CHAPTER 3

AFFECTED ENVIRONMENT

INTRODUCTION

This chapter describes existing conditions for resource areas within the National Forest that may be affected by the alternatives. The resource summaries focus on those aspects of the physical, biological, and human environment most likely to be affected by the alternatives. More detailed information on each resource can be found in the resource specialist's reports in the project file.

REGULATORY FRAMEWORK

FOREST PLAN MANAGEMENT DIRECTION

Management direction for weed control on the CNF is set at the national and forest levels. As described in Chapter 1, federal laws guide implementation of noxious weed control actions. Forest Service policies developed in response to these laws are set forth in Forest Service Manual 2080, Noxious Weed Management. These policies are incorporated into the 1987 Custer National Forest Land and Resource Management Plan (Forest Plan) and the proposed action (Alternative 1).

Management direction of the CNF is found in the Forest Plan which provides Forest-wide goals and objectives for managing diverse resources (Forest Plan, II-3 and II-24). A general management goal of the CNF is to implement an integrated pest management program, as described in the Forest Plan on page II-3. Relevant area-wide management goals found in the Forest Plan (p. II-24) include:

- An integrated pest management approach to noxious weed treatment will be used with control emphasized on new starts, priority areas, and areas of minor infestations. Holding actions will be implemented on areas of existing large infestations. Noxious weed infestations will be inventoried periodically to monitor existing and new infestations. This effort will include cooperation with livestock producers, grazing associations, county weed boards, state agriculture departments, other Federal agencies, state and Federal research organizations, and adjacent landowners.
- The priorities of control efforts will be: a) on areas where small infestations, including new starts, can be eliminated, contained, or reduced in size, b) containment of large infestations, and c) control of the entire infestation. Emphasis will be given to treatment on a drainage basis in cooperation with all landowners.
- Only those chemicals which are labeled under State and Federal laws for target species, and which experience and research have proven effective for weed control, will be used. Chemical treatment will be avoided in areas where such treatment will have a significant impact on water resources, key wildlife habitat or unique vegetation. Isolated new noxious weed starts will be controlled to prevent further expansion into these habitats. Where chemicals are used, techniques will be utilized to reduce the amount applied per acre. All pesticide applicators on National Forest System lands will be certified under the applicable Federal of state law. The use of chemicals will be in agreement with NEPA requirements.
- Biological control techniques which become available and are proven safe and effective will be favored over chemical methods. Research efforts by universities and research stations will be encouraged and new feasible technology resulting from this research will be applied.
- Pre- and post-evaluations of effectiveness will be completed on all weed control projects.

Management area descriptions are found in Chapter III of the Custer Forest Plan. These descriptions provide specific goals and management direction to achieve the Forest-wide goals and standards of the Forest Plan. Proposed actions could occur on all management area allocations identified in the Forest Plan. None of the management areas restrict the control of noxious weeds. Some management areas, however, restrict motorized access. The Forest Service may use motorized vehicles to apply weed control in closed areas, when necessary, by obtaining a variance to the closure order. Steps will be taken to minimize tracks, by staying on established tracks. Weed control methods will comply with motorized restrictions in Wilderness Areas and Research Natural Areas.

Among the resource goals listed in chapter II of the Forest Plan, the proposed activities directly or indirectly address the following goals (paraphrased and emphasis added):

- *Threatened and Endangered Species:* Conserve listed endangered and threatened species and their habitats. This includes conservation of listed sensitive species and their habitats (Forest Plan, page II-17).
- *Watershed Quality and Fisheries:* Maintain or improve quality of watersheds, including water quality and soil productivity. Maintain water quality and quantity in order to maintain fish habitat (Forest Plan, page II-19).
- *Key Indicator / Wildlife Species and Habitat:* Maintain and improve habitats for these species (Forest Plan, page II-16-19).
- *Research Natural Areas:* Provide natural occurring ecological processes within Research Natural Areas (Forest Plan, page III-78).
- *Wilderness Values:* Maintain Wilderness values through use of weed seed free forage use and noxious weed control. (Forest Plan, Appendix II, pages 155-156)

AGENCY POLICY AND DIRECTION

Important policy and direction relevant to weed control is given in the Chief's Natural Resource Agenda (1998), the Northern Region Overview, and the Forest Service Manual. It is also emphasized as one of the four threats to National Forest System lands as outlined by the current Chief of the Forest Service.

1988 Natural Resource Agenda. In March of 1998, Forest Service Chief Mike Dombeck presented the Agency's emphasis in management direction for the 21st century. In this Agenda was a strong emphasis on conserving and restoring degraded ecosystems, including actions to "attain desirable plant communities", and "prevent exotic organisms from entering or spreading in the United States."

Forest Service Manual 2259.03. "Forest office shall cooperate fully with State, County and Federal officials in implementing 36 CFR 222.8 and sections 1 and 2 of PL 90-583 (see below). Within budgetary constraints, the Forest Service shall control to the extent practical, noxious farm weeds on all National Forest System lands."

Forest Service Chief's Four Threats: Forest Service Chief, Dale Bosworth, describes that in the 21st century, the nation's forests and grasslands face four threats. Invasive species is a listed threat, along with fire and fuels, loss of open space, and unmanaged recreation. Management emphasis is being placed on these four threats. Of 2,000 nonnative plants found in the United States, 400 are invasive species. The U.S. spends $13 billion per year to prevent and contain the spread of invasives. For all invasives combined, the price tag is $138 billion per year in total economic damages and associated control costs (http://www.fs.fed.us/projects/four-threats/index.shtml).

LAWS AND REGULATIONS

Laws and regulations give both broad and specific authority and direction for control of noxious weeds on National Forest system lands. These laws and regulations are found in Chapter I.

ENVIRONMENTAL JUSTICE

Executive Order 12898, "General Actions to Address Environmental Justice in Minority Populations and Low Income Populations, requires all Federal agencies to incorporate environmental justice into their mission. The well-being and the health of minorities and low income groups were not identified as an issue during scoping. American Indian Tribes are located within the region. However, issues of disproportionate distribution of project impacts have not been identified regarding any racial minorities or impoverished populations within the project area that might be affected by implementation of this project. The proposed action would not disproportionately affect minority or low-income populations.

NATIVE AMERICAN TREATY RIGHTS

Many tribes use areas within the Custer National Forest. The Crow, Northern Cheyenne, Assiniboine, Shoshone, Arapahoe, Shoshone-Bannock, Three Affiliated, and the Great Sioux Nation, have treaty rights under the 1851 Fort Laramie Treaty to use the National Forests for hunting and gathering.

AFFECTED ENVIRONMENT

VEGETATION

Vegetation - Regulatory Framework

Chapter 1 and the previous section (Agency Policy and Direction; and Law and Regulations) discussed the regulations that pertain to weeds.

Vegetation - Affected Area

The analysis area for vegetation includes all vegetation communities in proximity to proposed treatment areas or those habitats where weeds have potential to invade. These plant communities have the potential to be directly or indirectly impacted by weeds and proposed treatment methods.

Vegetation - Analysis Method

Information used came from data on file at the Custer National Forest, literature review, and personal communications with resource specialists with knowledge of vegetation, weed control, and herbicide effects. Acreage values were derived utilizing GIS.

Vegetation - Affected Environment

Components of the affected vegetation are the weed species themselves, and the native plants communities. The vegetation information is presented in three sub-sections: Weed Species; Native Plant Communities; and Rare Native Plant Species.

WEED SPECIES

Of the 2000 plus vascular plant species that have been documented on the CNF, 16 that occur on the CNF are considered weeds. However, an additional 37 species are listed as occurring adjacent to the CNF for a total of 53 species of concern (see Appendix A). Most of these species only grow in highly disturbed areas where there has been severe disturbance to the ground (such as parking lots, gravel pits, or horse corrals). Many of these weeds are unable to compete with native vegetation and are benign in their effects to the natural environment.

The Custer National Forest could experience a massive invasion of spotted knapweed, leafy spurge, houndstongue, Canada thistle, sulfur cinquefoil, Dalmatian toadflax, and/or yellow toadflax in the very near future, especially in light of some of the large scale wildfires that have occurred and will likely continue to occur.

Some weed species, however, are extremely hardy, competitive, and have the ability to displace native plant species and permanently alter the structure, composition and function of native plant communities. These species are considered very invasive and are typically listed as noxious by States. Many plant species have been identified as an undesirable weed on the CNF (see Appendices A and B). For purposes of this analysis, a weed is defined as any plant that interferes with management objectives for a given area of land (or body of water) at a given point in time. Throughout this document references to weeds include noxious, exotic, invasive, other undesirable species, and poisonous plant species.

There are around 275 invasive plant species in or adjacent to the Custer National Forest (Appendix B). Of these, a weed species concern list of 53 species (Appendix A) has been formulated based on species occurring on noxious weed lists by state and county, on invasive lists from adjacent lands (Greater Yellowstone), and undesirable poisonous species.

Of the 53 concern species listed in the area (Appendix A), 16 have been located and mapped on the Forest. Tables 3 – 1 through 3 -6 displays the acreage for each of these weed species. Canada thistle, spotted knapweed, houndstongue, and leafy spurge are the predominant noxious weed species, comprising 96 percent or 1,400 net acres of the Custer National Forest inventory of 1,458 net acres. The remaining weed species, of varying densities, grow on the remaining four percent or 58 mapped net acres. The acres identified are by species and not by overall infestation area. Due to some sites having multiple weed species the actual infested acreage may be slightly overestimated.

The 53 species of concern for the Custer National Forest include:

- 28 weed species listed as State noxious weeds in Montana and South Dakota found within the counties associated with the Custer National Forest.
- Nine additional weed species listed by counties as being noxious.
- 12 additional weed species listed by the Greater Yellowstone Coordinating Committee and the State of Wyoming (in consideration of their proximity to the Custer National Forest).
- One additional species (tall larkspur) listed by the Custer National Forest as an undesirable poisonous plant to livestock.

Although species have been identified as invasive as of the time of this analysis, it is important to convey the dynamic nature of this list. Every year, counties reassess their noxious weed lists to determine if additions or deletions are needed. The changing nature of the lists is caused by the rapid influx of exotic species into this area in recent years. Although particular species will be highlighted and discussed in this document, it is important to understand that the general discussion regarding invader species applies to any species currently identified as invasive.

In order to better describe the current threat, distribution, and level of concern for invaders, the weed categories as defined by Montana's County Noxious Weed Control Act have been adopted for this analysis. This strategy categorizes weeds by their invasive status. Every weed is categorized in one of three categories, described below. The Tables 3 – 1 through 3 - 6 display the invader species by category, along with known presence on ranger districts.

Category 1 species (wide-spread) are the most difficult to assess because they are so widely distributed. There are good indications based on field observations and documented sightings that species in this category exist in much of their potential habitat in the CNF. This is not to say that there is no room for expansion. On the contrary, many sites currently house small infestations that could grow significantly.

The alpine/subalpine settings (including those settings in the Absaroka-Beartooth Wilderness Area) are noted as the exceptions to this assumption for Category 1 invaders, because many potential sites in these areas are not currently infested nor do they have environmental conditions conducive to weed establishment.

Category 2 species (new invaders) are expected to be very limited in their distribution in or near the project area. Less than an acre of Salt Cedar on the Ashland Ranger District and about 3 acres of common tansy on the Beartooth Ranger District have been recorded.

Category 3 species (potential invaders) are expected to be very limited in their distribution in or near the project area. A trace amount of common crupina has been recorded on the Sioux Ranger District.

The following tables display Custer National Forest’s Category 1, 2, and 3 Weed Acreage by Ranger District. Due to some sites having multiple weed species the actual infested acreage may be slightly overestimated.

TABLE 3 – 1. BEARTOOTH RANGER DISTRICT NOXIOUS WEEDS[1]

Acreage Summary by Ownership Within NFS Boundary[2]

Common Name	Category[3]	USFS Gross[4]	USFS Infested[5]	Private Gross	Private Infested	Total Gross	Total Infested
Leafy Spurge	1	29.5	13.9	5.1	4.2	34.6	18.1
Spotted Knapweed	1	2145.9	127.8	12.8	9.5	2158.7	137.3
Canada Thistle	1	2448.0	142.9	1.0	0.3	2449.0	142.2
Russian Knapweed	1						
Field Bindweed	1	7.4	0.8			7.4	0.8
Houndstongue	1	851.8	57.8	0.9	0.7	852.7	58.5
Dalmatian Toadflax	1	55.4	5.1	3.0	3.0	58.4	8.1
Yellow Toadflax	1	7.1	3.9			7.1	3.9
Oxeye Daisy	1	29.2	3.8			29.2	3.8
Sulfur Cinquefoil	1	201.4	8.5	12.6	9.4	214.0	17.9
Salt Cedar	2						
Meadow Hawkweed	2	0.1	0.1			0.1	0.1
Common Tansy	2	3.3	3.3			3.3	3.3
Common Crupina	3						
Common Mullein	Roadside Weed	Trace					
Musk Thistle	Roadside Weed	Trace					
Perennial Sow Thistle	Roadside Weed						
Total		**5779**	**367**	**35**	**27**	**5814**	**394**

TABLE 3 – 2. BEARTOOTH RANGER DISTRICT NOXIOUS WEEDS

Acreage Summary by County (USFS managed lands only)[6]

Common Name	Category	Carbon Gross	Carbon Infested	Stillwater Gross	Stillwater Infested	Sweet Grass Gross	Sweet Grass Infested
Leafy Spurge	1	17.0	7.7	17.6	10.3		
Spotted Knapweed	1	1463.1	84.7	638.8	48.6	56.7	0.5
Canada Thistle	1	1329.7	52.4	936.9	82.7	182.4	7.1
Russian Knapweed	1						
Field Bindweed	1	7.3	0.7	0.1	0.1		
Houndstongue	1	456.9	12.6	339.1	45.5	56.7	0.5
Dalmatian Toadflax	1	56.4	7.9	2.0	0.2		
Yellow Toadflax	1	3.0	0.5	4.0	3.3		
Oxeye Daisy	1	25.2	0.8	4.0	3.1		
Sulfur Cinquefoil	1	150.3	7.9	63.7	3.7		
Salt Cedar	2						
Meadow Hawkweed	2	0.1	0.1				
Common Tansy	2	0.1	0.1	3.2	3.2		
Common Crupina	3						
Common Mullein	Roadside Weed						
Musk Thistle	Roadside Weed						
Perennial Sow Thistle	Roadside Weed						
Total		**3509**	**175**	**2009**	**211**	**296**	**8**

[1] As Of 6-15-2004
[2] Acreage falls within Beartooth Weed Management Area.
[3] Category 1, Wide Spread, Category 2, Rapid Spreading, Category 3, New Invader
[4] Gross acreage is a mapped unit around infestations and does not necessarily represent actual infested acres.
[5] Infested acreage is the estimated infested portions of an overall gross mapping unit and more closely represents areas receiving actual treatment.
[6] No infested areas known to occur in Park County at this time

TABLE 3 – 3. SIOUX RANGER DISTRICT NOXIOUS WEEDS[7]

Acreage Summary by Ownership Within NFS Boundary

Common Name	Category[8]	USFS Gross	USFS Infested	Private Gross	Private Infested	State Gross	State Infested	Total Gross	Total Infested
Leafy Spurge	1	62.0	23.8	1.0	0.2	1.9	0.2	64.8	24.1
Spotted Knapweed	1	18.8	13.6					18.8	13.6
Canada Thistle	1	1151.3	748.6	0.4	0.4	7.9	5.4	1159.6	754.3
Russian Knapweed	1			0.1	0.1			0.1	0.1
Field Bindweed	1								
Houndstongue	1	97.2	23.7	0.1	0.1	1.0	0.2	98.3	24.0
Dalmatian Toadflax	1								
Yellow Toadflax	1								
Oxeye Daisy	1								
Sulfur Cinquefoil	1								
Salt Cedar	2								
Common Tansy	2								
Common Crupina	3								
Common Mullein	Roadside Weed	12.6	9.2					12.6	9.1
Musk Thistle	Roadside Weed	4.1	4.0					4.1	4.0
Perennial Sow Thistle	Roadside Weed	3.1	3.0					3.1	3.0
Other	Roadside Weed	9.6	5.1	3.0	1.1	1.0	0.8	13.6	7.0
Total		**1359**	**831**	**5**	**2**	**12**	**7**	**1375**	**840**

TABLE 3 – 4. SIOUX RANGER DISTRICT NOXIOUS WEEDS

Acreage Summary by County (USFS ownership only)

Common Name	Category	MT-Carter Gross	MT- Carter Infested	SD-Harding Gross	SD-Harding Infested
Leafy Spurge	1	58.9	22.3	3.0	1.5
Spotted Knapweed	1	18.8	13.6		
Canada Thistle	1	1142.1	746.6	9.3	2.0
Russian Knapweed	1				
Field Bindweed	1				
Houndstongue	1	97.2	23.7		
Dalmatian Toadflax	1				
Yellow Toadflax	1				
Oxeye Daisy	1				
Sulfur Cinquefoil	1				
Salt Cedar	2				
Common Tansy	2				
Common Crupina	3				
Common Mullein	Roadside Weed	12.6	9.2		
Musk Thistle	Roadside Weed	4.1	4.0		
Perennial Sow Thistle	Roadside Weed	3.1	3.0		
Other		9.6	5.1		
Total		**1346**	**827**	**12**	**3**

[7] As Of 6-15-2004

[8] Category 1, Wide Spread, Category 2, Rapid Spreading, Category 3, New Invader

TABLE 3 – 5. ASHLAND RANGER DISTRICT NOXIOUS WEEDS[9]

Summary by Ownership Within NFS Boundary

Common Name	Category[10]	USFS Gross	USFS Infested	Private Gross	Private Infested	State Gross	State Infested	Total Gross	Total Infested
Leafy Spurge	1	89.8	9.9	0.5	0.1	0.5	0.1	91.7	10.1
Spotted Knapweed	1	6414.7	191.7					6414.7	191.7
Canada Thistle	1	13.3	0.7					13.3	0.7
Russian Knapweed	1	181.3	20.0					181.3	20.0
Field Bindweed	1							0.0	0.0
Houndstongue	1	12.5	1.7					12.5	1.7
Dalmatian Toadflax	1								
Yellow Toadflax	1								
Oxeye Daisy	1								
Sulfur Cinquefoil	1								
Salt Cedar	2	0.9	0.1					0.9	0.1
Common Tansy	2								
Common Crupina	3								
Common Mullein	Roadside Weed	0.9	0.1					0.9	0.1
Musk Thistle	Roadside Weed								
Perennial Sow Thistle	Roadside Weed								
Other									
Total		**6713**	**224**	**0.5**	**0**	**0.5**	**0**	**6714**	**224**

TABLE 3 – 6. ASHLAND RANGER DISTRICT NOXIOUS WEEDS

Ashland Noxious Weed Acreage Summary by County (USFS ownership only *)

Common Name	Category	Rosebud Gross	Rosebud Infested	Powder River Gross	Powder River Infested
Leafy Spurge	1	8.4	1.1	81.4	8.8
Spotted Knapweed	1	33.8	1.4	6380.8	190.3
Canada Thistle	1	12.1	0.5	1.2	0.2
Russian Knapweed	1			181.3	20.0
Field Bindweed	1				
Houndstongue	1	12.5	1.7		
Dalmatian Toadflax	1				
Yellow Toadflax	1				
Oxeye Daisy	1				
Sulfur Cinquefoil	1				
Salt Cedar	2	0.9	0.1		
Common Tansy	2				
Common Crupina	3				
Common Mullein	Roadside Weed			0.9	0.1
Musk Thistle	Roadside Weed				
Perennial Sow Thistle	Roadside Weed				
Other					
Total		**68**	**5**	**6646**	**219**

[9] As Of 6-15-2004
[10] Category 1, Wide Spread, Category 2, Rapid Spreading, Category 3, New Invader

Appendix E depicts weed treatment priorities commonly utilized on the Custer National Forest due to a shortage of funding and effectiveness potential. Priority is generally given to those new populations of aggressive invader species where long-term management can be successful. An example would be a new site consisting of five plants of sulfur cinquefoil. On larger, well established infestations, such as many acres of leafy spurge, where long term effectiveness is questionable, containment strategies play a much more important role, such as in the Powder River Breaks on the Ashland Ranger District. Even then control emphasis is provided along the spread vector areas such as trailheads, roadways, and parking areas.

WEED BIOLOGY

Due to the large number of species identified as a weed to the CNF, a detailed discussion of the biology and ecology of each species is not provided here. Appendix I provides further biological features of common weed species on or near the Custer NF. Much more detailed information can be found in the project file. There are a number of species that are of particular concern to this analysis and these are discussed below in more detail.

Category 1 - Widespread Invaders

Species in this category are already widespread in and around the project area. These species have been here for decades yet are still increasing their range; some steadily and others rapidly. Current Category 1 invaders in and around the project area are:

Leafy Spurge (*Euphorbia esula*) **-** Leafy spurge is a long-lived, deep-rooted perennial that reproduces vegetatively and by seeds. The most distinguishable part of leafy spurge is a milky, latex fluid found in every part of the plant.

Leafy spurge can cause serious environmental damage by completely dominating a site and excluding all other species. It prefers grasslands and open gravel river bottoms. There are large infestations in and adjacent to the project area. Leafy spurge is known to occur on the Beartooth, Ashland, and Sioux Districts.

Spotted Knapweed (*Centaurea maculosa*) –Spotted knapweed is a biennial or short-lived perennial varying from eight inches to 4 feet tall with a stout tap root. The stout taproot, pink flowers tipped with white, and noticeable dark spots on the bud are what makes spotted knapweed different from the creeping-root form of Russian knapweed.

Spotted knapweed can cause serious environmental damage by completely dominating a site and excluding all other species. This species, for the most part, is restricted to non-forest environments and disturbed areas such as roadsides and gravel pits. Spotted knapweed is known to occur on the Beartooth, Ashland, and Sioux Districts.

Houndstongue (*Cynoglossum officianale)* – Houndstongue is a biennial growing 1 to 4 feet tall and reproducing by seed. It forms a rosette the first year and sends up a flowering stalk the second year. The nutlets break apart at maturity and cling to clothing or animals.

Houndstongue tends to grow in coulees, trees and brushy areas and fairly shaded sites, although not limited to, this environment. Houndstongue is known to occur on the Beartooth, Ashland, and Sioux Districts.

Canada thistle (*Cirsium arvense*) **–** Canada thistle is a creeping perennial that reproduces by seeds and fleshy, horizontal roots. The erect stem is hollow, smooth and slightly hairy, 1 to 5 feet tall. Sharp spines are numerous on the outer edges of the leaves and on the branches and main stem of the plant.

Canada thistle is usually found in open areas with moderate or medium moisture conditions. It is found most frequently in colonies along roadsides and railroad rights-of-way, and on rangeland, forestland, cropland, and abandoned fields. It is also found on stream banks, lakeshores, and other riparian areas.

Canada thistle is probably the most widespread of all thistle species, and thus is considered by many to be the most difficult to control. Canada thistle is known to occur on the Beartooth, Ashland, and Sioux Districts, especially in wildfire areas, prescribed burn areas, and timber harvest areas.

Sulfur cinquefoil (*Potentilla recta*) - Sulfur cinquefoil is a perennial, 1 to 1.5 feet tall, with well-developed rootstocks. Flowers are light yellow with 5 petals, each flower producing numerous single-seeds. Sulfur cinquefoil is a very aggressive plant and will grow and crowd spotted knapweed.

This is a relatively new invader to our area. First recorded in the 1980s, it has rapidly increased and now is widespread throughout the Beartooth foothills, mostly in disturbed non-forest environments. It can also be found in isolated spots in undisturbed settings. This plant is found largely in the project area within the Beartooth District.

Dalmatian Toadflax (*Linaria dalmatica*) – Dalmatian toadflax is a creeping perennial that closely resembles yellow toadflax, but is taller and can grow 2 to 4 feet in height, and the leaves are heart-shaped, clasping the stem. It is a deep-rooted (6 feet +), short-lived perennial that reproduces by seeds and by vegetative buds on the roots. The toadflaxes are easily distinguished from other rangeland weeds by the distinctive resemblance to domestic snapdragon.

Dalmatian toadflax is especially well adapted to arid sites and can spread rapidly once established. It is highly competitive where summer moisture is limited. It is found on the Beartooth Ranger District.

Yellow or Common Toadflax (*Linaria vulgaris*) – Yellow toadflax is a creeping perennial that closely resembles Dalmatian toadflax, but is shorter, growing only 12 to 30 inches tall, and the leaves are linear rather than heart-shaped. Like Dalmatian toadflax, yellow toadflax also resembles the snapdragon in appearance. Generally, yellow toadflax is found on moister, more fertile sites than Dalmatian toadflax. It is a deep-rooted (3 feet plus), short-lived perennial that reproduces by seeds and by vegetative buds on the roots.

Yellow toadflax has now become a serious problem to higher elevation rangelands and mountain meadows. Yellow toadflax is known to occur on the Beartooth District.

Oxeye Daisy (*Chrysanthemum leucanthemum*) **–** Oxeye daisy is an erect rhizomatous perennial, 10 to 24 inches tall. Leaves progressively reduce in size upward on the stem.

Oxeye daisy can be found in meadows, roadsides, and waste places. Oxeye daisy is known to occur on the Beartooth District.

Common Tansy (*Tanacetum vulgare*) **–** This species is an aromatic perennial. Stems are 1 ½ to 6 feet tall. It reproduces from seeds and rootstalks. Common tansy is sometimes mistaken for tansy ragwort.

Common tansy is generally found along roadsides, water areas, stream banks, and in pastures. It has long been used as a medicinal herb. Common tansy is known to occur on the Beartooth District.

Whitetop (*Lepidium draba*) – Whitetop is a creeping perennial which reproduces by seed and creeping roots. The extensive root system spreads horizontally and vertically with frequent shoots arising from the root stock. Lateral roots eventually turn down to become vertical roots which often reach greater depths than the parent roots. Both the vertical and lateral roots produce adventitious buds, which develop into rhizomes and shoots. The deep root system and the weed's ability to reproduce vegetatively make these weeds very difficult to control.

Whitetop, or hoary cress, is found on cultivated lands, along roadsides, in pastures, rangelands, and other non-crop areas. It grows in waste places, cultivated fields, and pastures, and is capable of vigorous growth on the irrigated, alkaline soils. Whitetop is known to occur adjacent to the Beartooth District.

Field Bindweed (*Convolvulus arvensis*) **–** Field bindweed is a perennial with an extensive root system. It often climbs or forms dense tangled mats. Stems are prostrate, 1 to 4 feet long.

Because of its remarkable adaptability to different environmental conditions, field bindweed may be found from low to high altitudes. Field bindweed is found on the Beartooth Ranger District.

Russian Knapweed (*Acroptilon repens)* –Russian knapweed is much like spotted knapweed in its appearance and flower color, except Russian knapweed has pale egg-shaped flowerhead bracts. Unlike spotted knapweed, Russian knapweed is a creeping perennial that forms dense colonies and is much more lush in appearance.

Russian knapweed grows in cultivated fields, along ditch banks, fence rows, roadsides, and in waste places. It invades open, disturbed ground, suppresses growth of surrounding plants and once established, forms a single species stand. It is considered a noxious weed in 412 counties within 21 western states. It is a serious habitat invader because of its aggressive nature and allelopathic properties. It is very poisonous to horses. It is especially prevalent from 4,500 to 7,500 feet.

Russian knapweed is known to occur in trace amount on the Ashland Ranger District and adjacent to the Beartooth Ranger District. It is found from the East Bridger to Warren area between the Pryor and Beartooth Mountains.

Diffuse Knapweed (*Centaurea diffusa*) – Diffuse knapweed is an annual, biennial, or short-lived perennial that can grow to a height of 3 feet, with a single, much-branched stem that gives the plant a bushy appearance.

Diffuse knapweed spreads by seed, aided by the tumbling of windblown mature plants, and it grows under a wide range of conditions. Diffuse knapweed is known to occur adjacent to the Beartooth Ranger District in trace amounts on the Shoshone and Gallatin National Forests.

Common St. Johnswort (*Hypericum perforatum)* – St. Johnswort is a hardy perennial weed that reproduces vegetatively and by seed.

It invades grassland habitats readily, but can also be found along roadsides in our moist forest environments. This species is highly valued as a medicinal herb and is being commercially harvested in large quantities. St. Johnswort is known to occur adjacent to the Beartooth Ranger District.

Category 2 - New Invaders

These species are known to occur in and around the project area, but have only recently invaded, so are still limited in geographic extent. Some are restricted to even smaller areas such as one river drainage, or meadow. Some of these species are not noticeably increasing, while others are exhibiting exponential growth. If left unchecked, most of these species are expected to transition into Category 1 in the near future. Category 2 species in and around the CNF are:

Absinth Wormwood (*Artemisia absinthium)* –Absinth wormwood, a perennial, grows 16-48 inches tall with relatively large dissected leaves that are 1.25 to 3 inches long.

This species is not listed on the Montana or South Dakota Noxious Weed List, but it is listed locally as a species of concern by Carbon County, MT and Harding County, South Dakota.

This species is often mistaken for a sagebrush variety of plant. This plant is very aggressive. It likes soil disturbance and will grow in most any type soils and tends to be in areas with moisture. Most common places to find absinth wormwood are gravel pits, topsoil stockpiled areas, new roads or construction sites, and irrigation ditch banks. Livestock and wildlife will not graze this plant due to the odor. Wormwood is known to occur adjacent to the Beartooth, Ashland, and Sioux Ranger Districts.

Orange Hawkweed (*Hieracium aurantiacum)* – Orange hawkweed is a fibrous rooted perennial forb up to 12 inches tall. The plant contains milky juice. Yellow hawkweed (*H. pratense*) is similar in appearance to orange hawkweed. This plant forms a solid mat on the ground choking out all grasses around it. It spreads similar to a strawberry and by seed dispersal.

The distribution of this species is limited. It is reported to be west of the Cascades. It is found in areas in Western Montana. This species was recently discovered in Carbon County near Luther. This species is known to occur on the Beartooth Ranger District.

Meadow Hawkweed Complex (*Hieracium pratense, H. floribundum,* and/or *H. piloselloides)* – These three yellow-petaled species are referred to as the meadow hawkweed complex. They have been highly successful at spreading because of their ability to reproduce by seeds, rhizomes, stolons, and adventitious root buds.

Meadow hawkweed tends to grow in places such as meadows, roadsides, pastures, lawns, and fields. Meadow hawkweed is known to occur on the Beartooth Ranger District in the Pryor Mountains, East Rosebud, and West Rosebud areas.

Dyer's Woad (*Isatis tinctoria*) – Dyer's woad is a winter annual, biennual or short-lived perennial. It has thick taproots and lateral roots. It adapts to dry areas and spreads primarily by seed. This species is not known to occur on or near the Custer National Forest.

Perrenial Pepperweed (*Lepidium latifolium)* - The perennial pepperweed is an aggressive weed that establishes and colonizes very fast. It usually grows from 1 to 3 ft. and sometimes up to 6 ft. tall. It is known to be a problem on the roadsides, rangeland, cropland to riversides or on mountain tops. This species is not known to occur on or near the Custer National Forest.

Purple Loosestrife (*Lythrum* species) – Purple loosestrife is a stout, erect perennial aquatic and wetland plant. Its invasion into a wetland system results in suppression of the native plant community and the eventual alteration of the wetland's structure and function. Loosestrife crowds out native vegetation and eventually becomes a virtual monoculture. Infestations appear to follow a pattern of establishment, maintenance at low numbers, and then dramatic population increases when conditions are optimal.

Unlike most invaders, this species grows in wetlands where it can completely dominate the vegetative cover and replace diverse native wetland communities. Purple loosestrife is a popular ornamental plant, commonly referred to as "lythrum." Purple loosestrife is known to occur in Carbon County, adjacent to the Beartooth District.

Tall Buttercup (*Ranunculus acris*) – Tall buttercup is a hairy perennial; often reaching 3 feet in height.

Buttercup species usually occur in meadows and pastures and are generally avoided by livestock. It has been reported to cause livestock poisonings. Tall buttercup is known to occur adjacent to the Beartooth Ranger District.

Tansy Ragwort (*Senecio jacobaea)* - Tansy ragwort's stem stands straight up and branches out at the top. This plant is a biennial plant, it sprouts in late fall or early winter. These plants get to about 6-feet high, with yellow colored flower petals numbering about 13 petals each. This plant when eaten by livestock can cause liver cancer and eventual death. Once eaten by the organism, the harmful materials and toxic milk stay in the organism's system and build up over time. This species is not known to occur on or near the Custer National Forest.

Saltcedar (*Tamarix* species) – Saltcedar is a deciduous or evergreen shrub or small tree, 5-20 feet tall. Bark on saplings and stems are reddish-brown. When given the chance, this tree can dry up complete waterways. As the water level lowers, the root system follows and continues to draw water. The plant transpires and lets off salt therefore the name "salt cedar." This salt kills non-salt tolerant plant life around it and turns the soil sterile to native plants.

Saltcedar is found along streams, canals, and reservoirs in much of the west. A few locations are known on the Ashland Ranger District. It also exists adjacent to the Beartooth Ranger District along the Clarks Fork River from Belfry to Laurel and east of Bridger on Bridger Creek near the Pryor Mountains.

Category 3 - Potential Invaders

Only one of these species is located in the project area (common crupina on the Sioux Ranger District). They are, however, either known from nearby areas or are expected to invade our area in the near future, based on their rapid rate of spread in our direction. Many of these species have caused severe ecological damage in other areas. Examples of significant Category 3 invaders near the project area are:

Yellow Starthistle (*Centaurea solstitialis)* **-** Yellow starthistle is a winter annual and is 2 to 3 feet tall.

Yellow starthistle grows on various soil types and is usually introduced on roadsides and waste areas. "Chewing disease" results when horses are forced to eat the yellow starthistle.
It has been discovered in alfalfa plantings in Carbon County (Joliet and Bridger) and is suspected in Rosebud County. It prefers drier habitats than typically occur on the CNF; however, the driest portions of the Forest are still at risk.

Rush Skeletonweed (*Chondrilla juncea)*- Rush skeletonweed is a long-lived perennial. It infests waste areas and areas of well drained sandy or rocky soils of dry to moist environments, although healthy native vegetation has been found to be more resistant to infestation. This species is not known to occur on or near the Custer National Forest.

Common Crupina (*Crupina vulgaris*) – Common crupina is a fall geminating annual. Crupina has rough, short, stiff spines on its leaves.

Crupina is found in range and disturbed non-crop lands. It can be found on southern slopes in steep canyon grasslands. Crupina has been documented on the Sioux Ranger District.

Yellowflag Iris (*Iris pseudacorus*) – Yellowflag iris is a herbaceous perennial wetland species that reproduces from seeds and vegetatively by rhizomes. It forms large dense colonies. It grows in wet areas and in water up to 10 inches deep. This species is not known to occur on or near the Custer National Forest.

Eurasian Milfoil (*Myriophyllum spicatum*) – Erasian milfoil is an emergent, herbaceous aquatic plant that reproduces vegetatively by rhizomes and fragmented stems. It forms large, floating mats of vegetation on the water surface, preventing light penetration. Red flowers bloom near the water surface. This species is not known to occur on or near the Custer National Forest.

NATIVE PLANT COMMUNITIES: VULNERABILITY TO INFESTATIONS - RATE OF SPREAD

Since the late 1800's exotic plant species have been spreading across the Pacific Northwest and Northern Great Plains. It is clear when studying distribution records of exotic plant species over time that the plants are increasing and expanding their range once they are established (Rice 1999). Based on these historic trends, these patterns of expansion will continue due to transport of seeds from increasing intercontinental travel and trade, and through continued disturbance on all lands (through agricultural, residential, recreational, and commercial developments). Nationally, Forest Service lands have an estimated six to seven million acres that are infested with noxious or invader weeds. This figure is increasing at an exponential rate of 8-12 percent per year. For example, 10 acres of spotted knapweed left unmanaged today in a disturbed environment has the potential of increasing to 1,000 acres in ten years.

Invasive species have been recognized as being second only to land development in the loss of biodiversity. Some exotic species are so fast to colonize and convert native vegetation that little can be done in time to stave off the invasion. A review of the timing of action taken to address the threats from these species has shown that action often comes too late. Many species are not recognized and placed on noxious weed lists until they have already caused irreparable harm. To remedy this problem, researchers and managers have recently moved towards developing more proactive approaches, such as analyzing the risk of exotic species to the environment. Evaluating risk to native plant communities from invasion by the most imminent and threatening of exotic plant species is important in identifying opportunities for action.

The 1.2 million acres of Custer National Forest land supports a very diverse mixture of plant communities. Vegetation runs from open, dry grasslands and sagebrush/grass in the valley bottoms, to dense lodgepole, subalpine fir and Douglas fir forest in the mid elevations. Subalpine/alpine grasslands, tundra and rock barrens dominate the high elevations. Wetlands and riparian areas are scattered throughout the Forest.

Forested vegetation dominates the majority of the lands on the Beartooth District, while the Sioux and Ashland Districts are composed of about half forested and half non-forested systems. However, the areas dominated by non-forest vegetation encompass the highest species and plant community diversity. Some of these areas are also at the greatest risk for invasion by exotic species.

Alpine vegetation: Alpine communities occur at the highest elevations along the Beartooth Mountain Range. These communities are highly significant from a diversity standpoint, because they serve as refugia for arctic/alpine species that are topographically isolated from one another. Consequently, a number of rare native species and local endemics (plants that grow nowhere else in the world) can be found there. Although exotic species can occur on these sites, these communities are not at risk by the species currently identified as invaders because these sites are incompatible for the growth and establishment of the invader species.

Grasslands (steppe) and Shrub-steppe: A shrub-steppe is a grassland, co-dominated by shrubs, such as shrubby cinquefoil or sagebrush. These are sites that are not favorable to tree growth (usually not enough moisture), where grass species or a combination of grasses and shrubs dominate. Although there is not a great deal of acreage in these communities on the CNF, they are important from a species diversity perspective. They are also at the greatest risk from exotic species invasion, because environmental conditions in these vegetation types are very similar to the conditions where many invader species originated.

Nearly all of the montane and foothill grasslands found on the CNF outside the Absaroka-Beartooth Wilderness are classified in the Idaho fescue/bluebunch wheatgrass habitat type (Mueggler and Stewart 1980). These are typically found on warm (southerly aspect), well-drained sites at all elevations throughout the Forest. Dominant species are Idaho fescue and bluebunch wheatgrass, however, many other native grasses and forbs can be found. Many of these communities on the CNF are currently free of invasive species; however, with any degree of disturbance or introduction of exotic seeds, these sites are highly at risk.

In the Absaroka-Beartooth Wilderness, drier plant communities are minor components of the designated area. Idaho fescue grasslands are found.

Wetlands and Riparian Communities: Plant communities dominated by moisture-loving plants occupy a small fraction (about 25,000 acres – less than 5%) of the total landscape on the CNF. However, these sites have the greatest species diversity of all vegetation communities in our area. Many different types of wetlands exist, including sedge, bulrush or cattail dominated marshes; grass or sedge dominated wet meadows; fens, and peat land. Riparian areas are those stringers of vegetation along stream courses that are highly influenced by the high water table adjacent to the flowing water. Species composition on these sites is highly variable, but tends to be shrub dominated with willows, red-osier dogwood and alder. Riparian / Wetlands are at risk from exotic species invasion. Some wetlands tend to out-compete many invasives, while other riparian areas in a drier setting are at higher risk to invasion.

Currently, Canada thistle can be deleterious to native wetland and riparian communities. A trace amount of inventoried weeds are found in riparian systems (mostly Canada thistle). Protection measures in Appendix C and label instructions address riparian / wetland concerns. Other wetland/riparian weeds include poison hemlock, purple loosestrife, reed canarygrass, tall buttercup, and water milfoil.

Canada thistle is also widespread, growing in dense colonies of disturbed wet meadows and riparian areas. Purple loosestrife and reed canarygrass has been found in adjacent lands within Carbon County, Montana. Poison hemlock is known to occur on the Ashland District. Tall buttercup and water milfoil have not been found in any wetland or riparian environments in or near the project area.

Although leafy spurge is not considered a moisture-loving plant, it can flourish in well-drained river cobbles and gravel bars along stream courses.

Forested Plant Communities: Most closed canopy environments of common forest types found on the Custer National Forest are not conducive to invasion and infestation by exotic species. Even those species that can flourish in a forest setting need more sunlight, some degree of disturbance, or a combination of the two. However, in more open and / or disturbed conditions, nearly all but the wetland/riparian invaders can occur.

Many invader species are more successful in the more open canopy, drier forest types (dominated by Douglas fir or ponderosa pine), especially when there is some type of disturbance such as a road, skid trail, livestock grazing, or high recreational use. On the CNF, the most noticeable and widespread invaders in this situation are spotted knapweed, houndstongue, Canada thistle, dalmatian toadflax, and leafy spurge. Other species, however, are rapidly spreading such as sulfur cinquefoil.

Table 3 - 7 quantifies the acreage at risk of invasion if the current weed populations are allowed to grow unchecked. Some of the associated sites are already infested with early pioneering plant species making them prime candidates for weed spread. Approximately 45% percent or roughly 550,000 acres is naturally susceptible or at high risk to weed invasion in the project area.

TABLE 3 - 7. COVER TYPE VULNERABILITY TO WEED INFESTATION[11]

(figures in **Bold** print considered most at risk)

Cover Type	Beartooth			Sioux	Ashland	CNF.
	Ac. Over 8000'	Ac. Below 8000'	Total Ac.	Total Ac.	Total Ac.	Total Ac.
Non-irrigated Ag Land		**60**	60	**429**	**1261**	1750
Irrigated Ag Land		**15**	15	**318**	**2521**	2854
Non-native Grassland		**1037**	1037	**883**	**2956**	4876
Very Low Cover Grassland	20572	**11983**	32555	**2002**	**66436**	100992
Low / Moderate Cover Grassland	51317	**27030**	78347	**73460**	**117433**	269240
Moderate / High Cover Grassland	2020	**7367**	9387	**29972**	**21549**	60909
Open Canopy Sagebrush 5-25%			0	**427**	**7993**	8420
Closed Canopy Sagebrush >25%			0	**96**	**16132**	16228
Mesic Shrublands	6558	**2260**	8818	**3596**	**27571**	39985
Xeric Shrublands - Sagebrush		**6960**	6960			6960
Horizontal Juniper			0	12		12
Aspen	125	**8657**	8783			8783
Mixed Broadleaf / Cottonwood		**1058**	1058	**10470**	**4536**	16064
Lodgepole Pine	11223	36273	47496			47496
Whitebark Pine	41645	**4968**	46613			46613
Limber Pine	234	**12549**	12782			12783
Ponderosa Pine Closed Canopy >25%	26	1372	1398	35309	170452	207159
Ponderosa Pine Open Canopy <25%		**1300**	1300	**13615**	**22092**	37007
Douglas Fir Closed Canopy >25%	1525	28975	30500		3356	33856
Douglas Fir Open Canopy <25%		**5990**	5990			5990
Rocky Mtn. Juniper			0	**371**		371
Utah Juniper		**1300**	1300			1300
Douglas Fir / Lodgepole Pine	2898	21696	24594			24594

[11] Acreage is within NF Boundary and includes private and state inholdings. Based on Silc3bnd04 Grids (postfire version CNF cover types).

Cover Type	Beartooth			Sioux	Ashland	CNF.
	Ac. Over 8000'	Ac. Below 8000'	Total Ac.	Total Ac.	Total Ac.	Total Ac.
Douglas Fir / Ponderosa Pine		347	347			347
Subalpine Fir / Spruce	38590	15683	54273			54273
Mixed Subalpine Conifer	55		55			55
Mixed Upper Subalpine Conifer	2410	14	2424			2424
Mixed Lower Subalpine Conifer	1772	10620	12392			12392
Mixed Xeric Conifer	97	4099	4196			4196
Water	2479	1207	3686	69	442	4197
Rock	112283	7013	119296	1298	9023	129617
Mines / Quarries		154	154			154
Grass Dominated Badlands			0	**3277**	**12048**	15325
Shrub Dominated Badlands			0	**635**	**15781**	16416
Snow	23919	36	23995			23995
Acreage Over 8000'	319748					
Acreage Below 8000'		220023				
Entire Unit Acreage			539771	176240	501580	1217594
Acreage Vulnerable to Weeds (taken from figures indicated in Bold print)		**92534**		**139552**	**318308**	**550394**
Vulnerable Acreage % of Unit		**17%**		**79%**	**63%**	**45%**

The degree of risk from some of the most threatening species can be evaluated when completing project risk assessments using the Northern Region protocols outlined in Appendix D. The susceptibility of an area to species' establishment, the level of threat to susceptible areas, and the probability of exposure of each site to plant propagules affecting dispersal can be evaluated. Overlaying weed inventories with this vulnerability assessment can further identify areas that are potentially at risk from invasion.

Ground disturbing catastrophic events, such as a wildfire, create an environment most prone to the spread of noxious weeds. Weeds typically establish most quickly on previously forested areas having burned under high intensity and high severity conditions. Prior to recent large wildfires, shading by conifers inhibited noxious weeds from spreading into areas with unburned overstories. The large wildfires that occurred on the Custer National Forest (1988 Storm Creek, 1992 Blank, 2000 Stag/Tobin, 2001 Willie, and 2003 Red Waffle and Kraft Springs) opened the overstory forest canopy and reduced understory vegetation on about 22% of the Custer NF landscape which allowed a prime seedbed for competing weeds. Post-fire monitoring indicates a definite increase in the number of weeds, especially Canada thistle, Spotted Knapweed, and Leafy Spurge following the fires. These large scale fire areas are most prone to long-term invasion.

POISONOUS PLANTS

Tall Larkspurs (*Delphinium occidentale and D. barbeyi*) – Some plant species can be considered an undesirable even though they are native to the area. Tall larkspur, especially where conditions support it becoming a major component of the landscape, can be poisonous to cattle. Management of these sites often occurs where significant poisoning occurs. There is an economic loss associated with livestock poisoning from tall larkspur. Additional financial losses associated with poisonous plants include: reduced weight gains, increased management costs (i.e. labor, veterinary, fencing, etc.), and control costs. Poisoning on rangelands occurs with irregularity because of changes in climatic conditions.

Among all of the poisonous plants, tall larkspur causes a large number of cattle deaths on western ranges (USDA, ARS, 1998, USDA, ARS, 2000, USDA, ARS, 2001. Tall larkspur claims average death losses of 4-5% annually in some areas in Utah, Colorado, Wyoming, Idaho and Montana. Some ranchers experience death losses of more than 15% (Ralphs et al., 2003). Tall larkspur causes poisoning in June and July, depending on the elevation. At lower elevations the plant material is not considered poisonous after August 15. Some cattle death losses on the Beartooth District are attributed to tall larkspur.

The principle poisoning agent is found throughout the tissue of young larkspur, and concentrates in the reproductive parts of the plant as the plant matures. In mature plants, only the seeds are considered poisonous (Ralphs et al., 2003).

As a result, the presence of tall larkspur on many rangelands forces livestock operators to avoid some pastures early in the season. An avenue of control is herbicides. The entire taproot and underground buds must be killed, or it will regrow the next year. Total eradication is nearly impossible, but reducing larkspur density can significantly lower the amount eaten and reduce death losses.

Current management practices include deferring livestock entry into tall larkspur areas until plants become more mature and less toxic. This minimizes permittee economic loss due to livestock fatality from poisoning. However, due to variability in seasonal precipitation, population densities, livestock behavior, and timing of actual plant maturity, livestock losses still occur. This equates to an economic loss that can be further minimized through control of tall larkspur populations in primary rangelands under permit. Sheep grazing, fertilizing, and grazing avoidance during the early summer months, and herbicides have all proven effective.

Tall larkspur is a member of the buttercup family and it stands from two to six feet tall. The flowers are deep blue of purple and have the characteristic spurs of the delphinium flower group. Tall larkspur is found in the foothills of the Rocky Mountains, growing in moist draws or coulees and on hillsides at higher elevations. Larkspur needs some shade and a well-drained, fertile soil.

Tall Larkspur is abundant in moist mountain settings along the Beartooth front on the Beartooth Ranger District. It is responsible for cattle losses over the years, especially in the Pass Creek and Picket Pin areas.

Picloram (Tordon), Metsulfuron (Escort), Glyphosate (Roundup), and triclopyr (Garlon 4) control tall larkspur (USDA, FS, FEIS database 2003). Picloram (Tordon) is effective on tall larkspur and can be used throughout the growing season. Metsulfuron (Escort) works well during the early stages of growth, but is less effective as larkspur matures. (Ralphs, 1995). Glyphosate (Roundup) can be selectively applied by hand spraying or with a wipe-on applicator to kill larkspur in the bud stage. However, it is not as effective after the plants have flowered. Reinvasion and re-establishment of tall larkspur proceed slowly due to slow growth and development of seedlings and juvenile stages. After herbicide treatment, tall larkspur may have a period of about 15 years before it again reaches potentially dangerous levels relative to livestock poisoning (Cronin, 1976 and Ralphs, 1995).

Keeping cattle off herbicide treated areas until plants are completely dead and dry is recommended. Larkspur's toxicity and palatability may actually increase after the plants are sprayed. To be safe, cattle should be kept off the area for the remainder of the grazing season (USDA Poisonous Plant Research Laboratory, 2003).

Use of ammonium sulfate fertilizer to control patches of tall larkspur is another method available under the proposed action (cutting to ground level and applying 1/2 cup to base of each tall larkspur, cutting to 10 inch height and applying ¾ cup at the base of each tall larkspur, or no cutting and applying one cup at the base of each tall larkspur). 100% mortality occurred in study plots in Lone Spring Butte in Northwestern Colorado (9,400 ft. elevation, 25 inches precipitation per year, in soils predominantly from shale origin) the first year after application. Long-term results, nine years after application, indicated no tall larkspur. Additionally, some other broadleaf forbs treated were not found nine years post treatment, while some broadleaf forbs remained. However, the main plants identified in the treatment plots were native perennial grasses (Clementson, 1999).

For spot treatment, there are advantages for using ammonium sulfate fertilizer compared to herbicide treatment. They include (Clementson, 1999):

- The fertilizer is granular so it is easy to pack into areas of difficult access or rough terrain.
- The fertilizer can be purchased at any local feed store.
- There is no requirement for a certified applicator.

- The application method is simple and easy to learn.
- The cost of application is less than the cost of the application of herbicides.
- As with herbicide control, larkspur mortality occurs within one year and continues for many years.
- With the addition of a weed eater, the application rate can be reduced by up to 50%, which could ultimately lead to a cost savings.
- Areas cut with a weed eater die the same season they are treated, allowing for grazing to occur in the immediate area without further threat of livestock loss from poisoning.
- Application of the fertilizer does not appear to adversely affect nearby vegetation in the area.

OTHER UNDESIRABLE PLANTS

Areas of land used for transportation, utilities and other services include paved roads; helibases, drainage culverts, special use permits such as telephone and electric transmission lines; and ditches can have undesirable vegetation growing in or adjacent to them. Undesirable plants may increase maintenance costs of the infrastructure (i.e. plants encountered in pavement cracks that can cause pavement crumbling and deterioration), be a safety problem, or cause injury.

Paved roads. Less than 5 acres along paved roads on the Beartooth District (see Table 3 – 8) may need periodic treatment to reduce pavement deterioration from vegetation growth (predominantly grasses). Pre-treatment with glyphosate is helpful to reduce existing vegetation. This can be followed up by treating a foot from the shoulders' edge or on other hairline fractures with herbicides such as diuron or diuron and sulfometuron methyl mix.

TABLE 3 – 8. TREATABLE ACREAGE OF PAVED ROADSIDES

Road #	Road Name	Treatable Acres[12]
2071	West Fort Rock Creek	1.17
2071C	Basin Creek Campground	0.10
2087	Red Lodge Ranger Station	0.01
2177	East Rosebud	0.92
2346	Lake Fork	0.42
2379D	Westminster Spires	0.01
2400	Stillwater Trailhead Road	0.23
2400A	Woodbine Campground Entrance Road	0.06
2400B	Woodbine Campground First Loop Left	0.13
2400C	Woodbine Campground Second Loop Left	0.05
2400D	Woodbine Campground First Loop Right	0.08
2400E	Woodbine Campground Second Loop Right	0.05
2421	Main Fork Rock Creek	0.22
2421A	Upper Parkside Campground	0.11
2421B	Limber Pine Campground	0.08
2421D	Greenough Lake Campground	0.13
2421F	Lower Parkside Campground Loop	0.07
2846	West Fork Stillwater	0.05
	Grand Total	3.89

Special Use Permits: Approximately 910 acres of the 1066 acres under special use permit have a higher likelihood for localized disturbances where weeds are likely to periodically occur or where there is a need for vegetative maintenance. It is estimated that less than 5 acres would need annual integrated pest management treatment.

TREATMENT METHODS

The goal of integrated pest management is to manage undesirable plants in such a manner that management objectives are maintained and adverse side effects are minimized. Various management techniques can be effective. Treatment methods by Alternative are described in Chapter 2 and their

[12] Acres determined using the assumption that herbicide treatment for paved road maintenance would consist of up to one foot from the edge of each side of the paved road length.

effectiveness in Appendices F and J. Methods include mechanical, cultural, biological, and chemical. Existing uses of these methods occur to varying degrees on the Custer NF, although herbicide use has been the primary treatment method. Table 3 - 9 summarizes some key points regarding the treatment methods.

TABLE 3 – 9. SUMMARY OF TREATMENT METHODS

Treatment Method	Discussion/Considerations
Cultural Control	
Competitive Seeding	Most effective after weed populations have been reduced by other control actions.
Grazing Animals	Must match the species with the appropriate grazer for best success; treatment must occur during proper phenological stage; herding required; sometimes nonselective.
Fertilization	Could improve the success of desirable species; may be limited depending on species/soil characteristics.
Manual / Mechanical Control	
Mowing-Weed Whipping	Limited to level and gently sloping smooth-surface terrain. Must be conducted for several consecutive years; treatment timing critical.
Hand-Pulling /Grubbing	Labor intensive; not effective on deep-rooted or rhizomatous perennials; causes ground disturbance that may increase susceptibility of site to reinvasion by weeds; effective on single plants or small, low-density infestations.
Prescribed Fire	Variable effectiveness. Most use has been in grassland restoration. May cause resprouting or stimulated germination of the treated vegetation. Most effective in combination with other treatments
Biological Control	
Parasites, Predators, and Pathogens	Most effective when integrated with other strategies; does not achieve eradication; not effective on all invasive plants; long term process required.
Herbicides	
Ground Application	Not cost-effective on steep slopes; application timing limited based on plant phenology and weather conditions. Most appropriate for small, relatively accessible infestations and areas where controlling off-site drift is critical.
Aerial Application	Potential for off-site drift must be considered; application timing limited based on plant phenology and weather conditions. Most appropriate for large, relatively inaccessible infestations

CULTURAL TREATMENTS

Cultural methods of noxious weed management are generally targeted toward enhancing desirable vegetation to minimize weed invasion. Planting or seeding desirable species to shade or out-compete weeds, applying fertilizer to desirable vegetation, and controlled grazing are common cultural treatments.

Cultural treatments would occur on sites where the native vegetation lends itself to this type of treatment. Most of the other weed sites have an adequate source of native plants and do not require additional seeding with native species. Less than 5 acres of isolated areas are anticipated for cultural treatment at this time. However, future areas may have the need for this type of treatment, for example, reclaiming gravel pits, decommissioned roads, or well pads.

Seeding

The National Strategy for Invasive Species Management (2004) for the Forest Service also encourages the use of native species in rehabilitation and restoration. It encourages the shifting of restoration projects from the use of invasive non-natives to other less invasive and native species.

Forest Service Manual 2523.2 under Watershed Protection and Management sets priorities for burned area emergency response treatments stating that natural recovery by native species is preferred. It states that when practical, use seeds and plants in these project areas that originate from genetically local sources on native species or when native materials are not available or suitable, give preference to non-native species that meet the treatment objectives, are non-persistent and are not likely to spread beyond the treatment area.

When seed is introduced to a site by non-natural means (e.g., seeding by humans), there is a risk of introducing non-native and/or invasive species. Use of certified weed-free seed is required and reduces this risk. The magnitude of the risk varies and may be determined by seed source, cleaning practices, and other factors. Certified weed free seed has tolerances for certain weed species and is only certified free of certain weed species (Montana Weed Act Section 4.12.3010-11).

Invasive weeds are often able to establish and occupy a site relatively quickly after introduction because native species are typically slower to germinate and establish. Seedling establishment of native species depends on proper seeding depths, soil, adequate soil moisture, prior removal of as many invasive weeds as possible, and often exclusion of livestock (Goodwin and Sheley, 2001). Use of mulching and/or barriers to travel paths in high use areas can also make this treatment more effective.

Selection of a native versus non-native seed mix depends on management objectives. If the objective is naturalness in a plant community dominated by less competitive species, native mixes would be used. Non-native species may be more appropriate where erosion control and competition with invasive weeds are the objective. A compromise is to include short-lived, non-native, less dominant species mixed with native seeds. On many National Forest sites, there is adequate residual native and desirable vegetation under the invasive weed canopy such that re-vegetation is not necessary. Once the invasive weeds are removed, individual vegetation can respond and often results in dense, competitive, and desirable vegetation communities.

Numerous annual or sterile cereal grasses could be used instead of the above persistent non-natives. For example, cereal wheat, barley, annual ryegrass or sterile wheatgrass have been used in restoration efforts. In the case of wildfire recovery, some studies are being done to assess the success of seeding with these species. Keeley (2004) found that seeding with cereal wheat, at high seeding rates, reduced invasive species after two years. The study also found decreases in species richness and ponderosa pine seedlings. The dense stands of wheat did appear to reduce erosion, but left thick thatch which increased fire hazard at least initially. Such studies suggest determining if seeding is necessary and the amount of seed per acre considered crucial for reducing disruption to ecosystem processes.

Attempts to replace cheatgrass with perennial grasses can be difficult. Efforts to remove cheatgrass will require filling the interspaces between the plants. This requires seeding shallow rooted species such as sandberg bluegrass, Sherman big bluegrass, or covar sheep fescue. The perennial plant cover in a stand of cheatgrass is generally less than five percent. A successful weed treatment seeding would occur if the perennial species establish a groundcover of 15 to 25 percent.

Attempts to replace smooth brome, Kentucky bluegrass, timothy grass, or crested wheatgrass with other native perennial grasses can be difficult and would require significant investment for several years of combined treatments. Combined treatments could include grazing, mowing, burning, herbicide treatment, and plowing, etc., followed up be seeding, fertilizing, and/or mulching. Restoration of native vegetation in these areas dominated by these exotics is not an easily attainable objective. Given the nature of these environments, particularly in large scale landscapes such as occurs on the Custer NF where these species are already well established, full restoration of native vegetation may be an unreasonable objective. Thus, until other technologies have been examined and proven effective, goals for restoring native flora in these areas should remain conservative.

Grazing

Grazing can be an effective management tool on several weed species. Since grazing animals prefer certain forage, selective use of forage can shift competitive balance of plant communities. For example, goats and sheep have been used in various areas for controlling knapweed and leafy spurge. Controlled, repeated grazing of spotted knapweed by sheep has been found to reduce the number of one and two year old spotted knapweed plants within an infestation (BIRC). Appropriate grazing by animals preferring weeds can shift the plant community toward more desired grasses (Stannard, 1993). Conversely, grazing can also selectively reduced grass competitiveness, shifting the community in favor of weeds.

Use of grazing animals as a weed management tool must be based on selecting the appropriate grazer (cattle, sheep, or goats) for the target weed. Managers must also determine when, how much, and how often to graze animals to have maximum impact on the weeds with minimum impact on desirable species. Use of grazing animals as a weed management tool on roadsides, trailheads and larger infestations on the

Forest is limited due to factors associated with maintenance and management of the animals. A long-term commitment to small ruminant grazing is necessary for effective weed control and achievement of desired results. Invasive weeds can compensate quickly after the grazing pressure is removed because of their dormant seeds in the soil, and because they can rapidly increase flower stem and seed production once grazing pressure is removed.

Many of the areas proposed for weed treatment still have relatively viable native plant communities intermixed with the weed invaders. Vulnerable landscapes are dynamic plant communities that are constantly being shaped by the process of succession. Successful restoration should compliment successional processes. Grassland species evolved with grazing, and in many cases, grasses require defoliation every two to four years to remove old stems that shade plants and hinder growth. Defoliation methods, such as grazing, mowing or burning stimulate grass growth and enhance its competitive ability. However, proper grazing management is essential in maintaining long-term objectives for weed management. Most weedy species are well adapted to invade heavily grazed areas, allowing competitive advantage.

Grazing animals can be used to assist in weed control efforts, but in most cases will not eradicate mature infestations when used alone. Sheep and goat grazing is being considered under all alternatives however there are some major concerns. For example small ruminant animals are at risk to predation from wolves and bears, and there is the risk of transmitting disease from domestic sheep to bighorn sheep. Initial use of sheep and goats will require protection measures to ensure that predation and disease transfer do not occur. Also, both the animals and the experience will need to be gained from commercial practitioners.

Grazing management considerations are important in assisting with the restoration of native grasslands. Timing and frequency of cattle grazing can be adjusted to minimize impact on grasses. Permittees are authorized to graze livestock on National Forest System lands by permit. The General Terms and Conditions of the grazing permit, part 8(b) and (c) allow for annual adjustments as deemed necessary by the Forest Service, to coincide with resource protection measures. This could include restoration measures essential for achieving long-term effectiveness of weed treatment programs.

Grazing Knapweeds: Grazing knapweed stands with sheep and goats can suppress knapweeds (IPMPA, 2000. http://www.efn.org/~ipmpa/Noxknapw.html). Continual grazing of the tops of young plants can retard plant development, seed formation, and gradually deplete root reserves. Since animals usually prefer to eat nearby grasses in lieu of knapweeds, grazing is most effective against knapweeds when the livestock is enclosed in a fenced-off, weedy area. Animals will not graze on Russian knapweed when other vegetation is available because of its bitter taste (Stannard, 1993).

Spotted knapweed is more palatable in late spring or early summer and repeated grazing can reduce flower stem production. Diffuse knapweed seed production can be reduced when grazed during the bolting stage for 10 days, and again after 14 days for an additional 10 days. Although grazing diffuse knapweed can reduce seed production, it can also cause diffuse knapweed to become a short-lived perennial and when grazing is removed, populations often return to its former levels (DiTomaso, 1999).

Goats and sheep are economical and they do not pose the environmental dangers of applying chemicals. In addition to their value for weed control, sheep can also be used for income from the sale of their wool. If confined, Angora and Spanish goats will trample or browse virtually any vegetation within a fenced area. Desirable trees or shrubs can be protected with light-weight flexible fencing reinforced with electrified wire.

Grazing impacts should be considered on biocontrols, if present. Long-term grazing can be detrimental to seedhead insects because of the removal of seedheads. Also, grazing can delay flowering times and cause asynchrony between the insect and knapweed life cycle. Grazing is compatible with root feeding biocontrols.

Grazing Leafy Spurge: Sheep and goats provide an alternative to herbicides for controlling leafy spurge top growth in pasture and rangeland. Grazing alone will not eradicate leafy spurge but will reduce the infestation, slow the spread of the weed, and allow grasses to be grazed by cattle and horses. Grazing should be started early in the spring when the plant first emerges. On large infestations, pastures should be divided so animals can be regularly rotated and the entire infestation grazed in a timely manner.

Sheep and goats are best suited to control leafy spurge on large infestations, or along waterways and tree areas where chemical control is restricted or cost is prohibitive. North Dakota State University (NDSU) research has shown that grazing leafy spurge with goats followed by a fall applied herbicide treatment provided better leafy spurge control than either method used alone. The goats were allowed to graze until mid-August, then removed to allow 3 to 4 inches of leafy spurge regrowth. Then Tordon plus 2,4-D was applied at 0.5 plus 1 pound per acre in mid-September. Leafy spurge density was reduced over 95 percent when this program was followed for three consecutive years.

Recommended stocking rates vary with terrain, leafy spurge density, and rainfall during the growing season. Sheep should be grazed at approximately three to six head per acre of leafy spurge per month or one to two ewes per acre of leafy spurge for the summer. North Dakota State University research using Angora goats found that 12 to 16 goats per acre of leafy spurge per month or three to four goats per acre of leafy spurge for four months (growing season) controlled leafy spurge with little utilization of the grass species. The stocking rate will decline over time as the leafy spurge infestation is reduced. Prevention of flowering and seed-set by leafy spurge is important. Before moving animals to a leafy spurge free area, they should be contained for three to five days so viable seed can pass through the digestive system (NDSU, 1995. http://www.ext.nodak.edu/extpubs/plantsci/weeds/w866w.htm).

MECHANICAL TREATMENTS

Weeds can be treated by various mechanical methods such as hand pulling, prescribed burning, mowing, and tilling. Pulling weeds by hand, would probably be the primary mechanical treatment method on the CNF and would occur on particularly sensitive areas, or areas of small infestations. Hand pulling is not very effective on plants that spread via roots because the soil needs to be excavated repeatedly to remove all root fragments. Sites less than a tenth acre with non-rhizomatous species and low weed density could be hand pulled. On some sites herbicides can be used in conjunction with pulling to help reduce plant density so that pulling is cost efficient.

Mechanical weed management methods can be effective on small infestations. Hand pulling and hoeing are the oldest and most traditional weed management methods. These methods are labor intensive and relatively ineffective for management of large, dense infestations of perennial noxious weeds. Best results are achieved when the entire root is removed on non-clonal species. This is not always possible when treating deep rooted or rhizomatous weeds. Hand pulling often leaves root fragments that generate new plants. Hand pulling also causes disturbance that may increase susceptibility of the site to reinvasion. While this control method is effective on single plants or relatively small infestations, it is not economically feasible on large, well-established knapweed infestations. In addition, hand pulling plants that contain toxins or skin allergens can expose individuals to their poisonous effects (DiTomaso, 1997 and 1999).

Test plots established on Blue Mountain (Lolo National Forest) and the Lee Metcalf National Wildlife Refuge near Stevensville, Montana, measured effects of hand pulling on spotted knapweed. On the two sites spotted knapweed covered 76 percent and 53 percent, respectively. Average pulling cost for the two locations was calculated at $8494 per acre per year and is used to estimate and analyze pulling costs. Hand pulling provided 100 percent flower control and 56 percent plant control at Blue Mountain, but increased bare ground from 2.7 percent to 13.7 percent during the first year after treatment (USDA, FS 2005).

Mowing and tilling (such as discing or plowing) prevent plants from producing seeds when treated in the bud stage or earlier. Efforts repeated every 21 days during the growing season can deplete the underground food supply of some perennials. These methods would be required for at least a three-year period to attain satisfactory control. These methods would also weaken non-target species in treated areas.

Mechanical treatments such as tillage are most applicable to tap-rooted weed species; this method can be used on small acreages, level terrain, and infestations that are “tended’ or visited on a regular basis in order to remove new plants and re-sprouts as they occur. Tillage removes all vegetation and must be combined with seeding or planting of desirable species. Although mechanical treatments can reduce seed production for the treated season, invasive weed seeds may remain viable in the soil for several years (Stannard 1993; Messersmith et al., 1985). Re-infestation of a site from residual seed, especially when disturbed, will often occur without continued follow-up treatment. Tilling would be considered only in areas where slope is less than 10 percent and a small percentage of the vegetation consists of shrubs.

In most cases, endemic native species do not appear capable of out-competing invasive weeds. On appropriate sites, herbicide application after weeds have emerged, followed by tillage and drill seeding, can be an effective treatment for establishing desirable species. This process, however, can lead to increased soil compaction (DiTomaso, 1999), and cannot be conducted on steep, remote, and rocky sites, characteristic of most sites on the Forest.

Mowing or cutting is more effective on tap-rooted perennials such as spotted knapweed compared to rhizomatous perennials. Cutting or mowing plants can reduce seed production, if conducted at the right phenological stage. For example, a single mowing at late bud growth stage can reduce the number of seeds produced by spotted knapweed (Duncan et al.). Mowing can also weaken the competitive advantage of weeds by depleting root carbohydrate reserves. Because of large carbohydrate reserves, mowing must be conducted several times a year for consecutive years to reduce the competitive ability of the weed.

Because invasive weeds flower throughout the summer, it is difficult to time mechanical treatments to prevent flowering and seed production. Repeated mechanical treatment too early in the growing season can result in a low growth form that is still capable of producing flowers and seed (DiTimaso 2001, Goodwin and Sheley, 2001). Mechanical treatments on some rhizomatous weeds, such as leafy spurge, can encourage sprouting and result in an increase in stem density (Goodwin and Sheley, 2001).

Mulching with plastic or organic material can be used on relatively small weed infested areas (less than ¼ acres), but will also stunt or stop growth of desirable native species. Mulching prevents weed seeds and seedlings from receiving sunlight necessary for survival, and can smother some established weeds. Although hay mulch was used in Idaho to reduce flowering of Canada thistle (Tu et al., 2001), most rhizomatous perennial weeds cannot be controlled by this method because their extensive root reserves allow re-growth through or around mulch.

The most effective prescribed fires for controlling invasive plant species are typically those administered just before flower or seed set, or at the young seedling/sapling stage. Sometimes prescribed burns that were not originally designed to suppress an invasive species have had a good side effect. But in some cases, prescribed burns can unexpectedly promote an invasive, such as when their seeds are specially adapted to fire, or when they re-sprout vigorously. These prescriptions must be modified or other management actions taken to undo or reverse the promotion of the invader.

Most successful weed control efforts that result from burning are due to the restoration of historical (natural) fire regimes, which had been disrupted by land use changes, urban development, fire breaks, or fire suppression practices. Many prescribed burn programs are, in fact, designed to reduce the abundance of certain native woody species that spread into unburned pinelands, savannas, bogs, prairies, and other grasslands. Repeated burns are sometimes necessary to effectively control weedy plants, and herbicide treatments may be required to kill the flush of seedlings that germinate following a burn.

Burning can be implemented when weather or fuel conditions are favorable, usually between March and November and only at times approved by state organizations responsible for smoke management. Burning permits will be obtained where required. An air quality analysis was not conducted. Prescribed burning on any sizeable scale is unlikely due to the biology of the weeds being addressed in the analysis; therefore emissions are not of concern. If prescribed fires are used as a tool, smoke management considerations will be addressed during the development of the burn plan. Any classified airsheds (Class I and II areas – Northern Cheyenne Indian Reservation, AB Wilderness Area, and Yellowstone National Park) will be identified and compliance with state implementation plans and state smoke management plans will be evaluated.

All burning would be conducted in accordance with Custer National Forest fire management policy which requires the site specific preparation of a prescribed burn plan before every burn. The prescribed burn plan addresses the objectives of the burn, physical characteristics of the burn area, type of fuels, weather conditions under which the plan will be carried out, expected fire behavior, air and water quality restrictions, ignition pattern and sequence, emergency fire control workforce requirements, public contacts, and safety.

The most common methods are hand-held fusees and drip torches and are applied directly to the vegetation. When using hand-carried drip torches or fusees, individuals cross the area in a specified pattern described in the prescribed burn plan. Tailoring traverse patterns to each area identified to be treated can maintain effectiveness, maximum safety, and control.

BIOLOGICAL CONTROL TREATMENTS

Biological control agents include the use of insects or pathogens to consume or kill select portions of individual weeds, reducing growth or reproduction of the weed. See Appendix I for species-specific biological controls available.

Biological weed management is the deliberate use of natural enemies (parasites, predators, or pathogens) to reduce weed densities. Natural enemies and competitive vegetation prevent weed species from dominating other species. Non-native invasive weeds are such a problem, in part, due to the lack of natural enemies.

Biological management is self-perpetuating selective, energy self-sufficient, economical, and well suited to integration of an overall weed management program (DiTomaso, 1999). Management with biological agents is a slow process that does not achieve eradication. Biological agents may be ineffective if they are not integrated into other strategies. Currently, there are strict standards met before biological control agents are approved. About 29 percent of the biological management efforts in the United States have demonstrated some level of success (DiTomaso, 1999).

A weed infestation may increase in density and area faster than the newly released biocontrol agent population; therefore, other control methods must be used in conjunction with the release of biocontrol agents. The perimeter of the infestation may be sprayed to keep the weeds from spreading.

Various federal and state clearances are required for the release of any biocontrol agent in the states of Montana and South Dakota. Existing and newly approved biological controls could be introduced where appropriate. Some of the biological control agents in use are: Canada thistle stem weevil (*Ceutorhynchus litura*), knapweed seed head gall flies and knapweed flower weevil (*Urophora affinis, U.quadrifasciata,* and *Larinus minutus*), knapweed root feeding insect (*Agapeta zoegana*, and *Cyphocleonus achates*); leafy spurge flee beetles (*Aphthonia czwalinae, A. flava, A. nigriscutis,* and *A. lacertosa*); toadflax stem boring beetles (*Mecinus janthinus*); and toadflax seed head beetles (*Gymnetron linariae* and *Brachypterolus pulicarius*) and a defoliating moth (*Calophasia lunula*).

Leafy spurge has a biological control agent that can substantially reduce plant density in a wide variety of sites. Sites with both large number of acres (more than 25 to 50 acres) and with weed species that have an effective biological control agent available will be managed with biological control. Spotted knapweed and musk thistle have also been greatly reduced by biological control agents. Since biological control agents are usually very slow to establish and will never eradicate its host, these sites will need to be contained with the use of herbicides for the most effectiveness.

Biological control is becoming more important where actual eradication or control is not likely. The best defense has been one of attacking weeds from every angle possible. While some agents can reduce weed densities by as much as 30 to 40 percent, none have eliminated a weed completely. Some agents require a number of years to become established and have a significant effect on weed populations. Efforts to establish insectaries will continue as the biological control program develops more options. Use of these biological control agents are generally targeted for larger infestations, rather than isolated trace infestations. Therefore, not all infestations are good candidates for biological control efforts.

Biological control agents are chosen for their host specificity (i.e., they are designed to target only a particular weed species). In this sense they are useful in native plant communities because they avoid other non-target vegetation.

In order to assure that agents considered for bio-control are host specific, the Animal and Plant Health Inspection Service (APHIS) has designed a rigorous screening process which includes testing agents proposed for release on a representative group of native plant species, including plants that are similar taxonomically. Particular attention is paid to related threatened, endangered, and sensitive plant species. Because of the remote possibility of effects to native plants from bio-control agents, the CNF may consider new releases on the Forest.

Biological control agents have been periodically released on the CNF between 1993 and 2003. Black leafy spurge flea beetles (*Aphthona nigriscutis*) have been released on the Ashland (two releases) and Sioux Ranger Districts (five releases). Some effectiveness of these releases has been observed.

HERBICIDE TREATMENTS[13]

Use of herbicides for weed treatment involves application of products developed, labeled and produced to treat weed species at certain stages of plant growth. Herbicides considered in this analysis include: 2, 4-D, aminopyralid, chlorsulfuron, clopyralid, dicamba, diuron, glyphosate, hexazinone, imazapic, imazapyr, metsulfuron methyl, picloram, sulfometuron methyl, and triclopyr. Ammonium sulfate (fertilizer), an herbicide adjuvant, is also considered in this analysis as an effective herbicide for use on tall larkspur. Several herbicides are considered because they vary in effectiveness on different weeds.

The length of time each herbicide controls invasive weeds varies with the type of herbicides, environmental conditions, and target weeds. Some herbicides control weeds for a short time, while others can provide a few years of control from one application. The U.S. Environmental Protection Agency approved herbicide labels include safe handling practices, application rates, and practices to protect human health and the environment. A description of herbicides including copies of labels, susceptibility of weeds to different herbicides, Material Safety Data Sheets (MSDS), and guidelines proposed for use on the Project are contained in the Project Record. Herbicide labels and MSDS information can be found at http://www.greenbook.net/search/QuickList/ .

One feature of the proposed action alternative is the flexibility to use current and updated agents as they are registered and approved by the EPA. All herbicides will be applied according to label specification; or when additional protection measures are required by Forest Service policy as described in this chapter. Impacts on soil and water will be mitigated to meet State laws and Pesticide Application Requirements, Northern Region Soil and Water Standards, and Custer Forest Plan Standards. Appendix G lists the herbicides addressed in this document, and their associated target weed species. See Appendix F for species and herbicide specific effectiveness information.

Herbicide selection would be based on environmental conditions such as groundwater depth, soil type, non-target vegetation, and management objectives. Appendix I displays examples of herbicides proposed for use and a range of application rates. Herbicide selection considers the following criteria:

- Herbicide label considerations;
- Herbicide effectiveness on target weed species;
- Proximity to water or other sensitive resources;
- Soil characteristics;
- Potential unintended impacts to non-target species such as conifers or shrubs;
- Application method (aerial-broadcast, ground-spot, ground-broadcast, or wick application);
- Other weed species present at the site, and effectiveness of herbicides on those species (for example spotted knapweed infestations with inclusions of toadflax);
- Adjacent treatments (private land);
- Timing of treatments (spring/fall); and
- Priority weeds – new invaders vs. existing.

[13] Refer to Chapter 5 Glossary for terms and concepts about herbicides.

Herbicides, like biological control agents, go through an extensive screening and testing process before they are registered and approved for use, by the U.S. EPA. Initial pesticide registrations with the EPA typically require a minimum of 120 tests, take seven to ten years to complete, and cost between $30 and $50 million. Herbicide labels have the force of law and include safe handling practices, application rates, and practices to avoid undesirable impacts to humans and the environment.

Safe application methods and practices would minimize health risks to applicators and forest visitors, and protect native vegetation, wildlife, and watersheds. All chemicals would be handled within Forest Service Handbook 6709 and 2109 guidelines and the EPA label restrictions included with each type of herbicide for storage, mixing, application, and disposal methods.

Application of herbicides to treat weeds would be performed by, or directly supervised by, a State licensed applicator following all current legal application procedures administered by the Montana or South Dakota Department of Agriculture.

A spill plan (included in Appendix M) will be utilized to reduce the risk and potential severity of accidental spills. This plan identifies methods to report and clean up spills.

All herbicide label restrictions and procedures would be followed, as approved by the Environmental Protection Agency (EPA). These labels are the laws governed by federal and state agencies. Labels contain information for the proper administration of each herbicide and cover such items as a list of the ingredients, EPA registration number, precautionary statements (hazards to humans and domestic animals, personal protective equipment, user safety recommendations, first aid, and environmental hazards), directions for use, storage and disposal, mixing and application rates, approved uses, inherent risks of use, limitations of remedies, and general information. Herbicides would also be applied in accordance with directions specified in Forest Service Handbooks 6709 and 2109.

Herbicide treatments would include both ground and aerial herbicide applications, in compliance with the protection measures listed in this document. Chemical applications would take place at the appropriate time of year for targeted weed species and incorporate environmental considerations as outlined in Chapter 2 protection measures. Equipment such as helicopters, trucks, ATVs, horses, backpack sprayers, and other hand held application equipment will be used.

Following the Adaptive Management Strategy (see Appendix E), other herbicides may be used when they become available if they are permitted by the EPA, have a human health and environmental risk assessment completed per direction of Forest Service Handbook 2109.14, Chapter 10, and are registered for use by the states of Montana or South Dakota.

Surfactant adjuvant would be used in certain situations to increase efficacy, primarily on target species with a waxy cuticle (especially toadflax), or when temperature and humidity are not optimal (but still within label and more locally-prescribed limits) yet other conditions, such as plant phenology, are ideal. Surfactants may be used during periods of drought. Surfactants proposed for use will follow the same protection measures as picloram. Only those labeled for use in and around water would be used within 50 feet of water, or the edge of sub-irrigated land, whichever distance is greater, or on high run-off areas. Some surfactants are labeled for use in and around water including Activate Plus ®, LI-700 ®, Preference ®, R-11 ®, Widespread® and X-77®.

Areas with aerial applications would also include ground applications, to treat buffer areas and skipped areas. These areas are typically estimated at 5 to 10 percent of the aerial treatment acres. Based on monitoring, follow-up aerial and ground treatments are expected to occur on third and fifth years after initial treatment, as portions of the dormant seed or root system propagate. Based on previous experience with weed treatments, it is likely that the treatment areas would then enter “maintenance mode” where spot treatments of infestations would continue to occur until weeds are eradicated. Aerial application will not be in designated wilderness areas, research natural areas, or near sensitive areas (such as near water or sensitive plant populations). Sites identified for aerial treatment are either not accessible by roads (previous roads have been decommissioned) or have steep slopes which make walking difficult.

All herbicide applicators, including Forest Service or contractor employees, will follow label instructions and protection measures. A field inspector will be on-site during all aerial applications to monitor drift and compliance with label specification. Label information is available in the Project File and at http://www.fs.fed.us/foresthealth/pesticide/index.html , an Environmental Health Reference and Resource Materials website.

Ground applied herbicide treatments would occur in areas where there is good access, a manageable size of infestation, and available funding. See Appendix C for Protection measures by Alternative.

THE DECISION TO USE HERBICIDES

The choice of whether an herbicide is used over other control methods would be based on integrated weed management principles. Decisions would be made based on whether other methods or combination of methods are known to be effective on the species in similar habitat. The choice of herbicide would be based on the undesirable species; how it reproduces, its seed viability, the size of its population, site conditions, known effectiveness under similar site conditions and the ability to mitigate effects on non-target species.

In most cases, if an herbicide is selected, it would be used in combination with other methods. For example, initial treatment on an undesirable species may be done by an herbicide, but then manual or mechanical methods would be implemented as maintenance treatments over the long term. Large established populations would be less apt to undergo herbicide treatment. Such populations may be controlled at their perimeters to maintain “weed-free” zones or may be candidates for biological control. The focus of any herbicide treatment would be on the species of highest concern where the negative effects can be mitigated.

Application methods used would be based on site accessibility. Aerial spraying, for example, would only be used in areas where access is remote and difficult and/or populations are of the size that non-herbicide methods or selective herbicide application are not feasible.

Herbicide treatment consists of applying chemicals, usually of a manufactured or synthetic origin, to a plant or to soil. The plant absorbs the herbicide through roots, leaves, or stems. The herbicide interferes with plant metabolic processes, stopping growth and usually killing the plant. A suite of available herbicides is needed to help meet the variety of long-term site goals and address the complex resource issues at the Forest level. Different herbicides vary in effectiveness and length of control on different invasive plants. Herbicides also vary in their effects to the environment and suitability to different environmental conditions.

Herbicides vary in their environmental activity, physical form, and the equipment used to apply them. In combination with other site and biological factors, these characteristics influence both the probability of meeting site-specific goals for weed control, and the potential of impacting non-target components of the environment. Soil properties impact the effectiveness of weed treatment and restoration actions as well.

Herbicides may be selective or non-selective. This means they control all types of vegetation (non-selective), or they selectively control either some broadleaf plants or grasses while not affecting others (selective). Some herbicides may control only actively growing vegetation at the time of application, or they may provide undesirable species control through root uptake from the soil (short-term to over a few years). In soil and water, herbicides may persist or decompose by sunlight, microorganisms, or other environmental factors.

Herbicides vary in selectivity of control for various plant groups. Those differences in selectivity are the basis for developing effective weed control prescriptions while minimizing adverse effects and facilitating native plant community maintenance or restoration. Another variation among herbicides is the duration of control of the target undesirable plants. Label application restrictions can also limit the number of herbicides available to control any site-specific undesirable plant infestations.

Physical form of herbicides varies. Some may be oil- or water-soluble molecules dissolved in liquids, or attached to granules for dry application to soil surface. Herbicides may move from their location of application through leaching (dissolved in water as it moves through soil), volatilization (moving through air as a dissolved gas), or adsorption (attached by molecular electrical charges to soil particles that are moved by wind or water).

Herbicides may be applied with a variety of equipment and techniques. The techniques vary in effectiveness, environmental effects, and costs. Helicopters or fixed-wing aircraft are used for aerial application of sprays or granules for rapid broadcast coverage of large or inaccessible areas.

Herbicides may be sprayed via ground vehicles with hose sprayers or booms using an array of spray nozzles. This equipment is most commonly used for broadcast spraying of roads, but can also be used on all-terrain vehicles for broadcast or spot spray in remote areas.

Some application equipment is often used for selective treatment and/or to minimize non-target effects. Backpack sprayers are most frequently used to spray the foliage, stem, and/or surrounding soil of target undesirable plants. Other equipment includes herbicide-soaked wicks or paintbrushes for wiping target vegetation, and lances, hatchets, or syringes for injection of herbicide into stems of target plants. Granular herbicides may be applied using hand-held seeders, or other specialized dispensing devices.

Each herbicide is sold as one or more commercial products, called formulations. The product label for herbicide formulation provides legally binding direction on its use, including safe handling practices, application rates, and practices to protect human health and the environment.

Foliar Herbicides are often used for the control of herbaceous plants and small trees and shrubs. Brush can be defoliated with foliar herbicides to improve access for soil or trunk treatments, but foliar herbicides are normally not recommended for the larger brush species because the potential for drift is too great when tall species are sprayed. The applicator should operate the spray gun from the ground and with a hose of sufficient length to be able to treat from a position close to the plants.

Herbicides that are applied after the emergence of a crop or a weed are referred to as post-emergence. Herbicides that are applied before the emergence of a crop or a weed are referred to as pre-emergence. They may be either selective or nonselective and either contact or systemic, depending upon the herbicide used. Selective herbicides kill some kinds of plants but have little or no effect on others.

The use of selective herbicides allows the removal of unwanted weeds from desirable plant communities. 2, 4-D is a selective herbicide that removes broadleaf weeds but will not injure grasses. Nonselective herbicides kill all vegetation. Examples are diuron (Karmex) and glyphosate (Roundup, Accord).

Contact herbicides do not move readily in the plant and usually only kill the part of the plant they touch. Contact herbicides are most effective when applied to actively growing plants before flowering. They kill most annual weeds but do not provide any residual control; thus, a new flush of weeds may germinate from seed after an herbicide application. Contact herbicides also will burn off the top-growth of perennial weeds (e.g., Canada thistle), but these weeds will usually re-sprout from underground parts. Because contact herbicides fail to prevent later germination of annual weeds and only burn off the top-growth of perennials, they have limited importance in right-of-way situations.

Systemic herbicides are absorbed through plant top-growth or plant roots and interrupt critical physiological processes necessary for plant growth. They move into and throughout the plant as long as the plant is actively growing. They are of particular value in their ability to control established perennial weeds.

The effectiveness of some foliar treatments will be reduced if rain falls shortly after application. The ester formulations of 2,4-D are absorbed in 1 to 2 hours, whereas 6 to 8 hours are required for adequate absorption of dicamba, glyphosate and 2,4-D amine formulations. Thorough wetting of the leaves and stems to the point of runoff is essential for some foliage treatments to be effective (see Appendix J for rainfastness).

The label may suggest that an adjuvant (see Appendix J), such as a surfactant, be added to the herbicide to improve its activity. These chemicals allow the herbicide to spread over more leaf surface so that more herbicide can be absorbed. Use of an adjuvant may be necessary for better absorption by foliage that is extremely waxy or hairy. The activity of systemic herbicides, such as 2,4-D, is also increased when they are applied along with a surfactant. Increased activity of selective herbicides may result in severe injury of desirable plants, so additives should not be added in all situations. Label guidelines should be followed.

Soil Applied Herbicides. Some herbicides move through the soil to the root zone, where they are absorbed. Others are absorbed by the shoots of emerging seedlings as the plant grows through the herbicide layer in the soil. Soil-applied herbicides are either selective or nonselective; they range in residual activity from none to several months. Soil-applied herbicides are formulated as liquids, granules, or pellets. Granules and pellets can be applied by hand shakers or by equipment such as rotary applicators, cyclone seeders, or other spinning-disk equipment. Even though granules drift less than do liquid sprays, their pattern of application from rotary applicators can be distorted by wind, resulting in an overdose in one area and under-application in another area.

However, some labels recommend that applications be made after the last hard frost in spring and before the first hard frost in autumn. A soil herbicide usually needs to be leached by rain into the soil where it can be absorbed by the plant root or shoot. It may take the herbicide several weeks to reach the roots of some deep-rooted plants. Injury symptoms will not appear until the plant has absorbed and translocated the herbicide. Symptoms from a late fall treatment may not be visible until the following spring.

Soil herbicides should not be applied in areas where they may leach into groundwater, or run off into water sources or cropping areas. Sandy soils have little adsorptive (binding) capacity, and may not hold the herbicide near the soil surface where most weed seeds germinate. Avoid making herbicide applications in areas where tree and shrub roots may extend. The recommended rates for soil-applied herbicides depend upon the weed species present, the soil texture (percent sand, silt, and clay) and the amount of soil organic matter.

Woody plants (i.e. Salt Cedar) are controlled by a number of different methods. Individual stem applications are used to apply herbicides directly onto or inside the stems of individual woody plants (trees or shrubs). Tree injectors, hack and squirt techniques, Hypo-Hatchets™ or similar devices, and cut stump treatments are used to deliver herbicides directly to the transport and growing tissues beneath the bark of woody plants.

Basal-bark treatments can be used to control brush, and to control trees up to 5 inches in diameter. They are useful to selectively remove undesirable brush species from stands of desirable plants. Basal-bark treatments are made with oil-soluble herbicides in a carrier of diesel oil, kerosene, or other carriers. The spray is applied to the lower 18 inches of the stems, and should thoroughly drench the stem, crown, and all exposed roots. However, care must be taken during application because most vegetative ground cover will be injured by herbicide applied in a diesel oil carrier. Where only a limited number of trees are to be controlled, a 3- to 5-gallon knapsack sprayer works well for the application of a basal-bark spray. Basal-bark applications made during the dormant season do not result in brownout of foliage, which may make dormant treatments desirable. In addition, since vapors from basal-bark applications may drift out of the treatment area, undesirable brush in areas adjacent to susceptible plants can be treated during the dormant season to reduce injury potential.

Herbicide application to cut surfaces in the bark of trees is an effective method for controlling woody species. Cut-surface applications are recommended when plants have thick bark or when they have stems greater than 5 inches in diameter. Applications can be made effectively during any season except in the spring during heavy sap flow. The cut must be made rapidly with a sharp saw or pair of pruning shears. A chain saw should be used on larger trees. The cut surface should be saturated with herbicide as soon as possible after cutting. On large tree trunks, the cambium area next to the bark is the most vital area to wet. The stump should be painted within a few minutes. Woody plants have a wound response that quickly seals the cut surface and restricts the movement of herbicide into the roots. The best results are achieved by treating woody perennials that are not water stressed and are growing actively. Common herbicides used for cut stump treatments include 2, 4- D amine, glyphosate, and triclopyr. Only the most concentrated herbicide formulations should be used for cut surface treatments.

Herbicide Drift

Spray drift is the direct movement of herbicide from the target to areas where herbicide application was not intended. Movement of spray droplets or herbicide vapor causes herbicide drift. Several factors affect spray drift and are defined below, the results of which are summarized in Table 3-10. Incorporating these factors into the project design protection measures (see Appendix C) will reduce the risk of drift. Appendix N displays aerial application models used in the analysis. An air quality analysis was not conducted for aerial application since protection measures include drift control measures and closing treatment areas for spray operations.

Spray Particle Size: Spray drift can be reduced by increasing droplet size, since large droplets move less than small droplets in wind. Reducing spray pressure, increasing nozzle orifice size, special drift reducing nozzles, additives that increase spray viscosity, and rearward nozzle orientation, all can increase droplet size.

Method of Application: Herbicide spray drift is generally greater from aerial application than from ground boom or broadcast application. Little or no drift occurs when spot treating by hand. Low-pressure ground sprayers generally produce larger spray droplets, which are released from the nozzle closer to the target than with aerial sprayers.

Distance Between Nozzle and Target: Less distance between the droplet release point (the boom arm) and the target reduces spray drift. The spray travels a shorter distance with less opportunity for drift.

Herbicide Volatility: All herbicides can drift as spry droplets, but some are sufficiently volatile to cause plant injury from drift of fumes.

Relative Humidity and Temperature: Low relative humidity and/or high temperature cause more rapid evaporation of spray droplets between the nozzle and target than high relative humidity and/or low temperature. Evaporation reduces droplet size, which in turn increase the potential drift of the spray droplets.

Wind Direction: Herbicides should only be applied when the wind is blowing away from non-target plants.

Wind Velocity: The amount of herbicide lost from the target area and the distance the herbicide moves will increase as wind velocity increase, so greater wind velocity will generally cause more drift.

Air Stability: Horizontal air movement is generally recognized as an important factor affecting drift, but vertical air movement is often overlooked. Vertical stable air (temperature inversion) occurs when air near the soil surface is cooler or similar in temperature to higher air. Small spray droplets can be suspended in stable air, move laterally in a light wind and impact plants downwind. Spray drift in vertically stable air can be reduced by increasing spray droplet size.

Spray Pressure: Spray pressure influences the size of droplets formed from the spray solution.

Nozzle Spray Angle: Spray angle is the angle formed between the edges of the spray pattern from a single nozzle. Nozzles with wider spray angles produce smaller spray droplets than those with narrower spray angle at the same delivery rate.

Nozzle Type: Nozzle types vary in droplet sizes produced at various spray pressures and gallons per minute output.

Air Movement around Aircraft: Vortices are irregular drifts of air around the fixed wing of airplanes or the rotary blades of helicopters. The fixed wing or rotor tips produce an updraft, while the body of the aircraft produces a downdraft. Vortices affect the deliver of spray particles accordingly.

TABLE 3 - 10. EFFECTS OF DRIFT FACTORS ON HERBICIDE DRIFT

Factor of Drift	More Drift	Less Drift
Spray particle size	Smaller	Larger
Release height	Higher	Lower
Wind Speed	Higher	Lower
Spray pressure	Higher	Lower
Nozzle size	Smaller	Larger
Nozzle orientation	Forward	Backward
Nozzle location	>3/4 wingspan	<3/4 wingspan
Air temperature	Higher	Lower
Relative humidity	Lower	Higher
Nozzle type	Small droplets	Large droplets
Air stability	Stable	Unstable
Herbicide volatility	Volatile	Non-volatile

MODE OF ACTION AND HERBICIDE FAMILIES

Herbicides that are chemically similar are said to belong to the same "herbicide family". The compounds in a given family typically exhibit similar characteristics and function, due to their chemical and structural similarities. For example, clopyralid, picloram, and triclopyr are all grouped in the pyridine family.

An herbicide is often chosen for use based on its mode of action. If one herbicide is ineffective, another herbicide with a different mode of action may provide better results. When and how an herbicide is applied may be determined by its mode of action.

An herbicide's mode of action is the biochemical or physical mechanism by which it kills plants. Most herbicides kill plants by disrupting or altering one or more of their metabolic processes. The mode of action is generally dictated by its chemical structure, and therefore, herbicides in the same family, tend to have the same Mode of Action. For instance, clopyralid, picloram, and triclopyr are all in the pyridine family and are all auxin mimic herbicides, while glyphosate is an amino acid inhibitor. Some herbicides from different families, however, can have the same mode of action. For example, the phenoxy 2,4-D is an auxin mimic, just like the pyridines picloram, clopyralid, and triclopyr. Animals typically suffer little or no effect from most herbicides sold today because these compounds principally affect processes exclusive to plants, like photosynthesis or production of aliphatic amino acids.

"Pre-emergent" herbicides are those applied to the soil before the weed germinates, and either disrupt germination or kill the germinating seedling. "Post-emergent" herbicides are those that are applied directly to established plants and/or soil. Some herbicides are effective both before ("pre-emergent") and after ("post-emergent") germination.

COMPARISON OF HERBICIDES

Appendix G and Table 3 - 11 lists the herbicides included in the analysis. These herbicides or formulations are registered by the EPA for use in forestry applications, right-of-ways, or rangelands and are appropriate for use against undesirable plant species in Montana and South Dakota. The characteristics listed are meant to give a general overview of the capabilities of each herbicide. More details on these herbicides can be found in the commercial labels provided on all EPA approved products. Vast information is available on undesirable plant control using resources from numerous authorities such as the State noxious weed programs or county noxious weed coordinators, Nature Conservancy, and number weed organizations (Project File).

The following table summarizes those herbicides and their properties that may be useful in treating undesirable plants when using an integrazted pest management approach.

TABLE 3 – 11. COMPARISON OF HERBICIDES[14]

Chemical/Brand Names/Mode of Action	Properties	General Uses/Known to be Effective on:[15]	Comparisons/Issues [16]
2,4-D / (Weedone, Weedar, many more) / *Synthetic auxin - Mimics natural plant hormones.*	Readily absorbed through leaves or roots. Accumulation is primarily in the young, rapidly growing meristematic regions of roots or shoots.	Readily absorbed and metabolized. Used for the control of many broadleaf species.	Half-life in soil is usually not longer than 1 or 2 weeks during the growing season due to rapid decomposition by soil micro-organisms. Amines and esters are the most common formulations of 2,4-D. The esters are the most active and can be used at the lower rates and for brush control. Since vapor drift is a potential problem with the ester formulations, only the amines should be used in susceptible lawn, garden, or crop areas. Low-volatile esters can be used in areas where risk of damage to sensitive non-target vegetation is low.
Aminopyralid / (Milestone) pyridine carboxylic acid *auxinic growth regulator - disrupts plant growth metabolic pathways*	Aminopyralid provides systemic postemergence control	Broad-spectrum control of a number of key noxious and invasive annual, biennial and perennial weed species, as well as agronomic broadleaf weeds. Aminopyralid can also provide residual weed control activity controlling re-infestations and reducing the need for re-treatment depending on the rate applied and the target weeds.	It provides broad-spectrum broadleaf weed control at very low labeled use rates (4 to 7 fl oz/acre, or 0.06 to 0.1 lb ae/acre), compared to currently registered herbicides with the same mode of action, including 2,4-D, clopyralid, triclopyr, picloram and dicamba. Can be applied up to the water's edge
Chlorsulfuron / (Telar,Glean,Corsair) / *Sulfonylurea-Interferes with enzyme acetolactate synthase w/ rapid cessation of cell division and plant growth in shoots and roots.*	Glean -Selective preemergent or early postemergent Telar – Selective pre- and post-emergent. Chlorsulfuron can be used for many annual, biennial and perennial broadleaf species.	Use at very low rates on annual, biennial and perennial species; especially Canada thistle, dalmation toadflax, hounds tongue and perennial pepperweed. Safe for most grasses.	Safe for most perennial grasses, conifers. Some soil residual. Potential for offsite movement through runoff or wind erosion is substantial in conditions that favor these actions. Damage to some aquatic plants possible at peak concentration. Without drift mitigation (selective spot hand treatment, etc.), offsite drift from ground broadcast application may cause damage to non-tolerant species up to 900 feet[17].
Clopyralid / (Transline) / *Synthetic auxin –Mimics natural plant hormones.* Similar to picloram. Contains hexachlorobenzene.	A highly translocated, selective herbicide active primarily through foliage of broadleaf species. Little effect on grasses.	Particularly effective on Asteraceae, Fabaceae, Polygonaceae, Solanaceae. Some species include knapweeds, yellow starthistle, Canada thistle, hawkweeds.	Not as persistent as picloram. Can persist from one month to one year. More selective than picloram. Potentially mobile depending on site specific conditions. Without drift mitigation (selective

[14] This table is a brief summary of some of the attributes of these herbicides. More information is provided in the species write ups or more information can be found from the references given.
[15] The information on effectiveness by species (third column) contains examples of just some of the species the herbicides can treat.
[16] Issues listed in this table and in following species-specific tables were identified in Forest Service Risk Assessments prepared by Syracuse Environmental Research Associates, Inc. Risk assessments are available at: http://www.fs.fed.us/foresthealth/pesticide/work.shtml
[17] **Off site drift may cause damage to non-tolerant plants.** Whether or not damage due to drift would actually be observed after the application would depend on a several site-specific conditions, including wind speed and foliar interception by the target vegetation. For example, in a right-of-way application conducted at low wind speeds and under conditions in which vegetation at or immediately adjacent to the application site would limit off-site drift, damage due to drift would probably be inconsequential or limited to the area immediately adjacent to the application site. Tolerant plant species would probably not be impacted by the drift and might show relatively little damage unless they were directly sprayed (SERA Risk Assessments).

Chemical/Brand Names/Mode of Action	Properties	General Uses/Known to be Effective on:[15]	Comparisons/Issues[16]
			spot hand treatment, etc.), off site drift from ground broadcast application may cause damage to non-tolerant species up to 300 feet.
Dicamba / (Banvel , Vanquish) *Synthetic auxin -Mimics natural plant hormones*	Readily absorbed by roots, stems or leaves and then translocated to other plant parts. Control is best when weeds are small and actively growing.	Used for the control of a variety of broadleaf and woody vegetation. Particularly effective against bindweed and Canada thistle.	Spray drift is toxic to non-tolerant plants in the same manner as 2, 4-D, thus similar precautions should be followed. Banvel is more likely to generate dicamba vapor than Vanquish. Dicamba is often mixed with grass herbicides or with phenoxy herbicides to provide a broader spectrum of weed control.
Diuron / (Karmex, Diurex 80W) / *Substituted urea; strong inhibitor of photosynthesis*	Most readily absorbed by roots, less so by foliage. Translocated upward in the xylem. Applied to crops as a preemergence or directed early postemergence spray, preferably before weed growth becomes dense. Better control of emerged weeds is obtained by the addition of a suitable surfactant. In non-crop areas, diuron may be sprayed anytime except when ground is frozen.	Used as a herbicide to control a wide variety of annual and perennial broadleaf and grassy weeds. Diuron is used on industrial sites, on rights-of-way, around buildings, and on irrigation and drainage ditches.	Should not be used where it is likely to leach or wash into contact with the roots of desirable trees or shrubs. Diuron is a highly persistent and fairly immobile herbicide. When applied to soil it will not leach below 5 to 10 cm from the surface.
Glyphosate / (RoundUp, Rodeo etc.) / *Inhibits three amino acids and protein synthesis.*	A broad spectrum, nonselective translocated herbicide with no apparent soil activity. Translocates to roots and rhizomes of perennials. Adheres to soil which lessens or retards leaching or uptake by non-targets.	Low volume applications are most effective. Control for purple loosestrife, reed canarygrass and other weeds common in wetland and riparian habitats.	Aquatic formulations can be used near water. Rain within 6 hours of application may reduce effectiveness. Complete control may require re-treatment. Without drift mitigation (selective spot hand treatment, etc.), off site drift damage from ground broadcast application to non-tolerant species up to 100' possible.
Hexazinone / (Velpar) Inhibits photosynthesis	Primarily soil-active; some foliar activity.	Broad spectrum control with some selectivity for conifers	Minimal volatility. Adsorbed by organic matter and clay; highly water-soluble with potential for leaching on sandy soils
Imazapic / (Plateau) / *Inhibits the plant enzyme acetolactate, which prevents protein synthesis.*	Selective against some broadleaf plants and some annual grasses.	Use at low rates can control leafy spurge, cheatgrass, and hounds tongue. Useful in grassland prairie habitat restoration because it is selective against annual grasses.	Without drift mitigation (selective spot hand treatment, etc.), off site drift from ground broadcast application may damage non-tolerant species up to 50' possible; over 100' if aerially applied. Even very tolerant species could be damaged directly. Some damage to aquatic plants at peak concentrations.
Imazapyr / (Arsenal, Chopper, Stalker, Habitat) / *Inhibits the plant enzyme acetolactate, which prevents protein synthesis.*	Broad spectrum, nonselective pre- and postemergent for annual and perennial grasses and broadleaved species.	Most effective as a postemergent. Has been used on cheatgrass, white top, perennial pepperweed, tamarisk, dyers woad, and woody species.	High potential for leaching. Highly mobile and persistent. Residual toxicity up to several years. May be actively exuded from the roots of legumes, likely as a defense mechanism by these plants.
Metsulfuron methyl / (Escort) / *Sulfonylurea –*	Selective against broadleaf and woody	Use at low rates to control such species as houndstongue,	Potentially mobile in water or through wind erosion. Damage to

Chemical/Brand Names/Mode of Action	Properties	General Uses/Known to be Effective on:[15]	Comparisons/Issues [16]
Inhibits acetolactate synthesis, protein synthesis inhibitor, block formation of amino acids.	species. Most sensitive crop species in the Lily family.	perennial pepperweed, sulfur cinquefoil. Safest sulfonylurea around non-target grasses.	some aquatic plants possible at peak concentrations. Without drift mitigation (selective spot hand treatment, etc.), off site drift from ground broadcast application may cause damage to non-tolerant plants up to 500'.
Picloram (Tordon) Restricted Use Herbicide Contains hexachlorobenzene.	Selective, systemic for many annual and perennial broadleaf herbs and woody plants.	Use at low rates to control such species as knapweeds, Canada thistle, yellow starthistle, houndstongue, toadflaxs, St. Johnswort, sulfur cinquefoil and hawkweeds.	Without drift mitigation (selective spot hand treatment, etc.), off site drift from ground broadcast application may cause damage to non-tolerant plants up to 1000'. Also can leak out of roots to non-targets. One application may be effective for 2 or more years. Can move offsite through surface or subsurface water. Can be relocated through livestock urine.
Sulfometuron methyl / (Oust) / *Sulfonylurea - Inhibits acetolactase synthase, a key step in branch chain amino acid synthesis.*	Broad spectrum pre- and post-emergent herbicide for both broadleaf species and grasses.	Used at low rates as a pre-emergent along roadsides. Known to be effective on canary reedgrass (but not labeled for aquatic use), cheatgrass and medusahead.	Without drift mitigation (selective spot hand treatment, etc.), offsite drift from ground broadcast application may cause damage to non-tolerant plants up to 900'. Highly mobile by water or by wind erosion. Substantial damage has occurred to croplands in arid and wet regions. Damage to some aquatic plants possible at peak concentration
Triclopyr / (Garlon, Pathfinder, Remedy) / *Synthetic auxin - Mimics natural plant hormones.*	A growth regulating selective, systemic herbicide for control of woody and broadleaf perennial weeds.	Not for broadcast application under proposed action. Little or no impact on grasses. Effective for many woody species such as basal bark or cut stump treatment for salt cedar.	Garlon 4 (ester compound) is toxic to fish and aquatic invertebrates. Amine formulations may be used near or over water. Offsite movement by water possible. Without drift mitigation (selective spot hand treatment, etc.), off site drift from ground broadcast application may damage non-tolerant plants up to 100 feet.

FORMULATIONS

A herbicide formulation is the total marketed product, and is typically available in forms that can be sprayed on as liquids or applied as dry solids. It includes the active ingredient(s), any additives that enhance herbicide effectiveness, stability, or ease of application such as surfactants and other adjuvants, and any other ingredients including solvents, carriers, or dyes. The application method and species to be treated will determine which formulation is best to use. In most cases, manufacturers produce formulations that make applications and handling simpler and safer. Some herbicides are available in forms that can reduce risk of exposure during mixing, such as pre-measured packets that dissolve in water, or as a liquid form already mixed with surfactant and dye (e.g., triclopyr - Pathfinder II®).

Sprayable / Liquid Formulations

Water-soluble formulations: soluble liquids , soluble powders or packets, and soluble granules. Only a few herbicidal active ingredients readily dissolve in water. These products will not settle out or separate when mixed with water.

Emulsifiable formulations (oily liquids): emulsifiable concentrates and gels. These products tend to be easy to handle and store, require little agitation, and will not settle out of solution. Disadvantages of these products are that most can be easily absorbed through the skin and the solvents they contain can cause the rubber and plastic parts of application equipment to deteriorate.

Liquid suspensions (liquid or flowable) that are dispersed in water include: suspension concentrates, aqueous suspensions, emulsions of water-dissolved herbicide in oil, emulsions of an oil-dissolved herbicide in water, micro-encapsulated formulations, and capsule suspensions. All these products consist of a particulate or liquid droplet active ingredient suspended in a liquid. They are easy to handle and apply, and rarely clog nozzles. However, they can require agitation to keep the active ingredients from separating out.

Dry solids that are suspended in water include: wettable powders, water-dispersible granules, or dry flowables. These formulations are some of the most widely used. The active ingredient is mixed with a fine particulate carrier, such as clay, to maintain suspension in water. These products tend to be inexpensive, easy to store, and are not as readily absorbed through the skin and eyes as emulsifiable concentrates or other liquid formulations. These products, however, can be inhalation hazards during pouring and mixing. In addition, they require constant agitation to maintain suspension and they may be abrasive to application pumps and nozzles.

Dry Formulations

Granules: Granules consist of the active ingredient absorbed onto coarse particles of clay or other substance, and are most often used in soil applications. These formulations can persist for some time and may need to be incorporated into the soil.

Pellets or tablets: Pellets are similar to granules but tend to be more uniform in size and shape.

Dusts: A dust is a finely ground pesticide combined with an inert or inactive dry carrier. They can pose a drift or inhalation hazard.

Salts versus Esters

Many herbicidally active compounds are acids that can be formulated as a salt or an ester for application. Once the compound enters the plant, the salt or ester cation is cleaved off. This allows the parent acid (active ingredient) to be transported throughout the plant. When choosing between the salt or ester formulation, consider the following characteristics:

Salts: Most salts are highly water soluble, which reduces the need for emulsifiers or agitation to keep the compound suspended. Salts are not soluble in oil. They generally require a surfactant to facilitate penetration through the plant cuticle (waxy covering of leaves and stems). Salts are less volatile than esters and can dissociate in water. In hard water the parent acid (i.e. the active ingredient) may bind with calcium and magnesium in the water, precipitate out, and be inactivated.

Esters: Esters can penetrate plant tissues more readily than salts, especially woody tissue. Esters generally are more toxic to plants than salts. They are not water soluble and require an emulsifying agent to remain suspended in water-based solvents. Esters have varying degrees of volatility

Adjuvants / Surfactants

An adjuvant is any material added to a pesticide mixture that facilitates mixing, application or pesticide efficacy. An adjuvant enables an applicator to customize a formulation to be most effective in a particular situation. Adjuvants include surfactants, stickers, extenders, activators, compatibility agents, fertilizers, buffers and acidifiers, deposition aids, de-foaming agents, thickeners, and dyes. See Appendix J for more details on adjuvants. Some fertilizers, alone, may be effective for tall larkspur control, such as ammonium sulfate.

Surfactants are the most important adjuvants. They are chemical compounds that facilitate the movement of the active herbicide ingredient into the plant. They may contain varying amounts of fatty acids that are capable of binding to two types of surfaces, such as oil and water. Some herbicide formulations come with a surfactant already added, in others, surfactants can be added prior to application. Whether a surfactant should be added will be determined by the type of herbicide being applied and the target plant. The label should be followed for use of appropriate surfactants.

Adjuvants are not under the same registration guidelines as are pesticides. The U.S. Environmental Protection Agency (U.S. EPA) does not register or approve the labeling of spray adjuvants. All adjuvants are generally field tested by the manufacturer with several different herbicides against many weeds, and under different environments. Basic information concerning adjuvants commonly used with herbicides describes hazard information and is used in conjunction with Forest Service national herbicide risk assessments (Bakke 2002).

MECHANISMS OF DISSIPATION

Dissipation refers to the movement, degradation, or immobilization of an herbicide in the environment.

Degradation: Degradation occurs when an herbicide is decomposed to smaller component compounds, and eventually to CO_2, water, and salts, through photochemical, chemical, or biological (microbial metabolism) reactions. Biodegradation accounts for the greatest percentage of degradation for most herbicides (Tu, et. al., 2001). When a single herbicide degrades, it usually yields several compounds (“metabolites”), each of which has its own chemical properties including toxicity, adsorption capacity, and resistance to degradation. Some metabolites are more toxic and/or persistent than the parent compound. In most cases, the natures of the metabolites are largely unknown.

Photodegradation: Photodegradation refers to decomposition by sunlight. Sunlight intensity varies with numerous factors including latitude, season, time of day, weather, pollution, and shading by soil, plants, litter, etc. Studies of the photodegradation of herbicides are often conducted using UV light exclusively, but there is some debate as to whether most UV light actually reaches the surface of the earth. Therefore, photodegradation rates determined in the laboratory may over-estimate the importance of this process in the field (Tu, et. al., 2001).

Microbial Degradation: Microbial degradation is decomposition through microbial metabolism. Different microbes can degrade different herbicides, and consequently, the rate of microbial degradation depends on the microbial community present in a given situation (Voos and Groffman 1997). Soil conditions that maximize microbial degradation include warmth, moisture, and high organic content.

Herbicides may be microbially degraded via one of two routes. They may be metabolized directly when they serve as a source of carbon and energy (i.e. food) for microorganisms, or they may be co-metabolized in conjunction with a naturally occurring food source that supports the microbes (Tu, et. al., 2001). Herbicides that are co-metabolized do not provide enough energy and/or carbon to support the full rate of microbial metabolism on their own.

There is sometimes a lag time before microbial degradation proceeds. This may be because the populations of appropriate microbes or their supplies of necessary enzymes start small, and take time to build up. If this lag time is long, other degradation processes may play more important roles in dissipation of the herbicide (Tu, et. al., 2001). Degradation rates of co-metabolized herbicides tend to remain constant over time.

Chemical Decomposition: Chemical decomposition is degradation driven by chemical reactions, including hydrolyzation (reaction with hydrogen, usually in the form of water), oxidation (reaction with oxygen), and disassociation (loss of an ammonium or other chemical group from the parent molecule). The importance of these chemical reactions for herbicide degradation in the field is not clear (Tu, et. al., 2001).

Immobilization/Adsorption: Herbicides may be immobilized by adsorption to soil particles or uptake by non-susceptible plants. These processes isolate the herbicide and prevent it from moving in the environment, but both adsorption and uptake are reversible. In addition, adsorption can slow or prevent degradation mechanisms that permanently degrade the herbicide.

Adsorption refers to the binding of herbicide by soil particles, and rates are influenced by characteristics of the soil and of the herbicide. Adsorption is often dependent on the soil or water pH, which then determines the chemical structure of the herbicide in the environment. Adsorption generally increases with increasing soil organic content, clay content, and cation exchange capacity, and it decreases with increasing pH and temperature. Soil organic content is thought to be the best determinant of herbicide adsorption rates (Tu, et. al., 2001). Adsorption is also related to the water solubility of an herbicide, with less soluble herbicides being more strongly adsorbed to soil particles. Solubility of herbicides in water generally decreases from salt to acid to ester formulations, but there are some exceptions. For example, glyphosate is highly water-soluble and has a strong adsorption capacity.

The availability of an herbicide for transport through the environment or for degradation is determined primarily by the adsorption/desorption process. Adsorption to soil particles can stop or slow the rate of microbial metabolism significantly. In other cases, adsorption can facilitate chemical or biological degradation (Tu, et. al., 2001). Adsorption can change with time and, in most cases, is reversible (i.e. the herbicide can desorb from the soil or sediments and return to the soil solution or water column).

Movement/Volatilization: Movement through the environment occurs when herbicides are suspended in surface or subsurface runoff, volatilized during or after application, evaporated from soil and plant surfaces, or leached down into the soil. Although generally studied and discussed separately, these processes actually occur simultaneously and continuously in the environment (Tu, et. al., 2001).

Volatilization occurs as the herbicide passes into the gaseous phase and moves about on the breeze. Volatilization most often occurs during application, but also can occur after the herbicide has been deposited on plants or the soil surface. The volatility of an herbicide is determined primarily by its molecular weight. Most highly volatile herbicides are no longer used.

Volatility generally increases with increasing temperature and soil moisture, and with decreasing clay and organic matter content (Tu, et. al., 2001). The use of a surfactant can change the volatility of a herbicide. In extreme cases, losses due to volatilization can be up to 80 or 90% of the total herbicide applied (Tu, et. al., 2001). Of the herbicides in this analysis, only 2, 4-D and triclopyr can present volatilization problems in the field.

HERBICIDE RESISTANCE

Herbicide resistance is the genetic ability of an individual plant to survive a herbicide application to which the wild-type population is otherwise susceptible. Resistant individuals remain reproductively compatible with the wild-type, and may confer genetic resistance to their offspring.

Resistance may occur in plants by random and infrequent mutations. Through selection, where the herbicide is the selection pressure, susceptible plants are killed while herbicide resistant plants survive to reproduce without competition from susceptible plants. If the herbicide is continually used, resistant plants successfully reproduce and become dominant in the population.

Herbicide resistance was first reported in 1957 in California with common groundsel (*Senecio vulgaris*) (Prather et al., 2000). Development of resistance occurs mostly in croplands where repeated applications of a single herbicide select for resistant survivors. However, resistance is known to occur in a few wildland invasives, including yellow starthistle resistance to picloram and clopyralid (Sabba et al., 2003). A resistant biotype was observed in Washington in a pasture subjected to intensive picloram selective pressure. Reports of resistant strains of perennial ryegrass (*Lolium perenne*) to sulfometuron methyl, Russian thistle (Salsola tragus) to chlorosulfuron and sulfometuron have been found in California (Prather et al, 2000). Other resistant species were reported.

Resistance to glyphosate is debated in the literature (Owen and Zelaya, 2005). Arguments indicate that not only would the evolution of glyphosate resistance be an issue, but also weed populations shifts would occur in response to the adoption of glyphosate-resistant crops. In field situations, resistance to sulfonylurea herbicides has been reported to occur after 3 to 5 years of repeated use (Liebman, et. al., 2001).

Herbicide factors that contribute to the potential for resistance include long soil residual activity, single target site and specific mode of action, and high effective kill of a wide range of weed species. All of these factors rapidly deplete susceptible genes from the population (Prather et al., 2000). Resistance is avoided or overcome by having multiple herbicides with different modes of action (plant-killing chemistries) available for use. The use of short-residual herbicides also reduces selection pressure for herbicide resistance as well as integrating non-herbicide control techniques into a weed management program (Prather et al., 2000).

The repeated use of one herbicide allows these few resistant plants to survive and reproduce. As the number of resistant plants increases, the efficacy of the herbicide diminishes until the herbicide no longer effectively controls the undesirable plant populations. Where repeated herbicide use is predicted to be necessary to meet control objectives, strategies must be designed to minimize risk of developing resistance.

To develop resistance avoidance strategies, long-term site plans should recognize which of the various herbicide families have available and effective herbicides if multiple applications are expected to be necessary. Integrated chemical and non-chemical controls are highly effective where feasible because any surviving herbicide resistant plants can be removed from the site.

The threat of the weeds occurring on the Custer National Forest developing a resistance to the herbicides has not been documented to date. However, the likelihood of this happening does exist. As an adaptive management approach, herbicide rotation will be considered where resource management objectives can still be met. Rotating herbicides by chemical family and preferably by mode of action would minimize the potential development of herbicide resistant weeds. See Appendix E.

BEHAVIOR IN THE ENVIRONMENT

Perhaps the most important factor determining the fate of herbicide in the environment is its solubility in water (Tu, et. al., 2001). Water-soluble herbicides generally have low adsorption capacities, and are consequently more mobile in the environment and more available for microbial metabolism and other degradation processes. Esters, in general, are relatively insoluble in water, adsorb quickly to soils, penetrate plant tissues readily, and are more volatile than salt and acid formulations (Tu, et. al., 2001).

The toxicology information indicated is for the technical grade of the herbicide unless otherwise noted. In some cases, it is not the herbicide itself that is the most toxic component of the applied formula. Adjuvants, such as petroleum solvents (e.g. diesel fuel, deodorized kerosene, methanol), can be highly toxic (Tu, et. al., 2001). In addition, impurities resulting from the manufacturing process can be more toxic than the active ingredient itself.

Soils

An herbicide’s persistence in soils is often described by its half-life (also known as the DT50). The half-life is the time it takes for half of the herbicide applied to the soil to dissipate. The half-life gives only a rough estimate of the persistence of an herbicide since the half-life of a particular herbicide can vary significantly depending on soil characteristics, weather (especially temperature and soil moisture), and the vegetation at the site. Dissipation rates often change with time (Voos and Groffman, 1997). Nonetheless, half-life values do provide a means of comparing the relative persistence of herbicides.

The distribution of an herbicide in the soil is determined primarily by the amount, type, and surface area of clays and organic matter in the soil, the amount and quality of soil moisture, and soil temperature and soil pH (Tu, et. al., 2001). Most natural soils have pH values between 5 and 8. Rainfall and the amount of leaching that has occurred strongly influence these values. In wet areas and/or coarse soils, cations can be leached out, leaving the soil acidic. In arid and semi-arid regions, soils retain cations and are more alkaline. Acidic soils can also be found in bogs where organic acids lower the soil’s pH.

See the Soils and Groundwater section of this chapter for more detailed information.

Water

Water bodies can be contaminated by direct overspray, or when herbicides drift, volatilize, leach through soils to groundwater, or are carried in surface or subsurface runoff. Amounts of leaching and runoff are largely dependent on total rainfall the first few days after an application. Total losses to runoff generally do not exceed five to ten percent of the total applied, even following heavy rains (Tu, et. al., 2001). High soil adsorption capacity, low rates of application and low rainfall reduce total runoff and contamination of local waterways (Bovey et al. 1978).

The behavior of an herbicide in water is dictated by its solubility in water. Salts and acids tend to remain dissolved in water until degraded through photolysis or hydrolysis. Esters will often adsorb to the suspended matter in water, and precipitate to the sediments. Once in the sediments, esters can remain adsorbed to soil particles or be degraded through microbial metabolism. Highly acidic or alkaline waters can chemically alter an herbicide and change its behavior in water. The average pH of surface waters is between five and nine (Tu, et. al., 2001).

See the Water Quality, Fisheries, and Amphibians section of this chapter for more detailed information.

Birds and Mammals

A herbicide's toxicity is described by its LD50, which is the dose received either orally (taken through the mouth) or dermally (absorbed through the skin) that kills half the population of study animals. The oral LD50s reported here were determined for adult male rats. The dermal LD50s were determined for rabbits. The LD50 is typically reported in grams of herbicide per kilogram of animal body weight. LD50s are determined under varying circumstances so comparisons between different herbicides may provide only a rough sense of their relative toxicities. Dermal LD50 values may be more meaningful to herbicide applicators because they are more likely to be exposed to herbicide through their skin rather than by oral ingestion. In any event, very few people, even among applicators, are exposed to herbicide doses as high as the LD50.

The LD50 does not provide any information about chronic, long-term toxic effects that may result from exposure to lesser doses. Sublethal doses can lead to skin or eye irritation, headache, nausea, and, in more extreme cases, birth defects, genetic disorders, paralysis, cancer, and even death. Impurities derived from the formulation of the herbicide and the adjuvants added to the formulation may be more toxic than the herbicide compound itself, making it difficult to attribute increased risks of cancer or other effects directly to a herbicide (Ibrahim et al. 1991).

The most dramatic effects of herbicides on non-target plants and animals often result from the habitat alterations they cause by killing the targeted weeds. For example, loss of invasive riparian plants can cause changes in water temperature and clarity that can potentially impact the entire aquatic community, and the physical structure of the system through bank erosion. Removing a shrubby understory can make a habitat unsuitable for certain bird species and expose small mammals to predation.

See the Wildlife section of this chapter for more detailed information.

Aquatic Species

A herbicide's toxicity to aquatic organisms is quantified with the LC50, which is the concentration of herbicide in water required to kill half of the study animals. The LC50 is typically measured in micrograms of pesticide per liter of water.

In general, ester formulations are more dangerous for aquatic species than salt and acid formulations because ester formulations are lipophilic (fat-loving), and consequently, can pass through the skin and gills of aquatic species relatively easily. Ester formulations, additionally, are not water soluble, and are less likely to be diluted in aquatic systems.

See the Water Quality, Fisheries, and Amphibians section of this chapter for more detailed information.

Soil Microbes

Herbicides have varying effects on soil microbial populations depending on herbicide concentrations and the microbial species present. Low residue levels can enhance populations while higher levels can cause population declines. In many cases, studies are too short in duration to determine the true long-term impacts of herbicide use on soil microbes.

HUMAN TOXICOLOGY

When proper safety precautions are taken, human exposure to herbicides used in natural areas should be minimal. Properly fitted personal protective equipment and well-planned emergency response procedures will minimize exposure from normal use as well as emergency spill situations (see Appendix M). See the Human Health section of this chapter for more detailed information.

Exposure

Agricultural workers are often exposed to herbicides when they unintentionally re-enter a treated area too soon following treatment. People who mix and apply herbicides are at the greatest risk of exposure. The most common routes of exposure are through the skin (dermal) or by inhalation (to the lungs). Accidental spills or splashing into the eyes is also possible and with some compounds, can result in severe eye damage and even blindness.

Agricultural herbicide applicators are typically exposed to herbicide levels ranging from micrograms to milligrams per cubic meter of air through inhalation, but exposures through the skin are thought to be much greater (Tu, et. al., 2001). Spilling concentrated herbicide on exposed skin can be the toxic equivalent of working all day in a treated field (Tu, et. al., 2001). Dermal exposure can occur to the hands (directly or through permeable gloves), splashes onto clothing or exposed skin, and anywhere you wipe your hands (e.g., thighs, brow). Some tests have found relatively high levels of dermal exposure to the crotch and seat of workers who got herbicide on their hands, and then touched or wiped the seat of their vehicles. Because adsorption through the skin is the most common route of exposure for applicators (Tu, et. al., 2001), the dermal LD50 may provide more practical information on the relative toxicity of an herbicide rather than the oral LD50, which is based on oral ingestion.

Toxic Effects

A person’s reaction to pesticide poisoning depends on the toxicity of the pesticide, the size of the dose, duration of exposure, route of absorption, and the efficiency with which the poison is metabolized and excreted by the person’s body (Tu, et. al., 2001). Different individuals can have different reactions to the same dose of herbicide. Smaller people are, in general, more sensitive to a given dose than are larger people.

Herbicides can poison the body by blocking biochemical processes or dissolving or disrupting cell membranes. Small doses may produce no response while large doses can cause severe illness or death. The effects may be localized, such as irritation to the eyes, nose, or throat, or generalized, such as occurs when the compound is distributed through the body via the blood stream. Symptoms can occur immediately after exposure or develop gradually. Injuries are usually reversible, but in extreme cases can be permanently debilitating (Tu, et. al., 2001).

Common symptoms of low-level exposure (such as occurs when mixing or applying herbicides in water) to many herbicides include skin and eye irritation, headache, and nausea. Higher doses (which can occur when handling herbicide concentrates) can cause blurred vision, dizziness, heavy sweating, weakness, stomach pain, vomiting, diarrhea, extreme thirst, and blistered skin, as well as behavioral alterations such as apprehension, restlessness, and anxiety (Tu, et. al., 2001). Extreme cases may result in convulsions, unconsciousness, paralysis, and death.

Impurities produced during the manufacturing process and adjuvants added to the formulation may be more toxic than the herbicide compound itself. Consequently, LD50s determined for the technical grade of the herbicide may not be the same as that for the brand name formulation. Combinations of herbicides furthermore, can have additive and synergistic effects in which a formulation of two or more herbicides is two to 100 times as toxic as any one of the herbicides alone (Thompson 1996). Labels for manufacturer's warnings and safety precautions that may be required for a particular formulation should be read carefully.

HUMAN HEALTH

The control of weeds by chemical, than by other means, is often of concern to the public from the standpoint of possible effects on human health.

Human Health - Regulatory Framework

Safety standards for herbicide use are set by the Environmental Protection Agency (EPA), Occupational Health and Safety Administration, Code of Federal Regulations (40 CFR part 170), and individual states. In addition, several sections of the Forest Service Manual (FSM, 1994) provide guidance to the safe handling and application of herbicides. These include:

- Consultation of pesticide handling requirements set forth in the Forest Service Health and Safety Code Handbook (FSM 6709.11) and (FSM 2156) (see Appendix M);
- Pesticide-Use Management and Coordination Handbook that requires the Forest Service to review pesticide use proposals in terms of human health (FSM 2109.13.2);
- Recommendation to complete environmental and human health risk assessments prior to pesticide use to ensure public safety (FSM 2109.14);
- Completion of project work plans prior to implementation, including a description of personal protective clothing and equipment required (FSM 2109.14.3);
- Development of a safety plan to protect the public and employees from unsafe work conditions when pesticides are involved (FSM 2109.16, FSM 2153.3);
- Safety and Health Hazard Analysis that requires completion of a Job Hazard Analysis (Form FS-6700-7) to determine hazards on the project and identify ways to eliminate them (FSM 2109.16.2, FSM 6700, FSH 6709.11) (see Appendix M).

Finally, FSM 2109.16.3 states the requirement for, and defines Pesticide Risk Assessment as another method of helping to ensure environmental health and human safety in pesticide use. Risk analysis is used to quantitatively evaluate the probability that a given pesticide use might impose harm on humans or other species in the environment. It is the same process used for regulation of food activities, medicine, cosmetics and other chemicals.

These analyses are usually incorporated into the decision making documents prepared in compliance with the National Environmental Policy Act (FSM 1950). A pesticide risk assessment does not, in itself, ensure safety in pesticide use. The analysis is tied to protection measures (see Appendix C) and label requirements to avoid potential risks identified by the risk assessment.

Human Health - Methodology for Analysis

As herbicides have the potential to adversely affect the environment or human health, the U.S. Environmental Protection Agency (EPA) must register all herbicides prior to their sale, distribution, or use in the United States. In order to register herbicides for outdoor use, the EPA requires the manufacturers to conduct a lab evaluation of potential hazards to humans and on wildlife including toxicity testing on representative species of birds, mammals, freshwater fish, aquatic invertebrates, and terrestrial and aquatic plants. An ecological risk assessment uses the data collected to evaluate the likelihood that adverse ecological effects may occur as a result of herbicide use.

The effects from the use of any herbicide depends on the toxic properties (hazards) of that herbicide, the level of exposure to that herbicide at any given time, and the duration of that exposure. The risk from herbicide use can be reduced by reducing exposure through site-specific project design criteria, such as the use of streamside buffer zones, personal protective equipment for applicators, and posting of treated areas. Protection measures specified in Chapter 2, and Appendices, C, G, and J along with scientific literature on toxicity and risks will help assess effects of possible exposure, pesticide toxicity, and pesticide doses workers and the public may receive, and are compared to levels of no observed effects.

Treatments under all alternatives would be accomplished according to strict safety and health standards.

To assess concerns related to herbicide use, the USDA Forest Service (Forest Service) contracted Syracuse Environmental Research Associates, Inc. (SERA), to complete risk assessments for herbicides the Forest Service uses to control noxious weeds and other invasive species. These assessments and EPA risk assessments evaluate potential risks to human health and the environment. The SERA assessments use peer-reviewed articles from the open scientific literature and current EPA documents, including Confidential Business Information.

Human Health Risk Assessments

The methodologies used to assess human health risks meet Forest Service direction for completion of a risk assessment per Forest Service Handbook 2109.14, Chapter 10. Human health risks are based on information found in various herbicide risks assessments conducted by the Forest Service (SERA, 1999-2004) (http://www.fs.fed.us/foresthealth/pesticide/risk.shtml), the Bureau of Land Management (http://www.blm.gov/nhp/spotlight/VegEIS/hhra.htm), and the Environmental Protection Agency (EPA) (http://www.epa.gov/iris/index.html) and EPA re-registration decisions (http://cfpub.epa.gov/oppref/rereg/status.cfm?show=rereg) for each EPA approved herbicide considered, and are incorporated into this analysis by reference. These assessments are incorporated into this analysis by reference. Toxicity and exposure information for herbicides was reviewed to determine the levels of these chemicals that would be harmful to human health. Potential exposures and doses are estimated for workers and the general public. Toxic effect levels are compared to predicted dose levels to determine the possibility of human impact.

EPA regulates pesticides under two major federal statutes. Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), EPA registers pesticides for use in the United States and prescribes labeling and other regulatory requirements to prevent unreasonable adverse effects on health or the environment. Under the Federal Food, Drug, and Cosmetic Act (FFDCA), EPA establishes tolerances (maximum legally permissible levels) for pesticide residues in food. The 1996 Food Quality Protection Act (FQPA) amended both major pesticide laws to establish a more consistent, protective regulatory scheme, grounded in sound science. It mandates a single, health-based standard for all pesticides in all foods; provides special protections for infants and children; expedites approval of safer pesticides; creates incentives for the development and maintenance of effective crop protection tools for American farmers; and requires periodic re-evaluation of pesticide registrations and tolerances to ensure that the scientific data supporting pesticide registrations will remain up to date in the future. EPA evaluates the available toxicity data and considers its validity, completeness, and reliability as well as the relationship of the results of the studies to human risk.

The FQPA requirements included a new safety standard for reasonable certainty of no harm that must be applied to all pesticides used on foods. The dose at which no adverse effects are observed (the NOAEL) from the toxicology study identified as appropriate for use in risk assessment is used to estimate the toxicological level of concern (LOC). However, the lowest dose at which adverse effects of concern are identified (the LOAEL) is sometimes used for risk assessment if no NOAEL was achieved in the toxicology study selected. An uncertainty factor (UF) is applied to reflect uncertainties inherent in the extrapolation from laboratory animal data to humans and in the variations in sensitivity among members of the human population as well as other unknowns. An UF of 100 is routinely used, 10X to account for interspecies differences and 10X for intraspecies differences.

Three other types of safety or UFs may be used: “Traditional uncertainty factors;'' the “special Food Quality Protection Act of 1996 (FQPA) safety factor;'' and the “default FQPA safety factor.'' By the term “traditional uncertainty factor,'' EPA is referring to those additional UFs used prior to FQPA passage to account for database deficiencies. These traditional uncertainty factors have been incorporated by the FQPA into the additional safety factor for the protection of infants and children. The term “special FQPA safety factor'' refers to those safety factors that are deemed necessary for the protection of infants and children primarily as a result of the FQPA. The “default FQPA safety factor'' is the additional 10X safety factor that is mandated by the statute unless it is decided that there are reliable data to choose a different additional factor (potentially a traditional uncertainty factor or a special FQPA safety factor).

For dietary risk assessment (other than cancer) the EPA uses the UF to calculate an acute or chronic reference dose (acute RfD or chronic RfD) where the RfD is equal to the NOAEL divided by an UF of 100 to account for interspecies and intraspecies differences and any traditional uncertainty factors deemed appropriate (RfD = NOAEL/UF). Where a special FQPA safety factor or the default FQPA safety factor is used, this additional factor is applied to the RfD by dividing the RfD by such additional factor. The acute or chronic population adjusted dose (aPAD or cPAD) is a modification of the RfD to accommodate this type of safety factor.

For non-dietary risk assessments (other than cancer) the UF is used to determine the LOC. For example, when 100 is the appropriate UF (10X to account for interspecies differences and 10X for intraspecies differences) the LOC is 100. To estimate risk, a ratio of the NOAEL to exposures (margin of exposure (MOE) = NOAEL/exposure) is calculated and compared to the LOC.

The linear default risk methodology (Q*) is the primary method currently used by the EPA to quantify carcinogenic risk. The Q* approach assumes that any amount of exposure will lead to some degree of cancer risk. A Q* is calculated and used to estimate risk which represents a probability of occurrence of additional cancer cases (e.g., risk). An example of how such a probability risk is expressed would be to describe the risk as one in one hundred thousand (1 X 10-\5\), one in a million (1 X 10-\6\), or one in ten million (1 X 10-\7\).

Under certain specific circumstances, MOE calculations will be used for the carcinogenic risk assessment. In this non-linear approach, a “point of departure'' is identified below which carcinogenic effects are not expected. The point of departure is typically a NOAEL based on an endpoint related to cancer effects though it may be a different value derived from the dose response curve. To estimate risk, a ratio of the point of departure to exposure (MOE_{cancer} = point of departure/exposures) is calculated.

Specific methods used in preparing the Forest Service (FS) / SERA herbicide risk assessments are described in SERA, 2001-Preparation (project file) and incorporate EPA methods. To evaluate potential risks to human health and the environment, FS/SERA (2003-2004) risk assessments use peer-reviewed articles from the open scientific literature and current EPA documents, including Confidential Business Information. Only specific information that is not derived from the relevant SERA Risk Assessments is specifically cited. The risk assessments and associated documentation is available in total in the project record for this EIS.

Toxicity studies were evaluated individually for scientific quality, and cumulatively for all similar studies to identify the No observed adverse effects level (NOAEL) and Reference Dose (RfD) for the most sensitive adverse effect on the test organism. Each EPA and Forest Service/SERA Risk Assessment contains citations for all studies that are reviewed.

The analysis of the potential human health effects associated with the use of herbicides uses the methodology of risk assessment generally accepted by the scientific community (National Research Council, 1983; EPA, 1987 in SERA, 2001-Preparation). Forest Service/SERA Risk Assessments estimate doses to workers from herbicide application, and doses to the public from being on or near an application site. Estimated worker doses and public doses are compared to Reference Doses (RfD). A RfD is a dose of herbicide determined to be safe by the EPA over a lifetime of daily exposure. RfDs are based upon doses shown to cause no observed ill effects to test animals in either short-term (acute) or long-term (subchronic or chronic) studies. Human exposure doses are reduced from those found protection of test animals, based on possible variation between species and among individual people. Different types of possible effects are considered, including acute and chronic systemic effects, cancer, teratogenic (birth defects), mutagenic (gene mutation), and reproductive effects.

The risk assessments use the threshold levels for acceptable risk established by EPA: the RfD is the threshold level for exposure for non-carcinogenic health effects, and one-chance-in-one million is the cancer risk threshold level. A Hazard Quotient (HQ) has been computed for the exposures estimated for workers and members of the public by dividing the dose predicted from a noxious weed treatment by the RfD. In general, if the HQ is less than or equal to 1, the risk of effects is considered negligible.

One of the primary uses of a risk assessment is for risk management. Decision-makers can use the EIS human health risk assessment to identify those herbicides, application methods, or exposure rates that pose the greatest risks to workers and the public. Specific protection measures can then be employed where the decision-maker feels the risks are unacceptably high. Reducing exposure can reduce risk. The use of streamside buffer zones, personal protective equipment for applicators, and posting of treated areas are all examples of ways to reduce exposure to workers and the public. Decision-makers determine when to implement protection measures on specific treatment projects for herbicides available for use in the Record of Decision for the EIS.

Because any risk assessment is based on a number of assumptions, readers and decision-makers should not conclude that the risk values are absolute. If the assumptions are changed, the risk values change. However, the relative risk among herbicides or methods should remain the same unless new toxicity data becomes available.

Health risks from herbicide use depend on the toxic properties of that herbicide, the level of exposure to that herbicide, and the duration of exposure. Chapter 4 discloses the potential for adverse health effects to workers and members of the public, from treatment of noxious weeds using the herbicides as proposed in the EIS alternatives.

In addition to the analysis of potential hazards to human health from every herbicide active ingredient, EPA and Forest Service/SERA Risk Assessments evaluate any available scientific studies of potential hazards of these other substances associated with herbicide applications: impurities, metabolites, inert ingredients, and adjuvants. There is usually less information available on these substances (compared to the herbicide active ingredient) because they are not subject to the extensive testing that is required for herbicide active ingredients under FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act).

Other chemical effects associated with the application of herbicides (Impurities, Metabolites, and Inert Ingredients) are discussed in Chapter 4. Potential human risk and environmental effects are also analyzed in relevant sections of Chapter 4.

Limitations of Risk Assessments

The analysis in Chapter 4 refers extensively to Forest Service risk assessments (prepared by SERA, Inc.) and to some degree the EPA risk assessments for every herbicide considered in the alternatives. Risk assessments use information from laboratory and field studies of herbicide toxicity, exposure, and environmental fate to estimate the risk of adverse effects to non-target organisms. Risk assessments are often used to inform decision makers, notwithstanding the presence of some degree of uncertainty inherent in any methodology used to assess risk. When used in conjunction with information on local conditions and specific treatments, risk assessments become a more precise tool. There are advantages and disadvantages to the risk assessment process as it relates to natural resources.

Advantages of risk assessment include: providing quantitative bases for comparing and prioritizing risks of alternatives; providing to decision makers and the public an estimate of the risk of the occurrence of an adverse effect under typical and extreme scenarios.

Disadvantages include a high degree of uncertainty in interpretation and extrapolation of data. Uncertainty may result from a study design, questions asked (and questions avoided), data collection, data interpretation, and extreme variability associated with aggregate effects of natural and synthesized chemicals on organisms, including humans, and with ecological relationships. Numbers used, particularly in ecological realms, are uncertain, and there are limits on our ability to understand or demonstrate causal relationships. Because of data gaps, assessments rely heavily on extrapolation from laboratory animal tests (Power and Adams, 1997).

Regardless of disadvantages and limitations of ecological and human health risk assessments, the analysis provided by Forest Service/SERA Risk Assessments is the most current and thorough that is available. Risk assessments can determine (given a particular set of assumptions) whether there is a basis for asserting that a particular adverse effect is plausible. The bottom line for all risk analyses is that absolute safety can never be proven and the absence of risk can never be guaranteed (SERA, 2001).

Human Health - Affected Environment

Weed management has potential to affect human health. Concerns are related to the exposure to toxicants found in the herbicides used in ground and aerial applications. Mechanical methods of control may expose workers to plant chemicals, which can cause a reaction in some workers. To date biological, seeding, and grazing control methods have not been shown to be of concern from a human health standpoint. An integrated weed program must be implemented in such a manner as to minimize risk to workers and the general public.

The general public use of the Custer National Forest is primarily recreational in nature. However, other human uses include commodity-oriented such as logging, grazing and mineral extraction, and traditional cultural uses such as plant gathering and use.

The Forest provides a wide range of recreation experiences. At one end of the spectrum are primitive non-motorized opportunities in places like the Cook Mountain Riding and Hiking Area, and the Absaroka-Beartooth Wilderness Area. The other end of the spectrum includes more developed settings like Red Lodge Mountain Ski Area. Weeds can be found in most any of the recreation settings on the Forest. Weeds are frequently spread through recreational activities, particularly along roads, trails, campgrounds, and dispersed recreation sites. See the Recreation section of Chapters 3 and 4 for more detailed information.

Other human uses include domestic water. West Fork Rock Creek (Beartooth Ranger District) is a municipal watershed for the city of Red Lodge and classified as A-1 waters. A-1 classification standards are the most stringent and specific to maintaining water quality for domestic uses. The City of Red Lodge, however, is currently using an alternate source of water and may use the West Fork Rock Creek intake as a backup source. See the Water Quality section of Chapters 3 and 4 for more detailed information. Summer homes, adjacent private land uses in East Rosebud, West Rosebud, and Stillwater drainages may have developed water sources for culinary uses. Label instruction and protection measures outlined in Appendix C will be followed near potable water sources.

Generally, less than 20 workers load, mix, and apply herbicides annually on the Custer National Forest either through government employees, contractors, or agreements with counties.

SOILS AND GROUND WATER

Soils and Ground Water - Regulatory Framework

The National Forest Management Act requires that lands be managed to ensure the maintenance of long-term soil productivity, soil hydrologic function, and ecosystem health. Soil resource management will be consistent with these goals.

The Forest Service Manual (FSM) 2550 – Soil management has a goal to optimize sustained yield of goods and services without impairing the productivity of the land, and it is the policy of the Forest Service to manage land in a manner that will improve soil productivity.

Other laws and guidance include the Soil Conservation and Domestic Allotment Act (16 USC 590) that states soil erosion is a menace to national welfare. This Act provides for the prevention of erosion on lands owned or controlled by the United States through a variety of means including the establishment of vegetative cover. In addition, Congress declares that unsatisfactory conditions on public lands present a high risk of soil loss, subsequent loss of productivity, and unacceptable levels of siltation that can be mediated by increasing rangeland management (43. CFR §1901).

Soils and Ground Water - Affected Area

Affected areas for the impact analysis of proposed actions on soil quality are weed-infested sites currently under consideration for spray with herbicides. Noxious weeds currently infest approximately 1,500 net acres on the Custer National Forest. (see Chapter 2 and project file).

Noxious weeds occur on most combinations of landforms, geology, and soil in the plains to mid-montane elevation zones. Soils are usually highly variable in degree of development, texture, organic matter and coarse fragments (Published County Soil Surveys of Harding County, SD, Carter County, MT, Powder River Area, MT, and Carbon County, MT and the Beartooth Terrestrial Ecological Unit Inventory (TEUI), in progress, available at the Supervisor's Office, Billings, MT).

Soils and Ground Water - Analysis Method

Impacts on soil quality resulting from weed infestation and weed control measures were incorporated by reference from other recent weed EIS (as discussed below). To assess impacts to ground water quality, the RAVE (Relative Aquifer Vulnerability Evaluation) model was used (developed by Montana State University Extension Service, 1990). Geographic Information System (GIS) incorporated the RAVE model, herbicide soil mobility rate, the soil survey and draft Terrestrial Ecological Unit Inventory information, distance to water, and topographic position. The GIS analysis allowed for a landscape analysis so that areas with low to unacceptable risk of groundwater contamination could be identified. See Chapter 4 for more details of this analysis process and the map section for landscape level maps.

In most cases pesticide contamination of ground water can be avoided by using common sense and following label instructions. However, some areas are particularly vulnerable to pesticide contamination and thus require special consideration prior to making an application. The use of this score card may indicate whether an alternative pesticide should be used within a given area or if the area is not suited to pesticide applications.

Several major factors in a particular area determine the relative vulnerability of ground water to pesticide contamination. Nine of these factors were incorporated into the RAVE score card and are defined below and in Chapter 4. Values for these factors were developed on a landscape basis, as defined below. Pesticide leaching potential is based on the soil persistence and herbicide mobility. For this planning effort, a highly leachable herbicide was modeled. This was done to give a "worst case" scenario.

The herbicide picloram (Tordon®) is considered a highly leachable chemical (Montana State University, Extension Service. 1990). It is quite soluble in water, and it is poorly bound to soils. It is also moderately persistent (average of 90 days ½ life.) Degradation by microorganisms is mainly aerobic. Volatilization is low and photochemical degradation occurs only at the soil surface. For these reasons, picloram is used as an index in this evaluation. Because of its moderate ½ life, and high leachability it is not considered a candidate for long-term buildup in soils. However, traces of it can remain in the soil for up to eleven years, so it is important to carefully consider application rates (Rew, Lisa, PhD, Montana State University, personal communication 2003 as cited in Gallatin National Forest FEIS, USFS, 2005).

Factor definitions used in the RAVE score card system.

- *Irrigation Practice:* A rating based on whether a field is flood, sprinkler or non-irrigated.
- *Depth to Ground Water:* The distance, in vertical feet, below the soil surface to the water table.
- *Distance to Surface Water:* The distance, in feet, from the application site to the nearest flowing or stationary surface water.
- *Percent Organic Matter:* The relative amount of decayed plant residue in the soil (most Montana soils are < 3 percent).
- *Pesticide Application Frequency:* The number of times the particular pesticide is applied during one growing season.
- *Pesticide Application Method:* A rating based on whether the pesticide is applied above or below ground.

- *Pesticide Leachability:* A relative ranking of the potential for a pesticide to move downward in soil and ultimately contaminate ground water based upon the persistence, adsorptive potential and solubility of the pesticide.
- *Topographic Position:* Physical surroundings of the field to which the pesticide application is to be made. Flood plain = within a river or lake valley, Alluvial Bench = lands immediately above a river or lake valley, Foot Hills = rolling up-lands near mountains, Upland Plains = high plains not immediately affected by open water or mountains.

All spatial layers were co-located in a geo-database. Ratings for the factors listed above were assigned to soil survey map units (USDA, 1971, 1975, and 1988). These were spatially joined to the buffered stream and lake layers to rate depth to ground water. All rankings were totaled and classified as described below for risk categories. The resulting layer was limited to the Custer National Forest boundary. The resulting tables were queried to provide risk classification summaries by Districts and Forest. All spatial data and analytical procedures are located in the project file.

The RAVE score card rates aquifer vulnerability on a scale of 30 to 100 for individual application sites and pesticides. Higher values indicate high vulnerability of ground water to contamination by the pesticide used in the evaluation. Those values greater than or equal to 65 indicate a potential for ground water contamination. In such instances when broadcast spraying, alternative pesticides should be sought which have a lower leaching potential (see Table 3 -13 for leachability). Scores of 80 or greater indicate that pesticide broadcast applications should not be made at this location unless an alternative product greatly reduces the score. Scores between 45 and 64 indicate a moderate to low potential for ground water contamination and scores less than 45 indicate a low potential for ground water contamination by the pesticide in question. Even in such cases, careful use of pesticides and following label instructions is imperative to protect ground water. The following table describes risk classes.

TABLE 3 - 12. RISK CLASSES FOR HERBICIDE/GROUNDWATER AQUIFER CONTAMINATION

RAVE Rating Score	Risk Class
< 45	Low
45-64	Low to moderate
65-79	High
80-100	Unacceptable

Soils and Ground Water - Affected Environment

Because of the relatively low proportion of weeds on the Custer Forest, there has not been a large soil effect from their incursion. Of 1.2 million acres, less than 1,500 net acres have weed infestations. However, it is important to keep these values low to prevent soil degradation and erosion.

Other recent EIS documents (Gallatin National Forest FEIS, USFS, 2005. Helena National Forest DEIS, USFS, 2003 and Beaverhead-Deerlodge National Forest EIS 2002), incorporated by reference, have addressed the effects of weeds on soil organic matter, soil water interactions, soil evaporation rates, soil erosion, soil biota, and soil nutrients. The amount of impact is proportional to the amount of weeds. These documents also addressed the effects of herbicide on soil productivity. The Beaverhead-Deerlodge Noxious Weeds EIS stated that adverse effects of soil quality or productivity could not be detected (USFS 2002, page 3-43). They cited annual or semi-annual herbicide treated knapweed infested areas have lower knapweed cover and higher native grass cover than observed untreated knapweed stands. This agreed with studies elsewhere (USFS 2002 (HNF DEIS). Since these documents did not find a measurable effect on projects that involved more acres (Helena National Forest proposed treatment on 23,000 acres, and the Beaverhead - Deerlodge National Forest proposed treatment on 16,000 acres) it is logical to assume that there will be no measurable effect with this proposed project. Consequently, the effects of weeds and herbicides on soil productivity will not be repeated in this document, rather they will be incorporated by reference (see soil analysis in project file).

HERBICIDE DEGRADATION AND ENVIRONMENTAL FATE

The following discussion on herbicide degradation and environmental fate is references the Gallatin National Forest Noxious and Invasive Weed Treatment Environmental Impact Statement (USDA FS, 2005) and is hereby incorporated into this analysis by reference.

Pesticide applicators of today are faced with growing concern over the potential for pesticide contamination of ground water. A large percentage of Montanan's and South Dakotan's consumes ground water as their source of drinking water. Protecting this fragile resource from pesticide contamination is imperative, because some pesticides may be harmful to humans at very low concentrations and clean-up of ground water is extremely difficult. Pesticide residues in ground water may also adversely affect sensitive crops and wildlife.

There are several ways for herbicides to damage resources. These include buildup in the soil, contamination of groundwater through infiltration, and surface runoff to streams. This analysis deals only with groundwater contamination and buildup. Other models are used to predict surface water contamination by runoff (see the following the water quality section).

Caution must be taken to avoid long-term buildup of herbicides in soils. Not only could they approach toxic levels, they may become more susceptible to movement and contamination as concentrations increase. Several processes affect persistence in soils. These include transport (volatilization, leaching, runoff, and erosion), adsorption and partition (immobilization by soil components), transformation (degradation by biological, photochemical, or other chemical processes), and plant processes (uptake, metabolization, immobilization.)

Herbicides vary in their persistence, but generally have short "half-lives" (the period of time it takes for one-half of the amount of pesticide in the soil to degrade. Each half-life that passes reduces the amount of pesticide present in the soil by one-half, i.e. 1 to 1/2 to 1/4 to 1/8 to 1/16, etc.). This measure is a result of those processes described above with the exception of removal. Pesticides can be categorized on the basis of their half-life as non-persistent, degrading to half the original concentration in less than 30 days; moderately persistent, degrading to half the original concentration in 30 to 100 days; or persistent, taking longer than 100 days to degrade to half the original concentration. A "typical soil half-life" value is an approximation and may vary greatly because persistence is sensitive to variations in site, soil, and climate.

Table 3 - 13 is an abridged version of the Oregon State University Extension Pesticide Properties Database[18] which outlines four parameters describing pesticide behavior in soils. Columns include a 'Pesticide Movement Rating' derived from the typical soil half-life value, the solubility of the herbicide in water, and the soil sorption coefficient. The movement rating provides a sense of the potential for a given herbicide to move towards groundwater, rather than a precise characterization that could be used for comparative purposes. There are too many variable factors that influence soil half-life and soil sorption to allow for a precise prediction of the behavior of an herbicide in the soil.

[18]OSU Extension, 1994 http://www.npic.orst.edu/ppdmove.htm and OSU Extension, 1999 http://eesc.orst.edu/agcomwebfile/edmat/html/EM/EM8561/EM8561.html ; USDA FS, 2005. Inyo NF, Inyo National Forest Integrate Weed Mangement EA; MT, UT, WY Ext., 2002; MSU Extension, 2005.

TABLE 3 – 13. HERBICIDE BEHAVIOR IN SOILS

Common Name	Trade Name	Pesticide Movement Rating (Leachability)[19]	Soil Half-life (days) (Persistence)	Water Solubility (mg/l) (Surface Loss Potential)[20]	Sorption Coefficient (soil Koc)[21]
2,4-D acid	Weedar,	Moderate leachability	10 Non-persistent	890	20
2,4-D esters or oil sol. amines	Weed RHAP	Moderate leachability	10 Non-persistent	100	100
Aminopyralid	Milestone	Moderate leachability	34 Moderately Persistent	205,000	10.8
Chlorsulfuron	Glean	High leachability	40 Moderately persistent	7000	40
Clopyralid amine salt	Transline	Very High leachability	20 Moderately persistent	300,000	6
Dicamba salt	Banvel	Very High leachability	14 Non-persistent	400,000	2
Diuron	Karmex, Diurex, Direx	Moderate leachability	90 Moderately persistent	42	480
Glyphosate isopropylamine salt	Accord, Rodeo, Roundup	Extremely Low leachability	30 Moderately persistent	900,000	24,000
Hexazinone	Velpar	Very High leachability	60 Moderately persistent	33,000	54
Imazapic	Plateau	High leachability	120 Highly persistent	206	7-267
Imazapyr acid	Arsenal, Chopper, Contain	High leachability	90 Moderately persistent	11,000	100
Imazapyr isopropylamine salt	Arsenal, Chopper, Contain	High leachability	90 Moderately persistent	500,000	100
Metsulfuron-methyl	Escort Ally	High leachability	30 Moderately persistent	9500	35
Picloram salt	Tordon	Very High leachability	90 Moderately persistent	200,000	16
Sulfometuron-methyl	Oust	Moderate leachability	20 Non-persistent	70	78
Triclopyr ester	Garlon4,Garlon 3A	Low leachability	46 Moderately persistent	23	780

[19] The Pesticide Movement Rating is categorically derived from the Groundwater Ubiquity Score (GUS), which is GUS = log10 (half-life) x [4 - log10 (Koc)]. Movement ratings range from 'Extremely Low' to 'Very High'. Pesticides with a GUS less than 0.1 are considered to have an extremely low potential to move toward groundwater. Values of 1.0-2.0 are low, 2.0-3.0 are moderate, 3.0-4.0 are high, and values greater than 4.0 have a very high potential to move toward groundwater.

[20] Water solubility describes the amount of pesticide that will dissolve in a known amount of water. Most of the values reported were determined at room temperature (20° C or 25° C). The higher the solubility value, the more likely the pesticide will be removed from the soil in runoff or by leaching.

[21] The sorption coefficient (Koc) describes the tendency of a pesticide to bind to soil particles. Sorption retards movement of the pesticide through soil, and may also increase persistence (increase the half-life) because the pesticide is protected from degradation processes. The higher the Koc value, the greater the tendency for a pesticide to bind to the soil.

WATER QUALITY, FISHERIES, AND AMPHIBIANS

Water Quality, Fisheries, and Amphibians - Regulatory Framework

Clean Water Act: This Act requires Federal Agencies to comply with all Federal, State, and local requirements, administrative authority, process and sanctions related to the control and abatement of water pollution (CWA, Sections 313(a) and 319(k)). The Act gives authority to individual States to develop, review, and enforce water quality standards under Section 303. This section also requires the States to identify existing water bodies that do not meet water quality standards, and develop plans to meet them. These plans are commonly called TMDLs, which stands for total maximum daily load.

Montana Water Quality Law: The Beartooth District of the Custer National Forest is classified as B-1 waters by the Montana Department of Environmental Quality (ARM 16.20.611). The western portion of the Ashland District (Tongue River) is classified as B-2 waters. The associated beneficial uses of B-1 and 2 waters are drinking, culinary and food processing purposes and conventional treatment: bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl, furbearers, and other wildlife; and agricultural and industrial water supply (ARM 17.30.623 & 624).

The eastern portion of the Ashland District (Powder River) and the Montana portion of the Sioux District are classified as C-3 waters (ARM 16.20.611 & 612). The associated beneficial uses of C-3 waters are: bathing, swimming, and recreation; growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl and furbearers. The quality of these waters is naturally marginal for drinking, culinary and food processing purposes, agricultural and industrial water supply. Degradation which will impact established beneficial uses will not be allowed. (ARM 17.30.629).

Two of the most applicable surface water quality standards for streams on the Custer National Forest include 1) a maximum allowable increase in naturally occurring turbidity of five (B-1 waters) or ten (C-3 waters) nephelometric turbidity units (NTU); and 2) no increases are allowed above naturally occurring concentrations of sediment, settleable solids, oil, or floating solids, which will or are likely to create a nuisance or render the water harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife (ARM 17.30.623 & 629).

West Fork Rock Creek was historically a is a municipal watershed for the city of Red Lodge. Even though the city no longer uses the intake (it now uses a well for their source of water), the watershed is still and classified as A-1 waters. A-1 classification standards are the most stringent of those discussed and specific to maintaining water quality for domestic uses after conventional treatment.

It is important to understand that many herbicides are toxic to aquatic life even though numerical aquatic life criteria have not been established by Montana or South Dakota. The Montana Water Quality Standards, however, do include a general narrative standard requiring surface water to be free from substances that create concentrations which are toxic or harmful to aquatic life.

In Montana, numeric water quality standards (MDEQ 2004) for human health water quality standards and herbicides that could be use in the Forest are listed in the table below.

TABLE 3 - 14. MONTANA WATER QUALITY HUMAN HEALTH STANDARDS FOR HERBICIDES[22]

Common Name	Category	Human Health Standards		Required Reporting Value[23] micro-grams/liter
		Surface Water micro-grams/liter	Groundwater micro-grams/liter	
2,4-D	Toxin	70	70	1
Aminopyralid	Not Listed	Not Listed	Not Listed	Not Listed
Chlorsulfuron	Toxin	15	15	No Set Standard
Clopyralid	Toxin	3,500	3,500	No Set Standard
Dicamba	Toxin	200	200	No Set Standard
Diuron	Toxin	10	10	No Set Standard
Glyphosate	Toxin	700	700	50
Hexazinone	Toxin	400	400	No Set Standard
Imazapic	Not Listed	Not Listed	Not Listed	Not Listed
Imazapyr	Toxin	21,000	21,000	No Set Standard
Methsulfuron methyl	Toxin	1,750	1,750	No Set Standard
Picloram	Toxin	500	500	1
Sulfometuron methyl	Toxin	1,750	1,750	No Set Standard
Triclopyr	Toxin	350	350	No Set Standard

The Montana Water Quality Act, Nondegradation Rules, and Surface Water Quality Standards require that land management activities must not generate pollutants in excess of those that are naturally occurring, regardless of the stream's classification. "Naturally occurring means conditions or material present from runoff or percolation over which man has no control or from developed lands where all reasonable land, soil and water conservation practices have been applied." "Reasonable land, soil and water conservation practices means methods, measures or practices that protect present and reasonably anticipated beneficial uses" (ARM 17.30.602) and are commonly called Best Management Practices (BMPs). Best management practices are considered reasonable only if beneficial uses are protected. The Forest Service will utilize the protection measures identified in Chapter 2 to ensure compliance with State Water Quality Laws.

Section 303(d) of the federal Clean Water Act directs states to list water quality impaired streams and develop "total maximum daily loads" (TMDLs) for the affected stream segment. The 2004 Montana DEQ 303(d) List identifies one stream segment adjacent to the Custer National Forest as needing a TMDL: Hanging Woman Creek, north of Birney. The probable cause for stream impairment is siltation, and the probable source is grazing related. Herbicide is not identified as a cause for impairment. The 2004 List also indicates that 14 stream segments on or adjacent to the Custer National Forest have insufficient data to assess some or all uses and therefore require reassessment to determine beneficial use support. A list, map, and impairment specifics as well as a description of the Montana DEQ 303(d) process are located at: http://nris.state.mt.us/wis/environet/2002_303dhome.html.

South Dakota Water Quality Law: Beneficial use classification for all streams in the South Dakota portion of the Sioux District include (6) warm water marginal fish life propagation waters, and (8) limited contact recreation waters (South Dakota Administrative Rules (SDAR), Surface Water Quality Standards, 74:51:03:02, 19 & 22). Warmwater marginal fish life propagation is defined as "a beneficial use assigned to surface waters of the state which will support aquatic life and more tolerant species of warmwater fish naturally or by frequent stocking and intensive management but which suffer frequent fish kills because of critical natural conditions" (SDAR 74:51:01:01 (60)).

The most applicable surface water quality standards for streams in South Dakota include:

[22] MT DEQ, January 2004 (http://www.deq.state.mt.us/wqinfo/Circulars/WQB-7.PDF).

[23] Required Reporting Value is the Department of Montana best determination of a level of analysis that can be achieved in routine sampling. It is based on levels actually achieved at both commercial and government laboratories in Montana using accepted methods. The Required Reporting Value is the detection level that must be achieved in reporting ambient or compliance monitoring result to the Department. Higher detection levels may be used if it has been demonstrated that the higher detection levels will be less than 10% of the expected level of the sample.

Compliance with criteria for beneficial use. A person may not discharge or cause to be discharged into surface waters of the state pollutants which cause the receiving water to fail to meet the criteria for its existing or designated beneficial use or uses (SDAR 74:51:01:02).

Biological integrity of waters. All waters of the state must be free from substances, whether attributable to human-induced point source discharges or nonpoint source activities, in concentrations or combinations which will adversely impact the structure and function of indigenous or intentionally introduced aquatic communities (SDAR 74:51:01:12).

Antidegradation of waters of the state. The antidegradation policy for this state is as follows (SDAR 74:51:01:34):

- The existing beneficial uses of surface waters of the state and the level of water quality that is assigned by designated beneficial uses shall be maintained and protected;
- Surface waters of the state in which the existing water quality is better than the minimum levels prescribed by the designated beneficial use shall be maintained and protected at that higher quality level;
- The board, or secretary, may allow a lowering of the water quality to levels established under the designated beneficial use if it is necessary in order to accommodate important economic or social development in the area in which the waters are located;
- Surface waters of the state which do not meet the levels of water quality assigned to the designated beneficial use shall be improved as feasible to meet those levels;
- No further reduction of water quality may be allowed for surface waters of the state that do not meet the water quality levels assigned to their designated beneficial uses as a result of natural causes or conditions, and all new discharges must meet applicable water quality standards; and
- The secretary shall assure that regulatory requirements are achieved for all new and existing point sources and that nonpoint sources are controlled through cost effective and reasonable best management practices.

The criteria for warm water marginal fish life propagation and recreation waters and their allowable variations that are not included under South Dakota Administrative Rules 74:51:01:55 and its corresponding Appendix B, unless set under § 74:51:01:24, (http://legis.state.sd.us/rules/rules/7451.htm). Numeric water quality standards specified to herbicides have not been established for South Dakota.

The 2002 South Dakota 303(d) List does not identify any stream segments on or adjacent to the Custer National Forest as impaired. However, two segements located well below the Forest boundary are listed. These include the lower reaches of the South Fork Grand River and Moreau River.

Presidential Executive Order 12962: Presidential Executive Order 12962, signed June 7, 1995, furthered the purpose of the Fish and Wildlife Act of 1956, the National Environmental Policy Act of 1969, and the Fish and Wildlife Coordination Act, seeking to conserve, restore, and enhance aquatic systems to provide for increased recreational fishing opportunities nationwide. This order directs Federal agencies to “improve the quantity, function, sustainable productivity, and distribution of aquatic resources for increased recreational fishing opportunity by evaluating the effects of Federally funded, permitted, or authorized actions on aquatic systems and recreational fisheries and document those effects relative to the purpose of this order.”

Cooperative Conservation Agreement for Yellowstone Cutthroat Trout within Montana and Land-use Strategy for Implementation of the 1999 Memorandum of Understanding and Conservation Agreement for Westslope Cutthroat Trout in Montana: The Custer National Forest is an active cooperator in The Cooperative Conservation Agreement for Yellowstone Cutthroat Trout within Montana (CCA). The long term goal of the CCA is to ensure the long term persistence of the Yellowstone cutthroat trout subspecies within its historic range in Montana at levels and under conditions that provide for protection and maintenance of both intrinsic and recreational values associated with this fish. The Memorandum of Understanding and Conservation Agreement (MOUCA) for Westslope Cutthroat Trout in Montana (adopted by the Custer and Gallatin National Forests for Yellowstone cutthroat trout populations) includes as objectives 1) to protect all pure and slightly introgressed (90 percent or greater purity) populations; and 2) to ensure their long-term persistence within their native range. The Land-use Strategy for Implementation of the 1999 MOUCA in Montana adopted by the Forest Service and Bureau of Land Management in 2002, further defines how the MOUCA will be implemented by federal land management agencies. For new activities, the Strategy stipulates that the Forest Service will 1) provide watersheds supporting conservation populations with the level of protection necessary to ensure their long-term persistence; 2) defer any new federal land management action if it cannot be modified to prevent unacceptable aquatic/riparian habitat degradation; and 3) maintain cutthroat trout habitat at 90 percent of optimum habitat conditions. When this 90 percent of optimum condition criteria is not met, only activities resulting in habitat improvement are to be considered. The Strategy also states that Forest Service Biological Evaluations (FSM 2670) prepared for new activities should, in most cases, conclude that there will be a beneficial effect or no effect to the cutthroat trout population or its habitat.

Forest Plan: The Custer N.F. Plan provides the following direction for weed treatment and herbicide application in relation to water and aquatic resources:

Chapter II, E. Management Standards, 5. Range, e. Noxious Farm Weed Control,

1) Utilize an integrated pest management approach to control infestations.
2) Prioritize control efforts.
3) Use only approved chemicals and avoid chemical use in areas where significant impact is expected on water resources, key wildlife habitat or unique vegetation.
4) Utilize proven biological control over chemical control where available.
5) Coordinate and cooperate with county weed boards.
6) Monitor treatments for effectiveness.
7) Allow only certified, weed free hay or palletized feed where hay use for recreation purposes is allowed.

Chapter III, Management Area Direction, Management Area M (Riparian), 3. Range,

e. Noxious weed control through chemical application will be evaluated by an appropriate NEPA process and done by hand application to individual plants within 50 feet of riparian zones and open water.

The Custer National Forest possesses a diversified fisheries resource. High mountain lakes and cold mountain streams support abundant recreational and native salmonid populations, whereas small impoundments and prairie streams in pine hill and grassland regions support numerous warm water fish species.

Goals of the Custer National Forest Plan as they relate to fisheries include: 1) to manage fisheries through habitat improvement and coordination with state agencies, 2) increasing fisheries potential through protection of existing habitats and development of improvement projects, 3) increasing the quantity and quality of fish habitats on Custer National Forest lands, and 4) to maintain or expand the range of native Yellowstone cutthroat trout (USFS 1986, pages 124,154).

SENSITIVE FISH AND AMPHIBIAN SPECIES

Sensitive species are those animal species identified by a Regional Forester for which population viability is a concern as evidenced by a significant current or predicted downward trend in population numbers, density, or in habitat capability that will reduce a species' existing distribution (FSM 2670.5.19). There are four amphibian and three fish species listed as sensitive for the Custer National Forest which are discussed in this section.

Protection of sensitive species and their habitats is a response to the mandate of the National Forest Management Act (NFMA) to maintain viable populations of all native and desired non-native vertebrate species (36 CFR 219.19). The sensitive species program is intended to be pro-active by identifying potentially vulnerable species and taking positive action to prevent declines that will result in listing under the Endangered Species Act.

As part of the National Environmental Policy Act (NEPA) decision-making process, proposed Forest Service programs or activities are to be reviewed to determine how an action will affect any sensitive species (FSM 2670.32). The goal of the analysis should be to avoid or minimize impacts to sensitive species. If impacts cannot be avoided, the degree of potential adverse effects on the population or its habitat within the project area, and on the species as a whole, needs to be assessed.

Published reports in scientific journals were reviewed along with file data from the Custer National Forest, unpublished reports, and personal communications. Information on ecology, distribution, and habitat affinities for sensitive species was also obtained online from the 1) Montana Natural Heritage Program Database; 2) Montana Chapter of the American Fisheries Society; and 3) Montana Department of Fish, Wildlife and Parks (http://nhp.nris.state.mt.us/animalguide**,**
http://www.fisheries.org/AFSmontana/SSCpages,
http://fwp.state.mt.us/fieldguide).

Great Plains Toad *(Bufo cognatus)*

The Great Plains toad (*Bufo cognatus*) is recognized as a distinct species, ranging across the Great Plains from central Mexico to southeastern Alberta and in the desert southwest as far west as eastern California and as far north as southern Utah at elevations up to 2,440 M (8,000 ft) (Stebbins 1985; Goebel 1996; as reported in Maxell 2000). The Great Plains toad inhabits the eastern plains of Montana, especially on the plateaus between and flanking the Yellowstone and Missouri Rivers (Werner et al. 2004).

Great Plains toads inhabit upland grasslands and upper reaches of drainages. They are often observed in glacial potholes, stock reservoirs, irrigation ditches, and small coulees, and spend considerable time underground in self-excavated burrows (Maxell 2000; Werner et al. 2004). Adults feed nocternally and during rainy days (Werner 2004). Diets consists primarilly of small terrestrial arthropods, ants, termites, and beetles (Maxell 2000; Werner et al. 2004). Great Plains toads reach sexual maturity in 2 to 5 years (Maxell 2000) and can hybridize with Woodhouse's toads (*Bufo woodhousii*); the hybrids can resemble either species (Werner et al. 2004). Breeding occurs in clear shallow temporary pools, marshes, and reservoirs in late spring and summer, often after heavy precipitation events (Maxell 2000; Werner et al. 2004). Indivduals may not breed during periods of severe drought (Werner et al. 2004). Eggs are often laid communally and hatch in two to three days; tadpoles undergo metomorphosis three to six weeks after hatching (Maxell 2000; Werner et al. 2004).

Great Plains toads have been documented at about 30 localities across the plains east of the Rocky Mountains in the past 150 years and their status across this region is almost completely unknown (Maxell 2000). Although the historic distribution of the Great Plains toad includes portions of the Custer National Forest (CNF), only two historic records exist from areas adjacent to and no sightings have been documented on CNF lands in eastern Montana (Hendricks and Reichel 1996).

Plains Spadefoot (*Spea bombifrons*)

A single distinct species of plains spadefoot (*Spea bombifrons*) is recognized as ranging across the Great Plains from northern Mexico to southern Canada at elevations up to 2,440 M (8,000 ft) (Stebbins 1985; Wiens and Titus 1991; as reported in Maxell 2000). In Montana, despite large distribution gaps between the Missouri and Musselshell rivers, the plains spadefoot is found east of the Continental Divide in intermountain valleys (around Dillon, Bozeman and Helena) and east across the prairies (MTFWP 2005)

This species is often found in areas with soft sandy soils near permanent or temporary bodies of water. The plains spadefoot is seldom encountered outside of the bredding season since they spend most daylight hours undergound (Werner et al. 2004). For much of each year it lives largely inactive in burrows of its own construction or occupies rodent burrows, and enters water only to breed (MTFWP 2005). Breeding occurs between May and July in shallow temporary pools and is usually initiated by significant rainfall and temperatures above 12 ^{o}C (Hendricks and Reichel 1996; Werner et al. 2004). Two morphologies are commonly observed in tadpoles: 1) omnivores which feed on phytoplankton and detritus, and 2) carnivores which feed on fresh water shrimp, other invertebrates, and frequently their own or other amphibian larvae (Maxell 2000). Adults mostly feed on insects (Werner et al. 2004). Juveniles and adults may disperse distances over 2 kilometers from breeding ponds (Klassen 1998; as reported in Maxell 2000).

The plains spadefoot is sparsely documented in central and eastern Montana, including a few sightings in the mountain valleys of the upper Missouri watershed (Werner et al. 2004). However, plains spadefoot sightings are documented to the east, north, and west of the Ashland District, Custer Natioanl Forest (Reichel 1995; as reported in Hendricks and Reichel 1996). Therefore, the plains spadefoot likley occurs on Forest lands in eastern Montana; Hendricks and Reichel (1996) recommended watching for the species in prairie or shrub-steppe habitat on the Ashland District.

Northeren Leopard Frog (*Rana pipiens*)

The northern leopard frog (*Rana pipiens*) historically ranged from Newfoundland and northern Alberta in the north to the Great Lakes region, the desert Southwest and the Great Basin in the south (Maxell 2000). A number of isolated populations historically existed in the Pacific Northwest and California (Stebbins 1985). In Montana they have been documented across the eastern plains and in many of the mountain valleys on both sides of the Continental Divide at elevations up to 6,700 feet (Werner et al. 2004).

The northern leopard frog is found in and adjacent to permanent slow moving or standing water bodies with considerable vegetation, but may range widely into moist meadows, grassy woodlands and even agricultural areas (Nussbaum et al. 1983). Adults feed on invertebrates, but may cannibalize smaller individuals. Adults overwinter on the bottom surface of permanent water bodies, under rubble in streams or in underground crevices that do not freeze. Northern leopard frogs breed from mid-March to early June (Maxell 2000). Mating occurs when males congregate in shallow water and begin calling during the day (Maxell 2000). Eggs are laid at the water surface in large, globular masses of 150 to 500 (Maxell 2000). Juveniles may move as much as 8 kilometers from their natal ponds to their adult seasonal territories (Dole 1971; Seburn et al. 1997). Young and adult frogs often disperse into marsh and forest habitats, but are not usually found far from open water (Maxell 2000).

Over the last few decades the northern leopard frog has undergone declines across much of the western portion of their range (Stebbins and Cohen 1995; as reported in Maxell 2000). Most northern leopard frogs in western Montana became extinct in the 1970's or early 1980's. The only 2 population centers known to exist in western Montana are near Kalispell and Eureka (Maxell 2000). However, the northern leopard frog is still abundant and widespread in southeastern Montana and northwestern South Dakota (Reichel 1995; as reported in Hendricks and Reichel 1996). This species was encountered at seven locations in 1995 on the Ashland District of the Custer National Forest, but breeding was confirmed at only one of the sites (Hendricks and Reichel 1996). The northern leopard frog is a sensitive species on all Region 1 Forests.

Western Toad (*Bufo boreas)*

The western toad (*Bufo boreas)* is currently recognized as two subspecies ranging from the Rocky Mountains to the Pacific Coast and From Baja Mexico to southeast Alaska and the Yukon Territory (Stebbins 1985; as reported in Maxell 2000). They are found in a variety of habitats, including wetlands, forests, sagebrush meadows and floodplains. Western toads inhabit all types of aquatic habitats ranging from sea level to 12,000 ft in elevation (Maxell 2000). The subspecies of western toad found in Montana is the boreal toad (*Bufo boreas boreas*).

Adult and juvenile toads are freeze intolerant and overwinter and shelter in underground caverns, or rodent burrows (Maxell 2000). Adults feed on a variety of ground dwelling invertebrates and are known to eat smaller individuals of their own species. Adults must utilize thermally buffered microhabitats during the day, and can be found under logs or in rodent burrows (Maxell 2000). Because of their narrow environmental tolerance (10-25 ^{o}C throughout the year), adults are active at night and can be found foraging for insects in warm, low-lying areas (Maxell 2000). Breeding typically occurs from May to July in shallow areas of large and small lakes, ponds, slow moving streams and backwater channels of rivers (Black 1970; Metter 1961; as reported in Maxell 2000). Tadpoles metamorphose in 40 to 70 days and can be found in dense aggregations adjacent to breeding grounds (Werner et al. 2004).

In the northern Rocky Mountains western toads have undergone declines. Surveys in the late 1990's revealed they were absent from a number of areas they historically occupied. While they remain widespread across the landscape, they appear to be occupying only 5 –10%, or less, of the suitable habitat (Maxell 2000). Based on these findings the USFS listed the western toad as sensitive in all of Region 1's National Forests, and initiated a regional inventory in Montana. As a result, a systematic inventory of standing water bodies in 40 randomly chosen 6th level hydrologic unit code (HUC) water sheds was completed, across western Montana, during the summer of 2000. Results indicated they were widespread, but extremely rare. Western toads have been found on the Beartooth Plateau, Custer National Forest, at altitudes as high as 9,200 ft (Werner et al. 2004).

Activities on National Forest lands that may pose a risk to population viability of amphibian species include: timber harvest, grazing, fire and fire management activities, nonindigenous species and their management, road and trail development, on and off road vehicle use, development and management of water impoundments and recreational facilities, the impact of habitat loss and fragmentation on regional sets of populations or metapopulations, and impacts of weeds and weed and pest management activities (Maxell 2000; Werner et al 2004).

Northern Redbelly Dace (*Phoxinus eos*)

The northern redbelly dace (*Phoxinus eos*) is a cyprinid fish native to Montana. The species persists in the lower Missouri River drainage and in tributaries of the lower Yellowstone River basin in Montana (MTNHP 2005). Northern redbelly dace are found from British Columbia and the Northwest Territories across southern Canada to Nova Scotia, and are widely distributed in the north half of North America, from the Rocky Mountain front to the East Coast.

Northern redbelly dace prefer clear, cool, slow-flowing creeks, ponds and lakes with aquatic vegetation, including filamentous algae. During the spawning season (May through August), this species becomes quite colorful with red flanks (MTFWP 2005). This species is sexually mature at 1 year and females may spawn twice each year. Spawning takes place on clumps of filamentous algae; during spawning episodes, 5 to 30 non-adhesive eggs are released and become entangled in the algal filaments. Incubation occurs in 8 to 10 days at 20 to 27 ^{o}C (MTNHP 2005). Maximum size is about 3 inches (MTFWP 2005). Their diet consoisits of plant material, including diatoms and filamentous algae, as well as zooplankton, aquatic insects, and occasionally fish. The northern redbelly dace hybridizes with the finescale dace (*Phoxinus neogaeus*) in some locations in the northern United States and Canada (MTFWP 2005). Resultant hybrids are all females and produce offspring that are also all female (MTNHP 2005). Eggs from the hybrids are "fertilized" by the sperm of northern redbelly dace and it appears that "fertilization" is necessary for egg development to begin; none of the genetic traits of the male are incorporated into the fertilized embryo (MTFWP 2005).

The northern redbelly dace is considered common and abundant in the state of Montana (MTFWP 2005). However, Northern redbelly dace are listed as sensitive species in Region 1 and by the state of South Dakota. Although there is no record of the species on Custer National Forest lands within South Dakota, headwater streams originating on National Forest lands are suspected to support northern redbelly dace populations historically; current distribution data within the state is limited.

Sturgeon Chub *(Macrhybopsis gelida)*

The sturgeon chub (*Macrhybopsis gelida*) is a cyprinid fish indigenous to the Missouri and Mississippi river basins (Gould 1998). Due to suspected low numbers in Montana waters, the sturgeon chub was designated as a state species of special concern over two decades ago (Holton 1980; as reported in Gould 1998). However, recent collections of sturgeon chub in Montana revealed that it is more widespread and abundant than previously understood. The species are present in the Powder River, lower Yellowstone River, and the mid-Missouri River (Gould 1998; USFWL 2001). The historic record of sturgeon chub abundance and distribution in South Dakota is limited (USFWL 2001). Although considered abundant in the White River (Cunningham 1999), the species is regarded as rare in South Dakota; low numbers of sturgeon chub have been detected in the Cheyenne and Little White rivers (USWFL 2001).

Sturgeon chub are typically found in free flowing riverine systems, characterized by highly variable flow regimes, bradied channels, sand/fine gravel substrates, and high turbidity (USFWL 2001). Food habits are largely unknown unknown, but the ventral mouth and short intestine indicate they feed on bottom-dwelling insects. Sturgeon chubs attain a maximum length of about 4 inches (MTFWP 2005). Sexuall maturity is thought to be achieved at age 2 or older. Spawning is believed to occur in spring, coresponding to water temperature ranging from 20 to 25 ^{o}C (USFWL 2001).

Sturgeon chub are listed as sensitive fish species in the states of Montana and South Dakota. Custer National Forest (CNF) lands in Montana and South Dakota are within the native range of the sturgeon chub. This species has never been documented on CNF lands and requires rapid, turbid waters of plains streams larger than most streams found on National Forest in these areas. However, limited information exists on native warm water fish's distributions on CNF lands in headwater tributaries to larger prairie streams.

Yellowstone Cutthroat Trout (*Oncorhynchus clarki bouvieri*)

Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*), a member of the family Salmonidae, were first described by C. E. Bendire in 1882 based on a sample from a population in Waha Lake, Idaho; however, many explorers had made earlier observations of this subspecies in Montana and Wyoming (Behnke 1992; May 1996; as reported in Young 2001). Yellowstone cutthroat trout (YCT) historically occupied approximately 17,397 miles of habitat in the western U.S., including, from east to west, the upper portions of the Yellowstone River drainage within Montana and Wyoming and the upper Snake River drainage in Idaho, Wyoming, Nevada and Utah (Behnke 1992; as reported in May et al. 2003). In Montana, YCT were historically widely distributed throughout the upper Yellowstone River basin and its tributary streams, ranging as far downstream as the Tongue River (MTFWP 2005).

Yellowstone cutthroat trout inhabit relatively clear, cold stream, river, and lake environments (Young 2001). Spawn typically occurs in spring and early summer, after flows have declined from their seasonal peak, in sites with suitable substrate (gravel less than 85 mm in diameter), water depth (9-30 cm), and water velocity (16-60 cm/s) (Varley and Gresswell 1988; Byorth 1990; Thurow and King 1994; as reported in Young 2001). Upon emergence, fry immediately begin feeding, typically in nearby stream margin habitats, but they may also undertake migrations to other waters (Gresswell 1995; as reported in Young 2001). Sexual maturity is generally achieved by age 3 or older. Yellowstone cutthroat trout and rainbow trout readily hybridize, producing fertile offspring; sympatric populations often form hybrid swarms (Allendorf and Leary 1988; Henderson et al. 2000; as reported in Young 2001).

Yellowstone cutthroat trout exhibit three primary life history patterns: resident, fluvial, and adfluvial (Gresswell 1995; as reported in MTFWP 2005). Resident lifeforms occupy home ranges entirely within relatively short reaches of streams; fluvial fish migrate from larger streams or rivers to smaller streams to reproduce; adfluvial life history forms of YCT exhibit a similar pattern, but migrate, sometimes many kilometers, as mature adults from lakes to inlet or outlet streams to spawn (Young 2001).

Throughout their historic range, YCT trout have undergone substantial declines in distribution and abundance (Young 2001). Genetically unaltered YCT occupy about 7 to 25% of historical habitats (May et al. 2003). The distribution of stream resident YCT on the Custer National Forest is restricted from its historic range, with five known, genetically pure YCT populations currently occupying less than 18 miles of stream habitat. Few (two-six) lake dwelling populations of YCT are thought to have existed in Montana historically (MTFWP 2000). At present, a purported 179 lakes likely support pure populations in Montana (118 of these lakes reside in the Absaroka-Beartooth Wilderness Area; MTFWP 2000). Most current stream populations of YCT are at risk from either hybridization or demographic or stochastic influences (MTFWP 2005).

Water Quality, Fisheries, and Amphibians - Affected Area

Spatial Bounds

Aquatic environments in forested ecosystems are heavily influenced by the physical and biological processes within the watershed (Vannote et al. 1980). For this reason the analysis area, for both fish and amphibians, will encompass all watersheds within the project area boundary.

Sensitive fish and amphibian species historically present in the project area include: northern redbelly dace, sturgeon chub, Yellowstone cutthroat trout, boreal toad, Great Plains toad, northern leopard frog, and plains spadefoot.

The distribution of Yellowstone cutthroat trout in Custer National Forest watersheds is restricted from its historic range, with five known, pure strain Yellowstone cutthroat populations currently occupying less than 18 miles of stream habitat. The current distribution of stream resident Yellowstone cutthroat trout is displayed in Table 3 - 15. Cyprind and amphibian species distributions are likely also truncated, although distribution data are limited.

TABLE 3 - 15. WEEDS WITHIN 300' OF YELLOWSTONE CUTTHROAT TROUT STREAMS[24]

5th CODE HUC	Drainage	Stream Name	Gross Acres of Weeds within 300' of Stream (drainage)
1007000502	Limestone Creek	Picket Pin Creek	206
1007000503	Bad Canyon Creek	Bad Canyon Creek	36
1007000609	Rock Creek	Wyoming Creek	544
1008001005	Crooked Creek	Crooked Creek	186
1008001008	Dry Head Creek	Dry Head Creek	0

Temporal Bounds

Because stream fish habitats may continue to be impacted by anthropogenic activities for many decades after the initial disturbance, temporal cumulative effects for fish and fish habitat will span the breadth of known human activity in the project area. Therefore, the temporal bounds for fish and fish habitat are from 1880 to five years after project implementation (year 2011).

Amphibian habitats may also be negatively impacted long after certain types of anthropogenic actions (Maxell, 2000). Therefore, the cumulative effects will be examined for the period for which literature suggests habitat may continue to be impacted: 50 years in the past (1955) and five years into the future (2010).

Land management activities noted as having possible impacts on amphibian and fish species leopard frogs include timber harvest, grazing, fire and fire management activities, non-native species, road and trail development and use, water impoundment, development and use recreational facilities, harvest, noxious weeds and weed management, and habitat fragmentation.

Water Quality, Fisheries, and Amphibians - Analysis Method

The methodology used in this analysis is based on the Beaverhead-Deerlodge National Forest Noxious Weed Control Program Final EIS (2002) and the Gallatin National Forest Noxious Weed FEIS (2005). It is a risk based assessment that identifies watersheds which have the potential to exceed recommended "safe" concentrations of herbicide deemed necessary to protect fish and aquatic life. Water and fish resources were evaluated together because of related impacts from herbicide application for the control of noxious weeds on the Custer National Forest. Due to limited occurrence and extent of perennial flow

[24] Confirmed presence does not indicate uniform distribution in a drainage; for example, most cutthroat populations are fragmented and restricted to drainage headwaters.

regimes on the Ashland and Sioux Districts, this risk assessment is only applied to the Beartooth Ranger District.

Active ingredients in herbicides proposed for use, include 2, 4-D, aminopyralid, chlorsulfuron, clopyralid, dicamba, diuron, glyphosphate, hexazinone, imazapic, imazapyr, metsulfuron methyl, picloram, sulfometuron methyl, and triclopyr. The Custer National Forest Weed Management EIS interdisciplinary team, the Beaverhead-Deerlodge National Forest Noxious Weed Control Program Final EIS (2002) and the Gallatin National Forest Noxious Weed Final EIS (2005) evaluated these herbicide characteristics and toxicities and concluded that picloram tends to be more toxic to aquatic organisms than all other herbicides. With this in mind, picloram was used as a surrogate for all herbicides to assess risks to aquatic species in this analysis. The selection of a "safe" concentration level for fish follows recommendations presented in the USFS Fisheries and Herbicides Work Group Final Findings and Recommendations, (March 8, 2004). The "safe" concentration level chosen is synonymous with a "maximum allowable toxicant concentration" or MATC equaling 0.075ppm. This value was derived by taking 1/20 of 1.5 ppm (the 96 hour LC-50 for cutthroat trout).

The method of risk assessment is as follows:

1) Determine the total amount of picloram to be applied in a given watershed. Total pounds of picloram applied = the application rate (0.25 lbs/acre) X acres treated. Acres treated include all infested acres, plus 35 percent of the proposed aerial treatment polygon acres by 6^{th} HUC watershed.
2) Determine the routing coefficients to be applied to the treatment acres. A conservative approach was used to determine runoff versus infiltration routing coefficients. Half of the treated acres were considered to be runoff dominant sites and half were considered infiltration dominant sites. The final recommendations from the Western Montana Level 2 Team recommend routing coefficients of 0.01 for runoff dominant sites and 0.02 for infiltration dominant sites (USFS 2004). Using a 50/50 conservative approach for determining runoff versus infiltration acres results in a 0.015 coefficient applied to all treated acres.
3) Determine the maximum amount of picloram that could be routed to surface waters. Total pounds of picloram routed = Total pounds applied (from #1) X 0.015.
4) Determine the low flow (Q95, 95 percent of the time flows are greater than) for a given watershed. The Custer National Forest used a regression equation developed by the Gallatin National Forest. This equation was based on flow duration curves developed from daily discharge data from US Geologic Service gauging records of six gauges on and near the Gallatin NF. The equation is Q95 discharge = $0.2143x^{0.893}$, where x is the watershed area in square miles. It has a R^2 value of 0.7149. This equation was applied to watersheds on the Beartooth Ranger District of the Custer National Forest to determine the Q95 low flow for each 6^{th} HUC (hydrologic unit code) watershed. The low flow is used as a worst case scenario as the capacity for dilution is at its lowest point.
5) Determine the maximum probable concentration of herbicide at the mouth of each 6^{th} HUC headwater watershed and lower cumulative watershed where appropriate. Maximum probable concentration = total pounds of picloram routed (from #3) / Q95 flow converted to pounds of water for a 6 hr flow duration (Q95 X 62.43 lbs/cu.ft X 21600 seconds/6hrs).
6) Compare the maximum probable concentration to the recommended safe level of 0.075ppm picloram.
7) Calculate the maximum amount of acres that can be treated while not exceeding the recommended safe level of 0.075ppm picloram. This value includes all application methods.
8) Calculate the maximum percent of aerial polygon that can be treated while not exceeding the recommended safe level of 0.075ppm picloram. This value assumes no ground-based treatment occurs.

The results from this analysis are listed in Chapter 4, Table 4 - 14.

Water Quality, Fisheries, and Amphibians - Affected Environment

Water quality varies tremendously across the Custer National Forest from pristine wilderness streams to headwater prairie streams. Wilderness streams in the Beartooth Mountain Range are generally perennial and support cold water fisheries, while prairie streams have low or discontinuous flow, which support warm water fisheries or amphibians. Water quality is excellent within wilderness areas, but is influenced by multiple use activities elsewhere. The Custer National Forest contains about 333 miles of perennial streams and 3,713 acres of lakes that are considered fishable, many of which are of national scenic, historic, and recreational significance.

Average precipitation on the Forest varies from 15 to 60 inches a year with about 50 percent as snow in lower elevations and 75 percent at higher elevations. June receives the largest amount of moisture. Precipitation intensity is relatively moderate. The two year-six hour precipitation varies from 0.7 to 1.5 inches (Miller et al. 1973). Winters are long and cold and snow usually remains at the higher elevations in the Beartooth Mountain Range for eight to nine months.

For most of the Custer National Forest, private agriculture (primarily ranching) is located adjacent to the Forest with more extensive irrigation agriculture land use further downstream. Along the Forest boundary of the Beartooth Range, rural housing development is common. Downstream beneficial uses include fish and aquatic life, recreation, irrigation, stock use, public water supply, private water supply, and wildlife. West Fork Rock Creek is classified as a municipal watershed for the city of Red Lodge, although the city now obtains its domestic water from groundwater sources.

A major beneficial use in and downstream of the Custer National Forest is salmonid habitat. The Custer National Forest encompasses headwater tributaries of the Clarks Fork of the Yellowstone and the Yellowstone Rivers. Pristine high mountain lakes provide diverse fishing opportunity throughout the Absaroka-Beartooth Wilderness Area. Several significant tributaries such as East Rosebud Creek, Rock Creek, the Stillwater River, and West Rosebud Creek provide aquatic habitat and fish populations that support the nationally renowned trout fisheries of Montana.

Wetlands are lands in transition between terrestrial and aquatic systems where the water table is at or near the surface of the land and often covered by shallow water. In order to be considered jurisdictional wetlands, the wetland must be saturated, and at least for part of a year, have un-drained hydric soils, and support predominantly hydrophytic vegetation. Wetlands are extremely valuable to recreational users, esthetic quality, and wildlife habitats, and serve important functions such as sediment filtration, flow moderation, nutrient and other pollutant attenuation. They also act as sources of organic energy for adjacent aquatic habitats. In general, wetlands on the Custer National Forest occur in narrow bands along streams and lake shorelines.

SENSITIVE PLANT SPECIES

Sensitive Plants - Regulatory Framework

Forest Service Manual 2670.22 Sensitive Species provides the following direction for sensitive plants:

- Develop and implement management practices to ensure that species do not become threatened or endangered because of Forest Service actions.
- Maintain viable populations of all native and desired nonnative wildlife, fish, and plant species in habitats distributed throughout their geographic range on National Forest System lands.
- Develop and implement management objectives for populations and/or habitat of sensitive species.

Sensitive Plants - Affected Area

The analysis area for sensitive plants includes all vegetation communities in proximity to proposed treatment areas or those habitats where weeds have potential to invade. These plant communities have the potential to be directly or indirectly impacted by weeds and proposed treatment methods.

Sensitive Plants - Analysis Method

Information used came from data on file at the Custer National Forest, literature review, and personal communications with resource specialists with knowledge of vegetation, weed control, and herbicide effects.

Sensitive Plants - Affected Environment

Habitat for 16 sensitive plant species and one watch species exists on the Custer National Forest. Most of the listed sensitive plant species are located in riparian or wetland areas, one species in alpine, and a few species in drier open cover types. All but four are vulnerable to weed infestations and all but one can be vulnerable to herbicide treatments.

Federally listed Threatened and Endangered plant species do not occur on the CNF. Forest Service listed sensitive plant species that are known or suspected to occur on the CNF, along with occurrence by Ranger District, are displayed in Table 3-16.

TABLE 3 - 16. DESCRIPTION OF SENSITIVE PLANT HABITAT

Species	District	Habitat	Habitat Vulnerable to Herbicide Treatment	Habitat Vunerable to Weed Spread
Adoxa moschatellina Musk-root	Beartooth	Grows in moist, mossy areas often in rock crevices and boulder slopes that may provide protection from human activities from 4,400-5,400 feet.	Yes	No
Asclepias ovalifolia Ovalleaf milkweed	Sioux	Sandy, gravelly or clayey soils of prairies and woodlands	Yes	Yes
Astragalus barrii Barr's milkvetch	Ashland	Gullied knolls, buttes, and barren hilltops, often on calcareous soft shale and siltstone.	Yes	Yes
Carex gravida var. gravida Pregnant sedge	Sioux & Ashland	Open woods, often in ravines with deciduous trees, on the plains.	Yes	Yes
Cypridium parviflorum Small Yellow lady's-slipper	Beartooth	Occurs in damp woods, bogs, mossy seeps and moist forest-meadow ecotones from 3,000-6200 feet.	Yes	Yes
Epipactis gigantea Giant Helleborine	Beartooth	In Montana, occurs only around thermal springs, perennial springs with year-round water flow, bogs and fens, and seeps from 2,000-5,750 feet.	Yes	Yes
Eriogonum visherii Dakota buckwheat	Sioux	Barren, often bentonitic badlands slopes and outwashes in the plains.	Yes	No
Gentiana affinis Prairie gentian	Sioux	Wet meadows, shores, springs, seepage areas and low prairie	Yes	Yes
Gentianopsis simplex Hiker's Gentian	Beartooth	Found growing in mountain bogs, meadows and seepage areas from 4,400-8,400 feet. Flowers in July and August.	Yes	Yes
Haplopappus subsquarrosus var. subsquarrosus	Beartooth	Generally found growing between xx and xx feet) in rocky, open areas. Flowers in late July and August. xx sites have been located on the forest.	Yes	Yes
Juncus hallii Hall's Rush	Beartooth	Associated with montane to subalpine meadows, moist to dry meadows and slopes between 6,900-8,400 feet. Flowers in July and August.	Yes	Yes
Primula incana Mealy Primrose	Beartooth	Wet meadows, springs and shores, often where alkaline; calcareous bog meadows; wet meadows & quaking bogs; NOT found in alpine or subalpine areas..	Yes	Yes
Mertensia ciliata Mountain bluebaells	Sioux	Forested slopes-damp thickets in course to medium textured soils. Valley bottoms associated with springs, seeps, and spring fed water courses. Intermediate shade tolerance. Very drought intolerant. Occasionally found in non-wetlands	Yes	Yes
Ranunculus jovis	Beartooth	Sagebrush grasslands to open forest slopes	Yes	Yes

Species	District	Habitat	Habitat Vulnerable to Herbicide Treatment	Habitat Vunerable to Weed Spread
Jove's Buttercup		in the montane and subalpine zones.		
Salix barrattiana Barratt's willow	Beartooth	Found growing in cold, moist soils near or above treeline (6,800-10,500 feet) especially in alpine areas. Fruits in late July or August.	No	No
Shoshonea pulvinata Shoshonea	Beartooth	Grows on open, windswept limestone substrates (in thin, rocky soils) along ridges and canyon rims from 6,800-9,000 feet. Blooms in late June through July.	Yes	No

In addition, recently discovered areas on the Ashland District have *Lomatium nuttallii* and areas on the Beartooth District have populations of *Ranunculus jovis.* . Although these species are not currently on the Custer National Forest Sensitive Plant list, they are listed as species of concern in Montana according to the Montana Heritage Program (http://nhp.nris.state.mt.us/plants/index.html). The *Lomatium* site does not have weeds adjacent to its location. The *Ranunculus* sites have historically known leafy spurge and knapweed sites nearby.

At least one species is particularly vulnerable to weed infestations and weed management activities. Roadside low density infestations of spotted knapweed, dalmatian toadflax, and houndstongue are found adjacent to three Beartooth goldenweed populations on the Beartooth District. These situations currently occur in Sage Creek, Robertson Draw, and Seeley Creek.

Not only is Beartooth goldenweed vulnerable to weed competition and herbicide use, the level of risk on the viability of the population is increased because it is considered an endemic only recorded in 8 locations in Carbon County, MT and 14 locations in Park County, WY. Given its vulnerability and current proximity to known weed infestations, priority should be given to weed treatment efforts to prevent spotted knapweed or other weeds from out-competing Beartooth goldenweed.

Both the risk from weed infestation and the method of controlling the weeds can impact the sensitive plants. Some weed species and sensitive plant species are in the same plant family and therefore, herbicides that are specific to a plant family can affect both species (i.e. spotted knapweed and Beartooth goldenweed are both in the composite family). However, implementing protection measures outlined in Chapter 2 will minimize drift in these situations (i.e., no broadcast or aerial spraying within specific distances, sensitive species identification training of weed treatment crews, spot treat and/or wick treat weed species).

Also, to help protect sensitive species, periodically inspect known populations for the presence of invasive weeds. Treatment efforts are more effective and less disruptive when only treating a few weeds. If spotted knapweed or other invasive weeds become well established, then the herbicide broadcast treatment may be detrimental to sensitive plants, leaving backpack spot treatment or possibly only individual wicking applications and hand-pulling as options.

WILDLIFE

Wildlife - Regulatory Framework

Regulations on wildlife resources are outlined in 36 CFR 219.12 and 219.27. These regulations state that management indicator species (MIS) will be identified by each national forest in order to adequately maintain distributed habitat for these species and to evaluate the impacts of management activities on these species. Forest Service Manual 2670.31 (6) directs "identify and prescribe measures to prevent adverse modification or destruction of critical habitat and other habitats essential for the conservation of endangered, threatened, and proposed species."

Forest Service Manual 2670 at 2670.22 – Sensitive Species, provides the following direction for sensitive wildlife:

- Develop and implement management practices to ensure that species do not become threatened or endangered because of Forest Service actions;
- Maintain viable populations of all native and desired nonnative wildlife, fish, and plant species in habitats distributed throughout their geographic range on national forest system lands;
- Develop and implement management objectives for populations and/or habitat of sensitive species.

The Endangered Species Act requires the conservation of threatened and endangered species, and prohibits carrying out or authorizing any action that may jeopardize a listed species or its critical habitat.

The National Forest Management Act provides for balanced consideration of all resources. It requires the Forest Service to plan for diversity of plant and animal communities. Under its regulations, the Forest Service is to maintain viable populations of existing and desired species, and to maintain and improve habitat of management indicator species.

The Custer National Forest Plan provides management direction, objectives and standards for management of wildlife species and habitats on the Forest. The Forest Plan also identifies Habitat Indicator Species which are more commonly known as Management Indicator Species.

Wildlife - Affected Area

The analysis area for wildlife includes species-specific habitats in proximity to proposed treatment areas, areas with identified noxious infestations. These habitats have the potential to be directly or indirectly impacted by herbicide application and disturbances associated with the proposed weed treatment methods.

Wildlife - Analysis Method

Published reports in scientific journals were reviewed along with file data from the Custer National Forest, unpublished reports, and personal communications. A Biological Evaluation and Biological Assessment are located in the project file.

Information on ecology, distribution, and habitat affinities for sensitive species was also obtained from the Montana Natural Heritage Database on the internet at http://nris.state.mt.us/animal/index.html.

Species known to occur on the Forest and species with the potential to occur are identified and discussed. Potential impacts were assessed based on animal habitat affinities and probability that a given habitat would be treated with herbicide to control noxious weed communities.

Wildlife - Affected Environment

The wildlife issue is grouped into four main categories: Threatened and Endangered Species; Sensitive Species; Management Indictor Species/Key Species and Herbicide Toxicity to Terrestrial Mammals and Birds.

THREATENED AND ENDANGERED SPECIES

Grizzly Bear

The grizzly bear was once found throughout much of the lower 48 states west of the Mississippi River. Currently, their distribution is restricted to five discreet populations: the Greater Yellowstone Ecosystem in portions of Montana, Wyoming, and Idaho; the Northern Continental Divide Ecosystem in Montana; the Cabinet-Yaak area in Montana and Idaho; the Selkirk Mountains in Idaho and Washington; and the North Cascades in Washington (USFWS 1993). The Custer National Forest provides secondary habitat for grizzly bears in the Yellowstone Ecosystem. The Greater Yellowstone Ecosystem grizzly bear population has increased in size and distribution over the past decade, and has now met all recovery criteria (IGBC, 2003). They have expanded their range on the Forest over the past decade, and most of the available habitat on the Forest within the Beartooth Mountains has the potential for Grizzly bear occupation (Schwartz *et al.,* 2002).

Grizzly bears are large omnivores that typically utilize a wide variety of foods. Vegetation such as roots, tubers, bulbs, berries, nuts, and green herbaceous plants are seasonally important to grizzly bears. Additionally, high calorie animal food sources such as ungulates, ground squirrels, carrion, fish, and insects are highly valuable to them when they can be obtained (Robbins *et al*, 2004). To utilize such a wide variety of foods, bears use a wide variety of vegetation types spread out over large distances. These vegetation types include lower elevation sagebrush/grasslands or Douglas-fir stands as well as higher-elevation whitebark pine, lodgepole pine, and Engelmann spruce/subalpine fir.

Because maintaining secure areas with low levels of human disturbance is a key component of grizzly bear habitat management, the Custer Forest Plan adopted guidance from the Interagency Grizzly Bear Committee Taskforce Report (IGBC, 1986). The Forest supports approximately 5500 acres of MS I habitat and 105,000 of MS II habitat. All but 1300 acres of MS II habitat occur within the Absaroka-Beartooth Wilderness Area. The Final Conservation Strategy for the Grizzly Bear in the Yellowstone Ecosystem (IGBC, 2003) provides standards for road density and motorized access within the recovery zone. These standards require that there be no decrease in core areas within each Bear Management Subunit. Core areas are at least 0.3 miles from any open road or trail, where no motorized or high-intensity non-motorized use is allowed during the non-denning period. The Final Conservation Strategy also provides additional direction for access management, and specifies that reoccurring low-level helicopter flights should not be allowed within 500 meters of core habitat (IGBC, 2003). The Custer National Forest has adopted the standards and guidelines outlined by the Final Conservation Strategy for the Grizzly Bear in the Yellowstone Ecosystem (IGBC, 2003).

The use of sheep or goat grazing as a weed management tool has the potential to cause conflicts with grizzly bears. Grizzly bear depredations on domestic sheep and goat have long been a source of conflict between humans and bears. Custer National Forest livestock grazing permits and the Final Conservation Strategy for the Grizzly Bear in the Yellowstone Ecosystem (IGBC, 2003) contain standards addressing this fact. As a condition of grazing permits appropriate measures are required for removal or destruction of livestock carcasses to avoid habituation of grizzlies to livestock as food. The standards from the Conservation Strategy are: 1) no new active commercial livestock grazing allotments will be created inside the primary recovery area; and 2) there will be no increases in permitted sheep animal months inside the primary recovery area from the identified 1998 baseline.

Gray Wolf

Wolves were reintroduced to the Yellowstone area in 1995. The Forest Service is a full partner in implementing the conservation measures outlined in the Federal Register final rule, November 22, 1994. Wolves reintroduced to Yellowstone National Park (YNP) and the Greater Yellowstone Area (GYA), have been designated as a non-essential experimental population in accordance with Section 10 of the Endangered Species Act. The gray wolf historically occupied the Custer National Forest, and the Forest is within the Greater Yellowstone Gray Wolf Recovery Area. As of December 2004, there were an estimated 324 wolves in this area (USFWS *et al.*, 2004). There are approximately 17 packs within the GYA, but only 3 packs' territories are entirely or partially within the Forest. One pack maybe denning on the Forest (J. Trapp, MT Fish, Wildlife & Parks, personnel communication on 4/1/05).

In the Yellowstone area, wolves feed on elk, deer, moose, bison, and other ungulates, but elk are their primary prey (USFWS *et al*., 2004). Wolves also preyed on livestock (USFWS *et al*., 2003). Wolves follow big game movements and may concentrate on elk winter ranges, elk calving areas, and elk feeding areas (refuges) (USFWS *et al*., 2002). Pups are whelped in a den during the spring (Mech, 1970), and moved to a rendezvous site several months later when they are able to leave the den until they are mobile enough to travel with the pack (Mech 1970).

Wolf territories are variable and may range from 60 to 900 square miles in size. Wolf packs recently reintroduced into YNP initially ranged over an area of 650 square miles (Fritts *et al.* 1997). Wolves may occupy a variety of habitats including grasslands, sagebrush steppes, coniferous and mixed forests, and alpine areas. Wolf distribution and habitat use is more closely tied to availability of food (especially ungulate prey) and denning areas than to vegetation cover type. Because of this tie with ungulate distribution, there would be overlap between wolf habitat and areas infested with weeds.

Canada Lynx

Optimal lynx habitat can generally be described as a mosaic of early-successional forest stands for foraging and late-successional forests with deadfall for security cover and denning habitat (Ruggiero *et al.,* 1994). Lynx inhabit the mid to high elevations where snow excludes most other predators during winter. Denning habitat occurs most often in subalpine fir forests where there is a high amount of down material (Ruggiero *et al*., 1994). Snowshoe hares are the primary prey for lynx. Primary forest types that support snowshoe hare are subalpine fir, Engelmann spruce, Douglas-fir and lodgepole pine. The key component of snowshoe hare habitat is dense understory vegetation. In winter, lynx forage for hares in vegetation that provides a high density of young conifer stems or branches that protrude above the snow (Ruediger *et al.*, 2000). Snowshoe hares appear to avoid clear-cuts and very young stands (Ruediger *et al*., 2000).

Lynx habitat and weed infestations generally do not overlap, because lynx are typically found in dense forested stands in which weeds are not able to compete with native vegetation. Approximately 2,500 gross acres of managed weed areas on the Forest are located within mapped lynx foraging and/or denning habitats. These weeds infestations are generally found in old cutting units that have not yet regenerated enough for weeds to be shaded out and are currently unsuitable lynx habitat or are located along narrow riparian stringers that offer limited lynx habitat. The exception is orange hawkweed, which can invade closed-canopy forests and is currently known to occur on a couple of sites on the Forest. Because its distribution is so limited, it does not occur on lynx habitat and treatments of orange hawkweed are not expected to occur within the next 10-15 years on a scale that could affect lynx or their habitat. Therefore, lynx will not be discussed further in this report.

Black-Footed Ferret

Black-footed ferrets are members of the weasel family (Mustelidae) and inhabit grassland habitats. Black-footed ferrets are long, slender-bodied animals (two feet long and weighing 2.5 pounds) similar in size to the mink. Their physical characteristics include: a brownish-black mask across the face, a brownish head, black feet and legs, and a black tip on the tail. Ventral hair is lighter than dorsal hair. The middle of the back has brown-tipped guard hairs, which create the appearance of a dark saddle (USFWS 2000).

Black-footed ferrets have one litter with four to five young per year. The young do not come above ground until six weeks old. Mothers and young stay together until mid-August. At that time, females begin to separate siblings into different burrows. From August through early September, young ferrets become increasingly solitary. By early October they are self-sufficient (USFWS 2000).

Typical black-footed ferret behavior revolves around prairie dog towns. Ferrets are obligate associates of prairie dogs, which they prey upon. Research from ferret-occupied prairie dog colonies indicates that the most important attribute of ferret habitat is the distribution and abundance of prairie dogs. To support a viable population of ferrets, a prairie dog colony complex of 2,500-3,000 ha (6,200-7,400 acres) composed of individual colonies at least 12 ha (30 acres) in size, with the majority 50 ha (125 acres) or larger, is needed (Forrest et al., 1985).

The current distribution of prairie dogs on the Custer National Forest is approximately 1000 acres. Currently about 100 acres of white-tailed prairie dogs occupy the Beatooth RD, 100 acres of black-tailed prairies on the Sioux Rd and 800 acres of black-tailed prairie dogs on the Ashland RD. None of the active towns would meet the criteria for a prairie dog colony complex because of size or distribution. Most of the NFS land within the Forest boundary is unsuitable habitat for prairie dogs because of steep slopes, shallow soil over bedrock, or forest cover. There is insufficient suitable habitat to support back-footed ferrets on or immediately adjacent to NFS lands. Therefore, black-footed ferrets will not be discussed further in this report.

Bald Eagle

The Forest provides some yearlong habitat for bald eagles but primarily provides wintering habitat. In Montana, bald eagle nest sites are generally distributed around the periphery of lakes and reservoirs greater than 80 acres (32.4 ha) as well as in forested corridors within one mile (1.6 km) of major rivers (MT Bald Eagle Working Group, 1994). Currently the Custer National Forest does not have any known active nest sites. An historic nest site was thought to occur near Mystic Lake on the Beartooth RD but has not been active for at least the past two years. In Montana, an annual breeding cycle from initiation of courtship and nest building through fledging of young occurs approximately from February 1-August 15 (MT Bald Eagle Working Group, 1994). Once fledged, young are dependent on adults for six to ten weeks (MT Bald Eagle Working Group, 1994).

Adults may migrate or remain within their ecosystems during the winter. Wintering bald eagles occupy areas near unfrozen portions of lakes and free flowing rivers, or upland areas where ungulate carrion and lagomorphs are available (MT Bald Eagle Working Group, 1994). Bald eagles primarily winter in open water areas along the Yellowstone River and Clarks Fork of the Yellowstone River.

An available prey base may be the most important factor determining the nesting habitat suitability, the nesting density and the productivity (MT Bald Eagle Working Group, 1994) of bald eagles. Bald eagles are opportunist feeders and will prey on fishes, waterfowl, lagomorphs, and some ground dwelling mammals, as well as ungulate carrion. Ungulate carrion and waterfowl may also provide seasonal food sources (Stangl, 1994).

Bald eagles may be affected by a variety of human activities (MT Bald Eagle Working Group, 1994). Responses of eagles may range from abandonment of nest sites to temporary temporal and spatial avoidance of human activities. Responses may also vary depending on type, intensity, duration, timing, predictability and location of human activities. Individual pairs may respond differently to human disturbances because some birds are more tolerant than others (MT Bald Eagle Working Group, 1994). Generally, eagles are most sensitive to human activities during nest building, egg-laying, and incubation from February 1-May 30 (MT Bald Eagle Working Group, 1994). Human activities during this time may cause nest abandonment and reproductive failure. Once young have hatched, a breeding pair is less likely to abandon the nest. However, eagles may leave the nest due to prolonged disturbances, exposing young to predation and adverse weather conditions (MT Bald Eagle Working Group, 1994). Weed treatment activities have the potential to cause disturbance to nesting bald eagles if they occurred within nesting territories.

The Custer Forest Plan (USFS, 1986) outlines specific management direction for nesting bald eagles. The FP guidelines were derived from the Greater Yellowstone Bald Eagle Management Plan (Greater Yellowstone Bald Eagle Working Group 1996). This document provides guidelines for managing human activities around bald eagle nest sites (Greater Yellowstone Bald Eagle Working Group, 1996). The plan states that human activities should not exceed minimal levels (no human activity except for existing agricultural uses, nesting surveys, or river boat traffic during less than 70 percent of daylight hours) within the occupied nesting area or zone I (less than 400 meter from a nest) of eagle nests from February 15-July 15. Within the primary use area or zone II (less than 800 meter from a nest), no more than light human activity levels (day use and low impact activities at low densities and frequencies) should be allowed during the same time period. Moderate activity (low impact activities at any intensities) would be allowed within the home range or zone III (<4 km of a nest). Since the Forest currently does not have any active nest sites and protection measures are in place in the FP should a nest occur on NFS lands, bald eagles will not be discussed further in this report.

SENSITIVE WILDLIFE SPECIES

Sensitive species are those animal species identified by the Regional Forester for which population viability is a concern as evidenced by a significant downward trend in population numbers, density, or in habitat capability that will reduce a species' existing distribution (FSM 2670.5.19). There are 18 terrestrial wildlife species listed as sensitive for the Northern Region National Forests including the Custer, and which are discussed in this section. Sensitive fish, amphibians and reptiles are addressed in the Fisheries/Amphibians section. Sensitive plants are addressed in the Vegetation section.

Protection of sensitive species and their habitats is a response to the mandate of the National Forest Management Act (NFMA) to maintain viable populations of all native and desired non-native vertebrate species (36 CFR 219.19). The sensitive species program is intended to be proactive by identifying potentially vulnerable species and taking positive action to prevent declines that will result in listing under the Endangered Species Act.

As part of the National Environmental Policy Act (NEPA) decision-making process, proposed Forest Service programs or activities are to be reviewed to determine how an action will affect sensitive species (FSM 2670.32). The goal of the analysis should be to avoid or minimize impacts to sensitive species. If impacts cannot be avoided, the degree of potential adverse effects on the population or its habitat within the project area needs to be assessed.

American Peregrine Falcon

Peregrines occupy a variety of habitat but are typically found near water because of the abundance of prey associated with such sites. Nests are generally located below 8500 feet in elevation, less than 3,000 feet from water or a wetland, on a greater than 150 percent slope, and on a cliff ledge that is 3,000 feet in length and greater than 4,000 feet in height. Prey consists almost entirely of birds, which are usually taken on the wing. Surveys of potential peregrine falcon nesting habitat are completed on the Forest each year to monitor known nest sites and document new breeding pairs. One known active eyrie (hack site) is located on the Beartooth Ranger District. This nest site has been active every year since 1997. This nest site is located approximately ¾ of a mile from the nearest known noxious weed infestation along East Rosebud Creek.

It appears that peregrine falcons are sensitive to human activities, especially those occurring above the nest site. They are more tolerant of activities that occur below the nest site if there is pronounced relief from the valley floor to the nest site (U.S. Fish and Wildlife Service, 1984). Human disturbance at the nest may lead to abandonment and interference with care of the chicks. Guidelines for minimizing disturbance to nesting peregrine falcons are to restrict human activities and disturbances in excess of what historically occurred during the nesting season within one mile of nest cliffs (U.S. Fish and Wildlife Service, 1984). Human activity along East Rosebud Creek is high since the road is paved and many recreation residences occur in the area. The use of pesticides that persist in the environment and magnify through the food chain also presents a risk to peregrines (U.S. Fish and Wildlife Service, 1984). Because peregrines may forage in a variety of habitats, some areas used by these birds for foraging may be at risk of weed infestation while others would not be. Since the falcons occupying this site are acclimated to the level of human disturbance occurring in the area and the protection measures for herbicide use near aquatic habitats, peregrine falcons will not be discussed further in this report.

Northern goshawk

The goshawk is a large forest-dwelling hawk. Their prey may include grouse, smaller birds such as jays and woodpeckers, snowshoe hares, and squirrels (Reynolds *et al*., 1992). Reynolds et al. (1992) identified the three components of a goshawk nesting home range as being the nest area, post-fledging family area (PFA), and foraging area. Nest areas are composed of older-aged forests with a closed canopy and larger diameter trees located on northern aspects with gentle to moderately steep slopes below 7500 feet in elevation (Reynolds *et al.*, 1992). PFAs contain a large percentage of mature forest habitats. Closed crowns forming a matrix enable young fledged birds to branch from one tree to the next and move throughout the forest canopy. Foraging areas are increasingly larger and more diverse than either the habitat maintained for nesting or the PFA. A diverse complex of vegetation within the foraging area supports a varied and abundant preybase. Foraging habitat in Montana includes forest edges, open meadows, and moderate to densely forested stands (Hayward *et al.,* 1990). Goshawks are known to occur on the Forest and suitable goshawk habitat is found on all districts, but the number of nesting goshawks is unknown. Goshawk foraging areas may include areas at risk of weed infestations, but nesting and PFAs would generally not because the level of canopy closure would be limiting.

Black-Backed Woodpecker

Black-backed woodpecker inhabits mature to over-mature coniferous forests across North America. It is rare throughout its range, but may be locally common in response to a temporary abundance of food. Black-backed woodpeckers respond opportunistically to insect outbreaks and seem to prefer recently burned stands, where they forage on insects. Populations of the black-backed woodpecker tend to be irruptive in nature and correspond with the sporadic abundance of bark beetles, its preferred prey. The woodpecker shows a preference for mature pine stands at elevations at or below 5200 feet (O'Conner and Hillis, 2001). Black-backed woodpeckers will use higher elevation areas once a fire or other disturbance occurs which brings in snags and insects (O'Conner and Hillis, 2001). Burned areas inhabited by this species may be at high risk for weed infestation. However, they are dependant on forest structure rather than ground vegetation, and would not be affected by project activities. Therefore, they will not be discussed further in this report.

Baird's Sparrow

Baird's sparrow nests on the ground in extensive, idle, or lightly grazed mixed-grass prairie with or without scattered low shrubs (Green et al. 2002). Because a relatively complex structure is so important for nesting, areas with little to no grazing activity are required (MTNHP 2005). Therefore habitat suitability would be mostly regulated by the livestock grazing intensities. Suitable habitat for the Baird's sparrow may be found on the Ashland and Sioux Ranger Districts where occupation would be limited by the availability of lightly grazed or ungrazed mixed-grass prairie. Rested or lightly grazed patches of native grasslands tend to occur in relatively small patches at scattered locations and the patterns of grazing shift from year to year within the grazing allotments. On the average, any areas lightly grazed areas on gentle terrain would generally be located at least 0.5 miles from water sources available to livestock. To date, three Baird's sparrows have been identified with the Forests landbird monitoring program in 2002. Landbird data has been recorded forest-wide in 2002 thru 2004. Potential nesting and foraging habitats may be at risk for weed infestation.

Blue-gray gnatcatcher

Blue-gray gnatcatcher breeding habitat in Montana seems to be restricted to open juniper and limber pine stands with intermixed big sage. Nests were found in juniper or big sage located on lower slopes or canyon bottoms (MTNHP 2005). Range-wide they typically inhabit a broad range of broad-leaved wooded habitats from shrublands to mature forest. They are rarely found in habitats dominated by needle-leaved conifers (Ellison 1992). Blue-gray gnatcatchers feed on adult insects and their larva and eggs as well as spiders (MTNHP 2005). They forage by gleaning food from outer foliage and occasionally along branches and trunks (Ellison 1992). They also dart out from perches to catch insects from the air MTNHP 2005). To date, blue-gray gnatcatchers have been verified in the Pryor Mountains with the Forests landbird monitoring program. Landbird data has been recorded forest-wide in 2002 thru 2004. Potential nesting and foraging habitats may be at risk for weed infestation.

Burrowing Owl

Burrowing owls are found in open grassland habitat where they nest and roost in abandoned animal burrows. They typically perch on the lip of their prairie burrows but have been observed perched on fence posts (MTNHP 2005). Black-tailed prairie dog and Richardson's ground squirrel provide the primary and secondary habitat for burrowing owls in Montana (Klute et al. 2003). They are opportunistic feeders with a varied diet that changes with the season of the year. Invertebrates comprise the bulk of their diet but small mammals, amphibians, reptiles, and birds may be taken (Haug et al, 1993). Recreational shooting of prairie dogs has the high potential for direct illegal mortality to burrowing owls (Haug et al, 1993). An historic burrowing owl record was documented on the Forest in 1989 on the Ashland RD. This sighting was associated with a black-tailed prairie dog town. No burrowing owl sightings during the breeding season have been recorded on the Forest during the past three years with the Landbird inventory program. All of the Forest prairie dog colonies have been inventoried and mapped over the past five years and no burrowing owl sightings have been documented. Since burrowing owls are highly associated with prairie dog colonies in eastern Montana, the effects of noxious weed infestations and treatments should be the same for both animal species. Therefore no further discussion on burrowing owls will be documented in this report. Refer to habitat effects discussion for black-tailed prairie dogs.

Greater Sage Grouse

The sage grouse is North America's largest grouse. They are closely associated with sagebrush ecosystems. Since sagebrush ecosystems have a large amount of natural variation in vegetative composition, fragmentation, topography, weather, and fire regimes, sage grouse are adapted to a wide array of sagebrush conditions throughout their habitat (Schroeder et al. 1999). Sage grouse live year-round in portions of Montana east of the Continental Divide (Lenard et al. 2003). Sage grouse diets vary with the season but big sagebrush, succulent forbs, and invertebrates are important dietary components (Connelly et al. 2000). Sage grouse rely on the availability of breeding habitat, nesting habitat, brood-rearing habitat and wintering habitat. Breeding habitat typically consists of strutting grounds (leks) which are flat openings surrounded by sagebrush with a 20 to 50 % canopy closure (cc). Sage grouse prefer sagebrush (15-30%cc) with residual grass for nesting cover. Brood-rearing habitat can be highly variable but usually consists of areas with an abundance of succulent forbs and sagebrush with 8 to 14 % canopy closure. Sage grouse generally select areas with tall and large expanses of dense sagebrush for winter habitat (MTSGWG 2005). Currently about 4,850 gross acres of managed weed areas fall within sagebrush habitats on the Forest. Potential sage grouse brood rearing habitat and wintering habitat may be at risk for weed infestation.

Harlequin Duck

Harlequin duck population winters along the north Pacific Coast, and migrates inland to breed east to the Rocky Mountains. In Montana, they inhabit fast moving, moderate to high gradient, clear mountain streams during the breeding season (MTNHP 2005). Both females and males usually return to the same breeding sites each year (Carlson 2004). The harlequin duck is known to nest in the Beartooth Mountains on the Beartooth RD. Harlequins feed primarily on aquatic invertebrates (MTNHP 2005). Historically harlequins were documented to nest on the West Fork and Lake Fork of Rock Creek. Recent occupation has not been documented in the past three survey seasons. There is little overlap between harlequin duck habitat and areas at risk of weed infestation. Therefore, they would not be affected by this project and will not be discussed further in this report.

Loggerhead shrike

Loggerhead shrikes breed throughout the eastern two-thirds of Montana. They nest in thickets of small trees and shrubs (sagebrush or woody draws) or shelterbelts adjacent to native grassland or cropland (MTNHP 2005). The diet of the loggerhead shrike consists primarily of insects in the summer and mice in the winter. Habitat loss, sagebrush and woody draws, due to agricultural conversion is a major reason for the decline. Shrikes are susceptible to automobiles because of their habitat of feeding on grasshoppers and other insects (Rauscher 1999). Based on 2002-2004 Landbird data, loggerhead shrikes are present throughout the Forest especially on the Ashland and Sioux RDs. The intermingled patches of sagebrush and woody draw habitats with grasslands offer breeding and foraging habitat. These habitats may be at risk for weed infestations.

Long-Billed Curlew

Long-billed curlews are the largest North American shorebird. They are endemic to the Great Plains and breed in short-grass and mixed-grass habitats in eastern Montana (Dugger and Dugger 2002). They select for flat to rolling topography with short, open or sparse grassland where areas with dense, tall vegetation are generally avoided (Dugger and Dugger 2002). Within their breeding habitat, they feed on terrestrial insects. On the Custer National Forest suitable habitat for curlews would primarily be located on moderately to highly grazed livestock grazing allotments or on black-tailed prairie dog towns. Suitable habitats as a result of livestock grazing are susceptible to weed infestations. Habitats associated with prairie dogs towns seem to be less susceptible to weed infestations.

Long-Eared Myotis

Long-eared myotis are thought to be widespread and found throughout Montana (MTNHP 2005). They are found in a variety of habitats but are strongly associated with coniferous forests (Worthington 1991). They feed between treetops and over woodland ponds by gleaning form vegetation and taking aerial prey using echolocation (Worthington 1991). Primary roosting habitat is normally large diameter snags with intermediate stages of decay with exfoliating bark or cavities (MTNHP 2005). Secondary roost sites include mines, caves, sinkholes, cliff fissures, and abandoned buildings (Schmidt 2003). Optimum roost habitat is located within 0.5-1km of open water for foraging and drinking (MTNHP 2005). They use caves or mines for hibernacula. Long-eared myotis foraging habitat could include areas at risk of weed infestation.

Long-Legged Myotis

Long-legged myotis are thought to be widespread and found throughout Montana (MTNHP 2005). Primarily a coniferous-juniper forest bat found at moderate elevations (≥6000 ft) but may also inhabit riparian cottonwood bottoms and desert areas (Foresman 2001). They feed on insects using fast, direct flight along forest edges or in or above the forest canopy (Fenton and Bell 1979). Long-legged myotis use trees/snags (under bark or in cavities), caves, mines and rock crevices for roost sites (Tigner and Stukel 2003). They use caves or mines for hibernacula. Long-eared myotis foraging habitat could include areas at risk of weed infestation.

Pallid Bat

The Pallid bat occurs in arid and semi-arid habitats in the western United States and central Mexico. In Montana, this species has only been recorded in the Pryor Mountains adjacent to the Custer NF. Pallid bats inhabit areas with rocky outcrops dominated by desert shrubs, dry forest communities such as riparian forest along lakes and streams, and dry forest dominated by ponderosa pine. The Pryor Mountain sites were dominated by juniper and black sagebrush (Worthington 1991). Daytime roosts are predominately in rock cavities and buildings, whereas night roosting occurs in open shelters such as bridges, and cave or mine openings (Genter and Jurist 1995). Habitat use in Montana by this species remains poorly unknown and unstudied (MTNHP 2005). Pallid bats forage close to or on the ground for prey such as grasshoppers, crickets, mice and lizards (Hermanson and O'Shea, 1983). Pallid bat foraging habitat could include areas at risk of weed infestation.

Spotted Bat

Spotted bats occur in open ponderosa pine, sagebrush, rabbitbrush, and juniper as well as in deserts and other arid terrain (Watkins 1977). They are invariably found in remote, undisturbed settings such as the numerous caves and rock crevices found in the Pryor Mountains (MTNHP 2005). Day roosting typically occurs in fractured sedimentary cliffs, and openings in drier ponderosa pine forests provide foraging habitat. Spotted bats are territorial and space themselves along regular foraging routes in suitable habitat (Woodsworth et al. 1981). Specific foraging habitat requirements are not well understood, but previous studies have shown that spotted bats feed almost exclusively on moths. Suitable spotted bat roosting and foraging habitat occurs on the Custer National Forest portion of the Pryor Mountains. Spotted bats are thought to be highly sensitive to human disturbance, the disturbance or destruction of roosting habitat is the greatest threat to the species. Spotted bat foraging habitat could include areas at risk of weed infestation.

Townsend's Big-Eared Bat

Townsend's big-eared bats inhabit high-elevation conifer forests, pinyon-juniper woodlands, and desert shrublands, and ranges throughout western North America south to central Mexico. Habitat use in Montana has not been evaluated in detail but seems to be similar to other locations in the western United States (MTNHP 2005). They roost in caves, mines, crevices on rocky cliffs, or in buildings. Males and females roost separately during summer, when males roost singly and females gather in nursery colonies located in caves or mines (Worthington 1991). Both males and females move to caves and mine tunnels in winter to hibernate (Worthington 1991). Townsend's big-eared bats are dependent on underground structure year-round (SDGFP 2003). They forage over sagebrush-grasslands, riparian areas, open pine forests, and arid scrub, feeding mainly in the air along forest edges (Schmidt 2003). They are insectivorous and feed primarily on moths (Schmidt 2003). Townsend's big-eared bats are thought to be highly sensitive to human disturbance during hibernation and temperature variation during hibernation. These disturbances are thought to be the greatest threats to the species. Townsend's big-eared bat foraging habitat could include areas at risk of weed infestation.

Black-tailed prairie dog

The black-tailed prairie dog (BTPD) is the largest of the five prairie dog species. The black-tailed prairie dog is the most widely distributed species in Montana. They occupy flat, open short and mixed-grass habitats and shrub/grassland habitats east on the Continental Divide in Montana (MTPDWG 2002). BTPD prefer to feed on grasses but their diet will shift to forbs with the seasons. Prairie dogs are semi-fossorial, digging burrows that provide protection from predators and weather. Black-tailed prairie dogs are the most colonial of the five prairie dog species and occur at the highest densities (MTPDWG 2002). Sylvatic plague, recreational shooting, poisoning, and habitat fragmentation are the primary threats to black-tailed prairie dogs (MTPDWG 2002).

The Forest Plan identifies a goal for the maximum acreage of primary suitable range occupied by prairie dogs for each Ranger District: 300 acres on Ashland, 50 acres on Sioux and 50 acres on Beartooth (USFS, 1986, p. 20). No limits are established for prairie dog acreage on secondary and unsuitable range. The USFS was a participant in the multi-party development of a Conservation Plan for black-tailed and white-tailed prairie dogs in Montana, which was recently approved (MTPDWG 2002). "The goal of this conservation plan for the state of Montana is to provide for management of prairie dog populations and habitats to ensure long-term viability of prairie dogs and associated species." In 2003, there were at least 680 acres in 55 active colonies of black-tailed prairie dog on NFS lands on the Ashland Ranger District and 16 acres in two active towns on the Sioux RD. All of the Forest prairie dog colonies have been inventoried and mapped over the past five. To date none of the 696 acres of active BTPD colonies have noxious weed infestations.

White-tailed prairie dog

The white-tailed prairie dog (WTPD) is a medium sized prairie dog species. The white-tailed prairie dog has a very limited distribution in south central Montana between the Pryor and Beartooth Mountains (MTPDWG 2002). They inhabit xeric sites with mixed stands of shrubs and grasses (MTNHP 2005). WTPD are much more tolerant of sloped topography and dense vegetation than BTPD. Their range in Montana is at higher elevations than other areas across their distribution, south central Montana is on the edge of their range (MTNHP 2005). White-tailed prairie dogs feed on sagebrush, with a shift to forbs when they become available (Foresman 2001). They are semi-fossorial, digging burrows that provide protection from predators and weather. White-tailed prairie dogs occur at low densities and are less colonial with more space in between mounds (MTPDWG 2002). Sylvatic plague, recreational shooting, poisoning, and habitat fragmentation are the primary threats to white-tailed prairie dogs (MTPDWG 2002).

The Forest Plan identifies a goal for the acceptable acreage of primary suitable range occupied by prairie dogs for each Ranger District: 300 acres on Ashland, 50 acres on Sioux and 50 acres on Beartooth (USFS, 1986, p. 20). No limits are established for prairie dog acreage on secondary and unsuitable range. The USFS was a participant in the multi-party development of a Conservation Plan for black-tailed and white-tailed prairie dogs in Montana, which was recently approved (MTPDWG 2002). "The goal of this conservation plan for the state of Montana is to provide for management of prairie dog populations and habitats to ensure long-term viability of prairie dogs and associated species." In 2002-4, there was an active 92 acre white-tailed prairie dog town on the Beartooth RD. As of 2004, this colony does not have noxious weed infestations.

Wolverine

Wolverines are the largest member of the weasel family. Although few studies have been conducted on them, they appear to utilize a wide variety of food sources including carrion, rodents, berries, insects, and birds (Reel *et al*., 1989; Ruggiero et al. 1994). In the western United States they occupy a variety of mostly remote montane habitats throughout the year including alpine areas, boulder and talus fields, mature and intermediate forests adjacent to natural openings, big game winter ranges, and riparian areas

(Reel *et al*., 1989; Ruggiero et al. 1994). Extensive travel by wolverines is not unusual and home ranges are typically very large (Ruggiero *et al*., 1994). Although wolverine populations have increased in western Montana since the 1920's, they occur at low densities even where habitat is optimal (Ruggiero *et al*., 1994). Suitable habitat for wolverines on the Forest is found in the Beartooth and Absaroka Mountain Ranges. Wolverines are known to occur on the Forest as on occasion observations of wolverines or their tracks are reported, but their distribution and abundance remains unclear. Most wolverine habitat would be at low risk of weed infestation, with the exception of big-game winter ranges.

MANAGEMENT INDICATOR SPECIES (MIS) AND KEY SPECIES

Management Indicator Species (MIS) are species whose habitat is most likely to be affected by forest management activities and serve as indicators of change for threatened or endangered species, big game species, or certain habitat types. There are ten terrestrial MIS for the Custer National Forest, one of which was discussed earlier in this section. There are eight Key Species for the Forest as identified in the Forest Plan. Key Species are defined as major interest species that are commonly hunted, fished, or have special or unique habitat needs (USFS Custer Forest Plan 1986). MIS and Key Species are shown in Table 3 – 17.

TABLE 3 - 17. TERRESTRIAL MANAGEMENT INDICATOR SPECIES AND KEY SPECIES

Species	Type of Habitat	Suitable Habitat on R.D.
MIS		
Northern Goshawk	Forest: old growth	All Districts
White-tailed Deer	Forest: dog hair ponderosa pine	All Districts
Ruffed grouse	Forest: aspen	Beartooth RD
Western kingbird	Forest: open savanna	All Districts
Bullock's (Northern) oriole	Riparian: tree	All Districts
Yellow warbler	Riparian: shrub	All Districts
Ovenbird	Hardwood draw: tree	Sioux RD, Ashland RD
Spotted (Rufous-sided) towhee	Hardwood draw: shrub	Sioux RD, Ashland RD
Brewer's sparrow	Evergreen shrubs: sagebrush	Sioux RD, Ashland RD
Sharp-tailed grouse	Prairie grasslands	Sioux RD, Ashland RD
Key Species		
Elk	Key (Major Interest)	All Districts
Golden eagle	Key (Major Interest)	All Districts
Merlin	Key (Major Interest)	All Districts
Mule deer	Key (Major Interest)	All Districts
White-tailed deer	Key (Major Interest)	All Districts
Bighorn sheep	Key (Major Interest)	Beartooth RD
Pronghorn antelope	Key (Major Interest)	Sioux RD, Ashland RD
Sharp-tailed grouse	Key (Major Interest)	Sioux RD, Ashland RD

The ecology of these Management Indicator Species and Key Species is representative of the diversity of terrestrial wildlife species found in grassland, sagebrush, ponderosa pine, riparian, hardwood draw and mixed forest habitats located across the Custer National Forest. At varying degrees, all of the listed MIS and key species are dependent on native vegetation to provide adequate nesting cover, forage, shelter or cover for prey. Northern goshawks, golden eagles, and merlins eat either mice, voles, or a variety of other small mammals, birds, and reptiles (MTNHP 2005).

Ruffed grouse, Western kingbirds, Bullock's orioles, yellow warblers, ovenbirds, spotted towhees, Brewer's sparrows, and sharp-tailed grouse either nest on the ground or within branches of trees and shrubs. They forage on insects, forbs, plant buds and plant seeds (MTNHP 2005).

Noxious weeds were listed as a threat for species inhabiting grasslands, sagebrush shrub steppe and riparian habitats (Casey 2000). White-tailed deer, elk and mule deer are highly adaptable species that annually use a wide variety of habitats including riparian areas, open grasslands as well as all forest types. Nearly the entire Forest provides habitat for these ungulates during some time of the year. They are capable of grazing or browsing a wide range of plants during different seasons, but in Montana browse plants such as sagebrush, chokecherry and snowberry are an important dietary component year-round but grasses or forbs may be used part of the year (MTNHP 2005).

Noxious weeds are typically not eaten by white-tailed deer, elk or mule deer at all, or are of very low palatability. Part of their seasonal habitats such as grasslands and riparian areas are at high risk for weed infestation. Infestations of weeds such as spotted knapweed can lead to 60-90 percent decreases in forage production on seasonal ranges (Rice *et al*., 1997), which would potentially decrease the number of ungulates that seasonal ranges can support. White-tailed deer, elk and mule deer populations on the Forest are currently at or above objectives set by the Montana Department of Fish, Wildlife, and Parks (MDFWP). Pronghorn antelope occupy open, rolling sagebrush / grasslands (MTNHP 2005). They feed on forbs in the spring and summer and browse on primarily sagebrush during the winter (MTNHP 2005). Again noxious weeds are a threat to grassland/sagebrush habitats.

Bighorn sheep typically inhabit cliffs and high mountain slopes during the spring, summer and fall. Rolling foothills are used for winter habitat (MTNHP 2005). They feed on bunchgrasses and shrubs on winter range and a wide variety of grasses, sedges, and forbs on summer range (MTNHP 2005). Noxious weed infestation is generally not a threat to summer range but may be a problem on winter habitat.

WILDERNESS AND INVENTORIED ROADLESS AREAS

Wilderness Areas are areas of federally owned land that have been designated by Congress as Wilderness, in accordance with the Wilderness Act of 1964. These areas are protected and managed so as to preserve their natural conditions which (1) generally appear to have been affected primarily by forces of nature with the imprint of man's activity substantially unnoticeable; (2) have outstanding opportunities for solitude or a primitive and confined type of recreation; (3) have at least 5,000 acres or is of sufficient size to make practical their preservation, enjoyment, and use in an unimpaired condition; and (4) may contain features of scientific, educational, scenic, or historical value as well as ecologic and geologic interest.

Inventoried Roadless Areas (IRAs) have been identified in a set of inventoried roadless area maps, contained in the 1986 Custer National Forest Plan FEIS Appendices and September 15, 2000 Roadless Area Inventory.

Wilderness and Inventoried Roadless Areas - Regulatory Framework

Designated Wilderness is mandated to be administered so that its community of life is untrammeled by man, its primeval character retained and naturally functioning ecosystems preserved (PL 88-577).

Wilderness areas are managed as directed by the Wilderness Act of 1964. Management actions within Wilderness focus on maintaining naturally functioning ecosystems, providing access, and managing some pre-existing uses (i.e. outfitter operations). Examples of management activities include trail construction and maintenance, fire suppression or management of naturally ignited fires, removal of existing structures, and noxious weed treatment.

Forest Service Manual (FSM) 2323.26b allows plant control for "noxious farm weeds by grubbing or with chemicals when they threaten lands outside Wilderness or when they are spreading within the Wilderness, provided that it is possible to effect control without causing serious adverse impacts on Wilderness values. FSM 2109.14 (13.4) requires Regional Forester approval of a pesticide use proposal in designated Wilderness Areas.

Congress gives no specific direction as to management of noxious weeds in Forest Service recommended wilderness areas. The Custer Forest Plan direction is to manage these areas to maintain their presently existing Wilderness character including opportunities for solitude, a sense of remoteness, and a natural appearing environment.

General direction for Wilderness and recommended wilderness management is found in the Custer Forest Plan, pages 4, 67-71. Specific direction for the Absaroka Beartooth is found in Forest Plan Appendix II, pages 155-161. Specifically, Forest Plan direction relating to management of noxious weeds in the Wilderness states:

- *All feed packed into the Wilderness will either be certified weed free or processed feed.*
- *Visitors will be encouraged to remove burs and weed seeds from stock prior to entering the Wilderness. This will be accomplished through brochures and at trailheads.*
- *Develop a program of noxious weed control.*

Inventoried Roadless Lands: There is currently no specific congressional oversight of inventoried roadless lands. Weed treatments on inventoried roadless lands would not need special approval simply because of the area's roadless status.

Wilderness and Inventoried Roadless Areas - Affected Area

The analysis area for wilderness and inventoried roadless areas is the extent of the individual wilderness area and/or roadless area.

Wilderness and Inventoried Roadless Areas - Analysis Method

Geographic Information System (GIS) spatial data was used to determine the location of Wilderness Areas, Wilderness Study Areas and IRAs relative to the proposed activities in the action alternatives. Existing condition was determined through mapping of known weed infestations from the GIS weed database. Potential types of treatments within these areas were estimated.

Management activities (proposed, and past, present and reasonably foreseeable) were evaluated for their potential effects on the Wilderness attributes listed in the Forest Service Northern Region "Our Approach to Effects Analysis" for assessing the impacts on Wilderness and roadless characteristics. This method was used for designated Wilderness, Forest Service recommended wilderness, and Inventoried Roadless Areas. The attributes include: natural integrity, apparent naturalness, remoteness and solitude, management, and boundaries. Natural integrity is the extent to which long-term ecological processes are intact and operating. Apparent naturalness is a measure of how natural the environment appears. Impacts to natural integrity and apparent naturalness are measured by the presence and magnitude of human induced change to an area. Solitude is a personal subjective value defined as isolation from the sights, sounds and presence of others, and the developments of man. Management and boundaries will not be affected by proposed activities and will not be discussed further.

Wilderness and Inventoried Roadless Areas - Affected Environment

The Beartooth Ranger District of the Custer National Forest is largely comprised of designated Wilderness, Forest Service recommended wilderness, or IRAs. Of the Forest's approximate 1.2 million acres of public land, over 75 percent of the Forest is within designated Wilderness, WSA, or Inventoried Roadless Areas. See Table 3 - 18 for the breakdown of acres.

TABLE 3 - 18. LAND IN WILDERNESS AND ROADLESS DESIGNATION[25].

Total Forest Acres	Absaroka Beartooth Wilderness Acres	Recommended Wilderness Acres	Inventoried Roadless (excluding Wilderness and Recommended Wilderness) Acres	Total Acres of Wilderness, Recommended Wilderness, and Inventoried Roadless Areas
1,200,000	333,000	14,000	131,900	478,900 or 40% of total Custer NF Acreage

Absaroka Beartooth Wilderness: Congress designated the Absaroka-Beartooth (AB) Wilderness Area in 1978. It encompasses a total of 943,626 acres. Montana contains 920,343 acres, divided between the Gallatin and Custer National Forests. The Wyoming portion contains 23,283 acres (located on the Shoshone NF).

The Crow Indians called themselves Apsaalooke, hence the name of the mountain range that, along with Beartooth, characterizes this Wilderness. Active glaciers, sweeping tundra plateaus, deep canyons,

[25] Inventoried Roadless Areas, September 15, 2000.

sparkling streams, and hundreds of alpine lakes combine to make this one of the most outstanding Wilderness areas in America.

The Absarokas, unlike the Beartooths, have ample vegetative cover, including dense forests and broad mountain meadows crossed by meandering streams. Bighorn sheep and mountain goats roam about the mostly rugged country, along with elk, deer, moose, marmots, coyotes, black bears, wolves and members of a substantial grizzly population. The harsher Beartooths accommodate far fewer animals. Trout reside in many of the lakes and streams in both ranges.

The history of domestic livestock grazing in the Absaroka-Beartooth has played a role in noxious weed distribution throughout this area. At one time, over 300,000 domestic sheep grazed in the AB Wilderness Area. There are currently no active allotments in the Custer NF portion of the Absaroka-Beartooth Wilderness Area.

Prevention and education has long been an important tactic in preventing the spread of noxious weeds in the Absaroka-Beartooth. Since 1977, all commercial outfitters have been required to use only certified weed free feeds. Since the mid 1990's all users were required to use certified weed free feeds. Educating the public about the weed issue, and vulnerability of weeds in the Absaroka-Beartooth has been a priority for over a decade.

Wilderness managers have been inventorying and monitoring weed populations in the Absaroka-Beartooth for over 20 years. Hand control operations, grubbing, pulling have been used throughout the Wilderness. Limited chemical and biological controls have been applied in specific locations on the Gallatin portion of the AB Wilderness (e.g. East Dam Ck. Spotted Knapweed Control Project). Chemical control of weeds on the Custer NF portion of the AB Wilderness has not been implemented since it has not previously undergone National Environmental Policy Act analysis.

The following table represents the weed inventory (Custer portion only) in the Absaroka-Beartooth at the end of 2002.

Of the 330,000 acres of Custer portion of the A-B Wilderness Area, only 45 net acres of Canada thistle exist. This species invaded the Stillwater drainage after the 1988 Storm Creek fire. The remaining acreage of the Wilderness remains fairly weed-free. This is likely due to the reduced ability for seed transport into the wilderness area as motorized or mechanized traffic is not permitted. However, weeds are annually found and treated in the 18 Wilderness Area trailheads on the Beartooth District. The current requirement to use only weed seed free hay Forest-wide has and will help limit the introduction of invaders. Also, the geographic high elevation settings seem to lessen invader's abilities to establish in alpine/subalpine habitats.

There are many aggressive weed infestations peripheral to the Absaroka-Beartooth. These aggressive weeds have the potential to infest the Wilderness, and destroy naturally functioning ecosystems.

Recommended Wilderness: Forest Plan management area H outlines Forest Service recommended wilderness in the West Rosebud, Burnt Fork, Red Lodge Creek, North of Twin Lakes, and Lost Water Canyon areas of the Beartooth Ranger District.
Weed monitoring has been infrequent in these areas. Weed infestations are not known to occur in these areas.

Inventoried Roadless Lands: Approximately 131,900 acres of inventoried roadless areas are located on the Custer National Forest. The inventory was displayed in the Custer Forest Plan FEIS, Appendices (USDA, 1987) and more recently reflected in the September 15, 2000 Roadless Area Inventory. In the late 1990's the Clinton Administration completed a nationwide study of "roadless" lands on public land, and maps of record included in the final rule (USDA, 2001). The final rule acknowledges that this inventory may not be perfectly accurate, and likely included lands which no longer retained their roadless characteristics. Inventoried roadless lands are found in all the mountain ranges on the Custer National Forest, and are currently allocated a wide variety of Forest Plan Management Area designations from the most protection (recommended wilderness) to allocations focusing on timber or range management. A wide variety of land uses occur within these areas, from grazing allotments and mineral development to dispersed recreation use of trails and non-trail areas.

Weed monitoring has been infrequent in these areas. Weed infestations are not known to occur in these areas.

WILD AND SCENIC RIVERS

Regulatory Framework – Wild and Scenic Rivers

The Wild and Scenic Rivers Act (16 US1271) and Interagency Guidelines provided in the Wild and Scenic Rivers Reference Guide (USDA and others, 1995) provide the general direction for management of these rivers. Additional goals, guidelines, and standards are found in the Custer Forest Plan, as amended by Amendment #2. Management activities will comply with the standards for Wild and Scenic Rivers from Chapter 8 of the Forest Service handbook 1909.12.

The analysis is based on the potential for the proposed weed treatment activities to impact the values inherent to rivers or streams on the Custer National Forest that are potentially eligible for protection under the Wild and Scenic Rivers Act.

Wild and Scenic Rivers - Affected Environment

The Wild and Scenic Rivers Act was enacted to preserve in a free-flowing condition rivers which possessed outstanding scenic, recreational, geologic, fish and wildlife, historic cultural or other similar values. Congress declared that is was important to manage certain rivers in their free flowing condition, and to manage them and their immediate environment to protect those qualities for the benefit and enjoyment of present and future generations. The presence of weeds along the river corridor can detract from the aesthetic and recreational opportunities. The eligible river segments are assigned a potential classification of wild, scenic, or recreational. Characteristics of these classifications are:

- Wild River areas -free of impoundments, generally accessible only by trail, shorelines primitive and the water unpolluted;
- Scenic River areas - free of impoundments, shorelines largely undeveloped but accessible in places by road;
- Recreational River areas –readily accessible by roads, some development and may have impoundment or diversion.

Portions of seven streams were identified as "eligible" for Wild and Scenic River designation in the Record of Decision and Amendment #2 of the Custer Forest Plan (USDA, 1987). No suitability studies have been completed or transmitted to Congress to date. They include:

TABLE 3 – 19. ELIGIBLE WILD AND SCENIC RIVER INFESTATIONS

River / Segment	Potential Classification	Miles	Outstanding / Remarkable Values	Approx. Weed Net Infested Acres
Crooked Creek – Lost Water Canyon	Wild	8	Cultural, Fisheries, Geologic, Scenic	5
East Rosebud Creek	Recreational and Wild	20	Geologic, Recreation, Scenic	5
West Rosebud	Wild	8	Geologic, Recreation, Scenic	5
Stillwater	Recreational and Wild	27	Fisheries, Recreation, Scenic	45
Rock Creek	Recreational and Wild	16	Geologic, Recreation	20
West Fk. Rock Cr.	Recreational and Wild	20	Fisheries, Recreation, Scenic	15
Lake Fork Rock Cr.	Recreational and Wild	10	Geologic, Scenic	5
Total		109		100

RESEARCH NATURAL AREAS

Research Natural Areas - Regulatory Framework

Reasearch Natural Areas (RNAs) are managed to maintain the undisturbed conditions and natural processes that characterize these areas. The Custer Forest Plan, as amended, identifies three RNAs for their representative and/or unique natural and ecological features. Current RNAs include the Poker Jim on the Ashland District, Lost Water Canyon; and Line Creek Plateua RNAs on the Beartooth District. Deer Draw on the Sioux District is considered a candidate RNA.

The Code of Federal Regulations (CFR) provides management direction as follows "Forest Planning shall provide for the establishment of RNAs" (36 CFR 219.25) and "[RNAs] will be retained in a virgin or unmodified condition except where measures are required to maintain a plant community which the area is intended to represent" (36 CFR 251.23). The Forest Service Manual (FSM) also provides guiding management direction for RNAs (FSM 4063) and SIAs (FSM 2372). In addition, the individual establishment records for each area serve as Forest Plan direction (as amended).

Applicable to invasive species management, FSM 4063.3.8, 9 directs activities to comply with the following standards: *8) Where pest management activities are prescribed, they shall be as specific as possible against target organisms and induce minimal impact to other components of the ecosystem, and 9) If practicable, remove exotic plant or animal life.* Further, FSM 4063.32 directs that "*If exotic plants or animals have been introduced into an established RNA, the Station Director and the Regional Forester shall exercise control measures that are in keeping with established management principles and standards to eradicate them, when practical.*"

Lastly, FSM 4063.34 [in part] "*Use only tried and reliable vegetation management techniques and then apply them only where the vegetative type would be lost without management. The criterion here is that management practices must provide a closer approximation of the naturally occurring vegetation and the natural processes governing the vegetation than would be possible without management. Unless the manager is certain that the management practice will meet this criterion, do nothing.* Responsibility for management of RNAs is shared between the National Forest System and the Forest Service Research Station. The Regional Forester, with concurrence of the Research Station Director, has the authority to establish RNAs and approve research and monitoring activities. FSM 4063.34 continues, "*The Station Director, with the concurrence of the Forest Supervisor, may authorize management practices that are necessary for noxious weed control or to preserve the vegetation for which the research natural area was created.*

Procedures permitted for control of noxious weeds and uses of herbicides are described in FSM 4063. *Generally, the broad application of herbicides within RNA/ SIA would not be allowed. Actions would be taken to prevent introduction of noxious weeds to RNAs.*." However, it does not preclude the use of herbicides as a control measure.

The establishment records for all of the RNAs also state "*Pest management and noxious weed control will be as specific as possible against target organisms and induce minimal impact to other components of the area… If invasive exotics are discovered within the RNA, measures will be taken to control or eradicate these populations*." Relative to some RNAs within designated wilderness areas is the direction that "*Management of the RNA will be compatible with and consistent with Wilderness management direction*."

Research Natural Areas - Analysis area

The analysis areas for RNAs are the RNAs and their surrounding area. The focus of the analysis will be those RNAs that currently have some level of weed infestation as identified in the Affected Environment Section.

Research Natural Areas - Analysis Method

Information for the Affected Environment came from the Establishment Records for the individual RNAs, and current GIS and weed inventory data. The analysis is based on the effect the proposed activities in each alternative would have on the establishing criteria for each RNA, and potential for affecting ecological integrity.

RECREATION

Recreation - Regulatory Framework

The goal of the Custer National Forest Plan (1997) relative to recreation is to provide a broad spectrum of recreation opportunities in a variety of Forest settings. The Forest Service Manual, FSM 2300, describes the Forest Service Authority, Objectives, Policy, and Responsibility for recreation management. Pertinent Federal Laws are the Forest Rangeland Renewable Resources Planning Act of 1974, as amended by the National Forest Management Act, and the Wilderness Act of 1964.

Recreation - Analysis Area

The analysis area for recreation analysis is confined to all developed and non-developed recreation sites on the Custer National Forest.

Recreation - Analysis Method

The source of information for the Affected Environment was the Forest Plan and its associated EIS. The analysis is based on the potential for proliferation of invasive weeds if left untreated and proposed weed treatment activities to impact recreational opportunities on the Custer National Forest.

Recreation - Affected Environment

The Custer National Forest provides a wide range of recreation experiences. At one end of the spectrum are primitive non-motorized opportunities in places like the Cook Mountain Riding and Hiking Area, and the Absaroka-Beartooth Wilderness Area. The other end of the spectrum includes more developed settings like Red Lodge Mountain Ski Area. Weeds can be found in any of the recreation settings on the Forest.

Invasive weeds can affect the recreation experience. Invading weeds such as spotted knapweed, thistles, toadflax, leafy spurge, houndstongue, and oxeye daisy detract from the desirability of using recreation sites and enjoyment of the forest environment. These species diminish the usefulness of sites because the stiff plant stalks, thorns, or toxic sap can discourage or prevent walking, sitting, or setting up a camp. Invasive weeds also detract from the recreation experiences by reducing the variety and abundance of native flora to observe or study and reducing forage availability for wildlife and recreational livestock.

Weeds are frequently spread through recreational activities, particularly along roads, trails, campgrounds, and dispersed recreation sites. The Custer National Forest provides a variety of recreational experiences including camping, hiking, hunting, fishing, mountain biking, snowmobiling, horseback riding, skiing, and driving for pleasure. On the Beartooth District, there are an estimated 63,000 visitors annually accessing 18 major trailheads between the Memorial and Labor Day season. Campgrounds receive steady use.

Passenger vehicle roads provide primary transportation routes into and through out the Forest. While these roads provide access for a variety of purposes (commercial, residential, administrative), the primary public benefit is generally for recreational purposes. Controlling weeds along roads and recreational sites will reduce the tendency for recreational activities to spread weeds into adjacent areas.

Recreational stock can also spread weed seeds. Most of the recreational stock use on the Beartooth District is in the Stillwater, West Fork Stillwater, and East Rosebud. There is currently a weed seed free feed order in place which requires that any feed brought into public lands in Montana and South Dakota must be certified as weed seed free.

Forest visitor response to presence of weeds also covers a wide range. To some forest visitors the presence of weeds has a minimal impact on their experiences. This seems to the case, most frequently, to visitors and users of the more developed recreation sites. There appears to be more concern expressed by the recreating public over the presence of weeds in less developed recreation opportunity classes with primitive non-motorized setting having the greatest sensitivity. For example, users in the

Absaroka Beartooth Wilderness area seem to feel that weeds detract from their experience and in general this group is supportive of weed control efforts and reports new weed populations when they are discovered. In summary, there does seem to be a growing concern among recreationists that weeds are a negative impact on their experiences.

The issue of effects of herbicides on human health is treated separately in this analysis. Please refer to the human health sections in Chapters 3 and 4 for more information.

HERITAGE

Heritage - Regulatory Framework

The National Historic Preservation Act of 1966 (NHPA) and the Forests Plan provide the primary requirements applicable to situations where proposed management activities could potentially affect heritage resources on the Forests. Other applicable requirements come from the Archaeological Resources Protection Act, American Indian Religious Freedom Act, Executive Orders (11593, 13175 and 13287), and other laws, regulations and policies. Under Section 106 of NHPA, the Forest Service is required to evaluate effects of proposed management activities to historic properties (archaeological sites and ethnographic resources including traditional cultural properties). The Forest must also follow Forest Plan standards and guidelines for protecting heritage resources and coordinating with Native American tribes.

This document analyzes proposed weed treatment activities in accordance with NEPA, and tiers to applicable Section 106 NHPA process requirements. Tribal consultation requirements are also addressed, as well as monitoring requirements. If adverse effects cannot be avoided, then the Forest would consult with the SHPO, the Advisory Council and interested parties and develop an appropriate mitigation plan.

Heritage - Analysis Area

The analysis area for the heritage resource analysis is confined to all archeological and ethnographic sites known to occur on the Custer National Forest.

Heritage - Analysis Method

The source of information for the Affected Environment includes archeological resource surveys that have been conducted and various ethnographic studies that have been performed in and adjacent to the Custer National Forest. The analysis is based on the potential for proliferation of invasive weeds if left untreated and proposed weed treatment activities that could impact heritage resources on the Custer National Forest.

Heritage - Affected Environment

Weed infestations have not had any known impact on historic, prehistoric, or traditional cultural properties on the CNF. Nor have past herbicide and biological weed control resulted in known effects on historic properties or traditional plant gathering sites. However, invasive plants can crowd out plants traditionally gathered for food, dress, or ceremonial purposes and can influence wildlife and fish habitat ecology. Invasive weeds have diminished populations of some plants traditionally used by local tribes.

The Custer National Forest consults with eight tribes who have expressed interest in the projects and management of the CNF and who have aboriginal ties to the lands the National Forest administers. These tribes include the Crow, Northern Cheyenne, Assiniboine, Shoshone, Arapahoe, Shoshone-Bannock, Three Affiliated, and the Great Sioux Nation. Many tribal members continue to gather plant materials for traditional or cultural purposes.

During tribal consultation for this project, relevant concerns arose about the potential impacts from weed control treatments, such as: (1) potential loss of plant species that have a traditional, religious, or other use, and (2) potential health risks to those who collect herbicide-treated plants.

Heritage resource sites that may be affected by weed treatment activities fall broadly into two categories: (1) archaeological, and (2) ethnographic resources (including traditional cultural properties). These resources are described in the following two sections.

Archaeological Resources

Archaeological resources are generally defined as the nonrenewable evidence of human occupation or activity (as indicated by sites, buildings, structures, artifacts, ruins, objects, works of art, petroglyphs/pictographs, architecture, or natural features) that were important in human history at the State, local, or national level. Archaeological resources consist of the material remains of human activities on the Forest, including prehistoric and historic sites. The Forests have a long history of human use. Site types are diverse across both forests and include, but are not limited to, small artifact scatters, quarry and other resource procurement sites, historic cabins, homesteads, and mines. Historic sites represent a wide variety of activities that include logging, mining, ranching, exploration, trade, railroading, and homesteading.

Both prehistoric and historic archaeological sites may exhibit surface characteristics with the potential to be affected by weed treatments. Perishable remains that could be affected include wood, paint, and other organic materials. In addition, sites may contain sources of information that could be potentially affected, such as datable remains, including wood for C14 dating, obsidian for hydration dating, intact thermal surfaces for archaeomagnetic dating, and residual materials on artifact and feature surfaces.

Archeological resource surveys have been conducted on the Custer National Forest. In general, the distribution of sites reflects the distribution of heritage resource survey; such that known sites that overlap inventoried weed infestations serve as an indicator of the extent of weeds within heritage resource sites. Since weeds have not been systematically inventoried and the distribution of heritage resource survey is a function of where projects have occurred, the existing sample of weed infestations compared to site distribution may not accurately reflect the true distribution of weeds across heritage resources.

The affected environment considered for this weed control project includes all areas containing heritage resources (archaeological and ethnographic resources) on the Forest, since new weed infestations may occur virtually anywhere on the Forest. However, the number of known heritage resource sites that overlap inventoried weed infestation sites is low. Approximately 260 acres of known heritage sites contain some level of weed infestation.

Weed control methods such as manual and mechanized ground-disturbing treatments would need to follow the protection measures outlined in Appendix C. Other methods, such as biological methods or direct hand application of herbicides to target weed species, were considered to have little or no effect on heritage resources and are exempt from further consideration under Section 106.

Because the project is designed to avoid direct impacts to archaeological sites (see Appendix C), it is anticipated that all sites will be avoided by mechanical treatments. If sites cannot be avoided, or if human remains are found during project implementation, the tribes, SHPO, and the Advisory Council will be contacted, and protection measures will be developed.

Ethnographic and Traditional Cultural Property Resources

Ethnographic and Traditional Cultural Property resources include sites and resources generally associated with living communities that have traditional and long-standing ties to an area. The Forest will consider other traditional or tribal concerns, especially if they fall within the purview of executive orders and other legislation. These may consist of physical remains, but they can also include areas of cultural importance such as communal or ceremonial locations without an obvious physical context.

On the Forest, these types of sites are generally associated with areas traditionally used by area tribal communities. The Forests have a unique relationship with Federally recognized American Indian tribes, and other traditional communities. As Federal agencies undertake activities that may affect a tribe's rights, property interests, or trust resources, they carefully implement those activities in a manner that respects the tribe's sovereignty and resource needs. In addition, the NHPA requires an agency to evaluate effects to traditional cultural properties and practices within a project area.

Native Americans and other groups use the Forest to collect plants and animals for food, medicine and religious ceremonies, and wood for fuel and construction. Approximately 290 plant species have been documented to be used by various area tribal groups (i.e., Plains Native Americans and Montana Native Americans) and tribes, including Northern Cheyenne, Crow, Sioux, Bannock, and Shoshone (USDA, Forest Service, 1995. There are at least 170 plants documented as having current use by the Northern Cheyenne (USDI BLM and DNRC, 2002). Most of the plants identified are broadleaf forbs, while a few trees and shrubs are listed as well. Some grasses and grass-like species are also identified. Most of the weed species proposed for treatment do not appear to be those collected for traditional uses by Native American tribes associated with the Custer National Forest. The following species listed are noteworthy relative to their potential treatment as an undesirable species by some.

Curly cup gumweed (*Grindelia squarrosa*) and Broom Snakeweed (*Gutierresia sarothrae*), native species, are known to be treated as an undesirable species on some farms or ranches since they tend to increase with grazing pressure and are generally unpalatable to livestock. They are known to occur in isolated low elevation areas on or adjacent to the Forest, but are not typically priority plants for IPM treatment.

Yellow Sweet Clover (*Melilotus officinalis*), a non-native species, is known to be used for ceremonial purposes. It is known to occur in isolated low elevation areas on the Forest, but is not typically a priority plant for IPM treatment.

Rush Skeletonplant (*Lygodesmia juncea*) is listed for its medicinal use. It is a native species that should not be confused with Rush Skeletonweed (*Chondrilla juncea*). Rush Skeletonweed is a non-native species and a category 3 noxious weed targeted for eradication under Montana State law.

All other documented species are a desired native component to the desired condition of overall plant community health and diversity.

In locations off the Custer National Forest, weeds have invaded a number of the sites where these traditional-use plants grow. In general, the weeds can and have out-competed native plants, reducing plant populations and reducing the availability of these plants for traditional uses.

Although some specific areas are used as collection sites by specific clans, very few specific historic gathering sites have been identified on the CNF (USDA, Forest Service, 1996). Specific plant species and communities have special rules concerning their procurement and use. The specialized knowledge is only available to those tribal members who have the right to use the plants (USDI, BLM and MT DNRC, 2002; USDA, Forest Service, 1996). There are many areas of all three Districts of the Custer National Forest, where plant gathering for traditional ceremonial, medicinal, and subsistence purposes occurs. Where there are known special plant gathering areas (USDI, BLM and MT DNRC, 2002; USDA, Forest Service, 1996; and USDI, NPS, 1994), tribal consultation would be employed to adaptively add any new protection measures that might be needed to minimize effects to the plant population(s) in question (i.e., changes in weed treatment timing, application methods, treatment priority). Protection measures and adaptive management measures (Appendices C and E) would be employed.

SOCIAL AND ECONOMIC ASPECTS

Social and Economic Aspects - Regulatory Framework

There are no regulatory requirements for a social and economics analysis. However, it is an issue that was determined to be considered for this analysis.

Social and Economic Aspects - Analysis Area

The analysis area is considered the lands of the Custer National Forest, its associated eight counties of Montana and South Dakota, and another eight adjacent counties are within the zones of local influence of the Custer National Forest.

Social and Economic Aspects - Analysis Method

The source of information for the Affected Environment includes county and state found on the internet. The analysis is based on the potential for proliferation of invasive weeds if left untreated and proposed weed treatment activities that could impact social and economic aspects within the analysis area.

Social and Economic Aspects - Affected Environment

Population

The lands of the Custer National Forest occur in eight counties of Montana and South Dakota. Another eight adjacent counties are within the zones of local influence of the Custer National Forest. These 16 counties are referred to as zone counties.

The total populations of these 16 counties in the 2000 census were 273,520. Of this total, 47% people were in one metropolitan county (Yellowstone County, Montana). Nine of these counties have populations of less than 10,000 and six of those have populations of 5,000 or less. Thus, a “typical” zone-of-influence county has a population of about 9,600, with a county seat of perhaps 1,700, with various small settlements of between 40 and 800 people, and a rural population of about 3,000.

The 2000 population projection assumes a continuation of three trends: 1) additional growth in counties experiencing significant oil, natural gas, and coal development; 2) modest growth of counties serving these energy-producing counties as wholesale, retail, and service centers; and 3) modest growth of the counties in the Beartooth District due to the retirement amenities they offer, the recreational opportunities, and possibly the hardrock mining activity that is again increasing.

Economy

In the majority of the zone counties, agriculture and its related support services is the primary economic base. A few counties are experiencing high oil, natural gas, and/or coal development. However, their agricultural activities are still the long-term bases of their economy. Yellowstone County has business, manufacturing, professional services, and other economic foundations, as well as the agricultural components.

The average 2000 per capita income of people in the 15 rural zone counties was $32,900 for Montana and South Dakota, and the average of $36,700 for Yellowstone County (http://www.epodunk.com).

The primary agricultural component of this area has a strong interest in the control of weeds as it can affect many economic considerations.

Public Land Receipts

In 1908, in response to the mounting opposition to the creation of the National Forest System in the West, Congress passed a bill which created a revenue sharing mechanism to offset the effects of removing these lands from economic development. The 1908 Act specified that 25 percent of all revenues generated from the multiple-use management of the National Forests would be shared with the counties to support public roads and public schools. It was the intent of Congress in establishing our National Forests, that they would be managed in a sustained multiple-use manner in perpetuity, and that they would provide revenues for local counties and the federal treasury in perpetuity as well. And, from 1908 until about 1986, this revenue sharing mechanism worked extremely well. However, from 1986 to the present, multiple-use management receipts from the National Forests dropped sharply, and as a consequence, so did the revenues. Most counties saw a decline of over 85 percent in actual revenues generated on our National Forests, largely as a result of the reduction in all forms of green and salvage timber harvesting.

In 2000, Congress passed the Secure Rural Schools and Community Self-Determination Act to address the negative effects of declining federal receipts on local governments. The Act is now authorized through September 30, 2013. Under the Act, counties are eligible for annual payments based on the value of the highest three-year average of the 25% fund between the years 1986 and 1999. Counties can wait to decide whether to opt into the program, but they may not withdraw from the program during the lifetime of the act. The following are fiscal year 2005 county payments for project affected counties in Montana.

FEDERAL FISCAL YEAR 2005 PL 106-393 FOREST RESERVE PAYMENTS - DECEMBER 2005[26]

County	Principal	Title I	Title III
Carbon	**$ 53,543.35**	**$ 53,543.35**	**$ -**
Carter	**$ 14,456.71**	**$ 14,456.71**	**$ -**
Park	**$ 153,241.09**	**$ 130,254.92**	**$ 22,986.17**
Powder River	**$ 55,042.57**	**$ 55,042.57**	**$ -**
Rosebud	**$ 15,527.57**	**$ 15,527.57**	**$ -**
Stillwater	**$ 30,091.37**	**$ 30,091.37**	**$ -**
Sweet Grass	**$ 52,044.15**	**$ 52,044.15**	**$ -**

Payments in Lieu of Taxes (PILT), conceived in 1976, are Federal payments to local governments that help offset losses in property taxes due to nontaxable Federal lands within their boundaries. Payment in lieu of tax public land receipts by county are shown in the following table.

TABLE 3 – 20. PILT REVENUES BY COUNTY

County	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005
Carbon County, MT	$ 515,820	$ 541,960	$ 613,244	$ 553,359	$ 591,318
Carter County, MT	$ 94,327	$ 99,002	$ 110,473	$ 112,769	$ 117,657
Park County, MT	$ 688,024	$ 723,202	$ 792,382	$ 815,523	$ 832,686
Powder River County, MT	$ 124,482	$ 131,131	$ 141,855	$ 113,630	$ 117,698
Rosebud County, MT	$ 365,274	$ 384,326	$ 433,077	$ 61,803	$ 64,482
Stillwater County, MT	$ 209,436	$ 220,596	$ 247,114	$ 251,505	$ 257,768
Sweet Grass County, MT	$ 262,470	$ 275,850	$ 306,812	$ 313,408	$ 318,443
Harding County, SD[27]	$ 97,956	$ 105,123	$ 111,920	$ 115,122	$ 118,781

The annual PILT payments to local governments are computed based on the number of acres of federal entitlement land within each county or jurisdiction with a cap based on population. Federal entitlement lands include Department of the Interior lands and water projects (National Park System, Bureau of Land Management, U.S. Fish and Wildlife Service and Bureau of Reclamation) as well as those of the U.S. Army Corps of Engineers and U.S. Department of Agriculture National Forest lands.

Individual county payments may increase or decrease from the previous year as a result of changes to acreage data, which is updated annually by the federal agency administering the land and population data updated by the Census Bureau. By statute, the per-acre and population variables used in the formula to compute payment amounts are subject to annual inflationary adjustments using the Consumer Price Index. The computation also adjusts the payment for the level of prior-year revenue payments and the amount that a county receives under Sections 6904 and 6905 of the PILT Act. Revenue payments are federal payments made to local governments under programs other than PILT during the previous year and include those made under the National Forest Fund, the Mineral Leasing Act, and the Secure Rural Schools and Community Self-Determination Act of 2000.

[26] http://maco.cog.mt.us/pages/FY-05ForestPayments&Worksheet.htm
[27] National Association of Counties:
http://www.naco.org/Template.cfm?Section=Find_a_County&Template=/cffiles/counties/pilt_res.cfm&state=SD and
http://www.naco.org/Template.cfm?Section=Find_a_County&Template=/cffiles/counties/pilt_res.cfm&state=MT

Economic Comparison of Treatments

This decision is about how to, not whether to, manage weeds on the Custer National Forest. This section provides the decision maker with comparative information on the relative costs per acre of the alternatives. The following table displays the experienced costs for each of the treatment methods being considered:

TABLE 3 - 21. ESTIMATED COST COMPARISON.

Treatment	Direct Cost per Acre
Biological Control	$150
Hand Pulling/Cultural/Mechanical - Average	$350
Ground Applied Herbicide – Average	$150
Aerial Applied Herbicide	$40

Biological control agents in general have not been in place long enough to show results on an area basis. The Custer averages about $750 per site or $150 per acre to collect and release bugs that prey on select invasive plant species.

Hand pulling is the only manual control practical on many parts of the forest. Four people can pull an acre of weeds in one day and the Forest Service commonly assigns this work to seasonal employees at the GS 3, 4 and 5 wage levels. A total cost per acre of $400 dollars is representative of the Forest's experienced costs on many of the more lightly infested sites. Cultural or mechanical work includes the use of fire, grazing, mowing, seeding and other activities that aid in achieving weed defense. A total cost per acre of $250 dollars is representative of the Forest's experienced costs. An average of $350 per acre will be used in this analysis.

Ground application commonly involves spraying an herbicide from a vehicle, usually a pick-up truck or an ATV. Experienced costs for ground application are approximately $100 per acre to apply Tordon 22-K®, the herbicide most commonly used on the Forest for spotted knapweed. Backpack sprayers cost a minimum of $200 per acre. This system is used less frequently than trucks or ATV's and the production rate (acres treated per hour) is less because applicators have to walk from one site to another. Difficult access increases the costs of these methods and access is frequently the limiting factor determining whether a site can be treated from a vehicle or on foot. An average of $150 per acre will be used in this analysis.

Aerial application costs include both fixed wing and helicopters. This analysis uses a value of $40 per acre since the areas to be treated tend to be small and few areas have been identified as suitable for aerial treatment.

The following table displays the reasonably foreseeable treatment acres, generated by GIS analysis of vegetative data, by treatment method and Alternative:

TABLE 3 - 22. TREATMENT ACRES (NET AREA) BY ALTERNATIVE[28]

Alt. [29]	Biological Control	Cultural/ Mechanical*	Ground Herbicide	Aerial Herbicide	Tall Larkspur Herbicide	Infrastructure Herbicide	Not Treated by Herbicide
1	155	5	1415	85	60	5	0
2	155	5	0	0	0	0	1340
3	155	5	1450	0	0	0	45

[28] Some acres are counted more than once because more than one species is present on the same site and each species may have unique treatment strategy.
[29] For all alternatives except Alternative 2, herbicides will be used in conjunction with biological, cultural, and mechanical control methods.

The following table displays the relative costs per acre, by Alternative:

TABLE 3 - 23. POTENTIAL ANNUAL[30] DIRECT WEED CONTROL ACRES BY METHOD

Alternative	Biological Control	Hand/Cultural/ Mechanical	Herbicide - Ground Application	Herbicide - Aerial Application	Herbicide - Tall Larkspur	Right of Way Undesirable Weeds	Total Annual Treatments
Alternative 1	$23,250	$1,750	$212,250	$3,400	$9,000	$1,750	$251,400
Alternative 2	$23,250	$1,750	$0	$0	$0	$0	$25,000
Alternative 3	$23,250	$1,750	$217,500	$0	$0	$0	$242,500

Average appropriations for weed control are about $130,000, annually. Expenditures are increased by various funds from grants and partnership projects.

Alternatives 1 and 3 show a total cost greater than the Forest is generally allocated to accomplish on an annual basis. Because of this reality, priority criteria have been developed in order to most efficiently utilize resources to combat weeds (see Appendix E). To give a more fiscally realistic portrayal of what the Forest weeds program could be expected to accomplish, the acreage figures in the following table were revised to (1) limit total annual costs to approximate historic budget amounts and (2) reflect the choices that have to be made when too few dollars are available to fully satisfy the objectives. The following table displays the acres by Alternative and treatment method that could be treated, assuming continuing budget support at historic levels:

TABLE 3 - 24. ANNUAL BUDGET DRIVEN WEED CONTROL ACRES BY METHOD

Alternative	Biological Control	Hand/Cultural /Mechanical	Herbicide - Ground Application	Herbicide - Aerial Application	Herbicide - Tall Larkspur	Right of Way Undesirable Weeds	Total Annual Treatments
Alternative 1	$7,500	$1,500	$114,100	$3,400	$3,000	$500	$130,000
Alternative 2	$23,250	$22,750	$0	$0	$0	$0	$46,000
Alternative 3	$7,750	$1,750	$117,500	$0	$3,000	$0	$130,000

The distribution of acres by treatment method and Alternative was guided by the following assumptions:

1. Table 3 - 24 reflects an estimated mix of treatment types. The Ranger Districts update their weed priorities each year and adjust treatment priorities accordingly to maximize long-term effectiveness.
2. Some early detection and mechanical pulling of small infestations remains a high priority under every alternative.
3. Cultural/mechanical treatment types: grazing, burning, seeding, etc while not currently given many acres will increase as technology and native seed sources improve. Emphasis is currently directed towards those wildfire areas having a potential weed problem following a high intensity, high severity burn.
4. Current biological control agents on the Custer National Forest have had limited success in limiting weed spread to date. More emphasis will be given to these agents as their effectiveness and spread improve.

The following table lists approximate retail prices (2005) for small quantities for some herbicides[31]. Herbicide prices do not include cost of such additives as surfactants, oils, fertilizer or application costs. Prices may vary depending on area of the state, wholesaler, bulk discounts, seasonal changes, quantities purchased and particular programs the manufacturing company offers. Prices are averages based on statewide dealer survey for small quantities. Producers should consult local agricultural product suppliers for exact price of each product in their area.

[30] Right-of-Way herbicide treatment is estimated to be done every four years
[31] NDSU, 2005. http://www.ag.ndsu.nodak.edu/weeds/w253/w253-5c.htm

TABLE 3 - 25. COST PER UNIT BY HERBICIDE

Product	Active Ingredients	Formulation	Cost $/Unit	Product/A			Cost $/A		
				Low	Med	High	Low	Med	High
Redeem Dow	clopyralid-tea + triclopyr-tea	0.75 + 2.25EC	92.00 gal	1.5 pt	2.5 pt	4 pt	17.25	28.75	46.00
Remedy Dow	triclopyr ester	4EC	92.00 gal	1 qt	1.5 qt	2 qt	23.00	34.50	46.00
Rifle D UAP	2,4-D-dea + dicamba-dea	2.87 + 1SL	26.00 gal	0.5 pt	2 pt	4 pt	1.65	6.50	13.00
Rodeo Dow	glyphosate-ipa salt	4SL	50.00 gal	0.75 pt	1.5 pt	3 pt	4.70	9.40	18.75
RU Original Max Mons	glyphosate-K salt	4.5SL	30.00 gal	0.67 pt	1.33 pt	2.67 pt	2.50	5.00	10.00
RU UltraMax II "	glyphosate-K salt	4.5SL	56.00 gal	0.67 pt	1.33 pt	2.67 pt	4.70	5.50	11.00
RU WeatherMax "	glyphosate-K salt	4.5SL	56.00 gal	0.67 pt	1.33 pt	2.67 pt	4.60	9.15	18.35
RT Master II "	glyphosate-K salt	4.5SL	26.00 gal	0.67 pt	1.33 pt	2.67 pt	2.20	4.35	8.70
Sahara BASF	imazapyr acid + diuron	7.78 + 62.2WDG	11.00 lb	5 lb	10 lb	15 lb	55.00	110.00	165.00
Salvo PC UAP	2,4-D ester	5EC	26.00 gal	6.4 fl oz	9.6 fl oz	12.8 fl oz	1.30	1.95	2.60
Sterling Agriliance	dicamba-dma salt	4SL	82.00 gal	2 fl oz	1 pt	4 pt	1.28	10.25	40.95
Stinger Dow	clopyralid-monoea salt	3SL	480.00 gal	0.25 pt	0.5 pt	0.67 pt	15.00	30.00	40.00
Telar DuPont	chlorsulfuron	75DF	22.00 oz	½ oz	1 oz	3 oz	11.00	22.00	66.00
TopSite UAP	imazapyr acid +diuron	0.5 + 2G	3.50 lb	200 lb	250 lb	300 lb	700.00	875.00	Too much
Tordon 22K Dow	picloram - K salt	2SL	92.00 gal	1 pt	2 pt	4 pt	11.50	23.00	46.00
Touchdown CF Syng	glyphosate - diammonium	3SL	17.00 gal	1 pt	2 pt	4 pt	2.15	4.25	8.50
Touchdown HiTech "	glyphosate - K salt	5SL	30.00 gal	10 fl oz	30 fl oz	40 fl oz	2.35	7.05	9.40
Touchdown iQ Syng	glyphosate - diammonium	3SL	24.00 gal	1 pt	2 pt	4 pt	3.00	6.00	12.00
Touchdown Total "	glyphosate - K salt	4.17SL	32.00 gal	12 fl oz	24 fl oz	48 fl oz	3.00	6.00	12.00
Transline Dow	clopyralid-monoea salt	3SL	350.00 gal	0.67 pt	1 pt	1.33 pt	29.30	43.75	58.20
Velpar DuPont	hexazinone	2L	60.00 gal	2 pt	4 pt	6 pt	15.00	30.00	45.00
Weedone 638 Nufarm	2,4-D acid + 2,4-D ester	2.8EC	23.00 gal	0.67 pt	2 pt	3 pt	1.95	5.75	11.50
Weedmaster BASF	2,4-D-dea + dicamba-dea	2.87 + 1SL	26.00 gal	0.5 pt	2 pt	4 pt	1.65	6.50	13.00
2,4-D Products	2,4-D								
2,4-D amine		3.8SL	12.00 gal	0.5 pt	2 pt	4 pt	0.75	3.00	6.00
2,4-D ester		3.8EC	14.00 gal	0.4 pt	2 pt	4 pt	0.70	3.50	7.00
LV ester		5.7EC	18.00 gal	0.33 pt	2 pt	4 pt	0.75	4.50	9.00

Lifestyles

The population is largely rurally oriented, with strong ties to the land and to the many small towns. The population of Yellowstone County (includes Billings, Montana) is roughly 65% urban and 35% rural.

Ranch and farm families constitute 25% or more of the populations of six of the zone counties. These long-time residents exert considerable political and economic influence, and tend to favor traditional land uses and the preservation of intergenerational family operations. Another 25% or more of the populations in a majority of the counties are long-established small town residents.

Another 10% of the populations outside of Yellowstone County are Native Americans, and largely are residents of five different Indian reservations in or near the zone counties.

In recent years, the areas of major mineral activity have seen an influx of people from other areas. Many of these people regard their employment as temporary, expecting to move on to other areas, and usually do not play an integral part in community affairs.

Another distinct group is a small but growing population of professionals, craftsmen, retirees, and others who have moved to small towns to enjoy the slower pace of life and various amenities.

Lastly, Yellowstone County is growing, with a wide diversity of business, manufacturing, transportation, medical, educational, and cultural components, as well as significant agricultural components outside of the immediate metropolitan areas. The population of Billings, Montana is cosmopolitan when compared to the rural areas and smaller towns, and have attracted people from many parts of the Nation. The people of this area view the National Forest primarily as valuable recreational areas rather than as integral parts of their economies.

Many of these lifestyles integrate with the enjoyment or use of the Custer National Forest's native habitat components that invasive weeds can drastically alter when not aggressively managed.

Partnerships and Collaboration in Weed Management

Invasive plants spread across landscapes, unimpeded by municipal, state, international, and other physical and political boundaries. Behaviors of forest users and neighboring landowners influence the effectiveness of Forest Service actions to control weeds. Partnership and cooperation with forest users, neighboring landowners, and other stakeholders increase invasive plant prevention program effectiveness. Scoping comments applauded partnership and collaboration efforts in invasive plant management, and expressed that such efforts should be increased. The 2004 "National Strategy and Implementation Plan for Invasive Species Management" (http://www.fs.fed.us/news/2004/releases/10/invasives-species.shtml) emphasizes partnerships and collaboration at all levels of the agency and across all programs. Beartooth Weed Management Area is an example of such partnerships.