ADDENDUM 17.24.313B
TECHNICAL STANDARDS
SPRING CREEK MINE, MONTANA

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TECHNICAL STANDARDS DESIGNED FOR POST-MINE LAND USES AT THE SPRING CREEK MINE, MONTANA

1.0 INTRODUCTION

The Montana Strip and Underground Mine Reclamation Act (MSUMRA) specifies the requirements for application, permit issuance, operation, and reclamation for coal mining within the state. Before a permit for mining is issued, the operator must file a bond with the Department that will cover the costs of reclamation should the operator fail to complete such work.

Four levels of bond release occur as progressive stages of reclamation are completed. Phase III bond release may be applied for after the revegetation has had at least ten growing seasons. Eligibility for Phase III bond release is contingent upon meeting the revegetation criteria specified in the Act and the Administrative Rules of Montana (ARM).

MSUMRA and the federal Surface Mining Control and Reclamation Act (SMCRA) clearly intend that land be reclaimed to a state that fully supports the post-mining land uses that are approved in the mining permit. Such post-mining land uses are predicated on the uses that existed prior to mining, unless an alternative post-mining land use is proposed and approved. In general, the intent is that the land be functionally equivalent to its pre-mining state. However, the law clearly recognizes that "...duplication of pre-mining topography, soils, and vegetation composition is not practical" (MCA 82-4-202(3)(c)).

Two different approaches are allowed by law to determine if revegetation criteria have been met for Phase III bond release. The first approach specifies the use of a reference area as a control for determining success. The vegetation production, cover, and woody plant density numbers are compared to reference areas sampled in the same growing season. The second approach specifies the use of technical standards. Rather than comparing measures of the reclaimed vegetation against similar measures on a specific plot of ground, revegetation monitoring results are compared against numeric technical standards. Technical standards may be derived from historical data, from previously revegetated areas that are compared to historical data, or from data and information provided by U.S. Department of Agriculture or U.S. Department of Interior (ARM 17.24.724(3)).

The Spring Creek Mine (SCM) chooses to develop technical standards for Phase III bond release, but reserves the option to use reference area data for Phase III bond release. Sections 2.0 through 4.0 below discuss the development of a woody plant density standard for Wildlife Habitat. Sections 5.0 and 6.0 below discuss the development of cover and production standards for Pastureland and Grazing Land, and cover for Wildlife Habitat. Samples used to develop the technical standards represent the Grazing Land, Pastureland, and Wildlife Habitat land use types for the general region around the Spring Creek Mine. As a result, the technical standards do not require revision as additional areas are added to the mine permit boundary unless additional land use types are encountered.

2.0 WILDLIFE RECLAMATION COMMITMENTS

The purpose of this review is to describe the primary components of mule deer and sage-grouse habitat and to develop standards for assessing the development of those habitat components in a post-mine, reclamation landscape designated as Wildlife Habitat land use. The premise of this review is that the type of wildlife habitat reclaimed within the SCM footprint should be prioritized according to: 1) the type of habitat that existed pre-mine; 2) habitats that will provide components that are otherwise limited on the landscape; and 3) habitat reclamation is planned in context with the surrounding, undisturbed landscape. All baseline woody plant density data available for the Spring Creek Mine area were reviewed and incorporated into this standards assessment (Prodgers 2007, 1998, 1991, 1990; VTN 1977).

The SCM Environmental Baseline Studies (EBS's) document that land management practices at the SCM have varied. Pre-mine attempts have been made to put portions of the permit area into dryland cultivation. Such attempts have failed due to one or more of the following reasons: climatic factors, soil depth, slope, land use configurations, available water supply and management practices. An extensive search of agricultural records has been made to determine any history of intensive agricultural use. In addition, local landowners have been contacted to discuss historical practices. Little evidence has been found to indicate that lands within the permit area have ever been successfully used for anything other than Pastureland and Grazing Land.

The EBS's document a variety of commonly occurring wildlife species utilizing the area. For example, portions of the SCM have been designated as crucial sage-grouse habitat. Additionally, coal leasing stipulations require SCM to have an additional post-mining land use of Wildlife Habitat. As a result, SCM has post-mining land uses of Pastureland, Grazing Land and Wildlife Habitat.

ARM 17.24.726 requires Pastureland and Grazing Land to meet production and cover for Phase III Bond release. Wildlife Habitat is required to meet cover and woody plant density for Phase III Bond release. SCM has committed to enhance fish and wildlife habitats by complying with a woody plant density standard for Grazing Land areas as discussed in Section 5.0 below. In addition, SCM commits to constructing wildlife habitat enhancement features (WHEFs) on 5 percent of the areas designated as Grazing Land and Pastureland consistent with Department guidelines.

SCM has the following stipulations associated with coal leases.

- Federal Lease MTM-69782 was the original coal lease issued to SCM in 1965. The original lease did not stipulate a post mining land use of Wildlife Habitat. This lease was amended in 2000. The amended lease includes a letter from the MDFWP to the BLM which states, "...restore disturbed lands to their full potential as mule deer winter range...", this statement affecting 2,505 acres.

- State coal lease C-1088-05 was issued to SCM in 1965. Approximately 265 acres of this area has been recently designated as crucial sage-grouse habitat. The State, who owns the surface, requires a post-mining land use designation of Wildlife Habitat associated with the 265 acres.

- Federal Lease MTM-88405 (150 acres) was issued in 2001. The Environmental Assessment states, "...land must be restored to the appropriate original contour and revegetated to restore mule deer and grouse habitat."

- Federal Lease MTM-94378 was issued in 2007. The Record of Decision states, "....land must be restored to the appropriate original contour and revegetated to restore mule deer and grouse habitat," this statement affecting 482 acres.

- Federal Lease MTM-69782 was modified in 2010 through a Lease by Modification (LBM). The LBM Record of Decision requires reclaiming 848 acres as Wildlife Habitat of which 108 acres will be disturbed by the Pearson Creek Permit Amendment (Application 183).

These stipulations affect a total of 3,510 acres. In summary, the SCM has commitments identified reclaiming 3,510 acres of Wildlife Habitat; specifically, 2,505 acres of mule deer (*Odocoileus hemionus*) habitat, 373 acres of greater sage-grouse (sage-grouse, *Centrocercus urophasianus*) habitat, and 632 acres of habitat designated for both species. Habitat for both of these species is not homogeneous but includes a diverse assemblage of vegetation, and in the case of mule deer particularly, topography.

The preliminary land use balance table (Table 313-3 in Section 313 of SMP C1979012) associates these lease stipulations with wildlife focus areas targeted for the post-mine Wildlife Habitat land use. Table 1 correlates pre-mine vegetation types with pre-mine land uses. In addition to the lease stipulations summarized above, minor permit revision 235 is an Incidental Boundary Change (IBC) which disturbs an area designated as general sage-grouse habitat as discussed in Section 312 and 313 of SMP C1979012. This revision converts 60 acres of premine Pastureland to Wildlife Habitat as a conservation measure.

Table 1. Acreage of Pre-mine Vegetation Physiognomic Types at Spring Creek Mine (based on Plate 23), 2017.

		PRE-MINE ACRES[1]					
Vegetation Physiognomic Type[1]	**Pre-mine Land Use[1]**	Projected Disturbance	Percent of Total	Undisturbed	Percent of Total	Total	Percent of Total
Grassland	Grazing Land (Wildlife Habitat)	188.4	2%	70.8	1%	260.2	3%
GHF		332.0	4%	254.3	3%	586.3	6%
Mixed Shrub		501.4	5%	317.3	3%	818.7	9%
Sagebrush		3,725.3	40%	1,832.4	20%	5,557.7	60%
Pine-Juniper		456.6	5%	269.9	3%	735.5	8%
Subtotal		**5,212.7**	**57%**	**2,744.7**	**30%**	**7,958.4**	**86%**
Special Use Pasture	Pastureland (Wildlife Habitat)	702.5	8%	106.9	1%	808.2	9%
Subtotal		**702.5**	**8%**	**106.9**	**1%**	**808.2**	**9%**
Disturbance	Support Facilities	20.5	0%	10.6	0%	31.1	0%
Pond[2]		2.5	0%	0.1	0%	2.6	0%
Rock Outcrop		NA	-	NA	-	NA	-
Subtotal		**23**	**0%**	**10.7**	**0%**	**33.7**	**0%**
Miscellaneous[3]	Grazing Land (Wildlife Habitat)	181.7	2%	237.8	3%	419.5	5%
Subtotal		**181.7**	**2%**	**237.8**	**3%**	**419.5**	**5%**
TOTAL		**6,120**	**66%**	**3,100**	**34%**	**9,220**	**100%**

[1]As delineated on Plate 23. Wildlife habitats (vegetation types) are held to be "concurrent joint uses" with all other pre-mine land uses in the mine area, therefore acreages were not tallied separately for wildlife use, but were based on lease stipulations. Similarly, selected pine-juniper stands are occasionally logged for timber, fence posts, etc.; as the primary pre-mine land use of these stands is grazing, the forestry use is considered to be a "concurrent joint use" and acreages cannot be tallied separately for the forestry use. Physiognomic types were derived from the vegetation types depicted on Plate 23 as follows:

PHYSIOGNOMIC TYPE	VEGETATION TYPE
Grassland	AGSM, STCO
Grass/Half Shrub/Forb	GHF, GHF variant
Mixed Shrub	RHTR, SS, DB
Sagebrush	ATSP, ATSM, ATSM/AGCR, ARCA
Pine-Juniper	PJO, PJC

[2]Disturbance acreages include roads/gravel pits, dwellings, livestock facilities, logging slash piles, etc., which are held to be "support facilities for pre-mine land uses", and their acreages are subsumed under the appropriate pre-mine land use(s). Ponds and rock outcrops are also placed in the "support facilities" category.

[3]Miscellaneous acreage accounts for unmapped vegetation in the permitted railroad corridor.

3.0 HABITAT COMPONENT DESCRIPTIONS

Mule deer and sage-grouse habitat components are described below by species. Some of the habitat components are important to both species, for example canopy cover of Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*). These shared components have been described separately for each species in this document to facilitate developing reclamation standards pursuant to the lease stipulations.

3.1 Mule Deer Habitat Components

Mule deer occur throughout western North America and inhabit a variety of ecosystems and habitats (Wallmo 1981). These major habitats have been divided into different provinces and finer habitat distinctions to describe habitat components and habitat use at more local levels (Wallmo 1981, Mackie 1998). Mule deer habitats at SCM occur near the juncture of the Rocky Mountain/Intermountain region and the Great Plains region (Wallmo 1981). Specific mule deer habitats at the SCM fit within the definitions of prairie-badlands and timbered-breaks (Mackie *et al*. 1998), and include six habitat associations:

- Sagebrush-grassland
- Grassland
- Ponderosa pine
- Juniper
- Bottomland
- Playa (Thunderbird Wildlife Consulting 2010).

In addition to these specific habitat associations, much of the SCM permit area occurs within "crucial" mule deer winter range (Montana Department of Fish, Wildlife, and Parks 2010).

The primary components of mule deer habitat include a variety of forages to support mule deer populations at different times of year, cover (escape, thermal, resting, and fawning), and water (Wallmo 1981). Each component is discussed below, in the context of the Spring Creek Mine site.

3.1.1 Forage for Mule Deer

Mule deer forage requirements vary by season. Seasonal forage requirements are generally described in terms of higher amounts of grasses and forbs in spring and summer, and higher amounts of shrubs and forbs in fall and winter (Kufeld *et al*. 1973). This seasonal forage distribution, however, is a function of forage availability rather than preference based on nutritional needs or palatability (Wallmo 1981). Native grasses and forbs on many native ranges are cured and/or unavailable beneath snow cover compared to shrubs which may be browsed throughout the winter under most conditions. The ability to provide a diversity of forages, particularly in winter, can reduce mule deer mortality (Wallmo 1981) in part because providing a variety of forages reduces the necessity of deer browsing senescent sagebrush or juniper which contain indigestible volatile oils (Bissel *et al*. 1955, Longhurst *et al*. 1968). Native grasses and forbs, as well as forbs with high protein contents, such as alfalfa, can also improve mule deer winter condition by improving the digestibility of browse or cured grass (Milchunas 1977, Carpenter *et al*. 1979). Inclusion of "choice" foods that retain a higher percentage of green forage such as bluegrasses, annual grains, and alfalfa are important to supporting healthy mule deer populations throughout the year (Mackie *et al*. 2006). In fact, the most heavily utilized forage that was identified on the SCM area during baseline surveys was alfalfa and yellow sweet clover in pasturelands; skunkbush sumac and Rocky Mountain juniper were also commonly consumed in the summer and fall, while

rabbitbrush, silver sagebrush, and skunkbush sumac were commonly consumed in the winter (VTN Environmental Consultants 1977).

3.1.2 Cover for Mule Deer

Cover components for mule deer include vegetation, topography, and a combination of both components (Wallmo 1981, Hamlin and Mackie 1989). Rough and/or varied topography creates micro-climates that support different types of vegetation, provides different thermal environments, and provides hiding and escape cover from predators (Mackie *et al.* 1998). South-facing slopes are snow-free for longer periods during the winter and provide greater access to forage. Forage on south-facing slopes is often more sparse than on north-facing slopes, and is often composed of forbs, grasses, and limited shrubs. Forage on north-facing slopes is often composed of dense stands of grass or shrubs on relatively gentle slopes, and trees on steeper slopes. These topographic differences are a key feature in providing suitable environments for establishing diverse revegetation and providing a diversity of forages as noted by numerous authors (Wallmo 1981, Mackie *et al.* 1998, Watkins *et al*. 2007).

3.1.3 Water Sources for Mule Deer

Water sources are an important habitat component for mule deer, but typically do not limit deer distribution in Montana (Mackie 1970). Nevertheless, well-distributed water sources improve deer survival, particularly in arid environments (Wallmo 1981). Uniformly dispersed, small ponds improve mule deer habitat and also promote livestock distribution which can reduce livestock/deer competition (Kie *et al.* 1994, Parrish and Anderson 1994, Watkins *et al*. 2007). Upon receiving MDEQ approval, SCM will create several moisture catchment basins, small depressions, and larger ponds. These will serve as WHEFs.

3.1.4 Mule Deer Habitat Components and Pre-Mine Vegetation Types

The ideal amount and distribution of mule deer habitat components varies by season (Olson 1992) and depends, to some extent, on the home range of mule deer. Home ranges can serve as a measure for the amount and distribution of different habitat components that should be present on the reclaimed mine.

Home ranges of female mule deer in the prairie-badlands environment averages 2.1 to 3.4 km^2 for migratory deer between summer and winter, and 6.3 km^2 for resident mule deer (Wood *et al*. 1989). Average home ranges of resident female mule deer in timbered breaks environments average 5.2 km^2 (Hamlin and Mackie 1989). Within each home range there should be topographic and vegetative diversity (Hamlin and Mackie 1989). Some of this diversity (such as mature ponderosa pine, juniper, or sagebrush stands) occurs in abundance in the surrounding undisturbed habitat. Given that the majority of the surrounding landscape is native, undisturbed habitat, most of which is designated crucial winter range by Montana Department of Fish, Wildlife, and Parks (MDFWP). Habitat components that improve body condition prior to the onset of winter, and during the winter, such as high-quality herbaceous forage, may be in more limited supply than browse. Numerous studies have noted that the quality and

availability of summer and fall forage is a critical element in improving mule deer production, winter condition, and ultimately survival (Julander *et al*. 1961, Wallmo 1981, Cuthill and Houston 1997).

Home ranges, and habitat needs, on the reclaimed, post-mine area will overlap with home ranges and habitat use in adjacent undisturbed areas. This overlap between native, undisturbed habitats and reclaimed habitats provides an opportunity to supplement limited habitat components in undisturbed habitats with reclamation. For example, extensive sagebrush stands surround SCM. These communities provide important habitat for mule deer, but, because of their abundance they are not a limiting feature on the landscape. Further, increasing forage diversity improves mule deer ability to digest sagebrush in the winter (Milchunas 1977, Carpenter *et al*. 1979). Therefore since a variety of vegetation types comprise mule deer habitat, and since supplementing common, undisturbed habitats with more limited components will improve mule deer habitat in the general SCM area, pre-mine vegetation communities have been variously combined into seasonal mule deer habitats as shown in Table 2. In addition, the average shrub and tree density within the pre-mine vegetation types is shown weighted by each type's acreage. These densities are then averaged within each seasonal mule deer habitat to identify an average shrub and tree density by seasonal habitat. Finally, an overall mean of shrub and tree density is calculated. This stepwise procedure incorporates weighted averages to reflect shrub and tree densities in the pre-mine landscape, and emphasizes seasonally important habitat types by including and weighting them in different seasonal categories. For example, the pine-juniper, sagebrush, and grass/half shrub/forb types occur in both the spring/summer, and fall/winter seasonal habitats, effectively doubling these communities' density recognition. Deriving a single shrub and tree density in this manner provides the basis for the woody plant density standard presented in Table 5 for the post-mine Wildlife Habitat land use.

Table 2. Pre-Mine Vegetation Types Correlated with Seasonal Mule Deer Habitat Types, and Associated Baseline Shrub and Tree Density.

	SEASONAL MULE DEER HABITAT								
Pre-mine Vegetation Type[1]	Spring & Summer				Fall & Winter				
	Pine-Juniper	Sagebrush	Grass/Half Shrub/Forb	Grassland[3]	Pine-Juniper	Sagebrush	Mixed Shrub	Grass/Half Shrub/Forb	Pastureland[3]
Mean baseline shrub and tree densities plants/acre (plants/ha)[2]	2108 (5,210)	3674 (9,079)	1521 (3,758)	329 (812)	2108 (5,210)	3674 (9,079)	1944 (4,804)	1521 (3,758)	0 (0)
Mean baseline shrub and tree density by seasonal habitat type	2161 (5339)				2312 (5712)				
Overall mean shrub and tree density within mule deer habitat plants/acre (plants/ha)[2]	2236 (5526)								

[1] Pre-mine vegetation types are defined in baseline vegetation reports for the Pearson Creek, Carbone and South Fork Expansions (Prodgers 2007, 1998 and 1991). Shrub density was not measured during the original baseline effort (VTN Environmental Consultants 1977). Pine-Juniper is comprised of the PJO and PJC types. Sagebrush is comprised of the ATSP, ATSM, ATSM/AGCR, and ARCA types. Grass/Halfshrub/Forb is comprised of the GHF and GHF Variant types. Grassland is comprised of the AGSM and STCO types. Mixed Shrub is comprised of the RHTR, SS, and DB types. Pastureland is comprised of the SUP type with emphasis on hay meadows.

[2] Baseline densities are acreage-weighted shrub and tree densities derived from data provided in the Pearson Creek (2006), Carbone Amendment (1993-1994) and South Fork Expansion (1991) baseline reports as shown in Appendix A.

[3] As documented in the discussion above (Section 3.1), Mule deer utilize the pre-mine Grassland and Pastureland vegetation types. However, Grassland areas are weighted at half and Pastureland areas are excluded from these calculations, as these vegetation types will be provided in the Grazing Land and Pastureland post-mine land uses.

3.2 Sage-Grouse Habitat Components

Sage-grouse occur throughout western North America, primarily in areas that are dominated by the various species and subspecies of sagebrush (Wallestad 1975). Similar to mule deer habitat components, forage, cover, and water are important habitat components for sage-grouse. Unlike mule deer, rough topography is less of a habitat component for sage-grouse, although different aspects do enhance some habitat components such as forage availability in winter on south-facing slopes.

3.2.1 Forage for Sage-Grouse

Sage-grouse forage varies by season. Seasonal forage requirements are generally described in terms of higher amounts of grasses, forbs, and insects in spring and summer, and higher amounts of sagebrush in fall and winter, although sagebrush is consumed in the spring and summer also (Wallestad 1975). Juvenile sage-grouse in Montana consume primarily forbs (76 percent of diet) and insects (24 percent of diet) until approximately 12 weeks of age (Peterson 1970). Adult sage-grouse in Montana consume primarily sagebrush and forbs (97 percent of diet by volume) and insects (3 percent of diet) (Wallestad *et al*. 1975). Sagebrush is usually the only food consumed by adult birds between December and February, but can vary between 1 percent and 19 percent of their diet (by volume) between June and September when forbs are primarily consumed (Wallestad *et al*. 1975). Primary forbs consumed by juvenile and adult sage-grouse include fringed sagewort (*Artemisia frigida*), salsify (*Tragopogon dubius*), dandelion (*Taraxacum officinale*), prickly lettuce (*Lactuca serriola*), and alfalfa (*Medicago sativa*) (Peterson 1970, Wallestad *et al*. 1975). Forbs are known to contain high amounts of protein and nutrients such as calcium and phosphorus that improve the nutritional status of hen sage-grouse and reproductive success (Barnett and Crawford 1994, Hess and Beck 2010).

3.2.2 Cover for Sage-Grouse

Sage-grouse utilize different habitats seasonally, and have different cover requirements for breeding display, nesting, brood-rearing, and wintering. Primary elements of sage-grouse seasonal habitat include the following (based on Braun *et al*. 2005, Southwest Wyoming Sage-Grouse Working Group 2007, Atamian *et al.* 2010, Doherty *et al.* 2010):

- Spring – Lek habitat includes areas with low amounts of sagebrush but extensive cover of low grasses and forbs. Nesting habitat includes areas with abundant sagebrush and substantial grasses and forbs. Sagebrush cover in spring habitats varies from 15 to 25 percent.
- Summer – Summer habitats provide adequate forage, especially succulent forbs, and escape cover. These habitats include pastures and grasslands, mesic drainages, and the edges of agricultural fields. Habitat adjacent to these open areas includes shrub stands that provide escape and resting areas. Sagebrush cover in these escape and resting areas varies from 10 to 25 percent.
- Fall – Similar to summer habitat, fall habitat includes areas where succulent forbs are present, but also includes areas with higher amounts of sagebrush. North-facing slopes are often preferred since green forage persists later in the year at these sites. Extensive sagebrush stands,

with canopy cover greater than 20 percent begin to be used with greater frequency than in the summer.

- Winter – Winter habitat includes areas with extensive sagebrush as well as windswept ridges with more limited sagebrush cover. Sage-grouse tend to prefer south to southwest aspects where snow accumulation is less. Sagebrush canopy cover varies from 10 to 30 percent (Braun *et al*. 2005, Southwest Wyoming Sage-Grouse Working Group 2007).

3.2.3 Water Sources for Sage-Grouse

Water is an important habitat component for sage-grouse in summer both for drinking and since succulent forbs and insects are typically more common near water late in the growing season (Connelly *et al*. 2000).

3.2.4 Sage-Grouse Habitat Components and Pre-Mine Vegetation Types

Similar to mule deer habitat, sage-grouse habitat is comprised of a variety of vegetation types. Sage-grouse also have fairly large ranges within and between seasons. Sage-grouse hens have been documented moving up to 11 miles (18 km) between leks during the breeding season (Wallestad 1975). Hens may also nest relatively far away from a lek; about 70 percent of hens nest within four miles (6.5 km) of a lek (Holloran and Anderson 2005) although some hens nest almost six miles (10 km) from a lek (Wallestad 1975). Sage-grouse in eastern Montana are primarily non-migratory (Wallestad 1975), however, non-migratory birds still move from five to six miles (8 to 10 km) between seasonal habitats and use home ranges up to 40 mi^2 (104 km^2)(BLM 2003). Consequently, areas within the SCM reclaimed area will be part of a much larger home range for the sage-grouse that inhabit the adjacent undisturbed area. Supplementing undisturbed native vegetation with forage types in reclamation that may be more limited within a home range could improve sage-grouse survival and productivity.

Table 3 correlates seasonal sage-grouse habitats with average shrub density within the pre-mine vegetation types. The stepwise averaging procedure follows the same method described for mule deer in Section 3.1.4. Deriving a single shrub density in this manner provides the basis for the woody plant density standard presented in Table 5.

4.0 IMPLEMENTING WILDLIFE HABITAT RECLAMATION

SCM has described reclamation practices for establishing a post-mine Wildlife Habitat Land Use in their Reclamation Plan (Section 17.24.313). The wildlife habitat components that will be created by these practices are described in terms of topography, vegetation, and corresponding general wildlife habitats in Table 4 below.

Table 3. Pre-Mine Vegetation Types Correlated with Seasonal Sage-Grouse Habitat Types, and Associated Baseline Shrub and Tree Density.

	SEASONAL SAGE-GROUSE HABITAT							
	Spring		Summer			Fall		Winter
Pre-mine Vegetation Type[1]	Sagebrush	Grass/Half Shrub/Forb	Grass/Half Shrub/Forb	Sagebrush	Grassland[3]	Sagebrush	Grass/Half Shrub/Forb	Sagebrush
Mean baseline shrub densities plants/acre (plants/ha)[2]	3674 (9,079)	1521 (3,758)	1521 (3,758)	3674 (9,079)	329 (812)	3674 (9,079)	1521 (3,758)	3674 (9,079)
Mean baseline shrub density by seasonal habitat type	2598 (6,419)		2219 (5484)			2598 (6,419)		3674 (9,079)
Overall mean shrub density within sage-grouse habitat plants/acre (plants/ha)	2772 (6850)							

[1] Pre-mine vegetation types are defined in baseline vegetation reports for the Pearson Creek, Carbone and South Fork Expansions (Prodgers 2007, 1998 and 1991). Shrub density was not measured during the original baseline effort (VTN Environmental Consultants 1977). Sagebrush is comprised of the ATSP, ATSM, ATSM/AGCR, and ARCA types. Grassland is comprised of the AGSM and STCO types. Grass/Halfshrub/Forb is comprised of the GHF and GHF Variant types.

[2] Baseline densities are acreage-weighted shrub densities derived from data provided in the Pearson Creek (2006), Carbone Amendment (1993-1994) and South Fork Expansion (1991) baseline reports as shown in Appendix A. Tree density was not included since trees are not important components of sage-grouse habitat.

[3] As documented in the discussion above (Section 3.2), Sage-grouse utilize the pre-mine Grassland and Pastureland vegetation types. However, Grassland areas are weighted at half, as Grassland will be provided in the Grazing Land post-mine land use.

Table 4. Habitat Components Within the Wildlife Habitat Land Use, Spring Creek Mine, 2010.

Habitat Component	Component Attributes	Corresponding Wildlife Habitat
Topography		
Steep north-facing slopes	Steep north-facing slopes will provide substrate for establishing shrubs and trees. Steep slopes will also serve as topographic and thermal cover.	Mule Deer (Year-round habitat)
Steep south-facing slopes	Steep south-facing slopes will provide substrate and growing conditions conducive to arid shrubs such skunkbush sumac, rabbitbrush, and native forbs. Diminished accumulation of snow on south-facing slopes will facilitate access to winter forage and topographic/thermal cover.	Mule Deer (Winter habitat)
Moderate north-facing slopes	Moderate north-facing slopes (typically between 5 and 15 percent) provide a relatively cool aspect and greater moisture holding capacity. These areas will provide suitable sites for implementing sagebrush establishment.	Sage-grouse (Year-round habitat) Mule Deer (Winter habitat)
Draws	Draws include shallow ravines that will channel surface runoff. Substrates will vary from unconsolidated rock to fines. Draws will provide opposing aspects on either side to promote vegetation diversity and topographic cover for wildlife.	Mule Deer (Year-round habitat)
Terraced basins	Terraced basins include small-scale surface variations where small escarpments have been created to mimic streambank terraces or isolated, upland basins. Terraced basins will typically be less than 1,000 square feet and less than 4 feet deep. These areas will provide topographic cover for wildlife and vegetation diversity resulting from different substrates and topographic positions. Rainwater or runoff may be present in these basins ephemerally or seasonally.	Mule Deer (Year-round habitat)
Benchland	Benchlands include extensive flats and meadows dominated by herbaceous vegetation including pastures and non-native grasses and forbs.	Sage-grouse (Spring-fall habitat) Mule Deer (Year-round habitat)
Vegetation		
Tree-focus vegetation	Tree-focus vegetation will include areas targeted for future dominance by trees. Tree-focus areas include steep, north-facing slopes with a rocky substrate and suitable fines. Tree-focus areas will be broadcast seeded with a mixture that emphasizes ponderosa pine, Rocky Mountain juniper, native shrubs, and relatively low rates of native grasses. In addition, tree-	Mule Deer (Year-round habitat)

Table 4. Habitat Components Within the Wildlife Habitat Land Use, Spring Creek Mine, 2010.

Habitat Component	Component Attributes	Corresponding Wildlife Habitat
	focus areas will include ponderosa pine and Rocky Mountain juniper as discussed in Section 313. Tree-focus revegetation efforts will be implemented on many steep, north-facing slopes.	
Shrub-focus vegetation	Shrub-focus vegetation will include areas targeted for eventual dominance of native shrubs. Shrub-focus areas will be seeded using techniques that include: preparing a firm seedbed; broadcast seeding during advantageous conditions, such as when snow is imminent; and seed mixtures that include high shrub seed rates (e.g. up to 9 PLS lb/acre of Wyoming big sagebrush), low native grass rates (e.g. 1-4 PLS lb/acre of native grasses), and inclusion of palatable native forbs (e.g. fringed sagewort.). Shrub-focus revegetation efforts will be implemented on many north-facing slopes, draws, and terraced basins, and on some south-facing slopes. South-facing slopes will include skunkbush sumac as discussed in Section 313.	Sage-grouse (Year-round habitat) Mule Deer (Winter habitat)
Grass and forb-focus vegetation	Grass and forb-focus vegetation will include a variety of slopes, aspects, and landforms. This vegetation type will provide spring through fall forage for sage-grouse and mule deer, and will produce insects for sage-grouse. Grass and forb-focus vegetation will be implemented on all benchlands, some terraced basins, and some south-facing slopes.	Sage-grouse (Spring-fall habitat) Mule Deer (Year-round habitat)
Water		
Pond	Small dams will be created and distributed along drainages throughout the reclaimed area. Ponds will provide seasonal water to wildlife and create a fringe of mesic vegetation that will diversify forage and produce insects.	Sage-grouse & Mule Deer (Spring-fall habitat feature)

Table 5 below relates these general habitat components to reclamation substrates and seed mixes described in the Reclamation Plan and also presents pre-mine woody plant densities to derive a single, proposed woody plant density standard for the Wildlife Habitat land use. Vegetation conditions in the Mine area pre-settlement were likely similar to those described by Arno (1985), as excerpted from Appendix H of the Pearson Creek vegetation baseline report (Prodgers 2007):

> "Sagebrush (*Artemisia spp.)*-grass communities cover a large part of the semiarid Intermountain West...On the more productive sites--those that are relatively moist and have well-developed soils--sagebrush dominance often appears to have resulted from past grazing and fire suppression. Grassland may have dominated those areas until the late 1800's. By that time, however, heavy domestic grazing had reduced grass vigor, giving sagebrush the competitive advantage; heavy grazing also removed fine fuels and thus prevented fires from spreading. In contrast, before the introduction of livestock, fire was relatively frequent...Many of these fires were apparently ignited by Indians, and fire's effect was to favor grass relative to most kinds of sagebrush and bitterbrush (*Purshia tridentata*), mountain mahogany (*Cercocarpus spp.*), and most other shrubs...
>
> Frequent surface fires...were characteristic where ponderosa pine was abundant...Indian fires were common; their frequencies probably equaled or exceeded those of lightning fires in some of these forests. Frequent surface fires kept stands open and parklike, and numerous 19th century travelers remarked that it was easy to ride horseback through them without a trail.
>
> Pine and juniper woodland...sometimes occurs in a mosaic pattern with sagebrush-grass, occupying the stoniest soils, where fires spread poorly and competition from grasses and shrubs is minimal...pines and junipers can survive light surface fires but are killed by wind-driven crown fires. Indian fires no doubt often spread into pinyon-juniper woodlands and also kept the trees from invading the adjacent sagebrush-grass communities...[B]efore the introduction of domestic livestock in the mid-1800's, fires may have occurred at 15- to 90-year intervals, maintaining open or patchy stands in areas where woodlands have since become very dense. Tree densities have increased in many areas and undergrowth is so sparse (as a result of shading as well as past grazing) that surface fuels do not support fire. Thus, these stands now can burn only under extreme conditions--hot dry weather and strong winds." (Arno 1985)

Tree and shrub densities in pre-settlement vegetation communities were therefore substantially lower than currently exists. Cooper *et al*. (2007) recorded Wyoming big sagebrush densities in burned and unburned areas in eastern Montana, concluding that sagebrush density in burned areas was approximately five percent of that in unburned areas (0.08 stems/m^2 in burned areas compared to 1.52 stems/m^2 in unburned areas) even after 70 years. However, Cooper *et al.* (2007) noted that the

Table 5. Habitat Components, Acreage, Targeted Seed Mix, Woody Plant Density, and Vegetation Standards Targeted for the Wildlife Habitat Land Use, Spring Creek Mine, 2010.

Topographic Habitat Component	Vegetation Habitat Component	Substrate[1]	Targeted Seed Mix	Targeted Wildlife Habitat	Woody plant density plants/acre (plants/ha)[2]			
					Mule Deer	Sage-grouse	Mean[3]	Composited Woody Plant Density [4]
Steep north-facing slopes	Tree-focus	Salvaged pine-juniper soils over scoria and suitable unconsolidated shaley/sandy spoil.	11, 11a, and 12	Mule Deer (Year-round habitat)	2236 (5526)	-	2236 (5526)	2322 (5738)
Moderate to Steep south-facing slopes	Mixed shrub-focus and grass/ forb-focus	Suitable spoil and scoria.	12, 12a, 16, and 16a	Mule Deer (Winter habitat)	2312 (5712)	-	2312 (5712)	
Draws Terraced basins	Mixed shrub-focus and grass/forb-focus	Generic topsoil with areas of suitable spoil or scoria where shrub and shrub-forb mosaics are seeded.	10, 10a, and 10b	Mule Deer (Year-round habitat)	2236 (5526)	-	2236 (5526)	
Benchland	Grass/forb-focus	Generic topsoil	13a, 13b	Sage-grouse (Spring-summer habitat) Mule Deer (Year-round habitat)	2236 (5526)	2408[3] (5951)	2322 (5738)	
Moderate north-facing slopes	Sagebrush shrub-focus	Suitable spoil and scoria.	17	Sage-grouse (Year-round habitat) Mule Deer (Year-round habitat)	2236 (5526)	2772 (6850)	2504 (6187)	

Table 5. Habitat Components, Acreage, Targeted Seed Mix, Woody Plant Density, and Vegetation Standards Targeted for the Wildlife Habitat Land Use, Spring Creek Mine, 2010.

[1]Preferred substrate is described in the Spring Creek Mine Reclamation Plan (Section 313).

[2]Woody plant density is based on pre-mine densities presented in Appendix A.

[3] The mean is the average of densities listed under the mule deer and sage-grouse columns, taken from Tables 2 and 3, respectively.
Sage grouse spring-summer habitat density (2408 woody plants per acre) is an average of spring (2598) and summer (2219) densities shown in Table 4.

[4] Woody plant density is averaged as a composite of all targeted wildlife habitat focus areas.

resulting increase in perennial grass cover was beneficial to greater sage-grouse according to several authorities (*e.g.,* Wallestad and Pyrah 1974, Aldridge and Brigham 2002). Perennial grass and forb cover are also beneficial to mule deer as previously noted in Section 3.1.1. Given that these species evolved under a more frequent fire regime, it is not surprising that lower shrub and tree cover, and higher grass and forb cover provide wildlife habitat benefits.

As discussed above, the pre-mine woody plant densities developed over decades. The environmental baseline study of the Pearson Creek Permit amendment area in Appendix C of Volume B3 (Prodgers 2007) classifies the woody plants into three age classes; immature/young, mature, and senescent/ decadent. The environmental baseline study discusses classifying shrubs by age class in Montana, following Lonner (1972). Lonner's study determined for example that young big sagebrush plants had a mean age of 10 years (range 2-12); mature plants had a mean age of 24 (range 3-70); decadent plants had a mean age of 32 (range 12-60).

The age distribution of immature plants at 29 percent represents plants approximately ten years in age, similar to the age of woody plants meeting the ten-year responsibility period for Phase III bond release. In summary, 71 percent of the plants measured in baseline inventories, on average, are older than ten years. While not successionally comparable, the evaluation of shrub age structure in pre-mine vegetation communities can be used to indicate an expectation of woody plant density levels in revegetation within the ten-year responsibility period.

Based on the considerations noted above, SCM submits the following rationale for determining the overall shrub density standard relative to baseline conditions:

1) sagebrush habitat occurs in the landscape surrounding the Mine;
2) natural fire regimes (pre-settlement) would have reduced shrub and tree density and increased perennial grass and forb cover, noting that mule deer and sage-grouse have evolved under these ecological conditions;
3) increased perennial grass and forb production provide forage for mule deer and sage-grouse that is otherwise limited in the Mine area; and
4) Pre-mine woody plant density establishment during the 10-year responsibility period (for Phase III bond release) can be related to woody plant age structure in pre-mine vegetation communities.

5.0 SHRUB DENSITY IN POST-MINE GRAZING LAND

In practice, essentially all pre-mine vegetation types (including special use pasture) were utilized and managed primarily for livestock grazing. Woody plants are generally not valued for this use, and often inhibit it (aside from tree-shaded loafing areas). To achieve the Grazing Land post-mine land use, SCM will reclaim grassland vegetation communities. In consideration for wildlife, which also utilize Grazing Land, SCM will commit to establishing a post-mine shrub density standard as well as 5 percent of the

area as WHEFs. SCM proposes half of the shrub density that was present in high-productivity communities pre-mine (Table 6), as shrubs generally reduce the amount of palatable forage available for livestock grazing.

A review of pre-mine peak standing crop or PSC (vegetation production) data presented in Spring Creek Mine's baseline inventory reports (Prodgers 2007, 1998, 1991) indicates that preferred palatable forage (*i.e.*, production of perennial species minus shrub production) is consistently, substantially higher in the vegetation types listed in Table 7 than in other types in the permit area. These types yielded approximately 2.6 times as much total palatable forage per unit area as all other vegetation types sampled during baseline studies.

Table 6 indicates a direct correlation between higher production of palatable forage (x 2.6) and lower woody plant density (x 0.3) in these vegetation types versus types averaging lower production (x 0.4) and correspondingly higher woody plant density (x 3.5). SCM is proposing a density standard of 450 shrubs per acre on Grazing Land. As a surface owner, SCM has committed to a reclamation plan that will likely exceed 450 shrubs per acre.

6.0 COVER AND PRODUCTION TECHNICAL STANDARDS

6.1 Technical Standards

As discussed in ARM 17.24.724, either reference areas or technical standards may be used as bond release criteria. In general, cover and production vary greatly with precipitation and affect the reliability of technical standards. Reliable revegetation that is satisfactory relative to reference areas most of the time might not "pass" technical standards in certain years, including possibly a sequence of years, for reasons relating mainly to weather cycles.

Baseline and reference area data are appropriate bases for standards since both represent pre-mine conditions. It remains true that in some respects pre-mine conditions reflected more than 100 years of fire exclusion and periods of abusive grazing both historical and recent.

SCM has cover and production data for historical types from the South Fork, Carbone, and Pearson Creek amendment areas augmented with reference area monitoring. Collectively this comprises a reasonable database for computing representative pre-mine cover and production. SCM data represent numerous precipitation regimes over the past 24 years.

The data were summarized for each of the recognized vegetation types at the mine (Appendices B and C). These are proposed as technical performance standards. They could be modified in the future with Department approval, if additional baseline data are collected (mine expansion) or as other approved areas continue to be sampled, providing additional data upon which to refine the standards.

Table 6. An Examination of the Correlation Between Forage Production and Woody Plant Density in Pre-mine[1] Grazing Land, Spring Creek Mine.

NATIVE VEGETATION TYPE	ACRES	Forage Production[2] (lbs/acre)	Woody Plant Density (shrubs per acre)
AGSM	148.2	801	337
STCO	37.2	788	295
ARCA	202.6	970	2881
DB	39.8	1151	891
SUP	325.6	1096	0
Subtotal	**753.4**		
Acreage-weighted Mean		991	903

[1]Derived from SCM baseline report data (Prodgers 2007, 1998, 1991).
[2]Production reflects palatable forage (production of perennial species minus shrub production).

With a few exceptions later described, the summary cover and production values were calculated by pooling data available for each land use, and calculating a one-tailed 90 percent confidence interval, which was subtracted from the mean as was done for the South Fork data. Each entry represents the mean for one sampling. For example, the ATSM type is represented by six entries: South Fork baseline, reference area same year, Carbone baseline, Carbone baseline for a variant of the ATSM type, reference area sampled in 2004, and Pearson Creek baseline.

If the mean for each historical type (the mean of means) were used as a single entry, the small number of entries would be too small to calculate a reasonable confidence interval, and in the case of Pastureland it couldn't be done (n=1). The small number of samples would yield a high variance and a large confidence interval, thus making the standard unrealistically low. This is not our intent. The negative repercussions from increasing the confidence interval is also discussed on page 9 of the MDEQ Vegetation Guidelines.

The following conditions also were applied:

- In each case, cover/production of annuals and biennials were not counted toward totals. Including annuals and biennials not only greatly increases the temporal variance, but the amount of annuals and biennials varies enormously among types. Types associated with Wildlife Habitat and Pastureland have relatively few weeds. Types associated with grazing have lots of weeds, mainly cheatgrass, in some years but few weeds in others. Only perennial cover and production are being used to calculate standards.
- Riparian "drainage bottom" (DB) types were not included because they are very minor in extent, highly variable in composition and structure, and little vegetation data exist.
- For the GHF type, data from the old reference area were not used, which was really more representative of the ATSP type. Consequently there is a new GHF reference area. The 1991 GHF data were applied to the ATSP type.

- Data from 1992 in the old ARCA reference area were also not used; the main grass was crested wheatgrass, which is unrepresentative of the pre-mine type. Again, data from the new reference area were used.
- Reference area data were used whenever available to improve accuracy of the dataset.

Table 7 below summarizes the technical standards for production, cover, and woody plant density designed for each post-mine land use.

Table 7. Performance Standards for Three Sample Parameters in Targeted Post-mine Land Uses at the Spring Creek Mine.

Post-mine Land Use	Woody Plant Density per acre (per hectare)	Canopy Cover percent	Annual Production lbs/acre (kg/ha)
Grazing Land	450 (1112)	50	690 (775)
Pastureland	NA[1]	62	948 (1063)
Wildlife Habitat	2322 (5738)	46[2]	NA

[1]Grazing Land and Pastureland areas will contain 5 percent WHEFs as discussed in Section 313.
[2]Shrub density is the primary goal of wildlife land use reclamation. Young shrubs generally provide less cover than mature shrubs. Additionally, herbaceous vegetation competes with shrubs for moisture and can reduce shrub establishment. The primary goal for the wildlife land use cover standard is soil stability and erosion control. SCM will conduct a study of baseline data, reclamation and reference area data, and literature to determine what the optimal level of herbaceous cover is in a young shrub stand, and will adjust the cover standard for wildlife habitat accordingly though the minor revision process.
NA = Not Applicable

6.2 Making Revegetation Commitments

Standards will be applied to a Bond Release Unit (BRU) organized by post-mine land use, not by applying the standards to individual PAR fields. For example, a BRU may contain Livestock Grazing Land and Wildlife Habitat which will be analyzed separately.

6.3 Comparing Bond Release Units to Technical Standards

6.3.1 Phase III Sampling Options

Given the land-use framework, two alternative approaches to calculating cover, production, or shrub density are possible. One is to sample randomly all areas within a BRU when an application is desired. This approach would be subject to the random nature of precipitation regimes. The other alternative is to use annual monitoring data stratified by PARs. Using the first approach, outcomes can't be known until sampling is complete or additional sampling is required, entailing years of delay. It also runs the

risk of multinomial or badly skewed distributions resulting from pooling individual transects representing different classes of revegetation. This would likely rule out a confidence-interval approach to comparing monitoring data to standards.

The approach described here is based on stratifying data by PARs and using historical annual monitoring data.

6.3.2 Sampling Methods

The PAR is the basic seeding and monitoring unit. If uniformly seeded, each PAR is represented by a number of sample transects correlating roughly to field. Where differently seeded, PARs may be represented by transects representing different revegetation types. Differing in shrub density may qualify portions of PARs as Wildlife Habitat if a threshold shrub density is exceeded. It may be an option to treat these PARs or portions there of as Wildlife Habitat for bond release, cover and shrub density would be handled analogously to cover and production data in Grazing Land.

When PARs were first sampled, transects were placed in a stratified random distribution within different seedings. It is useful to remember that at this time, fields are typically covered with kochia, Russian thistle, etc., and the character of revegetation isn't known until small plots are examined, moving big annuals aside to view small perennials.

When first sampled, the number of transects in a field was determined by field size and number of special seedings (See 17.24.313(1)(h)(xi) of SCM permit) to accurately represent the post mining vegetation communities in a PAR. Some cases, entire fields were seeded with a single mix. In others, uplands, shrub mosaics, and alluvial zones may have received different seed mixes and practices.

The PARs in a BRU will likely be grouped by age, so the fields in a BRU will to a large extent share seed mixes, precipitation, and revegetation practices.

Each land use type in a BRU may be considered a "stratum." The concept behind stratifying fields is to put most of the variance between strata, or you could say to make strata more homogeneous. The method described in Gilbert (1987) makes use of prior knowledge (e.g., where different seedings were applied) to divide the target population (the fields in a BRU land use) into subgroups that are internally homogeneous. That does not mean physically near one another. "If the stratification has been effective in creating relatively homogeneous strata, then the estimated average and inventory for the entire population of N units should be more accurate than would be obtained if a simple random sample had been collected from the N units without first stratifying the population" (p. 46). This is integral to the described approach.

6.3.3 General Statistical Analysis Procedure

1. Obtain qualifying monitoring data for each transect (canopy coverage, production, and woody plant density as appropriate to land use) from annual monitoring reports. Two years of data are selected from monitoring data.

2. Separate the transect data in a BRU by land use type, if necessary. Where different portions of a field are of different land uses, such as shrub mosaics that go beyond "wildlife habitat enhancement features" and qualify as Wildlife Habitat, different transects within a PAR may go toward the Grazing Land calculation vs. the Wildlife Habitat calculation. Each would be weighted by the acreage they represent as a percentage of the total land-use acreage.
3. Separate the transect data into cover, production, and shrub density as needed.
4. Map the area associated with transect(s) representing different land uses to determine the appropriate acreage using Plate 4A as a starting point. These boundaries will be staked in the field for clarification during the bond release inspection.
5. Calculate a mean and a variance from the two years of data for each transect.
6. Calculate the "percent area" based on the area associated with each transect. Weights are the percent of total area for the BRU. A weighted area for the BRU is needed because representative area for each transect will vary greatly in size.
7. Calculate the weighted mean.
    a. Multiplying the "percent area" by the two year mean for each sample.
    b. Add them up to determine the weighted mean.
8. Determine the "n" value from the students "t" table. The "n" is the number of samples. Then "n"-1 is used to determine the t table value.
9. Calculate the variance associated with the mean ("pooled variance") for each parameter. This is better understood by example: "Cover-Production Tech Standards for MDEQ 2-10." The variance is equal to the sum across all strata of [product of weight of each strata squared times variance of each strata] divided by "n" number of samples. This reduces to a single number which is the pooled variance.
10. Calculate the Standard Deviation (S.D.) = (square root of the "pooled variance").
11. Calculate a weighted Confidence Interval (C.I.) (*i.e.*, 0.10 Type I Error for a one-tailed distribution) for stratified random samples is described by Gilbert (1987) in Chapter 5, Stratified Random Sampling. Since the procedure requires a variance for each "stratum" (e.g., each land use type), each stratum must be represented by at least two transects. In the event that a land use within a BRU is represented by a single transect, SCM agrees to sample it with at least one additional transect so that the variance can be computed. The weighted C.I. = (Student's t value x S.D.).
12. Use the S.D., mean, "n", and any other necessary number to demonstrate sample adequacy.
13. Calculate the upper C.I. by adding the weighted mean to the weighted C.I. The standard is met if the upper C.I. exceeds 90 percent of the standard [ARM 17.24.726(2)] as shown in Table 8.

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APPENDICES

TECHNICAL STANDARDS

APPENDIX A. WOODY PLANT DENSITY

APPENDIX B. COVER

APPENDIX C. PRODUCTION

APPENDIX A of ADDENDUM 17.24.313B. A Summary of Premine [1] Woody Plants per Acre, Arranged by Wildlife Habitat Focus Types, Spring Creek Mine.

WOODY PLANTS	PJO 1991-2006 Mean n=100	PJC 1991-2006 Mean n=57	PINE-JUNIPER Mean n=157	GHF 1991-2006 Mean n=94	GHF variant 1993-1994 Mean n=12	GRASSLAND/ HALF SHRUB/ FORB Mean n=106	RHTR 1993-2006 Mean n=39	SS 1991-2006 Mean n=104	DB 1991-2006 Mean n=40	MIXED SHRUB Mean n=183	ATSM/ AGCR 1993-1994 Mean n=5	ATSM 1991-2006 Mean n=65	ARCA 1991-2006 Mean n=64	ATSP 1991-2006 Mean n=68	SAGEBRUSH Mean n=202	AGSM 1991-2006 Mean n=NA	STCO 1993-2006 Mean n=NA	GRASSLAND Mean n=NA	SUP Mean n=35	COMPOSITE 1991-2006 Mean n=NA
Acres	**638.3**	**73.9**	**712.2**	**317.1**	**18.5**	**335.6**	**77.4**	**545.6**	**39.8**	**662.8**	**75.3**	**1010.8**	**202.6**	**2172.3**	**3461.0**	**148.2**	**37.2**	**185.4**	**325.6**	**5682.6**
SHRUBS																				
Ame aln	10.6		9.5																	1.2
Art can	6.5	5.8	6.5	1.2		1.2	73.0	16.5	255.0	37.4	16.2	41.5	2651.4	20.6	180.6					115.2
Art tri	1254.4	591.7	1185.7	865.5	620.8	852.0	284.2	1367.6	6.1	1159.3	4127.9	2942.7	197.2	3644.8	3248.4	198.7	252.9	209.6		2319.5
Atr con								145.3		119.6				7.2	4.5					16.7
Cer lan	4.4		4.0	414.0		391.2		8.7		7.2		171.1		17.7	61.1	129.9	27.9	109.4		65.2
Chr nau	146.9	99.8	142.1	67.1		63.4	2.3	491.6		405.0		6.2		59.5	39.2	8.5	14.2	9.6		92.9
Pru vir	16.0	3.0	14.7	1.7		1.6		8.1	109.9	13.3										3.5
Rhu tri	114.0	89.4	111.4	158.6	715.1	189.3	619.3	61.0		122.5		11.0	0.8	71.1	47.9					68.6
Rib aur									8.0	0.5										0.1
Rib cer	1.0	14.0	2.4																	0.3
Rib set		3.0	0.3						92.0	5.5			3.8		0.2					0.8
Ros ark								24.9	1.9	20.6										2.4
Ros woo/aci	9.7	1.2	8.8	7.5		7.1	19.3	6.2	23.7	8.8		6.2	5.7	12.0	9.7					8.5
Sar ver								3.8		3.1		177.9		31.9	72.0					44.2
Sym alb	74.5	1806.1	254.2																	31.9
Sym occ									380.3	22.8		21.8	22.7		7.7					7.4
TOTAL SHRUB	**1638.1**	**2614.0**	**1739.4**	**1515.8**	**1335.9**	**1505.8**	**998.1**	**2133.7**	**877.0**	**1925.6**	**4144.1**	**3378.5**	**2881.6**	**3864.8**	**3671.3**	**337.1**	**295.0**	**328.7**	**0.0**	**2778.3**
TREES																				
Ace neg									**4.2**	0.3										0.1
Fra pen									**8.0**	0.5										0.1
Jun sco	242.7	430.3	262.2	12.6		11.9		7.0		5.8		1.7		3.6	2.8					35.9
Pin pon	104.3	131.5	107.1	2.3	13.4	2.9	2.3	14.3		12.0										15.0
Sal amy									**1.9**	0.1										
TOTAL TREE	**347.0**	**561.8**	**369.3**	**15.0**	**13.4**	**14.9**	**2.3**	**21.3**	**14.1**	**18.7**	**0.0**	**1.7**	**0.0**	**3.6**	**2.8**	**0.0**	**0.0**	**0.0**	**0.0**	**51.0**
TOTAL WOODY	**1985.1**	**3175.8**	**2108.7**	**1530.7**	**1349.3**	**1520.7**	**1000.5**	**2155.0**	**891.0**	**1944.3**	**4144.1**	**3380.3**	**2881.6**	**3868.4**	**3674.0**	**337.1**	**295.0**	**328.7**	**0.0**	**2829.3**

[1]Density data are compiled from SCM baseline reports (Prodgers 2007, 1998, 1991).

Note: Means are weighted according to acreage.

ND = No Data
NA = Not Applicable

APPENDIX B of ADDENDUM 17.24.313B

Using Baseline and Reference Area Information to Develop Technical Standards for COVER at SCM. Data from baseline data collected for the South Fork, Carbone, and Pearson Creek amendments and reference area sampling.

Baseline Cover Minus Annual and Biennials (% Cover)

TYPE	AREA BY TYPE (acres)	% AREA	COVER	WEEDS	COVER W/O WEEDS	WEIGHTED AVERAGE COVER
WILDLIFE COVER						
ATSP Ref. 96	1895.5	41%	45.8	2.1	43.7	20.6
ATSP SF			79.4	11.4	68	
ATSP REF			66.3	16.1	50.2	
ATSP REF 2003			45.5	4.2	41.3	
ATSP CARB			55.7	2.6	53.1	
ATSP PEARSON			49.6	4.5	45.1	
ATSP REF 08			53.6	3.2	50.4	
				AVG.	50.3	
ATSM SF	1401.62	30%	111	25.3	85.7	16.9
ATSM REF			120.5	66.9	53.6	
ATSM CARB			63.3	2.6	60.7	
ATSM/AGCR CARB			66.1	2.2	63.9	
ATSM REF 2004			42	6.7	35.3	
ATSM PEARSON			48.1	12.8	35.3	
				AVG.	55.8	
PJO SF	482.85	10%	60.1	4.4	55.7	4.9
PJO REF			56.3	2	54.3	
PJO CARB			52.9	1.4	51.5	
PJO PEARSON			18.1	0	18.1	
PJO REF 06			55.2	2.2	53.0	
				AVG.	46.5	
PJC SF	65.69	1%	42.5	2.4	40.1	0.5
PJC REF			54.4	5.5	48.9	
PJC CARB			21.2	0.3	20.9	
PJC PEARSON			12.9	0	12.9	
PJC REF 06			50.6	0.4	50.2	
				AVG.	34.6	
GHF SF	318.95	7%	49.1	3.3	45.8	2.5
GHF NEW REF			38.8	2.4	36.4	
GHF CARB			43.4	2.7	40.7	
GHF VARIANT CARB			47.6	1.4	46.2	
GHF REF 2004			22.8	0.2	22.6	
GHF PEARSON			25.5	1.1	24.4	
				AVG.	36.0	
SS SF	431.19	9%	42.2	4.6	37.6	3.4
SS REF			44.2	4.4	39.8	
SS CARB			36.9	1.2	35.7	
SS PEARSON			26.7	0.3	26.4	
SS REF 08			49.8	5.4	44.4	
				AVG.	36.8	

NOTE: Sample adequacy is documented in each Environmental Baseline Study. Including the reference area data improves data accuracy by using data over different precipitation years.

APPENDIX B of ADDENDUM 17.24.313B

Using Baseline and Reference Area Information to Develop Technical Standards for COVER at SCM. Data from baseline data collected for the South Fork, Carbone, and Pearson Creek amendments and reference area sampling.

Baseline Cover Minus Annual and Biennials (% Cover)

RHTR SF	25.15	1%	60	20.6	39.4	0.2
RHTR CARB			62.8	14.7	48.1	
RHTR REF 2004			28	7	21.0	
RHTR PEARSON			51.9	12.5	39.4	
Total Area (acres)	4,620.95			AVG.	37.0	

Total Weighted Cover	**49.00**
Mean	49.00
STDEV	14.7
C.I. = (t table x stdev)/sqrt of n	3.1
mean - C.I. =	45.9

n = 38
n-1 = 37
t table value = 1.305

Wildlife Cover = 46

TYPE	AREA BY TYPE (acres)	% AREA	COVER	WEEDS	COVER W/O WEEDS	WEIGHTED AVERAGE COVER
GRAZING COVER						
STCO REF	53.04	13%	80.2	17.9	62.3	6.1
STCO CARB			67	8.9	58.1	
STCO PEARSON			41.2	6.3	34.9	
STCO REF 06			50.1	12.7	37.4	
				AVG.	48.2	
AGSM SF	141.83	34%	105.5	52.8	52.7	14.2
AGSM REF			93.8	48.3	45.5	
AGSM REF 2003			102.5	70.8	31.7	
AGSM CARB			52.2	5	47.2	
AGSM PEARSON			52.2	19.8	32.4	
				AVG.	41.9	
ARCA SF	223.54	53%	121.2	41.5	79.7	35.2
ARCA NEW REF			67.7	3	64.7	
ARCA CARB			75.6	4.3	71.3	
ARCA PEARSON			61.6	13.6	48	
ARCA REF 08			95.4	29.4	66	
Total Area (acres)	418.41			AVG.	65.9	

Total Weighted Cover	**55.5**
Mean	55.5
STDEV	15.2
C.I. = (t table x stdev)/sqrt of n	5.5
mean - C.I. =	50.0

n = 14
n-1 = 13
t table value = 1.350

Grazing Cover = 50

NOTE: Sample adequacy is documented in each Environmental Baseline Study. Including the reference area data improves data accuracy by using data over different precipitation years.

APPENDIX B of ADDENDUM 17.24.313B

Using Baseline and Reference Area Information to Develop Technical Standards for COVER at SCM. Data from baseline data collected for the South Fork, Carbone, and Pearson Creek amendments and reference area sampling.

Baseline Cover Minus Annual and Biennials (% Cover)

TYPE	AREA BY TYPE (acres)	% AREA	COVER	WEEDS	COVER W/O WEEDS	WEIGHTED AVERAGE COVER
PASTURELAND COVER						
SUP SF	566.4	100%	102.4	38	64.4	62.7
SUP CARB			65.9	3.5	62.4	
SUP CARB			64.4	3.4	61	
SUP CARB			69.1	6.1	63	
Agcr PEARSON*	N/A					

Total Area (acres)	566.40	AVG.	62.7	
			Total Weighted Cover	**62.7**
n =	4		Mean	62.7
n-1 =	3		STDEV	1.4
t table value =	1.638	C.I. = (t table x stdev)/sqrt of n		1.2
			mean - C.I. =	61.5

Pasture Cover = 62

*Not sampled for cover. Please see Pearson Creek Baseline Vegetation inventory Section 3.5.1 for the discussion.

NOTE: Sample adequacy is documented in each Environmental Baseline Study. Including the reference area data improves data accuracy by using data over different precipitation years.

APPENDIX C of ADDENDUM 17.24.313B

Using Baseline and Reference Area Information to Develop Technical Standards for PRODUCTION (PSC) at SCM. Data from baseline data collected for the South Fork, Carbone, and Pearson Creek amendments and reference area sampling.

Baseline Production Minus Annual and Biennials (% Cover)

TYPE	AREA BY TYPE (acres)	% AREA	PSC (kg/ha)	WEEDS	PSC W/O WEEDS	WEIGHTED AVERAGE PSC
GRAZING PRODUCTION						
STCO REF	53.04	13%	1522	298	1224	109.1
STCO CARB			1191	180	1011	
STCO PEARSON			870	110	760	
STCO REF 06			682	235	447	
				AVG.	860.5	
AGSM SF	141.83	34%	1763	968	795	289.8
AGSM REF			1540	949	591	
AGSM REF 2003			2153	1273	880	
AGSM CARB			1189	54	1135	
AGSM PEARSON			1055	182	873	
				AVG.	854.8	
ARCA SF	223.54	53%	2243	768	1475	528.9
ARCA NEW REF			707	16	691	
ARCA CARB			1552	35	1517	
ARCA PEARSON			1140	280	860	
ARCA REF 08			715	308	407	
Total Area (acres)	418.41			AVG.	990.0	

		Total Weighted Production	**927.8**
n =	9	Mean	927.8
n-1 =	8	STDEV	340.2
t table value =	1.350	C.I. = (t table x stdev)/sqrt of n	153.1
		mean - C.I. =	774.7

Grazing Production = 775 kg/ha or 690 lb/acre

mple adequacy is documented in each Environmental Baseline Study. Including the reference area data improves data accuracy by using data over different precipitation years.

APPENDIX A of ADDENDUM 17.24.313B. A Summary of Premine [1] Woody Plants per Acre, Arranged by Wildlife Habitat Focus Types, Spring Creek Mine.

WOODY PLANTS	PJO 1991-2006 Mean n=100	PJC 1991-2006 Mean n=57	PINE-JUNIPER Mean n=157	GHF 1991-2006 Mean n=94	GHF variant 1993-1994 Mean n=12	GRASSLAND/ HALF SHRUB/ FORB Mean n=106	RHTR 1993-2006 Mean n=39	SS 1991-2006 Mean n=104	DB 1991-2006 Mean n=40	MIXED SHRUB Mean n=183	ATSM/ AGCR 1993-1994 Mean n=5	ATSM 1991-2006 Mean n=65	ARCA 1991-2006 Mean n=64	ATSP 1991-2006 Mean n=68	SAGEBRUSH Mean n=202	AGSM 1991-2006 Mean n=NA	STCO 1993-2006 Mean n=NA	GRASSLAND Mean n=NA	SUP Mean n=35	COMPOSITE 1991-2006 Mean n=NA
Acres	**638.3**	**73.9**	**712.2**	**317.1**	**18.5**	**335.6**	**77.4**	**545.6**	**39.8**	**662.8**	**75.3**	**1010.8**	**202.6**	**2172.3**	**3461.0**	**148.2**	**37.2**	**185.4**	**325.6**	**5682.6**
SHRUBS																				
Ame aln	10.6		9.5																	1.2
Art can	6.5	5.8	6.5	1.2		1.2	73.0	16.5	255.0	37.4	16.2	41.5	2651.4	20.6	180.6					115.2
Art tri	1254.4	591.7	1185.7	865.5	620.8	852.0	284.2	1367.6	6.1	1159.3	4127.9	2942.7	197.2	3644.8	3248.4	198.7	252.9	209.6		2319.5
Atr con								145.3		119.6				7.2	4.5					16.7
Cer lan	4.4		4.0	414.0		391.2		8.7		7.2		171.1		17.7	61.1	129.9	27.9	109.4		65.2
Chr nau	146.9	99.8	142.1	67.1		63.4	2.3	491.6		405.0		6.2		59.5	39.2	8.5	14.2	9.6		92.9
Pru vir	16.0	3.0	14.7	1.7		1.6		8.1	109.9	13.3										3.5
Rhu tri	114.0	89.4	111.4	158.6	715.1	189.3	619.3	61.0		122.5		11.0	0.8	71.1	47.9					68.6
Rib aur									8.0	0.5										0.1
Rib cer	1.0	14.0	2.4																	0.3
Rib set		3.0	0.3						92.0	5.5			3.8		0.2					0.8
Ros ark								24.9	1.9	20.6										2.4
Ros woo/aci	9.7	1.2	8.8	7.5		7.1	19.3	6.2	23.7	8.8		6.2	5.7	12.0	9.7					8.5
Sar ver								3.8		3.1		177.9		31.9	72.0					44.2
Sym alb	74.5	1806.1	254.2																	31.9
Sym occ									380.3	22.8		21.8	22.7		7.7					7.4
TOTAL SHRUB	**1638.1**	**2614.0**	**1739.4**	**1515.8**	**1335.9**	**1505.8**	**998.1**	**2133.7**	**877.0**	**1925.6**	**4144.1**	**3378.5**	**2881.6**	**3864.8**	**3671.3**	**337.1**	**295.0**	**328.7**	**0.0**	**2778.3**
TREES																				
Ace neg									**4.2**	0.3										0.1
Fra pen									**8.0**	0.5										0.1
Jun sco	242.7	430.3	262.2	12.6		11.9		7.0		5.8		1.7		3.6	2.8					35.9
Pin pon	104.3	131.5	107.1	2.3	13.4	2.9	2.3	14.3		12.0										15.0
Sal amy									**1.9**	0.1										
TOTAL TREE	**347.0**	**561.8**	**369.3**	**15.0**	**13.4**	**14.9**	**2.3**	**21.3**	**14.1**	**18.7**	**0.0**	**1.7**	**0.0**	**3.6**	**2.8**	**0.0**	**0.0**	**0.0**	**0.0**	**51.0**
TOTAL WOODY	**1985.1**	**3175.8**	**2108.7**	**1530.7**	**1349.3**	**1520.7**	**1000.5**	**2155.0**	**891.0**	**1944.3**	**4144.1**	**3380.3**	**2881.6**	**3868.4**	**3674.0**	**337.1**	**295.0**	**328.7**	**0.0**	**2829.3**

[1]Density data are compiled from SCM baseline reports (Prodgers 2007, 1998, 1991).

Note: Means are weighted according to acreage.

ND = No Data
NA = Not Applicable

APPENDIX B of ADDENDUM 17.24.313B

Using Baseline and Reference Area Information to Develop Technical Standards for COVER at SCM. Data from baseline data collected for the South Fork, Carbone, and Pearson Creek amendments and reference area sampling.

Baseline Cover Minus Annual and Biennials (% Cover)

TYPE	AREA BY TYPE (acres)	% AREA	COVER	WEEDS	COVER W/O WEEDS	WEIGHTED AVERAGE COVER
WILDLIFE COVER						
ATSP Ref. 96	1895.5	41%	45.8	2.1	43.7	20.6
ATSP SF			79.4	11.4	68	
ATSP REF			66.3	16.1	50.2	
ATSP REF 2003			45.5	4.2	41.3	
ATSP CARB			55.7	2.6	53.1	
ATSP PEARSON			49.6	4.5	45.1	
ATSP REF 08			53.6	3.2	50.4	
				AVG.	50.3	
ATSM SF	1401.62	30%	111	25.3	85.7	16.9
ATSM REF			120.5	66.9	53.6	
ATSM CARB			63.3	2.6	60.7	
ATSM/AGCR CARB			66.1	2.2	63.9	
ATSM REF 2004			42	6.7	35.3	
ATSM PEARSON			48.1	12.8	35.3	
				AVG.	55.8	
PJO SF	482.85	10%	60.1	4.4	55.7	4.9
PJO REF			56.3	2	54.3	
PJO CARB			52.9	1.4	51.5	
PJO PEARSON			18.1	0	18.1	
PJO REF 06			55.2	2.2	53.0	
				AVG.	46.5	
PJC SF	65.69	1%	42.5	2.4	40.1	0.5
PJC REF			54.4	5.5	48.9	
PJC CARB			21.2	0.3	20.9	
PJC PEARSON			12.9	0	12.9	
PJC REF 06			50.6	0.4	50.2	
				AVG.	34.6	
GHF SF	318.95	7%	49.1	3.3	45.8	2.5
GHF NEW REF			38.8	2.4	36.4	
GHF CARB			43.4	2.7	40.7	
GHF VARIANT CARB			47.6	1.4	46.2	
GHF REF 2004			22.8	0.2	22.6	
GHF PEARSON			25.5	1.1	24.4	
				AVG.	36.0	
SS SF	431.19	9%	42.2	4.6	37.6	3.4
SS REF			44.2	4.4	39.8	
SS CARB			36.9	1.2	35.7	
SS PEARSON			26.7	0.3	26.4	
SS REF 08			49.8	5.4	44.4	
				AVG.	36.8	

NOTE: Sample adequacy is documented in each Environmental Baseline Study. Including the reference area data improves data accuracy by using data over different precipitation years.

APPENDIX B of ADDENDUM 17.24.313B

Using Baseline and Reference Area Information to Develop Technical Standards for COVER at SCM. Data from baseline data collected for the South Fork, Carbone, and Pearson Creek amendments and reference area sampling.

Baseline Cover Minus Annual and Biennials (% Cover)

RHTR SF	25.15	1%	60	20.6	39.4	0.2
RHTR CARB			62.8	14.7	48.1	
RHTR REF 2004			28	7	21.0	
RHTR PEARSON			51.9	12.5	39.4	
Total Area (acres)	4,620.95			AVG.	37.0	

Total Weighted Cover	**49.00**
Mean	49.00
STDEV	14.7
C.I. = (t table x stdev)/sqrt of n	3.1
mean - C.I. =	45.9

n = 38
n-1 = 37
t table value = 1.305

Wildlife Cover = 46

TYPE	AREA BY TYPE (acres)	% AREA	COVER	WEEDS	COVER W/O WEEDS	WEIGHTED AVERAGE COVER
GRAZING COVER						
STCO REF	53.04	13%	80.2	17.9	62.3	6.1
STCO CARB			67	8.9	58.1	
STCO PEARSON			41.2	6.3	34.9	
STCO REF 06			50.1	12.7	37.4	
				AVG.	48.2	
AGSM SF	141.83	34%	105.5	52.8	52.7	14.2
AGSM REF			93.8	48.3	45.5	
AGSM REF 2003			102.5	70.8	31.7	
AGSM CARB			52.2	5	47.2	
AGSM PEARSON			52.2	19.8	32.4	
				AVG.	41.9	
ARCA SF	223.54	53%	121.2	41.5	79.7	35.2
ARCA NEW REF			67.7	3	64.7	
ARCA CARB			75.6	4.3	71.3	
ARCA PEARSON			61.6	13.6	48	
ARCA REF 08			95.4	29.4	66	
Total Area (acres)	418.41			AVG.	65.9	

Total Weighted Cover	**55.5**
Mean	55.5
STDEV	15.2
C.I. = (t table x stdev)/sqrt of n	5.5
mean - C.I. =	50.0

n = 14
n-1 = 13
t table value = 1.350

Grazing Cover = 50

NOTE: Sample adequacy is documented in each Environmental Baseline Study. Including the reference area data improves data accuracy by using data over different precipitation years.

APPENDIX B of ADDENDUM 17.24.313B

Using Baseline and Reference Area Information to Develop Technical Standards for COVER at SCM. Data from baseline data collected for the South Fork, Carbone, and Pearson Creek amendments and reference area sampling.

Baseline Cover Minus Annual and Biennials (% Cover)

TYPE	AREA BY TYPE (acres)	% AREA	COVER	WEEDS	COVER W/O WEEDS	WEIGHTED AVERAGE COVER
PASTURELAND COVER						
SUP SF	566.4	100%	102.4	38	64.4	62.7
SUP CARB			65.9	3.5	62.4	
SUP CARB			64.4	3.4	61	
SUP CARB			69.1	6.1	63	
Agcr PEARSON*	N/A					

Total Area (acres)	566.40	AVG.	62.7	
			Total Weighted Cover	**62.7**
n =	4		Mean	62.7
n-1 =	3		STDEV	1.4
t table value =	1.638	C.I. = (t table x stdev)/sqrt of n		1.2
			mean - C.I. =	61.5

Pasture Cover = 62

*Not sampled for cover. Please see Pearson Creek Baseline Vegetation inventory Section 3.5.1 for the discussion.

NOTE: Sample adequacy is documented in each Environmental Baseline Study. Including the reference area data improves data accuracy by using data over different precipitation years.

APPENDIX C of ADDENDUM 17.24.313B

Using Baseline and Reference Area Information to Develop Technical Standards for PRODUCTION (PSC) at SCM. Data from baseline data collected for the South Fork, Carbone, and Pearson Creek amendments and reference area sampling.

Baseline Production Minus Annual and Biennials (% Cover)

TYPE	AREA BY TYPE (acres)	% AREA	PSC (kg/ha)	WEEDS	PSC W/O WEEDS	WEIGHTED AVERAGE PSC
GRAZING PRODUCTION						
STCO REF	53.04	13%	1522	298	1224	109.1
STCO CARB			1191	180	1011	
STCO PEARSON			870	110	760	
STCO REF 06			682	235	447	
				AVG.	860.5	
AGSM SF	141.83	34%	1763	968	795	289.8
AGSM REF			1540	949	591	
AGSM REF 2003			2153	1273	880	
AGSM CARB			1189	54	1135	
AGSM PEARSON			1055	182	873	
				AVG.	854.8	
ARCA SF	223.54	53%	2243	768	1475	528.9
ARCA NEW REF			707	16	691	
ARCA CARB			1552	35	1517	
ARCA PEARSON			1140	280	860	
ARCA REF 08			715	308	407	
Total Area (acres)	418.41			AVG.	990.0	

		Total Weighted Production	**927.8**
n =	9	Mean	927.8
n-1 =	8	STDEV	340.2
t table value =	1.350	C.I. = (t table x stdev)/sqrt of n	153.1
		mean - C.I. =	774.7

Grazing Production = 775 kg/ha or 690 lb/acre

mple adequacy is documented in each Environmental Baseline Study. Including the reference area data improves data accuracy by using data over different precipitation years.

APPENDIX C of ADDENDUM 17.24.313B

Using Baseline and Reference Area Information to Develop Technical Standards for PRODUCTION (PSC) at SCM. Data from baseline data collected for the South Fork, Carbone, and Pearson Creek amendments and reference area sampling.

Baseline Production Minus Annual and Biennials (% Cover)

TYPE	AREA BY TYPE (acres)	% AREA	PSC (kg/ha)	WEEDS	PSC W/O WEEDS	WEIGHTED AVERAGE PSC
PASTURELAND PRODUCTION						
SUP SF	566.4	88%	2220	562	1658	1,192.6
SUP CARB			1408	58	1350	
SUP CARB			1017	43	974	
SUP CARB			1440	15	1425	
				AVG.	1351.8	
Agcr PEARSON	75.6	12%	845	0	845	99.5
Total Area (acres)	642.00			AVG.	845.0	
					Total Weighted Production	**1292.1**
n = 5					Mean	1292.1
n-1 = 4					STDEV	334.4
t table value = 1.533				C.I. = (t table x stdev)/sqrt of n		229.3
					mean - C.I. =	1062.8

Pasture Production = 1063 kg/ha or 948 lb/acre

mple adequacy is documented in each Environmental Baseline Study. Including the reference area data improves data accuracy by using data over different precipitation years.