C/007/0038 Incoming

#4901

PLATEAU MINING CORPORATION

May 21, 2015

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 for a Portion of the Mine, Plateau Mining Corporation, Willow Creek Mine, C/007/0038

Dear Mr. Haddock:

Plateau Mining Corporation is herewith submitting three copies of the Willow Creek Mine Phase III Bond Release Application.

This application includes the C1 and C2 forms as required by the Division as well as replacement pages and new additions to the permit.

I will forward to you the notarized Public Notice to replace the proposed Public Notice in the application once the publication has run for four weeks.

If you have any questions or need additional information, please do not hesitate to contact me.

Sincerely,

Dennis N. Ware
Company Representative

Enclosures

Enviro/PermitActions/WillowCreek/PhaseIIIBondRelease/CoverLetter

RECEIVED
MAY 28 2015
DIV. OF OIL, GAS & MINING

APPLICATION FOR COAL PERMIT PROCESSING

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

Permittee: PLATEAU MINING CORPORATION
Mine: WILLOW CREEK MINE **Permit Number:** C/007/0038
Title: [redacted] PHASE III BOND RELEASE

Description, Include reason for application and timing required to implement:
PHASE II 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	Company Representative	05/11/2015	05-11-15
Print Name	Position	Date	Signature (Right-click above choose certify then have notary sign below)

Subscribed and sworn to before me this 11th day of May, 2015

Notary Public: Ruanne Leeflang, state of Utah.

My commission Expires: 6-30-17
Commission Number: 667709
Address: 25 No. Main
City: Huntington State: Utah Zip: 84537

ss:

Notary Public
RUANNE LEEFLANG
Commission #667709
My Commission Expires
June 30, 2017
State of Utah

For Office Use Only:	Assigned Tracking Number:	Received by Oil, Gas & Mining
		RECEIVED MAY 28 2015 DIV. OF OIL, GAS & MINING

Form DOGM- C1 (Revised December 10, 2007)

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

Permittee: PLATEAU MINING CORPORATION
Mine: WILLOW CREEK MINE **Permit Number:** C/007/0038
Title: [redacted] PHASE III BOND RELEASE

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	VOLUMES 1 AND 4 THROUGH 17, REPLACE "LIST OF EXHIBITS"
☒ Add	☐ Replace	☐ Remove	VOLUME 17, ADD EXHIBIT 25, PARTIAL PHASE III BOND RELEASE
☐ Add	☐ Replace	☐ Remove	
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Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.	Received by Oil, Gas & Mining
	RECEIVED MAY 28 2015 DIV. OF OIL, GAS & MINING

LIST OF EXHIBITS

Field Code Changed

Exhibit No.	Exhibit Title	Location
1	Ownership Information	Volume 4
2	Compliance Information	Volume 4
3	Public Notice and Proof of Publication, Hearing Notices and Documentation	Volume 4
4	Other Permits	Volume 4
5	Soils Information	Volumes 4 & 5
6	Vegetation, Fish, and Wildlife Information	Volume 5
7	Documentation of Existing Site Conditions	Volume 5
8	Deleted October 1999	
9	Geologic Information	Volume 6
10	Hydrologic Information	Volume 6
11	Geotechnical Investigations	Volumes 6 & 7
12	Deleted February 2000	
13	Drainage and Sediment Control Plan	Volumes 7 & 8
14	Willow Creek Realignment Plans	Volume 9
15	Blasting Plan	Volume 9
16	Subsidence Information	Volume 9
17	Bonding and Insurance Information	Volume 9
18	Bibliography	Volume 9
19	Castle Gate Information	Volumes 10 thru 14
20	Crandall Canyon Information	Volumes 15 & 16
21	Deleted October 1999	
22	Barn Canyon Shaft Information (Removed in March 2008)	Volume 16
23	As-Built Reclamation, Willow Creek Mine, Mine Facilities Area	Volume 17
24	Phase II Bond Release	Volume 17
	Partial Phase III Bond Release on 94.21 Acres	Volume 17

Revised: May 2012

Exhibit 25

Phase III Bond Release on a Portion of the Mine
Plateau Mining Corporation
Willow Creek Mine, C/007/0038

Phase III Bond Release on a Portion of the Mine
Plateau Mining Corporation
Willow Creek Mine, C/007/0038
May 2015

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Attachment 4.....Landowner and Government Agency Notification

Attachment 5.....Reclamation Certification

Attachment 6.....Bond Release Calculation

PLATEU MINING CORPORATION

WILLOW CREEK MINE

Permit Number C/007/0038

Phase III Bond Release on a Portion of the Mine

May 2015

Introduction

The Willow Creek Mine is located approximately 4 miles north of Helper, Utah where the Price River and Willow Creek have cut canyons through the western Book Cliffs Coal Field.

Following the permanent cessation of operations in 2001, Plateau Mining Corporation began the reclamation of the Willow Creek Mine. By the fall of 2004 all demolition, earthwork, drainage construction and final seeding was completed on all but 1.17 acres within the disturbed area boundary referred to as the Loadout. In 2005 the demolition of the Loadout was completed and the 0.22 acres of actual disturbance was reshaped and seeded in the spring of 2006.

Plateau Mining Corporation has completed phase III of the approved reclamation plan for 94.21 acres of the 95.40 acres in the disturbed area boundary at Willow Creek Mine leaving 1.19 acres remaining in the permit. This 1.19 acres is that land around the eastern most shaft in Crandall Canyon which was re-disturbed in 2007 and again reclaimed in 2008.

This bond release is based on meeting the vegetation and water quality requirements for phase III reclamation in accordance with the approved reclamation plan. In order to receive phase III bond release the Permittee must demonstrate that, (1) the vegetation on the reclaimed site has been established in accordance with the approved reclamation plan and (2) that no part of the land is contributing suspended solids to the stream flow or runoff outside the permit area in excess or the requirements set by UCA 40-10-17(2) (j) of the Act or by R645-301-751of the rules.

This phase III bond release application includes the year-ten and year-nine vegetation monitoring studies (attachment 1), sediment yield calculations

(attachment 2), public notice (attachment 3), landowner and government agency notification (attachment 4), reclamation certification (attachment 5), and the bond release calculation (attachment 6). Maps showing the disturbed area boundary, the dates of reclamation as well as dates of previous bond release actions can be found in Volume 17, Exhibit 24 of the MRP.

Plateau Mining Corporation is seeking phase III bond release on 94.21 acres in the Willow Creek Permit disturbed area boundary. After this bond release is approved there will remain 1.19 acres in the permit. This remaining 1.19 acres is that land around the eastern most shaft in Crandall Canyon which can be seen on the Crandall Canyon As-Built Reclamation Treatment Areas map in Volume 17, Exhibit 24, Attachment 7 of the MRP. This remaining 1.19 acres was re-disturbed in 2007 and again reclaimed in 2008.

The acres covered in this phase III bond release are broken down as follows: 18.35 acres referred to as the Surface Facilities/Conveyor Corridor, 38.34 acres referred to as the Preparation Plant, Loadout and Refuse Pile, 5.75 acres referred to as Gravel Canyon and 31.77 acres referred to as Crandall Canyon for a total of 94.21 acres. All of these lands/acres received phase II bond release in 2012 (see Exhibit 24 in Volume 17 of the MRP).

There are no remaining sediment control structures (ponds, silt fences, straw bales or diversions) to be removed.

A performance bond in the amount of $489,166 is currently held to ensure that reclamation is accomplished. Following the approval of this phase III bond release the bond will be reduced to $10,452. The bond reduction calculation can be found in attachment 6 of this application.

Vegetation

Vegetation sampling on the reclaimed and reference areas at the Willow Creek Mine was conducted during the growing seasons of 2012 and 2013 as a means to monitor the success of the revegetation and to determine whether or not phase III bond release was warranted. These studies were conducted by Mt. Nebo Scientific, Inc. for all reclaimed acres within the disturbed area boundary. These studies are included in this application as attachment 1.

This vegetation sampling reports presents the methodology and data as required by the mining and reclamation plan. The data show that the revegetation at the Willow Creek Mine met or exceeded all final revegetation success standards.

On page 25 of the 2014 (year-ten) study in the Summary and Conclusion section it states “In conclusion, the 2014 sampling results show that the restored plant communities at the Willow Creek Mine site have met or exceeded all final revegetation success standards. This conclusion, as well as consideration of 2013 findings, suggests that final or Phase III Bond Release at the Willow Creek Mine site may be warranted.”

Sediment Yield

EarthFax Engineering prepared sediment yield calculations for each of the areas where phase III bond release is being sought. The sediment yield calculations used the revised universal soil loss equation (RUSLE) under both pre-disturbance and post-reclamation conditions. The sediment yield calculations show the sediment yield to be substantially less after reclamation than before the area was disturbed by mining. The sediment yield calculations can be found in attachment 2 of this application.

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.

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Attachment 1

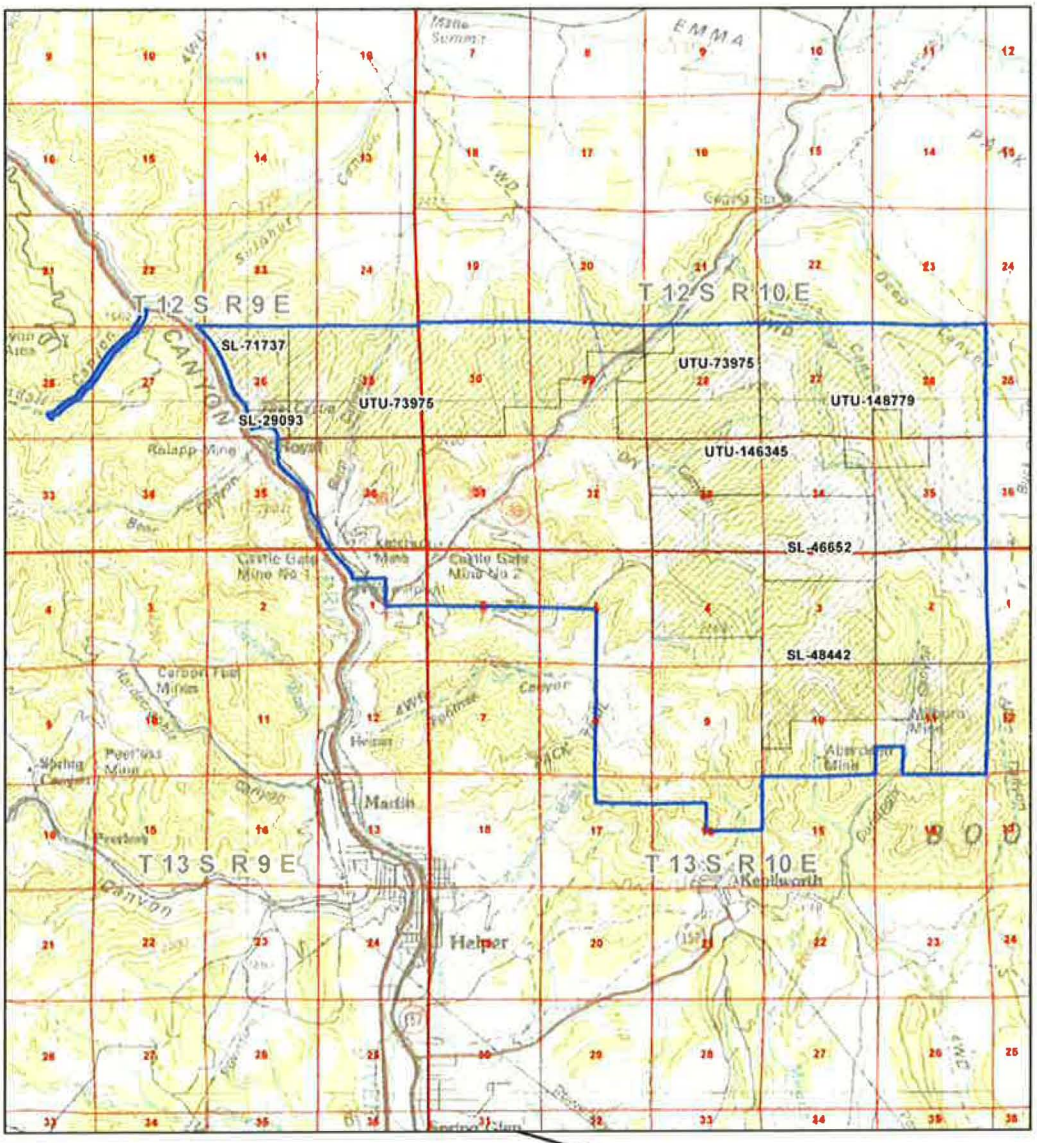
Years Nine and Ten Vegetation Monitoring

Revegetation Monitoring for Phase III Bond Release at the Willow Creek Mine

Year 10: 2014

for

Plateau Mining Corporation



Willow Creek Mine

C0070038
Carbon County, Utah
January 2006

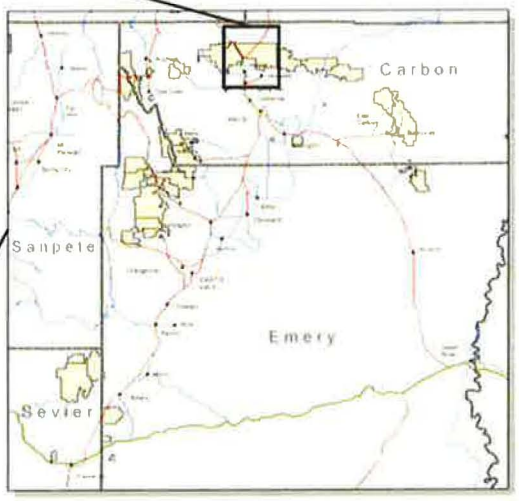
Township 12 South Range 9 & 10 East
Township 13 South Range 9 & 10 East

File N:/gis/coal/coalareamaps/C0070038.pdf

Permit Area
Proposed Mine Plan Modification (if shown)
Federal Lease Areas

0 0.4 0.8 1.6 Miles
1:60,000

State of Utah



Locator Map

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 592
Orangeville, Utah 84537

March 2015

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INTRODUCTION

The Study

The Willow Creek Mine, located in Price Canyon about 3.5 miles northwest of the town of Helper, Utah, ceased coal mining operations in 2000. Subsequently, reclamation began and by 2004, revegetation activities at the site were completed including areas called Gravel Canyon, Refuse Pile, Conveyor Corridor, Loadout, Riparian Bottoms and Crandall Canyon.

Following reclamation activities, mine sites are required to provide enough time to pass for acceptable plant establishment before applications can be made for bond release. This time-frame, called the *Responsibility Period*, prescribes at least 10 years before the mine owner can submit a request for *final* or *Phase III Bond Release* through the State of Utah, Division of Oil, Gas & Mining (DOGM). It has been estimated that this period of time is long enough to determine whether or not adequate re-establishment of the plant communities has occurred on the reclaimed areas to the extent that they have become *diverse, effective, permanent and are capable of self-regeneration and plant succession.*

The restored vegetation of the reclaimed lands must meet specific state and federal requirements. Consequently, beginning in Year 9 of the 10-year time-frame mentioned above, 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 success standards can be prescribed using *reference areas*, or native, undisturbed plant communities chosen beforehand that approximate the mine site before it was disturbed by the mining activities. Using this approach, data are recorded and compared in the reference areas during the same sample period as the reclaimed areas. An alternate method for assigning success standards can be used by recording quantitative data beforehand, and using it as *baseline data* for comparisons with the disturbed areas once they are reclaimed

In 2013, the reclaimed sites were quantitatively sampled to provide vegetation data for year 9 following reclamation. A document was prepared and submitted to report the findings for that sample period. In 2014, the site was again sampled to provide results of the second of

two consecutive years of sampling required prior to submittal of an application for final bond release.

The scope of this report is to provide results from monitoring plant establishment, or to study revegetation success of the reclaimed sites in order to determine whether or not an application for reclamation bond release may soon be warranted. Even though a *separate* report was prepared that provided the 2013 sample results, some of that dataset has been included in this 2014 monitoring report for comparison purposes.

History of Onsite Vegetation Sampling

Vegetation data has been collected and compiled for the Willow Creek Mine since at least 1981. These datasets and methodologies can be challenging to follow, but this document attempts to clarify them. First, there have been ownership and operator changes at the mine site over that time period. Moreover, data collection methodologies have changed over time, and in most cases there are explanations for the changes. The Willow Creek Mining and Reclamation Plan (MRP) explains these changes (MRP Section 3.2.1.2). To begin, the primary vegetation dataset and report that was used for permitting was prepared for the Price River Coal Company. This document was called *"Vegetation Data Report of Price River Coal Company's Mine Area"* (Mariah Associates 1981). In 1988, a modification of this document was used for permitting purposes for the Blackhawk Coal Company at the Willow Creek Mine. Later in 1989, the Castle Gate Coal Company used some of these same datasets for the Willow Creek area with subsequent permitting changes submitted in 1994. Finally, more vegetation work was conducted by the State of Utah, Division of Oil, Gas & Mining (DOGM), Abandoned Mine Reclamation (AMR) program in areas where some sites had been reclaimed. These sites had been disturbed prior to the Surface Mining Control and Reclamation Act of 1977 (SMRCA); the MRP refers to them as the "Reclaimed Areas" and there is no longer a reclamation bond associated with them.

Many changes have been made regarding the vegetation success standards since those early studies. Willow Creek's MRP (Section 3.2.1.2) states that *"given the changes in regulatory requirements which have occurred since much of the data was originally collected*

and subsequent disturbance of many of the areas previously sampled at this location, the original data cannot be used directly to comply with current vegetation baseline requirements". For this and other plant nomenclature problems in the original dataset, the 1981 data were no longer sufficient to meet the state regulations. Accordingly, more vegetation sampling was conducted in 1994-1996 by K.A. Crofts to supplement the early vegetation data; these data can be found in an appendix in Willow Creek Mine's MRP called *"Supplemental Tables of Vegetation Sampling Data: 1994-1996".*

Sample Areas

The terminology used in the MRP for specific sample areas and the methodology criteria applied to sample them have been described below. The following information also drove the sample design and plans made to monitor the reclaimed areas by *Mt. Nebo Scientific, Inc.* in 2013 and 2014.

1. **Disturbed Areas** - This refers to those areas where the plant communities were disturbed pre-SMCRA and were later re-disturbed post-SMCRA by coal mining activities. Because of this, they are regulated differently and have different revegetation success standards for final reclamation from those areas that were not re-disturbed after the Act. Both types of areas at the Willow Creek Mine site, pre-SMCRA and post-SMCRA, have now been reclaimed under appropriate state and federal regulations. The reclaimed *Disturbed Areas* were sampled to provide the 'supplemental data' (1994-96) mentioned above and were again sampled in 2014 using the same methodologies for this report. The Disturbed Areas include the following sites:
    a. Gravel Canyon
    b. Refuse Pile
    c. Conveyor Corridor
    d. Loadout [2]

    "Baseline Data Methods" as per DOGMs *Vegetation Information Guidelines* (1992)[1] were employed to sample these areas. More detail about these methods has been provided in the METHODS section of this report.

[1] Vegetation Information Guidelines (Revised, February 1992). Utah Division of Oil, Gas and Mining, 1596 West North Temple, Suite 1210, Salt Lake City, Utah 84114-5801.

[2] There was some uncertainty where to place this small (<0.25 acre) reclaimed site for revegetation success comparisons.

2. **Reclaimed Areas** - These *Reclaimed Areas* were those areas that were disturbed pre-SMCRA and not re-disturbed by more current mining activities. These areas were later reclaimed by the AML program and are therefore not subject to the monitoring program required by Plateau Mining Corporation. Accordingly, these areas were <u>not</u> required to be sampled in 2013 and 2014.

3. **Riparian Bottoms** - This area was first sampled in 1994 to expand on the 'supplemental data' needed. They did not have the pre-SMCRA designation. Sample methods were different than those used for the *Disturbed Areas* above (more information about this will be described in the METHODS section of this report).

4. **Crandall Canyon** - Crandall Canyon, an area also associated with the Willow Creek Mine, is located on the west side of Price Canyon rather than the east side where the other reclaimed areas are located (see Willow Creek Mine Locator Map included at the beginning this report). Revegetation standards and sampling methods are yet again different than the above-mentioned areas. Again, more details about the methodologies employed will be provided later in this report.

5. **Reference Areas** - Based on the methods employed to monitor revegetation success and the standards that were pre-determined by representatives from the past mine operators and officials from DOGM, *Reference Areas* may or may not be used to determine adequate revegetation success at the Willow Creek Mine. Or in other words, Reference Areas are used as success standards for some of the reclaimed areas, whereas, they are not used in other areas.

   Reference Areas are those sites that were chosen earlier to be sampled following final reclamation. Data from the Reference Areas and specific areas that have been reclaimed are to be compared statistically to determine whether or not successful revegetation has been achieved at the time of *final* or Phase III Bond Release. The "Reference Area Method" has been described in DOGMs *Vegetation Information Guidelines* [1].

   The Reference Areas sampled in association with the Willow Creek Mine's monitoring plan were:

   a. Mountain Brush (MB) Reference Area
   b. Crandall Canyon (SB) Reference Area

The above sample areas have been described in Willow Creek's MRP. Their locations can be found on several maps provided in that document.

METHODS

Methodologies used for vegetation sampling were consistent between years and performed in accordance with the aforementioned guidelines provided by DOGM. For reasons described above, and depending on the sample area, there has been an assortment of methods that have been employed to sample the vegetation at the Willow Creek Mine site. We have attempted to apply sampling methods that have appropriate scientific merit and comply with all state and federal regulations and guidelines, as well as remain consistent with previous sampling methods to make the earlier and current datasets comparable to each other. The vegetation sampling at the mine site for this report was conducted in August 2014.

Transect & Quadrat Placement

Random/regular placement of sample quadrats were designed as an attempt to provide unbiased accuracy of the data compiled. This was accomplished by establishing several transect lines along the entire length of each reclaimed 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 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 in an attempt to adequately address and represent each site as a whole.

Cover, Frequency & Composition

Depending on the sample area and the history of sampling it, cover estimates were made by using two different methods. In some areas ocular methods with meter square quadrats were used; other areas employed the point-intercept method using an inclined metal 10-point frame. Species composition and relative frequencies were also assessed from the cover data. Plant nomenclature follows "A Utah Flora" (Welsh et al. 2008)[3].

Density

Similar to the reasons for employing different sample methods for cover, woody species density measurements also varied depending on the area. These methods were dictated by either community type, previous sampling history, or commitments about methods that were stated in the MRP. In some areas, woody plant numbers were measured using a distance method called the point-quarter technique. In this method, random points were placed on the sample sites and measured 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. In other areas, densities were measured using 1.5 meter x 50.0 meter belt transects. Here, all woody plants were counted inside the belts; the counts were then summarized and converted into the number of individual woody plants per acre.

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[3] Welsh, S.L., N.D. Atwood, S. Goodrich and L.C. Higgins. 2008. A Utah flora. Print Services, Brigham Young University, Provo, UT. 1019 pp.

Biomass Production

Total annual biomass production was estimated by clipping, drying and weighing current annual growth in each sample quadrat. "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 recorded separately, then combined to provide the total annual biomass production estimate.

Similarity & Diversity Indices

In specific areas only, and as specified in Willow Creek's Mining & Reclamation Plan (MRP), Sorensen's Similarity Index (SI) was calculated. The SI formula is shown below.

$$SI = \frac{2C}{A+B} X100$$

where,

SI = Similarity Index
A = Total number of species in community A
B = Total number of species in community B
C = Number of species common to both communities

Additionally, a diversity index has been employed to the reclaimed areas for comparisons to the 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.

Sample Size & Adequacy

Sampling adequacy was calculated using 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 and reported for 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 study area, resulting in more samples taken in larger areas.

Photographs

Color photographs of the sample areas were taken at the time of sampling and a subset of them have been submitted in this report.

Success Standards

The sampling history above describes some of the reasons that certain methodologies were employed in specific sample areas at the Willow Creek Mine site. Often the methods to be

used to monitor a given parameter were dictated by the DOGM protocol that was chosen by representatives from the past mine operators and officials from that agency. Again, for some areas, the "**Reference Area**" protocol as described in DOGM's *Vegetation Information Guidelines* was employed. In other areas, the "**Baseline Information**" protocol was employed (refer to History of Onsite Vegetation Sampling above for more discussion about this).

Summary of Sampling Methods

Below is a list of the protocols, sampling methods employed, and sample sizes for cover, woody species density and productivity of each sample site at the Willow Creek Mine site.

Summary of Vegetation Sample Areas, Protocols, Methods and Sample Sizes (2014)

SAMPLE AREA	PROTOCOL	COVER (sample size)	DENSITY (sample size)	PRODUCTIVITY (sample size)
Gravel Canyon	Baseline	Point-intercept (n=25)	Belt transects (n=10)	Clipped/Wt. (n=10)
Conveyor Corridor	Baseline	Point-intercept (n=50)	Belt transects (n=25)	Clipped/Wt. (n=25)
Refuse Pile	Baseline	Point-intercept (n=80)	Belt transects (n=30)	Clipped/Wt. (n=40)
Loadout	Baseline	Point-intercept (n=2)	Belt transects (n=1)	Clipped/Wt. (n=2)
Riparian Bottoms	Baseline	Ocular (n=30)	Point-quarter (n=30)	n/a
Crandall Canyon Reclaimed Sagebrush	Reference Area	Ocular (n=80)	Point-quarter (n=80)	Clipped/Wt. (n=40)
Crandall Canyon (East) Reclaimed Mtn. Brush	Reference Area	Ocular (n=10)	Point-quarter (n=10)	Clipped/Wt. (n=10)
Crandall Canyon (West) Reclaimed Mtn. Brush	Reference Area	Ocular (n=10)	Point-quarter (n=10)	Clipped/Wt. (n=10)
Mtn. Brush (MB) Reference Area	Reference Area	Ocular (n=40)	Point-quarter (n=40)	Clipped/Wt. (n=40)
Crandall Canyon (SB) Reference Area	Reference Area	Ocular (n=60)	Point-quarter (n=60)	Clipped/Wt. (n=60)

RESULTS

Gravel Canyon

In 2014, quantitative sampling of the vegetation at the reclaimed Gravel Canyon site showed the area to be dominated by bluebunch wheatgrass (*Elymus spicatus*), fourwing saltbush (*Atriplex canescens*), Gt. Basin wildrye (*Elymus cinereus*), big sagebrush (*Artemisia tridentata*) and Palmer penstemon (*Penstemon palmeri*). For a list of all plant species present in the sample quadrats along with their cover and frequency values, refer to Table 1. The total living cover of this reclaimed site was estimated at 57.20% (Table 2-A). Of that living cover, grasses comprised 57.11%, shrubs 25.23% and forbs 20.06% (Table 2-B).

The total woody species density was estimated at 1,835 individuals per acre and was dominated by fourwing saltbush and big sagebrush (Table 3). Total annual biomass production of the site was estimated to be 1,632.33 pounds per acre, with 1,005.84 pounds coming from herbaceous and 626.49 pounds from woody plants (Table 4).

Conveyor Corridor

The reclaimed Conveyor Corridor was dominated by bluebunch wheatgrass, fourwing saltbush, big sagebrush and Western wheatgrass (*Elymus smithii*). For a list of the plant species present in the sample quadrats along with their cover and frequency values, refer to Table 5. The total living cover for this reclaimed site was estimated to be 61.80% (Table 6-A). The composition of the cover by lifeform was 57.82% grasses, 42.56% shrubs and 4.29% forbs (Table 6-B).

Table 7 shows the woody species density in this area consisted of 1,981 individuals per acre with the dominants for this parameter consisting of fourwing saltbush, rubber rabbitbrush (*Chrysothamnus nauseosus*) and big sagebrush. Productivity for the site was estimated at 1,779.10 pounds per acre with 1,226.28 pounds coming from woody plants and 552.82 pounds from herbaceous species (Table 8).

Refuse Pile

Quantitative sampling in the reclaimed Refuse Pile showed that the area was dominated by fourwing saltbush, bluebunch wheatgrass, thickspike wheatgrass (*Elymus lanceolatus*), Gt. Basin wildrye and Palmer penstemon. For a list of all plant species present in the sample quadrats and their cover and frequency values, refer to Table 9. The total living cover of this reclaimed site was estimated at 58.38% (Table 10-A). In that living cover, grasses comprised 57.00%, shrubs 26.13% and forbs 16.87% (Table 10-B).

The total woody species density was estimated at 1,826 individuals per acre and was dominated by fourwing saltbush, rubber rabbitbrush and big sagebrush (Table 11). Total annual biomass production of the site was estimated to be 1,479.88 pounds per acre, with 846.23 pounds coming from herbaceous species and 633.65 pounds from woody plants (Table 12).

Loadout

This was a very small area (less than ¼ acre), but because of its isolated location, it was sampled and reported separately. A very small portion of the reclaimed area is adjacent to the Price River, but the majority of it lies within an upland plant community.

The plant species present in the reclaimed Loadout consisted of thickspike wheatgrass, winterfat (*Ceratoides lanata*), bluestem wheatgrass and Gt. Basin wildrye (Table 13). The total living cover for this reclaimed site was estimated to be 65.00% (Table 14-A). The composition of the cover by lifeform was 71.43% grasses and 28.57% shrubs (Table 14-B).

Table 15 shows the woody species density in this area consisted of 1,835 individuals per acre and included winterfat, narrowleaf cottonwood (*Populus angustifolia*), rubber rabbitbrush and fourwing saltbush). Productivity for the site was estimated at 1,261.75 pounds per acre with 728.14 pounds coming from shrubs and 533.61 pounds from herbaceous species (Table 16).

Riparian Bottoms

The reclaimed Riparian Bottoms was greatly dominated by coyote willow (*Salix exigua*) in both the overstory and understory cover. For a list of the plant species present in the sample quadrats and their cover and frequency values, refer to Table 17.

The total living cover (overstory and understory cover combined) for this reclaimed site was estimated to be 66.50% (Table 18-A). The composition of the understory cover by lifeform was 85.70% shrubs, 11.16% grasses and 3.14% forbs (Table 18-B).

Table 19 shows the woody species density in this area consisted of 6,069 individuals per acre with the dominants here consisting of coyote willow, big sagebrush, Wood's rose (*Rosa woodsii*), rubber rabbitbrush and golden current (*Ribes aureum*). Production was not required as a revegetation success standard for the riparian zone.

Crandall Canyon Sagebrush Areas

Cover values by plant species for the Sagebrush Areas in Crandall Canyon are shown in Table 20. These results indicated that the area was dominated by big sagebrush and curl-leaf mountain-mahogany (*Cercocarpus ledifolius*). The total living cover of the reclaimed site was estimated at 61.06% (Table 21-A). In that living cover, shrubs comprised 51.48%, grasses 36.97% and forbs 11.55% (Table 21-B).

The total woody species density was estimated at 6,756 individuals per acre and was dominated by fourwing saltbush and curl-leaf mountain-mahogany (Table 22). Total annual biomass production of the site was estimated to be 1498.36 pounds per acre, with 850.13 pounds coming from woody and 648.24 pounds from herbaceous plants (Table 23).

Crandall Canyon Mtn. Brush Areas (East)

Two different relatively small areas were reclaimed as the Mountain Brush community type in Crandall Canyon. These areas were disjunct from each other therefore were sampled and recorded separately (the data were later lumped for the statistical comparisons).

Quantitative sampling the reclaimed Mountain Brush (East) site in Crandall Canyon revealed that the area was dominated by Gt. Basin wildrye (*Elymus cinereus*) and big sagebrush (Table 24). The total living cover of this reclaimed community was estimated at 63.50% (Table 25-A). Of the living cover, the composition was comprised of grasses at 58.61%, shrubs were 33.50% and forbs were 7.89% (Table 25-B).

The total woody species density was estimated at 1,230 individuals per acre and consisted of sagebrush, rubber rabbitbrush and narrowleaf cottonwood (Table 26). Total production of the site was estimated to be 1,715.42 pounds per acre, with 1,002.98 pounds coming from herbaceous and 712.44 pounds from woody plants (Table 27).

Crandall Canyon Mountain Brush Areas (West)

The other isolated reclaimed Mountain Brush site that was sampled in Crandall Canyon was located west of the first site. Quantitative sampling at this site showed that the area was dominated by big sagebrush, Gt. Basin wildrye, western wheatgrass and Pacific aster (*Aster chilensis*). For a list of all plant species present in the sample quadrats along with their cover and frequency values, refer to Table 28. The total living cover of this reclaimed site was estimated at 64.50% (Table 29-A). Of that living cover, grasses represented 44.89%, whereas forbs and shrubs were represented at 33.53% and 21.58%, respectively (Table 29-B).

The total woody species density was estimated at 3,601 individuals per acre and consisted of big sagebrush, curl-leaf mountain-mahogany and rubber rabbitbrush (Table 30). Total production of the site was estimated to be 1,326.72 pounds per acre, with 778.11 pounds coming from herbaceous and 548.61 pounds from woody plants (Table 31).

Crandall Canyon Mountain Brush (MB) Reference Area

When DOGM's *Reference Area* protocol was employed, the reclaimed areas were compared to these communities for standards of final revegetation success. The reference area to be compared to the reclaimed mountain brush communities in Crandall Canyon was called the Mountain Brush (MB) Reference Area. This reference area, however, was located near the old Conveyor Corridor at the Willow Creek Mine on the east side of Price Canyon rather than the west side where reclaimed Crandall Canyon sites are located.

Cover and frequency by plant species for this reference area is shown in Table 32. The 2014 sampling results in this area indicated that it was dominated by Salina wildrye by quite a wide margin, but followed by big sagebrush and Indian ricegrass (*Stipa hymenoides*). The tree and shrub species present in this community were Utah Juniper (*Juniperus osteosperma*) and Utah serviceberry (*Amelanchier utahensis*). The total living cover (including overstory and understory cover combined) of this reference area was estimated at 47.63% (Table 32-A). In living understory cover, grasses comprised 73.79%, shrubs 24.58% and forbs 1.63 (Table 32-B).

The total woody species density was estimated at 1,550 individuals per acre and was dominated by big sagebrush, Utah serviceberry, and Utah juniper (Table 34). Total production of the site was estimated to be 803.30 pounds per acre, with 450.20 pounds coming from herbaceous and 353.10 pounds from woody plant species (Table 35).

Crandall Canyon (SB) Reference Area

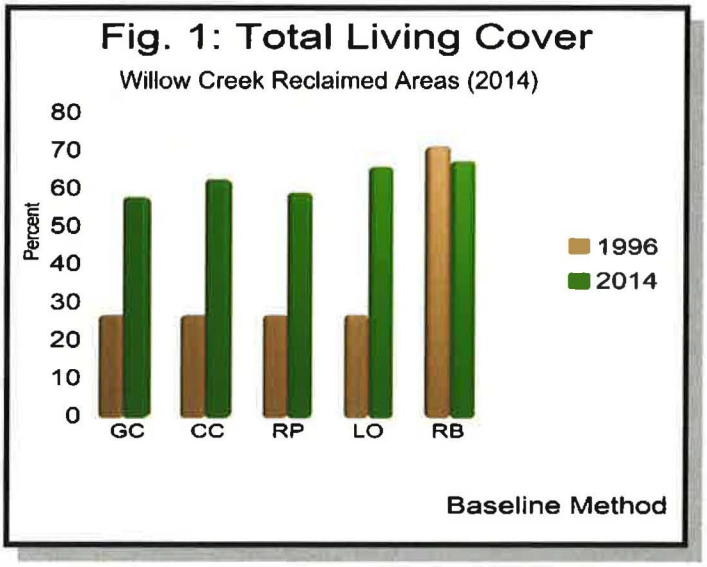
The reference area to be compared to the Reclaimed Sagebrush communities in Crandall Canyon was called the Crandall Canyon (SB) Reference Area. Like the above reference area, this area was located at the Willow Creek Mine on the east side of Price Canyon rather than the west side where the reclaimed sites of Crandall Canyon were located. The locations of the two reference areas, the Crandall Canyon Mountain Brush (MB) Reference Area and the Crandall Canyon (SB) Reference Area, are shown on maps in the Willow Creek Mine MRP, but a general locator map of the permit area (prepared by DOGM) shows the location of Crandall Canyon. This map was provided at the beginning of this report.

Cover and frequency by plant species for this reference area are shown in Table 36. In 2014, this reference area was dominated by Salina wildrye and big sagebrush by quite a wide margin. The total living cover of this reference area was estimated at 49.25% (Table 37-A). In that living cover, grasses comprised 57.47%, shrubs 40.48% and forbs 2.05% (Table 37-B).

The total woody species density was estimated at 1,160 individuals per acre and was dominated greatly by big sagebrush (Table 38). Total production of the site was estimated to be 952.39 pounds per acre, with 533.59 pounds coming from woody and 418.80 pounds from herbaceous plants (Table 39).

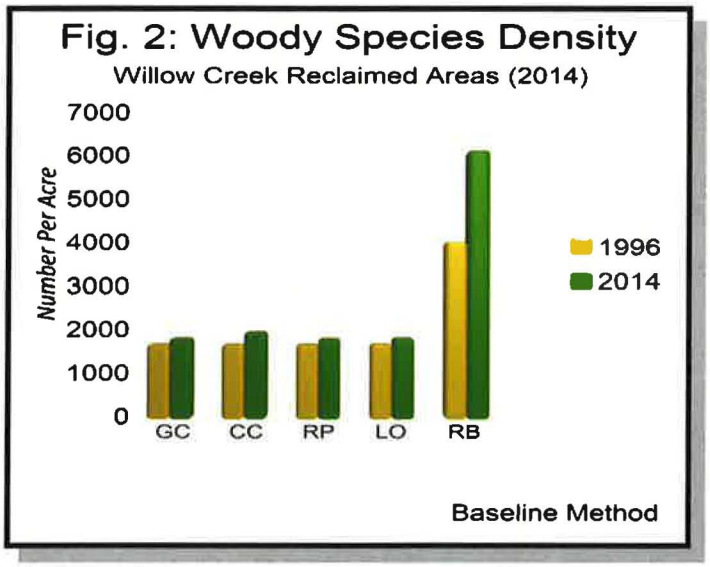
Comparisons Between Reclaimed Areas

Like the 2013 datasets provided in a report prepared for that year, the 2014 datasets were first summarized separately to show the similarities and differences between sample areas. This design enables the reviewer to observe the successes (or failures) of individual reclaimed areas. The following section provides graphical representations of the parameters for each reclaimed area and compares them to the success standards.



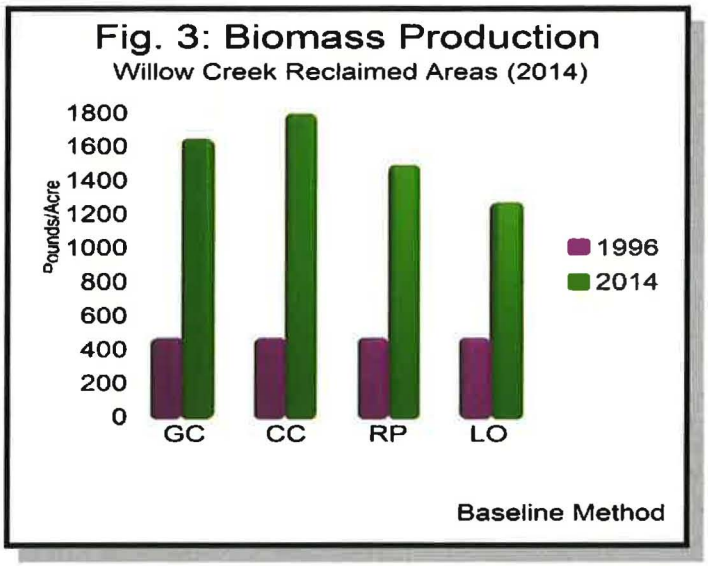
GC = Gravel Canyon; CC = Conveyor Corridor; RP = Refuse Pile; LO = Loadout; RB = Riparian Bottoms

Willow Creek Mine Areas - The "Disturbed Areas" at the Willow Creek Mine site are comprised of reclaimed areas including: 1) Gravel Canyon, 2) Conveyor Corridor, 3) Refuse Pile and 4) Loadout. The reclaimed Riparian Bottoms have also been included in the Willow Creek monitoring regime. Because the protocol for revegetation success standards here employed the *Baseline Method*, comparisons were made between fixed success standards [or baseline datasets (1994-96)] and current datasets (2014). Fig. 1 illustrates that the total living cover values of the current dataset were almost all greater than that of the baseline data (only slightly lower in the Riparian Bottoms). The woody species density values of the these same areas were also greater in the current dataset when compared to the baseline standards (Fig. 2). Finally, total annual biomass production of the Disturbed



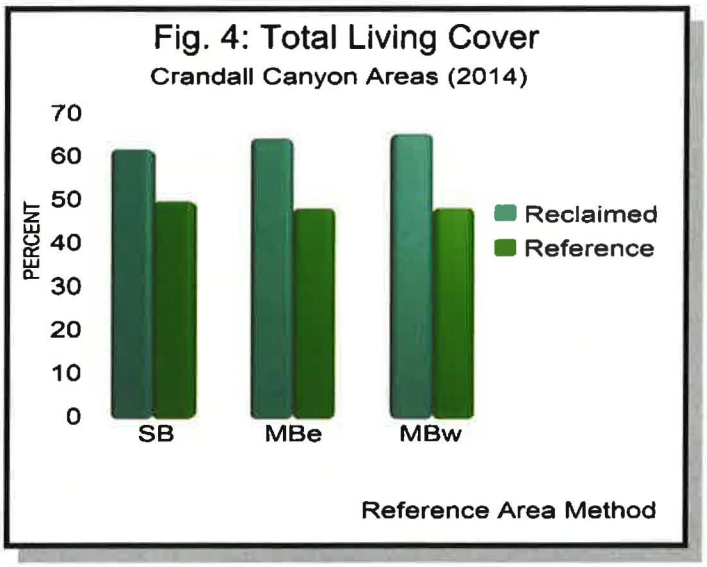
GC = Gravel Canyon; CC = Conveyor Corridor; RP = Refuse Pile; LO = Loadout; RB = Riparian Bottoms

Areas were also compared graphically (Fig. 3). The current productivity estimates greatly exceeded those shown in the baseline dataset.



GC = Gravel Canyon; CC = Conveyor Corridor;
RP = Refuse Pile; LO = Loadout

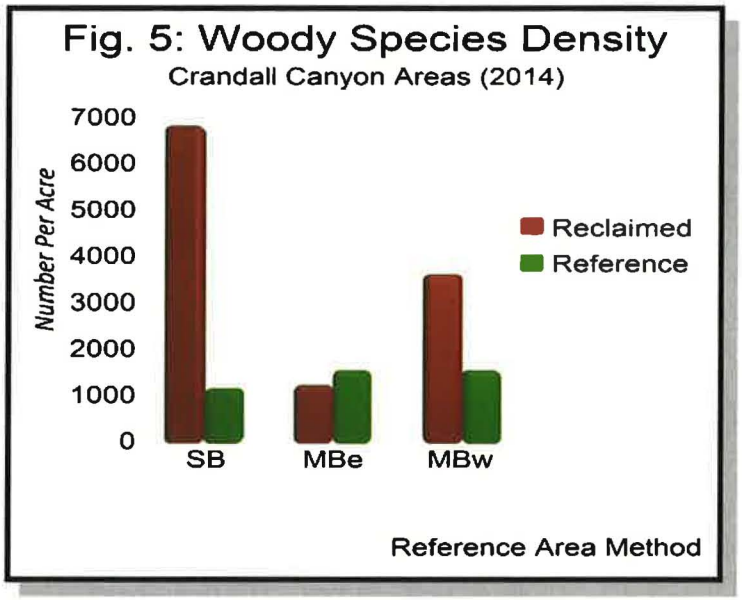
Crandall Canyon Areas - The reclaimed areas in Crandall Canyon consist of: 1) Sagebrush Areas, 2) Mountain Brush Areas (East), and 3) Mountain Brush Areas (West). The protocol to measure revegetation success in these areas employed the *Reference Area* method. This method uses pre-determined reference areas, or undisturbed plant communities chosen to represent future revegetation success standards. Two reference areas were chosen to be compared with the reclaimed areas of Crandall Canyon including 1) Mountain Brush (MB) Reference Area and 2) Crandall Canyon (SB) Reference Area. Graphic illustrations comparing the <u>total living cover</u> of the reclaimed areas in Crandall Canyon with their respective reference areas show that the reclaimed areas have exceeded their success standard (Fig. 4). In most cases,



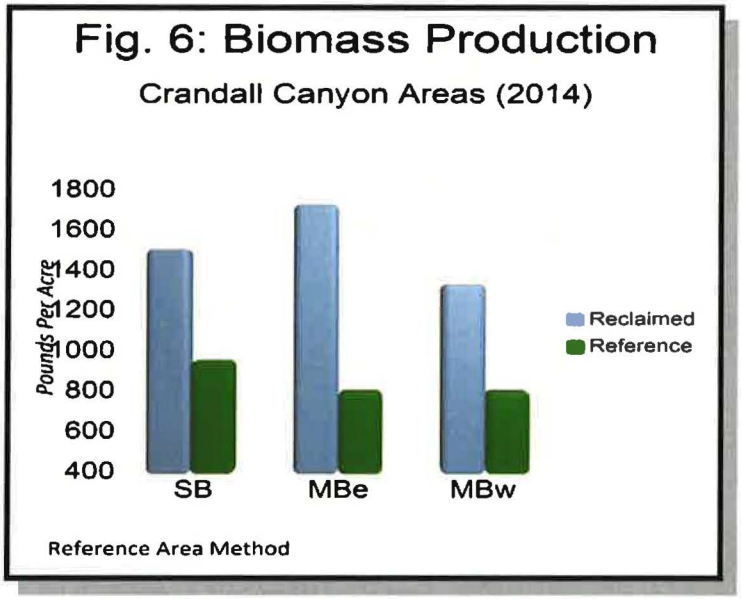
SB = Sagebrush; MBe = Mtn. Brush (east); MBw = Mtn. Brush (west)

woody species density values of the reclaimed sites in Crandall Canyon exceeded those of the reference area (Fig. 5).

Annual biomass production was again higher in the reclaimed areas when compared to the reference areas (Fig. 6).

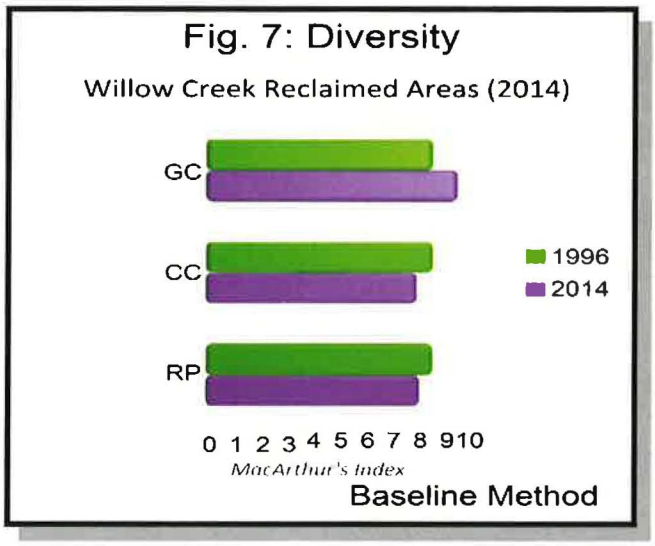


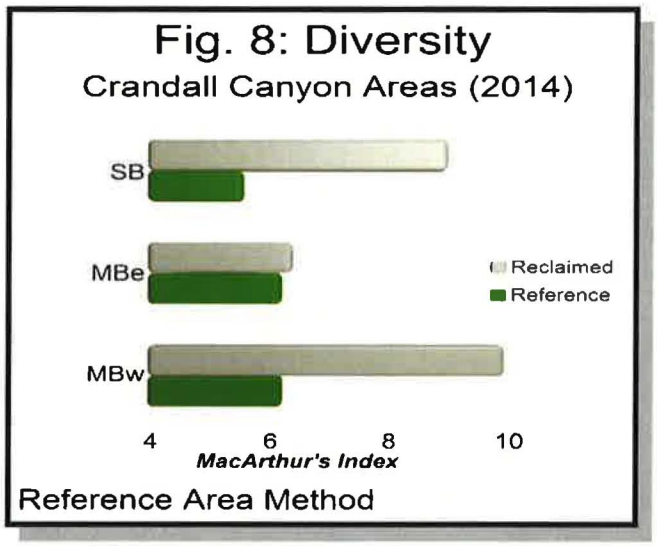
As prescribed in the MRP, Sorenson's Similarity Index was applied to the Willow Creek reclaimed sites. Accordingly, the similarity between the reclaimed areas (2014 data) and the success standards (1994-96 data) was calculated. The similarity value was measured at 31.11% – not a high value. This similarity value was close to what it was in the 2013 dataset, however, this index only takes into consideration the number of species the two datasets have in common. It does not consider whether or not the species present were "desirable" or compatible with the post-mining land use. In other words, the two datasets may have different plant species, but both may be appropriate for a successful revegetated plant community. That said, perhaps a more meaningful parameter to consider may be community diversity. Consequently, MacArthur's Index was employed for total diversity comparisons.



SB = Sagebrush; MBe = Mtn. Brush (east); MBw = Mtn. Brush (west)

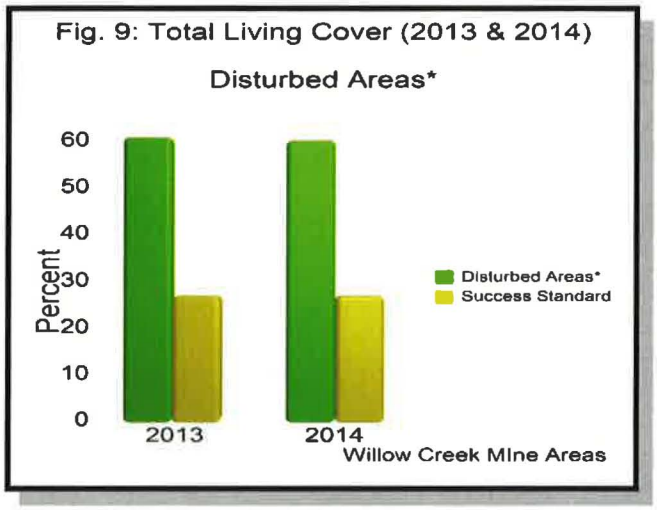
For the Willow Creek sites, the 1994-96 and 2014 data were close (Fig. 7). In Crandall Canyon, all reclaimed areas were more diverse than their respective reference areas (Fig. 8).



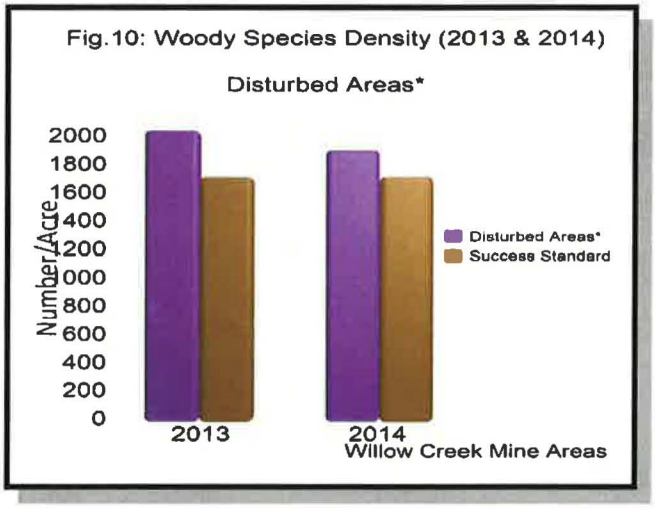


Comparisons Between Years

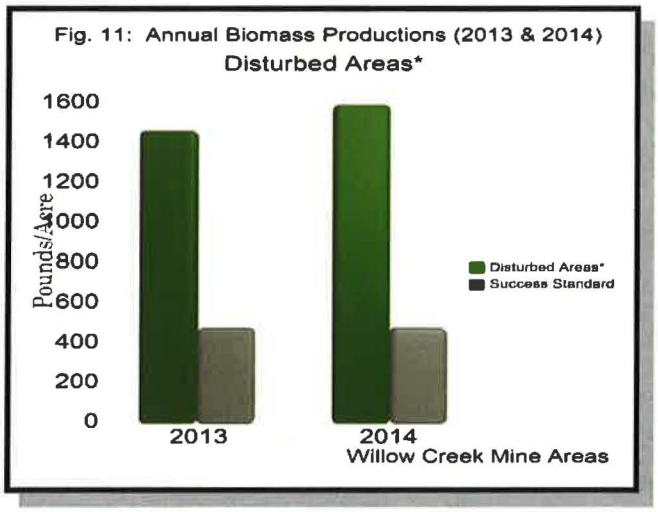
Although the scope of this report was to show the findings of the 2014 vegetation sampling for the second of the two consecutive sample years required for Phase III Bond Release (as mentioned, a report was previously submitted for the 2013 sample year), two-year comparisons of the primary parameters used for comparisons with the reference area has been shown graphically below (Figs 9-16).



* Disturbed Areas: Gravel Canyon; Conveyor Corridor; Refuse Pile, Loadout



* Disturbed Areas: Gravel Canyon; Conveyor Corridor; Refuse Pile, Loadout



* Disturbed Areas: Gravel Canyon; Conveyor Corridor; Refuse Pile, Loadout

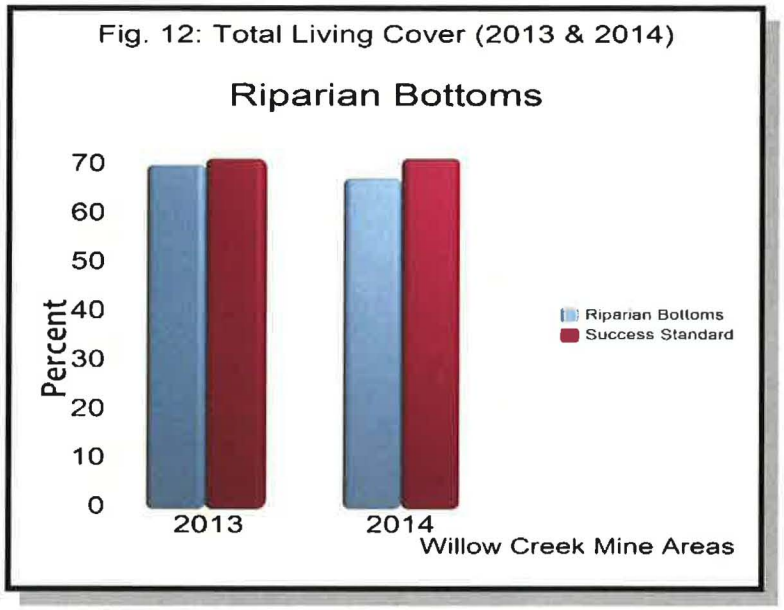


Fig. 12: Total Living Cover (2013 & 2014)
Riparian Bottoms
70
60
50
40
30
20
10
0
Percent
2013
2014
Willow Creek Mine Areas
Riparian Bottoms
Success Standard

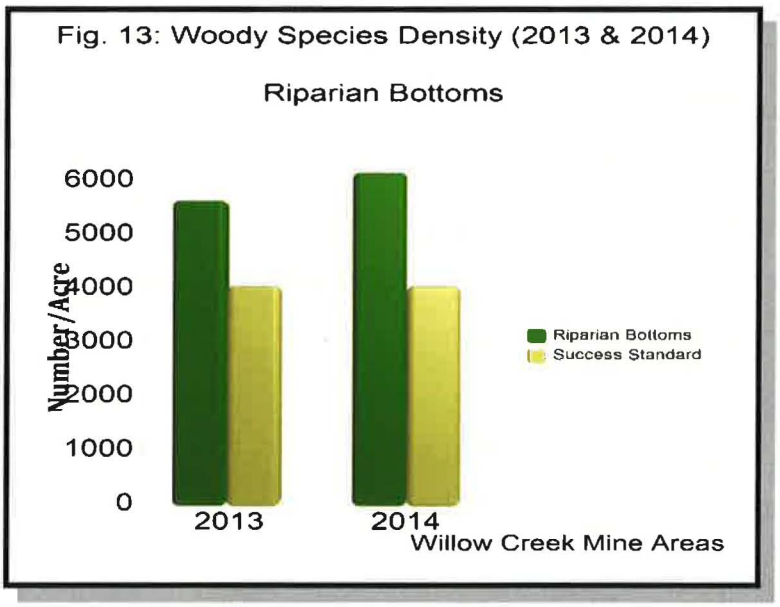


Fig. 13: Woody Species Density (2013 & 2014)
Riparian Bottoms
6000
5000
4000
3000
2000
1000
0
Number/Acre
2013
2014
Willow Creek Mine Areas
Riparian Bottoms
Success Standard

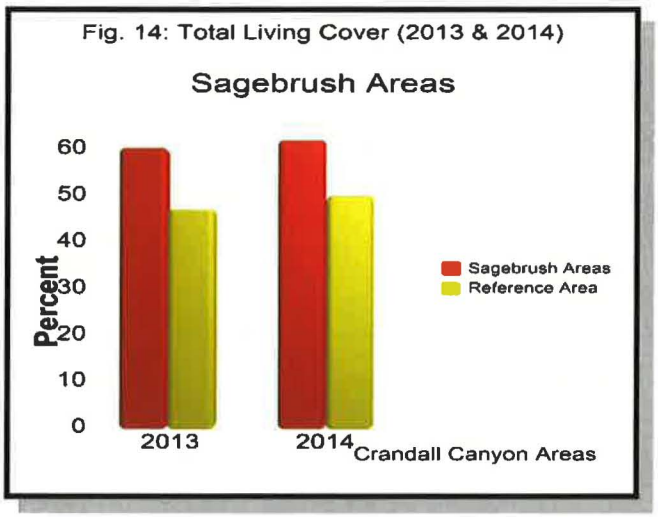


Fig. 14: Total Living Cover (2013 & 2014)
Sagebrush Areas
Percent
60
50
40
30
20
10
0
2013
2014
Crandall Canyon Areas
Sagebrush Areas
Reference Area

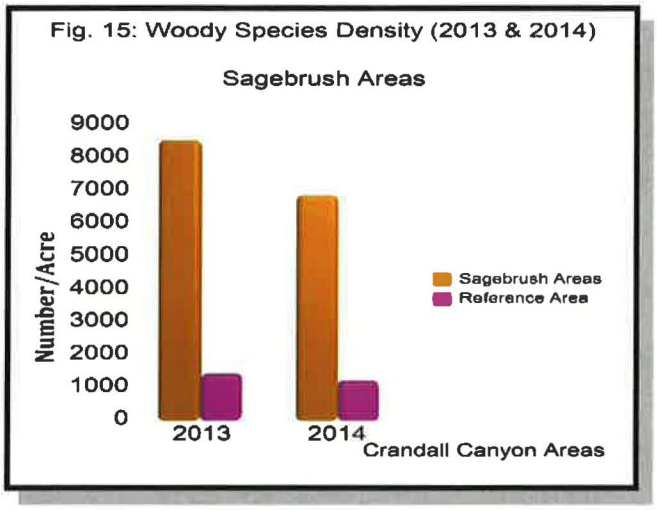


Fig. 15: Woody Species Density (2013 & 2014)
Sagebrush Areas
Number/Acre
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
2013
2014
Crandall Canyon Areas
Sagebrush Areas
Reference Area

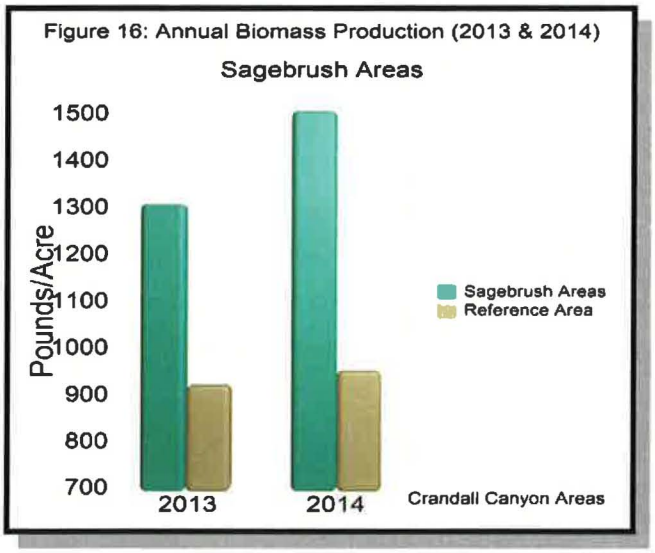


Figure 16: Annual Biomass Production (2013 & 2014)
Sagebrush Areas
Pounds/Acre
1500
1400
1300
1200
1100
1000
900
800
700
2013
2014
Crandall Canyon Areas
Sagebrush Areas
Reference Area

Statistical Comparisons

This section provides statistical comparisons of the fundamental parameters (those suggested by state and federal regulations) with the revegetation success standards that are provided by reference areas or baseline datasets. The like-reclaimed areas that are to be compared with the success standards (whether from a fixed standard or a reference area standard) have been "lumped" together for the analyses. In other words, because some of the reclaimed areas of Willow Creek Mine site such as Gravel Canyon, Conveyor Corridor, Refuse Pile and Loadout areas have the same standards for revegetation success, and have been reclaimed to the same plant community, they have been lumped together for the statistical analyses. Results of the lumped data are shown on Tables 40-45.

Fig. 17: Statistical Analyses - Student's t-tests comparing **total living cover** of the reclaimed areas and success standards (2014).

A. WILLOW CREEK MINE AREA

Disturbed Areas*: $\bar{x}$=59.36; s=9.82; n=157
Standard (1996): $\bar{x}$=26.72; s=6.68; n=25
t =16.0200; df =180; SL= p<0.01
nMIN
80%± 0.10 = 10 samples
90%± 0.10 = 16 samples

Riparian Bottoms: $\bar{x}$=66.50; s=5.94; n=30
Standard (1996): $\bar{x}$=70.43; s=14.41; n=21
t =1.3439 ; df =49; SL= NS

B. CRANDALL CANYON AREA

Sagebrush Areas: $\bar{x}$=61.06; s=9.70; n=80
Reference Area: $\bar{x}$=49.25; s=10.03; n=60
t =7.6658 ; df =138; SL= p<0.01

Mountain Brush Areas**: $\bar{x}$=64.00; s=8.75; n=20
Reference Area: $\bar{x}$=47.63; s=8.73; n=40
t =6.8419 ; df =58; SL= p<0.01

* Disturbed Areas = Reclaimed Gravel Canyon, Conveyor Corridor, Refuse Pile and Loadout (lumped)
** Mountain Brush Areas = Reclaimed Mountain Brush East & West (lumped)
$\bar{x}$ = 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
nMIN = sample adequacy

Willow Creek Mine Area - In Willow Creek Mine area the total living cover value for the "Reclaimed Areas" (Gravel Canyon, Conveyor Corridor, Refuse Pile and Loadout) was significantly greater statistically than the revegetation success standards; the Riparian Bottom was not significantly different

(Fig. 17-A). Next, the woody species densities for those same areas were greater (Fig. 18-A). Lastly, total annual biomass production estimates shown on Fig. 19-A were significantly greater in the reclaimed sites when compared to the standards (production was not required for the Riparian Bottoms).

Crandall Canyon Area - In the Crandall Canyon area the total living cover of the reclaimed Sagebrush Areas was significantly greater than the reference area standard (Fig. 17-B). The same was true for the results in cover of the reclaimed Mountain Brush Areas (East & West). For woody species densities, the statistical analyses suggest that Sagebrush Areas had a greater density value (Fig. 18-B). Although the reclaimed Mountain Brush sites were somewhat higher than the reference area, the difference was not significant statistically (Fig. 18-B). Finally, total annual biomass production of all reclaimed sites in Crandall Canyon were significantly greater than the reference area (Fig. 19-B).

Fig. 18: Statistical Analyses - Student's t-tests comparing **woody species density** of the reclaimed areas and success standards (2014).

A. WILLOW CREEK MINE AREA

Disturbed Areas*: $\bar{x}$=1886.06; s=391.85; n=61
Standard (1996): $\bar{x}$=1700.00; s=n/a; n=n/a
t = n/a (fixed standard)

Riparian Bottoms: $\bar{x}$=6068.60; s=1799.80; n=30
Standard (1996): $\bar{x}$=4000.00; s=n/a; n=n/a
t = n/a (fixed standard)

B. CRANDALL CANYON AREA

Sagebrush Areas: $\bar{x}$=6755.92; s=3410.40; n=80
Reference Area: $\bar{x}$=1160.08; s=488.00; n=60
t =12.6022; df =138; SL= p<0.01

Mountain Brush Areas**: $\bar{x}$=1925.16; s=2636.72; n=20
Reference Area: $\bar{x}$=1549.77; s=457.34; n=40
t =0.8815 ; df =58; SL= NS

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* Disturbed Areas = Reclaimed Gravel Canyon, Conveyor Corridor, Refuse Pile and Loadout (lumped)
** Mountain Brush Areas = Reclaimed Mountain Brush East & West (lumped)
$\bar{x}$= 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

Fig. 19: Statistical Analyses - Student's t-tests comparing **annual biomass production** of the reclaimed areas and success standards (2014).

A. WILLOW CREEK MINE AREA

Disturbed Areas*: $\bar{x}$=1570.76; s=503.61; n=77
Standard (1996): $\bar{x}$=472; s=n/a; n=n/a
t = n/a; (fixed standard from baseline data)

Riparian Bottoms: $\bar{x}$=n/a; s=n/a; n=n/a
Standard (1996): $\bar{x}$=n/a; s=n/a; n=n/a
t = n/a (no production required)

B. CRANDALL CANYON AREA

Sagebrush Areas: $\bar{x}$=1498.36; s=372.05; n=40
Reference Area: $\bar{x}$=952.39; s=244.22; n=60
t =8.8668 df =98; SL= p<0.01

Mountain Brush Areas**: $\bar{x}$=1521.07; s=386.17; n=20
Reference Area: $\bar{x}$=803.30; s=192.79; n=40
t =9.6449 ; df =58; SL= p<0.01

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* Disturbed Areas = Reclaimed Gravel Canyon, Conveyor Corridor, Refuse Pile and Loadout (lumped))
** Mountain Brush Areas = Reclaimed Mountain Brush East & West (lumped)
$\bar{x}$= 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

SUMMARY & CONCLUSIONS

Willow Creek Mine ceased coal mining operations in the year 2000. Subsequently, reclamation began and by 2004, revegetation activities at the site were completed. Following reclamation activities, mine sites must allow enough time to pass for acceptable plant establishment before applications can be made for *final* or *Phase III Bond Release* through the State of Utah, Division of Oil, Gas & Mining (DOGM). Consequently, beginning in year 9 of the 10-year *responsibility 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. This sampling began in 2013 and was completed in 2014 for the Willow Creek Mine site. Although some data from the 2013 sampling were included in this report to facilitate comparisons between years, the complete datasets and results for that year were provided in an earlier report. This report provides the findings for the sampling conducted in 2014.

Reclaimed areas were sampled and reported separately at first. The *separated data* show the differences between each study site as well as comparisons with the reference areas. The summary tables also show additional information for individual sites including lifeform composition, frequency, species presence and diversity, as well as the more fundamental parameters such as total living cover, density and annual biomass productivity. For the fundamental parameters, analogous datasets were lumped to be compared statistically with their respective reference areas.

The parameters from quantitative sampling included: cover by species, total living cover, species composition, woody species density, annual biomass production, similarity and diversity. Although all these parameters can be compared, the primary parameters that were compared statistically with the revegetation success standards were: total living cover, woody species density and annual biomass productivity. The statistical analyses suggested *all reclaimed areas were equal to, or greater than the revegetation success standards.* Furthermore, diversity, plant species presence and composition all compared positively with the success standards.

In conclusion, the 2014 sampling results show that the restored plant communities at the Willow Creek Mine site have met or exceeded all final revegetation success standards. This conclusion, as well as consideration of 2013 findings, suggests that *final* or *Phase III Bond Release* at the Willow Creek Mine site may be warranted.

DATA SUMMARY TABLES

Table 1: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2014).

Gravel Canyon			n=25
SHRUBS	**Mean Percent**	**Standard Deviation**	**Percent Frequency**
Artemisia tridentata	4.80	9.43	24.00
Atriplex canescens	7.60	15.04	24.00
Chrysothamnus nauseosus	2.00	6.93	8.00
FORBS			
Achillea millefolium	3.20	5.46	28.00
Artemisia dracunculus	0.40	1.96	4.00
Aster chilensis	1.20	5.88	4.00
Linum lewisii	1.20	3.25	12.00
Penstemon palmeri	4.80	6.40	40.00
GRASSES			
Elymus cinereus	6.80	8.35	48.00
Elymus lanceolatus	4.00	6.32	32.00
Elymus smithii	2.40	5.85	16.00
Elymus spicatus	18.80	14.78	76.00

Table 2: Willow Creek Mine Area. Total Cover and Composition (2014).

Gravel Canyon		n=25*
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Total Living Cover	57.20	11.50
Litter	12.80	4.49
Bareground	14.80	7.55
Rock	15.20	7.55
B. % COMPOSITION		
Shrubs	25.23	27.36
Forbs	20.06	20.50
Grasses	57.11	24.75
* SAMPLE ADEQUACY (nMIN) (calculated for the "lumped" dataset)		

Table 3: Willow Creek Mine Area.
Woody Species Density (2014).

Gravel Canyon	n=10*
SPECIES	**Individuals Per Acre**
Artemisia tridentata	760.80
Atriplex canescens	836.34
Ceratoides lanata	10.79
Chrysothamnus nauseosus	161.87
Ephedra viridis	5.40
Symphoricarpos oreophilus	59.35
TOTAL	**1834.56**

* SAMPLE ADEQUACY (nMIN)
(calculated for the "lumped" dataset)

Table 4: Willow Creek Mine Area. Annual Production (2014).

Gravel Canyon		n=10*
	Pounds/Acre	
LIFEFORM	Mean	Std. Dev.
Herbaceous	1005.84	752.09
Woody	626.49	982.29
TOTAL	**1632.33**	**519.83**

* SAMPLE ADEQUACY (nMIN)
(calculated for the "lumped" dataset)

Table 5: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2014).

Reclaimed Conveyor Corridor			n=50
SHRUBS	**Mean Percent**	**Standard Deviation**	**Percent Frequency**
Artemisia nova	0.40	2.80	2.00
Artemisia tridentata	6.80	14.62	22.00
Atriplex canescens	10.20	15.03	38.00
Bassia prostrata	0.40	2.80	2.00
Ceratoides lanata	2.60	8.44	10.00
Chrysothamnus nauseosus	4.20	10.79	16.00
Suaeda torreyana	0.20	1.40	2.00
FORBS			
Achillea millefolium	1.20	3.82	10.00
Halogeton glomeratus	0.00	0.00	0.00
Penstemon palmeri	1.60	5.04	10.00
GRASSES			
Bromus carinatus	1.00	4.12	6.00
Bromus tectorum	0.80	3.37	6.00
Elymus cinereus	1.20	4.31	8.00
Elymus lanceolatus	5.00	7.81	32.00
Elymus smithii	5.80	10.22	28.00
Elymus spicatus	19.00	17.80	68.00
Stipa hymenoides	1.40	5.66	6.00

Table 6: Willow Creek Mine Area. Total Cover and Composition (2014).

Reclaimed Conveyor Corridor		n=50*
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Total Living Cover	61.80	7.92
Litter	12.20	4.14
Bareground	11.80	3.84
Rock	14.20	6.35
B. % COMPOSITION		
Shrubs	42.56	29.82
Forbs	4.29	10.90
Grasses	57.82	33.54
* SAMPLE ADEQUACY (nMIN) (calculated for the "lumped" dataset)		

Table 7: Willow Creek Mine Area.
Woody Species Density (2014).

Reclaimed Conveyor Corridor	n=25*
SPECIES	**Individuals Per Acre**
Artemisia tridentata	418.71
Atriplex canescens	807.21
Ceratoides lanata	43.17
Suaeda torreyana	10.79
Chrysothamnus nauseosus	682.02
Ephedra viridis	17.27
Symphoricarpos oreophilus	2.16
TOTAL	**1981.32**

* SAMPLE ADEQUACY (nMIN)
(calculated for the "lumped" dataset)

Table 8: Willow Creek Mine Area. Annual Production (2014).
Reclaimed Conveyor Corridor

n=25*

	Pounds/Acre	
LIFEFORM	Mean	Std. Dev.
Herbaceous	552.82	697.75
Woody	1226.28	1092.14
TOTAL	**1779.10**	**569.04**

* SAMPLE ADEQUACY (nMIN)
(calculated for the "lumped" dataset)

Table 9: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2014).

Reclaimed Refuse Pile			n=80
SHRUBS	**Mean Percent**	**Standard Deviation**	**Percent Frequency**
Atriplex canescens	12.38	16.07	45.00
Artemisia tridentata	1.38	5.42	6.25
Ceratoides lanata	0.88	4.53	3.75
Chrysothamnus nauseosus	0.75	4.68	2.50
FORBS			
Achillea millefolium	1.38	4.68	10.00
Linum lewisii	0.75	3.80	3.75
Penstemon palmeri	7.00	10.42	38.75
GRASSES			
Elymus cinereus	7.13	12.77	27.50
Elymus lanceolatus	8.25	11.81	41.25
Elymus salinus	0.13	1.11	1.25
Elymus smithii	5.13	10.95	26.25
Elymus spicatus	9.88	14.70	40.00
Stipa hymenoides	3.25	8.77	15.00

Table 10: Willow Creek Mine Area. Total Cover and Composition (2014).

Reclaimed Refuse Pile		n=80*
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Total Living Cover	58.38	10.06
Litter	11.00	3.39
Bareground	14.88	5.48
Rock	15.75	7.38
B. % COMPOSITION		
Shrubs	26.13	29.44
Forbs	16.87	23.59
Grasses	57.00	28.87
* SAMPLE ADEQUACY (nMIN) (calculated for the "lumped" dataset)		

Table 11: Willow Creek Mine Area.
Woody Species Density (2014).

Reclaimed Refuse Pile	n=30*
SPECIES	**Individuals Per Acre**
Amelanchier utahensis	5.40
Artemisia tridentata	120.51
Atriplex canescens	1302.18
Ceratoides lanata	170.87
Chrysothamnus nauseosus	196.05
Gutierrezia sarothrae	5.40
Ephedra viridis	10.79
Atriplex confertifolia	3.60
Symphoricarpos oreophilus	10.79
TOTAL	**1825.57**

* SAMPLE ADEQUACY (nMIN)
(calculated for the "lumped" dataset)

Table 12: Willow Creek Mine Area. Annual Production (2014).

Reclaimed Refuse Pile		n=40*
	Pounds/Acre	
LIFEFORM	Mean	Std. Dev.
Herbaceous	846.23	738.99
Woody	633.65	803.90
TOTAL	**1479.88**	**346.32**

* SAMPLE ADEQUACY (nMIN)
(calculated for the "lumped" dataset)

Table 13: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2014).

Reclaimed Loadout			n=2
SHRUBS	**Mean Percent**	**Standard Deviation**	**Percent Frequency**
Ceratoides lanata	20.00	20.00	50.00
FORBS			
GRASSES			
Elymus cinereus	5.00	5.00	50.00
Elymus lanceolatus	30.00	30.00	50.00
Elymus spicatus	10.00	10.00	50.00

Table 14: Willow Creek Mine Area. Total Cover and Composition (2014).

Reclaimed Loadout		n=2*
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Total Living Cover	65.00	5.00
Litter	10.00	0.00
Bareground	15.00	5.00
Rock	10.00	0.00
B. % COMPOSITION		
Shrubs	28.57	28.57
Forbs	0.00	0.00
Grasses	71.43	28.57
* SAMPLE ADEQUACY (nMIN) (calculated for the "lumped" dataset)		

Table 15: Willow Creek Mine Area.
Woody Species Density (2014).

Reclaimed Loadout	n=1*
SPECIES	**Individuals Per Acre**
Atriplex canescens	215.83
Chrysothamnus nauseosus	485.62
Ceratoides lanata	593.53
Populus angustifolia	539.58
TOTAL	**1834.56**

* SAMPLE ADEQUACY (nMIN)
(calculated for the "lumped" dataset)

Table 16: Willow Creek Mine Area. Annual Production (2014).

Reclaimed Loadout		n=2*
	Pounds/Acre	
LIFEFORM	Mean	Std. Dev.
Herbaceous		
Woody	533.61	533.61
	728.14	728.14
TOTAL	**1261.75**	**194.53**

* SAMPLE ADEQUACY (nMIN)
(calculated for the "lumped" dataset)

Table 17: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2014).

Reclaimed Riparian Bottoms			n=30
OVERSTORY	**Mean Percent**	**Standard Deviation**	**Percent Frequency**
Salix exigua	13.50	16.89	46.67
Rosa woodsii	5.33	14.66	13.33
Populus augustifolia	1.33	7.18	3.33
UNDERSTORY			
TREES/SHRUBS			
Artemisia tridentata	4.00	7.12	30.00
Atriplex canescens	2.50	11.01	6.67
Chrysothamnus nauseosus	4.33	11.74	16.67
Ephedra viridis	1.50	8.08	3.33
Populus augustifolia	1.00	5.39	3.33
Ribes aureum	4.67	11.61	16.67
Rosa woodsii	7.00	13.76	23.33
Salix exigua	13.17	17.39	46.67
FORBS			
Linum lewisii	0.67	3.59	3.33
Penstemon palmeri	1.33	4.46	10.00
GRASSES			
Bromus tectorum	0.83	4.49	3.33
Elymus cinereus	1.50	5.65	6.67
Elymus lanceolatus	2.00	6.53	10.00
Elymus smithii	0.67	3.59	3.33
Elymus spicatus	0.83	4.49	3.33
Stipa hymenoides	0.33	1.80	3.33

Table 18: Willow Creek Mine Area. Total Cover and Composition (2014).

Reclaimed Riparian Bottoms		n=30*
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Overstory (O)	20.17	18.91
Understory (U)	46.33	16.78
Litter	27.13	23.04
Bareground	10.43	9.37
Rock	16.10	14.17
O + U	66.50	5.94
B. % COMPOSITION		
Shrubs	85.70	26.37
Forbs	3.14	8.66
Grasses	11.16	20.62

* SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 1 sample
90%± 0.10 = 2 samples

Table 19: Willow Creek Mine Area.
Woody Species Density (2014).

Reclaimed Riparian Bottoms	n=30*
SPECIES	**Individuals Per Acre**
Artemisia tridentata	1163.15
Atriplex canescens	455.14
Ephedra viridis	101.14
Populus angustifolia	50.57
Chrysothamnus nauseosus	859.72
Rosa woodsii	910.29
Ribes aureum	455.14
Salix exigua	2073.44
TOTAL	**6068.60**

* SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 14 samples
90%± 0.10 = 24 samples

Table 20: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2014).

Reclaimed Sagebrush (Crandall Canyon) n=80

TREES/SHRUBS	Mean Percent	Standard Deviation	Percent Frequency
Artemisia tridentata	17.13	14.57	77.50
Cercocarpus ledifolius	11.81	16.21	41.25
Chrysothamnus nauseosus	1.50	8.34	3.75
Pinus ponderosa	0.56	3.26	3.75
Pseudotsuga menziesii	0.63	3.20	5.00
FORBS			
Artemisia ludoviciana	0.19	1.24	2.50
Aster chilensis	1.19	4.42	8.75
Linum lewisii	1.38	3.53	16.25
Melilotus officinalis	3.25	4.48	38.75
Penstemon sp.	0.44	2.26	3.75
GRASSES			
Elymus cinereus	7.13	12.77	33.75
Elymus junceus	0.94	4.41	6.25
Elymus lanceolatus	3.86	5.90	36.25
Elymus smithii	4.00	7.47	36.25
Elymus spicatus	3.56	8.11	21.25
Poa secunda	3.56	8.49	25.00

Table 21: Willow Creek Mine Area. Total Cover and Composition (2014).

Reclaimed Sagebrush (Crandall Canyon) n=80*

A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	61.06	9.70
Litter	11.19	4.28
Bareground	10.88	4.79
Rock	16.88	9.56
B. % COMPOSITION		
Shrubs	51.48	25.49
Forbs	11.55	15.13
Grasses	36.97	25.01

* SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 4 samples
90%± 0.10 = 7 samples

Table 22: Willow Creek Mine Area.
Woody Species Density (2014).

Reclaimed Sagebrush
(Crandall Canyon) n=80*

SPECIES	Individuals Per Acre
Artemisia tridentata	4433.57
Artemisia nova	21.11
Cercocarpus ledifolius	1921.21
Chrysothamnus nauseosus	190.01
Pinus ponderosa	42.22
Purshia tridentata	21.11
Pseudotsuga menziesii	126.67
TOTAL	**6755.92**

* SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 42 samples
90%± 0.10 = 69 samples

Table 23: Willow Creek Mine Area. Annual Production (2014).

Reclaimed Sagebrush
(Crandall Canyon) n=40*

	Pounds/Acre	
LIFEFORM	Mean	Std. Dev.
Herbaceous	648.24	716.41
Woody	850.13	852.84
TOTAL	**1498.36**	**372.05**

* SAMPLE size (n) = 40
* SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 10 samples
90%± 0.10 = 17 samples

Table 24: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2014).

Reclaimed Mountain Brush - East (Crandall Canyon)			n=10
SHRUBS	**Mean Percent**	**Standard Deviation**	**Percent Frequency**
Artemisia tridentata	18.50	20.62	60.00
Cercocarpus ledifolius	1.50	4.50	10.00
FORBS			
Linum lewisii	1.50	3.20	20.00
Melilotus officinalis	0.50	1.50	10.00
Penstemon sp	2.00	3.32	30.00
GRASSES			
Elymus cinereus	29.00	26.25	80.00
Elymus lanceolatus	3.00	5.10	20.00
Elymus smithii	4.00	6.24	30.00
Poa secunda	3.50	7.76	20.00

Table 25: Willow Creek Mine Area. Total Cover and Composition (2014).

Reclaimed Mountain Brush - East (Crandall Canyon)		n=10*
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Total Living Cover	63.50	10.74
Litter	11.00	4.36
Bareground	18.30	10.76
Rock	7.20	5.33
B. % COMPOSITION		
Shrubs	33.50	30.57
Forbs	7.89	13.23
Grasses	58.61	37.31
* SAMPLE ADEQUACY (nMIN) (calculated for the "lumped" dataset)		

Table 26: Willow Creek Mine Area.
Woody Species Density (2014).

Reclaimed Mountain Brush - East (Crandall Canyon) n=10*

SPECIES	Individuals Per Acre
Artemisia tridentata	1106.82
Chrysothamnus nauseosus	92.24
Populus angustifolia	30.75
TOTAL	**1229.80**

* SAMPLE ADEQUACY (nMIN)
(calculated for the "lumped" dataset)

Table 27: Willow Creek Mine Area. Annual Production (2014).

Reclaimed Mountain Brush - East (Crandall Canyon) n=10*

Pounds/Acre

LIFEFORM	Mean	Std. Dev.
Herbaceous	1002.98	1033.81
Woody	712.44	732.66
TOTAL	**1715.42**	**420.02**

* SAMPLE ADEQUACY (nMIN)
(calculated for the "lumped" dataset)

Table 28: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2014).

Reclaimed Mountain Brush - West (Crandall Canyon) n=10

SHRUBS	Mean Percent	Standard Deviation	Percent Frequency
Artemisia tridentata	12.50	10.31	70.00
Chrysothamnus nauseosus	1.00	3.00	10.00
FORBS			
Achillea millefolium	2.00	4.00	20.00
Artemisia ludoviciana	1.00	2.00	20.00
Aster chilensis	8.00	12.69	40.00
Linum lewisii	2.00	3.32	30.00
Melilotus officinalis	7.22	4.16	80.00
Penstemon sp.	2.50	4.61	30.00
GRASSES			
Elymus cinereus	12.00	10.54	80.00
Elymus lanceolatus	5.50	6.50	50.00
Elymus smithii	8.00	11.87	50.00
Poa secunda	3.50	3.91	50.00

Table 29: Willow Creek Mine Area. Total Cover and Composition (2014).

Reclaimed Mountain Brush - West (Crandall Canyon) n=10*

A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	64.50	6.10
Litter	7.50	2.50
Bareground	10.00	4.47
Rock	18.00	5.10
B. % COMPOSITION		
Shrubs	21.58	17.38
Forbs	33.53	25.20
Grasses	44.89	23.30
* SAMPLE ADEQUACY (nMIN) (calculated for the "lumped" dataset)		

Table 30: Willow Creek Mine Area.
Woody Species Density (2014).

Reclaimed Mountain Brush - West (Crandall Canyon) n=10*	
SPECIES	**Individuals Per Acre**
Artemisia tridentata	2700.93
Cercocarpus ledifolius	810.28
Chrysothamnus nauseosus	90.03
TOTAL	**3601.24**

* SAMPLE ADEQUACY (nMIN)
(calculated for the "lumped" dataset)

Table 31: Willow Creek Mine Area. Annual Production (2014).

Reclaimed Mountain Brush - West (Crandall Canyon)		n=10*
	Pounds/Acre	
LIFEFORM	Mean	Std. Dev.
Herbaceous	778.11	667.53
Woody	548.61	674.13
TOTAL	**1326.72**	**215.17**

* SAMPLE ADEQUACY (nMIN)
(calculated for the "lumped" dataset)

Table 32: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2014).

Mountain Brush Reference Area			n=40
OVERSTORY			
Amelanchier utahensis	0.13	0.78	2.50
Pinus edulis	0.50	3.12	2.50
UNDERSTORY			
TREES/SHRUBS			
Amelanchier utahensis	2.13	6.31	12.50
Artemisia nova	0.63	3.90	2.50
Artemisia tridentata	7.75	11.34	37.50
Atriplex canescens	1.00	4.36	5.00
Ephedra viridis	0.25	1.56	2.50
Juniperus osteosperma	0.50	3.12	2.50
FORBS			
Machaeranthera canescens	0.63	2.29	7.50
GRASSES			
Bromus tectorum	1.00	4.36	5.00
Elymus salinus	27.50	15.17	45.00
Poa secunda	0.25	1.56	2.50
Stipa comata	0.38	2.34	2.50
Stipa hymenoides	5.00	8.37	30.00

Table 33: Willow Creek Mine Area. Total Cover and Composition (2014).

Mountain Brush Reference Area		n=40*
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Overstory (O)	0.63	3.20
Understory (U)	47.00	9.14
Litter	10.88	4.01
Bareground	14.50	4.44
Rock	27.63	10.25
O + U	47.63	8.73
B. % COMPOSITION		
Shrubs	24.58	25.27
Forbs	1.63	5.93
Grasses	73.79	24.37

* SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 6 samples
90%± 0.10 = 10 samples

Table 34: Willow Creek Mine Area.
Woody Species Density (2014).

Mountain Brush Reference Area	n=40*
SPECIES	**Individuals Per Acre**
Amelanchier utahensis	203.41
Artemisia nova	29.06
Artemisia tridentata	1026.72
Atriplex canescens	87.17
Atriplex confertifolia	9.69
Rhus aromatica	9.69
Ephedra viridis	38.74
Juniperus osteosperma	106.55
Opuntia polyacantha	9.69
Pinus edulis	29.06
TOTAL	**1549.77**

* SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 14 samples
90%± 0.10 = 24 samples

Table 35: Willow Creek Mine Area. Annual Production (2014).

Mountain Brush Reference Area		n=40*
	Pounds/Acre	
LIFEFORM	Mean	Std. Dev.
Herbaceous	450.20	399.07
Woody	353.10	442.40
TOTAL	**803.30**	**192.79**

* SAMPLE size (n) = 40
* SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 9 samples
90%± 0.10 = 16 samples

Table 36: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2014).

Crandall Canyon (SB) Reference Area n=60

SHRUBS	Mean Percent	Standard Deviation	Percent Frequency
Artemisia tridentata	17.92	18.63	53.33
Atriplex canescens	1.50	7.26	5.00
Chrysothamnus nauseosus	0.33	2.56	1.67
Gutierrezia sarothrae	0.17	1.28	1.67
Opuntia polyacantha	0.25	1.42	3.33
FORBS			
Artemisia ludoviciana	0.95	2.40	15.00
GRASSES			
Bromus tectorum	4.00	6.11	35.00
Elymus salinus	18.17	16.98	66.67
Hilaria jamesii	0.17	1.28	1.67
Stipa comata	5.80	10.12	36.67

Table 37: Willow Creek Mine Area. Total Cover and Composition (2014).

Crandall Canyon (SB) Reference Area n=60*

A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	49.25	10.03
Litter	9.83	2.88
Bareground	10.67	4.96
Rock	30.25	10.39
B. % COMPOSITION		
Shrubs	40.48	36.83
Forbs	2.05	5.32
Grasses	57.47	36.01

* SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 7 samples
90%± 0.10 = 11 samples

Table 38: Willow Creek Mine Area.
Woody Species Density (2014).

Crandall Canyon (SB) Reference Area	n=60*
SPECIES	**Individuals Per Acre**
Amelanchier utahensis	9.67
Artemisia tridentata	1019.90
Atriplex canescens	43.50
Chrysothamnus nauseosus	14.50
Ephedra viridis	4.83
Echinocereus triglochidiatus	4.83
Gutierrezia sarothrae	4.83
Opuntia polyacantha	24.17
Rhus aromatica	9.67
Yucca harrimaniae	24.17
TOTAL	**1160.08**

* SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 29 samples
90%± 0.10 = 40 samples

Table 39: Willow Creek Mine Area. Annual Production (2014).

Crandall Canyon (SB) Reference Area		n=60*
	Pounds/Acre	
LIFEFORM	Mean	Std. Dev.
Herbaceous	418.80	434.32
Woody	533.59	563.86
TOTAL	**952.39**	**244.22**

* SAMPLE size (n) =
* SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 11 samples
90%± 0.10 = 18 samples

Table 40: Willow Creek Mine Area. *Lumped* Data for Total Cover (2014).

Reclaimed Areas (Gravel Canyon, Conveyor Corridor, Refuse Pile, Loadout)		
	Mean Percent	Standard Deviation
TOTAL LIVING COVER	59.36	9.82

SAMPLE size (n) = 157
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 4 samples
90%± 0.10 = 7 samples

Table 41: Willow Creek Mine Area. *Lumped* Data for Total Woody Species Density (2014).

Reclaimed Areas (Gravel Canyon, Conve'âr Corridor, Refuse Pile, Loadout)		
Number of Individuals Per Acre	Mean	Standard Deviation
TOTAL	1886.06	391.85

SAMPLE size (n) = 61
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 7 samples
90%± 0.10 = 12 samples

Table 42: Willow Creek Mine Area. *Lumped* Data for Total Annual Biomass Production (2014).

Reclaimed Areas (Gravel Canyon, Conveyor Corridor, Refuse Pile, Loadout)		
Pounds/Acre	Mean	Standard Deviation
TOTAL	**1570.76**	**503.61**

SAMPLE size (n) = 77
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 17 samples
90%± 0.10 = 28 samples

Table 43: Willow Creek Mine Area. *Lumped* Data for Total Cover (2014).

Reclaimed Areas in Crandall Canyon (Mountain Brush - East, West)		
	Mean Percent	Standard Deviation
TOTAL LIVING COVER	64.00	8.75

SAMPLE size (n) = 20
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 3 samples
90%± 0.10 = 5 samples

Table 44: Willow Creek Mine Area. *Lumped* Data for Total Woody Species Density (2014).

Reclaimed Areas in Crandall Canyon (Mountain Brush - East, West) Number of Individuals Per Acre	Mean	Standard Deviation
TOTAL	1925.16	2636.72

SAMPLE size (n) = 20
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 307 samples
90%± 0.10 = 508 samples

Table 45: Willow Creek Mine Area. *Lumped* Data for Total Annual Biomass Production (2014).

Reclaimed Areas in Crandall Canyon (Mountain Brush - East, West) Pounds/Acre	Mean	Standard Deviation
TOTAL	**1521.07**	**386.17**

SAMPLE size (n) = 20
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 11 samples
90%± 0.10 = 17 samples

COLOR PHOTOGRAPHS OF THE SAMPLE AREAS

Willow Creek Mine Area

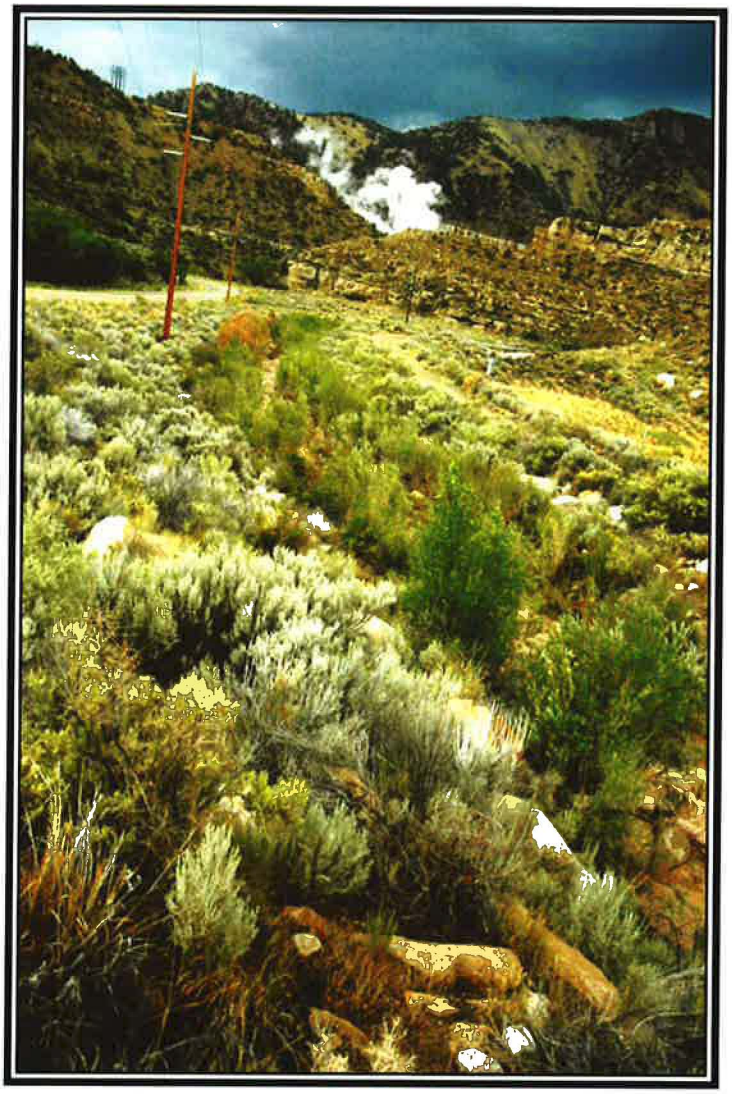
Reclaimed Gravel Canyon

Reclaimed Conveyor Corridor

Reclaimed Refuse Pile

Reclaimed Loadout

Reclaimed Riparian Bottoms



Crandall Canyon Area

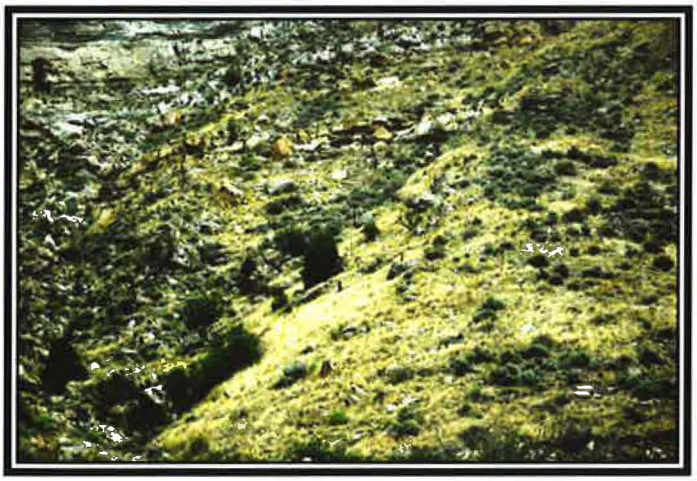
Reclaimed Sagebrush

Reclaimed Mountain Brush (East)

Reclaimed Mountain Brush (West)

Mountain Brush Reference Area

Crandall Canyon Reference Area



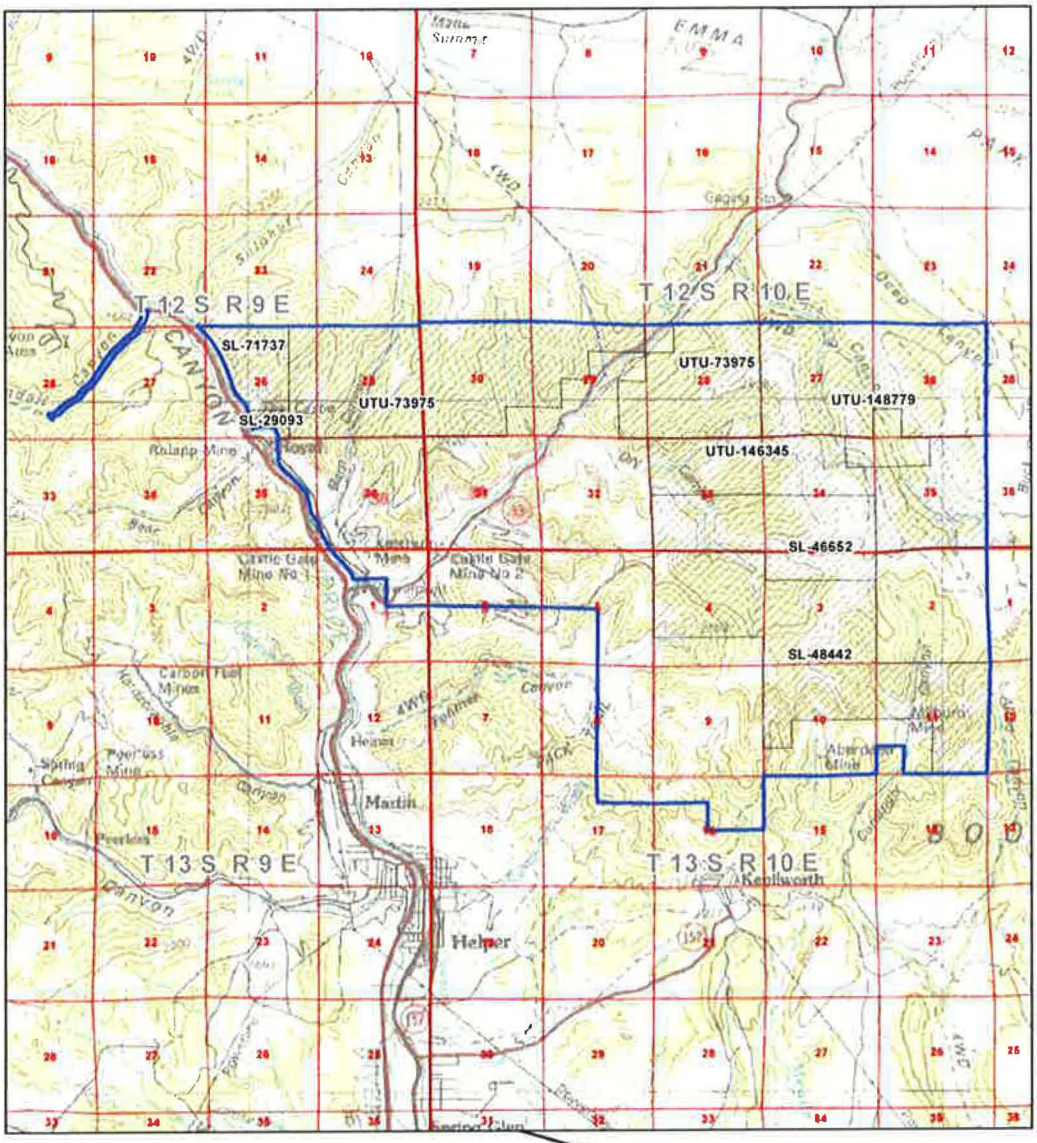
Revegetation Monitoring for Phase III Bond Release at the Willow Creek Mine

Year 9: 2013

for

Plateau Mining Corporation

Reclaimed Refuse Pile at the Willow Creek Mine, Utah



Willow Creek Mine

C0070038
Carbon County, Utah
January 2006

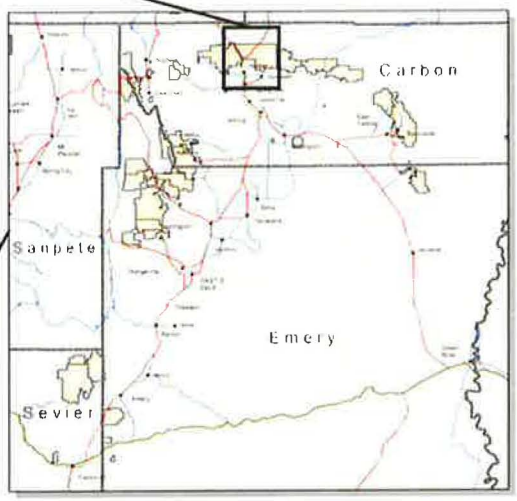
Township 12 South Range 9 & 10 East
Township 13 South Range 9 & 10 East

File N:/gis/coal/coal/areamaps/C0070038.pdf

Permit Area
Proposed Mine Plan Modification (if shown)
Federal Lease Areas

0 0.4 0.8 1.6 Miles
1:69,000

State of Utah



Locator Map

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March 2014

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INTRODUCTION

Purpose for the Study

The Willow Creek Mine is located in Price Canyon about 3.5 miles northwest of the town of Helper, Utah. Elevation of the site ranges from 6,100 ft to 6,400 ft above sea level. The mine ceased coal mining operations in 2000. By 2004, reclamation and revegetation activities were completed at the mine site including areas called Gravel Canyon, Refuse Pile, Conveyor Corridor, Loadout, Riparian Bottoms and Crandall Canyon. The scope of this report is to provide results from monitoring plant establishment, or to study revegetation success of these sites in order to determine whether or not an application for reclamation bond release may soon be warranted.

Following reclamation activities, mine sites are required to provide enough time to pass for acceptable plant establishment before applications can be made for bond release. This time-frame, called the *Responsibility Period*, prescribes at least 10 years before the mine owner can submit a request for *Final* or *Phase III Bond Release* through the State of Utah, Division of Oil, Gas & Mining (DOGM). It has been estimated that this period of time is long enough to determine whether or not adequate re-establishment has occurred on the reclaimed areas to the extent that they have become *diverse, effective, permanent and are capable of self-regeneration and plant succession.*

The restored vegetation of the reclaimed lands must meet specific state and federal requirements. Consequently, beginning in Year 9 of the 10-year period mentioned above, 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 success standards can be determined using a *reference area*, or a native, undisturbed plant community chosen beforehand that approximates the mine site before it was disturbed by the mining activities. Data is recorded in the reference areas during the same sample period as the reclaimed areas. An alternate method for assigning success standards can be used by recording quantitative data beforehand, or using *baseline data.*

In 2013, the reclaimed sites were quantitatively sampled to provide vegetation data for Year 9 following reclamation, or the first results of the two consecutive years of sampling required prior to submittal of an application for bond release.

History of Onsite Vegetation Sampling

Vegetation data has been collected and compiled for the Willow Creek Mine since 1981 and earlier. These datasets can be challenging to follow, but this document attempts to clarify them. First, there have been ownership and operator changes at the mine site over that time period. Moreover, data collection methodologies have changed over time, and in most cases there are explanations for the changes. The Willow Creek Mining and Reclamation Plan (MRP) attempts to explain these changes (MRP Section 3.2.1.2). To begin, the primary vegetation dataset and report that was used for permitting was prepared for the Price River Coal Company. This document was called *"Vegetation Data Report of Price River Coal Company's Mine Area"* (Mariah Associates 1981). In 1988, a modification of this document was used for permitting purposes for the Blackhawk Coal Company at the Willow Creek Mine. Later in 1989, the Castle Gate Coal Company used some of these same datasets for the Willow Creek area with subsequent permitting changes submitted in 1994. Finally, more vegetation work was conducted by the State of Utah, Division of Oil, Gas & Mining (DOGM), Abandoned Mine Reclamation (AMR) program in areas where some sites were reclaimed. These sites had been disturbed prior to the Surface Mining Control and Reclamation Act of 1977 (SMRCA); the MRP refers to them as the "Reclaimed Areas" and there is no longer a reclamation bond associated with them.

Many changes have been made regarding the vegetation success standards since those early studies. Willow Creek's MRP (Section 3.2.1.2) states that *"given the changes in regulatory requirements which have occurred since much of the data was originally collected and subsequent disturbance of many of the areas previously sampled at this location, the original data cannot be used directly to comply with current vegetation baseline requirements"*. For this and other plant nomenclature problems in the original dataset, the 1981 data were no longer sufficient to meet the state regulations. Accordingly, more vegetation sampling was conducted in 1994-1996 by K.A. Crofts to supplement the early

vegetation data; these data can be found in an appendix in Willow Creek Mine's MRP called "*Supplemental Tables of Vegetation Sampling Data: 1994-1996*".

Sample Areas

The terminology used in the MRP for specific sample areas and the methodology criteria applied to sample them have been described below. The following information also drove the sample design and plans made to monitor the reclaimed areas for this report.

1. **Disturbed Areas** - This refers to those areas where the plant communities were disturbed pre-SMCRA and were later re-disturbed post-SMCRA by coal mining activities. Because of this, they are regulated differently and have different revegetation success standards for final reclamation from those areas that were not re-disturbed after the Act. Both types of areas at the Willow Creek Mine site, pre-SMCRA and post-SMCRA, have now been reclaimed under appropriate state and federal regulations. The reclaimed *Disturbed Areas* were sampled to provide the 'supplemental data' (1994-96) mentioned above and were again sampled in 2013 using the same methodologies for this report. The Disturbed Areas include the following sites:
    a. Gravel Canyon
    b. Refuse Pile
    c. Conveyor Corridor
    d. Loadout [2]

    "Baseline Data Methods" as per DOGMs *Vegetation Information Guidelines* (1992)[1] were employed to sample these areas. More detail about these methods has been provided in the METHODS section of this report.

2. **Reclaimed Areas** - These *Reclaimed Areas* were those areas that were disturbed pre-SMCRA and not re-disturbed by more current mining activities. These areas were later reclaimed by the AML program and are therefore not subject to the monitoring program required by Plateau Mining Corporation. Accordingly, these areas were <u>not</u> required to be sampled for this 2013 monitoring report.

---

[1] Vegetation Information Guidelines (Revised, February 1992). Utah Division of Oil, Gas and Mining, 1596 West North Temple, Suite 1210, Salt Lake City, Utah 84114-5801.

[2] This was some uncertainty where to place this small (<0.25 acre) reclaimed site for revegetation success comparisons.

3. **Riparian Bottoms** - This area was first sampled in 1994 to expand on the 'supplemental data' needed. They did not have the pre-SMCRA designation. Sample methods were different than those used for the *Disturbed Areas* above (more information about this will be described in the METHODS section of this report).

4. **Crandall Canyon** - Crandall Canyon, an area also associated with the Willow Creek Mine, is located on the west side of Price Canyon rather than the east side where the other reclaimed areas are located (see Willow Creek Mine Locator Map included at the beginning this report). Revegetation standards and sampling methods are yet again different than the above-mentioned areas. Again, more details about the methodologies employed will be provided later in this report.

5. **Reference Areas** - Based on the methods employed to monitor revegetation success and the standards that were pre-determined by representatives from the past mine operators and officials from DOGM, *Reference Areas* may or may not be used to determine adequate revegetation success at the Willow Creek Mine. Or, in other words, Reference Areas are used as success standards for some of the reclaimed areas, whereas, they are not used in other areas.

   Reference Areas are those sites that were chosen earlier to be sampled following final reclamation. Data from the Reference Areas and specific areas that have been reclaimed are to be compared statistically to determine whether or not successful revegetation has been achieved at the time of *Final* or Phase III Bond Release. The "Reference Area Method" has been described in DOGMs *Vegetation Information Guidelines* [1].

   The Reference Areas sampled in association with the Willow Creek Mine's monitoring plan were:

   a. Mountain Brush (MB) Reference Area
   b. Crandall Canyon (SB) Reference Area

The above sample areas have been described in Willow Creek's MRP. Their locations can be found on several maps provided in that document.

METHODS

Methodologies used for vegetation sampling were performed in accordance with the aforementioned guidelines provided by DOGM. For reasons described above, and depending on the sample area, there has been an assortment of methods that have been employed to sample the vegetation at the Willow Creek Mine site. We have attempted to employ sampling methods that have appropriate scientific merit and comply with all state and federal regulations and guidelines, as well as remain consistent with previous sampling methods to make the earlier and current datasets comparable to each other. The vegetation sampling in 2013 was conducted between August 19th and September 10th.

Transect & Quadrat Placement

Random/regular placement of sample quadrats were designed as an attempt to provide unbiased accuracy of the data compiled. This was accomplished by establishing several transect lines along the entire length of each reclaimed 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 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 in an attempt to adequately address and represent each site as a whole.

Cover, Frequency & Composition

Depending on the sample area and the history of sampling it, cover estimates were made by using two different methods. In some areas ocular methods with meter square quadrats were used; other areas employed the point-intercept method using an inclined metal 10-point frame. Species composition and relative frequencies were also assessed from the cover data. Plant nomenclature follows "A Utah Flora" (Welsh et al. 2008)[3].

Density

Similar to the reasons for employing different sample methods for cover, woody species density measurements also varied depending on the area. These methods were dictated by either community type, previous sampling history, or commitments about methods that were stated in the MRP. In some areas, woody plant numbers were measured using a distance method called the point-quarter technique. In this method, random points were placed on the sample sites and measured 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. In other areas, densities were measured using 1.5 M x 50.0 M belt transects. Here, all woody plants were counted inside the belts; the counts were then summarized and converted into the number of individual woody plants per acre.

Biomass Production

Total annual biomass production was estimated by clipping, drying and weighing current annual growth in each sample quadrat. "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 recorded separately, then combined to provide the total annual biomass production estimate.

Similarity & Diversity Indices

In specific areas only, and as specified in Willow Creek's Mining & Reclamation Plan (MRP), Sorensen's Similarity Index (SI) was calculated. The SI formula is shown below.

---

[3] Welsh, S.L., N.D. Atwood, S. Goodrich and L.C. Higgins. 2008. A Utah flora. Print Services, Brigham Young University, Provo, UT. 1019 pp.

$$SI = \frac{2C}{A+B} X100$$

where,

SI = Similarity Index
A = Total number of species in community A
B = Total number of species in community B
C = Number of species common to both communities

Additionally, a diversity index has been employed to the reclaimed areas for comparisons to the 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.

Sample Size & Adequacy

Sampling adequacy was calculated using 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 and reported 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 study area, resulting in more samples taken in larger areas.

Photographs

Color photographs of the sample areas were taken at the time of sampling and a subset of them have been submitted in this report.

Success Standards

The sampling history above describes some of the reasons that certain methodologies were employed in specific sample areas at the Willow Creek Mine site. Often the methods to be used to monitor a given parameter were dictated by the DOGM protocol that was chosen by representatives from the past mine operators and officials from that agency. Again, for some areas, the "**Reference Area**" protocol as described in DOGMs *Vegetation Information Guidelines* was employed. In other areas, the "**Baseline Information**" protocol was employed (refer to History of Onsite Vegetation Sampling above for more discussion about this).

Summary of Sampling Methods

Below is a list of the protocols, sampling methods employed, and sample sizes for cover, woody species density and productivity of each sample site at the Willow Creek Mine site.

Summary of Vegetation Sample Areas, Protocols, Methods and Sample Sizes (2013)

SAMPLE AREA	PROTOCOL	COVER (sample size)	DENSITY (sample size)	PRODUCTIVITY (sample size)
Gravel Canyon	Baseline	Point-intercept (n=25)	Belt transects (n=10)	Clipped/Wt. (n=10)
Conveyor Corridor	Baseline	Point-intercept (n=50)	Belt transects (n=25)	Clipped/Wt. (n=25)
Refuse Pile	Baseline	Point-intercept (n=80)	Belt transects (n=30)	Clipped/Wt. (n=40)
Loadout	Baseline	Point-intercept (n=2)	Belt transects (n=1)	Clipped/Wt. (n=2)
Riparian Bottoms	Baseline	Ocular (n=30)	Point-quarter (n=30)	n/a
Crandall Canyon Reclaimed Sagebrush	Reference Area	Ocular (n=80)	Point-quarter (n=80)	Clipped/Wt. (n=40)
Crandall Canyon (East) Reclaimed Mtn. Brush	Reference Area	Ocular (n=10)	Point-quarter (n=10)	Clipped/Wt. (n=10)
Crandall Canyon (West) Reclaimed Mtn. Brush	Reference Area	Ocular (n=10)	Point-quarter (n=10)	Clipped/Wt. (n=10)
Mtn. Brush (MB) Reference Area	Reference Area	Ocular (n=40)	Point-quarter (n=40)	Clipped/Wt. (n=40)
Crandall Canyon (SB) Reference Area	Reference Area	Ocular (n=60)	Point-quarter (n=60)	Clipped/Wt. (n=60)

RESULTS

Gravel Canyon

Quantitative sampling the vegetation at the reclaimed Gravel Canyon site in 2013 revealed that the area was dominated by bluebunch wheatgrass (*Elymus spicatus*), big sagebrush (*Artemisia tridentata*), fourwing saltbush (*Atriplex canescens*), western wheatgrass (*Elymus smithii*) and Gt. Basin wildrye (*E. cinereus*). For a list of all plant species present in sample quadrats along with their cover and frequency values, refer to Table 1. The total living cover

of this reclaimed site was estimated at 62.00% (Table 2-A). Of that living cover, grasses comprised 48.42% , shrubs 36.51% and forbs 15.07% (Table 2-B).

The total woody species density was estimated at 2,547 individuals per acre and was dominated by big sagebrush and fourwing saltbush (Table 3). Total annual biomass production of the site was estimated to be 1,548.91 pounds per acre, with 872.34 pounds coming from woody and 676.57 pounds from herbaceous plants (Table 4).

Conveyor Corridor

The reclaimed Conveyor Corridor was dominated by bluebunch wheatgrass, fourwing saltbush and rubber rabbitbrush (*Chrysothamnus nauseosus*). For a list of the plant species present in sample quadrats along with their cover and frequency values, refer to Table 5. The total living cover for this reclaimed site was estimated to be 60.00% (Table 6-A). The composition of the cover by lifeform was 54.41% grasses, 38.47% shrubs and 7.11% forbs (Table 6-B).

Table 7 shows the woody species density in this area consisted of 2,102 individuals per acre with the dominants for this parameter consisting of fourwing saltbush, rubber rabbitbrush and big sagebrush. Productivity for the site was estimated at 1,420.53 pounds per acre with 754.49 pounds coming from herbaceous and 666.04 pounds from woody species (Table 8).

Refuse Pile

Quantitative sampling the of vegetation at the reclaimed Refuse Pile showed that the area was dominated by bluebunch wheatgrass, fourwing saltbush, western wheatgrass, and Palmer penstemon (*Penstemon palmeri*). For a list of all plant species present in sample quadrats and their cover and frequency values, refer to Table 9. The total living cover of this reclaimed site was estimated at 59.38% (Table 10-A). In that living cover, grasses comprised 60.28%, shrubs 23.46% and forbs 16.26% (Table 10-B).

The total woody species density was estimated at 1,719 individuals per acre and was

dominated by fourwing saltbush, rubber rabbitbrush and big sagebrush (Table 11). Total annual biomass production of the site was estimated to be 1,491.80 pounds per acre, with 823.71 pounds coming from herbaceous species and 688.09 pounds from woody plants (Table 12).

Loadout

This was a very small area (< ¼ acre), but because of its isolated location, it was sampled and reported separately. A very small portion of the reclaimed area is adjacent to the Price River, but the vast majority of it lies within an upland plant community.

The plant species present in the reclaimed Loadout consisted of narrow-leaf cottonwood (*Populus angustifolia*), rubber rabbitbrush, Indian ricegrass, common reed (*Phragmites australis*) and thickspike wheatgrass (Table 13). The total living cover for this reclaimed site was estimated to be 60.00% (Table 14-A) The composition of the cover by lifeform was 55.71% shrubs and 44.29% grasses (Table 14-B).

Table 15 shows the woody species density in this area consisted of 3,831 individuals per acre with the rubber rabbitbrush as the dominant plant by a wide margin, but followed by narrowleaf cottonwood, fourwing saltbush and winterfat (*Ceratoides lanata*). Productivity for the site was estimated at 928.02 pounds per acre with 571.09 pounds coming from shrubs and 356.93 pounds from herbaceous species (Table 16).

Riparian Bottoms

The reclaimed Riparian Bottoms was greatly dominated by coyote willow (*Salix exigua*). For a list of the plant species present in sample quadrats and their cover and frequency values, refer to Table 17.

The total living cover (overstory and understory cover combined) for this reclaimed site was estimated to be 69.17% (Table 18-A). The composition of the understory cover by lifeform was 82.60% shrubs, 14.45% grasses and 2.95% forbs (Table 18-B).

Table 19 shows the woody species density in this area consisted of 5,561 individuals per acre with the dominants here consisting of coyote willow, Wood's rose (*Rosa woodsii*), big sagebrush and golden current (*Ribes aureum*). Production was not required as a revegetation success standard for the riparian zone.

Crandall Canyon Sagebrush Areas

Cover by plant species for the Sagebrush Areas in Crandall Canyon are shown in Table 20. These results indicated that the area was dominated by big sagebrush and curl-leaf mountain-mahogany (*Cercocarpus ledifolius*). The total living cover of the reclaimed site was estimated at 59.44% (Table 21-A). In that living cover, shrubs comprised 54.61%, grasses 31.13% and forbs 14.26% (Table 21-B).

The total woody species density was estimated at 8,409 individuals per acre and was dominated by fourwing saltbush and curl-leaf mountain-mahogany (Table 22). Total annual biomass production of the site was estimated to be 1,303.43 pounds per acre, with 925.26 pounds coming from woody and 378.17 pounds from herbaceous plants (Table 23).

Crandall Canyon Mtn. Brush Areas (East)

Two different relatively small areas were reclaimed as the Mountain Brush community type in Crandall Canyon. These areas were disjunct from each other therefore were sampled and first recorded separately (the data were later lumped for the statistical comparisons).

Quantitative sampling the reclaimed Mtn. Brush (East) site in Crandall Canyon revealed that the area was dominated by Gt. Basin wildrye (*Elymus cinereus*) and big sagebrush (Table 24). The total living cover of this reclaimed community was estimated at 63.50% (Table 25-A). Of the living cover, the composition was comprised of grasses at 62.46%, shrubs were 27.23% and forbs were 10.31% (Table 25-B).

The total woody species density was estimated at 930 individuals per acre and consisted of sagebrush and rubber rabbitbrush (Table 26). Total production of the site was estimated to

be 1,106.49 pounds per acre, with 649.62 pounds coming from herbaceous and 456.87 pounds from woody plants (Table 27).

Crandall Canyon Mtn. Brush Areas (West)

The other isolated reclaimed Mountain Brush site that was sampled in Crandall Canyon was located west of the first site. Quantitative sampling at this site showed that the area was dominated by Gt. Basin wildrye, western wheatgrass and yellow sweet clover (*Melilotus officinalis*). For a list of all plant species present in sample quadrats along with their cover and frequency values, refer to Table 28. The total living cover of this reclaimed site was estimated at 58.50% (Table 29-A). Of that living cover, grasses represented 48.72%, whereas forbs and shrubs were represented at 32.05% and 19.23%, respectively (Table 29-B).

The total woody species density was estimated at 5,500 individuals per acre and consisted of big sagebrush, curl-leaf mountain-mahogany and rubber rabbitbrush (Table 30). Total production of the site was estimated to be 1,191.44 pounds per acre, with 656.04 pounds coming from herbaceous and 535.40 pounds from woody plants (Table 31).

Crandall Canyon Mtn. Brush (MB) Reference Area

When DOGM's *Reference Area* protocol was employed, the reclaimed areas were compared to these communities for standards of final revegetation success. The reference area to be compared to the reclaimed Mtn. Brush communities in Crandall Canyon was called the Mountain Brush (MB) Reference Area. This reference area, however, was located near the old Conveyor Corridor at the Willow Creek Mine on the east side of Price Canyon rather than the west side where reclaimed Crandall Canyon sites are located.

Cover and frequency by plant species for this reference area is shown in Table 32. Sampling results in this area indicated that it was dominated by Salina wildrye by quite a wide margin, but followed by big sagebrush and Indian ricegrass (*Stipa hymenoides*). The tree and shrub species present in this community, probably the reason for calling it a "Mtn. Brush Reference Area", were Utah Juniper (*Juniperus osteosperma*), pinyon-pine (*Pinus edulis*) and

Utah serviceberry (*Amelanchier utahensis*). The total living cover (including overstory and understory cover combined) of this reference area was estimated at 39.76% (Table 32-A). In living understory cover, grasses comprised 68.46%, shrubs 30.87% and forbs 0.67% (Table 32-B).

The total woody species density was estimated at 1,773 individuals per acre and was dominated by big sagebrush, Utah serviceberry, Mormon tea (*Ephedra viridis*) and Utah juniper (Table 34). Total production of the site was estimated to be 606.79 pounds per acre, with 317.67 pounds coming from herbaceous and 289.12 pounds from woody plant species (Table 35).

Crandall Canyon (SB) Reference Area

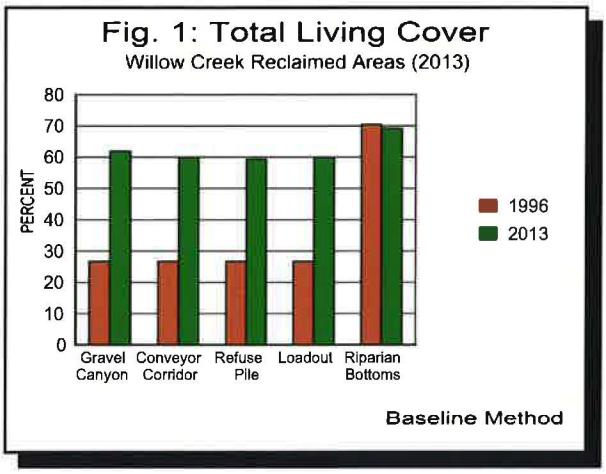
The reference area to be compared to the Reclaimed Sagebrush communities in Crandall Canyon was called the Crandall Canyon (SB) Reference Area. Like the above reference area, this area was located at the Willow Creek Mine on the east side of Price Canyon rather than the west side where the reclaimed sites of Crandall Canyon were located. The locations of the two reference areas, the Crandall Canyon Mtn. Brush (MB) Reference Area and the Crandall Canyon (SB) Reference Area, are shown on maps in the Willow Creek Mine MRP, but a general locator map of the permit area (prepared by DOGM) shows the location of Crandall Canyon. This map is provided at the beginning of this report.

Cover and frequency by plant species for this reference area are shown in Table 36. This reference area was dominated by Salina wildrye and big sagebrush by quite a wide margin. The total living cover of this reference area was estimated at 46.42% (Table 37-A). In that living cover, grasses comprised 59.50%, shrubs 36.00% and forbs 4.50% (Table 37-B).

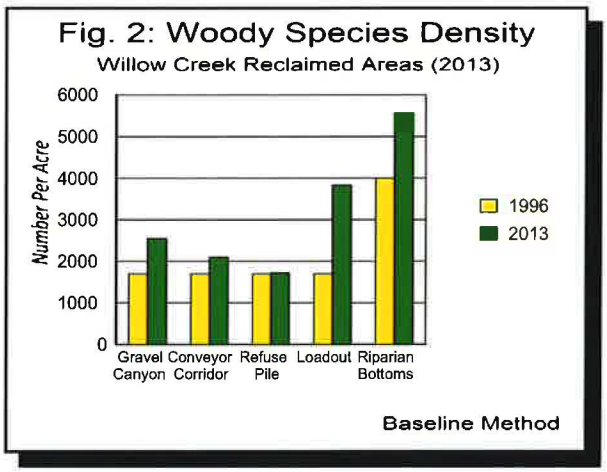
The total woody species density was estimated at 1,380 individuals per acre and was dominated greatly by big sagebrush, but also included fourwing saltbrush, Mormon tea and other species (Table 38). Total production of the site was estimated to be 922.73 pounds per acre, with 530.34 pounds coming from woody and 392.39 pounds from herbaceous plants (Table 39).

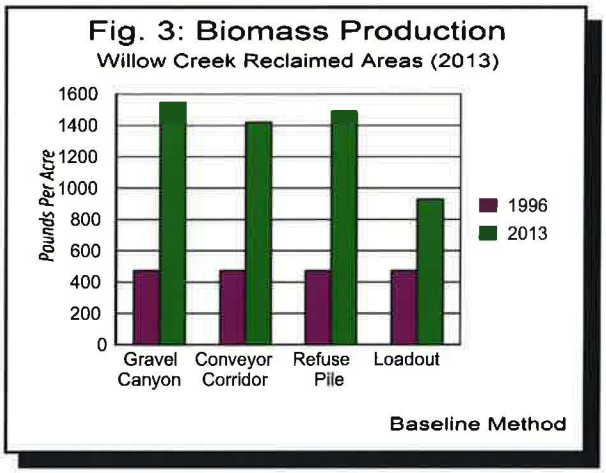
Comparisons Between Reclaimed Areas

As a means to show the results and differences between sample areas, the datasets were first summarized separately. This design enables the reviewer to observe the successes (or failures) of individual reclaimed areas. The following section provides graphical representations of the parameters for each reclaimed area and compares them to the success standards.



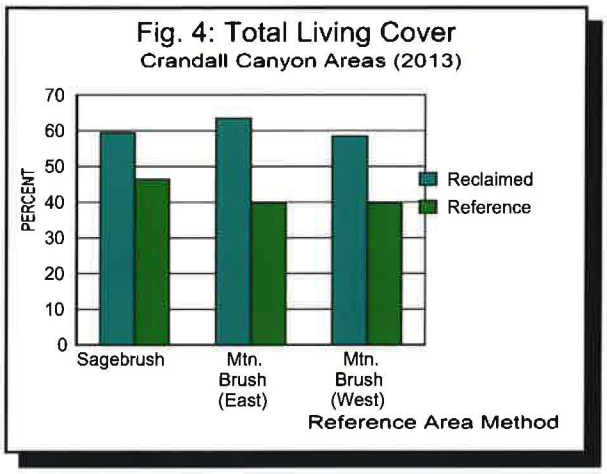
Willow Creek Mine Areas - The "Disturbed Areas" at the Willow Creek Mine site are comprised of reclaimed areas including: 1) Gravel Canyon, 2) Conveyor Corridor, 3) Refuse Pile and 4) Loadout. The reclaimed Riparian Bottoms have also been included in the Willow Creek monitoring regime. Because the protocol for revegetation success standards here employed the *Baseline Method*, comparisons were made between fixed success standards [or baseline datasets (1994-96)] and current datasets (2013). Fig. 1 illustrates that the total living cover values of the current dataset were almost all greater than that of the baseline data (only slightly lower in the Riparian Bottoms). The woody species density values of the these same areas were also greater in the current dataset when compared to the baseline standards (Fig. 2). Finally, total annual biomass production of the

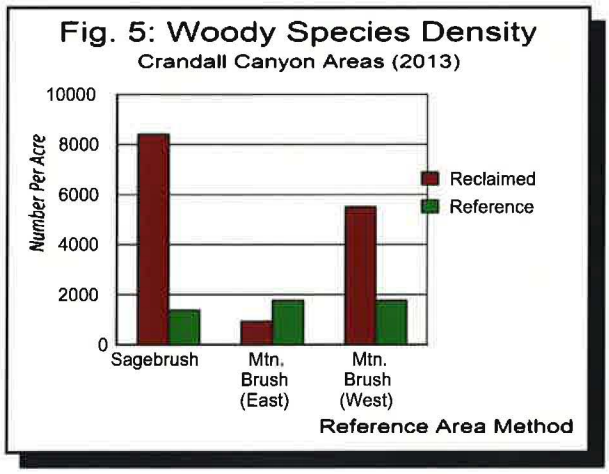




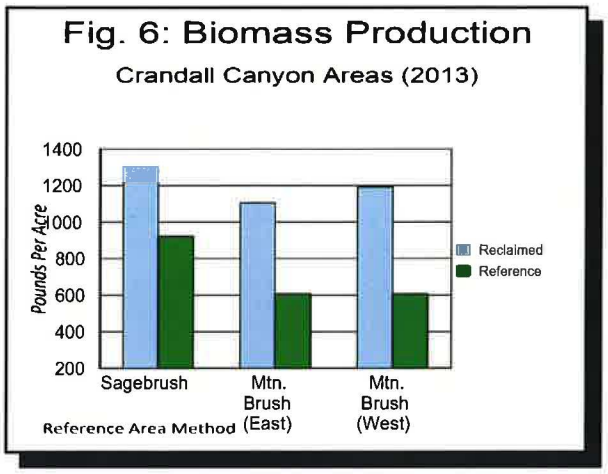
Disturbed Areas were also compared graphically (Fig. 3). The current productivity estimates greatly exceeded those shown in the baseline dataset.

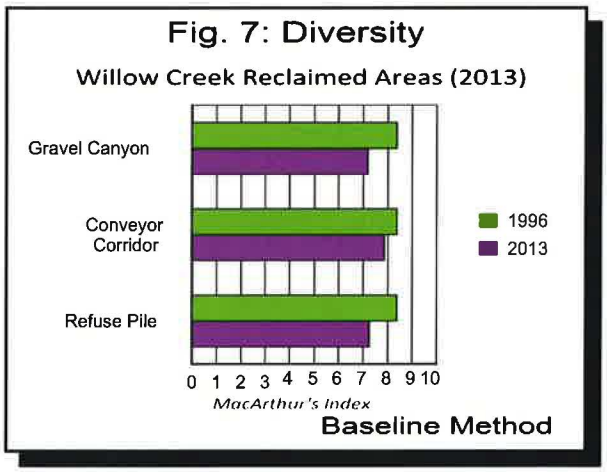
Crandall Canyon Areas - The reclaimed areas in Crandall Canyon consisted of: 1) Sagebrush Areas, 2) Mtn. Brush Areas (East), and 3) Mtn. Brush Areas (West). The protocol to measure revegetation success in these areas employed the *Reference Area* method. This method uses pre-determined reference areas, or undisturbed plant communities chosen to represent future revegetation success standards. Two reference areas were chosen to be compared with the reclaimed areas of Crandall Canyon including 1) Mountain Brush (MB) Reference Area and 2) Crandall Canyon (SB) Reference Area. Graphic illustrations comparing the <u>total living cover</u> of the reclaimed areas in Crandall Canyon with their respective reference areas show that the reclaimed areas have exceeded their success standard (Fig. 4). Furthermore, <u>woody species density</u> values of the reclaimed sites in Crandall Canyon mostly exceeded those of the reference area (Fig. 5). <u>Annual biomass production</u> was again higher in the reclaimed areas when compared to the reference areas (Fig. 6).



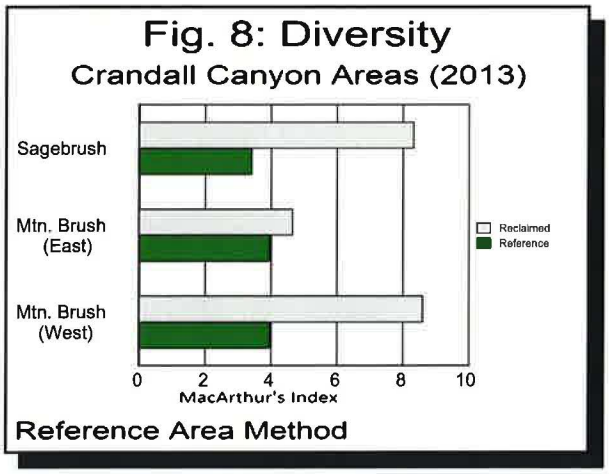


As prescribed in the MRP, Sorenson's Similarity Index was applied to the Willow Creek reclaimed sites. Accordingly, the similarity between the reclaimed areas (2013 data) and the success standards (1994-96 data) was calculated. The similarity value was measured at 28.56% – not a high value. This value, however, only takes into consideration the number of species the two datasets have in common. It does not consider whether or not the species present are more "desirable" or compatible with the post-mining land use. In other words, the two datasets may have different plant species, but both may be appropriate for a successful revegetated plant community. That said, perhaps a more meaningful parameter to consider may be community diversity. Consequently, MacArthur's Index was employed for total diversity comparisons.





For the Willow Creek sites, the 1994-96 data was more diverse than the 2013 data — but only slightly so (Fig. 7). In Crandall Canyon, all reclaimed areas were more diverse than their respective reference areas (Fig. 8).



Statistical Comparisons

This section provides statistical comparisons of the fundamental parameters (those suggested by state and federal regulations) with the revegetation success standards that are provided by reference areas or baseline datasets. The like-reclaimed areas that are to be compared with the success standards (whether from a fixed standard or a reference area standard) have been "lumped" together for the analyses. In other words, because some of the reclaimed areas of Willow Creek Mine site such as Gravel Canyon, Conveyor Corridor, Refuse Pile and Loadout areas have the same standards for revegetation success, and have been reclaimed to the same plant community, they have been lumped together for the statistical analyses. Results of the lumped data are shown on Tables 40-45.

Willow Creek Mine Area - In Willow Creek Mine area the total living cover values for the "Reclaimed Areas" (Gravel Canyon, Conveyor Corridor, Refuse Pile and Loadout) and the Riparian Bottoms were significantly greater statistically than the revegetation success standards (Fig. 8-A). Next, the woody species densities for those same areas were again significantly greater (Fig. 9-A). Lastly, total annual biomass production estimates shown on Fig. 10-A were significantly greater in the reclaimed sites when compared to the standards (production was not required for the Riparian Bottoms).

Crandall Canyon Area - In the Crandall Canyon area the total living cover of the reclaimed Sagebrush Areas was significantly greater than the reference area standard (Fig. 8-B). The same was true for the results in cover of the reclaimed Mountain Brush Areas (East & West). For woody species densities, the statistical analyses suggest that Sagebrush Areas had a greater density value (Fig. 9-B). Although the reclaimed Mountain Brush sites were somewhat lower than the reference area, the difference was not significant statistically (Fig. 9-B). Finally, total annual biomass production of all reclaimed sites in Crandall Canyon were significantly greater than the reference area (Fig. 10-B).

Fig. 8. Statistical Analyses - Student's t-tests comparing **total living cover** of the reclaimed areas and success standards (2013).

A. WILLOW CREEK MINE AREA

Disturbed Areas*: $\bar{x}$=60.00; s=9.51; n=157
Standard (1996): $\bar{x}$=26.72; s=6.68; n=25
t =16.3515 ; df =110; SL= p<0.01

Riparian Bottoms: $\bar{x}$=69.17; s=7.08; n=30
Standard (1996): $\bar{x}$=70.43; s=14.41; n=21
t =0.6807 ; df =49; SL= NS

B. CRANDALL CANYON AREA

Sagebrush Areas: $\bar{x}$=59.44; s=8.94; n=80
Reference Area: $\bar{x}$=46.42; s=11.15; n=60
t =7.6658 ; df =138; SL= p<0.01

Mountain Brush Areas**: $\bar{x}$=61.00; s=8.15; n=20
Reference Area: $\bar{x}$=39.76; s=6.80; n=40
t =10.6683 ; df =58; SL= p<0.01

---

*Disturbed Areas = Reclaimed Gravel Canyon, Conveyor, Refuse Pile and Loadout (lumped)
** Mountain Brush Areas = Reclaimed Mountain Brush East & West (lumped)
$\bar{x}$ = 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

Fig. 9. Statistical Analyses - Student's t-tests comparing **woody species density** of the reclaimed areas and success standards (2013).

A. WILLOW CREEK MINE AREA

Disturbed Areas*: $\bar{x}$=2021.77; s=525.43; n=61
Standard (1996): $\bar{x}$=1700.00; s=n/a; n=n/a
t = n/a (fixed standard)

Riparian Bottoms: $\bar{x}$=5561.09; s=1186.03; n=30
Standard (1996): $\bar{x}$=4000.00; s=n/a; n=n/a
t = n/a (fixed standard)

B. CRANDALL CANYON AREA

Sagebrush Areas: $\bar{x}$=8409.16; s=3550.45; n=80
Reference Area: $\bar{x}$=1380.03; s=466.40; n=60
t =15.2237; df =138; SL= p<0.01

Mountain Brush Areas**: $\bar{x}$=1591.24; s=2514.28; n=20
Reference Area: $\bar{x}$=1772.79; s=557.92; n=40
t =0.5738 ; df =88; SL= NS

Disturbed Areas = Reclaimed Gravel Canyon, Conveyor, Refuse Pile and Loadout (lumped)
** Mountain Brush Areas = Reclaimed Mountain Brush East & West (lumped)
$\bar{x}$= 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

Fig. 10. Statistical Analyses - Student's t-tests comparing **annual biomass production** of the reclaimed areas and success standards (2013).

A. WILLOW CREEK MINE AREA

Disturbed Areas*: $\bar{x}$=1442.70; s=392.20; n=77
Standard (1996): $\bar{x}$=472; s=n/a; n=n/a
t = n/a; (fixed standard from baseline data)

Riparian Bottoms: $\bar{x}$=n/a; s=n/a; n=n/a
Standard (1996): $\bar{x}$=n/a; s=n/a; n=n/a
t = n/a (no production required)

B. CRANDALL CANYON AREA

Sagebrush Areas: $\bar{x}$=1303.43; s=281.32; n=40
Reference Area: $\bar{x}$=922.73; s=295.93; n=60
t =6.4267; df =98; SL= p<0.01

Mountain Brush Areas**: $\bar{x}$=1148.97; s=325.99; n=20
Reference Area: $\bar{x}$=606.79; s=148.25; n=40
t =8.8902 ; df =58; SL= p<0.01

Disturbed Areas = Reclaimed Gravel Canyon, Conveyor, Refuse Pile and Loadout (lumped))
** Mountain Brush Areas = Reclaimed Mountain Brush East & West (lumped)
$\bar{x}$= 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

SUMMARY & CONCLUSIONS

Plant communities disturbed by mining operations at the Willow Creek Mine site have now been reclaimed for nine years. This time frame, known as the *Responsibility Period*, allows the required time frame to consider *Final* or *Phase III Bond Release*. Prior to submitting a bond release application two consecutive monitoring years must be conducted on the reclaimed plant communities to ascertain whether or not revegetation success standards have been achieved. Consequently, intensive quantitative sampling was conducted at the Willow Creek Mine site and Crandall Canyon area in 2013. This report provides the results of the 2013 study, or Year 1 of the two years required for bond release consideration.

As a means to compare data for specific sites within the reclaimed areas, datasets were first presented *separately*. The separated data shows the differences between each reclaimed study site as well as comparisons with the revegetation success standards. It also shows additional information of individual sites including lifeform composition, frequency, species presence and diversity as well as the more fundamental parameters such as total living cover, density and total annual biomass production.

Later, where appropriate, data for the reclaimed areas were *lumped* (combined) making them more applicable to be used for statistical comparisons *as a whole* with the revegetation success standards. The lumped data of the reclaimed sites focuses on the total living cover, woody species density and biomass production. The summaries of the lumped datasets, when compared statistically with the reference areas, suggest that *all reclaimed areas have met or exceeded those standards pre-determined for revegetation success*.

Although the parameters mentioned above are perhaps the most crucial values used to determine revegetation success, other indicators can also be used from the datasets. For example, species diversity, species cover, frequency, presence of "desirable" plant species versus "weedy" or exotic species, and species composition can be compared between the reclaimed areas and their respective success standards. In all instances, the reclaimed areas have progressed to a point that the plant communities could be considered "diverse, effective and permanent" as required by state and federal regulations for reclaimed land once disturbed by coal mining operations – or they have met the final revegetation success standards, at least for Year 1 of the two years required for the bond release application.

DATA SUMMARY TABLES

Table 1: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2013).

Gravel Canyon			n=25
TREES & SHRUBS	**Mean Percent**	**Standard Deviation**	**Percent Frequency**
Artemisia tridentata	10.00	14.42	36.00
Atriplex canescens	9.60	13.71	40.00
Ceratoides lanata	1.20	5.88	4.00
Chrysothamnus nauseosus	1.60	7.84	8.00
FORBS			
Achillea millefolium	0.80	2.71	8.00
Linum lewisii	1.60	6.12	8.00
Penstemon palmeri	6.80	10.09	40.00
GRASSES			
Elymus cinereus	6.80	12.56	28.00
Elymus lanceolatus	2.40	7.09	12.00
Elymus smithii	8.40	16.17	24.00
Elymus spicatus	12.80	12.81	64.00

Table 2: Willow Creek Mine Area. Total Cover and Composition (2013).

Gravel Canyon		n=25
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Total Living Cover	62.00	6.93
Litter	11.20	4.31
Bareground	12.00	4.00
Rock	14.80	5.74
B. % COMPOSITION		
Shrubs	36.51	23.32
Forbs	15.07	21.91
Grasses	48.42	28.10

Table 3: Willow Creek Mine Area.
Woody Species Density (2013).

Gravel Canyon	n=10
SPECIES	**Individuals Per Acre**
Artemisia tridentata	1203.25
Atriplex canescens	1030.59
Chrysothamnus nauseosus	259.00
Ephedra viridis	10.79
Symphoricarpos oreophilus	43.17
TOTAL	**2546.80**

Table 4: Willow Creek Mine Area. Annual Production (2013).

Gravel Canyon		n=10
	Pounds/Acre	
LIFEFORM	Mean	Std. Dev.
Herbaceous	676.57	731.99
Woody	872.34	899.15
TOTAL	**1548.91**	404.81

Table 5: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2013).

Reclaimed Conveyor Corridor			n=50
TREES & SHRUBS	**Mean Percent**	**Standard Deviation**	**Percent Frequency**
Artemisia nova	0.40	1.96	2.00
Artemisia tridentata	4.60	11.70	16.00
Atriplex canescens	9.60	18.00	28.00
Bassia prostrata	1.00	7.00	2.00
Ceratoides lanata	0.80	3.37	4.00
Chrysothamnus nauseosus	7.00	11.87	24.00
FORBS			
Achillea millefolium	1.00	4.12	6.00
Halogeton glomeratus	0.20	1.40	2.00
Linum lewisii	0.20	1.40	2.00
Penstemon palmeri	2.80	6.34	20.00
GRASSES			
Elymus cinereus	3.20	7.60	18.00
Elymus lanceolatus	1.60	4.63	12.00
Elymus salinus	1.20	8.40	2.00
Elymus smithii	8.80	13.95	40.00
Elymus spicatus	16.00	18.22	58.00
Stipa hymenoides	1.60	5.04	8.00

Table 6: Willow Creek Mine Area. Total Cover and Composition (2013).

Reclaimed Conveyor Corridor		n=50
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Total Living Cover	60.00	9.59
Litter	11.20	3.82
Bareground	12.20	5.76
Rock	16.60	8.63
B. % COMPOSITION		
Shrubs	38.47	31.50
Forbs	7.11	13.73
Grasses	54.41	32.82

Table 7: Willow Creek Mine Area.
Woody Species Density (2013).

Reclaimed Conveyor Corridor	n=25
SPECIES	**Individuals Per Acre**
Artemisia nova	21.58
Artemisia tridentata	207.20
Atriplex canescens	1079.15
Atriplex confertifolia	2.16
Bassia prostrata	4.32
Ceratoides lanata	41.01
Ceratoides lanata	19.42
Chrysothamnus nauseosus	699.29
Ephedra viridis	25.90
Rosa woodsii	2.16
TOTAL	**2102.19**

Table 8: Willow Creek Mine Area. Annual Production (2013).

Reclaimed Conveyor Corridor

n=25

	Pounds/Acre	
LIFEFORM	Mean	Std. Dev.
Herbaceous	754.49	752.81
Woody	666.04	771.69
TOTAL	**1420.53**	396.49

Table 9: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2013).

Reclaimed Refuse Pile			n=80
SHRUBS	**Mean Percent**	**Standard Deviation**	**Percent Frequency**
Atriplex canescens	11.63	16.16	40.00
Artemisia tridentata	1.88	6.73	7.50
Ceratoides lanata	0.25	2.22	1.25
Chrysothamnus nauseosus	1.00	5.39	3.75
FORBS			
Achillea millefolium	0.63	3.66	2.50
Halogeton glomeratus	0.25	2.22	
Linum lewisii	0.75	3.46	5.00
Machaeranthera canescens	0.38	2.47	2.50
Penstemon palmeri	7.75	10.72	41.25
GRASSES			
Elymus cinereus	5.88	9.04	35.00
Elymus lanceolatus	5.63	9.06	35.00
Elymus salinus	0.25	2.22	1.25
Elymus smithii	10.38	13.82	46.25
Elymus spicatus	12.25	13.87	51.25
Stipa hymenoides	0.50	2.69	3.75

Table 10: Willow Creek Mine Area. Total Cover and Composition (2013).

Reclaimed Refuse Pile		n=80
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Total Living Cover	59.38	10.04
Litter	11.13	3.16
Bareground	12.50	4.87
Rock	17.00	7.97
B. % COMPOSITION		
Shrubs	23.46	26.58
Forbs	16.26	20.98
Grasses	60.28	27.50

Table 11: Willow Creek Mine Area.
Woody Species Density (2013).

Reclaimed Refuse Pile	n=30
SPECIES	**Individuals Per Acre**
Amelanchier utahensis	1.80
Artemisia tridentata	228.42
Atriplex canescens	1203.25
Ceratoides lanata	28.78
Chrysothamnus nauseosus	241.01
Ephedra viridis	3.60
Gutierrezia sarothrae	3.60
Symphoricarpos oreophilus	8.99
TOTAL	**1719.45**

Table 12: Willow Creek Mine Area. Annual Production (2013).

Reclaimed Refuse Pile		n=40
	Pounds/Acre	
LIFEFORM	Mean	Std. Dev.
Herbaceous	823.71	700.97
Woody	688.09	834.80
TOTAL	**1491.80**	**296.00**

Table 13: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2013).

Reclaimed Loadout			n=2
TREES & SHRUBS	**Mean Percent**	**Standard Deviation**	**Percent Frequency**
Chrysothamnus nauseosus	10.00	10.00	50.00
Populus angustifolia	25.00	25.00	50.00
FORBS			
GRASSES			
Elymus lanceolatus	5.00	5.00	50.00
Stipa hymenoides	10.00	10.00	50.00
Phragmites australis	10.00	10.00	50.00

Table 14: Willow Creek Mine Area. Total Cover and Composition (2013).

Reclaimed Loadout		n=2
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Total Living Cover	60.00	10.00
Litter	10.00	0.00
Bareground	20.00	10.00
Rock	10.00	0.00
B. % COMPOSITION		
Shrubs	55.71	15.71
Forbs	0.00	0.00
Grasses	44.29	15.71

Table 15: Willow Creek Mine Area.
Woody Species Density (2013).

Reclaimed Loadout	n=1
SPECIES	**Individuals Per Acre**
Atriplex canescens	161.87
Chrysothamnus nauseosus	2482.05
Ceratoides lanata	107.92
Populus angustifolia	1079.15
TOTAL	**3830.99**

Table 16: Willow Creek Mine Area. Annual Production (2013).

Reclaimed Loadout		n=2
	Pounds/Acre	
LIFEFORM	Mean	Std. Dev.
Herbaceous	356.93	356.93
Woody	571.09	571.09
TOTAL	**928.02**	**214.16**

Table 17: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2013).

Reclaimed Riparian Bottoms			n=30
OVERSTORY	Mean Percent	Standard Deviation	Percent Frequency
Populus fremontii	0.83	4.49	3.33
Rosa woodsii	2.83	7.03	13.33
Salix exigua	16.50	16.18	63.33
UNDERSTORY			
TREES & SHRUBS			
Artemisia tridentata	3.00	8.02	16.67
Atriplex canescens	0.83	3.18	6.67
Chrysothamnus nauseosus	2.33	7.72	10.00
Ephedra viridis	0.33	1.80	3.33
Ribes aureum	4.17	8.57	23.33
Rosa woodsii	12.50	21.24	36.67
Salix exigua	16.67	15.13	63.33
FORBS			
Aster chilensis	0.83	3.67	6.67
Melilotus officinalis	0.83	3.18	6.67
GRASSES			
Bromus tectorum	1.00	3.74	6.67
Elymus cinereus	1.67	6.37	6.67
Elymus lanceolatus	0.33	1.80	3.33
Elymus smithii	1.50	5.02	10.00
Elymus spicatus	3.00	7.70	16.67

Table 18: Willow Creek Mine Area. Total Cover and Composition (2013).

Reclaimed Riparian Bottoms		n=30
A. TOTAL COVER	Mean Percent	Standard Deviation
Overstory (O)	20.17	14.35
Understory (U)	49.00	16.09
Litter	18.00	15.14
Bareground	10.00	10.80
Rock	23.00	14.58
O + U	69.17	7.08
B. % COMPOSITION		
Shrubs	82.60	23.61
Forbs	2.95	7.97
Grasses	14.45	23.49
Sample size (n) = 30 SAMPLE ADEQUACY (nMIN) 80%± 0.10 = 2 samples 90%± 0.10 = 3 samples		

Table 19: Willow Creek Mine Area.
Woody Species Density (2013).
Reclaimed Riparian Bottoms **n=30**

SPECIES	Individuals Per Acre
Artemisia tridentata	648.79
Atriplex canescens	231.71
Chrysothamnus nauseosus	695.14
Ephedra viridis	46.34
Populus fremontii	92.68
Rhus aromatica	92.68
Ribes aureum	324.40
Rosa woodsii	834.16
Salix exigua	2595.17
TOTAL	**5561.09**

Sample size (n) = 30
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 7 samples
90%± 0.10 = 12 samples

Table 20: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2013).

Reclaimed Sagebrush (Crandall Canyon)			n=80
TREES & SHRUBS	**Mean Percent**	**Standard Deviation**	**Percent Frequency**
Artemisia tridentata	17.88	14.16	81.25
Cercocarpus ledifolius	14.38	18.09	48.75
Pinus ponderosa	0.19	1.67	1.25
FORBS			
Artemisia ludoviciana	0.69	1.72	13.75
Aster chilensis	1.25	5.51	6.25
Linum lewisii	1.06	2.82	13.75
Melilotus officinalis	4.50	5.73	47.50
Penstemon sp	0.88	2.60	11.25
GRASSES			
Elymus cinereus	5.44	8.85	35.00
Elymus junceus	0.94	3.07	10.00
Elymus lanceolatus	2.19	4.86	20.00
Elymus smithii	4.56	9.26	25.00
Elymus spicatus	2.31	6.47	15.00
Poa secunda	3.00	6.64	21.25
Stipa hymenoides	0.19	1.67	1.25

Table 21: Willow Creek Mine Area. Total Cover and Composition (2013).

Reclaimed Sagebrush (Crandall Canyon)		n=80
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Total Living Cover	59.44	8.94
Litter	10.94	3.17
Bareground	10.13	4.87
Rock	19.50	8.72
B. % COMPOSITION		
Shrubs	54.61	28.53
Forbs	14.26	15.04
Grasses	31.13	27.90
Sample size (n) = 80 SAMPLE ADEQUACY (nMIN) 80%± 0.10 = 4 samples 90%± 0.10 = 6 samples		

Table 22: Willow Creek Mine Area.
Woody Species Density (2013).

Reclaimed Sagebrush
(Crandall Canyon) n=80

SPECIES	Individuals Per Acre
Artemisia tridentata	5649.92
Cercocarpus ledifolius	2601.59
Chrysothamnus nauseosus	52.56
Pinus ponderosa	105.11
TOTAL	**8409.18**

Sample size (n) = 80
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 29 samples
90%± 0.10 = 48 samples

Table 23: Willow Creek Mine Area. Annual Production (2013).

Reclaimed Sagebrush
(Crandall Canyon) n=40

	Pounds/Acre	
LIFEFORM	Mean	Std. Dev.
Herbaceous	378.17	566.76
Woody	925.26	676.56
TOTAL	**1303.43**	**281.32**

Sample size (n) = 40
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 8 samples
90%± 0.10 = 13 samples

Table 24: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2013).

Reclaimed Mountain Brush - East (Crandall Canyon)			n=10
SHRUBS	**Mean Percent**	**Standard Deviation**	**Percent Frequency**
Artemisia tridentata	16.50	18.85	60.00
FORBS			
Artemisia ludoviciana	0.50	1.50	10.00
Linum lewisii	2.50	4.03	30.00
Penstemon sp	2.50	5.12	20.00
GRASSES			
Elymus cinereus	34.50	31.18	80.00
Elymus lanceolatus	1.00	3.00	10.00
Elymus smithii	6.00	12.00	30.00

Table 25: Willow Creek Mine Area. Total Cover and Composition (2013).

Reclaimed Mountain Brush - East (Crandall Canyon)		n=10
A. TOTAL COVER	**Mean Percent**	**Standard Deviation**
Total Living Cover	63.50	7.43
Litter	13.50	7.09
Bareground	14.30	5.02
Rock	8.70	6.86
B. % COMPOSITION		
Shrubs	27.23	29.57
Forbs	10.31	18.63
Grasses	62.46	40.24

Table 26: Willow Creek Mine Area.
Woody Species Density (2013).

Reclaimed Mountain Brush - East (Crandall Canyon) n=10

SPECIES	Individuals Per Acre
Artemisia tridentata	604.61
Chrysothamnus nauseosus	325.56
TOTAL	**930.17**

Table 27: Willow Creek Mine Area. Annual Production (2013).

Reclaimed Mountain Brush - East (Crandall Canyon) n=10

	Pounds/Acre	
LIFEFORM	Mean	Std. Dev.
Herbaceous	649.62	699.77
Woody	456.87	472.93
TOTAL	**1106.49**	**346.06**

Table 28: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2013).

Reclaimed Mountain Brush - West (Crandall Canyon) n=10

TREES & SHRUBS	Mean Percent	Standard Deviation	Percent Frequency
Artemisia tridentata	6.50	9.76	40.00
Cercocarpus ledifolius	5.00	12.04	20.00
FORBS			
Achillea millefolium	2.50	6.02	20.00
Artemisia ludoviciana	1.00	2.00	20.00
Aster chilensis	0.50	1.50	10.00
Linum lewisii	1.00	3.00	10.00
Melilotus officinalis	9.00	12.81	50.00
Penstemon sp	4.50	5.68	40.00
GRASSES			
Elymus cinereus	15.00	15.81	80.00
Elymus lanceolatus	1.50	3.20	20.00
Elymus smithii	10.50	12.34	60.00
Elymus spicatus	0.50	1.50	10.00
Poa secunda	1.00	3.00	10.00

Table 29: Willow Creek Mine Area. Total Cover and Composition (2013).

Reclaimed Mountain Brush - West (Crandall Canyon) n=10

A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	58.50	8.08
Litter	12.00	6.40
Bareground	8.00	3.32
Rock	21.50	12.05
B. % COMPOSITION		
Shrubs	19.23	23.51
Forbs	32.05	16.41
Grasses	48.72	24.07

Table 30: Willow Creek Mine Area.
Woody Species Density (2013).

Reclaimed Mountain Brush - West (Crandall Canyon)	n=10
SPECIES	**Individuals Per Acre**
Artemisia tridentata	4400.36
Cercocarpus ledifolius	412.53
Chrysothamnus nauseosus	412.53
Pseudotsuga menziesii	275.02
TOTAL	**5500.45**

Table 31: Willow Creek Mine Area. Annual Production (2013).

Reclaimed Mountain Brush - West (Crandall Canyon)		n=10
	Pounds/Acre	
LIFEFORM	Mean	Std. Dev.
Herbaceous	656.04	693.95
Woody	535.40	556.86
TOTAL	**1191.44**	**298.62**

Table 32: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2013).

Mountain Brush Reference Area			n=40
OVERSTORY	Mean Percent	Standard Deviation	Percent Frequency
Juniperus osteosperma	0.38	1.32	7.50
Pinus edulis	0.25	1.56	2.50
UNDERSTORY			
TREES & SHRUBS			
Amelanchier utahensis	1.13	4.40	7.50
Artemisia tridentata	7.38	10.31	40.00
Atriplex canescens	1.38	5.59	7.50
Ephedra viridis	0.38	2.34	2.50
Gutierrezia sarothrae	0.38	1.73	5.00
Juniperus osteosperma	0.50	3.12	2.50
Opuntia polyacantha	0.38	1.73	5.00
Pinus edulis	0.63	3.90	2.50
FORBS			
Machaeranthera canescens	0.13	0.78	2.50
Salsola tragus	0.13	0.78	2.50
GRASSES			
Bromus tectorum	1.13	3.79	10.00
Elymus salinus	20.75	12.77	90.00
Stipa hymenoides	4.88	8.18	30.00

Table 33: Willow Creek Mine Area. Total Cover and Composition (2013).

Mountain Brush Reference Area		n=40
A. TOTAL COVER	Mean Percent	Standard Deviation
Overstory (O)	0.63	2.00
Understory (U)	39.13	7.06
Litter	11.63	4.53
Bareground	16.88	5.21
Rock	32.38	8.21
O+U	39.76	6.80
B. % COMPOSITION		
Shrubs	30.87	29.27
Forbs	0.67	2.93
Grasses	68.46	29.06
Sample size (n) = 40 SAMPLE ADEQUACY (nMIN) 80%± 0.10 = 5 samples 90%± 0.10 = 8 samples		

Table 34: Willow Creek Mine Area.
Woody Species Density (2013).

Mountain Brush Reference Area	n=40
SPECIES	**Individuals Per Acre**
Amelanchier utahensis	144.04
Artemisia tridentata	1252.03
Atriplex canescens	110.80
Echinocereus triglochidiatus	11.08
Ephedra viridis	77.56
Juniperus osteosperma	77.56
Opuntia polyacantha	44.32
Pinus edulis	55.40
TOTAL	**1772.79**

Sample size (n) = 40
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 16 samples
90%± 0.10 = 27 samples

Table 35: Willow Creek Mine Area. Annual Production (2013).

Mountain Brush Reference Area		n=40
	Pounds/Acre	
LIFEFORM	Mean	Std. Dev.
Herbaceous	317.67	280.00
Woody	289.12	356.74
TOTAL	**606.79**	**148.25**

Sample size (n) = 40
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 10 samples
90%± 0.10 = 16 samples

Table 36: Willow Creek Mine Area. Living Cover and Frequency by Plant Species (2013).

Crandall Canyon (SB) Reference Area n=60

SHRUBS	Mean Percent	Standard Deviation	Percent Frequency
Artemisia tridentata	16.00	16.85	61.67
Atriplex canescens	0.75	4.26	3.33
Ephedra viridis	0.67	5.12	1.67
Opuntia polyacantha	0.42	2.29	5.00
FORBS			
Artemisia ludoviciana	0.42	1.89	5.00
Chenopodium sp.	1.17	3.69	10.00
Stanleya pinnata	0.33	1.80	3.33
GRASSES			
Bromus tectorum	2.17	5.51	20.00
Elymus salinus	22.67	13.98	90.00
Elymus spicatus	0.33	2.56	1.67
Sporobolus airoides	1.00	4.81	3.33
Stipa comata	0.50	3.84	1.67

Table 37: Willow Creek Mine Area. Total Cover and Composition (2013).

Crandall Canyon (SB) Reference Area n=60

A. TOTAL COVER	Mean Percent	Standard Deviation
Total Living Cover	46.42	11.15
Litter	10.00	3.54
Bareground	9.75	5.04
Rock	33.83	10.66
B. % COMPOSITION		
Shrubs	36.00	31.47
Forbs	4.50	10.59
Grasses	59.50	30.39
Sample size (n) = 60 SAMPLE ADEQUACY (nMIN) 80%± 0.10 = 9 samples 90%± 0.10 = 16 samples		

Table 38: Willow Creek Mine Area.
Woody Species Density (2013).

Crandall Canyon (SB) Reference Area	n=60
SPECIES	**Individuals Per Acre**
Artemisia tridentata	1265.03
Atriplex canescens	40.25
Atriplex confertifolia	5.75
Ephedra viridis	40.25
Gutierrezia sarothrae	5.75
Opuntia polyacantha	17.25
Ribes aureum	5.75
TOTAL	**1380.03**

Sample size (n) = 60
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 19 samples
90%± 0.10 = 31 samples

Table 39: Willow Creek Mine Area. Annual Production (2013).

Crandall Canyon (SB) Reference Area		n=60
	Pounds/Acre	
LIFEFORM	Mean	Std. Dev.
Herbaceous	392.39	400.67
Woody	530.34	585.87
TOTAL	**922.73**	**295.93**

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

Table 40: Willow Creek Mine Area. *Lumped* Data for Total Cover (2013).

Reclaimed Areas (Gravel Canyon, Conveyor Corridor, Refuse Pile, Loadout)		
	Mean Percent	Standard Deviation
TOTAL LIVING COVER	60.00	9.51

Sample size (n) = 157
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 4 samples
90%± 0.10 = 7 samples

Table 41: Willow Creek Mine Area. *Lumped* Data for Total Woody Species Density (2013).

Reclaimed Areas (Gravel Canyon, Conveyor Corridor, Refuse Pile, Loadout)

Number of Individuals Per Acre	Mean	Standard Deviation
TOTAL	2021.77	525.43

Sample size (n) = 61
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 11 samples
90%± 0.10 = 18 samples

Table 42: Willow Creek Mine Area. *Lumped* Data for Total Annual Biomass Production (2013).

Reclaimed Areas (Gravel Canyon, Conveyor Corridor, Refuse Pile, Loadout)

Pounds/Acre	Mean	Standard Deviation
TOTAL	**1442.70**	**392.20**

Sample size (n) = 77
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 12 samples
90%± 0.10 = 20 samples

Table 43: Willow Creek Mine Area. *Lumped* Data for Total Cover (2013).

Reclaimed Areas in Crandall Canyon (Mountain Brush - East, West)		
	Mean Percent	Standard Deviation
TOTAL LIVING COVER	61.00	8.15

Sample size (n) = 20
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 3 samples
90%± 0.10 = 5 samples

Table 44: Willow Creek Mine Area. *Lumped* Data for Total Woody Species Density (2013).

Reclaimed Areas in Crandall Canyon (Mountain Brush - East, West)		
Number of Individuals Per Acre	Mean	Standard Deviation
TOTAL	1591.24	2514.28

Sample size (n) = 20
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 409 samples
90%± 0.10 = 676 samples

Table 45: Willow Creek Mine Area. *Lumped* Data for Total Annual Biomass Production (2013).

Reclaimed Areas in Crandall Canyon (Mountain Brush - East, West)		
Pounds/Acre	Mean	Standard Deviation
TOTAL	**1148.97**	**325.99**

Sample size (n) = 20
SAMPLE ADEQUACY (nMIN)
80%± 0.10 = 785 samples
90%± 0.10 = 1296 samples

COLOR PHOTOGRAPHS OF THE SAMPLE AREAS:

WILLOW CREEK AREA

Reclaimed Gravel Canyon

Reclaimed Conveyor Corridor

Reclaimed Refuse Pile

Reclaimed Loadout

Reclaimed Riparian Bottoms

CRANDALL CANYON AREA

Reclaimed Sagebrush

Reclaimed Mountain Brush (East)

Reclaimed Mountain Brush (West)

Mountain Brush Reference Area

Crandall Canyon (SB) Reference Area

Attachment 2

Sediment Yield Calculations

Sediment Yield Calculations
Pre-Mining vs. Post-Reclamation Condition
Willow Creek Mine Phase III Bond Release
Plateau Mining Corporation

Summary

EarthFax Engineering Group, LLC used the Revised Universal Soil Loss Equation (RUSLE) to calculate sediment yields from the area of the Willow Creek 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 under pre-mining baseline conditions or in undisturbed reference areas. Estimated sediment yields are

Area	Sed Yield (ton/ac/yr)		Percent
	Pre-Mine	Post-Mine	Difference
Gravel Canyon	4.86	0.08	-98.4
Refuse Pile	22.37	0.67	-97.0
Conveyor Corridor	20.88	0.21	-99.0
Loadout	4.25	0.27	-93.6
Riparian Bottoms	5.75	0.36	-93.8
Crandall Canyon	6.08	0.14	-97.8

As indicated, it is estimated that sediment yields are more than 90% less after reclamation as compared with natural conditions before the area was disturbed by mining.

Sediment Yield Calculation

Vegetative Community	R	K	LS	C	P	A (t/ac/yr)
Pre-Disturbance						
Gravel Canyon	8	0.10	28.90	0.21	1	4.86
Refuse Pile	8	0.55	24.21	0.21	1	22.37
Conveyor Corridor	8	0.43	28.90	0.21	1	20.88
Loadout	8	0.43	5.89	0.21	1	4.25
Riparian Bottoms	8	0.43	7.95	0.21	1	5.75
Crandall Canyon	12	0.10	42.24	0.12	1	6.08
Post-Reclamation						
Gravel Canyon	8	0.10	1.02	0.098	1	0.08
Refuse Pile	8	0.55	1.61	0.095	1	0.67
Conveyor Corridor	8	0.43	0.71	0.086	1	0.21
Loadout	8	0.43	1.02	0.078	1	0.27
Riparian Bottoms	8	0.43	1.38	0.075	1	0.36
Crandall Canyon	12	0.10	1.30	0.087	1	0.14

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 (ft-tons/acre/hr). Values interpolated 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). Values obtained from the NRCS Web Soil Survey. 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 assumed that P=1.

References:

1. *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.

LS Calculation Table

Location	s	l	m	LS
Pre-Disturbance				
Gravel Canyon	71	100	0.5	28.90
Refuse Pile	62	100	0.5	24.21
Conveyor Corridor	71	100	0.5	28.90
Loadout	25	100	0.5	5.89
Riparian Bottoms	30	100	0.5	7.95
Crandall Canyon	100	100	0.5	42.24
Post-Reclamation				
Gravel Canyon	25	3	0.5	1.02
Refuse Pile	33	3	0.5	1.61
Conveyor Corridor	20	3	0.5	0.71
Loadout	25	3	0.5	1.02
Riparian Bottoms	30	3	0.5	1.38
Crandall Canyon	29	3	0.5	1.30

Notes:

1. s = slope angle (%). Since pre-disturbance topography was not available, pre-disturbance slopes were estimated from adjacent undisturbed areas. Post-reclamation slopes represent the steepest conditions for each site. Slope data were obtained from maps provided in the
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. Natural 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 typical 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 percent living cover at the site was taken from the 10-year revegetation monitoring report for the site performed by Mt. Nebo Scientific, Inc. and dated March 2015. The comparison standards (baseline or reference area) are those used by Mt. Nebo Scientific in their revegetation monitoring report.

C factors were interpolated linearly from the tables provided by Haan et al. (1994). The Mt. Nebo Scientific report presents percent living cover data for three vegetative types in Crandall Canyon (Sagebrush, Mountain Brush East, and Mountain Brush West). The percent living cover for these vegetative types raged from 61.1 to 64.5%. As a conservative measure, the lowest percent cover was used to determine the C factor for post-reclamation conditions in Crandall Canyon. Similarly, the Mt. Nebo Scientific report presents data for two reference areas (Sagebrush and Mountain Brush). The living cover in these reference areas ranged from 47.6% to 49.2%. As a conservative measure, the highest of these value4s was used to represent undisturbed conditions.

It was also assumed that no appreciable canopy exists and that the cover at the surface consists of mostly broadleaf herbaceous plants. This is a conservative assumption since canopy 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.

Area	Comparison Standard	Pre-Mine		Post-Reclamation	
		% Living Cover	C	% Living Cover	C
Gravel Canyon	Baseline	26.7	0.21	57.2	0.098
Refuse Pile	Baseline	26.7	0.21	58.4	0.095
Conveyor Corridor	Baseline	26.7	0.21	61.8	0.086
Loadout	Baseline	26.7	0.21	65.0	0.078
Riparian Bottoms	Baseline	26.7	0.21	66.5	0.075
Crandall Canyon	Reference Area	49.2	0.12	61.1	0.087

References:

1. Haan, C.T., B.J. Barfield, and J.C. Hayes. 1994. *Design Hydrology and Sedimentology for Small Catchments*. Academic Press, San Diego, California.
2. Mt. Nebo Scientific, Inc., 2015, Revegetation Monitoring for Phase III Bond Release at the Willow Creek Mine, Year 10: 2014. prepared by Patrick Collins, Ph.D. for Plateau Mining Corporation.

Attachment 3

Public Notice

Public Notice
Application for Phase III Bond Release on a Portion of the Mine
Plateau Mining Corporation, Willow Creek Mine
Permit C/007/0038, Renewed 04/24/2011

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 for phase III bond release for certain acres of land in the Willow Creek Mine Permit C/007/0038. This phase III bond release applies to the 93.21 acres of the 94.40 acres that remain in the permit. Plateau Mining Corporation has completed phase III of the approved reclamation plan for 93.21 acres in the Willow Creek Mine Permit based on meeting the vegetation and water quality requirements for phase III reclamation in accordance with the approved reclamation plan. In order to receive phase III bond release the Permittee must demonstrate that, (1) the vegetation on the reclaimed site has been established in accordance with the approved reclamation plan and (2) that no part of the land is contributing suspended solids to the stream flow or runoff outside the permit area in excess or the requirements set by UCA 40-10-17(2) (j) of the Act or by R645-301-751of the rules.

In accordance with the provision of R645-301-880 and R645-301-400 of the State of Utah Coal Mining Rules, notice is hereby given that Plateau Mining Corporation is applying for total release of the performance bond posted for this 93.21 acres. The surety bond posted for the Willow Creek Mine is $489,166; Plateau Mining Corporation is seeking release of $478,714 which will reduce the bond to $10,452 which will continue to cover the remaining 1.19 acres.

The permit area is shown on the Helper, Standardville and Kyune U.S. Geological Survey 7.5-minute maps. The portion of the permit area that is affected contains a total of 94.40 acres and is located in Carbon County, Utah as follows:

Sec. 35, T. 12 S., R. 9 E. NE ¼ SE ¼, SE ¼ SE ¼
Sec. 36, T. 12 S., R. 9 E. NE ¼ SW ¼, NW ¼ SW ¼, SW ¼ SW ¼, SE ¼ SW ¼
Sec. 22, T. 12 S., R. 9 E. SE ¼ SW ¼, SW ¼ SE ¼
Sec. 27, T. 12 S., R. 9 E. NE ¼ NW ¼, NW ¼ NW ¼, SW ¼ NW ¼, NW ¼ SW ¼
Sec. 28, T. 12 S., R. 9 E. NE ¼ SW ¼, SE ¼ SW ¼, NE ¼ SE ¼, NW ¼ SE ¼, SW ¼ SE ¼
Sec. 1, T. 13 S., R. 9 E. NE ¼ NE ¼, NW ¼ NE ¼, SW ¼ NE ¼, SE ¼ NE ¼, NE ¼ NW ¼, NW, ¼ NW ¼

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 public hearing or informal conference on this proposal may be addressed to:

Utah Coal Program
Utah Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
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 this proposal must be submitted by July 18, 2015.

Published in the Sun Advocate on May 28th, June 4th, 11th and 18th, 2015.

Attachment 4

Landowner and Government Agency Notifications

PLATEAU MINING CORPORATION

May 28, 2015

Mark Stilson, Regional Engineer
State of Utah
Division of Water Rights
319 Carbonville Rd. Suite B
Price, Utah 804501

Re: Notification of Application for Phase III Bond Release on a Portion of the Mine, Plateau Mining Corporation, Willow Creek Mine, C/007/038, Carbon County, Utah

Dear Mr. Stilson,

Plateau Mining Corporation, P.O. Box 30, Helper, UT 84526, has completed Phase III of the approved reclamation plan for 93.21 of the 94.40 remaining disturbed acres of in the Willow Creek Permit. This Phase III bond release application is based meeting the vegetation and water quality requirement for Phase III reclamation in accordance with the approved reclamation plan.

In accordance with the requirements 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 these 93.21 acres. The bond posted for the Willow Creek Mine is $489,166 from which Plateau Mining Corporation is seeking Phase II release of $478,714.

The permit area is shown on the Helper, Standardville and Kyune U.S. Geological Survey 7.5-minute maps. The portion of the permit area that is affected contains a total of 94.40 acres and is located in Carbon County, Utah as follows:

Sec. 35, T. 12 S., R. 9 E.	NE ¼ SE ¼, SE ¼ SE ¼
Sec. 36, T. 12 S., R. 9 E.	NE ¼ SW ¼, NW ¼ SW ¼, SW ¼ SW ¼, SE ¼ SW ¼
Sec. 22, T. 12 S., R. 9 E.	SE ¼ SW ¼, SW ¼ SE ¼
Sec. 27, T. 12 S., R. 9 E.	NE ¼ NW ¼, NW ¼ NW ¼, SW ¼ NW ¼, NW ¼ SW ¼
Sec. 28, T. 12 S., R. 9 E.	NE ¼ SW ¼, SE ¼ SW ¼, NE ¼ SE ¼, NW ¼ SE ¼, SW ¼ SE ¼
Sec. 1, T. 13 S., R. 9 E.	NE ¼ NE ¼, NW ¼ NE ¼, SW ¼ NE ¼, SE ¼ NE ¼, NE ¼ NW ¼, NW, ¼ NW ¼,

Comments concerning Phase II I 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 Ware, P.O. Box 30 Helper, Utah 84526 prior to July 18, 2015.

Sincerely,

Dennis Ware
Company Representative
(435) 472-4737
dware@alphanr.com

Mailed to:

Carbon County Planning and Zoning
120 East Main Street
Price, Utah 84501

Director Land Management
Blackhawk Coal Company
700 Morrison Road
Gahanna, Ohio 43230-6642

Helper City
P.O. Box 221
Helper, Utah 84526

Utah Power and Light
Carbon Plant
Helper, Utah 84526

Carbon County Commissioners
120 East Main Street
Price, Utah 84501

Price River Water Improvement District
P.O. Box 903
265 South Fairgrounds Road
Price, Utah 84501

Mr. Steven Rigby
Bureau of Land Management
125 South 600 West
Price, Utah 84501

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

State of Utah
Department of Transportation
940 South Carbon Avenue
Price, Utah 84501

Mr. Reed Martineau
Snow, Christensen & Martineau
P.O. Box 45000
Salt Lake City, Utah 84145-5000

Eric Larson, Regional Supervisor
State of Utah
Division of Wildlife Resources
319 North Carbonville, Rd. Suite A
Price, Utah 84501

Mark Stilson, Regional Engineer
State of Utah
Division of Water Rights
319 Carbonville Rd. Suite B
Price, Utah 804501

Field Office Director
Office of Surface Mining
1999 Broadway, Suite 3320
Denver, CO 80202-3050

Attachment 5

Reclamation Certification

Plateau Mining Corporation
Willow Creek Mine
C/007/0038

Partial Phase III Bond Release for 94.21 acres of land in the Willow Creek Mine Permit C/007/0038

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

Company Representative
Position

5-11-15
Signature, Date

Subscribed and sworn to before me this 11th day of May, 2015

Ruanne Leeflang
Notary Public

Notary Public
RUANNE LEEFLANG
Commission #667709
My Commission Expires
June 30, 2017
State of Utah

My Commission Expires: 6-30, 2017
Attest: State of Utah
County of Emery

Attachment 6

Bond Release Calculation

Bond Release Calculation

Willow Creek Mine Phase III Bond Reduction on a Portion of the Mine

Rule R645-301-880.320 "...When determining the amount of bond to be released after successful revegetation has been established, the Division will retain that amount of bond for the revegetated area which would be sufficient to cover the cost of reestablishing revegetation if completed by a third party for the period specified for operator responsibility in UCA 40-10-17(t) of the Act for reestablishing revegetation." ..."

As part of the Willow Creek Mine phase II bond release a detailed calculation and explanation of the cost or reestablishing vegetation was provided (see Volume 17, Exhibit 24, Attachment 6 of the MRP). This document demonstrated that the cost to reestablish vegetation in Crandall Canyon in 2012 dollars was $8,446.84 per acre. The Division of Oil Gas and Mining provided escalation factors for bonds through the year 2015 in a letter from Wayne Western dated February 12, 2015 (see attachment). The escalation factors for the years 2013, 2014 and 2015 are 1.019, 1.012 and 1.900 respectively. Escalating the Crandall Canyon revegetation cost in 2012 dollars by the above escalation factors results in a 2015 cost per acre of $8,783.03. Following the approval of this Phase III bond release application 1.19 acres will remain in the Willow Creek Permit, therefore, the remaining bond should be $10,452 ($8,783 X 1.19 acres). The current bond is $489,166 and the bond following approval of this bond release application should be $10,452, therefore, the amount of this bond release should be $478,714.

GARY R. HERBERT
Governor

SPENCER J. COX
Lieutenant Governor

State of Utah

DEPARTMENT OF NATURAL RESOURCES

MICHAEL R. STYLER
Executive Director

Division of Oil, Gas and Mining

JOHN R. BAZA
Division Director

February 12, 2015

TO: General File
Dana Dean, Associate Director
Steve Christensen, Permit Supervisor
Daron Haddock, Permit Supervisor
Paul Baker, Minerals Program Manager

FROM: Wayne Western, Environmental Scientist

RE: Escalation Factor for 2015 – 1.9%

Following are the index numbers and escalation factor from the Means Historical Cost Index for Site Construction, National Average:

Year	Index	Escalation (5 Year Averages)
2003	119.2	
2004	120.2	1.005
2005	125.0	1.016
2006	131.8	1.032
2007	134.6	1.038
2008	130.0	1.013
2009*	133.8	1.005
2010	136.2	1.017
2011**	140.2	1.012
2012	145.0	1.015
2013	143.1	1.019
2014	141.7	1.012

The escalation factor for bonds estimated from this date forward in 2015 will use the 1.2% escalation factor. The escalation factor was calculated from the Historic Cost Index for Site Construction.

*Starting with January 2009, fuel costs and routine maintenance costs are included in the equipment cost.

** Starting in 2011 the escalation will be based on a five-year prior factors were based on a three-year average.

P:\GROUPS\MINERALS\WP\BondAverageCostPerAcre\2015\EscalationMemo2015.doc