Bighorn National Forest Plan Revision
Existing Condition Assessment

Shell Creek

Geographic Area Assessment

1999 Picture of Shell Falls

Shell Geographic Area Existing Condition Assessment for Forest Plan Revision

Appendix: Maps

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I. Preface

This is one of nine geographic area existing condition assessments that will be used in the Bighorn Forest Plan Revision to describe resources at the geographic area scale and how they relate to the existing Forest Plan. A map of the Forest Plan revision geographic areas is in the appendix. A similar assessment will be done at the Forest-wide scale, and will include numerous resources/topics:

- that are not amenable to analysis at the geographic area scale. For example, most wildlife species are not bound by geographic area boundaries, and to avoid needless repetition in the assessments, such topics will only be discussed at the Forest scale.
- where data bases are not complete or where analysis is still on going at the time the geographic area scale assessments are completed. Examples in this category are fire condition classes and timber suitability, which are expected to be completed by early 2002.

This existing condition geographic area assessment includes the portions of the Shell Creek watershed that occurs on the Bighorn National Forest, unless noted otherwise.

There is very little information in this assessment concerning other than National Forest System land. This information will be gathered and analyzed, where appropriate, in the draft and final environmental impact statements' effects analyses.

These existing condition assessments focus on the physical and biological resources, and in some cases, human uses and resources, such as timber harvest, grazing and recreation. There will be a social and economic section in the Forest-wide existing condition assessment, and the draft and final environmental impact statements will also include the work of the social and economic analyses, which are currently being compiled by the University of Wyoming.

Despite the fact that these assessments primarily focus on the environmental effects of human uses, it must be remembered that National Forests are managed *to be used* by people. This is implicit in the laws governing National Forest management[1]. Human use of the National Forests has been directed administratively since the earliest days of the Forest Service, "This force has two chief duties: to protect the reserves against fire, and to assist the people in their use."[2] That tradition continues to this day in the "Caring for the land and serving people" mission. While these assessments focus on the environmental effects that people are having on the resource, the point is to make sure that the uses we enjoy today are sustainable so that our children and grandchildren can continue to use and enjoy the Bighorn National Forest.

Disclaimer for GIS generated data: The Forest Service uses the most current and complete data available. GIS data and product accuracy may vary. They may be: developed from sources of differing accuracy, accurate only at certain scales, based on modeling or interpretation, incomplete while being created or revised, etc. Using GIS products for purposes other than those for which they were created, may yield inaccurate or misleading results. The Forest Service reserves the right to correct, update, modify or replace GIS products without notification. The GIS data in these documents were generated using ArcInfo 7.2.1, operating on a Unix platform, with analysis occurring between August of 2001 and January of 2002. For more information, contact the Bighorn National Forest.

[1] The Multiple Use Sustained Yield Act of 1960, the Renewable Resources Planning Act, and the National Forest Management Act, just to name a few.
[2] Forest Service "Use Book" of 1905.

II. Forest Plan

Table 1. Existing Forest Plan Management Area Allocations

Forest Plan Prescriptions	Prescription Description	GIS Acres with 9A Riparian Applied	
		Acres	%
1B	Existing and Potential Winter Sports Sites	663	0.5%
2A	Semi-Primitive Motorized Recreation Opportunities	8592	6.1%
2B	Rural and Roaded Natural Recreation Opportunities	4199	3.0%
3A	Semi-Primitive Nonmotorized Recreation Opportunities	5431	3.9%
4B	Wildlife Habitat Management for Management Indicator Species	22284	15.9%
4D	Aspen Stand Management	183	0.1%
5A	Wildlife Winter Range in Non-Forested Areas	9848	7.0%
6A	Livestock Grazing, Improve Forage Condition	12306	8.8%
6B	Livestock Grazing, Maintain Forage Condition	40014	28.6%
7E	Wood Fiber Production	1316	0.9%
1.11	Pristine Wilderness (17,607 including the 9A)	16243	11.6%
1.13	Semi-Primitive Wilderness (7030 including the 9A)	5774	4.1%
9A	Riparian and Aquatic Ecosystem Management	12570	9.0%
10A	Research Natural Area	551	0.4%
Total		139,974	
Non-FS		157	

Some interpretations from Table 1 include:

- Grazing prescriptions, 6A and 6B, are the largest allocation in this geographic area, comprising about 37% of the geographic area.
- The next highest allocations are for 4B, Wildlife Habitat, and Wilderness, at just under 16% each.
- Less than 1% of the geographic area is allocated to 7E, wood fiber production, which is the smallest amount of any of the Forest Plan scale geographic areas.

What is broken and needs to be fixed in the Forest Plan?

- MIS species selection, modeling (elk habitat), and monitoring provisions.
- Riparian and Aspen communities forage utilization standards and guidelines.
- Road Density standards/guidelines need incorporated for elk security habitat.
- "C" Area provision for off road vehicle travel needs removed. Closure of big game winter ranges to motorized vehicles.
- Past monitoring has indicated a need to revise the standard/guideline regarding old growth.
- Vacant allotments need consideration for bighorn sheep reintroduction.
- Fences rebuilt/constructed need to have wildlife passage considered.

What are the issues in this geographic area?

- Unique rock/cave features provide habitat for bats, etc. Potential MIS/Focal species.
- Riparian/Aspen conditions are of concern primarily due to ungulate browsing. Beaver at reduced levels and may be potential MIS/Focal.
- Road densities may constitute concern for elk security habitat.
- Big game winter range occurs in the geographic area. Elk transitional range particularly occurs.
- Bighorn sheep potential habitat, currently occupied though possibly not sustainable.
- Potential sage grouse summer habitat use due to leks near Forest. Potential peregrine falcon nesting due to recovery efforts (hacking) in area.

III. Disturbance Factors

Riparian

Disturbance influences upon riparian areas and riparian vegetation are discussed in the forest-wide assessment.

Fire

- Fire is the most dominant disturbance factor in this landscape, from the perspective of total number of acres affected. A very small percentage of fires affect a majority of the acres burned.
- The historic fire database only shows one fire of about 3000 acres that occurred in the 1930s in the upper reaches of Cedar Creek; the name is not listed in the database.
- FE Town lists two large fires that occurred in 1898. One began in Shell Canyon and burned about 10,000 acres near the divide, and another burned in Bear, Alkali, Beaver and Shell Creeks, and totaled about 12,000 acres.
- Fire's role is different among the major forest cover types of Douglas-fir, Lodgepole pine and Engelmann Spruce/Subalpine Fir. These are described in more detail in Meyer and Knight (2001), and will be summarized in the forest-wide assessment.
    - While little is known quantitatively about the role of fire in Bighorn Douglas-fir forests, the bark usually has at least 4-inch deep furrows, which is indicative of a frequent surface fire regime. It is also likely that Douglas-fir had infrequent catastrophic fire, so this fire regime can be described as mixed severity, moderately frequent.
    - The lodgepole and spruce/fir forests are typified by infrequent (100-300+ year), large scale, catastrophic fire, as evidenced by research from Yellowstone National Park and elsewhere in the Northern Rockies (Lotan, 1985).

Timber Harvest and Other Disturbance

Table 2 shows the amount of timber harvest and other disturbances since the 1960s. This data is from the RIS database, unless otherwise noted, and is not considered accurate prior to 1960. Some known blowdown events (Ranger Creek and Willet Creek) are not included in this table.

Table 2. Timber Harvest and Fires in the Shell Analysis Area

Harvest Type	1940's	1950's	1960's	1970's	1980's	1990's	2000
Clearcut	293	33	9	39	0	0	0
Shelterwood: Prep Cut	0	0	3	358	0	0	0
Shelterwood: Seed Cut	0	0	0	0	0	0	0
Shelterwood: Overstory Removal	0	0	0	0	0	0	0
Seed Tree	0	0	0	0	0	0	0
Selection	0	0	0	0	0	0	0
Commercial Thin	0	0	0	0	0	0	0
Sanitation/Salvage	0	0	0	0	0	0	0
Pre-commercial Thin	0	0	0	0	0	0	0
Aspen Clearcut	0	0	0	0	0	0	0
Fire[3]	0	0	0	0	0	0	0
Blowdown	0	0	0	0	0	0	0

[3] This data is from the historic fire record, which shows three approximately 250 acre fires.

Some of the insights from table 3 are:

- This geographic area has had very little timber harvest.
- Very little of it is roaded for timber harvest.
- Only 0.2% of the forested area received a final harvest" (clearcut, shelterwood removal or seed cut, selection, fire or blowdown) between 1960 and 2000, which ranks 10th out of 10 geographic areas on the forest for most timber harvest during that period.

Tinker, et al, 1998 quantifies fragmentation caused by timber harvest and roads on the Bighorn National Forest. That analysis and conclusions are presented in the Forest wide portion of the Forest Plan Revision existing condition assessment, rather than in each geographic area discussion.

Figure 1 shows the relative amounts of suited timber by geographic area. Shell has the lowest percentage of forested area that is currently classified as suitable for timber harvest, at approximately 10%. This table could be considered an indicator of the relative amount of forested area *available* for timber productions purposes.

Figure 1. Amount of Forested Area Available That is Suited Timber, by Geographic Area

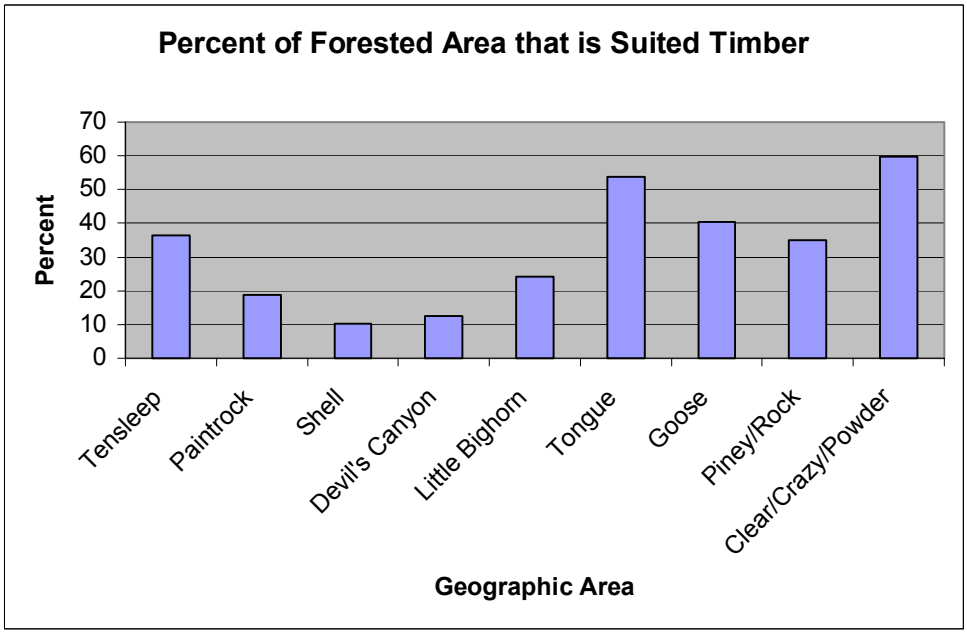


Figure 2 shows the percentage of the suited timber area that has received a final harvest (clearcut, shelterwood removal or seed cut, selection harvests) or stand-replacing fire or blowdown between 1960 and 2000. This is an indicator of the *intensity* of forest successional change, as it indicates how much of the suited land has actually had a stand-replacing event between 1960 and 2000. This is from the RIS activity database and includes the time between January 1, 1960 and February 1, 2000. Each bar is divided into "fire and blowdown" and "timber harvest" to show the relative amounts of each type of disturbance.

Figure 3 shows the percentage of all forested lands that has received a final harvest (clearcut, shelterwood removal or seed cut, selection harvests) or stand-replacing fire or blowdown between 1960 and 2000. This is an indicator of the *intensity* of forest successional change, as it indicates how much of the forested area has actually had a stand-replacing event between 1960 and 2000. This is from the RIS activity database and includes the time between January 1, 1960 and February 1, 2000. Each bar is divided into "fire and blowdown" and "timber harvest" to show the relative amounts of each type of disturbance.

Figure 2. Percent of Suited Timber that Received a Stand Replacing Event, 1960-2000

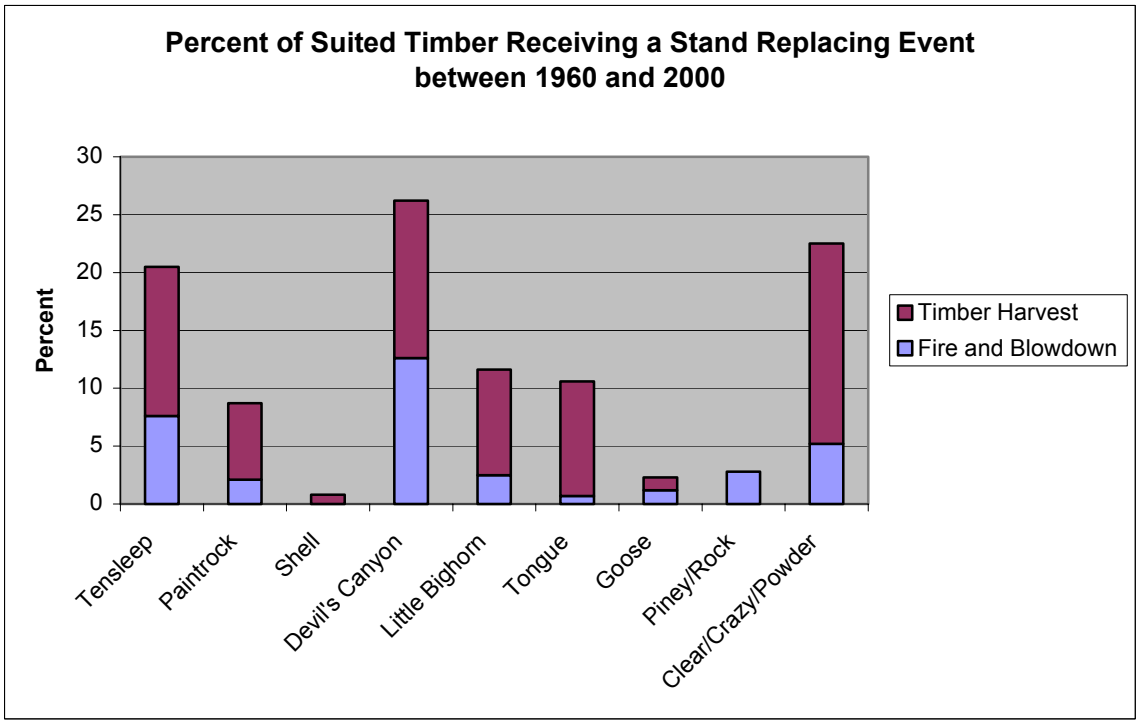
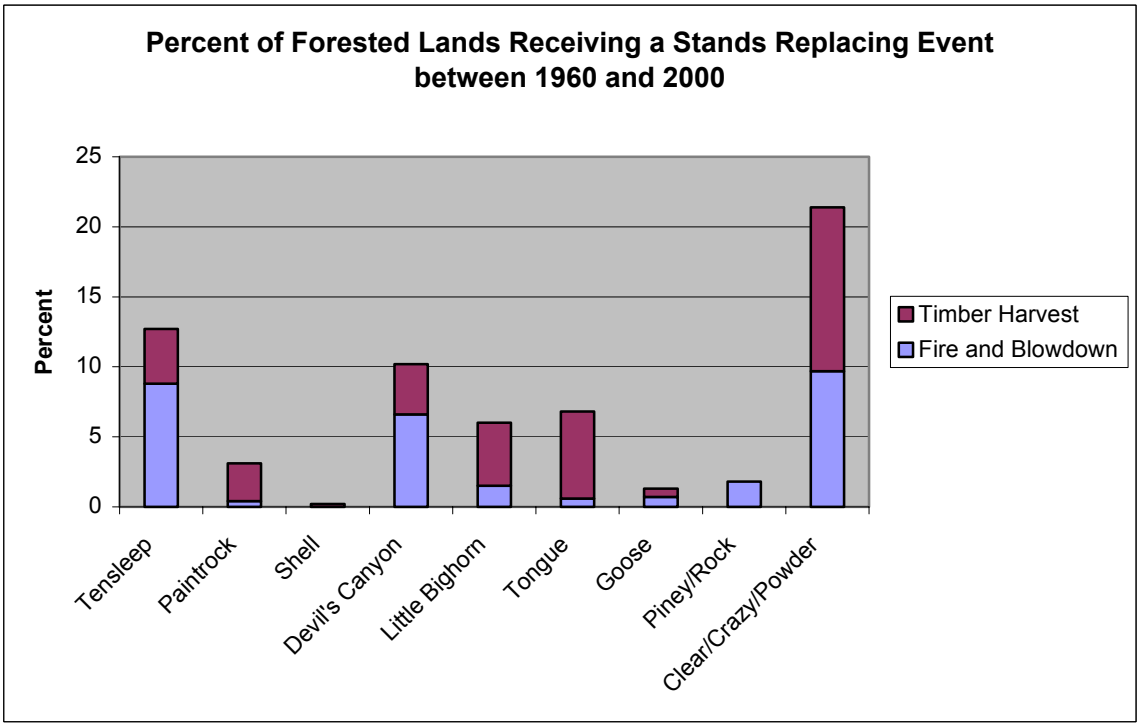


Figure 3. Percent of All Forested Lands that Received a Stand Replacing Event, 1960-2000



Exotic Species

The following species are known to exist in the Shell geographic area, and other exotic species may exist:

- Forest-wide issue of non-native grass/forb seed mix for revegetation and erosion control.
- Fish
- Canadian thistle, musk thistle, whitetop, and Russian Knapweed are the known weed species in the Shell geographic area.

IV. Geology and Geomorphology

Table 3 shows the Landtype Associations (LTAs) within the assessment area. Landtype associations are general descriptions of local geology and topography[4]. A map of the LTAs is in the appendix. A discussion on the geology of this area will be covered in the Forest-wide assessment.

Table 3. Acres of Landtypes within Shell Geographic Area

Landtype Description	Acres	% of total
Glacial cirquelands	1,548	1
Alpine mountain slopes and ridges	19,686	14
Glacial/tertiary terrace deposits	5,147	4
Granitic mountain slopes, gentle	19,438	14
Granitic mountain slopes, steep	1,375	1
Granitic breaklands	3,788	3
Sedimentary breaklands	31,718	23
Sedimentary mountain slopes, limestone/dolomite	36,041	26
Sedimentary mountain slopes, shale/sandstone	7,423	5
Landslide colluvial deposits	13,965	10
Totals	**140,129**	**101%**

Geologic Hazards

The landslide map used in this analysis were created from 1:24,000 scale maps obtained from the Wyoming State Geological Survey office in Laramie, WY. Within the Shell geographic area there are 25,737 acres of soils prone to landslides. The areas subject to slides are widely distributed in small units throughout the geographic area.

Table 4. Landslide Prone Acres

Geographic Area Name	Acres of Soils Prone to Landslides
Shell Geographic Area	25,737

Erodibility

There are approximately 2,447 acres of soils within the analysis area classified as having a severe risk for erosion. Ground disturbing activities on these soils would increase the risk of generating erosion from these areas.

Table 5. Acres of Erodible Geology

Geographic Area Name	Acres of Erodible Geology
Shell Geographic Area	2,447

[4] Landtype associations are groupings of landtypes or subdivisions of subsections based upon similarities in geomorphic process, geologic rock types, soil complexes, stream types, lakes, wetlands, and plant association vegetation communities. Names are often derived from geomorphic history and vegetation community. Avers, et al, 1993. See also Table 3, Chapter 1, for hierarchical location of landtype associations.

Mineral resources

A detailed minerals report for this area does not exist at this time. Minerals information for this area will be incorporated into the Forest-wide assessment.

V. Soils and Topography

Table 6 displays the soils types that occur in the Shell Creek geographic area ant the amount of the analysis area comprised of each soil type. A description of the soil type can be found in the project file. Forage production is provided to indicate the productivity of each soil within the analysis area (Nesser 1976).

Table 6. Acres of Soils within Geographic Area

Soil Identification Number	Acres	Productivity as Measured by Forage Production (#/acre)
10	7842	500-700
11	2679	500-700
12	1112	600-800
13	309	Na
14	20780	500-700
15	0	500-1,800
16	1669	3,000-3,500
17	5022	1,500-1,800
18	472	1,500-1,800
19 A and B	3176	500-700
20	3833	600-800
22	0	1,200-1,700
24	642	1,600-2,400
25	5878	1,500-1,800
26	3930	600-1700
27	15871	1,600-2,400
28	277	1,200-1,700
29	4746	1,600-2,400
30	4440	1,600-2,400
31	3965	500-700
32	11326	500-700
33	7929	600-800
36	0	500-800
37	0	Na
38	0	500-700
39	0	600-1,700
40	0	500-700
41 A and B	0	1,500-1,800
43	0	500-700
Water	276	Na

Erosional processes

This topic is relevant at the Forest-scale and is discussed in the Forest-wide assessment.

Range of variability in soil conditions

This topic is relevant at the Forest-scale and is discussed in the Forest-wide assessment.

Risk to soil resources including soil loss or compaction

This topic is relevant at the Forest-scale and is discussed in the Forest-wide assessment.

VI. Hydrology and Water Quality

Table 7 shows the main 6th field watersheds in the Shell Creek drainage. Each 7th level sub-watershed in the Shell Creek basin is discussed separately. The information on each watershed was collected during the Shell Creek Allotment Management Plan revision in 1999.

Table 7. 6th Field Watershed Data within Shell Planning Area

6th Field Watershed Name	6th Field Watershed Number	Perennial Stream Miles	Intermittent Stream Miles	FS WS Acres	Other WS Acres	Total WS Acres
Shell Creek at Shell Reservoir	100800100101	57	91	37,616	0	37,616
Shell Creek in Shell Canyon	100800100102	69	146	53,872	2	53,874
White Creek	100800100103	0	8	1,645	155	1,800
Trapper Creek	100800100104	14	10	6,073	0	6,073
Horse Creek	100800100105	22	25	11,005	0	11,005
Beaver Creek	100800100106	13	117	27,120	0	27,120
Shell Creek at Shell	100800100107	0	17	2,580	0	2,580
Bear Creek	100800100204	0	1	219	0	219
Totals:		**175**	**415**	**140,130**	**157**	**140,287**

Granite Creek Watershed
The Granite Creek watershed is a major tributary to Shell Creek. This watershed is comprised of Granite Creek and its unnamed tributaries and Salt Creek.

Riparian Areas / Wetlands - During the summer of 1998, the IDT and field crew inventoried riparian conditions at three locations (see project file for locations).

Stream Channels - The channels in the Granite Creek watershed are primarily steep (slope > 4%) with narrow valleys. There is approximately 1.5 miles of channel that have a lower gradient and wide floodplain. These areas have much higher sensitivities to grazing pressure and the resulting effects on the channel banks. The Antelope Butte ski area is located within the Granite Creek watershed. There are compounding effects on the stream and riparian areas where recreational use and grazing have combined to adversely affect the stream channel. Based on assessment of key stream reaches within the Granite Creek drainage, there are 1.5 miles of stream that support fish where fish habitat is "sensitive" to disturbances. Rosgen stream channel types C, E, F, and G, generally depict areas that are sensitive to disturbances. Valley segments with low stream gradients typically have streambanks consisting of fine-grain sediments. These low gradient reaches have the potential to provide excellent fish habitat in the form of lateral scour pools and undercut streambanks. The health of these components depends in part on the health of the riparian vegetation.

The stream reach at the base of the ski hill and downstream is classified as C and G type channels. Ski area development, heavy livestock use, roads, and public use of the riparian area have impacted the condition of the fish habitat. In contrast to the stream reaches that are considered to be sensitive to livestock grazing, there are 5.3 miles of stream that are inherently resistant to the impacts of livestock grazing due to the amount of large rock material in the streambed and streambank as well as the lack of forage adjacent to the streambank. These are typically A, B, stream channel types with higher stream gradients where the fish habitat components are formed as a function of woody debris in the stream channel, and by boulder and rubble scour pools within the channel.

Water Quality - In 1998, there were two T-WALK inventories conducted (see project file for data and locations). These inventories suggest that timbered reaches have less impact and are retaining their natural form and function. This is contrasted with reaches lacking tree cover, where bank damage and sedimentation are much more evident. Water quality within the basin as a whole is expected to be adequate, however reaches lacking natural stability and providing easy cattle access may have less than adequate water quality.

The State of Wyoming has listed Granite Creek on the 303(d) monitoring list. This suggests that Granite Creek may be impaired but actual designation will be withheld until further data analysis is conducted.

Fisheries - Based on electrofishing evaluations conducted by the Forest Service and Wyoming Game and Fish Department between 1979 and 1996, brook and rainbow trout occupy 6.8 miles of stream in the drainage. The extent of fish distribution and populations are depicted in Table 8.

Table 8. Fish population estimates for the Granite Creek Watershed

Stream	Date	Location	BKT/mile (Avg Length)	BKT/mile> 6 in (Avg Length)	RBT/mile (Avg Length)	RBT/ mile > 6in (Avg Length)
Granite Creek	8/96	R88W, T54N, Sect 31 NW, 1/4 mile above ski lift, above road crossing.	1349(5.2)	316(6.7)	na	na
Granite Creek	8/96	R89W, T53N, Sect 15NE, Picnic Area above Hwy. 14.	30(7.4)	30(7.4)	1086(7.2)	905(7.6)
North Granite Creek	8/96	R89W, T53N, Sect 2 NW, Above Confluence with Granite Creek.	84(4.9)	17(6.5)	67(5.7)	17(8.0)

*Fish Species Code: BKT - Brook Trout, RBT - Rainbow Trout

Recent sampling (1996) has documented strong populations of brook trout in the upper sections of Granite Creek, upstream of the ski area. Lower Granite Creek and North Granite contain naturally reproducing populations of both rainbow and brook trout. Although the central Bighorn Mountains fall within the historic range of Yellowstone cutthroat trout (Varley and Gresswell, 1988), there is no evidence that native populations exist in the analysis area. Stocking records indicate that brook, brown, and rainbow trout were stocked in the Shell drainage in the 1930's and 1940's. If native Yellowstone cutthroat were present in the drainage, competition from these introduced species may have led to their decline.

The WGFD has rated Granite Creek as a class 3 trout stream (an important trout water and a fisheries of regional importance). The WGFD trout stream classification uses various characteristics to calculate a value for a stream's aesthetics, availability, and productivity. These values are then weighted and combined to determine a stream's classification. Based on the survey information, fish numbers varied as a function of stream size, channel type, amount and condition of the habitat, and the inherent natural productivity of the stream.

Shell Creek and its upper tributaries including Granite Creek have the lowest natural productivity of waters in the Bighorn Mountains. The streams flow primarily through the Precambrian granitic core of the Bighorn Mountains. Logically, cold temperatures, short growing seasons, shallow streams,

high densities, and the relatively low productivity of the granitic watersheds are all factors that could limit the maximum size fish attain in these streams.

Shell Creek (mainstem)
This discussion covers the conditions along the mainstem of Shell Creek from Brindle Creek at the lower end of the analysis area up to Buckley Creek near the top.

Riparian Areas / Wetlands - During the summer of 1998, one PFC survey was conducted on the main stem of Shell Creek (see project file for data and location). This survey showed that at this location, the stream and its riparian area were being maintained in a proper functioning condition. This reach is nearly a mile long, so there is considerable local variability within the reach. The channel type is C3. Bank trampling affects up to 30% of the bank length in some segments, and much less in others. Drying of riparian areas is evident in some segments by the invasion of sage into some willow communities and the presence of upland vegetation at the waters edge in other segments.

Stream Channels - The main stem from Brindle Creek to just above Grouse Creek is estimated to be a Rosgen 'F' stream type. This stream type is typically a response to downcutting and is subject to bank scour and trampling. The stream types above Grouse Creek up to Buckley Creek are predominately a Rosgen 'B' stream type. These stream types are typically more resistent to bank disturbance and less likely to show adverse effects of grazing.
Surveys done in 1998 show that in the T-WALK location the channel is a fast flowing stream with large banks and high velocities. Impacts are generally away from the main channel. Some cattle trailing along the stream was noted, however most of the channel is too steep for easy cow access. The stream bed consisted mainly of large cobbles and boulders.

Water Quality - In 1998, a T-WALK survey was done in a reach just above Ruble Creek (see project file for data and location). The data suggests that there is minimal impact to the main stem of Shell Creek where physical access by cattle is limited. Banks are stable and well vegetated, channels consist of large material, and biologic production is good. Overall, where the main stem of Shell Creek is timbered and steep, the water quality is considered adequate.

Fisheries - The upper Shell Creek drainage includes mainly coldwater trout streams that originate in the central Bighorn Mountains. Shell Creek begins on the Bighorn National Forest at an elevation of 10,170 feet and flows westerly to its confluence with the Bighorn River. Based on electrofishing evaluations conducted by the Forest Service and WGFD between 1979 and 1997, brook and rainbow trout occupy 11.4 miles of stream in the analysis area. Recent sampling (1996-1997) has documented fair populations of brook trout in the upper section of Shell Creek. Shell creek above Shell Falls contains naturally reproducing populations of both rainbow and brook trout. Although Shell Creek falls within the historic range of Yellowstone cutthroat trout (Varley and Gresswell, 1988) and this species has been found in other portions of the drainage, there is no evidence that native populations exist in the analysis area today. The extent of fish distribution and populations are depicted in Table 9.

Table 9. Fish population estimates for the Shell Creek Watershed

Stream	Date	Location	BKT/mile (Avg Length)	BKT/mile> 6 in (Avg Length)	RBT/mile (Avg Length)	RBT/ mile > 6in (Avg Length)
Shell Creek	9/83	R87 T53 S36	754	na	175	na
Shell Creek	9/85	R89 T53 S23	289	na	3362	na
Shell Creek	7/96	R87 T52 S6 SW1/4	739(6.1)	458(6.7)	na	na
Shell Creek	7/97	R88 T53 S19 SW	89(6.2)	56(7.0)	380(6.9)	302(7.4)

*Fish Species Code: BKT - Brook Trout, RBT - Rainbow Trout

The WGFD has rated Shell Creek as a class 3 trout stream (an important trout water and a fisheries of regional importance). Shell Creek and its upper tributaries are the lowest productivity waters in the Bighorn Mountains. Based on the survey information, fish numbers varied as a function of stream size, channel type, amount and condition of the habitat, and the inherent natural productivity of the stream.

Shell Creek is characterized by relatively steep channel gradients and limited productivity. Although trout densities are relatively low for long stream reaches, large deep pools are found throughout the reach, which provide good habitat and fishing opportunities. Habitats in portions of the upper Shell drainage are in excellent condition, due to remote access and minimal human use of the area. Livestock grazing is the biggest impact to selected segments of the drainage.

Willett Watershed

The Willett Creek watershed is a major tributary to Shell Creek. This watershed is comprised of Willett creek and its tributaries including Klondike Creek and Johnie Creek. The watershed is located in the Salt Creek and Shell Creek Allotments.

Riparian Areas/Wetlands -
Willett Creek: We surveyed the reach at Willett meadow, within the exclosure. The reach was rated as FAR, with an upward trend. This reach is recovering from severe overgrazing. Riparian vegetation is reestablishing, but some banks are still bare. Floodplains exist in some segments, but are still building in others.

Klondike Creek: Please note that Klondike Creek is a local name. The Forest map indicates that the stream is an unnamed tributary to Willett Creek. We surveyed two stream reaches. The lower reach was at the old Mail crossing. The upper was the steeper stream reach above the crossing. The lower reach was rated as FAR. Concerns included lack of age class diversity and low vigor of riparian vegetation, insufficient bank vegetation at some raw banks, accelerated lateral stream movement and evidence that the stream was not capable of transporting the sediment supplied to the channel, as exhibited by large, unvegetated point bars. The upper reach was rated as PFC. Few concerns noted were that the channel had slightly incised in some sections, and that Woodchuck Pass road was contributing to sediment loading.

Johnie Creek: Please note that Johnie Creek is a local name. The Forest map indicates that the stream is an unnamed tributary to Willett Creek. This tributary to Willett Creek is directly west and parallel to Klondike Creek. Two reaches were delineated, based on distinct changes in riparian vegetation. The lower reach was rated as PFC. When we visited the site on Aug 18, 1998, the

water level was only 2-4 inches below the bankfull level. The frequent floodplain is hundreds of feet wide with the water table nearly at the ground surface. We noted no concerns except that hoof compaction may be slightly reducing the extent of riparian vegetation at the edge of the marsh.

Drier site conditions were evident at the upper stream reach by the change from a sedge-dominated community to a willow sedge community. The upper reach was rated as FAR, with an upward trend. Concerns included channel widening at livestock crossings, accelerated erosion at the outside of some bends caused by trampling, and evidence of some channel incision in the past.

Stream Channels

Willett Creek: Within the exclosure, the channel has had some rehabilitation work performed on it. High vertical banks were graded back, and downed trees were positioned laterally along the streambanks to provide bank stability and to trap sediment. Of greater concern is that in some locations, the channel straightened as it downcut. Straightening increases channel slope and stream power. This can put additional stress on recovering banks and inadequate floodplains.

Klondike Creek: We surveyed two stream reaches. The lower reach was at the old Mail crossing. The upper was the steeper stream reach above the crossing. While there was still enough flood prone width in the lower site to classify the channel type as an 'E' channel, there was evidence that the channel had incised enough to reduce the width of the riparian area by as much as 400 feet. There was also evidence of extensive historic bank damage, particularly in the lower part of the reach. The upper reach does not fit neatly into a Rosgen stream classification. It exhibits the slope, sinuosity, particle size, and width/depth characteristics of an A2, but it is only slightly entrenched.

Johnie Creek: This tributary to Willett Creek is directly west and parallel to Klondike Creek. The lower reach is a classic 'E4' channel, very deep and narrow with extremely tortuous meanders running though a sedge marsh.

Water Quality - In 1998, there was one T-Walk inventory conducted at the lower end of Willett creek just upstream from the confluence.

Fisheries - Based on electrofishing evaluations conducted by Forest Service and WGFD between 1991 and 1997, brook trout occupy 10.5 miles of stream in the watershed. The extent of fish distribution and populations are depicted in table 10.

Table 10. Fish population estimates in the Willett Creek Watershed

Stream	Date	Location	BKT/mile (Avg Length)	BKT/mile> 6 in (Avg Length)	RBT/mile (Avg Length)	RBT/ mile > 6in (Avg Length)
Willett Ck	9/91	R88 T53 S21NW	7825	na	na	na
Willett Ck	7/96	R88 T53 S21	1350(5.9)	708(6.8)	na	na
Johnie Ck	8/96	R88 T53 S10NE	1506(4.9)	430(6.5)	na	na

*Fish Species Code: BKT - Brook Trout, RBT - Rainbow Trout

The fish fauna of this watershed consists primarily of brook trout. The streams are managed as wild fisheries and support good natural reproduction with an abundance of young-of-the- year and yearling brook trout. Based on stream channel type and IRI data, within the watershed there are

approximately 3.6 miles of stream that support fish where fish habitat is "sensitive" to damage by livestock grazing. The condition of habitat on selected stream reaches within "sensitive to disturbance " areas was found to vary from good to poor as measured by PFC, IRI, T-Walk and Riparian Classification. These evaluations showed that sensitive stream reaches, where they have been consistently grazed year after year, have noticeable grazing impacts on isolated sections and subsequent bank instability has resulted in bank erosion, sedimentation and channel widening.

Moraine Watershed

Moraine Creek is a major tributary to Willett Creek. This watershed is located in the Shell Creek and Shell Basin Allotments and includes Buckskin Ed Creek.

Riparian Areas/Wetlands - Four reaches were surveyed along Moraine Creek. There are a series of large meadows along the creek interspersed with steeper, forested reaches. We performed PFC ratings at the lower, third, fourth and upper meadows, counting up from the confluence with Shell Creek.

The reach in the lower meadow is a transitional channel, recovering from past impacts. The reach was rated as low FAR, with an upward trend. We listed the following concerns: The floodplain is discontinuous, and is non-existent in 'F' and 'G' segments. Hydraulic geometry (sinuosity, width/depth ratio, gradient, etc.) and rate of lateral stream movement is not in balance with the landscape in this channel in transition. Raw banks are subject to erosion and trampling damage. In areas where there is no floodplain, there is insufficient energy dissipation during high flows. Sediment is being produced in excess of the streams capacity to transport it, as evidenced by advancing, unvegetated bars in 'C' segments.

We rated the third Moraine Creek meadow as low FAR, with an upward trend. The riparian area has narrowed considerably and is now confined to the recovering areas adjacent to the stream channel. It was once much wider. Streamside vegetation is discontinuous, and inadequate to protect banks and dissipate energy in some locations.

The fourth meadow is locally known as Flitner Meadow. The reach was rated as FAR, with an upward trend. We noted two concerns; the new narrowed floodplain is not as effective at dispersing energy as the abandoned, wider floodplain, and sediment inputs from upstream reaches are greater than can be effectively transported through the reach.

The upper meadow is an E4-C4 complex that has neared complete recovery from past disturbance. The reach was rated at the low end of PFC. One member of the IDT noted that five years ago, nearly the entire stream reach was an 'F' channel, with no floodplain and with nearly continuous raw, vertical banks. This would indicate that the current grazing and monitoring is providing for recovery.

Buckskin Ed Creek: This is a local name for an unnamed tributary to Moraine Creek, which joins Moraine Creek in Flitner Meadow. We surveyed two reaches. The lower reach is located in Flitner Meadow, above the confluence with Moraine Creek. We rated this reach as nonfunctional (NF). Not much riparian vegetation remains and most banks are bare, but the little that does exist is composed of sedge species that may provide a base for recovery.

The upper stream reach near the Buckskin Ed mine has a vegetation community that is dominated by low seral species that indicate that the riparian area is drying, and there is a high incidence of forbs. The riparian plants that are present are largely composed of young age classes. This reach was rated as FAR, with an upward trend.

Stream Channels - Four reaches were surveyed along Moraine Creek. There are a series of large meadows along the creek interspersed with steeper, forested reaches. We performed PFC ratings at the lower, third, fourth, and upper meadows, counting up from the confluence with Shell Creek. The reach in the lower meadow is a transitional channel, recovering from past impacts. The stream channel was probably originally an 'E4' channel. Due to channel incision, the reach is now a complex of 'F4', 'G4', and 'C4' stream types. The 'C' channel types occur in areas where recovery is progressing and a floodplain is developing. With proper management, the channel may return to an 'E4' type within the incision.

We rated the third Moraine Creek meadow as low FAR, with an upward trend. The stream channel through this reach is also downcut. However, the downcut is deeper than in the lower two meadows, with a depth of 4-6 feet. The stream type is a 'F 4-5', 'G 4-5' complex. Few segments have recovered to 'C4'. Excessive sedimentation has largely buried stream gravels and has caused accelerated bar formation. The fourth meadow is locally known as Flitner Meadow. This stream reach is also a recovering downcut channel. Downcut depth averaged 1-2 feet. This reach has progressed further in recovery than have the lower meadows. Channel type is predominantly C4-5, recovering from F4-5. Recovery is occurring with establishment of a new floodplain within the channel incision.

The upper meadow is an E4-C4 complex that has neared complete recovery from past disturbance. The past downcut was to a depth of 0.5-1 foot, but did not downcut nearly to the depth of the lower reaches. Some very large point bars show that high sediment loads are still a concern. While recovery is advanced, the channel is very sensitive to disturbance from grazing.

Buckskin Ed Creek: This is a local name for an unnamed tributary to Moraine Creek, which joins Moraine Creek in Flitner Meadow. We surveyed two reaches. The lower reach is located in Flitner Meadow, above the confluence with Moraine Creek. We rated this reach as nonfunctional (NF). The lower reach can be divided into three segments. The lower segment is downcut 1-6 feet. The upper segment is downcut 6-8 feet. The upper and lower segments are separated by a remnant 'E' channel. However a four foot headcut is progressing upstream from the lower down cut reach and remains of the 'E' channel with it. The channel type in the incised reaches is 'F4'. Recovery is occurring, but very slowly.

The IDT discussed one option to speed recovery. Several old abandoned channels traverse the meadow at the old floodplain level. It may be possible to divert the stream into one of these old channels, which would circumvent the need for the existing channel to erode tons and tons of streambank material to establish a new floodplain within the downcut channel. Several concerns would have to be addressed for such a diversion to be successful. The old channels are partially filled and may have inadequate capacity in places to carry streamflow. It may be possible to restore capacity with shovels. It may also be worthwhile to explore the possibility of creating a diversion on the creek that would be capable of diverting variable amounts of flow. Small amounts of water could then be directed down the new channels. By slowly increasing the flow, capacity could be naturally restored by the flow without the undesirable effects of rapid adjustment. Another concern is that the new confluence where flow would reenter the existing channel of Buckskin Ed Creek or Moraine Creek would have to be carefully selected so that elevations matched. Creating a confluence at one of the existing downcut segments may create conditions for a headcut, which would then progress back up the new channel.

The upper reach is located near the old cabin at the Buckskin Ed mine. The upper stream reach near the Buckskin Ed mine is a complex of A2 and B3 stream types. Large rock and boulders provide primary bank stability. This stream reach is relatively stable and physically functional.

Water Quality - In 1997 a T-WALK survey was done in a reach just downstream of the crossing at trail 817. Variables measured indicated a Tarzwell substrate rating of 21.2. Tarzwell substrate ratings are a means of quantifying stream substrates and their relative productivity potential for macroinvertebrates and fish. The Tarzwell value obtained is at the lower end of the spectrum, and reflects sand bedloads that have been transported from the upper portions of the watershed. The particle size distribution plot for the site is a smooth sigmoid curve with slightly elevated levels of sand and very fine gravel. Local widening and damage has occurred at the trail crossing. The crossing may contribute to multiple channels immediately downstream. Sand and gravel is infilled in some places, and deposited on point bars as splays.

Fisheries - Recent sampling has documented strong populations of brook trout in Moraine Creek. Based on the survey information, brook trout occupy the entire 5.2 miles of this stream. Fish composition and estimated abundances are summarized in Table 11.

Table 11. Fish population estimates for the Moraine Creek Watershed

Stream	Date	Location	BKT/mile (Avg Length)	BKT/mile> 6 in (Avg Length)	RBT/mile (Avg Length)	RBT/ mile > 6in (Avg Length)
Moraine Ck	10/91	R88 T53 S24	2806	na	na	na
Moraine Ck	10/91	R88 T53 S23	3651	na	na	na
Moraine Ck	7/96	R88 T53 S21NE	1553(5.7)	718(6.6)	na	na

*Fish Species Code: BKT - Brook Trout, RBT - Rainbow Trout

The WGFD has rated Moraine Creek as a class 3 trout stream (an important trout water and a fisheries of regional importance. The stream supports good natural reproduction of brook trout and is managed as a wild fishery. Based on stream channel type and IRI data, within the watershed, there are approximately 2 miles of stream that support fish where fish habitat is "sensitive" to damage by livestock grazing. The condition of habitat on the lower, third and fourth meadows, counting up from the confluence with Shell Creek, was found to vary from fair to poor. Evaluations showed that sensitive stream reaches have noticeable grazing impacts on isolated sections and subsequent bank instability has resulted in bank erosion, sedimentation and channel widening. The upper meadow has a narrower, deeper channel with a noticeable increase in quality pools and overwintering habitat and a good population of adult brook trout, providing quality sport fishing opportunities.

It should be noted that an unnamed tributary to Moraine Ck. (Flitner meadows) has downcut up to six feet through soft sediments to reach a new equilibrium. It also appears that the deposition in this reach and meadow reaches on Moraine and Willett Creeks was a function of past beaver activity. Loss of beaver populations and eventual loss of the dams, which functioned as check dams/nick points in the stream system, resulted in this downcutting during high water events. Grazing on the immediate riparian areas adjacent to these streams has resulted in degradation of the shrub communities. Therefore, little beaver habitat potential remains. Without beaver, the fishery is below its potential productivity.

The streamside shrub community is important from the aspect of formation of lateral scour pools and stable undercut streambanks, reducing the loss of fish habitat during high intensity / low frequency flood events, and providing forage for beaver. Beaver can affect the formation and maintenance of certain stream channel types, vegetation communities, and therefore the formation of quality fish habitat. Current grazing practices have resulted in an improvement of aquatic habitat in Moraine Creek over the past few years.

Shell Tributaries

These watersheds are located in the Salt and Shell Creek Allotments and flow directly into Shell Creek. Cabin, Ruble, Antelope, and Ranger Creeks are small perennial/intermittent tributaries to Shell Creek and are not large contributors to downstream watershed conditions.

Riparian Areas/Wetlands - During the summer of 1998, the IDT did not collect PFC or riparian classification within these watersheds. Based on past knowledge and IRI data the riparian areas, for the most part, are very narrow along these streams and were not subject to disturbance by grazing.

Stream Channels - The IRI data for these streams suggest that the channels in these watersheds are very steep (slope > 10%) and are comprised of coarse alluvium. These channels are generally resistant to grazing impacts due to their inaccessibility, armored banks and confined valleys.

Water Quality - During the summer of 1998, T-WALK data was collected only on Cabin Creek. However, the stream was dry from June to September (see project file for data and location). Based on past knowledge and experience in the area, there is minimal impact to these tributaries of Shell Creek where physical access by cattle is limited. Banks are stable and well vegetated, channels consist of large material, and biologic production is good. Overall, where stream channels are timbered and steep, the water quality is considered adequate.

Fisheries - Due to the intermittent nature of these streams they are rated by WGFD as class 4 and 5 trout streams and are generally unsuitable for supporting fish populations. However, these streams do influence water quality to a downstream fishery.

Mail/McKinnon Watershed

Riparian Areas/Wetlands -
Mail Creek: The IDT examined three reaches along Mail Creek. The upper meadow, a long stringer meadow below the glacial moraine at the bottom of the upper meadow, and a lower reach, which is located along the second meadow, above the boundary between the Shell Creek and Shell Basin allotments.

In the upper meadow, the riparian width varies from zero feet along the unrecovered downcut, to 50 feet along the E channel remnant. It appears that the riparian zone has permanently narrowed. The reach was rated as on the line between FAR and NF. We noted concerns with the following: Floodplain is developing or non-existent for much of the reach. Vegetation lacks age class diversity, vigor, and is not composed of species that will provide bank stability or of species that are indicative of high soil moisture.

The stream reach below the moraine is a moderate gradient, B2-G2 complex. The team noted concerns with age class diversity and vigor of riparian vegetation. The reach was rated as PFC.

The lower Mail Creek reach was rated as NF. Raw, unvegetated, or failing banks are frequent. Where there is some floodplain development, sedges are establishing. The rest of the streamside zone is occupied by grass and forbs.

McKinnon Creek: IRI data for this stream suggests that the riparian width is very narrow and vegetation consists of a conifer canopy. The stream is resistant to grazing impacts due to the armored banks and narrow valley.

Stream Channels - *Mail Creek*: The IDT examined three reaches along Mail Creek, the upper meadow, a long stringer meadow below the glacial moraine at the bottom of the upper meadow. The lower reach was located along the second meadow above the boundary between the Shell Creek and Shell Basin allotments.

The stream reach through the upper meadow is downcut. The channel is a complex of C-E-F-G, 4-5 stream types. There is a remnant of E4 channel approximately 250 yards above the moraine. Below the E remnant, channel type is primarily C and F. Above the remnant, the type alternates from F to G, depending on width/depth ratio. Some of the channel narrowing appears to be caused by bank failure resulting from undercutting and trampling. The stream channel does not have hydraulic geometry characteristic of a stable channel. Lateral stream movement is accelerated and the stream is not in balance with the water and sediment supplied to it.

The stream reach below the moraine is a moderate gradient, B2-G2 complex. Where the channel is entrenched (the G2 channel type), it appears that it is a natural occurrence. Large rock and boulders provide bank stability. However, a strong bimodal particle size distribution of boulders and sand show the effects of the heavy sediment load delivered from upstream.

The lower Mail Creek reach was rated as NF. The stream is deeply incised to a depth of 4-6 feet. Channel type is primarily F5 and G5, with some segments beginning to recover toward C4.

McKinnon Creek - The IRI data suggests that the channel in this stream is fairly steep (slope > 4%) and is comprised of glacial bed materials. These channel types are generally less sensitive to disturbance.

Water Quality - In 1997 a T-Walk inventory was conducted in lower Mail Creek downstream from the bridge crossing on trail 057. Sand and very fine gravel are moderately abundant (8 percent finer than 2mm, 15 percent finer than 4mm). Medium and coarse gravels are scarce. The sediment supply appears to be high. The trail crossing is by far the sandiest spot in the reach, and the banks there are trampled. The State of Wyoming has listed Mail Creek on the 303(d) monitoring list. This suggests that Mail Creek may be impaired but actual designation will be withheld until further data analysis is conducted.

Fisheries - Based on electrofishing evaluations done between 1991 and 1996, brook trout and rainbow trout occupy 5 miles of stream in Mail Creek. A fish population and habitat inventory was conducted on McKinnon Creek in August of 1996. The lower end of the station was located at the confluence with Shell Creek. Population estimates suggest that the reach contains primarily brook trout with rainbow trout occurring down near the confluence. Fish population estimates for selected sites on Mail and McKinnon Creeks are depicted in Table 12.

Table 12. Fish population estimates from the Mail and McKinnon Creek watersheds

Stream	Date	Location	BKT/mile (Avg Length)	BKT/mile> 6 in (Avg Length)	RBT/mile (Avg Length)	RBT/ mile > 6in (Avg Length)
Mail Ck	10/91	R88 T53 S27	643	na	191	na
Mail Ck	8/96	R88 T53 S28NE	1036(5.7)	588(6.7)	259(7.0)	207(7.7)
McKinnon Ck	8/96	R88 T53 S29NE	517(4.8)	136(6.6)	54(6.7)	54(6.7)

*Fish Species Code: BKT - Brook Trout, RBT - Rainbow Trout

The WGFD has rated Mail Creek as a class 3 trout stream (an important trout water and a fisheries of regional importance). The stream supports natural reproduction of brook and rainbow trout and is managed as a wild fishery. Based on stream channel type and IRI data, within the watershed, there are approximately 1.7 miles of stream that support fish where fish habitat is "sensitive" to damage by livestock grazing. In the upper and lower meadows of Mail Creek, livestock grazing contributes to degraded habitat conditions for the fishery. However, aquatic habitat in the upper meadow has improved over the last few years.

McKinnon Creek is characterized by a high gradient V-shaped valley with long riffles interspersed with a few pools. The average channel width is 13.6 ft. with an average depth of .5 ft. Dominant substrate is gravel, some boulders with a mix of cobbles and sand. Trout spawning index is high with plenty of gravel pockets. Trout cover is abundant in the form of undercuts and woody debris. Streambank condition is excellent with very little erosion and well vegetated with forbs and conifers. This is an important nursery stream and provides critical spawning habitat for fish populations in Shell Creek.

Adelaide Watershed

This watershed is a tributary to Shell Creek and is located in the Shell creek and Shell Basin Allotments. Standing water within the drainage includes Arden, Dollar, and Adelaide Lakes. Adelaide Lake serves as an irrigation supply reservoir.

Riparian Areas/Wetlands - During the summer of 1998, the IDT did not collect PFC or riparian classification within this watershed.

Stream Channels - The IRI data for this portion of the watershed suggests that 1.7 mile of this 3.4 mile stream are high gradient (> 4.0) , type A, Aa, and B stream channels. These stream types are typically more resistent to bank disturbance and less likely to show adverse effects of grazing. Approximately 1.7 mile of the reach consists of C, E, and G channel types with gradients between 1.5 and 3.9 %. These channels have a lower gradient and wide floodplains and are more sensitive to grazing pressure and the resulting effects on the channel banks.

Water quality - A T-Walk inventory was conducted in 1998 approximately 1/2 mile downstream from the dam on Adelaide lake. Field evidence suggests that the portion below Adelaide Lake is being adversely affected by releases from the dam. Field crew notes indicate scouring and bank erosion above what would be expected. The downstream effects of the dam should be further evaluated.

Fisheries - The most recent fish population data was collected by WGFD approximately 1/2 mile downstream from the dam on Adelaide Lake in September of 1985. Results of the survey reveal a population estimate of 996 brook trout per mile with an average size of 5.6 inches. Also captured were rainbow trout with an estimate of 208 fish per mile and an average size of 5.6 inches. The fisheries in the lakes are comprised mainly of brook trout, which are maintained by natural reproduction. The most recent gillnet sampling for Lake Adelaide was conducted in June 1990. Results revealed a fairly high population of brook trout with an average size of 8.5 inches and a length range between 4.8 - 11.8 inches.

At the inventory station on Adelaide Creek, the average channel width is 19.5 ft. and depths range from 1.2 to 3.2 feet. Dominant substrate is cobble and gravel, some boulders, with primarily sand in the pools. Cover types include abundant undercut banks and woody debris is common. The WGFD has rated Adelaide Creek as a class 3 trout stream (an important trout water and a fisheries of regional importance). Of the 3.4 miles of occupied fish habitat, 1.7 miles are considered to be sensitive to disturbance based on stream channel type derived from IRI data.

Buckley Watershed

Buckley creek is located in the upper portions of the Shell creek drainage and is in the Shell basin allotment.

Riparian Areas/Wetlands - Buckley Creek is diverted into Lake Adelaide just above the surveyed reaches. There are two exclosures on Buckley Creek below the diversion. Bar development and fine sediments in lower gradient reaches may be an indicator that flow reduction is causing a reduction in transport capacity. We surveyed three reaches along the stream. We did not do a PFC rating on the upper exclosure or for the reach between the upper and lower exclosures. However, the proportion of stable banks was noticeably greater within the upper exclosure than below it. Trampling damage was evident below the exclosure both by bank shear and by soil pedestals within the active channel.

The lower exclosure was rated as PFC. About 90% of the banks were stable and vegetated. Two concerns were noted. Access trails to the wilderness and cattle trails were contributing sediment to the stream. Flow reductions have reduced the ability of the stream to transport sediment from these sources as well as from cattle impacts to banks upstream of the exclosure. This has increased instream deposition of sediment, particularly in pools.

The next surveyed reach was from the lower exclosure down to the Boulder Basin road crossing. The reach was rated as FAR, with no trend apparent. We noted the following concerns: In areas where the stream channel is not protected by boulders, the channel is widening and changes in plant composition indicate riparian area drying. Roads, trails and bank trampling are contributing sediment. Willow vigor is reduced through heavy grazing. Bank vegetation is inadequate to protect banks, which in turn is leading to accelerated lateral stream movement in the lower gradient reaches.

The lower reach is located below the Boulder Basin road crossing. In the low gradient meadow below the crossing, the stream has downcut to the point where the floodplain has been abandoned. Some of the collapsed banks are being stabilized by Carex species and a new floodplain is beginning to develop within the downcut. Currently the stream type is an F4, which is slowly recovering toward a C4. The reach was rated at the very low end of functional - at risk. We noted the following concerns: The floodplain has been abandoned as described above, and the developing floodplain is insufficient to dissipate energy from flood flows. The stream is wider and shallower than would be expected in a stable channel. Roads, trails and bank trampling are contributing sediment. One result of the downcutting has been that the level of the water table has fallen below the rooting depth of the desirable riparian vegetation on the abandoned floodplain. This is leading to conversion to drier site species. Lateral stream movement is accelerated as the channel evolves from an 'F' type to a 'C' type.

Stream Channels - The stream is characterized by a sequence of stream types. Steep, boulder, A2 channel sections are followed by moderate gradient, boulder, B2 or C2 channel sections, which are followed by low gradient, sand or gravel substrate channels (C4, E4-5, or F5).

The channel type within the lower exclosure is E5, very deep and wide with near zero flow velocity when we visited the reach on August 20, 1998.

The next surveyed reach was from the lower exclosure down to the Boulder Basin road crossing. This reach contained the sequence of stream types described above. The stream type changed about every 100 feet. None of the stream types characterized a long enough length of channel to make it useful to perform a separate rating for each stream type. It should be noted that the

steeper stream segments exhibited the characteristics of low entrenchment described above for the upper reach of Klondike Creek, which make them difficult to characterize using the Rosgen channel classification.

The lower reach is located below the Boulder Basin road crossing. This reach is also composed of short segments of the sequence of stream types described above. In the low gradient meadow below the crossing, the stream has downcut to the point where the floodplain has been abandoned. Past bank failure is almost continuous along both banks. Currently the stream type is an F4, which is slowly recovering toward a C4.

Water Quality - During the summer of 1998, the IDT did not collect T-WALK information or inventory these watersheds for sources of sediment.

Fisheries - Fish population estimates completed in 1985 suggest that this stream contains primarily brook trout. The estimate of 4,295 fish/mile suggests an abundant population of this trout species. The WGFD has rated Buckley Creek as a class 3 trout stream (important trout water and a fishery of regional importance. Of the 3.4 miles of occupied fish habitat, 1.7 miles are considered to be sensitive to disturbance based on stream channel type derived from IRI data. There appears to be a decent sport fishery in this stream for larger brook trout. This can be attributed to difficult access and low fishing pressure.

Upper Shell/Porcupine Watersheds

This area includes the upper portion of Shell Creek above the mouth of Buckley Creek and Porcupine creek, all within the Shell Basin Allotment and the Cloud Peak Wilderness.

Riparian Areas/Wetlands - The survey station is located above the confluence of Shell Creek and Buckley Creek, approximately 1 mile above Shell Reservoir. We rated the reach as PFC. We did note that heavy willow browsing along the stream channel is a concern. During the summer of 1998, the IDT did not collect PFC or riparian classification on Porcupine Creek.

Stream channels - On Shell Creek, just upstream of the Buckley confluence, is a broad, meandering C4 channel, in near reference condition. There are some raw banks at the outside of some bends, but they are not continuous.

Water Quality - During the summer of 1998, the IDT did not collect T-WALK information or inventory these watersheds for sources of sediment.

Fisheries - No recent trout population data is available for the upper portion of Shell creek, however data collected from Porcupine creek in 1991 suggests the occurrence of a naturally reproducing population of brook trout. The estimate for the brook trout population in the lower reaches of Porcupine creek was 580 fish per mile. Based on the occurrence of brook trout in the lower reaches of Shell Creek, it is assumed that they are also present in the upper reaches. Of the 4 miles of occupied habitat in Porcupine Creek, 1.5 miles is considered to be sensitive to grazing impacts.

Crooked Creek Watershed

Crooked Creek flows into Shell Creek from the south just above the mouth of Mail Creek and is within the Crooked Creek Allotment.

Riparian Areas/Wetlands - We looked at two stream reaches on Crooked Creek. Both are located in the meadow north of the intersection of FDR 17 and FDR 321 between the high gradient reach at the upstream end and the reach at the lower end where surface flow disappears. The two reaches are subdivisions of a longer reach. They were divided because of changes in gradient, channel type, and dominant vegetation. Both reaches were rated as proper PFC. Concerns noted in the upper reach were that some sections of the channel were widened due to bank damage, and that point bars forming in these sections were not revegetating. Concerns in the lower reach included a wider, shallower channel in some sections than would be expected, some unvegetated point bars, as well as channel incision in one location where a meander cut off has caused channel straightening and local increases in slope and energy.

Stream Channels - The upper reach is an 'E' channel, according to the Rosgen channel classification (Rosgen, 1994), and the lower reach is a 'C' channel.

Water Quality - During the summer of 1998, the IDT did not collect T-WALK information or inventory these watersheds for sources of sediment.

Fisheries - Crooked Creek is classified as a class 4 trout stream and is considered unsuitable for supporting fish populations.

Jack/Johnny Watersheds

Both Jack and Johnny Creek flow into Trapper Creek that flows into lower Shell drainage.

Riparian Areas/Wetlands - Jack Creek: One stream reach above FDR 17 was surveyed. The reach was rated as PFC. Concerns that were noted were that willows were only represented by one age class, with little evidence of young, newly established plants. The willows had been nearly uniformly browsed to a height of 8-10 inches. In addition, some point bars were not vegetated. However, the point bars were composed primarily of coarse gravels and cobbles. This size of substrate slows the establishment of vegetation.

Johnny Creek: One stream reach was surveyed, where Johnny Creek runs roughly parallel to FDR 17. The reach was rated as PFC. Concerns identified were primarily related to road encroachment. Road fill has caused steep, poorly vegetated banks to abut the channel. The road location has also reduced the sinuosity of the stream and has created truncated meanders when the stream encounters fill slopes.

Stream Channels -
Jack Creek: IRI data for this portion of the watershed suggests that of the 1.1 miles of stream within the analysis area .6 miles are lower gradient (1.5 - 3.9) type G stream channels. These are characterized by a slightly entrenched, narrow step pool channel with a low to moderate sinuosity. This channel type is sensitive to grazing impacts, however the habitat is in good condition. The remaining .5 miles are high gradient and resistant to disturbance.

Johnny Creek: IRI data for this portion of the watershed suggests that of the 1.7 miles of stream within the analysis area 1.6 miles are high gradient (> 4.0) , type A and Aa stream channels.

These stream types are typically more resistant to bank disturbance and less likely to show adverse effects of grazing.

Water Quality - During the summer of 1998, the IDT did not collect T-WALK information or inventory these watersheds for sources of sediment.

Fisheries - Based on electrofishing evaluations conducted by Forest Service and WGFD in 1983 and 1995, brook trout occupy 1.1 miles of stream in Jack Creek and .5 of the 1.7 miles of stream in Johnny Creek within the analysis area. In Johnny Creek, brook trout are present below the road crossing (FDR 17) and absent above. The WGFD has rated both Jack and Johnny Creeks as class 3 trout streams (important trout waters and fisheries of regional importance). The extent of fish distribution and populations are depicted in table 13.

Table 13. Fish population estimates for the Jack and Jonnie Creek Watersheds

Stream	Date	Location	BKT/mile (Avg Length)	BKT/mile> 6 in (Avg Length)	RBT/mile (Avg Length)	RBT/ mile > 6in (Avg Length)
Jack Ck	9/83	R88 T52 S4	42	na	na	na
Johnny Ck	9/83	R88 T52 S14	229	na	na	na
Johnny Ck	9/95	R88 T52 S16NE	443(5.0)	208(7.2)	na	na
Johnny Ck	9/95	R88 T52 S16 above FR 17	---	---	na	na

***Fish Species Code: BKT - Brook Trout, RBT - Rainbow Trout**

Water Quality and Water Uses

Historically, the water quality in the Shell Creek geographic area has been good. However, there are some water quality problems below the Forest boundary. Table 14 displays the surface water quality standards for the streams within the Shell geographic area.

Table 14. Wyoming Surface Water Quality Classifications (2000) and Domestic Water Users

Watershed	Wyoming Surface Water Quality Class	Tributaries	Wyoming Surface Water Quality Class	Community Water System being Served
Shell Creek	2AB			Shell, Wyoming
		Beaver Creek	2AB	
		Horse Creek	2AB	
		Trapper Creek	2AB	
		White Creek	2AB	
		Cedar Creek	2AB	
		Willett Creek	2AB	
		Granite Creek	2AB	

All streams within the analysis area are classified as Class 2AB.

Class 2, Fisheries and Drinking Waters. Class 2 waters are waters that are known to support fish or drinking water supplies or where those uses are attainable. Class 2 waters may be perennial, intermittent or ephemeral and are protected for the uses indicated in each sub-category. There are four sub-categories of Class 2 waters. Class 2AB waters are those known to support

game fish populations or spawning and nursery areas at least seasonally and all their perennial tributaries and adjacent wetlands and where a game fishery and drinking water use is otherwise attainable.

In 2000, the State conducted a review of all watersheds within the State to determine whether or not they are meeting the designated beneficial uses (i.e., fisheries, recreational use, etc.). The results of that review can be found in the document titled, "Wyoming 2000 305(b) State Water Quality Assessment Report". Table 15 summarizes the watersheds within this analysis area listed in the State 2000 305(b) report. There are currently no streams in the Shell Creek watershed with water quality impairments.

Table 15. Water Quality Impaired Watersheds (2000)

Watershed	Listed on 2000 State 305(b) Report?	Type of Listing (Impaired or Threatened)	Reason for Listing and Location of Impairment
Shell Creek	No		

Human Impacts Upon Water Quality

Influence of Timber Harvesting upon Water Quality

Timber harvest activities are a relatively minor land management activity within this analysis area. The mechanical processes involved in timber harvest and associated road construction, in conjunction with natural conditions, influence the level of disturbance within watersheds. Negative effects tend to increase when activities occur on environmentally sensitive terrain with steep slopes composed of highly erodible soils that are subject to high climatic stresses.

Soil and site disturbance that inevitably occur during timber harvest activities are often responsible for increased rates of erosion and sedimentation, modification and destruction of terrestrial and aquatic habitats, changes in water quality and quantity, and perturbation of nutrient cycles within aquatic ecosystems. Physical changes affect runoff events, bank stability, sediment supply, large woody debris retention, and energy relationships involving temperature. All of these changes can eventually culminate in the loss of biodiversity within a watershed.

Increased delivery of sediments, especially fine sediments, is usually associated with timber harvesting and road construction. As the deposition of fine sediments in salmonid spawning habitat increase, mortality of embryos, alevens, and fry rises. Erosion potential is greatly increased by reduction in vegetation, compaction of soils, and disruption of natural surface and subsurface drainage patterns. Generally, logged slopes contribute sediment to streams based on the amount of bare compacted soils that are exposed to rainfall and runoff. Slope steepness and proximity to channels determine the rate of sediment delivery.

Research by Troendle, et al (1998), shows that when approximately 24% or more of the basal area of a watershed is removed, peak flows (instantaneous maximum flow or maximum mean daily flow) were not significantly increased. However, the duration of the higher, near bankfull discharges were extended.

Table 16 gives the acres of treatment followed by the equivalent clearcut acres for that treatment. An equivalent clearcut acre is roughly equal to the basal area removal for a given harvest type. For example, a shelterwood prep-cut removes approximately 33% of the basal area in a treated stand. The ECA for that prescription is 0.33.

Table 16. Equivalent Clearcut Acres for Shell Geographic Area

Harvest Type	Equivalent Clearcut Multiplier	1950's	1960's	1970's	1980's	1990's	2000	Totals
Clearcut (acres) (ECA)	1.00	293 293	33 33	9 9	39 39			 **374**
Shelterwood: Prep Cut (acres) (ECA)	0.33			3 1	358 118			 **119**
Shelterwood: Seed Cut (acres) (ECA)	0.33							
Shelterwood: Overstory Removal (acres) (ECA)	1.00							
Seed Tree (acres) (ECA)	0.85							
Selection (acres) (ECA)	0.35							
Commercial Thin (acres) (ECA)	0.35							
Sanitation/Salvage (acres) (ECA)	0.35							
Pre-commercial Thin (acres) (ECA)	0.20							
Aspen Clearcut (acres) (ECA)	1.00							
Fire (acres) (ECA)	1.00							
Blowdown (acres) (ECA)	1.00							
TOTAL ECA **% of Area**[5]								**493** **0%**

As shown in Table 16, approximately 0% of the geographic area is in an ECA condition. In reality, this number would be somewhat less due to vegetation recovery following fire or timber removal. However, given this worst-case scenario, timber management combined with natural wildfire has probably not exceeded the range of variability in vegetation removal in this geographic area.

[5] This number does not account for vegetation recovery over time. Following fire or timber harvest, trees will reestablish themselves on a site and the ECA for that activity will approach zero. Therefore, the ECA's for this watershed will probably be somewhat less than suggested by this table. Also, roads were not included in this table at this time. Roads add approximately 4 acres of ECA per mile.

Influence of Roads

Roads contribute more sediment to streams than any other land management activity, but most land management activities such as mining, timber harvest, grazing, recreation, and water diversions are dependant on roads. The majority of sediment from timber harvest activities is related to roads and road construction and associated increased erosion rates. Serious degradation of fish habitat has been shown to result from poorly planned, designed, located, constructed, or maintained roads.

Road/stream crossings can also be a major source of sediment to streams resulting from channel fill around culverts and subsequent road crossing failures. Plugged culverts and fill slope failures are frequent and often lead to catastrophic increases in stream channel sediment, especially on old abandoned or unmaintained roads. Unnatural channel widths, slope, and streambed form occur upstream and downstream of stream crossings, and these alterations in channel morphology may persist for long periods of time. Channelized stream sections resulting from rip-rapping of roads adjacent to stream channels are directly affected by sediment from side casting, snow removal, and road grading; such activities can trigger fill slope erosions and failure. Because improper culverts can reduce or eliminate fish passage, road crossings are a common migration barrier to fishes.

Table 17. Number of Stream Crossings in Planning Area

Watershed	No. of Stream Crossings	No. of Stream Crossings/Square Mile
Shell Creek at Shell Reservoir	21	1.04
Shell Creek in Shell Canyon	91	1.08
White Creek	3	1.17
Trapper Creek	9	0.95
Horse Creek	9	0.52
Beaver Creek	40	0.94

Roads in the analysis area directly affect natural sediment and hydrologic regimes by altering stream flow, sediment loading, sediment transport and deposition, channel morphology, channel stability, substrate composition, stream temperatures, water quality, and riparian conditions within a watershed. Road related mass movements can continue for decades after the roads have been constructed. Such habitat alterations can adversely affect all life-stages of fishes, including migration, spawning, incubation, emergence, and rearing.

Field inventories have shown that the amount of watershed risk presented by roads in the analysis area is directly related to maintenance level. The lower maintenance level roads tend to be more susceptible to yearly input of sediment into nearby streams. Table 18 displays the existing miles of road by maintenance level in the analysis area. This number will be used to compare watersheds at highest risk for road related watershed impacts.

Table 18. Miles of Forest Service Road by Maintenance Level

Maintenance Level	Miles of road within the Geographic Area	Overall Condition and Watershed Risk
Unclassified	40	In the watershed, roads in this category are generally either user-created or abandoned system roads (50/50). The level of watershed risk depends upon the treatments used to reclaim them. They tend to be used seasonally to access recreation areas. No maintenance occurs on these roads. Watershed impacts can occur when these roads are near water bodies. However, limited use reduces the risk to water quality.
Level 1	28	These roads are generally not open to the public. They are closed except for administrative purposes. Watershed impacts tend to vary with the amount of use and the effectiveness of erosion control measures.
Level 2	129	These roads tend to be native surface roads with poor drainage design. During wet seasons, rutting frequently occurs. Stream crossings are generally a source of sediment. These roads pose the highest risk to water quality due to their frequent use, number of stream crossings, and low standard design. However, road maintenance is beginning to catch up on the tremendous backlog of improvement needs in this area.
Level 3	10	These roads are generally designed with good road drainage and maintained on a regular basis. These roads tend to be in-sloped with a ditch and have a gravel surface. They usually do not pose a serious threat to water quality.

Influence of General Recreational Activities upon Water Quality
This topic is relevant at the Forest-scale and is discussed in the Forest-wide assessment.

Reservoirs and Impoundments

Shell Reservoir is the only man-made impoundment in the geographic area.

Wetlands/Riparian Areas

Table 19 shows the acres of riparian area within the geographic area, and a map of the riparian areas is in the appendix. Riparian areas are defined in management prescription area 9A of the 1985 Forest Plan, page III-198:

"The aquatic ecosystem, the riparian ecosystem (characterized by distinct vegetation), and adjacent ecosystems that remain within approximately 100 ft. measure horizontally from both edges of all perennial streams and from the shores of lakes and other still waters bodies."

Table 19. Acres of Riparian within Geographic Area

6th Field Watershed Name	6th Field Watershed Number	Acres of Riparian	Miles of Road within Riparian
Shell Creek at Shell Reservoir	100800100101	5003	2.62
Shell Creek in Shell Canyon	100800100102	3626	6.38
White Creek	100800100103	45	0.25
Trapper Creek	100800100104	578	0.93
Horse Creek	100800100105	676	0.75
Beaver Creek	100800100106	2561	2.25
Totals:		**12,489**	**13.18**

At the time of the 1985 Forest Plan, only a few of the larger riparian areas were mapped. Since then, the riparian mapping project defined areas of riparian vegetation, and Geographic Information Systems (GIS) were developed, making the mapping of riparian areas feasible. The riparian mapping project on the Bighorn was completed in about 1995. The project consisted of using 1992 color infrared, 1:24,000 scale, aerial photography to map riparian areas based upon a combination of the riparian vegetation and the stream course geomorphology and topography.

Riparian vegetation has a moderate influence on water yield due to evapotranspiration rates associated with riparian species. Since evapotranspiration rates are highest during periods of highest runoff, the effect of riparian vegetation on the timing of water yield is only moderate. Riparian vegetation is extremely important for control of sediment from upslope sources during high runoff/surface erosion periods. Riparian vegetation is also critical for the stability of lower gradient stream reaches.

VII. Aquatic Species and Their Habitat

Streams in the analysis area support a diverse assemblage of fish species. Based on electro-fishing evaluations, conducted by the Wyoming Game and Fish Department (WGFD) and BNF personnel, between 1983 and 2000, brook trout (BKT), brown trout (BNT), rainbow trout (RBT), and cutthroat trout (CUT) are present in the analysis area however, there is limited information on the distribution and concentration of fish in the analysis area.

Sensitive Species
This information is covered in the individual watershed write-ups presented earlier in this assessment.

Habitat Information
This information is covered in the individual watershed write-ups presented earlier in this assessment.

Natural and human causes of change affecting aquatic life
This topic is relevant at the Forest-scale and is discussed in the Forest-wide assessment.

Influence Of Non-Native Fish Species Introductions
This topic is relevant at the Forest-scale and is discussed in the Forest-wide assessment.

Influence of Aquatic Habitat Fragmentation and Simplification
This topic is relevant at the Forest-scale and is discussed in the Forest-wide assessment.

VIII. Air Quality and Visibility

This topic is relevant at the Forest-scale and is discussed in the Forest-wide assessment.

IX. Climate

This topic is relevant at the Forest-scale and is discussed in the Forest-wide assessment.

X. Vegetation

Composition, distribution, and abundance of the major vegetation types and successional stages of forest and grassland systems

Figure 4 shows the major vegetation cover types that occur in the Shell geographic area area. Data are from the Common Vegetation Unit (CVU) database. The Shell geographic area is very diverse in comparison to other Bighorn NF geographic areas; with a low percentage of forested area relative to a high percentage grass/forb and shrub cover types.

Figure 4. Vegetation Cover Types in the Shell area.

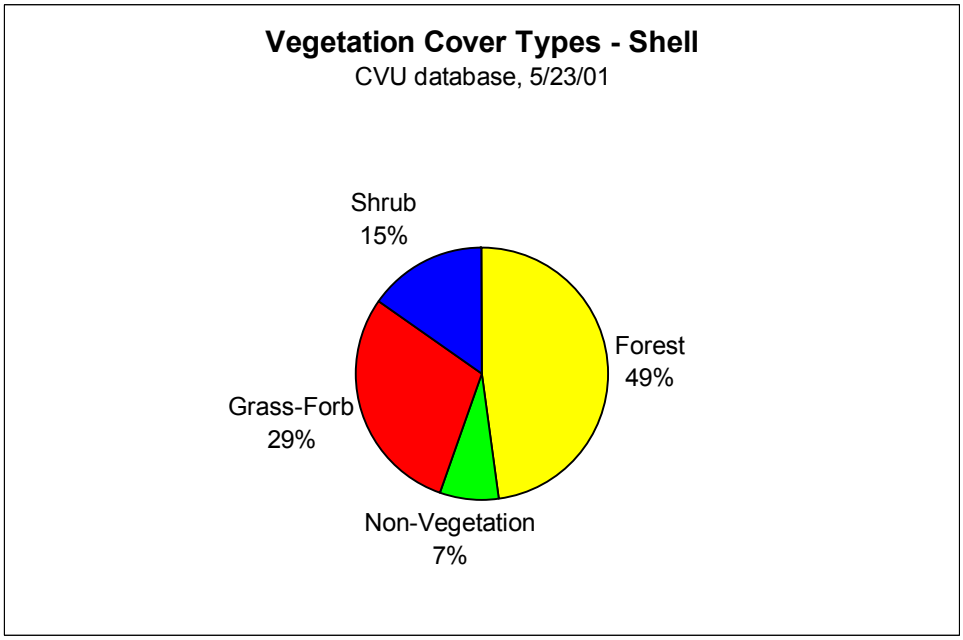
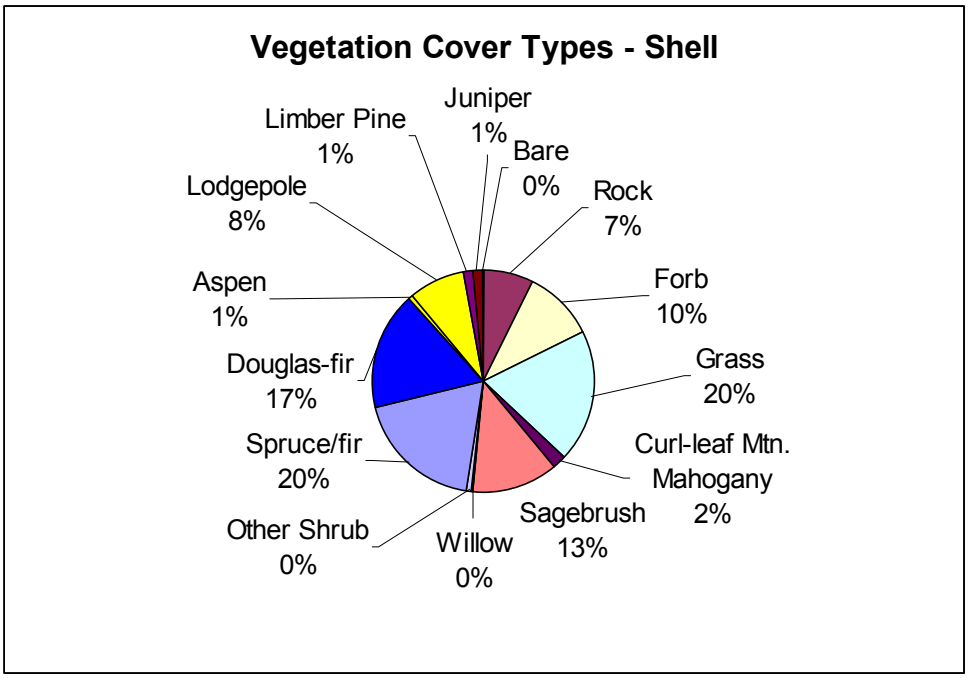


Figure 5 is from the CVU database, 5/23/01, and shows the relative amounts of the dominant cover types. Shell has a high diversity of plant cover types. Some plant types, such as cottonwood and ponderosa pine, exist in the geographic area but do not cover enough area to be listed as a cover type in the common vegetation unit.

Figure 5. Vegetation Cover Types in the Shell area.



The origin dates chart, figure 6, shows the stand origin dates for the forested stands in the assessment area. This data is either from the Stage II point information, or origin years were assigned to stands that regenerated after harvests or fires. This information indicates that the forests in the Shell geographic area are relatively old for the Bighorn Mountains.

Figure 6. Forested Stand Origin Dates in the Shell area

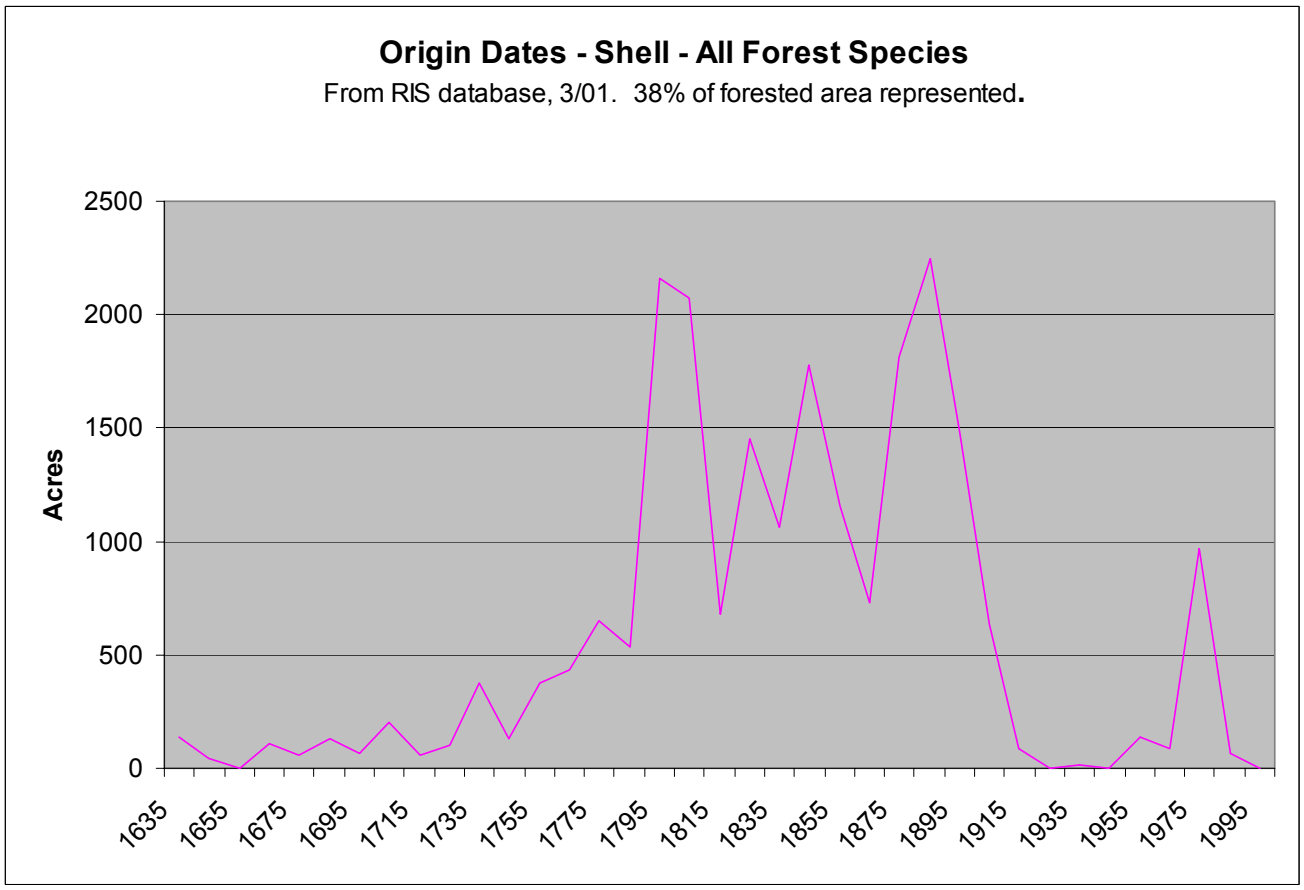


Figure 7 shows the habitat structural stages for the forests in the geographic area. Table 20 defines habitat structural stages. There are no structural stage 1, forests that recently received a stand replacing event that are in a transitory grass/forb stage, in this geographic area.

Habitat structural stage provides a "coarse filter" look at habitats provided by forests in the geographic area. It gives an indication of forest size and density, which can be interpreted for wildlife habitat suitability. The number on the structural stage refers to the stand size, in terms of average diameter of the trees, while the letter (a, b, or c) refers to the crown density. Compared to other geographic areas on the Bighorn, this geographic area is low in structural stages 1 and 2. And, it has relatively equal amounts of structural stage 3 and 4 classes, compared to many geographic areas that have dominance in one size class or another.

Figure 7. Habitat Structural Stages in the Shell Geographic Area

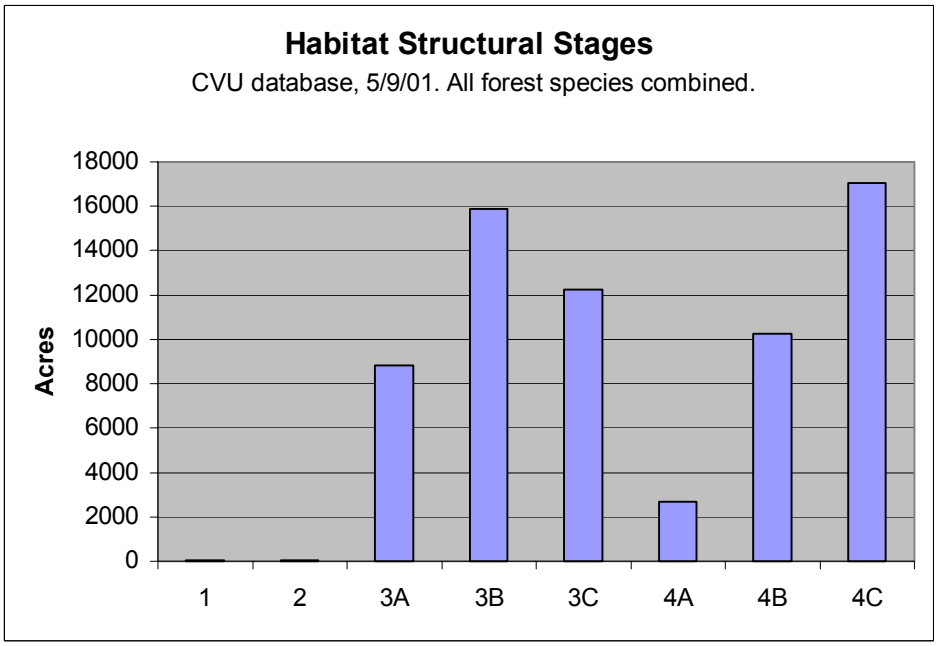


Table 20. Habitat Structural Stage Definitions, Hoover and Wills 1987

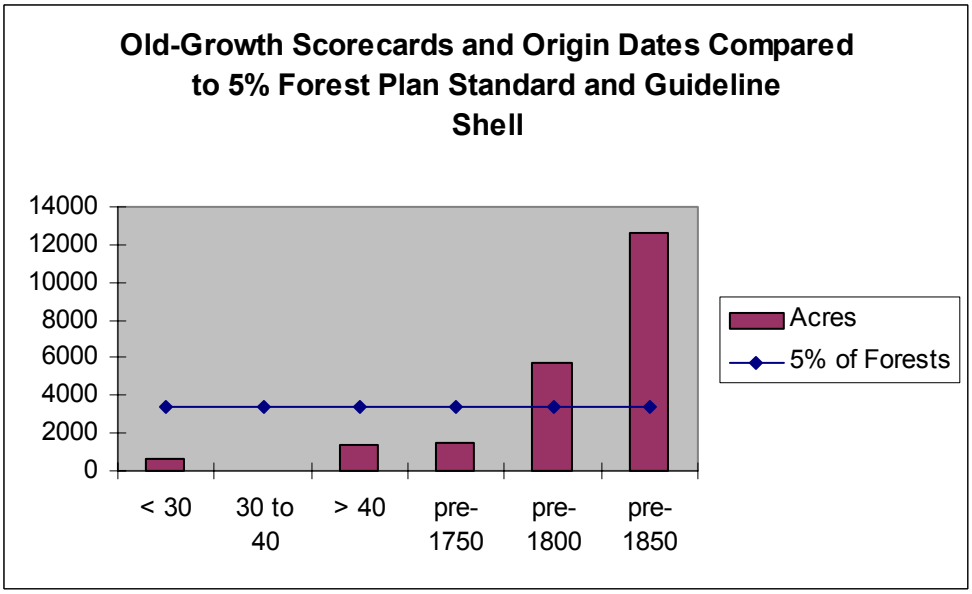
Habitat Structural Stage	Diameter	Crown Cover %	Habitat Structural Stage	Diameter	Crown Cover %
1	Not applicable	0-10%	3C	1 – 9 inches	70-100%
2	< 1 inch	10-100%	4A	9+ inches	10-40%
3A	1 – 9 inches	10-40%	4B	9+ inches	40-70%
3B	1 – 9 inches	40-70%	4C	9+ inches	70-100%

Concerning old-growth, approximately 3357 acres of old-growth are needed to represent 5% of the forested area in the Shell geographic area. Different measures of old-growth are listed in table 21 and Figure 8.

Table 21. Old-Growth Acres

Old Growth Scorecard			Acres by Cover Type over 250 years old				Acres by Cover Type over 200 years old			
Acres <30	Acres 30-40	Acres >40	Doug-fir	Lodgepole Pine	Spruce/ fir	Limber Pine	Doug-fir	Lodgepole Pine	Spruce/ fir	Limber Pine
677	0	1358	324	266	666	184	2147	1327	1863	366
			Total Acres over 250 years old: 1440				Total Acres over 200 years old: 5703			

Figure 8. Old-Growth Scorecards and Origin Dates



Estimate the Range of Variability in Vegetative conditions

- The overall change in the relative amounts of forests to meadows in the subalpine habitat types changes very little, due to soil conditions. (Despain, 1973) Thus the current ratio of about 49% forested to 44% grassland and shrubland fluctuates by only a few percent over time.
- Riparian areas may fluctuate as large, catastrophically burned areas return to a forested condition, and more water is lost to transpiration and sublimation off of the forested canopy in the winter. This would only occur in watersheds and subwatersheds that have a large percentage of the watershed burned in the same event.
- Aspen is declining for three factors:
    - Long term climatic warming since the little ice age about 10,000 years ago. There was also a relative drying of the climate since that time until the last 100 years, at which point, the climate became relatively wetter. (Knight, 1994)
    - Effects on seedling survival due to wildlife and domestic livestock grazing.
    - While the subalpine fire cycle has only marginally been affected (since this type has a fire frequency interval of 100-300 years, and European man has only been suppressing fires for about 100 years), continued fire suppression will decrease the amount of aspen in the geographic area, since stand replacing fire events are regeneration events for aspen.

Effects from air quality

There have been no studies to date on the Bighorn concerning air quality effects on plants. An applicable study from Yellowstone National Park concluded that ozone levels are suspected to be well below the level that would affect human health or vegetation.

Risks to ecological sustainability

- Vegetation in high use areas of the Cloud Peak Wilderness is threatened by overuse by people. This affects both trees (used for firewood) and long term soil productivity (soil compaction and removal of plant/litter layer in heavily used campsites.) This has been recently addressed by additional use restrictions, but monitoring will be needed to see if the restrictions are sufficient in light of increased rates of human visitation.
- The cumulative effects of human intervention in the ecosystem. This includes:
    - People as vectors of exotic species. This includes plant and animal species.
    - Roads
    - Livestock and wildlife grazing and browsing
    - Timber harvest
    - Fire suppression
    - Recreation use

Describe reference conditions (landscapes)

There is one existing Research Natural Area in this geographic area, Shell Canyon RNA. It is 295 hectares, and was the first RNA in the US established primarily because of its Rocky Mountain Juniper community. While most other Rocky Mountain juniper sites have been disturbed by grazing or fence post harvest, this was considered to be in good condition.

Elephant Head is the one area within the Shell geographic area that has been identified as a potential RNA. It is located on the north side of Shell Canyon. About two-thirds of the pRNA has south-facing aspects, including the sheer Madison limestone cliffs on the west side of the area that dramatically exhibits the folding of sedimentary rock layers. The pRNA includes sagebrush-grassland benches, deep river canyons, mosaics of conifer forest, juniper woodlands, and rolling grass-forb meadows. In addition, the area contains habitat for five US Forest Service Region 2 Sensitive plant and animal species and 3 additional rare plants tracked by the Wyoming Natural Diversity Database.

In the Fine Filter Analysis (Welp, et al., 2000), two areas within the geographic area were considered areas "…that contain a high concentration of important taxa or representative vegetation communities." (For a complete discussion of ranking criteria, codes and descriptions, see pages 1192 to 1230 of the Fine Filter Analysis):

- Cloud Peak, B2 rank (very high significance): Contains nine species tracked by Wyoming Natural Diversity Database (WYNDD); alpine, granite, habitats are unique in the Bighorn Mountains, and are relatively undisturbed.
- Cedar Creek, B3 rank (high significance): Contains yellowstone cutthroat trout, genetically pure based on previous research. Origins of population unknown, whether transplanted here or not.

XI. Terrestrial Species and their Habitat

Most of the wildlife existing condition information will be presented at the Forest wide scale, since geographic areas rarely bound terrestrial species. Topics included in the forest wide scale assessment include population viability, species categories (species of local concern, species at risk, etc.), and species habitats.

General Theme/Vegetation

Wildlife species composition, distribution, and abundance are determined primarily by the distribution, structure, and composition of vegetative and non-vegetative habitat components. It is assumed that managing the vegetative components within the Historic Range of Variability (HRV) would be the most beneficial for the most wildlife species. Refer to the vegetation section description of current vegetation distribution and relevance to HRV.

The vegetation is highly diverse in this geographic area, with one of the lowest percentages of forested cover types of any geographic area. Of concern in this area were the riparian areas and aspen stands. Aspen are at risk from a lack of disturbance and from ungulate browsing levels. Riparian areas may be at risk from livestock and wildlife grazing, dispersed recreation use, noxious weeds, and past road construction within these areas. It is assumed that priority geographic areas will be identified through this process at the Forest level to prioritize any treatment or restoration activities needed relative to HRV.

Unique non-vegetative attributes of the geographic area may include abandoned mines or cave resources, and this geographic area may have a high potential for this. Old growth conifer likely exists within the geographic area, though inventories are lacking. Stand origin dates available in RIS indicate the prevalence of old growth. The conifer stands in this geographic area remain largely un-harvested, as there is little access, and little suitable timber. The majority of timber within the geographic area was classed as unsuitable for timber production and retains roadless areas.

Viability/Species At Risk

All information relative to these species and viability concerns will be handled from a Forest wide compilation of species, recommended conservation measures, and viability assessments. Primary information for this analysis will be derived from the WYNDD database and existing literature reviews.

WYNDD Biological Areas

The areas within the geographic area identified by Wyoming Natural Diversity Database as having a high concentration of important taxa or representative vegetation communities are described within the Vegetation section. These include Cedar Creek and the Cloud Peak site. Cedar Creek is noted for occurrence of Yellowstone cutthroat trout. Cloud Peak was first described in the Clear/Crazy assessment.

Wildlife Species Information/Recommendations

Historically, *beaver* were likely more present in the geographic area than presently occur. The species is important for shaping and maintaining riparian communities. The link to deteriorated quality and reduced presence of aspen was also noted as an important consideration for this area.

Aspen habitats are frequently used by beaver for dam construction when they occur in riparian areas.

- Consider beaver as a potential focal species for this geographic area area due to the habitat potential and previous use.

Elk habitat use in the geographic area would be similar to that described in the Clear/Crazy assessment. In addition, there are conflicts with livestock occurring in this geographic area due to combined use of vegetative resources. In addition, elk calving may be limited in some instances due to the conflict with livestock if livestock are present in all pastures in the spring. Issues of wildlife winter range and motorized vehicle access persist in this area, as described in the Clear/Crazy assessment. However, road access is generally less available in this area and reduces potential conflicts. Adjoining BLM lands also provide a good availability of winter range.

Bighorn sheep are currently present in the area, but were more abundant in the pre-European settlement era. Elements of extirpation included loss of open corridors for migration habitat use, disease from domestic livestock, and over hunting. There is likely more suitable habitat in this geographic area than in others on the Forest. Approximately 20 sheep may remain resident in this geographic area. Opportunities for expansion of habitat should be considered in conjunction with livestock management to reduce potential conflicts of disease. Summer use areas may occur up in the Shell Lake area in the wilderness. Potential issues include livestock management and protection for lambing areas where recreation may be a conflict.

Peregrine falcons were hacked into Shell Canyon in the early 1990's, with some nesting success in succeeding years. No active nests have been noted the past couple of years on the Forest. Potential issues would involve nest protection from recreation pursuits as management activities would not likely be an issue due to nesting habitat location.

Sage grouse may utilize the Forest boundary areas for summer habitat (e.g. Sunlight Mesa) as two leks are located within two miles of the boundary in the Sunlight Canyon area, and two leks are located in the Petes Hole and Beaver Creek area. Issues would involve integrity of sage steppe habitat with respect to understory conditions (weeds, cheatgrass) as well as the extent and age class diversity of sage habitat.

XII. Cultural, Human Uses, Land Use Patterns

Recreation and Travel Management

Participation in outdoor recreation has grown in most activities on the Bighorn National Forest including camping, hiking, horseback riding, atvs, motorcycles, fishing, snowmobiling and cross country skiing. Access is associated with almost every activity that takes place on the forest. There area both motorized and nonmotorized activities. The emphasis in the north part of the geographic area is nonmotorized and motorized in the south part.

A wide variety of recreation environments and types of mountain terrain occur in the analysis area. These environments include alpine meadows, coniferous forest, sagebrush parks, bare mountain peaks, canyons, lakes and streams.

Summer travel: There are a wide variety of recreation opportunities in this geographic area. Developed recreation sites include four campgrounds and two picnic areas. Shell Falls Visitor Center receives the most use at any one site on the forest. Highway 14 traverses the area and is a scenic byway. The highway provides access to many uses. Lake Adelaide and Shell Reservoir are popular areas for fishing and motorized use. The Bench Trail is a popular mountain bike route. Willet Meadow is a popular dispersed camping area. There are about thirty summer recreation residences in this geographic area.

Part of the area is in a "C" travel area open to cross-country travel. The area is open country with little access to water and tall sagebrush. Most users stay on the roads and trails due to topography and those roads and trails provide adequate access in the area.

Winter travel: Antelope Butte ski area is a downhill ski area that provides winter recreation to downhill and cross-country skiers and opportunities to snowshoe and snowmobile. Ranger Creek and Snowshoe Lodge are open and provide overnight lodging. Approximately ten miles of State snowmobile trail P traverse this area.

Relationship between supply and demand of opportunities: The developed campgrounds are normally not full. Dispersed camping is popular with local persons. Supply may not meet demand due to the numbers of people with highway access. However, there are not usually conflicts due to the expectation to encounter others during recreation experiences.

Recreation Opportunities: There are many recreation opportunities within the Shell geographic area. The Forest Service describes different recreation experiences using the setting, activities and the experience. These experiences are separated in recreation opportunity spectrum (ROS) classes. Table 22 shows ROS classes and acres found within the analysis area.

Table 22. Recreation Opportunity Spectrum (ROS) Classes within the Shell Creek Analysis Area

ROS class	Acres in analysis area	Percent
Primitive	15,660	11
Semi-primitive nonmotorized	44,915	32
Semi-primitive motorized	57,736	41
Roaded natural	15,036	11
Roaded modified	1,187	<1
Rural	5,598	4

As displayed in table 22, the geographic area has a variety of uses. Forty-three percent of the area is nonmotorized and the remaining fifty-seven percent provides motorized opportunities.

Primitive – 15,660 acres
These areas are characterized by an unmodified environment and have a very high probability of experiencing solitude, freedom, closeness to nature, tranquility, self-reliance, challenge and risk. There is very low interaction between recreation users. Access and travel is nonmotorized on trails or cross-country.

Semi-primitive nonmotorized – 44,915 acres
Areas in a semi-primitive nonmotorized class are in a natural appearing environment with a high probability of experiencing solitude, closeness to nature, tranquility, self-reliance, challenge and risk. There is low interaction between users. Access and travel is nonmotorized on trails, some primitive roads or cross-country.

Semi-primitive motorized – 57,736 acres
There is a moderate probability of experiencing solitude, closeness to nature and tranquility. The setting is in a predominantly natural appearing environment. There is a low concentration of users, but often evidence of others on trails. Motorized vehicles are allowed for travel.

Roaded natural – 15,036 acres
Self-reliance on outdoor skill is of only moderate importance to the recreation user with little challenge and risk. The environment is mostly natural appearing. Access and travel is motorized including sedan and trailers.

Roaded modified – 1,187 acres
In a roaded modified setting, there is opportunity to get away from others, but with easy access. There is moderate evidence of other users on roads and little evidence of others or interaction at campsites. Conventional motorized access includes sedan, trailer, atv and motorcycle travel.

Rural – 5,598 acres
The opportunity to observe and affiliate with other users is important as is convenience of facilities and recreation opportunities. There is little challenge and risk. Interaction between users may be high as is evidence of other users.

Areas of conflict: Conflicts exist between recreation users and livestock near Willet Meadow.

Additional information needed: There is a need to designate an area for nonmotorized winter uses near the Antelope Butte ski area to separate nonmotorized and motorized uses. Antelope Butte has an increasing amount of snowmobile use that conflicts with cross country skiers and persons using snowshoes.

Grazing

In 1995 the Bighorn National Forest in conjunction with the University of Wyoming Department of Renewable Resources, University of Wyoming Extension Service, and Bighorn National Forest Grazing Permittees Association developed the ***Bighorn National Forest Vegetation Grazing Guidelines.*** These guidelines were revised in 1996 and finalized on April 9, 1997.

The Guidelines outline vegetation-monitoring requirements for riparian areas on the Forest. This monitoring is mandatory for all allotments on the Forest with penalties established if the monitoring

is not completed. The Forest rangeland management personnel spot check permittee monitoring and if discrepancies are found they are resolved on the ground or Forest Service data is used as the baseline for that season. Upland vegetative standards are outlined in the 1985 Bighorn National Forest Plan and still apply to all upland use.

Bighorn National Forest staff are in the process of completing geographic area level Allotment Management Plans (AMPs). The Shell geographic areas' AMPs were completed recently. The Tongue and Devil's Canyon AMPs are in the process of being completed, and data collection began on the Paintrock AMP during the summer of 2001. Until the geographic area level AMPs are complete, existing AMPs will remain in affect and Annual Operating Instructions will be used to adjust the Plans to fit current resource objectives and assure management meets existing on the ground needs.

To assure objectives are being met annually the Forest Service, permittees or both complete riparian and upland monitoring. If problems occur adjustments in grazing use (changes in season of use, livestock numbers, rest periods, or deferment of on-dates) are made to allow the herbaceous vegetation to recover.

Table 23 shows selected information for the six grazing allotments in the Shell analysis area.

Table 23. Select Information for Grazing Allotments in the Shell Analysis Area

Allotment	Livestock Permitted	Number Permitees	Total Acres	Capable Acres	Current AMP	Scheduled AMP Update	Permitted Season
Crooked Cr. C&H	110 C/C	1	2,462	1359	9/1/99	Current	7/11-9/20
Granite Cr. C&H	498 C/C	2	7,090	4248	9/1/99	Current	7/8-10/7
Salt Creek C&H	640 C/C 95 y	3	15,999	7621	9/1/99	Current	6/16-10/15
Shell Basin C&H	300 C/C	2	21,748	7,696	9/1/00	Current	7/11 to 9/20
Shell Creek C&H	Variable	1	11462	4626	9/1/99	Current	7/1-9/3
Prospect Cedar C&H	169 C/C	1	5899	3,402	1983	2002	7/6 to 10/5
Southside C&S	121 C/C	1	8940	2609	1997	Current	
Trapper C&H	422 C/C	1	17276	10517		9/2003	7/11-9/30
Dry Fork Medicine Lodge S&G	1250 S	1	12378	6381		9/2003	
Beaver S&G	1000S	*	4940	2682		2005	
Whaley S&G	1030 S	1	6396	2744		2005	
Hunt Mtn. S&G	0	Vacant				2005	
Red Canyon S&G	0	Vacant				2005	
Red Canyon C&H	100 C/C	1	6405	2792		2005	
Sunlight Mesa C&H	238 C/C	1	10643	5899		2005	6/21-10/15
Grouse Cr. C&H	56 C/C	1	3169	2212		2005	5/16 – 8/30
Wiley Sundown C&H	334 C/C	1	4262	2280		2005	7/6-9/23
Finger Cr. C&H	*	*	2667	1984		2005	

The geographic area was analyzed in 1999 and a decision notice signed on September 30, 1999. This decision notice outlined strategies for managing five allotments in the Shell geographic area.

The analysis included the Granite Creek C&H, Salt Creek/Willet C&H, Shell Creek C&H and Shell Basin C&H. Following the analysis the Allotment Management Plans for these allotments were completed in 2000.

The Southside C&S analysis and Allotment Management Plan were completed in 1997. Based on the schedule developed based on the Rescission Act of 1995 the remaining allotments in the drainage will be analyzed in 2005. With the Forest Plan revision occurring and delays occurring on the Tongue Geographic area this schedule could be moved back a year or two.

Overall the herbaceous vegetation in the geographic area is in good condition with static to upward trends on most allotments. Isolated areas occur where vegetation use exceeds standards and guides but corrective action is normally taken the following year to allow these areas to recover. All allotments in the drainage are considered to be moving toward 1985 Forest Plan objectives. The rate of movement varies by allotment with the vegetation improving faster on some allotments than others.

XIII. Transportation System (Roads and Trails)

A Forest-wide roads analysis will be conducted during the effects analysis part of Forest Plan revision. It will be done under the 1985 Forest Plan direction. When the revised Forest Plan is implemented, the roads analysis will be reviewed and applicable revisions made.

Roads

There are currently approximately 236 miles of roads in the Shell Analysis Area. This system of roads accesses an area of approximately 219 square miles, including wilderness and private lands. The road system in this analysis area varies from high standard US Highways to primitive, abandoned wheel tracks. Table 24 gives a breakdown of roads within the analysis area.

Table 24. Miles of Road by Jurisdiction

Jurisdiction	Length (miles)
Forest Service	171.6
BLM	0.1
State	18.6
Private/Other	5.6
Unclassified	39.8
Total	**235.7**

The roads within the analysis area under Forest Service jurisdiction are divided into categories called maintenance levels. Maintenance levels range from 1-5, with 5 being the highest standard, and 1 being the lowest standard. There may also be additional roads no longer required for management purposes, or which have been created by off road vehicle use, but there still exists a road 'footprint'. These roads are called unclassified, and the mileage of these unclassified roads is an approximation. A description of maintenance levels is shown in Table 25.

Table 25. Description of Road Maintenance Levels

Maintenance Level	Description
1	Closed to public travel – can be used intermittently for management purposes.
2	Maintained for use by high clearance vehicles.
3	Maintained for use by a prudent driver in a passenger car.
4	Maintained for use by passenger cars with a moderate degree of user comfort. Usually double lane, gravel roads.
5	Maintained for a high degree of user comfort, double lane, often paved.

Figure 9 shows a breakdown of Forest Service roads within the analysis area by maintenance level, as well as other roads within the analysis area by jurisdiction.

Figure 9. Roads by Forest Service Maintenance Level and Roads by Other Jurisdiction

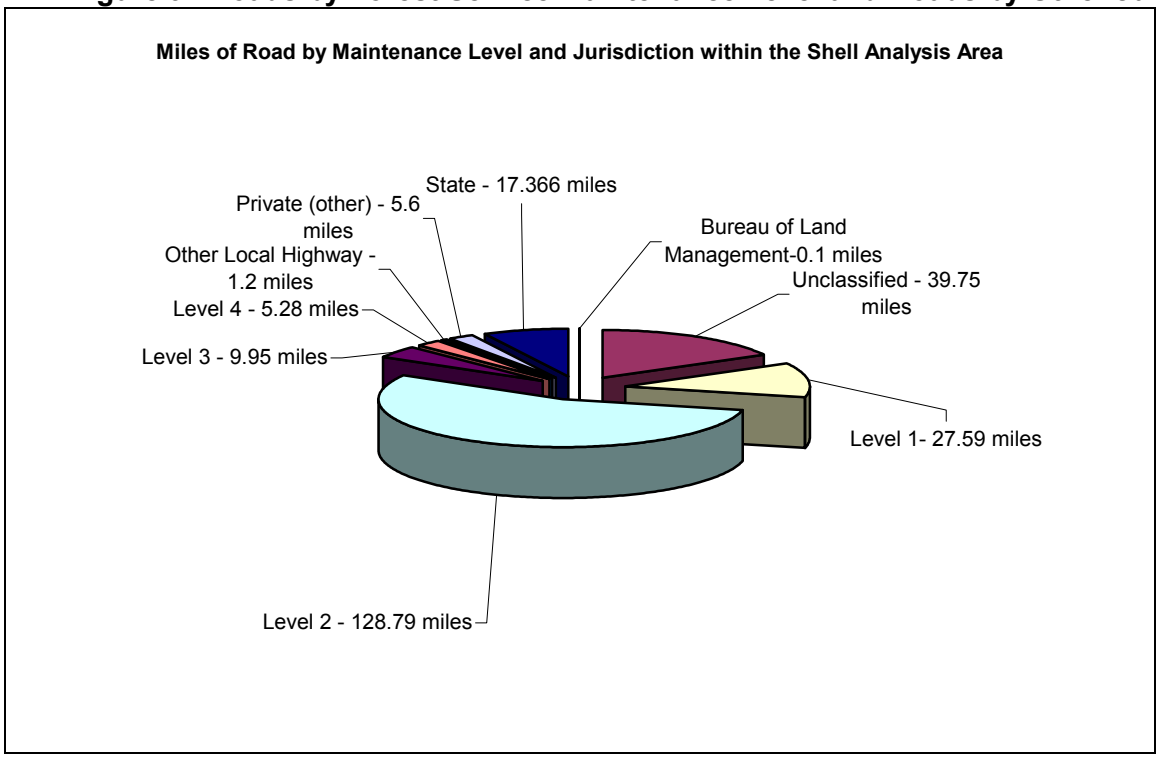


Table 26 lists the road density in the Shell analysis area. These figures do not include wilderness and private land. The open road density does not include unclassified roads.

Table 26. Road Density in Shell Analysis Area (National Forest System, Non-wilderness land only)

Total Road Density	1.31 miles per square mile
Open Road Density	0.93 miles per square mile

Various structures and components are needed to manage and operate those roads under Forest Service jurisdiction. These structures include bridges, culverts, cattleguards, waterbars, rolling dips, gates, and signs. These structures along with the roads themselves represent a great investment in the transportation system, as well as a great cost for annual maintenance and, over the years, a resulting backlog of maintenance needs. Table 27 shows the breakdown of annual and deferred maintenance needs by maintenance level[6].

[6] Costs arrived from performing condition surveys on each level 3, 4, and 5 road on the Bighorn National Forest in 1999, and from a random sample of level 1 and 2 roads in 2000. Costs per mile were interpolated from these surveys. Also, these costs do not reflect annual and deferred costs for bridges. Those costs are not yet readily available.

Table 27. Annual and Deferred Maintenance Needs by Maintenance Level

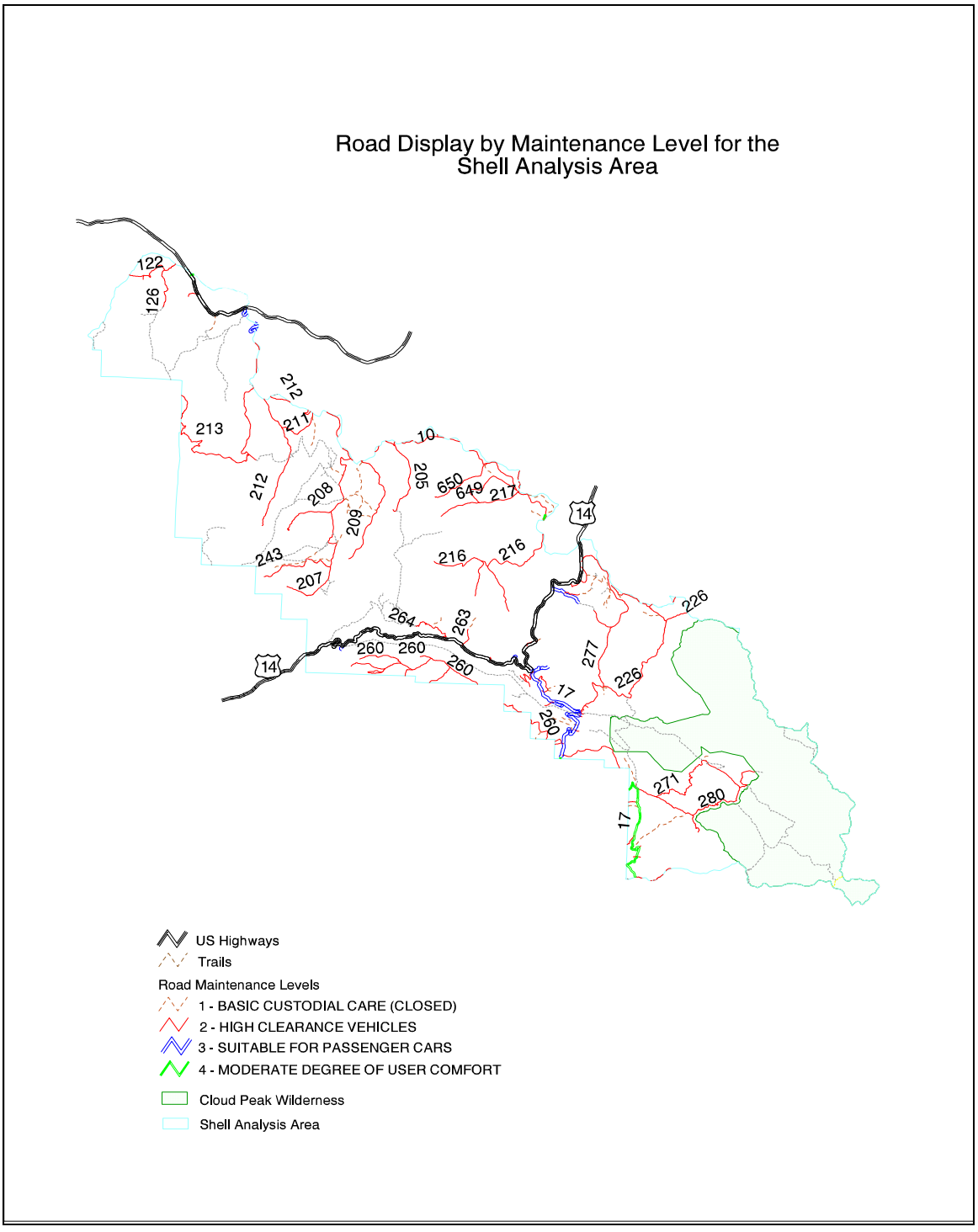
Maintenance Level	Miles	Annual Cost/Mile	Deferred Cost/Mile
1	27.59	$683	$886
2	128.79	$920	$2,316
3	9.95	$6,561	$8,109
4	5.28	$5,991	$14,730
Total needs for annual maintenance in Shell = $234,245			
Total needs for deferred maintenance in Shell = $481,181			

Current funding levels for road maintenance over the past 3 years have remained fairly constant, with an approximate allocation of $460,000. This amount is far below the level needed for full implementation of the current transportation system forest wide. Current forest plan standard for full maintenance is also not being met under current allocations. Currently, general plan direction states to keep roads open to public use unless financing is not available to maintain the facility, or use is causing unacceptable damage to soil and water resources. Based on current deferred maintenance and annual maintenance needs, plan direction is not being met.

Forest Plan Goals/Desired Conditions

Forest Plan direction for road management and operations are primarily based on resource needs rather than the road systems as a separate entity. In other words, the driving force behind road management decisions are primarily based on the management directions resource needs for an area. The Forest Plan does, however, give direction that roads may be closed if financing is not available to maintain the facility, if use is causing unacceptable resource damage, if they are unsafe, or if their use conflicts with the management objectives for an area. The Forest Plan also states that arterial and collector roads shall be maintained to a minimum maintenance level of 3, and all open local roads shall be maintained to a minimum maintenance level of 2. In contrast, forest plan goals to provide additional road and trail access to the National Forest boundary are being met.

The map on page 50 shows the current Forest Service Road system by maintenance level in the Shell analysis area.


Road Display by Maintenance Level for the
Shell Analysis Area
122
126
212
213
217
10
205
650
649
217
14
212
208
209
243
207
216
216
226
264
263
260
260
260
277
226
17
20
271
280
17
14
US Highways
Trails
Road Maintenance Levels
1 - BASIC CUSTODIAL CARE (CLOSED)
2 - HIGH CLEARANCE VEHICLES
3 - SUITABLE FOR PASSENGER CARS
4 - MODERATE DEGREE OF USER COMFORT
Cloud Peak Wilderness
Shell Analysis Area

Trails

There are currently approximately 93 miles of trail in the Shell Analysis Area. This trail system accesses an area of approximately 219 square miles, including 38.5 square miles of wilderness. The trail system in the analysis area varies from high standard ATV trails to primitive single-track trails. The majority of the trails within the analysis area are constructed and maintained by the forest service. However, there is also a small length of trails in the analysis that are user created, or are abandoned trails that still have an existing footprint. These trails are referred to as unclassified. Table 28 shows the breakdown of classified and unclassified trails within the analysis area.

Table 28. Miles of Trail by Status in Shell

Trail Status	Length (Miles)
Forest Service	92.6

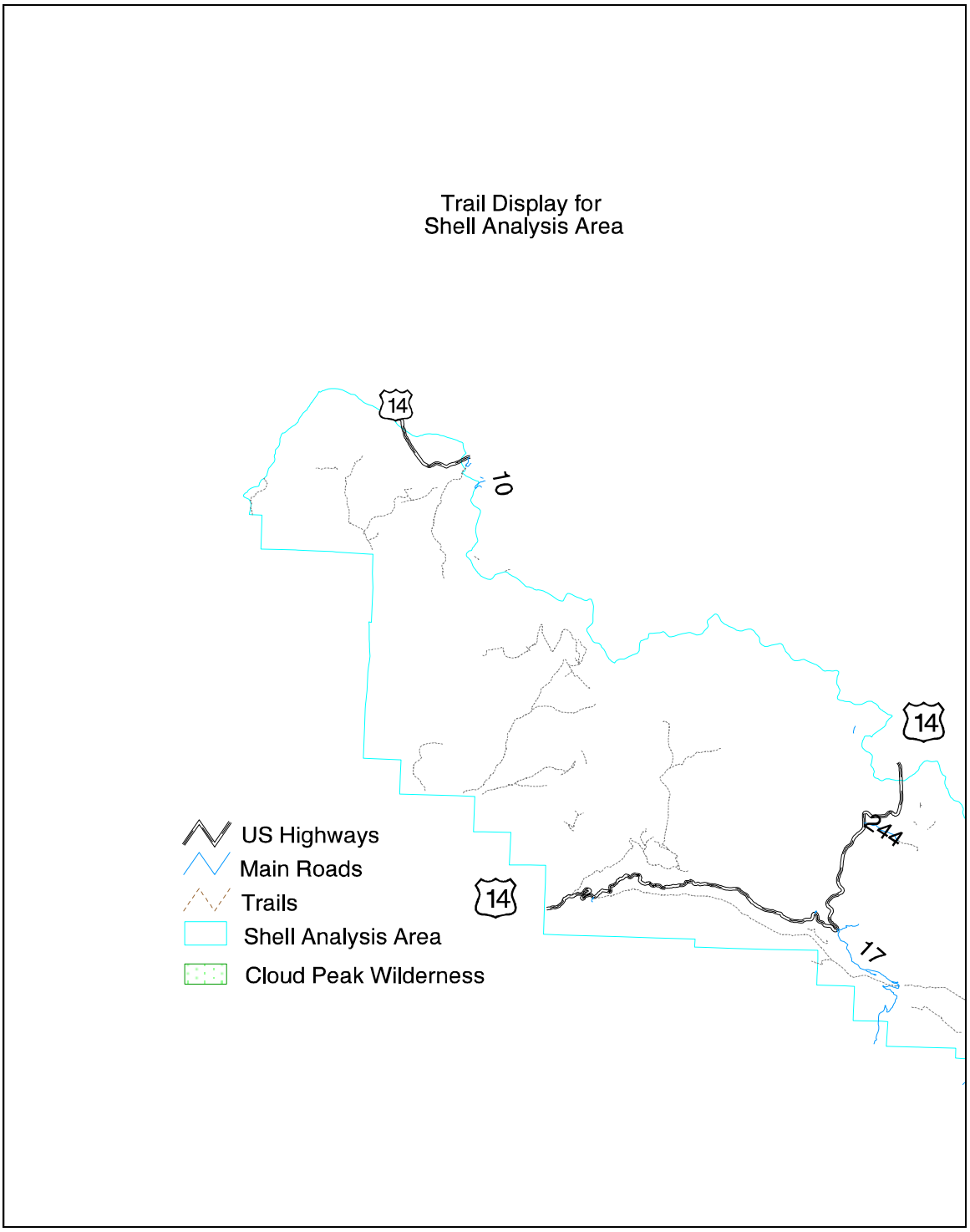
Forest Plan Goals/Desired Conditions

Forest Plan direction for transportation facilities are primarily based on resource needs rather than the road systems as a separate entity. In other words, the driving force behind road management decisions are primarily based on the management directions resource needs for an area. Currently, general plan direction states to maintain all trails to certain minimum requirements, including maintaining drainage structures to prevent unacceptable resource damage, and to remove all hazards from trails to allow safe passage for specified classes of users. For the most part, this direction of the plan is being met, however, deferred maintenance surveys have revealed that a lack of a steady budget in trail maintenance has caused some degradation of the trail system that is not consistent with current plan direction. In contrast, plan direction for providing a full range of trail opportunities in coordination with other state, federal and county municipal jurisdictions and private industries is generally being met.

The current annual trail maintenance need is estimated to be $1,217 per mile and deferred maintenance costs are estimated to be $13,125 per mile[7]. Total trial maintenance needs in the Shell analysis area are estimated to be $112,694 annually maintenance, with a $1,215,375 deferred maintenance backlog.

The map on page 52 shows the current trail system within the Shell analysis area.

[7] These costs are interpolated from the forest wide condition survey assessments done in 2000 and 2001.


Trail Display for
Shell Analysis Area
14
10
14
244
14
17
US Highways
Main Roads
Trails
Shell Analysis Area
Cloud Peak Wilderness

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