Phase III Bond Release
Plateau Mining Corporation
Star Point Mine
C/007/0006

April 2013

C/007/006 Incoming

PLATEAU MINING CORPORATION

Star Point Mine
P.O. Box 30
Helper, Utah 84526
Office Phone (435) 472-0475

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March 28, 2013

RECEIVED
APR 03 2013
DIV. OF OIL, GAS & MINING

Mr. Daron Haddock
Utah Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
P.O. Box 145801
Salt Lake City, Utah 84114-5801

Re: Phase III Bond Release, Plateau Mining Corporation, Star Point Mine, C/007/0006

Dear Mr. Haddock:

Plateau Mining Corporation is hereby submitting its application for Phase III Bond Release for its Star Point Mine. Please find enclosed three copies and the Phase III Bond Release Application. Plateau Mining Corporation believes it has prepared a complete package that adequately addresses the requirements for Phase III Bond Release. This application includes all the required documentation including the C1 and C2 forms, permit replacement pages, and a new exhibit to the permit (Exhibit 880.200). Included in Exhibit 880.200 is documentation which includes mining history, reclamation history, evidence that the extended responsibility period has been met, vegetation information for the last two years of the extended responsibility period, sediment yield information, public notice, landowner and government agency notification letters, a reclamation certification and bond release calculations.

A notarized statement from the newspapers where the public notice was published will be provided to the Division following its final publication date.

If you have any questions please give me a call at 435-650-2951 or email me at dware@alphanr.com.

Sincerely,

Dennis N. Ware
Authorized Agent

Enclosures

File in:
- ☐ Confidential
- ☒ Shelf
- ☐ Expandable

Date Folder 040313 C 0070006
Incoming

Phase III Bond Release
Plateau Mining Corporation
Star Point Mine
C/007/0006

C 1 and C2

APPLICATION FOR COAL PERMIT PROCESSING

Permit Change ☐ New Permit ☐ Renewal ☐ Exploration ☐ Bond Release ☒ Transfer ☐

Permittee: PLATEAU MINING CORPORATION
Mine: STAR POINT MINE **Permit Number:** C/007/0006
Title: PHASE III BOND RELEASE APPLICATION

Description, Include reason for application and timing required to implement:
PHASE III BOND RELEASE

Instructions: If you answer yes to any of the first eight questions, this application may require Public Notice publication.

☐ Yes ☐ No 1. Change in the size of the Permit Area? Acres: _____ Disturbed Area: _____ ☐ increase ☐ decrease.
☐ Yes ☐ No 2. Is the application submitted as a result of a Division Order? DO# _____
☐ Yes ☐ No 3. Does the application include operations outside a previously identified Cumulative Hydrologic Impact Area?
☐ Yes ☐ No 4. Does the application include operations in hydrologic basins other than as currently approved?
☒ Yes ☐ No 5. Does the application result from cancellation, reduction or increase of insurance or reclamation bond?
☒ Yes ☐ No 6. Does the application require or include public notice publication?
☐ Yes ☐ No 7. Does the application require or include ownership, control, right-of-entry, or compliance information?
☒ Yes ☐ No 8. Is proposed activity within 100 feet of a public road or cemetery or 300 feet of an occupied dwelling?
☐ Yes ☐ No 9. Is the application submitted as a result of a Violation? NOV # _____
☐ Yes ☐ No 10. Is the application submitted as a result of other laws or regulations or policies?
Explain: _____
☐ Yes ☐ No 11. Does the application affect the surface landowner or change the post mining land use?
☐ Yes ☐ No 12. Does the application require or include underground design or mine sequence and timing? (Modification of R2P2)
☐ Yes ☐ No 13. Does the application require or include collection and reporting of any baseline information?
☐ Yes ☐ No 14. Could the application have any effect on wildlife or vegetation outside the current disturbed area?
☐ Yes ☐ No 15. Does the application require or include soil removal, storage or placement?
☒ Yes ☐ No 16. Does the application require or include vegetation monitoring, removal or revegetation activities?
☐ Yes ☐ No 17. Does the application require or include construction, modification, or removal of surface facilities?
☒ Yes ☐ No 18. Does the application require or include water monitoring, sediment or drainage control measures?
☒ Yes ☐ No 19. Does the application require or include certified designs, maps or calculation?
☐ Yes ☐ No 20. Does the application require or include subsidence control or monitoring?
☒ Yes ☐ No 21. Have reclamation costs for bonding been provided?
☐ Yes ☐ No 22. Does the application involve a perennial stream, a stream buffer zone or discharges to a stream?
☐ Yes ☐ No 23. Does the application affect permits issued by other agencies or permits issued to other entities?
☐ Yes ☐ No 24. Does the application include confidential information and is it clearly marked and separated in the plan?

Please attach three (3) review copies of the application. If the mine is on or adjacent to Forest Service land please submit four (4) copies, thank you. (These numbers include a copy for the Price Field Office)

I hereby certify that I am a responsible official of the applicant and that the information contained in this application is true and correct to the best of my information and belief in all respects with the laws of Utah in reference to commitments, undertakings, and obligations, herein.

Dennis N. Ware	Authorized Agent	03/29/2013	
Print Name	Position	Date	Signature (Right-click above choose certify then have notary sign below)

Subscribed and sworn to before me this 27 day of March, 2013

Notary Public: Cindy Nielson, state of Utah.

My commission Expires: Oct 2, 2014
Commission Number: 600691
Address: PO Box 677 ~~Orange~~
City: Orangeville State: UT Zip: 84537

ss:

Notary Public
CINDY NIELSON
Commission #600691
My Commission Expires
October 2, 2014
State of Utah

For Office Use Only:	Assigned Tracking Number:	Received by Oil, Gas & Mining
		RECEIVED APR 03 2013 DIV. OF OIL, GAS & MINING

APPLICATION FOR COAL PERMIT PROCESSING
Detailed Schedule Of Changes to the Mining And Reclamation Plan

Permittee: PLATEAU MINING CORPORATION
Mine: STAR POINT MINE
Permit Number: C/007/0006
Title: PHASE III BOND RELEASE APPLICATION

Provide a detailed listing of all changes to the Mining and Reclamation Plan, which is required as a result of this proposed permit application. Individually list all maps and drawings that are added, replaced, or removed from the plan. Include changes to the table of contents, section of the plan, or other information as needed to specifically locate, identify and revise the existing Mining and Reclamation Plan. Include page, section and drawing number as part of the description.

			DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☐ Add	☒ Replace	☐ Remove	Table of Contents and page 800-2, Volume 5, Section 800
☒ Add	☐ Replace	☐ Remove	Exhibit 800.200, Volume 5, Section 800
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Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.

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DIV. OF OIL, GAS & MINING

Phase III Bond Release
Plateau Mining Corporation
Star Point Mine
C/007/0006

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PMC will, from time to time, request reduction of the performance bond amount when circumstances warrant a reduction.

840. thru 840.520. GENERAL TERMS AND CONDITIONS OF THE BOND.

The bond purchased by PMC meets the General Terms and Conditions.

850. thru 850.320. BONDING REQUIREMENTS FOR UNDERGROUND.

The bond will remain in full force until the reclamation is completed as outlined in the approved Mining and Reclamation Plan. It is not anticipated that the bond will be fully released less than five years after seeding of the disturbed acreage.

Long-term intensive agricultural postmining land use is not anticipated.

860. FORMS OF BONDS.

860.100. thru 860.120. SURETY BONDS.

The PMC bond is a surety bond.

860.200. thru 860.260. COLLATERAL BONDS.

PMC will not use a collateral bond.

860.300. thru 860.380. SELF-BONDING.

PMC will not self bond.

870. thru 870.200. REPLACEMENT OF BONDS.

If PMC replaces its current bond the replacing bond will provide equivalent coverage and conditions.

880. thru 880.932. REQUIREMENT TO RELEASE PERFORMANCE BONDS.

PMC commits to the requirements of R645-301-880. through R645-301-880.932. Phase II bond release was granted to PMC by the Division ~~on~~ effective June 12, 2008, reducing the remaining bond amount to $734,000 (see Exhibit 880.100a). PMC ~~requests~~ received Phase III bond release on the 40 acres of land in SE/4 SE/4 Sec. 9, T. 15 S., R. 8 E. that ~~will be~~ was purchased by ConocoPhillips for use in natural gas production in June of 2010 reducing the bond amount to $672,000 (see Exhibit 880.100b).. PMC now requests Phase III bond release of the entire remaining bond amount which is $672,000 (see Exhibit 880.200). ~~After Phase III bond release of this area, PMC requests that the reclamation bond associated with the Star Point Mine be reduced to $672,000.00 (see Exhibit 880.100b).~~

890. thru 890.400. TERMS AND CONDITIONS FOR LIABILITY.

The certificate of liability insurance is in Exhibit 117.100a (2).

Exhibit 880.200

Phase III Bond Release
Plateau Mining Corporation
Star Point Mine
C/007/0006

April 2013

Appendix 1

Vegetation Monitoring Years 9 and 10
For Phase III Bond Release
Star Point Mine

Phase III Bond Release
Plateau Mining Corporation
Star Point Mine
C/007/0006

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Phase III Bond Release
Plateau Mining Corporation
Star Point Mine
C/007/0006

Introduction

The Star Point Mine is located on Gentry Mountain approximately 23 miles southwest of Price, Utah on the east side of the Wasatch Plateau Coal Field. The Star Point Mine permit area is 8780 acres as shown on map 112.500a in Volume 1 of the MRP. The permit includes 87.3 acres within the disturbed area boundary which can be seen on maps 542.200a, 542.200b, 542.200c, 542.200g and 542.200h in Volume 2 of the MRP.

Plateau Mining Corporation has completed Phase III of the approved reclamation plan for the entire remaining acreage at the Star Point Mine. This is based on meeting the vegetation and water quality requirements for Phase III reclamation in accordance with the approved reclamation plan.

The permit was renewed on January 28, 2012 and expires on January 28, 2017. The current performance bond for the Star Point Mine is $672,000. This phase III bond release application is requesting full bond release.

Mining History

Mining operations began in 1916 when the Wattis Brothers bought 160 acres from the United States and developed the property for coal production. The Lion Coal Company operated Wattis No.1 and 2 mines until the end of 1963. There were no coal mining activities from 1964 until 1967. Plateau Mining, Ltd. operated the Star Point No.1 mine in the Hiawatha Coal Seam, and the Star Point No.2 Mine in the Wattis Coal Seam, from 1967 through the fall of 1971. United Nuclear Corporation acquired the Star Point Mine in the fall of 1971. Modernization of the coal mine started when the Lion Deck portal area was expanded in October 1977. United Nuclear Corporation operated the mine until July 1980. The current Permittee, Plateau Mining Corporation (PMC) operated the Star Point Mine from July of 1980 until is closure in February of 2000.

Reclamation History

Following the permanent cessation of operations in 2000, PMC began reclamation activities. Reclamation in 2000 dealt with: the demolition of the overland conveyor system and preparation plant; the removal of equipment and machinery from underground; the demolition, backfilling and grading, and reseeding of the 1.54 acres at the Mud Water and the Corner Canyon Fan sites; and the sealing of the portals at the Lion Deck. As a footnote to the backfilling and grading activities at the remote fan sites, PMC earned a 2001 Earth Day Award for outstanding results following applications of innovative environmental technology for backfilling remote locations from within the mine (outside-in).

Reclamation activities continued in 2001 with further demolition, backfilling and grading, and reseeding activities on approximately 45 acres, which include the No. 1 Mine area encompassing 35 acres and the Unit Train Loadout and Silo area encompassing 10 acres.

During 2002, demolition, backfilling and grading, and revegetation operations were performed on approximately 49.0 acres. The reclaimed acres included 25.5 acres associated with the Lions Deck and Pond 1 Areas and 23.5 acres associated with the Overland Conveyor and Main Channel Areas. Also in 2002, a post mining land use change was permitted and achieved to facilitate the installation of two coal bed methane wells and utility corridor by ConocoPhillips within PMC's permit area. By the end of 2002 the entire disturbed acreage within the permit had been reclaimed and seeded. (In 2006 PMC received an Earth Day Award for this reclamation identifying outstanding final reclamation of a pre-SMCRA site as the reason for the award). Also, during 2002, PMC demonstrated that mining did not impact the hydrologic balance and through the permit amendment process received approval from DOGM to discontinue further water monitoring, on all but three water sample locations. These three remaining locations deal with the North Fork of the Right Fork of Miller Creek and monitoring for offsite contributions of sediment below the reclaimed lands. In 2012 PMC received approval to discontinue further water monitoring on these three sites.

The refuse pile and associated topsoil stockpile areas were removed from the Star Point Mine Permit in November of 2003, and permitted by Sunnyside Cogeneration Associates under Permit C/007/0042 for use as a fuel source for their power generating facility. In 2003 activities included the abandonment of water monitoring wells, boreholes, and minor backfilling and/or fencing of subsidence cracks and the repair of two small gullies on the slope north of the reclaimed Clean Coal Stacking Tube. During 2003, PMC demonstrated that subsidence has substantially ceased and through the permit amendment process received approval from DOGM to discontinue further subsidence monitoring. Also in 2003, an amendment to discontinue color infrared vegetation monitoring was approved by the Forest Service and DOGM.

Phase I bond release for the Star Point Mine was approved on October 12, 2004.

In February of 2006 the Bureau of Land Management issued coal lease relinquishments for the Star Point Mine Federal Coal Leases.

Phase II bond release for the Star Point Mine was approved on January 14, 2009.

In 2010, 40 acres were removed from the permit including 8 acres of disturbed and reclaimed land in order to facilitate the development of coal bed methane by ConocoPhillips.

In 2011 and 2012 all subsidence monitoring stations and all disturbed area boundary markers were removed from the permit area.

In 2012 repairs were made to the main reclamation channel (SPRD-31) and a tributary channel (SPRD-30) following the Seeley fire and subsequent thunderstorms. The damage to the channels was repaired back to the original reclamation design in October and November of 2012. The repair of the channel and subsequent seeding is considered an accepted husbandry practice. See Exhibit 761d of the permit for more information on this subject.

There are no remaining sediment control structures (ponds, silt fences, straw bales) or diversions to be removed. The only structure approved to remain for the postmining land use is County Road 290 (Gentry Mountain Road). The roads that once supported the mining operation have been reclaimed, transferred to Sunnyside Cogeneration Associates or in the case of County Road 290, used to support the postmining land uses. The roads are shown on Table 534.200a on pages 500-70 and 71 in Volume 2 of the MRP and discussed in Section 542.600 on pages 500-80and 81 in Volume 2 of the MRP.

For information on As-Built Topography, Treatment and Cross Sections refer to Maps 542.200a through 542.200h in Volume 2 of the Star Point MRP.

No augmented seeding has taken place since the initial seeding dates provided above. Each year since the initial seeding, the reseeded land has been inspected for noxious weeds and those found have been either treated or removed.

Extended Responsibility Period

The Extended Responsibility Period for the Star Point Mine is 10 years after the last year of augmented seeding. The entire disturbed area within the Star Point Permit had been reclaimed and seeded by the end of the year 2002. There has been no augmented seeding, fertilization, irrigation or other work, excluding accepted husbandry practices since the initial seeding was completed in 2002. The Extended Responsibility Period began in 2003 and reached the 10 year mark at the end of 2012.

Vegetation Information

The vegetation of the reclaimed lands within the Star Point Permit meets or exceeds the requirements of the permit. The vegetative cover is diverse, effective and permanent. It is comprised of species native to the area, at least equal in extent of cover to the natural vegetation of the area and capable of stabilizing the soil surface from erosion. The plant species is compatible with the approved post mining land use and has the same seasonal characteristics of growth as the original vegetation. It is capable of self-regeneration and plant succession and is compatible with the plant and animal species of the area.

PMC conducted detailed vegetation studies during the last two years of the Extended Responsibility Period. These studies were conducted during the growing seasons in the years 2011 and 2012 as a means to monitor the success of the revegetation and to determine whether on not Phase III bond release was appropriate. The reports from these studies (see Appendix 1) present the methodology and data as required by the mining and reclamation plan. The results, through the use of statistical analyses as well as other comparisons, suggest that the reclaimed plant communities at the Star Point Mine site have met or exceeded the revegetation success standards and warrant Phase III bond release.

Sediment Yield Information

To demonstrate that the reclaimed area will generate the same amount or less sediment than the undisturbed condition, the revised universal soil loss equation (RUSLE) was used.

The revised universal soil loss equation takes into several factors in determining the sediment yield for an area. The factors involved are: 1) rainfall-runoff erosivity, 2) soil erodibility, 3) length of slope, 4) cover management, and 5) support practice.

The RUSLE demonstrates that the reclaimed area sediment yield at the Star Point Mine is much less than the sediment yields under undisturbed conditions (see Appendix 2).

Conclusion

As authorized by R645-301-880.300, Phase III Bond Release should be approved based on the Permittee meeting vegetation and water quality requirements in accordance with the mining and reclamation plan.

Vegetation Monitoring Year 10
For Phase III Bond Release
Star Point Mine

Revegetation Monitoring
for
Phase III Bond Release
Year 2 (2012)

at the
Star Point Mine
for
Plateau Mining Corporation

Prepared by

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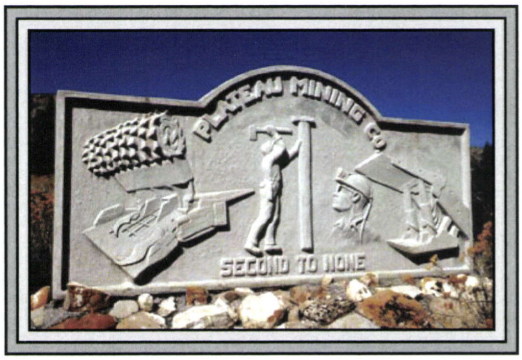

February 2013

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INTRODUCTION

Study Rationale

This report contains data and information from quantitative sampling in 2012, or **Year 2** of a two-year study period on the vegetation at the reclaimed Star Point Mine site in eastern Utah. **Year** 1 (2011) results were provided in an earlier report. The purpose of this document is to compare reclaimed areas of the mine site with specific standards for revegetation success. The content of this report along with the earlier report provides some of the information and data necessary to be included in an application for bond release by the mine owner through the State of Utah, Division of Oil, Gas & Mining (DOGM).

Reclaimed mine sites are required to allow enough time for acceptable plant establishment before applications can be made for bond release. This time period, called the "*Responsibility Period*", prescribes at least 10 years following reclamation before the mine operator can submit a request for *Final* or *Phase III Bond Release* through state and federal regulatory authorities. This period of time is considered to be long enough to determine whether or not adequate re-establishment of a given reclaimed plant community has occurred on sites at this precipitation zone in the western United States. The vegetation of the reclaimed lands must meet specific state and federal requirements.

Study Area

The Star Point Mine is a reclaimed mine site located on the east side of the Wasatch Plateau on Gentry Mountain approximately 23 miles southwest of Price, Utah. Historically, coal mining at the Star Point Mine began in 1916. Coal was shipped to the town of Wattis by 1917 when a railroad was completed there. In 1967, a company called Plateau Limited opened a new mine in the area. By 1971, another company, United Nuclear, purchased the mine. Finally, in 1980, Plateau Mining Company bought and mined the properties. The current permittee, Plateau Mining Corporation, began final reclamation of the mine site in 2001, with final seeding for revegetation finalized in 2003.

Previous Studies

Following reclamation and revegetation, the plant communities have been closely monitored to document the progress on those areas disturbed by the previous mining activities. Earlier documents submitted to the regulatory agencies reported updates on the revegetation process from sampling the area in 2006 (Year 4), 2008 (Year 6) 2010 (Year 8) and as mentioned 2011 (Year 9).

METHODS

Methodologies used for sampling have been consistent between sample years and were performed in accordance with the guidelines provided by DOGM. The reclaimed areas were sampled and separated *between* vegetation types; when the types were comprised of relatively large acreage, additional areas were further separated *within* the types. This method allows for closer scrutiny of the reclaimed mine site on a smaller, area-by-area basis. For the analyses required for bond release comparisons, the datasets were then *lumped* according to the plant community types (more on that later).

To facilitate comparisons between the two consecutive sample years, 2011 and 2012, colors used on the summary tables and graphs remain consistent.

Transect & Quadrat Placement

Random/regular placement of sample quadrats was designed as an attempt to provide unbiased accuracy of the data compiled. This was accomplished by establishing several transect lines through the entire length of each reclaimed and reference area (areas chosen to represent revegetation success standards). At regular intervals along the transect lines, random numbers were generated and used to measure distances at right angles from the line to determine sample locations. Whether these random numbers were odd or even determined which side of the transect line a given quadrat was placed. The random numbers selected were high enough to place quadrats to the lateral limits of each sample area and all areas in-between. This insured that the sample quadrats were placed randomly

over the entire study area to adequately address and represent each study site as a whole.

Cover, Frequency & Composition

Cover estimates were made employing ocular methods with meter square quadrats. Species composition and relative frequencies were also assessed from the quadrats. Additional information, when applicable, was also recorded on the raw data sheets such as: slope, exposure, grazing use, animal disturbance and other appropriate notes. Plant nomenclature follows *A Utah Flora* (Welsh et al. 2008).

Density

In nearly all areas, density estimates for woody plant species on the reclaimed and reference areas were made using a distance method called the *point-quarter technique*. This technique determines the mean area an individual plant occupies, which then yields the number of these individuals per acre. In this method, random points were placed on the sample sites and divided into four quarters. The distances to the nearest woody plant species were then recorded in each quarter. The average point-to-individual distance was equal to the square root of the mean area per individual.

The one area where this method was not suitable due to its size and community structure was the Mudwater Canyon site. At this site 5x25 ft belt transects were employed. In this method individuals were counted in each transect, summarized for mean and standard deviation, then converted to the number of individuals per acre.

Biomass Production

Total annual biomass production was estimated by clipping, drying and weighing current annual growth in sample quadrats. "Double sampling" methods were employed by placing four additional quadrats around the clipped quadrat, then estimating the production of them relative to the clipped plot. Herbaceous and woody species production were clipped, weighed and recorded separately.

Diversity and Similarity Indices

There are several well-documented methods to assess diversity and similarity in plant communities. The *Motyka Index* is a modified form of the *Sorenson Index*, both similarity indices. This index was used on the data; the equation is shown below:

$$IS_{MO}=\left(\frac{2MW}{MA+MB}\right)x100$$

where,

MW = $\sum$ of the smaller quantitative values of species of two communities,
MA = $\sum$ of the quantitative values of all species in one community,
MB = $\sum$ of the quantitative values of all species in another community.

Two diversity indices have been employed to measure the reclaimed and reference areas. *MacArthur's Diversity Index* is an effective diversity measurement and is computed using the following equation:

$$1/\sum pi^2$$

where,

pi is the proportion of sum frequency contributed by the *i*th species in the sample area of concern.

The proportional contribution of each species is then squared and the values for all species in the sample areas are summed. This index integrates the number of species and the degree to which frequency of occurrence was equitably distributed among those species.

Another diversity measurement was provided that shows the *average number of species* encountered at each quadrat.

Sample Size & Adequacy

Sampling adequacy was calculated using the formula given below.

$$nMIN = \frac{t^2 s^2}{(dx)^2}$$

where,

nMIN	= minimum adequate sample
t	= appropriate confidence t-value
s	= standard deviation
x	= sample mean
d	= desired change from mean

Confidence levels were calculated at 80% and 90% (t) with the desired change from the mean (d) placed at 0.10. Sample sizes were, however, also based on the size of each subdivision within each vegetation type, resulting in more samples taken in larger areas.

Photographs

Color photographs of each sample area were taken at the time of sampling; a subset of them have been submitted with this report.

Vegetation Sample Maps

The locations of the reclaimed sample areas were mapped during the field work. These locations were then placed on "as-built" reclamation maps prepared previously by *Earthfax Engineering*, resulting in three Vegetation Sample Area maps; they have been submitted in this report.

RESULTS

Sample Areas

The Star Point Mining & Reclamation Plan (MRP) divided the disturbed areas into three main types based on the native plant communities that existed in the area prior to their disturbance by coal mining and related activities. The three types represented in the "reclaimed areas" and were called: 1) **Sagebrush Areas,** 2) **Mountain Grassland Areas,** and 3) **Saltbush Areas.** During reclamation these sites were seeded with mixtures developed specifically for each area. Additionally, **reference areas,** or areas chosen in undisturbed plant communities to represent final revegetation success standards, were chosen for each disturbed (reclaimed) type. Reference areas were sampled in 2011 and 2012 for comparisons to the reclaimed areas.

Reclaimed Areas

As mentioned above, there were three disturbance types delineated at the mine site. Additionally, these types were further subdivided into smaller areas to allow closer, independent evaluations for the specific sites (see *VEGETATION SAMPLE AREA MAPS* and *COLOR PHOTOGRAPHS OF THE SAMPLE AREAS*). The following table shows the three vegetation types and subdivisions within them.

Table 1: Sample area subdivisions of each reclaimed type.

Reclaimed Sagebrush	Reclaimed Mtn Grassland	Reclaimed Saltbush
Area A	Area E	Area I
Area B	Area F	
Area C	Area G (pre- & post-SMCRA)	
~~Area D~~ *(area was sold and removed from the permit area)*	Mudwater Canyon	
Area H	Corner Canyon	

Reference Areas

The three reference areas along with their corresponding reclaimed areas, are shown in Table 2. The reference areas data can be compared to the reclaimed areas and provide accompaniment for future bond release application through the State of Utah.

Table 2: Reference areas and their respective reclaimed areas.

Reference Areas	**Reclaimed Areas**
Sagebrush	Area A Area B Area C Area H
Mountain Grassland	Area E Area F Area G Mudwater Canyon Corner Canyon
Saltbush	Area I

Results of Separated Data

General comparisons *between* reclaimed types and *within* each community type for the 2012 datasets can be done by reviewing the summary tables of the sample results that have been provided for each reclaimed area as well as the reference areas (Tables 4 through 54). Table 3 shows the number of the appropriate table for each parameter in all sample areas of the study.

Table 3: Separated data locator at the Star Point Mine site (2012).

SAMPLE AREA	Sub-Division	Cover by Species	Total Cover	Composition	Woody Species Density	Production
Reclaimed Sagebrush	A	Table 4	Table 5 (A)	Table 5 (B)	Table 6	n/a
Reclaimed Sagebrush	B	Table 7	Table 8 (A)	Table 8 (B)	Table 9	n/a
Reclaimed Sagebrush	C	Table 10	Table 11 (A)	Table 11 (B)	Table 12	Table 13
Reclaimed Sagebrush	H	Table 28	Table 29 (A)	Table 29 (B)	Table 30	Table 31
Reclaimed Mountain Grassland	E	Table 14	Table 15 (A)	Table 15 (B)	Table 16	n/a
Reclaimed Mountain Grassland	F	Table 17	Table 18 (A)	Table 18 (B)	Table 19	Table 20
Reclaimed Mountain Grassland	G (pre-SMCRA) G (post-SMCRA)	Table 21 Table 24	Table 22 (A) Table 25 (A)	Table 22 (B) Table 25 (B)	Table 23 Table 26	n/a Table 27
Reclaimed Mountain Grassland	Mudwater Canyon	Table 36	Table 37 (A)	Table 37 (B)	Table 38	n/a
Reclaimed Mountain Grassland	Corner Canyon	Table 39	Table 40 (A)	Table 40 (B)	Table 41	Table 42
Reclaimed Saltbush	I	Table 32	Table 33 (A)	Table 33 (B)	Table 34	Table 35
Sagebrush Reference Area	n/a	Table 43	Table 44 (A)	Table 44 (B)	Table 45	Table 46
Mountain Grassland Reference Area	n/a	Table 47	Table 48 (A)	Table 48 (B)	Table 49	Table 50
Saltbush Reference Area	n/a	Table 51	Table 52 (A)	Table 52 (B)	Table 53	Table 54

Dominant Plant Species

In 2012, the most important or dominant plant species in the reclaimed areas at the Star Point Mine site by cover and frequency for the **Reclaimed Sagebrush Areas** were primarily shrubs, or rubber rabbitbrush (*Chrysothamnus nauseosus*), fourwing saltbush (*Atriplex canescens*), shadscale (*A. confertifolia*), winterfat (*Ceratoides lanata*) and big sagebrush (*Artemisia tridentata*). Dominant forbs here consisted of: Pacific aster (*Aster chilensis*), northern vetch (*Hedysarum boreale*), Lewis flax (*Linum lewisii*) and Palmer penstemon (*Penstemon palmeri*). The most important grasses in these reclaimed areas were thickspike wheatgrass (*Elymus lanceolatus*), bluebunch wheatgrass (*E. spicatus*), crested wheatgrass (*Agropyron cristatum*) and Indian ricegrass (*Stipa hymenoides*). All species present in the sample quadrats in the Reclaimed Sagebrush Areas have been provided on Tables 4, 7, 10 and 28.

The dominant shrub species for the **Reclaimed Mountain Grassland Areas** were comprised of big sagebrush, corymb buckwheat (*Eriogonum corymbosum*), Antelope bitterbrush (*Purshia tridentata*), rubber rabbitbrush and curl-leaf mountain mahogany (*Cercocarpus ledifolius*). The dominant forbs in this community were Lewis flax, Pacific aster and Palmer penstemon. The most important grasses here were: Great Basin wildrye (*Elymus cinereus*), mountain brome (*Bromus carinatus*), thickspike wheatgrass and bluebunch wheatgrass. For a list of all species encountered in the Reclaimed Mountain Grassland Areas, refer to Tables 14, 17, 21, 24, 36 and 39.

Lastly, the dominant shrubs by cover and frequency in the **Reclaimed Saltbush Areas** consisted of: shadscale, rubber rabbitbrush and black sagebrush (*Artemisia nova*). The dominant forb here was cicer milkvetch (*Astragalus cicer*), and the most important grasses consisted of bluebunch wheatgrass, western wheatgrass (*Elymus smithii*), Salina wildrye (*Elymus salinus*) and thickspike wheatgrass. For cover and frequency values in the Reclaimed Saltbush Areas, refer to Tables 32.

In the reference areas, the most important shrub species in the **Sagebrush Reference Area** by a wide margin was big sagebrush. In 2012, the only forb present in the sample quadrats

was hoary aster (*Machaeranthera canescens*). Dominant grasses in this community were: Indian ricegrass, created wheatgrass and Salina wildrye. For a list of the plants found in the Sagebrush Reference Area, refer to Table 43.

The dominant shrubs in the **Mountain Grassland Reference Area** were: corymb buckwheat and low rabbitbrush (*Chrysothamnus viscidiflorus*). Although forbs were relatively unimportant here, the dominants were: yarrow (*Achillea millefolium*), buckwheat (*Eriogonum* sp.) and hoary aster. The dominant grass by a very wide margin was Salina wildrye. For a list of all species in this reference area, refer to Table 47.

Lastly, for the reference areas, the most important shrub in the **Saltbush Reference Area** was Gardner saltbush (*Atriplex gardneri*), followed distantly by shadscale. Forbs were again relatively unimportant here and were not present in the sample quadrats in 2012. The only grasses present in the sample quadrats was Salina wildrye. For a list of all species present in this community, refer to Table 51.

Lifeform Composition

As a short summary on composition in the **Reclaimed Sagebrush Areas**, grasses were the dominate lifeform followed closely by shrubs and less closely by forbs in all sample sites. For lifeform composition percentages in these reclaimed areas, refer to Tables 5, 8, 11 and 29.

In the **Reclaimed Mountain Grassland Areas**, with only one exception, grasses were the dominant lifeform, shrubs and forbs demonstrated mixed proportions depending on the reclaimed area. For lifeform composition percentages in these areas, refer to Tables 15, 18, 22, 25, 37 and 40.

The composition order of the **Reclaimed Saltbush Areas** showed that grasses comprised more that 3 times that of shrubs; forbs were inconsequential. For composition results in this reclaimed site, refer to Table 33.

In the **Sagebrush Reference Area**, grasses and shrubs were relatively close in proportion,

but followed distantly by forbs (Table 44).

The **Mountain Grassland Reference Area** was very much dominated by grasses (greater than 80%) as shown in the composition, but shrubs and forbs were also represented (Table 48).

Finally, the composition of the **Saltbush Reference Area** was nearly equally represented by shrubs and grasses, with few forbs (Table 52).

The dominant species information as well as the lifeform composition results described above have been provided as additional information to further demonstrate the current condition of the vegetation at the Star Point Mine site. However, the primary parameters for comparing the reclaimed areas with the reference areas were: total living cover, woody species density, annual biomass productivity and diversity. Therefore, these parameters are first shown graphical for the *separated data*, then compared statistically later in the report for the *lumped* (or *combined data*).

Total Living Cover

Total living cover, one of the primary parameters in assessing revegetation success at the mine site, has been shown for individual areas in summary tables provided later in the report; these values have also been shown graphically in figures here. Figure 1 illustrates the total living cover in each Reclaimed Sagebrush Area as well as the Sagebrush Reference Area (RF).

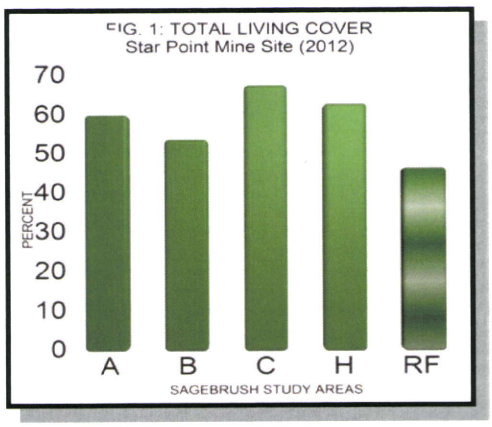


Figure 2 shows the same parameter, total living cover, for all the Reclaimed Mountain Grassland Areas as well as the Mountain Grassland Reference Area.

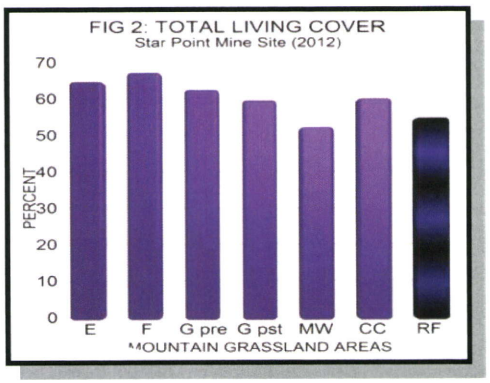
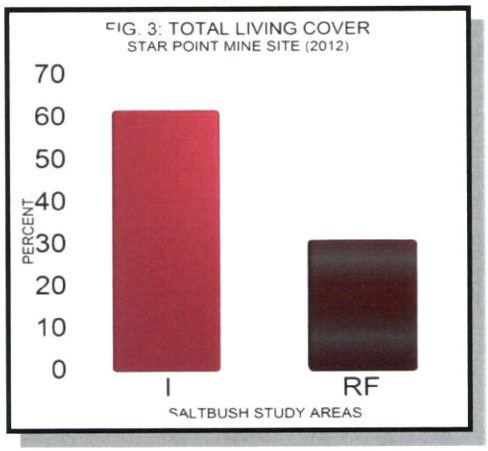
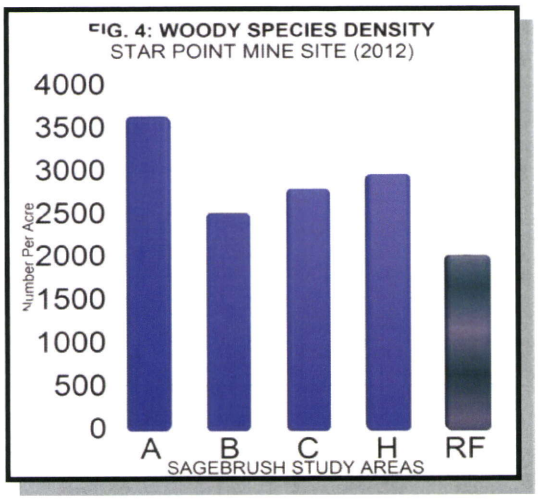


Figure 3 illustrates total living cover for the Reclaimed Saltbush Area along with the Saltbush Reference Area.

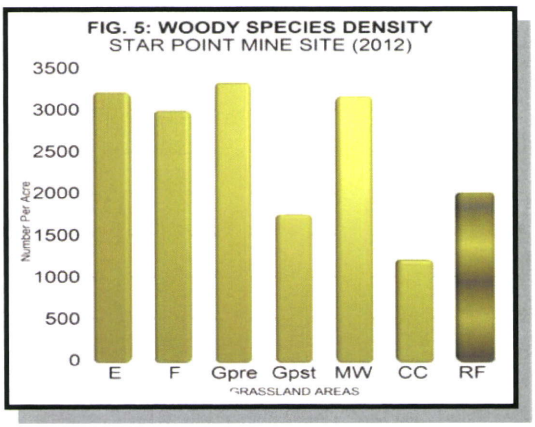


Woody Species Density

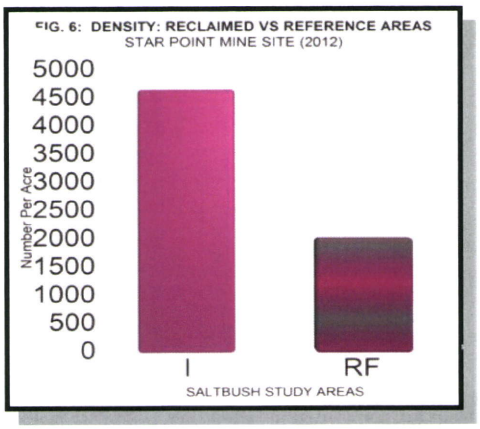
Woody species density values, or the total number of individuals per acre, for each Reclaimed Sagebrush Area as well as the Sagebrush 'standard' [a pre-determined number, *not* the reference area value (further explained later)] are shown in Figure 4.



This same parameter for each Reclaimed Grassland Area and its density standard are shown in Figure 5 (the figure shows both pre=pre-SMCRA and pst=post SMCRA results).



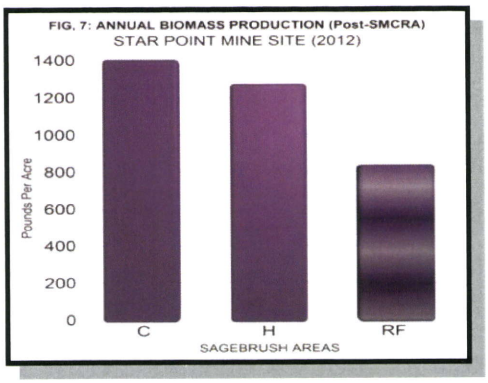
Finally, the woody species density for the Reclaimed Saltbush Areas along with the Saltbush density standard are shown in Figure 6.

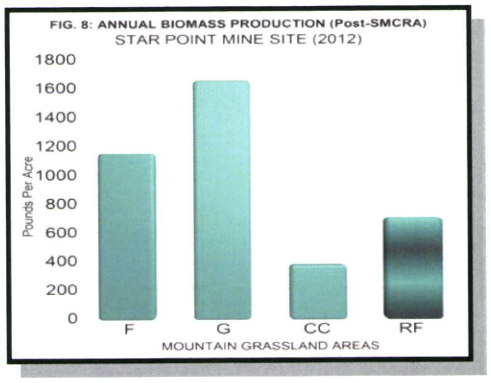


Annual Biomass Production

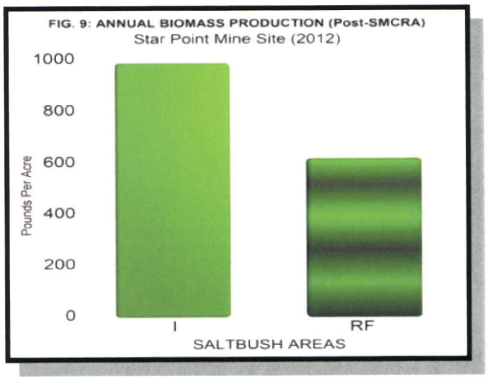
As dictated by the final revegetation success standards in the Star Point Mine's MRP, total annual biomass production was only measured and compared with reference areas in the post-SMCRA sites. The production shown in pounds per acre for the Reclaimed Sagebrush Areas and Sagebrush Reference Area are shown in Figure 7.

Next, the production of the Reclaimed Mountain Grasslands and its associated reference area are shown graphically in Figure 8.





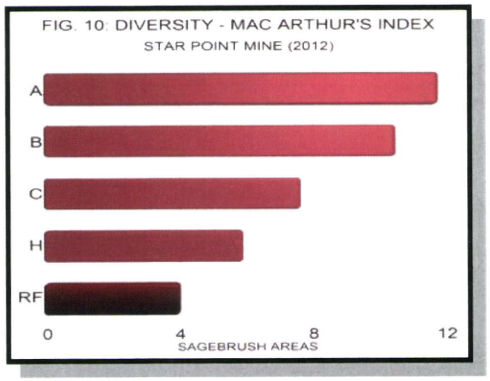
Lastly, the production of the Reclaimed Saltbush Areas can be compared to the Saltbush Reference Area in Figure 9.

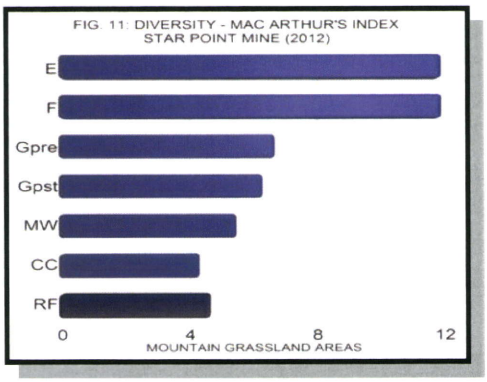


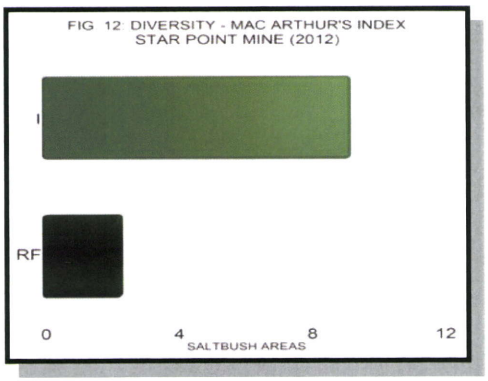
Diversity

Two different diversity measurements have been applied to the reclaimed and reference areas – MacArthur's Index and the Average Number of Species per Quadrat. Graphical representations of these diversity indices are shown below.

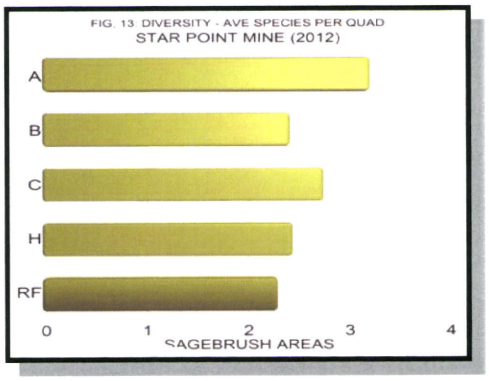
MacArthur's Index

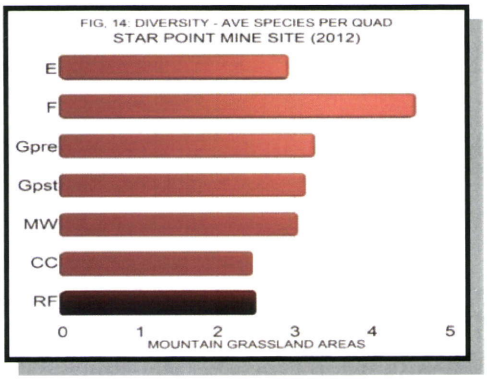


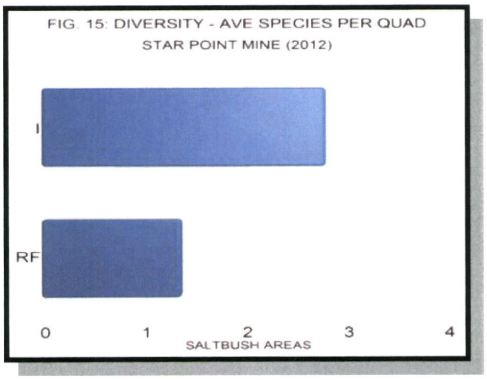




Average Species Per Quadrat







Separating vs Lumping Data

The section above provides the summary data for each sample area including the Reclaimed Areas and Reference Areas along with the subdivisions within the larger reclaimed vegetation types. As explained, this design enables the reviewer to observe the successes (or failures) of individual areas even *within each reclaimed vegetation type*. For example, Areas A, B, C and H are all within the Sagebrush type, yet the sample data were summarized separately for these areas to enable closer scrutiny of the revegetated landscapes.

As important as it is to be able to review individual reclaimed areas by separating the datasets, combining the data of each vegetation type, then comparing them statistically with their respective reference areas is the most logical rational in the process of considering the mine site for final bond release. Combined dataset summaries have been provided in Tables 55 through 67.

Results of Lumped Data

There has been a significant amount of vegetation data collected at the Star Point Mine site in 2012 (and 2011) to assess the revegetation success when compared to the success standards.

Even though much data has been recorded in the area, the author has tried to find a logical and straightforward method to compare the *applicable parameters* to assess revegetation success (those required by state and federal regulations), yet also provide other meaningful data (that cannot readily be compared using statistics).

In this attempt, the following section discusses the methods used to compare key parameters for the reclaimed areas and their respective reference areas for bond release.

To begin, it may seem logical to simply lump all the Reclaimed Sagebrush sites together into one dataset, then all the Reclaimed Mountain Grassland sites to another dataset and so forth – then compare these datasets with the appropriate Reference Area. However, different revegetation success standards have been assigned to reclaimed areas – even though they may be in the same vegetation type. Reasons for the dissimilar standards was based on whether or not a given reclaimed area was disturbed prior to, or after, the Surface Mining Control and Reclamation Act of 1977 (SMCRA). Those areas disturbed after, or post-SMCRA, have more stringent revegetation success standards than those disturbed pre-SMCRA. (More information and justification for this distinction can be found in the Star Point Mine's MRP).

Reclaimed Areas divided by vegetation type and Surface Mining Control and Reclamation Act.

1. **Pre-SMCRA**
   - a. Reclaimed Sagebrush
     - i. Area A
     - ii. Area B
   - b. Reclaimed Mountain Grassland
     - i. Area E
     - ii. Area G
     - iii. Mudwater Canyon
2. **Post-SMCRA**
   - a. Reclaimed Sagebrush
     - i. Area C
     - ii. Area H
   - b. Reclaimed Mountain Grasslands
     - i. Area F
     - ii. Area G (Area G has both pre- and post-SMCRA areas)
     - iii. Corner Canyon
   - c. Reclaimed Saltbush
     - i. Area I

With that in mind, the datasets have been lumped (combined) by vegetation type and the SMCRA time-frame. The outline above summarizes this treatment of datasets. The following describes the sample results for combined datasets.

Total Living Cover in the pre-SMCRA Areas

The total living cover (combined) for the pre-SMCRA Reclaimed Sagebrush Areas (Areas A & B) was estimated at 57.63% (Table 55). The total living cover for the Reclaimed Mountain Grassland Areas (Areas E, G & Mudwater Canyon) was estimated at 61.47% (Table 60). There were no pre-SMCRA Reclaimed Saltbush Areas at the site.

Woody Species Density in the pre-SMCRA Areas

The pre-SMCRA woody species density for the Reclaimed Sagebrush Areas (Areas A & B) combined was estimated at 3,282 individuals per acre (Table 56). The pre-SMCRA density for the Reclaimed Mountain Grasslands Areas (Areas E, G & Mudwater Canyon) was estimated at 2,962 plants per acre (Table 61). Again, there were no pre-SMCRA Reclaimed Saltbush Areas at the site.

Total Living Cover in the post-SMCRA Areas

Next, the total living cover of the post-SMCRA Reclaimed Sagebrush Areas (Areas C & H) was estimated at 64.17% (Table 57). The total living cover for the Reclaimed Mountain Grassland Areas (Areas F, G & Corner Canyon) was estimated at 62.88% (Table 62). And finally, the post-SMCRA Saltbush Area (Area I) had a total living cover of 60.90% (Table 65).

Woody Species Density in the post-SMCRA Areas

The density for the post-SMCRA Reclaimed Sagebrush Areas (Areas C & H) was estimated at 2,899 plants per acre (Table 58). The density for the Reclaimed Mountain Grassland Areas (Areas F, G & Corner Canyon) was estimated at 2,327 plants per acre (Table 63). Lastly, the post-SMCRA Saltbush Area (Area I) had a density 4,587 (Table 66).

Annual Biomass Production in the post-SMCRA Areas

Annual biomass production was only sampled in the post-SMCRA sites. The combined Reclaimed Sagebrush Areas (Areas C & H) was estimated at 1,328.17 pounds per acre (Table 59). The production for the Reclaimed Mountain Grassland Areas (Areas F, G & Corner

Canyon) was estimated at 1,232.53 pounds per acre (Table 64). Lastly, the Saltbush Area (Area I) had a productivity estimate of 973.74 pounds per acre (Table 67).

Reference Areas

Total Living Cover

The total living cover for the Sagebrush Reference Area was estimated at 45.70% (Table 44). The total living cover for the Mountain Grassland Reference Area was estimated at 54.33% (Table 48). And finally, the Saltbush Reference Area had a total living cover of 30.70% (Table 52).

Woody Species Density

The density for the Sagebrush Reference Area was estimated at 6,558 plants per acre (Table 45), but the pre-determined success standard for this parameter was 2,000 plants per acre[1]. The density for the Mountain Grassland Reference Area was estimated at 1,470 plants per acre (Table 49), but the pre-determined success standard for this parameter was also 2,000 plants per acre. Lastly, the Saltbush Reference Area had a density 3,574 (Table 53), and again the pre-determined success standard for this parameter was 2,000 plants per acre.

Annual Biomass Production

The annual biomass production for the Sagebrush Reference Area was estimated at 835.02 pounds per acre (Table 46). The production for the Mountain Grassland Reference Area was estimated at 698.33 pounds per acre (Table 50). Lastly, the Saltbush Reference Area had a productivity estimate of 609.81 pounds per acre (Table 54).

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[1] The pre-determined density standard here (and in the other reclaimed communities) was determined more appropriate than the reference area for wildlife habitat by state biologists. More details about this can be found in the MRP.

Revegetation Success Standards

A summary of the revegetation success standards for the Star Point Mine has been provided in Table 68. Statistical comparisons between the reclaimed and reference areas are shown in Tables 69 through 71. Some success standards required Natural Resources Conservation Service (NRCS) estimates. For the NRCS information required, refer to the APPENDIX of this report.

Statistical Comparisons

Reclaimed Sagebrush (pre-SMCRA) vs. Reference Area

When the **total living cover** of the pre-SMCRA Reclaimed Sagebrush Areas *combined* was compared to Sagebrush Reference Area, the reclaimed area had a higher cover; the difference was significant statistically [Table 69 (A)]. In other words, the reclaimed area's total living cover was significantly higher than its revegetation success standard.

A **woody species density** comparison of the pre-SMCRA Reclaimed Sagebrush Areas *combined* and the pre-set standard of 2,000 individuals per acre indicated that the density of the former was greater than the standard [Table 69 (A)].

An **annual biomass productivity** standard was not assigned to the pre-SMCRA sites.

Reclaimed Sagebrush (post-SMCRA) vs. Reference Area

In a comparison of the **total living cover** of the post-SMCRA Reclaimed Sagebrush Areas *combined* and the reclaimed areas, again the reclaimed areas value was greater and was statistically significant [Table 69 (B)].

A **woody species density** comparison of the post-SMCRA Reclaimed Sagebrush Areas *combined* and the pre-set standard of 2,000 indicated that the density of the reclaimed areas was greater [Table 69 (B)].

When the **annual biomass productivity** of post-SMCRA Reclaimed Sagebrush Areas *combined* was compared statistically with the Sagebrush Reference Area, the difference was statistically significant – the reclaimed areas had more production [Table 69 (B)].

Reclaimed Mountain Grasslands (pre-SMCRA) vs. Reference Area

In 2012, when the **total living cover** of the pre-SMCRA Reclaimed Mountain Grassland Areas *combined* was compared to Mountain Grassland Reference Area, the reclaimed areas had a statistical greater value [Table 70 (A)].

A **woody species density** comparison of the pre-SMCRA Reclaimed Mountain Grassland Areas *combined* and the pre-set standard of 2,000 indicated that the density of the former was greater than the standard [Table 70 (A)].

An **annual biomass productivity** standard was not given to the pre-SMCRA sites.

Reclaimed Mountain Grasslands (post-SMCRA) vs. Reference Area

In a comparison of the **total living cover** of the post-SMCRA Reclaimed Mountain Grassland Areas *combined*, the reclaimed areas had significantly more cover in 2012 [Table 70 (B)].

In a **woody species density** comparison between the post-SMCRA Reclaimed Mountain Grassland Areas *combined* and the pre-set standard of 2,000 individuals per acre, the reclaimed areas had about 16 percent more plants [Table 70 (B)].

When the **annual biomass productivity** of post-SMCRA Reclaimed Mountain Grassland Areas *combined* was compared statistically with the Mountain Grassland Reference Area, the difference was statistically significant – the reclaimed areas had much more annual biomass production [Table 70 (B)].

Reclaimed Saltbush (post-SMCRA)vs. Reference Area

There were no pre-SMCRA sites in the Reclaimed Saltbush Areas, but a comparison of the **total living cover** of the reclaimed post-SMCRA Saltbush Areas revealed this value to be slightly more than double that of the Saltbush Reference Area [Table 71 (A)].

A **woody species density** comparison of the post-SMCRA Reclaimed Saltbush Areas and the pre-set standard of 2,000 indicated that the density of the reclaimed areas was much greater than the standard [Table 71 (A)].

When the **annual biomass productivity** of post-SMCRA Reclaimed Saltbush Areas was compared statistically with the Saltbush Reference Area, the difference was statistically significant – the reclaimed areas had more annual biomass production here too [Table 71].

SUMMARY & CONCLUSIONS

Subsequent to the long history of mining in the area, the surface disturbances at the Star Point Mine site have been reclaimed and revegetated according to the specifications provided in the Mining & Reclamation Plan. Quantitative vegetation sampling has been conducted at the site to monitor revegetation success. Additionally, specific standards for revegetation success were determined prior to the reclamation activities. This report provides the findings of the more intensive vegetation sampling required for two consecutive years at the end of the *Responsibility Period.* The 2012 data presented herein, along with that previously reported for 2011, can be used to determine whether or not the mine site has met revegetation success standards and may warrant *Phase III* or *Final Bond Release.*

At the Star Point Mine, there are three vegetation types that were restored including Sagebrush, Mountain Grasslands and Saltbush Areas. Accordingly, there were also three reference areas of similar vegetation types that were chosen earlier to be used for revegetation success standards.

As a means to compare data for specific sites within each reclaimed area, datasets were first *separated* and summarized into smaller reclaimed sites. Later, the data were *lumped* (combined) into larger datasets making them more amenable to be used for comparisons with the reference areas for bond release considerations.

Statistical analyses, as well has other comparisons, suggest that reclaimed plant communities at the Star Point Mine site have met or exceeded the revegetation success standards and warrant consideration for Phase III Bond Release.

To conclude, although the complete datasets for 2011 were previously reported and have not been included in this report, the following information summarizes these results and compares them with the 2012 results. The complete datasets reported for both sample years illustrate the condition of the revegetated land at the Star Point Mine site, <u>but the concise graphical summaries of the most relevant parameters for final bond release,</u> are shown below.

Fig. 16: Summary Information for the Pre-SMCRA Reclaimed Sagebrush and Reference Areas (2011 & 2012)

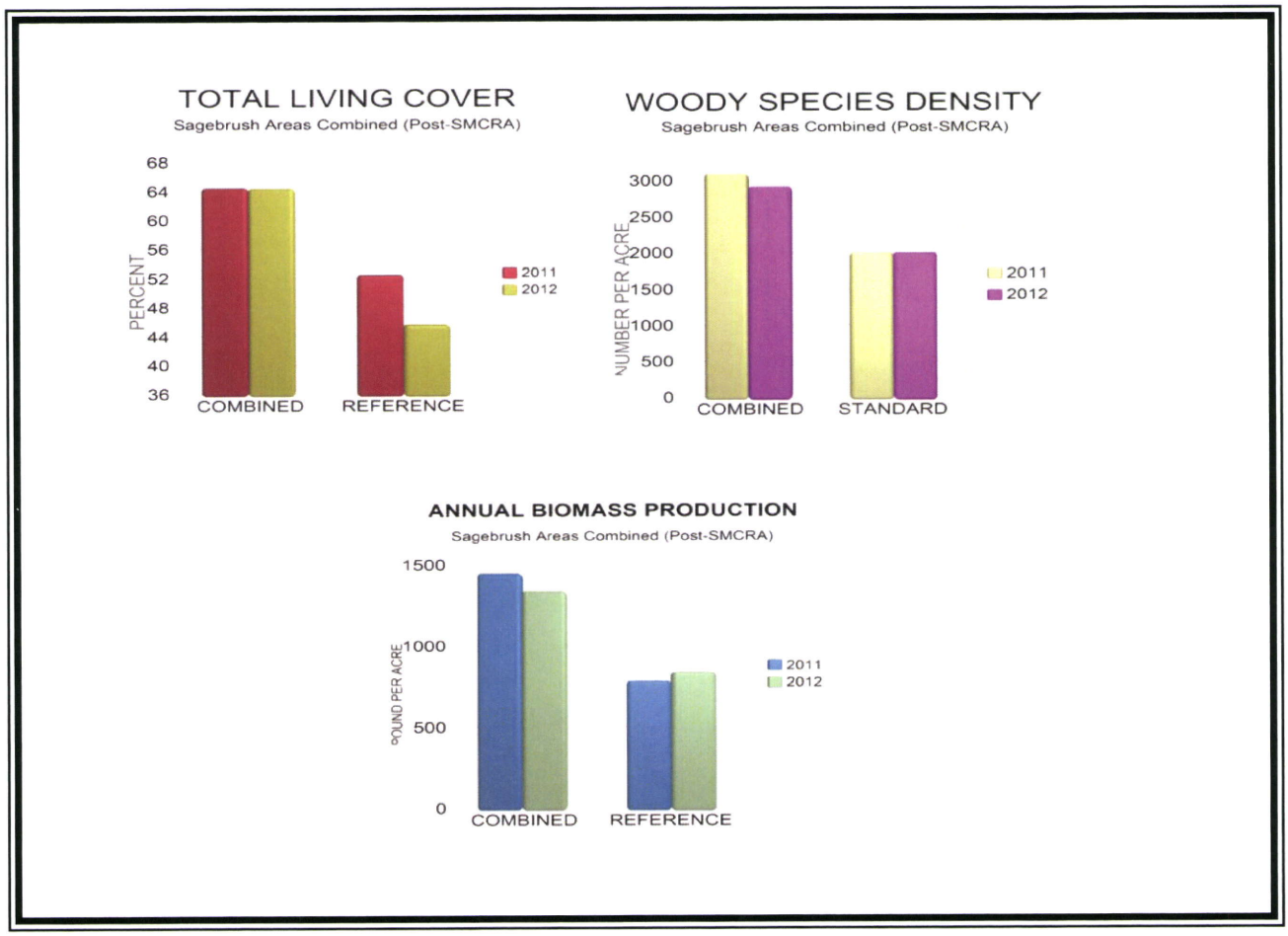


Fig. 17: Summary Information for the Post-SMCRA Reclaimed Sagebrush and Reference Areas (2011 & 2012)

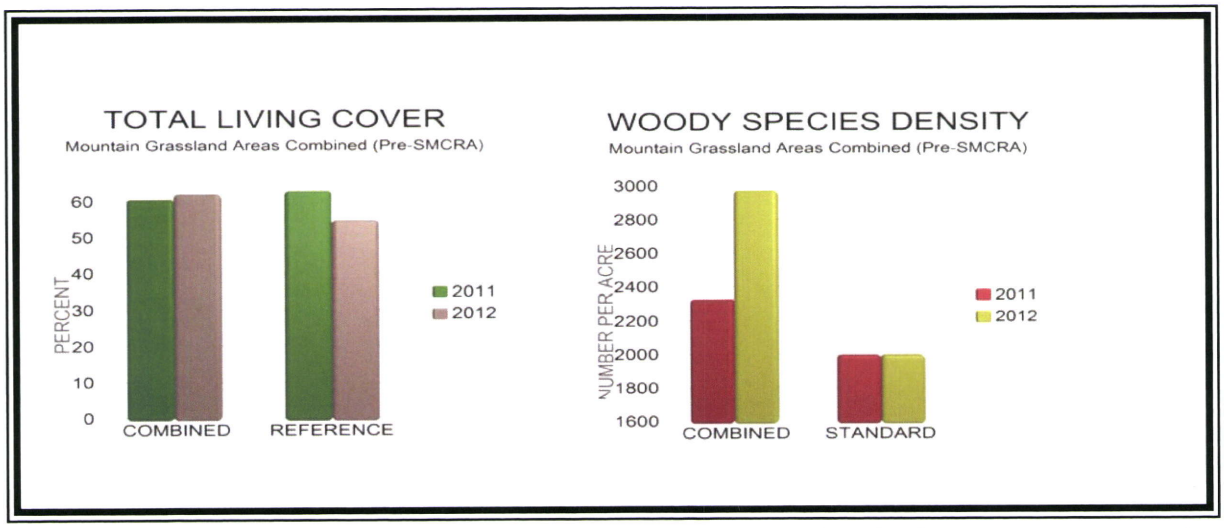


Fig. 18: Summary Information for the Pre-SMCRA Reclaimed Mtn. Grasslands and Reference Areas (2011 & 2012)

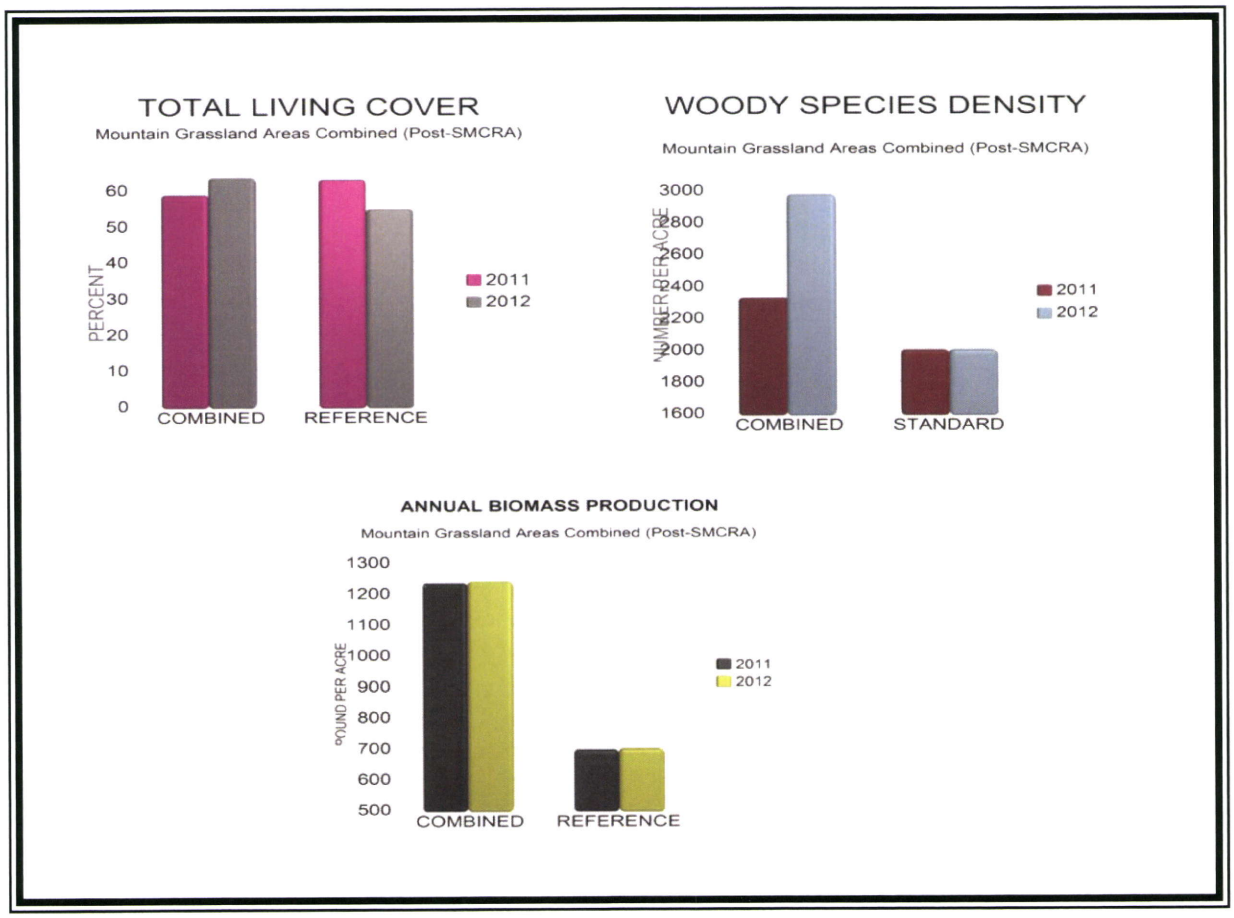


Fig. 19: Summary Information for the Post-SMCRA Reclaimed Mtn. Grasslands and Reference Areas (2011 & 2012)

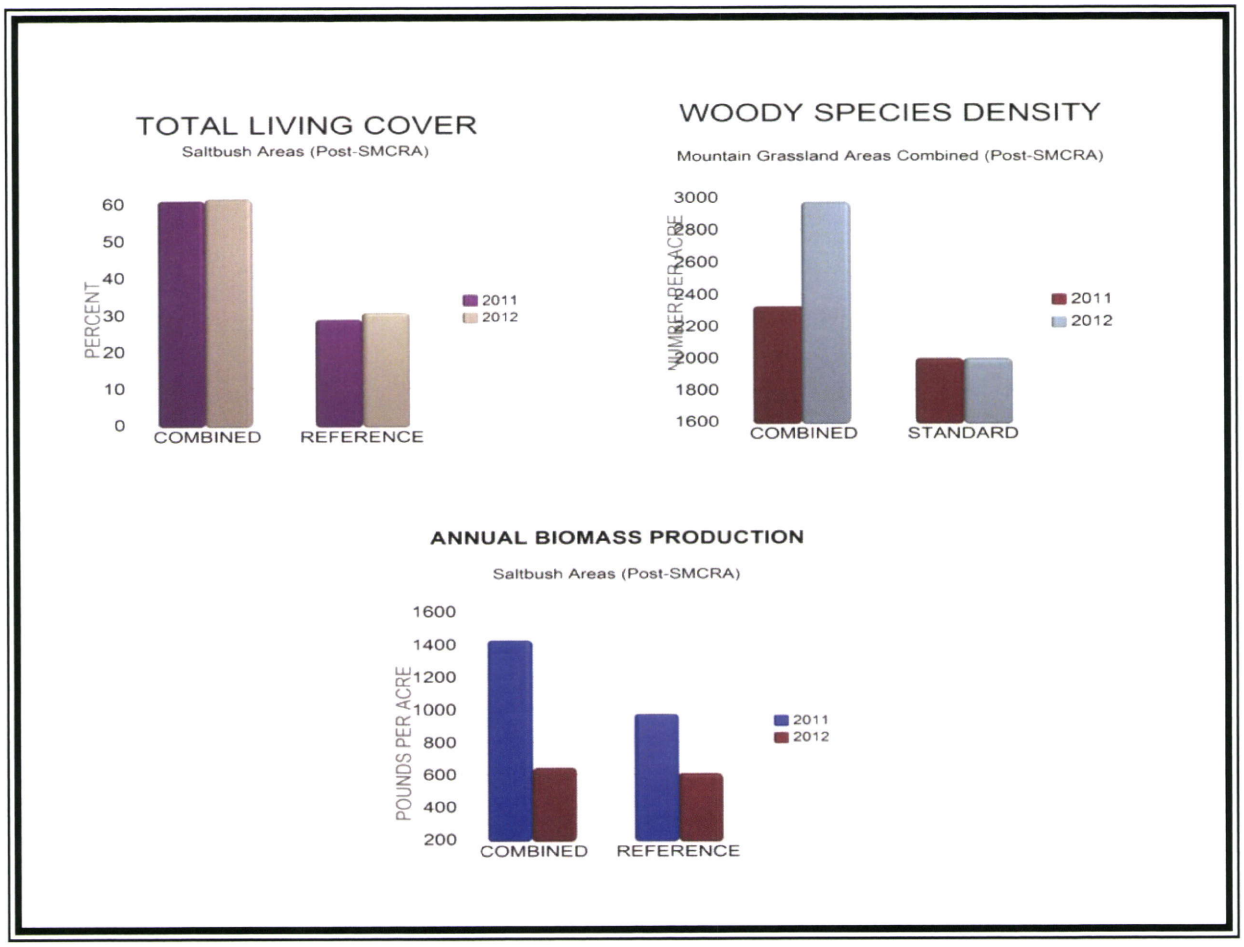


Fig. 20: Summary Information for the Post-SMCRA Reclaimed Saltbush and Reference Areas (2011 & 2012)

DATA SUMMARY TABLES

Table 4: Star Point Mine. **Living Cover and Frequency by Plant Species (2012).**

Reclaimed Sagebrush Area A			n=60
	Mean Percent	**Standard Deviation**	**Percent Frequency**
TREES & SHRUBS			
Acer glabrum	0.17	0.90	3.33
Artemisia tridentata	0.92	3.93	6.67
Atriplex canescens	2.92	11.08	8.33
Atriplex confertifolia	4.17	11.59	15.00
Ceratoides lanata	2.25	7.15	13.33
Cercocarpus ledifolius	0.83	5.26	3.33
Cercocarpus montanus	0.42	3.20	1.67
Chrysothamnus nauseosus	9.55	13.70	46.67
Symphoricarpos oreophilus	1.17	4.60	6.67
FORBS			
Artemisia dracunculus	1.28	4.66	8.33
Aster chilensis	0.83	5.18	5.00
Grindelia squarrosa	0.42	1.89	5.00
Hedysarum boreale	0.75	3.39	5.00
Linum lewisii	1.60	3.93	18.33
Machaeranthera canescens	0.08	0.64	1.67
Melilotus officinalis	1.92	6.53	11.67
Penstemon palmeri	3.52	5.33	45.00
GRASSES			
Agropyron cristatum	2.67	6.36	16.67
Bromus carinatus	0.17	1.28	1.67
Elymus cinereus	1.33	7.68	3.33
Elymus lanceolatus	7.05	12.39	33.33
Elymus salinus	3.50	11.08	11.67
Elymus spicatus	10.92	15.96	41.67
Stipa hymenoides	0.75	3.63	5.00

Table 5: Star Point Mine.
Total Cover and Composition (2012).

Reclaimed Sagebrush Area A		n=60
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Understory	59.17	12.08
Litter	8.00	3.44
Bareground	11.00	8.79
Rock	21.83	13.10
B. % COMPOSITION		
Shrubs	36.89	27.46
Forbs	17.99	22.09
Grasses	45.12	28.40

Table 6: Star Point Mine. Woody Species Density (2012).

SPECIES	**Individuals Per Acre**
Reclaimed Sagebrush Area A	n=60
Acer glabrum	30.01
Amelanchier utahensis	45.01
Artemisia tridentata	360.11
Atriplex canescens	330.10
Atriplex confertifolia	480.15
Ceratoides lanata	240.08
Cercocarpus ledifolius	285.09
Cercocarpus montanus	45.01
Chrysothamnus nauseosus	1680.53
Gutierrezia sarothrae	15.00
Symphoricarpos oreophilus	90.03
TOTAL	**3601.13**

Table 7: Star Point Mine. Living Cover and Frequency by Plant Species (2012).

Reclaimed Sagebrush Area B			n=20
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Artemisia tridentata	1.00	4.36	5.00
Atriplex canescens	4.00	12.41	10.00
Atriplex confertifolia	2.50	6.42	15.00
Ceratoides lanata	0.50	2.18	5.00
Chrysothamnus nauseosus	3.50	6.34	30.00
Eriogonum corymbosum	2.00	6.20	10.00
FORBS			
Grindelia squarrosa	0.25	1.09	5.00
Linum lewisii	2.50	5.12	20.00
Penstemon palmeri	2.00	4.30	20.00
GRASSES			
Agropyron cristatum	8.00	12.88	30.00
Elymus lanceolatus	6.25	12.93	20.00
Elymus salinus	7.25	17.64	15.00
Elymus spicatus	10.00	15.57	40.00
Stipa hymenoides	3.25	8.41	15.00

Table 8: Star Point Mine.
Total Cover and Composition (2012).

Reclaimed Sagebrush Area B		n=20
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Understory	53.00	13.82
Litter	7.75	2.49
Bareground	30.25	13.27
Rock	9.00	5.15
B. % COMPOSITION		
Shrubs	22.50	20.69
Forbs	11.25	16.89
Grasses	66.25	20.81

Table 9: Star Point Mine . Woody Species Density (2012).

Reclaimed Sagebrush Area B	n=20
SPECIES	**Individuals Per Acre**
Amelanchier utahensis	62.38
Artemisia tridentata	93.57
Atriplex canescens	311.92
Atriplex confertifolia	467.87
Ceratoides lanata	187.15
Cercocarpus ledifolius	31.19
Chrysothamnus nauseosus	998.13
Eriogonum corymbosum	280.72
Pinus edulis	31.19
Symphoricarpos oreophilus	31.19
TOTAL	**2495.33**

Table 10: Star Point Mine. Living Cover and Frequency by Plant Species (2012).

Reclaimed Sagebrush Area C			n=30
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Amelanchier utahensis	1.00	5.39	3.33
Artemisia tridentata	1.00	5.39	3.33
Atriplex canescens	2.83	9.37	10.00
Atriplex confertifolia	1.17	4.78	6.67
Ceratoides lanata	3.50	9.14	16.67
Chrysothamnus nauseosus	11.83	17.25	40.00
FORBS			
Artemisia dracunculus	1.00	3.27	10.00
Aster chilensis	1.67	8.10	6.67
Grindelia squarrosa	0.33	1.80	3.33
Hedysarum boreale	0.33	1.80	3.33
Linum lewisii	1.00	2.71	13.33
Penstemon palmeri	0.17	0.90	3.33
Viguiera multiflora	0.50	1.98	6.67
GRASSES			
Agropyron cristatum	11.83	15.99	50.00
Bromus carinatus	0.50	2.69	3.33
Elymus lanceolatus	4.67	9.83	20.00
Elymus spicatus	21.17	21.63	66.67
Stipa hymenoides	2.00	7.59	6.67

Table 11: Star Point Mine. Total Cover and Composition (2012).

Reclaimed Sagebrush Area C		n=30
A. TOTAL COVER	Mean Percent	Standard Deviation
Understory	66.50	3.91
Litter	8.17	3.53
Bareground	14.80	6.12
Rock	10.53	4.99
B. % COMPOSITION		
Shrubs	32.38	27.55
Forbs	7.33	16.60
Grasses	60.29	26.21

Table 12: Star Point Mine . Woody Species Density (2012).

Reclaimed Sagebrush Area C	n=30
SPECIES	**Individuals Per Acre**
Amelanchier utahensis	46.20
Artemisia tridentata	184.78
Atriplex canescens	415.77
Atriplex confertifolia	207.88
Ceratoides lanata	947.02
Chrysothamnus nauseosus	923.92
Eriogonum corymbosum	23.10
Gutierrezia sarothrae	23.10
TOTAL	**2771.77**

Table 13: Star Point Mine . Annual Biomass Production (2012).

Reclaimed Sagebrush
Area C

(n=30; double sampling n=120)

	Pounds/Acre	
LIFEFORM	**MEAN**	**STD. DEV.**
Herbaceous	606.10	474.12
Woody	786.57	675.15
TOTAL	**1392.67**	439.77

Table 14: Star Point Mine. Living Cover and Frequency by Plant Species (2012).

Reclaimed Mountain Grassland Area E			n=100
	Mean Percent	**Standard Deviation**	**Percent Frequency**
TREES & SHRUBS			
Amelanchier utahensis	0.10	0.99	1.00
Artemisia tridentata	5.50	11.54	24.00
Cercocarpus ledifolius	0.65	3.98	3.00
Chrysothamnus nauseosus	5.70	14.83	16.00
Eriogonum corymbosum	3.80	10.61	16.00
Pseudotsuga menziesii	0.30	2.22	2.00
Purshia tridentata	2.50	6.26	15.00
Symphoricarpos oreophilus	0.10	0.99	1.00
FORBS			
Achillea millefolium	1.50	5.07	10.00
Artemisia dracunculus	0.10	0.99	1.00
Aster chilensis	5.40	12.92	19.00
Grindelia squarrosa	0.55	2.22	6.00
Linum lewisii	2.55	5.63	23.00
Machaeranthera grindelioides	0.35	1.46	5.00
GRASSES			
Agropyron cristatum	0.65	3.37	4.00
Bromus carinatus	3.20	8.47	19.00
Elymus cinereus	13.90	20.09	50.00
Elymus junceus	0.40	2.89	2.00
Elymus lanceolatus	7.20	13.39	32.00
Elymus salinus	1.55	6.88	6.00
Elymus spicatus	6.80	13.59	30.00
Poa pratensis	1.05	5.93	4.00
Stipa hymenoides	0.40	2.71	3.00

Table 15: Star Point Mine.
Total Cover and Composition (2012).

Reclaimed Mountain Grassland Area E		n=100
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Understory	64.25	10.11
Litter	7.35	3.04
Bareground	10.45	6.86
Rock	17.95	10.20
B. % COMPOSITION		
Trees/Shrubs	29.68	27.49
Forbs	16.10	21.64
Grasses	54.22	29.46

Table 16: Star Point Mine . Woody Species Density (2012).

Reclaimed Mountain Grassland Area E	n=100
SPECIES	**Individuals Per Acre**
Acer glabrum	7.97
Amelanchier utahensis	63.74
Artemisia tridentata	1051.69
Cercocarpus ledifolius	63.74
Chrysothamnus nauseosus	733.00
Chrysothamnus viscidiflorus	7.97
Ephedra viridis	23.90
Eriogonum corymbosum	509.91
Gutierrezia sarothrae	31.87
Populus tremuloides	15.93
Purshia tridentata	565.68
Pseudotsuga menziesii	79.67
Symphoricarpos oreophilus	31.87
TOTAL	**3186.94**

Table 17: Star Point Mine. Living Cover and Frequency by Plant Species (2012).

Reclaimed Mountain Grassland Area F			n=40
	Mean Percent	**Standard Deviation**	**Percent Frequency**
TREES & SHRUBS			
Artemisia tridentata	2.38	7.33	12.50
Cercocarpus ledifolius	1.25	5.89	5.00
Chrysothamnus nauseosus	11.13	20.99	25.00
Purshia tridentata	2.63	5.12	22.50
Symphoricarpos oreophilus	0.25	1.56	2.50
FORBS			
Achillea millefolium	1.00	4.21	7.50
Aster chilensis	4.00	7.60	27.50
Grindelia squarrosa	0.50	2.18	5.00
Hedysarum boreale	4.50	10.17	20.00
Linum lewisii	1.38	3.53	15.00
Medicago sativa	1.13	5.64	5.00
Melilotus officinalis	17.38	14.01	77.50
Penstemon palmeri	0.75	2.63	7.50
GRASSES			
Bromus carinatus	2.25	9.87	7.50
Dactylis glomeratus	1.25	5.89	5.00
Elymus cinereus	10.75	13.58	50.00
Elymus lanceolatus	1.38	5.81	7.50
Elymus spicatus	2.75	8.29	12.50

Table 18: Star Point Mine. Total Cover and Composition (2012).

Reclaimed Mountain Grassland Area F		n=40
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Understory	66.63	6.16
Litter	7.13	2.71
Bareground	14.00	5.15
Rock	12.25	5.24
B. % COMPOSITION		
Shrubs	26.67	31.87
Forbs	45.81	25.31
Grasses	27.53	24.07

Table 19: Star Point Mine . Woody Species Density (2012).

Reclaimed Mountain Grassland Area F	n=40
SPECIES	**Individuals Per Acre**
Acer glabrum	27.83
Artemisia tridentata	834.78
Cercocarpus ledifolius	92.75
Cercocarpus montanus	9.28
Chrysothamnus nauseosus	1205.80
Eriogonum corymbosum	9.28
Pseudotsuga menziesii	55.65
Purshia tridentata	677.10
Symphoricarpos oreophilus	55.65
TOTAL	**2968.12**

Table 20: Star Point Mine . Annual Biomass Production (2012).

Reclaimed Mountain Grassland
Area F

(n=40)

	Pounds/Acre	
LIFEFORM	**MEAN**	**STD. DEV.**
Herbaceous	758.56	534.08
Woody	385.37	566.04
TOTAL	**1143.93**	372.75

Table 21: Star Point Mine. Living Cover and Frequency by Plant Species (2012).

Reclaimed Mountain Grassland Area G (Pre-SMCRA)			n=20
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Artemisia tridentata	13.75	15.80	60.00
Cercocarpus ledifolius	5.50	13.31	15.00
Machaeranthera canescens	0.25	1.09	5.00
Pseudotsuga menziesii	1.25	5.45	5.00
Purshia tridentata	1.25	3.11	15.00
Symphoricarpos oreophilus	0.75	2.38	10.00
FORBS			
Aster chilensis	6.50	9.50	45.00
Astragalus cicer	0.25	1.09	5.00
Linum lewisii	2.75	6.80	25.00
Penstemon palmeri	0.50	1.50	10.00
GRASSES			
Elymus cinereus	22.25	16.77	80.00
Elymus spicatus	7.00	7.97	50.00

Table 22: Star Point Mine.
Total Cover and Composition (2012).

Reclaimed Mountain Grassland Area G (Pre-SMCRA)		n=20
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Understory	62.00	10.54
Litter	10.00	3.16
Bareground	12.00	6.40
Rock	16.00	7.84
B. % COMPOSITION		
Trees/Shrubs	36.76	23.76
Forbs	17.14	20.70
Grasses	46.09	26.89

Table 23: Star Point Mine . Woody Species Density (2012).

Reclaimed Mountain Grassland Area G (Pre-SMCRA)	n=20
SPECIES	**Individuals Per Acre**
Artemisia tridentata	1647.49
Cercocarpus ledifolius	247.12
Chrysothamnus nauseosus	164.75
Eriogonum corymbosum	41.19
Pseudotsuga menziesii	205.94
Purshia tridentata	453.06
Symphoricarpos oreophilus	494.25
TOTAL	**3294.99**

Table 24: Star Point Mine. Living Cover and Frequency by Plant Species (2012).

Reclaimed Mountain Grassland Area G (Post SMCRA)			n=30
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Amelanchier utahensis	0.50	2.69	3.33
Artemisia tridentata	3.07	12.77	10.00
Cercocarpus ledifolius	1.17	4.78	6.67
Cercocarpus montanus	0.27	1.44	3.33
Chrysothamnus nauseosus	3.17	10.12	13.33
Purshia tridentata	0.67	2.49	6.67
Symphoricarpos oreophilus	0.33	1.25	6.67
FORBS			
Aster chilensis	5.00	11.25	20.00
Astragalus cicer	2.50	6.68	13.33
Linum lewisii	6.17	6.01	60.00
Penstemon palmeri	4.17	5.18	46.67
GRASSES			
Elymus cinereus	26.33	17.60	86.67
Elymus spicatus	5.67	8.73	36.67

Table 25: Star Point Mine. Total Cover and Composition (2012).

Reclaimed Mountain Grassland Area G (Post SMCRA)		n=30
A. TOTAL COVER	Mean Percent	Standard Deviation
Understory	59.00	11.79
Litter	8.33	2.36
Bareground	12.33	5.73
Rock	20.33	7.63
B. % COMPOSITION		
Shrubs	15.26	26.83
Forbs	30.51	21.12
Grasses	54.23	28.31

Table 26: Star Point Mine . Woody Species Density (2012).

Reclaimed Mountain Grassland Area G (Post SMCRA)	n=30
SPECIES	**Individuals Per Acre**
Amelanchier utahensis	29.08
Artemisia tridentata	261.76
Cercocarpus ledifolius	276.30
Cercocarpus montanus	43.63
Chrysothamnus nauseosus	465.34
Eriogonum corymbosum	14.54
Purshia tridentata	508.97
TOTAL	**1745.04**

Table 27: Star Point Mine . Annual Biomass Production (2012).

Reclaimed Mountain Grassland
Area G (Post SMCRA)

(n=30)

	Pounds/Acre	
LIFEFORM	**MEAN**	**STD. DEV.**
Herbaceous	1349.74	684.67
Woody	286.58	715.12
TOTAL	**1636.32**	914.49

Table 28: Star Point Mine. Living Cover and Frequency by Plant Species (2012).

Reclaimed Sagebrush Area H			n=30
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Atriplex canescens	6.33	13.10	23.33
Ceratoides lanata	3.17	8.90	16.67
Chrysothamnus nauseosus	17.50	19.57	53.33
FORBS			
Bassia scoparia	1.83	5.24	13.33
Medicago sativa	0.33	1.80	3.33
Penstemon palmeri	0.17	0.90	3.33
GRASSES			
Agropyron cristatum	19.17	18.53	63.33
Bromus tectorum	0.50	2.69	3.33
Elymus lanceolatus	3.50	8.58	16.67
Elymus spicatus	8.83	12.89	43.33
Stipa comata	0.50	2.69	3.33

Table 29: Star Point Mine. Total Cover and Composition (2012).

Reclaimed Sagebrush Area H		n=30
A. TOTAL COVER	Mean Percent	Standard Deviation
Understory	61.83	7.69
Litter	12.33	5.73
Bareground	17.33	7.93
Rock	8.50	5.94
B. % COMPOSITION		
Shrubs	42.96	26.86
Forbs	4.38	10.32
Grasses	52.66	30.04

Table 30: Star Point Mine . Woody Species Density (2012).

Reclaimed Sagebrush Area H	n=30
SPECIES	**Individuals Per Acre**
Artemisia tridentata	24.47
Atriplex canescens	440.51
Atriplex confertifolia	195.28
Ceratoides lanata	1443.89
Chrysothamnus nauseosus	1443.89
TOTAL	**2936.74**

Table 31: Star Point Mine . Annual Biomass Production (2012).

Reclaimed Sagebrush
Area H

(n=30)

	Pounds/Acre	
LIFEFORM	**MEAN**	**STD. DEV.**
Herbaceous	433.50	370.61
Woody	830.17	590.31
TOTAL	**1263.66**	486.94

Table 32: Star Point Mine. Living Cover and Frequency by Plant Species (2012).

Reclaimed Saltbush Area I			n=50
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Reclaimed Saltbush			
Amelanchier utahensis	0.90	6.30	2.00
Artemisia nova	1.20	4.96	8.00
Artemisia tridentata	0.10	0.70	2.00
Atriplex canescens	1.70	7.46	8.00
Atriplex confertifolia	7.40	11.06	38.00
Atriplex corrugata	0.80	2.89	8.00
Atriplex gardneri	0.30	2.10	2.00
Ceratoides lanata	0.50	2.50	4.00
Chrysothamnus nauseosus	3.70	6.77	34.00
Eriogonum corymbosum	0.70	3.16	6.00
FORBS			
Aster chilensis	0.40	2.80	2.00
Grindelia squarrosa	0.20	1.40	2.00
Linum lewisii	0.30	1.55	4.00
GRASSES			
Agropyron cristatum	2.00	5.74	12.00
Elymus junceus	0.70	4.90	2.00
Elymus lanceolatus	6.60	13.69	24.00
Elymus salinus	5.70	14.97	16.00
Elymus smithii	11.80	16.58	44.00
Elymus spicatus	14.30	17.46	50.00
Stipa hymenoides	1.60	5.87	8.00

Table 33: Star Point Mine. Living Cover and Frequency by Plant Species (2012).

Reclaimed Saltbush Area I		n=50
A. TOTAL COVER	Mean Percent	Standard Deviation
Understory	60.90	10.43
Litter	9.16	2.08
Bareground	20.40	8.77
Rock	9.54	4.53
B. % COMPOSITION		
Shrubs	28.00	19.32
Forbs	1.36	5.08
Grasses	70.64	19.62

Table 34: Star Point Mine. Woody Species Density (2012).

Reclaimed Saltbush Area I	n=50
SPECIES	**Individuals Per Acre**
Amelanchier utahensis	22.93
Artemisia nova	366.94
Artemisia tridentata	22.93
Atriplex canescens	229.34
Atriplex confertifolia	1903.50
Atriplex corrugata	321.07
Atriplex gardneri	114.67
Ceratoides lanata	114.67
Chrysothamnus nauseosus	986.15
Eriogonum corymbosum	504.54
TOTAL	4586.74

Table 35: Star Point Mine . Annual Biomass Production (2012).

Reclaimed Saltbush Area I

(n=50)

	Pounds/Acre	
LIFEFORM	**MEAN**	**STD. DEV.**
Herbaceous	688.77	256.45
Woody	284.96	355.25
TOTAL	**973.74**	330.71

Table 36: Star Point Mine. Living Cover and Frequency by Plant Species (2012).

Reclaimed Mountain Grassland Mudwater Canyon Area			n=30
	Mean Percent	**Standard Deviation**	**Percent Frequency**
TREES & SHRUBS			
Pseudotsuga menziesii	0.17	0.90	3.33
Rosa woodsii	0.67	3.59	3.33
Rubus idaeus	0.23	1.26	3.33
FORBS			
Achillea millefolium	0.17	0.90	3.33
Aster glaucodes	2.10	6.39	13.33
Cynoglossum officinale	0.47	1.31	13.33
Fragaria vesca	0.07	0.36	3.33
Geranium viscosissimum	10.93	8.88	80.00
Viguiera multiflora	0.40	1.52	6.67
GRASSES			
Bromus carinatus	11.37	17.97	46.67
Elymus lanceolatus	7.10	13.45	36.67
Elymus smithii	17.33	13.32	80.00
Festuca ovina	0.17	0.90	3.33
Phleum pratense	0.33	1.80	3.33
Poa pratensis	0.33	1.80	3.33

Table 37: Star Point Mine. Living Cover and Frequency by Plant Species (2012).

Reclaimed Mountain Grassland Mudwater Canyon Area		n=30
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Understory	51.83	15.78
Litter	7.17	3.08
Bareground	14.33	7.93
Rock	26.67	13.31
B. % COMPOSITION		
Trees/Shrubs	2.15	6.78
Forbs	28.20	18.93
Grasses	69.65	18.02

Table 38: Star Point Mine . Woody Species Density (2012).

Reclaimed Mountain Grassland Mudwater Canyon Area	n=21
SPECIES	**Individuals Per Acre**
Acer glabrum	215.67
Juniperus communis	16.59
Lonicera involucrata	49.77
Populus tremuloides	82.95
Pseudotsuga menziesii	49.77
Ribes aureum	116.13
Ribes viscosissimum	116.13
Rosa woodsii	580.65
Rubus idaeus	1675.59
Symphoricarpos oreophilus	232.26
TOTAL	**3135.51**
sd	3815.89

Table 39: Star Point Mine. Living Cover and Frequency by Plant Species (2012).

Reclaimed Grassland Corner Canyon Area			n=10
	Mean Percent	**Standard Deviation**	**Percent Frequency**
TREES & SHRUBS			
Symphoricarpos oreophilus	4.00	8.31	20.00
FORBS			
Cirsium sp.	0.90	1.58	30.00
Cynoglossum officinale	0.20	0.60	10.00
Geranium viscosissimum	6.10	7.29	6.00
Viguiera multiflora	0.20	0.60	10.00
GRASSES			
Elymus lanceolatus	4.80	6.58	40.00
Elymus smithii	37.80	10.27	100.00
Phleum pratense	5.50	9.60	30.00

Table 40: Star Point Mine. Living Cover and Frequency by Plant Species (2012).

Reclaimed Grassland Corner Canyon Area		n=10
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Understory	59.50	10.59
Litter	9.00	3.00
Bareground	10.00	3.87
Rock	21.50	7.09
B. % COMPOSITION		
Shrubs	5.48	11.27
Forbs	12.12	11.44
Grasses	82.40	15.19

Table 41: Star Point Mine . Woody Species Density (2012).

Reclaimed Grassland Corner Canyon Area Area	n=10
SPECIES	**Individuals Per Acre**
Chrysothamnus nauseosus	90.53
Lonicera involucrata	120.71
Pseudotsuga menziesii	30.18
Rosa woodsii	30.18
Symphoricarpos oreophilus	935.47
TOTAL	**1207.06**

Table 42: Star Point Mine . Annual Biomass Production (2012).

Reclaimed Grassland
Corner Canyon Area

(n=10)

	Pounds/Acre	
LIFEFORM	**MEAN**	**STD. DEV.**
Herbaceous	296.34	151.71
Woody	79.24	204.53
TOTAL	**375.58**	191.06

Table 43: Star Point Mine. Living Cover and Frequency by Plant Species (2012).

Sagebrush Reference Area			n=50
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Artemisia tridentata	18.74	13.05	86.00
Chrysothamnus nauseosus	0.20	1.40	2.00
Gutierrezia sarothrae	0.80	2.32	10.00
Pinus edulis	0.30	2.10	2.00
FORBS			
Machaeranthera canescens	0.20	1.40	2.00
GRASSES			
Agropyron cristatum	8.40	11.72	46.00
Bromus tectorum	0.40	2.20	4.00
Elymus salinus	7.00	14.63	24.00
Stipa hymenoides	9.66	11.45	52.00

Table 44: Star Point Mine. Living Cover and Frequency by Plant Species (2012).

Sagebrush Reference Area		n=50
Understory	45.70	12.65
Litter	14.20	4.54
Bareground	37.70	12.32
Rock	2.40	2.09
B. % COMPOSITION		
Shrubs	43.60	23.76
Forbs	0.50	3.50
Grasses	55.90	23.63

Table 45: Star Point Mine . Woody Species Density (2012).

Sagebrush Reference Area	n=50
SPECIES	**Individuals Per Acre**
Amelanchier utahensis	65.58
Artemisia tridentata	6229.87
Chrysothamnus nauseosus	32.79
Gutierrezia sarothrae	163.94
Pinus edulis	65.58
TOTAL	**6557.76**

Table 46: Star Point Mine . Annual Biomass Production (2012).

Sagebrush Reference Area

(n=50)

	Pounds/Acre	
LIFEFORM	**MEAN**	**STD. DEV.**
Herbaceous	504.55	309.42
Woody	330.47	302.00
TOTAL	**835.02**	335.40

Table 47: Star Point Mine. Living Cover and Frequency by Plant Species (2012).

Mountain Grassland Reference Area			n=30
TREES & SHRUBS	**Mean Percent**	**Standard Deviation**	**Percent Frequency**
Artemisia tridentata	0.33	1.80	3.33
Chrysothamnus viscidiflorus	5.83	8.95	36.67
Eriogonum corymbosum	2.33	7.27	10.00
Gutierrezia sarothrae	0.17	0.90	3.33
FORBS			
Achillea millefolium	0.67	2.13	10.00
Eriogonum sp.	0.50	1.98	6.67
Linum lewisii	0.33	1.80	3.33
Machaeranthera canescens	0.83	2.27	13.33
GRASSES			
Elymus salinus	34.67	14.54	96.67
Koeleria macrantha	3.50	5.65	30.00
Poa secunda	5.17	8.61	36.67

Table 48: Star Point Mine. Living Cover and Frequency by Plant Species (2012).

Mountain Grassland Reference Area		n=30
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Understory	54.33	8.44
Litter	17.50	8.92
Bareground	12.17	7.15
Rock	16.00	10.28
B. % COMPOSITION		
Shrubs	15.53	17.49
Forbs	4.45	7.91
Grasses	80.01	18.05

Table 49: Star Point Mine . Woody Species Density (2012).

Mountain Grassland Reference Area	n=30
SPECIES	**Individuals Per Acre**
Artemisia tridentata	134.78
Chrysothamnus viscidiflorus	661.67
Cercocarpus montanus	24.51
Eriogonum corymbosum	563.64
Gutierrezia sarothrae	73.52
Pseudotsuga menziesii	12.25
TOTAL	**1470.37**

Table 50: Star Point Mine . Annual Biomass Production (2012).

Mountain Grassland
Reference Area

(n=30)

	Pounds/Acre	
LIFEFORM	**MEAN**	**STD. DEV.**
Herbaceous	549.61	246.72
Woody	148.72	241.66
TOTAL	**698.33**	225.00

Table 51: Star Point Mine . Woody Species Density (2012).

Saltbush Reference Area			n=50
	Mean Percent	Standard Deviation	Percent Frequency
SHRUBS			
Artemisia nova	0.30	2.10	2.00
Atriplex confertifolia	2.00	7.14	8.00
Atriplex gardneri	17.80	13.57	70.00
Chrysothamnus nauseosus	0.10	0.70	2.00
FORBS			
GRASSES			
Elymus salinus	10.50	11.97	54.00

Table 52: Star Point Mine. Living Cover and Frequency by Plant Species (2012).

Saltbush Reference Area		n=50
A. TOTAL COVER	Mean Percent	Standard Deviation
Understory	30.70	5.48
Litter	8.68	5.08
Bareground	49.40	11.34
Rock	11.22	9.33
B. % COMPOSITION		
Shrubs	65.75	38.68
Forbs	0.00	0.00
Grasses	34.25	38.68

Table 53: Star Point Mine . Woody Species Density (2012).

Saltbush Reference Area	n=50
SPECIES	**Individuals Per Acre**
Artemisia nova	160.81
Atriplex confertifolia	607.50
Atriplex gardneri	2680.15
Chrysothamnus nauseosus	89.34
Ephedra viridis	17.87
Eriogonum corymbosum	17.87
TOTAL	**3573.54**

Table 54: Star Point Mine . Annual Biomass Production (2012).

Saltbush Reference Area

(n=50)

	Pounds/Acre	
LIFEFORM	**MEAN**	**STD. DEV.**
Herbaceous	155.05	206.21
Woody	454.76	375.10
TOTAL	**609.81**	251.77

COMBINED BY TIME PERIOD (PRE-SMCRA VS. POST-SMCRA)

Table 55: Star Point Mine. *Combined* Data for Total Cover (2012).

Pre-SMCRA Reclaimed Sagebrush Areas (Includes: Area A & Area B)		
	Mean Percent	Standard Deviation
TOTAL LIVING COVER	57.63	12.82
Sample size (n) = 80 SAMPLE ADEQUACY (nMIN) 80%± 0.10 = 8 samples 90%± 0.10 = 13 samples		

Table 56: Star Point Mine . *Combined* Data for Woody Species Density (2012).

Pre-SMCRA Reclaimed Sagebrush Areas (Includes: Area A & Area B)		
Number of Individuals Per Acre	Mean	Standard Deviation
TOTAL	3282.49	1587.49
Sample size (n) = 80 SAMPLE ADEQUACY (nMIN) 80%± 0.10 = 38 samples 90%± 0.10 = 63 samples		

Table 57: Star Point Mine. *Combined* Data for Total Cover (2012).

Post-SMCRA Reclaimed Sagebrush Areas (Includes: Area C & Area H)		
	Mean Percent	Standard Deviation
TOTAL LIVING COVER	64.17	6.53
Sample size (n) = 60 SAMPLE ADEQUACY (nMIN) 80%± 0.10 = 2 samples 90%± 0.10 = 3 samples		

Table 58: Star Point Mine . *Combined* Data for Woody Species Density (2012).

Post-SMCRA

Reclaimed Sagebrush Areas

(Includes: Area C & Area H)

Number of Individuals Per Acre	Mean	Standard Deviation
TOTAL	2899.40	1162.26

Sample size (n) = 60
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 26 samples
90%± 0.10 = 43 samples

Table 59: Star Point Mine . *Combined* Data for Annual Biomass Production (2012).

Post-SMCRA

Reclaimed Sagebrush Areas

(Includes: Area C & Area H)

	Pounds/Acre	
LIFEFORM	**MEAN**	**STD. DEV.**
Herbaceous	519.80	434.18
Woody	808.37	634.53
TOTAL	**1328.17**	**468.42**

Sample size (n) = 60
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 20 samples
90%± 0.10 = 34 samples

Table 60: Star Point Mine. *Combined* Data for Total Cover (2012).

Pre-SMCRA Reclaimed Mountain Grassland Areas (Includes: Area E, Area G & Mudwater Canyon)		
	Mean Percent	Standard Deviation
TOTAL LIVING COVER	61.47	12.51
Sample size (n) = 150 SAMPLE ADEQUACY (nMIN) 80%± 0.10 = 7 samples 90%± 0.10 = 11 samples		

Table 61: Star Point Mine . *Combined* Data for Woody Species Density (2012).

Pre-SMCRA

Reclaimed Mountain Grassland Areas

(Includes: Area E, Area G & Mudwater Canyon)

Number of Individuals Per Acre	Mean	Standard Deviation
TOTAL	2961.71	1365.02
Sample size (n) = 141 SAMPLE ADEQUACY (nMIN) 80%± 0.10 = 35 samples 90%± 0.10 = 57 samples		

Table 62: Star Point Mine. *Combined* Data for Total Cover (2012).

Post-SMCRA Reclaimed Mountain Grassland Areas (Includes: Area F, Area G & Corner Canyon)		
	Mean Percent	**Standard Deviation**
TOTAL LIVING COVER	62.88	6.96
Sample size (n) = 80 SAMPLE ADEQUACY (nMIN) 80%± 0.10 = 4 samples 90%± 0.10 = 7samples		

Table 63: Star Point Mine . *Combined* Data for Woody Species Density (2012).

Post-SMCRA

Reclaimed Mountain Grass Land Areas

(Includes: Area F, Area G & Corner Canyon)

Number of Individuals Per Acre	**Mean**	**Standard Deviation**
TOTAL	2326.94	1296.65

Sample size (n) = 120
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 51 samples
90%± 0.10 = 84 samples

Table 64: Star Point Mine . *Combined* Data for Annual Biomass Production (2012).

Post-SMCRA

Reclaimed Mountain Grass Land Areas

(Includes: Area F, Area G & Corner Canyon)

	Pounds/Acre	
LIFEFORM	**MEAN**	**STD. DEV.**
Herbaceous	922.48	672.45
Woody	310.06	605.73
TOTAL	**1232.53**	**737.91**

Sample size (n) = 80
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 59 samples
90%± 0.10 = 97 samples

Table 65: Star Point Mine. *Combined* Data for Total Cover (2012).

Post-SMCRA Reclaimed Saltbush Areas (Includes: Area I)		
	Mean Percent	Standard Deviation
TOTAL LIVING COVER	60.90	10.43
Sample size (n) =50 SAMPLE ADEQUACY (nMIN) 80%± 0.10 = 6 samples 90%± 0.10 = 10 samples		

Table 66: Star Point Mine . *Combined* Data for Woody Species Density (2012).

Post-SMCRA

Reclaimed Saltbush Areas

(Includes: Area I)

Number of Individuals Per Acre	Mean	Standard Deviation
TOTAL	4586.74	1949.48

Sample size (n) = 50
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 30 samples
90%± 0.10 = 49 samples

Table 67: Star Point Mine . *Combined* Data for Annual Biomass Production (2012).

Post-SMCRA

Reclaimed Saltbush Areas

(Includes: Area I)

LIFEFORM	Pounds/Acre MEAN	STD. DEV.
Herbaceous	688.77	256.45
Woody	284.96	355.25
TOTAL	**973.74**	**330.71**

Sample size (n) = 50
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 19 samples
90%± 0.10 = 31 samples

Table 68: Summary of revegetation success standards for success at the Star Point Mine (source: from the Star Point Mine, Mining & Reclamation Plan).

SEEDED AREA	DISTURBANCE	COVER	DENSITY	DIVERSITY	PRODUCTION
SALTBUSH	Pre-SMCRA	(no pre-SMCRA)	(no pre-SMCRA)	(no pre-SMCRA)	(no pre-SMCRA)
	Post-SMCRA	Saltbush Reference Area	2,000 plants/ac	Saltbush Reference Area	Saltbush Reference Area
SAGEBRUSH	Pre-SMCRA	Sagebrush Reference Area	2,000 plants/ac	(no standard)	NRCS estimates
	Post-SMCRA	Sagebrush Reference Area	2,000 plants/ac	Sagebrush Reference Area	Sagebrush Reference Area
MOUNTAIN GRASSLAND	Pre-SMCRA	Mtn. Grassland Reference Area	2,000 plants/ac	(no standard)	NRCS estimates
	Post-SMCRA	Mtn. Grassland Reference Area	2,000 plants/ac	Mtn. Grassland Reference Area	Mtn. Grassland Reference Area
FOREST SERVICE	Pre-SMCRA	(no pre-SMCRA)	(no pre-SMCRA)	(no pre-SMCRA)	(no pre-SMCRA)
	Post-SMCRA	(F.S. approval)	(F.S. approval)	(F.S. approval)	(F.S. approval)

TABLE 69: Statistical summary sheet comparing the Reclaimed Sagebrush areas and Sagebrush Reference Area at the Star Point Mine site (2012).

A. SAGEBRUSH AREAS (Pre-SMCRA)			
Reclaimed Area A & Area B (Combined)			
Total Living Cover	$\bar{x}$=57.63	s=12.82	n=80
Density	$\bar{x}$=3282.49	s=1587.79	n=80
Sagebrush Reference Area			
Total Living Cover	$\bar{x}$=45.70	s=12.65	n=50
Density	$\bar{x}$=2000.00*	s=n/a	n=n/a
STATISTICAL ANALYSES			
Total Living Cover	t=5.188	df=128	SL=p<0.001
Density	t=n/a	df=n/a	SL=n/a
B. SAGEBRUSH AREAS (Post-SMCRA)			
Reclaimed Area C & Area H (Combined)			
Total Living Cover	$\bar{x}$=64.17	s=6.53	n=60
Density	$\bar{x}$=2899.40	s=1162.26	n=60
Production	$\bar{x}$=1328.17	s=468.42	n=60
Sagebrush Reference Area			
Total Living Cover	$\bar{x}$=45.70	s=12.65	n=50
Density	$\bar{x}$=2000.00*	s=n/a	n=n/a
Production	$\bar{x}$=835.02	s=335.40	n=50
STATISTICAL ANALYSES			
Total Living Cover	t=9.850	df=108	SL=p<0.001
Density	t=n/a	df=n/a	SL=n/a
Production	t=6.630	df=108	SL=p<0.001

$\bar{x}$= sample mean, s = sample standard deviation, n = sample size,
NS = non-significant, t = Student's t-value, df = degrees of freedom,
SL = significance level, p = probability level, *= pre-determined standard

TABLE 70: Statistical summary sheet comparing the Reclaimed Mountain Grass areas and Mountain Grassland Reference Area at the Star Point Mine site (2012).

A. MOUNTAIN GRASSLAND AREAS (Pre-SMCRA)

Reclaimed : Area E, Area G & Mudwater Canyon (Combined)

Total Living Cover	$\bar{x}$=61.47	s=12.51	n=150
Density	$\bar{x}$=2961.71	s=1365.02	n=141

Mountain Grassland Reference Area

Total Living Cover	$\bar{x}$=54.53	s=8.44	n=30
Density	$\bar{x}$=2000.00*	s=n/a	n=n/a

STATISTICAL ANALYSES

Total Living Cover	t=2.906	df=178	SL=p<0.005
Density	t=n/a	df=n/a	SL=n/a

B. MOUNTAIN GRASSLAND AREAS (Post-SMCRA)

Area F, Area G & Corner Canyon (Combined)

Total Living Cover	$\bar{x}$=62.88	s=6.96	n=80
Density	$\bar{x}$=2326.94	s=1296.65	n=120
Production	$\bar{x}$=1232.53	s=737.91	n=80

Mountain Grassland Reference Area

Total Living Cover	$\bar{x}$=54.53	s=8.44	n=30
Density	$\bar{x}$=2000.00*	s=n/a	n=n/a
Production	$\bar{x}$=698.33	s=225.00	n=30

STATISTICAL ANALYSES

Total Living Cover	t=5.280	df=108	SL=p<0.001
Density	t=n/a	df=n/a	SL=n/a
Production	t=3.888	df=108	SL=p<0.001

$\bar{x}$= sample mean, s = sample standard deviation, n = sample size,
NS = non-significant, t = Student's t-value, df = degrees of freedom,
SL = significance level, p = probability level, *= pre-determined standard

TABLE 71: Statistical summary sheet comparing the Reclaimed Saltbush areas and Saltbush Reference Area at the Star Point Mine site (2012).

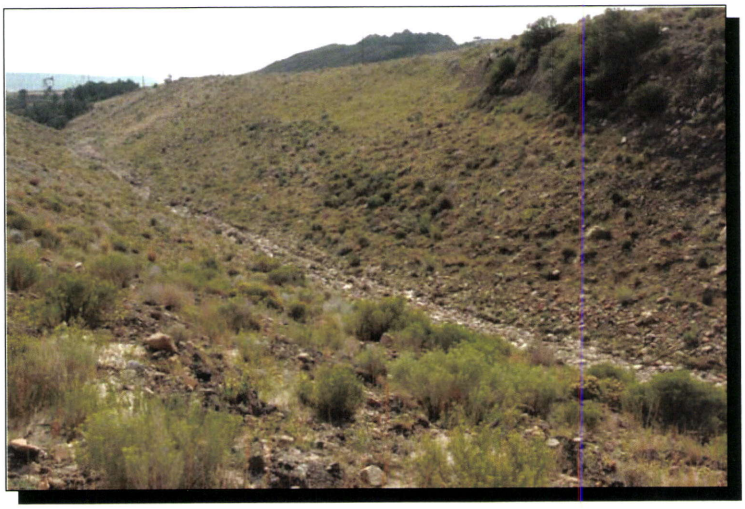
A. SALTBUSH AREAS (Post-SMCRA)			
Area I			
Total Living Cover	$\bar{x}$=60.90	s=10.43	n=50
Density	$\bar{x}$=4586.74	s=1949.48	n=50
Production	$\bar{x}$=973.74	s=330.71	n=50
Saltbush Reference Area			
Total Living Cover	$\bar{x}$=30.70	s=5.48	n=50
Density	$\bar{x}$=2000.00*	s=n/a	n=n/a
Production	$\bar{x}$=609.81	s=251.77	n=50
STATISTICAL ANALYSES			
Total Living Cover	t=18.125	df=98	SL=p<0.001
Density	t=n/a	df=n/a	SL=n/a
Production	t=6.191	df=98	SL=p<0.001

$\bar{x}$= sample mean, s = sample standard deviation, n = sample size,
NS = non-significant, t = Student's t-value, df = degrees of freedom,
SL = significance level, p = probability level, *= pre-determined standard

COLOR PHOTOGRAPHS
OF THE
SAMPLE AREAS

Reclaimed Area A

Reclaimed Area A (continued)



Reclaimed Area B

Reclaimed Area C

Reclaimed Area E

Reclaimed Area E (continued)

Reclaimed Area F

Reclaimed Area G (Pre-SMCRA)

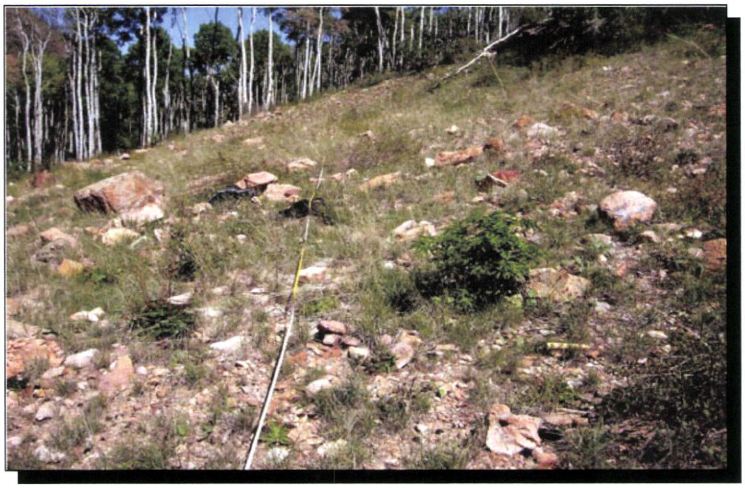
Reclaimed Area G (Post-SMCRA)

Reclaimed Area H

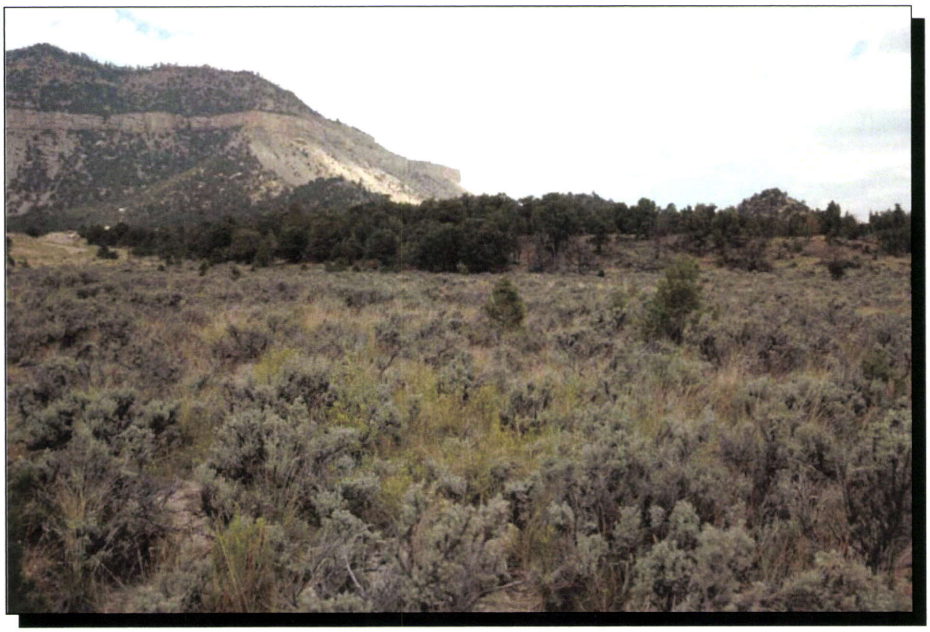
Reclaimed Area I

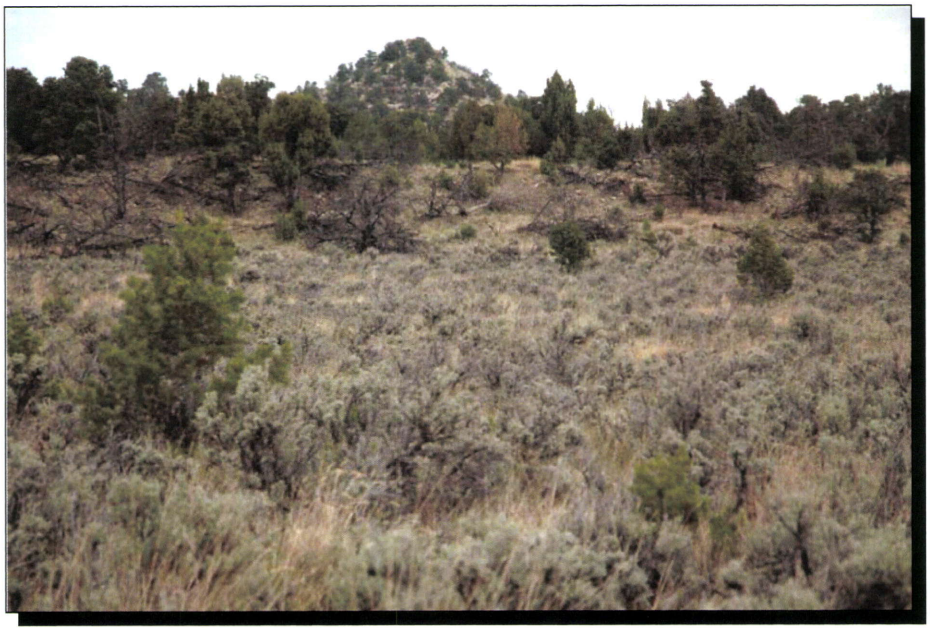
MUDWATER CANYON AREA

CORNER CANYON AREA



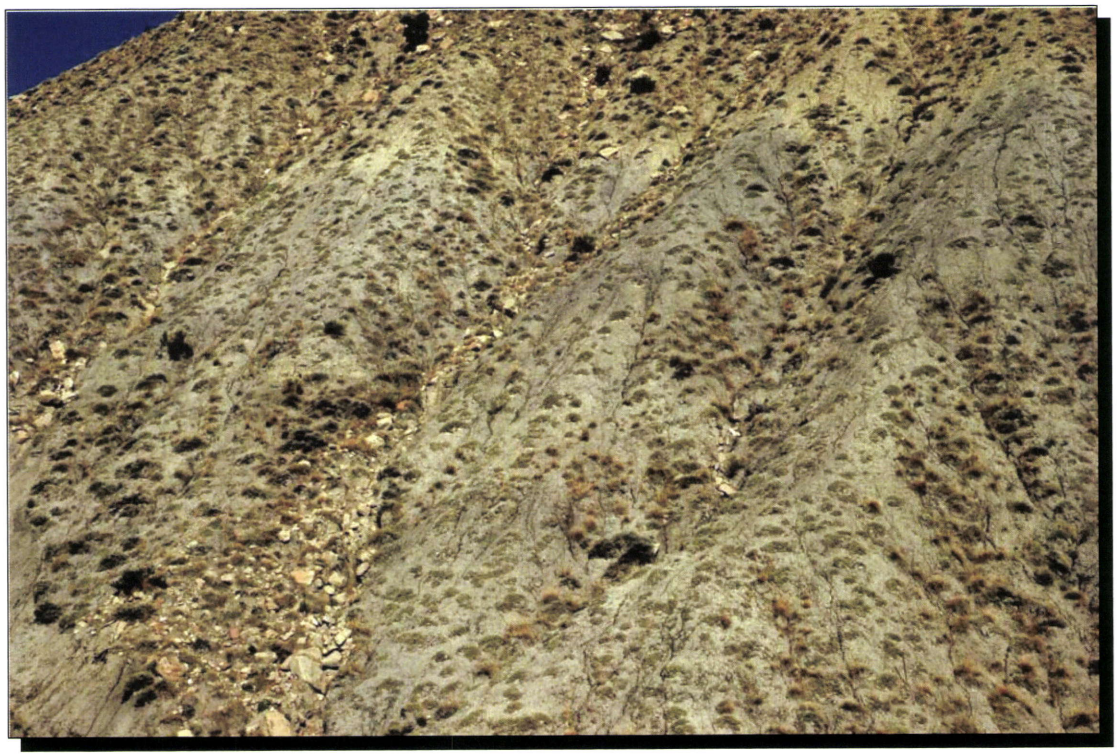
SAGEBRUSH REFERENCE AREA



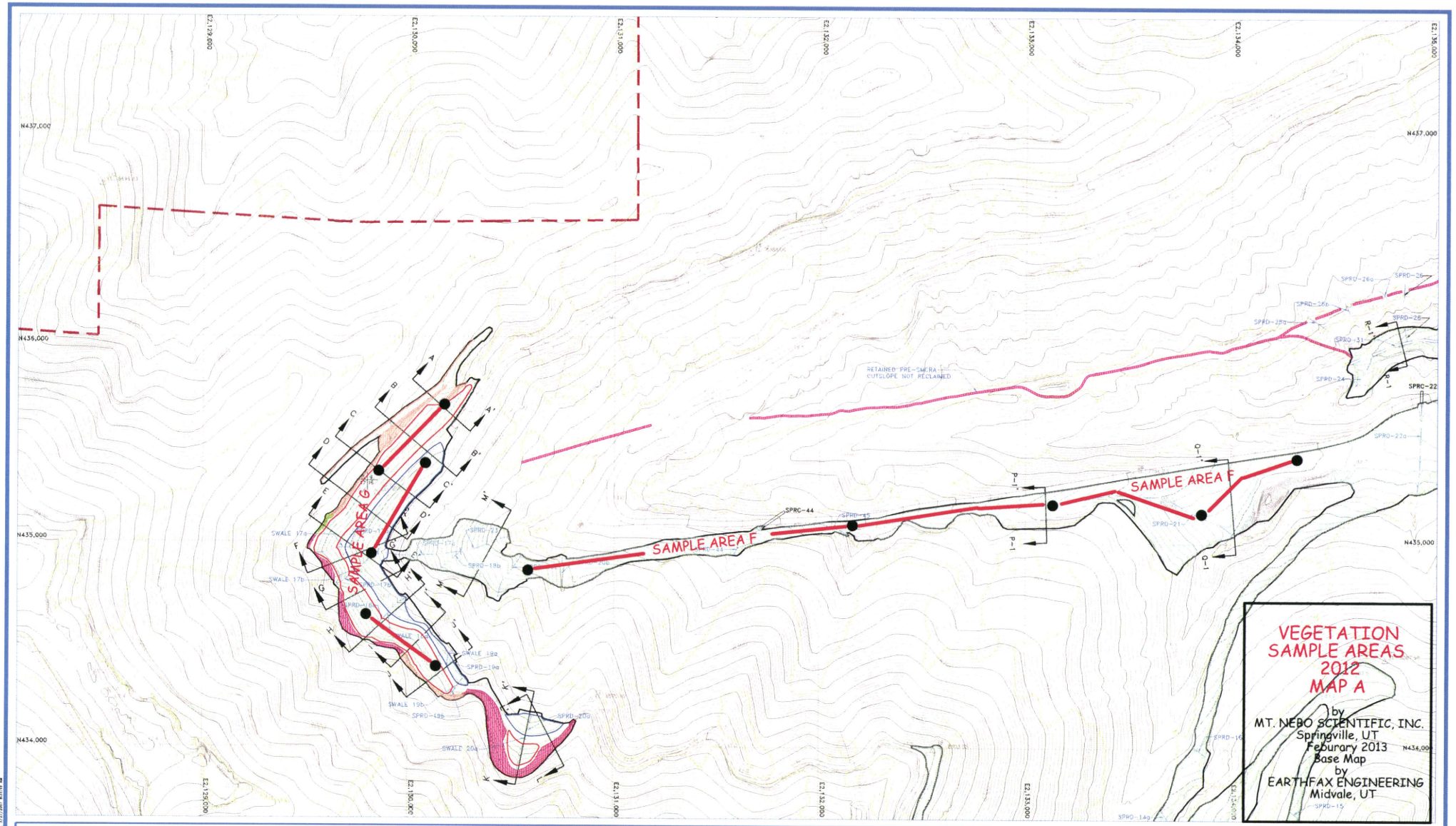


MOUNTAIN GRASSLAND REFERENCE AREA

SALTBUSH REFERENCE AREA



SAMPLE AREA MAPS



LEGEND

- PRIMARY ROAD
- SECONDARY ROAD
- TRAIL
- BRIDGE, CULVERT
- RAILROAD
- BUILDINGS, STRUCTURES
- LAKE, POND
- RIVER, STREAM
- FENCE
- ASBUILT CONTOURS
- TREE LINES
- RECLAMATION DISTURBED AREA BOUNDARY
- CROSS SECTION
- PERMIT BOUNDARY
- PARTIALLY BACKFILLED PRE-SMCRA HIGHWALL
- PARTIALLY BACKFILLED PRE-SMCRA CUTSLOPE
- PARTIALLY BACKFILLED POST-SMCRA CUTSLOPE
- RECLAMATION CHANNEL
- DEEP GOUGED SURFACE (HAY AND STRAW MULCH) LAST AUGMENTED SEEDING FALL 2002
- SECTION CORNER
- AREA OF COAL REFUSE BURIAL. COAL REFUSE BURIED WITH A MIN. OF 4' OF COVER MATERIAL. (APPROX. 113,532 CY HAULED TO THE LION'S DECK)
- AREA PROVIDING COVER MATERIAL FOR COAL REFUSE PLACED ON THE LION'S DECK (APPROX. 14,700 CY WAS USED TO FILL THE STOPE HOLE AND 54,502 CY WAS USED TO COVER THE COAL REFUSE)
- Sample Transect Lines

NOTES:

1. PHASE 1 BOND RELEASE FOR 93.77 ACRES.
2. BACKFILL, GRADING AND GROWTH MEDIA/TOPSOIL PLACEMENT FOR THE MINE #1 AND MINE #2 AREAS BEGAN IN AUGUST, 2001 AND WERE COMPLETED IN DECEMBER, 2001. GROWTH MEDIA/TOPSOIL PLACEMENT OCCURRED CONCURRENTLY WITH BACKFILLING AND GRADING AS AREAS ACHIEVED FINAL GRADE.
3. BACKFILL, GRADING AND GROWTH MEDIA/TOPSOIL PLACEMENT FOR THE LION'S DECK, PONDS 1 AND 2, AND THE LOWER FACILITIES AREAS BEGAN IN APRIL, 2002 AND WERE COMPLETED IN NOVEMBER, 2002. GROWTH MEDIA/TOPSOIL PLACEMENT OCCURRED CONCURRENTLY WITH BACKFILLING AND GRADING AS AREAS ACHIEVED FINAL GRADE.
4. TOWNSHIP 15 SOUTH, RANGE 8 EAST.

REGISTERED PROFESSIONAL ENGINEER No. 189797 LAYNE D. JENSEN STATE OF UTAH

RAG

FILE: G:\UC779\07\DWG\542200a-AB\, 08-08-03

REVISION/HISTORY

BY	DATE	DESCRIPTION
LDJ	05-05-02	RESPONG TO TA COMMENTS
3		
LDJ	10-10-03	AS-BUILT
2		
LDJ	02-05-04	RESPONG TO TA COMMENTS
1		
PDC	02-27-07	VEGETATION SAMPLE LOCATIONS ADDED
4		
5		
6		
7		

STARPOINT MINE

AS-BUILT RECLAMATION TOPOGRAPHY AND TREATMENT MAP

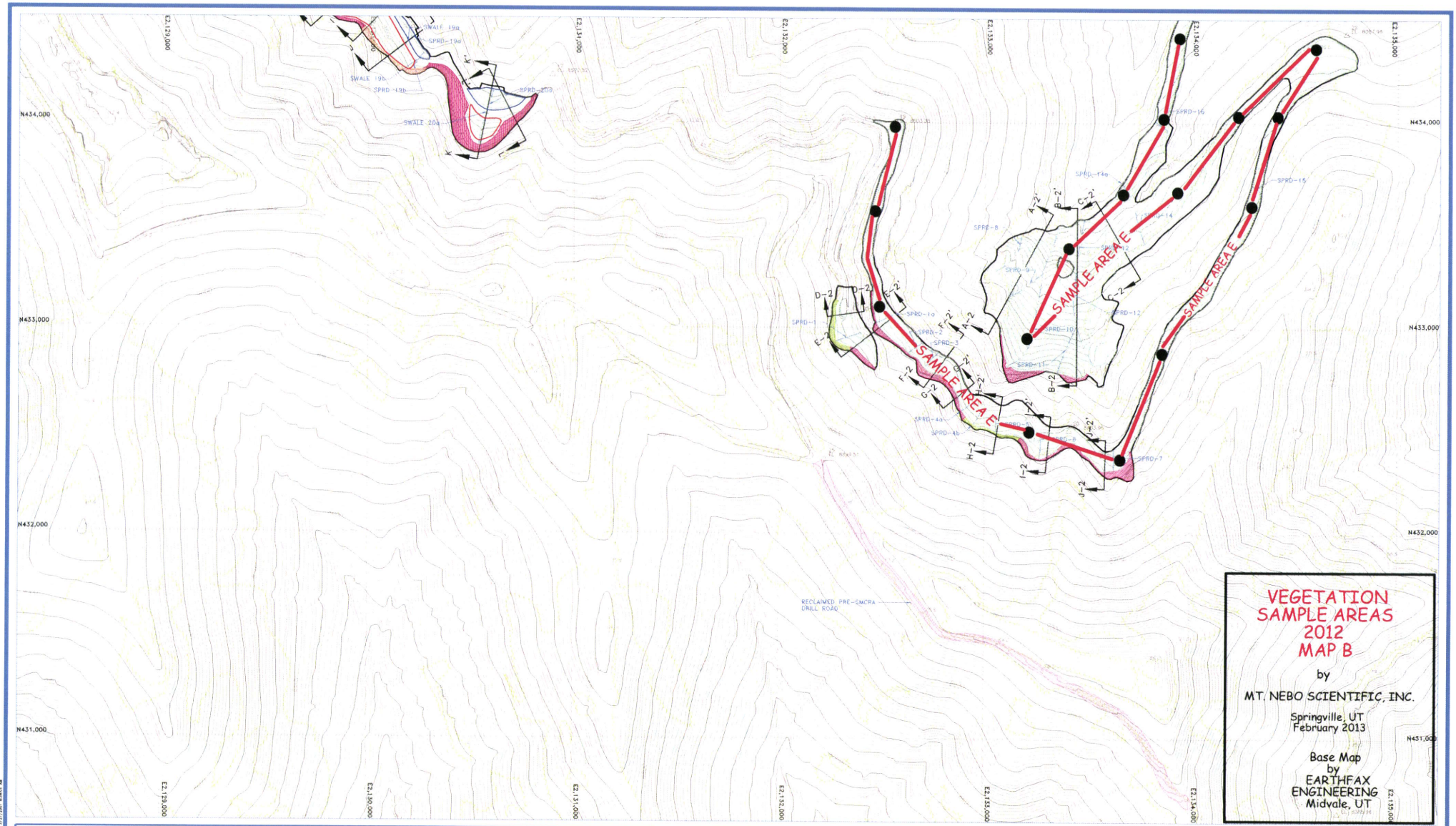
SHEET 1

PLATEAU MINING CORPORATION

847 NW HIGHWAY 191 HELPER, UTAH 84526
PHONE (435) 472-0475

1 of 3

MAP 542.200a



VEGETATION SAMPLE AREAS 2012 MAP B

by

MT. NEBO SCIENTIFIC, INC.

Springville, UT
February 2013

Base Map
by
EARTHFAX
ENGINEERING
Midvale, UT

LEGEND

- PRIMARY ROAD
- SECONDARY ROAD
- TRAIL
- BRIDGE, CULVERT
- RAILROAD
- BUILDINGS, STRUCTURES
- LAKE, POND
- RIVER, STREAM
- FENCE
- ASBUILT CONTOURS
- TREE LINES
- RECLAMATION DISTURBED AREA BOUNDARY
- CROSS SECTION
- PERMIT BOUNDARY
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- PARTIALLY BACKFILLED POST-SMCRA CUTSLOPE
- RECLAMATION CHANNEL
- DEEP GOUGED SURFACE (HAY AND STRAW MULCH) LAST AUGMENTED SEEDING FALL 2002
- DEEP GOUGED SURFACE LAST AUGMENTED SEEDING FALL 2003
- SAMPLE TRANSECT LINES
- SECTION CORNER
- AREA OF COAL REFUSE BURIAL. COAL REFUSE BURIED WITH A MIN. OF 4' OF COVER MATERIAL. (APPROX. 113,532 CY HAULED TO THE LION'S DECK)
- AREA PROVIDING COVER MATERIAL FOR COAL REFUSE PLACED ON THE LION'S DECK (APPROX. 14,700 CY WAS USED TO FILL THE STOPE HOLE AND 54,502 CY WAS USED TO COVER THE COAL REFUSE)

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4. TOWNSHIP 15 SOUTH, RANGE 8 EAST.

NORTH

200' 100' 0 200'

REGISTERED PROFESSIONAL ENGINEER No. 189797 LAYNE D. JENSEN STATE OF UTAH

RAG

FILE G:\UC779\07\DWG\542200B-AB\, 08-08-03

REVISION/HISTORY		
BY	DATE	DESCRIPTION
RBW	10-99	RESPOND TO TA COMMENTS
3		
LDJ	10-10-03	AS-BUILT
2		
LDJ	02-05-04	RESPOND TO TA COMMENTS
1		
PDC	03-27-07	VEGETATION SAMPLE LOCATIONS ADDED
4		
5		
6		
7		

STARPOINT MINE

AS-BUILT RECLAMATION TOPOGRAPHY AND TREATMENT MAP

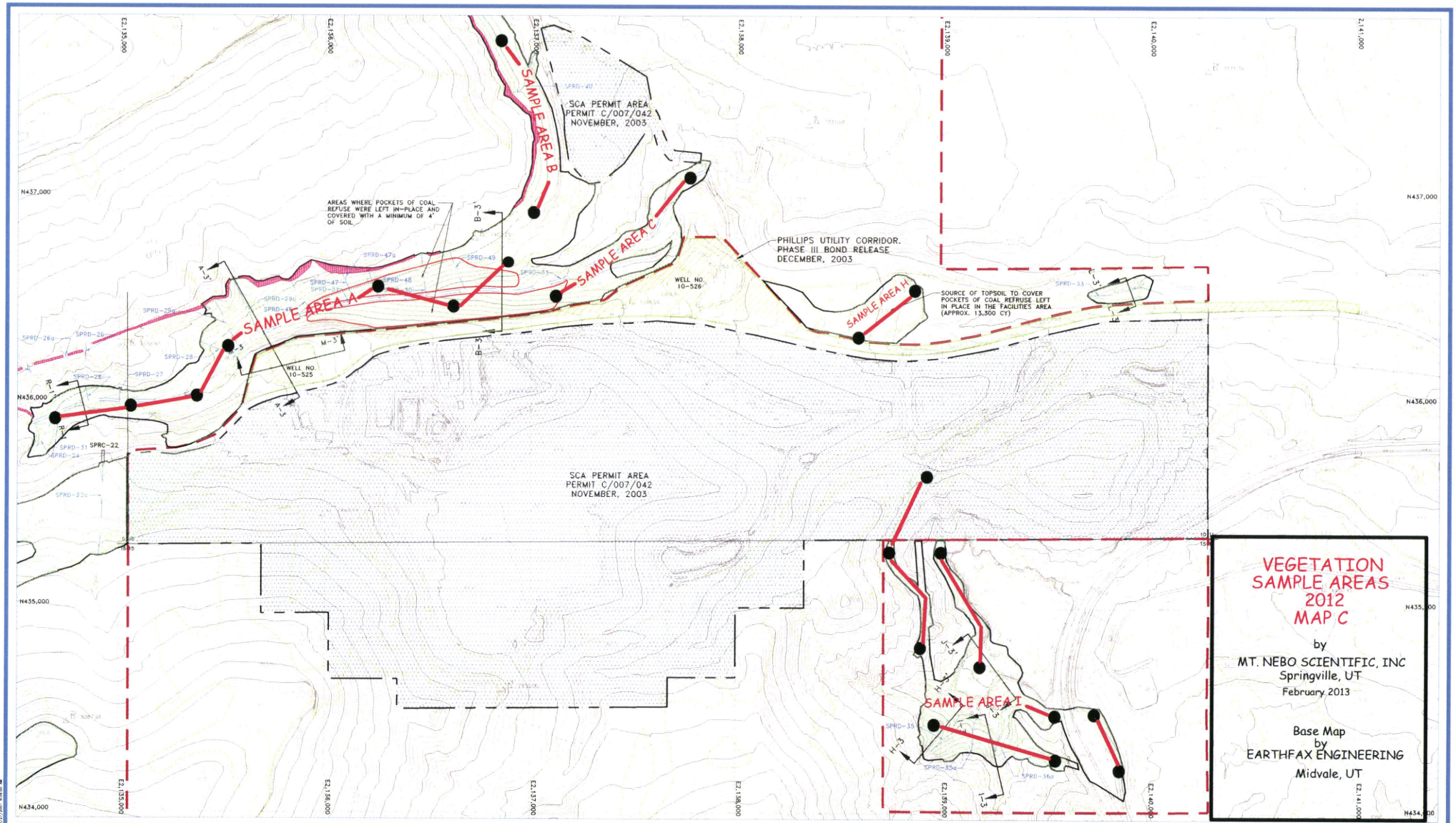
SHEET 2

PLATEAU MINING CORPORATION

847 NW HIGHWAY 191 HELPER, UTAH 84526
PHONE (435) 472-0475

2 of 3

MAP 542.200b



VEGETATION SAMPLE AREAS 2012 MAP C

by

MT. NEBO SCIENTIFIC, INC
Springville, UT
February 2013

Base Map
by
EARTHFAX ENGINEERING
Midvale, UT

LEGEND

- PRIMARY ROAD
- SECONDARY ROAD
- TRAIL
- BRIDGE, CULVERT
- RAILROAD
- BUILDINGS, STRUCTURES
- LAKE, POND
- RIVER, STREAM
- FENCE
- ASBUILT CONTOURS
- TREE LINES
- RECLAMATION DISTURBED AREA BOUNDARY
- CROSS SECTION
- PERMIT BOUNDARY
- PHILLIPS GAS WELLS AND UTILITY CORRIDOR (11.77 ACRES POST MINING LAND USE CHANGE AND PHASE III BOND RELEASED IN DECEMBER 2003)
- SECTION CORNER
- PARTIALLY BACKFILLED PRE-SMCRA CUTSLOPE
- SCA PERMIT BOUNDARY AND PERMIT C/007/042 NOVEMBER, 2003
- RECLAMATION CHANNEL
- DEEP GOUGED SURFACE (HAY AND STRAW MULCH) LAST AUGMENTED SEEDING FALL 2002
- SAMPLE TRANSECT LINES

NOTES:

1. PHASE 1 BOND RELEASE FOR 93.77 ACRES.
2. BACKFILL, GRADING AND GROWTH MEDIA/TOPSOIL PLACEMENT FOR THE MINE #1 AND MINE #2 AREAS BEGAN IN AUGUST, 2001 AND WERE COMPLETED IN DECEMBER, 2001. GROWTH MEDIA/TOPSOIL PLACEMENT OCCURRED CONCURRENTLY WITH BACKFILLING AND GRADING AS AREAS ACHIEVED FINAL GRADE.
3. BACKFILL, GRADING AND GROWTH MEDIA/TOPSOIL PLACEMENT FOR THE LOADOUT AREA BEGAN IN SEPTEMBER, 2001 AND WERE COMPLETED IN DECEMBER, 2001. GROWTH MEDIA/TOPSOIL PLACEMENT OCCURRED CONCURRENTLY WITH BACKFILLING AND GRADING AS AREAS ACHIEVED FINAL GRADE.
4. ALL EXCESS COAL REFUSE FROM THE MAIN CHANNEL AREA, NOT USED AS BACKFILL, WAS PLACED ON THE REFUSE PILE.
5. TOWNSHIP 15 SOUTH, RANGE 8 EAST.

NORTH

200' 100' 0 200'

REGISTERED PROFESSIONAL ENGINEER No. 180797 LAYNE D. JENSEN STATE OF UTAH

RAG

FILE: G:\UC779\07\DWG\542200C-AB\ 08-08-03

REVISION/HISTORY		
BY	DATE	DESCRIPTION
LDJ	10-10-03	AS-BUILT
LDJ	02-05-04	RESPOND TO TA COMMENTS
FGC	03-27-07	VEGETATION SAMPLE LOCATIONS ADDED

STARPOINT MINE

AS-BUILT RECLAMATION TOPOGRAPHY AND TREATMENT MAP

SHEET 3

PLATEAU MINING CORPORATION

847 NW HIGHWAY 191 HELPER, UTAH 84526
PHONE (435) 472-0475

3 OF 3

MAP 542.200c

APPENDIX

United States Department of Agriculture

NRCS
Natural Resources Conservation Service
540 West Price River Drive
Area Office
Price, UT 84501
(435) 637-0041
FAX (435) 637-3146

October 4, 2012

Patrick D. Collins, Ph.D.
Mt. Nebo Scientific, Inc.
Research & Consulting
P.O. Box 337
330 East 400 South, Suite 6
Springville, UT 84663

Dear Mr. Collins:

Following our visit on September 10, 2012 to the reclamation sites at the Star Point Mine and our visit on October 1, 2012 to the reclamation site in Mudwater Canyon, it appears that the vegetative conditions were very similar to the conditions we observed in September of 2011. The overall vegetative community appears to be well-established and vigorous. Plant productivity is good and seed production is evident. In my opinion, the vegetative community has done well, especially considering the amount of rock content in the soils and the amount of rock on the soil surface. The vegetation also appeared to be more vigorous than expected following the severe 2012 drought season. Refer to the report dated September 14, 2011 for more specific vegetative information (plant species, estimated production) at both the Star Point Mine and Mudwater Canyon reclamation sites. I have attached photographs from both the Star Point Mine and Mudwater Canyon reclamation sites which were taken on September, 10 2012 and October 1, 2012, respectively.

If you have any questions or comments, please feel free to contact me at (435) 637-0041, Ext. 120.

Sincerely,

/s/

Jeff Fenton
Rangeland Management Specialist
USDA Natural Resources Conservation Service
Price, Utah

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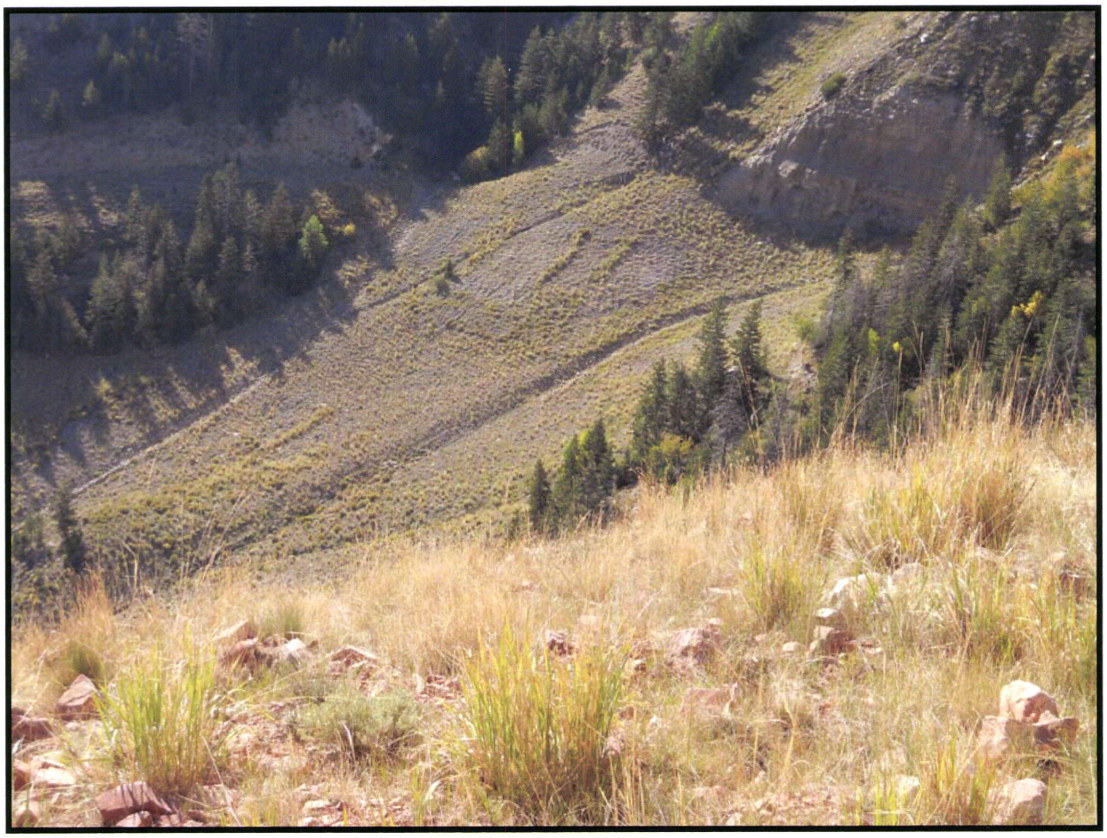
Star Point Mine (Site E)
Township 15 South, Range 8 East, Section 16



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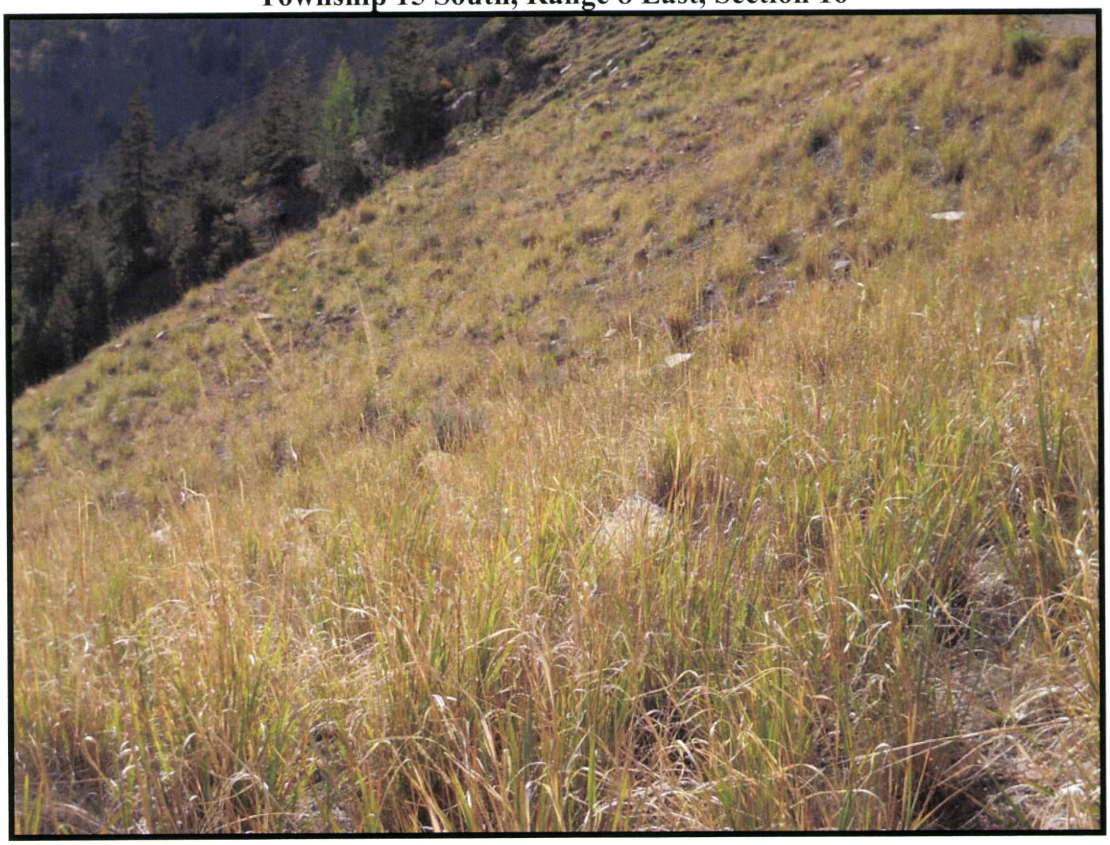
Star Point Mine (Site G)
Township 15 South, Range 8 East, Section 16



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Star Point Mine (Site A)
Township 15 South, Range 8 East, Section 10

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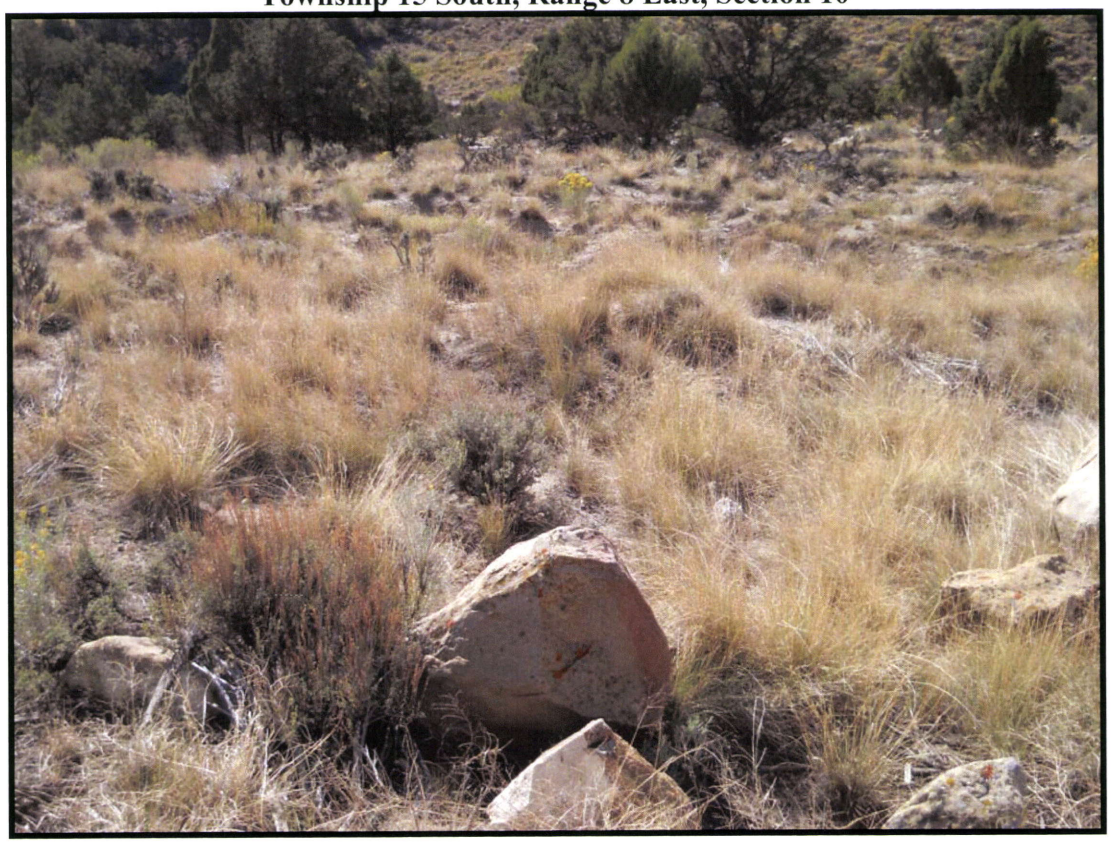
Star Point Mine (Site B)
Township 15 South, Range 8 East, Section 10



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Mudwater Canyon
Township 15 South, Range 8 East, Section 8

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Vegetation Monitoring Year 9
For Phase III Bond Release
Star Point Mine

Revegetation Monitoring
for
Phase III Bond Release
Year 1 (2011)

at the
Star Point Mine
for
Plateau Mining Corporation

Palmer penstemon *(Penstemon palmeri)*
at the Star Point Mine

Prepared by

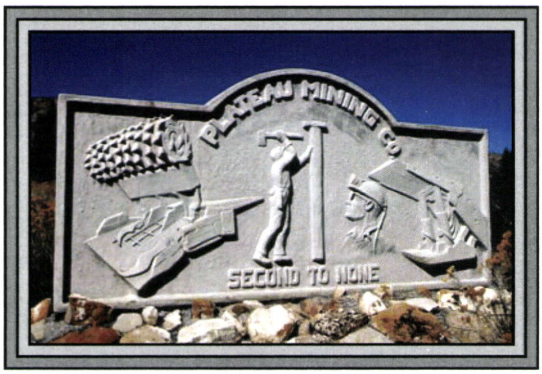
MT. NEBO SCIENTIFIC, INC.
330 East 400 South, Suite 6
P.O. Box 337
Springville, Utah 84663
(801) 489-6937

by

Patrick Collins, Ph.D.

for

PLATEAU MINING CORPORATION
P.O. Box 92
Orangeville, Utah 84537



March 2012

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INTRODUCTION

The Star Point Mine is a reclaimed mine site located on the east side of the Wasatch Plateau on Gentry Mountain approximately 23 miles southwest of Price, Utah. Historically, coal mining at the Star Point Mine began in 1916. Coal was shipped to the town of Wattis by 1917 when a railroad was completed there. In 1967, a company called Plateau Limited opened a new mine in the area. By 1971, another company, United Nuclear, purchased the mine. Finally, in 1980, Plateau Mining Company bought and mined the properties. The current permittee, Plateau Mining Corporation, began final reclamation of the mine site in 2001, with final seeding for revegetation finalized by 2003.

Following reclamation and revegetation, restoration of the plant communities has been closely monitored to document the progress on those areas disturbed by the previous mining activities. Earlier documents submitted to the regulatory agencies reported updates on the revegetation process from sampling the area in 2006 (Year 4), 2008 (Year 6) and 2010 (Year 8).

Reclaimed mine sites are required to provide enough time for acceptable plant establishment before applications can be made for bond release. This time period, called the "*responsibility period*", prescribes at least 10 years before the mine operator can submit a request for *Final* or *Phase III Bond Release* through state and federal regulatory authorities. It has been estimated that this period of time is long enough to determine whether or not adequate re-establishment of a given reclaimed plant community has occurred on sites at this precipitation zone in the western United States. The vegetation of the reclaimed lands must meet specific state and federal requirements. Consequently, at the beginning of Year 9 of the 10-year period, intensive sampling can be initiated for two consecutive years to determine whether or not the reclaimed site has met pre-determined revegetation success standards.

The purpose of this document is to compare reclaimed areas of the mine site

with specific standards for revegetation success (more information about these standards are provided later in this document). The content of this report provides **Year 1** results of the two consecutive years of sampling required prior to submittal of an application for bond release by the mine operator through the State of Utah, Division of Oil, Gas & Mining (DOGM).

METHODS

Methodologies used for sampling were performed in accordance with the guidelines provided by DOGM. The reclaimed areas were sampled *between* vegetation types, and when the types were comprised of relatively large acreage, additional areas were further separated *within* the types. This method allows for closer scrutiny of the reclaimed mine site on a smaller, area-by-area basis.

Transect and Quadrat Placement

Random/regular placement of sample quadrats was designed as an attempt to provide unbiased accuracy of the data compiled. This was accomplished by establishing several transect lines through the entire length of each reclaimed and reference area. At regular intervals along the transect lines, random numbers were generated and used to measure distances at right angles from the line to determine sample locations. Whether these random numbers were odd or even determined which side of the transect line a given quadrat was placed. The random numbers selected were high enough to place quadrats to the lateral limits of each sample area and all areas in-between. This insured that the sample quadrats were placed randomly over the entire study area to adequately address and represent each study site as a whole.

Cover, Frequency and Composition

Cover estimates were made employing ocular methods with meter square quadrats. Species composition and relative frequencies were also assessed from the quadrats. Additional information, when applicable, was also recorded on the raw data sheets such as: slope, exposure, grazing use, animal disturbance and other appropriate notes. Plant nomenclature follows "A Utah Flora" (Welsh et al. 2008).

Density

In nearly all areas, density estimates for woody plant species on the reclaimed and reference areas were made using a distance method called the *point-quarter*. In this method, random points were placed on the sample sites and divided into four quarters. The distances to the nearest woody plant species were then recorded in each quarter. The average point-to-individual distance was equal to the square root of the mean area per individual.

The one area where this method was not suitable due to its size and community structure was the Mudwater Canyon site. At this site 5x25 ft belt transects were employed. In this method individuals were counted in each transect, summarized for mean and standard deviation, then converted to the number of individuals per acre.

Biomass Production

Total annual biomass production was estimated by clipping, drying and weighing current annual growth in sample quadrats. "Double sampling" methods were employed by placing four additional quadrats around the clipped quadrat, then estimating the production of them relative to the clipped plot. Herbaceous and woody species production were clipped, weighed and recorded separately.

Sample Size & Adequacy

Sampling adequacy was calculated using the formula given below.

$$nMIN = \frac{t^2 s^2}{(dx)^2}$$

where,

nMIN	= minimum adequate sample
t	= appropriate confidence t-value
s	= standard deviation
x	= sample mean
d	= desired change from mean

Confidence levels were calculated at 80% and 90% (t) with the desired change from the mean (d) placed at 0.10. Sample sizes were, however, also based on the size of each subdivision within each vegetation type, resulting in more samples taken in larger areas.

Photographs

Color photographs of each sample area were taken at the time of sampling; a subset of them have been submitted with this report.

Vegetation Sample Maps

The locations of the reclaimed sample areas were mapped during the field work. These locations were then placed on "as-built" reclamation maps prepared previously by *Earthfax Engineering*, resulting in three Vegetation Sample Area maps that have been submitted in this report.

RESULTS

Separation of Areas

The Star Point Mining & Reclamation Plan (MRP) divided the disturbed areas into three main types based on the native plant communities that existed in the area prior to their disturbance by coal mining and related activities. The three types now represent the "reclaimed areas" and are called: 1) **Sagebrush Areas**, 2) **Mountain Grassland Areas**, and 3) **Saltbush Areas**. During reclamation these sites were seeded with seed mixtures developed specifically for each area. Additionally, **reference areas**, or areas chosen in undisturbed plant communities to represent final revegetation success standards, were chosen for each disturbed (reclaimed) type. Reference areas were sampled in 2011 for comparisons with the reclaimed areas.

Reclaimed Areas

As mentioned above, there were three disturbance types delineated at the mine site. Additionally, these types were further subdivided into smaller areas to allow closer, independent evaluations for the specific sites (see *VEGETATION SAMPLE AREA MAPS* and *COLOR PHOTOGRAPHS OF THE SAMPLE AREAS*). The following table shows the three types and subdivisions within them.

Table 1: Sample area subdivisions of each reclaimed type.

Reclaimed Sagebrush	Reclaimed Mtn Grassland	Reclaimed Saltbush
Area A	Area E	Area I
Area B	Area F	
Area C	Area G (pre- & post-SMCRA)	
~~Area D~~ *(area was sold and removed from the permit area)*	Mudwater Canyon	
Area H	Corner Canyon	

Reference Areas

The three reference areas, or areas chosen previously to represent future standards for revegetation success, along with their corresponding reclaimed areas, are shown in Table 2. The reference areas data can be compared to the reclaimed areas and provide accompaniment for future the Phase III Bond Release application through the State of Utah.

Table 2: Reference areas and their respective reclaimed areas.

Reference Areas	**Reclaimed Areas**
Sagebrush	Area A Area B Area C Area H
Mountain Grassland	Area E Area F Area G Mudwater Canyon Corner Canyon
Saltbush	Area I

DATA SUMMARIES
(Areas Separated)

General comparisons *between* reclaimed types and *within* each community type for the 2011 datasets can be done by reviewing the summary tables that have been provided of the sample results for each reclaimed area as well as the reference areas (Tables 4 through 54). Table 3 shows the number of the appropriate table for each parameter in all sample areas of the study.

Table 3: Separated data locator at the Star Point Mine site (2011).

SAMPLE AREA	Sub-Division	Cover by Species	Total Cover	Composition	Woody Species Density	Production
Reclaimed Sagebrush	A	Table 4	Table 5 (A)	Table 5 (B)	Table 6	n/a
Reclaimed Sagebrush	B	Table 7	Table 8 (A)	Table 8 (B)	Table 9	n/a
Reclaimed Sagebrush	C	Table 10	Table 11 (A)	Table 11 (B)	Table 12	Table 13
Reclaimed Sagebrush	H	Table 28	Table 29 (A)	Table 29 (B)	Table 30	Table 31
Reclaimed Mountain Grassland	E	Table 14	Table 15 (A)	Table 15 (B)	Table 16	n/a
Reclaimed Mountain Grassland	F	Table 17	Table 18 (A)	Table 18 (B)	Table 19	Table 20
Reclaimed Mountain Grassland	G (pre-SMCRA)	Table 21	Table 22 (A)	Table 22 (B)	Table 23	n/a
	G (post-SMCRA)	Table 24	Table 25 (A)	Table 25 (B)	Table 26	Table 27
Reclaimed Mountain Grassland	Mudwater Canyon	Table 36	Table 37 (A)	Table 37 (B)	Table 38	n/a
Reclaimed Mountain Grassland	Corner Canyon	Table 39	Table 40 (A)	Table 40 (B)	Table 41	Table 42
Reclaimed Saltbush	I	Table 32	Table 33 (A)	Table 33 (B)	Table 34	Table 35

Table 3: Separated data locator at the Star Point Mine site (2011).

Sagebrush Reference Area	n/a	Table 43	Table 44 (A)	Table 44 (B)	Table 45	Table 46
Mountain Grassland Reference Area	n/a	Table 47	Table 48 (A)	Table 48 (B)	Table 49	Table 50
Saltbush Reference Area	n/a	Table 51	Table 52 (A)	Table 52 (B)	Table 53	Table 54

Dominant Plant Species

For the reclaimed areas at the Star Point Mine site, the most important or dominant plant species by cover and frequency for the **Reclaimed Sagebrush Areas** were primarily the shrubs: big sagebrush *(Artemisia tridentata)*, rubber rabbitbrush (*Chrysothamnus nauseosus*), fourwing saltbush (*Atriplex canescens*), shadscale (*A. confertifolia*) and winterfat (*Ceratoides lanata*). Dominant forbs here consisted of: Pacific aster (*Aster chilensis*), northern vetch (*Hedysarum boreale*), Lewis flax (*Linum lewisii*) and Palmer penstemon (*Penstemon palmeri*). The most important grasses in these reclaimed areas were thickspike wheatgrass (*Elymus lanceolatus*), bluebunch wheatgrass (*E. spicatus*), crested wheatgrass (*Agropyron cristatum*) and Indian ricegrass (*Stipa hymenoides*). All species present in the sample quadrats in the Reclaimed Sagebrush Areas have been provided on Tables 4, 7, 10 and 28.

The dominant shrub species for the **Reclaimed Mountain Grassland Areas** were comprised of big sagebrush, corymb buckwheat (*Eriogonum corymbosum*), Antelope bitterbrush (*Purshia tridentata*), rubber rabbitbrush and curl-leaf mountain mahogany (*Cercocarpus ledifolius*). The dominant forbs in this community were Lewis flax, Pacific aster and Palmer penstemon. The most important grasses here were: Great Basin wildrye (*Elymus cinereus*), mountain brome (*Bromus carinatus*), thickspike wheatgrass and bluebunch wheatgrass.

For a list of all species encountered in the Reclaimed Mountain Grassland Areas, refer to Tables 14, 17, 21, 24, 36 and 39.

Lastly, the dominant shrubs by cover and frequency in the **Reclaimed Saltbush Areas** consisted of: shadscale, rubber rabbitbrush and black sagebrush (*Artemisia nova*). The dominant forb here was cicer milkvetch (*Astragalus cicer*), and the most important grasses consisted of bluebunch wheatgrass, western wheatgrass (*Elymus smithii*), Salina wildrye (*Elymus salinus*) and thickspike wheatgrass). For cover and frequency values in the Reclaimed Saltbush Areas, refer to Tables 32.

In the reference areas, the most important shrub species in the **Sagebrush Reference Area** by a wide margin was big sagebrush. The only forbs present in the sample quadrats were milkvetch (*Astragalus* sp.), Palmer penstemon and hoary aster (*Machaeranthera canescens*). Dominant grasses in this community were: Indian ricegrass, created wheatgrass and Salina wildrye. For a list of the plants found in the Sagebrush Reference Area, refer to Table 43.

The dominant shrubs in the **Mountain Grassland Reference Area** were: corymb buckwheat and low rabbitbrush (*Chrysothamnus viscidiflorus*). Although forbs were relatively unimportant here, the dominants were: buckwheat (*Eriogonum* sp.) and hoary aster. The dominant grass by a very wide margin was Salina wildrye. For a list of all species in this reference area, refer to Table 47.

Lastly, for the reference areas, the most important shrub in the **Saltbush Reference Area** was Gardner saltbush (*Atriplex gardneri*). Forbs were again relatively unimportant here, but the dominant forb was the annual plant, brittle phacelia (*Phacelia demissa*). The only grasses present in the sample quadrats were: Salina wildrye and Indian ricegrass. For a list of all species present in this community, refer to Table 51.

Lifeform Composition

As a short summary on composition in the **Reclaimed Sagebrush Areas**, the three lifeforms represented here, shrubs, forbs and grasses were nearly equally represented at most sample sites. In all areas, and in descending order, grasses > shrubs > forbs by varying degrees. For lifeform composition percentages in these reclaimed areas, refer to Tables 5, 8, 11 and 29.

In the **Reclaimed Mountain Grassland Areas**, with only one exception, grasses had about twice the amount of forbs and shrubs, the later two demonstrated mixed proportions. For lifeform composition percentages in these areas, refer to Tables 15, 18, 22, 25, 37 and 40.

The composition order of the **Reclaimed Saltbush Areas** comprised of grasses > shrubs > forbs, with the grasses more that twice as much as the shrubs and forbs combined. For composition results in this reclaimed site, refer to Table 33.

In the **Sagebrush Reference Area**, grasses > shrubs > forbs, with grasses and shrubs relatively close in proportion, but followed distantly by forbs (Table 44).

The **Mountain Grassland Reference Area** was very much dominated by grasses (> 80%) as shown in the composition, but shrubs and forbs were also represented (Table 48).

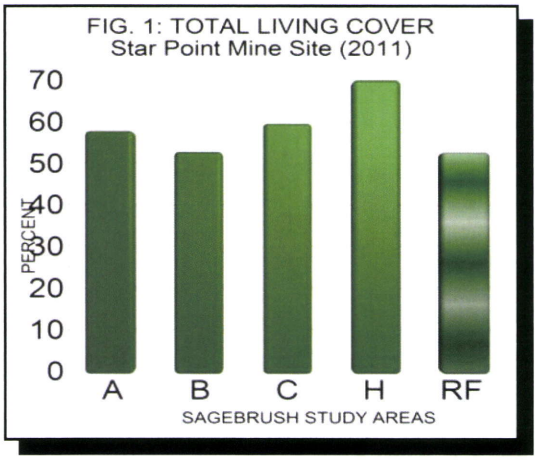
Finally, the composition of the **Saltbush Reference Area** was nearly equally represented by shrubs and grasses, with few forbs (Table 52).

The dominant species information as well as the lifeform composition results described above have been provided as additional information to further demonstrate the current condition of the vegetation at the Star Point Mine site. However, the primary parameters for comparing the reclaimed areas with the reference areas were: total living cover, woody species density, annual biomass

productivity and diversity. Therefore, these parameters are first shown graphical for the *separated data*, then compared statistically later in the report for the *lumped* (or *combined data*).

Total Living Cover

Total living cover, one of the key parameters in assessing revegetation success at the mine site, has been shown for individual areas in summary tables provided later in the report, and have also been shown graphically in figures here. Figure 1 illustrates the total living cover in each Reclaimed Sagebrush Area as well as the Sagebrush Reference Area (RF).



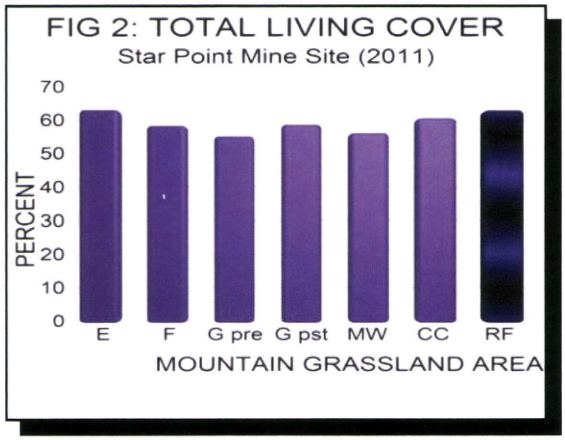
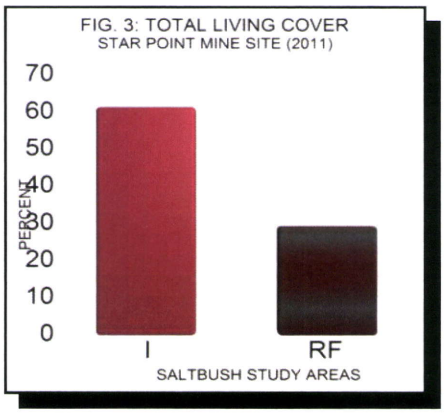


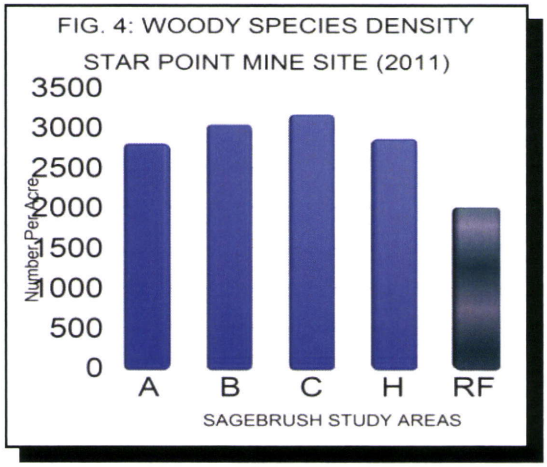
Figure 2 shows the same parameter, total living cover, for all the Reclaimed Mountain Grassland Areas as well as the Mountain Grassland Reference Area.

Figure 3 illustrates total living cover for the Reclaimed Saltbush Area along with the Saltbush Reference Area.

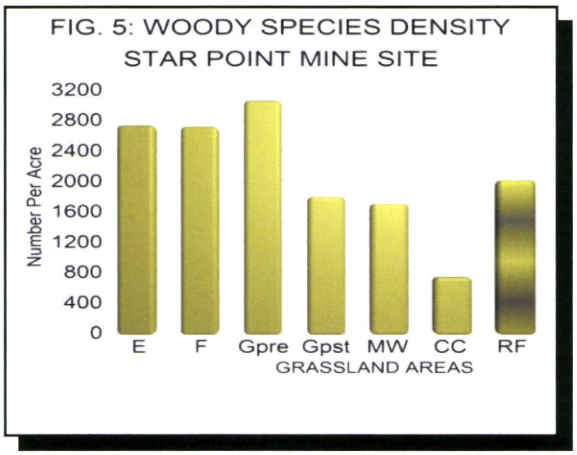


Woody Species Density

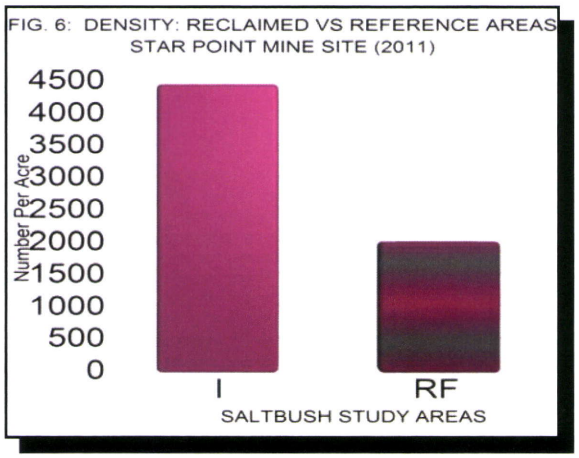
Woody species density values, or the total number of individuals per acre, for each Reclaimed Sagebrush Area as well as the Sagebrush 'standard' [a pre-determined number, *not* the reference area value (further explained later)] are shown in Figure 4.



This same parameter for each Reclaimed Grassland Area and its density standard are shown in Figure 5 (in the figure, pre=pre-SMCRA; pst=post SMCRA).

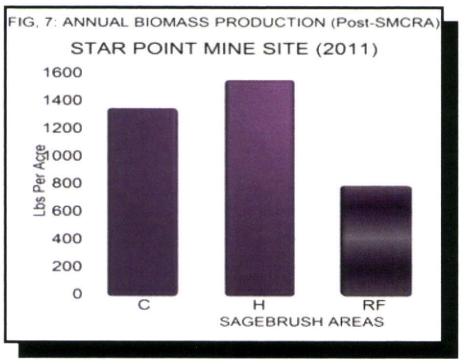


Finally, the woody species density for the Reclaimed Saltbush Areas along with the Saltbush density standard are shown in Figure 6.

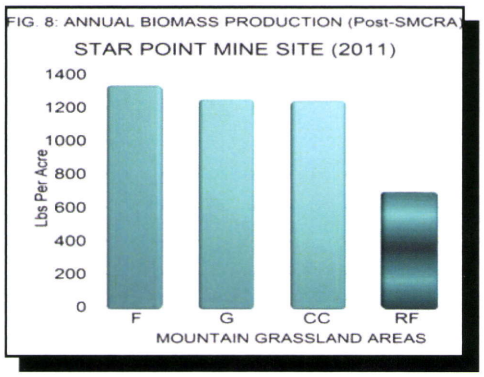


Annual Biomass Production

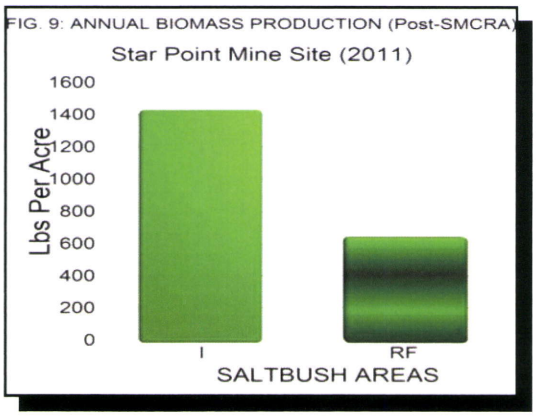
As dictated by the final revegetation success standards in the Star Point Mine's MRP, total annual biomass production was only measured and compared with reference areas in the post-SMCRA sites. The production shown in pounds per acre for the Reclaimed Sagebrush Areas and Sagebrush Reference Area are shown in Figure 7.



Next, the production of the Reclaimed Mountain Grasslands and its associated reference area are shown graphically in Figure 8.



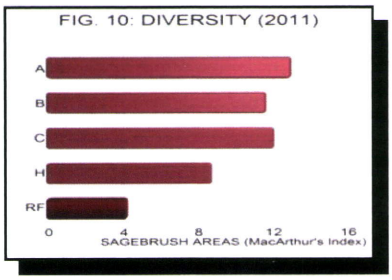
Lastly, the production of the Reclaimed Saltbush Areas can be compared to the Saltbush Reference Area in Figure 9.

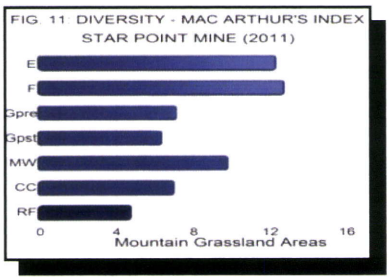


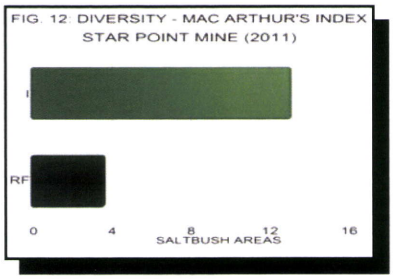
Diversity

Two different diversity measurements have been applied to the reclaimed and reference areas – MacArthur's Index and the Average Number of Species per Quadrat. Graphical representations of these diversity indices are shown below.

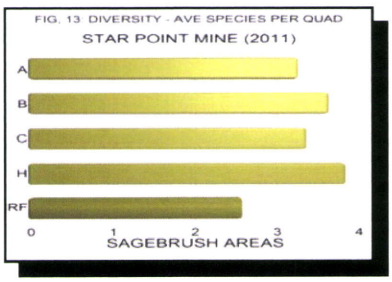
MacArthur's Index

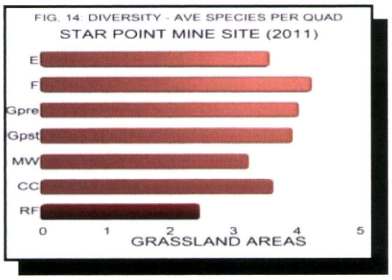


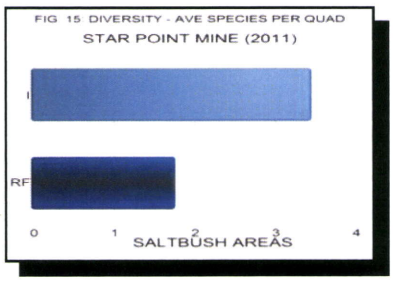




Average Species Per Quadrat







DATA SUMMARIES

(Areas Lumped/Combined)

As the reviewer has observed by now, there has been a lot of vegetation data collected at the Star Point Mine site in 2011 as a means to assess the revegetation success. The goal will ultimately be to submit an application for Phase III Bond Release through the State of Utah. This, of course, can only be accomplished if the restored plant communities have met final revegetation success standards as dictated in the MRP.

Even though much data has been recorded in the area, the author has tried to find a logical and straightforward method to compare the *applicable parameters* to assess revegetation success (or those required by state and federal regulations), yet also provide other meaningful data (that cannot readily be compared using statistics). In this attempt, the following section discusses the methods used to compare key parameters with the reclaimed areas and their respective reference areas.

Separating vs. Lumping Data

The RESULTS section above provides the data for each sample area including the Reclaimed Areas and Reference Areas along with the subdivisions within the larger reclaimed vegetation types. As explained, this design enables the reviewer to observe the successes (or failures) of individual areas even within each reclaimed vegetation type. For example, Areas A, B, C and H are all within the Sagebrush type, yet sample data were first summarized separately for these areas in 2011 (as well as previous monitoring years) for closer scrutiny of the revegetated landscapes. However, because the objective of this report is NOT to compare each individual sample site within each type for bond release separately, but rather to provide some means for logical comparisons of the reclaimed vegetation with the respective reference areas (or revegetation success standards). That said, to make these comparisons, "*lumping*" or

combining some data would seem appropriate for future bond release applications. Combined dataset summaries are provided in Tables 55 through 67).

Pre-SMCRA vs. Post-SMCRA

At first it would seem logical to simply lump all the Reclaimed Sagebrush sites together into one dataset; then all the Reclaimed Mountain Grassland sites to another dataset and so forth – then compare these datasets with the appropriate Reference Area. However, different revegetation success standards have been assigned to reclaimed areas – even though they may be in the same vegetation type. Reasons for the dissimilar standards was based on whether or not a given reclaimed area was disturbed prior to, or after, the Surface Mining Control and Reclamation Act of 1977 (SMCRA). Those areas disturbed after, or post-SMCRA, have more stringent revegetation success standards than those disturbed pre-SMCRA. (More information and justification for this distinction can be found in the Star Point Mine's MRP).

With that in mind, the datasets have been lumped (combined) by vegetation type and the SMCRA time-frame. The outline in Table 4 summarizes this treatment of datasets. The following

Table 4: Reclaimed Areas divided by vegetation type and Surface Mining Control and Reclamation Act.

1. **Pre-SMCRA**
   - a. Reclaimed Sagebrush
     - i. Area A
     - ii. Area B
   - b. Reclaimed Mountain Grassland
     - i. Area E
     - ii. Area G
     - iii. Mudwater Canyon
2. **Post-SMCRA**
   - a. Reclaimed Sagebrush
     - i. Area C
     - ii. Area H
   - b. Reclaimed Mountain Grasslands
     - i. Area F
     - ii. Area G (Area G has both pre- and post-SMCRA areas)
     - iii. Corner Canyon
   - c. Reclaimed Saltbush
     - i. Area I

describes the sample results for combined datasets.

Pre-SMCRA

Total Living Cover

The total living cover (combined) for the pre-SMCRA Reclaimed Sagebrush Areas (Areas A & B) was estimated at 56.19% (Table 55). The total living cover for the Reclaimed Mountain Grassland Areas (Areas E, G & Mudwater Canyon) was estimated at 60.10% (Table 60). There were no pre-SMCRA Reclaimed Saltbush Areas at the site.

Woody Species Density

The pre-SMCRA woody species density for the Reclaimed Sagebrush Areas (Areas A & B) combined was estimated at 2,907 individuals per acre (Table 56). The pre-SMCRA density in for the Reclaimed Mountain Grasslands Areas (Areas E, G & Mudwater Canyon) was estimated at 2,328 plants per acre (Table 61). Again, there were no pre-SMCRA Reclaimed Saltbush Areas at the site.

Post-SMCRA

Total Living Cover

Next, the total living cover of the post-SMCRA Reclaimed Sagebrush Areas (Areas C & H) was estimated at 64.25% (Table 57). The total living cover for the Reclaimed Mountain Grassland Areas (Areas F, G & Corner Canyon) was estimated at 58.25% (Table 62). And finally, the post-SMCRA Saltbush Area (Area I) had a total living cover of 60.40% (Table 65).

Woody Species Density

The density for the post-SMCRA Reclaimed Sagebrush Areas (Areas C & H) was estimated at 3,080 plants per acre (Table 58). The density for the Reclaimed

Mountain Grassland Areas (Areas F, G & Corner Canyon) was estimated at 1,893 plants per acre (Table 63). Lastly, the post-SMCRA Saltbush Area (Area I) had a density 4,391 (Table 66).

Annual Biomass Production

(Post-SMCRA only)

The annual biomass production for the post-SMCRA Reclaimed Sagebrush Areas (Areas C & H) was estimated at 1,437.38 pounds per acre (Table 59). The production for the Reclaimed Mountain Grassland Areas (Areas F, G & Corner Canyon) was estimated at 1,227.88 pounds per acre (Table 64). Lastly, the post-SMCRA Saltbush Area (Area I) had a productivity estimate of 1,419.29 pounds per acre (Table 67).

Reference Areas

Total Living Cover

The total living cover for the Sagebrush Reference Area was estimated at 52.40% (Table 44). The total living cover for the Mountain Grassland Reference Area was estimated at 62.33% (Table 48). And finally, the Saltbush Reference Area had a total living cover of 28.90% (Table 52).

Woody Species Density

The density for the Sagebrush Reference Area was estimated at 5,854 plants per acre (Table 45), but the pre-determined success standard for this parameter was 2,000 plants per acre [1]. The density for the Mountain Grassland Reference Area was estimated at 1,171 plants per acre (Table 49), but the pre-determined success standard for this parameter was also 2,000 plants per acre. Lastly, the Saltbush Reference Area had a density 3,647 (Table 53), and again the pre-determined success standard for this parameter was 2,000 plants per acre.

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[1] The pre-determined density standard here (and in the other reclaimed communities) was determined more appropriate than the reference area for wildlife habitat by state biologists.

Annual Biomass Production

The annual biomass production for the Sagebrush Reference Area was estimated at 786.81 pounds per acre (Table 46). The production for the Mountain Grassland Reference Area was estimated at 695.88 pounds per acre (Table 50). Lastly, the Saltbush Reference Area had a productivity estimate of 644.30 pounds per acre (Table 54).

CONCLUSIONS

Summary of Revegetation Success Standards

A summary of the revegetation success standards for the Star Point Mine has been provided in Table 68. Statistical comparisons between the reclaimed and reference areas are shown in Tables 69 through 71. Some success standards required Natural Resources Conservation Service (NRCS) estimates. For the USDA information required, refer to the Appendix of this report.

Statistical Comparisons

Reclaimed Sagebrush vs. Reference Area

When the **total living cover** of the pre-SMCRA Reclaimed Sagebrush Areas *combined* was compared to Sagebrush Reference Area, the reclaimed area had a higher cover, but the difference was not significant statistically [Table 69 (A)].

A **woody species density** comparison of the pre-SMCRA Reclaimed Sagebrush Areas *combined* and the pre-set standard of 2,000 indicated that the density of the former was greater than the standard [Table 69 (A)].

An **annual biomass productivity** standard was not given to the pre-SMCRA sites.

In a comparison of the **total living cover** of the post-SMCRA Reclaimed Sagebrush Areas *combined*, again the reclaimed areas value was greater and in this case the difference was statistically significant [Table 69 (B)]. In other words, the reclaimed areas' total living cover was significantly higher than its revegetation success standard.

A **woody species density** comparison of the post-SMCRA Reclaimed Sagebrush Areas *combined* and the pre-set standard of 2,000 indicated that the density of the reclaimed areas was greater [Table 69 (B)].

When the **annual biomass productivity** of post-SMCRA Reclaimed Sagebrush Areas *combined* was compared statistically with the Sagebrush Reference Area, the difference was statistically significant – the reclaimed areas had more production [Table 69 (B)].

Reclaimed Mountain Grasslands vs. Reference Area

When the **total living cover** of the pre-SMCRA Reclaimed Mountain Grassland Areas *combined* was compared to Mountain Grassland Reference Area, the reference area had a slightly higher cover, but the difference was non-significant statistically [Table 70 (A)].

A **woody species density** comparison of the pre-SMCRA Reclaimed Mountain Grassland Areas *combined* and the pre-set standard of 2,000 indicated that the density of the former was greater than the standard [Table 70 (A)].

An **annual biomass productivity** standard was not given to the pre-SMCRA sites.

In a comparison of the **total living cover** of the post-SMCRA Reclaimed Mountain Grassland Areas *combined*, the reference areas value was greater,

but the difference was non-significant statistically [Table 70 (B)].

A **woody species density** comparison of the post-SMCRA Reclaimed Mountain Grassland Areas *combined* and the pre-set standard of 2,000 indicated that the density of the reclaimed areas was only slightly less, or the reclaimed areas had 95% as many plants per acre as the standard [Table 70 (B)].

When the **annual biomass productivity** of post-SMCRA Reclaimed Mountain Grassland Areas *combined* was compared statistically with the Mountain Grassland Reference Area, the difference was statistically significant – the reclaimed areas had much more annual biomass production [Table 70 (B)].

Reclaimed Saltbush vs. Reference Area

There were no pre-SMCRA sites in the Reclaimed Saltbush Areas.

A comparison of the **total living cover** of the post-SMCRA Saltbush Areas, revealed that the reclaimed area value was significantly greater statistically when compared to the Saltbush Reference Area [Table 71 (A)].

A **woody species density** comparison of the post-SMCRA Reclaimed Saltbush Areas and the pre-set standard of 2,000 indicated that the density of the reclaimed areas was much greater than the standard [Table 71 (A)].

When the **annual biomass productivity** of post-SMCRA Reclaimed Saltbush Areas was compared statistically with the Saltbush Reference Area, the difference was statistically significant – the reclaimed areas had much more annual biomass production here too [Table 71].

Future Studies

In conclusion, the **Year 2** vegetation sampling for the second consecutive year will be conducted in 2012. Results from that study will be summarized as a companion to this 2011 study. If the results so warrant it, both sample years will be submitted with an application for Phase III Bond Release at the Star Point Mine site in the future.

SUMMARY

In 2011, quantitative vegetation sampling was conducted within areas that were once disturbed by coal mining and related activities at the Star Point Mine site. Subsequent to the long history of mining in the area, these disturbances were reclaimed and revegetated according the Mining & Reclamation Plan. Accordingly, specific standards for revegetation success were determined prior to the reclamation activities. This report provides the findings for the vegetation sampling in 2011; the sampling was necessary for conducting **Year 1** of two consecutive years to ascertain whether or not the mine site has met revegetation success standards, thus meeting requirements needed to ultimately apply for Phase III or Final Bond Release.

At the Star Point Mine, there are three vegetation types that were restored including Sagebrush, Mountain Grasslands and Saltbush Areas. Accordingly, there were also three reference areas of similar vegetation types chosen previously to be used for revegetation success standards.

As a means to compare data for specific sites within each reclaimed area, datasets were first *separated* and summarized into smaller reclaimed sites. Later the data were *lumped* (combined) into larger datasets more amenable to be used for comparisons with the reference areas.

The report shows that in 2011 the summaries of the combined datasets for the reclaimed vegetation types, when compared to the applicable reference areas, have met or exceeded those standards set for revegetation success.

DATA SUMMARY TABLES

Table 4: Star Point Mine. Living Cover and Frequency by Plant Species (2011).

Reclaimed Sagebrush Area A			n=60
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Amelanchier utahensis	0.58	3.17	3.33
Artemisia tridentata	2.25	8.29	8.33
Atriplex canescens	0.83	3.31	6.67
Atriplex confertifolia	3.25	9.35	15.00
Ceratoides lanata	1.08	3.99	8.33
Cercocarpus ledifolius	1.58	4.52	13.33
Cercocarpus montanus	0.83	6.40	1.67
Chrysothamnus nauseosus	7.92	14.09	36.67
Purshia tridentata	1.17	5.80	5.00
FORBS			
Artemisia dracunculus	0.67	2.95	6.67
Aster chilensis	1.83	7.07	8.33
Bassia scoparia	0.25	1.42	3.33
Grindelia squarrosa	0.67	2.95	5.00
Hedysarum boreale	2.33	7.16	10.00
Linum lewisii	0.83	3.67	6.67
Machaeranthera canescens	0.25	1.92	1.67
Melilotus officinalis	0.50	1.98	6.67
Penstemon palmeri	4.20	6.67	36.67
Viguiera multiflora	0.08	0.64	1.67
GRASSES			
Agropyron cristatum	3.00	6.00	25.00
Elymus cinereus	1.33	4.73	8.33
Elymus junceus	0.17	1.28	1.67
Elymus lanceolatus	9.67	12.51	50.00
Elymus salinus	1.50	10.30	3.33
Elymus smithii	1.30	6.91	3.33
Elymus spicatus	6.42	11.00	33.33
Stipa comata	0.75	5.76	1.67
Stipa hymenoides	2.17	7.32	11.67

Table 5: Star Point Mine.
Total Cover and Composition (2011).

Reclaimed Sagebrush Area A		n=60
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Understory	57.42	12.02
Litter	8.17	3.87
Bareground	16.33	9.78
Rock	18.08	10.25
B. % COMPOSITION		
Shrubs	34.60	31.38
Forbs	21.12	22.18
Grasses	44.28	28.31

Table 6: Star Point Mine . Woody Species Density (2011).

SPECIES	Individuals Per Acre
Reclaimed Sagebrush Area A	n=60
Amelanchier utahensis	150.67
Artemisia tridentata	243.39
Atriplex canescens	197.03
Atriplex confertifolia	254.98
Ceratoides lanata	278.16
Cercocarpus ledifolius	139.08
Cercocarpus montanus	46.36
Chrysothamnus nauseosus	1390.79
Eriogonum corymbosum	11.59
Purshia tridentata	34.77
Symphoricarpos oreophilus	34.77
TOTAL	**2781.58**

Table 7: Star Point Mine. Living Cover and Frequency by Plant Species (2011).

Reclaimed Sagebrush Area B			n=20
	Mean Percent	**Standard Deviation**	**Percent Frequency**
TREES & SHRUBS			
Atriplex canescens	2.00	7.65	10.00
Atriplex confertifolia	1.75	5.31	10.00
Ceratoides lanata	2.50	6.98	15.00
Chrysothamnus nauseosus	7.25	14.36	25.00
Purshia tridentata	1.00	4.36	5.00
FORBS			
Achillea millefolium	0.75	2.38	10.00
Artemisia dracunculus	0.25	1.09	5.00
Grindelia squarrosa	1.00	2.55	15.00
Hedysarum boreale	3.75	8.20	20.00
Linum lewisii	4.25	4.82	50.00
Medicago sativa	0.75	3.27	5.00
Penstemon palmeri	2.00	3.32	30.00
GRASSES			
Agropyron cristatum	4.25	6.57	35.00
Elymus lanceolatus	9.50	10.94	55.00
Elymus salinus	3.00	6.20	20.00
Elymus spicatus	2.50	5.59	20.00
Stipa hymenoides	6.00	9.82	30.00

Table 8: Star Point Mine.
Total Cover and Composition (2011).

Reclaimed Sagebrush Area B		n=20
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Understory	52.50	12.20
Litter	7.75	3.70
Bareground	29.50	11.72
Rock	10.25	5.58
B. % COMPOSITION		
Shrubs	25.27	29.41
Forbs	24.77	21.33
Grasses	49.96	28.38

Table 9: Star Point Mine . Woody Species Density (2011).

Reclaimed Sagebrush Area B	n=20
SPECIES	**Individuals Per Acre**
Artemisia tridentata	37.69
Atriplex canescens	75.38
Atriplex confertifolia	904.57
Ceratoides lanata	188.45
Cercocarpus ledifolius	37.69
Cercocarpus montanus	75.38
Chrysothamnus nauseosus	1620.69
Eriogonum corymbosum	37.69
Purshia tridentata	37.69
TOTAL	**3015.23**

Table 10: Star Point Mine. Living Cover and Frequency by Plant Species (2011).

Reclaimed Sagebrush Area C			n=30
	Mean Percent	**Standard Deviation**	**Percent Frequency**
TREES & SHRUBS			
Artemisia tridentata	0.90	3.76	6.67
Atriplex canescens	2.50	8.83	10.00
Atriplex confertifolia	0.17	0.90	3.33
Ceratoides lanata	5.60	12.71	26.67
Chrysothamnus nauseosus	4.83	11.51	26.67
FORBS			
Achillea millefolium	0.50	1.98	6.67
Artemisia dracunculus	2.67	7.27	16.67
Bassia scoparia	0.17	0.90	3.33
Ceratoides lanata	0.33	1.80	3.33
Grindelia squarrosa	1.83	4.56	16.67
Hedysarum boreale	1.00	5.39	3.33
Linum lewisii	2.17	5.87	20.00
Machaeranthera canescens	0.33	1.25	6.67
Medicago sativa	0.17	0.90	3.33
Melilotus officinalis	0.17	0.90	3.33
Penstemon palmeri	1.00	2.71	13.33
Viguiera multiflora	0.33	1.80	3.33
GRASSES			
Agropyron cristatum	8.67	9.83	56.67
Bromus carinatus	1.67	6.75	6.67
Elymus cinereus	0.83	4.49	3.33
Elymus lanceolatus	12.17	16.47	46.67
Elymus salinus	1.00	3.74	6.67
Elymus smithii	0.33	1.80	3.33
Elymus spicatus	8.50	15.23	30.00
Stipa comata	1.00	5.39	3.33
Stipa hymenoides	0.33	1.80	3.33

Table 11: Star Point Mine. Total Cover and Composition (2011).

Reclaimed Sagebrush Area C		n=30
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Understory	59.17	9.32
Litter	10.33	4.27
Bareground	18.80	10.67
Rock	11.70	4.45
B. % COMPOSITION		
Shrubs	23.73	28.88
Forbs	17.76	19.53
Grasses	58.51	31.45

Table 12: Star Point Mine . Woody Species Density (2011).

Reclaimed Sagebrush Area C	n=30
SPECIES	**Individuals Per Acre**
Amelanchier utahensis	52.30
Artemisia tridentata	392.23
Atriplex canescens	366.08
Atriplex confertifolia	78.45
Ceratoides lanata	1072.10
Cercocarpus ledifolius	0.00
Chrysothamnus nauseosus	1176.69
TOTAL	**3137.85**

Table 13: Star Point Mine . Annual Biomass Production (2011).

Reclaimed Sagebrush
Area C

(n=30; double sampling n=120)

	Pounds/Acre	
LIFEFORM	**MEAN**	**STD. DEV.**
Herbaceous	908.66	441.34
Woody	429.09	470.61
TOTAL	**1337.75**	**450.74**

Table 14: Star Point Mine. Living Cover and Frequency by Plant Species (2011).

Reclaimed Mountain Grassland Area E			n=100
	Mean Percent	**Standard Deviation**	**Percent Frequency**
TREES & SHRUBS			
Artemisia tridentata	5.19	9.71	31.00
Cercocarpus ledifolius	0.40	2.71	3.00
Cercocarpus montanus	0.08	0.80	1.00
Chrysothamnus nauseosus	0.68	2.58	6.00
Chrysothamnus viscidiflorus	0.07	0.70	1.00
Eriogonum corymbosum	6.18	12.45	25.00
Gutierrezia sarothrae	0.50	2.60	4.00
Pseudotsuga menziesii	0.55	3.31	3.00
Purshia tridentata	1.15	4.17	9.00
Ribes sp.	0.05	0.50	1.00
Symphoricarpos oreophilus	0.45	4.48	1.00
FORBS			
Achillea millefolium	1.35	5.09	13.00
Artemisia dracunculus	0.75	4.32	3.00
Aster chilensis	4.90	10.61	25.00
Astragalus cicer	0.50	4.97	1.00
Cynoglossum officinale	0.05	0.50	1.00
Grindelia squarrosa	0.20	1.21	3.00
Linum lewisii	3.05	5.52	35.00
Machaeranthera canescens	0.20	0.98	4.00
Machaeranthera grindelioides	0.25	1.30	4.00
Medicago sativa	1.05	5.40	5.00
Penstemon palmeri	0.55	2.33	7.00
GRASSES			
Agropyron cristatum	0.65	2.71	6.00
Bromus carinatus	4.75	9.91	27.00
Elymus cinereus	12.40	18.20	49.00
Elymus junceus	0.25	2.49	1.00
Elymus lanceolatus	6.75	13.65	35.00
Elymus salinus	1.15	4.99	6.00
Elymus spicatus	7.45	11.63	40.00
Stipa comata	0.25	2.49	1.00
Stipa hymenoides	0.70	4.00	4.00

Table 15: Star Point Mine.
Total Cover and Composition (2011).

Reclaimed Mountain Grassland Area E		n=100
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Understory	62.50	9.96
Litter	8.33	3.34
Bareground	13.19	7.77
Rock	15.98	8.57
B. % COMPOSITION		
Trees/Shrubs	25.30	24.80
Forbs	20.31	21.99
Grasses	54.39	28.71

Table 16: Star Point Mine . Woody Species Density (2011).

Reclaimed Mountain Grassland Area E	n=100
SPECIES	**Individuals Per Acre**
Amelanchier utahensis	27.11
Artemisia tridentata	1070.66
Cercocarpus ledifolius	115.20
Cercocarpus montanus	13.55
Chrysothamnus nauseosus	426.91
Chrysothamnus viscidiflorus	20.33
Eriogonum corymbosum	474.34
Gutierrezia sarothrae	115.20
Populus tremuloides	13.55
Purshia tridentata	311.71
Pseudotsuga menziesii	54.21
Ribes sp.	6.78
Symphoricarpos oreophilus	60.99
TOTAL	**2710.53**

Table 17: Star Point Mine. Living Cover and Frequency by Plant Species (2011).

Reclaimed Mountain Grassland Area F			n=40
	Mean Percent	**Standard Deviation**	**Percent Frequency**
TREES & SHRUBS			
Amelanchier utahensis	0.13	0.78	2.50
Artemisia tridentata	3.50	7.52	22.50
Cercocarpus ledifolius	1.13	4.40	7.50
Chrysothamnus nauseosus	2.88	6.70	20.00
Pseudotsuga menziesii	0.50	1.87	7.50
Purshia tridentata	2.50	6.71	15.00
Symphoricarpos oreophilus	0.13	0.78	2.50
FORBS			
Achillea millefolium	2.25	6.02	20.00
Artemisia dracunculus	0.13	0.78	2.50
Aster chilensis	6.50	10.44	40.00
Grindelia squarrosa	0.13	0.78	2.50
Hedysarum boreale	5.25	10.84	25.00
Iva axillaris	0.50	1.87	7.50
Linum lewisii	4.45	6.17	42.50
Medicago sativa	1.00	6.24	2.50
Melilotus officinalis	6.75	10.46	47.50
Penstemon palmeri	0.68	1.81	12.50
Viguiera multiflora	0.13	0.78	2.50
GRASSES			
Bromus carinatus	3.13	5.56	30.00
Elymus cinereus	10.75	13.40	60.00
Elymus lanceolatus	2.25	6.80	12.50
Elymus smithii	0.50	3.12	2.50
Elymus spicatus	2.75	5.47	32.50

Table 18: Star Point Mine.
Total Cover and Composition (2011).

Reclaimed Mountain Grassland Area F		n=40
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Understory	57.88	10.42
Litter	9.00	3.20
Bareground	16.25	7.31
Rock	16.88	8.99
B. % COMPOSITION		
Trees/Shrubs	18.71	23.49
Forbs	47.74	21.14
Grasses	33.55	22.99

Table 19: Star Point Mine . Woody Species Density (2011).

Reclaimed Mountain Grassland Area F	n=40
SPECIES	**Individuals Per Acre**
Acer glabrum	84.09
Amelanchier utahensis	33.63
Artemisia tridentata	975.41
Cercocarpus ledifolius	235.44
Chrysothamnus nauseosus	756.79
Eriogonum corymbosum	33.63
Pseudotsuga menziesii	84.09
Purshia tridentata	454.07
Rosa woodsii	33.63
TOTAL	**2690.79**

Table 20: Star Point Mine . Annual Biomass Production (2011).

Reclaimed Mountain Grassland
Area F

(n=40)

	Pounds/Acre	
LIFEFORM	**MEAN**	**STD. DEV.**
Herbaceous	1045.47	363.56
Woody	278.70	381.90
TOTAL	**1324.16**	**350.20**

Table 21: Star Point Mine. Living Cover and Frequency by Plant Species (2011).

Reclaimed Mountain Grassland Area G (Pre-SMCRA)			n=20
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Artemisia tridentata	6.75	8.41	50.00
Cercocarpus ledifolius	4.00	8.60	25.00
Chrysothamnus nauseosus	0.50	2.18	5.00
Purshia tridentata	1.00	3.39	10.00
Symphoricarpos oreophilus	1.25	2.68	20.00
FORBS			
Achillea millefolium	0.50	1.50	10.00
Aster chilensis	2.00	4.85	20.00
Astragalus cicer	1.00	3.39	10.00
Linum lewisii	5.50	4.97	65.00
Penstemon palmeri	0.75	2.38	10.00
GRASSES			
Bromus carinatus	0.75	2.38	10.00
Elymus cinereus	19.00	13.29	85.00
Elymus spicatus	11.75	9.12	80.00

Table 22: Star Point Mine.
Total Cover and Composition (2011).

Reclaimed Mountain Grassland Area G (Pre-SMCRA)		n=20
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Understory	54.75	11.01
Litter	11.25	3.83
Bareground	13.50	6.73
Rock	20.50	9.34
B. % COMPOSITION		
Shrubs	25.36	24.53
Forbs	19.80	17.13
Grasses	54.84	29.91

Table 23: Star Point Mine . Woody Species Density (2011).

Reclaimed Mountain Grassland Area G (Pre-SMCRA)	n=20
SPECIES	**Individuals Per Acre**
Artemisia tridentata	1741.64
Acer glabrum	37.86
Cercocarpus ledifolius	302.89
Chrysothamnus nauseosus	75.72
Pseudotsuga menziesii	113.59
Purshia tridentata	340.76
Symphoricarpos oreophilus	416.48
TOTAL	**3028.94**

Table 24: Star Point Mine. Living Cover and Frequency by Plant Species (2011).

Reclaimed Mountain Grassland Area G (Post SMCRA)			n=30
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Artemisia tridentata	2.33	7.16	13.33
Chrysothamnus nauseosus	0.83	3.67	6.67
Eriogonum corymbosum	0.17	0.90	3.33
Pseudotsuga menziesii	0.33	1.80	3.33
Purshia tridentata	1.67	5.06	10.00
Symphoricarpos oreophilus	0.50	2.69	3.33
FORBS			
Achillea millefolium	0.17	0.90	3.33
Aster chilensis	5.00	9.92	26.67
Astragalus cicer	0.67	3.59	3.33
Hedysarum boreale	0.17	0.90	3.33
Linum lewisii	6.77	5.37	73.33
Penstemon palmeri	4.70	4.29	66.67
Viguiera multiflora	0.50	1.98	6.67
GRASSES			
Bromus carinatus	0.83	4.49	3.33
Elymus cinereus	23.60	11.95	93.33
Elymus lanceolatus	0.20	0.91	6.67
Elymus spicatus	9.73	9.04	63.33

Table 25: Star Point Mine.
Total Cover and Composition (2011).

Reclaimed Mountain Grassland Area G (Post SMCRA)		n=30
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Understory	58.17	10.61
Litter	12.67	4.03
Bareground	12.50	6.68
Rock	16.67	7.78
B. % COMPOSITION		
Shrubs	9.84	14.87
Forbs	31.65	18.90
Grasses	58.52	18.86

Table 26: Star Point Mine . Woody Species Density (2011).

Reclaimed Mountain Grassland Area G (Post SMCRA)	n=30
SPECIES	**Individuals Per Acre**
Artemisia tridentata	462.21
Cercocarpus ledifolius	342.93
Chrysothamnus nauseosus	342.93
Eriogonum corymbosum	59.64
Prunus virginiana	29.82
Pseudotsuga menziesii	14.91
Purshia tridentata	372.75
Symphoricarpos oreophilus	164.01
TOTAL	**1789.19**

Table 27: Star Point Mine . Annual Biomass Production (2011).

Reclaimed Mountain Grassland
Area G (Post SMCRA)

(n=30)

	Pounds/Acre	
LIFEFORM	**MEAN**	**STD. DEV.**
Herbaceous	1131.50	578.31
Woody	109.99	189.26
TOTAL	**1241.50**	**646.97**

Table 28: Star Point Mine. Living Cover and Frequency by Plant Species (2011).

Reclaimed Sagebrush Area H			n=30
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Artemisia tridentata	0.83	4.49	3.33
Atriplex canescens	2.67	10.06	6.67
Ceratoides lanata	1.83	6.39	10.00
Chrysothamnus nauseosus	14.50	17.14	50.00
FORBS			
Bassia scoparia	3.50	7.65	23.33
Descurainia pinnata	0.33	1.80	3.33
Lactuca tartarica	0.83	1.86	16.67
Medicago sativa	1.50	3.69	16.67
Penstemon palmeri	0.33	1.25	6.67
GRASSES			
Agropyron cristatum	15.83	14.03	76.67
Bromus tectorum	12.67	15.53	56.67
Elymus lanceolatus	1.50	4.50	16.67
Elymus smithii	4.00	6.63	33.33
Elymus spicatus	7.67	9.81	46.67
Stipa comata	1.00	3.00	10.00
Stipa hymenoides	0.33	1.80	3.33

Table 29: Star Point Mine.
Total Cover and Composition (2011).

Reclaimed Sagebrush Area H		n=30
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Understory	69.33	8.73
Litter	8.70	3.87
Bareground	14.07	8.13
Rock	7.90	5.71
B. % COMPOSITION		
Shrubs	29.67	25.12
Forbs	9.10	11.82
Grasses	61.24	22.38

Table 30: Star Point Mine . Woody Species Density (2011).

Reclaimed Sagebrush Area H	n=30
SPECIES	**Individuals Per Acre**
Artemisia tridentata	70.97
Atriplex canescens	189.26
Atriplex confertifolia	189.26
Ceratoides lanata	827.99
Chrysothamnus nauseosus	1561.36
TOTAL	**2838.83**

Table 31: Star Point Mine . Annual Biomass Production (2011).

Reclaimed Sagebrush
Area H

(n=30)

	Pounds/Acre	
LIFEFORM	**MEAN**	**STD. DEV.**
Herbaceous	848.23	480.34
Woody	688.79	581.77
TOTAL	**1537.02**	**322.46**

Table 32: Star Point Mine. Living Cover and Frequency by Plant Species (2011).

Reclaimed Saltbush Area I			n=50
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Artemisia nova	2.00	5.48	14.00
Artemisia tridentata	0.20	1.40	2.00
Atriplex canescens	1.66	4.80	16.00
Atriplex confertifolia	5.14	10.06	30.00
Atriplex corrugata	0.40	2.20	4.00
Atriplex gardneri	0.90	3.11	8.00
Chrysothamnus nauseosus	3.70	7.93	26.00
Eriogonum corymbosum	1.10	3.78	10.00
Purshia tridentata	0.70	3.74	4.00
FORBS			
Astragalus cicer	2.26	8.55	12.00
Grindelia squarrosa	0.10	0.70	2.00
Halogeton glomeratus	0.20	1.40	2.00
Hedysarum boreale	0.20	1.40	2.00
Linum lewisii	0.40	1.69	6.00
Malcomia africana	0.50	1.80	8.00
Penstemon palmeri	0.20	0.98	4.00
GRASSES			
Agropyron cristatum	2.90	8.31	20.00
Bromus carinatus	0.20	1.40	2.00
Elymus junceus	1.30	7.13	6.00
Elymus lanceolatus	5.30	9.19	34.00
Elymus salinus	7.60	17.27	18.00
Elymus smithii	8.70	11.61	44.00
Elymus spicatus	11.64	15.91	48.00
Elymus trachycaulus	0.60	4.20	2.00
Stipa hymenoides	2.50	5.94	18.00

Table 33: Star Point Mine. Living Cover and Frequency by Plant Species (2011).

Reclaimed Saltbush Area I		n=50
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Understory	60.40	11.66
Litter	11.26	4.91
Bareground	21.84	13.39
Rock	6.50	5.05
B. % COMPOSITION		
Shrubs	25.90	20.08
Forbs	6.25	13.64
Grasses	67.85	21.20

Table 34: Star Point Mine. Woody Species Density (2011).

Reclaimed Saltbush Area I	n=50
SPECIES	**Individuals Per Acre**
Artemisia nova	614.75
Artemisia tridentata	65.87
Atriplex canescens	329.33
Atriplex confertifolia	1624.70
Atriplex corrugata	65.87
Atriplex gardneri	307.38
Cercocarpus montanus	43.91
Ceratoides lanata	43.91
Chrysothamnus nauseosus	944.08
Eriogonum corymbosum	219.55
Purshia tridentata	131.73
TOTAL	**4391.09**

Table 35: Star Point Mine . Annual Biomass Production (2011).

Reclaimed Saltbush Area I

(n=50)

	Pounds/Acre	
LIFEFORM	**MEAN**	**STD. DEV.**
Herbaceous	920.20	293.51
Woody	499.09	478.02
TOTAL	**1419.29**	**487.57**

Table 36: Star Point Mine. Living Cover and Frequency by Plant Species (2011).

Reclaimed Mountain Grassland Mudwater Canyon Area			n=30
	Mean Percent	**Standard Deviation**	**Percent Frequency**
TREES & SHRUBS			
Acer glabrum	2.00	6.14	13.33
Chrysothamnus nauseosus	0.17	0.90	3.33
Ribes aureum	0.33	1.80	3.33
Ribes sp.	2.83	10.62	6.67
Rosa woodsii	3.00	9.97	13.33
Rubus idaeus	1.83	5.40	6.67
Symphoricarpos oreophilus	0.17	0.90	3.33
FORBS			
Achillea millefolium	0.17	0.90	3.33
Aster glaucodes	0.90	2.74	10.00
Chaenactis douglasii	0.17	0.90	3.33
Cynoglossum officinale	0.23	0.96	6.67
Erigeron sp.	0.17	0.90	3.33
Fragaria vesca	0.17	0.90	3.33
Geranium viscosissimum	7.10	8.75	53.33
Senecio integerrimus	0.67	1.70	10.00
Veratrum californicum	0.17	0.90	3.33
GRASSES			
Bromus carinatus	2.50	5.44	20.00
Dactylis glomeratus	2.33	7.04	10.00
Elymus hispidus	2.33	8.73	10.00
Elymus lanceolatus	9.83	22.19	26.67
Elymus smithii	14.67	15.38	70.00
Phleum pratense	2.10	4.19	23.33
Poa pratensis	1.83	4.37	16.67

Table 37: Star Point Mine. Living Cover and Frequency by Plant Species (2011).

Reclaimed Mountain Grassland Mudwater Canyon Area		n=30
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Understory	55.67	14.59
Litter	8.67	2.87
Bareground	12.67	6.55
Rock	23.00	11.22
B. % COMPOSITION		
Trees/Shrubs	17.72	26.86
Forbs	19.20	16.80
Grasses	63.08	26.11

Table 38: Star Point Mine . Woody Species Density (2011).

Reclaimed Mountain Grassland Mudwater Canyon Area	n=21
SPECIES	**Individuals Per Acre**
Acer glabrum	199.08
Lonicera involucrata	33.18
Pseudotsuga menziesii	33.18
Ribes aureum	82.95
Rosa woodsii	248.85
Rubus idaeus	464.52
Symphoricarpos oreophilus	82.95
TOTAL	**1144.71**
sd	1700.89

Table 39: Star Point Mine. Living Cover and Frequency by Plant Species (2011).

Reclaimed Grassland Corner Canyon Area			n=10
	Mean Percent	**Standard Deviation**	**Percent Frequency**
TREES & SHRUBS			
Mahonia repens	2.50	5.12	20.00
Rosa woodsii	1.00	3.00	10.00
FORBS			
Carduus nutans	1.00	3.00	10.00
Cirsium sp.	0.20	0.60	10.00
Cynoglossum officinale	0.70	2.10	10.00
Geranium viscosissimum	4.10	5.05	50.00
Melilotus officinalis	1.70	3.47	20.00
Smilacina stellata	2.50	6.02	20.00
Tragopogon dubius	1.00	2.00	20.00
GRASSES			
Agropyron cristatum	1.00	3.00	10.00
Bromus carinatus	0.50	1.50	10.00
Elymus smithii	37.50	21.59	100.00
Phleum pratense	5.30	6.15	60.00
Poa pratensis	1.00	3.00	10.00

Table 40: Star Point Mine. Living Cover and Frequency by Plant Species (2011).

Reclaimed Grassland Corner Canyon Area		n=10
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Understory	60.00	14.14
Litter	8.90	1.97
Bareground	8.60	4.32
Rock	22.50	16.62
B. % COMPOSITION		
Shrubs	6.98	16.74
Forbs	20.16	18.87
Grasses	72.85	25.33

Table 41: Star Point Mine . Woody Species Density (2011).

Reclaimed Grassland Corner Canyon Area Area	n=10
SPECIES	**Individuals Per Acre**
Chrysothamnus nauseosus	18.56
Lonicera involucrata	18.56
Mahonia repens	92.80
Populus tremuloides	37.12
Pseudotsuga menziesii	37.12
Rosa woodsii	37.12
Symphoricarpos oreophilus	501.12
TOTAL	**742.40**

Table 42: Star Point Mine . Annual Biomass Production (2011).

Reclaimed Grassland
Corner Canyon Area

(n=10)

	Pounds/Acre	
LIFEFORM	**MEAN**	**STD. DEV.**
Herbaceous	869.52	900.37
Woody	363.18	946.35
TOTAL	**1232.70**	**1383.71**

Table 43: Star Point Mine. Living Cover and Frequency by Plant Species (2011).

Sagebrush Reference Area			n=50
	Mean Percent	Standard Deviation	Percent Frequency
TREES & SHRUBS			
Amelanchier utahensis	0.30	2.10	2.00
Artemisia nova	0.70	4.90	2.00
Artemisia tridentata	22.00	12.88	92.00
Chrysothamnus viscidiflorus	0.10	0.70	2.00
Gutierrezia sarothrae	0.40	1.36	8.00
FORBS			
Astragalus sp.	1.40	5.20	8.00
Machaeranthera canescens	0.10	0.70	2.00
Penstemon palmeri	0.10	0.70	2.00
GRASSES			
Agropyron cristatum	7.26	11.96	36.00
Bromus tectorum	0.70	2.83	6.00
Elymus salinus	3.10	12.36	6.00
Hordeum jubatum	2.10	5.84	18.00
Stipa hymenoides	14.14	12.85	72.00

Table 44: Star Point Mine. Living Cover and Frequency by Plant Species (2011).

Sagebrush Reference Area		n=50
Understory	52.40	12.26
Litter	14.06	6.17
Bareground	31.54	13.95
Rock	2.00	2.14
B. % COMPOSITION		
Shrubs	44.81	24.29
Forbs	3.76	12.79
Grasses	51.43	24.32

Table 45: Star Point Mine . Woody Species Density (2011).

Sagebrush Reference Area	n=50
SPECIES	**Individuals Per Acre**
Amelanchier utahensis	58.54
Artemisia nova	58.54
Artemisia tridentata	5620.16
Cercocarpus montanus	29.27
Chrysothamnus nauseosus	29.27
Chrysothamnus viscidiflorus	29.27
Gutierrezia sarothrae	29.27
TOTAL	**5854.33**

Table 46: Star Point Mine . Annual Biomass Production (2011).

Sagebrush Reference Area

(n=50)

	Pounds/Acre	
LIFEFORM	**MEAN**	**STD. DEV.**
Herbaceous	462.75	337.38
Woody	324.06	236.64
TOTAL	**786.81**	**292.57**

Table 47: Star Point Mine. Living Cover and Frequency by Plant Species (2011).

Mountain Grassland Reference Area			n=30
TREES & SHRUBS	**Mean Percent**	**Standard Deviation**	**Percent Frequency**
Artemisia tridentata	0.83	3.67	6.67
Chrysothamnus viscidiflorus	2.93	5.64	26.67
Eriogonum corymbosum	3.40	8.52	16.67
Gutierrezia sarothrae	0.33	1.25	6.67
Mahonia repens	0.17	0.90	3.33
FORBS			
Achillea millefolium	0.33	1.80	3.33
Allium sp	0.50	1.98	6.67
Eriogonum sp.	1.67	4.15	16.67
Linum lewisii	0.67	2.13	10.00
Machaeranthera canescens	1.00	2.00	20.00
GRASSES			
Elymus salinus	46.00	13.44	100.00
Koeleria macrantha	3.50	6.47	26.67
Poa secunda	1.00	5.39	3.33

Table 48: Star Point Mine. Living Cover and Frequency by Plant Species (2011).

Mountain Grassland Reference Area		n=30
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Understory	62.33	5.28
Litter	17.50	5.12
Bareground	10.07	5.27
Rock	10.10	4.58
B. % COMPOSITION		
Shrubs	11.98	16.90
Forbs	7.01	10.08
Grasses	81.01	18.06

Table 49: Star Point Mine . Woody Species Density (2011).

Mountain Grassland Reference Area	n=30
SPECIES	**Individuals Per Acre**
Artemisia tridentata	156.16
Chrysothamnus depressus	48.80
Chrysothamnus viscidiflorus	488.00
Eriogonum corymbosum	380.64
Gutierrezia sarothrae	97.60
TOTAL	**1171.20**

Table 50: Star Point Mine . Annual Biomass Production (2011).

Mountain Grassland Reference Area

(n=30)

	Pounds/Acre	
LIFEFORM	**MEAN**	**STD. DEV.**
Herbaceous	556.22	194.45
Woody	139.66	195.05
TOTAL	**695.88**	**233.47**

Table 51: Star Point Mine . Woody Species Density (2011).

Saltbush Reference Area			n=50
	Mean Percent	**Standard Deviation**	**Percent Frequency**
TREES & SHRUBS			
Artemisia nova	0.20	1.40	2.00
Atriplex confertifolia	1.90	5.65	12.00
Atriplex gardneri	11.14	10.62	56.00
Chrysothamnus nauseosus	0.20	0.98	4.00
Eriogonum corymbosum	0.76	3.70	6.00
FORBS			
Malcomia africana	0.10	0.70	2.00
Phacelia demissa	1.34	2.86	20.00
Stanleya pinnata	0.10	0.70	2.00
GRASSES			
Elymus salinus	12.76	11.17	68.00
Stipa hymenoides	0.40	2.20	4.00

Table 52: Star Point Mine. Living Cover and Frequency by Plant Species (2011).

Saltbush Reference Area		n=50
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Understory	28.90	5.50
Litter	8.82	3.10
Bareground	47.70	14.67
Rock	14.58	11.31
B. % COMPOSITION		
Shrubs	50.58	36.45
Forbs	5.05	10.36
Grasses	44.38	38.34

Table 53: Star Point Mine . Woody Species Density (2011).

Saltbush Reference Area	n=50
SPECIES	**Individuals Per Acre**
Artemisia nova	328.19
Atriplex canescens	18.23
Atriplex confertifolia	856.95
Atriplex gardneri	2242.66
Chrysothamnus nauseosus	54.70
Ephedra viridis	36.47
Eriogonum corymbosum	109.40
Gutierrezia sarothrae	0.00
TOTAL	**3646.60**

Table 54: Star Point Mine . Annual Biomass Production (2011).

Saltbush Reference Area

(n=50)

	Pounds/Acre	
LIFEFORM	**MEAN**	**STD. DEV.**
Herbaceous	178.72	193.79
Woody	465.58	385.05
TOTAL	**644.30**	**296.97**

COMBINED BY TIME PERIOD (PRE-SMCRA VS. POST-SMCRA)

Table 55: Star Point Mine. *Combined* Data for Total Cover and Composition (2011).

Pre-SMCRA Reclaimed Sagebrush Areas (Includes: Area A & Area B)		
	Mean Percent	Standard Deviation
TOTAL LIVING COVER	56.19	12.25
Sample size (n) = 80 SAMPLE ADEQUACY (nMIN) 80%± 0.10 = 8 samples 90%± 0.10 = 13 samples		

Table 56: Star Point Mine . *Combined* Data for Woody Species Density (2011).

Pre-SMCRA

Reclaimed Sagebrush Areas

(Includes: Area A & Area B)

Number of Individuals Per Acre	Mean	Standard Deviation
TOTAL	2907.45	1436.21
Sample size (n) = 80 SAMPLE ADEQUACY (nMIN) 80%± 0.10 = 40 samples 90%± 0.10 = 66 samples		

Table 57: Star Point Mine. *Combined* Data for Total Cover and Composition (2011).

Post-SMCRA Reclaimed Sagebrush Areas (Includes: Area C & Area H)		
	Mean Percent	Standard Deviation
TOTAL LIVING COVER	64.25	10.36
Sample size (n) = 60 SAMPLE ADEQUACY (nMIN) 80%± 0.10 = 4 samples 90%± 0.10 = 7 samples		

Table 58: Star Point Mine . *Combined* Data for Woody Species Density (2011).

Post-SMCRA

Reclaimed Sagebrush Areas

(Includes: Area C & Area H)

Number of Individuals Per Acre	Mean	Standard Deviation
TOTAL	3080.23	1491.60

Sample size (n) = 60
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 38 samples
90%± 0.10 = 63 samples

Table 59: Star Point Mine . *Combined* Data for Annual Biomass Production (2011).

Post-SMCRA

Reclaimed Sagebrush Areas

(Includes: Area C & Area H)

LIFEFORM	Pounds/Acre MEAN	STD. DEV.
Herbaceous	878.44	462.24
Woody	558.94	544.82
TOTAL	**1437.38**	**681.39**

Sample size (n) = 60
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 37 samples
90%± 0.10 = 61 samples

Table 60: Star Point Mine. *Combined* Data for Total Cover and Composition (2011).

Pre-SMCRA Reclaimed Mountain Grassland Areas (Includes: Area E, Area G & Mudwater Canyon)		
	Mean Percent	Standard Deviation
TOTAL LIVING COVER	60.10	11.68
Sample size (n) = 150 SAMPLE ADEQUACY (nMIN) 80%± 0.10 = 6 samples 90%± 0.10 = 10 samples		

Table 61: Star Point Mine . *Combined* Data for Woody Species Density (2011).

Pre-SMCRA

Reclaimed Mountain Grassland Areas

(Includes: Area E, Area G & Mudwater Canyon)

Number of Individuals Per Acre	Mean	Standard Deviation
TOTAL	2328.29	1519.76
Sample size (n) = 150 SAMPLE ADEQUACY (nMIN) 80%± 0.10 = 70 samples 90%± 0.10 = 115 samples		

Table 62: Star Point Mine. *Combined* Data for Total Cover and Composition (2011).

Post-SMCRA
Reclaimed Mountain Grassland Areas
(Includes: Area F, Area G & Corner Canyon)

	Mean Percent	Standard Deviation
TOTAL LIVING COVER	58.25	11.04

Sample size (n) = 80
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 6 samples
90%± 0.10 = 10 samples

Table 63: Star Point Mine . *Combined* Data for Woody Species Density (2011).

Post-SMCRA
Reclaimed Mountain Grass Land Areas
(Includes: Area F, Area G & Corner Canyon)

Number of Individuals Per Acre	Mean	Standard Deviation
TOTAL	1893.23	1304.96

Sample size (n) = 80
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 78 samples
90%± 0.10 = 129 samples

Table 64: Star Point Mine . *Combined* Data for Annual Biomass Production (2011).

Post-SMCRA
Reclaimed Mountain Grass Land Areas
(Includes: Area F, Area G & Corner Canyon)

	Pounds/Acre	
LIFEFORM	**MEAN**	**STD. DEV.**
Herbaceous	1019.95	478.49
Woody	207.93	354.86
TOTAL	**1227.88**	**701.70**

Sample size (n) = 80
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 54 samples
90%± 0.10 = 88 samples

Table 65: Star Point Mine. *Combined* Data for Total Cover and Composition (2011).

Post-SMCRA
Reclaimed Saltbush Areas
(Includes: Area I)

	Mean Percent	Standard Deviation
TOTAL LIVING COVER	60.40	11.66

Sample size (n) =50
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 6 samples
90%± 0.10 = 10 samples

Table 66: Star Point Mine . *Combined* Data for Woody Species Density (2011).

Post-SMCRA
Reclaimed Saltbush Areas
(Includes: Area I)

Number of Individuals Per Acre	Mean	Standard Deviation
TOTAL	4391.09	2084.73

Sample size (n) = 50
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 37 samples
90%± 0.10 = 61 samples

Table 67: Star Point Mine . *Combined* Data for Annual Biomass Production (2011).

Post-SMCRA
Reclaimed Saltbush Areas
(Includes: Area I)

	Pounds/Acre	
LIFEFORM	**MEAN**	**STD. DEV.**
Herbaceous	920.20	293.51
Woody	499.09	478.29
TOTAL	**1419.29**	**685.47**

Sample size (n) = 50
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 38 samples
90%± 0.10 = 63 samples

Table 68: Summary of revegetation success standards for success at the Star Point Mine.

SEEDED AREA	DISTURBANCE	COVER	DENSITY	DIVERSITY	PRODUCTION
SALTBUSH	Pre-SMCRA	(no pre-SMCRA)	(no pre-SMCRA)	(no pre-SMCRA)	(no pre-SMCRA)
	Post-SMCRA	Saltbush Reference Area	2,000 plants/ac	Saltbush Reference Area	Saltbush Reference Area
SAGEBRUSH	Pre-SMCRA	Sagebrush Reference Area	2,000 plants/ac	(no standard)	NRCS estimates
	Post-SMCRA	Sagebrush Reference Area	2,000 plants/ac	Sagebrush Reference Area	Sagebrush Reference Area
MOUNTAIN GRASSLAND	Pre-SMCRA	Mtn. Grassland Reference Area	2,000 plants/ac	(no standard)	NRCS estimates
	Post-SMCRA	Mtn. Grassland Reference Area	2,000 plants/ac	Mtn. Grassland Reference Area	Mtn. Grassland Reference Area

TABLE 69: Statistical summary sheet comparing the Reclaimed Sagebrush areas and Sagebrush Reference Area at the Star Point Mine site (2011).

A. SAGEBRUSH AREAS (Pre-SMCRA)			
Reclaimed Area A & Area B (Combined)			
Total Living Cover	$\bar{x}$=56.19	s=12.25	n=80
Density	$\bar{x}$=2907.45	s=1436.21	n=80
Sagebrush Reference Area			
Total Living Cover	$\bar{x}$=52.40	s=12.26	n=50
Density	$\bar{x}$=2000.00*	s=n/a	n=n/a
STATISTICAL ANALYSES			
Total Living Cover	t=1.7156	df=128	SL=N.S.
Density	t=n/a	df=n/a	SL=n/a
B. SAGEBRUSH AREAS (Post-SMCRA)			
Reclaimed Area C & Area H (Combined)			
Total Living Cover	$\bar{x}$=64.25	s=10.36	n=60
Density	$\bar{x}$=3080.23	s=1491.60	n=60
Production	$\bar{x}$=1437.38	s=681.39	n=60
Sagebrush Reference Area			
Total Living Cover	$\bar{x}$=52.40	s=12.26	n=50
Density	$\bar{x}$=2000.00*	s=n/a	n=n/a
Production	$\bar{x}$=786.81	s=292.57	n=50
STATISTICAL ANALYSES			
Total Living Cover	t=5.4951	df=108	SL=p<.001
Density	t=n/a	df=n/a	SL=n/a
Production	t=6.2870	df=108	SL=p<.001

$\bar{x}$= sample mean, s = sample standard deviation, n = sample size,
NS = non-significant, t = Student's t-value, df = degrees of freedom,
SL = significance level, p = probability level, *= pre-determined standard

TABLE 70: Statistical summary sheet comparing the Reclaimed Mountain Grassland areas and Mountain Grassland Reference Area at the Star Point Mine site (2011).

A. MOUNTAIN GRASSLAND AREAS (Pre-SMCRA)

Reclaimed : Area E, Area G & Mudwater Canyon (Combined)

Total Living Cover	$\bar{x}$=60.10	s=11.68	n=150
Density	$\bar{x}$=2328.29	s=1519.76	n=150

Mountain Grassland Reference Area

Total Living Cover	$\bar{x}$=62.33	s=5.28	n=30
Density	$\bar{x}$=2000.00*	s=n/a	n=n/a

STATISTICAL ANALYSES

Total Living Cover	t=1.0232	df=178	SL=N.S.
Density	t=n/a	df=n/a	SL=n/a

B. MOUNTAIN GRASSLAND AREAS (Post-SMCRA)

Area F, Area G & Corner Canyon (Combined)

Total Living Cover	$\bar{x}$=58.25	s=11.04	n=80
Density	$\bar{x}$=1893.23	s=1304.96	n=80
Production	$\bar{x}$=1227.88	s=701.70	n=80

Mountain Grassland Reference Area

Total Living Cover	$\bar{x}$=62.33	s=5.28	n=30
Density	$\bar{x}$=2000.00*	s=n/a	n=n/a
Production	$\bar{x}$=695.88	s=233.47	n=30

STATISTICAL ANALYSES

Total Living Cover	t=1.9386	df=108	SL=N.S
Density	t=n/a	df=n/a	SL=n/a
Production	t=4.0590	df=108	SL=p<.001

$\bar{x}$= sample mean, s = sample standard deviation, n = sample size,
NS = non-significant, t = Student's t-value, df = degrees of freedom,
SL = significance level, p = probability level, *= pre-determined standard

TABLE 71: Statistical summary sheet comparing the Reclaimed Saltbush areas and Saltbush Reference Area at the Star Point Mine site (2011).

A. SALTBUSH AREAS (Post-SMCRA)			
Area I			
Total Living Cover	$\bar{x}$=60.40	s=11.66	n=50
Density	$\bar{x}$=4391.09	s=2084.73	n=50
Production	$\bar{x}$=1419.29	s=685.47	n=50
Saltbush Reference Area			
Total Living Cover	$\bar{x}$=28.90	s=5.50	n=50
Density	$\bar{x}$=2000.00*	s=n/a	n=n/a
Production	$\bar{x}$=644.30	s=296.97	n=50
STATISTICAL ANALYSES			
Total Living Cover	t=17.2772	df=98	SL=p<.001
Density	t=n/a	df=n/a	SL=n/a
Production	t=7.3357	df=98	SL=p<.001

$\bar{x}$= sample mean, s = sample standard deviation, n = sample size,
NS = non-significant, t = Student's t-value, df = degrees of freedom,
SL = significance level, p = probability level, *= pre-determined standard

COLOR PHOTOGRAPHS
OF THE
SAMPLE AREAS

Reclaimed Area A

Reclaimed Area A (continued)

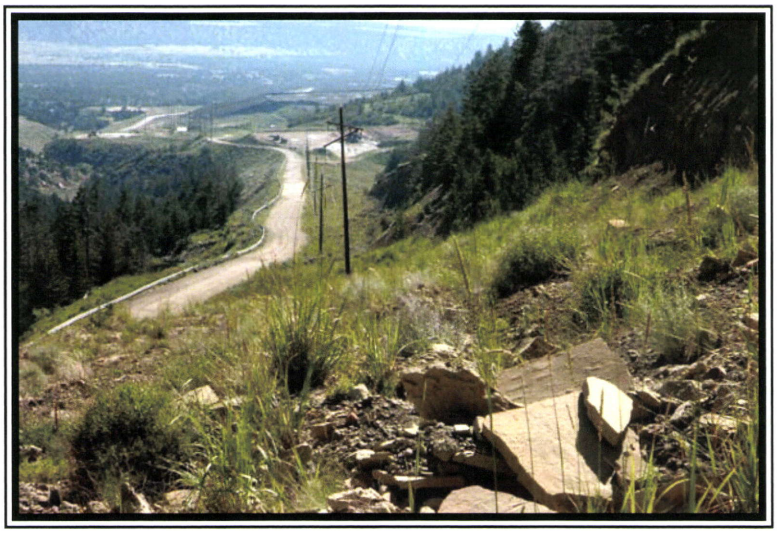
Reclaimed Area B

Reclaimed Area C

Reclaimed Area E

Reclaimed Area E (continued)

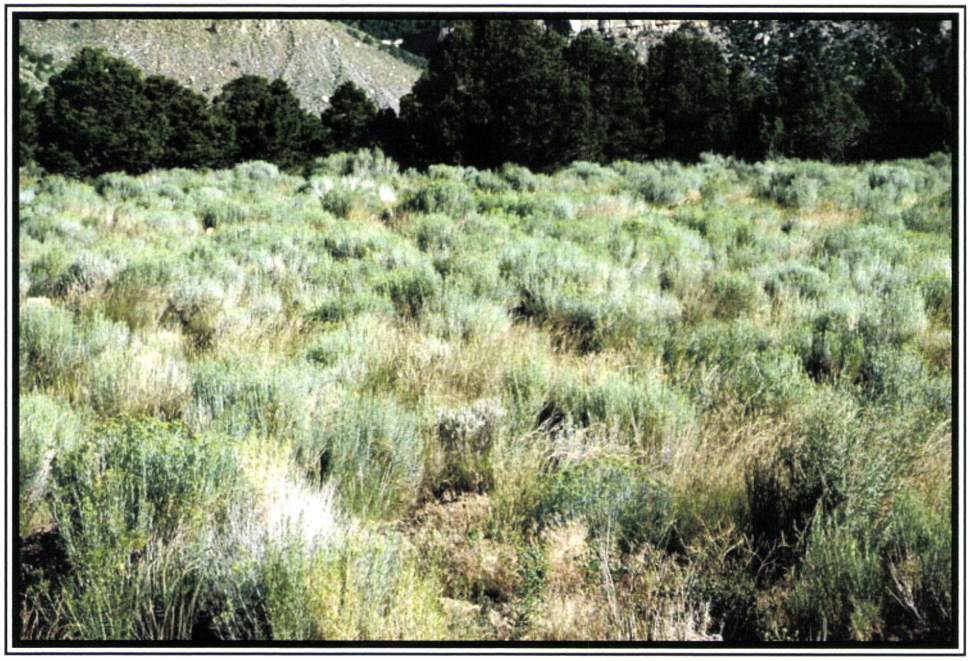
Reclaimed Area F



Reclaimed Area G (Pre-SMCRA)

Reclaimed Area G (Post-SMCRA)

Reclaimed Area H

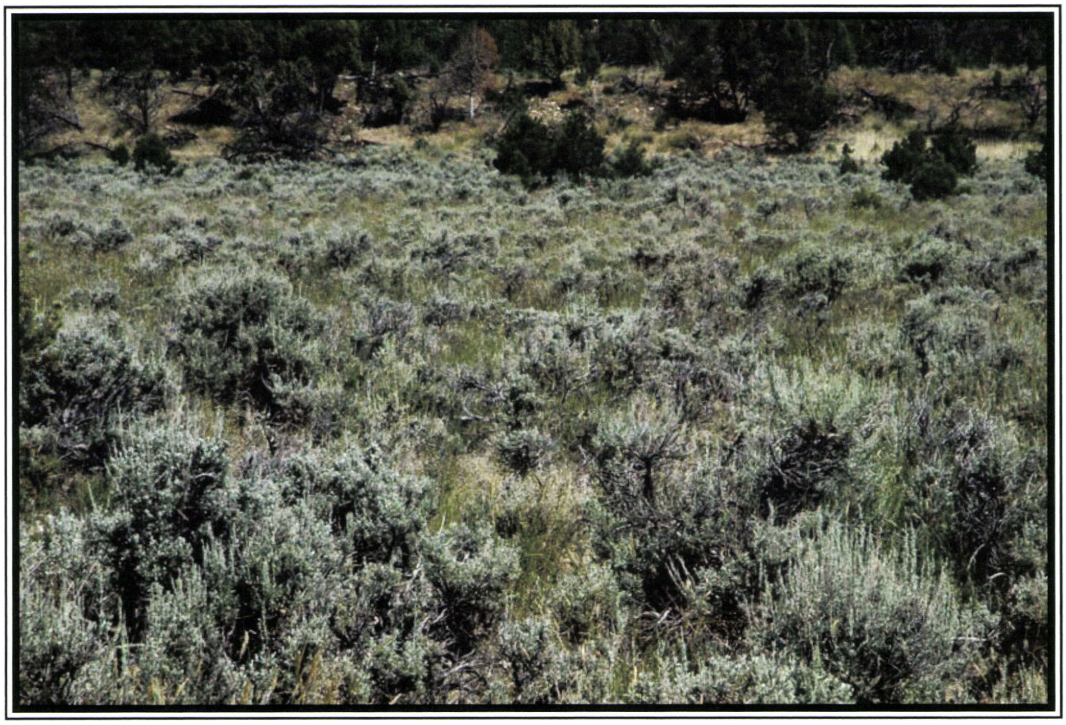


Reclaimed Area I

MUDWATER CANYON AREA

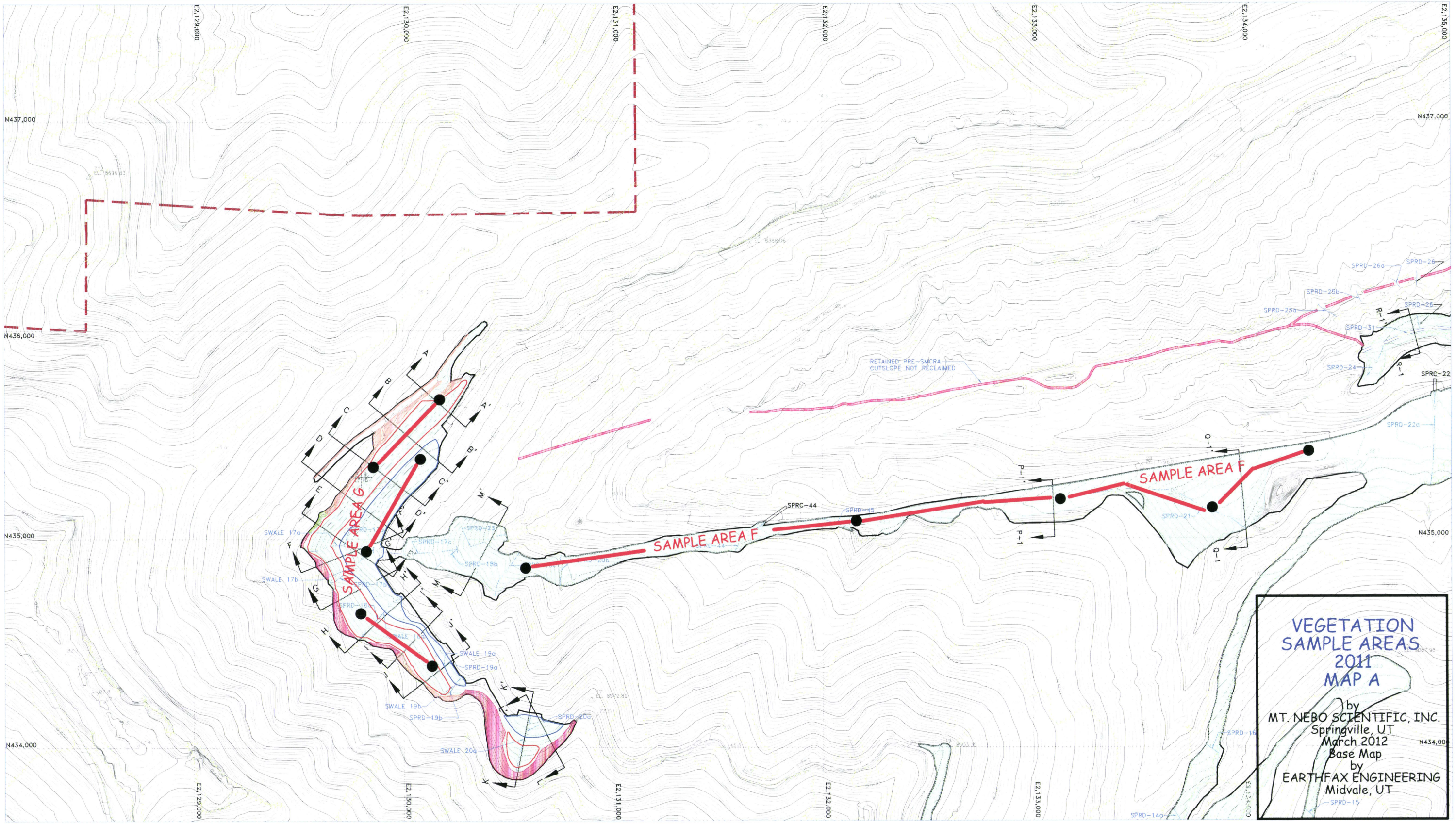
CORNER CANYON AREA

SAGEBRUSH REFERENCE AREA



MOUNTAIN GRASSLAND REFERENCE AREA

SALTBUSH REFERENCE AREA



LEGEND

- PRIMARY ROAD
- SECONDARY ROAD
- TRAIL
- BRIDGE, CULVERT
- RAILROAD
- BUILDINGS, STRUCTURES
- LAKE, POND
- RIVER, STREAM
- FENCE
- ASBUILT CONTOURS
- TREE LINES
- RECLAMATION DISTURBED AREA BOUNDARY
- CROSS SECTION
- PERMIT BOUNDARY
- PARTIALLY BACKFILLED PRE-SMCRA HIGHWALL
- PARTIALLY BACKFILLED PRE-SMCRA CUTSLOPE
- PARTIALLY BACKFILLED POST-SMCRA CUTSLOPE
- RECLAMATION CHANNEL
- DEEP GOUGED SURFACE (HAY AND STRAW MULCH) LAST AUGMENTED SEEDING FALL 2002
- SECTION CORNER
- AREA OF COAL REFUSE BURIAL. COAL REFUSE BURIED WITH A MIN. OF 4' OF COVER MATERIAL. (APPROX. 113,532 CY HAULED TO THE LION'S DECK)
- AREA PROVIDING COVER MATERIAL FOR COAL REFUSE PLACED ON THE LION'S DECK (APPROX. 14,700 CY WAS USED TO FILL THE STOPE HOLE AND 54,502 CY WAS USED TO COVER THE COAL REFUSE)
- Sample Transect Lines

NOTES:

1. PHASE 1 BOND RELEASE FOR 93.77 ACRES.
2. BACKFILL, GRADING AND GROWTH MEDIA/TOPSOIL PLACEMENT FOR THE MINE #1 AND MINE #2 AREAS BEGAN IN AUGUST, 2001 AND WERE COMPLETED IN DECEMBER, 2001. GROWTH MEDIA/TOPSOIL PLACEMENT OCCURRED CONCURRENTLY WITH BACKFILLING AND GRADING AS AREAS ACHIEVED FINAL GRADE.
3. BACKFILL, GRADING AND GROWTH MEDIA/TOPSOIL PLACEMENT FOR THE LION'S DECK, PONDS 1 AND 2, AND THE LOWER FACILITIES AREAS BEGAN IN APRIL, 2002 AND WERE COMPLETED IN NOVEMBER, 2002. GROWTH MEDIA/TOPSOIL PLACEMENT OCCURRED CONCURRENTLY WITH BACKFILLING AND GRADING AS AREAS ACHIEVED FINAL GRADE.
4. TOWNSHIP 15 SOUTH, RANGE 8 EAST.

NORTH

200' 100' 0 200'

REGISTERED PROFESSIONAL ENGINEER
No. 189797
LAYNE D. JENSEN
NOT VALID WITHOUT A SEAL
STATE OF UTAH

RAG

FILE: G:\UC779\07\DWG\542200a-AB\ 08-08-03

REVISION/HISTORY

BY	DATE	DESCRIPTION
LDJ	05-05-02	RESPOND TO TA COMMENTS
LDJ	10-10-03	AS-BUILT
LDJ	02-05-04	RESPOND TO TA COMMENTS
PDC	02-27-07	VEGETATION SAMPLE LOCATIONS ADDED

STARPOINT MINE

AS-BUILT RECLAMATION TOPOGRAPHY AND TREATMENT MAP

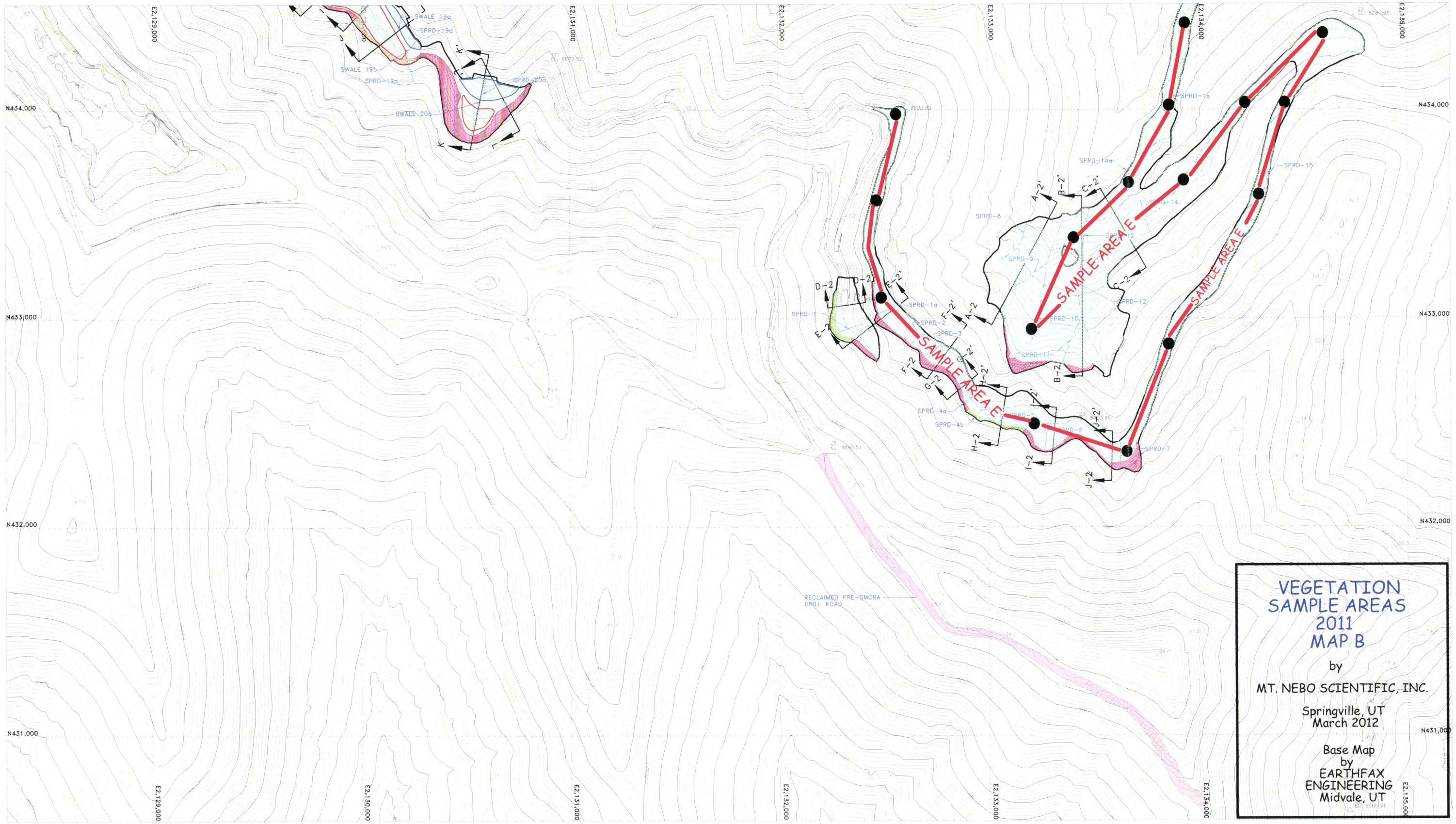
SHEET 1

PLATEAU MINING CORPORATION

847 NW HIGHWAY 191 HELPER, UTAH 84526
PHONE: (435) 472-0475

1 of 3

MAP 542.200a



LEGEND

- PRIMARY ROAD
- SECONDARY ROAD
- TRAIL
- BRIDGE, CULVERT
- RAILROAD
- BUILDINGS, STRUCTURES
- LAKE, POND
- RIVER, STREAM
- FENCE
- ASBUILT CONTOURS
- TREE LINES
- RECLAMATION DISTURBED AREA BOUNDARY
- CROSS SECTION
- PERMIT BOUNDARY
- PARTIALLY BACKFILLED PRE-SMCRA HIGHWALL
- PARTIALLY BACKFILLED PRE-SMCRA CUTSLOPE
- PARTIALLY BACKFILLED POST-SMCRA CUTSLOPE
- RECLAMATION CHANNEL
- DEEP GOUGED SURFACE (HAY AND STRAW MULCH) LAST AUGMENTED SEEDING FALL 2002
- DEEP GOUGED SURFACE LAST AUGMENTED SEEDING FALL 2003
- SAMPLE TRANSECT LINES
- 10 11 / 15 14 SECTION CORNER
- AREA OF COAL REFUSE BURIAL. COAL REFUSE BURIED WITH A MIN. OF 4' OF COVER MATERIAL. (APPROX. 113,532 CY HAULED TO THE LION'S DECK)
- AREA PROVIDING COVER MATERIAL FOR COAL REFUSE PLACED ON THE LION'S DECK (APPROX. 14,700 CY WAS USED TO FILL THE STOPE HOLE AND 54,502 CY WAS USED TO COVER THE COAL REFUSE)

NOTES:

1. PHASE 1 BOND RELEASE FOR 93.77 ACRES.
2. BACKFILL, GRADING AND GROWTH MEDIA/TOPSOIL PLACEMENT FOR THE MINE #1 AND MINE #2 AREAS BEGAN IN AUGUST, 2001 AND WERE COMPLETED IN DECEMBER, 2001. GROWTH MEDIA/TOPSOIL PLACEMENT OCCURRED CONCURRENTLY WITH BACKFILLING AND GRADING AS AREAS ACHIEVED FINAL GRADE.
3. BACKFILL, GRADING AND GROWTH MEDIA/TOPSOIL PLACEMENT FOR THE LION'S DECK, PONDS 1 AND 2, AND THE LOWER FACILITIES AREAS BEGAN IN APRIL, 2002 AND WERE COMPLETED IN NOVEMBER, 2002. GROWTH MEDIA/TOPSOIL PLACEMENT OCCURRED CONCURRENTLY WITH BACKFILLING AND GRADING AS AREAS ACHIEVED FINAL GRADE.
4. TOWNSHIP 15 SOUTH, RANGE 8 EAST.

NORTH

200' 100' 0 200'

REGISTERED PROFESSIONAL ENGINEER
No. 189797
LAYNE D. JENSEN
NOT VALID WITHOUT A SIGNATURE
STATE OF UTAH

RAG

FILE: G:\UC779\07\DWG\542200B-AB\ 08-08-03

REVISION/HISTORY

BY	DATE	DESCRIPTION
RBW	10-99	RESPOND TO TA COMMENTS
1		
LDJ	10-10-03	AS-BUILT
2		
LDJ	02-05-04	RESPOND TO TA COMMENTS
3		
PDC	03-27-07	VEGETATION SAMPLE LOCATIONS ADDED
4		
5		
6		

STARPOINT MINE

AS-BUILT RECLAMATION TOPOGRAPHY AND TREATMENT MAP

SHEET 2

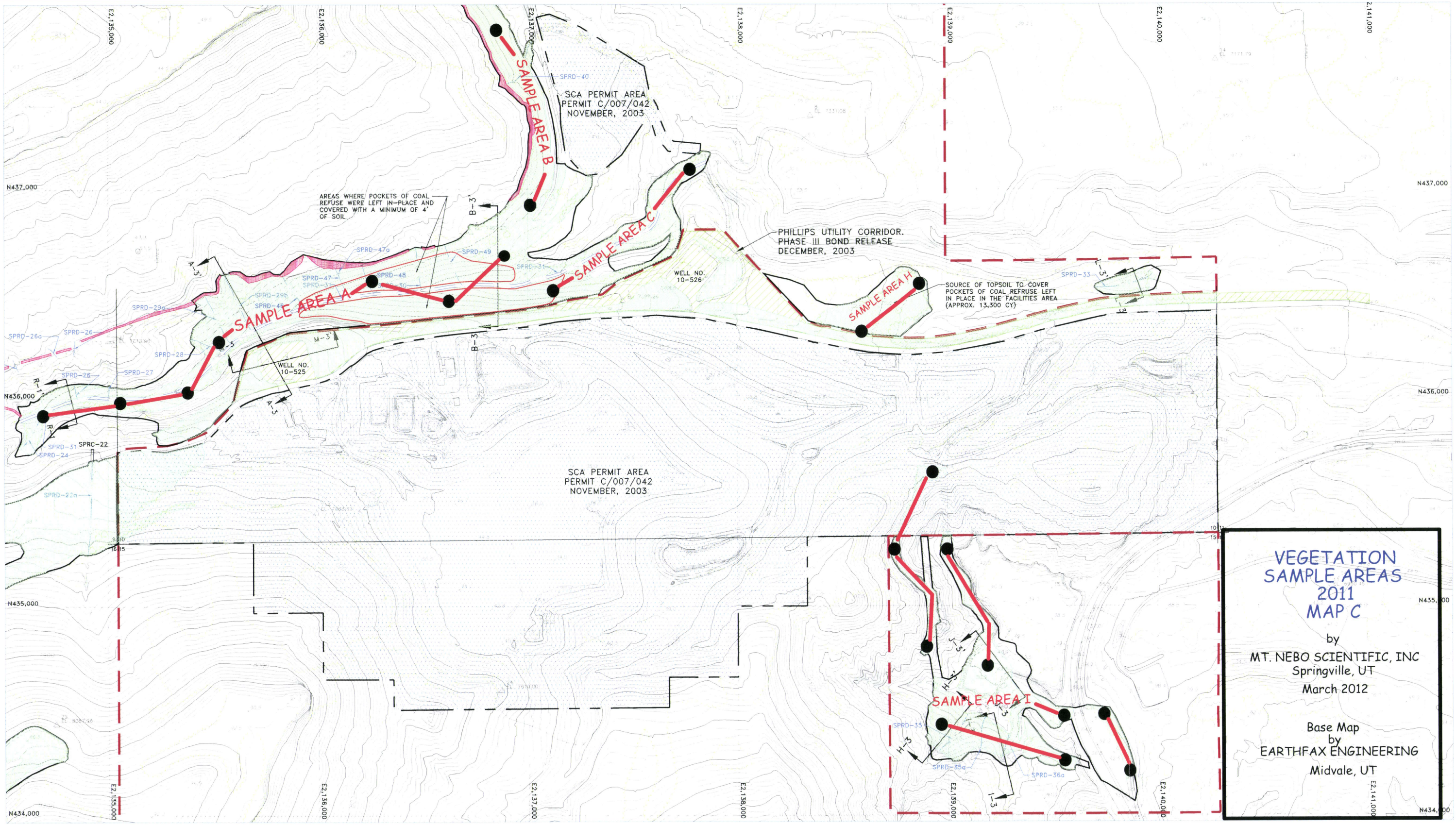
PLATEAU MINING CORPORATION

847 NW HIGHWAY 191 HELPER, UTAH 84526

PHONE: (435) 472-0475

2 of 3

MAP 542.200b



LEGEND

- PRIMARY ROAD
- SECONDARY ROAD
- TRAIL
- BRIDGE, CULVERT
- RAILROAD
- BUILDINGS, STRUCTURES
- LAKE, POND
- RIVER, STREAM
- FENCE
- ASBUILT CONTOURS
- TREE LINES
- RECLAMATION DISTURBED AREA BOUNDARY
- CROSS SECTION
- PERMIT BOUNDARY
- PHILLIPS GAS WELLS AND UTILLITY CORRIDOR (11.77 ACRES POST MINING LAND USE CHANGE AND PHASE III BOND RELEASED IN DECEMBER 2003)
- SECTION CORNER
- PARTIALLY BACKFILLED PRE-SMCRA CUTSLOPE
- SCA PERMIT BOUNDARY AND PERMIT C/007/042 NOVEMBER, 2003
- RECLAMATION CHANNEL
- DEEP GOUGED SURFACE (HAY AND STRAW MULCH) LAST AUGMENTED SEEDING FALL 2002
- SAMPLE TRANSECT LINES

NOTES:

1. PHASE 1 BOND RELEASE FOR 93.77 ACRES.
2. BACKFILL, GRADING AND GROWTH MEDIA/TOPSOIL PLACEMENT FOR THE MINE #1 AND MINE #2 AREAS BEGAN IN AUGUST, 2001 AND WERE COMPLETED IN DECEMBER, 2001. GROWTH MEDIA/TOPSOIL PLACEMENT OCCURRED CONCURRENTLY WITH BACKFILLING AND GRADING AS AREAS ACHIEVED FINAL GRADE.
3. BACKFILL, GRADING AND GROWTH MEDIA/TOPSOIL PLACEMENT FOR THE LOADOUT AREA BEGAN IN SEPTEMBER, 2001 AND WERE COMPLETED IN DECEMBER, 2001. GROWTH MEDIA/TOPSOIL PLACEMENT OCCURRED CONCURRENTLY WITH BACKFILLING AND GRADING AS AREAS ACHIEVED FINAL GRADE.
4. ALL EXCESS COAL REFUSE FROM THE MAIN CHANNEL AREA, NOT USED AS BACKFILL, WAS PLACED ON THE REFUSE PILE.
5. TOWNSHIP 15 SOUTH, RANGE 8 EAST.

NORTH

200' 100' 0 200'

FILE: G:\UC779\07\DWG\542200C-AB\ 08-08-03

REGISTERED PROFESSIONAL ENGINEER
No. 189797
LAYNE D. JENSEN
STATE OF UTAH

RAG

REVISION/HISTORY

BY	DATE	DESCRIPTION
LDJ	10-10-03	AS-BUILT
1		
LDJ	02-05-04	RESPOND TO TA COMMENTS
2		
RCK	03-27-07	VEGETATION SAMPLE LOCATIONS ADDED
3		
4		
5		
6		

STARPOINT MINE

AS-BUILT RECLAMATION TOPOGRAPHY AND TREATMENT MAP

SHEET 3

PLATEAU MINING CORPORATION

847 NW HIGHWAY 191 HELPER, UTAH 84526
PHONE: (435) 472-0475

3 OF 3

MAP 542.200c

APPENDIX

(NRCS Information)

United States Department of Agriculture

NRCS
Natural Resources Conservation Service
540 West Price River Drive
Area Office
Price, UT 84501
(435) 637-0041
FAX (435) 637-3146

September 14, 2011

Patrick D. Collins, Ph.D.
Mt. Nebo Scientific, Inc.
Research & Consulting
P.O. Box 337
330 East 400 South, Suite 6
Springville, UT 84663

Dear Mr. Collins:

Following our visit on September 6, 2011 to the four reclamation sites at the Star Point Mine and our visit on September 8, 2011 to the reclamation site in Mudwater Canyon, I was able to summarize my findings in regards to vegetation establishment and soil stability.

Star Point Mine (Site E)
Township 15 South, Range 8 East, Section 16 SWNE

The first site we examined within Site E was on an east aspect and occurs at 8,483 feet in elevation. This site occurs on the Doney-Toze Families Soil Complex (50-90% slopes) and on a Mountain Very Steep Loam (Salina Wildrye) Ecological Site (Soil Survey of Carbon Area Utah, June 1988). On an average year, the site will produce approximately 1,100-1,200 pounds/acre of air-dry herbage. The primary grass species on the site are comprised of Salina wildrye (*Leymus salinus*) and slender wheatgrass (*Elymus trachycaulus*) and the primary shrubs are mountain big sagebrush (*Artemisia tridentate vaseyana*) and mountain snowberry (*Symphoricarpos oreophilus*).

The reclamation area contained a very diverse mixture of grasses, forbs and shrubs with no noxious or invasive species detected. Native tree species were also re-establishing on the site. Some of the species identified included basin wildrye (*Leymus cinereus*), Salina wildrye (*Leymus salinus*), crested wheatgrass (*Agropyron cristatum*), bluebunch wheatgrass (*Pseudoroegneria spicata*), thickspike wheatgrass (*Elymus lanceolatus*), Indian ricegrass (*Achnatherum hymenoides*), yellow sweet clover (*Melilotus officinalis*), Lewis flax (*Linum lewisii*), Palmer's penstemon (*Penstemon palmeri*), curl-leaf mountain mahogany (*Cercocarpus ledifolius*), mountain big sagebrush (*Artemisia tridentate vaseyana*), antelope bitterbrush (*Purshia tridentata*), fringed sage or prairie sagewort (*Artemisia frigida*), rubber rabbitbrush (*Ericameria nauseosa*), mountain snowberry (*Symphoricarpos oreophilus*) and Douglas fir (*Pseudotsuga menziesii*). Overall, the plant species diversity, plant production and plant health and vigor were very good on the site, particularly considering the very rocky structure of the soil surface. All of the plants examined exhibited good seed production, a good indicator of future plant recruitment. Soil stability also appeared to be good overall, as erosion problems were not apparent and vegetative ground cover was persistent throughout a majority of the area. Areas where vegetative cover was not as persistent contained heavy amounts of larger-sized rocks across the soil surface. Vegetative production varied to some degree throughout the entire Site E depending on aspect, slope, soil surface rock content

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and other variables, but vegetative re-establishment was good overall. In my opinion, it is not fair to compare the production of the current vegetative community to the production of the natural ecological site plant community production based on some of the species used in rehabilitation efforts (i.e. basin wildrye). It is apparent that species such as basin wildrye were very well established and produce a much greater amount of annual herbage than the primary, natural species which occur on the ecological site such as Salina wildrye. On those sites adjacent to the reclamation sites, ecological sites appeared to be in overall good condition (healthy stands of Salina wildrye and other perennial grasses and shrubs). Based on my visual estimation, the herbage production throughout Site E averaged approximately 2,000-2,200 pounds/acre.

Star Point Mine (Site E)

Star Point Mine (Site G)
Township 15 South, Range 8 East, Section 16 NWNW

The second site we examined within Site G was on a north aspect and occurs at 8,559 feet in elevation. This site also occurs on the Doney-Toze Families Soil Complex (50-90% slopes) and on a Mountain Very Steep Loam (Salina Wildrye) Ecological Site (Soil Survey of Carbon Area Utah, June 1988). On an average year, the site will produce approximately 1,100-1,200 pounds/acre of air-dry herbage. The primary grass species on the site are comprised of Salina wildrye (*Leymus salinus*) and slender wheatgrass (*Elymus trachycaulus*) and the primary shrubs are mountain big sagebrush (*Artemisia tridentate vaseyana*) and mountain snowberry (*Symphoricarpos oreophilus*).

The vegetation at Site G was similar to that at Site E, although an additional species in northern sweetvetch (*Hedysarum boreale*) was identified. As with Site E, the overall plant species diversity, plant production and plant health and vigor were very good on the sites examined within Site G, particularly considering the very rocky structure of the soil surface. All of the plants examined exhibited good seed production, a good indicator of future plant recruitment.Soil stability also appeared to be good overall, as erosion problems were not apparent and vegetative ground cover was persistent throughout a majority of the area. Again, based on my visual estimation, the herbage production throughout Site G averaged approximately 2,000-2,200 pounds/acre.

Star Point Mine (Site G)

Star Point Mine (Site A)
Township 15 South, Range 8 East, Section 10 SESW

The third site we examined within Site A was on a south aspect and occurs at 7,437 feet in elevation. This particular site was not given a specific soil series classification or ecological site description in the 1988 Soil Survey of Carbon Area, Utah. The site was classified as a "Dumps/Mine" site which considered the area as piles of waste material from coal mines.

The reclamation area contained a very diverse mixture of grasses, forbs and shrubs. Some cheatgrass or downy brome (*Bromus tectorum*) and musk thistle (*Carduus nutans*) were present, but neither species were persistent. Some of the species identified included basin wildrye, salina wildrye, bluebunch wheatgrass, crested wheatgrass, Indian ricegrass, Utah serviceberry (*Amelanchier utahensis*), curl-leaf

mountain mahogany, shadscale (*Atriplex confertifolia*), rubber rabbitbrush, Wyoming big sagebrush (*Artemisia tridentate wyomingensis*), winterfat (*Krascheninnikovia lanata*), four-wing saltbush (*Atriplex canescens*), antelope bitterbrush, elderberry (*Sambucus* sp.), alfalfa (*Medicago sativa*), northern sweetvetch, Lewis flax, Palmer's penstemon, western yarrow (*Achillea millefolium*), fringed sage or prairie sagewort and curlycup gumweed (*Grindelia squarrosa*). Overall, the plant species diversity, plant production and plant health and vigor were very good on the site, particularly considering the very rocky structure of the soil surface. Soil stability also appeared to be good overall, as new erosion problems were not apparent, past erosion indicators were healing and vegetative ground cover was persistent throughout a majority of the area. As the vegetation establishment continues and plant recruitment increases (evident by good plant seed production), the potential for future erosion further decreases. Based on my visual estimation, the herbage production throughout Site A averaged approximately 800-1,000 pounds/acre.

Star Point Mine (Site A)

Star Point Mine (Site B)
Township 15 South, Range 8 East, Section 10 NESW

The fourth and final site we examined within Site B was on a south aspect and occurs at 7,424 feet in elevation and was immediately adjacent to Site A. This site occurs on the Gerst-Strych-Badland Soil Complex (3-50% slopes) and on an Upland Shallow Clay Loam and Upland Stony Loam (Utah Juniper/Pinyon) ecological sites (Soil Survey of Carbon Area Utah, June 1988). On an average year, the

Upland Shallow Clay Loam site will produce approximately 300-400 pounds/acre of air-dry herbage. The primary grass species on the site are comprised of Salina wildrye and Indian ricegrass and the primary shrubs are birchleaf mountain mahogany (*Cercocarpus montanus*) and Utah serviceberry. On an average year, the Upland Stony Loam site will produce approximately 700-800 pounds/acre of air-dry herbage. The primary grass species on the site is comprised of bluebunch wheatgrass and the primary shrubs are black sagebrush (*Artemisia nova*) and birchleaf mountain mahogany. Overall, the plant species diversity, plant production and plant health and vigor were very good on the site, particularly considering the very rocky structure of the soil surface. Soil stability also appeared to be good overall, as new erosion problems were not apparent, past erosion indicators were healing and vegetative ground cover was persistent throughout a majority of the area. As the vegetation establishment continues and plant recruitment increases (evident by good plant seed production), the potential for future erosion further decreases. Based on my visual estimation, the herbage production throughout Site B averaged approximately 1,000-1,200 pounds/acre.

Star Point Mine (Site B)

Star Point Mine (Site B)

Mudwater Canyon
Township 15 South, Range 8 East, Section 8 SWNW

The site we examined was on a northeast aspect and occurs at 8,680 feet in elevation. This site occurs on the Midfork-Comodore-Northorn complex (50-70% slopes) and on a High Mountain Very Steep Loam (Douglas Fir) ecological site. On an average year, the High Mountain Very Steep Loam site will produce approximately 300 pounds/acre of air-dry herbage.

The reclamation area contained a very diverse mixture of grasses, forbs and shrubs. Some Canada thistle (*Cirsium arvense*) was present, but not persistent. Some of the species identified included western wheatgrass (*Pascopyrum smithii*), mountain brome (*Bromus marginatus*), timothy (*Phleum pratense*), intermediate wheatgrass (*Thinopyrum intermedium*), thickspike wheatgrass, orchardgrass (*Dactylis glomerata*), sheep fescue (*Festuca ovina*), Kentucky bluegrass (*Poa pratensis*), western yarrow, Aster (*Aster sp.*), goatsbeard (*Tragopogon* sp.), fleabane (*Erigeron sp.*), wild cabbage (*Caulanthus sp.*), geranium (*Geranium sp.*), strawberry (*Fragaria sp.*), currant (*Ribes spp.*), mountain snowberry, woods rose (*Rosa woodsii*), elderberry (*Sambucus spp.*), raspberry (*Rubus sp.*) and Douglas fir. Overall, the plant species diversity, plant production and plant health and vigor were very good on the site, particularly considering the very rocky structure of the soil surface. All of the plants examined exhibited good seed production, a good indicator of future plant recruitment. Soil stability also appeared to be good overall, as erosion problems were not apparent and vegetative ground cover was persistent

throughout a majority of the area. Areas where vegetative cover was not as persistent contained heavy amounts of larger-sized rocks across the soil surface. Based on my visual estimation, herbage production throughout the site averaged approximately 800-1,000 pounds/acre.

Mudwater Canyon

The Natural Resources Conservation Service provides leadership in a partnership effort to help people conserve, maintain, and improve our natural resources and environment.

An Equal Opportunity Provider and Employer

Mudwater Canyon

If you have any questions or comments, please feel free to contact me at (435) 637-0041, Ext. 120.

Sincerely,

/s/

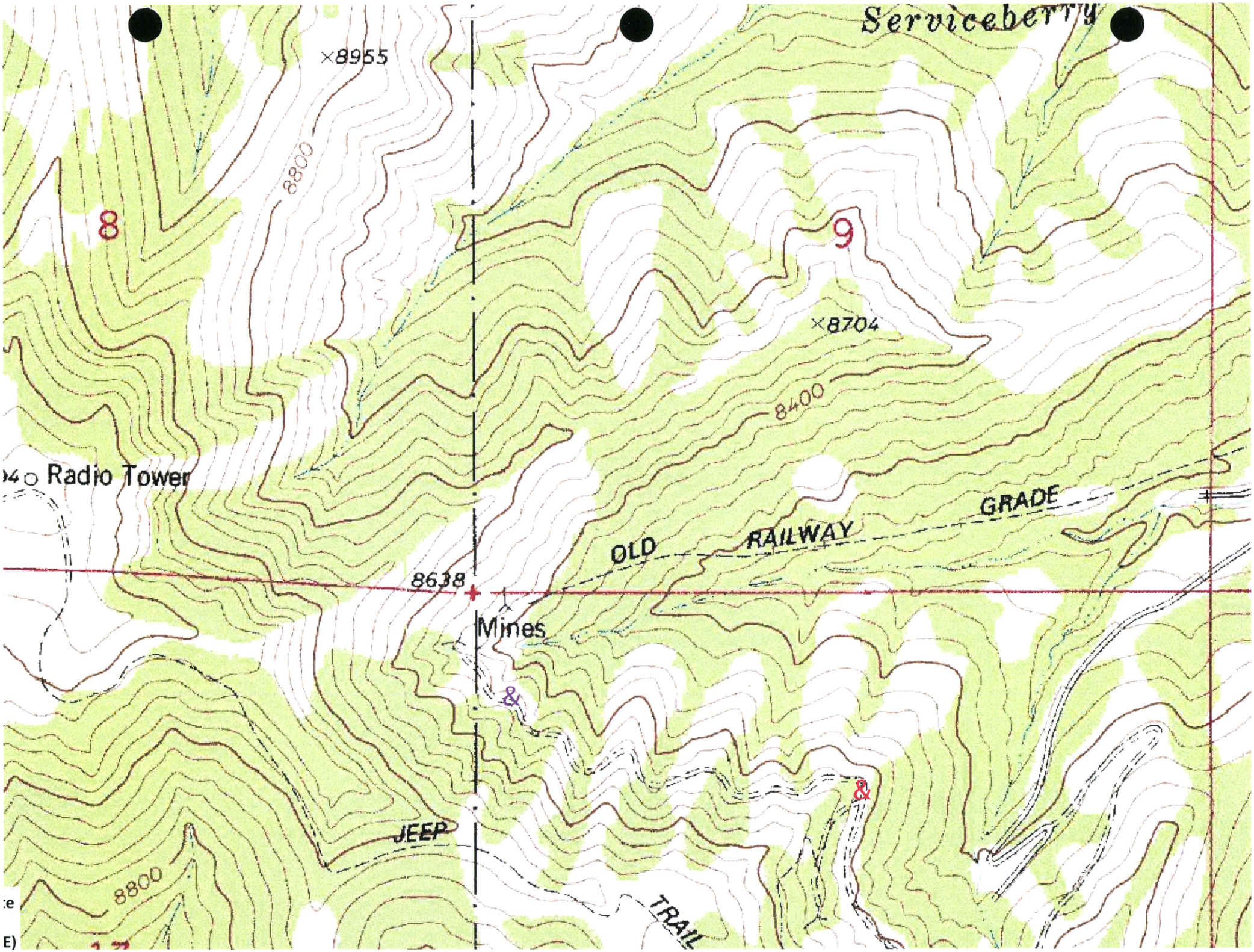
Jeff Fenton
Rangeland Management Specialist
USDA – NRCS
Price, Utah

cc: Barry A. Hamilton
Assistant State Conservationist for Field Operations

Jay Howard
Acting District Conservationist

The Natural Resources Conservation Service provides leadership in a partnership effort to help people conserve, maintain, and improve our natural resources and environment.

An Equal Opportunity Provider and Employer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OLD
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JEEP
TRAIL
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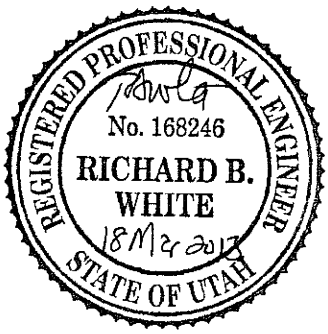
Appendix 2

Sediment Yield Calculations
For Phase III Bond Release
Star Point Mine

Sediment Yield Calculations
Phase III Bond Release Request
Star Point Mine
Plateau Mining Corporation



March 2013

Submitted by

EarthFax Engineering, Inc.
7324 South Union Park Avenue
Midvale, Utah 84047

Sediment Yield Calculations
Post-Reclamation Condition
Star Point Mine
Plateau Mining Corporation

Summary

The Revised Universal Soil Loss Equation (RUSLE) was used to calculate sediment yields from the area of the Star Point Mine under both pre-disturbance and post-reclamation conditions. Details regarding this methodology and the associated references are provided on the following pages. Under the pre-disturbance condition, slopes were taken as 100 feet long. Deep gouging was used in reclaimed areas, thereby limiting the post-reclamation slope length to approximately 3 feet. The changes in sediment yields resulting from revegetation of the site were also accounted for by comparing plant growth in several plots in reclaimed areas to the growth in undisturbed reference areas. The following calculations indicate that, depending on the vegetative community, sediment yields for the reclaimed condition range from 0.1 to 0.5 ton/acre/year, while those from the same areas under the rference areas (assumed to be equivalent to pre-mining conditions) range from 3.8 to 7.9 tons/acre/year. Hence, sediment yields are estimated to be substantially less after reclamation than before the area was disturbed by mining.

Sediment Yield Calculation

Vegetative Community	R	K	LS	C	P	A (t/ac/yr)
Pre-Disturbance						
Sagebrush	18	0.15	21.63	0.135	1	7.9
Mtn Grassland	18	0.15	21.63	0.105	1	6.1
Saltbush	18	0.05	21.63	0.20	1	3.8
Post-Reclamation						
Sagebrush	18	0.15	3.75	0.049	1	0.5
Mtn Grassland	18	0.15	3.75	0.040	1	0.4
Saltbush	18	0.05	3.75	0.041	1	0.1

Notes:

1. A = R K LS C P, where A is the annual sediment yield (tons/acre/year). This is the Revised Universal Soil Loss Equation (RUSLE). Each of the coefficients is explained below.
2. R = Rainfall-Runoff Erosivity Factor (unitless) = 18 from Map 7 (Isrealsen et al., 1984). R is identical for both the pre-disturbed and post-reclamation conditions.
3. K = Soil Erodibility Factor (unitless) = 0.15 for Doney-Toze Families Complex, 0.05 for the Pathead extremely bouldery fine sandy loam, 0.05 for the Cabba family, and 0.05 for the Badland-Rubbleland-Rock outcrop complexas stated in the published NRCS soil survey for this area (Jensen and Borchert, 1988). As a conservative measure, the highest K value (0.15) was used, except at the loadout area, where only the Badland-Rubbleland-Rock outcrop complex is present. Since onsite topsoil was redistributed during reclamation, this value is the same for both the pre-disturbance and post-reclamation conditions.
4. LS = Length-Slope Factor (unitless), taken from the following LS Calculation Table
5. C = Cover Management Factor (unitless), taken from the following Determination of C Factor
6. P = Support Practice Factor (unitless). Since during both the pre-disturbance and reclamation conditions the site is left undisturbed, this factor does not apply. Thus, it was asumed that P=1.

References:

1. Israelsen, C. Earl, Joel E. Fletcher, Frank W. Haws, and Eugene K. Israelsen, 1984. *Erosion and Sedimentation in Utah: A Guide for Control*. Hydraulics and Hydrology Series UWRL/H-84/03. Utah Water Research Laboratory, College of Engineering, Utah State University, Logan, Utah.
2. Jensen, E.H. and J.W. Borchert, 1988. *Soil Survey of Carbon Area, Utah.* U.S. Natural Resources Conservation Service, Salt Lake City, Utah.

LS Calculation Table

Location	s	l	m	LS
Pre-Disturbance (All Vegetative Communities)	57.14	100	0.5	21.63
Post-Reclamation (All Vegetative Communities)	57.14	3	0.5	3.75

Notes:

1. s = slope angle (%). The steepest reclaimed slopes at the site (1.75H:1V) were used as a conservative measure. Since the site is pre-SMCRA, pre-disturbance topography was not available. The same slopes were used for both the pre- and post-reclamation conditions. This is considered conservative since reclamation slopes are often flatter than natural slopes at this site.
2. l = slope length (ft). This value is defined as the distance from the origin of overland flow to the point of deposition or channelized flow. Slope lengths rarely exceed 400 feet, and in this case, the presence of rocks, trees, and roads are conservatively estimated to limit the pre-disturbance slope length to 100 feet. Post-reclamation slope lengths are taken as 3 feet, which is the average distance from the top to the bottom of a deep gouge.
3. m = a factor in the LS equation which is 0.5 for slopes steeper than 5%.
4. $LS = ((65.41s^2/(s^2+10{,}000)) + 4.56s/(s^2+10{,}000)^{0.5} + 0.065) / (l/72.6)^m$ (Israelsen et al., 1984)

References:

1. Israelsen, C. Earl, Joel E. Fletcher, Frank W. Haws, and Eugene K. Israelsen, 1984. *Erosion and Sedimentation in Utah: A Guide for Control*. Hydraulics and Hydrology Series UWRL/H-84/03. Utah Water Research Laboratory, College of Engineering, Utah State University, Logan, Utah.

Determination of C Factor

The cover and management factor (C) was determined using tabulated values provided by Haan et al. (1994). The vegetative cover at the site was taken from Tables 69 through 71 of the revegetation monitoring report for the site performed by Mt. Nebo Scientific, Inc. and dated February 2013. These tables present the percentages of living cover in both reference areas (assumed to be equivalent to pre-disturbance) and reclaimed areas for the three vegetative communities associated with this site. The pertinent data within these tables are shown in the following table. The percent living cover at each area was taken directly from the summary tables. C factors were interpolated linearly from the tables provided by Haan et al. (1994). As a conservative measure, the lowest percent cover (between pre- and post SMCRA sites) was used to determine the C factor for each vegetation type. It was also assumed that no appreciable canopy exists and that the cover at the surface consists of mostly broadleaf herbaceous plants (i.e., canoopy and a surface cover of grass both reduce rainfall impact and the associated C factor). Note that litter was not included in the ground cover calculation, since its presence is implicit in the tabulations provided by Haan et al. (1994). The C values were determined as shown below.

	Reference Area			**Reclamation Area**		
	%Living Cover			%Living Cover		
Vegetative Community	Pre-SMCRA	Post-SMCRA	C	Pre-SMCRA	Post-SMCRA	C
Sagebrush	45.70	45.70	0.135	57.63	64.17	0.049
Mtn Grassland	54.53	54.53	0.105	61.47	62.88	0.040
Saltbush	NA	30.70	0.195	NA	60.90	0.041

References:

1.

2. Haan, C.T., B.J. Barfield, and J.C. Hayes. 1994. Design *Hydrology and Sedimentology for Small Catchments*. Academic Press, San Diego, California.

Appendix 3

Public Notice
For Phase III Bond Release
Star Point Mine

Legal Notice

Published in the Sun Advocate

Plateau Mining Corporation
Star Point Mine
Permit C/007/0006, Renewed 01/28/2012
Phase III Bond Release

Notice is hereby given that Plateau Mining Corporation, P.O. Box 30, Helper, Utah 84526, has filed an application with the Utah Department of Natural Resources, Division of Oil, Gas and Mining pursuant to R645-301-880 for Phase III bond release for the Star Point Mine, Permit C/007/0006. The Phase III bond release applies to the entire permit which includes 87 acres of disturbed and reclaimed land. This bond release application is based on meeting the vegetation and water quality requirements for Phase III reclamation in accordance with the approved reclamation plan pursuant to the Utah Coal Program Regulations.

The reclamation of the Star Point mine began in 2000 and was completed in 2002. Phase I bond release was approved in 2004 and Phase II bond release was approved in 2009.

In accordance with the provision of R645-301-880, of the State of Utah R645 Coal Mining Rules, notice is hereby given that Plateau Mining Corporation is applying for full release of the performance bond posted for this property which is $672,000.

The permit area is located in Carbon and Emery counties, Utah as follows:

<u>Township 14 South, Range 7 East, SLB&M</u>

Section 34:	Lots 3, 4, N1/2SE1/4

<u>Township 15 South, Range 7 East, SLB&M</u>

Section 1:	S1/2
Section 2:	Lots 2 through 7, 10 through 12, SW1/4, W1/2SE1/4, SE1/4SE1/4
Section 3:	Lots 1, 2, 7 through 10, E1/2SE1/4, E1/2W1/2SE1/4
Section 10:	E1/2E1/2, E1/2, E1/2NW1/4NE1/4
Section 11:	All
Section 12:	All
Section 13:	N1/2
Section 14:	All
Section 15:	E1/2E1/2NE1/4, E1/2E1/2SE1/4
Section 22:	E1/2E1/2NE1/4NE1/4, Parts of E1/2SE1/4SE1/4, Parts of E1/2NE1/4SE1/4, Parts of E1/2E1/2SE1/4E1/4
Section 23:	All
Section 25:	W1/2NW1/4
Section 26	N1/2

Section 27: E1/2E1/2NE1/4NE1/4

Township 15 South, Range 8 East SLB&M

Section 5: Lots 4, 5, 12, NW1/4SW1/4
Section 6: Lots 2, 3, 6, 7, 8, 10, 11, 14, E1/2SW1/4, SE1/4
Section 7: All
Section 8: W1/2NW1/4, SW1/4, SE1/4SE1/4, S1/4SW1/4SE1/4
Section 9: SW1/4SW1/4, E1/2SW1/4
Section 10: SW1/4, W1/2SE1/4, SE1/4SE1/4
Section 15: N1/2N1/2
Section 16: All
Section 17: E1/2, NW1/4, NW1/4SW1/4 North of the Right Fork Miller Creek
Section 18: N1/2, N1/2SE1/4, NE1/4SW1/4, N1/2NW1/4SW1/4
Section 20: NE1/4
Section 21: E1/2NW1/4

The permit area is shown on the following U.S. Geological Survey 7.5-minute maps; Wattis and Hiawatha.

The Utah Division of Oil, Gas and Mining will now evaluate the proposal to determine whether it meets all the criteria of the Permanent Program Performance Standards according to the requirements of the Utah Coal Mining Rules.

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

Utah Coal Program
Utah Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
P.O. Box 145801
Salt Lake City, Utah 84114-5801

Closing date for submission of such comments, objections and requests for public hearing or informal conference on the proposal must be submitted by May 16, 2013.

Published in the Sun Advocate March 26, April 2, 9 and 16, 2013.

Legal Notice

Published in the Emery County Progress

Plateau Mining Corporation
Star Point Mine
Permit C/007/0006, Renewed 01/28/2012
Phase III Bond Release

Notice is hereby given that Plateau Mining Corporation, P.O. Box 30, Helper, Utah 84526, has filed an application with the Utah Department of Natural Resources, Division of Oil, Gas and Mining pursuant to R645-301-880 for Phase III bond release for the Star Point Mine, Permit C/007/0006. The Phase III bond release applies to the entire permit which includes 87 acres of disturbed and reclaimed land. This bond release application is based on meeting the vegetation and water quality requirements for Phase III reclamation in accordance with the approved reclamation plan pursuant to the Utah Coal Program Regulations.

The reclamation of the Star Point mine began in 2000 and was completed in 2002. Phase I bond release was approved in 2004 and Phase II bond release was approved in 2009.

In accordance with the provision of R645-301-880, of the State of Utah R645 Coal Mining Rules, notice is hereby given that Plateau Mining Corporation is applying for full release of the performance bond posted for this property which is $672,000.

The permit area is located in Carbon and Emery counties, Utah as follows:

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Section 1:	S1/2
Section 2:	Lots 2 through 7, 10 through 12, SW1/4, W1/2SE1/4, SE1/4SE1/4
Section 3:	Lots 1, 2, 7 through 10, E1/2SE1/4, E1/2W1/2SE1/4
Section 10:	E1/2E1/2, E1/2, E1/2NW1/4NE1/4
Section 11:	All
Section 12:	All
Section 13:	N1/2
Section 14:	All
Section 15:	E1/2E1/2NE1/4, E1/2E1/2SE1/4
Section 22:	E1/2E1/2NE1/4NE1/4, Parts of E1/2SE1/4SE1/4, Parts of E1/2NE1/4SE1/4, Parts of E1/2E1/2SE1/4E1/4
Section 23:	All
Section 25:	W1/2NW1/4
Section 26	N1/2

Section 27: E1/2E1/2NE1/4NE1/4

Township 15 South, Range 8 East SLB&M

Section 5: Lots 4, 5, 12, NW1/4SW1/4
Section 6: Lots 2, 3, 6, 7, 8, 10, 11, 14, E1/2SW1/4, SE1/4
Section 7: All
Section 8: W1/2NW1/4, SW1/4, SE1/4SE1/4, S1/4SW1/4SE1/4
Section 9: SW1/4SW1/4, E1/2SW1/4
Section 10: SW1/4, W1/2SE1/4, SE1/4SE1/4
Section 15: N1/2N1/2
Section 16: All
Section 17: E1/2, NW1/4, NW1/4SW1/4 North of the Right Fork Miller Creek
Section 18: N1/2, N1/2SE1/4, NE1/4SW1/4, N1/2NW1/4SW1/4
Section 20: NE1/4
Section 21: E1/2NW1/4

The permit area is shown on the following U.S. Geological Survey 7.5-minute maps; Wattis and Hiawatha.

The Utah Division of Oil, Gas and Mining will now evaluate the proposal to determine whether it meets all the criteria of the Permanent Program Performance Standards according to the requirements of the Utah Coal Mining Rules.

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

Utah Coal Program
Utah Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
P.O. Box 145801
Salt Lake City, Utah 84114-5801

Closing date for submission of such comments, objections and requests for public hearing or informal conference on the proposal must be submitted by May 16, 2013.

Published in the Emery County Progress March 26, April 2, 9 and 16, 2013.

Appendix 4

Landowner and Government Agency Letters
For Phase III Bond Release
Star Point Mine

Plateau Mining Corporation
Star Point Mine
P.O. Box 30
847 NW HWY 191
Helper, UT 84526
Phone (435) 472-4737

March 25, 2013

HAMAKER MARION R & GLORIA J
11 W 5200 S
PRICE UT 84501

Re: **Notification of Application for Phase III Bond Release, Plateau Mining Corporation, Star Point Mine, C/007/0006, Carbon and Emery Counties County, Utah**

Plateau Mining Corporation has completed Phase III of the approved reclamation plan for the Star Point Mine. This is based on meeting the vegetation and water quality requirements for Phase III reclamation in accordance with the approved reclamation plan.

In accordance with the provisions of R645-301-880 of the State of Utah R645 Coal Mining Rules, this letter will serve as notification that Plateau Mining Corporation intends to file an application with the Utah Division of Oil, Gas and Mining for full release of the performance bond posted for this operation.

The surety bond posted for the Star Point Mine is $672,000 from which Plateau Mining Corporation is seeking full release.

Comments concerning Phase III bond release from the legal or equitable owner of record of the surface areas to be affected and from the Federal, Utah and local government agencies which would have to initiate, implement, approve, or authorize the proposed use of the land following reclamation should be mailed to: Plateau Mining Corporation, Attention: Dennis N. Ware, PO Box 30, 847 NW Highway 191, Helper, Utah 84526.

Plateau Mining Corporation will publish the attached notification of this bond release application in both the Sun Advocate and the Emery County Progress.

If you have any questions or need additional information, please do not hesitate to contact me at (435) 472-0475 or (435) 650-2951.

Sincerely,

Dennis N. Ware
Authorized Agent

Env: Star Point, Permit Actions, Star Point Phase III

List:

Regional Supervisor
Utah Division of Wildlife Resources
319 North Carbonville Road, Suite A
Price, Utah 84501

Area Field Office Manager
MSHA
215 East Main Street
Price, Utah 84501

Office of Surface Mining
P.O. Box 4667
Denver, Colorado 80201-6667

Forest Supervisor
Manti-La Sal Notional Forest
599 West Price River Drive
Price, Utah 84501

Bureau of Land Management
Solid Minerals Group Mgr.
440 West 200 South, Suite 500
Salt Lake City, Utah 84145-0155

Carbon County Commission
120 East Main Street
Price, Utah 84501

Director
School and Institutional Trust Land Administration
675 East 500 South, Suite 500
Salt Lake City, Utah 84102-2818

General Manager
Sunnyside Cogeneration Associates
#1 Power Plant Road
Sunnyside, Utah 84539

Conoco Phillips
3960 E. 56th Avenue,
Commerce City, Colorado 80022

Emery County Commission
P.O. Box 629
Castle Dale, Utah 84513

ANR COMPANY INC
J KINGSTON
3212 S STATE ST
SALT LAKE CITY UT 84115-0000

PETITTI LLC
CATHY SHINER
1723 W 1625 S
PRICE UT 84501

HAMAKER MARION R & GLORIA J
11 W 5200 S
PRICE UT 84501-0000

Appendix 5

Reclamation Certification
For Phase III Bond Release
Star Point Mine

Phase III Bond Release
Plateau Mining Corporation
Star Point Mine
C/007/0006

I herby certify to the best of my information and belief all the information contained in this application for phase III 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.

Dennis N. Ware
Print Name

Authorized Agent
Position

3/27/2013
Signature, Date

Subscribed and sworn to before me this 27th day of March, 2013

Cindy Nielson
Notary Public

My Commission Expires: Oct 2, 2014
Attest: State of Utah
County of Emery

Notary Public
CINDY NIELSON
Commission #600691
My Commission Expires
October 2, 2014
State of Utah

Appendix 6

Bond Release Calculation
For Phase III Bond Release
Star Point Mine

Bond Release Calculation

The current reclamation bond amount for the Star Point Mine is $672,000. Plateau Mining Corporation is requesting Phase III bond release, therefore, the full amount of the bond or $672,000 is requested to be released upon approval of this bond release application.