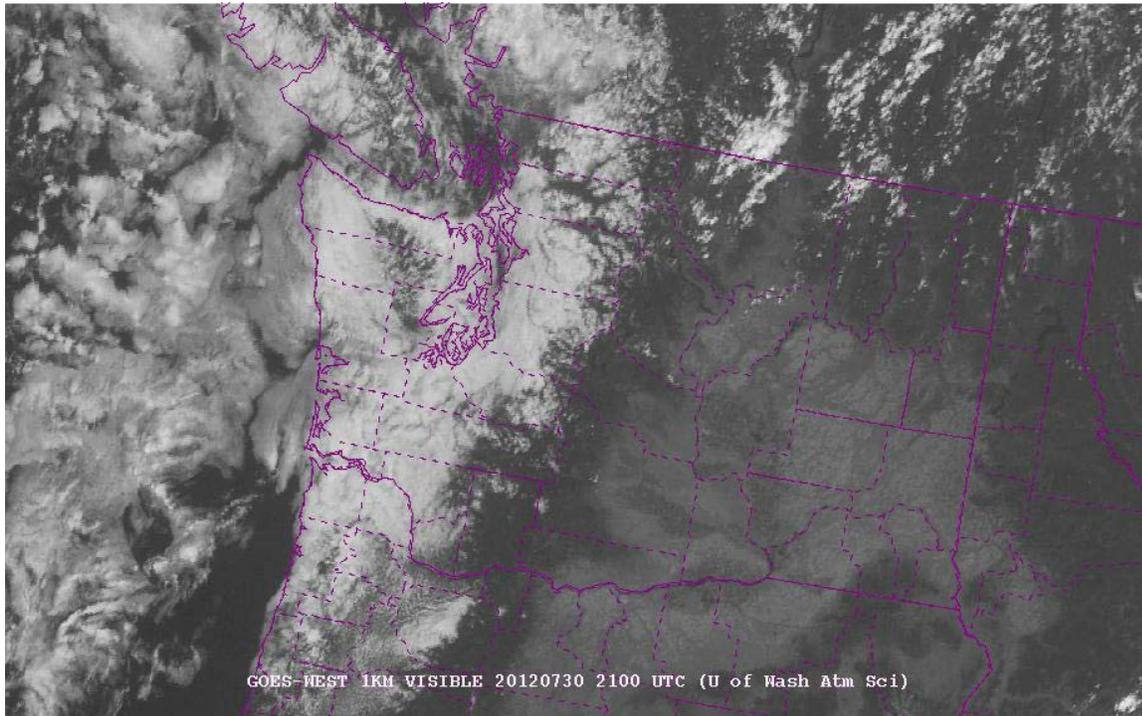


Figure 1. The satellite image shows areas of smoke on the Camas Prairie from the wildfires to the south and east of Grangeville on July 30, 2012.

August

August started out with an active upper level weather pattern over northern Idaho. There were a series of weather disturbances across southern and central British Columbia. The westerly jet stream dipped south over the northern Panhandle. No measurable rain was noted from the passage of these weak troughs (Figure 2).

A high pressure ridge, which is common in summer, established itself over the four corners area of the western U.S. Figure 3 depicts a weak upper level wave that moved through the ridge axis, weakening the ridge. The upper low over the Gulf of Alaska weakened and moved inland over northern British Columbia by August 10.

By mid-August the jet stream sagged a little farther south and flattened the four corners ridge. Surface wind increased, allowing wildfire smoke to scour out in the lower elevation airsheds. The high pressure ridge rebuilt for the remainder of August (Figure 4).

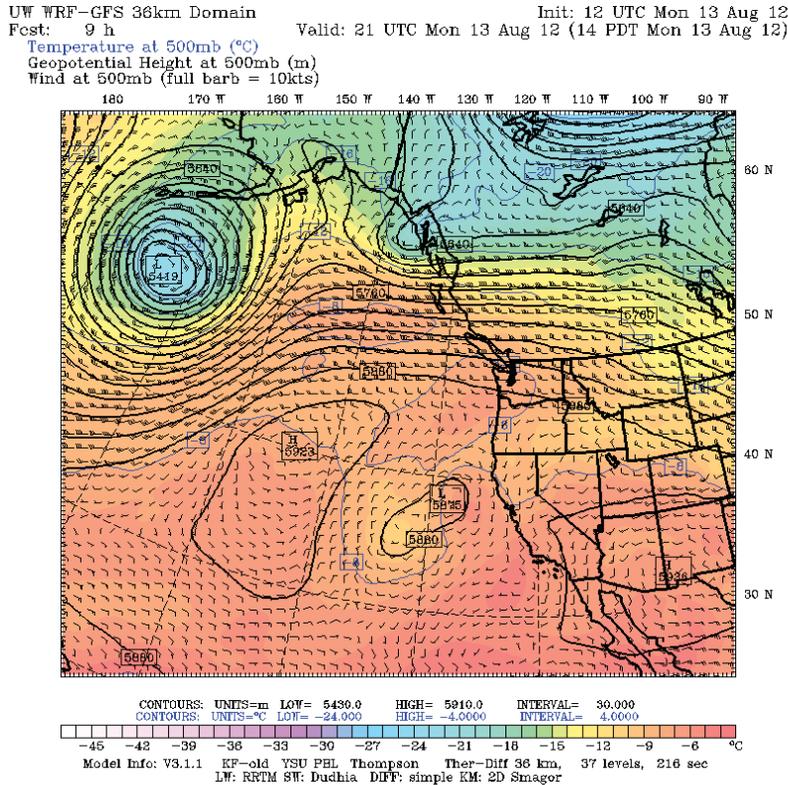


Figure 4. 500 millibar chart for August 13, 2012.

By the third week of August, more unsettled weather became an issue for field burning. An upper level trough developed along the west coast backing the flow aloft to a southwest direction (Figure 5). Usually this time of the year scattered thunderstorms would move into northern Idaho, but the thunderstorms that moved over the airsheds of northern Idaho were contained to the mountains. Lewiston only received a trace amount of rain, while Bonners Ferry picked up just under two tenths of an inch. This was the wettest day for the month of August.

The weather pattern over northern Idaho for the rest of August alternated between upper level Pacific troughs moving through the upper level ridge that had re-established over the eastern four corners allowing the weak upper troughs to move inland (Figure 6). Temperatures cooled a little as each trough moved inland, but precipitation was very limited and confined to the mountains and Boundary County. The temperatures were near to above average but precipitation was below average at all reporting weather stations. The progression of upper troughs from mid to late August produced stronger surface winds allowing some of the wildfire smoke to disperse.

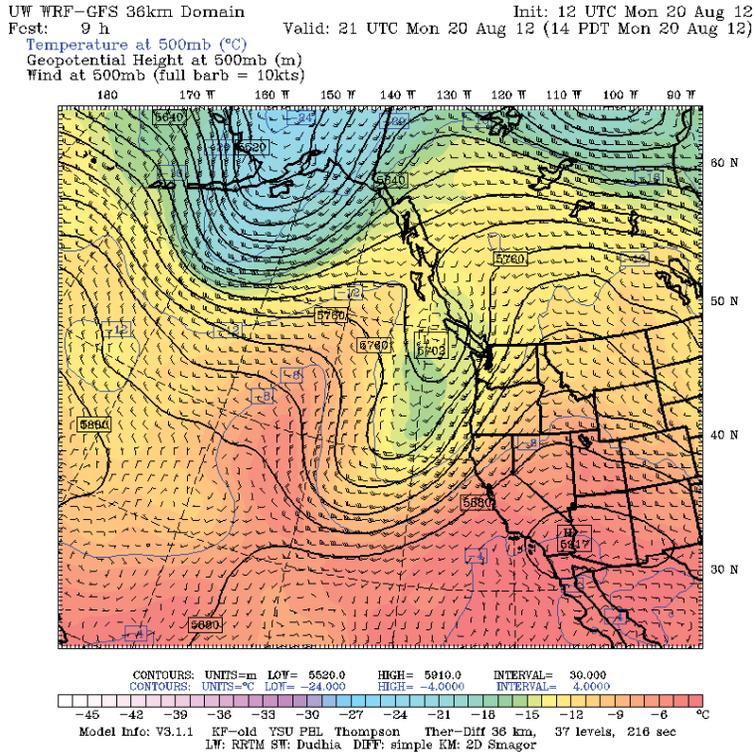


Figure 5. 500 millibar chart for August 20, 2012.

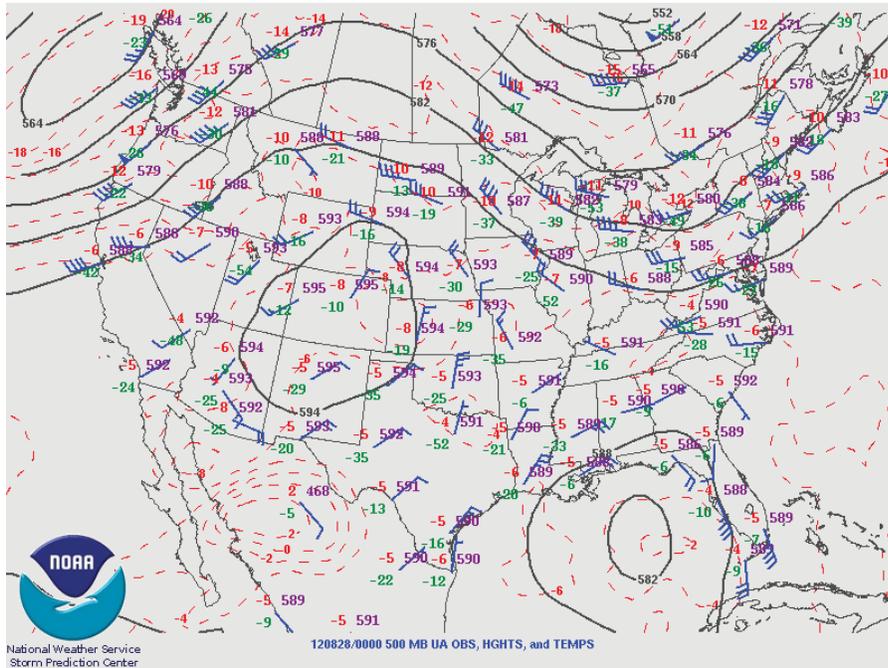


Figure 6. 500 millibar chart for August 28, 2012.

September

The dry and warm pattern from August continued into September with most stations recording temperatures that were above average for the month, while precipitation was below average. Several sites recorded no measurable rain in September. The major impediment to crop residue burning during the month of September was smoke from wildfires which reduced visibility for the majority of days in September.

Figure 7 shows the mean high pressure ridge offshore in the NE Pacific and over the four corners area on September 6. The flow was dry west to northwest. The weak trough over northern Idaho during the first week of September kept temperatures cooler. Rainfall at Bonners Ferry measured 0.38 inch on September 5, but the weather was essentially dry for the remainder of September. September 5 was the only day northern Idaho received rain in excess of 0.01 inch for the month.

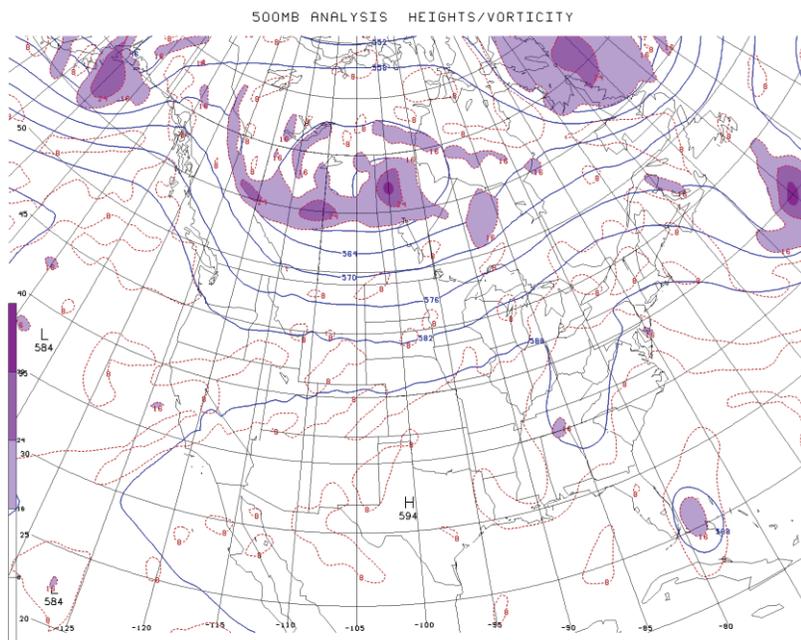


Figure 7. 500 millibar chart for September 6, 2012.

Between September 10 and September 20 northern Idaho was influenced by a stable high pressure ridge and was well protected from Pacific storms. The jet stream was well north of the Idaho Panhandle as it was positioned across central British Columbia (Figure 8).

During the same period light surface winds and a cool air mass were situated in the Columbia Basin (Figure 9). The marine intrusion, usually associated with a cool air mass, to the west had decreased. This pattern was typical of burn days in September. Light surface winds under high pressure aloft allowed the smoke to settle in the valleys and on the prairies. A weak upper level

analysis was completed for this particular smoke event. East winds, which normally result in a good burn day, were predicted (Figure 14), however, smoke intrusion occurred over eastern Idaho and western Montana.

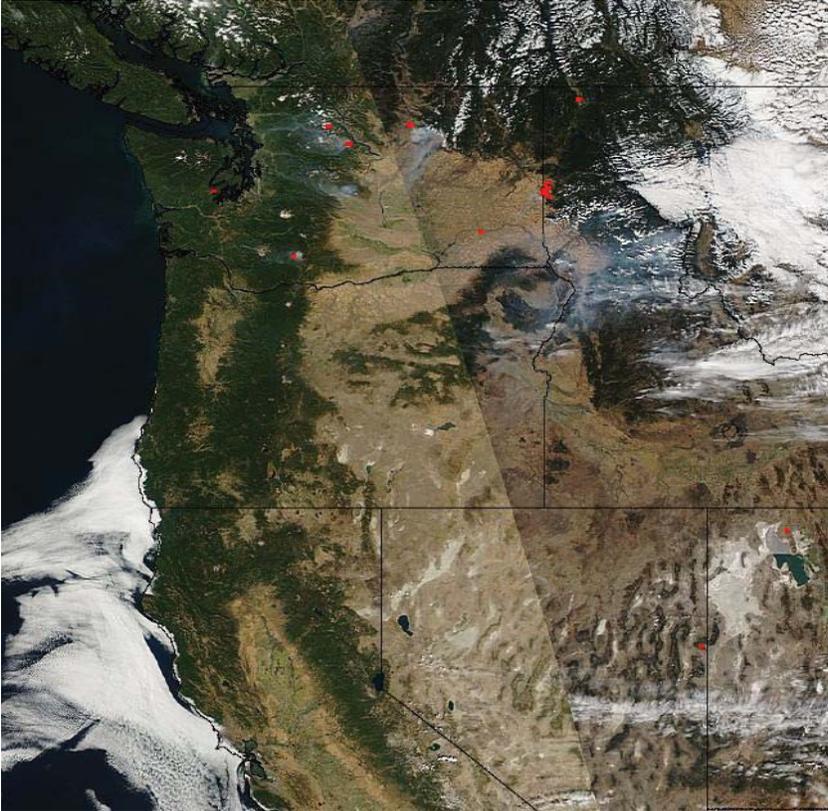


Figure 13. MODIS satellite image for October 3, 2012.

On October 12 another burn day analysis was completed for the Rathdrum Prairie due to a smoke issue. Weather on this day seemed to be good for burning assuming the fuel and soil moistures were within tolerance and the fuel was ready to burn. A minor surface wind shift, cool temperatures, and increasing clouds caused the smoke to fall.

A good southwest flow, which is perfect for burning on the Rathdrum Prairie, was predicted (Figure 15). The problem was a very weak disturbance moved through this level that allowed the surface wind to shift to southerly at field ignition time. The combination of the shifting wind, cool temperatures producing lower mixing heights, and high fuel moisture did not allow the smoke to rise adequately.

UW WRF-GFS 1.33km Domain Init: 12 UTC Wed 03 Oct 12
 Fcst: 9.00 h Valid: 21 UTC Wed 03 Oct 12 (14 PDT Wed 03 Oct 12)
 10m Wind Speed (knots)
 Wind at 10m (full barb = 10kts)
 Sea Level Pressure (hPa)

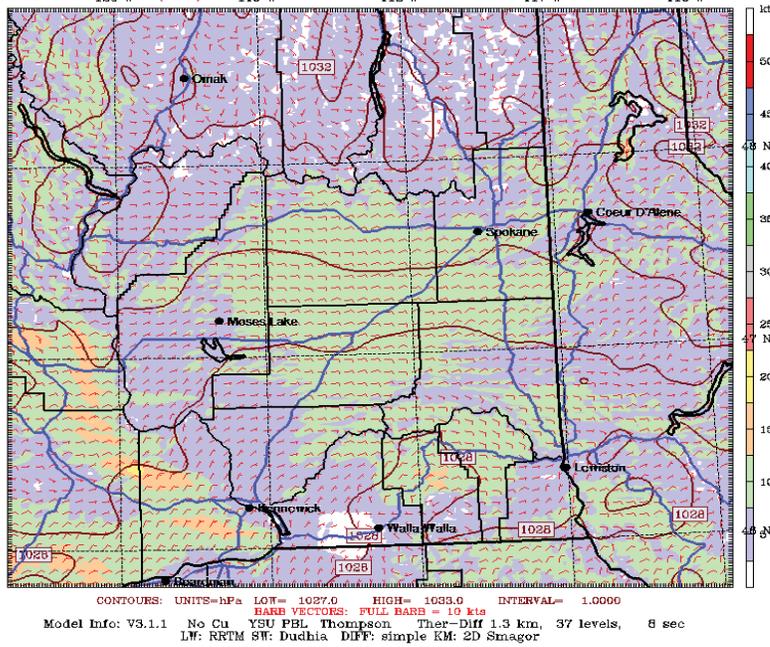


Figure 14. Wind at 10m chart for October 3, 2012.

UW WRF-GFS 12km Domain Init: 12 UTC Fri 12 Oct 12
 Fcst: 9 h Valid: 21 UTC Fri 12 Oct 12 (14 PDT Fri 12 Oct 12)
 Temperature at 850 mb (°C)
 Geopotential Height at 850mb (m) Wind at 850mb (full barb = 10kts)

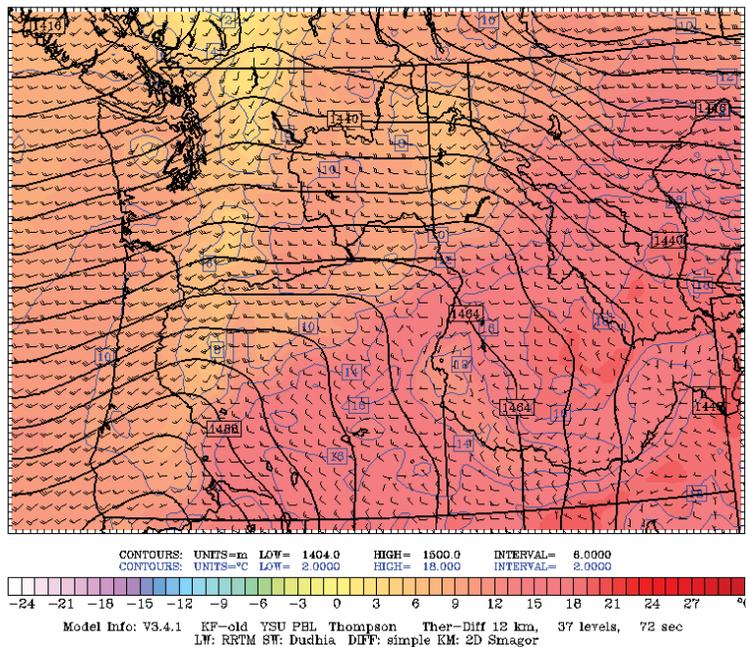


Figure 15. 850 millibar chart for October 12, 2012.

By the middle of October the weather pattern shifted to a progressive pattern. This put an end to the devastating wildfire season as well as the crop residue burning season. A series of Pacific storms continued to pound away at northern Idaho for the rest of the month. There were a couple of days without precipitation that allowed very limited burning to be completed, but the fuel and soil moisture increased with each passing storm.

October had slightly above average temperatures and above average precipitation. Bonners Ferry and Pullman/Moscow areas received in excess of an inch above average. Most of the precipitation fell in the last two weeks of the month.

Southern Idaho

August

The first week of August had an upper level trough move across the Pacific Northwest which remained well north of southern Idaho. Figure 16 shows the upper level low over Montana. The associated upper level trough was moved across southern Idaho as high pressure built off the west coast. Precipitation was quite limited with this trough and showers were widely scattered across the airsheds.

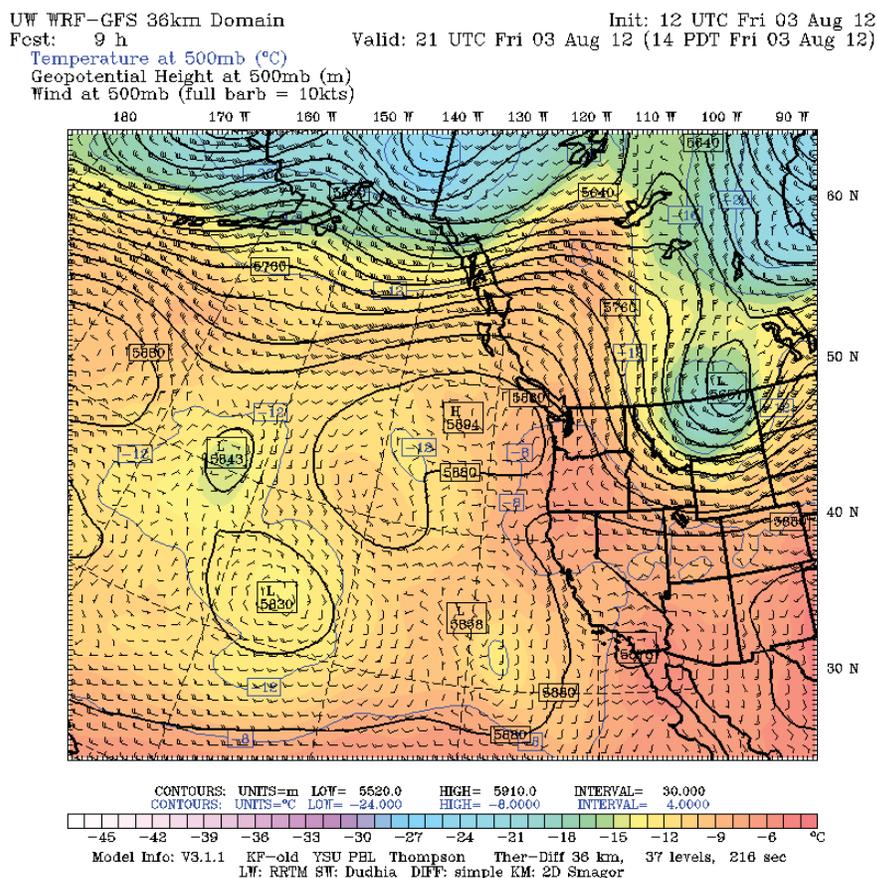


Figure 16. 500 millibar chart for August 3, 2012

Figure 20 indicates that the upper ridge axis had moved to the east as the low in the Gulf of Alaska moved into southern British Columbia on September 1. This upper level trough and the moist southerly flow aloft accompanying the trough produced spotty precipitation across southern Idaho on the first of September.

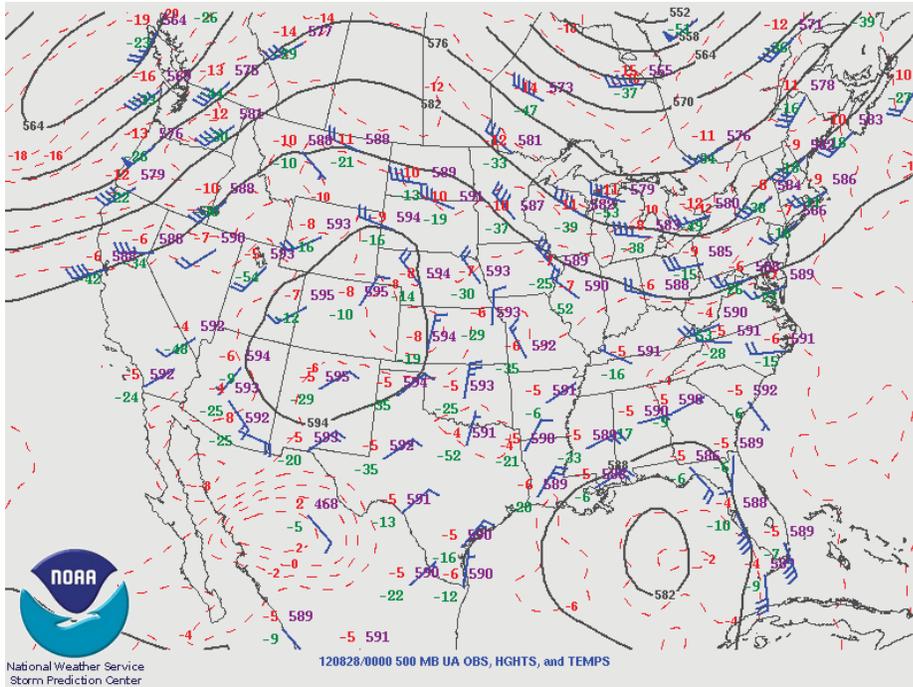


Figure 19. 500 millibar Chart for August 28, 2012

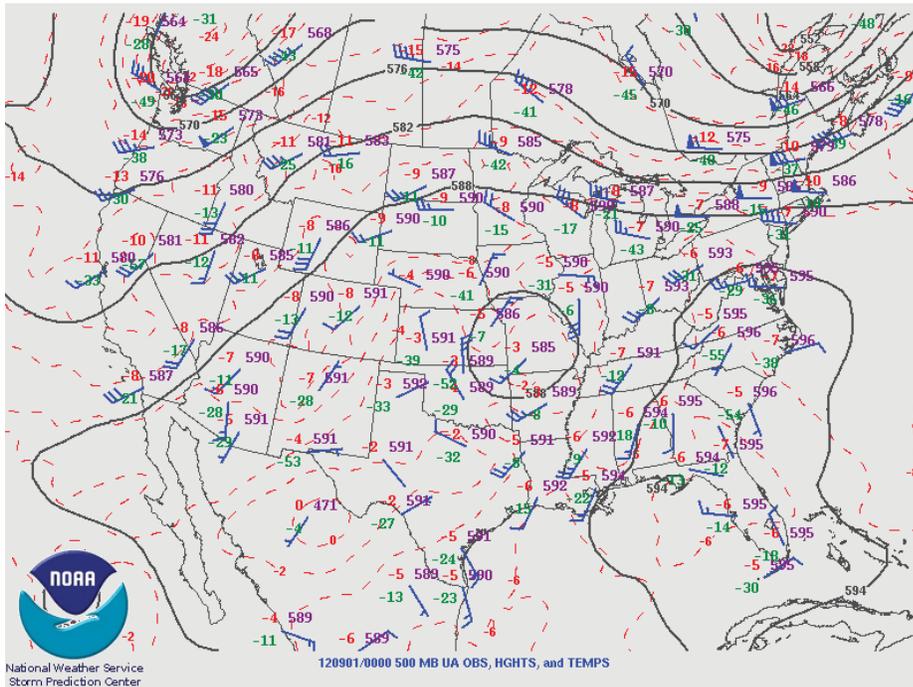


Figure 20. 500 millibar Chart for September 1, 2012

The southerly flow aloft into southern Idaho prompted another round of thunderstorms to invade all regions. The fire predictive services unit, located in Boise, used existing wildfire data combined with forecast data to come up with another graphic called the Significant Wildland Fire Potential Outlook. This outlook is a guide for what can be expected for September wildfires. The Significant Fire Potential Outlook (Figure 21) shows that all of southern Idaho was blanketed by an above normal fire potential. This would mean that the existing large fires would continue and new fire starts were likely.

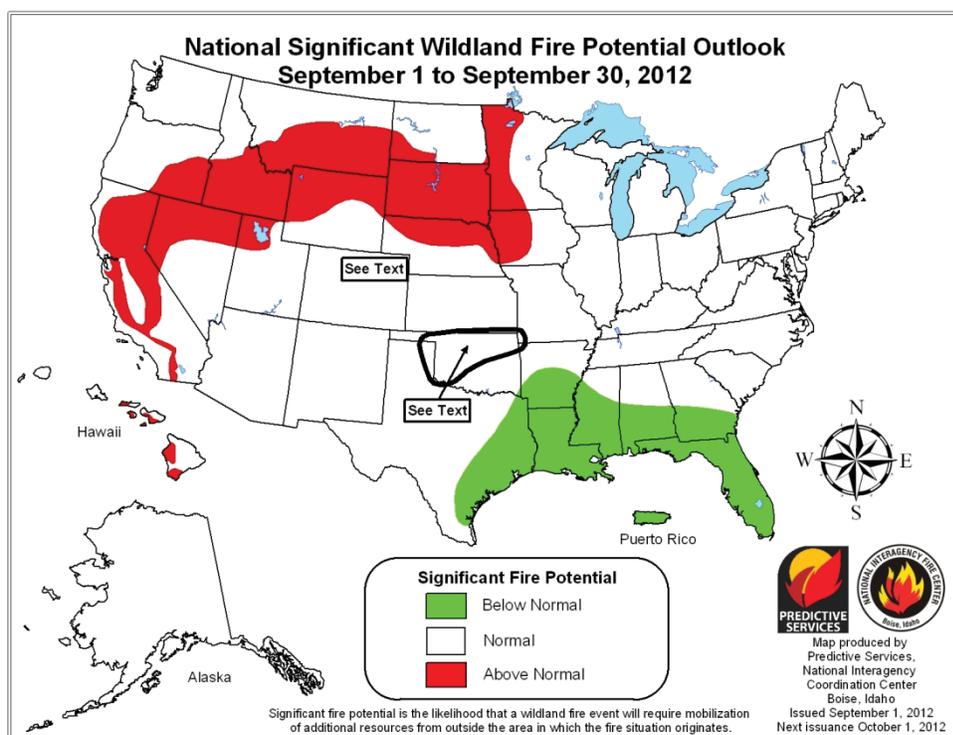


Figure 21. National Significant Wildland Fire Potential Outlook for September

September was another month with crop residue burning hindered due to wildfire smoke that inundated the lower valleys along the Snake River. Wildfires continued to spread throughout September and all weather stations recorded below average rainfall.

The aforementioned Pacific storm that moved an upper level trough through southern Idaho on the first couple of days of September produced the “lion’s share” of the monthly rainfall. Mountain Home AFB recorded a trace amount during September, while Boise and Twin Falls recorded 0.05 inch. Pocatello reported 0.10 inch, Idaho Falls 0.19 inch and Rexburg was the “wet” spot with 0.33 inch. All weather stations reported well below average September rainfall.

Summer returned to southern Idaho after the first week of the month. The cool upper level trough moved east as dry and stable higher pressure rebuilt off the west coast. Figure 22 and Figure 23 show the 500 millibar charts for September 11 and September 13 which were indicative of the next two weeks of September.

UW WRF-GFS 36km Domain Init: 12 UTC Tue 11 Sep 12
 Fcst: 9 h Valid: 21 UTC Tue 11 Sep 12 (14 PDT Tue 11 Sep 12)
 Temperature at 500mb (°C)
 Geopotential Height at 500mb (m)
 Wind at 500mb (full barb = 10kts)

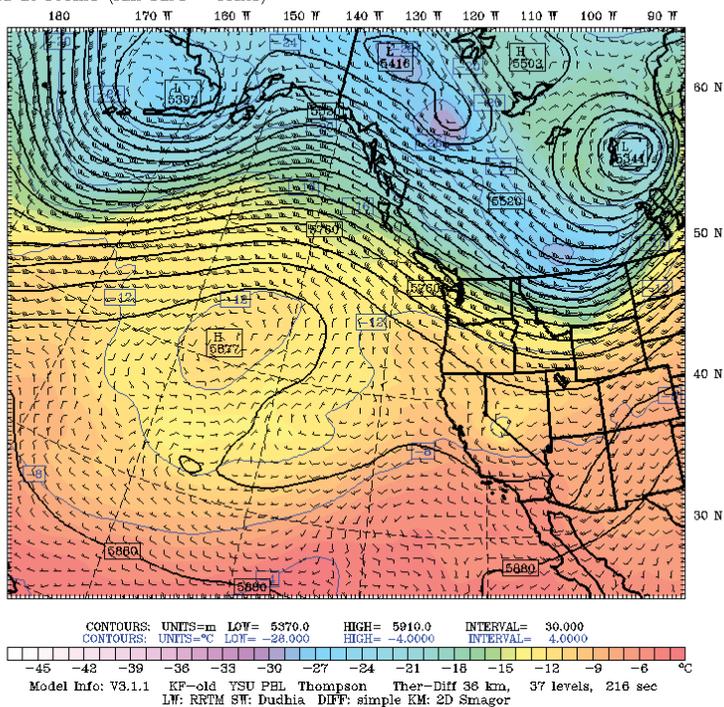


Figure 22. 500 millibar Chart for September 11, 2012

UW WRF-GFS 36km Domain Init: 12 UTC Thu 13 Sep 12
 Fcst: 9 h Valid: 21 UTC Thu 13 Sep 12 (14 PDT Thu 13 Sep 12)
 Temperature at 500mb (°C)
 Geopotential Height at 500mb (m)
 Wind at 500mb (full barb = 10kts)

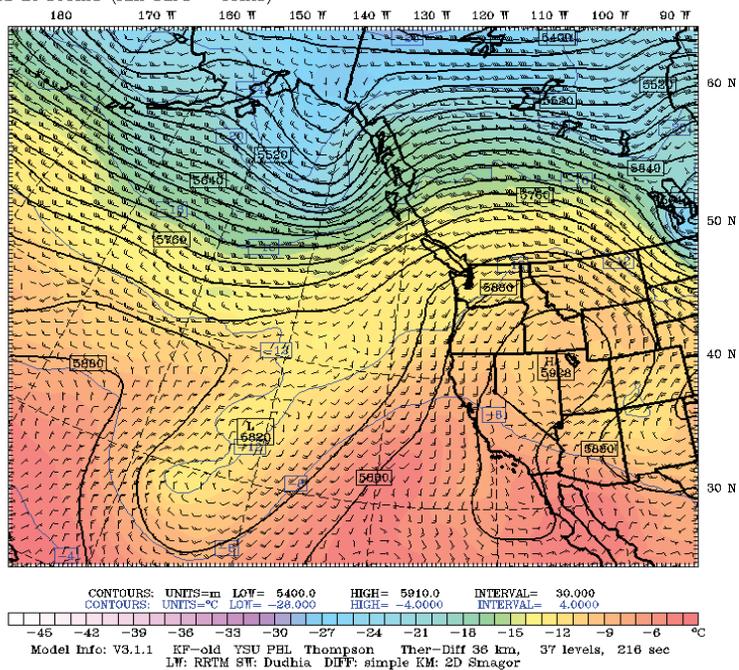


Figure 23. 500 millibar Chart for September 13, 2012

Figure 22 and Figure 23 show the upper level trough moving through the Gulf of Alaska that dug along the west coast, pumping up the ridge over southern Idaho. The high pressure ridge would then remain in a blocking position over southern Idaho for nearly two weeks. The ridge would break down after the 20th of September.

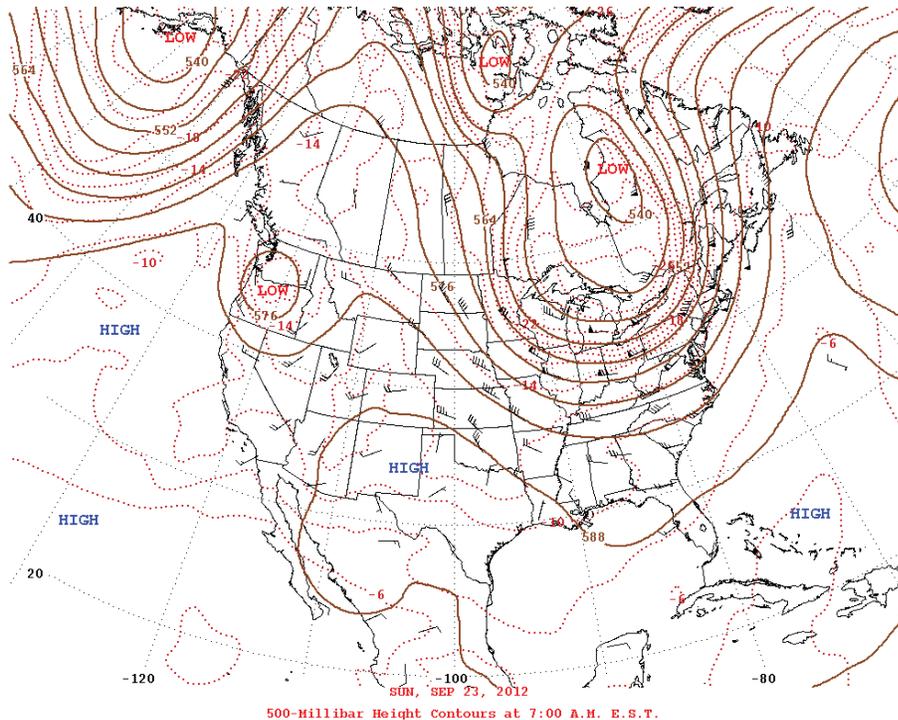


Figure 24. 500 millibar Chart for September 23, 2012

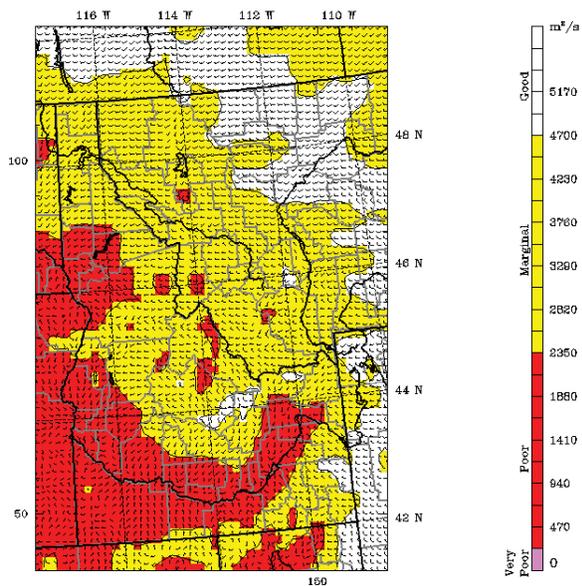
By September 23 an upper level low and trough moved through the Pacific Northwest producing a little more rain as showers brought light precipitation amounts to southern Idaho. Figure 24 shows the 500 millibar chart for September 23, which depicts the low over Oregon and Washington. Daytime temperatures also cooled over the eastern airsheds. By the end of September high pressure was again rebuilding into the Pacific Northwest and southern Idaho. No measurable rain was recorded after the September 25.

Wildfire smoke again inhibited crop residue burning on many days throughout the month. The available burn window decreased each day as mixing heights lowered due to decreasing solar heating associated with seasonal changes. Also, we were beginning to see prescribed burning from land management agencies late in the month continuing the smoke issues in the valleys.

October

The month of October began with a strong high pressure ridge over the western U.S. Figure 25 depicts a broad stable upper level ridge extending into southern Idaho. The storm track was over northern Idaho and southern British Columbia as a series of weak Pacific storms moved across that region.

UW WRF-GFS 12km Domain Init: 12 UTC Mon 01 Oct 12
 Fcst: 9 h Valid: 21 UTC Mon 01 Oct 12 (14 PDT Mon 01 Oct 12)
 Ventilation Index (m²/s)
 20m Horizontal Wind (full barb = 10kts)



Model Info: V3.1.1 KF-old YSU PBL Thompson Ther-Diff 12 km, 37 levels, 72 sec
 LW: RRTM SW: Dudhia DIFF: simple KM: 2D Smagor

Figure 26. Ventilation Index for October 1, 2012

UW WRF-GFS 36km Domain Init: 12 UTC Fri 05 Oct 12
 Fcst: 9 h Valid: 21 UTC Fri 05 Oct 12 (14 PDT Fri 05 Oct 12)
 Temperature at 500mb (°C)
 Geopotential Height at 500mb (m)
 Wind at 500mb (full barb = 10kts)

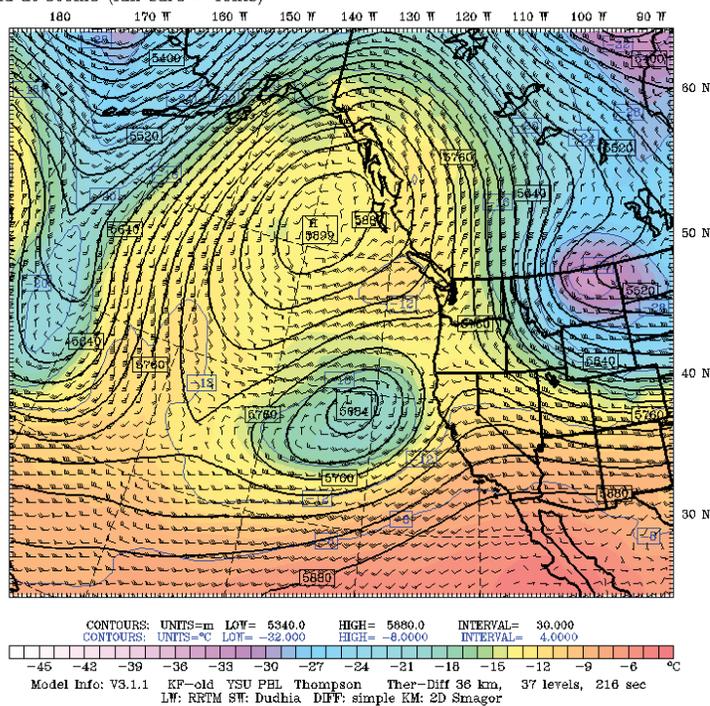


Figure 27. 500 millibar Chart for October 5, 2012

Appendix C. Meteorological Burn Day Analysis for October 12, 2012, in the Kootenai County SMA

Introduction

DEQ approved a 150 acre bluegrass field on the Rathdrum Prairie in Kootenai County. The approved burn resulted in smoke impacts above the 1-hour average PM_{2.5} program concentration limit of 64 µg/m³. As a result of the smoke impacts; DEQ requested a burn day analysis from the contract meteorologist, Bennett Fire Weather Services, LLC. DEQ completed enhanced documentation for this burn day to evaluate any possible adverse impacts at institutions with sensitive populations. DEQ did not receive any complaints about health impacts from this burn, however due to the magnitude of the impact during the school day, DEQ determined that an adverse impact possibly occurred.

Information reviewed by DEQ prior to the burn decision

DEQ reviewed weather forecasts and air quality monitoring data prior to making the burn decision. The morning forecast from the contract meteorologist is shown in Figure 1. DEQ also reviewed a weather checklist (Figure 2) that summarizes the forecasted winds, temperatures, and ventilation based on a meteorological forecast model developed by the University of Washington Northwest Modeling Consortium. Two meteorological weather stations are located near the approved burn location. DEQ operates a station located on Lancaster Road that collects weather data as well as air quality monitoring data. The National Weather Service operates a station at the Coeur d'Alene airport southeast of the burn location. The weather data from the Coeur d'Alene Airport and the DEQ Lancaster site are shown in Tables 1 and 2, respectively.

The meteorological forecasts suggested a high wind event would arrive in Kootenai County by 2:00 p.m. this day. The contract meteorologist recommended a conditional burn day due to strong and gusty winds.

PM_{2.5} concentrations recorded by the monitors located at the Garwood Elementary School and Athol were slightly elevated prior to ignition (Table 3). However, all measured concentrations were below pre-burn enhanced documentation trigger levels.

Based on the meteorological forecasts and air quality data, DEQ determined that burn approval was possible pending on-site field verification of conditions. The location of the field is presented in Figure 3. The following requirements were included in the burn approval:

Acres approved: 150 acres

Burn window: 11:00 am – 4:00 pm

Field Specific Permit Requirements:

1. Cannot burn if sustained surface winds are from the Southeast while school is in session.
2. Cannot burn if sustained surface winds are from the west-northwest.
3. Cannot burn if the sustained surface wind speed exceeds 12mph at any time during the burn.
4. Permittee must have verbal approval from onsite DEQ staff prior to ignition.

Forecast Prepared by: BENNETT FIRE WEATHER SERVICES, LLC

Forecast Time Prepared: 8:00 AM PDT – Friday October 12, 2012

Forecast for: FRIDAY – October 12, 2012

GENERAL WEATHER DISCUSSION:

FRIDAY:

The upper level high pressure ridge has moved east. A weak upper level trough moving into southern British Columbia has all but disappeared in the westerly flow aloft over northern Idaho. This trough effectively flattened the ridge and is opening the door for Pacific storms to enter the region over the weekend. At the surface today a weak cold front will be moving across northern today. By this afternoon the front looks to be oriented southwest to northeast from northeast Oregon to northwest Montana. The pressure gradient field is tightening and is oriented southwest to northeast along the front. The surface wind direction will be from the southwest to west over the air sheds. Wind speeds will be in the 5-15 mph range with local gusts to 20 mph. Mixing heights are expected to range from 3-6,000 feet AGL over the air sheds. Dispersion is marginal to good over northern Idaho. The strong to marginal morning inversion will break around 11 am to 12 noon at temperatures between 55-64 degrees. Ventilation will be marginal to locally good over northern Idaho air sheds as mixing increased at the surface and in the mixed layer by afternoon.

RATHDRUM PRAIRIE Air Shed:

Forecast for FRIDAY:

SKY/WEATHER: Partly sunny this afternoon.

TEMPERATURE: High temperatures 65-70.

HUMIDITY: Minimum RH around 25-35 percent.

WIND – SURFACE: Southwest 5-15 mph with gusts to 20 mph in the afternoon.

TRANSPORT: Southwest 10-15 mph in the afternoon.

INVERSIONS: Strong to moderate morning inversion breaking by 11am at a temperature of 63degrees.

MIXING HEIGHT: Air mass will become unstable to 3-4,000 feet AGL in the afternoon.

VENTILATION: POOR to MARGINAL in the morning remaining MARGINAL to locally GOOD in the afternoon.

AIRSHED Recommendations: Conditional for strong and gusty wind.

Rathdrum Prairie: Conditional

LOCAL TIME										
County	08	09	10	11	12	13	14	15	16	17
Kootenai	P	P	P	M	G	G	G	G	G	G

VENTILATION KEY: P = Poor M = Marginal G = Good E = Excellent

Figure 1. Weather forecast prepared by Bennett Fire Weather Services, LLC, for Kootenai County.

Morning Forecasting for Kootenai														
Model Resolution:	12km			Model Run:	2012101200			SiteID:	KCOE					
Date		Time in PDT											Comments	
10/12/2012		10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	
Vent. Index		P	P	M	M	M	G	M	NP	M	P	P	P	
G: good, M: marginal, P: poor, NP: very poor														
Surface (20m) Winds	Direction	S	SSW	SW	SW	SW	SW	SW	SW	SW	SW	SSW	SSW	5 kts = 5.75 mph,
	Speed (mph)	7.5	9.0	9.7	11.6	12.4	12.8	12.7	7.8	9.5	10.0	9.7	8.5	10 kts = 11.5 mph,
Surface (20m) Temperature (degree C)		10.0	11.7	12.9	14.1	14.3	14.6	14.5	14.1	13.1	12.1	11.4	10.5	15 kts = 17.25 mph
Surface (20m) Relative Humidity (%)		76.4	71.3	64.7	51.5	45.8	42.7	42.2	47.6	50.9	55.2	60.0	68.1	
Planetary Boundary Layer (PBL)	Height (feet)	810	1473	1847	2434	2539	2713	2707	180	2008	1598	1526	1358	Height is above model terrain surface
	Direction	SW	SW	SW	WSW	SW	SW	WSW	SW	WSW	WSW	WSW	WSW	
	Speed (mph)	18.2	19.3	17.2	20.7	18.9	18.6	18.3	13.2	23.1	25.7	26.3	27.1	
700mb (~10,000 ft MSL)	Height (feet)	7251	7251	7251	7251	7251	7251	7251	7251	7251	7251	7251	7251	Height is above model terrain surface
	Direction	WSW	WSW	WSW	WSW	WSW	W	W	WNW	WNW	WNW	WNW	W	
	Speed (mph)	33.6	34.8	35.1	34.8	36.2	33.9	32.6	31.1	27.1	25.3	25.6	28.4	
850mb (~5000 ft MSL)	Height (feet)	2048	2048	2044	2044	2048	2048	2048	2048	2481	2481	2481	2481	Height is above model terrain surface
	Direction	WSW	WSW	SW	SW	SW	SW	SW	SW	WSW	WSW	W	W	
	Speed (mph)	24.2	24.7	20.4	17.3	17.4	17.4	17.5	20.0	22.5	23.7	25.3	25.5	

Figure 2. Weather checklist for Kootenai County. Information taken from the University of Washington Northwest Modeling Consortium forecast model.

Table 1. National Weather Service observations at Coeur d'Alene Airport (Site ID KCOE) for October 12. Times are in Pacific Daylight Time (PDT).

Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Gust (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
10:15	53.6	11	5.8		170	clear	OK
10:35	53.6	12	5.8		210	clear	OK
10:55	55.4	11	6.9		200	clear	OK
11:35	57.2	11	8.1		170	partly cloudy	OK
11:55	57.2	11	6.9		180	mostly cloudy	OK
12:15	57.2	11	6.9		180	overcast	OK
12:35	59	10	5.8		180	mostly cloudy	OK
12:55	60.8	10	4.6		190	mostly clear	Caution
13:15	60.8	11	4.6		170	clear	Caution
13:35	62.6	11	0			clear	Caution
13:55	64.4	45	0			clear	Caution
14:15	62.6	39	3.5		180	mostly clear	Caution
14:35	64.4	37	4.6		260	partly cloudy	Caution
14:55	64.4	34	4.6		260	mostly cloudy	Caution
15:15	64.4	34	5.8		230	mostly cloudy	Caution
15:35	64.4	32	12.7	16.1	260	overcast	Caution
15:55	64.4	32	12.7		250	overcast	Caution

Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Gust (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
16:15	64.4	32	10.4		250	overcast	Caution
16:35	64.4	32	12.7		240	overcast	Caution
16:55	62.6	34	8.1		240	mostly cloudy	OK
17:15	62.6	34	9.2		240	mostly cloudy	OK
17:35	62.6	34	8.1		240	overcast	OK
17:55	59	36	5.8		210	partly cloudy	OK

Table 2 Observations at Lancaster monitor site operated by DEQ for October 12. Times are in Pacific Daylight Time (PDT).

Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)
1:00 AM	34.5	90.1	4	53.9
2:00 AM	32	92.3	3.6	59.8
3:00 AM	32.2	93.6	1.8	80.7
4:00 AM	30.7	92.8	2	14.8
5:00 AM	30.2	95	3.1	37.9
6:00 AM	28.4	95.2	2.9	27.3
7:00 AM	30.7	93.6	3.4	61.7
8:00 AM	40.46	85.5	4.5	59.7
9:00 AM	50.5	65.4	6.3	172
10:00 AM	54.5	56.1	4.7	203.5
11:00 AM	58.3	45.3	6.9	183.8
12:00 PM	59	42.9	6	192.4
1:00 PM	62.6	36.8	4.9	201.5
2:00 PM	64	33.5	3.1	200.8
3:00 PM	63.9	34.7	7.4	244.9
4:00 PM	62.2	36.3	10.5	237.9
5:00 PM	59.7	40	8.5	232.7
6:00 PM	58.5	39.9	9.4	189.8
7:00 PM	57.7	42.3	12.1	192.9
8:00 PM	56.3	51.6	11.4	181
9:00 PM	54.5	62.5	9.6	173
10:00 PM	53.1	68.2	9.2	190.1
11:00 PM	50.5	73.4	4	202.1
24:00 AM	48.7	79.6	3.8	264.6
1:00 AM	51.6	84.1	4.9	233.5

Table 3 Available PM_{2.5} monitoring data prior to burn decision for October 12.

Time	Lancaster			Garwood School			Athol		
	1-hour ^a	4-hour ^b	24-hour ^b	1-hour	4-hour	24-hour	1-hour	4-hour	24-hour
5:00 AM	8.5	6.7	6.5	13.7	14.3	11.1	11	12.9	12.0
6:00 AM	5.8	6.5	6.3	16	14.8	11.2	11.8	12.3	11.9
7:00 AM	22	9.9	6.8	14.6	14.7	11.2	14.8	12.5	12.0
8:00 AM	14.1	12.6	6.9	18.7	15.8	11.5	21.8	14.9	12.4
9:00 AM	11.9	13.5	7.0	16.6	16.5	11.7	16.3	16.2	12.7
10:00 AM	16	16.0	7.3	16.7	16.7	12.0	14.3	16.8	12.9

^a 1-hour average

^b Rolling average

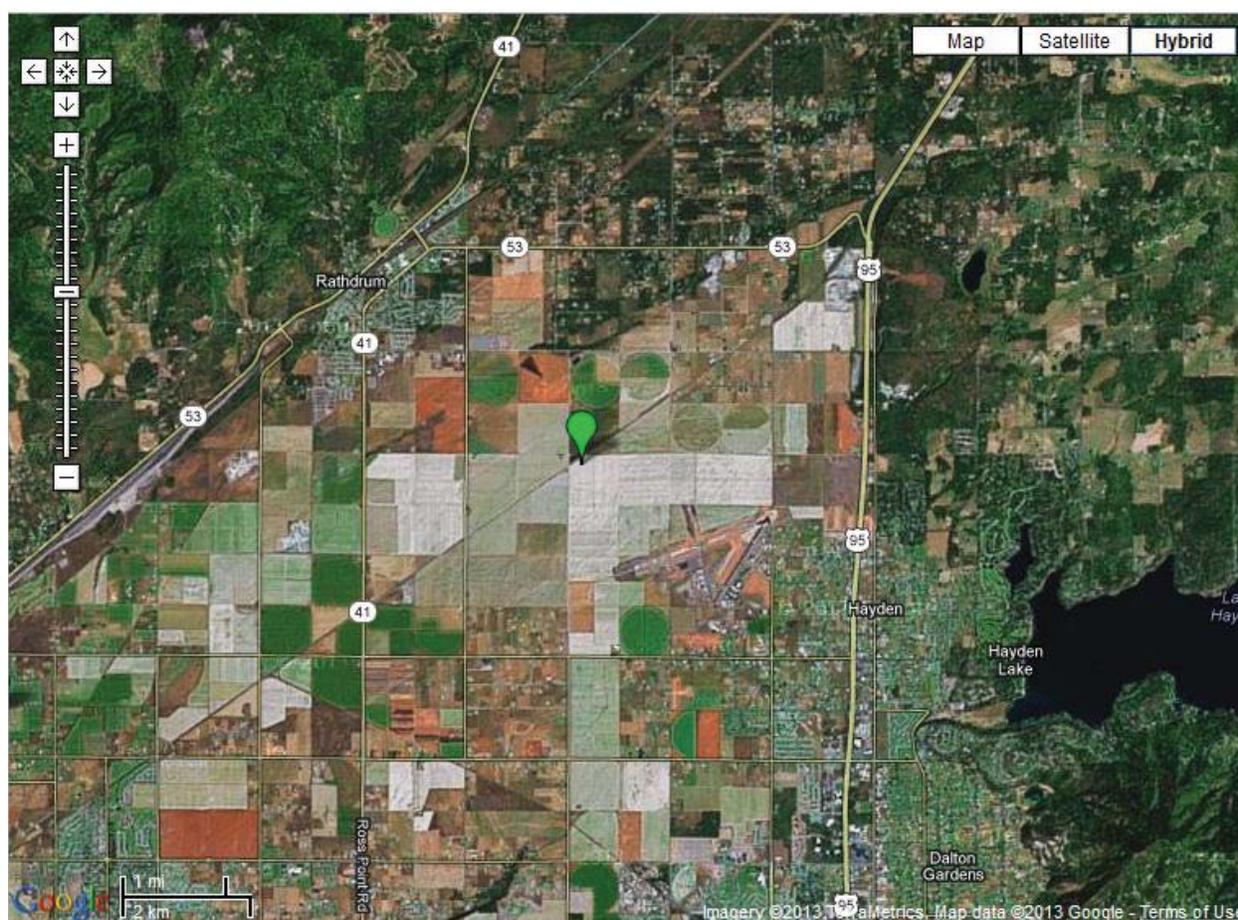


Figure 3. Location of approved field.

Field Observations

DEQ staff arrived at the field location and began verification of conditions at 11:30 a.m. The sky was beginning to clear slightly and winds were southwest at 3 mph. The fuel loading was very heavy, as is typical of a bluegrass field that has not been baled. The fuel was dry, crunching under foot. DEQ staff released a balloon to evaluate the upper level winds. The balloon

indicated light southerly winds up to about 1,500 – 2,000 ft. above ground level (AGL) at which point winds shifted to a strong westerly.

A 20 acre wheat stubble field, located about 8 miles southwest of the bluegrass field, was also approved for burning on the Rathdrum Prairie. Ignition on this 20 acre field occurred at approximately 11:30 a.m. Smoke behavior indicated good vertical plume rise and good ventilation.

DEQ reviewed meteorological stations in the Spokane area to determine the location of the forecasted increase in winds. At 12:10 p.m. the winds in the Spokane area were westerly and increasing with gusts to 17 mph, suggesting the wind event was moving to the east and expected in Rathdrum Prairie in about 2 hours. Surface winds at the field, measured by DEQ staff, were south to southwest at 1-2 mph. The temperature was 64 °F, which indicated that the temperature required to break the inversion had been reached.

Based on the information above, DEQ gave verbal burn approval to the grower at 12:19 p.m. Ignition began at 12:31 p.m. The verbal approval included the requirement that the grower would pause the ignition process after 80 acres were ignited so DEQ could evaluate the smoke dispersion.

The ignition of the first 80 acres was completed by 12:56 p.m. Based on observations of smoke dispersion, DEQ determined that the remaining 70 acres would be approved for burning and verbal approval was given to the grower. Ignition of the remaining 70 acres was completed by approximately 1:40 p.m. Smoke was observed moving to the northeast at a height of about 1,000 ft AGL. A smoke odor was detected at Garwood School at this time. Shortly after ignition of the entire field was completed, the plume began to collapse toward ground level.

Table 4 shows the PM_{2.5} concentrations recorded at the Lancaster, Garwood School, and Athol monitors. A 1-hour maximum PM_{2.5} concentration of 93 µg/m³ was recorded at the Garwood School for the hour ending at 2:00 p.m. As mentioned above, DEQ completed enhanced documentation for this burn.

Table 4 Air quality PM_{2.5} monitoring data during and after burning.

Time	Lancaster			Garwood School			Athol		
	1-hour ^a	4-hour ^b	24-hour ^b	1-hour	4-hour	24-hour	1-hour	4-hour	24-hour
11:00 AM	15.5	14.4	7.6	20.7	18.2	12.5	19.7	18.0	13.3
12:00 PM	20.9	16.1	8.2	24.1	19.5	13.1	21.6	18.0	13.8
1:00 PM	20.2	18.2	8.7	47.6	27.3	14.7	20.1	18.9	14.3
2:00 PM	20.4	19.3	9.3	93	46.4	18.2	44.3	26.4	15.7
3:00 PM	12.2	18.4	9.7	12.1	44.2	18.5	17.7	25.9	16.1
4:00 PM	9.8	15.7	10.1	10.3	40.8	18.7	10.9	23.3	16.2
5:00 PM	8.7	12.8	10.5	9.8	31.3	18.9	9.8	20.7	16.2
6:00 PM	8.8	9.9	10.6	9.6	10.5	19.0	9.9	12.1	16.3
7:00 PM	8.5	9.0	10.8	9.2	9.7	19.1	9.6	10.1	16.3
8:00 PM	12	9.5	11.0	8.8	9.4	19.1	8.8	9.5	16.2
9:00 PM	8.6	9.5	11.1	8.1	8.9	18.7	7.2	8.9	15.9
10:00 PM	4.6	8.4	11.0	6.1	8.1	18.4	5.7	7.8	15.1
11:00 PM	2.3	6.9	10.8	5.8	7.2	18.0	5.1	6.7	14.7
24:00 AM	6	5.4	10.8	6.1	6.5	17.7	5.1	5.8	14.2

^a 1-hour average^b Rolling average

Weather Analysis by Meteorologist

The following burn day analysis was prepared by Bennett Fire Weather Services, LLC, DEQ's contract meteorologist.

Weather observations used prior to ignition were taken automatically from the Coeur d' Alene Airport (COE), which is in very close proximity to the burn site. Between 0755 am and 0835 am there was reduced visibility due to wildfire smoke in the area.

Surface wind was from an easterly direction which is a diurnal direction for the Rathdrum Prairie and the Purcell Trench each day under this particular weather pattern. At this time of the day, the area is under a radiation type inversion. The inversion was moderate to strong for this time of the year. The MM5 high resolution sounding forecast for Coeur d' Alene, in Figure 4, shows that the inversion was significant and would not break before 1100 am.

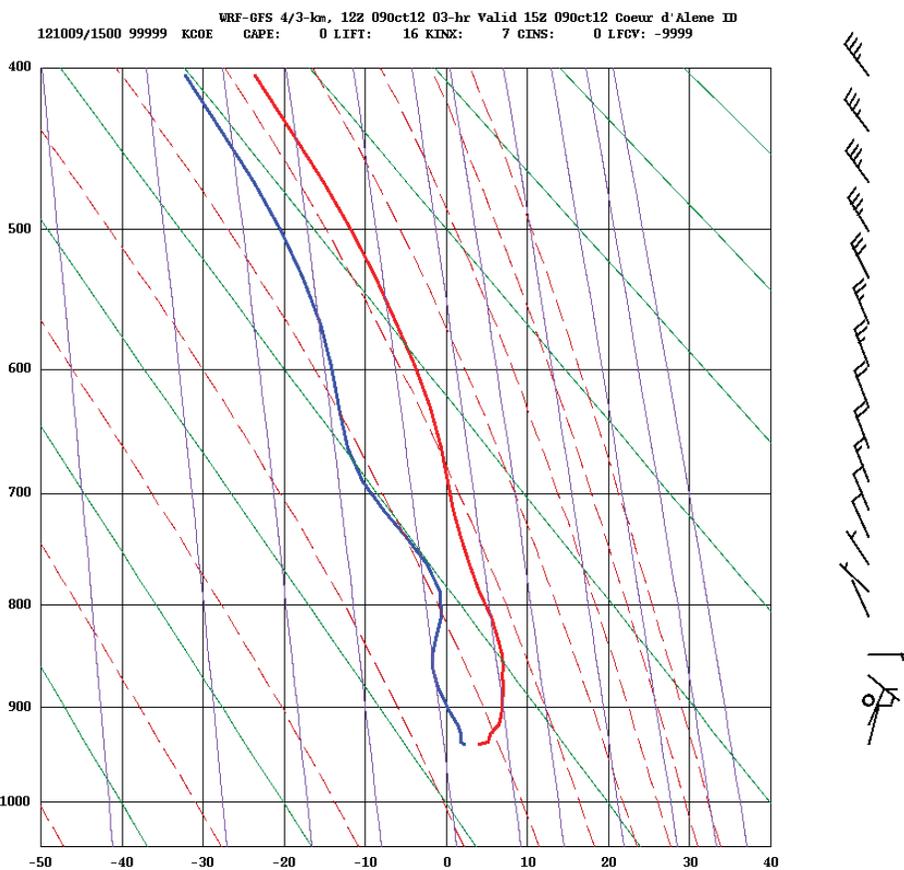


Figure 17 Modeled sounding for Coeur d'Alene Airport

The temperature cross section is in red and the dew point depression is in blue. Wind direction and wind speed are located along the vertical axis on the right side of the graphic. An inversion warms with elevation and this is the case on this day. This is not an uncommon feature; radiation inversions occur nearly every day, especially in the summer and fall months.

The weather observations were warming and visibility was 10 miles for the remainder of the day. There was a problem with the dew cell on the Coeur d'Alene Airport meteorological station which was giving erroneous dew point temperatures for approximately a 4.5 hour period. The relative humidity was therefore in error as well. The problem was not corrected until around 1435 pm. This resulted in a “caution” quality assurance flag in the data (see Table 1). Also a mid-level deck of clouds was moving through the burn area.

The data collected at the Coeur d'Alene Airport meteorological site did have some glaring problems. Relative humidity is a key parameter in crop residue burning which involves fine fuels.

The MM5 500 millibar (mbs) level from 1400 pm Friday, October 12th (Figure 5) was reviewed to evaluate the upper atmosphere to determine if something was previously missed in the weather forecast.

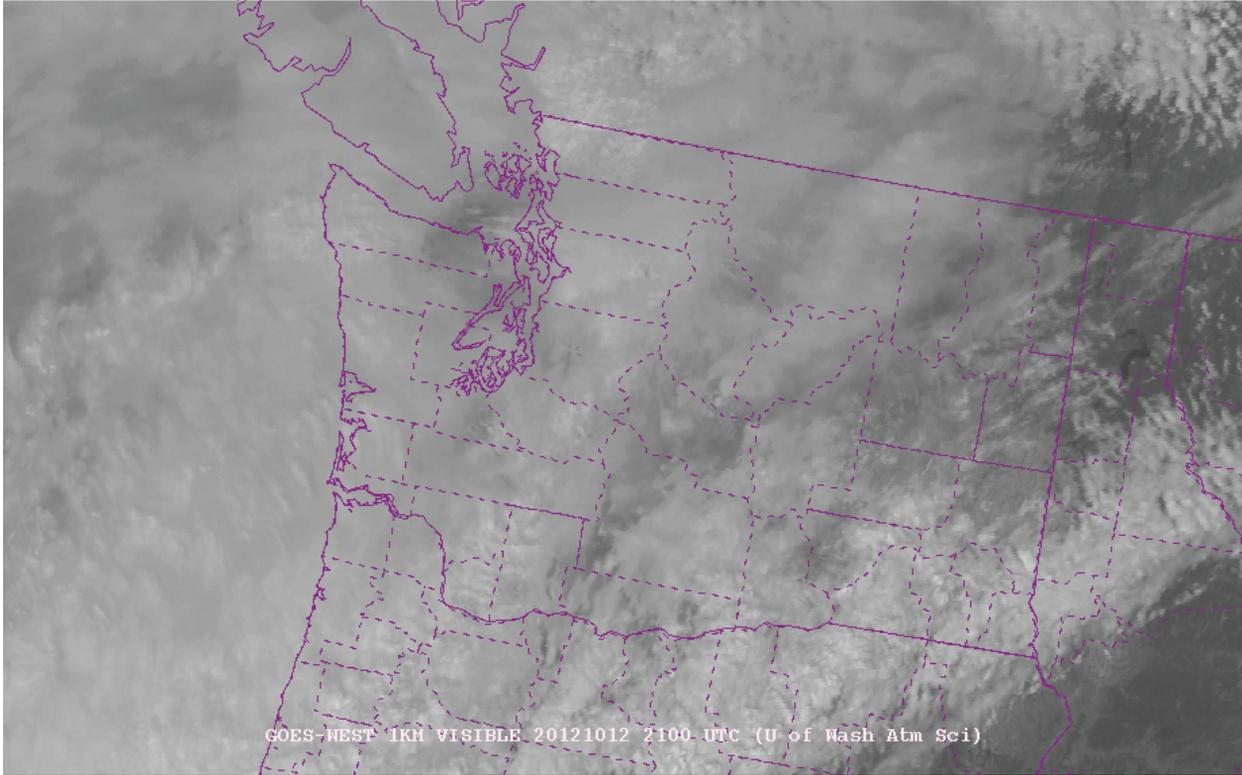


Figure 19 Visual satellite image from 1400 on October 12.

Figure 7 shows that the mid-level clouds have increased and are thickening, reducing the sunshine and heating. The Coeur d' Alene Airport weather station reached its maximum temperature of 64 degrees at the 1355 pm observation and remained at that temperature until nearly 1700 pm. Relative humidity settled in at around 32 percent for the minimum of the afternoon after the dew cell was fixed.

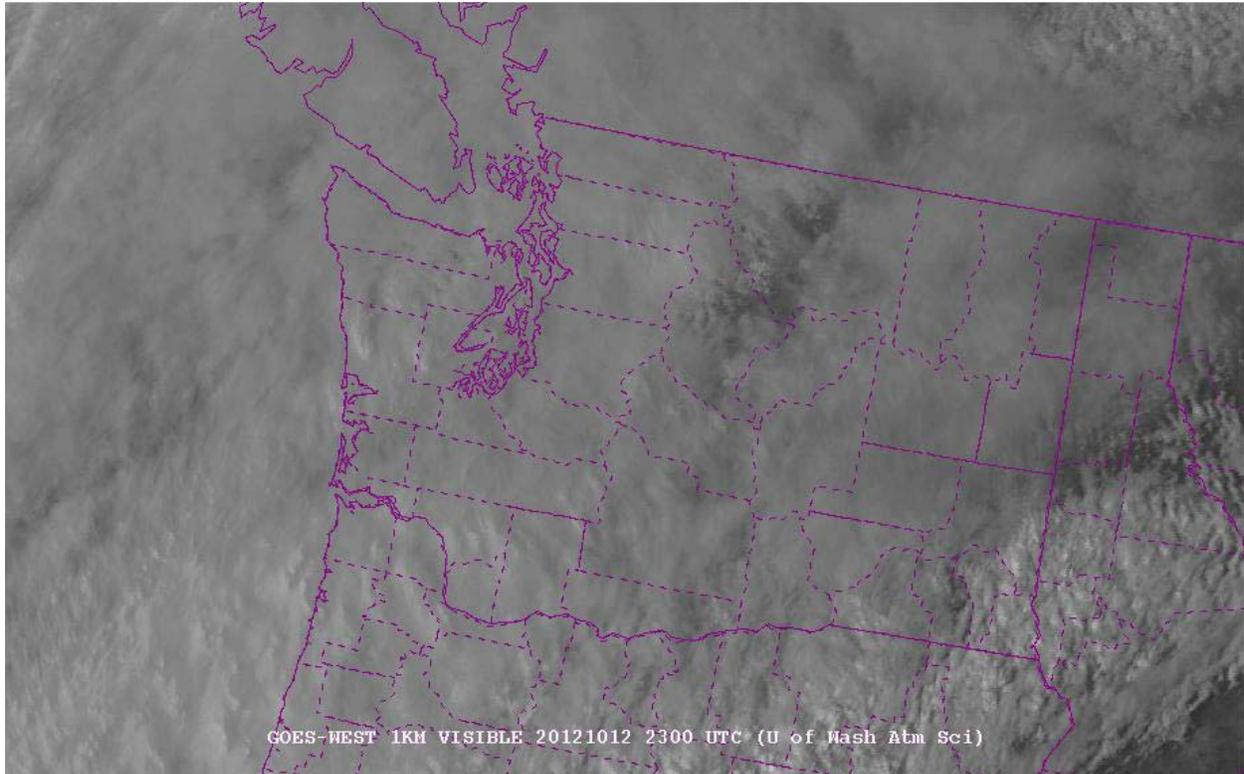


Figure 20 Visual satellite image for 1600 on October 12.

This type of partly cloudy day is very common under a westerly flow aloft as the mid-level clouds flow off the mountains. These are called “mountain wave” clouds and are clearly visible on the satellite pictures.

Next the surface weather on the day of the burn was analyzed. The first item to analyze is the sounding forecast from the high resolution MM5 sounding generator, produced by the University of Washington Northwest Modeling Consortium. Figure 8 shows the sounding graphic from 1100 am and provides an approximate time the inversion will break. The temperature trace has broken the surface based inversion at 1100 am at a temperature around 54-55 degrees. The wind has also become southwest at 10 mph. Next, the afternoon sounding was reviewed to get a maximum mixing height and the temperature at which that will occur.

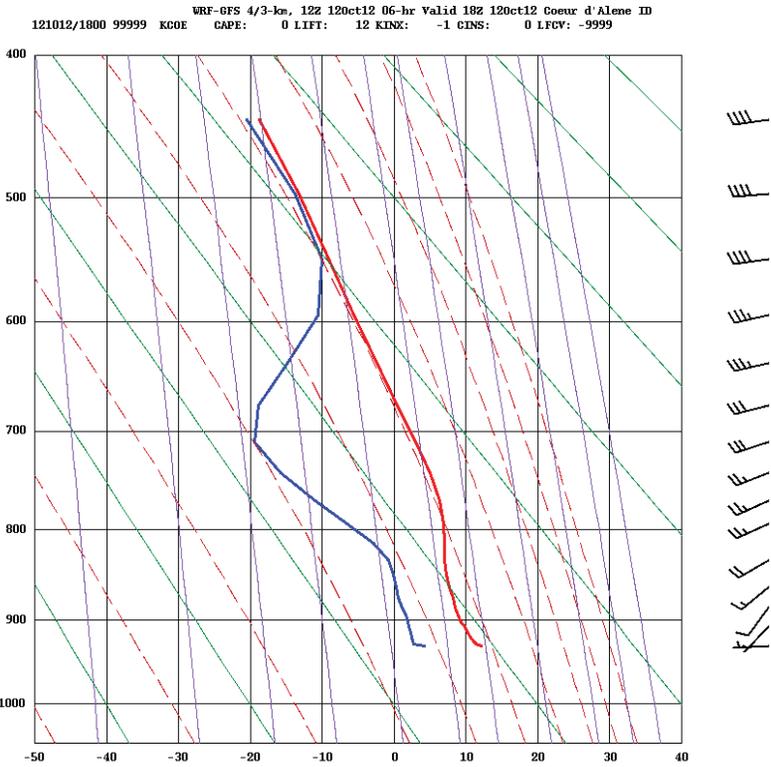


Figure 21 Modeled sounding for 1100 on October 12.

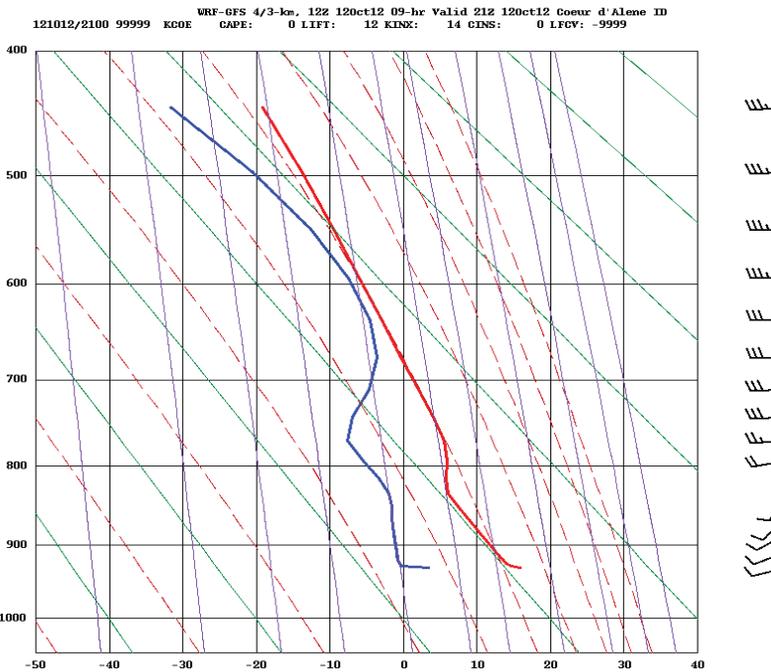


Figure 22 Modeled sounding for 1400 on October 12.

The temperature on the 1400 pm sounding (Figure 9) is near 16 or 17 degrees Celsius which is 61-63 degrees Fahrenheit. The maximum temperature for the day was forecasted at 64 degrees

so the mixing height forecast for the day of 3,000 feet AGL should have been achieved. The wind in the transport layer is from the southwest at 10 mph.

The smoke from the burn in question only rose to a level around 1,000 feet AGL. The cloud cover could and did inhibit the temperature from becoming warmer and this has a direct impact on the mixing depth. However, the temperature had not reached 64 degrees until later in the day (around 2pm) and ignition was at 1230 pm.

UW WRF-GFS 1.33km Domain Init: 12 UTC Fri 12 Oct 12
 Fcst: 9.00 h Valid: 21 UTC Fri 12 Oct 12 (14 PDT Fri 12 Oct 12)
 10m Wind Speed (knots)
 Wind at 10m (full barb = 10kts)
 Sea Level Pressure (hPa)

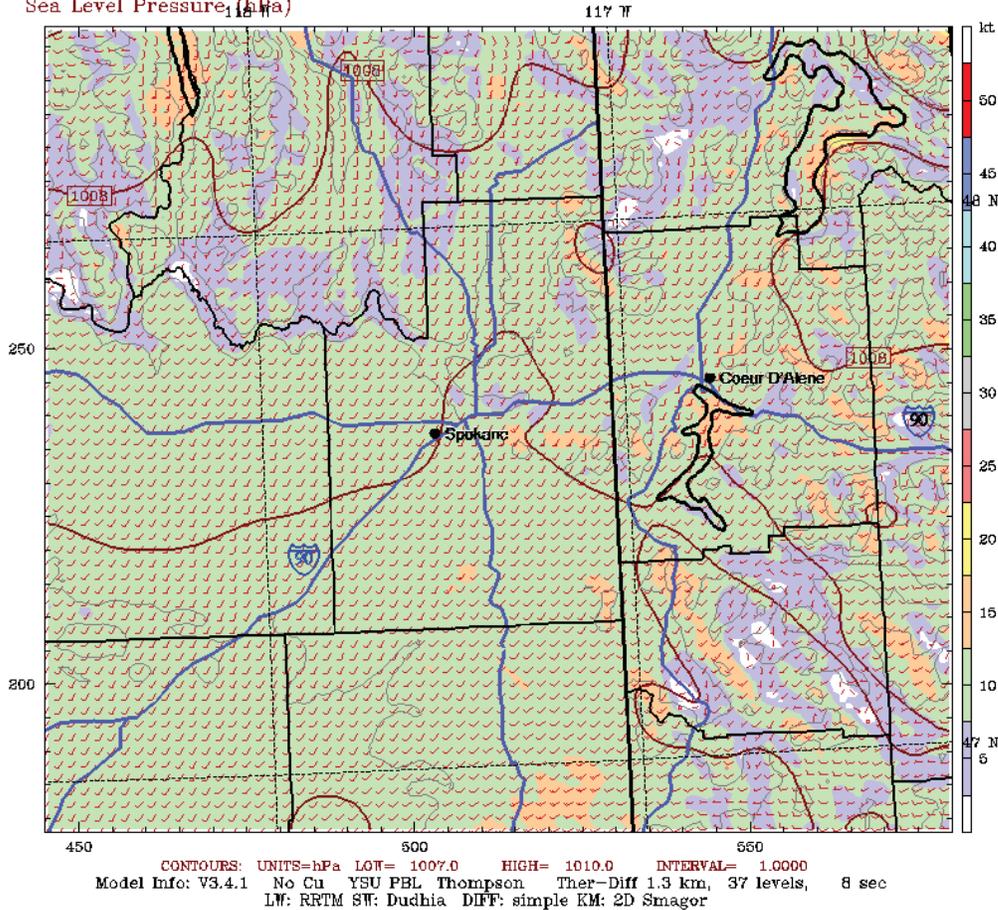


Figure 23 High resolution surface graphic forecast at 1400 on October 12.

Figure 10 shows the high resolution surface graphic forecast at 1400 pm after the burn was completed. Looking at the surface, wind the direction is predominately southwest but there are a couple of pixels with a south component. Winds speeds are in the 5-10 mph range at this time (Green and Purple). The actual wind reading from the Coeur d’Alene Airport was from the south at 6 mph at 12:35 p.m. and remained south at 5-6 mph until 2:15 p.m. when the wind shifted to the west then southwest and increased in speed.

CONCLUSIONS

After reading the field notes from the coordinators present, the forecast for the day was well within the forecast verification for the day. Burning was conducted under a marginal ventilation day with relatively light winds. Burning under a marginal ventilation forecast has been done very successfully in the past. The wind direction was too southerly at ignition time, however all models had a southwest surface wind after the morning inversion broke. There was also some background smoke from local wildfires in the area of the burn. So what influences played a role here if the weather (mainly wind direction) was not the only factor. What did not allow the smoke column to attain its maximum level? Was it inefficient ignition, too much fuel loading, and therefore a more compactness to the fuel? Kentucky Blue Grass (KBG) needs to be burned under optimum conditions.

The photo below (Figure 11) taken from the field notes stood out to the contract meteorologist as he went through the data for this analysis. The photo is the first picture of the field before ignition looks to have not only heavy fuel loading but is also “greening up” significantly. This burn would need a lot of heat to get the smoke lifting high enough into the transport layer. Mid October is not a very good time of the year to burn this type of fuel. Too cool of ambient air temperatures combined with higher relative humidity will produce a slow lift to the burn.



Figure 24 Photo of field prior to ignition.

Increasing cloud cover also played a role by stalling temperature rise. This combined with low level cold smoke inhibited the column from reaching higher and lead to its eventual collapse. This type of fuel should be ready and burned off during the height of the burn season, taking advantage of warmer temperatures and lower relative humidity.

Appendix D. Meteorological Burn Day Analysis for October 3, 2012, in the Central SMA

Introduction

There were a couple of days in the first part of October where a heavy smoke intrusion impacted some airsheds. The first was on October 3 when down slope (easterly) winds brought heavy smoke into the southern Clearwater Airshed. The MODIS visual satellite photo clearly shows the smoke intrusion (Figures 1 and 2). The meteorological forecasts indicated easterly winds, which would normally indicate a good burn day. However, on this day easterly winds brought in heavy smoke from wildfires over eastern Idaho and western Montana. This smoke impact from wildfires continued into October 4 (Figures 3 and 4). As a result of the smoke impacts, DEQ requested a burn day analysis from the contract meteorologist, Bennett Fire Weather Services, LLC.

Terra MODIS (morning) imagery for 10/3/12
250 m resolution

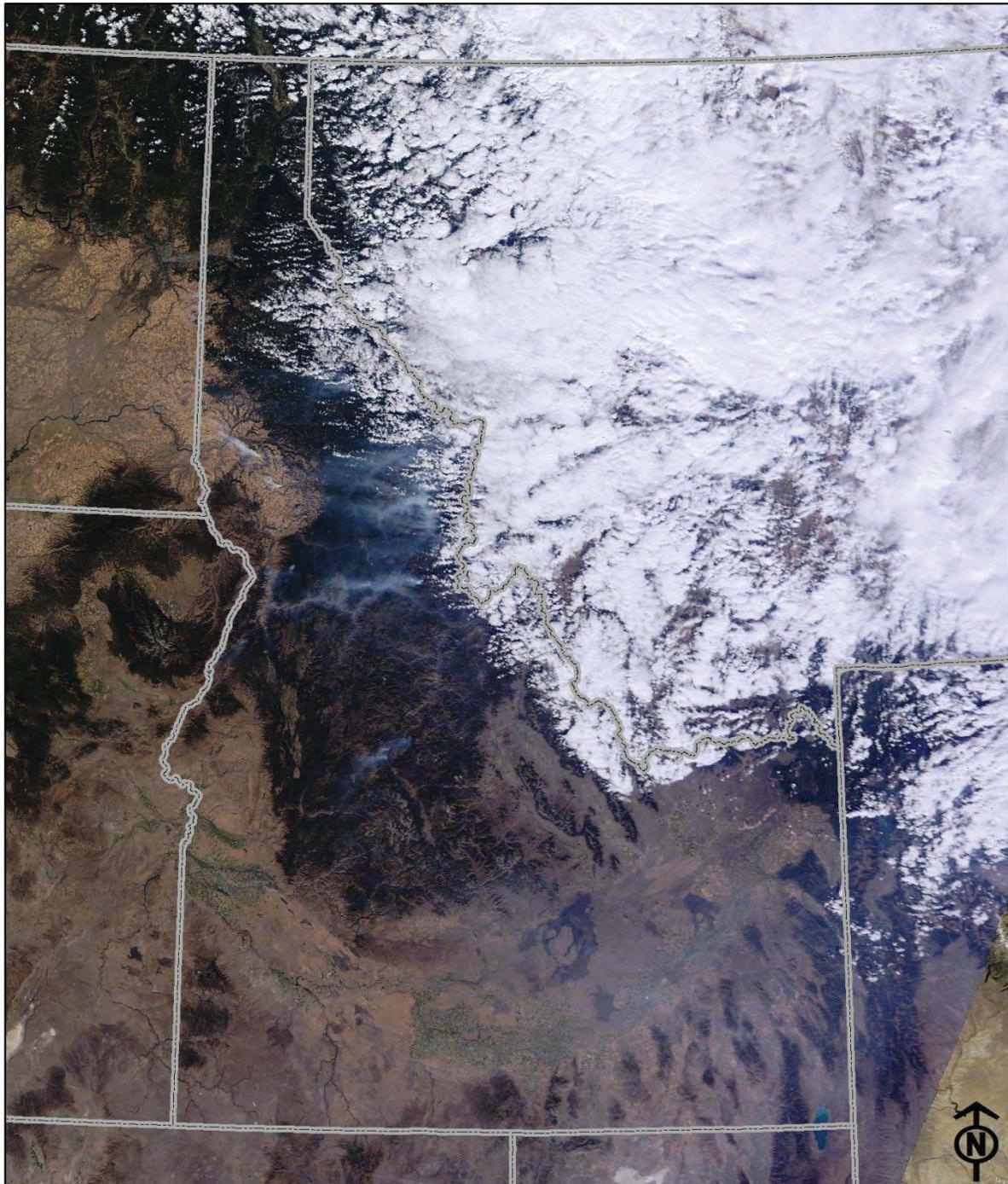
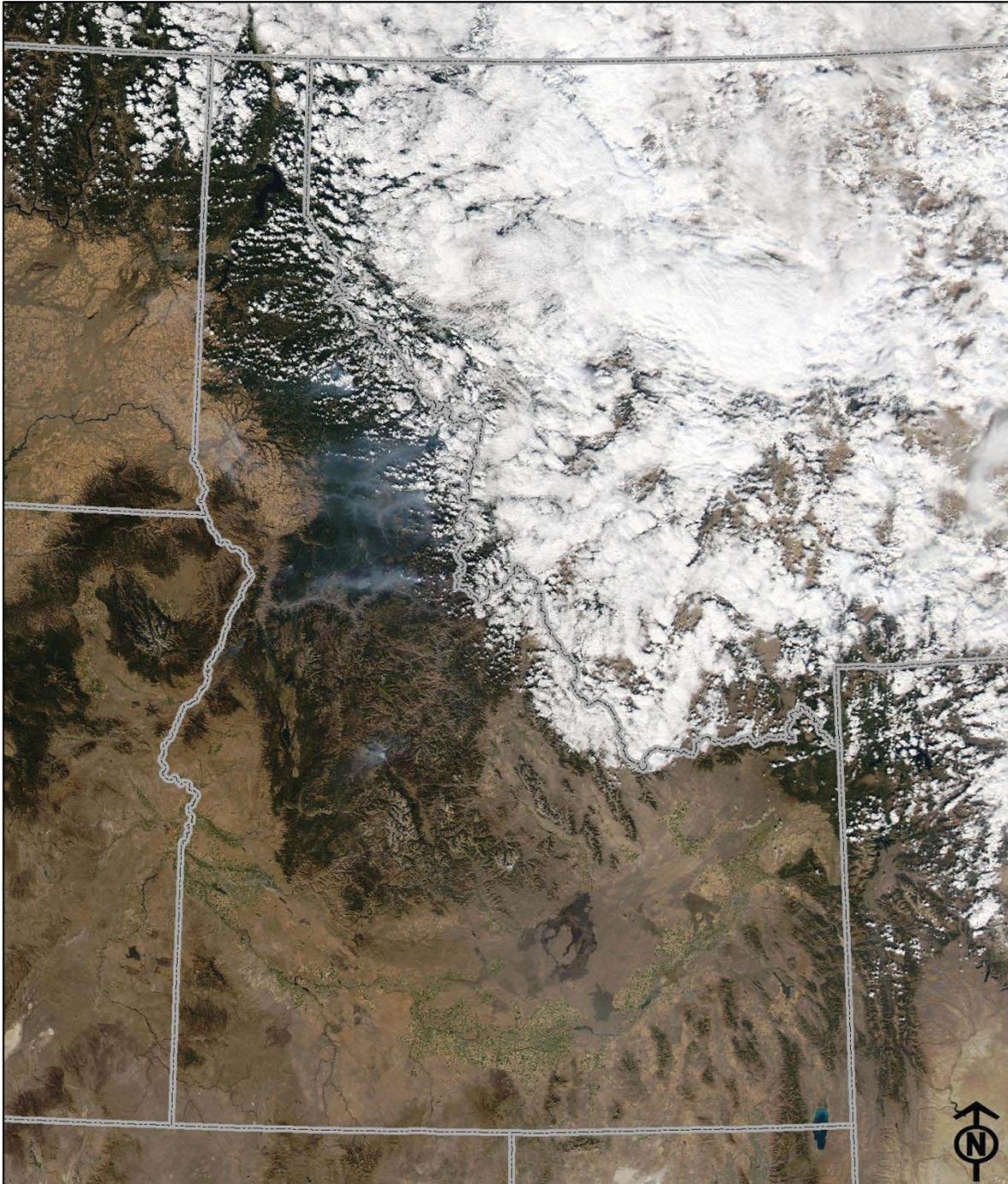


Figure 1. MODIS visual satellite photo from October 3 (morning) showing wildfire smoke intrusion.

Aqua MODIS (afternoon) imagery for 10/3/12
250 m resolution



0 15 30 60 90 120 Miles

Figure 2. MODIS visual satellite photo from October 3 (afternoon) showing wildfire smoke intrusion.

Terra MODIS (morning) imagery for 10/4/12
250 m resolution

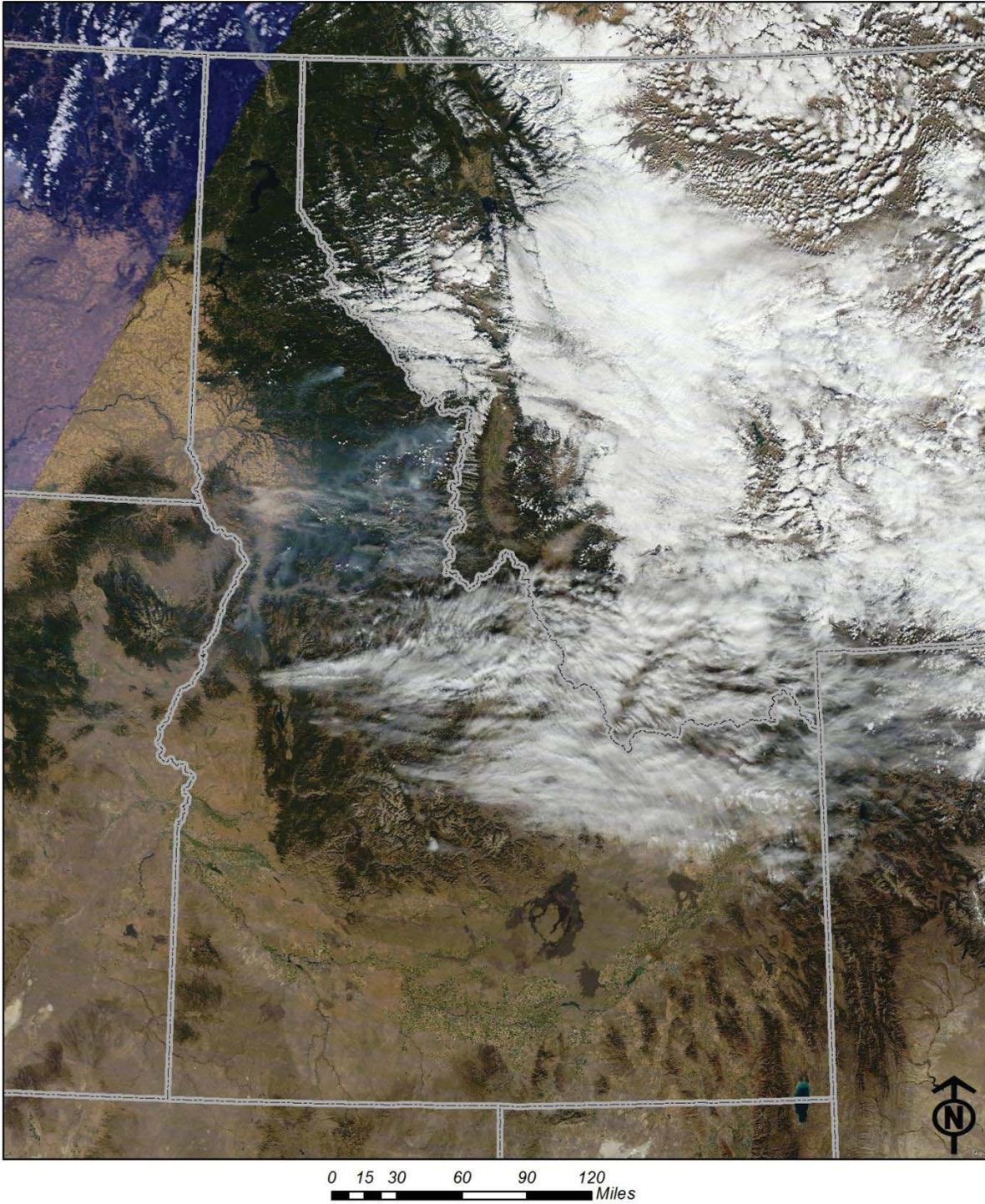


Figure 3. MODIS visual satellite photo from October 4 (morning) showing wildfire smoke intrusion.

Aqua MODIS (afternoon) imagery for 10/4/12
250 m resolution

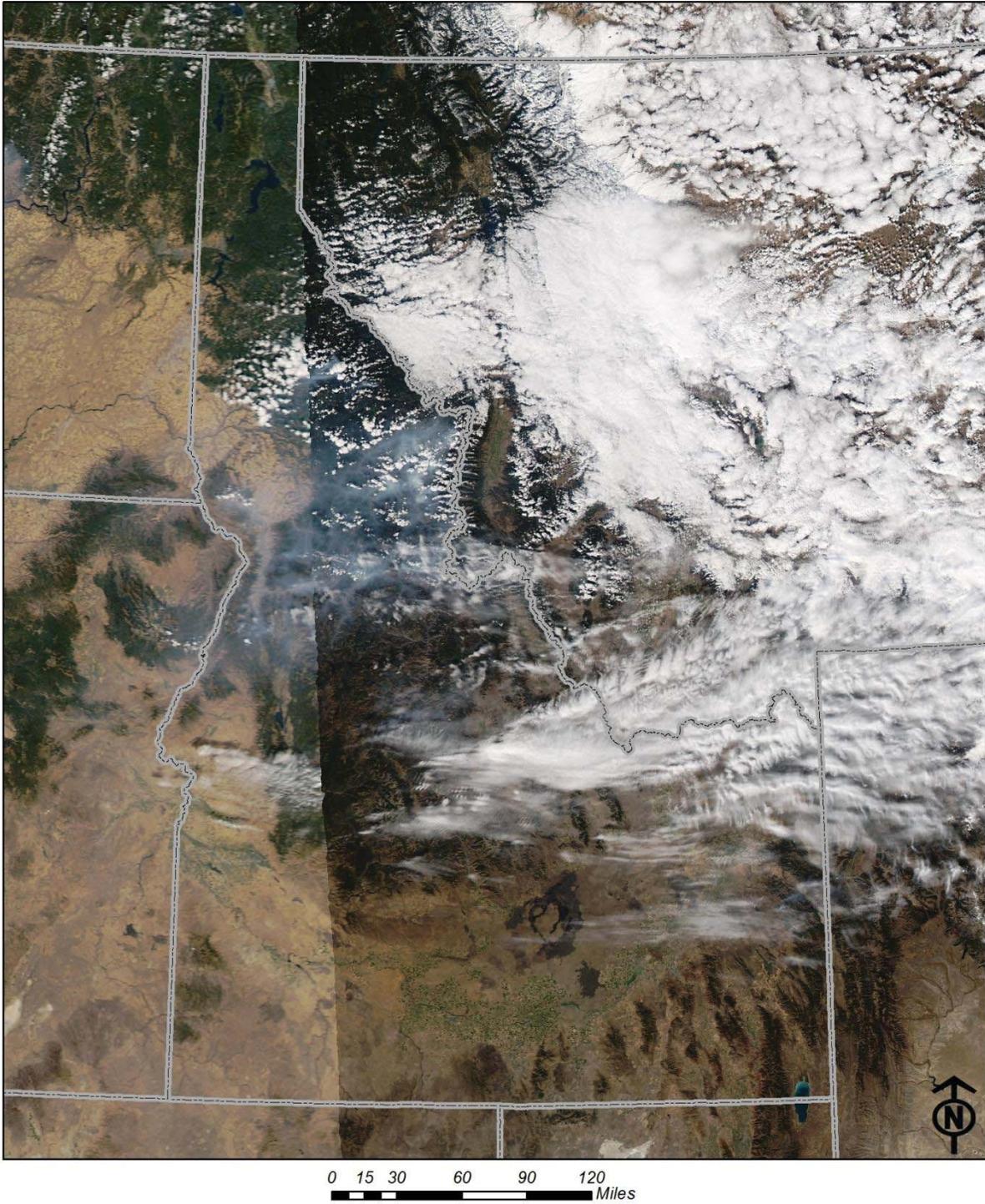


Figure 4. MODIS visual satellite photo from October 4 (afternoon) showing wildfire smoke intrusion.

Information Reviewed by DEQ Prior to the Burn Decision

The burn decision for this day was developed using forecasted winds, ventilation, and temperatures from the University of Washington Northwest Modeling Consortium, as displayed in DEQ’s weather checklist (Figure 5) and the daily forecast produced by the DEQ contract meteorologist, Bennett Fire Weather Services, LLC (Figure 6). Ventilation was expected to be good, with surface winds generally from the east to northeast at 6–15 mph. The upper level winds were forecasted to be from the east to northeast at 10–15 mph at an elevation of 5,000 ft AGL. The upper level conditions were conducive for good smoke management. As stated above, normally an east wind indicates a good burn day in this airshed.

The DEQ contract meteorologist recommended a burn day for all areas in this smoke management area (SMA). A burn window of 10:00 a.m.–4:00 p.m. was determined based on the forecasts.

DEQ reviewed the monitoring data (Tables 1–3) for Genesee, Grangeville, Kendrick, Lewiston, Moscow, and Potlatch. The maximum hourly PM_{2.5} concentration recorded at any of these sites prior to the burn decision was 6.5 µg/m³, recorded at Lewiston at 9:00 a.m. on October 3. This concentration is below all preburn enhanced documentation triggers.

DEQ’s general concern was the forecasted surface and transport wind direction. DEQ approved the following acres for burning: Nez Perce County 867 acres; Clearwater County 1,410 acres; Idaho County 1,029 acres; and Latah County 1,545 acres.

Morning Forecasting for Central														
Model Resolution:	12km			Model Run:	2012100300			SiteID:	KPUW					
Date	Time in PDT												Comments	
10/3/2012	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM		
Vent. Index	M	G	G	G	G	G	G	G	NP	P	P	M		
G: good, M: marginal, P: poor, NP: very poor														
Surface (20m) Winds	Direction	ENE	E	E	ENE	ENE	ENE	ENE	ENE	E	E	E	ENE	5 kts = 5.75 mph,
	Speed (mph)	9.8	8.7	6.7	5.2	5.3	5.5	7.4	8.2	4.8	9.6	9.4	11.2	10 kts = 11.5 mph,
Surface (20m) Temperature (degree C)	8.3	9.7	10.7	11.6	12.3	12.7	12.6	12.4	11.8	10.7	10.1	9.5	15 kts = 17.25 mph	
Surface (20m) Relative Humidity (%)	49.6	44.0	39.8	35.0	32.0	30.9	31.5	31.9	34.6	38.6	39.6	40.4		
Planetary Boundary Layer (PBL)	Height (feet)	2802	4003	5387	6854	7484	7628	7562	6581	128	1503	1240	1699	Height is above model terrain surface
	Direction	E	E	NE	NE	ENE	ENE	ENE	ENE	E	E	E	E	
	Speed (mph)	21.6	10.9	9.6	14.4	12.5	11.5	8.4	7.7	8.5	16.3	18.9	23.7	
700mb (~10,000 ft MSL)	Height (feet)	7235	7235	7238	7235	7235	7238	7238	7238	7238	7238	7238	7238	Height is above model terrain surface
	Direction	NNE	NNE	NE	NE	ENE	ENE	ENE	ENE	ENE	NE	E	ENE	
	Speed (mph)	18.3	17.4	16.6	14.4	12.5	11.5	8.4	5.6	6.4	5.3	4.0	0.9	
850mb (~5000 ft MSL)	Height (feet)	2317	2317	2317	2317	2317	2317	2317	2317	2317	2317	2317	2317	Height is above model terrain surface
	Direction	E	E	E	ENE	ENE	ENE	ENE	ENE	E	E	E	E	
	Speed (mph)	20.2	13.4	9.6	7.9	8.1	8.4	10.4	11.5	11.5	14.4	18.3	23.5	

Figure 5. Weather checklist for Pullman, WA. Information taken from the University of Washington Northwest Modeling Consortium forecast model.

Forecast Prepared by: BENNETT FIRE WEATHER SERVICES, LLC

Forecast Time Prepared: 8:00 AM PDT – Wednesday October 3, 2012
 Forecast for: WEDNESDAY – October 3, 2012

**GENERAL WEATHER DISCUSSION:
 WEDNESDAY:**

The cold upper level trough and cold front has moved southeast into Montana. Light precipitation fell last evening as the trough moved across northern Idaho. High pressure off the northwest coast is ridging north into southeast Alaska. This ridge is nearly stationary and blocked into position. The flow aloft is a cold and dry northwest flow. At the surface this afternoon a cold air mass resides over northwest Montana and is thereby producing a northeast to southwest pressure gradient field across northern Idaho. The surface wind direction will be east to northeast over the northern Idaho air sheds. Winds speeds will be in the 5-15 mph range. There will also be higher gusts to 20 mph over exposed terrain. Mixing heights are expected to range near 5-7,000 feet AGL over northern Idaho. Dispersion is good with the increase in vertical mixing. The morning inversion will break between 11am and 12 pm at temperatures between 41-52degrees. Ventilation will become generally good over all air sheds by afternoon.

**CLEARWATER Air Shed:
 Including Nez Perce Tribe Air Shed, Latah County, Clearwater County, and Idaho County
 Forecast for WEDNESDAY:**

SKY/WEATHER: Sunny and cooler.
 TEMPERATURE: High temperatures generally ranging from 56-63 on the Prairies, 60-67 in the lower valleys, and to 58-64 in Latah County.
 HUMIDITY: Minimum RH near 20-30 percent all areas.
 WIND – SURFACE: Northeast 5-15 mph over Latah County and East to northeast 5-15 mph over the Camas Prairie and Idaho County.
 TRANSPORT: Northeast 10 mph over Latah County and Northeast 10 mph over the NPT and Idaho County.
 INVERSIONS: Moderate to strong morning inversion breaking around 11 am at a temperature of around 46-48 degrees.
 MIXING HEIGHT: Air mass will become unstable to near 5,000 feet AGL over Latah County and near 5,000 feet AGL on the Nez Perce Tribe air shed and Idaho County in the afternoon.
 VENTILATION: POOR to MARGINAL in the morning becoming GOOD over Latah County and GOOD over Nez Perce and Idaho County air sheds.

AIRSHED Recommendations: WATCH for gusty afternoon winds at times.

Latah County: Burn
 Weippe Prairie/Clearwater County: Burn
 Camas Prairie/Idaho County: Burn

LOCAL TIME										
County	08	09	10	11	12	13	14	15	16	17
Boundary	P	P	P	M	G	G	G	G	G	G
Latah	P	P	P	M	G	G	G	G	G	G
Clearwater	P	P	P	M	G	G	G	G	G	G
Lewis	P	P	P	M	G	G	G	G	G	G
Nez Perce	P	P	P	M	G	G	G	G	G	G
Idaho	P	P	P	M	G	G	G	G	G	G

VENTILATION KEY: P = Poor M = Marginal G = Good E = Excellent

Figure 6. Weather forecast prepared by Bennett Fire Weather Services, LLC, for Central SMA.

Table 1. Air quality PM_{2.5} monitoring data for October 3 (1-hour average).

Date	Time	PM _{2.5} (µg/m ³)					
		Grangeville	Moscow	Potlatch	Genesee	Kendrick	Lewiston
10/3/2012	1:00 AM	2	1.8	2.6	2.1	2.2	1.8
10/3/2012	2:00 AM	-1.3	1.7	2.7	1.9	2.3	2.5
10/3/2012	3:00 AM	0.3	1.6	2.1	2	2.5	2.5
10/3/2012	4:00 AM	-1.4	1.5	1.1	2.1	2.3	2.3
10/3/2012	5:00 AM	0.2	2.5	1.1	2.1	2.3	2.4
10/3/2012	6:00 AM	0.9	2.4	3.1	2.1	2.8	2.3
10/3/2012	7:00 AM	4.6	4.6	4.7	2.2	4.1	4.6
10/3/2012	8:00 AM	3.4	5.4	No Data	4	3.7	3.9
10/3/2012	9:00 AM	1.1	5.7	No Data	2.5	3.8	6.5
10/3/2012	10:00 AM	-1	6.1	4.7	2.1	3.2	5.5
10/3/2012	11:00 AM	-0.9	10.1	5.9	4.1	No Data	1.6
10/3/2012	12:00 PM	0.3	12.3	7.1	7.1	8.1	0.8
10/3/2012	1:00 PM	5	15.1	6	10.4	6.4	11.1
10/3/2012	2:00 PM	11.4	14.1	8.4	32.5	8.5	39.4
10/3/2012	3:00 PM	24	11.4	9.6	11.1	9	35.4
10/3/2012	4:00 PM	35.1	10.1	3.7	10.1	12.2	15.4
10/3/2012	5:00 PM	44	9.7	2.8	12.3	16	7.5
10/3/2012	6:00 PM	45.9	4.2	2.9	15.4	19.8	11.7
10/3/2012	7:00 PM	34.2	3.8	3.8	11.4	21.7	24.2
10/3/2012	8:00 PM	25.3	1.9	3	3.5	21	27.6
10/3/2012	9:00 PM	16.4	2.9	3.8	3.5	16.8	14.5
10/3/2012	10:00 PM	22.7	2.1	5.4	3.4	13.8	11.7
10/3/2012	11:00 PM	34.8	2.4	6.8	4.3	10	19.5
10/3/2012	12:00 AM	35.9	1.3	4.1	4	8.4	21.3

Table 2. Air quality PM_{2.5} monitoring data for October 3 (4-hour rolling average).

Date	Time	PM _{2.5} (µg/m ³)					
		Grangeville	Moscow	Potlatch	Genesee	Kendrick	Lewiston
10/3/2012	1:00 AM	1.4	2.5	2.6	2.3	2.4	2.6
10/3/2012	2:00 AM	0.1	2.1	2.6	2.1	2.2	2.4
10/3/2012	3:00 AM	0.7	1.8	2.5	2.1	2.3	2.5
10/3/2012	4:00 AM	0.1	1.7	2.1	2.0	2.3	2.3
10/3/2012	5:00 AM	0.6	1.8	1.8	2.0	2.4	2.4
10/3/2012	6:00 AM	0.0	2.0	1.9	2.1	2.5	2.4
10/3/2012	7:00 AM	1.1	2.8	2.5	2.1	2.9	2.9
10/3/2012	8:00 AM	2.3	3.7	3.0	2.6	3.2	3.3
10/3/2012	9:00 AM	2.5	4.5	3.9	2.7	3.6	4.3
10/3/2012	10:00 AM	2.0	5.5	4.7	2.7	3.7	5.1
10/3/2012	11:00 AM	0.7	6.8	5.3	3.2	3.6	4.4
10/3/2012	12:00 PM	0.1	8.6	5.9	4.0	5.0	3.6
10/3/2012	1:00 PM	0.9	10.9	5.9	5.9	5.9	4.8
10/3/2012	2:00 PM	4.0	12.9	6.9	13.5	7.7	13.2
10/3/2012	3:00 PM	10.2	13.2	7.8	15.3	8.0	21.7
10/3/2012	4:00 PM	18.9	12.7	6.9	16.0	9.0	25.3
10/3/2012	5:00 PM	28.6	11.3	6.1	16.5	11.4	24.4
10/3/2012	6:00 PM	37.3	8.9	4.8	12.2	14.3	17.5
10/3/2012	7:00 PM	39.8	7.0	3.3	12.3	17.4	14.7
10/3/2012	8:00 PM	37.4	4.9	3.1	10.7	19.6	17.8
10/3/2012	9:00 PM	30.5	3.2	3.4	8.5	19.8	19.5
10/3/2012	10:00 PM	24.7	2.7	4.0	5.5	18.3	19.5
10/3/2012	11:00 PM	24.8	2.3	4.8	3.7	15.4	18.3
10/3/2012	12:00 AM	27.5	2.2	5.0	3.8	12.3	16.8

Table 3. Air quality PM_{2.5} monitoring data for October 3 (24-hour daily average).

Date	PM _{2.5} (µg/m ³)					
	Grangeville	Moscow	Potlatch	Genesee	Kendrick	Lewiston
10/2/2012	7.3	8.3	11.1	7.7	11.8	11
10/3/2012	14.2	5.6	4.3	6.5	8.7	11.4
10/4/2012	27.7	6.7	4.2	10.1	13.4	13.7

Burn Information

The following is a summary of field notes for burns in Latah and Idaho Counties on October 3. Burns throughout the Central SMA went well on this day. Smoke lifted and upper level winds dispersed the smoke. Latah County—specifically Moscow, Potlatch, and Kendrick areas—showed no impact from wildfires or other agency burning during the burn window. In Grangeville (Idaho County), wildfire smoke began to enter the area at 1:30 p.m. The Grangeville field coordinator shut down burning at this time. Lewiston and Genesee in Nez Perce County were impacted by smoke from other agency burning at approximately 2 p.m. DEQ contacted all growers in Latah and Clearwater Counties (fields were approved for Nez Perce County, but no burning was conducted) and required a shut-down of all DEQ-approved crop residue burning in the Central SMA that were not already ignited. DEQ-approved crop residue burning did not impact any institutions with sensitive populations (ISPs) on October 3.

Weather Analysis by Meteorologist

The daily forecast for October 3 was prepared by Gary Bennett, the contract meteorologist for the Nez Perce Tribe of Idaho, ERWM Smoke Management Division (NPT) and Idaho State Department of Environmental Quality (IDEQ).

The forecast weather on October 3, 2012 was not unusual meteorologically for this time of the year. In the past, agencies had burned numerous times with the weather pattern similar to the pattern experienced on this day. The following discussion will describe the meteorological events leading up to the smoke intrusion, weather analysis tools, satellite pictures, and observations from the Camas and Weippe Prairies in northern Idaho.

The weather pattern of Wednesday was beginning to take shape on the day before. A cold upper level low and trough were digging southeast across southern British Columbia. The jet stream was positioned over northern Idaho. Very cold arctic air was diving south through Alberta, Canada. The cold low and its associated trough moved southeast into Montana, east of the Continental Divide, pulling the cold air mass with it. The cold air mass would also continue into Montana setting up the weather pattern for Wednesday October 3 (Figure 7).

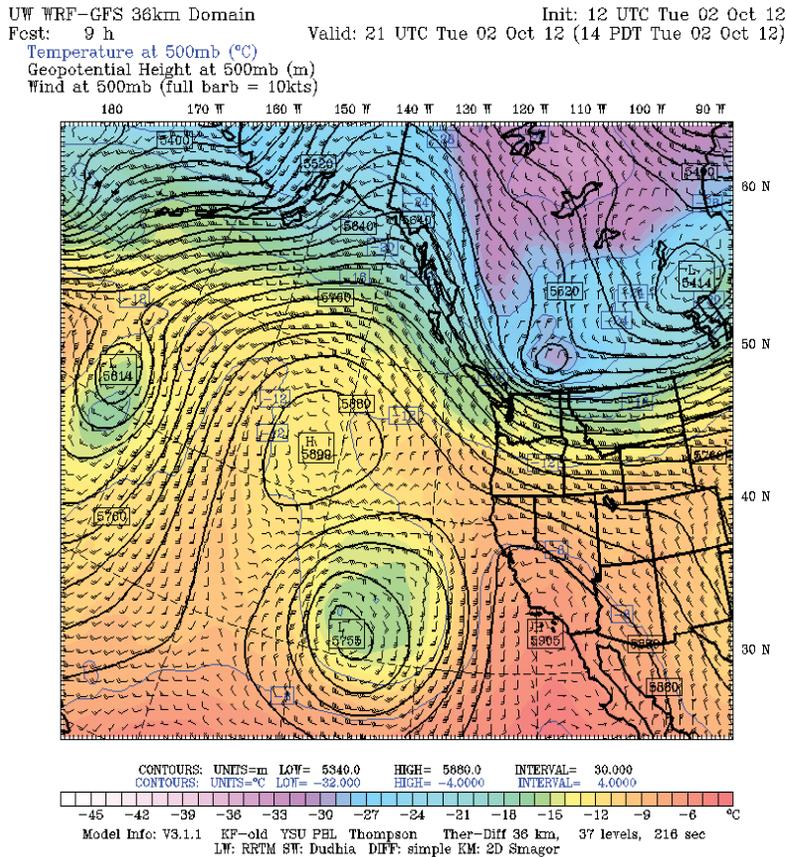


Figure 7. Temperature at 500 millibar chart for October 2, 2012.

By Wednesday afternoon the cold upper level trough had dug into eastern Montana. Importantly, a strong high pressure ridge was built over the Washington coast with an upper low well off the California coast. This particular weather pattern is known as a “Rex block,” which caused very

little movement in the three dominant upper level features over next few days. The cold air north of Montana fortified the trough and blocking pattern for the rest of the week (Figure 8).

The steering flow aloft was from the northwest as northern Idaho was situated on the leading edge of the high pressure ridge producing subsidence aloft. Subsiding air occurred with each and every high pressure area. The effect created an inversion aloft thereby reducing the mixing heights over the region.

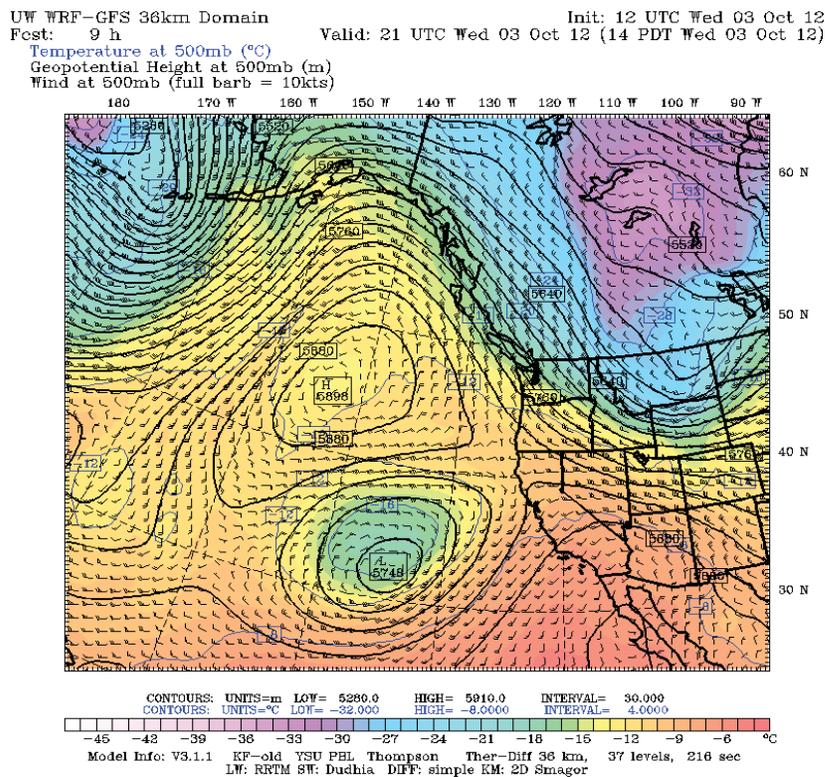


Figure 8. Temperature at 500 millibar chart for October 3, 2012.

The mid-level 850 millibar (mbs) graphic at approximately 5,000 feet MSL over the Inland Northwest shows an easterly component to the wind (Figure 9). The easterly component was due to the cold push of air with higher pressure sweeping into Montana and lower pressure and a little warmer air over northeast Oregon. The height contours at 850 mbs are quite compact thereby yielding a stronger wind at this level of the lower atmosphere. The easterly flow at 850 mbs was a down slope flow for the Camas and Weippe Prairies. All of northern Idaho was subjected to an easterly or down slope wind event under which agencies have burned effectively in the past.

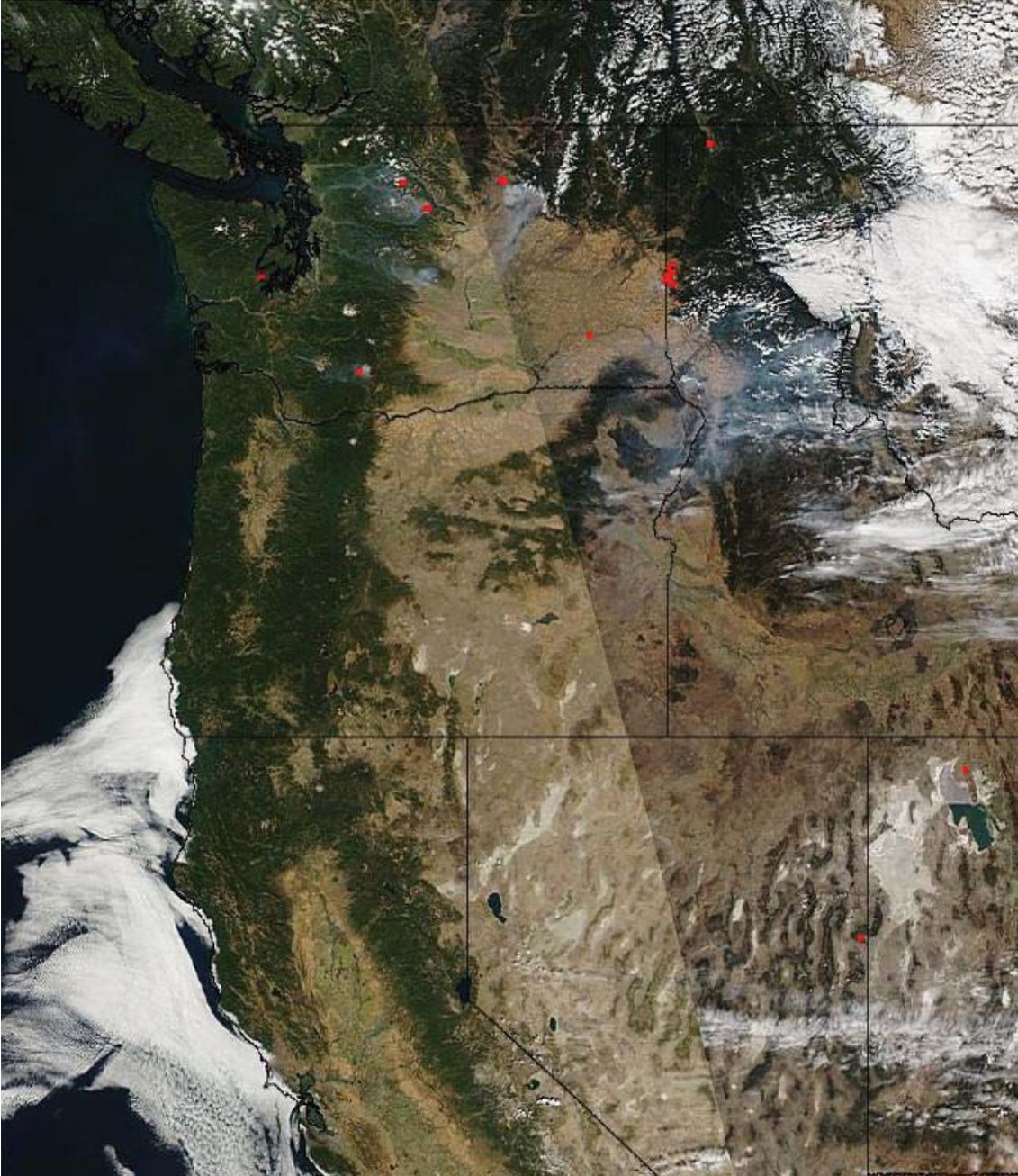


Figure 10. MODIS visual satellite photo.

The MM5 GFS surface analysis graphic also shows the easterly down slope component to the wind through the entire Clearwater Air Shed (Figure 11). The cold air mass over Montana (green) and the warmer air mass over eastern Washington (yellows) definitely shows the wind and smoke flowed into the Clearwater Air Shed. The depth of the easterly or down slope can be measured as high as approximately 10,000 feet on October 3. Also the mixing height on October 3 was higher than had experienced in the preceding several days. The soundings for Winchester and Grangeville, ID had forecasted mixing heights around 5-6,000 feet above ground level (AGL, Figures 12 and 13). Given this data and the type of pattern experienced this should have been a good burn day.

UW WRF-GFS 12km Domain
Fest: 9 h
Temperature at 925 mb (°C)
Sea Level Pressure (hPa)

Init: 12 UTC Wed 03 Oct 12
Valid: 21 UTC Wed 03 Oct 12 (14 PDT Wed 03 Oct 12)
Wind at 10m (full barb = 10kts)

Model Info: V3.1.1 KP-old YSU PBL Thompson Ther-Diff 12 km, 37 levels, 72 sec
LW: RRTM SW: Dudhia DIFF: simple KM: 2D Smagor

Figure 11. Temperature at 925 millibar chart for October 3, 2012.

14

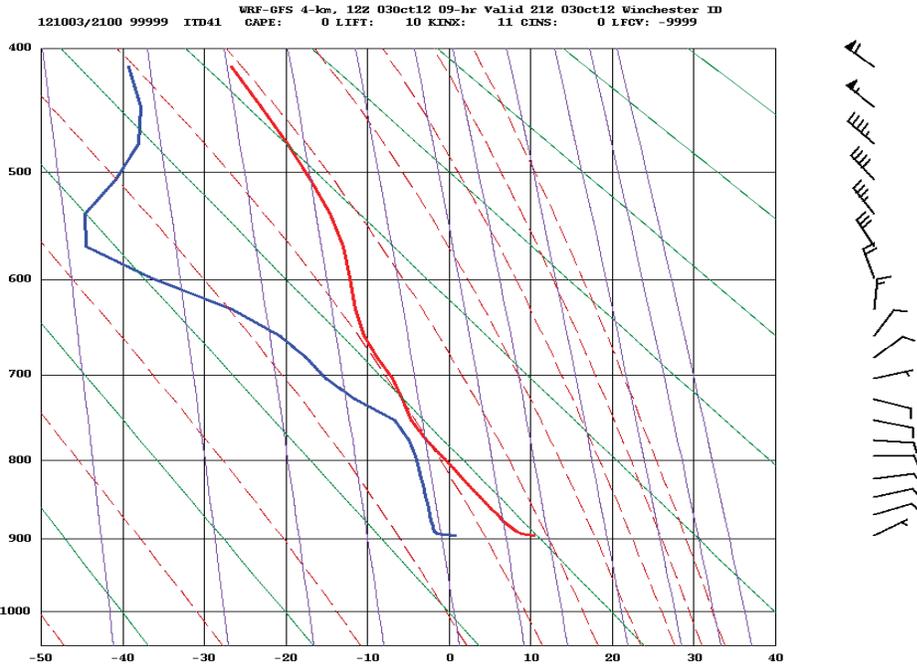


Figure 12. The model sounding data for Winchester, ID.

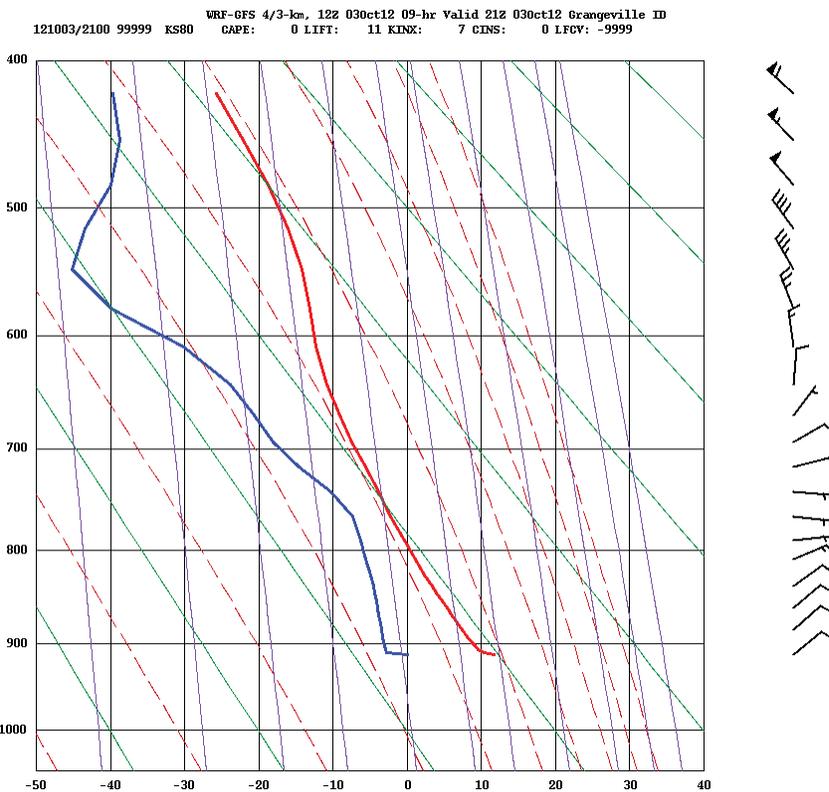


Figure 13. The model sounding data for Grangeville, ID.

The forecasted higher mixing heights and ample surface and low level mixing should have supported very good ventilation over the entire Clearwater Air shed. Figure 14 puts the air shed in the good category for the day.

UW MM5-GFS 1.33km Domain
 Fcst: 9 h

Init: 12 UTC Wed 03 Oct 12
 Valid: 21 UTC Wed 03 Oct 12 (14 PDT Wed 03 Oct 12)

Ventilation Index averaged over last 3 hrs (m^2/s)
 Winds at 10m averaged over last 3 hrs (full barb = 10kts)

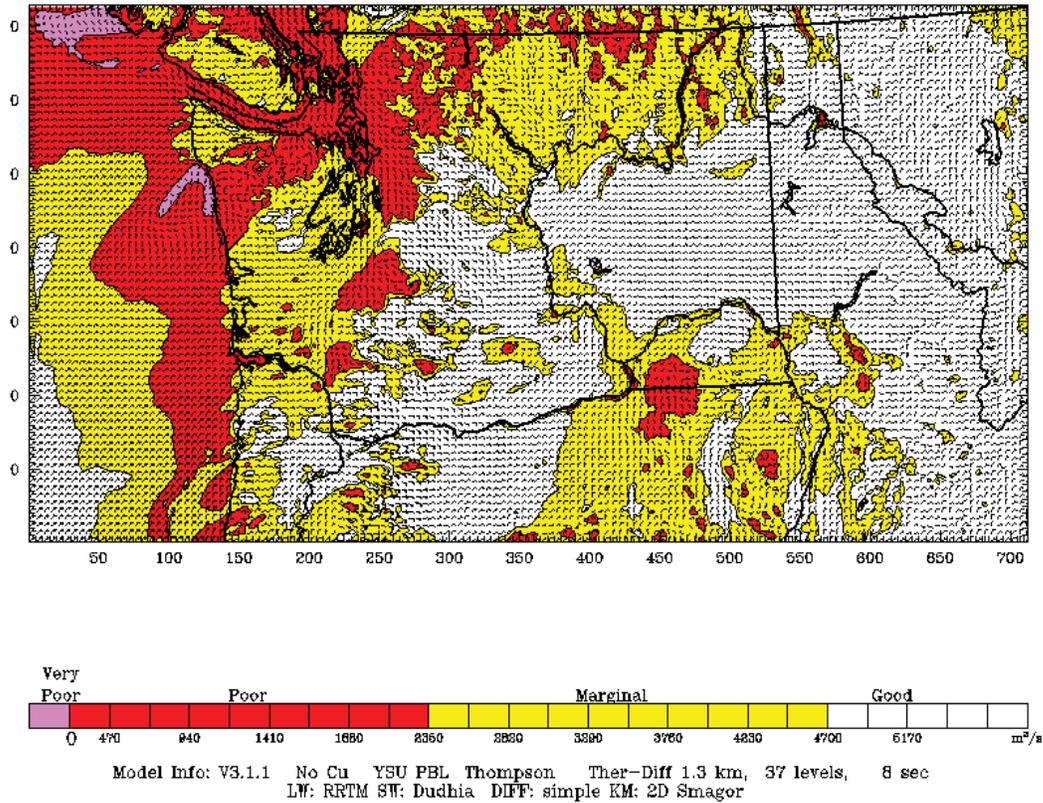


Figure 15. 1.33 high resolution GFS ventilation graphic on October 3, 2012.

The following photos were taken during the smoke event were very helpful in visualizing the impact on the region (Figures 16 and 17).



Figure 16. View of Lewiston valley on October 3, 2012. Photo from DEQ webcam.



Figure 17. Location unknown. View of airshed on October 3, 2012.

CONCLUSIONS

After examining all the data, pictures, and comments, a couple of things stood out to the meteorologist. First was the wildfire smoke from multiple wildfires burning in the Nez Perce, Clearwater and Lolo National Forests. The smoke from these fires played a large part in the behavior of field burns on October 3. Smoke from fires lit early during the burn day was still mostly aloft and burns were going smoothly at the time. As the low level mixed out with warming daytime temperatures the wildfire smoke abruptly dropped to the surface aided by the easterly down slope wind at the surface and in the lower levels of the atmosphere.

The wildfire smoke “coupled up” with the earlier “field burns” and compounded the smoke event. Field observers stated that “it seemed like a marine push from the east,” which is a very correct statement. Meteorologically speaking that was the same type of effect a marine push has on smoke at the surface and aloft under the marine layer in the Columbia Basin. The wildfire smoke aloft also could have had an influence on the daytime temperature never attaining its potential in time. Another field observer commented the “wildfire smoke just poured into the burn area,” which was from the same sinking air coming from the down slope winds.

The Coeur d’ Alene Tribe did not have the wildfire impact on their burns on October 3. This was due to the east winds and a lack of wild fire activity adjacent to the field burns. Therefore they burned nearly 4,000 acres very effectively.

This type of smoke event has been experienced before from prescribed burns, but not so much from wild fires.

Suggestions for the Future

In the future DEQ in the Central SMA will restrict burning on days with east winds forecasted. DEQ will advise other agencies to do so as well.

Appendix E. Detailed Summary of Burn Days for the Boundary County SMA

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Introduction

During the 2012 burn season, there was an increase in complaints received regarding crop residue burning in Boundary County. The Idaho Department of Environmental Quality (DEQ) determined that a detailed evaluation of each burn day was necessary to fully understand the burn season and identify any improvements needed. This appendix provides an analysis of each burn and includes a justification of the burn decision, field observations, monitoring data, complaints, and an overall summary of the burn day. DEQ's Crop Residue Burning (CRB) Program operating guide provides overall guidance and procedures for implementing the program. DEQ customarily uses several tools during the burn decision process, which are described below.

Air Quality Monitors

DEQ reviews all available air quality data prior to burn approval. The location of the PM_{2.5} monitors available for Boundary County is presented in Figure 1. PM_{2.5} refers to particulate matter with an aerodynamic diameter of less than 2.5 micrometers (i.e., fine particulates). The Porthill and Copeland PM_{2.5} monitors are operated by DEQ. The monitor in Creston, British Columbia (BC), is operated by BC Environment, and the monitor in Bonners Ferry is operated by the Kootenai Tribe of Idaho (KTOI).

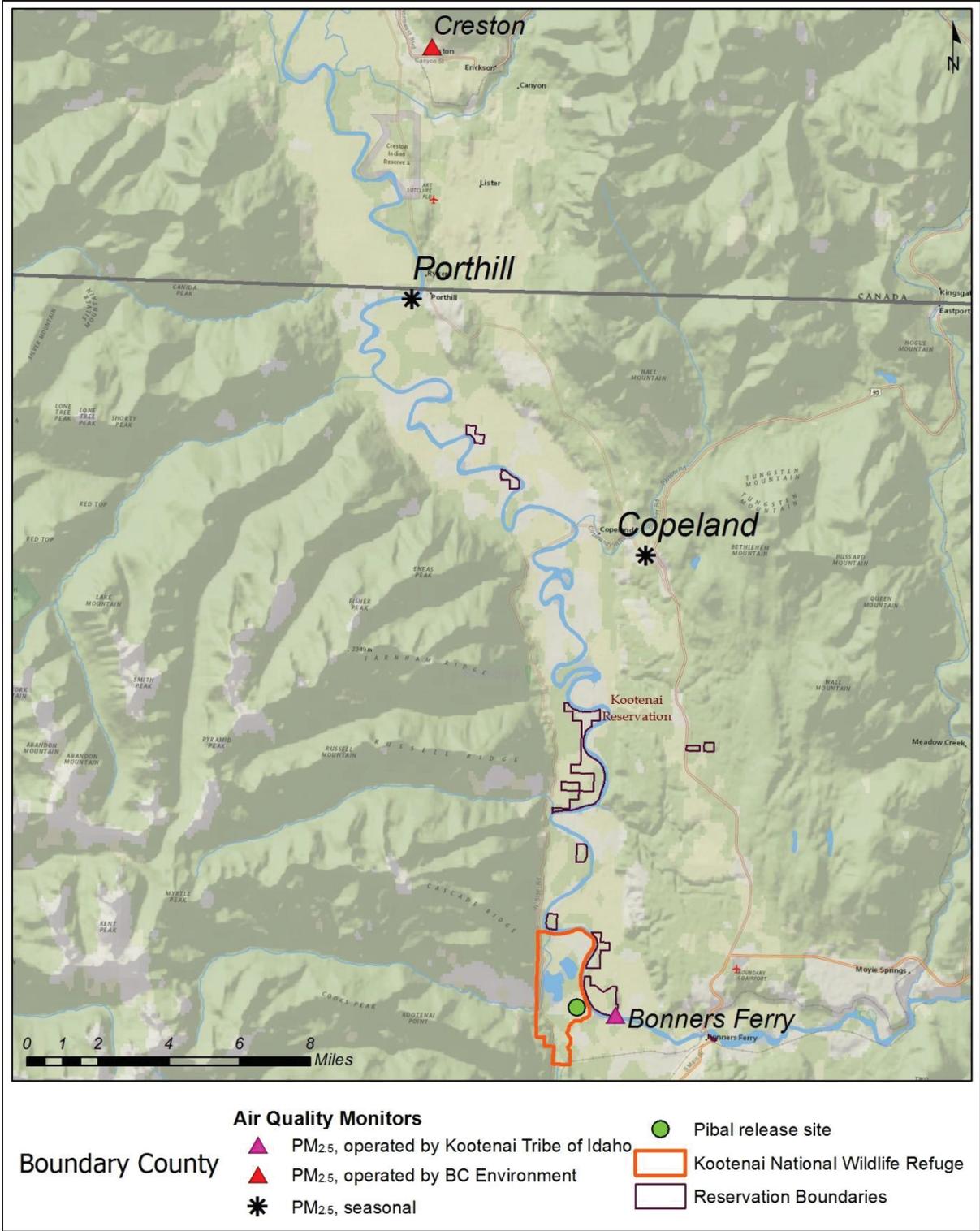


Figure 1. Location of air quality monitors available for Boundary County.

Meteorological Forecasting Tools

University of Washington Northwest Modeling Consortium (UW NWMC)—The University of Washington operates meteorological forecast models that are run twice a day and produce high resolution meteorological forecasts for use in air quality and weather forecasting. Graphical representations are produced that allow DEQ staff to review meteorological parameters important for smoke management over the entire state. The graphical representations are not archived, and therefore are not included in this report. DEQ developed a weather checklist that summarizes the forecasted winds, temperatures, and ventilations from the University of Washington forecast models for specific locations that are representative of areas where crop residue burning occur. Bonners Ferry was chosen for the location in Boundary County due to the availability of a National Weather Service (NWS) meteorological site. This tool is used the entire year.

Forecast from Bennett Fire Weather Services, LLC—DEQ contracts with a professional meteorologist during the fall burn season to provide twice daily forecasts for all areas in Idaho. The forecast includes a general weather discussion for north Idaho and detailed forecasts for specific airsheds. The detailed forecasts include the following parameters: general sky/weather, temperature, relative humidity, surface and transport wind speeds and direction, inversion strength and estimated time it will break, maximum mixing height, and overall ventilation for the day as well as forecasted hour-by-hour ventilation. The contract meteorologist also provides a burn recommendation for each airshed.

Real-Time Meteorological Tools

Meteorological stations—DEQ routinely reviews the current meteorological data at Bonners Ferry and Creston, BC. These data help identify concerns that might limit burning, such as precipitation.

Pibal data—DEQ developed an agreement with the Kootenai National Wildlife Refuge to release a pibal when requested by DEQ. Figure 1 shows the location of the pibal release in relation to the rest of the valley and air quality monitors. A pibal is a brightly colored balloon that, when tracked with a theodolite, provides data on the direction of the winds above the surface. A hodograph is produced that graphically shows the path the balloon takes as it rises in the atmosphere. This graphic shows the expected path of any smoke in the air as well. The example below shows that the balloon travelled to the south-southwest, indicating north-northeast winds (Figure 2). Dots on the hodograph indicate observational data at that point. If a burn occurred, the smoke can be expected to follow this same path. The pibal is released prior to final approval of any burns and the results, in the form of Figure 2 below, are sent to DEQ for review. This information is incorporated into the final decision of whether to allow burning or not.

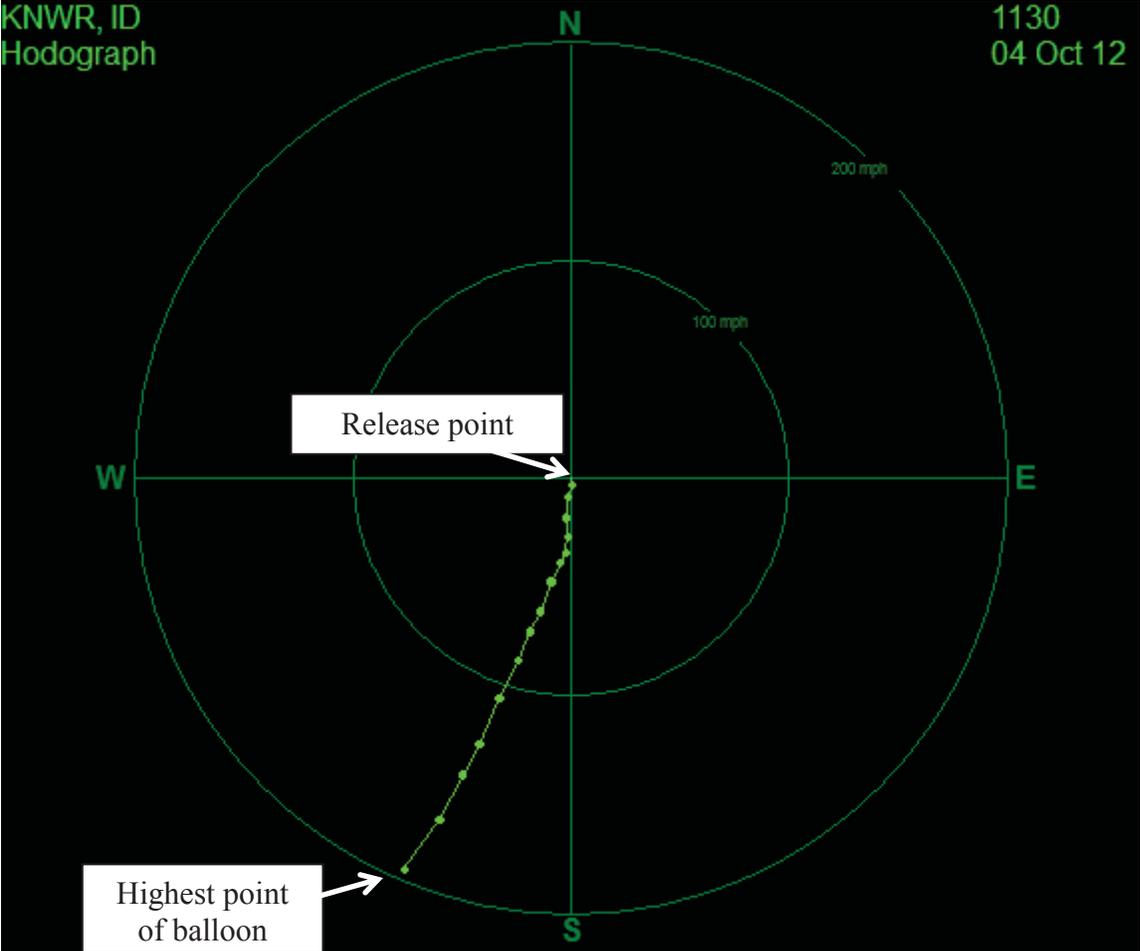


Figure 2. Hodograph derived from pibal release. Indicates a south-southwest flight path. Dots represent observational data points.

Burn Date: April 9, 2012

Burn Decision

Burn day: 1,200 acres approved—pending fuel moisture and meteorological conditions. Acreage could increase if conditions were good.

Burn Decision Justification

The burn decision was developed using NWS observations at Bonners Ferry and Creston, BC, (Table 1) and forecasted winds, ventilation, and temperatures from the UW NWMC, as displayed in DEQ's weather checklist (Figure 3). Ventilation was expected to be marginal, with surface winds generally from the east-northeast to east at 8–9 miles per hour (mph). The upper level winds were forecasted to be from the east-southeast at 15–20 mph at approximately 2,500 feet (ft) above ground level (AGL). With a north easterly wind forecasted and upper level winds, or planetary boundary layer (PBL) levels, in the 2,500 ft range, ventilation looked to be fairly good this day. Based on previous days when DEQ didn't authorize additional fields when conditions proved better than expected, DEQ identified several additional fields for potential burning in case conditions were better than forecasted or wet fuel conditions necessitated consideration of other fields.

DEQ reviewed the morning monitoring data (Table 2) for Bonners Ferry, Copeland, and Creston, BC. The maximum hourly concentrations recorded at Bonners Ferry, Copeland, and Creston were 5.9 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) at 7:00 a.m., 3.9 at 10:00 a.m., and 5.9 $\mu\text{g}/\text{m}^3$ at 2:00 a.m., respectively. These values are well below all preburn enhanced documentation triggers and indicated good ventilation in this airshed. Based on the preliminary forecast and monitoring data, a total of 1,570 acres were identified as potentially available for approval (only 1,200 acres were actually ready to burn for this airshed at this time). Any field would require verbal approval by on-site DEQ field staff prior to ignition. Figure 4 shows field locations considered for burning on this day. Final approval occurs after initial field conditions are determined suitable for attempting to burn. DEQ established a burn window of 12:00 p.m.–4:00 p.m. based on customary burn window times when atmospheric conditions support ventilation and the ventilation forecast (Figure 3).

Table 1. National Weather Service observations at Bonners Ferry (Site ID K65S).

Time (PDT)	Temp (°F)	Humidity (%)	Wind Direction	Wind Speed (mph)	Weather Conditions	Pressure (inches)	Control
09 Apr 11:15 am	52	37	N	8	CLR	27.686	OK
09 Apr 10:55 am	50	40	N	7	CLR	27.696	OK
09 Apr 10:35 am	48	40	N	10	CLR	27.696	OK
09 Apr 10:15 am	48	40	NNW	9	CLR	27.705	OK
09 Apr 9:55 am	48	37	NNW	10	CLR	27.714	OK
09 Apr 9:35 am	46	46	N	8	CLR	27.714	OK
09 Apr 9:15 am	46	46	N	6	CLR	27.724	OK

Time (PDT)	Temp (°F)	Humidity (%)	Wind Direction	Wind Speed (mph)	Weather Conditions	Pressure (inches)	Control
09 Apr 8:55 am	45	49	N	7	CLR	27.714	OK
09 Apr 8:35 am	43	49	CALM	n/a	CLR	27.724	OK
09 Apr 8:15 am	43	49	N	5	CLR	27.724	OK
09 Apr 7:55 am	41	52	CALM	n/a	CLR	27.714	OK
09 Apr 7:35 am	39	56	CALM	n/a	CLR	27.714	OK
09 Apr 7:15 am	36	69	CALM	n/a	CLR	27.714	OK
09 Apr 6:55 am	32	74	CALM	n/a	CLR	27.724	OK
09 Apr 6:35 am	32	74	CALM	n/a	CLR	27.733	OK
09 Apr 6:15 am	34	69	CALM	n/a	CLR	27.733	OK
09 Apr 5:55 am	36	64	CALM	n/a	CLR	27.733	

Morning Forecasting for Boundary														
Model Resolution:	12km			Model Run:	2012040900			SiteID:	IBONY					
Date	Time in PDT												Comments	
4/9/2012	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM		
Vent. Index	P	M	M	M	M	M	P	P	P	NP	NP	NP		
G: good, M: marginal, P: poor, NP: very poor														
Surface (20m) Winds	Direction	ENE	ENE	ENE	ENE	E	E	E	E	E	ENE	ENE	ENE	5 kts = 5.75 mph,
	Speed (mph)	6.2	7.4	8.2	8.5	8.6	8.5	8.1	7.4	5.9	4.2	3.7	3.6	10 kts = 11.5 mph,
Surface (20m) Temperature (degree C)	6.3	7.5	8.3	8.8	9.1	9.3	9.2	8.7	8.0	7.1	6.5	6.0	15 kts = 17.25 mph	
Surface (20m) Relative Humidity (%)	49.9	46.2	44.2	43.7	44.0	44.5	45.9	48.6	51.8	57.0	59.3	60.9		
Planetary Boundary Layer (PBL)	Height (feet)	2037	2448	2520	2503	2487	2402	1860	1401	889	157	59	59	Height is above model terrain surface
	Direction	ESE	ESE	ESE	ESE	ESE	ESE	ESE	ESE	E	ENE	ENE	ENE	
	Speed (mph)	24.4	22.0	20.4	19.0	17.7	17.3	16.6	15.4	13.7	6.5	3.7	3.6	
700mb (~10,000 ft MSL)	Height (feet)	7155	7155	7155	7155	7155	7155	7155	7155	7155	7155	7155	7155	Height is above model terrain surface
	Direction	S	S	S	S	S	S	S	S	SSW	SSW	SW	SW	
	Speed (mph)	2.0	4.8	8.1	11.9	14.0	15.7	19.3	21.6	22.7	21.0	19.7	19.6	
850mb (~5000 ft MSL)	Height (feet)	2292	2292	2043	2043	2043	2043	2043	2043	2043	2043	2043	2043	Height is above model terrain surface
	Direction	ESE	ESE	E	ESE	ESE	ESE	ESE	ESE	SE	SE	SE	SE	
	Speed (mph)	25.6	22.0	19.1	18.1	17.1	16.8	16.9	17.3	17.5	17.7	17.4	15.8	

Figure 3. Weather checklist for Bonners Ferry. Information taken from the University of Washington Northwest Modeling Consortium forecast model.

Table 2. Available PM_{2.5} monitoring data prior to burn decision

Date	Time	PM _{2.5} (µg/m ³)		
		Bonnors Ferry (KTOI)	Copeland	Creston, BC
4/9/2012	1:00 AM	5.3	3.3	3.80
4/9/2012	2:00 AM	5.9	3.4	3.50
4/9/2012	3:00 AM	5.8	3.4	4.80
4/9/2012	4:00 AM	5.1	3.4	4.80
4/9/2012	5:00 AM	5.1	3.3	4.20
4/9/2012	6:00 AM	5	3.3	5.70
4/9/2012	7:00 AM	5	3.3	5.90
4/9/2012	8:00 AM	5	3.2	4.70
4/9/2012	9:00 AM	3.2	3.4	3.30
4/9/2012	10:00 AM	2.4	3.9	2.90
4/9/2012	11:00 AM	2.2	3.3	2.00

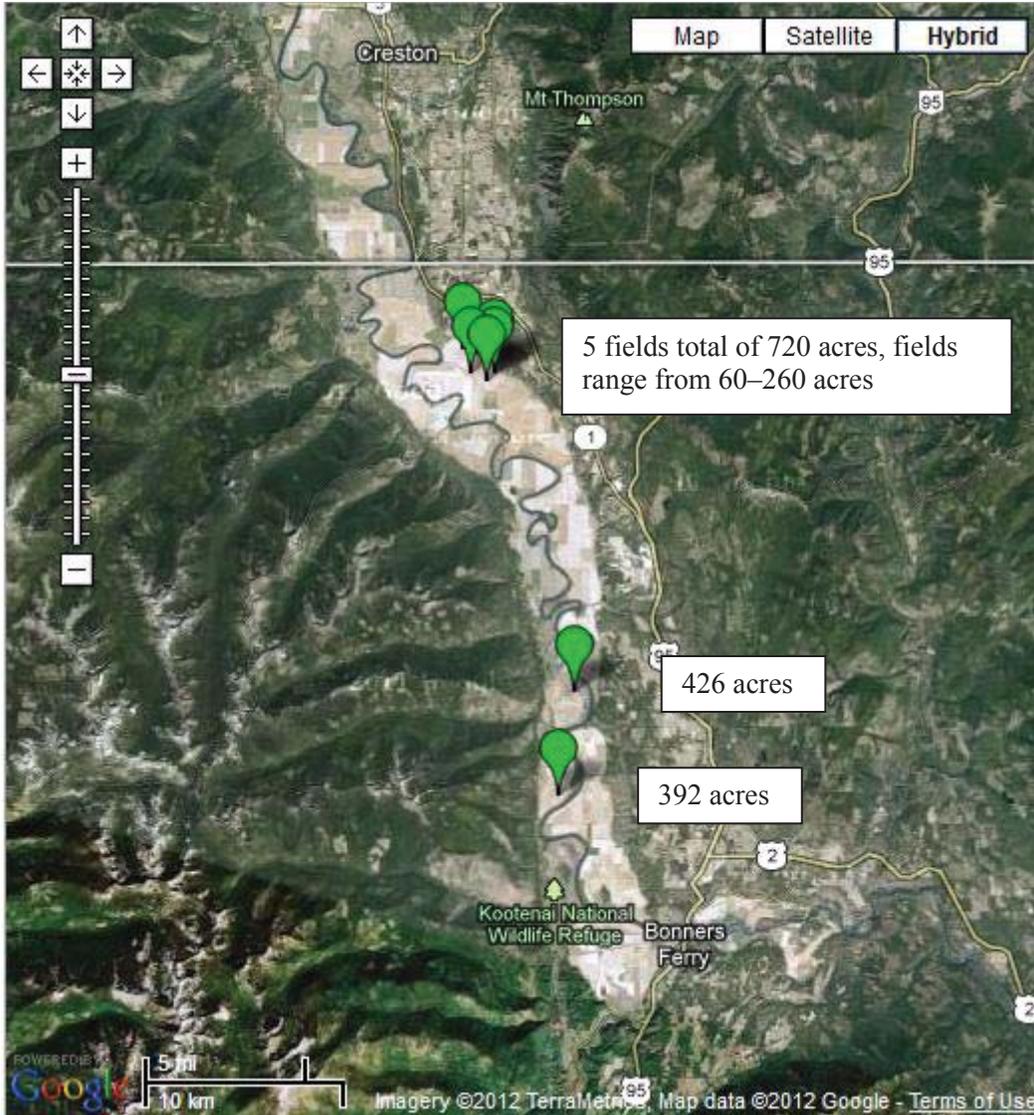


Figure 4. Map of approved fields for April 9, 2012.

Field Observations

Field observations were made to verify the meteorological forecast prior to burning. The temperature was 13 °F warmer than forecasted. Northeast wind was observed as expected. Relative humidity measured 31%, much lower than the forecasted 44%. Conditions in the fields indicated moderate or better ventilation could be expected. The first field, a 392-acre wheat field, was given final verbal approval and ignited at 12:05 p.m. Fair to good smoke dispersion was observed. The smoke had good initial lift with a smoke column staying vertical and moving initially to the south-southwest. Smoke continued moving up into the mountainous areas to the southwest of the field. Column height was initially identified as 500 ft AGL with good/excellent lift. Winds continued out of the northwest at 5 mph. Based on the good to excellent smoke dispersion, DEQ gave a second field verbal approval. As the day progressed, smoke columns from the various fields reached up to 2,500 ft AGL. Smoke dispersion continued to be described as “excellent” by DEQ field observers.

Two fields (approximately 820 acres) were burned in the middle part of the valley and three fields (approximately 360 acres) in the northern part of the valley. Wind directions were noted in the field as having a northeast component, which pushed most of the smoke to the southwest into the mountains. Transport dispersion for the southern fields was good to excellent, while horizontal dispersion was good. After burning was complete at approximately 2:30 p.m. local time, horizontal smoke dispersion (closer to ground) was considered fair, meaning some smoke remained closer to the ground; however, this smoke was well to the west in the uninhabited areas. Vertical/transport dispersion continued to be good to excellent throughout the day. Observations indicated that column heights from the earlier burns were extended to approximately 1,500 ft AGL. These increased to approximately 2,000–2,500 ft AGL later in the day. The fields in the north were burned with similar results. Burning started in the north around 1:00 p.m. and fields were mostly out by 2:15 p.m. The DEQ field coordinator was not on site to observe field conditions in the northern burns; however, he was in contact with the grower throughout the ignitions and could observe smoke behavior from these fields. Northern field smoke had good dispersion with smoke moving to the southwest toward the mountains. The grower on site specifically mentioned that no smoke was moving towards Creston, BC.

A total of 5 fields (1,180 acres) were given verbal approvals for ignition this day. All burning was complete by 2:30 pm. Only 3 of the 5 northernmost fields that were ready to burn were given final verbal approval (Figure 4).

Table 3 includes the monitoring data during and after the burns. The maximum hourly PM_{2.5} concentration at any of the monitors was 15.0 µg/m³, recorded at Creston, B.C., at 8:00 p.m. This value is below all enhanced documentation triggers and program concentration limits. Based on wind direction, observations, and smoke transport, the elevated concentrations were not likely caused by burning in Boundary County.

Table 3. Air quality PM_{2.5} monitoring data during and after burning.

Date	Time	PM _{2.5} (µg/m ³)		
		Bonnors Ferry (KTOI)	Copeland	Creston, BC
4/9/2012	12:00 PM	2.1	2.7	2.20
4/9/2012	1:00 PM	9.6	3.2	1.70
4/9/2012	2:00 PM	10	3.2	2.10
4/9/2012	3:00 PM	7.6	5.1	3.50
4/9/2012	4:00 PM	6.8	4.9	4.50
4/9/2012	5:00 PM	4.8	5.6	8.10
4/9/2012	6:00 PM	4	7.7	5.90
4/9/2012	7:00 PM	3.7	6.0	12.30
4/9/2012	8:00 PM	4.1	5.4	15.00
4/9/2012	9:00 PM	10.6	4.2	7.10
4/9/2012	10:00 PM	10.7	3.8	7.20
4/9/2012	11:00 PM	11.3	3.7	6.50
4/9/2012	12:00 AM	9.8	4.4	7.40

One complaint was received about this burn day. The complaint was received by the toll-free complaint hotline on April 10, 2012. The complainant was in Creston and saw a lot of smoke and wasn't sure if any agricultural burning took place on April 9. Based on smoke observations, DEQ determined that smoke from DEQ-approved crop residue burning was not likely the cause of the monitored impact nor likely impacting the complainant. The complainant indicated that the farmers in Canada had done some burning and that the burns went bad and the smoke hit Creston. This was confirmed on April 10 when a BC Canada Ministry of Environment air quality meteorologist contacted DEQ and reported road dust and an agriculture burn near Creston did not ventilate this day.

Summary

Five fields, a total of approximately 1,180 acres, were burned this day in Boundary County. Observed meteorological conditions were as good as or better than forecasted. Ventilation was forecasted to be moderate and field observations noted good to excellent dispersion. Observed winds showed more of a northerly component than was forecasted. Observed temperature was warmer than forecasted, while observed relative humidity was much lower than forecasted. The maximum mixing height was forecasted to be 2,450 ft AGL. The smoke behavior indicated mixing occurred in the 1,500–2,500 ft range. The warmer and drier than expected weather conditions may have helped to provide for the good dispersion this day. The winds had a slightly more northerly component than expected; however, this wind direction was optimal for burns located in the northern valley locations and proved advantageous for burning.

Burn Date: April 10, 2012

Burn Decision

Burn day: up to 1,570 acres approved—pending fuel moisture and meteorological conditions.

Burn window: 12–4 p.m.

Burn Decision Justification

This burn decision was developed using NWS observations at Bonners Ferry and Creston, BC, (Table 4) and forecasted winds, ventilation, and temperatures from the UW NWMC, as displayed in DEQ's weather checklist (Figure 5). Ventilation was expected to be poor to marginal, with surface winds generally from the east to southeast at 7–8 mph. The upper level winds were forecasted to be from the east-southeast to southeast at 19 mph at an elevation of 2,100 ft AGL. Easterly winds are favorable for burning fields located in the northern section of this airshed and need to be utilized when conditions are appropriate. DEQ also considered the results of burning on the previous day. The forecasted mixing heights, wind speeds, and wind directions were similar to the day before, when smoke ventilated from the airshed very effectively.

DEQ reviewed the monitoring data (Table 5) for Bonners Ferry, Copeland, and Creston, BC. The maximum hourly PM_{2.5} concentrations recorded at Bonners Ferry, Copeland, and Creston were 11.3 µg/m³, 7.7 µg/m³, and 15.0 µg/m³, respectively. All of these maximum concentrations

occurred on April 9 (the day prior) and were well below all preburn enhanced documentation triggers. These values demonstrate that the airshed was very well mixed at this time.

Eleven fields, a total of 1,570 acres of cereal grain stubble, were approved for this day (Figure 6). DEQ set a burn window of 12–4 p.m. because this is the time of day when atmospheric conditions provide the best opportunity for smoke ventilation and the information in Table 4 suggested ventilation conditions were most favorable during this time. Since observed conditions the day before far exceeded the forecasted conditions, DEQ anticipated this day’s forecast may be under-predicting conditions conducive to good burning and moved forward expecting similar results. All growers were contacted directly via telephone and instructed to wait until they heard from the field coordinator before burning. The growers in this area work closely with the field coordinator each day. From the list of potential burns this day, we did not identify any potential problems.

Table 4. National Weather Service observations at Bonners Ferry (Site ID K65S).

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
4-10-2012 5:55 PDT	35.6	75	0	n/a	Clear	OK
4-10-2012 6:15 PDT	35.6	75	0	n/a	Clear	OK
4-10-2012 6:35 PDT	35.6	75	0	n/a	Clear	OK
4-10-2012 6:55 PDT	39.2	65	0	n/a	Clear	OK
4-10-2012 7:15 PDT	37.4	81	0	n/a	Clear	OK
4-10-2012 7:35 PDT	39.2	70	0	n/a	Clear	OK
4-10-2012 7:55 PDT	39.2	75	0	n/a	Clear	OK
4-10-2012 8:15 PDT	41	70	0	n/a	Clear	OK
4-10-2012 8:35 PDT	41	70	0	n/a	Clear	OK
4-10-2012 8:55 PDT	44.6	61	0	n/a	Clear	OK
4-10-2012 9:15 PDT	44.6	61	3.5	20	Clear	OK
4-10-2012 9:35 PDT	46.4	57	0	n/a	Clear	OK
4-10-2012 9:55 PDT	46.4	57	0	n/a	Clear	OK
4-10-2012 10:15 PDT	48.2	53	0	n/a	Clear	OK
4-10-2012 10:35 PDT	50	50	0	n/a	Clear	OK
4-10-2012 10:55 PDT	51.8	47	0	n/a	Lt rain	OK
4-10-2012 11:15 PDT	53.6	44	4.6	310	Clear	OK
4-10-2012 11:35 PDT	53.6	44	8.1	300	Clear	OK

Morning Forecasting for Boundary														
Model Resolution:	12km			Model Run:	2012041000			SiteID:	IBONY					
Date		Time in PDT											Comments	
4/10/2012		10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	
Vent. Index		P	P	P	M	M	P	P	P	NP	NP	NP	NP	
G: good, M: marginal, P: poor, NP: very poor														
Surface (20m) Winds	Direction	ENE	ENE	E	E	ESE	ESE	SE	SE	SE	ESE	ESE	ESE	5 kts = 5.75 mph,
	Speed (mph)	5.0	6.4	7.5	8.1	8.6	7.9	7.0	6.2	4.5	3.9	3.6	3.3	10 kts = 11.5 mph,
Surface (20m) Temperature (degree C)		9.2	10.7	11.7	12.1	12.3	12.3	11.7	10.9	9.9	9.3	8.8	8.3	15 kts = 17.25 mph
Surface (20m) Relative Humidity (%)		53.5	47.2	43.9	43.8	44.8	46.7	47.6	48.7	54.0	56.9	58.2	60.4	
Planetary Boundary Layer (PBL)	Height (feet)	1437	2021	2146	2149	2100	1883	1608	758	276	344	246	59	Height is above model terrain surface
	Direction	E	ESE	ESE	ESE	SE	SSE	SSE	SSE	SE	SE	ESE	ESE	
	Speed (mph)	18.2	20.2	19.5	19.0	19.0	16.6	12.7	9.3	7.8	6.2	5.4	3.3	
700mb (~10,000 ft MSL)	Height (feet)	7155	7155	7155	7155	7155	7155	7155	7155	7155	7155	7155	7155	Height is above model terrain surface
	Direction	SE	SE	SE	SE	SE	S	SSW	SSW	SSW	SSW	SW	SW	
	Speed (mph)	12.5	18.9	23.7	31.0	32.4	29.1	26.9	25.8	25.0	24.0	23.8	23.6	
850mb (~5000 ft MSL)	Height (feet)	2043	2043	2043	2043	2043	2043	2043	2043	2043	2043	2043	2043	Height is above model terrain surface
	Direction	ESE	ESE	ESE	ESE	SE	SSE	S	SSW	SSW	SSW	SSW	SSW	
	Speed (mph)	21.5	20.2	19.5	19.0	19.0	17.6	13.1	9.1	9.0	9.6	10.1	8.3	

Figure 5. Weather checklist for Bonners Ferry. Information taken from the University of Washington Northwest Modeling Consortium forecast model.

Table 5. Available PM_{2.5} monitoring data prior to burn decision.

Date	Time	PM _{2.5} (µg/m ³)		
		Bonners Ferry (KTOI)	Copeland	Creston, BC
4/9/2012	1:00 AM	5.3	3.3	3.80
4/9/2012	2:00 AM	5.9	3.4	3.50
4/9/2012	3:00 AM	5.8	3.4	4.80
4/9/2012	4:00 AM	5.1	3.4	4.80
4/9/2012	5:00 AM	5.1	3.3	4.20
4/9/2012	6:00 AM	5	3.3	5.70
4/9/2012	7:00 AM	5	3.3	5.90
4/9/2012	8:00 AM	5	3.2	4.70
4/9/2012	9:00 AM	3.2	3.4	3.30
4/9/2012	10:00 AM	2.4	3.9	2.90
4/9/2012	11:00 AM	2.2	3.3	2.00
4/9/2012	12:00 PM	2.1	2.7	2.20
4/9/2012	1:00 PM	9.6	3.2	1.70
4/9/2012	2:00 PM	10	3.2	2.10
4/9/2012	3:00 PM	7.6	5.1	3.50
4/9/2012	4:00 PM	6.8	4.9	4.50

Date	Time	PM _{2.5} (µg/m ³)		
		Bonnars Ferry (KTOI)	Copeland	Creston, BC
4/9/2012	5:00 PM	4.8	5.6	8.10
4/9/2012	6:00 PM	4	7.7	5.90
4/9/2012	7:00 PM	3.7	6.0	12.30
4/9/2012	8:00 PM	4.1	5.4	15.00
4/9/2012	9:00 PM	10.6	4.2	7.10
4/9/2012	10:00 PM	10.7	3.8	7.20
4/9/2012	11:00 PM	11.3	3.7	6.50
4/9/2012	12:00 AM	9.8	4.4	7.40
4/10/2012	1:00 AM	8.5	4.1	7.70
4/10/2012	2:00 AM	8.8	4.0	8.50
4/10/2012	3:00 AM	7.4	4.3	9.10
4/10/2012	4:00 AM	6.9	3.9	7.50
4/10/2012	5:00 AM	6.4	3.9	8.70
4/10/2012	6:00 AM	7.4	4.3	10.50
4/10/2012	7:00 AM	6.5	4.8	10.10
4/10/2012	8:00 AM	6.3	4.7	10.00
4/10/2012	9:00 AM	5.3	4.6	7.20
4/10/2012	10:00 AM	4.5	4.4	5.10

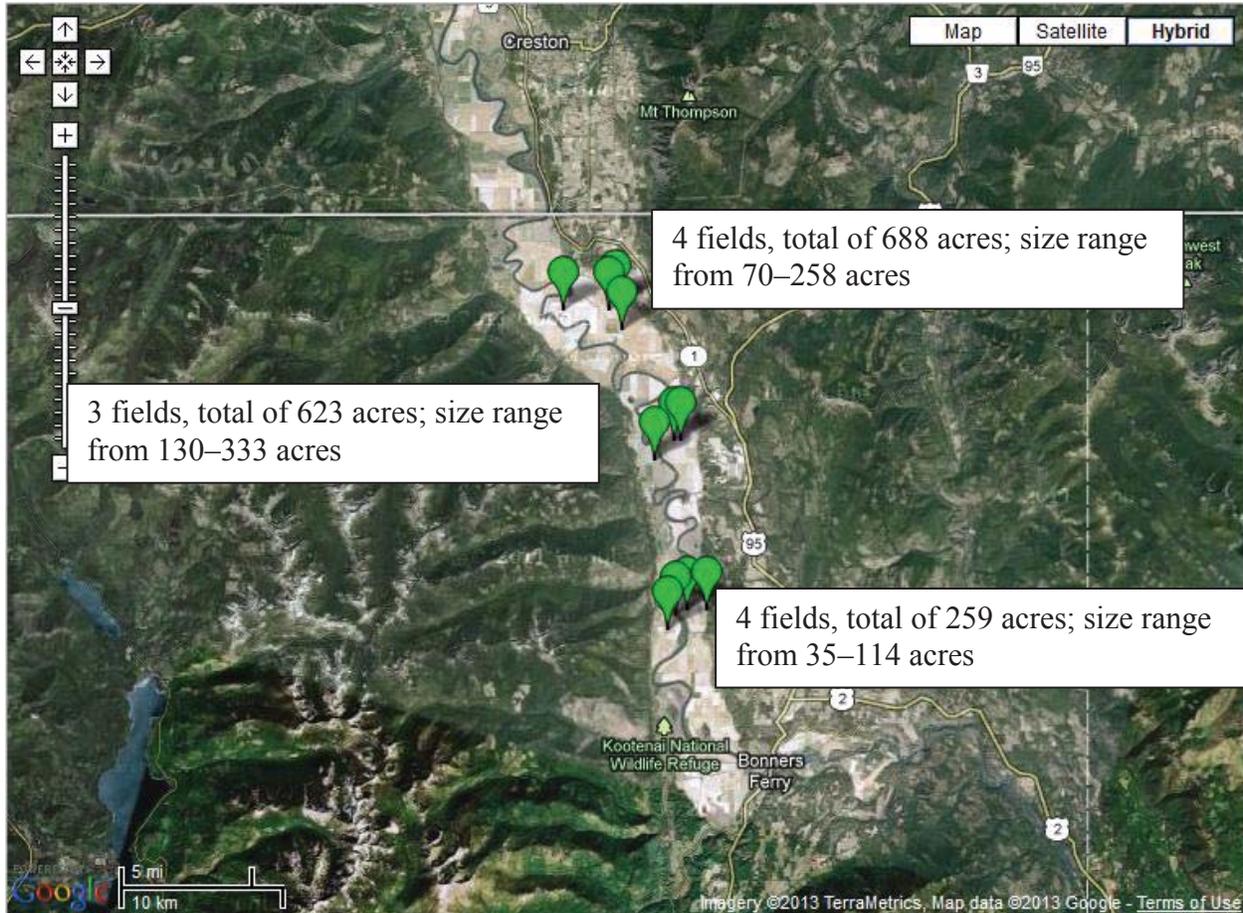


Figure 6. Map of approved fields for April 10, 2012.

Field Observations

Field observations were made prior to contacting the growers. The wind directions were not as forecasted—more northerly than the forecasted easterly winds. Conditions in the fields indicated moderate surface ventilation. The field coordinator approved only 3 acres of the registered 333-acre field in the north. This field is planted in rows and must be burned in strips. These 3 acres (about 6 strips) were used as a test burn for the remaining portions of this field. Strip burning takes considerable time to complete, and because the process does not produce much heat, vertical plume rise is not optimal. However, smoke production is usually limited and the ignition process can be halted easily at any time. Higher surface winds could help ventilate smoke from this field. The 3-acre section of wheat field was ignited around 12:30 p.m. Poor vertical (upper level) transport was noted because the field did not produce enough heat to provide good lift. Good horizontal smoke dispersion was observed due to decent surface winds. The DEQ field coordinator needed a more substantial field to determine potential vertical smoke lift for the day, so one 35-acre field was also given verbal approval for ignition at 1:00 p.m.

Wind directions were noted in the field as having a northwest component, which pushed most of the smoke to the south. Transport and horizontal dispersion for the southern 35-acre field was fair. After burning was complete at approximately 1:30 p.m. local time, horizontal smoke

dispersion (closer to ground) and vertical/transport dispersion were both still considered fair. Column heights were approximately 800–1,000 ft AGL. No smoke was observed moving toward Creston, BC.

DEQ visited the other northern fields that were identified in the morning as ready to burn to determine conditions. The soil was moist and one grower decided to let the fields dry out before burning. DEQ also visited a second grower with a large field where sustained northwest winds were 8–9 mph. This direction would push any ground smoke directly towards Mt. Hall Elementary School. The DEQ field coordinator discussed this condition with the grower and he agreed the wind direction would likely equate to a poor burn day results. DEQ contacted a third grower, and winds were still out of the northwest at 8–10 mph. Even though this grower's fields were due west of the school and not likely to impact it, the lift potential and orientation of this field (long and narrow) could have produced ground smoke creating the potential for impacts to the south. The burn day was cancelled due to poor dispersion results.

Table 6 includes the monitoring data during and after the burns. The maximum hourly PM_{2.5} concentration at any of the monitors was 19.7 µg/m³, recorded at Creston, BC, at 9:00 p.m. This value is below all enhanced documentation triggers and program concentration limits. The wind direction and smoke observation at the 38 acres that were burned showed that smoke was transported south and was not likely the cause of the increased concentration at the Creston monitor. The Copeland data recorded a maximum hourly concentration of 13.2 µg/m³ at 6:00 p.m. This elevated concentration could be attributed to DEQ-approved crop residue burning this day. Wind directions much later in the day did revert to a southwest direction, which could indicate some lingering smoke in the valley from earlier burning; however, this value remained well below all enhanced documentation triggers and program concentration limits.

Table 6. Air quality PM_{2.5} monitoring data during and after burning.

Date	Time	PM _{2.5} (µg/m ³)		
		Bonnors Ferry (KTOI)	Copeland	Creston, BC
4/10/2012	11:00 AM	4.2	5.0	5.80
4/10/2012	12:00 PM	4	5.0	4.40
4/10/2012	1:00 PM	4	4.9	4.50
4/10/2012	2:00 PM	10.1	4.5	5.10
4/10/2012	3:00 PM	9.7	4.8	8.50
4/10/2012	4:00 PM	5.9	5.8	13.10
4/10/2012	5:00 PM	6.9	5.7	13.40
4/10/2012	6:00 PM	6.5	13.2	10.20
4/10/2012	7:00 PM	5.7	9.7	18.70
4/10/2012	8:00 PM	8.2	5.7	18.70
4/10/2012	9:00 PM	10.5	4.7	19.70
4/10/2012	10:00 PM	10.4	4.7	15.70
4/10/2012	11:00 PM	10.9	4.7	13.20
4/10/2012	12:00 AM	12.8	4.8	13.90

One complaint was received about this burn day. The complaint was received by the toll-free complaint hotline on April 10 at 6:17 p.m. and delivered to DEQ staff on April 13. The complainant called from Creston and saw smoke at ground level at his or her location. Based on smoke observations and wind conditions during the burn window, it is unlikely that smoke from DEQ-approved crop residue burning would have been the cause of the complaint. The timing of an initial smoke impact at Creston was at approximately 4:00 p.m. Field staff documented smoke moving to the south on this day. Surface winds did change direction later in the day, and therefore it cannot be completely ruled out that DEQ-approved crop residue burning did not contribute to the buildup. However, burning in Boundary County was limited to 38 acres this day. This small acreage is not likely to produce substantial smoke that would get transported to the south, disperse, then return north and impact Creston at the level recorded. The British Columbia, Canada Ministry of Environment, Kootenay Region, air quality meteorologist discussed the air quality of this day with DEQ and suggested elevated concentrations in Creston could have been a result of a BC agriculture burn from the day before and road dust.

Summary

A total of 38 acres of cereal grain was burned this day in Boundary County. One field, a total of 35 acres, was completely burned, while a second field, a 333-acre cereal grain field, was partially burned (only 3 acres completed).

The observed meteorological conditions were similar to the forecasted conditions except the wind direction had more of a northerly component. The ventilation was forecasted to be poor to marginal. Field observations noted ventilation only achieved poor to marginal dispersion mainly because of the lack of vertical smoke movement. The field conditions also limited burning this day. High moisture in a field would be expected to produce less than ideal vertical plume rise. In addition, the odd shape and size of one of the fields would have restricted vertical smoke. The wind direction created a problem with several of the fields because of the potential for downwind impacts. On this day, the forecasted ventilation conditions seemed to match the actual conditions more closely than on April 9. DEQ halted burning for the day based on smoke results observed.

Burn Date: April 11, 2012

Burn Decision

Burn day: up to 380 acres approved—pending field conditions.

Burn Decision Justification

This burn decision was developed using NWS observations at Bonners Ferry and Creston, BC, (Table 7) and forecasted winds, ventilation, and temperatures from the UW NWMC, as displayed in DEQ's weather checklist (Figure 7). The final burn decision does not guarantee all or any of the fields slated to be burned will be burned. Ventilation could be expected to be poor to marginal with surface winds generally from the south-southeast at roughly 7 mph. The checklist also provides forecasted upper level winds that are used to consider smoke transport and

ventilation. For this day, the winds at the atmospheric mixing height were forecasted to be from the south-southeast to east at 8–12 mph at 1,800–2,400 ft AGL.

A burn window of noon–4:00 p.m. was determined based on the fact that mid-day heating customarily produces the best ventilation conditions for smoke. Because DEQ often has field staff deployed to this area, the burn window is not always a significant concern because field staff have good control over ignition times for each field. The first field burned for the day is used as a test burn to confirm meteorological forecast by observing the smoke.

DEQ reviewed the monitoring data (Table 8) for the Bonners Ferry monitor, Copeland monitor, and Creston, BC, monitor. No monitor reported concentrations above preburn enhanced documentation triggers.

After reviewing the forecast and air quality data, DEQ determined that burning would be attempted on this day but would likely be limited given the expected progression of the winds throughout the day. Two fields totaling approximately 377 acres were placed on standby for possible burning dependent on evaluated field conditions (Figure 8).

Table 7. National Weather Service observations at Bonners Ferry (Site ID K65S).

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
4-11-2012 5:55 PDT	37.4	87	0	n/a	No value	OK
4-11-2012 6:15 PDT	35.6	87	0	n/a	No value	OK
4-11-2012 6:35 PDT	37.4	81	0	n/a	No value	OK
4-11-2012 6:55 PDT	37.4	87	0	n/a	No value	OK
4-11-2012 7:15 PDT	41	70	0	n/a	No value	OK
4-11-2012 7:35 PDT	41	81	0	n/a	No value	OK
4-11-2012 7:55 PDT	39.2	81	0	n/a	No value	OK
4-11-2012 8:15 PDT	41	81	0	n/a	No value	OK
4-11-2012 8:35 PDT	42.8	76	0	n/a	No value	OK
4-11-2012 8:55 PDT	44.6	66	0	n/a	No value	OK
4-11-2012 9:15 PDT	44.6	70	0	n/a	No value	OK
4-11-2012 9:35 PDT	46.4	66	0	n/a	No value	OK
4-11-2012 9:55 PDT	48.2	62	0	n/a	No value	OK
4-11-2012 10:15 PDT	46.4	71	0	n/a	No value	OK
4-11-2012 10:35 PDT	48.2	66	0	n/a	No value	OK
4-11-2012 10:55 PDT	48.2	66	0	n/a	No value	OK
4-11-2012 11:15 PDT	50	62	0	n/a	No value	OK
4-11-2012 11:35 PDT	51.8	58	0	n/a	No value	OK
4-11-2012 11:55 PDT	53.6	54	0	n/a	No value	OK

Morning Forecasting for Boundary														
Model Resolution:	12km			Model Run:	2012041100			SiteID:	IBONY					
Date	Time in PDT												Comments	
4/11/2012	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM		
Vent. Index	P	P	P	M	P	P	P	P	P	NP	NP	NP		
G: good, M: marginal, P: poor, NP: very poor														
Surface (20m) Winds	Direction	ESE	SE	SSE	SSE	SSE	SSE	SSE	SE	ESE	E	ENE	5 kts = 5.75 mph,	
	Speed (mph)	5.4	6.5	7.1	7.3	7.2	6.7	5.8	4.4	3.8	3.4	2.2	2.6	10 kts = 11.5 mph,
Surface (20m) Temperature (degree C)	8.9	9.9	10.4	10.7	10.9	10.9	10.7	10.6	10.4	9.1	8.1	7.6	15 kts = 17.25 mph	
Surface (20m) Relative Humidity (%)	59.7	57.6	59.1	62.6	64.9	66.5	67.9	68.6	69.4	74.9	77.4	78.2		
Planetary Boundary Layer (PBL)	Height (feet)	1053	1686	2395	2398	2116	1886	1444	1260	899	69	59	59	Height is above model terrain surface
	Direction	SE	SSE	SSE	SSE	SSE	SSE	S	S	SE	ESE	E	ENE	
	Speed (mph)	15.2	14.8	12.4	11.7	11.0	9.6	8.1	4.9	2.5	3.4	2.2	2.6	
700mb (~10,000 ft MSL)	Height (feet)	7155	7155	7155	7155	7155	7155	7155	7155	7155	7155	7155	7155	Height is above model terrain surface
	Direction	S	S	SSE	SSE	S	S	S	SSW	SSW	SSW	S	S	
	Speed (mph)	28.7	29.1	29.9	31.6	32.5	33.3	32.6	29.0	26.2	21.7	17.3	16.1	
850mb (~5000 ft MSL)	Height (feet)	1797	1797	1797	1797	1797	1797	1797	1797	1797	1797	1797	1797	Height is above model terrain surface
	Direction	SSE	SSE	SSE	SSE	SSE	SSE	S	S	SSW	SSE	SSW	E	
	Speed (mph)	18.1	14.8	10.9	9.9	10.0	9.6	8.7	6.1	3.3	1.4	0.5	0.7	

Figure 7. Weather checklist for Bonners Ferry. Information taken from the University of Washington Northwest Modeling Consortium forecast model.

Table 8. Available PM_{2.5} monitoring data prior to burn decision.

Date	Time	PM _{2.5} (µg/m ³)		
		Bonners Ferry (KTOI)	Copeland	Creston, BC
4/10/2012	1:00 AM	8.5	4.073	7.70
4/10/2012	2:00 AM	8.8	4.035	8.50
4/10/2012	3:00 AM	7.4	4.27	9.10
4/10/2012	4:00 AM	6.9	3.932	7.50
4/10/2012	5:00 AM	6.4	3.886	8.70
4/10/2012	6:00 AM	7.4	4.276	10.50
4/10/2012	7:00 AM	6.5	4.791	10.10
4/10/2012	8:00 AM	6.3	4.688	10.00
4/10/2012	9:00 AM	5.3	4.561	7.20
4/10/2012	10:00 AM	4.5	4.445	5.10
4/10/2012	11:00 AM	4.2	4.972	5.80
4/10/2012	12:00 PM	4	5.039	4.40
4/10/2012	1:00 PM	4	4.913	4.50
4/10/2012	2:00 PM	10.1	4.518	5.10
4/10/2012	3:00 PM	9.7	4.751	8.50
4/10/2012	4:00 PM	5.9	5.786	13.10

Date	Time	PM _{2.5} (µg/m ³)		
		Bonnors Ferry (KTOI)	Copeland	Creston, BC
4/10/2012	5:00 PM	6.9	5.709	13.40
4/10/2012	6:00 PM	6.5	13.215	10.20
4/10/2012	7:00 PM	5.7	9.689	18.70
4/10/2012	8:00 PM	8.2	5.668	18.70
4/10/2012	9:00 PM	10.5	4.666	19.70
4/10/2012	10:00 PM	10.4	4.675	15.70
4/10/2012	11:00 PM	10.9	4.747	13.20
4/10/2012	12:00 AM	12.8	4.799	13.90
4/11/2012	1:00 AM	9.5	4.639	8.60
4/11/2012	2:00 AM	10.2	4.698	6.40
4/11/2012	3:00 AM	10	4.723	6.10
4/11/2012	4:00 AM	9.2	4.774	5.30
4/11/2012	5:00 AM	8.2	4.733	6.70
4/11/2012	6:00 AM	8.1	4.874	7.40
4/11/2012	7:00 AM	7.3	5.078	8.70
4/11/2012	8:00 AM	6.7	5.276	7.60
4/11/2012	9:00 AM	6	5.269	7.70
4/11/2012	10:00 AM	5.9	5.375	6.70



Figure 8. Map of approved fields for April 11, 2012.

Field Observations

Initial field measurements taken by field staff recorded 54 °F air temperature with 44% relative humidity. The barometer read 27.73, surface winds were measured at 5 mph from the south, and the sky was overcast. The first field had heavy fuel load with mixed soil moisture. The temperature on the ground at the time of ignition was 2 °F warmer than forecasted. The relative humidity was 13% less than forecasted; surface winds were lighter than forecasted. These measurements suggested the morning forecast could be under predicting vertical ventilation conditions, which was taken into consideration.

The first field was approved at 11:30 a.m. This field is planted in rows so it is a unique situation for smoke management; 40 acres were initially approved. Good initial lift of the smoke was observed. Since this field is lit in strips, seeing good lift of the smoke indicates good conditions for the smoke to rise. The upper smoke was observed moving generally to the south, which is familiar behavior in this valley when seeing light surface winds blowing opposite the transport winds. This initial burn was completed quickly, and smoke was being transported along the western mountain sides at 700 ft above ground level. For strip burning, a 700-ft lift of the smoke is good. Evaluating the smoke movement, the transport winds were estimated to be northwest at about 10 mph. Additional “strip burning” was approved for this field.

Because of the transport winds noted above, DEQ granted approval to burn the 44 acres in the mid valley. Ignition was swift, and initially the smoke column punched up through the smoke from the northern burn. As the smoke cooled, the top of the column leveled off and combined with the lower smoke and remained elevated at about 700 ft AGL.

Field observations continued to confirm a northerly component to the upper level wind, which continued to move smoke south. A very faint smoke smell was noted near the first wildlife refuge turn-out (which is located to the west of the Kootenai Tribe land in the southwest end of the valley) during the field observations, indicating possible surface smoke intrusion. The hospital in Bonners Ferry has a helipad with a wind sock that is useful for determining surface wind direction at this location. A southeast surface wind was indicated here between 1:45 p.m. and 2:30 p.m., which would suggest surface smoke would congregate near the west side of the valley. No smoke smell was noted at the KTOI health clinic or the hospital during our site visits. Based on the weather conditions after the burns were complete, which were described above, smoke was not expected to impact either institution with sensitive populations (ISP).

Table 9 includes the monitoring data during and after the burns. The maximum hourly concentration at the Bonners Ferry monitor was $27.7 \mu\text{g}/\text{m}^3$ at 3:00 p.m. The Bonners Ferry monitor is located at the KTOI health clinic. This facility is an ISP. A 1-hour $\text{PM}_{2.5}$ value above $26.25 \mu\text{g}/\text{m}^3$ triggers full enhanced documentation, which includes contacting the institution. Enhanced documentation was not completed for this impact. The Kootenai Tribe was contacted directly to discuss the smoke and potential impact. A tribal representative said smoke from somewhere was travelling “down the river channel.” The burns conducted this day occurred downstream from the Kootenai Tribe monitor. The tribal representative reported the smoke “wasn’t that bad,” but she didn’t know where the smoke was from.

Table 9. Air quality $\text{PM}_{2.5}$ monitoring data after burn decision and burning.

Date	Time	$\text{PM}_{2.5}$ ($\mu\text{g}/\text{m}^3$)		
		Bonners Ferry (KTOI)	Copeland	Creston, BC
4/11/2012	11:00 AM	5.2	5.793	11.10
4/11/2012	12:00 PM	5.1	6.384	8.80
4/11/2012	1:00 PM	8.8	5.947	7.90
4/11/2012	2:00 PM	13.3	6.156	7.20
4/11/2012	3:00 PM	27.7	5.634	6.50
4/11/2012	4:00 PM	23.1	4.601	7.20
4/11/2012	5:00 PM	23.7	4.447	9.90
4/11/2012	6:00 PM	11.7	6.841	18.20
4/11/2012	7:00 PM	7.3	7.384	12.40
4/11/2012	8:00 PM	8.4	6.919	11.60
4/11/2012	9:00 PM	8.3	8.374	7.50
4/11/2012	10:00 PM	7.2	7.862	8.90
4/11/2012	11:00 PM	7.1	7.588	9.00
4/11/2012	12:00 AM	6.5	7.345	8.50

No complaints were directly received by DEQ for this burn day. At approximately 1 p.m. the air quality meteorologist in British Columbia, Canada, contacted DEQ regarding the burn decision. He reported BC Environment had received communication that described numerous residents in Creston getting sick and requested the air quality meteorologist contact DEQ and urge the department to stop burning. He reported that their PM_{2.5} levels were elevated, but he felt the elevated levels were attributable to a burn in Creston that didn't disperse the day before and local road dust. He concluded that a burn in Boundary County would be unlikely to greatly affect Creston's air quality. However, the winds were expected to shift in the valley (from a northerly direction mid-day then slowly shift from the south later on), so the potential was there if significant acreage was burned on this day. He expected light winds and commented "not great venting" for this day. The air quality meteorologist interpretation of the surface and ventilation conditions reflected our observations and expectations for this burn day.

Summary

A total of 204 acres of cereal grain stubble was burned this day in Boundary County. The additional 173 acres previously identified were withheld because ventilation conditions did not support additional smoke in the airshed. Winds aloft, or winds for transporting smoke out of the area, were nearly 180 degrees from the forecasted direction, which allowed for minimal burning to occur. As described previously, smoke did not entirely ventilate out of the southern valley, indicating poor to marginal ventilation conditions as forecasted.

It should be noted that the burn approvals (permits) for this day indicated a burn start time of noon. However, one grower was given verbal approval at 11:30 a.m. Ignition occurred prior to the permitted start time. This is an apparent violation of the permit. However, since DEQ gave the grower verbal approval to ignite prior to noon, DEQ did not pursue enforcement. Instead, DEQ will review the CRB Program procedures and make the necessary changes to ensure this does not happen again.

Since the burn impacted the ISP, DEQ looked at the available meteorological and PM_{2.5} data and compared this with the coinciding time frames for these burns. The information raised questions as to whether a smoke source other than DEQ-approved crop residue burning could have contributed to the elevated levels at the KTOI health clinic. Ground smoke at 2:11 p.m. was estimated to be >3 miles away from the monitor. The surface winds were 2–3 mph in a south to southeast direction. At this time, it appears unlikely for smoke from DEQ-approved crop residue burning to have been impacting the Bonners Ferry monitor at 3:00 p.m. (when a 15-minute average of 28.1 µg/m³ was recorded). Nevertheless, the impact continued from 3:15 p.m. to approximately 6:15 p.m. During this time, winds rotated from a southerly direction to a west-northwest direction and increased in speed to about 5 mph. It is not possible to determine the extent of the impact from DEQ-approved crop residue burning in comparison to other burning activities. Slash burning, backyard open burning, and ditch bank burning can be a significant source of smoke in this valley (and can be expected to be occurring most days); however, these sources are virtually unregulated. This ISP was contacted directly to discuss the smoke impact and check on any health impacts. None were reported.

Burn Date: April 23, 2012

Burn Decision

Burn day: up to 1,300 acres approved—pending field coordinator approval, fuel moisture, and meteorological conditions. Burn window: 11:30 a.m.–4:00 p.m.

Burn Decision Justification

This burn decision was developed using NWS observations at Bonners Ferry (Table 10) and forecasted winds, ventilation, and temperatures from the UW NWMC, as displayed in DEQ's weather checklist (Figure 9). Ventilation was expected to be poor, with surface winds generally from the east at 4–5 mph. The presence of surface winds suggested ventilation may improve on this day. The upper level winds were forecasted to be from the southwest at 3–7 mph. The wind speeds were not impressive; however, the transport wind direction was quite promising for the day. After primarily reviewing the modeling information and the weather checklist, DEQ determined the wind direction, wind speeds, and ventilation could provide a “good day” for burning in Boundary County.

Two weeks earlier on April 9, a productive burn day of 1,118 acres and little surface impacts had similar wind speeds and direction. The only appreciable difference was that on April 9 the winds were out of the northeast instead of this day's forecasted southeast. However, this day was forecasted to be much warmer with conditions anticipated to be near 75 °F instead of the 55 °F forecasted for the 9. Overall, conditions were very similar to the successful burn day on the 9, with the exception of a significant increase in ambient temperature (which is favorable for smoke lift).

Springtime vertical mixing heights are routinely greater than what is developed in the fall. A burn window of 11:30 a.m.–4:00 p.m. was determined based on the planetary boundary layer increasing past the 850 mb level, indicating the smoke would make it to the mixing height. However, the burn approvals (permits) issued included a burn start time of noon instead of 11:30 a.m. In Boundary County, DEQ almost always carries out field verification prior to contacting the growers and informing them of their approval to burn. DEQ has worked hard in Boundary County to ensure communication with growers remains very high. Growers here expect to receive verbal approval from DEQ prior to igniting their fields. DEQ's final burn posting of permits to the website either includes stipulations that verbal approval is necessary or the postings don't occur until after field verification is completed. The map in Figure 10 does not include a time stamp for permit approval.

DEQ also reviewed the monitoring data (Table 11) for the Bonners Ferry, Copeland, and Creston, BC, monitors. The maximum hourly PM_{2.5} concentrations recorded at Bonners Ferry, Copeland, and Creston, BC, were 7.1 µg/m³, 4.9 µg/m³, and 9.5 µg/m³, respectively. The Bonners Ferry and Creston, BC, maximum concentrations occurred on April 22, 2012 (day prior to burning), while the Copeland maximum concentration occurred the morning of the burn from 8:00 a.m. through 10:00 a.m. These concentrations are well below all preburn enhanced documentation triggers. The Porthill monitor is not deployed in the spring burn season as spring burning in the past has been very limited with very few growers taking advantage of the

springtime conditions. Nine fields, a total of 1,199 acres of cereal grain stubble—were slated for approval and eventually listed on the DEQ website (Figure 10).

Table 10. National Weather Service observations at Bonners Ferry (Site ID K65S).

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
4-23-2012 5:55 PDT	41	93	0	n/a	Fog	OK
4-23-2012 6:15 PDT	44.6	81	0	n/a	No value	OK
4-23-2012 6:35 PDT	44.6	87	0	n/a	Fog	OK
4-23-2012 6:55 PDT	48.2	87	0	n/a	No value	OK
4-23-2012 7:15 PDT	48.2	76	4.6	320	No value	OK
4-23-2012 7:35 PDT	48.2	76	0	n/a	No value	OK
4-23-2012 7:55 PDT	50	71	0	n/a	No value	OK
4-23-2012 8:15 PDT	50	71	3.5	200	No value	OK
4-23-2012 8:35 PDT	51.8	66	0	n/a	No value	OK
4-23-2012 8:55 PDT	53.6	62	3.5	190	No value	OK
4-23-2012 9:15 PDT	53.6	62	0	n/a	No value	OK
4-23-2012 9:35 PDT	55.4	58	0	n/a	No value	OK
4-23-2012 9:55 PDT	57.2	59	0	n/a	No value	OK
4-23-2012 10:15 PDT	59	55	3.5	310	No value	OK
4-23-2012 10:35 PDT	60.8	51	0	n/a	No value	OK
4-23-2012 10:55 PDT	62.6	48	3.5	340	No value	OK
4-23-2012 11:15 PDT	62.6	52	0	n/a	No value	OK
4-23-2012 11:35 PDT	62.6	52	3.5	280	No value	OK
4-23-2012 11:55 PDT	64.4	49	0	n/a	No value	OK

Morning Forecasting for Boundary														
Model Resolution:	12km			Model Run:	2012042300			SiteID:	IBONY					
Date		Time in PDT											Comments	
4/23/2012		10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	
Vent. Index		P	P	P	P	P	P	P	P	P	NP	NP	NP	
G: good, M: marginal, P: poor, NP: very poor														
Surface (20m) Winds	Direction	ESE	E	E	ESE	E	E	ENE	ENE	ENE	ESE	E	ESE	5 kts = 5.75 mph,
	Speed (mph)	4.7	4.5	3.4	4.0	4.5	4.8	4.3	4.6	4.5	3.2	3.4	3.5	10 kts = 11.5 mph,
Surface (20m) Temperature (degree C)		13.9	16.2	17.3	18.7	19.4	19.7	19.6	18.8	17.4	15.5	13.6	12.5	15 kts = 17.25 mph
Surface (20m) Relative Humidity (%)		66.0	55.8	52.6	46.5	44.2	43.2	43.9	46.8	51.4	58.0	63.7	66.5	
Planetary Boundary Layer (PBL)	Height (feet)	1155	1663	2264	2697	3074	3264	2795	2034	1178	144	62	62	Height is above model terrain surface
	Direction	E	E	SSW	SSW	SW	SW	WSW	WNW	NNE	ENE	E	ESE	
	Speed (mph)	5.4	3.8	3.3	6.6	5.7	4.2	3.7	3.2	4.8	4.1	3.4	3.5	
700mb (~10,000 ft MSL)	Height (feet)	7155	7155	7155	7155	7155	7155	7155	7155	7155	7155	7155	7155	Height is above model terrain surface
	Direction	SW	SW	SW	SSW	SSW	SW	SW	WSW	WSW	WSW	WSW	WSW	
	Speed (mph)	21.2	22.8	23.4	25.0	26.9	26.0	25.7	25.2	27.2	26.7	25.0	24.4	
850mb (~5000 ft MSL)	Height (feet)	2043	2040	2043	2043	2043	2043	2043	2043	2043	2043	2043	2043	Height is above model terrain surface
	Direction	WNW	SSW	SSE	S	S	SW	W	WNW	WNW	W	WSW	SSW	
	Speed (mph)	4.5	1.5	2.2	4.3	2.5	1.1	2.2	3.2	3.5	2.5	2.5	3.9	

Figure 9. Weather checklist for Bonners Ferry. Information taken from the University of Washington Northwest Modeling Consortium forecast model.

Table 11. Available PM_{2.5} monitoring data prior to burn decision

Date	Time	PM _{2.5} (µg/m ³)		
		Bonnors Ferry (KTOI)	Copeland	Creston, BC
4/22/2012	1:00 AM	4.6	3.215	3.10
4/22/2012	2:00 AM	4.6	3.26	3.20
4/22/2012	3:00 AM	7.1	3.32	3.00
4/22/2012	4:00 AM	3.5	3.207	2.40
4/22/2012	5:00 AM	3.7	3.22	3.50
4/22/2012	6:00 AM	3.9	3.14	4.10
4/22/2012	7:00 AM	3.5	3.192	4.30
4/22/2012	8:00 AM	3.8	3.39	3.20
4/22/2012	9:00 AM	3.5	3.703	3.80
4/22/2012	10:00 AM	3.5	4.275	2.50
4/22/2012	11:00 AM	2.9	3.614	5.00
4/22/2012	12:00 PM	2.8	3.009	4.80
4/22/2012	1:00 PM	2.5	2.858	3.50
4/22/2012	2:00 PM	2.2	2.65	2.70
4/22/2012	3:00 PM	3	2.794	3.80
4/22/2012	4:00 PM	3.5	3.001	2.60
4/22/2012	5:00 PM	3.2	3.081	2.50
4/22/2012	6:00 PM	3.2	3.179	1.50
4/22/2012	7:00 PM	3.3	3.229	2.70
4/22/2012	8:00 PM	3.4	3.823	7.60
4/22/2012	9:00 PM	3.1	3.997	5.70
4/22/2012	10:00 PM	3.2	3.968	6.20
4/22/2012	11:00 PM	4.1	4.094	9.50
4/22/2012	12:00 AM	5	4.273	8.60
4/23/2012	1:00 AM	5.3	4.275	6.50
4/23/2012	2:00 AM	5	4.333	6.10
4/23/2012	3:00 AM	5.5	4.409	4.50
4/23/2012	4:00 AM	5	4.385	4.30
4/23/2012	5:00 AM	5.2	4.466	4.50
4/23/2012	6:00 AM	5	4.585	7.00
4/23/2012	7:00 AM	5.7	4.837	8.00
4/23/2012	8:00 AM	6	4.955	6.20
4/23/2012	9:00 AM	6.2	4.934	5.50
4/23/2012	10:00 AM	7	4.933	7.10

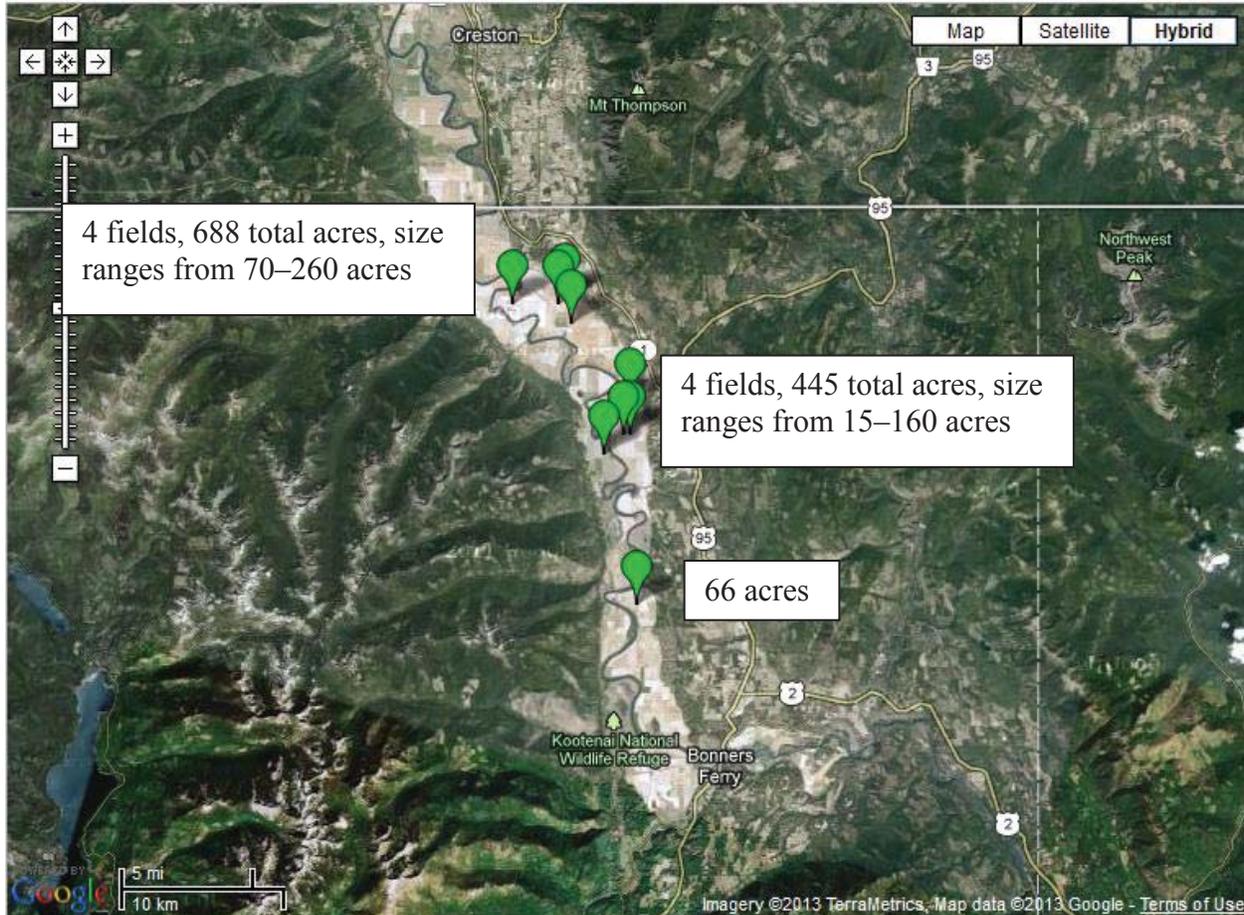


Figure 10. Map of approved fields for April 23, 2012.

Field Observations

Due to slightly higher than forecasted ground wind speeds taken with a Kestrel prior to burning and the wind direction having a more northerly component than the forecasted easterly direction, DEQ determined ventilation should be good, indicating conditions were at least as favorable if not better than the meteorological forecast predicted. The first field, a 140-acre wheat field, was verbally approved and immediately ignited at about 11:30 a.m. Good smoke dispersion was observed. Four fields (66 acres, 260 acres, 258 acres, and 100 acres) were given simultaneous approval to burn at noon. A 130-acre field was given approval to burn at 12:05 p.m.; 70-acre and 15-acre fields were approved at 12:30 p.m. All burns were completed by 1:37 p.m.

One field was burned in the middle part of the valley (approximately 66 acres) and the rest of the fields were located in the northern part of the valley (approximately 1,000 acres from six different growers). Initial wind directions were noted in the field as northerly, which pushed most of the smoke to the south-southwest into the mountains. Transport dispersion for the first field was good to excellent, while horizontal dispersion was fair to good.

After burning was complete at approximately 1:40 p.m. local time, horizontal smoke dispersion (closer to the ground) was considered poor to fair, indicating some low level smoke intrusion. Vertical/transport dispersion continued to be fair to good, so any smoke that was elevated moved

away from the area. Observations indicated that column height from the first burn was approximately 1,500 ft above ground level—a good height for this area. The subsequent smoke column heights for the remaining burns reached a similar height of 1,500 ft above ground level. The DEQ field coordinator was at the Hwy 95 overlook above the Mt. Hall Elementary School to observe all the burns. The DEQ field coordinator observed no smoke moving toward Creston, BC. All smoke was moving to the east-southeast or to the south in the afternoon after burning was complete. The smoke aloft appeared to start falling back towards the ground at around 12:30 p.m.

Table 12 includes the monitoring data during and after the burns. The maximum hourly concentrations recorded at Bonners Ferry, Copeland, and Creston, BC, were $41.8 \mu\text{g}/\text{m}^3$ (at 1:00 p.m.), $51.7 \mu\text{g}/\text{m}^3$ (at 2:00 p.m.), and $13.3 \mu\text{g}/\text{m}^3$ (at 8:00 p.m.), respectively. The Bonners Ferry monitor is located at the KTOI health clinic, an ISP. The Copeland monitor is located at the Mt. Hall Elementary School, which is also an ISP. The Boundary County Hospital is located in the southern end of the valley and is also an ISP. Because of the impact at the KTOI health clinic, it can be assumed that smoke may have also impacted the hospital on this day. A 1-hour $\text{PM}_{2.5}$ value above $26.25 \mu\text{g}/\text{m}^3$ triggers enhanced documentation, which includes contacting the ISP. Full enhanced documentation was completed for this burn day.

All three ISPs that were likely "impacted" by the DEQ-approved crop residue burning this day were contacted and interviewed in an effort to determine if any adverse health impacts occurred. No adverse health impacts were reported at any of the ISPs.

Table 12. Air quality $\text{PM}_{2.5}$ monitoring data during and after burning.

Date	Time	$\text{PM}_{2.5}$ ($\mu\text{g}/\text{m}^3$)		
		Bonners Ferry (KTOI)	Copeland	Creston, BC
4/23/2012	11:00 AM	4.6	5.5	6.10
4/23/2012	12:00 PM	16.1	7.2	6.20
4/23/2012	1:00 PM	41.8	26.6	7.10
4/23/2012	2:00 PM	26.3	51.7	8.30
4/23/2012	3:00 PM	41.4	16.2	6.00
4/23/2012	4:00 PM	39	22.0	10.80
4/23/2012	5:00 PM	31	31.6	7.10
4/23/2012	6:00 PM	15.9	22.0	6.40
4/23/2012	7:00 PM	7.7	10.3	4.90
4/23/2012	8:00 PM	6.9	15.1	13.30
4/23/2012	9:00 PM	8	11.8	6.10
4/23/2012	10:00 PM	7.6	8.1	3.80
4/23/2012	11:00 PM	7.6	7.5	5.20
4/23/2012	12:00 AM	7.4	7.0	7.50

One complaint was received about this burn day. The complaint was received by the toll-free complaint hotline on April 23, 2012, at 2:30 p.m. The complainant called from the Creston area and saw smoke hanging on the west side of the valley near Creston, BC. The complainant had a

heart condition and was not able to breathe easily. The complainant lives on the east side of the valley near Creston. Based on smoke observations and wind directions this day, it is not likely that smoke from DEQ-approved crop residue burning was at ground level at the caller's location. The activity for the day could certainly have caused the complainant concern and thus initiated the call.

Summary

A total of 1,039 acres of cereal grain stubble was burned this day in Boundary County.

It should be noted that the burn approvals (permits) for this day indicated a burn start time of noon. However, one grower was given verbal approval at 11:30 a.m. Ignition occurred prior to the permitted start time. This is an apparent violation of the permit. However, since DEQ gave the grower verbal approval to ignite prior to noon, DEQ did not pursue enforcement. Instead, DEQ will review the CRB Program procedures and make the necessary changes to ensure this does not happen again.

Initially observed meteorological conditions in the field were better than forecasted, but later in the day, after burning was complete, observed meteorological conditions deteriorated to conditions more resembling the forecast. Observed winds were more northerly than forecasted, helping to ensure smoke migrated south. The maximum mixing height was forecasted to be approximately 2,200–3,200 ft; smoke behavior indicated 1,500 ft above ground level. On days when the vertical lift maximum is observed to be less than the forecasted height, caution should be taken before igniting more fields. When the mixing height is higher than forecasted, it may indicate better than forecasted ventilation conditions.

Boundary County continues to be a very difficult area to predict, model, and forecast weather conditions and potential smoke behavior. For the April 23 final burn decisions, conditions from initial field verification through ignitions favored a successful burn day. It was only after the burns were complete that conditions deteriorated. Wind speeds essentially decreased to less than 2 mph and the smoke began to fall back to the ground.

Storm cells to the north of Creston, BC, and far west of the Kootenai River valley were noted on Doppler radar. This storm system was considered as a potential scouring source to disperse smoke out of the valley. The leading edge of these storm cells may have produced a cold air front and diminished vertical lift as it was moving toward the area and causing cooling.

In conclusion, the above modeling information, localized point forecasts and in-field observations were acceptable to make the burn decisions at the time. However, if the same conditions occur in the future, approving less acreage (500–750 instead of 1,000+) would be wise. Less acreage could have helped this day because the burning would have been completed much earlier and would have avoided the cold air, which possibly affected continuing plume rise and dispersion. Based on the results of burning on April 9 and the favorable transport wind direction, the burn decision was supported. Unfortunately, the postburn conditions deteriorated quickly and smoke settled back to the ground resulting in elevated monitor levels at Bonners Ferry and Copeland.

High pressure in the area possibly overpowered the earlier ventilation so that wind speeds died down to 2–3 mph for long enough to allow the smoke to cool enough to fall back down toward the ground. A combination of the weather conditions described above and too much smoke in the airshed at a given time could also explain the outcome of this burn day. More resources would ultimately be needed to further examine this burn day. Smoke in the Kootenai River valley commonly reaches 1,500 to 2,000 ft AGL and spreads out (even in the summer months). The smoke is then influenced by the predominant wind in the valley at the time (in this case, a north wind). On this day, the smoke appeared to reach a thermal equilibrium with the surrounding air mass—either by residence time or from the added cooling to the air after the burns were complete—causing the smoke to start settling into a very distinct layer fall back to the ground.

Burn Date: May 7, 2012

Burn Decision

Burn day: up to 450 acres approved—pending DEQ verification, fuel moisture, wind speeds, and meteorological conditions. Burn window: 12 p.m.–4 p.m.

Burn Decision Justification

This burn decision was developed using NWS observations at Bonners Ferry and Creston, BC, (Table 13) and forecasted winds, ventilation, and temperatures from the UW NWMC, as displayed in DEQ’s weather checklist (Figure 11). Ventilation was expected to be marginal with surface winds generally from the southeast at 4 mph. Low surface winds are sometimes helpful for plume development. The upper level winds were forecasted to be from the west at 7–8 mph. Westerly upper level winds are beneficial for transporting smoke out of this airshed because it helps to avoid impacts in areas such as Creston, BC. The elevation where smoke could be expected to mix was very high at 4,900–5,800 ft AGL.

DEQ reviewed the monitoring data (Table 14) for Bonners Ferry, Copeland, and Creston, BC. The hourly concentrations recorded in Bonners Ferry, Copeland, and Creston were very low this morning—all monitors recorded single digit concentrations, indicating very clean air and good mixing conditions. These maximum concentrations prior to burning were well below all preburn enhanced documentation triggers, which are a requirement for determining burn day applicability. With a high mixing zone forecasted, DEQ determined this should be a burn day and set a burn window of noon–4:00 p.m. when ventilation was expected to be best.

After staff discussion and meteorological data review, a final burn decision of 450 acres was made. Surface wind speeds and directions were not optimal for large-scale burning, but the mixing height forecast looked promising. DEQ decided that a small field of 81 acres would be used as a test burn to confirm the mixing height forecast. This field would be lit in two separate but equal parts. In total, two fields, with a total of 212 acres of cereal grain stubble, were approved and listed on the DEQ website (Figure 12); 238 additional acres would be approved if smoke dispersion was better than expected.

Table 13. National Weather Service observations at Bonners Ferry (Site ID K65S).

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
5-7-2012 5:55 PDT	33.8	93	0	n/a	No value	OK
5-7-2012 6:15 PDT	35.6	87	0	n/a	No value	OK
5-7-2012 6:35 PDT	37.4	93	0	n/a	No value	OK
5-7-2012 6:55 PDT	39.2	87	0	n/a	No value	OK
5-7-2012 7:15 PDT	41	81	0	n/a	No value	OK
5-7-2012 7:35 PDT	41	81	0	n/a	No value	OK
5-7-2012 7:55 PDT	42.8	76	0	n/a	No value	OK
5-7-2012 8:15 PDT	44.6	70	3.5	180	No value	OK
5-7-2012 8:35 PDT	46.4	71	0	n/a	No value	OK
5-7-2012 8:55 PDT	46.4	71	0	n/a	No value	OK
5-7-2012 9:15 PDT	48.2	66	0	n/a	No value	OK
5-7-2012 9:35 PDT	48.2	62	0	n/a	No value	OK
5-7-2012 9:55 PDT	50	58	0	n/a	No value	OK
5-7-2012 10:15 PDT	50	62	0	n/a	No value	OK
5-7-2012 10:35 PDT	53.6	54	0	n/a	No value	OK
5-7-2012 10:55 PDT	53.6	50	0	n/a	No value	OK
5-7-2012 11:15 PDT	55.4	51	3.5	200	No value	OK
5-7-2012 11:35 PDT	55.4	47	3.5	180	No value	OK
5-7-2012 11:55 PDT	57.2	44	0	n/a	No value	OK

Morning Forecasting for Boundary														
Model Resolution:	12km			Model Run:	2012050700			SiteID:	IBONY					
Date		Time in PDT											Comments	
5/7/2012		10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	
Vent. Index		P	P	M	M	M	M	P	P	P	NP	NP	NP	
G: good, M: marginal, P: poor, NP: very poor														
Surface (20m) Winds	Direction	SE	SE	SE	SSE	SSE	SSE	SSE	ESE	E	E	ESE	E	5 kts = 5.75 mph,
	Speed (mph)	2.7	3.6	4.1	4.7	4.3	3.7	2.7	2.0	2.9	3.4	2.6	3.6	10 kts = 11.5 mph,
Surface (20m) Temperature (degree C)		10.7	12.1	13.2	13.9	14.4	14.9	15.2	15.2	14.8	13.5	11.2	10.0	15 kts = 17.25 mph
Surface (20m) Relative Humidity (%)		43.4	38.5	35.0	33.0	31.7	30.3	29.4	29.6	31.2	36.0	43.3	45.3	
Planetary Boundary Layer (PBL)	Height (feet)	2385	3668	4921	5522	5768	5863	5883	5732	4793	220	66	62	Height is above model terrain surface
	Direction	W	W	W	W	W	W	W	W	W	ENE	ESE	E	
	Speed (mph)	5.0	6.1	6.8	7.6	7.9	8.1	8.8	10.3	8.3	3.3	2.6	3.6	
700mb (~10,000 ft MSL)	Height (feet)	7237	7237	7237	7237	7237	7237	7237	7237	7237	7240	7237	7237	Height is above model terrain surface
	Direction	WNW	WNW	WNW	WNW	WNW	W	W	W	W	WNW	WNW	W	
	Speed (mph)	8.3	7.1	7.2	7.2	7.8	9.0	10.7	12.6	12.9	11.8	10.3	10.8	
850mb (~5000 ft MSL)	Height (feet)	2315	2315	2315	2315	2315	2315	2315	2315	2315	2319	2315	2315	Height is above model terrain surface
	Direction	W	WSW	WSW	WSW	WSW	WSW	WSW	W	WNW	SSE	S	S	
	Speed (mph)	5.0	3.9	4.2	4.7	5.3	5.6	5.0	4.3	2.1	1.1	2.5	3.1	

Figure 11. Weather checklist for Bonners Ferry. Information taken from the University of Washington Northwest Modeling Consortium forecast model.

Table 14. Available PM_{2.5} monitoring data prior to burn decision.

Date	Time	PM _{2.5} (µg/m ³)		
		Bonnors Ferry (KTOI)	Copeland	Creston, BC
5/6/2012	1:00 AM	2.2	2.692	4.10
5/6/2012	2:00 AM	2.1	2.766	4.10
5/6/2012	3:00 AM	2.5	2.801	2.70
5/6/2012	4:00 AM	2.9	2.872	9.80
5/6/2012	5:00 AM	2.5	2.937	17.20
5/6/2012	6:00 AM	2.6	2.81	12.80
5/6/2012	7:00 AM	3.3	2.747	2.70
5/6/2012	8:00 AM	2.8	2.908	2.50
5/6/2012	9:00 AM	3	3.03	2.40
5/6/2012	10:00 AM	2.9	3.123	2.40
5/6/2012	11:00 AM	2.5	2.903	0.80
5/6/2012	12:00 PM	2.5	2.716	0.30
5/6/2012	1:00 PM	2.5	2.722	4.20
5/6/2012	2:00 PM	2.5	2.741	3.70
5/6/2012	3:00 PM	2.3	2.784	1.30
5/6/2012	4:00 PM	2.2	2.684	1.90
5/6/2012	5:00 PM	2.4	2.703	4.30
5/6/2012	6:00 PM	2.7	2.768	3.00
5/6/2012	7:00 PM	2.7	2.868	4.70
5/6/2012	8:00 PM	2.6	3.078	7.10
5/6/2012	9:00 PM	2.7	3.308	10.40
5/6/2012	10:00 PM	3.2	3.084	5.20
5/6/2012	11:00 PM	4.5	3.134	5.20
5/6/2012	12:00 AM	6.2	3.236	6.20
5/7/2012	1:00 AM	5.6	3.329	5.40
5/7/2012	2:00 AM	5.1	3.944	6.60
5/7/2012	3:00 AM	6.6	3.797	8.20
5/7/2012	4:00 AM	5.5	3.635	7.80
5/7/2012	5:00 AM	4.8	3.748	6.40
5/7/2012	6:00 AM	5.6	4.007	9.70
5/7/2012	7:00 AM	4.8	4.165	9.50
5/7/2012	8:00 AM	5.1	4.08	8.50
5/7/2012	9:00 AM	4.6	4.069	7.30
5/7/2012	10:00 AM	4.8	3.967	4.50

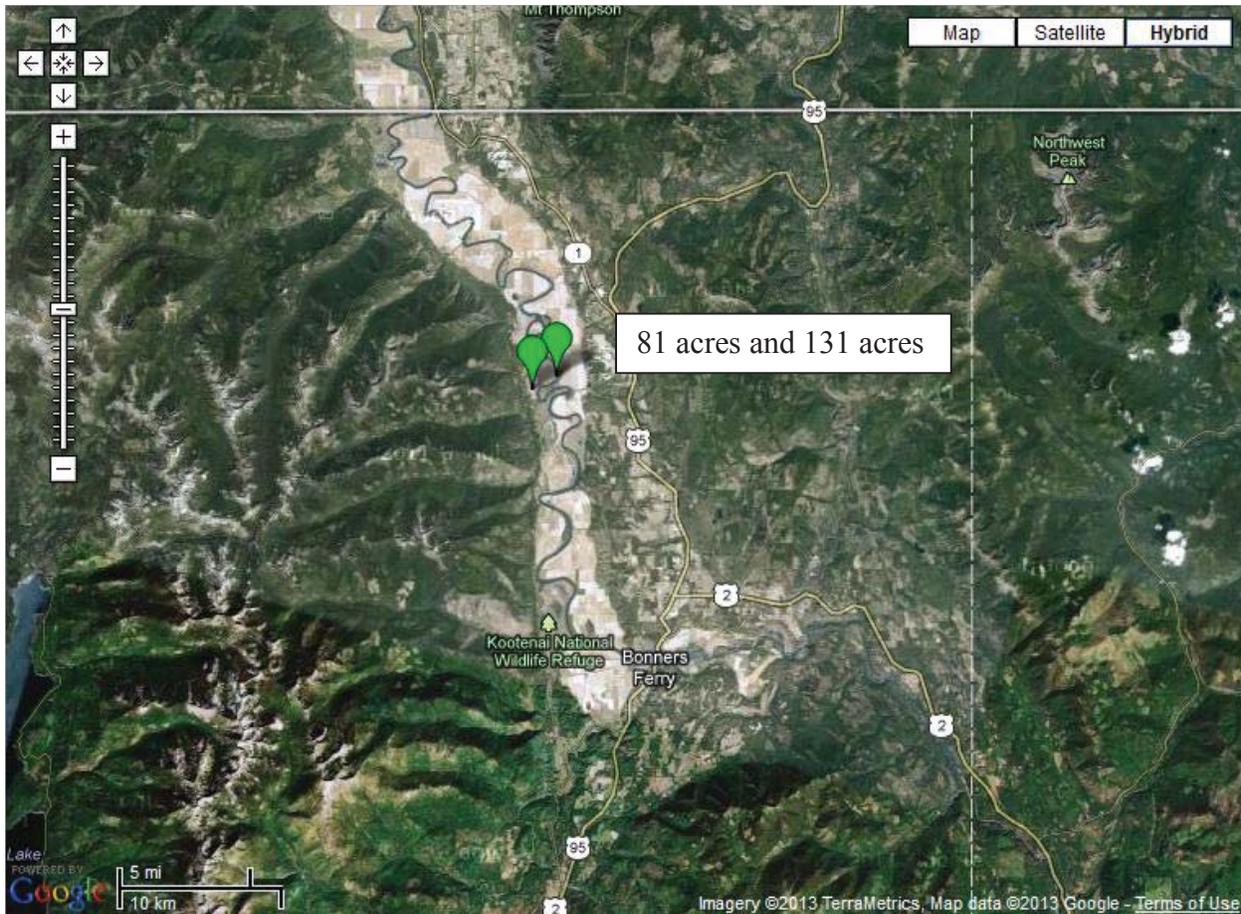


Figure 12. Map of approved fields for May 7, 2012.

Field Observations

Forty acres of wheat stubble were approved for burning and observed as a test burn for the day. Field staff measured winds from the southeast at the first field, very similar to the forecast. DEQ field staff released a helium-filled balloon to evaluate the low level air currents just above the surface, which confirmed a southeast surface wind direction up for several hundred feet. Smoke from this test burn dispersed fairly well toward the northwest. Smoke was observed from an elevated location located on highway 95, which provides a good vantage point for smoke trajectory height and thickness. Smoke dispersed adequately; therefore, the second half of this 81-acre field was approved by field staff. No additional acreage was approved for an hour after this so DEQ could observe the long-range transport of the smoke before approving further acreage. After an extended wait to ensure this smoke would finish dissipating, the additional 131 acres were approved. This acreage was planted in strips and burning was conducted through strip lighting, which does not release a great deal of smoke right away. On this day, this burn method helped disperse the smoke well. DEQ field staff noted numerous slash piles actively burning in the surrounding area, also contributing to the smoke generated this day.

Table 15 includes the monitoring data during and after the burns. The maximum hourly PM_{2.5} concentrations recorded at Bonners Ferry, Copeland, and Creston, BC, were 6.6 µg/m³ (at

midnight), $5.7 \mu\text{g}/\text{m}^3$ (at 4:00 p.m.), and $12.5 \mu\text{g}/\text{m}^3$ (at 7:00 p.m.), respectively. All values remained well below enhanced documentation triggers and program concentration limits.

Table 15. Air quality PM_{2.5} monitoring data during and after burning.

Date	Time	PM _{2.5} ($\mu\text{g}/\text{m}^3$)		
		Bonnors Ferry (KTOI)	Copeland	Creston, BC
5/7/2012	11:00 AM	4	Power failure	5.20
5/7/2012	12:00 PM	4.1	3.804	5.30
5/7/2012	1:00 PM	3.8	3.719	5.80
5/7/2012	2:00 PM	3.2	3.403	4.50
5/7/2012	3:00 PM	2.9	4.178	3.90
5/7/2012	4:00 PM	2.9	5.723	7.00
5/7/2012	5:00 PM	3	3.544	6.70
5/7/2012	6:00 PM	3.3	3.292	8.60
5/7/2012	7:00 PM	3.5	3.534	12.50
5/7/2012	8:00 PM	3.3	3.665	4.80
5/7/2012	9:00 PM	3.2	3.899	9.50
5/7/2012	10:00 PM	3.6	3.864	4.80
5/7/2012	11:00 PM	5.6	3.83	4.10
5/7/2012	12:00 AM	6.6	3.724	4.20

One complaint was received about this burn day. The complaint was received by the toll-free complaint hotline on May 7, 2012, at 4:51 p.m. The complainant was from Creston, BC, and reported shortness of breath and “very smoky” conditions in the Creston Valley. At the time of the call, the Creston monitor was reporting a PM_{2.5} concentration of approximately $7 \mu\text{g}/\text{m}^3$. This single digit concentration is considered very low. With the wind direction observed this day, DEQ-approved crop residue burning in the Boundary County area could have added some smoke to the Creston Valley. Prescribed fire or “slash burning,” which was observed to be quite active this day, would likely have also contributed to any smoke buildup.

Summary

A total of 212 acres of cereal grain stubble was burned on this day in Boundary County. Even though smoke dispersion was described as good on this day, only a limited number of acres were actually burned, primarily due to the type of fields approved to burn. Because this acreage was planted in strips, burning was conducted through strip lighting, which does not release a great deal of smoke right away but also takes much more time to complete. Overall, the impact from all activity this day appeared very minimal.

Burn Date: May 8, 2012

Burn Decision

Burn day: up to 434 acres available for approval—pending fuel moisture, wind speed and direction, and meteorological conditions. Burn window: 11 a.m.–4 p.m. Possibility of increasing burn acreage to 700 acres if conditions allowed.

Burn Decision Justification

This burn decision was developed using NWS observations at Bonners Ferry and Creston, BC, (Table 16) and forecasted winds, ventilation, and temperatures from the UW NWMC, as displayed in DEQ’s weather checklist (Figure 13). With no anomalies in the temperature or rainfall, DEQ recognized a potential for burning. Please note the relative humidity and temperature trends, which support possible burning (Table 16). Ventilation was expected to be marginal with surface winds generally from the south at 5–6 mph. The upper level winds were forecasted to be from the southwest at 16–21 mph at an elevation of 4,200 feet or higher. These are high wind speeds for transport winds; however, the model does not always perform well for this area. DEQ established a burn window of 11:00 a.m.–4:00 p.m. based on an improvement in ventilation during 11:00 a.m.–12:00 p.m. The 114-acre field, located near the south end of the valley, was used as a test burn to confirm meteorological forecast and expected smoke behavior. Observed conditions on the previous day exceeded forecast conditions; therefore, it was anticipated that the forecast could be underpredicting burn conditions for this day also.

DEQ reviewed the monitoring data (Table 17) for Bonners Ferry, Copeland, and Creston, BC. The maximum hourly PM_{2.5} concentrations recorded at Bonners Ferry, Copeland, and Creston, BC, were 7.6 µg/m³, 5.7 µg/m³, and 12.5 µg/m³, respectively. The maximum concentration at Creston, BC, occurred at 7:00 a.m. on May 7, 2012, the day prior. These concentrations are well below all preburn enhanced documentation triggers. This morning’s data suggest good air quality conditions and that burning could proceed if meteorological conditions warranted.

Two fields, totaling 434 acres of cereal grain stubble, were approved to burn (Figure 14). Permit approval occurs in conjunction with in-field verification. DEQ has worked extensively with the growers in this region and they will not ignite their fields until contacted directly by the field or regional representative. These two fields were the only ones identified for burning this morning.

Table 16. National Weather Service observations at Bonners Ferry (Site ID K65S).

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
5-8-2012 5:55 PDT	39.2	93	0	n/a	No value	OK
5-8-2012 6:15 PDT	41	93	0	n/a	No value	OK
5-8-2012 6:35 PDT	41	93	0	n/a	No value	OK
5-8-2012 6:55 PDT	44.6	81	0	n/a	No value	OK
5-8-2012 7:15 PDT	46.4	76	0	n/a	No value	OK
5-8-2012 7:35 PDT	46.4	76	0	n/a	No value	OK

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
5-8-2012 7:55 PDT	50	66	0	n/a	No value	OK
5-8-2012 8:15 PDT	50	66	0	n/a	No value	OK
5-8-2012 8:35 PDT	50	66	0	n/a	No value	OK
5-8-2012 8:55 PDT	53.6	58	0	n/a	No value	OK
5-8-2012 9:15 PDT	51.8	66	0	n/a	No value	OK
5-8-2012 9:35 PDT	53.6	62	3.5	260	No value	OK
5-8-2012 9:55 PDT	55.4	58	3.5	200	No value	OK
5-8-2012 10:15 PDT	55.4	58	0	n/a	No value	OK
5-8-2012 10:35 PDT	57.2	51	3.5	220	No value	OK
5-8-2012 10:55 PDT	59	48	3.5	330	No value	OK
5-8-2012 11:15 PDT	62.6	42	4.6	200	No value	OK
5-8-2012 11:35 PDT	62.6	45	4.6	190	No value	OK
5-8-2012 11:55 PDT	64.4	42	0	n/a	No value	OK

Morning Forecasting for Boundary														
Model Resolution:	12km			Model Run:	2012050800			SiteID:	IBONY					
Date	Time in PDT												Comments	
5/8/2012	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM		
Vent. Index	P	P	M	M	M	M	M	M	P	NP	NP	NP		
G: good, M: marginal, P: poor, NP: very poor														
Surface (20m) Winds	Direction	SE	SSE	SSE	S	S	S	S	S	SSE	SE	S	SSW	5 kts = 5.75 mph, 10 kts = 11.5 mph, 15 kts = 17.25 mph
	Speed (mph)	3.7	4.8	6.2	6.5	6.0	5.6	5.4	5.0	5.2	5.0	4.9	5.8	
Surface (20m) Temperature (degree C)	13.6	15.2	16.3	17.1	17.8	18.3	18.7	18.8	18.3	15.7	14.5	14.6		
Surface (20m) Relative Humidity (%)	44.2	39.2	36.7	35.0	33.6	33.2	32.2	31.2	33.4	43.9	45.9	42.6		
Planetary Boundary Layer (PBL)	Height (feet)	2182	3327	4219	4787	4967	5157	5335	5016	1765	115	272	295	Height is above model terrain surface
	Direction	SSW	SW	SW	SW	SW	WSW	SW	SW	SW	SE	SSW	SW	
	Speed (mph)	7.4	13.5	15.4	16.3	16.8	21.0	21.6	20.7	13.1	5.0	8.6	9.1	
700mb (~10,000 ft MSL)	Height (feet)	7237	7237	7237	7240	7237	7240	7240	7240	7240	7240	7237	7240	Height is above model terrain surface
	Direction	SW	SW	WSW	WSW	WSW	WSW	WSW	WSW	WSW	WSW	WSW	SW	
	Speed (mph)	19.8	20.2	21.0	22.2	23.7	26.6	29.1	30.1	31.5	31.9	32.0	32.4	
850mb (~5000 ft MSL)	Height (feet)	2315	2319	2319	2066	2066	2066	2066	2066	2066	2066	2066	2066	Height is above model terrain surface
	Direction	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	WSW	WSW	
	Speed (mph)	9.4	8.4	9.7	10.6	11.4	11.7	12.5	13.3	14.4	17.8	21.2	24.3	

Figure 13. Weather checklist for Bonners Ferry. Information taken from the University of Washington Northwest Modeling Consortium forecast model.

Table 17. Available PM_{2.5} monitoring data prior to burn decision.

Date	Time	PM _{2.5} (µg/m ³)		
		Bonnors Ferry (KTOI)	Copeland	Creston, BC
5/7/2012	1:00 AM	5.6	3.329	5.40
5/7/2012	2:00 AM	5.1	3.944	6.60
5/7/2012	3:00 AM	6.6	3.797	8.20
5/7/2012	4:00 AM	5.5	3.635	7.80
5/7/2012	5:00 AM	4.8	3.748	6.40
5/7/2012	6:00 AM	5.6	4.007	9.70
5/7/2012	7:00 AM	4.8	4.165	9.50
5/7/2012	8:00 AM	5.1	4.08	8.50
5/7/2012	9:00 AM	4.6	4.069	7.30
5/7/2012	10:00 AM	4.8	3.967	4.50
5/7/2012	11:00 AM	4	FailPwr	5.20
5/7/2012	12:00 PM	4.1	3.804	5.30
5/7/2012	1:00 PM	3.8	3.719	5.80
5/7/2012	2:00 PM	3.2	3.403	4.50
5/7/2012	3:00 PM	2.9	4.178	3.90
5/7/2012	4:00 PM	2.9	5.723	7.00
5/7/2012	5:00 PM	3	3.544	6.70
5/7/2012	6:00 PM	3.3	3.292	8.60
5/7/2012	7:00 PM	3.5	3.534	12.50
5/7/2012	8:00 PM	3.3	3.665	4.80
5/7/2012	9:00 PM	3.2	3.899	9.50
5/7/2012	10:00 PM	3.6	3.864	4.80
5/7/2012	11:00 PM	5.6	3.83	4.10
5/7/2012	12:00 AM	6.6	3.724	4.20
5/8/2012	1:00 AM	6.1	3.782	3.60
5/8/2012	2:00 AM	7.6	3.86	4.70
5/8/2012	3:00 AM	6.3	4.02	3.80
5/8/2012	4:00 AM	6.7	4.177	4.00
5/8/2012	5:00 AM	5.3	4.225	5.20
5/8/2012	6:00 AM	6.4	4.391	7.60
5/8/2012	7:00 AM	6.2	4.837	7.40
5/8/2012	8:00 AM	5.7	5.055	6.90
5/8/2012	9:00 AM	5.8	5.168	5.00
5/8/2012	10:00 AM	5.3	4.775	5.40



Figure 14. Map of approved fields for May 8, 2012.

Field Observations, Monitoring Data, and Complaints

Prior to verbally approving burning, DEQ field staff released a helium filled balloon to observe upper air wind direction and estimated speed. The balloon rose to approximately 2,000 ft AGL and then moved rapidly northeast, confirming the forecasted upper winds. The first field, a 114-acre wheat field, was verbally approved shortly after observing the balloon trajectory. The field was ignited at approximately 11:25 a.m. Good smoke dispersion was observed as the smoke was reported to have moved rapidly to the northeast. At 12:30 p.m., the other field was given verbal approval for ignition. Field staff noted hazy conditions towards the south. All burning in Boundary County on this day was complete by 1:30 p.m. By 1:55 p.m., regional office staff noted high wind speeds in the Moscow area and to the west in Washington, indicating a change in surface conditions may be expected in Boundary County later in the day. The high wind speeds to the south possibly caused the hazy conditions building to the south as described.

Only two fields (approximately 434 acres) were burned in the southern part of the valley. Wind directions were noted in the field coming from the southwest, which pushed most of the smoke to the northeast. Smoke dispersion was described as good to excellent. After the burning was complete, horizontal smoke dispersion (closer to ground) was evaluated. Based on visibility, horizontal smoke dispersion was considered good. The vertical/transport dispersion continued to

be good to excellent. All smoke from these fields had dissipated by approximately 1:50 p.m. Wind speeds were reportedly increasing to approximately 10 mph as the day progressed.

Table 18 includes the PM_{2.5} monitoring data during and after the burns. The maximum hourly concentration recorded at any of the monitors in the area was 9.4 µg/m³ (at 9:00 p.m.) in Creston. This maximum value is well below all enhanced documentation triggers and program concentration limits. Given the wind direction, smoke from DEQ-approved crop residue burning may have contributed to the concentrations in Creston. However, this increase is only 2 µg/m³ from before to after the burn.

Table 18. Air quality PM_{2.5} monitoring data during and after burning.

Date	Time	PM _{2.5} (µg/m ³)		
		Bonnars Ferry (KTOI)	Copeland	Creston, BC
5/8/2012	11:00 AM	5.3	4.584	7.20
5/8/2012	12:00 PM	4.6	4.375	6.00
5/8/2012	1:00 PM	4.1	4.222	5.60
5/8/2012	2:00 PM	4.1	3.932	3.90
5/8/2012	3:00 PM	4.2	4.003	7.20
5/8/2012	4:00 PM	3.9	3.972	5.90
5/8/2012	5:00 PM	3.4	3.688	4.60
5/8/2012	6:00 PM	3.3	3.424	5.70
5/8/2012	7:00 PM	3.6	3.555	7.30
5/8/2012	8:00 PM	3.9	3.711	6.50
5/8/2012	9:00 PM	4.3	3.954	9.40
5/8/2012	10:00 PM	4.7	4.048	8.20
5/8/2012	11:00 PM	6.7	4.152	6.00
5/8/2012	12:00 AM	6.5	4.266	6.80

No complaints were received about this burn day.

Summary

A total of 434 acres of cereal grain stubble was burned this day in Boundary County. The two fields were consumed very quickly as these two growers actually helped each other to get the fields lit very quickly. The speed of ignition plays a large role in providing vertical lift for the smoke. Ventilation was forecasted to be marginal and the field observations noted good to excellent dispersion. Observed surface winds were more southwesterly than forecasted. Burning occurred prior to any increased surface winds in the area. If burning was still occurring when winds picked up, more smoke may have been visible on the ground this day. The differences between observed and forecasted conditions and the timeliness of burn completion resulted in a good burn day.

Burn Date: May 10, 2012

Burn Decision

Burn day: up to 260 acres approved—pending meteorological conditions. Burn window: 11 a.m.–3 p.m.

Burn Decision Justification

This burn decision was developed using NWS observations at Bonners Ferry and Creston, BC, (Table 19) and forecasted winds, ventilation, and temperatures from the UW NWMC, as displayed in DEQ’s weather checklist (Figure 15). Conditions indicated the potential to conduct field burning on this day. Increasing wind speeds in the later afternoon needed to be considered. Ventilation was expected to be good, with surface winds generally from the northwest to west-northwest at 5–8 mph. The upper level winds were forecasted to be from the northwest to west-northwest at 15–25 mph. Although 25 mph is a fairly high wind speed for transport winds, the model does not always perform well for this area and field observations were made to confirm ventilation for the day. Data reviewed from the weather checklist also confirmed a potential for a burn day, and DEQ determined a burn window of 11:00 a.m.–3:00 p.m. based on rising temperatures throughout the day and a slight increase in surface wind speed.

DEQ reviewed the monitoring data (Table 20) for Bonners Ferry, Copeland, and Creston, BC. The maximum hourly PM_{2.5} concentrations recorded at Bonners Ferry, Copeland, and Creston were 6.0 µg/m³, 4.9 µg/m³, and 9.4 µg/m³, respectively. These concentrations were well below preburn enhanced documentation triggers, confirming this as a potential burn day.

Two fields, a total of 260 acres, were approved (Figure 16). A 240-acre cereal grain and 20-acre CRP field were identified as the only fields remaining on the ready-to-burn list for Boundary County. Permit approval occurs in conjunction with in-field verification. The forecasted wind direction and ventilation index indicated favorable conditions for burning the 240-acre field and possibly the 20-acre field (wind direction was a factor for this smaller field due to its proximity to the KTOI health clinic and increasing surface winds had to be considered).

Table 19. National Weather Service observations at Bonners Ferry (Site ID K65S).

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
5-10-2012 5:55 PDT	39.2	38	0	n/a	No value	OK
5-10-2012 6:15 PDT	37.4	48	0	n/a	No value	OK
5-10-2012 6:35 PDT	37.4	56	3.5	240	No value	OK
5-10-2012 6:55 PDT	41	41	0	n/a	No value	OK
5-10-2012 7:15 PDT	41	48	0	n/a	No value	OK
5-10-2012 7:35 PDT	44.6	36	3.5	160	No value	OK
5-10-2012 7:55 PDT	44.6	36	3.5	170	No value	OK
5-10-2012 8:15 PDT	44.6	36	0	n/a	No value	OK
5-10-2012 8:35 PDT	46.4	36	0	n/a	No value	OK

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
5-10-2012 8:55 PDT	46.4	31	4.6	160	No value	OK
5-10-2012 9:15 PDT	46.4	31	4.6	220	No value	OK
5-10-2012 9:35 PDT	46.4	31	0	n/a	No value	OK
5-10-2012 9:55 PDT	48.2	29	3.5	160	No value	OK
5-10-2012 10:15 PDT	50	25	6.9	200	No value	OK
5-10-2012 10:35 PDT	48.2	32	8.1	250	No value	OK
5-10-2012 10:55 PDT	48.2	32	0	n/a	No value	OK
5-10-2012 11:15 PDT	48.2	32	0	n/a	No value	OK
5-10-2012 11:35 PDT	50	27	12.7	260	No value	OK
5-10-2012 11:55 PDT	53.6	26	13.8	250	No value	OK

Morning Forecasting for Boundary														
Model Resolution:	12km			Model Run:	2012051000			SiteID:	IBONY					
Date	Time in PDT												Comments	
5/10/2012	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM		
Vent. Index	M	M	G	G	G	G	G	G	G	M	P	NP		
G: good, M: marginal, P: poor, NP: very poor														
Surface (20m) Winds	Direction	NW	WNW	NW	WNW	WNW	WNW	NW	NW	NW	NNW	N	C	5 kts = 5.75 mph,
	Speed (mph)	3.4	4.0	4.8	6.0	8.1	9.8	9.8	9.0	8.4	7.5	4.1	0.0	10 kts = 11.5 mph,
Surface (20m) Temperature (degree C)	5.8	7.0	7.8	8.4	8.9	9.0	8.9	8.7	8.3	7.5	6.2	5.2		15 kts = 17.25 mph
Surface (20m) Relative Humidity (%)	40.1	31.0	24.6	21.8	19.5	18.1	18.9	18.9	19.4	21.3	26.3	28.6		
Planetary Boundary Layer (PBL)	Height (feet)	6306	8166	9974	10627	11010	10807	10197	8885	7090	3885	1234	59	Height is above model terrain surface
	Direction	NNW	NW	NW	WNW	WNW	WNW	WNW	WNW	W	NW	NNW	C	
	Speed (mph)	20.1	21.3	26.3	26.2	26.2	26.8	28.8	28.5	24.0	16.5	13.5	0.0	
700mb (~10,000 ft MSL)	Height (feet)	7237	7237	7237	7237	7237	7237	7237	7237	7237	7237	7237	7237	Height is above model terrain surface
	Direction	NW	NW	NW	NW	WNW	WNW	WNW	WNW	W	W	W	W	
	Speed (mph)	21.7	18.9	16.3	15.2	16.6	19.0	21.0	22.9	24.0	25.0	25.6	25.8	
850mb (~5000 ft MSL)	Height (feet)	2319	2315	2315	2315	2315	2315	2315	2315	2315	2315	2315	2315	Height is above model terrain surface
	Direction	NW	NW	NW	NW	WNW	WNW	WNW	NW	NW	NNW	NNW	NNW	
	Speed (mph)	12.0	12.5	12.7	13.5	15.8	17.6	17.9	17.0	16.0	15.1	16.0	14.8	

Figure 15. Weather checklist for Bonners Ferry. Information taken from the University of Washington Northwest Modeling Consortium forecast model.

Table 20. Available PM_{2.5} monitoring data prior to burn decision.

Date	Time	PM _{2.5} (µg/m ³)		
		Bonnerr Ferry (KTOI)	Copeland	Creston, BC
5/9/2012	1:00 AM	6	4.841	6.00
5/9/2012	2:00 AM	5.5	4.906	6.00
5/9/2012	3:00 AM	5.7	4.964	7.40
5/9/2012	4:00 AM	6	4.591	6.90
5/9/2012	5:00 AM	5.3	4.579	5.50
5/9/2012	6:00 AM	5.3	4.373	8.70
5/9/2012	7:00 AM	4.8	4.626	9.50
5/9/2012	8:00 AM	3.9	4.294	8.30
5/9/2012	9:00 AM	3.2	3.68	2.70
5/9/2012	10:00 AM	3	3.294	3.10
5/9/2012	11:00 AM	2.9	3.047	4.30
5/9/2012	12:00 PM	2.8	3.032	2.30
5/9/2012	1:00 PM	2.7	2.962	6.00
5/9/2012	2:00 PM	2.9	2.951	5.10
5/9/2012	3:00 PM	3.1	3.06	3.70
5/9/2012	4:00 PM	3.2	3.479	3.60
5/9/2012	5:00 PM	3.4	3.994	2.90
5/9/2012	6:00 PM	3.4	4.558	1.00
5/9/2012	7:00 PM	3.5	4.08	2.10
5/9/2012	8:00 PM	3.4	3.606	4.70
5/9/2012	9:00 PM	3.5	3.252	4.60
5/9/2012	10:00 PM	2.9	2.783	1.90
5/9/2012	11:00 PM	2.4	2.494	1.40
5/9/2012	12:00 AM	2.2	2.375	1.70
5/10/2012	1:00 AM	2.2	2.42	4.10
5/10/2012	2:00 AM	2	2.418	7.00
5/10/2012	3:00 AM	2	2.374	1.60
5/10/2012	4:00 AM	2.1	2.264	0.80
5/10/2012	5:00 AM	2.1	2.133	2.90
5/10/2012	6:00 AM	2.1	2.008	3.70
5/10/2012	7:00 AM	1.9	1.963	0.00
5/10/2012	8:00 AM	1.6	1.826	0.00
5/10/2012	9:00 AM	1.4	1.85	0.10
5/10/2012	10:00 AM	1.3	Internal Audit	0.70

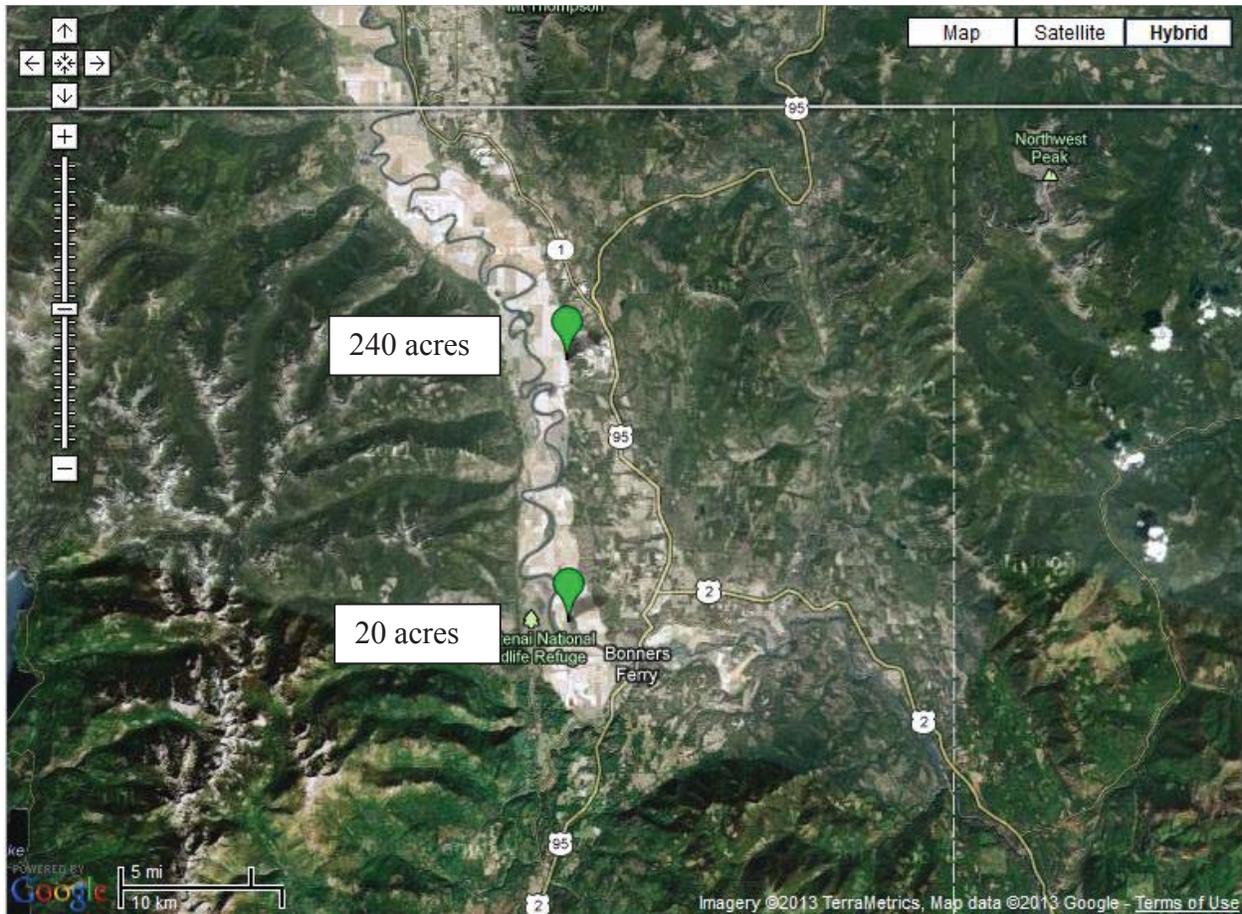


Figure 16. Map of approved fields for May 10, 2012.

Field Observations, Monitoring Data, and Complaints

Field observations prior to burning verified the meteorological forecast of west-northwest/northwest winds. The first field, a 240-acre wheat field, was ignited at approximately 11:30 a.m. after receiving verbal approval by the on-site DEQ field coordinator. Good smoke dispersion was observed. Smoke from the field was light and was pushed in a southerly direction by the wind. The burn was completed by approximately 1:00 p.m. The DEQ field coordinator observed the 240-acre burn from various locations around the valley and noted all smoke moved to the south and dissipated rapidly.

The remaining 20-acre CRP field was not given final verbal approval on this day. This field is not a high priority for the grower and he elected not to burn it after being contacted by the DEQ field coordinator. The DEQ field coordinator noted that winds were increasing in the area later in the day.

Table 21 includes the monitoring data during and after the burns. The maximum hourly $PM_{2.5}$ concentrations recorded at Bonners Ferry, Copeland, and Creston were $3.3 \mu\text{g}/\text{m}^3$, $2.8 \mu\text{g}/\text{m}^3$, and $5.6 \mu\text{g}/\text{m}^3$, respectively. All values are well below enhanced documentation triggers and program concentration limits. Based on wind direction during the burn window, it is highly unlikely any smoke from the 240-acre burn would have impacted Copeland or Creston monitors.

Wind direction and field location would suggest that any surface smoke would have been transported towards the Bonners Ferry monitor, but no impacts were noted.

Table 21. Air quality monitoring data during and after burning.

Date	Time	PM _{2.5} (µg/m ³)		
		Bonnors Ferry (KTOI)	Copeland	Creston, BC
5/10/2012	11:00 AM	1.3	1.931	0.90
5/10/2012	12:00 PM	1.3	1.949	1.20
5/10/2012	1:00 PM	1.3	1.976	1.00
5/10/2012	2:00 PM	1.3	1.896	4.10
5/10/2012	3:00 PM	1.3	1.904	0.90
5/10/2012	4:00 PM	1.4	2.047	0.10
5/10/2012	5:00 PM	1.4	1.92	1.00
5/10/2012	6:00 PM	1.6	1.927	0.30
5/10/2012	7:00 PM	1.5	1.969	1.70
5/10/2012	8:00 PM	1.6	2.095	2.00
5/10/2012	9:00 PM	1.7	1.961	2.20
5/10/2012	10:00 PM	2.1	2.028	5.60
5/10/2012	11:00 PM	3.3	2.093	2.60
5/10/2012	12:00 AM	3.1	2.822	2.30

No complaints were received by DEQ about this burn day.

Summary

A total of 240 acres of cereal grain stubble was burned in Boundary County on May 10, 2012. The minimal smoke generated from the field burn dissipated quickly, evident by the very low PM_{2.5} concentrations at the Bonners Ferry monitor this day. Because of wind direction and field location, any surface smoke would have been pushed towards the south where this monitor is located. The grower who ignited the 240-acre field worked alone, which resulted in a much slower ignition. The wind direction was as forecasted and the wind speed stayed favorable during the field burn, which helped move the smoke out of the area. This was the final CRB burn day for the spring burn season. The additional 20-acre field was never given final verbal approval by the DEQ field coordinator.

Burn Date: August 28, 2012

Burn Decision

Burn day: up to 250 acres approved—pending meteorological conditions. Burn window: 11 a.m. to 2 p.m.

Burn Decision Justification

This burn decision was developed using NWS observations at Bonners Ferry (Table 22); forecasted winds, ventilation, and temperatures from the UW NWMC, as displayed in DEQ's weather checklist (Figure 17); and the daily forecast produced by the DEQ contract meteorologist, Bennett Fire Weather Services, LLC (Figure 18). Ventilation was expected to be poor then improve to good throughout the day, with surface winds out of the north early then switching to the west and eventually southwest later in the day. The upper level winds were forecasted to be from the east-southeast at approximately 5 mph and switching to the south/southwest and increasing to approximately 20 mph later in the day. The data reviewed from the weather checklist indicated a potential burn day, keeping in mind that burns may need to end before winds became too strong, which could inhibit lift and low level dispersion.

The DEQ contract meteorologist recommended a burn day. The models do not always perform well for this area and field observations were made to confirm model forecasts before ignitions. Since Boundary County schools were not in session until September 6, Mt. Hall Elementary School was not considered an ISP at this time.

DEQ reviewed the monitoring data (Table 23) for Creston, BC; Porthill; and Copeland. The maximum hourly concentrations recorded at any of these sites were all below $20 \mu\text{g}/\text{m}^3$. This maximum occurred in Creston at 7:00 a.m. and again at 10:00 a.m. on August 27, 2012 (the day prior to burning). This concentration was below all preburn enhanced documentation triggers. The Bonners Ferry monitor was not providing data for this burn day. However, all other monitors showed fairly consistent concentrations throughout the valley.

DEQ issued a burn window of 11:00 a.m.–2:00 p.m. based on the information in Figure 17.

One 150-acre field of turf grass was approved after DEQ made initial field verifications (Figure 19). This field was listed on the DEQ website when approved.

Table 22. National Weather Service observations at Bonners Ferry (Site ID K65S).

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
8-28-2012 5:55 PDT	50	76	0	n/a	No value	OK
8-28-2012 6:15 PDT	50	76	3.5	100	No value	OK
8-28-2012 6:35 PDT	53.6	67	3.5	110	No value	OK
8-28-2012 6:55 PDT	50	82	0	n/a	No value	OK
8-28-2012 7:15 PDT	53.6	77	0	n/a	No value	OK
8-28-2012 7:35 PDT	53.6	71	0	n/a	No value	OK
8-28-2012 7:55 PDT	55.4	72	0	n/a	No value	OK
8-28-2012 8:15 PDT	59	63	0	n/a	No value	OK
8-28-2012 8:35 PDT	60.8	59	0	n/a	No value	OK
8-28-2012 8:55 PDT	60.8	59	0	n/a	No value	OK
8-28-2012 9:15 PDT	62.6	55	0	n/a	No value	OK
8-28-2012 9:35 PDT	62.6	55	4.6	210	No value	OK

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
8-28-2012 9:55 PDT	64.4	52	0	n/a	No value	OK
8-28-2012 10:15 PDT	66.2	49	0	n/a	No value	OK
8-28-2012 10:35 PDT	66.2	49	0	n/a	No value	OK
8-28-2012 10:55 PDT	68	49	4.6	210	No value	OK
8-28-2012 11:15 PDT	69.8	46	4.6	190	No value	OK
8-28-2012 11:35 PDT	69.8	46	0	n/a	No value	OK
8-28-2012 11:55 PDT	71.6	43	4.6	150	No value	OK

Morning Forecasting for Boundary														
Model Resolution:	12km			Model Run:	2012082712			SiteID:	IBONY					
Date	Time in PDT													Comments
8/28/2012	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM		
Vent. Index	P	P	P	P	G	G	G	G	G	NP	P	NP		
G: good, M: marginal, P: poor, NP: very poor														
Surface (20m) Winds	Direction	NNE	N	WNW	W	SW	SSW	SW	SW	SW	SW	WSW	WSW	5 kts = 5.75 mph,
	Speed (mph)	1.9	1.8	0.7	3.1	6.5	9.7	9.9	9.5	6.7	3.2	4.6	2.2	10 kts = 11.5 mph,
Surface (20m) Temperature (degree C)	19.3	21.3	23.1	24.7	25.9	26.1	25.8	25.3	24.3	22.4	21.6	20.2	15 kts = 17.25 mph	
Surface (20m) Relative Humidity (%)	43.5	37.4	33.4	31.7	29.5	28.7	28.7	29.8	31.9	39.3	39.7	44.0		
Planetary Boundary Layer (PBL)	Height (feet)	1942	2697	4052	4993	6601	7008	7293	7034	5440	171	755	62	Height is above model terrain surface
	Direction	E	SE	S	S	SSW	SSW	SW	SW	SW	SW	WSW	WSW	
	Speed (mph)	7.2	9.7	15.3	19.4	26.1	29.5	30.3	30.2	23.4	10.9	14.7	2.2	
700mb (~10,000 ft MSL)	Height (feet)	7404	7404	7407	7407	7407	7407	7407	7407	7407	7407	7407	7404	Height is above model terrain surface
	Direction	SSW	SSW	SSW	SSW	SSW	SSW	SW	SW	SW	SW	SW	SW	
	Speed (mph)	30.0	31.1	33.4	33.4	29.9	29.5	30.3	30.2	31.1	33.5	38.0	41.8	
850mb (~5000 ft MSL)	Height (feet)	2112	2112	2112	2112	2112	2112	2112	2112	2112	2112	2112	2112	Height is above model terrain surface
	Direction	E	ESE	SE	S	SSW	SW	SW	SW	SW	WSW	WSW	W	
	Speed (mph)	7.5	6.2	5.4	6.4	13.5	19.0	20.2	20.9	22.4	19.8	17.3	15.5	

Figure 17. Weather checklist for Bonners Ferry. Information taken from the University of Washington Northwest Modeling Consortium forecast model.

Forecast Prepared by: BENNETT FIRE WEATHER SERVICES, LLC

Forecast Time Prepared: 8:00 AM PDT – Tuesday August 28, 2012

Forecast for: TUESDAY – August 28, 2012

GENERAL WEATHER DISCUSSION:

TUESDAY:

Not a whole lot of change for today. The upper trough off the west coast begins to open up and will eventually eject northeast tonight and Wednesday. Strong high pressure ridge remains locked in over Colorado. Moming satellite loops show the trough is slowly moving. Winds aloft over northern Idaho remain from the southwest through this afternoon and are increasing. At the surface this afternoon a cooler air mass still resides over eastern Washington, while a warmer air mass with lower pressure is over Montana. This configuration will produce a southwest to northeast pressure gradient field over northern Idaho air sheds. Wind speeds are expected to increase into the 4-12 mph range producing better ventilation. Mixing heights by this afternoon are expected to range from 3-7,000 feet AGL over all air sheds. Transport winds will be from the southwest to west at 10-15 mph from Latah County north and northwest to southwest at 5-15 mph over the Camas Prairie. Dispersion is expected to be marginal to good. Ventilation is poor to marginal in the morning under a moderate to strong inversion. The inversions are expected break around 11 am leaving marginal to good ventilation over the air sheds. The inversion break temperatures look to be around 11 am-12 noon 68-75 degrees.

NORTHERN IDAHO BY AIRSHED:

BOUNDARY COUNTY Air Shed:

Forecast for TUESDAY:

SKY/WEATHER: Sunny in the afternoon.

TEMPERATURE: High temperatures ranging from 84-87.

HUMIDITY: Minimum RH around 20-30 percent.

WIND – SURFACE: South to southwest 5-15 mph in the afternoon.

TRANSPORT: Southwest 10-15 mph.

INVERSIONS: Strong to moderate morning inversion breaking by 11 am at a temperature around 71 degrees.

MIXING HEIGHT: Air mass becomes unstable to 4-5,000 feet AGL by the afternoon.

VENTILATION: POOR to MARGINAL in the morning becoming GOOD in the afternoon.

AIRSHED Recommendations: Marginal ventilation over Latah County. Watch for lift and gusty winds all air sheds.

Boundary County: Burn

LOCAL TIME

County	08	09	10	11	12	13	14	15	16	17
Boundary	M	M	M	M	G	G	G	G	G	G

VENTILATION KEY: P = Poor M = Marginal G = Good E = Excellent

Figure 18. Weather forecast prepared by Bennett Fire Weather Services, LLC, for Boundary County.

Table 23. Available PM_{2.5} monitoring data prior to burn decision.

Date	Time	PM _{2.5} (µg/m ³)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland
8/27/2012	1:00 AM	9.7	No data	12	13.387
8/27/2012	2:00 AM	11.2	No data	16	14.08
8/27/2012	3:00 AM	17	No data	14	15.577
8/27/2012	4:00 AM	15.7	No data	11	15.835
8/27/2012	5:00 AM	15.5	No data	13	16.39
8/27/2012	6:00 AM	16.5	No data	15	16.947
8/27/2012	7:00 AM	16.3	No data	20	16.532
8/27/2012	8:00 AM	16.6	No data	17	16.462
8/27/2012	9:00 AM	16.6	No data	16	16.15
8/27/2012	10:00 AM	14.4	No data	20	13.102
8/27/2012	11:00 AM	Z/S Chk	No data	9	11.397
8/27/2012	12:00 PM	10	No data	11	<Samp
8/27/2012	1:00 PM	9.5	No data	12	9.562
8/27/2012	2:00 PM	9.4	No data	11	9.66
8/27/2012	3:00 PM	9	No data	12	9.56
8/27/2012	4:00 PM	9	No data	14	10.205
8/27/2012	5:00 PM	9.8	No data	10	10.707
8/27/2012	6:00 PM	9.9	No data	12	10.44
8/27/2012	7:00 PM	10	No data	11	9.69
8/27/2012	8:00 PM	10.2	No data	14	9.26
8/27/2012	9:00 PM	10.4	No data	11	9.382
8/27/2012	10:00 PM	10.2	No data	9	9.382
8/27/2012	11:00 PM	10.2	No data	10	9.387
8/27/2012	12:00 AM	10.3	No data	9	9.254
8/28/2012	1:00 AM	10.5	No data	16	9.542
8/28/2012	2:00 AM	10.7	No data	11	11.745
8/28/2012	3:00 AM	10.6	No data	10	12.312
8/28/2012	4:00 AM	10.8	No data	11	12.852
8/28/2012	5:00 AM	11	No data	11	12.112
8/28/2012	6:00 AM	10.8	No data	12	12.535
8/28/2012	7:00 AM	11.2	No data	16	13.335
8/28/2012	8:00 AM	11.8	No data	15	12.987
8/28/2012	9:00 AM	11.4	No data	9	12.422
8/28/2012	10:00 AM	10.8	No data	13	10.95

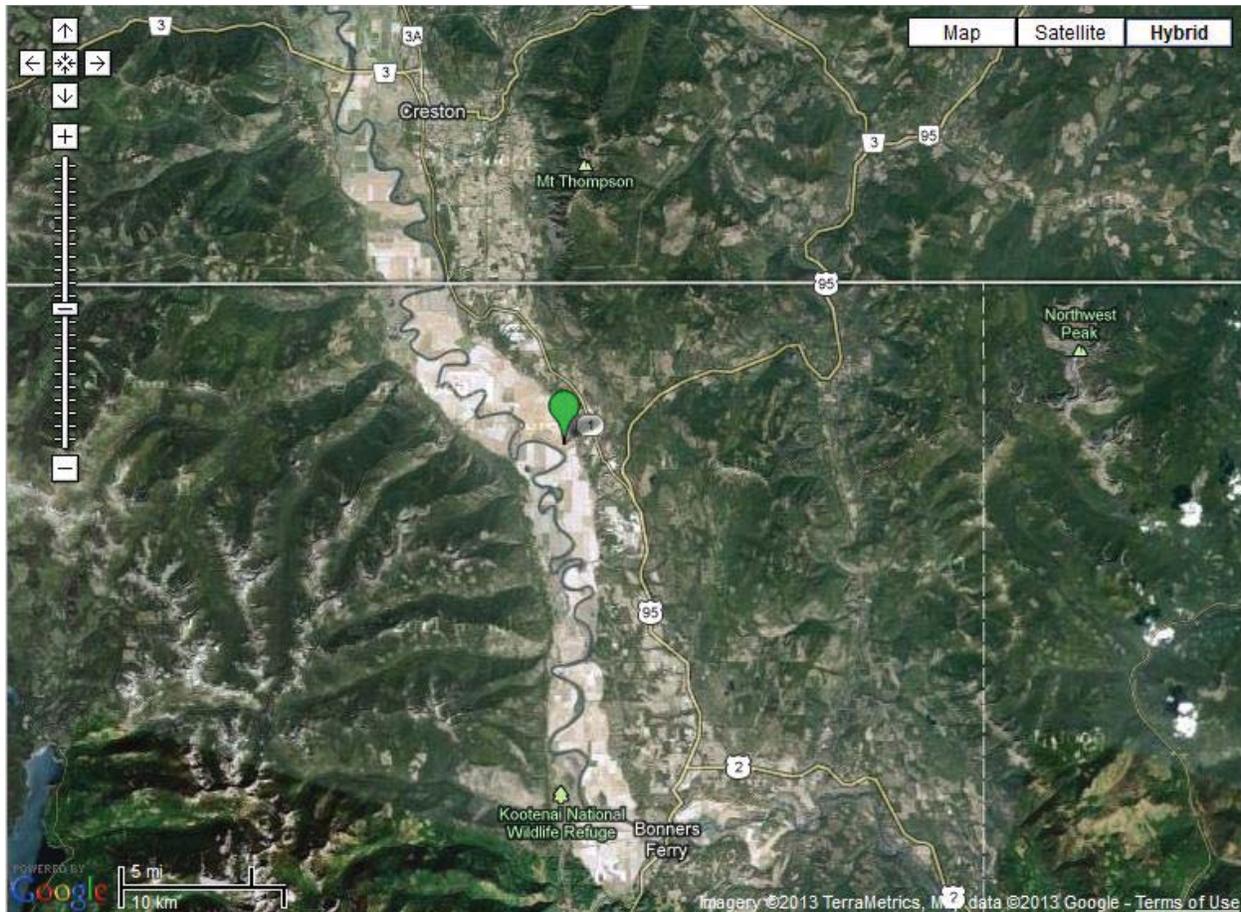


Figure 19. Map of approved fields for August 28, 2012.

Field Observations

Initial field observations indicated a temperature of 72 °F, which was what the forecast suggested for this time period. Surface winds were measured from the south-southwest, which was more southerly than expected at the time. Ventilation conditions in the field were estimated as marginal or better. Relative humidity was 39%, very close to what was anticipated at this time. The fuel was described as being loose and heavy with a uniform horizontal continuity. The vertical arrangement of the fuel was mixed and in a dry condition. A pibal was released prior to ignition. The results of the pibal (Figure 20) show that the transport winds would take the smoke to the north and northeast. The field coordinator confirmed slow surface winds and anticipated the smoke plume would produce substantial lift and reach the high winds in the transport layer and dissipate well.

The first field, a 150-acre blue grass field, was verbally approved by the onsite DEQ coordinator and immediately ignited at approximately 11:15 a.m. Four individuals ignited the field, and the initial smoke plume rose to approximately 1,000 feet AGL. The plume continued to rise to about 2,000 feet and was initially reported to be moving east. However, after the initial good smoke report, the plume was reported heading northeast and dispersion was becoming fair to poor as the leading edge of the plume started to “fall out.” The winds above the valley (at the US 95 overlook) were 3–5 mph. From this vantage point, the field coordinator noted that the smoke

plume appeared to be collapsing. The DEQ field coordinator decided to relocate to the Canadian border (near Porthill) to observe smoke behavior and document impacts at this location. As the field coordinator drove to Porthill, a noticeable smoke odor was noted at mile marker 5 along Hwy 1. This observation correlates to the initial increase at the Porthill monitor. The DEQ field coordinator noted that higher elevation smoke had fair dispersion, while smoke on or near the ground had poor dispersion. Winds were not pushing the smoke well. The burn was completed by approximately 12:50 p.m. No further field burns were approved due to difficulties encountered with ignition and smoke behavior during the first burn. By 1 p.m., increased surface winds were noted. Smoke was near ground level and would likely impact the Creston monitor based on low level dispersion and transport conditions.

Table 24 includes the monitoring data during and after the burns. The maximum hourly concentrations were $25.3 \mu\text{g}/\text{m}^3$ (1:00 p.m. at Porthill), $38 \mu\text{g}/\text{m}^3$ (2:00 p.m. at Creston), and $16.1 \mu\text{g}/\text{m}^3$ (5:00 p.m. at Copeland). It is not clear why the Copeland monitor had a reading of $16.1 \mu\text{g}/\text{m}^3$ at 6:00 p.m. Surface wind direction and speed after the field was ignited suggest smoke would have had to originate somewhere to the south of this location. This monitor is south of the burn location and all smoke was reported moving north earlier in the day. However, due to the nature of the wind patterns in the valley, smoke from the burn could have been brought back to this location later in the day or “dropped” from a higher elevation.

Table 24. Air quality monitoring data during and after burning.

Date	Time	PM _{2.5} ($\mu\text{g}/\text{m}^3$)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland
8/28/2012	11:00 AM	10.2	No data	11	10.3
8/28/2012	12:00 PM	17.7	No data	14	10.3
8/28/2012	1:00 PM	25.3	No data	22	10.6
8/28/2012	2:00 PM	10.3	No data	38	10.9
8/28/2012	3:00 PM	11.2	No data	9	11.9
8/28/2012	4:00 PM	16.4	No data	11	12.1
8/28/2012	5:00 PM	14.7	No data	16	12.8
8/28/2012	6:00 PM	12.4	No data	15	16.1
8/28/2012	7:00 PM	12.9	No data	13	14.0
8/28/2012	8:00 PM	13.7	No data	15	13.3
8/28/2012	9:00 PM	13.8	No data	14	11.6
8/28/2012	10:00 PM	13.1	No data	10	12.4
8/28/2012	11:00 PM	12.5	No data	11	10.0
8/28/2012	12:00 AM	10.5	No data	18	9.2

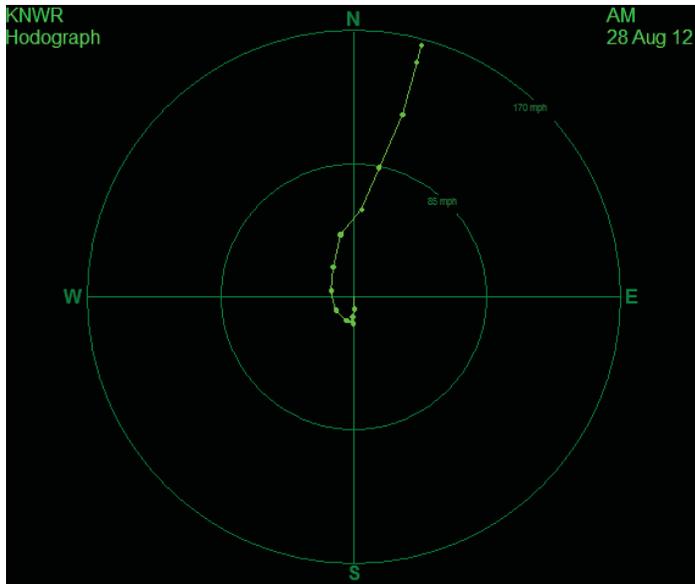


Figure 20. Daily pibal results. The line indicates the direction the wind would take the smoke.

Six complaints were received about this burn day: one on the day of the burn at approximately 3:00 p.m. and five additional on August 29. All complaints were received by the toll-free complaint hotline and all came from residents of the Creston Valley. All complainants indicated significant smoke at ground level. Based on smoke observations made on the day of the burn, monitoring readings, and winds during and after the burn, smoke from the DEQ-approved crop residue burn was likely the cause of the numerous complaints. This day recorded the most complaints directly attributed to field burning in Boundary County for any one day this year. This grass residue field has prompted multiple complaints during burnings previous years, suggesting this field needs optimal meteorological conditions to burn and successfully manage smoke.

Summary

One 150-acre field of turf grass was burned in Boundary County on August 28, 2012. The observed meteorological conditions were not entirely as forecasted, with more southwesterly winds early in the burn window when a westerly influence was initially expected. The observed temperature and relative humidity were as forecasted. The good ventilation forecast did not materialize. Initially the vertical mixing was expected to reach well above 5,000 ft AGL. Smoke behavior indicated only 1,500–2,000 ft was achieved. The field took more than 1.5 hours to ignite, indicating the fire was moving slowly through the field. It is not entirely clear why the smoke plume had good initial lift and then collapsed and created significant ground smoke. It may partially be due to the type of fuel. This was a bluegrass field, which produces more smoke and takes much longer to ignite. This would affect initial heat generation during the burn which would inhibit lift. The pibal results depicted the upper level winds well. This was one of the first burn days in Boundary County to use pibal data in the decision making process. A better understanding of processed pibal data was suggested to help forecast probable smoke behavior. This grass residue field needs optimal meteorological conditions for burning to successfully manage smoke. The amount of fuel on the field may also need to be considered.

Burn Date: September 4, 2012

Burn Decision

Burn day: up to 500 acres approved—pending meteorological conditions. Burn window: 11 a.m. to 4 p.m.

Burn Decision Justification

This burn decision was developed using NWS observations at Bonners Ferry and Creston, BC, (Table 25); forecasted winds, ventilation, and temperatures from the UW NWMC, as displayed in DEQ’s weather checklist (Figure 21); and the daily forecast produced by the DEQ contract meteorologist, Bennett Fire Weather Services, LLC (Figure 22). Ventilation was expected to be marginal, with surface winds generally from the north-northwest at 3–5 mph. The upper level winds were forecasted to be from the northwest at 11–18 mph at an elevation of 4,000–7,000 ft AGL. These mixing height elevations are very high and therefore DEQ anticipated a good burn day.

The DEQ contract meteorologist recommended a burn day. The ventilation forecast for Boundary County was good for the customary burn window. Figure 22 also describes favorable surface winds of 3–10 mph and acceptable transport winds of 5–10 mph. An 80-acre field was identified as a test burn due to its size and location to confirm the meteorological forecast and anticipated smoke behavior.

DEQ reviewed the monitoring data (Table 26) for Creston, BC; Porthill; and Copeland. The maximum hourly PM_{2.5} concentration recorded at any of these sites was below 7 µg/m³. This maximum concentration occurred at the Creston monitor at 5:00 p.m. on September 3, 2012 (the day prior to burning). This concentration is well below all pre-burn enhanced documentation triggers. The Bonners Ferry monitor was not providing data for this burn day. However, all other monitors showed consistent concentrations throughout the valley.

DEQ determined a burn window of 11:00 a.m.–4:00 p.m. based on the weather checklist and the customary time when daytime heating assists ventilation mechanisms in the atmosphere.

Three fields, a total of 485 acres of cereal grain, were ultimately approved for burning after initial field observations (Figure 23).

Table 25. National Weather Service observations at Bonners Ferry (Site ID K65S).

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
9-4-2012 5:55 PDT	48.2	76	0	n/a	no value	OK
9-4-2012 6:15 PDT	48.2	76	0	n/a	no value	OK
9-4-2012 6:35 PDT	46.4	81	0	n/a	no value	OK
9-4-2012 6:55 PDT	46.4	81	0	n/a	no value	OK
9-4-2012 7:15 PDT	48.2	81	0	n/a	no value	OK
9-4-2012 7:35 PDT	50	76	0	n/a	no value	OK

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
9-4-2012 7:55 PDT	53.6	67	0	n/a	no value	OK
9-4-2012 8:15 PDT	55.4	62	0	n/a	no value	OK
9-4-2012 8:35 PDT	55.4	67	3.5	170	no value	OK
9-4-2012 8:55 PDT	55.4	62	3.5	170	no value	OK
9-4-2012 9:15 PDT	57.2	63	3.5	200	no value	OK
9-4-2012 9:35 PDT	60.8	48	3.5	10	no value	OK
9-4-2012 9:55 PDT	59	59	3.5	180	no value	OK
9-4-2012 10:15 PDT	62.6	52	0	n/a	no value	OK
9-4-2012 10:35 PDT	64.4	45	4.6	220	no value	OK
9-4-2012 10:55 PDT	64.4	39	0	n/a	no value	OK
9-4-2012 11:15 PDT	66.2	40	3.5	320	no value	OK
9-4-2012 11:35 PDT	66.2	40	4.6	210	no value	OK
9-4-2012 11:55 PDT	68	35	0	n/a	no value	OK

Morning Forecasting for Boundary														
Model Resolution:	12km			Model Run:	2012090312			SiteID:	IBONY					
Date	Time in PDT												Comments	
9/4/2012	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM		
Vent. Index	P	M	M	M	M	M	M	M	P	NP	NP	P		
G: good, M: marginal, P: poor, NP: very poor														
Surface (20m) Winds	Direction	NNW	NNW	NNW	NNW	NNW	NNW	N	N	NE	SE	SW	WSW	5 kts = 5.75 mph,
	Speed (mph)	4.9	4.7	4.9	4.9	4.5	3.2	2.5	2.5	2.1	1.6	3.5	6.2	10 kts = 11.5 mph,
Surface (20m) Temperature (degree C)	15.2	16.6	18.0	19.1	19.9	20.6	20.9	21.0	20.6	19.5	18.3	17.7		15 kts = 17.25 mph
Surface (20m) Relative Humidity (%)	44.3	39.2	34.0	30.0	28.2	27.6	27.8	28.0	29.1	32.7	37.7	41.2		
Planetary Boundary Layer (PBL)	Height (feet)	2910	4026	5295	6033	6690	7018	7175	6932	2142	62	62	377	Height is above model terrain surface
	Direction	N	NNW	NW	NW	WNW	WNW	WNW	WNW	NW	SE	SW	W	
	Speed (mph)	12.8	11.3	13.3	16.8	18.0	18.5	17.0	16.8	4.8	1.6	3.5	9.6	
700mb (~10,000 ft MSL)	Height (feet)	7322	7322	7322	7322	7322	7322	7322	7322	7322	7322	7322	7322	Height is above model terrain surface
	Direction	NW	NW	NW	NW	NW	WNW	WNW	WNW	WNW	NW	NW	NW	
	Speed (mph)	19.7	18.9	18.7	18.8	19.2	18.5	17.0	16.8	17.1	17.4	17.4	17.9	
850mb (~5000 ft MSL)	Height (feet)	2345	2345	2345	2345	2345	2345	2345	2345	2345	2345	2345	2342	Height is above model terrain surface
	Direction	N	NNW	NNW	NW	NW	NW	NW	NW	NW	WNW	WNW	WNW	
	Speed (mph)	11.5	9.2	9.0	9.4	8.8	6.6	5.2	4.9	5.2	7.8	12.1	14.7	

Figure 21. Weather checklist for Bonners Ferry. Information taken from the University of Washington Northwest Modeling Consortium forecast model.

Forecast Prepared by: BENNETT FIRE WEATHER SERVICES, LLC

Forecast Time Prepared: 8:00 AM PDT – Tuesday September 4, 2012

Forecast for: TUESDAY – September 4, 2012

GENERAL WEATHER DISCUSSION:

TUESDAY:

A strong and stable high pressure ridge is building into northern Idaho from the west today. The dry northwest flow aloft accompanies the building ridge and will provide subsiding air over northern Idaho this afternoon. At the surface this afternoon a cooler air mass stretches west to east across northern Idaho. The pressure gradient field is oriented west to east. Surface wind direction will be westerly at speeds in the 4-10 mph range by this afternoon. Mixing heights this afternoon will range around 4-6,000 over all air sheds. Transport winds will be from the west to northwest at 5-10 mph over northern Idaho. Dispersion is expected to be marginal due to a lack of wind in the mixed layer. Ventilation is poor to marginal in the morning under a moderate to strong inversion. The inversions are expected break around 11 am leaving locally good ventilation over the air sheds. The inversion break temperatures look to be around 11 am-12 noon 60-68 degrees.

NORTHERN IDAHO BY AIRSHED:

BOUNDARY COUNTY Air Shed:

Forecast for TUESDAY:

SKY/WEATHER: Mostly sunny.

TEMPERATURE: High temperatures ranging from 74-78.

HUMIDITY: Minimum RH around 25-40 percent.

WIND – SURFACE: Northwest to northeast 3-10 mph in the afternoon.

TRANSPORT: Northwest to west 5-10 mph in the afternoon.

INVERSIONS: Strong to moderate morning inversion breaking by 11 am at a temperature around 60 degrees.

MIXING HEIGHT: Air mass becomes unstable to 5,000 feet AGL by the afternoon.

VENTILATION: POOR to MARGINAL in the morning becoming locally GOOD in the afternoon.

AIRSHED Recommendations: Watch the northwest wind direction.

Boundary County: Burn

LOCAL TIME										
County	08	09	10	11	12	13	14	15	16	17
Boundary	M	M	M	M	G	G	G	G	G	G

VENTILATION KEY: P = Poor M = Marginal G = Good E = Excellent

Figure 22. Weather forecast prepared by Bennett Fire Weather Services, LLC, for Boundary County.

Table 26. Available PM_{2.5} monitoring data prior to burn decision

Date	Time	PM _{2.5} (µg/m ³)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland
9/3/2012	1:00 AM	2.8	No data	1	2.661
9/3/2012	2:00 AM	2.8	No data	1	2.568
9/3/2012	3:00 AM	2.7	No data	1	2.571
9/3/2012	4:00 AM	2.9	No data	1	2.639
9/3/2012	5:00 AM	2.7	No data	1	2.928
9/3/2012	6:00 AM	2.8	No data	2	3.103
9/3/2012	7:00 AM	3.2	No data	6	3.502
9/3/2012	8:00 AM	4.1	No data	3	3.432
9/3/2012	9:00 AM	3.6	No data	3	3.731
9/3/2012	10:00 AM	2.8	No data	1	3.579
9/3/2012	11:00 AM	2.6	No data	2	3.242
9/3/2012	12:00 PM	2.7	No data	3	2.982
9/3/2012	1:00 PM	2.6	No data	2	2.705
9/3/2012	2:00 PM	2.7	No data	4	2.245
9/3/2012	3:00 PM	2.7	No data	0	2.295
9/3/2012	4:00 PM	2.5	No data	0	2.566
9/3/2012	5:00 PM	2.3	No data	7	2.478
9/3/2012	6:00 PM	2.4	No data	0	2.452
9/3/2012	7:00 PM	2.4	No data	2	2.516
9/3/2012	8:00 PM	2.7	No data	3	2.486
9/3/2012	9:00 PM	2.5	No data	2	2.479
9/3/2012	10:00 PM	2.6	No data	1	2.488
9/3/2012	11:00 PM	2.3	No data	1	2.52
9/3/2012	12:00 AM	2.4	No data	0	2.478
9/4/2012	1:00 AM	2.3	No data		2.235
9/4/2012	2:00 AM	2.2	No data	0	2.226
9/4/2012	3:00 AM	2.2	No data	0	2.214
9/4/2012	4:00 AM	2.3	No data	0	2.283
9/4/2012	5:00 AM	2.3	No data	2	4.444
9/4/2012	6:00 AM	2.3	No data	0	2.737
9/4/2012	7:00 AM	2.2	No data	2	2.929
9/4/2012	8:00 AM	2.2	No data	6	2.974
9/4/2012	9:00 AM	2.1	No data	3	2.71
9/4/2012	10:00 AM	2	No data	0	2.654

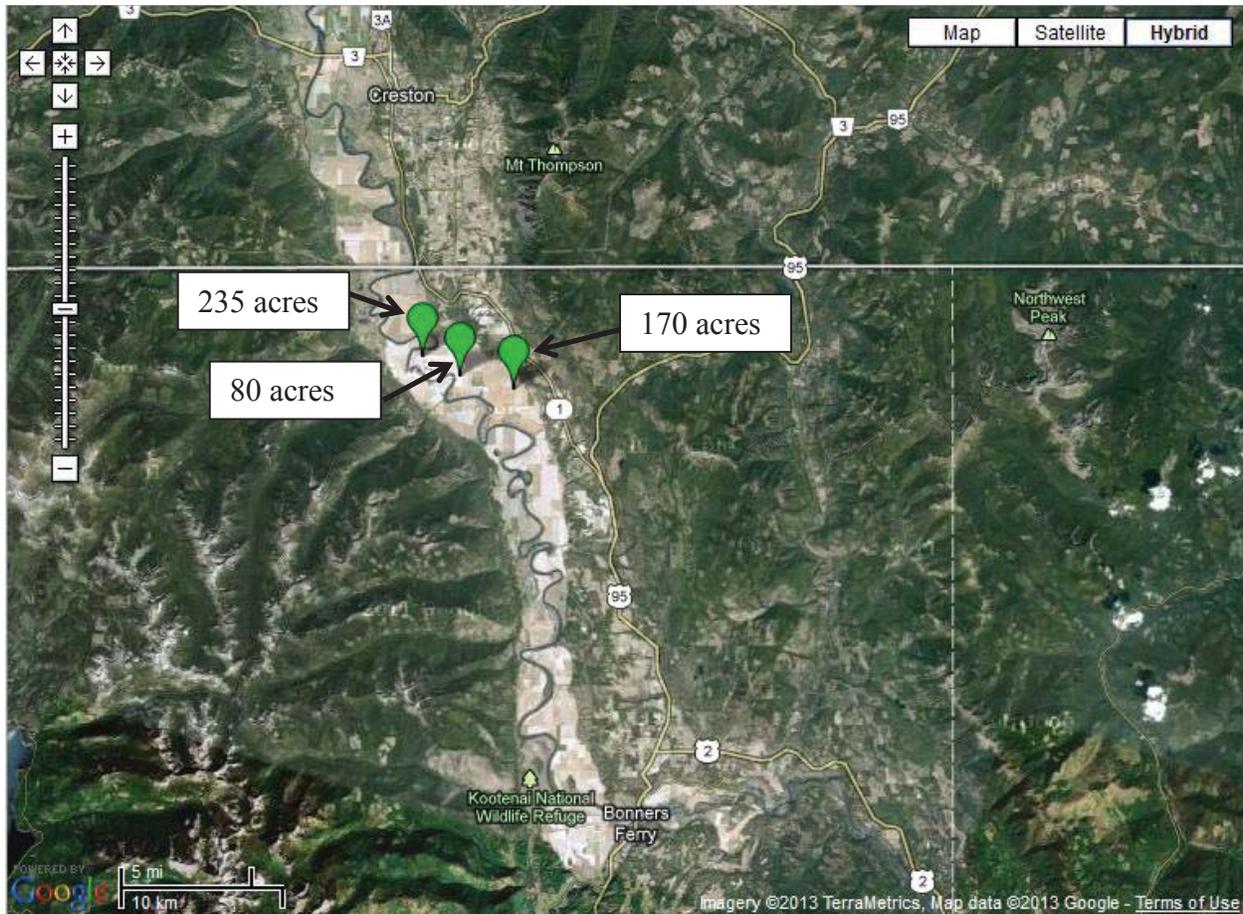


Figure 23. Map of approved fields for September 4, 2012.

Field Observations

DEQ staff made field observations prior to final burn approval to determine if the meteorological forecast was going to be representative of the day. A northwesterly surface wind at 3–7 mph was measured in the test burn field location. The forecast was for more of a north-northwest component to the wind. The temperature was 68 °F, 7 °F higher than expected at 11:00 a.m. Measured relative humidity was 43%, close to the forecasted value. The meteorological forecast was favorable for burning. Fuel conditions were brown and very dry for all fields. Soil moisture was very dry, fuel arrangement loose, and fuel loading heavy. Cloud cover was around 5%.

A pibal was released at 10:00 a.m. near the Kootenai National Wildlife Refuge located in the southwest corner of the valley. The pibals were tracked by two DEQ-trained interns employed by the wildlife refuge. The data gathered results in a “hodograph,” which shows a generally northwest wind throughout the airshed (Figure 24). The graph is customarily forwarded to field staff to help confirm upper air wind direction prior to final verbal approval.

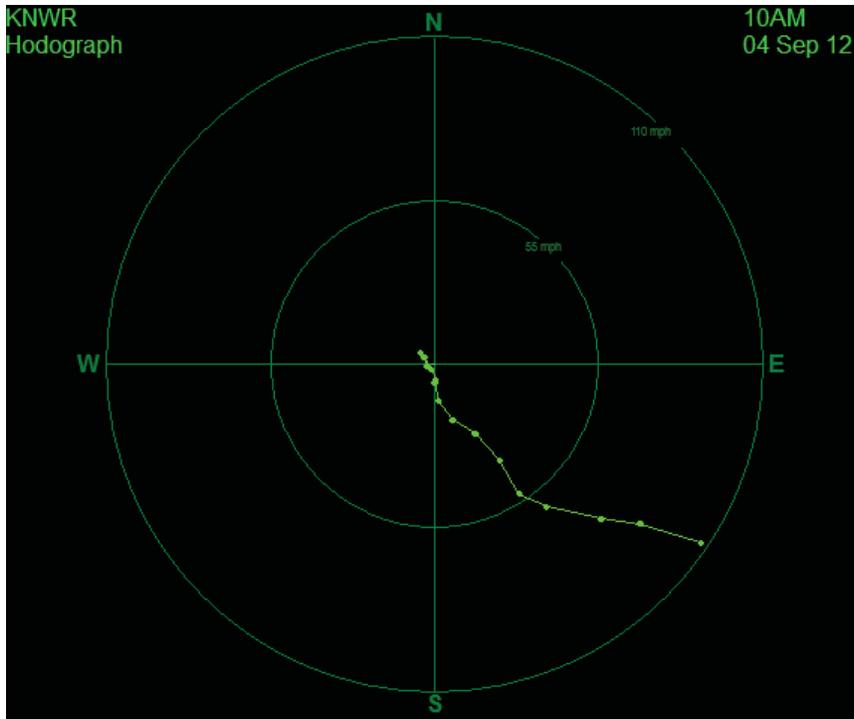


Figure 24. Daily pibal results. The line indicates the direction the wind would take the smoke.

Conditions in the fields indicated good or better ventilation. The first field, an 80-acre wheat stubble field in the north part of the valley, was ignited at 11:18 a.m. Initial smoke moved southeast influenced by a northwest surface wind. Horizontal dispersion and vertical dispersion was excellent. The 80-acre field was out at 11:36 a.m., with the highest level smoke at about 2,500 ft AGL. Conditions indicated good ventilation and transport direction, so DEQ approved the grower to burn the 170-acre wheat stubble field.

This 170-acre field was ignited at 11:56 a.m. Horizontal and vertical dispersion was excellent, and column heights increased to 3,500 ft–4,000 ft AGL with upper level smoke transporting to the east-southeast. Smoke that remained in the valley moved to the south with good dispersion. This burn was out by 12:40 p.m.

A 235-acre field near the 170-acre field was ignited at 1:21 p.m. The grower lit the field quickly, generating a lot of heat very quickly and resulting in extremely high column height, at least 5,000–6,000 ft AGL. Very few burns reach this height in the Kootenai River valley. Dispersion to the east was excellent for the entire burn. Smoke reached heights that produced clouds. This 235-acre field, and thus all burning, was complete at 1:49 p.m.

Field observations described ventilation and dispersion as far better than forecasted, especially for the last burn.

Table 27 includes the monitoring data during and after the burns. The maximum hourly concentration at any of the monitors was $5.7 \mu\text{g}/\text{m}^3$, recorded at Copeland at 2:00 p.m. This value is well below all enhanced documentation triggers and program concentration limits. The monitor at Copeland is located south of the burn locations. The smoke transport was described as moving to the southeast. If any ground smoke was created this day, it would have been expected

to transport towards this monitor. The test burn indicated good ventilation and demonstrated smoke would not impact the Copeland monitor.

Table 27. Air quality PM_{2.5} monitoring data during and after burning.

Date	Time	PM _{2.5} (µg/m ³)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland
9/4/2012	11:00 AM	1.9	No data	0	2.593
9/4/2012	12:00 PM	1.7	No data	0	2.99
9/4/2012	1:00 PM	1.5	No data	0	5.768
9/4/2012	2:00 PM	1.4	No data	0	5.707
9/4/2012	3:00 PM	1.4	No data	0	4.402
9/4/2012	4:00 PM	1.4	No data	0	3.507
9/4/2012	5:00 PM	1.6	No data	0	3.023
9/4/2012	6:00 PM	2	No data	0	2.532
9/4/2012	7:00 PM	2.2	No data	0	2.438
9/4/2012	8:00 PM	2	No data	2	2.358
9/4/2012	9:00 PM	1.8	No data	0	2.638
9/4/2012	10:00 PM	1.9	No data	1	2.494
9/4/2012	11:00 PM	2	No data	0	2.498
9/4/2012	12:00 AM	1.9	No data	1	2.553

No complaints were received from any DEQ-approved burning or any other sources on this day.

Summary

Three fields, a total of 485 acres of cereal grain stubble, were burned this day in Boundary County. All three fields were located in the northern part of the valley. Observed meteorological conditions were as good as or better than forecasted for most of the day. Ventilation was forecasted to be marginal to good and field observations noted excellent vertical and horizontal dispersion. The observed transport winds verified the forecasted northwesterly component. The observed surface and lower level winds were more north and northeast than forecasted or seen in the pibal hodograph (Figure 24). The pibal was released approximately 15 miles south of the fields, and this distance lends itself to variances in meteorological conditions. The observed relative humidity and temperatures were as expected, if not a little warmer. The maximum mixing height that smoke would be able to mix into was forecasted at 7,175 ft AGL. The actual smoke behavior indicated that it did mix to approximately that height, as seen by cloud formation. This day's burns were extremely successful, as conditions resulted in optimal dispersion and ventilation. These conditions were very conducive to good smoke management and should be identified in the future to take advantage of such good smoke ventilation conditions.

Burn Date: September 5, 2012

Burn Decision

Burn day: up to 500 acres approved—pending meteorological conditions. Burn window: 12 p.m. to 4 p.m.

Burn Decision Justification

This burn decision was developed using NWS observations at Bonners Ferry and Creston, BC, (Table 28); forecasted winds, ventilation, and temperatures from the UW NWMC, as displayed in DEQ's weather checklist (Figure 25); and the daily forecast produced by the DEQ contract meteorologist, Bennett Fire Weather Services, LLC (Figure 26). Ventilation was expected to be poor, with surface winds generally from the northeast at 1–2 mph. The forecasted surface wind speeds were anticipated to be under-predicted for this day. The upper level winds were forecasted to be from the west at 8–15 mph at an elevation of 4,000–7,300 ft AGL. These mixing height elevations are very high and the wind speed was good; therefore, a good burn day was anticipated.

The DEQ contract meteorologist recommended a conditional burn day. The ventilation forecast for Boundary County was marginal to good for the burn window. Lighter surface winds were expected to allow good column formation with good transport wind speeds for dispersion/ventilation. DEQ determined a burn window of noon–4:00 p.m. based on mixing heights in Figure 25 and the customary time when daytime heating assists ventilation mechanisms in the atmosphere.

DEQ reviewed the monitoring data (Table 29) for Creston, BC; Porthill; and Copeland. The maximum hourly PM_{2.5} concentration recorded at any of these sites was 6 µg/m³, which occurred at Copeland at 8:00 p.m. on September 4 (the day prior to burning). This concentration is below all preburn enhanced documentation triggers. The Bonners Ferry monitor was not providing data for this burn day. However, all other monitors showed consistent concentrations throughout the valley.

One field, a total of 220 acres of cereal grain stubble, was approved for burning after DEQ field verification (Figure 27).

Table 28. National Weather Service observations at Bonners Ferry (Site ID K65S).

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
9-5-2012 5:55 PDT	42.8	87	0	n/a	No value	OK
9-5-2012 6:15 PDT	41	93	0	n/a	No value	OK
9-5-2012 6:35 PDT	41	93	0	n/a	No value	OK
9-5-2012 6:55 PDT	42.8	87	0	n/a	No value	OK
9-5-2012 7:15 PDT	44.6	87	0	n/a	No value	OK
9-5-2012 7:30 PDT	46.4	81	0	n/a	No value	OK
9-5-2012 7:55 PDT	50	71	0	n/a	No value	OK

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
9-5-2012 8:15 PDT	53.6	62	0	n/a	No value	OK
9-5-2012 8:35 PDT	53.6	67	3.5	200	No value	OK
9-5-2012 8:55 PDT	51.8	66	0	n/a	No value	OK
9-5-2012 9:15 PDT	55.4	58	0	n/a	No value	OK
9-5-2012 9:35 PDT	57.2	59	0	n/a	No value	OK
9-5-2012 9:55 PDT	59	55	0	n/a	No value	OK
9-5-2012 10:15 PDT	59	55	3.5	210	No value	OK
9-5-2012 10:30 PDT	60.8	51	0	n/a	No value	OK
9-5-2012 10:55 PDT	62.6	45	3.5	240	No value	OK
9-5-2012 11:15 PDT	64.4	42	3.5	180	No value	OK
9-5-2012 11:35 PDT	66.2	40	4.6	120	No value	OK
9-5-2012 11:55 PDT	66.2	40	3.5	170	No value	OK

Morning Forecasting for Boundary														
Model Resolution:	12km			Model Run:	2012090412			SiteID:	IBONY					
Date	Time in PDT												Comments	
9/5/2012	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM		
Vent. Index	NP	NP	NP	P	P	P	P	P	NP	P	P	NP		
G: good, M: marginal, P: poor, NP: very poor														
Surface (20m) Winds	Direction	N	NNW	NE	NE	NNE	NNE	NW	W	SSW	SW	SW	WSW	5 kts = 5.75 mph,
	Speed (mph)	0.4	0.5	0.3	0.9	1.3	1.2	0.9	1.6	1.6	3.5	4.0	1.6	10 kts = 11.5 mph,
Surface (20m) Temperature (degree C)	15.4	17.1	18.8	20.1	21.0	21.6	21.8	21.8	21.0	19.9	19.1	17.5	15 kts = 17.25 mph	
Surface (20m) Relative Humidity (%)	47.5	42.8	38.3	35.0	32.7	31.1	30.5	31.1	36.5	41.7	43.5	49.7		
Planetary Boundary Layer (PBL)	Height (feet)	1677	2769	4068	5525	6532	7293	7779	7198	190	653	459	62	Height is above model terrain surface
	Direction	NW	WNW	WNW	WNW	W	W	WNW	WNW	SW	WSW	WSW	WSW	
	Speed (mph)	5.1	8.4	11.1	15.0	15.3	15.5	15.9	13.1	4.4	10.7	7.9	1.6	
700mb (~10,000 ft MSL)	Height (feet)	7322	7322	7322	7322	7322	7322	7322	7322	7322	7322	7322	7322	Height is above model terrain surface
	Direction	NW	NW	NW	WNW	WNW	W	W	WNW	WNW	WNW	NW	NW	
	Speed (mph)	19.6	18.4	18.2	18.1	17.3	15.5	14.0	13.1	13.4	14.3	14.2	15.6	
850mb (~5000 ft MSL)	Height (feet)	2345	2089	2089	2089	2089	2089	2089	2089	2089	2089	2089	2089	Height is above model terrain surface
	Direction	NW	WNW	WNW	W	W	W	W	W	WSW	W	W	WNW	
	Speed (mph)	10.5	4.8	4.0	3.6	3.6	4.3	5.6	8.8	12.6	14.3	13.5	11.2	

Figure 25. Weather checklist for Bonners Ferry. Information taken from the University of Washington Northwest Modeling Consortium forecast model.

Forecast Prepared by: BENNETT FIRE WEATHER SERVICES, LLC

Forecast Time Prepared: 8:00 AM PDT – Wednesday September 5, 2012

Forecast for: WEDNESDAY – September 5, 2012

GENERAL WEATHER DISCUSSION:

WEDNESDAY:

The flat high pressure ridge has eroded as an upper level trough moves into Southern British Columbia this afternoon. The upper trough is mainly dry except for a scattered showers and thunderstorms over Boundary County this evening. The flow aloft is westerly and strong. At the surface this afternoon the cold front accompanying the approaching trough will hold off until this evening and tonight before passing north to south across northern Idaho. Meanwhile, this afternoon a cooler air mass continues west to east across northern Idaho. The pressure gradient field is oriented west to east. Surface wind direction will be westerly at speeds in the 3-10 mph range this afternoon. Mixing heights this afternoon will range around 5-6,000 over all air sheds. Transport winds will be from the southwest to northwest at 5-10 mph over northern Idaho. Dispersion is expected to be marginal due to a lack of wind in the mixed layer. Ventilation is poor to marginal in the morning under a moderate to strong inversion. The inversions are expected break around 11 am leaving marginal to locally good ventilation over the air sheds as surface mixing is weaker. The inversion break temperatures look to be around 11am-12 noon 66-70 degrees.

NORTHERN IDAHO BY AIRSHED:

BOUNDARY COUNTY Air Shed:

Forecast for WEDNESDAY:

SKY/WEATHER: Mostly sunny becoming partly cloudy this afternoon.

TEMPERATURE: High temperatures ranging from 77-81.

HUMIDITY: Minimum RH around 25-40 percent.

WIND – SURFACE: Southwest to west 3-10 mph in the afternoon.

TRANSPORT: Southwest to west 5-10 mph in the afternoon.

INVERSIONS: Strong to moderate morning inversion breaking by 11am at a temperature around 66degrees.

MIXING HEIGHT: Air mass becomes unstable to 5,000 feet AGL by the afternoon.

VENTILATION: POOR to MARGINAL in the morning becoming MARGINAL to locally GOOD this afternoon.

AIRSHED Recommendations: Marginal Ventilation.

Boundary County: Conditional

LOCAL TIME										
County	08	09	10	11	12	13	14	15	16	17
Boundary	M	M	M	M	M	G	G	G	G	G

VENTILATION KEY: P = Poor M = Marginal G = Good E = Excellent

Figure 26. Weather forecast prepared by Bennett Fire Weather Services, LLC, for Boundary County.

Table 29. Available PM_{2.5} monitoring data prior to burn decision

Date	Time	PM _{2.5} (µg/m ³)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland
9/4/2012	1:00 AM	2.3	No data		2.235
9/4/2012	2:00 AM	2.2	No data	0	2.226
9/4/2012	3:00 AM	2.2	No data	0	2.214
9/4/2012	4:00 AM	2.3	No data	0	2.283
9/4/2012	5:00 AM	2.3	No data	2	4.444
9/4/2012	6:00 AM	2.3	No data	0	2.737
9/4/2012	7:00 AM	2.2	No data	2	2.929
9/4/2012	8:00 AM	2.2	No data	6	2.974
9/4/2012	9:00 AM	2.1	No data	3	2.71
9/4/2012	10:00 AM	2	No data	0	2.654
9/4/2012	11:00 AM	1.9	No data	0	2.593
9/4/2012	12:00 PM	1.7	No data	0	2.99
9/4/2012	1:00 PM	1.5	No data	0	5.768
9/4/2012	2:00 PM	1.4	No data	0	5.707
9/4/2012	3:00 PM	1.4	No data	0	4.402
9/4/2012	4:00 PM	1.4	No data	0	3.507
9/4/2012	5:00 PM	1.6	No data	0	3.023
9/4/2012	6:00 PM	2	No data	0	2.532
9/4/2012	7:00 PM	2.2	No data	0	2.438
9/4/2012	8:00 PM	2	No data	2	2.358
9/4/2012	9:00 PM	1.8	No data	0	2.638
9/4/2012	10:00 PM	1.9	No data	1	2.494
9/4/2012	11:00 PM	2	No data	0	2.498
9/4/2012	12:00 AM	1.9	No data	1	2.553
9/5/2012	1:00 AM	1.9	No data	1	2.651
9/5/2012	2:00 AM	2	No data	0	2.639
9/5/2012	3:00 AM	2.1	No data	1	2.7
9/5/2012	4:00 AM	2	No data	1	2.752
9/5/2012	5:00 AM	2.1	No data	1	2.877
9/5/2012	6:00 AM	2.2	No data	1	2.945
9/5/2012	7:00 AM	2.3	No data	3	3.078
9/5/2012	8:00 AM	2.4	No data	4	3.342
9/5/2012	9:00 AM	2.2	No data	5	3.498
9/5/2012	10:00 AM	2.1	No data	0	3.055

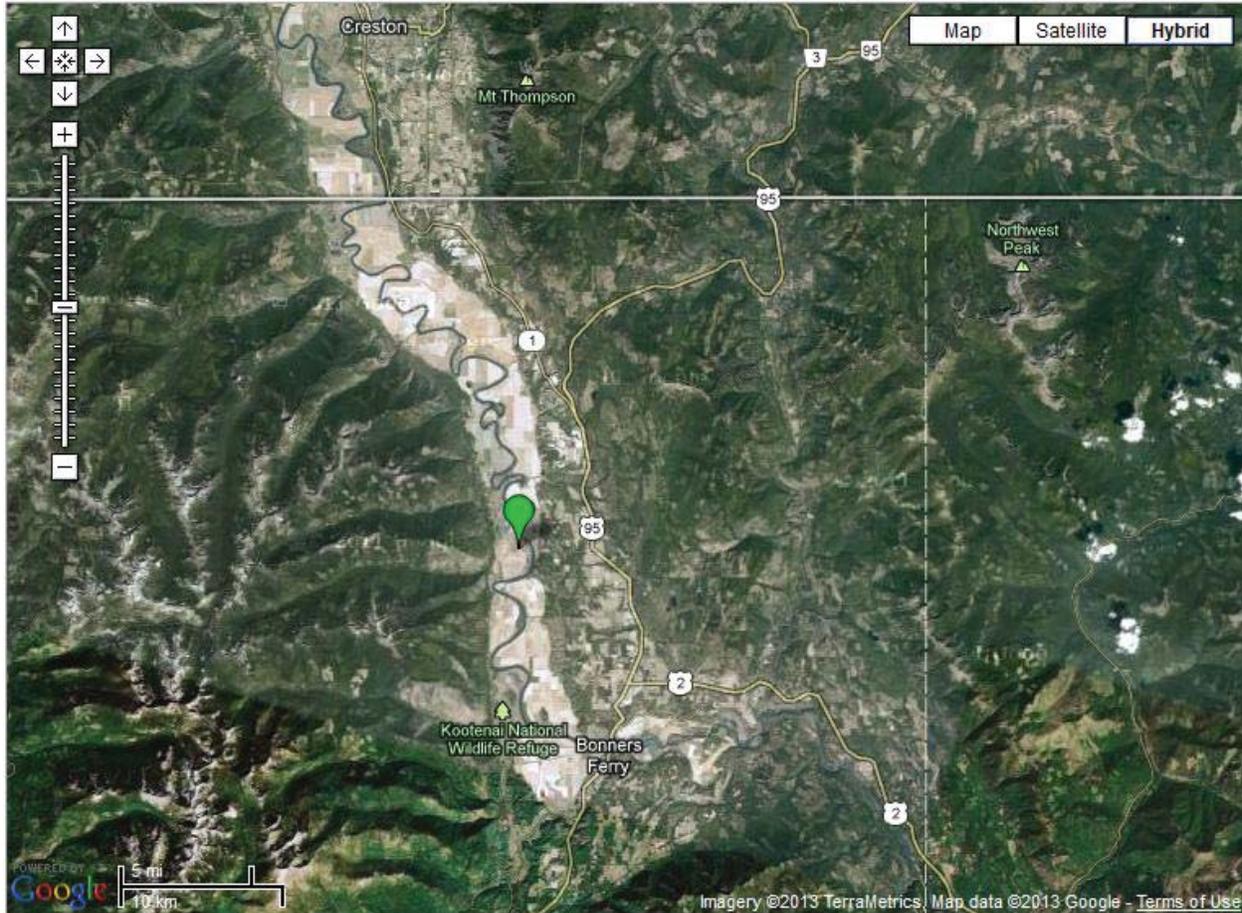


Figure 27. Map of approved fields for September 5, 2012.

Field Observations

The DEQ field coordinator made field observations before burn approvals to determine if the meteorological forecast was representative of field conditions. A south-southwest surface wind at 2–3 mph was measured in the field. The forecast was for a north-northeast component to the wind. The temperature was 73 °F at 1:00 p.m., 5 degrees warmer than expected. Measured relative humidity was 38%, as forecasted. The meteorological forecast indicated a marginal burn day. Fuel conditions were brown and very dry. Soil moisture was very dry, fuel arrangement loose, with heavy fuel loading. High cloud cover was around 75%. Although surface winds were not exactly as forecast, the conditions suggested burning would be successful.

A pibal was released at 10:30 a.m. near the Kootenai National Wildlife Refuge located in the southwest corner of the valley. The pibal was tracked by two DEQ-trained interns employed by the refuge. The data gathered results in a hodograph, which showed a south-southeast wind from the surface to about 4,400 ft AGL and then a shift to a pronounced northwest direction at elevations higher than 4,400 ft (Figure 28). The graph is customarily forwarded to field staff to help confirm upper air wind direction.

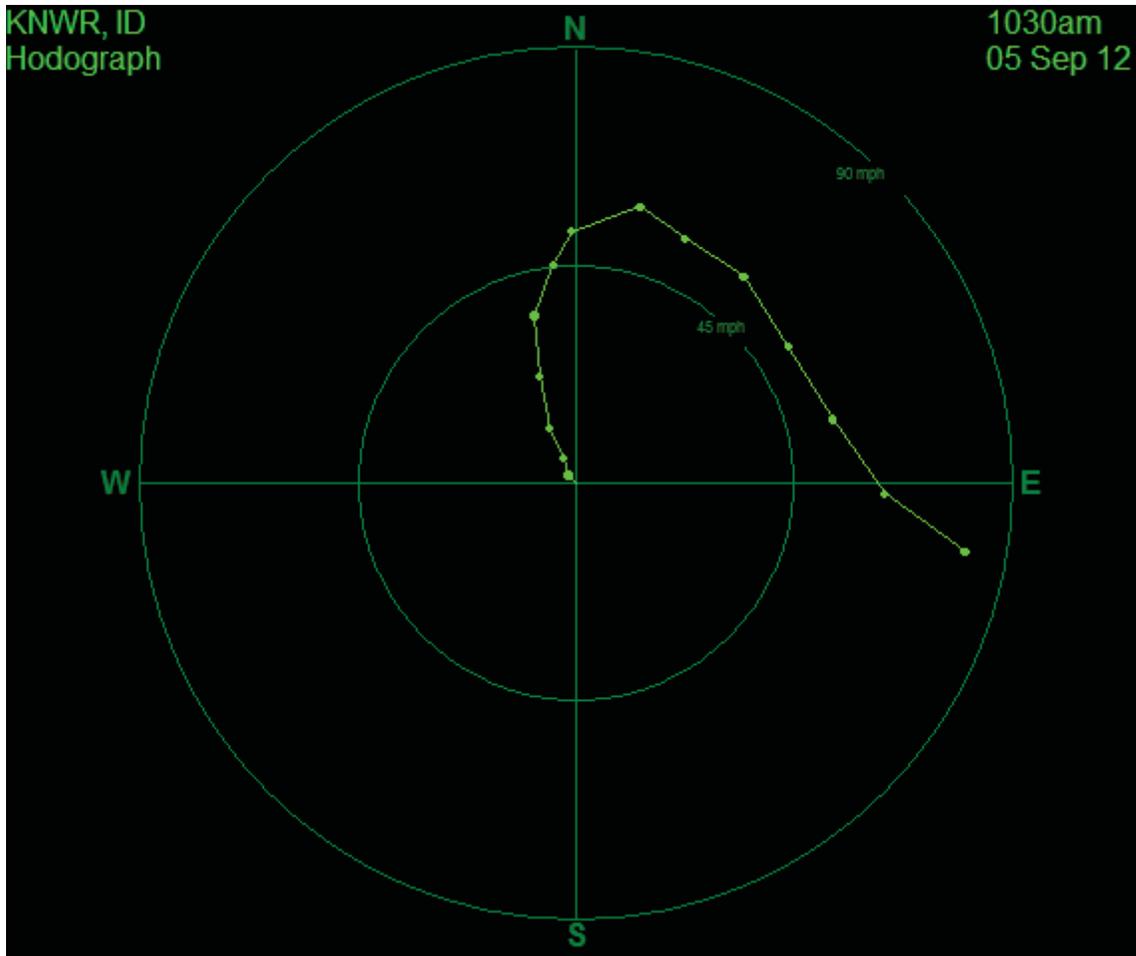


Figure 28. Daily pibal results. The line indicates the direction the wind would take the smoke.

Conditions in the fields indicated marginal or better ventilation. The grower was given verbal approval and ignited the 220-acre field at 12:53 p.m. The field was an irregular shape (long and narrow but not conforming to straight lines—“wave-like”) and lighting the field took longer than would be expected for a more traditional shaped field. Lower level clouds increased during ignition. Initial smoke from the early part of the ignition process moved northwest towards the mountains. Winds were out of the south at approximately 3 mph at a location about 4 miles north of the burn. The smoke column height was described as 2,000 ft AGL. Smoke started to level off at this height and move up the valley (to the north and northwest). Upper level cloud cover increased and moved in from the north. Horizontal smoke dispersion was good, and vertical dispersion was fair because the smoke leveled off and did not completely disperse. DEQ field staff noted that surface winds appeared to increase, the column started to “bend,” and lift was effectively reduced. Low level smoke was observed to be limited to only about 500 ft AGL. Upper level winds began to be affected by the approaching system from the north, and upper level smoke moved to the south. This smoke behavior verified the results of the pibal in Figure 28, although at a lower elevation than depicted in the pibal. Final horizontal smoke dispersion (low level) was poor to fair throughout the valley. The transport/vertical dispersion was good to excellent for this field. This 220-acre field was out at 2:15 p.m. This field took 1 hour and 25

minutes to ignite and burn, which likely contributed to poor to fair low level smoke behavior for this day. No more burning was approved after the 220-acre field was completed.

Table 30 includes the monitoring data during and after the burns. The maximum hourly concentration at any of the monitors was $11.3 \mu\text{g}/\text{m}^3$, recorded at Copeland at 4:00 p.m. This value is well below all enhanced documentation triggers and program concentration limits.

Table 30. Air quality PM_{2.5} monitoring data during and after burning.

Date	Time	PM _{2.5} ($\mu\text{g}/\text{m}^3$)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland ^a
9/5/2012	11:00 AM	2.1	No data		2.863
9/5/2012	12:00 PM	1.9	No data	3	2.986
9/5/2012	1:00 PM	1.9	No data	3	3.028
9/5/2012	2:00 PM	2.3	No data	1	3.785
9/5/2012	3:00 PM	2.3	No data	1	7.709
9/5/2012	4:00 PM	3.6	No data	6	11.298
9/5/2012	5:00 PM	2.9	No data	8	3.745
9/5/2012	6:00 PM	2.4	No data	6	3.924
9/5/2012	7:00 PM	3.3	No data	1	3.506
9/5/2012	8:00 PM	2.5	No data	0	No data
9/5/2012	9:00 PM	2.1	No data	0	No data
9/5/2012	10:00 PM	1.8	No data	1	No data
9/5/2012	11:00 PM	1.8	No data	1	No data
9/5/2012	12:00 AM	1.8	No data	1	No data

^a The Copeland monitor ceased functioning on 9/5/12. A temporary monitor was installed on 9/10/12.

One complaint from the Creston area was received on the toll-free complaint line in the evening of September 5. This complainant was experiencing “coughing and shortness of breath” but indicated there was no smoke on the ground at the caller’s location. Given the smoke trajectory described this day, it is possible that DEQ-approved crop residue burning could have contributed to initiating this complaint. The long, irregularly shaped field was not conducive to building enough heat to produce good lift. Smoke was observed dispersing throughout the valley and could have produced some slightly elevated readings in Creston and Copeland. However, the Porthill monitor did not show any elevated readings and will usually record surface smoke transporting across the US-Canada border.

Summary

The final burn decision of 500 acres was based on the morning’s forecasts; only one field, a total of 220 acres of cereal grain stubble, was burned in Boundary County this day. The field was in the middle part of the valley. Observed meteorological conditions were similar to forecasted values except for the mixing height. Vertical dispersion was good to excellent as the upper level smoke was transported to the southeast. However, as lower level cloud cover moved in during the burn, it was apparent the mixing height was not going to be reached. Smoke leveled off and

spread throughout the northern part of the valley. Horizontal dispersion was mostly poor to fair as a result. As seen in Table 31, at approximately 6:00 p.m. a cold front blew through the area bringing rain and north-northwest wind gusts to 40 mph, as noted by the Creston Automatic Weather Reporting System (CWJR). This front could have been a determining factor in the decreased mixing height and the leveling off of column lift.

Table 31. Weather observations at Creston, BC (Site ID CWJR).

Date/Time (MDT)	Temp (°F)	Dew Point (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Gust (mph)	Wind Direction (degrees)	Sea Level Pressure (mb)	Precipitation 1-hour (inches)
9-5-2012 13:00	65.1	47.1	42	2.3		360	30.05	
9-5-2012 14:00	69.1	49.7	41	2.3		260	30.02	
9-5-2012 15:00	68.4	50.9	44	3.5		290	30.01	
9-5-2012 16:00	69.8	50.2	40	4.6		300	29.99	
9-5-2012 17:00	68	50.3	44	4.6		290	29.98	
9-5-2012 18:00	61.5	50.2	58	19.6	32.2	330	30	
9-5-2012 19:00	58.5	51.6	72	21.9	36.8	340	30.02	
9-5-2012 20:00	54	51.9	91	23	40.3	330	30.08	0.04
9-5-2012 21:00	52.9	51.4	93	9.2		320	30.12	0.1
9-5-2012 22:00	51.8	50.7	95	6.9		140	30.08	0.13
9-5-2012 23:00	51.6	50.7	95	2.3		70	30.1	
9-6-2012 0:00	52.2	51.2	95	8.1		320	30.1	
9-6-2012 1:00	52	50.9	95	3.5		320	30.12	0.02
9-6-2012 2:00	51.6	50.7	95	1.2		340	30.13	0.03
9-6-2012 3:00	51.3	50.7	97	4.6		320	30.12	0.05
9-6-2012 4:00	50.2	49.6	97	1.2		120	30.14	
9-6-2012 5:00	49.5	48.8	97	2.3		100	30.15	
9-6-2012 6:00	48.9	48	95	2.3		40	30.16	
9-6-2012 7:00	49.3	47.8	93	2.3		50	30.19	
9-6-2012 8:00	48.6	47.1	93	2.3		50	30.21	

Burn Date: September 11, 2012

Burn Decision

Burn day: up to 250 acres approved—pending meteorological conditions. Burn window: 12 p.m. to 4 p.m.

Burn Decision Justification

This burn decision was developed using NWS observations at Bonners Ferry and Creston, BC, (Table 32); forecasted winds, ventilation, and temperatures from the UW NMC, as displayed in DEQ's weather checklist (Figure 29); and the daily forecast produced by the DEQ contract

meteorologist, Bennett Fire Weather Services, LLC (Figure 30). Ventilation was expected to be good, with surface winds generally from the west-southwest at 4–9 mph. The upper level winds were forecasted to be from the northeast at 15–25 mph at an elevation of 6,000–9,100 ft AGL. These are very high mixing height elevations; therefore, DEQ anticipated a good burn day.

The DEQ contract meteorologist recommended a burn day. The ventilation forecast for Boundary County was good for the burn window.

DEQ also reviewed the monitoring data (Table 33) for Creston BC; Porthill; and Copeland to determine if air quality would support a burn decision. The maximum hourly concentration recorded at any of these sites was 19 $\mu\text{g}/\text{m}^3$, which occurred at Copeland at 9:00 p.m. on September 10 (the day prior to burning). This concentration is below all preburn enhanced documentation triggers. The Bonners Ferry monitor was not providing data for this burn day. However, all other monitors showed consistent concentrations throughout the valley.

DEQ determined a burn window of noon–4:00 p.m. based on ventilation and the customary time when daytime heating assists ventilation mechanisms in the atmosphere. DEQ decided to use 40 acres of a 210-acre field as a test burn to confirm the meteorological forecast and anticipated smoke behavior.

Two fields, a total of 250 acres of cereal grain stubble, were approved after DEQ field confirmation (Figure 31).

Table 32. National Weather Service observations at Bonners Ferry (Site ID K65S).

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
9-11-2012 5:55 PDT	39.2	87	0	n/a	OK	No value
9-11-2012 6:15 PDT	37.4	93	0	n/a	OK	No value
9-11-2012 6:35 PDT	35.6	100	0	n/a	OK	No value
9-11-2012 6:55 PDT	35.6	93	0	n/a	OK	No value
9-11-2012 7:15 PDT	39.2	87	0	n/a	OK	No value
9-11-2012 7:35 PDT	41	87	0	n/a	OK	No value
9-11-2012 7:55 PDT	44.6	76	0	n/a	OK	No value
9-11-2012 8:10 PDT	44.6	76	0	n/a	OK	No value
9-11-2012 9:15 PDT	48.2	71	0	n/a	OK	No value
9-11-2012 9:35 PDT	50	62	0	n/a	OK	No value
9-11-2012 9:55 PDT	51.8	54	0	n/a	OK	No value
9-11-2012 10:15 PDT	53.6	54	3.5	240	OK	No value
9-11-2012 10:35 PDT	53.6	50	4.6	280	OK	No value
9-11-2012 10:55 PDT	53.6	47	0	n/a	OK	No value
9-11-2012 11:15 PDT	55.4	47	4.6	200	OK	No value
9-11-2012 11:35 PDT	55.4	41	0	n/a	OK	No value
9-11-2012 11:55 PDT	57.2	38	0	n/a	OK	No value

Morning Forecasting for Boundary														
Model Resolution:	12km			Model Run:	2012091000			SiteID:	IBONY					
Date		Time in PDT											Comments	
9/11/2012		10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	
Vent. Index		P	P	G	G	G	G	G	G	G	P	P	NP	
G: good, M: marginal, P: poor, NP: very poor														
Surface (20m) Winds	Direction	WNW	SW	WSW	WSW	WSW	WSW	W	W	W	W	WSW	WSW	5 kts = 5.75 mph,
	Speed (mph)	0.7	2.1	4.7	7.4	8.6	9.0	8.8	8.5	7.2	5.4	5.0	4.1	10 kts = 11.5 mph,
Surface (20m) Temperature (degree C)		9.8	11.3	12.9	14.0	14.6	15.0	15.1	14.9	14.4	13.1	12.4	11.8	15 kts = 17.25 mph
Surface (20m) Relative Humidity (%)		46.2	39.4	32.2	28.2	26.1	24.1	23.5	24.3	26.7	32.5	34.8	37.0	
Planetary Boundary Layer (PBL)	Height (feet)	4108	5971	7812	8927	9134	9117	8881	8205	6762	827	404	354	Height is above model terrain surface
	Direction	W	W	WNW	WNW	WNW	WNW	WNW	WNW	WNW	W	W	WSW	
	Speed (mph)	10.0	15.1	21.2	25.8	24.9	24.6	24.9	17.6	14.7	13.6	8.4	6.7	
700mb (~10,000 ft MSL)	Height (feet)	7322	7322	7322	7322	7322	7322	7322	7322	7322	7322	7322	7322	Height is above model terrain surface
	Direction	WNW	WNW	WNW	WNW	WNW	WNW	WNW	WNW	WNW	NW	NW	NW	
	Speed (mph)	20.6	20.9	18.1	16.1	16.1	16.0	15.5	15.0	15.8	18.3	20.4	20.9	
850mb (~5000 ft MSL)	Height (feet)	2345	2345	2345	2345	2345	2345	2345	2345	2345	2342	2342	2345	Height is above model terrain surface
	Direction	W	WSW	WSW	W	W	W	W	W	WNW	WNW	WNW	WNW	
	Speed (mph)	4.7	7.2	10.3	13.4	15.1	16.2	16.1	16.2	16.7	16.7	14.4	13.1	

Figure 29. Weather checklist for Bonners Ferry. Information taken from the University of Washington Northwest Modeling Consortium forecast model.

Forecast Prepared by: BENNETT FIRE WEATHER SERVICES, LLC

Forecast Time Prepared: 8:00 AM PDT – Tuesday September 11, 2012

Forecast for: TUESDAY – September 11, 2012

GENERAL WEATHER DISCUSSION:

TUESDAY:

The cold and unstable upper trough of Monday has moved east into Montana today. A high pressure area well off the west coast is ridging north into the Gulf of Alaska. This ridge will be nearing the coast by Wednesday afternoon. The flow aloft over northern Idaho this afternoon is from the northwest signaling the drier air mass is moving inland. The flow aloft is a subsiding flow which will limit mixing heights for the next few days. At the surface this afternoon, a cooler air mass is spread out over northern Idaho. The pressure gradient field is oriented west to east. Surface wind direction will be southwest to west across northern Idaho air sheds. Wind speeds look to be in the 4-10 mph range with occasional gustiness. Mixing heights this afternoon will range around 4-6,000 feet AGL over the air sheds. Transport winds will be from the southwest to northwest at 5-10 mph over northern Idaho. Dispersion is expected to be marginal to good. Ventilation is poor to marginal in the morning under a moderate to strong inversion. The inversions are expected break around 11 am leaving marginal to good ventilation over the air sheds as surface and low level mixing is weak. The inversion break temperatures look to be around 11am at 50-55 degrees.

NORTHERN IDAHO BY AIRSHED:

BOUNDARY COUNTY Air Shed:

Forecast for TUESDAY:

SKY/WEATHER: Mostly sunny in the afternoon.

TEMPERATURE: High temperatures ranging from 64-68.

HUMIDITY: Minimum RH around 25-35 percent.

WIND – SURFACE: Southwest to west 5-10 mph in the afternoon.

TRANSPORT: Northwest to west 5-10 mph in the afternoon.

INVERSIONS: Strong to moderate morning inversion breaking by 11am at a temperature around 50 degrees.

MIXING HEIGHT: Air mass becomes unstable to 6,000 feet AGL by the afternoon.

VENTILATION: POOR to MARGINAL in the morning becoming GOOD in the afternoon.

AIRSHED Recommendations: Conditional from Latah County south due to poorer ventilation as mixing heights are lower and surface wind is weak.

Boundary County: Burn

LOCAL TIME										
County	08	09	10	11	12	13	14	15	16	17
Boundary	M	M	M	M	G	G	G	G	G	G

VENTILATION KEY: P = Poor M = Marginal G = Good E = Excellent

Figure 30. Weather forecast prepared by Bennett Fire Weather Services, LLC, for Boundary County.

Table 33. Available PM_{2.5} monitoring data prior to burn decision.

Date	Time	PM _{2.5} (µg/m ³)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland ^a
9/10/2012	1:00 AM	5.2	No data	5	No data
9/10/2012	2:00 AM	4	No data	5	No data
9/10/2012	3:00 AM	4.8	No data	6	No data
9/10/2012	4:00 AM	6.8	No data	7	No data
9/10/2012	5:00 AM	8.8	No data	11	No data
9/10/2012	6:00 AM	9.9	No data	15	No data
9/10/2012	7:00 AM	8.8	No data	13	No data
9/10/2012	8:00 AM	6.9	No data	8	No data
9/10/2012	9:00 AM	6.6	No data	7	No data
9/10/2012	10:00 AM	6.8	No data	6	No data
9/10/2012	11:00 AM	8.7	No data	8	No data
9/10/2012	12:00 PM	5.6	No data	6	No data
9/10/2012	1:00 PM	3	No data	3	No data
9/10/2012	2:00 PM	2.8	No data	2	No data
9/10/2012	3:00 PM	2.3	No data	0	No data
9/10/2012	4:00 PM	1.9	No data	0	1
9/10/2012	5:00 PM	1.8	No data	0	-1
9/10/2012	6:00 PM	1.6	No data	0	-1
9/10/2012	7:00 PM	1.7	No data	2	1
9/10/2012	8:00 PM	1.6	No data	4	3
9/10/2012	9:00 PM	1.7	No data	2	19
9/10/2012	10:00 PM	2.1	No data	2	-3
9/10/2012	11:00 PM	1.7	No data	0	-3
9/10/2012	12:00 AM	1.6	No data	1	-1
9/11/2012	1:00 AM	1.7	No data	1	1
9/11/2012	2:00 AM	1.7	No data	0	1
9/11/2012	3:00 AM	1.8	No data	0	1
9/11/2012	4:00 AM	1.8	No data	1	3
9/11/2012	5:00 AM	1.8	No data	1	3
9/11/2012	6:00 AM	1.8	No data	0	2
9/11/2012	7:00 AM	1.9	No data	2	3
9/11/2012	8:00 AM	1.9	No data	3	1
9/11/2012	9:00 AM	1.7	No data	2	-1
9/11/2012	10:00 AM	1.7	No data	0	1

^a The Copeland monitor was replaced with a BAM on 9/10. Therefore, data is only available after 4:00 p.m.



Figure 31. Map of approved fields for September 11, 2012.

Field Observations

DEQ staff made field observations prior to burning to determine if the meteorological forecast was representative of current conditions. A south-southeast surface wind of 3–4 mph was measured at the southernmost field, while the forecast was for more of a west-southwest component to the wind. The temperature was 62 °F, 7 degrees higher than expected at 12:00 p.m. Measure relative humidity was 42%, about 10% higher than forecasted. The meteorological forecast appeared to indicate a good burn day even though surface winds were different than forecasted. Fuel condition of the 40-acre test burn was brown and very dry. Soil moisture was very dry and fuel arrangement was loose with a heavy fuel loading. High-level cloud cover was noted to be around 75%. These conditions suggested burning could be successful.

A pibal was released at 11:00 a.m. near the Kootenai National Wildlife Refuge located in the southwest corner of the valley. The pibal was tracked by two DEQ-trained interns employed by the refuge. The data gathered produces a hodograph, which showed a light north-northeast wind from the surface to about 4,000 ft AGL and then a very pronounced easterly wind at elevations above 4,000 ft (Figure 32). The graph is customarily forwarded to field staff to help confirm upper air wind direction. The location of the balloon release does not always represent surface conditions throughout the valley.

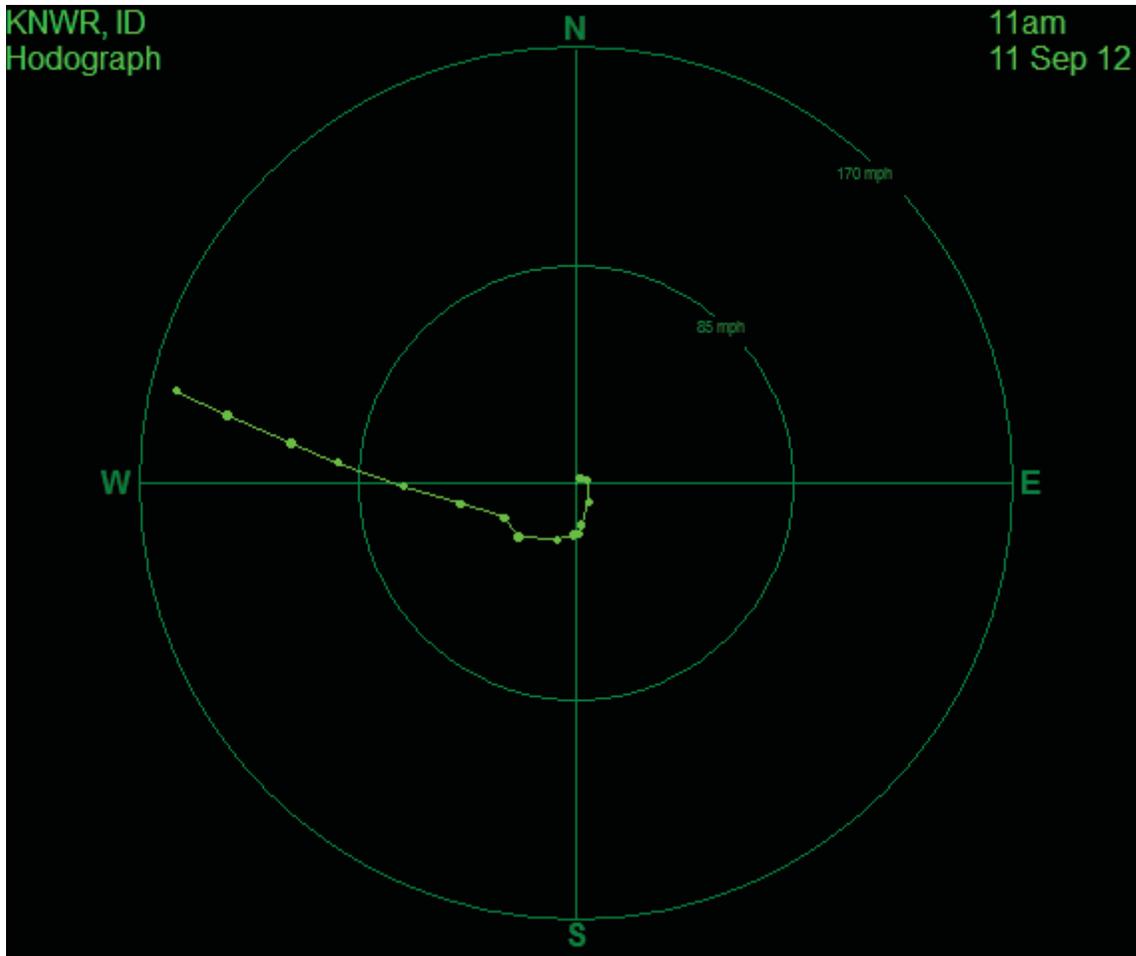


Figure 32. Daily pibal results. The line indicates the direction the wind would take the smoke.

The test burn, 40 acres of the 210-acre wheat stubble field in the middle part of the valley, was ignited at 12:54 p.m. Initial smoke moved to the south with a north-northeast surface wind, but as the smoke rose, it began to drift back to the northwest. Horizontal dispersion was good, and vertical dispersion was excellent, transporting smoke to the mountain to the northwest of the field. The 40-acre test was completed at 1:30 p.m. DEQ then gave the grower approval to burn the remaining 40 acres of the listed 210-acre field (80 acres were actually separated from another 130 acres, which together made up the 210-acre field). The second 40 acres was ignited at 1:39 p.m. The DEQ field coordinator mobilized to the northern field at this time.

Smoke observations of the southern field indicated potentially increased surface wind speeds as the smoke column appeared to be getting limited lift. Wind conditions at the northern 40-acre field were from the west-southwest at 3–5 mph, speeds acceptable for burning. The DEQ field coordinator gave the second grower verbal permission to burn a 40-acre barley stubble field at 1:44 p.m. This burn produced very little smoke, and both vertical and horizontal dispersion were good. Smoke height was 1,500 ft AGL. All burning was complete by approximately 1:57 p.m. after this 13-minute burn.

After these burns were complete, the DEQ field coordinator and two growers determined they were not comfortable with any additional burning for the day because of increasing surface

winds. One grower indicated surface gusts out of the west at 12–15 mph were being noted. Final horizontal and vertical dispersion for all burns was described as fair to good.

Table 34 includes the monitoring data during and after the burns. The maximum hourly concentration at any of the monitors was $3 \mu\text{g}/\text{m}^3$, recorded at Copeland at 8:00 p.m. This value is well below all enhanced documentation triggers and program concentration limits.

Table 34. Air quality $\text{PM}_{2.5}$ monitoring data during and after burning.

Date	Time	$\text{PM}_{2.5}$ ($\mu\text{g}/\text{m}^3$)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland
9/11/2012	11:00 AM	1.6	No data	0	2
9/11/2012	12:00 PM	1.5	No data	0	1
9/11/2012	1:00 PM	1.5	No data	0	3
9/11/2012	2:00 PM	1.4	No data	0	3
9/11/2012	3:00 PM	1.4	No data	0	1
9/11/2012	4:00 PM	1.4	No data	1	-1
9/11/2012	5:00 PM	1.4	No data	0	-1
9/11/2012	6:00 PM	1.4	No data	0	1
9/11/2012	7:00 PM	1.5	No data	0	2
9/11/2012	8:00 PM	1.6	No data	1	3
9/11/2012	9:00 PM	1.6	No data	1	2
9/11/2012	10:00 PM	1.7	No data	1	1
9/11/2012	11:00 PM	1.8	No data	1	2
9/11/2012	12:00 AM	2.1	No data	1	2

No complaints were received regarding DEQ-approved crop residue burning or any other burning.

Summary

Two fields, a total of 120 acres of cereal grain stubble, were burned this day in Boundary County. One field (40 acres) was located in the northern part of the valley and one field in the middle of the valley (80 acres burned in two 40-acre sections). Observed meteorological conditions were as good as forecasted for most of the day. Ventilation was forecasted to be good and field observations noted good to excellent vertical dispersion and fair (southern field) to good (northern field) horizontal dispersion. The winds were variable throughout the valley, and different smoke trajectories observed between the two burn locations indicated more of an upslope/downslope pattern than a pronounced valley-wide direction. The maximum mixing height that smoke would be able to mix into was forecasted to be 9,100 ft AGL. The actual smoke behavior indicated that it mixed to a maximum of 1,500 ft AGL. The limited lift could have been due to a wind “shearing” effect as wind speeds increased throughout the valley at the end of the burns. No more burning occurred after the northern 40-acre field because the wind gusts were not allowing the smoke to lift and disperse vertically; however, all burns produced minimal smoke and low-level ventilation was good. Higher surface wind speeds present a fire

hazard to the growers and surrounding fields. As a whole, the burn day resulted in good ventilation and dispersion of smoke from these two fields.

Burn Date: September 12, 2012

Burn Decision

Burn day: up to 250 acres approved—pending meteorological conditions. Burn window: 12 p.m. to 4 p.m.

Burn Decision Justification

This burn decision was developed using NWS observations at Bonners Ferry and Creston, BC, (Table 35); forecasted winds, ventilation, and temperatures from the UW NMC, as displayed in DEQ’s weather checklist (Figure 33); and the daily forecast produced by the DEQ contract meteorologist, Bennett Fire Weather Services, LLC (Figure 34). Ventilation was expected to be poor, with surface winds generally from the west at 1–2 mph. The upper-level winds were forecasted to be from the west-northwest at 5–14 mph at an elevation of 3,500–6,000 ft AGL. These mixing height elevations are very high and the transports winds are desirable; therefore, DEQ anticipated a good burn day.

The DEQ contract meteorologist recommended a conditional burn day. The ventilation forecast for Boundary County was marginal for the burn window. Lighter surface winds and warm temperatures were expected to allow for good column formation supporting good vertical lifting of smoke.

DEQ reviewed the monitoring data (Table 36) for Creston, BC; Porthill; and Copeland. The maximum hourly PM_{2.5} concentrations recorded at any of these sites were all below 9 µg/m³. The maximum concentration occurred at Copeland at 7:00 a.m. and was well below all preburn enhanced documentation triggers. The Bonners Ferry monitor was not providing data for this burn day. However, all operational monitors showed consistent low PM_{2.5} concentrations throughout the valley. DEQ determined a burn window of noon–4:00 p.m. based on Figure 33 and the customary time when daytime heating assists ventilation mechanisms in the atmosphere.

Two fields, a total of 225 acres of cereal grain stubble, were approved after DEQ field verification (Figure 35).

Table 35. National Weather Service observations at Bonners Ferry (Site ID K65S).

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
9-12-2012 5:55 PDT	35.6	80	0	n/a	No value	OK
9-12-2012 6:15 PDT	32	93	0	n/a	No value	OK
9-12-2012 6:35 PDT	35.6	80	0	n/a	No value	OK
9-12-2012 6:55 PDT	32	93	0	n/a	No value	OK
9-12-2012 7:15 PDT	32	93	0	n/a	No value	OK

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
9-12-2012 7:35 PDT	37.4	81	0	n/a	No value	OK
9-12-2012 7:55 PDT	41	75	0	n/a	No value	OK
9-12-2012 8:15 PDT	42.8	70	0	n/a	No value	OK
9-12-2012 8:35 PDT	42.8	65	0	n/a	No value	OK
9-12-2012 8:55 PDT	44.6	61	0	n/a	No value	OK
9-12-2012 9:15 PDT	46.4	57	0	n/a	No value	OK
9-12-2012 9:35 PDT	46.4	57	0	n/a	No value	OK
9-12-2012 9:55 PDT	48.2	57	0	n/a	No value	OK
9-12-2012 10:15 PDT	51.8	50	4.6	10	No value	OK
9-12-2012 10:35 PDT	51.8	54	0	n/a	No value	OK
9-12-2012 10:55 PDT	53.6	50	4.6	210	No value	OK
9-12-2012 11:10 PDT	53.6	47	0	n/a	No value	OK
9-12-2012 11:35 PDT	55.4	47	0	n/a	No value	OK
9-12-2012 11:55 PDT	55.4	47	4.6	180	No value	OK

Morning Forecasting for Boundary														
Model Resolution:	12km			Model Run:	2012091112			SiteID:	IBONY					
Date	Time in PDT												Comments	
9/12/2012	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM		
Vent. Index	P	P	P	P	P	P	P	P	NP	NP	P	P		
G: good, M: marginal, P: poor, NP: very poor														
Surface (20m) Winds	Direction	NNW	WNW	WNW	SW	SW	SW	SSW	SSE	SSW	SSW	SW	5 kts = 5.75 mph,	
	Speed (mph)	1.2	1.5	0.9	0.9	0.9	0.9	1.4	1.6	1.4	2.1	4.0	4.4	10 kts = 11.5 mph,
Surface (20m) Temperature (degree C)	10.7	12.5	14.2	15.4	16.5	17.4	18.0	18.2	17.8	16.5	15.4	14.7	15 kts = 17.25 mph	
Surface (20m) Relative Humidity (%)	37.2	32.2	27.6	25.8	24.9	24.2	23.5	23.5	25.6	31.2	33.9	35.3		
Planetary Boundary Layer (PBL)	Height (feet)	1929	3064	4734	5381	5830	6132	6191	5919	1165	374	522	463	Height is above model terrain surface
	Direction	N	WNW	WNW	WNW	WNW	NW	WNW	WNW	SW	SSW	SW	WSW	
	Speed (mph)	4.1	5.9	11.6	14.4	13.7	18.0	18.6	13.9	5.1	6.2	9.1	8.1	
700mb (~10,000 ft MSL)	Height (feet)	7322	7322	7322	7322	7322	7322	7322	7322	7322	7322	7322	7322	Height is above model terrain surface
	Direction	NNW	NNW	NNW	NNW	NNW	NW	NW	NW	NW	NNW	NNW	NNW	
	Speed (mph)	23.9	24.4	24.3	23.7	22.8	22.9	23.6	24.8	25.4	24.3	22.1	19.2	
850mb (~5000 ft MSL)	Height (feet)	2342	2342	2342	2342	2342	2342	2342	2342	2345	2342	2342	2342	Height is above model terrain surface
	Direction	NNW	WNW	WNW	WSW	WSW	WSW	WSW	WSW	WSW	W	WNW	WNW	
	Speed (mph)	4.0	3.7	4.0	4.1	5.1	5.9	6.2	6.1	6.8	8.3	8.8	7.9	

Figure 33. Weather checklist for Bonners Ferry. Information taken from the University of Washington Northwest Modeling Consortium forecast model.

Forecast Prepared by: BENNETT FIRE WEATHER SERVICES, LLC

Forecast Time Prepared: 8:00 AM PDT – Wednesday September 12, 2012

Forecast for: WEDNESDAY – September 12, 2012

GENERAL WEATHER DISCUSSION:

WEDNESDAY:

The upper level high pressure ridge is just off shore and will move onto the west coast this afternoon. The high is centered over southeast Oregon, this afternoon, and the ridge axis runs north into northern British Columbia. Winds aloft are from the northwest to north continuing the dry subsiding air from aloft producing lower mixing heights. At the surface this afternoon high pressure over Boundary County is producing a north to south pressure gradient field over northern Idaho. Surface wind direction will generally be northeast to northwest. Wind speeds are expected to be light in the 3-10 mph range. Mixing heights this afternoon will range around 4-5,000 feet AGL over the air sheds. Transport winds will be from the northwest to northeast at 5 mph over northern Idaho. Dispersion is expected to be poor to marginal. Ventilation is poor to marginal in the morning under a moderate to strong inversion. The inversions are expected break around 11 am leaving marginal ventilation over the air sheds as surface and low level mixing is weak. The inversion break temperatures look to be around 11am at 53-61 degrees.

NORTHERN IDAHO BY AIRSHED:

BOUNDARY COUNTY Air Shed:

Forecast for WEDNESDAY:

SKY/WEATHER: Mostly sunny and warmer in the afternoon.

TEMPERATURE: High temperatures ranging from 68-73.

HUMIDITY: Minimum RH around 25-30 percent.

WIND – SURFACE: Northwest to north 3-10 mph in the afternoon.

TRANSPORT: North 5 mph in the afternoon.

INVERSIONS: Strong to moderate morning inversion breaking by 11am at a temperature around 59 degrees.

MIXING HEIGHT: Air mass becomes unstable to 4-5,000 feet AGL by the afternoon.

VENTILATION: POOR to MARGINAL in the morning remaining MARGINAL in the afternoon.

AIRSHED Recommendations: Conditional over all air sheds today due to poorer ventilation as mixing heights are lower and surface/transport winds are light.

Boundary County: Conditional

LOCAL TIME

County	08	09	10	11	12	13	14	15	16	17
Boundary	M	M	M	M	M	M	M	M	M	M

VENTILATION KEY: P = Poor M = Marginal G = Good E = Excellent

Figure 34. Weather forecast prepared by Bennett Fire Weather Services, LLC, for Boundary County.

Table 36. Available PM_{2.5} monitoring data prior to burn decision.

Date	Time	PM _{2.5} (µg/m ³)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland ^a
9/11/2012	1:00 AM	1.7	No data	1	1
9/11/2012	2:00 AM	1.7	No data	0	1
9/11/2012	3:00 AM	1.8	No data	0	1
9/11/2012	4:00 AM	1.8	No data	1	3
9/11/2012	5:00 AM	1.8	No data	1	3
9/11/2012	6:00 AM	1.8	No data	0	2
9/11/2012	7:00 AM	1.9	No data	2	3
9/11/2012	8:00 AM	1.9	No data	3	1
9/11/2012	9:00 AM	1.7	No data	2	-1
9/11/2012	10:00 AM	1.7	No data	0	1
9/11/2012	11:00 AM	1.6	No data	0	2
9/11/2012	12:00 PM	1.5	No data	0	1
9/11/2012	1:00 PM	1.5	No data	0	3
9/11/2012	2:00 PM	1.4	No data	0	3
9/11/2012	3:00 PM	1.4	No data	0	1
9/11/2012	4:00 PM	1.4	No data	1	-1
9/11/2012	5:00 PM	1.4	No data	0	-1
9/11/2012	6:00 PM	1.4	No data	0	1
9/11/2012	7:00 PM	1.5	No data	0	2
9/11/2012	8:00 PM	1.6	No data	1	3
9/11/2012	9:00 PM	1.6	No data	1	2
9/11/2012	10:00 PM	1.7	No data	1	1
9/11/2012	11:00 PM	1.8	No data	1	2
9/11/2012	12:00 AM	2.1	No data	1	2
9/12/2012	1:00 AM	2	No data	1	0
9/12/2012	2:00 AM	2	No data	1	0
9/12/2012	3:00 AM	1.9	No data	1	-1
9/12/2012	4:00 AM	1.9	No data	1	0
9/12/2012	5:00 AM	2	No data	2	4
9/12/2012	6:00 AM	2	No data	2	7
9/12/2012	7:00 AM	2	No data	5	9
9/12/2012	8:00 AM	2	No data	2	3
9/12/2012	9:00 AM	2	No data	2	-2
9/12/2012	10:00 AM	1.9	No data	2	-2

^a The Copeland monitor was replaced with a BAM during the fall season.

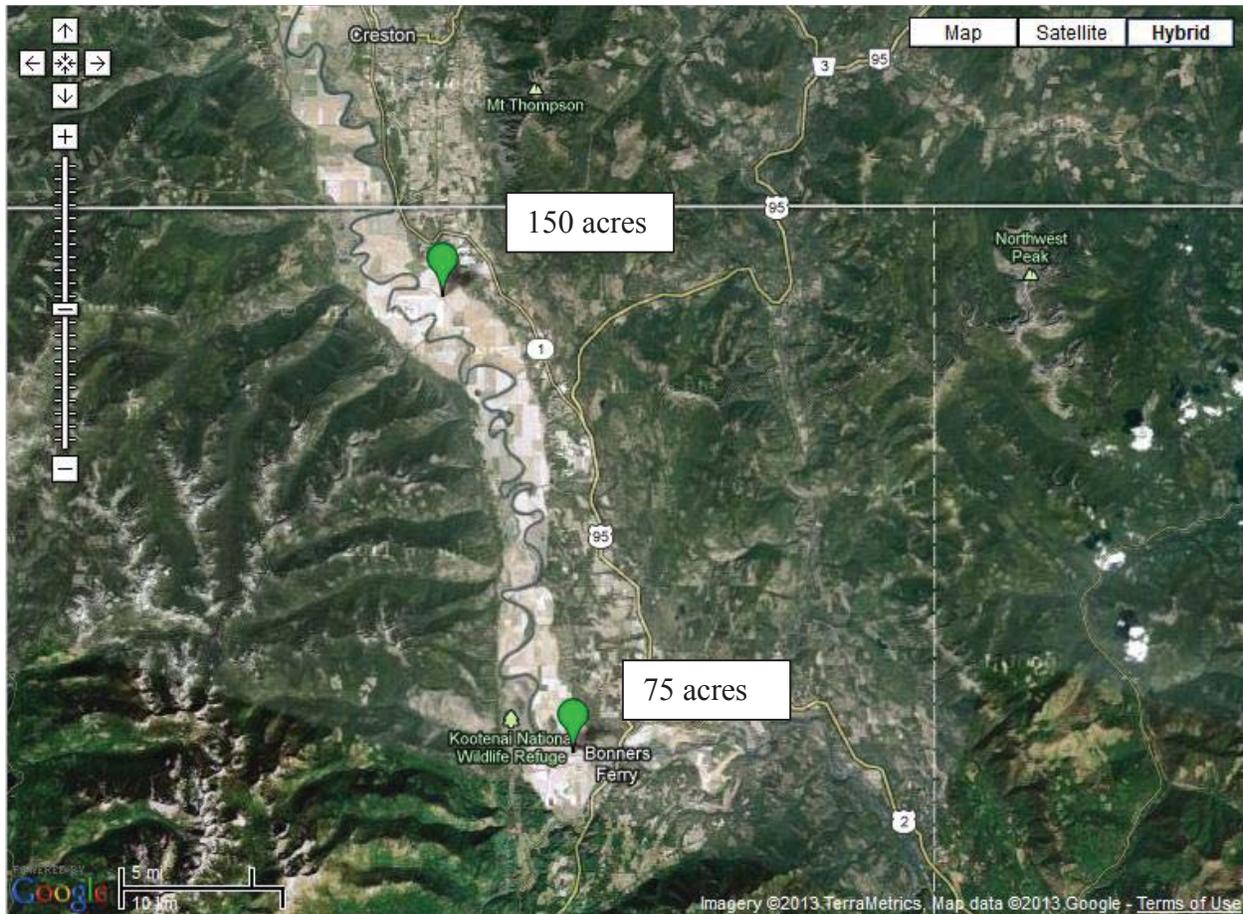


Figure 35. Map of approved fields for September 12, 2012.

Field Observations

DEQ staff made field observations before final burn approval to determine if the meteorological forecast was representative of the day. A northerly surface wind at 2–3 mph was measured in the south field location, while the forecast was for more of a west-northwest to west component to the wind. The temperature was 67 °F, 10 degrees higher than expected at 1:00 p.m. Measured relative humidity was 28%, close to the forecasted value. The meteorological forecast indicated a marginal burn day. The fuel condition of one field was described as brown and very dry. Soil moisture was very dry, fuel arrangement loose, and fuel loading heavy. Cloud cover was around 10%. Burning in the southern end of the valley requires a wind direction other than south and southwest, so the observed northerly component suggested limited burning would be successful.

A pibal was released at 11:00 a.m. near the Kootenai National Wildlife Refuge located in the southwest corner of the valley west of the 75-acre field. The pibal was tracked by two DEQ-trained interns employed by the wildlife refuge. The data gathered produces a hodograph, which showed a north to northeast wind from the surface to about 4,400 ft AGL and then a very pronounced westerly wind at elevations higher than 4,400 ft (Figure 36). The graph is customarily forwarded to field staff to help confirm upper air wind direction prior to final verbal approval.

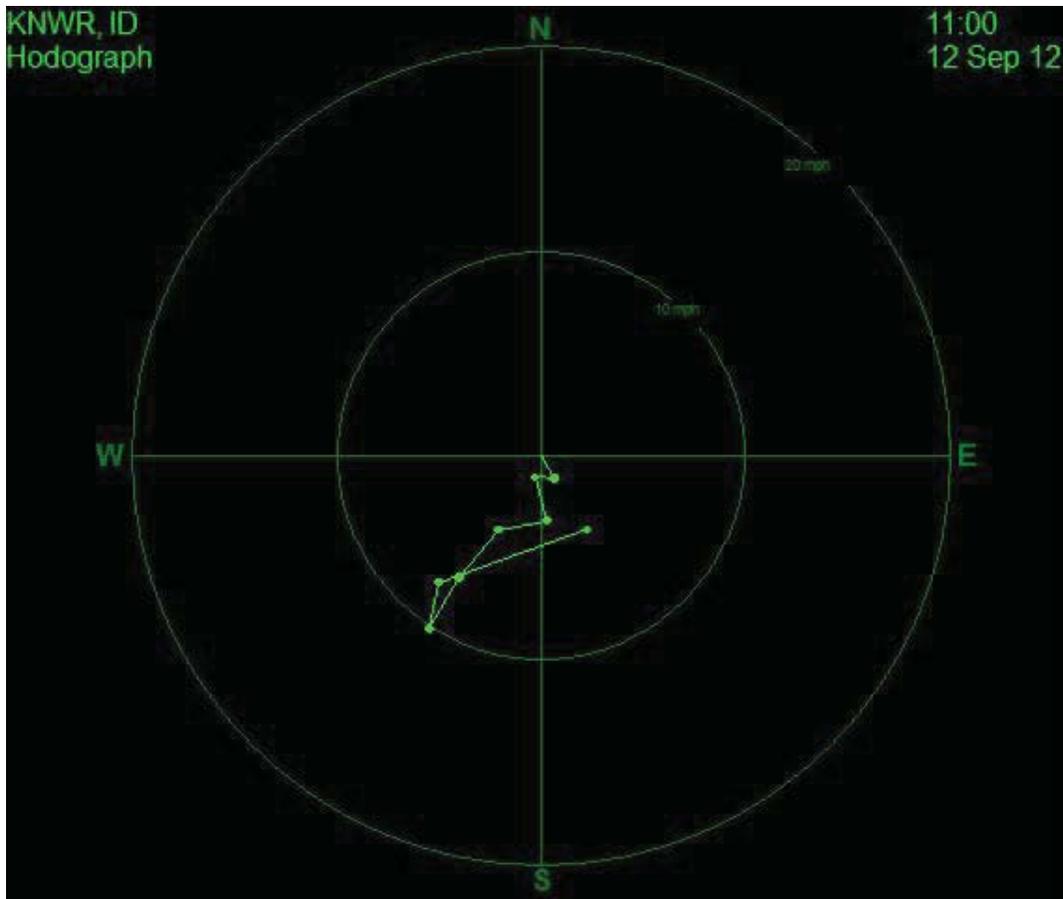


Figure 36. Daily pibal results. The line indicates the direction the wind would take the smoke.

Conditions in the fields indicated marginal or better ventilation. The first field, a 75-acre wheat stubble field, was ignited at 1:11 p.m. in the southern part of the valley. Initial smoke moved to the southwest influenced by a north-northeast surface wind, but as the smoke rose, it drifted back to the northeast. After ignition of this field, the DEQ field coordinator received a call about a potential illegal field burn underway in the northernmost part of the valley. The coordinator was dispatched to the northern part of the valley to document the alleged illegal activity for future enforcement needs. Prior to departure, the DEQ field coordinator described the vertical dispersion from this burn as excellent.

When arriving in the northern part of the valley, the coordinator reported very light smoke. DEQ contacted the Idaho Department of Lands (IDL) to inquire if anyone had an active permit on this day. IDL reported that the Idaho Department of Fish and Game (IDFG) was conducting burning at the wildlife refuge, which is located on the west side of the valley at the northernmost section of Boundary County. DEQ contacted IDFG, who confirmed they had burned some native grasses. This is an allowable form of open burning that is not regulated under the crop residue burning program.

In the northern valley, the DEQ field coordinator released another pibal to document transport wind direction. The pibal moved slowly to the northwest until about the 3,000 ft AGL and then started moving quickly to the east. This pibal indicated good potential for transport winds to move the smoke out of the valley and limit any potential for smoke to transport toward the

Creston, BC, monitor. DEQ gave the grower permission to burn a 150-acre wheat stubble field at 2:31 p.m. Very little smoke was produced from this burn and both vertical and horizontal dispersion was excellent. All burning was complete by approximately 3:25 p.m. Field observations described ventilation as better than forecasted, especially in the northern field burn.

Table 37 includes the monitoring data during and after the burns. The maximum hourly concentration at any of the monitors was $9 \mu\text{g}/\text{m}^3$, recorded at Copeland at 6:00 p.m. This value is well below all enhanced documentation triggers and program concentration limits and confirms that smoke effectively ventilated out of the valley.

Table 37. Air quality $\text{PM}_{2.5}$ monitoring data during and after burning.

Date	Time	$\text{PM}_{2.5}$ ($\mu\text{g}/\text{m}^3$)			
		Porthill	Bonners Ferry (KTOI)	Creston, BC	Copeland
9/12/2012	11:00 AM	1.8	No data	0	-3
9/12/2012	12:00 PM	1.8	No data	0	-1
9/12/2012	1:00 PM	1.8	No data	0	1
9/12/2012	2:00 PM	1.9	No data	0	0
9/12/2012	3:00 PM	1.9	No data	0	1
9/12/2012	4:00 PM	2.8	No data	0	2
9/12/2012	5:00 PM	3.9	No data	1	5
9/12/2012	6:00 PM	6.9	No data	2	9
9/12/2012	7:00 PM	4.9	No data	4	6
9/12/2012	8:00 PM	3.5	No data	5	2
9/12/2012	9:00 PM	3.4	No data	3	3
9/12/2012	10:00 PM	3.1	No data	2	2
9/12/2012	11:00 PM	2.9	No data	2	0
9/12/2012	12:00 AM	3	No data	2	1

No complaints were received from any DEQ-approved or other burning on this day.

Summary

Two fields, a total of 225 acres of cereal grain stubble, were burned on this day in Boundary County. One field (approximately 150 acres) was located in the northern part of the valley and one in the south (75 acres). Observed meteorological conditions were as good as forecasted for most of the day. Ventilation was forecasted to be poor to marginal and field observations noted excellent vertical dispersion and fair (south field) to excellent (north field) horizontal dispersion. The vertical plume rise was important in keeping smoke from causing impacts, resulting in a good burn day. The winds and smoke behavior observed indicated more of a northerly component near the surface and westerly component to the upper level transport winds as did the pibal. The upper level transport winds appeared to have mixed down later in the day assisting in good ventilation from the valley. The maximum mixing height that smoke would be able to mix into was forecasted to be 6,043 ft AGL. The actual smoke behavior indicated that it mixed to a maximum of 2,000 ft AGL. No more burning occurred after the 150-acre field because the field

was not completed until about 3:30 p.m. and this left little time in the day for optimal ventilation conditions. As a whole, the burn day resulted in better ventilation and dispersion than was initially forecasted.

Burn Date: September 13, 2012

Burn Decision

Burn day: up to 250 acres approved—pending meteorological conditions. Burn window: 12 p.m. to 4 p.m.

Burn Decision Justification

This burn decision was developed using NWS observations at Bonners Ferry (Table 38); forecasted winds, ventilation, and temperatures from the UW NWMC, as displayed in DEQ’s weather checklist (Figure 37); and the daily forecast produced by the DEQ contract meteorologist, Bennett Fire Weather services (Figure 38). Ventilation was expected to be poor, with surface winds generally from the northeast to northwest at 1–2 mph. The upper level winds were forecasted to be from the southeast around 5 mph.

The DEQ contract meteorologist suggested some minor acreage may be able to be burned as a “poor to marginal” ventilation condition was forecasted. Additionally, model forecasts for this area have been inaccurate on numerous occasions, resulting in the decision to provide onsite verification to ensure the CRB program does not miss burn opportunities. One field, a total of 150 acres of cereal grain, was chosen for further on-site verification by DEQ (Figure 39). Previously, DEQ agreed to attempt test burns during these type of periods when growers feel conditions are optimal but DEQ feels forecasts are not favorable, in order for both groups to learn.

DEQ reviewed the monitoring data (Table 39) for Creston, BC; Porthill; and Copeland. The maximum hourly concentration recorded at any of these sites was $9 \mu\text{g}/\text{m}^3$, which occurred on September 12, 2012 (the day prior to burning). This concentration was well below all preburn enhanced documentation triggers. The Bonners Ferry monitor was not providing data for this burn day, but smoke from the proposed burns would not be expected to migrate this way given the location of the proposed field and expected winds. All other monitors showed consistent low $\text{PM}_{2.5}$ concentrations throughout the valley. DEQ determined a burn window of noon–4:00 p.m.

Table 38. National Weather Service observations at Bonners Ferry (Site ID K65S).

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
9-13-2012 5:55 PDT	37.4	93	0	n/a	No value	OK
9-13-2012 6:15 PDT	37.4	93	0	n/a	No value	OK
9-13-2012 6:35 PDT	35.6	100	0	n/a	No value	OK
9-13-2012 6:55 PDT	37.4	93	0	n/a	No value	OK
9-13-2012 7:15 PDT	39.2	87	0	n/a	No value	OK

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
9-13-2012 7:35 PDT	41	87	0	n/a	No value	OK
9-13-2012 7:55 PDT	42.8	81	0	n/a	No value	OK
9-13-2012 8:15 PDT	46.4	71	0	n/a	No value	OK
9-13-2012 8:35 PDT	48.2	66	0	n/a	No value	OK
9-13-2012 8:55 PDT	50	62	3.5	210	No value	OK
9-13-2012 9:15 PDT	50	62	0	n/a	No value	OK
9-13-2012 9:35 PDT	53.6	58	0	n/a	No value	OK
9-13-2012 9:55 PDT	53.6	58	3.5	190	No value	OK
9-13-2012 10:15 PDT	55.4	54	3.5	190	No value	OK
9-13-2012 10:35 PDT	55.4	54	0	n/a	No value	OK
9-13-2012 10:55 PDT	57.2	51	3.5	300	No value	OK
9-13-2012 11:15 PDT	59	48	0		No value	OK
9-13-2012 11:35 PDT	59	51	4.6	200	No value	OK
9-13-2012 11:55 PDT	60.8	48	0		No value	OK

Morning Forecasting for Boundary														
Model Resolution:	12km			Model Run:	2012091212			SiteID:	IBONY					
Date	Time in PDT												Comments	
9/13/2012	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM		
Vent. Index	P	P	P	P	P	P	P	P	NP	NP	NP	NP		
G: good, M: marginal, P: poor, NP: very poor														
Surface (20m) Winds	Direction	NE	NNE	NNE	NNW	NW	W	W	WSW	WNW	SSE	SSE	SSE	5 kts = 5.75 mph,
	Speed (mph)	2.1	1.6	1.1	1.0	1.1	1.4	1.8	1.8	0.7	1.1	2.1	2.8	10 kts = 11.5 mph,
Surface (20m) Temperature (degree C)	13.5	15.6	17.5	19.1	20.5	21.5	22.1	22.2	21.6	20.0	18.3	17.2	15 kts = 17.25 mph	
Surface (20m) Relative Humidity (%)	37.3	32.3	28.7	26.1	24.2	23.2	23.0	23.1	25.7	31.1	35.4	37.0		
Planetary Boundary Layer (PBL)	Height (feet)	1365	2067	2680	2963	3255	3514	3583	3002	180	62	62	62	Height is above model terrain surface
	Direction	ESE	SE	SSE	SSE	S	S	S	S	WSW	SSE	SSE	SSE	
	Speed (mph)	6.7	8.1	8.6	7.5	8.8	9.0	9.2	11.4	1.6	1.1	2.1	2.8	
700mb (~10,000 ft MSL)	Height (feet)	7319	7322	7322	7322	7322	7322	7322	7322	7322	7322	7322	7322	Height is above model terrain surface
	Direction	WSW	WSW	WSW	WSW	WSW	WSW	WSW	WSW	WSW	WSW	WSW	WSW	
	Speed (mph)	11.5	12.5	13.8	15.4	16.9	17.6	18.7	19.7	19.9	19.4	19.2	19.5	
850mb (~5000 ft MSL)	Height (feet)	2342	2342	2342	2342	2342	2342	2342	2342	2345	2345	2342	2342	Height is above model terrain surface
	Direction	SE	SE	SE	SE	SE	SSE	S	SSW	S	S	SSW	SSW	
	Speed (mph)	7.9	8.9	6.7	5.5	4.3	4.6	5.2	6.2	9.7	12.0	13.6	14.3	

Figure 37. Weather checklist for Bonners Ferry. Information taken from the University of Washington Northwest Modeling Consortium forecast model.

Forecast Prepared by: BENNETT FIRE WEATHER SERVICES, LLC

Forecast Time Prepared: 8:00 AMPDT – Thursday September 13, 2012

Forecast for: THURSDAY – September 13, 2012

GENERAL WEATHER DISCUSSION:

THURSDAY:

The upper level high pressure is centered over southern Idaho and is ridging north through northern Idaho and into British Columbia. The flow aloft remains dry and is from the southwest to west over northern Idaho continuing the subsidence aloft. The subsiding air from aloft continues to produce lower mixing heights. At the surface this afternoon, high pressure over eastern Washington and northwest Montana is creating a south to north pressure gradient field. Surface winds will be south to southwest at speeds in the 3-10 mph range. Mixing heights Thursday afternoon will range around 3-5,000 feet AGL over the air sheds. Transport winds will be from the southeast to southwest at 5 mph over northern Idaho. Dispersion is expected to be poor to marginal. Ventilation is poor to marginal in the morning under a moderate to strong inversion. The inversions are expected break around 11 am leaving poor to marginal ventilation over the air sheds as surface and low level mixing is minimal. The inversion break temperatures look to be around 11 am at 59 over Boundary County and 66-70 degrees elsewhere.

NORTHERN IDAHO BY AIRSHED:

BOUNDARY COUNTY Air Shed:

Forecast for THURSDAY:

SKY/WEATHER: Sunny and warmer in the afternoon.

TEMPERATURE: High temperatures ranging from 77-81.

HUMIDITY: Minimum RH around 20-30 percent.

WIND – SURFACE: Southeast to southwest 3-8 mph in the afternoon.

TRANSPORT: Southeast to south 5 mph in the afternoon.

INVERSIONS: Strong to moderate morning inversion breaking by 11 am at a temperature around 59 degrees.

MIXING HEIGHT: Air mass becomes unstable to 3,000 feet AGL by the afternoon.

VENTILATION: POOR to MARGINAL in the morning remaining POOR to MARGINAL in the afternoon.

AIRSHED Recommendations: No Burn over most air sheds today due to poor ventilation as mixing heights are lower and surface/transport winds are light.

Boundary County: No Burn

LOCAL TIME										
County	08	09	10	11	12	13	14	15	16	17
Boundary	M	M	M	M	M	M	M	M	M	M

VENTILATION KEY: P = Poor M = Marginal G = Good E = Excellent

Figure 38. Weather forecast prepared by Bennett Fire Weather Services, LLC, for Boundary County.

Table 39. Available PM_{2.5} monitoring data prior to burn decision.

Date	Time	PM _{2.5} (µg/m ³)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland ^a
9/12/2012	1:00 AM	2	No data	1	0
9/12/2012	2:00 AM	2	No data	1	0
9/12/2012	3:00 AM	1.9	No data	1	-1
9/12/2012	4:00 AM	1.9	No data	1	0
9/12/2012	5:00 AM	2	No data	2	4
9/12/2012	6:00 AM	2	No data	2	7
9/12/2012	7:00 AM	2	No data	5	9
9/12/2012	8:00 AM	2	No data	2	3
9/12/2012	9:00 AM	2	No data	2	-2
9/12/2012	10:00 AM	1.9	No data	2	-2
9/12/2012	11:00 AM	1.8	No data	0	-3
9/12/2012	12:00 PM	1.8	No data	0	-1
9/12/2012	1:00 PM	1.8	No data	0	1
9/12/2012	2:00 PM	1.9	No data	0	0
9/12/2012	3:00 PM	1.9	No data	0	1
9/12/2012	4:00 PM	2.8	No data	0	2
9/12/2012	5:00 PM	3.9	No data	1	5
9/12/2012	6:00 PM	6.9	No data	2	9
9/12/2012	7:00 PM	4.9	No data	4	6
9/12/2012	8:00 PM	3.5	No data	5	2
9/12/2012	9:00 PM	3.4	No data	3	3
9/12/2012	10:00 PM	3.1	No data	2	2
9/12/2012	11:00 PM	2.9	No data	2	0
9/12/2012	12:00 AM	3	No data	2	1
9/13/2012	1:00 AM	2.6	No data	2	1
9/13/2012	2:00 AM	2.5	No data	1	-1
9/13/2012	3:00 AM	2.5	No data	2	0
9/13/2012	4:00 AM	2.7	No data	2	1
9/13/2012	5:00 AM	2.8	No data	2	1
9/13/2012	6:00 AM	2.6	No data	2	1
9/13/2012	7:00 AM	2.7	No data	4	2
9/13/2012	8:00 AM	3.1	No data	6	3
9/13/2012	9:00 AM	2.7	No data	3	0
9/13/2012	10:00 AM	2.5	No data	2	0

^a The Copeland monitor was replaced with a BAM during the fall season.

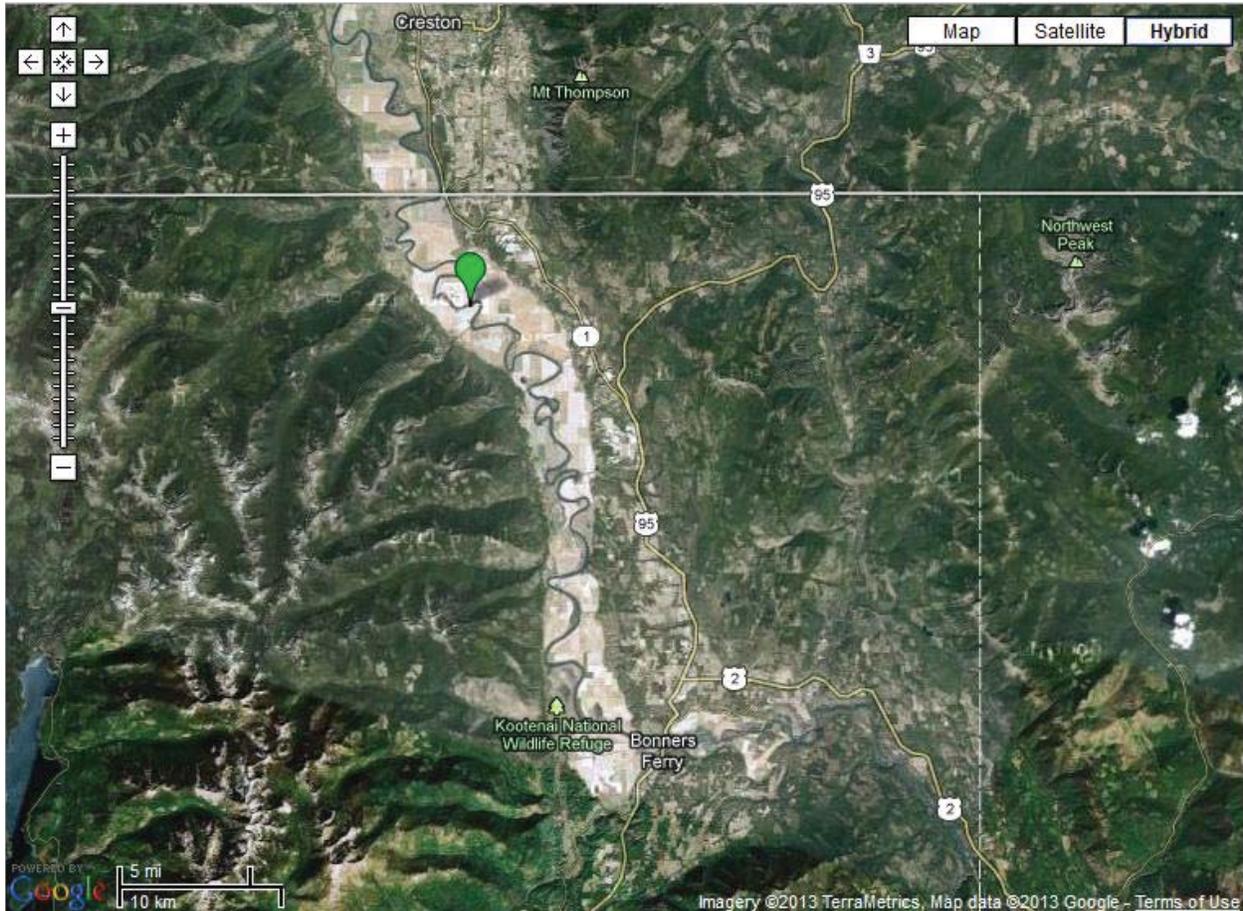


Figure 39. Map of approved fields for September 13, 2012.

Field Observations

Field observations verified the forecasted light winds. Conditions in the field indicated poor ventilation was present. Limited approval was given to burn around telephone poles located along the edge of the field at approximately 1:00 p.m. After completion of the limited burn, the field coordinator determined conditions (almost calm winds) and smoke behavior from the limited burn were not conducive to more extensive field burning. After discussing the decision with the grower, the grower was put in communication with the Coeur d'Alene Regional Office to discuss observations and conditions. The grower was very confident that any smoke from this field would be transported to the west into unpopulated areas. In previous years, this grower's assessment of the conditions has been accurate. Given the history of this grower's evaluations and years of burning experience, the regional office agreed to contact the program office in Boise and discuss potential results and impacts that might occur if burning was approved. Since very small burns such as the one conducted this day do not produce sufficient heat to provide much vertical lift, there was some degree of uncertainty about the vertical ventilation for the day. Based on these considerations, and the discussion between the regional office and the program office, DEQ agreed to proceed with this burn.

The 150-acre wheat field was ignited at approximately 2:15 p.m. Wind direction was noted in the field as having a northerly direction at the surface; once elevated, the smoke drifted northwest

toward the mountains and the Canadian border. Poor smoke dispersion was observed. The burn was complete by approximately 3:00 p.m. local time. Column heights from the burn were approximately 500–800 ft. AGL, which is low for a 150-acre field. The field coordinator remained in the area for approximately 45 minutes after burn completion to document smoke behavior. The regional office contacted the grower immediately after burn to assess the grower's interpretation of the burn. The grower noted that the smoke did not behave as he had expected and indicated some green-up was noted in the field.

Table 40 includes the monitoring data during and after the burns. The maximum hourly concentration at any of the monitors was $12.7 \mu\text{g}/\text{m}^3$, recorded at Porthill at 6:00 p.m. This value is well below all enhanced documentation triggers and program concentration limits. The elevated concentrations were more than likely the result of the DEQ-approved crop residue burn.

Table 40. Air quality PM_{2.5} monitoring data during and after burning.

Date	Time	PM _{2.5} ($\mu\text{g}/\text{m}^3$)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland
9/13/2012	11:00 AM	2.2	No data	1	2
9/13/2012	12:00 PM	2	No data	1	1
9/13/2012	1:00 PM	2	No data	1	1
9/13/2012	2:00 PM	1.9	No data	0	3
9/13/2012	3:00 PM	1.9	No data	0	3
9/13/2012	4:00 PM	3.2	No data	2	2
9/13/2012	5:00 PM	9.9	No data	3	5
9/13/2012	6:00 PM	12.7	No data	7	4
9/13/2012	7:00 PM	9.8	No data	5	3
9/13/2012	8:00 PM	7.7	No data	4	4
9/13/2012	9:00 PM	4.3	No data	3	5
9/13/2012	10:00 PM	6.5	No data	4	6
9/13/2012	11:00 PM	3.7	No data	3	6
9/13/2012	12:00 AM	4.2	No data	2	3

Two complaints were received about this burn day—both received by the toll-free complaint hotline on September 13. The first came in at 4:06 p.m.; the second at 5:50 p.m. Both the complainants indicated lots of smoke was in the area and causing health problems. Field notes described smoke transport was northwest and hugged the western mountains in the Creston Valley. DEQ contacted BC Department of Agriculture at 4:30 p.m. to report the smoke migrating to BC and ask for a description of the smoke impact from a Creston vantage point to confirm the first complaint. The BC Department of Agriculture representative reported that a fairly big smoke plume was coming in to the northwest. He described the “thickest part” of the plume as “above the habitation line,” which he described as 3,500 ft elevation (roughly 1,800 ft above the valley bottom on the west side). He also said that smoke was falling towards the ground below the large column and that some dissipation of the smoke was occurring.

Based on smoke observations, it was determined that smoke from DEQ-approved crop residue burning was the cause of the complaints; however, the low concentrations recorded at the Creston monitor suggest the town or residents who live on the east side of this valley were not impacted with significant smoke on the ground at their location. The second complaint originated from the east side and reported smoke on the ground at 5:50 p.m. when the Creston monitor recorded a concentration of $7 \mu\text{g}/\text{m}^3$. The Porthill monitor maximum concentration was recorded at 6:00 p.m., indicating some residual smoke in the area. This could explain the second complaint from the Creston area.

Summary

One field totaling 150 acres of cereal grain stubble was burned this day in Boundary County. The remaining 100 acres available for this day were not approved based on smoke results observed in the field. The grower of this 150-acre field reported that some green-up was noted in the field during ignition. He stated that this green-up couldn't have been seen prior to his access to the field during the ignition process. The high pressure system over the area along with light winds confirmed the forecasted light surface winds but did not appear to agree with the upper level mixing heights. For this day, the 850 millibar level winds were more indicative of the smoke transport conditions. The green-up conditions described by the grower may have contributed to restricted lift as well as the meteorological conditions. As a result of the immediate follow-up with the grower to discuss the burn day results, DEQ was able to establish the likely causes of poor smoke behavior this day and will use this knowledge to consider future burns during poor ventilation forecasts. This burn day helped growers and DEQ recognize the importance of the upper level wind and elevation forecast as well as role of green-up in the decision-making process for this valley.

Burn Date: September 14, 2012

Burn Decision

Burn day: up to 450 acres approved—pending meteorological conditions. Burn window: 11 a.m. to 4 p.m.

Burn Decision Justification

In making this burn decision, DEQ considered comments from growers in the southern part of the valley who reported light northerly winds in the morning for the past several days. This situation could potentially aid in completing field burns in that part of the valley if an early start is appropriate. This burn decision was developed using NWS observations at Bonners Ferry (Table 41); forecasted winds, ventilation, and temperatures from the UW NWMC, as displayed in DEQ's weather checklist (Figure 40); and the daily forecast produced by the DEQ contract meteorologist, Bennett Fire Weather Services, LLC (Figure 41). As always, field verification is required due to imprecise model forecasts and the wide variation in conditions that have been experienced in the Kootenai Valley. Ventilation was expected to be poor to marginal, with surface winds generally from the south-southwest at 2–7 mph. The upper level winds were forecasted to be from the southwest at 12–13 mph, which would be good for smoke ventilation.

DEQ determined a burn window of 11 a.m.–4 p.m., with a maximum of 450 acres, based on Figure 40 and the grower descriptions of early wind patterns.

DEQ reviewed the monitoring data (Table 42) for Creston, BC; Porthill; and Copeland. The maximum hourly concentration recorded at these sites was $12.7 \mu\text{g}/\text{m}^3$, which occurred on September 13 (the day prior to the burning) at Porthill. This concentration is well below all preburn enhanced documentation triggers and suggested burning may have been appropriate for this day. The Bonners Ferry monitor was not providing data for this burn day. However, all other monitors showed consistent concentrations throughout the valley. DEQ deployed personnel to the Kootenai Tribe area to observe smoke behavior.

Three fields, a total of 326 acres of cereal grain stubble, were ultimately approved (Figure 42).

Table 41. National Weather Service observations at Bonners Ferry (Site ID K65S).

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
9-14-2012 5:55 PDT	42.8	87	0	n/a	No value	OK
9-14-2012 6:15 PDT	42.8	87	0	n/a	No value	OK
9-14-2012 6:35 PDT	42.8	87	0	n/a	No value	OK
9-14-2012 6:55 PDT	41	93	0	n/a	No value	OK
9-14-2012 7:15 PDT	42.8	87	0	n/a	No value	OK
9-14-2012 7:35 PDT	44.6	87	0	n/a	No value	OK
9-14-2012 7:55 PDT	48.2	81	0	n/a	No value	OK
9-14-2012 8:15 PDT	50	76	0	n/a	No value	OK
9-14-2012 8:35 PDT	51.8	71	0	n/a	No value	OK
9-14-2012 8:55 PDT	51.8	71	0	n/a	No value	OK
9-14-2012 9:15 PDT	53.6	62	0	n/a	No value	OK
9-14-2012 9:35 PDT	55.4	62	0	n/a	No value	OK
9-14-2012 9:55 PDT	57.2	55	0	n/a	No value	OK
9-14-2012 10:15 PDT	57.2	63	3.5	210	No value	OK
9-14-2012 10:35 PDT	59	59	0	n/a	No value	OK
9-14-2012 10:55 PDT	62.6	52	0	n/a	No value	OK
9-14-2012 11:15 PDT	62.6	52	3.5	220	No value	OK
9-14-2012 11:35 PDT	64.4	49	0	n/a	No value	OK
9-14-2012 11:55 PDT	64.4	49	3.5	270	No value	OK

Morning Forecasting for Boundary														
Model Resolution:	12km			Model Run:	2012091312			SiteID:	IBONY					
Date		Time in PDT											Comments	
9/14/2012		10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	
Vent. Index		NP	P	P	M	M	M	M	M	NP	P	P	NP	
G: good, M: marginal, P: poor, NP: very poor														
Surface (20m) Winds	Direction	SSW	SSW	SSW	SSW	SSW	SSW	SSW	SSW	S	SSW	SSW	SW	5 kts = 5.75 mph,
	Speed (mph)	0.5	1.6	3.7	5.7	6.9	7.1	7.0	6.7	3.2	5.5	5.0	3.8	10 kts = 11.5 mph,
Surface (20m) Temperature (degree C)		16.4	18.7	21.0	22.4	23.1	23.5	23.6	23.2	21.9	20.9	19.9	18.9	15 kts = 17.25 mph
Surface (20m) Relative Humidity (%)		31.4	27.0	23.1	21.0	21.0	21.6	22.5	24.3	30.7	31.9	33.2	34.3	
Planetary Boundary Layer (PBL)	Height (feet)	968	1696	2657	3291	3553	3698	3520	2710	180	679	400	259	Height is above model terrain surface
	Direction	S	SSW	SW	WSW	WSW	WSW	WSW	SW	SSW	SSW	SW	SW	
	Speed (mph)	3.6	8.0	15.8	16.5	15.1	16.9	14.0	14.0	8.8	11.5	9.2	7.3	
700mb (~10,000 ft MSL)	Height (feet)	7322	7322	7322	7322	7322	7322	7322	7322	7322	7322	7322	7322	Height is above model terrain surface
	Direction	WSW	WSW	WSW	WSW	WSW	WSW	W	WSW	WSW	W	W	W	
	Speed (mph)	26.4	25.6	25.2	25.1	24.7	24.3	23.7	22.4	21.1	19.6	18.3	18.8	
850mb (~5000 ft MSL)	Height (feet)	2345	2345	2342	2345	2345	2345	2345	2345	2345	2345	2345	2345	Height is above model terrain surface
	Direction	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	WSW	
	Speed (mph)	11.1	13.7	12.8	11.9	12.3	12.7	13.1	14.2	14.8	14.5	14.7	15.5	

Figure 40. Weather checklist for Bonners Ferry. Information taken from the University of Washington Northwest Modeling Consortium forecast model.

Forecast Prepared by: BENNETT FIRE WEATHER SERVICES, LLC

Forecast Time Prepared: 8:00 AMPDT Friday September 14, 2012

Forecast for: FRIDAY – September 14, 2012

GENERAL WEATHER DISCUSSION:

FRIDAY:

Not much change in the forecast for this afternoon. The upper level high pressure is centered over southern Idaho will flatten Friday afternoon as an upper level trough moves across northern British Columbia. The ridge axis is over Montana this afternoon. Another upper trough is just off the west coast and will affect northern Idaho over the weekend. Northern Idaho will remain dry today and through the weekend. The wind aloft is from the southwest this afternoon. At the surface today high pressure over eastern Washington is producing a southwest to northeast pressure gradient field. Surface winds will be south to southwest at speeds in the 3-10 mph range. A RED FLAG WARNING has been posted for the Clearwater Air Shed for this afternoon. Mixing heights today will range around 3-5,000 feet AGL from Latah County north and 7-8,000 feet AGL on the Camas Prairie. Transport winds will be from the southwest at 5-15 mph over northern Idaho. Dispersion is expected to be poor/marginal, except locally good on the Camas Prairie. Ventilation is poor to marginal in the morning under a moderate to strong inversion. The inversions are expected to break around 11 am to 12 noon leaving poor to marginal ventilation over the air sheds as surface and low level mixing is minimal. The inversion break temperatures look to be around 11 am at 68 over Boundary County and 70-77 degrees elsewhere.

NORTHERN IDAHO BY AIRSHED:

BOUNDARY COUNTY Air Shed:

Forecast for FRIDAY:

SKY/WEATHER: Sunny and warmer in the afternoon.

TEMPERATURE: High temperatures ranging from 76-80.

HUMIDITY: Minimum RH around 20-30 percent.

WIND – SURFACE: Southeast to southwest 3-10 mph in the afternoon.

TRANSPORT: Southwest 10 mph in the afternoon.

INVERSIONS: Strong to moderate morning inversion breaking by 11 am at a temperature around 68 degrees.

MIXING HEIGHT: Air mass becomes unstable to 3,000 feet AGL by the afternoon.

VENTILATION: POOR to MARGINAL in the morning remaining MARGINAL in the afternoon.

AIRSHED Recommendations: No Burn over the Clearwater Air Shed due to Red Flag Warning. Rest conditional for ventilation as mixing heights are lower and surface/transport winds are light.

Boundary County: Conditional

LOCAL TIME										
County	08	09	10	11	12	13	14	15	16	17
Boundary	M	M	M	M	M	M	M	M	M	M

VENTILATION KEY: P = Poor M = Marginal G = Good E = Excellent

Figure 41. Weather forecast prepared by Bennett Fire Weather Services, LLC, for Boundary County.

Table 42. Available PM_{2.5} monitoring data prior to burn decision.

Date	Time	PM _{2.5} (µg/m ³)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland ^a
9/13/2012	1:00 AM	2.6	No data	2	1
9/13/2012	2:00 AM	2.5	No data	1	-1
9/13/2012	3:00 AM	2.5	No data	2	0
9/13/2012	4:00 AM	2.7	No data	2	1
9/13/2012	5:00 AM	2.8	No data	2	1
9/13/2012	6:00 AM	2.6	No data	2	1
9/13/2012	7:00 AM	2.7	No data	4	2
9/13/2012	8:00 AM	3.1	No data	6	3
9/13/2012	9:00 AM	2.7	No data	3	0
9/13/2012	10:00 AM	2.5	No data	2	0
9/13/2012	11:00 AM	2.2	No data	1	2
9/13/2012	12:00 PM	2	No data	1	1
9/13/2012	1:00 PM	2	No data	1	1
9/13/2012	2:00 PM	1.9	No data	0	3
9/13/2012	3:00 PM	1.9	No data	0	3
9/13/2012	4:00 PM	3.2	No data	2	2
9/13/2012	5:00 PM	9.9	No data	3	5
9/13/2012	6:00 PM	12.7	No data	7	4
9/13/2012	7:00 PM	9.8	No data	5	3
9/13/2012	8:00 PM	7.7	No data	4	4
9/13/2012	9:00 PM	4.3	No data	3	5
9/13/2012	10:00 PM	6.5	No data	4	6
9/13/2012	11:00 PM	3.7	No data	3	6
9/13/2012	12:00 AM	4.2	No data	2	3
9/14/2012	1:00 AM	3.6	No data	2	4
9/14/2012	2:00 AM	3.9	No data	2	5
9/14/2012	3:00 AM	3.6	No data	1	2
9/14/2012	4:00 AM	3	No data	2	2
9/14/2012	5:00 AM	3	No data	2	3
9/14/2012	6:00 AM	2.9	No data	3	3
9/14/2012	7:00 AM	2.9	No data	5	5
9/14/2012	8:00 AM	4	No data	5	7
9/14/2012	9:00 AM	3.9	No data	3	4
9/14/2012	10:00 AM	3.8	No data	4	2

^a The Copeland monitor was replaced with a BAM during the fall season.

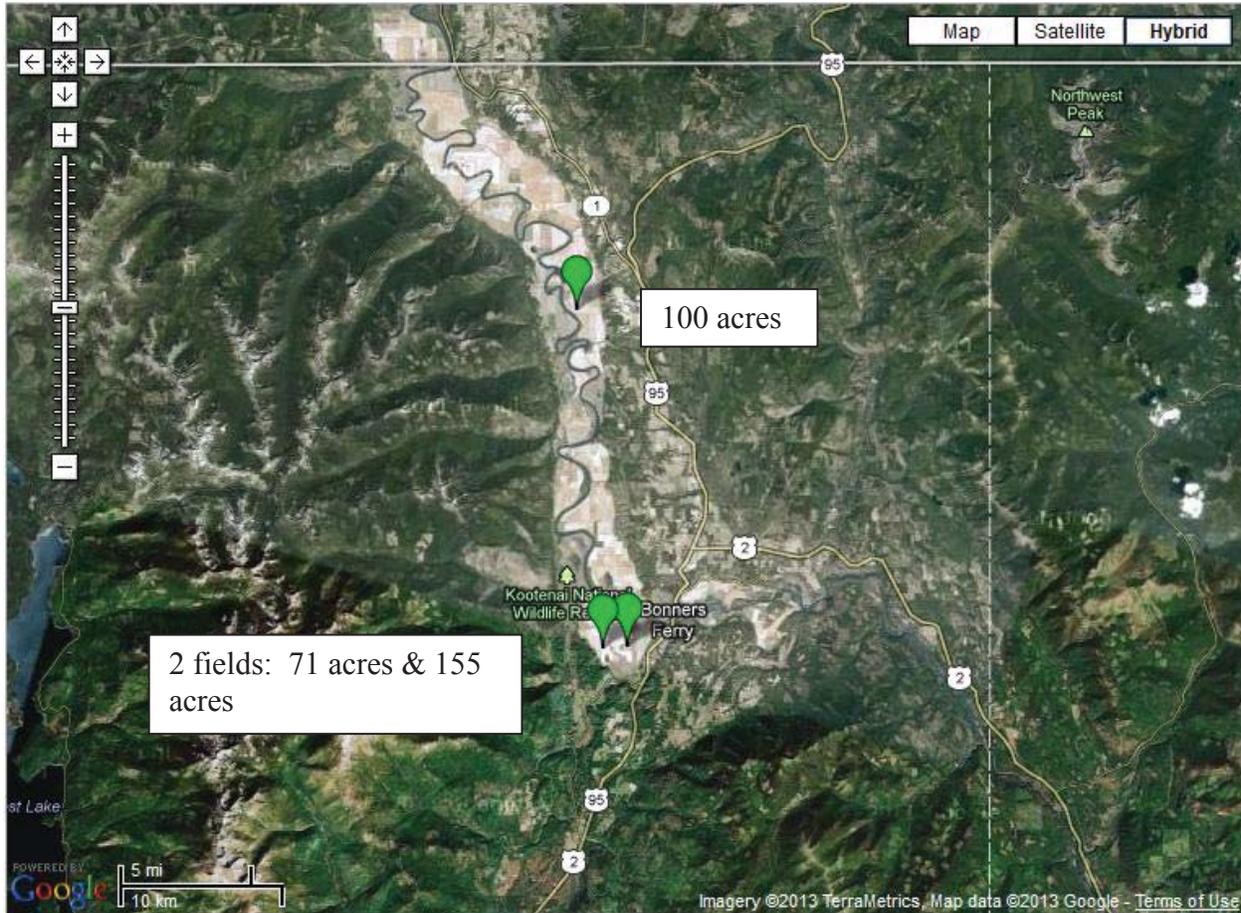


Figure 42. Map of approved fields for September 14, 2012.

Field Observations

Field observations in the southern end of the valley indicated a light northerly surface wind. The first field, a 71-acre wheat field, was approved and ignited at 11:30 a.m. Fair smoke dispersion was observed. The burn lasted approximately 30 minutes. Smoke from this burn was light with good lift with almost no ground smoke. Since the smoke from the 71-acre field dispersed fairly quickly and was transported to the northeast (which was the direction anticipated with the forecasted southwest transport winds), and northerly surface winds continued, the 155-acre wheat field was verbally approved for ignition. The stubble was dry and no green-up was observed in the field. This field was ignited at approximately 12:20 p.m. using two burners to ignite the field very quickly. The burn was completed by approximately 1:00 p.m. The smoke had good lift and dispersion was fair. Transport wind direction noted by the smoke behavior was from the south and very light, moving the smoke to the north. DEQ field staff checked the KTOI health clinic and Boundary County Hospital for impacts. None were noted. At 12:46 p.m. northerly surface winds were still observed. Smoke dissipation was fair and the smoke trajectory appeared to avoid town.

The final field ignited on this day was a 100-acre wheat stubble field located in the middle portion of the valley. Although the field coordinator was not at the site at the time of verbal approval, the grower is experienced and has a good record of cooperation with the program. The

permit was not finalized until verbal approval was issued. The grower was given approval to burn at approximately 12:30 p.m. The DEQ field coordinator observed the plume from his location in the southern part of the valley and took several pictures. The grower was contacted by phone at approximately 1:00 p.m. and reported that the burn was complete. He noted that the field was “clean, with very little green-up.”

All field burns were complete by approximately 1:00 p.m. The DEQ field coordinator remained in the area to observe smoke behavior. (Boundary County schools are not in session on Fridays, therefore the Copeland monitor at the Mt. Hall Elementary School was less of a concern.) The field coordinator proceeded to the middle portion of the valley to document the 100-acre field burn. He noted that additional smoke appeared to be moving into the area—likely wildfire smoke—and with this in mind, no additional burning was approved.

Table 43 includes the monitoring data during and after the burns. The maximum hourly concentration at any of the monitors was $24 \mu\text{g}/\text{m}^3$, recorded at Copeland at 2:00 p.m. and 8:00 p.m. This value is below all enhanced documentation triggers and program concentration limits. This impact first occurred 1 hour after completion of the last field burn of the day, which was located approximately 2 miles south of the Copeland monitor. Winds at 850 millibars were forecasted to be approximately 12 mph. The Mt. Hall Elementary School is closed on Fridays and not considered an ISP for this burn day. No enhanced documentation was performed for this day.

Table 43. Air quality PM_{2.5} monitoring data during and after burning.

Date	Time	PM _{2.5} ($\mu\text{g}/\text{m}^3$)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland
9/14/2012	11:00 AM	3.5	No data	3	3
9/14/2012	12:00 PM	3.3	No data	3	7
9/14/2012	1:00 PM	3.9	No data	3	7
9/14/2012	2:00 PM	4.5	No data	4	24
9/14/2012	3:00 PM	7.9	No data	6	17
9/14/2012	4:00 PM	12.4	No data	8	21
9/14/2012	5:00 PM	8.4	No data	9	23
9/14/2012	6:00 PM	9.2	No data	9	20
9/14/2012	7:00 PM	13.7	No data	14	22
9/14/2012	8:00 PM	10.7	No data	21	24
9/14/2012	9:00 PM	11.1	No data	21	20
9/14/2012	10:00 PM	10.1	No data	21	17
9/14/2012	11:00 PM	10.6	No data	20	22
9/14/2012	12:00 AM	11.3	No data	15	19

Numerous complaints were received on this day from a large geographic region (including calls from Creston, BC; Cataldo, ID; Rockford, WA; St. Maries, ID; and Fernwood, ID) regarding smoke in the area. The complaints were received by the toll-free complaint hotline starting after 5:00 p.m. (from Creston) on September 14 and several on the next day (Saturday). The

complainants indicated a lot of smoke in the area. It is difficult to determine if the Creston complaints were initiated by the field burns in Boundary County or from the wildfire smoke that moved into the area. It is clear that smoke infiltrated a very large region to a great enough degree to necessitate numerous calls all over the Coeur d'Alene region, not only in the Creston Valley. However, the field observations and descriptions of smoke from field burning along with the description of wildfire smoke moving into the area suggest both sources likely contributed to the elevated PM_{2.5} concentrations in this airshed. The progression of concentration increases from south to north indicates a significant source well beyond what 326 acres of wheat stubble would be expected to produce. The persistence of the smoke for several days also suggested a much stronger source.

Summary

Three fields, a total of 326 acres of cereal grain stubble, were burned this day in Boundary County. Conditions were improved for smoke behavior compared to the previous day, but only limited burning was conducted. The smoke behavior described on this day indicated a decent ventilation day, which would likely have been considered a good burn day if not for the intrusion of wildfire smoke into the area. The relatively quick introduction of wildfire smoke into the area was not anticipated. The light lower level winds over the region did not appear to threaten migration of smoke into the area earlier in the day. It is difficult to predict smoke intrusion from wildfire activity at any time. The elevated concentrations persisted for several days in this airshed. Although concentrations were obviously impacted from the field burning smoke from the 326 acres, this acreage would not create the entirety of the impact measured in the airshed.

Burn Date: September 18, 2012

Burn Decision

Burn day: up to 350 acres approved—pending meteorological conditions. Burn window: 12 p.m. to 4 p.m.

Burn Decision Justification

This burn decision was developed using NWS observations at Bonners Ferry and Creston, BC, (Table 44); forecasted winds, ventilation, and temperatures from the UW NWMC, as displayed in DEQ's weather checklist (Figure 43); and the daily forecast produced by the DEQ contract meteorologist, Bennett Fire Weather Services, LLC (Figure 44). Wind speeds and transport direction were favorable. Ventilation was expected to be marginal with surface winds generally from the southwest at 6–8 mph. The upper level winds were forecasted to be from the west-southwest at 11–14 mph.

The DEQ contract meteorologist recommended a conditional burn day. DEQ determined a burn window of noon–4:00 p.m. based on wind directions and speeds and atmospheric mixing heights depicted in Figure 43. As always, field verification was required for final approval due to imprecise model forecasts and the wide variation in conditions that have been experienced in the Kootenai Valley.

DEQ also reviewed the monitoring data (Table 45) for Creston, BC; Porthill; and Copeland to determine background air quality and expected PM_{2.5} concentrations. The maximum hourly PM_{2.5} concentration recorded at any of these sites was 9.0 µg/m³, which occurred in Creston at 9:00 a.m. on this burn day and is well below all preburn enhanced documentation triggers. Ventilation suggested concentrations would not build significantly on this day. The Bonners Ferry monitor was not providing data for this burn day. However, all other monitors showed consistent concentrations throughout the valley.

One field, 130 acres of cereal grain stubble, was ultimately approved (Figure 45) after field verification. This field was used as a test to determine if additional fields could be burned.

Table 44. National Weather Service observations at Bonners Ferry (Site ID K65S).

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
9-18-2012 5:55 PDT	42.8	87	0	n/a	Clear	OK
9-18-2012 6:15 PDT	41	93	0	n/a	Clear	OK
9-18-2012 6:35 PDT	41	87	0	n/a	Clear	OK
9-18-2012 6:55 PDT	41	93	0	n/a	Clear	OK
9-18-2012 7:15 PDT	41	93	0	n/a	Clear	OK
9-18-2012 7:35 PDT	44.6	87	0	n/a	Clear	OK
9-18-2012 7:55 PDT	48.2	76	0	n/a	Clear	OK
9-18-2012 8:15 PDT	50	71	0	n/a	Clear	OK
9-18-2012 8:35 PDT	51.8	66	0	n/a	Clear	OK
9-18-2012 8:55 PDT	53.6	67	0	n/a	Clear	OK
9-18-2012 9:15 PDT	55.4	62	0	v	Clear	OK
9-18-2012 9:35 PDT	55.4	62	0	n/a	Clear	OK
9-18-2012 9:55 PDT	55.4	62	3.5	170	Clear	OK
9-18-2012 10:15 PDT	57.2	59	0	n/a	Clear	OK
9-18-2012 10:35 PDT	59	59	3.5	170	Clear	OK
9-18-2012 10:55 PDT	60.8	55	4.6	210	Clear	OK
9-18-2012 11:15 PDT	62.6	52	0	n/a	Clear	OK
9-18-2012 11:35 PDT	64.4	49	3.5	270	Clear	OK
9-18-2012 11:55 PDT	64.4	45	0	n/a	Clear	OK

Morning Forecasting for Boundary														
Model Resolution:	12km			Model Run:	2012091712			SiteID:	IBONY					
Date		Time in PDT											Comments	
9/18/2012		10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	
Vent. Index		P	P	M	M	M	M	M	M	NP	P	P	P	
G: good, M: marginal, P: poor, NP: very poor														
Surface (20m) Winds	Direction	SSW	SSW	SW	SW	SW	SW	SW	SW	SSW	SW	SW	SSW	5 kts = 5.75 mph,
	Speed (mph)	4.1	4.7	5.6	6.8	7.6	8.1	8.2	8.4	4.6	7.6	6.5	4.8	10 kts = 11.5 mph,
Surface (20m) Temperature (degree C)		17.6	19.5	21.1	22.4	23.2	23.6	23.5	23.1	21.5	20.3	19.3	18.7	15 kts = 17.25 mph
Surface (20m) Relative Humidity (%)		39.7	35.1	31.6	28.6	27.6	27.9	29.3	31.3	38.5	40.0	42.6	43.6	
Planetary Boundary Layer (PBL)	Height (feet)	1329	2385	3274	3822	4229	4245	3593	2667	174	1115	856	646	Height is above model terrain surface
	Direction	WSW	W	W	WNW	WNW	WNW	WNW	W	SW	WSW	WSW	SW	
	Speed (mph)	12.2	13.2	14.8	16.2	16.0	16.0	16.9	18.1	12.9	18.9	16.8	13.0	
700mb (~10,000 ft MSL)	Height (feet)	7322	7322	7322	7322	7322	7322	7322	7322	7322	7322	7322	7322	Height is above model terrain surface
	Direction	NW	WNW	WNW	WNW	WNW	WNW	WNW	NW	NW	NW	NW	NW	
	Speed (mph)	21.0	22.7	24.0	25.3	26.2	26.6	26.8	27.0	26.1	25.0	23.7	22.2	
850mb (~5000 ft MSL)	Height (feet)	2345	2342	2345	2345	2345	2345	2345	2345	2345	2345	2345	2342	Height is above model terrain surface
	Direction	W	W	WSW	WSW	WSW	WSW	WSW	WSW	W	WNW	WNW	WNW	
	Speed (mph)	13.0	13.2	11.4	12.5	13.7	14.3	15.7	17.8	20.4	20.5	18.5	16.3	

Figure 43. Weather checklist for Bonners Ferry. Information taken from the University of Washington Northwest Modeling Consortium forecast model.

Forecast Prepared by: BENNETT FIRE WEATHER SERVICES, LLC

Forecast Time Prepared: 8:00 AM PDT - Tuesday September 18, 2012

Forecast for: TUESDAY – September 18, 2012

GENERAL WEATHER DISCUSSION:

TUESDAY:

An upper level high pressure ridge is building and strengthening over northern Idaho today. The air mass remains dry with a west to northwest flow aloft. Northern Idaho remains on the leading edge of the high pressure ridge keeping subsidence over northern Idaho. At the surface this afternoon, a cooler air mass and higher pressure is over the Columbia Basin. The pressure gradient field is oriented southwest to northeast yielding a southwest to northwest surface wind direction. Wind speeds will be light ranging from 3-10 mph as the gradient field is relaxed. Mixing heights this afternoon will range between 3-5,000 feet AGL over the air sheds. Transport winds will be from the southwest to northwest at 5-10 mph. Dispersion is expected to be marginal to locally good. Ventilation is poor to marginal in the morning under a moderate to strong inversion. The inversions are expected break around 11 am to 12 noon leaving marginal ventilation over the air sheds as surface and low level mixing is weak. The inversion break temperatures look to be around 11am at 64 over Boundary County and 70-72 degrees elsewhere.

NORTHERN IDAHO BY AIRSHED:

BOUNDARY COUNTY Air Shed:

Forecast for TUESDAY:

SKY/WEATHER: Sunny.

TEMPERATURE: High temperatures ranging from 80-85.

HUMIDITY: Minimum RH around 20-30 percent.

WIND – SURFACE: South to southwest 3-10 mph in the afternoon.

TRANSPORT: Southwest 10 mph in the afternoon.

INVERSIONS: Strong to moderate morning inversion breaking by 11am at a temperature around 64 degrees.

MIXING HEIGHT: Air mass becomes unstable to 3-4,000 feet AGL by the afternoon.

VENTILATION: POOR to MARGINAL in the morning remaining MARGINAL in the afternoon.

AIRSHED Recommendations: Ventilation continues to be marginal over all air sheds.

Boundary County: Conditional

LOCAL TIME										
County	08	09	10	11	12	13	14	15	16	17
Boundary	P	P	M	M	M	M	M	M	M	M

VENTILATION KEY: P = Poor M = Marginal G = Good E = Excellent

Figure 44. Weather forecast prepared by Bennett Fire Weather Services, LLC, for Boundary County.

Table 45. Available PM_{2.5} monitoring data prior to burn decision.

Date	Time	PM _{2.5} (µg/m ³)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland
9/17/2012	1:00 AM	5.3	No data	2	5
9/17/2012	2:00 AM	4.5	No data	3	6
9/17/2012	3:00 AM	4.6	No data	2	6
9/17/2012	4:00 AM	4.3	No data	3	6
9/17/2012	5:00 AM	4.5	No data	3	5
9/17/2012	6:00 AM	4.3	No data	3	5
9/17/2012	7:00 AM	5.2	No data	7	5
9/17/2012	8:00 AM	5.9	No data	9	5
9/17/2012	9:00 AM	5.1	No data	7	6
9/17/2012	10:00 AM	3.5	No data	4	8
9/17/2012	11:00 AM	3	No data	2	8
9/17/2012	12:00 PM	Internal Audit	No data	2	6
9/17/2012	1:00 PM	2.4	No data	1	7
9/17/2012	2:00 PM	2.4	No data	1	6
9/17/2012	3:00 PM	2.5	No data	1	4
9/17/2012	4:00 PM	2.6	No data	2	6
9/17/2012	5:00 PM	2.8	No data	5	6
9/17/2012	6:00 PM	2.9	No data	9	5
9/17/2012	7:00 PM	3.2	No data	5	4
9/17/2012	8:00 PM	3.4	No data	5	4
9/17/2012	9:00 PM	3.7	No data	5	7
9/17/2012	10:00 PM	3.7	No data	4	9
9/17/2012	11:00 PM	3.7	No data	3	8
9/17/2012	12:00 AM	3.7	No data	2	8
9/18/2012	1:00 AM	3.6	No data	3	8
9/18/2012	2:00 AM	3.8	No data	2	7
9/18/2012	3:00 AM	3.7	No data	2	6
9/18/2012	4:00 AM	3.7	No data	3	6
9/18/2012	5:00 AM	2.9	No data	2	7
9/18/2012	6:00 AM	3.1	No data	3	4
9/18/2012	7:00 AM	3.4	No data	5	4
9/18/2012	8:00 AM	5	No data	6	7
9/18/2012	9:00 AM	5.1	No data	5	5
9/18/2012	10:00 AM	4.3	No data	6	2

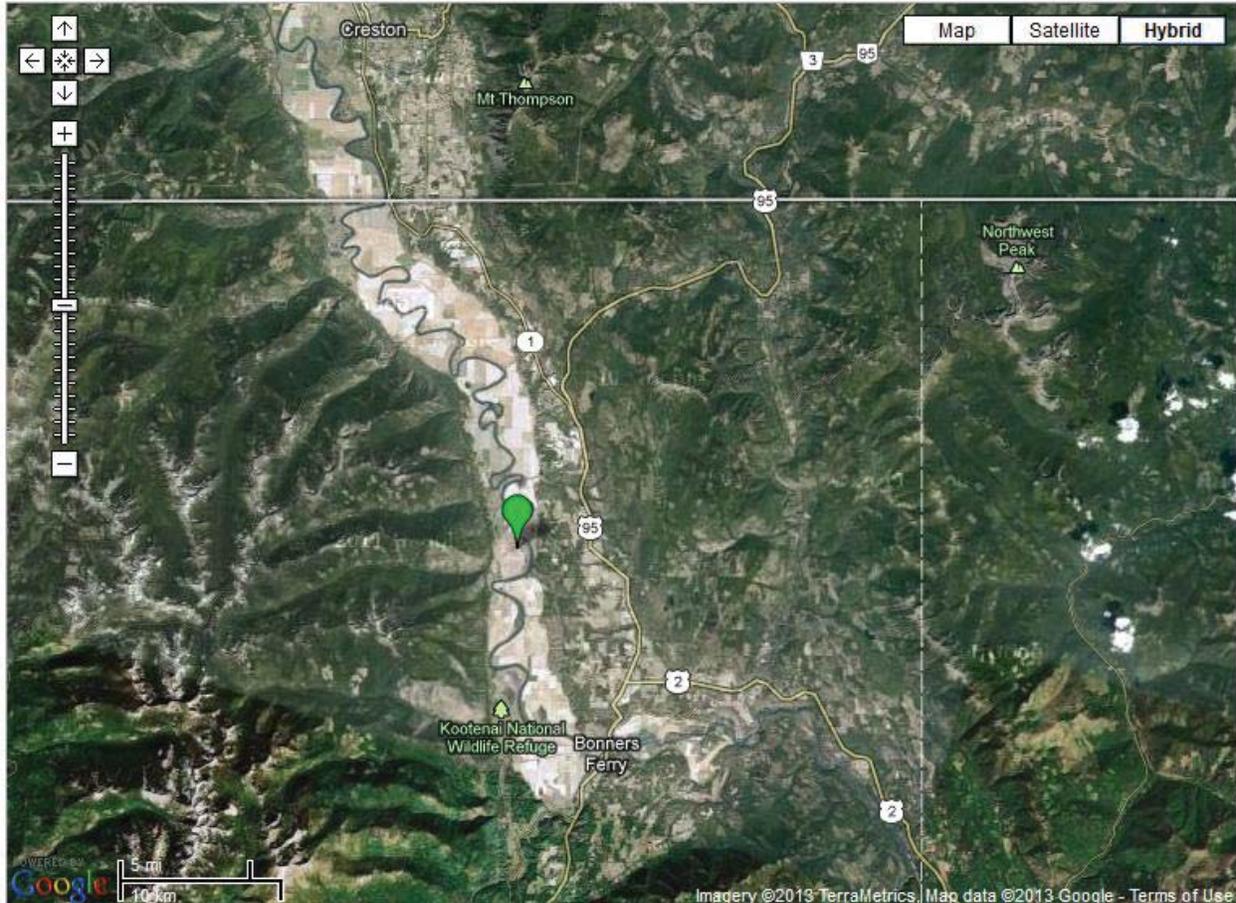


Figure 45. Map of approved fields for September 18, 2012.

Field Observations

DEQ personnel made field verification observations, noting a light north-northeast surface wind and 73 °F temperatures. The surface wind direction was 180 degrees opposite of what was forecasted; however, this is a favorable surface wind direction for burning in many locations in this valley. The temperature was very near to what was expected; however, relative humidity was approximately 10% higher in the field. The daily hodograph indicated transport winds would move smoke aloft to the east as expected from the forecast data (Figure 46). Given the location of the field and the surface winds present at the time, the 130 acre field was approved for burning. This acreage was the remaining portion of a 420-acre field that had been burned in stages throughout the season.

The field was ignited at approximately 12:20 p.m. Plume rise appeared to be at least 2,500 ft AGL and then capped off, indicating an inversion layer at this height. Little to no ground smoke suggested the burn created very good columnar lift. The burn lasted 40 minutes, finishing by 1:10 p.m. The DEQ field coordinator was on site to observe the burn and the smoke behavior. The field coordinator observed smoke behavior and delayed any additional burning until the final fate of smoke could be ascertained. Vertical transport dispersion was fair; however, smoke transport was slower than expected and was observed traveling to the north-northwest. After

discussions between the field coordinator, office staff, and Bennett Fire Weather Services, DEQ decided not to allow any more burning at approximately 2:45 p.m.

Table 46 includes the monitoring data during and after the burns. The maximum hourly concentration at any of the monitors was $23 \mu\text{g}/\text{m}^3$, recorded at Copeland at 8:00 p.m. The Mt. Hall Elementary School, where the Copeland monitor is located, closes for the day at 3:30 p.m. No students were anticipated to be present during this time frame. This value is below all enhanced documentation triggers and program concentration limits.

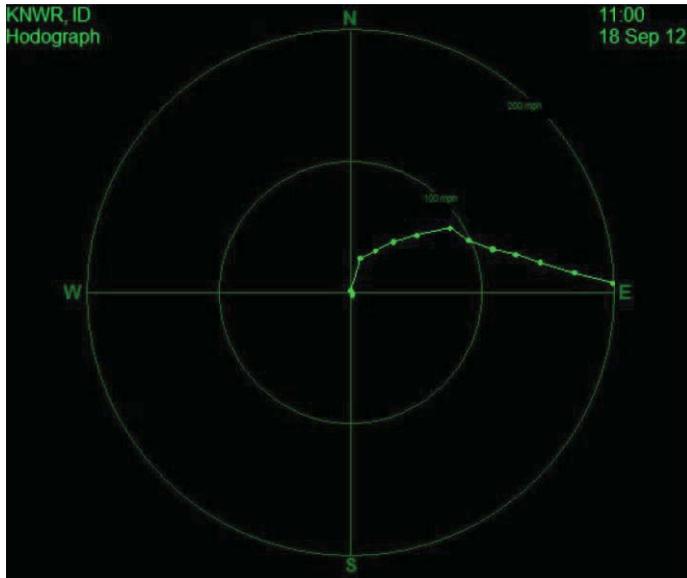


Figure 46. Daily pibal results. The line indicates the direction the wind would take the smoke.

Table 46. Air quality $\text{PM}_{2.5}$ monitoring data during and after burning.

Date	Time	$\text{PM}_{2.5}$ ($\mu\text{g}/\text{m}^3$)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland
9/18/2012	11:00 AM	3.4	No data	4	4
9/18/2012	12:00 PM	3.4	No data	4	4
9/18/2012	1:00 PM	4.3	No data	3	2
9/18/2012	2:00 PM	18.5	No data	5	6
9/18/2012	3:00 PM	14.7	No data	5	10
9/18/2012	4:00 PM	13.5	No data	8	9
9/18/2012	5:00 PM	14.9	No data	8	16
9/18/2012	6:00 PM	14.8	No data	9	12
9/18/2012	7:00 PM	10.9	No data	9	14
9/18/2012	8:00 PM	10.3	No data	13	23
9/18/2012	9:00 PM	9.5	No data	11	19
9/18/2012	10:00 PM	9	No data	11	20
9/18/2012	11:00 PM	8.8	No data	11	12
9/18/2012	12:00 AM	8.9	No data	12	12

Three complaints were received about this burn day, all by the toll-free complaint hotline on September 18. All three complaints came from the Creston area. The first, from a resident in the western hillside of the Creston Valley, was recorded at approximately 3:30 p.m. The Porthill monitor recorded smoke transporting through the area beginning at about the 3:00 p.m. Considering the observed north to northwest smoke transport, it is very likely that DEQ-approved crop residue burning was the cause of this complaint. The second complaint, also from Creston, was recorded at about the same time. This complainant was located on the eastern side of the Creston Valley. Given the observed smoke direction and timing of the call, it is difficult to ascertain if smoke was on the ground at this second complainant's location at the time of the complaint, as described, or if the complaint was triggered by the smoke that was visible across the valley. Winds in the Creston Valley swirl from the western side into the eastern side. During periods of slow wind speeds, smoke on one side of the valley would be expected to take several hours to be mixed and transported to the eastern edge. The timing of the rise in pollutant concentrations in Creston suggest this may have occurred on this day. Based on smoke observations, it was determined that smoke from DEQ-approved crop residue burning was more than likely the cause of the complaints.

Summary

One field, a total of 130 acres of cereal grain stubble, was burned this day in Boundary County. The observed meteorological conditions were not as good as predicted by the model forecast. The ventilation was forecasted to be marginal and field observations did note marginal dispersion; however, mixing heights were much lower than forecasted. A subsidence inversion was likely stronger than expected this day. Later in the day, the observed winds showed a southwesterly component as was forecast. Observed temperature was as forecasted, while observed relative humidity was higher than forecasted. The lingering high pressure system over the area resulted in marginal smoke dispersion. Based on the results of the test burn, no additional acreage was approved for burning this day.

Burn Date: October 1, 2012

Burn Decision

Burn day: up to 250 acres approved—pending meteorological conditions. Burn window: 12 p.m. to 4 p.m.

Burn Decision Justification

This burn decision was developed using NWS observations at Bonners Ferry and Creston, BC, (Table 47); forecasted winds, ventilation, and temperatures from the UW NWMC, as displayed in DEQ's weather checklist (Figure 47); and the daily forecast produced by the DEQ contract meteorologist, Bennett Fire Weather Services, LLC (Figure 48). Ventilation was expected to be marginal, with surface winds generally from the southwest at 6–8 mph. The upper level winds were forecasted to be from the west-southwest at 14–24 mph at an elevation of 3,300 ft AGL. The upper level conditions were conducive for good smoke management. The surface winds were predicted to increase as the day progressed. Since many forecast models and interpretation of region-wide forecasting tends to miss many of the local features that affect ventilation in this

valley, much weight is placed on the in-field observation and determination DEQ completes “on the ground” prior to giving final verbal burn approval.

The DEQ contract meteorologist recommended a conditional burn day. The ventilation forecast for Boundary County was good for the burn window, which also supported a burn day decision. However, ventilation was expected to be marginal in the afternoon, with increasing winds ahead of a frontal system that would move past the area overnight and the next day. DEQ determined a burn window of noon–4:00 p.m. based on the weather checklist and the optimal ventilation that is routinely experienced during this time frame. A total of 250 acres were available, per the final burn decision, for possible burning, pending field confirmation. Actual burning was expected to start closer to 1 p.m. if conditions allowed and would likely be stopped early in the afternoon. A test burn was planned for a 135-acre field.

DEQ reviewed the monitoring data (Table 48) for Bonners Ferry; Creston, BC; Porthill; and Copeland. The maximum hourly PM_{2.5} concentration recorded at any of these sites was 20 µg/m³, recorded at Copeland at 4:00 a.m. on September 30 (the day before burning). This concentration is below all pre-burn enhanced documentation triggers. The monitoring data showed that the air quality was improving and should support burning on this day; however, it did depict some region-wide smoke.

One field, a total of 135 acres of cereal grain stubble, was ultimately approved (Figure 49).

Table 47. National Weather Service observations at Bonners Ferry (Site ID K65S).

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
10-1-2012 5:55 PDT	41	81	3.5	130	Clear	OK
10-1-2012 6:15 PDT	44.6	70	3.5	100	Clear	OK
10-1-2012 6:35 PDT	44.6	70	3.5	170	Clear	OK
10-1-2012 6:55 PDT	41	81	0	n/a	Clear	OK
10-1-2012 7:15 PDT	42.8	76	0	n/a	Clear	OK
10-1-2012 7:35 PDT	44.6	70	0	n/a	Clear	OK
10-1-2012 7:55 PDT	44.6	70	4.6	110	Clear	OK
10-1-2012 8:15 PDT	44.6	70	0	n/a	Clear	OK
10-1-2012 8:35 PDT	48.2	66	0	n/a	Clear	OK
10-1-2012 8:55 PDT	48.2	66	3.5	140	Clear	OK
10-1-2012 9:15 PDT	50	62	0	n/a	Clear	OK
10-1-2012 9:35 PDT	53.6	54	3.5	150	Clear	OK
10-1-2012 9:55 PDT	55.4	51	3.5	190	Clear	OK
10-1-2012 10:15 PDT	55.4	54	3.5	170	Clear	OK
10-1-2012 10:35 PDT	57.2	47	3.5	200	Clear	OK
10-1-2012 10:55 PDT	59	44	4.6	170	Clear	OK
10-1-2012 11:15 PDT	62.6	39	5.8	160	Clear	OK
10-1-2012 11:35 PDT	62.6	39	3.5	130	Clear	OK
10-1-2012 11:55 PDT	64.4	37	4.6	140	Clear	OK

Morning Forecasting for Boundary														
Model Resolution:	12km			Model Run:	2012100100			SitID:	IBONY					
Date		Time in PDT											Comments	
10/1/2012		10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	
Vent. Index		P	P	P	M	M	M	M	P	NP	M	P	P	
G: good, M: marginal, P: poor, NP: vary poor														
Surface (20m) Winds	Direction	SSW	SW	SW	SSW	SW	SW	SW	SW	SSW	SSW	SSW	SSW	5 kts = 5.75 mph,
	Speed (mph)	4.4	5.5	6.4	8.3	10.0	10.8	11.2	7.0	5.6	9.6	8.2	7.9	10 kts = 11.5 mph,
Surface (20m) Temperature (degree C)		15.3	17.3	18.8	19.5	20.0	20.1	19.8	18.6	16.9	16.9	16.5	16.2	15 kts = 17.25 mph
Surface (20m) Relative Humidity (%)		38.1	33.5	31.8	32.6	33.3	33.9	35.6	40.7	48.0	45.8	48.3	50.5	
Planetary Boundary Layer (PBL)	Height (feet)	938	1804	2664	3215	3301	3133	2589	285	144	2388	1972	1555	Height is above model terrain surface
	Direction	SW	WSW	W	W	WSW	WSW	WSW	SW	SW	WSW	WSW	WSW	
	Speed (mph)	12.8	14.9	14.1	16.2	19.3	24.2	26.6	20.2	17.6	32.9	30.2	24.8	
700mb (~10,000 ft MSL)	Height (feet)	7237	7237	7237	7237	7237	7237	7237	7237	7237	7237	7237	7237	Height is above model terrain surface
	Direction	W	W	W	W	W	W	W	W	W	W	W	W	
	Speed (mph)	21.0	23.1	26.3	30.1	33.9	33.5	35.8	41.9	43.8	42.9	41.2	43.0	
850mb (~5000 ft MSL)	Height (feet)	2315	2315	2315	2315	2319	2319	2319	2319	2315	2066	2066	2066	Height is above model terrain surface
	Direction	W	W	WSW	WSW	WSW	SW	SW	WSW	WSW	WSW	WSW	WSW	
	Speed (mph)	18.1	16.8	13.1	14.5	18.6	22.7	25.9	29.4	33.6	31.3	30.2	29.4	

Figure 47. Weather checklist for Bonners Ferry. Information taken from the University of Washington Northwest Modeling Consortium forecast model.

Table 48. Available PM_{2.5} monitoring data prior to burn decision.

Date	Time	PM _{2.5} (µg/m ³)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland
9/30/2012	1:00 AM	14.1	13.3	12	13
9/30/2012	2:00 AM	13.1	13.9	9	15
9/30/2012	3:00 AM	13.1	13.8	10	13
9/30/2012	4:00 AM	13.3	13.8	8	20
9/30/2012	5:00 AM	13.1	13.8	7	16
9/30/2012	6:00 AM	12.6	13.9	7	18
9/30/2012	7:00 AM	11.9	13.5	10	12
9/30/2012	8:00 AM	11.7	13.8	11	16
9/30/2012	9:00 AM	11.3	14	5	5
9/30/2012	10:00 AM	7.5	11.1	1	7
9/30/2012	11:00 AM	5.4	9.7	3	7
9/30/2012	12:00 PM	4.4	8.9	2	7
9/30/2012	1:00 PM	3.8	7.9	0	8
9/30/2012	2:00 PM	3.7	7	2	9
9/30/2012	3:00 PM	3.5	5.3	0	7
9/30/2012	4:00 PM	3.7	4.5	1	8
9/30/2012	5:00 PM	3.9	4.8	3	10
9/30/2012	6:00 PM	4.8	6.1	7	8
9/30/2012	7:00 PM	4.5	6	1	4
9/30/2012	8:00 PM	5.8	5.3	2	6
9/30/2012	9:00 PM	5.5	5.6	2	6
9/30/2012	10:00 PM	5	5.7	2	4
9/30/2012	11:00 PM	5.1	6.2	1	4
9/30/2012	12:00 AM	5.2	5.9	0	4
10/1/2012	1:00 AM	5.1	6	1	6
10/1/2012	2:00 AM	5.2	5.7	1	6
10/1/2012	3:00 AM	5.2	5.7	1	3
10/1/2012	4:00 AM	5.1	5.7	1	5
10/1/2012	5:00 AM	5	5.5	2	7
10/1/2012	6:00 AM	5	5.5	3	5
10/1/2012	7:00 AM	5.3	5.6	2	2
10/1/2012	8:00 AM	6	5.9	6	2
10/1/2012	9:00 AM	6.1	5.2	9	5
10/1/2012	10:00 AM	5.7	5.3	3	6

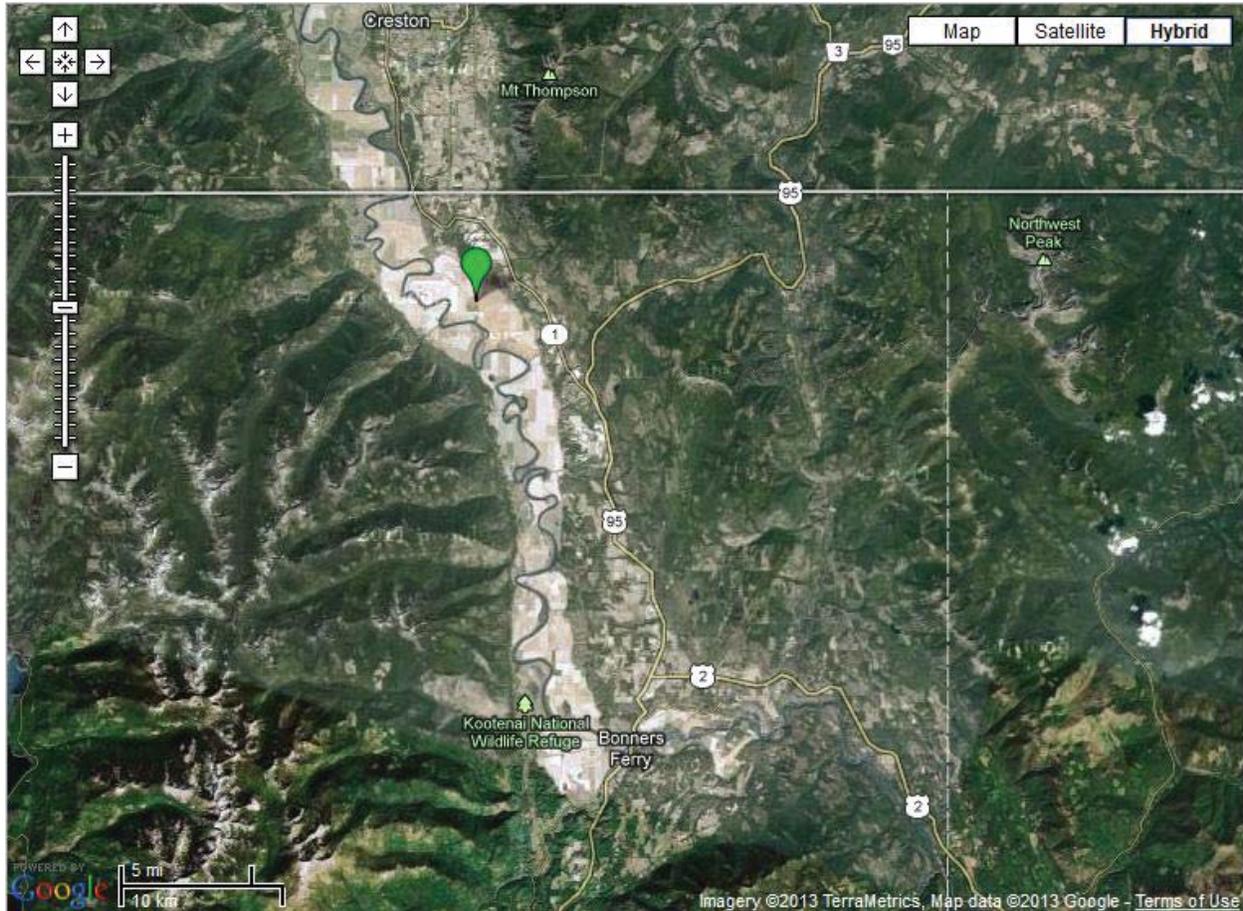


Figure 49. Map of approved fields for October 1, 2012.

Field Observations

Conditions in the field indicated marginal or better ventilation than predicted due to surface wind speed. Surface wind measurements taken by field staff indicated a southerly wind at 7 mph. The temperature was 66.5 °F, confirming the forecast. The relative humidity was 42%, which was higher than expected. Fuel evaluation noted brown conditions with a little green-up in the bottom. Soil moisture at this location was very dry. Field observations were similar to the forecast prior to burning.

The 135-acre barley field was approved for burning and ignited at 1:07 p.m. As the 135-acre field was burning, the fire escaped the permittee's control and swept across the adjacent field, burning an additional 176 acres. Good to excellent smoke dispersion aloft was observed on the approved field. Fair smoke dispersion from a combination of both fields near ground level was observed. This was likely due to the grower's attempt to backlight a fire in the adjacent field to gain fire safety control while surface winds increased. The approved 135-acre field was out by 1:48 p.m., a 40-minute burn. The escaped field, which was backlit to fight further spreading, took about an hour before it was completely out around 2:40 p.m. High surface wind speeds affected smoke by this time of the day.

These two fields were located adjacent to each other in the northern part of the valley. Wind directions were noted in the field as having a southerly component, which pushed the smoke to the north. Transport dispersion was good to excellent because of higher surface winds (measured around 10 mph during this time in the field and 12–15 mph at the US 95 overlook). Smoke dispersion close to ground was considered poor due to the higher wind speeds that cooled off the initial smoke and pushed it near the ground. Vertical/transport dispersion, or smoke aloft, continued to be good to excellent, likely due to the higher wind speeds. Observations indicated that column heights were approximately 2,000 ft AGL. The DEQ field coordinator observed the burn from the Hwy 95 overlook just above Mt. Hall Elementary School. At 2:15 p.m. wind speeds at the overlook were sustained out of the south-southeast at 12 mph with gusts to 15 mph.

Table 49 includes the monitoring data during and after the burns. The maximum hourly PM_{2.5} concentration at any of the monitors was 25 µg/m³, recorded at Copeland at 10:00 p.m. This value is below all enhanced documentation triggers and program concentration limits. Elevated levels at the monitors in Table 49 were influenced by wildfire smoke moving into the areas that evening. The higher surface winds indicated that a fast-moving front was on its way. With the location of the field, wind speed, and direction in relation to the monitor at Copeland (Mt. Hall Elementary School), the elevated readings could not have been caused by DEQ- approved crop residue burning this day. The elevated readings at Porthill and Creston, BC, were likely the result of DEQ-approved crop residue burning as well as the escaped fire (Table 49). These monitors were downwind of the burn. Formal enforcement action was pursued as a result of this escaped fire because of alleged violation of permit conditions.

Table 49. Air quality PM_{2.5} monitoring data during and after burning.

Date	Time	PM _{2.5} (µg/m ³)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland
10/1/2012	11:00 AM	5.5	5.4	3	7
10/1/2012	12:00 PM	4.7	5.1	5	7
10/1/2012	1:00 PM	8	6.7	0	6
10/1/2012	2:00 PM	16.4	9.2	24	8
10/1/2012	3:00 PM	8.6	10.6	13	9
10/1/2012	4:00 PM	8.7	11.4	9	12
10/1/2012	5:00 PM	8.5	15.1	17	13
10/1/2012	6:00 PM	9.4	14.4	12	12
10/1/2012	7:00 PM	9.8	14.3	16	13
10/1/2012	8:00 PM	9.7	16.2	8	12
10/1/2012	9:00 PM	11.2	18.6	10	24
10/1/2012	10:00 PM	15.9	15.4	15	25
10/1/2012	11:00 PM	15.8	11.1	18	16
10/1/2012	12:00 AM	13.9	8.8	18	20

Four complaints were received about this burn day, all by the toll-free complaint hotline on October 1 and 2. The complainants indicated there was smoke in the valley and it was hard to breathe. Two of the complainants were very angry that DEQ conducted crop residue burning

with wildfire smoke in the area. Based on smoke observations and wind speeds during the end of the burns, DEQ determined that smoke from DEQ-approved crop residue burning activities (and the escaped fire) likely impacted the Creston area as smoke moved north from the burn locations up into the Creston Valley. However, the wind speed and fast moving front would have moved smoke from DEQ-approved crop residue burning and the escaped fire through the area fairly quickly.

Compounding the smoke problem this day was the front that brought with it wildfire smoke. Data in Table 49 indicates the monitor furthest south (Bonners Ferry) showed smoke impacts sometime around 3 p.m. Since the DEQ-approved crop residue burn and escaped fire occurred north of Bonners Ferry, and winds transported the smoke north, the smoke impacts noted at Bonners Ferry indicates that wildfire smoke was being transported into the area. Smoke from the DEQ-approved crop residue burn and escaped fire likely contributed to the elevated concentrations at Porthill and Creston for this day. However, no monitor recorded concentrations above any established 1-hour postburn trigger level. But the smoke from these burns was certainly a catalyst for initiating the complaints.

Summary

Observed meteorological conditions verified the forecasted conditions for this day. Ventilation was forecasted to be moderate and field observations noted good to excellent vertical dispersion and poor to fair horizontal (ground) dispersion. This behavior was likely due to the higher surface winds entering the area. The observed winds confirmed a southerly component as forecasted. Wind speeds increased throughout the afternoon as was forecasted, but earlier than expected. These increased wind speeds most likely contributed to the fire escaping from the grower's 135-acre field into the adjacent 176-acre field. The maximum mixing height was forecasted to be 3,000–3,300 ft AGL, but smoke behavior indicated a mixing height of only 2,000 ft AGL. Typically, mixing heights of 2,000 ft AGL is sufficient to provide good smoke dispersion, however, the high surface winds on this day did not allow for good smoke dispersion.

The escaped fire likely contributed to much of the smoke impacts on this day, although not all. The burn decision suggested 250 acres could potentially be burned this day. While only 135 acres were approved, the escaped fire resulted in a total of 311 acres burned—61 acres above the burn decision limit. High surface winds, which developed later in the burn window, would likely have restricted burning any more during this day. Certainly, the 176-acre field would not have been approved.

Burn Date: October 4, 2012

Burn Decision

Burn day: up to 550 acres approved—pending meteorological conditions. Burn window: 12 p.m. to 4 p.m.

Burn Decision Justification

This burn decision was developed using NWS observations at Bonners Ferry and Creston, BC, (Table 50); forecasted winds, ventilation, and temperatures from the UW NWMC, as displayed in DEQ's weather checklist (Figure 50); and the daily forecast produced by the DEQ contract meteorologist, Bennett Fire Weather Services, LLC (Figure 51). Ventilation was expected to be good, with surface winds generally from the northeast at 5–7 mph. The upper level winds were forecasted to be from the northeast at 17–20 mph at an elevation of 5,000–7,500 ft AGL. These mixing height elevations are very high; therefore, DEQ anticipated a good burn day. DEQ determined a burn window of noon–4:00 p.m. based on the weather checklist and the customary time when daytime heating assists ventilation mechanisms in the atmosphere.

The DEQ contract meteorologist recommended a burn day. The ventilation forecast for Boundary County was good for the burn window. A 92-acre field was used as a test burn to confirm the meteorological forecast and anticipated smoke behavior.

DEQ reviewed the monitoring data (Table 51) for Bonners Ferry; Creston, BC; Porthill; and Copeland. The maximum hourly PM_{2.5} concentration recorded at any of these sites was 9 µg/m³, recorded at Copeland at 2:00 a.m. on October 4. This concentration is well below all preburn enhanced documentation triggers and confirmed that this would be an appropriate burn day.

Four fields, a total of 433 acres of cereal grain stubble, were ultimately approved (Figure 52). Additional fields were tentatively identified in case conditions proved to be conducive to more acreage; however, the airshed was limited to 550 acres for the day.

Table 50. National Weather Service observations at Bonners Ferry (Site ID K65S).

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
10-4-2012 5:55 PDT	28.4	93	0	n/a	Clear	OK
10-4-2012 6:15 PDT	30.2	86	0	n/a	Clear	OK
10-4-2012 6:35 PDT	28.4	86	0	n/a	Clear	OK
10-4-2012 6:55 PDT	28.4	93	0	n/a	Clear	OK
10-4-2012 7:15 PDT	26.6	93	0	n/a	Clear	OK
10-4-2012 7:35 PDT	28.4	93	0	n/a	Clear	OK
10-4-2012 7:55 PDT	30.2	86	0	n/a	Clear	OK
10-4-2012 8:15 PDT	32	86	0	n/a	Clear	OK
10-4-2012 8:35 PDT	35.6	75	0	n/a	Clear	OK
10-4-2012 8:55 PDT	35.6	75	0	n/a	Clear	OK
10-4-2012 9:15 PDT	37.4	70	0	n/a	Clear	OK
10-4-2012 9:35 PDT	39.2	65	0	n/a	Clear	OK
10-4-2012 9:55 PDT	41	65	0	n/a	Clear	OK
10-4-2012 10:15 PDT	42.8	56	0	n/a	Clear	OK
10-4-2012 10:35 PDT	44.6	53	0	n/a	Clear	OK
10-4-2012 10:55 PDT	44.6	53	0	n/a	Clear	OK

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
10-4-2012 11:15 PDT	46.4	49	0	n/a	Clear	OK
10-4-2012 11:35 PDT	48.2	43	0	n/a	Clear	OK
10-4-2012 11:55 PDT	48.2	43	4.6	300	Clear	OK

Morning Forecasting for Boundary														
Model Resolution:	12km			Model Run:	2012100400			SiteID:	IBONY					
Date	Time in PDT													Comments
10/4/2012	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM		
Vent. Index	P	P	M	G	G	G	G	M	NP	NP	NP	NP		
G: good, M: marginal, P: poor, NP: very poor														
Surface (20m) Winds	Direction	NNE	NE	NE	NE	ENE	ENE	ENE	ENE	ENE	NE	NE	ENE	5 kts = 5.75 mph,
	Speed (mph)	3.6	4.2	5.1	5.8	6.0	5.8	4.9	4.0	1.4	1.6	2.2	3.0	10 kts = 11.5 mph,
Surface (20m) Temperature (degree C)	5.2	7.1	8.8	10.0	10.6	11.0	11.2	11.0	10.3	9.4	8.3	7.5		15 kts = 17.25 mph
Surface (20m) Relative Humidity (%)	44.3	34.4	26.0	22.2	21.5	21.6	21.6	22.3	25.9	28.7	32.4	35.0		
Planetary Boundary Layer (PBL)	Height (feet)	1791	4042	5863	6965	7526	7635	7470	6821	446	62	59	59	Height is above model terrain surface
	Direction	ENE	ENE	ENE	NE	NE	NE	NE	NE	ENE	NE	NE	ENE	
	Speed (mph)	12.7	19.1	20.8	19.0	17.7	17.1	17.0	17.1	5.3	1.6	2.2	3.0	
700mb (~10,000 ft MSL)	Height (feet)	7237	7237	7237	7237	7237	7237	7237	7237	7237	7237	7237	7237	Height is above model terrain surface
	Direction	NE	NE	NE	NE	NE	NE	NE	NE	NNE	NNE	NNE	NNE	
	Speed (mph)	21.0	20.5	20.1	19.0	17.7	17.1	17.0	17.1	17.3	17.5	18.0	18.8	
850mb (~5000 ft MSL)	Height (feet)	2315	2315	2315	2315	2315	2315	2315	2315	2315	2315	2315	2315	Height is above model terrain surface
	Direction	ENE	ENE	ENE	ENE	ENE	ENE	ENE	ENE	ENE	ENE	ENE	E	
	Speed (mph)	17.1	12.5	13.0	12.9	12.5	12.0	10.9	9.9	10.3	10.8	10.3	10.3	

Figure 50. Weather checklist for Bonners Ferry. Information taken from the University of Washington Northwest Modeling Consortium forecast model.

Forecast Prepared by: BENNETT FIRE WEATHER SERVICES, LLC

Forecast Time Prepared: 8:00 AM PDT – Thursday October 4, 2012

Forecast for: THURSDAY – October 4, 2012

GENERAL WEATHER DISCUSSION:

THURSDAY:

Not much change from yesterdays forecast. The cold upper level trough is reluctant to leave and move on east as another shot of cold air is rotating around the low over the Dakotas and will carve out the cold trough over northern Idaho this afternoon. High pressure well off the northwest Washington coast is ridging north into extreme northwest British Columbia. This high center is slowly drifting north. The flow aloft over northern Idaho is a cold and dry north to northwest flow allowing mid and high clouds to drift over the air sheds at times. At the surface this afternoon the cold air mass resides over western Montana and is thereby producing a northeast to southwest pressure gradient field across northern Idaho. The surface wind direction will be north to northeast over the northern Idaho air sheds. Winds speeds will be in the 4-12 mph range. Mixing heights are expected to range near 4-5,000 feet AGL over northern Idaho. Dispersion is marginal to good. The morning inversion will break by 11 am at temperatures between 45-50degrees. Ventilation will become generally good over all air sheds by afternoon.

NORTHERN IDAHO BY AIRSHED:

BOUNDARY COUNTY Air Shed:

Forecast for THURSDAY:

SKY/WEATHER: Mostly sunny.

TEMPERATURE: High temperatures ranging from the mid 50s to near 60.

HUMIDITY: Minimum RH around 25-35 percent.

WIND – SURFACE: Northeast 5-12 mph this afternoon.

TRANSPORT: Northeast 10-15 mph in the afternoon.

INVERSIONS: Strong to moderate morning inversion breaking by 11 am at a temperature around 45 degrees.

MIXING HEIGHT: Air mass becomes unstable to near 5,000 feet AGL by the afternoon.

VENTILATION: POOR to MARGINAL in the morning becoming GOOD in the afternoon.

AIRSHED Recommendations:

Boundary County: Burn

LOCAL TIME										
County	08	09	10	11	12	13	14	15	16	17
Boundary	P	P	P	M	G	G	G	G	G	G

VENTILATION KEY: P = Poor M = Marginal G = Good E = Excellent

Figure 51. Weather forecast prepared by Bennett Fire Weather Services, LLC, for Boundary County.

Table 51. Available PM_{2.5} monitoring data prior to burn decision

Date	Time	PM _{2.5} (µg/m ³)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland
10/3/2012	1:00 AM	1.6	2.1	0	3
10/3/2012	2:00 AM	1.7	2.1	0	5
10/3/2012	3:00 AM	1.7	2.1	0	4
10/3/2012	4:00 AM	1.9	2.3	0	1
10/3/2012	5:00 AM	1.9	2.3	1	0
10/3/2012	6:00 AM	2	2.6	0	1
10/3/2012	7:00 AM	2.1	2.9	4	5
10/3/2012	8:00 AM	2.3	3	8	6
10/3/2012	9:00 AM	2.3	2.9	2	4
10/3/2012	10:00 AM	2.1	2.6	0	1
10/3/2012	11:00 AM	2.2	2.7	0	0
10/3/2012	12:00 PM	2.2	2.7	0	1
10/3/2012	1:00 PM	2.1	2.8	0	1
10/3/2012	2:00 PM	2.1	2.9	0	2
10/3/2012	3:00 PM	1.9	2.8	0	5
10/3/2012	4:00 PM	2	2.7	0	4
10/3/2012	5:00 PM	2.1	2.6	0	4
10/3/2012	6:00 PM	2.5	2.7	2	6
10/3/2012	7:00 PM	2.5	2.8	1	6
10/3/2012	8:00 PM	2.7	2.9	1	4
10/3/2012	9:00 PM	2.8	4	1	2
10/3/2012	10:00 PM	2.7	3.6	2	5
10/3/2012	11:00 PM	3.1	4.1	1	3
10/3/2012	12:00 AM	3.6	3.9	0	-1
10/4/2012	1:00 AM	4	4	1	5
10/4/2012	2:00 AM	4.1	3.8	0	9
10/4/2012	3:00 AM	3.8	3.8	1	4
10/4/2012	4:00 AM	3.5	3.8	0	0
10/4/2012	5:00 AM	3.3	3.9	0	3
10/4/2012	6:00 AM	4.1	3.5	2	3
10/4/2012	7:00 AM	3.9	3.7	4	1
10/4/2012	8:00 AM	3.4	3.9	5	2
10/4/2012	9:00 AM	3	3.6	3	4
10/4/2012	10:00 AM	2.9	3.3	2	5

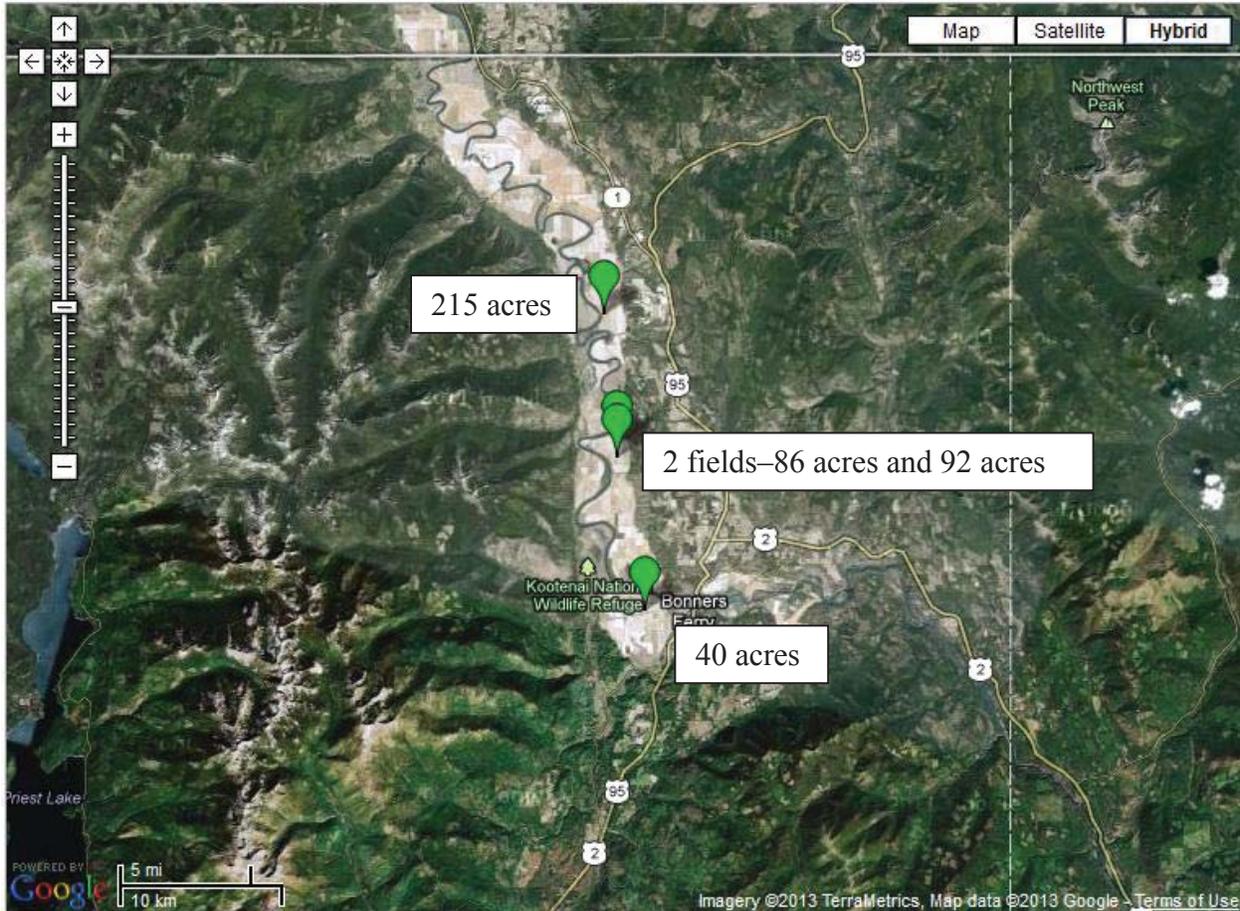


Figure 52. Map of approved fields for October 4, 2012.

Field Observations

Field observations were made prior to burning to determine if the meteorological forecast was representative. A north-northwest surface wind at 4 mph was measured in the mid-valley location. The forecast was for more of an easterly component to the wind. The temperature here was 53 °F, as expected. Measured relative humidity was 39%—higher than forecasted. Field observations confirmed the meteorological forecast. The fuel condition of one of the fields was described as brown with a little green-up in the bottom. Soil moisture was very dry, fuel arrangement loose, and fuel loading moderate. Cloud cover was around 15%. These conditions suggested burning would be successful.

A pibal was released at 11:30 a.m. near the Kootenai National Wildlife Refuge located in the southwest corner of the valley. The pibal was tracked by two DEQ-trained interns employed by the refuge. The data gathered produces a hodograph, which showed a north-northeast wind throughout the airshed (Figure 53). The graph is customarily forwarded to field staff to help confirm upper air wind direction.

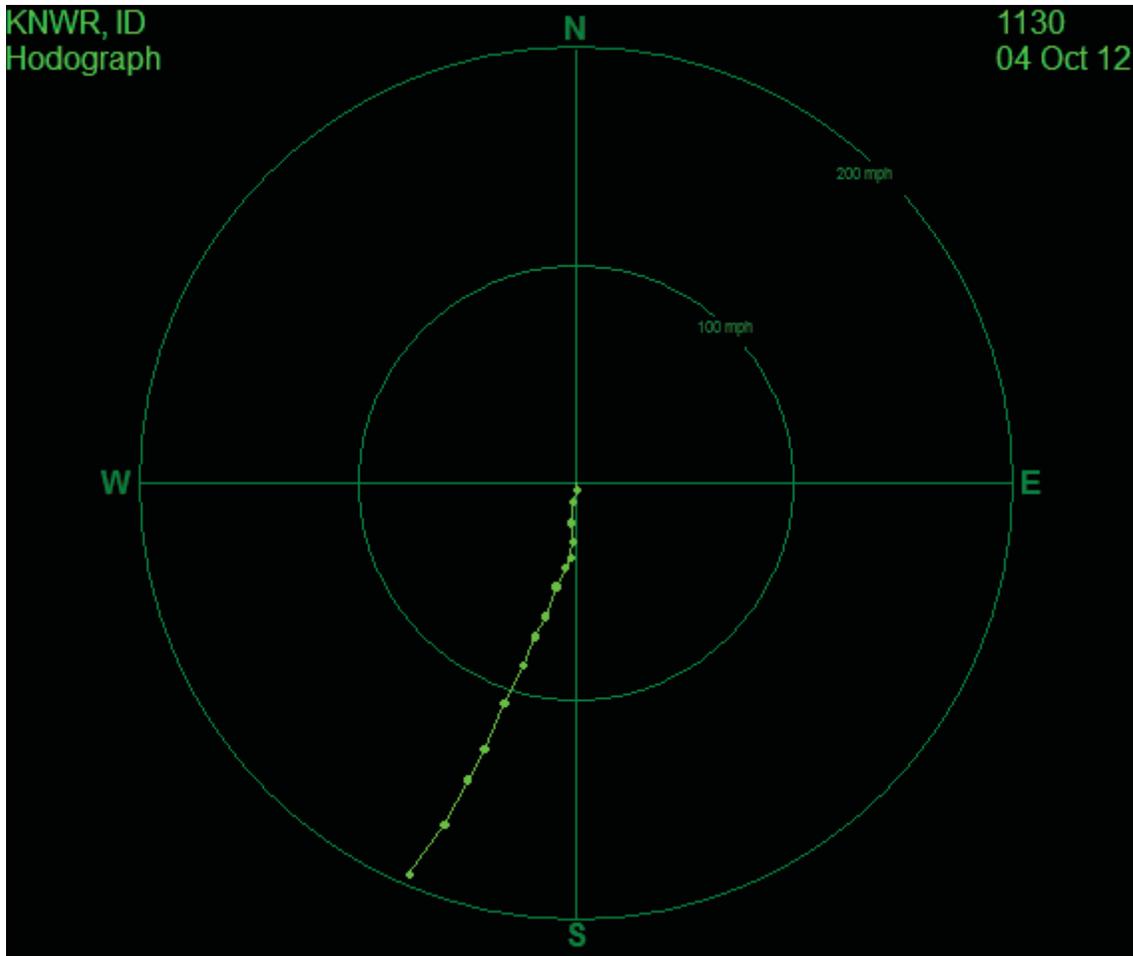


Figure 53. Daily pibal results. The line indicates the direction the wind would take the smoke.

Conditions in the fields indicated marginal or better ventilation. The first field, a 92-acre wheat field, was ignited at 12:52 p.m. DEQ observed excellent smoke dispersion and gave verbal approval for the 40 and 86-acre fields. Smoke had good lift and reached 1,500 ft AGL or better. This is good lift for this area. The final 215-acre field was approved for ignition at 2:04 p.m. All burning was complete by approximately 4:00 p.m.

Wind directions in the field had a north-northeast component, which pushed most of the smoke to the southwest into the mountains. Transport and horizontal dispersion for the southern and middle fields was excellent with a southwest direction. Smoke dissipated very well. Transport dispersion for the northern field was excellent, with smoke moving to the southeast and south, where horizontal dispersion was fair heading to the southeast. After burning was complete, horizontal smoke dispersion (closer to ground) was considered fair to good. Vertical/transport dispersion continued to be excellent. Column heights from the earlier burns topped out at approximately 4,000–5,000 ft AGL after a start of about 1,500 ft AGL earlier. The DEQ field coordinator was on site to observe the middle and northern burns. No smoke was observed moving north due to a northerly component to the wind.

Table 52 includes the monitoring data during and after the burns. The maximum hourly $PM_{2.5}$ concentration at any of the monitors was $9 \mu\text{g}/\text{m}^3$, recorded at Bonners Ferry at 5:00 p.m. This

value is below all enhanced documentation triggers and program concentration limits. With the northerly wind component, DEQ-approved crop residue burning may have contributed to the slight elevation in particulate concentrations.

Table 52. Air quality PM_{2.5} monitoring data during and after burning.

Date	Time	PM _{2.5} (µg/m ³)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland
10/4/2012	11:00 AM	2.9	3.3	0	1
10/4/2012	12:00 PM	2.7	3	0	0
10/4/2012	1:00 PM	2.3	2.7	0	0
10/4/2012	2:00 PM	2	4.5	0	3
10/4/2012	3:00 PM	2	4.4	0	1
10/4/2012	4:00 PM	2.3	8.3	0	-1
10/4/2012	5:00 PM	2	9	7	3
10/4/2012	6:00 PM	2.1	8.4	1	7
10/4/2012	7:00 PM	2.1	7.9	1	7
10/4/2012	8:00 PM	2.1	7.2	3	3
10/4/2012	9:00 PM	2.5	6.7	3	4
10/4/2012	10:00 PM	3.4	6.9	1	5
10/4/2012	11:00 PM	3.7	6.2	1	6
10/4/2012	12:00 AM	4.3	6.2	1	2

One complaint came in on the toll-free complaint line in the evening of October 5. This complaint from the Creston area stated that “smoke from yesterday went away.” Given the smoke trajectory described and the Porthill and Creston monitor data, it is highly unlikely that DEQ-approved crop residue burning contributed to this complaint.

Summary

A total of four fields, 433 acres of cereal grain stubble, were burned this day in Boundary County. Two fields (approximately 178 acres) were located in the mid-valley, one in the south (40 acres), and one in the north (215 acres). Observed meteorological conditions were as good as forecasted for most of the day. Ventilation was forecasted to be good and field observations noted excellent vertical dispersion and fair to good horizontal dispersion. The observed winds verified the forecasted northerly component, as did the pibal. The observed relative humidity was a bit higher than forecasted and might have contributed to a less than perfect burn day. The maximum mixing height was forecasted to be 7,635 ft AGL. The actual smoke behavior indicated a maximum of 4,000–5,000 ft AGL. No more burning occurred after the 215-acre field because the field was not completed until 3:30 p.m. and this left little time for optimal ventilation conditions to continue. An apparent shift in surface wind conditions affected the smoke and caused the tail end of the burn to cause smoke closer to the ground. Some reported green-up in the field may have also affected the heat generated from the burn, thus limiting the potential for lift at the end.

Burn Date: October 5, 2012

Burn Decision

Burn day: up to 140 acres approved—pending meteorological and field conditions. Additional fields could be added if the DEQ field coordinator verified that on-site meteorological conditions were suitable. Total acreage burned was not to exceed 550 acres.

Burn Decision Justification

This burn decision was developed using NWS observations at Bonners Ferry and Creston, BC, (Table 53); forecasted winds, ventilation, and temperatures from the UW NWMC, as displayed in DEQ's weather checklist (Figure 54); and the daily forecast produced by the DEQ contract meteorologist, Bennett Fire Weather Services, LLC (Figure 55). Ventilation was expected to be poor to marginal with surface winds generally from the northwest at 1–3 mph. The upper level winds were forecasted to be from the east to northeast at 11–13 mph at an elevation of 4,000–5,500 ft AGL. These mixing height elevations are very high, and DEQ anticipated a good burn day, even with lighter surface winds.

The DEQ contract meteorologist recommended a conditional burn day. The ventilation forecast for Boundary County was described as marginal for the burn window. The recommendation also indicates favorable surface winds of 4–12 mph and acceptable transport winds of 5–10 mph. A 140-acre field was available for burning this day and was used as a test burn, due to its size and location in the valley, to confirm meteorological forecast and anticipated smoke behavior.

DEQ reviewed the monitoring data (Table 54) for Bonners Ferry; Creston, BC; Porthill; and Copeland. The maximum hourly concentration recorded at any of these sites was $9 \mu\text{g}/\text{m}^3$, recorded at Creston at 9:00 a.m. on October 5. This concentration is well below all preburn enhanced documentation triggers. DEQ determined a burn window of noon–4:00 p.m. based on the wind speeds increasing between noon and 1 p.m. and the forecasted relative humidity. This burn window decision also considered the customary time when daytime heating assists ventilation mechanisms in the atmosphere.

Initially, one 140-acre field was approved as a test burn after DEQ field verification. Based on the smoke dispersion of the test burn, DEQ approved two additional fields, an additional 385 acres of cereal grain stubble (Figure 56). Mt. Hall Elementary School is not in session on Fridays.

Table 53. National Weather Service observations at Bonners Ferry (Site ID K65S).

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
10-5-2012 5:55 PDT	26.6	74	0	n/a	Clear	OK
10-5-2012 6:15 PDT	26.6	74	0	n/a	Clear	OK
10-5-2012 6:35 PDT	26.6	74	0	n/a	Clear	OK
10-5-2012 6:55 PDT	26.6	74	0	n/a	Clear	OK
10-5-2012 7:15 PDT	26.6	74	0	n/a	Clear	OK

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
10-5-2012 7:35 PDT	24.8	80	0	n/a	Clear	OK
10-5-2012 7:55 PDT	32	64	0	n/a	Clear	OK
10-5-2012 8:15 PDT	32	74	0	n/a	Clear	OK
10-5-2012 8:35 PDT	35.6	64	3.5	70	Clear	OK
10-5-2012 8:55 PDT	35.6	60	0	n/a	Clear	OK
10-5-2012 9:15 PDT	37.4	56	4.6	70	Clear	OK
10-5-2012 9:35 PDT	37.4	56	0	n/a	Clear	OK
10-5-2012 9:55 PDT	39.2	52	3.5	90	Clear	OK
10-5-2012 10:15 PDT	41	48	3.5	70	Clear	OK
10-5-2012 10:35 PDT	42.8	45	0	n/a	Clear	OK
10-5-2012 10:55 PDT	42.8	52	0	n/a	Clear	OK
10-5-2012 11:15 PDT	44.6	45	0	n/a	Clear	OK
10-5-2012 11:35 PDT	46.4	39	0	n/a	Clear	OK
10-5-2012 11:55 PDT	46.4	39	0	n/a	Clear	OK

Morning Forecasting for Boundary														
Model Resolution:	12km			Model Run:	2012100500			SiteID:	IBONY					
Date	Time in PDT												Comments	
10/5/2012	10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM		
Vent. Index	P	P	P	P	P	M	P	P	NP	NP	NP	NP		
G: good, M: marginal, P: poor, NP: very poor														
Surface (20m) Winds	Direction	N	NNE	N	NNW	NW	NW	NW	NW	NNW	ENE	ESE	SE	5 kts = 5.75 mph,
	Speed (mph)	1.6	1.6	1.6	2.3	3.0	3.3	3.0	2.4	0.8	1.3	2.2	4.4	10 kts = 11.5 mph,
Surface (20m) Temperature (degree C)	4.4	6.3	7.9	9.2	10.0	10.5	10.8	10.7	10.0	9.2	7.8	7.6		15 kts = 17.25 mph
Surface (20m) Relative Humidity (%)	43.6	36.9	32.3	29.1	27.3	26.3	25.8	25.9	28.5	30.1	35.5	36.6		
Planetary Boundary Layer (PBL)	Height (feet)	1220	2264	3976	4751	5295	5564	5515	2825	62	62	59	256	Height is above model terrain surface
	Direction	ENE	E	ENE	ENE	NE	NE	NE	N	NNW	ENE	ESE	SE	
	Speed (mph)	6.4	9.4	11.5	11.7	13.0	11.7	10.9	3.2	0.8	1.3	2.2	5.9	
700mb (~10,000 ft MSL)	Height (feet)	7237	7237	7237	7237	7237	7237	7237	7237	7237	7237	7237	7237	Height is above model terrain surface
	Direction	NNE	NNE	NNE	NNE	NNE	NNE	NNE	NNE	NNE	NNE	NNE	NNE	
	Speed (mph)	20.4	20.6	21.2	22.4	23.6	25.1	25.7	26.2	25.4	23.9	22.7	23.2	
850mb (~5000 ft MSL)	Height (feet)	2315	2315	2315	2315	2315	2315	2315	2315	2315	2315	2319	2315	Height is above model terrain surface
	Direction	E	E	ENE	ENE	NE	NNE	N	NNW	N	NE	E	ESE	
	Speed (mph)	12.2	9.4	6.4	4.8	4.1	3.5	3.1	3.3	2.7	2.2	2.9	3.1	

Figure 54. Weather checklist for Bonners Ferry. Information taken from the University of Washington Northwest Modeling Consortium forecast model.

Forecast Prepared by: BENNETT FIRE WEATHER SERVICES, LLC

Forecast Time Prepared: 8:00 AM PDT – Friday October 5, 2012

Forecast for: FRIDAY – October 5, 2012

GENERAL WEATHER DISCUSSION:

FRIDAY:

The cold upper level trough is being re-enforced by an upper level disturbance moving around the upper low over the Dakotas. The cold air mass will move into eastern Montana by this afternoon deepening the upper trough axis. High pressure is centered in the northeast Pacific by this afternoon and is ridging northeast into northern British Columbia. The combination of the high and the upper trough will keep a northerly flow aloft of cold and dry air into northern Idaho again today. At the surface this afternoon the cold air mass still resides over western Montana and is thereby producing a northeast to southwest pressure gradient field across northern Idaho. The surface wind direction will be northeast to north over the northern Idaho air sheds. Winds speeds will be in the 4-12 mph range. Mixing heights are expected to range near 3-5,000 feet AGL over northern Idaho. Dispersion is marginal to good. The morning inversion will break by 11am at temperatures between 46-51degrees. Ventilation will become marginal to generally good over all air sheds by Friday afternoon.

NORTHERN IDAHO BY AIRSHED:

BOUNDARY COUNTY Air Shed:

Forecast for FRIDAY:

SKY/WEATHER: Mostly sunny.

TEMPERATURE: High temperatures ranging from the mid 50s to near 60.

HUMIDITY: Minimum RH around 25-35 percent.

WIND – SURFACE: Northeast 4-12 mph this afternoon.

TRANSPORT: Northeast 5-10 mph in the afternoon.

INVERSIONS: Strong to moderate morning inversion breaking by 11am at a temperature around 46 degrees.

MIXING HEIGHT: Air mass becomes unstable to near 3-4,000 feet AGL by the afternoon.

VENTILATION: POOR to MARGINAL in the morning becoming MARGINAL in the afternoon.

AIRSHED Recommendations: Background wildfire smoke is still an issue on the Weippe and Camas Prairies today. Burning is not advisable.

Boundary County: Conditional

LOCAL TIME	08	09	10	11	12	13	14	15	16	17
County										
Boundary	P	P	P	M	M	M	M	M	M	M

VENTILATION KEY: P = Poor M = Marginal G = Good E = Excellent

Figure 55. Weather forecast prepared by Bennett Fire Weather Services, LLC, for Boundary County.

Table 54. Available PM_{2.5} monitoring data prior to burn decision.

Date	Time	PM _{2.5} (µg/m ³)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland
10/4/2012	1:00 AM	4	4	1	5
10/4/2012	2:00 AM	4.1	3.8	0	9
10/4/2012	3:00 AM	3.8	3.8	1	4
10/4/2012	4:00 AM	3.5	3.8	0	0
10/4/2012	5:00 AM	3.3	3.9	0	3
10/4/2012	6:00 AM	4.1	3.5	2	3
10/4/2012	7:00 AM	3.9	3.7	4	1
10/4/2012	8:00 AM	3.4	3.9	5	2
10/4/2012	9:00 AM	3	3.6	3	4
10/4/2012	10:00 AM	2.9	3.3	2	5
10/4/2012	11:00 AM	2.9	3.3	0	1
10/4/2012	12:00 PM	2.7	3	0	0
10/4/2012	1:00 PM	2.3	2.7	0	0
10/4/2012	2:00 PM	2	4.5	0	3
10/4/2012	3:00 PM	2	4.4	0	1
10/4/2012	4:00 PM	2.3	8.3	0	-1
10/4/2012	5:00 PM	2	9	7	3
10/4/2012	6:00 PM	2.1	8.4	1	7
10/4/2012	7:00 PM	2.1	7.9	1	7
10/4/2012	8:00 PM	2.1	7.2	3	3
10/4/2012	9:00 PM	2.5	6.7	3	4
10/4/2012	10:00 PM	3.4	6.9	1	5
10/4/2012	11:00 PM	3.7	6.2	1	6
10/4/2012	12:00 AM	4.3	6.2	1	2
10/5/2012	1:00 AM	3.7	5.8	1	3
10/5/2012	2:00 AM	5.3	5.4	2	4
10/5/2012	3:00 AM	4.5	5.3	1	3
10/5/2012	4:00 AM	3.9	4.8	1	5
10/5/2012	5:00 AM	3.8	4.6	2	4
10/5/2012	6:00 AM	4.1	4.7	3	4
10/5/2012	7:00 AM	4.2	4.5	5	5
10/5/2012	8:00 AM	4.9	4.6	9	3
10/5/2012	9:00 AM	4.4	4.2	5	0
10/5/2012	10:00 AM	3.6	3.7	3	2

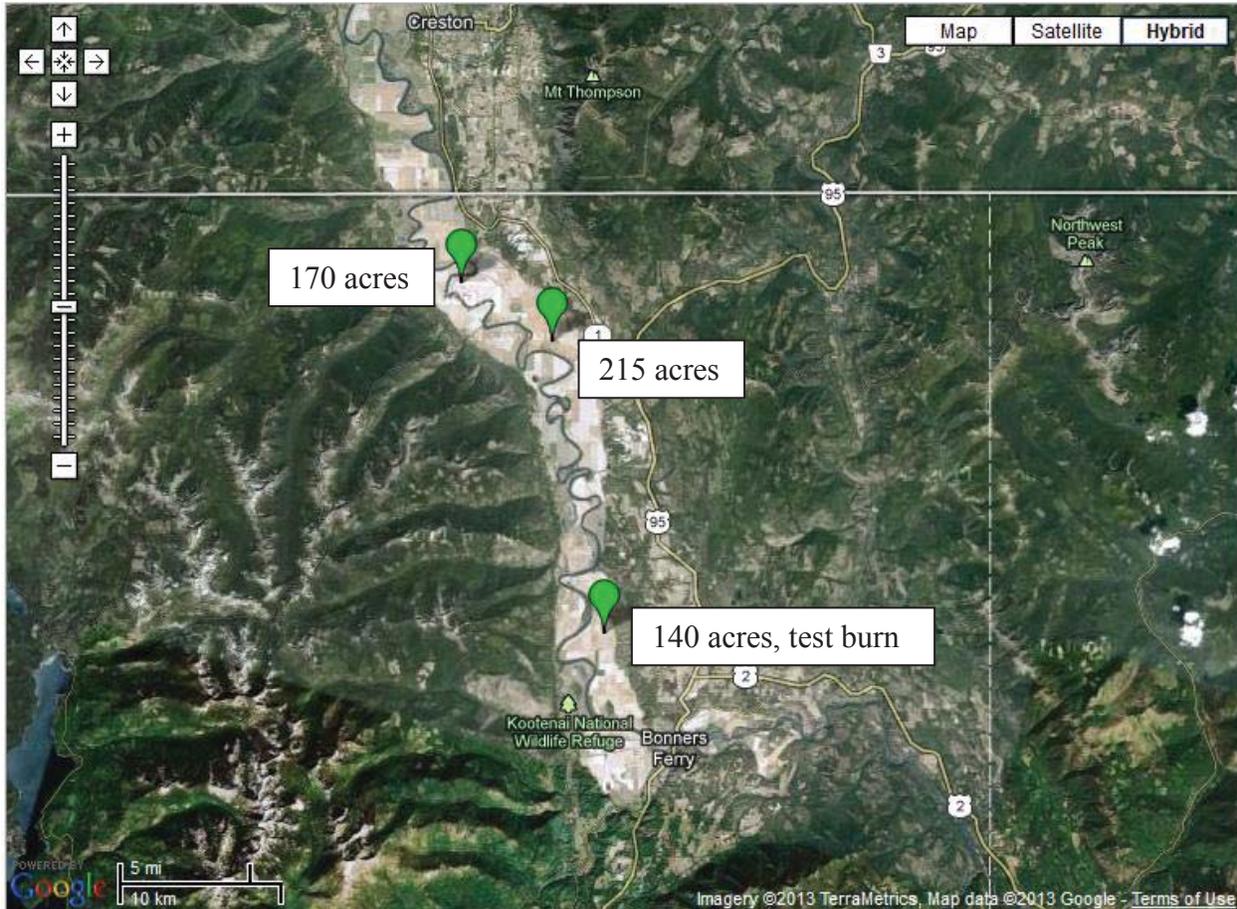


Figure 56. Map of approved fields for October 5, 2012.

Field Observations

Field observations were made prior to burning to determine if the meteorological forecast was representative. A westerly surface wind of 3–4 mph was measured at the 140-acre test burn field in the mid-valley location. The forecast was for more of a northerly component to the wind, but a west/northwesterly direction is acceptable for burning in this location. The temperature was 52 °F, as expected. Measured relative humidity was 30%, slightly higher than forecasted. The field observations confirmed the meteorological forecast. Fuel condition of the 140-acre field was brown with a little green-up in the bottom. Soil moisture was very dry and the fuel arrangement loose. Fuel loading was observed and described as moderate to heavy. Cloud cover was around 10%. Field observations indicated marginal or better ventilation and a successful burn day.

The test burn, a 140-acre wheat field, was ignited at 1:03 p.m. Excellent smoke dispersion was observed. Transport wind speeds appeared to increase more than forecasted. As smoke gained height, the smoke column initially went straight up. Dispersion was noted to be good to excellent. Smoke was described as getting good lift and reaching at least 2,000 ft AGL—good lift for this area. The 140-acre test burn was out at 1:42 p.m. Some lower level smoke from the 140-acre test burn was generated and observed to be moving south in the valley, at approximately 300 ft AGL, towards the KTOI health clinic. The DEQ field coordinator drove to

the clinic and determined the smoke was actually moving far to the east and was not going to impact either the reservation or the hospital in Bonners Ferry.

Due to successful dispersion from the test burn, the DEQ field coordinator requested the 215-acre and 170-acre fields be approved. The north Idaho smoke analyst was consulted and reaffirmed the approval of up to 550 total acres for the burn day. At approximately 1:45 p.m., the fields were approved by DEQ. The 215-acre and the 170-acre fields were given simultaneous verbal approval for ignition at 1:50 p.m. Both burns began at approximately 2:10 p.m. and were out at approximately 2:40 p.m. All burning in the valley was complete by approximately 2:40 p.m.

Surface wind directions were noted in the field as having a primarily westerly component, but the north-northeast transport component pushed most of the smoke aloft to the south-southwest into the uninhabited areas of the mountains. The 140-acre test burn had good to excellent smoke transport dispersion toward the south-southwest; horizontal dispersion (lower level) was fair with an easterly direction (as described above). Smoke dissipated very well from all burns this day. Transport dispersion for the northern fields was excellent, with smoke transporting to the south-southwest, and good horizontal dispersion transporting to the south. After burning was complete, horizontal smoke dispersion (closer to ground) was considered fair to good. Vertical/transport dispersion continued to be excellent. Observations indicated that column heights from the test burn reached approximately 2,000 ft AGL and increased to 3,000 ft for the later larger burns. The DEQ field coordinator was on site to observe the southern burn and observed the northern burns from the Hwy 95 overlook. No smoke was observed moving north due to the northerly wind component.

Table 55 includes the monitoring data during and after the burns. The maximum hourly PM_{2.5} concentration at any of the monitors was 23 µg/m³, recorded at Creston at 4:00 p.m. This value is below all enhanced documentation triggers and program concentration limits. Based on the description above and the supporting field documentation, it is highly unlikely that smoke from DEQ-approved crop residue burning impacted the Creston, BC, monitor. The 18.9 µg/m³ PM_{2.5} concentration recorded on the Porthill monitor at 3:00 p.m. also suggests a smoke source from the north or northeast in Canada.

Table 55. Air quality PM_{2.5} monitoring data during and after burning.

Date	Time	PM _{2.5} (µg/m ³)			
		Porthill	Bonners Ferry (KTOI)	Creston, BC	Copeland
10/5/2012	11:00 AM	3.4	3.6	3	4
10/5/2012	12:00 PM	3.2	3.5	2	2
10/5/2012	1:00 PM	2.7	3.1	0	1
10/5/2012	2:00 PM	10.8	2.8	0	0
10/5/2012	3:00 PM	18.9	3	0	-1
10/5/2012	4:00 PM	3.5	3	23	18
10/5/2012	5:00 PM	5.4	3.5	8	8
10/5/2012	6:00 PM	6.3	4.2	10	6
10/5/2012	7:00 PM	5.5	4.3	7	5

Date	Time	PM _{2.5} (µg/m ³)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland
10/5/2012	8:00 PM	6.3	No data	5	6
10/5/2012	9:00 PM	7.8	4.5	7	6
10/5/2012	10:00 PM	7.3	4.9	6	5
10/5/2012	11:00 PM	7.4	5.1	5	6
10/5/2012	12:00 AM	7.3	5.4	5	7

One complaint was received on the toll-free complaint line in the evening of October 5. This complaint from the Creston area stated that “smoke was real thick.” Given the smoke trajectory described and seen in Figure 57, taken at 2:32 p.m. showing smoke moving to the south with a light haze in the north near Creston, it is highly unlikely that DEQ-approved crop residue burning could have contributed to this complaint.



Figure 57. Smoke observation from US 95 vantage point (viewing north-northwest).

Summary

A total of three fields, 525 acres of cereal grain, were burned this day in Boundary County: two fields in the northern valley (385 acres) and one field in the south (140 acres). Observed meteorological conditions were as good as, or better than, what was forecasted for most of the day. Ventilation was forecasted to be poor to marginal and field observations noted excellent vertical dispersion (smoke transporting in the upper atmosphere) and fair to good horizontal dispersion (smoke transporting in the lower levels). Observed winds verified the forecasted northerly component, though it was observed as more north-northeast than northwest. The north-northeast direction for transport is a favorable transport direction in this valley. The observed

relative humidity and temperatures were similar to those forecasted. The maximum mixing height was forecasted to be 5,564 ft AGL, but actual smoke behavior mixed to a maximum of 2,000 ft–3,000 ft AGL. Even though smoke didn't reach the forecasted mixing height of 5,500 ft AGL, the surface and transport winds dispersed all smoke aloft resulting in a better than forecasted burn day. When smoke achieves 2,000–3,000 ft AGL in this area, results are usually favorable.

Burn Date: October 10, 2012

Burn Decision

Burn day: up to 310 acres approved—pending meteorological conditions. Burn window: 12 p.m. to 4 p.m.

Burn Decision Justification

This burn decision was developed using NWS observations at Bonners Ferry and Creston, BC, (Table 56); forecasted winds, ventilation, and temperatures from the UW NWMC, as displayed in DEQ's weather checklist (Figure 58); and the daily forecast produced by the DEQ contract meteorologist, Bennett Fire Weather Services, LLC (Figure 59). Ventilation was expected to be marginal, with surface winds generally from the south-southwest at 5–7 mph. The upper level winds were forecasted to be from the west-southwest to southwest at 10–15 mph at an elevation of 3,000–4,000 ft AGL. These mixing height elevations are normal for this time of year, and DEQ anticipated a good burn day with the forecasted surface and transport wind speeds. DEQ determined a burn window of noon–4:00 p.m. based on the weather checklist and the customary time when daytime heating assists ventilation mechanisms in the atmosphere.

The DEQ contract meteorologist recommended a conditional burn day. The ventilation forecast for Boundary County was marginal for the burn window. Figure 59 also shows favorable surface winds of 3–10 mph, acceptable transport winds of 10 mph, and mixing heights of 3,000–4,000 ft AGL. A 110-acre field was used as a test burn due to its size and location in the valley to confirm the meteorological forecast and anticipated smoke behavior for the second field located in the northern valley. The third field, located in the extreme southeastern part of the valley, was burned in conjunction with the KTOI representative, who provided observational information to the field coordinator for smoke behavior documentation.

DEQ reviewed the monitoring data (Table 57) for Bonners Ferry; Creston, BC; Porthill; and Copeland to assist in the burn day decision. The maximum hourly $PM_{2.5}$ concentration recorded at any of these sites was $11.0 \mu\text{g}/\text{m}^3$, recorded at Creston at 8:00 a.m. on October 9 (the day prior to burning). This concentration is well below all preburn enhanced documentation triggers.

Three fields, a total of 310 acres of cereal grain stubble (210 acres of wheat stubble and 100 acres of barley stubble), were ultimately approved for burning (Figure 60).

Table 56. National Weather Service observations at Bonners Ferry (Site ID K65S).

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
10-10-2012 5:55 PDT	37.4	87	0	n/a	Clear	OK
10-10-2012 6:15 PDT	39.2	87	0	n/a	Clear	OK
10-10-2012 6:35 PDT	39.2	87	0	n/a	Clear	OK
10-10-2012 6:55 PDT	35.6	93	0	n/a	Clear	OK
10-10-2012 7:15 PDT	35.6	93	0	n/a	Clear	OK
10-10-2012 7:35 PDT	37.4	87	0	n/a	Clear	OK
10-10-2012 7:55 PDT	39.2	87	0	n/a	Clear	OK
10-10-2012 8:15 PDT	39.2	87	0	n/a	Clear	OK
10-10-2012 8:35 PDT	41	81	0	n/a	Clear	OK
10-10-2012 8:55 PDT	44.6	70	0	n/a	Clear	OK
10-10-2012 9:15 PDT	44.6	70	0	n/a	Clear	OK
10-10-2012 9:35 PDT	44.6	70	0	n/a	Clear	OK
10-10-2012 9:55 PDT	46.4	66	0	n/a	Clear	OK
10-10-2012 10:15 PDT	48.2	66	0	n/a	Clear	OK
10-10-2012 10:35 PDT	50	62	0	n/a	Clear	OK
10-10-2012 10:55 PDT	50	62	3.5	170	Clear	OK
10-10-2012 11:15 PDT	53.6	54	0	n/a	Clear	OK
10-10-2012 11:35 PDT	53.6	54	0	n/a	Clear	OK
10-10-2012 11:55 PDT	55.4	51	0	n/a	Clear	OK

Morning Forecasting for Boundary														
Model Resolution:	12km			Model Run:	2012101000			SiteID:	IBONY					
Date		Time in PDT											Comments	
10/10/2012		10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	
Vent. Index		NP	P	P	M	M	M	M	P	P	P	NP	NP	
G: good, M: marginal, P: poor, NP: very poor														
Surface (20m) Winds	Direction	SSE	SSW	SSW	SSW	SSW	SSW	SSW	SSW	S	SSW	SSW	ESE	5 kts = 5.75 mph,
	Speed (mph)	2.2	4.0	4.9	5.6	6.6	7.0	7.2	5.7	5.7	5.8	3.6	1.8	10 kts = 11.5 mph,
Surface (20m) Temperature (degree C)		11.6	13.6	15.0	16.0	16.6	16.7	16.6	16.2	15.3	14.6	13.8	12.6	15 kts = 17.25 mph
Surface (20m) Relative Humidity (%)		53.1	45.5	41.1	39.5	39.1	39.8	41.2	43.8	48.4	51.0	53.9	58.3	
Planetary Boundary Layer (PBL)	Height (feet)	738	2057	2943	3763	4190	4242	4029	2457	1158	577	354	62	Height is above model terrain surface
	Direction	SSW	SW	WSW	WSW	WSW	WSW	WSW	SW	SW	SW	SW	ESE	
	Speed (mph)	12.2	15.5	13.9	15.8	13.4	12.7	12.5	13.0	12.1	9.9	7.0	1.8	
700mb (~10,000 ft MSL)	Height (feet)	7237	7237	7237	7240	7240	7240	7240	7240	7240	7240	7240	7240	Height is above model terrain surface
	Direction	W	W	W	W	W	W	W	WNW	WNW	WNW	NW	NNW	
	Speed (mph)	20.2	20.0	20.2	20.6	20.4	19.3	16.8	13.6	10.2	7.0	5.1	3.2	
850mb (~5000 ft MSL)	Height (feet)	2066	2066	2066	2066	2066	2066	2066	2066	2066	2066	2066	2066	Height is above model terrain surface
	Direction	SW	SW	SW	SW	SW	SW	SW	SW	SW	WSW	WSW	W	
	Speed (mph)	17.7	15.5	10.8	10.0	10.9	11.6	12.6	13.0	12.5	10.5	7.0	3.6	

Figure 58. Weather checklist for Bonners Ferry. Information taken from the University of Washington Northwest Modeling Consortium forecast model.

Forecast Prepared by: BENNETT FIRE WEATHER SERVICES, LLC

Forecast Time Prepared: 8:00 AM PDT – Wednesday October 10, 2012

Forecast for: WEDNESDAY – October 10, 2012

GENERAL WEATHER DISCUSSION:

WEDNESDAY:

The upper level high pressure ridge along the west coast continues to deflate as an upper level low moves east into the ridge and the Gulf of Alaska. An upper level low off the central California coast this afternoon continues to move south as the Pacific low forces it towards southern California. A weak upper level disturbance is moving across eastern Washington this afternoon mixing the low level air mass a little. The wind aloft over northern Idaho is from the west. At the surface this afternoon higher pressure is sitting over eastern Washington and northern Idaho producing a southwest to northeast pressure gradient field across northern Idaho. The pressure gradient field remains relaxed. The surface wind direction is expected to be from the southwest to west over the air sheds. Wind speeds in the afternoon will be in the 4-12 mph range. Mixing heights are lower due to the subsidence over northern Idaho. Mixing heights are likely to range near 3-5,000 feet AGL over the air sheds. Dispersion is poor to marginal over northern Idaho. The strong morning inversion will break around 11 am to 12 noon at temperatures between 54-63 degrees. Ventilation will be poor to marginal over northern Idaho air sheds due to low mixing heights and light wind speeds at the surface and in the mixed layer in the afternoon.

NORTHERN IDAHO BY AIRSHED:

BOUNDARY COUNTY Air Shed:

Forecast for WEDNESDAY:

SKY/WEATHER: Mostly sunny.

TEMPERATURE: High temperatures ranging from the 64-69.

HUMIDITY: Minimum RH around 25-35 percent.

WIND – SURFACE: Southeast to southwest 3-10 mph in the afternoon.

TRANSPORT: Southwest 10 mph in the afternoon.

INVERSIONS: Strong to moderate morning inversion breaking by 11 am at a temperature around 54 degrees.

MIXING HEIGHT: Air mass becomes unstable to near 3-4,000 feet AGL by the afternoon.

VENTILATION: POOR to MARGINAL in the morning becoming MARGINAL in the afternoon.

AIRSHED Recommendations: POOR ventilation over the Clearwater Air Shed and MARGINAL ventilation elsewhere this afternoon.

Boundary County: Conditional

LOCAL TIME										
County	08	09	10	11	12	13	14	15	16	17
Boundary	P	P	P	M	M	M	M	M	M	M

VENTILATION KEY: P = Poor M = Marginal G = Good E = Excellent

Figure 59. Weather forecast prepared by Bennett Fire Weather Services, LLC, for Boundary County.

Table 57. Available PM_{2.5} monitoring data prior to burn decision.

Date	Time	PM _{2.5} (µg/m ³)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland
10/9/2012	1:00 AM	8.7	10.8	3	8
10/9/2012	2:00 AM	7.3	10.4	5	10
10/9/2012	3:00 AM	7.5	10	6	8
10/9/2012	4:00 AM	7.6	10.1	3	7
10/9/2012	5:00 AM	7.8	9.5	4	8
10/9/2012	6:00 AM	7.5	10.3	4	6
10/9/2012	7:00 AM	7	8.8	7	6
10/9/2012	8:00 AM	6.8	8.7	11	6
10/9/2012	9:00 AM	6.4	9	6	3
10/9/2012	10:00 AM	5.8	8	6	1
10/9/2012	11:00 AM	5.6	7.1	5	2
10/9/2012	12:00 PM	5.5	6.9	3	4
10/9/2012	1:00 PM	5	5.5	5	4
10/9/2012	2:00 PM	4.7	5.2	4	2
10/9/2012	3:00 PM	4.5	6.1	3	1
10/9/2012	4:00 PM	4.5	6.5	3	0
10/9/2012	5:00 PM	4.4	5.8	3	3
10/9/2012	6:00 PM	4.7	6.8	8	6
10/9/2012	7:00 PM	5.1	5.9	2	8
10/9/2012	8:00 PM	6.1	6.1	4	6
10/9/2012	9:00 PM	7.3	6.9	5	6
10/9/2012	10:00 PM	6.5	7.4	4	7
10/9/2012	11:00 PM	6.1	7.4	4	7
10/9/2012	12:00 AM	6.4	7.5	2	5
10/10/2012	1:00 AM	6.5	7.5	2	8
10/10/2012	2:00 AM	5.8	7.3	1	10
10/10/2012	3:00 AM	5.5	7.2	2	7
10/10/2012	4:00 AM	5.1	7.3	2	8
10/10/2012	5:00 AM	5.9	7.3	3	10
10/10/2012	6:00 AM	4.3	7.2	4	10
10/10/2012	7:00 AM	4.4	7.4	6	7
10/10/2012	8:00 AM	5.1	7.2	10	6
10/10/2012	9:00 AM	7	7.1	6	4
10/10/2012	10:00 AM	7.2	6.4	5	3



Figure 60. Map of approved fields for October 10, 2012.

Field Observations

Field observations were made prior to burning to determine if the meteorological forecast was representative. A south surface wind of 6–7 mph was measured at the 110-acre test burn field in the northern valley. The temperature was 61 °F, as forecasted. Measured relative humidity in the field was 43%—slightly higher than forecasted (40%). The meteorological forecast indicated a good burn day. Fuel conditions of these fields were described as brown with a little green-up in the bottom. Soil moisture was very dry, fuel arrangement loose, and fuel loading moderate to heavy. Cloud cover was around 10%. These conditions suggested a successful burn day. A little haze was noted in the valley, likely attributed to the wildfire smoke that had plagued the area throughout much of the fall. However, the monitoring data supported a burn day.

Conditions in the northern part of the valley indicated marginal or better ventilation. The weather data in the southern end of the valley indicated surface winds in Moyie Springs coming from the west-southwest at 2–4 mph at 12 p.m. Field and meteorological conditions for the southern field was verified by the KTOI representative. The 100-acre field in the southeast part of the valley was approved to burn at 12:46 p.m.

The CRB field coordinator observed the northern burns from the Hwy 95 overlook and could barely see the 100-acre field to the south. Smoke appeared to have good dispersion. A phone

conversation with the KTOI representative indicated no smoke was heading into town and dispersion was good at the site. This field was out at approximately 2:11 p.m. with smoke dispersing to the northeast.

The 110-acre test burn wheat field in the northern part of the valley was ignited at 1:13 p.m. Dispersion was good to excellent, and the field was out at 1:36 p.m. Initial smoke from this field leveled off at about 800 ft and then increased to 1,500 ft AGL or higher. This is normal lift for this area at this time of year. Smoke had excellent dispersion with little to no ground smoke observed. The grower was given permission to burn the 100-acre field nearby at 1:48 p.m. and he ignited the field at 1:50 p.m. All burning was complete by approximately 3:15 p.m.

Wind directions were noted in the field as having a southerly surface and transport component, which pushed most of the smoke aloft to the north and northwest up the valley toward Canada. The 110-acre field had good to excellent transport dispersion and fair horizontal dispersion to the north. Smoke dissipated very well. The 100-acre northern field's smoke reached 500 ft to 1,000 ft AGL initially and then fell back to about 500 ft. Wind speeds were noted at the Porthill monitor at 10–12 mph from the south-southwest. This increase in wind speed prevented any further climb of smoke and pushed the smoke toward Creston and the northwest side of the mountains. After burning was complete, horizontal smoke dispersion (closer to ground) was considered fair to good. Vertical/transport dispersion continued to be excellent. Observations indicated that column heights from the first burn reached approximately 1,500 ft AGL and decreased to less than 1,000 ft for the last burn. Smoke moved quickly up the valley. By the end of the day, horizontal dispersion was poor, while vertical dispersion was fair to good. The DEQ field coordinator was on site to observe the northern burns from the Hwy 95 overlook.

Table 58 includes the monitoring data during and after the burns. The maximum hourly PM_{2.5} concentration at any of the monitors was 19 µg/m³, recorded at Creston at 5:00 p.m. This value is well below all enhanced documentation triggers and program concentration limits. Given surface wind speeds and wind direction, smoke from DEQ-approved crop residue burning could have caused some of the increase in particulate concentration in Creston this day. Field notes indicated some surface smoke transporting through the Porthill, as seen by the monitoring data. However, the hourly concentrations suggests the surface smoke did not linger.

Table 58. Air quality PM_{2.5} monitoring data during and after burning.

Date	Time	PM _{2.5} (µg/m ³)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland
10/10/2012	11:00 AM	7	6.6	3	2
10/10/2012	12:00 PM	6.5	6.8	5	0
10/10/2012	1:00 PM	10.1	7	5	6
10/10/2012	2:00 PM	17	7.7	6	11
10/10/2012	3:00 PM	8.1	7.3	8	6
10/10/2012	4:00 PM	11.4	6.9	12	6
10/10/2012	5:00 PM	14	7.2	19	10
10/10/2012	6:00 PM	13.2	7.3	14	10
10/10/2012	7:00 PM	10.8	7.3	17	11

Date	Time	PM _{2.5} (µg/m ³)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland
10/10/2012	8:00 PM	11	8	16	10
10/10/2012	9:00 PM	11.5	10	13	9
10/10/2012	10:00 PM	12.3	9.4	11	9
10/10/2012	11:00 PM	10.9	9.3	10	9
10/10/2012	12:00 AM	10.7	9.7	9	12

No complaints were received regarding burning on October 10, 2012.

Summary

A total of three fields, 310 acres of cereal grain, were burned this day in Boundary County: two fields (210 acres) in the northern valley and one in the southeast (100 acres). Observed meteorological conditions in the north were as good as forecasted for the earlier burns; however, the last burn of the day saw higher ground wind speeds than forecasted and this likely affected the smoke by preventing it from achieving forecasted mixing elevations. Ventilation was forecasted to be marginal and field observations noted mostly good to excellent vertical dispersion. However, conditions degraded to poor horizontal dispersion because of the higher surface winds during the last burn in the north. The observed winds verified the forecasted southerly component. Observed relative humidity and temperatures were also similar to the forecast. The maximum mixing height was forecasted at 4,242 ft AGL, but actual smoke behavior mixed to a maximum of 1,500 ft AGL and much lower in the last burn. Even though smoke did not reach the forecasted mixing height of over 4,000 ft AGL, the surface and transport winds dispersed all smoke vertically and the horizontal smoke quickly, resulting in a fair burn day. No trigger levels were reached, but horizontal dispersion was much poorer than desired.

Burn Date: October 12, 2012

Burn Decision

Burn day: up to 100 acres approved—pending air quality and meteorological conditions. Burn window: 10 a.m. to 2 p.m.

Burn Decision Justification

This burn decision was developed using NWS observations at Bonnors Ferry and Creston, BC, (Table 59); forecasted winds, ventilation, and temperatures from the UW NWMC, as displayed in the DEQ weather checklist (Figure 61); and the daily forecast produced by the DEQ contract meteorologist, Bennett Fire Weather Services, LLC (Figure 62). Ventilation was expected to be marginal to good, with surface winds generally from the southwest at 7–14 mph. The upper level winds were forecasted to be from the west-southwest to southwest at 20–22 mph at an elevation of 1,000–2,200 ft AGL. DEQ determined a burn window of 10:00 a.m.–2:00 p.m. based on the weather checklist and the DEQ contract meteorologist recommendation, which forecasted a cold front moving through the area bringing increased winds and subsequent dispersion. In this area, winds can pick up fairly quickly and completing burns early is desirable.

Field ignition practices for the 100-acre field were also taken into account during the burn decision. This particular field has heavy, standing wheat stubble in approximately 1-acre rows. Each row is separated by a 5-ft buffer zone that has treated lumber spaced evenly, and the buffer does not carry fire through it. As such, the grower is unable to light larger sections of rows at once. This type of ignition process produces less dense smoke due to the time it takes to light the field (i.e., allows more time for dispersion as the grower has to light, wait, light, wait, etc.).

DEQ reviewed the monitoring data (Table 60) for Bonners Ferry; Creston, BC; Porthill; and Copeland. The maximum hourly PM_{2.5} concentration recorded at any of these sites was 13 µg/m³, recorded at Copeland at 5:00 a.m. and 8:00 a.m. on October 11 (the day prior). This concentration is well below all preburn enhanced documentation triggers. Taking into account the particular ignition process, higher wind speeds forecasted to increase as the day progressed, and small amount of acreage, DEQ approved a burn start time of 10:00 a.m., which is before the time the inversion was forecasted to break. The grower has worked very well with the program in the past and was trusted to ignite at a particular time and conditions as instructed.

One field, a total of 100 acres, was approved (Figure 63). The grower was informed of the expected conditions for the day and instructed to cease burning if smoke was not behaving as expected or if winds were too high. Because it was a Friday, the Mt. Hall Elementary School was not in session.

Table 59. National Weather Service observations at Bonners Ferry (Site ID K65S).

Date/Time	Temperature (°F)	Relative Humidity (%)	Wind Speed (mph)	Wind Direction (degrees)	Weather Conditions	QA Flag
10-12-2012 5:55 PDT	41	81	4.6	140	clear	OK
10-12-2012 6:15 PDT	37.4	87	3.5	150	clear	OK
10-12-2012 6:35 PDT	39.2	81	5.8	140	clear	OK
10-12-2012 6:55 PDT	39.2	81	4.6	140	clear	OK
10-12-2012 7:15 PDT	37.4	87	3.5	140	clear	OK
10-12-2012 7:35 PDT	39.2	81	4.6	140	clear	OK
10-12-2012 7:55 PDT	41	81	5.8	110	clear	OK
10-12-2012 8:15 PDT	41	81	6.9	130	clear	OK
10-12-2012 8:35 PDT	41	81	9.2	120	clear	OK
10-12-2012 8:55 PDT	44.6	70	6.9	120	clear	OK
10-12-2012 9:15 PDT	44.6	70	4.6	180	clear	OK
10-12-2012 9:35 PDT	46.4	71	0	n/a	clear	OK
10-12-2012 9:55 PDT	46.4	71	4.6	190	clear	OK
10-12-2012 10:15 PDT	46.4	71	4.6	190	mostly clear	OK
10-12-2012 10:35 PDT	48.2	66	3.5	160	mostly clear	OK
10-12-2012 10:55 PDT	48.2	66	0	n/a	clear	OK
10-12-2012 11:35 PDT	50	62	3.5	170	clear	OK
10-12-2012 11:55 PDT	51.8	58	0	n/a	clear	OK

Morning Forecasting for Boundary														
Model Resolution:	12km			Model Run:	2012101200			SiteID:	IBONY					
Date		Time in PDT											Comments	
10/12/2012		10AM	11AM	12PM	1PM	2PM	3PM	4PM	5PM	6PM	7PM	8PM	9PM	
Vent. Index		NP	P	M	M	G	G	G	NP	M	M	M	M	
G: good, M: marginal, P: poor, NP: very poor														
Surface (20m) Winds	Direction	SSW	SSW	SW	SW	SW	SW	SW	SSW	SW	SSW	SSW	SSW	5 kts = 5.75 mph,
	Speed (mph)	6.8	10.9	13.5	14.5	15.8	14.8	13.8	8.3	12.6	11.5	10.3	10.3	10 kts = 11.5 mph,
Surface (20m) Temperature (degree C)		10.4	11.8	13.4	14.3	14.7	14.9	14.9	14.1	12.8	12.1	12.0	11.7	15 kts = 17.25 mph
Surface (20m) Relative Humidity (%)		71.9	64.3	55.9	50.8	48.6	47.0	44.9	49.7	55.8	58.3	59.3	61.6	
Planetary Boundary Layer (PBL)	Height (feet)	164	1083	1755	2260	2661	2785	2690	197	2178	2005	2044	1972	Height is above model terrain surface
	Direction	SSW	SW	WSW	WSW	WSW	WSW	WSW	SW	WSW	WSW	WSW	WSW	
	Speed (mph)	10.6	20.6	21.0	22.8	22.1	23.7	20.2	15.1	25.6	27.2	29.1	28.5	
700mb (~10,000 ft MSL)	Height (feet)	7233	7233	7233	7233	7233	7233	7233	7233	7233	7233	7233	7233	Height is above model terrain surface
	Direction	WSW	WSW	WSW	WSW	W	W	WNW	WNW	WNW	WNW	WNW	W	
	Speed (mph)	33.8	35.0	37.5	38.4	39.0	33.9	27.7	27.5	29.6	30.2	27.5	25.4	
850mb (~5000 ft MSL)	Height (feet)	2040	2040	2040	2043	2040	2040	2043	2043	2040	2043	2043	2040	Height is above model terrain surface
	Direction	WSW	WSW	WSW	WSW	SW	SW	SW	WSW	WSW	WSW	WSW	WSW	
	Speed (mph)	26.5	27.8	23.7	19.9	20.5	20.3	19.5	22.1	25.6	27.2	29.1	28.5	

Figure 61. Weather checklist for Bonners Ferry. Information taken from the University of Washington Northwest Modeling Consortium forecast model.

Forecast Prepared by: BENNETT FIRE WEATHER SERVICES, LLC

Forecast Time Prepared: 8:00 AM PDT – Friday October 12, 2012

Forecast for: FRIDAY – October 12, 2012

GENERAL WEATHER DISCUSSION:

FRIDAY:

The upper level high pressure ridge has moved east. A weak upper level trough moving into southern British Columbia has all but disappeared in the westerly flow aloft over northern Idaho. This trough effectively flattened the ridge and is opening the door for Pacific storms to enter the region over the weekend. At the surface today a weak cold front will be moving across northern today. By this afternoon the front looks to be oriented southwest to northeast from northeast Oregon to northwest Montana. The pressure gradient field is tightening and is oriented southwest to northeast along the front. The surface wind direction will be from the southwest to west over the air sheds. Wind speeds will be in the 5-15 mph range with local gusts to 20 mph. Mixing heights are expected to range from 3-6,000 feet AGL over the air sheds. Dispersion is marginal to good over northern Idaho. The strong to marginal morning inversion will break around 11am to 12 noon at temperatures between 55-64 degrees. Ventilation will be marginal to locally good over northern Idaho air sheds as mixing increased at the surface and in the mixed layer by afternoon.

NORTHERN IDAHO BY AIRSHED:

BOUNDARY COUNTY Air Shed:

Forecast for FRIDAY:

SKY/WEATHER: Partly cloudy this afternoon.

TEMPERATURE: High temperatures ranging from the 64-70.

HUMIDITY: Minimum RH around 25-40 percent.

WIND – SURFACE: Southwest 5-15 mph with gusts to 20 mph in the afternoon.

TRANSPORT: Southwest 15-20 mph in the afternoon.

INVERSIONS: Strong to moderate morning inversion breaking by 11am at a temperature around 54 degrees.

MIXING HEIGHT: Air mass becomes unstable to near 3,000 feet AGL by the afternoon.

VENTILATION: POOR to MARGINAL in the morning remaining MARGINAL in the afternoon.

AIRSHED Recommendations: Conditional for strong and gusty wind.

Boundary County: Conditional

LOCAL TIME										
County	08	09	10	11	12	13	14	15	16	17
Boundary	P	P	P	M	G	G	G	G	G	G

VENTILATION KEY: P = Poor M = Marginal G = Good E = Excellent

Figure 62. Weather forecast prepared by Bennett Fire Weather Services, LLC, for Boundary County.

Table 60. Available PM_{2.5} monitoring data prior to burn decision.

Date	Time	PM _{2.5} (µg/m ³)			
		Porthill	Bonnors Ferry (KTOI)	Creston, BC	Copeland
10/11/2012	1:00 AM	10.4	10	6.80	10
10/11/2012	2:00 AM	9.9	9.7	5.70	10
10/11/2012	3:00 AM	9.3	9.7	5.60	9
10/11/2012	4:00 AM	8.2	9.5	5.50	10
10/11/2012	5:00 AM	8.7	9.2	5.00	13
10/11/2012	6:00 AM	8	8.4	6.10	11
10/11/2012	7:00 AM	7.9	7.3	5.10	11
10/11/2012	8:00 AM	7.9	7.9	8.90	13
10/11/2012	9:00 AM	8.2	9.8	No data	11
10/11/2012	10:00 AM	6.7	7.9	2.30	8
10/11/2012	11:00 AM	5.8	6	3.00	5
10/11/2012	12:00 PM	5.9	6	3.80	0
10/11/2012	1:00 PM	5.7	5.8	3.80	2
10/11/2012	2:00 PM	5.6	6.4	4.50	5
10/11/2012	3:00 PM	6.1	6.8	4.50	4
10/11/2012	4:00 PM	6.3	6.8	3.90	4
10/11/2012	5:00 PM	6.4	7.4	4.30	8
10/11/2012	6:00 PM	6.7	7	7.10	8
10/11/2012	7:00 PM	6.9	7.9	6.00	6
10/11/2012	8:00 PM	7.6	8.1	6.30	8
10/11/2012	9:00 PM	8.4	7.9	8.50	8
10/11/2012	10:00 PM	8.9	7.8	6.90	8
10/11/2012	11:00 PM	8.6	8.2	6.20	8
10/11/2012	12:00 AM	8.2	8	5.40	6
10/12/2012	1:00 AM	8.1	8.2	5.10	6
10/12/2012	2:00 AM	7.6	7.8	5.30	7
10/12/2012	3:00 AM	7.1	7.6	5.40	3
10/12/2012	4:00 AM	7.2	7.6	5.40	4
10/12/2012	5:00 AM	7.1	7.6	5.20	8
10/12/2012	6:00 AM	6.9	7.7	5.30	7
10/12/2012	7:00 AM	7.2	7.8	4.70	3
10/12/2012	8:00 AM	7.4	7.7	6.50	1
10/12/2012	9:00 AM	7.6	7.6	9.50	3

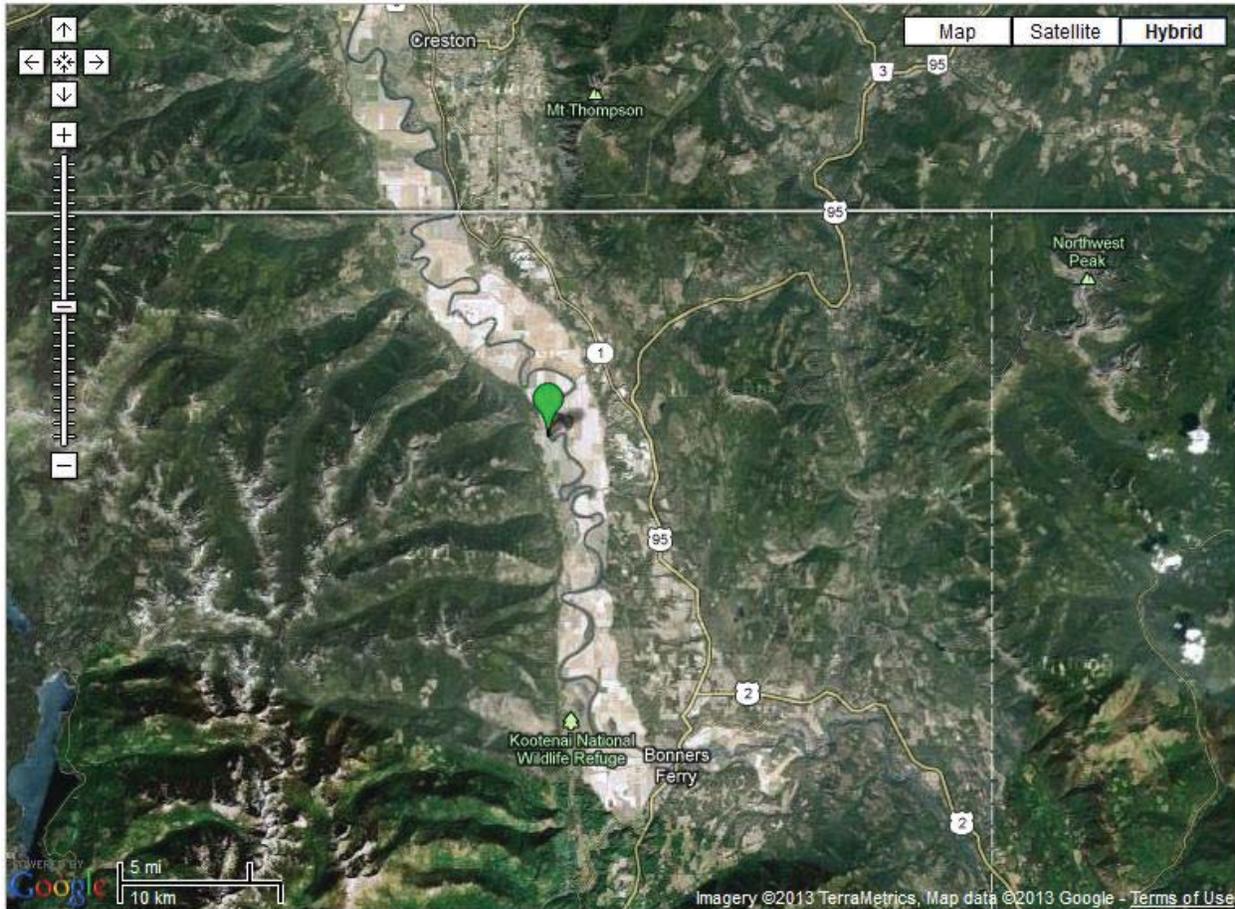


Figure 63. Map of approved fields for October 12, 2012.

Field Observations

The CRB field coordinator was not in the valley for the burn this day due to DEQ-approved crop residue burning activities on the Rathdrum Prairie. DEQ contacted the grower in the morning about the weather forecast and expected smoke behavior. The grower planned to start lighting at about 10:30 a.m.

Table 61 includes the particulate monitoring data during and after the burns. The maximum hourly $PM_{2.5}$ concentration at any of the monitors was $22.2 \mu\text{g}/\text{m}^3$, recorded at Porthill at noon on the burn day. This value is well below all enhanced documentation triggers and program concentration limits but likely depicts surface smoke from DEQ-approved crop residue burning on this day. However, the increased wind speeds of 10–12 mph could have been expected to scour smoke out of the valley to the north and subsequently lowered the monitor readings in Creston. The elevated readings at the Bonners Ferry and Copeland monitors (both south of the burn location) suggest another source of particulates contributed to the overall $PM_{2.5}$ concentration of the valley. The pronounced south-southwest winds and the location of the field (5 miles north of the Bonners Ferry monitor and due west of Copeland) make it highly unlikely these impacts were caused by DEQ-approved burning.

Surface meteorological data from the Porthill monitor (Table 62) indicated a steady surface wind out of the south-southwest from 8:00 a.m. until 3:00 p.m., with speeds 5–6 mph (8 a.m.–11:30 a.m.) and then increasing to 10–12 mph (11:30 a.m. until 3 p.m.). The surface wind data from Creston (Table 63) depicted a northwest flow for much of the burn window.

Table 61. Air quality PM_{2.5} monitoring data during and after burning.

Date	Time	PM _{2.5} (µg/m ³)			
		Porthill	Bonnars Ferry (KTOI)	Creston, BC	Copeland
10/12/2012	10:00 AM	7.7	7.8	9	5
10/12/2012	11:00 AM	8.1	7.9	7	6
10/12/2012	12:00 PM	22.2	13.2	6	7
10/12/2012	1:00 PM	11.2	15.7	15	17
10/12/2012	2:00 PM	12.3	13.7	18	14
10/12/2012	3:00 PM	12.9	13.2	19	13
10/12/2012	4:00 PM	14.8	12.8	17	12
10/12/2012	5:00 PM	13	12.8	17	15
10/12/2012	6:00 PM	10.1	13	16	17
10/12/2012	7:00 PM	10.7	12.1	14	20
10/12/2012	8:00 PM	11	11.2	13	19
10/12/2012	9:00 PM	11.3	10.6	14	13
10/12/2012	10:00 PM	11.1	9.1	15	12
10/12/2012	11:00 PM	10.1	8.5	12	12
10/12/2012	12:00 AM	8.5	7.4	13	10

Table 62. Porthill wind data.

Date	Time (PDT)	Wind Speed (mph)	Wind Direction (degrees)
10/12/2012	1:00 AM	0.8	164.1
10/12/2012	2:00 AM	1.7	188.3
10/12/2012	3:00 AM	1.5	182
10/12/2012	4:00 AM	1.5	192
10/12/2012	5:00 AM	1.8	184.2
10/12/2012	6:00 AM	1.7	224.3
10/12/2012	7:00 AM	1.2	192
10/12/2012	8:00 AM	3.2	203.6
10/12/2012	9:00 AM	5.8	209.4
10/12/2012	10:00 AM	4.9	207.9
10/12/2012	11:00 AM	2.7	182.4
10/12/2012	12:00 PM	8.7	185.9
10/12/2012	1:00 PM	10.8	212.3
10/12/2012	2:00 PM	9.7	205.8

Date	Time (PDT)	Wind Speed (mph)	Wind Direction (degrees)
10/12/2012	3:00 PM	5.3	222.3
10/12/2012	4:00 PM	2.6	101.1
10/12/2012	5:00 PM	1.9	138.6
10/12/2012	6:00 PM	4.9	211.3
10/12/2012	7:00 PM	4.4	222.1
10/12/2012	8:00 PM	1.7	160.1
10/12/2012	9:00 PM	2.1	201.3
10/12/2012	10:00 PM	2.9	180.2
10/12/2012	11:00 PM	5.6	185.7
10/12/2012	12:00 AM	10	204.2

Table 63. Creston wind data.

Date	Time (PDT)	Wind Speed (mph)	Wind Direction (degrees)
10/12/2012	1:00 AM	2.0	56
10/12/2012	2:00 AM	2.0	49
10/12/2012	3:00 AM	1.1	24
10/12/2012	4:00 AM	2.0	74
10/12/2012	5:00 AM	1.3	352
10/12/2012	6:00 AM	2.9	107
10/12/2012	7:00 AM	5.6	109
10/12/2012	8:00 AM	2.2	180
10/12/2012	9:00 AM	2.2	252
10/12/2012	10:00 AM	3.1	287
10/12/2012	11:00 AM	3.8	296
10/12/2012	12:00 PM	2.2	223
10/12/2012	1:00 PM	3.1	331
10/12/2012	2:00 PM	2.9	332
10/12/2012	3:00 PM	3.8	311
10/12/2012	4:00 PM	3.4	275
10/12/2012	5:00 PM	2.2	114
10/12/2012	6:00 PM	5.8	94
10/12/2012	7:00 PM	5.1	90
10/12/2012	8:00 PM	3.4	56
10/12/2012	9:00 PM	3.4	70
10/12/2012	10:00 PM	3.1	70
10/12/2012	11:00 PM	3.8	128
10/12/2012	12:00 AM	4.0	108

One complaint was received about this burn day. The complainant called the toll-free complaint hotline on October 12 indicating “poor visibility and bad particulate mass reading.” The complainant did not want a call back. Based on meteorological data from the Porthill monitor (and subsequent assumed smoke behavior), DEQ determined that smoke from DEQ-approved crop residue burning could have caused the complaint.

Summary

One field, a total of 100 acres, was burned this day in Boundary County. This field was ignited in strips, which limited vertical plume rise but also limited plume density, thus helping with surface dispersion, especially during higher wind speeds. The high surface winds (over 10 mph) were expected to assist in ventilation of any ground smoke from the approved field. The forecast called for higher winds and the arrival of a frontal system. The overall increase in particulate concentrations throughout the valley, including at monitors upwind of the burn, suggests smoke infiltration from another source, quite possibly from other open burning occurring at higher elevations (i.e., higher on the mountains). No DEQ staff were present in Boundary County for this burn.

