Date of Report: July 6th, 2006

Report edited by Rick Hopson (7/7/06)

BURNED-AREA REPORT

(Reference FSH 2509.13)

PART I - TYPE OF REQUEST

A. Type of Report:

[X] 1. Funding … request for Emergency Stabilization Funds

[ ] 2. Accomplishment Report

[ ] 3. No Treatment Recommendation

B. Type of Action:

[ ] 1. Initial Request (best estimate of funds needed to complete eligible stabilization measures)

[X] 2. Interim BAER / Report # 1

[X] Updating the initial funding request based on more accurate site data or design analysis

[ ] Status of accomplishments to date

[ ] 3. Final BAER Report (following completion of work)

PART II - BURNED-AREA DESCRIPTION

A. Fire Name: Annabella

B. Fire Number: UT-FIF-0055 (Wildland Fire)

C. State: Utah

D. County: Sevier

E. Region: Intermountain - 04

F. Forest: Fishlake National Forest

G. District: Richfield – D4

H. Fire Incident Job Code: P4CPU8

I. Date Fire Started: 06-07-2006

J. Date Fire Contained: 06-14-2006 @ 1800 Hours

K. Suppression Cost: $ 1,500,000 … Type I - Incident Summary / 06-15-2006 (Estimated Final Cost)

L. Fire Suppression Damages Repaired with Suppression Funds

1. Fireline waterbarred (miles) ~ 1 ¼ miles of dozer line with about a ½ mile of hand line
2. Fireline seeded (miles) Seeding was considered unnecessary on this high elevation terrain
3. Other (identify) Light rehabilitation to HeliSpots, Drop Points, Dip Sites and Spike Camp

M. Watershed Number: 160300030315 (Maple Creek – 6th Field HUC #)

N. Total Acres Burned: 573 (Summary of Acres Burned by Land Ownership)

485	**NFS Lands**	-0-	**Other Federal**	-0-	**State of Utah**	88	**Private**

O. Vegetation Types: Spruce - Fir / Aspen Forests (85 %), Aspen (7 %), Mountain Big Sagebrush with

Grasses (7 %) with trace amounts of Curlleaf Mountain-Mahogany and Silver Sagebrush (1 %)

P. Dominant Soils: Typic Haplocryalfs, Mollic Haplocryalfs, Alfic Argicryolls under the Spruce – Fir / Aspen Forests, Pachic Argicryolls and Typic Argicryolls under the stable Aspen, Typic Haplocryolls and Typic Argicryolls under the Mountain Big Sagebrush, Lithic Argicryolls and Lithic Haplocryolls under the Curlleaf Mountain-Mahogany with Vertic Argicryolls under the Silver Sagebrush and Perennial Grasses.

Q. Geologic Types: Intermediate and basic igneous rocks dominate the Lithology such as Rhyolite, Latite, Andesite and Basalt. Most areas on the mountain summit are derived from residuum – while, the very steep mountainside areas are derived from stony deposits of colluvium over hard residuum.

R. Miles of Stream Channels by Order or Class:

Stream Names	Zero Order	1st Order	2nd Order	3rd Order
Maple Creek	1.0	0.9	-0-	-0-
Cliff Creek	0.2	-0-	-0-	-0-

S. Existing Transportation Systems (2)

Trails: ~ 1/4 mile of foot, equestrian and OHV Trail Surface in Cliff Canyon
Roads: ~ 3/4 mile of improved dirt road surface leading into Circle Flat

PART III - WATERSHED CONDITION

A. Burn Severity … based on low-level flights, Landsat imagery & on-the-ground field sampling (# of acres)

160	**Low**	84	**Moderate**	329	**High**

B. Estimate of Water-Repellent Soils (acres): 439 (~ 76 % of the entire burned-area)

C. Soil Erosion Hazard Rating (# of acres)

49	**Low**	219	**Moderate**	305	**High**

D. Erosion Potential: 10.9 tons / acre

E. Sediment Potential: 2,290 cubic yards / square mile

PART IV - HYDROLOGIC DESIGN FACTORS

A. Estimated Vegetative Recovery Period	7 to 10 years
B. Design Chance of Success	88 %
C. Equivalent Design Recurrence Interval	2 years
D. Design Storm Duration	0.5 hours
E. Design Strom Magnitude	0.5 inches
F. Design Flow	10 cfs / mi^2
G. Estimated Reduction in Infiltration	78 %
H. Adjusted Design Flow	160 cfs / mi^2

PART V - SUMMARY OF THE ANALYSIS

A. Describe Critical Values / Resources and Immediate Threats: This wildland fire occurred on steep to very steep, high mountain terrain located in close proximity to the community of Annabella, Utah. Much of the upper watershed for both Maple Canyon and Cliff Canyon has been impacted by a severe burning disturbance. On-the-ground field sampling combined with resource information acquired during low - level / aerial reconnaissance flights indicate 72 % of the burned-area had either MODERATE or HIGH severoty burn zones in areas of spruce-fir / aspen forests. Most of the soils occurring within this burn will remain a fire-damaged resource for a period of 3 to 4 years. All of the high burn severity zones (~ 329 acres) are considered to be potential flood source sites – meaning, a threat to human life and property. In most instances, it will take the dead standing trees about 15 years to decay and finally drop to the ground. .

The community of Annabella, Utah is a relatively small town of about 700 residents; it is surrounded by irrigated croplands, wet meadows, dry pastures and scattered USDI - BLM administered lands. Homes in this rural area are commonly valued in the range of $ 50,000 to $ 250,000. The town is situated about 1¼ miles from the administrative boundary of the Forest Service. There is a genuine concern that accelerated flows of dirty water and floatable debris could impact the town from both the Cliff Canyon and Maple Canyon areas. Initially, a large flush of water coming-off the burned terrain of the Annabella Fire would (potentially) impact the east side of town near its cemetary, fairgrounds, irrigated croplands – and, may damage several well-established homes. Simply stated … in this instance, the immediate threat from the burn is to Human Life and Property. Even a 2-Year storm event would impact this small community; this is due to larger than usual flows being expected to reach town as a direct result of the recent fire. In the event of a larger storm (e.g. 5-Year, 10-Year, 50-Year Events etc) … it is probable that increased flows of water associated with the burn would adversely affect this small southern Utah town. During periods of high flows … there is no way to really predict the actual course of the flood waters – because, so many modifications have been made to the ground surface as the town has continued to evolve over time. What can be said is … overland flows could certainly impact basements, croplands, local properties, transportation surfaces etc for a period of several years – especially, if these gushes of water are allowed to flush unchecked off the very steep, fire-damaged terrain of the Annabella Fire.

(**Note**) – in CY 2000, we had a similar situation with the Swains Fire over in Millard County. Several weeks after the burn, two large storm events dropped rain over the wildfire causing significant flooding in the community of Holden, Utah; it should be stated, the town of Holden was located 6 miles west of the burn – just west of Interstate # 15. In order to deal with the overland flows of water, prision inmates from Millard County and local residents filled sand bags to channel the water away from their town. Still … basements and properties were flooded, sediment and debris covered the irrigated croplands and local roads and streets were scrapped to clean-away the mud from the storms. Damage to the small community of Holden (population – 393 residents) from the storm events was estimated to be in excess of $ 350,000. .

B. Emergency Treatment Objectives: The primary objective in applying the treatment of aerial mulching would be to stabilize the existing ground conditions within upper Cliff Canyon. Currently, the fire has consumed all the organic matter usually found at the ground surface under the spruce-fir / aspen trees, consumed all the 1000 hour fuels and caused strongly hydrophobic conditions within the upper mineral soil to a depth of about 4 inches. If this very steep terrain is left untreated … it will certainly behave much like a hot tin roof flushing large volumes of water away from the burned mountainside straight towards the community of Annabella, Utah. What we need here is to apply weed-free straw as mulch to the fire-damaged area using a Type II or Type III helicopter (A-Star) with its cargo nets at a rate of about 1 to 1½ tons / acre. The straw mulch will act as a protective ground cover which intercepts the raindrops during summer thunderstorm events. The mulch material will help retain some of the moisture up on the mountainside – and, it will allow for a slower (more controlled) release of water towards the town. Since the Richfield Ranger District has made a commitment of using their own funds to conduct a broadcast seeding treatment … the mulch in Cliff Canyon will help the seed stay moist and aid in its germination. The mulch itself will continue to have positive effects upon the treated area for a period of almost 1 year before it blows away or decomposes on the site. Any seed souce associated with the wheat mulch will help to add a crop of cereal grains to the fire-damaged terrain – which, assits in the emergency stabilization of the landscape. In my opinion, when everything is said and done … mulching remains the most effective treatment we have in our BAER Toolbox to limit soil erosion losses. All we have to

do is look at the Springville Fire of CY 2002 in Utah County to see how effective aerial mulching can be in protecting a nearby community from potential flooding hazards.

C. Probability of Completing Emergency Stabilization Treatments Prior to Storm Damaging Event:

Land 85 % Channel N/A % Roads / Trails N/A % Protection / Safety 95 %

D. Probability of Treatment Success:

Treatment Types:	← Years After Treatment →		
	1	3	5
Land Treatments	75 %	80 %	85%
Channel Treatments	-	-	-
Road / Trail Treatments	-	-	-
Protection / Safety Treatments	95 %	85 %	75 %

E. Cost of Taking No-Action (Including Loss) $ 683,000 (homes, croplands, soils, transportation surfaces)

F. Cost of the Selected Alternative (Including Loss) $ 348,000

G. Skills Represented on the Initial / Burned-Area Emergency Response Team:

X	Hydrology (2)	X	Soils	X	Geology		Range		BLM
	Forestry	X	Wildlife	X	Fire Mgt.		Engineering		NRCS
X	Contracting	X	Ecology	X	Botany		Archaeology	X	Helibase
	Fisheries		Research		Visuals	X	GIS Support	X	District Staff

Team Leader: Michael D. Smith / Soil Scientist

Email: mdsmith01@fs.fed.us Phone: (435) - 896 -1071 Fax: (435) - 896 - 9347

H. Treatment Narratives:

(Describe the emergency treatments, where and how they will be applied, and what they are intended to do. This information helps to determine qualifying treatments for the appropriate funding authorities. For seeding treatments, include species, application rates and species selection rationale)

❶ Land Treatments: Using a Type II helicopter (Bell 205 @ $ 1250 / hour) or a high-powered Type III helicopter (Lama @ $ 1300 / hour) drop weed-free straw mulch from its 15 x 15 foot cargo nets at a rate of 1 to 1½ tons / acre; the location to be treated would be about 76 acres of steep to very steep terrain within the upper Cliff Canyon area of Monroe Mountain. The specific purpose of this action would be to quickly stabilize erosive conditions on the severely burned mountainside located above the community of Annabella, Utah. Depending upon the availability of the aircraft, availability of our local helitack crew and the availability of the straw mulch product … treatments could begin as early as 07-01-2006. If the weather conditions permit – and, we have a skilled pilot … the straw mulch could be applied to the charred landscape over a period of 3 to 4 days. The purpose of the treatment would be to add a layer of protective ground cover to the severely burned terrain located directly

above the town of Annabella to minimize flooding **and debris flow** hazards **and thereby mitigate immediate downstream threats to human life and property.**

Hazard Pay would be provided to the Helitack Crew. FYI, 3 new cargo nets and a supply of carabineers were purchased for our local FS / BLM Helitack Crew during CY 2004 using National Fire Plan - Rehabilitation and Restoration (NFP – KP2) Funds.

(**Note**) - The Richfield Ranger District will be conducting broadcast seeding on ~ 70 % of the Annabella Fire during the next few days to a week; this treatment will be paid for with existing funds associated with the Wildlife Program on the District. Since the District is working outside the scope of BAER … seeding rates will be about 15 to 20 lbs / acre – and, treatments will include seeding within all the moderate burn severity polygons (please see our GIS display for Burn Severity at this time). FYI, a new seeding bucket was purchased for our local FS / BLM Helitack Crew during CY 2003 using NFP – KP2 Funds. Since we already have the seed available in a local storage bin … we are all set to begin implementing this emergency land treatment anytime during the week of 06-19-2006.

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I learned this morning, the District would like to use BAER Funds to pay for the cost of the helicopter when it comes time to spread the seed over the Annabella Fire (see Part VI – our Source of Funds Spreadsheet). As previously stated, the seed for this project has already been supplied to the Ranger District from the folks working at the Utah Division of Wildlife Resources in Ephraim, Utah (UDWR)

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(**Note**) – The Richfield Ranger District will be tacking-up approximately 1.5 miles of double-strand temporary field fence to protect areas having a fair to good potential for aspen regeneration following the recent fire disturbance. All of the fence would be placed along the mountain summit on nearly level to gently sloping terrain located southwest of Circle Flat. The fence would remain in place for a period of (at least) 4 years in order to give adequate protection to the emerging aspen suckers from domestic livestock, deer and elk. FYI … we are going to ask for NFP – KP2 / Rehabilitation and Restoration Funds during FY ' 07 using the NFPORS Database to reimburse the District for the cost of materials and the labor associated with building the fencing structure. According to the expenditures incurred while constructing a similar fence for the Johnson Fire during CY 2002 … the new fence should cost about $ 6,665 / mile – or, about $ 10,000 for the entire project.

What we learned from monitoring the Oldroyd Fire was … burned sites located on Monroe Mountain need IMMEDIATE PROTECTION from livestock and wildlife in order to manage the aspen resource – otherwise, the animals utilize the new aspen forage and the fragile site is trasformed from an aspen plant community into a grassland site.

❷ Channel Treatments: None

❸ Roads and Trail Treatments: None

❹ Protection and Safety Treatments: Two metal gates will be used as temporary barriers for road closure purposes in order to keep the general public away from the burn and off the dirt road leading through the fire incident into Circle Flat. The cost of these new gates is expected to be about $ 1800 each – which would include the installation by the Fishlake NF / Engineering Crew. Secondly, we would purchase four new explanatory signs to warn the general public about the inherent dangers of walking through a recently burned-area – especially, during inclement weather conditions. The signs would be useful in keeping folks away from our BAER treatment areas too. The cost of the new signs is expected to be about $ 400 / each. The signs would be placed near Circle Flat, in Henries Hollow and the two remaining signs would be put along an OHV trail located along the Forest Service boundary near Lower Cliff Canyon. The signs would remain in place for a period of at least 3 years –

or, until the mountainside started to resume normal hydrologic function once again. The signs would eventually be stored at the D4 / North Yard for future use when they were no longer needed for this particular burn.

(examples of two explanatory signs used by the Forest Service on wildfires)

I. Monitoring Narrative:

(Describe the monitoring needs, what treatments will be monitored, how they will be monitored, and when monitoring will occur. A detailed monitoring plan must be submitted as a separate document to the Regional BAER coordinator)

(Projected Cost in Year # 1 - $ 6,150)

Both the implementation and effectiveness of our approved treatments will need to be monitored – especially, the aerial mulching treatment in Year # 1.

The placement of the four explanatory signs and the two temporary gates, as well as the overall effectiveness of these items, will be monitored with several field visits. This will occur once the signs and gates are in place - sometime during the summer of 2006.

Vegetative monitoring will be done with walking transects through the treatment areas in the spring of 2007. The species present will be noted and compared to the seeded species list. In addition, hydrophobic soils will be checked for continuing water-repellent ground conditions while we're in the burned-area.

It will be necessary to monitor the application of straw mulch from a helicopter; the rugged terrain of Cliff Canyon is a genuine safety hazard for our employees and pretty much inaccessible from the ground. The presence of straw on the site will be monitored after the first large storm event (and, once again when deemed necessary by the BAER Team) using a reconnaissance flight in a Type III helicopter.

Post storm event monitoring will also take place by analyzing the movement of water off the mountain and into the valley below. Two storms in the first year will be monitored. Data collected by a tipping rain bucket as well as down-slope channel cross-section data will be used to do this analysis.

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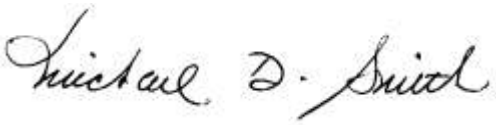
(A detailed Monitoring Plan will be submitted to Jeff Bruggink the R4 / BAER Coordinator with this 2500-8 / Initial BAER Report as a separate document)



Part VI – Emergency Stabilization Treatments and Source of Funds - Initial BAER Report

Line Items	Units	Unit Cost	# of Units	BAER $	Other $	# of units	Fed $	# of Units	Non Fed $	Total $
A. Land Treatments										
Broadcast Seeding - V	acre	37		$0	$0		$0	355	$13,135	$13,135
Helicopter for Seeding	acre	24	355	$8,520						$8,520
Aerial Mulching	acre	925	76	$70,300	$0		$0		$0	$70,300
Temporary Fencing for	mile	8350		$0	$0	1.5	$12,525		$0	$12,525
Insert new items above this line!				$0	$0		$0		$0	$0
Subtotal Land Treatments				$78,820	$0		$12,525		$13,135	$104,480
B. Channel Treatments										
				$0	$0		$0		$0	$0
N/A				$0	$0		$0		$0	$0
				$0	$0		$0		$0	$0
Insert new items above this line!				$0	$0		$0		$0	$0
Subtotal Channel Treat.				$0	$0		$0		$0	$0
C. Road / Trails										
				$0	$0		$0		$0	$0
N/A				$0	$0		$0		$0	$0
				$0	$0		$0		$0	$0
Insert new items above this line!				$0	$0		$0		$0	$0
Subtotal Road & Trails				$0	$0		$0		$0	$0
D. Protection / Safety										
Explanatory Signs	sign	400	4	$1,600	$0		$0		$0	$1,600
Road Closure Gate an	gate	1800	2	$3,600	$0		$0		$0	$3,600
				$0	$0		$0		$0	$0
Insert new items above this line!				$0	$0		$0		$0	$0
Subtotal Structures				$5,200	$0		$0		$0	$5,200
E. BAER Evaluation										
BAER Team	day	1600	6	$9,600	$0		$0		$0	$9,600
Helicopter - Lama	hour	1300	1	$1,300	$0	2.5	$3,250		$0	$4,550
Supplies & Document I	misc	350	1	$350	$0		$0		$0	$350
Landsat (RSAC)	image	580		$0	$0	1	$580		$0	$580
Insert new items above this line!				$0	$0		$0		$0	$0
Subtotal Evaluation				$11,250	$0		$3,830		$0	$15,080
F. Monitoring										
Year 1	year	6125	1	$6,125	$0		$0		$0	$6,125
Insert new items above this line!				$0	$0		$0		$0	$0
Subtotal Monitoring				$6,125	$0		$0		$0	$6,125
G. Totals				$101,395	$0		**$16,355**		**$13,135**	**$130,885**
Previously approved				$92,875						
Total for this request				**$8,520**						

Amendment to the Initial BAER Report – H4CPU8 **July 6th, 2006**

On June 21st of 2006, the BAER - Assessment Team working on behalf of the Fishlake National Forest submitted two siigned copies of the Initial / BAER Report for the Annabella Wildfire up to Jeff Bruggink (R4 / BAER Coordinator) in Ogden, Utah for his review of the document and its subsequent approval. Since we had not previously discussed the aerial seeding treatment being proposed by the Richfield Ranger District in relation to emergency soil stabilization and minimizing erosion losses from severely burned terrain ... the requested amount of $ 12,425 for our Type II / helicopter work was UNFUNDED in connection with the seeding operation; simply stated, it was thought the seeding treatment was simply being applied to Cliff and Maple Canyons in order to grow new forage for upland big game animals. It should be noted, most of the high mountain terrain occurring within these canyons is steeper than 50 % slopes.

In the days following our initial request for $ 105,300 in WFSU funds, it was finally determined that our proposed seeding ttreatment was specifically designed and intended for soil stabilization purposes – not, for improving wilflife habitat in our very steep canyon areas. The seed mix that was applied to the burned-area included 1) thickspike wheatgrass, 2) pubescent wheatgrass, 3) orchardgrass, 4) sandberg bluegrass, 5) canby bluegrass, 6) timothy, 7) slender wheatgrass and 8) big bluegrass; there were no forbs or shrub seed included in this mix. All of the seed is being used to stabilize erosive ground conditions on steep to very steep mountainsides damaged by the recent incident of wildfire. These are the same grass species that were successfully seeded for soil stabilization purposes on the Marysvale Peak / WFU during July of 2005

In addition to protecting long-term soil productivity on approximately 355 acres charred during the recent burn … the seeding should help to offset water-repellent ground conditions – and, minimize the threat of flooding hazards to the small community of Annabella, Utah. Originally, it was estimated that the seeding operation would cost about $ 35 / acre to complete using a Type II / Bell 205 - Super helicopter. When everything was said and done … the actual expenditure was lowered to about $ 24 / acre for a cost of $ 8,520 for the entire project. What lowered the cost was … 1) the staging area for the seeding operation was set-up in Long Valley – a mountain summit located in close proximity to the burn, 2) only a few Helitack were actually needed to conduct the treatment and 3) the larger Type II aircraft had a much faster turn-around-time for treating the burned-area and returning back to the staging grounds once again. Keep in mind, since we already own the seeding bucket … we did not have to involve 2 crew members with a day of driving time to retrieve and return the bucket for the planned seeding work. And, lucky for us, the existing FS / BLM Contract paid the daily avalability fee (~ $ 3,925) for the Initial Attack aircraft. Overall, the seeding operation was completed a few days ago and thought to be a complete success by both Kreig Rasmussen and Mace Crane - employees of the Richfield Ranger District and Jamie McIntosh our RIFC Helibase Manager. Now … if the area receives adequate moisture this summer and later next spring without flushing large volumes of water off the burned hillsides, the grasses should be germinated and growing during our Year # 1 monitoring activities.

The purpose in submitting this Interim # 1 / BAER Report is to request another $ 8,520 in WFSU funds to reimburse the Richfield Ranger District for the actual cost of using a Type II helicopter during the seeding treatments they completed for soil stabilization purposes within the Annabella Wildfire. And … this report is being used to update the cost of the acquiring seed along with the cost of constructing the temporary fence used to protect emerging aspen following the burn. It should be noted, a total of $ 12,500 has been requested for the Richfield RD using the NFPORS Database for its 1.5 miles of fence using KP2 Funds in FY ' 07.

Michael D. Smith

PART VII - APPROVALS

1. /s/ Diane Freeman — July 6, 2006
   Forest Supervisor (signature) — Date

2. /s/ Cathy Beaty for — July 10, 2006
   Regional Forester (signature) — Date

Watershed Condition Summary

19 June 2006

INTRODUCTION:

This summary presents the results from the hydrologic assessments done for the Burned Area Emergency Response report for the Annabella Wildfire. Map 1 shows the analysis watersheds that are expected to respond to the changed conditions created by the fire. The community of Annabella and outlying developments are the primary values-at-risk. The source area for the Annabella spring water source was unaffected by the fire. Channel flow paths cross underneath a power line located above Annabella. Map 2 shows the probable flow paths and depositional areas that a fire-induced flood would follow. This map also shows the town of Annabella in relation to the fire. Behavior of flows across alluvial fans is notoriously unpredictable so the lines and areas shown are only a best guess approximation and are not based on an elevation-controlled survey.

POST-FIRE CONDITION SUMMARY:

Post-fire conditions have been assessed to determine how fire induced changes to slope hydrology and soil conditions will impact the potential values at risk. Key to this assessment is the burn severity mapping shown in Map 1. Table 1 shows the number of acres affected by the different burn severities within the analysis watersheds. Field surveys indicate that the areas burned with high severity are strongly hydrophobic to a depth of 3 to 4 inches.

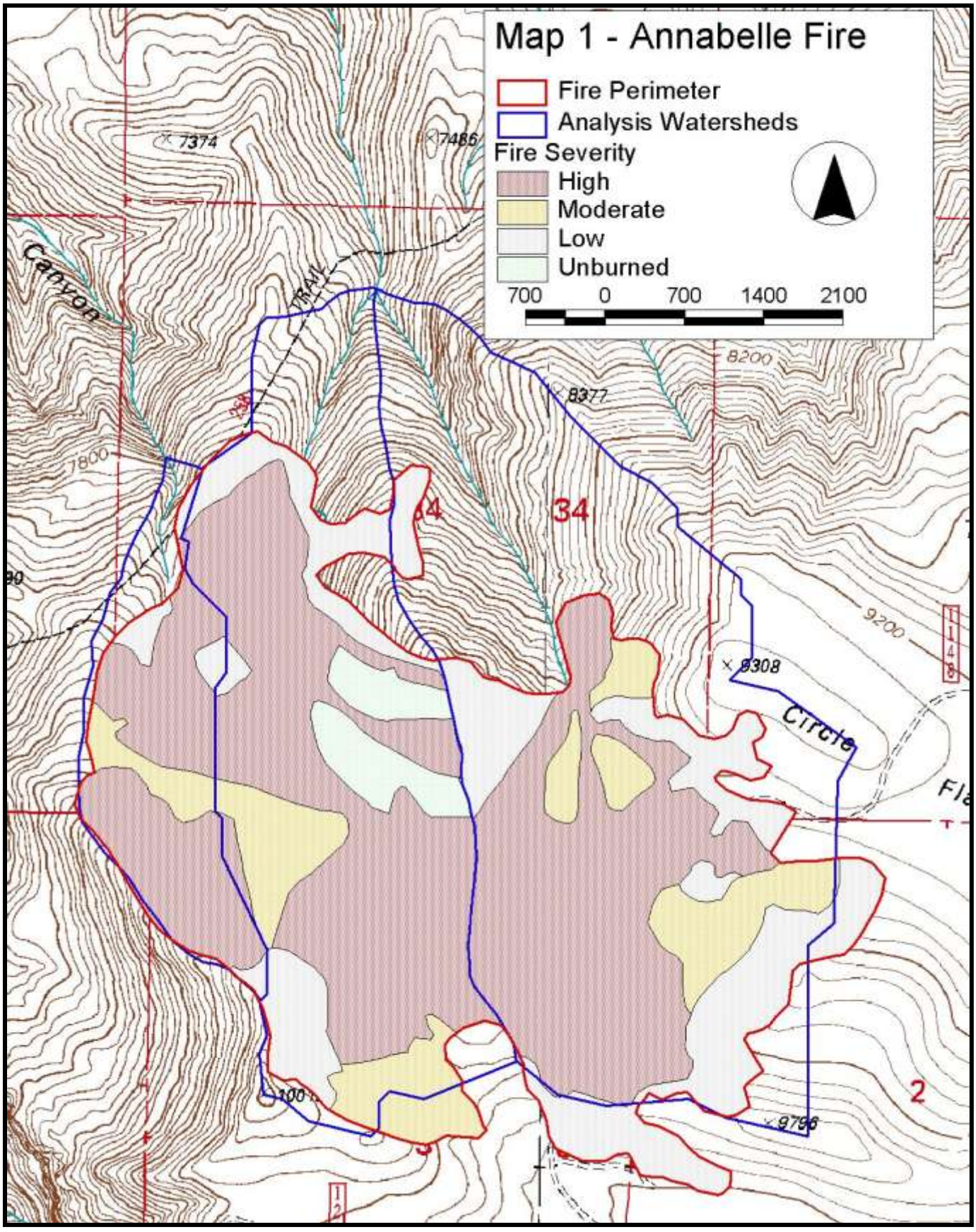
Table 1

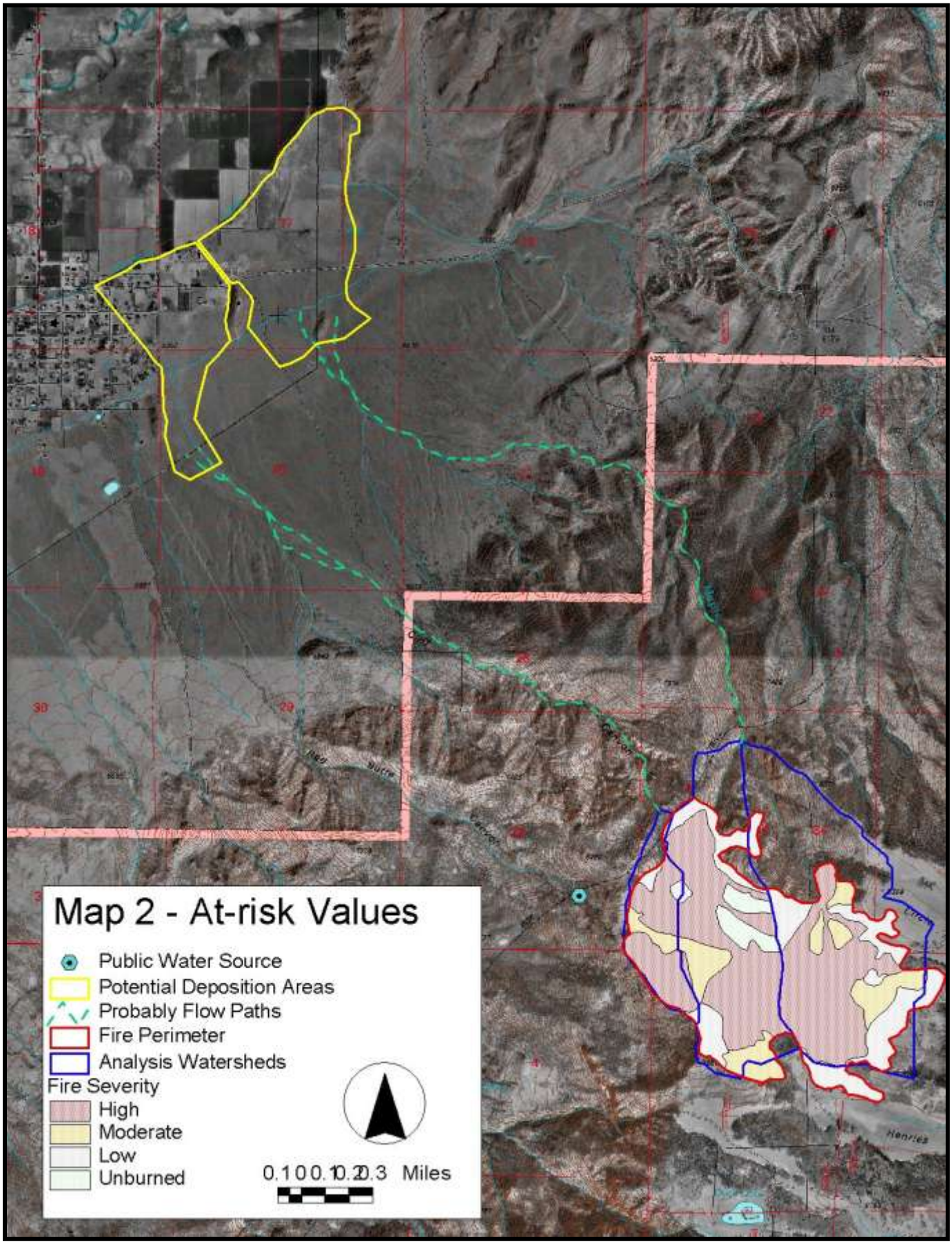
Watershed Name	Drainage Area	High Severity	Moderate Severity	Low Severity	Total Burned	Unburned
	acres	acres	acres	acres	acres	acres
Maple Creek at West & East Conf.	712	268	67	105	440	272
West Fork Maple Creek	290	140	30	37	207	83
East Fork Maple Creek	422	128	37	68	233	189
Cliff Creek	92	60	9	7	76	16

Table 2 shows the percentages of each burn severity class for each of the analysis watersheds. Floods and debris flows should normally be expected on steep watersheds of these sizes when roughly 40 percent or more of the basin is burned with moderate or high severity. An analysis of debris flow potential [see below] indicates that each of these basins is inherently prone to debris flows. The loss of vegetation and soil impacts from the fire greatly amplify this inherent risk. Coarse sediment and debris from a debris flow would be deposited before reaching any of the values-at-risk due to long distance between the top of the alluvial apron and the town Annabella. However, sediment-laden waters should be able to reach the depositional areas shown on Map 2.

Table 2

Watershed Name	Drainage Area	High Severity	Moderate Severity	Low Severity	Total Burned	Unburned
	acres	%	%	%	%	%
Maple Creek at West & East Conf.	712	38 %	9 %	15 %	62 %	38 %
West Fork Maple Creek	290	48 %	10 %	13 %	71 %	29 %
East Fork Maple Creek	422	30 %	9 %	16 %	55 %	45 %
Cliff Creek	92	65 %	10 %	8 %	83 %	17 %


Map 1 - Annabelle Fire
Fire Perimeter
Analysis Watersheds
Fire Severity
High
Moderate
Low
Unburned
700 0 700 1400 2100
7374
7486
8377
8200
9200
9308
9796
7800
34
2
Canyon
TRAIL
Circle


Map 2 - At-risk Values
Public Water Source
Potential Deposition Areas
Probably Flow Paths
Fire Perimeter
Analysis Watersheds
Fire Severity
High
Moderate
Low
Unburned
0.1 0 0.1 0.2 0.3 Miles

Basin Area	Relief Ratio
0.01	0.5
0.1	0.3
1	0.1

Cannon, S., Gartner, J., Holland-Sears, A., Thurston, B., Gleason, J. 2003. **Debris-flow response of basins burned by the 2002 Coal Seam and Missionary Ridge Fires, Colorado**. In Boyer, D.D., Santa, P.M., and Rogers, W.P., eds., Engineering Geology in Colorado-Contributions, Trends, and Case Histories: AEG Special Publication 14, on CD-ROM.

Analysis Watershed Data			
Watershed Name	**Drainage Area**	**Relief Ratio**	**Debris Flow Prone?**
Text	miles2	dimensionless	Y or N
Cliff Canyon	0.14	0.42	YES
Cliff Canyon above FS Boundary	0.78	0.33	YES
Maple CK west tributary	0.45	0.35	YES
Maple CK east tributary	0.66	0.34	YES
Maple CK above FS Boundary	1.39	0.25	YES
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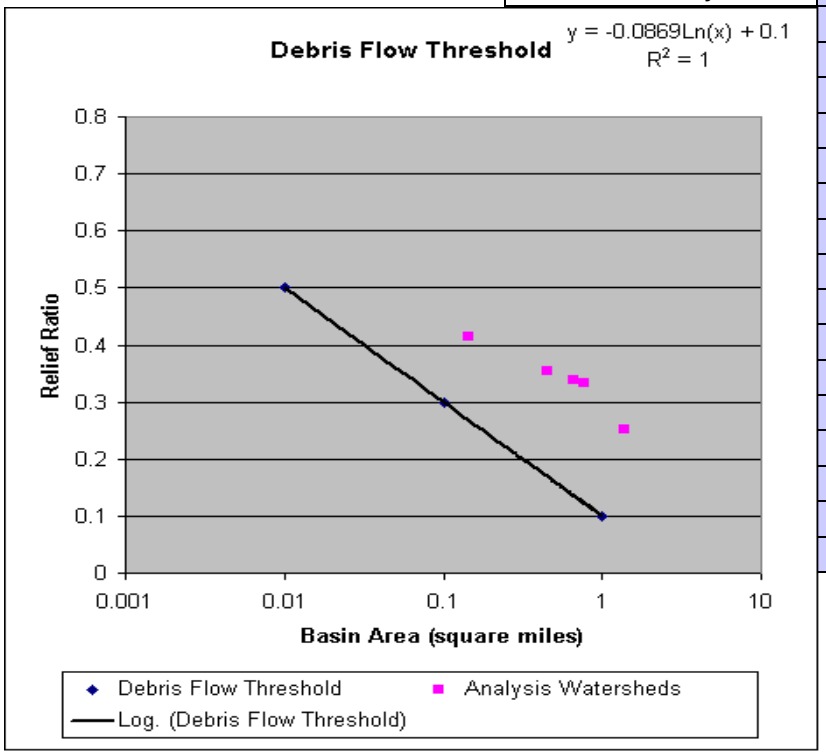

Tables 3 shows predicted pre-fire estimates for flood sizes following summer thunderstorms of differing return periods. This modeling is based on the Rational Method used in the HYDRO module of HYDRAIN.

Table 3

Watershed Name	Pre-fire 2 Year Return Interval Flood	Pre-fire 5 Year Return Interval Flood	Pre-fire 10 Year Return Interval Flood	Pre-Fire 50 Year Return Interval Flood
	Cfs	cfs	cfs	cfs
Maple Creek at West & East Conf.	13	18	23	35
West Fork Maple Creek	5	7	9	14
East Fork Maple Creek	8	11	14	21
Cliff Creek	2	2	3	5

Table 4 shows expected increases in flood size resulting from fire effects for the first year of recovery. Potential peak flows have increased about one order of magnitude and can now generate enough water to travel across the alluvial apron, even though this did not normally occur before the fire. A 2-year rainstorm intensity will now generate a larger flood than a 100-year storm before the fire. Experience in Utah indicates that it sometimes takes a few storms before the floods occur. The early precipitation events fill in available slope detention storage and create the rill and gully networks that are necessary to fully induce the expected increase in flood response from short-duration high intensity rainstorms.

Table 4

Watershed Name	Post-fire 2 Year Return Interval Flood	Post-fire 5 Year Return Interval Flood	Post-fire 10 Year Return Interval Flood	Post-Fire 50 Year Return Interval Flood
	Cfs	cfs	cfs	cfs
Maple Creek at West & East Conf.	172	239	296	457
West Fork Maple Creek	85	118	146	226
East Fork Maple Creek	87	121	150	231
Cliff Creek	34	47	58	90

Flood potential will decrease as soils re-vegetate, and infiltration capacity and slope roughness reestablish. However, recovery of the strongly hydrophobic soils may take as long as 5 years. Table 5 gives the probability that a storm of a given size will occur within the next three years, which is proportionally when most of the hydrologic recovery will occur.

Table 5

2 Year Return Interval	5 Year Return Interval	10 Year Return Interval	25 Year Return Interval	50 Year Return Interval	100 Year Return Interval
88 %	49 %	27 %	12 %	6 %	3 %

There is an 88 percent chance that a two year storm will occur before the slopes have hydrologically recovered, which makes it the most likely storm size that could lead to flooding. Table 4 shows that even a two-year storm will be capable of generating sizeable flows.

Table 6 uses a maximum flood envelope based on the largest floods on record in south-central Utah to indicate the largest size flood that could be expected from drainages of this size. Floods of these magnitudes are possible, but not expected.

Table 6

Watershed Name	Max Flood based on cfsm2
	cfs
Maple Creek at West & East Conf.	768
West Fork Maple Creek	630
East Fork Maple Creek	684
Cliff Creek	490

HYDRAIN was used to estimate volumes of water that could be associated with the post-fire floods shown in Table 4. These data are necessary to assess whether or not water detainment and storage on the alluvial fan is sufficient to prevent flooding of structures and property. Table 7 shows acre-feet estimates for storms of different sizes. For a worst-case scenario, assume that all of the storm flow is simultaneously delivered to the depositional areas near Annabella shown on Map 2. Table 8 shows the depths of water that would result depending on how big the actual depositional area actually is and how evenly the water could be distributed.

Table 7

Watershed Name	Post-Fire 2 Year Storm Volume	Post-Fire 5 Year Storm Volume	Post-Fire 10 Year Storm Volume	Post-Fire 50 Year Storm Volume
	acre-feet	acre-feet	acre-feet	acre-feet
Maple Creek at West & East Conf.	6.0	13.9	19.7	33.1
West Fork Maple Creek	2.6	6.0	8.5	14.3
East Fork Maple Creek	3.4	7.8	11.2	18.9
Cliff Creek	1.2	2.7	3.7	6.1

Increases or decreases in the actual depositional area, which is not known, inversely increase or decrease expected water depths. For example if only 25 acres of depositional area are available below Cliff Creek, then the flood depths would double the depth from 50 acres. For a sense of scale, the depositional areas shown on Map 2 below Cliff Creek represent 170 acres [West area] and 268 acres [East area] below Maple Creek.

Table 8

Watershed Name	Post-Fire 2 Year Storm Depth	Post-Fire 5 Year Storm Depth	Post-Fire 10 Year Storm Depth	Post-Fire 50 Year Storm Depth	Assumed Depositional Area
	inches	inches	inches	inches	acres
Maple Creek	0.4	0.8	1.2	2.0	200
	0.7	1.7	2.4	4.0	100
	1.4	3.3	4.7	8.0	50
	2.9	6.7	9.5	15.9	25

Table 8

Watershed Name	Post-Fire 2 Year Storm Depth	Post-Fire 5 Year Storm Depth	Post-Fire 10 Year Storm Depth	Post-Fire 50 Year Storm Depth	Assumed Depositional Area
	inches	inches	inches	inches	acres
Cliff Creek	0.1	0.2	0.2	0.4	200
	0.1	0.3	0.4	0.7	100
	0.3	0.6	0.9	1.5	50
	0.6	1.3	1.8	2.9	25

The question then becomes, "would the given depths of water overwhelm the soil infiltration and detainment capacity and result in nuisance flooding?" The yellow highlighted values indicate increased risk of flooding for the given conditions. Based on these estimates and the location and anticipated size of available depositional areas, nuisance flooding is not expected to impact values-at-risk. However, drainage below Cliff Creek has the greatest potential to impact the town of Annabella. Therefore, a larger margin of safety is warranted when considering BAER treatments in the burned portions of Cliff Creek.

The loss of vegetation and hydrologic changes will also lead to greater sediment delivery from increased slope and channel erosion. Disturbed WEPP modeling was used to estimates ranges for post-fire erosion rates that are shown in Table 9. For reference, pre-fire erosion rates in vegetated areas are estimated to be less than 0.05 tons per acre per year.

Table 9

Watershed Name	Post-fire Erosion
	tons/acre
Maple Creek at West & East Conf.	3.3 to 22.8
West Fork Maple Creek	5.1 to 22.8
East Fork Maple Creek	3.3 to 17.0
Cliff Creek	3.9 to 14.9

The soil recovery from fire impacts, and effectiveness of potential slope treatments were evaluated using the Erosion Risk Management Tool (ERMiT). Erosion rates typically drop significantly within three years after the fire, which is reflected in the probabilities shown for sediment delivery in the following graph. The largest portion of this recovery occurs in the first one to two years following the fire. For the Annabella Fire, aerial application of straw mulch is considered the best option to reduce flooding and erosion risks associated with fire effects. ERMiT modeling shown in Table 10 indicates that this would be more effective than applying other treatment options such as erosion barriers. The modeling also indicates that the biggest reduction of erosion occurs at an application rate of straw of 1 ton per acre. The model suggests that adding 1.5 or more tons of straw per acre provides a small marginal benefit for reducing erosion. A target slightly higher than 1 ton per acre may be warranted to make sure that 1-ton per acre prescription is achieved across the treatment area since it can be difficult to spread straw from a helicopter evenly.

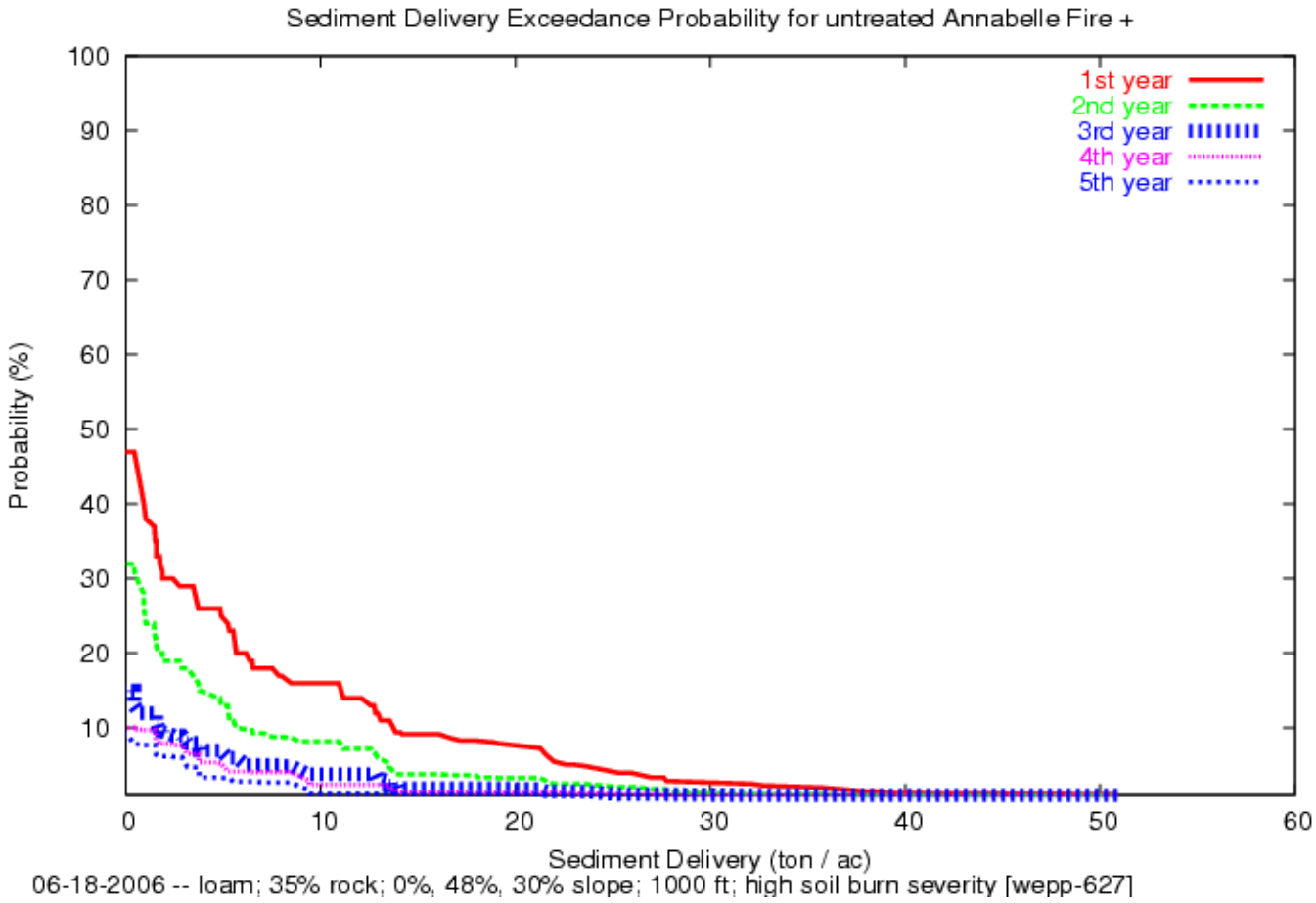

Table 10					
Mitigation Treatment Comparisons					
Probability that sediment yield will be exceeded [ ] % go	**Event sediment delivery (ton ac^{-1})**				
	Year following fire				
	1st year	**2nd year**	**3rd year**	**4th year**	**5th year**
Untreated	**13.8**	**6.02**	**1.73**	**0.78**	**0.02**
Seeding	**13.8**	**3.75**	**1.6**	**0.24**	**0.02**
Mulch (0.5 ton ac^{-1})	**4.94**	**3.73**	**1.73**	**0.78**	**0.02**
Mulch (1 ton ac^{-1})	**1.68**	**2.41**	**1.73**	**0.78**	**0.02**
Mulch (1.5 ton ac^{-1})	**1.68**	**2.04**	**1.73**	**0.78**	**0.02**
Mulch (2 ton ac^{-1})	**1.68**	**1.79**	**1.73**	**0.78**	**0.02**
Erosion Barriers: Diameter [ ] ft Spacing [ ] ft go ?					
Logs & Wattles	**8.29**	**1.84**	**0**	**0**	**0**

CONCLUSIONS:

Post-fire flood events from the Annabella Fire are likely following short-duration high-intensity rainstorms. Debris flows are also a possibility. These events can be created by 2-year return interval storms and would likely approach the town in less than half an hour after the initiation of a sustained storm. The potential effects from these storms will be ameliorated, but not eliminated by distance and unburned riparian areas below the fire. Flooding below Maple Creek is likely to be more of an annoyance than an event that will damage property. Flooding below Cliff Creek has greater potential for impacting the town of Annabella, even though flows will likely be much less than those from Maple Creek. Maple Creek has a larger and safer area where flood water and sediment can be dispersed and detained. Coarse sediment and debris from a debris flow would be deposited before reaching any of the values-at-risk due to long distance between the top of the alluvial apron and the town Annabella. The fire did not impact the source area for the spring that is a public water source for the town of Annabella. The power line is located on a transitional area where slope and channel gradient decreases. Therefore, scouring of the footers on these structures is not anticipated.

No road or motorized trail facilities on the forest are likely to affect or be affected by post-fire flooding and erosion. Channel treatments are not needed and would not be effective in any case due to the steep slope and channel gradients in the area affected by the fire.

RECOMMENDATIONS:

1. Aerial mulching of the burned areas in Cliff Creek (about 76 acres) should be considered given that portion of the fire drains directly towards the town of Annabella.

2. Signs should be posted to warn the public that flash floods are likely following summer thunderstorms. Public access to the bases of Maple and Cliff Creeks should be restricted until sufficient recovery from fire effects has occurred.

3. The town of Annabella should consult with the Natural Resource Conservation Service to determine if flood protection measures are needed and can be funded. For example, the City may want to consider maintaining the existing flood control ditch that parallels the base of the alluvial fan above the town [see Map 2]. The City may also want to evaluate storm drainage on the north end of town to make sure that it is functional.

4. The district should rest the suitable portion of the burned area from livestock grazing for a minimum of two years and preferably long enough for aspen regeneration to grow above the browse line.

5. The district should consider fencing a portion of the aspen stands on the flatter slopes at the top of Maple Creek where elk are likely to overgraze and possibly eliminate sprouting aspen clones.

6. Irrigators should monitor storms over the fire and consider temporarily closing lines that are susceptible to intercepting flood flows following intense rainstorms.

7. As a courtesy, the power line operators should be notified of the potential for flooding below their lines.

(Dale Deiter and Adam Solt / Hydrologists)

Soil Resource Summary

INTRODUCTION:

All of the soils located in the Annabella Fire were mapped within a cryic temperature regime area – meaning, the recent burn occurred upon a high mountain landscape. Elevations within the burned-area ranged from about 7,750 to 9.900 feet. Much of the disturbance had previously supported mature stands of spruce / fir on north and northwest facing slopes - a few scattered aspen were intermixed with these conifers. All of the soils in this area were derived from mixed igneous rocks; the soil resources were formed in deposits of stony colluvium – or, colluvium over residuum. Mean annual precipitation in this area is about 20 to 26 inches / year. The freeze-free period is about 40 to 80 days / year. The most common type of ecological unit occurring within the fire was the High Mountain Stony Loam (Mixed Conifer) range site. The following types of soil were mapped, sampled and described on Monroe Mountain in 1991 – and, were later found to be occurring inside the burn:

(Subgroup Level of Soil Taxonomy, 2003)

Typic Haplocryalfs	Mollic Haplocryalfs
Lithic Haplocryalfs	Alfic Argicryolls
Pachic Argicryolls	Pachic Argicryolls
Lithic Argicryolls	Pachic Haplocryolls
Lithic Haplocryolls	Typic Argicryolls

Fragile or non-renewable type soils that are situated on steep to very steep mountainsides have a maximum erosion tolerance of about 1 to 2 tons/acre/year. If accelerated rates of erosion surpass this stated threshold, it's not too long before the site is adversely affected and long-term soil productivity becomes an issue. However, when soil resources are found on deeper sites having nearly level to strongly sloping terrain, they demonstrate a better tolerance for erosion losses … in the range of 3 to 5 tons/acre/year. What we need to understand is … all of these soils can be stabilized, rehabilitated and restored to a normal type of hydrologic function once again. While the resource damage associated with a wildfire can be quite severe in some instances, it is not considered to be a permanent impairment of the ground.

OBSERVATIONS:

There was extreme fire behavior in the Cliff Canyon area during this burn. Most of the soils sampled in this area are currently strongly hydrophobic to a depth of about 4 inches. These soils will remain a fire-damaged resource for a period of 3 to 4 years – perhaps longer. Most of the terrain in Cliff Canyon consists of steep to very steep mountainsides intermixed with a few rock outcrops - some areas approach 80 % slopes. The pre-burn forest consisted of non-commercial stands of timber. A few areas had Douglas fir growing near the rock outcrops. Aspen was scattered throughout the canyon area ... but, much of the landscape supported mixed conifers. All of the organic layer(s) under the conifers were completely consumed during the fire. This is a clear indication that the mineral soil was super-heated during the blaze. A very thick layer of white and brown ash was seen on-the-ground under the dead standing trees. This is another indication of extreme heating. Many of the lateral branches usually observed on the trees were consumed during the fire event – meaning, the 1000 hour fuels are gone from this site. Currently, the soils have no hydrologic function whatsoever – meaning, the fire-damaged slopes will behave just like a hot tin roof during a summer rainfall event flushing large volumes of water away from the burn straight towards the community of Annabella, Utah. It has been determined by Hydrologic Modeling that … a 5-Year storm event would certainly cause some flooding problems in this small community.

The soils in upper Maple Canyon were damaged by the recent wildfire too – but, the hazard from flooding for the small town of Annabella is of lesser concern – because, the runoff waters in Maple Creek do NOT follow a

straight path towards the existing homes. Once again, the spruce / fir sites of Maple Canyon were affected by a severe burn. And … once again, the disturbance took place on steep to very steep terrain. The soils in this part of the burn are strongly hydrophobic – meaning, water did not infiltrate into the mineral horizons for at least 40 seconds after the field testing was started by the BAER Team. With respect to the issue of long-term soil productivity … I support the Districts decision to use seed acquired from UDWR for broadcast seeding purposes. After several conversations with the Hydrologist's … it was decided that aerial mulching would NOT be necessary in Maple Canyon. It was thought … if a large flow of water flushed off the burn towards town … it would jump the existing channel about 1 mile SE of town – and, the water would travel across the alluvial fan terraces dissipating its energy upon BLM lands

Much of the burn located on the mountain summit in close proximity to Henries Hollow and Circle Flat should have a beneficial effect on the seral aspen sites. For the most part, the disturbance was a ground fire that consumed the surface litter and large woody debris found under the aspen – without, torching up into the trees causing a stand-replacing canopy fire. Some of the issues on the mountain summit deal with public safety – especially, on the road to Circle Flat; this concern will be addressed with temporary gates and explanatory signs. The District has plans to build a double wire fence about 84 inches in height to protect the emerging aspen suckers from domestic livestock, deer and elk. The structure will be located ½ to 1 mile SW of Circle Flat on NFS lands. It will protect about 60 acres from forage utilization by cattle and wildlife. Good Job ! . . . .

RECOMMENDATIONS: (6)

- ➔ Complete the 355 acres of broadcast seeding as planned to protect long-term soil productivity and stabilize highly erosive sites
- ➔ Build the 1.5 miles of temporary fence to protect distinct areas having a fair to good potential for aspen regeneration following a ground disturbance; leave the fence in place for at least 4 years.
- ➔ Apply aerial mulching to 76 acres in Cliff Canyon to protect the small community of Annabella, Utah from potential flooding hazards associated with the recent burn.
- ➔ Have the Fishlake NF / Engineering Crew install 2 temporary road closure gates and 4 explanatory signs for public safety and control of entry into the burned-area
- ➔ Conduct monitoring activities for a period of 1 year to determine the effectiveness of the aerial mulching treatment in Cliff Canyon – and, to determine if mulch should have been applied to Maple Canyon too.
- ➔ Revise the existing Burn Severity Map once the Landsat Image is made available to the Fishlake NF / BAER Team from the RSAC folks (Jan Johnson)

ASPEN REGENERATION:

Generally speaking, all of the soils mapped on the mountain summit have a fair to good potential for aspen regeneration following a ground disturbance. Our soil suitability ratings have been defined as follows on the Fishlake National Forest / GIS Interpretive Plot for Aspen Regeneration:

(Please see the GIS / Interpretive Map at this time)

GOOD … this rating indicates both the soil properties and site characteristics are generally well suited for sustaining a stable type of aspen plant community. These areas should be managed with small disturbances or mortality events *(i.e. low to moderate severity / prescribed fire treatments or instances of wildland fire use, timber harvesting, mechanical thinning etc.)* every 70 to 100 years to provide the aspen clones with an opportunity to re-sprout which perpetuates the health of the stands. Some areas currently rated as good … are presently in over-mature or decadent condition; these sites should be treated as soon as possible. In order to achieve successful aspen regeneration, some stands will need to be protected from grazing by upland big game animals and domestic livestock for a period of 2 to 5 years. This can be accomplished by using fencing

or slashing to provide a temporary barrier around the treatment area allowing the aspen suckers continued growth to the desired 6 foot height. A stable aspen community is capable of producing > 2,000 lbs/acre/year of forage during normal climatic conditions; this potential rate of production qualifies for Rangeland Productivity / Class I – which is the highest category in the Intermountain Region of the Forest Service.

FAIR … this rating is being used to identify areas of seral aspen; sites which are currently at-risk to stand replacement by conifers due to the continuing encroachment of subalpine fir, white fir, Douglas fir and Englemann spruce in the area. Large tracts of land should be treated with a massive disturbance event in an effort to return the existing vegetative conditions back to a younger aspen forest. Once again, additional conservation measures may be necessary to protect the treatment areas from seasonal grazing pressure – especially from deer and elk. **If there is a lack of commitment or a problem associated with assuring adequate protection occurs within a project area – then, the treatments should not be implemented.** It should be noted, some stands of seral aspen which are 1) located on steep to very steep terrain, 2) observed on north aspects or 3) already have > 50 % conifer invasion … may not return to a stable aspen community following our ground-disturbing activities. In these areas, the best opportunity for aspen regeneration would be following a wildfire, after wildland fire use or when implementing prescribed fire treatments.

POOR … this rating means the site is considered to be quite marginal for aspen regeneration following all types of ground disturbances. Most of these locations have > 75 % conifers occurring within the overstory – some locations, were actually identified as being spruce - fir type forests on our existing vegetation map. These soils have limited topsoil development, strong albic horizons, acidic pH conditions, low to moderate water retention properties and few plant available nutrients; in some instances, the unit will be either too dry or simply too moist with respect to its mean annual precipitation to support healthy aspen plant communities. Most disturbances will result in a short-term response of aspen *(< 25 years)* with scattered regeneration observed throughout the treatment area … these sites will quickly revert back to conifers by natural succession. In areas of commercial timber, the harvested locations are commonly planted back to Englemann spruce as part of our reforestation effort.

(Michael D. Smith / Soil Scientist)

Vegetation, Noxious Weeds and TES Plant Species

SITE DESCRIPTION:

Almost all of the land encompassed by the Annabella Fire perimeter, prior to ignition, had an aspen vegetative component (92 %), the majority of the burn being in a mixed conifer / aspen vegetation type (85 %). The rest of the vegetation was either curlleaf mountain-mahogany or sagebrush (8 %).

With 92 % of the pre-fire vegetation having an aspen component the area has the potential to recover on its own. With some good summer precipitation the aspen could start to regenerate by this fall. However, the recovery may not be quick enough to help limit the movement of water and soil from the site as 72 % of the area burned was at a Moderate to High severity.

RECOMMENDATIONS:

Establishment or re-establishment of protective vegetation by seeding of the severely burned portions of high-risk watersheds is recommended. Aerial seeding is a useful tool for establishing vegetation, which can help stabilize soil, control water movement, and restore ecosystem function. Seeding in the area of the Annabella Fire will aid in achieving these goals.

It is also recommended that measures be taken to limit the consumption of new aspen suckers by wildlife and domestic livestock (see write-up below).

BROADCAST SEEDING:

The Richfield Ranger District will provide funds to aerially seed approximately 70 % of the Annabella Fire. The seed mix was developed by District personnel who are familiar with the area. Some areas of the step terrain to be seeded will also have straw mulch applied aerially. This has the potential to increase the success of the seeding treatment in those areas as it will hold moisture which, in turn aids in plant germination.

NOXIOUS and INVASIVE SPECIES:

There is minimal concern for invasive species to move into the burned area. Machinery used in the suppression efforts were washed prior to arrival on the Annabella Fire. The adjacent landscapes are presently void of invasive species although the potential for spread is present, as it is on all areas of the Forest that are adjacent to roads and trails. If any noxious weeds are discovered in or near the burned area the Forest will make efforts to eradicate them upon discovery.

TES PLANTS:

No Threatened, Endangered or Sensitive (TES) plant species are known to occur in the vicinity of the Annabella Fire. None of the TES species known to occur on the Richfield Ranger District have suitable habitat within the fire perimeter.

Potential for Aspen Regeneration

Most of the burned area inside the fire perimeter includes plant communities with quaking aspen as a major tree species. At this geographic latitude, aspen regenerate almost exclusively when suckers sprout from lateral root systems of mature aspen trees in a stand. This regeneration strategy accelerates when the mature trees in a stand are heat girdled and killed by fire.

The Fishlake National Forest has had similar potential for aspen regeneration in the past. The Oldroyd Fire in August of 2000 created a high potential for improved aspen ecosystems. At present the area consumed by the Oldroyd Fire has not met its potential for aspen regeneration. A high level of grazing pressure by wildlife and domestic livestock has consumed a majority of the aspen suckers in the area.

As demonstrated by other events on the Fishlake National Forest the success of aspen regeneration is dependent on efforts to protect the area from high levels of browsing. Temporary fencing designed to prevent livestock and wildlife from entering the burned area would give the aspen an opportunity to get established. It is possible that if some precautions are not taken with regards to browsing pressure that the aspen ecosystems in the Annabella Fire will never reach properly functioning condition.

(David Tait / Botanist; Bob Campbell / Ecologist and Linda Chappell / Fuels Specialist)