Date of Report: October 17th, 2002

USDA - FOREST SERVICE / BURNED - AREA REPORT

(Reference FSH 2509.13)

PART 1 … TYPE of REQUEST

A. Type of Report

(X) 1. Funding request for estimated WFSU - SULT funds

( ) 2. Accomplishment Report

( ) 3. No Treatment Recommendation

B. Type of Action

( ) 1. Initial Request
(Best estimate of funds needed to complete eligible rehabilitation measures)

(X) 2. Interim Report … # 2

(X) Updating the initial funding request based on more accurate site data and design analysis

( ) Status of accomplishments to date

( ) 3. Final Report - following completion of the emergency work

PART 2 … BURNED - AREA DESCRIPTION and FIRE LOCATION

A. Fire Name: Mollie

B. Fire Number: P48123 / UT - UIF - 18127

C. State: Utah

D. County: Utah … # 049

E. Region: R4 / Intermountain

F. Forest: Uinta … # 0418

G. District: D3 / Spanish Fork

H. Date Fire Started: 08-18-2001 @ 1740

I. Date Fire Contained: 09-01-2001

J. Time Fire Contained: 1800

K. Suppression Costs: $ 4,200,000 (estimated) … taken from the ICS - 209 dated 09-03-2001

L. Fire Suppression Damages Repaired with EFFS – PF12 Funds:

- Fireline Waterbarred (miles) — 3 miles of dozer line and 13 miles of hand line were stabilized
- Fireline Re-seeded (miles) — 3 miles of dozer line and all the hand lines were re-seeded
- Other Damages … (identify) — Repairs pending … on the Helibase located in Payson, UT.

M. Watershed Number: 160202020701 … Summit Creek in Santaquin Canyon (6th field HUC)

N. NFS Acres Burned: 6,944 **Total Acres Burned:** 8,021

Other Land Ownerships … list as follows:

(X) Private … 907 acres (X) State of Utah … 170 acres ( ) USDI - BLM ( ) Other

O. Vegetation Types:	Much of the upland terrain located on both the gently sloping alluvial fan terraces and along the moderately steep toeslopes at the base of Dry Mountain consisted of Gambel oak with mountain big sagebrush; in addition, Gambel oak and scattered sage communities had dominated large areas of the shoulderslopes occurring within the perimeter of the burned-area (55 %); dense stands of spruce - fir had occurred upon the moderately steep to steep (north facing) mountainsides and along very steep ridgetop areas within the fire (32 %); oak - maple plant communities existed on small, but distinct, areas of shoulderslopes occurring at elevations above 8,250 feet (3 %); some scattered Douglas fir had been mapped in areas of shallow soils (3 %); seral stands of aspen were observed on the ridgetops and on the eastern - facing mountainsides (3 %); isolated areas of mountain big sage were identified on the western edge of the burn along its stream terrace escarpments (2 %); riparian zones were dominated by trees – such as cottonwoods, Rocky Mountain maple, Douglas fir and box elder (1 %); finally … small areas of mountain brush were intermixed throughout the burn on its stony hillsides (1 %).
P. Dominant Soils:	Most of the land resources occurring within the low elevation areas of the Mollie Fire Incident were observed to have a mesic soil temperature regime. These locations were classified as being either Abruptic Palexerolls on the alluvial fan terraces or as Pachic Argixerolls on the foothills; the fan terraces occurring above 6,400 feet were mapped as Typic Haploborolls; much of the mid-elevation sites were identified as Typic Argixerolls and the Mountain Ecological Zones were mapped as Calcic Argixerolls; the mid-elevation areas support Gambel oak - mountain big sagebrush; much of the high elevation sites were delineated as Rock Outcrop -- which had scattered areas of Lithic Cryorthents and Lithic Cryoborolls; these sites supported only a few trees and shrubs; the ridgetop areas of the burn has been mapped as Pachic Cryoborolls and supported both spruce-fir and seral aspen stands. *(Soil Survey of Fairfield - Nephi Area, USDA - SCS, 1984)* *(Soil Survey of Utah County, USDA - SCS, 1972)*
Q. Geologic Types:	The majority of the burned-area has wildland soils formed in alluvium, colluvium and residuum derived from mixed sedimentary rocks such as limestone and sandstone. A few distinct areas have soils formed in secondary mineral deposits of dolomite and chert. The remainder of the land resources were derived from metamorphic rocks such as quartzite, schist and gneiss. *(Geologic Map of Northwestern Utah, The College of Mines and Mineral Industries, University of Utah, 1963)*

R. Miles of Stream Channels by Order: (Strahler 1952 method, within the fire perimeter)

1st: 14.0 2nd: 0.3 3rd: 2.9 4th: -0-

S. Transportation Systems: (occurring within the fire perimeter)

Trails … - 0 - miles (USDA - Forest Service) Roads … 8.3 miles (USDA - Forest Service)
15 miles (Total FS and Private Ownership)

PART 3 … WATERSHED CONDITION / NFS PROBLEM INVENTORY

A1. Mapping of the Burn Severity Zones: (8,021 total acres occur within the perimeter of the Mollie Fire Incident)

2,700 High (34 %) 2,207 Moderate (27 %) 3,114 Low / Unburned (39 %)

A2. Mapping of the Burn Severity Zones: (NFS lands … 6,944 acres)

2,544 High (37 %) 1,625 Moderate (23 %) 2,775 Low / Unburned (40 %)

B. Estimation of Water-Repellent soils occurring within the different Burn Severity Zones:
(NFS lands … acres)

2,289 High (90 %) 975 Moderate (60 %) 277 Low / Unburned (10 %)

Overall Total = 3,541 acres

C. Rating Soils for Potential Erosion Hazards within the Fire Perimeter: (NFS lands … 6,944 acres)

Very High	High	Moderate	Low
1,806 (26 %)	1,528 (22 %)	1,112 (16 %)	2,498 (36 %)

D1. Potential for Accelerated Erosion Losses without applying emergency rehabilitation treatments:

1st Year	2nd Year	3rd Year	4th Year
64 tons/acre/year	29 tons/acre/year	3 tons/acre/year	-0- tons/acre/year

Overall Total = 671,367 tons

(additional erosion over a 48 month period)

(Source) – Disturbed WEPP model … http://forest.moscowfsl.wsu.edu/fswepp/

D2. Potential for <u>Accelerated Erosion Losses</u> without applying emergency rehabilitation treatments:

1st Year	2nd Year	3rd Year	4th Year
44 tons/acre/year	21 tons/acre/year	10 tons/acre/year	5 tons/acre/year

Overall Total = 574,728 tons

(additional erosion over a 48 month period)

(Source) – Uinta National Forest … Nebo Soil Survey, June 1980, Carlos F. Lopez

E1. Total Sediment Potential: 3,282 tons / mile ^{2} … according to the Disturbed WEPP Model

E2. Total Sediment Potential: 2,864 tons / mile ^{2} … according to Nebo / LSI Project

(**<u>NOTE</u>**) - both sediment entries assume a 20 % delivery efficiency for a period of 4 years

PART 4 … HYDROLOGIC DESIGN FACTORS with <u>CALCULATED RISK and CLIMATE EVALUATIONS</u>

Average for Tributaries 3 & 4

A. Estimated Vegetative Recovery Period: 5 to 7 years
B. Design Chance of Success: 90 percent
C. Equivalent Design Recurrence Interval: 50 year
D. Design Storm Duration: 1 hour
E. Design Storm Magnitude: 1.35 inches
F. Design Flow: 26.0 ft^3 / sec / mi^2
G. Estimated Reduction in Infiltration: 45 percent
H. Adjusted Design Flow: 375 ft^3 / sec / mi^2

Average for Tributaries 5 & 6

A. Estimated Vegetative Recovery Period: 5 to 7 years
B. Design Chance of Success: 90 percent
C. Equivalent Design Recurrence Interval: 50 year
D. Design Storm Duration: 1 hour
E. Design Storm Magnitude: 1.35 inches
F. Design Flow: 26.1 ft^3 / sec / mi^2
G. Estimated Reduction in Infiltration: 49 percent
H. Adjusted Design Flow: 419 ft^3 / sec / mi^2

PART 5 … SUMMARY OF SURVEY & ANALYSIS

A. Describe the Watershed Emergency:

- **THREATS TO HUMAN LIFE AND PROPERTY** …On September 12, 2002 (over 1 year since the Mollie wildfire), a low intensity – short duration storm triggered 10 fire-related debris flows on Dry Mountain, just east of Santaquin Utah. Four of the ten debris flows threatened downstream residences in and near Santaquin. Two of this group of four events directly resulted in 2 to 5 million dollars of private property damage to adjacent subdivisions. One of the four debris flows resulted in sediment-laden flooding that was primarily a nuisance to the affected subdivision. A residential area below a tributary that did not have a debris flow also experienced nuisance flooding. Two of the same four tributaries also mobilized as much as 2,500 cubic yards of mine tailings that may contain potentially hazardous concentrations of heavy metals. Yet another of the ten debris flows hit the paved road up Summit Creek. The events of September 12th and reviews done for this assessment clearly indicate that the hydrologic function of the slopes has not returned to pre-fire conditions and that additional emergency treatments are warranted in an effort to minimize the potential threats to at-risk values.

- **LOSS OF SOIL PRODUCTIVITY** … The initial BAER team assessment and report for the Mollie Fire predicted that damage to property was likely; the predictions were based on aerial and field reviews, which showed that 34 percent of the burned-area experienced high severity fire and that about 90 percent of the high severity acres have water repellent soils. The combination of steep terrain, loss of ground cover and hydrophobic soils made the slopes of the Mollie Fire flood source sites that contributed to the debris flows of September 2002. The burned-area has not yet recovered from the effects of the fire. According to soil and water monitoring conducted by the Uinta National Forest, soils within the burn remain strongly hydrophobic in places. The hydrophobic conditions will continue to prevent water from infiltrating, adding to the risk of flooding. Vegetative recovery is limited, so much of the area lacks cover to protect the ground surface; plant roots that would help to stabilize the soil are also lacking. Aerial reconnaissance of the burned-area revealed that increased erosion has taken place and extensive rills and gullies have formed in the upper parts of the tributaries, affecting long-term soil productivity. Recommended treatments include aerial seeding and aerial mulching approximately 375 acres of the upper parts of tributaries 2, 3, 4 and 5. Establishing plant growth in these areas will provide protection for the ground surface and help to stabilize the soil. Vegetation also slows the flow of water and encourages infiltration. The straw mulch will provide immediate cover to shield the soil surface and help to protect the seeding treatment.

- **LOSS OF ECOSYSTEM INTEGRITY** … There is still a large portion of the Mollie Fire that requires various treatments in order to heal the landscape and prevent additional soil loss. Vegetative cover is still at a minimum in many places within the fire boundary. The debris flow events of 2002 only added to the need for treatment. In order to prevent future debris flow events and soil loss vegetative ground cover is needed. In an effort to provide the needed vegetative cover it is recommended that tributaries 2 through 5 be seeded and aerially mulched.

B. Emergency Treatment Objectives:

The primary objective of the proposed emergency rehabilitation is to take prompt actions deemed reasonable and necessary to effectively protect, reduce or minimize significant threats to human life and property; and prevent unacceptable resource degradation. The emergency treatments being recommended by the Uinta NF / BAER Team are specifically designed to achieve the following results:

1) reduce the possibility that debris flows and floods could threaten residential and commercial developments within the communities of Santaquin and Spring Lake, Utah, and infrastructure within the Uinta National Forest,

2) encourage soil stabilization and recovery of hydrophobic soil conditions through vegetative regeneration to maintain long-term productivity and to meet Regional and Forest Plan standards,

3) provide immediate cover to protect the ground surface and prevent excessive erosion,

4) reduce the potential for significant resource damage to and from roads as a result of increased fire related runoff,

5) continue to encourage public and political consideration of the natural long-term debris flow and flooding hazards below Dry Mountain.

C. Expected Probability of Completing Treatments Prior to First Major Damage-Producing Storm:

Land … 80 % Channel … 70 % Roads … 70 %

D. Probability of Accomplishing Treatment Success:

< ---------- Years after Treatment ---------- >

	1	3	5
♦ **Land**	**70 %**	**80 %**	**90 %**
♦ **Channel**	**80 %**	**75 %**	**70 %**
♦ **Roads**	**90%**	**80 %**	**70 %**

E. Cost of Taking No-Action: (including potential loss) According to Mr. Fred May / State of Utah – Department of Public Safety … Division of Comprehensive Emergency Management, the value of the commercial properties and private residences located east of I -15 within Santaquin City would be approximately **$ 40,000,000**; all of these homes and businesses are at-risk to episodes of flooding and some areas are quite vulnerable to debris flows. The initial Uinta NF / BAER Team approximated the values-at-risk to be about **$ 52,400,000** using the recent CIR photograph taken on 08-27-2001. However, since the initial report, substantial development has occurred and is planned or is in the process of being constructed.

F. Cost of the Selected Alternative: (including loss) The initial BAER report estimated potential damage at $ 2,000,000 to $ 4,000,000 dollars, assuming that all treatments were implemented,. The September 12th, 2002 events resulted in $ 2,000,000 to $ 5,000,000 dollars of damage to private property, but it was not a large event relative to what can potentially occur. Given that additional residential construction is ongoing, the values-at-risk will increase in the short and long-term. The City of Santaquin is now interested in taking measures to reduce risk to the existing and future developments. However, the potential costs will likely stay in a 2 to 8 million dollar range for the short-term.

G1. Skills Represented on the Initial / Burned-Area Survey Team:

(X) Soils (2)	( ) Geology	( ) Timber	(X) TES … Plants
(X) Hydrology (3)	(X) Landscape Arch.	(X) Wildlife	(X) Fire Dispatch
(X) Plant Ecology	(X) Provo Helitacks	(X) Research	(X) Archeology
(X) GIS Staff (2)	(X) Range Mgt.	(X) District Staff	(X) Engineering
(X) Fisheries	(X) USDA – NRCS	(X) Utah - DWR	(X) Lands

G1. Skills Represented on the Interim / Burned-Area Survey Team:

(X) Soils (2)	( ) Geology	( ) Timber	(X) TES … Plants
(X) Hydrology	( ) Landscape Arch.	( ) Wildlife	(X) Fire Dispatch
(X) Plant Ecology	(X) Provo Helitacks	(X) Noxious Weeds	( ) Archeology
(X) GIS Staff	( ) Range Mgt.	( ) District Staff	(X) Engineering
( ) Fisheries	( ) USDA – NRCS	( ) Utah - DWR	( ) Lands

Team Leader: Michael D. Smith (Soil Scientist / Fishlake National Forest)

Phone: (435) - 896 - 9233 / ext. # 1071 **E-Mail:** mdsmith01@fs.fed.us

RECOMMENDED TREATMENTS

National Forest System Lands

- **Land Treatments** … broadcast seed 375 acres in tributaries 2, 3, 4, and 5 for the specific purpose of reducing debris flow and flood potential and to maintain long-term soil productivity on severely burned landscapes, the seeding project will be accomplished with a Type III helicopter, the cost of the seeding already includes the helicopter, hazard pay for associated helitack and a few ground support personnel to complete the treatment in a timely manner ($ 43,875); use a Type III helicopter to complete aerial mulching on 375 acres in tributaries 2, 3, 4, and 5 for the purpose of short-term ground cover and soil stability; the cost includes the price of assistance of the Uinta NF / Helitack Crew, ground support and temporary helibase ($ 498,000); remove and/or re-contour tailings from the abandoned mine in tributary 3 so that the potentially hazardous material cannot be mobilized by debris flows or floods. ($ 16,000); test mine tailings from the abandoned mine in tributaries 3 and 4 for the presence of heavy metals ($ 1,000). **Total = $ 558,875**

- **Channel Treatments** … N / A

- **Roads and Trail Treatments** … re-condition 1.5 miles of the mine access road in tributary 3 by outsloping the road and adding rolling dips and water bars so that fire related surface flows are not intercepted, concentrated, and rerouted ($ 4,000). **Total = $ 4,000**

- **Structure or Ecosystem Management** … N / A

PART 6 … EMERGENCY REHABILITATION TREATMENTS & SOURCE OF FUNDS BY LAND OWNERSHIP(s)

A1. Primary Land Treatments

| < ---------- Recommended Treatments ---------- > | < -- Suggested Treatments -- > |

NFS Lands **Other Lands**

Line Items	Units	Unit Cost $	Number Of Units	WFSU–SULT $	Other $	Number of Units	UDWR $	EWP – Private $	Total $
Broadcast Seeding (Tributaries 2,3,4 and 5 using native plant species) (131 / 50 # bags)	Acres	$ 117	375	$ 43,875					$ 43,875
(all seeding includes the cost of using a Type III helicopter at the rate of about $ 24 / acre as well as … funds for the Helitack Crew and Ground Support Team to implement the treatment)									
Aerial Mulching (Using a Type III helicopter operating under the terms of a CWN contract) A-Star / Aircraft (Tributaries 2,3,4 and 5 at a rate of 1.5 tons / acre)	Acres	$ 1,300	375	$487,500					$ 487,500
Rental Fee for establishing a Temporary Helibase (Santaquin, UT)	Day	$ 250	42	$ 10,500					$ 10,500
Re-contour unstable tailings located at the Golden Spike and Syndicate Mines (Tributary 3) (using 2 excavators for a period of 4 days)	Job	$	1	$ 16,000					$ 16,000
Subtotal for Section A1	---	---	---	$557,875					$ 557,875

A2. Supplemental Land Treatments

Line Items	Units	Unit Cost $	Number Of Units	WFSU–SULT $	Other $	Number of Units	UDWR $	EWP – Private $	Total $
Test Mine Tailings (Tributaries 3 & 4) (for heavy metal concentrations such as Pb, Hg, As, Zn and Cd)	Sites	$ 500	2	$ 1,000					$ 1,000
Subtotal foe Section A2	---	---	---	$ 1,000					$ 1,000

B. Channel Treatments

N / A	---	---	---	---					---

C. Roads, Trails and Other Treatments

Re-Condition Road (Tributary 3) (using 2 excavators for a period of 1 day)	Job	$ 4,000	1	$ 4,000					$ 4,000
Subtotal for Section C	---	---	---	$ 4,000					$ 4,000

D. Structures or Ecosystem Management

N / A	---	---	---	---					---

E1. Interim BAER Evaluation / Administrative Support Services

BAER Team (New Survey and preparation of the Interim Report)	Job	$ 3,150	1	$ 3,150					$ 3,150
BAER Team (travel - 4 people)	Job	$ 700	1	$ 700					$ 700

Line Items	Units	Unit Cost $	Number Of Units	WFSU–SULT $	Other $	Number of Units	UDWR $	EWP – Private $	Total $
BAER Team Helicopter / Daily Availability Fee (Type III … A-Star)	Day	$ 2,224	1	$ 2,224					$ 2,224
BAER Team Low Level Helicopter Flights (Type III … A-Star) (includes salaries for the Helitack Crew)	Hour	$ 542	3.1	$ 1,680					$ 1,680
BAER Team Supplies	Misc.	$ 125	1	$ 125					$ 125
Subtotal for Section E1	---	---	---	$ 7,879					$ 7,879

E2. Implementation and Effectiveness Monitoring Activities

(Forest Service … Implementation and Effectiveness Monitoring – Year 2 of 3) **NOTE … if necessary, additional monitoring dollars can be acquired by the FS during Year 3 using a Interim type BAER Report to request and secure the appropriate funding; the individual to contact at the Intermountain Regional Office is Jeff Bruggink – R4 / Soil Scientist and BAER Coordinator at (801) - 625 - 5357**									
1) Soil & Water	Year 2	$ 6,705	1	$ 6,705					$ 6,705
2) Erosion Control - Seeding and Mulching	Year 2	$ 2,620	1	$ 2,620					$ 2,620
3) Noxious Weeds	Year 2	$ 420	1	$ 420					$ 420
Subtotal for Section E2	---	---	---	$ 9,745					$ 9,745
F. TOTALS	-	-	-	**$580,499**	**$**	-	**$**	**$**	**$ 580,499**

Fund Code for the Interim BAER Assessment Work … H49999 - 0418

and

Fund Code for Implementing Authorized BAER Treatments … H48123

PART 7 … APPROVALS

1. **(acting) Forest Supervisor: /s/ Reese Pope** **Date: October 17th, 2002**

2. **Regional Forester: _____ Date: _____**

NARRATIVES – SPECIALIST REPORTS

Hydrologic Assessment - Mollie Fire

This report summarizes aerial and field observations made from October 11 to October 15, 2002 and immediately following the Mollie Fire debris flows on September 12th 2002. The previous initial and interim BAER assessments are incorporated into this report by reference. The purpose of this assessment is to evaluate the emergency treatments that were implemented and evaluate post-fire responses to storm events to determine if additional emergency actions are warranted. A monitoring report by Wes Christensen 2002, provides an excellent summary of the treatment implementation and effectiveness for this fire.

Summary: The Mollie Fire burned in the summer of 2001, but did not experience any high intensity rainfall events for the following year. The drainages referred to as Tributaries 2, 3, 4, 5, 6, 7, 9, 11, 12, and 14 in the initial report had debris flows on September 12, 2002. Roughly 2 to 5 million dollars of damage was done to residences below Tributaries 2 and 4. Tributary 3 filled a small basin, immediately adjacent to the Eastside subdivision, but did no major damage. As much as 2,500 cubic yards of mine tailings in the bottoms of Tributaries 3 and 4 were also mobilized. The debris flow from Tributary 5 created sediment-laden floods, but the alluvial fan terrace functioned properly by trapping and dispersing most of the debris and water before reaching the downstream subdivision. The dissipated flows were mostly accommodated by the storm water system within the subdivision. If the planned developments are built up to the Forest boundary, this floodplain functionality will be lost and even more houses and lives will be at-risk. Crooked Creek had a flood response to the rains becoming a nuisance to some houses below, but causing no serious damage. About 500 cubic yards of debris from Tributary 12 buried the highway in Summit Creek, but did no permanent damage. A debris flow was also present in a small drainage immediately to the south of Tributary 12. Extensive rill networks were especially prominent in the upper elevations of the tributaries, particularly on the north and west facing slopes that burned with high severity. Several gullies are deeply incised to within 200 to 300 feet from the ridgeline.

These debris flows were preceded by two days of intermittent rains. The Mollie RAWS weather station (BAEU1) recorded 0.28 inches of rainfall in a 2-hour period (0.01" + 0.27") the day of the events. The data, available on the Internet at http://www.met.utah.edu/jhorel/html/mesonet/database_table_new.html only has a 1-hour resolution so it is difficult to precisely estimate what the actual rainfall intensity was. The RAWS station is set to send an alert to the Utah County Dispatch office if the rainfall intensity exceeds 0.2 inches within a 10-minute period. The station triggered a warning about 15 minutes before the debris flows hit Santaquin. Total accumulation was 0.91 inches for the 36-hour period preceding the events and 1.36 inches starting from the 6th of September. The intensity and the total rainfall accumulation recorded by the RAWS weather station at the top of the ridge above Tributaries 3 and 4, and by the tipping rain bucket recorders in the lower portions of the drainages indicate that the events were created by less than a 2-year return interval storm. The wide distribution and number of debris flows within the fire perimeter, and the evidence of high flows and soil erosion from the slopes and channels are perhaps consistent with a more intense storm than is otherwise indicated by the precipitation data. However, given the high values-at-risk it is safer to assume that the debris flows were caused by an ordinary rain event while determining if additional emergency treatments are necessary.

The storm on the 16th of September had similar rainfall amounts and greater intensity than the September 12th storms, but no new debris flows occurred. It is important to note that there is still plenty of material in the channel and on the fire damaged slopes for additional debris flows to be generated by future storms. Two members of the BAER team flew the Mollie fire in early July of 2002 to evaluate the effectiveness of

the slope treatments. At that time, the log erosion barriers (LEBs – contour felled logs) were not filled with sediment and the slopes and channels had not been significantly eroded, which is consistent with the observation that there were no substantial precipitation events in 2001 following the fire. Monitoring the day before the September 12th indicated that most of the LEBs were filled to capacity with eroded soil (see the monitoring report by Wes Christensen). One can only conjecture as to why the debris flows happened on September 12th rather than at an earlier or later time. Part of the reason is that the soils were saturated prior to the September 12th storm. Soil moistures measured at the RAWS station increased from 1 percent on September 8th to 84 percent on September 11th. It may also be that the ensuing debris flows were the culmination of a cumulative loss of slope roughness caused by ash and eroded soil filling in topographic depressions and behind obstructions during preceding storms. Networks of rills and small gullies may have become established from the previous storm events. All other things remaining equal, these conditions would increase the slope responsiveness to storm events of any given size. However, it will not be possible to determine the exact mechanisms and triggers with the information that we have available.

For reference, the BAER team observed the current conditions of the Springville Fire because it has similar debris flow potential as the drainages affected by the Mollie Fire, but was more extensively treated with aerially applied straw mulch and seeding. No debris flows or significant flood response was generated within the drainages impacted by Springville during the September 12th precipitation event. Figures 1 and 2 show that the storms experienced on the Springville Fire mirrored those on the Mollie Fire in both number and timing. However, the Springville precipitation events were generally less intense and had slightly less total accumulations. The Springville RAWS station (TR397) was not installed until later in the year from when the Mollie station went on-line so 4.9 inches was added to the initial precipitation total for the Springville station so that both stations started out with exactly the same rainfall totals for this comparison. Figure 3 displays soil moisture changes at both RAWS stations.

Figure 1. 2002 Total Accumulated Precipitation at RAWS Weather Stations

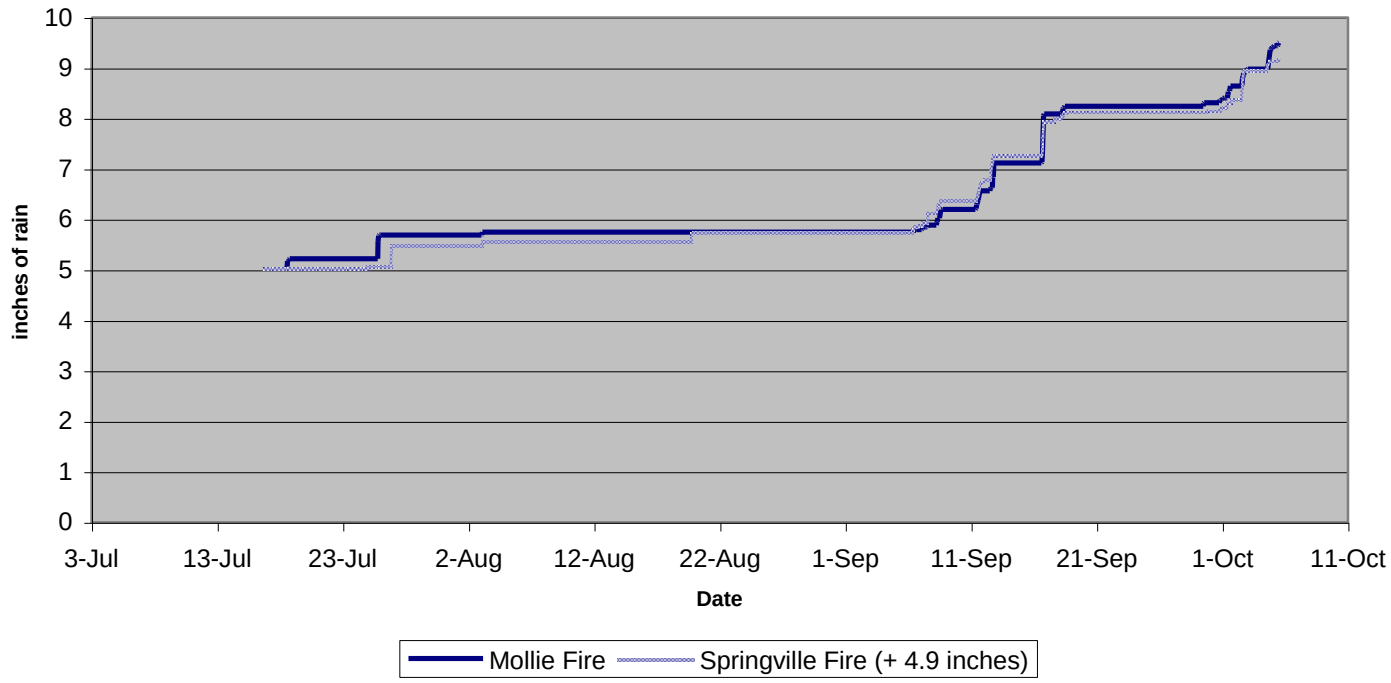


Figure 2. 2002 Rainfall Intensity at RAWS Weather Stations

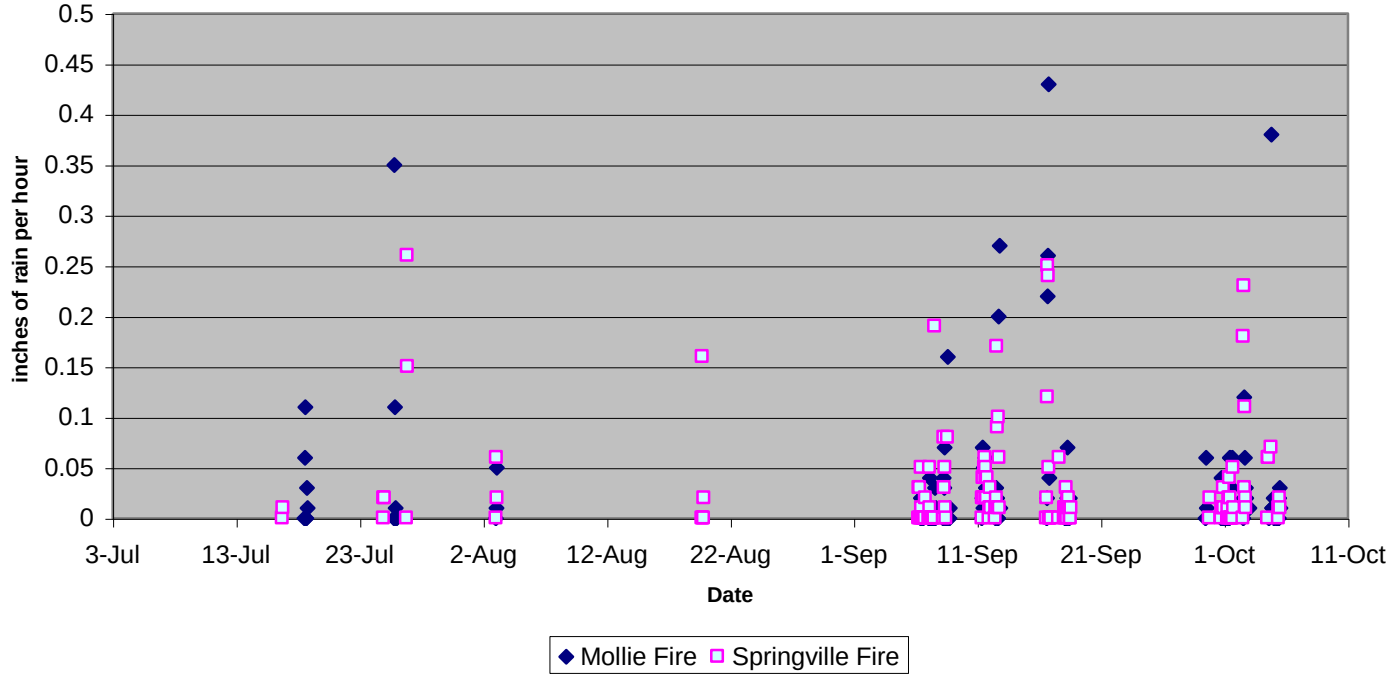
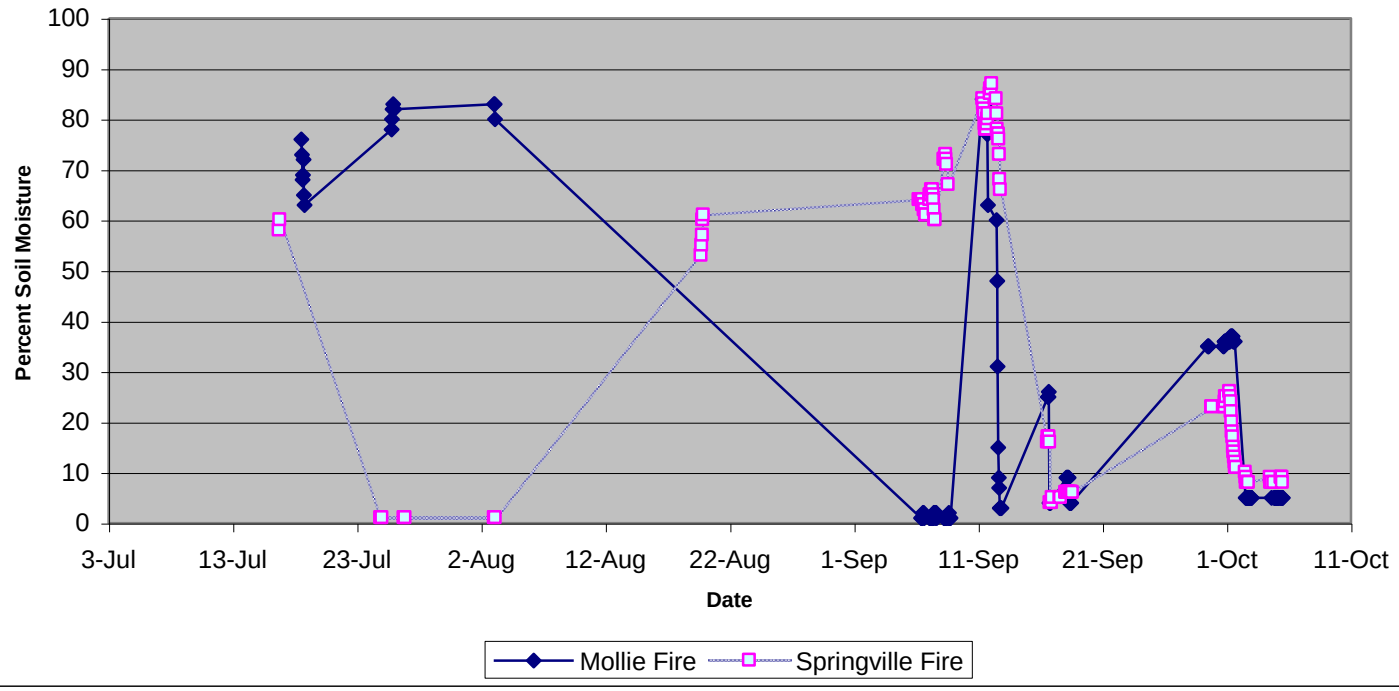


Figure 3. 2002 Soil Moisture at RAWS Weather Stations



The Springville RAWS weather station recorded 0.26 inches of rainfall in a 2-hour period (0.17" + 0.09") about four hours before the storm hit the Mollie Fire. Total accumulation was 0.88 inches for the 36-hour period preceding the events that hit Dry Mountain and 1.52 inches starting from the 6th of September. The straw mulch and barley cover crop were implemented to provide soil protection from rain splash and surface sealing, to act as a sponge and add surface roughness, and to provide favorable microsites for reestablishing vegetation. An aerial review done for this assessment confirms that this treatment has been

very effective so far. However, the burned slopes have not yet been "tested" by a substantially high intensity thunderstorm or a large snowmelt runoff.

All of the smaller tributaries affected by the Mollie Fire, including the ones that did not fail, are naturally prone to debris flows, even when unburned. However, the percentage of high burn severity within the drainage seems to correlate strongly with the occurrence of debris flows during the September 12th rain event as shown in the following table.

	Percentage of Drainage Area Burned listed by Fire Severity Class	
	High Severity	Moderate to High Severity
Tributaries affected by debris flows (N = 10)	Range: 37 % to 64 % Mean: 54 %	Range: 61 % to 89 % Mean: 77 %
Tributaries affected by floods or no apparent response (N = 6)	Range: 11 % to 46 % Mean: 28 %	Range: 28 % to 84 % Mean: 49 %

If Tributary 8, which did not have a debris flow but was extensively burned, is excluded from the "no response" set, then there is a wide gap and no overlap in the ranges between the two groups of drainages. These data demonstrate that the fire-damaged tributaries have not yet recovered and that treatments should focus on the high burn severity polygons.

General Recommendations: The September 12th events and reviews done for this assessment clearly indicate that the hydrologic function of the slopes has not returned to pre-fire conditions. In particular, the north and west facing slopes in the upper elevations of Tributaries 2, 3, 4, and 5 that were severely burned should be seeded and mulched. These slopes are important source areas for the initial flushes of water and sediment that accumulate into debris flows. Currently there are extensive rill networks in large portions of these areas. These treatments should be applied in the spring while the soils are moist to increase the potential for a successful vegetative response. The highest values-at-risk and some of the most severe debris flows occurred in and below these tributaries. Unless otherwise noted below, no slope or channel treatments are recommended in the other unnamed tributaries.

The City of Santaquin needs to recognize that the hazards and potential risks of living immediately below Dry Mountain will not be gone once the slopes have recovered from the Mollie Fire. The potential for debris flows and flooding is a fixed part of the landscape, especially in the locations where they are continuing to permit and promote development. It is the responsibility of the City to insist that developers provide them with integrated and well thought out site plans that protect existing as well as proposed developments. The effort should not be piecemealed. It is much more difficult and expensive to retrofit and design protective measures once the lands are developed. Subdivisions should not be permitted if the proponents cannot reasonably assure that residents will be protected from natural hazards. To do otherwise is irresponsible and naive.

The mine tailings in Tributaries 3 and 4 should be tested for the presence of heavy metals. The mineral content of the tailings is not known. However, tailings from similar hard rock mines on the Forest typically include lead and zinc, and possibly arsenic, cadmium, or mercury. If the tailings have high concentrations of metals then follow-up soil testing should be done in the subdivision that was affected by the debris flows and at the locations where the material was moved to during cleanup efforts. The Bureau of Reclamation has the required equipment and training and can assist the Forest Service with these efforts.

Tributary 2 Recommendations: The debris flow from this tributary filled and overflowed the Highline canal causing damage to residential developments below. The advice offered in the initial BAER assessment report still applies. The County and landowners in cooperation with the NRCS need to design and implement a structure or structures that will safely catch and divert debris and floodwaters towards a safe location.

Tributary 3 Recommendations: About 1,500 to 2,000 cubic yards of mine tailings that spanned the channel were entrained by the debris flow in this tributary. This is a rough estimate, but a significant volume of tailings was eroded. A volume this large is perhaps as much as 1/5th the total amount of material carried by the debris flow in Tributary 3. Another 3,000 to 5,000 cubic yards of tailings remain on site. There is a significant risk that the vertical slopes will cave into the channel and/or that a large portion of the remaining material will be entrained by future runoff or debris flow events. The mine tailings did not initiate the debris flow, but they did add to the intensity of the event. How much they affected the intensity depends on whether the tailings gradually scoured or failed catastrophically. Further field inspection and measurements would be necessary to make even a reasonable guess as to what actually occurred. These deposits should be recontoured to a less steep and more natural contour so that the tailings will not be available to the channel as sediment. The tailings should be tested for heavy metals. If a significant hazard exists, then capping of the recontoured material and/or end hauling to a permanent storage location off-site may be necessary. If the materials are stored on site, then the left slope (as viewed looking downstream) is the preferred location to store most of the material. This will also bury the open mine adit. The right slope is in direct line with the downstream orientation of the channel. Some of the material may be stored on this side, but adequate design and structural control should be used to assure that the tailings are not eroded by high flows. The natural channel cross-section and profile should be reinstated. Two large excavators will likely be necessary so that one excavator can pass material near the channel bottom up to the other excavator at the storage area. The outslope should be reinstated on the access road to the mine, and rolling dips and waterbars should be installed on about a 45 to 50 feet spacing. Currently the road is intercepting, concentrating, and rerouting surface flows and will continue to make a side-hill gully if not corrected.

Tributary 4 Recommendations: An estimated 20,000 cubic yards of debris was delivered to the subdivision below this tributary. This equates to about 12.4 acre-feet of sediment. Less than 500 cubic yards of mine tailings were mobilized during this debris flow. Two separate debris flows had already initiated – one above the tailings and the other in the side tributary to the south that ties in to the main channel about 700 feet below the mine. Therefore, the mine tailings did not trigger the debris flows that affected the subdivisions, but they did add to the intensity of the event. Less than 200 cubic yards of tailings are estimated as still remaining on site. The mine is extremely difficult to access with heavy equipment. Also, most of the tailings were removed by the September 12th debris flow. Unless the tailings are extremely toxic, there is no need to recontour or remove the remaining mine deposits from near the channel. The soil testing will need to be completed before the risks and treatment options can be fully assessed.

Tributary 5 Recommendations: The fan terrace below Tributary 5 functioned properly by trapping sediment, dispersing flows, and by promoting infiltration of overland runoff into the soil. If the planned developments are built up to the Forest boundary, this functionality will be lost and even more houses and lives will be at-risk, unless the site designs properly accommodate the potential for debris flows and flooding. Even with mitigation, some functionality will likely be lost. These factors and issues should be addressed before new development proceeds.

Tributary 12 Recommendations: Check the headcut for the same reasons and to the same specifications as described in the initial BAER assessment report.

(Dale Deiter – Hydrologist)

Vegetative Treatments - Mollie Fire

Aerial mulching and seeding treatments were used in portions of Tributaries 3 and 4 previously; we recommend a slight change in protocol. The treatments should occur in the spring or early summer in order to take advantage of the spring and summer rains. The amount of straw mulch in the treatment areas should also increase from 1 ton per acre to 1.5 tons per acre.

The following seed mix is recommended:

Native or Introduced	Grass Species	Seed Mix
		Pounds / Acre (PLS) < -------- -------- >
N	Slender Wheatgrass "San Louis"	4.5
N	Mountain brome "Bromar"	4.5
N	Thickspike wheatgrass "Bannock"	4.5
N	Bluebunch wheatgrass	4

Total Pounds / Acre	17.5
Total Seeds / Ft² *	48
Estimated Seed Cost / Acre	$93.00
Estimated Cost Seed Mix / Pound	$5.31

* Recommended rates for broadcast seeding mixes are about 50-100 seeds/ft^2.

We referred to seed mixes previously used on the Uinta National Forest and the Intermountain Planting Guide for Utah, from Utah State University Cooperative Extension Service, while designing the seed mixture to achieve the FSM objectives listed above. Three seed companies provided cost estimates: Rainier Seed, Inc., Granite Seed, and Maple Leaf. It may be more cost efficient for the Forest to purchase the seed this fall and store it until the appropriate time to seed due to a possible change in availability.

(*David Tait – Botanist*)

MONITORING PLAN

♦ Introduction: Why Monitor?

Monitoring is the periodic assessment of BAER treatments to evaluate their success and / or failure, recommend adjustments to treatments and report on these findings to management. Forest Service Manual 2523.03 directs that the implementation and effectiveness of treatments, as well as the consequences of decisions not to treat certain areas, will be monitored. This plan will assess BAER measures taken to assist in rapid recovery of the burned sites and nearby lands and resources affected by the burned sites. Direction in this monitoring plan complies with the Uinta National Forest Land and Resource Management Plan. The Forest Service Handbook 2509.13, Section 61.1 requires that, as a minimum, the following conditions be monitored:

1. The effectiveness and proper functioning of rehabilitation measures, especially road drainage facilities and channel structures.
2. Need for re-treatment, maintenance and removal of temporary structures.
3. Quality and quantity of water leaving the burned area and the location and causes of problems.
4. Rate of recovery of vegetation.
5. Effects of resource utilization, restoration activities and emergency rehabilitation measures on each other.

District and Supervisor's office personnel (with any requested assistance) will be assigned by the Leadership Team to conduct the implementation and the effectiveness monitoring (FSH 2509.13 Section 61.04).

♦ Types of Monitoring Planned

Implementation Monitoring: Did the job get done correctly on-the-ground?

Determine if the following proposed treatments were implemented as outlined in the BAER reports:

Interim BAER Report Recommendations

- Mine Tailing Re-contouring: Was the work completed correctly and safely?
- Channel Stabilization: Were the structures placed in the proper locations and built with the proper specifications?
- Road Reconditioning: Do the " as - built " treatments match the BAER plan prescriptions?
- Archeological Sites: Have the required surveys been conducted prior to conducting ground disturbing activities?
- Aerial Mulching: Was the mulch applied to the correct areas with the proper rates of application?
- Broadcast Seeding: Are the seed mixtures applied to the intended sites with the proper rates of application?

♦ **Effectiveness Monitoring: Did the expected response occur?**

This monitoring is specifically designed to answer the question: Did the BAER treatments provide the planned protection and rehabilitation of the burned area? Said another way, have the objectives of the treatments been met and if not, why?

Are the emergency treatments successful in: ….. protecting long-term soil productivity,

….. preventing the deterioration of water quality,

….. reducing the threats to human life and property and allowing for the management of ecosystems in their properly functioning condition?

Specific objectives of the treatments are described below:

Broadcast Seeding: Establish vegetative cover on the site quickly to:

- ✓ stabilize severely burned soils to maintain long-term productivity and meet Regional and Forest Plan standards,
- ✓ prevent production and delivery of off-site erosion to the stream channel network,
- ✓ reduce overland flow caused by rain-drop splash that seals the soil surface,
- ✓ and prevent the spread of existing noxious weed populations.

Year Two Effectiveness Monitoring:

- ♦ Has vegetation become established from the broadcast seeding efforts?
- ♦ Are seeded native species able to compete with non natives?
- ♦ Does the seeding appear to be helpful in providing ground cover and preventing erosion?

Aerial Mulching: Provide immediate ground cover to:

- ✓ protect soil surface from raindrop impact and overland flow,
- ✓ prevent production and delivery of off-site erosion to the stream channel network,
- ✓ and protect seeding treatment and provide moisture and shade to encourage plant growth.

Year Two Effectiveness Monitoring:

- ♦ Is the straw protecting the ground surface and preventing accelerated erosion?
- ♦ Does the straw mulch appear to be encouraging plant growth?

Mine Tailing Re-contouring: Re-contour to restore a more natural angle of repose for mine tailing dump that was partially eroded during the debris flow in Tributary 3 to:

- ✓ prevent more tailings from being carried down the channel during other debris flows,
- ✓ minimize the risk of transporting heavy metal towards downstream residences

Road Re-conditioning: Upgrade culverts, install a cross drain and outslope portions of the Santaquin Canyon Road to:

- ✓ insure increased flows caused by the fire in Summit Creek can be handled.
- ✓ disconnect the ditchline from the channel network,
- ✓ reduce the probability of sediment delivery from stream crossing failures.

Year Two Effectiveness Monitoring:

- ♦ Has the reconditioned road experienced increased flows? If so, did the reconditioning appear to have improved the situation?
- ♦ Have there been stream crossing failures on portions of the reconditioned roads?
- ♦ Has the ditchline been disconnected from the channel network?

Log Erosion Barriers: Provide physical obstructions in headwater portions of drainages to:

- ✓ provide slope roughness and break up continuous slope lengths,
- ✓ trap upland sediment to protect soil productivity and promote revegetation.

Year Two Effectiveness Monitoring:

- ♦ Are the log erosion barriers still in place? Have any shifted or failed? If so, did the failure appear to be a result of improper installation or simply large overland flows?
- ♦ Are the barriers still effective in year two? Are they still catching sediment?
- ♦ Are the barriers still flush with the ground surface?
- ♦ Do the log erosion barriers appear to be encouraging vegetation establishment in the trapped sediment?

Explanatory Signs: Place signs throughout the Mollie Fire to:

- ✓ provide for public safety and promote fire recovery by communicating the potential flooding hazards and the need to adhere to motorized access restrictions.

Year Two Effectiveness Monitoring:

- ♦ Are the signs still in place?
- ♦ Are the signs still clear and legible?
- ♦ Have any signs been vandalized?
- ♦ Do any of the signs require repair or replacement?

Temporary Fence: Fence the administrative boundary where damaged by the fire to:

- ✓ promote natural and seeded vegetative recovery.

Channel Stabilization: Stabilize existing head cut with rock buttresses and berms to:

- ✓ reduce material entering Summit Creek during mass wasting events.

- ✓ protect the Santaquin Canyon Road by reducing the mobile material from the debris flow damaged channel.

Silt Fences: Install silt fences in the channels along the fan terraces above the subdivisions in Santaquin to:

- ✓ dissipate and disperse flood flow energy before it can enter the subdivisions above the City of Santaquin.

- ✓ capture debris and sediment before it can impact the subdivisions above the City of Santaquin.

Year Two Effectiveness Monitoring:

- ♦ Were the silt fences effective in slowing water movement and trapping sediment?
- ♦ Was enough silt fencing installed to be effective?
- ♦ Will the fencing continue to be work, or does it need to be removed/replaced?

RAWS station: Install Remote Automated Weather Station to:

- ✓ provide an early warning system for the communities at risk from flooding and debris flows.

Year Two Effectiveness Monitoring:

- ♦ Did the RAWS station provide the communities of Santaquin, Utah and Spring Lake, Utah with adequate early warnings during storm events?
- ♦ Is the station still functioning and does it require any maintenance or repair?

Archeological Sites: Perform the necessary archeological evaluations prior to land disturbance to:

- ✓ insure all State of Utah and Forest Service rules and regulations regarding cultural heritage are followed.

♦ General Data Collection Procedures

The information to be recorded and documented will include the dates and type of emergency treatments implemented along with the total number of structures, acres and actual costs associated with these rehabilitation projects.

Photos will be taken before and after these treatments and locations will be plotted using GPS. These photo points will be established above, within and below the various treatments. All photos will be collected using a digital camera in order to easily enter the images into interim and final monitoring reports.

Any monitoring item having a specific location will be mapped using GPS and loaded into the corporate GIS database (e.g., weed infestations).

The Implementation Team leader will ensure that all data being collected meets the established standards. Data collected for inclusion into the Forest GIS database will meet corporate standards.

For all monitoring projects, as a minimum, record:

- The dates of installation or accomplishment
- Name(s) of person(s) collecting data
- Types of equipment used
- Time for project completion (length of treatment)
- GPS location as well as a detailed map and narrative of directions to the site
- Short narrative explaining how the job was completed, any problems encountered and how they were solved
- Recommendations for continued use of the treatment on other fire rehabilitation projects considering both implementation and effectiveness concerns.

♦ Specific Data To Be Collected

Soils and Hydrology:

- Monitoring time frames are before, during and immediately following large precipitation events
- Document evidence of mass wasting
- Describe and map the types of damage such as overland flow and the types of lands or resources damaged, such as rangelands, pastures, or riparian zones
- Describe the effectiveness of the road treatments. Note if additional treatments or maintenance are needed.

Erosion Control Seeding:

- Is there between 50 and 80% soil cover to protect the soil three years post seeding?
- Which species did well?
- Which species did poorly?
- What is the location and species of any noxious or invasive weed present?
- Are there any more effective ways of doing business (e.g., erosion blankets) compared with the treatment recommendations presented with the Initial Request for EFFS - FW22 funds?

  Ten vegetation transects (each 100' long) be installed to evaluate the amount of bare ground, seeding effectiveness and the spread of noxious weeds (see also discussion below under Invasive Plants). Burn severities will be sampled along the transect to help control for variation in microsites.

♦ **Noxious Weeds and Invasive Species**

The District Ranger is directed (FSM 2523.04d) to *" monitor burned areas to ensure rehabilitation treatments and other measures are functioning as planned and are effective. Monitor for the post-fire presence of invasive species. Maintain treatments to keep them functioning as designed. Use monitoring results to plan follow-up actions, including the control of invasive species. "* The treatment of noxious weeds will prevent permanent impairment of ecosystem structure and function in compliance with FSM 2523.02.

As awareness of the problems associated with the introduction of invasive plants species increases (see Executive Order 13112 in appendix), it becomes important to immediately evaluate the magnitude of any invasions quickly as possible and then take aggressive control action. Fire suppression activities in 2001 may have caused the introduction of some invasive species through transport by engines, dozers, and crew transport vehicles.

The suppression actions for this fire resulted in construction of about 4 miles of dozer line. The majority of this line is immediately adjacent to residential development areas where the land is already disturbed. Additionally, access into the fire area is available from a number of points that cross this dozer line. Ground disturbance from residential development will provide a greater opportunity for invasive species to establish due to the repeated entrance into the area by construction vehicles that most likely are not weed-free. The dozer line will provide a continuous corridor along the fire perimeter into which weeds can establish, and then move into the burn area and onto the Forest.

At a minimum, these dozer lines should be monitored for the presence of invasive species each spring for 5 years. Monitoring will, by necessity, be **coordinated with the Utah County Weed and Pest Control District**. The communities of Santaquin and Spring Lake should be included in monitoring activities, and data shared with them for use in community planning if they so desire. The BAER implementation team and Utah County Weed and Pest Control Supervisor should complete coordinated surveys in 2002 through 2006.

The **Spanish Fork Ranger District** will incorporate further monitoring and treatment of any populations found on the Forest into the annual noxious weed program. Treatment methods must be evaluated to determine the most appropriate course of action. Any action must be fully compliant with the National Environmental Protection Act (NEPA). It is anticipated any chemical treatment activities will fall under the current NEPA decisions for noxious weed control on the Uinta National Forest (USFS 1995). Any proposed deviation from the approved treatment methods will require additional NEPA, which will be the responsibility of the Forest to complete. All herbicide application activities on the Forest will be conducted

by certified applicators (either contracted, Utah County Weed and Pest personnel (under agreement) or Forest Service licensed personnel) as required by FSM 2154.2.

Monitoring should include the following items:

- GPS map of dozer lines constructed to contain the Mollie Fire
- GPS map of travelways that cross the dozer lines and access the interior of the fire.
- Annual assessment of the magnitude of infestations, including the following information:

    - GPS map of locations and perimeters or points of infestations
    - Estimates of number of plants per square foot
    - Copies of appropriate Pesticide Use Proposals and Pesticide Use Reports for treatment of target weed species
    - Record of treatment activities (dates, treatment methods, chemicals used)
    - Evaluation of treatment success

References

U.S. Department of Agriculture. Forest Service. Uinta National Forest. 1995. Environmental Assessment for Control of Noxious Weeds and Other Undesirable Vegetation on the Uinta National Forest.

U.S. Department of Agriculture. Forest Service. Uinta National Forest. 1995. Environmental Assessment for Control of Noxious Weeds in Wilderness on the Uinta National Forest.

♦ Wildlife

Utah DWR monitors a winter range trend study for deer and elk on the terrace above Santaquin. This data is collected on a 5-year rotation. Wildlife managers for the Forest Service will use this data to monitor wildlife habitat recovery in the burned area.

♦ Archaeology

- Surveys will be conducted for any ground disturbing activities for areas that are not adequately inventoried.

♦ Interim Evaluations

The Implementation Team Leader will conduct periodic evaluations (annually as a minimum) with the District and Forest implementation team to assess implementation progress, effectiveness monitoring and to determine if parameters measured and sampling frequency meet the planned objectives. **The BAER team understands that monitoring funds could be available for effectiveness monitoring in year 3 provided that the Uinta National Forest submits interim reports to request addition funding and provided that the Forest documents and shares their findings.**

♦ **Reports**

- An INTERIM REPORT will be prepared.

- The overall results will be presented in a detailed report during 2004. This report will be submitted to the Forest Supervisor, other unit District Rangers, the Regional Office and all cooperating agencies and other interested parties.

♦ **Annual Financial Requirements**

The annual cost of monitoring is itemized in the following table. The total cost for year 2 is $ 9,745 and $ 9,245 for Year 3.

(see attached financial worksheet on the following page)

Financial Worksheet	Year 2	Year 3
Soil and Hydrology		
PHOTO POINTS -- 1 day to gather/download data in Years 2 and 3	$ 375	$ 375
MONITORING -- 3 storms per year—Gather data 4.5 days; write-up 1 day, 5.5 days in Years 2 and 3 (includes evaluation and documentation of trail treatment and road reconditioning effectiveness)	$ 1,375	$ 1,375
MONITORING -- Hydrophobic soil conditions, log erosion barriers, straw mulch effectiveness and RAWS check--- 2 days and two people to view, 2 hours of helicopter time (A-Star); and one person to summarize and write report—(total of 5 person days for Years 2 and 3)	$ 1,950	$ 1,950
MONITORING -- reconnaissance flight of Mollie Fire --- 3 hours helicopter time.	$ 1,800	$ 1,800
MONITORING -- Mine tailing re-contouring -- 1 day and two people to view and one person to summarize and write report -- (total of 3 person days for Years 2 and 3)	$ 750	$ 750
MONITORING -- explanatory signs, temporary fence and silt fence -- 1 person 1 day to view, 1 person ½ day to summarize and write report.	$ 375	$ 375
SUPPLIES for soil and hydrology monitoring	$ 80	$ 80
Soil and Hydrology Subtotals	$ 6,705	$ 6,705
Erosion Control Seeding		
MONITORING -- Measure soil moisture and monitor coverage -- 2 days observation; write-up 1/2 day in Year 2.	$ 500	--
MONITORING --Vegetation transects -- 3 days and two people to measure in Years 2 and 3; 2 days and one person to summarize and write report each year -- (total of 8 person days for Years 2 and 3) Helicopter transport to monitor transects on upper slopes -- 1.5 hours total.	$ 2,020	$ 2,020
SUPPLIES	$ 100	$ 100
Erosion Control Seeding Subtotals	$ 2,620	$ 2,120

Financial Worksheet	Year 2	Year 3
Noxious Weeds MONITORING -- Noxious weed and shrub assessment --1 field day for 2 people and 1 write-up day for 1 person. (total of 3 people days for 3 years)	$ 420	$ 420
Noxious Weed Subtotals	$ 420	$ 420
TOTALS	$ 9,745	$ 9,245

(Michael D. Smith and Claire Brecher, Soil Scientists; Chad Hermandorfer & Dale Deiter, Hydrologists; David Tait, Botanist; Marlene DePietro, Range Management Specialist, and Karen Hartman, Wildlife Biologist)