Developing A Prescribed Fire Insurance Liability Product: *Actuarial Analysis of Survey Data*

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Executive Summary

This report was generated as an addendum to the project "Developing A Prescribed Fire Insurance Liability Product" funded by the U.S. Department of Agriculture's Risk Management Agency. The data collection and analysis for this addendum report were conducted using additional funding from the U.S. Department of Agriculture's Risk Management Agency and coordinated by Agren, Inc. Additional data were collected concerning prescribed burning in Virginia and these were added to the data from the original project. The data for Virginia and the combined data were analyzed in a manner comparable to that used in the original project. This report summarizes project data for Virginia and then updates the statistical analysis using the combined data. This report assumes familiarity with the final report from the original project and associated data, which are available at http://www.agren-inc.com/Final Report Rx Fire Survey 2006.pdf or by contacting the authors. If the explanation or description in this report seems incomplete or lacking, the issue in question has likely been more completely addressed in the original report which readers should consult.

Major activities for this smaller project included a mail survey of prescribed burners in Virginia, a follow-up telephone survey of those prescribed burners in the mail survey reporting escapes, a summary these new survey data and an update of the statistical analysis used to develop initial estimates of premiums for a prescribed fire liability policy. This report contains extensive summaries of the new mail and telephone surveys, including the "typical" prescribed burner and prescribed fire escape in Virginia. Analysis includes a description of a statistical model estimating the expected number of prescribed fire escapes for a prescribed burner that is slightly different than in the original report. The statistical model estimating the expected property damage for an escape, including the characteristics of prescribed burners at higher risk for escapes and property damage, changed very little for this addendum to the original project. These updated analyses are then combined to develop an updated estimate of the actuarially fair premium for a prescribed fire liability policy based on the characteristics of a prescribed burner. This new statistical analysis is then incorporated into an updated spreadsheet to perform calculations needed to estimate premiums based on these statistical models. Finally, updated spreadsheets are available that contain the original project data as well as the new data from Virginia to facilitate use of project data by others who want to conduct their own analysis.

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Introduction

This report is an addendum to the original project "Developing A Prescribed Fire Insurance Liability Product" funded by the U.S. Department of Agriculture's Risk Management Agency. This report summarizes project data for Virginia and its statistical analysis and describes the data files available for use by those wishing to conduct their own analysis of the Virginia data or all the project data. This report assumes familiarity with prescribed fire issues and terminology and with the final report from the original project and associated data, and so this report may be difficult to understand and follow for those not familiar with the issues and the original report. The original report and data files are available at http://www.agren-inc.com/Final Report Rx Fire Survey 2006.pdf or by contacting the authors. This addendum report also has separate data files that contain both the data collected from Virginia prescribed burners, as well as the data from the original project, which can be obtained from the Agren, Inc web page or by contacting the authors.

The remainder of this report is organized as follows. First is an extensive description of the additional survey data collected for this addendum to the original project. Next follows a non-technical summary of the statistical analysis of the data. More detail is provided concerning the analysis of the escape data, as the statistical model changed more than for the damage model. However, in both cases, the description relies at least in part on the reader being familiar with the original project report. Accompanying this report is a spreadsheet that uses the statistical results to estimate the actuarially fair premium based on the characteristics of a specific prescribed burner, plus two other spreadsheets containing the survey data for use by those wishing to conduct their own analysis.

Extensive Summary of New Survey Data

Two surveys were conducted for this project. First, a mail survey was sent to a list of private contractors involved in fire suppression and prescribed burning in Virginia. The survey asked questions concerning the characteristics of the business and prescribed fire practices, including how many of prescribed fire escapes they had. Next, a follow-up telephone survey was conducted of those who reported at least one escaped fires on the mail survey. Questions focused on the escaped fires and the amount of property damage and suppression costs. This section provides an extensive summary of the data collected from both surveys.

Mail Survey

A mail survey of Virginia prescribed burners was conducted following Dillman's (2000) method, which involved sending pre-survey letters, an initial survey mailing, a follow-up postcard and attempted telephone call, and then a second survey mailing. Initial mailings began in October 2006 and most surveys returned by December 2006. The initial mailing list consisted of 85 individuals and private contractors conducting fire suppression and prescribed burns for landowners, almost all from Virginia (two had addresses in Maryland, one in Illinois). Appendix A in the original report provides a copy of the actual mail survey. The Virginia version of the survey was the same as the survey for the original project, except that the five year period respondents were asked to report about was for 2001 to 2005, rather than 1999 to 2003 as for the original project.

Of the 85 on the initial mailing list, 41 surveys were returned (48%), which was essentially the same as for the original project. Of the 41 returned surveys, 19 reported conducting no prescribed burns during 2001 to 2005 (again comparable to the original project). Of the remaining 22 surveys, an additional 2 were dropped because they provided no information concerning the number of escapes and/or the number of burns for any of the years. The final data set consisted of 20 useable surveys that reported the number of prescribed burns and associated number of escapes for at least one year from 2001 to 2005. Because not all respondents conducted prescribed burns in all five years of the survey, the total number of burner-years was 80. The data from the mail survey are included in a spreadsheet accompanying this report as described in detail in the section "Summary of Spreadsheet Data Files." These data include the raw survey data, the reduced data set of the 20 useable surveys, and the final data set of the 80 burner-year observations used for statistical analysis, a summary sheet used to develop Tables 1-20, and as well as all written comments provided any survey respondents.

The survey asked a variety questions concerning prescribed fire practices and experiences during the five years (2001-2005), as well as the general business characteristics of respondents. What follows is a series of tables providing an extensive summary of the information collected through this mail survey of prescribed burners in Virginia. Each table summarizes responses to a specific survey question identified in the table title. Readers should consult the copy of the survey in Appendix A of the original report for the specific question actually asked and the available response categories. Also, the original report summarizes the comparable data for prescribed burners from the other surveyed states for comparison. In addition, the spreadsheet file accompanying this report contains the raw mail survey data that readers can use to construct their own summaries of the responses for the Virginia prescribed burners only or for the mail survey data collected from the other states. Finally, note that to protect the anonymity of respondents, responses to some questions are not summarized here nor are they included in the spreadsheet.

The "Typical" Virginia Prescribed Burner

Below are several general statements that describe the "typical" prescribed burner based on the responses to the mail survey and summarized in the indicated tables. After each category, a short statement summarizes how results for Virginia compare to those for the other states in the project. See the original project report or the data files for more detailed comparisons.

Technical Practices: (Tables 1 and 7)

- Most (90%) use written burn plans Always or Often, but 10% Never or Rarely do
- All (100%) predict smoke behavior Always or Often
- Most (70%) wear protective equipment Always or Often, but 5% Never or Rarely do.

- Most (75%) Never or Rarely begin a burn after sunset.
- Most (65%) Never or Rarely burn with open flames for more than 24 hours.
- 40% Sometimes extinguish a burn after sunset, 35% Often or Always do.

These results are all similar to those for other states, except that Virginia prescribed burners use written burn plans more often.

General Practices: (Tables 2-4 and 18-20)

- All burn for private land owners (100%), with farmers and ranchers (45%) and lumber companies (40%) the next most common clients.
- Most (80%) burn 2000 or fewer total acres per year.
- Most (89%) conduct 25 or fewer prescribed burns per year.
- Half report conducting burns with others not employed by their company, most commonly government agencies.
- Most (70%) burn in 1 state and only a fourth (25%) burn in 2 states.

Compared to prescribe burners in the rest of the project, Virginia prescribed burners include more lumber companies and fewer farmers and ranchers, conduct slightly fewer burns per year, burn more often with government agencies and burn more commonly in only one state.

Prescribed Fire Characteristics: (Tables 5, 6, and 8)

- Almost all (85%) conduct some burns in the wildland/urban interface, with almost a third (30%) conducting at least half of their burns in the wildland/urban interface.
- Most (65%) conduct no burns next to public lands.
- Not quite half (45%) conduct at least half of their burns in sparsely populated areas.

- Slash is the most common fuel type (80% report some burns in Slash) and then Timber.
- Very few (5%) burn exclusively in one fuel type (Grass).

- The median low size range for a typical burn is 10 acres.
- The median high size range for a typical burn is 100 acres.
- Most (85%) fires have a high size range less than 200 acres, with the maximum reported high size range of 250.

Relative to prescribe burners in the rest of the project, Virginia prescribed burners burn more often in the wildland/urban interface and less often next to public lands and in sparely populated areas, plus they burn much more Slash and less Grass, with somewhat smaller typical size ranges for their burns.

Experience and Certification: (Table 14)

- The average years of experience with prescribed fire is 21.3 years, with a range from 4 to 36 years.
- Only 10% report having no fire suppression experience.
- For those with fire suppression experience, the average years of experience is 15.8 years, with a range from 1 to 41 years.
- Almost half (60%) did not know if their burn boss had the Burn Boss II designation.
- Only 20% had Burn Boss II designation or higher and 10% more had state certification.

These results are all similar to those for other states, except that Virginia prescribed burners have more experience with prescribed fire and much more often with fire suppression, plus they less knowledgeable about the Burn Boss II designation and are less often certified.

Escape Experience: (Tables 9-11)

- Annually, most (50%-85%) have no escapes and those who have escapes usually have only 1 or 2 escapes. The maximum was 4 escapes.
- Claims for smoke damage from prescribed burns are rare. None reported a smoke claim from an escape and only 1 reported 2 smoke claims from non-escaped fires.

These results are all similar to those for other states, except that Virginia prescribed burners average fewer escapes.

Insurance Experience: (Tables 12 and 13)

- Most (85%) report having some form of general business liability insurance in the years they conducted burns, with a median premium of almost $3,000.
- Many (65%) report having a policy providing some form of liability coverage for prescribed burns; 10% have no coverage and 20% left the question blank.

These results are all similar to those for other states, except that more Virginia prescribed burners report having some form of liability coverage for prescribed burns.

Business Characteristics: (Tables 15-17 and 19)

- A fourth (25%) report less than $100,000 in gross income, 90% report less than $250,000 with the remaining 10% leaving the question blank.
- Prescribed burning is on average about 15% of their business income, with most income (78% on average) from other activities not related to controlling woody vegetation or fire.

- On average have been in business for 16 years and conduct burns almost 6 months a year.
- Most (60%) planned on conducting prescribed burns in the coming year.

These results are all similar to those for other states, except that the gross annual income for Virginia prescribed burners is generally lower and they burn for more months per year.

These generalizations are intended to indicate typical responses to the survey and should be fairly representative of the population of prescribed burners in Virginia. No cross tabulation between characteristics (e.g., how do the gross income responses correlate with experience with escapes) has been conducted or reported here, but are left to the readers to create using the accompanying spreadsheet.

Mail Survey Tables

Table 1. Summary of Responses to Question 2: Prescribe Fire Practices.

	Use Written Burn Plan		Predict Smoke Behavior		Wear Personal Protection	
	Responses	%	Responses	%	Responses	%
Never	1	5%	0	0%	0	0%
Rarely	1	5%	0	0%	1	5%
Sometimes	0	0%	0	0%	5	25%
Often	3	15%	2	10%	6	30%
Always	15	75%	18	90%	8	40%
Blank	0	0%	0	0%	0	0%

Table 2. Summary of Responses to Question 3: Clients.

	Lumber Companies		Farmers Ranchers		Game Preserves		Private Land Owners		Government	
	Responses	%	Responses	%	Responses		Responses	%	Responses	%
Yes	8	40%	9	45%	7	35%	20	100%	5	25%
Blank	12	60%	11	55%	13	65%	0	0%	15	75%

Table 3. Summary of Responses to Question 4: Number of Prescribed Burns.

	2001		2002		2003		2004		2005	
	Responses	%	Responses	%	Responses		Responses	%	Responses	%
Exceeding 0	14	70%	17	85%	16	80%	16	80%	17	85%
Equal 0	3	15%	2	10%	1	5%	1	5%	2	10%
Blank	3	15%	1	5%	3	15%	3	15%	1	5%
Responses Exceeding 0										
Average	17.7		13.4		10.4		11.1		11.2	
Minimum	1		1		1		1		1	
Maximum	63		60		44		54		43	
Median	10.5		10		7		6		6	
Average Over All Years			12.6		Median Over All Years				7	

Table 4. Summary of Responses to Question 4: Total Acres Burned.

	2001		2002		2003		2004		2005	
	Responses	%	Responses	%	Responses		Responses	%	Responses	%
Exceeding 0	14	1%	17	1%	16	1%	16	1%	17	1%
Equal 0	3	0%	2	0%	1	0%	1	0%	2	0%
Blank	3	0%	1	0%	3	0%	3	0%	1	0%
Responses Exceeding 0										
Average	1,579		3,270		815		816		824	
Minimum	10		5		5		45		5	
Maximum	6,000		42,000		4,000		3,700		2,900	
Median	766		550		213		298		315	
Average Over All Years			1,472		Median Over All Years				372	

Table 5: Summary of Responses to Questions 5-7: Prescribed Burn Characteristics.

	Wildland/Urban Interface		Next to Public Lands		Sparsely Populated Areas	
Range	Responses	%	Responses	%	Responses	%
0%	3	15%	13	65%	2	10%
1-25%	6	30%	6	30%	3	15%
26-50%	5	25%	1	5%	6	30%
51-75%	3	15%	0	0%	6	30%
76-100%	3	15%	0	0%	3	15%
Blank	0	0%	0	0%	0	0%

Table 6. Summary of Responses to Question 8: Percentage of Burns by Primary Fuel Type.

	Grass		Brush		Timber		Slash	
	Responses	%	Responses	%	Responses		Responses	%
Exceeding 0	11	55%	2	10%	9	45%	16	80%
Equal 0	7	35%	15	75%	8	40%	2	10%
Blank	2	10%	3	15%	3	15%	2	10%
Average	13%		2%		21%		63%	
Responses Exceeding 0								
Average	21%		14%		39%		71%	
Minimum	1		3		2		4	
Maximum	100		25		90		100	

Table 7. Summary of Responses to Question 9: Prescribed Burned Practices.

	Begin after Sunset		Open Flame > 24 Hours		Extinguish after Sunset	
	Responses	%	Responses	%	Responses	%
Never	11	55%	3	15%	2	10%
Rarely	4	20%	10	50%	2	10%
Sometimes	2	10%	4	20%	8	40%
Often	2	10%	1	5%	6	30%
Always	0	0%	1	5%	1	5%
Blank	1	5%	1	5%	1	5%

Table 8. Summary of Responses to Question 10: Typical Size Range.

	Low End Acres		High End Acres	
	Responses	%	Responses	%
Exceeding 0	19	95%	19	95%
Equal 0	0	0%	0	0%
Blank	1	5%	1	5%
Responses Exceeding 0				
Average	21		106	
Minimum	5		10	
Maximum	50		250	
Median	10		100	

Table 9. Summary of Responses to Question 11: Number of Escaped Fires.

	2001		2002		2003		2004		2005	
	Responses	%	Responses	%	Responses		Responses	%	Responses	%
Exceeding 0	5	25%	9	45%	3	15%	2	10%	5	21%
Equal 0	14	70%	10	50%	16	80%	17	85%	15	63%
Blank	1	5%	1	5%	1	5%	1	5%	4	17%
Responses Exceeding 0										
Average	1.4		1.9		1.3		2.0		1.8	
Minimum	1		1		1		1		1	
Maximum	2		3		2		3		4	
Median	1		2		1		2		1	
Average Over All Years			1.7		Median Over All Years				1.5	

Table 10. Summary of Responses to Question 11: Number of Smoke Claims with Escapes.

	2001		2002		2003		2004		2005	
	Responses	%	Responses	%	Responses		Responses	%	Responses	%
Exceeding 0	0	0%	0	0%	0	0%	0	0%	0	0%
Equal 0	19	95%	19	95%	19	95%	19	95%	20	100%
Blank	1	5%	1	5%	1	5%	1	5%	0	0%
Responses Exceeding 0										
Average	--		--		--		--		--	
Minimum	--		--		--		--		--	
Maximum	--		--		--		--		--	
Average Over All Years			--							

Table 11. Summary of Responses to Question 11: Number of Smoke Claims without Escapes.

	2001		2002		2003		2004		2005	
	Responses	%	Responses	%	Responses		Responses	%	Responses	%
Exceeding 0	0	0%	0	0%	0	0%	0	0%	2	10%
Equal 0	19	95%	19	95%	19	95%	19	95%	18	90%
Blank	1	5%	1	5%	1	5%	1	5%	0	0%
Responses Exceeding 0										
Average	--		--		--		--		1	
Minimum	--		--		--		--		1	
Maximum	--		--		--		--		1	
Average Over All Years			1.0							

Table 12. Summary of Responses to Questions 12-13: General Liability Coverage.

	General Liability in Any Year 2001-2005		General Liability Currently	
	Responses	%	Responses	%
Yes	17	85%	15	75%
No	2	10%	2	2%
Don't Know	1	5%	1	1%
Blank	0	0%	2	2%

Table 13. Summary of Responses to Questions 14-15: General Liability Coverage.

	Premium		General Liability Experience		
	Responses	%		Responses	%
Exceeding 0	14	70%	No	2	10%
Equal 0	6	30%	No, but covered	2	10%
Blank	0	0%	Yes, but no claims	8	40%
Responses Exceeding 0			Yes, and claims	3	15%
Average	$3,072		Don't know	1	5%
			Blank	4	20%
Minimum	$1,150				
Maximum	$8,000				
Median	$2,868				

Table 14. Summary of Responses to Questions 16-18: Experience and Burn Boss Training.

	Prescribed Burn Experience		Fire Suppression Experience				
	Responses	%	Responses	%	Training	Responses	%
Exceeding 0	20	100%	18	90%	< Burn Boss II	2	10%
Equal 0	0	0%	2	10%	= Burn Boss II	1	5%
Blank	0	0%	0	0%	> Burn Boss II	3	15%
Responses Exceeding 0					Don't Know	12	60%
Average	21.3		15.8		Other	2	10%
Minimum	4		1		Blank	0	0%
Maximum	36		41				
Median	23		16				

Table 15. Summary of Responses to Question 21: Business Gross Revenue.

	Responses	%
< $100,000	5	25%
$100,000-$250,000	9	45%
$250,000-$500,000	4	20%
$500,000-$1,000,000	0	0%
$1,000,000-5,000,000	0	0%
> $5,000,000	0	0%
Blank	2	10%

Table 16a. Summary of Responses to Question 22: Gross Revenue by Activity.

	Prescribed Burns		Mechanical Clearing		Chemical Treatment	
Range	Responses	%	Responses	%	Responses	%
Exceeding 0	15	75%	3	15%	5	15
Equal 0	3	15%	9	45%	6	3
Blank	2	10%	8	40%	9	2
Responses Exceeding 0						
Average ≥ 0	14%		4%		7%	
Average > 0	16%		15%		15%	
Minimum	2%		1%		5%	
Maximum	50%		30%		37%	
Median	10%		15%		10%	

Table 16b. Summary of Responses to Question 22: Gross Revenue by Activity.

	Fire Suppression		Consulting		Other 1 & 2	
Range	Responses	%	Responses	%	Responses	%
Exceeding 0	3	15%	2	10%	16	80%
Equal 0	8	40%	8	40%	0	0%
Blank	9	45%	10	50%	4	20%
Responses Exceeding 0						
Average ≥ 0	9%		1%		78%	
Average > 0	34%		3%		78%	
Minimum	2%		1%		30%	
Maximum	60%		5%		100%	
Median	40%		3%		83%	

Table 17. Summary of Responses to Questions 23-24: Months Burn and Years in Business.

	Months Burn per Year		Years Firm in Business	
	Responses	%	Responses	%
Exceeding 0	20	100%	19	95%
Equal 0	0	0%	0	0%
Blank	0	0%	1	5%
Responses Exceeding 0				
Average > 0	5.8		16.2	
Minimum	2		1.5	
Maximum	12		75	

Table 18. Summary of Responses to Question 25: States Where Conducting Prescribed Burns.

State	Respondents	Number of States	Respondents	%
VA	19	1	14	70%
NC	4	2	5	25%
GA	1	3	0	0%
Blank	1	4	0	0%
		5	0	0%
		6	0	0%
		Blank	1	5%

Table 19. Summary of Responses to Questions 26 and 27: Burning Practices and Plans

	Conduct Burns with Others		Conduct Burns in Coming Year		
	Responses	%		Responses	%
Yes	10	50%	Yes	12	60%
No	8	40%	No	5	25%
Blank	2	10%	Other	2	10%
			Don't Know	0	0%
			Blank	1	5%

Table 20. Summary of Responses to Questions 26: Hours Burned with Others.

	Other Private Consultants		Government Agencies		Other	
Range	Responses	%	Responses	%	Responses	%
Exceeding 0	4	20%	6	30%	3	15%
Blank	16	80%	14	70%	17	85%
Responses Exceeding 0						
Average > 0	90.0		1252.0		2388.0	
Adj. Avg. > 0*			82.4		32.0	
Minimum	20		16		16	
Maximum	200		7100		7100	
Adj. Max. *			200		48	

*Not including observation with 7,100 hours.

Telephone Survey

A telephone survey was conducted to collect data for estimating the probability and magnitude of damage from escaped fires. During January and February of 2007, attempts were made to contact the 13 prescribed burners in the Virginia mail survey who reported an escaped fire or claims for smoke damage from a prescribed burn. Of these 13, 2 were not able to be reached at the telephone number reported in the mail survey or in the mailing list or no one answered the telephone after repeated calls. Dropping these observations left 11 (85% of the 13) useable telephone surveys. Of these 11, all confirmed having one or more escapes and 1 also reported a smoke claim without an escape. These 11 were asked several questions about each escaped fire, for up to four escaped fires per respondent. Because some respondents had more than one escape, the final data set for escapes in Virginia consists of responses by 11 different private contractors regarding a total of 21 escaped fires and 1 smoke claim without an escape.

The Center for Survey Statistics and Methodology (CSSM) at Iowa State University conducted the telephone data collection. The original report provides more detail concerning the interview methodology. Also, Appendix B in the original report provides a copy of the coding manual that reports the text of the interviews and indicates how the answers were coded for the data file. An accompanying spreadsheet includes the raw data collected from the telephone survey, including a summary sheet used for construct Tables 21-30 and answers to open ended survey questions.

Note that these 11 respondents reporting escapes includes 1 that was dropped from the final mail survey data set and not included in the data summaries in Tables 1-20. Though this respondent answered many of the mail survey questions, the questions on the number of burns conducted each year were left blank, crucial data used for the analysis of the mail survey. This survey is part of the telephone survey data summarized below and was used for the statistical analysis of damage from escaped fires, but the responses were not included in the statistical analysis of the factors determining escapes using the mail survey data.

The telephone interviews included a variety questions regarding f each escaped fire or smoke claim and the value of all damage claims paid. Tables 21-30 provide a summary of the telephone survey information collected. Each table summarizes responses to specific questions identified in the table title by the field name from the coding manual in Appendix B of the original report, which includes each question asked and available response categories. The spreadsheet file accompanying this report also contains the raw telephone survey data for others to construct their own summaries of the responses. Finally, to protect the anonymity of respondents, responses to some questions are not summarized here nor are they included in the spreadsheet.

The "Typical" Virginia Prescribed Fire Escape

Below are several general statements that describe the "typical" prescribed fire escape based on the responses to the telephone interview and summarized in the indicated tables. Remember that these bullets described prescribed burns that escaped and were reported in our telephone survey. After each category, a short statement summarizes how results for Virginia compare to those for the other states in the project. See the original project report or the data files for more detailed comparisons.

Location (Table 21)

- Most occurred in Virginia (90%), with a few (10%) in North Carolina.

Fuels and Sizes (Tables 22 and 23)

- Most commonly prescribed burns that escape were burns in Slash (86%).
- Most commonly escaped fires burned additional Timber (67%).
- All escaped prescribed burns are less than 300 acres; 43 acres is the median size.
- All escapes burned less than 20 additional acres, 1 additional acres was the median.

Compared to the other surveyed states, escapes in Virginia tend to burn fewer additional acres, and occur far more commonly when burning Slash and then burn additional Timber.

Extinguishing the Escape (Tables 24 and 27)

- Most (86%) took less than 3 hours to extinguish; all took 6 or fewer hours.
- Additional costs to extinguish the escape ranged $20 to $1,000, with a median of $200.
- Additional resources to extinguish the escape typically included bulldozers, plows and other fire fighters (71%, 52%, and 33% of escapes, respectively).

Relative to escapes in the other surveyed states, escapes in Virginia tend to take less time, require fewer resources, and cost less to suppress.

Training and Experience (Tables 25 and 26)

- About half (52%) burn crews had 2-6 members besides the burn boss.
- Almost all (90%) had crews with Excellent or Very Good experience.
- Most respondent did not know if the burn boss had a Burn Boss II designation or state certification, but almost a third (30%) had Burn Boss II or better designation.

Compared to escapes in the other surveyed states, crews for escapes in Virginia are much more experienced, but farm ore respondents did not know what sort of certification, if any, the burn boss had.

Monetary Value of Damages (Tables 28-30)

- Most (86%) reported no property damage.
- None reported any payments for bodily injury.
- Most (86%) reported paying no out of pocket costs to settle damage claims.
- For the 24% of escapes paying claims, the total payment from all sources ranged $300 to $35,000, with an average of $9,560 and a median of $3,000.
- The single smoke claim in the survey required no damage payments.

In Virginia, more prescribed fire escapes required damage payments of some sort and threes payments were generally larger than in the other surveyed states.

These generalizations are intended to indicate typical responses to the telephone survey and should be fairly representative of escapes that occurred in Virginia. No cross tabulations of variables is reported here, nor are summaries that link information from the mail and telephone surveys, but these are left to readers using the data in the accompanying spreadsheet.

Telephone Survey Tables

Table 21. Summary of Responses to Fields Num1a and StateAb: Number and Location of Escaped Fires.

Year	Escapes	%	State	Escapes	%
2001	2	10%	Virginia	19	90%
2002	10	48%	North Carolina	2	10%
2003	0	0%			
2004	1	5%			
2005	8	38%			

Table 22. Summary of Responses to Fields Fuel3a, Fuel3b, Plan4: Fuels and Burn Plan Use.

	Prescribed Fire		Escaped Fire			Burn Plan	
Fuel	Escapes	%	Escapes	%	Answer	Escapes	%
Grass	0	0%	4	19%	Yes	20	95%
Brush	1	5%	1	5%	No	1	5%
Timber	2	10%	14	67%			
Slash	18	86%	1	5%			
Other	0	0%	1	5%			

Table 23. Summary of Responses to Fields Intend5 and Addl5: Acres Burned.

	Prescribed Fire Intended Acres	Escaped Fire Additional Burned Acres
Average	79.5	3.6
Minimum	4	0.1
Maximum	300	20
Median	43	1

Table 24. Summary of Responses to Fields Cost6 and Hours7: Cost to Suppress and Hours to Extinguish Escaped Fire.

	Suppression Cost ($)		Hours to Extinguish	
All Responses	Escapes	%	Escapes	%
Exceeding 0	13	62%	21	100%
Equal 0	5	24%	0	0%
No Response	3	14%	0	0%
Average	231		1.5	
Median	112.5		1	
Responses Exceeding 0				
Average	320		1.5	
Minimum	20		0.05	
Maximum	1,000		6	
Median	200		1	

Table 25. Summary of Responses to Fields Crew8: Crew Size.

Crew Size	Crew Size Escapes	%
0	4	19%
1	1	5%
2	1	5%
3	1	5%
4	6	29%
5	0	0%
6	3	14%
7	1	5%
8	0	0%
9	0	0%
10	1	5%
11	1	5%
16	1	5%
20	1	5%
Average	5.3	
Median	4.0	

Table 26. Summary of Responses to Fields Exper9, and Train10: Crew Size and Experience and Burn Boss Training.

Experience	Crew Experience Responses	%	Training	Burn Boss Training Responses	%
Excellent	8	38%	< Burn Boss II	4	19%
Very Good	11	52%	= Burn Boss II	4	19%
Good	1	5%	> Burn Boss II	2	10%
Fair	1	5%	Don’t Know	11	52%
Poor	0	0%	Other	0	0%
Don't Know	0	0%	Blank	0	0%

Table 27a. Summary of Responses to Fields Use11b: Additional Resources Used for Escape.

Resource	Hand Crews		Water Tenders		Lookout Crews		Other Fire Fighters	
	Escapes	%	Escapes	%	Escapes	%	Escapes	%
Exceeding 0	1	5%	3	14%	3	14%	7	33%
Equal 0	20	95%	18	86%	18	86%	14	67%
No Response	0	0%	0	0%	0	0%	0	0%
Average	0.3		0.1		0.6		1.4	
Median	0		0		0		0	
Responses Exceeding 0								
Average	6.0		1.0		4.0		4.1	
Minimum	6		1		3		1	
Maximum	6		1		5		9	
Median	6		1		4		3	

Table 27b. Summary of Responses to Fields Use11b: Additional Resources Used for Escape.

Resource	Plows		Light Engines		Med/Hvy Engines		Bulldzers	
	Escapes	%	Escapes	%	Escapes	%	Escapes	%
Exceeding 0	11	52%	4	19%	1	5%	15	71%
Equal 0	10	48%	17	81%	20	95%	6	29%
No Response	0	0%	0	0%	0	0%	0	0%
Average	0.7		0.4		0.1		1.0	
Median	1		0		0		1	
Responses Exceeding 0								
Average	1.3		2.3		2.0		1.3	
Minimum	1		1		2		1	
Maximum	2		4		2		3	
Median	1		2		2		1	

Table 27c. Summary of Responses to Fields Use11b: Additional Resources Used for Escape.

Resource	Explosives		Airtankers		Smokejumpers		Other	
	Esc.'s	%	Esc.'s	%	Esc.'s	%	Esc.'s	%
Exceeding 0	0	0%	0	0%	0	0%	0	0%
Equal 0	21	100%	21	100%	21	100%	21	100%
No Response	0	0%	0	0%	0	0%	0	0%
Average	0		0		0		0	
Median	0		0		0		0	
Responses Exceeding 0								
Average	0		0		0		0	
Minimum	0		0		0		0	
Maximum	0		0		0		0	
Median	0		0		0		0	

Table 28. Summary of Responses to Fields Prop15a, Injury15, and Pay16b: Cost of Escaped Fire Damage.

	Property Damage		Bodily Injury		Private Payment		Total Payment	
	Escapes	%	Escapes	%	Escapes	%	Escapes	%
Exceeding 0	3	14%	0	0%	3	14%	5	24%
Equal 0	18	86%	21	100%	18	86%	16	76%
No Response	0	0%	0	0%	0	0%	0	0%
Average	$2,190		$0		$86		$2,276	
Median	$0		$0		$0		$0	
Responses Exceeding 0								
Average	$15,333		$0		$600		$9,560	
Minimum	$3,000		$0		$300		$300	
Maximum	$35,000		$0		$900		$35,000	
Median	$8,000		$0		$600		$3,000	

Table 29. Raw Positive Responses to Fields Prop15a, Injury15, and Pay16b: Cost of Escaped Fire Damage, Sorted by Total Payment.

Rank	Total Payment	Property Damage	Bodily Injury	Private Payment
1	$35,000	$35,000	$0	$0
2	$8,900	$8,000	$0	$900
3	$3,000	$3,000	$0	$0
4	$600	$0	$0	$600
5	$300	$0	$0	$300

Table 30. Summary of Responses to Fields Smoke18a to Pay27b: Smoke Claims without Escapes.

State	Year	Fuel	Smoke Prediction Method	Private Payment	Total Payment
Virginia	2005	Slash	Weather predictions	$0	$0

Loss Analysis

The goal of the statistical analysis for the original project was to develop estimates of actuarially fair premiums for a liability insurance policy to cover damages from escaped prescribed burns. This addendum repeats the same analysis, but also has the goal of determining whether prescribed burners in Virginia statistically differ from those in the other states and regions where data was collected for the original project. This analysis was conducted by combining the Virginia data with the data from the original project. The description here does not elaborate on the statistical methods and models used. More information along these lines is presented in the original report and its cited references; for more detail, contact the author.

As for the original project, the analysis proceeded in two steps. First, the annual expected number of escapes is estimated as a function of the characteristics of a prescribed burner using the combined mail survey data for Virginia and the original project. Second, given that an escape has occurred, the probability that damage occurs and, if it does, how much damage occurs are estimated as functions of the characteristics of the prescribed burner using the combined data from both the telephone and mail survey for Virginia and the original project. The description here focuses on the final results, how to use them for estimating premiums, and how Virginia prescribed burners differ from those surveyed in the original project; the technical details are not presented or justified. For those with the expertise and interest, the survey data are available in the accompanying spreadsheets for those who wish to conduct their own analysis.

Note that variables used for estimation from the mail and telephone surveys are those that can be used to determine an insurance premium, as opposed to variables that are important, but could not be used. For example, the intended size of the prescribed burn is available from the telephone survey of escapes and has a statistically significant impact on the probability and magnitude of monetary damages from escapes. However, an insurance company typically does not insure a single prescribed burn, but rather an individual prescribed burner for a year/season. Hence, this implies that the variable to use to estimate the impact of prescribed burn size on the probability and magnitude of monetary damages is the average or typical size of prescribed burns the prescribed burner conducts as reported in the mail survey. The effect of variables such as the intended size of the prescribed burn is important, but not useable by an insurance company. However, such variables may be important for other types of analyses, and so all the survey data are available in the accompanying spreadsheets for those wishing to conduct their own analysis.

The analysis also combines ordinal categorical responses into fewer variables and converts continuous variables to discrete variables. For example, Business Gross Revenue was originally collected in the mail survey for six ranges (Table 15/Questions 21). For the analysis described below, these are combined into three ranges. Similarly, the responses to Questions 8 on the mail survey (Percentage of Burns by Primary Fuel Type: Table 6) were continuous variables, but were converted to indicator (dummy) variables equal to 1 if the response exceeded 33%. This combining/conversion of responses was used for several reasons. First, estimated coefficients were often statistically insignificant from zero or not statistically different from each other if all categories were used, but if categories were combined, this problem was eliminated or reduced. Second, a parsimonious model with few variables and mostly categorical variables seemed more consistent with insurance company practices. For example, car insurance premiums are based on a few age categories and do not varying continuously with age. Third, using fewer categories ensured smooth, monotonic effects for changes in responses, rather than "jumpy" responses that sometimes changed direction. For example, as the percentage of burns in the wildland-urban interface increases (Table 6/Question 8), the expected number of escapes follows the general pattern of the data and decreases. However, if a separate effect is estimated for each categorical variable, only one coefficient is significant and the effect is no longer monotonic for all cases. Different groupings of categorical variables and break points for converting continuous variables to indicator variables were explored statistically for the analysis here, but we do not present the details of this selection process, as it is rather tedious. Nevertheless, because different groupings or break points could be used or may be preferred for other applications, the survey data are available in the accompanying spreadsheets for those wanting to do their own analysis.

One important effect of adding the Virginia data to the analysis was to change the variables used in the analysis. Variables that in the original project had statistically significant effects on the number of escapes or the amount of damage were in some cases no longer statistically significant and vice versa—new variables now had statistically significant effects. Such changes were to be expected, as adding the Virginia data increased the number of observations in the mail survey by 17 % and in the telephone survey by 28%. These changes in variables are not highlighted in this addendum, except to note that they improved the model's ability to predict within the sample date used for estimation.

Updated Escape Model

The mail survey is used to estimate the expected number of escapes. As for the original project, the data were "stacked" to obtain annual observations. Thus the 132 useable mail surveys (112 from the original project and 20 from Virginia) generated 538 burner-year observations (458 from the original project and 80 from Virginia). Because the number of escapes must be an integer, as for the original project, several count data models were used to estimate the expected number of escapes each year by each prescribed burner. See the original project report and the references cited for more information concerning count data models, estimation methods, and results. The final model used for the analysis here is a sample-size weighted generalized Poisson model, which assumes the number of escapes is an integer with a generalized Poisson distribution, with a mean and variance that depend on burner characteristics and the annual number of burns conducted. This distribution is slightly different than was found statistically appropriate for the original project, where the distribution used was the sample-size weighted restricted generalized Poisson. Thus, more model details are reported for this slightly different model than for the model predicting expected damage for escapes. For more detail concerning these count data model distributions, see the original report and references cited there. Table 31 reports the variables from the mail survey used and a brief description. Table 32 reports the maximum likelihood coefficient estimates and associated statistics.

Using Table 32

Define e_i as the number of escapes in a year for burner i. The set (vector) of variables describing the characteristics of burner i is the vector W_i. The variables listed in the first column of Tables 31 and 32 are these characteristics W_i for each burner i. For the sample-size weighted generalized Poisson model, the probability density function of e_i is

(1) $$f(e_i) = \frac{n_i \mu_i}{(1+\lambda)^{e_i}} (n_i \mu_i + \lambda e_i)^{e_i - 1} \exp\left[\frac{-(n_i \mu_i + \lambda e_i)}{1+\lambda}\right] / e_i!,$$

where μ_i and λ are parameters determining the mean and variance of the number of escapes, n_i is the number of burns conducted by burner i, and e_i! is the factorial of e_i. The expected escape rate per burn for burner i is

(2) $$\mu_i = \exp(\theta' W_i)$$

and the expected (average) number of escapes per year for burner i is

(3) $$\mathrm{E}[e_i] = n_i \mu_i,$$

where θ is the set (vector) of estimated coefficients reported in Table 32, and $\theta' W_i$ is the vector product (the sum of each coefficient times the appropriate variable). In other words $\theta' W_i = \sum_{j=1}^{17} \theta_j W_{ij}$, where j = 1 to 17 indexes the coefficients in Table 32 and the value of the variables W_i for burner i. Based on this model, the probability that burner i will have k escapes is

(4) $$\Pr[e_i = k] = f(k) = \frac{n_i \mu}{(1+\lambda)^k} (n_i \mu + \lambda k)^{k-1} \exp\left[\frac{-(n_i \mu + \lambda k)}{1+\lambda}\right] / k!$$

where k! is the factorial of k. For this study, the parameter vector θ and the parameter λ are estimated using maximum likelihood based on the probability density function defined by equations (1) and (2) (Mitchell, Buman, and Buman 2006; Sarker and Surry 2004). Lastly, the variance of the annual number of escapes for burner i is

(5) $$\mathrm{Var}[e_i] = n_i \mu_i (1 + \lambda)^2.$$

To simplify calculations, an accompanying Excel spreadsheet allows users to calculate the expected number of escapes and the probability of the different number of escapes using these formulas and pull-down menus to choose the value of most regressors W_i.

Interpretation of Coefficients in Table 32

The coefficients in Table 32 indicate whether the variables have a positive or negative effect on the expected (average) number of escapes. If the coefficient is positive, then the variable increases the expected number of escapes. However, note that the magnitude of the increase is unclear, since the effect of any variable depends on the current expected number of escapes $\mathrm{E}[e_i] = n_i \exp(\theta' W_i)$. also, the p-value is the estimated probability that the estimated coefficient θ_j is actually zero (i.e., the variable W_{ij} has no effect on the expected number of escapes). Table 32 indicates that most of the variables are significant at the 1% level. All but two are significant at the 10% level. The insignificant variables (Primary Fuel > 33% Brush and Primary Fuel > 33% Grass) are included because comparable variables were included for the other fuel types. Also note that when a prescribed burner is categorized into one of several categories, one of the variables must be dropped from estimation to prevent singularity of the regressor matrix. Thus, coefficients must be interpreted as the effect of the variable relative to the excluded category.

The estimated coefficients for Burn in Midwest and Burn in South are both positive in Table 32, implying that those conducting burns in the Midwest or the South will have on average more escapes relative to those who Burn in West (the excluded category). For the original project, data were collected from prescribed burners in Texas and Florida who conducted burns in several southern states. With the added data from Virginia, as for the original project, we statistically tested whether intercept shifting coefficients for prescribed burners from each of these states were statistically different. For this project, we found that the coefficients for these three states did not statistically differ from one another, but did differ from the coefficients for the West and Midwest states. Thus, this addendum reports a single coefficient for these southern states.

Examining the coefficients in Table 32 indicates that, besides these regional effects, fuel types are also important. Those burning more than a third of their burns in slash on average have more expected escapes than those who burn less than a third of their burns in slash (the coefficient for Primary Fuel > 33% Slash is positive), while those burning more than a third of their burns in timber on average have fewer expected escapes than those who burn less than a third of their burns in timber (the coefficient for Primary Fuel > 33% Timber is negative). The comparable coefficients for the other two fuel types are smaller and statistically insignificant, implying that the effects implied by the signs of the coefficients could just as well be zero or even have the opposite sign. This, relative to a company conducting prescribed burns evenly distributed among fuel types (25% for each), a company specializing in Slash would have the largest expected number of escapes, then a company specializing in Grass, while a company specializing in Timber would have the fewest expected escapes and a company specializing in Brush would have more expected escapes.

Using annual business revenue as an indicator of size shows that the size of the company also has an effect on the expected number of escapes. Relative to companies with less than $250,000 in annual revenue, larger companies have more expected escapes, with the positive effect increasing as the company gets larger (the positive coefficient for Annual Revenue > $1,000,000 is larger than for those with Annual Revenue $250,000 to $1,000,000). These results may be evidence that small companies have fewer expected escapes because they conduct fewer and smaller prescribed burns. Companies earning more than 25% of their annual revenue from prescribed fire activities have fewer expected escapes (the coefficient for > 25% Revenue from Burns). This may be evidence that companies specializing in prescribed fire have fewer escapes and are generally more careful to prevent escapes, since an escape may create a bad reputation for their company and thus reduce their annual revenue.

The negative coefficient for > 50% Burns in Wildland-Urban Interface is evidence that those burning in locations of this sort with more potential for larger scale damage apparently take more precautions to prevent escapes. However, the positive coefficient for At Least 10 Years Suppression implies that the expected number of escapes increases if the burn boss has more than 10 years of experience in fire suppression. One interpretation is that those with substantial fire suppression experience are less worried about escapes (as they have long experience with extinguishing them) and so put forth less effort to prevent them. Also, note that the full effect of fire suppression experience will also depend on how it affects expected damage once an escape occurs, which is determined in the next estimated model.

The positive coefficient for Burn Boss II Certification implies that companies using burn bosses with recommended training have more expected escapes. This seems rather counter-intuitive, but may be due to an effect similar to At Least 10 Years Suppression in that burn bosses with higher levels of certification may be less concerned with stopping all minor escapes, as they have experience with controlling and suppressing them. Furthermore, the full effect of burn boss certification will also depend on how it affects expected damage once an escape occurs, which is determined in the next estimated model. However, the negative coefficient for Burn Plan Often or Always implies that this practice decreases the expected number of escapes. This would seem to be evidence that those using written burn plans are better prepared prescribed burners, which leads to the occurrence of fewer escapes.

The negative coefficient for Annual Number of Burns implies that the more prescribed burns a company conducts, the fewer escapes it has, holding annual acreage burned constant. This result can be interpreted as evidence that, as the average size of the burns a company conducts decreases, the expected number of escapes also decreases. The positive coefficient on Annual Acres Burned (1000's) implies that the more total acres a company burns (holding the number of burns constant), the greater the expected number of escapes. These results seem consistent, since burning more acres creates the potential for more escapes. However, the full effect of annual acreage and the number of burns will also depend on how it affects expected damage once an escape occurs, which is determined in the next estimated model.

Interestingly, the positive coefficient on Has Prescribed Fire Liability Coverage implies that prescribed burners with some form of liability coverage have more escapes on average. Those without liability coverage exert more effort to reduce escapes (and the potential for damage), because they would be responsible for the full cost of any escape causing damage, while those with insurance coverage have reduced incentives for this effort, since they will not pay the full cost of any damages. This coefficient captures this moral hazard effect that insurance can have on the behavior of those with insurance and is important to include when determining insurance premiums. However, the statistical support for this effect is somewhat weaker than for the other variables, as the coefficient has a relatively large p-value.

Finally, equation (5) indicates that the variance of the expected number of escapes depends on the parameter λ, as well as the expected escape rate μ and the number of burns n, and is actually proportional to $(1 + \lambda)$. Other count data models estimated did not imply this proportional relationship, but standard goodness of fit criteria indicated that the generalized Poisson provided the best fit among the estimated models (Sarker and Surry 2004).

Characteristics of Prescribed Burners at Higher Risk for Escapes

The following bullet points are meant to be a convenient and short summary of these results. According to these statistical results in Table 32, the following are characteristics of prescribed burners who have a larger expected number of escapes:

- Conduct prescribed burns in the South and to a lesser extent in the Midwest
- Conduct more than a third of their burns in slash fuels
- Have at least 10 years of fire suppression experience
- Use a written burn plan less than often or always
- Have Burn Boss II or better designation or are state certified
- Earn more than $250,000 in annual business revenue
- Earn less than 25% of their business revenue from prescribed burns
- Conduct a low number of burns annually
- Conduct less than 50% of their prescribed burns in the wildland-urban interface

Updated Damage Model
The purpose of the damage model was to estimate the expected amount of damage that would occur once an escape had occurred. The primary source of data was the telephone survey on the value of damage from escapes linked with data from the mail survey on prescribed burner characteristics. Several of the 58 (47 from the original project and 11 from Virginia) prescribed burners contacted for the telephone survey had more than one escape, so that the final data set of damages from escaped prescribed fires contained 95 observations (74 from the original project and 21 from Virginia). For the Virginia data, 5 of the 21 escapes (24%) had damage associated with them, which is higher than for the original project data, which had 16% with damage (see Tables 27 and 28 in both reports). The implied large number of observations with zero damage creates statistical problems when estimating the expected damage that require non-conventional regression methods (Greene 2003, pp. 761-780).

The problem of a large number of zeros for the dependent variable (damage) generally requires use of censored regression techniques that formulate a two step process. The first step estimates whether the dependent variable (damage) is zero or positive and the second step estimates the magnitude of the positive observations. Tobit models assume the same variables determine both steps, while the more flexible double-hurdle models use different regressors to simultaneously predict each step. The analysis of the data here indicated that a double-hurdle model was preferred to a Tobit model. Technically, the double hurdle model here estimates a probit model for the probability that damage potentially occurs after an escape and then estimates a truncated normal regression model for the actual amount of damage. The truncated regression for the second step allows the model to predict that no damage occurs even if the first step indicates that it may potentially occur. The name double hurdle is used because for positive damage to occur with the model, two hurdles must be passed. First the probability that damage potentially occurs must be positive, and then, if this probability is positive, the magnitude of this potential damage must be positive.

The description of the double-hurdle model as estimated for this addendum is not reported here, except to note that original report (p. 23) provides an accurate description of the model as estimated. The same model is estimated as for the original project, except the variables used in the estimation changed with the increased data set, since 28% more observation were added by including the Virginia data. Table 33 reports and defines the variables used for estimation, while Table 34 reports the coefficient estimates for the parameter vectors α and β (defined in the original report). The top part of Table 34 reports the coefficients of α used to predict if damage potentially occurs, while the bottom part reports the coefficient of β to predict how much damage occurs. The next section explains how to use the estimates in Table 34 to predict when and how much damage occurs from an escape for a specific prescribed burner.

Using Table 34
Using Table 34 to predict the expected damage is more complicated than for Table 32. The original report (p. 24) explains how to use the coefficient estimates to make these predictions, so the equations are not repeated here. However, for convenience, these calculations for the expected damage and probability are put together in an Excel spreadsheet with pull down menus to select values for most regressors. Note that the variables included in this analysis of damages were chosen because they were statistically significant; several other variables were tried in

different model not reported here. However, the data are available in the accompanying spreadsheet for those wishing to try other variables or models.

Interpretation of Coefficients in Table 34

Again, the signs of the coefficients in Table 34 indicate the general direction of the impact of each variable on the probability that damage occurs or its magnitude. The specific marginal effects for each variable can be determined via simple derivatives of equations (10)-(12) given in the original report, but note that they will depend on the levels of the other regressors. This report only discusses the general direction of each variable's effect, not the specific marginal effects, as these seem outside the focus of this addendum report.

The variables in the top part of Table 34 influence the probability that an escaped prescribed burn causes damage. For the updated model, several variables were tried to estimate different α coefficients, but only the coefficient for the South was significant. As for the escape model, we tried separate coefficients for the different southern stats (Texas, Florida and Virginia), but found that the coefficients for these three states did not statistically differ from one another, so this addendum reports a single coefficient for these southern states. Coefficients for the other states (Midwest and West) were not significant. The positive value for Burn in South implies that escapes from prescribed burns in the South are more likely to cause damage relative to escaped prescribed burns in the Midwest or West. The data and this analysis do not allow determining whether these regional differences arise from regional differences in conditions or from practices and the level of effort by prescribed burners.

The variables in the bottom portion of Table 33 determine the magnitude of damage if damage occurs. None of the state or regional variables were significant and so none are reported. Because the estimated model is linear, the estimated coefficient can be interpreted directly in terms of the dollar value of damages. However note that these coefficients are the effect of the variable on expected damages, given that damage potentially occurs. If the combined effect of all variables is negative potential damage, then no damage occurs. Thus, for example, if the burn crew has excellent or very good experience, the expected damage (conditional on damage occurring) decreases almost $4,100 because the coefficient for Crew Experience Excellent or Very Good is –$4,096.

The primary fuel in which a prescribed burner operates has an important effect on expected damage. If more than 33% of a burners prescribed burns are with timber as the primary fuel, the expected damage from an escape (conditional on damage occurring) increases by almost $25,000. The effect of burning more than 33% of prescribed burns with grass as the primary fuel increases expected damage also by around $25,000, while the effect for slash is almost $12,000. Note that the data contained no cases in which escapes that caused damage occurred for prescribed burners who had more than a third of their prescribed burns with brush as the primary fuel type, so no value for this variable could be estimated. These results imply that when escapes occur in timber or grass, they are likely to cause more damage then escapes that occur in slash. Slash has smaller expected damage because the valuable timber has already been removed and areas where logging is occurring are often far from residences and similar types of property that could be destroyed by an escaped fire.

The certification and training of the burn boss and the crew both have significant negative effects on the expected damage. A burn boss with at least Burn Boss II designation or with state certification implies almost a $15,000 decrease in expected damage, while a crew with excellent or very good training decreases expected damage by almost $4,100. These results seem rather intuitive. However, the large and significant positive coefficient for At Least 10 Years Fire Suppression seems counterintuitive, but possibly can be explained as evidence that prescribed burners with more suppression experience tend to take on prescribed burns with greater potential for damage because they feel more confident that they can suppress any escapes. Along a similar line of reasoning, the positive coefficient for prescribed burners conducting more than 75% of their burns in sparely populated areas may be evidence that such burners are more careless so that escapes more likely damage timber or similar types of resources. Similarly, the negative coefficient for prescribed burners conducting less than 75% of their prescribed burns next to public lands would seem to be evidence that those burning by private lands and private property are more careful to prevent escapes causing damage. Finally, the expected damage (conditional on damage occurring) decreases by more than $48 for each acre the average size of a contractor's prescribed burns increases, but this effect is countered by the positive coefficient for Lower Size of Burns Exceeds 10 Acres.

Characteristics of Prescribed Burners at Higher Risk for Damage

The following bullet points are meant to be a convenient and short summary of these results.

According to the statistical results in Table 34, the following are characteristics of prescribed burners who have greater likelihood for damage to occur once an escape has occurred:

- Conduct prescribed burns in the South

According to the statistical results in Table 34, the following are characteristics of prescribed burners who have larger expected damage once an escape has occurred:

- Conduct more than a third of their burns in timber, grass or slash fuels
- Have a burn boss without Burn Boss II designation or without state certification
- Use a crew with less than excellent or very good experience
- On average conduct smaller burns, but with a lower size range exceeding 10 acres
- Have 10 or more years of fire suppression experience
- Conduct more than 75% of their burns in sparsely populated areas
- Conduct less than 75% of their burns next to public lands

Answers to Open Ended Questions

The telephone survey had two open ended questions for respondents. One asked about any additional resources they used to suppress the escape. Another asked "Can you briefly summarize why the prescribed burn escaped and the extent of the damage it caused." In addition, respondents were offered the opportunity to offer final comments. The answers to these questions are included in the spreadsheet for the telephone survey data and are potentially useful for understanding the nature of escapes that cause damage. The final comments also offer a window into the type of people conducting prescribed burns and their experiences with escapes, damage, and insurance. An insurance company considering offering a prescribed fire liability policy would do well to read these responses.

Loss Analysis Tables

Table 31. Variables used to estimate the expected number of escapes per year.

Variable Name	Description
Burn in Midwest	Equals 1 if conduct burns mostly in IA, IL, IN, KS, MI, MN, MO, ND, SD, WI
Burn in South	Equals 1 if conduct burns mostly in AL, AR, FL, GA, LA, MS, NC, OK, SC, TX, VA
Primary Fuel > 33% Grass	Equals 1 if at least 33% of burns have grass (including scattered sagebrush, savannas and open pine with grass understory) as primary fuel
Primary Fuel > 33% Brush	Equals 1 if at least 33% of burns have brush (including chaparral and pocosins) as primary fuel
Primary Fuel > 33% Slash	Equals 1 if at least 33% of burns have slash (logging residues from partial or clear cuts) as primary fuel
Primary Fuel > 33% Timber	Equals 1 if at least 33% of burns have timber (closed canopy stands of short/long needle pine, hardwoods, or dense conifers) as primary fuel
> 50% Burns in Wildland-Urban Interface	Equals 1 if conduct more than 50% of burns in wildland-urban interface
At Least 10 Years Fire Suppression	Equals 1 if burn boss has at least 10 years of fire suppression experience
Burn Plan Often or Always	Equals 1 if burner uses a written burn plan often or always
Burn Boss II Certification	Equals 1 if burn boss training equals or exceeds National Wildfire Coordinating Group Burn Boss II designation or has state certification
> 25% Revenue from Burns	Equals 1 if at least 25% of Business Revenue from conducting prescribed burns
Annual Revenue $250,000 to $1,000,000	Equals 1 if business revenue in listed range
Annual Revenue > $1,000,000	
Annual Number of Burns	Reported number of prescribed burns conducted
Annual Acres Burned (1000's)	Reported total acreage burned
Has Prescribed Burn Liability Coverage	Equals 1 if reports having some type of liability coverage for prescribed burn damages

Table 32. Coefficient estimates for the expected number of escapes per year.

Variable	Coefficient	Error	t-statistic	p-value
Intercept	-6.747	0.621	-10.865	0.000
Burn in Midwest	2.237	0.627	3.567	0.000
Burn in South	3.667	0.542	6.771	0.000
Primary Fuel > 33% Grass	0.119	0.312	0.381	0.703
Primary Fuel > 33% Brush	-0.731	0.497	-1.470	0.142
Primary Fuel > 33% Slash	1.004	0.240	4.190	0.000
Primary Fuel > 33% Timber	-1.370	0.232	-5.903	0.000
> 50% Burns in Wildland-Urban Interface	-0.847	0.265	-3.201	0.001
At Least 10 Years Fire Suppression	0.632	0.199	3.167	0.002
Burn Plan Often or Always	-0.765	0.242	-3.160	0.002
Burn Boss II Certification	0.365	0.155	2.353	0.019
> 25% Revenue from Burns	-0.678	0.286	-2.366	0.018
Annual Revenue $250,000 to $1,000,000	1.054	0.229	4.595	0.000
Annual Revenue > $1,000,000	1.436	0.179	8.018	0.000
Annual Number of Burns	-0.020	0.003	-7.410	0.000
Annual Acres Burned (1000's)	0.045	0.013	3.433	0.001
Has Prescribed Burn Liability Coverage	0.384	0.218	1.766	0.077
Variance Parameter λ	0.116	0.051	2.255	0.024

Table 33. Variables used to estimate the expected damage if an escape occurs.

Variable	Description
Burn in South	Equals 1 if conduct burns mostly in AL, AR, FL, GA, LA, MS, NC, OK, SC, TX, VA
Primary Fuel > 33% Grass	Equals 1 if at least 33% of burns have grass (including scattered sagebrush, savannas and open pine with grass understory) as primary fuel
Primary Fuel > 33% Slash	Equals 1 if at least 33% of burns have slash (logging residues from partial or clear cuts) as primary fuel
Primary Fuel > 33% Timber	Equals 1 if at least 33% of burns have timber (closed canopy stands of short/long needle pine, hardwoods, or dense conifers) as primary fuel
At Least 10 Years Fire Suppression	Equals 1 if burn boss has at least 10 years of fire suppression experience
Burn Boss II Certification	Equals 1 if burn boss training equals or exceeds National Wildfire Coordinating Group Burn Boss II designation or has state certification
Crew Experience Excellent or Very Good	Equals 1 if crew experience reported as excellent or very good
Burns in Sparsely Populated Areas > 75%	Equals 1 if reports more than 75% of prescribed burns are in sparsely populated areas
Burns by Public Lands < 75%	Equals 1 if reports less than 75% of prescribed burns are by public lands
Lower Size of Burns Exceeds 10 Acres	Equals 1 if reported lower size range of burns exceeds 10 acres
Average Size of Burn (Acres)	Average of lower end and higher end of reported size range for typical burn

Table 34. Coefficient estimates for the expected damage if an escape occurs.

Variable	Coefficient	Error	t-statistic	p-value
Intercept	-1.2972	0.3828	-3.389	0.001
Burns in South	1.3320	0.4541	2.933	0.003
Intercept	-15,051.6	1,589.4	-9.470	0.000
Primary Fuel > 33% Grass	25,389.5	2,153.3	11.791	0.000
Primary Fuel > 33% Slash	11,840.6	1,443.9	8.200	0.000
Primary Fuel > 33% Timber	24,663.4	1,764.3	13.979	0.000
At Least 10 Years Fire Suppression	10,591.0	1,052.7	10.061	0.000
Burn Boss II Certification	-14,932.1	1,634.8	-9.134	0.000
Crew Experience Excellent or Very Good	-4,096.8	877.2	-4.670	0.000
Burns in Sparsely Populated Areas > 75%	5,494.9	915.7	6.001	0.000
Burns by Public Lands < 75%	-4,356.1	1,573.8	-2.768	0.006
Lower Size of Burns Exceeds 10 Acres	5,409.6	1,863.8	2.902	0.004
Average Size of Burn (Acres)	-48.248	2.471	-19.526	0.000
Variance Parameter σ	1,198.2	210.9	5.682	0.000

Insurance Analysis

In the original report, this section contained several subsections that apply directly to his report, but are not repeated here, as they do not change. These subsections include equations and explanations of how to use estimated coefficients to estimate prescribed burner liability insurance premiums, as well as an overview of how to use the accompanying spreadsheet that conveniently does these calculations. Also, as for the original insurance analysis, several caveats apply due to weaknesses in the data or analysis, which are not repeated here, but still apply. Finally, a subsection was included that described data collected concerning the expectations of prescribed burners regarding liability insurance, which again is not repeated here. We strongly encourage readers interested in the insurance analysis to consult this section in the original report, as key information is presented and important points are made.

Summary of Spreadsheet Data Files

In the original report, this section contained several subsections providing a detailed description of the two spreadsheet data files accompanying the original report. These descriptions still apply to the spreadsheets accompanying this addendum as well and so are not repeated here. The updated data files accompanying this report include all the data from the original mail and telephone surveys, as well as the new data from the mail and telephone surveys of Virginia prescribed burners. Thus, those wanting the most extensive and up-to-date data should use the spreadsheets accompanying this report and then consult the descriptions of these data files given in the original project report.

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