0036

Canyon Fuel Company, LLC.
Sufco Mine
A Subsidiary of Arch Western Bituminous Group, LLC.

Ken May, General Manager
397 South 800 West
Salina, UT 84654
(435) 286-4400 - Office
(435) 286-4499 - Fax

March 29, 2006

Utah Coal Regulatory Program
1594 West North Temple, Suite 1210
P. O. Box 145801
Salt Lake City, UT 84114-5801

Re: 2005 Annual Report for Canyon Fuel Company LLC, SUFCO Mine
C/041/002, Sevier County, Utah

Incoming
C/041/0002 OK
#2478

Dear Permit Supervisor:

Enclosed herewith is a copy of the annual report for the Canyon Fuel Company, SUFCO Mine for 2005. The information included is thought to be complete as requested. Questions should be referred to Mike Davis at (435) 286-4421.

Sincerely,
CANYON FUEL COMPANY, LLC
SUFCO Mine

Kenneth E. May
General Manager

Enclosures

KEM/MLD:kb

cc: Division of Oil, Gas and Mining – Price Field Office
Division of Oil, Gas and Mining Correspondence File

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MAR 31 2006
DIV. OF OIL, GAS & MINING

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Date _____ For additional information
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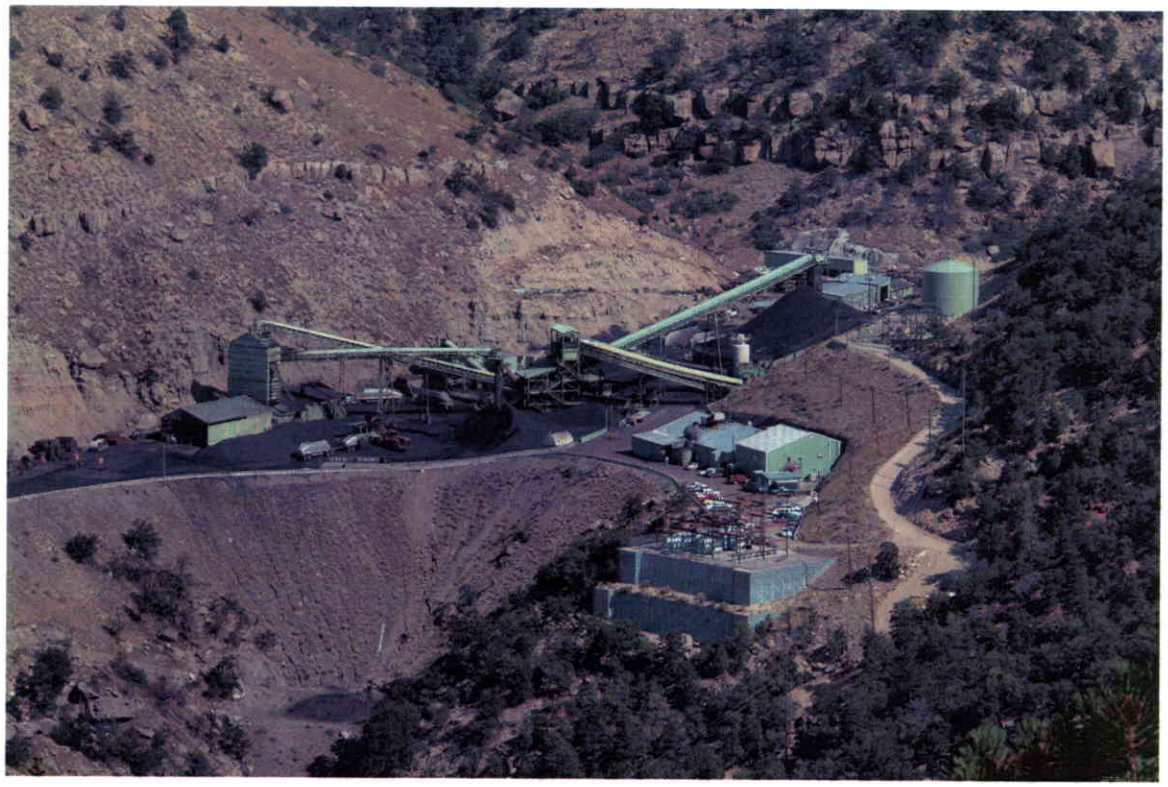
2005 ANNUAL REPORT



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

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*To enter text, click in the box and type your response. If a box already contains an entry select the entry and type the replacement. You can use the **tab** key to move from one field to the next. To select a check box, click in the box or type an x.*

GENERAL INFORMATION

Permittee 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, General Manager
Phone Number	(435) 286-4880
Fax Number	(435) 286-4499
E-mail Address	kmay@archcoal.com or 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
mber 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 udder the approved plan that must be periodically submitted t 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	☐	☒	☐	☐	
Refuse Piles	☒	☐	☐	☒	Certified Reports prev. submitted
Impoundments	☒	☐	☐	☒	Certified Reports prev. submitted
Other					
	☐	☐	☐	☐	
	☐	☐	☐	☐	

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	☒	☐	☒	☐	Included on disk in Appendix B
Subsidence Monitoring	☒	☐	☒	☐	Included in Appendix B
Vegetation Monitoring	☒	☐	☒	☐	Included in Appendix B
Raptor Survey	☒	☐	☒	☐	Included in Annual Report 2005 Confidential Folder
Soils Monitoring	☒	☐	☒	☐	Included in Appendix B
Water Monitoring	☐	☐	☐	☐	
First quarter	☐	☒	☐	☐	
Second quarter	☒	☐	☐	☒	Data previously submitted
Third quarter	☒	☐	☐	☒	Data previously submitted
Fourth quarter	☒	☐	☐	☒	Data previously submitted
Geological / Geophysical	☐	☒	☐	☐	
Engineering	☐	☒	☐	☐	
Non Coal Waste / Abandoned Underground Equipment*	☐	☐	☐	☐	
Other Data					
East Fork of Box Canyon Monitoring	☒	☐	☒	☐	Included in Appendix B
Macroinvertibrate Study of East Fork	☒	☐	☐	☐	Macroinvertibrate Study will be submitted when Consultant completes it.
05 Cultural Resource	☒	☐	☒	☐	Included in Annual Report 2005 Confidential Folder
Notices of Proposed Mining	☒	☐	☒	☐	Included in Appendix B

*Reminder: If equipment has been abandoned during 2005, 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.

LEGAL, FINANCIAL, COMPLIANCE AND RELATED INFORMATION

Change in administration or corporate structure can often bring about necessary changes to information found in the mining and reclamation plan. The Division is Requesting that each permittee review and update the legal, financial, compliance and related information in the plan as part of the annual report. Please provide the Department of Commerce, Annual Report of Officers, or other equivalent information as necessary to ensure that the information provided in the plan is current. Provide any other change as necessary regarding land ownership, lease acquisitions, legal results from appeals of violations, or other changes as necessary to update information required in the mining and reclamation plan. Include certified financial statements, audits or worksheets, which may be required to meet bonding requirements. Specify whether the information is currently on file with the Division or included as Appendix C to the report.

Legal / Financial Update	**Required**		**Included or on File with DOGM**		**Comments**
	Yes	No	Included	On file	
Department of Commerce, Annual Report Officers	☒	☐	☐	☒	Submitted in Canyon Fuel Co. General Chapter One
Other					
	☐	☐	☐	☐	
	☐	☐	☐	☐	
	☐	☐	☐	☐	

MINE MAPS

Copies of mine maps, current and up-to-date through at least December 31, 2004, are to be provided to the Division as Appendix D to this report in accordance with the requirements of R 645-301-525.240. These map copies shall be made in accordance with 30 CFR 75.1200 as required by MSHA. Upon request, the Division shall keep mine maps confidential. Please provide a CD.

Map Number(s)	**Map Title/ Description**	**Confidential**	
		Yes	No
	Mining Progress 2005	☒	☐
		☐	☐
		☐	☐
		☐	☐
		☐	☐
		☐	☐
		☐	☐
		☐	☐
		☐	☐
		☐	☐
		☐	☐

OTHER INFORMATION

Please provide any comments of further information to be included as part of the Annual Report. Any other attachments are to be provided as Appendix E to this report. If information is submitted as a group rather then by individual mine, please identify each of the mine's data in the list below.

Additional attachment to this report? **Yes** ☐ **No** ☒

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-Pines Tract
Vegetation Monitoring - Link Canyon Portals
Soils Monitoring - Waste Rock Disposal Site
East Fork of Box Canyon Studies-Biomonitoring
East Fork of Box Canyon Studies-Macroinvertibrate
East Fork of Box Canyon Studies-Hydrology
Notices of Proposed Mining

2005 SUBSIDENCE REPORT

CANYON FUEL COMPANY, LLC

SUFCO MINE

by

JOHN M. BLACK

CHIEF SURVEYOR

INTRODUCTION

Canyon Fuel Company LLC, SUFCO Mine's 2005 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 12.5 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.

2005 SUBSIDENCE

The 2004 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 has been mined out for four years, and monitoring suggests that it has settled. It is now assumed to be dormant.

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 has shown no significant movement in the last few years so will be considered dormant.

AREA 12

Area twelve is the first longwall mining block on the acquired lease UTU-76195. Due 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 and will continue until February 2007. Mining in the fourth longwall panel was completed in September 2004. This area is active and being monitored.

AREA 13

Area thirteen was to be the second longwall mining block on the UTU-76195 lease. This area was also modified and contained one short longwall panel. An elevation baseline was established in 1999. Due to mine plan changes this area will not be mined with the longwall. This area will be reassigned to the next longwall mining block in the northwestern part of the property.

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 a couple thousand 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.

Longwall mining at the top of the 13L4E longwall panel caused some cracking in the escarpment sandstone of upper Box Canyon. The panel was mined parallel and down the center of a portion of the canyon. Subsidence thus created an inward pull on the canyon walls. These cracks are in the rock along the edge of the escarpment and vary in width and displacement. A monitoring program was initiated in 2004 to observe the behavior of these cracks. A chart of this data is included at the end of this report.

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. Areas 10, 11 and 12 were monitored this year. Longwall mining of Area 10 was completed in August 2001 and all signs show this area stable. Area 11 was mined in 2000 and has shown no movement for a few years. There is active longwall mining in Area 12 until the February of 2007 causing subsidence. Areas 10 and 11 will be put into the dormant category starting in 2006. Yearly monitoring of Area 12 will continue until it has been determined that subsidence has ceased. The monitoring of the subsidence cracks in the escarpment along upper Box Canyon will continue.

JMB:kb
SUFSRV1\SUFPUB\GOVT2005\BLM\SUBSID05.DOC

BOX CANYON ESCARPMENT CRACKS

CRACK STATION SUFCO	WIDTH OF CRACKS	DROP OF CRACKS	X	Y	Z
BCE Crack 01 Sta 01			120843.93	131055.41	8369.66
AUGUST 2004	1.0'	0.50'			
SEPTEMBER 2005	1.05'	0.30'			
BCE Crack 01 Sta 02			120864.47	130972.33	8369.48
AUGUST 2004	1.7'	0.48'			
SEPTEMBER 2005	1.9'	0.50'			
BCE Crack 01 Sta 03			120903.89	130796.70	8370.63
AUGUST 2004	0.47'	0.35'			
SEPTEMBER 2005	0.47'	0.37'			
BCE Crack 02 Sta 01			121016.97	130673.02	8376.34
AUGUST 2004	0.08'	0.0'			
SEPTEMBER 2005	0.07'	0.0'			
BCE Crack 02 Sta 02			121024.30	130591.32	8373.91
AUGUST 2004	0.09'	0.0'			
SEPTEMBER 2005	0.07'	0.0'			
BCE Crack 03 Sta 01			120931.85	130817.12	8371.88
AUGUST 2004	0.33'	0.0'			
SEPTEMBER 2005	0.32'	0.0'			
BCE Crack 03 Sta 02			120940.62	130713.78	8373.38
AUGUST 2004	1.17'	0.01'			
SEPTEMBER 2005	1.15'	0.03'			
BCE Crack 03 Sta 03			120941.99	130593.20	8370.72
AUGUST 2004					
SEPTEMBER 2005	0.5'	0.3'			
BCE Crack 04 Sta 01			120291.04	131471.84	8366.01
AUGUST 2004	0.08'	0.03'			
SEPTEMBER 2005	0.08'	0.03'			
BCE Crack 04 Sta 02			120110.25	1311468.03	8358.60
AUGUST 2004	0.04'	0.0'			
SEPTEMBER 2005	0.04'	0.0'			

PINES TRACT VEGETATION STUDY

Prepared by
Keith W. Zobell, Environmental Specialist
August 19, 2005

The purpose of the "pines tract Vegetation Study" continues to be to determine if the 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 area.

On July 20, 2005 the Pines Tract area was visited by Keith W. Zobell, (Environmental Specialist) and Mike Davis (Mining Engineer for Canyon Fuel Company, SUFCO Mine). The purpose of this tip was to revisit all the original photo points that have been established and to retake photos at each site and determine the general vegetation growth, plant vigor and plant condition at each of the established photo sites. These sites are revisited each year at approximately the same date so as to reduce any possible seasonal variations. Photos of each site are identified and included at the end of this report.

The weather records at the SUFCO Mine site showed that approximately 150% of the normal moisture had been received through the end of June 2005 for this moisture year. This above normal precipitation has influenced the overall growth and vigor of the vegetation in the area. The vegetative over-all growth is definitely better that what has been observed for the past several years. The area has been in a six year period of drought and it can't be expected for this above average precipitation to replenish the ground water supply of the area in one season. The stream in Box Canyon continues to have no measurable flow at the established water monitoring stations. There is some standing pools of water from station 090 up to Pines station 219. However, the creek is totally dry above Pines station 219. The small pond at the "Grotto" area continues to be dry, however there is dripping water on the cliff faces just above the pond area. The spring in the East Fork at Photo Point 10 continues to have a good flow. The Pines tract was not grazed by cattle this spring and this has had a very positive affect on plant growth and vigor within the tract.

At photo point 1a there is one columbine plant with several inflorescence stems from 14 to17 inches long. The plant has good vigor. The plant is growing out of a rock facture and is probably getting moisture from the fracture.

At photo point 1b there are two columbine plants in bloom. The inflorescence stems are 24 to 28 inches long and the plants have good vigor. These plants are also growing on

the cliff face and growing out of a rock fracture and area probably getting moisture from the fracture.

At photo point 1c the columbine plants are located 15 to 20 feet up on the cliff face. It still appears that there is only one living plant. This columbine plant is in bloom and the inflorescence is 14 to 17 inches in length. The plant appears to have good vigor.

At photo point 2 there is still only two living columbine plants. The inflorescence on one plant is 18 to 20 inches in length. The second plant has no inflorescence. The plants are in good vigor.

At photo point 3 there are still two columbine plants. Neither of the plants have inflorescence. One plant has vegetative growth of 10 inches while the second plant has vegetative growth of only 4 inches. These plants are growing on a fairly dry site and are in only fair vigor condition.

At photo point 4 the columbine inflorescence is 12 to 14 inches in length. Carex vegetative growth is 5 to 7 inches in length, new growth on aspen is 7 to 10 inches in length, Woods Rose vegetative growth is 2 to 4 inches in length and one Potentilla plant has a new growth of 6 inches. This is a fairly dry site which results in a low density of supporting vegetation. There is good plant vigor at this site.

At photo point 5 there are still three columbine plants. One plant has no inflorescence but has a vegetative growth of 11 inches. The other two plants have inflorescence of 18 inches in length while the other one has an inflorescence of 36 inches. Bluegrass seed heads are 30 to 36 inches in length, Hair grass seed heads are 18 to 24 inches in length, new Aspen growth is 6 to 10 inches, and Yarrow seed heads are 20 to 24 inches in length. The Carex plants have a vegetative growth of 10 to 12 inches in length. The vigor at this site is good+. There is not flowing water in the creek bed.

Photo point 6 is a riparian area in Box Canyon. This area has been heavily grazed in the past. Ocular estimates show the site to have 30% bare ground. The Yarrow seed heads are 16 to 18 inches in length, Smooth Brome seed heads are 26 to 30 inches in length, Bluegrass seed heads are 22 to 26 inches in length and herbaceous sage seed heads 14 to 18 inches in length. Vegetative growth on Juncus is 8 to 12 inches in length, Wood Rose 6 to 8 inches in length, and Aspen new growth is 12 to 16 inches with a few new shoots reaching 36 inches in length. Carex adjacent to the stream channel is 12 to 16 inches in length. The vigor for this site is good

At photo 7 there are no Columbine plants. The site is a dry site and there is no moisture in the creek. The Geranium plants have no flower stocks and a vegetative growth of 4 to 6 inches. The yarrow plant has one seed stock 15 inches in length and there are some Horsetail plants which are 4 to 6 inches in length. The site has 50% bare ground and is in a low fair vigor condition.

Photo point 8a is a hanging fern area. There is dripping moisture coming from the cracks in the cliff face. Ferns are growing along the cracks and have vegetative growth of 5 to 8 inches in length. There is an increase in fern density. There are no new dead fern plants. There is also good lichen growth this year.

Photo points 9a & 9b are also a hanging fern area. There is moisture flowing over the cliff face and dripping off of it. There is increased fern growth and density with the fern vegetative growth of 5 to 8 inches in length. There is also good lichen growth this year. There are no new dead plants this year.

Photo point 10 is a riparian area in the East Fork of Box Canyon. The site has not been grazed this year and coupled with good moisture this spring has resulted in good plant growth and increased plant density. Ocular estimate shows the site to have 45 to 50 % bare ground. New vegetative growth is as follows; Aspen has 36 to 48 inch new sprouts, Woods Rose has 10 to 12 inch new growth, Sagebrush has 10 to 12 inch new growth, Juncus has a total height of 18 to 24 inches, and seed heads on Stipa grass are 24 to 26 inches in length. The vigor of the existing plants is good however density is poor.

The vegetation in the wet meadow adjacent to the photo point has not been grazed and has good vigor and good growth.

Photo Point 1a

Photo Point 1b

Photo Point 1c

Photo Point 2

Photo Point 3

Photo Point 5

Photo Point 4

Sorry Picture Didn't Turnout

Photo Point 6

Photo Point 7

Sorry Picture Didn't Turnout

Photo Point 8

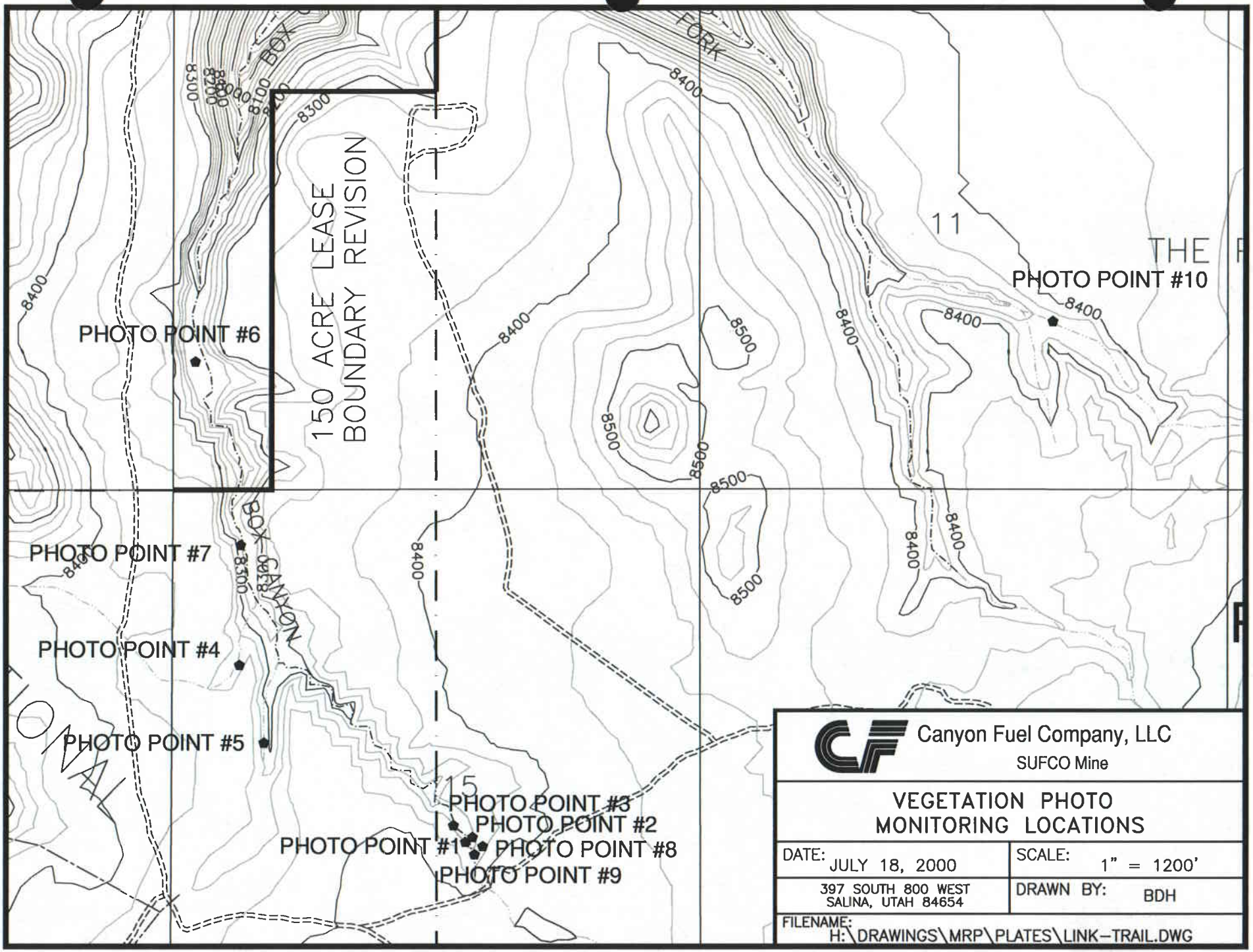
Sorry Picture Didn't Turnout

Photo Point 9a

Photo Point 9b

Photo Point 10

Wet Meadow Adjacent to Photo Point 10


150 ACRE LEASE
BOUNDARY REVISION
BOX CANYON
FORK
11
THE
15
PHOTO POINT #1
PHOTO POINT #2
PHOTO POINT #3
PHOTO POINT #4
PHOTO POINT #5
PHOTO POINT #6
PHOTO POINT #7
PHOTO POINT #8
PHOTO POINT #9
PHOTO POINT #10
8300
8400
8500
Canyon Fuel Company, LLC
SUFCO Mine
VEGETATION PHOTO
MONITORING LOCATIONS
DATE: JULY 18, 2000
SCALE: 1" = 1200'
397 SOUTH 800 WEST
SALINA, UTAH 84654
DRAWN BY: BDH
FILENAME: H:\DRAWINGS\MRP\PLATES\LINK-TRAIL.DWG

LINK CANYON MINE PORTAL
VEGETATIVE STUDY

Prepared by
Keith W. Zobell, Environmental Specialist
July 26, 2005

The purposed of the "Link Canyon Mine Portal Vegetation Study" is to help determine the impact of re-opening the old mine Link Canyon mine portals by the SUFCO mine.

The Link Canyon Mine was developed in the early 1940's and operated until 1952 when the mine closed down and was abandoned. Over time the two mine portals collapsed, and small quantities of water were observed discharging from the portals. In the report "Baseline Hydrologic Monitoring at the Link Canyon Portals, SUFCO Mine Permit Area, Utah" prepared by Petersen Hydrologic in December 2002 it states on Page 2 that "Groundwater discharges from the mine portals, albeit in meager quantities with discharge rates generally less than one to two gpm. It has been observed that the mine discharge rapidly infiltrates into the subsurface within a few hundred feet downstream of the portals."

Only the west Link Canyon Portal was re-opened by the SUFCO mine in late January 2003. The purpose of re-opening the portal was to act as air intake ventilation portal for the SUFCO mine. The average intake air at the portal is 268,800 cubic feet per minute.

Since the portals were re-opened their has been no observed measurable and reportable water discharge from the mine portals. In the Petersen Hydrologic report on page 2 it states that "It is possible that the Link Canyon Mine workings have filled with groundwater and are now spilling over the mine portals. Alternatively, it is also possible that the water discharging from the mine originates from groundwater seepage somewhere along the main mine entries. Under this scenario, the mine workings would not

necessarily be full. Rather, the ground water would gravity flow over the near horizontal mine floor and spill out the portals." The development of the portals showed that the second scenario is what actual exists. It is felt that the high volume of air being taken in to mine probably evaporates the small volume of water that was seeping into the mine entries.

It was determined that a photographic record should be established to record the changes in riparian vegetation at the mouths of the portals. On June 27, 2005 a photo point was established at the mouth of the West Portal and one at the mouth of the East Portal. Photo's are to be retaken during the quarterly water monitoring at the SUFCO Mine.

Link Canyon West Portal Photo Point

The spring moisture for this area has been above average with the SUFCO Mine reporting 150% of normal moisture at the mine site. With this above average moisture all plants are showing good growth. At this site as shown in the above photo the Willow (*Salix spp.*) shows indications of passed stress by the numerous dead stems. However, the current conditions show the Willow to be in bloom with 4-6 inches of current new growth. Woods Rose (*Rosa woodsii*) was in full bloom with 3-4 inches of new growth. The

Clematis (*Clematis ligusticifolia*) has good growth. There is one squawbush plant (*Rhus aromatica var. trilobata*) growing at this site and has 6 inches of new growth. One dogwood plant (*Cornus stolonifera*) has an average of 8 inches of new growth. The bluegrass plants (*Poa pratensis*) have an average seed head height of 24 inches. The wiregrass plants (*Juncus balticus*) are in seed and have an average seehead height of 18 inches.

Some of the shrub species show sighs of being stressed in the past The current conditions show good growth and vigor. This situation could change as the soil mantel dries out during the drier summer months.

Link Canyon East Portal Photo Point

This portal was not reopened by the SUFCO mine. No flow was being discharge at the time when the photo was taken. The general plant growth conditions are considered adequate and appear to be not as good as those at the West Portal area. The Dogwood bush shows signs of passed stress as indicated by some deadwood, current new growth is 2-4 inches. The Clematis growth is good. One Gooseberry plant (*Ribes spp.*) has an average new growth of 6-8 inches. The willow plant is in bloom and has an average new growth of 2-4 inches and does exhibit some signs of passed stress.

Wire grass is the predominant plant species at this site and has an average seed head height of 16 inches. Scattered bluegrass plants have and average seed head height of 28 inches. There are some scattered rabbitbrush plants (*Chrysothamnus spp.*) along the sides of the channel which show a fair amout of deadwood in them. This is not untypical of this species.

Photos at these to two photo points will be taken again during the third quarter and a follow up report prepared.

LINK CANYON MINE PORTAL
VEGETATIVE STUDY

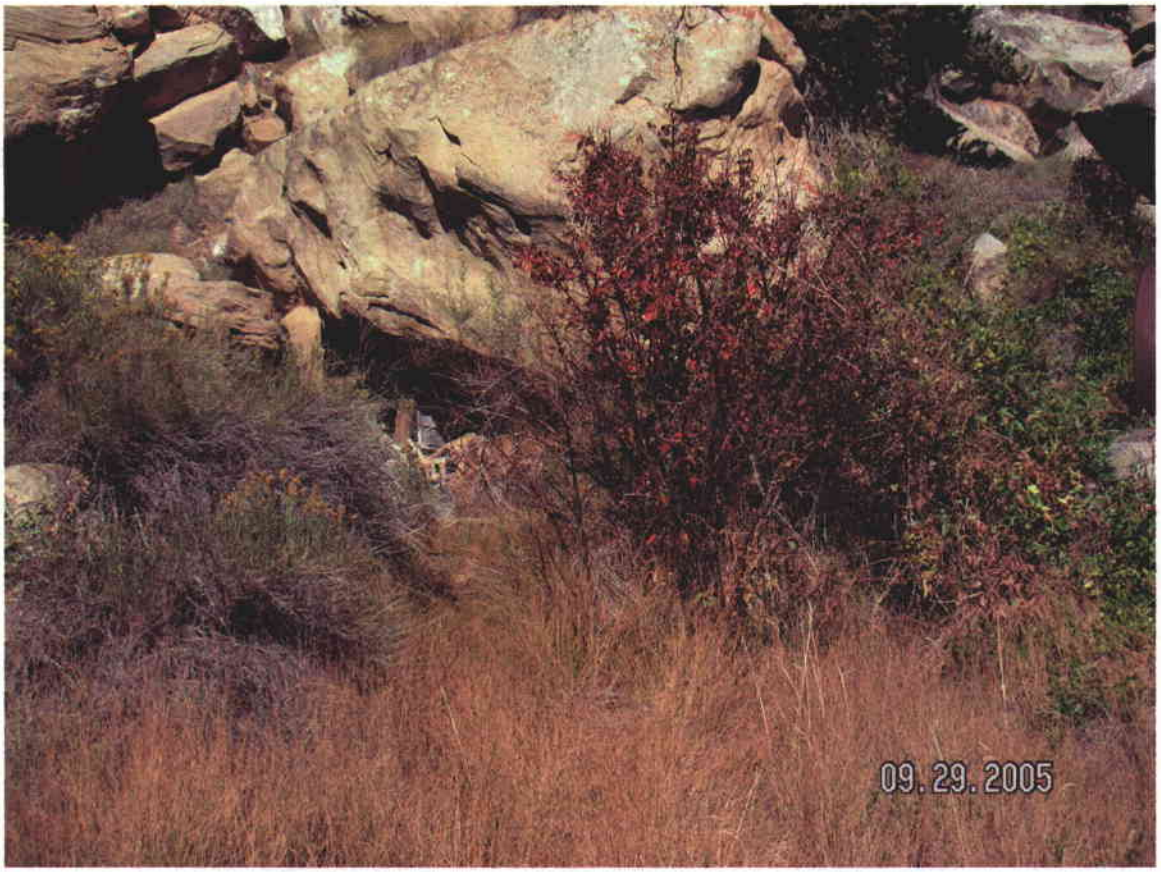
Prepared by
Keith Zobell, Environmental Specialist
September 29,2005

The portal area received good spring moisture and some scattered rain storms throughout the summer.

West Portal Area

The Dead willow are still evident as shown in the above photograph, however the existing live willow plants produced good growth with the current years growth being 8-24 inches in length. The living pants have good vigor. All of the grass species have matured and have a good production of seed heads. The squaw bush has current years growth of 6-10 inches with a good crop of fruit with good vigor and is not showing any signs of stress. Rabbitbrush is in bloom and has a current years growth of 12-18 inches and has good vigor. Woods Rose has 6-8 inches of current years growth with good vigor and has a good crop of Rose hips. Clematis has good growth with good vigor and a good crop of seed heads. Sagebrush along the edges has a current years growth of 6-10 inches

with good vigor and is in bloom. Overall the vegetation at this portal area is not showing any visible signs of stress.



East Portal Area

The Dogwood in the center of the above picture continues to show signs of stress. Almost all of the current years growth is dead with the leaves of the rest of the plant less dense the normal. The Juncus and Bluegrass plants have all matured and dried up but have good seed heads. The Rabbitbrush has 7-10 inches of current years growth and is in bloom and is starting to produce seed.. The Willow plants have 11-18 inches of current years growth with some of the new growth showing signs of stress. The Ribes plants have 12-18 inches of current years growth with now fruit showing. The Ribes normally produce fruit in early summer so any fruit produce by these plants may have already dried up and fallen. Overall this portal area does not have to vigor that the West portal has, and is show signs of stress probably produced by the lack of moisture.

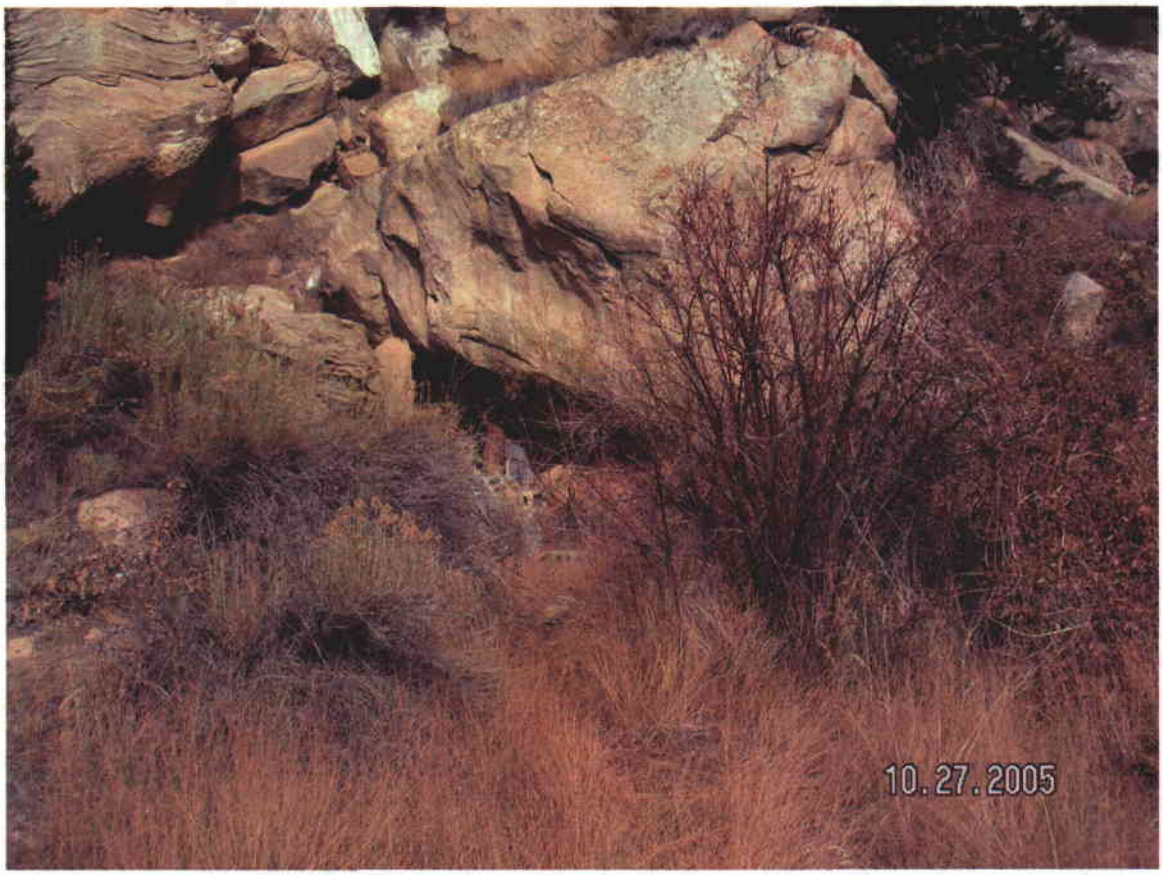
LINK CANYON MINE PORTAL
VEGETATIVE STUDY

Prepared by
Keith Zobell, Environmental Specialist
October 27, 2005

The Link Canyon Portal area has had no new growth since the last photographs were taken. This is due to the end of the growing season and the freezing nights that have been occurring for the past several weeks in this area.

West Portal Area

Although there are still some leaves still persisting the majority of the leaves have fallen due to the end of the growing season and the fall temperatures. No significant changes in vegetative conditions have taken place.



East Portal Area

Leaf fall is complete on the shrubs except for the rabbitbrush and the sagebrush. There has been no significant change in the vegetative vigor or growth since the last photographs were taken.

Waste Rock Disposal Site Material Analyses

Year	Quarter	Lab	Lab ID	pH	Saturation	EC @ 25° C	Calcium	Magnesium	Sodium	SAR	Total Sulfur	T.S. AB	Neutral. Pot.	T.S. ABP	Boron	Selenium	Alkalinity PE
				s.u.	%	dS/m	meq/L	meq/L	meq/L		%	t/1000t	t/1000t	t/1000t	ppm	ppm	meq/L
2000	1	Int	0100S20484	7.0	49.6	3.96	23.50	14.70	8.69	1.99	0.32	10.00	78.2	68.2	7.73	0.02	1.57
2000	2	Int	0100S20485	7.2	47.5	1.02	2.65	3.19	4.11	2.41	0.38	11.90	52.9	41	5.37	0.02	2.82
2000	3	Int	0100S20486	6.9	55.5	3.82	21.10	8.81	11.50	2.98	0.41	12.80	52.4	39.6	4.95	0.02	2.16
2000	4	Int	0100S20487	7.2	47.8	1.36	3.06	3.61	6.38	3.49	0.43	13.40	50.4	36.9	4.43	0.02	3.38
2001	1	Int	0101S09020	7.3	45.1	4.50	28.10	15.70	14.20	3.03	0.54	16.90	92.1	75.2	6.84	< 0.02	1.44
2001	2	Int	0101S11636	7.3	50.9	3.78	14.50	13.40	15.40	4.12	0.48	15.00	39.3	24.3	8.45	< 0.02	2.33
2001	3	Int	0101S19152	7.0	40.2	9.19	39.20	27.10	35.30	6.14	0.44	13.70	89.8	76.1	5.28	< 0.02	2.11
2001	4	Int	0101S23729	6.8	52.2	4.35	28.60	12.80	10.70	2.35	0.50	15.60	56.2	40.6	6.54	0.02	2.08
2002	1	Int	0102S06276	6.9	39.7	12.40	43.70	32.10	60.80	9.87	0.43	13.40	91.2	77.8	5.28	< 0.02	2.31
2002	2	Int	0102S12107	7.2	43.6	8.64	38.90	22.90	38.10	6.85	0.45	14.10	83.5	69.5	5.53	< 0.02	2.83
2002	3	Int	0102S19293	7.4	46.8	4.27	26.00	22.00	8.61	1.76	0.79	24.70	56.6	32.0	7.61	0.04	1.81
2002	4	Int	0102S24366	7.0	35.2	8.22	34.90	36.90	23.00	3.84	0.62	19.40	104.0	84.2	5.26	0.02	2.25
2003	1	Int	0103S02028	7.4	51.5	4.80	15.40	8.75	21.30	6.12	0.41	12.80	50.2	37.4	2.66	< 0.02	1.79
2003	2	Int	0103S07189	7.1	39.6	12.80	36.70	31.40	80.00	13.70	0.59	18.40	108.0	89.9	7.39	0.02	1.06
2003	3	Int	0103S14524	7.2	53.3	2.43	14.60	7.84	8.45	2.53	0.57	17.80	44.2	26.4	6.03	< 0.02	1.94
2003	4	Int	0103S19355	7.4	51.9	9.42	16.60	10.10	63.10	17.30	0.51	15.90	48.0	32.1	7.55	< 0.02	2.95
2004	1	Int	0104S03718a	7.4	60.5	4.14	5.08	2.22	27.10	14.20	0.37	11.60	26.9	15.4	4.08	< 0.02	2.93
2004	2	Int	0104S11683	7.3	44.2	8.38	31.30	21.10	39.30	7.67	0.48	15.00	41.1	26.1	13.30	0.04	3.47
2004	3	Int	0104S14234	6.8	41.8	19.80	44.80	25.50	145.00	24.50	0.28	8.75	146.0	137.0	5.74	< 0.02	3.33
2004	4	Int	0104S16558	7.1	47.5	6.21	35.50	13.00	21.40	4.35	0.40	12.50	61.5	49.0	7.56	0.02	3.06
2005	1	Int	0105S01676	7.2	44.0	17.80	45.60	29.90	127.00	20.70	0.41	12.80	144.0	131.0	5.18	< 0.02	2.18
2005	2	Int	0105S03977	7.5	61.9	2.05	7.44	4.47	7.17	2.94	0.27	8.43	156.0	147.0	2.96	< 0.02	1.85
2005	3	Int	0105S08168	5.9	55.6	5.47	35.40	29.20	8.22	1.45	0.50	15.60	92.7	77.1	5.27	0.04	7.47
2005	4	Int	0105S14664	6.9	41.5	7.99	40.30	23.60	40.20	7.11	0.39	12.20	129.0	116.0	7.16	0.02	1.45
Minimum				5.9	35.2	1.02	2.65	2.22	4.11	1.45	0.27	8.43	26.9	15.4	2.66	< 0.02	1.06
Maximum				7.5	61.9	19.80	45.60	36.90	145.00	24.50	0.79	24.70	156.0	147.0	13.30	0.04	7.47
Average				7.1	47.8	6.95	26.37	17.51	34.38	7.14	0.46	14.28	78.9	64.6	6.17	0.02	2.52

Inter-Mountain Laboratories, Inc.

1673 Terra Avenue
Sheridan, WY 82801

Report ID: 010501676

Soil Analysis Report
Canyon Fuel, LLC
Sufco Mine
397 S. 800 W.
Salina, UT 84654

Client Project ID: Mine Waste Rock
Date Received: 03/16/05

Set #0105S01676
Report Date: 03/23/05

Lab Id	Sample Id	pH s.u.	Saturation %	EC @ 25°C dS/m	Calcium meq/L	Magnesium meq/L	Sodium meq/L	SAR	Total Sulfur %	T.S. AB t/1000t	Neutral. Pot. t/1000t	T.S. ABP t/1000t
05S01676	Mine Waste Rock Sample 2005 1st Qtr	7.2	44.0	17.8	45.6	29.9	127	20.7	0.41	12.8	144	131

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By: _____
Joey Sheeley, Soils Lab Supervisor

Inter-Mountain Laboratories, Inc.

1673 Terra Avenue
Sheridan, WY 82801

Report ID: 010501676

Soil Analysis Report
Canyon Fuel, LLC
Sufco Mine
397 S. 800 W.
Salina, UT 84654

Client Project ID: Mine Waste Rock
Date Received: 03/16/05

Set #0105S01676
Report Date: 03/23/05

Lab Id	Sample Id	Boron ppm	Selenium ppm	Alkalinity PE meq/L
05S01676	Mine Waste Rock Sample 2005	5.18	<0.02	2.18

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed By: _____
Joey Sheeley, Soils Lab Supervisor

Inter-Mountain Laboratories, Inc.

1673 Terra Avenue
Sheridan, WY 82801

Report ID: 010503977

Soil Analysis Report
Canyon Fuel, LLC
Sufco Mine
397 S. 800 W.
Salina, UT 84654

Client Project ID: Mine Waste Rock
Date Received: 07/01/05

Set #0105S03977
Report Date: 07/14/05

Lab Id	Sample Id	pH s.u.	Saturation %	EC @ 25°C dS/m	Calcium meq/L	Magnesium meq/L	Sodium meq/L	SAR	Total Sulfur %	T.S. AB t/1000t	Neutral. Pot. t/1000t	T.S. ABP t/1000t
0105S03977	WRDS Sufco 2nd Qtr. 062905	7.5	61.9	2.05	7.44	4.47	7.17	2.94	0.27	8.43	156	147

These results only apply to the samples tested.

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Reviewed By: _____
Joey Sheeley, Soils Lab Supervisor

Inter-Mountain Laboratories, Inc.

1673 Terra Avenue
Sheridan, WY 82801

Report ID: 010503977

Soil Analysis Report
Canyon Fuel, LLC
Sufco Mine
397 S. 800 W.
Salina, UT 84654

Client Project ID: Mine Waste Rock
Date Received: 07/01/05

Set #0105S03977
Report Date: 07/14/05

Lab Id	Sample Id	Boron ppm	Selenium ppm	Alkalinity PE meq/L
)105S03977	WRDS Sufco 2nd Qtr. 062905	2.96	<0.02	1.85

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By: _____
Joey Sheeley, Soils Lab Supervisor

Inter-Mountain Laboratories, Inc.

1673 Terra Avenue
Sheridan, WY 82801

Report ID: 010508168

Soil Analysis Report
Canyon Fuel, LLC
Sufco Mine
397 S. 800 W.
Salina, UT 84654

Received
OCT 12 2005
Canyon Fuel Company
SUFCO Mine

Set #0105S08168
Report Date: 10/07/05

Client Project ID: Mine Waste Rock
Date Received: 09/15/05

Lab Id	Sample Id	pH	Saturation	EC @ 25°C	Calcium	Magnesium	Sodium	SAR	Total Sulfur	T.S. AB	Neutral. Pot.	T.S. ABP
		s.u.	%	dS/m	meq/L	meq/L	meq/L		%	t/1000t	t/1000t	t/1000t
105S08168	Mine Waste Rock Sample 2005 3RD Qtr	5.9	55.6	5.47	35.4	29.2	8.22	1.45	0.50	15.6	92.7	77.1

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Reviewed By: Joey Sheeley
Joey Sheeley, Soils Lab Supervisor

Inter-Mountain Laboratories, Inc.

1673 Terra Avenue
Sheridan, WY 82801

Report ID: 010508168

Soil Analysis Report
Canyon Fuel, LLC
Sufco Mine
397 S. 800 W.
Salina, UT 84654

Received
OCT 12 2005
Canyon Fuel Company
SUFCO Mine

Client Project ID: Mine Waste Rock
Date Received: 09/15/05

Set #0105S08168
Report Date: 10/07/05

Lab Id	Sample Id	Boron ppm	Selenium ppm	Alkalinity PE meq/L
105S08168	Mine Waste Rock Sample 2005	5.27	0.04	7.47

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
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Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By: Joey Sheeley
Joey Sheeley, Soils Lab Supervisor

Inter-Mountain Laboratories, Inc.

1633 Terra Avenue
Sheridan, WY 82801

Report ID: 010514664

Soil Analysis Report

Canyon Fuel, LLC

Sufco Mine -Canyon Fuel
397 S. 800 W.
Salina, UT 84654

Client Project ID: Mine Waste Rock
Date Received: 12/23/05

Set #0105S14664
Report Date: 01/10/06

Lab Id	Sample Id	pH s.u.	Saturation %	EC @ 25°C dS/m	Calcium meq/L	Magnesium meq/L	Sodium meq/L	SAR	Total Sulfur %	T.S. AB t/1000t	Neutral. Pot. t/1000t	T.S. ABP t/1000t
0105S14664	SU08NS-001 4th Qtr 05	6.9	41.5	7.99	40.3	23.6	40.2	7.11	0.39	12.2	129	116

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur. Neut. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By: Joey Sheeley
Joey Sheeley, Soils Lab Supervisor

Inter-Mountain Laboratories, Inc.

1633 Terra Avenue
Sheridan, WY 82801

Report ID: 010514664

Soil Analysis Report

Canyon Fuel, LLC

Sufco Mine -Canyon Fuel
397 S. 800 W.
Salina, UT 84654

Client Project ID: Mine Waste Rock
Date Received: 12/23/05

Set #0105S14664
Report Date: 01/10/06

Lab Id	Sample Id	Boron ppm	Selenium ppm	Alkalinity PE meq/L
0105S14664	SU08NS-001	7.16	0.02	1.45

These results only apply to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neut. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed By: Joey Sheeley
Joey Sheeley, Soils Lab Supervisor

Riparian Plant Communities
in the
East Fork of Box Canyon
- July 2005 -

A Vegetation Monitoring Study for the SUFCO Mine: July 2005

Prepared by

MT. NEBO SCIENTIFIC, INC.
330 East 400 South, Suite 6
Springville, Utah 84663
(801) 489-6937

Patrick D. Collins, Ph.D.

for

CANYON FUEL COMPANY, LLC.
397 South 800 West
Salina, Utah 84654

February 2006

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SCOPE

Quantitative and qualitative baseline vegetation data were recorded in several locations in the East Fork of Box Canyon in **July 2005.** Additionally, data were also recorded in several locations in the Main Fork of Box Canyon. These data sets may be used for controls to the study.

Coal mining activities were scheduled and conducted under the East Fork of Box Canyon during the winter of 2003-04. This document provides the *fourth* sample period of baseline data for the existing riparian plant communities in the two forks of Box Canyon. The *first* sample period was in the October 2003, prior to the mining activities below the East Fork (this final report was called *Riparian Plant Communities in the East Fork of Box Canyon - 2003*). The *second* sample period was in July 2004 after mining had occurred under the canyon (the final report was called *Riparian Plant Communities in the East Fork of Box Canyon: July 2004*). The *third* sample period was in October 2004 (the final report was called *Riparian Plant Communities in the East Fork of Box Canyon: October 2004*).

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 were 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 and followup information by monitoring the riparian communities in the East Fork of Box Canyon. Regular monitoring should provide data to determine long term trends, natural variability and benchmark information including the possible impacts on the riparian plant communities from mining beneath the creek.

Like the previous studies, this study primarily employed vegetation monitoring methods described by the USDA Forest Service for a "Level III Riparian Area Evaluation". The design of this study

will not provide data that could show subtle changes to community structure and species composition as a result of *minor* changes to the riparian habitat. Rather, the study was designed to be compared with earlier (and future) studies in an attempt to document *major* impacts to the plant communities along the stream due to catastrophic events, such as loss of water and habitat from the effects of subsidence caused from underground mining. (**Note**: On the data sheets in one of the aforementioned studies (the final report was called *Riparian Plant Communities in the East Fork of Box Canyon - 2003*, the report date was March 2004), a typographical error indicated that the data were recorded from October 6-10, 2004. The dates should have been October 6-10, 2003).

METHODS

Sample station locations were pre-determined from an earlier field visit in 2003 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 are 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

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:

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" on the previous 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 employed to those sample areas chosen by the 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 subsequent studies. Although data were recorded in 2003 and 2004 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 and 2004 studies 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 2003 and 2004 data sets were not designed specifically to be compared with the 1999 data – 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, 2004, and 2005 studies 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.

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-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 data sheets in this report. Each sheet shows all qualitative and quantitative data recorded as well as photographic documentation.

DISCUSSION & SUMMARY

Results from monitoring the riparian communities in July 2005 in the East Fork and Main Fork of Box Canyon have been included in this report. USDA Forest Service protocol and other methods were employed to monitor the riparian areas. These methods utilized the 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 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 study (1999) were also added to the sampling regime in October 2003, July 2004, October 2004, and July 2005. 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 studies so that comparisons could be made in the future. A method referred to as the *Green Line Method* for measuring the riparian communities was also employed at all sample locations. A summary of all qualitative and quantitative data taken at each sample location are shown in the RESULTS section of this report.

Upon scrutinizing the data sets for each sample period, **the Community Cover and Green Line Methods appear to be more conducive to noting changes in the riparian plant communities**. Although appropriate for other reasons (e.g. monitoring total living cover), it appears that the Total Cover Method may not have been as sensitive to note the changes in the riparian species.

Reports from previous sample periods suggested that many of the riparian communities in the East Fork of Box Canyon decreased, especially between October 2003 and July 2004. At other sample locations, little change was noticed. Other than the spring areas which will be discussed separately, the trend since that time was for the communities to stabilize and then begin to somewhat increase over time. Since no two sample areas appeared to have the exact same result over time, changes are best considered on a sample station-by-station basis. **Data will be plotted illustrating changes over time following the October 2005 sample period**.

In the spring areas, in all but one of the sample sites, there was a rather abrupt decrease in the riparian communities especially between October 2003 and July 2004. The trend for the spring areas was to increase after that, but not to the levels recorded in October 2003. One spring area (EFB-S1) maintained its riparian community in all but the last sample period where its community also decreased. Reasons for maintenance of it riparian species may be due to its location when compared to the other spring areas – it was located much lower on the hillside and much closer to the main channel. This spring appeared to retain more water than the upper elevation springs that nearly dried up completely sometime during the spring of 2004.

RIPARIAN COMPLEX DATA SHEET
July 2005

CLIENT: Canyon Fuel Company

COMPLEX: Number EFB-1

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 19 - July 23, 2005

OBSERVER(S): P.D. Collins[2]

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 resultsfor this information)	

SUCCESSIONAL STATUS: climax

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 1500 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)
Picea pungens	*Salix sp.*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides	*Potentilla fruticosa*	*Urtica dioica*	*Carex lanuginosa*
	Rosa woodsii		*Carex hoodii**
			Juncus longistylis
			Juncus arcticus
			Poa pratensis
			Stipa comata

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: 98

% bank length unvegetated, stable: 2

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY: 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 (60 ft; includes uplands).
3) Not much grazing by cattle this year.

DATA SUMMARIES

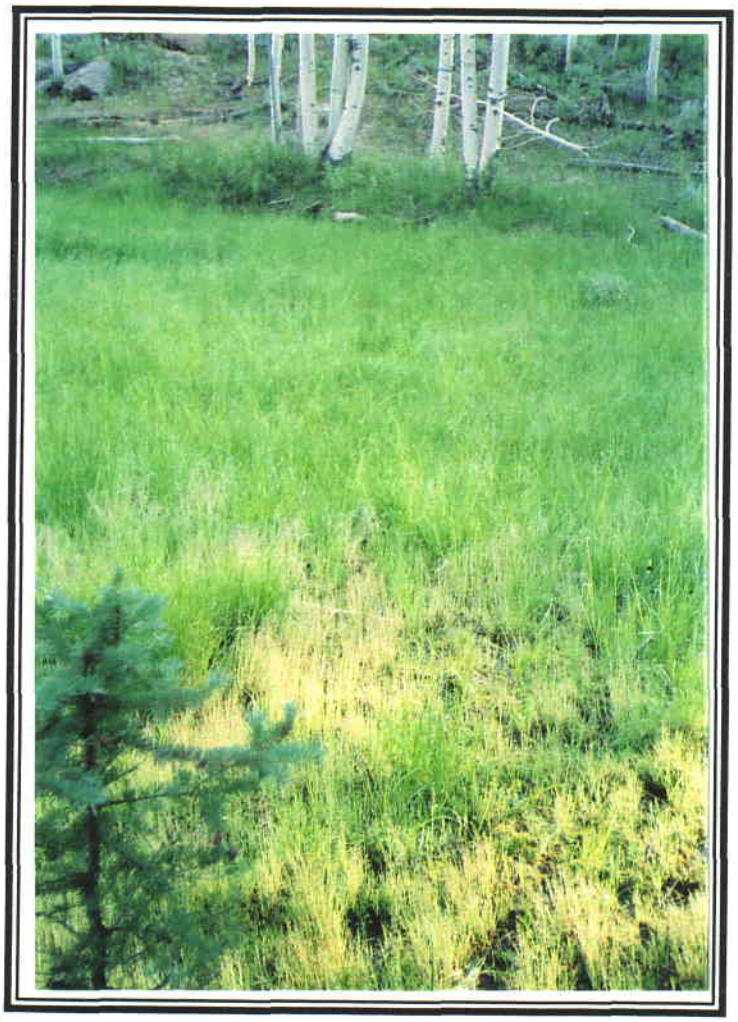
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-1		Left	25.5	*Carex hoodii/Agrostis stolonifera*
		Right	25.5	*Carex hoodii/Agrostis stolonifera*
		Channel	n/a	Wet

EFB-1: Cover using point quadrats (July 2005).

COVER BY SPECIES	**Percent**
TREES & SHRUBS	
FORBS	
Carex hoodii	60.00
GRASSES	
Agrostis stolonifera	15.00
TOTAL COVER	
LIVING COVER (vascular)	75.00
WATER	0.00
MOSS	5.00
LITTER	20.00
B/G	0.00
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-1

RIPARIAN COMPLEX DATA SHEET
July 2005

CLIENT: Canyon Fuel Company

COMPLEX: Number EFB-2

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 19 - July 23, 2005

OBSERVER(S): P.D. Collins[2]

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

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, ATV, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Pinus ponderosa	*Artemisia tridentata*	*Erigeron divergens*	*Juncus arcticus*
Populus tremuloides	*Potentilla fruticosa*	*Lepidium latifolium*	*Carex hoodii*
	Chrysothamnus viscidiflorus	*Taraxacum officinale*	*Stipa comata*
		Equisetum arvense	*Poa pratensis*
		Potentilla sp.	
		Eriogonum sp.	
		Campanula parryi	
		Achillea millefolium	

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°): 80

% bank length with overhanging vegetation: 0

BANK CONDITION

% bank length vegetated, stable: 50

% bank length unvegetated, stable: 50

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY: 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 (48 ft; includes uplands).

3) Not much grazing by cattle this year. Because of heavy cattle grazing last year making identifications more difficult, we may have thought *Poa pratensis* was *Agrostis stolonifera* last year.

DATA SUMMARIES

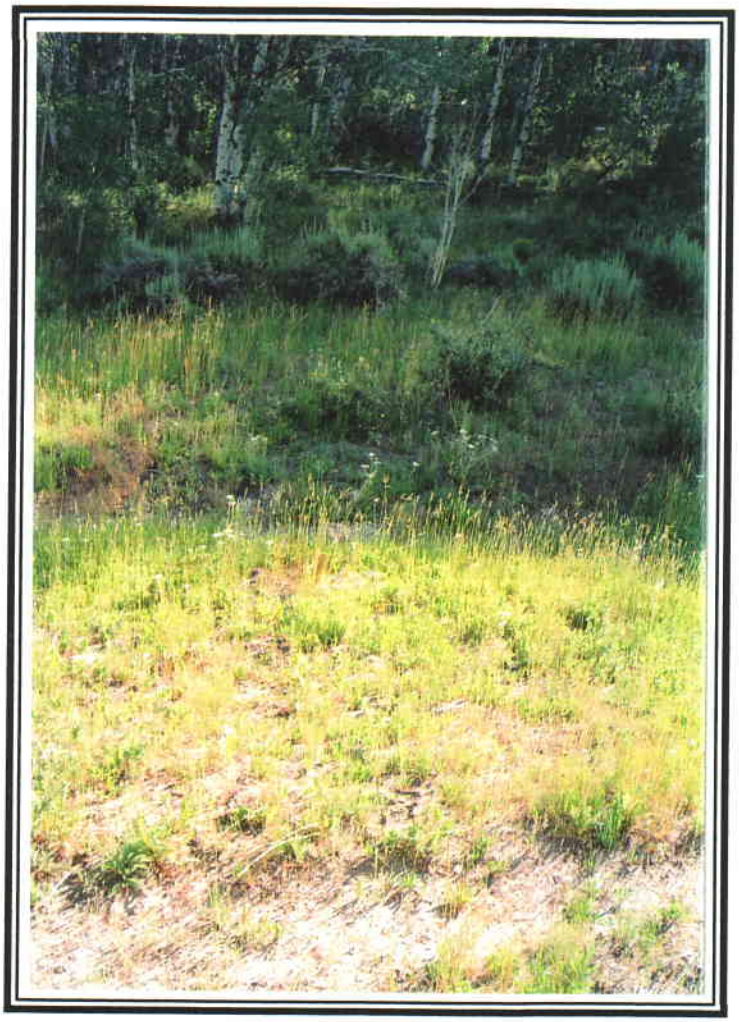
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-2		Left	2.0	*Equisetum arvense*
		Right	19.0	*Equisetum arvense/Juncus arcticus*
		Channel	2.0	Dry

EFB-2: Cover using point quadrats (July 2005).

COVER BY SPECIES	Percent
TREES & SHRUBS	
FORBS	
Potentilla sp.	6.25
Achillea millefolium	6.25
Taraxacum officinale	12.50
GRASSES	
Stipa comata	6.25
Poa pratensis	18.75
TOTAL COVER	
LIVING COVER (vascular)	50.00
WATER	0.00
MOSS	0.00
LITTER	18.75
B/G	31.25
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-2

RIPARIAN COMPLEX DATA SHEET
July 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-3

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 19 - July 23, 2005

OBSERVER(S): P.D. Collins[2]

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: 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)
Pinus ponderosa	*Artemisia tridentata*	*Equisetum arvense*	*Agrostis stolonifera*
Populus tremuloides		*Lupinus sp.*	*Carex lanuginosa*
		Taraxacum officinale	*Carex hoodii*
		Eriogonum sp.	*Juncus ensifolius*
			Juncus arcticus
			Eleocharis palustris
			Poa pratensis
			Poa fendleriana

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: 96
% bank length unvegetated, stable: 4
% 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 (48 ft; includes uplands).
2) Not much grazing by cattle this year.
3) Cattle trail in left side of riparian vegetation may influence green line measurements.

DATA SUMMARIES

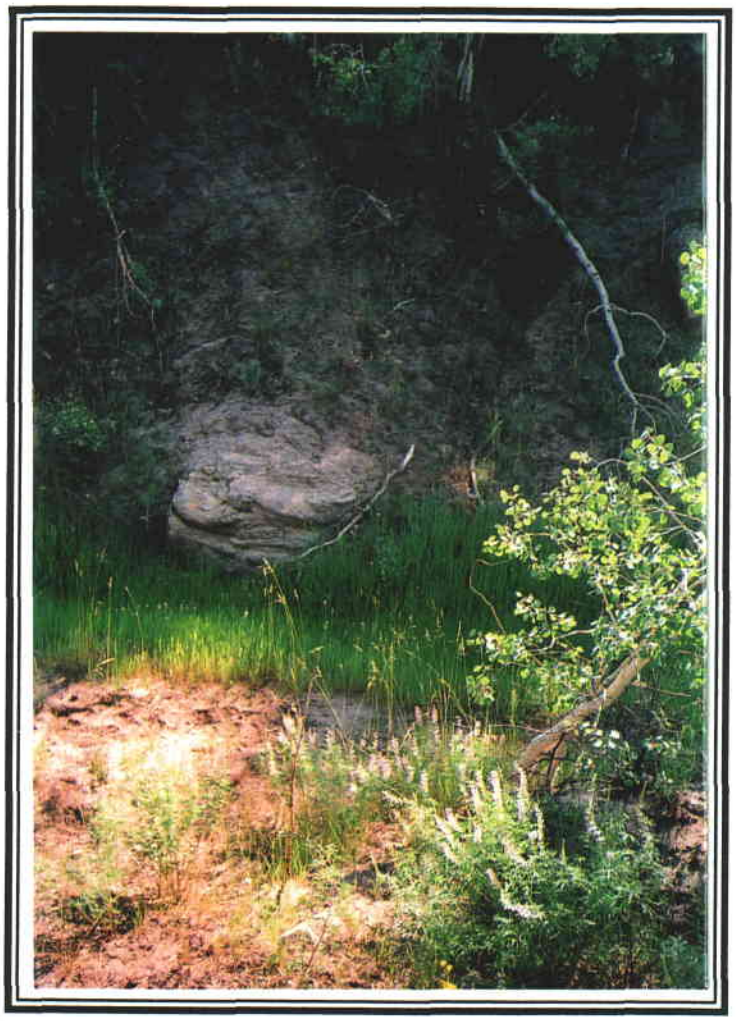
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-3		Left	5.0	*Agrostis stolonifera/Equisetum arvense/Carex lanuginosa*
		Right	2.0	*Agrostis stolonifera/Equisetum arvense/Carex lanuginosa*
		Channel	n/a	Dry

EFB-3: Cover using point quadrats (July 2005).

COVER BY SPECIES	Percent
TREES & SHRUBS	
FORBS	
Eriogonum sp.	18.75
Lupinus sp.	6.25
GRASSES	
Agrostis stolonifera	6.25
Equisetum arvense	12.50
TOTAL COVER	
LIVING COVER (vascular)	43.75
WATER	0.00
MOSS	0.00
LITTER	25.00
B/G	25.00
ROCK	6.25
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-3

RIPARIAN COMPLEX DATA SHEET
July 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-4

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 19 - July 23, 2005

OBSERVER(S): P.D. Collins[2]

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: 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)
Picea pungens	*Artemisia tridentata*	*Antennaria sp.*	*Agrostis stolonifera*
Populus tremuloides	*Chrysothamnus nauseosus*		*Carex lanuginosa*
Pinus ponderosa	*Potentilla fruticosa*		*Bromus carinatus*
	Rosa woodsii		*Juncus arcticus*
			Poa pratensis
			Juncus longistylis

POOL ATTRIBUTES

% area in pools: 0 (dry)
% 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°): 50
% bank length gently sloping (>135°): 5 (dry trail)
% bank length with overhanging vegetation: 20

BANK CONDITION

% bank length vegetated, stable: 40
% bank length unvegetated, stable: 25
% bank length vegetated, unstable: 10
% bank length unvegetated, unstable: 25

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 (48 ft; includes uplands).
2) Cattle trail has influenced green line on left side.
3) Side slopes on the right side have sloughed downward. Many young (green) aspen trees had fallen because of sloughing.

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	*Juncus arcticus/Juncus longistylis*
		Right	4.0	*Juncus arcticus*
		Channel	1.5	Dry

EFB-4: Cover using point quadrats (July 2005).

COVER BY SPECIES	Percent
TREES & SHRUBS	
Rosa woodsii	12.50
FORBS	
Antennaria sp.	6.25
GRASSES	
Juncus arcticus	12.50
Poa pratensis	31.25
TOTAL COVER	
LIVING COVER (vascular)	62.50
WATER	0.00
MOSS	0.00
LITTER	12.50
B/G	25.00
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION

EFB-4

RIPARIAN COMPLEX DATA SHEET
July 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-5

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 19 - July 23, 2005

OBSERVER(S): P.D. Collins[2]

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: 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)
Picea pungens	*Artemisia tridentata*	*Achillea millefolium*	*Agrostis stolonifera*
Populus tremuloides	*Potentilla fruticosa*	*Epilobium angustifolium*	*Poa fendleriana*
Pinus ponderosa	*Rosa woodsii*	*Potentilla sp.*	*Stipa hymenoides*
	Symphoricarpos oreophilus		*Juncus arcticus*
	Salix exigua		*Elymus salinus*

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 (but close to 135°)
% bank length with overhanging vegetation: 1%

BANK CONDITION

% bank length vegetated, stable: 35
% bank length unvegetated, stable: 65
% 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; 23.5 ft. transect on left side; 23.5 ft. transect on right side (47 ft; includes uplands).
3) No water in channel in this location.
4) Not much grazing by cattle this year.
5) There was a lot of sloughing of side slopes between EFB-4 and EFB-5. As a result of this, there were many 30-40 ft aspen trees falling over.

DATA SUMMARIES

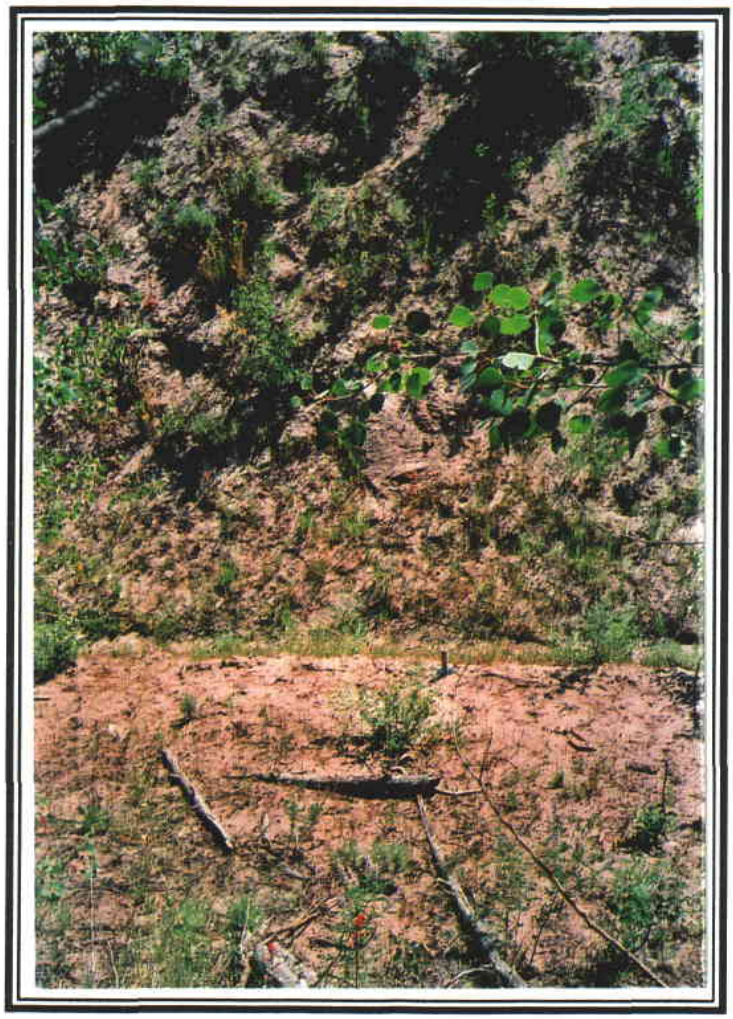
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-5		Left	3.0	*Juncus arcticus/Agrostis stolonifera*
		Right	3.0	*Juncus arcticus/Agrostis stolonifera*
		Channel	1.0	Dry

EFB-5: Cover using point quadrats (July 2005).

COVER BY SPECIES	Percent
TREES & SHRUBS	
FORBS	
GRASSES	
Poa pratensis	12.50
Elymus salinus	6.25
	0.00
TOTAL COVER	
LIVING COVER (vascular)	18.75
WATER	0.00
MOSS	0.00
LITTER	31.25
B/G	43.75
ROCK	6.25
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-5

RIPARIAN COMPLEX DATA SHEET
July 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-6

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 19 - July 23, 2005

OBSERVER(S): P.D. Collins[2]

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: 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)
Picea pungens	*Amelanchier utahensis*	*Taraxacum officinale*	*Agrostis stolonifera*
Populus tremuloides	*Potentilla fruticosa*	*Antennaria sp.*	*Bromus carinatus*
Pinus ponderosa	*Symphoricarpos oreophilus*	*Aster sp.*	*Juncus arcticus*
	Artemisia tridentata	*Swertia radiata*	*Poa fendleriana*
		Artemisia ludoviciana	
		Potentilla sp.	
		Achillea millefolium	
		Antennaria sp.	

POOL ATTRIBUTES

% area in pools: No water (mud)
% 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°): 40
% bank length gently sloping (>135°): (trail)
% bank length with overhanging vegetation: 15

BANK CONDITION

% bank length vegetated, stable: 30
% bank length unvegetated, stable: 35
% bank length vegetated, unstable: 5
% bank length unvegetated, unstable: 30

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 (48 ft; includes uplands).
3) Little or no grazing by cattle this year.

4) Cattle trail was on some of the riparian community and could affect results.
5) Like the previous sites, there was a lot of side-slope sloughing in this area.

DATA SUMMARIES

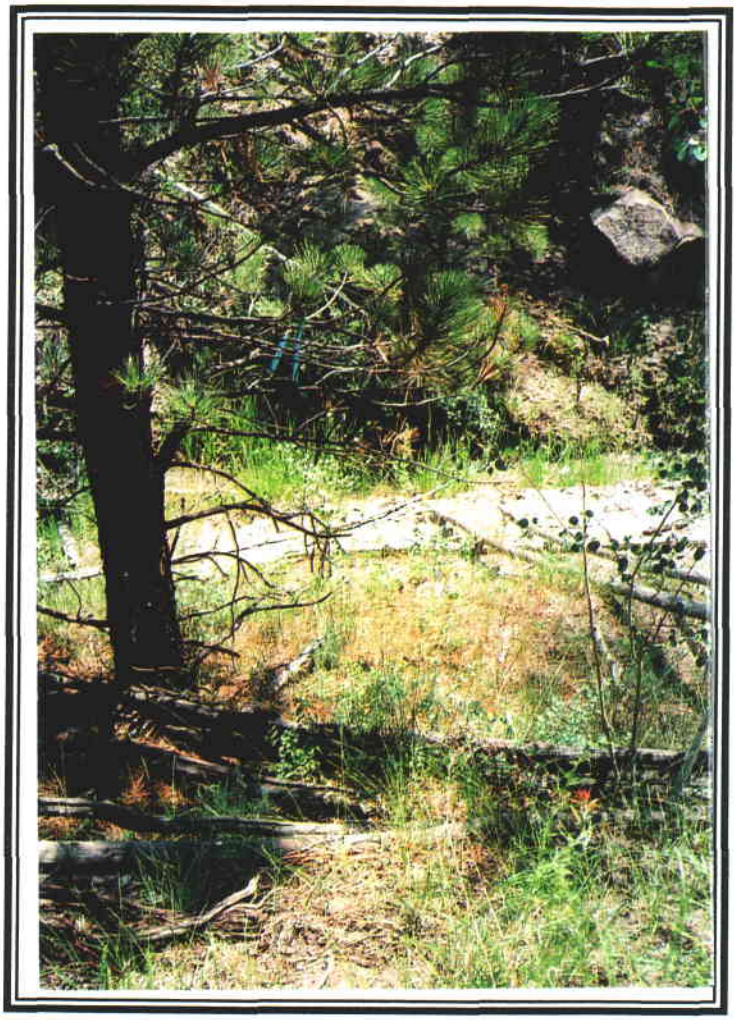
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-6		Left	3.0	*Agrostis stolonifera*
		Right	1.5	*Agrostis stolonifera*
		Channel	1.5	Mud

EFB-6: Cover using point quadrats (July 2005).

COVER BY SPECIES	Percent
TREES & SHRUBS	
Populus tremuloides	6.25
FORBS	
Potentilla sp.	6.25
Taraxacum officinale	6.25
Achillea millefolium	6.25
Antennaria sp.	6.25
GRASSES	
Agrostis stolonifera	6.25
Poa fendleriana	18.75
TOTAL COVER	
LIVING COVER (vascular)	56.25
WATER	0.00
MOSS	0.00
LITTER	18.75
B/G	25.00
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-6

RIPARIAN COMPLEX DATA SHEET
July 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-7

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 19 - July 23, 2005

OBSERVER(S): P.D. Collins[2]

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: 50 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)
Picea pungens	*Juniperus communis*	*Aster sp.*	*Agrostis stolonifera*
Populus tremuloides		*Artemisia drucunculus*	*Juncus longistylis*
			Poa fendleriana

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: 25

% bank length unvegetated, stable: 75

% 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 (48 ft; includes uplands).
3) Very unstable upper banks (above bankfull).
4) Little or no grazing by cattle this year.
5) Right side was sloughing off; lots of green aspen leaning and falling over in this area.

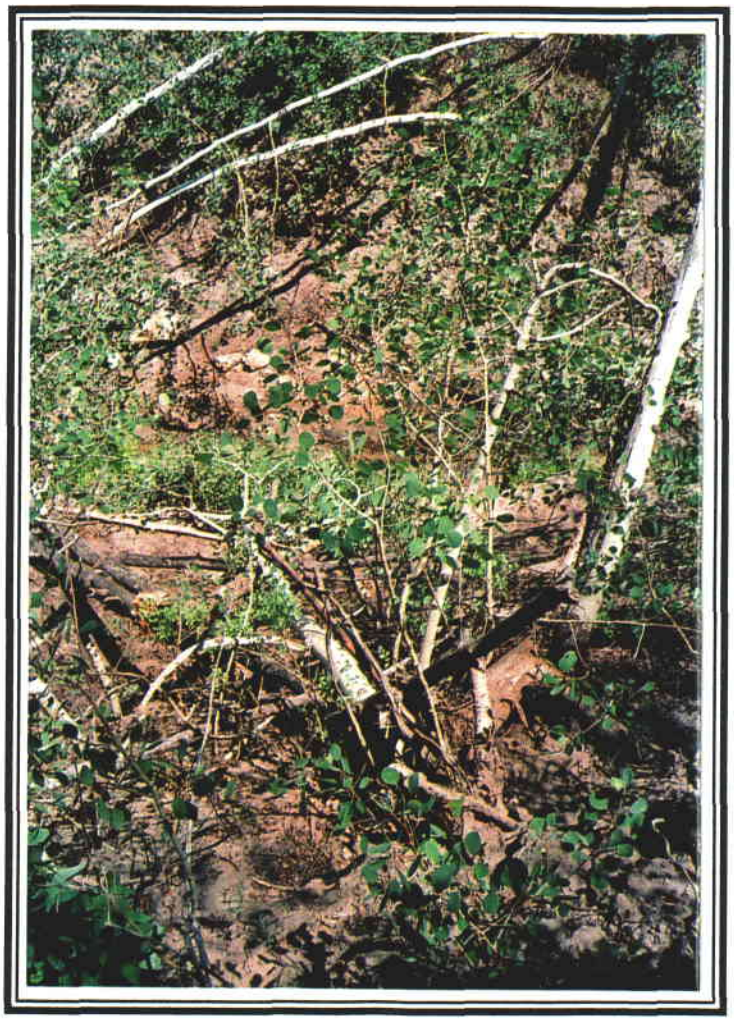
DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-7		Left	1.0	*Juncus longistylis*
		Right	0	bareground
		Channel	0.5	Water

EFB-7: Cover using point quadrats (July 2005).	
COVER BY SPECIES	**Percent**
TREES & SHRUBS	
Betula occidentalis	6.25
Populus tremuloides	6.25
FORBS	
Artemisia drucunculus	6.25
GRASSES	
TOTAL COVER	
LIVING COVER (vascular)	18.75
WATER	0.00
MOSS	0.00
LITTER	43.75
B/G	37.50
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-7

RIPARIAN COMPLEX DATA SHEET
July 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-8

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 19 - July 23, 2005

OBSERVER(S): P.D. Collins[2]

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: 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)
Picea pungens	*Symphoricarpos oreophilus*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides		*Achillea millefolium*	*Carex lanuginosa*
Pinus ponderosa		*Penstemon sp.*	*Juncus arcticus*
		Antennaria sp.	*Poa fendleriana*
		Equisetum arvensis	
		Potentilla sp.	
		Epilobium angustifolium	
		Geranium richardsonii	

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°): 25

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

% bank length with overhanging vegetation: 20

BANK CONDITION

% bank length vegetated, stable: 65

% bank length unvegetated, stable: 20

% bank length vegetated, unstable: 5

% 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 on a 55 ft transect.

3) There was a spring in this area near the stream. Right transect crossed the spring community too. I counted the "island" between the two as riparian.
4) The stream water width was about 1 ft. There was somewhat less than this in the spring, but still an appreciable amount.

DATA SUMMARIES

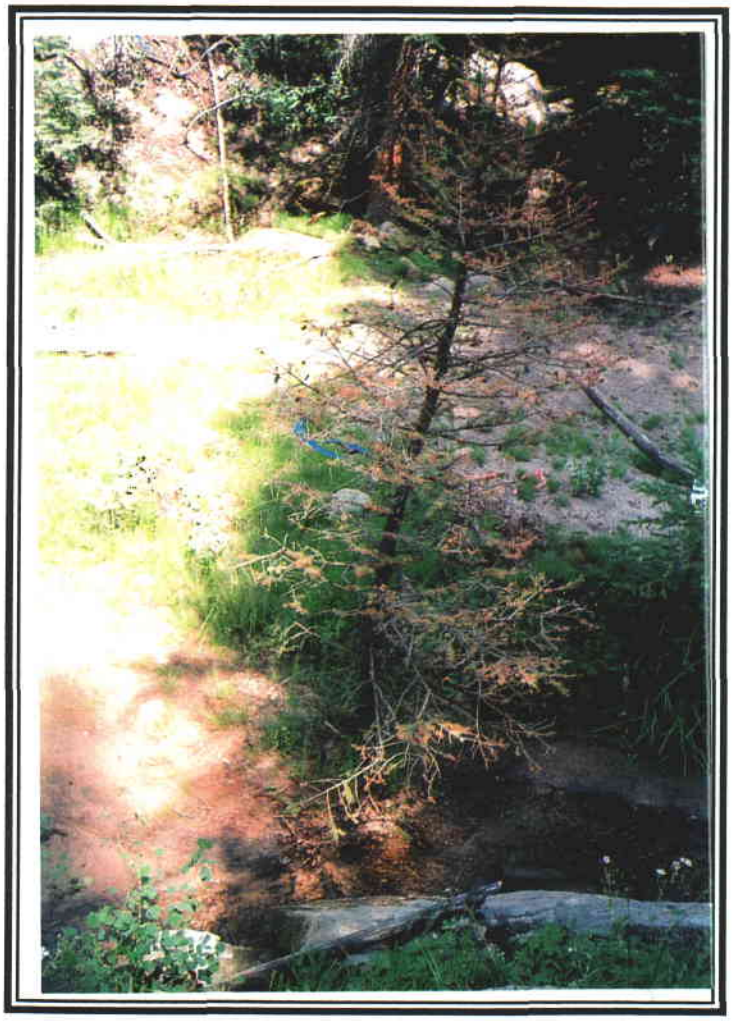
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-8		Left	1.0	*Agrostis stolonifera*
		Right	27.0	*Agrostis stolonifera* (includes spring area)
		Channel	1.5	Water (see note for measurements)

EFB-8: Cover using point quadrats (July 2005).

COVER BY SPECIES	Percent
TREES & SHRUBS	
FORBS	
Equisetum arvense	11.11
Geranium richardsonii	11.11
Achillea millefolium	5.56
Juncus arcticus	11.11
GRASSES	
Agrostis stolonifera	16.67
TOTAL COVER	
LIVING COVER (vascular)	55.56
WATER	0.00
MOSS	0.00
LITTER	33.33
B/G	5.56
ROCK	5.56
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-8

RIPARIAN COMPLEX DATA SHEET
July 2005

CLIENT: Canyon Fuel Company

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

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 19 - July 23, 2005

OBSERVER(S): P.D. Collins[2]

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)
Picea pungens	*Rosa woodsii*	*Equisetum arvensis*	*Agrostis stolonifera*
Populus tremuloides	*Symphoricarpos oreophilus*	*Ranunculus cymbalaria*	
Salix amygdaloides			

POOL ATTRIBUTES

% area in pools: 10

% 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°): 10

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

% bank length with overhanging vegetation: 30

BANK CONDITION

% bank length vegetated, stable: 35

% bank length unvegetated, stable: 60

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 5

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 for 38 ft.(see below). 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.

4) For point quadrats we had different transect lengths: Oct 03 (50 ft), July 04 (50 ft), Oct 04 (32 ft or 38 ft), July 05 (38 ft). This is probably because there were two transects marked in the field because we also utilized transects from our 1999 study which were different than the one's marked by the team for the more recent studies.

5) Green aspen fallen near photo point.

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	4.5	*Equisetum arvense*
		Right	3.5	*Equisetum arvense*
		Channel	2.5	Water

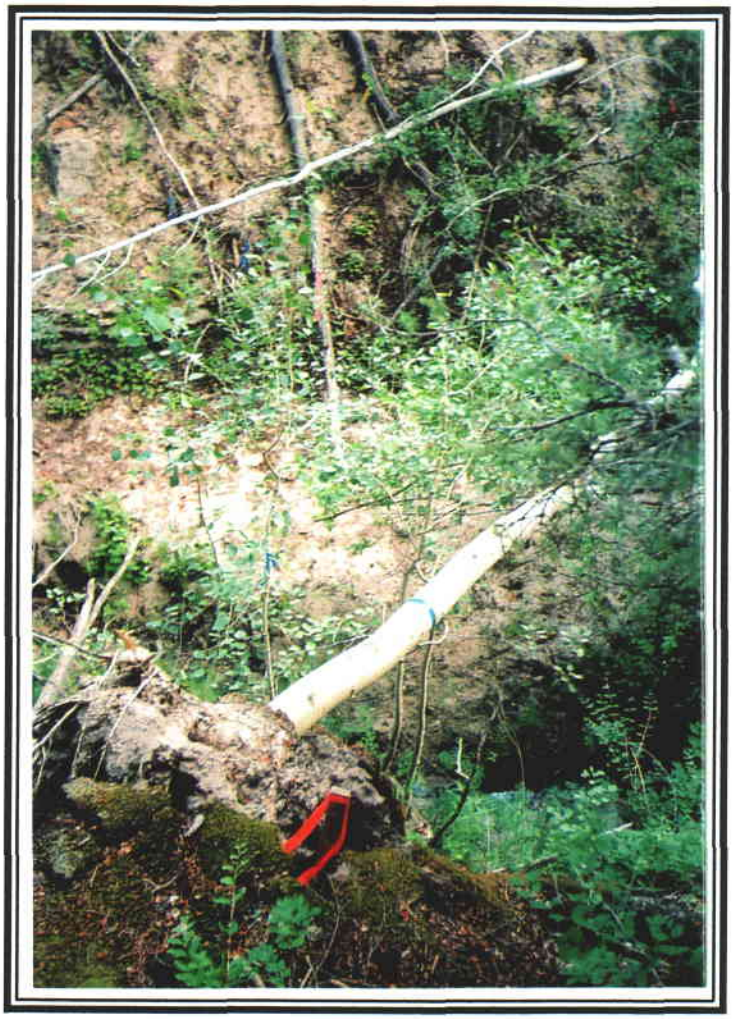
RE-10 (EFB-9): Cover using point quadrats (July 2005).

COVER BY SPECIES	Percent
TREES & SHRUBS	
Populus tremuloides	7.69
FORBS	
Equisetum arvense	15.38
GRASSES	
TOTAL COVER	
LIVING COVER (vascular)	23.08
WATER	7.69
MOSS	7.69
LITTER	15.38
B/G	46.15
ROCK	0.00
TOTAL	100.00

EFB-09 (RE-10): Cover by community types in Box Canyons (July 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Populus tremuloides/Picea pungens	16.00
Populus tremuloides/Rosa woodsii	12.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Equisetum arvensis	8.00
TOTAL COVER (Upland Species)	28.00
TOTAL COVER (Riparian Species)	8.00
BAREGROUND	0.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	2.00
TOTAL COVER	38.00

PHOTOGRAPHIC DOCUMENTATION



EFB-9 (RE-10)

RIPARIAN COMPLEX DATA SHEET
July 2005

CLIENT: Canyon Fuel Company

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

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 19 - July 23, 2005

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Blackkhawk

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: 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)
Picea pungens	*Salix sp.*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides	*Rosa woodsii*	*Geranium richardsonii*	
Betula occidentalis		*Equisetum arvense*	
Salix sp.		*Epilobium angustifolium*	

POOL ATTRIBUTES

% area in pools: 10
% 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°): 10
% bank length gently sloping (>135°): 50
% bank length with overhanging vegetation: 30

BANK CONDITION

% bank length vegetated, stable: 35
% bank length unvegetated, stable: 60
% 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 on a 28 ft transect. Even though there were two transect lines (28 ft and 36 ft), *but I think we've been consistent using the 28 ft line.* The reason for the two is because there was an early study done before the team studies (1999). Transect lines were staked in the field for both studies.

In addition, the USDA Forest Service Protocol for Level III was employed by the plant communities using the line intercept method (used 28 ft line here too; *may not have been consistent* with other years, but riparian (green line) would not been affected).

3) Left hillside suggests (by presence of horsetail) that there is probably a lot of soil moisture in the spring and early summer. No water in hillside observed

4) Waterfall is above this station.

5) Photo taken from left side.

6) There was lots of bareground that I counted in the upland community.

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	8.0	*Agrostis stolonifera/Ranunculus cymbalaria*
		Right	1.5	*Geranium richardsonii/Equisetum arvense*
		Channel	2.0	Water

RE-9 (EFB-10): Cover using point quadrats (July 2005).

COVER BY SPECIES	Percent
TREES & SHRUBS	
FORBS	
Geranium richardsonii	11.11
Equisetum arvense	22.22
GRASSES	
Agrostis stolonifera	11.11
TOTAL COVER	
LIVING COVER (vascular)	44.44
WATER	11.11
MOSS	0.00
LITTER	11.11
B/G	33.33
ROCK	0.00
TOTAL	100.00

EFB-10 (RE-09): Cover by community types in Box Canyons (July 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Picea pungens	6.00
Populus tremuloides/Picea pungens	9.50
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Ranunculus cymbalaria	5.00
Geranium richardsonii/Equisetum arvense	4.50
TOTAL COVER (Upland Species)	15.50
TOTAL COVER (Riparian Species)	9.50
BAREGROUND	1.50
ROCK	0.00
WATER/MUD/DRY CHANNEL	2.00
TOTAL COVER	28.50

PHOTOGRAPHIC DOCUMENTATION

EFB-10 (RE-09)

RIPARIAN COMPLEX DATA SHEET
July 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-11

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 19 - July 23, 2005

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: 300 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)
Picea pungens	*Pachystima myrsinites*	*Cirsium sp.*	*Agrostis stolonifera*
Populus tremuloides	*Symphoricarpos oreophilus*	*Geranium richardsonii*	*Juncus longistylis*
Salix sp.		*Equisetum arvense*	*Poa fendleriana*
Cornus sericea			
Betula occidentalis			

POOL ATTRIBUTES

% area in pools: 10

% 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°): 10

% bank length with overhanging vegetation: 35-40

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 site is just below the confluence of a spring (EFB-S1) and below a 2-3' waterfall.
2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals on a 45 ft transect line.
3) Almost no grazing by cattle this year.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-11		Left	3.5	*Equisetum arvense*
		Right	6.0	*Equisetum arvense/Geranium richardsonii*
		Channel	3.0	Water

EFB-11: Cover using point quadrats (July 2005).

COVER BY SPECIES	Percent
TREES & SHRUBS	
Symphoricarpos oreophilus	6.67
FORBS	
Equisetum arvense	6.67
Geranium richardsonii	6.67
GRASSES	
Agrostis stolonifera	6.67
TOTAL COVER	
LIVING COVER (vascular)	26.67
WATER	6.67
MOSS	0.00
LITTER	26.67
B/G	20.00
ROCK	20.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION

EFB-11

RIPARIAN COMPLEX DATA SHEET
July 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-S1

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 19 - July 23, 2005

OBSERVER(S): P.D. Collins[2]

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: Unstable

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)
Picea pungens	*Salix sp.*	*Equisetum arvense*	*Agrostis stolonifera*
Populus tremuloides	*Symphoricarpos oreophilus*	*Ranunculus cymbalaria*	*Carex lanuginosa*
		Aster sp.	*Elymus trachycaulus*
		Geranium richardsonii	*Juncus arcticus*
			Juncus longistylis

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: 80

% bank length unvegetated, stable: 15

% 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) 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.

3) Stakes were gone. We created a 37 ft transect line. This shouldn't make a difference because we are monitoring more for green (riparian) areas for these methods.
4) Like last sample period, there was not water cascading off rocks, but there was some surface water maintaining the riparian species at the station location.

DATA SUMMARIES

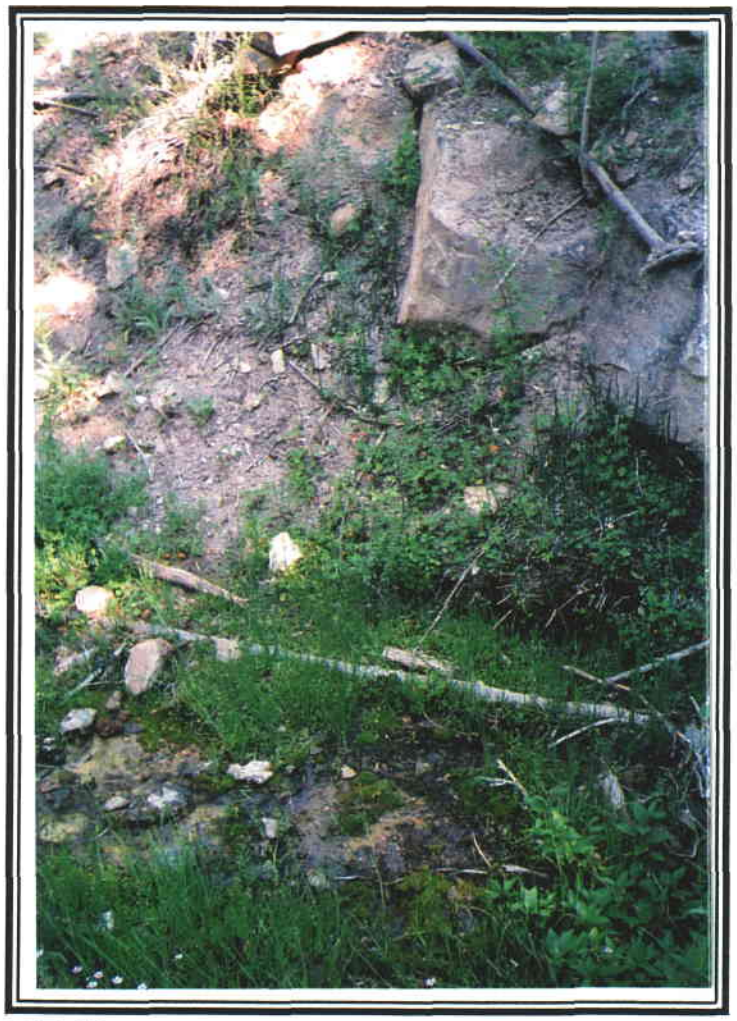
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-S1		Left	5.0	*Ranunculus cymbalaria/Geranium richardsonii*
		Right	8.0	*Equisetum arvense/Juncus longistylis*
		Channel	4.0	Water & Moss

EFB-S1: Cover by community types in Box Canyons (July 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Aster/Bareground	10.00
Elymus trachycaulus	10.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Geranium richardsonii/Eqisetum arvense	6.00
Juncus arcticus/Ranunculus cymbalaria	7.00
TOTAL COVER (Upland Species)	20.00
TOTAL COVER (Riparian Species)	13.00
BAREGROUND	0.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	4.00
TOTAL COVER	37.00

PHOTOGRAPHIC DOCUMENTATION



EFB-S1

RIPARIAN COMPLEX DATA SHEET
July 2005

CLIENT: Canyon Fuel Company

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

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 19 - July 23, 2005

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: Picea pungens Right: Picea pungens

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: changing

APPARENT FORAGE TREND: unstable

ESTIMATED FORAGE PRODUCTION: 50 lbs./ac (Oct 2004 estimate likely inaccurate).

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)
Picea pungens	*Juniperus communis*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides		*Equisetum arvense*	*Carex lanuginosa*
Lonicera involucrata		*Geranium richardsonii*	*Juncus longistylis*
Betula occidentalis			

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: 15

% bank length unvegetated, stable: 75

% bank length vegetated, unstable: 0

% 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) This was an area that includes 2 springs near each other. Previous data (Oct. 2003) was taken at the head of the springs; water diffused downslope over a broad area in which data collection would have been difficult and possibly ambiguous.
2) The area was dry this sample period (July 2005) due to a large sandstone cliff failure and rockslide over the entire spring area. A few riparian species remained, but not many. It's

basically an upland-looking community at this time.
3) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. I found both end stakes or the previous transect line. Green Line: Also measured on transects.
4) The cover measurement were taken where the old transect was.
5) Some seeps may be beginning to form again below the sample area because riparian species such as *Carex lanuginosa* and other species were beginning to show up.

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	5.0	*Agrostis stolonifera/Equisetum arvense*
		Right	11.0	*Agrostis stolonifera/Equisetum arvense*
		Channel	n/a	

EFB-S2 (EFB-12): Cover by community types in Box Canyons (July 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Populus tremuloides	43.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Equisetum arvensis	16.00
TOTAL COVER (Upland Species)	43.00
TOTAL COVER (Riparian Species)	16.00
BAREGROUND	0.00
ROCK	20.00
WATER/MUD/DRY CHANNEL	0.00
TOTAL COVER	79.00

PHOTOGRAPHIC DOCUMENTATION

EFB-S2 (EFB-12)

RIPARIAN COMPLEX DATA SHEET
July 2005

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: July 19 - July 23, 2005

OBSERVER(S): P.D. Collins[2]

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: changing

APPARENT FORAGE TREND: unstable

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)
Picea pungens	*Symphoricarpos oreophilus*	*Equisetum arvense*	*Agrostis stolonifera*
Populus tremuloides	*Juniperus communis*	*Geranium richardsonii*	*Elymus trachycaulus*
Pinus ponderosa	*Rosa woodsii*		
Salix amygdaloides			

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: 10
% bank length unvegetated, stable: 90
% 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. Green Line: Also measured on these transects.

2) I found the found stakes. I measured the north end and south end separately, then later combined.
3) This spring is still dry the sample period (July 2005).
4) The spring channel is about 11 ft wide; this is probably the approx width of earlier measurements (before spring went dry). I recorded some Redtop and horsetail species. It's arbitrary and may be closer to last sample period. Or, perhaps is should all be considered "upland".
5) Living cover was ~ 20%.
6) There may be a little more riparian species in the spring channel when compared to last sample period.
7) There was another spring south of this area that I once called S-3 (so). It had about the same conditions - dry. Measure 31 ft (right 10 ft; old spring area 13 ft; left 8 ft).
8) See photo for conditions.

DATA SUMMARIES

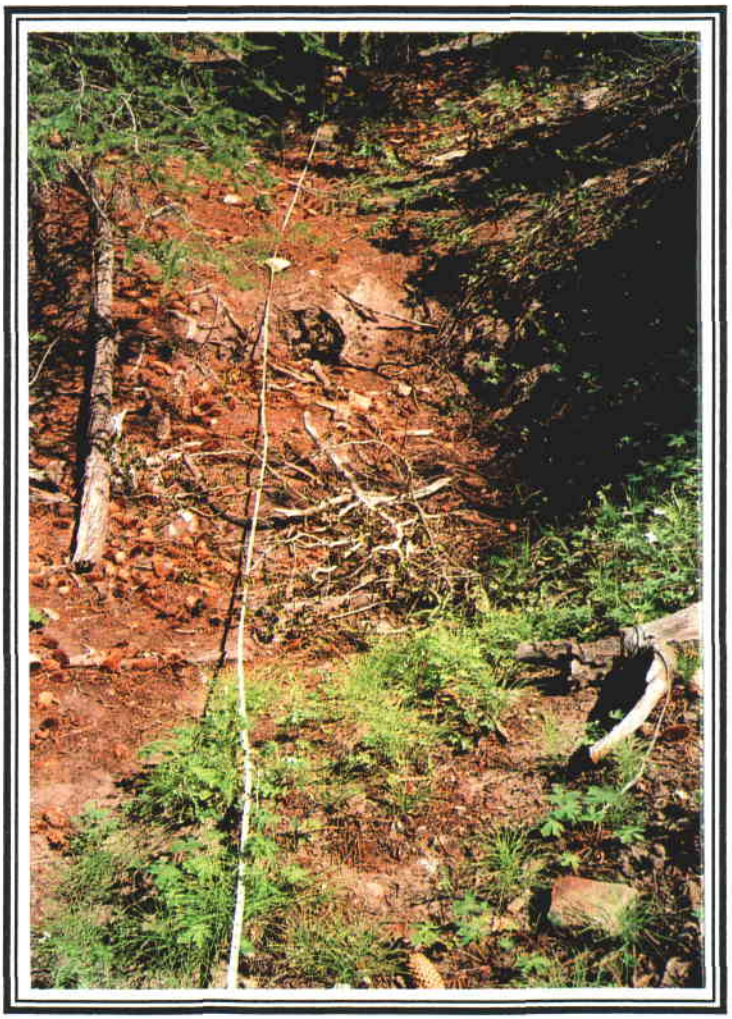
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-S3	EFB-13	North	11.0	*Agrostis stolonifera/Equisetum arvense*
		South		
		Channel	n/a	

EFB-S3 (EFB-13): Cover by community types in Box Canyons (July 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Populus tremuloides/Picea pungens	50.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Equisetum arvensis	11.00
TOTAL COVER (Upland Species)	50.00
TOTAL COVER (Riparian Species)	11.00
BAREGROUND	0.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	0.00
TOTAL COVER	61.00

PHOTOGRAPHIC DOCUMENTATION



EFB-S3 (EFB-13)

RIPARIAN COMPLEX DATA SHEET
July 2005

CLIENT: Canyon Fuel Company

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

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 19 - July 23, 2005

OBSERVER(S): P.D. Collins[2]

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: unstable

APPARENT FORAGE TREND: unstable

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)
Picea pungens	*Symphoricarpos oreophilus*	*Geranium richardsonii*	
Populus tremuloides	*Potentilla fruticosa*	*Equisetum arvense*	
Salix amygdaloides	*Rosa woodsii*		
	Pachistima myrsinites		

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: 45
% bank length unvegetated, stable: 35
% bank length vegetated, unstable: 0
% bank length unvegetated, unstable: 25

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. There was a seep here on the first sample period (Oct 2003). It has been dry after that and still is.
2) Hillside has *Equisetum arvense.*

2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. Green Line: Also measured on these transects.

DATA SUMMARIES

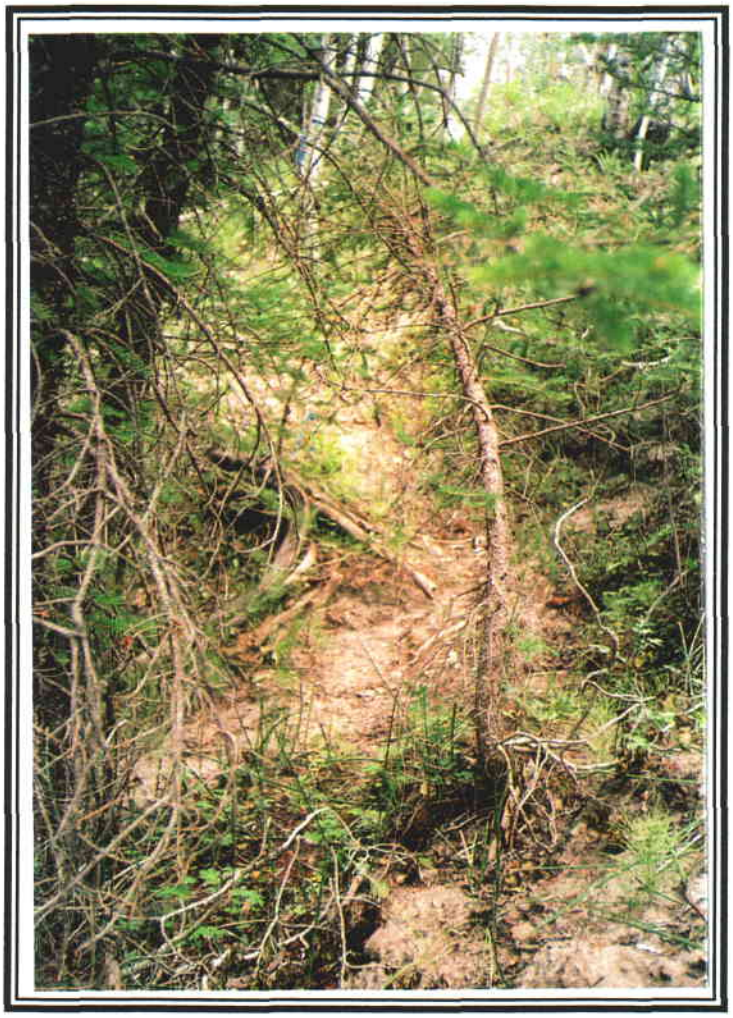
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-S4	EFB-14	Left	12.5	*Equisetum arvense*
		Right	12.5	*Equisetum arvense*
		Channel	25.0	(see notes)

EFB-S4 (EFB-14): Cover by community types in Box Canyons (July 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Equisetum arvensis	25.00
TOTAL COVER (Upland Species)	0.00
TOTAL COVER (Riparian Species)	25.00
BAREGROUND	0.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	0.00
TOTAL COVER	25.00

PHOTOGRAPHIC DOCUMENTATION



EFB-S4 (EFB-14)

RIPARIAN COMPLEX DATA SHEET
July 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number RE-11

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 19 - July 23, 2005

OBSERVER(S): P.D. Collins[2]

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: 50lbs./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)
Picea pungens	*Rosa woodsii*	*Equisetum arvense*	*Agrostis stolonifera*
Populus tremuloides			

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°): 30

% bank length gently sloping (>135°): 30

% bank length with overhanging vegetation: 35

BANK CONDITION

% bank length vegetated, stable: 20

% bank length unvegetated, stable: 60

% bank length vegetated, unstable: 10

% bank length unvegetated, unstable: 10

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 noted as unstable in Fall 2003. The Spring 2004 sample period revealed that a large spruce tree had fallen directly in the sample area. The upland areas were unstable and movement of sample markers was observed. There were no riparian species in the transect area due to fallen tree and extensive cattle disturbance in Spring and Fall 2004. In July 2005, right side had *Equisetum arvense* from hillside water.

2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. Green Line: Also measured on these transects.

DATA SUMMARIES

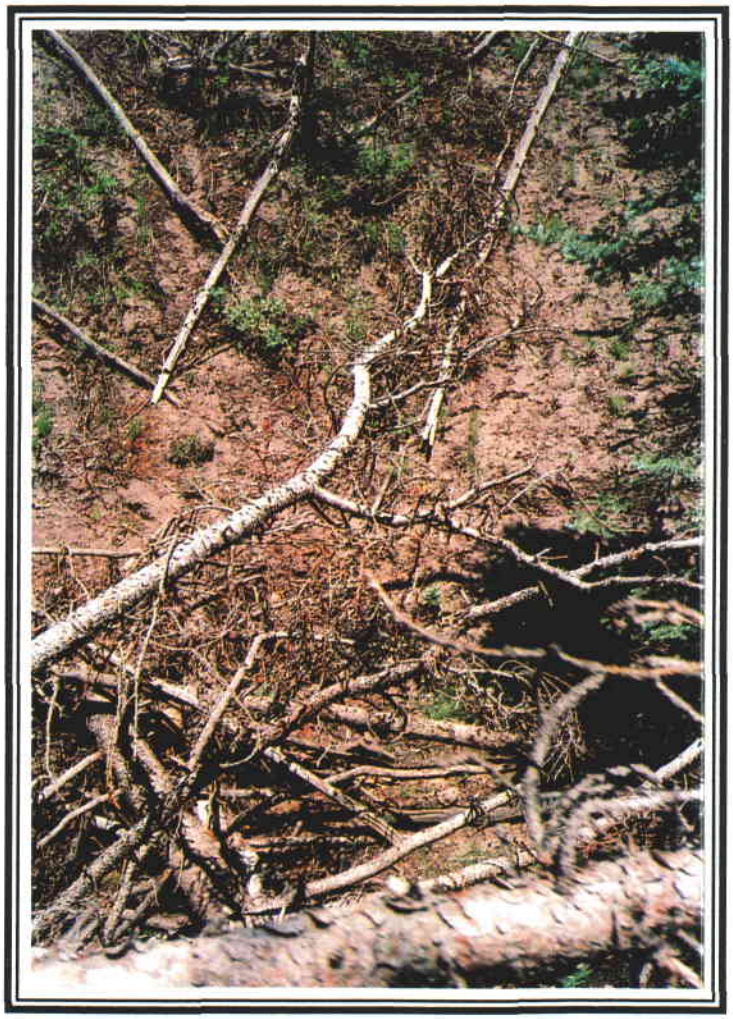
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
RE-11		Left	1.5	*Equisetum arvense*
		Right	3.0	*Equisetum arvense*
		Channel	2.5	Water

RE-11: Cover by community types in Box Canyons (July 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Populus tremuloides/Rosa woodsii	23.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Equisetum arvensis	4.50
TOTAL COVER (Upland Species)	23.00
TOTAL COVER (Riparian Species)	4.50
BAREGROUND	0.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	2.50
TOTAL COVER	30.00

PHOTOGRAPHIC DOCUMENTATION



RE-11

RIPARIAN COMPLEX DATA SHEET
July 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number RE-12

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 19 - July 23, 2005

OBSERVER(S): P.D. Collins[2]

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: 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)
Populus tremuloides	*Salix sp.*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
	Artemisia tridentata	*Taraxacum officinale*	*Carex lanuginosa*
	Rosa woodsii	*Eriogonum sp.*	*Juncus longistylis.*
		Equisetum arvense	*Juncus arcticus*
			Poa secunda

POOL ATTRIBUTES

% area in pools: 10

% 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: 5

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 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 MethodsU sed USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method.
2) The area looked more stable and better than the site upstream.
3) Photo taken from left side.
4) There were lots of trees fallen down upstream.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
RE-12		Left	6.5	*Agrostis stoloniferaJuncus longistylis*
		Right	2.0	*Juncus longistylis*
		Channel	2.5	Water

RE-12: Cover by community types in Box Canyons (July 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Artemisia tridentata/Elymus trachycaulus	8.00
Populus tremuloides/Rosa woodsii	10.50
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera	4.00
Juncus longistylis	4.50
TOTAL COVER (Upland Species)	18.50
TOTAL COVER (Riparian Species)	8.50
BAREGROUND	0.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	2.50
TOTAL COVER	29.50

PHOTOGRAPHIC DOCUMENTATION

RE-12

RIPARIAN COMPLEX DATA SHEET
July 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number RE-13

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 19 - July 23, 2005

OBSERVER(S): P.D. Collins[2]

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: 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)
Picea pungens	*Artemisia tridentata*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides	*Potentilla fruticosa*	*Equisetum arvense*	*Carex lanuginosa*
Pinus ponderosa	*Symphoricarpos oreophilus*	*Artemisia dracunculus*	*Festuca ovina*
		Erigeron divergens.	*Juncus arcticus*
		Achillea millefolium	*Elymus trachycaulus*
		Lupinus sp.	
		Sedum sp.	

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: 10

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) 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.
3) Site was dry (mud).

DATA SUMMARIES

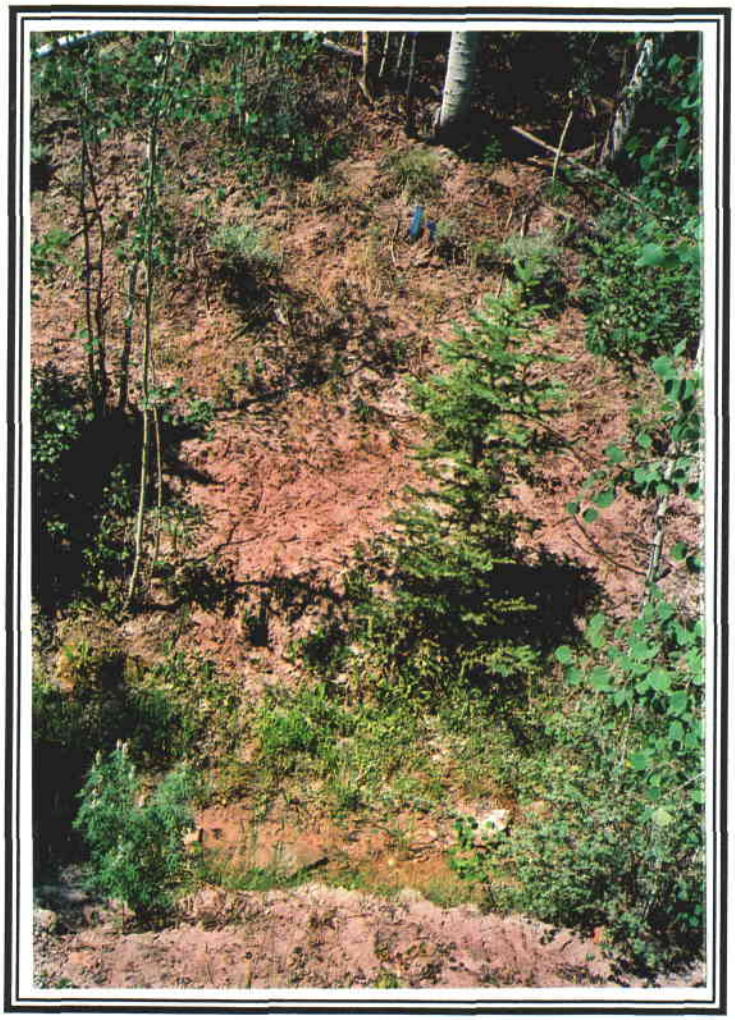
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
RE-13		Left	3.5	*Juncus arcticus/Ranunculus cymbalaria*
		Right	1.5	*Agrostis stolonifera/Ranunculus cymbalaria*
		Channel	1.5	Dry

RE-13: Cover by community types in Box Canyons (July 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Artemisia tridentata/Elymus trachycaulus	9.00
Populus tremuloides	11.50
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Ranunuculus cymbalaria	1.50
Juncus arcticus/Ranunculus cymbalaria	3.50
TOTAL COVER (Upland Species)	20.50
TOTAL COVER (Riparian Species)	5.00
BAREGROUND	0.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	1.50
TOTAL COVER	27.00

PHOTOGRAPHIC DOCUMENTATION



RE-13

RIPARIAN COMPLEX DATA SHEET
July 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-07

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 19 - July 23, 2005

OBSERVER(S): P.D. Collins[2]

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: 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)
Picea pungens	*Juniperus communis*	*Achillea millefolium*	*Agrostis stolonifera*
Populus tremuloides	*Potentilla fruticosa*	*Equisetum arvense*	*Carex lanuginosa*
Populus fremontii		*Urtica dioica*	*Juncus longistylis*
Betula occidentalis			*Bromus tectorum*
			Juncus arcticus

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: 30
% bank length unvegetated, stable: 30
% bank length vegetated, unstable: 10
% bank length unvegetated, unstable: 4

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.
3) *Equisetum arvense* was moving into upland on left side; right side was bare and *Bromus tectorum.*

DATA SUMMARIES

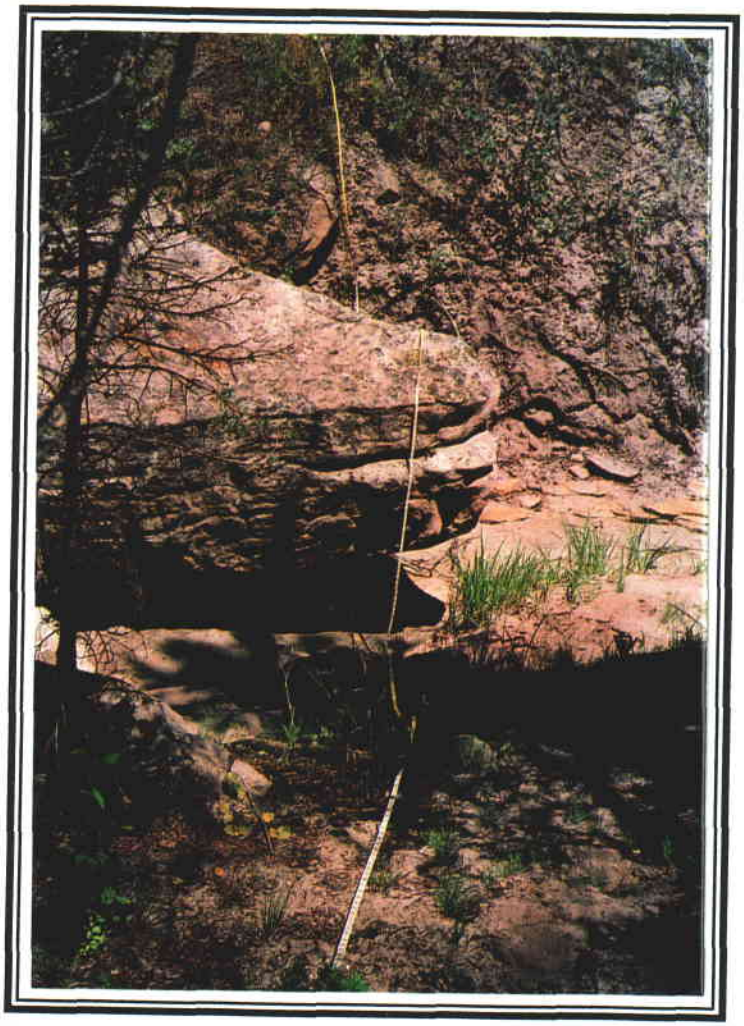
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-07		Left	7.0	*Juncus arcticus*
		Right	0.0	*Juncus arcticus*
		Channel	9.0	Rock

R-07: Cover by community types in Box Canyons (July 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Picea pungens	4.00
Populus tremuloides	4.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Equisetum arvensis	3.00
Juncus arcticus/Populus fremontii	4.00
TOTAL COVER (Upland Species)	8.00
TOTAL COVER (Riparian Species)	7.00
BAREGROUND	16.00
ROCK	9.00
WATER/MUD/DRY CHANNEL	0.00
TOTAL COVER	40.00

PHOTOGRAPHIC DOCUMENTATION



R-07

RIPARIAN COMPLEX DATA SHEET
July 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-09

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 19 - July 23, 2005

OBSERVER(S): P.D. Collins[2]

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

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: 700 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)
Picea pungens	*Salix lutea.*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides	*Rosa woodsii*	*Equisetum arvense*	*Juncus longistylis*
Juniperus scopulorum		*Urtica dioica*	*Juncus arcticus*
		Geranium richardsonii	

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°): 0

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

% bank length with overhanging vegetation: 45

BANK CONDITION

% bank length vegetated, stable: 100

% bank length unvegetated, stable: 0

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable (left side); moderately 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) Before 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). This was now *Equisetum arvense.*
4) The right side had hillside water influence. It was undercut from main water channel.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-09		Left	13.5	*Agrostis stolonifera/Equisetum arvense/Juncus arcticus*
		Right	11.0	*Rosa woodsii/Equisetum arvense/Agrostis stolonifera*
		Channel	2.0	Water 0.5/ Rock1.5

R-09: Cover by community types in Box Canyons (July 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Populus tremuloides	3.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera	2.50
Equisetum arvensis	2.00
Equisetum arvensis/Juncus arcticus	12.00
Equisetum arvensis/Rosa woodsii	8.00
TOTAL COVER (Upland Species)	3.00
TOTAL COVER (Riparian Species)	24.50
BAREGROUND	0.00
ROCK	1.50
WATER/MUD/DRY CHANNEL	0.50
TOTAL COVER	29.50

PHOTOGRAPHIC DOCUMENTATION

R-09

RIPARIAN COMPLEX DATA SHEET
July 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-11

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 19 - July 23, 2005

OBSERVER(S): P.D. Collins[2]

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: 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)
Picea pungens	*Rosa woodsii*	*Epilobium angustifolium*	*Agrostis stolonifera*
Populus tremuloides		*Equisetum arvense*	*Juncus longistylis*
		Ranunculus cymbalaria	*Juncus arcticus*
			Poa secunda

POOL ATTRIBUTES

% area in pools: 75

% 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°): 50

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

% bank length with overhanging vegetation: 10

BANK CONDITION

% bank length vegetated, stable: 45

% bank length unvegetated, stable: 25

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 30

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.
3) We could not find the right stake, so we measured from the aspen tree with flagging (see photo). This may account for difference from 28 ft to 31 ft during previous sample period).
4) Left side had Equisetum arvense encroaching on the upland community.

DATA SUMMARIES

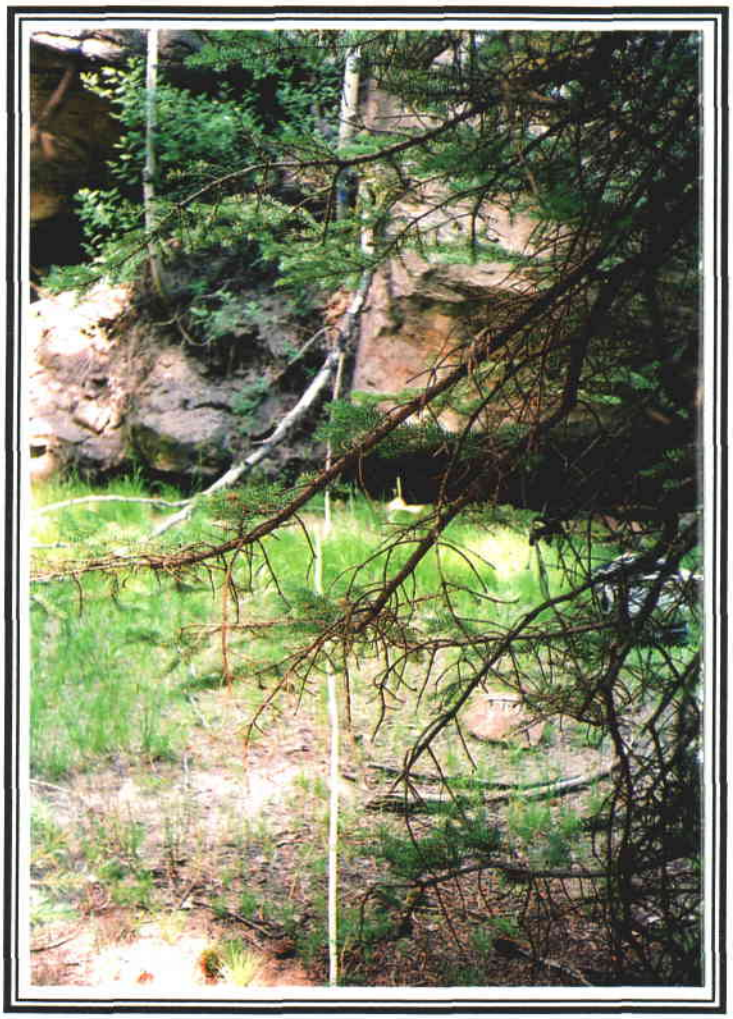
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-11		Left	12.0	*Equisetum arvense/Agrostis stolonifera/Juncus arcticus*
		Right	0	
		Channel	11.0	Water 1.0/Bare 4.0/ Mud 6.0

R-11: Cover by community types in Box Canyons (July 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Picea pungens/Poa secunda	5.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Equisetum arvensis	3.00
Equisetum arvensis/Juncus arcticus	9.00
-	-
TOTAL COVER (Upland Species)	5.00
TOTAL COVER (Riparian Species)	12.00
BAREGROUND	10.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	1.00
TOTAL COVER	28.00

PHOTOGRAPHIC DOCUMENTATION



R-11

RIPARIAN COMPLEX DATA SHEET
July 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-13

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 19 - July 23, 2005

OBSERVER(S): P.D. Collins[2]

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: 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)
Picea pungens	*Potentilla fruticosa*	*Equisetum arvense*	*Agrostis stolonifera*
Populus tremuloides	*Juniperus communis*	*Cirsium sp.*	*Carex lanuginosa*
Salix lutea		*Ranunculus cymbalaria*	*Juncus longistylis*
Salix sp.		*Achillea millefolium*	*Bromus carinatus*
			Elymus trachycaulus
			Poa secunda
			Juncus arcticuls

POOL ATTRIBUTES

% area in pools: dry

% 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: 40

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 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 Oct 2003 (45 ft.); July 2004, October 2004, July 2005 were consistent at 45 ft.

2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. Green Line: Also measured on these transects.

3) Photograph taken from the left side.

4) The upper banks were wetland and probably influenced by the stream water.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-13		Left	4.0	*Equisetum arvense/Juncus arcticus*
		Right	17.0	*Juncus longistylis/Equisetum arvense/Juncus arcticus*
		Channel	1.0	Bare/Mud

R-13: Cover by community types in Box Canyons (July 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Picea pungens	23.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera	2.00
Agrostis stolonifera/Equisetum arvensis	2.00
Equisetum arvensis/Juncus arcticus	4.00
Juncus longistylis/Equisetum arvense	3.00
Juncus arcticus/Poa secunda	10.00
TOTAL COVER (Upland Species)	23.00
TOTAL COVER (Riparian Species)	21.00
BAREGROUND	1.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	0.00
TOTAL COVER	45.00

PHOTOGRAPHIC DOCUMENTATION

R-13

RIPARIAN COMPLEX DATA SHEET
July 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-15

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: July 19 - July 23, 2005

OBSERVER(S): P.D. Collins[2]

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: 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)
Picea pungens	*Juniperus communis*	*Aster sp.*	*Agrostis stolonifera*
Populus tremuloides	*Symphoricarpos oreophilus*	*Equisetum arvense*	
Cornus stolonifera	*Salix lutea*	*Epilobium angustifolium*	

POOL ATTRIBUTES

% area in pools: 75

% 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°): 50

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

% bank length with overhanging vegetation: 20

BANK CONDITION

% bank length vegetated, stable: 40

% bank length unvegetated, stable: 30

% bank length vegetated, unstable: 10

% bank length unvegetated, unstable: 30

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) Left side had horsetail in the "upland" area, but it was high enough in elevation that we felt it was influenced by side-slope water.
2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. Green Line: Also measured on these transects.
3) Length of transect line in Oct. 2003 was less than 1999 due to movement; in July 2004. October 2004, and Spring 2005 it was the same as mentioned in October 2003.

4) Photo from 1999 was from a different place (stake number indicated I was in the correct location in Oct 2003, July 2004, July 2005).

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-15		Left	8.5	*Equisetum arvense*
		Right	0	
		Channel	2.0	Water 1.0; rock/mud 1.0

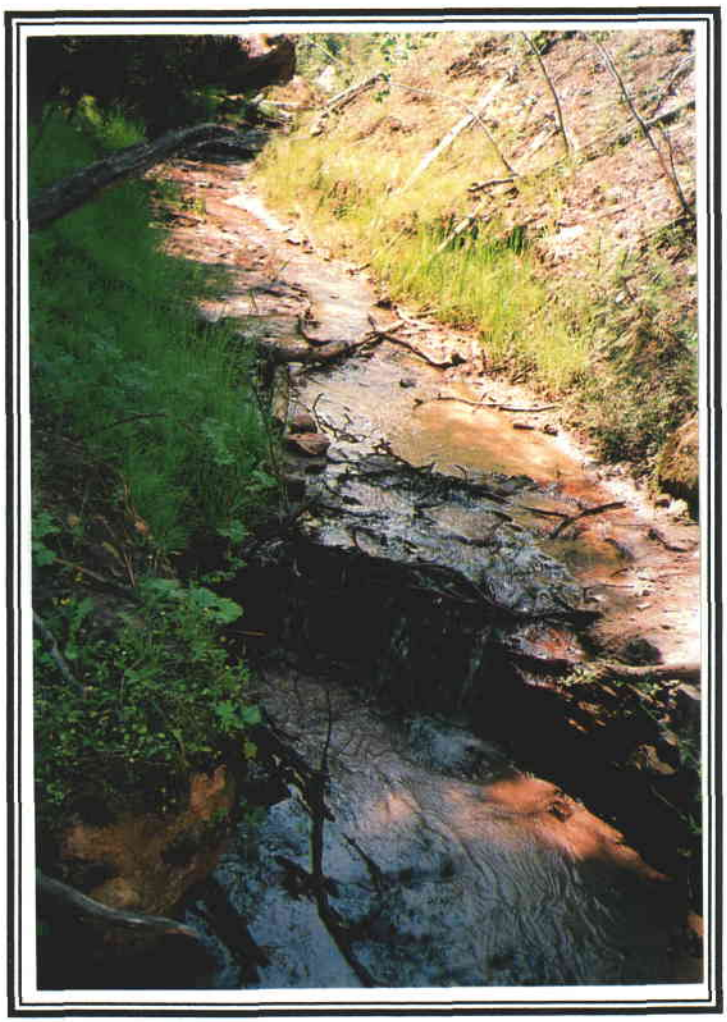
R-15: Cover by community types in Box Canyons (July 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Populus tremuloides/Picea pungens	11.50
Populus tremuloides/Rosa woodsii	
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Equisetum arvensis	8.50
TOTAL COVER (Upland Species)	11.50
TOTAL COVER (Riparian Species)	8.50
BAREGROUND	1.00
ROCK	4.00
WATER/MUD/DRY CHANNEL	1.00
TOTAL COVER	26.00

PHOTOGRAPHIC DOCUMENTATION

R-15

Riparian Plant Communities
in the
East Fork of Box Canyon
- October 2005 -



A Vegetation Monitoring Study for the SUFCO Mine: October 2005

Prepared by

MT. NEBO SCIENTIFIC, INC.
330 East 400 South, Suite 6
Springville, Utah 84663
(801) 489-6937

Patrick D. Collins, Ph.D.

for

CANYON FUEL COMPANY, LLC.
397 South 800 West
Salina, Utah 84654

March 2006

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SCOPE

Quantitative and qualitative baseline vegetation data were recorded in several locations in the East Fork of Box Canyon in **October 2005.** Additionally, data were also recorded in several locations in the Main Fork of Box Canyon. These data sets may be used for controls to the study.

Coal mining activities were scheduled and conducted under the East Fork of Box Canyon during the winter of 2003-04. This document provides the *fifth* sample period of baseline data for the existing riparian plant communities in the two forks of Box Canyon. The *first* sample period was in the October 2003, prior to the mining activities below the East Fork (this final report was called *Riparian Plant Communities in the East Fork of Box Canyon - 2003*). The *second* sample period was in July 2004 after mining had occurred under the canyon (the final report was called *Riparian Plant Communities in the East Fork of Box Canyon: July 2004*). The *third* sample period was in October 2004 (the final report was called *Riparian Plant Communities in the East Fork of Box Canyon: October 2004*). This last or *fourth* sample period was in July 2005 (*Plant Communities in the East Fork of Box Canyon: July 2005).*

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 were 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 and followup information by monitoring the riparian communities in the East Fork of Box Canyon. Regular monitoring should provide data to determine long term trends, natural variability and benchmark information including the possible impacts on the riparian plant communities from mining beneath the creek.

Like the previous studies, this study primarily employed vegetation monitoring methods described

by the USDA Forest Service for a "Level III Riparian Area Evaluation". The design of this study will not provide data that could show subtle changes to community structure and species composition as a result of *minor* changes to the riparian habitat. Rather, the study was designed to be compared with earlier (and future) studies in an attempt to document *major* impacts to the plant communities along the stream due to catastrophic events, such as loss of water and habitat from the effects of subsidence caused from underground mining.

METHODS

Sample station locations were pre-determined from an earlier field visit in 2003 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 are 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*.

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:

Qualitative Data

The "Riparian Complex Data Sheet" on the previous 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 employed to those sample areas chosen by the 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 subsequent studies. Although data were recorded in 2003 and 2004 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 and 2004 studies so that, if necessary, they may provide worthwhile information through time that otherwise would not have been available with one baseline data set.

With the one exception to the protocol modification mentioned above, the parameters for all sample stations in the 2003, 2004, and 2005 studies 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.

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-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 data sheets in this report. Each sheet shows all qualitative and quantitative data recorded as well as photographic documentation.

DISCUSSION & SUMMARY

Results from monitoring the riparian communities in October 2005 in the East Fork and Main Fork of Box Canyon have been included in this report. USDA Forest Service protocol and other methods were employed to monitor the riparian areas. These methods utilized the 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 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 study (1999) were also added to the sampling regime in October 2003, July 2004, October 2004, July 2005 and October 2005. Five of these previous 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 studies so that comparisons could be made later. A method referred to as the *Green Line Method* for measuring the riparian communities was also employed at all sample locations. A summary of all qualitative and quantitative data taken at each sample location are shown in the RESULTS section of this report.

As suggested in the last monitoring report (July 2005 sample period), upon scrutinizing the data sets for each sample period, **the Community Cover and Green Line Methods appear to be more conducive to noting changes in the riparian plant communities**.

Monitoring reports from previous sample periods suggested that many of the riparian communities in the East Fork of Box Canyon decreased, especially between October 2003 and July 2004. At other sample locations, little change was noticed. Other than the spring areas which will be discussed separately, the trend since that time was for the communities to stabilize and then begin to somewhat increase over time. Since no two sample areas appeared to have the exact same results over time, changes are best considered on a sample station-by-station basis. According, data has been plotted on charts to illustrate changes over time from the October 2003 through the October 2005 sample periods (Figs. 1-4).

To make it easier to review, the data in the figures were summarized in groups. In Fig. 1, the data show the results over time for sample stations EFB-1 through EFB-8 using the *Green Line* method. In Fig. 2, the data were also grouped by site numbers, or RE-09 through RE-13, using the *Community Type Cover* method. Data summaries shown in Fig. 1 and Fig. 2 are comparable to each because both show the cover width of the riparian communities (or Green Lines) in feet over time. (**Note**: Some of the sample stations have two identification names; refer to the RESULTS section above for cross-referencing).

As can be observed in Fig. 1, most of the riparian plant communities have remained relatively stable over time for these sites, much like the control sites in the Main Fork of Box Canyon (Fig. 4). Fig. 2 results are somewhat more dynamic. In these sample locations, results suggest a decline in most riparian plant communities cover from October 2003 to July 2004. After that, the

communities seem to stabilize, then begin to increase where some reach or exceed their original (2003) values.

Fig. 3 shows the results of the sample stations that were placed in spring areas. In all but one of the sites, there was a rather abrupt decrease in the riparian communities especially between October 2003 and July 2004. The trend for the spring areas was to increase after that, but not to the values recorded in October 2003. One spring area (EFB-S1) maintained its riparian community for the first three sample periods, but decreased in the last two. Reasons for maintenance of it riparian species may be due to its location when compared to the other spring areas – it was located much lower on the hillside and much closer to the main channel. This spring appeared to retain more water than the upper elevation springs that nearly dried up completely sometime during the spring of 2004.

Although many of the environmental conditions in the Main Fork of Box Canyon were not exactly the same as those in the East Fork, they were the best "control" conditions found at the time the studies began in 2003 (plus, there was the benefit of earlier recorded 1999 data). Consequently, five of these sites were also monitored during the same periods as the East Fork monitoring regime. Fig. 4 shows that, although these plant communities have somewhat fluctuated over time, they have remained relatively constant from October 2003 through October 2005.

FIG. 1: EAST FORK BOX CANYON

GREEN LINE METHOD

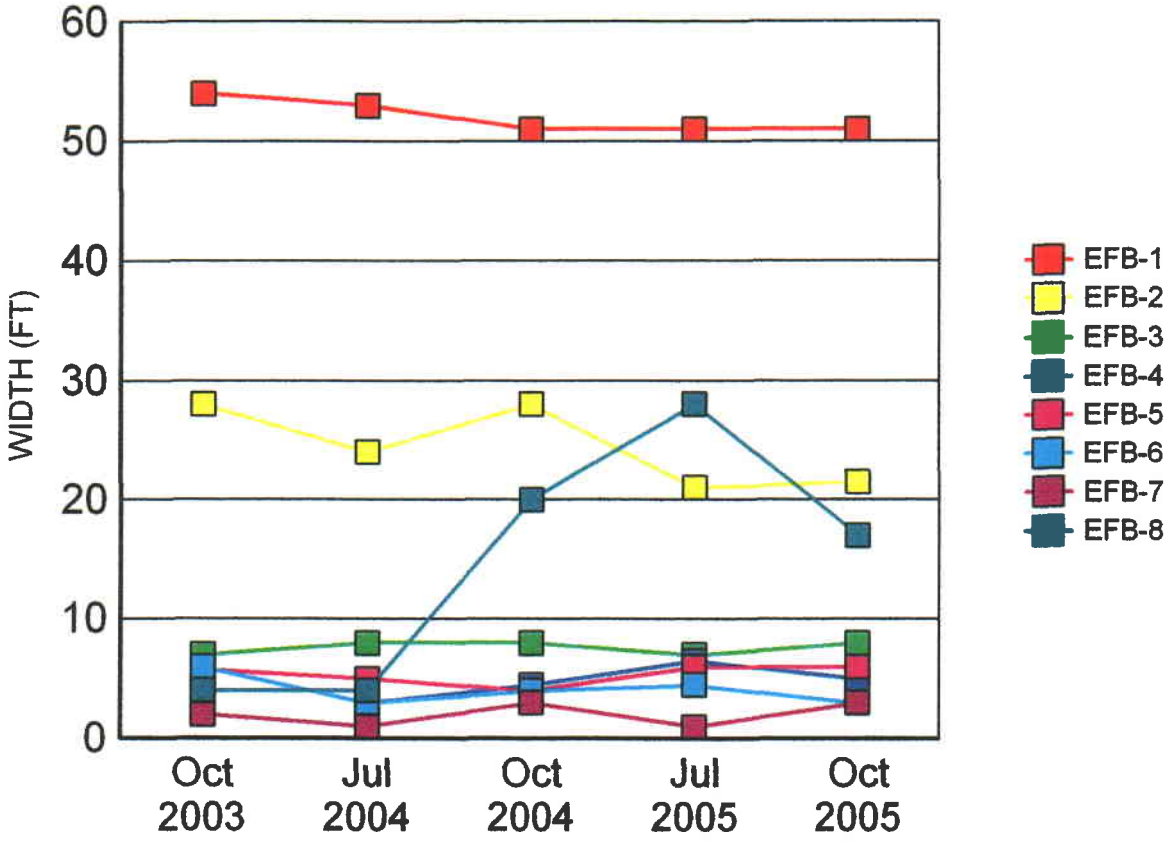


FIG 2: EAST FORK BOX CANYON
RIPARIAN COMMUNITY METHOD

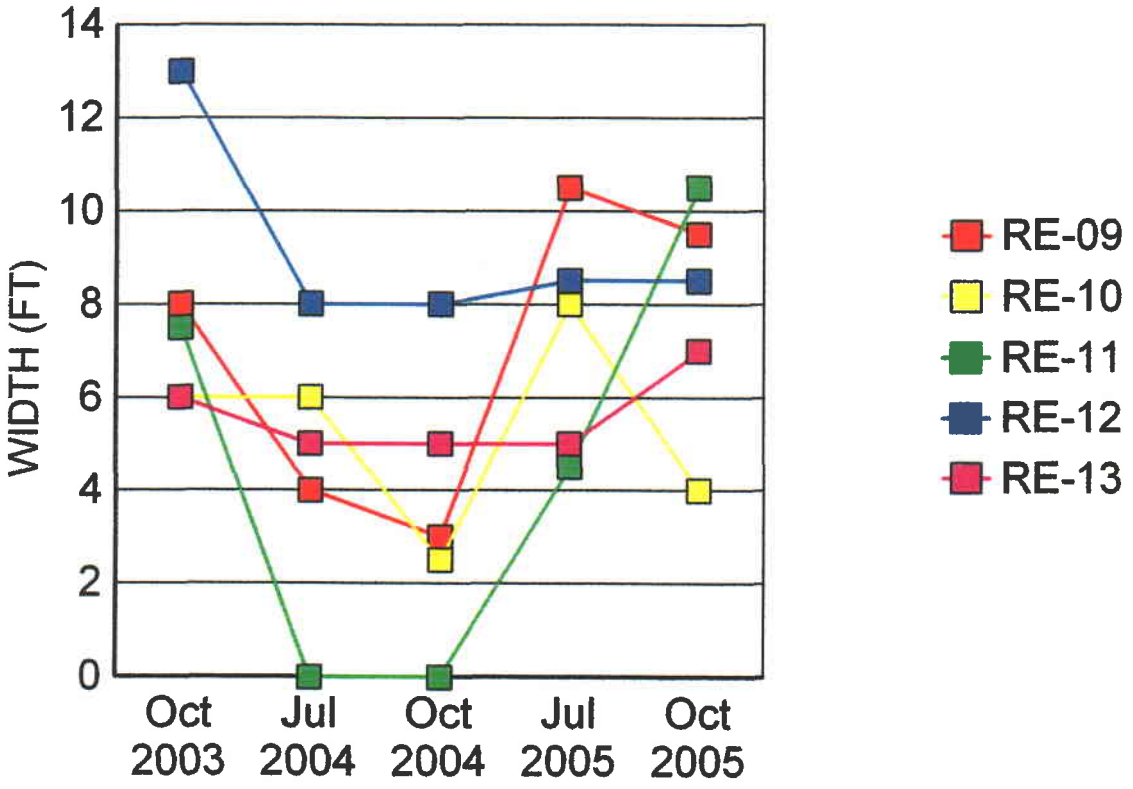


FIG 3: EAST FORK BOX CANYON

GREEN LINE METHOD (SPRINGS)

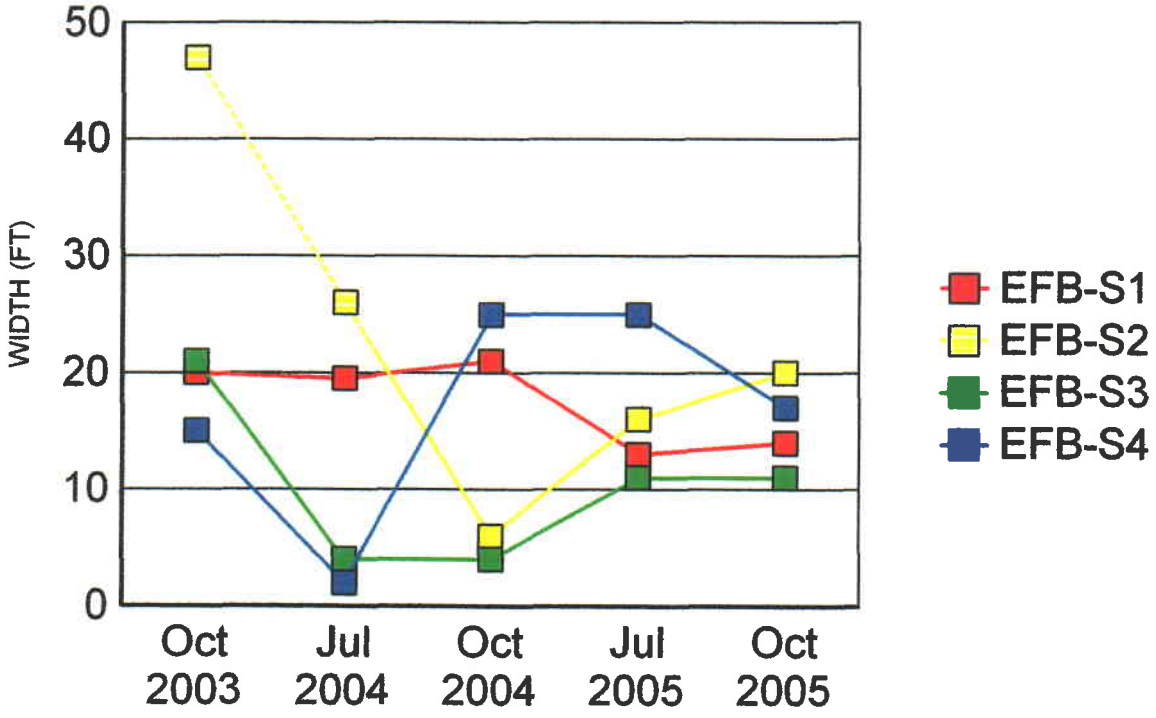
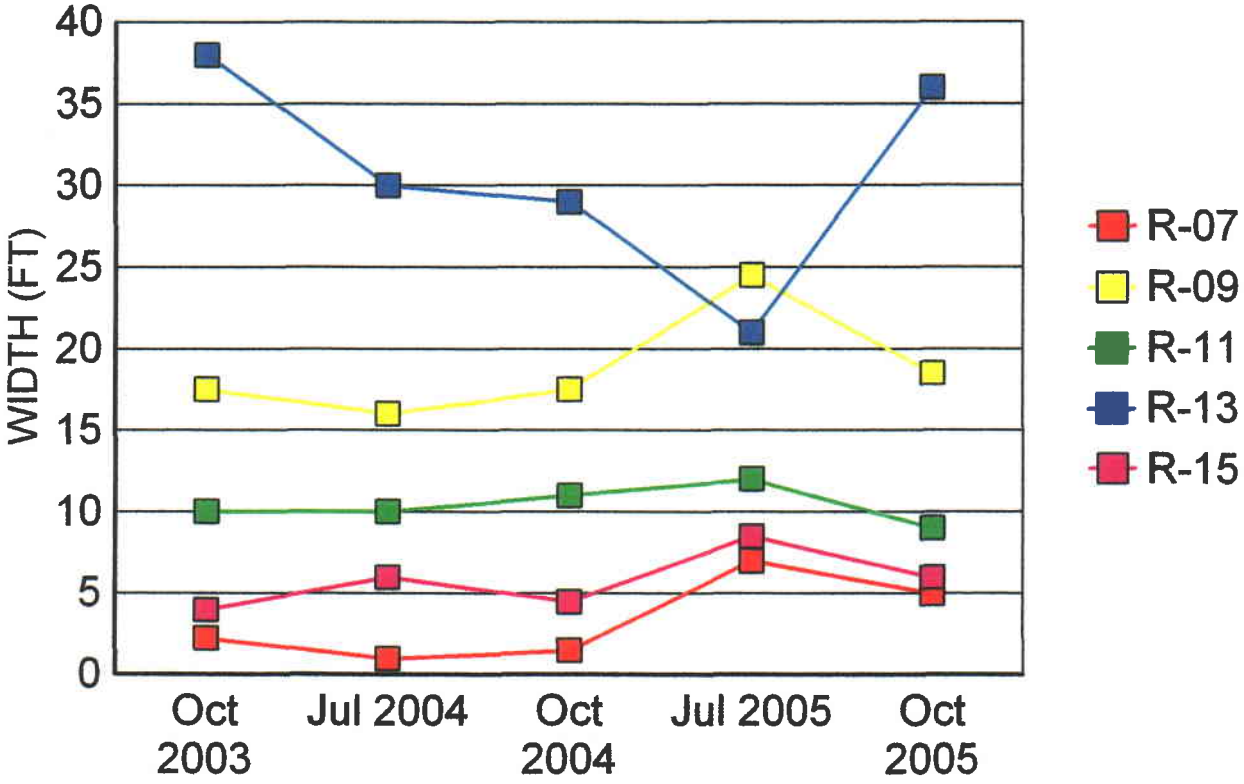


FIG 4: MAIN FORK BOX CANYON

RIPARIAN COMMUNITY METHODS



RIPARIAN COMPLEX DATA SHEET
October 2005

CLIENT: Canyon Fuel Company

COMPLEX: Number EFB-1

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 3 - 8, 2005

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

APPARENT FORAGE TREND: stable

ESTIMATED FORAGE PRODUCTION: 1200 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)
Picea pungens	*Salix sp.*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides	*Potentilla fruticosa*		*Carex hoodii*
	Rosa woodsii		*Carex lanuginosa*
			Juncus longistylis
			Juncus arcticus
			Poa pratensis

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: 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 (60 ft; includes uplands).
3) Little or no grazing by cattle this year. A lot of vegetation present. Area was wet.

4) Check measurements in July 2006. For some reason, I recorded a total of 60 ft. this period.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-1		Left	25.5	*Carex lanuginosa/Agrostis stolonifera*
		Right	25.5	*Carex lanuginosa/Agrostis stolonifera*
		Channel	n/a	Dry (no standing water)

EFB-1: Cover using point quadrats (October 2005).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
FORBS	
Ranunculus cymbalaria	10.00
GRASSES	
Agrostis stolonifera	30.00
Carex lanuginosa	25.00
TOTAL COVER	
LIVING COVER (vascular)	65.00
WATER	0.00
MOSS	0.00
LITTER	35.00
B/G	0.00
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION

EFB-1

RIPARIAN COMPLEX DATA SHEET
October 2005

CLIENT: Canyon Fuel Company

COMPLEX: Number EFB-2

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 3 - 8, 2005

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

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, ATV, grazing, hunting, recreation.

SPECIES OBSERVED:

Trees	Shrubs	Forbs	Grasses (or grasslike)
Pinus ponderosa	*Artemisia tridentata*	*Aster sp.*	*Juncus arcticus*
Populus tremuloides	*Potentilla fruticosa*	*Lepidium latifolium*	*Agrostis stolonifera*
		Taraxacum officinale	*Poa pratensis*
		Equisetum arvense	*Poa secunda*
		Eriogonum sp.	*Juncus longistylis*
		Achillea millefolium	*Carex lanuginosa*

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°): 80

% bank length with overhanging vegetation: 0

BANK CONDITION

% bank length vegetated, stable: 45

% bank length unvegetated, stable: 55

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 0

BANK STABILITY: 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. Site was dry.
2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side (48 ft; includes uplands).
3) Little or no grazing by cattle this year.
4) Meadow was dominated by Kentucky bluegrass; wetter areas by redtop, wiregrass and rush.

DATA SUMMARIES

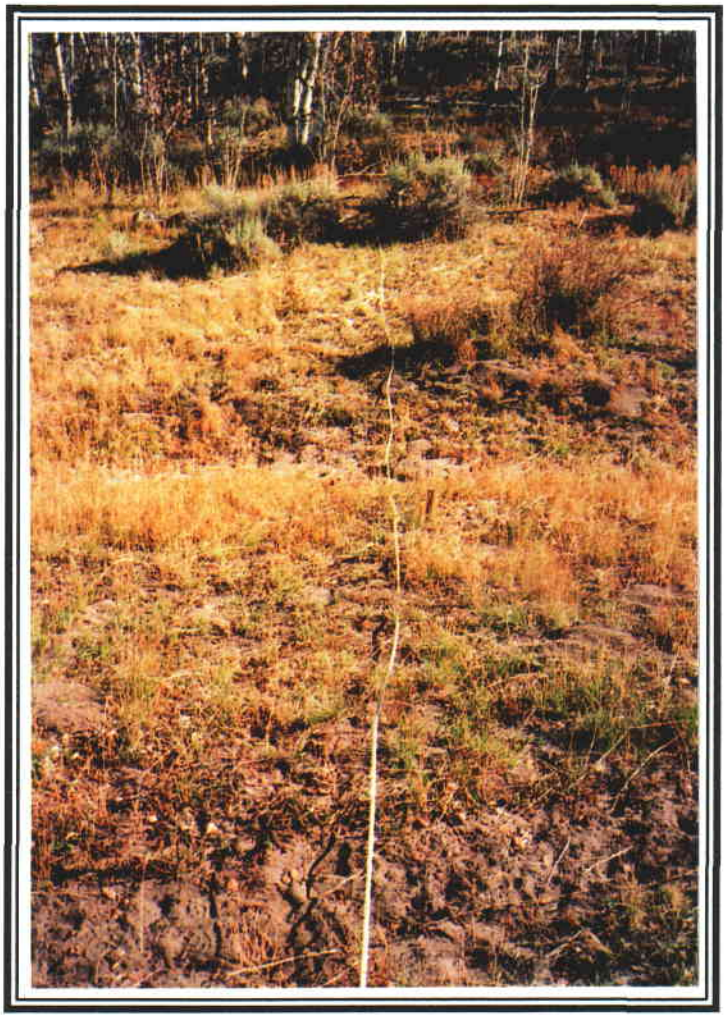
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-2		Left	11.0	*Agrostis stolonifera/Juncus arcticus*
		Right	10.5	*Agrostis stolonifera/Juncus arcticus*
		Channel	2.0	Dry

EFB-2: Cover using point quadrats (October 2005).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
FORBS	
Equisetum arvense	12.50
Eriogonum sp.	6.25
GRASSES	
Agrostis stolonifera	12.50
Juncus arcticus	18.75
TOTAL COVER	
LIVING COVER (vascular)	50.00
STREAM	0.00
MOSS	0.00
LITTER	12.50
B/G	37.50
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-2

RIPARIAN COMPLEX DATA SHEET
October 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-3

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 3 - 8, 2005

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: 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)
Pinus ponderosa	*Artemisia tridentata*	*Equisetum arvense*	*Agrostis stolonifera*
Populus tremuloides		*Lepidium latifolia*	*Carex lanuginosa*
		Lupinus sp.	*Juncus ensifolius*
		Taraxacum officinale	*Juncus arcticus*
		Eriogonum sp.	*Poa fendleriana*
			Poa pratensis

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: 80
% bank length unvegetated, stable: 20
% 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. (48 ft; includes uplands).
2) Little or no grazing by cattle this year.
3) Cattle trail in left side of riparian vegetation may influence green line measurements.

DATA SUMMARIES

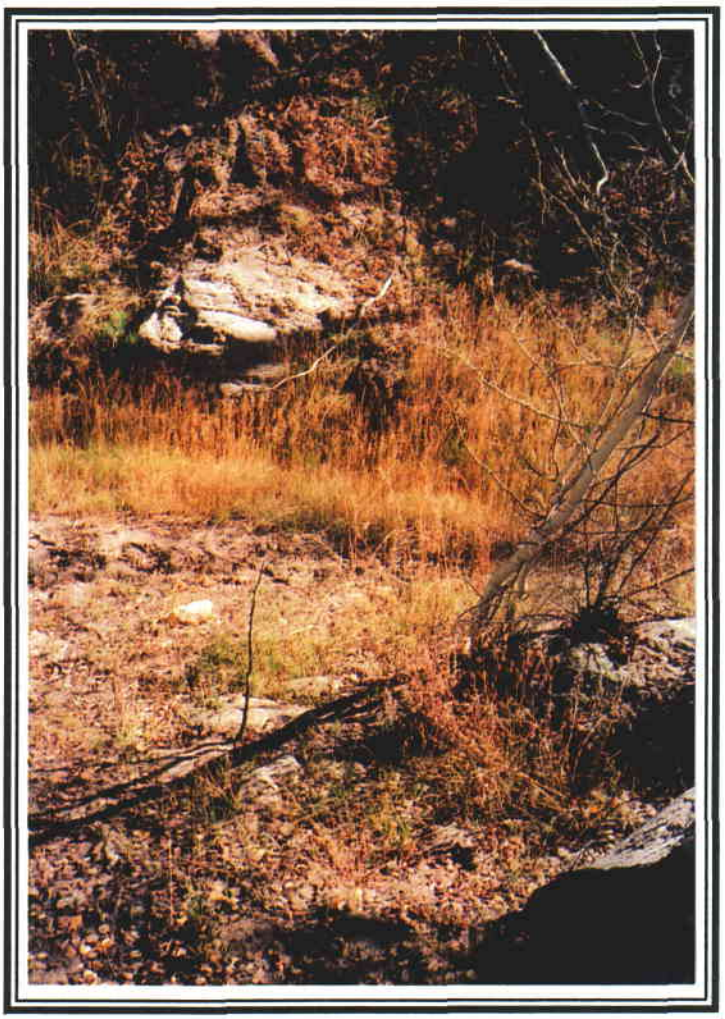
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-3		Left	5.0	*Agrostis stolonifera/Juncus arcticus*
		Right	3.0	*Agrostis stolonifera/Juncus arcticus*
		Channel	n/a	Dry

EFB-3: Cover using point quadrats (October 2005).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
FORBS	
Eriogonum sp.	12.50
Lupinus sp.	
GRASSES	
Agrostis stolonifera	12.50
Equisetum arvense	6.25
Poa pratensis	12.50
TOTAL COVER	
LIVING COVER (vascular)	43.75
WATER	0.00
MOSS	0.00
LITTER	37.50
B/G	18.75
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-3

RIPARIAN COMPLEX DATA SHEET
October 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-4

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 3 - 8, 2005

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: 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)
Picea pungens	*Artemisia tridentata*	*Antennaria sp.*	*Agrostis stolonifera*
Populus tremuloides	*Chrysothamnus nauseosus*		*Juncus longistylis*
Pinus ponderosa	*Potentilla fruticosa*		*Juncus arcticus*
	Rosa woodsii		*Poa fendleriana*
			Poa secunda

POOL ATTRIBUTES

% area in pools: Dry

% 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 (dry trail)

% bank length with overhanging vegetation: 5

BANK CONDITION

% bank length vegetated, stable: 40

% bank length unvegetated, stable: 40

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 20

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 (48 ft; includes uplands).
2) Little or no grazing by cattle this year.

DATA SUMMARIES

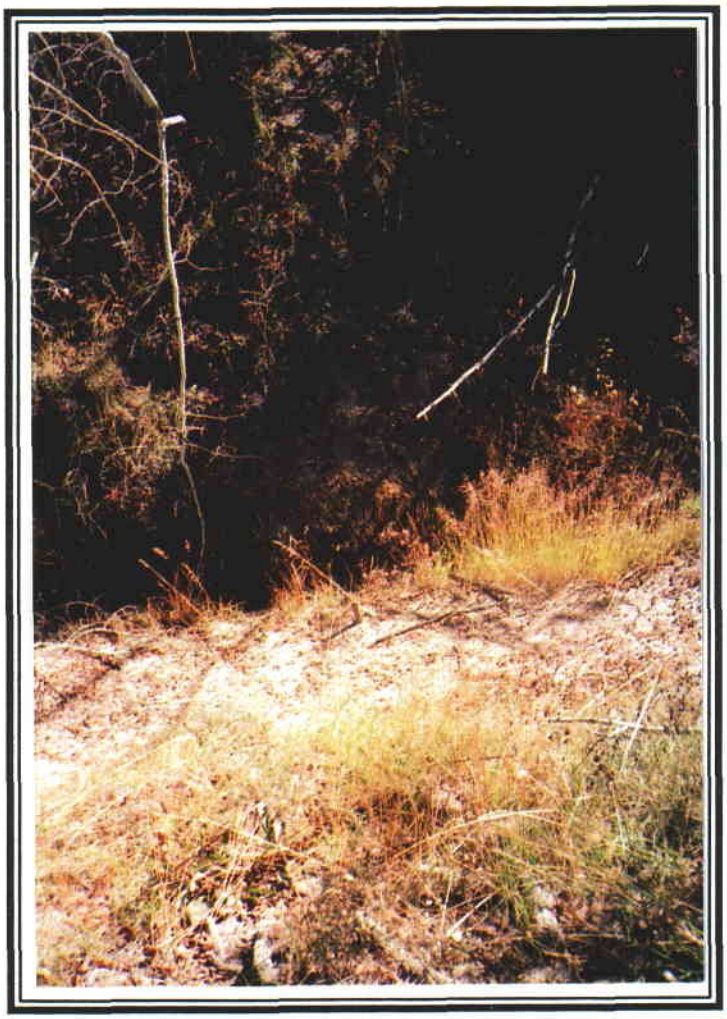
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-4		Left	3.0	*Agrostis stolonifera/Juncus arcticus*
		Right	2.0	*Agrostis stolonifera/Juncus arcticus*
		Channel	1.5	Dry

EFB-4: Cover using point quadrats (October 2005).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
Rosa woodsii	6.25
FORBS	
GRASSES	
Poa secunda	25.00
TOTAL COVER	
LIVING COVER (vascular)	31.25
WATER	0.00
MOSS	0.00
LITTER	43.75
B/G	25.00
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-4

RIPARIAN COMPLEX DATA SHEET
October 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-5

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 3 - 8, 2005

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: 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)
Picea pungens	*Artemisia tridentata*		*Agrostis stolonifera*
Populus tremuloides	*Potentilla fruticosa*		*Poa fendleriana*
Pinus ponderosa	*Rosa woodsii*		*Stipa hymenoides*
	Symphoricarpos oreophilus		*Carex lanuginosa*
			Poa secunda

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 (but close to 135°)

% bank length with overhanging vegetation: 1%

BANK CONDITION

% bank length vegetated, stable: 35

% bank length unvegetated, stable: 40

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 25

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 (48 ft; includes uplands).
3) No water in channel in this location.
4) Little or no grazing by cattle this year.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-5		Left	3.0	*Agrostis stolonifera*
		Right	3.0	*Agrostis stolonifera*
		Channel	1.0	Dry

EFB-5 Cover using point quadrats (October 2005).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
FORBS	
GRASSES	
Poa secunda	18.75
Agrostis stolonifera	12.50
TOTAL COVER	
LIVING COVER (vascular)	31.25
WATER	0.00
MOSS	0.00
LITTER	37.50
B/G	31.25
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION

EFB-5

RIPARIAN COMPLEX DATA SHEET
October 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-6

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 3 - 8, 2005

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)
Picea pungens	*Amelanchier utahensis*	*Taraxacum officinale*	*Agrostis stolonifera*
Populus tremuloides	*Potentilla fruticosa*	*Antennaria sp.*	*Bromus carinatus*
Pinus ponderosa	*Symphoricarpos oreophilus*	*Aster sp.*	*Juncus arcticus*
Populus fremontii	*Artemisia tridentata*	*Swertia radiata*	*Poa fendleriana*
		Artemisia ludoviciana	*Elymus trachycaulus*

POOL ATTRIBUTES

% area in pools: Dry

% 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: 30

% bank length unvegetated, stable: 35

% bank length vegetated, unstable: 5

% bank length unvegetated, unstable: 30

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 (48 ft; includes uplands).
3) Little or no grazing by cattle this year. Dry this Oct., but water was just downstream ~20 ft.
4) Cattle trail was on some of the riparian community and could affect results.

DATA SUMMARIES

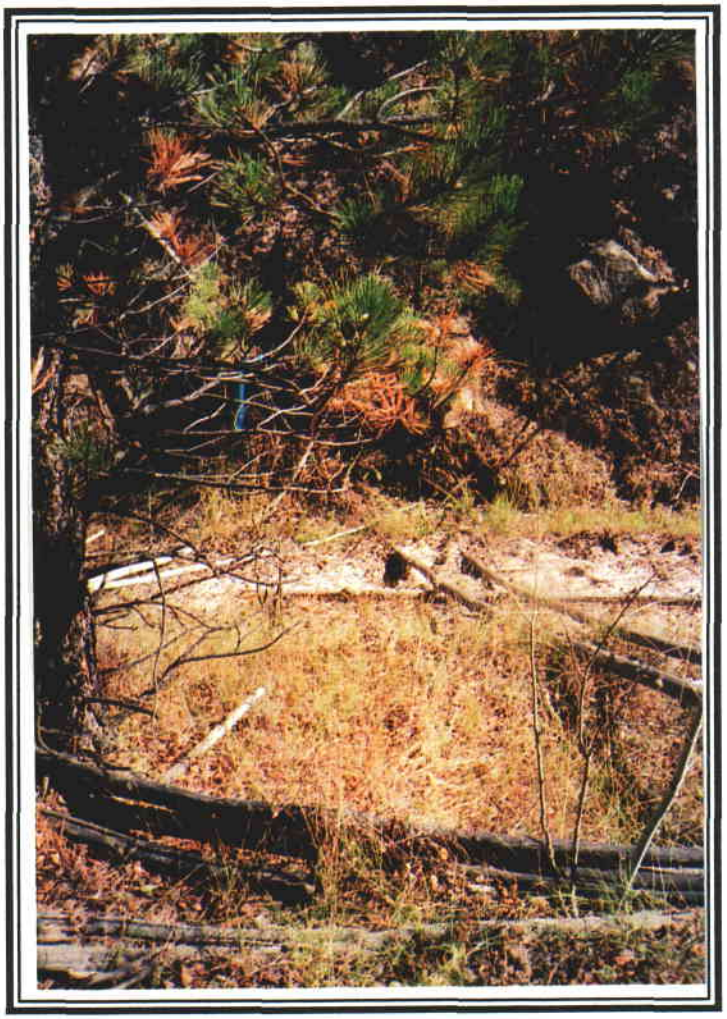
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-6		Left	1.5	*Agrostis stolonifera*
		Right	1.5	*Agrostis stolonifera*
		Channel	2.0	Dry

EFB-6 Cover using point quadrats (October 2005).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
Populus tremuloides	6.25
FORBS	
Antennaria sp.	6.25
GRASSES	
Agrostis stolonifera	12.50
Poa fendleriana	31.25
Elymus trachycaulus	6.25
TOTAL COVER	
LIVING COVER (vascular)	62.50
WATER	0.00
MOSS	0.00
LITTER	18.75
B/G	18.75
ROCK	0.00
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-6

RIPARIAN COMPLEX DATA SHEET
October 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-7

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 3 - 8, 2005

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: Unstable

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)
Picea pungens	*Juniperus communis*	*Aster sp.*	*Agrostis stolonifera*
Populus tremuloides			*Poa fendleriana*

POOL ATTRIBUTES

% area in pools: Dry

% 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: 30

% bank length unvegetated, stable: 10

% bank length vegetated, unstable: 10

% bank length unvegetated, unstable: 50

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. Sample area was dry, but water was ~7 ft downstream.
2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals; 24 ft. transect on left side; 24 ft. transect on right side (48 ft; includes uplands).
3) Very unstable upper banks (above bankfull).
4) Little or no grazing by cattle this year.
5) Much side slope movement on right and left sides.

DATA SUMMARIES

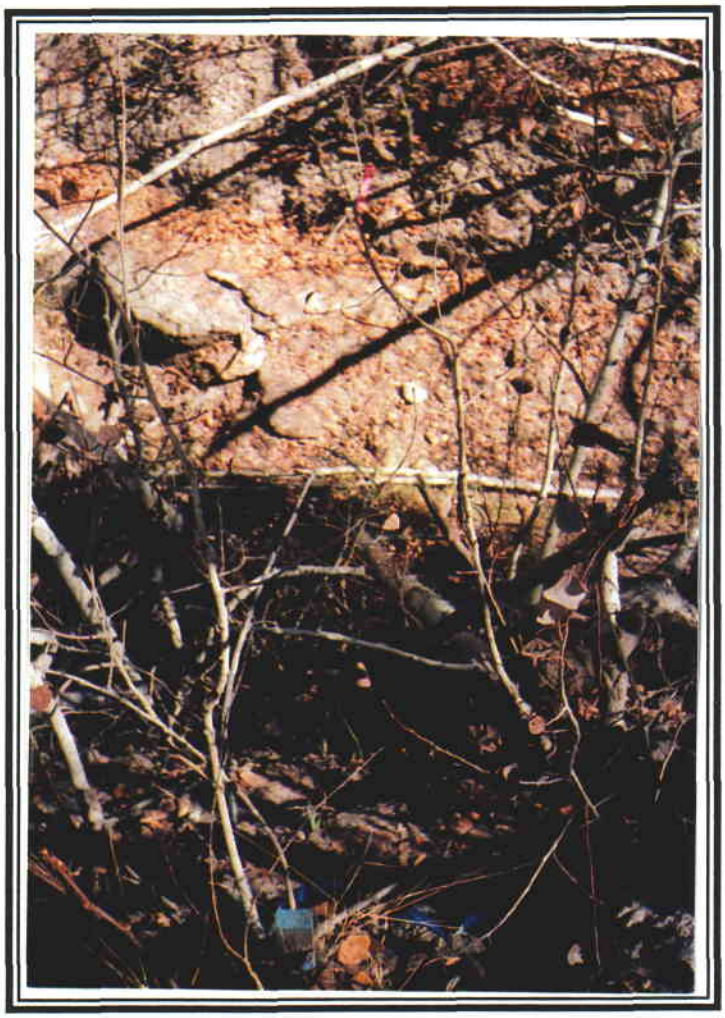
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-7		Left	3.0	*Agrostis stolonifera*
		Right	0	
		Channel	1.5	Dry

EFB-7 Cover using point quadrats (October 2005).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
Populus tremuloides	6.25
FORBS	
Artemisia dracunculus	6.25
GRASSES	
Agrostis stolonifera	6.25
TOTAL COVER	
LIVING COVER (vascular)	18.75
WATER	0.00
MOSS	0.00
LITTER	43.75
B/G	31.25
ROCK	6.25
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-7

RIPARIAN COMPLEX DATA SHEET
October 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-8

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 3 - 8, 2005

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: Unstable

ESTIMATED FORAGE PRODUCTION: 350 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)
Picea pungens	*Symphoricarpos oreophilus*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides		*Achillea millefolium*	*Carex lanuginosa*
Pinus ponderosa		*Penstemon sp.*	*Juncus arcticus*
		Antennaria sp.	*Bromus japonicus*
		Equisetum arvensis	*Poa fendleriana*
		Potentilla sp.	*Poa pratensis*

POOL ATTRIBUTES

% area in pools: 10

% 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°): 40

% bank length with overhanging vegetation: 20

BANK CONDITION

% bank length vegetated, stable: 40

% bank length unvegetated, stable: 50

% bank length vegetated, unstable: 5

% 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) Beginning to see more blue spruce and less ponderosa pine in uplands in this area.

2) Quantitative Methods: This is a difficult area to monitor because there is a spring on the right side with water flowing from it. The information above is for the main channel. The main channel had 1.5 ft mud and 4.0 ft water.

3) For the point quads, the transect crossed the spring community too (transect total = 54 ft). *I did not count the "island" between the two as riparian* (but I may have previously). Perhaps it could all be considered riparian. For both separate data, see the Green Line method below.
4) The stream water width in main channel was about 1.5 ft. There was somewhat less than this in the spring.
5) Little or grazing by cattle this year.

DATA SUMMARIES

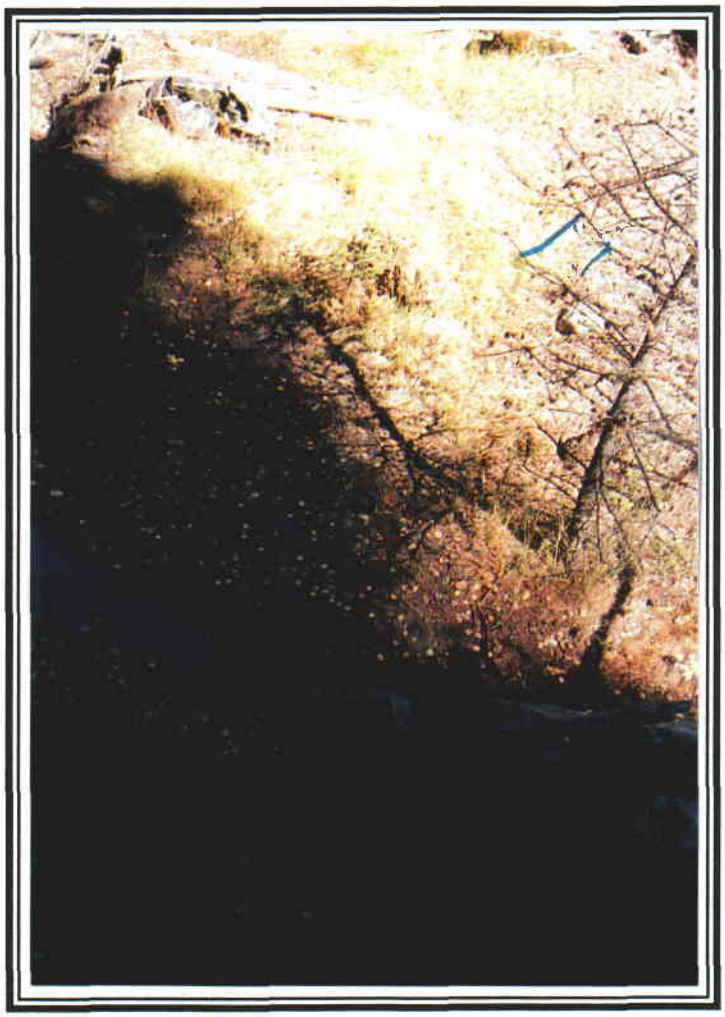
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-8 Main Channel		Left	1.0	*Agrostis stolonifera*
		Right	5.0	*Equisetum arvense*
		Channel	1.5	Water
EFB-8 Spring Channel		Left	10.0	*Agrostis stoloniferal Equisetum arvense*
		Right	1.0	*Equisetum arvense*
		Channel	0.5	Water
Total w/o island w/island			17.0 ~28.0	Island not counted as riparian Island counted as riparian

EFB-8 Cover using point quadrats (October 2005).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
FORBS	
Equisetum arvense	5.56
Ranunculus cymbalaria	5.56
GRASSES	
Agrostis stolonifera	22.22
Poa pratensis	11.11
TOTAL COVER	
LIVING COVER (vascular)	44.44
WATER	5.56
MOSS	0.00
LITTER	33.33
B/G	11.11
ROCK	5.56
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-8

RIPARIAN COMPLEX DATA SHEET
October 2005

CLIENT: Canyon Fuel Company

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

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 3 - 8, 2005

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: 100

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)
Picea pungens	*Rosa woodsii*	*Equisetum arvensis*	*Agrostis stolonifera*
Populus tremuloides	*Symphoricarpos oreophilus*	*Ranunculus cymbalaria*	
Salix amygdaloides			

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°): 0

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

% bank length with overhanging vegetation: 35

BANK CONDITION

% bank length vegetated, stable: 30

% bank length unvegetated, stable: 45

% bank length vegetated, unstable: 5

% bank length unvegetated, unstable: 20

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 for 38 ft.(see below).
In addition, the USDA Forest Service Protocol for Level III was employed by measuring the plant communities using the line intercept method.
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 and left side.

4) Little or no grazing by cattle this year.

5) For point quadrats we had different transect lengths: Oct 03 (50 ft), July 04 (50 ft), Oct 04 (32 ft or 38 ft); July 05 (38 ft); Oct 05 (38 ft). This is probably because there were two transects marked in the field because we also utilized transects from our 1999 study which were different than the one's marked by the team for the more recent studies. *Note that comparisons of these data can be confusing because pt. quad transects were sometimes different than line transects.*

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	2.0	*Agrostis stolonifera*
		Right	2.0	*Agrostis stolonifera/Geranium richardsonii*
		Channel	2.5	Water

RE-10 (EFB-9) Cover using point quadrats (October 2005).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
FORBS	
GRASSES	
Agrostis stolonifera	16.67
TOTAL COVER	
LIVING COVER (vascular)	16.67
WATER	8.33
MOSS	16.67
LITTER	41.67
B/G	16.67
ROCK	0.00
TOTAL	100.00

RE-10 (EFB-9): Cover by community types in Box Canyons (October 2005).

USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Populus tremuloides/Picea pungens	21.50
Populus tremuloides/Rosa woodsii	10.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera	4.00
TOTAL COVER (Upland Species)	31.50
TOTAL COVER (Riparian Species)	4.00
BAREGROUND	0.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	2.50
Moss	0.00
TOTAL COVER	38.00

PHOTOGRAPHIC DOCUMENTATION

EFB-9 (RE-10)

RIPARIAN COMPLEX DATA SHEET
October 2005

CLIENT: Canyon Fuel Company

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

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 3 - 8, 2005

OBSERVER(S): P.D. Collins

QUAD NAME: Flagstaff Peak, Utah

GEOLOGIC PARENT MATERIAL: Blackkhawk

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: 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)
Picea pungens	*Salix sp.*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides	*Rosa woodsii*	*Geranium richardsonii*	
Betula occidentalis		*Equisetum arvense*	
Salix sp.		*Epilobium angustifolium*	

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°): 10
% bank length gently sloping (>135°): 50
% bank length with overhanging vegetation: 30

BANK CONDITION

% bank length vegetated, stable: 60
% bank length unvegetated, stable: 30
% bank length vegetated, unstable: 5
% 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: There were two transect lines here because of the older (1999) study. One was 28 ft (from 1999) and one was 36 ft (team study). For point quadrats for Oct 2005, we sampled at 3 ft. intervals for the 28 ft transect line. I also sampled on 36 ft line (left in raw data). Regarding the two pt. quad transect lines (28 ft and 36 ft), *I think we've been consistent using the 28 ft line.*

In addition, the USDA Forest Service Protocol for Level III was employed by measuring the plant communities using the line intercept method (used 36 ft transect line; *not consistent with July 2005*).

3) Right hillside suggests (by presence of horsetail) that there is probably a lot of soil moisture in the spring and early summer. No water in hillside observed

4) Waterfall is above this station.

5) Photo taken from left side.

6) Negligible grazing by cattle this year.

7) There was lots of bareground that I counted in the upland community.

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	7.5	*Equisetum arvense/Geranium richardsonii*
		Right	2.0	*Agrostis stolonifera/Equisetum arvense*
		Channel	4.0	Water

RE-9 (EFB-10) Cover using point quadrats (October 2005).

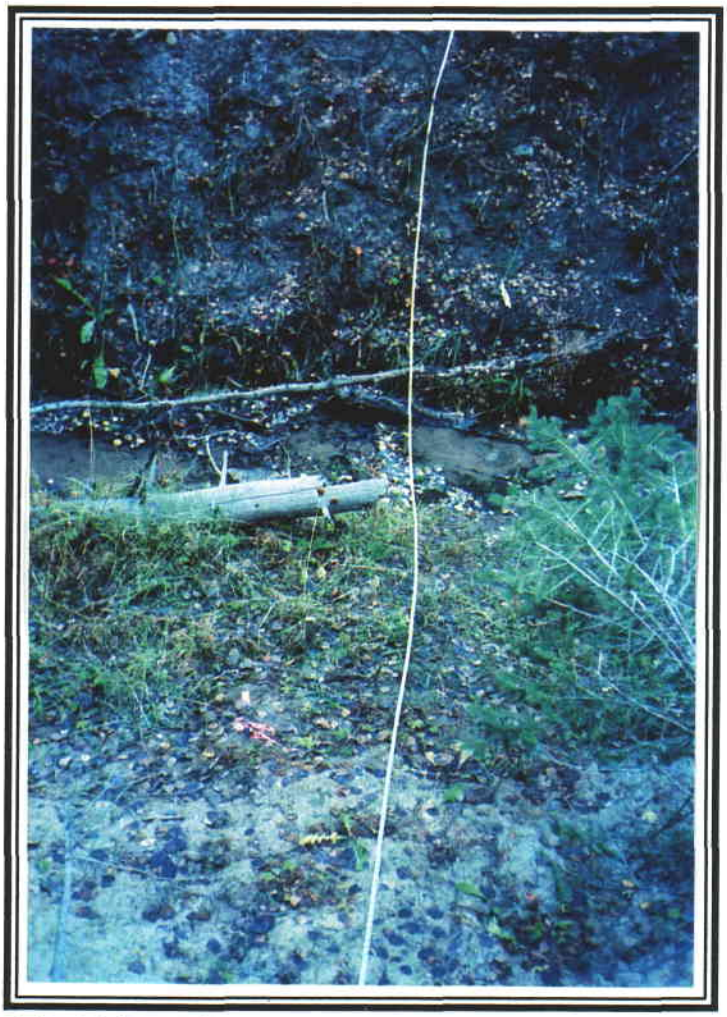
COVER BY SPECIES	PERCENT
TREES & SHRUBS	
FORBS	
Geranium richardsonii	11.11
Equisetum arvense	11.11
GRASSES	
Agrostis stolonifera	22.22
TOTAL COVER	
LIVING COVER (vascular)	44.44
WATER	11.11
MOSS	0.00
LITTER	33.33
B/G	11.11
ROCK	0.00
TOTAL	100.00

RE-09 (EFB-10): Cover by community types in Box Canyons (October 2005).

USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Picea pungens	8.00
Populus tremuloides/Picea pungens	14.50
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Equisetum arvensis	2.00
Agrostis stolonifera/Geranium richardsonii	4.50
Geranium richardsonii	3.00
TOTAL COVER (Upland Species)	22.50
TOTAL COVER (Riparian Species)	9.50
BAREGROUND	0.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	4.00
Moss	0.00
TOTAL COVER	36.00

PHOTOGRAPHIC DOCUMENTATION



EFB-10 (RE-09)

RIPARIAN COMPLEX DATA SHEET
October 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-11

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 3 - 8, 2005

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: 300 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)
Picea pungens	*Pachystima myrsinites*	*Cirsium sp.*	*Agrostis stolonifera*
Populus tremuloides	*Symphoricarpos oreophilus*	*Geranium richardsonii*	*Juncus longistylis*
Salix sp.		*Equisetum arvense*	*Poa fendleriana*
Cornus sericea			
Betula occidentalis			

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: 50

% bank length unvegetated, stable: 40

% bank length vegetated, unstable: 0

% 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) This site is just below the confluence of a spring (EFB-S1)
2) Quantitative Methods: Point quadrats; sampled at 3 ft. intervals on a 45 ft transect line.
3) Little or no grazing by cattle this year.

DATA SUMMARIES

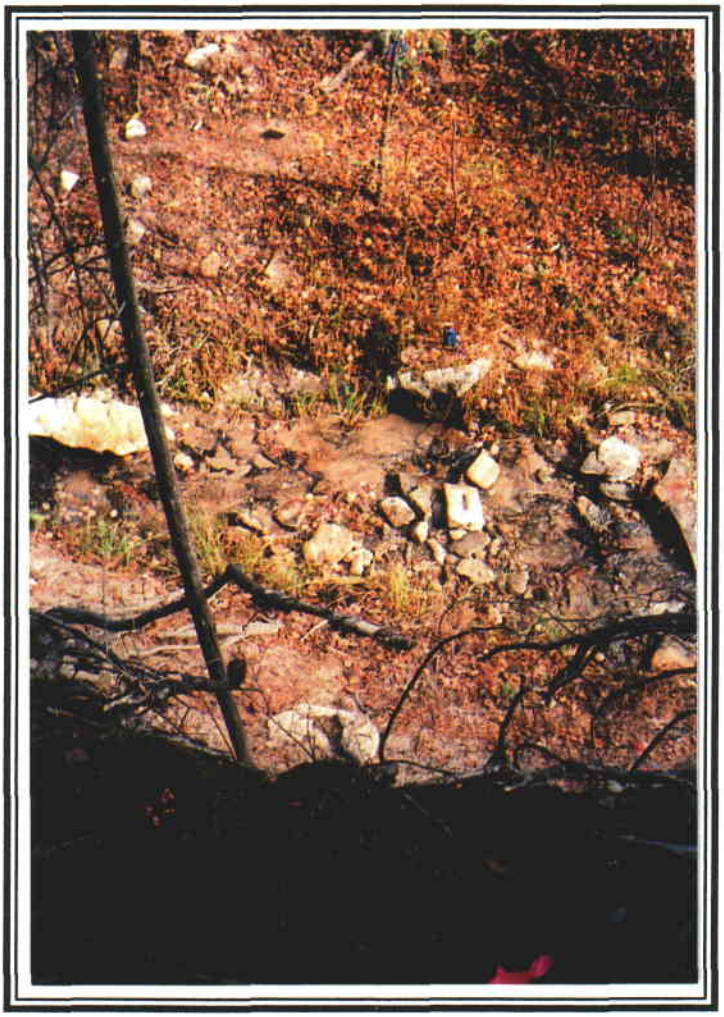
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-11		Left	3.5	*Equisetum arvense/Juncus longistylis*
		Right	4.0	*Equisetum arvense/Juncus longistylis*
		Channel	3.0	Water

EFB-11 Cover using point quadrats (October 2005).

COVER BY SPECIES	PERCENT
TREES & SHRUBS	
FORBS	
Equisetum arvense	6.67
Geranium richardsonii	13.33
GRASSES	
Juncus longistylis	6.67
TOTAL COVER	
LIVING COVER (vascular)	26.67
WATER	6.67
MOSS	6.67
LITTER	26.67
B/G	20.00
ROCK	13.33
TOTAL	100.00

PHOTOGRAPHIC DOCUMENTATION



EFB-11

RIPARIAN COMPLEX DATA SHEET
October 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number EFB-S1

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 3 - 8, 2005

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: unstable

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)
Picea pungens	*Salix sp.*	*Equisetum arvense*	*Agrostis stolonifera*
Populus tremuloides	*Symphoricarpos oreophilus*	*Ranunculus cymbalaria*	*Carex lanuginosa*
		Aster sp.	*Elymus trachycaulus*
		Geranium richardsonii	*Juncus arcticus*

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°): 30 (of wet area studied)

% bank length with overhanging vegetation: 10 (but increases above this area)

BANK CONDITION

% bank length vegetated, stable: 80

% bank length unvegetated, stable: 15

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 5 (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.

3) Original Stakes were gone. I put blue flagging and made a 37 ft transect line.
4) Unlike last sample period, there was now a little water cascading off rocks, and there was some surface water maintaining the riparian species at the station location.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-S1		Left	7.0	*Equisetum arvense*
		Right	7.0	*Equisetum arvense/Juncus longistylis*
		Channel	4.0	Water (1.0)/Moss (3.5)

EFB-S1: Cover by community types in Box Canyons (October 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Aster/Bareground	9.00
Bromus carinatus	10.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Equisetum arvensis	3.00
Geranium richardsonii	11.00
TOTAL COVER (Upland Species)	19.00
TOTAL COVER (Riparian Species)	14.00
BAREGROUND	0.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	0.50
Moss	3.50
TOTAL COVER	37.00

PHOTOGRAPHIC DOCUMENTATION

EFB-S1

RIPARIAN COMPLEX DATA SHEET
October 2005

CLIENT: Canyon Fuel Company

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

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 3 - 8, 2005

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: Picea pungens Right: Picea pungens

VEGETATIVE DESCRIPTION (Dominance by Community Types)

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

SUCCESSIONAL STATUS: Not climax, unstable.

APPARENT FORAGE TREND: Unstable

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)
Picea pungens	*Juniperus communis*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides		*Equisetum arvense*	*Carex lanuginosa*
Lonicera involucrata		*Geranium richardsonii*	
Betula occidentalis			

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: 0

% bank length unvegetated, stable: 0

% bank length vegetated, unstable: 20

% bank length unvegetated, unstable: 80

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. Previous data (Oct. 2003) was taken at the head of the springs; water diffused downslope over a broad area in which data collection would have been difficult and possibly ambiguous.
2) The area was dry again this sample period (Oct. 2005) due to a large sandstone cliff failure and rockslide over the entire spring area. A few riparian species remained, but not many. It's

basically an upland-looking community at this time.
3) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. I found both end stakes or the previous transect line. Green Line: Also measured on transects.
4) As mentioned last sample period, some seeps may be beginning to form again below the sample area because riparian species such as *Carex lanuginosa* and other species were beginning to show up, but the historical spring is still remains mostly absent.

DATA SUMMARIES

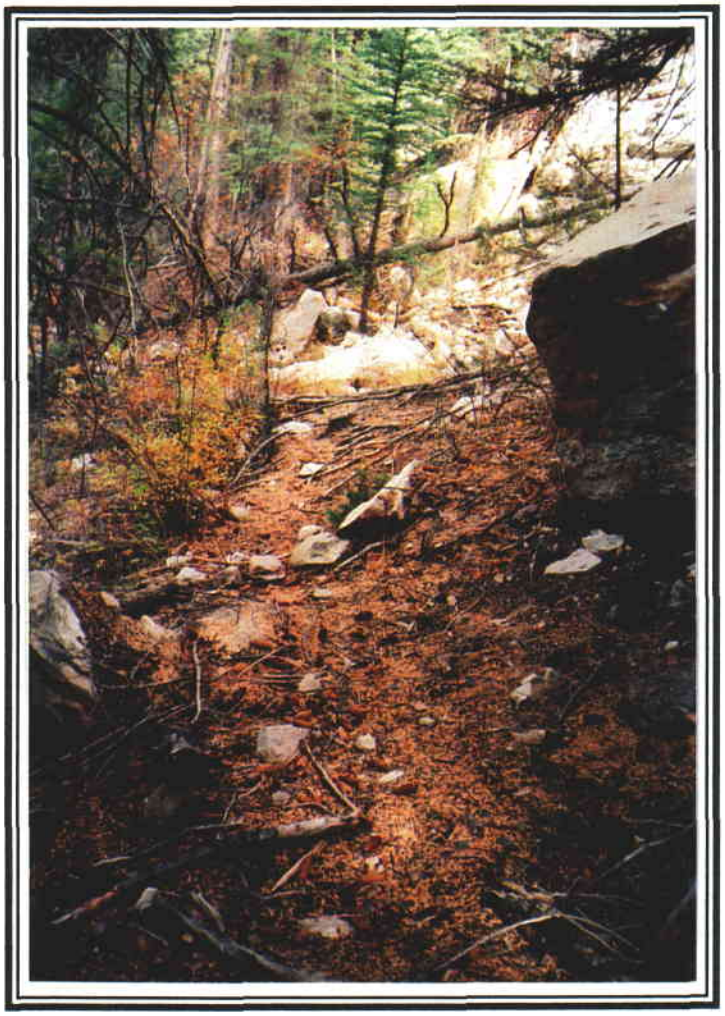
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
EFB-S2	EFB-12	Left	7.0	*Carex lanuginosa*
		Right	13.0	*Agrostis stolonifera/Equisetum arvense/Carex lanuginosa*
		Channel	n/a	

EFB-S2 (EFB-12): Cover by community types in Box Canyons (October 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Populus tremuloides	59.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Equisetum arvensis	9.00
Agrostis stolonifera/Geranium richardsonii	2.00
Carex lanuginosa	9.00
TOTAL COVER (Upland Species)	59.00
TOTAL COVER (Riparian Species)	20.00
BAREGROUND	0.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	0.00
Moss	0.00
TOTAL COVER	79.00

PHOTOGRAPHIC DOCUMENTATION



EFB-S2 (EFB-12)

RIPARIAN COMPLEX DATA SHEET
October 2005

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 3 - 8, 2005

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: Unstable, no longer considered "climax".

APPARENT FORAGE TREND: unstable

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)
Picea pungens	*Symphoricarpos oreophilus*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides	*Juniperus communis*	*Equisetum arvense*	*Elymus trachycaulus*
Pinus ponderosa	*Rosa woodsii*	*Geranium richardsonii*	
Salix amygdaloides			

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: 30
% bank length unvegetated, stable: 70
% 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. Green Line: Also measured on these transects.

2) I found the found stakes. I measure north S3 (30 ft) and south S3 (31 ft) separately.
3) This spring area has gone dry.
4) Riparian species present but they have decreased since October 2003.
5) There were wetland/riparian species i.e. buttercup and redtop (see Green Line data).
6) The understory in the area was mostly bareground.
7) Difficult to call data here.

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	11.0	*Agrostis stolonifera*
		South	0.0	
		Channel	n/a	

EFB-S3 (EFB-13): Cover by community types in Box Canyons (October 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Populus tremuloides/Picea pungens	50.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera	11.00
TOTAL COVER (Upland Species)	50.00
TOTAL COVER (Riparian Species)	11.00
BAREGROUND	0.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	0.00
Moss	0.00
TOTAL COVER	61.00

PHOTOGRAPHIC DOCUMENTATION

EFB-S3 (EFB-13)

RIPARIAN COMPLEX DATA SHEET
October 2005

CLIENT: Canyon Fuel Company

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

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 3 - 8, 2005

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: not climax.

APPARENT FORAGE TREND: Unstable

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)
Picea pungens	*Symphoricarpos oreophilus*	*Geranium richardsonii*	
Populus tremuloides	*Potentilla fruticosa*	*Equisetum arvense*	
Salix amygdaloides	*Rosa woodsii*		

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: 65 (including moss)

% 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) Spring area. There was a seep here first sample period (Oct 2003). It was dry leaving bareground for last sample periods. Some riparian species remain. The entire transect area was dominated by horsetail with some redtop this period.
2) Judging by the plants, there may have been some seepage, but none was noted at this time.

2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. Green Line: Also measured on these transects.
3) I'm not sure why transect measure 19 ft this sample period, while other times it measures 25 ft. *We will check it next sample period.*

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	12.0	*Equisetum arvense*
		Right	5.0	*Agrostis stolonifera/Equisetum arvense*
		Channel	2.0	Bareground

EFB-S4 (EFB-14): Cover by community types in Box Canyons (October 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION

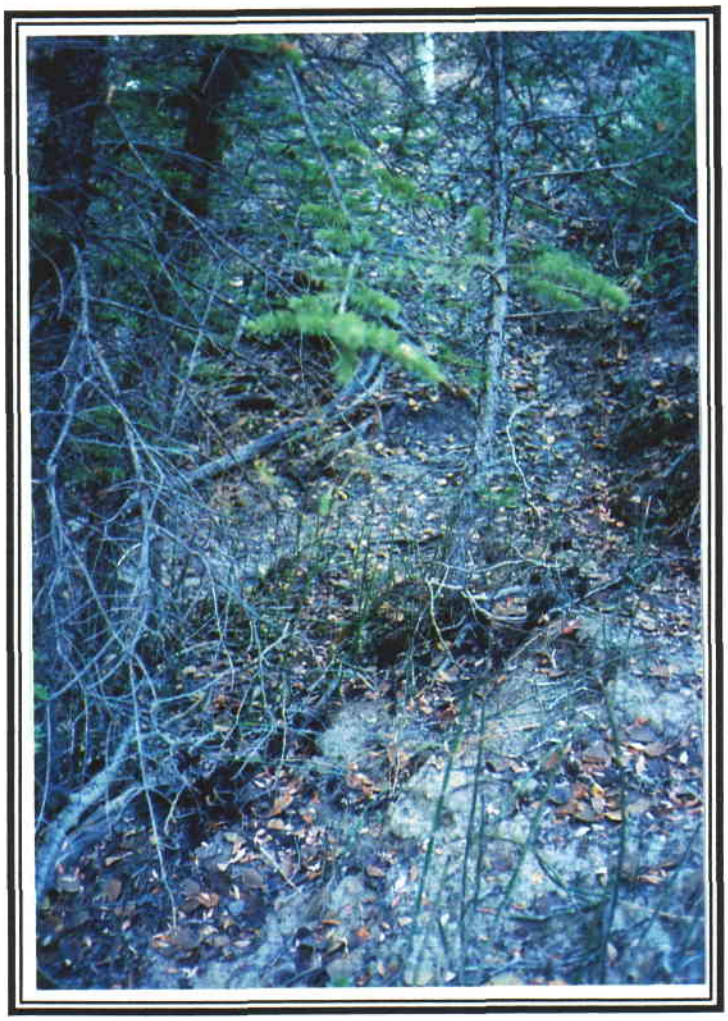
RIPARIAN VEGETATION

Dominant Woody Species

Dominant Herbaceous Species

Agrostis stolonifera/Equisetum arvensis	5.00
Geranium richardsonii	12.00
TOTAL COVER (Upland Species)	0.00
TOTAL COVER (Riparian Species)	17.00
BAREGROUND	2.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	0.00
Moss	0.00
TOTAL COVER	19.00

PHOTOGRAPHIC DOCUMENTATION



EFB-S4 (EFB-14)

RIPARIAN COMPLEX DATA SHEET
October 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number RE-11

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 3 - 8, 2005

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: 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)
Picea pungens	*Rosa woodsii*	*Equisetum arvense*	*Agrostis stolonifera*
Populus tremuloides			*Juncus longistylis*

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°): 30

% bank length gently sloping (>135°): 30

% bank length with overhanging vegetation: 35

BANK CONDITION

% bank length vegetated, stable: 20

% bank length unvegetated, stable: 40

% bank length vegetated, unstable: 5

% bank length unvegetated, unstable: 35

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 noted as unstable in Fall 2003. The Spring 2004 sample period revealed that a large spruce tree had fallen directly in the sample area. The upland areas were unstable and movement of sample markers was observed. There were no riparian species in the transect area due to fallen tree and extensive cattle disturbance in Spring and Fall 2004. Riparian species are returning here. In July 2005, right side had *Equisetum arvense* from hillside water. This sample period (October 2005) had some *Equisetum arvense* and *Agrostis stolonifera.*

2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. Green Line: Also measured on these transects.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
RE-11		Left	2.0	*Agrostis stolonifera*
		Right	8.5	*Agrostis stolonifera/Equisetum arvense*
		Channel	3.5	Water

RE-11: Cover by community types in Box Canyons (October 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Populus tremuloides/Rosa woodsii	15.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Juncus longistylis	4.50
Equisetum arvensis	6.00
TOTAL COVER (Upland Species)	15.00
TOTAL COVER (Riparian Species)	10.50
BAREGROUND	0.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	3.50
Moss	0.00
TOTAL COVER	29.00

PHOTOGRAPHIC DOCUMENTATION

RE-11

RIPARIAN COMPLEX DATA SHEET
October 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number RE-12

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 3 - 8, 2005

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: 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)
Populus tremuloides	*Salix sp.*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Salix sp.	*Artemisia tridentata*	*Taraxacum officinale*	*Carex lanuginosa*
	Rosa woodsii	*Eriogonum sp.*	*Juncus longistylis.*
		Equisetum arvense	*Juncus arcticus*
			Poa secunda

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°): 0

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

% 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) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method.
2) The area looked more stable and better than the site upstream.
3) Photo taken from left side.

DATA SUMMARIES

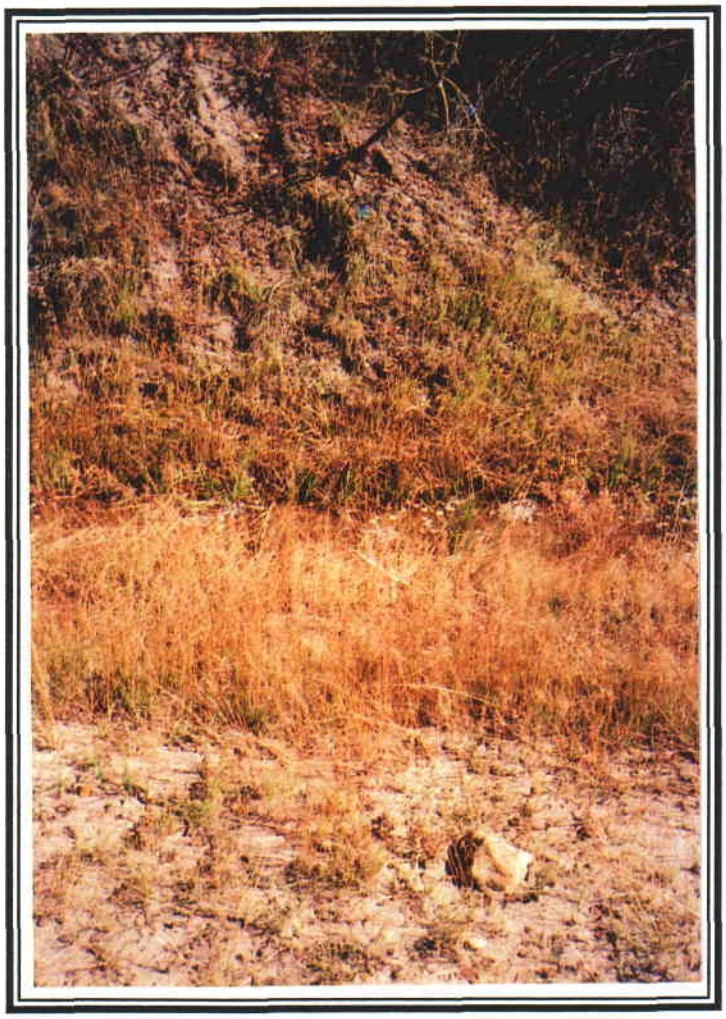
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
RE-12		Left	6.5	*Agrostis stolonifera*
		Right	2.0	*Agrostis stoloniferaJuncus longistylis*
		Channel	2.5	Water

RE-12: Cover by community types in Box Canyons (October 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Artemisia tridentata/Elymus trachycaulus	8.00
Populus tremuloides/Rosa woodsii	11.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera	8.50
TOTAL COVER (Upland Species)	19.00
TOTAL COVER (Riparian Species)	8.50
BAREGROUND	0.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	2.50
Moss	0.00
TOTAL COVER	30.00

PHOTOGRAPHIC DOCUMENTATION



RE-12

RIPARIAN COMPLEX DATA SHEET
October 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number RE-13

WATERBODY NAME: East Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 3 - 8, 2005

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: 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)
Picea pungens	*Artemisia tridentata*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides	*Potentilla fruticosa*	*Equisetum arvense*	*Carex lanuginosa*
Pinus ponderosa	*Symphoricarpos oreophilus*	*Artemisia dracunculus*	*Festuca ovina*
		Erigeron divergens.	*Juncus sp.*
		Achillea millefolium	*Elymus trachycaulus*
		Lupinus sp.	*Juncus arcticus*

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: 50
% bank length unvegetated, stable: 40
% bank length vegetated, unstable: 0
% 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) Photo taken from both sides.
2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method.
3) Site was dry.

DATA SUMMARIES

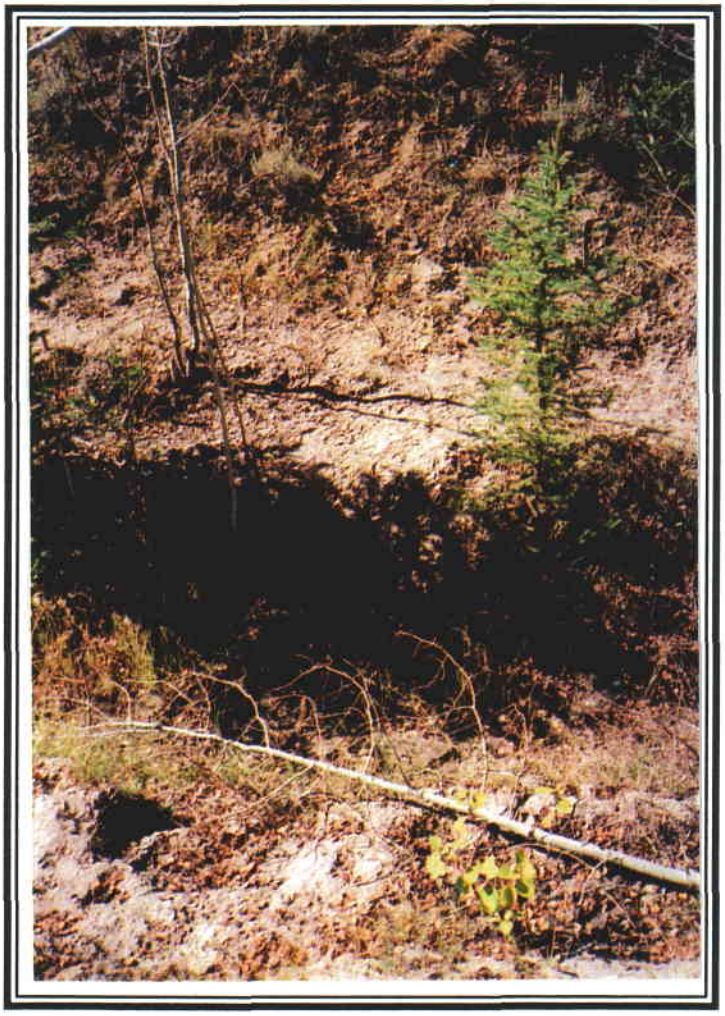
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
RE-13		Left	3.5	*Agrostis stolonifera/Ranunculus cymbalaria*
		Right	3.5	*Agrostis stolonifera/Ranunculus cymbalaria*
		Channel	1.0	Rock & Bareground

RE-13: Cover by community types in Box Canyons (October 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Artemisia tridentata/Elymus trachycaulus	10.00
Populus tremuloides	10.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Ranunuculus cymbalaria	7.00
TOTAL COVER (Upland Species)	20.00
TOTAL COVER (Riparian Species)	7.00
BAREGROUND	0.50
ROCK	0.00
WATER/MUD/DRY CHANNEL	0.50
Moss	0.00
TOTAL COVER	28.00

PHOTOGRAPHIC DOCUMENTATION



RE-13

RIPARIAN COMPLEX DATA SHEET
October 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-07

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 3 - 8, 2005

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: 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)
Picea pungens	*Juniperus communis*	*Achillea millefolium*	*Agrostis stolonifera*
Populus tremuloides	*Potentilla fruticosa*	*Equisetum arvense*	*Carex lanuginosa*
Betula occidentalis		*Urtica dioica*	*Juncus longistylis*
		Artemisia ludoviciana	

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°): 35
% bank length gently sloping (>135°): 50
% bank length with overhanging vegetation: 35

BANK CONDITION

% bank length vegetated, stable: 35
% bank length unvegetated, stable: 30
% bank length vegetated, unstable: 0
% bank length unvegetated, unstable: 35

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

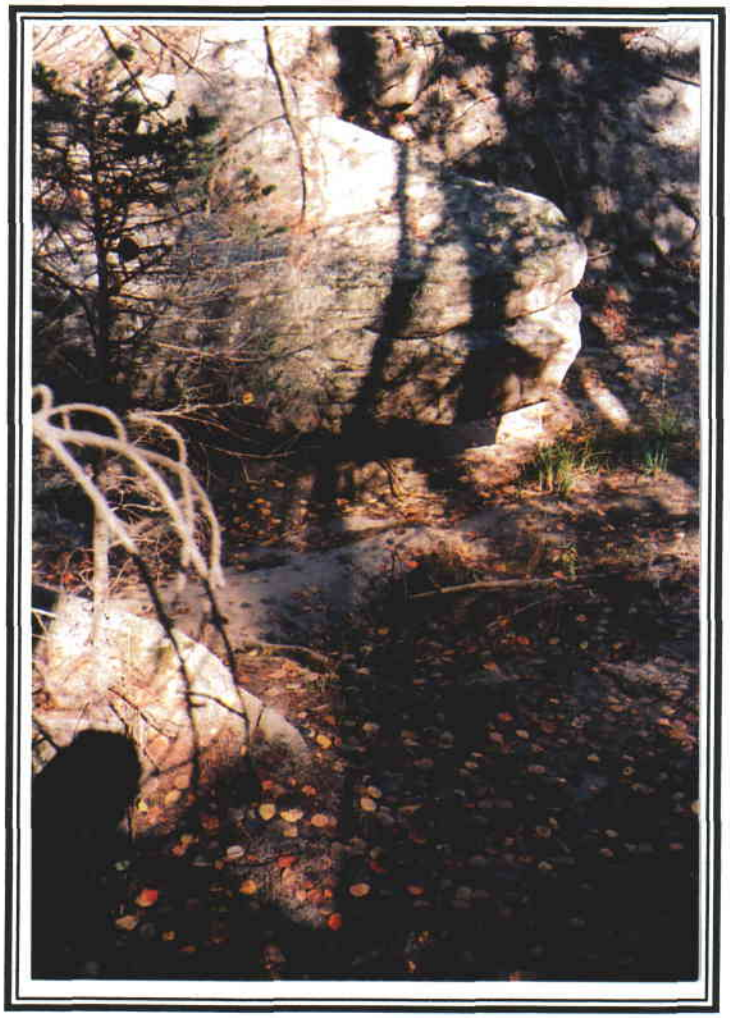
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-07		Left	5.0	*Agrostis stolonifera/Carex lanuginosa*
		Right	0.0	
		Channel	7.0	Bareground

R-07: Cover by community types in Box Canyons (October 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Picea pungens	7.00
Populus tremuloides	10.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Carex lanuginosa/Agrostis stolonifera	5.00
TOTAL COVER (Upland Species)	17.00
TOTAL COVER (Riparian Species)	5.00
BAREGROUND	7.00
ROCK	10.00
WATER/MUD/DRY CHANNEL	0.00
Moss	0.00
TOTAL COVER	39.00

PHOTOGRAPHIC DOCUMENTATION



R-07

RIPARIAN COMPLEX DATA SHEET
October 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-09

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 3 - 8, 2005

OBSERVER(S): P.D. Collins

QUAD NAME: Emery West, Utah

GEOLOGIC PARENT MATERIAL: Castlegate Ss

ASPECT: N

VALLEY BOTTOM TYPE: II

STREAM GRADIENT: ~2°

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: 550 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)
Picea pungens	*Salix lutea.*	*Ranunculus cymbalaria*	*Agrostis stolonifera*
Populus tremuloides	*Artemisia tridentata*	*Equisetum arvense*	*Juncus longistylis*
Juniperus scopulorum	*Rosa woodsii*	*Urtica dioica*	*Juncus arcticus*

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°): 40

% bank length gently sloping (>135°): 40

% bank length with overhanging vegetation: 50

BANK CONDITION

% bank length vegetated, stable: 75

% bank length unvegetated, stable: 10

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 15

BANK STABILITY (bankfull area only; many sideslopes above these areas were quite unstable): stable (left side); moderately 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) The left side of the river there was had mostly riparian species. It was difficult to tell if it was from hillside water or stream. Seemed more like stream influence.
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	14.5	*Agrostis stolonifera/Juncus longistylis /J.arcticus*
		Right	4.0	*Agrostis stolonifera/Ranunculus cymbalaria*
		Channel	0.5	Water

R-09: Cover by community types in Box Canyons (October 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Populus tremuloides	10.50
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera	4.50
Agrostis stolonifera/Ranunuculus cymbalaria	4.00
Juncus longistylis/Equisetum arvense	
Juncus arcticus/Juncus longistylis	10.00
TOTAL COVER (Upland Species)	10.50
TOTAL COVER (Riparian Species)	18.50
BAREGROUND	0.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	0.50
Moss	0.00
TOTAL COVER	29.50

PHOTOGRAPHIC DOCUMENTATION

R-09

RIPARIAN COMPLEX DATA SHEET
October 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-11

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 3 - 8, 2005

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: 350 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)
Picea pungens	*Rosa woodsii*	*Epilobium angustifolium*	*Agrostis stolonifera*
Populus tremuloides		*Equisetum arvense*	*Juncus longistylis*
		Ranunculus cymbalaria	*Juncus arcticus*
			Poa secunda

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°): 40

% bank length gently sloping (>135°): 60

% bank length with overhanging vegetation: 10

BANK CONDITION

% bank length vegetated, stable: 35

% bank length unvegetated, stable: 0

% bank length vegetated, unstable: 0

% bank length unvegetated, unstable: 65

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.

3) Right stake was missing. For transect, we measured from aspen tree (see photo) with blue flag.

4) Right side had no vegetation; all unstable; left side ave. 70% veg (ave. of two sides therefore 35% (see Bank Condition above).

5) Left side had more riparian vegetation and less upland.

DATA SUMMARIES

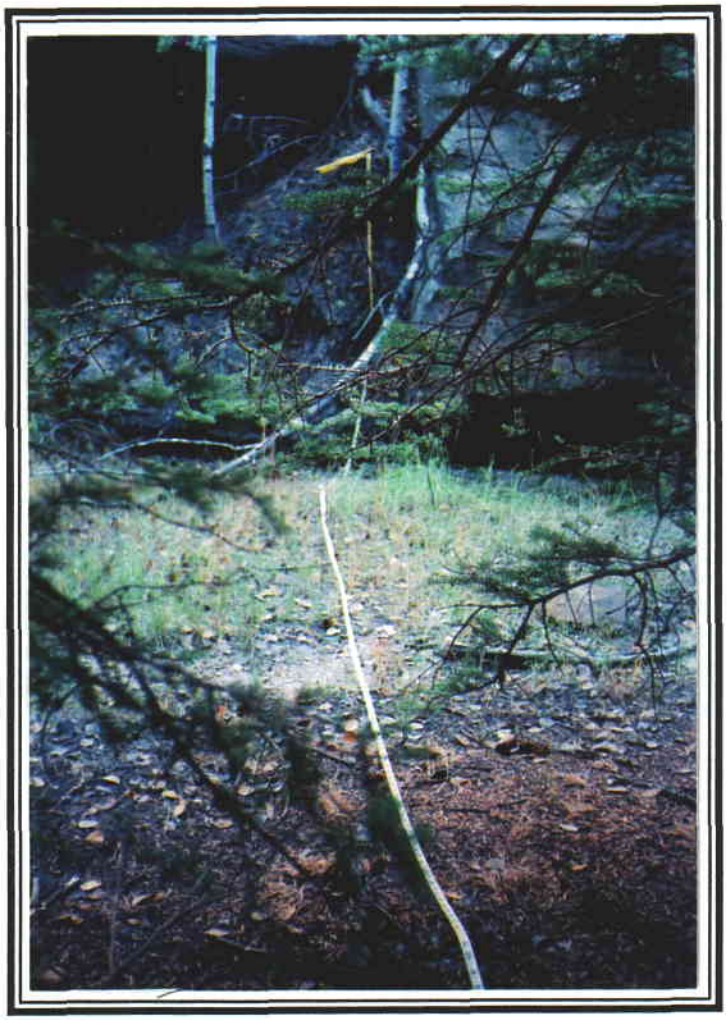
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-11		Left	9.0	*Equisetum arvense/Agrostis stolonifera/Juncus longistylis*
		Right	0	
		Channel	4.5	Water (0.5); bareground (4.0)

R-11: Cover by community types in Box Canyons (October 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Picea pungens/Poa secunda	13.50
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera/Juncus longistylis	6.00
Juncus longistylis/Equisetum arvense	3.00
TOTAL COVER (Upland Species)	13.50
TOTAL COVER (Riparian Species)	9.00
BAREGROUND	4.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	0.50
Moss	0.00
TOTAL COVER	27.00

PHOTOGRAPHIC DOCUMENTATION



R-11

RIPARIAN COMPLEX DATA SHEET
October 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-13

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 3 - 8, 2005

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: 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)
Picea pungens	*Potentilla fruticosa*	*Equisetum arvense*	*Agrostis stolonifera*
Populus tremuloides	*Juniperus communis*	*Cirsium sp.*	*Carex lanuginosa*
Salix lucida		*Ranunculus cymbalaria*	*Juncus longistylis*
Salix sp.			*Bromus carinatus*
			Elymus trachycaulus
			Juncus arcticus
			Poa fendleriana

POOL ATTRIBUTES

% area in pools: 70 (slow water this time of year)
% 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: 50

BANK CONDITION

% bank length vegetated, stable: 80
% bank length unvegetated, stable: 20
% 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 Oct 2003 (45 ft.); July 2004, October 2004, July 2005, October 2005 were consistent at 45 ft.
2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. Green Line: Also measured on these transects.
3) Photograph taken from the left side.
4) About 15 ft of right side riparian community (Redtop/Wiregrass) was influence by tributary on that side.

5) The upper banks were wetland and probably influenced by the stream water.
6) Redtop was increasing and dominated the riparian community as a whole.

DATA SUMMARIES

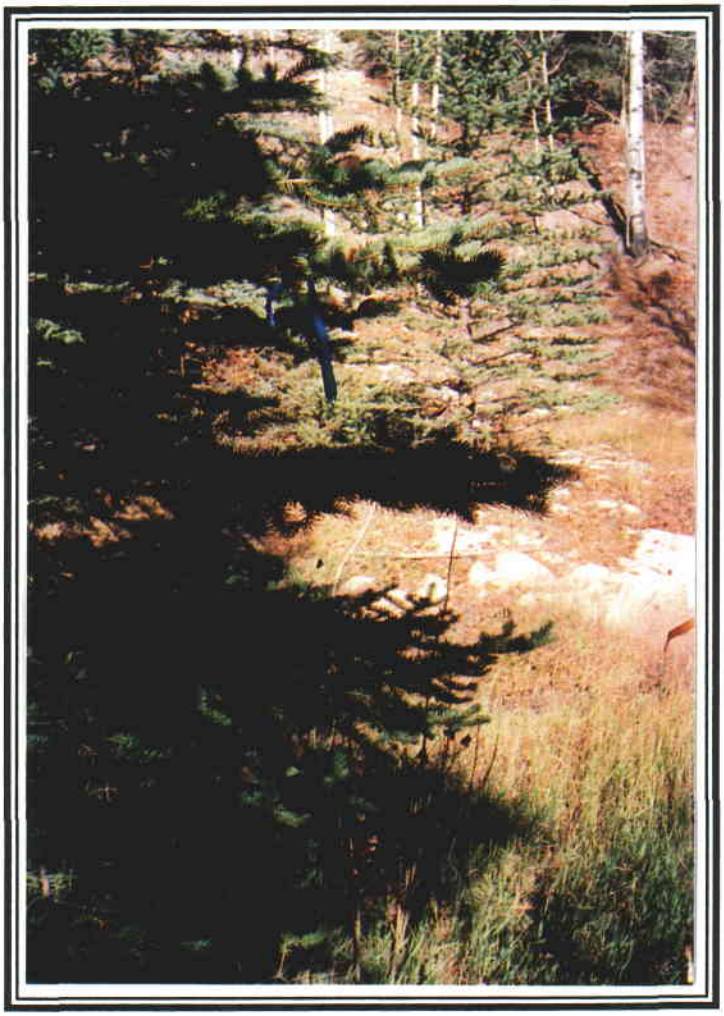
GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-13		Left	17.0	*Agrostis stolonifera*
		Right	19.0	*Agrostis stolonifera/Salix lutea/Carex lanuginosa*
		Channel	2.0	Water

R-13: Cover by community types in Box Canyons (October 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Picea pungens	8.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera	17.00
Agrostis stolonifera/Juncus arcticus	15.00
Agrostis stolonifera/Salix lucida	4.00
TOTAL COVER (Upland Species)	8.00
TOTAL COVER (Riparian Species)	36.00
BAREGROUND	0.00
ROCK	0.00
WATER/MUD/DRY CHANNEL	2.00
Moss	0.00
TOTAL COVER	46.00

PHOTOGRAPHIC DOCUMENTATION



R-13

RIPARIAN COMPLEX DATA SHEET
October 2005

CLIENT: Canyon Fuel Company

COMPLEX: Riverine - Number R-15

WATERBODY NAME: Main Fork Box Canyon

LOCATION: Southern Wasatch Plateau, Utah

DATE: October 3 - 8, 2005

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: 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)
Picea pungens	*Juniperus communis*	*Aster sp.*	*Agrostis stolonifera*
Populus tremuloides	*Symphoricarpos oreophilus*	*Equisetum arvense*	
Cornus stolonifera	*Salix lutea*	*Epilobium angustifolium*	

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°): 40

% bank length gently sloping (>135°): 5

% bank length with overhanging vegetation: 20

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) Left side had horsetail in the "upland" area, but it was high enough in elevation that we felt it was influenced by side-slope water.
2) Quantitative Methods: Used USDA Forest Service Protocol for Level III by measuring the plant communities using the line intercept method. Green Line: Also measured on these transects.
3) Length of transect line in Oct. 2003 was less than 1999 due to movement; since that time it as been consistent (26 ft.).

4) Photo from 1999 was from a different place (stake number indicated I was in the correct location in Oct 2003, July 2004, July 2005, Oct 2005).
5) Right side had patchy vegetation and sandy bareground areas. Left side had virtually no riparian vegetation.

DATA SUMMARIES

GREEN LINE WIDTH (HYDRIC) & COMMUNITY TYPE :

Sample Site	Other Name	Side of Stream (looking downstream)	Width (ft.)	Community Type
R-15		Left	6.0	*Equisetum arvense/Agrostis stolonifera/Carex lanuginosa*
		Right	0	
		Channel	6.0	Water (2.0); rock (4.0)

R-15: Cover by community types in Box Canyons (October 2005).
USDA Forest Service Protocol (1992)

UPLAND VEGETATION	
Populus tremuloides/Picea pungens	14.00
RIPARIAN VEGETATION	
Dominant Woody Species	
Dominant Herbaceous Species	
Agrostis stolonifera	1.00
Equisetum arvensis/Carex lanuginosa	5.00
TOTAL COVER (Upland Species)	14.00
TOTAL COVER (Riparian Species)	6.00
BAREGROUND	0.00
ROCK	4.00
WATER/MUD/DRY CHANNEL	2.00
Moss	0.00
TOTAL COVER	26.00

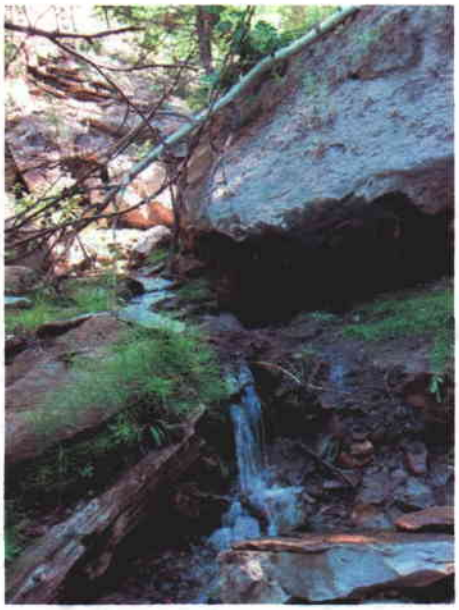
PHOTOGRAPHIC DOCUMENTATION

R-15

East Fork of Box Canyon Studies-Macroinvertibrate

Canyon Fuel Company, LLC – Sufco Mine has not received a copy of the 2005 Macroinvertibrate Survey Report to date. A copy of the Macroinvertibrate Study will be submitted when Consultant completes it.

Report of Hydrologic Monitoring of the East Fork of Box Canyon Creek, 2005 Sufco Mine



28 March 2006

Canyon Fuel Company, LLC
Sufco Mine
Salina, Utah

PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

Report of Hydrologic Monitoring of the East Fork of Box Canyon Creek, 2005 Sufco Mine

28 March 2006

Canyon Fuel Company, LLC
SUFCO Mine
Salina, Utah

Prepared by:

Erik C. Petersen, P.G.
Senior Hydrogeologist
Utah P.G. No. 5373615-2250

PETERSEN HYDROLOGIC, LLC
CONSULTANTS IN HYDROGEOLOGY

2695 N. 600 E.
LEHI, UTAH 84043
(801) 766-4006

Report of Hydrologic Monitoring of the East Fork of Box Canyon Creek, 2005

1.0 Introduction

Canyon Fuel Company's Sufco Mine is located in the southern Wasatch Plateau coal district, approximately 20 miles east of Salina, Utah. During late 2003, longwall mining in the 3 Left Pines East (3LPE) longwall panel commenced beneath a portion of the East Fork of Box Canyon Creek, a tributary to Box Canyon Creek (Figure 1). Beginning in mid-November 2003 and continuing through early January 2004, an approximate 2,000-foot reach of the East Fork stream drainage was subsided. During 2005, longwall mining in the 4LPE and 5LPE panels occurred beneath the upper reaches of the East Fork of Box Canyon drainage (Figure 1).

In accordance with Sufco's approved mining plan for the undermining of the East Fork, Canyon Fuel Company committed to performing routine monitoring of discharge rates in potentially impacted stream reaches and springs. Canyon Fuel Company commissioned Petersen Hydrologic, LLC to perform this monitoring, commencing in October 2003. The results of the ongoing monitoring activities at the East Fork of Box Canyon through 2005 are summarized in this report.

Including this introduction, this report contains the following sections:

1. Introduction
2. Methods of Study
3. Presentation of Data
4. Overview of Hydrology of the East Fork
5. Discussion
6. References Cited

2.0 Methods of Study

- A site visit to the East Fork of Box Canyon was made on 22-23 September 2003 with representatives of the Utah Division of Oil, Gas, and Mining, the Manti La Sal National Forest, and Canyon Fuel. During this site visit, locations along the East Fork of Box Canyon Creek and at adjacent springs were selected for flow monitoring. The designated monitoring sites were labeled and marked in the field with flagging and wooden stakes. At a later time, three additional monitoring sites located further downstream in the East Fork drainage were selected for monitoring.

  Additional monitoring data in the East Fork drainage were collected as part of Canyon Fuel Company's regular quarterly hydrologic monitoring program (DOGM, 2005).

- The East Fork of Box Canyon was accessed and individual monitoring sites were monitored at intervals specified in the approved monitoring plan. During the summer and early fall months, the canyon was accessed by vehicle. Where possible, during the late fall, winter, and spring months, the canyon was accessed using ATV's or snowmobiles. During certain times of the year, the canyon could not reasonably be accessed in a safe manner.

- Discharge rates in the East Fork of Box Canyon Creek and at springs were measured using a stopwatch and a calibrated container. The measurements were performed by diverting the stream or spring discharge through a plastic pipe and performing time-to-fill measurements using a suitable container. Time-to-fill measurements were repeated at a site until the discharge through the pipe had stabilized. Generally, after the discharge from the pipe had stabilized, at least three additional time-to-fill measurements were performed. The time-to-fill values measured after the discharge had stabilized were averaged and used to calculate the discharge rate. Where noted, in a few instances, such as where stream flow was partially obscured beneath the ice, discharge rates in the East Fork were estimated.

- The monitoring station was digitally photographed during each monitoring event.

- The discharge data were compiled into electronic format and analyzed using graphical methods.

3.0 Presentation of Data

The locations of spring and stream monitoring stations in the East Fork drainage are shown on Figure 1. Also shown on Figure 1 are the approximate areas of subsidence associated with the mining of the 3, 4, and 5 Left Pines East longwall panels in the East Fork drainage. Discharge measurements for the East Fork of Box Canyon Creek and nearby springs during 2003, 2004, and 2005 are presented in Table 1.

4.0 Overview of Hydrology of the East Fork of Box Canyon Drainage

The East Fork of Box Canyon is a small drainage that is tributary to Box Canyon Creek. Box Canyon Creek is tributary to Muddy Creek about 2 miles below the study area. Historically, discharge in the creek during the summer and fall months has ranged from about 8 to 22 gpm at the confluence with Box Canyon Creek (Utah Division of Oil, Gas and Mining, 2005, on-line hydrology database). Appreciably higher flows are common during the spring runoff season and during heavy precipitation events.

Historically, the upper extent of perennial discharge in the East Fork of Box Canyon Creek has occurred below monitoring site EFB-6 (Sufco quarterly monitoring site Pines 106). Above station EFB-6, the drainage is commonly dry or has only meager discharge (<1 gpm; Table 1). Below EFB-6, the discharge in the creek gradually increases downstream as a result of discharge from shallow groundwater systems. Based on observations of the stream channel made since 1998, it is apparent that the stream does not gain appreciably below monitoring station EFB-11. Rather, it has been observed that surface-water discharge rates

in the middle and lower reaches of the East Fork of Box Canyon (below subsided areas) are sometimes lower than those near EFB-11 located higher in the drainage. This is particularly true in the hot summer and early fall months. This condition is likely a result of evapotranspiration losses and groundwater-surface water interactions between the creek and adjacent alluvial groundwater systems in the middle and lower reaches of the canyon.

It is noteworthy that climatic conditions in the region have varied substantially during the period of monitoring at the East Fork of Box Canyon (2003-2005). This is illustrated by a plot of the Palmer Hydrologic Drought Index (PHDI) for Utah Region 4 (Figure 2). The PHDI is a monthly numerical value generated by the National Climatic Data Center (NCDC) that indicates the severity of wet and dry spells. The PHDI is calculated from various hydrologic parameters including precipitation, temperature, evapotranspiration, soil water recharge, soil water loss, and runoff. Consequently, it is useful for evaluating the relationship between climatic conditions and groundwater discharge and potentiometric data. It is apparent in Figure 2 that the region was experiencing a mild to moderate drought during late 2003 and the first three quarters of 2004. Beginning in October of 2004 the region transitioned to a period of significant wetness that continued throughout 2005.

5.0 Discussion

On 10 October 2003, prior to undermining in the East Fork drainage, the East Fork monitoring stations were monitored and inspected to determine pre-mining conditions in the canyon. The East Fork of Box Canyon Creek was first undermined using full-extraction

longwall mining techniques in the 3LPE panel starting in mid November 2003 (Figure 1). Undermining of the East Fork drainage in the 3LPE panel continued as mining progressed southward until early January 2004. Undermining of the upper reaches of the East Fork of Box Canyon in the 4LPE longwall panel began in early 2005 and continued for several months. During November and December of 2005 the middle reaches of the East Fork of the East Fork (near spring Pines 105; Figure 1) were undermined in the 5LPE longwall panel.

It was noted that discharge in the East Fork increased appreciably shortly after the stream was first undermined in late 2003 with the 3LPE longwall panel (Table 1). A similar occurrence was observed at spring Pines 214 (Table 1). This condition was anticipated and was most likely related to the compression (squeezing) of the aquifer matrix as the stress field associated with the progression of the longwall mining face moved through the area. The effects of this phenomenon are apparent in the hydrograph of stream discharge at monitoring station EFB-11 in Figure 3. It is apparent in Figure 3 that the discharge in the East Fork increased rapidly during November 2003 as mining progressed beneath the area, then declined rapidly during December 2003 and January 2004 as the longwall face passed beyond the region.

It was predicted prior to mining that tension fractures in the East Fork stream substrate would likely have small (less than ½-inch) apertures. Inspection of the stream substrate in 2003-2004, after subsidence related to mining of the 3LPE had occurred, confirmed that this was the case. Similarly, tension fractures in the East Fork stream channel overlying the 4LPE and 5LPE longwall panels were observed to have small apertures. Other than some moderate

bedrock cracking/buckling of a short (~40-foot) section of the stream substrate immediately above monitoring station EFB-7, tension cracking of the stream channel overlying the 4LPE and 5LPE was relatively minor.

It was also anticipated that tension cracks in the stream channel would be "dead-end" openings that would not convey surface water out of the East Fork drainage or downward into the Sufco Mine. Based on discharge measurements performed in the East Fork during 2003 and 2004, it is apparent that no significant quantities of surface water were lost from the drainage as a result of longwall mining in the 3LPE panel. Stream discharge data from the 3LPE subsidence area measured during 2005 continued to support that conclusion. It is also apparent in the 2005 data that discharge in the creek increased appreciably in response to the wetter climatic conditions the region experienced during 2005.

In Figure 4, the maximum discharge measured in the creek (station EFB-11, located near the middle of the 3LPE panel) is plotted against the maximum downstream discharge rate below the subsided area (stations EFB-11A, B, or C) for the period 2003 - 2005. It is apparent in Figure 4 that the quantity of water flowing out of the subsided area is similar to the maximum quantity measured upstream in the creek (at EFB-11). During the spring and summer months of 2004, the discharge at the downstream monitoring site was slightly less than that measured above, while in November of 2004 and during 2005 the discharge at the downstream site was greater than that measured above. This information demonstrates that appreciable quantities of surface water were not lost from the drainage (at least in the lower, western half of the 3LPE panel area). The fact that groundwater contributions to stream

baseflow have occurred consistently in the upper, eastern half of the 3LPE area since undermining occurred suggests that stream flow was likewise not removed from the drainage in the upper half of the 3LPE area. Based on this information, and the fact that the overall discharge in the creek was generally similar to that observed and measured in pre-mining years, there is no evidence to suggest that any appreciable quantity of surface water has been removed from the East Fork drainage as a result of mining-related activities at the Sufco Mine.

It was observed during December 2003 that discharge from the springs located along the base of the Castlegate Sandstone cliff on the northeast hillside above the creek ceased. Decreases in discharge from spring Pines 214 were also measured during this time. During baseflow conditions in October 2003, the combined flow from springs EFB-12, EFB-13, and EFB-14 was approximately 3.0 gpm (Table 1). Although it was considered unlikely, it had been predicted that discharge from these springs could be diverted small distances down-gradient as a result of mining-induced cracking of bedrock near the springs. It is apparent that this phenomenon occurred at these springs. Although there is currently no discharge from these springs at the surface (EFB-12, EFB-13, and EFB-14), it appears that the groundwater system that previously supported discharge from these springs now discharges groundwater to the creek through diffuse seepage along the stream bank a short distance lower in the drainage. This conclusion is based on two considerations. Firstly, a zone of saturated soil and colluvium was noted along the stream bank slightly down-gradient of the spring locations at approximately the same time as the springs were going dry. On 8 December 2003, it was observed that the saturated sediments had slid, forming a small slump

near the East Fork channel bottom. Visible groundwater discharge from the slumped colluvial sediments was observed throughout 2005. It seems likely that this discharge, and diffuse discharge occurring at other locations along the stream channel represent the approximately 3 gpm of groundwater that was previously discharging from the springs higher on the hillside.

The second line of evidence suggesting that discharge from the groundwater system that previously supported springs EFB-12, EFB-13, and EFB-14 continues to flow into the East Fork drainage is shown in Figure 5. In Figure 5, discharge measurements from monitoring stations during six selected monitoring events are plotted together with their relative linear distance down the stream channel from EFB-1. Measurements are plotted for the pre-mining baseflow condition (10 October 03), the peak of mining-enhanced discharge in the creek (15 December 03), the early summer of 2004 after a minimal runoff season (25 June 2004), late-season baseflow conditions after repairs to the stream channel (discussed later) had been performed (2 November 2004), during late spring runoff in a wet year (1 June 2005), and during baseflow conditions in a wet year (27 October 2005). It is apparent in each of these plots that discharge rates in the East Fork increased downstream from EFB-6 to EFB-11 (which generally corresponds to the area of spring discharge from near the base of the Castlegate Sandstone). If the groundwater system that provided baseflow to the creek and supported springs EFB-12, EFB-13, and EFB-14 was drained (i.e., the groundwater was diverted downward into the mine or laterally into another drainage) measurable groundwater contributions to baseflow discharge to the creek would not be anticipated. That the stream continues to gain water through this reach under all seasonal and climatic conditions at

magnitudes similar to those measured before mining supports the conclusion that only the discharge locations of the impacted springs have been moved, and dewatering of the groundwater system has not occurred.

When the East Fork drainage was visited early in the spring of 2004 (29 April 2004), it was noted that several short reaches of the creek were dry. The lengths of the dry reaches varied from a few feet to a few hundred feet. Because the stream drainage was mostly covered with snow during the December 2003 and January 2004 monitoring events, it was not known whether the dry reaches of the creek existed prior to April 2004 or whether they had occurred more recently. As discussed above, it has been demonstrated that surface water was not being diverted into deeper geologic formations or into the Sufco Mine openings, nor was it being redirected to adjacent surface water drainages. It is noteworthy that the dry stream reaches were primarily observed in the Blackhawk Formation where thin- to medium-bedded silty sandstone rocks were exposed in the bottom of the stream channel. Where these bedded sedimentary rocks are exposed at the surface in areas that experienced subsidence fracturing and high geologic stresses, the sandstones tended to buckle or break along horizontal bedding planes. This resulted in loose slabs of rock lying on top of more competent rock in the stream channel. The buckling of the thin-bedded strata likely occurs primarily near the surface where there is no vertical confining pressure on the rocks. In deeper horizons where there is vertical confining pressure, the buckling of the rocks is likely much less intense, and fracture apertures (through which water can travel through the subsurface) are likely small. During periods of low flow in the East Fork, surface water was observed flowing beneath the loose, broken rock strata in the shallow subsurface, leaving the overlying channel surface

dry. Surface water was also observed flowing through tension fractures that were largely oriented parallel or sub-parallel to the direction of the stream flow. It is likely that movement of surface water through both the loose, buckled, bedded sedimentary strata and through the tension cracks was limited to the shallow sub-surface. This conclusion is supported by the fact that the dry stream reaches were typically relatively short in length, with generally only a few feet to a few tens of feet of topographic elevation difference between the upper and lower extents of the dry reaches. Typically, surface water re-emerged in the stream drainage where the first or second low-permeability shaley horizon intersected the channel bottom. If the surface water beneath the dry stream reaches were migrating through deep strata, it would be anticipated that the lengths of the dry reaches would be longer (i.e., the surface water would re-emerge farther downstream at lower topographic elevations).

The conclusion that the water flowing beneath the dry stream reaches was moving through the shallow subsurface is also evidenced by observations at ledges and waterfalls in the East Fork drainage. At many such locations, water was observed discharging from the waterfall or ledge only a few inches to a few feet below the top of the ledge.

Beginning on 21 September 2004 and continuing to 5 October 2004, repairs were made to the stream channel in the East Fork to restore continuous surface water flow to the dry stream reaches. In some locations, this was accomplished simply by removing the loose, buckled, bedded rocks from the channel substrate, revealing the surface flow beneath. In other locations, this was accomplished by placing bentonite in the stream channel in tension

cracked zones. These repairs were successful in restoring surface water flow in essentially all of the stream reaches in the East Fork channel subsided by the mining of the 3 Left Pines East panel. When the East Fork drainage was monitored on 2-3 November 2004, it appeared that stream flow in the drainage was continuous, although portions of the drainage were obscured by snow and ice cover. Discharge measurements and site observations made during 2005 confirmed the presence of continuous, substantial discharge in the stream from EFB-7 to the confluence with the Main Fork of Box Canyon during all 2005 site visits. Likewise, there was no indication of any downstream diminution in creek discharge that would indicate that surface flow was being diverted into the subsurface.

It is noteworthy that discharge from spring Pines 214 increased steadily beginning in August 2004 and continuing through 2005 (Figure 6; Table 1). Pines 214 flowed at approximately 2 gpm prior to undermining, then surged to 37 gpm concurrent with undermining in November 2003, then declined to as little as 0.08 gpm in June 2004 after mining had occurred. Since August 2004 the discharge has increased steadily from 0.09 gpm to 0.54 gpm in August 2005. Discharge from this spring will continue to be closely monitored to determine whether this recovery continues.

Discharges from spring Pines 105 and the spring at EFB-8 are plotted in Figure 7. The spring at EFB-8 is situated near the eastern margin of the 3LPE panel, while Pines 105 spring is located near the middle of the 5LPE panel (Figure 1). It is apparent in Figure 7 that discharges from these springs have not declined in response to longwall mining in the 3LPE,

4LPE, or 5LPE panels. This suggests that the groundwater systems that support these springs have not been impacted appreciably as a result of the subsidence of the spring areas. Spring Pines 105 was monitored on 21 December 2005 to determine whether impacts to spring discharge had occurred. The spring area had recently been undermined during November and December of 2005. A small-aperture subsidence fracture was observed along the north canyon rim trending toward a location about 100 feet upstream of the spring discharge location. However, the discharge measured at the spring was substantial (9.3 gpm) which was similar to that measured previously on 29 September 2005 (9.6 gpm) before the spring area was undermined. Discharge at spring Pines 105 will be monitored closely in the future for any potential mining-related impacts.

A 40-foot zone of dry streambed and buckled bedrock stream substrate was observed immediately upstream of EFB-7 during 2005. Stream flow in this zone apparently flowed through the shallow subsurface before reemerging about 2 feet below EFB-7 (subsequent discharge measurements during 2005 were taken at that location). This condition is likely related to longwall mining in the 4LPE panel, as no subsidence at the site was noted during mining of the adjacent 3LPE panel. This was the only notable occurrence of bedrock fracturing/buckling of the stream substrate observed during 2005 in the East Fork. Based on previous experience in the East Fork drainage, it is considered likely that this short reach of dry stream channel will naturally heal over time (if it is not manually repaired by the mine).

As discussed above, discharge data from the East Fork stream channel above EFB-6 indicate that the East Fork drainage is usually mostly dry above EFB-6. During 2003 and 2004, all

monitoring stations above EFB-6 were dry, with the exception of a small discharge (~0.5 gpm) measured at EFB-4 (Table 1). Discharge near EFB-4 was typically present for a distance of several tens to hundreds of feet above or below the EFB-4 during 2003-2004. Additionally, during 2003-2004 there were a few localized muddy/damp zones a few tens of feet in length present between EFB-5 and EFB-2. During 2005, no discharge was measured at EFB-4, although muddy/damp zones continued to be present in the East Fork between EFB-5 and EFB-2 (including near EFB-4). Stream flow in the poorly defined stream channel above EFB-2 was not observed prior to 2005, nor was it observed in 2005.

Continuous discharge in the East Fork of Box Canyon during 2003-2004 typically began at EFB-6. During 2005, continuous discharge in the East Fork also began at EFB-6. Historically, discharge in the creek increased rapidly between EFB-6 and EFB-7 (Figure 8). During late 2005, while seepage continued to occur at the marked EFB-6 monitoring location, it was apparent that considerably more discharge emerged from the stream channel about 30 feet below the marked EFB-6 location. It is unclear whether this slight shift in the location of the emergence of discharge in the East Fork is a mining-related occurrence, or whether it is the result of other factors. Regardless of the cause of the minor shift, substantial discharge (appreciably greater than that present during 2003-2004) was present throughout 2005 at a location about 30 feet below EFB-6.

References Cited

NCDC, 2005, Online monthly climatic parameters: www.ncdc.noaa.gov/coop-precip.html.

Utah Division of Oil, Gas and Mining, 2005, On-line hydrology database, Sufco Mine, http://ogm.utah.gov/coal/edi/wqdb.htm.

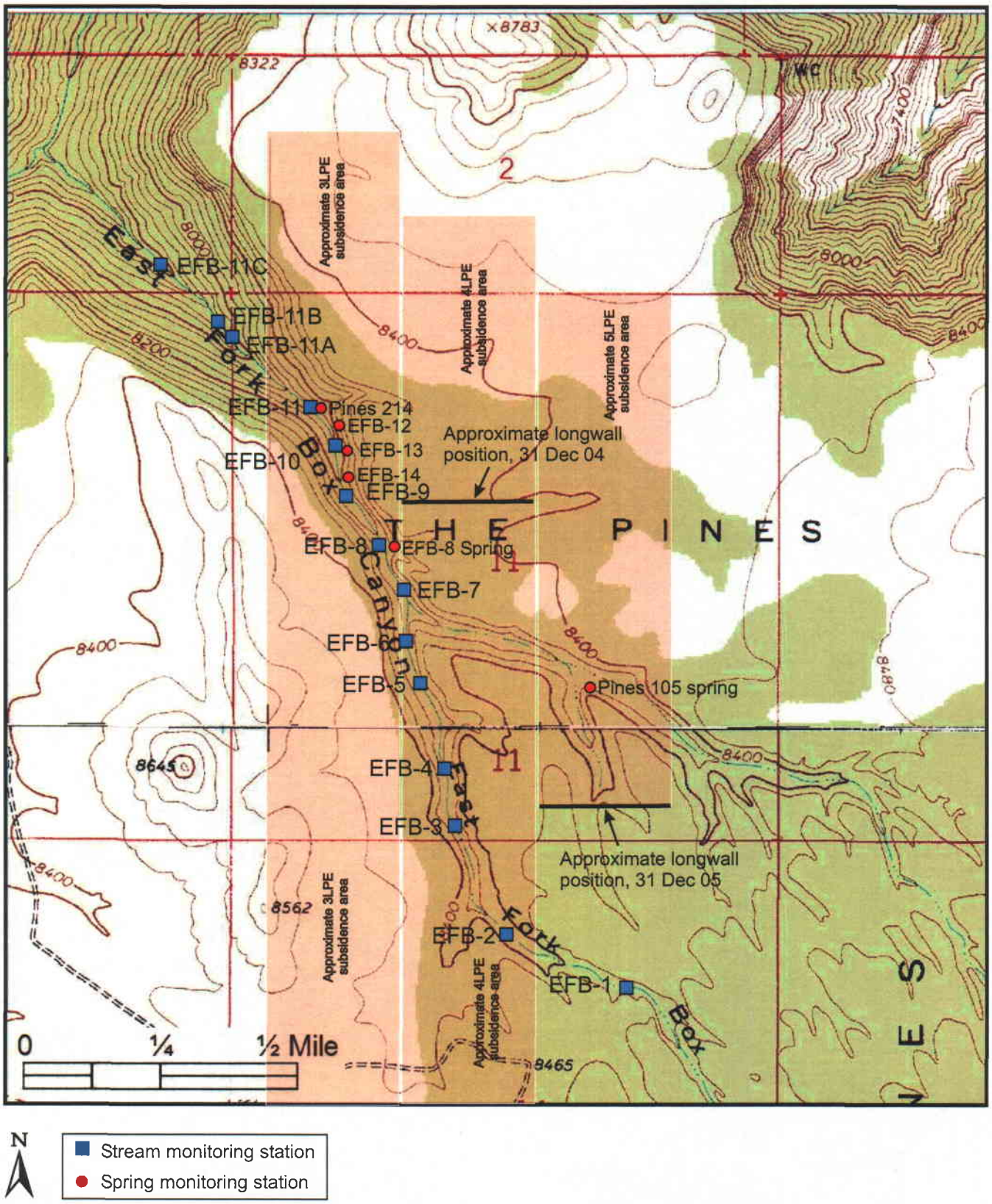
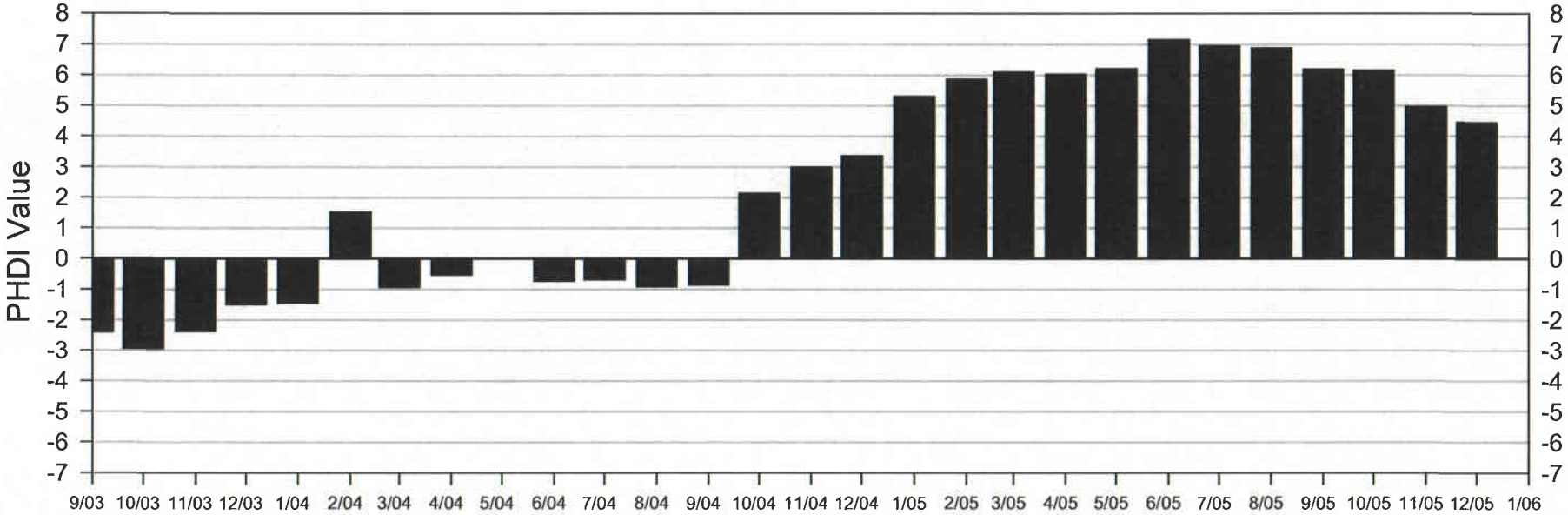


Figure 1 Monitoring locations in the East Fork of Box Canyon.



-1 to -2	Mild Drought	1 to 2	Mild Wet Spell
-2 to -3	Moderate Drought	2 to 3	Moderate Wet Spell
-3 to -4	Severe Drought	3 to 4	Severe Wet Spell
-4 to -5	Extreme Drought	4 to 5	Extreme Wet Spell

Figure 2 Plot of Palmer Hydrologic Drought Index for Utah Region 4.

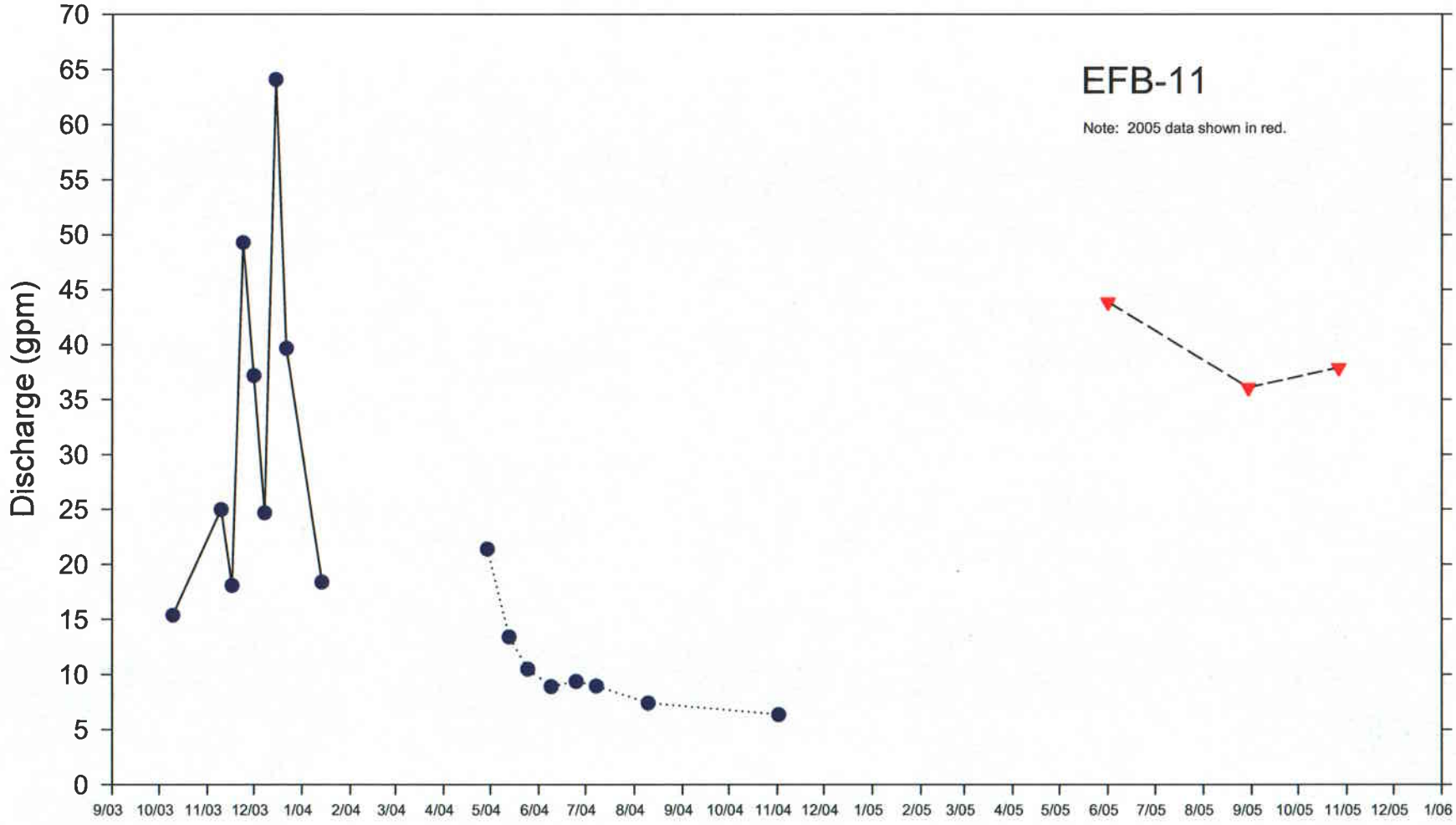


Figure 3 Discharge in the East Fork of Box Canyon Creek at monitoring station EFB-11.

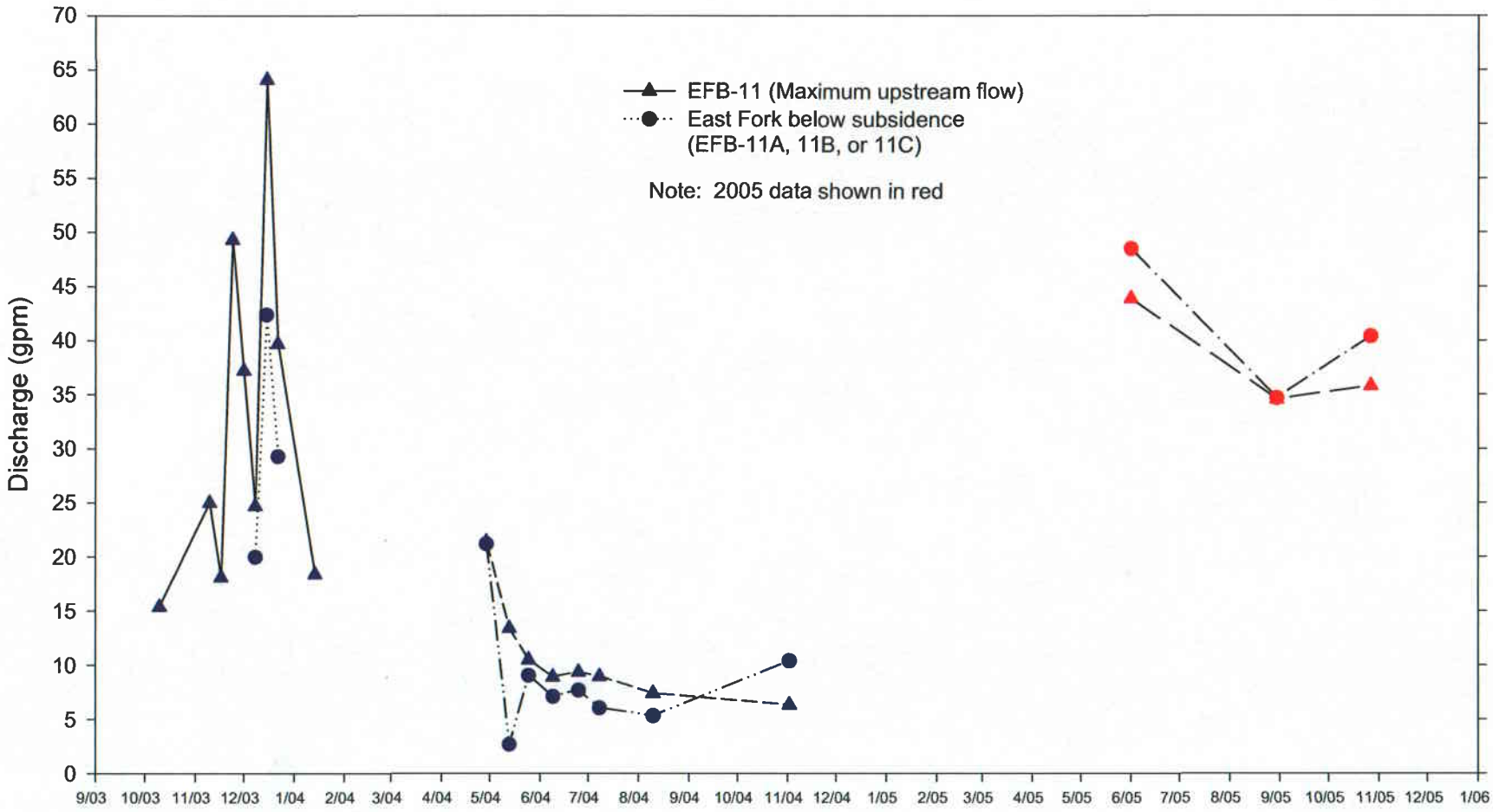
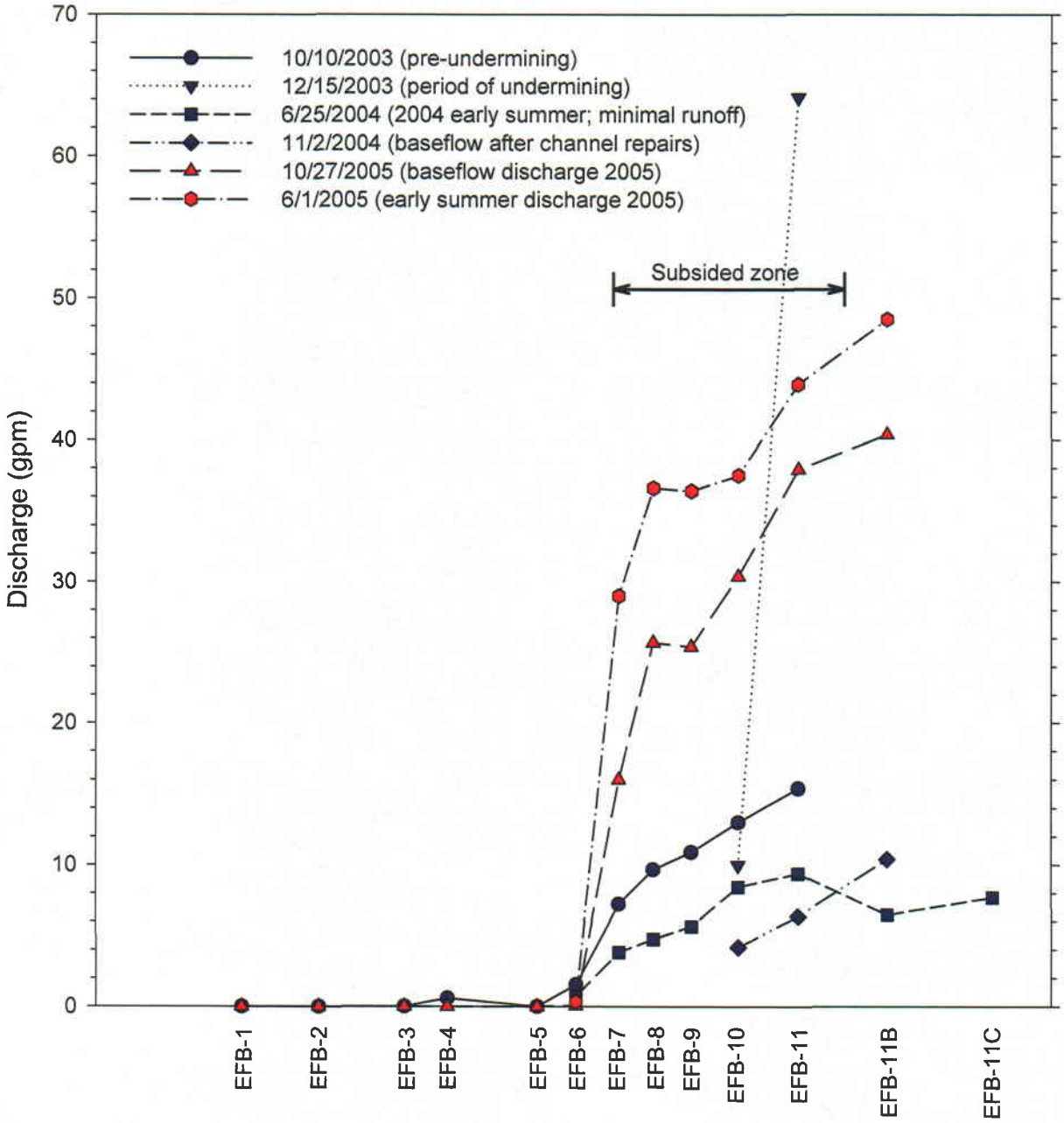


Figure 4 Comparison of maximum discharge in the East Fork of Box Canyon Creek with maximum discharge in the creek below the subsided area.



Note: 2005 data shown in red.
Discharge data from EFB-11A not shown on graph.

Figure 5 Plots of discharge from East Fork of Box Canyon Creek monitoring sites.

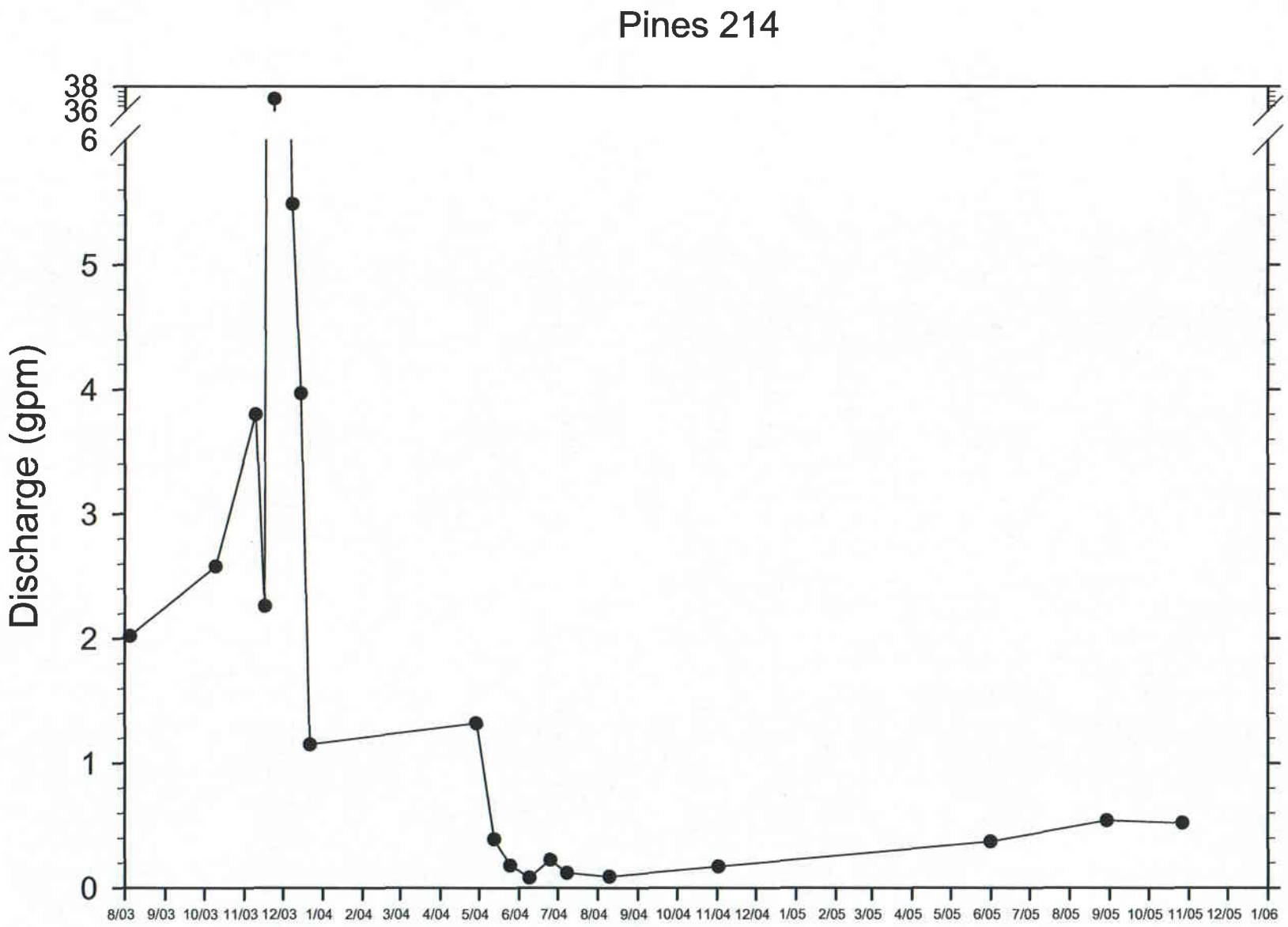


Figure 6 Discharge hydrograph for spring Pines 214.

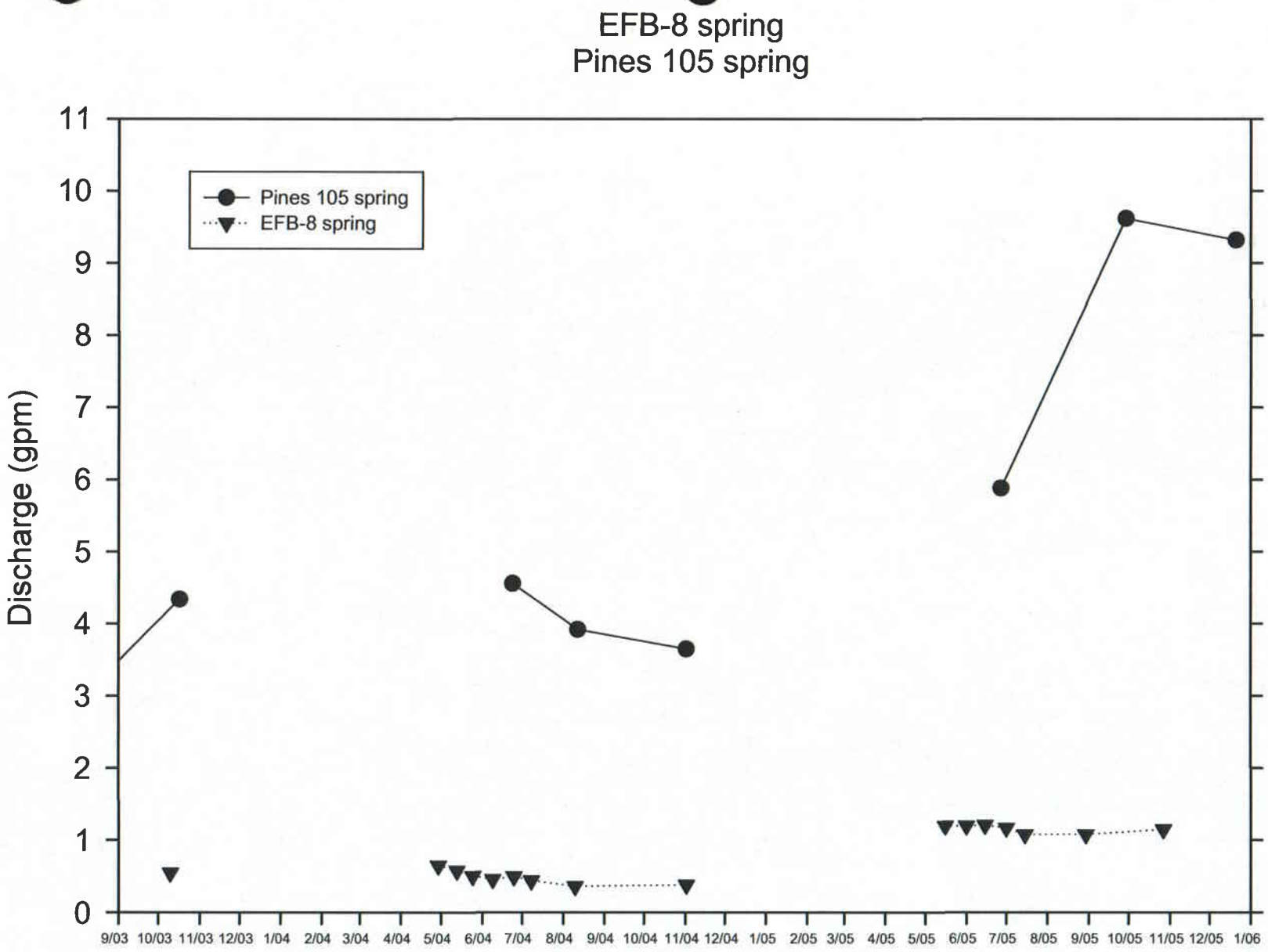


Figure 7 Discharge hydrographs for EFB-8 spring and Pines 105 spring.

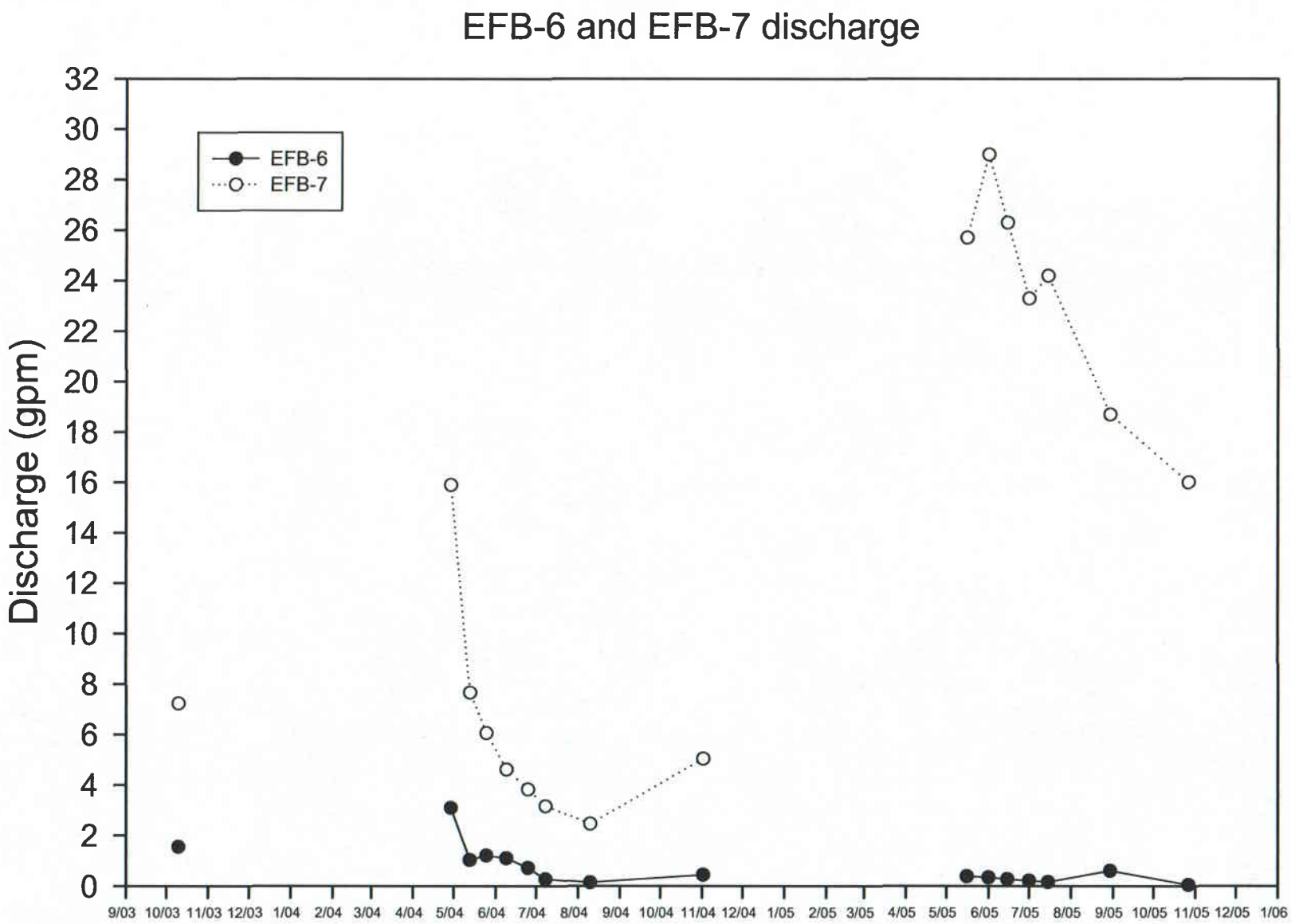


Figure 8 Discharge hydrographs for EFB-6 and EFB-7.

Table 1 East Fork Box Canyon flow measurements 2003 - 2005

PETERSEN HYDROLOGIC, LLC

Station	10/10/03	11/10/03	11/17/03	11/24/03	12/1/03	12/8/03	12/15/03	12/22/03	12/29/03	1/5/04	1/14/04	4/23/04	4/29/04	5/13/04	5/25/04	6/9/04	6/25/04	7/8/04	8/10/04	11/2/04	5/16/05	6/1/05	6/15/05	7/1/05	7/15/05	8/30/05	10/27/05
EFB-1	0								Inaccessible	Inaccessible		Inaccessible				0		0		0	0	0	0	0	0	0	0
EFB-2	0								Inaccessible	Inaccessible		Inaccessible				0		0		0	0	0	0	0	0	0	0
EFB-3	0								Inaccessible	Inaccessible		Inaccessible				0		0		0	0.05	0	0	0	0	0	0
EFB-4	0.588								Inaccessible	Inaccessible		Inaccessible				0.441		0.20		0.46	0	0	0	0	0	0	0
EFB-5	0								Inaccessible	Inaccessible		Inaccessible				0		0		0	0	0	0	0	0	0	0
EFB-6 (Pines 106)	1.55								Inaccessible	Inaccessible		Inaccessible	3.1	1.03	1.21	1.10	0.72	0.27	0.14	0.44	0.38	0.34	0.27	0.21	0.16	0.60	0.05
EFB-7	7.23								Inaccessible	Inaccessible	frozen	Inaccessible	15.9	7.66	6.06	4.62	3.83	3.16	2.46	5.04	25.7	29	26.3	23.3	24.2	18.7	16.0
EFB-8 (creek)	9.68							frozen	Inaccessible	Inaccessible	frozen	Inaccessible	15.4	8.42	7.02	5.20	4.76	4.34	3.36	8.25	43.3	36.5	38.7	27.1	33.5	30.2	25.7
(spring)	0.545							frozen	Inaccessible	Inaccessible	frozen	Inaccessible	0.65	0.58	0.503	0.457	0.495	0.44	0.36	0.38	1.20	1.2	1.21	1.17	1.08	1.08	1.15
EFB-9	10.9						frozen	frozen	Inaccessible	Inaccessible	frozen	Inaccessible	16.7	7.74	6.98	5.50	5.64	4.41	2.91	8.53	50.9	36.4				31.5	25.4
EFB-10	13.0	18.8	14.5	8.6	11.0	frozen	10 est.	30 est.	Inaccessible	Inaccessible	Inaccessible	Inaccessible	18.4	6.8	9.09	7.76	8.44	7.35	5.45	4.19		37.5				30.8	30.4
Pines 214	2.58	3.8	2.26	37.0	9.1	5.49	3.97	1.15	Inaccessible	Inaccessible	frozen	Inaccessible	1.32	0.39	0.18	0.081	0.224	0.12	0.09	0.17		0.37				0.54	0.52
EFB-11	15.4	25.0	18.1	49.3	37.2	24.7	64.1	39.7	Inaccessible	Inaccessible	18.4	Inaccessible	21.4	13.4	10.5	8.91	9.38	8.96	7.41	6.36		43.9				36.1	37.9
EFB-11A						20.0	42.4	29.3	Inaccessible	Inaccessible			10.1	2.69	2.20	1.29	1.15	0.98	1.13	Inaccessible		45.5				34.6	35.8
EFB-11B									Inaccessible	Inaccessible			21.2		9.05	7.11	6.47	6.05	5.36	10.40		48.5				34.7	40.4
EFB-11C									Inaccessible	Inaccessible							7.69	6.02	5.1	Inaccessible							
EFB-12 (north)	0.407			0.371	0.254	frozen	0	0	Inaccessible	Inaccessible		Inaccessible	0	0	0	0	0	0	0	0	0	0				0	0
EFB-12 (south)	0.176			0.156	0.144	frozen	0	0	Inaccessible	Inaccessible		Inaccessible	0	0	0	0	0	0	0	0	0	0				0	0
EFB-13 (north)	0.704			0.785	0.719	0.39	0	0	Inaccessible	Inaccessible		Inaccessible	0	0	0	0	0	0	0	0	0	0				0	0
EFB-13 (south)	1.57			1.85	1.82	1.64	0.093	0.0061	Inaccessible	Inaccessible		Inaccessible	0	0	0	0	0	0	0	0	0	0				0	0
EFB-14	0.140			.15 est.	0.142	0.108	0.071	0	Inaccessible	Inaccessible		Inaccessible	0	0	0	0	0	0	0	0	0	0				0	0

Canyon Fuel
Company, LLC.
Sufco Mine
A Subsidiary of Arch Western Bituminous Group, LLC.

Ken May, General Manager
397 South 800 West
Salina, UT 84654
(435) 286-4400 - Office
(435) 286-4499 - Fax

Via Certified Mail

January 23, 2006

Manti-LaSal National Forest
c/o Mr. Dale Harber – NEPA Coordinator
599 W. Price River Drive
Price, Utah 84501

RE: Canyon Fuel Company, LLC, Sufco Mine; Continued Mining in State of Utah Coal Lease ML 49443-OBA, commonly referred to as the "SITLA Muddy Tract Lease"

Dear Mr. Harber:

As required by State mining regulations (R645-301-525.700), Canyon Fuel Company, LLC (CFC) Sufco Mine is notifying you of the mine's plan to expand mining into Sections 4, 5, 7(Lots 2, 3, 4, S1/2NE1/4, SE1/4), 8, and 9, in Township 21 South, Range 5 East, SLB&M. CFC currently holds the coal lease in this area, commonly referred to as the "SITLA Muddy Tract Lease" and plans to mine State of Utah Coal Lease ML 49443-OBA underlying National Forest lands in these areas. Mining is ongoing and will continue through approximately 2011. Longwall mining is projected to commence in these areas in early 2007. No subsidence or surface disturbance will occur as the result of developing the mains in any of the areas listed. Minor surface subsidence may occur in areas where longwall mining will be conducted, but no surface or ground water flows will be interrupted or diminished as a result of this mining activity. Copies of the mine plan may be examined at the Sevier County Courthouse or at the Utah Division of Oil, Gas & Mining offices in Salt Lake City, Utah.

If you have any questions regarding this letter or would like to discuss future mining plans for the above referenced sections, please call Mike Davis at (435) 286-4421 or me at (435) 286-4400.

Sincerely,
Canyon Fuel Company, LLC.
Sufco Mine

Kenneth E. May
Mine Manager

xc: Wayne Hedberg, Utah Division of Oil, Gas & Mining

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Canyon Fuel
Company, LLC.
Sufco Mine
A Subsidiary of Arch Western Bituminous Group, LLC.

Ken May, General Manager
397 South 800 West
Salina, UT 84654
(435) 286-4400 - Office
(435) 286-4499 - Fax

Via Certified Mail

January 23, 2006

Emery County Water Conservancy District
c/o Mr. Jay Mark Humphrey
PO Box 998
Castle Dale, Utah 84513

RE: Canyon Fuel Company, LLC, Sufco Mine; Continued Mining in State of Utah Coal Lease ML 49443-OBA, commonly referred to as the "SITLA Muddy Tract Lease"

Dear Mr. Humphrey:

As required by State mining regulations (R645-301-525.700), Canyon Fuel Company, LLC (CFC) Sufco Mine is notifying you of the mine's plan to expand mining into Sections 4, 5, 7(Lots 2, 3, 4, S1/2NE1/4, SE1/4), 8, and 9, in Township 21 South, Range 5 East, SLB&M. CFC currently holds the coal lease in this area, commonly referred to as the "SITLA Muddy Tract Lease" and plans to mine State of Utah Coal Lease ML 49443-OBA underlying National Forest lands in these areas. Mining is ongoing and will continue through approximately 2011. Longwall mining is projected to commence in these areas in early 2007. No subsidence or surface disturbance will occur as the result of developing the mains in any of the areas listed. Minor surface subsidence may occur in areas where longwall mining will be conducted, but no surface or ground water flows will be interrupted or diminished as a result of this mining activity. Copies of the mine plan may be examined at the Sevier County Courthouse or at the Utah Division of Oil, Gas & Mining offices in Salt Lake City, Utah.

If you have any questions regarding this letter or would like to discuss future mining plans for the above referenced sections, please call Mike Davis at (435) 286-4421 or me at (435) 286-4400.

Sincerely,
Canyon Fuel Company, LLC.
Sufco Mine

Kenneth E. May
Mine Manager

xc: Wayne Hedberg, Utah Division of Oil, Gas & Mining

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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

Submitted in Canyon Fuel Company, LLC General Chapter One

APPENDIX D

Mine Maps

As required under R645-302-525-270

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Mining Progress Map 2005

APPENDIX E

Other Information

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

CONTENTS

None