Big Sheep Creek Watershed Assessment Report

Dillon Field Office

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Bighorn Sheep in Big Sheep Creek Watershed, August 2015

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Assessment Process

This document reports the land health assessment of the public lands administered by the Bureau of Land Management (BLM) in the Big Sheep Creek Watershed (BSCW).

This is the first in a series of documents: the Watershed Assessment Report, the Authorized Officer's Determination of Standards, and the appropriate National Environmental Policy Act (NEPA) documentation and subsequent Decision(s).

The Watershed Assessment reports the condition and/or function of BLM administered land within the BSCW to the Authorized Officer. The Authorized Officer considers the report to determine if the five Standards for Rangeland Health (Standards) are currently being met, and then signs a Determination of Standards documenting where land health standards are, or are not, in compliance.

This assessment will report condition and/or function for the following five Standards:

- Standard #1 Upland Health
- Standard #2 Riparian /Wetland Health
- Standard #3 Water Quality
- Standard #4 Air Quality
- Standard #5 Biodiversity

The Standards are assessed on an allotment scale, with the exception of Air Quality, which is made at the watershed level.

In addition, this assessment will report condition and/or function of forest health and fuels. Forest health can affect each of the five standards, but in this assessment will be reflected under Standard #5 Biodiversity, along with other factors pertinent to biodiversity including Special Status Species and invasive species.

Condition/function declarations regarding the Standards are made as either:

- Proper Functioning Condition (PFC),
- Functioning At Risk (FAR); which is assigned a trend of up, down, static, or not apparent, or
- Nonfunctioning (NF).

Land Health Standards are met when conditions across an allotment as a whole are at PFC or FAR with an upward trend. This is dependent on scope and scale and determined by the Authorized Officer.

Reporting the conditions of the Standards will follow the following format:

- 1) Affected Environment - This section briefly describes the area and resources that were assessed.
- 2) Analysis and Recommendations - This section outlines the procedures the interdisciplinary team (IDT) used to determine conformance with the various standards,

- lists the findings, and includes recommendations suggested by the IDT during the field assessments.

The Standards are described in detail in the Record of Decision (ROD) Standards for Rangeland Health and Guidelines for Livestock Grazing Management (S&Gs) for Montana, North Dakota, and South Dakota-Western Montana Standards. The preamble of the Western Montana Standards states: "The purpose of the S&Gs are to facilitate the achievement and maintenance of healthy, properly functioning ecosystems within the historic and natural range of variability for long-term sustainable use." Standards are statements of physical and biological condition or degree of function required for healthy sustainable lands. Achieving or making significant progress towards these functions and conditions is required of all uses of BLM administered lands as stated in 43 CFR 4180.1.

This assessment was done in accordance with the BLM regulations regarding Rangeland Health Standards.

- BLM Manual H-4180-1, Rangeland Health Standards Handbook and Guidance for Conducting Watershed-Based Land Health Assessments.
- Code of Federal Regulation 43 CFR, Subpart 4180
- Record of Decision - Standards for Rangeland Health and Guidelines for Livestock Grazing Management for Montana, North Dakota and South Dakota.

Available trend monitoring data, existing inventories, historical photographs and standardized methodology are used by the IDT to assess condition and function of BLM administered lands. This information, including technical references, BLM policy and procedure handbooks, and monitoring guidelines and methodologies are available for review at the Dillon Field Office. Technical references and BLM procedural handbooks are also available on the BLM library website at http://web.nc.blm.gov/blmlibrary. See appendix B for a summary of Daubenmire study data.

The initial recommendations developed by the IDT during field assessments contained in this report focus primarily on livestock management, timber and fuels management, wildlife and fisheries habitat and invasive species management. Other BLM administered public land resources, uses and activities addressed in the BSCW include recreation, cultural, travel management, wilderness, and special status species.

The assessed land health conditions and/or functionality are the basis for the IDT's management recommendations in this report and the Determination of Standards. As required by NEPA regulations, an Environmental Assessment (EA) will be completed to address resource concerns identified within the 23 grazing allotments and un-allotted or un-leased BLM administered public lands within the BSCW.

Alternative management will be analyzed wherever it is determined that:

- specific grazing allotments are not meeting the Standards
- allotments are meeting the Standards but have site specific concerns
- there are unhealthy forest conditions in the watershed
- fuels conditions are outside the natural range of variability

- there are other documented resources concerns

Also, if existing grazing management practices or levels of grazing use on BLM administered lands are determined to be significant factors in failing to achieve one or more of the five Standards, the BLM is required by regulation (43 CFR 4180.1) to make grazing management adjustments. Alternative management will may also be analyzed where permittees or BLM staff have suggested changes to better facilitate current livestock management.

Implementation of new plans will begin in 2017, but it may take several years to fully implement revised grazing management plans, range improvement projects, forest treatments and/or fuels projects. The new plans will be developed in consultation and coordination with the affected lessees, the agencies having lands or managing resources within the area and other interested parties.

As with all similar BLM decisions, affected parties will have an opportunity to protest and/or appeal these decisions.

Background

The BSCW is located in Beaverhead County, Montana and drains portions of the Tendoy and Beaverhead Mountain ranges. Elevations range from 6,000 feet at the mouth of Big Sheep Creek to nearly 11,000 feet on top of the Continental Divide near Italian Peak. The watershed lies within Townships 12-15 South and Ranges 9-12 West, Montana Principal Meridian (M.P.M.). (**See Map 1: Big Sheep Creek Vicinity Map and Allotments).**

The entire BSCW contains approximately 181,302 acres of BLM, private, State of Montana and Forest Service administered land. About 54,667 acres (30%) is public land administered by the BLM. With the exception of two allotments, only BLM administered land was physically assessed for this document. The Crystal Creek and Muddy Creek Allotment are co-managed with the Forest Service through a Memorandum of Understanding which identifies the BLM as the lead management agency for these allotments. Therefore, 6,123 acres of Forest Service Lands were also assessed in this allotment. Twenty-three grazing allotments contain about 51,165 acres of BLM administered land. An additional 3,502 acres of un-allotted public tracts are located within the watershed.

Big Sheep Creek Watershed, 2015.

All BLM administered land within the Dillon Field Office has been assessed for land health over the last 13 years, with the exception of the Muddy Creek allotment. The first time the allotments with in the Big Sheep Creek Watershed were assessed they were split up and completed in separate years. The majority of BSCW was assessed in 2005 while allotments known at that time as the Bear Creek Ranches allotments were assessed in 2002, and the Muddy Creek allotment was assessed for the first time by itself in 1992. All allotments within the BSCW were combined and re-assessed during the 2015 field season. By working on a watershed basis, a broader landscape is considered and more consistent management can be applied. It is the BLM's intent to implement watershed management cooperatively. Any changes in livestock management will be implemented through grazing decisions that address allotments or groups of allotments with a common permittee. Forest health and fuels management treatments or projects and any other management projects or changes will be implemented through Decisions appropriate for the respective programs.

Over the previous 13 years (2002 to 2015), BLM has been conducting watershed assessments on a 10 year adaptive management schedule. All 17 watersheds within the Dillon Field Office covering over 900,000 acres of BLM administered land have been assessed at least once and several have been assessed a second time. These watershed assessments examined all five standards for Rangeland Health including upland, riparian/wetland and aquatic systems. Uplands are defined as any part of the landscape beyond the non-streamside boundary of the riparian area (USDI, BLM 1998). Riparian areas are the “green zones” which lie between channels of flowing water and uplands. For each watershed assessment, an interdisciplinary team of trained BLM resource professionals observed these systems and made an on-the-ground rating whether they were meeting BLM Standards for Healthy Rangelands following approved BLM protocols.

Vegetation

In this report, sagebrush and grassland areas are discussed under Standard #1 Uplands, while forest and woodland habitats are discussed under Standard #5 Biodiversity.

The variety and distribution of plant communities and seral stages in the watershed area is a function of climate, geology, and soil combined with:

- historic uses (e.g., grazing, mining, logging, etc.)
- short term weather patterns
- disturbance regimes (e.g., drought, fire, floods, and herbivory)

Current vegetative cover was calculated using satellite imagery (LANDFIRE 2014 Existing Vegetation Type). Table 1 summarizes the different cover types within the BSCW.

Table 1: General Cover Types Summary

Cover Type	BLM Acreage	% of BLM Acreage in Cover type	Total Watershed Acreage	% of Total Watershed in Cover Type
Forested	5270	10	33,000	18
Grasslands	1155	2	8956	5
Sagebrush/Mountain Shrubs	44,384	81	113,415	63
Riparian/Mesic Shrubs	2620	5	13,637	7
Mountain Mahogany	199	.5	236	.5
Aspen	72	.5	1236	.5
Other/Agriculture	963	1	10,779	6
Open Water	4	0	43	0
Totals	**54,667**	100	**181,302**	100

Average annual precipitation within the watershed varies from about 12 inches on the lower Dixon Mountain Allotment to 30 inches on the high mountain slopes in the Beaverhead-Deerlodge National Forest in the Beaverhead mountain range.

Prehistory and History

The Native American presence in the BSCW probably spans the entire record of documented human occupation in North America. The abundant floral, faunal and lithic resources of this high mountain valley, coupled with the presence of natural travel corridors, have attracted native peoples to the area for the past 10,000 to 12,000 years. The uninterrupted use of the area by Native Americans is documented within the archaeological record, which to date consists of over 57 recorded prehistoric sites within the Big Sheep Creek Assessment area. Early fur trappers traversed the area where they encountered native peoples belonging to the Shoshone, Bannock, Flathead, and Blackfeet Tribes. The Lemhi Shoshone continued to use the area until the 1930s and to this day consider this area important.

Historically, ranching in Beaverhead County began during the fall of 1864, when William C. Orr of the California-based Poindexter and Orr partnership drove a herd into the Beaverhead Valley for wintering. Within a few years, Poindexter and Orr ran one of the territory's largest cattle and sheep operations (Malone, Roeder, and Lang, 1991: 146-148). Early homestead ranchers, such as Edgar Kenison and Ernest Harkness worked for the Poindexter-Orr ranch prior to establishing sheep and cattle ranches in the Sheep Creek Valley. These early homesteads were established during the earliest part of the Twentieth Century (Stauffer, 1990).

Agricultural History and Socioeconomics

Although mining was an impetus in the region's development, cattle ranching was already established when the first miners found their way into Montana. The Grants and Orrs in the Beaverhead region and the Kohrs in Deer Lodge were grazing cattle and providing beef to local miners as well as to consumers in other parts of the west and east. These early ranchers faced difficult circumstances fighting with Blackfeet and other tribes over territory and initially competing with bison for range. Yet, through the 1870s the cattle and sheep business as well as farming continued to expand. By the end of the 1870s, bison were on the brink of extinction. Public lands became more accessible facilitated by an "open range" policy that made available

public lands for grazing. Cattle ranching in Montana became another means to "strike it rich" and spurred another rush of settlers and speculators.

Before the boom of the 1880s, most Montana cattle operations were partnerships or family affairs, but many of the new outfits were full-fledged corporations with access to plenty of capital and plenty of livestock. Dozens of corporate ranches held Montana charters by 1886; and many others, such as the Texas-based XIT, and Continental Land and Cattle spreads, were incorporated in other states or territories. By 1886, at the peak of the open range boom, roughly 664,000 cattle and 986,000 sheep grazed Montana range lands. A large percentage of the animals belonged to the new corporate ranchers, whose managers packed them onto limited ranges with no provisions of winter hay, in hope of quick profits from minimal investments (Malone, Roeder, and Lang, 1991: 157).

A severe drought and hard winter in 1886-87 combined with overgrazing on public lands resulted in severe impacts to Montana's cattle business, with some estimates that half or more of the cattle died (Fletcher, 1960:89-94). Small operators who put up hay adapted better than the "get rich quick" operators did, and after 1887, the cattle industry settled into a period of recuperation and ultimately further expansion as the value of hay for winter feed became apparent (Fletcher 1960).

The agricultural boom began to go bust in the post-war depression of the 1920s, and large numbers of Montana farmers moved out of state, leaving a demographic profile that is similar to that of present day Montana: larger numbers of older persons and younger persons with the middle-age demographic group showing sharp declines. Prior to World War II, ranching and farming continued under pressure, but various New Deal programs supported these industries into World War II, when once again there was a small boom. A combination of weather, world economics, and cultural changes in the United States have continued to influence boom and bust cycles in ranching and farming in southwest Montana. Today these activities remain important to the overall economy and culture of the region, but the face of agriculture and ranching are changing. Ranchers or their family members may also work as fishing guides or outfitters or in town to supplement their income. Fluctuations in cattle prices, other market forces, and increasing equipment and operating costs require some diversification in order to ensure the fiscal viability of present-day ranching operations. Some choose to lease their lands, or access through them for hunting or fishing and thereby supplement ranch income. It is common for wives and children to work for the cash needed to keep family and ranching life viable. Unfortunately, for many ranchers, children are not staying on to ranch, either because the isolation and lifestyle demands are not appealing or because financial realities do not allow it.

The BSCW is sparsely populated with Dillon being the largest town near the watershed. Recreation and tourism are important components of the economy of the BSCW. Most of this recreation occurs during the big game hunting season which provides substantial contributions to the local economy.

Of Montana's 56 counties, Beaverhead County is the largest livestock producer. The USDA 2007 Census of Agriculture Inventory (http://www.agcensus.usda.gov/publications) indicated that there were 212,412 head of cattle and calves and beef cattle in the county. Beaverhead

County was also third in sheep production with 14,065 sheep and lambs inventoried. Very few grain-fed cattle were produced. The focus was on calves and feeder steers along with beef cows or breeding stock. This type of ranching requires large expanses of grazing land.

According to the National Agricultural Statistical Service (http://www.nass.usda.gov/mt/), overall cattle production in Montana has been relatively stable since 1986. The January inventories in 1986 and 2002 reported 2.45 million head with a peak of 2.75 million during 1996. Sheep production, on the other hand, showed a general decline across the state, reflecting a broader national pattern. The data from 2010 reports that, of Montana's 56 counties, Beaverhead county ranked 1st in total hay production. The data from 2011 reports that, Beaverhead county ranked 1st in total cattle numbers; and 3rd in sheep numbers.

Several economic factors have changed since the early 1980s which might have affected ranching operations in southwest Montana, including rising real estate values, volatile commodity price fluctuations and rising overhead costs for agriculture. These factors along with state and national politics and changing livestock market conditions have affected the livestock industry over the last twenty years. Social factors include the rising popularity of southwest Montana as a place to live, work and play accompanied by related population growth and change.

BLM grazing fees are calculated using the formula required by 43 CFR 4130.8 and are considerably less than those charged by private landowners. In 2004, the average fee in Montana for grazing on private land was $16 per AUM based on Montana Agricultural Statistics Service, National Agricultural Statistics Service figures, and the minimum fee charged on Montana State Lands was $5.48 per AUM. In 2015, these same fees rose as the average fee in Montana for grazing on private land was $21.00 per AUM, and the minimum fee charge on Montana State Lands is $11.41 per AUM. The BLM and Forest Service used the same formula to derive a $1.69 per AUM fee in 2015, which makes federal land the least expensive grazing available to area ranchers. Federal grazing permits are desirable for area cattle producers as a source of inexpensive forage, even though additional management costs are usually incurred.

On page 252 of the Dillon RMP/Final EIS, Table 48, Employment and Labor Earnings by Major Type and Sector in 2000, reports that private on-farm employment accounted for 17% of total employment in Beaverhead County. Refer to Table 56 on page 286 of the Proposed Dillon RMP and Final EIS, which shows employment and labor income response coefficients related to livestock grazing, timber management and recreation use for the area influenced by the Dillon Field Office. In addition, page 251 of the EIS presents personal income statistics from 2000 that indicate that labor earnings are the largest source of income in Beaverhead County.
The Proposed Dillon RMP/Final EIS is available at
http://www.blm.gov/mt/st/en/fo/dillon_field_office/rmp/Final.html.

Special Management Designations

The Big Sheep Creek/Medicine Lodge Back Country Byway passes through the majority of the Big Sheep Creek watershed. This 50+ mile designation was made in 1990 and included identification of the Big Sheep Creek portion as a Watchable Wildlife Area. Identification of

Back Country Byways was a national BLM initiative intended to highlight some of BLM's more scenic multiple use landscapes.

The Continental Divide National Scenic Trail in many places constitutes the western and southern boundary of Big Sheep Creek basin, as it follows the continental divide. This congressionally designated national trail became part of the national trails system in 1978. Although it is intended primarily for non-motorized recreational uses, provisions of the Act allow motorized uses on designated segments.

The Muddy Creek/Big Sheep Creek Area of Critical Environmental Concern (ACEC) lies four miles southwest of Dell, Montana, including portions of the Muddy Creek drainage and continuing upstream along the Big Sheep Creek drainage to its confluence with Deadman Creek. The area contains approximately 22, 289 acres of public land with relevant and important scenic values along Big Sheep Creek and the cultural resource values throughout. Portions of the ACEC fall within the Hidden Pasture Wilderness Study Area (WSA). The geomorphology along Muddy Creek proper has resulted in deeply stratified buried cultural deposits located on public lands. There is also a high concentration of rock art pictograph sites. The geomorphological regime and highly erodible soils coupled with the density of known archaeological sites in the area results in circumstances that make the area vulnerable to adverse change. The area provides spectacular scenery, characterized by high palisades and timbered peaks that rise dramatically from the canyon floor. Big Sheep Creek passes through three narrow canyons with intervening open valleys and contains scenic values not typically found in the planning area. (See map 1)

Hidden Pasture Creek Wilderness Study Area

The Hidden Pasture Creek WSA contains 15,509 acres inventoried and studied for wilderness characteristics in the late 70's to early 80's. Although the BLM recommended the area for uses other than wilderness, the WSA must be managed to prevent impairment of wilderness characteristics until such time as Congress either designates it as wilderness or releases it to be managed for more traditional multiple uses. The BLM released BLM Manual 6330 – *Management of BLM Wilderness Study Areas* in 2012 to provide for future management of WSAs to ensure protection, or enhancement of wilderness characteristics until Congress acts on BLM's recommendations, which were made in 1991. Wilderness characteristics identified in the area included naturalness and outstanding opportunities for solitude.

Lands with Wilderness Characteristics

The BSCW was inventoried for lands with wilderness characteristics in accordance with BLM Manual 6310 – Conducting Wilderness Characteristics Inventory on BLM Lands, published in March, 2012. Wilderness characteristics inventories are available at the Dillon Field Office. The purpose of an inventory is to determine the presence or absence of wilderness characteristics. The BLM must document existing conditions and evaluate wilderness characteristics as defined in Section 2(c) of the Wilderness Act and incorporated in FLPMA. In order for an area to qualify as lands with wilderness characteristics, it must possess sufficient size, naturalness, and outstanding opportunities for either solitude or primitive and unconfined recreation. In addition, it may also possess supplemental values.

There were three units identified within the BSCW as having the potential minimum size for wilderness; a minimum of 5,000 contiguous acres. Two of those were inventoried in 2015. One unit was dismissed for not meeting the size requirements. Two of these units were part of the original inventory from 1979, and one is a new unit. Each unit has a unique identifier in a number and name. As a result of this inventory, none of the areas were determined to possess wilderness characteristics as defined in that guidance. Below are brief descriptions of the units and the findings of the inventory.

Coyote Lakes #MT-076-020 was dismissed from further consideration as it is only 1200 acres.

Caboose Canyon #MT-076-021 does not meet the size requirement as it is split in the center by a wilderness inventory road. The Caboose Canyon Road bisects the unit, making two separate units, neither of which is of sufficient size to be further considered for wilderness characteristics. This road was constructed and will be maintained to ensure regular and continuous use. Two other roads bisect the two remaining units further reducing their size. Both of these roads were constructed and would be maintained if needed. The remaining parcels are 3,450 acres, 3,110 acres, 1,706 acres and 234 acres.

Old Bannock Pass #MT-050-100 is located mostly within the Medicine Lodge Watershed with 2,460 acres extending into the Big Sheep Creek Watershed. This unit is 5,356 acres and it primarily appears to be natural. Due to the shape of the unit and the amount of vehicle ways (routes) that bisect the unit, there are not outstanding opportunities for solitude. Some opportunities exist for primitive and unconfined recreation, primarily in the form of big game hunting; however these recreation opportunities are not outstanding within this region.

Geology

The Big Sheep Creek Assessment Area is dominated by structural complexity as the Medicine Lodge Thrust Plate, including a mélange of Precambrian, Paleozoic and Paleogene sediments was thrust eastward over younger sedimentary rocks. This complexity is enhanced by the presence of older Precambrian quartzofeldspathic gneiss and schist and Paleozoic granitic rocks of the Beaverhead pluton. The oldest rocks in the area, and some of the oldest rocks in Montana, are the Precambrian Archean schists and gneisses that appear to form the basal unit for the Medicine Lodge Thrust Plate (Ruppel et al. 1981). These Archean rocks date to over 2 billion years ago and are found in structural settings overlain by a variety of Paleozoic and Paleogene sediments and Paleogene volcanic rocks of the Challis and Medicine Lodge Volcanics. Virtually all the major contacts between the various sedimentary, intrusive igneous and metasedimentary rocks are fault contacts. The Challis and Medicine Lodge Volcanics are overlain on top of this mélange of lithologies. The most recent (Quaternary) deposits include hot springs deposits and various glacial deposits as well as landslides, alluvial fan and modern alluvial/floodplain deposits.

Perhaps the most notable feature of the Paleogene sedimentary units (TS on the map) is a strong tendency for mass wasting/landslide features which can be a critical factor in land use decisions. More detailed maps (Ruppel, 1998) show extensive areas of Quaternary landslides. The three MBMG Open File Reports referenced have more detailed maps which should be used in the event a project needs more detailed geologic input.

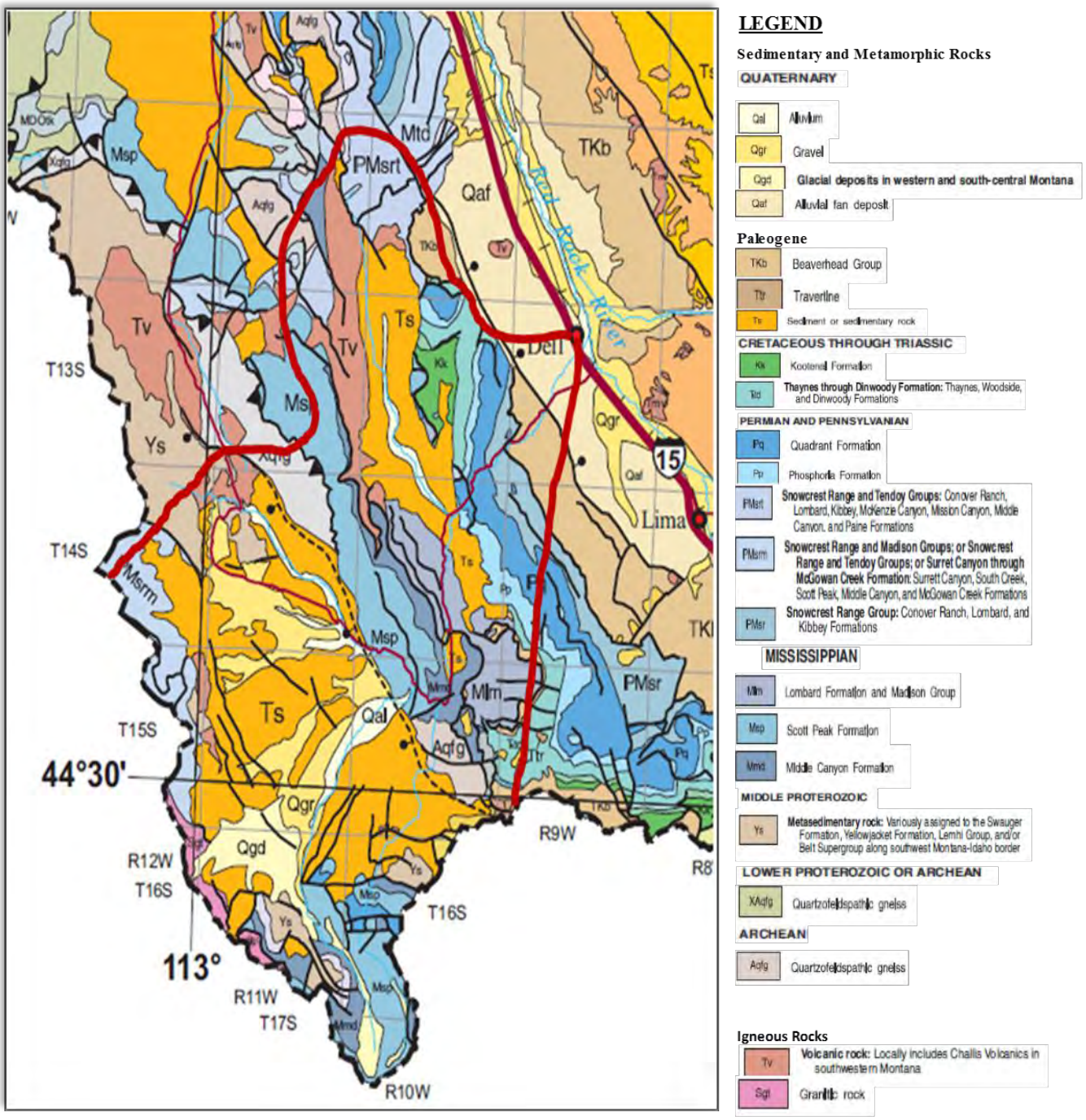


Figure 1: Geology map of BSCW

Visual Resource Management
The Hidden Pasture Wilderness Study Area (16,197 acres) will be managed as Class I. Preservation of the landscape is the primary management goal in Class I areas. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.

Another 8,984 acres adjacent to the WSA and along the scenic byway corridor will be managed as Class II. The objective of this class is to retain the existing character of the landscape. Activities or modifications of the environment should not be evident or attract the attention of the casual observer. Changes should repeat the basic elements of form, line, color and texture found in the predominant natural features of the characteristic landscape.

The remaining 29,473 acres will be managed under Class III guidelines. The objective of this class is to partially retain the existing character of the landscape. The level of change to the characteristic landscape may be moderate. Management activities may attract attention, but should not dominate the view of the casual observer. Changes caused by management activities may be evident but should not detract from the existing landscape.

The visual resource contrast rating system will be used during project level planning to determine whether or not proposed activities will meet VRM objectives. Projects will identify mitigation measures to reduce visual contrasts and prepare rehabilitation plans to address landscape modifications on a case-by-case basis.

Authorized Uses

Forest Products
Forest resources in the watershed have been utilized since the beginning of European settlement during the early 1900's. Evidence in the form of old stumps can be found across all ownerships through many of the forested habitats in the assessment area. The BLM sells permits authorizing firewood removal and Christmas tree cutting which may have been utilized in areas of the BSCW.

Livestock Grazing
The assessment area includes 23 grazing allotments covering 54,667 acres of BLM administered public land and 3,502 acres of unalloted BLM administered public land (**Map 1**). Twelve different business entities or individuals hold grazing authorizations on these allotments. Grazing allotments in the BSCW provide operators important late spring, summer and fall forage for their livestock. There are 5,747 animal-unit months (AUMs) of allocated livestock forage on BLM administered lands within the allotments. The stocking rate on BLM administered lands within the watershed ranges from 1.8 acre/AUM to 26.8 acres/AUM. This variance is influenced by soils, vegetative type, topography (aspect, elevation, and slope), distance from water and local weather. Cattle (mature individuals or cow/calf pairs) are the primary type of livestock authorized on the 23 allotments; however, several allotments allow the flexibility to graze yearling cattle.

Livestock grazing allotments were assigned to a management category during development of the resource management plan.

All grazing allotments in the Dillon Field Office have been categorized as either *Improve (I), Maintain (M)* or *Custodial (C)* based on resource values, opportunities for improvement and the BLM's level of management. Allotment categorization is also used to establish priorities for distributing available funds and personnel during plan implementation to achieve cost-effective improvement of rangeland resources. Improve *(I)* category allotments are managed more intensively and are monitored more frequently. Maintain *(M)* category allotments are usually at a desired ecological condition and are managed to maintain or improve that condition. Custodial *(C)* category allotments are generally isolated parcels where BLM administered land is a small part of the total grazing unit, there is limited or no public access, and/or have few resource concerns. These small allotments are managed in conjunction with the lessee's normal livestock operation and generally monitored less frequently. Thirteen allotments in the BSCW are categorized as *I* allotments, five are *M*, and the remaining five are *C* allotments. Table 2 summarizes grazing allotment information.

Table 2: Grazing Allotments Summary

Allotment number category	Grazing Authorization Number	Livestock Number and Kind	Season of Use	Grazing System	Stocking Rate on BLM	BLM Active AUMs	BLM Acres	Acres in Other Ownerships[1]	Total Acres
Alkali Creek 30024 M	2505662	140 Cattle	6/1-7/31	DEFERRED REST ROTATION	4.9	194	950	PVT=337	1287
Cabin Creek 20704 C	2504668	11 Cattle	6/15-11/30	CUSTODIAL USE	3.1	61	190	PVT=151	341
Cottonwood 30638 C	2505071	24 Cattle	6/15-11/30	CUSTODIAL USE	2.7	133	359	--	359
Crystal Creek 30102 I	2504668	154 Cattle	6/15-10/15	REST ROTATION	3.8	343	1287	PVT=637 FS=1544	3468
Dixon Mountain 30022 I	2505060	190 Cattle	5/5-6/5 11/1-12/31	REST ROTATION	5.3	146 278	2229	PVT=514	2743
Four Eyes 30269 I	2501975	50 Cattle	6/15-10/15	REST ROTATION	26.8	200	5342	PVT=302	5644
Four Eyes Isolated 20612 I	2501975	50 Cattle	6/15-10/15	SEASONAL (no more than 30 days within listed season of use)	3.9	80	308	--	308
Indian Creek 10741 I	2504762	140 Cattle	6/15-10/15	REST ROTATION	4.6	509	2330	PVT=118	2448
Indian Creek Isolated 30653 C	2504762	23 Cattle	6/15-11/30	CUSTODIAL USE	5.6	126	703	--	703
Junction 20009 I	2504668	127 Cattle	6/15-11/30	REST ROTATION	3.7	670	2509	PVT-153	2662
Meadow Creek 20042 M	2504668	103 Cattle	7/1-11/8	REST ROTATION	6.0	191	1149	PVT=209 FS=5721 ST=1279	8358
Meadow Creek Isolated 30611 I	2504668	7 Cattle	6/15-11/30	CUSTODIAL USE	4.1	39	160	--	160

Allotment number category	Grazing Authorization Number	Livestock Number and Kind	Season of Use	Grazing System	Stocking Rate on BLM	BLM Active AUMs	BLM Acres	Acres in Other Ownerships[1]	Total Acres
Muddy Creek 30039 I	2504702	350 Cattle	6/20-10/15	REST ROTATION	14.5	1236	17969	PVT=1740 FS=4579	24288
Nicholia 10699 I	2505071	9 Cattle	6/15-11/30	SEASONAL (no more than 30 days within listed season of use)	5.6	50	280	--	280
North Dixon 30602 C	2505060	5 Cattle	6/15-11/30	CUSTODIAL USE	5.8	5	29	--	29
Pine Creek 30001 I	2505100	342 Cattle	6/16-7/11	REST ROTATION	9.5	225	2132	PVT=431 FS=1606 ST=640	4809
Porcupine Canyon 20107 I	2500037	112 Cattle 3 Cattle (C)	6/15-8/31	DEFERRED ROTATION	6.9	247	1693	PVT=681 FS=14	2388
Rio Puerco 10700 I	2504747	82 Cattle 4 Horses	5/1-12/31 9/15-12/15	SEASONAL (no more than 30 days within listed season of use)	25.0	222	5567	--	5567
Rock Creek Isolated 20698 C	2505100	1 Cattle	6/15-11/30	CUSTODIAL USE	1.8	8	14	--	14
Rock Creek Seeding 20041 M	2505100	33 Cattle	6/1-10/15	SEASONAL (no more than 15 days within listed season of use)	3.3	143	467	PVT=32	499
Simpson Creek 20158 I	2505153	250 Cattle	6/1-7/15	DEFERRED REST ROTATION	8.3	370	3068	PVT=7	3075
Simpson Creek FS 30207 M	2505153	130 Cattle	7/16-9/30	REST ROTATION	5.5	135	746	FS=6822	7568
Whitworth 20720 M	2505083	75 Cattle	7/1-8/31	REST ROTATION	12.4	136	1684	PVT=168	1852
Unalloted	--	--	--	--	--	--	3502	--	--
BLM Totals	**--**	**--**	**--**	**--**	**AVG=7.5**	**5747**	**54,667**	**27,685**	**82,352**

[1]PVT=Private, FS=US Forest Service, ST=Montana Department of Natural Resources

The BLM has worked cooperatively with individual livestock permittees/lessees in the watershed for many years to develop Allotment Management Plans (AMPs) that prescribe grazing management to maintain or improve natural resource conditions. Of the BLM-administered lands in the watershed that are available for livestock grazing (51,165), about 97% of the acres are managed under formal AMPs, or have agreed upon grazing systems that prescribe a grazing system, such as rest rotation or deferred rotation (Table 2). About 3% of the BLM-administered acres that are available for livestock grazing are in custodial allotments, where BLM management inputs are minimal because of the small proportion of public land in the allotments (Map 1).

Recreation
The Big Sheep Creek watershed receives moderate levels of recreational use throughout much of the year. Road conditions limit recreational use through the winter and early spring, but use of the Back Country Byway is popular when conditions allow, fishing on Big Sheep Creek provides opportunities from late spring through the autumn, and big game, upland bird and waterfowl hunting become the dominant uses late in the year. There is one semi-developed campground at Deadwood Gulch that provides a vault toilet and a few fire rings and camping spots. The campground is popular especially during hunting and fishing seasons. Other user-defined camping areas can be found along the Big Sheep Creek Road, mostly through the canyon. These are also used primarily by hunters and anglers.

Two commercial recreation providers hold current Special Recreation Permits within the watershed. Both are authorized to conduct big game hunting and summer horseback activities within the area. One of those businesses averages approximately 100 – 150 user days per year while the other averages less than 30.

Mining, Minerals and Abandoned Mine Lands
The Big Sheep Creek Assessment Area includes three mining districts, the Nicholia, Big Muddy and Medicine Lodge districts. The Big Muddy and Nicholia Mining Districts have little evidence of past activity, production or exploration and could be best described as loosely defined. The Medicine Lodge District covers the southern portion of the Assessment area and is a relatively recent district which has seen minor production during the 1940s. The Sweeney Mine was the only producer of note, producing 596 tons of lead/zinc/copper ore. Minor occurrences of thorium, asbestos, rare earths, fluorite and graphite have also been noted. A minor gypsum site was reclaimed by the Bureau several years ago as well.

There is little evidence of locatable mineral activity in the BSCW. While the Archean schists and gneisses do host valuable mineral deposits elsewhere in Montana that is not the case for the exposures of Archean rocks in the BSCW.

The Permian Phosphoria Formation, which has been mined for phosphate near Melrose, Montana and along the crest of the Centennial Mountains to the southeast of the area, occurs in the eastern portions of the BSCW. There has been no activity associated with these outcrops of the Phosphoria Formation.

This watershed has not had large scale extensive hard rock mining and as a result there is not an extensive number of abandon mine features. Some mining has occurred in various areas of the watershed and as a result there are pockets of historic mine features. There are no known and/or inventoried open hazardous shafts, adits or mine features.

<u>Oil and Gas</u>
The BLM is currently processing an Application for Permit to Drill (APD) for a single exploratory well to be drilled either on BLM or Forest Service (FS) administered lands. The

environmental analysis will be done under another document and not within this watershed assessment. There will be three alternatives analyzed; Alternative A will be a no action. Alternative B will be to drill on BLM administered land and if chosen, the well will be located at T. 14 S., R. 10 W., Section 14. Alternative C will be to drill on FS and if chosen, the well will be located at T. 14 S., R. 9 W., Section 18. Alternative B would use the Big Sheep Creek road for access and additionally approximately four miles of road would need to be constructed to the site. Under Alternative C, access would be up Little Sheep Creek and then on an existing road to the top of White Pine Ridge.

Format for Standards

The Upland, Riparian, Air Quality, and Water Quality Standards will follow the following format:

- **Affected Environment** - This section briefly describes the area and resources that were assessed.
- **Findings and Analysis** - This section describes the findings of the IDT during the field assessment.
- **Recommendations** - This section presents initial recommendations developed by the IDT during the field assessment.

Uplands

Western Montana Standard #1: *"Uplands are in Proper Functioning Condition."*

Affected Environment

Photo looking west on the Muddy Creek allotment July, 2015

Uplands are defined as land at a higher elevation than the alluvial plain or low stream terrace; all lands outside the riparian-wetland and aquatic zones (USDI 1996). Properly Functioning Condition (PFC) for uplands is defined as the condition in which vegetation and ground cover maintain soil conditions that can sustain natural biotic communities. The functioning condition of uplands is influenced by geomorphic features, soil, water, and vegetation (USDI 1994).

Soils

The Big Sheep Creek Watershed is extensive and encompasses several major drainages and their associated tributaries including: Muddy Creek, Cabin Creek, Nicholia Creek, and Big Sheep Creek itself. Soils in the BSCW are primarily affected by climate (temperature and precipitation), topography (slope and aspect), and parent material (geology and geomorphology). The soils in the BSCW are in the Frigid (generally below 6,600 feet elevation) and Cryic (generally above 6,600 feet elevation) soil temperature regimes. Lands administered by BLM within the BSCW receive about 12 to 30 inches of Relative Effective Annual Precipitation, commonly referred to as REAP, and fall into the Aridic (driest), Ustic, and Udic (wettest) soil moisture regimes; most BLM administered land in the BSCW falls into the Cryic soil temperature and Ustic (15 to 24 inch REAP) soil moisture regimes and have a 50 to 90 day growing season. Within the BSCW boundary, elevations range from about 6,000 feet at Dell, to almost 11,000 feet at the head of the Nicholia watershed. The soils within the BSCW in general formed from alluvium, slope alluvium, colluvium, residuum, and glacial till mainly from quartzite, limestone, sandstone, other sedimentary & metamorphic rock, conglomerate, and some igneous rock sources including volcanic ash. Soil depth and development is quite variable throughout the BSCW and is tied more specifically to parent materials, landform, position, slope steepness and slope shape.

The Cabin Creek and Nicholia Creek watersheds are rimmed and bound by the Continental Divide to the west and south respectively. Steep and very steep mountain slopes with skeletal soils, rock outcrop, and rubbleland define this rugged area. Broadly spreading below these mountain slopes, glacial till is most pronounced on the west side of the Cabin Creek drainage and well up into the Nicholia Creek watershed and is evidenced by a series of moraine landforms extending out into the valley. A wide variety of rock types influence the parent material origin of the till. Surface textures associated with this till material vary, but lie predominately within the sandy loam to loam textural classes. Due to the large amount of fragments inherent to glacial till, gravelly to extremely stony soil surface classes are common. The moraines eventually give way to hills, low hills, and alluvial fan remnants composed of uplifted sedimentary beds that run parallel to the main drainageways. The beds themselves are composed of calcareous sediments (siltstone, mudstone, shales, and a minor component of sandstone), as well as weathered, mostly calcareous, conglomerate. Soil depth within the glacial till is almost all very deep, with the sedimentary beds showing a mix of shallow to very deep, due to the bedrock expression near the soil surface in some areas. Minor components of salt and sodium affected soils also occur in these drainage areas. A majority of the soils here are very deep, range widely in texture, and are mostly gently sloping.

Muddy Creek is also rimmed by steep and very steep, rocky, mountain slopes that formed in a variety of parent materials including limestone, sandstone, quartzite, volcanic ash, andesite, rhyolite, and complex landslide deposits. The soils range widely in depth and texture but include significant areas of heavy clay, fine textured soils. Below these mountain slopes, the Muddy Creek landforms are composed of more highly weathered and calcareous sedimentary parent materials. Landforms include mountain slopes, hills, and fan remnants; soil depths range from shallow to very deep, and soil textures include more loamy and loamy-skeletal families. Muddy Creek also has a small component of salt and sodium affected soils that are associated with the drainageways and can usually be identified by the salt tolerant vegetation. Soil surface textures existing within these landforms are generally loam and silt loam to clay loam and silty clay loam. Extensive areas of limestone dominated geology and soils occur within several locations of the BSCW and exhibit silt loam to loam surface textures. They mostly occur in the Muddy Creek and Big Sheep Creek areas and exist on the steeper mountain slope, escarpment and hillslope landforms. Calcium carbonate levels high enough to affect plant growth are restricted mainly to convex and linear/convex landform positions.

Rhyolite hills in the Muddy Creek drainage. 2015

The canyon portions of BSCW are dramatic and dominated by sedimentary and metamorphic parent materials including: limestone, sandstone, and quartzite. These areas have significant rock outcrop, rubbleland, and shallow soils as well as deeper colluvial soil deposits. Slopes are predominately steep to very steep and surface rock fragments are commonly more than 50 percent. The dominant landforms along the drainageways throughout the BSCW include: flood plains, flood plain steppes, and stream terraces. Soils formed within the flood plain and flood plain steppe landforms are generally very poorly to poorly drained with widely variable soil textures; sandy-skeletal substratum underlays a significant portion of these soils and is indicative of the variable alluvial parent material deposition through time. Ecosites within the drainageway include Riparian Wet Meadow within the very poorly drained flood plain and Wet Meadow or Riparian Subirrigated which are generally restricted to the flood plain steppe and lower stream terrace landforms and reflect poorly drained to somewhat poorly drained soil drainage classes.

Within the watershed as a whole, slopes range from nearly level and undulating (1 to 8 percent), rolling and hilly (8 to 30 percent), to steep and very steep (25 to more than 45 percent). Soil properties include sandy loam, loam, and clay loam soil surface textures; soil depths vary from shallow (less than 20 inches to a root restrictive layer) to very deep (more than 60 inches to a

restrictive layer); the relative amount of lime or calcium carbonate within the rooting zone, as measured by observable effervescence with hydrochloric acid, ranges from none to more than 40 percent; salinity and sodicity (alkalinity) occur within the assessment area to a minor extent; rock fragments, both on the soil surface and within the soil profile, range from none to more than 65 percent.

Soil classifications and ecological sites within the assessment area reflect these soil physical and chemical properties and associated variables. The main soil Orders encountered within the assessment area include: Alfisols, Entisols, Inceptisols, and Mollisols. Major Ecological Sites associated within the upland areas include: Very Shallow, Shallow, Shallow Limy Droughty, Limy Droughty, Droughty, Droughty Steep, Clayey, Saline Upland, Loamy Steep, and Loamy; within the riparian areas the major Ecological Sites include: Wet Meadow, Riparian Wet Meadow, Riparian Subirrigated, Subirrigated, Saline Subirrigated, and Overflow.

Some unique soil and landform features of the BSCW include: glacial moraines (Cabin Creek & Nicholia Creek), small areas of organic soils associated with very poorly drained conditions & perched water tables mostly west side of Cabin Creek, minor components of salt and sodium affected soils with associated salt tolerant vegetation (found throughout BSCW usually in the lowest parts of drainageways), cliffs & solution overhangs in the limestone geology mostly around the Big Sheep canyon area, other very steep areas of rock outcrops and rubble land in early stages of soil formation, and alpine tundra at the highest elevations along the Continental divide.

Vegetation

As is the case across all landscapes, the upland plant composition in the BSCW is changing as the result of ecological succession. The natural progression from early seral stage plant communities towards a climax plant community is inevitable without disturbance. The spread of primarily Douglas-fir and Rocky Mountain juniper can be attributed, in part, to the reduced frequency of wildfire which has changed the dominant plant species and habitat types on some of the BLM administered lands in the BSCW. Expansion of conifers is discussed in more detail under the Biodiversity section (Standard #5) below.

Mountain big sagebrush/Idaho Fescue community type is very common in the Big Sheep Creek Watershed.

Sagebrush and grassland areas are considered uplands for purposes of this report. According to satellite imagery, 83% of the watershed is classified as sagebrush-steppe and grassland uplands (81% sagebrush, 2% grasslands). Forest and woodland habitats are discussed under Standard #5 Biodiversity.

Most of the watershed's BLM administered uplands are dominated by either forests (10%) or sagebrush (81%), including mountain big sagebrush, Wyoming big sagebrush, basin big sagebrush, black, low, alkali, silver and three-tip sagebrush. Winterfat is also found on many alkaline sites in the watershed. Grasslands make up 2% of the public land acreage. Some of the prominent herbaceous species included in the grasslands are bluebunch wheatgrass, bearded wheatgrass, western wheatgrass, green needlegrass, Sandberg's bluegrass, prairie junegrass, and Idaho fescue. Rubber rabbitbrush, green rabbitbrush, fringed sagewort, and gray horsebrush are common native shrubs found on numerous ecological sites throughout the watershed, they are included in the sagebrush/mountain shrub category in table 1 above. If any of these shrubs have greater than 5% canopy cover on a site, it usually indicates that site has been subject to some kind of past disturbance.

Forested habitats occupy 10% of BLM administered land in the BSCW, primarily at higher elevations and on north-facing slopes. Species include Douglas-fir, lodgepole pine, limber pine, Englemann spruce, subalpine fir, whitebark pine, and Rocky Mountain juniper. Also, scattered stands of aspen, black cottonwood, water birch and thin-leaved alder contribute to structural diversity and canopy cover.

Scattered patches of curleaf mountain mahogany are found on rocky slopes and ridges throughout the watershed. The Big Sheep Creek canyon has some very healthy stands of curleaf mountain mahogany. It provides year-round cover and forage for deer and is a crucial source of winter forage for many wildlife species.

Curleaf mountain mahogany. Big Sheep Creek canyon. 2015

The mountain big sagebrush/Idaho fescue plant association is the most extensive upland plant community type within the watershed. Less common is the three-tip sagebrush/Idaho fescue community type which generally occupies a drier site than the mountain big sagebrush/Idaho fescue plant community. Since mountain big sagebrush is killed by fire, and three-tip sage resprouts after a fire, fire history may play a role in determining the distribution of these two plant communities across the landscape. Data collected in 2014 indicate that mountain big sagebrush has increased slightly in the watershed since the 1970s, when the studies were established.

The Idaho fescue/bluebunch wheatgrass plant association is a common "grass type" at low to mid elevations, while the Idaho fescue/bearded wheatgrass plant association is more common at 7,500 ft. and above.

Vegetative Treatments

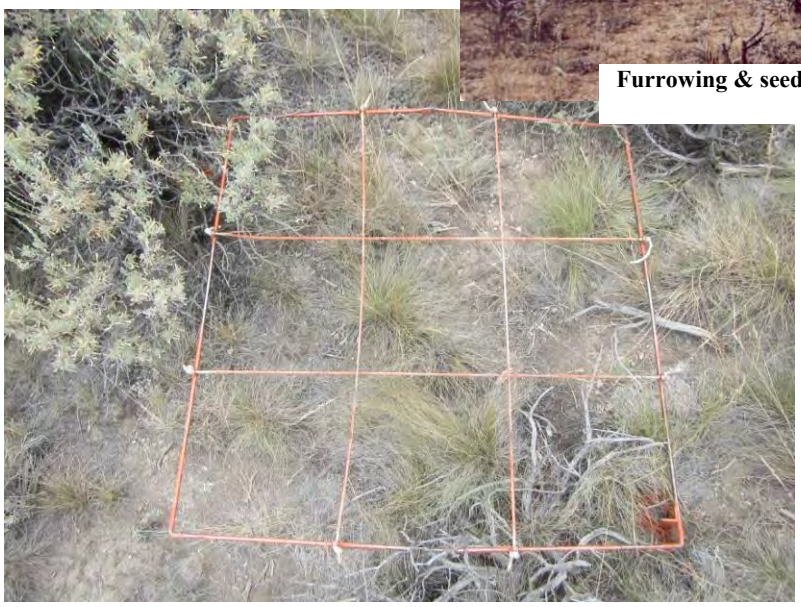
Grass Seeding/Sagebrush Reduction

As was mentioned in the previous Agricultural History and Socioeconomics section, the livestock industry expansion continued in the 1900s as the value of hay for winter feed became apparent (Fletcher 1960). This livestock industry expansion, coupled with unregulated livestock grazing on public lands that continued after World War II, caused rangeland health to deteriorate and led to a shift in vegetation community composition on many rangelands in southwest Montana. The more livestock palatable and productive cool-season grasses and plants found on allotments in the BSCW, such as bluebunch wheatgrass, were greatly reduced due to improper livestock grazing. Plants that were more grazing tolerant but usually less productive grasses and forbs increased on the rangelands causing a lower vegetative productivity and diversity on the allotments in the watershed.

Beginning as early as the early 1950s, the newly formed agency called the Bureau of Land Management began to evaluate rangelands in southwest Montana and noted the poor rangeland health conditions that resulted from 50+ years of unregulated livestock grazing. Starting in 1955 and continuing into the 1980's, the BLM began a multi-decade plan to establish a new forage species on public lands, increase the amount of forage available for domestic livestock grazing and reduce erosion on BLM allotments. This effort largely focused on reducing the amount of sagebrush and preparing the seedbed for planting a non-native grass by plowing, chiseling or treating the area with herbicide. The grasses chosen for planting in a few specific areas in the BSCW were mostly Siberian wheatgrass, green needle grass and hard fescue which were marketed as good spring forage for livestock grazing, were inexpensive to purchase, could withstand moderate to heavy spring grazing, and would stabilize soil. The BLM was successful in establishing 695 acres of Siberian wheatgrass in the southern portion of the Junction allotment in the BSCW. In the 1960s, the BLM was also successful at in establishing approximately 1,000 acres of hard fescue, Siberian wheatgrass, and sweet clover. Hard fescue (Festuca brevipila) has very low palatability for livestock and wildlife and therefore has out-competed almost all other species in the Contours pasture of the Muddy Creek allotment, as well as on the Rock Creek Seeding allotment, creating a monoculture of hard fescue. It is an introduced cool-season perennial bunchgrass developed by re-selection from seed collected by Virgil Hawk in 1934 at the Eastern Oregon Livestock Experiment Station at Union, Oregon. It was released for commercial production in 1949, named 'Durar' in 1961 and registered with Crop Science in 1964. This was the first commercial release of hard fescue. (USDA Plant Fact Sheet, 2015)

In 1963 and 1966, aerial sprays of 2,4-D were done as a vegetative treatment in an attempt to increase forage. In those two years approximately 11,000 acres of sagebrush on the Muddy Creek allotment were sprayed with the chemical, to reduce sagebrush and subsequently rejuvenate existing grasses by eliminating competition for resources with sagebrush.

Furrowing & seeding in Contours pasture of Muddy Creek allotment, August 1962



Contours pasture study #13s10w2001 dominated by seeded hard fescue July, 2014

The specifics of each treatment are described in Table 3 in chronological order and the treatment areas are illustrated on Map 4.

Table 3: Historic vegetation treatments within the Big Sheep Creek Watershed.

Project Name & Number	Allotment Name	Treatment	Acres	Date
Rock Creek Habitat Restoration #002427	Rock Creek Seeding	Chemically treat Hard Fescue Native plant re-seeding	~100(BLM) ~50(BLM)	9/2009 9/2008
Alkali Flats Habitat Restoration #002428	Simpson Creek	Sagebrush mowing & Re-seeding with native sagebrush and forbs	~400(BLM)	11/2007
Big Sheep Creek Juniper Removal	Dixon Mountain	Slashing juniper	~30 (BLM)	2009

Bull Cave Willow Planting	Whitworth	Willow cuttings planted on raw soil banks		7/1981
Rock Creek Seeding #0458	Rock Creek Seeding	Range plowed and seeded with non-native grasses including Hard fescue	~287 (BLM)	1963
Junction Reseeding #0459	Junction	Range plowed and seeded with non-native grasses including Siberian wheatgrass	~695 (BLM)	1962
Little Water Aerial Spray #0608	Muddy Creek	Sagebrush spray with 2, 4-D	6946 (BLM) 215 (FS)	1966
Muddy Creek Aerial Spray #0470	Muddy Creek	Sagebrush spray with 2, 4-D	4,100 (BLM)	6/1963
Muddy Creek Furrowing #0450	Muddy Creek	Contour furrowing & seeding with non-native grass species including Hard fescue	722 (BLM)	8/1962

Findings, Analysis and Recommendations

Procedure to determine conformance with Standard

The uplands were assessed on an allotment basis according to Interagency Technical Reference 1734-6 *Interpreting Indicators of Rangeland Health*. This technical reference is available to the public to read or download on the BLM Library webpage, http://web.nc.blm.gov/blmlibrary. This qualitative process evaluates 17 "indicators" (e.g., soil compaction, water flow patterns, plant community composition) to assess three interrelated components or "attributes" of rangeland health: soil/site stability, hydrological function, and biotic integrity. The IDT visits specific ecological sites and rates each indicator on the degree of departure, if any, from what is expected for the site. The rating for each indicator is then weighed to determine the degree of departure of the three attributes of rangeland health.

The NRCS has developed Ecological Site Descriptions based on specific soil types, precipitation zones and location. They describe various characteristics and attributes including what vegetative species, and relative percentage of each, are expected to be present on the site. The IDT refers to these site descriptions while completing the upland evaluation matrix.

Members of the IDT visited all 23 grazing allotments, un-allotted and un-leased BLM administered land in the BSCW during 2015 and completed 22 rangeland health indicator evaluation matrices. In addition, Daubenmire trend studies established in the 1960s and late 1970s were duplicated in 2014 to help determine vegetative trend. Several photo sites were also established that date back to the 1960s. These photo points were also duplicated in 2014 to provide a photographic record of how the landscape has changed over time. The data collected from the Daubenmire studies was summarized and compared to baseline data providing

supporting information, along with the photographic record, for interpreting the upland indicators.

Table 4 outlines the findings from the completed upland evaluation forms. A moderate departure from expected conditions is analogous to functional at risk (FAR) rating (USDI BLM, 2000). Upland sites are considered to be in PFC if they are in none-to-slight or slight-to-moderate departure from expected conditions.

Table 4: Upland Qualitative Assessment Summary

Allotment Name & Number	Ecological Site Name	Dominant Plant Species	Degree of Departure from Expected		
			Soil Site Stability	Hydrologic Function	Biotic Integrity
Alkali #30024-Meadow pasture	Loamy 10-14" Precip. Zone	Bluebunch Wheatgrass	slight	slight	slight
Cottonwood #30638	Droughty 14-19" Precip. Zone	Mountain Big Sage/Idaho Fescue	none to slight	none to slight	none to slight
Crystal Creek #30102	Droughty 14-19" Precip. Zone	Mountain Big Sage/Bluebunch wheatgrass	slight	slight	slight
Dixon Mountain #30022 – pasture #1	Loamy 12-16" Precip. Zone	Bluebunch wheatgrass	slight	slight	none to slight
Dixon Mountain #30022 – pasture #3	Limy/Droughty 12-16" Precip. Zone	Bluebunch wheatgrass	none to slight	none to slight	none to slight
Four Eyes #30269	Limy/Droughty 12-16" Precip. Zone	Bluebunch Wheatgrass	slight	slight	slight
Indian Creek Isolated #30653	Loamy 15-19" Precip. Zone	Mountain Big Sage/Idaho Fescue	slight	slight	slight
Junction #20009 – East pasture	Entisol (plowed up soil) 10-14" Precip. Zone	Crested wheatgrass	slight	slight to moderate	slight
Meadow Creek Isolated #30611	Limy/Droughty 12-16" Precip. Zone	Bluebunch Wheatgrass	slight	slight	none to slight
Muddy Creek #30039 – Muddy bottom pasture	Loamy 15-19" Precip. Zone	Basin Big Sage/Bluebunch wheatgrass	slight	slight	none to slight
Muddy Creek #30039 – Contours pasture	Limy 12-16" Precip. Zone	Hard Fescue	moderate	moderate	moderate
Muddy Creek #30039 – Little Water pasture	Loamy 14-19" Precip. Zone	Mountain Big Sage/Idaho Fescue	none to slight	none to slight	none to slight
Muddy Creek #30039 – Timber Butte pasture	Limy 14-19" Precip. Zone	Bluebunch wheatgrass	none to slight	none to slight	slight
Muddy Creek #30039 – McNinch pasture	Droughty 15-19" Precip. Zone	Mountain Big Sage/Idaho Fescue	none to slight	none to slight	none to slight
Nicholia #10699	Droughty/Loamy 14-19" Precip. Zone	Mountain Big Sage/Bluebunch wheatgrass	none to slight	none to slight	none to slight

Allotment Name & Number	Ecological Site Name	Dominant Plant Species	Degree of Departure from Expected		
			Soil Site Stability	Hydrologic Function	Biotic Integrity
Porcupine Canyon #20107 – North pasture	Limy/Droughty 14-19" Precip. Zone	Bluebunch wheatgrass	slight	slight	none to slight
Porcupine Canyon #20107 – South pasture	Limy/Droughty 14-19" Precip. Zone	Mountain Big Sage/Idaho Fescue	none to slight	none to slight	none to slight
Rio Puerco #10700	Limy 14-19" Precip. Zone	Mountain Big Sage/Bluebunch wheatgrass	slight	slight	slight
Rio Puerco #10700	Loamy 11-15" Precip. Zone	Mountain Big Sage/Bluebunch wheatgrass	slight	slight	none to slight
Rock Creek Seeding #20041	Droughty 11-15" Precip Zone	Hard fescue	slight	slight	none to slight
Simpson Creek #20158 – Strutting Ground pasture	Limy/Droughty 11-15" Precip. Zone	Bluebunch Wheatgrass	moderate	moderate	slight
Simpson Creek #20158 – Alkali pasture	Droughty 11-15" Precip. Zone	Bluebunch Wheatgrass	none to slight	none to slight	none to slight

The BSCW was evaluated for weed infestations using treatment records and inventories from the Dillon Field Office, the Beaverhead County Weed Coordinator and the IDT's collective inventories and observations during the field assessments. A more comprehensive discussion of noxious weeds in the BSCW is included in the Biodiversity section below.

Findings and Analysis

On the sites rated PFC or FAR with an upward trend, the quantitative monitoring data supports the findings of the IDT. The ecological condition at these upland sites is stable or improving. Evidence of erosion appears to be remnant of historical impacts, and generally matches what is expected for that ecological site.
Based on the evaluation methodology and process, comparative analysis of quantitative data collected at long term trend study sites, and extensive field observations and discussions by the IDT, the

Dave Ruppert, FS Soil Scientist, digging a soil pit for upland health evaluation in BSCW. August, 2015

uplands in 23 of 23 grazing allotments were rated as PFC, with the exception of one pasture in the Muddy Creek allotment. The upland site in the strutting ground pasture of Simpson Creek allotment rated moderated departures in two attributes while only a slight departure in the biotic integrity attribute. However, after looking at past monitoring data and comparing past photos to current conditions this pasture proved to be in an upward trend. All of the uplands in the un-allotted, approximately 3,502 acres are in PFC.

Muddy Creek allotment has nine pastures and all except the Contours pasture met the three attributes of upland health and were functioning properly. As a whole, the allotment met the upland health standard. Contours pasture was treated in the 1960s by first furrowing the soil and then reseeding with grasses, one of which was hard fescue. Hard fescue has since then out-competed most all other species, creating a monoculture. The condition of the upland health in this pasture has nothing to do with the current livestock management. Contours pasture was rated FAR with a static trend by the IDT and received a moderate departure rating in all three upland health attributes which are, soil and site stability, hydrologic function, and biotic integrity.

The upland plant composition along the forest/sagebrush ecotone and within mid-elevation aspen stands, within the BSCW, is changing toward a more conifer-dominated community. Established photo points and Daubenmire photos, that in some cases date back to 1960s and 70s, show the spread of coniferous forest species downslope onto benches previously dominated by sagebrush and cool season grasses. The spread of primarily Douglas-fir and Rocky Mountain juniper can be attributed, in part, to the reduced frequency of wildfire. This is discussed in more detail in the Biodiversity Standard # 5 and Forestry/Fuels sections of this report.

Muddy Creek allotment study #13s11w1101, 7/31/2014

Muddy Creek allotment study #13s11w1101, 8/6/1970

Recommendations for Upland Health

1. Continue to maintain or improve upland health in all 23 allotments and the unallotted parcels of public land that exhibit healthy or improving upland conditions.

2. Consider experimenting with upland treatments to decrease or exterminate hard fescue and restore to native plant communities in the Contours pasture of Muddy Creek allotment.

3. Consider mechanical and/or prescribed fire treatments to maintain/restore sagebrush steppe habitat by reducing or eliminating expanding Rocky Mountain juniper and Douglas fir.

4. Consider constructing a drift fence on the north side of the Jacob's pasture in the Alkali allotment to prevent cattle from getting out of the allotment and down onto Cabin Creek in the Four Eyes allotment.

Riparian and Wetland Areas

Western Montana Standard #2: *"Riparian and wetland areas are in proper functioning condition"*

Affected Environment

Streams
There is approximately 53 miles of stream in the BSCW, consisting of numerous smaller intermittent and perennial reaches in the higher elevations that feed the larger perennial streams down in the valley bottoms. Stream flow in the BSCW fluctuates annually and seasonally in response to precipitation in the form of rain and snow. The major streams (creeks) within the assessment area are Alkali, Big Sheep, Cabin, Deadman, Meadow, Muddy, Nicholia, and Simpson Creek. The vegetation community type along these streams is dominated by Geyer willow/beaked sedge with a few streams winding through open meadows consisting mostly of beaked sedge. Red-osier dogwood and water birch is found along the main reach of Big Sheep Creek and a few spruce habitat types are found mostly along steeper north facing aspects of small perennial reaches in the higher elevations.

Springs and Wetlands
Numerous isolated springs and wetlands exist within the assessment area. The Dillon Field Office has not developed nor does it plan to develop a comprehensive wetland inventory, but rather supports the Montana Natural Heritage Program wetland mapping program. Nevertheless some wetlands have been mapped and inventoried. See discussion below under National Wetland Inventory (NWI).

Developed springs within the BSCW were inventoried and assessed. All the developed springs in the watershed are listed and described in the Findings, Analysis and Recommendations section.

National Wetland Inventory
The National Wetland Inventory (NWI) was developed by the US Fish and Wildlife Service to conduct a nationwide inventory of wetlands. The Inventory was developed to facilitate conservation efforts by identifying various wetland types and their distribution throughout the United States. To do this, a wetland classification system (Cowardin et al. 1979) was developed that is now the Federal Standard (see glossary). The Montana Natural Heritage Program (MNHP), with financial assistance from the BLM, is in the process of mapping riparian and wetland resources to NWI standards. Wetland and riparian mapping within the BSCW is progressing, but has not been completed. Current wetland mapping status is available on the MNHP webpage at: http://mtnhp.org/nwi/NWI_Status_map.asp. The Cowardian wetland classification system is accessible at: http://mtnhp.org/nwi/Cowardin.pdf

The streams in BSCW assessment area drain 181,302 acres of BLM, Forest Service, State and private land (**Maps 2 & 3)**. About 54,667 acres (30%) is public land administered by the BLM.

Soils
See soils section under uplands above, page 16.

Findings, Analysis and Recommendations

Procedure to determine conformance with Standard
BLM policy specifies using several complimentary monitoring and evaluation methodologies to determine conformance with the Riparian Health Standard regarding riparian (lotic) and wetland (lentic) areas. The IDT used the Lotic and Lentic Riparian Area Management Assessment Methodologies TR 1737-15 and TR 1737-16 (USDI 1998, 1999), also known as Proper Functioning Condition (PFC) Assessment Methodologies as well as Interpreting Indicators of Rangeland Health TR 1734-6 (USDI 2000, 2005) , to evaluate riparian wetland systems including streams, riparian meadows and riparian wet meadows. The lotic methodology is used for flowing water systems and their associated riparian areas. The lentic methodology is used for ponds and still water systems. Wetlands are transitional areas between terrestrial and aquatic systems. Sensitivity to grazing impacts varies along a gradient from wet to dry. The wettest and the driest sites are often more resilient than intermediate sites where pugging frequently occurs. Applicable portions of the lentic methodology are used to assess springs and wet meadows. A Guide to Managing, Restoring, and Conserving Springs in the Western United States TR 1737-17 (USDI 2001) is also used for springs. These technical references are available online at www.blm.gov/nstc/library/library.html

Proper Functioning Condition (PFC) is a range of conditions (continuum), not a single point. A high PFC rating may be analogous to Desired Future Condition (DFC), however a low PFC rating, while meeting the Riparian Health Standard, may not meet site specific objectives. "Riparian-wetland areas can function properly before they achieve their potential."(USDI 1998).

The lotic PFC assessment utilizes attributes and processes that can be judged visually to evaluate riparian wetland areas with flowing water against their capability and potential. Some of these attributes and processes include the stream channel's physical characteristics or stream geometry (dimension, pattern and profile). To function properly, adequate vegetation, landform or woody debris should be present to dissipate energy associated with relatively frequent high flow events and to filter sediment, capture bed load and aid floodplain development so the stream does not excessively aggrade or degrade (down-cut). The IDT uses the Rosgen Stream Classification System as a tool to help determine stream potential (Rosgen 1994). This system has gained wide recognition throughout the United States and abroad and its use is recommended in the Second Edition of the BLM Technical Reference 1737-15 (2015). A major benefit of the system is the ability to determine stream sensitivity and to predict channel evolution with some level of accuracy (Rosgen 1996). The classification system is available online at http://www.wildlandhydrology.com/assets/A_Classification_of_Natural_Rivers-Catena_Paper.pdf.

The Dillon Field Office used its riparian database, which has been developed over the course of 20 years, as a starting point for the BSCW. Many of the riparian areas in the assessment area were originally described and mapped based on aerial photos and U.S. Geological Survey (USGS) topographical maps. This information was the basis for GIS mapping. In recent years, springs and wetlands have been added to the GIS inventory and mapping effort. Subsequent ground-truthing has verified that a number of drainages previously mapped as riparian habitat are actually dry washes which lack riparian characteristics. These reaches have been removed from the stream/wetland inventory. Conversely, several stream reaches, springs and wetlands not previously categorized were identified during the watershed assessment process. These new streams, springs and wetlands were assessed by the BLM and added to the BLM riparian-wetland data base.

Data were collected on all the streams in the BSCW area using a modified version of the Montana Riparian Wetland Assessment (MRWA) methodology (Hansen et al. 1995) during the 2014 field season prior to the IDT's PFC assessments. In accordance with the Dillon Resource Management Plan, the MRWA methodology has been adapted and modified by the Dillon Field Office to include channel morphology parameters. The MRWA methodology includes inventories of physical and vegetative characteristics and streambed materials, and measurements of channel dimensions (bank full width, mean bank full depth, flood prone width). Physical measurements are utilized to assess channel morphology and stability and tentatively classify streams at Rosgen Level II (Rosgen 1994, 1996). The MRWA also includes inventories and observations of the composition, cover, vigor and the amount of recruitment, regeneration and utilization of vegetative species within the riparian zone. The data gathered were used by the IDT in conjunction with the PFC assessment process to ascertain riparian health and trends on a reach by reach basis.

Riparian coverboards, greenline, woody browse and cumulative width/depth transects, pebble counts and Rosgen Methodology monitoring were also used to measure various riparian attributes in the BSCW. Riparian coverboards were established in the BSCW in the 1980's. Coverboard data measures relative change in canopy cover of woody species in the riparian zone. Greenline transects are also used to measure changes in the relative abundance of different plant community types in the riparian area. Greenline data track changes in vegetative composition and cover within the narrow green vegetation ribbon adjacent to the channel.

Woody browse, short for woody browse regeneration, is used to monitor age classes and recruitment of deciduous woody shrubs. Pebble counts are utilized to determine changes in substrate. Cumulative width/depth is used to monitor changes in stream geometry. Rosgen monitoring, similar to cumulative width/depth, is conducted to track changes in channel morphology. Photographs are also taken at the various monitoring sites to record current conditions and relative changes over time. All the monitoring data used to aid the IDT in its assessment are included in the BSCW project file and are available for review at the Dillon Field Office.

Findings and Analysis

Streams

Many streams within the BSCW have extensive wet meadows. The ID Team used the Lentic methodology for many of these streams. Sixty-five stream reaches, totaling approximately 53 miles, were assessed for functional condition. Forty two reaches, totaling 38 miles, were rated PFC. Eleven reaches, totaling 9 miles, were rated FAR with an upward trend. Ten reaches, totaling approximately 6 miles, were rated FAR with a static or no apparent trend. One reach, totaling 0.55 miles, rated FAR with a downward trend. One reach was rated NF, totaling 0.1miles.

Big Sheep Creek reach #109. 2015

Where streams were not PFC, some of the concerns included: alteration of stream morphology, reduced access to floodplains, down cutting, reduction in species diversity and composition, reduced vegetative cover, limited vegetative species recruitment and regeneration, reduced structural diversity, and/or decreased vigor of streamside vegetation. Generally, ungulate grazing and browsing, roads and road crossings and irrigation ditches and diversions were the most frequently observed causal factors.

Stream morphology (channel shape and dimensions, including width and depth, and gradient) and bed materials provide important information to determine a stream's function. Critical shear stress must be achieved before a stream channel is capable of reshaping and maintaining itself. Stream power is reduced as a channel becomes wider. With reductions in critical shear stress and stream power, the ability of a stream to maintain riffles and pools and move channel materials is diminished. As these reductions continue, sediments often accumulate which force the stream to widen even more (TR1737-15 2015). The BLM's regulations require streams to

have the ability to maintain stable dimensions, patterns and profiles. See Figure 2 below and Table 5 which summarize functional status of stream reaches in the BSCW.

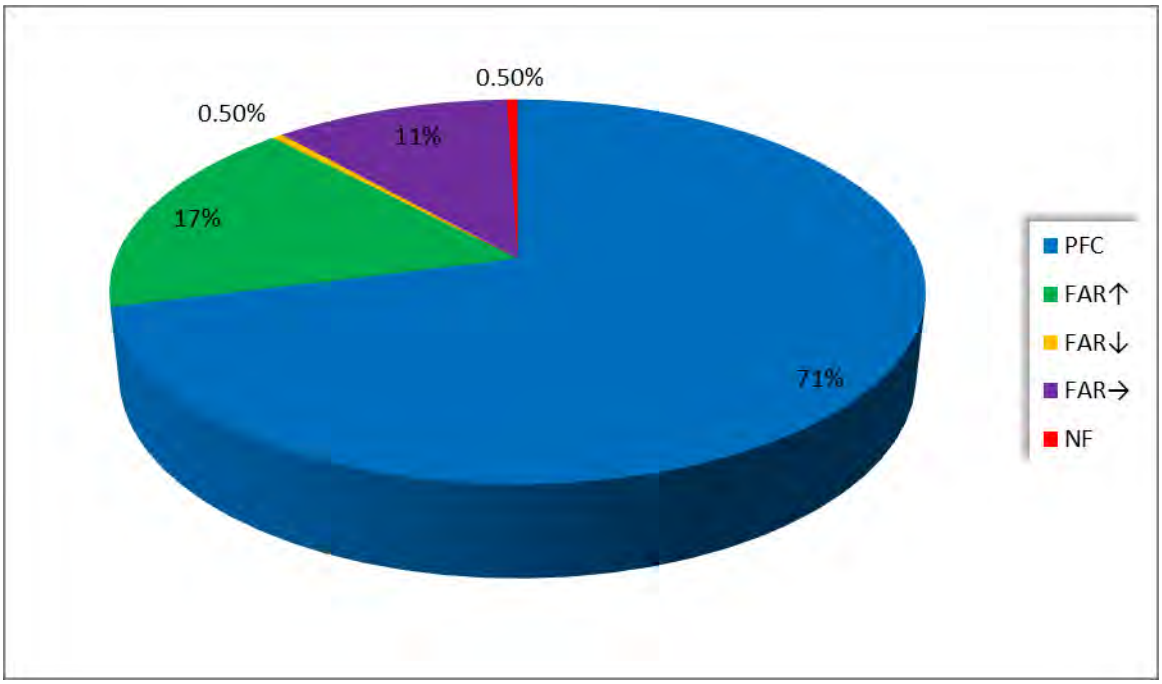


Figure 2: Percentage of Stream Miles Assessed by Functionality Calls

Table 5 summarizes the functional status of all the surveyed stream reaches in the BSCW.

Table 5: Functional Status of Stream Reaches

Stream Name	Allotment	BLM Reach ID	Vegetative Community Type	Functional Rating & Trend*	Miles
Meadow Creek	Alkali Creek	130	Geyer willow/Beaked sedge	FAR↑	0.61
Meadow Creek	Alkali Creek	134	Geyer willow/Beaked sedge	FAR↑	0.92
Meadow Creek	Alkali Creek	131	Beaked sedge	PFC	0.52
Meadow Creek	Alkali Creek	132	Beaked sedge	PFC	0.31
Alkali Creek	Cabin Creek	1442	Beaked sedge	FAR↑	0.67
Cabin Creek	Crystal Creek	182	Beaked sedge	FAR→	1.9
Big Sheep Creek	Dixon Mountain	108	Geyer willow/Beaked sedge	PFC	2.85
Big Sheep Creek	Four Eyes	107	Geyer willow/Beaked sedge	PFC	1.4
Cabin Creek	Four Eyes	178	Shrubby cinquefoil	PFC	0.96
Big Sheep Creek	Four Eyes	105	Geyer willow/Beaked sedge	PFC	0.73

Stream Name	Allotment	BLM Reach ID	Vegetative Community Type	Functional Rating & Trend*	Miles
Deadman Creek	Four Eyes	122	Geyer willow/Beaked sedge	PFC	0.72
Big Sheep Creek	Four Eyes Isolated	106	Geyer willow/Beaked sedge	PFC	0.8
Simpson Creek	Indian Creek	169	Geyer willow/Beaked sedge	PFC	1.1
Sawlog Creek	Indian Creek	128	Geyer willow/Beaked sedge	PFC	0.6
Sawlog Creek Trib.	Indian Creek	1459	Geyer willow/Beaked sedge	FAR↑	0.5
Indian Creek	Indian Creek	127	Geyer willow/Beaked sedge	PFC	1.26
Simpson Creek Trib.	Indian Creek	168	Geyer willow/Beaked sedge	Upper FAR↑, Lower PFC	1.33
Simpson Creek	Indian Creek Isolated	167	Geyer willow/Beaked sedge	FAR↑	0.26
Tex Creek	Junction	174	Beaked sedge	FAR↑	1.11
Cabin Creek	Junction	179	Beaked sedge	FAR↑	1.09
Cabin Creek	Junction	181	Geyer willow/Beaked sedge	FAR↑	0.46
Cabin Creek	Junction	180	Geyer willow/Beaked sedge	FAR↑	0.30
Coyote Creek Trib.	Meadow Creek AMP	120	Geyer willow/Beaked sedge	PFC	0.5
Coyote Creek Trib.	Meadow Creek AMP	121	Geyer willow/Beaked sedge	PFC	0.1
Muddy Creek	Muddy Creek	145	Geyer willow/Beaked sedge	PFC	1.54
Muddy Trib.	Muddy Creek	139	Beaked Sedge	PFC	1.2
Muddy Trib.	Muddy Creek	177	Geyer willow/Beaked sedge	FAR↑	1.51
McNinch Creek	Muddy Creek	156	Geyer willow/Beaked sedge	PFC	1.36
McNinch Creek	Muddy Creek	154	Geyer willow/Beaked sedge	PFC	1.21
McNinch Trib.	Muddy Creek	1418	Spruce	PFC	0.45
McNinch Trib.	Muddy Creek	1417	Geyer willow/Beaked sedge	PFC	0.5
McNinch Trib.	Muddy Creek	1419	Geyer willow/Beaked sedge	PFC	0.52
McNinch Trib.	Muddy Creek	1420	Spruce	PFC	0.73
McNinch Trib.	Muddy Creek	155	Geyer willow/Beaked sedge	PFC	0.44
Muddy Creek Trib.	Muddy Creek	1415	Geyer willow/Beaked sedge	FAR→	0.54

Stream Name	Allotment	BLM Reach ID	Vegetative Community Type	Functional Rating & Trend*	Miles
Muddy Creek Trib.	Muddy Creek	138	Beaked sedge	PFC	0.92
Muddy Creek Trib.	Muddy Creek	1422	Beaked sedge	PFC	0.40
Muddy Creek Trib.	Muddy Creek	1423	Beaked sedge	PFC	0.32
Muddy Creek Trib.	Muddy Creek	1411	Geyer willow/Beaked sedge	FAR→	0.22
Muddy Creek Trib.	Muddy Creek	142	Geyer willow/Beaked sedge	FAR→	0.56
McKnight Creek	Muddy Creek	195 & 196	Spruce	PFC	0.89
Sourdough Creek	Muddy Creek	172	Geyer willow/Beaked sedge	PFC	1.52
Sourdough Trib.	Muddy Creek	1402	Geyer willow/Beaked sedge	PFC	1.2
Wilson Creek Trib.	Muddy Creek	1408	Geyer willow/Beaked sedge	PFC	0.35
Muddy Creek	Muddy Creek	157	Geyer willow/Beaked sedge	PFC	1.4
Muddy Creek	Muddy Creek	148	Beaked sedge	PFC	0.21
Meadow Creek	Nicholia	135	Geyer willow/Beaked sedge	PFC	0.35
Meadow Creek Trib.	Nicholia	136	Geyer willow/Beaked sedge	PFC	0.39
Deadman Creek	Pine Creek	123	Geyer willow/Beaked sedge	PFC	1.0
Pine Creek	Pine Creek	126	Geyer willow/Beaked sedge	FAR→	0.43
Big Sheep Creek Trib.	Pine Creek	158	Geyer willow/Beaked sedge	FAR→	0.55
Porcupine Creek	Porcupine Canyon	161	Geyer willow/Beaked sedge	FAR→	0.6
Porcupine Creek	Porcupine Canyon	159 & 160	Geyer willow/Beaked sedge	FAR→	1.56
Cabin Creek spring brook	Porcupine Canyon	746	Geyer willow/Beaked sedge	NF	0.1
Muddy Creek	Rio Puerco	1491	Beaked sedge	PFC	0.19
Muddy Creek	Rio Puerco	1433	Beaked sedge	PFC	0.10
Muddy Creek	Rio Puerco	149	Beaked sedge	PFC	0.68
Coyote Creek	Simpson Creek FS	118 & 119	Geyer willow/Beaked sedge	FAR→	0.44
Coyote Trib.	Simpson Creek FS	117	Geyer willow/Beaked sedge	FAR↓	0.55
Crystal Creek	Simpson Creek FS	170	Geyer willow/Beaked sedge	FAR→	0.51
Tex Creek	Simpson Creek FS	175	Geyer willow/Beaked sedge	PFC	0.63

Stream Name	Allotment	BLM Reach ID	Vegetative Community Type	Functional Rating & Trend*	Miles
Alkali Creek	Simpson Creek	100	Beaked sedge	PFC	2.3
Big Sheep Creek	Unalloted	109	Douglas fir/Red osier dogwood	PFC	2.32
Big Sheep Creek	Unalloted	104	Geyer willow/Beaked sedge	PFC	1.3
Meadow Creek	Unalloted	133	Beaked sedge	FAR→	0.3
Total stream miles					**53.29**

*↑=upward, →=static, ↓=downward

Wetlands

Forty-three lentic (wetland) areas totaling roughly 519 acres were also assessed in the BSCW. Of the 43 lentic areas assessed, 32 totaling roughly 152 acres, were rated PFC. Four lentic areas, totaling nearly 311 acres, rated FAR with an upward trend. Approximately 89% of the acres were PFC or FAR with an upward trend. Six lentic areas, totaling approximately 55 acres, were rated FAR with a static or no apparent trend. Zero lentic areas were rated FAR with a downward trend. One lentic area, totaling 1.5 acres, was rated NF.

Wetland #1450 study #14s11w2603. June 2, 2014

Frequently observed wetland impacts which resulted in departures from PFC, included: hummocking and soil compaction which lead to drying and alterations to hydrology as well as loss of the 'sponge.' Reduction in species diversity and composition, reduced vegetative cover, limited vegetative species recruitment and regeneration, reduced structural diversity, and/or decreased vigor of wetland vegetation were also observed. Generally, ungulate grazing and browsing was the most frequently observed causal factor.

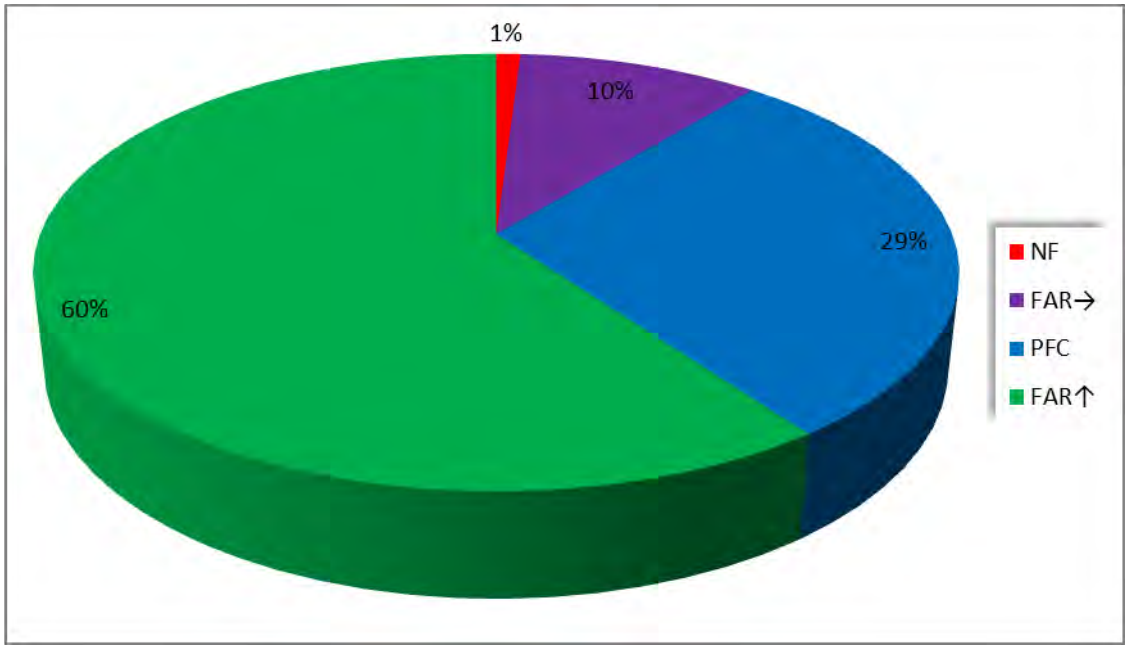


Figure 3: Functional Condition, by proportion of acres, for lentic areas within the Big Sheep Creek Watershed

Table 6: Wetland Functional Calls by Allotment

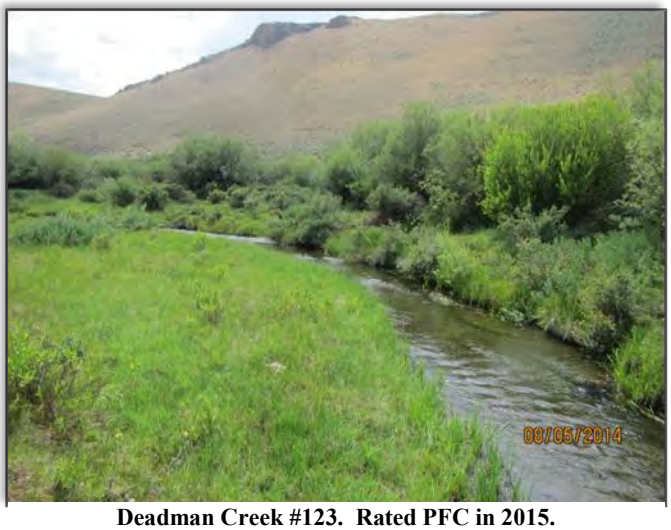
Functional Call	Wetland Number	Wetland Acres	Allotment
PFC	1450	41.2	Crystal Creek
PFC	1453	2.2	Indian Creek
PFC	1452	9.43	Indian Creek
PFC	1456	0.36	Indian Creek
FAR→	1477	2.19	Indian Creek
FAR↑	1447	200	Junction
FAR↑	1443	90	Junction
PFC	191	6.87	Muddy Creek
PFC	1431	1.93	Muddy Creek
PFC	1429	1.67	Muddy Creek
PFC	1431	1.93	Muddy Creek
PFC	1429	1.67	Muddy Creek
PFC	1425	2.34	Muddy Creek
PFC	191	2	Muddy Creek
PFC	192	1.5	Muddy Creek
PFC	186	5.92	Muddy Creek
PFC	1409	0.69	Muddy Creek
FAR→	1414	0.87	Muddy Creek
PFC	1410	1	Muddy Creek
PFC	1416	2.3	Muddy Creek
PFC	138	1	Muddy Creek
PFC	139	1.2	Muddy Creek
FAR→	140	2.92	Muddy Creek
FAR↑	187	3.34	Muddy Creek
PFC	184	10.64	Muddy Creek
FAR↑	188	17.26	Muddy Creek
PFC	1427	2.15	Muddy Creek

Spring Source PFC, Brook NF	1421	2.44-PFC 1.5-NF	Muddy Creek
PFC	141	3.1	Muddy Creek
PFC	185	6.4	Muddy Creek
PFC	1407	0.67	Muddy Creek
PFC	1490	12.2	Pine Creek
PFC	1440	11.28	Pine Creek
FAR→	1464	2.66	Porcupine Canyon
FAR→	163	4	Porcupine Canyon
NF	1460	2.5	Porcupine Canyon
FAR→	1463	42	Porcupine Canyon
PFC	152	3.01	Rio Puerco
PFC	1441	1	Rock Creek Seeding
PFC	1446	3.61	Simpson Creek FS
PFC	1445	.81	Simpson Creek FS
PFC	166	7.27	Simpson Creek
Total		**519.03 acres**	

Allotments in which the majority of the riparian and wetland resources rated as PFC or FAR with and upward trend are not discussed in this section, but information on these resources is available upon request. Additional stream reach specific data for any of the riparian/wetland areas in the BSCW is available at the Dillon Field Office. Three allotments, Pine Creek, Porcupine Canyon and Simpson Creek FS, had above average riparian/wetland resource impacts and are discussed in more detail below.

Pine Creek

There are roughly two stream miles and 23 acres of wetlands in the Pine Creek allotment. Fifty percent of the stream miles (Deadman Creek Creek) rated PFC and 50 percent (Pine Creek and a tributary of Big Sheep Creek) rated FAR-Static. Streams were overwidened resulting in reduced shear stress and a reduction in the streams ability to transport its bedload and maintain dimensions, patterns and profiles within natural ranges of variability. Livestock impacts were a causal factor resulting in the FAR-Static calls. Wetlands were given a low PFC rating with some concerns of drying on the fringes, also resulting from livestock impacts.



Deadman Creek #123. Rated PFC in 2015.

Porcupine Canyon

There are roughly two stream miles (Porcupine Creek) and 51 acres of wetland resources in the Porcupine Canyon Allotment. These include three reaches and four wetlands. Two reaches rated FAR-Static and one short spring brook rated NF. Three wetlands totaling 49 acres were

also FAR-Static. One wetland totaling 2.5 acres was rated NF. Livestock grazing is the causal factor.

Simpson Creek FS
Simpson Creek FS has four reaches totaling approximately two miles and two wetlands totaling approximately four acres. One of the reaches, Tex Creek (0.6 miles) rated PFC. Crystal Creek, 0.5 miles was rated FAR. The trend was not apparent. Coyote Creek and a tributary rated FAR-Static (0.4 miles) and FAR Down (0.5). As with Pine Creek and Porcupine Canyon, these ratings were the result of grazing impacts.

Developed Springs
The BLM's Rangeland Improvement Project System (RIPS) database shows 25 spring developments in the BSCW. BLM staff visited most of these developments to determine resource condition, condition of infrastructure, and water production (flow). Table 7 lists the spring developments on BLM administered land in the watershed.

Table 7: Developed Springs

Spring Name	Project Number	Allotment
Elk Track Spring	000804	Indian Creek
Dixon Mountain Spring	470759	Dixon Mountain
Eagle Spring	470593	Dixon Mountain
Kelner Spring	000795	Indian Creek
Burnt Log Spring	476623	Muddy Creek
Contours West Spring	470691	Muddy Creek
Elk Pocket Spring	476625	Muddy Creek
Hidden Pasture Spring*	470093	Muddy Creek
Hidden Pasture Spring*	476625	Muddy Creek
Little Water Spring	470391	Muddy Creek
Little Water West Spring	476648	Muddy Creek
Lou Creek Spring	476663	Muddy Creek
Muddy Creek Spring 2/North Contours	470692	Muddy Creek
North 49 Spring	477390	Muddy Creek
Red Dirt Spring	476424	Muddy Creek
Rufous Spring	477288	Muddy Creek
Willow Spring	470088	Muddy Creek
Wyatt Spring	470087	Muddy Creek
Sweeney Spring	470398	Pine Creek
Island Butte Spring	002423	Porcupine Canyon
Carr Spring	470105	Rio Puerco
Y A Bar Spring	470556	Rio Puerco
Caboose Spring	476522	Whitworth
Patterson Spring	002421	Whitworth
Whitworth Spring	476261	Whitworth

*Note there are two springs named Hidden Pasture Spring.

Maintenance of water developments was a noted concern on several developments in the watershed. Maintenance problems include lines not being drained, sediment in troughs, plumbing not properly working, lack of float valves and or shutoff valves, and leaking troughs. These maintenance issues can negatively impact wetland hydrology and do not help attain the objective(s) that the development was originally intended to achieve (i.e., livestock distribution or mitigation of impacts to perennial streams). They may also impact water rights since water right holders are expected to conserve water. Though not related to maintenance per se, troughs may present wildlife hazards and escape ramps help mitigate the hazard. Properly maintained water developments are considered Best Management Practices for riparian resources. The BLM must report on BMP effectiveness as part of our participation in Montana's Nonpoint Source Management Strategy. Permittee partnership and cooperation is critical to achieve these goals.

Recommendations for Riparian

1. Revise livestock management in the following allotments, pastures or site specific areas to mitigate impacts to riparian/wetland habitat: Contours pasture of Muddy Creek, Porcupine Canyon, Simpson Creek FS, Pine Creek and site specific reaches that rated as FAR-Static or down during the assessment. Consider changes in timing, duration, frequency and/or intensity of use as well as number and/or kind of livestock. Incorporation of rest, or where applicable, additional rest, into a grazing systems as well as structural projects should also be considered to mitigate resource concerns.
2. Consider livestock management revisions to avoid livestock use during westslope cutthroat trout spawning time in the Simpson Creek pasture of the Indian Creek allotment.
3. Consider hardening the streambank along Big Sheep Creek in the water gap for Dixon Mountain pasture #3. Also analyze installing a silt fence to prevent runoff from entering directly into Big Sheep Creek
4. Consider removal of Cutthroat exclosure on Indian Creek.
5. Consider the installation of two culverts along open travel route on Indian Creek.
6. Consider the installation of a large culvert in the Pine Creek allotment on Deadman Creek.
7. Clean up and abandon Wyatt Spring in Contours pasture of Muddy Creek.
8. Redevelop Red Dirt Spring and pipeline in Muddy Creek and Rio Puerco allotments.
9. Consider developing spring source on south & north end of Contours pasture to facilitate better cattle disbursement and to protect spring sources with larger exclosures.
10. Consider constructing exclosure around spring in McNinch pasture to protect the source.
11. Verify that routine maintenance is conducted by the permittees on all spring developments on an annual basis as agreed to in the Cooperative Agreements for the projects. If spring developments are dry and dysfunctional, they should be abandoned and infrastructure cleaned up. Exclosures should be constructed, maintained, reconstructed or removed depending on resource needs.

Water Quality

Western Montana Standard #3: *"Water quality meets State standards"*

Affected Environment

The affected environment is described in the introduction and the sections addressing the Upland and Riparian Health Standards. Big Sheep Creek and its tributaries fall within the Red Rock TMDL Planning Area which DEQ has not fully assessed.

Findings, Analysis and Recommendations

Procedure to determine conformance with Standard

The Bureau of Land Management defers to the State of Montana with respect to this standard. The Bureau of Land Management and the State of Montana work together to implement the objectives of the Clean Water Act "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters" and Article IX of the Montana Constitution "…maintain and improve a clean and healthful environment in Montana for present and future generations." Restoring and maintaining the Nations Waters and a clean and healthful environment require assessment and problem identification. In Montana water quality impairment is more often the result of nonpoint source pollution. "Nonpoint source pollution generally results from land runoff, precipitation, atmospheric deposition, drainage, seepage or hydrologic modification. The term "nonpoint source" is defined to mean any source of water pollution that does not meet the legal definition of "point source" in section 502(14) of the Clean Water Act. Unlike pollution from industrial and sewage treatment plants, nonpoint source (NPS) pollution comes from many diffuse sources." (http://water.epa.gov/polwaste/nps/whatis.cfm). Montana has developed a nonpoint source management plan for the State and the Montana-Dakotas BLM, through a Memorandum of Understanding, works with the State of Montana to implement this plan on public land. http://deq.mt.gov/wqinfo/nonpoint/NonpointSourceProgram.mcpx

The following is an excerpt from the 2012 Plan, "The goal of Montana's Nonpoint Source Management Program is to provide a clean and healthy environment by protecting and restoring water quality from the harmful effects of nonpoint source pollution. We believe this can best be achieved through the voluntary implementation of best management practices identified in science-based, community-supported watershed plans. The goals of this plan are to:

• Inform Montana citizens about the causes and effects of NPS pollution on water quality.
• Set priorities for controlling NPS pollution on a statewide basis.
• Identify strategies for restoring water quality affected by NPS pollution.
• Describe a set of focused, short-term activities (5-year action plan) for attaining the statewide NPS pollution control program goals." One way that the Dillon Field Office works to implement provisions of the nonpoint source management plan is through the watershed assessment process and implementation of management and projects.

Section 319 of the Clean Water Act addresses non-point source pollution through the application of Best Management Practices (BMPs). The BLM uses a variety of BMPs to address nonpoint source pollution resulting from silviculture, livestock grazing, road construction and maintenance

and mining. Allotment Management Plans (AMPs) are recognized as grazing BMPs to the extent that they address non-point pollution (EPA2003). The BLM uses AMPs developed to improve riparian and upland conditions as an effective BMP to improve water quality. Western Montana Guideline #10 states "Livestock management should utilize BMPs for livestock grazing that meet or exceed those approved by the State of Montana in order to maintain, restore or enhance water quality." Other grazing BMPs used by the BLM include offstream water, exclosures and riparian fences.

The BLM's responsibilities under the 1987 amendments of the Clean Water Act include evaluation of the effectiveness of implemented BMPs. The watershed assessment is an evaluation of BMP effectiveness as well as an evaluation of land health. For the BSCW assessment, the IDT used a combination of methodologies to evaluate the watershed characteristics, as well as condition and function of floodplains, springs, streams, and wetlands.

In conducting watershed assessments with respect to nonpoint water pollution, upland, forest, wetland and riparian assessments are used to determine how BLM management is affecting water quality. The BLM evaluates uplands for land cover condition (ability of plants, rocks, and litter to protect soil from erosion, promote infiltration and reduce runoff). Wetlands are assessed to determine their extent and condition and their ability to recharge ground water, cycle nutrients, filter sediments, promote infiltration and mitigate flooding. Streams and their adjacent riparian areas are evaluated to determine channel morphology and stability, access to floodplains, species composition and condition of riparian vegetation. Wells, pipelines and spring developments are recognized as BMPs, and are evaluated to determine condition and effectiveness. Due to the extent of stream miles in the Dillon Field Office, temperature monitoring is limited to selected streams. PFC assessments also provide clues to stream temperature. Shallow, overwidened streams with limited vegetation receive more solar radiation and are more at risk for thermal impacts than deep, narrow, well vegetated streams. Improvements in channel condition and riparian cover directly correlate to reductions in thermal impacts. See Biodiversity Special Status Species page 46 for more details.

The assessment team also looks at current and historic mining, timber harvests, abandoned beaver dams, erosion from roads, concentrated livestock waste and other disturbances that may contribute to NPS pollution. Road maintenance, including culvert sizing and installations are also evaluated.

There are 23 allotments in the BSCW. Of the 23 allotments, 19 have streams and/or wetlands. Allotments within the Big Sheep Creek Watershed were assessed in 1992, 2002 and 2004. An Environmental Assessment was completed for Muddy Creek Allotment in 1993, however there were numerous protests. In 1999, a Final Decision was issued and new management was initiated in 2000. In 2003 and 2005, Final Decisions were issued for the Big Sheep Creek allotments and new management was authorized for twenty-two allotments: Alkali Creek, Cabin Creek, Cottonwood Creek, Crystal Creek, Dixon Mountain, Four Eyes, Four Eyes Isolated, Indian Creek, Indian Creek Isolated, Junction, Meadow Creek, Meadow Creek Isolated, Nicholia, North Dixon, Pine Creek, Porcupine Canyon, Rio Puerco, Rock Creek Isolated, Rock Creek Seeding, Simpson Creek, Simpson Creek FS and Whitworth.

The 2015 field based land health assessments indicated that BMP effectiveness was achieved for nineteen of the twenty allotments discussed in the previous paragraph. Riparian conditions in the Porcupine Canyon Allotment did not improve. BLM administered land on two allotments, Pine Creek and Simpson Creek FS, which are co-managed with the USFS, met the riparian health standard during the previous assessment, but did not meet the standard during the 2015 assessment. The USFS is the lead management agency for both of these allotments.

In addition to the Allotment Management Plans, there are numerous water developments in the watershed assessment area. Some of these were well designed and working effectively, others were in need of repair or were not providing sufficient water.

Also refer to sections on upland and riparian health above for PFC determinations and information that helps indicate where BLM resource conditions and/or authorized uses may be either contributing to or mitigating water quality impairment. The State makes Beneficial Use Determinations. The BLM shares their findings to assist DEQ in making Beneficial Use Determinations.

Recommendations

1. Work with Montana DEQ as they develop TMDLs and Water Quality Restoration Plans.
2. Continue BMP implementation and effectiveness monitoring to address NPS pollution.
3. Continue to share Watershed Assessment findings with DEQ.
4. Continue implementation of Water Quality MOU (BLM-MOU-MT923-1030) between Montana DEQ and BLM, including submission of biannual reports.
5. Continue to implement the Montana Nonpoint Source Management Plan and strategies for Agriculture, Forestry, Mining and Road Maintenance.
6. Continue temperature monitoring on high priority streams.

Air Quality

Western Montana Standard #4: *"Air quality meets State standards"*

Affected Environment

The United States Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS) that limit air pollutant concentrations of six principal pollutants (particulate matter, sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, and lead). The EPA also regulates additional pollutants such as hazardous air pollutants and greenhouse gases (GHGs), although these pollutants have no regulatory thresholds for ambient concentrations. Emissions of GHGs, including primarily carbon dioxide and methane, contribute to climate change.

Under the Clean Air Act (CAA) Amendments of 1990, the EPA must regularly review and revise the NAAQS, ensure that the standards are attained (in cooperation with States), require control of hazardous air pollutant emissions, and set standards for air quality monitoring. Installation and

operation of monitors is primarily carried out by State and local agencies and the monitors are typically located in population centers or near certain industrial sites. Monitors are rare in rural areas, unless air quality agencies have reason to believe that pollutant concentrations may approach or exceed ambient air standards in rural locations.

The closest air quality monitor is located in Butte, Montana. Pollutant concentrations at this monitor indicate high levels of small particulate, known as PM_{10}, that have a diameter less than or equal to 10 microns. PM_{10} exceeds the NAAQS within the Butte valley and the area is designated nonattainment for PM_{10}. Recent monitoring data also indicate some high $PM_{2.5}$ (diameter less than 2.5 microns) concentrations in winter due to wood burning on days with temperature inversions. According to Montana DEQ, high $PM_{2.5}$ concentrations are confined to a small area within Butte city limits.

For most of the year, air quality in rural southwestern Montana is excellent. Air quality issues in the BSCW develop predominantly during wildfires and are limited to $PM_{2.5}$ emissions, which can travel hundreds and even thousands of miles. Consequently, air quality in the BSCW can be affected by fires located far from the BSCW. Because pollutant emissions associated with wildfires are largely beyond human control, exceedances of air quality standards that are associated with large wildfires are considered to be natural events and are typically exempted from consideration when determining NAAQS compliance.

The closest population to the BSCW is Dillon, Montana. The 2010 U.S. Census population estimate for Dillon Census County Division (CCD) was 7,880. Beaverhead County's population estimate, also for 2010, was 9,246.

Findings, Analysis and Recommendations

Procedure to determine conformance with Standard

The CAA of 1990, as amended (42 U.S.C. 7401 et seq) and Executive Order 12088 requires the BLM to work with appropriate agencies to protect air quality, maintain Federal and State designated air quality standards, and abide by the requirements of State Implementation Plans.

The EPA delegated the authority to implement the provisions of the CAA to the State of Montana. Determination of compliance with air quality standards is the responsibility of the State of Montana. To address the issue of wildland fire, the EPA developed the 1998 Interim Air Quality Policy for Wildland and Prescribed Fires which required states to develop smoke management plans. Montana and Idaho responded by forming the Montana/Idaho Airshed Group and by developing the Montana/Idaho Smoke Management Program.

Findings and Analysis

Air quality issues in the planning area center mainly around smoke. Smoke contributors in the planning area include wildfire, prescribed fires, private debris burning, agricultural burning, slash burning, and wood burning stoves and fireplaces. Wildfire can produce short-term adverse effects on air quality. Air quality and visibility can deteriorate due to temporary air stagnation during wildfire events, which are most common during the months of July, August, and

September. Concerns regarding human health revolve around smoke from wildland and prescribed fire.

Prescribed burning is done in accordance with the Montana/Dakotas Fire Management Plan and is coordinated with MT DEQ and the Montana/Idaho Airshed Group. During prescribed fire season, the Smoke Monitoring Unit supports the Montana/Idaho Airshed Group to prevent or reduce the impact of smoke on area communities, especially when that smoke could contribute to a violation of national air quality standards. During the summer wildfire season, the Smoke Monitoring Unit assists state and local governments in monitoring smoke levels and providing information about smoke to the public, firefighters, and land managers.

Recommendation for Air Quality

1. Continue to follow Burn Plans and to coordinate with the Smoke Monitoring Unit.

Biodiversity

Western Montana Standard #5: *"Provide habitat as necessary, to maintain a viable and diverse population of native plant and animal species, including special status species"*

Affected Environment

The assessment area provides seasonal and year-long habitat for a wide variety of species. Wildlife uses are enhanced by the interspersion and diversity of grasslands, sagebrush, riparian, rocky outcrops and forested areas. Specific habitat conditions and associated recommendations are described above in the Upland Health and Riparian Health sections.

Sagebrush Habitats and Sagebrush Dependent Species

Sagebrush and grassland habitat types make up 83% of BLM administered lands in the BSCW. Of this, 81% is in the sagebrush/mountain shrub cover type and 2% is grassland. The sagebrush species in the watershed are Wyoming big sagebrush, mountain big sagebrush, basin big sagebrush, low sagebrush, silver sagebrush, black sagebrush, alkali sagebrush, and three tip sagebrush. The variety of sagebrush provides habitat for pronghorn, mule deer, sage grouse, pygmy rabbits, and various bird species.

BLM administered lands in the BSCW provide year-round sage grouse habitat. The majority of the BSCW is within a sage grouse priority habitat management area (PHMA) (see Map 4). Sagebrush is an important habitat component for sage grouse. It comprises nearly 100% of sage grouse winter diets and provides thermal, hiding, and nesting cover. Broods require a high protein diet of forbs and insects, usually found in riparian habitats.

The Big Sheep Creek Watershed also provides year-round pygmy rabbit habitat. Pygmy rabbits also require sagebrush for forage and cover, as well as deep alluvial soil to dig burrows. Sagebrush comprises nearly 100% of their winter diet and over half of their summer diet. Pygmy rabbits are endemic to sagebrush and are the only rabbit on the continent to dig their own

burrows. Pygmy rabbits have been documented in numerous BSCW allotments. Active burrows were found in a variety of sagebrush communities.
Basin big sagebrush communities are present in drainage bottoms. These provide important structure and cover for wildlife in otherwise open habitat, particularly for special status species that require tall dense sagebrush such as sage thrasher, Brewer's sparrow, sagebrush sparrow and loggerhead shrike. Golden eagles, prairie falcons, great horned owls, Swainson's hawks, and ferruginous hawks also inhabit the sagebrush grassland habitat in the watershed.

Riparian, Aquatic and Wetland Habitat and Associated Species
The westslope cutthroat trout (WCT), mountain whitefish, white, longnose and mountain sucker and mottled sculpin are native fishes in the Big Sheep Creek watershed. Rainbow, brown, brook and Yellowstone cutthroat trout were introduced, probably about the turn of the century and are found in several streams.

Most streams within the assessment area receive little fishing pressure. The exception is Big Sheep Creek, which is a popular sport fishery providing an average of 1,138 angler use days of fishing (MFWP 2013). The lower reaches support a predominately brown trout fishery with the occasional rainbow trout, while upstream reaches above Muddy Creek are predominately rainbow with brown trout and the occasional brook trout and rainbow x cutthroat trout hybrid found.

Fishery habitat conditions on streams within the BSCW are generally in good condition. Several streams have localized issues caused by livestock and/or roads. In many cases, streams were surveyed multiple times over the last 10 years to address data gaps in past fishery related surveys. These include evaluating WCT genetic purity, assessing suitability for WCT restoration and monitoring general fishery habitat condition.

Table 8: Fisheries Streams and Fish Species Present on BLM

Stream	Stream Reach (s)	Fish Species Present on BLM	BLM Stream miles
Big Sheep Creek	107,106, 104,105,1438 108,109,1434,	Rainbow, brown, brook and cutthroat trout, whitefish, mottled sculpin, longnose dace, mountain and white sucker	9.4
Meadow Creek	135	WCT, mottled sculpin	.35
Rock Creek	1441	Hybridized cutthroat trout, mottled sculpin	<0.10
Simpson Creek	169	WCT, mottled sculpin	1.1
Deadman Creek	122,123,126	WCT, mottled sculpin, cutthroat trout hybrids, rainbow, brown and brook trout	1.72
Muddy Creek	1491,149, 157,145,154	WCT, mottled sculpin	3.81
Tex Creek	120	Species undetermined-2016 survey planned	.63
Indian Creek	168	Rainbow trout hybrids	1.26

Riparian/mesic shrubs make up 5% of the BLM administered lands in the BSCW. Riparian areas provide important habitat for moose, elk, beaver, songbirds, and sage grouse. Columbia spotted frogs and western toads were observed at different sites within the watershed. Columbia spotted frogs are the most common frog in mountainous regions of Montana and frequent wetlands in both forested and non-forested habitat. Adults overwinter in larger ponds and in extremely dry conditions they become inactive and burrow in the mud or under rocks (Werner et al., 2004). Riparian, aquatic, and wetland habitat offers habitat diversity and are crucial water sources for wildlife. Succulent forbs, largely found in riparian areas, are a key component of sage grouse brood diets. Wildlife and livestock concentrate in riparian habitat, as it provides green vegetation later into the summer and fall, resulting in a disproportionate amount of use in these areas.

Aspen in the BSCW is also an important forage, cover, and nesting component for various species including elk, moose, and ruffed grouse. Riparian woodlands support the highest diversity of landbird species of all habitats. Riparian corridors are crucial to several northern-breeding Neotropical migrants and breeding or wintering species, even though they may not carry water year-round (Rich et al., 2004). Most species are summer residents that use habitats ranging from lower elevation wetlands to high elevation forests for breeding and raising young. Some species are migratory, but small populations may stay yearlong depending on seasonal conditions. The USFWS has a list of 22 "Birds of Conservation Concern" for Bird Conservation Region (BCR) 10 (Northern Rockies U.S. portion only), many of which depend on riparian habitat for all or part of their lifecycle (U.S. Fish and Wildlife Service, 2008). Table 9 lists the 18 species that potentially occur within the BSCW.

Table 9: USFWS Birds of Conservation Concern, BCR 10, Potentially Occurring in BSCW

Bald Eagle	Williamson's Sapsucker
Swainson's Hawk	Olive-sided Flycatcher
Ferruginous Hawk	Willow Flycatcher
Peregrine Falcon	Loggerhead Shrike
Long-billed Curlew	Sage Thrasher
Flammulated Owl	Brewer's Sparrow
Calliope Hummingbird	Sage Sparrow
Lewis's Woodpecker	McCown's Longspur
Black Rosy-Finch	Cassin's Finch

Generalist or Widespread Species

Within BSCW the Tendoy Mountains, White Pine Ridge area, and south into the Deadman Creek area are important elk winter range. Some elk migrate from Idaho to winter in this area. The elk population has increased and Montana Fish, Wildlife and Parks (MFWP) may propose more liberal hunting opportunities within this area to reduce numbers (pers. comm. Fager, 2015). The higher elevation mountain big sagebrush communities on the west side of the watershed provide elk calving habitat in the Beaverhead Mountains. Elk from the Sage Creek population east of Interstate-15, which had individuals who were seropositive for exposure to *Brucella abortus*. interchange with the Tendoy herd, more likely during winter. *Brucella abortus*, is the bacteria that causes the infectious disease brucellosis, that infects cattle, bison, and elk. In these species, brucellosis typically results in an abortion during the first pregnancy after infection,

although it can also cause abortions during subsequent pregnancies, or the birth of weak calves with high mortality. *B. abortus* is primarily transmitted through contact with infected birth tissues and fluids (MFWP, 2015).

Sagebrush habitat in the watershed provides mule deer and antelope winter range. A large portion of Big Sheep Creek Basin is antelope winter range. During the winter of 2007, BLM personnel mowed units within Simpson Creek and Meadow Creek allotments to rejuvenate decadent sagebrush in antelope winter range. Percent canopy of sagebrush is gradually increasing within these mowed units. It is still evident where mowing occurred, but small sagebrush plants are sprouting throughout the area. Antelope numbers have increased throughout this area (pers. comm. Fager, 2015). Mountain mahogany provides important winter forage for mule deer and moose. It is heavily browsed in some areas within the watershed, however rockier and steeper slopes such as along Big Sheep Creek, are not as accessible for browsing. Mule deer numbers are up from recent population estimates, however they have declined over time likely due to high elk numbers and intense browse on mountain mahogany and aspen by mule deer and elk (pers. comm. Fager, 2015). Mule deer winter range covers an area similar to elk winter range in the BSCW. There are very few white-tailed deer inhabiting the BSCW.

Bighorn sheep core habitat covers the east side of the Tendoy Mountains within BSCW. There was a population die-off in 1993, an augmentation of nearly 20 sheep from Rock Creek in 1997, and another die-off in 1999. The population was augmented in 2002 with around 30 bighorns relocated from the Sun River population. Another 49 bighorn sheep were relocated to the Tendoys from Flathead Lake's Wildhorse Island in 2012. Since then, the population has steadily declined due to endemic pneumonia (pers. comm. Fager, 2015). From September 5th through November 29th, 2015 MFWP opened a hunt to the public to remove all individuals from the population. After the population is gone, MFWP plans to reintroduce a new healthy population into the area, since adding individuals to a sickly population has not worked. Mountain goats are found at higher elevations on Forest Service lands on the west side of the watershed in the Beaverhead Mountains and Italian Peaks.

Table 10. Primary Game Species and Habitat Use within the BSCW

Species	Forested	Sagebrush	Riparian
Antelope		Y	
Bighorn Sheep		Y	
Black bear	Y	S	S
Dusky grouse	Y	S,B	Y
Elk	S,C	W,C	Y
Gray Wolf	Y	Y	Y
Hungarian Partridge		Y	
Moose	Y	Y	Y
Mountain lion	Y		Y
Mule deer	S,C	Y	W
Ruffed Grouse	Y		Y
Sage grouse		Y	B
White-tail deer		S	Y

Y = yearlong, S = summer, B = brood rearing, C = calving/fawning, W = winter

Special Status Species

"Special Status Species" refers to both plants and animals and includes proposed species, listed species, and candidate species under the Endangered Species Act (ESA); State-listed species; and BLM State Director-designated sensitive species (USDI, 2014a). Special Status Species are vital to maintain watershed biodiversity. In 2014 the Special Status Species List was updated to assist in addressing conservation management needs and to help establish priorities. The 6840 manual gives the State Director the responsibilities of designating the Bureau of Land Management (BLM) sensitive species and periodically reviewing/updating the list in cooperation with states and with the Natural Heritage Programs. The sensitive species designation is used for species requiring special management consideration to promote their conservation and reduce the likelihood and need for future listing under the Endangered Species Act (ESA).

Table 11 lists Special Status Species that potentially occur within the BSCW during all or part of the year.

Table 11. Special Status Species Occurring within the Big Sheep Creek Watershed

Wildlife Species	Current Management Status	Occurrence*	Preferred habitat
Canada lynx (*Lynx canadensis*)	Threatened	T	Forest
Grizzly bear (*Ursus arctos*)	Threatened	T	All
Bald eagle (*Haliaeetus leucocephalus*)	Sensitive	R	Forest/Riparian/wetland
Black-backed woodpecker (*Picoides arcticus*)	Sensitive	T	Forest
Boreal/western toad (*Bufo boreas*)	Sensitive	R	Riparian/wetland/forest
Brewer's sparrow (*Spizella breweri*)	Sensitive	R	Sagebrush shrubland
Burrowing owl (*Athene cunicularia*)	Sensitive	T	Grassland
Ferruginous hawk (*Buteo regalis*)	Sensitive	R	Sagebrush shrubland
Flammulated owl (*Otus flammeolus*)	Sensitive	T	Forest
Fringed myotis (*Myotis thysanodes*)	Sensitive	T	All
Gray wolf (*Canis lupus*)	Sensitive	R	All
Great Basin pocket mouse (*Perognathus parvus*)	Sensitive	R	Sagebrush shrubland
Golden eagle (*Aquila chrysaetos*)	Sensitive	R	Riparian/wetland Sagebrush shrubland
Great gray owl (*Strix nebulosa*)	Sensitive	R	Forest
Greater sage grouse (*Centrocercus urophasianus*)	Sensitive	R	Sagebrush shrubland
Lewis' woodpecker (*Melanerpes lewis*)	Sensitive	R	Forest/woodland
Loggerhead shrike (*Lanius ludovicianus*)	Sensitive	R	Sagebrush shrubland

Long-billed curlew (*Numenius americanus*)	Sensitive	R	Grassland
McCown's longspur (*Calcarius mccownii*)	Sensitive	R	Grasslands
North American wolverine *(Gulo gulo luscus*)	Sensitive	T	Alpine Forest
Peregrine falcon (*Falco peregrinus*)	Sensitive	R	Grassland/shrubland/riparian
Pygmy rabbit (*Brachylagus idahoensis*)	Sensitive	R	Sagebrush shrubland
Sagebrush sparrow (*Artemisiospiza nevadensis*)	Sensitive	R	Sagebrush shrubland
Sage thrasher (*Oreoscoptes montanus*)	Sensitive	R	Sagebrush shrubland
Spotted Bat (*Euderma maculatum*)	Sensitive	T	All
Townsend's big-eared bat (*Corynorhinus townsendii*)	Sensitive	R	Forest/riparian
Veery (*Catharus fuscescens)*	Sensitive	R	Riparian/wetland/woodland
Fish Species	**Current Management Status**	**Known from BLM lands?**	**Preferred habitat**
Westslope cutthroat trout (*Oncorhynchus clarki lewisi*)	Sensitive	Yes	Aquatic
Plant Species	**Current Management Status**	**Known from BLM lands?**	**Preferred habitat**
Idaho sedge (*Carex idahoa*)	Sensitive	Yes	Moist alkaline meadows
Cusick's horse-mint (*Agastache cusickii*)	Sensitive	Yes	Steep, loose talus slopes often below limestone outcrops
Chicken sage (*Sphaeromeria argentea*)	Sensitive	Yes	Sagebrush steppe and grasslands
Alkali primrose (*Primula alkali*)	Sensitive	Yes	Wet to moist alkaline meadows
Tree Species	**Current Management Status**	**Known from BLM lands?**	**Preferred habitat**
Whitebark Pine (*Pinus albicaulis*)	Candidate	Yes	High elevation sub-alpine zone

*Resident (R) = yearlong or main part of lifecycle including reproduction, Transient (T) = seasonal use or migratory, not expected to be found regularly.

Special Status Wildlife

Lynx are primarily restricted to northwestern Montana from the Purcell Mountains east to Glacier National Park, then south through the Bob Marshall Wilderness complex to Highway 200 (Interagency Lynx Biology Team, 2013). The Dillon Field Office does not contain any lynx critical habitat. Forested areas may provide temporary habitat for transient lynx dispersing from established lynx populations, but these areas likely do not contain all physical and biological features in adequate quantities and spatial arrangements to support lynx populations over time (USDI, 2013). The forest habitat within the DFO is generally drier than the preferred moist boreal forests that include dense understories that provide foraging habitat and cover for the lynx's main prey, the snowshoe hare (USDI, 2013). Forest habitat in BSCW isn't considered adequate lynx habitat. The watershed may be used as a lynx linkage zone between suitable habitats. However, lynx have not been documented within the BSCW.

According to the Interagency Grizzly Bear Study Team (IGBST), the current Greater Yellowstone Ecosystem (GYE) grizzly bear population is roughly 757 individuals (Haroldson et al, 2014). BSCW is outside the Occupied Range of the Yellowstone Grizzly Bear, as well as the Distinct Population Segment (DPS) boundary. The DPS boundary distinguishes the population of grizzly bears in the GYE as distinct from the remaining populations in the lower 48 states. The DPS boundary includes all landscapes where genetically distinct Yellowstone grizzly bear occur and may occur given future range expansion, delineated along easily identifiable boundary features (i.e. Interstate 15). The Dillon Field Office is outside the Grizzly Bear Recovery Zone, which depicts an area surrounding Yellowstone National Park where inter-agency grizzly bear recovery efforts are concentrated for the long-term conservation of the distinct Yellowstone grizzly bear population (IGBST, 2014). Although reports claiming grizzly sightings within the watershed have occurred over the years, there has not been a confirmed grizzly bear located in the BSCW.

In September, 2015 after reviewing petitions to list the greater sage grouse on the Endangered Species List, the U.S. Fish and Wildlife Service (USFWS) announced that listing of the greater sage grouse was not warranted (USFWS, 2015). The BLM completed Resource Management Plan (RMP) amendments and revisions to demonstrate to the USFWS that protections for sage grouse have been improved. The Record of Decision and Approved Resource Management Plan Amendments for the Great Basin Region, Including the Greater Sage-Grouse Sub-Regions of Idaho and Southwestern Montana (September, 2015) and Sage-Grouse Habitat Assessment Framework (Stiver et al., 2015) are used as a guidance for sage grouse habitat management. Sage grouse are also discussed above under "Sagebrush Habitats and Sagebrush Dependent Species".

In 2014 the United States Fish and Wildlife Service withdrew a proposal to list the North American wolverine in the contiguous United States as a threatened species under the ESA (USDI, 2014b). Wolverines occur in coniferous montane forest types, preferring rugged, roadless, isolated habitats. Home range size in western Montana averages 150 mi^2 for females and 163 mi^2 for males (Foresman, 2012). Wolverines are more likely to occur at higher elevations on Forest Service land in the Beaverhead Mountains and Tendoy Mountains, with transient individuals on BLM lands. However, the Tendoy Mountains likely do not have enough high elevation alpine habitat to sustain the large home range females require for natal areas.

The Northern Rocky Mountain population of gray wolves, including Montana wolves, was delisted from the list of Endangered and Threatened Wildlife in 2011 as part of the Appropriations Act. To avoid relisting, Montana will comply with federal regulations to manage wolves in a manner that will guarantee that the state maintains at least a minimum of 150 wolves and 15 breeding pairs (MFWP, 2013). Since delisting, a hunting season for wolves has been implemented in Montana. The combined maximum hunting and trapping bag limit is five wolves per person during the 2015 season. At the end 2014, a minimum estimate of 94 wolves and 20 packs were documented in the Montana portion of the Central Idaho Experimental Area. This is a decrease from the 2013 estimate of 123 wolves and 26 packs. There was one newly identified pack in 2014. (Bradley et al., 2015). Conflicts between wolves and livestock are an issue.

Fringed myotis occurs in a variety of habitats, from low- to mid-elevation grass, woodland, and desert regions (Foresman, 2012). Fringed myotis is found primarily in desert shrublands, sagebrush-grassland, and woodland habitats. They roost in caves, mines, rock crevices, buildings, and other protected sites (MNHP, 2015a). Townsend's big-eared bats are found in a variety of habitats from western mesic Douglas-fir forests to more arid Rocky Mountain juniper-limber pine-curlleaf mountain mahogany vegetative types (Foresman, 2012).

The bald eagle and golden eagle are protected under the Bald and Golden Eagle Protection Act, and are BLM sensitive species. Cooperative interagency monitoring is occurring through the Montana Bald Eagle Management Plan. Golden eagles, ferruginous hawks, and Swainson's hawks are found throughout the watershed. While there are no known peregrine falcon nest sites in the BSCW, nests are typically located on cliff ledges, ideally in areas with a wide view, near water, and close to plentiful prey (MNHP, 2015a).

The Brewer's sparrow, sagebrush sparrow, and sage thrasher utilize sagebrush habitats. McCown's longspur and long-billed curlew nest in dry, shortgrass prairies. Great gray owl habitat consists of mature forests with clearings such as bogs, meadows, and wetlands for foraging. Loggerhead shrikes are associated with open woodlands, and have also been documented nesting in sagebrush, bitterbrush, and greasewood.

Black-backed woodpeckers inhabit early successional, burned forest of mixed conifer, lodgepole pine, Douglas-fir, and spruce-fir. Western toads breed in any clean standing water and may wander miles from their breeding sites through coniferous forests and subalpine meadows, lakes, ponds, and shoreline (Werner et al., 2004).

Special Status Fish

Native westslope cutthroat trout (WCT) in Montana are currently listed as a special status species. Historically, WCT were likely present in all perennial streams within the assessment area. Remnant WCT populations within the BSCW are characterized by small isolated populations residing in small stream habitat. It is estimated that WCT populations within Montana are genetically unaltered in only 2.5% (McIntyre and Reiman 1995) to 10% (Shepard et al. 2003) of their historical range. Within the assessment area, Simpson Creek is the only verified genetically pure population. Meadow Creek supports a population that has either a very low level of introgression (<0.2%) with Yellowstone cutthroat trout or is genetically pure but shares an allele with Yellowstone cutthroat trout.

These two remaining pure populations within the BSCW are the result of dewatering of the lower reaches of the stream either through irrigation diversions across the valley floor or natural subbing of the stream which isolated these streams from non-native trout populations in downstream waters. Non-native salmonid introductions circa 1900 are likely the main factor in the loss of WCT populations within the area. There are currently five streams that support WCT with genetics between 90% and 100% on BLM-administered lands within the BSCW. The WCT found in Deadman Creek result from periodic stocking of hatchery WCT into a headwater lake.

Special Status Plants

Alkali primrose (*Primula alcalina*) is found in moist to wet alkaline meadows near headwaters streams at 6,300 to 7,200 feet elevation. It appears to be restricted to wet meadow habitats associated with relatively stable water tables. Soils remain moist to saturated throughout the growing season, but there is little or no inundation. The density of Alkali primrose declines with increased abundance of rhizomatous graminoids such as sedge and rushes. It is often most abundant on the tops and sides of hummocks where little other vegetation is present. Hummock habitats are moist without being wet and are more open than the wetter microhabitats dominated by sedges and rushes. Livestock congregate near wetlands in the summer for the lush vegetation and proximity to water. The effects of livestock grazing on Alkali primrose are both positive and negative. Because the leaves of Alkali primrose are all at ground level, livestock grazing can prevent seed production, however it will not kill the plant or remove significant photosynthetic tissue. Grazing can also be positive by partially removing the overtopping canopy of grasses and sedges, allowing more light to reach the leaf rosettes. Livestock grazing can also indirectly affect wetland vegetation by altering hydrologic regimes. Trampling by livestock may benefit this species by creating microhabitats on the tops and sides of the hummocks. Loss of wetlands would likely result in population declines. This can be minimized by restricting livestock grazing to later summer in as many years as possible to reduce trampling and grazing in these hummocked wetland habitats. Alkali primrose trend monitoring data that was collected in 2014 indicates that populations occurring in the Big Sheep Creek basin are maintaining or slightly increasing in density. Grazing by livestock has been present at both study sites for years and in one case is managed under a deferred grazing system while managed under a deferred rest rotation system at the other study site.

Alkalie primrose – *Primula alcalina*

Idaho sedge (*Carex idahoa*) is found in a few different riparian habitat locations throughout the BSCW. It is found in wet to moist alkaline meadows, is palatable, and sensitive to intensive grazing, especially during spring and early summer. Repeated herbivory, particularly between mid-May and mid-July may lead to population declines. Rest-rotation grazing regimes may allow enough recruitment to maintain stable populations of these palatable sensitive plants. Kentucky bluegrass and common dandelion are present in most wet meadow habitat and along many stream reaches. Kentucky bluegrass may compete with Idaho sedge. Canada thistle and houndstongue are scattered throughout the BSCW and were observed in many riparian and wetland habitats, especially along intermittent stream reaches. These noxious weeds may also compete with Idaho sedge which prefers these streamside and meadow habitats.

Chicken sage (*Sphaeromeria argentea*) prefers sparsely vegetated habitats with low competition. The known populations of this plant species, in the BSCW, face no anthropogenic threats. They

appear to tolerate and may benefit from disturbances that reduce competition such as livestock grazing.

Cusick's horse-mint (*Agastache cusickii*) is known in Montana from only a few locations in the Tendoy and Beaverhead Mountains. One large population of Cusick's horse-mint exists in the Big Sheep Creek canyon on talus limestone slopes above the county road, these slopes can be vulnerable to destabilization if impacted by activities such as quarrying of limestone and road maintenance. The steepness of this habitat tends to make it inaccessible to cattle, and the timber on these slopes is not of commercial quality. Future road improvement or maintenance will continue to be managed to avoid impacting the populations and habitat.

Cusick's horse-mint – *Agastache cusickii*

During the summer of 2010, the U.S. Fish and Wildlife Service announced a 90-day finding on a petition to list whitebark pine (*Pinus albicaulis*) as endangered or threatened and to designate critical habitat. In July of 2011, the finding was released; whitebark was given a warranted but precluded listing with a priority of 2 and is currently on the candidate species list (For a complete description of whitebark pine in the BSCW see Forest and Woodland Habitat section below).

Noxious Weeds and Invasive Species

Noxious weeds are defined in the Montana Weed Management Plan as "plants of foreign origin that can directly or indirectly injure agriculture, navigation, fish or wildlife, or public health." Currently there are 38 weeds on the statewide noxious weed list that infest about 7.6 million acres in Montana. Of these 38 there are only two of major concerns in the BSCW: spotted knapweed and houndstongue. Canada thistle, another state declared noxious weed, is also found in the BSCW. It is widespread throughout the Dillon Field Office and mostly found in riparian areas making treatment difficult.

Spotted knapweed (*Centaura maculosa*) is one of the more aggressive noxious weeds in the area administered by the Dillon Field Office. Spotted knapweed is found scattered in small infestations throughout the BSCW primarily along roads and in other disturbance areas. Because of where it is found, the potential is high for knapweed to be spread by vehicles, livestock, wildlife, recreation and other activities.

Houndstongue *(Cynoglossum officinale),* a noxious weed that is toxic to animals due to high levels of alkaloids contained in the plant, is found scattered throughout the BSCW in moderate sized infestations along roads, trails, and streams. Because of its seeds ability to cling to hair and clothing, the potential is high for it to be spread rapidly within the watershed.

Other noxious or invasive weeds present in isolated locations are cheatgrass (*Bromus tectorum)*, black henbane *(Hyoscyamus nigar),* and Common teasel (*Dipsacus fullonum*). Cheatgrass appears to be expanding along roadsides but is also present on a few steep slopes with southern exposures. Black henbane is also common along major roads and disturbed sites, but doesn't appear to be invading adjacent habitat. Presently less than 10 acres of private ground is infested by teasel and the landowner is actively treating the site.

Two small infestations of leafy spurge (*Euphorbia esula*) have been found in the BSCW. The first is located near an old building foundation and was last treated in 2004. The site has been visited every year since and to date no reoccurrence of spurge has been noticed. The site will continue to be visited for at least another five years before declaring the infestation eradicated. The second was found on a closed road in Muddy Creek by a Beaverhead County employee in 2008 and is about ten feet in diameter. This infestation has been treated yearly since and has slowly decreased in size.

Invasive Aquatic Species
There are no known populations of aquatic invasive species found within the Big Sheep Watershed.

Forest and Woodland Habitat and Associated Species
Forest and woodland habitats comprise approximately 10% of BLM administered lands within the BSCW. Effective precipitation and aspect influences the establishment and composition of forests and woodlands. The close association of forests with adjoining sagebrush and riparian habitats supports a broad array of wildlife species. This habitat provides important thermal and hiding cover, including security habitat for big game. Forest and woodland habitat offers high protein browse species in the fall and winter, as well as year-round, for deer, elk, and moose. Forests in the BSCW provide habitat for a large variety of species including mountain lions, dusky grouse, ruffed grouse, northern goshawk, black bear, and bobcat. This habitat provides important linkage corridors for large carnivores. Forest-dwelling bird species require suitable nesting and foraging habitat. Several bird species help protect forests by eating millions of damaging insects, such as the western spruce budworm.

In broad terms, a healthy forest is one that maintains desirable ecosystem functions and processes. Aspects of forest health include biological diversity; soil, air, and water productivity; natural disturbances; and the capacity of the forest to provide a sustaining flow of goods and services for people. On a landscape level, diversity of tree species, size classes and age classes are desirable. A mosaic of patches and openings provide diverse habitat for wildlife, breakup fuel continuity, and provide wildlife cover and corridors. Healthy forests may not always be entirely free of insects and diseases, but may have a presence at endemic, not epidemic populations. Spacing of trees, which varies by species, is also important to consider when assessing forest conditions. Trees require ample space to acquire enough sunlight, moisture, and

nutrients to grow adequately. Tree growth can be limited due to lack of resources in dense stands.

The majority of forested areas identified in the BSCW are found in the Muddy Creek drainage including: McNinch Creek, Johnson Creek, Thompson Creek, and Trail Creek. Conifer forests here, primarily on northern aspects, are dominated by single story Douglas-fir. Douglas-fir occupies the largest latitudinal range of any commercial conifer in western North America. This species occupies a wide variety of climatic, soil, and topography conditions. The IDT noted, in the BSCW, that many Douglas-fir along these drainages were found to be in the gray-phase with standing dead and/or decadent trees that appear to have been affected by Douglas-fir beetle and/or spruce budworm. The stands here appear to be dense with smaller diameter trunks (approximately ~8-10" DBH) and relatively short (approximately ~50 feet tall). Conifer density appears high in many of these areas, and has resulted in "dog-hair" stands of Douglas-fir.

Dead "dog-hair" Douglas fir in McNinch Creek, August 2015

Overview of Douglas-fir in McNinch Creek, August 2015

Western spruce budworm is a native defoliating insect which is present in the BSCW, and has caused heavy defoliation on many Douglas-fir trees in the assessment area. Western spruce budworm is favored by dry summer conditions and mild winters, and has the greatest impact on trees that are stressed from dense stocking, found in multi-storied stands, and/or are impacted by drought conditions (Kamps et al., 2008). Budworms grow more vigorously in stressed trees, and budworm populations can increase dramatically during drought conditions. Prolonged budworm epidemics cause reduced diameter and height growth (Bulaon and Sturdevant, 2006). While spruce budworm does not usually cause direct tree mortality, it will predispose trees to attacks by other insects or diseases.

Douglas-fir beetle is a native bark beetle which kills Douglas-fir trees, preferring mostly large diameter trees growing in mixed or pure stands. Douglas-fir trees most susceptible to attack from Douglas-fir beetle are those larger than 14 inches diameter at breast height (DBH), older than 120 years, and growing in dense stands (Weatherby and Their, 1993). Douglas-fir beetle

normally kills small groups of trees, but at epidemic levels may kill groups of 100 trees or more (Schmitz and Gibson, 1996).

Dusky grouse forage on Douglas-fir needles and buds in the winter and, along with other birds, heavily rely on Douglas-fir communities for cover. Several bird species extract seeds from Douglas-fir cones or forage for seeds on the ground (Steinberg, 2002). Douglas-fir habitat types provide excellent hiding and thermal cover for deer, elk, and bighorn sheep. It also provides nesting and/or roosting habitat for numerous bird species including great-horned owls, sharp-shinned hawks, great gray owls, and northern goshawks.

Both whitebark pine (WBP) and limber pine are found on the Big Sheep Creek Watershed. Whitebark pine can be found primarily in the subalpine and krummholz habitats on elevations ranging from 5,900 to 9,300 feet. Whitebark pine can be found growing on soils that are typically nutriet poor soils derived from basalt or granite. The IDT identified whitebark pine in the southwest corner of the watershed. WBP was present on the lower ends of slopes along Indian Creek mixed with Douglas-fir. Whitebark in this area showed little to no sign of mountain pine beetle and/or white pine blister rust. Cone crops were found on many trees. WBP was also found in the Indian Creek Isolated allotment. WBP on the tops of these slopes appear to have been affected by mountain pine beetle and/or white pine blister rust, and many trees were dead and/or dying. Within the stands though, there is a good representation of age classes and tree vigor.

Dead and drying whitebark pine on north end of Indian Creek allotment, August 2015

The cones and seeds of whitebark are a primary food source for several wildlife species due to their high caloric and fat content. Seed dispersal is done almost entirely by the Clark's nutcracker, a bird that caches the seeds which will eventually germinate, if not found again by the Clark's nutcracker, bears, rodents or other birds. Whitebark pine has been recognized as a keystone species of high elevation habitats. They are important resources for wildlife food, snowpack retention, and watershed protection. Limber pine seeds provide critical food for rodents and birds, including squirrels and Clark's nutcrackers, which also cache the seeds for later use. Other birds, small mammals, and bears benefit from these caches.

Mountain pine beetle (MPB) is a native bark beetle, that affects many species of pine including: lodgepole pine, ponderosa pine, and whitebark and limber pines. This beetle, unlike some others, must kill the host tree in order to successfully reproduce. Outbreaks tend to occur when climatic conditions are favorable, and in mature forests, typically associated in lodgepole pine stands. More recently, MPB outbreaks are occurring in whitebark and limber pines, where previous

Whitebark pine along Indian Creek mixed with Douglas-fir, August 2015.

climatic conditions, mainly cold temperatures, were thought to be inhospitable to the insect. MPB outbreaks can be rather extensive, and many areas in the Greater Yellowstone Ecosystem are currently experiencing declines in whitebark pine stands due to outbreaks of MPB (Logan et al. 2010)

White pine blister rust is a non-native pathogen which attacks white pines. Blister rust originated somewhere in Asia. The life-cycle requires two stages of spore production: from whitebark pine and the alternate hosts from either *Ribes* or *Pedicularis* spp. This fungus causes the tree to create cankers on the branches and bole that eventually girdle the tree leading to top-kill, and eventually kills the stem above the canker (Campbell and Antos, 2000). White pine blister rust has led to declines in abundance and extent of whitebark pine populations in the United States.

The IDT also identified Limber pine on the north corner of the Big Sheep Creek Watershed in the Muddy Creek Allotment. Limber pine is found in much of Montana on rocky slopes and ridges on a wide range of elevations from montane to subalpine zones. It is able to grow on harsh sites that may be rocky, steep, windswept and nutrient poor sites. It often grows on calcareous soils derived from limestone and/or other parent materials. Limber pine found on the BSCW was found mixed with Douglas-fir and Rocky Mountain Juniper. There were many age classes of limber pine present, as well as varying levels of tree vigor. Many trees showed signs of mountain pine beetle and are dead and/or dying, but there are also many healthy trees present on the landscape with good cone crops, and regeneration is occurring as evidenced by seedlings.

Limber pine mixed with Douglas-fir and Rocky Mountain Juniper on the north end of Muddy Creek Allotment, August 2015

Many animals browse aspen year-round, but it is especially valuable during fall and winter when protein levels are high relative to other browse species (Howard, 1996). Aspen is an important browse species for ungulates including deer, elk, and moose. It also provides hiding cover, summer shade and some thermal cover for ungulates in the winter, as well as hiding and thermal cover for many small mammals. Aspen also provides nesting and foraging habitat for a variety of bird species including dusky grouse, dark-eyed junco, house wren, chipping sparrow, and pine siskin. Aspen buds, flowers, and seeds are palatable to many bird species. Ruffed grouse depend on aspen for foraging, courting, breeding, and nesting throughout most of its range. Aspen buds, catkins, and leaves provide year-round food for ruffed grouse. The IDT identified quaking aspen stands that occur in patches within the McNinch drainage, with remnant stems remaining among the Douglas-fir. Although aspen represents a small proportion of the forested area in these drainages, these stands have a great impact on the local biodiversity. Conifer stands have expanded their previous range greatly, and have since crowded the aspen. Quaking aspen is classified as being very shade intolerant, and as a result of the conifer expansion, the IDT found aspen stands to be declining in coverage and vigor.

Fire Ecology and Fire Regimes of the Big Sheep Creek Watershed

As a prominent disturbance process in southwestern Montana, fire is directly tied to land health by affecting seral stage diversity, age classes, and landscape structures. Understanding the historic role of fire helps inform decisions on ecological status, trend and treatment needs. Recently, fire regimes for most terrestrial communities have been mapped and textually described for vegetation types across the entire U.S. (LANDFIRE, 2011). These descriptions give context for assessing land health, reference conditions, and functioning ecosystems.

Biophysical Settings (BpS) are most simply defined as the native vegetation communities present in the pre-Euro-American era, and therefore developed under the influence of natural disturbances such as fire. BpS's describe vegetation communities at a larger scale than Ecological Sites, and as such can be applied to characterize broad areas such as watersheds. Each BpS description describes the historic composition and dominance of seral stages for that type, as well as the historic fire frequency and severity. Together, this information describes a reference condition, or a standard against which current conditions may be compared.

Comparing Biophysical Settings to current conditions is useful for identifying trends in forest and non-forest vegetation communities. Based upon field reconnaissance and LANDFIRE National data, the dominant BpS's found in the entire BSCW include several species of big sagebrush, Douglas-fir forest, spruce forest, and subalpine tree species forests. Many other individual BpS's are present within this watershed that are isolated or comprise a small percentage of the total area; these BpS's are grouped in the "other" category in the table below.

Successional processes, seral stage descriptions, and historic fire regimes for these types are described in the LANDFIRE BpS description documents for Map Zone 19 (LANDFIRE, 2011). These descriptions of historic conditions were compared with current conditions to depict landscape trends in vegetation and fire regime departure. The approximate distribution of dominant BpS's in the watershed is presented in Table 12.

Table 12: Distribution of Dominant BpS's in the BSCW (All Ownerships)

Biophysical Setting Name (Number)	Acres by BpS in BSCW	% of BSCW
Inter-mountain basins montane sagebrush steppe (1911260)	98824	55%
Rocky Mountain Subalpine/Upper Montane Riparian (1911600)	14307	8%
Northern Rocky Mountain Subalpine Woodland and Parkland (1910460)	12071	7%
Middle Rocky Mountain Montane Douglas-fir Forest and Woodland (1911661)	9379	5%
Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest (1910451)	9383	5%
Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland (1910550)	7232	4%
Other	30117	17%

Fire Regimes in the Big Sheep Creek Watershed

The fire regime concept is used to describe the fire frequency, behavior, ecological effects, seasonality, pattern, and type for a given ecosystem or vegetation type. Based upon the most current fire regime classification system, each BpS corresponds to a unique fire regime group (Schmidt et al., 2002).

Table 13. Natural fire regime groups and descriptions.

Group	Frequency	Severity	Severity Description
I	0-35 years	Low/Mixed	Generally low-severity fires replacing less than 25% of the dominant overstory vegetation; can include mixed-severity fires that replace up to 75% of the overstory.
II	0-35 years	Replacement	High-severity fires replacing greater than 75% of the dominant overstory vegetation.
III	35-200 years	Mixed/Low	Generally mixed-severity; can also include low-severity fires.
IV	35-200 years	Replacement	High-severity fires.
V	200+ years	Replacement/ Any severity	Generally replacement-severity; can include any severity type in this frequency range.

Mountain Big Sagebrush (BpS 1911260)

Fire Regime: Mountain big sagebrush dominated communities are found above about 7000 feet in elevation, and on sites that annually receive 12-20 inches of effective precipitation. This vegetative community is characterized by Fire regime Group I. Fire is a major disturbance factor for mountain big sagebrush and likely played a large role in maintaining this habitat as a sagebrush/grassland. Periodic fire restricted conifer establishment on sites capable of supporting trees, and held in check the conversion of sagebrush habitat to forest habitat. Mountain big sagebrush has the fastest recovery rate of the three subspecies of big sagebrush. Fire size for this type is larger than other big sagebrush species because of greater fine fuel load, but some unburned pockets remain after fires, often resulting in a patchy mosaic. The fire return intervals vary from 10-200yrs. However, estimating historic fire regimes for sagebrush ecosystems is tenuous at best and often based on fire scar and age structure data from adjacent forest types,

shrub age structure and fuel characteristics. Fire regimes also vary considerably across the range of mountain big sagebrush, based on factors like elevation, soil depth, slope, aspect, adjacent vegetation, frequency of lightning and climate. While the majority of fires were likely stand-replacing, some mixed severity fire may have occurred. Mixed severity fires were likely small in area, but ignitions may have occurred as frequently as 5-20yrs. There were probably also portions of this system that never carried fire because of sparse fuel. Historic fires likely occurred during the summer months and were wind driven events. Lightning ignitions are variable and affect fire frequency on regional landscapes in the Northern Rockies. Fire may spread from adjacent forested communities. Mountain big sagebrush does not resprout following fire and recolonization of burned areas must come from either a short-lived seed bank or seed dispersed by plants in unburned patches or adjacent stands.
Current Conditions:
The mountain big sagebrush stratum is slightly departed from reference conditions due to fire exclusion and the effects of conifer encroachment. The proportions of mid- to late-development mountain big sagebrush are near reference conditions, however the early development sagebrush component is lacking throughout the watershed. Douglas-fir and juniper are establishing in areas where conditions are suitable for conifers and are converting former sagebrush habitat into closed canopy forest habitat.

Rocky Mtn. Subalpine/Upper Montane Riparian Systems & Subalpine Forest (BpS 1910600 & 1910460)
Fire Regime: The highest elevation forest types in this watershed are dominated by five-needle pines, subalpine fir, Engleman spruce and lodgepole pine. This forest type is characterized by Fire Regime Groups III and IV, primarily long-interval (100-200+ year) mixed severity (25-75% top kill) and stand replacement fires. Ignitions are frequent due to lightning, though fires seldom carry due to lack of fuel from the slow-growing vegetation. Nonlethal surface fires may be possible where short grasses provide a continuous ground fuel; individual tree torching is more common. Climate variability and slow fuel loading could extend the stand-replacing fire interval to many hundreds of years.
Current Conditions: The subalpine forest stratum is within the range of variation for its natural fire regime. Fire has not recently affected large portions of this forest type in this area, which has led to predominantly mid to late-development stands. However, most of the whitebark and limber pine is being affected by both white pine blister rust and mountain pine beetle. White pine blister rust is not a native disease agent; therefore the current whitebark pine die-off is creating an uncharacteristic condition. Mortality caused by these agents will increase fuel loading and will lead to more open stands dominated by tree species not susceptible to blister rust or pine beetle. Even with increased fuel loading, many fires that start in these high elevation stands will continue to be inhibited from spreading by rock, scree and green and/or sparse vegetation. Fires that start in lower elevation, drier forest types may affect the fringes of the subalpine forest.

Douglas-fir Forest (BpS's 1910451 and 1911661)
Fire Regime: The Douglas-fir forest in this watershed is best characterized by Fire Regime Groups I and III. Fires were predominantly surface and mixed-severity, with a mean fire interval of 7-80 years. Occasional stand replacement fires may also occur. Much of the Douglas-fir forest is on dry, south-facing slopes at the sagebrush-forest interface and was historically

affected by fires in adjacent vegetation. Abundant evidence of past fires is present in the lower elevation, mature Douglas-fir timber stands, primarily in the form of fire scars on large diameter relic trees. The low frequency and wide spacing of existing relic trees and stumps in these stands indicates historic low-severity fires likely promoted and maintained a fairly open Douglas-fir forest. Mixed-severity fires occurred primarily in denser stands, and at higher elevations. The mean fire interval in these stands was lengthened, with slightly more late-development, closed-canopy forest structure. Douglas-fir increases in canopy density in the absence of fire disturbance. Much of this landscape today has canopy cover denser than the historic range of variability. Canopy closure of >80% in this BpS is considered uncharacteristic. Many of the young, dense Douglas-fir stands (<100 years old) in this watershed have sagebrush skeletons on the ground, which indicates these sites were previously dominated by sagebrush.
Current Conditions:
The Douglas-fir forest stratum is moderately to severely departed from reference conditions due to altered stand structure. Past timber harvesting followed by more than a century of fire exclusion has promoted an increase of dense, single age-class Douglas-fir forest. Herbaceous understory vegetation is sparse in many stands due to nearly complete canopy closure.

Lodgepole pine-Spruce Forest (BpS 1910550)
Fire Regime: The lodgepole pine and Englemann spruce-dominated forests are found at higher elevations or on cooler, moister aspects than Douglas-fir forests. This forest type is characterized by Fire Regime Groups IV or III; primarily moderately long-interval mixed and stand replacement fires. Lightning strikes are frequent, but will often result in small, patchy spot fires. The low elevation extent of this forest type was likely affected by the more frequent fire intervals of the adjacent, drier Douglas-fir forest. More moist sites, or sites protected from fire by topographic features have much longer fire intervals, possibly up to 600 years. Fire sizes ranged widely from single tree spot fires, to many thousands of acres. Variability of climate, topography and other site factors can result in a wide range of representation of successional stages on the landscape. Fire regimes in this system are strongly related to climatic cycles. Long-term changes in climate as well as interannual climate variability will affect the frequency of fire in this system and its distribution along an elevational gradient.
Current Conditions:
The lodgepole pine-spruce forest stratum is predominantly within the range of variation for its natural fire regime. Fire has not recently affected large portions of this forest type in this area. The current fuel loading is sufficient to propagate stand replacing fire in many areas, but only under very dry, and windy conditions. Fuel loading is anticipated to increase in lodgepole pine stands as a result of recent beetle-caused mortality.

Fire Regime Condition Class

Fire Regime Condition Class (FRCC) is a general index providing two pieces of information: the historic fire regime group, and the condition class. Fire Regime Groups are described in the previous section and summarized in Table 14 below. Condition class reflects the degree of ecological departure when current conditions are compared against modeled reference conditions in terms of two main ecosystem components: fire regime and associated vegetation. This departure is from changes to one (or more) of the following ecological components: vegetation characteristics (species composition, structural stages, stand age, canopy closure, and mosaic

pattern); fuel composition; fire frequency, severity, and pattern; and other associated disturbances (e.g. insect and disease mortality, grazing, and drought).

Three fire regime condition classes have been defined (Schmidt et al. 2002) based on the following criteria: FRCC 1 represents ecosystems with low (<33 percent) departure and that are still within an estimated historical range of variation as determined by modeling for the pre-Euro-American era; FRCC 2 indicates ecosystems with moderate (33 to 66 percent) departure; and FRCC 3 indicates ecosystems with high (>66 percent) departure (Hann and Bunnell 2001; Hardy et al. 2001, and Schmidt et al. 2002). A low departure indicates current conditions are characteristic of those occurring in the natural fire regime and associated vegetation. A high departure indicates uncharacteristic conditions that did not occur within the natural fire regime. Condition classes were assessed using the FRCC Software Application.

Table 14 : FRCC Summary for Big Sheep Creek Watershed (All Ownerships)

Biophysical Setting	Fire Regime Group (I-V)	Condition Class 1 (ac)	Condition Class 2 (ac)	Condition Class 3 (ac)	Total Acres
Inter-mountain basins montane sagebrush steppe (1911260)	I	21903	58842	17169	97914
Rocky Mountain Subalpine/Upper Montane Riparian (1911600)	III &IV	2414	9493	1248	13155
Northern Rocky Mountain Subalpine Woodland and Parkland (1910460)	III & IV	6389	5117	106	11612
Middle Rocky Mountain Montane Douglas-fir Forest and Woodland (1911661)	III	1898	7170	208	9276
Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest (1910451)	I	1057	8060	125	9242
Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland (1910550)	IV	1864	5061	108	7033
Other BpS acres not included in FRCC assessment					13802
Total Acres		35525	93743	18964	162034
% of Watershed		24%	63%	13%	

Findings, Analysis and Recommendations

Procedure to Determine Conformance with the Standard

This Standard is an overall assessment of biodiversity and plant and wildlife habitat. The present state of each allotment and habitat type was compared to the natural and historic condition. The indicators described under the definition of Standard #5, as well as condition/function of the

other standards, specifically uplands and riparian, were considered to determine whether or not the Biodiversity Standard was met. The IDT considered the range of natural variation within this ecosystem as well as the species composition, condition of available habitat, and forest health to determine the condition/function of biodiversity.

Findings and Analysis

Sagebrush Habitats and Sagebrush Dependent Species

There are at least six active leks within the watershed. Numbers of male sage grouse attending leks is relatively stable in the Cabin Creek and Simpson Creek areas, with a higher than average count in the Alkali Creek area. Other leks have not shown persistent attendance over the years, with some leks moving locations. Resident and migratory sage grouse are present in Big Sheep Creek Basin during the year. Some birds are present yearlong and may travel no further than two to three miles from leks. Some birds, particularly males, breed and spend the summer in the Basin and then migrate to southeastern Idaho during the winter. Other birds, primarily females with broods, breed in southeastern Idaho and migrate to Montana during late spring and summer with their broods, and return to Idaho during the winter. The DFO radio-collared sage grouse throughout the Field Office from 1999-2012. Based on the telemetry data gathered, some sage grouse captured from leks within the BSCW wintered in the watershed, mainly in the Crystal Creek and Simpson Creek allotments.

Habitat plots completed during the 2015 brood rearing season, within three miles of leks in the watershed, averaged 49.7 cm shrub height, 30 cm herbaceous height, 32% shrub cover, and 64% herbaceous cover. All of these indicators, except shrub cover, are within the "suitable" habitat range for sage grouse breeding habitat outlined in the Sage-Grouse Habitat Assessment Framework (June 2015), which is BLM's guidance for sage grouse habitat. Suitable habitat guidelines include: 15-25% shrub cover (marginal includes >25%), 40-80 cm sagebrush height in mesic areas and 30-80 cm in arid sites, ≥18 cm perennial grass and forb height, ≥15% perennial grass cover at a mesic site and ≥10% perennial grass cover at an arid site. It is important to remember that the BSCW provides year-round sage grouse habitat and sagebrush cover ≥10% and sagebrush height ≥ 25 cm is considered "suitable" winter habitat.

Within the Muddy Creek and Rio Puerco allotments, conifer is expanding into sagebrush grassland in several different areas. As conifers continue to expand, sagebrush habitat will be lost in the long-term.

Riparian, Aquatic and Wetland Habitat and Associated Species

Beavers have declined significantly region-wide, but active beaver dams were found on BLM administered lands across the watershed. Private lands also contain active beaver complexes in the BSCW. Historic beaver activity was also documented on BLM lands. The aspen is either no longer existent along these reaches, with the beaver having cut them all down, or colonies of mature aspen remain with little regeneration or heavy browsing reducing the vigor of the regeneration. Existing beaver colonies could provide beaver recruitment elsewhere into vacant streams and into adjoining watersheds but suitable habitat to sustain long-term occupancy is generally lacking, with many aspen communities transitioned into willow dominated systems.

WCT habitat surveys were conducted on BLM administered lands within the BSCW during the 2012, 2013 and 2014 field seasons. Surveys were conducted on random 500 foot reaches on selected streams. In-stream habitat was identified to type (pool, riffle, run) with habitat length, width and residual pool depth measurements taken. Stream substrate data was collected using a 500 point "zig zag" pebble count method within riffle habitats within each reach.

Recent beaver activity along Cabin Creek. 2015

Overall, riparian habitat condition on streams surveyed was in good condition with stable banks and low levels of bank disturbance. Within the assessment area sediment levels in some streams was an identified concern. Most of this is likely natural, and due to either high levels of clay and fines present in the soil, as is the case in Muddy Creek or in Simpson Creek, an old beaver complex a short distance upstream of the habitat survey area was identified as the source of elevated sediment within the survey reach.

During the 2015 BSCW assessment, "trout" were observed in relative abundance while assessing Tex Creek. Prior fishery surveys in 1993 and 2002 did not document a fish population within the stream. A 2016 fish survey is planned to identify species present and abundance.

Meadow Creek

Meadow Creek supports one of two genetically pure WCT populations remaining within the watershed. A 2010 population estimate conducted on BLM land found ~14 WCT per 100 feet of stream in one reach and ~2 WCT/100' in a lower reach. Heavy vegetation and high flows was noted as likely impacting collection efficiency in this reach and WCT numbers were assuredly higher than the estimate indicates. WCT were found to be distributed in about 5 miles of habitat within the drainage.

A habitat survey was conducted within the BLM reach in 2014. Habitat conditions were found to be in very good condition. Stream bed substrate was primarily comprised of gravels and small cobble. Substrate fines were found to be ~20%, which is within the normal range expected for channel type. Stream banks were found to be stable and well vegetated and comprised primarily of willow with scattered sedge and herbaceous vegetation. Spawning habitat was present throughout most of the BLM stream length.

Simpson Creek

Simpson Creek supports one of two genetically pure WCT populations remaining within the watershed. Genetic testing has been conducted multiple times between 1992 and 2014. The drainage supports a relatively large population of WCT for a stream this size. A 2014 population

estimate conducted on BLM land found there were ~ 26 WCT per 100 feet of stream and WCT were distributed through about 5 miles of habitat.

Habitat surveys were conducted on BLM administered land in 2014, with conditions found to be in good condition overall. Fine sediment was found to be at elevated levels (~ 37%), but can be primarily linked to a degrading beaver complex in close proximity upstream of the survey area. Stream banks were overall found to be stable and well vegetated. The vegetative community was comprised primarily of willow and sedges with scattered herbaceous vegetation. High quality spawning gravels was found to be present in several areas upstream of the beaver complex.

Muddy Creek-

Muddy Creek supports a population of slightly hybridized WCT (98%) and a large population of mottled sculpin in approximately nine miles of stream. A population estimate was attempted in 2010 and again in 2015. Due to the very low shocking efficiency related to water chemistry, the estimates are low quality. The 2010 estimate found very low numbers (<0.3 WCT/300') of large adult WCT in the lower reach. A survey/genetic collection in a reach near the headwaters found fair numbers with multiple age classes present. The 2015 survey collected no WCT in a 300'reach in the lower drainage, but found sculpin to be abundant. An additional population survey was conducted within the area of the 2010 genetic collection and found low numbers of WCT (~4.5 WCT/300' of stream). During 2015 the Muddy Creek drainage was experiencing low flows and high stream temperatures. These conditions may have forced WCT to seek refuge in cooler tributary habitat upstream of the stream reaches surveyed.

Starting in 2007, a non-native brown trout removal was conducted. Between 2007 and 2011 approximately 200 brown trout were removed from the drainage. No brown trout were collected during the 2015 surveys. This may indicate successful eradication or that brown trout numbers have been suppressed to levels where odds of detection are low.
Fish habitat surveys were conducted in two portions of the drainage in 2014, one in the lower portion and one in the upper portion of the drainage. Stream bank conditions in both were found to be in good condition with heavily vegetated banks consisting primarily of rushes and sedges. Sediment levels throughout the drainage were found to be very high. Within the lower reach substrate surveys found fine levels of around 90%. Fines within the upper basin were much lower at around 44%, but still excessive even for a low gradient E channel such as Muddy Creek. Overall, this is primarily a naturally high level of sediment. The parent material within the basin contains a very high level of clays and fines. However, there are several areas of anthropogenic sediment sources which are contributing sediment. There are three primitive road crossings that at times are contributing additional sediment to the stream. These areas also tend to encourage livestock to congregate which has degraded the stream banks and over widened the stream at localized locations. With these sediment levels, it is unlikely that any successful spawning takes place within Muddy Creek proper. Any successful spawning most likely takes place in one or two headwater tributaries.

There is an existing fish barrier located on BLM land that is reaching the end of its functionality. In 2010, high flows damaged the structure and yearly maintenance has since been required to maintain it as a fish barrier. A new fish passage barrier will be required in the near future to prevent the loss of the WCT population in Muddy Creek.

Several studies have indicated that cutthroat trout reproduction can be impacted by low levels of fine sediment (Ringler and Hall 1975; Irving and Bjornn 1984; Weaver and Fraley 1991; Horan et al. 2000; Bjornn et. Al 1977) found that as the percentage of fine sediment exceeds 20% to 30% in spawning riffles, salmonid reproduction begins to decline. Bryce, et al. (2010) evaluated fine sediment impacts on fish and macro-invertebrates and found that sediment impacts begin at 13% for fish and 10% for macro-invertebrates. As indicated in table 15 below, sediment levels in some surveyed streams are higher than optimum. With the sediment levels observed, it is probable that salmonid spawning success and pool quality is being impacted.

Using baselines identified in the "Beaverhead Sediment Total Maximum Daily Loads and Framework Water Quality Protection Plan" (Montana DEQ. 2012), streams < 15 foot wetted width would be expected to have a minimum of ≥ 90 pools per stream mile while streams 15-30 feet bankfull width would be expected to have ≥ 52. Residual pool depth would be expected to be approximately 10 inches and % fines (<6mm) would be expected to be between 10% and 30% depending on stream gradient and channel type. Steeper gradient "B" channels would be expected to have slightly more or less than 10% fines < 6mm while lower gradient "E" type channels are expected to have up to 30% fines < 6mm. Stream size and gradient will affect pool number, residual depth and the percentage of fine sediment present. Generally, as stream size decreases pool frequency increases and pool depth decreases. Using the data in Table 15 below, the surveyed streams are likely within the natural range of variability expected based on stream size with the exception of elevated sediment levels in Muddy and Simpson creeks. The elevated sediment levels are likely inhibiting pool frequency and quality to some extent in these streams, especially in the lower reach of Muddy Creek.

Table 15: Pool Frequency, Depth and % fines

Stream	Primary Channel Type	Average Stream width (feet)	Pool Frequency (per mile)	Residual Pool Depth (inches)	% Fines (<6mm)	Riparian Habitat Condition 2015
Meadow Creek	B/E	4.6	139	8.6	20	PFC
Simpson Creek	B/E	3.5	174	8	37	PFC
Muddy Creek-lower reach	E	4.6	70	7	90	PFC
Muddy Creek-upper reach	E	3.25	139	12.75	44	PFC

Throughout the west, the threat of increasing water temperatures on fisheries habitat due to climate change is a growing concern. Studies have linked water temperature with lower cutthroat performance in water temperatures >59F (DeStatso and Rahel 1994; Dunham et al. 1999; Novinger 2000). Water temperature monitoring within the assessment area was initiated in 2012 on selected streams to track potential changes in summer stream temperatures. Data collected to date shows that both average and summer peak temperatures have remained relatively consistent since temperature monitoring began (see Table 16 below). However,

several streams have shown an increase in the number of days where water temperatures reached or exceeded 60 degrees. In most cases this can likely be attributed to variations in summer temperatures. With only a few years of temperature data, it's difficult to say whether this is normal climatic fluctuation or the beginnings of a long term trend. In most cases where temperatures reached or exceeded 60 degrees F, it was for short periods of a few hours during the day with temperatures in most streams dropping back into the 40 or 50 degree range overnight. However in the case of Big Sheep Creek, it would appear that the high stream temperatures within the drainage may be the natural norm rather than the exception. The landscape setting in the big sheep drainage is likely a strong contributor to the elevated temperatures. The drainage is located in a confined, rocky, low elevation valley. This likely does not allow release of the days thermal input very rapidly. The thermograph data shows that generally the summer nighttime lows were usually in the mid 50 degree range spiking back into the 70s by mid-morning.

Table 16- Big Sheep Creek Watershed Stream Temperature Data

Stream/Year	Avg. temperature 6/1-9/1	Peak temperature 6/1-9/1
Meadow Creek 2012	47.5	58.7
Meadow Creek 2014	48.5	60.6
Meadow Creek 2015	47.5	58.1
Running avg	***47.8***	***59.1***
Simpson Creek 2013	51.6	68.7
Simpson Creek 2015	48.8	60
Running avg	***50.2***	***64.35***
Big Sheep Creek 2013	51.5	68.7
Big Sheep Creek 2014	58.8	72.7
Big Sheep Creek 2015	59.5	72.9
Running avg	***56.6***	***71.4***
Muddy Creek 2011	54.3	64.1
Muddy Creek 2013	54.2	69.3
Muddy Creek 2014	53.6	68.8
Muddy Creek 2015	57.5	72.3
Running avg	***54.9***	***68.6***
Deadman Creek 2015	55.9	71.7
Running avg	***55.9***	***71.7***

Additional information on assessed stream and riparian condition can be found above under the Riparian and Wetland Health section.

Generalist or Widespread Species

Heavy browse on mountain mahogany and aspen regeneration in areas throughout the watershed may be limiting mule deer winter range quality. Browsing from livestock and wildlife including mule deer, moose, and elk are all contributing. Aspen provides browse for big game and forage for ruffed grouse. Aspen decline is a concern in the watershed. Past seedings of hard fescue in Rock Creek Seeding allotment and Contours pasture of the Muddy Creek allotment introduced an unpalatable grass species, removing native perennial bunchgrasses such as bluebunch wheatgrass for big game winter forage. Conifer has expanded into sagebrush grassland habitat

within bighorn sheep core habitat. As conifer cover increases, it may act as a barrier to bighorn sheep movement, as bighorns prefer vegetation types with greater horizontal visibility and avoid closed forests (Tilton and Willard, 1982). Overall, bighorn sheep core habitat provides adequate forage and escape terrain.

Net-wire and barbed-wire fences are common throughout BSCW. These fences represent an entanglement hazard and travel barrier, especially for antelope, and deer, elk and moose calves. Barbed wire fences with more than four wires, wires spaced too closely, or wires higher than 40-inches or lower than 16-inches hinder wildlife movement between pastures and are also an entanglement hazard. Fences for modification, removal, or rebuilding have been identified in several BSCW allotments.

Spring developments are an important water source for wildlife, but associated tanks can be fatal when escape ramps for birds and small mammals are not installed in them. Escape ramps will be installed in stock tanks that were lacking them. Fences near sage grouse leks or in areas with low visibility can be a collision hazard for sage grouse. Fence markers have already been placed near some leks in BSCW and will be placed in additional locations as needed.

Special Status Species

Overall, throughout BSCW sensitive wildlife species habitat is adequate. In allotments that didn't meet riparian/wetland standards, an improvement in this habitat will enhance conditions for cover, forage, and nesting. Where noxious weeds are a concern, controlling these invasives will reduce the likelihood that they out-compete native herbaceous and forb species, retaining it for wildlife forage and cover. In areas where conifer encroachment is converting sagebrush grassland into forest, sagebrush obligate sensitive species' habitat would eventually be lost.

See discussion above in Forest and Woodland Habitat and Associated Species for whitebark pine.

Noxious Weeds Summary

Noxious or invasive weeds that could present a threat to the BSCW in the future include; dyer's woad, yellow starthistle and rush skeletonweed. Dyer's woad, a highly competitive biennial, can form large dense colonies that displace desirable rangeland species. Infestations of this invader have been found along the railroad tracks from Monida to Lima, MT. Large infestations also occur in the southern and eastern parts of Idaho. Yellow starthistle, a winter annual, is highly competitive and typically develops dense, impenetrable stands that displace desirable vegetation and causes chewing disease in horses. An infestation of starthistle was found in the Limekiln Canyon area in 2010 and large infestations are known to be in areas of Idaho. Rush skeletonweed, a perennial, and reproduces through adventitious root buds and seeds that are transported by wind over distances of up to twelve miles. An infestation of skeletonweed was found in 2014 eight miles north of the Idaho border along Interstate 15. The infestation consisted of three plants that had gone to seed the previous year. Other infestations with the potential to spread into Montana from Idaho have been found in Clark County and within twenty miles of the Montana - Idaho border in Lemhi County. All of these plants could be a major threat to the BSCW if allowed to spread. In 2007, the BLM became involved in the Continental Divide Barrier Zone project which works to improve communication between counties and

agencies within Idaho and Montana concerning noxious weed locations. The goal of this partnership project is to stop the spread of yellow starthistle and rush skeletonweed before they become established in Montana.

Since 1989, BLM has been involved in cooperative control efforts with Beaverhead County. A cooperative spray day has been held each year with Beaverhead County, the Nature Conservancy, the BLM and private landowners participating. Throughout this period, the goal has been to prevent new noxious weed infestations and control or eradicate existing infestations in Beaverhead County using Integrated Pest Management. Due to the small size of the noxious weed infestations, the harshness of the climate and the elevation of the valley, no biological controls have been released.

Noxious and invasive species are spread primarily along roads by motorized vehicles. The Big Horn sheep hunt that was conducted this year increased the amount of off road travel in the area and has raised concerns about noxious weed spread. The leafy spurge infestation in Muddy creek was driven through numerous times by an off-road vehicle and other closed roads were used by both local and out of area recreationists. This disturbance could create new infestations by either spreading current infestations further or by introducing new invaders from out of the watershed. Increasing off-road vehicle use during the big game hunting season is also a concern for potential weed spread.

Table 17: Recent Weed Inventories and Treatments

Year	Acres Treated	Acres Inventoried
2011	20	1000
2012	25	650
2013	30	760
2014	20	1600
2015	20	1200

Forest and Woodland Summary

Current forest stand conditions will likely continue to support epidemic insect and disease activity. Douglas-fir canopy defoliation caused by spruce budworm may encourage the reestablishment of former sagebrush/grassland openings within forested habitat. Partial defoliation causing top-kill will permanently stunt tree growth and likely result in deformed, bushy trees. Commercial salvage opportunities to harvest merchantable dead and/or dying timber in the BSCW are limited by the low value of potential products, steep rocky terrain, and the lack of usable existing roads. In much of the BSCW, non-commercial mechanical treatment to improve forest health and/or to remove conifers is cost prohibitive due to size and density of existing trees. Using prescribed fire to mitigate smaller size-class conifer expansion in appropriate areas is listed as a recommendation below.

Recommendations for Biodiversity

1. Modify old net-wire fence, dilapidated fences, and fences with improper wire spacing to meet wildlife-friendly specifications and ensure that new fences are built to BLM specifications. Remove any unnecessary fences and work with private landowners to improve BLM-private boundary fences.
2. Continue to maintain wildlife escape ramps in all stock tanks in the watershed.
3. Identify fences that pose a collision hazard with sage grouse or other wildlife and install fence markers to improve visibility and reduce the risk of collision.
4. Consider treatments to reduce hard fescue in the Rock Creek Seeding allotment and Contours pasture of the Muddy Creek allotment to increase native perennial bunchgrasses.
5. Reduce conifer expansion in sagebrush grassland habitat in Muddy Creek and Rio Puerco allotments to retain sagebrush habitat for the long-term.
6. Install culverts at all BLM stream crossings on Muddy Creek.
7. Ensure the road runoff is not contributing additional sediment to Muddy Creek.
8. Explore options for replacing the Muddy Creek fish barrier.
9. Maintain a six inch herbaceous/sedge stubble height along greenline and/or three inches on the floodplain by reach, whichever occurs first to provide a sediment buffer on WCT streams.
10. Consider livestock management revisions to avoid livestock use during WCT spawning/egg incubation (July1/Aug1) in the Simpson Creek pasture of Indian Creek allotment
11. Explore options to construct a fish passage barrier on lower Meadow Creek to preserve the genetic integrity WCT in the drainage.
12. Continue to address localized weed infestations cooperatively with Beaverhead County, The Nature Conservancy, other landowners and partners as appropriate. Continue the existing education effort on weed identification with permittees and other people who use this area. Continue, through participation in the Borders program, to identify and eradicate any new infestations of rush skeletonweed or yellow starthistle moving into Montana from Idaho.
13. Limit any ground disturbance activities that may increase the risk of noxious weed invasion. Where disturbance does occur, use BMPs to mitigate the chance of noxious weed establishment.
14. Explore opportunities to enhance/improve/protect “Priority Habitats” such as aspen, mahogany, whitebark pine and limber pine.

Additional Programs, Issues, and/or Concerns

Recreation and Travel Management
An overview of recreational use within the BSCW is provided on page 14. As a result of the 2006 Dillon Field Office RMP, public motorized wheeled vehicle use is limited to those routes designated as open. All other routes are considered closed, with few exceptions to accommodate administration of permits, to access private lands, or other limited circumstances. Travel management will continue be implemented as prescribed in the Dillon RMP. Roads identified as open to public use will be signed with a white arrow symbol on a flexible sign post. Roads not identified as open to public use would be:

- Left unsigned unless there is evidence of regular use.
- Signed closed if there is evidence of regular use.
- If signing is ineffective at discouraging use, roads would be obliterated to the extent possible (made unnoticeable), at least at the intersection with an open route, or physically closed when continued use is causing significant unacceptable resource impacts or user conflicts.

Corrections of mapping errors in the original route designations in the RMP, and other minor adjustments to route designations will be made through this watershed assessment process and specified in the environmental assessment and decision record.

Recreation and Travel Management Recommendations

1. Analyze, and make necessary adjustments to route designations where concerns were documented.
2. Consider installing culverts or other appropriate structures where frequently traveled roads intersect perennial streams within the BSCW.
3. Consider options to increase compliance with travel management and reduce off-road or closed road motorized vehicle use. Discuss and decide where to physically close or obliterate roads due to noncompliance with signing.
4. Analyze installing horse gates to allow non-motorized access to public land at the end of open motorized routes, specifically in the Muddy Creek drainage adjacent to the Hidden Pasture WSA.

Muddy Creek/Big Sheep Creek ACEC
The Muddy Creek/Big Sheep Creek ACEC lies four miles southwest of Dell, Montana, including portions of the Muddy Creek drainage and continuing upstream along the Big Sheep Creek drainage to its confluence with Deadman Creek. The area contains approximately 22,829 acres of public land with relevant and important scenic values along Big Sheep Creek and the cultural resources values throughout.

Muddy Creek/Big Sheep Creek ACEC Recommendations

1. Develop a research design to study the archaeological significance of cultural resources within the ACEC in order to better delineate the Muddy Creek Archaeological District.
2. Prepare Muddy Creek Archaeological District National Register of Historic Places nomination package.

Interdisciplinary Team Composition

Core IDT members:
Kelly Savage, Rangeland Management Specialist/TES Plants – ID Team Leader
Pat Fosse, Supervisory Natural Resource Specialist
Katie Benzel, Wildlife Biologist
Steve Armiger, Hydrologist/Riparian Coordinator (Soil, Water, and Air)
Paul Hutchinson, Fisheries Biologist

Support IDT members:
Rick Waldrup, Outdoor Recreation Planner/Wilderness Specialist
Jason Strahl, Archeologist
Michael Mooney, Weeds Specialist
Emily Guiberson, Forester
Ashley Wells, Forestry Technician
Joe Sampson, Fuels Specialist
Laurie Blinn, GIS Specialist
Dave Williams, Geologist Butte Field Office
Bob Gunderson, Geologist/Mining
Keith Johnson, Supervisory Land Use Specialist
Wendy Velman, Montana/Dakotas BLM Botanist Lead
Dave Ruppert, FS Soil Scientist
Ken Scalzone, NRCS Soil Scientist
Kyle Schmitt, USFS Rangeland Management Specialist
Katie Bonogofsky, USFS Rangeland Management Specialist

Other support personnel:
Kate Allder, Administrative Assistant
Ellen Daugherty, Administrative Assistant
Floyd Thompson, Montana/Dakotas BLM Range Program Lead
Mike Philbin, Branch Chief for Biological Resources & Science, Montana/Dakotas BLM State Office
Alden Shallcross, Montana/Dakotas BLM Hydrology Program Lead
Susan Bassett, Air Quality Specialist, Montana/Dakotas BLM State Office
LeeAnn Pallett, Soils Science Technician, Butte Field Office
Berett Erb, Range Technician
Leah Anderson, Range Technician
Cari Forsgren, Range Technician
Haleigh Stott, Range Technician
Melanie Finch, Biological Technician
Tempe Regan, Biological Technician
Jed Berry, Fisheries Technician
Brand Browning, Recreation Technician
Chris Carparelli, Beaverhead Conservation District

GLOSSARY

Allotment: an area of land designated and managed for grazing of livestock.

Allotment Management Plan (AMP): a documented program developed as an activity plan that focuses on, and contains the necessary instructions for, the management of livestock grazing on specified public lands to meet resource conditions, sustained yield, multiple use, economic and other objectives.

Alluvium: clay, silt, sand, gravel or similar detrital material deposited by running water.

Animal unit month (AUM): amount of forage necessary for the sustenance of one cow or its equivalent for a period of 1 month.

Anthropogenic: caused or influenced by humans.

Area of Critical Environmental Concern (ACEC): areas within the BLM administered lands where special management attention is required to: (1) protect and prevent irreparable damage to important historic, cultural or scenic values, fish and wildlife resources, or other natural systems or processes, or (2) protect life and safety from natural hazards.

Aridic Soil Moisture Regime: dryer than Ustic soil moisture regime, and moisture is considered "limiting" to plant growth. Areas that are considered arid have little to no chemical leaching so areas where salts are present usually have serious salinity issues because there is not enough "water" to leach them through the profile.

Census County Division: Census county divisions (CCDs) are geographic statistical subdivisions of counties established cooperatively by the Census Bureau and officials of state and local governments in states where minor civil divisions (MCDs) either do not exist or are unsatisfactory for census purposes.

Climax plant community: the final or stable biotic community in a successional series; it is self-perpetuating and in equilibrium with the physical habitat.

Colluvium: is the name for loose bodies of sediment that have been deposited or built up at the bottom of a low-grade slope or against a barrier on that slope, transported by gravity.

Cryic Soil Temperature Regime: soils in this temperature regime have a mean annual temperature higher than 0 degrees but lower than 8 degrees Celsius, with a difference between mean summer and mean winter soil temperatures greater than 5 degrees C at 50 cm, and COLD summer temperatures.

DEQ: Department of Environmental Quality

Ecological site: a kind of land with specific physical characteristics which differs from other kinds of land in its ability to produce distinctive kinds and amounts of vegetation and in its response to management.

Endemic: a population of potentially injurious plants, animals, or viruses that are at low levels.

Epidemic: pertaining to populations of plants, animals, and viruses that build up, often rapidly, to unusually and generally injurious high levels – *synonym* outbreak – *note* many insect and other animal populations cycle (periodically or irregularly) between endemic and epidemic levels.

Fen: a type of wetland fed by surface and/or groundwater. Fens are characterized by their water chemistry, which is neutral or alkaline.

Forest land: land that is now, or has the potential of being, at least 10 percent stocked by forest trees (based on crown closures) or 16.7 percent stocked (based on tree stocking).

Frigid Soil Temperature Regime: soils in this temperature regime have a mean annual temperature higher than 0 degrees but lower than 8 degrees, with a difference between mean summer and mean winter soil temperatures greater than 5 degrees C at 50 cm, and WARM summer temperatures.

Functional at risk (FAR): riparian wetland areas that are functional, but an existing soil, water, or vegetation attribute makes them susceptible to degradation.

Geomorphology: is the scientific study of landforms and the processes that shape them.

Glacial Till: is unsorted glacial sediment. It is that part of glacial drift which was deposited directly by the glacier.

Greenline: that specific area where a more or less continuous cover of vegetation is encountered when moving away from the center of an observable channel. The greenline is often, but not necessarily, located at the water's edge.

Hummocking: a form of micro-topographic relief characterized by raised pedicels of vegetated soil as much as 0.6 m (2ft) higher than the surrounding ground which results from long term large animal trampling and tracking in soft soil. Vegetation on the pedicels usually differs from that on the surrounding lower area due to moisture difference between the two levels. Hummocking is also caused by abnormal hydrologic heaving.

Hydric soil: soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part.

Hydrophyte: plants growing in water or on a substrate that is at least periodically deficient in oxygen due to excessive wetness.

Hydrologic Unit: the USGS has developed a system of geographic units based upon watersheds. These units were originally subdivided to four levels. Subsequently two additional subdivisions have been developed. Currently there are six levels, with the sixth being the smallest unit.

Hydrologically Connected: Hydrologically connected is used in this document in the same sense as in Rapanos vs. United States in the question of isolated wetlands. That is there is continuous surface connection. It is acknowledged that there are other definitions.

Interrupted Stream: a stream with discontinuities in space. A stream which surfaces and subs at various locations along a length of channel.

Krummholz: the shrubby, multistemmed form assumed by trees and other woody vegetation near the treeline.

Lands With Wilderness Characteristics: those lands that have been inventoried and determined by the BLM to contain wilderness characteristics as defined in Section 2 (c) of the Wilderness Act. These are separate from lands already designated as Wilderness or wilderness study areas.

Lentic: standing or still water such as lakes and ponds.

Lotic: flowing or actively moving water such as rivers and streams.

Moraine: accumulated glacial debris - a mass of earth and rock debris carried by an advancing glacier and left at its front and side edges as it retreats.

Nonpoint source pollution (NPS): pollution originating from diffuse sources (land surface or atmosphere) having no well-defined source.

Obligate wetland species: plant species that occur almost always under natural conditions in wetlands.

Palustrine: from the Latin "palus" or marsh. non-tidal wetlands dominated by trees, shrubs, persistent emergent plants, emergent mosses or lichens.

Parent Material: the underlying geological material (generally bedrock or a superficial or drift deposit) in which soil horizons form.

Pedestal: plants or rocks that appear to be elevated as a result of soil loss by wind or water erosion.

Proper functioning condition (PFC): lotic riparian-wetland areas are considered to be in proper functioning condition when adequate vegetation, landform, or large woody debris is present to: Dissipate stream energy associated with high waterflows, reducing erosion and improving water quality; Filter sediment, capture bedload, and aid floodplain development;

Improve flood-water retention and ground-water recharge; Develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; Support greater biodiversity

Pugging: is tracking depressions left by large animals (typically hooved animals, but occasionally humans) left in fine textured soil. Moist clay or silt usually has a consistency to hold tracks. Upon drying, pugged areas will have a hard, irregular surface, difficult to walk across. Bare soil may or may not be present**.**

Riparian zone: the banks and adjacent areas of water bodies, water coursed, seeps, and springs whose waters provide soil moisture sufficiently in excess of that otherwise available locally so as to provide a moister habitat than that of contiguous flood plains and uplands.

Rosgen Classification System: A classification system for natural rivers in which a morphological arrangement of stream characteristics is organized into relatively homogeneous stream types. Morphologically similar stream reaches are divided into 7 major stream type categories that differ in entrenchment, gradient, width/depth ratio, and sinuosity in various landforms. Within each major category are six additional types delineated by dominant channel materials from bedrock to silt/clay along a continuum of gradient ranges.

Seral: of, relating to, or constituting an ecological sere

Sere: a series of ecological communities that succeed one another in the biotic development of an area or formation.

Spring brook: a channel that carries water from a spring. Where there is sufficient flow, the channel forms a perennial stream. Frequently in arid environments, the flow is insufficient to create a perennial stream. Groundwater emerges at the springhead, flows a short distance within the spring brook, and then submerges.

Topography: the study of Earth's surface shape and features. It is also the description of such surface shapes and features (especially their depiction in maps). The topography of an area can also mean the surface shape and features themselves.

Total Maximum Daily Load (TMDL): the goal of the Clean Water Act (CWA) is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Under section 303(d) of the CWA, states are required to develop lists of impaired waters. The law requires that states establish priority rankings for waters on the lists and develop TMDLs for these waters. A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards.

TMDL Planning Areas: Montana DEQ is using a watershed approach to address TMDLs based on the premise that water quality restoration and protection are best addressed through integrated efforts within a defined geographic area. DEQ has divided the state into 91 watershed planning areas to facilitate development of TMDL/water quality restoration plans.

Ustic Soil Moisture Regime: it is wetter than aridic soil moisture regime and moisture is present during the time of year that is suitable for plant growth.

Wilderness Characteristics: these attributes include the area's size, its apparent naturalness, and outstanding opportunities for solitude or a primitive and unconfined type of recreation. They may also include supplemental values.

Woodland: forest communities occupied primarily by noncommercial species such as juniper, mountain mahogany, or quaking aspen groves. All western juniper forest lands are classified as woodlands, since juniper is classified as a noncommercial species. Woodland tree and shrub canopy cover varies, but generally individual plant crowns do not overlap.

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Appendix A

A List of Known Plants
Found On or Near BLM Lands
Within the Big Sheep Creek Watershed

And

Wildlife Species List

(Plant scientific names and alphanumeric codes presented in the following table correspond to those found in *The PLANTS Database*/http://plants.usda.gov; and the *Synthesis of the North American Flora*. Plant common names are generally those listed for the State of Montana in the above references unless BLM resource specialists are aware of a more frequently used locally accepted plant name.)

Common Name	**Scientific Name**	**USDA Symbol**
Agoseris	*Agoseris* spp	AGOSE
Alfalfa	*Medicago sativa*	MESA
Alkali primrose	*Primula alcalina*	PRAL6
Alkali Sagebrush	*Artemisia arbuscula ssp. longiloba*	ARARL
Alpine Forget-me-not	*Eritrichium spp.*	ERITR
Alpine Timothy	*Phleum alpinum*	PHAL2
Alumroot	*Heuchera spp.*	HEUCH
American Bistort	*Polygonum bistortoies*	POBI6
Baltic Rush	*Juncus arcticus ssp. littoralis*	JUARL
Basin Big Sagebrush	*Artemisia tridentata ssp. tridentata*	ARTRT
Basin Wildrye	*Leymus cinereus*	LECI4
Beaked Sedge	*Carex utriculata*	CAUT
Bearded wheatgrass	*Elymus trachycaulus ssp. trachycaulus*	ELTRT
Bebb Willow	*Salix bebiana*	SABE2
Bitterroot	*Lewisia rediviva*	LERE7
Black Cottonwood	*Populus balsamifera ssp. trichocarpa*	POBAT
Black Henbane	*Hyoscyamus nigar*	HYNI
Bladderwort	Utricularia spp.	UTRIC
Blue Flax	*Linum perenne*	LIPE2
Blue Grama	*Bouteloua gracilis*	BOGR2
Bluebunch Wheatgrass	*Pseudoroegneria spicata*	PSSP6
Bluegrass	*Poa spp.*	POA
Bluejoint Reedgrass	*Calamagrostis canadensis*	CACA4
Booth's Willow	*Salix boothii*	SABO2
Broom Snakeweed	*Gutierrezia sarothrae*	GUSA2
Buckwheat	*Eriogonum spp.*	ERIOG
Bull Thistle	*Cirsium vulgare*	CIVU
Canada Thistle	*Cirsium arvense*	CIAR4
Chicken sage	*Sphaeromeria argentea*	SPAR2
Cheatgrass	*Bromus tectorum*	BRTE
Cinquefoil	*Potentilla spp.*	POTEN
Clustered Field Sedge	*Carex praegracilis*	CAPR5
Common Cattail	*Typha latifolia*	TYLA
Common Dandelion	*Taraxacum officinale*	TAOF
Common Juniper	*Juniperus communis*	JUCO6
Common Mullein	*Verbascum thapsus*	VETH
Common Snowberry	*Symphoricarpos albus*	SYAL

Common Name	Scientific Name	USDA Symbol
Common Yarrow	*Achillea millefolium*	ACMI2
Cow Parsnip	*Heracleum maximum*	HEMA80
Coyote Willow	*Salix exigua*	SAEX
Creeping Catchfly	*Silene repens*	SIRE
Creeping Juniper	*Juniperus horizontalis*	JUHO2
Curl-leaf Mountain Mahogany	*Cercoarpus ledifolius*	CELE3
Currant	*Ribes spp.*	RIBES
Cusick's horse-mint	*Agastache cusickii*	AGCU
Cutleaf daisy	*Erigeron compositus*	ERCO4
Deathcamas	*Zigadenus spp.*	ZIGAD
Douglas-fir	*Pseudotsuga menziesii*	PSME
Drummond's willow	*Salix drummondiana*	SADR
Elephanthead	*Pedicularis groenlandica*	PEGR2
Elk thistle	*Cirsium foliosum*	CIFO
Engelmann Spruce	*Picea engelmannii*	PIEN
Foxtail Barley	*Hordeum jubatum*	HOJU
Fringed Sagewort	*Artemisia frigida*	ARFR4
Gardner saltbush	*Atriplex gardneri*	ATGA
Geyer Willow	*Salix geyeriana*	SAGE2
Greasewood	*Sarcobatus vermiculatus*	SAVE4
Green Needlegrass	*Nassella viridula*	NAVI4
Green Rabbitbrush	*Chrysothamnus vividiflorus*	CHVI8
Grey Horsebrush	*Tetradymia canescens*	TECA2
Heartleaf Arnica	*Arnica cordifolia*	ARCO9
Hoary Phacelia	*Phacelia incana*	PHIN9
Houndstongue	*Cynoglossum officinale*	CYOF
Idaho Fescue	*Festuca idahoensis*	FEID
Indian Paintbrush	*Castilleja spp.*	CASTI2
Idaho Sedge	*Carex idahoa*	CAID
Inflated Sedge	*Carex vesicaria*	CAVE6
Indian Ricegrass	*Achnatherum hymenoides*	ACHY
Kentucky Bluegrass	*Poa pratensis*	POPR
Kinnikinick	*Arctostaphylos uva-ursi*	ARUV
Lewis Flax	*Linum lewisii*	LILE3
Limber Pine	*Pinus flexilis*	PIFL2
Limestone Larkspur	*Delphinium bicolor ssp. calcicola*	DEBIC
Low Sagebrush	*Artemisia arbuscula ssp. arbuscula*	ARARA
Lupine	*Lupinus spp.*	LUPIN
Mealy primrose	*Primula incana*	PRIN
Meadow Barley	*Hordeum brachyantherum*	HORR2
Montana Sweet Pea	*Thermopsis montana*	THMO6
Mountain Big Sagebrush	*Artemisia tridentata ssp. vaseyana*	ARTRV
Mountain Brome	*Bromus carinatus*	BRCA5

Common Name	Scientific Name	USDA Symbol
Mountain Snowberry	*Symphoricarpos oreophilus*	SYOR2
Musk Thistle	*Carduus nutans*	CANU4
Narrowleaf Cottonwood	*Populus angustifolia*	POAN3
Nebraska Sedge	*Carex nebrascensis*	CANE2
Nodding Brome	*Bromus anomalus*	BRAN
Northwestern groundsel	*Packera conterminal*	PACO53
Oniongrass	*Melica bulbosa*	MEBU
Owl-clover	*Orthocarpus spp.*	ORTHO
Phlox	*Phlox spp.*	PHLOX
Pinegrass	*Calamagrostis rubescens*	CARU
Plains Pricklypear	*Opuntia polyacantha*	OPPO
Planeleaf Willow	*Salix planifolia*	SAPL2
Prairie Junegrass	*Koeleria macrantha*	KOMA
Prairie smoke	*Geum triflorum*	GETR
Prostrate hutchinsia	*Hornungia procumbens*	HOPR
Pussy-toes	*Antennaria spp.*	ANTEN
Quaking Aspen	*Populus tremuloides*	POTR5
Redoiser Dogwood	*Cornus sericea ssp. sericea*	COSES
Redtop	*Agrostis gigantean*	AGGI2
Rocky Mountain Groundsel	*Packera streptanthifolia*	PAST10
Rocky Mountain Iris	*Iris missouriensis*	IRMI
Rocky Mountain Juniper	*Juniperus scopulorum*	JUSC2
Rubber Rabbitbrush	*Ericameria nauseosa*	ERNA10
Rush	*Juncus spp.*	JUNCU
Sandberg Bluegrass	*Poa secunda*	POSE
Sandwort	*Arenaria spp.*	ARENA
Scarlet Globe-mallow	*Sphaeralcea coccinea*	SPCO
Sedge	*Carex spp.*	CAREX
Shy Wallflower	*Erysimum inconspicuum*	ERIN7
Short-fruited Willow	*Salix brachycarpa*	SABR
Shrubby Cinquefoil	*Dasiphora fruticosa ssp. floribunda*	DAFRF
Silverweed Cinquefoil	*Argentina anserine*	ARAN7
Silver Sagebrush	*Artemisia cana*	ARCA13
Slender Sedge	*Carex lasiocarpa*	CALA11
Slender thelpody	*Thelypodium sagittatum ssp. sagittatum*	THSA
Slender Wheatgrass	*Elymus trachycaulus*	ELTR7
Small-flowered Pennycress	*Noccaea parviflora*	NOPA5
Smooth Brome	*Bromus inermis*	BRIN2
Spike Fescue	*Leucopoa kingii*	LEKI2
Spotted Knapweed	*Centaurea stoebe ssp. micranthos*	CESTM
Spruce	*Picea spp.*	PICEA
Stemless Mock Goldenweed	*Stenotus acaulis*	STAC
Sticky Geranium	*Geranium viscosissimum*	GEVI2

Common Name	Scientific Name	USDA Symbol
Stiffleaf Penstemon	*Penstemon aridus*	PEAR2
Stonecrop	*Sedum spp.*	SEDUM
Subalpine Fir	*Abies lasiocarpa*	ABLA
Suksdorf Monkey flower	*Mimulus suksdorfii*	MISU2
Sweetscented Bedstraw	*Galium triflorum*	GATR3
Taper-tip Desert-parsley	*Lomatium attenuatum*	LOAT
Thick-spike Wheatgrass	*Elymus lanceolatus*	ELLA3
Thinleaf Alder	*Alnus incana*	ALIN2
Three-tip Sagebrush	*Artemisia tripartita*	ARTR4
Threadleaf Sedge	*Carex folifolia*	CAFI
Timothy	*Phleum pratense*	PHPR3
Tufted Hairgrass	*Deschampsia cespitosa*	DECE18
Water Birch	*Betula occidentalis*	BEOC2
Water Sedge	*Carex aquatilis*	CAAQ
Water Smartweed	*Polygonum amphibium*	POAM8
Western Joepye-weed	*Eupatorium occidentale*	AGOC2
Western Meadow-rue	*Thalictrum occidentale*	THOC
Western Wheatgrass	*Pascopyrum smithii*	PASM
Western Yarrow	*Achillea millefolium var. occidentalis*	ACMIO
Wheeler's bluegrass	*Poa wheeleri*	POWH2
Whiplash Willow	*Salix lucida ssp. lasiandra*	SALUL
White Clover	*Trifolium repens*	TRRE3
White Sagebrush	*Artemisia ludoviciana*	ARLU
Whitebark Pine	*Pinus albicaulis*	PIAL
White-stemmed Globe-mallow	*Sphaeralcea munroana*	SPMU2
Winterfat	*Krascheninnikovia lanata*	KRLA2
Wolf's Willow	*Salix wolfii*	SAWO
Wyoming Big Sagebrush	*Artemisia tridentata ssp. wyomingensis*	ARTRW8
Yampa	*Perideridia gairdneri*	PEGA3
Yellow Sweetclover	*Melilotus officinalis*	MEOF
Yellow Willow	*Salix lutea*	SALU2

WILDLIFE SPECIES LIST

Birds

American kestrel (*Falco sparverius*)
Bald eagle (*Haliaeetus leucocephalus*)
Black rosy-finch (*Leucosticte atrata*)
Brewer's sparrow (*Spizella breweri*)
Calliope hummingbird (*Stellula calliope*)
Cassin's finch (*Carpodacus cassinii*)
Chipping sparrow (*Spizella passerina*)
Clark's nutcracker (*Nucifraga Columbiana*)

Cooper's hawk (*Accipiter cooperii*)
Dark-eyed junco (*Junco hyemalis*)
Downy woodpecker (*Picoides pubescens*)
Dusky grouse (*Dendragapus obscures*)
Ferruginous hawk (*Buteo regalis*)
Flammulated owl (*Otus flammeolus*)
Golden eagle (*Aquila chrysaetos*)
Great gray owl (*Strix nebulosa*)
Great horned owl (*Bubo virginianus*)
Greater sage grouse (*Centrocercus urophasianus*)
Green-tailed Towhee (*Pipilo chlorurus*)
Hairy woodpecker (*Picoides villosus*)
House wren (*Troglodytes aedon*)
Hungarian partridge/Gray partridge (*Perdix perdix*)
Lewis' woodpecker (*Melanerpes lewis*)
Loggerhead shrike (*Lanius ludovicianus*)
Long-billed curlew (*Numenius americanus*)
McCown's longspur (*Calcarius mccownii*)
Northern goshawk (*Accipiter gentilis*)
Olive-sided flycatcher (*Contopus cooperi*)
Peregrine falcon (*Falco peregrinus*)
Pine siskin (*Carduelis pinus*)
Ruffed grouse (*Bonasa umbellus*)
Sage sparrow (*Amphispiza belli*)
Sage thrasher (*Oreoscoptes montanus*)
Sharp-shinned hawk (*Accipiter striatus*)
Short-eared owl (*Asio flammeus*)
Swainson's hawk (*Buteo swainsoni*)
Williamson's sapsucker (*Sphyrapicus thyroideus*)
Willow flycatcher (*Empidonax traillii*)
Wilson's phalarope (*Phalaropus tricolor*)

Mammals
American pika (*Ochotona princeps*)
Badger (*Taxidea taxus*)
Beaver (*Castor canadensis*)
Big brown bat (*Eptesicus fuscus*)
Bighorn sheep (*Ovis canadensis*)
Black bear (*Ursus americanus*)
Bobcat (*Lynx rufus*)
Coyote (*Canis latrans*)
Elk (*Cervus elaphus*)
Fringed myotis (*Myotis thysanodes*)
Gray wolf (*Canis lupus*)
Great Basin pocket mouse (*Perognathus parvus*)
Grizzly bear (*Ursus arctos*)

Hoary bat (*Lasiurus cinereus*)
Little brown myotis (*Myotis lucifugus*)
Long-eared myotis (*Myotis evotis*)
Long-legged myotis (*Myotis volans*)
Long-tailed weasel (*Mustela frenata*)
Moose (*Alces alces*)
Mountain goat (*Oreamnos americanus*)
Mountain lion (*Puma concolor*)
Mule deer (*Odocoileus hemionus*)
North American wolverine (*Gulo gulo*)
Pronghorn (*Antilocapra americana*)
Pygmy rabbit (*Brachylagus idahoensis*)
Red fox (*Vulpes vulpes*)
Silver-haired bat (*Lasionycteris noctivagans*)
Townsend's big-eared bat (*Corynorhinus townsendii*)
Western small-footed myotis (*Myotis ciliolabrum*)
White-tailed deer (*Odocoileus virginianus*)

Amphibians and Reptiles
Columbia spotted frog (*Rana luteiventris*)
Western toad (*Bufo boreas*)
Terrestrial gartersnake (*Thamnophis elegans*)
Common gartersnake (*Thamnophis sirtalis*)

Appendix B
Daubenmire Trend Data Summary

Upland Trend Data Summary: Daubenmire Tran

Allotme Alkali Creek
Pasture Jacobs
Study # 15s10w0801 Daubenmire

			POSE (Sandberg Bluegrass)			PHLOX spp			PENST (Penstemon)			Carex spp.			SCIRPUS (Spikerush)			ANTEN (Pussy-toes)			PASM (Western Wheatgrass)			ACMIO (Western Yarrow)		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	88	77	92	11	14							8	1	1	35	1	1	23	2	3	42	2	2			
Aug-03	96	28	92	7	25							50	1	4	23	1	2	39	3	12	50	1	4			
Jun-14	96	43	96	8	19	27	1	2	8	1	1				4	1	1	15	3	6	62	3	6	4	1	1

			KOSHA			POTEN (Cinquefoil)			TAOF (Common Dandelion)			ARCA13 (Silver sagebrush)			VIOLA (Violet)			Misc Forb			ERIOG (Buckwheat)			GUSA2 (Broom Snakeweed)		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79									100	12	16	77	28	37				92	12	15						
Aug-03												85	13	45				65	2	6						
Jun-14			4	1	1	12	1	1	35	1	2	73	25	58	12	1	1				35	2	4	4	1	1

			IRMI (Rocky Mountain Iris)			GETR (Praiirie Smoke)			ASTER			KOMA (Prairie junegrass)			AGTRA		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79			4	1	1				4	1	1	50	3	4	35	3	4
Aug-03												27	1	2			
Jun-14						4	1	1	4	1	1						

Allotme Alkali Creek
Pasture Meadow
Study # 15s11w1203 Daubenmire

			ARTRV (Mountain Big Sagebrush)			ANTEN (Pussy-toes)			ACMIO (Western Yarrow)			CAREX spp			POSE (Sandberg Bluegrass)			ASTER			SCIRPUS (Spikerush)			LECI4 (Basin Wildrye)		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	100	46	23	4	8	8	2	4	35	3	6	73	3	6	69	7	15	4	1	1	50	2	5	8	1	1
Aug-03	100	27	8	2	10	16	3	16	48	2	8	80	3	12	84	4	17				56	3	16	4	1	1
Jun-14	96	31	27	13	41	15	1	1	42	3	8	4	1	1	92	5	17	8	1	1	27	1	2			

	PHLOX spp			GUSA2 (Broom Snakeweed)			ERIOG (Buckwheat)			PASM (Western Wheatgrass)			TAOF (Common Dandelion)			ASTRA (Milkvetch)			PLANTAIN			MISC FORB		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79										65	3	7	54	6	12							88	4	9
Aug-03				12	1	1				32	1	6										88	2	11
Jun-14	4	1	1	15	6	18	12	1	1	23	1	2				8	1	1	58	1	5	4	1	1

	IRMI (Rocky Mountain Iris)			BRASSICA			SPGR?			ERNA (Rubber rabbitrush)			LILE3 (Lewis Flax)		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	12	1	3				85	6	12	42	3	7	27	1	1
Aug-03	8	1	1	12	1	1									
Jun-14	8	1	4												

Allotme Crystal Creek
Pasture West **Daubenmire**
Study # 14s11w2201

			VETCH			PASM (Western Wheatgrass)			PSSP6 (Bluebunch Wheatgrass)			KOMA (Prairie Junegrass)			ANTEN (Pussy-toes)			GUSA2 (broom snakeweed)			CHIVI8 (Green Rabbitbrush)			ARTRV (Mountain Big Sagebrush)		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-80	100	50				60	4	10	80	11	25	8	1	1										24	7	14
Jul-89	100	37				8	1	1	96	9	24	8	1	1	4	1	1				4	1	1	32	8	23
Jul-14	96	31	8	1	1	24	1	2	100	14	45	20	2	5	8	1	1	8	1	1	4	1	1	28	7	24

	ARENA (Sandwort)			ERIG (Erigeron)			POA (Bluegrass)			MISC FORB			PHLOX			LEKI2 (Spike Fescue)			Arar8 (Little sagebrush)		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-80							52	2	4	100	8	16	92	8	17	20	2	4	60	8	17
Jul-89				36	2	5	84	4	11	32	1	2	88	8	21	60	3	7	28	2	5
Jul-14	28	1	2	20	2	5	8	1	1				56	4	14						

Allotme Crystal Creek
Pasture:
Study # 14s11w2301 **Daubenmire**

			PASM (Western Wheatgrass)			PHHO (Spiny Phlox)			FEID (Idaho Fescue)			PSSP6 (Bluebunch Wheatgrass)			KOMA (Prairie Junegrass)			POSE (Sandberg Bluegrass)			ARTRV (Mountain Big Sagebrush)			ARAR8 (little sagebrush)		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-80	96	66	75	2	3	71	5	7	79	5	7	100	28	42	4	1	1	63	2	2	21	1	2	67	14	21
Sep-99	100	51		-		54	4	8	75	9	17							50	7	13	67	20	40			
Jul-14	140	34	20	1	1	48	4	13	12	1	1	60	4	10	40	2	6				92	22	64			

	LEKI2 (Spike Fescue)			Misc. Forb			Carex			ANTEN (Pussy-toes)			CHVI8 (Green rabbitbrush)			Mustard								
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp							
Jul-80	8	1	1	100	9	13				38	2	3													
Sep-99							21	1	2	54	10	20	13	1	1										
Jul-14										12	1	2	12	1	1	12	1	1							

Allotme Crystal Creek
Pasture East
Study # 14s11w2302 Daubenmire

			KOMA (Prairie Junegrass)			FEID (Idaho Fescue)			POSE (Sandberg Bluegrass)			ANTEN (pussy toes)			ACMI (Yarrow)			PASM (Western Wheatgrass)			PSSP6 (Bluebunch Wheatgrass)			ARTRV (Mountain Big			PHLOX		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Aug-80	100	53	20	1	1				68	5	9	100	13	24				4	1	1	92	11	21						
Sep-99	80	61	4	1	1	68	13	21	16	3	5	84	32	52	12	1	1				24	4	7	32	5	8			
Jul-14	80	62				52	9	15	84	17	28	68	11	17	8	1	1	40	2	3	8	1	1				20	1	2

	TAOF (Dandelion)			Misc. Forb			LEKI2 (Spike fescue)			TECA2 (Gray horsebrush)			Astragalus			K-Nick			Erigeron			Silversage		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Aug-80	92	7	14	100	7	13	64	7	13	24	3	5												
Sep-99	4	1	1										4	1	1	4	1	1	52	3	5			
Jul-14				8	1	1							60	4	6				64	4	7	44	12	19

Allotme Dixon Mountain
Study # 13s09w1802 Daubenmire

			PSSP (Bluebunch wheatgrass)			FEID (Idaho Fescue)			POSE (Sandberg Bluegrass)			CHNA (Rubber rabbitbrush)			CAREX spp.			PASM (Western Wheatgrass)			CHVI8 (Green rabbitbrush)			ARTRWY (Wyoming sagebrush)			JUHO2			PENSTEMON		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Aug-81	100	47	96	14	30	88	8	16	60	2	4	12	1	2	84	2	5	8	1	1	8	1	2	16	4	8						
Sep-90	100	36	80	7	20	80	6	17	4	1	1	24	4	10	20	1	1	32	1	2	8	1	2	40	8	23						
Aug-03	96	35	64	2	6	96	14	40	28	1	2	8	1	2				16	1	1				52	12	36						
Aug-14	104	41	12	2	4	96	20	48	24	1	3							16	1	1	8	1	1	20	7	17	4	1	1	4	1	1

	OPPO (plains prickly pear cactus)			ARFR (Fringed sagewort)			KOMA (Prairie Junegrass)			PHLO (phlox)			ANTEN (Pussy-toes)			GUSA (broom snakeweed)			Misc. Forb			CALMON (Planins reedgrass)			ARENA			SEDUM		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Aug-81	8	1	2	28	1	2	12	1	1	72	4	9	16	2	5	52	2	4	80	5	10	32	1	2						
Sep-90	4	1	1	28	1	2				80	5	13	16	1	4	20	1	3	28	1	2	16	1	1						
Aug-03				12	1	1				56	1	4	40	2	7				20	1	1									
Aug-14				20	2	5				20	1	1	48	6	14				4	1	1				16	1	2	4	1	1

Allotme Dixon Mountain
Pasture:
Study # 13s09w3001 Daubenmire

			PSSP6 (Bluebunch wheatgrass)			STICOM (Needle and Thread)			KOMA (Prairie junegrass)			CAREX			PASM (Western Wheatgrass)			Astragalus			POSE (Sandberg Bluegrass)			SPCO (Scarlet globemallow			CIRISIUM (thistle)			ARFR (Fringed sagewort)		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jun-79	100	30	4	1	1	92	15	51				44	1	4	48	1	4	16	1	1	28	1	2	16	1	1						
Aug-03	80	18	40	2	8	88	10	54				8	1	1	32	1	5	12	1	2	16	1	5	4	1	1	20	1	3	44	1	6
Aug-14	104	49	32	2	4	104	29	59							44	5	9	28	2	3	4	1	1	16	1	1	12	1	1	16	1	2

	GUSA (broom snakeweed)			CHNA (Rubber rabbitbrush)			CHVI8 (Green rabbitbrush)			TRDU (Yellow salsify)			ANTEN (Pussy-toes)			BOGR2 (blue gramma)			PHLO (phlox)			Misc. Forb			OPPO (plains prickly pear		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jun-79	56	2	8	8	2	7	8	1	2	16	1	1				4	1	1	32	5	17						
Aug-03	32	1	7										4	1	1	4	1	1	24	1	4	4	1	1	24	1	3
Aug-14	24	3	6				4	1	1										28	1	1	12	1	1	32	5	10

Allotme Dixon Mountain
Pasture:
Study # 13s09w3101 Daubenmire

			PSSP6 (Bluebunch Wheatgrass)			ARTRWY (Wyoming sagebrush)			LECI4 (Basin wildrye)			POSE (Sandberg Bluegrass)			CHNA (Rubber rabbitbrush)			ARFR (Fringed sagewort)			GUSA (broom snakeweed			JUHO2			Penstemon			ARDR (rockcress)		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jun-79	96	38	96	10	27	4	1	2	20	6	15	8	1	1	44	11	30	76	5	13	40	1	3				4	1	1	8	1	1
Aug-03	68	24	96	6	24				12	2	7	32	1	3	28	2	9	44	1	5	36	6	25									
Aug-14	116	35	72	4	11	4	1	1				52	6	22	32	13	38	44	3	9				4	1	1						

	CHVI8 (Green rabbitbrush)			ACMI2 (Western Yarrow)			PHLOX spp.			TAOF (Dandelion)			ANTEN (Pussy-toes)			FEID (Idaho fescue)			MISC. FORBS			Erigeron			ACHY (Indian ricegrass)			Oxytropis		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jun-79	8	1	3	16	1	2				24	1	2										12	1	1	8	1	3	4	1	1
Aug-03	20	2	6	8	1	1	40	2	6				4	1	1	12	1	1	16	1	2	28	1	3	4	1	3			
Aug-14	64	6	18	20	1	3	32	3	10																					

TECA (gray horsebrush)			KOMA (Prairie Junegrass)			STICOM (Needle and Thread)		
Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
			4	1	1			
			8	1	1	20	1	4
4	1	1	4	1	1			

Allotme Four Eyes
Pasture East
Study # 14s10w3501 Daubenmire

			PSSP6 (Bluebunch Wheatgrass)			Cersium (Thistle)			LEKI2 (Spike fescue)			TECA (Gray horsebrush)			ARFR (Fringed sagewort)			Lomatium			ARTR (Wyoming Big Sagebrush)			CHVI (Green Rabbitbrush)			ANRO (Pussytoes)		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	96	48	54	4	12	4	1	1	35	2	6	4	1	4	65	4	10	4	1	1	8	2	6	4	1	1			
Aug-03	100	17	81	5	32				58	3	20	4	1	9	12	1	2				4	1	9						
Aug-14	104	27	76	13	47										20	1	4				8	1	4	16	1	3	8	1	1

	ACHY (Indian ricegrass)			PHHO (Phlox Hoodii)			Penstemon			Erigeron (Daisy)			ASTRAG (Milkvetch)			MISC. FORBS			GUSA (Broom snakeweed			CHNA (Rubber rabbitbrush)			Viola		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	77	5	15	31	2	5	85	5	13	23	1	2	4	1	1	58	4	12	42	2	4	27	3	9			
Aug-03	27	1	4	12	1	2	54	1	8							12	1	2	50	1	8						
Aug-14				52	4	16				28	1	3							12	1	3				24	1	2

	POFR (Shrubby cinquefoil)			Arenaria (sandwort)			BRIN2 (Smooth brome)			CAREX (sedge)			HECO26 (Needle and thread)			ARCA13 (Silver sagebrush)			Aster			Vetch		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	4	1	1	12	1	1																		
Aug-03							4	1	1	4	1	4				12	1	2						
Aug-14				28	1	3	4	1	1				8	1	4	4	1	2	60	2	7	4	1	1

Allotme Indian Creek
Pasture Simpson Creek
Study # 14s12w2503 Daubenmire

			POFR (Shrubby cinquefoil)			JUNBAL(Baltic Rush)			Carex 1			Carex 2			CARNEB (Nebraska Sedge)			Trifolium (Prairie smoke)			Agrostis (Ticklegrass)			CALCAN (Bluejoint reedgrass)		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jun-03	36	61	52	8	13	56	8	13	72	6	9	4	1	1	88	22	36	28	2	3	4	1	1	8	1	1
Aug-14	60	74	88	27	37	64	9	12							88	15	20									

	SALBRA (Short fruit willow)			THAALP (Alpine meadowrue)			Misc Forb #1			Misc Forb #2			Misc. Grass #1			Misc. Grass #2			SALBEB (Bebbs willow)			SAPL2 (Planeleaf willow)		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jun-03	40	6	10	12	1	1	60	5	8	12	1	1	28	3	5	4	1	1						
Aug-14	40	6	8																4	1	1	4	1	1

	ASTER			TAOF (Dandelion)			ANTEN (Pussytoes)			Saxifrage			CAUT		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jun-03															
Aug-14	44	2	3	8	1	1	4	1	1	16	1	1	88	13	17

Allotme Indian Creek
Pasture:
Study # 14s11w1801 Daubenmire

			POSE (poa secunda)			FEID (Idaho Fescue)			PASM (western wheatgrass)			ARTRV (Mountain bigsagebrus			KOMA (prairie junegrass)			ANTEN (Pussytoes)			PHLOX			BESSE (Kittentail)		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Aug-79	100	37	32	1	2	88	21	58	48	1	3	36	4	11	16	1	1	44	4	11	24	5	14			
Aug-14	104	50	52	3	7	96	17	33				60	12	23	12	1	1	80	12	24	12	1	2	8	1	1

	SEDUM (Stonecrop)			Misc. Forbs			ARENARIA (Sandwort)			VETCH			STIPA		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Aug-79															
Aug-14	4	1	1	4	1	1	44	4	8	48	1	2	4	1	1

Allotme Indian Creek
Pasture:
Study # 14s11w1901 Daubenmire

			POSE (Sandberg bluegrass)			FEID (Idaho fescue)			KOMA (prairie junegrass)			Carex spp			ARTRV (Mountain bigsage)			ANRO (pussytoes)			POTEN (Cinquefoil)			PHLO (Pholx)		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Aug-79	100	36	52	2	6	84	13	37	4	1	1	8	1	1	28	4	10	64	9	25	4	1	1	12	1	1
Aug-14	92	55	88	18	33	4	1	1							48	17	31	60	5	9	4	1	1			

	ARENA (Sandw ort)			TAOF (dandelion)			Misc. Forbs			ACMIO (Western Yarrow)			JUNCUS (Rush)			LUPINE			ERIOG (Buckwheat)			ASTER		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Aug-79				20	1	3	72	6	16	20	1	1												
Aug-14				44	4	7	28	1	4	40	2	3	8	1	1	16	2	3	20	1	2	4	1	1

	MEOF (Sweet clover)			VETCH			PASM (Western wheatgrass)					
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Aug-79												
Aug-14	8	1	1	48	2	4	68	2	4			

Allotme Indian Creek
Study # 14s11w1701 Daubenmire

			PSSP6 (Bluebunch Wheatgrass)			FEID (Idaho Fescue)			POSE (poa secunda)			ARTR (mt. big sagebrush)			KOMA (prairie junegrass)			PHLO (longleaf phlox)			ACMIO (Western Yarrow)			Elymus (basin wildrye)			PASM (w estern w heatgrass)		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Aug-79	60	38				76	19	50	48	1	3	36	2	6	28	1	2	16	1	1							4	1	1
Aug-14	128	43	52	2	5	84	12	29	68	7	15	8	1	2	12	1	1	40	4	9				8	1	1			

	GUSA (broom snakeweed)			ANRO (pussytoes)			ARFR (fringed sagewort)			Eriogonum (buckwheat)			Misc. Forbs			Stickseed			Arenaria (sandwort)			Vetch			Aster		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Aug-79				28	2	6	24	1	2	16	1	1							52	10	28						
Aug-14	4	2	3	84	10	24	8	1	1	4	1	1				24	3	8	12	1	1	8	1	1	4	1	1

Allotme Rock Creek Seeding
Pasture:
Study # 15s11w1202 Daubenmire

			POSE (Sandberg bluegrass)			ASTER			KOMA (prairie junegrass)			FEOV (Sheep fescue)			PHLO (Pholx)			ANRO (pussytoes)			ARFR (fringesage)			FEID (Idaho fescue)		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	96	24	73	3	7	19	1	3							46	2	5	12	1	2				92	27	58
Jul-86	50	71	8	1	1				19	1	1	96	62	87	15	1	1	8	1	1	4	1	1			
Jun-14	69	52													15	1	1	12	1	1				115	49	94

	AGSM (Western Wheatgrass)			AGCR (Crested wheatgrass)			CHNA (rubber rabbitbrush)			ARTRWY			ARENA (Sandw ort)			GETR (Praiirie Smoke)			Astragalus			Misc. Forbs		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	54	2	5	38	2	5				23	7	15	4	1	1				8	1	1	12	1	1
Jul-86	23	2	3	4	1	1				15	5	8				4	1	1				4	1	1
Jun-14	4	1	1				4	1	1	12	2	4							4	1	1			

Allotme Muddy Creek
Pasture: Hidden
Study # 13s10w2202 Daubenmire

			PSSP6 (Bluebunch Wheatgrass)			FEID (Idaho Fescue)			POSE (poa secunda)			ARTRV (mt. big sagebrush)			KOMA (prairie junegrass)			PHLO (longleaf phlox)			CHNA (Rubber rabbitbrush)			Carex spp			ERIGERON (Fleabane)		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Aug-83	100	58	69	4	6	100	20	34	4	1	1	50	18	32	23	1	1				4	1	1	27	3	5	12	1	1
Aug-89	100	59	100	5	9	96	15	25	38	1	2	88	21	35				12	1	1	4	1	2	38	2	3	8	1	1
Aug-14	77	64	50	6	9	65	18	28	12	1	1	85	30	47	23	1	1				8	1	2				15	1	1

	POA (bluegrass)			ANRO (pussytoes)			TAOF (dandelion)			Lupine			Misc. Forbs			LECI4 (Basin wildrye)			CHVI (Rabbitbrush)			TECA (gray horsebrush)			ERIOGONUM (Buckwheat)		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Aug-83	12	1	1	69	5	9	23	1	1				46	2	3	8	2	4	35	1	2						
Aug-89	4	1	1	92	9	15	31	1	1				42	1	2	8	2	3	4	1	1	4	1	1	8	1	1
Aug-14				38	3	5				19	1	2				8	1	1	4	1	1				4	1	1

	PENSTEMON			SEDUM			GUSA			Mustard			ACMI (Yarrow)			ZIGAD (Death Camas)		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Aug-83																		
Aug-89	8	1	1	19	1	1												
Aug-14							8	1	1	4	1	1	8	1	1	27	1	2

Allotme Junction
Pasture East
Study # 15s10w0602 Daubenmire

			POSE (Sandberg bluegrass)			ASTER			KOMA (prairie junegrass)			TECA (gray horsebrush)			PHLO (Pholx)			ANRO (pussytoes)			ARFR (fringesage)			CHVI (Rabbitbrush)		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	100	43	92	6	13	35	3	7							50	4	9	4	1	1	77	6	14	12	1	2
Jul-81	100	53	96	7	13	19	1	2	81	41	19	4	1	1	62	7	13	23	1	1	81	10	18	12	1	1
Jun-14	88	32	77	3	9	12	1	1							62	5	15	4	1	2	8	1	1	12	1	2

	AGSM (Western Wheatgrass)			FEID			CHNA (Rubber rabbitbrush)			ELEL (Squirreltail)			ARENA (Sandw ort)			ASTRAG (milkvetch)			TAOF (dandelion)			Misc. Forbs		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	42	3	8	4	1	1	8	1	2	4	1	1	4	1	1	4	1	1	8	1	2	46	2	4
Jul-81	42	3	7				8	1	1	23	2	3										46	1	2
Jun-14	31	1	2	4	1	1										4	1	2						

	Carex spp			ARAR (little sagebrush)			ROCR			AGCR (Crested wheatgrass)			ARTRWY			HOJU (Foxtail barley)			GUSA		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	4	1	1	50	7	17	38	2	5	69	7	16									
Jul-81	15	1	1	42	5	9				42	3	7	8	2	3						
Jun-14										4	1	1	88	19	59	19	1	5	8	1	2

Allotme Junction
Pasture West
Study # 15s11w1201 Daubenmire

			AGCR (Crested wheatgrass)			FEID (Idaho Fescue)			POSE (poa secunda)			ARTRWY (w yoming big sagebrush)			KOMA (prairie junegrass)			Erigeron			TAOF			Carex spp			ARENA (Sandw ort)		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	100	44	81	15	34	46	4	9	92	9	20	4	1	1										4	1	1	19	1	1
Jul-82	100	43	88	17	41	12	1	1	81	5	13	12	1	1										4	1	1	12	1	1
Jun-14	88	25	77	6	23	12	1	1				27	6	23	62	4	17	27	1	3	8	1	1				23	1	2

	ARFR (fringed sagewort)			ANRO (pussytoes)			PHLOX			ASTRAG (milkvetch)			Misc. Forbs			ASTER			PESIR (Mtn. ball cactus)			AGSM (western wheatgrass)		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	62	3	7				35	1	3	85	6	15	12	1	1	15	1	3				50	3	6
Jul-82	73	8	20	15	1	1	27	1	3	58	1	3	31	1	2	4	1	1				62	6	15
Jun-14	42	2	8				65	5	20	8	1	1				4	1	1	4	1	1			

Allotme Porcupine Canyon
Pasture:
Study # 14s11w1501 Daubenmire

			POSE (Sandberg bluegrass)			PSSP6 (Bluebunch Wheatgrass)			KOMA (prairie junegrass)			ARTRWY (wyoming big			AGSM (Western Wheatgrass			ANRO (pussytoes)			FEID (Idaho fescue)			CHVI (Rabbitbrush)		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	104	41	48	1	3	76	8	23	28	1	2	52	10	30	52	2	5	48	7	19	4	1	1	52	2	5
Jul-82	100	23	60	2	4	96	15	32	36	1	3	44	11	23	36	1	2	80	5	10	4	1	1	52	5	11
Aug-03	88	28	48	2	6	80	4	12	76	5	15	64	12	36	24	1	3	60	3	9	28	1	2	32	1	4
Jul-14	68	44	8	1	1	72	6	14	28	1	2	64	23	52	8	2	5	32	1	2	4	1	1	4	1	1

	ASTER			TAOF (dandelion)			ERIGERON (Fleabane)			Misc. Forbs			PHLOX			CASTI (paintbrush)			LEPTOD			TECA (gray horsebrush)		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79				16	1	1							36	2	5	4	1	1	12	1	2	4	1	1
Jul-82	4	1	1	52	2	4	4	1	1				40	1	2				20	2	3	4	1	1
Aug-03							4	1	1				72	4	11				4	1	1	4	1	1
Jul-14													68	7	16							8	1	3

	ASTRAG (milkvetch)			Misc. Forb			CHNA (rubber rabbitbrush)			GILIA			GUSA (broom snakeweed)		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	8	1	1				8	1	1						
Jul-82	32	1	3	16	1	2									
Aug-03	4	1	1							12	1	1			
Jul-14	16	1	1										8	1	1

Allotme Porcupine Canyon
Study # 14s11w2101 Daubenmire

			PSSP6 (Bluebunch Wheatgrass)			FEID (Idaho Fescue)			POSE (poa secunda)			ARTRWY (wy. big sagebrush)			KOMA (prairie junegrass)			PHLOX			AGSM (Western Wheat)			Carex spp			OXYTROPIS		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	80	55	56	5	10	68	13	24	36	1	2	64	17	32				48	3	6	24	1	1	4	1	1			
Jul-89	92	63	56	2	4	96	22	35	68	4	6	44	13	20				76	3	5	72	2	3				92	3	5
Aug-03	100	35	52	2	7	100	16	46							16	1	1	56	2	3	24	1	2	4	1	1			
Jul-14	96	42	76	13	32	84	10	24	8	1	1	52	9	22	24	1	3												

	Arenaria (Sandwort)			ANRO (pussytoes)			TAOF (dandelion)			Lupine			Misc. Forbs			TECA (gray horsebrush)			GETR (Prairie smoke)			Astragalus (milkvetch)			ERIGERON		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	4	1	1	36	6	11	4	1	1	20	6	11				8	1	1				56	1	3			
Jul-89	56	2	3	84	11	18				4	1	1	8	1	1	8	1	1									
Aug-03				48	2	5										4	1	1				28	1	2	8	1	1
Jul-14	16	1	1	40	1	2										8	1	1	4	1	1				28	2	4

Allotme Rio Puerco
Study # 13s10w3302 Daubenmire

			PSSP6 (Bluebunch Wheatgrass)			FEID (Idaho Fescue)			POSE (poa secunda)			ARTRWY (wy. big sagebrush)			KOMA (prairie junegrass)			PHLOX			AGSM (Western Wheat)			ARFR (fringed sagewort)			CHNA (rubber rabbitbrush)			STICOM		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	100	37	100	10	27				24	1	2							96	20	54	8	1	1	32	1	4	28	3	7			
Aug-03	100	27	100	16	59	16	1	2							8	1	1	96	5	20				36	1	3	16	1	3			
Aug-14	104	48	96	19	39	4	1	1	32	1	2	40	4	8				96	12	26				24	1	2	20	3	6	16	3	7

	Arenaria (Sandwort)			CAREX			TAOF (dandelion)			OPPO (prickly pear cactus)			Misc. Forbs			OXYTROPIS			ERIOG (buckwheat)			Astragalus (milkvetch)			ERIGERON			CASTI		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	20	1	1				4	1	1	4	1	1	36	1	4							8	1	1	4	1	1			
Aug-03	8	1	1										44	1	4	28	1	3							52	1	5			
Aug-14	20	1	1	4	1	1													16	1	1	8	1	1	56	3	7	4	1	1

Allotme Rio Puerco
Study # 14s10w0401 Daubenmire

			PSSP6 (Bluebunch Wheatgrass)			FEID (Idaho Fescue)			POSE (poa secunda)			ARTRWY (wy. big sagebrush)			KOMA (prairie junegrass)			PHLOX			AGSM (Western Wheat)			Carex spp			ORTHOC (owl clover)					
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp			
Jul-79	96	41	68	7	17	4	1	1	36	1	2	68	16	39				56	2	12	56	2	5	20	1	2	##	10	24			
Aug-03	96	19	56	4	20				20	1	3	48	8	45	4	1	3	36	1	5	36	1	5	44	2	11	4	1	1			
Jul-14	56	65	52	9	13				36	2	3	60	30	47				44	2	3							12	1	1			

	Arenaria (Sandwort)			ARFR (fringed sagewort)			TAOF (dandelion)			ASTER			Misc. Forbs			STICOM (needle and thread)			ACHY (indian ricegrass)			CHVI (green rabbitbrush)			ERIOG (buckwheat)		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79				16	2	4	4	1	1																		
Aug-03	4	1	1	12	1	2				4	1	1	40	1	5												
Jul-14				4	1	1				8	1	1				84	9	14	64	4	6	4	1	1	52	9	13

Allotme Rio Puerco
Study # 14s10w1401 Daubenmire

			PSSP6 (Bluebunch Wheatgrass)			ACMI (Yarrow)			POSE (poa secunda)			ARTRWY (wy. big sagebrush)			ARFR (Fringed sagewort)			PHLOX			AGSM (Western Wheat)			ASTER			CHNA (rubber rabbitbrush)		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	92	43	64	9	21				44	1	3	60	21	49	16	1	2	68	5	12	48	2	4				16	1	2
Aug-03	96	22	64	5	21	4	1	1	60	2	7	36	6	26	56	2	11	84	5	24	32	1	4				8	1	3
Jul-14	104	41	88	12	30				40	2	4	64	9	23	28	1	3	84	13	33				8	1	1			

	CHVI (green rabbitbrush)			ANRO (pussytoes)			Hedgehog cactus			GUSA (broom snakeweed)			Astragalus (milkvetch)														
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	4	1	1							28	1	3	20	1	2												
Aug-03				4	1	1				20	2	7															
Jul-14	28	2	4	16	1	2	4	1	1				4	1	1												

Allotme Whitworth
Study # 14s10w2201 Daubenmire

			PSSP6 (Bluebunch Wheatgrass)			FEID (Idaho Fescue)			POSE (poa secunda)			ARTRWY (wy. big sagebrush)			KOMA (prairie junegrass)			PHLOX			CHNA (rubber rabbitbrush)			CASTI (paintbrush)			ACMI (Yarrow)			ARFR (Fringed sagewort)		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	100	49	72	4	9	68	10	21	52	5	10	32	7	14	24	1	1	60	6	12	4	3	5	28	2	5	36	1	2	4	1	1
Aug-14	100	23	76	11	18	96	13	23	40	2	3	36	6	10				80	18	31	4	1	1	4	1	1	24	1	1	12	1	1

	Arenaria (Sandwort)			ANRO (pussytoes)			TAOF (dandelion)			SENE (groundsel)			ERIOG (buckwheat)			TECA (gray horsebrush)			GUSA (broom snakeweed			Astragalus (milkvetch)			ARDR (rockcress)			LOMAT (bisquitroot)		
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	20	1	1	52	5	11	4	1	1	4	1	1	4	1	1	4	1	1	8	1	1	64	3	6	4	1	1			
Aug-14	20	1	1										60	2	3							40	1	2				12	1	1

Allotment: Whitworth
Study # 14s10w2202 Daubenmire

			PSSP6 (Bluebunch Wheatgrass)			BRTE (cheatgrass)			POSE (poa secunda)			ARTRTR (basin big sagebrush)			ARFR (fringed sagewort)			Unknown grass			AGSM (Western Wheat)			ELEL5 (squirreltail)			CHNA (rubber rabbitbrush)		
Date	BG Freq	% Total Canopy	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	88	45	20	3	6				44	4	8	80	26	59	4	1	1				20	2	5	52	6	14	36	3	6
Jul-86	72	58	40	7	12	4	1	1	68	9	15	92	27	46							28	4	6	36	6	10	4	1	1
Aug-03	32	21	56	5	20	4	1	2	28	2	8	56	12	44				16	3	12				24	2	8			

	STICOM (needle and thread)			GUSA (broom snakeweed)			CHVI (green rabbitbrush)			Misc. Forb			Goldenrod			LECI4 (basin wildrye)											
Date	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp	Freq	Can	Comp
Jul-79	4	1	1				12	1	1	8	1	1															
Jul-86	8	1	1				8	1	1	4	1	1	8	1	1	12	4	7									
Aug-03				4	1	1				4	1	1															

Appendix C- Livestock Grazing Tools Available to Improve Resource Conditions

Rangeland health standards have been assessed on all 900,000 acres of BLM administered lands in the Dillon Field Office (DFO) on a ten year adaptive management schedule since 2002. Nearly all (>90%) of the uplands in the DFO met the BLM Upland standard signifying that AUMs authorized by BLM (stocking densities) are appropriate for most allotments across the field office. There are about 860 miles of streams and 854 separate stream reaches identified by BLM in the field office. Of these 854 reaches, about half met the BLM riparian health standard while about half failed to meet this standard. This failure to meet the BLM riparian health standard is typically due to the grazing period or length of time livestock are allowed access to the riparian area (Marlow 1991). Generally, livestock stocking density or AUMs authorized by BLM on an allotment is **not** the most important parameter affecting riparian health.

Upland health standards on BLM allotments are highly dependent on the stocking density or stocking rate for the allotment. A stocking density or rate that is not in concert with the carrying capacity of the allotment will result in the allotment not meeting the Upland Health Standard. This is true for all allotments across the DFO. However, riparian systems are usually much more dynamic than uplands (USDI, 1998). Riparian health is dependent on a variety of key grazing attributes including Duration, Timing, Intensity and Frequency. These four terms have corresponding terms that the Society for Range Management calls: **Grazing Period** (the length of time that livestock are grazed on a specific area), **Seasonal Grazing** (Grazing restricted to a specific season or time of year), **Stocking Density** (Number of animals per unit area expressed as AUM/ac), and **Frequency** (Number of repeat grazing events in a pasture). Three other important grazing factors are: **Palatability of Forage**, **Availability of Off-Stream Watering Sources** and **Class of Animal** (Age and/or sex-group of a kind of animal).

Grazing Period or Duration - The most critical aspect in any grazing plan for the protection of riparian areas is the Grazing Period or length of time cattle have access to a particular stream reach (Marlow 1991). Myers (1989) after reviewing 34 allotments in southwestern Montana, concluded, "Duration in grazing treatments becomes a key factor in determining the severity of damage". He added that cattle have a tendency to gather at riparian areas and spend a considerable amount of time in the riparian area even when they are not feeding. Cattle spend a disproportionate amount of time in the riparian area and tend to over-utilize the forage that grows there (Clary and Webster 1989). This attrition to riparian areas by a small herd or a large herd of cattle has an important bearing on riparian management and its connection to Grazing Period

duration and Stocking Density. Due to social factors associated with cattle dominance around a riparian area and the limited availability of space in the riparian area, it is understood that doubling the number of livestock in a pasture with a riparian area does not equate to doubling the grazing use in the riparian area. A relatively smaller number of livestock will usually graze the riparian area close to the same degree as a large number of livestock during the same period of use. Therefore, decreasing the **Grazing Period** and increasing the **Stocking Density** in a pasture with riparian will generally benefit riparian conditions by reducing the use in the riparian area even when the same number of AUMs are grazed. This strategy of a reduced duration in a riparian pasture and an increased stocking density will improve the riparian system.

Frequency or Number of Grazing Events- Frequency is simply the number of occurrences of a grazing event during a specified period of time or incorporation of non-grazing (rest) of an area of grazing land ranging from a few days to a full year or more. To fully understand frequency, there must be a time frame associated with the frequency of the given event. Historically, the term "rest" referred to non-grazing for a full year along with foregoing grazing on that year's complete forage crop, but the term now is commonly used to include any period of non-grazing. Thus, rest must be carefully described and interpreted in order to be meaningful. The length of time of prescribed rest will be highly dependent on site specific conditions and objectives for each riparian system. Repeat grazing events during the year are important when dealing with plant health. Plants must have time to recover from a grazing event to properly replenish lost photosynthetic material and recharge energy reserves. The time it takes for this recovery is highly dependent on the growth stage the cool-season plant is in when defoliated and the season of defoliation. Defoliation during the early stages of plant growth in the spring was formerly presumed to be the most detrimental time to graze a cool-season plant (Stoddart 1946). Later research has shown that late growing season grazing is the most critical period to negatively impact perennial forage plants, and adequate time away from grazing during this period is necessary to replenish energy reserves and for bud development (Vallentine 1990). Furthermore, grazing during any time of the plants growing season and then repeat grazing during the same growing season without allowing adequate plant recovery away from grazing will reduce plant health. The greater the frequency of grazing events, the more damage to plants that will occur. Even more detrimental to riparian plant health is when frequency increases during a specific calendar year and this scenario is continued for multiple consecutive years. Recovery of channel morphology or browse species in a riparian system will generally require longer periods of rest within a specified timeframe than recovery of herbaceous riparian vegetation.

Seasonal Grazing – Another key attribute in meeting riparian health standards is **Seasonal Grazing** or grazing during a specific time of year. Clipping studies have indicated that timing

can greatly affect plant productivity and vigor (Miller and Donart 1981). Seasonal Grazing is simply changing the time or season of the year when the riparian pasture is grazed. During periods of hotter temperatures, July to September, livestock will congregate considerably more around riparian areas to decrease body temperatures and to forage on green vegetation that is only available near the water. This could result in an over-used riparian. Continual grazing during the plant's growth period will eventually cause roots to die and the plant to lose vigor and reproductive capacity (USDI, BLM 1998). By simply changing nothing but the seasonal grazing period from summer to fall, spring or winter grazing, the riparian area can improve and may meet BLM standards for riparian areas. The grazing seasons are generally divided into three seasons (USDI, BLM 1998).

Early Season (spring) Use - Early Spring grazing (April 1 to July 15) in riparian areas may improve a riparian system for a variety of reasons as listed below.

1) Livestock may be attracted to succulent vegetation in the uplands and will not loiter in the riparian areas as much compared to other seasons of the year.

2) Cool temperatures may discourage cows from staying in the riparian or weather is not as harsh in the uplands. Hot temperatures experienced during the hottest months may force cattle into the riparian areas

3) Soil in the riparian area may be wet as to discourage cows from entering

4) Well drained soils reduce the possibility of compaction

Late Season (fall) Grazing Use- Late Season (July 15 to October 31) grazing in riparian areas may improve a riparian system but livestock affinity for browse species later in fall may be a concern. Benefits of late season grazing are listed below.

1) Soils are drying during this period which reduces the probability of compaction and bank trampling

2) Most plants have completed their life cycle and removing plant material by grazing will not adversely affect plant development and health compared to Grazing during April to July.

3) Ground nesting birds that nest in riparian areas are not negatively impacted

Winter Use – Winter use (November 1 to March 31) usually has the least impact to the health of riparian systems.

1) Soil compaction is typically not an issue due to frozen soils

2) Most plants have completed their life cycle and removing plant material by grazing will not adversely affect plant development and health compared to Grazing during April to July.

3) Livestock distribution should improve due animals need for water is lessoned

Palatability- Livestock palatability is simply an animal's desire or ability to consume a particular plant species or plant part (Kothmann 2008). Palatability is tied closely with the life cycle of a particular grass plant species (Raleigh and Wallace 1965). Palatability becomes important to riparian and upland management when producers are determining a livestock rotation that will benefit a riparian or upland system. In general, livestock palatability or the closely tied digestibility of a cool-season perennial rangeland grass is high from growth initiation in spring (April/May) and continues being relatively high until the grass sets its seeds in mid to late summer (Raleigh and Wallace 1965). Palatability decreases after seed set and continues to decline into the dormancy period in late summer and into fall. This low palatability continues until the following spring when growth initiation begins.

In a similar timing scenario, negative impacts to cool-season rangeland plants caused by a grazing herbivore removing photosynthetic material are much more pronounced during a period when palatability is high. However, herbivory by livestock has little impact to plants when palatability is low. When determining a grazing plan that improves conditions in riparian or upland pastures, management should focus on grazing cattle in pastures that need improvement during periods when the plant growth cycle is completed and palatability is low.

The dates and terms used in the Seasonal Grazing heading listed above generally correspond to both palatability and the life cycle of a cool-season rangeland plant. Early spring grazing (April 1 to July 15) is when the plant is completing its life cycle and it is most palatable to livestock. During this period, plants are most vulnerable to excessive grazing by livestock (Laycock 1970). Late season grazing (July 16 to November 1) is after rangeland plant's life cycle is completed and when palatability is low. Grazing during this period has little impact on rangeland plant health if grazing is not extreme (Cook 1971, Laycock 1970). Winter grazing is also after the plant's life cycle is completed and when palatability is lowest. Grazing during this period has little impact on plant health but excessive grazing may lead to increased erosion and a loss of topsoil (Heady 1984).

Stocking Density –Stocking density is simply the number of animals in a given area. As Myers (1989) and Marlow (1991) stated, length of time is the most important factor when determining the amount of use a riparian area will receive. However, stocking density is important. It is fundamentally understood that if a given number of AUMs are be grazed in a riparian pasture, it

is most beneficial for the riparian area to graze the largest number of animals for the shortest period of time to harvest the given number of AUMs. This assumption is valid only when strictly dealing with riparian resource health and does not factor important economic and logistical factors such as livestock performance, breeding performance, health of the livestock, logistics of moving livestock, etc.

Class of animal – Class of animal is an important consideration when trying to improve a riparian area that has failed standards. A livestock operation that grazes cows and their calves will typically have a livestock herd that travels less and has poorer grazing distribution in the pasture compared to a yearling cattle operation. Yearling or younger cattle will usually spend less time in the riparian area and more time exploring the entire pasture which has the potential to improve riparian conditions and get better use of your upland vegetation.

Off-Stream Watering Locations- Developing ways to influence the amount of time livestock spend in the riparian area is a critical part of proper riparian management (USDI, BLM 1998). The development of alternative clean water sources may lure livestock out of the riparian areas. Livestock usually prefer clean water provided in a livestock trough rather than a riparian area, especially during periods outside the hot summer months (July to September). By developing an alternative water system, livestock can improve distribution in the pastures with riparian present and lessen the impact of livestock in the riparian areas.

Other Tools to Improve Riparian Areas- There are other options that may be effective in improving a riparian system, yet each one by itself will not change a non-function riparian system into a health riparian.

Hardened crossings – Hardened crossings are graveled or rocked areas that allow cattle to cross creeks or streams without adding excessive sediment to the stream or compacting soils is this area. Cattle often prefer to use these areas if constructed properly and will travel less on the riparian area that isn't hardened.

Watering Access Point- Sometimes, riparian streams are fenced off from livestock use for protection. However, providing a watering location from the stream is still needed to water the remainder of the pasture. Creating a watering access point off the creek using rock or gravel can allow livestock to water without negatively impacting riparian condition or increasing sediment in the stream. The goal is to construct an access point that allows livestock to water but encourages them to leave quickly and to avoid creating an area where livestock are able to loiter.

Riding Cattle Out of Riparian Areas- Riding is increasingly being used as a method to move livestock out of riparian areas (Storch 1979). Proper riding can be an effective tool to improve riparian areas but the quality and quantity of the riding will correspond to the benefits that area derived in improving the riparian area.

Drift Fences- In hilly topography, livestock are likely to use the riparian area and sometimes the stream bed itself as a corridor to travel to and from lower and higher elevations. A strategically placed drift fence can interrupt this habitual corridor and reduce pressure on the riparian area.

Riparian Pasture- As stated by Marlow and Myers above, length of time is the most critical factor when determining whether or not a riparian will meet BLM standards. Increasing the number of pastures by constructing a grazed riparian pasture may give an operator more flexibility to graze pastures with higher stocking densities but for shorter durations.

Pasture Divisions- In a similar fashion to Riparian pastures, dividing an existing pasture may provide more flexibility in the producers operation and result in grazing a pasture with riparian for a shorter period of time which will likely improve riparian condition.

Salt and Mineral Placement- Although these alone may not solve a riparian problem, they can improve livestock distribution and reduce the time cattle spend in the riparian area.

In conclusion, the length of time livestock are allowed access to a riparian area is the paramount grazing parameter that determines the health of the system. However, many other tools mentioned above may help to reach the goals for the livestock operation and to meet the desired natural resource condition. In summary, there is no single, let alone simple solution for how to graze livestock in riparian areas where both ecologic and economic goals are desired. Ultimately, what is required is an on-the-ground review of the site specific circumstances by resource professionals (livestock producers and land managers) and a carefully considered prescription developed to address the unique conditions and desired objectives of the parties involved (Anderson 1993, Buchhouse and Elmore 1993).

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