

1997 Annual Report

Savage Coal Terminal

ACT/007/022

The grasses were warm season grasses. Paul thinks because C4 plants doing better under coal this is solar thing and not chemical.

June 18, 1999

TO: File

THRU: Daron Haddock, Permit Supervisor

FROM: Paul Baker, Reclamation Biologist

RE: Field Visit to Wildcat Loadout to Resolve Concerns of the Division of Wildlife Resources, Andalex Resources, Inc., Wildcat Loadout, ACT/007/033, Folder #2, Carbon County, Utah

SUMMARY:

On April 26, 1999, the Division received a letter from the Division of Wildlife Resources commenting about operations at the Wildcat Loadout. They expressed concern about collisions between coal trucks and wildlife and about the effects of coal fines on vegetation in adjacent areas. Because the road leading to the loadout is not permitted, the problem of collisions with wildlife is beyond the Division's jurisdiction. However, if operations at the loadout are adversely affecting vegetation and wildlife habitat in adjacent areas, this is within the Division's purview.

On May 6, 1999, Chris Colt of the Division of Wildlife Resources and I visited the site and took measurements of vegetation cover and shrub density and observed the depth and apparent severity of coal fines in six one square meter plots in areas east (affected) and three plots south (unaffected) of the loadout. Mike Glasson of Andalex was with us at the beginning of this visit and explained some of the history of the site, but he left before we actually started taking measurements.

HISTORY:

The mining and reclamation plan contains information about two wildlife habitat mitigation projects the operator has done in conjunction with the BLM. Based on information in the plan, it appears the operator interseeded about 56 acres, removed some pinyons and junipers, and installed a water catchment with a capacity of 2100 gallons. This work was apparently to mitigate for the disturbance of the loadout itself and not for adjacent affected areas.

In 1994, the Division wrote a violation based on off-site coal fines contaminating surface

D:

water. The operator was required to submit a plan to prevent the migration of coal fines outside the disturbed area and to clean up the fines already there. This plan apparently consisted of installing and maintaining straw bales in certain areas, and the disturbed area was expanded to include some area east of the loadout beyond the fence. Topsoil and vegetation have not been removed from this area even though it has been included in the disturbed area boundary.

OBSERVATIONS:

Vegetation cover measurements are summarized in Table 1.

Table 1

Species	Affected Area		Unaffected Area	
	% Cover	No. per m ² (Woody only)	% Cover	No. per m ² (Woody only)
Sagebrush _{C3}	2.0	0.3	9.3	3.6
Winterfat _{C4}	11.3	6.9	0.3	0.1
Snakeweed _{C3}	0.3	0.2	3.3	6.8
Prickly Pear	1.2	0.1	0.0	0.0
Grasses	16.2	--	7.7	--
Total	31.0	7.5	20.7	10.5

more cool season

Galleta grass, Bouteloua

We estimated the depth of coal fines at each sampling site and assigned a numerical rating for how severely it appeared each area was affected. The average depth in the affected area was 1.3 inches, and the average rating was 2.75 on a scale of 1 to 5 (1=no fines, 5=black). There were no coal fines in the unaffected area.

Not enough samples were taken that a statistical analysis could be done; however, the trends in the data are consistent with our general observations. The unaffected area clearly had more sagebrush than the affected area, but the affected area had many more winterfat plants. In addition, the unaffected area had many sagebrush seedlings where many of the sagebrush plants in the affected area were decadent.

The affected area had much more total cover, and the difference is primarily in the amount of cover from grasses. These grasses, however, were mostly blue grama and galleta

which provide less forage and cover for wildlife than shrubs or many cool season grasses.

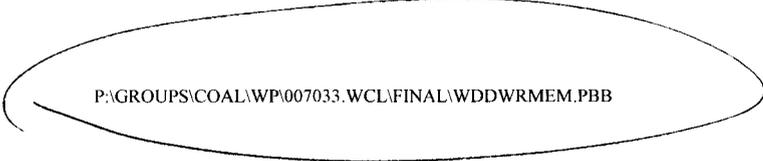
POSSIBLE CAUSES:

1. Entirely natural. Since the affected areas have many decadent and dead sagebrush plants and few seedlings, and since the unaffected areas have many seedlings, it appears sagebrush was once able to reproduce in the affected area and grow to maturity. Therefore, an entirely natural cause does not seem likely.
2. Changes in soil chemistry caused by coal. This is possible since winterfat is more tolerant of higher salt concentrations than sagebrush. This could also affect the number of sagebrush and snakeweed seedlings that can become established. Based on coal sample results in the mining and reclamation plans for both the Crandall Canyon and Centennial Mines, it does not appear this is the reason; however, there are some samples with low pH values. It does not appear there are problems with boron or selenium.
3. Snow melts earlier in affected areas. Coal on the snow surface would increase absorption of energy from visible light and accelerate snow melt. Early snowmelt could result in two possible problems:
 - a. As mentioned in the letter from Wildlife Resources, snow melting early allows the soil to dry more quickly. Sagebrush would come out of dormancy early and use available water, so less water would be in the soil later in the summer.
 - b. If the snow melts, sagebrush would be exposed to more browsing. Browsing would stress the plants and increase mortality. Winterfat, being a lower-growing plant, is less likely to be browsed than sagebrush.
4. Grass cover in affected areas may be increased by the lack of competition from sagebrush. Studies have shown interspecific competition between sagebrush and grasses, but there is less competition from some of the chenopods. This probably does not increase the amount of forage available, however, especially during the winter, because the grasses and winterfat would not generally protrude above the snow.
5. Increased soil temperatures caused by the darkened soil. This is also mentioned in the letter from Wildlife Resources. This could affect the established sagebrush, but it is more likely it decreases the number of seedlings that can get established.

RECOMMENDATIONS:

Since one possible reason for the observed changes in vegetation composition is a change in soil chemistry, the operator should take soil samples from affected and unaffected areas and compare them. Parameters that should be measured are pH and electrical conductivity. These are relatively simple and inexpensive tests. In the affected area, five samples should be taken of both the coal on the surface and of soil under the coal. A few samples should also be taken of the soil in undisturbed areas, and Division personnel need to be present when the samples are taken.

The Division of Wildlife Resources suggested the operator interseed a few plots of about three acres each with a mixture of salt desert shrub species which are more temperature, drought, and salt tolerant but would still provide quality browse for wintering big game. It is expected fourwing saltbush would be well adapted to a site like this. If the interseeding is successful, the rest of the affected area should eventually be interseeded to increase the number of shrubs available to big game during the winter. At some time, possibly at reclamation or before if the fines become too deep, the operator would probably need to vacuum or scrape coal fines from the area.

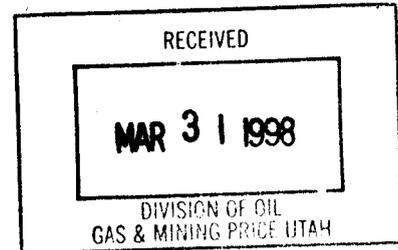


P:\GROUPS\COAL\WP\007033.WCL\FINAL\WDDWRMEM.PBB



Savage Industries Inc.
2025 E. 5000 S.
Price, Utah 84501
(801) 637-5664
(801) 637-3418 FAX

Mary Ann Wright
Associate Director of Mining
Utah Coal Regulatory Program
1594 West North Temple, Suite 1210
Box 145801
Salt Lake City, Utah 84114-5801



Re: Submittal of 1997 Annual Reports
Savage Coal Terminal
ACT/007/022; Folder #2
Carbon County, Utah

Dear Ms. Wright:

Enclosed are 2 copies of the Annual Report for 1997 for the Savage Coal Terminal.

The report is filed in the format provided by the Division.

Sincerely,

Dan W. Guy
for
Boyd Rhodes

cc: Jeff Chesler - Savage
Dan Guy - Blackhawk
File

GENERAL INFORMATION

1. Permit Number	ACT/007/022
2. Mine Name	Savage Coal Terminal
3. Permittee Name	Savage Industries, Inc.
4. Operator Name (if other than Permittee)	
5. Permit Expiration Date	08/07/99
6. Company Representative, Title	Boyd Rhodes,
7. Phone Number	(801) 637-5664
8. Fax Number	(801) 637-3418
9. Mailing Address	Savage Industries, Inc. 5250 South 300 West Suite 200 Salt Lake City, Utah 84107
10. Resident Agent, Title	Corp. Trust Company
Mailing Address	1209 Orange Steet Wilmington, DE 19801

IDENTIFICATION OF OTHER PERMITS

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

Permit Type	ID Number	Description	Expires on
1. MSHA Mine ID(S)	42-01444	Plant Loadout	N/A
	1211-UT-09-0034	Refuse Pile	N/A
2. MSHA Impoundment(s)	N/A		
3. NPDES/UPDES Permit(s) (water)	UTG040005	UPDES Permit 01/10/97	04/30/98
4. PSD (Air) Permit(s)	DAQE-007-97	Approval Order	N/A
5.			

APPENDIX A

Certified Reports

**Excess Spoil Piles
Refuse Piles
Impoundments**

as required under R645-301-514

CONTENTS

Refuse Pile Inspections

Annual Pond Certifications

REFUSE PILE INSPECTIONS

**SAVAGE COAL TERMINAL
REFUSE PILE INSPECTION REPORT**

MSHA SITE: 1211-UT-09-0034

QUARTER: 01/97

<i>ITEM</i>	<i>REMARKS</i>
(1) <i>Potential Safety Hazards</i>	<u>None Noted.</u> _____ _____
(2) <i>Slope Stability</i>	<u>Slopes appear stable.</u> _____ _____
(3) <i>Removal of Topsoil/Organics</i>	<u>N/A - No new removal necessary.</u> _____ _____
(4) <i>Construction and Maintenance Performance Standards</i>	<u>Pile Graded - O.K.</u> <u>Culvert - O.K.</u> <u>Ditches - O.K.</u> _____ _____
(5) <i>Recommendations/Comments</i>	<u>None</u> _____ _____

I have performed the above inspection on this refuse pile and do hereby certify it to be a true and accurate representation of the pile at this time.



[Handwritten Signature]

(Signature)

03/21/97

SAVAGE COAL TERMINAL

REFUSE PILE INSPECTION REPORT

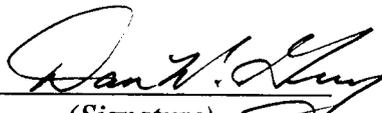
MSHA SITE: 1211-UT-09-0034

QUARTER: 2/97

ITEM	REMARKS
(1) Potential Safety Hazards	None Noted.
(2) Slope Stability	Slopes appear stable.
(3) Removal of Topsoil/Organics	N/A - No new removal necessary.
(4) Construction and Maintenance Performance Standards	Pile Graded - O.K.
	Culvert -O.K.
	Ditches - O.K.
(5) Recommendations/Comments	None

I have performed the above inspection on this refuse pile and do hereby certify it to be a true and accurate representation of the pile at this time.




(Signature)

06/26/97
(Date)

SAVAGE COAL TERMINAL

REFUSE PILE INSPECTION REPORT

MSHA SITE: 1211-UT-09-0034

QUARTER: 3/97

ITEM	REMARKS
<i>(1) Potential Safety Hazards</i>	<i>None Noted.</i>
<i>(2) Slope Stability</i>	<i>Slopes appear stable.</i>
<i>(3) Removal of Topsoil/Organics</i>	<i>N/A - No new removal necessary.</i>
<i>(4) Construction and Maintenance Performance Standards</i>	<i>Pile Graded - O.K.</i>
	<i>Culvert -O.K.</i>
	<i>Ditches - O.K.</i>
<i>(5) Recommendations/Comments</i>	<i>None</i>

I have performed the above inspection on this refuse pile and do hereby certify it to be a true and accurate representation of the pile at this time.



Dan W. Guy
(Signature)

09/09/97
(Date)

SAVAGE COAL TERMINAL

REFUSE PILE INSPECTION REPORT

MSHA SITE: 1211-UT-09-0034

QUARTER: 4/97

ITEM	REMARKS
(1) Potential Safety Hazards	None Noted.
(2) Slope Stability	Slopes appear stable.
(3) Removal of Topsoil/Organics	N/A - No new removal necessary.
(4) Construction and Maintenance Performance Standards	Pile Graded - O.K. Culvert -O.K. Ditches - O.K.
(5) Recommendations/Comments	Minor erosion on top of pile.

I have performed the above inspection on this refuse pile and do hereby certify it to be a true and accurate representation of the pile at this time.




(Signature)

11/24/97
(Date)

ANNUAL POND CERTIFICATIONS

SAVAGE INDUSTRIES, INC.

1997 ANNUAL POND INSPECTION REPORT

POND: SED. POND 1

LOCATION: SAVAGE COAL TERMINAL

IMPOUNDMENTS

(1) Stability	<u>Slopes Stable. Incised Pond.</u>
(2) Structural Weakness/Erosion	<u>None Noted.</u>
(3) Potential Safety Hazards	<u>None Noted.</u>
(4) Depth of Impounded Water	<u>5.0'</u>
(5) Existing Storage Capacity	<u>0.31 acre feet</u>
(6) Monitoring Procedures	<u>Quarterly Inspection.</u>

SEDIMENT PONDS ONLY

(7) Sediment Accumulation (Elev.)	<u>5485.8</u>
(8) Sediment Cleanout Level (Elev.)	<u>5487.2</u>
(9) Principle Spillway (Elev.)	<u>5491.8</u>
(10) Emergency Spillway (Elev.)	<u>5491.8</u>
(11) Existing Sediment Capacity (To Cleanout)	<u>0.50 acre feet</u>

GENERAL

(12) Comments/Recommendations	<u>Pond O.K.</u>
	<u>No Discharge.</u>

STATEMENT

I hereby certify that; I am experienced in the construction of impoundments; I am qualified and authorized in the State of Utah to inspect and certify the condition and appearance of impoundments in accordance with the certified and approved designs for this structure; that the impoundment has been maintained in accordance with approved design and meets or exceeds the minimum design requirements under all applicable federal, state and local regulations; and, that inspections and inspection reports are made by myself and include any appearances of instability, structural weakness or other hazardous conditions of the structure affecting stability.


(Signature)

11/24/97
(Date)



SAVAGE INDUSTRIES, INC.

1997 ANNUAL POND INSPECTION REPORT

POND: SED. POND 2

LOCATION: SAVAGE COAL TERMINAL

IMPOUNDMENTS

- (1) Stability Slopes Stable. Incised Pond.
- (2) Structural Weakness/Erosion None Noted.
- (3) Potential Safety Hazards None Noted.
- (4) Depth of Impounded Water 4.0'
- (5) Existing Storage Capacity 0.46 acre feet
- (6) Monitoring Procedures Quarterly Inspection.

SEDIMENT PONDS ONLY

- (7) Sediment Accumulation (Elev.) 5484.3
- (8) Sediment Cleanout Level (Elev.) 5485.5
- (9) Principle Spillway (Elev.) 5492.3
- (10) Emergency Spillway (Elev.) 5492.3
- (11) Existing Sediment Capacity (To Cleanout) 0.24 acre feet

GENERAL

- (12) Comments/Recommendations No Discharge.

STATEMENT

I hereby certify that; I am experienced in the construction of impoundments; I am qualified and authorized in the State of Utah to inspect and certify the condition and appearance of impoundments in accordance with the certified and approved designs for this structure; that the impoundment has been maintained in accordance with approved design and meets or exceeds the minimum design requirements under all applicable federal, state and local regulations; and, that inspections and inspection reports are made by myself and include any appearances of instability, structural weakness or other hazardous conditions of the structure affecting stability.

Dan W. Guy
(Signature)

11/24/97
(Date)



SAVAGE INDUSTRIES, INC.

1997 ANNUAL POND INSPECTION REPORT

POND: SED. POND 3

LOCATION: SAVAGE COAL TERMINAL

IMPOUNDMENTS

(1) Stability	<u>Slopes Stable. Incised Pond.</u>
(2) Structural Weakness/Erosion	<u>None Noted.</u>
(3) Potential Safety Hazards	<u>None Noted.</u>
(4) Depth of Impounded Water	<u>5.0'</u>
(5) Existing Storage Capacity	<u>0.57 acre feet</u>
(6) Monitoring Procedures	<u>Quarterly Inspection.</u>

SEDIMENT PONDS ONLY

(7) Sediment Accumulation (Elev.)	<u>5484.0</u>
(8) Sediment Cleanout Level (Elev.)	<u>5484.8</u>
(9) Principle Spillway (Elev.)	<u>5491.4</u>
(10) Emergency Spillway (Elev.)	<u>5491.4</u>
(11) Existing Sediment Capacity (To Cleanout)	<u>0.16 acre feet</u>

GENERAL

(12) Comments/Recommendations	<u>No Discharge.</u>
	<u> </u>
	<u> </u>

STATEMENT

I hereby certify that; I am experienced in the construction of impoundments; I am qualified and authorized in the State of Utah to inspect and certify the condition and appearance of impoundments in accordance with the certified and approved designs for this structure; that the impoundment has been maintained in accordance with approved design and meets or exceeds the minimum design requirements under all applicable federal, state and local regulations; and, that inspections and inspection reports are made by myself and include any appearances of instability, structural weakness or other hazardous conditions of the structure affecting stability.


(Signature)

11/24/97
(Date)



SAVAGE INDUSTRIES, INC.

1997 ANNUAL POND INSPECTION REPORT

POND: PLANT OVERFLOW (#4)

LOCATION: SAVAGE COAL TERMINAL

IMPOUNDMENTS

(1) Stability	<u>Slopes Stable. Incised Pond.</u>
(2) Structural Weakness/Erosion	<u>None Noted.</u>
(3) Potential Safety Hazards	<u>None Noted.</u>
(4) Depth of Impounded Water	<u>4.8'</u>
(5) Existing Storage Capacity	<u>0.15 acre feet</u>
(6) Monitoring Procedures	<u>Not a Sediment Pond.</u> <u>Quarterly Inspection.</u>

SEDIMENT PONDS ONLY

(7) Sediment Accumulation (Elev.)	<u>N/A</u>
(8) Sediment Cleanout Level (Elev.)	<u>N/A</u>
(9) Principle Spillway (Elev.)	<u>N/A</u>
(10) Emergency Spillway (Elev.)	<u>N/A</u>
(11) Existing Sediment Capacity (To Cleanout)	<u>N/A</u>

GENERAL

(12) Comments/Recommendations	<u>Overflow to Sed. Pond</u> <u>6 - then recirculated.</u>
-------------------------------	---

STATEMENT

I hereby certify that; I am experienced in the construction of impoundments; I am qualified and authorized in the State of Utah to inspect and certify the condition and appearance of impoundments in accordance with the certified and approved designs for this structure; that the impoundment has been maintained in accordance with approved design and meets or exceeds the minimum design requirements under all applicable federal, state and local regulations; and, that inspections and inspection reports are made by myself and include any appearances of instability, structural weakness or other hazardous conditions of the structure affecting stability.

Dan W. Guy
(Signature)

11/24/97
(Date)



SAVAGE INDUSTRIES, INC.

1997 ANNUAL POND INSPECTION REPORT

POND: SED. POND 5

LOCATION: SAVAGE COAL TERMINAL

IMPOUNDMENTS

- | | |
|---------------------------------|-------------------------------------|
| (1) Stability | <u>Slopes Stable. Incised Pond.</u> |
| (2) Structural Weakness/Erosion | <u>None Noted.</u> |
| (3) Potential Safety Hazards | <u>None Noted.</u> |
| (4) Depth of Impounded Water | <u>2.0'</u> |
| (5) Existing Storage Capacity | <u>2.78 acre feet</u> |
| (6) Monitoring Procedures | <u>Quarterly Inspection.</u> |

SEDIMENT PONDS ONLY

- | | |
|--|-----------------------|
| (7) Sediment Accumulation (Elev.) | <u>5474.0</u> |
| (8) Sediment Cleanout Level (Elev.) | <u>5475.2</u> |
| (9) Principle Spillway (Elev.) | <u>5482.0</u> |
| (10) Emergency Spillway (Elev.) | <u>5482.0</u> |
| (11) Existing Sediment Capacity
(To Cleanout) | <u>0.40 acre feet</u> |

GENERAL

- | | |
|-------------------------------|---|
| (12) Comments/Recommendations | <u>No Discharge.</u>
<u>Sediment accumulation at</u>
<u>inlets.</u> |
|-------------------------------|---|

STATEMENT

I hereby certify that; I am experienced in the construction of impoundments; I am qualified and authorized in the State of Utah to inspect and certify the condition and appearance of impoundments in accordance with the certified and approved designs for this structure; that the impoundment has been maintained in accordance with approved design and meets or exceeds the minimum design requirements under all applicable federal, state and local regulations; and, that inspections and inspection reports are made by myself and include any appearances of instability, structural weakness or other hazardous conditions of the structure affecting stability.


(Signature)

11/24/97
(Date)



SAVAGE INDUSTRIES, INC.

1997 ANNUAL POND INSPECTION REPORT

POND: SED. POND 6

LOCATION: SAVAGE COAL TERMINAL

IMPOUNDMENTS

- | | |
|---------------------------------|--|
| (1) Stability | <u>Slopes Stable. Incised Pond.</u> |
| (2) Structural Weakness/Erosion | <u>None Noted.</u> |
| (3) Potential Safety Hazards | <u>None Noted.</u> |
| (4) Depth of Impounded Water | <u>2.5'</u> |
| (5) Existing Storage Capacity | <u>1.10 acre feet</u> |
| (6) Monitoring Procedures | <u>Quarterly Inspection.</u>
<u>U.P.D.E.S. Discharge.</u> |

SEDIMENT PONDS ONLY

- | | |
|--|-----------------------|
| (7) Sediment Accumulation (Elev.) | <u>5471.1</u> |
| (8) Sediment Cleanout Level (Elev.) | <u>5474.7</u> |
| (9) Principle Spillway (Elev.) | <u>5480.3</u> |
| (10) Emergency Spillway (Elev.) | <u>5480.3</u> |
| (11) Existing Sediment Capacity
(To Cleanout) | <u>0.13 acre feet</u> |

GENERAL

- | | |
|-------------------------------|---|
| (12) Comments/Recommendations | <u>No Discharge.</u>
<u>Sediment accumulation on</u>
<u>SW inlet.</u> |
|-------------------------------|---|

STATEMENT

I hereby certify that; I am experienced in the construction of impoundments; I am qualified and authorized in the State of Utah to inspect and certify the condition and appearance of impoundments in accordance with the certified and approved designs for this structure; that the impoundment has been maintained in accordance with approved design and meets or exceeds the minimum design requirements under all applicable federal, state and local regulations; and, that inspections and inspection reports are made by myself and include any appearances of instability, structural weakness or other hazardous conditions of the structure affecting stability.

Dan W. Guy
(Signature)

11/24/97
(Date)



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 requirements of R645-301-130 and R645-301-140.

CONTENTS

Test Plot Vegetation Monitoring - Included

4th Quarter Water Monitoring - On File

TEST PLOT MONITORING

VEGETATION MONITORING
OF THE
C.V. SPUR TEST PLOTS
1997



This Document includes two separate reports called:

VEGETATION MONITORING
OF THE
C.V. SPUR NO.1 TEST PLOTS
1997

&

VEGETATION MONITORING
OF THE
C.V. SPUR NO.2 TEST PLOTS
1997

Prepared by

MT. NEBO SCIENTIFIC, INC.

330 East 400 South, Suite 6

Post Office Box 337

Springville, Utah 84663

(801) 489-6937

Patrick Collins, Ph.D.

for

BLACKHAWK ENGINEERING

214 East 1st No.

Price, Utah 84501

Dates

Fieldwork: August 1997

Report: March 1998

VEGETATION MONITORING
OF THE
C.V. SPUR NO.1 TEST PLOTS
1997



Prepared by

MT. NEBO SCIENTIFIC, INC.

330 East 400 South, Suite 6

Post Office Box 337

Springville, Utah 84663

(801) 489-6937

for

BLACKHAWK ENGINEERING

214 East 1st No.

Price, Utah 84501

Report:

Patrick Collins, Ph.D.

Fieldwork:

Patrick Collins

P. Dean Collins

Report Date:

March 1998

TABLE OF CONTENTS

SCOPE	1
INTRODUCTION	1
METHODS	2
Cover and Composition	2
Woody Species Density	3
Photographs	3
Raw Data	4
RESULTS	4
DISCUSSION	5
SUMMARY	6
DATA SUMMARY TABLES	7-22
FIGURES & GRAPHS	23-28
COLOR PHOTOGRAPHS	29-30
RAW DATA	Appendix

VEGETATION MONITORING
OF THE
C.V. SPUR NO.1 TEST PLOTS
1997

SCOPE

The following is a report to describe the ninth year progress by monitoring the reclamation test plots at the C.V. Spur site. Monitoring methodologies were performed in accordance with the guidelines supplied by the State of Utah, Division of Oil, Gas and Mining (DOGGM).

INTRODUCTION

The C.V. Spur area is located approximately 4 miles southeast of the city of Price in Carbon County, Utah. The area is comprised of nearly 120 acres of disturbed land associated with coal cleaning and loading activities. The disturbed area lies within a salt desert community on soils derived from Mancos Shale.

Revegetation test plots investigating different treatments were established in the fall of 1987 by the former owner, Beaver Creek Coal Company. The entire research plot size is approximately 120 ft by 140 ft. This area was divided into sixteen 25 ft by 25 ft "subplots" to test different reclamation treatments. The treatments consisted of comparing controls, topsoil depths, coarse refuse mixtures and mulches. More specifically, the treatments investigated with their respective

subplot numbers are listed below.

SUBPLOT NUMBERS	TREATMENT
1, 9	6 in. soil, seed, (control)
2, 6	6 in. soil, seed, wood fiber mulch
3, 7	4 in. soil, 2 in. coal refuse, seed, wood fiber mulch
4, 8	3 in. soil, 3 in. coal refuse, seed, wood fiber mulch
5	6 in. soil, wood fiber mulch, (strip planting)
10, 14	6 in. soil, seed, hay mulch
11, 15	4 in. soil, 2 in. coal refuse, seed, hay mulch
12, 16	3 in. soil, 3 in. coal refuse, seed, hay mulch
13	6 in. soil, hay mulch, (strip planting)

METHODS

Quantitative and qualitative data were taken on each of the subplots of the C.V. Spur No. 1 Test on August 26, 1997. Sampling methodologies were nearly identical to the previous years' sampling to facilitate comparisons between years.

Cover and Composition

Bi-directional random placement of sampling plots were designed to provide unbiased accuracy of the data compiled. This was accomplished by placing surveying tapes perpendicularly on two sides of each subplot, forming X and Y axes. The intersection of random numbers along each axis dictated the sample point locations within the subplots. Six of these samples were placed in each of the 25 ft X 25 ft subplots.

Cover estimates were made (to the nearest percentage point) using ocular methods with meter square quadrats in each of the subplots. Species composition by lifeform and relative frequencies were also assessed from the quadrats. Additional information recorded on data sheets were: estimated precipitation, slope, exposure, grazing use, animal disturbance and other appropriate notes.

Sample means, standard deviations, and sample sizes were included in this report to enable the reviewers to apply further statistical tests if desired. Plant nomenclature follows Welsh et al. (1993).

Woody Species Density

Density of woody plant species of the subplots were estimate using belt transects that were 5 ft by 25 ft (125 ft²). Total number of individuals by species were counted in each of the belt transects. The average number was then calculated followed by the number of individuals per acre.

Photographs

A color photograph was taken of the plot and was included in this report.

Raw Data

Summarized raw data were included in this report to facilitate additional statistical analyses by the reviewer if desired.

RESULTS

Summaries and results from all sampling are given on Tables 1 - 16. Comparisons of much of the information from the tables can easily be made by examining the graphs that are also included in this report (Figures 1 - 5).

Figure 1 shows the total cover for each subplot and was based on the data listed in the summary tables. Because total living cover results can be somewhat misleading when “weedy” species are common in the quadrats, Figure 1 also shows the results when forbs were excluded from the cover (most of the forbs were weeds). Figure 2 compares the composition of the cover and Figure 3 shows the woody species density for each of the subplots.

As an attempt to simplify results or enable one to compare different treatments without comparing like-treatments, Figures 4 and 5 shows the mean for each parameter for like-treatments. For example, Subplot 2 and Subplot 6 both had 6 inches of soil cover, were seeded with the same seed mix, and were mulched with wood fiber. Therefore, Figures 4 and 5 show average values for Subplots 1 and 9 and are represented by bars in the graphs. (Exceptions were Subplots 5 and

13 -- they were not averaged because their treatments were slightly different).

DISCUSSION

Figure 1 is informative because it shows the living cover of each subplot with and without forbs included. The total living cover graph that *includes* forbs may be misleading in some ways. For example, if one compares the total living cover of Subplot 5 and Subplot 12, they are virtually identical. But when the living covers (*excluding* forbs) were compared, Subplot 5 had almost no desirable species and Subplot 12 comprises many desirable species. Therefore, the graph showing the cover (*excluding* forbs) could perhaps be more informative when comparing treatments for revegetation success with desirable species.

The lifeform composition of Figure 2 illustrates at-a-glance the proportions of shrubs, forbs and grasses for each subplot.

Most meaningful data are perhaps the means of the cover and density illustrated in Figures 4 and 5, respectively. The cover in Figure 4 excludes the forbs which were mostly comprised of weedy species. Interestingly, the two highest cover values (Subplots 12/16 & 4/8) had the same seedbed medium (3" soil, 3" coal refuse). The next highest cover also had similar growth medium (4" soil, 2" coal refuse). Conversely, the subplots that performed with the least success for living cover were the subplots that has 6 inches of soil with no coal refuse added (Subplots 1/9, 5 & 13).

Woody species density also revealed interesting patterns as illustrated in Figure 5. If one considers the subplots with the wood fiber mulch, for example, most subplots had high density values, especially those that also had coal refuse cover (Subplots 2/6, 3/7, & 4/8). The trend for the hay mulch is that density increased as coal refuse cover increased (Subplots 10/14, 11/15 & 12/16). Like the cover data, the Subplots that performed poorest were those with the most soil cover (Subplots 5, 13, & 1/9).

SUMMARY

Subplots that compared revegetation techniques were compared including soil cover, coal refuse cover, wood fiber mulch, straw mulch and strip planting methods. Living cover data suggest those subplots that had more coal refuse performed better. Although the trend is not as evident for woody species density, data also suggest that density was superior in those plots with more coal refuse.

TABLE 1: Subplot 1 - Total cover (A), composition (B), cover and frequency by species (C), and woody species density (D), summaries for the C.V. Spur No. 1 Test Plot for 1997.

A. TOTAL COVER	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZES
Total Living Cover	45.83	11.70	6
Litter	10.83	3.44	6
Bareground	35.83	16.44	6
Rock	7.50	2.50	6

B. COMPOSITION

Shrubs	3.33	7.45	6
Forbs	89.72	10.56	6
Grasses	6.94	10.11	6

C. COVER BY SPECIES

	% MEAN COVER	RELATIVE FREQUENCY	SAMPLE SIZES
<u>Shrubs</u>			
<i>Ceratoides lanata</i>	1.67	16.67	6
<u>Forbs</u>			
<i>Halogeton glomeratus</i>	27.50	100.00	6
<i>Iva axillaris</i>	10.00	83.33	6
<i>Kochia scoparia</i>	0.83	16.67	6
<i>Malcomia africana</i>	3.33	33.33	6
<u>Grasses</u>			
<i>Agropyron cristatum</i>	2.50	33.33	6

D. WOODY SPECIES DENSITY

	NUMBER/ACRE
<i>Atriplex corrugata</i>	696.96
<i>Ceratoides lanata</i>	<u>1045.44</u>
TOTAL	1742.40

TABLE 2: Subplot 2 - Total cover (A), composition (B), cover and frequency by species (C), and woody species density (D), summaries for the C.V. Spur No. 1 Test Plot for 1997.

A. TOTAL COVER	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZES
Total Living Cover	30.83	4.49	6
Litter	9.17	1.86	6
Bareground	50.83	4.49	6
Rock	9.17	1.86	6
B. COMPOSITION			
Shrubs	10.42	12.21	6
Forbs	49.31	32.67	6
Grasses	40.28	26.53	6
C. COVER BY SPECIES			
	% MEAN COVER	RELATIVE FREQUENCY	SAMPLE SIZES
<u>Shrubs</u>			
<i>Atriplex canescens</i>	1.67	16.67	6
<i>Atriplex corrugata</i>	1.67	33.33	6
<u>Forbs</u>			
<i>Halogeton glomeratus</i>	14.17	100.00	6
<u>Grasses</u>			
<i>Agropyron cristatum</i>	13.33	83.33	6
D. WOODY SPECIES DENSITY			
		NUMBER/ACRE	
<i>Atriplex canescens</i>		1393.92	
<i>Atriplex corrugata</i>		464.64	
<i>Ceratoides lanata</i>		<u>1858.56</u>	
TOTAL		3717.12	

TABLE 3: Subplot 3 - Total cover (A), composition (B), cover and frequency by species (C), and woody species density (D), summaries for the C.V. Spur No. 1 Test Plot for 1997.

A. TOTAL COVER	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZES
Total Living Cover	37.50	17.97	6
Litter	6.67	2.36	6
Bareground	47.50	17.97	6
Rock	8.33	2.36	6
B. COMPOSITION			
Shrubs	31.20	31.49	6
Forbs	33.33	41.10	6
Grasses	35.47	24.51	6
C. COVER BY SPECIES			
	% MEAN COVER	RELATIVE FREQUENCY	SAMPLE SIZES
<u>Shrubs</u>			
<i>Atriplex canescens</i>	12.50	50.00	6
<i>Ceratoides lanata</i>	3.33	33.33	6
<u>Forbs</u>			
<i>Halogeton glomeratus</i>	2.50	33.33	6
<i>Malcomia africana</i>	5.00	50.00	6
<u>Grasses</u>			
<i>Agropyron cristatum</i>	14.17	83.33	6
D. WOODY SPECIES DENSITY			
		NUMBER/ACRE	
<i>Atriplex canescens</i>		2323.20	
<i>Ceratoides lanata</i>		<u>813.12</u>	
TOTAL		3136.32	

TABLE 4: Subplot 4 - Total cover (A), composition (B), cover and frequency by species (C), and woody species density (D), summaries for the C.V. Spur No. 1 Test Plot for 1997.

A. TOTAL COVER	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZES
Total Living Cover	43.33	3.73	6
Litter	9.17	1.86	6
Bareground	27.50	6.92	6
Rock	20.00	7.07	6
B. COMPOSITION			
Shrubs	34.07	24.35	6
Forbs	2.08	4.66	6
Grasses	63.84	22.91	6
C. COVER BY SPECIES			
	% MEAN COVER	RELATIVE FREQUENCY	SAMPLE SIZES
<u>Shrubs</u>			
<i>Atriplex canescens</i>	13.33	100.00	6
<i>Ceratoides lanata</i>	1.67	16.67	6
<u>Forbs</u>			
<i>Machaeranthera canescens</i>	0.83	16.67	6
<u>Grasses</u>			
<i>Agropyron cristatum</i>	26.67	100.00	6
<i>Elymus lanceolatus</i>	0.83	16.67	6
D. WOODY SPECIES DENSITY			
		NUMBER/ACRE	
<i>Atriplex canescens</i>		3252.48	
<i>Ceratoides lanata</i>		1742.40	
<i>Chrysothamnus nauseosus</i>		<u>116.16</u>	
TOTAL		5111.04	

TABLE 5: Subplot 5 - Total cover (A), composition (B), cover and frequency by species (C), and woody species density (D), summaries for the C.V. Spur No. 1 Test Plot for 1997.

A. TOTAL COVER	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZES
Total Living Cover	50.83	7.31	6
Litter	10.00	0.00	6
Bareground	32.50	8.54	6
Rock	6.67	2.36	6
B. COMPOSITION			
Shrubs	0.00	0.00	6
Forbs	98.61	3.11	6
Grasses	1.39	3.11	6
C. COVER BY SPECIES			
	% MEAN COVER	RELATIVE FREQUENCY	SAMPLE SIZES
<u>Shrubs</u>			
<u>Forbs</u>			
<i>Halogeton glomeratus</i>	40.00	100.00	6
<i>Malcomia africana</i>	8.33	83.33	6
<i>Salsola pestifer</i>	1.67	16.67	6
<u>Grasses</u>			
<i>Agropyron cristatum</i>	0.83	16.67	6
D. WOODY SPECIES DENSITY			
		NUMBER/ACRE	
<i>Ceratoides lanata</i>		<u>464.64</u>	
TOTAL		464.64	

TABLE 6: Subplot 6 - Total cover (A), composition (B), cover and frequency by species (C), and woody species density (D), summaries for the C.V. Spur No. 1 Test Plot for 1997.

A. TOTAL COVER	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZES
Total Living Cover	31.67	8.50	6
Litter	9.17	1.86	6
Bareground	52.50	11.09	6
Rock	6.67	2.36	6

B. COMPOSITION

Shrubs	15.24	22.54	6
Forbs	38.39	30.16	6
Grasses	46.37	29.09	6

C. COVER BY SPECIES

	% MEAN COVER	RELATIVE FREQUENCY	SAMPLE SIZES
<u>Shrubs</u>			
<i>Atriplex canescens</i>	4.17	33.33	6
<i>Atriplex corrugata</i>	1.17	33.33	6
<u>Forbs</u>			
<i>Halogeton glomeratus</i>	7.17	66.67	6
<i>Helianthus annuus</i>	0.67	33.33	6
<i>Malcomia africana</i>	4.67	50.00	6
<i>Salsola pestifer</i>			
<u>Grasses</u>			
<i>Agropyron cristatum</i>	6.67	66.67	6
<i>Elymus smithii</i>	5.83	16.67	6
<i>Stipa hymenoides</i>	1.33	16.67	6

D. WOODY SPECIES DENSITY

	NUMBER/ACRE
<i>Atriplex canescens</i>	1393.92
<i>Atriplex corrugata</i>	580.80
<i>Ceratoides lanata</i>	1045.44
TOTAL	3020.16

TABLE 7: Subplot 7 - Total cover (A), composition (B), cover and frequency by species (C), and woody species density (D), summaries for the C.V. Spur No. 1 Test Plot for 1997.

A. TOTAL COVER	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZES
Total Living Cover	32.50	5.59	6
Litter	8.33	3.73	6
Bareground	46.67	6.24	6
Rock	12.50	2.50	6

B. COMPOSITION

Shrubs	29.88	20.81	6
Forbs	53.10	21.32	6
Grasses	17.02	12.37	6

C. COVER BY SPECIES

	% MEAN COVER	RELATIVE FREQUENCY	SAMPLE SIZES
<u>Shrubs</u>			
<i>Atriplex canescens</i>	9.17	66.67	6
<i>Ceratoides lanata</i>	0.83	16.67	6
<u>Forbs</u>			
<i>Halogeton glomeratus</i>	12.50	83.33	6
<i>Malcomia africana</i>	3.33	33.33	6
<i>Salsola pestifer</i>	0.83	16.67	6
<u>Grasses</u>			
<i>Agropyron cristatum</i>	3.33	33.33	6
<i>Stipa hymenoides</i>	2.50	33.33	6

D. WOODY SPECIES DENSITY

	NUMBER/ACRE
<i>Atriplex canescens</i>	1393.92
<i>Ceratoides lanata</i>	<u>929.28</u>
TOTAL	2323.20

TABLE 8: Subplot 8 - Total cover (A), composition (B), cover and frequency by species (C), and woody species density (D), summaries for the C.V. Spur No. 1 Test Plot for 1997.

A. TOTAL COVER	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZES
Total Living Cover	45.00	7.07	6
Litter	10.83	4.49	6
Bareground	17.50	7.50	6
Rock	26.67	10.27	6

B. COMPOSITION

Shrubs	5.68	5.79	6
Forbs	52.08	29.87	6
Grasses	42.23	28.81	6

C. COVER BY SPECIES

	% MEAN COVER	RELATIVE FREQUENCY	SAMPLE SIZES
<u>Shrubs</u>			
<i>Atriplex canescens</i>	1.67	33.33	6
<i>Atriplex corrugata</i>			
<i>Ceratoides lanata</i>	0.83	16.67	6
<u>Forbs</u>			
<i>Bassia hyssopifolia</i>	0.83	16.67	6
<i>Halogeton glomeratus</i>	16.67	100.00	6
<i>Machaeranthera grindelioides</i>	0.83	16.67	6
<i>Salsola pestifer</i>	5.00	50.00	6
<u>Grasses</u>			
<i>Agropyron cristatum</i>	15.83	83.33	6
<i>Elymus elymoides</i>	0.83	16.67	6
<i>Elymus smithii</i>	2.50	16.67	6
<i>Stipa hymenoides</i>			

D. WOODY SPECIES DENSITY

	NUMBER/ACRE
<i>Atriplex canescens</i>	1277.76
<i>Ceratoides lanata</i>	464.64
<i>Chrysothamnus nauseosus</i>	174.24
TOTAL	1916.64

TABLE 9: Subplot 9 - Total cover (A), composition (B), cover and frequency by species (C), and woody species density (D), summaries for the C.V. Spur No. 1 Test Plot for 1997.

A. TOTAL COVER	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZES
Total Living Cover	44.17	8.37	6
Litter	8.33	2.36	6
Bareground	37.50	9.46	6
Rock	10.00	4.08	6
B. COMPOSITION			
Shrubs	10.71	18.33	6
Forbs	89.29	18.33	6
Grasses	0.00	0.00	6
C. COVER BY SPECIES			
	% MEAN COVER	RELATIVE FREQUENCY	SAMPLE SIZES
<u>Shrubs</u>			
<i>Atriplex canescens</i>	4.17	16.67	6
<i>Atriplex corrugata</i>	0.83	16.67	6
<u>Forbs</u>			
<i>Halogeton glomeratus</i>	22.50	100.00	6
<i>Malcomia africana</i>	16.67	83.33	6
<u>Grasses</u>			
D. WOODY SPECIES DENSITY			
		NUMBER/ACRE	
<i>Atriplex canescens</i>		580.80	
<i>Ceratoides lanata</i>		<u>116.16</u>	
TOTAL		696.96	

TABLE 10: Subplot 10 - Total cover (A), composition (B), cover and frequency by species (C), and woody species density (D), summaries for the C.V. Spur No. 1 Test Plot for 1997.

A. TOTAL COVER	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZES
Total Living Cover	42.50	10.31	6
Litter	10.83	7.31	6
Bareground	40.83	13.97	6
Rock	5.83	1.86	6

B. COMPOSITION

Shrubs	19.39	23.45	6
Forbs	34.62	28.08	6
Grasses	45.99	25.57	6

C. COVER BY SPECIES

	% MEAN COVER	RELATIVE FREQUENCY	SAMPLE SIZES
<u>Shrubs</u>			
<i>Atriplex canescens</i>	10.00	50.00	6
<u>Forbs</u>			
<i>Halogeton glomeratus</i>	10.83	83.33	6
<i>Machaeranthera grindelioides</i>	0.83	16.67	6
<i>Malcomia africana</i>	1.67	33.33	6
<i>Salsola pestifer</i>			
<u>Grasses</u>			
<i>Agropyron cristatum</i>	15.00	83.33	6
<i>Sporobolus airoides</i>	2.50	16.67	6
<i>Stipa hymenoides</i>	1.67	16.67	6

D. WOODY SPECIES DENSITY

	NUMBER/ACRE
<i>Atriplex canescens</i>	929.28
TOTAL	928.28

TABLE 11: Subplot 11 - Total cover (A), composition (B), cover and frequency by species (C), and woody species density (D), summaries for the C.V. Spur No. 1 Test Plot for 1997.

A. TOTAL COVER	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZES
Total Living Cover	39.17	7.86	6
Litter	8.33	2.36	6
Bareground	43.33	9.43	6
Rock	9.17	1.86	6

B. COMPOSITION

Shrubs	30.18	25.00	6
Forbs	44.74	34.57	6
Grasses	25.08	30.88	6

C. COVER BY SPECIES

	% MEAN COVER	RELATIVE FREQUENCY	SAMPLE SIZES
<u>Shrubs</u>			
<i>Atriplex canescens</i>	12.50	66.67	6
<i>Atriplex corrugata</i>			
<i>Ceratoides lanata</i>	0.83	16.67	6
<u>Forbs</u>			
<i>Halogeton glomeratus</i>	11.67	83.33	6
<i>Malcomia africana</i>	4.17	50.00	6
<u>Grasses</u>			
<i>Agropyron cristatum</i>	10.00	50.00	6

D. WOODY SPECIES DENSITY

	NUMBER/ACRE
<i>Atriplex canescens</i>	1974.72
<i>Ceratoides lanata</i>	<u>813.12</u>
TOTAL	2787.84

TABLE 12: Subplot 12 - Total cover (A), composition (B), cover and frequency by species (C), and woody species density (D), summaries for the C.V. Spur No. 1 Test Plot for 1997.

A. TOTAL COVER	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZES
Total Living Cover	50.83	8.86	6
Litter	10.00	0.00	6
Bareground	18.33	7.45	6
Rock	20.83	5.34	6

B. COMPOSITION

Shrubs	29.34	28.68	6
Forbs	16.35	18.50	6
Grasses	54.32	40.39	6

C. COVER BY SPECIES

	% MEAN COVER	RELATIVE FREQUENCY	SAMPLE SIZES
<u>Shrubs</u>			
<i>Atriplex canescens</i>	14.17	66.67	6
<i>Ceratoides lanata</i>	1.67	16.67	6
<u>Forbs</u>			
<i>Halogeton glomeratus</i>	6.67	50.00	6
<i>Salsola pestifer</i>	0.83	16.67	6
<u>Grasses</u>			
<i>Agropyron cristatum</i>	25.83	66.67	6
<i>Sporobolus airoides</i>	1.67	16.67	6

D. WOODY SPECIES DENSITY

	NUMBER/ACRE
<i>Atriplex canescens</i>	2323.20
<i>Ceratoides lanata</i>	<u>929.28</u>
TOTAL	3252.48

TABLE 13: Subplot 13 - Total cover (A), composition (B), cover and frequency by species (C), and woody species density (D), summaries for the C.V. Spur No. 1 Test Plot for 1997.

A. TOTAL COVER	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZES
Total Living Cover	42.50	2.50	6
Litter	8.33	2.36	6
Bareground	39.17	5.34	6
Rock	10.00	4.08	6

B. COMPOSITION

Shrubs	0.00	0.00	6
Forbs	100.00	0.00	6
Grasses	0.00	0.00	6

C. COVER BY SPECIES

	% MEAN COVER	RELATIVE FREQUENCY	SAMPLE SIZES
<u>Shrubs</u>			
<u>Forbs</u>			
<i>Halogeton glomeratus</i>	30.83	100.00	6
<i>Malcomia africana</i>	11.67	83.33	6

Grasses

D. WOODY SPECIES DENSITY

	NUMBER/ACRE
<i>Atriplex canescens</i>	<u>116.16</u>
TOTAL	116.16

TABLE 14: Subplot 14 - Total cover (A), composition (B), cover and frequency by species (C), and woody species density (D), summaries for the C.V. Spur No. 1 Test Plot for 1997.

A. TOTAL COVER	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZES
Total Living Cover	43.33	2.36	6
Litter	9.17	3.44	6
Bareground	39.17	5.34	6
Rock	8.33	2.36	6
B. COMPOSITION			
Shrubs	1.85	4.14	6
Forbs	98.15	4.14	6
Grasses	0.00	0.00	6
C. COVER BY SPECIES			
	% MEAN COVER	RELATIVE FREQUENCY	SAMPLE SIZES
<u>Shrubs</u>			
<i>Atriplex canescens</i>	0.83	16.67	6
<u>Forbs</u>			
<i>Halogeton glomeratus</i>	42.50	100.00	6
<u>Grasses</u>			
D. WOODY SPECIES DENSITY			
		NUMBER/ACRE	
<i>Atriplex canescens</i>		<u>813.12</u>	
TOTAL		813.12	

TABLE 15: Subplot 15 - Total cover (A), composition (B), cover and frequency by species (C), and woody species density (D), summaries for the C.V. Spur No. 1 Test Plot for 1997.

A. TOTAL COVER	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZES
Total Living Cover	45.00	5.77	6
Litter	10.83	6.72	6
Bareground	31.67	6.24	6
Rock	12.50	4.79	6

B. COMPOSITION

Shrubs	20.83	22.44	6
Forbs	66.25	37.19	6
Grasses	12.92	15.17	6

C. COVER BY SPECIES

	% MEAN COVER	RELATIVE FREQUENCY	SAMPLE SIZES
<u>Shrubs</u>			
<i>Atriplex canescens</i>	9.17	50.00	6
<u>Forbs</u>			
<i>Halogeton glomeratus</i>	15.83	83.33	6
<i>Machaeranthera canescens</i>	0.83	16.67	6
<i>Malcomia africana</i>	13.33	83.33	6
<u>Grasses</u>			
<i>Agropyron cristatum</i>	5.83	50.00	6

D. WOODY SPECIES DENSITY

	NUMBER/ACRE
<i>Atriplex canescens</i>	1045.44
<i>Ceratoides lanata</i>	<u>232.32</u>
TOTAL	1277.76

TABLE 16: Subplot 16 - Total cover (A), composition (B), cover and frequency by species (C), and woody species density (D), summaries for the C.V. Spur No. 1 Test Plot for 1997.

A. TOTAL COVER	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZES
Total Living Cover	46.67	10.67	6
Litter	10.00	0.00	6
Bareground	29.17	9.75	6
Rock	24.17	1.86	6

B. COMPOSITION

Shrubs	33.33	24.27	6
Forbs	31.85	24.74	6
Grasses	34.81	31.62	6

C. COVER BY SPECIES

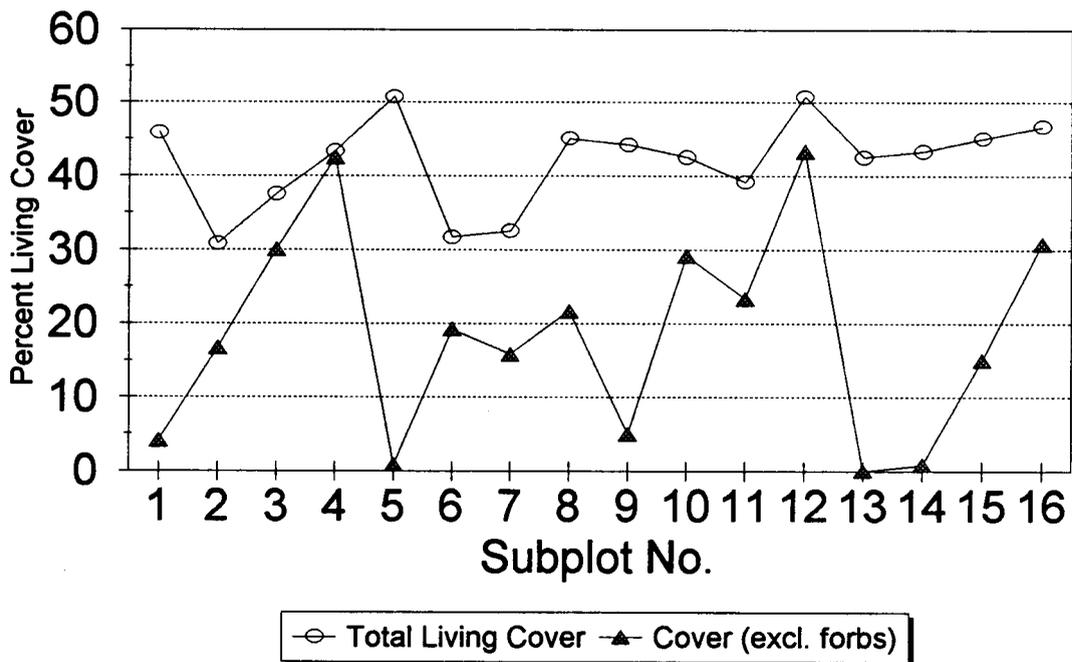
	% MEAN COVER	RELATIVE FREQUENCY	SAMPLE SIZES
<u>Shrubs</u>			
<i>Atriplex canescens</i>	15.83	66.67	6
<i>Ceratoides lanata</i>	1.67	33.33	6
<u>Forbs</u>			
<i>Halogeton glomeratus</i>	10.83	66.67	6
<i>Helianthus annuus</i>	0.83	16.67	6
<i>Machaeranthera grindelioides</i>	2.50	50.00	6
<i>Sphaeralcea grossulariifolia</i>	1.67	16.67	6
<u>Grasses</u>			
<i>Agropyron cristatum</i>	10.00	66.67	6
<i>Stipa hymenoides</i>	3.33	33.33	6

D. WOODY SPECIES DENSITY

	NUMBER/ACRE
<i>Atriplex canescens</i>	1974.72
<i>Ceratoides lanata</i>	<u>116.16</u>
TOTAL	2090.88

FIGURES & GRAPHS

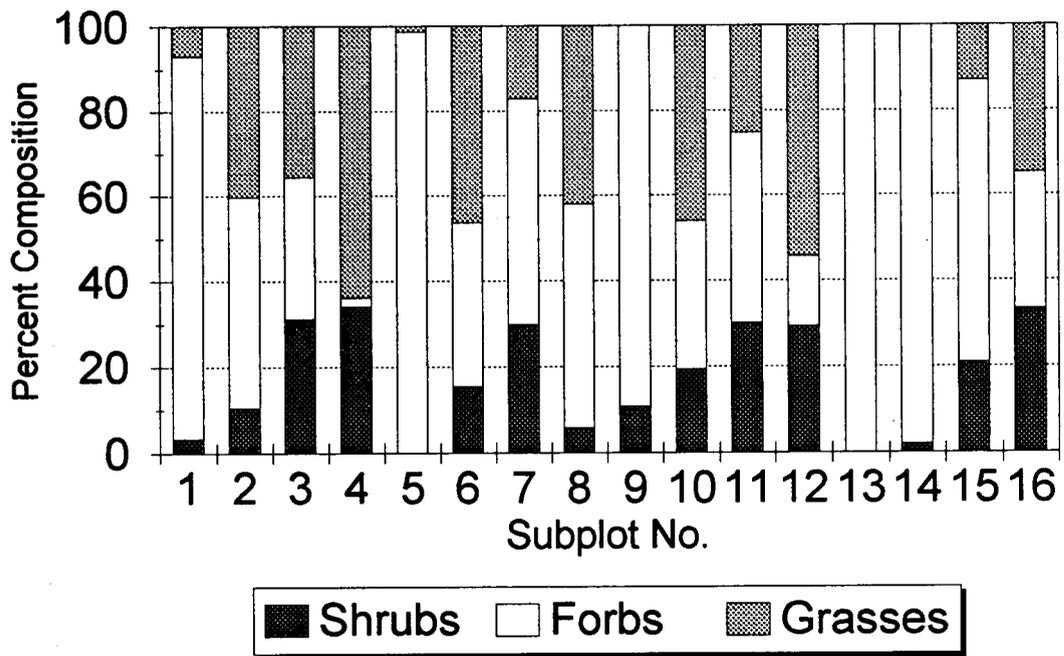
Fig. 1: TOTAL LIVING COVER
C.V. Spur No. 1 (1997)



TREATMENT KEY

Subplot No.	Treatment
1, 9	6" soil, seed (control)
2, 6	6" soil, seed, wood fiber mulch
3, 7	4" soil, 2" coal refuse, seed, wood fiber mulch
4, 8	3" soil, 3" coal refuse, seed, wood fiber mulch
5	6" soil, wood fiber mulch (strip planting)
10, 14	6" soil, seed, hay mulch
11, 15	4" soil, 2" coal refuse, seed, hay mulch
12, 16	3" soil, 3" coal refuse, seed, hay mulch
13	6" soil, hay mulch (strip planting)

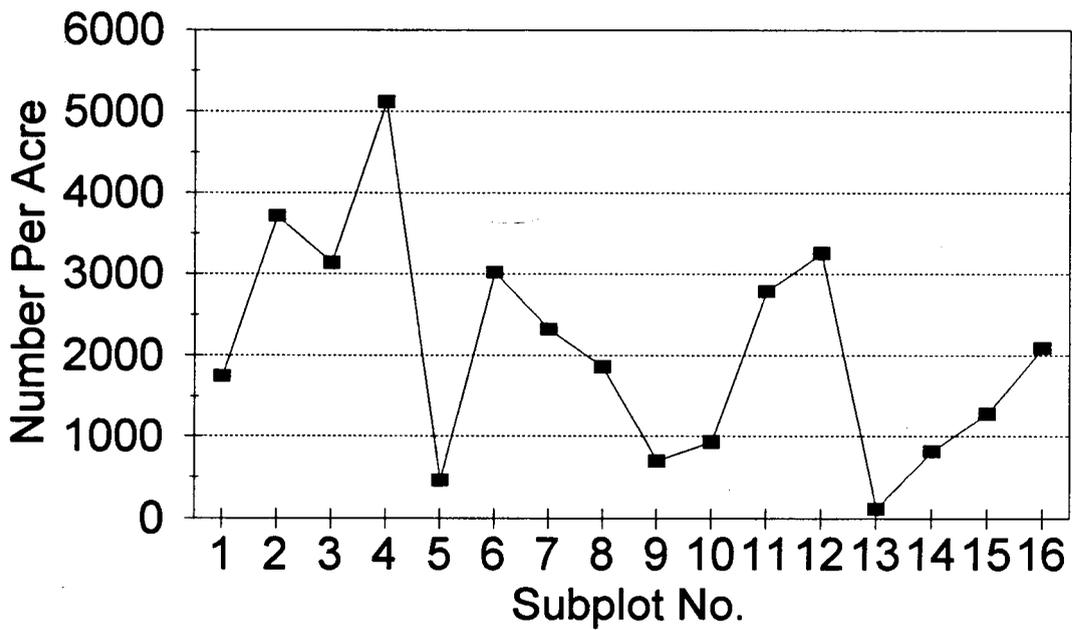
Fig. 2: LIFEFORM COMPOSITION
C.V. Spur No. 1 (1997)



TREATMENT KEY

Subplot No.	Treatment
1, 9	6" soil, seed (control)
2, 6	6" soil, seed, wood fiber mulch
3, 7	4" soil, 2" coal refuse, seed, wood fiber mulch
4, 8	3" soil, 3" coal refuse, seed, wood fiber mulch
5	6" soil, wood fiber mulch (strip planting)
10, 14	6" soil, seed, hay mulch
11, 15	4" soil, 2" coal refuse, seed, hay mulch
12, 16	3" soil, 3" coal refuse, seed, hay mulch
13	6" soil, hay mulch (strip planting)

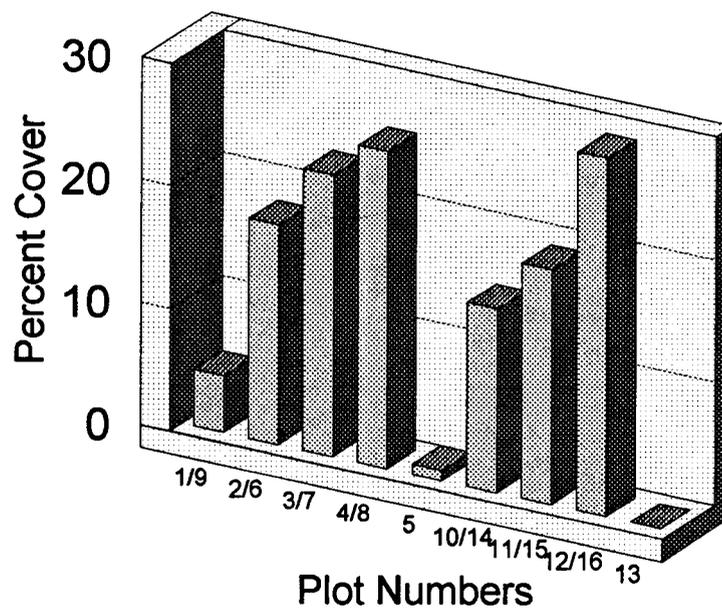
Fig. 3: Woody Species Density
C.V. Spur No. 1 (1997)



TREATMENT KEY

Subplot No.	Treatment
1, 9	6" soil, seed (control)
2, 6	6" soil, seed, wood fiber mulch
3, 7	4" soil, 2" coal refuse, seed, wood fiber mulch
4, 8	3" soil, 3" coal refuse, seed, wood fiber mulch
5	6" soil, wood fiber mulch (strip planting)
10, 14	6" soil, seed, hay mulch
11, 15	4" soil, 2" coal refuse, seed, hay mulch
12, 16	3" soil, 3" coal refuse, seed, hay mulch
13	6" soil, hay mulch (strip planting)

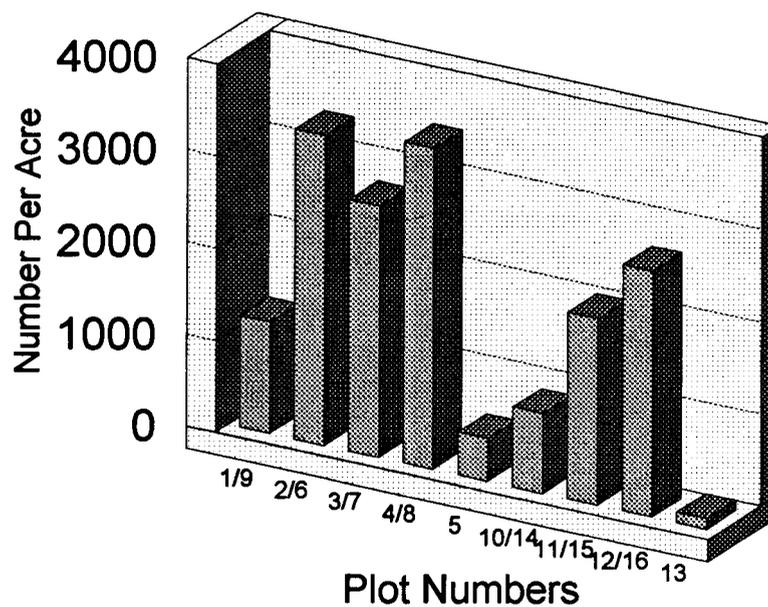
Fig. 4: MEAN COVER OF EACH TREATMENT
C.V. Spur No 1 (1997)



TREATMENT KEY

Subplot No.	Treatment
1, 9	6" soil, seed (control)
2, 6	6" soil, seed, wood fiber mulch
3, 7	4" soil, 2" coal refuse, seed, wood fiber mulch
4, 8	3" soil, 3" coal refuse, seed, wood fiber mulch
5	6" soil, wood fiber mulch (strip planting)
10, 14	6" soil, seed, hay mulch
11, 15	4" soil, 2" coal refuse, seed, hay mulch
12, 16	3" soil, 3" coal refuse, seed, hay mulch
13	6" soil, hay mulch (strip planting)

Fig. 5: MEAN DENSITY OF EACH TREATMENT
C.V. Spur No. 1 (1997)



TREATMENT KEY

Subplot No.	Treatment
1, 9	6" soil, seed (control)
2, 6	6" soil, seed, wood fiber mulch
3, 7	4" soil, 2" coal refuse, seed, wood fiber mulch
4, 8	3" soil, 3" coal refuse, seed, wood fiber mulch
5	6" soil, wood fiber mulch (strip planting)
10, 14	6" soil, seed, hay mulch
11, 15	4" soil, 2" coal refuse, seed, hay mulch
12, 16	3" soil, 3" coal refuse, seed, hay mulch
13	6" soil, hay mulch (strip planting)

COLOR PHOTOGRAPHS



C V Spur No. 1 Test Plot

APPENDIX
Raw Data

CV SPUR
 Reveg Test Plots #1
 Date: 26 Aug 1997
 Slope: 1 deg.
 Exposure: North
 Workers: P. & D. Collins

CELL 1:
 Control, 6" Soil, Seed Only

	1.00	2.00	3.00	4.00	5.00	6.00	Mean	SDev	Freq
--	------	------	------	------	------	------	------	------	------

SHRUBS
Ceratoides lanata

	10.00	0.00	0.00	0.00	0.00	0.00	1.67	3.73	16.67
--	-------	------	------	------	------	------	------	------	-------

FORBS
Halogeton glomeratus
Iva axillaris
Kochia scoparia
Malcomia africana

<i>Halogeton glomeratus</i>	40.00	15.00	40.00	20.00	40.00	10.00	27.50	12.83	100.00
<i>Iva axillaris</i>	0.00	10.00	10.00	10.00	10.00	20.00	10.00	5.77	83.33
<i>Kochia scoparia</i>	0.00	0.00	0.00	5.00	0.00	0.00	0.83	1.86	16.67
<i>Malcomia africana</i>	0.00	0.00	10.00	0.00	10.00	0.00	3.33	4.71	33.33

GRASSES
Cynopyron cristatum

<i>Cynopyron cristatum</i>	0.00	5.00	0.00	0.00	0.00	10.00	2.50	3.82	33.33
----------------------------	------	------	------	------	------	-------	------	------	-------

Living Cover	50.00	30.00	60.00	35.00	60.00	40.00	45.83	11.70	
Litter	10.00	10.00	15.00	5.00	15.00	10.00	10.83	3.44	
Bareground	35.00	55.00	15.00	55.00	15.00	40.00	35.83	16.44	
Rock	5.00	5.00	10.00	5.00	10.00	10.00	7.50	2.50	
Trees/Shrubs	20.00	0.00	0.00	0.00	0.00	0.00	3.33	7.45	
Forbs	80.00	83.33	100.00	100.00	100.00	75.00	89.72	10.56	
Grasses	0.00	16.67	0.00	0.00	0.00	25.00	6.94	10.11	

=====

CELL 2: 6" Soil, Seed & Mulch

Wood Fiber 2000#/ac	1.00	2.00	3.00	4.00	5.00	6.00	Mean	SDev	Freq
SHRUBS									
Atriplex canescens	0.00	0.00	0.00	0.00	10.00	0.00	1.67	3.73	16.67
Atriplex corrugata	0.00	0.00	5.00	0.00	0.00	5.00	1.67	2.36	33.33
FORBS									
Halogeton glomeratus	25.00	25.00	5.00	15.00	10.00	5.00	14.17	8.37	100.00
GRASSES									
Agropyron cristatum	0.00	5.00	20.00	15.00	10.00	30.00	13.33	9.86	83.33
<hr/>									
Living Cover	25.00	30.00	30.00	30.00	30.00	40.00	30.83	4.49	
Water	5.00	10.00	10.00	10.00	10.00	10.00	9.17	1.86	
Background	60.00	50.00	50.00	50.00	50.00	45.00	50.83	4.49	
Rock	10.00	10.00	10.00	10.00	10.00	5.00	9.17	1.86	
<hr/>									
Trees/Shrubs	0.00	0.00	16.67	0.00	33.33	12.50	10.42	12.21	
Forbs	100.00	83.33	16.67	50.00	33.33	12.50	49.31	32.67	
Grasses	0.00	16.67	66.67	50.00	33.33	75.00	40.28	26.53	
<hr/>									

CELL 3: 4" Soil, 2" Coal Refuse

Seed&Mulch,WoodFiber2000#/ -----	1.00	2.00	3.00	4.00	5.00	6.00	-----	Mean	SDev	Freq
SHRUBS										
Atriplex canescens	35.00	0.00	30.00	10.00	0.00	0.00		12.50	14.65	50.00
Ceratoides lanata	0.00	0.00	10.00	10.00	0.00	0.00		3.33	4.71	33.33
FORBS										
Halogeton glomeratus	0.00	10.00	0.00	0.00	5.00	0.00		2.50	3.82	33.33
Malcomia africana	0.00	10.00	0.00	0.00	15.00	5.00		5.00	5.77	50.00
GRASSES										
Agropyron cristatum	30.00	0.00	20.00	10.00	5.00	20.00		14.17	10.17	83.33
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Living Cover	65.00	20.00	60.00	30.00	25.00	25.00		37.50	17.97	
Water	5.00	10.00	10.00	5.00	5.00	5.00		6.67	2.36	
Reground	25.00	60.00	20.00	55.00	65.00	60.00		47.50	17.97	
Rock	5.00	10.00	10.00	10.00	5.00	10.00		8.33	2.36	
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Trees/Shrubs	53.85	0.00	66.67	66.67	0.00	0.00		31.20	31.49	
Forbs	0.00	100.00	0.00	0.00	80.00	20.00		33.33	41.10	
Grasses	46.15	0.00	33.33	33.33	20.00	80.00		35.47	24.51	
=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====

CELL 4: 3" Soil, 3" Coal Refuse,
Seed&Mulch,WoodFiber2000#//

	1.00	2.00	3.00	4.00	5.00	6.00	Mean	SDev	Freq
SHRUBS									
Atriplex canescens	5.00	30.00	10.00	20.00	5.00	10.00	13.33	8.98	100.00
Ceratoides lanata	0.00	0.00	0.00	10.00	0.00	0.00	1.67	3.73	16.67
FORBS									
Machaeranthera canescens	0.00	0.00	0.00	0.00	5.00	0.00	0.83	1.86	16.67
GRASSES									
Agropyron cristatum	35.00	20.00	35.00	10.00	25.00	35.00	26.67	9.43	100.00
Elymus lanceolatus	0.00	0.00	0.00	0.00	5.00	0.00	0.83	1.86	16.67
Summary Statistics									
Living Cover	40.00	50.00	45.00	40.00	40.00	45.00	43.33	3.73	
Litter	5.00	10.00	10.00	10.00	10.00	10.00	9.17	1.86	
Reground	30.00	25.00	20.00	20.00	40.00	30.00	27.50	6.92	
Rock	25.00	15.00	25.00	30.00	10.00	15.00	20.00	7.07	
Overall Totals									
Trees/Shrubs	12.50	60.00	22.22	75.00	12.50	22.22	34.07	24.35	
Forbs	0.00	0.00	0.00	0.00	12.50	0.00	2.08	4.66	
Grasses	87.50	40.00	77.78	25.00	75.00	77.78	63.84	22.91	

CELL 5: Strip Planting of Species

Wood, Fiber, Mulch	1.00	2.00	3.00	4.00	5.00	6.00	Mean	SDev	Freq
=====									
.RUBS									
FORBS									
Halogeton glomeratus	45.00	30.00	45.00	40.00	40.00	40.00	40.00	5.00	100.00
Malcomia africana	0.00	10.00	10.00	10.00	10.00	10.00	8.33	3.73	83.33
Salsola pestifer	0.00	0.00	0.00	10.00	0.00	0.00	1.67	3.73	16.67
GRASSES									
Agropyron cristatum	0.00	0.00	5.00	0.00	0.00	0.00	0.83	1.86	16.67
=====									
Living Cover	45.00	40.00	60.00	60.00	50.00	50.00	50.83	7.31	
Water	10.00	10.00	10.00	10.00	10.00	10.00	10.00	0.00	
Ground	40.00	45.00	25.00	20.00	35.00	30.00	32.50	8.54	
Rock	5.00	5.00	5.00	10.00	5.00	10.00	6.67	2.36	
=====									
Trees/Shrubs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Forbs	100.00	100.00	91.67	100.00	100.00	100.00	98.61	3.11	
Grasses	0.00	0.00	8.33	0.00	0.00	0.00	1.39	3.11	
=====									

CELL 6: 6" Soil, Seed & Mulch

Wood Fiber 2000#/ac	1.00	2.00	3.00	4.00	5.00	6.00	Mean	SDev	Freq
SHRUBS									
Atriplex canescens	0.00	0.00	0.00	10.00	15.00	0.00	4.17	6.07	33.33
Atriplex corrugata	0.00	0.00	0.00	2.00	5.00	0.00	1.17	1.86	33.33
FORBS									
Halogeton glomeratus	25.00	5.00	8.00	0.00	0.00	5.00	7.17	8.47	66.67
Helianthus annuus	0.00	0.00	2.00	2.00	0.00	0.00	0.67	0.94	33.33
Malcomia africana	15.00	0.00	0.00	8.00	5.00	0.00	4.67	5.53	50.00
GRASSES									
Agropyron cristatum	0.00	15.00	10.00	5.00	10.00	0.00	6.67	5.53	66.67
Elymus smithii	0.00	0.00	0.00	0.00	0.00	35.00	5.83	13.04	16.67
Stipa hymenoides	0.00	0.00	0.00	8.00	0.00	0.00	1.33	2.98	16.67
Summary									
Living Cover	40.00	20.00	20.00	35.00	35.00	40.00	31.67	8.50	
litter	10.00	10.00	5.00	10.00	10.00	10.00	9.17	1.86	
bareground	40.00	65.00	70.00	45.00	50.00	45.00	52.50	11.09	
Rock	10.00	5.00	5.00	10.00	5.00	5.00	6.67	2.36	
Overall									
Trees/Shrubs	0.00	0.00	0.00	34.29	57.14	0.00	15.24	22.54	
Forbs	100.00	25.00	50.00	28.57	14.29	12.50	38.39	30.16	
Grasses	0.00	75.00	50.00	37.14	28.57	87.50	46.37	29.09	

CELL 7: 4" Soil, 2" Coal Refuse

Seed&Mulch,WoodFiber2000#/ -----	1.00	2.00	3.00	4.00	5.00	6.00	-----	Mean	SDev	Freq
SHRUBS										
Atriplex canescens	20.00	10.00	0.00	20.00	5.00	0.00		9.17	8.37	66.67
Ceratoides lanata	0.00	0.00	0.00	0.00	0.00	5.00		0.83	1.86	16.67
FORBS										
Salsola pestifer	5.00	0.00	0.00	0.00	0.00	0.00		0.83	1.86	16.67
Malcomia africana	0.00	10.00	0.00	10.00	0.00	0.00		3.33	4.71	33.33
Halogeton glomeratus	0.00	10.00	25.00	5.00	20.00	15.00		12.50	8.54	83.33
GRASSES										
Agropyron cristatum	10.00	10.00	0.00	0.00	0.00	0.00		3.33	4.71	33.33
Stipa hymenoides	0.00	0.00	10.00	0.00	0.00	5.00		2.50	3.82	33.33

Living Cover	35.00	40.00	35.00	35.00	25.00	25.00		32.50	5.59	
Litter	5.00	10.00	10.00	5.00	15.00	5.00		8.33	3.73	
reground	45.00	35.00	45.00	50.00	50.00	55.00		46.67	6.24	
Rock	15.00	15.00	10.00	10.00	10.00	15.00		12.50	2.50	

Trees/Shrubs	57.14	25.00	0.00	57.14	20.00	20.00		29.88	20.81	
Forbs	14.29	50.00	71.43	42.86	80.00	60.00		53.10	21.32	
Grasses	28.57	25.00	28.57	0.00	0.00	20.00		17.02	12.37	
=====										

CELL 8: 3"soil,3"coal ref.,

Seed&Mulch,WoodFiber,2000#/	1.00	2.00	3.00	4.00	5.00	6.00	Mean	SDev	Freq
SHRUBS									
Atriplex canescens	0.00	0.00	0.00	5.00	0.00	5.00	1.67	2.36	33.33
Ceratoides lanata	5.00	0.00	0.00	0.00	0.00	0.00	0.83	1.86	16.67
FORBS									
Bassia hyssopifolia	0.00	0.00	0.00	5.00	0.00	0.00	0.83	1.86	16.67
Halogeton glomeratus	15.00	15.00	10.00	20.00	35.00	5.00	16.67	9.43	100.00
Machaeranthera grindelioides	0.00	5.00	0.00	0.00	0.00	0.00	0.83	1.86	16.67
Salsola pestifer	0.00	10.00	0.00	5.00	15.00	0.00	5.00	5.77	50.00
GRASSES									
Agropyron cristatum	0.00	10.00	30.00	5.00	5.00	45.00	15.83	16.18	83.33
Elymus elymoides	5.00	0.00	0.00	0.00	0.00	0.00	0.83	1.86	16.67
Elymus smithii	15.00	0.00	0.00	0.00	0.00	0.00	2.50	5.59	16.67
Other Categories									
ng Cover	40.00	40.00	40.00	40.00	55.00	55.00	45.00	7.07	
Litter	5.00	10.00	10.00	10.00	10.00	20.00	10.83	4.49	
Bareground	10.00	25.00	15.00	30.00	15.00	10.00	17.50	7.50	
Rock	45.00	25.00	35.00	20.00	20.00	15.00	26.67	10.27	
Summary									
Trees/Shrubs	12.50	0.00	0.00	12.50	0.00	9.09	5.68	5.79	
Forbs	37.50	75.00	25.00	75.00	90.91	9.09	52.08	29.87	
Grasses	50.00	25.00	75.00	12.50	9.09	81.82	42.23	28.81	

CELL 9:

Control, 6" Soil, Seed Only	1.00	2.00	3.00	4.00	5.00	6.00	Mean	SDev	Freq
.IRUBS									
Atriplex canescens	0.00	0.00	0.00	0.00	25.00	0.00	4.17	9.32	16.67
Atriplex corrugata	0.00	0.00	5.00	0.00	0.00	0.00	0.83	1.86	16.67

FORBS									
Halogeton glomeratus	20.00	20.00	15.00	40.00	10.00	30.00	22.50	9.90	100.00
Malcomia africana	20.00	20.00	15.00	0.00	15.00	30.00	16.67	8.98	83.33

Total Living Cover	40.00	40.00	35.00	40.00	50.00	60.00	44.17	8.37	
Litter	10.00	5.00	10.00	5.00	10.00	10.00	8.33	2.36	
Bare ground	40.00	50.00	45.00	40.00	25.00	25.00	37.50	9.46	
Rock	10.00	5.00	10.00	15.00	15.00	5.00	10.00	4.08	
Trees/Shrubs	0.00	0.00	14.29	0.00	50.00	0.00	10.71	18.33	
Forbs	100.00	100.00	85.71	100.00	50.00	100.00	89.29	18.33	
Grasses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

CELL 10: 6" Soil, Seed & Hay

Mulch, 2000#/ac	1.00	2.00	3.00	4.00	5.00	6.00	Mean	SDev	Freq
SHRUBS									
<i>Atriplex canescens</i>	5.00	35.00	0.00	0.00	0.00	20.00	10.00	13.23	50.00
FORBS									
<i>Halogeton glomeratus</i>	25.00	0.00	5.00	10.00	20.00	5.00	10.83	8.86	83.33
<i>Machaeranthera grindelioides</i>	0.00	5.00	0.00	0.00	0.00	0.00	0.83	1.86	16.67
<i>Malcomia africana</i>	5.00	0.00	0.00	0.00	5.00	0.00	1.67	2.36	33.33
GRASSES									
<i>Agropyron cristatum</i>	5.00	10.00	35.00	25.00	0.00	15.00	15.00	11.90	83.33
<i>Sporobolus airoides</i>	0.00	15.00	0.00	0.00	0.00	0.00	2.50	5.59	16.67
<i>Stipa hymenoides</i>	0.00	0.00	0.00	0.00	10.00	0.00	1.67	3.73	16.67
Summary Statistics									
Total Living Cover	40.00	65.00	40.00	35.00	35.00	40.00	42.50	10.31	
Water	5.00	15.00	10.00	25.00	5.00	5.00	10.83	7.31	
Background	50.00	15.00	45.00	30.00	55.00	50.00	40.83	13.97	
Rock	5.00	5.00	5.00	10.00	5.00	5.00	5.83	1.86	
Overall Totals									
Trees/Shrubs	12.50	53.85	0.00	0.00	0.00	50.00	19.39	23.45	
Forbs	75.00	7.69	12.50	28.57	71.43	12.50	34.62	28.06	
Grasses	12.50	38.46	87.50	71.43	28.57	37.50	45.99	25.57	

CELL 11: 4" Soil, 2" Coal Ref, Seed & Hay Mulch, 2000#/ac	1.00	2.00	3.00	4.00	5.00	6.00	Mean	SDev	Freq
SHRUBS									
Atriplex canescens	0.00	10.00	40.00	15.00	0.00	10.00	12.50	13.46	66.67
Ceratoides lanata	0.00	5.00	0.00	0.00	0.00	0.00	0.83	1.86	16.67
FORBS									
Halogeton glomeratus	25.00	25.00	0.00	5.00	5.00	10.00	11.67	9.86	83.33
Malcomia africana	10.00	0.00	0.00	5.00	0.00	10.00	4.17	4.49	50.00
GRASSES									
Agropyron cristatum	0.00	0.00	15.00	15.00	30.00	0.00	10.00	11.18	50.00
<hr/>									
Living Cover	35.00	40.00	55.00	40.00	35.00	30.00	39.17	7.86	
Herb	5.00	5.00	10.00	10.00	10.00	10.00	8.33	2.36	
Background	55.00	45.00	25.00	40.00	45.00	50.00	43.33	9.43	
Rock	5.00	10.00	10.00	10.00	10.00	10.00	9.17	1.86	
<hr/>									
Trees/Shrubs	0.00	37.50	72.73	37.50	0.00	33.33	30.18	25.00	
Forbs	100.00	62.50	0.00	25.00	14.29	66.67	44.74	34.57	
Grasses	0.00	0.00	27.27	37.50	85.71	0.00	25.08	30.88	
<hr/>									

CELL 12: 3" soil, 3" Coal Ref.

Seed & Hay Mulch, 2000#/ac	1.00	2.00	3.00	4.00	5.00	6.00	Mean	SDev	Freq
SHRUBS									
<i>Atriplex canescens</i>	40.00	0.00	0.00	20.00	20.00	5.00	14.17	14.26	66.67
<i>Ceratoides lanata</i>	10.00	0.00	0.00	0.00	0.00	0.00	1.67	3.73	16.67
FORBS									
<i>Halogeton glomeratus</i>	15.00	10.00	0.00	15.00	0.00	0.00	6.67	6.87	50.00
<i>Salsola pestifer</i>	0.00	0.00	0.00	5.00	0.00	0.00	0.83	1.86	16.67
GRASSES									
<i>Agropyron cristatum</i>	0.00	30.00	45.00	0.00	30.00	50.00	25.83	19.67	66.67
<i>Sporobolus airoides</i>	0.00	0.00	10.00	0.00	0.00	0.00	1.67	3.73	16.67
Summary									
Living Cover	65.00	40.00	55.00	40.00	50.00	55.00	50.83	8.86	
Litter	10.00	10.00	10.00	10.00	10.00	10.00	10.00	0.00	
Bareground	10.00	30.00	10.00	20.00	25.00	15.00	18.33	7.45	
Rock	15.00	20.00	25.00	30.00	15.00	20.00	20.83	5.34	
Trees/Shrubs	76.92	0.00	0.00	50.00	40.00	9.09	29.34	28.68	
Forbs	23.08	25.00	0.00	50.00	0.00	0.00	16.35	18.50	
Grasses	0.00	75.00	100.00	0.00	60.00	90.91	54.32	40.39	

CELL 13: Strip Planting 6" Soil

2000#/ac Hay, Mulch

1.00 2.00 3.00 4.00 5.00 6.00 Mean SDev Freq

SHRUBS

FORBS

Halogeton glomeratus	30.00	30.00	25.00	30.00	40.00	30.00	30.83	4.49	100.00
Malcomia africana	10.00	15.00	20.00	10.00	0.00	15.00	11.67	6.24	83.33

GRASSES

Living Cover	40.00	45.00	45.00	40.00	40.00	45.00	42.50	2.50
Herb	10.00	10.00	10.00	10.00	5.00	5.00	8.33	2.36
Background	35.00	40.00	35.00	35.00	50.00	40.00	39.17	5.34
Rock	15.00	5.00	10.00	15.00	5.00	10.00	10.00	4.08
Trees/Shrubs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Forbs	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0.00
Grasses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

CELL 14: 6" Soil, Seed & Hay
Mulch, 2000#/ac

	1.00	2.00	3.00	4.00	5.00	6.00	Mean	SDev	Freq
FORBS									
Atriplex canescens	0.00	0.00	0.00	0.00	0.00	5.00	0.83	1.86	16.67
FORBS									
Halogeton glomeratus	45.00	40.00	45.00	40.00	45.00	40.00	42.50	2.50	100.00

GRASSES

Living Cover	45.00	40.00	45.00	40.00	45.00	45.00	43.33	2.36
Water	5.00	5.00	15.00	10.00	10.00	10.00	9.17	3.44
Background	45.00	45.00	30.00	40.00	40.00	35.00	39.17	5.34
Rock	5.00	10.00	10.00	10.00	5.00	10.00	8.33	2.36
Trees/Shrubs	0.00	0.00	0.00	0.00	0.00	11.11	1.85	4.14
Forbs	100.00	100.00	100.00	100.00	100.00	88.89	98.15	4.14
Grasses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

CELL 15: 4" Soil, 2" Coal Ref,
Seed & Hay Mulch, 2000#/ac

	1.00	2.00	3.00	4.00	5.00	6.00	Mean	SDev	Freq
SHRUBS									
<i>Atriplex canescens</i>	0.00	0.00	10.00	20.00	25.00	0.00	9.17	10.17	50.00
FORBS									
<i>Halogeton glomeratus</i>	30.00	25.00	5.00	5.00	0.00	30.00	15.83	12.72	83.33
<i>Malcomia africana</i>	15.00	15.00	20.00	5.00	0.00	25.00	13.33	8.50	83.33
<i>Machaeranthera canescens</i>	0.00	0.00	0.00	0.00	5.00	0.00	0.83	1.86	16.67
GRASSES									
<i>Agropyron cristatum</i>	0.00	0.00	5.00	10.00	20.00	0.00	5.83	7.31	50.00
Summary									
Living Cover	45.00	40.00	40.00	40.00	50.00	55.00	45.00	5.77	
Herb	10.00	10.00	5.00	10.00	25.00	5.00	10.83	6.72	
Ground	30.00	35.00	35.00	40.00	20.00	30.00	31.67	6.24	
Rock	15.00	15.00	20.00	10.00	5.00	10.00	12.50	4.79	
Trees/Shrubs	0.00	0.00	25.00	50.00	50.00	0.00	20.83	22.44	
Forbs	100.00	100.00	62.50	25.00	10.00	100.00	66.25	37.19	
Grasses	0.00	0.00	12.50	25.00	40.00	0.00	12.92	15.17	

CELL 16: 3" Soil,3"Coal Ref.

Seed & Hay Mulch, 2000#/ac

	1.00	2.00	3.00	4.00	5.00	6.00	Mean	SDev	Freq
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.RUBS

Atriplex canescens	0.00	25.00	20.00	0.00	30.00	20.00	15.83	11.70	66.67
Ceratoides lanata	0.00	5.00	5.00	0.00	0.00	0.00	1.67	2.36	33.33

FORBS

Halogeton glomeratus	25.00	20.00	0.00	0.00	10.00	10.00	10.83	9.32	66.67
Helianthus annuus	0.00	0.00	0.00	0.00	5.00	0.00	0.83	1.86	16.67
Machaeranthera grindelioides	0.00	0.00	5.00	0.00	5.00	5.00	2.50	2.50	50.00
Sphaeralcea grossulariifolia	10.00	0.00	0.00	0.00	0.00	0.00	1.67	3.73	16.67

GRASSES

Agropyron cristatum	10.00	0.00	10.00	25.00	0.00	15.00	10.00	8.66	66.67
Stipa hymenoides	0.00	0.00	10.00	0.00	10.00	0.00	3.33	4.71	33.33

Living Cover	45.00	50.00	50.00	25.00	60.00	50.00	46.67	10.67
litter	10.00	10.00	10.00	10.00	10.00	10.00	10.00	0.00
ground	20.00	15.00	15.00	40.00	10.00	15.00	19.17	9.75
rock	25.00	25.00	25.00	25.00	20.00	25.00	24.17	1.86
Trees/Shrubs	0.00	60.00	50.00	0.00	50.00	40.00	33.33	24.27
Forbs	77.78	40.00	10.00	0.00	33.33	30.00	31.85	24.74
Grasses	22.22	0.00	40.00	100.00	16.67	30.00	34.81	31.62

VEGETATION MONITORING
OF THE
C.V. SPUR NO. 2 TEST PLOTS
1997



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Report Date:

March 1998

TABLE OF CONTENTS

INTRODUCTION	1
Section 1 (west side)	1
Section 2 (east side)	2
Section 3 (middle)	2
METHODS	2
Cover and Composition	2
Woody Species Density	3
Photographs	3
Raw Data	3
RESULTS	4
Section 1 (west side)	4
Section 2 (east side)	4
Section 3 (middle)	5
DISCUSSION	5
DATA SUMMARY TABLES	6-7
FIGURES & GRAPHS	8-13
COLOR PHOTOGRAPHS	14-15
RAW DATA	Appendix

VEGETATION MONITORING
OF THE
C.V. SPUR NO. 2 TEST PLOTS
1997

INTRODUCTION

In the fall of 1989 previous owners of the C.V. Spur site, Beaver Creek Coal Company, implemented a reclamation test plot on a disturbed area in the NE corner of the C.V. Spur Coal Processing and Loadout Facility property. *MT. NEBO SCIENTIFIC* did not construct this plot but was contracted to monitor it. Qualitative data were recorded in 1990, whereas, qualitative *and* quantitative data were compiled in the years' 1991, 1992 and 1997. This document reports the data from the 1997 sample year.

The test plot was divided into two larger sections for seeding mixtures, plus a middle section for single species. The plot was also fenced.

Section 1 (west side)

This is a 50 ft. by 100 ft. area. Design included techniques proposed for final reclamation methodologies as outlined in Chapter 3, Section 3.5 of the MRP. A species list is included in this report.

Section 2 (east side)

This area is another 50 ft. by 100 ft. section utilizing the same methods as Section 1 with the addition of 1 ton of 3rd crop alfalfa hay tilled into the top 6 inches of the soil. A species list is included in this report.

Section 3 (middle)

This section was apparently seeded with single species with two controls that were not seeded.

METHODS

Quantitative and qualitative data were taken on the subplots of the C.V. Spur No. 2 Test Plot. Sampling was accomplished on August 26-27, 1997. Sampling methods were identical to 1991 and 1992 to facilitate comparisons between sample years.

Cover and Composition

Regular placement of sample points were predetermined to provide unbiased accuracy of the data compiled. This was accomplished by establishing transect lines at regular intervals on each end of the plots. These transect lines were placed over the entire study area to adequately represent the area as a whole. Regular points on the transect lines were then marked. From these marks, the

sample points were determined by random distance numbers at right angles to the transect lines.

Cover estimates were made using ocular methods with meter square quadrats. Species composition and relative frequencies were also assessed from the quadrats. Additional information recorded on data sheets were: estimated precipitation, slope, exposure, grazing use, animal disturbance and other appropriate notes. Plant nomenclature follows Welsh et al. (1993).

Woody Species Density

Density of woody plant species of the subplots were estimated using belt transects that were 5 ft by 25 ft (125 ft²). Total number of individuals by species were counted in each of the belt transects. The average number was then calculated followed by the number of individuals per acre.

Photographs

Color photographs were taken of the plot and are included in this report.

Raw Data

Summarized raw data were included in this report to facilitate additional statistical analyses by the reviewer if desired.

RESULTS

Section 1 (west side)

Mean total living cover of Section 1 was estimated to be 53.61% (Table 1A). Most of the living cover was comprised of forbs (82.11%; Table 1B), and most of the forbs were “weedy” species i.e. tumble mustard (*Sisymbrium altissimum*) and fivehook bassia (*Bassia hysopifolia*). Crested wheatgrass (*Agropyron cristatum*) was the only grass species present in the plot (Table 1C).

Total woody plant density of the plot was 435.60 individuals per acre (Table 1D). The only woody plant present in the density belt transects was greasewood (*Sarcobatus vermiculatus*).

Section 2 (east side)

Total living cover of Section 2 was 55.83% (Table 2A), but was comprised of significantly more grasses in the composition (Table 2B). Crested wheatgrass made up 25.00% of the living cover in this plot, whereas, weedy species comprised most on the remaining cover (Table 2C).

Woody species density was even less than Section 1 in the test plot comprising 58.08 individuals per acre, all of which were greasewood (Table 2D).

Section 3 (middle)

As reported in previous years, the single species that were planted still show little success to date. The only species observed this year were "weedy" species

DISCUSSION

Graphs have been prepared to plot the success of some of the parameters over time. Figure 1 shows the total living cover and total cover (excluding weeds) for the west side of C.V. Spur No. 2. As one will note, total living cover increases in time for each sample year. The cover for "desirable species" (living cover excluding weeds) also increases significantly, but remains below 10% -- a number that is still well below most standards for final revegetation success.

Total living cover for the east side of the plot also increased markedly with time (Figure 2). Furthermore, the total cover (excluding weeds) also increased each year and results for 1997 has a much more respectable final cover value of near 25%.

Woody species density was low each year but seems to be increasing, however, none of the values for either side of the plot (Figures 3 and 4) were high enough to approach acceptable levels for density in most final success standards. Figure 5 shows the species that were planted when the test plots were constructed.

TABLE 1: Section 1 (west side) - Total cover (A), composition (B), cover and frequency by species (C), and woody species density (D), summaries for the C.V. Spur No. 2 Test Plot for 1997.

A. TOTAL COVER	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZES
Total Living Cover	53.61	13.72	18
Litter	13.00	10.96	18
Bareground	28.33	16.58	18
Rock	5.06	1.51	18
B. COMPOSITION			
Shrubs	1.22	3.62	18
Forbs	82.11	18.36	18
Grasses	16.67	17.36	18
C. COVER BY SPECIES			
	% MEAN COVER	RELATIVE FREQUENCY	SAMPLE SIZES
<u>Shrubs</u>			
<i>Sarcobatus vermiculatus</i>	0.83	11.11	18
<u>Forbs</u>			
<i>Bassia hyssopifolia</i>	0.28	5.56	18
<i>Kochia scoparia</i>	0.56	11.11	18
<i>Sisymbrium altissimum</i>	43.33	100.00	18
<u>Grasses</u>			
<i>Agropyron cristatum</i>	8.61	66.67	18
D. WOODY SPECIES DENSITY			
		NUMBER/ACRE	
<i>Sarcobatus vermiculatus</i>		<u>435.60</u>	
TOTAL		435.60	

TABLE 2: Section 2 (east side) - Total cover (A), composition (B), cover and frequency by species (C), and woody species density (D), summaries for the C.V. Spur No. 2 Test Plot for 1997.

A. TOTAL COVER	% MEAN COVER	STANDARD DEVIATION	SAMPLE SIZES
Total Living Cover	55.83	15.75	18
Litter	9.72	3.52	18
Bareground	29.56	16.51	18
Rock	4.89	1.66	18

B. COMPOSITION

Shrubs	0.35	1.43	18
Forbs	55.74	28.31	18
Grasses	43.91	28.43	18

C. COVER BY SPECIES

	% MEAN COVER	RELATIVE FREQUENCY	SAMPLE SIZES
<u>Shrubs</u>			
<i>Sarcobatus vermiculatus</i>	0.28	5.56	18
<u>Forbs</u>			
<i>Bassia hyssopifolia</i>	8.08	14.54	18
<i>Halogeton glomeratus</i>	1.39	4.66	18
<i>Kochia scoparia</i>	5.28	11.60	18
<i>Sisymbrium altissimum</i>	15.83	77.78	18
<u>Grasses</u>			
<i>Agropyron cristatum</i>	25.00	15.09	18

D. WOODY SPECIES DENSITY

	NUMBER/ACRE
<i>Sarcobatus vermiculatus</i>	<u>58.08</u>
TOTAL	58.08

FIGURES & GRAPHS

FIG. 1: LIVING COVER

C.V. Spur No. 2 (West Side)

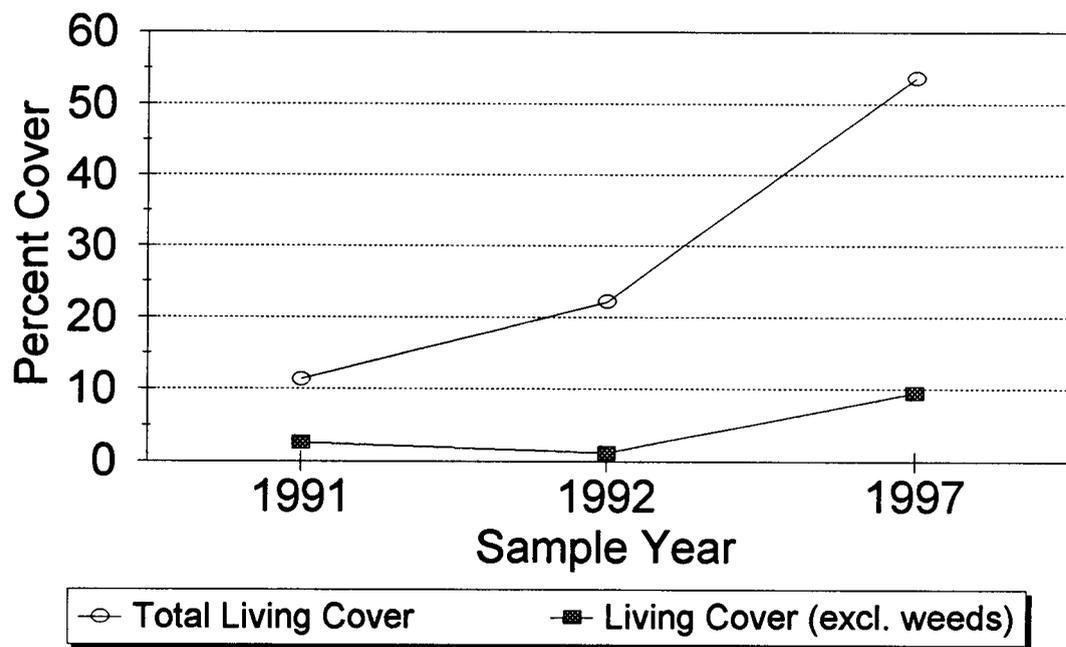


FIG. 2: LIVING COVER

C.V. Spur No. 2 (East Side)

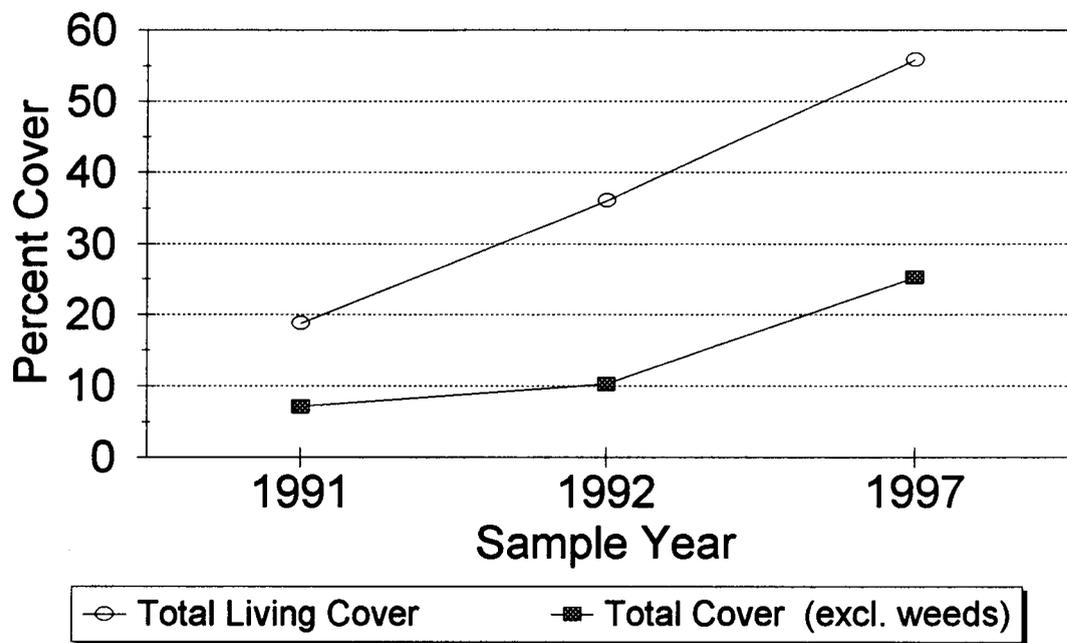


FIG. 3: WOODY SPECIES DENSITY

C.V. Spur No. 2 (West Side)

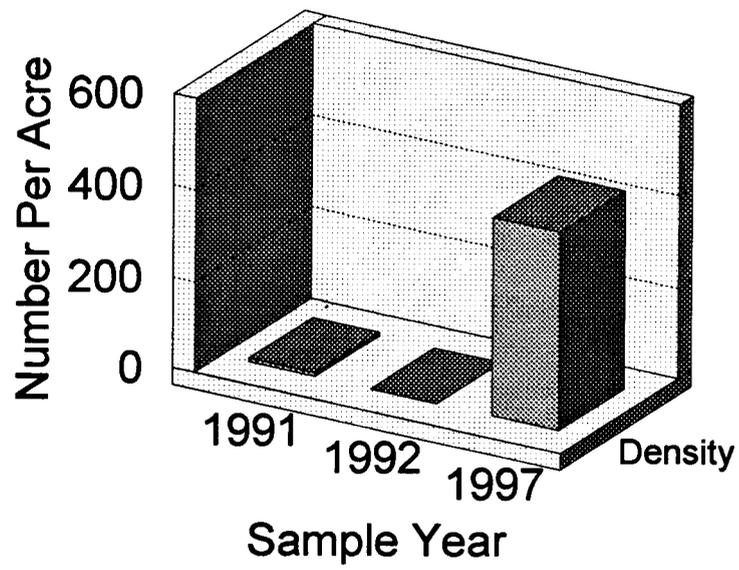


FIG. 4: WOODY SPECIES DENSITY

C.V. Spur No. 2 (East Side)

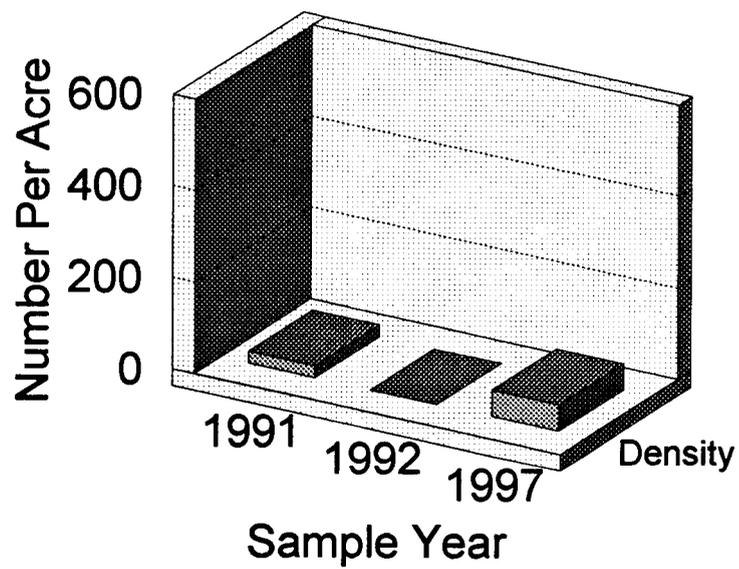


Fig. 5: Species Planted in Section 1 & 2 (East & West)
for the C.V. Spur No. 2 Test Plot

Rate #PLS/A

SHRUBS

<i>Atriplex confertifolia</i>	2.0
<i>Ceratoides lanata</i>	1.0

FORBS

<i>Helianthus annuus</i>	3.0
<i>Kochia prostrata</i>	1.0
<i>Melilotus officinalis</i>	1.0
<i>Penstemon palmeri</i>	.5
<i>Sphaeralcea grossulariaefolia</i>	.25

GRASSES

<i>Agropyron cristatum ephraim</i>	2.0
<i>Agropyron cristatum fairway</i>	2.0
<i>Elymus lanceolatus</i>	2.0
<i>Elymus elymoides</i>	.5
<i>Elymus junceus</i>	1.0
<i>Stipa hymenoides</i>	4.0

Section 3 (middle section)

Single spp. planted in 10 ft. strips: clover, winterfat, globemallow, shadscale, sunflower, kochia, Russian wildrye, crested wheatgrass, squirreltail, thickspike, Palmer penstemon, Indian ricegrass.

COLOR PHOTOGRAPHS



C V Spur No. 2
Section 1 (West Side)



C V Spur No. 2
Section 2 (East Side)

APPENDIX
Raw Data

BLACKHAWK

CV Spur - Reveg. Test Plot #2

Slope & Exp:

Section #1 (West Side)

Sample Date: 26 Aug 97

	1.00	2.00	3.00	4.00	5.00	6.00	7.00
--	------	------	------	------	------	------	------

SHRUBS

<i>Sarcobatus vermiculatus</i>	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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FORBS

<i>Bassia hyssopifolia</i>	0.00	0.00	0.00	0.00	0.00	0.00	5.00
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<i>Kochia scoparia</i>	0.00	5.00	0.00	0.00	0.00	0.00	0.00
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<i>Sisymbrium altissimum</i>	35.00	55.00	45.00	35.00	65.00	25.00	25.00
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GRASSES

<i>Agropyron cristatum</i>	5.00	0.00	15.00	0.00	5.00	20.00	10.00
----------------------------	------	------	-------	------	------	-------	-------

COVER

Total Living Cover	40.00	60.00	60.00	35.00	70.00	45.00	40.00
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Litter	5.00	5.00	10.00	55.00	10.00	9.00	10.00
--------	------	------	-------	-------	-------	------	-------

Bareground	50.00	30.00	25.00	5.00	15.00	45.00	45.00
------------	-------	-------	-------	------	-------	-------	-------

Rock	5.00	5.00	5.00	5.00	5.00	1.00	5.00
------	------	------	------	------	------	------	------

% COMPOSITION

Shrubs	0.00	0.00	0.00	0.00	0.00	0.00	0.00
--------	------	------	------	------	------	------	------

Forbs	87.50	100.00	75.00	100.00	92.86	55.56	75.00
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Grasses	12.50	0.00	25.00	0.00	7.14	44.44	25.00
---------	-------	------	-------	------	------	-------	-------

8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00
0.00	0.00	0.00	5.00	10.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00
30.00	70.00	30.00	55.00	35.00	20.00	35.00	40.00	45.00	70.00
0.00	0.00	30.00	5.00	25.00	20.00	5.00	10.00	5.00	0.00
30.00	70.00	60.00	65.00	70.00	40.00	40.00	50.00	50.00	75.00
5.00	20.00	10.00	20.00	10.00	10.00	10.00	10.00	10.00	15.00
60.00	5.00	25.00	10.00	15.00	40.00	45.00	35.00	35.00	5.00
5.00	5.00	5.00	5.00	5.00	10.00	5.00	5.00	5.00	5.00
0.00	0.00	0.00	7.69	14.29	0.00	0.00	0.00	0.00	0.00
100.00	100.00	50.00	84.62	50.00	50.00	87.50	80.00	90.00	100.00
0.00	0.00	50.00	7.69	35.71	50.00	12.50	20.00	10.00	0.00

BLACKHAWK
 CV Spur - Reveg. Test Plot #2
 Slope & Exp:
 Section #1 (West Side)
 Sample Date: 26 Aug 97

18.00	Mean	SDev	Freq	
<hr/>				
0.00	0.83	2.50	11.11	SHRUBS <i>Sarcobatus vermiculatus</i>
0.00	0.28	1.15	5.56	FORBS <i>Bassia hyssopifolia</i>
0.00	0.56	1.57	11.11	<i>Kochia scoparia</i>
65.00	43.33	15.81	100.00	<i>Sisymbrium altissimum</i>
0.00	8.61	9.25	66.67	GRASSES <i>Agropyron cristatum</i>
<hr/>				
65.00	53.61	13.72		COVER Total Living Cover
10.00	13.00	10.96		Litter
20.00	28.33	16.58		Bareground
5.00	5.06	1.51		Rock
<hr/>				
0.00	1.22	3.62		% COMPOSITION Shrubs
100.00	82.11	18.36		Forbs
0.00	16.67	17.36		Grasses
<hr/>				

BLACKHAWK
 CV Spur - Test Plot #2
 Slope & Exp:
 Section #2 (East Side)

Sample Date: 26 Aug 97 1.00 2.00 3.00 4.00 5.00 6.00 7.00

 SHRUBS

Sarcobatus vermiculatus 0.00 0.00 0.00 0.00 0.00 0.00 0.00

FORBS

Bassia hyssopifolia 0.00 5.00 0.00 0.00 0.00 0.00 0.00

Halogeton glomeratus 0.00 20.00 0.00 0.00 0.00 0.00 0.00

Kochia scoparia 45.00 0.00 20.00 0.00 0.00 0.00 0.00

Sisymbrium altissimum 5.00 5.00 5.00 30.00 20.00 5.00 45.00

GRASSES

Agropyron cristatum 20.00 0.00 25.00 0.00 25.00 45.00 10.00

 COVER

Total Living Cover 70.00 30.00 50.00 30.00 45.00 50.00 55.00

Litter 10.00 5.00 10.00 10.00 10.00 10.00 10.00

Bareground 15.00 60.00 30.00 55.00 40.00 35.00 30.00

Rock 5.00 5.00 10.00 5.00 5.00 5.00 5.00

 % COMPOSITION

Shrubs 0.00 0.00 0.00 0.00 0.00 0.00 0.00

Forbs 71.43 100.00 50.00 100.00 44.44 10.00 81.82

Grasses 28.57 0.00 50.00 0.00 55.56 90.00 18.18

8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00	17.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00
0.00	40.00	50.00	15.00	0.00	0.00	0.00	20.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.00	0.00	0.00	0.00	0.00	0.00	20.00	0.00	0.00	0.00
25.00	0.00	10.00	15.00	0.00	30.00	30.00	10.00	50.00	0.00
15.00	40.00	20.00	30.00	55.00	30.00	20.00	30.00	25.00	50.00
50.00	80.00	80.00	60.00	55.00	60.00	70.00	60.00	80.00	50.00
10.00	10.00	5.00	10.00	10.00	10.00	20.00	5.00	15.00	5.00
35.00	5.00	14.00	25.00	30.00	25.00	5.00	30.00	3.00	40.00
5.00	5.00	1.00	5.00	5.00	5.00	5.00	5.00	2.00	5.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.25	0.00
70.00	50.00	75.00	50.00	0.00	50.00	71.43	50.00	62.50	0.00
30.00	50.00	25.00	50.00	100.00	50.00	28.57	50.00	31.25	100.00

BLACKHAWK
 CV Spur - Test Plot #2
 Slope & Exp:
 Section #2 (East Side)
 Sample Date: 26 Aug 9

18.00	Mean	SDev	Freq	
<hr/>				
0.00	0.28	1.15	5.56	SHRUBS <i>Sarcobatus vermiculatu</i>
15.00	8.06	14.54	33.33	FORBS <i>Bassia hyssopifolia</i>
5.00	1.39	4.66	11.11	<i>Halogeton glomeratus</i>
0.00	5.28	11.60	22.22	<i>Kochia scoparia</i>
0.00	15.83	15.39	77.78	<i>Sisymbrium altissimum</i>
10.00	25.00	15.09	88.89	GRASSES <i>Agropyron cristatum</i>
<hr/>				
30.00	55.83	15.75		COVER Total Living Cover
10.00	9.72	3.52		Litter
55.00	29.56	16.51		Bareground
5.00	4.89	1.66		Rock
<hr/>				
0.00	0.35	1.43		% COMPOSITION Shrubs
66.67	55.74	28.31		Forbs
33.33	43.91	28.43		Grasses
<hr/>				

APPENDIX C

Legal, Financial, Compliance and Related Information
Annual Report of Officers
as submitted to the Utah Department of Commerce
and other changes in ownership and control information
as required under R645-301-110.

CONTENTS

(No Change)

APPENDIX D

Mine Maps

as required under R645-301-525.270.

CONTENTS

N/A - Not Required

APPENDIX E

Other Information

in accordance with the requirements of R645-301 and R645-302.

CONTENTS

N/A