

Horse Canyon Mine Part "A"  
Phase III  
Bond Release Application  
November 6, 2008



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**Chapter III  
RECLAMATION PLAN**

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#### **4.7 RECLAMATION COST ESTIMATE**

The cost estimate for reclamation includes demolition and disposal of structures and foundations, backfilling of portals and highwalls, distribution of topsoil, establishment of sedimentation controls, revegetation, fencing, monitoring of sediment control and revegetation, and maintenance of sediment controls. Details of the cost estimate are found in Appendix IV-4. Total bonding estimate for the permit is \$1,950,002.

Phase I bond release for \$812,726 was approved by the Division on February 5, 1997. Phase II bond release for \$191,672 was approved by the Division on April 11, 2002.

Phase III bond release application was submitted for \$1,053,328.00. The bond for \$8,000 will remain in place to cover .49 acres involved with a repaired drainage ditch. Bond calculations can be found on the next page.

Bonding Calculations  
Horse Canyon MineC/007/013  
Lila Canyon Section

Bond Summary

Direct Costs

Subtotal Demolition and Removal	
Subtotal Backfilling and Grading	
Subtotal Revegetation	\$4,840.00
Direct Costs	\$4,840.00

Indirect Costs

Mob/Demob	\$484.00	10.0%
Contingency	\$242.00	5.0%
Engineering Redesign	\$121.00	2.5%
Main Office Expense	\$329.00	6.8%
Project Mainagement Fee	\$121.00	2.5%
Subtotal Indirect Costs	\$1,297.00	26.8%

Total Cost	\$6,137.00
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Escalation factor		0.0444
Number of years		5
Escalation	\$1,489.00	

Reclamation Cost	\$7,626.00
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Bond Amount (rounded to nearest \$1,000) 2008 Dollars	\$8,000.00
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Bond Posted 2003	\$1,061,328.00
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Difference Between Cost Estimate and Bond	\$1,053,328.00
Percent Difference	13166.60%

Ref.	Description	Materials	Means Reference Number	Unit Cost	Unit	Length	Width	Height	Diameter	Area	Volume	Weight	Density	Time	Number	Unit	Swell Factor	Quantity	Unit	Cost	
	Vegetation																				
	Ground Preparation																				
	See Chapter 5 page 85-96 Sec. 553.230																				
	Soil to be ripped	75 HP Dozer/w/scarifiers	M029107103100	3.87	MSF					0.49						AC		21	MSF	81	
	Grouting/Posting																				
	Assume 340 CY/AC	Excavation Bulk Bank 2 CY (322BL)	M023154240260	1.7	CY					0.49						AC		167	CY	284	
	Subtotal																				365
	Seeding																				
	Fertilize Material	Fertilizer Hydro Spread Mat. Only	Reveg006	8.71	MSF					0.49						AC		21	MSF	183	
	Fertilize Application	Hydro Spreader (equip. & labor) B-81 80MS	Reveg002	19.13	MSF					0.49						AC		21	MSF	402	
	Seeding Materials	Grasses for Lila Canyon	Lila07131	140.5	AC					0.49						AC		0.49	AC	69	
	Seeding Materials	Ferns for Lila Canyon	Lila07132	92.2	AC					0.49						AC		0.49	AC	45	
	Seeding Materials	Shrubs for Lila Canyon	Lila07133	108.45	AC					0.49						AC		0.49	AC	52	
	Seeding Application	Hydro Spreader (equip. & labor) B-81 80MS	Reveg002	19.13	MSF					0.49						AC		21	MSF	402	
	Mulch Materials	Hay 1" material only 029105000250	Reveg001	68	MSF					0.49						AC		21	MSF	1428	
	Mulch Application	Hydro Spreader (equip. & labor) B-81 80MS	Reveg002	19.13	MSF					0.49						AC		21	MSF	402	
	Subtotal																				2883
	Reseeding																				
	Assume 50% reseeding rate																				1492
	Subtotal																				1492
	Total																				4940

**Appendix III-1**

**Phase III Bond Release Application  
Horse Canyon Mine**

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**APPENDIX III-1**

**Phase III Bond Release Application  
Horse Canyon Mine**

**January 25, 2008**

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**Appendix III-1**  
**Phase III Bond Release Application**  
**Horse Canyon Mine**

The purpose of this application is to request Phase III Bond Release for the Horse Canyon Mine including the Post Mine Land Use Change area with structures and buildings approved by the Division of Oil Gas and Mining (Division) on February 25, 2004. This application includes the lands included in the previous bond releases:

1. Phase I (51.56 acres) bond release for \$812,726 was approved by the Division on February 5, 1997.
2. Phase II (51.56 acres) bond release for \$191,672 was approved by the Division on April 11, 2002.

One area not included in this application is a small 0.49 acre area on the Road Junction Refuse Pile shown on Map III-2A. This area consists of an access road to the channel that sustained storm runoff damage, and the channel repair area. The damaged channel was repaired and the area seeded.

This application is for a total of 91.97 acres including the land donated to CEU, 6.5 acres designated for disturbance but never disturbed, the west bridge abutment left in place as required by Emery County. In addition, the Horse Canyon (Range Creek) public road is included in Phase III but will remain as required by Emery County. The Maps included with this application show the as-built contours after reclamation for the areas included in the Phase I and Phase II Bond Release applications. The area included in the CEU donation area where the postmining land use change was approved is also shown on the same maps with contours and with the facilities, and buildings shown and labeled. A list of these facilities and buildings can also be found in appendix X-4. The Emery County Horse Canyon (Range Creek) public road is also shown on the maps as dashed lines indicating the right-of-way lines.

**Application Format**

This application is formatted following Technical Directive Tech - 006, Requirements for Phased Bond Release, March 1, 2001.

This application will present the appropriate Technical Directive section headings in bolded italics followed by responses as follows:

**5. Procedure**  
**Prior to Bond Release Request**

Permit reclamation changes and post mine land use changes:

All permit revisions have been approved by the Division and incorporated into the MRP.

A Post Mine Land Use Change (PMLU) for 16.18 acres not included in the Phase I and Phase II bond release areas was submitted and later approved by the Division on February 25, 2004 for a portion of the Horse Canyon Mine including buildings and areas donated to the College of Eastern Utah (CEU) under an Asset Assignment Agreement. The post mining land use change was added to the MRP as Appendix X-4 in Chapter X, Volume IV.

The Post Mine Land Use Change area can be seen on Exhibits A-1, A-2, A-3 and A-4 of the PMLU Change application (Appendix X-4, Volume IV of the MRP). The areas covered by this bond release application can be found on Plates III-2A thru III-2G attached to this application as Exhibit III-1-4 including the PMLU area and the areas covered by the approved Phases I and II bond releases. The base map for Plates III-2A through III-2F have been assembled by duplicating Plates III-1A through III-1F, Plate III-2G has been added to include small areas that extended off of Plates III-2A, and III-2B. Four (4) copies are include for insertion into the MRP document.

A copy of the Asset Assignment Agreement with CEU can be found in the Division files under the PLMU application, and as Exhibit III-1-1 of this application.

**1. Certify Reclamation**

As-build drawings (Plates III-1A thru III-1F) were submitted and approved as part of the Phase II bond release application; these plates have been incorporated into the MRP. Information adequate for Phase I and Phase II bond releases were previously submitted and accepted by the Division as evidenced by the approved Phase I and Phase II bond releases. The approved Post Mine Land Use Change referenced above modified the reclamation plan to leave the buildings, structures and areas as-is for use by the CEU. Therefore, that area, buildings and structures were not reclaimed.

Form C1 included with this application contains a notarized certification.

A statement certifying that applicable reclamation activities have been accomplished in accordance with requirements of the R645 rules is included as Appendix III-1-8.

**2. Provide agreements for structures remaining for post mine land use.**  
**Phase III Bond Release Area:**

Exhibit III-1-1 to this application includes a signed copy of the Asset Assignment Agreement with the CEU for the post mine land use change area. The structures and areas not reclaimed, and left for post mine land use are shown on Maps III-2C, III-2D, III-2E, and III-2F in the area designated on the maps, "Post Mine Land Use Change Area Donated To CEU." The structures and areas are described in detail in Appendix III-1-1 of this submittal, and in the Post Mine Land Use Change previously approved by the UDOGM.

0.01 Acre Area For Emery County Road West Bridge Abutment and the Horse Canyon (Range Creek Road)

On October 4, 1995, a Special Warranty Deed and Dedication Agreement between Intermountain Power Agency, and Emery County was executed giving Emery County rights to the Horse Canyon (Range Creek) road for it's use(refer to Appendix I-6 in Chapter I, Volume I of the MRP). This agreement states that, "The road was established and used by the public to access public lands for recreational and ranching purposes prior to Grantor's improvement of the Road and use thereof for mining purposes." The road has been used by many landowners in Range Creek for decades to access their property, as well as property on the Tavaputs Plateau. Therefore, the Horse Canyon (Range Creek) road by prescriptive use has been a public road for decades. Prescriptive use is a legal precedent established by long-time public use, and has been upheld in many court cases nation-wide, and in Utah. On page X-16 of the approved MRP, it states:

The public road currently in existence through the permit area will be retained during and following the mining and reclamation periods. A road has been present in Horse Canyon through the mine area since at least 1899 and presumably has been used by the public. Maps illustrating the existence of this road have been provided as Plates X-1 and X-2 As shown on Plate X-1, the road parallels the course of the Horse Canyon Creek through Sections 3 through 6, 8, and 9 of T. 16 S., R. 14 E.. The road crosses from the south side to the north side of the creek bed in the northern portion of Section 8. The road apparently drops into the creek bed in the northern portion of Section 9 and then continues up the drainage. The road appears to become a trail in the northwest portion of Section 3. The trail continues up the South fork of Horse Canyon as illustrated on Plate X-2.

A copy of a letter from the Emery County Road Department, dated February 26, 1996 discussing the Horse Canyon (Range Creek) road is included in Appendix I-6. This letter specifically says that Emery County understands that "•••the right-of-way includes all structures within the legal description of the property." Further, the letter states, "The structures within the right-of-way also include the bridge that spans Horse Canyon Creek within the mine area."

The Emery County road has been clearly marked and labeled on all maps included in this application. The road includes a 100 foot wide strip centered on the Horse Canyon (Range Creek) road, with wider sections where there are drainage structures, and where the bridge crosses the creek. As can be seen on the maps, areas where mining activity disturbed land within the road were reclaimed and have been included in Phases I and II bond releases. The areas not included in Phase I and Phase II bond releases within the Emery County road are shown on the attached drawings III-2A through III-2G, and are included in this request for Phase III bond release. The Public Road was not included in the Phase I and Phase II bond release applications, and there was no bond amount designated for the Public Road. This application includes this road to clarify any misconception that may arise over the Public Road.

The current bridge is only one lane wide, and initially Emery County indicated the need to widen the bridge to two lanes. The Horse Canyon (Range Creek) road has been a public road for many decades, long before the SMCRA law came into being. Being a public road, it could not be reclaimed by UEI, or any of its predecessors. Private property owners in Range Creek and on the Tavaputs Plateau rely on the road for access to their properties. The Emery County Road Supervisor, Mr. Morris Sorensen has determined the west bridge abutment serves to stabilize the channel and road embankment and needs to be left. Further, Mr. Morris indicated that the east abutment could become unstable and should be removed. The east abutment was removed as required.

The approved postmining land use is Wildlife habitat for the major portion of the permit and surrounding areas. As stated in Chapter X of the MPR, on page X-4 Horse Canyon was historically used as a cattle trail, and on page X-16 it states that the road has existed since about 1899. This trail/road likely traversed up the canyon and over the mountain into Range Creek. Further documentation is discussed on page X-16. By necessity, use of the road by ranching requires access for domestic animals, and by ranchers and later when the road was established, their vehicles. Because of long established use, the trail, and then the road became public access to Range Creek and the Tavaputs Plateau. Even though this use may not have been fully discussed in the Horse Canyon Mine permits, it nevertheless existed and cannot be ignored. Court case precedence has been well established that common and long standing use of a trail, or road by the public must be maintained for the benefit of the public. Therefore, the Horse Canyon (Range Creek) road would have to be left operational after mining ceased. As stated on page X-16 of the approved MRP, "The public road currently in existence through the permit area will be retained during and following the mining and reclamation periods."

As can be seen on Plate II-1B of the approved MRP, the disturbed areas include areas used for mining operations and clearly exclude the original Horse Canyon (Range Creek) road. Therefore, the original road was not included in the Phase I, or Phase II Bond release applications. This application requests Phase III bond release for the areas shown on Maps III-2A through III-2G, as well as the entire Emery County road area.

A Post Mining Land Use Change (PMLU) application for 16.18 acres of the mining area

was submitted to the UDOGM and approved for Residential/Recreational for the area including the Horse Canyon Mine buildings. The land and buildings were donated to the Center for Mine Land Redevelopment, and the College of Eastern Utah for use as a science field camp. The Horse Canyon (Range Creek) Road is necessary access to the PMLU area.

In view of the above discussion, the Horse Canyon (Range Creek) road meets the post mining land use objectives. The west bridge abutment is a necessary part of the bridge structure, and therefore will remain after Phase III bond release.

### 6.5 Acre Borrow Area Disturbed and Not Reclaimed

Map III-2G shows the borrow pit area used to obtain soil materials for final reclamation. As can be seen on the map, the Western portion of the area was used as the borrow area, with the Eastern portion reserved for final reclamation of the buildings area. Since the buildings area was donated to the college of Eastern Utah, and a Land Use Change was approved by the UDOGM, the necessity for borrow from the Eastern area of the borrow pit was precluded. As can be seen by the contours of the Eastern area, no excavations, or removal of soils materials was done. In addition, mature vegetation including pinion and juniper trees in the area attest to the fact that the area has not been disturbed in the past several decades. A pre-law two-track road traverses this area, and it can be verified by the contours along this road that no disturbance has been done. Since the Eastern portion of the borrow area was never disturbed it will be removed from the disturbed area.

The Western portion of the borrow pit area was used for reclamation materials for the Horse Canyon Mine as discussed previously. This Western area was included in Phases I and II reclamation bond release, and is included in this Phase III bond release application. It is requested by this application to included both the Western and Eastern portions of the borrow pit for final Phase III bond release since all reclamation standards have been met for the Western portion, and the Eastern portion was never disturbed.

### **3. Address performance standards.**

The land use change area and structures will be used by the CEU. The area has been donated in total including ownership of the property and therefore is removed from reclamation responsibility, although no bond reduction has been applied for. This Phase III bond release application includes the acreage, buildings and structures including the post mine land use change area as well as the areas reclaimed under the Phase I and Phase II bond releases. All pertinent requirements were addressed in the post mine land use change application.

## Post Mining Landuse

The postmining landuse of Wildlife Habitat has been achieved by providing much better vegetation for foraging animals than exists in the undisturbed surrounding area. The attached vegetation reports verify that the vegetation reclamation standards have been met or exceeded.

The Horse Canyon Mine buildings and other areas were included in a postmining land use change to Wildlife and Residential/Recreational approved by the UDOGM, with the intent to be used by the CEU for a science field camp. Reclamation in the area provides a good environment for a science field camp by providing vegetation that will attract wildlife. In addition, the buildings and area will provide a base for science studies possibly including, vegetation, soils, geology, paleontology, archeology, and wildlife.

## AOC Considerations

### *6.5 Acre area*

As can be seen on Map III-2G, the contour lines in the 6.5 acre area not reclaimed or used for a borrow area for reclamation are quite irregular in nature, indicating that no excavation was conducted during reclamation of the Horse Canyon Mine. Two old pre-law roads criss-cross the area, and it can be seen by observing the contour lines that they have not been modified by borrow activities. In addition, mature vegetation and large mature trees in the area indicate that no disturbance has been done in this area for many decades. Since the area has not been disturbed, the existing contours are the original contours, and require no modification, this area was removed from the disturbed area.

### *0.01 Acre area*

The east bridge abutment is included in the 0.01 acre area. The Horse Canyon Creek is a deeply incised canyon with very steep side walls in this area. This has likely been the case for this canyon for eons, and is typical of canyons in the general area. The bridge abutments do not alter the general shape of the canyon. Since the road is a public road, and the west abutment is necessary to stabilize the channel and road embankment, the road and west abutment supports post mining land use. The west abutment will be left in place as requested by Emery County officials. The east abutment was removed.

## Underground Mine Openings

Page IV-15 of the approved MRP states: "There are twelve openings within the Horse Canyon permit area that are sealed. The seals used are suitable for temporary closure or permanent reclamation".

Page II-8 of the approved Horse Canyon MRP states: "In the third quarter of 1986 all portals were sealed with solid block walls to prevent unauthorized entry of the mine. The seals used are suitable for temporary closure or permanent reclamation."

A Minor Exploration Permit was approved by DOGM in January of 1992. This permit allowed for BXG, Inc. To breach the seals and explore the Horse Canyon mine. The exploration plan states: "This exploration is not being conducted by the owner or permit holder. Thus, no permit will be modified or revised."

BXG's Horse Canyon Exploration Project began in late August of 1992 with MSHA's approval of the Seal Breaching Plan and subsequent breaching of the Horse and Lila Canyon seals on August 26 and 27, 1992. Mine exploration began January 22, 1993, after MSHA approval of the mine Exploration Plan received on December 30, 1992. A resealing plan was submitted to MSHA on April 27, 1993 and approved May 14, 1993. The Lila and Horse Canyon seals breached in August, 1992 have been restored to original condition.

The BLM has approved a permanent closure for the old Lila fan portals. The closure obligation will be assigned to Part "B".

### **REQUEST FOR BOND RELEASE**

#### ***I. A. Notarized signature***

This application has been formatted as new Appendix III-1, Chapter III, Volume I of the MRP, and includes form C1 which includes a certification with notarization.

#### ***I. B. Notification letters***

Exhibit III-1-2 includes copies of notification letters sent to the appropriate individuals and entities included in the following list:

### **ADJACENT PROPERTY OWNERS**

Mr. Josiah K. Eardley  
2433 So. Highway 10  
Route 1, Box 119  
Price, Utah 84501

Mr. Dave Stokes  
Bronco Coal  
340 South Carbon Ave. Suite 126  
Price, Utah 84501

College Of Eastern Utah Foundation  
451 East 400 North  
Price, Utah 84501

**GOVERNMENT AGENCIES**

Mr. Bruce Andrews, Mayor  
Sunnyside City  
701 Market St.  
Sunnyside, Utah 84539

Mr. Orlando LaFontaine, Mayor  
East Carbon City  
101 W. Geneva Dr.  
East Carbon, Utah 84520

Mr. Drew Sitterud  
Emery County Commission  
95 East Main Street  
Castle Dale, Utah 84112

Mr. Bill Krompel  
Carbon County Commission  
120 East Main St.  
Price, Utah 84501

Department of Natural Resources  
Division of Sovereign Lands & Forestry  
1594 W. North Temple, Suite 3520  
P.O. Box 145703  
Salt Lake City, Utah 84114-5703

United States Department of The Interior  
Bureau of Land Management  
Mr. Mark Mackiewicz  
125 South 600 West  
Price, Utah 84501

Emery County Planning and Zoning Commission  
PO Box 727  
75 East Main St.  
Castle Dale, Utah 84513

**WATER & SEWER**

Castle Valley Special Service District  
86 South 100 East  
Castle Dale, Utah 84513

***I. C. NEWSPAPER ADVERTISEMENT***

Exhibit III-1-3 includes a copy of the public notice required by R645-301-880-120. Proof of publication will be submitted following posting and receipt of signed affidavit of publication

***I. D. PERMIT CONDITIONS***

There are no outstanding permit conditions.

***II. A. 1. Legal description of the permit area.***

The permit area is shown on the Lila Point, and Cedar U.S. Geological Survey 7.5-minute Quadrangle maps. The areas covered in this Phase III Bond release application include 51.56 acres covered by the Phase I and Phase II bond releases as well as 6.5 acres at the borrow area which was partially disturbed during reclamation efforts in 1990 -1991 by removing some fill material for reclamation. This disturbance of the borrow area was reclaimed at that time and has not been disturbed since. In addition, 0.01 acres including the west bridge abutment was retained by Emery County for the bridge providing access to the Horse Canyon (Range Creek) County road. Also, 16.18 acres were donated to CEU, making a total of 74.26 acres included in this bond release application.

The complete permit legal description can be found in Chapter I, Volume 1 of the MRP. More specifically, the disturbed areas included in the reclamation bond are as follows:

Post Mining Land Use Change Area:

Township 16 South, Range 14 East, SLB&M

Section 3: Lots 3, 6, 11, 12

Section 4: NE4SE4, SE4SE4, NW4SE4, SW4SE4

Containing 16.18 acres.

Phase III Bond Release Areas:

Township 16 South, Range 14 East, Salt Lake Base & Meridian

Section 3

Lot 1, 2, 3, 5, 6, 7, 8, 9, 11, 12; N2SW4SW4, SW4SE4, NW4SW4, NE4SW4  
N2SE4, SE4SE4

Section 4

SE4NE4, S2SW4, S2SE4NE4, Lot 9, SE4

Section 5

S2SE4SE4

Section 8

NE4NE4

Section 9

NW4NW4, NE4NW4, NW4NE4

Containing 58.08 acres of disturbed area.

***II.A.2. Maps***

All disturbed areas where reclamation has been completed are included in this Phase III Bond Release application. Those areas can be seen on Plates III-1A thru 1F, III-1A-1, III-B-1, III-1C-1, III-1D-1, and III-1G in Chapter III, Volume I of the MRP. The disturbed area boundary can also be seen on Plates II-1A and 1B in Chapter II, Volume I. Plates III-A thru III-1F have been revised to reflect the Phase III bond release request including the areas

donated to CEU included in the PMLU and the areas previously reclaimed under the Phase I and Phase II bond releases, and can be seen in Exhibit III-1-4 of this application.

The maps included with this application show the topography of the area including reclaimed area topographic lines. The Emery County public road has been added to clearly designate it's location in relationship to areas reclaimed, and the area donated to the CEU. The donation area is clearly shown on Maps III-2C, III-D, and III-F.

***II.A.3. Vegetation Sampling***

Vegetation sampling was conducted in 2003 and 2004 for Phase III bond release evaluation. The sampling reports are included in this application as Exhibit III-1-5, Horse Canyon Vegetation Survey - 2003, and Exhibit III-1-6, Horse Canyon Mine Vegetation Survey - 2004. The Division was notified and consulted in this regard as stated in the 2003

sampling report included as Appendix III-1-5, Horse Canyon Vegetation Study - 2003. The vegetation meets the requirements of the standards as follows:

Quoting from the 2003 study report:

A vegetation inventory was conducted on 6 revegetation sites on the Horse Canyon Mine property between June and August, 2003. Data were collected regarding percent cover, percent cover by species, and woody plant density at each site. Data were also collected from a reference site located on Bureau of Land Management property adjacent to mine property. Revegetation sites were compared to the reference area with respect to cover and woody plant density to determine similarity. All sites cover averages exceed the cover average for the reference site and should be judged to have satisfactorily exceeded minimum requirements with respect to cover. Woody plant density in all revegetated sites exceeded woody plant density in the reference area. Species diversity was also higher in all revegetated areas when compared to the reference area.

Quoting from the 2004 study report:

A vegetation inventory was conducted on 6 revegetation sites on the Horse Canyon Mine property between June and August, 2003. Data were collected regarding percent cover, percent cover by species, and woody plant density at each site. Data were also collected from a reference site located on Bureau of Land Management property adjacent to mine property. Revegetation sites were compared to the reference area with respect to cover and woody plant density to determine similarity. All sites cover averages exceed the cover average for the reference site and should be judged to have satisfactorily exceeded minimum requirements with respect to cover. Woody plant density in all revegetated sites exceeded woody plant density in the reference area. Species diversity was also higher in all revegetated areas when compared to the reference area. Life form similarity comparisons indicated that in almost every case, the revegetated areas exceeded the 70% standard with respect to percent cover.

**II.A.4. Reclamation treatments, areas and work accomplished**

The following MRP Chapters address the information required:

Reclamation areas and plan .....	Chapter 3, Volume I
Postmining Topography .....	Chapter 3, Volume I
Drainage Control .....	Chapter 3, Volume I
Vegetation .....	Chapter VIII, Volume IV
Land Use .....	Chapter X, Volume IV

\*\*\* The Post Mine Land Use Change including the CEU donation area is included

in Appendix X-4.

## Roads

All roads were reclaimed except for the Horse Canyon (Range Creek) public road. All reclaimed roads are included on the maps in the areas designated "Phase III Reclaimed Areas." The roads were reclaimed according to the approved MRP. A short road will be needed to access the Road Junction Refuse Pile channel that sustained storm damage as shown on Map III-2A. This road will be opened up to access the channel for repairs and will be immediately reclaimed and seeded during the first available reclamation season according to the approved MRP.

### ***II.A.5. Mining history and reclamation activities***

The Horse Canyon Mine was initially opened by the Defense Plant Corporation in 1942 as a source for coal for the Geneva Steel Works in Orem, Utah. The mine was sold to U.S. Steel in 1946, who operated it until January 1984, when mining was permanently suspended. U.S. Steel submitted a mining and reclamation permit application in March, 1981. In October 1982, U.S. Steel informed the Division that it was temporarily suspending mining operations, and in January 1984 permanent suspension was announced.

In November 1984, Kaiser Steel Corporation purchased the mine property and submitted a reclamation bond in the amount of \$918,649, and indicated to the Division that it would maintain the operations in a temporary suspension status until further corporate decisions were made. In February 1987, Kaiser Coal, successor to Kaiser Steel filed a petition for bankruptcy under Chapter 11, Title 11, of the U.S. Bankruptcy Code. Intermountain Power Agency (IPA) acquired the mine and the permit was transferred to IPA in August 1990. IPA was issued a mining and reclamation plan on May 6, 1991, and a reclamation bond in the amount of \$1,950,000 was issued in the form of a letter of credit.

Reclamation work proceeded on 51.56 acres of the 74.26 acres in 1990 and 1991. Phase I bond release was granted on February 5, 1997 for \$812,276. Phase II bond release application was submitted on December 19, 1997.

UtahAmerican Energy, Inc. acquired the mine from IPA on December 21, 1998. Phase II bond release was granted on April 11, 2002.

### ***II.A.6. Extended Responsibility***

One area of extended responsibility period for the Horse Canyon Mine is shown on Map III-2A consisting of a short access road to the channel that sustained storm runoff damage, and the channel repair area. This area and road consist of 0.49 acres.

***II.A.7. Remaining sediment control structures***

There are no remaining sediment control structures that need to be removed.

***II.A.8. Schedule and cost estimate for remaining reclamation***

Phase II Bond release has been granted; this application is for Phase III bond release, completing the reclamation process, except for the 0.49 acre area on the Road Junction Refuse Pile where the channel will be repaired.

With the post mine land use change for the CEU donation, all un-reclaimed facilities and land have been removed from permit responsibility.

**II.A.9. Summary of bond acreages, dates of bond releases**

<b>Date</b>	<b>Status</b>	<b>Amount</b>	<b>Acreages</b>
11 Nov 84	Initial Kaiser Bond	\$ 918,649	74.26 Disturbed
6 May 91	IPA Bond	\$ 1,950,000	74.26 Disturbed
5 Feb 97	Phase I Bond Release (IPA)	\$ 812,726	74.26 - 51.56 = 22.7 Balance
15 Sept 98	Intital Horse Canyon Bond (UAE)	\$ 1,137,726	22.7 Disturbed Remaining
24 Jan 01	Adjustment at permit renewal by \$115,274	\$ 1,253,000	22.7 Disturbed Remaining
11 Apr 02	Phase II Bond Released \$191,672	\$ 1,061,328	22.7 Disturbed Remaining
25 Feb 04	Post Mine Land Use Change Approved including 16.18 acres	No Change	22.7 - 16.18 = 6.52 Remaining
	<b>Phase III Bond Release Application</b>	<b>\$1,053,328</b>	<b>91.48 = 91.48 Ph III</b>
	<b>Road Junction Refuse Pile Channel &amp; Access Road (.49 Ac)</b>	<b>\$8,000</b>	<b>0.49 Remaining</b>

<sup>A</sup> Refer to Section II.A.1 on page 2 of this application for an explanation of the 6.5 acres.

**Appendix III-1-1**

**Asset Assignment Agreement**

## ASSET ASSIGNMENT AGREEMENT

This ASSET ASSIGNMENT AGREEMENT (this "Agreement"), is made and entered into as of the 13 day of September, 2005 (the "Effective Date"), by and between **UTAHAMERICAN ENERGY, INC.** ("UEI" or "Assignor"), a Utah corporation, having an address of P.O. Box 986, Price, Utah 84501, and the **COLLEGE OF EASTERN UTAH FOUNDATION** ("CEUF" or "Assignee"), a Utah Non-Profit Corporation located in Price Utah, having an address of 451 East 400 North, Price, Utah 84501.

### RECITALS

A. UEI is the owner of certain assets held in connection with the Horse Canyon Mine, an underground coal mine, including certain surface lands and facilities which are being reclaimed pursuant to the provisions of the Utah Coal Mining and Reclamation Act and Permit No. C/007/013, situated in Carbon County and Emery County, Utah.

B. UEI desires to donate, transfer and assign to CEUF and CEUF desires to accept and acknowledge the donation from UEI of certain of the Horse Canyon Mine property assets and water rights, collectively referred to as the "Donated Property," all subject to the terms and conditions of this Agreement.

NOW, THEREFORE, In consideration of the promises and benefits contained herein and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, UEI as Assignor and CEUF as Assignee, agree as follows:

### ARTICLE I Definitions

1.1 Certain Definitions. In this Agreement, capitalized terms and other defined terms described before shall have the meanings set forth as follows:

"Agreement" means this Asset Assignment Agreement and the exhibits attached hereto and all agreements or instruments executed in connection herewith or described pursuant hereto.

"Bond" means the Horse Canyon Mine reclamation bond provided by UEI to the Division.

"Coal Act" means the Coal Mining and Reclamation Act and the Federal Surface Mining Control and Reclamation Act.

"Conveyance Documents" means those instruments transferring title to the Donated Property from UEI to CEUF described at Exhibit F hereto.

"Division" means the State of Utah Department of Natural Resources, Division of Oil, Gas and Mining.

"Donated Facilities" means the list of buildings and surface facilities donated by UEI to CEUF and described at Exhibit E hereto.

"Donated Property" means all of UEI's right, title and interest to the real property and surface facilities described at Exhibits A and E hereto and as further depicted on the map attached as Exhibit C hereto and the Water Rights described at Exhibit B hereto.

"Effective Date" means the date of this Agreement first set forth above.

"Environmental Law" means all applicable statutes, ordinances, rules, regulations, licenses, permits, orders and other authorizations of all federal, state and local entities having jurisdiction over the Donated Property.

"Horse Canyon Mine" means the underground coal mine located in Carbon County, Utah, and all associated facilities.

"IRC" means the Internal Revenue Code of 1986, as amended.

"Lila Canyon Mine" means the UEI mining operation located near or adjacent to the Donated Property.

"Phase II and Phase III Bond Release" means the release of portions of UEI's Bond on the Horse Canyon Mine in accordance with the Coal Act.

"Post Mine Land Use" means the land use of the Donated Property under the Coal Act.

"Retained Assets" means those assets retained by UEI as set forth at 3.2 of the Agreement.

"State Historic Preservation Officer" or "SHPO" means the Utah Department of Community and Economic Development, Division of State History.

"Water Rights" means those water rights described in Exhibit B.

## **ARTICLE II AGREEMENT TO ASSIGN DONATED PROPERTY**

2.1 Agreement to Assign. Subject to the terms and conditions of this Agreement, UEI agrees to donate, transfer and assign and CEUF agrees to accept from UEI the Donated Property.

## **ARTICLE III ASSETS AND LIABILITIES TO BE ASSIGNED AND RETAINED**

3.1 Assets to be Assigned. The assets to be donated, transferred and assigned are referred to as the Donated Property.

3.2 Assets to be Retained. The assets to be retained by UEI are:

(a) Coal and Mineral Rights. UEI reserves its interest, if any, in the coal, oil and gas, coalbed methane and other minerals of whatsoever kind, determination or description located within the following described lands within Emery County, Utah:

Township 16 South, Range 14 East:

Section 3: Lots 1, 3, 7, 8, and 11 (approximately 176.13 acres)

(b) Retained Assets described at Exhibit A. UEI retains the assets described under the column "UEI to Retain Ownership" at Exhibit A hereto.

(c) Redden Spring. UEI reserves all right, title and interest in the Redden Spring Water Right No. 91-5084, as described at Exhibit B hereto, and reserves easements across the Donated Property for access to the Water Rights and construction and operation of water pipelines and diversionary facilities related to use of the Water Rights, until the earlier of 5 years from the Effective Date or release by UEI to CEUF upon replacement of the water supplied by this water right.

(d) Water Replacement. UEI reserves the right to use of the Water Rights described at Exhibit B for UEI's mining purposes or for water replacement purposes as defined in the Coal Act, or for any other regulatory compliance requirement and reserves easements across the Donated Property for access to the Water Rights and construction and operation of water pipelines and diversionary facilities related to use of the Water Rights.

(e) Access for Environmental Monitoring and Bond Release. UEI reserves access to the Donated Property for the purpose of conducting environmental monitoring under applicable Environmental Laws and for purposes of completing activities related to Phase II and Phase III Bond Release.

3.3 Liabilities Assumed by Assignee. With the exception of those liabilities retained by Assignor as described at Section 3.4 herein, Assignee assumes all liabilities and obligations with regard to the Donated Property arising after the Effective Date, including but not limited to those arising under Environmental Laws. To the fullest extent permitted by law, except as specifically provided at § 3.4 herein, Assignee shall and hereby agrees to, as of the Effective Date, indemnify and hold harmless Assignor and its shareholders, directors, officers, agents, employees, attorneys, representatives, successors and assigns, individually and collectively (the "UEI Indemnified Parties") from and against any and all claims, demands, suits, proceedings, damages, losses, liabilities, liens, fines, penalties, claims from indemnification or contribution, and any other matters whatsoever, and all costs and expenses incurred in connection therewith, including attorneys' fees (collectively the "Claims"), arising from ownership and use of the Donated Facilities or Donated Property after the Effective Date, including but not limited to Claims involving bodily injury and death, property damage and environmental conditions of the Donated Facilities or Donated Property. Assignee shall defend all Claims and pay all costs and expenses incidental thereto, but any of the UEI Indemnified Parties shall have the right, at their option, to participate in their own defense through separate counsel without relieving Assignee of any obligation herein. This Section 3.3 shall survive the Effective Date.

3.4 Liabilities Retained by Assignor. UEI retains all liabilities and obligations relating to the Donated Property that arose prior to the Effective Date, including but not limited to those arising under Environmental Laws and permit requirements. Further, UEI retains responsibility for all liabilities of, obligations for, and terms of compliance with: (i) the UPDES

on the Sedimentation Pond described at Exhibit E; (ii) the Bond and associated reclamation activities under the Coal Act necessary to achieve Phase II and Phase III Bond Release; (iii) the Horse Canyon Mine Permit; and (iv) the Lila Canyon Mine Permit (collectively the "Permitted Activities"). To the fullest extent permitted by law, Assignor shall and hereby agrees to, as of the Effective Date, indemnify and hold harmless Assignee and the College of Eastern Utah and their respective directors, officers, agents, employees, attorneys, representatives, successors and assigns, individually and collectively (the "CEUF Indemnified Partners") from and against any and all claims, demands, suits, proceedings, damages, losses, liabilities, liens, fines, penalties, claims for indemnification or contribution and any other matters whatsoever, and all costs and expenses incurred in connection therefore, including attorneys' fees (collectively the "Claims") arising from ownership and use of the Donated Facilities and Donated Property prior to the Effective Date, and after the Effective Date, only as to Claims arising from the Permitted Activities, including but not limited to Claims involving bodily injury and death, property damage and environmental conditions of the Donated Facilities and Donated Property. Assignor shall defend all Claims and pay all costs and expenses incidental thereto, but any of the CEUF Indemnified Parties shall have the right, at their option, to participate in their own defense through separate counsel without relieving Assignor of any objections hereunder. This Section 3.4 shall survive the Effective Date.

#### **ARTICLE IV REPRESENTATIONS AND WARRANTIES**

4.1 Conveyance of Donated Property. UEI is donating, transferring and assigning the Donated Property to CEUF, "AS IS," "WHERE IS" WITHOUT ANY WARRANTIES OR REPRESENTATIONS AND NEITHER UEI NOR ANY OF ITS DIRECTORS, OFFICERS, EMPLOYEES, AFFILIATES, ATTORNEYS, AGENT OR REPRESENTATIVES HAS MADE OR MAKES ANY WARRANTY OR REPRESENTATION WHATSOEVER REGARDING THE PROPERTY, OR ANY OTHER MATTER IN ANY WAY RELATED TO THE PROPERTY, INCLUDING, BUT NOT LIMITED TO TITLE TO THE DONATED PROPERTY, LEASE, USE, VALUE, ENVIRONMENTAL CONDITION, ACCESS, WETLANDS, OR ANY OTHER CONDITION OF THE PROPERTY OR ANY IMPROVEMENT OR PERSONAL PROPERTY LOCATED THEREON. This Article 4.1 shall survive the Effective Date.

4.2 Charitable Status of CEUF. CEUF represents and warrants that it is a charitable organization under § 501(c)(3) of the IRC.

#### **ARTICLE V SCOPE OF WORK ON DONATED PROPERTY**

5.1 UEI Scope of Work. UEI shall perform, and as of the Effective Date, represents that it has completed the Scope of Work described at Exhibit D ("Scope of Work").

#### **ARTICLE VI MINING ON UEI'S ADJACENT PROPERTY**

6.1 Acknowledgment of Mining. CEUF acknowledges that UEI intends to conduct coal mining activities at the Lila Canyon Mine adjacent to the Donated Property and waives all claims arising from the impact of such land use on the Donated Property. This Section 6.1 shall survive the Effective Date.

## ARTICLE VII CONVEYANCE OF DONATED PROPERTY

7.1 Assignor's Conveyance Documents. Upon the Effective Date, UEI shall execute, acknowledge and deliver to CEUF quit claim deeds for the Donated Property in the form set forth at Exhibits F and G hereto.

7.2 Assignee's Acknowledgment of Donation. This Agreement serves as CEUF's acknowledgment of UEI's donation, transfer and assignment of the Donated Property to CEUF and confirmation that no goods or services were provided by CEUF in return for UEI's contribution of the Donated Property. Upon UEI's request, CEUF will provide a separate written acknowledgement of UEI's contribution consistent with Section 170(f)(8) of the IRC and Section 1.170A-13(f) of the Income Tax Regulations.

7.3 Covenant Not to Convey. Except as otherwise agreed to by UEI in writing, CEUF hereby agrees that CEUF will not sell, transfer or otherwise convey the Donated Property to any third party other than any successor in interest within twenty-four (24) months after the date the quit claim deeds referenced in Section 7.1 hereto are recorded in the applicable county recorder's office. CEUF acknowledges that, pursuant to applicable federal tax law, any conveyance within such time period may result in adverse tax consequences to UEI. Accordingly, CEUF hereby agrees to indemnify and hold UEI harmless from any increase in federal and state taxes that result from CEUF's breach of this Section 7.3

## ARTICLE VIII MISCELLANEOUS

8.1 Assignment. This Agreement shall not be assigned in whole or part by any party without the prior written consent of the other party, which consent may not unreasonably be withheld.

8.2 Notices. All notices, payments and other communications under this Agreement must be in writing and shall be addressed respectively as follows:

**ASSIGNOR:** UtahAmerican Energy, Inc.  
P.O. Box 986  
Price, Utah 84501  
Attn: Jay Marshall  
Telephone: (435) 637-5511  
Facsimile: (425) 675-8840

**With copy to:**

Snell & Wilmer L.L.P.  
15 West South Temple  
Suite 1200  
Salt Lake City, Utah 84101  
Attn: Denise Drago, Esq.  
Telephone: (801) 257-1998  
Facsimile: (801) 257-1800

**ASSIGNEE:** John Craven, President  
College of Eastern Utah Foundation  
451 East 400 North  
Price, Utah 84501  
Telephone: (435) 637-1706

8.3 Expenses and Fees. Each party hereto agrees to pay, without right of reimbursement from the other, the costs incurred by it incident to the preparation of this Agreement, and the fees and disbursements of counsel, accountants and consultants employed by it in connection with the negotiation of this Agreement and the consummation of the transactions contemplated herein.

8.4 Successors and Assigns. Except as otherwise provided herein, this Agreement shall be binding upon and inure to the benefit of the parties hereto and their respective successors and permitted assigns.

8.5 Entire Agreement. This Agreement (together with the exhibits hereto, all of which are incorporated herein and made a part hereof by this reference: (i) supersedes any other agreements, whether written or oral, that may have been made or entered into by any of the parties hereto (or by any director, officer or representative of such parties) relating to the matter contemplated hereby; and (ii) constitutes the entire agreement by and between the parties hereto and there are no representations, warranties, covenants, agreements or commitments except as expressly set forth herein.

8.6 Survival. CEUF's obligations described in Section 3.3, 6.1, 7.2 and 7.3 and UEI's obligations described in Section 3.4 of this Agreement shall survive any expiration or termination of this Agreement and shall not merge into any deed delivered and accepted upon the consummation of the transaction herein contemplated.

[remainder of page left intentionally blank]

IN WITNESS WHEREOF, the parties hereto have executed this Agreement by their duly authorize representations the day and year first above written.

ASSIGNOR:

ASSIGNEE:

UTAHAMERICAN ENERGY, INC.

COLLEGE OF EASTERN UTAH  
FOUNDATION

By: Robert E. Murray  
Its: Director

By: John A. Craven  
Its: President

**EXHIBIT A**  
to  
**Asset Assignment Agreement**

**College of Eastern Utah Foundation**  
**Horse Canyon Project**

Legal Description		UEI to Retain Ownership		Donate to College of Eastern Utah Foundation	
		Description	Acres	Description	Acres
T.16S R.14E Emery County Fee Surface	3			Lots 1,3,7,8,11	176.13
	4	S2SW4	80	NW4SE4, SE4SE4	80
	5	SE4SE4	40		
	9	S2NW4, W2SE4	160	NW4NE4, SE4NE4, NE4SE4	120
	10	SE4	160		
	15	SE4NW4, N2NE4, SE4NE4	160		
T.15S R.14E Carbon County Fee Surface	33			S2SE4	80
	34			SW4SW4	40
T.16S R.14E Emery County Fee Simple	3			Lots 5, 6, 12, NW4SW4, S2SW4	240
	4			Lots 8, 9, NE4SE4, SW4SE4	160
	8	NE4NE4	40		
	9	N2NW4	80		
T.16S R.14E Emery County Fee Simple	15	S2NE4, ALSO, Beginning at the NE corner of the NW4SE4, and running thence W 1000 feet; thence SE'y to a point 500 feet S of beginning; thence N 500 feet to beginning	91.25		
<b>TOTAL</b>			<b>811.25</b>		<b>896.13</b>

**EXHIBIT B**  
to  
**Asset Assignment Agreement**

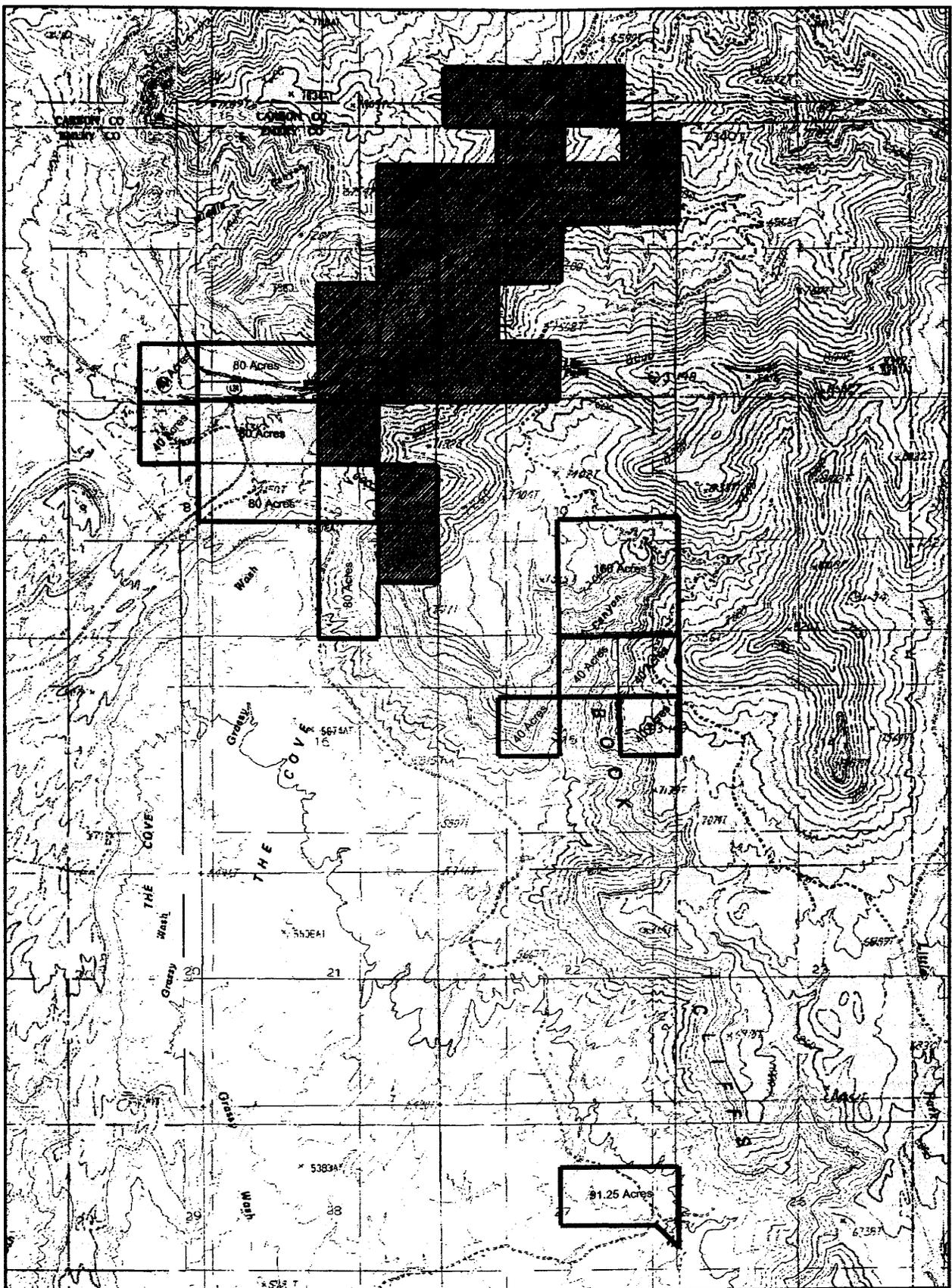
**DESCRIPTION OF DONATED WATER RIGHTS**

- (1) Water User's Claim 91-183: Certificate of Appropriation of Water No. 4592, Application No. 20888, Water Users Claim 91-183, dated August 30, 1952, recorded in Book C of Water Rights at Page 259 in the office of the Emery County Recorder, United States Steel Company, appropriator, appropriating eighty thousandths second feet (.08 cfs) from Horse Canyon Creek, Emery County, Utah, for the period from January 1 to December 31, inclusive, for mining purposes, for diversion and use as set forth in the Deed.
  
- (2) Water Right No. 91-5084, to appropriate 5.0 acre-feet of water from Redden Spring, located at a point South 2145 feet and West 330 feet from the NE Corner of Section 3, T16S, R14E, SLBM.

Provided, that Assignor reserves the right to use water from the above-described Water Rights for reclamation and mining purposes or water replacement uses at the Horse Canyon Mine and the Lila Canyon Mine, Emery County and Carbon County, Utah.

**EXHIBIT C**  
**to**  
**Asset Assignment Agreement**

**MAP**



**LEGEND:**

Not to Be Retained 

Proposed Benefits 

REVISIONS	
2/17/2003	RJM

N  
↑  
A  
S  
H

SCALE:  
1000' 0' 2000'



**Exhibit C**

DATE: April 2, 2003	SCALE: 1:50,000
PROJECT: AS 200000	DATE: 04/02/03

**EXHIBIT D**  
**to**  
**Asset Assignment Agreement**

**Scope of Work**

**I. Facility Area:**

- 1) Cover all window and door openings. Any damaged or missing plywood panels covering the windows on the following facilities will be replaced with new 3/8" plywood or equivalent.
  - A) Office
  - B) Bath House
  - C) Warehouse
  - D) Shop
- 2) Retain one door opening in each building, preferably in the rear away from traffic. This requirements does not apply to the shop building. The single door retained in each of the three buildings will be steel.
- 3) Install simple lock on the retained doors.
- 4) Fill in all grease sumps and underground passage openings in the shop building with sand/gravel material.
- 5) Remove all equipment & materials not built in, including paper, trash and personal property.

**II. Portal Area:**

- 1) Remove and dispose of temporary metal fan housing.
- 1) Remove both concrete head collars at ground level.
- 2) Cover remaining concrete with a minimum of 3' of cover material obtained from the existing pad keeping pad as flat as practical.
- 3) Backfill underground rock dust bin.

**NOTE:**

- a) All concrete and metal will be disposed of in an approved disposal site for non-coal waste. Metal may be salvaged by UEI.
- b) All efforts will be made to minimize disturbance of vegetation and soil.

**EXHIBIT E**  
**to**  
**Asset Assignment Agreement**

**LIST OF FACILITIES**

The following is a list of facilities at the Horse Canyon Mine to be donated to the College of Eastern Utah Foundation by UtahAmerican Energy, Inc.

1. Sedimentation Pond #2 (including associated drainage features)
2. Pump House
3. Office Building
4. Bath House
5. Warehouse
6. Shop
7. Chain Link Fence
8. Building Pads
9. Parking Lot
10. Powder Magazine
11. Cap Magazine
12. Water Tank
13. Portal Pad

**EXHIBIT F**  
to  
**Asset Assignment Agreement**

**QUIT-CLAIM DEED**

**WHEN RECORDED, RETURN TO:**

**Ryan Thomas**  
**College of Eastern Utah**  
**451 East 400 North**  
**Price, Utah 84501**

**Quit-Claim Deed**

UTAHAMERICAN ENERGY, INC., a Utah corporation, having an address of P.O. Box 986, Price, Utah 84501 ("Grantor"), for TEN DOLLARS (\$10.00) and other good and valuable consideration, receipt of which is hereby acknowledged, hereby conveys and quitclaims to the COLLEGE OF EASTERN UTAH FOUNDATION, a Utah Non-Profit Corporation, having an address of 451 East 400 North, Price, Utah 84501 ("Grantee"), all of its rights, title and interest in the lands in Emery County, Utah, described in Schedule "A" hereto, including the buildings and surface facilities described at Schedule B hereto. The conveyance provided for herein shall not include any rights to water or water shares in connection with said real property.

Grantor reserves such easements and rights of way as necessary for Grantor and its employees and representatives to i) access certain water rights located on said real property and to construct and operate water pipelines and diversionary facilities thereon and compliance as necessary; and ii) to access said real property to conduct environmental compliance, monitoring and reclamation activities.

This instrument is executed and delivered pursuant to that certain Asset Assignment Agreement between the parties dated as of September 13, 2005, the terms and conditions of which shall survive the execution and delivery of this instrument.

DATED this 13 day of September, 2005.

GRANTOR:

UTAHAMERICAN ENERGY, INC.

By

Its

Robert G. Murray  
Director

STATE OF OHIO )  
 : ss.  
COUNTY OF BELMONT )

The foregoing instrument was acknowledged before me this 15<sup>th</sup> day of July,  
2005, by Robert E. Murray on behalf of UtahAmerican Energy, Inc.

Denise E. Jackson

Notary Public

Residing at: 62838 McMillan Rd.  
Barnesville, OH 43713

My Commission Expires:

DECEMBER 31, 2005  
Notary Public  
My Comm. No. 005

**SCHEDULE "A"**  
**to**  
**Quit-claim Deed**

**EMERY COUNTY LANDS**

**Surface Only:**

**Township 16 South, Range 14 East:**

Section 3: Lots 1, 3, 7, 8, 11 (176.13 acres)

Section 4: NW1/4SE1/4, SE1/4SE1/4 (80 acres)

Section 9: NW1/4NE1/4, SE1/4NE1/4, NE1/4SE1/4 (120 acres)

**Fee Simple:**

**Township 16 South, Range 14 East**

Section 3: Lots 5, 6, 12, NW1/4SW1/4, S1/2SW1/4 (240 acres)

Section 4: Lots 8, 9, NE1/4SE1/4, SW1/4SE1/4 (160 acres)

**CARBON COUNTY LANDS**

**Surface Only:**

**Township 15 South, Range 14 East:**

Section 33: S1/2SE1/4 (80 acres)

Section 34: SW1/4SW1/4 (40 acres)

**SCHEDULE "B"**  
**to**  
**Quit-claim Deed**

**Buildings and Surface Facilities**

1. Sedimentation Pond #2 (including associated drainage features)
2. Pump House
3. Office Building
4. Bath House
5. Warehouse
6. Shop
7. Chain Link Fence
8. Building Pads
9. Parking Lot
10. Powder Magazine
11. Cap Magazine
12. Water Tank
13. Portal Pad

**EXHIBIT G**  
to  
**Asset Assignment Agreement**

**WATER RIGHTS DEED**

**WHEN RECORDED, RETURN TO:**

**Ryan Thomas**  
**College of Eastern Utah**  
**451 East 400 North**  
**Price, Utah 84501**

**Water Rights Deed**

UTAHAMERICAN ENERGY, INC., a Utah corporation, having an address of P.O. Box 986, Price, Utah 84501 ("Grantor"), for TEN DOLLARS (\$10.00) and other good and valuable consideration, receipt of which is hereby acknowledged, hereby conveys and quitclaims to the COLLEGE OF EASTERN UTAH FOUNDATION, a Utah Non-Profit Corporation, having an address of 451 East 400 North, Price, Utah 84501 ("Grantee"), all of Grantor's rights, title and interests in and to the following described water rights, whose points of diversion and place of use are located in Emery County, State of Utah:

1. Water Right No. 91-183: Certificate of Appropriation of Water No. 4592, Application No. 20888, filed July 22, 1949, Water Users Claim 91-183, dated August 30, 1952, recorded in Book C of Water Rights at Page 259 in the office of the Emery County Recorder, appropriating eighty thousandths second feet (.08 cfs) from Horse Canyon Creek, at a point of diversion located South 910 feet West 1305 feet from the East  $\frac{1}{4}$  Corner, Section 4, Township 16 South, Range 14 East, SLBM, Emery County, Utah, for the period from January 1 to December 31, inclusive, for industrial and domestic uses.
2. Water Right No. 91-5084, to appropriate for mining and other uses 5.0 acre-feet of water from Redden Spring, located at a point South 2145 feet and West 330 feet from the NE Corner of Section 3, Township 16 South, Range 14 East, SLBM.

Grantor expressly reserves and retains the use of said water rights for mining and water replacement purposes and reserves all other water and water rights not specifically herein conveyed.

This instrument is executed and delivered pursuant to that certain Asset Assignment Agreement between the parties dated as of September 13, 2005, the terms and conditions of which shall survive the execution and delivery of this instrument.



**Appendix III-1-2**

**Letters to Surface and Subsurface Owners**

UtahAmerican Energy, Inc.



Lila Canyon Project  
P. O. Box 986, Price, Utah 84501  
Phone: (435) 888-4000  
(435) 650-3157  
Fax: (435) 888-4002

January 29, 2008

United States Department of The Interior  
Bureau of Land Management  
Mr. Mike Robinson  
125 South 600 West  
Price, Utah 84501

**Re: Phase III Bond Release, Horse Canyon Mine, DOGM Permit C\007\013**

Dear Mr. Robinson,

In accordance with the requirements of R645-301-880.120, UtahAmerican Energy, Inc. (UAE) is notifying the surface land owners and local government body within and adjacent to the Horse Canyon Mine of intention to seek Phase III bond release on those disturbed lands approved for reclamation, and on lands donated to the College of Eastern Utah. The land is described on the attached public notice.

The Phase III bond release application is for Surety #4892 for \$1,061,328 and covers a total of 91.97 acres, including 16.18 acres donated to the College of Eastern Utah Foundation. The areas donated to the College of Eastern Utah are covered under an approved post mine land use change, from Wildlife to Residential/Recreation. After Phase III 0.49 acres in Surety #4892 for \$5,000 will remain for the Road Junction Refuse Pile channel.

Reclamation of the 51.65 remaining acres was completed in 1991, and meets the requirements of the regulations for post mine land use of Wildlife Habitat, including stabilization of lands, restoration of drainages, and vegetation establishment. After the 1991 reclamation, storm damaged the Road Junction Refuse Pile channel requiring channel repairs including an access road to the channel for a total of 0.49 acres which will remain under Surety #4892.

In summary:    51.56 (acres included in Phase I and Phase II bond releases)  
                  16.18 (acres donated to CEU)  
                  .02 (bridge abutments within Emery County Road ROW)  
                  24.21 (acres included in the Emery County road right of Way)  
                  91.97 Acres

Comments from the legal or equitable owner of record of the surface areas to be affected and from the Federal, Utah and local government agencies should be mailed to: Utah Division of Oil, Gas and Mining, Attention: Pamela Grubaugh-Littig, Permit Supervisor, 1594 West North Temple, Suite 1210, P.O. Box 145801, Salt Lake City, Utah 84114-5801.

If you have any questions or need additional information, please do not hesitate to contact me at (435) 888-4007, or Pamela Grubaugh-Littig at (801) 538-5268.

Sincerely,

Jay Marshall  
Chief Engineer/Project Manager

Enclosure

UtahAmerican Energy, Inc.



Lila Canyon Project  
P. O. Box 986, Price, Utah 84501  
Phone: (435) 888-4000  
(435) 650-3157  
Fax: (435) 888-4002

January 29, 2008

Mr. Bill Krompel  
Carbon County Commission  
120 East Main St.  
Price, Utah 84501

**Re: Phase III Bond Release, Horse Canyon Mine, DOGM Permit C\007\013**

Dear Commissioner Krompel,

In accordance with the requirements of R645-301-880.120, UtahAmerican Energy, Inc. (UAE) is notifying the surface land owners and local government body within and adjacent to the Horse Canyon Mine of intention to seek Phase III bond release on those disturbed lands approved for reclamation, and on lands donated to the College of Eastern Utah. The land is described on the attached public notice.

The Phase III bond release application is for Surety #4892 for \$1,061,328 and covers a total of 91.97 acres, including 16.18 acres donated to the College of Eastern Utah Foundation. The areas donated to the College of Eastern Utah are covered under an approved post mine land use change, from Wildlife to Residential/Recreation. After Phase III 0.49 acres in Surety #4892 for \$5,000 will remain for the Road Junction Refuse Pile channel.

Reclamation of the 51.65 remaining acres was completed in 1991, and meets the requirements of the regulations for post mine land use of Wildlife Habitat, including stabilization of lands, restoration of drainages, and vegetation establishment. After the 1991 reclamation, storm damaged the Road Junction Refuse Pile channel requiring channel repairs including an access road to the channel for a total of 0.49 acres which will remain under Surety #4892.

In summary:

51.56	(acres included in Phase I and Phase II bond releases)
16.18	(acres donated to CEU)
.02	(bridge abutments within Emery County Road ROW)
<u>24.21</u>	(acres included in the Emery County road right of Way)
91.97	Acres

Comments from the legal or equitable owner of record of the surface areas to be affected and from the Federal, Utah and local government agencies should be mailed to: Utah Division of Oil, Gas and Mining, Attention: Pamela Grubaugh-Littig, Permit Supervisor, 1594 West North Temple, Suite 1210, P.O. Box 145801, Salt Lake City, Utah 84114-5801.

If you have any questions or need additional information, please do not hesitate to contact me at (435) 888-4007, or Pamela Grubaugh-Littig at (801) 538-5268.

Sincerely,

R. Jay Marshall  
Chief Engineer/Project Manager

Enclosure

UtahAmerican Energy, Inc.



Lila Canyon Project  
P. O. Box 986, Price, Utah 84501

Phone: (435) 888-4000

(435) 650-3157

Fax: (435) 888-4002

January 29, 2008

College of Eastern Utah Foundation  
451 East 400 north  
Price, Utah 84501

**Re: Phase III Bond Release, Horse Canyon Mine, DOGM Permit C\007\013**

To Whom it May concern,

In accordance with the requirements of R645-301-880.120, UtahAmerican Energy, Inc. (UAE) is notifying the surface land owners and local government body within and adjacent to the Horse Canyon Mine of intention to seek Phase III bond release on those disturbed lands approved for reclamation, and on lands donated to the College of Eastern Utah. The land is described on the attached public notice.

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Enclosure

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Lila Canyon Project  
P. O. Box 986, Price, Utah 84501

Phone: (435) 888-4000

(435) 650-3157

Fax: (435) 888-4002

January 29, 2008

Mr. Darrel Lemaster  
Castle Valley Special Service District  
86 South 100 East  
Castle Dale, Utah 84513

**Re: Phase III Bond Release, Horse Canyon Mine, DOGM Permit C\007\013**

Dear Mr. Lemaster,

In accordance with the requirements of R645-301-880.120, UtahAmerican Energy, Inc. (UAE) is notifying the surface land owners and local government body within and adjacent to the Horse Canyon Mine of intention to seek Phase III bond release on those disturbed lands approved for reclamation, and on lands donated to the College of Eastern Utah. The land is described on the attached public notice.

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Sincerely,

R. Jay Marshall  
Chief Engineer/Project Manager

Enclosure

UtahAmerican Energy, Inc.



January 29, 2008

Department of Natural Resources  
Division of Sovereign Lands & Forestry  
1594 W. North Temple, Suite 3520  
P.O. Box 145703  
Salt Lake City, Utah 84114-5703

**Re: Phase III Bond Release, Horse Canyon Mine, DOGM Permit C\007\013**

Dear Sirs,

In accordance with the requirements of R645-301-880.120, UtahAmerican Energy, Inc. (UAE) is notifying the surface land owners and local government body within and adjacent to the Horse Canyon Mine of intention to seek Phase III bond release on those disturbed lands approved for reclamation, and on lands donated to the College of Eastern Utah. The land is described on the attached public notice.

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Sincerely,

R. Jay Marshall  
Chief Engineer/Project Manager

Enclosure

UtahAmerican Energy, Inc.



Lila Canyon Project  
P. O. Box 986, Price, Utah 84501  
Phone: (435) 888-4000  
(435) 650-3157  
Fax: (435) 888-4002

January 29, 2008

Mr. Josiah K. Eardley  
2433 S Highway 10  
Route 1, Box 119  
Price, Utah 84501

**Re: Phase III Bond Release, Horse Canyon Mine, DOGM Permit C\007\013**

Dear Mr. Eardley,

In accordance with the requirements of R645-301-880.120, UtahAmerican Energy, Inc. (UAE) is notifying the surface land owners and local government body within and adjacent to the Horse Canyon Mine of intention to seek Phase III bond release on those disturbed lands approved for reclamation, and on lands donated to the College of Eastern Utah. The land is described on the attached public notice.

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Sincerely,

R. Jay Marshall  
Chief Engineer/Project Manager

Enclosure

**UtahAmerican Energy, Inc.**



**Lila Canyon Project**  
**P. O. Box 986, Price, Utah 84501**

**Phone: (435) 888-4000**

**(435) 650-3157**

**Fax: (435) 888-4002**

January 29, 2008

Mr. Orlando LaFontaine, Mayor  
East Carbon City  
101 West Geneva Dr.  
East Carbon, Utah 84520

**Re: Phase III Bond Release, Horse Canyon Mine, DOGM Permit C\007\013**

Dear Mayor LaFontaine,

In accordance with the requirements of R645-301-880.120, UtahAmerican Energy, Inc. (UAE) is notifying the surface land owners and local government body within and adjacent to the Horse Canyon Mine of intention to seek Phase III bond release on those disturbed lands approved for reclamation, and on lands donated to the College of Eastern Utah. The land is described on the attached public notice.

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Sincerely,

R. Jay Marshall  
Chief Engineer/Project Manager

Enclosure

**UtahAmerican Energy, Inc.**



**Lila Canyon Project**  
**P. O. Box 986, Price, Utah 84501**

**Phone: (435) 888-4000**  
**(435) 650-3157**  
**Fax: (435) 888-4002**

January 29, 2008

Mr. Drew Sitterud  
Emery County Commission  
95 East Main Street  
Castle Dale, Utah 84112

**Re: Phase III Bond Release, Horse Canyon Mine, DOGM Permit C\007\013**

Dear Mr. Sitterud,

In accordance with the requirements of R645-301-880.120, UtahAmerican Energy, Inc. (UAE) is notifying the surface land owners and local government body within and adjacent to the Horse Canyon Mine of intention to seek Phase III bond release on those disturbed lands approved for reclamation, and on lands donated to the College of Eastern Utah. The land is described on the attached public notice.

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Sincerely,

R. Jay Marshall  
Chief Engineer/Project Manager

Enclosure

**UtahAmerican Energy, Inc.**



**Lila Canyon Project**  
**P. O. Box 986, Price, Utah 84501**

**Phone: (435) 888-4000**

**(435) 650-3157**

**Fax: (435) 888-4002**

January 29, 2008

Emery County Planning & Zoning Commission  
PO Box 727  
75 East Main St.  
Castle Dale, Utah 84513

**Re: Phase III Bond Release, Horse Canyon Mine, DOGM Permit C\007\013**

To Whom It May concern,

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R. Jay Marshall  
Chief Engineer/Project Manager

Enclosure

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January 29, 2008

Department of Natural Resources  
Division of Sovereign Lands & Forestry  
1594 W. North Temple, Suite 3520  
P.O. Box 145703  
Salt Lake City, Utah 84114-5703

**Re: Phase III Bond Release, Horse Canyon Mine, DOGM Permit C\007\013**

Dear Sirs,

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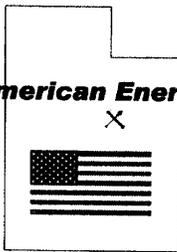
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Enclosure

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**Lila Canyon Project**  
**P. O. Box 986, Price, Utah 84501**

**Phone: (435) 888-4000**

**(435) 650-3157**

**Fax: (435) 888-4002**

January 29, 2008

Mr. Bruce Andrews, Mayor  
Sunnyside City  
701 Market St.  
Sunnyside, Utah 84539

**Re: Phase III Bond Release, Horse Canyon Mine, DOGM Permit C\007\013**

Dear Mayor Andrews,

In accordance with the requirements of R645-301-880.120, UtahAmerican Energy, Inc. (UAE) is notifying the surface land owners and local government body within and adjacent to the Horse Canyon Mine of intention to seek Phase III bond release on those disturbed lands approved for reclamation, and on lands donated to the College of Eastern Utah. The land is described on the attached public notice.

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Sincerely,

R. Jay Marshall  
Chief Engineer/Project Manager

Enclosure

**Appendix III-1-3**

**Public Notice**

**Public Notice**

**Application for Phase III Bond Release  
Horse Canyon Mine  
UtahAmerican Energy , Inc.  
Permit C/007/013, Renewed 5/6/2006  
Emery County, Utah**

Notice is hereby given that UtahAmerican Energy, Inc., 153 Highway 7 South, Powhatan Point, Ohio 43942, with R. Jay Marshall as Resident Agent, P.O. Box 910, East Carbon, Utah 84520, has filed an application with the Utah Department of Natural Resources, Division of Oil, Gas and Mining for a Phase III bond release on disturbed lands currently in Permit C/007/013 Part "A" pursuant to R645-301-880 and R645-301-400 of the Utah Coal Program Regulations. The permit area is shown on the Cedar and Lila Point U.S. Geological Survey 7.5-minute Quadrangle maps. The permit area affected is located in Emery County and Carbon County, Utah as follows:

Township 16 South, Range 14 East, Salt Lake Base & Meridian

Section 3

Lot 1, 2, 3, 5, 6, 7, 8, 9, 11, 12, N2SW4SW4, SW4SE4, NW4SW4, NE4SW4, N2SE4 SE4SE4

Section 4

SE4NE4, S2SW4, S2SE4NE4, SE4, Lot 9

Section 5

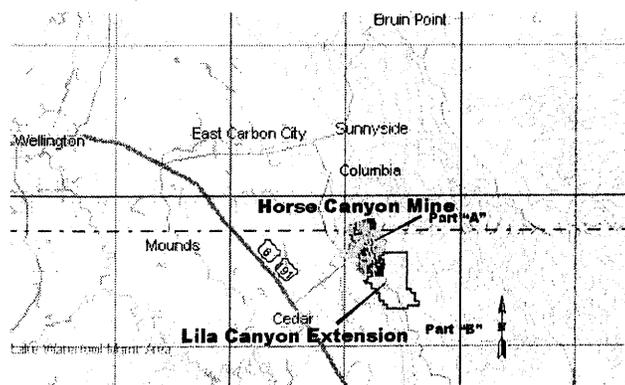
S2SE4SE4

Section 8

NE4NE4

Section 9

NW4NW4, NE4NW4, NW4NE4



The Phase III bond release application is for Surety #4892 for \$1,061,328 and covers a total of 91.97 acres. Bond will be retained on approximately .49 acres to cover a small channel. The total amount of bond that will be retained is \$5,000, the remainder \$1,056,328 on the disturbed acres which meet the requirements of the regulations for post mine land use of Wildlife Habitat, including stabilization of lands, restoration of drainages, and vegetation establishment and will be released.

Reclamation of 51.56 acres was completed in 1991 and were included in Phase I and Phase II bond release. The bond release application includes 16.18 acres donated to the College of Eastern Utah Foundation and are covered under an approved post mine land use change, from Wildlife to Residential/Recreation. In addition the .02 acres within the Emery County Road right of way is included in bond release. The public road known as "The Range Creek Road" (24.21 acres) is included in Phase III bond release and will not be reclaimed. Six acres of the Range Creek Road were included in Phase I and Phase II bond release.

In summary: 51.56 (acres included in Phase I and Phase II bond release)(.49 acres of channel area not included)  
16.18 (acres donated to the College of Eastern Utah)  
.02 (acres bridge abutments within the Emery County Road right of way)  
24.21 (acres included in the Emery County Road Right of Way)  
91.97Acres

After Phase III Bond Release .49 acres associated with the channel area will remain.  
In addition, 6.5 acres identified as disturbed, was never disturbed, therefore will be removed from the disturbed area.

Written comments, objections and requests for an informal conference on this proposal may be addressed to:

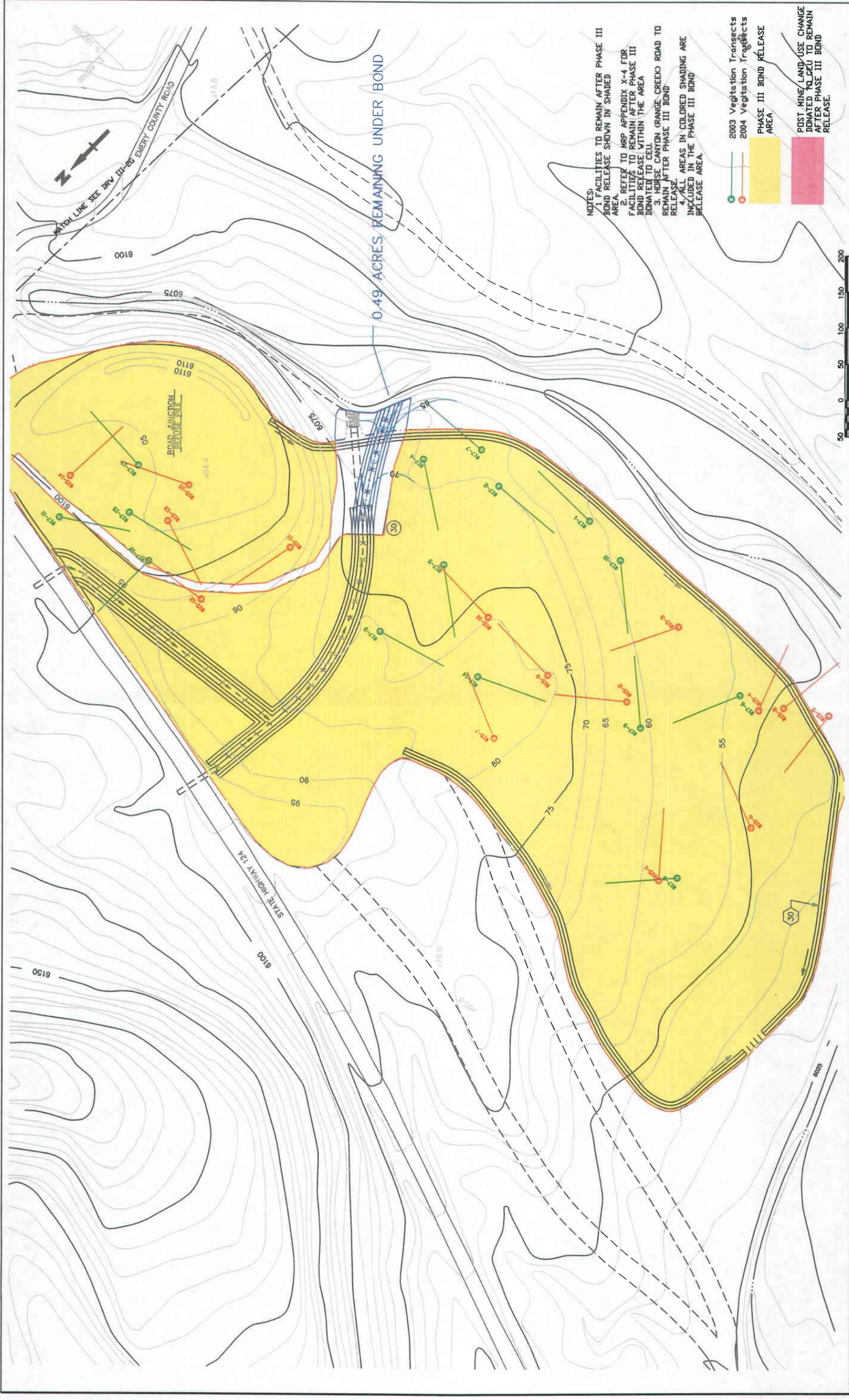
Utah Coal Program  
Utah Division of Oil, Gas and Mining  
1594 West North Temple, Suite 1210  
Salt Lake City, Utah 84114-5801

Closing date for submission of such comments, objections and requests for an informal conference on this proposal must be submitted by \_\_\_\_\_.

Published in the Sun Advocate - \_\_\_\_\_, and the Emery County Progress - \_\_\_\_\_.

**Appendix III-1-4**

**Plates III-2A through III-2G**



NOTES:  
 1. FACILITIES TO REMAIN AFTER PHASE III BOND RELEASE SHOWN IN SHADED AREA.  
 2. REFER TO MRP APPENDIX X-4 FOR FACILITIES TO REMAIN AFTER PHASE III BOND RELEASE WITHIN THE AREA DONATED TO CEU.  
 3. HORSE CANYON CREEK ROAD TO REMAIN AFTER PHASE III BOND RELEASE.  
 4. ALL AREAS IN COLORED SHADING ARE INCLUDED IN THE PHASE III BOND RELEASE AREA.

- 2003 Vegetation Transects
- 2004 Vegetation Transects
- PHASE III BOND RELEASE AREA
- POST-MINE LAND-USE CHANGE DONATED TO CEU TO REMAIN AFTER PHASE III BOND RELEASE.



UTAHAMERICAN ENERGY, INC.  
 P.O. BOX 986, PRICE, UTAH 84501

PHASE III BOND RELEASE AREAS  
 HORSE CANYON MINE

BARBER, ALLEN & JUICE, INC.  
 ENGINEERS  
 215 S. CENTER ST., SUITE 200, PRICE, UTAH 84501

JOB NO. 304-01.100      DWG. NO. III-2A      SHEET NO. 2

NO.	DATE	REVISION
1	7/06	ADDED 0.49 ACRE AREA
2	12/06	ADDED NOTES

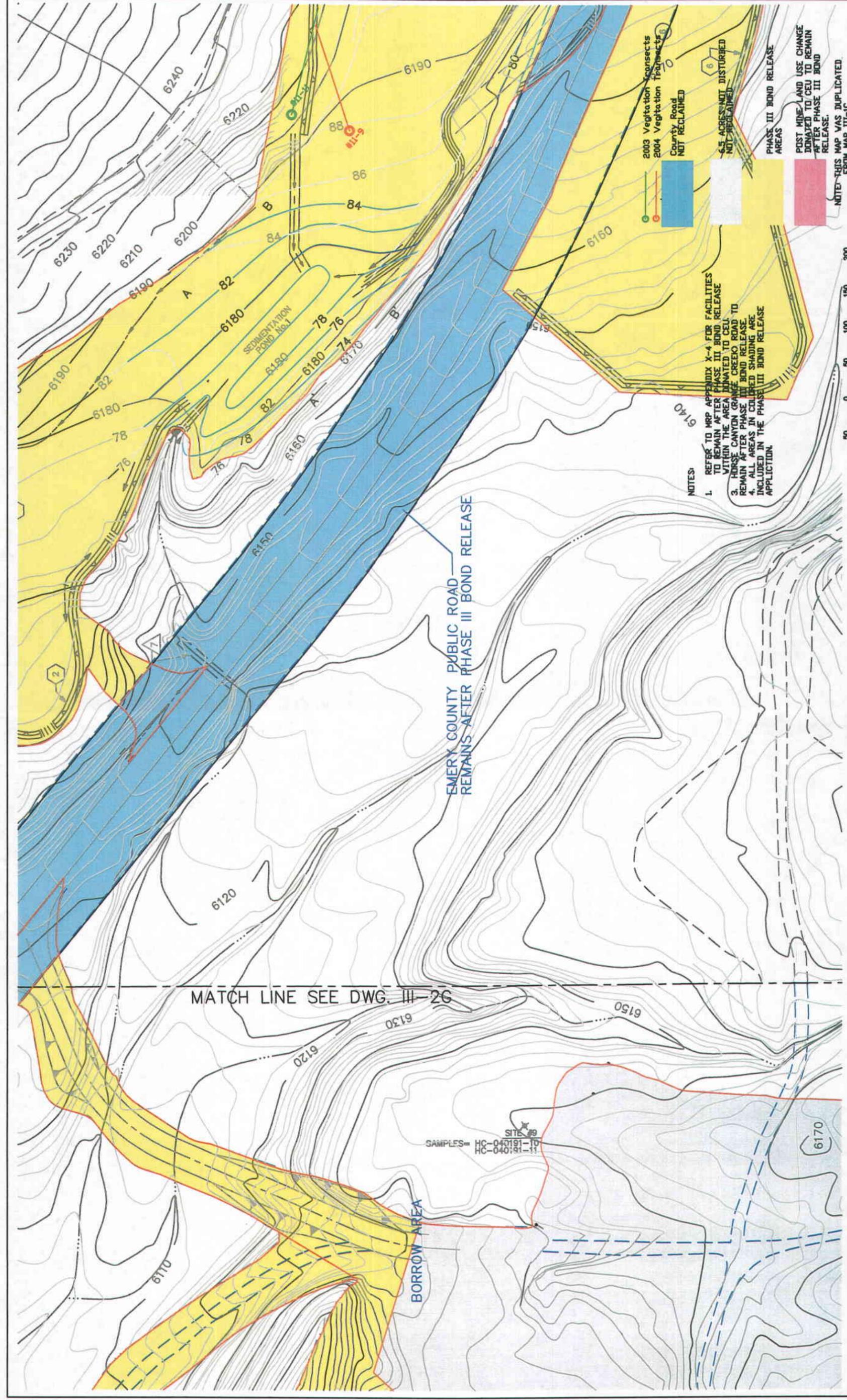
  

SCALE:	AS SHOWN	DATE:	10-25-06
DESIGNED BY:	B.A. CRIMES	CHECKED BY:	
DRAWN BY:		APPROVED BY:	
DATE:	10-25-06	SCALE:	AS SHOWN

FOR LORNO SEE PLATE W-3, VOL. 3.  
 1. TOPO BASED ON 1988 AERIAL PHOTO BY WYDE MOUNTAIN TECHNICAL SERVICES, INC. OF GRAND JUNCTION, COLORADO.  
 2. DATUM IS 1988 SEA LEVEL.  
 3. COORDINATE SYSTEM IS EASER STEEL LOCAL.  
 4. INTERIM AND FINAL REGULATORY TOPOGRAPHY DESIGNED AND DEVELOPED BY OF KASBER ENGINEERS, INC. 1980-1981.  
 5. COMPLIANCE TOPOGRAPHY DESIGN AND DEVELOPMENT MODIFIED AND PREPARED BY LANDFAX ENGINEERING, INC.  
 6. DATE: 10/25/06





NO.	DATE	REVISION
1	11/08	REVISED COUNTY ROAD NOTE
2	17/08	ADDED COUNTY ROAD & 6.5 ACRES AREA
3	10/08	PHASE III BOND RELEASE

DATE	AS SHOWN	BY
10-28-08	B.A. CRIMES	

FOR ADDITIONAL LICENSE SEE PLATE W-4, VOL. 1.  
 THIS MAP IS BASED ON 1989 AERIAL PHOTO BY INTER SOLUTIONS TECHNICAL SERVICES, INC. OF GRAND JUNCTION, COLORADO.  
 DATUM IS 1983 NAD 83.  
 COORDINATE SYSTEM IS NAD83 UTM LOCAL.  
 INTERIOR AND FINAL REGULATIONS INFORMATION OBTAINED AND DEVELOPED BY UTAHAMERICAN, INC. 1000-1001.  
 COMPLIANCE TOPOGRAPHY DESIGN AND DEVELOPMENT SECURED AND PREPARED BY LANDSPACE ENGINEERING, INC.

UTAHAMERICAN ENERGY, INC.  
 P.O. BOX 986, PRICE, UTAH 84501

PHASE III BOND RELEASE AREAS  
 HORSE CANYON MINE

BLANDFORD, ALBERT & LYDIE, INC.  
 ENGINEERS  
 1000-1001  
 1000-1001  
 1000-1001  
 1000-1001  
 1000-1001

NOTE: THIS MAP WAS DUPLICATED FROM MAP III-1C

POST MINE LAND USE CHANGE DONATED TO CEU TO REMAIN AFTER PHASE III BOND RELEASE.

PHASE III BOND RELEASE AREAS

6.5 ACRES NOT DISTURBED NOT RECLAIMED

County Road NOT RECLAIMED

2004 Vegetation Treatments

2003 Vegetation Treatments

NOTES:

- REFER TO MRP APPENDIX X-4 FOR FACILITIES TO REMAIN AFTER PHASE III BOND RELEASE WITHIN THE AREA DONATED TO CEU.
- HORSE CANYON GRANGE CREEK ROAD TO REMAIN AFTER PHASE III BOND RELEASE.
- ALL AREAS IN COLORED SHADING ARE INCLUDED IN THE PHASE III BOND RELEASE APPLICATION.

EMERY COUNTY PUBLIC ROAD REMAINS AFTER PHASE III BOND RELEASE

SEDIMENTATION POND No. 1

BORROW AREA

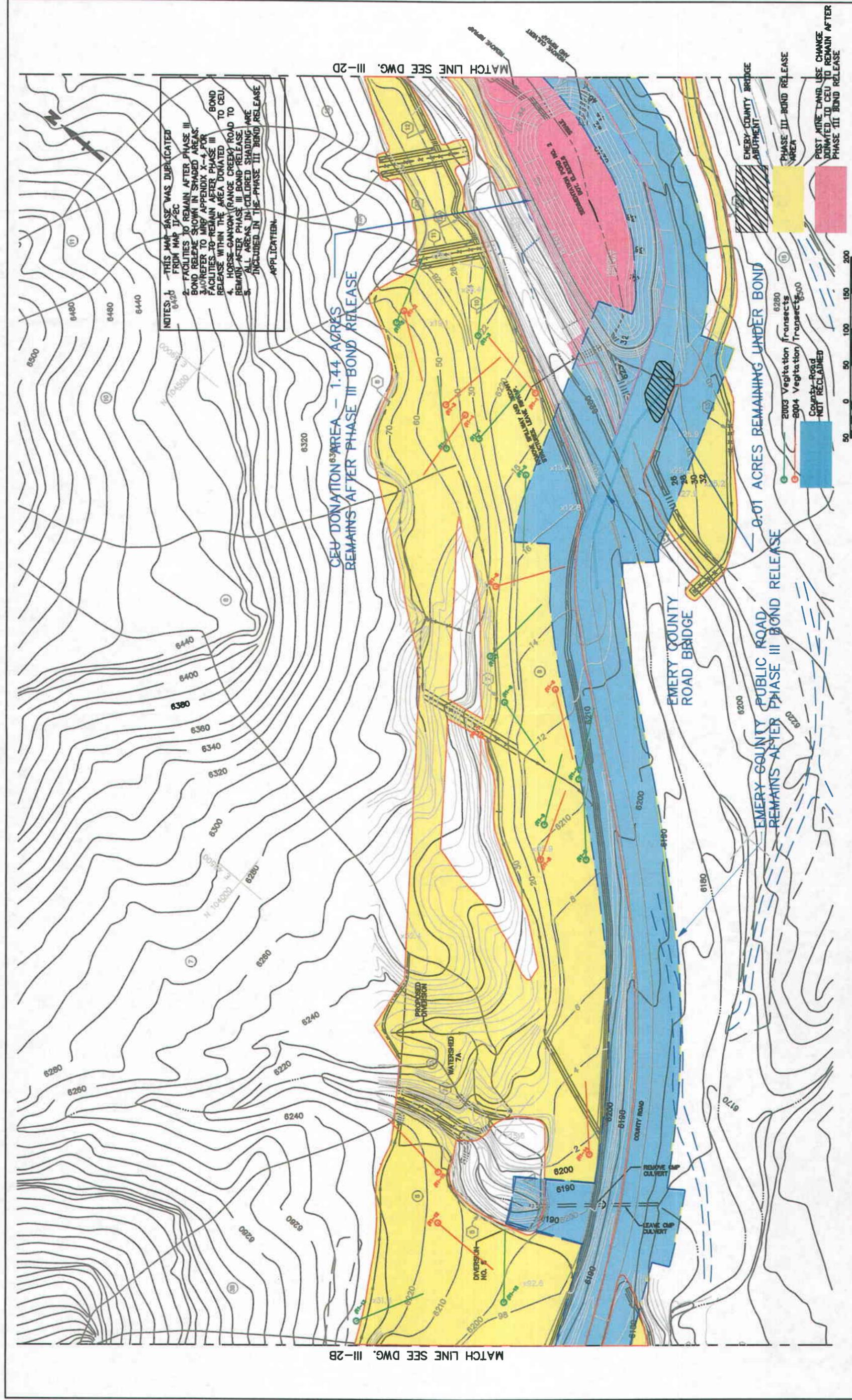
SITE #9  
 SAMPLES =  
 HC-040191-10  
 HC-040191-11

MATCH LINE SEE DWG. III-2G

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0 50 100 150 200

JOB NO. 304.01.100 DWG. NO. III-2B 3



NOTES:  
 1. THIS MAP BASE WAS DUPLICATED FROM MAP II-2C  
 2. FACILITIES TO REMAIN AFTER PHASE III BOND RELEASE SHOWN IN SHADED AREAS.  
 3. REFER TO MIREY APPENDIX X-4 FOR FACILITIES TO REMAIN AFTER PHASE III BOND RELEASE WITHIN THE AREA DONATED TO CEU.  
 4. HORSE CANYON (FRANCE CREEK) ROAD TO REMAIN AFTER PHASE III BOND RELEASE.  
 5. ALL AREAS IN COLORED SHADING ARE INCLUDED IN THE PHASE III BOND RELEASE APPLICATION.

NO	DATE	REVISION
1	12/20	ADDED NOTES
2	7/20	ADDED COUNTY ROAD
3	10/20	PHASE III BOND RELEASE

DESIGNED BY	DATE
DRAWN BY	DATE
CHECKED BY	DATE
APPROVED BY	DATE

FOR ADDITIONAL LEGEND SEE PLATE I-1, VOL. 3  
 THIS MAP IS BASED ON THE Aerial PHOTO OF THE MINE AND SURROUNDING AREAS, WHICH IS IN THE PUBLIC DOMAIN.  
 COORDINATE SYSTEM IS UTM ZONE 12N.  
 STREAM AND POND PERIMETERS REPRESENTED BY DASHED LINES.  
 CONTOUR INTERVAL IS 10 FEET.  
 CONTOUR INTERVAL IS 10 FEET.  
 CONTOUR INTERVAL IS 10 FEET.

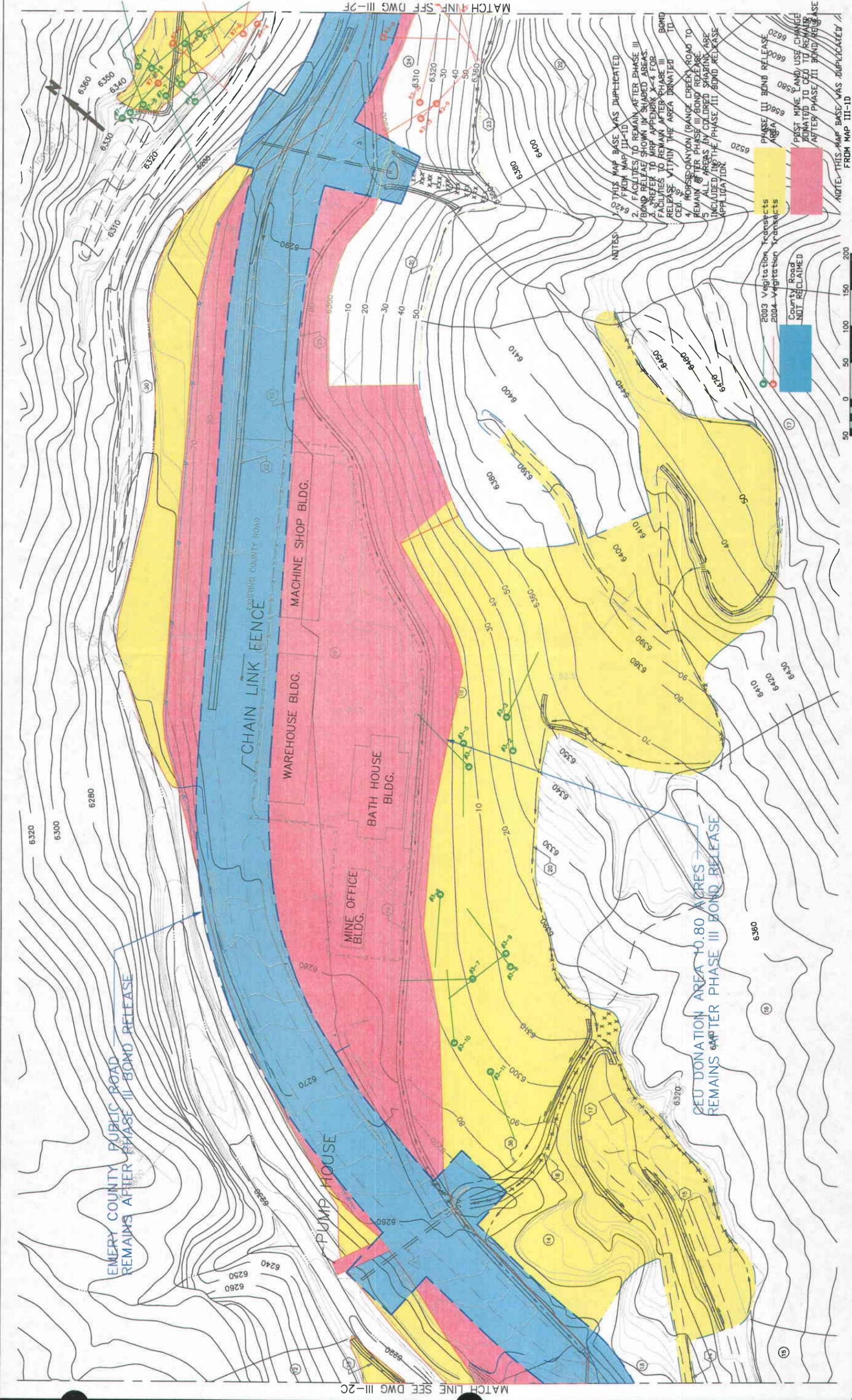
UTAHAMERICAN ENERGY, INC.  
 P.O. BOX 986, PRICE, UTAH 84501

EMERY COUNTY, UTAH  
 PHASE III BOND RELEASE AREAS  
 HORSE CANYON MINE

JOB NO. DWG. NO. III-2C 3



MATCH LINE SEE DWG III-2C

MATCH LINE SEE DWG III-2F

- NOTES:
1. THIS MAP BASE WAS DUPLICATED FROM MAP III-1D.
  2. FACILITIES TO REMAIN AFTER PHASE III BOND RELEASE SHOWN IN SHADDED AREAS.
  3. REFER TO MRP APPENDIX X-4 FOR FACILITIES TO REMAIN AFTER PHASE III BOND RELEASE WITHIN THE AREA DONATED TO CEU.
  4. HORSE CANYON (RANGE CREEK) ROAD TO REMAIN AFTER PHASE III BOND RELEASE.
  5. ALL AREAS IN COLORED SHADING ARE INCLUDED IN THE PHASE III BOND RELEASE APPLICATION.

PHASE III BOND RELEASE AREA

2003 Vegetation Transects  
2004 Vegetation Transects

County Road NOT RECLAIMED

NOTE: THIS MAP BASE WAS DUPLICATED FROM MAP III-1D

HANSEN, ALLEN & LUCE, INC.  
Engineers  
25 25 CORNER 4TH ST. & 1ST AVE. SALT LAKE CITY, UT 84143

PHASE III BOND RELEASE AREAS  
HORSE CANYON MINE

JOB NO. 304.01.100      DWG. NO. III-2D      SHEET NO. 3

UTAHAMERICAN ENERGY, INC.  
P.O. BOX 986, PRICE, UTAH 84501

NO.	DATE	REVISION
1	12/06	ADDED NOTES
2	7/05	ADDED COUNTY ROAD
3	10/05	PHASE III BOND RELEASE

SCALE	AS SHOWN	DATE
AS SHOWN	AS SHOWN	10-25-05
DRAWN BY	B.A. GRIMES	
CHECKED BY		
APPROVED BY		
DATE		

FOR LEGEND SEE PLATE W-1, VOL. 1

TOPIC BASED ON 1985 AERIAL PHOTO BY INTER MOUNTAIN TECHNICAL SERVICES, INC. OF GRAND JUNCTION, COLORADO.

DATUM IS 1929 SEA LEVEL.

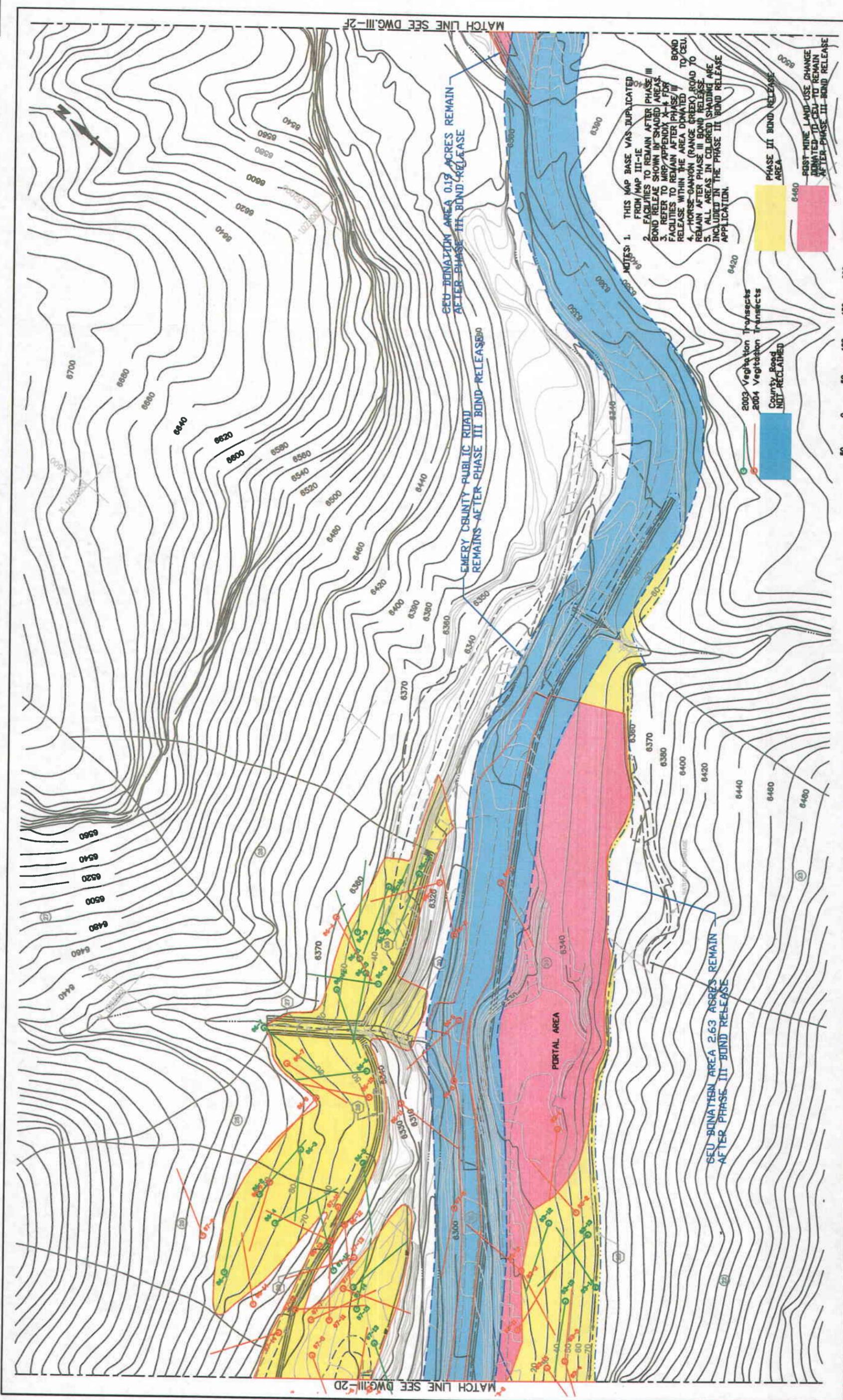
COORDINATE SYSTEM IS NAD83 UTM LOCAL.

INTERIM AND FINAL RECLAMATION TOPOGRAPHY DESIGNED AND DEVELOPED BY ICF MAUER ENGINEERS, INC., 1990-1991.

COMPLIANCE TOPOGRAPHY DESIGN AND DEVELOPMENT MODIFIED AND PREPARED BY GARTHWALE ENGINEERING, INC.

NOTES





MATCH LINE SEE DWG. III-2F

MATCH LINE SEE DWG. III-2D

- NOTES: 1. THIS MAP BASE WAS DUPLICATED FROM MAP III-1E  
 2. FACILITIES TO REMAIN AFTER PHASE III BOND RELEASE SHOWN IN SHADED AREAS.  
 3. REFER TO MRP APPENDIX X FOR FACILITIES TO REMAIN AFTER PHASE III BOND RELEASE WITHIN THE AREA DONATED TO CEU.  
 4. HORSE CANYON (RANGE CREEK) ROAD TO REMAIN AFTER PHASE III BOND RELEASE  
 5. ALL AREAS IN COLORED SHADING ARE INCLUDED IN THE PHASE III BOND RELEASE APPLICATION.

PHASE III BOND RELEASE AREA

2003 Vegetation Transects  
 2004 Vegetation Transects  
 County Road NOT RECLAIMED



MANAGER, ALLEN & LEITCH, INC.  
 1000 WEST 1000 SOUTH  
 SALT LAKE CITY, UTAH 84119

PHASE III BOND RELEASE AREAS  
 HORSE CANYON MINE

JOB NO. 304-01.100      DWG. NO. III-2E      3

UTAHAMERICAN ENERGY, INC.  
 P.O. BOX 986, PRICE, UTAH 84501

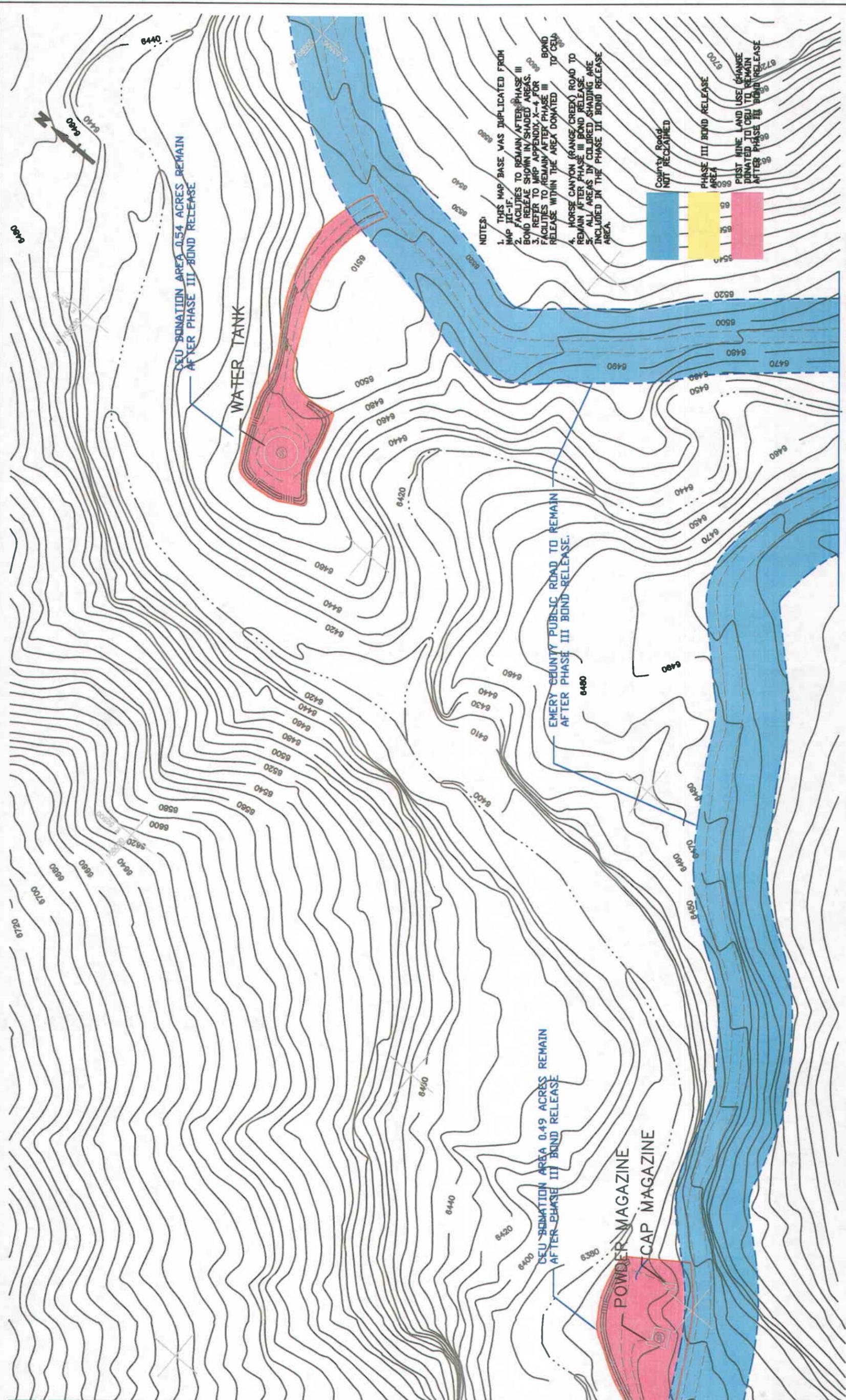
DATE	REVISIONS AS SHOWN
04-20-04	B.A. GRIMES

FOR ADDITIONAL LEGEND SEE PLATE W-4, VOL. 3.  
 TOPO BASED ON 1989 AERIAL PHOTO BY INTER LOCATION TECHNICAL SERVICES, INC. OF GRAND JUNCTION, COLORADO.  
 DATUM IS 1983 SEA LEVEL.  
 COORDINATE SYSTEM IS NAD83 UTM ZONE 12N.  
 REVIEW AND FINAL REGULATION COMPLIANCE DETERMINED AND DEVELOPED BY STUBBS ENGINEERS, INC. 1999-2004.  
 COMPLIANCE TOPOGRAPHY DESIGN AND DEVELOPMENT NUMBER AND PREPARED BY CAROLAN ENGINEERING, INC.



NO.	DATE	REVISION
1	12/04	ADDED NOTES
2	7/05	ADDED COUNTY ROAD
3	10/03	PHASE III BOND RELEASE

MATCH LINE SEE DWG. III-2E



- NOTES:
1. THIS MAP BASE WAS DUPLICATED FROM MAP XII-1F.
  2. FACILITIES TO REMAIN AFTER PHASE III BOND RELEASE SHOWN IN SHADED AREAS.
  3. REFER TO MAP APPENDIX X-4 FOR FACILITIES TO REMAIN AFTER PHASE III BOND RELEASE WITHIN THE AREA DONATED TO CELU.
  4. HORSE CANYON (GRANGE CREEK) ROAD TO REMAIN AFTER PHASE III BOND RELEASE.
  5. ALL AREAS IN COLORED SHADING ARE INCLUDED IN THE PHASE III BOND RELEASE AREA.

County Road NOT RECLAIMED

PHASE III BOND RELEASE AREA

PAST MINE LAND USE CHANGE DONATED TO CELU TO REMAIN AFTER PHASE III BOND RELEASE

NO.	DATE	REVISION
1	12/06	ADDED NOTES
2	7/08	ADDED COUNTY ROAD
3	10/08	PHASE III BOND RELEASE

PROFESSIONAL SEAL

FOR ADDITIONAL LEGEND SEE PLATE V-4, VOL. 2

TOPO BASED ON 1986 AERIAL PHOTO BY STEEL MOUNTAIN TECHNICAL SERVICES, INC. OF GRAND JUNCTION, COLORADO

SCALE IS 1" = 100' HORIZONTAL

COORDINATE SYSTEM IS NAD83 UTM ZONE 12Q

VERTICAL AND HORIZONTAL DATUMS ARE THE SAME

COMPILED BY: B.A. GRIMES

DATE: 10-08-08

BLAIRBERRY, ALBERT & LIPKOW, INC.  
Engineers

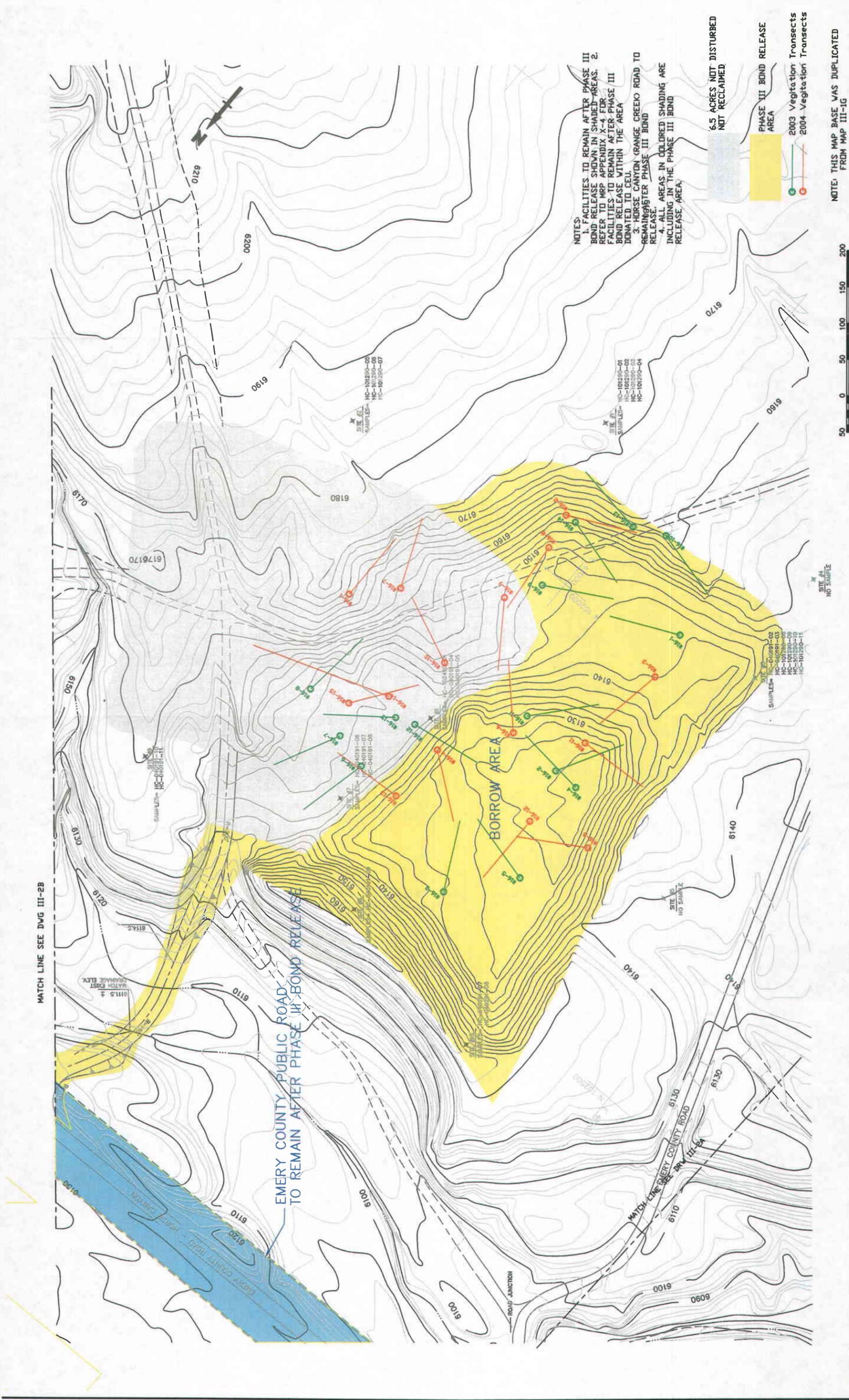
PHASE III BOND RELEASE AREAS  
HORSE CANYON MINE

JOB NO. 304-01-100

DWG. NO. III-2F

3

UTAHAMERICAN ENERGY, INC.  
P.O. BOX 986, PRICE, UTAH 84501



- NOTES:**
1. FACILITIES TO REMAIN AFTER PHASE III BOND RELEASE SHOWN IN SHADED AREAS. 2. REFER TO MRP APPENDIX X-4 FOR FACILITIES TO REMAIN AFTER PHASE III BOND RELEASE WITHIN THE AREA DONATED TO CEU.
  3. HORSE CANYON CREEK ROAD TO REMAIN AFTER PHASE III BOND RELEASE.
  4. ALL AREAS IN COLORED SHADING ARE INCLUDING IN THE PHASE III BOND RELEASE AREA.

6.5 ACRES NOT DISTURBED NOT RECLAIMED

PHASE III BOND RELEASE AREA

2003 Vegetation Transects  
2004 Vegetation Transects

NOTE: THIS MAP BASE WAS DUPLICATED FROM MAP III-1G



SCALE AS SHOWN	DATE
AS SHOWN	9-08
BY B.A. GRIMES	
FOR UTAH	
APPROVED	
DATE	

1. FOR LEGAL SIZE RATE 1/4" = 1' VOL. 1  
 2. TOPO BASED ON 1985 AERIAL PHOTO BY INTER MOUNTAIN TECHNICAL SERVICES, INC. OF GRAND JUNCTION, COLORADO.  
 3. DATUM IS 1985 SEA LEVEL.  
 4. COORDINATE SYSTEM IS NAD83 STATE LOCAL.  
 5. INTERMEDIATE AND FINAL RECLAMATION TOPOGRAPHY DESIGNED AND DEVELOPED BY OF KASER ENGINEERS, INC. 1989-1991.  
 6. COMPLIANCE TOPOGRAPHY DESIGN AND DEVELOPMENT RECEIVED AND PREPARED BY EARTHFAK ENGINEERING, INC.



NO.	DATE	REVISION	BY	APP.
1				
2				
3				
4				
5				

UTAHAMERICAN ENERGY, INC.  
 P.O. BOX 986, PRICE, UTAH 84501

PHASE III BOND RELEASE AREAS  
 HORSE CANYON MINE

MATCH LINE SEE DWG III-2B

EMERY COUNTY PUBLIC ROAD TO REMAIN AFTER PHASE III BOND RELEASE

ROAD JUNCTION

MATCH LINE SEE DWG III-2A

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NO SAMPLE

SITE #2  
SAMPLES  
HC-101250-06  
HC-101250-08  
HC-101250-07

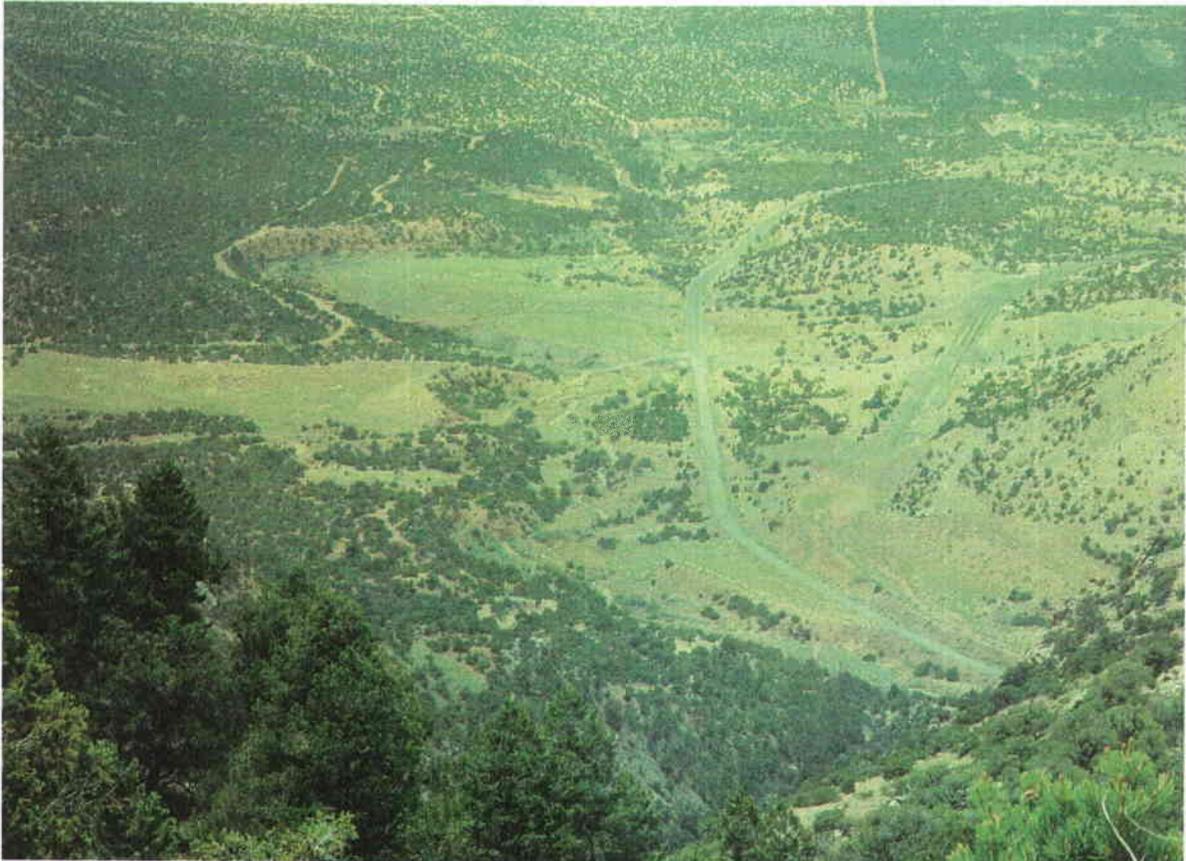
SITE #3  
SAMPLES  
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HC-101250-02  
HC-101250-03  
HC-101250-04

SITE #4  
SAMPLES  
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HC-101250-03  
HC-101250-04  
HC-101250-05  
HC-101250-06  
HC-101250-07  
HC-101250-08  
HC-101250-09  
HC-101250-10  
HC-101250-11

**Appendix III-1-5**

**Horse Canyon Vegetation Survey 2003**

# Horse Canyon Vegetation Survey - 2003



Submitted by  
**Mike King, Ph.D.**

April 15, 2004

## **Abstract**

A vegetation inventory was conducted on 6 revegetation sites on the Horse Canyon Mine property between June and August, 2003. Data were collected regarding percent cover, percent cover by species, and woody plant density at each site. Data were also collected from a reference site located on Bureau of Land Management property adjacent to mine property. Revegetated sites were compared to the reference area with respect to cover and woody plant density to determine similarity. All sites cover averages exceed the cover average for the reference site and should be judged to have satisfactorily exceeded minimum requirements with respect to cover. Woody plant density in all revegetated sites exceeded woody plant density in the reference area. Species diversity was also higher in all revegetated areas when compared to the reference area.

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## **Introduction**

In June of 2003, Dr. Mike King was contacted by UtahAmerican Energy about conducting a vegetation survey on revegetated sites of the Horse Canyon mine site located in eastern Carbon and Emery counties. Meetings were held between Dr. King and Utah American Energy and the Utah Division of Oil, Gas and Mining to discuss and determine the scope of the project. Fieldwork was initiated in June and continued through August 2003. The purpose of the study was to document vegetation condition of a reference area and 6 representative revegetated sites on the Horse Canyon Mine property. It also was conducted to fulfill the sampling requirement for year 9 of reclamation and to substantiate that the vegetation requirements were met for Phase II bond release.

The project was to include vegetation surveys of 6 revegetated sites and a reference area established in 1985 according to Utah Division of Oil, Gas, and Mining (DOG M) permitting requirements. Data collection was to include percent cover, percent cover by species, woody plant density, and species diversity for each site. Similarity indices were to be calculated between revegetated sites and the reference area to determine if the revegetation efforts have satisfactorily met prescribed revegetation standards determined as part of the Horse Canyon Mine reclamation plan.

Vegetative cover was also determined for 5 sloped areas within the revegetated sites. Data from these sites is detailed in Appendix 5.

The information below includes summary and analyses of these vegetation surveys.

## **Materials and Methods**

Six revegetation sites were selected for analysis based on previous survey work conducted on the mine property in 1995 (Table 1). These areas were selected based on revegetation treatment, slope, aspect, and general topographic similarities. The sites correspond to reclamation treatment areas in the horse Canyon Mine reclamation plan. The reference area, located adjacent to the Horse Canyon mine property on Bureau of Land Management land, was selected several years ago as the revegetation plan was established. The Vegetation Surveys were carried out according to the Division of Oil, Gas and Mining (DOG M) vegetation sampling methods (February 1992 Revised DOGM Vegetation Information Guidelines). Data collected during the surveys were used to determine ground cover, cover by species, and woody plant density. A comparison of the reference areas and revegetated areas was made to determine similarity of the 2 areas.

<b>Table 1. Horse Canyon Vegetation Survey Sites*</b>	
<b>Site Number</b>	<b>Description</b>
3	North-facing slope
6	South-facing slope
7	Rabbitbrush treatment; South-facing slope
11,13,14	Flat topography near canyon mouth
16	Borrow pit area
15, 17	Former refuse pile and landfill area
Reference Area	Mature Pinon - Juniper Woodland

\* See Appendix 3 for photographs of each site

#### Percent Cover

The point-intercept method was used to sample cover. A total of 15 - 100 ft sampling transects were run at each revegetation site to determine percent cover. Transects were located using coordinates selected from a random number table. Coordinates were paced off and a compass direction was selected using the random number table as well. Once transect start point and compass direction were established, investigators laid out a 100 ft tape in the appropriate direction and then walked the length of the tape to record vegetation. Investigators took samples at 2ft intervals along the length of the tape. A total of 50 points were recorded for each transect. Similar methods were used in the reference area except 30 transects were run rather than 15.

Cover categories included: 1) Physical Features including a) bare ground (rock or soil material less < 12 inches in diameter), b) litter (dead plant material lying on ground surface), c) rock (rock material >12 inches in diameter), 2) Cryptobiotic Soil, 3) Vegetation including a) shrubs b) forbs and succulents (cactus species), c) grasses, and d) trees. When possible, plants were identified to species level. Points were selected by viewing the transect at 2 foot intervals with an ocular viewing device with cross hairs. When there was an overhead canopy, verticle projections were made above the 100 ft tape to include the highest level of vegetation in the sample.

Adequacy of sample size was determined as per DOGM guidelines (DOGM 1992); see

Table 2. Sample adequacy for cover was met at the 90% confidence level with a 10% change in the mean as required by DOGM. Thirty transects were run in the reference area to meet the sample adequacy of 27 and to be consistent with the vegetation surveys conducted in year 5.

<b>Table 2. Minimum sample sizes</b>		
<b>Area</b>	<b>Cover</b>	<b>Woody Plant Density</b>
Reference	27.06	171.24
3	1.66	32.64
6	3.93	10.18
7	10.48	74.56
11/13/14	3.16	40.04
15/17	6.36	25.51
16	9.36	34.67

### Woody Plant Density

Woody plant densities were estimated using the belt transect method (DOGM 1992). A total of 15 - 100 ft X 10ft transects were run in each area to determine woody plant density. Transects were located using coordinates selected from a random number table. Coordinates were paced off and a compass direction was selected using the random number table as well. Once transect start point and compass direction were established, investigators walked the length of the transect and recorded species of all individual shrubs rooted in each belt. Total number of plants per acre was calculated using DOGM guidelines. Minimum sample sizes for adequacy ranged from 10 to 171 (Table 2). To keep sampling consistent and avoid excessive disturbance to sites, shrub densities were estimated using the minimum of 15 transects as was done in the year 5 Vegetation Survey.

### Similarity

Similarity of revegetated sites and the reference area with respect to species composition was determined using the Jaccard's Community Coefficient (DOGM

1992).

### Species Diversity

Species diversity lists were compiled based on data collected during cover sampling.

### Results

The survey was conducted during one of the driest years in recent history. Annual precipitation at the Sunnyside City Center weather station (approximately 7 miles north of Horse Canyon) and the Price Warehouses weather station (approximately 30 miles west of horse Canyon) was below long-term averages for both sites. The precipitation for the 2003 water year (Oct 1, 2002-Sept 31,2003) was 10.53 inches compared to the 30 year average of 13.87 inches. Similarly annual precipitation for the Price Warehouses station for the 2003 water year was 5.96 inches compared to a 25 year average of 9.3 inches (Utah Climate Center records, Utah State University, Logan, Utah). This pattern is typical of most regions in Utah due to several years of drought throughout the state. This prolonged period of reduced moisture has no doubt had an effect on plant production and survival throughout the state and the eastern Utah area.

Though plant growth was likely limited during the year, there were no signs of disease or insect damage and plants generally appeared to be in good health. Sagebrush die-off as seen around the Price, Utah area was not detected. Moderate numbers of Mormon Crickets were observed above the mine site and the revegetated areas, but none were observed in either the reference area or revegetated areas.

All areas including the reference area had been used during the previous year to some degree by livestock. Cattle sign was found in all areas, though the use was not extensive. Plants showed no signs of overgrazing. It is assumed that the used was limited to the few days livestock operators in the area moved their cattle to and from summer range in the Range Creek area. Mule deer sign was also observed in all revegetated areas as well as the reference area. Chukar partridges were heard in or near area 16 and also near area 15/17.

### Percent Cover

#### Reference Area

Cover data for the Horse Canyon reference area are included in Table 3 (data for each transect are included in Appendix 1). The average vegetation cover for the

Reference area was 32.83%. The vegetative component was comprised of 62.70% trees, 32.10% grasses, 3.00% percent shrubs, and 2.20% forbs and succulents (for relative percent vegetation for each transect see Appendix 1).

**Table 3. Horse Canyon Average Cover Summary**

Cover Type	Area						
	Ref	3	6	7	11,13,14	15,17	16
<b>Shrubs</b>	1.00	33.07	33.60	49.87	24.80	34.27	15.73
<b>Forbs</b>	0.73	6.53	0.93	1.6	1.33	1.20	8.40
<b>Grasses</b>	10.53	46.53	54.53	25.87	42.80	41.87	42.13
<b>Trees</b>	20.57	0	0	0	0	0	0
<b>Total Vegetation</b>	32.83	86.13	89.07	77.33	72.53	77.33	66.27
<b>Cryptobiotic</b>	5.4	0.13	0.53	0	0.53	0	0.13
<b>Physical Features</b>	60.60	13.73	10.13	22.27	26.93	22.67	33.60

**Area 3**

The average vegetation cover for Area 3 was 86.13%. The vegetative component was comprised of 38.40% shrubs, 7.60% forbs and succulents, and 54.00% grasses, (Appendix 1; for relative percent vegetation for each transect also see Appendix 1).

**Area 6**

The average vegetation cover for Area 6 was 89.07%. The vegetative component was comprised of 37.70% shrubs, 1.00% forbs and succulents, and 61.20% grasses, (Appendix 1; for relative percent vegetation for each transect also see Appendix 1).

**Area 7**

The average vegetation cover for Area 7 was 77.33%. The vegetative component was comprised of 64.50% shrubs, 2.10% forbs and succulents, and 33.50% grasses, (Appendix 1; for relative percent vegetation for each transect also see Appendix 1).

### **Area 11,13,14**

The average vegetation cover for Area 11/13/14 was 72.53%. The vegetative component was comprised of 34.20% shrubs, 1.80% forbs and succulents, and 59.00% grasses, (Appendix 1; for relative percent vegetation for each transect also see Appendix 1).

### **Area 15,17**

The average vegetation cover for Area 15/17 was 77.33%. The vegetative component was comprised of 42.00% shrubs, 1.60% forbs and succulents, and 54.10% grasses, (Appendix 1; for relative percent vegetation for each transect also see Appendix 1).

### **Area 16**

The average vegetation cover for Area 16 was 66.27%. The vegetative component was comprised of 23.70% shrubs, 12.70% forbs and succulents, and 63.00% grasses, (Appendix 1; for relative percent vegetation for each transect also see Appendix 1).

In order to meet the revegetation plan success standard, 90% of undisturbed reference area, each site should meet or exceed 24.90% cover. Since all sites cover averages exceed the minimum requirement, it should be judged that the treatments have been satisfactory with respect to percent cover.

## Woody Plant Density

Woody plant density data for the Horse Canyon reference area are included in Table 4 (data for each transect are included in Appendix 2).

<b>Table 4. Horse Canyon Woody Plant Densities</b>		
<b>Area</b>	<b>Average</b>	<b>90% Confidence Interval</b>
Reference	659.21	518.17 - 800.25
3	1957.30	1687.32 - 2227.28
6	3891.36	3591.86 - 4190.86
7	5180.74	4101.85 - 6295.63
11/13/14	1771.41	1501.08 - 2041.74
15/17	2625.22	2305.44 - 2945.00
16	2883.67	2474.20 - 3293.14
Revegetated Areas Average	2709.84	2080.13 - 3339.55

### Reference Area.

The Reference area was the least populated area with respect to woody plants. Including tree species, stems/acre ranged from 87.12 to 1132.56, with an average of 659.21 (90% confidence intervals are also listed in Table 4). The most predominant woody plants in the Reference area were Snakeweed (*Gutierrezia sarothrae* - 363 stems/acre, 55.1%) and Utah Juniper (*Juniperus osteosperma* - 246 stems/acre, 37.3%).

### Area 3.

Area 3 had an average stems/acre of 1957.30 (90% confidence intervals are listed in Table 4). Individual transect values ranged from 1219.68 - 3441.24. The site was dominated by Sagebrush (*Artemisia tridentata* - 676.63 stems/acre, 34.6%), Four Wing Saltbush (*Atriplex canescens* - 662.11 stems/acre, 33.8%), and Douglas Rabbitbrush (*Chrysothamnus viscidiflorus* - 482.06 stems/acre, 24.6%).

#### Area 6.

Area 6 had an average stems/acre of 3891.36 (95% confidence intervals are listed in Table 4). Individual transect values ranged from 2744.28 - 4922.28. The site was dominated by Sagebrush (*Artemisia tridentata* - 1655.28 stems/acre, 42.5%), Four Wing Saltbush (*Atriplex canescens* - 1228.39 stems/acre, 31.6%), and Douglas Rabbitbrush (*Chrysothamnus viscidiflorus* - 537.24 stems/acre, 13.8%).

#### Area 7.

Area 7 had an average stems/acre of 5180.74 (95% confidence intervals are listed in Table 4). Individual transect values ranged from 1873.08 - 11369.16. The site was dominated by Sagebrush (*Artemisia tridentata* - 3746.16 stems/acre, 72.3%) and Four Wing Saltbush (*Atriplex canescens* - 816.02 stems/acre, 15.8%).

#### Area 11,13,14.

Area 11/13/14 had an average stems/acre of 1771.44 (95% confidence intervals are listed in Table 4). Individual transect values ranged from 261.36 - 2482.92. The site was dominated by Sagebrush (*Artemisia tridentata* - 418.18 stems/acre, 23.6%) and Four Wing Saltbush (*Atriplex canescens* - 1097.71 stems/acre, 62.0%).

#### Area 15,17.

Area 15/17 had an average stems/acre of 2625.22 (95% confidence intervals are listed in Table 4). Individual transect values ranged from 1873.08 - 4181.76. The site was dominated by Sagebrush (*Artemisia tridentata* - 1193.54 stems/acre, 45.5%) and Four Wing Saltbush (*Atriplex canescens* - 1013.50 stems/acre, 38.6%).

#### Area 16.

Area 16 had an average stems/acre of 2883.67 (95% confidence intervals are listed in Table 4). Individual transect values ranged from 1418.04 - 4094.64. The site was dominated by Sagebrush (*Artemisia tridentata* - 1405.54 stems/acre, 48.7%) and Four Wing Saltbush (*Atriplex canescens* - 958.32 stems/acre, 33.2%).

#### Average of all Treatment Areas

An average was calculated combining data for all treatment areas. The average woody plant stems/acre when considering all treatment areas was 2709.84. Calculation of a

90% confidence interval indicates that we can be 90% confident that the actual mean of the population lies between 2080.13 - 3339.55 stems/acre.

With respect to woody plant density, only 2 sites clearly exceeded the standard of 3000 stems/acre established in the revegetation plan for the Horse Canyon area. Area 6 (3891.36) and Area 7 (5180.74) clearly exceeded the 3000 stems/acre standard. Area 15/17 and Area 16 were relatively close to the standard with 90% confidence that the actual mean falls between 2325.22-2945.00 and 2474.20-3293.14 respectively. Areas 3 (1957.30) and 11/13/14 (1771.41) both have averages below 2000. However, when compared to the Reference area (659.21), even areas 3 and 11/13/14 far exceed the undisturbed site with respect to woody plants/acre. Given these data, the woody plant density treatments should be characterized as relatively successful.

### **Species Diversity**

Lists of species for the Reference area and each of the revegetation sites is listed in Table 5. All comparisons show more total species in each of the revegetated sites than in the Reference area.

<b>Table 5. Species Lists for Horse Canyon Inventory Area</b>							
<b>Species</b>	<b>Site</b>						
	<b>Ref.</b>	<b>3</b>	<b>6</b>	<b>7</b>	<b>11, 13,14</b>	<b>15/ 17</b>	<b>16</b>
Shrubs							
Artemisia nova			x	x			
Artemisia tridentata		x	x	x	x	x	x
Atriplex canescens		x	x	x	x	x	x
Atriplex confertifolia					x	x	x
Ceratoides lanata			x		x	x	x
Chrysothamnus nauseosus		x	x	x	x	x	x
Chrysothamnus viscidiflorus		x	x	x	x	x	x
Cowania mexicana	x			x			
Ephedra viridis	x						
Gutierrezia sarothrae	x			x			
Sarcobatus vermiculatus					x	x	

Forbs & Succulents							
<i>Echinocereus triglochidiatus</i>	x						
<i>Medicago sativa</i>		x	x	x	x	x	x
<i>Melilotus officinalis</i>		x	x		x	x	
<i>Penstemon palmeri</i>		x	x	x			x
<i>Euphorbia fendleri</i>	x				x	x	
<i>Sisymbrium altissimum</i>			x	x			
<i>Sphaeralcia coccinea</i>	x			x			
Grasses							
<i>Agropyron cristatum</i>		x	x		x	x	x
<i>Agropyron smithii</i>			x	x	x	x	
<i>Agropyron spicatum</i>		x	x	x	x	x	x
<i>Bromus inermis</i>			x		x	x	
<i>Bromus japonicus</i>		x	x		x	x	
<i>Bromus tectorum</i>	x	x	x	x	x	x	x
<i>Elymus cinereus</i>		x	x		x	x	
<i>Elymus giganteus</i>			x		x	x	x
<i>Elymus salinus</i>	x	x	x	x	x	x	
<i>Hilaria jamesii</i>	x						
<i>Oryzopsis hymenoides</i>		x	x	x	x	x	x
<i>Sitanion hystrix</i>		x	x		x	x	x
<i>Stipa comata</i>				x	x	x	
<i>Vulpia octaflora</i>	x	x			x	x	
Trees							
<i>Juniperus osteosperma</i>	x						
<i>Pinus edulis</i>	x						
Total Species in each area	12	16	21	17	23	20	14

Also in each revegetation site there were more species with greater than 5% cover than in the Reference area. The Reference area had a total of 12 species with 2 species, Utah juniper (17%) and Salina wild rye (7%), with percent cover greater than 5%. Only 2 species, 1 tree and 1 grass, exceeded 5%.

Area 3 had a total of 16 species with 5 species, Bluebunch wheatgrass (29.2%), Fourwing saltbush (13.3%), Big sagebrush (13.3%), Basin wild rye (7.1%), and Douglas rabbitbrush (5.1%), with percent cover greater than 5%. Five species, 3 shrubs and 2 grasses, exceeded 5%.

Area 6 had a total of 21 species with 5 species, Cheat grass (27.1%), Bluebunch wheatgrass (22.9%), Fourwing saltbush (18.9%), Big sagebrush (9.9%), and Douglas rabbitbrush (5.5%), with percent cover greater than 5%. Five species, 3 shrubs and 2 grasses (one of the grasses was the undesirable Cheat grass), exceeded 5%.

Area 7 had a total of 17 species with 4 species, Cheat grass (22.1%), Bluebunch wheatgrass (22.0%), Fourwing saltbush (12.4%), and Big sagebrush (24.9%), with percent cover greater than 5%. Four species, 2 shrubs and 2 grasses (one of the grasses was the undesirable Cheat grass), exceeded 5%.

Area 11/13/14 had a total of 23 species with 4 species, Cheat grass (15.7%), Bluebunch wheatgrass (20.8%), Fourwing saltbush (14.1%), and Big sagebrush (5.7%), with percent cover greater than 5%. Four species, 2 shrubs and 2 grasses (one of the grasses was the undesirable Cheat grass), exceeded 5%.

Area 15/17 had a total of 20 species with 4 species, Cheat grass (19.1%), Bluebunch wheatgrass (18.9%), Fourwing saltbush (14.1%), and Big sagebrush (15.1%), with percent cover greater than 5%. Four species, 2 shrubs and 2 grasses (one of the grasses was the undesirable Cheat grass), exceeded 5%.

Area 16 had a total of 14 species with 4 species, Cheat grass (6.5%), Bluebunch wheatgrass (28.5%), Fourwing saltbush (5.6%), and Alfalfa (6.7%), with percent cover greater than 5%. Four species, 1 shrub, 2 grasses (one of the grasses was the undesirable Cheat grass), and 1 forb (alfalfa), exceeded 5%.

Species diversity with respect to percent cover by species is recorded in Table 6 for each site.

<b>Table 6. Species Diversity Tables</b>			
<b>Reference Area (12 total species)</b>		<b>Area 3 (16 total species)</b>	
	<b>Species (% cover)</b>		<b>Species (% cover)</b>
> 20 %		> 20%	Agropyron spicatum (29.2)
10 - 20%	Juniperus osteosperma (17.0)	10 - 20%	Atriplex canescens (13.3)
			Artemisia tridentata (13.3)
5 - 10 %	Elymus salinus (7.0)	5 - 10 %	Elymus cinereus (7.1)
			Chrysothamnus viscidiflorus (5.1)
1 - 5%	Pinus edulis (4.0)	1 - 5%	Bromus tectorum (4.1)
	Bromus tectorum (2.0)		Medicago satvia (3.5)
	Gutierrezia sarothrae (1.0)		Melilotus officianalis (1.6)
	Hilaria jamesii (1.0)		Agropyron cristatum (1.5)
	Sphaeralcia coccinea (1.0)		Chrysothamnus nauseosus (1.2)
			Sitanion hystrix (1.1)
< 1%	Vulpia octaflora (0.3)	< 1%	Oryzopsis hymenoides (0.9)
	Epehdra viridis (0.2)		Penstemon palmeri (0.8)
	Euphorbia fendleri (0.1)		Bromus japonicus (0.3)
	Cowania mexicana (0.1)		Elymus salinus (0.3)
	Echinocereus triglochidiatus (0.1)		Vulpia octaflora (0.1)

<b>Table 6. Species Diversity Tables (cont.)</b>			
<b>Area 6 (21 total species)</b>		<b>Area 7 (17 total species)</b>	
	<b>Species (% cover)</b>		<b>Species (% cover)</b>
> 20 %	Bromus tectorum (27.1)	> 20%	Artemisia tridentata (24.9)
	Agropyron spicatum (22.9)		Bromus tectorum (22.0)
10 - 20%	Atriplex canescens (12.4)	10 - 20%	Atriplex canescens (18.9)
5 - 10 %	Artemisia tridentata (9.9)	5 - 10 %	
	Chrysothamnus viscidiflorus (5.5)		
1 - 5%	Artemisia nova (1.9)	1 - 5%	Chrysothamnus viscidiflorus (4.0)
	Ceratoides lanata (1.6)		Agropyron spicatum (2.0)
			Artemisia nova (1.1)
< 1%	Elymus cinereus (0.8)	< 1%	Stipa comata (0.9)
	Oryzopsis hymenoides (0.7)		Elymus salinus (0.7)
	Chrysothamnus nauseosus (0.5)		Sisymbrium altissimum (0.5)
	Penstemon palmeri (0.4)		Medicago sativa (0.5)
	Elymus gigantius (0.3)		Sphaeralicia coccinea (0.3)
	Elymus salinus (0.3)		Cowania mexicana (0.3)
	Sitanion hystrix (0.3)		Oryzopsis hymenoides (0.3)
	Sisymbrium altissima (0.3)		Gutierrezia sarothrae (0.1)
	Bromus japonicus (0.1)		Penstemon palmeri (0.1)
	Bromus inermis (0.1)		Chrysothamnus nauseosus (0.1)
	Agropyron cristatum (0.1)		Agropyron smithii (0.1)
	Agropyron smithii (0.1)		
	Medicago sativa (0.1)		
	Melilotus officinalis (0.1)		

<b>Table 6. Species Diversity Tables (cont.)</b>			
<b>Area 11/13/14 (23 total species)</b>		<b>Area 15/17 (20 total species)</b>	
	<b>Species (% cover)</b>		<b>Species (% cover)</b>
> 20 %	Agropyron spicatum (20.8)	> 20%	
10 - 20%	Bromus tectorum (15.7)	10 - 20%	Bromus tectorum (19.1)
	Atriplex canescens (14.1)		Agropyron spicatum (18.9)
			Artemisia tridentata (15.1)
			Atriplex canescens (14.1)
5 - 10 %	Artemisia tridentata (5.7)	5 - 10 %	
1 - 5%	Chrysothamnus nauseosus (2.4)	1 - 5%	Sarcobatus vermiculatus (2.1)
	Atriplex confertifolia (1.7)		Chrysothamnus nauseosus (1.1)
	Chrysothamnus viscidifloris (1.6)		
	Gutierrezia sarothrae (1.6)		
	Oryzopsis hymenoides (1.3)		
< 1%	Medicago sativa (0.8)	< 1%	Stipa comata (0.9)
	Ceratoides lanata (0.7)		Oryzopsis hymenoides (0.8)
	Agropyron cristatum (0.7)		Elymus cinereus (0.7)
	Elymus cinerius (0.7)		Medicago sativa (0.7)
	Agropyron smithii (0.5)		Elymus salinus (0.5)
	Elymus giganteus (0.5)		Ceratoides lanata (0.4)
	Sitanion hystrix (0.5)		Melilotus officinalis (0.4)
	Elymus salinus (0.4)		Atriplex confertifolia (0.4)
	Stipa comata (0.4)		Agropyron smithii (0.3)
	Vulpia octiflora (0.3)		Bromus japonicus (0.3)
	Bromus inermis (0.1)		Sphaeralcia coccinea (0.1)
	Bromus japonicus (0.1)		Gutierrezia sarothrae (0.1)
	Medicago officinalis (0.1)		Chrysothamnus viscidifloris (0.1)
	Euphorbia fendleri (0.1)		Bromus inermis (0.1)

<b>Table 6. Species Diversity Tables (cont.)</b>	
<b>Area 16 (14 total species)</b>	
	<b>Species (% cover)</b>
> 20 %	Agropyron spicatum (28.5)
10 - 20%	
5 - 10 %	Medicago satvia (6.7)
	Bromus tectorum (6.5)
	Atriplex canescens (5.6)
1 - 5%	Artemisia tridentata (4.7)
	Chrysothamnus nauseosus (1.6)
	Elymus giganteus (1.2)
	Atriplex confertifolia (1.1)
< 1%	Penstemon palmeri (0.4)
	Chrysothamnus viscidifloris (0.1)
	Ceratoides lanata (0.1)
	Oryzopsis hymenoides (0.1)
	Agropyron cristatum (0.1)
	Sitanion hystrix (0.1)

Targets for revegetated areas were to have 3 shrubs, 2 grasses, and 1 forb with % cover above 5%. These targets are not reached with respect to forbs in any area with the exception of Area 16. However, the forb which exceeded 5% cover was alfafa, part of the revegetation seed mixture, but not a native species and probably should not be considered.

### **Similarity**

Comparisons of similarity made between the Reference area and revegetated sites indicates that there are only minor similarities between the revegetated sites and the Reference area (Table 7). Similarity coefficients ranged from 4.0 to 20.8. Similarity is strong when values approach 100. Given the revegetation treatments, it is not surprising

that the areas are dissimilar with respect to species.

<b>Table 7. Similarity Comparisons - Cover</b>				
Site	Number of Species in Reference Area	Number of Species in Revegetation Site	Number of Species Common to both	Similarity Coefficient
Area 3	12	16	3	12.0
Area 6	12	21	2	6.5
Area 7	12	17	5	20.8
Area 11/13/14	12	23	3	9.4
Area 15/17	12	20	4	14.3
Area 16	12	14	1	4.0

Areas were also different with respect to overall vegetation cover. In each instance, the revegetated areas were more densely vegetated than the reference area. The average percent cover for the Reference area was 32.83%. Percent vegetation cover for the revegetation sites ranged from 66.27% to 89.07% (Table 3).

## References

- Anderson, B. Desert Plants of Utah. EC 376. Cooperative Extension Service, Utah State University, Logan, UT. 146 pp.
- DOGM 1992. Vegetation Information Guidelines. Utah Division of Oil, Gas, and Mining. Salt Lake City, UT.
- Parker, K. G., L. R. Mason, and J. F. Valentine. Utah Grasses. EC 384. Cooperative Extension Service, Utah State University, Logan, UT. 69 pp.
- Welsch, S. L. and G. Moore. 1973. Utah Plants. Brigham Young University Press. Provo, UT. 474 pp.
- Utah Climate Center. January 2004. Utah State University, Logan, Utah.

# **Appendix 1**

## **Percent Cover Data**

## **Appendix 2**

### **Woody Plant Density Data**

## **Appendix 3**

### **Diversity and Similarity Data**

## **Appendix 4**

### **Site Photographs**

## **Appendix 5**

### **Sloped Areas Cover Data**



**Reference Area Cover Data**

































Plant Species	January										February										March										April										Total	Percent Cover	Relative Vegetation Cover																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40				41	42	43	44	45	46	47	48	49	50								
<i>Agrostis capillaris</i>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	0	0	0	0	0	0	0	0	0	0	
<i>Agrostis canadensis</i>																																																				0	0	0	0	0	0	0	0	0	0
<i>Agrostis comperata</i>																																																				0	0	0	0	0	0	0	0	0	0
<i>Agrostis exaristata</i>																																																				0	0	0	0	0	0	0	0	0	0
<i>Agrostis hyemalis</i>																																																				0	0	0	0	0	0	0	0	0	0
<i>Agrostis spicata</i>																																																				0	0	0	0	0	0	0	0	0	0
<i>Agrostis stricta</i>																																																				0	0	0	0	0	0	0	0	0	0
<i>Agrostis trichophylla</i>																																																				0	0	0	0	0	0	0	0	0	0
<i>Agrostis setacea</i>																																																				0	0	0	0	0	0	0	0	0	0
<i>Agrostis exaristata</i>																																																				0	0	0	0	0	0	0	0	0	0
<i>Agrostis setacea</i>																																																				0	0	0	0	0	0	0	0	0	0
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<i>Agrostis setacea</i>																																																				0	0	0	0	0	0	0	0	0	0
<i>Agrostis setacea</i>																																																				0	0	0	0	0	0	0	0	0	0
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### Area 3 Cover Summary

Cover Type	Transect #															Site Average	Std. Dev.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
Shrubs	36	24	32	32	10	32	22	34	26	20	50	42	56	42	38	33.07	11.85
Forbs	2	2	4	6	4	6	20	4	6	10	0	2	8	10	14	6.53	5.26
Grasses	56	58	42	52	78	46	42	56	54	44	28	48	24	30	40	46.53	13.64
Trees	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Vegetation	94	84	78	90	92	84	84	94	86	74	78	92	88	82	92	86.13	6.30
Cryptobiotic	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0.13	.52
Physical Features	6	16	22	10	8	14	16	6	14	26	22	8	12	18	8	13.73	6.27

### Area 6 Cover Summary

Cover Type	Transect #															Site Average	Std. Dev.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
Shrubs	28	32	38	28	26	30	50	36	32	44	30	38	34	34	24	33.60	6.90
Forbs	2	0	0	2	0	0	0	0	0	0	0	6	4	0	0	0.93	1.83
Grasses	66	62	52	58	68	56	48	62	68	46	54	44	46	24	64	54.53	11.80
Trees	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Vegetation	96	94	90	88	94	86	98	98	100	90	84	88	84	58	88	89.07	10.02
Cryptobiotic	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0.53	2.07
Physical Features	4	6	10	12	6	14	2	2	0	10	16	12	16	30	12	10.13	7.54

# Area 11/13/14 Cover Summary

Cover Type	Transect #															Site Average	Std. Dev.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
Shrubs	64	46	40	50	52	48	44	48	46	34	40	62	60	66	48	49.87	9.40
Forbs	0	0	6	2	0	2	2	4	0	0	2	0	4	0	2	1.6	1.88
Grasses	26	24	10	10	8	30	8	24	40	52	48	24	20	22	42	25.87	14.27
Trees	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Vegetation	90	70	56	62	60	80	54	76	86	86	90	86	84	88	92	77.33	13.41
Cryptobiotic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physical Features	10	30	38	38	40	20	46	24	14	14	10	14	16	12	8	22.27	12.80

# Area 11/13/14 Cover Summary

Cover Type	Transect #															Site Average	Std. Dev.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
Shrubs	14	24	36	46	38	22	28	32	30	22	32	28	28	8	38	24.80	9.66
Forbs	0	4	2	0	2	0	0	4	6	2	0	0	0	0	0	1.33	1.95
Grasses	64	30	50	30	32	42	34	30	32	54	62	50	40	58	34	42.80	12.44
Trees	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Vegetation	78	58	88	76	72	64	62	66	68	78	94	78	68	66	72	72.53	9.72
Cryptobiotic	0	0	0	2	0	0	0	2	0	4	0	0	0	0	0	0.53	1.19
Physical Features	22	42	12	22	28	36	38	32	32	18	6	22	32	34	28	26.93	9.91

# Area 15/17 Cover Summary

Cover Type	Transect #															Site Average	Std. Dev.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
Shrubs	42	14	38	40	36	42	46	52	50	36	22	24	14	28	30	34.27	11.97
Forbs	0	4	0	0	0	2	0	0	0	0	2	6	2	0	2	1.20	1.82
Grasses	34	44	42	42	44	38	32	28	40	50	42	48	60	36	48	41.87	7.95
Trees	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Vegetation	76	62	80	82	80	82	78	80	90	86	66	78	76	64	80	77.33	7.81
Cryptobiotic	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physical Features	24	38	20	18	20	18	22	20	10	14	34	22	24	36	20	22.67	7.81

# Area 16 Cover Summary

Cover Type	Transect #															Site Average	Std. Dev.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
Shrubs	16	22	28	26	18	14	8	22	2	20	4	12	4	20	20	15.73	8.17
Forbs	0	0	20	12	20	12	16	14	0	8	0	4	4	2	14	8.4	7.45
Grasses	48	32	36	30	40	24	40	18	62	44	56	38	82	42	40	42.13	15.68
Trees	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Vegetation	64	54	84	68	78	50	64	54	64	72	60	54	90	64	74	66.27	11.61
Cryptobiotic	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	.13	.52
Physical Features	36	46	16	32	22	50	34	46	36	28	40	46	10	36	26	33.60	11.59

**Area 3 Cover Data**





























































**Area 6 Cover Data**



Date: 3/23/03	Horse Canyon Investigation Project Tally Sheet																				Relative Vegetative Cover																														
	UTM: 32S 5742N 83R 03S										Headings: 0																																								
Area: 7	Transect 2										Transect 3										Total	Percent Cover	Relative Vegetative Cover																												
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50																																																			
Plant Species																																																			
<i>Atriplex canescens</i>																																																			17.14
<i>Atriplex confertifolia</i>																																																			0.00
<i>Artemisia nova</i>																																																			0.00
<i>Artemisia tridentata</i>																																																			6.71
<i>Chrysothamnus nauseosus</i>																																																			31.43
<i>Chrysothamnus viscidiflorus</i>																																																			0.00
<i>Covardia medicana</i>																																																			8.57
<i>Cercidiphyllum</i>																																																			0.00
<i>Ephedra viridis</i>																																																			0.00
<i>Sarcobatus vermiculatus</i>																																																			0.00
<i>Gutierrezia sarothrae</i>																																																			2.86
<b>Total Grasses Cover</b>																																																			68.71
<b>SPERMATOPHYTES</b>																																																			
<i>Neochloa eriantha</i>																																																			0.00
<i>Medicago sativa</i>																																																			0.00
<i>Trifolium officinale</i>																																																			0.00
<i>Pennisetum palmifolium</i>																																																			0.00
<i>Sphaeralcea coccinea</i>																																																			0.00
<b>Total Forb Cover</b>																																																			0.00
<b>GRASSES</b>																																																			
<i>Agropyron smithii</i>																																																			0.00
<i>Agropyron spicatum</i>																																																			0.00
<i>Agropyron cristatum</i>																																																			0.00
<i>Agropyron trichosperum</i>																																																			0.00
<i>Bromus tectorum</i>																																																			0.00
<i>Elymus salinus</i>																																																			20.00
<i>Elymus cinereus</i>																																																			14.29
<i>Elymus giganteus</i>																																																			0.00
<i>Festuca tenax</i>																																																			0.00
<i>Cryptantha hymenoides</i>																																																			0.00
<i>Stipa lysichia</i>																																																			0.00
<i>Stipa comata</i>																																																			0.00
<b>Total Grasses Cover</b>																																																			34.29
<b>Trees</b>																																																			
<i>Juniper</i>																																																			0.00
<i>Pinus</i>																																																			0.00
<b>Total Tree Cover</b>																																																			0.00
<b>Total Vegetation Cover</b>																																																			103.00
<b>Cryptogams</b>																																																			
<b>Physical Features</b>																																																			
<i>Litter</i>																																																			0.00
<i>Rock</i>																																																			0.00
<i>Bare Ground</i>																																																			0.00
<b>Total Physical Features</b>																																																			0.00
<b>Comments:</b>																																																			









**Area 7 Cover Data**



















**Area 11/13/14 Cover Data**































**Area 15/17 Cover Data**























Date: 8/19/03	Area: 15477												Transect: 12												UTM: 5595864387120												Heading: 01												Percent Cover	Relative Vegetative Cover		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48			49	50
Plant Species																																																				
<i>Shrubs</i>																																																				
<i>Albizia canescens</i>																																																				
<i>Albizia confertifolia</i>																																																				
<i>Azadirachta indica</i>																																																				
<i>Artemisia tridentata</i>																																																				
<i>Chrysothamnus nauseosus</i>																																																				
<i>Chrysothamnus viscidiflorus</i>																																																				
<i>Covillea mexicana</i>																																																				
<i>Ceratoides lincea</i>																																																				
<i>Ephedra viridis</i>																																																				
<i>Sarcobatus vermiculatus</i>																																																				
<i>Gutierrezia serotina</i>																																																				
<b>Total Shrubs Cover</b>																																																				
<i>Forbs &amp; Grasses</i>																																																				
<i>Hesperomithris canescens</i>																																																				
<i>Medicago sativa</i>																																																				
<i>Parthenocissus palmifolia</i>																																																				
<i>Sphaeralcea coccinea</i>																																																				
<b>Total Forb Cover</b>																																																				
<i>Grasses</i>																																																				
<i>Agropyron amabilis</i>																																																				
<i>Agropyron cristatum</i>																																																				
<i>Agropyron cristatum</i>																																																				
<i>Agropyron trachypachum</i>																																																				
<i>Bromus tectorum</i>																																																				
<i>Elymus salinus</i>																																																				
<i>Elymus cinereus</i>																																																				
<i>Elymus biflorus</i>																																																				
<i>Hilaria jamesii</i>																																																				
<i>Cynopsis hymenoides</i>																																																				
<i>Stanton lynchii</i>																																																				
<i>Sida acuta</i>																																																				
<i>Bromus horridus</i>																																																				
<b>Total Grass Cover</b>																																																				
<i>Tree</i>																																																				
<i>Juniper</i>																																																				
<i>Pinon</i>																																																				
<b>Total Tree Cover</b>																																																				
<b>Total Vegetation Cover</b>																																																				
<i>Cryptobiotic</i>																																																				
<i>Physical Features</i>																																																				
<i>Litter</i>																																																				
<i>Rock</i>																																																				
<i>Bare Ground</i>																																																				
<b>Total Physical Features</b>																																																				
<b>Comments:</b>																																																				
Hesperomithris canescens, Elymus cinereus present, signs of cattle - last year																																																				







**Area 16 Cover Data**























Date: 8/18/83	Area: 16												Transect: 12												Heading: 251												Relative Vegetative Cover														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36		37	38	39	40	41	42	43	44	45	46	47	48	49	50
Plant Species																																																			
<i>Stipa</i>																																																			
<i>Artemisia tridentata</i>																																																			
<i>Chrysothamnus nauseosus</i>																																																			
<i>Chrysothamnus viscidiflorus</i>																																																			
<i>Croton leucanthemus</i>																																																			
<i>Ephedra viridis</i>																																																			
<i>Gutierrezia sarothrae</i>																																																			
<b>Total Shrub Cover</b>																																																			12
<i>Stipa A. Breweri</i>																																																			
<i>Melilotus alba</i>																																																			
<i>Penstemon palmeri</i>																																																			
<i>Sphaeralcea obtusicaulis</i>																																																			
<b>Total Herb Cover</b>																																																			4
<b>Total Grass Cover</b>																																																			74.1
<i>Agropyron smithii</i>																																																			
<i>Agropyron spicatum</i>																																																			
<i>Agropyron ciliatum</i>																																																			
<i>Agropyron trichosperum</i>																																																			
<i>Bromus tectorum</i>																																																			
<i>Elymus salinus</i>																																																			
<i>Elymus cinereus</i>																																																			
<i>Elymus giganteus</i>																																																			
<i>Hesperis matronalis</i>																																																			
<i>Cryptantha hymenocoides</i>																																																			
<i>Silene spaldingii</i>																																																			
<i>Sida acuta</i>																																																			
<b>Total Grass Cover</b>																																																			70.37
<b>Total Tree Cover</b>																																																			0.00
<b>Total Vegetation Cover</b>																																																			74.1
<b>Physical Features</b>																																																			
Liiter																																																			
Rock																																																			
Bare Ground																																																			
<b>Physical Features</b>																																																			
Comments:																																																			







**Appendix 2**

**Woody Plant Density Data**

### Horse Canyon Woody Plant Density Comparisons

<b>Site</b>	<b>Average Plants per Acre</b>	<b>St. Deviation</b>
<b>Reference Area</b>	659.21	332.10
<b>Area 3</b>	1957.30	634.98
<b>Area 6</b>	3891.36	705.21
<b>Area 7</b>	5180.74	2540.36
<b>Area 11/13/14</b>	1771.44	636.52
<b>Area 15/17</b>	2626.22	752.95
<b>Area 16</b>	2883.67	964.13















## **Appendix 3**

### **Diversity and Similarity Data**

## Horse Canyon Similarity Comparisons - Reference Area & Area 3

Reference Area			Area 3		
Species	Frequency (per 30 transects)	% Cover (per 1500 points)	Species	Frequency (per 15 transects)	% Cover (per 750 points)
Juniper	26	17.0	Juniper	0	0.0
Salina wild rye	24	7.0	Salina wild rye	2	0.3
Pinyon	13	4.0	Pinyon	0	0.0
Cheat grass	5	2.0	Cheat grass	8	4.1
Globe mallow	3	1.0	Globe mallow	0	0.0
Snake weed	9	1.0	Snake weed	0	0.0
Galleta	8	1.0	Galleta	0	0.0
Six weeks fescue	4	0.3	Six weeks fescue	1	0.1
Ephedra	3	0.2	Ephedra	0	0.0
Purple	2	0.1	Purple	0	0.0
Cliffrose	1	0.1	Cliffrose	0	0.0
Hedgehog cactus	1	0.1	Hedgehog cactus	0	0.0
<b>Similarity Comparison</b>			Bluebunch wheatgrass	14	29.2
Reference Area: 12 species (A)			Fourwing	15	13.3
Area 3: 16 species (B)			Sagebrush	15	13.3
Common species: 3 (C)			Basin wild rye	13	7.1
Jaccard's Community Coefficient:			Douglas rabbitbrush	10	5.1
$S = C / (A + B - C)$			Alfalfa	9	3.5
$S = 3 / (12 + 16 - 3)$			Yellow sweet clover	6	1.6
$S = 12.0$			Crested wheatgrass	3	1.5
			Squirreltail	5	1.1
			Indian rice grass	6	0.9
			Palmer penstemon	4	0.8
			Japanese brome	1	0.3
			Big rabbitbrush	6	1.2
<b>12 Total species; 2 species &gt;5% cover</b>			<b>16 total species; 5 species &gt;5%</b>		

## Horse Canyon Similarity Comparisons - Reference Area & Area 6

Reference Area			Area 6		
Species	Frequency (per 30 transects)	% Cover (per 1500 points)	Species	Frequency (per 15 transects)	% Cover (per 750 points)
Juniper	26	17.0	Juniper	0	0.0
Salina wild rye	24	7.0	Salina wild rye	1	0.3
Pinyon	13	4.0	Pinyon	0	0.0
Cheat grass	5	2.0	Cheat grass	15	27.1
Globe mallow	3	1.0	Globe mallow	0	0.0
Snake weed	9	1.0	Snake weed	0	0.0
Galleta	8	1.0	Galleta	0	0.0
Six weeks fescue	4	0.3	Six weeks fescue	0	0.0
Ephedra	3	0.2	Ephedra	0	0.0
Purple	2	0.1	Purple	0	0.0
Cliffrose	1	0.1	Cliffrose	0	0.0
Hedgehog cactus	1	0.1	Hedgehog cactus	0	0.0
<b>Similarity Comparison</b>			Bluebunch wheatgrass	15	22.9
Reference Area: 12 species (A)			Fourwing	14	12.4
Area 6: 21 species (B)			Sagebrush	13	9.9
Common species: 2 (C)			Douglas rabbitbrush	9	5.5
Jaccard's Community Coefficient:			Winterfat	8	1.6
$S = C / (A + B - C)$			Basin wild rye	3	0.8
$S = 2 / (12 + 21 - 2)$			Alfalfa	1	0.1
$S = 6.50$			Yellow sweet clover	1	0.1
			Crested wheatgrass	1	0.1
			Squirreltail	1	0.3
			Indian rice grass	2	0.7
			Palmer penstemon	1	0.4
			Japanese brome	1	0.1
			Smooth brome	1	0.1
			Big rabbitbrush	3	0.5
			Western wheat grass	1	0.1
			Tumble mustard	1	0.3
			Black sagebrush	3	1.9

	Giand wild rye	1	0.3
12 Total species; 2 species >5% cover	21 Total species; 5 species >5% cover		

## Horse Canyon Similarity Comparisons - Reference Area & Area 7

Reference Area			Area 7		
Species	Frequency (per 30 transects)	% Cover (per 1500 points)	Species	Frequency (per 15 transects)	% Cover (per 750 points)
Juniper	26	17.0	Juniper	0	0.0
Salina wild rye	24	7.0	Salina wild rye	1	0.7
Pinyon	13	4.0	Pinyon	0	0.0
Cheat grass	5	2.0	Cheat grass	15	22.0
Globe mallow	3	1.0	Globe mallow	2	0.3
Snake weed	9	1.0	Snake weed	1	0.1
Galleta	8	1.0	Galleta	0	0.0
Six weeks fescue	4	0.3	Six weeks fescue	0	0.0
Ephedra	3	0.2	Ephedra	0	0.0
Purple	2	0.1	Purple	0	0.0
Cliffrose	1	0.1	Cliffrose	2	0.3
Hedgehog cactus	1	0.1	Hedgehog cactus	0	0.0
<b>Similarity Comparison</b>			Bluebunch wheatgrass	15	2.0
Reference Area: 12 species (A)			Fourwing	15	18.9
Area 7: 17 species (B)			Sagebrush	15	24.9
Common species: 5 (C)			Douglas rabbitbrush	12	4.4
Jaccard's Community Coefficient:			Alfalfa	3	0.5
$S = C / (A + B - C)$			Needle and Thread	4	0.9
$S = 5 / (12 + 17 - 5)$			Indian rice grass	2	0.3
$S = 20.80$			Palmer penstemon	1	0.1
			Big rabbitbrush	1	0.1
			Western wheat grass	1	0.1
			Tumble mustard	4	0.5
			Black sagebrush	4	1.1
<b>12 Total species; 2 species &gt;5% cover</b>			<b>17 Total species; 3 species &gt;5% cover</b>		

## Horse Canyon Similarity Comparisons - Reference Area & Area 11/13/14

Reference Area			Area 11/13/14		
Species	Frequency (per 30 transects)	% Cover (per 1500 points)	Species	Frequency (per 15 transects)	% Cover (per 750 points)
Juniper	26	17.0	Juniper	0	0.0
Salina wild rye	24	7.0	Salina wild rye	2	0.4
Pinyon	13	4.0	Pinyon	0	0.0
Cheat grass	5	2.0	Cheat grass	13	15.7
Globe mallow	3	1.0	Globe mallow	0	0.0
Snake weed	9	1.0	Snake weed	0	0.0
Galleta	8	1.0	Galleta	0	0.0
Six weeks fescue	4	0.3	Six weeks fescue	0	0.0
Ephedra	3	0.2	Ephedra	0	0.0
Purple	2	0.1	Purple	1	0.1
Cliffrose	1	0.1	Cliffrose	0	0.0
Hedgehog cactus	1	0.1	Hedgehog cactus	0	0.0
<b>Similarity Comparison</b>			Bluebunch wheatgrass	15	20.8
Reference Area: 12 species (A)			Fourwing	13	14.1
Area 11/13/14: 23 species (B)			Sagebrush	12	5.7
Common species: 3 (C)			Douglas rabbitbrush	5	1.6
Jaccard's Community Coefficient:			Winterfat	5	0.7
$S = C / (A + B - C)$			Alfalfa	4	0.8
$S = 3 / (12 + 23 - 3)$			Needle and Thread	1	0.4
$S = 9.4$			Indian rice grass	6	1.3
			Shadscale	3	1.7
			Big rabbitbrush	6	2.4
			Greasewood	2	1.6
			Crested wheatgrass	2	0.7
			Basin wild rye	3	0.7
			Western wheatgrass	3	0.5
			Giant rye grass	3	0.5
			Squirrel tail	2	0.5
			Six weeks fescue	2	0.3

	Smooth brome	1	0.1
	Japanese brome	1	0.1
	Yellow sweet clover	1	0.1
<b>12 Total species; 2 species &gt;5% cover</b>		<b>23 Total species; 4 species &gt;5% cover</b>	

## Horse Canyon Similarity Comparisons - Reference Area & Area 15/17

Reference Area			Area 15/17		
Species	Frequency (per 30 transects)	% Cover (per 1500 points)	Species	Frequency (per 15 transects)	% Cover (per 750 points)
Juniper	26	17.0	Juniper	0	0.0
Salina wild rye	24	7.0	Salina wild rye	1	0.5
Pinyon	13	4.0	Pinyon	0	0.0
Cheat grass	5	2.0	Cheat grass	13	19.1
Globe mallow	3	1.0	Globe mallow	1	0.1
Snake weed	9	1.0	Snake weed	1	0.1
Galleta	8	1.0	Galleta	0	0.0
Six weeks fescue	4	0.3	Six weeks fescue	0	0.0
Ephedra	3	0.2	Ephedra	0	0.0
Purple	2	0.1	Purple	0	0.0
Cliffrose	1	0.1	Cliffrose	0	0.0
Hedgehog cactus	1	0.1	Hedgehog cactus	0	0.0
<b>Similarity Comparison</b>			Bluebunch wheatgrass	15	18.9
Reference Area: 12 species (A)			Fourwing	15	14.1
Area 15/17: 20 species (B)			Sagebrush	15	15.1
Common species: 4 (C)			Douglas rabbitbrush	1	0.1
Jaccard's Community Coefficient:			Winterfat	2	0.4
$S = C / (A + B - C)$			Alfalfa	4	0.7
$S = 4 / (12 + 20 - 4)$			Needle and Thread	2	0.9
$S = 14.30$			Indian rice grass	3	0.8
			Shadscale	3	0.4
			Big rabbitbrush	5	1.1
			Greasewood	7	2.1
			Basin wild rye	4	0.7
			Western wheatgrass	2	0.3
			Yellow sweet clover	3	0.4
			Smooth brome	1	0.1
			Japanese brome	2	0.3
<b>12 Total species; 2 species &gt;5% cover</b>			<b>20 Total species; 4 species &gt;5% cover</b>		



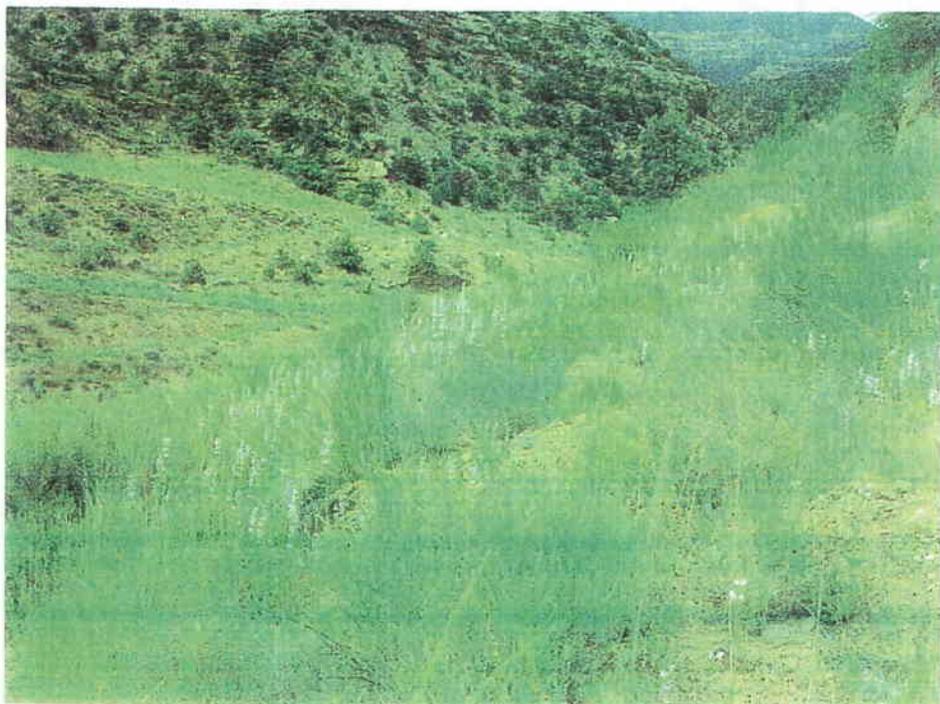
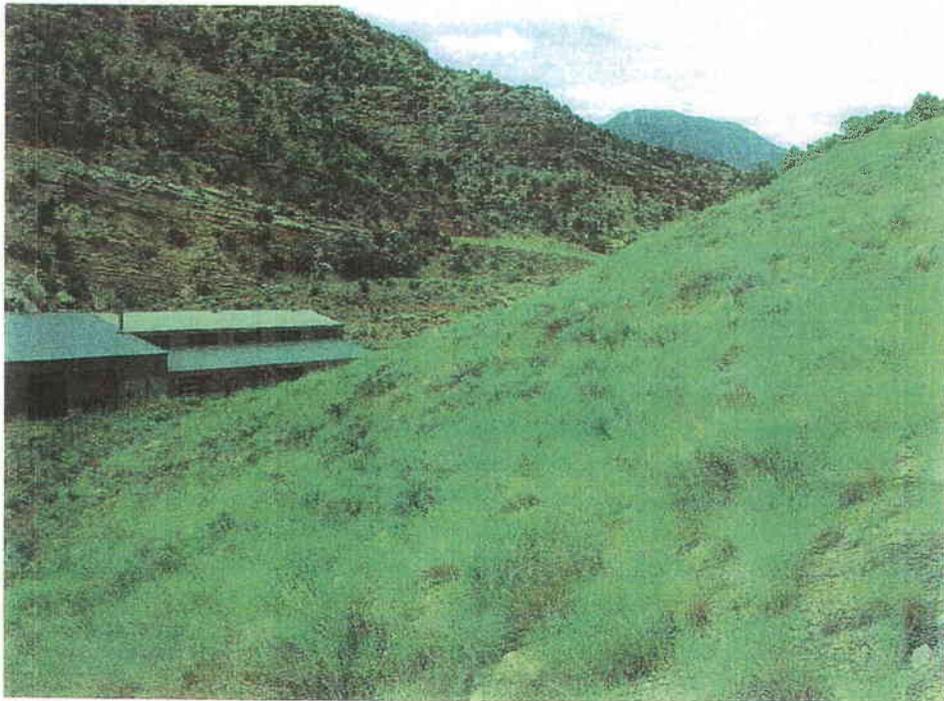


## **Appendix 4**

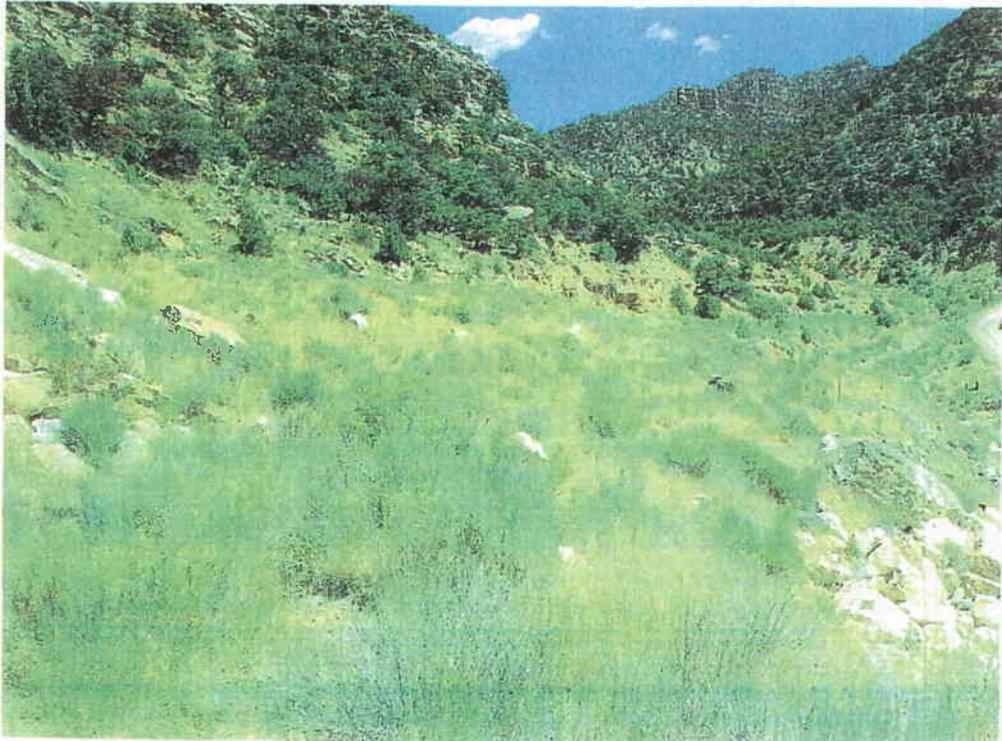
### **Site Photographs**



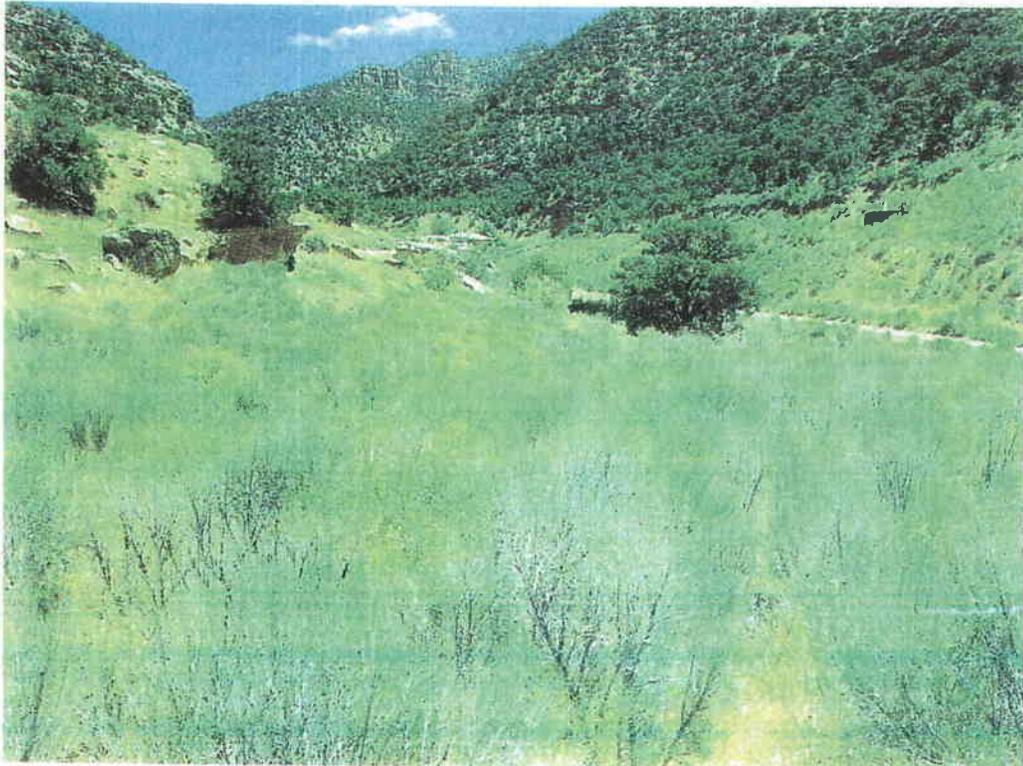
**Area 3**



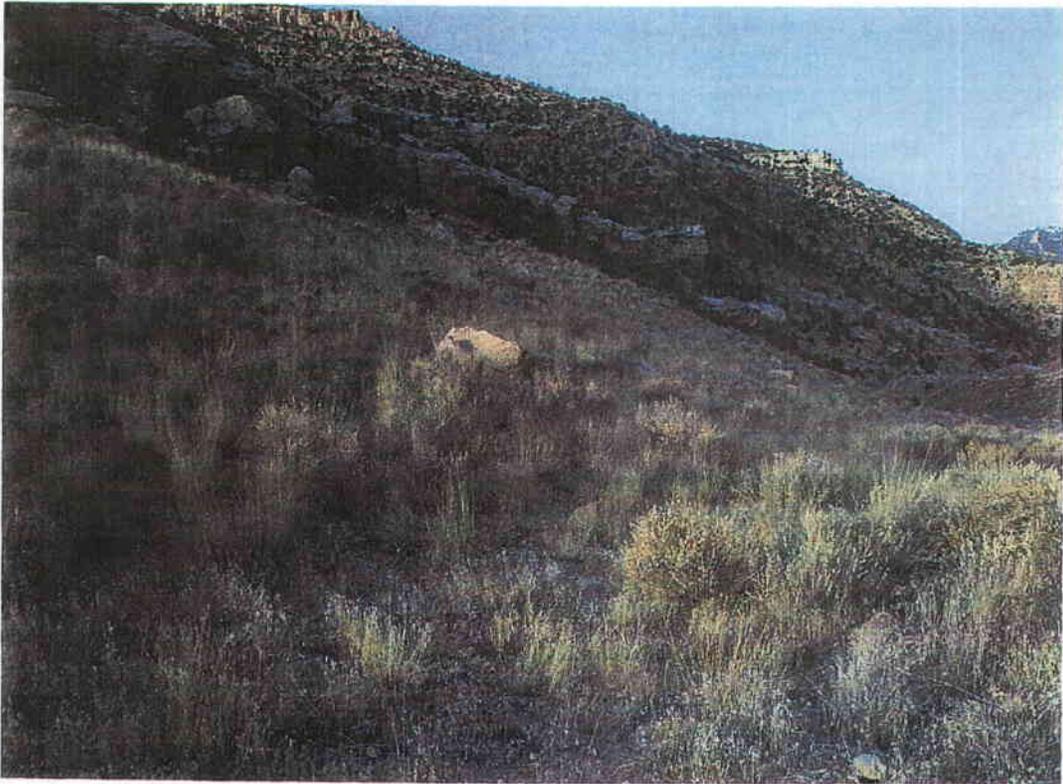
## Area 6



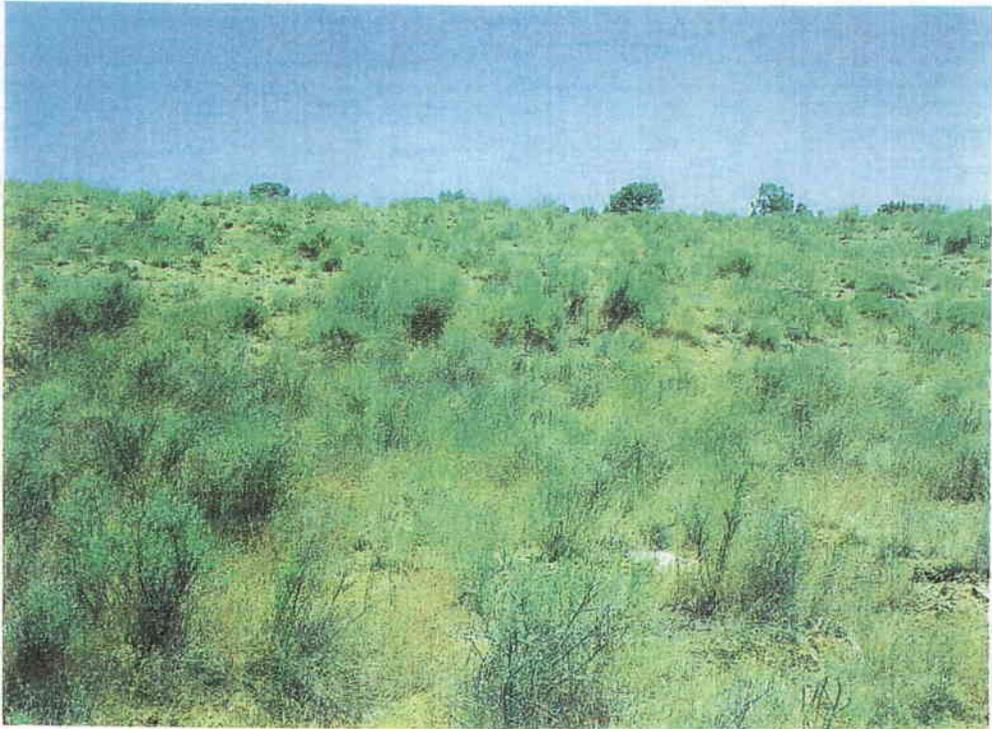
**Area 7**



**Area 11/13/14**



**Area 16**



**Area 15/17**





## **Appendix 5**

### **Sloped Areas Cover Data**



## **Slopes Cover**

UtahAmerican Energy asked for a survey of percent cover for 5 sloped areas on the Horse Canyon Mine property. The 5 survey areas were 1) sloped areas around the portal area (Portal Slopes Area) , 2) sloped areas on the north-facing slope above the mine buildings (Area 3 Slopes Area), 3), sloped areas immediately adjacent to the fence on the south side of the mine buildings (Fence Slopes Area) 4) sloped areas surrounding the magazine area (Magazine Slopes Area), and 5) sloped areas adjacent and just north of the pond area (Pond Slopes Area).

A minimum of 3 transects were run at each site, and when sufficient space was available, a maximum of 5 transects were run. Fifty points were collected from each 100 foot transect. Transects were not located randomly because of the restrictively small size of the sloped areas. Data for percent cover for each area are summarized in the tables and data sheets that follow. These data include vegetation category and species for each transect at each site.

### **Portal Slopes Area**

In the Portal slopes area, 5 transects were run. Average percent cover of all vegetation in the area was 64.80 percent. Dominant vegetative type at the site was shrubs; 41.20%, followed by grasses; 23.60 %.

### **Area 3 Slopes Area**

In the Area 3 slopes area, 5 transects were run. Average percent cover of all vegetation in the area was 63.60 percent. Dominant vegetative type at the site was grasses; 28.80%, followed by shrubs; 27.20%).

### **Fence Slopes Area**

In the Fence slopes area, 3 transects were run. Average percent cover of all vegetation in the area was 56.67 percent. Dominant vegetative type at the site was grasses; 24.00%, followed by forbs; 19.33%, and shrubs; 13.33%).

### **Magazine Slopes Area**

In the Magazine slopes area, 5 transects were run. Average percent cover of all



vegetation in the area was 60.40 percent. Dominant vegetative type at the site was shrubs; 38.00%, followed by grasses; 20.80%).

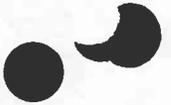
### **Pond Slopes Area**

In the Pond slopes area, 4 transects were run. Average percent cover of all vegetation in the area was 57.00 percent. Dominant vegetative type at the site was grasses; 27.50%, followed by shrubs; 26.00%).

Vegetation in these sloped areas appeared to be in good condition, with no signs of disease, insect damage or overgrazing. Though total vegetative cover in the sloped areas (range 57.00% to 64.80%) is less than the revegetated areas (range 66.27% to 89.07%), there is overlap between the two. In all cases, the sloped sites were more densely vegetated than the Horse Canyon reference area which had an average vegetative cover of 33.47%.



There are more areas of bare ground in the sloped areas than are present in the revegetation study areas, but no signs of excessive erosion were observed. In general, the sloped areas appear to have satisfactory levels of vegetation.



Slopes Cover Data

Area 3 Slopes								
		Transect Number						
Percent								
Cover		1.00	2.00	3.00	4.00	5.00	Average	Std. Dev.
Shrubs		46.00	50.00	48.00	22.00	40.00	41.20	11.37
Forbs		0.00	2.00	0.00	0.00	0.00	0.40	0.89
Grasses		16.00	28.00	22.00	28.00	24.00	23.60	4.98
Trees		0.00	0.00	0.00	0.00	12.00	2.40	5.37
Total Vegetation		62.00	80.00	68.00	50.00	64.00	64.80	10.83
Cryptobiotic		0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Physical Features		38.00	20.00	32.00	50.00	36.00	35.20	10.83

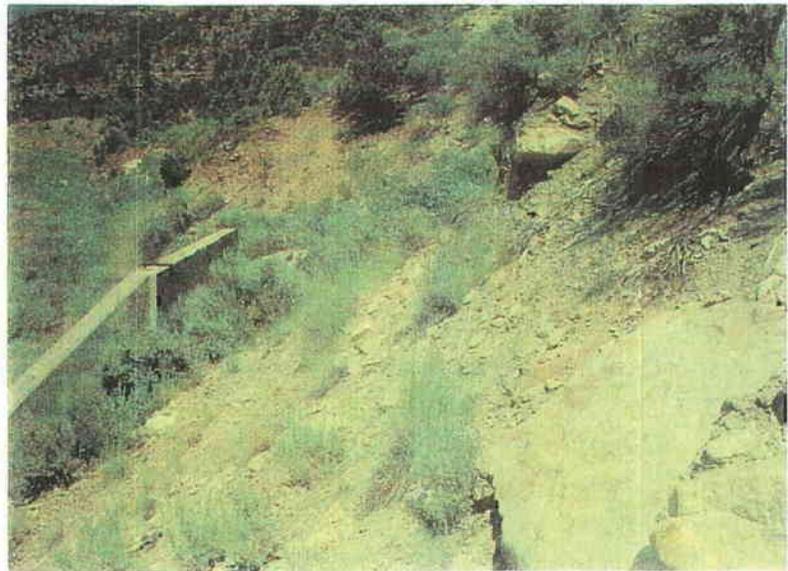
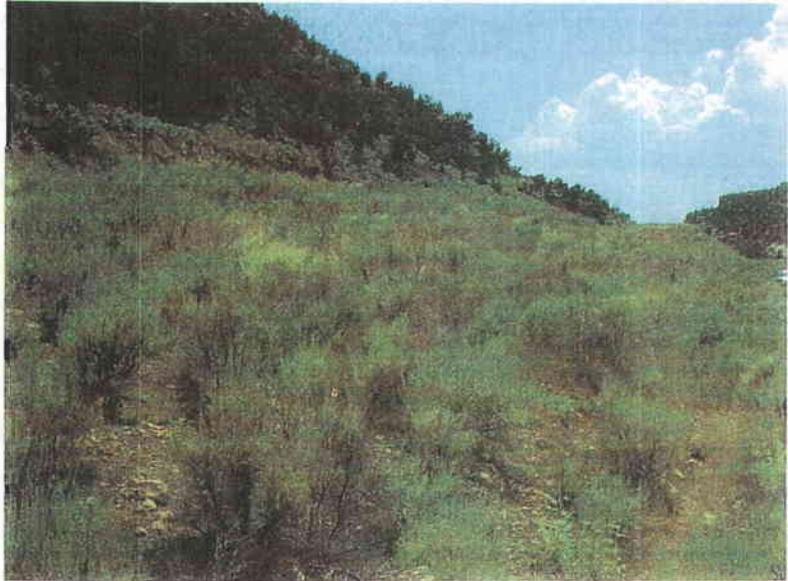
Building Slopes Data								
		Transect Number						
Percent								
Cover		1.00	2.00	3.00	4.00	5.00	Average	Std. Dev.
Shrubs		32.00	14.00	40.00	32.00	18.00	27.20	10.83
Forbs		2.00	12.00	10.00	14.00	0.00	7.60	6.23
Grasses		38.00	34.00	6.00	18.00	48.00	28.80	16.71
Trees		0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Vegetation		72.00	60.00	56.00	64.00	66.00	63.60	6.07
Cryptobiotic		0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Physical Features		28.00	40.00	44.00	36.00	34.00	36.40	6.07

Fence Slopes Data						
		Transect Number				
Percent						
Cover		1.00	2.00	3.00	Average	Std. Dev.
Shrubs		8.00	22.00	10.00	13.33	7.57
Forbs		34.00	2.00	22.00	19.33	16.17
Grasses		12.00	36.00	24.00	24.00	12.00
Trees		0.00	0.00	0.00	0.00	0.00
Total Vegetation		54.00	60.00	56.00	56.67	3.06
Cryptobiotic		0.00	0.00	0.00	0.00	0.00
Total Physical Features		46.00	40.00	44.00	43.33	3.06

Magazine Slopes Data										
		Transect Number								
Percent										
Cover		1.00	2.00	3.00	4.00	5.00	Average	Std. Dev.		
Shrubs		38.00	50.00	40.00	42.00	20.00	38.00	11.05		
Forbs		0.00	0.00	2.00	0.00	0.00	0.40	0.89		
Grasses		28.00	22.00	38.00	4.00	12.00	20.80	13.31		
Trees		0.00	0.00	0.00	0.00	6.00	1.20	2.68		
Total Vegetation		66.00	72.00	80.00	46.00	38.00	60.40	17.74		
Cryptobiotic		0.00	0.00	0.00	0.00	4.00	0.80	1.79		
Total Physical Features		34.00	28.00	20.00	54.00	58.00	38.80	16.53		

Pond Slopes Data										
		Transect Number								
Percent										
Cover		1.00	2.00	3.00	4.00		Average	Std. Dev.		
Shrubs		26.00	26.00	32.00	20.00		26.00	4.90		
Forbs		2.00	6.00	2.00	0.00		2.50	2.52		
Grasses		14.00	40.00	20.00	36.00		27.50	12.48		
Trees		0.00	4.00	0.00	0.00		1.00	2.00		
Total Vegetation		42.00	76.00	54.00	56.00		57.00	14.09		
Cryptobiotic		0.00	0.00	0.00	4.00		1.00	2.00		
Total Physical Features		58.00	24.00	46.00	40.00		42.00	14.14		

## Portal Slopes Cover Data





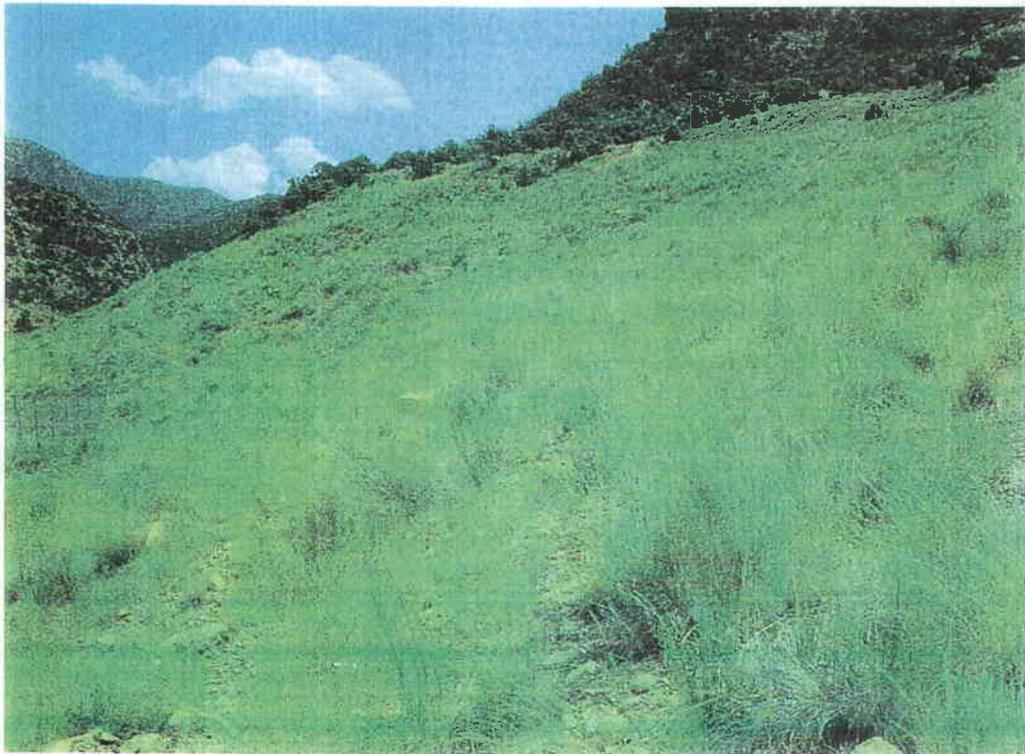








## Area 3 Slopes Cover Data





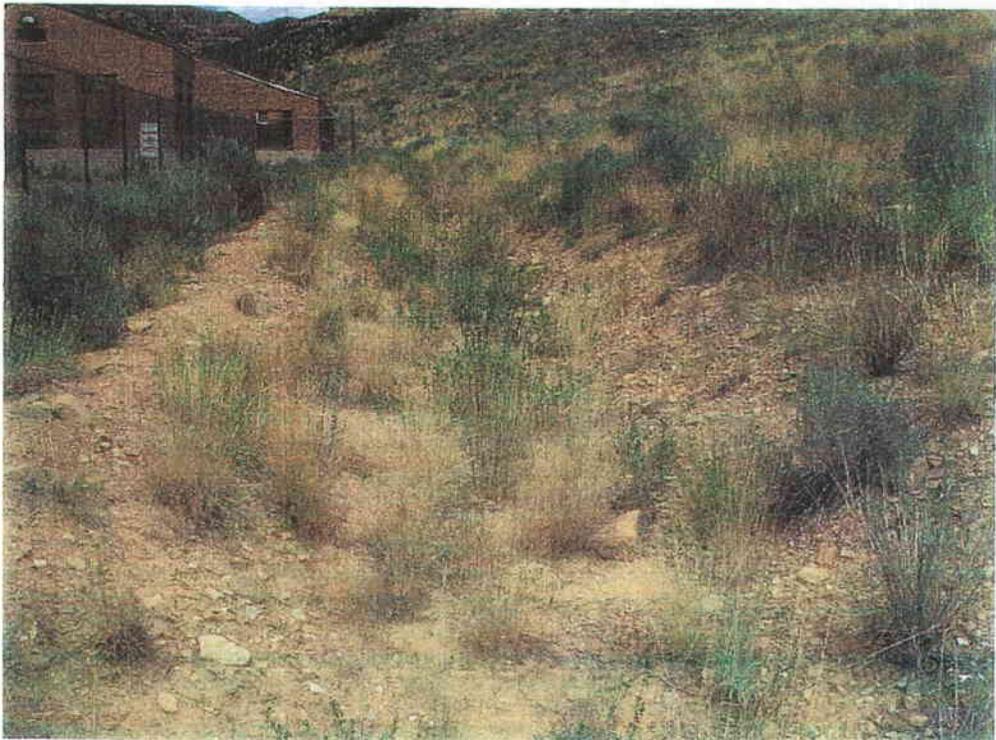








## Fence Slopes Cover Data









## Magazine Slopes Cover Data













# Pond Slopes Cover Data











**Appendix III-1-6**

**Horse Canyon Vegetation Survey 2004**

# Horse Canyon Vegetation Survey - 2004



Submitted by  
**Mike King, Ph.D.**

July 30, 2005



## **Abstract**

A vegetation inventory was conducted on 6 revegetation sites on the Horse Canyon Mine property between June and August, 2004. Data were collected regarding percent cover, percent cover by species, and woody plant density at each site. Data were also collected from a reference site located on Bureau of Land Management property adjacent to mine property. Revegetated sites were compared to the reference area with respect to cover and woody plant density to determine similarity. All sites cover averages exceed the cover average for the reference site and should be judged to have satisfactorily exceeded minimum requirements with respect to cover. Woody plant density in all revegetated sites exceeded woody plant density in the reference area. Species diversity was also higher in all revegetated areas when compared to the reference area. Life form similarity comparisons indicated that in almost every case, the revegetated areas exceeded the 70% standard with respect to percent cover.

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## **Introduction**

In June of 2004, fieldwork was initiated and continued through August 2004 to document vegetation condition of a reference area and 6 representative revegetated sites on the Horse Canyon Mine property. It also was conducted to fulfill the sampling requirement for year 10 of reclamation and to substantiate that the vegetation requirements were met for Phase II bond release.

The project included vegetation surveys of 6 revegetated sites and a reference area established in 1985 according to Utah Division of Oil, Gas, and Mining (DOGGM) permitting requirements. Data collection included percent cover, percent cover by species, woody plant density, and species diversity for each site. Similarity indices were to be calculated between revegetated sites and the reference area to determine if the revegetation efforts have satisfactorily met prescribed revegetation standards determined as part of the Horse Canyon Mine reclamation plan.

The information below includes summary and analyses of these vegetation surveys.

## **Materials and Methods**



Six revegetation sites were selected for analysis based on previous survey work conducted on the mine property in 1995 (Table 1). These areas were selected based on revegetation treatment, slope, aspect, and general topographic similarities. The sites correspond to reclamation treatment areas in the horse Canyon Mine reclamation plan. The reference area, located adjacent to the Horse Canyon mine property on Bureau of Land Management land, was selected several years ago as the revegetation plan was established. The Vegetation Surveys were carried out according to the Division of Oil, Gas and Mining (DOGGM) vegetation sampling methods (February 1992 Revised DOGM Vegetation Information Guidelines). Data collected during the surveys were used to determine ground cover, cover by species, and woody plant density. A comparison of the reference areas and revegetated areas was made to determine similarity of the 2 areas.

<b>Table 1. Horse Canyon Vegetation Survey Sites*</b>	
<b>Site Number</b>	<b>Description</b>
3	North-facing slope
6	South-facing slope
7	Rabbitbrush treatment; South-facing slope
11,13,14	Flat topography near canyon mouth
16	Borrow pit area
15, 17	Former refuse pile and landfill area
Reference Area	Mature Pinon - Juniper Woodland

\* See Appendix 3 for photographs of each site

### ***Percent Cover***

The point-intercept method was used to sample cover. A total of 15 - 100 ft sampling transects were run at each revegetation site to determine percent cover. Transects were located using coordinates selected from a random number table. Coordinates were paced off and a compass direction was selected using the random number table as well. Once transect start point and compass direction were established, investigators laid out a 100 ft tape in the appropriate direction and then walked the length of the tape to record vegetation. Investigators took samples at 2ft intervals along the length of the tape. A total of 50 points were recorded for each transect. Similar methods were used in the reference area.

Cover categories included: 1) Physical Features including a) bare ground (rock or soil material less < 12 inches in diameter), b) litter (dead plant material lying on ground surface), c) rock (rock material >12 inches in diameter), 2) Cryptobiotic Soil, 3) Vegetation including a) shrubs b) forbs and succulents (cactus species), c) grasses, and d) trees. When possible, plants were identified to species level. Points were selected by viewing the transect at 2 foot intervals with an ocular viewing device with cross hairs. When there was an overhead canopy, verticle projections were made above the 100 ft tape to include the highest level of vegetation in the sample.

Adequacy of sample size was determined as per DOGM guidelines (DOGM 1992); see Table 2. Sample adequacy for cover was met at the 90% confidence level with a 10% change in the mean as required by DOGM. Fifteen transects were run in the

reference area even though sample adequacy suggested that 16 transects be run to keep consistency with the number of transects run in revegetated areas.

<b>Area</b>	<b>Cover</b>	<b>Woody Plant Density</b>
Reference	16.60	155.33
3	1.46	33.26
6	1.62	38.67
7	1.31	63.10
11/13/14	5.38	47.51
15/17	3.35	54.32
16	3.38	80.32

### ***Woody Plant Density***

Woody plant densities were estimated using the belt transect method (DOGM 1992). A total of 15 - 100 ft X 10 ft transects were run in each area to determine woody plant density. Transects were located using coordinates selected from a random number table. Coordinates were paced off and a compass direction was selected using the random number table as well. Once transect start point and compass direction were established, investigators walked the length of the transect and recorded species of all individual shrubs rooted in each belt. Total number of plants per acre was calculated using DOGM guidelines. Minimum sample sizes for adequacy ranged from 33 to 155 (Table 2). To keep sampling consistent and avoid excessive disturbance to sites, shrub densities were estimated using the minimum of 15 transects as was done in previous vegetation surveys.

### ***Similarity***

Similarity of revegetated sites and the reference area with respect to species composition was determined using the Jaccard's Community Coefficient (DOGM

1992). The index of similarity is calculated by:

$$SI = C/(A + B - C) * 100$$

where:

A = number of species in the reference area

B = number of species in the revegetated area

C = number of species common to both sites

### ***Species Diversity***

Species diversity lists of all sites were compiled based on data collected during cover sampling. Also, similarity of sites with respect to cover was based on Jaccard's Similarity Index:

$$SI = \text{Cover (\%)} \text{ for Life Forms/Total Vegetation Cover}$$

where:

Life forms = Shrubs, Forbs, or Grasses.

SI values for each life form were calculated for the reference area and each revegetation site. If the SI value of the revegetation area equaled or exceeded 70% of the reference area value it was judged to be successful.

### **Results**

The survey was conducted during the seventh year of abnormally dry weather in Utah and the western United States. Annual precipitation at the Sunnyside City Center weather station (approximately 7 miles north of Horse Canyon) and the Price Warehouses weather station (approximately 30 miles west of horse Canyon) was below long-term averages for both sites. The precipitation for the 2004 water year (Oct 1, 2003-Sept 31,2004) at Sunnyside was 12.72 inches compared to the 30 year average of 13.87 inches. Similarly annual precipitation for the Price Warehouses station for the 2004 water year was 8.31 inches or 85% of the normal (Utah Climate Center records, Utah State University, Logan, Utah). This pattern is typical of most regions in Utah due to several years of drought throughout the state. This prolonged period of reduced moisture has no doubt had an effect on plant production and

survival throughout the state and the eastern Utah area. *Signs of significant shrub death was evident in all study sites.*

Though plant growth was likely limited during the year, there were no signs of disease or insect damage and plants generally appeared to be in good health.

As with the vegetation study conducted in 2003, all areas showed some use by livestock. Cattle sign was found in all areas, though the use was not extensive. Plants showed no signs of overgrazing. It is assumed that the used was limited to the few days livestock operators in the area moved their cattle to and from summer range in the Range Creek area. Mule deer sign was also observed in all revegetated areas as well as the reference area. Chukar partridges were heard in or near areas 16, 15/17, and 11/13/14. A group of 5 Rocky Mountain bighorn ewes was seen in a site close to area 11/13/14 in July 2004.

### ***Percent Cover***

#### **Reference Area**

Cover data for the Horse Canyon reference area are included in Table 3 (data for each transect are included in Appendix 1). The average vegetation cover for the Reference area was 43.20%. The vegetative component was comprised of 24.00% trees, 15.60% grasses, 1.87% percent shrubs, and 1.73% forbs and succulents (for relative percent vegetation for each transect see Appendix 1).

**Table 3. Horse Canyon Average Cover Summary\***

Cover Type	Area						
	Ref	3	6	7	11,13,14	15,17	16
<b>Shrubs</b>	1.87 1.00	51.87 33.07	40.40 33.60	56.00 49.87	28.80 24.80	37.07 34.27	27.20 15.73
<b>Forbs</b>	1.73 0.73	2.93 6.53	0.93 0.93	2.67 1.60	2.00 1.33	0.13 1.20	3.47 8.40
<b>Grasses</b>	15.60 10.53	33.73 46.53	44.00 54.53	25.47 25.87	50.13 42.80	33.60 41.87	42.00 42.13
<b>Trees</b>	24.00 20.57	0 0	0 0	0 0	0 0	0 0	0 0
<b>Total Vegetation</b>	43.20 32.83	88.53 86.13	85.33 89.07	83.73 77.33	80.93 72.53	70.80 77.33	74.13 66.27

<b>Cryptobiotic</b>	10.13 <i>5.4</i>	0.27 <i>0.13</i>	0.27 <i>0.53</i>	0 <i>0</i>	0.27 <i>0.53</i>	0 <i>0</i>	0 <i>0.13</i>
<b>Physical Features</b>	49.73 <i>60.60</i>	11.20 <i>13.73</i>	14.40 <i>10.13</i>	16.27 <i>22.27</i>	18.80 <i>26.93</i>	29.20 <i>22.67</i>	25.87 <i>33.60</i>

\* Italicized values are from the 2003 vegetation survey report

### **Area 3**

The average vegetation cover for Area 3 was 88.53%. The vegetative component was comprised of 51.87% shrubs, 2.93% forbs and succulents, and 33.73% grasses, (Appendix 1; for relative percent vegetation for each transect also see Appendix 1).

### **Area 6**

The average vegetation cover for Area 6 was 85.33%. The vegetative component was comprised of 340.40% shrubs, 0.93% forbs and succulents, and 44.00% grasses, (Appendix 1; for relative percent vegetation for each transect also see Appendix 1).

### **Area 7**

The average vegetation cover for Area 7 was 83.73%. The vegetative component was comprised of 56.00% shrubs, 2.67% forbs and succulents, and 25.47% grasses, (Appendix 1; for relative percent vegetation for each transect also see Appendix 1).

### **Area 11,13,14**

The average vegetation cover for Area 11/13/14 was 80.93%. The vegetative component was comprised of 28.80% shrubs, 2.00% forbs and succulents, and 50.13% grasses, (Appendix 1; for relative percent vegetation for each transect also see Appendix 1).

### **Area 15,17**

The average vegetation cover for Area 15/17 was 70.80%. The vegetative component was comprised of 37.07% shrubs, 0.13% forbs and succulents, and 33.60% grasses, (Appendix 1; for relative percent vegetation for each transect also see Appendix 1).

### **Area 16**

The average vegetation cover for Area 16 was 74.13%. The vegetative component was comprised of 27.20% shrubs, 3.47% forbs and succulents, and 42.00% grasses,

(Appendix 1; for relative percent vegetation for each transect also see Appendix 1).

In order to meet the revegetation plan success standard, 90% of undisturbed reference area, each site should meet or exceed 38.88% cover. Since all sites cover averages exceed the minimum requirement, it should be judged that the treatments have been satisfactory with respect to percent cover as was the case for the year 9 vegetation survey.

### **Woody Plant Density**

Woody plant density data for the Horse Canyon reference area are included in Table 4 (data for each transect are included in Appendix 2).

<b>Table 4. Horse Canyon Woody Plant Densities (plants/acre)</b>				
<b>Area</b>	<b>Average</b>	<b>Std. Dev.</b>	<b>90% Confidence Interval</b>	<b>Min. - Max.</b>
Reference	1112.23	787.16	334.31	777.92 - 1446.54
3	1794.67	587.70	249.60	1545.07 - 2044.27
6	3905.88	1379.32	585.80	3320.08 - 4491.68
7	4817.74	2173.13	922.93	3894.81 - 5740.67
11/13/14	1542.02	603.54	256.32	1285.70 - 1798.34
15/17	2247.70	940.73	399.53	1848.17 - 2647.23
16	2572.94	1309.44	556.12	2016.82 - 3129.06
Revegetated Areas Average	2813.49	1283.97	545.30	2268.19 - 3358.79

### **Reference Area.**

The Reference area was the least populated area with respect to woody plants. Including tree species, plants/acre ranged from 479.16 to 2657.16, with an average of 1112.23 (90% confidence intervals are also listed in Table 4). The most predominant woody plants in the Reference area were Snakeweed (*Gutierrezia sarothrae* - 763.75 plants/acre, 68.67%) and Utah Juniper (*Juniperus osteosperma* - 258.46 plants/acre, 23.23%).

### **Area 3.**

Area 3 had an average plants/acre of 1794.67 (90% confidence intervals are listed in Table 4). Individual transect values ranged from 958.32 - 3223.44. The site was dominated by Sagebrush (*Artemisia tridentata* - 813.12 plants/acre, 45.30%), Four Wing Saltbush (*Atriplex canescens* - 743.42 plants/acre, 41.42%), and Big Rabbitbrush (*Chrysothamnus nauseosus* - 136.48 plants/acre, 7.60%).

### **Area 6.**

Area 6 had an average plants/acre of 3905.88 (90% confidence intervals are listed in Table 4). Individual transect values ranged from 2003.76 - 5314.32. The site was dominated by Sagebrush (*Artemisia tridentata* - 1591.39 plants/acre, 40.74%), Four Wing Saltbush (*Atriplex canescens* - 1269.05 plants/acre, 32.49%), Winterfat (*Ceratoides lanata* - 10.56%), and Douglas Rabbitbrush (*Chrysothamnus viscidiflorus* - 264.26 plants/acre, 6.77%).

### **Area 7.**

Area 7 had an average plants/acre of 4817.74 (90% confidence intervals are listed in Table 4). Individual transect values ranged from 3615.48 - 10846.44. The site was dominated by Sagebrush (*Artemisia tridentata* - 33232.15 plants/acre, 67.09%) and Four Wing Saltbush (*Atriplex canescens* - 1097.71 plants/acre, 22.78%).

### **Area 11,13,14.**

Area 11/13/14 had an average plants/acre of 1542.02 (90% confidence intervals are listed in Table 4). Individual transect values ranged from 522.72 - 2831.40. The site was dominated by Sagebrush (*Artemisia tridentata* - 354.29 plants/acre, 22.98%) and Four Wing Saltbush (*Atriplex canescens* - 990.26 plants/acre, 64.22%).

### **Area 15,17.**

Area 11/13/14 had an average plants/acre of 2247.70 (90% confidence intervals are listed in Table 4). Individual transect values ranged from 435.60 - 3659.04. The site was dominated by Sagebrush (*Artemisia tridentata* - 1042.54 plants/acre, 46.38%) and Four Wing Saltbush (*Atriplex canescens* - 772.46 plants/acre, 34.37%).

### **Area 16.**

Area 11/13/14 had an average plants/acre of 2572.94 (90% confidence intervals are listed in Table 4). Individual transect values ranged from 784.084835.16 - 4094.64. The site was dominated by Sagebrush (*Artemisia tridentata* - 972.84 plants/acre, 37.81%), Four Wing Saltbush (*Atriplex canescens* - 891.53 plants/acre, 34.65%), Big Rabbitbrush

(*Chrysothamnus nauseosus* - 360.10 plants/acre, 14.00%), and Shadscale (*Atriplex confertifolia* - 241.03, 9.37%) .

### ***Average of all Treatment Areas***

An average was calculated combining data for all treatment areas. The average woody plant plants/acre when considering all treatment areas was 2813.49. Calculation of a 90% confidence interval indicates that we can be 90% confident that the actual mean of the population lies between 2268.19 - 3358.79 plants/acre.

With respect to woody plant density, only 2 sites did not clearly exceed the standard of 2000 plants/acre established in the revegetation plan for the Horse Canyon area. Area 6 (3905.88), Area 7 (4817.74), Area 15/17 (2247.70), and Area 16 (2572.94 ) all exceeded 2000 plants per acre. Areas 3 (1794.67; 90% confidence interval: 1545.07 - 2044.27) and 11/13/14 (1542.02; 90% confidence interval; 1285.70 - 1798.34) both have averages below 2000. Considering the confidence intervals, only Area 11/13/14 falls clearly below the 2000 shrubs/acre standard. However, when compared to the Reference area (1112.23), even areas 3 and 11/13/14 far exceed the undisturbed site with respect to woody plants/acre. Given these data, the woody plant density treatments should be characterized as relatively successful.

### **Species Diversity**

Lists of species for the Reference area and each of the revegetation sites is listed in Table 5. All comparisons show more total species in each of the revegetated sites than in the Reference area.

<b>Table 5. Species Lists for Horse Canyon Inventory Area</b>							
<b>Species</b>	<b>Site</b>						
	<b>Ref.</b>	<b>3</b>	<b>6</b>	<b>7</b>	<b>11/ 13/14</b>	<b>15/ 17</b>	<b>16</b>
<b><i>Shrubs</i></b>							
<i>Artemisia nova</i>		x	x	x		x	
<i>Artemisia tridentata</i>		x	x	x	x	x	x
<i>Atriplex canescens</i>		x	x	x	x	x	x
<i>Atriplex confertifolia</i>			x	x		x	x
<i>Ceratoides lanata</i>			x	x	x	x	x
<i>Chrysothamnus nauseosus</i>		x	x	x	x	x	x
<i>Chrysothamnus viscidiflorus</i>		x	x	x	x		x

<i>Cowania mexicana</i>		x		x	x		
<i>Ephedra viridis</i>							
<i>Gutierrezia sarothrae</i>	x	x	x	x	x	x	x
<i>Sarcobatus vermiculatus</i>	x		x		x	x	
<b>Forbs &amp; Succulents</b>							
<i>Echinocereus triglochidiatus</i>							
<i>Medicago sativa</i>					x		x
<i>Melilotus officinalis</i>		x					
<i>Penstemon palmeri</i>		x	x	x	x		x
<i>Euphorbia fendleri</i>	x				x		
<i>Sisymbrium altissimum</i>		x	x	x			
<i>Sphaeralcia coccinea</i>	x			x	x		
<i>Grindelia squarrosa</i>		x	x		x		
<i>Machaeranthera canescens</i>	x	x	x		x	x	x
<i>Phlox sp.</i>	x						
<i>Plantago patagonica</i>	x						
<i>Opuntia compressa</i>	x						
<b>Grasses</b>							
<i>Agropyron cristatum</i>		x			x		x
<i>Agropyron smithii</i>		x	x				
<i>Agropyron spicatum</i>		x	x	x	x	x	x
<i>Bromus inermis</i>			x				
<i>Bromus japonicus</i>							
<i>Bromus tectorum</i>	x	x	x	x	x	x	x
<i>Elymus cinereus</i>		x	x	x	x	x	x
<i>Elymus giganteus</i>		x	x		x	x	
<i>Elymus salinus</i>	x		x		x	x	
<i>Hilaria jamesii</i>			x			x	
<i>Oryzopsis hymenoides</i>			x	x	x	x	x

<i>Sitanion hystrix</i>			x	x			
<i>Stipa comata</i>				x			
<i>Vulpia octaflora</i>							
<b>Trees</b>							
<i>Juniperus osteosperma</i>	x						
<i>Pinus edulis</i>	x						
<b>Total Species in each area</b>	12	18	23	18	21	16	15

Also in each revegetation site, there were more species with greater than 5% cover than in the Reference area. The Reference area had a total of 12 species with 2 species, Utah juniper (20.54%) and Salina wild rye (13.74%), with percent cover greater than 5%. Only 2 species, 1 tree and 1 grass, exceeded 5%. See summary of shrubs and grasses that exceeded 5% cover in Table 6.

<b>Table 6. Grasses and Shrubs with % Cover &gt; 5%</b>		
Site	Shrubs > 5% cover	Grasses > 5% cover
Reference 1 grass	none	Salina wild rye (13.74%)
Area 3 3 shrubs 1 grass	Big sagebrush (26.26%) Four-wing saltbush (25.06%) Douglas rabbitbrush (5.06%) <i>Green rabbitbrush</i> (3.06%)	Giant wild rye (16.80%)
Area 6 2 shrubs 2 grasses	Four-wing saltbush (18.60%) Big sagebrush (11.46%) <i>Winterfat</i> (3.34%) <i>Green rabbitbrush</i> (2.66%)	Bluebunch wheatgrass (26.66%) Cheatgrass (12.80%)
Area 7 2 shrubs 2 grasses	Big sagebrush (29.46%) Four-wing saltbush (21.06%)	Cheatgrass (16.94%) Bluebunch wheatgrass (5.46%)

Area 11/13/14  2 shrubs 2 grasses	Four-wing saltbush (9.87%) Big sagebrush (4.80%) <i>Green rabbitbrush</i> (3.46%)	Bluebunch wheatgrass (27.06%) Cheatgrass (18.94%)
Area 15/17  2 shrubs 2 grasses	Big sagebrush (16.40%) Four-wing saltbush (15.60%)	Bluebunch wheatgrass (22.40%) Cheatgrass (9.74%)
Area 16  2 shrubs 2 grasses	Four-wing saltbush (13.74%) Big sagebrush (7.60%) <i>Douglas rabbitbrush</i> (3.20%) <i>Shadscale</i> (2.94%)	Blue bunch wheatgrass (28.40%) Cheatgrass (13.20%)

Area 3 had a total of 18 species with 5 species, Big sagebrush (26.26%), Fourwing saltbush (25.06%), Bluebunch wheatgrass (20.14%), Giant wild rye (16.80%), and Green rabbitbrush (5.06%) with percent cover greater than 5%. *Five species, 3 shrubs and 2 grasses, exceeded 5%.*

Area 6 had a total of 23 species with 4 species, Bluebunch wheatgrass (26.66%), Fourwing saltbush (18.60%), Cheat grass (12.80%), and Big sagebrush (11.46%) with percent cover greater than 5%. *Four species, 2 shrubs and 2 grasses (one of the grasses was the undesirable Cheat grass), exceeded 5%.* Two additional shrub species Winterfat (3.34%) and Green rabbitbrush (2.66%) were also relatively abundant.

Area 7 had a total of 18 species with 4 species, Big sagebrush (29.46%), Fourwing saltbush (21.06%), Cheat grass (16.94%), and Bluebunch wheatgrass (5.46%) with percent cover greater than 5%. *Four species, 2 shrubs and 2 grasses (one of the grasses was the undesirable Cheat grass), exceeded 5%.*

Area 11/13/14 had a total of 21 species with 4 species, Bluebunch wheatgrass (27.06%), Fourwing saltbush (19.74%), Cheat grass (18.94%), and Big sagebrush (4.80%) with percent cover greater than 5%. *Four species, 2 shrubs and 2 grasses (one of the grasses was the undesirable Cheat grass), exceeded 5%.* In addition, Green rabbitbrush (3.46%) was also relatively abundant.

Area 15/17 had a total of 16 species with 4 species, Bluebunch wheatgrass (22.40%), Big sagebrush (16.40%), Fourwing saltbush (15.60%), and Cheatgrass (9.74%) with percent cover greater than 5%. *Four species, 2 shrubs and 2 grasses (one of the grasses was the undesirable Cheat grass) exceeded 5%.*

Area 16 had a total of 15 species with 4 species, Bluebunch wheatgrass (28.40%), Fourwing saltbush (13.74%), Cheatgrass (13.20%), and Big sagebrush (7.6%) with percent cover greater than 5%. *Four species, 2 shrubs, 2 grasses (one of the grasses was the undesirable Cheat grass) exceeded 5%.* In addition, Green rabbitbrush (3.20%) and Shadscale (2.94%) were relatively abundant.

Species diversity with respect to percent cover by species is recorded in Table 7 for each site.

<b>Reference Area (12 total species)</b>		<b>Area 3 (18 total species)</b>	
	<b>Species (% cover)</b>		<b>Species (% cover)</b>
> 20 %	<i>Juniperus osteosperma</i> (20.54)	> 20%	<i>Artemisia tridentata</i> (26.26)
			<i>Atriplex canescens</i> (25.06)
			<i>Agropyron spicatum</i> (20.14)
10 - 20%	<i>Elymus salinus</i> (13.74)	10 - 20%	<i>Elymus giganteus</i> (16.80)
5 - 10 %		5 - 10 %	<i>Chrysothamnus nauseosus</i> (5.06)
1 - 5%	<i>Pinus edulis</i> (3.46)	1 - 5%	<i>Chrysothamnus viscidiflorus</i> (3.06)
	<i>Gutierrezia sarothrae</i> (1.60)		<i>Penstemon palmeri</i> (2.14)
< 1%	<i>Opuntia compressa</i> (0.66)	< 1%	<i>Cowania mexicana</i> (0.80)
	<i>Bromus tectorum</i> (0.40)		<i>Agropyron smithii</i> (0.54)
	<i>Phlox sp.</i> (0.40)		<i>Elymus cinereus</i> (0.40)
	<i>Sphaeralcia coccinea</i> (0.26)		<i>Melilotus officinalis</i> (0.26)
	<i>Euphorbia fendleri</i> (0.14)		<i>Maecharantha canescens</i> (0.26)
	<i>Elymus cinereus</i> (0.14)		<i>Agropyron cristatum</i> (0.14)
	<i>Maecharantha canescens</i> (0.14)		<i>Artemisia nova</i> (0.14)
	<i>Plantago patagonica</i> (0.14)		<i>Bromus tectorum</i> (0.14)
			<i>Grindella squarrosa</i> (0.14)
			<i>Gutierrezia sarothrae</i> (0.14)
			<i>Sysimbrium altissimum</i> (0.14)

<b>Table 7. Species Diversity Tables (cont.)</b>			
<b>Area 6 (23 total species)</b>		<b>Area 7 (18 total species)</b>	
	<b>Species (% cover)</b>		<b>Species (% cover)</b>
> 20 %	<i>Agropyron spicatum</i> (26.66)	> 20%	<i>Artemisia tridentata</i> (29.46)
			<i>Atriplex canescens</i> (21.06)
10 - 20%	<i>Atriplex canescens</i> (18.60)	10 - 20%	<i>Bromus tectorum</i> (16.94)
	<i>Bromus tectorum</i> (12.80)		
	<i>Artemisia tridentata</i> (11.46)		
5 - 10 %		5 - 10 %	
1 - 5%	<i>Ceratoides lanata</i> (3.34)	1 - 5%	<i>Agropyron spicatum</i> (5.46)
	<i>Chrysothamnus viscidiflorus</i> (2.66)		<i>Atriplex confertifolia</i> (2.14)
	<i>Elymus salinus</i> (2.46)		<i>Chrysothamnus viscidiflorus</i> (2.14)
	<i>Gutierrezia sarothrae</i> (1.60)		<i>Sphaeralicia coccinea</i> (1.60)
	<i>Artemisia nova</i> (1.20)		<i>Oryzopsis hymenoides</i> (1.56)
	<i>Atriplex confertifolia</i> (1.20)		<i>Gutierrezia sarothrae</i> (1.06)
			<i>Stipa comata</i> (1.06)
< 1%	<i>Oryzopsis hymenoides</i> (0.54)	< 1%	<i>Penstemon palmeri</i> (0.66)
	<i>Agropyron smithii</i> (0.40)		<i>Chrysothamnus nauseosus</i> (0.26)
	<i>Elymus giganteus</i> (0.40)		<i>Sisymbrium altissimum</i> (0.26)
	<i>Chrysothamnus nauseosus</i> (0.26)		<i>Artemisia nova</i> (0.14)
	<i>Grindella squarrosa</i> (0.26)		<i>Ceratoides lanata</i> (0.14)
	<i>Hilaria jamesii</i> (0.26)		<i>Cowania mexicana</i> (0.14)
	<i>Maecharantha canescens</i> (0.26)		<i>Elymus cinereus</i> (0.14)
	<i>Penstemon palmeri</i> (0.26)		<i>Sitanion hystrix</i> (0.14)
	<i>Bromus inermis</i> (0.14)		
	<i>Elymus cinereus</i> (0.14)		
	<i>Sarcobatus vermiculatum</i> (0.14)		
	<i>Sitanion hystrix</i> (0.14)		
	<i>Sisymbrium altissima</i> (0.14)		

<b>Table 7. Species Diversity Tables (cont.)</b>			
<b>Area 11/13/14 (20 total species)</b>		<b>Area 15/17 (16 total species)</b>	
	<b>Species (% cover)</b>		<b>Species (% cover)</b>
> 20 %	<i>Agropyron spicatum</i> (27.06)	> 20%	<i>Agropyron spicatum</i> (22.40)
10 - 20%	<i>Atriplex canescens</i> (19.94)	10 - 20%	<i>Artemisia tridentata</i> (16.40)
	<i>Bromus tectorum</i> (18.94)		<i>Atriplex canescens</i> (15.60)
5 - 10 %		5 - 10 %	<i>Bromus tectorum</i> (9.74)
1 - 5%	<i>Artemisia tridentata</i> (4.80)	1 - 5%	<i>Gutierrezia sarothrae</i> (1.86)
	<i>Chrysothamnus viscidifloris</i> (3.46)		<i>Sarcobatus vermiculatus</i> (1.46)
	<i>Oryzopsis hymenoides</i> (1.46)		
	<i>Agropyron cristatum</i> (1.34)		
< 1%	<i>Elymus cinerius</i> (0.80)	< 1%	<i>Chrysothamnus nauseosus</i> (0.94)
	<i>Medicago sativa</i> (0.66)		<i>Elymus giganteus</i> (0.54)
	<i>Ceratoides lanata</i> (0.54)		<i>Oryzopsis hymenoides</i> (0.40)
	<i>Maecharantha canescens</i> (0.54)		<i>Artemisia nova</i> (.26)
	<i>Chrysothamnus nauseosus</i> (0.40)		<i>Atriplex confertifolia</i> (0.26)
	<i>Gutierrezia sarothrae</i> (0.40)		<i>Ceratoides lanata</i> (0.26)
	<i>Penstemon palmeri</i> (0.40)		<i>Elymus salinus</i> (0.26)
	<i>Sarcobatus vermiculatus</i> (0.40)		<i>Elymus cinereus</i> (0.14)
	<i>Cowania mexicana</i> (0.26)		<i>Hilaria jamesii</i> (0.14)
	<i>Elymus giganteus</i> (0.26)		<i>Maecharantha canescens</i> (0.14)
	<i>Elymus salinus</i> (0.26)		
	<i>Grindelia squarrosa</i> (0.14)		
	<i>Phacelia crenulata</i> (0.14)		
	<i>Sphaeralcia coccinea</i> (0.14)		

<b>Table 6. Species Diversity Tables (cont.)</b>	
<b>Area 16 (15 total species)</b>	
	<b>Species (% cover)</b>
> 20 %	<i>Agropyron spicatum</i> (28.40)
10 - 20%	<i>Atriplex canescens</i> (13.74)
	<i>Bromus tectorum</i> (13.20)
5 - 10 %	<i>Artemisia tridentata</i> (7.60)
1 - 5%	<i>Chrysothamnus nauseosus</i> (3.20)
	<i>Atriplex confertifolia</i> (2.94)
	<i>Medicago satvia</i> (1.86)
	<i>Penstemon palmeri</i> (1.06)
< 1%	<i>Elymus cinerius</i> (0.66)
	<i>Ceratoides lanata</i> (0.54)
	<i>Oryzopsis hymnenooides</i> (0.54)
	<i>Agropyron cristatum</i> (0.40)
	<i>Chrysothamnus viscidifloris</i> (0.40)
	<i>Gutierrezia sarothrae</i> (0.40)
	<i>Maecharantha canescens</i> (0.40)

### Similarity

Comparisons of similarity made between the Reference area and revegetated sites indicates that there are only minor similarities between the revegetated sites and the Reference area (Table 8). Similarity coefficients ranged from 11.11 (area 7) to 26.92 (area 11/13/14). See similarity comparisons between the reference area and revegetated areas in Appendix 3. Similarity is strong when values approach 100. Given the revegetation treatments, it is not surprising that the areas are dissimilar with respect to species.

Site	Number of Species in Reference Area	Number of Species in Revegetation Site	Number of Species Common to both	Similarity Coefficient
Area 3	12	17	3	11.54
Area 6	12	23	5	16.67
Area 7	12	18	3	11.11
Area 11/13/14	12	21	7	26.92
Area 15/17	12	16	5	21.73
Area 16	12	15	3	12.50

Areas were also different with respect to overall vegetation cover. In each instance, the revegetated areas were more densely vegetated than the reference area. The average percent cover for the Reference area was 43.20%. Percent vegetation cover for the revegetation sites ranged from 70.80% to 88.53% (Table 3).

### ***Life Form Similarity Comparisons***

Vegetation treatments have been judged to be successful when cover values of life forms (Shrubs, Forbs, Grasses) in treatment areas are greater or equal to 70% between reclaimed areas and the undisturbed reference area. A Jaccard's similarity index for cover ( $SI = \frac{\text{Cover}(\%)}{\text{Total Vegetation Cover}(\%)}$ ) was used to calculate comparative SI values for life forms in revegetated and reference areas (Table 9). Cover values are found in Table 3.

Life Form	Similarity Index Values by Site							
	Ref	70%	3	6	7	11/13/14	15/17	16
Shrubs	.04	.028	.59*	.47*	.67*	.36*	.52*	.37*
Forbs	.04	.028	.03*	.01	.03*	.02	.01	.05*
Grasses	.36	.252	.38*	.52*	.30*	.62*	.47*	.57*

\* Sites that exceed the 70% standard

The comparison of life forms similarity indicates that revegetated areas meet or exceed the 70% standard for almost all life forms in each of the revegetated sites. The revegetated sites all exceeded the 70% standard for both shrubs and grasses. The exceptions were in the forb category. Forbs did not exceed the 70% standard in 3 of the 6 revegetated sites; specifically sites 6, 11/13/14, and 15/15. Given that these are the only 3 treatments of 18 total (17% of total treatments), it appears that the diversity of the sites with respect to life forms generally exceeds that of the reference area.

## References

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Parker, K. G., L. R. Mason, and J. F. Valentine. Utah Grasses. EC 384. Cooperative Extension Service, Utah State University, Logan, UT. 69 pp.

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Utah Climate Center. July 2005. Utah State University, Logan, Utah.

# **Appendix 1**

## **Percent Cover Data**





























































Horse Canyon Revegetation Project Tally Sheet

UTM: 556177 4368160

Date:	Area: 6										Transact: 1										Heading: 202										Total	Percent Cover	Relative Vegetation Cover																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30				31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Plant Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50			
Shrub																																																					
Atriplex canescens					1	1	1	1	1	1																																							11	22	28.18		
Atriplex confertifolia																																																	0	0	0.00		
Artemisia tridentata tridentata																																																	0	0	0.00		
Chrysothamnus nauseosus																																																	2	4	4.76		
Chrysothamnus viscidiflorus																																																	0	0	0.00		
Cercocarpus montana																																																	0	0	0.00		
Ceanothus laevis																																																	1	2	2.38		
Ephedra viridis																																																	0	0	0.00		
Sarcobatus vermiculatus																																																	0	0	0.00		
Gutierrezia sarothrae																																																	0	0	0.00		
Total Shrub Cover	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	32	38.10					
<b>Forbs &amp; Succulents</b>																																																	0	0	0.00		
Machaeranthera canescens																																																	0	0	0.00		
Medicago sativa																																																	0	0	0.00		
Malva officinalis																																																	0	0	0.00		
Parthenocissus palmeri																																																	0	0	0.00		
Sphaeralcea pedunculata																																																	0	0	0.00		
Synanthrium albidum																																																	0	0	0.00		
Total Forb Cover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00					
<b>Grasses</b>																																																	0	0	0.00		
Agropyron arifolium																																																	0	0	0.00		
Agropyron spicatum																																																	1	2	26.19		
Agropyron cristatum																																																	0	0	0.00		
Bromus tectorum																																																	1	2	33.33		
Elymus salinus																																																	0	0	0.00		
Elymus densius																																																1	2	2.38			
Elymus pycnanthus																																																0	0	0.00			
Holcus lanatus																																																0	0	0.00			
Oryzopsis hymenoides																																																0	0	0.00			
Silphium laciniatum																																																0	0	0.00			
Stipa comata																																																0	0	0.00			
Total Grass Cover	0	0	0	0	0	1	0	0	1	1	1	1	1	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26	62	81.90							
<b>Legumes</b>																																															0	0	0.00				
Juniper																																															0	0	0.00				
Pinon																																															0	0	0.00				
Total Tree Cover	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00						
Total Vegetation Cover	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42	84	100.00						
<b>Cryptobiotic</b>																																														0	0	0.00					
<b>Physical Features</b>																																														2	4	4.76					
Mud																																														0	0	0.00					
Rock																																														0	0	0.00					
Sand																																														1	2	2.38					
Total Physical Features	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	16	19.05								
Total Physical Features	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	100	100.00							
Comments:																																																					





















































































































Horse Canyon Revegetation Project Tally Sheet

UTM: 553966/ 4367085

Heading: 65

Plant Species	Area: 15					Transect: 15					Heading: 65					Total	Percent Cover	Relative Vegetation Cover																																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15				16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
<i>Plant Species</i>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50			
<i>Plant Species</i>																																																					
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## **Appendix 2**

### **Woody Plant Density Data**

Horse Canyon Revegetation Shrub Density Sheet

Date:	7/23/2004																
Area:	Reference																
UTM:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total	Plant/acre
Heading:	114	283	154	338	70	138	311	106	285	316	97	2	203	250	119		
Shrubs																	
<i>Ariflex canescens</i>	1																2,904
<i>Ariflex confertifolia</i>																	
<i>Ariflex conrugata</i>																	
<i>Ariflex cuneata</i>																	
<i>Atemisia nova</i>																	
<i>Atemisia tidentata tidentata</i>																	
<i>Chrysothamnus nauseosus</i>																	
<i>Chrysothamnus viscidiflorus</i>																	
<i>Cercobites lanata</i>			1														2,904
<i>Ephedra viridis</i>							1										2,904
<i>Sarcobatus vermiculatus</i>	10																29,04
<i>Leptodactylon pungens</i>						1				1							5,808
<i>Gutierrezia sarothrae</i>		15	19	15	71	14	1	5	4	12	56	29	10	9	3	263	763,752
Total Shrubs	11	15	20	15	71	15	2	5	4	13	56	29	10	9	3	276	807,312
Trees																	
Juniper	3	7	8	4	1	10	8	10	6	10	5	3	3	5	6	89	268,458
Pinyon		1				3	5	5	1	1						16	46,464
Total Trees	3	8	8	4	1	13	13	15	7	11	5	3	3	5	6	105	304,92
Total Woody Plants	14	23	28	19	72	28	15	20	11	24	61	32	13	14	9	383	1,112,232
Plants/acre	609.84	1001.88	1219.88	827.64	3136.32	1219.88	663.4	871.2	479.16	1045.44	2667.16	1393.92	566.28	609.84	392.04		
Average Plants/acre	1112.232																
Standard Deviation	787.1623224																
Comments:																	



Horse Canyon Revegetation Shrub Density Sheet

Date:	8/7/2004															Total	Plant/acre
Area:	6																
Transect:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total	Plant/acre
UTM:	555622	555556	555522	555529	555509	555521	555472	555470	555440	555418	555448	555420	555471	555544	555581		
Heading:	4368177	4368189	4368213	4368190	4368189	4368147	4368152	4368157	4368139	4368139	4368155	4368130	4368140	4368187	4368141		
Shrubs:	240	215	209	306	116	250	162	254	115	43	230	18	74	13	283		
<i>Albizia canescens</i>	10	30	20	12	34	23	34	27	18	44	38	57	30	19	41	437	1289.048
<i>Albizia confertifolia</i>																	
<i>Albizia conyugata</i>																	
<i>Albizia gmelina</i>																	
<i>Artemisia nova</i>	2	2	8	15	3	8	1						1	3	1	44	127.776
<i>Artemisia tridentata tridentata</i>	29	26	57	50	36	45	28	28	29	8	8	36	77	54	37	548	1591.392
<i>Chrysothamnus nauseosus</i>	1			1				3	1				2			8	23.232
<i>Chrysothamnus viscidiflorus</i>	15	2	2	1	1	3	14	5	39	2			6	1		91	264.264
<i>Covania mexicana</i>																	
<i>Cercoides lanata</i>			9	100	25	1		3		2		1			1	142	412.368
<i>Ephedra viridis</i>																	
<i>Sarcobatus vermiculatus</i>							13									13	37.752
<i>Gutierrezia sarothrae</i>	11	1	4	3		4		11		9		7	6	6		62	180.048
<b>Total Shrubs</b>	<b>68</b>	<b>61</b>	<b>100</b>	<b>182</b>	<b>99</b>	<b>84</b>	<b>90</b>	<b>77</b>	<b>87</b>	<b>65</b>	<b>46</b>	<b>101</b>	<b>122</b>	<b>83</b>	<b>80</b>	<b>1345</b>	<b>3805.88</b>
<b>Trees</b>																<b>0</b>	<b>0</b>
Juniper																	
Pinyon																	
<b>Total Trees</b>																<b>0</b>	<b>0</b>
<b>Total Vegetation</b>	<b>68</b>	<b>61</b>	<b>100</b>	<b>182</b>	<b>99</b>	<b>84</b>	<b>90</b>	<b>77</b>	<b>87</b>	<b>65</b>	<b>46</b>	<b>101</b>	<b>122</b>	<b>83</b>	<b>80</b>	<b>1345</b>	<b>3805.88</b>
<b>Plant/acre</b>	<b>2982.08</b>	<b>2657.16</b>	<b>4356</b>	<b>7927.92</b>	<b>4312.44</b>	<b>3659.04</b>	<b>3820.4</b>	<b>3354.12</b>	<b>3789.72</b>	<b>2831.4</b>	<b>2003.76</b>	<b>4399.56</b>	<b>5314.32</b>	<b>3615.48</b>	<b>3484.8</b>		
<b>Average Plant/acre</b>	<b>3905.88</b>																
<b>Standard Deviation</b>	<b>1379.323577</b>																
<b>Comments:</b>	yellow flower forb/cryptantha-umbel - like), curly cup gum weed, composite, unknown shrub 2, Hedystrum, globe mallow, Turnbe mustard, yellow clover, deer pellets, poa babosa? Present																

Horse Canyon Revegetation Shrub Density Sheet

Date:	8/6/2004																
Area:	7																
Transact:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total	Plants/acre
UTM:	555418	555390	555395	555389	555429	555437	555409	555448	555373	555419	555431	555414	555362	555392	555416		
Heading:	4368099	4368040	4368085	4368088	4368082	4368124	4368102	4368078	4368088	4368127	4368109	4368128	4368037	4367992	4368061		
Shrubs:	216	44	231	60	294	237	86	240	51	90	209	172	100	30	58		
<i>Altriplex canescens</i>	38	4	16	14	35	36	21	45	21	26	26	13	23	28	32	378	1097.712
<i>Altriplex confertifolia</i>						48										48	139.392
<i>Altriplex canneola</i>																	
<i>Artemisia nova</i>		8	13	1	2			1			1		1			27	78.408
<i>Artemisia tridentata</i>	50	165	208	83	46		54	47	90	56	48	71	86	56	53	1113	3232.152
<i>Chrysothamnus nauseosus</i>		1	1										1			3	8.712
<i>Chrysothamnus viscidiflorus</i>		8	4							5	1		1		2	21	60.984
<i>Cowania mexicana</i>																	
<i>Ceratoides lanata</i>																2	5.808
<i>Cowania mexicana</i>	1						1									2	5.808
<i>Ephedra viridis</i>																	
<i>Gutierrezia sarothrae</i>		24					19		1		1	4	4	5		58	169.432
<i>Sarcobatus vermiculatus</i>			7													7	20.328
<b>Total Shrubs</b>	<b>89</b>	<b>210</b>	<b>249</b>	<b>98</b>	<b>83</b>	<b>84</b>	<b>95</b>	<b>93</b>	<b>112</b>	<b>89</b>	<b>77</b>	<b>88</b>	<b>116</b>	<b>89</b>	<b>87</b>	<b>1659</b>	<b>4817.736</b>
<b>Trees</b>																<b>0</b>	<b>0</b>
Juniper																	
Pinyon																	
<b>Total Trees</b>																<b>0</b>	<b>0</b>
<b>Total Vegetation</b>	<b>89</b>	<b>210</b>	<b>249</b>	<b>98</b>	<b>83</b>	<b>84</b>	<b>95</b>	<b>93</b>	<b>112</b>	<b>89</b>	<b>77</b>	<b>88</b>	<b>116</b>	<b>89</b>	<b>87</b>	<b>1659</b>	<b>4817.736</b>
<b>Plant/acre</b>	<b>3876.84</b>	<b>9147.6</b>	<b>10846.44</b>	<b>4288.88</b>	<b>3615.48</b>	<b>3659.04</b>	<b>4138.2</b>	<b>4051.08</b>	<b>4878.72</b>	<b>3876.84</b>	<b>3354.12</b>	<b>3833.28</b>	<b>5052.96</b>	<b>3876.84</b>	<b>3789.72</b>		
<b>Average Plant/acre</b>	<b>4817.736</b>																
<b>Standard Deviation</b>	<b>2173.128277</b>																
<b>Comments:</b>	Parthenon Palmeri, Globe mallow with wide leaf, Tumble mustard, Shakedown present																

Horse Canyon Revegetation Shrub Density Sheet																	
Date:	8/7/2004																
Area:	11, 13 & 14																
Transect:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total		
UTM:	554572	554595	554600	554544	554635	554602	554700	554772	554806	554808	554816	554831	554907	554859	554910	Plants/acre	
Heading:	4367275	4367314	4367289	4367253	4367275	4367288	4367333	4267375	4367373	4367382	4367426	4367442	4367485	4367850	4367872		
Shrubs:	348	136	220	47	9	93	28	184	360	29	254	46	31	216	156		
<i>Albizia canescens</i>	14	10	34	25	18	40	14	26	22	14	31	13	22	28	30	341	990.284
<i>Albizia confertifolia</i>																	
<i>Albizia corrugata</i>																	
<i>Albizia curneola</i>																	
<i>Artemisia nova</i>					1				2						4	7	20.328
<i>Artemisia tridentata tridentata</i>					17	13	12	6	14	5	9	17	2	9	9	122	354.288
<i>Chrysothamnus nauseosus</i>				1		1	2		1			6			1	12	34.848
<i>Chrysothamnus viscidiflorus</i>					1		1					1				3	8.712
<i>Covania mexicana</i>																	
<i>Cercoides lanata</i>	1	1	1					1	1		1		2		5	12	34.848
<i>Covania mexicana</i>								1	1							2	5.808
<i>Ephedra viridis</i>																	
<i>Gutierrezia sarothrae</i>					2	3	1			1		11			1	18	52.272
<i>Sarcobatus vermiculatus</i>		1			3	8			1							13	37.752
<b>Total Shrubs Cover</b>	15	12	35	35	42	85	29	35	41	20	41	48	26	37	50	531	1542.024
<b>Trees</b>																0	0
Juniper																	
Pinon																	
<b>Total Tree Cover</b>																0	0
<b>Total Vegetation Cover</b>	15	12	35	35	42	85	29	35	41	20	41	48	26	37	50	531	1542.024
<b>Plants/acre</b>	653.4	522.72	1524.6	1524.6	1829.52	2831.4	1263.24	1524.6	1785.96	871.2	1785.96	2090.88	1132.56	1611.72	2178		
<b>Average Plants/acre</b>	1542.024																
<b>Standard Deviation</b>	603.5401541																
<b>Comments:</b>	Cliff rose, Globe mallow, Crested wheat grass, Medicago, Yellow dower, Curly cup gum weed present																

Horse Canyon Revegetation Shrub Density Sheet

Date:	7/23/2004																
Area:	15 & 17																
UTM:	553702	553710	553757	553796	553737	553789	553824	553827	553851	553837	553923	554012	553966	553943	553972	Total	Plant/acre
Heading:	4366972	4366987	4366963	4366984	4367020	4367099	4367046	4367093	4367049	4367000	4367077	4367117	4367084	4367089	4367117		
Shrubs:	212	159	94	333	2	81	292	136	242	283	346	181	250	77	308		
Aliphex canescens	13	8	23	12	23	26	25	19	45	19	14	10	4	6	19	266	772.464
Aliphex confertifolia					4		2									6	17.424
Aliphex confertifolia																	
Aliphex cornigata																	
Aliphex cornuta																	
Aternalia nova	1		2		1	1			1							7	20.328
Aternalia tridentata tridentata	43	18	56	39	9	41	46	7	16	19	15	9	21	3	17	359	1042.536
Chrysothamnus nauseosus	2	2	2	1		5	1				2		3	1		19	55.176
Chrysothamnus viscidiflorus													1		1	2	5.808
Cowania mexicana																	0
Ceratoides lanata	2	2	1	1		4	2	1	3	1	1	2	1		1	22	63.888
Ehretia virdis																	0
Gutierrezia sarothrae	1	2					1									11	63.888
Sarcobatus vermiculatus	2			8	22			2	1	4	29	3				71	206.184
Total Shrubs	64	32	84	61	59	77	77	29	66	43	61	24	42	10	45	774	2247.696
Trees:																	0
Juniper																	0
Pinyon																	0
Total Trees																	0
Total Vegetation	64	32	84	61	59	77	77	29	66	43	61	24	42	10	45	774	2247.696
Plant/acre	2787.84	1393.92	3659.04	2657.16	2570.04	3354.12	3354.12	1293.24	2874.96	1873.08	2657.16	1045.44	1829.52	435.6	1980.2		
Average Plant/acre	2247.696																
Standard Deviation	840.7346528																
Comments:	Japanese bromes, Aliphex with purple stem, Halogelion glomeratus, Salina wild rye, Tumble mustard, Erodium cicutaria, Western wheat grass, Unknown forb present																
	Yellow clover, Skeleton weed, Aliphex cornuta,																

Horse Canyon Revegetation Shrub Density Sheet

Date:		7/22/2004																	
Area:		16																	
Transect:		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total	Plant/acre	
UTM:	554239	554243	554243	554228	554285	554284	554238	554241	554246	554195	554206	554270	554250	554300	554231				
	4366964	4366991	4366989	4367001	4366901	4366902	4366984	4366831	4366866	4366876	4366984	4366903	4366974	4366959	4366959				
Heading:	95	232	211	287	9	128	104	57	350	92	70	260	180	188	337				
<b>Shrubs</b>																			
Altriplex canescens	51	44	45	3	5	4	8	24	11	15	9	6	35	4	43		307	891.528	
Altriplex confertifolia	1	1		1	8	8	2	13	4	6	12	5	1	21			83	241.032	
Altriplex confertifolia																			
Altriplex canescens																			
Artemisia nova																			
Artemisia tridentata	34	66	46	12	3		16	12	16	13	12		34	5	1		3	8.712	
Chrysothamnus nauseosus				1	16	26	7	17	11	10	8	19						335	972.84
Chrysothamnus viscidiflorus							1	1										124	360.086
Cowania mexicana																		2	5.808
Cercoides lanata				1	2					1	3							9	26.136
Ephedra viridis																			
Sarcobatus vermiculatus																			
Gutierrezia sarothrae					1	1	2	15	2		1	1						23	66.792
																			0
<b>Total Shrubs</b>	<b>86</b>	<b>111</b>	<b>91</b>	<b>18</b>	<b>35</b>	<b>39</b>	<b>36</b>	<b>83</b>	<b>44</b>	<b>47</b>	<b>45</b>	<b>31</b>	<b>70</b>	<b>40</b>	<b>110</b>	<b>886</b>	<b>2572.844</b>		
<b>Trees</b>																			
Juniper																			
Pinyon																			
<b>Total Trees</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Total Vegetation</b>	<b>86</b>	<b>111</b>	<b>91</b>	<b>18</b>	<b>35</b>	<b>39</b>	<b>36</b>	<b>83</b>	<b>44</b>	<b>47</b>	<b>45</b>	<b>31</b>	<b>70</b>	<b>40</b>	<b>110</b>	<b>886</b>	<b>2572.844</b>		
<b>Plant/acre</b>	<b>3746.16</b>	<b>4833.16</b>	<b>3963.96</b>	<b>784.08</b>	<b>1524.6</b>	<b>1698.84</b>	<b>1568.16</b>	<b>3615.48</b>	<b>1916.64</b>	<b>2047.32</b>	<b>1980.2</b>	<b>1350.36</b>	<b>3048.2</b>	<b>1742.4</b>	<b>4791.6</b>				
<b>Average Plant/acre</b>	<b>2572.844</b>																		
<b>Standard Deviation</b>	<b>1309.438593</b>																		
<b>Comments:</b>																			

## **Appendix 3**

### **Diversity and Similarity Data**

### Appendix 3. Similarity comparisons

Unique Species Reference Area (A)	Unique Species Area 3 (B)	Common Species (C)	Similarity Index $C/(A+B-C)*100$
<i>Sarcobatus vermiculatus</i>	<i>Artemisia nova</i>	<i>Gutierrezia sarothrae</i>	$3/(12+17-3)*100 = 11.54$
<i>Euphorbia fendleri</i>	<i>Artemisia tridentata</i>	<i>Machaeranthera canescens</i>	
<i>Sphaeralcea coccinea</i>	<i>Atriplex canescens</i>	<i>Bromus tectorum</i>	
<i>Phlox hoodii</i>	<i>Chrysothamnus nauseosus</i>		
<i>Plantago patagonica</i>	<i>Chrysothamnus viscidiflorus</i>		
<i>Opuntia compressa</i>	<i>Cowania mexicana</i>		
<i>Elymus salinus</i>	<i>Melilotus officinalis</i>		
<i>Juniperus osteosperma</i>	<i>Penstemon palmeri</i>		
<i>Pinus edulis</i>	<i>Grindelia squarrosa</i>		
	<i>Agropyron cristatum</i>		
	<i>Agropyron smithii</i>		
	<i>Agropyron spicatum</i>		
	<i>Elymus cinereus</i>		
	<i>Elymus gigantius</i>		

### Appendix 3. Similarity comparisons

Unique Species Reference Area (A)	Unique Species Area 6 (B)	Common Species (C)	Similarity Index $C/(A+B-C)*100$
Euphorbia fendleri	Artemisia nova	Gutierrzia sarothrae	$5/(12+23-5)*100 = 16.67$
Sphaeralcia coccinea	Artemisia tridentata	Sarcobatus vermiculatus	
Phlox hoodii	Atriplex canescens	Machaeranthera canescens	
Plantago patagonica	Atriplex confertifolia	Bromus tectorum	
Opuntia compressa	Ceratoides lanata	Elymus salinus	
Juniperus osteosperma	Chrysothamnus nauseosus		
Pinus edulis	Chrysothamnus viscidiflorus		
	Penstemon palmeri		
	Sysimbrium altissimum		
	Grindelia squarrosa		
	Agropyron smithii		
	Agropyron spicatum		
	Bromus inermis		
	Elymus cinereus		
	Elymus gigantius		
	Hilaria jamesii		
	Oryzopsis hymenoides		
	Sitanion hystrix		

### Appendix 3. Similarity comparisons

Unique Species Reference Area (A)	Unique Species Area 7 (B)	Common Species (C)	Similarity Index $C/(A+B-C)*100$
<i>Sarcobatus vermiculatus</i>	<i>Artemisia nova</i>	<i>Gutierrzia sarothrae</i>	$3/(12+18-3)*100 = 11.11$
<i>Euphorbia fendleri</i>	<i>Artemisia tridentata</i>	<i>Sphaeralcia coccinea</i>	
<i>Sphaeralcia coccinea</i>	<i>Atriplex canescens</i>	<i>Bromus tectorum</i>	
<i>Phlox hoodii</i>	<i>Atriplex confertifolia</i>		
<i>Plantago patagonica</i>	<i>Ceratoides lanata</i>		
<i>Opuntia compressa</i>	<i>Chrysothamnus nauseosus</i>		
<i>Elymus salinus</i>	<i>Chrysothamnus viscidiflorus</i>		
<i>Juniperus osteosperma</i>	<i>Cowania mexicana</i>		
<i>Pinus edulis</i>	<i>Penstemon palmeri</i>		
	<i>Sysimbrium altissimum</i>		
	<i>Agropyron spicatum</i>		
	<i>Elymus cinereus</i>		
	<i>Oryzopsis hymenoides</i>		
	<i>Sitanion hystrix</i>		
	<i>Stipa comata</i>		

### Appendix 3. Similarity comparisons

Unique Species Reference Area (A)	Unique Species Area 11/13/14 (B)	Common Species (C)	Similarity Index $C/(A+B-C)*100$
Phlox hoodii	Artemisia tridentata	Gutierrzia sarothrae	$7/(12+21-7)*100 = 26.92$
Plantago patagonica	Atriplex canescens	Sarcobatus vermiculatus	
Opuntia compressa	Ceratoides lanata	Euphorbia fendleri	
Juniperus osteosperma	Chrysothamnus nauseosus	Sphaeralcia coccinea	
Pinus edulis	Chrysothamnus viscidiflorus	Machaeranthera canescens	
	Cowania mexicana	Bromus tectorum	
	Medicago satvia	Elymus salinus	
	Penstemon palmeri		
	Grindelia squarrosa		
	Agropyron cristatum		
	Agropyron spicatum		
	Elymus cinereus		
	Elymus gigantius		
	Oryzopsis hymenoides		

### Appendix 3. Similarity comparisons

Unique Species Reference Area (A)	Unique Species Area 15/17 (B)	Common Species (C)	Similarity Index $C/(A+B-C)*100$
Euphorbia fendleri	Artemisia nova	Gutierrzia sarothrae	$5/(12+16-5)*100 = 21.73$
Sphaeralcia coccinea	Artemisia tridentata	Sarcobatus vermiculatus	
Phlox hoodii	Atriplex canescens	Machaeranthera canescens	
Plantago patagonica	Atriplex confertifolia	Bromus tectorum	
Opuntia compressa	Ceratoides lanata	Elymus salinus	
Juniperus osteosperma	Chrysothamnus nauseosus		
Pinus edulis	Agropyron spicatum		
	Elymus cinereus		
	Elymus giganteus		
	Hilaria jamesii		
	Oryzopsis hymenoides		

### Appendix 3. Similarity comparisons

Unique Species Reference Area (A)	Unique Species Area 16 (B)	Common Species (C)	Similarity Index $C/(A+B-C)*100$
<i>Sarcobatus vermiculatus</i>	<i>Artemisia tridentata</i>	<i>Gutierrezia sarothrae</i>	$3/(12+15-3)*100 = 12.50$
<i>Euphorbia fendleri</i>	<i>Atriplex canescens</i>	<i>Machaeranthera canescens</i>	
<i>Sphaeralcea coccinea</i>	<i>Atriplex confertifolia</i>	<i>Bromus tectorum</i>	
<i>Phlox hoodii</i>	<i>Ceratoides lanata</i>		
<i>Plantago patagonica</i>	<i>Chrysothamnus nauseosus</i>		
<i>Opuntia compressa</i>	<i>Chrysothamnus viscidiflorus</i>		
<i>Elymus salinus</i>	<i>Medicago sativa</i>		
<i>Juniperus osteosperma</i>	<i>Penstemon palmeri</i>		
<i>Pinus edulis</i>	<i>Agropyron cristatum</i>		
	<i>Agropyron spicatum</i>		
	<i>Elymus cinereus</i>		
	<i>Oryzopsis hymenoides</i>		

**Appendix III-1-7**

**1996 Revegetation Monitoring Report  
JBR**



environmental consultants, inc.

8160 South Highland Drive • Sandy, Utah 84093 • (801) 943-4144 • Fax (801) 942-1852

October 11, 1996

William W. Engels  
Department of Water and Power  
City of Los Angeles  
111 No. Hope Street, Room 1164  
Los Angeles, California 90012

RE: Horse Canyon Revegetation Monitoring Report

Dear Bill:

The revegetation monitoring report for Year 5 at Horse Canyon has been completed. I have enclosed three copies for you and also mailed a copy to Chris Hansen of Earth Fax. Chris will need this information for the Phase II Bond Release.

The results of the survey indicate that while this was a dry year, the revegetation at Horse Canyon is doing well and exceeds the goals for final bond release. The total vegetative cover in the revegetated areas ranged from 47 to 55 percent, well above the 33 percent required for bond release. The shrub density ranged from 2,744 to 6,181 plants per acre which compares favorably with the bond release goal of 3,000 plants per acre. The monitoring in Year 5 also establishes that the shrubs have persisted for five years and probably should be present for Year 9 when the next monitoring is due.

The data for the reference area is also included in this report.

Sincerely,

*Joseph M. Jarvis* 

Joseph M. Jarvis  
President

cc: Chris Hansen, Earth Fax

**INTERMOUNTAIN POWER AGENCY  
HORSE CANYON REFERENCE AREA AND  
REVEGETATION AREAS  
VEGETATION STUDY**

**October 11, 1996**

**Prepared for:**

**Department of Water and Power  
City of Los Angeles  
111 North Hope Street, RM 1161  
Los Angeles, CA 90012**

**Prepared by:**

**JBR Consultants Group  
8160 So. Highland Dr. #A-4  
Sandy, UT 84093**

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Appendix II	Horse Canyon Revegetation and Reference Areas - Sample Location Maps
Appendix III	Horse Canyon Revegetation Areas - Percent Cover Data
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Appendix V	Horse Canyon Revegetation Areas - Shrub Density Data

# HORSE CANYON REFERENCE AREA AND REVEGETATION AREAS VEGETATION STUDY

## 1.0 Introduction

A vegetation study was conducted by JBR Consultants Group at the Horse Canyon reclamation treatment area and the vegetation reference area in August, 1996. Reclamation of mining related disturbances was done in the fall, 1991. The reference area was established as part of the Utah Division of Oil, Gas and Mining (DOG M) permitting requirements in 1985. The purpose of the study was to quantitatively and qualitatively sample the pinyon-juniper woodland within the reference area and representative revegetated sites with respect to plant species composition, cover, and woody species density. This study was completed to fulfill the sampling requirement for year five of reclamation and to substantiate that the vegetation reclamation requirements were met for Phase II bond release.

Vegetation sampling methods were designed in accordance with the February, 1992 Revised DOGM Vegetation Information Guidelines, and with the prior vegetation study done at the reference area in 1985, 1991 and 1993. These methods are described below. Results of the study are presented as well.

Precipitation information for the Horse Canyon area was obtained from monthly records for the closest weather station at the USDI Bureau of Land Management, Price Office. The average annual precipitation for 1996 was 7.94 inches and monthly precipitation for the 1996 water year, October, 1995 through September, 1996 was as follows:

October, 1995	0.02 inches	April	0.33 inches
November	0.00	May	1.58
December	0.42	June	0.45
January, 1996	0.73	July	0.34
February	0.32	August	0.02
March	1.46	September	2.27

Annual precipitation for 1996 was 79 percent of the 30 year average. The 30 year average annual precipitation is 9.99 inches.

## 2.0 Vegetation Sampling

### 2.1 Location of Sample Sites

Transects were located randomly throughout the 3.4-acre reference area and six revegetated areas. Each transect was considered to represent one sample.

The revegetation areas chosen for sampling were selected on the basis of revegetation treatment, slope, aspect and general topographic similarities. The sampled revegetated areas correspond to reclamation treatment areas identified in the Reclamation Plan as follows:

Areas 15 and 17	Former refuse pile and landfill area
Area 16	Borrow pit area
Areas 11,13,and 14	Flat topography near canyon mouth
Area 3	North facing slope
Area 6	South facing slope
Area 7	Rabbitbrush treatment area

Fifteen samples were taken in each area for a total of 75 samples within the revegetation area. This combined data, excluding Area 7 data, was used to determine the overall success of the revegetation area. Sample adequacy was met at the 90% confidence level with a 10% change in the mean as required by DOGM.

### 2.2 Quantitative Sample Types

The point-intercept method was used to sample cover. Points were observed every two feet along a transect 100 feet in length. Vegetation species, or presence of rock, litter, or bare ground was recorded at each point. Dead, mostly decayed organic matter that was still attached to the ground was counted as litter rather than as live vegetation; organic matter that was dried, attached, but not decayed was counted as vegetation. The fifty-point sample was then used to calculate percent cover statistics for the site. Fifteen cover transects were sampled in each of the revegetation sites, for a total of 90 samples. A total of 31 cover transects was sampled in the reference area.

Shrub densities were estimated using a 0.05-acre macroplot within the revegetation area. These macroplots were in the shape of a Lindsey elbow, with two 10 x 100 foot plots at a right angle

to each other. All individual shrubs rooted in the plots were counted. Fifteen Lindsey elbows were sampled in each of the revegetated sites, (except for Area 7, rabbitbrush treatment area) a total of 90 in the entire revegetation area. The total number of shrub plants per acre was calculated.

### 2.3 Qualitative Sample Types

Observations were made at each of the six revegetation sampling areas. Notes were made recording growth, species success, soil conditions, erosion, livestock or wildlife use, insect damage, and/or other special conditions. Photo stations were also visited.

### 2.4 Data Analysis

All data obtained from cover and density sampling were checked for completeness, and statistical information was generated. The Jaccard's Community Coefficient was used to compare similarity of each of the revegetated sites with the reference area.

For each transect sampled, percent cover was recorded separately for each vegetative species, and the ground cover components of litter, rock and bare ground. Additionally, presence of cryptogamic soil was recorded within the reference area. The 50 points along a transect were considered to represent one sample. The data for all transects within the reference area and revegetated sites were averaged to provide mean cover values.

### 3.0 Discussion of the Results

Appendix I provides color photos of photo stations. Appendix II provides location maps of sample transects. Appendices III-V provide sampling results for both cover and shrub density for the revegetation area and cover data for the reference area, as listed below. Following is a summary of these results.

Appendix I	Photo Stations
Appendix II	Horse Canyon Revegetation and Reference Areas - Sample Location Maps
Appendix III	Horse Canyon Revegetation Areas - Percent Cover Data
Appendix IV	Horse Canyon Reference Area - Percent Cover Data
Appendix V	Horse Canyon Revegetation Areas - Shrub Density Data

### 3.1 Revegetation Areas

The average vegetation cover in the six revegetation areas ranged from 47 to 55 percent, with species makeup generally quite consistent among the six sites. Grasses were the dominant plant form, followed by shrubs. Forbs were very low in numbers due to the abnormally low precipitation during the early growing season. Also, introduced species such as *Melilotus officinalis* and *Medicago sativa* have been reduced greatly as expected under native range climatic conditions. It should be noted that Area 7 was left out of combined data calculations due to the different treatment of this area. Area 7 is the rabbitbrush treatment area and was handled separately when calculations were combined for an overall cover and shrub density figure for the revegetation area.

*Atriplex canescens* and *Artemisia tridentata tridentata* shared dominance as the shrub species. *Agropyron spicatum* was the dominant grass.

Shrub density ranged from 2744-6181 plants per acre with a mean of 4773 plants per acre. Dominant shrubs did have young recruitment, *Artemisia tridentata tridentata* and *Atriplex canescens* plants.

#### Area 15-17

Total vegetation cover averaged 53.5 percent for the 15 sample sites within Area 15-17. Of this amount grasses comprised of 61 percent of total vegetation, shrubs 39 percent and forbs < 1 percent.

Shrub density averaged 5248 plants/acre, with the dominance being shared by *Artemisia tridentata* and *Atriplex canescens*.

#### Area 16

Total vegetation cover averaged 53.4 percent for the 15 sample sites within Area 16. Of this amount, grasses comprised of 72 percent of the total vegetation, shrubs 27 and forbs 1 percent.

Shrub density averaged 5116 plants/acre, with the dominance being shared by *Artemisia tridentata* and *Atriplex canescens*.

### Area 3

Total vegetation cover averaged 54.5 percent for the 15 sample sites within Area 3. Of this amount grasses comprised 59 percent of the total vegetation, shrubs 40 percent and forbs 1 percent.

Shrub density average 2744 plants/acre, with the dominant being *Atriplex canescens*.

### Area 6

Total vegetation cover averaged 47.1 percent for the 15 sample sites within Area 6. Of this amount, grasses comprised 63 of the total vegetation, shrubs 35 percent and forbs 2 percent.

Shrub density averaged 6181 plants/acre, with the dominant being *Artemisia tridentata tridentata*.

### Area 7

Total vegetation cover averaged 51.2 percent for the 15 sample sites within Area 7. Of this amount, shrubs comprised of 65 percent of the total vegetation, grasses 35 percent and shrubs < 1 percent.

### Areas 11, 13 & 14

Total vegetation cover averaged 47.5 percent for the 15 sample sites within Areas 11, 13 & 14. Of this amount, grasses comprised of 54 percent of the total vegetation, shrubs 44 percent and forbs 2 percent.

Shrub density averaged 4144 plants/acre, with the dominant being *Atriplex canescens*.

## **3.2 Reference Area**

Total vegetation cover at the reference area averaged 36.3 percent. Of this amount, trees comprised 56.4 percent, shrubs 5.6 percent, forbs 1.8 percent, grasses 36.0 percent and succulents 0.4 percent. *Juniperus osteosperma* was the dominant tree species, *Xanthocephalum sarothrae* was the dominant shrub species, and *Elymus salinus* was the dominant grass species recorded during the survey. There was no dominant forb or succulent species.

As a target of 3000 shrub plants per acre was established for the reference area, it was not necessary to sample shrub/tree density as an index for comparison with revegetation areas.

### 3.3 Comparison of Revegetation Areas with Reference Area

The Jaccard's Community Coefficient was calculated as a measure of the similarity of each of the revegetated sites with the reference area. The index can range from 1 to 100, with an index of 0 representing sites with no species in common and thus very dissimilar, and an index of 100 representing sites that have all the same species and thus are very similar. As the data table shows, the similarity ranged from 6.9 to 14.3, indicating that the sites have some species in common, but not a majority. This is expected given the differences in species in the recently seeded area with those present in the native reference area.

A comparison of vegetative cover in the six revegetated sites (ranging from 47.1 to 54.5 percent) with the 1996 reference area survey (36.3 percent) shows that a much greater cover is present on the revegetated sites. As specified in the reclamation plan, the revegetation will be considered successful when vegetative cover and diversity are within 90% of the undisturbed communities at a 90% statistical confidence. The vegetative cover mean for the reference area at the 90% confidence level is 36.3 percent cover. The vegetative cover mean for the combined data for the revegetated areas at the 90% confidence level is 51.4 percent cover.

$$36.3\% \times (90\%) = 32.7\%$$

The 51.4 percent vegetative cover in the revegetation areas is greater than the required 32.7 percent vegetative cover in the reference area (90 percent of the undisturbed communities). Therefore vegetation cover has been met by the reclamation effort on the revegetation areas at Horse Canyon.

A comparison of shrub density in the six revegetated sites (ranging from 2744 to 6181 plants/acre, with a mean of 4773 plants/acre) with the target of 3000 plants per acre in the reclamation plan indicates that the target has been met for shrub density in the reclamation site, except for Area 3 (2,744 plants/acre). Further, success of this site is illustrated by the establishment for five years, the majority of the plants are mature, producing seed and plants have survived both good and poor precipitation years. Shrub density on the revegetated sites met the goal of 3,000 plants/acre at a 90% statistical confidence in order to be considered successful.

### 3.4 Qualitative Samples

Overall qualitative observations indicate that there is little or no soil movement due to erosion. This is due to the high percentage of ground cover, soil binding plants that have been established such as grasses and the relatively low precipitation that has taken place during the previous spring and summer months.

For the most part grasses and shrubs have very little seed production due to the drought over the growing season. Few shrubs have been able to produce seed, however these are isolated plants that have a microclimate that would have concentrated any available moisture. Overall, grass and shrub species are healthy and stable. Due to the lack of moisture and the present drought year, plants have very low annual production.

The forbs are for the most part absent. The low precipitation eliminated much of the introduced species over the last couple of years, such as *Melilotus officinalis* and *Medicago sativa*. *Melilotus officinalis* is generally a part of a revegetation mixture for quick establishment and site stabilization, however, as a biannual, is soon eliminated and out competed by natives and more adapted introduced species. *Medicago sativa* is a long-lived species and its decline may be due to the dense grass cover.

Shrub density has been greatly reduced over the years, as expected. The early establishment years were high in seedling numbers, however, stronger individuals out competed and established fewer mature plants on the site.

Overall there has been a decrease in *Chrysothamnus viscidiflorus* and *Chrysothamnus nauseosus*, the leaves show signs of some sort of insect damage, however this is not conclusive. Further, these sites are not typical *Chrysothamnus* spp. sites and these plants are apparently out competed by better adapted species such as *Artemisia tridentata tridentata* and *Atriplex canescens*.

Litter is lower in some areas due to the lack of annual production. In past years *Bromus tectorum* contributed significantly to annual litter production.

## Area 6

An odd utilization pattern that follows the old road in this site indicates that grazing has taken place by a feral cow and/or calf. Cow manure is present on site as well.

### 3.5 Sample Adequacy Calculations

To determine the number of transects required to adequately sample the vegetation in the reference area, the formula presented in the DOGM guidelines was used.

A 90 percent confidence level, with a 10 percent change in the mean was used to determine sample adequacy levels for both cover and density parameters. Results of the adequacy tests are shown in the following tables. Only the vegetation cover values were used in the cover parameter sample adequacy calculations.

SAMPLE ADEQUACY INFORMATION HORSE CANYON REVEGETATION AREA 15-17				
Parameter	n	Mean	Std	$n_{min}$
Cover	15	53.5	10.8	6.4
Shrub Density	15	5247.5	2293.9	34.9

SAMPLE ADEQUACY INFORMATION HORSE CANYON REVEGETATION AREA 16				
Parameter	n	Mean	Std	$n_{min}$
Cover	15	53.4	6.8	2.9
Shrub Density	15	5115.6	2744.3	54.3

SAMPLE ADEQUACY INFORMATION HORSE CANYON REVEGETATION AREA 3				
Parameter	n	Mean	Std	$\Pi_{min}$
Cover	15	54.5	14.2	12.4
Shrub Density	15	2744.4	1169.2	32.8

SAMPLE ADEQUACY INFORMATION HORSE CANYON REVEGETATION AREA 6				
Parameter	n	Mean	Std	$\Pi_{min}$
Cover	15	47.1	13.4	14.5
Shrub Density	15	6181.2	1626.5	12.6

SAMPLE ADEQUACY INFORMATION HORSE CANYON REVEGETATION AREA 7				
Parameter	n	Mean	Std	$\Pi_{min}$
Cover	15	51.2	9.2	5.8
Shrub Density	None	n/a	n/a	n/a

SAMPLE ADEQUACY INFORMATION HORSE CANYON REVEGETATION AREA 11,13,14				
Parameter	n	Mean	Std	$\Pi_{min}$
Cover	15	47.5	13.2	13.8
Shrub Density	15	4144.0	3217.8	110.5

SAMPLE ADEQUACY INFORMATION HORSE CANYON REVEGETATION AREA COMBINED DATA				
Parameter	n	Mean	Std	n <sub>min</sub>
Cover	75	51.4	12.1	13.8
Shrub Density	75	4773.0	2549.6	50.3

SAMPLE ADEQUACY INFORMATION HORSE CANYON REFERENCE AREA				
Parameter	n	Mean	Std	n <sub>min</sub>
Cover	31	36.3	12.4	19.7
Tree/Shrub	None	n/a	n/a	n/a

### 3.6 Similarity Index

The Jaccard's Community Coefficient was used to compare similarity of each of the revegetated sites with the reference area.

JACCARD'S COMMUNITY COEFFICIENT Horse Canyon Revegetation				
Revegetation Community	a	b	c	Similarity Index
Area 15-17	16	16	3	10.3
Area 16	12	16	2	7.7
Area 3	12	16	2	7.7
Area 6	15	16	2	6.9
Area 7	16	16	4	14.3
Area 11, 13, & 14	11	16	2	8.0
Combined Data	20	16	3	9.1

Jaccard's Community Coefficient:

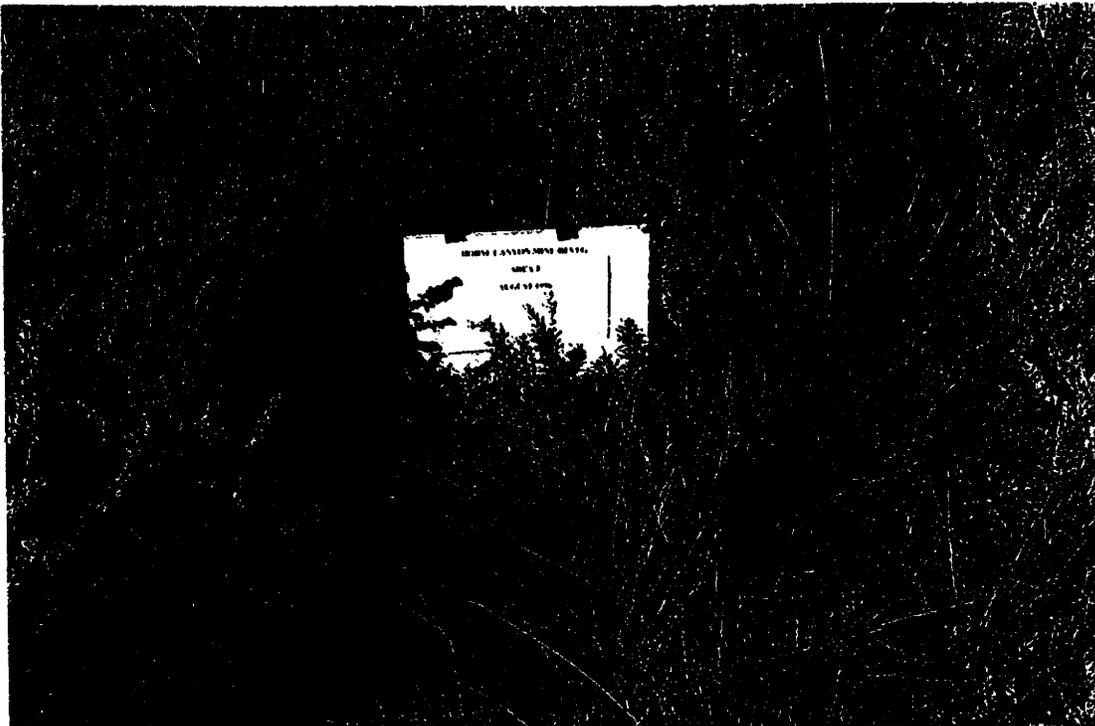
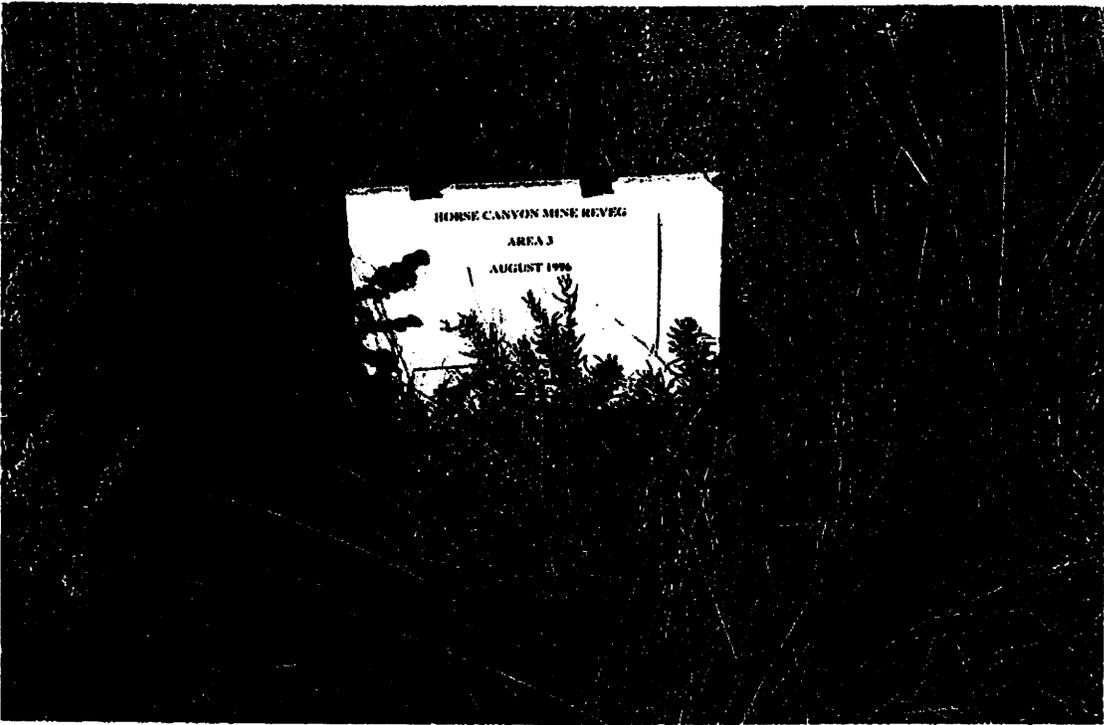
$$\text{Similarity Index} = \frac{\text{common species}}{\text{total species}} \times 100 \quad \text{or} \quad \text{SI} = \frac{c}{a + b - c} \times 100$$

Where:      SI = Similarity Index  
              a = Total number of species in revegetated community  
              b = Total number of species in reference community  
              c = Number of species common to both communities

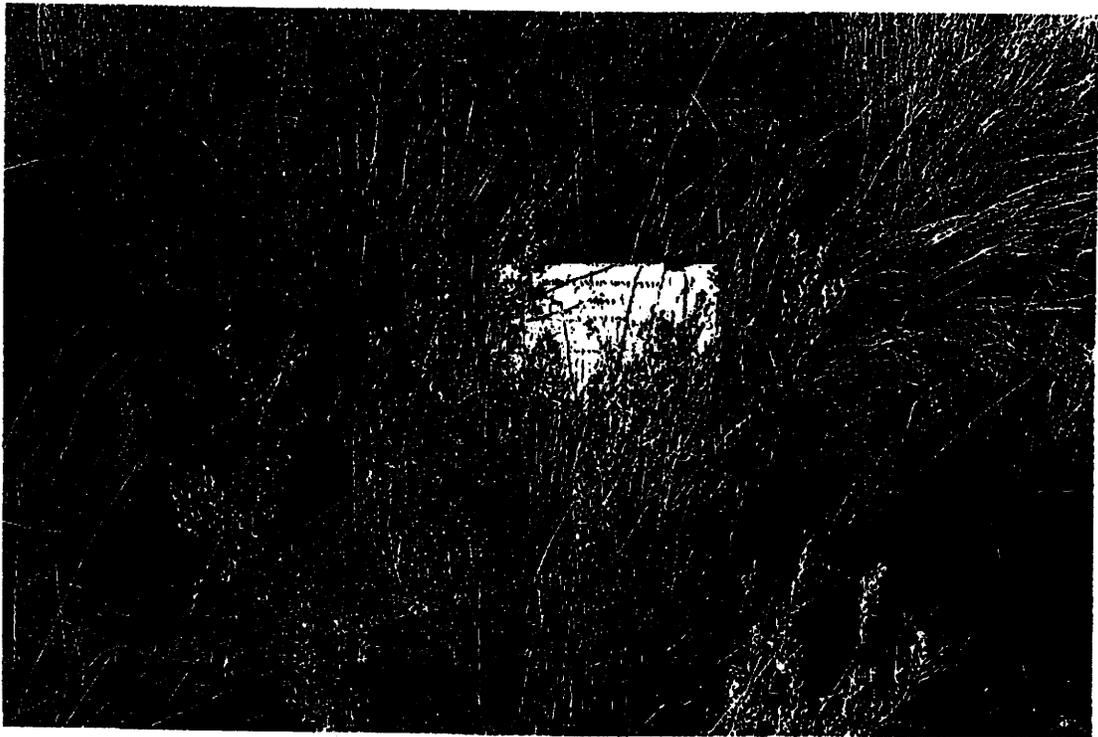
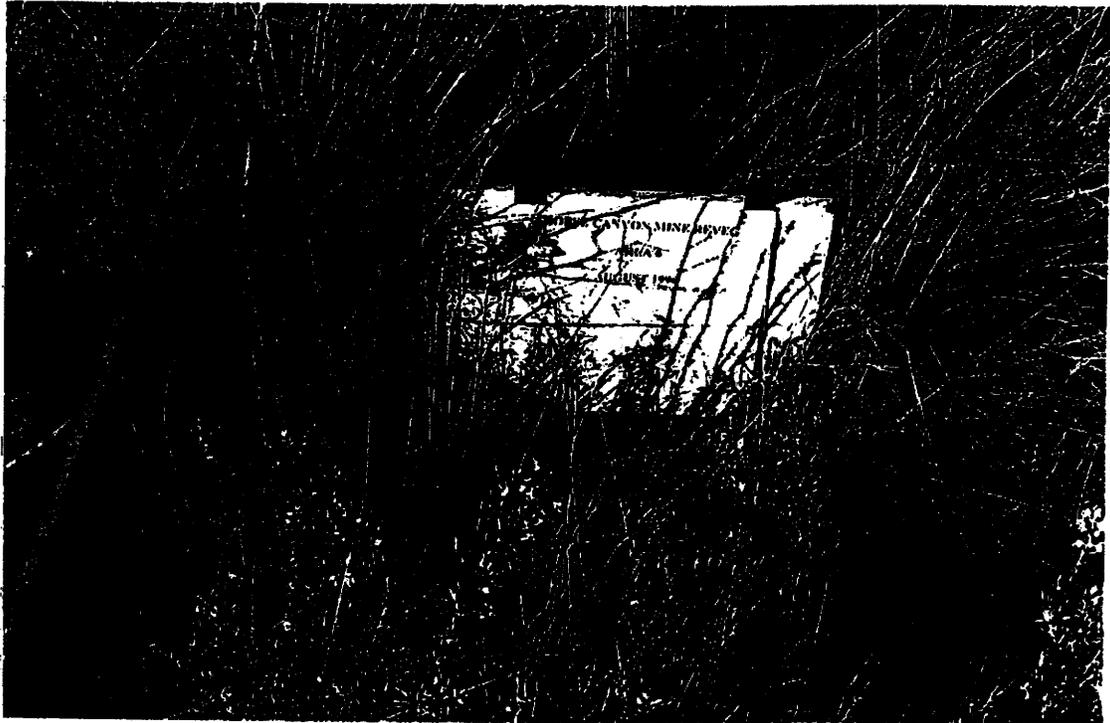
**APPENDIX I**

**Horse Canyon  
1996 Photo Stations**

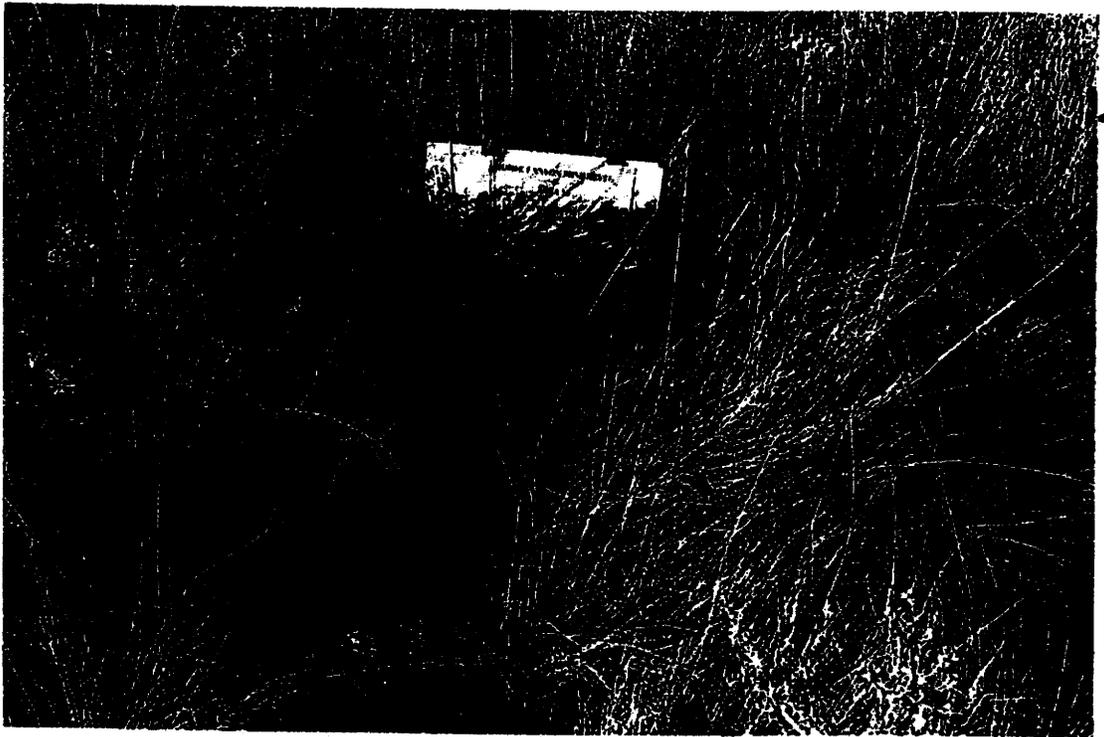
# HORSE CANYON AREA 3



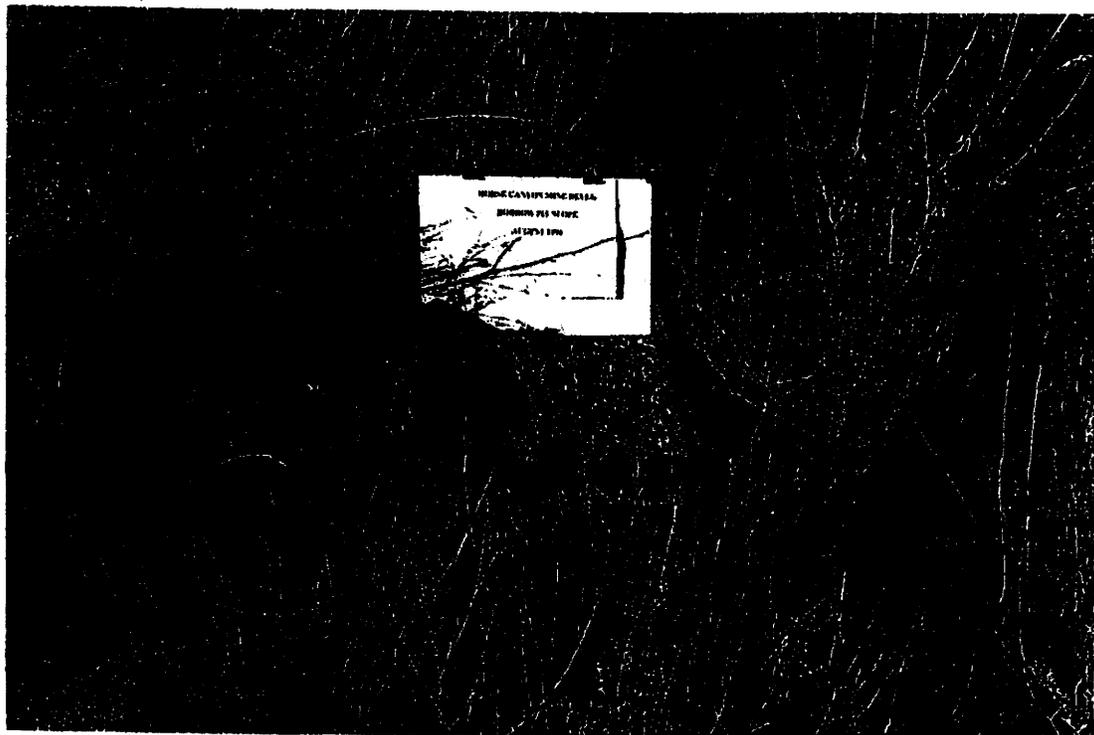
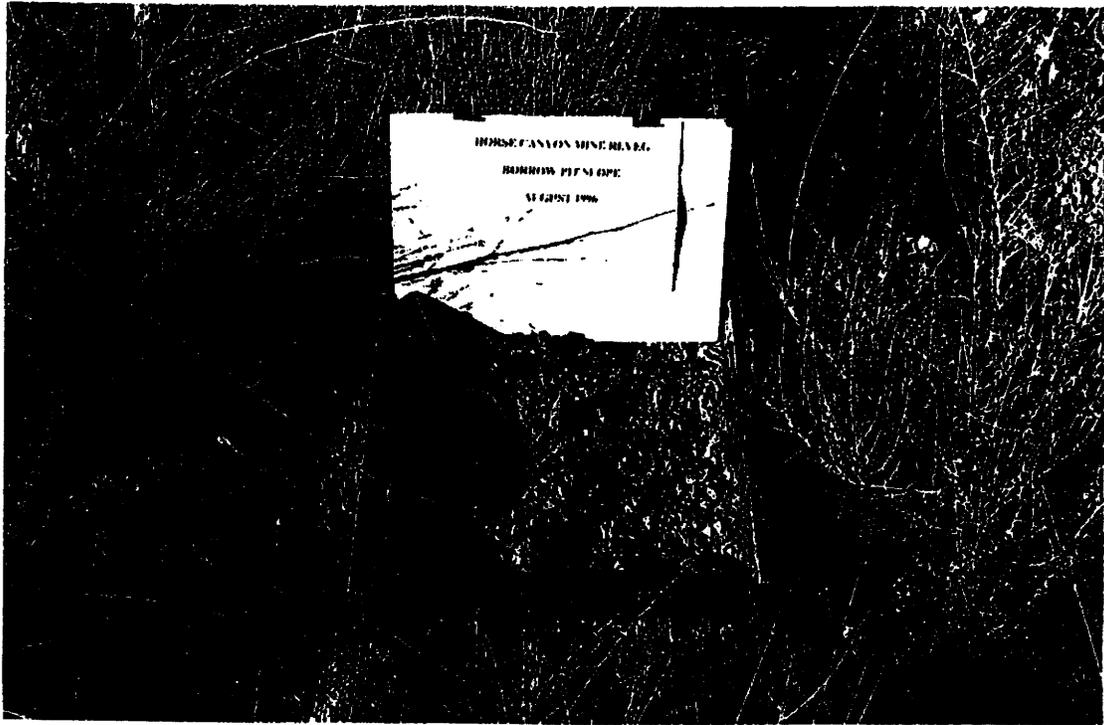
# HORSE CANYON AREA 6



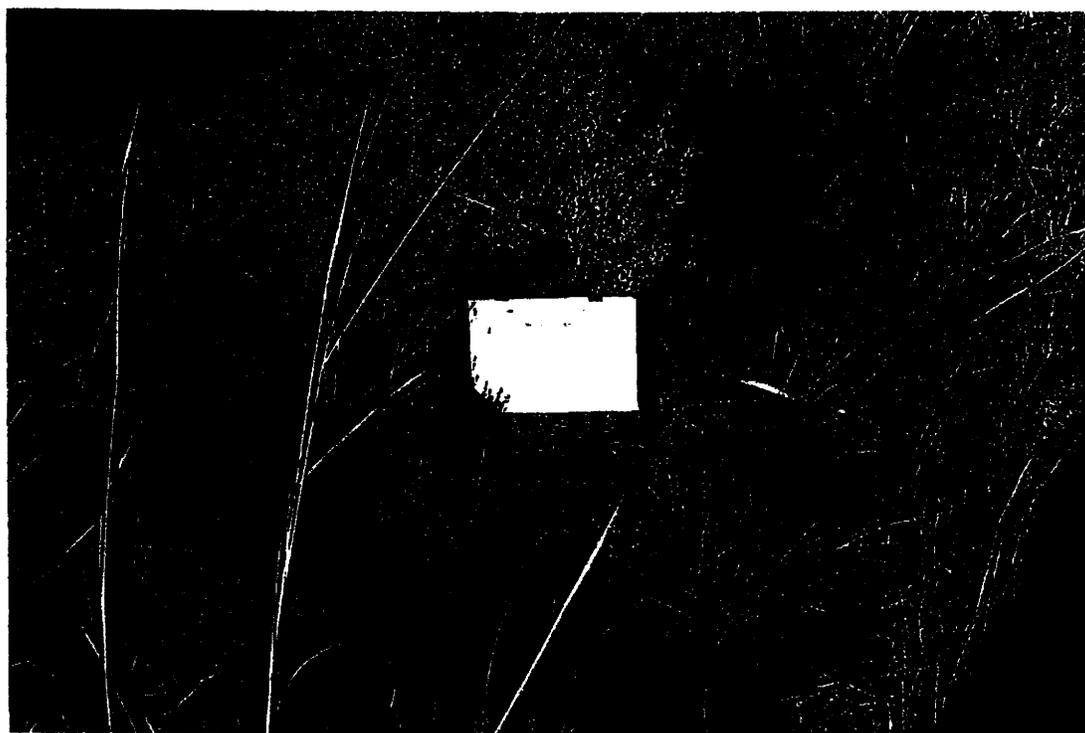
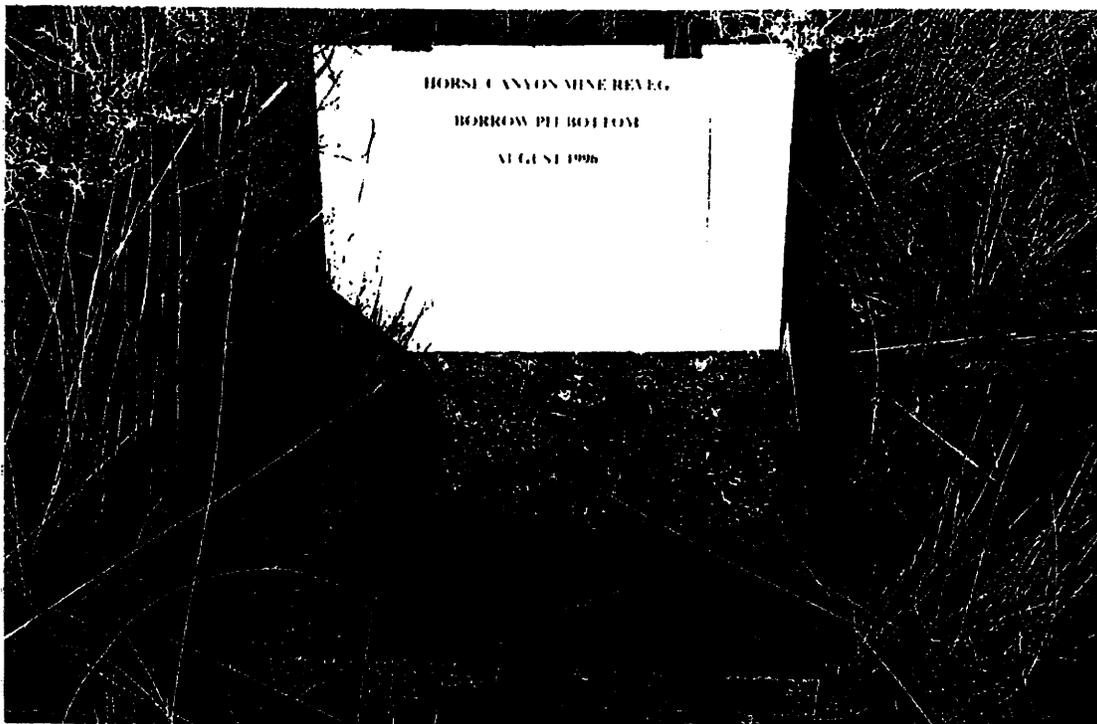
**HORSE CANYON AREA 10**



# HORSE CANYON BORROW PIT SLOPE

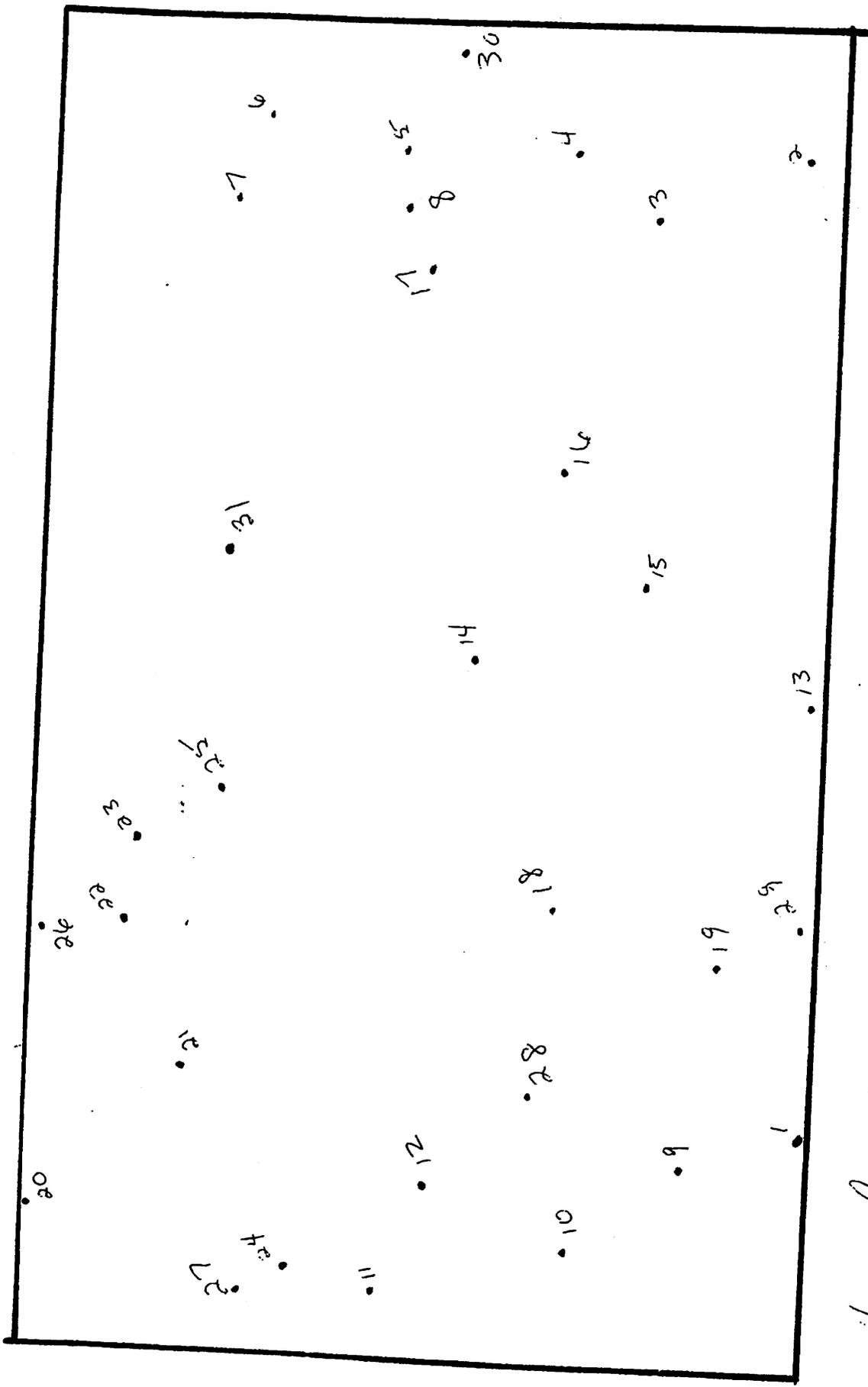


# HORSE CANYON BORROW PIT FLAT

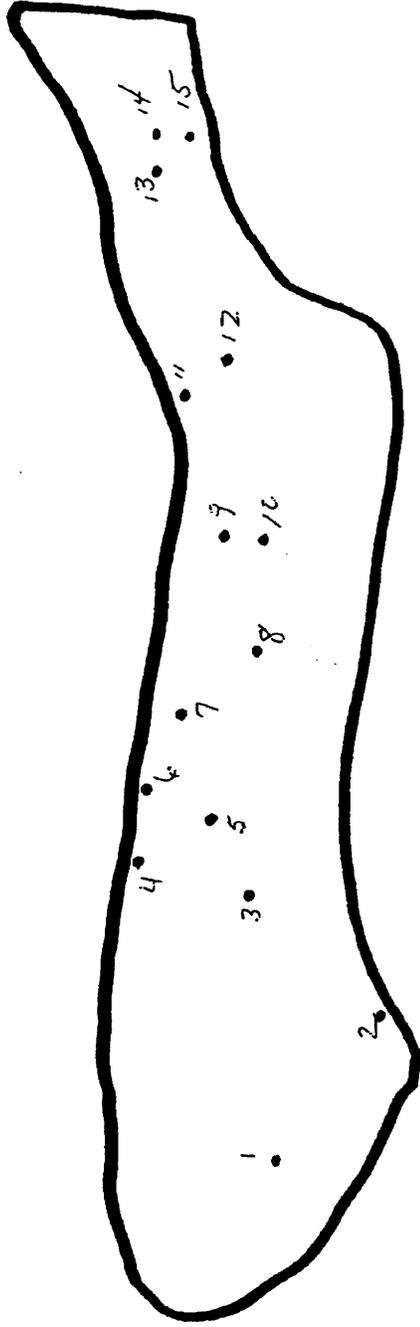


**APPENDIX II**

**Horse Canyon Reference Area and Revegetation Area  
Sample Location Maps**



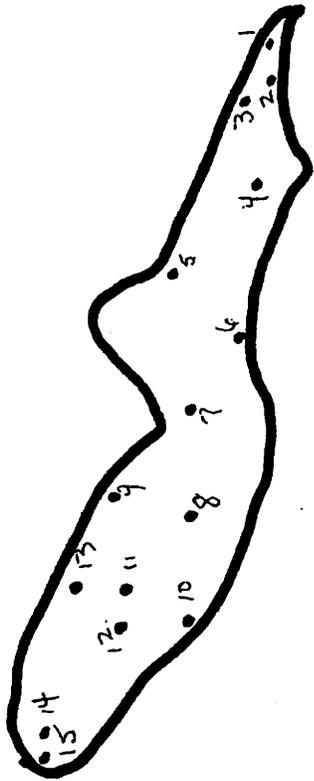
Horse Canyon  
 Reference Area  
 1996 Sample Sites



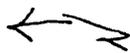
N ↑

Alorse Canyon  
Recreation Area 3

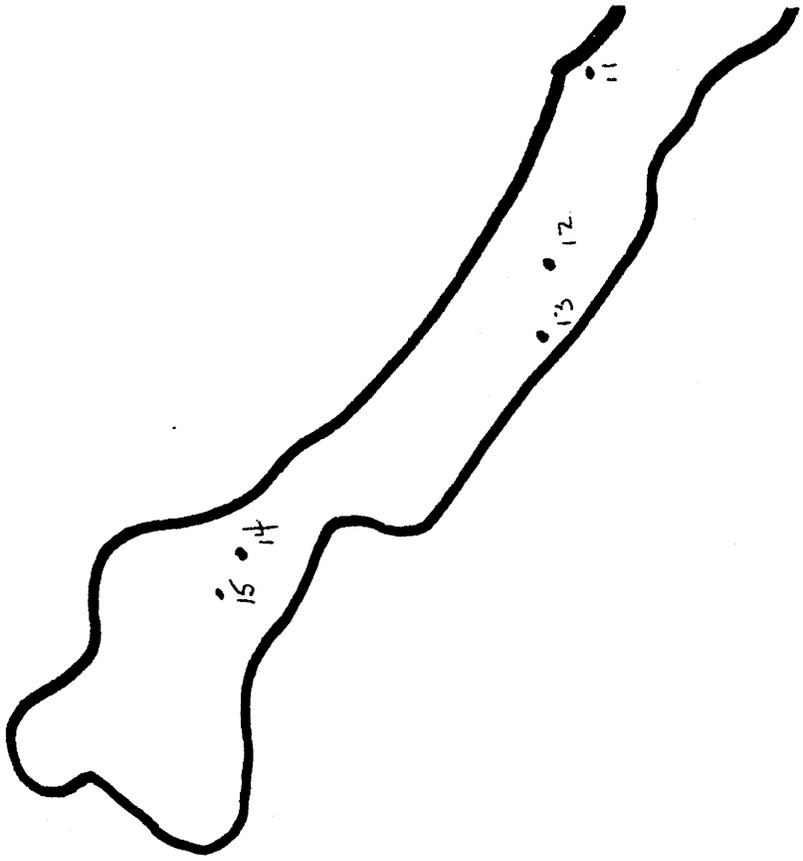
1996 Sammie Pears



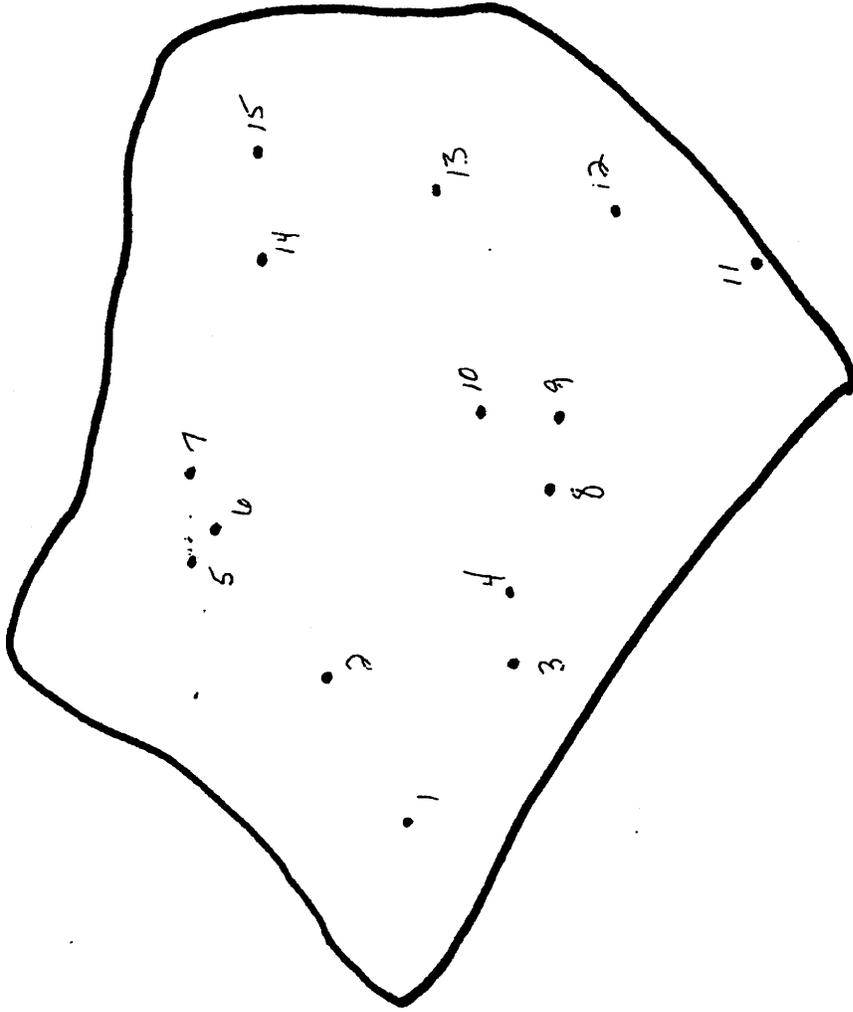
HORSE CANYON  
REVEGETATION AREA 6  
1996 SAMPLE SITES



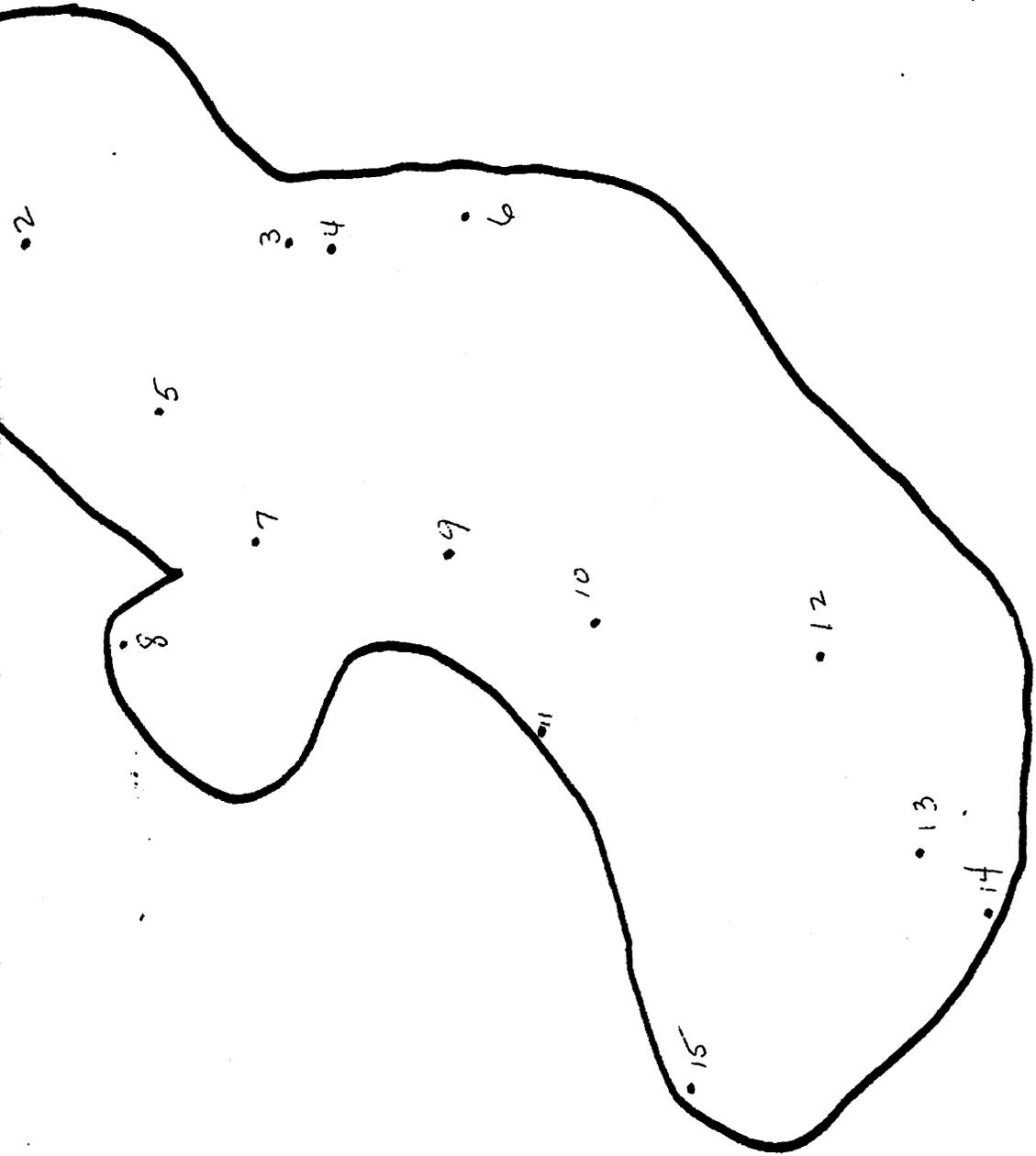
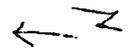
HORSE CANYEN  
REVEGETATION AREA 11, 13 & 14  
SAMPLE SITES  
1996

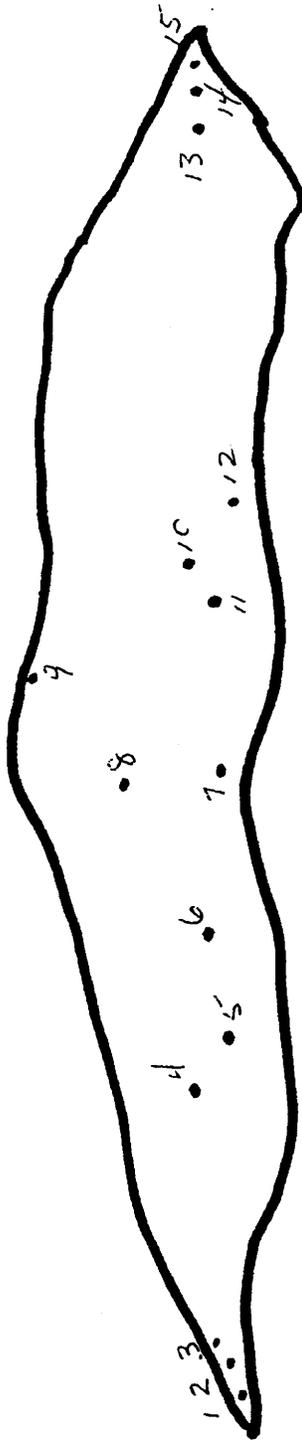


DECONTAMINATION AREA '16  
1996 SAMPLE SITES



1996 Spring SWS





HORSE CANYON  
REVEGETATION AREA 7  
RABBIT BUSH TREATMENT AREA  
1996 SAMPLE SITES

**APPENDIX III**

**Horse Canyon Revegetation Areas  
Percent Cover Data**

Horse Canyon Revegetation Area  
Percent Cover Data (Area 11, 13 & 14)

PLANT SPECIES	STAND							
	1	2	3	4	5	6	7	8
<b>Shrubs</b>								
Atriplex canescens	14	22	34	18	12	4	8	18
Artemisia tridentata tridentata	0	0	2	0	6	0	0	0
Chrysothamnus nauseosus	0	2	2	0	0	0	0	0
Chrysothamnus viscidiflorus	0	0	0	0	0	4	0	0
<b>Total Shrubs Cover</b>	<b>14</b>	<b>24</b>	<b>38</b>	<b>18</b>	<b>18</b>	<b>8</b>	<b>8</b>	<b>18</b>
<b>Forbs</b>								
Melilotus officinalis	0	0	4	0	2	4	0	0
<b>Total Forb Cover</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>2</b>	<b>4</b>	<b>0</b>	<b>0</b>
<b>Graminoid</b>								
Agropyron spicatum	26	30	6	24	6	4	44	22
Agropyron cristatum	0	2	0	0	0	0	0	0
Agropyron trachycaulum	0	0	0	0	0	0	2	0
Elymus cinereus	0	0	0	0	2	0	0	4
Oryzopsis hymenoides	2	0	0	2	0	0	0	0
Sitanion hystrix	2	0	0	0	0	0	0	0
<b>Total Graminoid Cover</b>	<b>30</b>	<b>32</b>	<b>6</b>	<b>26</b>	<b>8</b>	<b>4</b>	<b>46</b>	<b>26</b>
<b>Total Vegetation Cover</b>	<b>44</b>	<b>56</b>	<b>48</b>	<b>44</b>	<b>28</b>	<b>16</b>	<b>54</b>	<b>44</b>
Litter	46	30	50	42	68	80	42	52
Rock	0	2	0	0	0	2	0	0
Bare Ground	10	12	2	14	4	2	4	4

Horse Canyon Revegetation Area  
Percent Cover Data (Area 11, 13 & 14)

PLANT SPECIES	STAND						
	9	10	11	12	13	14	15
<b>Shrubs</b>							
Atriplex canescens	6	28	26	24	24	26	10
Artemisia tridentata tridentata	6	0	0	4	0	2	12
Chrysothamnus nauseosus	0	0	0	2	0	0	2
Chrysothamnus viscidiflorus	0	0	0	0	0	0	0
<b>Total Shrubs Cover</b>	<b>12</b>	<b>28</b>	<b>26</b>	<b>30</b>	<b>24</b>	<b>28</b>	<b>24</b>
<b>Forbs</b>							
Melilotus officinalis	0	0	0	0	2	0	0
<b>Total Forb Cover</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>
<b>Graminoid</b>							
Agropyron spicatum	28	16	42	34	12	30	32
Agropyron cristatum	2	2	0	0	0	0	0
Agropyron trachycaulum	0	2	0	0	2	0	0
Elymus cinereus	0	0	0	0	2	0	0
Oryzopsis hymenoides	2	0	0	0	0	0	0
Sitanion hystrix	2	0	0	0	0	0	0
<b>Total Graminoid Cover</b>	<b>34</b>	<b>20</b>	<b>42</b>	<b>34</b>	<b>16</b>	<b>30</b>	<b>32</b>
<b>Total Vegetation Cover</b>	<b>46</b>	<b>48</b>	<b>68</b>	<b>64</b>	<b>42</b>	<b>58</b>	<b>56</b>
Litter	52	56	30	32	44	22	34
Rock	0	0	0	2	6	16	10
Bare Ground	2	6	2	2	8	4	0

Horse Canyon Revegetation Area  
Percent Cover Data (Area 15, 17)

PLANT SPECIES	STAND							
	1	2	3	4	5	6	7	8
<b>Shrubs</b>								
<i>Atriplex canescens</i>	6	12	26	26	18	6	24	18
<i>Atriplex confertifolia</i>	0	0	0	0	0	0	2	0
<i>Atriplex corrugata</i>	0	0	0	0	0	2	0	0
<i>Artemisia tridentata tridentata</i>	10	4	0	0	2	2	0	0
<i>Chrysothamnus nauseosus</i>	0	0	0	0	0	0	0	0
<i>Chrysothamnus viscidiflorus</i>	0	0	0	0	0	0	0	2
<i>Ceratoides lanata</i>	0	0	0	0	0	0	0	0
<i>Sarcobatus vermiculatus</i>	0	4	0	0	0	0	0	2
<b>Total Shrubs Cover</b>	16	20	26	26	20	10	26	22
<b>Forbs</b>								
<i>Melilotus officinalis</i>	0	0	0	0	0	0	0	2
<b>Total Forb Cover</b>	0	0	0	0	0	0	0	2
<b>Graminoid</b>								
<i>Agropyron spicatum</i>	16	32	38	44	42	44	40	18
<i>Agropyron cristatum</i>	0	0	0	0	0	0	0	0
<i>Agropyron trachycaulum</i>	0	0	0	0	0	0	0	0
<i>Elymus cinereus</i>	0	0	2	0	0	0	0	0
<i>Oryzopsis hymenoides</i>	0	0	0	0	2	0	0	2
<i>Poa species</i>	0	0	0	0	0	0	0	2
<i>Sitanion histrix</i>	0	0	0	0	0	0	0	0
<b>Total Graminoid Cover</b>	16	32	40	44	44	44	40	22
<b>Total Vegetation Cover</b>	32	52	66	70	64	54	66	46
<b>Litter</b>	38	24	26	24	26	46	24	30
<b>Rock</b>	26	2	4	0	0	0	0	10
<b>Bare Ground</b>	4	22	4	6	10	0	10	14

Horse Canyon Revegetation Area  
Percent Cover Data (Area 15, 17)

PLANT SPECIES	STAND						
	9	10	11	12	13	14	15
<b>Shrubs</b>							
<i>Atriplex canescens</i>	20	18	2	12	16	10	14
<i>Atriplex confertifolia</i>	2	0	0	0	0	0	0
<i>Atriplex corraguta</i>	0	0	0	0	0	0	0
<i>Artemisia tridentata tridentata</i>	0	4	6	10	6	12	2
<i>Chrysothamnus nauseosus</i>	0	2	0	0	0	0	0
<i>Chrysothamnus viscidiflorus</i>	0	2	0	2	0	2	0
<i>Ceratoides lanata</i>	0	2	0	0	0	0	0
<i>Sarcobatus vermiculatus</i>	2	0	0	0	0	0	0
<b>Total Shrubs Cover</b>	<b>24</b>	<b>28</b>	<b>8</b>	<b>24</b>	<b>22</b>	<b>24</b>	<b>16</b>
<b>Forbs</b>							
<i>Melilotus officinalis</i>	0	0	0	0	0	0	0
<b>Total Forb Cover</b>	<b>0</b>						
<b>Graminoid</b>							
<i>Agropyron spicatum</i>	32	22	32	30	30	10	26
<i>Agropyron cristatum</i>	2	0	0	0	0	0	0
<i>Agropyron trachycaulum</i>	0	0	2	0	0	0	0
<i>Elymus cinereus</i>	0	2	0	0	2	0	4
<i>Oryzopsis hymenoides</i>	0	0	0	0	2	0	4
<i>Poa species</i>	0	0	2	0	2	0	0
<i>Sitanion hystrix</i>	0	2	2	0	0	0	0
<b>Total Graminoid Cover</b>	<b>34</b>	<b>26</b>	<b>38</b>	<b>30</b>	<b>36</b>	<b>10</b>	<b>34</b>
<b>Total Vegetation Cover</b>	<b>58</b>	<b>54</b>	<b>46</b>	<b>54</b>	<b>58</b>	<b>34</b>	<b>50</b>
Litter	36	32	42	44	34	60	32
Rock	0	6	4	2	2	4	0
Bare Ground	6	8	8	0	6	2	18

Horse Canyon Revegetation Area  
Percent Cover Data (Area 16)

PLANT SPECIES	STAND							
	1	2	3	4	5	6	7	8
<b>Shrubs</b>								
<i>Atriplex canescens</i>	14	16	14	14	2	4	4	4
<i>Atriplex confertifolia</i>	0	0	0	0	0	6	2	0
<i>Artemisia tridentata tridentata</i>	4	2	0	4	6	2	0	0
<i>Chrysothamnus nauseosus</i>	0	0	0	0	0	0	2	0
<i>Chrysothamnus viscidiflorus</i>	0	0	0	0	0	4	8	2
<i>Ceratoides lanata</i>	4	0	4	0	0	0	0	0
<b>Total Shrubs Cover</b>	221 8	18	18	18	8	16	16	6
<b>Forbs</b>								
<i>Melilotus officinalis</i>	0	2	0	0	10	0	0	0
<b>Total Forb Cover</b>	0	2	0	0	10	0	0	0
<b>Graminoid</b>								
<i>Agropyron spicatum</i>	38	20	28	22	30	38	40	28
<i>Agropyron cristatum</i>	0	0	0	4	0	0	0	0
<i>Agropyron trachycaulum</i>	0	0	0	0	0	0	0	18
<i>Elymus cinereus</i>	0	0	2	0	0	2	2	0
<i>Oryzopsis hymenoides</i>	0	0	2	0	2	2	4	0
<b>Total Graminoid Cover</b>	38	20	32	26	32	42	46	46
<b>Total Vegetation Cover</b>	60	40	50	44	50	58	62	52
Litter	28	32	18	44	32	26	26	24
Rock	0	14	4	2	8	2	0	6
Bare Ground	12	14	28	10	10	14	12	18

Horse Canyon Revegetation Area  
Percent Cover Data (Area 16)

PLANT SPECIES	STAND						
	9	10	11	12	13	14	15
<b>Shrubs</b>							
<i>Atriplex canescens</i>	10	10	8	0	0	22	14
<i>Atriplex confertifolia</i>	2	0	0	0	6	0	0
<i>Artemisia tridentata tridentata</i>	0	0	0	0	0	0	0
<i>Chrysothamnus nauseosus</i>	0	0	2	2	8	0	0
<i>Chrysothamnus viscidiflorus</i>	2	0	2	0	2	2	0
<i>Ceratoides lanata</i>	0	0	0	0	0	0	0
<b>Total Shrubs Cover</b>	<b>14</b>	<b>10</b>	<b>12</b>	<b>2</b>	<b>16</b>	<b>24</b>	<b>14</b>
<b>Forbs</b>							
<i>Melilotus officinalis</i>	0	0	0	0	0	0	0
<b>Total Forb Cover</b>	<b>0</b>						
<b>Graminoid</b>							
<i>Agropyron spicatum</i>	22	40	40	38	40	42	24
<i>Agropyron cristatum</i>	2	0	0	0	0	0	0
<i>Agropyron trachycaulum</i>	2	0	0	2	0	0	8
<i>Elymus cinereus</i>	6	0	0	2	2	0	4
<i>Oryzopsis hymenoides</i>	4	2	2	6	0	0	4
<b>Total Graminoid Cover</b>	<b>36</b>	<b>42</b>	<b>42</b>	<b>48</b>	<b>42</b>	<b>42</b>	<b>40</b>
<b>Total Vegetation Cover</b>	<b>50</b>	<b>52</b>	<b>54</b>	<b>50</b>	<b>58</b>	<b>66</b>	<b>54</b>
Litter	30	38	18	34	24	22	18
Rock	0	6	2	0	6	0	6
Bare Ground	20	4	26	16	12	12	22

Horse Canyon Revegetation Area  
Percent Cover Data (Area 3)

PLANT SPECIES	STAND							
	1	2	3	4	5	6	7	8
<b>Shrubs</b>								
<i>Atriplex canescens</i>	14	20	22	2	16	4	10	2
<i>Artemisia tridentata tridentata</i>	2	6	0	2	0	0	0	0
<i>Chrysothamnus nauseosus</i>	0	0	4	0	0	0	0	0
<i>Chrysothamnus viscidiflorus</i>	2	0	2	4	12	12	14	10
<b>Total Shrubs Cover</b>	<b>18</b>	<b>26</b>	<b>28</b>	<b>8</b>	<b>28</b>	<b>16</b>	<b>24</b>	<b>12</b>
<b>Forbs</b>								
<i>Melilotus officinalis</i>	0	0	0	0	0	0	0	2
<i>Penstemon palmeri</i>	0	0	0	0	0	0	0	0
<b>Total Forb Cover</b>	<b>0</b>	<b>2</b>						
<b>Graminoid</b>								
<i>Agropyron spicatum</i>	34	22	38	24	38	10	28	12
<i>Agropyron cristatum</i>	0	0	0	0	0	0	4	0
<i>Agropyron trachycaulum</i>	2	0	2	12	6	2	4	0
<i>Elymus cinereus</i>	0	6	2	0	4	2	0	2
<i>Elymus giganteus</i>	0	0	0	0	0	0	0	0
<i>Oryzopsis hymenoides</i>	0	0	0	0	0	0	0	0
<b>Total Graminoid Cover</b>	<b>36</b>	<b>28</b>	<b>42</b>	<b>36</b>	<b>48</b>	<b>14</b>	<b>36</b>	<b>14</b>
<b>Total Vegetation Cover</b>	<b>54</b>	<b>54</b>	<b>70</b>	<b>44</b>	<b>76</b>	<b>30</b>	<b>60</b>	<b>28</b>
<b>Litter</b>	<b>26</b>	<b>44</b>	<b>26</b>	<b>50</b>	<b>22</b>	<b>58</b>	<b>32</b>	<b>60</b>
<b>Rock</b>	<b>18</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>
<b>Bare Ground</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>6</b>	<b>2</b>	<b>10</b>	<b>8</b>	<b>12</b>

Horse Canyon Revegetation Area  
Percent Cover Data (Area 3)

PLANT SPECIES	STAND						
	9	10	11	12	13	14	15
<b>Shrubs</b>							
<i>Atriplex canescens</i>	0	14	10	20	28	8	2
<i>Artemisia tridentata tridentata</i>	0	0	12	4	0	8	2
<i>Chrysothamnus nauseosus</i>	0	0	4	4	0	0	0
<i>Chrysothamnus viscidiflorus</i>	26	22	0	4	0	0	0
<b>Total Shrubs Cover</b>	26	36	26	32	28	16	4
<b>Forbs</b>							
<i>Melilotus officinalis</i>	0	0	0	0	0	0	0
<i>Penstemon palmeri</i>	0	0	0	0	0	0	2
<b>Total Forb Cover</b>	0	0	0	0	0	0	2
<b>Graminoid</b>							
<i>Agropyron spicatum</i>	10	20	28	36	26	38	38
<i>Agropyron cristatum</i>	0	0	0	0	0	0	0
<i>Agropyron trachycaulum</i>	0	0	2	0	0	2	6
<i>Elymus cinereus</i>	0	0	0	0	6	8	8
<i>Elymus giganteus</i>	0	0	0	0	0	0	2
<i>Oryzopsis hymenoides</i>	0	0	0	0	2	0	0
<b>Total Graminoid Cover</b>	10	20	30	36	34	48	54
<b>Total Vegetation Cover</b>	36	56	56	68	62	64	60
<b>Litter</b>	44	28	30	16	34	28	32
<b>Rock</b>	2	4	10	8	0	2	4
<b>Bare Ground</b>	18	12	4	8	4	6	4

Horse Canyon Revegetation Area  
Percent Cover Data (Area 6)

PLANT SPECIES	STAND							
	1	2	3	4	5	6	7	8
<b>Shrubs</b>								
<i>Atriplex canescens</i>	8	16	2	12	6	12	2	12
<i>Artemisia tridentata tridentata</i>	0	2	2	4	4	0	4	4
<i>Chrysothamnus nauseosus</i>	0	0	0	2	0	0	0	0
<i>Chrysothamnus viscidiflorus</i>	2	2	4	14	0	2	0	0
<i>Ceratoides lanata</i>	0	0	2	0	0	0	4	4
<b>Total Shrubs Cover</b>	10	20	10	32	10	14	10	20
<b>Forbs</b>								
<i>Medicago sativa</i>	0	0	0	0	0	0	0	2
<i>Melilotus officinalis</i>	2	0	0	0	0	0	0	0
<i>Penstemon palmeri</i>	0	2	0	0	0	0	0	2
<i>Salsola kali</i>	0	2	2	0	0	2	0	0
<b>Total Forb Cover</b>	2	4	2	0	0	2	0	42
<b>Graminoid</b>								
<i>Agropyron spicatum</i>	28	26	10	6	30	14	18	24
<i>Agropyron cristatum</i>	0	0	0	0	0	0	0	0
<i>Agropyron trachycaulum</i>	0	2	2	0	0	0	0	0
<i>Elymus cinereus</i>	0	0	0	0	4	0	0	2
<i>Oryzopsis hymenoides</i>	0	0	0	4	0	0	0	0
<i>Sitanion histrix</i>	0	0	0	0	0	0	0	0
<b>Total Graminoid Cover</b>	28	28	12	10	34	14	18	26
<b>Total Vegetation Cover</b>	40	52	24	42	44	28	28	50
Litter	42	32	38	30	42	36	26	20
Rock	6	4	2	4	0	4	28	18
Bare Ground	12	12	36	24	14	32	18	12

Horse Canyon Revegetation Area  
Percent Cover Data (Area 6)

PLANT SPECIES	STAND						
	9	10	11	12	13	14	15
<b>Shrubs</b>							
<i>Atriplex canescens</i>	8	12	10	6	24	22	8
<i>Artemisia tridentata tridentata</i>	2	4	2	2	2	0	4
<i>Chrysothamnus nauseosus</i>	2	0	2	0	0	0	0
<i>Chrysothamnus viscidiflorus</i>	6	0	8	0	6	0	0
<i>Ceratoides lanata</i>	0	0	0	0	0	0	0
<b>Total Shrubs Cover</b>	18	16	22	8	32	22	12
<b>Forbs</b>							
<i>Medicago sativa</i>	0	0	0	0	0	0	0
<i>Melilotus officinalis</i>	0	0	0	0	0	0	0
<i>Penstemon palmeri</i>	0	0	0	0	0	0	0
<i>Salsola kali</i>	0	0	0	0	0	0	0
<b>Total Forb Cover</b>	0	0	0	0	0	0	0
<b>Graminoid</b>							
<i>Agropyron spicatum</i>	30	36	28	40	36	40	42
<i>Agropyron cristatum</i>	2	0	0	0	0	0	0
<i>Agropyron trachycaulum</i>	0	0	0	0	0	0	0
<i>Elymus cinereus</i>	0	0	2	0	0	0	0
<i>Oryzopsis hymenoides</i>	0	0	4	4	4	2	2
<i>Sitanion histrix</i>	0	2	0	0	0	0	0
<b>Total Graminoid Cover</b>	32	38	34	44	40	42	44
<b>Total Vegetation Cover</b>	48	54	56	52	72	64	56
<b>Litter</b>	42	34	34	40	20	32	38
<b>Rock</b>	0	0	0	0	0	0	0
<b>Bare Ground</b>	10	12	10	8	8	4	16

Horse Canyon Revegetation Area  
Percent Cover Data (Area 7)

PLANT SPECIES	STAND							
	1	2	3	4	5	6	7	8
<b>Shrubs</b>								
<i>Atriplex canescens</i>	18	10	14	10	12	24	18	26
<i>Artemisia tridentata tridentata</i>	4	4	6	4	10	6	10	2
<i>Chrysothamnus nauseosus</i>	0	2	0	0	0	0	0	0
<i>Chrysothamnus viscidiflorus</i>	0	12	18	16	16	14	14	12
<i>Ceratoides lanata</i>	0	0	0	0	0	0	0	0
<b>Total Shrubs Cover</b>	<b>22</b>	<b>28</b>	<b>38</b>	<b>30</b>	<b>38</b>	<b>44</b>	<b>42</b>	<b>40</b>
<b>Forbs</b>								
<i>Machaeranthera canescens</i>	0	0	0	0	0	0	0	2
<i>Penstemon palmeri</i>	0	0	0	0	0	0	0	0
<b>Total Forb Cover</b>	<b>0</b>	<b>2</b>						
<b>Graminoid</b>								
<i>Agropyron spicatum</i>	24	18	10	20	22	10	4	12
<i>Agropyron cristatum</i>	2	0	0	0	0	0	0	0
<i>Bromus tectorum</i>	2	0	0	0	0	0	0	0
<i>Elymus cinereus</i>	0	0	0	0	0	0	0	0
<i>Oryzopsis hymenoides</i>	2	6	2	0	6	0	0	0
<i>Poa species</i>	4	0	0	0	0	0	0	2
<i>Sitanion hystrix</i>	0	0	0	0	0	0	0	0
<i>Sporobolus cryptandrus</i>	0	2	0	0	4	6	6	2
<i>Stipa comata</i>	0	0	0	0	0	0	0	0
<b>Total Graminoid Cover</b>	<b>34</b>	<b>26</b>	<b>12</b>	<b>20</b>	<b>32</b>	<b>16</b>	<b>10</b>	<b>16</b>
<b>Total Vegetation Cover</b>	<b>56</b>	<b>54</b>	<b>50</b>	<b>50</b>	<b>70</b>	<b>60</b>	<b>52</b>	<b>58</b>
Litter	44	44	42	0	0	0	42	34
Rock	0	0	0	0	0	0	0	0
Bare Ground	0	2	8	50	30	40	6	8

Horse Canyon Revegetation Area  
Percent Cover Data (Area 7)

PLANT SPECIES	STAND						
	9	10	11	12	13	14	15
<b>Shrubs</b>							
<i>Atriplex canescens</i>	0	10	8	6	0	0	0
<i>Artemisia tridentata tridentata</i>	6	12	12	14	14	10	12
<i>Chrysothamnus nauseosus</i>	0	0	2	0	0	0	0
<i>Chrysothamnus viscidiflorus</i>	26	4	16	16	18	12	16
<i>Ceratoides lanata</i>	0	0	0	2	0	0	0
<b>Total Shrubs Cover</b>	32	26	38	38	32	22	28
<b>Forbs</b>							
<i>Machaeranthera canescens</i>	0	0	0	0	0	0	0
<i>Penstemon palmeri</i>	0	2	0	0	0	0	0
<b>Total Forb Cover</b>	0	2	0	0	0	0	0
<b>Graminoid</b>							
<i>Agropyron spicatum</i>	0	8	12	16	12	8	6
<i>Agropyron cristatum</i>	0	0	0	0	0	0	0
<i>Bromus tectorum</i>	0	0	0	0	0	0	0
<i>Elymus cinereus</i>	0	0	0	0	2	0	0
<i>Oryzopsis hymenoides</i>	0	6	2	0	4	6	2
<i>Poa species</i>	0	0	0	0	0	0	0
<i>Sitanion hystrix</i>	0	8	0	0	2	0	2
<i>Sporobolus cryptandrus</i>	0	0	0	0	0	0	2
<i>Stipa comata</i>	2	0	0	0	0	0	0
<b>Total Graminoid Cover</b>	2	22	14	16	20	14	12
<b>Total Vegetation Cover</b>	34	50	52	54	52	36	40
Litter	60	44	38	44	32	40	40
Rock	0	0	0	0	10	12	0
Bare Ground	6	6	10	2	6	12	20

Horse Canyon Revegetation Area  
Percent Cover Data (Area 11, 13 & 14)

PLANT SPECIES	STATISTICS			
	Mean	Std	Relative Cover	Constancy
<b>Shrubs</b>				
<i>Atriplex canescens</i>	18.1	8.9	38.1	100
<i>Artemisia tridentata tridentata</i>	2.1	3.5	4.5	40
<i>Chrysothamnus nauseosus</i>	0.5	0.9	1.1	26.7
<i>Chrysothamnus viscidiflorus</i>	0.3	1	0.6	6.7
<b>Total Shrubs Cover</b>	<b>21</b>	<b>8.5</b>	<b>44.3</b>	
<b>Forbs</b>				
<i>Melilotus officinalis</i>	0.8	1.5	1.7	26.7
<b>Total Forb Cover</b>	<b>0.8</b>	<b>1.5</b>	<b>1.7</b>	
<b>Graminoid</b>				
<i>Agropyron spicatum</i>	23.7	12.7	49.9	100
<i>Agropyron cristatum</i>	0.4	0.8	0.8	20
<i>Agropyron trachycaulum</i>	0.4	0.8	0.8	20
<i>Elymus cinereus</i>	0.5	1.2	1.1	20
<i>Oryzopsis hymenoides</i>	0.4	0.8	0.8	20
<i>Sitanion hystrix</i>	0.3	0.7	0.6	13.3
<b>Total Graminoid Cover</b>	<b>25.7</b>	<b>12.6</b>	<b>54</b>	
<b>Total Vegetation Cover</b>	<b>47.5</b>	<b>13.2</b>		
Litter	44.7	15		
Rock	2.5	4.7		
Bare Ground	5.1	4.1		

Horse Canyon Revegetation Area  
Percent Cover Data (Area 15-17)

PLANT SPECIES	STATISTICS			
	Mean	Std	Relative Cover	Constancy
<b>Shrubs</b>				
<i>Atriplex canescens</i>	15.2	7.3	28.4	100
<i>Atriplex confertifolia</i>	0.3	0.7	0.5	13.3
<i>Atriplex corrugata</i>	0.1	0.5	0.2	6.7
<i>Artemisia tridentata tridentata</i>	3.9	4.1	7.2	66.7
<i>Chrysothamnus nauseosus</i>	0.1	0.5	0.2	6.7
<i>Chrysothamnus viscidiflorus</i>	0.5	0.9	1	26.7
<i>Ceratoides lanata</i>	0.1	0.5	0.2	6.7
<i>Sarcobatus vermiculatus</i>	0.5	1.2	1	20
<b>Total Shrubs Cover</b>	<b>20.7</b>	<b>5.9</b>	<b>38.7</b>	
<b>Forbs</b>				
<i>Melilotus officinalis</i>	0.1	0.5	0.2	6.7
<b>Total Forb Cover</b>	<b>0.1</b>	<b>0.5</b>	<b>0.2</b>	
<b>Graminoid</b>				
<i>Agropyron spicatum</i>	30.4	10.6	56.7	100
<i>Agropyron cristatum</i>	0.1	0.5	0.2	6.7
<i>Agropyron trachycaulum</i>	0.1	0.5	0.2	6.7
<i>Elymus cinereus</i>	0.7	1.2	1.3	26.7
<i>Oryzopsis hymenoides</i>	0.7	1.2	1.3	26.7
<i>Poa species</i>	0.4	0.8	0.8	20
<i>Sitanion hystrix</i>	0.3	0.7	0.5	13.3
<b>Total Graminoid Cover</b>	<b>32.7</b>	<b>10.3</b>	<b>61</b>	
<b>Total Vegetation Cover</b>	<b>53.5</b>	<b>10.8</b>		
<b>Litter</b>	<b>34.5</b>	<b>10.2</b>		
<b>Rock</b>	<b>4.3</b>	<b>6.7</b>		
<b>Bare Ground</b>	<b>7.6</b>	<b>6.4</b>		

Horse Canyon Revegetation Area  
Percent Cover Data (Area 16)

PLANT SPECIES	STATISTICS			
	Mean	Std	Relative Cover	Constancy
<b>Shrubs</b>				
Atriplex canescens	9.1	6.67	17	86.7
Atriplex confertifolia	1.1	2.1	2	26.7
Artemisia tridentata tridentata	1.2	2	2.3	33.3
Chrysothamnus nauseosus	0.9	2.1	1.7	26.7
Chrysothamnus viscidiflorus	1.5	2.2	2.8	46.7
Ceratoides lanata	0.5	1.4	1	13.3
<b>Total Shrubs Cover</b>	<b>14.3</b>	<b>5.9</b>	<b>26.8</b>	
<b>Forbs</b>				
Melilotus officinalis	0.8	2.6	1.5	13.3
<b>Total Forb Cover</b>	<b>0.8</b>	<b>2.6</b>	<b>1.5</b>	
<b>Graminoid</b>				
Agropyron spicatum	32.7	8	61.3	100
Agropyron cristatum	0.4	1.1	0.8	13.3
Agropyron trachycaulum	2	4.9	3.8	26.7
Elymus cinereus	1.3	1.8	2.5	46.7
Oryzopsis hymenoides	1.9	1.9	3.5	60
<b>Total Graminoid Cover</b>	<b>38.3</b>	<b>7.8</b>	<b>71.9</b>	
<b>Total Vegetation Cover</b>	<b>53.4</b>	<b>6.8</b>		
Litter	28.9	8.9		
Rock	3.7	4		
Bare Ground	15.3	6.4		

Horse Canyon Revegetation Area  
Percent Cover Data (Area 3)

PLANT SPECIES	STATISTICS			
	Mean	Std	Relative Cover	Constancy
<b>Shrubs</b>				
<i>Atriplex canescens</i>	11.5	8.6	21	93.3
<i>Artemisia tridentata tridentata</i>	2.4	3.6	4.4	46.7
<i>Chrysothamnus nauseosus</i>	0.8	1.7	1.5	20
<i>Chrysothamnus viscidiflorus</i>	7.2	8.5	13.2	10
<b>Total Shrubs Cover</b>	<b>21.9</b>	<b>8</b>	<b>40.1</b>	
<b>Forbs</b>				
<i>Melilotus officinalis</i>	0.1	0.5	0.2	6.7
<i>Penstemon palmeri</i>	0.1	0.5	0.2	6.7
<b>Total Forb Cover</b>	<b>0.2</b>	<b>0.7</b>	<b>0.4</b>	
<b>Graminoid</b>				
<i>Agropyron spicatum</i>	26.9	10.5	49.3	100
<i>Agropyron cristatum</i>	0.3	1	0.5	6.7
<i>Agropyron trachycaulum</i>	2.5	3.3	4.6	60
<i>Elymus giganteous</i>	0.1	0.5	0.2	6.7
<i>Elymus cinereus</i>	2.5	3.1	4.6	53.3
<i>Oryzopsis hymenoides</i>	0.1	0.5	0.2	6.7
<b>Total Graminoid Cover</b>	<b>32.4</b>	<b>13.2</b>	<b>59.4</b>	
<b>Total Vegetation Cover</b>	<b>54.5</b>	<b>14.2</b>		
Litter	35.3	13		
Rock	3.5	5		
Bare Ground	6.7	4.7		

Horse Canyon Revegetation Area  
Percent Cover Data (Area 7)

PLANT SPECIES	STATISTICS			
	Mean	Std	Relative Cover	Constancy
<b>Shrubs</b>				
Atriplex canescens	10.3	8.4	20.1	73.3
Artemisia tridentata tridentata	8.4	4	16.4	100
Chrysothamnus nauseosus	0.3	0.7	0.5	13.3
Chrysothamnus viscidiflorus	14	6	27.3	93.3
Ceratoides lanata	0.1	0.5	0.3	6.7
<b>Total Shrubs Cover</b>	<b>33.1</b>	<b>7.1</b>	<b>64.6</b>	
<b>Forbs</b>				
Machaeranthera canescens	0.1	0.5	0.3	6.7
Penstemon palmeri	0.1	0.5	0.2	6.7
<b>Total Forb Cover</b>	<b>0.2</b>	<b>0.7</b>	<b>0.5</b>	
<b>Graminoid</b>				
Agropyron spicatum	12.1	6.8	23.7	93.3
Agropyron cristatum	0.3	0.7	0.5	13.3
Bromus tectorum	0.1	0.5	0.3	6.7
Oryzopsis hymenoides	2.4	2.5	4.7	60
Poa species	0.4	1.1	0.8	13.3
Sitanion hystrix	0.8	2.1	1.6	30
Sporobolus cryptandrus	1.5	2.2	2.9	40
Stipa comata	0.3	0.7	0.5	13.3
<b>Total Graminoid Cover</b>	<b>17.9</b>	<b>8.3</b>	<b>35</b>	
<b>Total Vegetation Cover</b>	<b>51.2</b>	<b>9.2</b>		
Litter	41.6	7.3		
Rock	1.5	3.9		
Bare Ground	5.7	5.6		

Horse Canyon Revegetation Area  
Percent Cover Data (Area 6)

PLANT SPECIES	STATISTICS			
	Mean	Std	Relative Cover	Constancy
<b>Shrubs</b>				
Atriplex canescens	10.5	6.3	22.4	100
Artemisia tridentata tridentata	2.3	1.5	4.8	80
Chrysothamnus nauseosus	0.3	0.7	0.6	20
Chrysothamnus viscidiflorus	2.9	4.1	6.2	53.3
Ceratoides lanata	0.7	1.5	1.4	20
<b>Total Shrubs Cover</b>	<b>16.7</b>	<b>7.7</b>	<b>35.4</b>	
<b>Forbs</b>				
Medicago sativa	0.1	0.5	0.3	6.7
Melilotus officinalis	0.1	0.5	0.3	6.7
Penstemon palmeri	0.3	0.7	0.6	13.3
Salsola kali	0.4	0.8	0.9	20
<b>Total Forb Cover</b>	<b>0.9</b>	<b>1.5</b>	<b>2.1</b>	
<b>Graminoid</b>				
Agropyron spicatum	27.2	11.1	58	100
Agropyron cristatum	0.1	0.5	0.3	6.7
Agropyron trachycaulum	0.4	0.8	0.9	20
Elymus cinereus	0.4	0.8	0.9	20
Oryzopsis hymenoides	1.3	1.8	2.8	40
Sitanion hystrix	0.1	0.5	0.3	6.7
<b>Total Graminoid Cover</b>	<b>29.5</b>	<b>11.6</b>	<b>63.2</b>	
<b>Total Vegetation Cover</b>	<b>47.1</b>	<b>13.4</b>		
Litter	33.7	7.3		
Rock	4.4	8		
Bare Ground	15.2	9		

Horse Canyon Revegetation Area  
 Percent Cover Data Combined Data  
 (Excluding Area 7 Data)

PLANT SPECIES	STATISTICS			
	Mean	Std	Relative Cover	Constancy
<b>Shrubs</b>				
<i>Atriplex canescens</i>	12.9	8.2	25.1	96
<i>Atriplex confertifolia</i>	0.3	1.2	0.5	8
<i>Atriplex corraguta</i>	<0.1	0.2	<0.1	1.3
<i>Artemisia tridentata tridentata</i>	2.4	3.2	4.7	53.3
<i>Chrysothamnus nauseosus</i>	0.6	1.3	1.1	20
<i>Chrysothamnus viscidiflorus</i>	2.5	5	4.8	40
<i>Ceratoides lanata</i>	0.3	1	0.5	8
<i>Sarcobatus vermiculatus</i>	0.1	0.6	0.2	4
<b>Total Shrubs Cover</b>	<b>19.1</b>	<b>8.3</b>	<b>36.9</b>	
<b>Forbs</b>				
<i>Medicago sativa</i>	<0.1	0.2	<0.1	1.3
<i>Melilotus officinalis</i>	0.4	1.4	0.8	12
<i>Penstemon palmeri</i>	0.1	0.4	0.2	4
<i>Salsola kali</i>	0.1	0.4	0.2	4
<b>Total Forb Cover</b>	<b>0.6</b>	<b>1.5</b>	<b>1.2</b>	
<b>Graminoid</b>				
<i>Agropyron spicatum</i>	28.2	10.8	54.9	100
<i>Agropyron cristatum</i>	0.3	0.8	0.5	10.7
<i>Agropyron trachycaulum</i>	1.1	2.8	2.1	26.7
<i>Elymus cinereus</i>	1.1	2	2.2	33.3
<i>Elymus giganteous</i>	<0.1	0.2	<0.1	1.33
<i>Oryzopsis hymenoides</i>	0.9	1.5	1.7	30.7
<i>Poa species</i>	<0.1	0.4	0.2	4
<i>Sitanion hystrix</i>	0.1	0.5	0.3	6.7
<b>Total Graminoid Cover</b>	<b>31.7</b>	<b>11.7</b>	<b>61.9</b>	
<b>Total Vegetation Cover</b>	<b>51.4</b>	<b>12.1</b>		
<b>Litter</b>	<b>35.4</b>	<b>12.1</b>		
<b>Rock</b>	<b>3.7</b>	<b>5.8</b>		
<b>Bare Ground</b>	<b>10</b>	<b>7.6</b>		

**APPENDIX IV**

**Horse Canyon Reference Area  
Percent Cover Data**

Horse Canyon Reference Area  
Percent Cover Data

PLANT SPECIES	STAND							
	1	2	3	4	5	6	7	8
<b>Trees</b>								
Juniperus osteoperma	28	4	16	0	2	20	44	24
Pinus edulis	0	0	0	0	0	0	0	28
<b>Total Tree Cover</b>	<b>28</b>	<b>4</b>	<b>16</b>	<b>0</b>	<b>2</b>	<b>20</b>	<b>44</b>	<b>52</b>
<b>Shrubs and Subshrubs</b>								
Atriplex canescens	0	0	0	0	0	0	0	0
Ephedra viridis	2	2	0	0	0	0	0	0
Xanthocephalum sarothra	0	0	4	10	2	2	2	0
<b>Total Shrubs/Subshrubs cover</b>	<b>2</b>	<b>2</b>	<b>4</b>	<b>10</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>0</b>
<b>Forbs</b>								
Hackelia spp.	0	0	0	0	0	0	0	0
Phlox spp.	2	0	0	0	0	0	0	0
Astragalus spp.	0	0	0	0	0	0	0	0
Haplopappus acaulis	0	0	0	0	0	0	0	0
<b>Total Forb Cover</b>	<b>2</b>	<b>0</b>						
<b>Graminoid</b>								
Boutelous gracilis	0	0	0	4	0	2	0	0
Elymus salinus	12	26	12	14	6	4	2	2
Hilaria jamesii	0	2	0	0	2	0	0	0
Oryzopsis hymenoides	0	0	4	12	0	0	0	0
Poa species	2	0	0	0	0	0	0	0
Stipa comata	0	0	0	0	2	0	0	0
<b>Total Graminoid Cover</b>	<b>14</b>	<b>28</b>	<b>16</b>	<b>30</b>	<b>10</b>	<b>6</b>	<b>2</b>	<b>2</b>
Echinocereus trilochidiatus	0	0	0	0	0	0	0	0
<b>Total Succulent Cover</b>	<b>0</b>							
<b>Total Vegetation Cover</b>	<b>46</b>	<b>34</b>	<b>36</b>	<b>40</b>	<b>14</b>	<b>28</b>	<b>48</b>	<b>54</b>
Litter	10	2	14	10	2	18	12	6
Cryptogamic soil	10	28	16	6	2	12	6	4
Rock	22	8	24	12	50	24	16	30
Bare Ground	12	28	10	32	32	18	18	6

Horse Canyon Reference Area  
Percent Cover Data

PLANT SPECIES	STAND							
	9	10	11	12	13	14	15	16
<b>Trees</b>								
Juniperus osteoperma	6	38	8	24	34	26	16	0
Pinus edulis	0	0	0	0	0	0	0	0
<b>Total Tree Cover</b>	<b>6</b>	<b>38</b>	<b>8</b>	<b>24</b>	<b>34</b>	<b>26</b>	<b>16</b>	<b>0</b>
<b>Shrubs and Subshrubs</b>								
Atriplex canescens	0	0	0	0	0	0	0	0
Ephedra viridis	0	0	0	0	0	0	0	0
Xanthocephalum sarothra	2	0	4	2	0	2	0	16
<b>Total Shrubs/Subshrubs cover</b>	<b>2</b>	<b>0</b>	<b>4</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>16</b>
<b>Forbs</b>								
Hackelia spp.	0	0	0	0	0	0	0	0
Phlox spp.	0	0	0	0	0	0	0	0
Astragalus spp.	0	0	0	0	0	0	0	0
Haplopappus acaulis	0	0	0	0	0	0	0	0
<b>Total Forb Cover</b>	<b>0</b>							
<b>Graminoid</b>								
Boutelous gracilis	0	0	10	0	0	0	0	0
Elymus salinus	14	20	12	22	2	16	16	4
Hilaria jamesii	2	0	0	2	0	0	0	0
Oryzopsis hymenoides	6	0	0	0	0	0	0	6
Poa species	0	0	0	0	0	0	0	0
Stipa comata	0	0	0	0	0	0	0	0
<b>Total Graminoid Cover</b>	<b>22</b>	<b>20</b>	<b>22</b>	<b>24</b>	<b>2</b>	<b>16</b>	<b>16</b>	<b>10</b>
<b>Succulent</b>								
Echinocereus trilochidiatus	0	0	0	2	0	0	0	2
<b>Total Succulent Cover</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>
<b>Total Vegetation Cover</b>	<b>30</b>	<b>58</b>	<b>34</b>	<b>52</b>	<b>36</b>	<b>44</b>	<b>32</b>	<b>28</b>
Litter	22	20	12	10	12	10	16	24
Cryptogamic soil	6	2	10	2	12	2	4	10
Rock	18	16	26	20	22	24	34	22
Bare Ground	24	4	18	16	18	20	14	16

Horse Canyon Reference Area  
Percent Cover Data

PLANT SPECIES	STAND							
	17	18	19	20	21	22	23	24
<b>Trees</b>								
Juniperus osteoperma	4	10	34	26	12	10	8	4
Pinus edulis	0	0	0	18	0	8	0	8
<b>Total Tree Cover</b>	<b>4</b>	<b>10</b>	<b>34</b>	<b>44</b>	<b>12</b>	<b>18</b>	<b>8</b>	<b>12</b>
<b>Shrubs and Subshrubs</b>								
Atriplex canescens	4	0	0	0	0	0	0	0
Ephedra viridis	0	0	0	0	0	0	0	0
Xanthocephalum sarothra	2	0	0	0	0	0	0	0
<b>Total Shrubs/Subshrubs cover</b>	<b>6</b>	<b>0</b>						
<b>Forbs</b>								
Hackelia spp.	0	0	0	0	0	0	0	0
Phlox spp.	0	0	2	0	2	4	0	0
Astragalus spp.	0	0	0	0	0	0	0	4
Haplopappus acaulis	0	0	0	0	0	6	0	0
<b>Total Forb Cover</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>10</b>	<b>0</b>	<b>4</b>
<b>Graminoid</b>								
Boutelous gracilis	0	6	6	0	0	0	0	0
Elymus salinus	4	28	14	0	10	4	6	10
Hilaria jamesii	2	0	0	0	0	0	4	0
Oryzopsis hymenoides	6	0	0	0	0	2	2	0
Poa species	0	0	0	0	0	0	0	0
Stipa comata	0	0	0	0	0	0	0	0
<b>Total Graminoid Cover</b>	<b>12</b>	<b>34</b>	<b>20</b>	<b>0</b>	<b>10</b>	<b>6</b>	<b>12</b>	<b>10</b>
Echinocereus trilochidiatus	0	0	0	0	0	0	0	0
<b>Total Succulent Cover</b>	<b>0</b>							
<b>Total Vegetation Cover</b>	<b>22</b>	<b>44</b>	<b>56</b>	<b>44</b>	<b>24</b>	<b>34</b>	<b>20</b>	<b>26</b>
Litter	10	20	10	8	6	18	2	20
Cryptogamic soil	8	6	14	2	2	0	6	2
Rock	34	20	12	38	54	32	42	44
Bare Ground	26	10	8	8	14	16	30	8

Horse Canyon Reference Area  
Percent Cover Data

PLANT SPECIES	STAND						
	25	26	27	28	29	30	31
<b>Trees</b>							
Juniperus osteoperma	28	26	32	46	10	20	8
Pinus edulis	0	0	0	0	0	10	0
<b>Total Tree Cover</b>	<b>28</b>	<b>26</b>	<b>32</b>	<b>46</b>	<b>10</b>	<b>30</b>	<b>8</b>
<b>Shrubs and Subshrubs</b>							
Atriplex canescens	0	0	0	0	0	0	0
Ephedra viridis	0	0	0	0	0	0	0
Xanthocephalum sarothra	0	2	0	2	2	0	0
<b>Total Shrubs/Subshrubs cover</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>0</b>
<b>Forbs</b>							
Hackelia spp.	0	0	0	0	2	0	2
Phlox spp.	0	0	0	0	0	0	0
Astragalus spp.	0	0	0	0	0	0	0
Haplopappus acaulis	0	0	0	0	0	0	0
<b>Total Forb Cover</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>2</b>
<b>Graminoid</b>							
Boutelous gracilis	2	0	0	4	0	0	2
Elymus salinus	6	8	8	8	10	2	2
Hilaria jamesii	0	0	0	0	0	0	0
Oryzopsis hymenoides	4	2	0	2	0	0	0
Poa species	0	0	0	0	0	0	0
Stipa comata	0	0	0	0	0	0	0
<b>Total Graminoid Cover</b>	<b>12</b>	<b>10</b>	<b>8</b>	<b>14</b>	<b>10</b>	<b>2</b>	<b>4</b>
Echinocereus trilochidiatus	0	0	0	0	0	0	0
<b>Total Succulent Cover</b>	<b>0</b>						
<b>Total Vegetation Cover</b>	<b>40</b>	<b>38</b>	<b>40</b>	<b>62</b>	<b>24</b>	<b>32</b>	<b>14</b>
Litter	14	6	12	14	14	28	8
Cryptogamic soil	10	8	0	4	24	2	20
Rock	14	28	38	12	24	24	50
Bare Ground	22	20	10	8	14	14	8

Horse Canyon Reference Area  
Percent Cover Data

PLANT SPECIES	STATISTICS			
	Mean	Std	Relative Cover	Constancy
<b>Trees</b>				
Juniperus osteosperma	17.9	13.0	49.6	90.3
Pinus edulis	2.5	6.6	6.8	12.9
<b>Total Tree Cover</b>	<b>20.4</b>	<b>14.9</b>	<b>56.4</b>	
<b>Shrubs</b>				
Atriplex canescens	0.1	0.7	0.4	3.2
Ephedra viridis	0.1	0.5	0.4	6.5
Xanthocephalum sarothrae	1.7	3.3	4.8	45.2
<b>Total Shrubs Cover</b>	<b>1.9</b>	<b>3.4</b>	<b>5.6</b>	
<b>Forbs</b>				
Astragalus spp.	0.1	0.7	0.4	3.2
Hackelia spp.	0.3	1.1	0.7	6.5
Haplopappus acaulis	0.2	1.1	0.5	3.2
Phlox spp.	0.1	0.4	0.2	3.2
<b>Total Forb Cover</b>	<b>0.7</b>	<b>2.0</b>	<b>1.8</b>	
<b>Graminoid</b>				
Bouteloua gracilis	1.2	2.4	3.2	22.6
Elymus salinus	9.8	7.3	27.1	96.8
Hilaria jamesii	0.5	1.0	1.2	19.4
Oryzopsis hymenoides	1.5	2.8	4.1	32.3
Poa species	0.1	0.4	0.2	3.2
Stipa comata	0.1	0.4	0.2	3.2
<b>Total Graminoid Cover</b>	<b>13.2</b>	<b>8.7</b>	<b>36.0</b>	
<b>Succulents</b>				
Echinocereus trilochiditus	0.1	0.5	0.4	3.2
<b>Total Succulent Cover</b>	<b>0.1</b>	<b>0.5</b>	<b>0.4</b>	<b>3.2</b>
<b>Total Vegetation Cover</b>	<b>36.3</b>	<b>12.4</b>		
Cryptogamic soil	7.7	6.9		
Litter	12.5	6.3		
Rock	26.9	12.1		
Bare Ground	16.2	7.8		

**APPENDIX V**

**Horse Canyon Revegetation Areas  
Shrub Density Data**

Horse Canyon Revegetation Area  
Density Data for Shrubs/Subshrubs Plants per Acre  
Area 15-17

PLANT SPECIES	STAND					
	1	2	3	4	5	6
<b>Shrubs and Subshrubs</b>						
Atriplex canescens	915	719	5075	1481	3637	4639
Atriplex confertifolia	0	0	0	0	0	65
Atriplex corrugata	0	0	0	0	0	0
Artemisia nova	0	0	0	0	0	0
Artemisia tridentata tridentata	1307	1764	588	871	1851	3027
Chrysothamnus nauseosus	87	65	22	87	0	0
Chrysothamnus viscidiflorus	436	283	22	370	109	0
Ceratoides lanata	65	65	131	174	305	370
Sarcobatus vermiculatus	109	131	44	1764	22	131
Xanthocephalum sarothrae	0	0	0	0	0	0
<b>Total Shrubs</b>	<b>2919</b>	<b>3027</b>	<b>5882</b>	<b>4747</b>	<b>5924</b>	<b>8232</b>
	7	8	9	10	11	12
<b>Shrubs and Subshrubs</b>						
Atriplex canescens	2723	937	1045	2418	2047	1154
Atriplex confertifolia	22	0	87	0	0	0
Atriplex corrugata	0	0	0	0	0	0
Artemisia nova	0	22	0	0	0	0
Artemisia tridentata tridentata	3746	2243	2853	2788	6447	893
Chrysothamnus nauseosus	109	22	261	0	44	44
Chrysothamnus viscidiflorus	675	196	436	109	218	196
Ceratoides lanata	588	348	65	131	152	44
Sarcobatus vermiculatus	697	0	240	0	109	0
Xanthocephalum sarothrae	0	0	22	0	65	44
<b>Total Shrubs</b>	<b>8560</b>	<b>3768</b>	<b>5009</b>	<b>5446</b>	<b>9082</b>	<b>2375</b>

Horse Canyon Revegetation Area  
Density Data for Shrubs/Subshrubs Plants per Acre  
Area 15-17

PLANT SPECIES	STAND			STATISTICS	
	13	14	15	Mean	Std
<b>Shrubs and Subshrubs</b>					
<i>Atriplex canescens</i>	2810	2069	2352	2268.0	1345.6
<i>Atriplex confertifolia</i>	65	0	0	16.0	30.3
<i>Atriplex corrugata</i>	131	44	0	11.6	34.9
<i>Artemisia nova</i>	0	0	0	1.5	5.7
<i>Artemisia tridentata tridentata</i>	4443	980	261	2270.9	1674.9
<i>Chrysothamnus nauseosus</i>	0	0	0	47.9	70.4
<i>Chrysothamnus viscidiflorus</i>	44	87	43	214.9	192.8
<i>Ceratoides lanata</i>	240	65	65	183.0	151.8
<i>Sarcobatus vermiculatus</i>	87	22	0	223.6	460.9
<i>Xanthocephalum sarothrae</i>	22	0	0	10.1	20.0
<b>Total Shrubs</b>	<b>7842</b>	<b>3267</b>	<b>2721</b>	<b>5247.5</b>	<b>2293.9</b>

Horse Canyon Revegetation Area  
Density Data for Shrubs/Subshrubs Plants per Acre  
Area 11, 13 & 14

PLANT SPECIES	STAND					
	1	2	3	4	5	6
<b>Shrubs and Subshrubs</b>						
Atriplex canescens	2875	1742	1024	3354	3833	3964
Artemisia tridentata tridentata	3267	1241	218	1307	2047	9322
Chrysothamnus nauseosus	22	22	109	0	0	240
Chrysothamnus viscidiflorus	196	22	22	22	22	370
Ceratoides lanata	196	240	22	152	152	632
Sarcobatus vermiculatus	0	0	0	196	0	0
Xanthocephalum sarothrae	0	22	0	0	0	0
<b>Total Shrubs</b>	<b>6556</b>	<b>3289</b>	<b>1395</b>	<b>5031</b>	<b>6054</b>	<b>14528</b>
	7	8	9	10	11	12
<b>Shrubs and Subshrubs</b>						
Atriplex canescens	1133	2069	2069	1503	457	1590
Artemisia tridentata tridentata	545	2069	893	1111	196	1590
Chrysothamnus nauseosus	22	87	65	196	0	65
Chrysothamnus viscidiflorus	109	65	0	22	0	22
Ceratoides lanata	152	0	0	22	22	22
Sarcobatus vermiculatus	0	0	0	22	0	44
Xanthocephalum sarothrae	0	0	22	0	0	0
<b>Total Shrubs</b>	<b>1961</b>	<b>4290</b>	<b>3049</b>	<b>2876</b>	<b>675</b>	<b>3333</b>

Horse Canyon Revegetation Area  
Density Data for Shrubs/Subshrubs Plants per Acre  
Area 11, 13 & 14

PLANT SPECIES	STAND			STATISTICS	
	13	14	15	Mean	Std
<b>Shrubs and Subshrubs</b>					
<i>Atriplex canescens</i>	1786	2069	1938	2111.1	993.6
<i>Artemisia tridentata tridentata</i>	1241	588	523	1743.2	2248.6
<i>Chrysothamnus nauseosus</i>	44	0	22	59.5	73.0
<i>Chrysothamnus viscidiflorus</i>	109	22	65	73.4	98.2
<i>Ceratoides lanata</i>	22	44	22	113.3	164.0
<i>Sarcobatus vermiculatus</i>	87	261	0	40.7	81.0
<i>Xanthocephalum sarothrae</i>	0	0	0	2.8	7.6
<b>Total Shrubs</b>	<b>3289</b>	<b>2984</b>	<b>2570</b>	<b>4144.0</b>	<b>3217.8</b>

Horse Canyon Revegetation Area  
Density Data for Shrubs/Subshrubs Plants per Acre  
Area 16

PLANT SPECIES	STAND					
	1	2	3	4	5	6
<b>Shrubs and Subshrubs</b>						
Atriplex canescens	1176	3485	2178	2222	370	457
Atriplex confertifolia	0	109	87	152	174	545
Atriplex corrugata	0	22	0	0	0	0
Artemisia tridentata tridentata	327	3528	697	2897	958	0
Chrysothamnus nauseosus	283	0	0	958	915	1568
Chrysothamnus viscidiflorus	218	22	44	1721	762	697
Ceratoides lanata	22	87	44	370	87	152
Xanthocephalum sarothrae	0	0	0	0	0	0
<b>Total Shrubs</b>	<b>2026</b>	<b>7253</b>	<b>3050</b>	<b>8320</b>	<b>3266</b>	<b>3419</b>
	7	8	9	10	11	12
<b>Shrubs and Subshrubs</b>						
Atriplex canescens	3855	2984	3267	1960	2004	1917
Atriplex confertifolia	0	65	44	131	588	828
Atriplex corrugata	0	0	0	0	0	0
Artemisia tridentata tridentata	5728	2287	2439	3115	715	457
Chrysothamnus nauseosus	44	87	152	44	327	414
Chrysothamnus viscidiflorus	261	261	348	523	1176	544
Ceratoides lanata	762	283	893	566	152	305
Xanthocephalum sarothrae	22	0	0	0	0	0
<b>Total Shrubs</b>	<b>10672</b>	<b>5967</b>	<b>7143</b>	<b>6339</b>	<b>4962</b>	<b>4465</b>

Horse Canyon Revegetation Area  
Density Data for Shrubs/Subshrubs Plants per Acre  
Area 16

PLANT SPECIES	STAND			STATISTICS	
	13	14	15	Mean	Std
<b>Shrubs and Subshrubs</b>					
<i>Atriplex canescens</i>	1721	849	44	1899.2	1168.1
<i>Atriplex confertifolia</i>	566	414	370	271.6	260.1
<i>Atriplex corrugata</i>	0	0	0	1.5	5.7
<i>Artemisia tridentata tridentata</i>	109	22	0	1565.3	1697.8
<i>Chrysothamnus nauseosus</i>	1481	283	1481	535.8	583.7
<i>Chrysothamnus viscidiflorus</i>	632	370	849	561.9	448.0
<i>Ceratoides lanata</i>	196	87	174	278.8	265.1
<i>Xanthocephalum sarothrae</i>	0	0	0	1.5	5.7
<b>Total Shrubs</b>	<b>4705</b>	<b>2025</b>	<b>2918</b>	<b>5115.6</b>	<b>2744.3</b>

Horse Canyon Revegetation Area  
Density Data for Shrubs/Subshrubs Plants per Acre  
Area 3

PLANT SPECIES	STAND					
	1	2	3	4	5	6
<b>Shrubs and Subshrubs</b>						
Artemisia canescens	283	937	1285	1089	1154	479
Artemisia nova	0	0	22	0	0	0
Artemisia tridentata tridentata	479	1503	436	1394	2156	240
Chrysothamnus nauseosus	44	44	87	218	349	196
Chrysothamnus viscidiflorus	22	0	87	218	501	1764
Ceratoides lanata	0	0	0	22	0	0
<b>Total Shrubs</b>	<b>828</b>	<b>2484</b>	<b>1917</b>	<b>2941</b>	<b>4160</b>	<b>2679</b>
	7	8	9	10	11	12
<b>Shrubs and Subshrubs</b>						
Artemisia canescens	1154	305	653	327	719	588
Artemisia nova	0	0	0	0	0	0
Artemisia tridentata tridentata	1089	153	131	349	153	240
Chrysothamnus nauseosus	174	174	65	22	65	22
Chrysothamnus viscidiflorus	1372	1242	1982	1895	436	523
Ceratoides lanata	0	0	0	0	0	0
<b>Total Shrubs</b>	<b>3789</b>	<b>1874</b>	<b>2831</b>	<b>2593</b>	<b>1373</b>	<b>1373</b>

Horse Canyon Revegetation Area  
Density Data for Shrubs/Subshrubs Plants per Acre  
Area 3

PLANT SPECIES	STAND			STATISTICS	
	13	14	15	Mean	Std
<b>Shrubs and Subshrubs</b>					
<i>Atriplex canescens</i>	2309	1546	2243	1004.8	643.0
<i>Artemisia nova</i>	0	0	0	1.5	5.7
<i>Artemisia tridentata tridentata</i>	719	2134	2047	881.4	772.8
<i>Chrysothamnus nauseosus</i>	44	65	65	108.9	93.2
<i>Chrysothamnus viscidiflorus</i>	174	218	523	730.4	715.8
<i>Ceratoides lanata</i>	65	87	87	17.4	33.1
<b>Total Shrubs</b>	<b>3311</b>	<b>4050</b>	<b>4965</b>	<b>2744.4</b>	<b>1169.2</b>

Horse Canyon Revegetation Area  
Density Data for Shrubs/Subshrubs Plants per Acre  
Area 6

PLANT SPECIES	STAND					
	1	2	3	4	5	6
<b>Shrubs and Subshrubs</b>						
Atriplex canescens	1721	1525	958	1830	1655	327
Artemisia nova	0	44	65	44	0	44
Artemisia tridentata tridentata	3964	2069	2243	1786	1590	1525
Chrysothamnus nauseosus	65	131	22	87	0	44
Chrysothamnus viscidiflorus	348	566	479	1307	893	1045
Ceratoides lanata	1525	327	3354	1133	741	2352
Sarcobatus vermiculatus	0	0	0	0	0	0
Xanthocephalum sarothrae	65	196	65	0	0	44
<b>Total Shrubs</b>	<b>7688</b>	<b>4858</b>	<b>7186</b>	<b>6187</b>	<b>4879</b>	<b>5381</b>
	7	8	9	10	11	12
<b>Shrubs and Subshrubs</b>						
Atriplex canescens	1568	1721	2222	1873	2047	1655
Artemisia nova	87	22	0	0	22	0
Artemisia tridentata tridentata	2265	1350	4291	1481	3681	1721
Chrysothamnus nauseosus	152	22	261	22	131	0
Chrysothamnus viscidiflorus	240	370	958	174	1938	1481
Ceratoides lanata	5140	3637	196	392	131	152
Sarcobatus vermiculatus	22	22	0	0	0	0
Xanthocephalum sarothrae	0	0	22	0	0	0
<b>Total Shrubs</b>	<b>9474</b>	<b>7144</b>	<b>7950</b>	<b>3942</b>	<b>7950</b>	<b>5009</b>

Horse Canyon Revegetation Area  
Density Data for Shrubs/Subshrubs Plants per Acre  
Area 6

PLANT SPECIES	STAND			STATISTICS	
	13	14	15	Mean	Std
<b>Shrubs and Subshrubs</b>					
<i>Atriplex canescens</i>	2352	2592	2897	1796.1	623.6
<i>Artemisia nova</i>	0	0	0	21.9	28.5
<i>Artemisia tridentata tridentata</i>	1634	1263	1721	2172.2	985.1
<i>Chrysothamnus nauseosus</i>	44	22	0	66.8	73.8
<i>Chrysothamnus viscidiflorus</i>	1634	240	152	788.4	584.8
<i>Ceratoides lanata</i>	196	152	174	1306.8	1590.2
<i>Sarcobatus vermiculatus</i>	0	0	0	2.9	7.7
<i>Xanthocephalum sarothrae</i>	0	0	0	26.1	52.8
<b>Total Shrubs</b>	<b>5860</b>	<b>4269</b>	<b>4944</b>	<b>6181.2</b>	<b>1626.5</b>

Horse Canyon Revegetation Area  
Density Data for Shrubs/Subshrubs Plants per Acre  
Area 7

PLANT SPECIES	STAND					
	1	2	3	4	5	6
<b>Shrubs and Subshrubs</b>						
<i>Atriplex canescens</i>	2026	1067	1416	1634	1634	1568
<i>Atriplex confertifolia</i>	0	0	0	0	0	0
<i>Artemisia nova</i>	0	0	0	0	0	0
<i>Artemisia tridentata tridentata</i>	4356	3202	4704	4922	4704	4269
<i>Chrysothamnus nauseosus</i>	22	87	0	0	44	22
<i>Chrysothamnus viscidiflorus</i>	784	1568	1002	1024	1394	1503
<i>Ceratoides lanata</i>	0	0	44	65	44	65
<i>Xanthocephalum sarothrae</i>	0	174	0	0	0	0
<b>Total Shrubs</b>	<b>7188</b>	<b>5924</b>	<b>7166</b>	<b>7645</b>	<b>7820</b>	<b>7427</b>
	7	8	9	10	11	12
<b>Shrubs and Subshrubs</b>						
<i>Atriplex canescens</i>	1024	2004	1045	1394	784	726
<i>Atriplex confertifolia</i>	0	0	0	22	0	0
<i>Artemisia nova</i>	0	0	0	22	22	87
<i>Artemisia tridentata tridentata</i>	7253	6098	7166	11434	14941	16945
<i>Chrysothamnus nauseosus</i>	324	283	283	109	305	261
<i>Chrysothamnus viscidiflorus</i>	1568	1786	2113	1590	1546	1525
<i>Ceratoides lanata</i>	44	0	0	0	0	22
<i>Xanthocephalum sarothrae</i>	109	22	261	348	370	44
<b>Total Shrubs</b>	<b>10325</b>	<b>10193</b>	<b>10868</b>	<b>14919</b>	<b>17986</b>	<b>19610</b>

Horse Canyon Revegetation Area  
Density Data for Shrubs/Subshrubs Plants per Acre  
Area 7

PLANT SPECIES	STAND			STATISTICS	
	13	14	15	Mean	Std
<b>Shrubs and Subshrubs</b>					
<i>Atriplex canescens</i>	937	370	414	1205.2	516.6
<i>Atriplex confertifolia</i>	0	0	0	2.90	7.6
<i>Artemisia nova</i>	0	65	0	13.1	27.0
<i>Artemisia tridentata tridentata</i>	16531	18557	18644	9583.2	5892.1
<i>Chrysothamnus nauseosus</i>	436	327	87	172.8	148.1
<i>Chrysothamnus viscidiflorus</i>	2831	2047	3942	1748.2	783.2
<i>Ceratoides lanata</i>	44	0	22		
<i>Xanthocephalum sarothrae</i>	305	0	22	23.2	25.3
<b>Total Shrubs</b>	<b>21084</b>	<b>22041</b>	<b>23915</b>		<b>6215.8</b>

Horse Canyon Revegetation Area  
 Density Data for Shrubs/Subshrubs Plants per Acre  
 Combined Data (excluding Area 7)

PLANT SPECIES	STATISTICS	
	Mean	Std
<b>Shrubs and Subshrubs</b>		
Atriplex canescens	1816.0	1064.6
Atriplex confertifolia	57.5	156.8
Atriplex corrugata	2.6	15.9
Artemisia nova	109.1	15.5
Artemisia tridentata tridentata	1726.7	1606.1
Chrysothamnus nauseosus	163.8	323.4
Chrysothamnus viscidiflorus	466.8	541.0
Geratoides lanata	369.2	842.7
Sarcobatus vermiculatus	53.5	221.5
Xanthocephalum sarothrae	7.8	26.6
<b>Total Shrubs</b>	<b>4773.0</b>	<b>2549.6</b>

**Appendix III-1-8**

**Reclamation Certification**



# UtahAmerican Energy, Inc.

## Horse Canyon Mine ACT/007/013

Re: Phase III Bond Release Horse Canyon Mine ACT 007/013

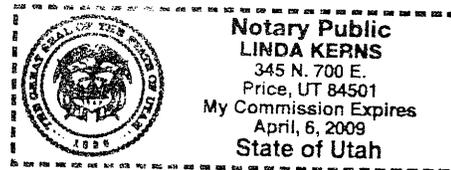
I hereby certify to the best of my information and belief all the information contained in this request for bond release is true and correct and that all applicable reclamation activities have been accomplished in accordance with the requirement of the Act, the regulatory program and the approved reclamation plan. The area of the channel repair (.49 acres) is not included in this application.

R. Jay Marshall

R. Jay Marshall  
\_\_\_\_\_  
Sign Name, Position, Date

Subscribed and sworn to before me this 5<sup>TH</sup> day of November, 2008

Linda Kerns  
\_\_\_\_\_  
Notary Public



My Commission Expires: April 6, 2009  
Attest: State of Utah  
County of Carbon