

2003 ANNUAL REPORT

CANYON FUEL COMPANY, LLC SUFCO MINE ACT/041/002

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GENERAL INFORMATION

Permitte Name	Canyon Fuel Company, LLC
Mine Name	SUFCO Mine
Operator Name (If other then permittee)	
Permit Expiration Date	05/20/2007
Permit Number	C/041/002
Authorized Representative Title	Kenneth E. May, Mine Manager
Phone Number	(435) 286-4880
Fax Number	(435) 286-4499
E-mail Address	kmay@archcoal.com, mdavis@archcoal.com
Mailing Address	397 South 800 West, Salina, UT 84654
Designated Representative	C. T. Corporation
Resident Agent	Corporation Trust Center
Resident Agent Mailing Address	1209 Orange Street, Wilmington, DE
Number of Binders Submitted	1-Salt Lake City and 1-Price Field Office

IDENTIFICATION OF OTHER PERMITS

Identify other permits that are required in conjunction with mining and reclamation activities.

Permit Type	ID Number	Description	Expiration Date
MSHA Mine ID(s)	4200089	Minesite	
	1211UT090008901	Waste Rock Disposal	
MSHA Impoundment(s)			
NPDES/UPDES Permit(s)	UT0022918	Minesite Sediment Pond Major Industrial	April 30, 2006
	UTR000576	Multi-Sector Storm Water Permit	December 31,2006
PSD Permit(s) (Air)	DAQE-AN0665006-03	Minesite Air Quality Approval Order	
	BAQE-126-88	Waste Rock Disposal Air Quality Approval Order	
Other			

CERTIFIED REPORTS

List the certified inspection reports as required by the rules and under the approved plan that must be periodically submitted to the Division. Specify whether the information is included as Appendix A to this report or currently on file with the Division.

Certified Reports:	Required		Included or on file with DOGM		Comments
	Yes	No	Included	On File	
Excess Spoil Piles	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Refuse Piles	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Certified Reports prev. submitted
Impoundments	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Certified Reports prev. submitted
Other	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

REPORTING OF OTHER TECHNICAL DATA

List other technical data and information as required under the approved plan, which must be periodically submitted to the Division. Specify whether the information is included as Appendix B to this report or currently on file with the Division.

Technical Data:	Required		Included or on file with DOGM		Comments
	Yes	No	Included	On file	
Climatological	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Included on disk in Appendix B
Subsidence Monitoring	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Included in Appendix B
Vegetation Monitoring	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Included in Appendix B
Raptor Survey	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Included in Appendix B
Soils Monitoring	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Water Monitoring	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
First quarter	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Second quarter	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Data previously submitted
Third quarter	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Data previously submitted
Fourth quarter	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Data previously submitted
Geological / Geophysical	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Engineering	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Non Coal Waste / Abandoned Underground Equipment*	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Amendment approved on 09/09/2003 for abandoned underground equipment in 2003.
Other Data					
East Fork of Box Canyon Monitoring	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Included in Appendix B
East Fork Box Infrared Aerial Survey	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Data previously submitted
2003 Cultural Resource	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Included in Appendix B
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

*Reminder: If equipment has been abandoned during 2003, an amendment must be submitted that includes a map showing its location, a description of what was abandoned, whether there were any hazardous or toxic materials and any revision to the PHC as necessary.

APPENDIX A

Certified Reports

Excess Spoil Piles
Refuse Piles
Impoundments

As required under R645-301-514

CONTENTS

None - Certified Reports previously submitted.

APPENDIX B

Reporting of Technical Data

Including monitoring data, reports, maps, and other information
As required under the approved plan or as required by the Division

In accordance with the requirement of R645-310-130 and R645-301-140

CONTENTS

- Climatological Data on Disk
- Subsidence Report
- Vegetation Monitoring-Waste Rock Disposal Site
- Vegetation Monitoring-Pines Tract
- Raptor Survey
- East Fork of Box Canyon Studies-Biomonitoring
- East Fork of Box Canyon Studies-Macroinvertebrate
- 2003 Cultural Resource Monitoring Report

2003 SUBSIDENCE REPORT

CANYON FUEL COMPANY, LLC

SUFCO MINE

by

JOHN M. BLACK

CHIEF SURVEYOR

INTRODUCTION

Canyon Fuel Company LLC, SUFCO Mine's 2003 subsidence report is an update of annual subsidence data that has been accumulated since 1976 as the former Southern Utah Fuel Company. Prior to 1985, the data was derived from conventional survey methods. Since then, photogrammetric surveys have been employed to monitor the ground movement.

During 1985, the entire SUFCO Mine property was flown to establish a set of baseline photography and a grid of surface elevations. Where possible, an elevation was photogrammetrically determined on an approximate 200-foot grid. These original x, y and z locations serve as a comparative base for determining ground movement in the succeeding years. Other lease holdings that are acquired are flown for similar baseline information. Lease U-63214 was flown in 1991 and the 150-acre modification to lease U-63214 and lease UTU-76195 were flown in 1999.

Once each year around the end of August, another set of aerial photography is obtained. A new elevation is then found at the same x and y coordinates as all the originals within all areas considered to be active. The new, or current, elevations are compared to the originals and the difference between the two is used to generate a contour map. The result is the subsidence contour map included with each annual subsidence report.

The mine subsidence map accompanying this report shows surface control monuments, overburden contours, subsidence contours, surface tension cracks, a current outline of the mine, a one year mining projection and other miscellaneous items as explained in the legend.

SUBSIDENCE HISTORY

SUFCO Mine began operations that cause surface subsidence in June, 1976. Continuous miners were used to extract coal from pillars that were developed as part of a retreating panel. The panels were approximately 650 feet wide and varied in length up to 2,500 feet. The average mining height approached 11 feet and the extraction ratio averaged about 80%.

The resulting subsidence from these continuous miner panels averaged 4 feet in the plateau areas where overburden was 900 feet thick. In areas where panel boundaries were outside the escarpment and beyond the Castlegate Sandstone, subsidence increased with decreasing overburden thickness. The maximum subsidence measured to date, 8.5 feet, occurred in one of these areas. The overburden was only 600 feet thick.

Retreat mining continued in this manner until October, 1985, when a retreating longwall system was added. Longwall panels have ranged from 550 feet to 930 feet wide and up to 18,500 feet in length. Mining heights have varied from 8.5 feet to 12 feet.

Subsidence above the longwall panels has averaged 5 feet in the center of the panels. The overburden thickness has been from 1,800 feet to 1,000 feet (except outside the escarpment where overburden rapidly decreases). The maximum measured subsidence caused by longwall mining is seven feet. This occurred in two cases; 1. An area outside the escarpment very similar to the one mentioned above for the continuous miner panel and 2. Down the center of panels that are under plateaus with 1,000 feet of overburden, but this is not typical.

DORMANT AND ACTIVE AREAS

Dormant areas are those areas that have shown no movement for several consecutive years. Yearly digitizing of these areas will not be done, but photographic coverage can be obtained in the event that a need should arise for reevaluation. These areas may not be shown on the current subsidence map.

Active areas are those currently being mined or that have evidence of movement within a reasonable time period. Active areas are digitized and evaluated for subsidence yearly, until they meet the parameters of a dormant area.

2003 SUBSIDENCE

The 2002 subsidence map (Map 1) was updated using data from current photogrammetric monitoring. Each subsidence area is labeled as an independent block. A brief description of each follows:

AREA 1

This was SUFCO Mine's first subsidence area. Undermining began in June, 1976, and continued into 1979. The area is composed of five continuous miner panels that averaged 650 feet in width. Mining height averaged 11 feet with about an 80% extraction ratio.

Subsidence ranged from 4.5 feet to a maximum of 8.5 feet. It was first detected in 1976 and continued until 1985. No surface movement was detected in this entire area from 1986 to 1989. Area 1 was not digitized for the 1990 subsidence report and is considered dormant.

AREA 2

This is another continuous miner area. The panels here were irregular shaped and the extraction ratio was modest. Undermining ceased in 1984.

Maximum subsidence has been measured at 2 feet. The area has been stable since 1985 and has not been monitored since 1989. This area is dormant.

AREA 3

This area is another continuous miner section, but the extracted area is a portion of mains with protective barriers instead of a panel. Coal recovery was moderate with mined areas which were subcritical. Undermining ceased in 1983.

Maximum subsidence was measured at 2 feet. Because of the limited extraction and subcritical areas, the subsidence occurred slowly with small changes noticeable until 1987. The area appeared stable in 1988 and 1989. It has not been monitored since 1989 and is considered dormant.

AREA 4

This subsidence area is comprised of three continuous miner panels. The mining height averaged 11 feet with a good extraction ratio. Undermining ceased in 1985.

Maximum subsidence was 5 feet with no detectable change in 1989. This area was monitored again in 1993, 1994 and 1995 with no detectable changes. This area was monitored for ten years after undermining ceased. The last detectable subsidence was in 1988. Therefore, this area will be considered dormant.

AREA 5

The four continuous miner panels that make up this area were mined from September, 1978, to November, 1981. Mining height averaged 11 feet with an 80% extraction ratio.

Maximum subsidence was 5 feet with no detectable changes from 1985 through 1991. This area has not been monitored since 1991, and will also remain dormant.

AREA 6

Area 6 is SUFCO Mine's first longwall induced subsidence area. It is comprised of nine longwall panels varying from 540 feet to 700 feet in width and 1,700 feet to 3,900 feet in length. Also, there is a section of recovered mains between two of the longwall blocks. Undermining began in Area 6 during October, 1985, and continued through the mains recovery in March, 1990.

Maximum subsidence measured in areas bounded by the plateau is five feet. There is a location on the map that shows seven feet; but this area is outside the escarpment where the overburden is only 600 feet thick. The subsided escarpment is intentional and is part of a study agreed upon by SUFCO Mine, the Division of Oil, Gas and Mining, the Bureau of Land Management and the U. S. Forest Service. This particular section of escarpment was removed from the "no subsidence zone" to study the effects of longwall mining on the escarpment.

Area 6 has shown no significant changes since 1992. It has been determined that this area is dormant.

AREA 7

Area 7 was originally planned for no subsidence. Pillars were made to support the overburden but began to fail in the north end in 1984 when the underground workings were flooded. The failures progressed towards the south and by 1986, subsidence was detected over the area.

The map shows up to seven feet of subsidence. There was no additional subsidence movement detected from 1988 to 1994. Therefore, this area will also be considered dormant.

AREA 8

Undermining this area began in June, 1983, and was sporadic until 1992. Continuous miners were used with extraction ratios over 80% and average mining heights of 10 feet. This area stayed active longer than most due to its proximity to an adjacent active longwall block.

Maximum subsidence is five feet. No noticeable vertical movement has been detected since 1993. This area is dormant.

AREA 9

This area is a longwall mining area that is composed of four panels. The first began in June, 1989 and the block was finished in January 1992. The mining height averaged about 11 feet and the maximum subsidence is five feet. There has been no indication of movement since 1996. This area is determined to be dormant.

AREA 10

Area ten is a longwall mining block that began in January 1992. Mining was completed in August 2001. The entire surface area above this block was digitized for base-line elevations during 1991. Maximum subsidence shown to date is seven feet. This area did indicate some settling movement in the last two panels on the east side this year. The east side will be monitored for another year to determine its stability.

The experimental mining practice area discussed under "Area 6" was extended, with regulatory approval, to the east side of the canyon under the Southwest corner of "Area 10". An extensive pre-mining survey of this location was conducted late in 1992. A detailed survey of the post-mining subsidence effects was provided in the 1993 report.

AREA 11

Area eleven is an extension of the last longwall panel in area ten. It extends into a 150-acre modification to lease U-63214. An elevation baseline was established in 1999. Mining under this area began in January 1999 with gateroad development. Longwall mining took place from May 2000 thru September 2000. Subsidence to date shows a maximum of six feet. This area shows movement and monitoring will continue.

AREA 12

Area twelve is the first longwall mining block on the acquired lease UTU-76195. Do to a mine plan change at the start of 2003, this area now consists of six longwall panels. An elevation baseline was established in 1999. Gateroad development began in March 2000. Longwall mining began in September 2001. The second longwall panel mining was completed in September 2003. This area is being monitored.

AREA 13

Area thirteen is the second longwall mining block on the acquired lease UTU-76195. As in Area 12 this area was also modified and now contains one longwall panel. An elevation baseline was established in 1999.

DRAW ANGLE SURVEYS

Several draw angle surveys have been performed during the past years. Completed surveys have been over continuous miner areas and have been oriented both parallel and perpendicular to the long axis of the panel. The average of all measurements is 15°. Individual measurements ranged from 10° to 21°.

New longwall draw angle data was obtained in 1995. Draw angle points were installed in May 1986, on the southern end of the first panel in "Area 6". As shown on the subsidence map, survey lines were placed parallel and perpendicular to the axis of the panel. Undermining of this panel was completed in June 1986. Measurements were taken in 1995 and indicate an angle 15.25° for the perpendicular line. An angle for the parallel line was not obtained because the mains underlying the survey line were partially extracted. These findings coincide with the average of 15° as stated above.

SUBSIDENCE TENSION CRACKS

Tension cracks have occurred above most of the subsidence areas. Most have been located by survey and are shown on the map. Their lengths vary from a few feet to five hundred feet. Most are oriented either parallel to the natural jointing pattern or to the boundaries of the underground excavation. Vertical displacement along the cracks is uncommon and horizontal displacement varies from hairline to several inches in width depending on the surface topography (rock, hard packed or loose soil).

The U. S. Forest Service completed a tension crack study in 1978. They monitored twenty-two different cracks (located in Area 1) with widths varying from 1/8 inch to six inches. Results show that most cracks self-heal, or close, from 13% to 100% of their original width.

DETAILED LONGWALL SUBSIDENCE PROFILE

In 1998 a project was initiated to monitor longwall subsidence in relation to the advancing face. Preparation consisted of first installing two monitoring points outside the subsidence area. Then two base lines were established one 3000 feet long running parallel down the center and the second 1300 feet long perpendicular across the 967 feet wide panel. Markers were installed along these lines on 100 feet spacing using approximately 2.5 feet long rebar with an aluminum cap or a hardened nail drilled into the exposed rock. Initial horizontal and vertical readings were obtained by shooting each marker with a Topcon GTS-3 distance meter from the monitoring points.

Monitoring was done weekly to gather new readings on markers behind and up to 500 feet ahead of the advancing face. The data collected reveals that vertical movement starts approximately 150 feet ahead of the face with 15 hundredths of a foot of subsidence at the face. It then drops off quickly to 4 feet at 600 feet behind the face and gradually levels off at 4 to 5 feet. Horizontal readings indicate the ground initially moves about 30 hundredths of a foot away from the face, then back toward the face 80 hundredths of a foot.

CONCLUSION

Areas 1, 2, 3, 4, 5, 6, 7, 8, 9 are all considered to be dormant. Photographic coverage can be obtained if circumstances deem it necessary. Longwall mining of area 10 was completed in August 2001 but shows some settling on the east side. Area 11 was mined in 2000 and is still active. There was active longwall mining in area 12 causing subsidence. Yearly monitoring of Areas 10 (east side), 11, and 12 will continue until it has been determined that subsidence has ceased (on an area-by-area basis).

JMB:kb

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ENDANGERED PLANT STUDIES, INC.
129 North 1000 East
Orem, Utah 84057
(801-225-7085) ← 9
SLSLWELSH@aol.com

31 July 2003

Mr. Michael L. Davis
Canyon Fuel Company--Sufco Mine
397 S. 800 W.
Salina, Utah 84654

Dear Mike:

The report on the vegetative analysis of the three lifts of the waste rock site, and the demonstration site for 2003 is enclosed. The current dry year, in a series of at least four years of drought, is reflected in the somewhat lower total live cover percentages for the average over all of the years of measurement, but the total live cover is either about the same or slightly greater than for the even drier growing season of 2002. All lifts are, nevertheless, either improving, and in good condition or only slightly down from previous measurements. There are minor changes in species richness, mainly loss of some of the forb species from among the mix. These are expected to increase in years of more abundant precipitation.

Lateness of our measurements and this report this year are the result of my hospitalization earlier in the springtime. I have recovered nicely, and look forward to working with you into the future. Your attempts at revegetation of the demonstration area and the various lifts of the Waste Rock disposal site are proceeding nicely. My best wishes to you. I will be available at the office or home all summer. It is a pleasure to do business with you. Both Ron and I want to thank you for your kindness during our visit; the steel clappers fit this time, and I didn't even fall off the slope above the mine site.

Sincerely yours,


Stanley L. Welsh
President

**Vegetation Monitoring
of the
Waste Rock Disposal**

Prepared for:

**Canyon Fuels Company -- Sufco Mine
397 S. 800 W.
Salina, Utah 84654**

**Attention: Mr. Michael L. Davis
(435) 286-4421**

Prepared by:

**Stanley L. Welsh and Ronald J. Kass
Endangered Plant Studies, Inc.
129 North, 1000 East
Orem, Utah 84057**

30 July 2003

INTRODUCTION

This report describes the 17th of July 2003 sampling and monitoring of Canyon Fuels Company -- Sufco Mine (SUFCO) Waste Rock Disposal (WRD) Site and Demonstration Plot (DEM). The WRD site was sampled previously during 1992, 1994, 1995, 1996, 1998, 2000, 2001, and 2002. This year represents the 9th year of monitoring the WRD and the seventh year of sampling and monitoring the DEM plot.

The WRD site is composed of three parts; the smooth east side first lift, a pitted second lift contiguous to the west, and a third deeply pitted lift contiguous to the west, which was evidently treated to reseeded initially in 1999. A fourth lift is now being filled with waste rock and will be reclaimed subsequently and the status of the revegetation included in subsequent reports. The DEM plot is located immediately east of the SUFCO main office building at the Convulsion Canyon mine. The currently reclaimed lifts of the WRD represent two different treatments and at least three different seed mixtures. The lifts have been sampled separately and the results are compared below. The second, pitted lift was treated and reclaimed in 1994, the third lift in 1998. Results of the DEM measurements are included in Table 7. Comparison data for 1992, 1994, 1995, 1996, 1998, 2000, 2001, 2002, and 2003 WRD, and the 1992 reference site are included in Table 6A and 6B.

Vegetation was measured during 2003 at or near the height of the growing season (Tables 1-4), but the current year is another in a series drought years when precipitation has been below average. Precipitation is the singly most important factor that determines vegetative cover, aside from plant species involved, and the temperature regimen. The DEM plot has suffered most from the extended drought. It is situated on a steep hillside, and is subjected to coal dust from the yard below; it had responded well from the precipitation received during the 2002-2003 weather regimen, however.

Methods

Sampling techniques complied with Division of Oil Gas and Mining (DOGGM) vegetation guidelines (February 1992), and were discussed with Paul Baker (Reclamation Specialist DOGM) in 1992. Sampling was conducted by Drs. Stanley L. Welsh and Ronald J. Kass of Endangered Plant Studies.

Percent cover was estimated by the ocular method for all plots. A 75 m tape was stretched across the longest axis of each treatment type on the WRD and on the DEM. Random numbers were generated and the corresponding numbers were used to locate the 1m² quadrats along the 75 m transect. After sampling a minimum of 15 quadrats, sample adequacy was computed; minimal sample size for the each WRD treatment was N=15. A t-value=1.645 and d-value=0.1 were used as coefficients to calculate sample adequacy.

Results

WRD-First Lift--Treatment Smooth--2003

Total mean plant cover was 51.35% (s = 9.39). Grasses accounted for 50.68% of the total vegetative cover, or 98.68% of the species composition. The remaining cover and composition was accounted for by *Rosa woodsii*, and a trace of *Viguiera multiflora* (Table 1). Shrubs other than the rose were present, however. There are scattered plants of rabbitbrush on the first lift area.

WRD-Second Lift--Treatment Pitted--2003

Total mean plant cover was 63.00% (s = 11.65). Grasses accounted for 42.27% comprising 67.09% of the species composition. Forbs accounted for 11.86%, representing 18.86% of the species

composition, and shrubs contributed 8.87%, or 14.06% of the species composition (Table 2).

WRD-Third Lift--Treatment Pitted--2003

Total mean plant cover was 61.06 (s = 10.19). Grasses accounted for 42.05 percent of the total live cover and 68.80 percent of the species composition. Forbs represented 8.81 percent of the cover and 14.43 percent of the species composition. Shrubs were represented by the rabbitbrush species, *Chrysothamnus nauseosus*, at 10.2 percent of cover and 16.70 percent in composition (Table 3).

DEM-Demonstration Plot--2003

Total mean plant cover was 55.67% (s = 9.77). Grasses accounted for 53.66% of the cover, and represented 96.43% of the species composition. Forbs, represented by *Linum perenne*, constituted only 1.34% of the cover and 2.40% of the species composition. Shrubs accounted for 0.67% of the cover and 1.2% of the species composition (Table 4).

Table 1. Percent cover and species composition of WRD 1st lift, smooth--2003.

	% cover	% composition
Bare ground	29.33	
Litter	19.33	
<u>Grasses</u>		
<i>Elymus cinereus</i>	0.67	1.30
<i>Elymus smithii</i>	48.67	94.78
<i>Elymus spicatus</i>	1.34	2.60
Grass totals	50.68	98.68
<u>Forbs</u>		
<i>Viguiera multiflora</i>	t	t
Forb totals	t	t
<u>Shrubs</u>		
<i>Rosa woodsii</i>	0.67	1.30
Shrub totals	0.67	1.30
Live Cover Total	51.35	99.98

Table 2. Percent cover and species composition for WRD second lift, pitted-2003.

	% cover	% composition
Bare ground	26.6	
Litter	10.4	
<u>Grasses</u>		
<i>Dactylis glomerata</i>	13.33	21.16
<i>Elymus cinereus</i>	1.34	2.13
<i>Elymus smithii</i>	19.93	31.63
<i>Elymus spicatus</i>	1.67	2.65
<i>Elymus trachycaulis</i>	6.00	9.52
Grass totals	42.27	67.09
<u>Forbs</u>		
<i>Achillea millefolium</i>	1.06	1.68
<i>Astragalus drummondii</i>	0.67	1.11
<i>Linum perenne</i>	6.00	9.52
<i>Viguiera multiflora</i>	4.13	6.55
Forb totals	11.86	18.86
<u>Shrubs</u>		
<i>Amelanchier utahensis</i>	0.33	0.56
<i>Artemisia tridentata</i>	3.34	5.25
<i>Chrysothamnus nauseosus</i>	5.20	8.25
Shrub totals	8.87	14.06
Live Cover Totals	63.00	100.01

Table 3. Percent cover and species composition for WRD third lift, pitted-2003.

	% cover	% composition
Bare ground	28.67	
Litter	10.20	
<u>Grasses</u>		
<i>Agropyron cristatum</i>	2.67	4.37
<i>Dactylis glomerata</i>	0.01	>0.01
<i>Elymus cinereus</i>	2.00	3.27
<i>Elymus hispidus</i>	20.33	33.30
<i>Elymus junceus</i>	0.67	1.09
<i>Elymus smithii</i>	9.67	15.84
<i>Elymus spicatus</i>	6.67	10.92
Grass totals	42.05	68.80
<u>Forbs</u>		
<i>Achillea millefolium</i>	1.67	2.73
<i>Linum perenne</i>	1.67	2.73
<i>Melilotus officinalis</i>	2.13	3.49
<i>Penstemon strictus</i>	3.34	5.47
Forb totals	8.81	14.43
<u>Shrubs</u>		
<i>Chrysothamnus nauseosus</i>	10.2	16.70
Shrub totals	10.2	16.70
Live Cover Totals	61.06	99.93

Table 4. Percent cover and species composition for DEM-Demonstration plot 2003.

	% cover	% composition
Bare ground	23.0	
Litter	15.0	
<u>Grasses</u>		
<i>Agropyron cristatum</i>	12.00	21.54
<i>Bromus inermis</i>	0.67	1.20
<i>Elymus cinereus</i>	16.33	29.33
<i>Elymus hispidus</i>	6.33	11.37
<i>Elymus junceus</i>	17.67	31.79
<i>Elymus lanceolatus</i>	0.33	0.60
<i>Stipa hymenoides</i>	0.33	0.60
Grass totals	53.66	96.43
<u>Forbs</u>		
<i>Linum perenne</i>	1.34	2.40
Forb totals	1.34	2.40
<u>Shrubs</u>		
<i>Chrysothammus nauseosus</i>	0.00	0.00
<i>Eriogonum corymbosum</i>	0.67	1.20
<i>Gutierrezia sarothrae</i>	0.00	0.00
Shrub totals	0.67	1.20
Live Cover Totals	55.67	100.03

Table 5. Percent cover and species richness for 1st lift 1992-1998, 2nd lift 1995-1998, and 1992 reference site.

Years Variables	1992 1st li	1994 1st li	1995 2nd li	1995 1st li	1996 2nd li	1996 1st li	1998 2nd li	1998 1st li	Ref. site
Bare ground	35.4	28.6	31.8	16.7	26.7	21.0	20.3	14.5	8.8
Litter	8.3	12.2	8.3	12.3	20.4	32.9	8.7	8.0	24.0
Grasses	45.1	30.3	36.7	68.7	41.9	44.9	51.9	76.5	30.1
Forbs	11.2	27.0	20.9	1.1	8.1	0.8	8.3	0.0	0.2
Shrubs	0.0	2.0	2.3	1.0	2.9	0.4	10.8	0.5	36.8
Totals	56.3	59.4	59.7	71.0	52.9	46.1	71.0	77.1	67.2
Species richness	14	16	20	19	13	6	14	5	7

Table 6A. Percent cover and species richness for 1st, 2nd, and 3rd lifts, 2000 and 2001.

Years Variables	2000 1st lift	2001 1st lift	2000 2nd lift	2001 2nd lift	2000 3rd lift	2001 3rd lift
Bare ground	10.7	15.33	24.6	14.80	41.0	22.86
Litter	27.4	20.67	16.0	19.27	10.6	12.00
Grasses	57.7	62.00	42.9	42.53	26.6	54.66
Forbs	3.9	1.99	12.1	15.72	21.3	8.87
Shrubs	1.0	0.00	4.3	7.67	0.6	1.6
Totals	61.9	63.99	59.4	65.92	48.5	65.14
Species richness	13	10	20	16	11	12

Table 6B. Percent cover and species richness for 1st, 2nd, and 3rd lifts, 2000 and 2001.

Years Variables	2002 1st lift	2003 1st lift	2002 2nd lift	2003 2nd lift	2002 3rd lift	2003 3rd lift
Bare ground	17.8	29.33	17.5	26.6	28.5	28.67
Litter	22.7	19.33	17.0	10.4	12.5	10.20
Grasses	58.8	50.68	50.0	42.27	36.0	42.05
Forbs	0.2	t	3.0	11.86	6.0	8.81
Shrubs	0.2	0.67	12.5	8.87	25.0	10.2
Totals	59.5	51.35	65.5	63.00	56.0	61.06
Species richness	10	5	15	12	13	13

Table 7. Percent cover and species richness for Demonstration plot, 1996-2001.

Variables	1996	1998	2000	2001	2002	2003
Bare ground	15.0	15.4	26.1	15.00	32.0	23.0
Litter	36.0	12.8	17.7	15.33	19.0	15.0
Grasses	39.7	64.3	50.8	58.00	42.5	53.66
Forbs	4.5	3.7	2.3	5.00	2.5	1.34
Shrubs	4.3	3.7	3.1	2.67	4.8	0.67
Percent live cover	49.0	71.6	56.2	69.67	47.3	55.67

Discussion

The 17 July 2003 determinations of plant cover and species richness describes condition of the vegetation in another dry growing season. The vegetative cover reflects to a large extent the weather regime of the current year, and is indicative of cyclical change in both vegetative cover and in species richness. The two different treatments, smooth for the 1st lift, and pitted for the 2nd and 3rd lifts have responded well in the reclamation attempt so far as vegetative cover is concerned. Total live cover for the first lift vegetation continues at a high level, starting at 56.3% in 1992, 59.4% in 1994, 71.0% in 1995, falling to 46.1% in the drought year of 1996, and rising to 77.1% during the wet spring of 1998. Despite the dry spring season of 2000 the percent live cover stood at 61.9 percent, and in a second dry year in 2001 stood at almost 64 percent. In 2002 cover was 59.5 %, but in 2003 was measured at 51.35. Thus, the trend over the seven measurements is difficult to determine due to rather wide fluctuations in precipitation during the period of this study. However, , averaging at 60.74 which is near that of the reference site's 67.2%.

Total live cover for the second lift was 59.7% when first measured in 1995, dropped to 52.9% during the drought year of 1996, and responded at 71.0% during the wet spring of 1998. During 2000 and 2001, both years of dry spring weather, the second lift vegetative cover measured 59.4 and 65.92 respectively, and in 2002 and 2003 the vegetative cover was 65.5 and 63%. This lift too averages near the reference site total live cover.

The east portion, i.e., Lift 1, was graded to a smooth surface prior to planting before 1992—that of Lifts 2 and 3, were treated to a basin-lifting technique that resulted in a dimpled surface. Effects of the 1996 drought were especially apparent on the smooth surface of Lift 1, but recovery during the wet year of 1998 was readily apparent, and the site has continued to gain or remain relatively stable during the period 2000 to 2003. Both kinds of treatment have responded well in spite of the drought interludes of 1996 and 2000 to 2003. Seed mixtures were evidently different for each of the lifts. Shrubs are doing better on the dimpled 2nd and 3rd lifts than on the smooth first lift treatment, on which grasses provide most of the live cover. Only the first lift treatment had lower species richness than for the reference site in 1998, but exceeds the reference site in richness in 2000 to 2003, except for Lift 1. Forbs especially were reduced in most of the sites during the 2003 measurements, possibly as a result of the continued drought.

A possible solution to increasing shrubs in the long term, as emphasized in the 1995 and 1996 reports and subsequently, might involve harvesting of mature inflorescences of big sagebrush and perhaps rabbitbrush from below the reference site and broadcasting them on both lifts one and two. That should provide an abundant seed source on site. Substantial germination of sagebrush seeds might increase the potential for shrub intermix among the other grass and forb vegetation. Lack of forbs on the first lift quadrats is a result of sampling in some part, but represents the continued decline in forbs following their initial success. Such a decline is predictable.

The third lift, dimpled as was the second, evidently was reclaimed with a different seed mix than was utilized on either lifts one or two. Yellow sweet clover formed a large percentage of the total live cover on that lift in 2000, but was less important in 2001 and subsequently. This lift is recovering nicely, however.

The demonstration site, on a steep slope (58%) immediately east of the loadout area in Convulsion Canyon, was measured this year for the fourth time. Despite the steepness of the slope and the use of very raw substrate, the success of the revegetation attempt is readily apparent. Total live cover percentage was measured at 49.0 in 1996, 71.6 during the wetter than normal year 1998, 67.2 in the dry year of 2000, and 69.7

in the relatively dry year of 2001. There was a sharp decline in vegetative cover in 2002, and only modest recovery in 2003. Reclamation of this slope proceeds well, however. There is still evidence of creep of the soil mantle at the upper edge of the slope, but general stability of the remainder continues to be encouraging. Establishment of the native buckwheat, *Eriogonum corymbosum*, is of interest, but its total contribution to plant cover is low as indicated in 2003 measurements. This plant is evident as a dominant on the adjoining, untreated slope. It is a common component of vegetation along the coal measures in Utah.

PINES TRACT VEGETATION STUDY

Prepared by
Keith W. Zobell
July 19, 2003

The purpose of the "Pines Tract Vegetation Study" is to determine if under-mining of the coal reserves has had any affect on the "Link Canyon Trail Columbine" (*Aquiligia flavenscens* var. *rubicunda*) and the riparian areas within the Pines Tract coal lease.

On July 16, 2003 the Pines Tract area was visited by Keith W. Zobell (Environmental Specialist), and Mike Davis (Mining Engineer for Canyon Fuel Company, LLC, SUFCO Mine). The purpose of this trip was to revisit all the photo points that have been established, and to retake photos at each site and to determine the general vegetative growth and plant vigor condition at each photo site.

The weather records at the SUFCO Mine showed that the area continued to receive below average precipitation during the winter of 2002-2003. A couple of good rain storms did provide good precipitation in early May, however only .14 inches of moisture to date has been received since then. This is the fifth consecutive year that the area has been in a drought condition. This continued drought condition continues to exhibit itself in reduced flows in the seeps, springs and streams as well as a reduction in vigor and growth of the vegetation in the general area. The spring rains in early May did provide enough moisture for the perennial plants in the area to produce a poor to fair vegetative growth. This vegetative growth is better than last year when very little growth occurred. The small pond at the "Grotto" area continues to be dry and the stream in Box Canyon had no flow at monitoring site 090 for the first time. There were some standing pools of water still in the streambed in Box Canyon but no flow. The Pines Tract was not grazed this spring. This has helped over-all vegetative condition of the area, however, due to the continued drought conditions the vegetation has not recovered as expected from the heavy early grazing last year. Plant density and vigor continues to decline.

At photo points 1,2, & 3 the growth of the Link Canyon Trail Columbine continues to be poor to fair. The plants that were growing where they would receive some shade and moisture from the fractures in the bedrock had a few inflorescence growths of 10-12 inches in length. The plants that received little or no shade had poor inflorescence, and none on some plants, with a total plant height of 4-7 inches.

At photo points 8 & 9 ("Hanging Fern Garden) there was some fern growth 5-8 inches in length. The density of the fern is only poor and is very spotty. There is very little moss growth and it occurs mainly along fractures in the bedrock where there is a little moisture. In the locations where the cattle ate the moss last year there is no moss growing yet this year. These areas where the moss has been removed are now covered with lichens.

In Box Canyon at photo point 6 the vegetation density is only fair. This is probably due to the heavy grazing last year or to the fact that there has been a 2-3 inch deposit of alluvial that has been deposited by high spring flows earlier this year. Kentucky Bluegrass has seeded out with seed heads averaging 12-14 inches in height and yarrow inflorescence being 12-14 inches in height. Carex is 6-8 inches in height and is starting to head out. Most of the Rose and Aspen are starting to sprout, however some of the plants that were heavily grazed last year appear to be dead. The adjacent creek is dry.

At photo point 7 the vegetation density is poor. This is probably due to drought, last years heavy grazing and this springs alluvial deposit. There is no evidence of any living Link Canyon Trail Columbine plants at this site. Carex is 6-7 inches tall with no seed heads.

At photo point 5 the vegetative density and vigor is only fair. Carex is 7-9 inches high and is starting to head out. This site also has a deposit of alluvial material as a result of this springs high run-off. There are two Link Canyon Trail Columbine plants at this site. The crowns are fairly small and the inflorescence is in the late flower stage and is 6-8 inches tall.

At photo point 4 the vigor is poor to fair. The inflorescence is in the late flowering stage. The plants are 4-6 inches tall with the inflorescence being 8-10 inches in height.

At photo point 10 the vigor in the wet meadow bottom is good and still has good density. However, the drier portions of meadow above the wet meadow have significantly deteriorated to the point where they can hardly still be considered as dry meadows. The vegetation in-between the sagebrush plants has changed from Bluegrasses and Carex to scattered Stipa and weedy annuals. The wet meadow growth is fair to good with Carex 8-10 inches high, Juncus 7-9 inches high, and Kentucky Bluegrass seed heads 15-18 inches high.

Continued drought conditions and last years heavy grazing has contributed to the decreased vegetative density in the drier portions of this area. Although the Link Canyon Trail Columbine vigor and density has decline no evidence has been identified to tie this change to under-mining of the coal reserves. It appears at this time that this decline is probably due to continued drought conditions and heavy grazing.



Photo Point 1A

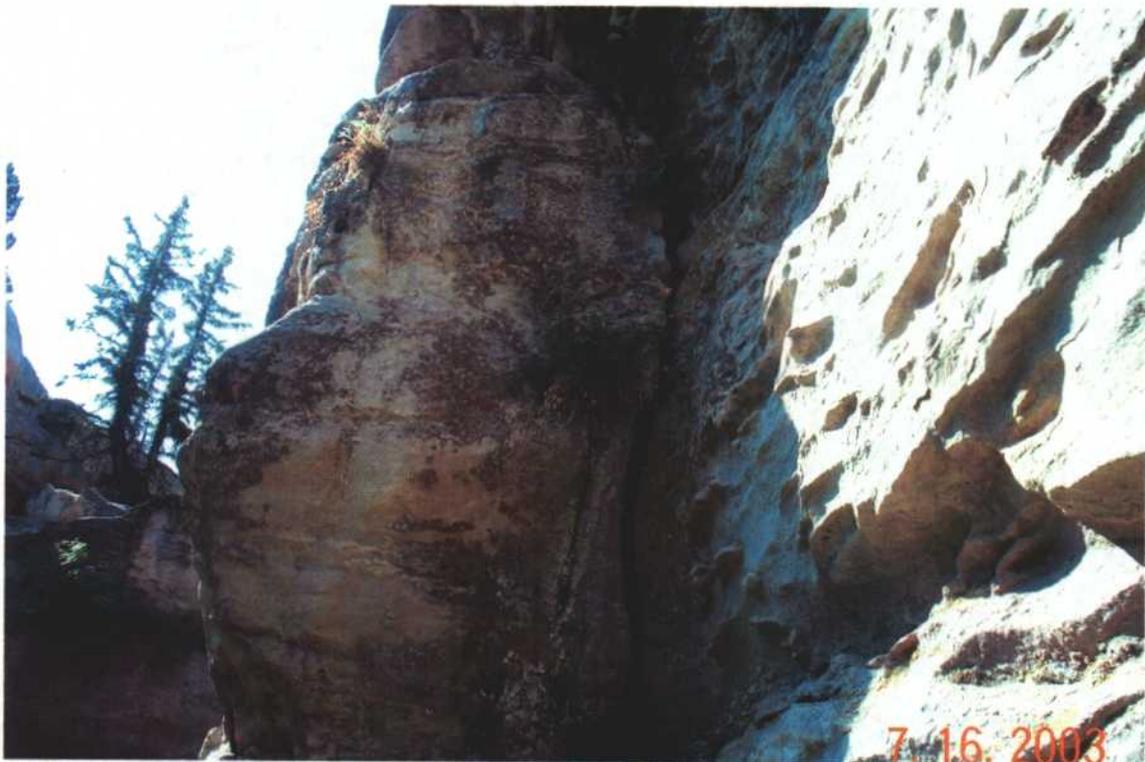


Photo point 1B



Photo Point 1C

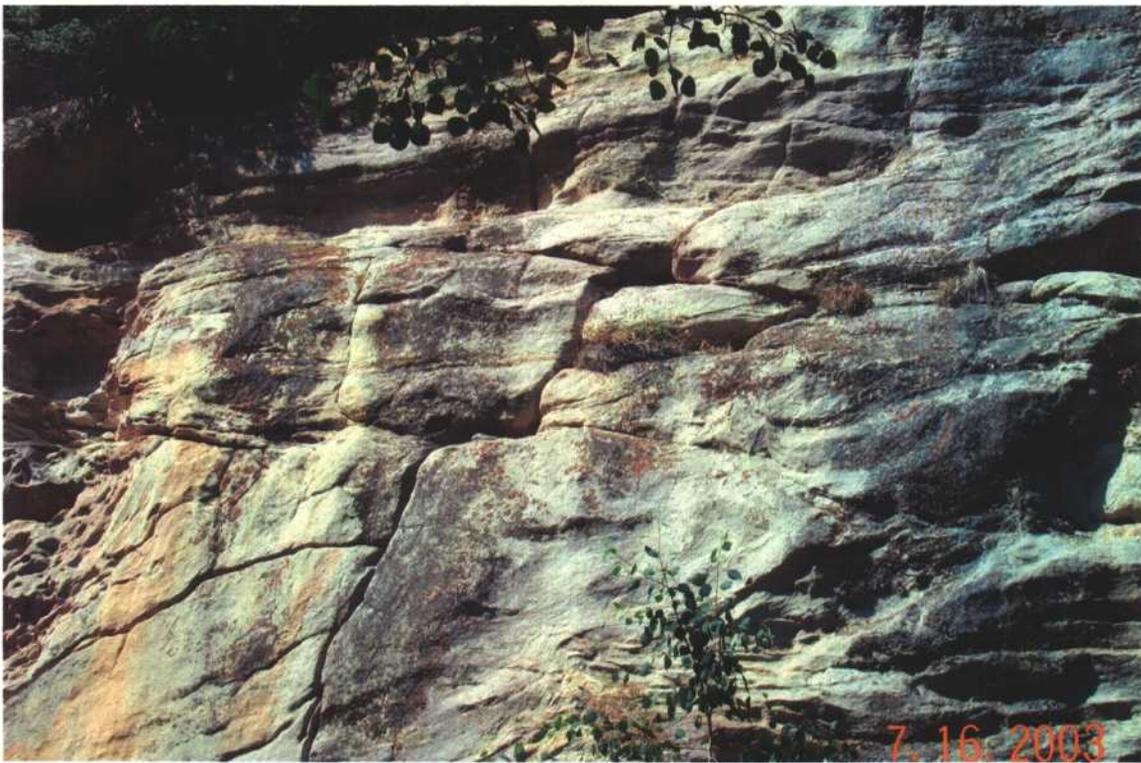


Photo Point 2

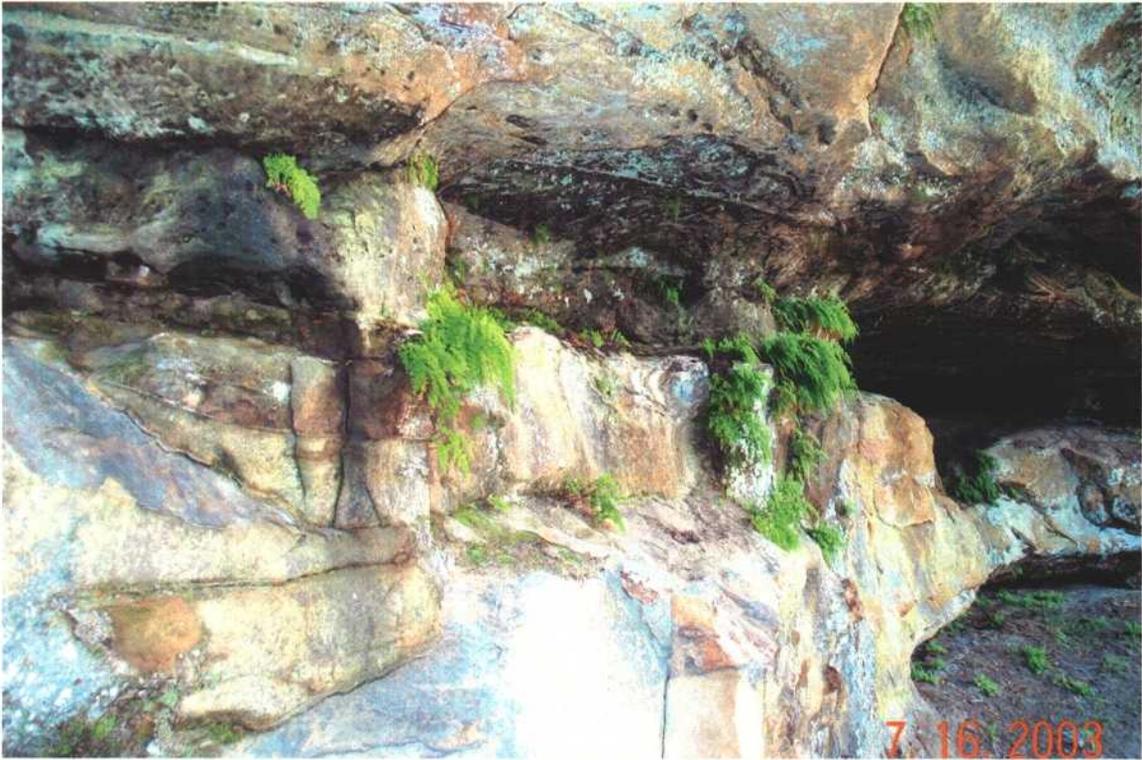


Photo Point 8



Photo Point 9A



Photo Pont 9B

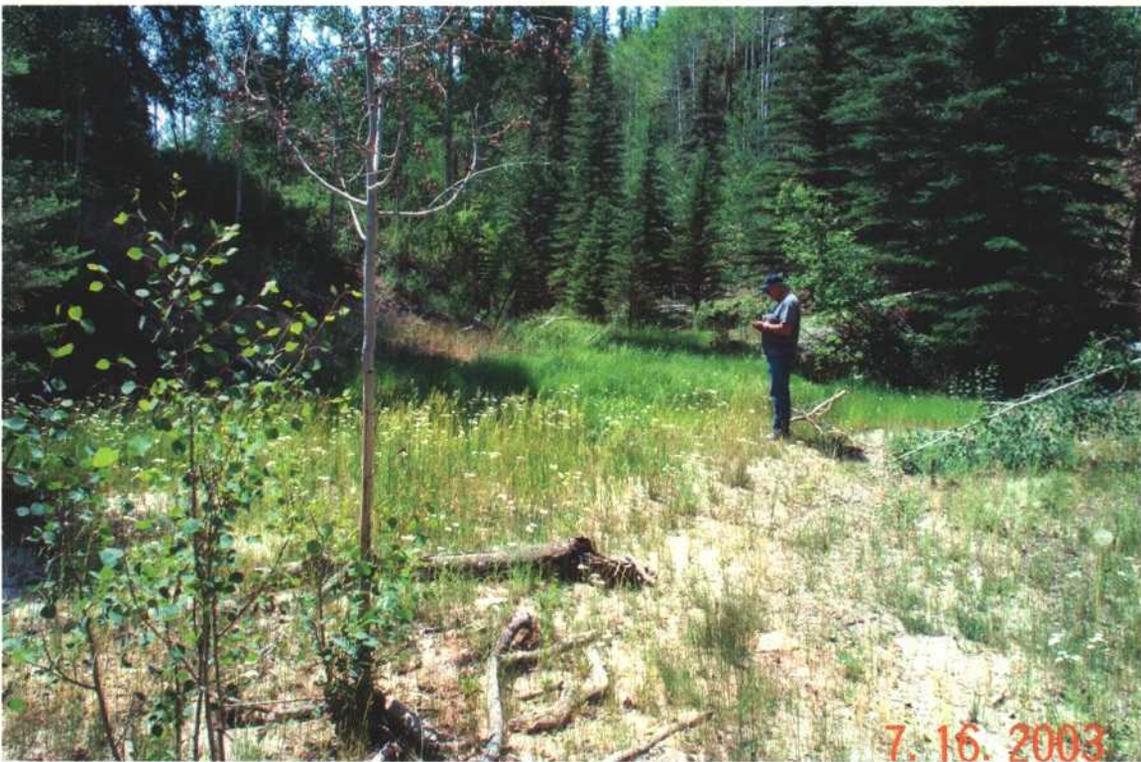


Photo Point 6



Photo Point 7



Photo Point 5



Photo Point 4



Photo Point 10



Photo Point 10 (close-up)

**AN ASSESSMENT OF THE
MACROINVERTEBRATES
OF BOX CANYON,
SEVIER COUNTY, UTAH
IN OCTOBER 2003**

**A BASELINE MONITORING STUDY
FOR THE
SUFCO MINE
2003**



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INTRODUCTION

Coal mining activities were expected to induce subsidence under East Box Canyon on the Southeastern Wasatch Plateau, Sevier County, Utah in the late fall of 2003. In order to obtain baseline information on the invertebrate communities in the East Fork of Box Creek, sampling was undertaken on October 20 of 2003. The Main Canyon of Box Creek was sampled to establish a control station where no subsidence was expected. Box Creek is a tributary to Muddy Creek, which joins with the Fremont River to form the Dirty Devil River of the Colorado River drainage. Box Creek heads at an elevation of approximately 2600 meters above sea level. Photographs of the sample sites are included at the end of this report.

METHODS

While the Main Fork of Box Creek was selected as a control reach, it had a lower gradient than the East Fork of Box Creek. Flowing water was present, but moved much more slowly and had reaches where the stream bed was anoxic. No plunge pool-like habitat was found. Further, precipitated sulfates exposed at seeps at the surface of decomposing Blackhawk formation shales exposed at stream-side indicated that the Main Fork had a different chemical composition than did the East Fork. The increased retention of leaf litter in the fall sampling period resulted in a more organic rich riffle habitat, possibly a function of different flushing rates. After walking the stream channel, we selected one site (Table 1) with extensive riffle habitat, consisting of rubble and cobble substrate. This site will be useful for appraising both seasonal and long term changes induced by external factors (droughts, ENSO, etc.) so that such changes could be considered when interpreting data from the East Fork of Box Creek.

The bed of the stream channel in the East Fork of Box Creek included several habitat types. These ranged from mobile sand bottom, to exposed bedrock. A number of short plunge pools developed where the stream had downcut through Castlegate sandstone to shales at the top of the underlying Blackhawk formation. The plunge pools had sand bottoms, and short riffles existed at the outflow of the plunge pools. These riffles consisted of gravel-rubble accumulations. Because the habitat types in the East Fork of Box Canyon were quite discrete, each would contain different invertebrate communities. Random sampling under such conditions would likely result in significant variations in the composition of the community measured at each station. For this reason sampling was focused on the riffles at the outflow of the plunge pools. That habitat type is most likely to contain a diverse invertebrate assemblage. Such an assemblage would be expected to be more sensitive to changes in flows. Sampling in the East Fork of Box Creek began in the downstream-most station (Site 1) which corresponds to one of the vegetation monitoring stations. We progressively sampled upstream where adequate plunge pool/riffle habitats were found (Table 1).

Table 1. Sampling station locations.

	Station	Station Code	Zone	East	North
Main Fork of Box Creek	Site 1	SBXM01	Z12S	E 0469490	N 4316829
East Fork of Box Creek	Site 1	SEFM01	Z12S	E 0471321	N 4317506
East Fork of Box Creek	Site 2	SEFM02	Z12S		
East Fork of Box Creek	Site 3	SEFM03	Z12S	E 0471336	N 4317420
East Fork of Box Creek	Site 4	SEFM04	Z12S	E 0471333	N4317378

Conductivity, pH, alkalinity, and hardness were measured to characterize the stations. Three box samples were taken at each site. Since the data are being used to monitor changes in the stream over time, each site in the East Fork of Box Canyon is being treated as a replicate. The individual samples taken from within each site are therefore subsamples for estimates of the density at the individual site (Jordan et al 1999). Thus the samples were bulked together in the field. A modified Surber-type sampler based on the dimensions of the box sampler developed by Shiozawa (1986), with with a net mesh of 250 microns, was used to collect the samples. The substrate was stirred to a depth of approximately 5 cm. All rocks within the area of the sampler were removed and individually washed to insure quantitative collection of the invertebrates. The samples were concentrated on a screen with a mesh of 64 microns and field preserved in ethyl alcohol. A GPS unit was used to both locate and record the positions of the sample stations.

In the laboratory the samples were sorted in illuminated pans. All invertebrates were removed and identified to the lowest possible taxonomic level using the keys of Merritt and Cummins (1996). We took sub-samples from the samples after they were visually sorted. The sub-samples were placed in a beaker with a total volume of 200 ml and five 2 ml subsamples were processed under magnification with a dissecting scope. The mean density per subsample was used to project the total density of organisms remaining in the visually sorted sample, and these projections were added to the total count from the visual sorting. The data were then used to determine the density of taxa per square meter. Mean biomass estimates were also generated so that trends in standing crop could be documented.

RESULTS AND DISCUSSION

The Main fork of Box Creek clearly differed in water chemistry from that recorded for the East Fork of Box Creek (Table 2). The Main Fork had lower pH, conductivity, alkalinity and hardness. In particular, alkalinity in the Main Fork, was about a sixth of that in the East Fork, and hardness was about a third less. Alkalinity, a measure of carbonate, bicarbonate, and hydroxide ions should largely reflect the concentrations of calcium/magnesium carbonate and calcium/magnesium bicarbonate ions. If the total alkalinity equals hardness, the usual interpretation is that carbonate species are the main

ion constituents in the system. However, if hardness exceeds alkalinity, as it does in the Box Canyon Creek samples, then other anions are present as well. In the case of these two streams it is probable that the difference is made up of sulfate ions. While we did not measure the sulfate concentrations, the deposition of sulfates in the Main Fork were noted above. Assuming the majority of the anions were composed of sulfate and that these were largely tied to divalent cations, the Main Fork sulfate levels were probably in the minimum range of about 80 to 90 mg/l and in the East Fork the levels were likely to be in the range of around 40 mg/l. These levels are used when determining the CTQp values (Winget and Mangum 1979). The four East Fork stations did not differ appreciably from one another.

Table 2. Water Chemistry

	Main Fork Box Canyon	East Fork Box Canyon Site 1	East Fork Box Canyon Site 2	East Fork Box Canyon Site 3	East Fork Box Canyon Site 4
Conductivity	170 micro siemens	300	270	290	280
pH	7.83	8.52	8.39	8.43	8.44
Alkalinity	34 mg/l	154 mg/l	137 mg/l	137 mg/l	154 mg/l
Hardness	120 mg/l	188 mg/l	188 mg/l	171 mg/l	188 mg/l

The Main Fork of Box Canyon had 15 taxa and 20,563 organisms per square meter (Table 3). These were predominantly chironomids, but high numbers of both oligochaetes and ostracods were also collected. *Dicosmoecus*, which are omnivorous (Merritt and Cummins 1996), were likely acting as shredders and detritivores in the high concentrations of organic materials within the stream bed at the Main Fork site. The four East Fork of Box Canyon Creek stations had total densities of 8242, 13,271, 11,635, and 8959 respectively, about half of the total density recorded in the Main Fork. The four station also have fewer taxa, 11 to 14 as opposed to the 15 in the Main Fork. The four East Fork sites were unique in that chironomids comprised between about 13% to 32% of the organisms at each of the stations and the number of *Baetis* mayfly nymphs

Table 3. Summary of densities per square meter and diversity for Box Canyon, Fall 2003

		Main Fork Box Canyon	East Fork Box Canyon Site 1	East Fork Box Canyon Site 2	East Fork Box Canyon Site 3	East Fork Box Canyon Site 4
Ephemeroptera	<i>Baetis</i>	20.2	3312.8	2009.9	2242.2	3333
Plecoptera	Early instar Plecoptera	0	414.1	1353.4	50.5	0
	<i>Malenka californica</i>	10.1	0	0	797.9	444.4
	<i>Paraperla</i>	191.1	0	0	2514.9	1484.7
	<i>Zapada</i>	0	151.5	171.7	60.6	0
Trichoptera	<i>Brachycentrus</i>	0	10.1	10.1	0	0
	<i>Dicosmoecus</i>	262.6	0	0	0	10.1
	<i>Hydropsyche</i>	0	30.3	171.7	1353.4	0
	<i>Limnephilus</i>	0	0	10.1	0	0
	<i>Psychomyia</i>	0	10.1	646.4	0	0
	<i>Rhyacophila</i>	0	0	0	20.2	0
Coleoptera	<i>Heterlimnius</i> (larvae)	10.1	0	0	0	0
	<i>Heterlimnius</i> (adult)	20.2	0	0	0	0
	<i>Optioservus</i> (larvae)	0	0	0	0	0
	<i>Optioservus</i> (adult)	525.2	0	0	0	0
Diptera	Ceratopogonidae	10.1	0	40.4	0	10.1
	<i>Chelifera</i>	0	30.3	60.6	0	0
	Chironomidae (larvae)	16089.3	2636.1	2656.3	2030.1	1181.7
	Chironomidae (pupae)	10.1	0	40.4	0	40.4
	<i>Dixa</i>	0	10.1	0	0	0
	<i>Pericoma</i>	10.1	0	10.1	0	10.1
	<i>Simulium</i> (larvae)	0	1010	5847.9	1888.7	999.9
	<i>Tipula</i>	60.6	90.9	232.3	70.7	90.9
Crustacea	Copepoda	303	535.3	0	0	0
	Ostracoda	1686.7	0	0	0	10.1
Arachnida	Hydracarina	20.2	0	10.1	0	0
Mollusca	<i>Sphaerium</i>	30.3	0	0	0	0
Annelida	Oligochaeta	1302.9	0	0	606	1343.3
TOTAL		20563.3	8241.6	13271.4	11635.2	8958.7
number of taxa		15	12	14	11	11

Table 4. Diversity and Biomass

	Main Fork Box Canyon	East Fork Box Canyon Site 1	East Fork Box Canyon Site 2	East Fork Box Canyon Site 3	East Fork Box Canyon Site 4
Diversity	0.88129	1.50511	1.61401	1.92913	1.71273
Biomass	2.389 g	0.3501	1.4155	0.8783	1.3890

were very close to, and in some cases exceeded, the total number of chironomid larvae. In contrast, chironomids comprised about 80% of the organisms in the Main Fork and total densities of chironomids were about 6 to 12 times higher than in the East Fork of Box Canyon. In addition relatively high numbers of stoneflies occurred in the East Fork samples and station 3 had high densities of filter feeding *Hydropsyche* caddisflies. Simuliids, another filter feeding group, were also abundant at all four East Fork stations. Simuliids were absent at the Main Fork site, reflecting the higher current in the East Fork, a direct result of its higher gradient.

The higher number of taxa at the Main Fork implies that it would have a higher diversity than the East Fork sites. But the heavy dominance of chironomids in that station overrode the higher number of taxa in the computation of the Shannon Weiner diversity index values (Table 4). The East Fork diversity ranged between 1.5 and 1.9, while the diversity recorded for the Main Fork was 0.91. The East Fork diversity values were similar to those for the Eccles Creek above South Fork collected in August of 1979 (Winget 1980, Shiozawa 2002), but were considerably lower than other reference sites established on Eccles Creek. Given the substrate present in the stream, it is probable that the diversity values recorded are typical of the stream in the fall. The high sand input and relatively unstable bank conditions indicate that the stream has been stressed for some time. Whether this is due to anthropogenic effects (e.g. grazing induced erosion in the late 1800's) or natural effects of being in a relatively easily eroded sandy soil is unknown.

Biomass, highest in the Main Fork, was most likely influenced by extremely high density of midges and secondarily by the number of caddisfly larvae. A standing crop of 2.39 g per square meter was recorded in the Main Fork of Box Canyon, while the next highest biomass reading was 1.42 grams per square meter at station 2 of the East Fork. The lowest standing crop was recorded from Station 1 of the East Fork, 0.35 grams per square meter. The biomass was consistently lower in the East Fork. That is likely associated with the difference in organic matter retention between the two forks.

The Biotic Condition Index

The Community Tolerance Quotient (CTQa) was determined (Table 5), and was used to generate the Biotic Comparison Index for each of the stations sampled. The highest CTQa value was obtained from the Main Fork of Box Canyon site, followed by the East Fork of Box Canyon Site 2, then Site 1, Site 4, and Site 3 respectively. The CTQa value is higher for those communities that represent a more stressful environment (Winget and Mangum 1979). This ranking is similar

Table 5. Biotic Condition index, for Box Canyon, Fall 2003

		Main Fork Box Canyon	East Fork Box Canyon Site 1	East Fork Box Canyon Site 2	East Fork Box Canyon Site 3	East Fork Box Canyon Site 4
Ephemeroptera	<i>Baetis</i>	72	72	72	72	72
Plecoptera	Early instar Plecoptera	0	48	48	48	0
	<i>Malenka californica</i>	36	0	0	36	36
	<i>Paraperla</i>	48	0	0	48	48
	<i>Zapada</i>	0	16	16	16	0
Trichoptera	<i>Brachycentrus</i>	0	24	24	0	0
	<i>Dicosmoecus</i>	24	0	0	0	24
	<i>Hydropsyche</i>	0	108	108	108	0
	<i>Limnephilus</i>	0	0	108	0	0
	<i>Psychomyia</i>	0	108	108	0	0
	<i>Rhyacophila</i>	0	0	0	18	0
Coleoptera	<i>Heterlimnius</i>	108	0	0	0	0
	<i>Optioservus</i>	108	0	0	0	0
Diptera	Ceratopogonidae	108	0	108	0	108
	<i>Chelifera</i>	0	108	108	0	0
	Chironomidae	108	108	108	108	108
	<i>Dixa</i>	0	108	0	0	0
	<i>Pericoma</i>	108	0	108	0	108
	<i>Simulium</i>	0	108	108	108	108
	<i>Tipula</i>	36	36	36	36	36
Crustacea	Copepoda	108	108	0	0	0
	Ostracoda	108	0	0	0	108
Arachnida	Hydracarina	108	0	108	0	0
Mollusca	<i>Sphaerium</i>	108	0	0	0	0
Annelida	Oligochaeta	108	0	0	108	108
CTQa		86.4	79.33	83.43	64.18	78.55
CTQp		51	53	53	53	53
BCI		59.0	66.8	63.5	81.8	67.5

to that seen with the diversity values (Table 4), where the Main Fork of Box Canyon was the least diverse and the East Fork of Box Creek station 3 was the most diverse. The CTQp values can only be estimated since sulfate levels were not directly measured. The gradients of both sites, estimated from topographical maps, are less than 1.2%. The Main Fork of Box Canyon was a gravel-rubble substrate while the stations on the East Fork were sorted gravels or rubble substrates. The estimated CTQp for the Main Fork of Box Canyon was 51 while the East Fork Stations had a CTQp of 53.

The Biotic Condition Index is the ratio of CTQp/CTQa. The ideal situation would have a BCI of 1.0. In all five stations the BCI was 82 or less, and in the Main Fork it was less than 60 and three of the four East Fork sites were less than 70. This supports the results found with diversity indices, where the diversity values in the East Fork stations were higher than that of the Main Fork station, but were below values that reflect more pristine conditions.

Cluster Analysis

The cluster analysis of the data utilizing the Bray-Curtis dissimilarity index (Poole 1974, Krebs 1989) with the unweighted pairs group averaging algorithm (UPGMA) with NTSYS (Rolf 2000). Clustering showed that the four stations on the East Fork of Box Canyon were much more similar to each other than to the Main Fork station (Figure 1). Collectively the four East Fork Box Canyon samples were only 19% similar (81% dissimilar) to the Main Fork Box Canyon station. Within the East Fork stations, the most dissimilar was station 2, which also had the highest number of taxa and highest CTQa value of the East Fork sites. Stations 3 and 4 were the most similar to each other. These two stations had the highest diversity values among the East Fork sites.

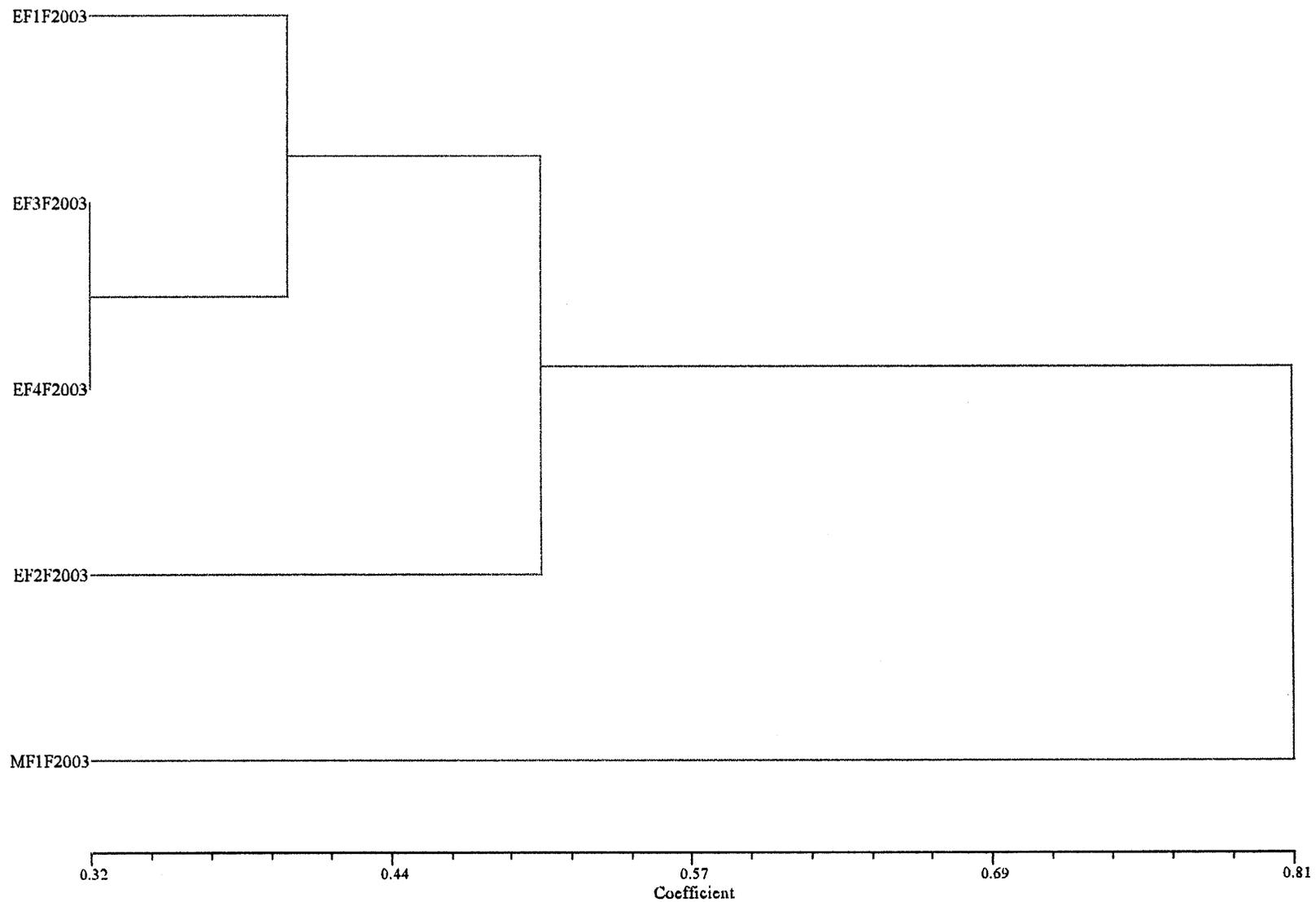
CONCLUSIONS

The East Fork sites were clearly different from the Main Fork station, and our visual survey of the two stream channels indicated that significant differences in the macrobenthic communities were likely. The East Fork station had the highest diversity, which was related to the higher current velocity at the outflow of the plunge pools where the samples were taken. No similar habitats were found in the Main Fork of Box Canyon. The data collected will establish a base condition for the fall season in the East Fork of Box Canyon, but the ability to utilize the Main Fork as a control stream, responding identically to seasonal variations in physical-temporal conditions, is unlikely. While monitoring of the Main Fork station should detect general trends associated with differences in precipitation, the Main Fork is likely to respond positively to increased precipitation, by spring sorting of sediments and increased water flow within the hyporheos, while the East Fork may be more prone to scouring and thus reduced diversity under the same conditions.

Post subsidence impacts on the East Fork can vary. If the underlying Blackhawk formation is fractured and water seeps out of the stream channel, reduced flows could result in convergence of the East Fork community towards the Main Fork conditions, where low flows result in stagnant habitats in the pools. If, instead, the gradient is increased, stream channel scouring could increase,

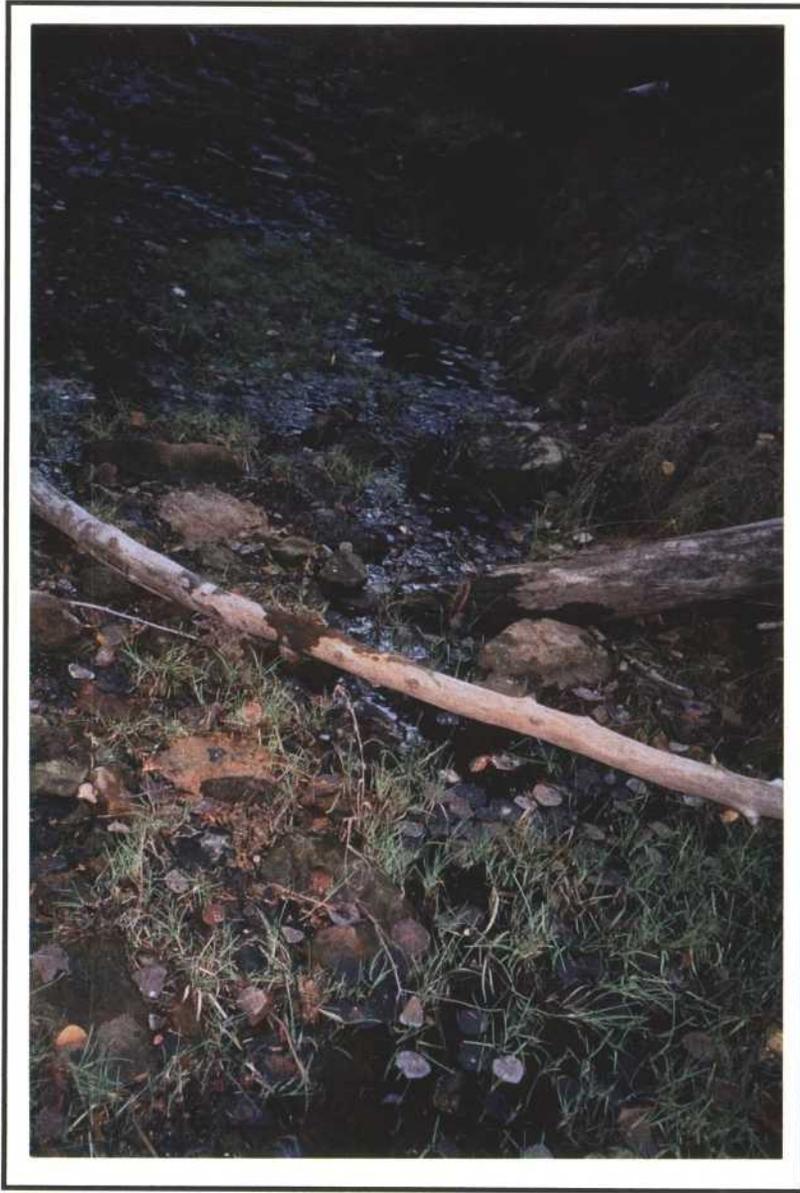
thus reducing the pool and riffle habitat at the pool outflow. A decrease in stream gradient could improve the retention of gravel and rubble below plunge pools, thus positively impacting the macrobenthos by increasing both total interstitial habitat and retention of organic material. However if the gradient is reduced too much, then sand will tend to fill the interstitial spaces and this will reduce the macrobenthic community diversity.

Figure 1. Cluster dendrogram for the Box Canyon samples.



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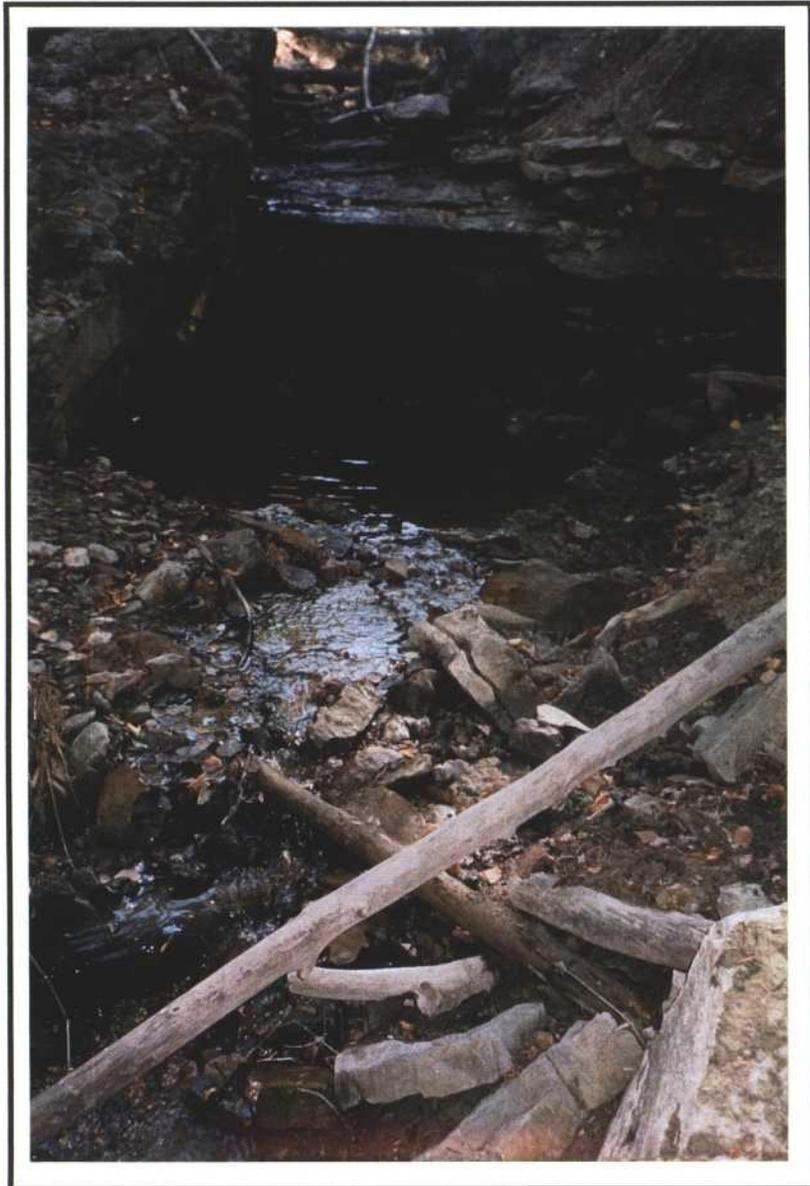
Main Fork of Box Creek: Site 1



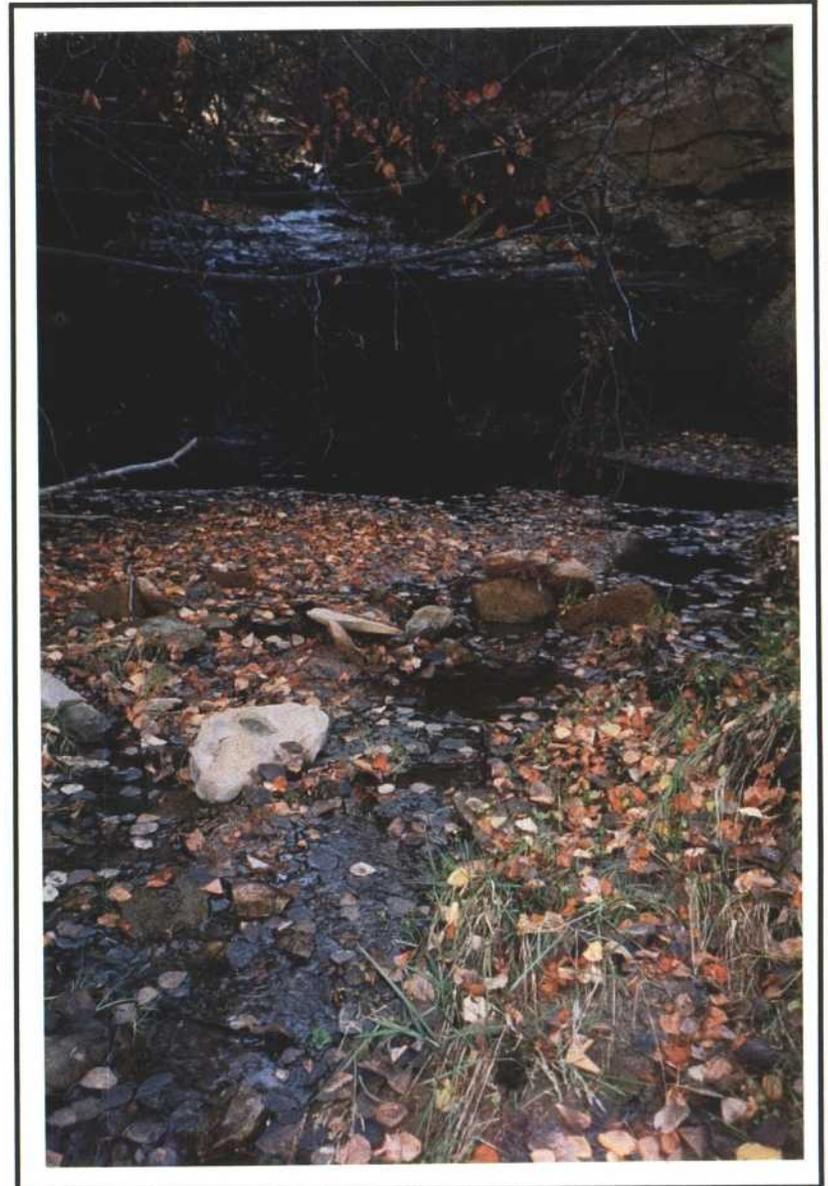
East Fork of Box Creek: Site 1



East Fork of Box Creek: Site 2

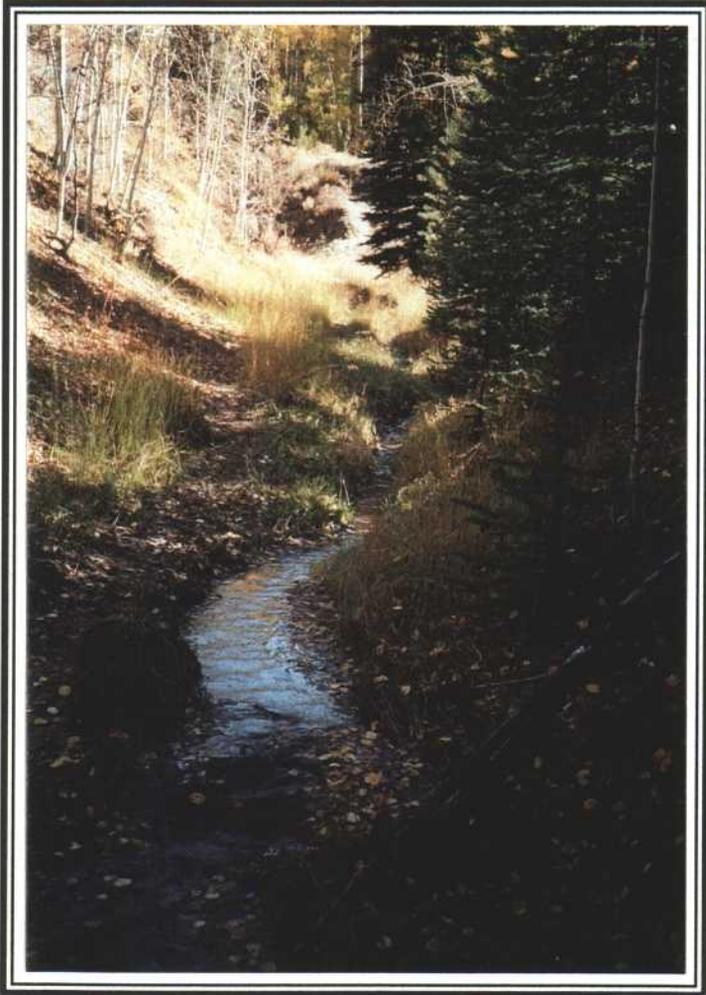


East Fork of Box Creek: Site 3



Main Fork of Box Creek: Site 4

**RIPARIAN PLANT COMMUNITIES
IN THE
EAST FORK OF BOX CANYON**



**A BASELINE MONITORING STUDY
FOR THE
SUF CO MINE
2003**

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SCOPE

Quantitative and qualitative baseline vegetation data were recorded in several locations in the East Fork of Box Canyon in 2003. Additionally, data were also recorded in several locations in the Main Fork of Box Canyon that may be used for controls to the study.

Coal mining activities were scheduled to be conducted under the East Fork of Box Canyon during the winter of 2003-04. The scope of this document is to provide at least one sample period of baseline data for the existing riparian plant communities in the two forks of Box Canyon prior to underground mining activities near the East Fork drainage.

INTRODUCTION

The Box Canyons and their drainages are located at the southern end of the Wasatch Plateau which is a subprovince of the Colorado Plateau Physiographic Province. This area is west of the town of Emery, Utah in Sevier County and is located within the Manti-LaSal National Forest. The Box Canyon drainages are tributaries to Muddy Creek which runs into the Dirty Devil River and ultimately drains into the Colorado River. Geology of the study areas were within the Cretaceous strata of the Mesa Verde Group. The upper portions of the study area was comprised of rocks and soils derived from the cliff-forming Castlegate Sandstone. The lower reaches of the study area encounters shales of the Blackhawk Formation. Elevation of the study area was between 8,000 ft to 8,500 ft above sea level.

This study concentrated on the riparian plant communities within the East Fork of Box Canyon because underground mining had been proposed in this area. However, because no mining was planned underneath the Main Fork of Box Canyon, some control transects were also placed in this drainage.

A variety of biological and other resource information can be studied to evaluate and characterize riparian complexes including vegetation, geology, channel morphology, aquatic biology, soils, and stream flow. The primary focus of this study was on the vegetation as to provide baseline information by monitoring the riparian communities in the East Fork of Box Canyon. The baseline monitoring should provide data to determine long term trends, natural variability and benchmark information for future comparison purposes.

The study primarily employed vegetation monitoring methods described by the USDA Forest Service for a "Level III Riparian Area Evaluation". The data recorded from this study when compared with post-mining studies may determine major impacts to the plant communities along the stream due to catastrophic events, such as loss of water and habitat from the affects of subsidence caused from underground mining. The scope of the study does not, however, provide data that show subtle changes to community structure and species composition as a result of minor changes to the riparian habitat.

METHODS

Sample station locations were pre-determined from an earlier field visit by a team of specialists and representatives from the State of Utah, Division of Oil, Gas & Mining (DOGM), Canyon Fuel Company (CFC), USDA Forest Service (USFS), Mt. Nebo Scientific, Inc. and other consultants. These stations were placed in areas with the intent to provide similar study areas where data could be recorded in several disciplines including biology, hydrology and geology. These sample stations area called "team stations" in this report.

The vegetation monitoring methods of the study was principally based on those described by the USDA Forest Service for a "Level III Riparian Area Evaluation" (Integrated Riparian Evaluation Guide, March 1992), but does expand on those methodologies.

Qualitative and quantitative data were recorded at each sample location. Although some maintenance may be required, locations and extent of the line transects were permanently marked using numbered and flagged wooden stakes and 12-inch metal nails. Photographic stations for documentation and future comparisons were established at each sample location.

In this report, when reference is made to the left or right side of the drainage, this means "river left" or "river right", *as characterized by looking downstream.*

Qualitative Data

The "Riparian Complex Data Sheet" to the right of the page lists all of the qualitative data (and some of the quantitative data) that were collected at all sample stations.

Quantitative Data

As mentioned previously, USFS protocol was utilized for the study. However, to increase the level of detail, some modifications to this protocol were utilized to those sample areas chosen by the

RIPARIAN COMPLEX DATA SHEET

CLIENT:
COMPLEX: Riverine - Number
WATERBODY NAME:
LOCATION:
DATE:
OBSERVER(S):
QUAD NAME:
GEOLOGIC PARENT MATERIAL:
ASPECT:
VALLEY BOTTOM TYPE:
STREAM GRADIENT:
ELEVATION: .
SIZE OF COMPLEX:
SOILS INFORMATION:
ADJACENT UPLAND VEGETATION (looking downstream)
Left: Right:
VEGETATIVE DESCRIPTION (Dominance by Community Types)
SUCCESSIONAL STATUS:
APPARENT FORAGE TREND:
ESTIMATED FORAGE PRODUCTION:
BEAVER ACTIVITY:
PHOTOGRAPH TAKEN: (from right side unless otherwise stated)
LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA:
SPECIES OBSERVED:
POOL ATTRIBUTES
 % area in pools:
 % pool area made up of pools > 2' deep:
AQUATIC VEGETATION
 % streambed with filamentous algae:
 % stream margin with rooted aquatic:
BANK TYPE & VEGETATION OVERHANG
 % bank length undercut (<90°):
 % bank length gently sloping (>135°):
 % bank length with overhanging vegetation:
BANK CONDITION (bankfull area only)
 % bank length vegetated, stable:
 % bank length unvegetated, stable:
 % bank length vegetated, unstable:
 % bank length unvegetated, unstable:
BANK STABILITY (near water line):
CHANNEL MORPHOLOGY
NOTES:

team specialists (team stations). The primary reason for the modifications were twofold. First, it will provide more diverse data sets, or other ways to measure potential changes to the vegetation in the canyons. Second, there is an existing baseline data set that was recorded in 1999 for the riparian communities in the two Box Canyons. With only a couple of exceptions, the sample areas in the 1999 data set were different than the team stations of the 2003 study. Although data were recorded in 2003 at some of the same sample locations as were used in 1999, in an attempt to maintain standardized data sets, the modifications to the protocol were not made at these stations. Some of the 1999 stations were located for the 2003 study so that, if necessary, they may provide worthwhile information through time that otherwise would not have been available with one baseline data set. *(One note of caution, however, is that the 1999 and 2003 data sets were not designed specifically to be compared – there may be some issues or problems associated with these comparisons).*

With the one exception to the protocol modification mentioned above, the parameters for all sample stations in the 2003 study were identical. The modification to the USFS protocol was in the methods that cover data were recorded. Depending on the site, three different methods were employed to measure cover. They are explained below.

Total Cover

For all the team stations, “total cover” was recorded. First, transect lines were established perpendicular to the stream channel. With a few exceptions such as constraints imposed by rock ledges or other topographical features, the transect line lengths were consistent, or 24 ft. on each side of the stream. The length of the transect lines extended far enough upslope to insure that they also included upland vegetation types (usually 3 quadrats on each side) as well as the riparian vegetation being sampled. The transect lines on each side of the stream began at the bottomland near the edge of the water, or where the riparian vegetation began. In some cases, no water was present at a given sample site. In those instances, the transect lines began where the water would normally be present (i.e. sandy or rock bottom). Water or dry channel widths were measured and added to the total length of the transects.

Regular points were placed at 3 ft. intervals on the transect lines. At these points, point quadrats were used to record the total cover. Cover by these “hits” could include the plant species, moss, litter, bareground or rock. Therefore, total cover when the data were summarized, included 1) percent of the living cover of each plant species, 2) total living cover (vascular), 3) total living cover (nonvascular), 4) litter cover, 5) bareground cover, and 6) rock cover.

Community Type Cover

The Community Type Cover was one method to record cover in the USFS Level III protocol and was used in those additional areas that were added to the riparian study. In other words, these areas were part of the 1999 study and were added to the study **in addition to** those chosen by the team. (In a few areas, the sample locations chosen by the team and those from the 1999 study

were the same – in those cases, both methods for estimating cover were employed).

At these locations permanently marked transects lines had previously been placed across (or perpendicular to) the stream channel. The line transects had varied lengths by design which were based on several factors. Although sometimes limited by topographical features such as sandstone cliffs, the intent was to make the transects long enough to cover the entire stream, its riparian communities, plus an additional 10 ft on each side of the stream to record the adjacent upland communities. Monitoring the total extent of the riparian plant communities including some upland community information should provide information about possible increases or decreases in the riparian communities relative to the adjacent upland communities.

Once the transect was placed, the line-intercept method was employed measuring the extent of each major riparian plant community. The plant communities were named by the dominant two plant species. If only one species dominated the community by a wide margin, the plant community was named by this single species. In this method, cover by each plant species is not calculated.

Green Line Cover

In addition to the methods for estimating cover described above, “Green Line” cover was also recorded at *all sample locations*. This method consisted of using a tape to measure the riparian community (Green Line) on each side of the stream. Similar to the Community Type cover described above, the dominant one or two species were listed with each measurement. Results from the Green Line method is similar to the Community Type method in that it quantifies the extent of the riparian community of each sample site. Differences are that the Green Line method separates the riparian data for each side of the stream, whereas the Community Type method provides total cover including: riparian community types, upland community types, bareground, litter, rock and stream.

Site Numbers

The sample sites that were pre-determined by the team of specialists (team stations) that will be used for studies other than those for this report were numbered accordingly and will be consistent with those other studies (geology and hydrology). However, those additional sites that were chosen to supplement the data sets, or the subset of riparian sites that were sampled in 1999, were numbered to be consistent with those sample sites. In some cases, they are the same location. A summary to clarify the numbered sites and the cover sampling method used at each site is shown in the RESULTS section below.

RESULTS

Listed below is a summary of the sample locations, site numbers and protocol used is shown below.

Sample Site Number	Other Name or Number	USFS Level III Protocol	Cover Protocol: Green Line	Cover Protocol: Point Quadrat	Cover Protocol: Community Type
EFB-1		X	X	X	
EFB-2		X	X	X	
EFB-3		X	X	X	
EFB-4		X	X	X	
EFB-5		X	X	X	
EFB-6		X	X	X	
EFB-7		X	X	X	
EFB-8		X	X	X	
EFB-9	RE-10	X	X	X	X
EFB-10	RE-09	X	X	X	X
EFB-11		X	X	X	
EFB-S1*		X	X		X
EFB-S2*	EFB-12	X	X		X
EFB-S3*	EFB-13	X	X		X
EFB-S4*	EFB-14	X	X		X
RE-09	EFB-10	X	X		X
RE-10	EFB-9	X	X		X
RE-11		X	X		X
RE-12		X	X		X
RE-13		X	X		X
R-07		X	X		X
R-09		X	X		X
R-11		X	X		X
R-13		X	X		X
R-15		X	X		X
*S= Spring					

Sample results are shown for each site on the following data sheets. Each sheet shows all qualitative and quantitative data recorded as well as photographic documentation.

RIPARIAN COMPLEX DATA SHEET

2003

CLIENT: Canyon Fuel Company

COMPLEX: Number EFB-1

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 6-10, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: West

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~1°

ELEVATION: 8,410ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
 - Falcon Family Soils: 55 %
 - Sandstone Outcrop: 30%
 - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Aspen

Right: Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data results for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: moderately stable

ESTIMATED FORAGE PRODUCTION: 1300 lbs./acre

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: *Mining, grazing, hunting, recreation.*

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Salix sp.</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Potentilla fruticosa</i>		<i>Carex lanuginosa</i>
	<i>Rosa woodsii</i>		<i>Juncus ensifolius</i>
			<i>Juncus arcticus</i>
			<i>Poa pratensis</i>

POOL ATTRIBUTES (meadow, no well defined stream channel)

% area in pools: 0

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 0

% bank length with overhanging vegetation: 0

BANK CONDITION

% bank length vegetated, stable: 90

% bank length unvegetated, stable: 10

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many of the sideslopes above these areas were quite unstable): *stable*

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) This was a meadow area, not a stream.

2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 27 ft. transect on left side; 33 ft. transect on right side.

DATA SUMMARIES

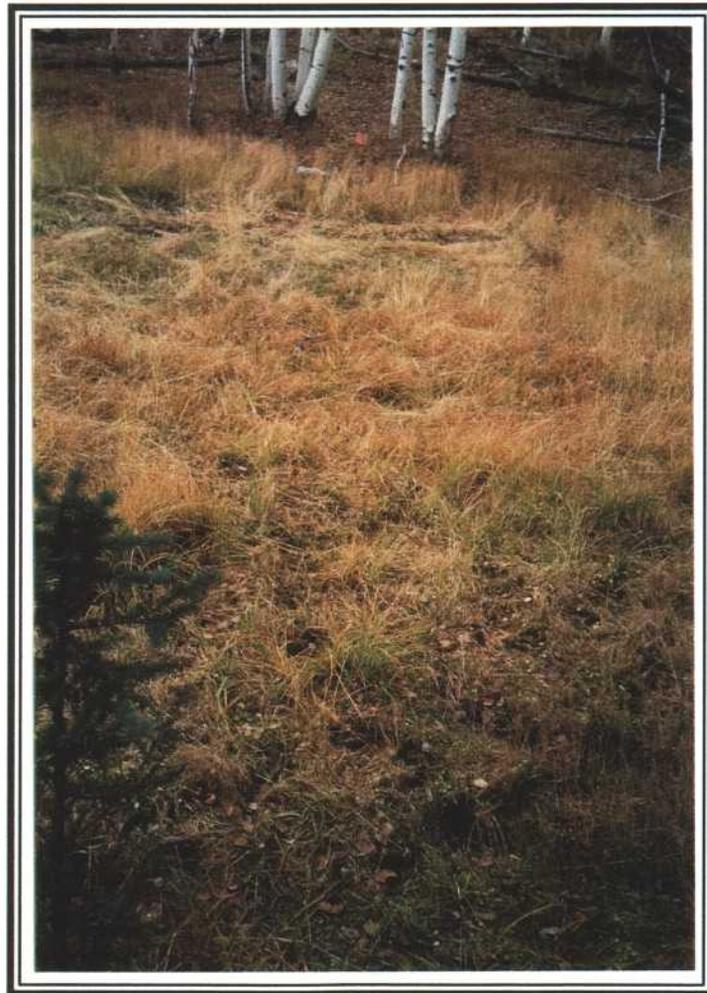
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-1		Left	24.0	<i>Carex lanuginosa/Agrostis stolonifera</i>
		Right	30.0	<i>Carex lanuginosa/Agrostis stolonifera</i>

EFB-1: Cover using point quadrats.

COVER BY SPECIES	
TREES & SHRUBS	
FORBS	
<i>Ranunculus cymbalaria</i>	9.52
GRASSES OR GRASSLIKES	
<i>Agrostis stolonifera</i>	23.81
<i>Carex lanuginosa</i>	23.81
<i>Juncus arcticus</i>	4.76
TOTAL COVER	
Living Cover (Vascular)	61.90
Moss	4.76
Litter	19.05
Bareground	14.29
Rock	
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-1

RIPARIAN COMPLEX DATA SHEET

2003

CLIENT: Canyon Fuel Company

COMPLEX: Number EFB-2

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 6-10, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: WNW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~1-2°

ELEVATION: 8,380 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
 - Falcon Family Soils: 55 %
 - Sandstone Outcrop: 30%
 - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen/Sagebrush

Right: Aspen/Sagebrush

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 900 lbs./ac

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: *Mining, grazing, hunting, recreation.*

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Pinus ponderosa</i>	<i>Artemisia tridentata</i>	<i>Aster sp.</i>	<i>Juncus arcticus</i>
<i>Populus tremuloides</i>	<i>Potentilla fruticosa</i>	<i>Lepidium latifolium</i>	<i>Poa secunda</i>
		<i>Taraxacum officinale</i>	<i>Poa pratensis</i>

POOL ATTRIBUTES (*meadow, no well defined stream channel*)

- % area in pools: 0
- % pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

- % streambed with filamentous algae: 0
- % stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): 0
- % bank length gently sloping (>135°): 0
- % bank length with overhanging vegetation: 0

BANK CONDITION

- % bank length vegetated, stable: 85
- % bank length unvegetated, stable: 15
- % bank length vegetated, unstable: 0
- % bank length unvegetated, unstable: 0

BANK STABILITY (*bankfull area only; many of the sideslopes above these areas were quite unstable*): **stable**

CHANNEL MORPHOLOGY

(*Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists*).

NOTES:

- 1) This was a meadow area, not a stream.
- 2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side.

DATA SUMMARIES

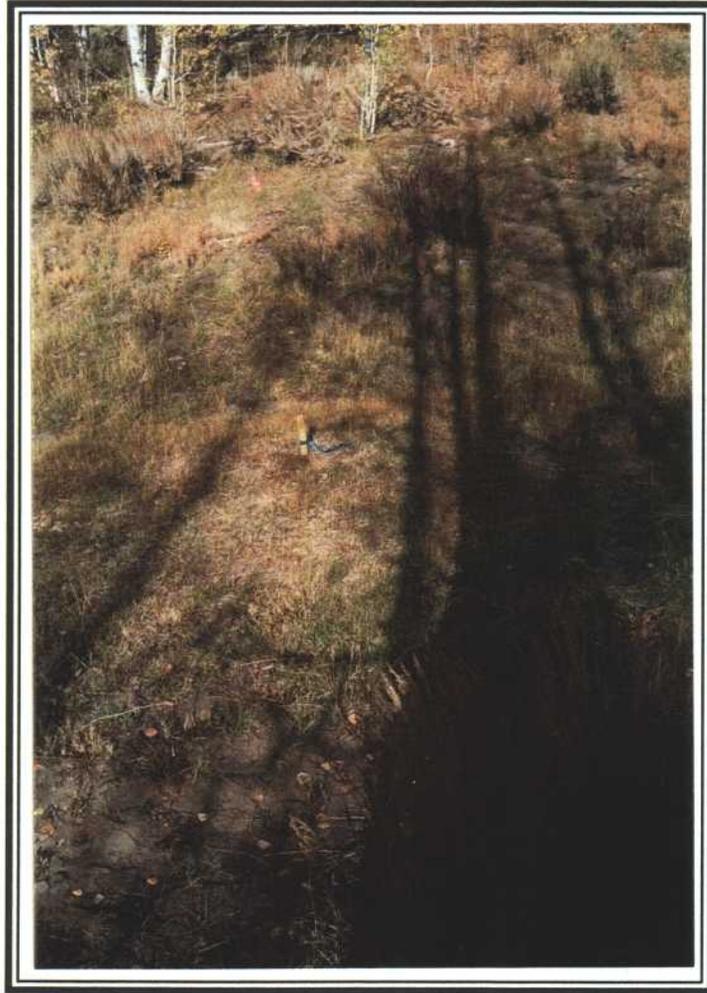
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-2		Left	14.0	<i>Agrostis stolonifera/Poa pratensis</i>
		Right	14.0	<i>Agrostis stolonifera/Poa pratensis</i>

EFB-2: Cover using point quadrats.

COVER BY SPECIES	
TREES & SHRUBS	
<i>Artemisia tridentata</i>	5.88
FORBS	
<i>Achillea millefolium</i>	5.88
<i>Aster</i>	11.76
<i>Lepidium latifolium</i>	5.88
GRASSES OR GRASSLIKES	
<i>Agrostis stolonifera</i>	17.65
<i>Poa pratensis</i>	11.76
TOTAL COVER	
Living Cover (Vascular)	58.81
Litter	35.29
Bareground	5.88
Rock	0.00
TOTAL	99.98

PHOTOGRAPHIC DOCUMENTATION



EFB-2

RIPARIAN COMPLEX DATA SHEET

2003

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-3

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 6-10, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,360 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
 - Falcon Family Soils: 55 %
 - Sandstone Outcrop: 30%
 - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen

Right: Aspen/Ponderosa Pine

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 1,100 lbs./ac

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: *Mining, grazing, hunting, recreation.*

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Pinus ponderosa</i>	<i>Artemisia tridentata</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Lepidium latifolia</i>	<i>Carex lanuginosa</i>
		<i>Lupinus sp.</i>	<i>Juncus ensifolius</i>
		<i>Taraxacum officinale</i>	<i>Juncus arcticus</i>
			<i>Poa fendleriana</i>

POOL ATTRIBUTES

- % area in pools: *n/a (no water in the channel at this location)*
- % pool area made up of pools > 2' deep: *n/a (no water in the channel at this location)*

AQUATIC VEGETATION

- % streambed with filamentous algae: *n/a (no water in the channel at this location)*
- % stream margin with rooted aquatic: *n/a (no water in the channel at this location)*

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): *0*
- % bank length gently sloping (>135°):
- % bank length with overhanging vegetation: *0*

BANK CONDITION

- % bank length vegetated, stable: *95*
- % bank length unvegetated, stable: *5*
- % bank length vegetated, unstable: *0*
- % bank length unvegetated, unstable: *0*

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): *stable*

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

- 1) Quantitative Methods: *Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side. (1 ft. bare stream area).*

DATA SUMMARIES

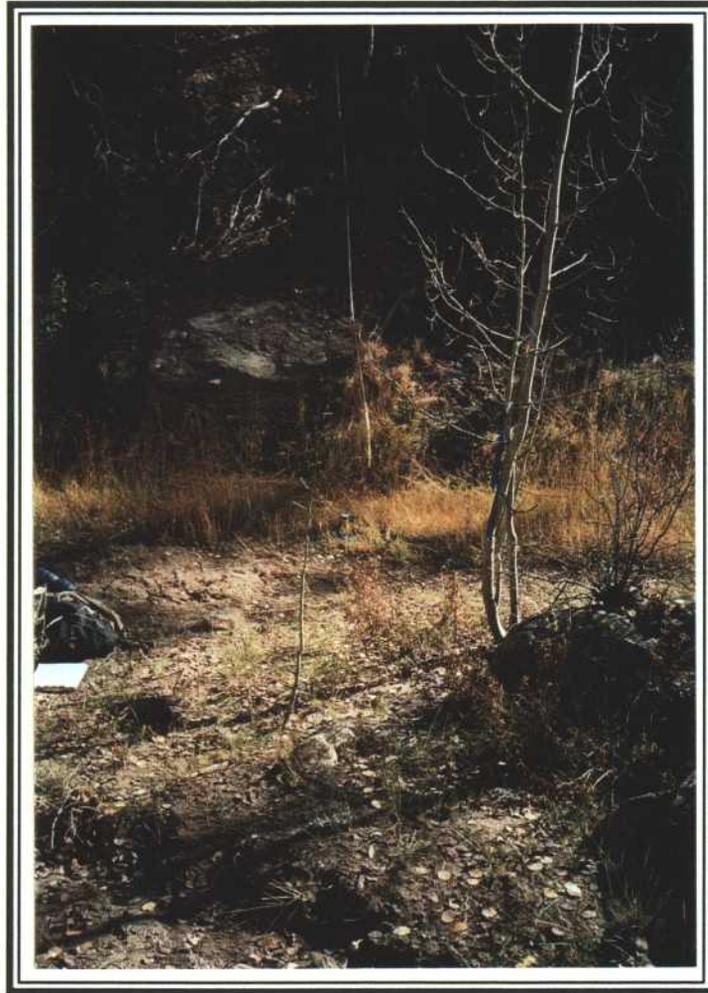
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-1		Left	4.5	<i>Agrostis stolonifera/Juncus arcticus</i>
		Right	2.5	<i>Agrostis stolonifera/Juncus arcticus</i>

EFB-3: Cover using point quadrats.

COVER BY SPECIES	
TREES & SHRUBS	
FORBS	
GRASSES OR GRASSLIKES	
<i>Agrostis stolonifera</i>	16.67
<i>Poa fendleriana</i>	5.56
TOTAL COVER	
Living Cover (Vascular)	22.23
Litter	38.89
Bareground	38.89
Rock	0.00
TOTAL	100.01

PHOTOGRAPHIC DOCUMENTATION



EFB-3

RIPARIAN COMPLEX DATA SHEET

2003

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-4

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 6-10, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~3°

ELEVATION: 8,355 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
 - Falcon Family Soils: 55 %
 - Sandstone Outcrop: 30%
 - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Ponderosa Pine/Aspen

Right: Aspen/Ponderosa Pine

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 500 lbs./ac

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Artemisia tridentata</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Chrysothamnus nauseosus</i>	<i>Antennaria sp.</i>	<i>Carex lanuginosa</i>
<i>Pinus ponderosa</i>	<i>Potentilla fruticosa</i>	<i>Taraxacum officinale</i>	<i>Bromus carinatus</i>
<i>Salix sp.</i>	<i>Rosa woodsii</i>		<i>Juncus arcticus</i>
			<i>Poa fendleriana</i>
			<i>Triglochin maritima</i>

POOL ATTRIBUTES

% area in pools: 25
 % pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0
 % stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0
 % bank length gently sloping (>135°): 5 (trail)
 % bank length with overhanging vegetation: 5

BANK CONDITION

% bank length vegetated, stable: 60
 % bank length unvegetated, stable: 25
 % bank length vegetated, unstable: 0
 % bank length unvegetated, unstable: 15

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side (1 ft. water).

DATA SUMMARIES

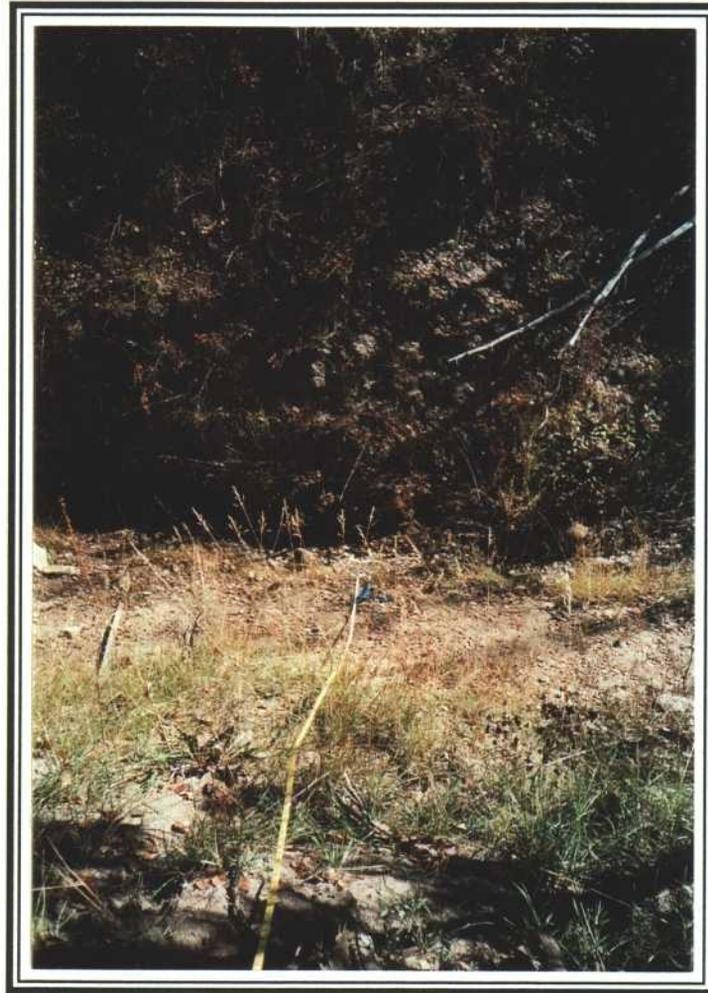
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-4		Left	2.5	<i>Agrostis stolonifera/Poa fendleriana</i>
		Right	3.0	<i>Agrostis stolonifera/Juncus arcticus</i>

EFB-4: Cover using point quadrats.

COVER BY SPECIES	
TREES & SHRUBS	
FORBS	
GRASSES OR GRASSLIKES	
<i>Elymus trachycaulus</i>	5.56
<i>Juncus arcticus</i>	16.67
<i>Poa fendleriana</i>	16.67
TOTAL COVER	
Living Cover (Vascular)	38.90
Litter	38.89
Bareground	16.67
Rock	5.56
TOTAL	100.02

PHOTOGRAPHIC DOCUMENTATION



EFB-4

RIPARIAN COMPLEX DATA SHEET
2003

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-5

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 6-10, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,320 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
 - Falcon Family Soils: 55 %
 - Sandstone Outcrop: 30%
 - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen

Right: Ponderosa Pine/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: moderately stable

ESTIMATED FORAGE PRODUCTION: 400 lbs./ac

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Artemisia tridentata</i>	<i>Tragopogon dubius</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Potentilla fruticosa</i>	<i>Senecio sp.</i>	<i>Poa fendleriana</i>
<i>Pinus ponderosa</i>	<i>Rosa woodsii</i>		<i>Stipa hymenoides</i>
	<i>Symphoricarpos oreophilus</i>		

POOL ATTRIBUTES

- % area in pools: n/a (no water in this area)
- % pool area made up of pools > 2' deep: n/a (no water in this area)

AQUATIC VEGETATION

- % streambed with filamentous algae: n/a (no water in this area)
- % stream margin with rooted aquatic: n/a (no water in this area)

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): 0
- % bank length gently sloping (>135°): 0
- % bank length with overhanging vegetation: 1%

BANK CONDITION

- % bank length vegetated, stable: 65
- % bank length unvegetated, stable: 35
- % bank length vegetated, unstable: 0
- % bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

- 1) Side slopes (above bankfull) were very unstable.
- 2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side (1.25 ft. of sandy bottom).
- 3) No water in channel in this location

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-5		Left	2.75	<i>Agrostis stolonifera/Erigeron divergens</i>
		Right	3.0	<i>Agrostis stolonifera/Erigeron divergens</i>

EFB-5: Cover using point quadrats.

COVER BY SPECIES	
TREES & SHRUBS	
FORBS	
<i>Antennaria sp.</i>	5.56
GRASSES OR GRASSLIKES	
<i>Agrostis stolonifera</i>	11.11
<i>Poa fendleriana</i>	11.11
TOTAL COVER	
Living Cover (Vascular)	27.78
Moss	5.56
Litter	44.44
Bareground	22.22
Rock	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-5

RIPARIAN COMPLEX DATA SHEET

2003

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-6

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 6-10, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,280 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
 - Scout Family Soils: 35 %
 - Doney Family Soils: 25%
 - Guben Family Soils: 25%
 - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen/Ponderosa Pine

Right: Pinus ponderosa/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 100 lbs./ac

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Amelanchier utahensis</i>	<i>Taraxacum officinale</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Potentilla fruticosa</i>	<i>Antennaria sp.</i>	<i>Bromus carinatus</i>
<i>Pinus ponderosa</i>	<i>Symphoricarpos oreophilus</i>	<i>Aster sp.</i>	<i>Juncus arcticus</i>
<i>Populus fremontii</i>	<i>Artemisia tridentata</i>	<i>Tragopogon dubius</i>	<i>Poa fendleriana</i>
		<i>Senecio sp.</i>	<i>Elymus trachycaulus</i>
		<i>Swertia radiata</i>	<i>Juncus longistylis</i>
		<i>Artemisia ludoviciana</i>	

POOL ATTRIBUTES

- % area in pools: 20
- % pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

- % streambed with filamentous algae: 0
- % stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): 30
- % bank length gently sloping (>135°): (trail)
- % bank length with overhanging vegetation: 10

BANK CONDITION

- % bank length vegetated, stable: 50
- % bank length unvegetated, stable: 30
- % bank length vegetated, unstable: 10
- % bank length unvegetated, unstable: 10

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

- 1) Side slope banks above bankfull unstable
- 2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side (2.5 ft. of water).

DATA SUMMARIES

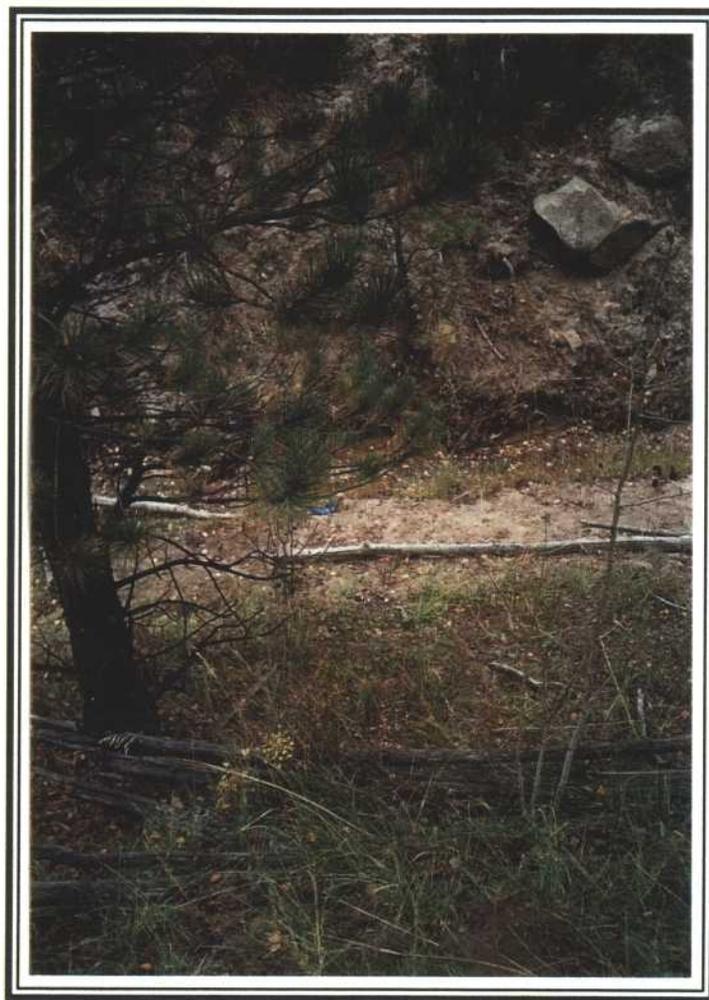
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-6		Left	3.0	<i>Agrostis stolonifera</i>
		Right	3.0	<i>Agrostis stolonifera</i>

EFB-6: Cover using point quadrats.

COVER BY SPECIES	
TREES & SHRUBS	
<i>Populus fremontii</i>	5.56
FORBS	
<i>Antennaria sp.</i>	5.56
GRASSES OR GRASSLIKES	
<i>Agrostis stolonifera</i>	5.56
<i>Elymus trachycaulus</i>	5.56
<i>Juncus arcticus</i>	5.56
<i>Poa fendleriana</i>	5.56
TOTAL COVER	
Living Cover (Vascular)	33.36
Moss	5.56
Litter	44.44
Bareground	16.67
Rock	0.00
TOTAL	100.03

PHOTOGRAPHIC DOCUMENTATION



EFB-6

RIPARIAN COMPLEX DATA SHEET
2003

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-7

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 6-10, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NNW

VALLEY BOTTOM TYPE: I or II

STREAM GRADIENT: ~2°

ELEVATION: 8,270 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
 - Scout Family Soils: 35 %
 - Doney Family Soils: 25%
 - Guben Family Soils: 25%
 - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen/Spruce

Right: Aspen/Spruce

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 150 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Juniperus communis</i>	<i>Aster sp.</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>			<i>Juncus longistylis</i>
			<i>Poa fendleriana</i>

POOL ATTRIBUTES

- % area in pools: 25
- % pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

- % streambed with filamentous algae: 0
- % stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): 0
- % bank length gently sloping (>135°): 100 until steep, unstable, upper banks, then 0.
- % bank length with overhanging vegetation: 2

BANK CONDITION

- % bank length vegetated, stable: 50
- % bank length unvegetated, stable: 50
- % bank length vegetated, unstable: 0
- % bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

- 1) Low species diversity.
- 2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side (1.0 ft. water, 1.5 ft. rock).
- 3) Very unstable upper banks (above bankfull).

DATA SUMMARIES

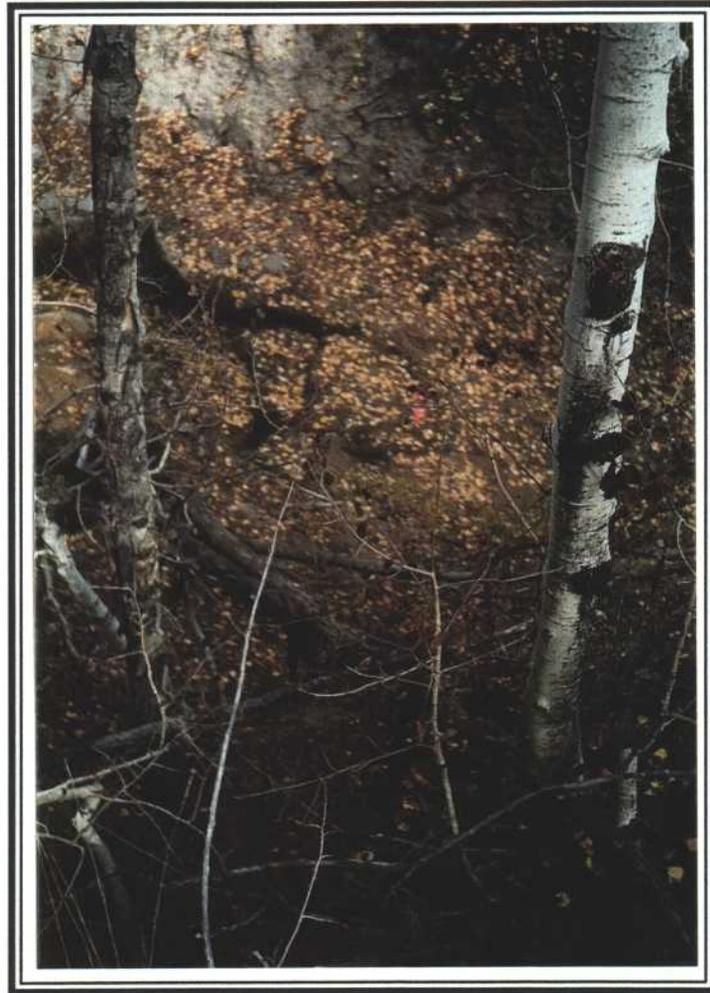
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-7		Left	2.0	<i>Agrostis stolonifera</i>
		Right	0	bareground

EFB-7: Cover using point quadrats.

COVER BY SPECIES	
TREES & SHRUBS	
FORBS	
GRASSES OR GRASSLIKES	
<i>Agrostis stolonifera</i>	5.56
<i>Poa fendleriana</i>	5.56
TOTAL COVER	
Living Cover (Vascular)	11.12
Litter	38.89
Bareground	38.89
Rock	11.11
TOTAL	100.01

PHOTOGRAPHIC DOCUMENTATION



EFB-7

RIPARIAN COMPLEX DATA SHEET
2003

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-8

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 6-10, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NNW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,265 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
 - Scout Family Soils: 35 %
 - Doney Family Soils: 25%
 - Guben Family Soils: 25%
 - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Aspen

Right: Aspen/Spruce

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 300 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: *Mining, grazing, hunting, recreation.*

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Symphoricarpos oreophilus</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Achillea millefolium</i>	<i>Carex lanuginosa</i>
<i>Pinus ponderosa</i>		<i>Penstemon sp.</i>	<i>Juncus arcticus</i>
		<i>Antennaria sp.</i>	<i>Bromus japonicus</i>
		<i>Equisetum arvensis</i>	<i>Poa fendleriana</i>
		<i>Potentilla sp.</i>	

POOL ATTRIBUTES

- % area in pools: 15
- % pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

- % streambed with filamentous algae: 0
- % stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): 0
- % bank length gently sloping (>135°): 70
- % bank length with overhanging vegetation: 10

BANK CONDITION

- % bank length vegetated, stable: 40
- % bank length unvegetated, stable: 40
- % bank length vegetated, unstable: 10
- % bank length unvegetated, unstable: 10

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): *stable*

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

- 1) Beginning to see more blue spruce and less ponderosa pine in uplands in this area.
- 2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 12 ft. transect on left side (rock ledge after 12 ft.); 33 ft. transect on right side (7 ft sand/mud plus 4 ft water).

3) There was a spring in this area near stream. Right transect crossed spring community too.

DATA SUMMARIES

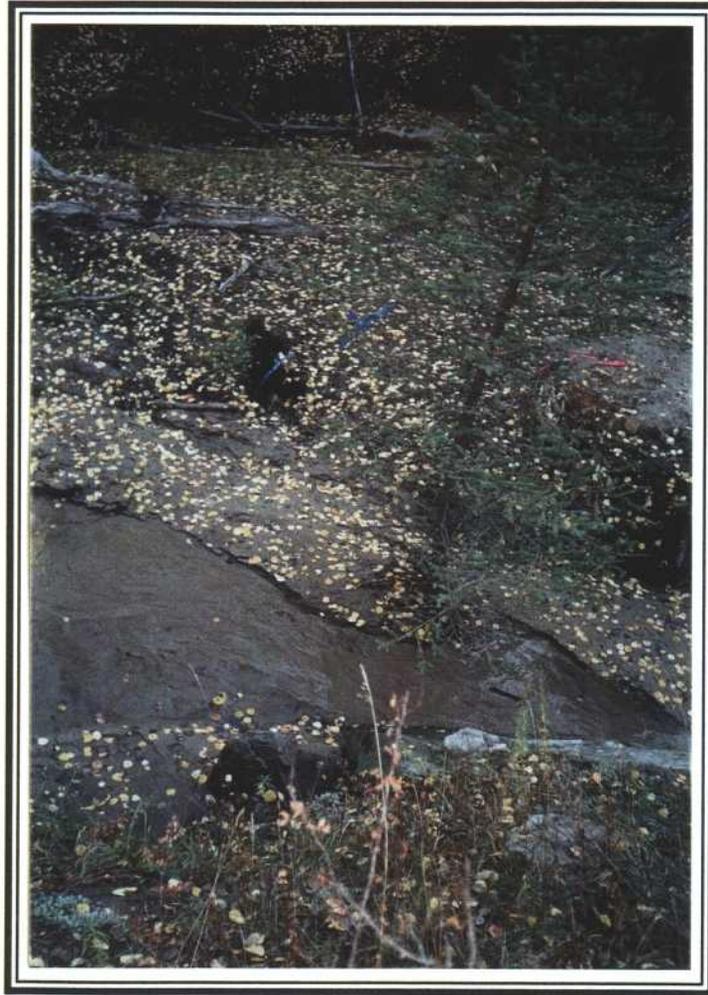
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-8		Left	1.5	<i>Agrostis stolonifera</i>
		Right	2.5	<i>Agrostis stolonifera</i>

EFB-8: Cover using point quadrats.

COVER BY SPECIES	
TREES & SHRUBS	
FORBS	
<i>Antennaria sp.</i>	5.88
<i>Equisetum arvense</i>	5.88
GRASSES OR GRASSLIKES	
<i>Agrostis stolonifera</i>	17.65
<i>Juncus arcticus</i>	5.88
<i>Poa fendleriana</i>	5.88
TOTAL COVER	
Living Cover (Vascular)	41.17
Litter	41.18
Bareground	17.65
Rock	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-8

RIPARIAN COMPLEX DATA SHEET
2003

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-9 (RE-10)

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 6-10, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss/Blackhawk Fm

ASPECT: W

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~3°

ELEVATION: 8,240 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
 - Scout Family Soils: 35 %
 - Doney Family Soils: 25%
 - Guben Family Soils: 25%
 - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen

Right: Spruce/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: moderately stable

ESTIMATED FORAGE PRODUCTION: 150

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Rosa woodsii</i>	<i>Equisetum arvensis</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Symphoricarpos oreophilus</i>	<i>Ranunculus cymbalaria</i>	<i>Poa fendleriana</i>
<i>Salix amygdaloides</i>			

POOL ATTRIBUTES

- % area in pools: 50
- % pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

- % streambed with filamentous algae: 0
- % stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): 25
- % bank length gently sloping (>135°): 0
- % bank length with overhanging vegetation: 35

BANK CONDITION

- % bank length vegetated, stable: 20
- % bank length unvegetated, stable: 45
- % bank length vegetated, unstable: 10
- % bank length unvegetated, unstable: 25

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable (left side)/unstable (right side)

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

- 1) Bank cut on right side.
- 2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side (plus 1 ft. mud and 1.5 ft water).

In addition, the USDA Forest Service Protocol for Level III was employed by measuring the plant communities using the line intercept method.

- 3) Photo taken from right side.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-9	RE-10	Left	4.0	<i>Agrostis stolonifera</i> / <i>Equisetum arvense</i>
		Right	2.0	<i>Agrostis stolonifera</i> / <i>Equisetum arvense</i>

EFB-9: Cover using point quadrats.

COVER BY SPECIES	
TREES & SHRUBS	
<i>Populus tremuloides</i>	5.56
FORBS	
<i>Equisetum arvense</i>	11.11
<i>Ranunculus cymbalaria</i>	5.56
GRASSES OR GRASSLIKES	
<i>Poa fendleriana</i>	11.11
TOTAL COVER	
Living Cover (Vascular)	33.34
Moss	11.11
Litter	50.11
Bareground	5.56
Rock	
TOTAL	100.12

Cover by Community Types - EFB-9 (RE-10)

USDA Forest Service Protocol (1992)

UPLAND VEGETATION

<i>Populus tremuloides</i> / <i>Picea pungens</i>	13.00
<i>Populus tremuloides</i> / <i>Rosa woodsii</i>	10.50

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

<i>Agrostis stolonifera</i>	4.50
<i>Equisetum arvensis</i>	1.50
-	-

TOTAL COVER (Upland Species) 23.50

TOTAL COVER (Riparian Species) 6.00

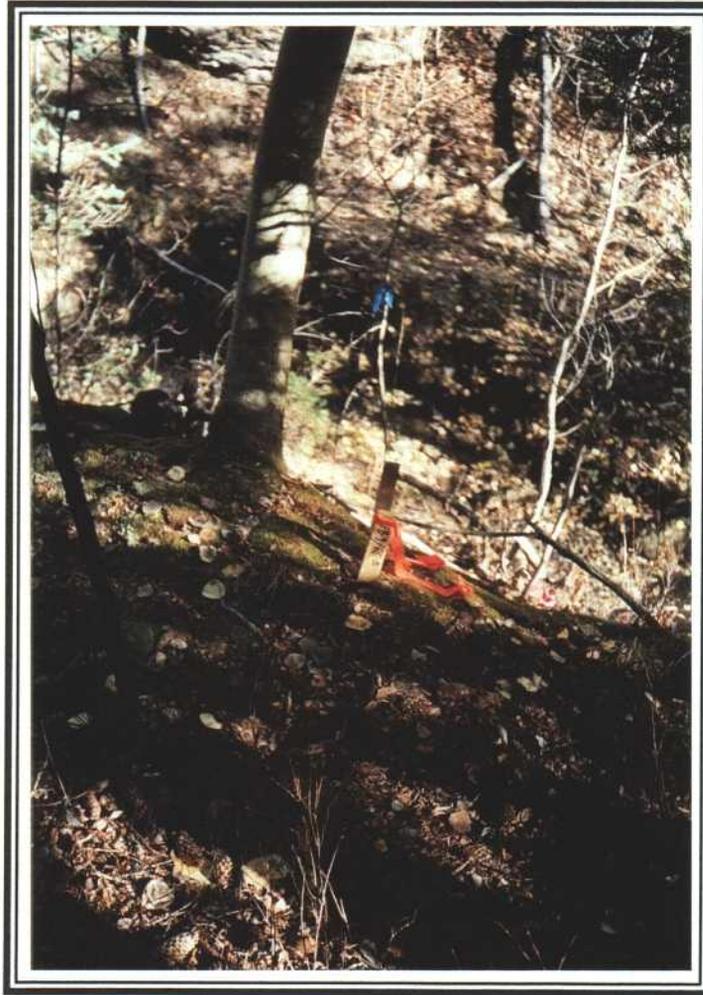
BAREGROUND 0.50

ROCK 0.50

STREAM (water width) 1.50

TOTAL COVER 32.00

PHOTOGRAPHIC DOCUMENTATION



EFB-9 (RE-10)

RIPARIAN COMPLEX DATA SHEET

2003

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-10 (RE-09)

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 6-10, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~3°

ELEVATION: 8,120 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
 - Scout Family Soils: 35 %
 - Doney Family Soils: 25%
 - Guben Family Soils: 25%
 - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

MORE SOILS INFORMATION:

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
 - Falcon Family Soils: 55 %
 - Sandstone Outcrop: 30%
 - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce

Right: Spruce/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 150 lbs./ac

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Salix sp.</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Potentilla fruticosa</i>	<i>Geranium richardsonii</i>	<i>Bromus japonicus</i>
<i>Betula occidentalis</i>	<i>Rosa woodsii</i>	<i>Equisetum arvense</i>	
<i>Salix sp.</i>			

POOL ATTRIBUTES

% area in pools: 20

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 5

% bank length gently sloping (>135°): 50

% bank length with overhanging vegetation: 35-40

BANK CONDITION

% bank length vegetated, stable: 60

% bank length unvegetated, stable: 35

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 5

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

- 1) Just beginning to see river birch in this area.
- 2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 12 ft. transect on right side until rock ledge (plus 2.5 ft. of water).

In addition, the USDA Forest Service Protocol for Level III was employed by measuring the plant communities using the line intercept method.

- 3) Left hillside suggests that there is probably a lot of soil moisture in the spring and early summer.
- 4) Waterfall is below this station.
- 3) Photo taken from left side.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

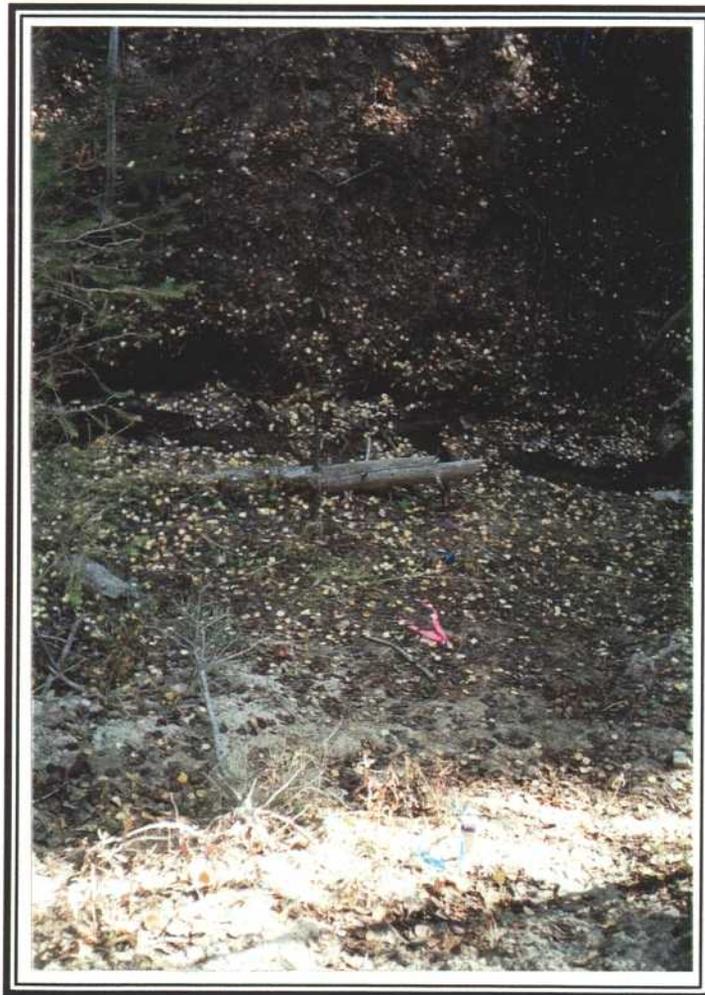
Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-10	RE-09	Left	6.0	<i>Geranium richardsonii</i> / <i>Agrostis stolonifera</i>
		Right	2.0	<i>Agrostis stolonifera</i> / <i>Equisetum arvense</i>

RE-09: Cover using point quadrats.

EFB-10	
COVER BY SPECIES	
TREES & SHRUBS	
FORBS	
<i>Equisetum arvense</i>	14.29
<i>Geranium richardsonii</i>	7.14
<i>Ranunculus cymbalaria</i>	7.14
GRASSES OR GRASSLIKES	
<i>Agrostis stolonifera</i>	7.14
TOTAL COVER	
Living Cover (Vascular)	35.71
Litter	42.86
Bareground	21.43
Rock	0.00
TOTAL	100.00

<u>Cover by Community Types - RE-09 (EFB-10)</u>	
<u>USDA Forest Service Protocol (1992)</u>	
-	-
UPLAND VEGETATION	
<i>Picea pungens</i>	10.00
<i>Populus tremuloides/Picea pungens</i>	9.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera</i>	3.00
<i>Agrostis stolonifera/Equisetum arvensis</i>	2.00
<i>Geranium richardsonii</i>	3.00
-	-
TOTAL COVER (Upland Species)	19.00
TOTAL COVER (Riparian Species)	8.00
BAREGROUND	0.00
ROCK	0.00
STREAM (water width)	3.00
-	-
TOTAL COVER	30.00

PHOTOGRAPHIC DOCUMENTATION



EFB-10 (RE-09)

RIPARIAN COMPLEX DATA SHEET

2003

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-11

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 6-10, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Fm

ASPECT: NW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~3°

ELEVATION: 8,120 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
 - Scout Family Soils: 35 %
 - Doney Family Soils: 25%
 - Guben Family Soils: 25%
 - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

MORE SOILS INFORMATION:

- Soil Map Unit No. 20
- Family: Strych
- Composition:
 - Strych Family Soils: 30 %
 - Pathead Family Soils: 30%
 - Podo Family Soils: 15%
 - Rubbleland: 15%
 - Contrasting inclusions of rock outcrops, and finer textured soils: 10%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Aspen

Right: Spruce/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 400 lbs/ac. (including woody species)

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Pachystima myrsinites</i>	<i>Cirsium sp.</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Symphoricarpos oreophilus</i>	<i>Geranium richardsonii</i>	<i>Juncus longistylis</i>
<i>Salix sp.</i>		<i>Equisetum arvense</i>	<i>Poa fendleriana</i>
<i>Cornus sericea</i>			
<i>Betula occidentalis</i>			

POOL ATTRIBUTES

% area in pools: 35

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 0

% bank length with overhanging vegetation: 35-40

BANK CONDITION

% bank length vegetated, stable: 65

% bank length unvegetated, stable: 30

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 5

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

- 1) This site is just below the confluence of a spring (EFB-S1)
- 2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 18 ft. transect on left side; 24 ft. transect on right side (plus 3 ft. water and 2 ft rock).

DATA SUMMARIES

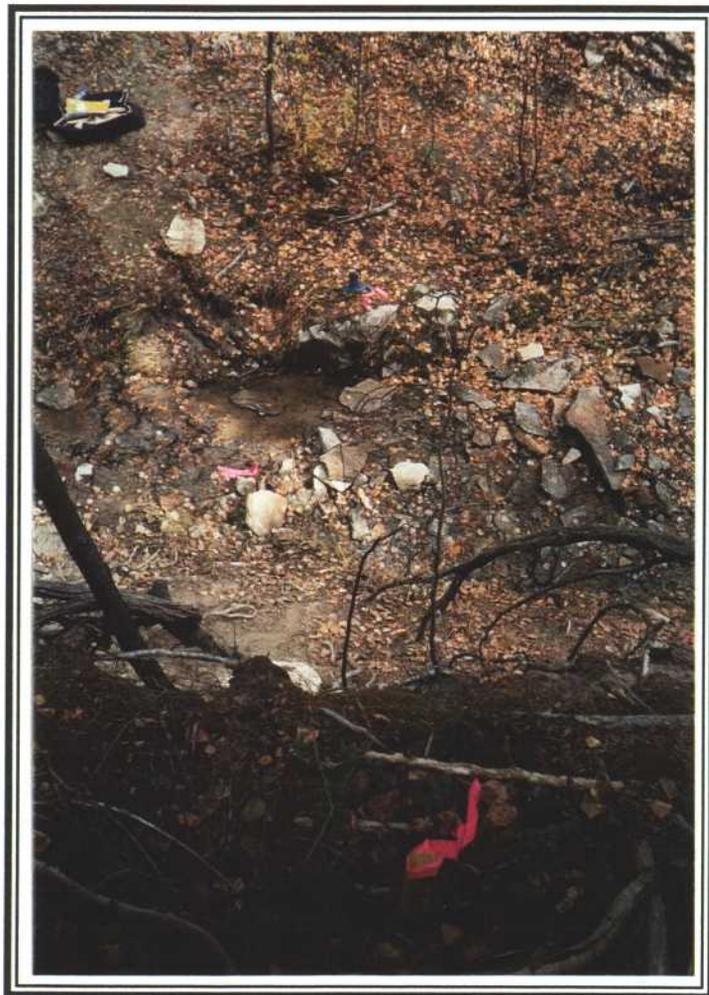
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-11		Left	2.0	<i>Agrostis stolonifera</i>
		Right	3.0	<i>Juncus longistylis</i>

EFB-11: Cover using point quadrats.

COVER BY SPECIES	
TREES & SHRUBS	
<i>Picea pungens</i>	6.25
FORBS	
<i>Geranium richardsonii</i>	6.25
GRASSES OR GRASSLIKES	
<i>Agrostis stolonifera</i>	6.25
<i>Juncus arcticus</i>	6.25
TOTAL COVER	
Living Cover (Vascular)	25.00
Moss	12.50
Litter	25.00
Bareground	12.50
Rock	25.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-11

RIPARIAN COMPLEX DATA SHEET
2003

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-S1

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 6-10, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Blackhawk Fm

ASPECT: W

VALLEY BOTTOM TYPE: II

STREAM (SLOPE) GRADIENT: ~28°

ELEVATION: 8,120 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 20
- Family: Strych
- Composition:
 - Strych Family Soils: 30 %
 - Pathead Family Soils: 30%
 - Podo Family Soils: 15%
 - Rubbleland: 15%
 - Contrasting inclusions of rock outcrops, and finer textured soils: 10%

MORE SOILS INFORMATION:

- Soil Map Unit No. 107
- Family: Scout
- Composition:
 - Scout Family Soils: 35 %
 - Doney Family Soils: 25%
 - Guben Family Soils: 25%
 - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Aspen

Right: Spruce/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 500 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Salix sp.</i>	<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Ranunculus cymbalaria</i>	<i>Carex lanuginosa</i>
	<i>Symphoricarpos oreophilus</i>	<i>Aster sp.</i>	<i>Elymus trachycaulus</i>
			<i>Juncus arcticus</i>

POOL ATTRIBUTES

- % area in pools: <2
- % pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

- % streambed with filamentous algae: 0
- % stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): 0
- % bank length gently sloping (>135°): 30 (of wet area studied)
- % bank length with overhanging vegetation: 10 (but increases above this area)

BANK CONDITION

- % bank length vegetated, stable: 50
- % bank length unvegetated, stable: 25
- % bank length vegetated, unstable: 0
- % bank length unvegetated, unstable: 25 (left bank above green)

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

- 1) A spring area, it is located about 50 ft. above confluence with the main channel of East Fork of Box Canyon.
- 2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-S1		Left	6.5	<i>Carex lanuginosa/Equisetum arvense</i>
		Right	13.5	<i>Equisetum arvense/Ranunculus cymbalaria</i>

Cover by Community Types - EFB-S1

USDA Forest Service Protocol (1992)

UPLAND VEGETATION

<i>Aster/Bareground</i>	10.00
<i>Elymus trachycaulus</i>	10.00

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

<i>Carex lanuginosa/Ranunculus cymbalaria</i>	8.00
<i>Equisetum arvensis</i>	12.00

TOTAL COVER (Upland Species) 20.00

TOTAL COVER (Riparian Species) 20.00

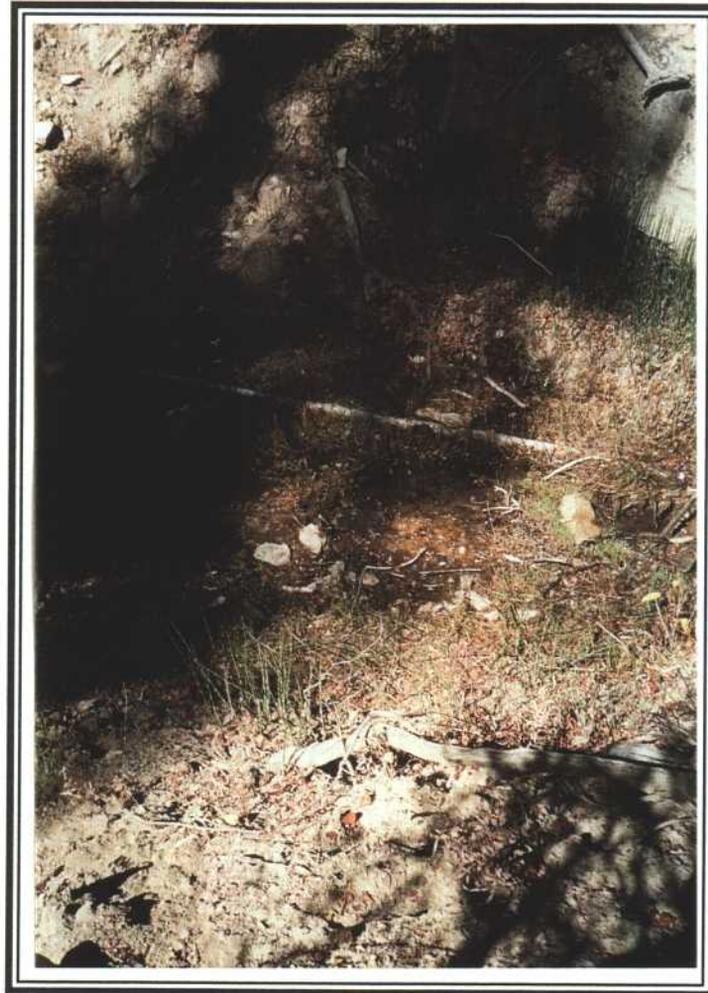
BAREGROUND 0.00

ROCK 1.00

STREAM (water width) 2.00

TOTAL COVER 43.00

PHOTOGRAPHIC DOCUMENTATION



EFB-S1

RIPARIAN COMPLEX DATA SHEET

2003

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-S2 (EFB-12)

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 6-10, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss/Blackhawk Fm

ASPECT: W

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~30°

ELEVATION: 8,200 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
 - Scout Family Soils: 35 %
 - Doney Family Soils: 25%
 - Guben Family Soils: 25%
 - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

MORE SOILS INFORMATION:

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
 - Falcon Family Soils: 55 %
 - Sandstone Outcrop: 30%
 - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Ponderosa Pine

Right: Ponderosa Pine

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 1,000 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Juniperus communis</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Equisetum arvense</i>	<i>Carex lanuginosa</i>
<i>Lonicera involucrata</i>			
<i>Betula occidentalis</i>			

POOL ATTRIBUTES

% area in pools: 0

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 100

% bank length with overhanging vegetation: 65 (more below or downhill)

BANK CONDITION

% bank length vegetated, stable: 65

% bank length unvegetated, stable: 35

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) This was an area that includes 2 springs near each other. Data was taken at the head of the springs. I looked lower on the slope, but the water diffuses and data collection would have been difficult and possibly ambiguous.

2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method.

3) I placed one long transect that dissected the whole area including both springs because it was quite wet between the two and differentiation would have been difficult.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-S2	EFB-12	Left	30.0	<i>Carex lanuginosa/Equisetum arvense/Betula occidentalis</i>
		Right	17.0	<i>Agrostis stolonifera/Ranunculus cymbalaria</i>

Cover by Community Types - EFB-S2

USDA Forest Service Protocol (1992) (EFB-12)

UPLAND VEGETATION

Juniperus communis/Equisetum arvense 15.00
Picea pungens 20.00

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

Agrostis stolonifera/Ranunculus cymbalaria 9.00
Carex lanuginosa/Betula occidentalis 15.00
Equisetum arvense 8.00

TOTAL COVER (Upland Species) 35.00

TOTAL COVER (Riparian Species) 32.00

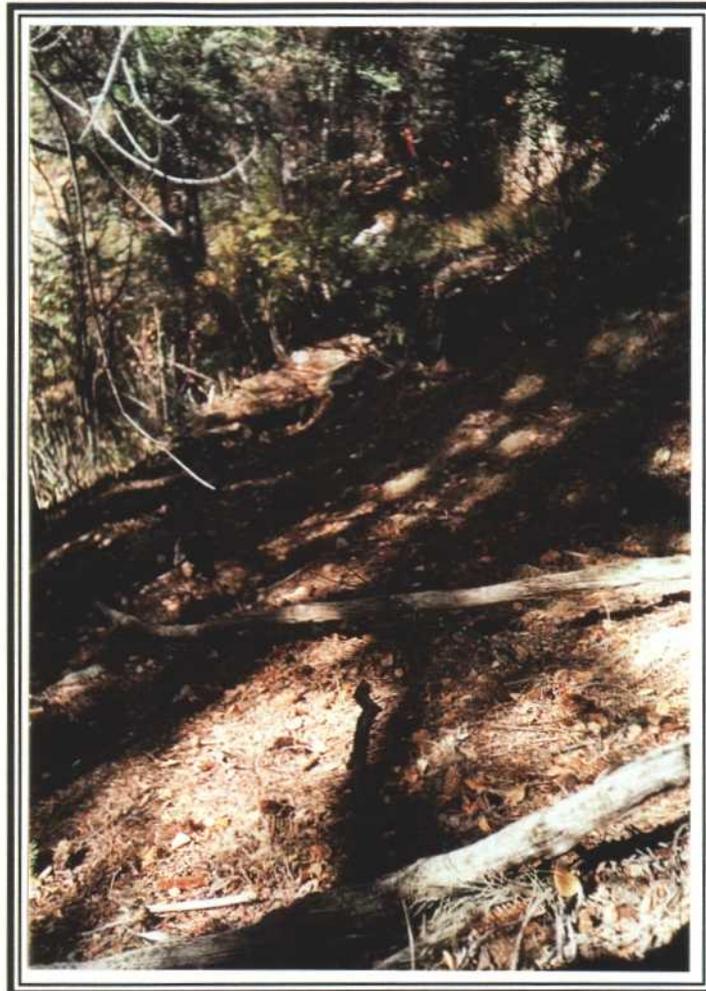
BAREGROUND 11.00

ROCK 0.00

STREAM (water width) 1.00

TOTAL COVER 79.00

PHOTOGRAPHIC DOCUMENTATION



EFB-S2 (EFB-12)

RIPARIAN COMPLEX DATA SHEET
2003

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-S3 - North & South (EFB-13)

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 6-10, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss/Blackhawk Fm

ASPECT: W

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2-30°

ELEVATION: 8,245 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
 - Scout Family Soils: 35 %
 - Doney Family Soils: 25%
 - Guben Family Soils: 25%
 - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

MORE SOILS INFORMATION:

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
 - Falcon Family Soils: 55 %
 - Sandstone Outcrop: 30%
 - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Ponderosa Pine

Right: Ponderosa Pine

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 250 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Symphoricarpos oreophilus</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Juniperus communis</i>	<i>Equisetum arvense</i>	<i>Elymus trachycaulus</i>
<i>Pinus ponderosa</i>	<i>Rosa woodsii</i>	<i>Geranium richardsonii</i>	
<i>Salix amygdaloides</i>			

POOL ATTRIBUTES

% area in pools: 100 in green line
 % pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0
 % stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0
 % bank length gently sloping (>135°): 100
 % bank length with overhanging vegetation: 60

BANK CONDITION

% bank length vegetated, stable: 50
 % bank length unvegetated, stable: 50
 % bank length vegetated, unstable: 0
 % bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

- 1) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method.
- 2) This is a spring area.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-S3	EFB-13	North	10.0	<i>Agrostis stolonifera/Ranunculus cymbalaria</i>
		South	11.0	<i>Agrostis stolonifera/Ranunculus cymbalaria</i>

Cover by Community Types - EFB-S3

USDA Forest Service Protocol (1992) (EFB-13)

UPLAND VEGETATION

Picea pungens 20.00

Picea pungens/Equisetum arvense 20.00

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

Agrostis stolonifera/Ranunculus cymbalaria 21.00

- -

TOTAL COVER (Upland Species) 40.00

TOTAL COVER (Riparian Species) 21.00

BAREGROUND 0.00

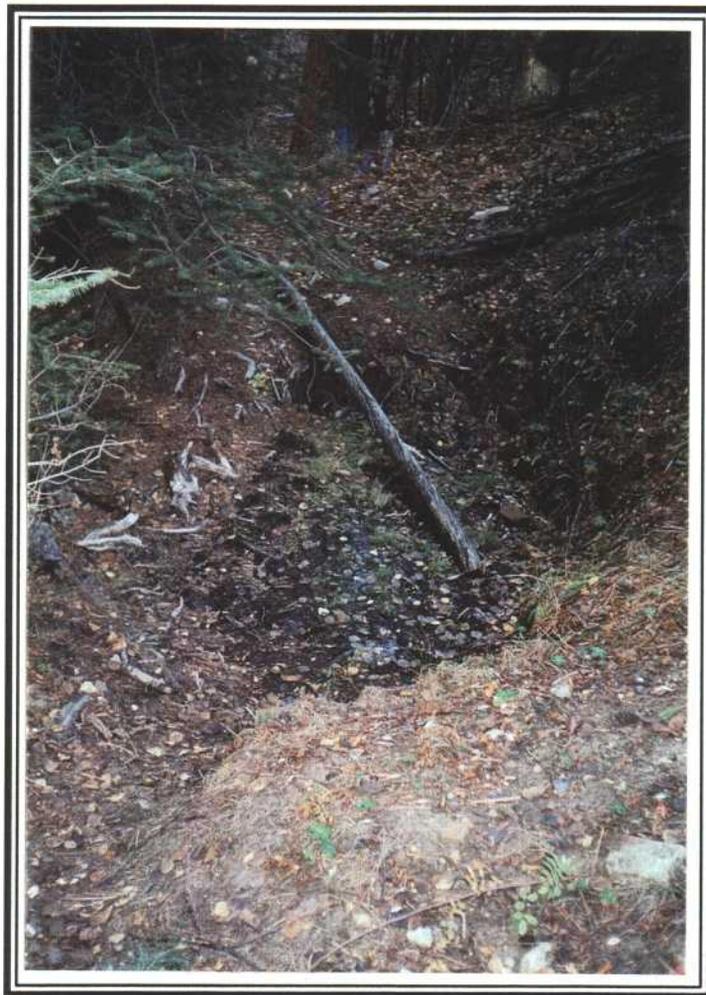
ROCK 0.00

STREAM (water width) 0.00

- -

TOTAL COVER **61.00**

PHOTOGRAPHIC DOCUMENTATION



EFB-S3 (EFB-13)

RIPARIAN COMPLEX DATA SHEET

2003

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-S4 (EFB-14)

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 6-10, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss/Blackhawk Fm

ASPECT: W

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~25°

ELEVATION: 8,240 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
 - Scout Family Soils: 35 %
 - Doney Family Soils: 25%
 - Guben Family Soils: 25%
 - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

MORE SOILS INFORMATION:

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
 - Falcon Family Soils: 55 %
 - Sandstone Outcrop: 30%
 - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Horsetail (uphill)/Spruce

Right: Horsetail (uphill)/Spruce

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 500 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Symphoricarpos oreophilus</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Potentilla fruticosa</i>	<i>Geranium richardsonii</i>	
<i>Salix amygdaloides</i>	<i>Rosa woodsii</i>	<i>Equisetum arvense</i>	

POOL ATTRIBUTES

% area in pools: 0

% pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0

% stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 0

% bank length with overhanging vegetation: 65

BANK CONDITION

% bank length vegetated, stable: 50

% bank length unvegetated, stable: 50

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Spring area. Most of the hillside is where the water (spring) filters through. A little discharge (seep) appears near East Fork Box stream where the vegetation changes.

2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

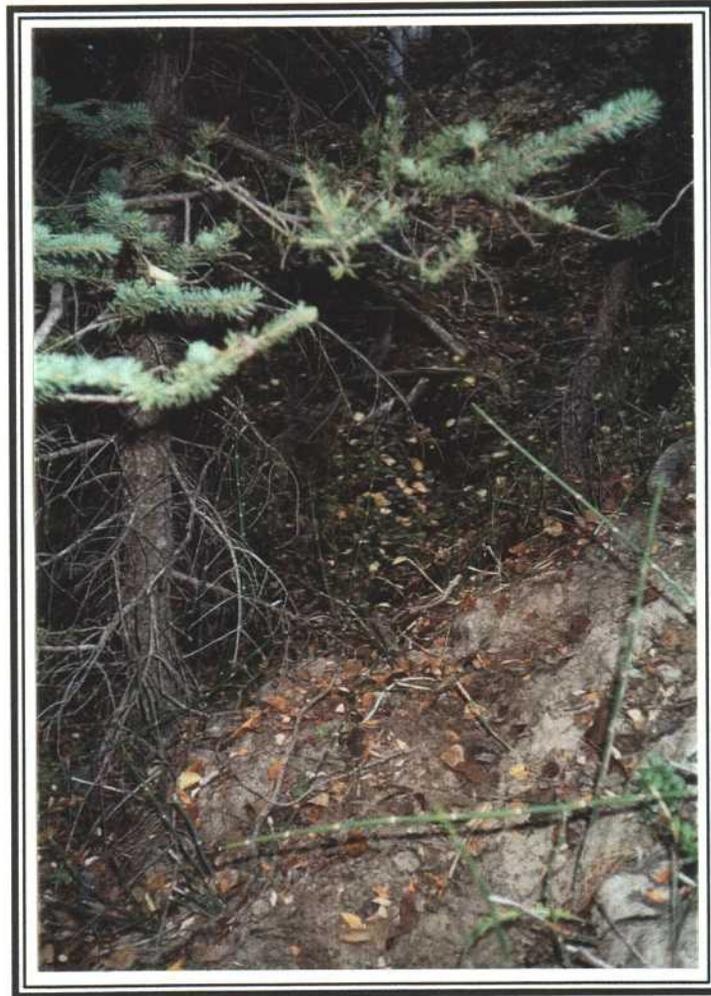
Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-S4	EFB-14	Left	7.5	<i>Agrostis stolonifera/Ranunculus cymbalaria</i>
		Right	7.5	<i>Agrostis stolonifera/Ranunculus cymbalaria</i>

Cover by Community Types - EFB-S4

USDA Forest Service Protocol (1992) (EFB-14)

-	-
UPLAND VEGETATION	
<i>Picea pungens/Equisetum arvense</i>	20.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera/Ranunculus cymbalaria</i>	15.00
-	-
TOTAL COVER (Upland Species)	20.00
TOTAL COVER (Riparian Species)	15.00
BAREGROUND	0.00
ROCK	0.00
STREAM (water width)	0.00
-	-
TOTAL COVER	35.00

PHOTOGRAPHIC DOCUMENTATION



EFB-4 (EFB-14)

RIPARIAN COMPLEX DATA SHEET
2003

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number RE-11

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 6-10, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,265 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
 - Scout Family Soils: 35 %
 - Doney Family Soils: 25%
 - Guben Family Soils: 25%
 - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Wood's Rose/Aspen

Right: Aspen/Spruce

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 200 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Rosa woodsii</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Taraxacum officinale</i>	<i>Carex lanuginosa</i>
			<i>Juncus arcticus</i>
			<i>Poa fendleriana</i>

POOL ATTRIBUTES

- % area in pools: 20
- % pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

- % streambed with filamentous algae: 0
- % stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): 35
- % bank length gently sloping (>135°): 60
- % bank length with overhanging vegetation: 20

BANK CONDITION

- % bank length vegetated, stable: 60
- % bank length unvegetated, stable: 20
- % bank length vegetated, unstable: 5
- % bank length unvegetated, unstable: 15

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable):
 unstable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

- 1) Sideslopes were unstable. The plant species in this area suggest slope seepage in spring and summer, but this area was dry at the time of sampling.
- 2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method.
- 3) Low species diversity.
- 4) Earth movement by approx. 1 ft. when 2003 was compared a 1999 measurement.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
RE-11		Left	4.0	<i>Agrostis stolonifera</i>
		Right	3.5	<i>Agrostis stolonifera</i>

Cover by Community Types - RE-11

USDA Forest Service Protocol (1992)

UPLAND VEGETATION

Populus tremuloides/Rosa woodsii 19.00

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

Agrostis stolonifera 7.50

TOTAL COVER (Upland Species) 19.00

TOTAL COVER (Riparian Species) 7.50

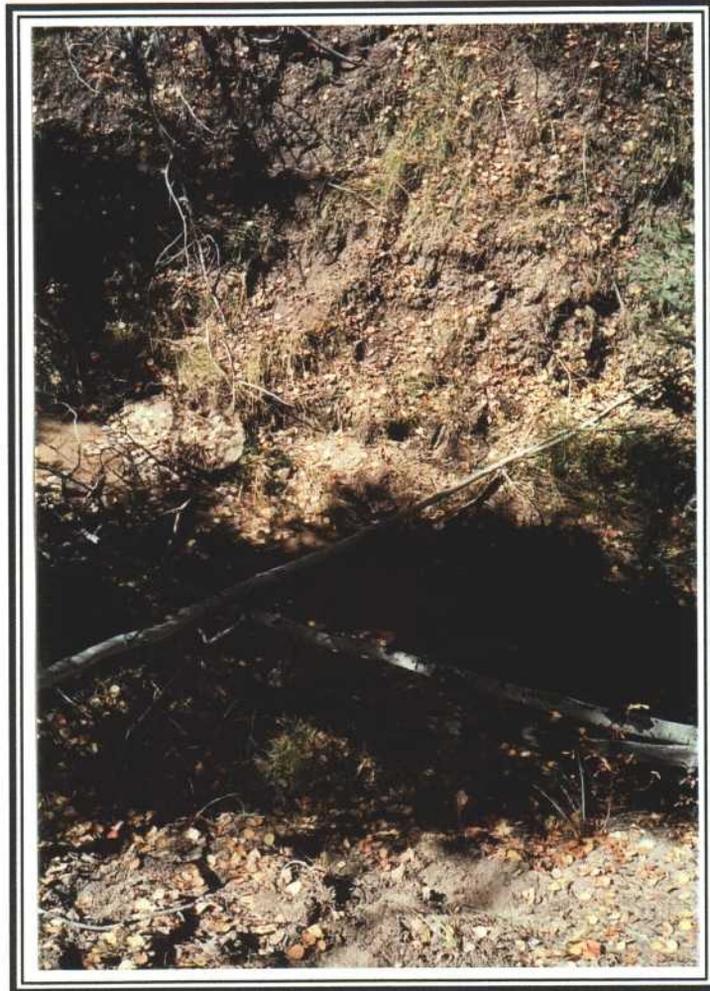
BAREGROUND 1.50

ROCK 0.00

STREAM (water width) 3.00

TOTAL COVER 31.00

PHOTOGRAPHIC DOCUMENTATION



RE-11

RIPARIAN COMPLEX DATA SHEET

2003

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number RE-12

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 6-10, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,275 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 107
- Family: Scout
- Composition:
 - Scout Family Soils: 35 %
 - Doney Family Soils: 25%
 - Guben Family Soils: 25%
 - Contrasting inclusions of rock outcrops, shallow soils, and more sandy or more clayey soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Sagebrush/Grass

Right: Wood's Rose/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 400 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Populus tremuloides</i>	<i>Salix sp.</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
	<i>Artemisia tridentata</i>	<i>Taraxacum officinale</i>	<i>Carex lanuginosa</i>
	<i>Rosa woodsii</i>	<i>Eriogonum sp.</i>	<i>Juncus longistylis.</i>
		<i>Equisetum arvense</i>	<i>Juncus arcticus</i>
			<i>Poa secunda</i>

POOL ATTRIBUTES

- % area in pools: 0
- % pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

- % streambed with filamentous algae: 0
- % stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): 0
- % bank length gently sloping (>135°): ~70
- % bank length with overhanging vegetation: 75

BANK CONDITION

- % bank length vegetated, stable: 70
- % bank length unvegetated, stable: 30
- % bank length vegetated, unstable: 0
- % bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

- 1) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method.
- 2) Side slopes seemed to have moved when compared to a measurement taken in 1999.
- 3) Photo taken from left side.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

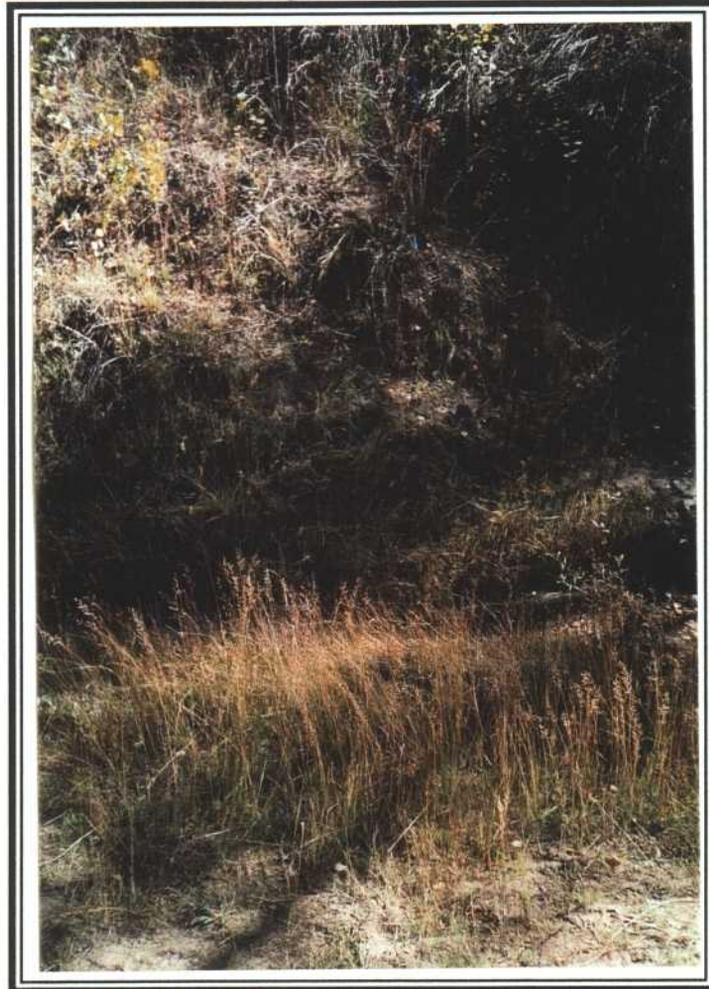
Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
RE-12		Left	7.5	<i>Agrostis stolonifera</i>
		Right	5.5	<i>Agrostis stolonifera</i> / <i>Juncus longistylis</i>

Cover by Community Types - RE-12

USDA Forest Service Protocol (1992)

-	-
UPLAND VEGETATION	
<i>Artemisia tridentata/Poa secunda</i>	8.00
<i>Populus tremuloides/Rosa woodsii</i>	8.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera</i>	10.50
<i>Agrostis stolonifera/Equisetum arvensis</i>	2.50
-	-
TOTAL COVER (Upland Species)	16.00
TOTAL COVER (Riparian Species)	13.00
BAREGROUND	0.00
ROCK	0.00
STREAM (water width)	1.00
-	-
TOTAL COVER	30.00

PHOTOGRAPHIC DOCUMENTATION



RE-12

RIPARIAN COMPLEX DATA SHEET

2003

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number RE-13

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 6-10, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,315 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
 - Falcon Family Soils: 55 %
 - Sandstone Outcrop: 30%
 - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Aspen

Right: Aspen/Ponderosa Pine

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 450 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Artemisia tridentata</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Potentilla fruticosa</i>	<i>Equisetum arvense</i>	<i>Carex lanuginosa</i>
<i>Pinus ponderosa</i>	<i>Symphoricarpos oreophilus</i>	<i>Artemisia dracunculus</i>	<i>Festuca ovina</i>
		<i>Erigeron divergens.</i>	<i>Juncus sp.</i>
		<i>Fragaria vesca</i>	<i>Elymus trachycaulus</i>
		<i>Lupinus sp.</i>	

POOL ATTRIBUTES

% area in pools: n/a (no water at this site)

% pool area made up of pools > 2' deep: n/a (no water at this site)

AQUATIC VEGETATION

% streambed with filamentous algae: n/a (no water at this site)

% stream margin with rooted aquatic: n/a (no water at this site)

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0

% bank length gently sloping (>135°): 0

% bank length with overhanging vegetation: 5

BANK CONDITION

% bank length vegetated, stable: 70

% bank length unvegetated, stable: 30

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

1) Photo taken from right side.

2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
RE-13		Left	3.0	<i>Agrostis stolonifera/Ranunculus cymbalaria</i>
		Right	3.0	<i>Agrostis stolonifera/Ranunculus cymbalaria</i>

Cover by Community Types - RE-13

USDA Forest Service Protocol (1992)

UPLAND VEGETATION

<i>Artemisia tridentata/Elymus trachycaulus</i>	10.00
<i>Populus tremuloides</i>	11.00

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

<i>Agrostis stolonifera/Ranunculus cymbalaria</i>	6.00
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TOTAL COVER (Upland Species)	21.00
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TOTAL COVER (Riparian Species)	6.00
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BAREGROUND	2.00
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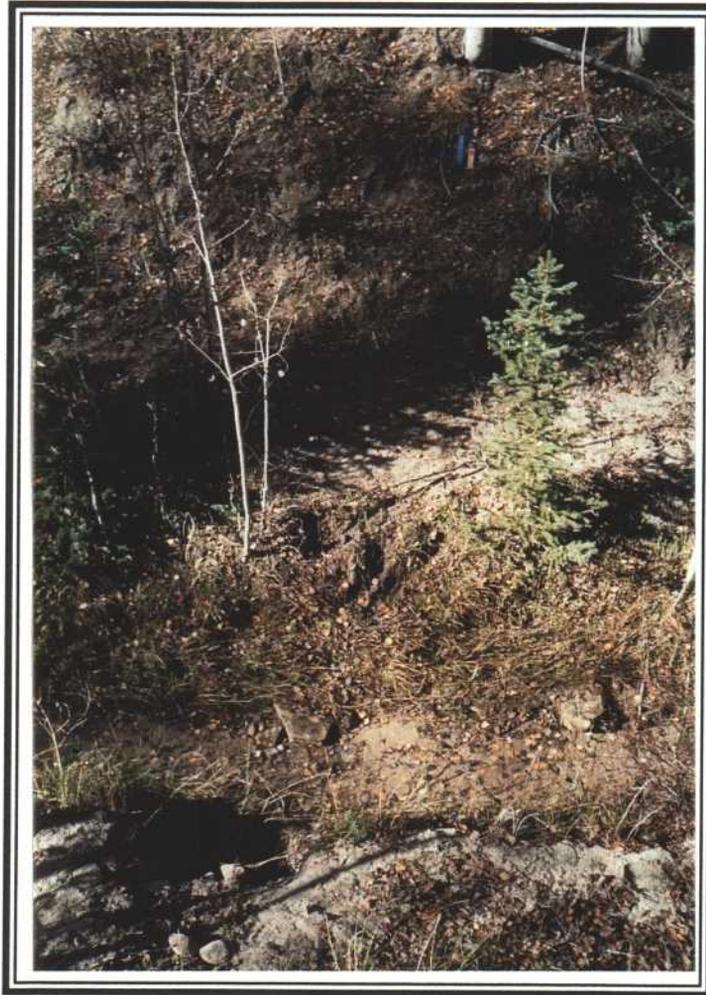
ROCK	0.00
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STREAM (water width)	0.00
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-	-
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TOTAL COVER	29.00
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PHOTOGRAPHIC DOCUMENTATION



RE-13

RIPARIAN COMPLEX DATA SHEET
2003

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-07

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 6-10, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,220 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
 - Falcon Family Soils: 55 %
 - Sandstone Outcrop: 30%
 - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Aspen

Right: Aspen/Spruce

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 200 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Juniperus communis</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Potentilla fruticosa</i>	<i>Erigeron sp.</i>	<i>Carex lanuginosa</i>
<i>Betula occidentalis</i>		<i>Achillea millefolium</i>	<i>Juncus longistylis</i>
		<i>Equisetum arvense</i>	<i>Bromus carinatus</i>
		<i>Geranium richardsonii</i>	
		<i>Urtica dioica</i>	

POOL ATTRIBUTES

- % area in pools: n/a (no water at this site)
- % pool area made up of pools > 2' deep: n/a (no water at this site)

AQUATIC VEGETATION

- % streambed with filamentous algae: n/a (no water at this site)
- % stream margin with rooted aquatic: n/a (no water at this site)

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): 25
- % bank length gently sloping (>135°): 50
- % bank length with overhanging vegetation: 35

BANK CONDITION

- % bank length vegetated, stable: 35
- % bank length unvegetated, stable: 20
- % bank length vegetated, unstable: 0
- % bank length unvegetated, unstable: 45

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable (left side); unstable (right side)

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

- 1) Photo taken from the left side
- 2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-07		Left	2.25	<i>Equisetum arvense</i>
		Right	0	

Cover by Community Types - R-07

USDA Forest Service Protocol (1992)

UPLAND VEGETATION

<i>Picea pungens</i>	8.00
<i>Populus tremuloides</i>	2.00

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

<i>Equisetum arvense</i>	2.25
<i>Geranium richardsonii</i>	0.00

- -

TOTAL COVER (Upland Species) 10.00

TOTAL COVER (Riparian Species) 2.25

BAREGROUND 8.00

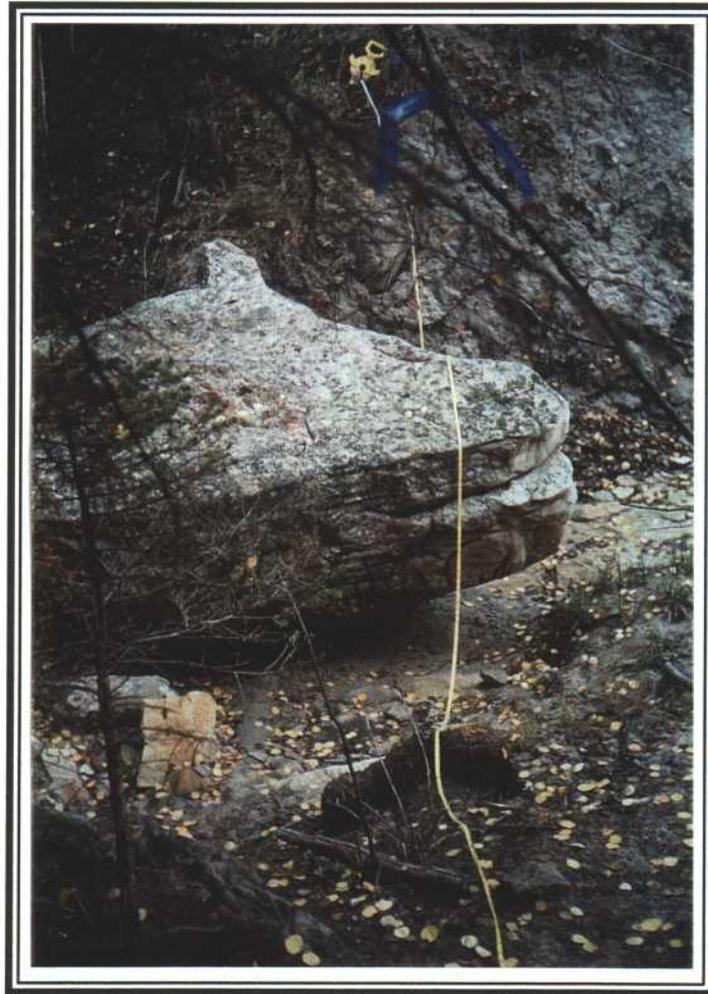
ROCK 14.75

STREAM (water width) 0.00

- -

TOTAL COVER **35.00**

PHOTOGRAPHIC DOCUMENTATION



R-07

RIPARIAN COMPLEX DATA SHEET

2003

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-09

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 6-10, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: $\sim 2^\circ$

ELEVATION: 8,210 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
 - Falcon Family Soils: 55 %
 - Sandstone Outcrop: 30%
 - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Aspen

Right: Aspen/Horsetail

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 600 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Salix lutea.</i>	<i>Ranunculus cymbalaria</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Artemisia tridentata</i>	<i>Equisetum arvense</i>	<i>Juncus longistylis</i>
<i>Juniperus scopulorum</i>	<i>Rosa woodsii</i>	<i>Urtica dioica</i>	
		<i>Epilobium angustifolia</i>	

POOL ATTRIBUTES

- % area in pools: 5
- % pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

- % streambed with filamentous algae: 0
- % stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): 0
- % bank length gently sloping (>135°): 50
- % bank length with overhanging vegetation: 75

BANK CONDITION

- % bank length vegetated, stable: 75
- % bank length unvegetated, stable: 15
- % bank length vegetated, unstable: 0
- % bank length unvegetated, unstable: 10

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): moderately stable (left side); stable (right side)

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

- 1) Photo taken from the left side.
- 2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method.
- 3) On the left side of the river there was about 8 ft wide area of redtop that it was uncertain where the water that supports it comes from (hillside seeps or stream).
- 4) The right side had hillside water influence.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-09		Left	14.0	<i>Agrostis stolonifera</i> / <i>Equisetum arvense</i>
		Right	3.5	<i>Agrostis stolonifera</i>

Cover by Community Types - R-9

USDA Forest Service Protocol (1992)

UPLAND VEGETATION

Equisetum arvensis/*Agrostis stolonifera* (hillside) 10.00

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

Agrostis stolonifera 8.00

Agrostis stolonifera/*Equisetum arvensis* 9.50

- -

TOTAL COVER (Upland Species) 10.00

TOTAL COVER (Riparian Species) 17.50

BAREGROUND 0.00

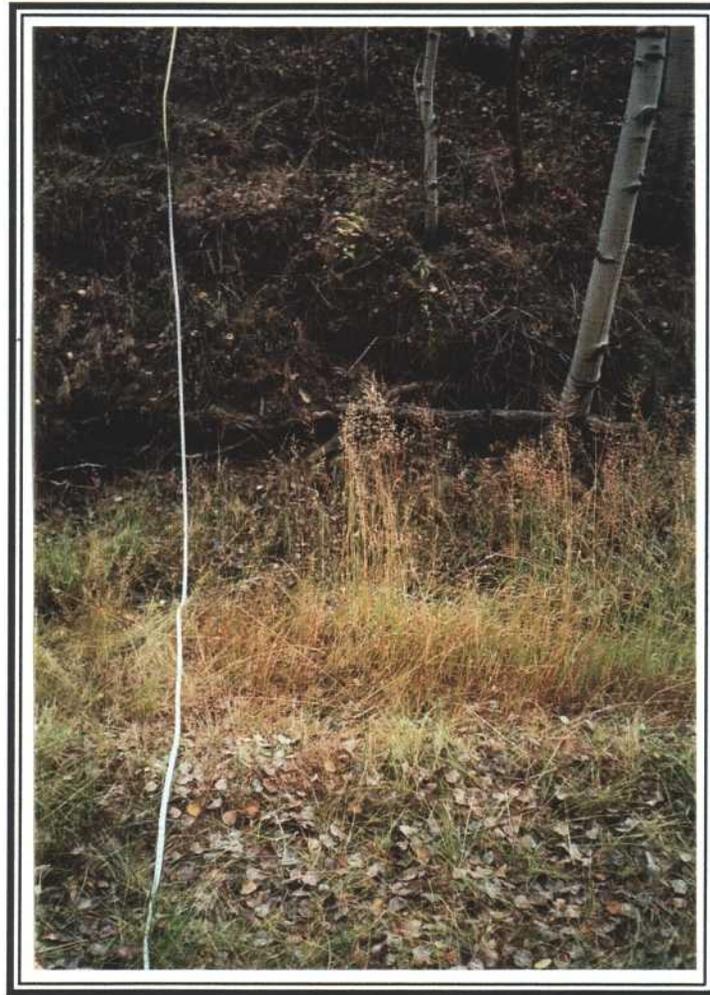
ROCK 1.00

STREAM (water width) 1.00

- -

TOTAL COVER 29.50

PHOTOGRAPHIC DOCUMENTATION



R-09

RIPARIAN COMPLEX DATA SHEET
2003

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-11

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 6-10, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NNW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,180 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
 - Falcon Family Soils: 55 %
 - Sandstone Outcrop: 30%
 - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Grass

Right: Aspen/Wood's Rose

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 250 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: *Mining, grazing, hunting, recreation.*

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Rosa woodsii</i>	<i>Epilobium angustifolium</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>		<i>Equisetum arvense</i>	<i>Muhlenbergia asperifolia</i>
			<i>Juncus longistylis</i>
			<i>Juncus arcticus</i>
			<i>Poa secunda</i>

POOL ATTRIBUTES

- % area in pools: 50
- % pool area made up of pools > 2' deep: 50

AQUATIC VEGETATION

- % streambed with filamentous algae: 0
- % stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): 15
- % bank length gently sloping (>135°): 85
- % bank length with overhanging vegetation: 10

BANK CONDITION

- % bank length vegetated, stable: 70
- % bank length unvegetated, stable: 20
- % bank length vegetated, unstable: 0
- % bank length unvegetated, unstable: 10

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable):
 moderately stable (left side); stable (right side)

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

- 1) Photograph taken from the left side.
- 2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-11		Left	10.0	<i>Equisetum arvense/Agrostis stolonifera/Juncus longistylis</i>
		Right	0	

Cover by Community Types - R-11

USDA Forest Service Protocol (1992)

UPLAND VEGETATION

<i>Picea pungens/Poa secunda</i>	10.00
<i>Populus tremuloides/Rosa woodsii</i>	10.00

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

<i>Agrostis stolonifera/Equisetum arvensis</i>	4.00
<i>Agrostis stolonifera/Juncus longistylis</i>	6.00

- -

TOTAL COVER (Upland Species) 20.00

TOTAL COVER (Riparian Species) 10.00

BAREGROUND 0.00

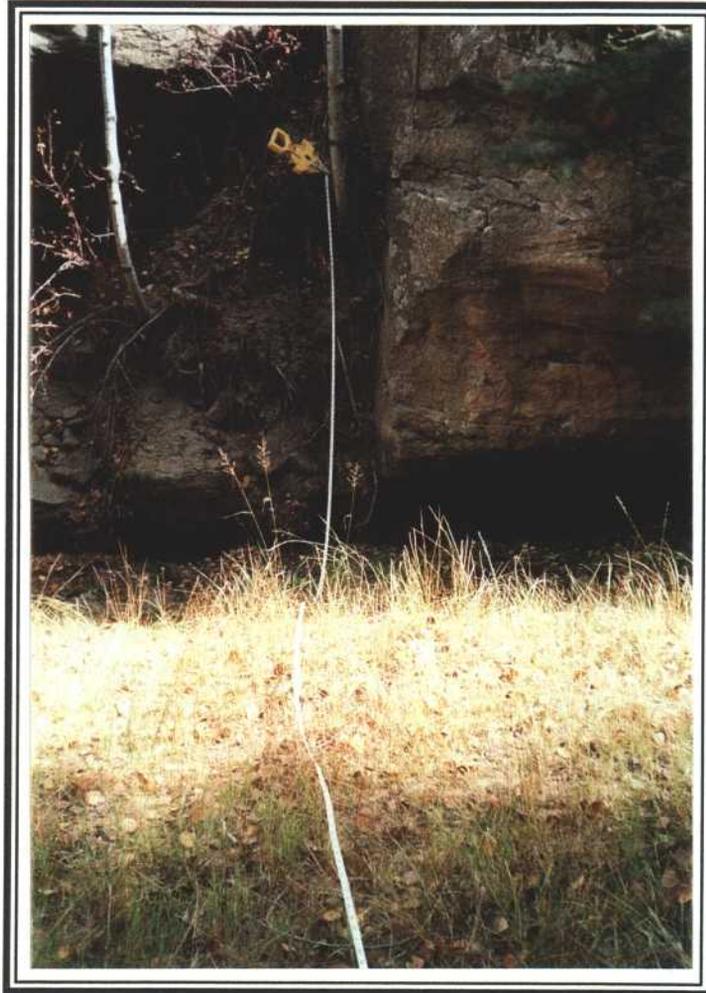
ROCK 0.00

STREAM (water width) 2.00

- -

TOTAL COVER **32.00**

PHOTOGRAPHIC DOCUMENTATION



R-11

RIPARIAN COMPLEX DATA SHEET
2003

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-13

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 6-10, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: NNW

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,175 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
 - Falcon Family Soils: 55 %
 - Sandstone Outcrop: 30%
 - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce

Right: Spruce/Aspen

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: climax (but recent years' upper bank movement could influence status).

APPARENT FORAGE TREND: moderately stable

ESTIMATED FORAGE PRODUCTION: 100 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: Yes

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>		<i>Equisetum arvense</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Potentilla fruticosa</i>	<i>Cirsium sp.</i>	<i>Carex lanuginosa</i>
<i>Salix lutea</i>	<i>Juniperus communis</i>		<i>Juncus longistylis</i>
			<i>Bromus carinatus</i>
			<i>Elymus trachycaulus</i>
			<i>Poa fendleriana</i>

POOL ATTRIBUTES

% area in pools: 35
 % pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

% streambed with filamentous algae: 0
 % stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

% bank length undercut (<90°): 0
 % bank length gently sloping (>135°): 65
 % bank length with overhanging vegetation: 70

BANK CONDITION

% bank length vegetated, stable: 75
 % bank length unvegetated, stable: 25
 % bank length vegetated, unstable: 0
 % bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

- 1) There was a discrepancy with total transect length between 1999 (42 ft.) and 2003 (45 ft.).
- 2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method.
- 3) Photograph taken from the left side.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

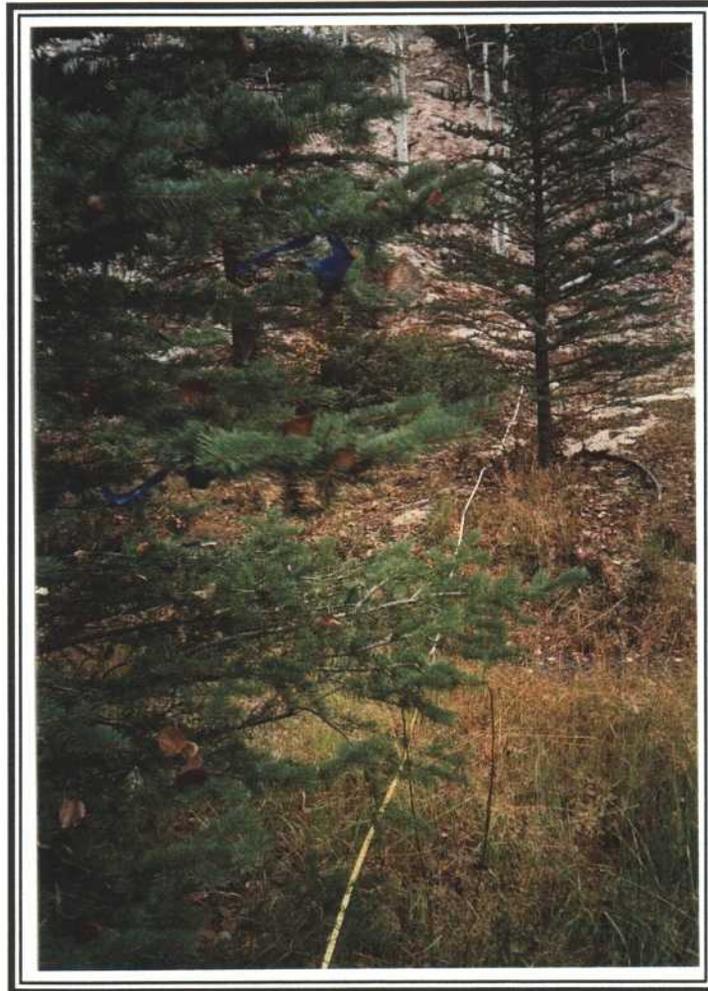
Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-13		Left	17.0	<i>Agrostis stolonifera/Salix lutea</i>
		Right	21.0	<i>Agrostis stolonifera/Juncus longistylis</i>

Cover by Community Types - R-13

USDA Forest Service Protocol (1992)

-	-
UPLAND VEGETATION	
<i>Bromus carinatus</i>	5.00
RIPARIAN VEGETATION	
<u>Dominant Woody Species</u>	
<u>Dominant Herbaceous Species</u>	
<i>Agrostis stolonifera/Juncus longistylis</i>	15.00
<i>Agrostis stolonifera/Salix lucida</i>	20.50
<i>Carex lanuginosa/Agrostis stolonifera</i>	2.50
-	-
TOTAL COVER (Upland Species)	5.00
TOTAL COVER (Riparian Species)	38.00
BAREGROUND	0.00
ROCK	0.00
STREAM (water width)	2.00
-	-
<u>TOTAL COVER</u>	45.00

PHOTOGRAPHIC DOCUMENTATION



R-13

RIPARIAN COMPLEX DATA SHEET

2003

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-15

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 6-10, 2004

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss (Blackhawk Fm just upstream)

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

ELEVATION: 8,170 ft.

SIZE OF COMPLEX: (see quantitative data)

SOILS INFORMATION: (USDA Forest Service. 1997 (Unpub.). Manti La Sal National Forest. Manti Division. Price, UT.)

- Soil Map Unit No. 57
- Family: Falcon
- Composition:
 - Falcon Family Soils: 55 %
 - Sandstone Outcrop: 30%
 - Contrasting inclusions of deeper, more stony, and sandier soils: 15%

ADJACENT UPLAND VEGETATION (looking downstream)

Left: Spruce/Aspen

Right: Spruce

VEGETATIVE DESCRIPTION (Dominance by Community Types)

Community Name	% of Complex
(refer to quantitative data summaries for this information)	

SUCCESSIONAL STATUS: active movement (not climax)

APPARENT FORAGE TREND: moderately stable

ESTIMATED FORAGE PRODUCTION: 100 lbs./ac.

BEAVER ACTIVITY: none observed

PHOTOGRAPH TAKEN: *Yes*

LAND USE ACTIVITIES THAT COULD INFLUENCE RIPARIAN AREA: Mining, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
<i>Picea pungens</i>	<i>Juniperus communis</i>	<i>Aster sp.</i>	<i>Agrostis stolonifera</i>
<i>Populus tremuloides</i>	<i>Symphoricarpos oreophilus</i>	<i>Equisetum arvense</i>	
<i>Cornus stolonifera</i>	<i>Salix lutea</i>	<i>Epilobium angustifolium</i>	

POOL ATTRIBUTES

- % area in pools: 40
- % pool area made up of pools > 2' deep: 0

AQUATIC VEGETATION

- % streambed with filamentous algae: 0
- % stream margin with rooted aquatic: 0

BANK TYPE & VEGETATION OVERHANG

- % bank length undercut (<90°): 55
- % bank length gently sloping (>135°): 0
- % bank length with overhanging vegetation: 2

BANK CONDITION

- % bank length vegetated, stable: 30
- % bank length unvegetated, stable: 20
- % bank length vegetated, unstable: 10
- % bank length unvegetated, unstable: 40

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable (left side); unstable (right side)

CHANNEL MORPHOLOGY

(Cross-sections, stream profiles and other geomorphological data for the East Fork of Box Canyon was measured by another team of scientists).

NOTES:

- 1) Active ground movement here due to moisture.
- 2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method.
- 3) Length of transect line in 2003 was less than 1999 due to movement.
- 4) Photo from 1999 was from a different place (stake number indicated I was in the correct location in 2003).

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-15		Left	4.0	<i>Equisetum arvense/Agrostis stolonifera</i>
		Right	0	

Cover by Community Types - R-15

USDA Forest Service Protocol (1992)

UPLAND VEGETATION

Picea pungens 10.00

RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

Agrostis stolonifera 2.00

Equisetum arvense 2.00

- -

TOTAL COVER (Upland Species) 10.00

TOTAL COVER (Riparian Species) 4.00

BAREGROUND 7.00

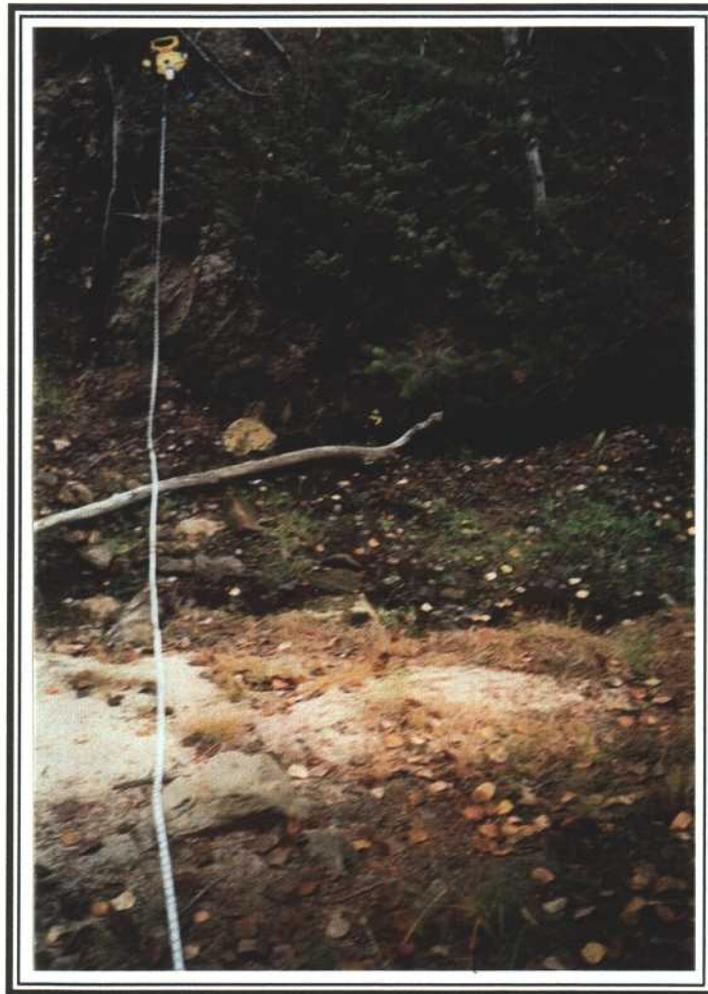
ROCK 4.00

STREAM (water width) 1.00

- -

TOTAL COVER 26.00

PHOTOGRAPHIC DOCUMENTATION

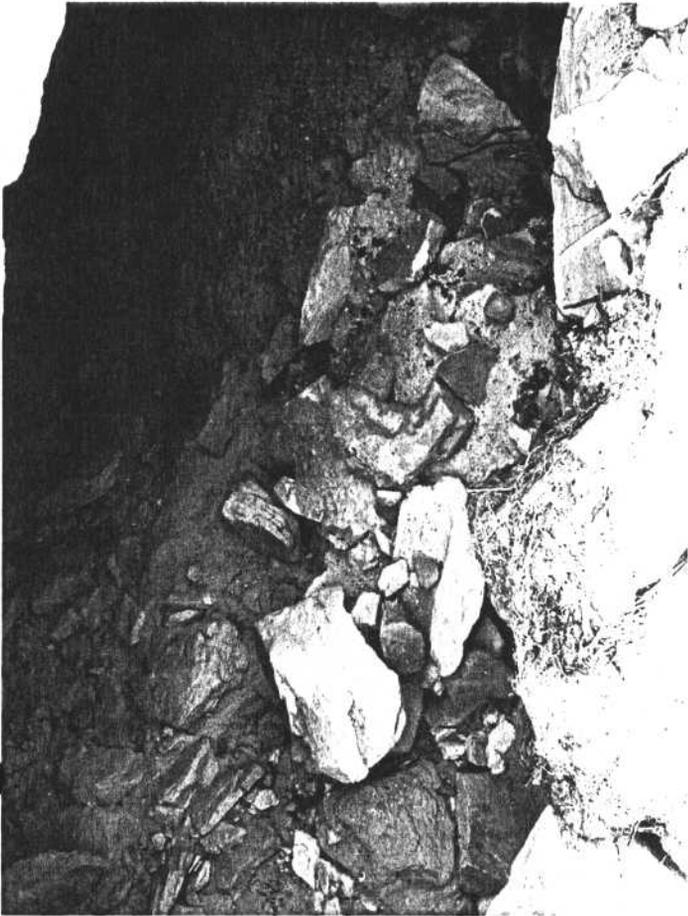


R-15

SUMMARY & CONCLUSIONS

Results from monitoring the riparian communities in the East Fork of Box Canyon have been included in this report. The USDA Forest Service protocol was employed to monitor the riparian communities. This protocol utilizes results from qualitative data of the riparian complex such as geology, geomorphology, biology, physiognomy, soils, and channel characteristics as part of the data collection process. Quantitative data were also recorded from the riparian plant communities. The methods used to record cover data at the team stations employed the use of point quadrats to record *Total Cover*. Additional sample stations from a previous sample year (1999) were also added to the sampling regime in 2003. Five of these sample stations were located in the East Fork of Box Canyon and five were in the Main Fork of Box Canyon. Methodologies to estimate cover (*Community Cover*) for the additional sites remained consistent with the earlier study in the event that some comparisons are made in the future.

A summary of all qualitative and quantitative data for each sample location are shown in the RESULTS section of this report.



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APPENDIX C

Legal Financial, Compliance and Related Information

Annual Report of Officers
As submitted to the Utah Department of Commerce

Other change in ownership and control information
As required under R645-301-110

CONTENTS

Data Sheet Report of Directors and Officers

Officers and Directors

The following lists describe the officers and directors of Canyon Fuel Company, LLC, Arch Western Resources, LLC, Arch Coal, Inc., Itochu Corporation, and Itochu Coal International, Inc. The addresses for the officers, directors, representatives to the management board listed are the same as those of the respective business entities as listed below for which the individuals are officers, directors or representatives.

ADDRESS:

Arch Coal, Inc.
CityPlace One, Suite 300
St. Louis, MO 63141-7056

ADDRESS:

Arch Western Resources, LLC
City Place One, Suite 300
St. Louis, MO 63141-7056

Itochu Coal International, Inc. is a wholly owned subsidiary of Itochu Corporation, a Japanese corporation.

ADDRESS:

Itochu Coal International, Inc.
555 17th Street, Suite 845
Denver, Colorado 80202

ADDRESS:

Itochu Corporation, 5-1
Kita-Aoyama 2-Chome
Minato-ku, Tokyo 107-77, Japan

Effective: 10/11/2000

William H. Rose
Effective: 06/01/1998

Assistant Secretary

ARCH COAL, INC.:

Directors:

James R. Boyd
Effective: 07/01/1997

Chairman

Frank M. Burke
Effective: 09/07/2000

Robert G. Potter
Effective: 04/26/2001

Theodore D. Sands
Effective: 02/25/1999

Michael A. Perry
Effective: 09/28/1998

Douglas H. Hunt
Effective: 07/01/1997

Steven F. Leer
Effective: 07/1/1997

James L. Parker
Effective: 07/01/1997

Thomas A. Lockhart
Effective: 02/21/2003

Officers:

Steven F. Leer
Effective: 07/1/1997

President and Chief Executive Officer

Kenneth G. Woodring
Effective: 07/01/1997

Executive Vice President-Mining Operations

C. Henry Besten, Jr. Effective: 07/01/1997	Vice President - Strategic Marketing
Larry R. Brown Effective: 07/01/1997	Vice President & Chief Information Officer
John W. Eaves Effective: 12/11/2002	Executive Vice President, Chief Operating Officer
David B. Peugh Effective: 07/01/1997	Vice President - Business Development
Robert W. Shanks Effective: 07/01/1997	Vice President - Operations
Robert J. Messey Effective: 12/1/2000	Senior Vice President, Chief Financial Officer
Robert G. Jones Effective: 10/16/2000 and 3/01/2000	Vice President, General Counsel and Secretary
James E. Florczak Effective: 08/17/1998	Treasurer
Deck S. Slone Effective: 04/26/2001	Vice President, Investor and Public Relations
Bradley M. Allbritten Effective: 03/1/2000	Vice President, Marketing
Shiela B. Feldman Effective: 02/03/2003	Vice President, Human Resources
Janet L. Horgan Effective: 10/16/2000	Assistant Secretary and Counsel
John W. Lorson Effective: 04/9/1999	Comptroller
Charles David Steele Effective: 04/24/2003	Vice President, Tax Planning
Bennett K. Hatfield Effective: 04/24/2003	Vice President

Arch Western Resources, LLC, Representatives to the Management Board:

Name: Steven F. Leer
Effective: 06/01/98

Name: Robert W. Shanks
Effective: 06/01/98

Alternate:

Name: Kenneth G. Woodring
Effective: 06/01/98

Itochu Coal International, Inc. Representatives to the Management Board:

Board:

Akio Shigetomi
Effective: 11/30/1996

Masayoshi Araya
Effective: 11/30/1996

Yuzo Hirono
Effective: 12/31/1999

Alternates:

Yutaka Nakazawa
Effective: 12/20/1996

Tsutomu Niwa
Effective: 6/01/2001

Canyon Fuel Company, LLC

March 11, 2004

Masahisa Naitoh	Vice Chairman	April 2000
Uichiro Niwa	President, CEO	April 1998
Hiroshi Sumie	Executive Vice President	April 2000
Makoto Kato	Executive Vice President	April 2001
Yushin Okazaki	Executive Vice President	April 2001
Sumitaka Fujita	Executive Vice President	April 2001
Mitsuaki Fukuda	Sr. Managing Director	April 2000
Akira Yokota	Sr. Managing Director	April 2001
Kiyomi Yamada	Managing Director	April 2001
Motonori Toyota	Managing Director	June 2001
Kouhei Wantanabe	Managing Director	April 2002
Hiroshi Ueda	Managing Director	April 2002

ITOCHU COAL INTERNATIONAL INC.

Masayoshi Araya	Chairman of the Board	Dec. 1999
Yuzo Hirono	President and Chief Executive Officer	Dec. 1999
Tsutomu Niwa	Chief Financial Officer	June 1996
Dietz Fry	Vice President, Finance and Administration	March 1997
Yutaka Nakazawa	Vice President Commercial and Secretary	Dec. 1996
Hiroshi Akiba	Assistant Secretary	Feb. 2000

APPENDIX D

Mine Maps

As required under R645-302-525-270

CONTENTS

Mining Progress Map 2003

APPENDIX E

Other Information

In accordance with the requirements of R645-301 and R645-302

CONTENTS

None