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Appendices

Draft Revised Forest Plan

Custer Gallatin National Forest

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Draft Revised Forest Plan Appendices

Custer Gallatin National Forest

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Contents

Appendix A: Proposed Management Approaches and Possible Actions

Introduction

The 2012 Planning Rule requires land management plans to "…contain information reflecting proposed and possible actions that may occur during the life of the plan, including: the planned timber sale program; timber harvesting levels; and the proportion of probable methods of forest vegetation management practices expected to be used" (16 United State Code (U.S.C.) 1604(e)(2) and (f)(2)). Such information is not a commitment to take any action and is not a 'proposal' as defined by the Council on Environmental Quality regulations for implementing the National Environmental Policy Act (40 CFR 1508.23, 42 U.S.C. 4322(2)(C)) (36 CFR 219.7(f)(1)). Management approaches and strategies presented may include suggestions for on-the-ground implementation, analysis, assessment, inventory or monitoring, and partnership and coordination opportunities the forest is proposing as helpful to make progress in achieving its desired conditions. The potential approaches and strategies are not all-inclusive, nor commitments to perform particular actions.

The revised Custer Gallatin National Forest plan employs a strategy of adaptive management in its decision making and achievement of forest plan desired conditions and objectives. An adaptive management strategy emphasizes the learning process. It involves using the best current knowledge to design and implement management actions, followed by monitoring and evaluating results and adjusting future actions on the basis of what has been learned. This is a reasonable and proactive approach to decision making considering the degree of uncertainty in future ecological, social and economic factors. Effects of climate change could figure heavily in adaptive management strategies as more information comes available regarding specific changes in temperature and precipitation regimes.

This appendix describes possible actions, potential management approaches, and strategies the Custer Gallatin National Forest may undertake to make progress in achieving desired conditions and objectives. It includes a list of possible project types that may be undertaken. These include the possible timber sale program, timber-harvesting levels, and the probable methods of forest vegetation management practices expected to be used over the life of the plan. However, speculation about the specific amount or treatment types, frequency, location, magnitude, or numbers of actions during the plan period are not included. This appendix does not serve as a "to do" list of projects and expected dates. The potential management approaches may be used to inform future proposed and possible actions. These strategies and actions provide guidance for plan implementation, and represent possibilities, preferences, or opportunities, rather than obligatory actions. Under an adaptive management approach, proposed strategies and actions are dynamic. They are changeable, augmentable, or replaceable, to be responsive to results of new research, practical experience, and other information and observations.

This appendix also provides information intended to clarify: the baseline and desired trend of selected desired conditions, the intent and suggested means to achieve specific direction and components, and additional information that may help managers interpret and implement plan components. Not all plan components are addressed, but only those for which additional information is warranted. This approach recognizes the highly variable site conditions and management situations that can occur across the national forest that are most appropriately addressed at the level of project analysis.

This appendix does not commit the Custer Gallatin National Forest to perform or permit activities, but provides descriptions of actions that would likely be consistent with plan components. Information included does not direct or compel processes such as analysis, assessment, consultation, planning, inventory, or monitoring.

Ecosystem Resources

Air Quality

Wildfires in the Western US are predicted to increase in size, severity, intensity, and frequency over the life of this plan. The type and amount of smoke emissions released from wildfires depends on the fuel loading, fuel moisture, and fire behavior. Smoke emissions contain hundreds of compounds that pose risk to human and ecosystem health. Smoke events also affect local economies. Management strategies that reduce fuel loading such as prescribed burns, thinning, or certain logging techniques in areas of concern may decrease the probability of severe smoke events from large wildfires. Prescribed burning can meet goals of forest restoration and air quality by aligning burn project characteristics with optimal atmospheric conditions to reduce smoke impacts.

The majority of atmospheric pollutants that deposit on or affect national forest resources come from off-forest sources. Increasing nitrogen deposition is currently the biggest concern, but localized deposition of other pollutants are also a concern. Deposition of pollutants can adversely affect aquatic and terrestrial resources and ecosystems. Ozone and ozone precursors are also air pollutants of concern. Ozone is highly phototoxic to plants and can damage lung tissue and impact human and wildlife health. The Custer Gallatin has the ability to reduce the impacts of air pollution on the national forest by working with State and Federal Agencies and participating in New Source Review including prevention of significant deterioration permit review, National Environmental Policy Act, and State or Federal Implementation Plans. Monitoring and modelling helps assess impacts of projects or pollutants to forest ecosystems and resources. Because the Forest Service is not a regulatory agency, working partnerships with the regulatory agencies are important to communicate information to help protect National Forest lands.

Soils

Potential strategies that could be used to trend toward soil quality desired conditions and improved soil resource information include:

Restoration of Detrimental Soil Disturbance – General Concepts

- Direct restoration actions are generally not undertaken unless the level of management activity caused detrimental soil disturbance within an activity area approaches or exceeds the maximum 15 percent detrimental soil disturbance standard for Region One or if existing conditions threaten to create additional resource degradation in the future.
- Restoration actions, when needed, can be designed to address the specific type or types of detrimental soil disturbance that are creating the non-compliance condition.
- Primary locations of new detrimental soil disturbance under present timber harvesting practices on the Custer Gallatin National Forest occur along temporary roads and beneath burn piles at large landings associated with whole tree logging. Area wide mechanized ground scarification and piling

with bull dozers are no longer used as part of silvicultural prescriptions on the Custer Gallatin National Forest.

Mitigation and Restoration at Landings

- The detrimental soil disturbance that occurs in the donut area surrounding burn piles at landings is primarily detrimental soil compaction or compaction and rutting, depending on whether the landing was used during wet soil conditions. These types of detrimental soil disturbance can most often be readily mitigated by shallow ripping of the top 6 to 8 inches of mineral soil. Ripping generally can be restricted to just those areas of bare soil or where ruts are readily apparent.
- Burning large slash piles at landings currently occurs almost exclusively in the winter on the Custer Gallatin National Forest. The primary cause of detrimental soil disturbance from winter burning of large slash piles is the accumulation of a thick wood ash layer covering the burn pile area after the slash pile has been burned. This ash layer does not allow for the creation of good soil-seed contact essential to the establishment of seeded native grass species. In addition, highly alkaline conditions are created when rain water passes through the ash layer to the soil below. In a process similar to the industrial production of lye, high concentrations of potassium carbonate in the ash leach into the soil. The single valent potassium ions have the same effect as sodium in an alkaline soil, sealing the soil surface to both air or water entry. Desired native plants most often fail to become established. Without competition Canada thistle and houndstongue take over the site. The net result unless appropriate mitigation actions are taken is the creation of severe, long term detrimental soil disturbance in the footprint of large slash piles after the piles have been burned.
- A management approach that has shown excellent results in test trials has been to create enough ground disturbance to expose mineral soil over at least 50 percent of the burned area. This can be accomplished in multiple ways using ground based equipment with attached rippers, a grapple hook, various tool bars with ripping shanks or any blade or bucket with ripping teeth that can be pulled backwards across the ground surface. Moving large pieces of partially burned wood off of the burned area will likely be required but even that operation can be used to expose mineral soil.
- Mechanical scarification will likely be needed to obtain the level of ground scarification needed within the burn pile footprint. Tests conducted jointly by fuels and soils at selected burn pile footprints in the South Bridger project area clearly demonstrated that hand scarification by an experienced, six person fire crew spending over two hours per landing did not come close to reaching the 50 percent exposed mineral soil target. Exposed mineral soil, in this regard means that the original, mineral soil layer surface has been exposed and that areas of exposed mineral soil are well distributed across the full burn area.
- In very rocky or otherwise rough sites, the 50 percent scarification level may not be obtainable. In those instances a lesser amount of exposed mineral soil could suffice down to 30 percent. Since landing sites are seldom located in very rocky areas, this should rarely be an issue. In general, for native plant seeding of burn pile areas, the more mineral soil exposed the better so there is no upper limit of mineral soil exposed.

Mitigation and Restoration along Temporary Roads

- The primary, long-term source of detrimental soil disturbance on temporary roads is loss of topsoil or upper soil horizons, for example detrimental soil displacement, during road construction. Soils vary tremendously in there susceptibility to degradation due to soil displacement based on inherent differences in soil properties. There are multiple ways the level of detrimental soil

disturbance created along temporary roads can be mitigated or reduced but no single approach is suitable for all conditions and all soil types.

- Based on existing soil and site conditions, options include re-contouring or in some instances simply ripping the temporary road surface, utilizing pre-existing road prisms, windrowing and re-spreading soil in low slope areas, and in all cases maintaining noxious weed control.
- Proper placement of temporary roads on linear or slightly concave areas where the underlying soil resource is deep can greatly simplify the restoration process in many instances. Even a moderate amount of soil displacement when a temporary road is placed along a convex ridge or knob where the soil resource is shallow could create permanent detrimental soil displacement.
- When pre-existing soil conditions along temporary roads cannot be completely restored, the total level of detrimental soil disturbance within treatment units served by the road can still in most instances be maintained below the 15 percent detrimental soil disturbance standard, including the amount of total temporary road disturbance allocated to each treatment unit.

Use of Soil Disturbance as a Management Tool

- Soil disturbance can at times be used as a valuable management tool for resource benefit.
- Many plant species; rhizomatous species, some wetland species, aspens, will respond positively to moderate levels of soils disturbance.
- Disturbance on the contour can be used to capture water that would otherwise be flowing downslope. It can also shorten slope length, a primary factor in predicting overland flow and soil erosion. Even roughening the soil surface in a sloped area can capture water and create favorable microsites for plant establishment.
- Critical to the appropriate use of soil disturbance as a management tool is careful consideration of the type, extent, and orientation of soil disturbance that can be used based on target plant species and existing soil and site conditions.

Soil Moisture Restrictions

- The use of soil moisture restrictions to determine when conditions are suitable for ground based equipment to operate off temporary roads and skid trails, has proved to be quite effective in minimizing the level of dispersed detrimental soil disturbance that occurs during timber harvest while having very little impact on timber harvest operations.
- Restrictions are based on soil texture, the amount of rock fragments in surface soil layers and Natural Resources Conservation Service guidelines for making field determinations of relative soil moisture content in the field. The Custer Gallatin Soil Scientist can be consulted at any time if questions arise.

Creating or Updating Available Forest Soil Inventories (Soil Surveys)

- The opportunity exists to use a combined approach that includes computer modelling, expert knowledge, existing soil profile and vegetation field data, and some additional field reconnaissance along with a limited amount of targeted field sampling to create a soil survey for the Custer Gallatin National Forest System lands in the Absaroka-Beartooth Wilderness where no soils survey currently exists.

- The same basic approach can be used to update existing low quality soil surveys and create a single, continuous soil resource inventory covering the entire forest. This resource inventory could be available to both national forest managers and the public.
- Areas to be mapped or updated can be prioritized on an as needed basis but a likely starting point could be areas where no current soil survey exists.
- The concept of soil-landscapes could be used as the basis for soil mapping and the development of map unit concepts.
- The final product, based on soil-landscapes, can be scaled both in and out on the basis of how the available soil and landscape information data is distributed between map unit and soil component concepts.

Management of Coarse Woody Debris

The level of coarse woody debris left behind in treatment units can exceed the minimum soil coarse woody debris levels defined in the soils plan components based on the management needs of specific plant community types. Guidance to consider when determining soil coarse woody debris levels is outlined below.

- The minimum target levels are most appropriate where wildfire protection is the primary management concern or where the availability of coarse woody debris is limited.
- Multiple resource benefits to soils, vegetation, wildlife, and riparian resources can be obtained at coarse woody debris levels well above those recommended as the minimum for "other resources" where wildfire protection is not an overriding concern. Most importantly, abundant coarse woody debris, within reasonable levels, remain a critical factor in maintaining the health and productivity of coniferous forest and riparian corridors.
- Optimum coarse woody debris levels are most appropriate for treatment areas where maintaining or improving soil productivity is the primary management concern.
- Greatest soil benefit can be retained when coarse woody debris material retained on the site consists of the largest pieces available and coarse woody debris have good contact with the ground surface.
- Target coarse woody debris levels above the minimum levels may be reduced proportionately in partial harvest units relative to the percentage of mature trees or basal area to be left standing after timber harvesting.
- If minimum desired levels may cannot be met, some low quality standing trees may be marked for retention and dropped after timber harvesting is complete or after log processing some of coarse would material may be moved from the burn pile back into the stand on a return trip.

Watershed, Aquatic, and Riparian Resources

Watershed

Potential strategies that could be used to trend toward watershed, aquatic habitat, and riparian management zone desired conditions include:

- To support watershed quality and resiliency, beavers and their dams/complexes (including wetlands and riparian areas) could be enhanced or maintained. Introductions of beavers, in

coordination with appropriate partners could be pursued. Where beavers are not socially or ecologically tolerable beaver dam analogue structures could be installed to increase aquatic habitat or restore watersheds.

- Instream flow water rights on National Forest System lands could be secured to support functioning riparian and aquatic habitats, stable and effective stream function, and maintain or enhance the ability of National Forest System lands to produce clean water under Montana Code Annotated 2015, 85-20-1301; USDA-FS-Montana compact ratified.
- In order to restore normative stream flows and aquatic habitat, reservoirs could be deconstructed and stream channels could be reconfigured to represent natural ecological function and process prior to the anthropogenic disturbance. This would only happen where and when ecologically and socially tolerable.
- Riparian habitat, aquatic in-stream habitat (for example, geomorphologic processes and attributes), and aquatic biota community reference condition for the Northern Great Plains Ecoregion of the Custer Gallatin National Forest is needed to inform monitoring and management of these rare aquatic/terrestrial ecotones. (Ashland and Sioux Geographic Areas) If funding becomes available 3-5 miles of stream and adjacent riparian areas could be fenced off in the Ashland or Sioux Geographic Areas, preferably within 5 years, as permanent exclosures to understand and monitor aquatic habitat and riparian reference condition. Within those exclosures disturbance treatments may be applied to understand the ecological response to various disturbances. Examples of those treatments could include vegetation treatments, fuels management, alternate grazing prescriptions (for example high intensity/short duration), among other treatments.
- Where ecologically suitable and socially tolerable, dispersed camping sites falling within, or negatively impacting, riparian management zones could be removed or consolidated with a dispersed site, or new site, that is located outside the riparian management zone. This effort would decrease potential sediment delivery to waterbodies.
- In order to understand the trends in glacier size and their future on the landscape and in the context of other North American and worldwide glacier monitoring, an inventory and monitoring program could be started. This would involve setting up permanent benchmarks and stream gauges or using remote sensing (LIDAR, aerial photography, etc.) in the wilderness areas and other areas where glaciers are found, in coordination with partners.
- All activities with potential to modify the bed or banks of any intermittent or perennial stream will be coordinated with a national forest fisheries biologist or hydrologist to ensure compliance with State and Federal permitting requirements and compliance with national forest plan standards and guidelines.

Management activities having the potential to increase sediment delivery to waterbodies could be evaluated by contextualizing the effects of management-related sediment delivery on resource issues including, but not limited to, water quality and stream stability/morphology. A weight of evidence approach may be taken for evaluating sediment effects. Management approaches used for such evaluation may include, but not be limited to, the following:

- Compliance with Federal and State water quality requirements.
- Qualitative and quantitative data/observations from field reconnaissance.

- Application of known geology, soil, physiographic, stream type/condition, and vegetative data to inform relative site susceptibility and resilience to sediment delivery.
- Predicted effects of project-related changes in sediment delivery and yield upon resource indicators of concern.
- Past monitoring data and guidance from scientific literature for similar project activities.
- Data from appropriate reference watersheds.
- Analysis of sediment delivery and sediment yield using process- or empirically-based runoff and erosion models.

Analysis catchment scale could generally be the 6th Hydrologic Unit Code (HUC) scale, but a larger or smaller catchment scale may be designated based on the scope of the proposed activity, data availability, or perceived threat of increased sedimentation.

When the WATSED sediment model (Cline et al. 1981) is utilized to calculate sediment yield for analysis, sediment yield could be evaluated relative to the estimated mean annual reference sediment yield. This reference sediment yield is that which is estimated to have occurred prior to anthropogenic forest management and is calculated by the WATSED model based on land types found within the analysis catchment. Project-affected sediment yield would be the sum of the reference yield, the yield associated with past management activities and natural disturbance, and the yield associated with proposed project activities. Standard allowable sediment yield and associated fine substrate sediment levels associated with project implementation are shown in table 1. These levels may be exceeded when other sediment evaluation approaches, such as those listed above, indicate that predicted effects of project-related changes in sediment yield upon resource indicators of concern is within the range allowed by national forest plan standards.

Table 1. Allowable sediment yield and associated fine substrate sediment levels for WATSED model analyses

Category	Management Objective (Percentage of reference)	Percentage Fine Substrate Sediment (under 6.3mm)	Annual Sediment Yield Percentage over Reference
A Species of Conservation Concern and Blue Ribbon fisheries	90	0 – 26	30
B All other streams	75	0 – 30	50

Fisheries and Aquatic Habitat/Conservation Watershed Network

Potential strategies that could be used to trend toward fisheries and aquatic habitat desired conditions include:

- Manage towards reference conditions to maintain or restore the inherent resiliency of aquatic ecosystems to maintain native aquatic wildlife populations during and after stressor events (acute and chronic) such as: warming air and water temperatures, prolonged droughts, earlier season runoff, and higher intensity floods and wildfire. Although some aquatic systems may not currently have aquatic species of conservation concern, or other aquatic species, the potential for changing climate could render these areas as refugia in the future.

- The Memorandum of Understanding and Conservation Agreement for Westslope Cutthroat Trout and Yellowstone Cutthroat Trout in Montana (Montana Department of Fish Wildlife and Parks 2007) has goals, strategies, and actions that the Custer Gallatin National Forest would continue to follow (until and if a new Agreement is reached) over the life of the plan. The Custer Gallatin National Forest would work with partners to enhance and maintain habitat or re-introduce populations of westslope cutthroat trout and Yellowstone cutthroat trout with a goal of increasing westslope cutthroat trout and Yellowstone cutthroat trout presence in historically occupied watersheds.
- Arctic grayling habitat could be enhanced or maintained on Custer Gallatin National Forest. Custer Gallatin National Forest's current four populations of Arctic Grayling were considered part of the species' distinct population segment when the U.S. Fish and Wildlife Servicer found the species not warranted for Endangered Species Act listing in 2014. Custer Gallatin National Forest could work with Montana Fish Wildlife and Parks to introduce Arctic Grayling when and where ecologically feasible.

Riparian and Wetland Areas

See the Riparian and Wetland portion of the Terrestrial Vegetation section of this appendix for activities and strategies that may be used to meet the desired conditions for riparian and wetland areas.

Terrestrial Vegetation

The following sections describe potential management strategies and possible actions, at both the landscape and stand level, for plan components related to the terrestrial vegetation. These strategies and actions are intended to provide guidance and recommendations for plan implementation, and represent possibilities, preferences or opportunities, rather than obligatory actions. Under an adaptive management approach, these strategies and actions may be dynamic in order to respond to monitoring results, new research, practical experience, emerging technology, or other information and observations.

In addition to at-risk plant species, certain plant communities warrant emphasis for conservation measures (for example, Montana State Wildlife Action Plan identified sagebrush steppe-grasslands communities, deciduous hardwoods such as aspen and woody draws, riparian areas and wetlands, and old growth forest as areas of greatest conservation need). Plan components and management approaches have been developed with that in mind. Refer to various state conservation plans, other conservation strategies, and research natural area targeted community types for inclusion into the national research natural area network (table 3 and table 4) which may provide additional information relative to plant communities that may warrant additional conservation needs.

Forested Vegetation

Perhaps the most significant change in the new generation of forest plans (under the 2012 planning rule) is the explicit focus on maintaining ecological integrity through restoration of natural resources and making National Forest lands more resilient, particularly to climate change. Ecological restoration focuses on reestablishing the composition, structure, pattern, and ecological processes necessary to facilitate terrestrial and aquatic ecosystems sustainability, resilience, and health under current and future conditions (36 CFR 219.19). Thus, implementation of the new plan necessarily requires focusing on all aspects of ecosystem structure and function and analyzing systems at a landscape scale. This contrasts with a land management approach primarily focused on outputs or with vegetation projects

focused on a singular objective such as the treatment of fuels or improving habitat for a single species. The following elements could be important to consider when managing for ecological integrity:

- **Plan and implement at the landscape scale.** Managing for ecological integrity (for example the full suite of desired conditions) can be, at times, both complementary and conflicting. Working at larger scales allows managers the flexibility to meet multiple objectives. Consider focusing attention in key geographic, topographic, and edaphic locations that because of soils, aspect, elevation, and site climate are not likely to sustain dense, drought- and disturbance-intolerant conditions. Likewise consider reestablishing the inherent landscape heterogeneity, using topography as the underlying template.
- **Natural disturbance processes, particularly fire and bark beetle outbreaks, as primary agents of change.** For a variety of reasons, including land allocations (for example the proportion of the Custer Gallatin National Forest that is unavailable for timber harvest) as well as limited access and resources, conventional stand-level vegetation management may not achieve forestwide ecosystem restoration and landscape pattern modification. Moreover, mechanical treatments alone may not be able to fully restore the suite of ecological functions performed by natural disturbances such as fire and insects (such as nutrient cycling, snag creation, surface fuel reduction, mineral seedbed preparation, and regenerating associated shrub and herb vegetation). In reality, natural disturbances could continue to be the dominant force of change across the Custer Gallatin National Forest landscapes. The judicious use of managed wildfire over large areas and prescribed burning, in association with mechanical treatments where high certainly in outcome is required, could lead to the most ecologically desirable outcomes. The application of these tools at a spatial scale several orders of magnitude greater than their current use is required to restore patterns of vegetation structure and composition at a scale that successfully synchronizes successional patterns, disturbances and climate dynamics. Where feasible and compatible with other management priorities, create management conditions that enable natural processes to do important work on the ground that is otherwise expensive and less effective to emulate with direct management. Doing this could be economically beneficial, contribute to fire and climate resiliency, and improve diversity of wildlife habitat conditions. Repeated treatments overtime could be required to achieve such goals given the century's worth of successional inertia and fuel accumulation that has occurred in many areas.
- **Natural range of variation is useful as a guide but look to the future.** Knowledge of historic structure, composition and disturbance regimes is critical to understanding ecologically functional and sustainable states. These insights form the basis of an ecological-processes oriented approach to land management. However, vegetation managers must also recognize that restoring historical conditions will not always be possible or even desirable in all situations. As such, while understanding the historic link between climate, disturbance, ecosystem conditions, and biological consequences is critical, vegetation managers must also be prepared to manage for vegetation conditions without a historical analog when necessary to create a resilient and sustainable forest under future conditions.

Desired Conditions: General Information

The desired conditions in the plan for vegetation components describe, to the best of our ability, what is desired for maintaining ecosystem integrity, while contributing to social and economic sustainability (as required by the 2012 planning rule). Analysis of natural range of variation is the underpinning for the

desired conditions, with integration of additional factors, such as habitat needs for at-risk wildlife species; existing or anticipated human use patterns; consideration of changing climate; and ecosystem services that may be desired or expected of the forest (such as reduction of fire hazard or production of forest products).

The Forest Inventory and Analysis data (Northern Region Summary Database) is the source for most of the quantified existing conditions for vegetation components (such as, vegetation dominance types, species presence, forest size class, old growth, snag and downed wood, large live trees). The one exception to this is forest density. Here, we relied on VMAP data as it is a more direct and accurate measurement of canopy cover. National forest inventory and analysis data provides information and estimates appropriate for use at the broad scale of analysis, such as the national forest or a geographic area, but is not spatially explicit and is generally not sufficient for use at the project level due to the small sample size as smaller scales. Field verification of vegetation conditions and components is expected to occur at the project level using a variety of methods, including field surveys.

Many desired conditions for vegetation characteristics are described in the plan but there is no implied priority. Individual vegetation management projects could focus on contributing to the forestwide conditions related to one or more vegetation desired conditions but not all desired conditions would need to be the focus of a particular project. In fact, given the nature of forest ecosystem dynamics, progress towards one desired condition may result in a short-term or localized movement away from another desired condition. However, implementation of treatments that achieve one or more desired conditions at the project level would not foreclose the opportunity to maintain or achieve any other desired condition over the long term. The particular vegetation desired conditions that might be a focus for a project could be determined based on the unique ecological opportunities and capabilities of each project area as well as other resource considerations and direction provided by the deciding official.

Ranges in vegetation conditions are expressed for some desired conditions. Maintaining vegetation conditions anywhere within this range would be considered acceptable to meet the desired condition. Fluctuations in vegetation conditions over time are expected. Managing a particular vegetation characteristic at the upper, lower or mid-point of the desired range may be determined to be appropriate, as influenced by other ecological, social or economic objectives. Monitoring assists in evaluation of vegetation change over time, and supports an adaptive management approach to forest management (36 CFR 219.12).

Project-Level Considerations

Temporal and spatial scale are important factors to consider when interpreting and applying desired conditions at the project level. Desired conditions for vegetation could can be viewed and interpreted from both short-term and long-term perspectives. It may take substantially longer than one forest plan period to achieve desired conditions for some vegetation components, and monitoring of the trend over time could be key to assess whether conditions are moving in the desired direction. Vegetation change can be rapid (such as with fire) or slow and gradual (such as with succession). Direction and degree of change in vegetation can vary substantially over the short term (for example, a few decades), but over the long term would be trending in the right direction. This is due not only to the nature of change due to succession and disturbances, but also because of the discrete classifications we apply to vegetation (such as the four forest size classes) when in reality vegetation conditions and change over time on a continuum. Ecological, social and economic sustainability concepts require a relatively long-term

perspective for appropriate interpretation and evaluation but also requires consideration of short-term factors such as market demands.

Spatial scale is also important to acknowledge in the application of desired conditions at the project level. Vegetation desired conditions are designed to describe conditions desired at the forestwide or Geographic Area scale, not at the scale of the individual project, and are not necessarily appropriate to apply at these smaller scales. Stand level decisions and treatments are made at the site specific level, and would be designed to contribute to forestwide desired conditions and not preclude their achievement.

Natural disturbance processes, such as fire and succession, as opposed to vegetation management treatments, are the primary drivers of vegetation change on the Custer Gallatin National Forest. Forestwide, this means there is limited ability for management actions to influence vegetation change. However, there are portions of the forest (such as the wildland urban interface, municipal watersheds or suitable timber base), and some potential vegetation types (such as the warm dry potential vegetation type) where the effects of management actions have greater potential and opportunity of influencing vegetation conditions.

Focusing on a particular desired vegetation condition for a project may appear to conflict with another desired condition. For example, large diameter shade tolerant trees may be removed from a high density forest by regeneration harvest and the site planted to a desired, shade intolerant species. The primary intent is to increase early seral species, reduce high density forests, lower risk and loss of trees to insect/disease, and increase forest resilience, as well as provide timber outputs and contribute to economic sustainability. To meet these desired conditions, removal of larger trees is required, which might appear to conflict with FW-DC-08. However, forestwide, tree growth through vegetation succession is the primary means by which very large trees develop, and natural disturbances (mainly insect, disease and fire) the primary means of their removal. Management actions that promote forest densities, species and structures that are resilient to these disturbances and are of moderate and lower densities that facilitate more rapid growth rates are the primary means by which large trees can be developed and sustained over the long term in the ecosystems of the Custer Gallatin National Forest. Harvest of larger trees addresses and achieves desired conditions listed above but does not preclude the attainment of desired conditions related to large tree sizes, and may even facilitate or improve the probability of their persistence over the long term.

The primary intent of using the Desired Conditions to help guide project development is to promote resilience at both the stand and landscape scales over the long term. It is important to recognize that silvicultural treatments that promote stand-level resistance to some disturbances, such as spruce beetle or mountain pine beetle attacks, are important but will likely fall short at providing resilience at the landscape-scale once beetles reach epidemic levels. While intermediate treatments will enhance resistance to some disturbances, building long-term resilience will often require proactive implementation of appropriate regeneration methods to provide desirable post-disturbance conditions (Long, Windmuller-Campione and DeRose 2018). For example, silvicultural regeneration methods could be used to regenerate stands of “over-represented” and highly vulnerable size classes, thereby increasing resilience to future disturbances (DeRose and Long 2014). In many cases, achieving the Desired Condition (for example resilience) will require the establishment of a new cohort of desirable species ahead of the disturbance and waiting until after a large disturbance will forego valuable opportunities and could result in significant restoration challenges. The proactive use of regeneration

treatments that take advantage of currently existing vegetation to create desirable age and species diversity will be key to building resilience to inevitable large-scale disturbances.

Climate Change

Considering climate change when developing site-specific silvicultural prescriptions will be critical to promoting ecological integrity and resilience over the long-term. For example, in determining residual density or when choosing species to plant and determining planting densities, it may be appropriate to consider recommended stocking levels for a habitat type that is one notch warmer and drier than the current. For specific information on climate change vulnerabilities and recommended management strategies related to potential climate change that are relevant to landscape and stand level prescriptions, refer to documents produced by the Northern Rockies Adaptation Partnership, the Reforestation-Revegetation Climate Change Primer for the Northern Region, (Hansen et al. 2018) and other publications as they are available.

Snags

The desired conditions for snags are expressed as an average density/distribution across broad geographic areas and it is recognized that there will be significant variability around this average. For example, on lands managed for timber production and within the wildland urban interface, there will likely be fewer snags than in more remote areas where vegetation will be less actively managed. This variability in snag density and distribution is expected and desirable.

The guideline for snag retention in treatment areas is intended to help retain snag conditions that contribute to wildlife habitat and other ecosystem benefits not just within wilderness and roadless areas but also within areas that are more intensively managed and where snag-producing natural disturbances (fire and insects and disease) are expected to be more limited (for example, lands suitable for timber production). The following factors may be considered in development of direction for snag management in project areas:

- The guideline requires that the largest snags always be prioritized for retention. Larger diameter snags are particularly important due to their rarity and high contribution to soil function and wildlife habitat.
- The snag guideline applies as an average of all treatment units across a project area, so that the condition of snags may be considered at a scale larger than individual treatment units. This should allow projects to design snag requirements as needed to best meet the unique conditions of each project. Snags would not necessarily be required to be left in each treatment unit, depending on the landscape context.
- If fewer than the minimum snags are present across treatment units, or it is not safe or operationally feasible to retain them, retain the snags that are available as well as live tree replacements to achieve the guideline. When selecting live replacement trees, retain the largest and most decadent trees; those with rot or wildlife use are preferred. Live tree replacements may consist of trees retained for other purposes, or damaged by harvest could also be selected. These trees may also be used to meet FW-VEGF-GDL-05.
- Consider retaining more than the minimum number of snags or replacement trees to provide snag habitat in both the short and long term, particularly in areas adjacent to past harvest areas with few or no snags or live reserve trees.

Old Growth

Old growth stands are defined by specific structural attributes and other characteristics as described in the Forest Service publication, Old growth forest types of the Northern Region (Green et al. 2011), with correction notices dated 2005, 2007 and 2008. The publication is available at http://fsweb.r1.fs.fed.us/forest/inv/project/old_growth.shtml. If that document is revised or replaced by the Northern Region, the updated version would be used.

In general, old growth stands are in the late stages of stand development and are distinguished by old trees and related structural attributes. These old growth stands are typically distinguished from earlier developmental stages by combinations of characteristics such as tree age, tree size, number of large old trees per acre, and stand density expressed as basal area). Specific values for these attributes vary by local ecological type and forest type. Other characteristics sometimes associated with old growth stands (canopy layers, snags, down wood, etc.) are not part of the minimum criteria needed to meet the definition of an old growth stand because those other characteristics can vary greatly even in stands that are clearly old growth.

The presence or absence of old growth within a project area is intended to be assessed at the stand level. In other words, the minimum old growth criteria presented in (Green et al. 2011)is intended be applied as a stand-level average. As such, an inclusion of large, old trees found within a stand dominated by younger and smaller trees is not intended to be considered a patch of old growth in and of itself. Although FW-GDL-VEGF-01 would not apply to such remnants of large old trees, these biological legacies are highly desirable to maintain on the landscape for purposes of promoting resilience, landscape heterogeneity and wildlife habitat. Where small pockets of large and old trees occur, managers may consider design criteria that seek to maintain and protect them.

Old growth habitat includes stands that meet the definitions for old growth forest, in addition to stands that may have some of the structural or other characteristics that provide habitat for wildlife species associated with old growth but do not fully meet the definitions for old growth. For example, old growth habitat may include stands that contain large diameter trees but these trees are younger than required to meet old growth forest definitions.

The primary function of FW-GDL-VEGF-01 and FW-DC-VEGF-10 is to highlight the ecological importance and dynamic nature of old growth and underscore the importance of planning for long-term development while also protecting existing old growth. It is understood that old growth may be lost to disturbances and gained through natural succession. Forest plan direction for old growth acknowledges and supports the enhancement of the successional process towards old growth that could be achieved through management. In addition, other desired conditions (FW-DC-VEGF-08, and FW-DC-VEGF-03) related to large live trees and size class are intended to contribute to the needs of wildlife species associated with old growth.

The intent of the plan is to (1) increase the resilience of old growth to potential future disturbance, which may result in loss of old growth characteristics (for example, high severity wildfire or epidemic insect outbreaks); and (2) promote the long-term (such as, beyond the plan period) development of future old growth forest or old growth habitat.

At the landscape or watershed level, areas where it is desirable to alter old growth conditions (for example, the size, shape, structure and connectivity of old growth forest patches), a possible management strategy may include the following considerations:

- When planning harvest, retain stands adjacent to existing old growth that would provide future old growth in the shortest time frame possible. Selection of stands for development of future old growth may be emphasized in watersheds where existing old growth forest or habitat acres are less than the desired conditions at the forestwide scale; where shape of old growth forest or habitat patches is largely linear and narrow; where individual patches are relatively small (average less than 100 acres); or where connectivity of patches is poor.
- At the project level, assess old growth patch size by analyzing the amount of high contrast edge between old growth habitat and openings
- Consider treatment of forest adjacent or near old growth stands to result in reduced fire hazard, alter potential fire spread or fire severity, or reduce potential insect or disease outbreak that may spread to old growth forest.

Grassland, Shrubland, Woodland, Riparian, Alpine, and Sparse Vegetation

Refer to documents produced by the Northern Rockies Adaptation Partnership and other similar publications as they are available to help assess vulnerability of natural resources and ecosystem services to climate change; and science-based adaptation strategies that might be used mitigate the negative effects of warming trends.

Activities and strategies that may be used to meet the desired conditions for grassland, shrubland, woodland, riparian/wetlands, alpine and sparse vegetation include the following:

Grasslands/Shrublands

- Refer to The Vegetation of the Grand River/Cedar River, Sioux, and Ashland Districts of the Custer National Forest: A Habitat Type Classification (Hansen and Hoffman 1988), Grassland and Shrubland Habitat Types of Western Montana (Mueggler and Stewart 1980), Classification of the Grasslands, Shrublands, Woodlands, Forests, and Alpine Vegetation Associations of the Custer National Forest Portion of the Beartooth Mountains in Southcentral Montana (Williams 2012), Fire Effects Information System (USFS, online database), available ecological site descriptions, state and transition models, or similar classifications applicable to the national forest for information on potential vegetation, succession, and response to disturbance in grasslands/shrublands.
- Interpreting Indicators of Rangeland Health (Pellant et al. 2000) or equivalent methods can be used when assessing upland rangeland vegetation. This publication and Rangeland Health (National Research Council 1994)highlight the integration of soil, vegetation, and hydrologic attributes and indicators as important elements in assessing rangeland ecosystem health. They provide an ecological framework for identifying, assessing, and discussing the importance and interdependence of soils, biotic communities, and hydrologic elements to a functioning and resilient ecosystem. Soil condition has historically been included along with vegetation condition as an integrated approach for assessing the condition of rangeland ecosystems.
- Utilization Studies and Residual Measurements Technical Reference (Coulloudon et al. 1996) provides an interagency approved methods for monitoring. Other available methods include the

modified robel pole (Benkobi et al. 2000), (Uresk and Benzon 2007), (Uresk, Mergen and Benzon 2009).

- Conifer species that are encroaching upon rangelands may be removed to maintain shrubland/grassland potential vegetation types. Consider other resource values during project analysis when determining removal of the conifer component. A silvicultural prescription is encouraged, but is optional. In rangelands where the encroaching trees are less than 3-feet high, prescribed fire may be the preferred treatment. Mechanical methods may be the preferred treatment in areas where trees are over 3-feet high.

Pollinators (honey bees and native pollinators) enhance biodiversity and support stronger and more resilient ecosystems. While pollinators pollinate more than 80 percent of wild flowering plants (such as those found in grasslands and shrublands), they are also important to other habitats. Refer to Pollinator-Friendly Best Management Practices for Federal Lands(U.S. Department of Agriculture 2015), Pollinators and Roadsides: Best Management Practices for Managers and Decision Makers (Hopwood, Hoffman Black and Fleury 2016), An Overview of the Potential Impacts of Honey Bees to Native Bees, Plant Communities, and Ecosystems in Wild Landscapes: Recommendations for Land Managers (Hatfield et al. 2018) or similar references for information on best practices for pollinators and apiary placement.

Deciduous Broadleaf Woodlands

Woody Draws

- Refer to The Vegetation of the Grand River/Cedar River, Sioux, and Ashland Districts of the Custer National Forest: A Habitat Type Classification (Hansen and Hoffman 1988), Classification and Management of Montana's Riparian and Wetland Sites (Hansen et al. 1995), Fire Effects Information System (USDA Forest Service, online database), available ecological site descriptions, or similar classifications applicable to the national forest for information on potential vegetation, succession, and response to disturbance in woody draws.
- Refer to Green Ash Woodlands, A Review, by Lesica and Marlow (2013) or other applicable publications for information on physical environment, composition, values and for management considerations for these important habitats.
- Monitoring Seral Stages in Green ash-Prunus Ecological Type (Uresk et al. 2010), Woody Draw Inventory and Health Assessment for Range Allotment Plan Revision, Sioux and Ashland Ranger Districts, Custer National Forest (DiBenedetto 2001), or equivalent method can be used when assessing woody draws. Place monitoring emphasis on recruitment of green ash seedlings and saplings.
- Place emphasis on maintaining woody draws that are in good condition. Functional—at risk areas can be considered for restoration. These areas may be near the threshold of degrading into a nonfunctional condition. Planned actions to begin recovery can usually be implemented at a much lower cost in these areas than in non-functional areas. Once an area is nonfunctional, the effort, cost, and time required for recovery dramatically increase. Only reserve restoration of nonfunctional systems for those situations when recovery is possible, efforts are not at the expense of functional- at-risk systems, or unique opportunities exist.
- Where practicable, suitable management techniques can be employed to restore woody draws. The frequency of seedling-, sapling- and pole-size green ash has been positively associated with the canopy cover of chokecherry in many woodlands in the northwestern Great Plains and this association suggests that recruitment of green ash from seed may be enhanced by a tall shrub

understory. Recruitment of green ash seedlings might be possible by first establishing a chokecherry understory to act as nurse plants. Reduced vigor of sod grasses associated with shading by a healthy shrub layer would likely mean more suitable sites for tree seedlings (Lesica and Marlow 2013). Herbicide-treated areas to lower perennial grass cover followed by supplemental seeding to chokecherry or other applicable shrub planting are plausible techniques but consider testing it first before it is widely applied.

- Stump sprouting may have been the dominant form of reproduction for green ash in the northwestern Great Plains even in the absence of livestock grazing, woodcutting or exotic grasses. The last major recruitment event for green ash across eastern Montana occurred as a result of stump sprouting during a time when deer populations were low and stands were being less impacted by browsing (Lesica and Marlow 2013). Coppicing, or pruning to ground level, have not been shown to produce more trees but it can increase tree canopy cover by replacing diseased or weakened trees with new and more vigorous trunks and branches. Successful coppicing would require controlling livestock to minimize browsing and may not be possible in areas with high densities of white-tailed deer (Lesica and Marlow 2013).
- Livestock and wildlife browsing access and trailing by livestock, wildlife or recreationists can impact regeneration of stands. To achieve protection of regeneration in stand, fence construction and maintenance is a useful method but is often impractical because of sparse funding or inaccessibility to areas. Slash treatment barriers can be considered to impede access by livestock and wildlife. One slash treatment consists of stacking and piling downed trees and brush among patches of suckers, seedlings, and saplings. Small-diameter (under six inch diameter breast height) conifer or deciduous trees, where available, can create the slash barriers. Another slash treatment consists of felling trees at approximately three to four feet above the ground while maintaining stem connection to the stump (hinge treatment). The resulting barrier consists of the lateral bole and full canopy of the downed tree. In areas with mostly dead deciduous trees, another method is to mimic the “hinging” by using the boles that are completely detached and propped onto the stump in a v-shaped notch. Refer to (M. Kota and L. Bartos 2010),for more detail on timing and effectiveness considerations.
- Where feasible and when budgets allow, consider relocating existing allotment infrastructure to minimize livestock impacts in woody draws.
- See management approaches for the emerald ash borer in the invasive species section of this appendix.

Aspen

- Options to help aspen stands persist or expand on the landscape include prescribed fire, aspen cutting, conifer reduction, and temporary exclusion from browsing. Where feasible, consider relocating existing allotment infrastructure to minimize livestock impacts in aspen stands. When possible, treat a large enough area to help distribute wildlife and livestock use across numerous stands. Harvest or thinning of aspen or encroaching conifers can be equally effective for aspen restoration. Cutting may also prevent root damage from severe burning. Consider treating large areas over multiple years, further diffusing ungulate use and maintaining a mosaic of aspen age classes and the values associated with different successional stages.
- Livestock and wildlife browsing access and trailing by livestock, wildlife or recreationists can impact regeneration of stands. To achieve protection of regeneration in stand, fence construction and maintenance is a useful method but is often impractical because of sparse funding or

inaccessibility to areas. Slash treatment barriers can be considered to impede access by livestock and wildlife. One slash treatment consists of stacking and piling downed trees and brush among patches of suckers. Small-diameter (under six inch diameter breast height) conifer or deciduous trees, where available, can create the slash barriers. Another slash treatment consists of felling trees at approximately three to four feet above the ground while maintaining stem connection to the stump (hinge treatment). The resulting barrier consists of the lateral bole and full canopy of the downed tree. In areas with mostly dead deciduous trees, another method is to mimic the "hinging" by using the boles that are completely detached and propped onto the stump in a v-shaped notch. Refer to Kota and Bartos (2010) for more detail on timing and effectiveness considerations.

Xeric Woodlands

Juniper

- Refer to The Vegetation of the Grand River/Cedar River, Sioux, and Ashland Districts of the Custer National Forest: A Habitat Type Classification (Hansen and Hoffman 1988), Grassland and Shrubland Habitat Types of Western Montana (Mueggler and Stewart 1980), Plant Community Classification for Vegetation on BLM Lands, Pryor Mountains, Carbon County, Montana (DeVelice and Lesica 1993) Classification and Management of Montana's Riparian and Wetland Sites (Hansen et al. 1995), Holocene Vegetation and Climate History of the Northern Bighorn Basin, Southern Montana (Lyford, Betancourt and Jackson 2002), Influence of Landscape Structure and Climate Variability on a Late Holocene Plant Migration (Lyford et al. 2003) Fire Effects Information System (USDA Forest Service, online database), available ecological site descriptions, state and transition models, or similar classifications applicable to the national forest for information on ecology, succession, and response to disturbance in juniper woodlands.

Limber Pine

- Refer to Current Status of Limber Pine in Montana (Jackson et al. 2010), Plant Community Classification for Vegetation on BLM Lands, Pryor Mountains, Carbon County, Montana (DeVelice and Lesica 1993), Fire Effects Information System (USDA Forest Service, online database) or similar publications for information on ecology, succession, response to disturbance, and management implications in limber pine woodlands.

Riparian, Wetland, and Groundwater Dependent Ecosystems

- Refer to *Classification and Management of Montana's Riparian and Wetland Sites* (Hansen et al. 1995), Fire Effects Information System (USDA Forest Service, online database), ecological site descriptions, or similar classifications applicable to the national forest for information on potential vegetation, succession, and response to disturbance in riparian/wetlands.
- Riparian area management: Proper Functioning Condition Assessment for Lotic Areas (Dickard et al. 2015), A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lentic Areas (Prichard 2003), Groundwater-Dependent Ecosystems: Level I and Level II Inventory Field Guides (U.S. Department of Agriculture 2012a, U.S. Department of Agriculture 2012b), Technical Guide to Managing Ground Water Resources (Glasser et al. 2007) or equivalent method can be used when assessing riparian, wetlands, and groundwater dependent ecosystems.
- The National Wetland Plant List (Lichvar et al. 2016) or subsequent update can be used in assessing riparian and wetland vegetation, such as when evaluating composition shifts between

upland, mesic or hydric species. The National Wetland Plant List is a list of wetland plants, by geographic area, and their assigned indicator statuses that reflects the likelihood that a particular plant occurs in a wetland or upland. Sioux and Ashland geographic areas should use ratings from the Great Plains wetland region list and Pryor; Absaroka-Beartooth; Bridger, Bangtail, and Crazy; and Madison, Henrys Lake, and Gallatin Mountain Geographic Areas should use ratings from the western mountains, valleys, and coast wetland region list. The National Wetland Plant List is available through the Army Corp of Engineers web application (http://wetland-plants.usace.army.mil/nwpl_static/v33/home/home.html#) or USDA Plants web application (https://plants.sc.egov.usda.gov/core/wetlandSearch).

- USDA Forest Service National Riparian Vegetation Monitoring Core Protocol and associated Technical Guide (Merritt, Manning and Hough-Snee 2017); Effectiveness Monitoring Sampling Methods for Riparian Vegetation Parameters (Archer et al. 2012); Modified PIBO – Custer Gallatin National Forest Riparian Framework, 2018; Multiple Indicator Monitoring (MIM) (Burton, Smith and Cowley 2011); Photo Points (Hall 2002) or similar methods can be used for evaluating long term trends.
- Place emphasis on maintaining or improving riparian/wetlands that are in functional condition. Prioritize functional—at risk areas for restoration. These areas may be near the threshold of degrading into a nonfunctional condition. Planned actions to begin recovery can usually be implemented at a much lower cost in these areas. Once an area is nonfunctional, the effort, cost, and time required for recovery dramatically increase. Restoration of nonfunctional systems ought to be reserved for those situations when recovery is possible, efforts are not at the expense of functional-at-risk systems, or unique opportunities exist.

Alpine

- Refer to The alpine vegetation of the Beartooth Plateau in relation to cryopedogenic processes and patterns (Johnson and Billings 1962), Vegetation and Flora of the Line Creek Plateau Area (Lesica 1993), Classification of the Grasslands, Shrublands, Woodlands, Forests, and Alpine Vegetation Associations of the Custer National Forest Portion of the Beartooth Mountains in Southcentral Montana (Williams 2012), Montana Natural Heritage Program's description of Alpine Dwarf-Shrubland, Turf, Bedrock and Scree, Fell-Field, and Glacier and Ice Field ecological systems, Fire Effects Information System (USFS, online database) ecological site descriptions, or similar classifications applicable to the plan area for information on potential vegetation, succession, and response to disturbance in alpine. Refer to Plant Community Classification for Alpine Vegetation on the Beaverhead National Forest, Montana (Cooper, Lesica and Page-Dumroese 1997) or similar publications for other concepts and insights to alpine processes and management implications.
- The harsh environmental conditions in alpine make growth and the accumulation of biomass a slow process. Furthermore, soil formation takes much longer at high elevations because of the slow pace of biological processes. As a result, recovery from disturbance is generally slow. Although most of the alpine vegetation in the plan area is provided considerable protection from impacts through Wilderness Area designation or Research Natural Area designation, there remain some areas that may need revegetation attention. Refer to *Rehabilitation problems in alpine and arctic regions* (Brown, et al. 1978), *Bioassay of Alpine Mine Spoils for Plant growth and development* (Brown and Johnston 1980) or similar publications for management implications.

Sparse Vegetation

- Western Great Plains badland sparse vegetation communities are adapted to soils that are dry throughout the growing season. Typically soils are easily erodible and can be strongly influenced by infrequent but often torrential rains. Refer to *The Distribution of Plant Communities in the Badlands of Southeastern Montana* (Brown 1971), Montana Natural Heritage Program's description of Great Plains Badlands ecological system or similar publications for information and management implications.
- Wyoming Basin cliff and canyon sparse vegetation communities are found in the Pryor Mountains. Vegetation inhabiting this ecological system is typically sparse and may include conifers and woody shrubs adapted to limited soil moisture and soil development. Herbaceous cover is typically very sparse and limited to species adapted to inhabiting cliff faces and unstable talus slides. Refer to Montana Natural Heritage Program's description of Wyoming Basin Cliff and Canyon ecological system or similar publications for management implications.
- Rocky Mountain cliff, canyon and bedrock sparse vegetation communities are found on steep cliff faces, narrow canyons, on smaller rock outcrops and on unstable scree and talus slopes. Limited soil availability, harsh weather extremes, and water stress impose constraints on plant communities leading to plant species that are uniquely adapted to these conditions. These ecosystem are fragile due to extremely limited soil development and plant colonization. Because they are typically difficult to access these habitats are relatively free of anthropogenic disturbance, however climbing recreation and mining have been known to impact this system. Refer to Montana Natural Heritage Program's description of Rocky Mountain Cliff, Canyon and Massive Bedrock ecological system or similar publications for management implications.

At Risk Plant Species

The following strategies related to at-risk plant species could be considered for application at a programmatic or project-level stage to support the maintenance or achievement of desired conditions:

General

- Evaluate areas proposed for ground disturbing activities for the presence of occupied or suitable habitat for at-risk plant species, including conducting pre-field review and field surveys. Provide mitigation and protection measures to maintain occurrences and habitats that are important for species sustainability.
- Focus botanical surveys on increasing known information about other plant species (Montana and South Dakota state species of concern, newly discovered species, etc.) on the national forest, including information that may warrant changing their status to species of conservation concern list. If such information is found, the national forest should consider the species according to at-risk plan components until such time that the Regional Forester makes a determination on whether to designate it as a species of conservation concern.
- Monitor known occurrences of at-risk species within project areas and forestwide to determine trend data of individual occurrences, to contribute to trend data at the species-range level, and to document impacts of project activities, prioritizing those project activities for which species specific data is currently lacking.

Whitebark Pine

Whitebark pine (*Pinus albicaulis*) has been declining across much of its range in North America because of the combined effects of mountain pine beetle epidemics, fire exclusion policies, and widespread exotic blister rust infections. Whitebark pine seed is dispersed by a bird, the Clark's nutcracker, which caches seed in open, pattern-rich landscapes created by fire.

On July 19, 2011, the U.S. Fish and Wildlife Service published in the Federal Register its 12-month status review finding on a petition to list whitebark pine under the Endangered Species Act (ESA). After a review of all available scientific and commercial information, the U.S. Fish and Wildlife Service concluded that listing the species as threatened or endangered is warranted, but precluded by higher priority actions. Detailed information about the assessment of threats to the species is provided in the finding. This finding results in whitebark pine being a U.S. Fish and Wildlife Service candidate for listing under Endangered Species Act.

In the 2011 findings, the U.S. Fish and Wildlife Service identified several risks and threats to whitebark pine. They include forest insects and disease (blister rust and pine beetle), fire exclusion, and climate change factors. Timber harvest is not among the threats to whitebark pine identified by the U.S. Fish and Wildlife Service.

In general, there is a high degree of spatial separation between timber harvest locations and where whitebark pine exists, as whitebark pine tends to occur outside suitable timber ground. Accordingly, whitebark pine tends to be only an incidental species where it does occur in association with a timber sale (for example not at levels where(U.S. Department of Agriculture and Center 2008) impacts could adversely affect the viability of the species) (Weldon 2011). However, targeted restoration treatments may be desirable in whitebark pine stands where disturbance is determined to benefit the species. For example, removing shade-tolerant conifers may aid in the persistence of mature whitebark pine, increase the potential for nutcracker caching, and to open up areas for planting of rust-resistant trees. All projects should be evaluated to assess their potential impacts to the species, especially in cases where there are healthy cone-producing trees present.

Conservation and restoration of whitebark pine is not dependent upon mitigating ongoing actions, but rather a shift of focus that proactively and programmatically targets whitebark pine habitats at landscape scales. Specific conservation and restoration treatments would typically be designed to create openings in sites that are advantageous for re-establishing whitebark pine.

For information based on the most up-to-date understanding and documentation of whitebark physiology, ecology, genetics, distribution, mortality, and regeneration on the national forest, refer to Whitebark Pine Strategy for the Greater Yellowstone Area (Greater Yellowstone Coordinating Committee Whitebark Pine Subcommittee 2011) and Adaptive Action Plan prepared by the Greater Yellowstone Coordinating Committee (Subcommittee 2015) and any new best available science for possible whitebark pine restoration strategies and activities (Keane et al. 2012a).

In designated wilderness areas, allow, wherever possible, the natural recovery process of disturbed communities. Consider vegetative assistance only as a last resort.

Activities associated with whitebark pine restoration are allowed to occur within recommended wilderness areas, where determined to be appropriate and supported by a project-level analysis. These

activities may include prescribed burning, planting, insect and disease protection measures, fuel reduction around cone-collection trees, caging cones, and collection of seed and scion within recommended wilderness areas. Site-specific environmental assessment and analysis would occur prior to applying activities related to the restoration of whitebark pine.

Possible approaches to planning, analysis and implementation of whitebark pine restoration within recommended and designated wilderness areas include the following:

- Conduct a minimum requirements analysis, with guidance provided by Minimum Requirements Decision Guide (U.S. Department of Agriculture and Center 2008) and the supplement Evaluation Framework for Proposed Ecological Intervention in Wilderness (Naficy et al. 2016). These are intended as support tools to inform wilderness stewardship related to ecological intervention and restoration in wilderness, but the concepts may be applied to recommended wilderness as well.
- Use the most recent guidance or documents to provide additional information and support for restoration activities within recommended and designed wilderness areas. Currently, these include the publication "A Range-Wide Restoration Strategy for Whitebark Pine" (Keane et al. 2012b).

Fire and Fuels

Plan components recognize that fire has been and will likely remain the primary disturbance factor on the national forest. Given the importance of fire as a key ecosystem process, maintaining vegetation and forest diversity, sustaining fire adapted species and structures, and creating vegetation conditions at multiple scales that support and sustain native wildlife species in the short and long term are critical components of the Plan. Fire could play a role in all areas of the forest, whether unplanned (wildfires) or planned (prescribed fires). Along with mechanical fuels treatments, these approaches can also create fuel conditions to mitigate the risk of wildfire to values at risk. A variety of management strategies could be used to meet desired vegetation conditions based on feasibility, economics, access, and successful implementation. These approaches would also support the three objectives of the National Cohesive Wildland Fire Management Strategy: restore resilient landscapes, maintain fire adapted communities, and provide for effective, safe fire response.

Site specific analysis is conducted for planned ignitions and mechanical fuels treatments and for any unplanned ignition that extends beyond initial attack. For planned ignitions and mechanical fuels treatments, the decision document is the signed National Environmental Policy Act decision. For unplanned ignitions a decision support process is used to guide and document wildfire management decisions that provide for firefighter and public safety, minimize costs and resource damage, and are consistent with values to be protected, resource benefits, and management objectives.

Unplanned Ignitions

For unplanned ignitions, the full range of fire management strategies may be used to achieve desired conditions, using appropriate response strategies based on potential resource benefits and risks as documented in the decision support process. These strategies are driven by fuel conditions, current and expected weather, current and expected fire behavior, topography, resource availability, and values at risk and could include risk assessments that can occur at multiple scales, both spatial and temporal. These assessments are grounded in experience and analyzed with data and models appropriate to the scale of analysis. The approach is to look at risk in three tiers: long-term (5 to 10 years), annual, and incident:

- Long-term: analyzing the existing conditions that change typically in the 5 to 10 year time frame, informing broad questions and decisions for programmatic risk assessments. Items may include highly valued resources and assets such as structures, infrastructure, commercial timber, and wildlife habitat. See below for further information on wildfire risk assessments.
- Annual: analyzing factors such as seasonal weather, fuel conditions, and drought impacts to inform decisions pre-season to identify areas that with reduced large fire/long-duration risk may have the opportunity for short-term fire management.
- Incident: when the ignition occurs utilizing the now known specific condition, location, etc., to specifically analyze the situation for incident risk assessments.

Utilization of this three tiered risk analysis would allow managers to make informed decisions that respond to our various desired conditions where they could utilize one or more of the following strategies and options for any one fire (list not inclusive): monitoring the fire from a distance; monitoring on-site; point-protection or confinement; monitoring with limited contingency actions; monitoring with mitigation actions; suppression with multiple strategies; control and extinguish; or any combination of some or all of the above as well as other options.

To develop practical strategies and tactics that meet agency administrator and incident objectives and to avoid, minimize, or mitigate impacts to natural, cultural, wilderness and other resources during and after wildfires, Resource Advisors can be assigned to work on small local responses or with Incident Management Teams.

Naturally-caused wildfire may be allowed to play, as nearly as possible, its natural ecological role on the landscape. However, if a naturally ignited, unplanned wildland fire does not meet identified resource objectives, the fire may be suppressed. In research natural areas and special areas, naturally-caused wildfire may be used to achieve and maintain vegetative conditions and desired fuel levels if appropriate for meeting the area objectives.

These strategies are similar to the fire management strategies already in-place on most Greater Yellowstone Area national forests and national parks and would maintain the coordination, collaboration and management of wildland fire (both unplanned and planned ignitions) occurring along the administrative boundaries with Greater Yellowstone Area partners.

Planned Ignitions and Mechanical Fuels Treatments

Planned ignitions (prescribed fire) may be used forestwide to achieve desired conditions where necessary and appropriate. Planned ignitions may also be used in research natural areas and special areas to perpetuate the natural diversity of plant communities. Concurrence of the Research Station director is required for planned ignitions and other management actions proposed in research natural areas.

In wilderness and wilderness study areas, planned ignitions may be used to achieve desired conditions and reduce the risk to these protected areas. Where wilderness management objectives and conditions are met, planned ignitions may be conducted outside of wilderness boundaries, within wilderness boundaries, outside of wilderness boundaries that burn into wilderness, and inside of wilderness boundaries that burn out of the boundary.

A suite of mechanical fuels reduction treatments may also be used, including commercial timber sales and noncommercial treatments such as thinning, mowing, mastication, and herbicide application.

Fuels Reduction and Wildland Urban Interface

It is anticipated that there are areas in the wildland urban interface where forest conditions would be created and maintained at densities that are lower than what would occur under natural disturbance regimes. Decisions to create and maintain very low forest densities, where needed to protect community assets, may occur as determined through site specific project analysis, and these conditions would meet desired conditions in the plan for wildland fuel management (FW-DC-FIRE-02).

If these areas are on lands suitable for timber production, maintaining very low densities of trees over the long term would typically not be optimal from the timber production perspective. However, this would not be inconsistent with plan direction, which recognizes that there are multiple resource objectives and desired conditions to be considered at all scales of management, from the stand to the landscape, and project specific conditions would determine the site-specific treatments that would be applied. Project proposals and stand-level treatments do not need to address all forestwide desired conditions but they must not preclude the achievement of plan desired conditions.

Wildfire Risk Assessment

A wildfire risk assessment for the forest will be utilized and follows the methods outlined in the publication "A Wildfire Risk Assessment Framework for Land and Resource Management" (Scott, Thompson and Calkin 2013). This identified areas of risk and the spatial data used in the assessment analyzes where resource objectives and protection objectives can be met.

For this analysis, FSim, a computer program for large-fire simulation, was used to quantify wildfire hazard across the landscape. FSim is a comprehensive fire occurrence, growth, behavior, and suppression simulation system that uses locally relevant fuel, weather, topography, and historical fire occurrence information to estimate the contemporary likelihood and intensity of wildfire across the landscape (Finney et al. 2011). A geographic information systems model combined the FSim outputs and highly valued resources and assets to identify areas of risk.

A major part of a wildfire risk assessment is to have a good indication of where potential damages and benefits can occur. This is more than just locating the highly valued resources and assets, it is locating where they have the potential to be positively or negatively affected considering the likelihood of a wildfire occurring and the intensity at which it would likely burn. The two main indicators are location (where the potential damages and benefits to highly valued resources and assets are located) and source (where the wildfire ignitions of these potential damages and benefits start).

The technical measure of the potential damages and benefits is determined by the conditional net value change. The conditional net value change is how the landscape would change if a fire were to burn with expected fire intensity, taking into account the values at risk, how important those values are, and how those values would respond to fire. It is the net effect of damaging and beneficial effects to the value of a resource or asset. Negative values indicate net loss while positive numbers indicate net benefit (Thompson et al. 2016).

The results from the wildfire risk assessment provide another science-based tool for achieving the three goals for the National Cohesive Wildland Fire Management Strategy.

- Goal 1: Restoring and Maintaining Landscapes: the assessment identifies areas of low risk and high chance of obtaining resource objectives, or positive net value change.
- Goal 2: Creating Fire Adapted Communities: areas of high risk, or negative net value change, are identified, which could help prioritize fuels treatments.
- Goal 3: Wildfire Response: wildfire response can be prioritized by assessing the risk and benefit up front, based on a conditional net value change.

Invasive Species

Use *Forest Service Strategic Framework for Invasive Species* (U.S. Department of Agriculture 2013b) or subsequent strategic frameworks to help prioritize and guide the prevention, detection, and control of invasive insects, pathogens, plants, wildlife, and fish that threaten terrestrial and aquatic ecosystems. The 2013 Framework describes how National and Regional Invasive Species Issue Teams could coordinate activities within the Forest Service and with Federal, State, and local partners.

Activities and strategies that may be used to meet the desired conditions for invasive species include the following.

All Invasive Species

- Integrate invasive species management funding broadly across a variety of National Forest System programs, while associating the funding with the specific aquatic or terrestrial invasive species that is being prioritized for management, as well as the purpose and need of the project, program objective, or by program creating the disturbance with high risk of invasion.
- Coordinate and cooperate with Federal, State, and County agencies and adjacent landowners in invasive species prevention, early detection and rapid response, control and containment, restoration and rehabilitation, and inventory and monitoring activities.

Invasive Plant Species

- An integrated pest management approach to noxious weed treatment typically have eradication emphasized on smaller priority areas and new species, with control emphasized on new starts and areas of minor infestations, and with containment actions applied to areas of existing large infestations. Noxious weed infestations could be inventoried periodically to monitor the existing and new infestations.
- Noxious weed species listed by the States of Montana and South Dakota have priority for integrated pest management. Some Montana counties have additional species listed as noxious and can be found on their websites.
- Use protection measures outlined in applicable weed management National Environmental Policy Act decisions (Custer National Forest Noxious Weed Management Environmental Impact Statement and Record of Decision (2006) and the Gallatin National Forest Noxious and Invasive Weed Treatment Project Environmental Impact Statement and Record of Decision (2005)) or subsequent weed National Environmental Policy Act decisions. Refer to *CNF GNF Weed EIS Protection and Prevention Measures Comparison* (Reid 2018) for a side-by-side comparison between the two final environmental impact statements' (FEIS) protection measures. Refer to *Custer National Forest Weed Field* Guide *(U.S. Department of (Agriculture 2007)* and Custer and Gallatin Herbicide Spill Plans (Reid 2017) as a field friendly sources of decisions made in the Custer

National Forest Weed Management FEIS, 2006 regarding prevention, best management practices, treatment, safety, and monitoring/reporting.

- Prioritize noxious weed prevention and treatment activities with emphasis on all Forest Service administrative sites and high use sites such as trailheads, campgrounds, interpretive or historic sites, and road corridors. In addition, emphasize areas of high botanical value such as known populations of at-risk-plant species, traditional cultural plant collection areas identified by tribal traditional users, research natural areas, and botanical special areas.
- Evaluate infested at-risk plant sites before treatment. If at-risk plants occur in or near infestations, a weed control plan could be developed to help protect the at-risk plant population. Review weed National Environmental Policy Act protection measures for sensitive or at-risk species and consult with a botanist or designated resource specialist prior to treating in known at-risk plant locations. Provide weed crews or contractors with maps of all known at-risk plant populations so that known sites can be identified and protected. Provide training for weed crews to identify sensitive plants so that new sites can be identified and protected.
- Where tribal plant collection areas have been identified by traditional practitioners, follow the protection measures outlined for sensitive plant populations (now termed as "at-risk plants") in the plan components and the 2006 Custer National Forest Weed Management EIS decision and 2005 Gallatin National Forest Noxious and Invasive Weed Treatment Project EIS decision or subsequent weed National Environmental Policy Act decisions for at-risk species. When tribal traditional users identify plant gathering areas, other protection measures may be designed to minimize effects to various aspects of the activity. These could include, but are not limited to, adjusting the timing of the treatment, adjusting the type of treatment, adjusting the treatment method (for example spot spraying, wick application), or adjusting the priority of the treatment.
- Consider the following factors when prioritizing weed treatment: 1) weed category – potential invader, new invader, widespread invader; 2) relative invasive nature of the species and its potential to displace native vegetation; 3) relative ecological importance or rarity of the site that could be damaged by the presence of the weed; 4) potential for off-site movement of seeds; 5) determination of control method, which is dependent on the species and site; 6) site monitoring to determine the need to repeat or alter treatment; and 7) available funding.
- Determine the risk of introducing, establishing, or spreading invasive species associated with any proposed action, as an integral component of project planning and analysis, and where necessary provide for alternatives or mitigation measures to reduce or eliminate that risk prior to project approval. *The Northern Region Weed Risk Assessment* P*rotocol* (USDA FS Northern Region Weed Risk Assessment) or similar method can determine the risk of weed spread for projects, needed prevention and protection measures, and monitoring needs.
- During risk assessments, *USFS Region One Eastside Weed Susceptibility Assessment* (Mantas and Jones 2001) can be used to help determine the level of risk depending upon the environmental settings and invasiveness of a weed. Mantas provides a table of several potential vegetation types and weed species and categorizes each as to their susceptibility and threat east of the continental divide. Susceptibility refers to the vulnerability of a native plant community to colonization and establishment of an invasive species. Susceptibility is rated using a categorical system where each combination of a species is coded as invasive in undisturbed and disturbed settings, invasive in disturbed settings, closed to invasion, or unknown. Even without any disturbance on the landscape, some areas are susceptible to the infestation by invasive plants. Threat refers to the

degree of change to the structure, composition, or function of a native community from an exotic species. Threat is displayed in Mantas' table using a qualitative ranking of three classes: low, high, and none.

- Restore soil disturbed surfaces with certified weed seed free native plants as quickly as possible when moisture conditions are suitable for germination and monitor for weed invasion and restoration success which may take up to three to five years. Place monitoring emphasis during the growing season after the disturbance activity for early detection and rapid response to potential invasions. When revegetating disturbed sites, soil testing, use of stockpiled soil or fertilizer may be needed.
- To minimize spread or new invasions, manage priority areas for pre-treatment of noxious weeds in any defined project or use area, as needed (for example, fuels treatment, timber harvest, or fire camp areas).
- Use the following prevention measures and best management practices: Best Management Practices for Weed Control by Resource Area (FSM 2080); Best Management Practices - Soil and Water Conservation Practices (FSH 2509.22); Forest Service Timber Sale Contract Provisions; Special Use Supplemental Clause; USDA-Forest Service, Northern Region; Pit and Stockpile Guidelines; and enforce Weed Free Feed Special Orders for all National Forests in Montana and the South Dakota portion of the Sioux Ranger District.
- Enforce weed seed free special orders for National Forest System lands applicable to the Custer Gallatin National Forest (1997 Montana National Forest System lands and 2007 South Dakota National Forest System lands of the Custer National Forest) and as codified in the selected alternatives in applicable weed management National Environmental Policy Act decisions (Custer National Forest Noxious Weed Management Environmental Impact Statement and Record of Decision [2006] and the Gallatin National Forest Noxious and Invasive Weed Treatment Project Environmental Impact Statement and Record of Decision [2005]).
- Ensure that contracts and permits contain clauses and specifications requiring the implementation of measures to prevent, control, and contain aquatic or terrestrial invasive species (including noxious weeds). Oversee contract and permit administration to ensure compliance with the provisions.
- Forest Service cooperation and collaboration with state livestock health agencies, Tribal governments, permittees/producers, targeted weed sheep or goat operators, and permitted pack goat users supports development of specific state health certification protocols and required certification, in areas where wild sheep movements are expected, before domestic sheep or goats are turned out for any vegetation management effort. The intent is to prevent turnout of sick or diseased domestic sheep and goats on grazing allotments, permitted trails, trailing routes or on National Forest System lands when used for weed control or other vegetation management efforts.
- Educational prevention materials provided at District offices and at trailheads or other recreational areas, need to communicate requirements of local, state, and National Forest certified weed seed free hay or pelletized feed orders and to encourage removal of weed seeds/burs from treads of mountain bikes, all-terrain vehicles or other motorized vehicles, in the socks, shoelaces or gear of hikers and hunters, and in the hair or fur of pets, riding or pack animals.
- Provide continuing education for forest field personnel in weed identification.

Aquatic Invasive Species

- Refer to the *Guide to Preventing Aquatic Invasive Species (AIS) Transport by Wildland Fire Operations* (Invasive Species Subcommittee of the Equipment Technology Committee/ National Wildfire Coordination Group, 2017) or similar guidance documents which provides best management practices to help wildland firefighters prevent contact with and spread of aquatic invasive species, best procedures for decontaminating ground and aviation equipment, aquatic invasive species prevention recommendations for resource advisors, and aquatic invasive species of concern to firefighters and disinfection methods. The South Dakota Department of Game, Fish and Parks and Montana Fish, Wildlife, and Parks require boat and equipment disinfection to help stop the spread of aquatic invasive species and are another sources for educational materials.

Emerald Ash Borer

- The emerald ash borer, a devastating invasive wood boring beetle native to Asia, is responsible for killing millions of ash trees throughout much of the Midwestern United States, including green ash. The current closest infestations occur in eastern South Dakota, Colorado, and Minnesota. Movement of ash material from infested areas is now prohibited by federal quarantine regulations. However, unintentional movement may still occur due to lack of awareness of the quarantine regulations into the plan area (for example transported firewood, pallets). Detection of emerald ash borer infestations is difficult when trees are first attacked, showing few signs that emerald ash borer is present. However, healthy ash trees are killed in 2-4 years. Refer to *National Response Framework for Emerald Ash Borer* (U.S. Department of Agriculture 2011) for strategic goals of prevention, preparedness, response and recovery for areas with established emerald ash borer infestations and areas where emerald ash borer has not been detected. This framework also identifies and aligns key roles and responsibilities of USDA's Forest Service and Animal and Plant Health Inspection Service (APHIS), National Association of State Foresters, and the National Plant Board. Also refer to USFS Northern Research Station's and APHIS websites for additional resources regarding emerald ash borer detection and management. Consider an educational approach by posting applicable "Don't Move Firewood" type of posters on the national forest, having educational material on internet, intranet, and social media. Restriction through special closure orders may also be considered in coordination with applicable partners.

White Pine Blister Rust

- White pine blister rust is a non-native disease that entered the U.S. at the turn of the 20th century. Its primary host species on the national forest are whitebark pine and limber pine. It also infects *Ribes* species (currants and gooseberries), and possibly louseworts and Indian paintbrush, which are alternative hosts required for the disease to complete its life cycle. There is no known method for eradicating the disease, although actions such as pruning can reduce infections. A small percentage of host trees display one or more resistance traits that enable them to avoid or survive infection; encouraging regeneration (natural or artificial) from these seed sources provides hope for perpetuation of the species. Refer to *White Pine Blister Rust in Northern Idaho and Western Montana: Alternatives for Integrated Management* (Hagle, McDonald and Norby 1989) or similar sources for information on control efforts, disease resistance and management alternatives.

White-Nose Syndrome

- White-Nose Syndrome, a disease that is caused by a fungus (*Pseudogymnoascus destructans)* (*Pd*) that can be transmitted by other bats as well as by humans visiting caves where bats are roosting. Refer to *A National Plan for Assisting States, Federal Agencies, and Tribes in Managing White-Nose Syndrome in Bats* (U.S. Department of the Interior 2011) for general practices and response strategies. This Plan is a coordinated approach for addressing *Pd* among Department of Interior, Department of Agriculture, Department of Defense, and State wildlife management agencies. Refer to the *National White-Nose Syndrome Decontamination Protocol* (U.S. Department of the Interior 2016a) or similar sources for recommendations to effectively clean and treat clothing footwear, and gear that may have been exposed to *Pd*. Refer to White-Nose Syndrome Spread Maps for the most updated information on the status of county and state.

Wildlife

Grizzly Bears

The Custer Gallatin Forest Plan formally adopts habitat standards for grizzly bears from the 2016 Conservation Strategy for the Grizzly Bear in the Greater Yellowstone Ecosystem (U.S. Department of the Interior 2016b). This document is intended to be dynamic and responsive to changes in science, technology and ecological conditions. The national forest plan can be adapted to incorporate substantive changes made in the Conservation Strategy over time.

Habitat standards adopted from the Conservation Strategy were developed with the overall goal of maintaining or improving habitat conditions relative to those present in 1998; for example refer to the "1998 baseline." The U.S. Fish and Wildlife Service selected 1998 as a baseline year because it was demonstrated that habitat conditions (such as amounts of secure habitat, number and capacity of developed sites, and number and acreage of domestic livestock allotments) in 1998 were compatible with an increasing grizzly bear population throughout the 1990s (U.S. Department of Interior 2017).

Management of human access is a primary factor with potential to influence the suitability of grizzly bear habitat. The Conservation Strategy addresses human access parameters, including open motorized access route density, total motorized access route density and secure habitat, as useful metrics for long-term monitoring of potential effects to grizzly bears and their habitats. The appropriate scale for calculating open motorized access route density, total motorized access route density and secure habitat include the bear management subunit inside the primary conservation area, and the bear analysis unit outside the primary conservation area. The Greater Yellowstone Ecosystem Grizzly Bear Motorized Access Model and associated database maintained by the Greater Yellowstone Ecosystem Grizzly Bear Database Coordinator, is the appropriate tool for calculating human access metrics for effects analyses as well as long-term monitoring.

While the three different motorized access parameters remain useful for monitoring purposes, the only habitat standard in the Conservation Strategy relative to motorized human access is to maintain the proportion of secure habitat inside the primary conservation area at or above baseline levels. In the development of the Conservation Strategy it was determined that maintaining habitat standards for all three access parameters (open motorized access route density, total motorized access route density and secure habitat) was unnecessary and somewhat redundant in meeting grizzly bear habitat management goals. Open motorized access route density and total motorized access route density are calculated using

GIS with a moving window application to determine the percent of a Bear Management Subunit in a defined motorized route density category. Route densities of particular concern with respect to grizzly bear habitat management are open motorized access route density over 1 mile per square mile and total motorized access route density over 2 miles per square mile. Secure habitat is calculated as the proportion of area at least ten acres in size, that is at least 0.31 miles (500 meters) from an open or gated motorized route. Constructing a new motorized route or reopening a previously closed motorized route would typically affect secure habitat. The only way a new or reopened motorized route would not affect secure habitat is if it were located in close proximity (within one-third mile) of existing motorized routes on both sides. Such an event would be rare, and would not likely have a notable effect on the proportion of open motorized access route density or total motorized access route density at or above established threshold levels, so there are consequently no plan components associated with open motorized access route density or total motorized access route density levels, but rather these metrics are included in the monitoring section of the Custer Gallatin Forest Plan.

Grizzly bear movement within and between Custer Gallatin National Forest administrative units (or geographic areas), as well as grizzly bear movement between the Custer Gallatin National Forest and other parts of the Greater Yellowstone Ecosystem, or ultimately, to other grizzly bear ecosystems, is an integral factor in maintaining/enhancing genetic diversity and conserving the species. Custer Gallatin National Forest personnel can work cooperatively with State and Federal agencies (such as Montana Fish Wildlife and Parks, Montana Department of Transportation, Interagency Grizzly Bear Study Team, Yellowstone National Park, and adjacent National Forest System administrative units), plus private land owners and other entities (such as universities, non-governmental organizations) to collect information that may help identify important grizzly bear travel routes, as well as areas with relatively high levels of human-caused grizzly bear mortality, in order to manage for habitat connectivity that could facilitate successful grizzly bear movement and dispersal.

Wolverine

Management activities that require motorized access (wheeled vehicles or snowmobiles) can have disturbance impacts if conducted in suitable reproductive habitat for wolverines during the denning season of mid-February through mid-May. Non-motorized activities such as skiing, snowshoeing or hiking can also disturb and displace wolverines if conducted in close proximity (within one-half mile) to known, occupied reproductive wolverine den sites during the same time period. These types of activities can be evaluated at the project level to determine whether a proposed action meets the intent of FW-GDL-WLWV).

Bison

Management of Yellowstone bison and their habitat is primarily conducted under the auspices of the Interagency Bison Management Plan (www.ibmp.info). The purpose of the Interagency Bison Management Plan is to maintain a wild population of Yellowstone bison while also addressing the risk of brucellosis transmission from bison to domestic livestock in order to protect the economic interest and viability of the livestock industry in the state of Montana. As a result, the presence, abundance and distribution of wild bison on the Custer Gallatin National Forest is dictated by state-delineated bison tolerance zones. Within these tolerance zones, management actions can be designed to favor bison expansion into unoccupied habitat. For example, design criteria can be applied if bison approach active livestock allotments inside the tolerance zones. Such management options include, but are not limited to the following: strategically-placed fencing may be used to create physical separation between bison and

domestic livestock, livestock use dates may be adjusted, non-use for resource protection may be authorized, changing the kind or class of livestock from cows to horses or steers may be authorized, or livestock may be relocated to vacant allotments outside of tolerance zones.

As with any wild animal, bison can pose a threat to humans that approach too closely. Because of their relative rarity on public lands, bison sightings are highly valued by many forest visitors, but their behavior patterns may not be well understood, while their speed and agility are often underestimated. To address potential concerns, educational information can be made available to the public, including signage at trailhead and campground portals that describe potential risks of being around bison, and identify appropriate human behavior in areas frequented by bison.

Prairie Dogs

Prairie dogs are keystone species that contribute important ecological conditions for a variety of prairie-associated wildlife species, and colony expansion may be desirable in some locations. However, prairie dogs can also have unwanted impacts such as loss of vegetation and potential travel hazards to domestic livestock, so colony expansion may not be desired in other locations. Habitat needs differ between white-tailed and black-tailed prairie dogs, so management approaches could vary accordingly. White-tailed prairie dogs occur in habitats of greater topographic and vegetative diversity, and have a higher tolerance for shrubs and tall vegetation than do black-tailed prairie dogs (Nistler 2009). Livestock grazing, mowing, or prescribed fire may be used to reduce vegetative structure and thereby enhance habitat suitability for prairie dogs where colony expansion is desired, either adjacent to existing prairie dog colonies or within or near abandoned colony sites. If black-tailed prairie dog colonies expand into areas where they are undesirable; such as encroaching onto adjacent private lands, non-lethal measures to control movement include increasing vegetative structure through planting of tall shrubs, and creating visual impairment by piling slash or building artificial structures to restrict prairie dog expansion into areas where their presence is not desired.

Greater Sage-grouse

Potential strategies that could be used to trend toward greater Sage-grouse desired conditions include:

- New recreation facility development could occur in priority or general sage-grouse habitat where such development serves to consolidate and reduce existing dispersed facilities, leading to less overall impact on sage-grouse habitat.
- Where new energy development activities cannot be avoided in priority or general sage-grouse habitat due to pre-existing rights, development can be located in non-habitat inclusions (such as non-vegetated areas) or in the least suitable habitat possible. New structures can be consolidated where possible to minimize impact of infrastructure.
- Where new energy development activities cannot be avoided in priority sage-grouse habitat, the Forest Service may attempt to negotiate minimum impact techniques for surface use and occupation in areas with outstanding mineral rights.
- Where new energy development could impinge on sage-grouse priority habitat, options such as Administratively Un-Available, No Lease, or Leasing with a No Surface Occupancy stipulation, could be considered and evaluated.
- Fence markers can reduce grouse collisions on flat or gently rolling terrain near leks. Consider marking fence wires within a half a mile of leks with flagging or durable vinyl markers since it

makes them more visible, and can minimize grouse collisions without disrupting fences needed for livestock. When planning new fence projects, avoid building fences in these high-risk areas where possible. These concepts can be applied to other seasonal habitats where grouse are known to concentrate and where they could collide with fences, such as brood-rearing habitat and wintering sites.

Bats

Multiple bat species are known to occur on the national forest on either a seasonal or year-round basis. A variety of management approaches can help protect and enhance bat roosting habitat, proximate foraging and drinking habitat, and reduce the spread of disease. Detailed methods and additional scientific information can be found on the Bat Conservation International website: www.batcon.org.

- Maintaining and recruiting clusters of large diameter snags and live trees in the early to middle stages of decay may provide suitable roosting structures, especially when located near water, foraging habitat and night roosts.
- Bats often roost in artificial structures such as buildings and bridges. Removal, reconstruction or heavy maintenance of such facilities can disturb or displace roosting bats. Such activities can be scheduled to occur before early summer occupancy (late May) or after the late summer dispersal (late August to early September) to avoid impacts to bats.
- If known bat roosts occur in buildings or bridges that are scheduled for removal or maintenance, artificial bat roosts may provide supplemental opportunities for bats. In colder areas, bat houses can be painted black and positioned for maximum solar exposure to make them more hospitable.
- Abandoned mines that provide suitable roosting habitat can be fitted with bat friendly gates to restrict human access to dangerous mines, but also to limit human disturbance while allowing free passage for roosting bats. Bat friendly gates can be permanent, or can be fitted with locks so that they may be opened to facilitate monitoring of bat use.
- At known or suspected roost sites, external and acoustic surveys may provide insight about the significance of bat use. For example, a large number of bats exiting during mid-summer may indicate the presence of a maternal colony, which may warrant seasonal use restrictions in the area or gate installation if the roost site is near a proposed project or is in an area regularly frequented by human traffic (such as near a road, trail or developed site).
- Bats typically drink on the fly and are vulnerable to obstructions such as barbed wire across natural water sources (such as ponds, or pools in creeks) and artificial water sources (such as stock tanks). Barbed wire can be placed away from water openings, and escape ramps can be placed in stock tanks to reduce incidences of bats drowning. Tall structures can be placed away from stock tanks or natural water sources, to avoid creating potential perches for bat predators.
- Many bat species are susceptible to a fungal infection known as “white-nose syndrome”. Human use can spread the white-nose pathogen between and among bat habitats, particularly winter hibernacula, such as caves. Education materials could be made available to cavers and other members of the public regarding decontamination procedures and other precautionary measures that can be used to prevent or curtail the spread of diseases such as white-nose syndrome, as well as to limit disturbance of bats at hibernacula and roost sites. United States National White-nose Syndrome Decontamination Protocol (U.S. Department of the Interior 2016a) is based on the best available scientific information known to effectively clean and treat clothing, footwear, or

equipment that may have been exposed to the fungus. Prevention measures and messages in limiting white-nose syndrome spread can be done by adopting the following precautions:

- Stay out of caves, mines, and areas that are closed.
- Decontaminate your caving and hiking gear and boots. Do not reuse gear that has been used in white-nose syndrome-affected areas. Visit www.whitenosesyndrome.org for more information.
- Contact your state wildlife agency or the U.S. Fish and Wildlife Service immediately if you suspect you have seen bats with white-nose syndrome, or if you see bats flying outside during freezing temperatures.
- Do not touch live or dead bats.

All Wildlife Species

Potential strategies that could be used to trend toward desired conditions for all wildlife include:

- Wildlife habitat management and improvement projects can take a multi-species approach, with biological diversity a goal at the landscape scale to provide habitat and connectivity for a wide range of native and desired non-native species.
- Fences, where needed, can be made "wildlife friendly" by using smooth wire (as opposed to barbed wire) for the top and bottom strands so that wildlife can pass over or under the fences without being trapped or injured by barbed wire. Also, adding brightly colored flags or tags that move in the breeze can make fences more visible to animals and birds, which may help reduce wildlife collisions with fences.
- Special Orders for proper food storage can be issued and enforced where needed to reduce or remove unnatural food sources for wildlife, avoid human food conditioning of wild animals, and minimize food-related wildlife-human conflicts. Food storage and related sanitation efforts can achieve better consistency through coordination with adjacent jurisdictions and state wildlife management agencies.
- Integrated resource projects can be designed to avoid disturbance of wildlife during key timeframes when energy demands are highest. Long-term or permanent habitat alterations are generally not desirable, but where such alterations are needed to meet the purpose and need of a project, mitigation measures can be used to minimize negative impacts to wildlife. Mitigation measures may include but are not limited to: timing restrictions, project feature designs (such as minimum distance to cover), artificial wildlife structures to replace structure lost, and habitat acquisitions, protections, or improvements in other areas.
- Forest Service personnel can work cooperatively with State (Montana and South Dakota), Federal (US Fish and Wildlife Service, Yellowstone National Park, Bureau of Land Management, Interagency Grizzly Bear Study Team), and Tribal entities, to share knowledge, coordinate activities, and collaborate on data gathering and other scientific endeavors.
- State (Montana or South Dakota) wildlife management agencies can be consulted for current information about the spatial and temporal use and definitions of key wildlife habitats.
- Forest Service personnel can participate in cooperative efforts with universities, research entities and non-governmental organizations to gain and distribute information, and to utilize partnerships and volunteer resources for educational purposes, wildlife or habitat surveys, and habitat improvement projects.

- A variety of approaches to managing habitat for elk and other big game species outlined in the 2013 document co-authored by the US Forest Service and Montana Fish Wildlife and Parks can be utilized, which provides a collaborative overview and recommendations for elk habitat management specific to the Custer Gallatin National Forest (U.S. Department of Agriculture 2013a).
- Big game winter range in the montane ecosystem can vary considerably depending on the species using it (such as, white-tailed deer versus elk), topography, elevation, average snow depth, climate, and local disturbance factors. Accordingly, site-specific big game winter range is best identified through coordination with Montana Fish, Wildlife, and Parks biologists at the project level.
- Mature conifer stands (generally 10 inches or greater tree size class with at least 40 percent canopy cover) provide snow intercept, hiding, and thermal cover attributes for most big game species.
- Younger (generally less than 10 inches size class), dense (at least 40 percent canopy cover) conifer stands can provide hiding and thermal cover, but may not provide adequate snow intercept function. Hiding and thermal functionality typically improves with higher density of trees in younger stands.
- Topography (such as, hills, swales), non-vegetative components (such as, large rock features), deciduous trees or shrubs, and dead trees (standing, leaning or down) can also contribute to hiding cover, and somewhat to thermoregulation, but typically do not contribute to snow intercept function.
- Cover features (as described above) that are contiguous, or in reasonably close proximity to one another, allow big game animals to move through an area with lower energy demands than required to move long distances through deep or crusted snow.
- A combination of tree sizes and densities may be desirable to achieve optimal cover and forage conditions on big game winter range.
- Wind energy turbines can cause displacement, injury or fatality of birds and bats through changes in air pressure as well as animal collisions with wind turbine blades. Such impacts can be mitigated by locating wind turbines away from known migratory routes of flying species. Increasing rotor start-up wind speeds, changing the pitch angle of turbine blades, and lowering the required generator speed for electricity production are additional methods that can be used to reduce potential collisions of airborne wildlife with wind turbine structures. More information about these methods can be found in Baerwald et al. (2009).

Threatened, Endangered, Proposed, and Candidate Wildlife Species

Potential strategies that could be used to trend toward desired conditions for all federally listed wildlife include:

- Management strategies are shaped by recovery plans, conservation strategies, and other applicable guiding documents for federally listed species. National forest personnel are engaged in interagency efforts to protect and restore listed species and their habitats.
- Forest Service personnel can work with the US Fish and Wildlife Service in the planning and analysis of management activities, including consultation under Section 7 of the Endangered Species Act for all management actions that may affect any federally listed species.

- Forest Service personnel can participate in the development of conservation strategies for at risk species.

Benefits to People: Multiple Uses and Ecosystem Services

General Contributions to Society and Economic Sustainability

Potential strategies that could be used to trend toward desired conditions for contributions to social and economic sustainability include:

The Custer Gallatin could analyze impacts of potential management actions on contributions to well-being, quality of life and the health and safety of the public.

- The Custer Gallatin could work closely with youth and underserved populations to design and implement projects that contribute to their well-being, quality of life and health and safety.
- The Custer Gallatin could develop programs with youth and underserved populations to learn about the benefits of ecosystems and conservation to humankind.
- Through experiential activities and programs, the national forest could increase opportunities for youth and underserved populations to experience the joys of connecting with nature and recreating outdoors.
- Existing local and regional economic conditions, and potential changes to direct and indirect economic contributions from the national forest, are accounted for and could help inform project planning and management of land, ecosystems and usable resources including public access.

Areas of Tribal Importance

Potential strategies that could be used to trend toward desired conditions for areas of tribal importance include:

- The national forest may coordinate with tribes in managing traditional cultural properties and cultural landscapes, where historic preservation laws alone may not adequately protect the resources or values.
- The Forest Service may accommodate and facilitate the use of areas of tribal importance such as sacred sites and traditional use areas (trails, campsites, plant collection locations, springs, etc.) that are essential in maintaining the cultural identity and cultural practices of tribal communities.
- A government to government tribal consultation protocol may be developed for each Indian Tribe that has treaty rights or aboriginal ties to the national forest.
- Tribal perspectives, needs, and concerns, as well as traditional ecological knowledge, may be incorporated into project design and decisions, as appropriate.
- The Forest Service may develop a national forest policy, in consultation with the treaty tribes for the collection of forest products for traditional cultural and purposes.
- The Forest Service may consult with tribes to identify sacred sites and traditional cultural locations and develop a strategy for appropriate recognition and management.
- In consultation with the tribes , the national forest may undertake protective measures for areas of scenic, cultural, traditional values, and natural resources habitats (such as plants and wildlife, minerals, fossils) identified by tribes and traditional practitioners that occur on the national forest.

- Areas of tribal importance including the Chalk Buttes, Crazy Mountains, Pryor Mountains, Tongue River Breaks, Chalk Buttes, Slim Buttes, and North Cave Hills may be managed in close consultation with the tribes to protect and honor tribal reserved rights, traditional uses and sacred land.
- Where traditional cultural plant collection areas have been identified by tribal traditional users, follow the protection measures outlined for sensitive plant populations in 2006 Custer National Forest Weed Management EIS decision and 2005 Gallatin National Forest Noxious and Invasive Weed Treatment Project EIS decision or subsequent National Environmental Policy Act decisions. When tribal traditional users identify plant gathering areas, other protection measures may be designed to minimize effects to various aspects of the activity. These could include, but are not limited to, adjusting the timing of the treatment, adjusting the type of treatment, adjusting the treatment method (for example spot spraying, wick application), or adjusting the priority of the treatment.
- Tribal traditional ecological knowledge may be used to help in the development of direction and approaches to adapt to global warming and forest resiliency restoration.

Cultural and Historic Resources

Potential strategies that could be used to trend toward cultural and historic resource desired conditions include:

- A comprehensive strategy for cultural resource management may be developed to preserve and enhance significant cultural resource values and provide a structure for implementation of the Custer Gallatin Forest Plan. This historic preservation plan may be updated as needed to reflect accomplishments and new direction.
- The Forest Service may complete or update the cultural resource overviews that include prehistory, history and ethnographic studies for the national forest to provide a context for the cultural resources sites. These overviews may be updated at 10 year intervals to include new information and discoveries.
- The Forest Service may focus inventory efforts on the generation and refinement of site predictive and distributional models.
- The Forest Service may encourage scientific research by universities and colleges through partnership agreements as a means of acquiring additional inventory, interpretive data, and cultural resource synthesis.
- Artifacts and records may be stored in appropriate curation facilities and available for academic research, interpretation, and public education.
- Multiple property nominations, contextual nominations and Historic Districts could be emphasized for management efficiency.
- Restored historic buildings, such as cabin rental and administrative sites, could be maintained to reflect agency history, identity, and function.
- Volunteers may have opportunities to participate in cultural resource conservation activities such as research, site stabilization, protection, conservation and interpretation.
- The Forest Service could enhance and interpret significant cultural resource sites for education and enjoyment of the public when such development does not degrade the cultural resource property or conflict with other resource considerations.

- The OTO administrative site could continue to provide a venue for conservation education, stewardship, and partnership opportunities while preserving the historic significance and use of National Registered Listed OTO Homestead and Dude Ranch property for generations to come.
- The Forest Service could evaluate at least five cultural resource sites per year to address the backlog of unevaluated cultural resource sites.

Permitted Livestock Grazing

Activities and strategies that may be used to meet the desired conditions for permitted livestock grazing include:

Allotment Planning and Management

- As part of the terms and conditions of permitted grazing, the allotment management plan and annual operating instructions are the tools used to implement national forest plan direction.
- National Environmental Policy Act for Allotment management plans or plan revisions, or National Environmental Policy Act sufficiency reviews (FSH 1909.15 Section 18) are to be completed on a scheduled priority basis. Priorities could include, but are not limited to, allotments where monitoring indicates downward trends, allotments where there are other resource considerations or conflicts, or allotments where opportunities arise for improving conditions.
- Allotment management plans or permit terms and conditions are to be reviewed/updated or modified as identified through the allotment inspection process.
- Forest Service coordination with the applicable agencies is to continue on those allotments that contain State or BLM lands.
- Timing, duration, and intensity of livestock grazing are to be controlled to move toward and achieve desired conditions.
- Montana Best Management Practices for Grazing (1999) can be utilized. This publication was developed by a working group with representation from: Montana State University, Society of American Fisheries, Montana Stockgrowers Association, Montana Woolgrowers Association, USDI Bureau of Land Management, USDA Forest Service, USDA Natural Resources Conservation Service, Montana Farm Bureau, and Montana Department of Natural Resource and Conservation. It describes best management practices for livestock grazing designed to protect and enhance water quality, soils, plant communities, and other rangeland resources. It explains how and why to use best management practices to manage upland rangeland, forested rangeland, and riparian areas. Although developed for Montana, these practices also apply to the South Dakota portion of the Custer Gallatin National Forest.
- Utilization levels, stubble height, streambank disturbance, and woody stem use, etc., are all short-term indicators of grazing effects on meeting long-term upland and riparian desired conditions (for example, vegetation composition, streambank stability). Each can be used in the appropriate situation.
    - Upland utilization criteria is to be informed from best available science, the dominant habitat type, functional groups, ecological sites (or equivalent) within the allotment pasture and local rangeland conditions (relative to site potential and capability).
    - Riparian utilization, stubble height, or streambank alteration criteria is to be informed from best available science applicable to the site. Only those indicators and numeric values that are

appropriate to the site and necessary for maintaining or moving towards desired conditions are to be applied.

- ♦ It is not appropriate to use end of season stubble height method on Rosgen channel types A, G, and woody dominated B or C. End of season stubble height method is appropriate on low gradient herbaceous Rosgen channel types C and E. It is only appropriate to measure hydrophilic vegetation when using end of season riparian greenline stubble height indicators (Clary and Leininger 2000, Bryant et al. 2004). Obligate wetland or facultative wetland species are considered as hydrophilic species with bank stabilizing roots appropriate for end of season stubble height measurement. Obligate wetland or facultative wetland species provide root mass needed for streambank stability (Manning 2017). A species wetland indicator status can be determined using *The National Wetland Plant List* (Lichvar et al. 2016)) or subsequent updates. The National Wetland Plant List is available through the Army Corp of Engineers web application (http://wetland-plants.usace.army.mil/nwpl_static/v33/home/home.html#) or USDA Plants web application (https://plants.sc.egov.usda.gov/core/wetlandSearch). Sioux and Ashland geographic areas should use ratings from the Great Plains wetland region list and Pryor; Absaroka-Beartooth; Bridger, Bangtail, and Crazy; and Madison, Henrys Lake, and Gallatin Mountain Geographic Areas should use ratings from the western mountains, valleys, and coast wetland region list.
- ♦ Utilization Studies and Residual Measurements Technical Reference (Coulloudon et al. 1996) provides an interagency approved method for measuring stubble height.
- ♦ When using streambank alteration criteria, identify the protocol being used since different protocols can produce different results. Northern Region streambank alteration protocol is a recommended protocol.
- ♦ Specific indicators and indicator values can be prescribed and adjusted, if needed, in a manner applicable to site conditions for the specific geo-climatic, hydrologic and vegetative setting in which they are being applied. Indicator values can be adapted over time based on long-term monitoring and evaluation of conditions and trends.

- Project planners for project activities in allotments (for example, timber harvest, aspen regeneration treatments, prescribed fire) are to coordinate with rangeland managers in case adjustments are needed to grazing management or applicable techniques used to minimize resource concerns.
- Existing grazing allotments in wilderness areas are to be managed in accordance with wilderness values. Applicable grazing direction is found in FSM 2323.2 which includes direction from H.R. Report No. 96-1126, dated June 24, 1981. Similarly, existing grazing allotments in Forest Service recommended wilderness or backcountry areas are to be managed in accordance with concepts from this same grazing direction listed above. Designations should not prevent the maintenance of existing fences or development of other livestock management improvements necessary for the protection of the range. Where practical alternatives do not exist, maintenance or other activities may be accomplished through the occasional use of motorized equipment. Such occasional use of motorized equipment should be based on a rule of practical necessity and reasonableness, and be expressly authorized in the grazing permit.
- Combining or dividing existing allotments inside the grizzly bear recovery zone could be allowed as long as the net acreage and number of active allotments does not exceed 1998 levels. Table 2

displays allotments and acres that are tracked as part of the 1998 Grizzly Bear Recovery Zone baseline.

Table 2. Grizzly bear recovery zone 1998 allotment baseline

Allotment	Status in 1998	2017 Allotment Status	Allotment Acres in recovery zone	Allotment Acres out of recovery zone	Total Allotment Acres	Percent of Allotment Acres in recovery zone
Green Lake	Active Cattle	Active Cattle	3557	0	3557	100
Horse Creek / Reeder Creek	Active Cattle	Active Cattle	4826	0	4826	100
Sixmile North	Active Cattle	Active Cattle	1840	2288	4128	45
Slip and Slide	Active Cattle	Active Cattle	6794	0	6794	100
South Fork	Active Cattle	Active Cattle	154	0	154	100
Tom Miner / Ramshorn	Active Cattle	Active Cattle	14602	7	14609	100
Watkins Creek	Active Cattle	Active Cattle	3496	0	3496	100
Wigwam	Active Cattle	Active Cattle	2762	0	2762	100
Cinnamon North	Active Horse	Active Horse	1378	0	1378	100
Cinnamon South	Active Horse	Active Horse	2120	0	2120	100
Grayling Creek	Active Horse	Active Horse	115	0	115	100
Moose	Active Horse	Active Horse	18	0	18	100
Sage Creek	Active Horse	Active Horse	14650	0	14650	100
Taylor Fork	Active Horse	Active Horse	932	0	932	100
Current Active Allotment Subtotal	(no data)	(no data)	**57244**	**2295**	**59539**	
Percent of Total	(no data)	(no data)	**21 percent**	(no data)	(no data)	(no data)
Cottonwood	Vacant Cattle	Vacant Cattle	2199	0	2199	100
Lion Creek	Vacant Cattle	Vacant Cattle	6999	0	6999	100
Mill Creek	Active Cattle	Vacant Cattle	800	0	800	100
Section 22	Active Cattle	Vacant Cattle	586	0	586	100
Sixmile South	Vacant Cattle	Vacant Cattle	6456	0	6456	100
Current Vacant Allotment Subtotal	(no data)	(no data)	**17040**	**0**	**17040**	
Percent of Total	(no data)	(no data)	**6 percent**	(no data)	(no data)	(no data)
Basin	Active Cattle	2015 Closure - Cattle*	59	0	59	100
Beaver Creek	Active Cattle	2016 Closure - Cattle	713	6350	7063	10
Cache / Eldridge	Active Cattle	2015 Closure - Cattle	7606	0	7606	100
Canyon	Vacant Cattle	2007 Closure - Cattle	4105	365	4470	92
Cedar Creek	Vacant Cattle	2007 Closure - Cattle	8233	0	8233	100

Allotment	Status in 1998	2017 Allotment Status	Allotment Acres in recovery zone	Allotment Acres out of recovery zone	Total Allotment Acres	Percent of Allotment Acres in recovery zone
Dry Gulch	Vacant Cattle	2008 Closure - Cattle	1421	0	1421	100
Duck Creek	Vacant Cattle	2008 Closure - Cattle	930	0	930	100
Horse Butte	Active Cattle	2009 Closure - Cattle	2200	0	2200	100
Little Trail Creek	Vacant Cattle	2007 Closure - Cattle	2683	0	2683	100
Ousel Falls	Vacant Cattle	2016 Closure - Cattle	8170	11576	19746	41
Park	Active Cattle	2007 Closure - Cattle	14647	0	14647	100
Red Canyon	Vacant Cattle	2015 Closure - Cattle	5227	0	5227	100
Sentinel Butte	Active Cattle	2007 Closure - Cattle	570	0	570	100
Sulphur Springs	Active Cattle	2015 Closure - Cattle	257	0	257	100
Wapiti	Active Cattle	2015 Closure - Cattle	7376	0	7376	100
Ash / Iron Mountain	Active Sheep	2006 Closure - Sheep	75002	0	75002	100
Haystack	Active Sheep	2009 Closure - Sheep	16568	0	16568	100
Lionhead	Vacant Sheep	2008 Closure - Sheep	5730	0	5730	100
Meatrack/Carbonate	Vacant Sheep	2009 Closure - Sheep	18202	6778	24980	73
Two Top	Vacant Sheep	2008 Closure - Sheep	3710	1004	4713	79
University	Vacant Sheep	2008 Closure - Sheep	15074	0	15074	100
Current Closed Allotment Subtotals	(no data)	(no data)	**198483**	**26073**	**224555**	(no data)
Percent of Total	(no data)	(no data)	**73 percent**	(no data)	(no data)	(no data)
Grand Total	(no data)	(no data)	**272767**	**28368**	**301135**	(no data)

* Basin cattle allotment on the Hebgen Lake District consisted of two units, West and East. When the allotment was closed, 34 acres of the West Unit was closed to permitted livestock grazing, and the 25 acres of the East Unit was added to the Basin Administrative site to be used as administrative pasture for minor periodic government stock use.

- If sheep or goats are permitted on the national forest in the future, proportional to the risk of contact between domestic sheep and goats and wild sheep, work with permittees, state wildlife agencies, wild sheep advocates, and others to implement a variety of mitigation strategies

- ♦ Mitigation includes, but is not limited to, use of herders, dogs or other guarding animals trained to repel animals foreign to domestic sheep bands or goat flocks (such as wandering wild sheep, various predators), confinement of domestic sheep and goats at night to minimize strays, and adequate fencing configurations designed to achieve the most effective separation possible.
- ♦ Stocking of allotments with sheep or goat use or associated trailing routes, vegetation management (for example targeted weed control), or any other permitted uses involving domestic sheep and goats shall closely evaluate the timing of permitted domestic sheep and goat grazing or trailing activities, to reduce disease transmission risk. For example, grazing domestic sheep when ewes are in estrus heightens the possibility of contact between wild sheep and domestic sheep. Effective separation should be based on temporal and spatial separation of wild sheep and domestic sheep and goats.
- ♦ Written operating instructions for permitted sheep or goats could include direction for individually identifiable marking of sheep or goats, physical control of sheep or goats, reasonable efforts to keep sheep or goats from contacting bighorn sheep when the potential for contact arises, and emergency actions to undertake when bighorn sheep presence is likely to result in contact with domestic sheep or goats while grazing or trailing.
- ♦ Consult the Montana Bighorn Sheep Conservation Strategy (MTFWP 2010) and Action Plan for Management of Bighorn Sheep in South Dakota (South Dakota Department of Game 2013) or subsequent updated plans for additional mitigation measures.

Allotment Inspections

- Rangeland inspections are to be conducted annually on selected allotments to determine the degree of compliance with National Environmental Policy Act decisions, grazing permits, allotment management plans, or annual operating instructions, and could provide monitoring information for initiating changes or improvements, as applicable.
- National Forest permittees are to be encouraged to participate in allotment inspections to help resolve problems on the ground.
- It is recognized that in some of the smaller pastures that salt and supplement placement one-quarter (1/4) mile away from groundwater-dependent ecosystems, streams, water developments, aspen stands, woody draws, special habitats and populations of at-risk plant species may not be feasible. In these instances, placement needs to be as far away from these areas as possible in order to minimize livestock impacts. In some instances, limited salting within ¼ mile from some of these resources may be necessary to achieve resource goals and objectives.
- Consider removing excess salt or mineral blocks in areas of human concentration to minimize conflicts with wildlife, such as bison, bears and cougars which may be attracted to livestock supplements.

Allotment Infrastructure

- The highest priority for allocation of funding for wells and pipelines are for those that provide offsite water developments to reduce impacts to riparian/wetlands, woody draws, aspen stands and or at-risk plant populations that are susceptible to grazing impacts, and that improve livestock distribution.

- The highest priorities for the allocation of funding for nonstructural range improvements are for projects which reduce the percent composition of undesirable plant species and to improve desirable species over the long-term.
- To help with livestock management and rotation integrity, consider placing signs near gates instructing visitors on proper gate management, especially in areas of high visitor use.
- Consider screening new grazing infrastructure by use of terrain or vegetation to minimize visual impacts, where feasible.
- As opportunities arise or as issues are identified, existing allotment infrastructure that attract livestock use in or near aspen, woody draws, riparian areas, groundwater-dependent ecosystems or at-risk plant species are encouraged to be removed or relocated.
- As opportunities arise or as issues are identified, consider retrofitting water developments to be wildlife friendly and to facilitate animal escape.
- As opportunities arise, consider decommissioning stock water impoundments that are no longer needed to restore the hydrologic conditions of those drainages.
- If an improvement is found to be damaged or deteriorated through lack of assigned maintenance and care, consider it as the permittee's sole responsibility to reconstruct to Forest Service specifications.
- Rangeland improvement reconstruction required for the management of the rangeland resource may be cost-shared between the Forest Service and grazing permittees when:
    - A determination has been made that the improvement is necessary for the management of the rangeland resource.
    - The improvement is damaged by: 1) an unforeseen incident due to natural causes, 2) theft, or 3) vandalism.
    - The improvement has been properly maintained, but has exceeded its life expectancy.

Special Forest and Botanical Products

Special forest and botanical products include, but are not limited to, mosses, fungi (including mushrooms), roots, bulbs, berries, seeds, wildflowers, forbs, sedges, grasses, nuts, boughs, cones, transplants, Christmas trees, firewood, posts and poles, mine props, and rails. Some of the most popular special forest and botanical products on the national forest are firewood, post and poles, Christmas trees, boughs, and mushrooms. Activities and strategies that may be used to meet the desired conditions for personal and commercial uses of special forest and botanical products include:

- About 30 species of roughly 110 native medicinal plants harvested in Montana have been listed as highly popular for collection. About 37 of these species are cultivated for the herb market (Klein 2000). Klein (2000) provides estimates on what constitutes a personal amount of harvested plant material versus a commercial amount by species. For personal use amounts, none of the species exceeded two grocery bags full (wet, not dried, plant material).
- Of the United Plant Savers “at risk” medicinal plant species considered sensitive to harvest and other human activities, echinacea (all *Echinacea* species), eyebright (all *Euphrasia* species), lady’s slipper orchid (all *Cypripedium* species, lomatium (*Lomatium dissectum*), osha (*Ligusticum porteri*), sundew (all *Drosera* species) and trillium, (*Trillium ovatum*) are found within the Custer Gallatin National Forest. These species were, at one time, under a moratorium from harvest and removal.

Even though the ban has been lifted, these species could receive close evaluation prior to permitting harvest. According to policy (Forest Service Handbook R1 Supplement No. 2409.18-2007-1), forest supervisors are to use discretion when permitting these special forest or botanical products and only permit those medicinal species that are not listed on the threatened, endangered, or sensitive plant list. Scientific and research permits for these species may be issued to accredited schools, colleges, universities, or other institutions of higher learning, or to any government agency or to recognized Indian tribes having reserved rights for non-commercial gathering on National Forest System lands.

- Teepee poles are a special forest product that has high value for tribal traditional use. Forest vegetation desired conditions include forest cover types and structures that promote this specialty product (FW-DC-VEGF-01, 03 and 04). Lodgepole pine in the cool moist vegetation type has a desired range of 50 to 60 percent, a small tree size class (5 to 9 inches) desired range of 8 to 40 percent, a medium density class (canopy cover) range of 40 to 60 percent, and a high density class range over 60 percent. Lodgepole pine stands with these conditions are important for tribal use. During project level planning, areas that meet these desired conditions could be made available for this tribal use. In addition, timber stand improvement activities and no treatment on regenerating lodgepole pine stands, could be considered as options to produce this specialty product in the future.

Energy and Minerals

When attempting to portray proposed and possible mineral and energy actions which may take place over the life span of the Custer Gallatin National Forest Plan, it is important to note that much of this type of activity is driven by the minerals industry. Via existing law, regulation, and policy, the task of the Forest Service is to accept, review, approve, administer, and ensure site reclamation in places where these types of activities take place.

The portrayal of proposed and possible actions related to mineral and energy cannot be precise. The timing, amount and scope of proposed and possible actions could be determined based on commodity prices, environmental constraints, societal demand and generally, the “cost of doing business”. The Custer Gallatin has discretion pertaining to geologic resources and geologic hazards management.

Potential strategies that could be used to trend toward desired conditions for energy and mineral use include:

- The Forest Service could process and administer a variety of mineral and energy proposals during the life span of the national forest plan. Locatable mineral proposals are anticipated to be principally located in the Absaroka-Beartooth Geographic Area. Additionally, the national forest could process and administer some leasable mineral (oil/gas/coal) proposals principally located in the eastern portions of the national forest.
- The Custer Gallatin could make available for public use and enjoyment a number of geologic resources and opportunities such as personal use mineral material collection and geological interpretive opportunities.
- The Custer Gallatin could assess and manage geologic hazards such as abandoned mine lands, naturally occurring hazardous fibers and radio-active particulates.

- Abandoned Mine Lands could be identified, assessed and reclaimed in order to protect the natural and human environments surrounding them comparable to adjacent lands or pre-mining site conditions.
- Cave and karst resources could be managed to perpetuate existing natural features, characteristics, and values in conformance with the Federal Cave Resource Protection Act.
- Paleontological resources could be managed in conformance with the Paleontological Resource Preservation Act.

Recreation Settings, Opportunities, Access, and Scenic Character

Potential management approaches are those that (1) assist in providing a range of recreation opportunities across the forest, (2) minimize visitor impacts to natural resources and conflicts between user groups, and (3) construct and maintain facilities and trails to address capacity issues and meet visitor needs. Potential strategies that could be used to trend toward desired recreation conditions include:

Sustainable Recreation

- Integrated resource planning during projects to respond to changing conditions in recreation settings.
- Management strategies to mitigate recreation use and resource conflicts.
- Where administrative boundaries meet, coordinate trail construction, rerouting, improvement and maintenance with cooperating or affected agencies.
- Encouraging mass transit opportunities to major recreational destinations or events where feasible.
- Collaborating with local communities, partner organizations, and Federal, State, local and Tribal Agencies to restore, maintain and enhance recreation settings impacted by climate change, declining ecosystem health, wildfire and inappropriate use, in order to improve the quality of outdoor experiences and to promote citizen stewardship of public lands.
- Effectively managing concentrated recreation use; provide a quality visitor experience while managing ecosystem effects within sustainable levels.
- Collaborating with neighboring communities, partner organizations, State and local agencies, Tribes and adjacent Forest Service and National Park Service units to provide recreation opportunities that are economically, socially and environmentally sustainable. Work to harmonize direction that affects users to the extent practical in order to minimize confusion when crossing administrative boundaries.
- Actively engaging urban populations, youth and underserved communities in outreach programs, such as conservation education, recreation and volunteer programs, to help people connect to the benefits of national forests and develop stewardship of public lands.
- Exploring partnership opportunities with user groups and seek reliable information sources outside of the agency to improve data collection and data management on recreation use and demand.
    - Strategically engaging volunteers and partners to prioritize and complete deferred maintenance and trail degradation due to sustained use to engage in resource stewardship and restoration.

- ♦ Making determinations about how increasing human populations and associated levels and types of use are affecting the national forest. Noting changes in trends of desired recreation opportunities and managing opportunities responsively, which may or may not mean increasing capacity to accommodate growth.
- ♦ Alternative C only- Under regulations and constraints within existing fee legislation, the national forest could develop a fee-based system (for example, annual pass, parking permit fee, etc.) for all or part of the Hyalite Recreation Emphasis Area. Revenues generated could be used to support investments in recreation infrastructure and enforcement in the Hyalite Recreation Emphasis Area.

Settings – Recreation Opportunity Spectrum

- Developing a prioritization process that provides direction for maintenance of existing recreation facilities, construction of new facilities, and reconstruction of or additions to existing facilities. The prioritization process emphasizes the national forest's recreation niche and is in alignment with regional and national direction.
- Integrating recreation opportunity spectrum settings into project level designs and management decisions.

Developed Recreation Sites

- Resolving recreation and wildlife conflicts within developed sites through proper food storage facilities, signage, education, timing and use restrictions, location (or re-location) of developed sites, wildlife habitat alteration to discourage wildlife use within or near developed sites and to encourage wildlife use in areas away from developed sites.
- Addressing developed campgrounds that need improvements, by prioritizing improvements that address accessibility, health and safety, types of use, size of recreational vehicles, and reduction of bear-human interactions.
- Modifying existing developed recreation facilities, and developing new facilities to accommodate the diversity of cultures, abilities, family structures and preferred activities of current populations who could benefit from recreation opportunities.

Dispersed Recreation

- Where visitor use is accommodated, seeking opportunities to proactively rehabilitate, design, reconstruct, and harden the site; locate new facilities and areas for redistributing human use away from sensitive resources.
- Where visitor use is restricted, limiting or controlling use at developed recreation sites and areas through permit system (such as, group campgrounds). When other actions are ineffective, enacting and enforcing forest orders to protect sensitive resource areas through use of seasonal or temporary closures of developed recreation sites and areas. Seeking opportunities to proactively design and locate new facilities and areas for re-distributing human use away from sensitive resources.
- Where visitor use is prohibited when seasonal or temporary closures are ineffective, enacting and enforcing forest orders to close recreation sites or areas. If monitoring and evaluation indicate that closure is ineffective, taking steps to decommission facilities and permanently discontinue visitor use.

- Emphasizing sustainable alternatives for refuse management that protect the recreation experience in all settings including messages of visitor responsibility and pack-in, pack-out guidance in lightly used developed recreation areas and dispersed recreation areas.
- Addressing dispersed campsites with erosion and sanitation issues. Prioritizing rehabilitation needs by focusing on dispersed campsites located near river or stream corridors.
- Developing closure orders for dispersed recreation areas where visitor safety is at risk or changes need to be made to avoid or rehabilitate environmental impacts.
- Informing and educating users about Leave No Trace techniques for responsible, outdoor activities with minimal impacts on National Forest lands.
- Closing and rehabilitating, or otherwise mitigating, dispersed recreation sites when conditions deteriorate to an unacceptable level and cannot be managed to Forest Service standards. Conditions could include unacceptable environmental damage, visitor conflicts and overcrowding.
- Providing seasonal sanitation facilities, such as portable toilets, in areas where available service makes them a valid type of facility to provide, especially to protect riparian areas from the impacts of human waste.

Opportunities – Recreation Special Uses

- An open season system could be implemented to resolve capacity to facilitate permits. Also due to the lack of resource capacity to accommodate all requests.

Recreation Residences

- To reduce the number of wells and septic drain fields within tracts, permit holders could be encouraged to share facilities with their neighbors for new requests to install water systems or septic drain fields.
- Reasonable consistency in administration of recreation residence permits across the national forest could be guided by the Custer Gallatin National Forest Handbook Supplement. As new issues develop, the Handbook Supplement could be updated regularly.
- To address weed control, reduce vandalism at cabins, and developing hazard tree issues, the Forest Service could encourage permit holders to work together to pay for contract weed spraying and coordinate schedules for maintaining an owner presence in the tracts.
- The Forest Service could send out regular electronic updates on Forest happenings and offer opportunities for volunteer participation, which could range from oral history documentation (for personal accounts of historic events such as the Madison Canyon Earthquake) to informal trail patrols or photo documentation (such as of regrowth after the Millie Fire.

Visitor Education and Interpretation

- Education programming could promote conservation, stewardship, and understanding of natural resources and ecological processes (such as watershed, fisheries, native plants, fire ecology, and wildlife) as well as cultural resources on public lands. Conservation education efforts are experiential, contemporary, and culturally and generationally-relevant.
- Educational media focused on wildlife safety could be available for visitors with little previous experience.

- The Custer Gallatin could use a variety of media to seasonally focus educational messages to hunters on what to expect and how to interact with permittee activities on active range allotments, such as closing gates and not shooting near livestock.
- Interpretive and educational materials could be published in a variety of languages likely used by visitors.
- Interpretive and environmental education programs could be developed about sensitive resources and habitats for the public, Forest Service personnel, concessionaires, other special-use authorization holders, and volunteers. The services of special-use authorization holders that provide services to the public (for example, concessionaires, organization camps, outfitter guides) could be engaged to assist in the development and delivery of these programs. Authorization holders could be provided with messages about sensitive resources and management issues so that they can use them to educate people. Efforts could be coordinated between national forests for maximum results and cost efficiencies. Existing visitor centers could be used where appropriate.

Emerging Recreational Technologies

- New technology and recreational products could be evaluated and reviewed by the agency and public to consider if and where to incorporated them into the National Forest landscape.

Scenic Character

This section describes potential approaches and management strategies for the scenery management plan components. These approaches reflect the fact that scenery management can be proactive for the scenery resource or responsive to actions proposed for the benefits of other resources. This distinction is important to understand because one of the basic concepts of scenery management - Scenic Integrity Objectives - serve as minimum thresholds for scenic integrity within a larger management context, and do not necessarily reflect the desired condition. For example, in an area with an existing scenic integrity of high and an assigned scenic integrity objective of moderate, the national forest would never develop a project expressly to lower the scenic integrity from high to low.

Proactive strategies and approaches include:

- Consider opportunities to improve the scenery as part of vegetation treatment and fuels reduction projects, especially in areas that do not meet established scenic integrity objectives.
- Consider opportunities for increasing public enjoyment of the scenery, such as vista clearing, where the work would not lower the scenic integrity of the immediate foreground below the assigned forest plan scenic integrity objective.
- Consider opportunities to perpetuate valued scenic attributes and improve the scenic stability especially in areas where the visual setting is important, such as within or surrounding heavily-used recreation areas.
- Prepare for work done within the context of emergencies, such as fire suppression-related activity or indirect control lines that could have long term negative effects on scenery and may be difficult to mitigate.
    - For highly valued viewsheds such as from the Continental Divide National Scenic Trail, the Beartooth Scenic Byway and other critical viewing platforms especially where the assigned scenic integrity objective is moderate or high, provide the incident commanders, burn area

emergency rehabilitation team leaders or post burn area emergency rehabilitation team leader with a list of critical viewing platforms and scenic integrity objectives and suggested approaches.

Responsive strategies and approaches include:

- Tailor the application of the assigned forest plan scenic integrity objectives of high, moderate and low to each new project by conducting a project-specific visibility analysis from the applicable mapped critical viewing platforms.
- Determine how a project might affect scenic integrity based upon each area's scenic character, which includes the viewer and viewing context, overall sense-of-place and may include non-natural valued scenic elements such as rustic fences, old buildings or historic cabins. Certain somewhat transitory features such as the wild horses in the east side of the Pryor Mountains may contribute to the scenic character. Also integral to the scenic character is the natural range of dynamics relevant to the vegetation component of the scenery, which includes fire regimes.
- During project analysis, aim to integrate scenery management goals with other resources such as soil or hydrology, to develop design features that address multiple resources. Recognize that forest plan components for resources other than scenery may be more restrictive of activities than the scenic integrity objectives
    - ♦ Recreation Opportunity Spectrum: in an area that is semi-primitive non-motorized, the desired condition of "naturally-appearing vegetation" may be more constraining to vegetation management activities than the scenic integrity objective
    - ♦ Wilderness Study Area or Inventories Roadless: the activities allowed by the nature of those designations may be more constraining than the assigned forest plan scenic integrity objectives
- Consider a variety of approaches to meet or exceed the scenic integrity objectives.
- During project implementation, the landscape architect or scenery specialist could work with the timber sale administrator to resolve issues with applying design features.
- Use examples of naturally-occurring line, form, color, texture and patterns from surrounding landscapes to reduce the discernibility of landscape modifications resulting from management actions, most especially vegetation management.
- Reduce the long-term discernibility of timber harvest or fuel reduction work by shaping the edges to avoid unnatural-appearing geometric shapes or lines; transitioning the edges by decreasing or increasing amount of removal along unit edges; reducing the vertical wall-of-trunks effect by leaving younger trees along unit edges; aiming for treatment over a larger mosaic area vs smaller intensely-treated units; and linking created openings to natural openings wherever possible.
- Aim to reduce the visual contrast of new facilities with their surroundings by carefully choosing colors, non-reflective, textured materials, and by facing inherently shiny, reflective or lit-up elements (such as windows or lights) away from viewers.
- Incorporate the tools of visual absorption capability and visual magnitude into project work.
- Refer to the Management Approaches section in this document on "Soil" to reduce the visual dominance of roads and landings that are visible in the foreground.
- Consult the National Forest Landscape Management document Chapter 2 volumes for project-specific ideas to meet or exceed national forest plan scenic integrity objectives. These include:

Chapter 2 “Utilities”, Chapter 3 “Range”, Chapter 4 “Roads”, Chapter 5 “Timber”, Chapter 6 “Fire”, Chapter 7 “Ski Areas”; Chapter 8 “Recreation”. While these chapters date from the 1970s and 1980s, many of the suggested approaches to scenery management and mitigation of impacts to the scenery are still useful.

- After project completion, determine whether a completed project has met the assigned scenic integrity objectives and if the design features were appropriate.

Designated Areas

Potential strategies that could be used to trend toward desired conditions and the nature and purposes for which areas were designated include:

Continental Divide National Scenic Trail

- Encouraging trail partners and volunteers to assist in the planning, development, maintenance, and management of the trail, where appropriate and as consistent with the Continental Divide National Scenic Trail Comprehensive Plan.
- Evaluating proposed trail relocations or new trail segment locations using Continental Divide National Scenic Trail optimal location criteria.
- Identifying and pursuing opportunities to acquire lands or rights-of-way within or adjacent to the Continental Divide National Scenic Trail corridor.
- Considering how project work within the visible foreground (up to ½ mile on either side of the Trail) and beyond may affect user experiences so as to meet the assigned Scenic Integrity Objectives.
- Providing consistent signage along the trail corridor at road and trail crossings to adequately identify the trail, and providing interpretive signs at key trail entry points and limited historic and cultural sites to orient visitors and enhance the visitor experience.
- Ensuring Incident Commanders are aware of the Continental Divide National Scenic Trail as a resource to be protected during wildfire suppression activities, and clearly identifying fire suppression rehabilitation and long term recovery of the Continental Divide National Scenic Trail corridor as high priorities for Incident Commanders, Burned Area Emergency Response (BAER) Team Leaders and post-fire rehabilitation efforts.
- Establishing appropriate carrying capacities for specific segments of the Continental Divide National Scenic Trail, monitoring use and conditions, and taking appropriate management actions to maintain or restore the nature and purposes of the Continental Divide National Scenic Trail if the results of monitoring or other information indicate a trend away from the desired condition.

National Recreation Trails

- The Custer Gallatin could evaluate all currently listed National Recreation Trails to ensure they are being managed under the correct designation. A few of the currently designated trails are lightly used, do not offer exemplary, outstanding or unique experiences and might be reconsidered as to whether they are appropriate for the designation. There may be other trails on the forest that would be more worthy of being designated a national recreation trail.

Research Natural Areas

An objective of the Forest Service's research natural area program is to maintain a representative array of all significant natural ecosystems as baseline areas for research and monitoring. The Custer Gallatin National Forest has ten established research natural areas. The Northern Region Natural Areas Assessment recommended new research national area targets for each forest based on plant community type and priority and its likelihood of occurring on a particular forest (Chadde, Kimball and Evenden 1996). Although *Pinus ponderosa*/*Agropyron spicatum* and *Pinus ponderosa*/*Prunus virginiana* show up as a target in Chadde, et al. (1996), they are represented in Poker Jim Research Natural Area).

Refer to the following publications, establishment records and decisions:

Aus and Curriden 2000.

Bosworth and Laverty 2000.

Chadde, S. W., Kimball, S. F., and Evenden, A. G. 1996.

Evendan et al. 2001

Fishburn 1994.

Jolley 1994.

McCallister, K. 1997.

McCallister, K. 2004.

McGuire 1974.

USDA Forest Service 1983.

Potential strategies that could be used to trend toward desired conditions for Research Natural Areas include:

- The overall approach for management of research natural areas is expressed by a cooperative relationship between the Forest Service and the Rocky Mountain Research Station (Evenden et al. 2001) provide additional information on research natural areas). The Research Station Director, with the concurrence of the Forest Supervisor, may authorize management practices that are necessary for invasive weed control or to preserve the vegetation for which the research natural area was created (Forest Service Manual 4063.3). As stated in the manual, limited use of vegetation management may occur within research natural areas, in situations where the vegetative type would be lost or degraded without management. The criterion is that management practices provide a closer approximation of the naturally occurring vegetation and the natural processes governing the vegetation than would be possible without management. These practices may include prescribed burning (Evenden et al. 2001).
- In the case of unplanned ignitions that occur in or near research natural areas, consider that natural process of fire is desirable in research natural areas, but may also have potential impacts on plant communities at risk. These impacts would generally be considered acceptable (unless the fire severity is considered outside natural range of variation), but it is recommended to consult research natural area establishment records, manual direction (for example, Forest Service Manual 4063) and Rocky Mountain Research Station personnel for additional guidance with fire management.

- Past fire suppression has affected ecological conditions in Poker Jim Research Natural Area. Colonization of forest vegetation into openings and meadows has occurred. Fencing may be needed to keep livestock use as only incidental to no use. Poker Jim Research Natural Area likely does not provide optimum conditions for which it was set aside and further review is warranted to determine whether management can restore the features for which the area was established.
- Management actions such as identifying the research natural area on maps distributed to the general public or signing the areas as research natural areas would typically not be done so as to not encourage recreational use.
- Field inventories are needed to identify whether these plant community types occur and, if so, where they are located on the Custer Gallatin National Forest. As opportunities arise, inventories could be conducted and the process for establishing additional research natural areas could be pursued. Potential strategies to conduct inventories may include partnering with non-agency groups or organizations to locate and inventory rare plant communities.
- Table 3 and table 4 display the unfilled plant community type research natural area target recommendations and the associated priority ranking for the Custer Gallatin National Forest resulting from the Northern Region assessment.

Table 3. Unfilled community type target recommendations for Custer portion of Custer Gallatin National Forest and priority ranking

Class	Community Type	Likelihood of Occurring	Priority
Forest and Woodland	*Fraxinus pennsylvanica-(Ulmus americana) / Prunus virginiana series*	Ashland and Sioux Districts	Moderate
Forest and Woodland	*Fraxinus pennsylvanica/Prunus virginiana*	Ashland and Sioux Districts	High
Forest and Woodland	*Fraxinus pennsylvanica / Symphoricarpos occidentalis*	Ashland and Sioux Districts	Moderate
Forest and Woodland	*Juniperus scopulorum / Agropyron spicatum*	Beartooth, Ashland, and Sioux Districts	Moderate
Forest and Woodland	*Pinus ponderosa / Carex heliophila*	Sioux District	High
Forest and Woodland	*Pinus ponderosa / Festuca idahoensis*	Ashland District	High
Forest and Woodland	*Pinus ponderosa/ Juniperus communis*	Ashland and Sioux Districts	Moderate
Forest and Woodland	*Populus angustifolia / Cornus stolonifera*	Beartooth District	Moderate
Forest and Woodland	*Populus deltoides/Cornus stolonifera*	Beartooth, Ashland, and Sioux Districts	Moderate
Forest and Woodland	*Populus tremuloides communities*	Beartooth, Ashland, and Sioux Districts	Moderate
Shrubland	*Artemisia cana/Agropyron smithii*	Ashland and Sioux Districts	Moderate
Shrubland	*Artemisia cana/Festuca idahoensis*	Ashland District	Moderate
Shrubland	*Artemisia tridentata/Agropyron smithii*	Beartooth, Ashland, and Sioux Districts	Moderate
Shrubland	*Artemisia tridentata/Agropyron spicatum*	Beartooth, Ashland, and Sioux Districts	Moderate
Shrubland	*Artemisia tridentata - Atriplex confertifolia*	Beartooth District	Moderate

Class	Community Type	Likelihood of Occurring	Priority
Shrubland	*Potentilla fruticosa/Andropogon scoparius*	Ashland District	High
Shrubland	*Rhus aromatica/Agropyron spicatum*	Beartooth, Ashland, and Sioux Districts	Moderate
Shrubland	*Rhus aromatica/Festuca idahoensis*	Beartooth and Ashland Districts	Moderate
Shrubland	*Rhus aromatica/Muhlenbergia cuspidata*	Ashland and Sioux Districts	Moderate
Shrubland	*Sarcobatus vermiculatus/Agropyron smithii*	Sioux District	Moderate
Shrubland	*Sarcobatus vermiculatus/Agropyron spicatum*	Sioux District	Moderate
Shrubland	*Shepherdia argentea*	Ashland and Sioux Districts	Moderate
Shrubland	*Symphoricarpos occidentalis*	Beartooth, Ashland, and Sioux Districts	Moderate
Dwarf Shrubland	*Artemisia arbuscula/Agropyron smithii*	Beartooth District	Moderate
Dwarf Shrubland	*Artemisia arbuscula/Agropyron spicatum*	Beartooth District	Moderate
Dwarf Shrubland	*Juniperus horizontalis/Andropogon scoparius*	Ashland and Sioux Districts	Moderate
Dwarf Shrubland	*Juniperus horizontalis/Carex heliophila*	Sioux District	Moderate
Herbaceous Vegetation	*Agropyron smithii - Carex filifolia*	Sioux District	Moderate
Herbaceous Vegetation	*Agropyron spicatum - Agropyron smithii*	Ashland District	High
Herbaceous Vegetation	*Agropyron spicatum - Bouteloua curtipendula*	Ashland District	High
Herbaceous Vegetation	*Agropyron spicatum - Carex filifolia*	Ashland District	High
Herbaceous Vegetation	*Carex scopulorum*	Beartooth District	Moderate
Herbaceous Vegetation	*Distichlis spicata*	Sioux and Ashland Districts	Moderate
Herbaceous Vegetation	*Festuca idahoensis - Carex heliophila*	Ashland District	High
Herbaceous Vegetation	*Scirpus acutus*	Sioux and Ashland Districts	Moderate
Herbaceous Vegetation	*Spartina pectinata*	Sioux and Ashland Districts	Moderate
Herbaceous Vegetation	*Stipa comata - Carex filifolia*	Sioux and Ashland Districts	Moderate
Herbaceous Vegetation	*Scirpus acutus*	Sioux and Ashland Districts	Moderate
Herbaceous Vegetation	*Typha latifolia*	Sioux and Ashland Districts	Moderate

Note: Chapter 10 (Chadde et al 1996 pp. 145-147 and pers. Comm. Steve Shelly, 2016 to sort out non-applicable Dakota Prairie National Grassland types)

Table 4. Unfilled community type target recommendations for Gallatin portion of Custer Gallatin National Forest and priority ranking

Class	Community Type	Likelihood of Occurring	Priority
Dwarf Shrubland	*Artemisia arbuscular / Agropyron smithii*	Gardiner and Hebgen Districts	Moderate
Dwarf Shrubland	*Artemisia arbuscular / Agropyron spicatum*	Gardiner and Hebgen Districts	Moderate
Dwarf Shrubland	*Artemisia arbuscular / Festuca idahoensis*	Gardiner and Hebgen Districts	Moderate
Shrubland	*Potentilla fruticosa / Festuca idahoensis*	All Districts	High
Herbaceous Vegetation	*Agropyron spicatum-Bouteloua gracilis*	All Districts	High
Herbaceous Vegetation	*Festuca idahoensis - Stipa richardsonii*	All Districts	High

Note: Chapter 11 Chadde et al (1996) pp. 148-149 and pers. comm. Steve Shelly, 2016; Carex scopulorum may be present in Line Creek Plateau and Lost Water Canyon research natural areas

Special Areas

Refer to the following for background and decisions regarding the Black Sand Springs and Bangtail designated Special Areas:

McCallister, K. 2007

McCallister, K. 1997

Garber, D. 1998

Potential management approaches that could be used to trend toward desired conditions for Special Areas include:

- Black Sand Springs and Bangtail designated Special Areas and Pryor Mountain candidate Botanical Special Area. Due to the high value for biological integrity of these areas, invasive species control in and around these areas is to be considered a high priority.
- New candidate Special Areas could be considered based upon local knowledge of vegetation types or identified rare elements and features. Field surveys would be needed to identify candidate sites. Regional Forester approval is necessary for areas less than 100,000 acres under 36 CFR 294.1b (FSM 2372.04a(2)).

Pryor Mountain Wild Horse Territory

Refer to United States of America Public Law 195-92 1971, 1976, 1978, 2004. Wild Free-Roaming Horse and Burro Act as amended, the Code of Federal Regulations. 36 CFR Subpart B - 222.20-36. Management of Wild Free- Roaming Horses and Burros and FSM 2260 for additional direction for wild horse territory management.

The 2009 Interagency Herd Management Area and Territory Plan, or subsequent plans, provides operational decisions and direction for management of the Pryor Mountain wild horses and range. Management approaches include:

- The north boundary buck and rail fence is to be maintained to keep wild horses within their designated lands, pursuant to the 1971 Wild and Free-Roaming Horses and Burros Act, and prevent wild horse access into the Lost Water Canyon Research Natural Area and Lost Water Canyon recommended wilderness.
- Burnt Timber Road #2849 and the two long-term rangeland study exclosures are important to retain for wild horse management. The historic horse trap adjacent to the Burnt Timber Road are important to retain for cultural/historical purposes.
- Drone use can be allowed for administrative purposes or in approved research projects. If recreational or commercial drone use harasses wild horses, consider issuing a citation under 36 CFR 261.23(b) which prohibits harassment or inhumane treatment of wild horses.
- Refer to the followings sources for further information regarding the Pryor Mountain Wild Horse Range: (Jack 1984, Jaynes 1992, U.S. Department of Interior, U.S. Department of Interior and U.S. Department of Agriculture 2008, U.S. Department of Interior, U.S. Department of Interior and U.S. Department of Agriculture 2009, Hall 1972, Schoenecker 2004, Sneed and Winterowd 2006, Peterson 1999, Ricketts 2004, Heidel 2001)

Lands

The strategy for lands management could include the following elements:

Land Status and Ownership

Adjust land ownership through purchase, exchange or other authority, to protect resources and improve efficiency of management. Consider the following criteria when evaluating lands for acquisition:

- Lands that can contribute to recovery of threatened or endangered species.
- Lands important for wildlife connectivity and big game winter range.
- Lands needed for the protection of important historical or cultural resources.
- Lands that enhance recreation, public access, and protection of aesthetic values.
- Lands within designated Wilderness.
- Lands that contain rivers with potential for Wild and Scenic designation.
- Other environmentally sensitive lands.
- Lands that reduce expenses and support logical and efficient management.

Consider the following criteria when evaluating lands for conveyance:

- Lands and administrative buildings adjacent to communities that are chiefly valuable for non-National Forest uses.
- Lands with low resource value.
- Inaccessible, isolated, or intermingled ownership parcels.
- Lands with long-term, special use permits that are not consistent with national forest purposes and character.
- Lands not logical or efficient to manage.
- Lands eligible under the Small Tracts Act.

Prioritize National Forest land boundary surveys to areas where trespass is most likely.

Land Uses

The strategy for prioritizing the workload for land uses could include the following:

- Process renewals and re-issuances in a timely fashion. Environmental analysis should be commensurate and minimal for those uses where the decision to allow the use has already been made and the new permit is simply an administrative function.
- Emphasize processing new proposals that contribute to the greater public good (utility projects, public highways, reciprocal access cases).
- For utility authorizations that do not have current Operation and Maintenance Plans, work with holders to develop and implement Plans.
- Prioritize and facilitate vegetation management activities within and adjacent to utility line rights-of-ways.

Communication Uses

- Proponents for new communication uses (cellular, FM radio, internet service provider, etc.) should first consider co-location in an existing site that has an approved communication site management plan. There are currently eleven locations on the national forest where leases for communication sites have been authorized. Per special uses policy, the Forest Service authorizes use of National Forest System lands as communication sites by issuing leases to facility owners or managers, who may sublease their facilities to multiple occupants for operation of communications equipment. Currently, many sites have space for additional occupants in or on existing facilities, as well as space for construction of additional facilities.
- New facilities, which would require new leases, at these eleven sites could be authorized after a site-specific environmental analysis pursuant to the National Environmental Policy Act is completed. Communication sites are designated for a specific type or types of communication uses. Broad categories of communications uses include:
    - ♦ Broadcast. Television, AM/FM radio, cable television, broadcast translator, and low power television and radio.
    - ♦ Non-Broadcast. Intermittent transmitter use, including mobile radio service (two-way radio or paging), cellular phone, microwave.
- At existing communication sites, the senior use at the site establishes the site designation.
- Sometimes a use that is not compatible with the designated use is proposed. In these situations, the proponent must demonstrate that the equipment for the proposed use can be installed and operated in a manner that is compatible with the site designation.
- In addition to the site designation, some sites have specific restrictions, such as Government-entities only. Table 5 summarizes information about the existing sites, including the categories of use. Communication site locations are displayed on figure 1 through figure 6.

Table 5. Communication sites

Communication Site Name	Geographic Area	Ranger District	Legal Description	Site Designation
Bridger Ridge	Bridger, Bangtail, Crazy Mountains	Bozeman	T1N, R6E, sections 24 and 25.	Low Power, Non-Broadcast
Buck Ridge	Madison, Henrys Lake, Gallatin Mountains	Bozeman	T8S, R3E, section 11	Low Power, Non-Broadcast
Eaglehead	Madison, Henrys Lake, Gallatin Mountains	Bozeman	T7S, R5E, section 17	Low Power, Non-Broadcast
East Pryor Mountain	Pryors Mountains	Beartooth	T8S, R28E, section 6	Low Power, Non-Broadcast
Home Creek Butte	Ashland	Ashland	T3S, R47E, section 4	Low Power Broadcast
Horse Butte	Madison, Henrys Lake, Gallatin Mountains	Hebgen	T12S, R4E, section 26	Low Power, Broadcast
Henderson Mountain	Absaroka Beartooth Mountains	Gardiner	T9S, R14E, section 13	Government use only
North End	Sioux	Sioux	T18N, R8E, section 6	Low Power, Non-Broadcast
Obsidian Flat	Madison, Henrys Lake, Gallatin Mountains	Bozeman	T14S, R5E, section 3	Broadcast
Tower Hill	Sioux	Sioux	T1N, R58E, section 25	Low Power, Non-Broadcast
TriPoint	Sioux	Sioux	T2S, R61E, section 22	Low Power, Non-Broadcast

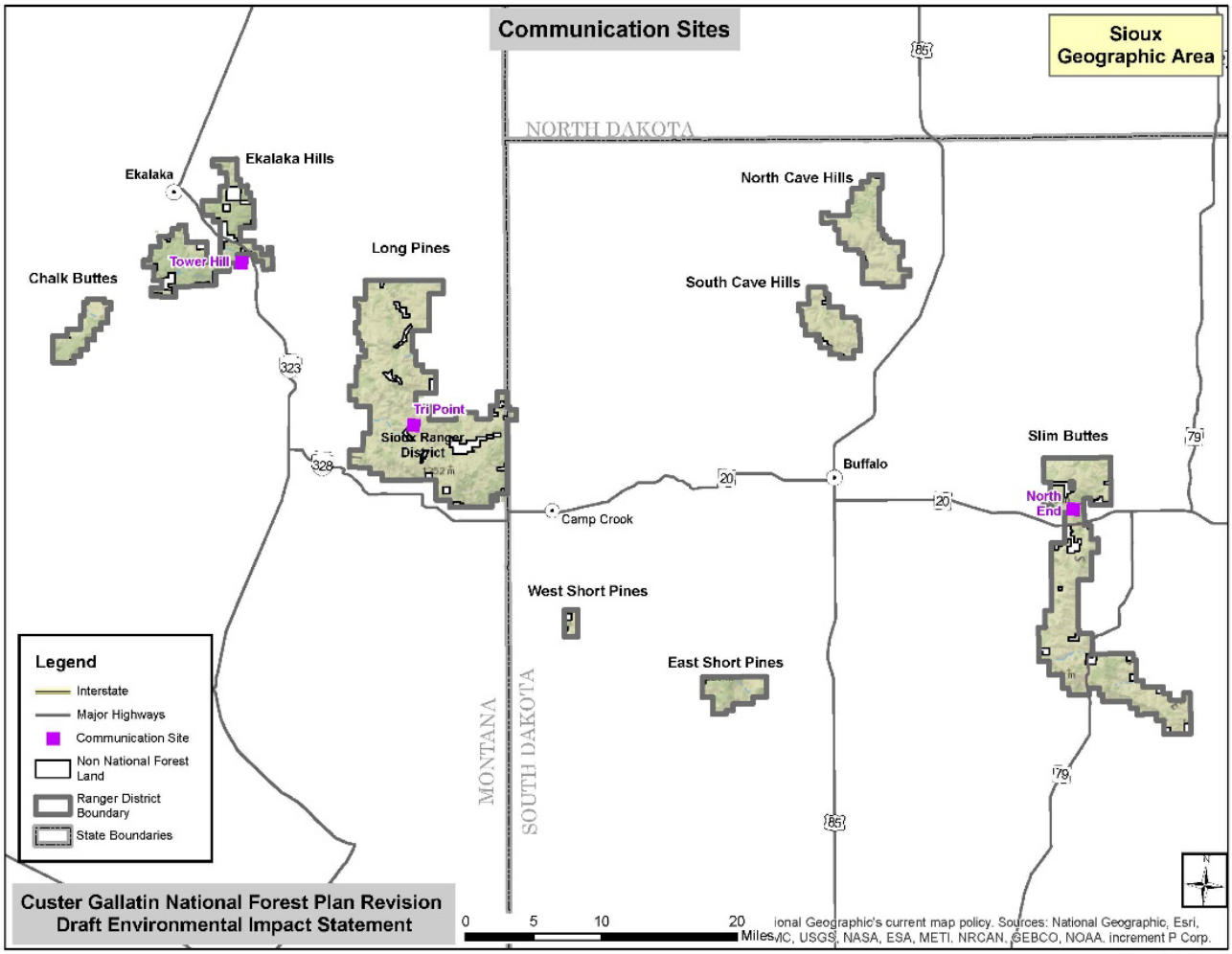

Figure 1. Communication sites on the Sioux Geographic Area

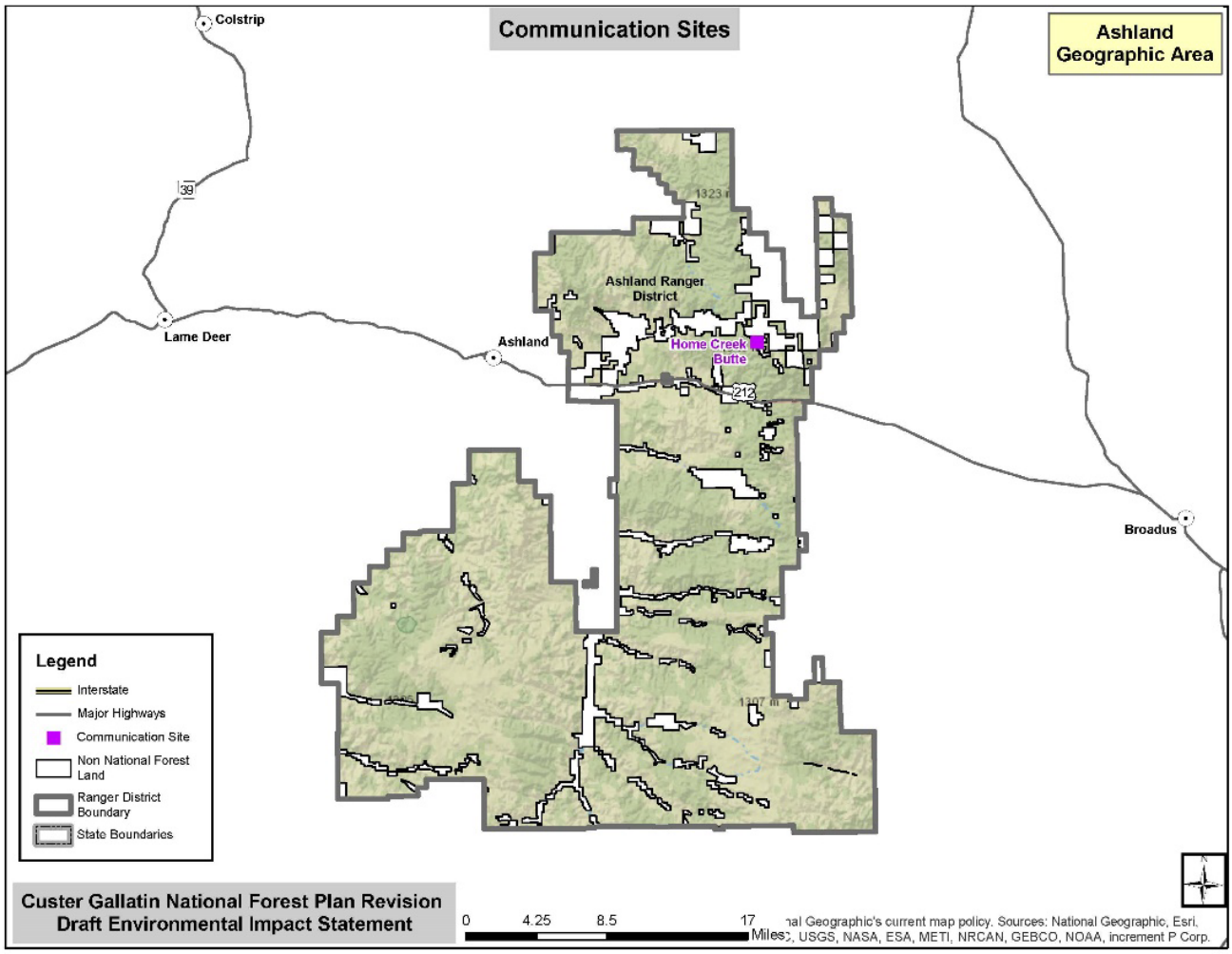

Figure 2. Communication sites on the Ashland Geographic Area

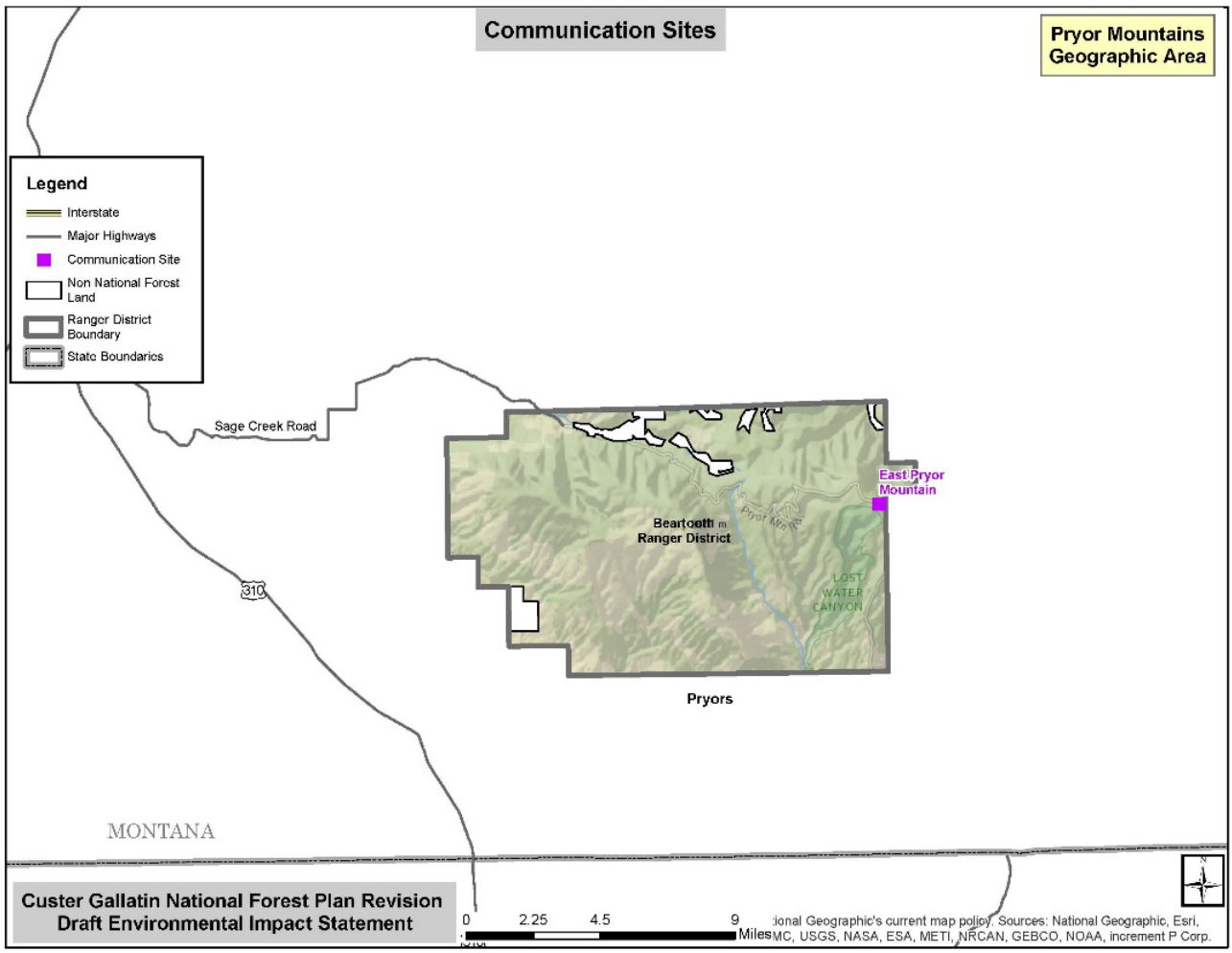

Figure 3. Communication sites on the Pryor Mountains Geographic Area

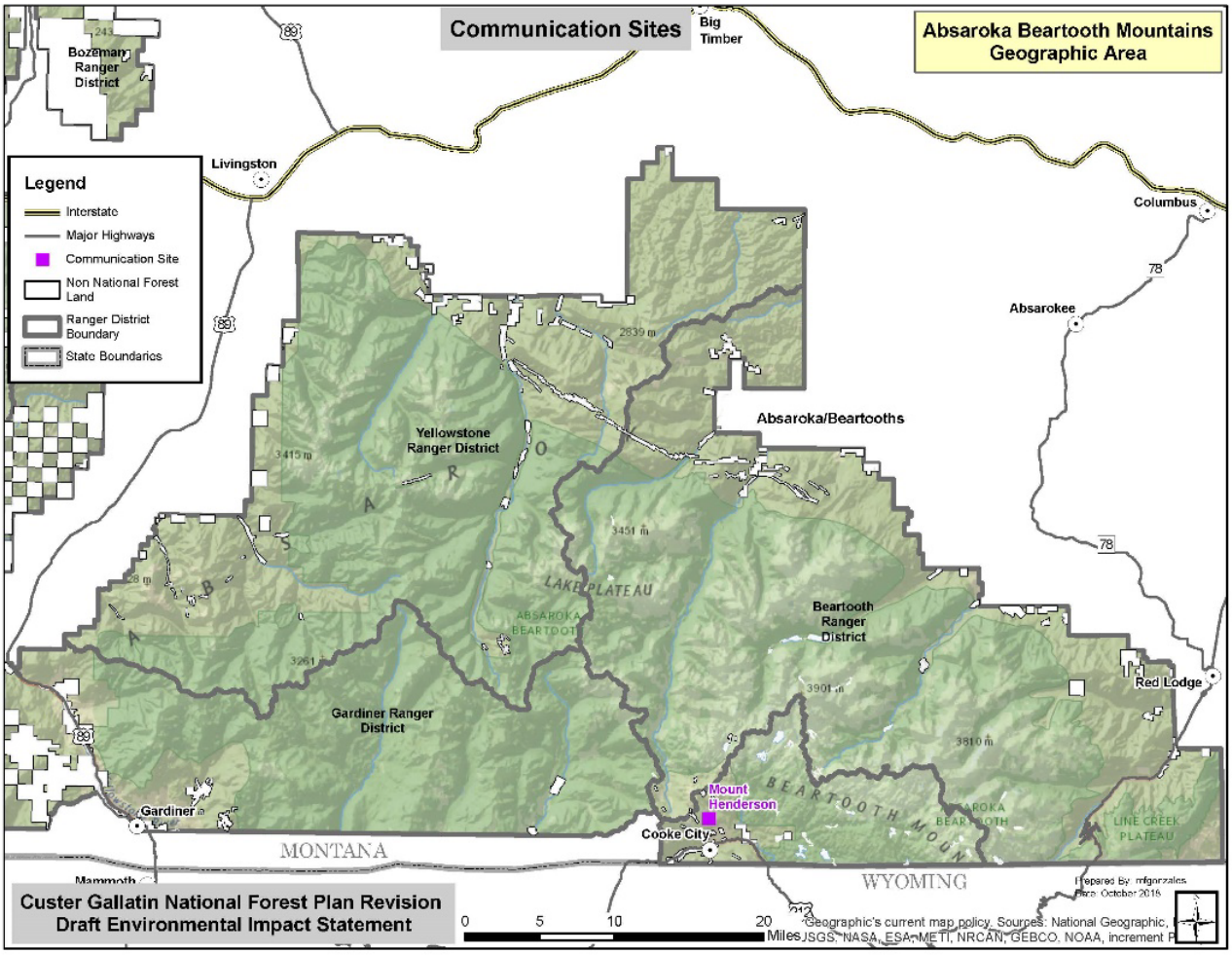

Figure 4. Communication sites on the Absaroka Beartooth Mountains Geographic Area

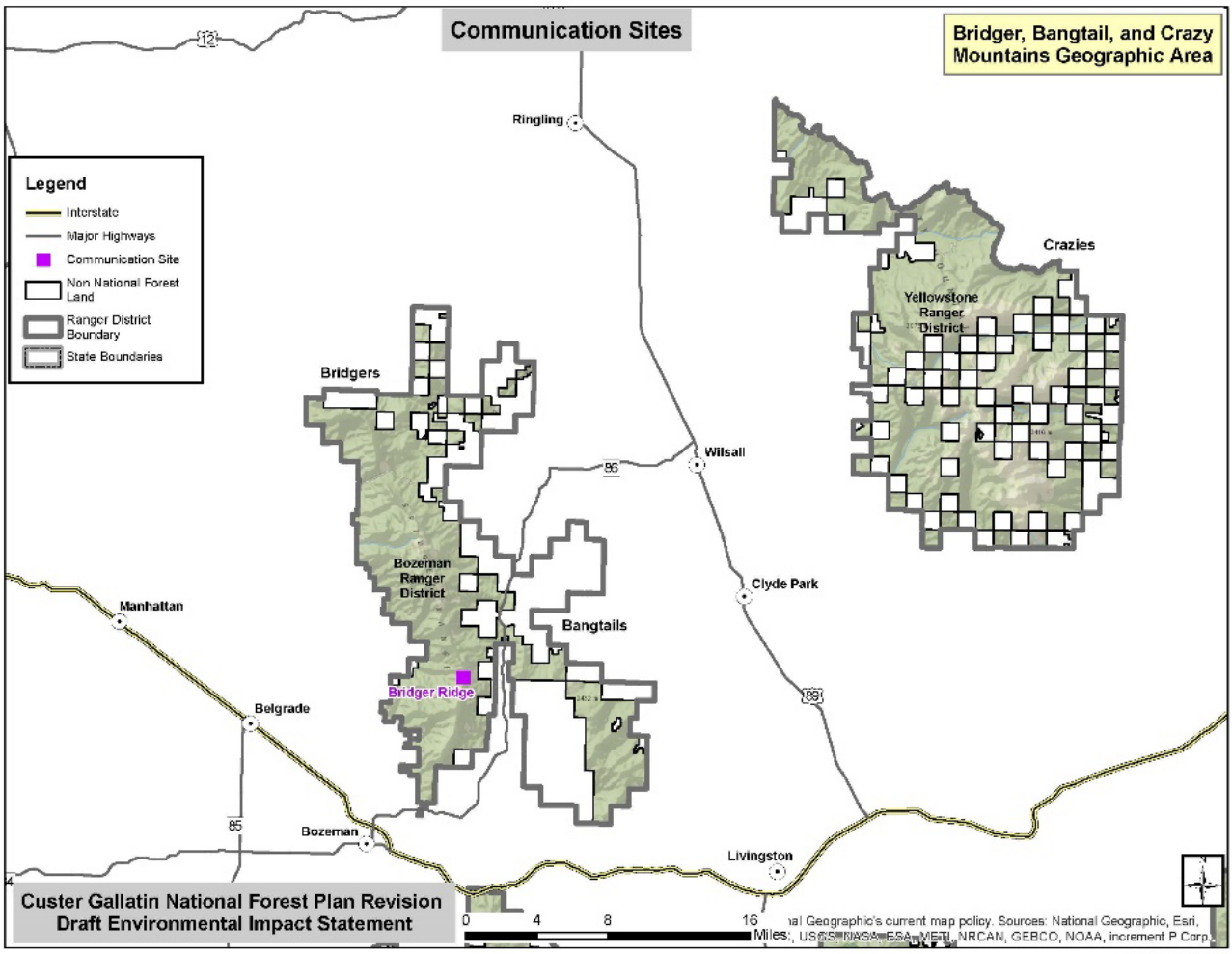

Figure 5. Communication sites on the Bridger, Bangtail, Crazy Mountains Geographic Area

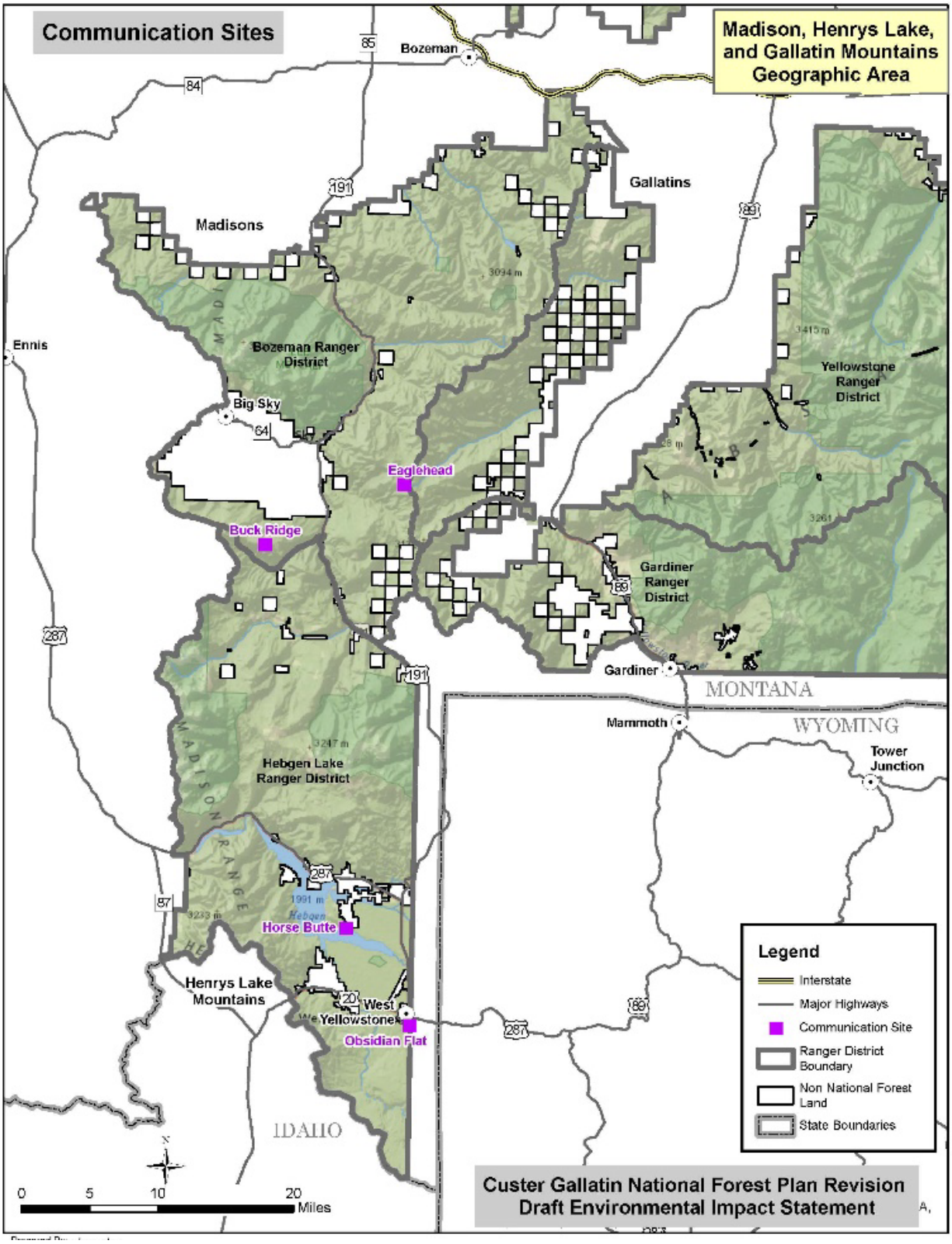

Figure 6. Communication sites on the Madison, Henrys Lake, Gallatin Mountains Geographic Area

Water Uses

- Tools to help minimize effects of authorized facilities or improvements to fish, water and riparian resources may include requirements for screens, headgates, diversion monitoring devices, or fish-bypass systems in the authorization.
- Permit reissuance of existing hydropower support facilities located within the riparian management zones could reduce impacts on aquatic and riparian resources, by methods such as moving support facilities outside of riparian management zones or further from water bodies where feasible.

Appendix B: Maps

At this stage of the analysis, all of the maps are provided in appendix A of the Custer Gallatin Draft Environmental Impact Statement, and in some cases vary by alternative. To avoid duplication, they are omitted from this appendix. Maps of the selected alternative will be included here when the revised forest plan is finalized at the end of the planning process.

Appendix C: Priority Watersheds and Conservation Watershed Network

Introduction

One of the original purposes for establishing the National Forest System was to protect our Nation's water resources. The 2012 Planning Rule includes a newly created set of requirements associated with maintaining and restoring watersheds and aquatic ecosystems, water resources, and riparian areas on the national forests. The increased focus on watersheds and water resources in the 2012 Planning Rule reflects the importance of this natural resource, and the commitment to stewardship of our waters.

The 2012 Planning Rule requires that plans identify watersheds that are a priority for restoration and maintenance. The 2012 Planning Rule requires all plans to include components to maintain or restore the structure, function, composition, and connectivity of aquatic ecosystems and watersheds in the plan area, taking into account potential stressors, including climate change, and how they might affect ecosystem and watershed health and resilience.

Plans are required to include components to maintain or restore water quality and water resources, including public water supplies, groundwater, lakes, streams, wetlands, and other bodies of water. The planning rule requires that the Forest Service establish best management practices for water quality, and that plans ensure implementation of those practices.

Plans are also required to include direction to maintain and restore the ecological integrity of riparian areas. The Custer Gallatin National Forest proposes to maintain riparian areas through ecological desired conditions striving to maintain ecosystems as a whole as well as specific riparian and aquatic standards, guidelines, and management approaches. This direction will also protect native fish and further strengthen the watershed condition framework priority watersheds and Watershed Conservation Network.

Watershed Condition Framework

In 2011, sixth-level watersheds (typically 10,000 to 40,000 acres) across all National Forest lands were classified using the national watershed condition framework. This framework was designed to be a consistent, comparable, and credible process for improving the health of watersheds across all National Forest lands. The first step was to rate the watershed condition of each watershed, utilizing existing data, knowledge of the land, and professional judgment. Watersheds were rated using a set of indicators of geomorphic, hydrologic, and biotic integrity relative to potential natural condition. The ratings are entered into a computer database, which generates an overall rating for each watershed. The results are also used to create a watershed condition class map.

Geomorphic functionality or integrity is defined in terms of attributes such as slope stability, soil erosion, channel morphology, and other upslope, riparian, and aquatic habitat characteristics. Hydrologic functionality or integrity relates primarily to flow, sediment, and water-quality attributes. Biological functionality or integrity is defined by the characteristics that influence the diversity and abundance of aquatic species, terrestrial vegetation, and soil productivity.

In each case, integrity is evaluated in the context of the natural disturbance regime, geoclimatic setting, and other important factors within the context of a watershed. The definition encompasses both aquatic and terrestrial components because water quality and aquatic habitat are inseparably related to the integrity and functionality of upland and riparian areas within a watershed. The three watershed classes are as follows:

- Class 1- functioning properly: watersheds exhibit high geomorphic, hydrologic, and biotic integrity relative to their natural potential condition.
- Class 2 functioning-at-risk: watersheds exhibit moderate geomorphic, hydrologic, and biotic integrity relative to their natural potential condition.
- Class 3 impaired: watersheds exhibit low geomorphic, hydrologic, and biotic integrity relative to their natural potential condition.

In this framework, a watershed is considered in good condition if it is functioning in a manner similar to one found in natural wildland conditions. This characterization would not be interpreted to mean that managed watersheds cannot be in good condition. A watershed is considered to be functioning properly if the physical attributes are appropriate to maintain or improve biological integrity. This consideration implies that a class 1 watershed in properly functioning condition has minimal undesirable human impact on natural, physical, or biological processes and is resilient and able to recover to the desired condition when or if disturbed by large natural disturbances or land management activities. By contrast, a class 3 watershed has impaired function because some physical, hydrological, or biological threshold has been exceeded. Substantial changes to the factors that caused the degraded state are commonly needed to set them on a trend or trajectory of improving conditions that sustain physical, hydrological, and biological integrity.

The Custer Gallatin National Forest is located in 269 subwatersheds. Eighty-one of these are in pine savanna geographic areas, while 188 are in montane geographic areas. Following the watershed condition class protocol in 2016, 221 watersheds were rated as functioning properly, 48 watersheds were rated as functioning at risk, and none were rated as impaired. Of the functioning at risk watersheds 20 were in pine savanna geographic areas, while 28 were in montane geographic areas. Table 6 is a summary of watershed condition classes across the Custer Gallatin National Forest by geographic area.

Table 6. 6th level watersheds rated in each condition class using the watershed condition framework

Geographic Area	Class 1	Class 2	Class 3	Total
Sioux	35	7	0	42
Ashland	26	13	0	39
Pryor Mountains	9	0	0	9
Absaroka Beartooth Mountains	72	12	0	84
Bridger, Bangtail, and Crazy Mountains	24	11	0	25
Madison, Henrys Lake, and Gallatin Mountains	55	5	0	60
Total	**221**	**48**	**0**	**269**

The next step of the watershed condition framework was to use the watershed condition class data to identify priority watersheds, develop watershed action plans, and implement projects to maintain or restore conditions in priority watersheds. Since the onset of the watershed condition framework the

Custer Gallatin National Forest has moved 3 priority watersheds to an improved state which include Pass Creek, Upper South Fork Sixteen Mile Creek, and Odell Creek.

Benefits from implementing the watershed condition framework are as follows:

- Strengthens the effectiveness of Forest Service watershed restoration.
- Establishes a consistent, comparable, credible process for determining watershed condition class.
- Enables a priority-based approach for the allocation of resources for restoration.
- Improves Forest Service reporting and tracking of watershed condition.
- Enhances coordination with external agencies and partners.

Priority Watersheds

Current forest priority watersheds on the Custer Gallatin National Forest are displayed in table 7. Future priority watersheds will be re-evaluated and determined throughout the life of this plan based on budget, partnerships, public input, and resource needs.

Priority areas for potential restoration activities could change quickly because of events such as wildfire or the introduction of invasive species. Therefore, the 2012 Planning Rule includes priority watersheds as plan content, so that an administrative change could be used to quickly respond to changes in priority.

Table 7. Current priority watersheds on the Custer Gallatin National Forest

HUC 6 Watershed Name	Attributes Rated at Risk in Watershed Condition Framework Assessment	Partnerships	Notes
Bozeman Creek	Water quality and quantity (303d listed); channel shape and function; non-native species; FRDD rating of at-risk; Insect and disease puts Forest Health at-risk; road density	City of Bozeman, Montana Fish Wildlife and Parks, Montana Department of Natural Resources	Opportunity for forest and riparian area restoration through treatments
Upper Hyalite Creek	Water quality and quantity (303d listed); channel shape and function; non-native species; FRDD rating of at-risk; Insect and disease puts forest health at-risk; road density	City of Bozeman, Montana Fish Wildlife and Parks, Montana Department of Natural Resources	Opportunity for forest and riparian area restoration through treatments
Shields River-Bennett Creek	Water quality; habitat fragmentation; channel form and function; nonnative species; FRCC rating at-risk;	Montana Fish Wildlife and Parks	Opportunity to conserve Yellowstone cutthroat trout by eradicating non-native brook trout as a barrier was installed in 2016; reduce sedimentation and increase fish passage by installing aquatic organism passages

Restoration of Impaired Waterbodies

In 1972 Congress passed the Water Pollution Control Act, more commonly known as the Clean Water Act. Its goal is to “restore and maintain the chemical, physical, and biological integrity of the Nation’s waters.” The Clean Water Act requires each state to set water quality standards to protect designated

beneficial water uses and to monitor the attainment of those uses. Fish and aquatic life, wildlife, recreation, agriculture, industrial, and drinking water are all types of beneficial uses. Streams and lakes (also referred to as waterbodies) that do not meet the established standards are called "impaired waters." These waters are identified on the 303(d) list, named after Section 303(d) of the Clean Water Act, which mandates the monitoring, assessment, and listing of water quality limited waterbodies.

Both Montana state law (75 MCA § 5-703) and section 303(d) of the Federal Clean Water Act require the development of total maximum daily loads for impaired waters where a measurable pollutant (for example, metals, nutrients, e. coli) is the cause of the impairment. A total maximum daily load is a loading capacity and refers to the maximum amount of a pollutant a stream or lake can receive and still meet water quality standards.

The Montana Water Quality Act requires the Montana Department of Environmental Quality to develop total maximum daily loads for streams and lakes that do not meet, or are not expected to meet, Montana water quality standards. The Montana Department of Environmental Quality submits the total maximum daily loads to the United States Environmental Protection Agency for approval. Total maximum daily loads provide an approach to improve water quality so that streams can support and maintain their state-designated beneficial uses.

According to the Montana Department of Environmental Quality 303(d) list, 34 stream segments on the Custer Gallatin National Forest are not meeting water quality standards (table 8). Sixteen of these are listed for agriculture related impacts, 8 are mining or abandoned mine land related, 3 are natural, 3 are forest roads, 2 are irrigation, and the remaining 2 are land development impacts. A 303 (d) listing does not necessarily indicate that Forest Service practices are contributing to the listing even when a stream segment intersects Forest Service lands. First a 303 (d) listing can, and does occur, when an initial analysis indicates there may be an impairment to beneficial use (s). It can then take the Montana Department of Environmental Quality some time, as complex analysis of this sort often do, to investigate this thoroughly and come up with a definitive conclusion sometimes leading to that stream being taken back off the list. Second when impairment has indicated Custer Gallatin National Forest may be contributing to impairment the Custer Gallatin National Forest has a history of addressing and resolving those issues. For example Upper Taylor Creek (HUC 100200080107) and Lower Taylor Creek (HUC 100200080108) are on the 303 (d) list for sediment input to streams from Forest Service roads (as far as Forest Service impacts are concerned). The Forest Service has invested millions of dollars in those drainages decommissioning and re-routing roads, replacing culverts, and improving road surfaces substantially decreasing Forest Service road sediment sources such that all reasonable land, soil and water conservation practices are satisfied for these roads in a manner that is consistent with state law and eventual recovery from sediment impairment to the stream. Impairment can no longer be attributed to on-going practices yet those streams remain on the list.

Table 8. 303(d) listed stream segments by geographic area*

Geographic Area	Number of stream segments	Sources of Pollutants	TMDL Assessments
Sioux	0	n/a	n/a
Ashland	1	Natural sources	Otter Creek
Pryor Mountains	0	n/a	n/a
Absaroka Beartooth Mountains	12	Largely impacts from mining and abandoned mine land.	Boulder River, Clarks Fork Yellowstone River
Bridger, Bangtail, and Crazy Mountains	9	Primarily agriculture and grazing.	Bear Creek, Jackson Creek, Bridger Creek, Shields River
Madison, Henrys Lake, and Gallatin Mountains	13	Primarily natural sources and forest road construction. Some silvicultural activities and grazing. Land development in the Big Sky area, none of which is on National Forest lands.	Hyalite Creek, West Fork Gallatin, South Fork West Fork Gallatin

*Montana Department of Environmental Quality 303 listing will change throughout the life of this plan.

Conservation Watershed Network

A conservation watershed network is a designated collection of watersheds where management emphasizes habitat conservation and restoration to support native fish and other aquatic species. The goal of the network is to sustain the integrity of key aquatic habitats to maintain long-term persistence of native aquatic species. Designation of conservation watershed networks, which could include watersheds that are already in good condition or could be restored to good condition, are expected to protect native fish and help maintain healthy watersheds and river systems. Selection criteria for inclusion could help identify those watersheds that have the capability to be more resilient to ecological change and disturbance induced by climate change. For example, watersheds containing unaltered riparian vegetation will tend to protect streambank integrity and moderate the effects of high stream flows. Rivers with high connectivity and access to their floodplains will experience moderated floods when compared to channelized and disconnected stream systems. Wetlands with intact natural processes slowly release stored water during summer dry periods, whereas impaired wetlands are likely less effective retaining and releasing water over the season. For all of these reasons, conservation watershed networks represent the best long-term conservation strategy for native fish and their habitats.

Many watersheds in the Absaroka Beartooth Mountains and the Madison, Henrys Lake, and Gallatin Mountains geographic areas that support healthy populations of native trout or other aquatic organisms already have their headwaters protected through lands managed as Congressionally-designated wilderness areas (Absaroka Beartooth and Lee Metcalf Wilderness). Several watersheds in the Ashland and Sioux geographic areas have perennial waters with native fish and other aquatic species present. These locations are the building blocks of a conservation network as naturally functioning headwaters have a large influence on the function of downstream stream reaches.

The best available science indicates the Custer Gallatin National Forest is and will be an important stronghold for conservation of native salmonids (westslope and Yellowstone cutthroat trout) across their range and also will be important habitat for native warm-water prairie fish ecosystems in the pine savanna ecoregions. For montane watersheds, Montana Fish Wildlife and Parks and Forest Service data

were used to identify watersheds with larger metapopulations of westslope and Yellowstone cutthroat trout, isolate populations of westslope and Yellowstone cutthroat trout above natural or constructed barriers, and watersheds with potential of cutthroat projects in the future. Data collected by the Forest Service from 2015 to 2017 was examined to identify watersheds that consistently have an assemblage of native fish and perennial water in the pine savanna geographic areas. These watersheds were included as part of the conservation watershed network displayed in table 9 and in figure 7 through figure 12.

Table 9. Conservation Watershed Network subwatersheds

Subwatershed/6th Code HUC (HUC #)	6th Code HUC Acres
Sioux Geographic Area Subwatersheds	
Plum Creek (101102010802)	12819
Slick Creek (101102010803)	37776
Snow Creek (1011020509)	12658
Speelmon Creek (101102020505)	17718
Upper Crooked Creek (101303010104)	18,033
Ashland Geographic Area Subwatersheds	
Brian Creek-Otter Creek (100901020210)	36063
Horse Creek-Otter Creek (100901020203)	21592
Odell Creek (100901020406)	29692
Taylor Creek (100901020205)	29059
Pryor Mountains Geographic Area Subwatersheds	
Commissary Creek-Crooked Creek (100800100501)	13,739
Lost Water Creek-Crooked Creek (100800100501)	21,618
North Fork Sage Creek-Sage Creek (100800140401)	31,025
Piney Creek-Sage Creek (100800140404)	38,861
Upper Dry Head Creek (100800100801	22,737
Absaroka Beartooth Mountains Geographic Area Subwatersheds	
Bad Canyon Creek (100700050502)	12,244
Bear Creek (100700010901)	31,133
Cedar Creek (100700020104)	13,774
East Fork Mill Creek (100700020304)	20,923
Elbow Creek (100700020401)	18,833
Falls Creek (100700020801)	9338
Fishtail Creek (100700050401)	24,113
Fourmile Creek (100700020903)	20,118
Limestone Creek (100700050202)	31726
Line Creek (100700060511)	24,881
Lower Hellroaring Creek (100700010805)	23,017
Lower Mill Creek (100700020305)	22,257
Lower West Boulder River (100700020805)	30,786
Lower West Fork Rock Creek (100700060905)	22,567
Lower Tom Miner Creek (100700020106)	27,510
Lower Upper Deer Creek (100700021402)	21,783

Subwatershed/6th Code HUC (HUC #)	6th Code HUC Acres
Lower West Fork Stillwater River (100700050203)	14773
Middle Hellroaring Creek (100700010803)	25,210
Middle Slough Creek(100700010706)	36,803
Middle West Boulder River (100700020804)	17,044
Passage Creek (100700020301)	13,586
Reese Creek-Yellowstone River (100700010902)	28,501
Sixmile Creek (100700020205)	30,520
Trout Creek (100700050504)	16,873
Upper East Boulder River (100700020701)	36,219
Upper Lower Deer Creek (100700021404)	16,382
Upper Hellroaring Creek (100700010802)	28,619
Upper Mill Creek (100700020302)	21,591
Upper Slough Creek (100700010705)	30,026
Upper Soda Butte Creek (100700010702)	37,564
Upper Tom Miner Creek (100700020105)	14,318
Upper Upper Deer Creek (100700021401)	16,360
Upper West Boulder River (100700020802)	16,996
Upper West Fork Rock Creek (100700060904)	21,136
West Fork Mill Creek (100700020303)	25,895
West Fork Red Lodge Creek (100700061001)	30,089
Willow Creek (100700061005)	32,362
Woodbine Creek-Stillwater River (100700050105)	40,510
Bridger, Bangtail, and Crazy Mountains Geographic Area Subwatersheds	
Bangtail Creek (100700030502)	8,260
Bennet Creek-Shields River (100700030301)	31,910
Canyon Creek (100700030501)	14,015
Carrol Creek (100700030201)	19,184
Cottonwood Creek (100700030402)	23,515
Elk Creek (100901020208)	19,754
Lower Bridger Creek (100200080802)	13,553
Muddy Creek (100700030204)	13,470
Rock Creek (100700030405)	33,902
Smith Creek (100700030302)	15,908
Upper Bracket Creek (100700030403)	27605
Upper Flathead Creek (100700030202)	14,650
Upper South Fork Sixteen Mile Creek (100301010201)	17,124
Willow Creek (100700030503)	19,888
Madison, Henrys Lake, and Gallatin Mountains Geographic Area Subwatersheds	
Bacon Rind Creek (100200080104)	10396
Bozeman Creek (100200080904)	33,236
Buck Creek (100200080303)	14651
Cabin Creek (100200070401)	19488

Subwatershed/6th Code HUC (HUC #)	6th Code HUC Acres
Deer Creek-Gallatin River (100200080306)	24535
Elkhorn Creek-Gallatin River (100200080302)	15,980
Grayling Creek (100200070305)	32,750
Hebgen Lake (100200070307)	40,373
Lower Big Creek (100700020203)	22,649
Lower Taylor Fork (100200080108)	28154
Middle Cherry Creek (100200071402)	11,180
Middle South Fork Madison River (100200070204)	15,933
North Fork Spanish Creek (100200080401)	20,788
Porcupine Creek (100200080305)	16927
Rock Creek (100700020201)	18,233
Tepee Creek (100200070306)	14,398
Upper Beaver Creek (100200070402)	18,649
Upper Cherry Creek (100200071401)	13,265
Upper Hyalite Creek (100200081001)	31,067
Upper South Fork Madison River (100200070203)	31715
Upper Taylor Fork (100200080107)	34639

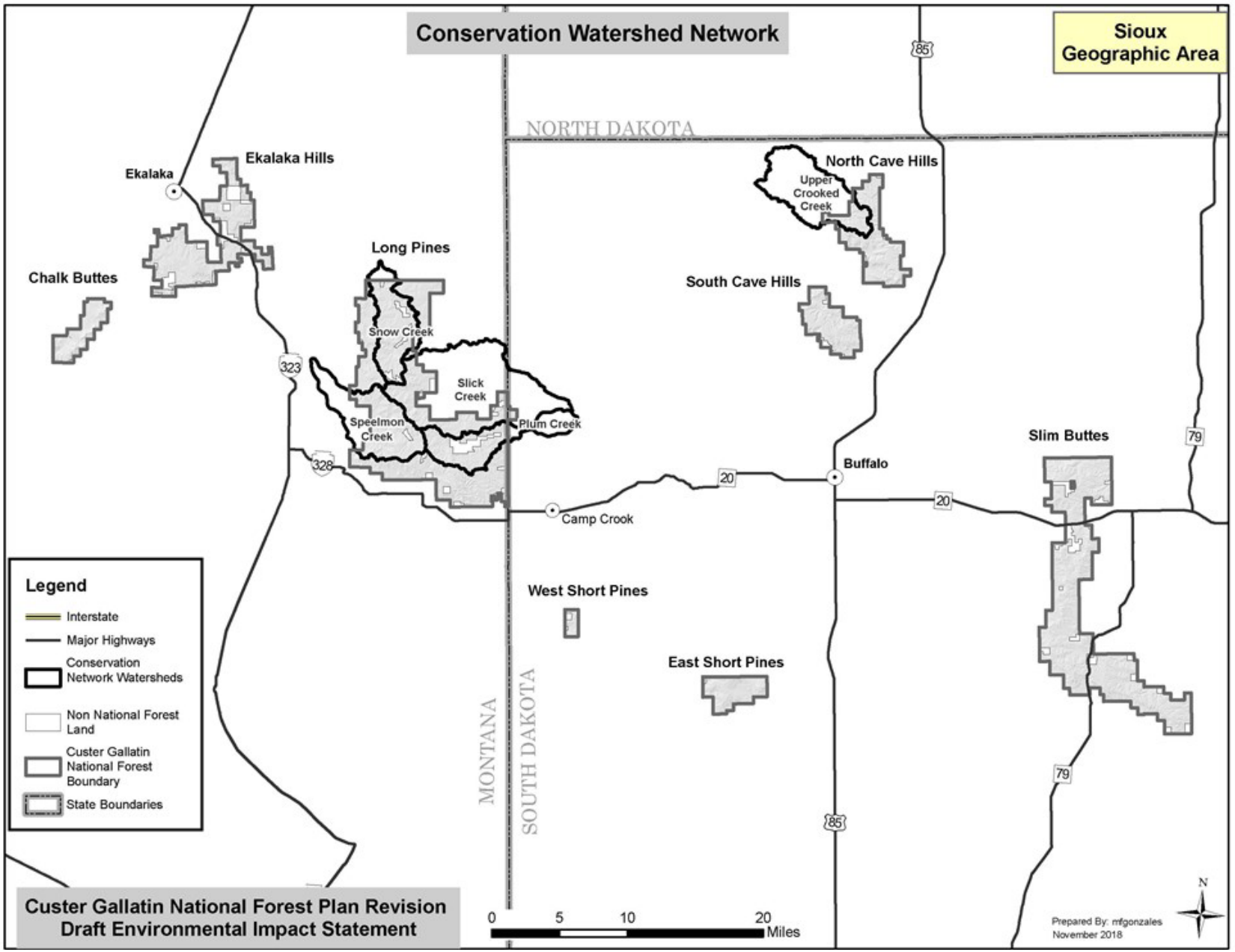

Figure 7. Conservation Watershed Network Sioux Geographic Area

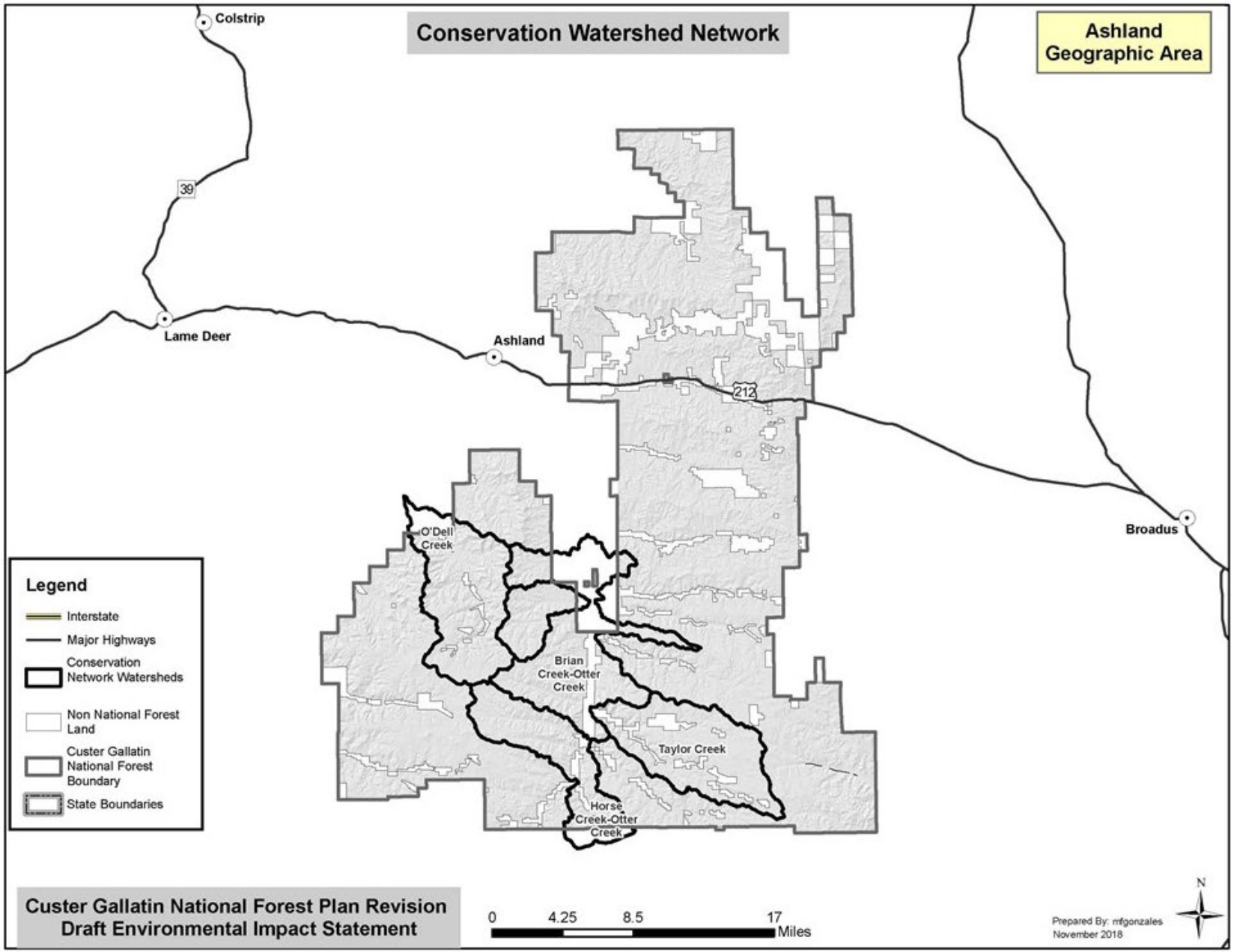

Figure 8. Conservation Watershed Network Ashland Geographic Area

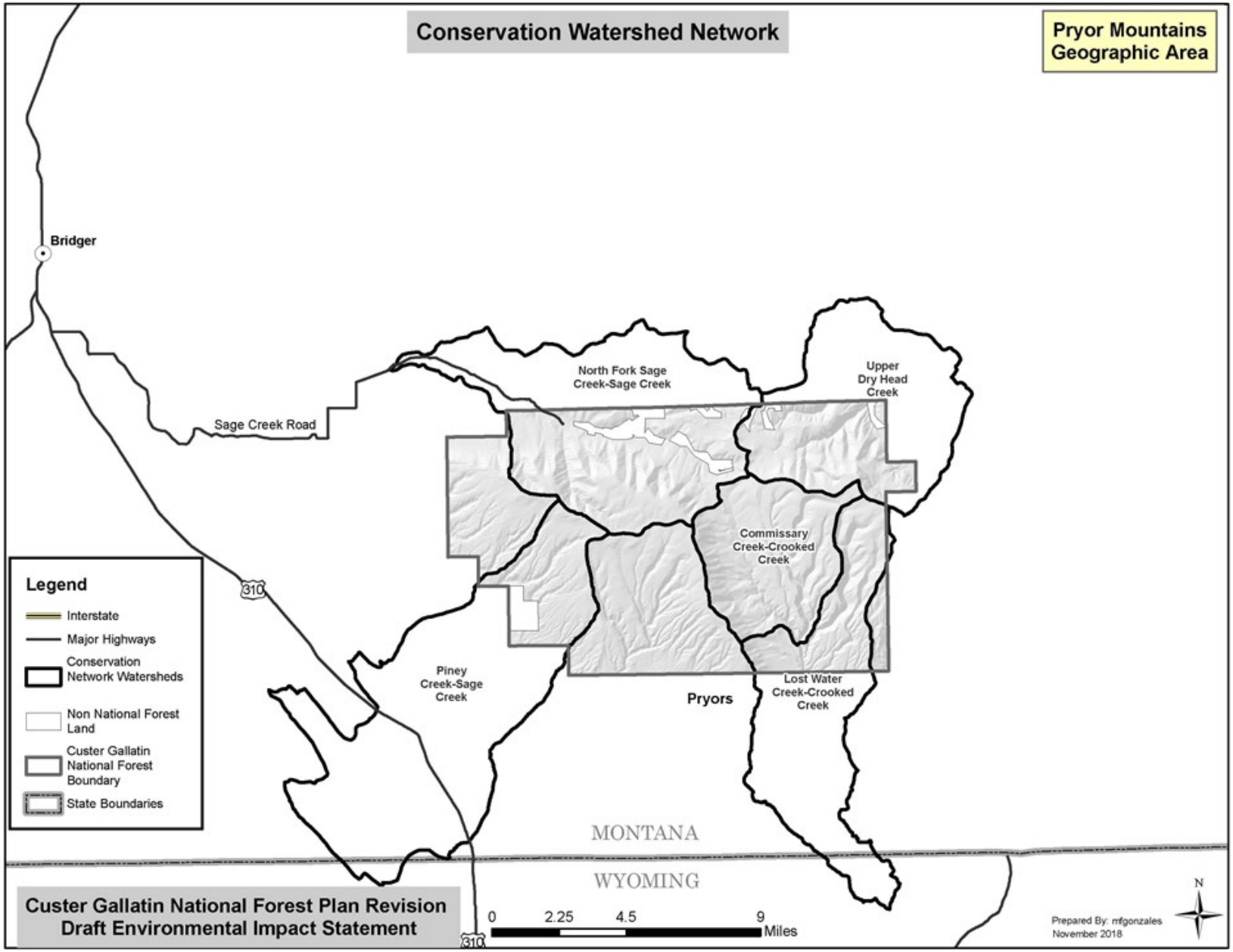

Figure 9. Conservation Watershed Network Pryor Mountains Geographic Area

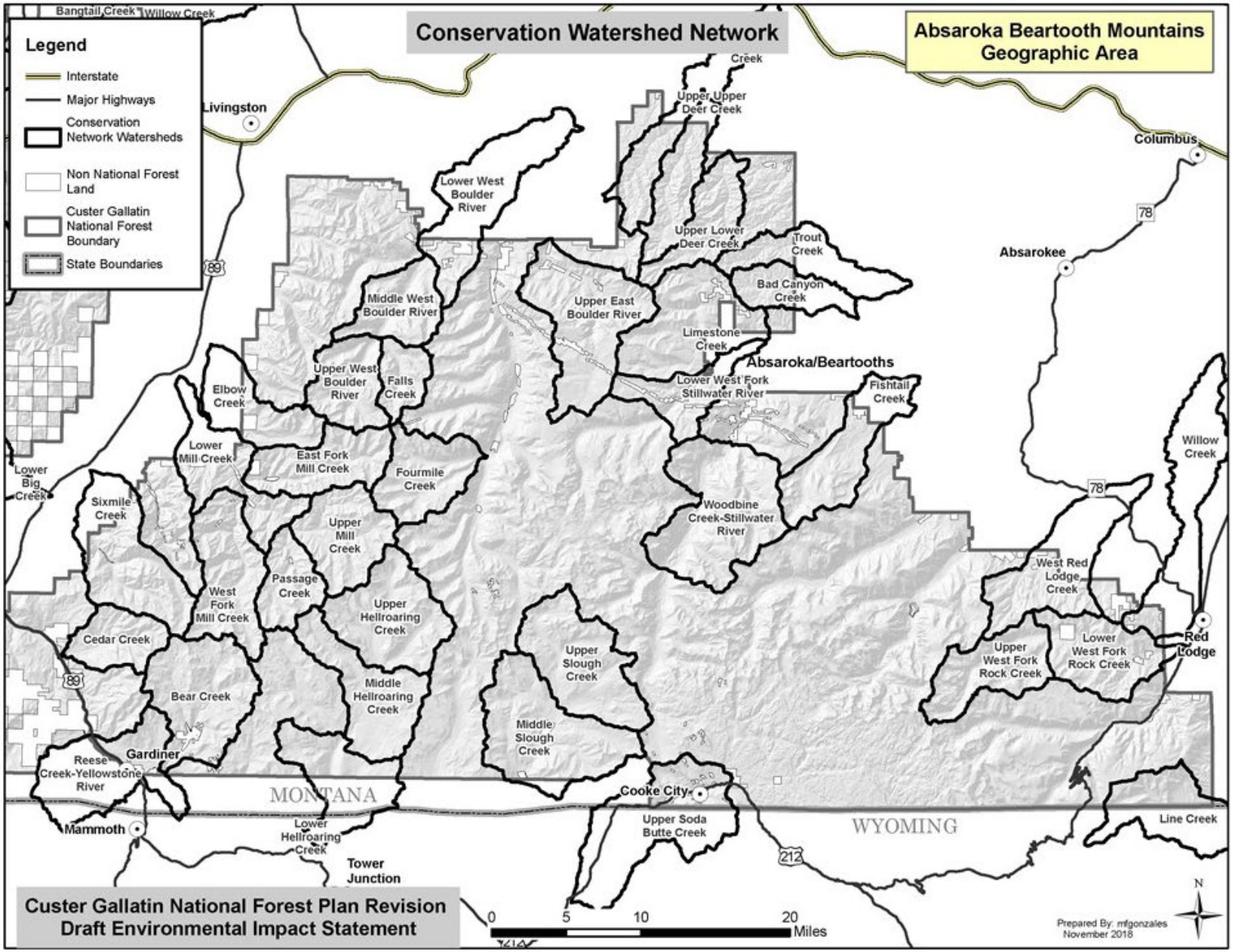

Figure 10. Conservation Watershed Network Absaroka Beartooth Mountains Geographic Area

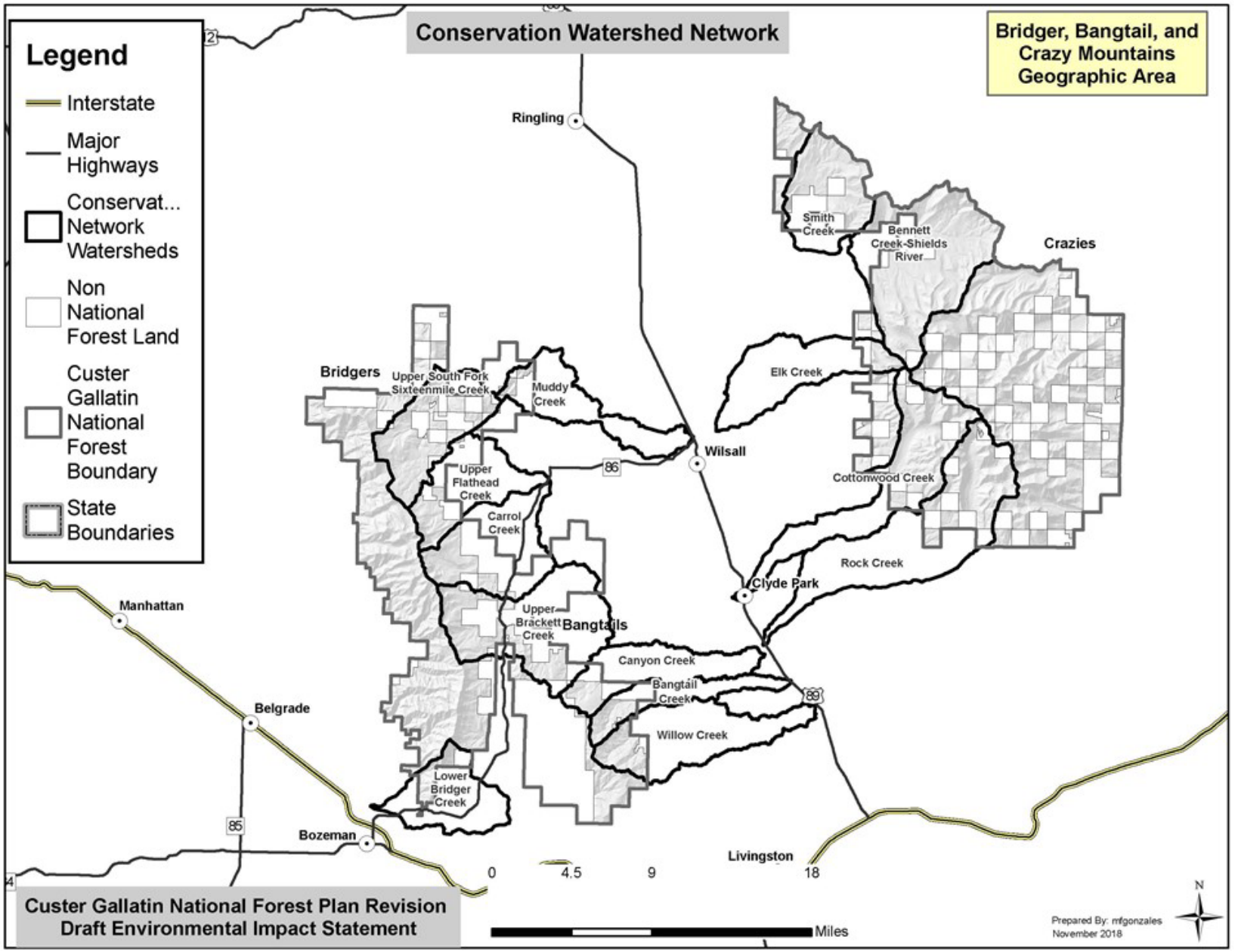

Figure 11. Conservation Watershed Network Bridger, Bangtail, and Crazy Mountains Geographic Area

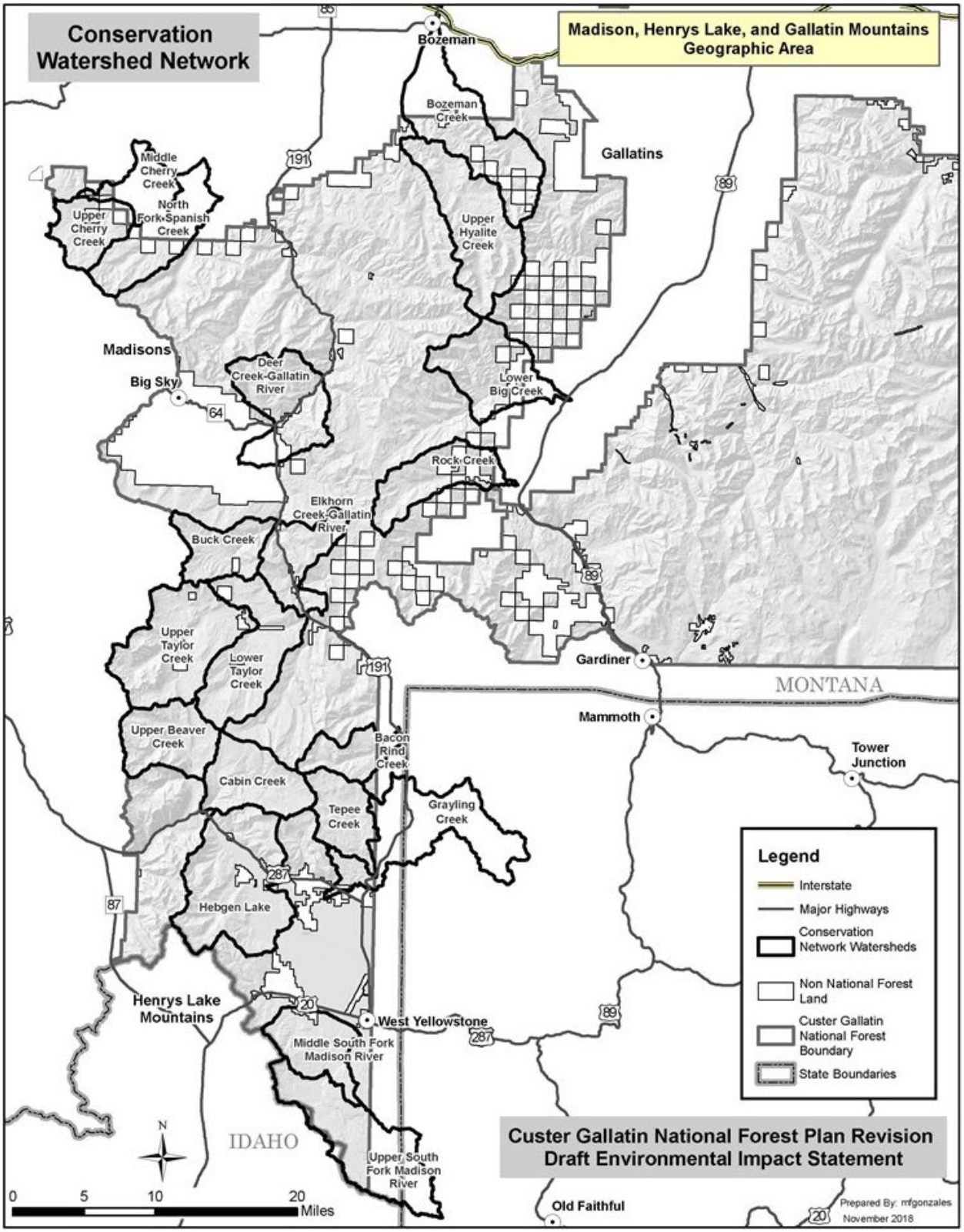

Figure 12. Conservation Watershed Network Madison, Henrys Lake, and Gallatin Mountains Geographic Area

Appendix D: Vegetation Classifications and Development of Vegetation Plan Components

Introduction

This appendix describes in detail the vegetation classifications and plant communities upon which many plan components are built, forming the basis for many forest plan components related to vegetation and wildlife habitat. This appendix also describes the process by which the natural range of variation was developed or modeled for vegetation attributes, and used to inform desired conditions.

Vegetation Classifications

Lands across the Custer Gallatin National Forest have been grouped into broad potential vegetation types, based on climatic and site conditions. Potential vegetation types serve as a basis for description of ecological conditions across the national forest. These groups are useful in understanding the various ecosystems, their potential productivity, natural biodiversity, and processes. Potential vegetation types are essentially assemblages of habitat types, which are aggregations of ecological sites of like biophysical environments (such as climate, aspect, and soil characteristics) that produce plant communities of similar composition, structure and function (Pfister et al. 1977, Mueggler and Stewart 1980, Hansen and Hoffman 1988). The vegetation communities that would develop over time given no major disturbances (the climax plant community) would be similar within a habitat type or potential vegetation type. However, existing vegetation condition may vary widely on a potential vegetation type, reflecting each site's unique history, forest character, pattern of disturbances, and point in time along the successional pathways. Therefore, plan components also use classifications of cover types, which are assemblages of existing vegetation that occur at any one point in time. Cover types change through time whereas potential vegetation types generally remain constant.

A consistent hierarchy of broad potential vegetation type and cover type was developed for Custer Gallatin National Forest plan revision (Reid et al. 2018). This system is based on the Northern Region Existing and Potential Vegetation Groupings used for Broad-level Analysis and Monitoring (Milburn et al. 2015). Potential vegetation types and cover types are classified for plot data and map products. Estimates are made using plot data that is summarized with Northern Region analysis tools (Bush 2014). Attributes are also approximated on maps to understand the distribution and connectivity on the landscape. Mapping of potential vegetation types was completed across the Northern Region using data sources that included field plots, remote sensing, and modeling. Mapping of cover types is derived from dominance types classified in the Northern Region Vegetation Map (Brown 2016). The Northern Region Vegetation Map is a spatially explicit, polygon-based vegetation map derived from remotely sensed data that contains information about the extent, composition, and structure of vegetation across National Forest System lands in Northern Region. The Custer Gallatin National Forest's vegetation map used for analysis is a compilation of the Northern Region Vegetation Map and the Northern Region Broad Potential Vegetation Map.

Table 10 and the following sections describing potential vegetation types show the classification for Northern Region broad potential vegetation types for forested and non-forested vegetation, based on (Reid et al. 2018).

Table 10. Potential vegetation type classification for forested habitat types[1] found on the Custer Gallatin National Forest

Northern Region Broad Potential Vegetation Type	Northern Region Habitat Type Groups	Northern Region Potential Vegetation Types[1]	Automatic Data Processing Habitat Type Code[2]
Warm Dry	Hot Dry	limber pine	091[3], 092[3], 093[3], 095[3]
Warm Dry	Warm Dry	ponderosa pine	100, 110, 130, 140, 141, 142, 160,161, 162
		Douglas fir 1	200, 210, 220
		Douglas fir 2	311, 380
		Douglas fir 3	321
		ponderosa pine	180, 181, 182
Warm Dry	Mod Warm Dry	ponderosa pine	170, 171, 172
		spruce	430
		Douglas fir 2	260, 261, 262, 280,281, 292, 310, 312, 313
		Douglas fir 3	320, 321, 323, 330, 340, 360, 370
Warm Dry	Mod Warm Mod Dry	Douglas fir 2	290
Cool Moist	Cool Moist	subalpine fir 2	600, 660, 661, 663,670, 740
		spruce	400, 460, 461, 470
Cool Moist	Cool Wet	subalpine fir 1	630, 650, 651, 653
		spruce	410, 440, 480
Cool Moist	Cool Mod Dry to Moist	subalpine fir 2	661, 663, 740
		subalpine fir 3	691, 720, 750, 770, 780, 790, 791, 792
		spruce	450
		lodgepole pine	900, 910, 930, 950
Cold	Cold	subalpine fir 3	731, 732, 733
		subalpine fir 4	730,740, 800, 810, 820
		lodgepole pine	940
Cold	Timberline	whitebark pine	850, 870

1. R1 potential vegetation types based on "Jones" metadata logic and labels.
2. Automatic Data Processing Code (habitat type publications) - includes all codes from valid references in Northern Region for use with NRM FSVeg. Unless otherwise specified, codes are from 101 (Forest Habitat Types of Montana, Pfister and others 1977)
3. Reference 199 = FSH 2409.21h R-1 Timber Management Data Handbook. Used in R1 until 2001.

Potential Vegetation Type Classification for Grassland Habitat Types

Northern Region Broad Potential Vegetation Type Xeric Grassland

Northern Region Habitat Type Group Bluebunch Wheatgrass

Habitat types classified by Hansen and Hoffman (1988):

- Needle and thread / threadleaf sedge habitat type (Sioux Ranger District)

[1] A habitat type is land that supports, or has the potential of supporting, the same reference condition vegetation type (association). A phase is a finer subdivision of a habitat type representing a minor variation in reference vegetation. In addition to habitat types, several major seral plant communities that are stable for time frames relevant to land management decisions have been described. These are referred to as community types.

- Needle and thread / sun sedge habitat type (Sioux Ranger District)
- Prairie sandreed / sun sedge habitat type (Sioux Ranger District)
- Western wheatgrass / threadleaf sedge habitat type (Sioux Ranger District)
- Western wheatgrass / green needlegrass habitat type (Sioux Ranger District)
- Little bluestem / threadleaf sedge (Sioux and Ashland Ranger Districts)
- Bluebunch wheatgrass / side-oats grama habitat type (Ashland Ranger District)
- Bluebunch wheatgrass / threadleaf sedge habitat type (Ashland Ranger District)
- Habitat types classified by Mueggler and Stewart (1980)
- Needle and thread grass/ blue grama habitat type (all Ranger Districts)
- Needle and thread grass/ blue grama habitat type – western wheatgrass phase (all Ranger Districts)
- Bluebunch wheatgrass/ blue grama habitat type (Ashland, Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)
- Bluebunch wheatgrass/ blue grama habitat type – liatris phase (Ashland, Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)
- Bluebunch wheatgrass / western wheatgrass habitat type (Ashland, Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)
- Bluebunch wheatgrass / western wheatgrass habitat type –green needlegrass phase (Ashland, Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)
- Bluebunch wheatgrass/ Sandberg bluegrass habitat type (Ashland, Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)
- Bluebunch wheatgrass/ Sandberg bluegrass – needle and thread grass (Ashland, Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)

Northern Region Broad Potential Vegetation Type Mesic Grassland

Northern Region Habitat Type Group Western Wheatgrass; Fescue

Habitat types classified by Hansen and Hoffman (1988):

- Idaho fescue / sun sedge habitat type (Ashland Ranger District)

Habitat types classified by Mueggler and Stewart (1980):

- Idaho fescue /western wheatgrass habitat type (Ashland, Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)
- Idaho fescue / bluebunch wheatgrass habitat type (Ashland, Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)
- Idaho fescue / slender wheatgrass habitat type (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)
- Idaho fescue / slender wheatgrass habitat type - sticky geranium phase (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)
- Idaho fescue / threadleaf sedge habitat type (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)

- Idaho fescue / Richardson's needlegrass habitat type (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)
- Idaho fescue / tufted hairgrass habitat type (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)
- Tufted hairgrass/sedge species habitat type (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)

Potential Vegetation Type Classification for Shrubland Habitat

Northern Region Broad Potential Vegetation Type Xeric Shrubland

Northern Region Habitat Type Group Xeric Shrubland

Habitat types classified by Hansen and Hoffman (1988):

- Skunkbrush / threadleaf sedge habitat type (Sioux Ranger District);
- Skunkbrush /bluebunch wheatgrass (Sioux Ranger District);
- Horizontal juniper / sun sedge habitat type (Sioux Ranger District)

Habitat types classified by Mueggler and Stewart (1980):

- Bitterbrush / bluebunch wheatgrass habitat type (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)
- Bitterbrush / Idaho fescue habitat type (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)
- Mountain mahagony / bluebunch wheatgrass habitat type (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)
- Skunkbrush/ bluebunch wheatgrass habitat type (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)
- Skunkbrush/ Idaho fescue habitat type (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)

Community Types

- Wood's rose
- Chokecherry
- Serviceberry

Northern Region Broad Potential Vegetation Type Xeric Shrubland

Northern Region Habitat Type Group Low Shrubland

Habitat types classified by Mueggler and Stewart (1980)

- Low sagebrush/ bluebunch wheatgrass habitat type
- Low sagebrush / bluebunch wheatgrass habitat type –needle and thread grass phase
- Low sagebrush / Idaho fescue;
- Black sage

Community types classified by Develice and Lesica (1993) Pryor Mountains

- Black sagebrush/bluebunch wheatgrass
- Birdfoot sage/bluebunch wheatgrass
- Birdfoot sage/Nuttall's saltbush

Northern Region Broad Potential Vegetation Type Xeric Shrubland

Northern Region Habitat Type Group Mountain Shrubland

Habitat types classified by Hansen and Hoffman (1988):

- Wyoming big sagebrush / bluebunch wheatgrass habitat type (Ashland Ranger District)
- Wyoming big sagebrush / western wheatgrass habitat type (Ashland Ranger District)

Habitat types classified by Mueggler and Stewart (1980)

- Wyoming sagebrush / bluebunch wheatgrass
- Wyoming sagebrush / Idaho fescue

Northern Region Broad Potential Vegetation Type Xeric Shrubland

Northern Region Habitat Type Group Mountain Shrubland

Habitat types classified by Mueggler and Stewart (1980):

- Mountain sagebrush / bluebunch wheatgrass
- Mountain sagebrush/ Idaho fescue

Northern Region Broad Potential Vegetation Type Xeric Shrubland

Northern Region Habitat Type Group Mountain Shrubland

Habitat types classified by Hansen and Hoffman (1988):

- Silver sage / western wheatgrass habitat type (Sioux and Ashland Ranger District)

Northern Region Broad Potential Vegetation Type Xeric Shrubland

Northern Region Habitat Type Group Xeric Shrubland

Habitat types classified by Mueggler and Stewart (1980)

- Mountain sagebrush/ bluebunch wheatgrass

Northern Region Broad Potential Vegetation Type Mesic Shrubland

Northern Region Habitat Type Group Mesic Shrubland

Habitat types classified by Hansen and Hoffman (1988):

- Greasewood / bluebunch wheatgrass (Ashland Ranger District)
- Greasewood / western wheatgrass habitat type (Ashland Ranger District)
- Western snowberry community type (Sioux and Ashland Ranger District)

- Silver buffaloberry community type (Sioux and Ashland Ranger District)

Habitat types classified by Mueggler and Stewart (1980)

- Shrubby cinquefoil /Idaho fescue habitat type (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)
- Greasewood / western wheatgrass habitat type (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)
- Greasewood / basin wildrye habitat type (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)

Community Types

- Ceanothus/ bluebunch wheatgrass,
- Mallow ninebark / serviceberry,
- Mallow ninebark /OSOC,
- Smooth sumac,
- Smooth sumac/ bluebunch wheatgrass,
- Snowberry /bluebunch wheatgrass,
- Snowberry /balsamroot,
- Snowberry/Idaho fescue,
- Snowberry/ gallium

Potential Vegetation Type Classification for Xeric Woodland Habitat

Northern Region Broad Potential Vegetation Type Xeric Woodland

Northern Region Habitat Type Group Mountain Mahogany Woodland

Habitat types classified by Mueggler and Stewart (1980) (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)

- Curl-leaf mountain mahogany/ bluebunch wheatgrass,
- Bitterbrush/ bluebunch wheatgrass,
- Bitterbrush/Idaho fescue,
- Skunkbrush/Idaho fescue,
- Rabbitbrush/ bluebunch wheatgrass,
- Horizontal juniper/little bluestem,
- Bitterbrush/ bluebunch wheatgrass

Northern Region Broad Potential Vegetation Type Xeric Woodland

Northern Region Habitat Type Group Juniper Woodland

Habitat types classified by Hansen and Hoffman (1988):

- Rocky Mountain juniper / bluebunch wheatgrass habitat type (Ashland Ranger District)

- Rocky Mountain juniper / littleseed ricegrass habitat type (Ashland Ranger District)

Community types classified by Develice and Lesica (1993) for Pryor Mountains (Beartooth Ranger District)

- Utah juniper/bluebunch weatgrass,
- Utah juniper/big sagebrush,
- Utah juniper/mountain mahagony,
- Rocky Mountain juniper/black sagebrush,
- Limber pine-Utah juniper,
- Limber pine – Rocky Mountain juniper,
- Limber pine/Idaho fescue,
- Limber pine/Common juniper

Potential Vegetation Type Classification for Riparian Areas and Wetlands

Northern Region Broad Potential Vegetation Type Riparian/ Wetland

Northern Region Habitat Type Group Riparian - Green Ash Woodland

Habitat types classified by Hansen and Hoffman (1988):

- Green ash / chokecherry habitat type (Sioux and Ashland Ranger Districts) (Non-riparian - green ash woodland)

Habitat types classified by Hansen and Hoffman (1988):

- Green ash / chokecherry habitat type (Sioux and Ashland Ranger Districts) (riparian - green ash woodland)

Habitat types/community types classified by Hansen et al. (1995):

- Northern Great Plains (Sioux and Ashland Ranger Districts)
- Green ash/common chokecherry habitat type
- Box-elder/common chokecherry habitat type

Northern Region Broad Potential Vegetation Type Riparian/Wetland

Northern Region Habitat Type Group Aspen Woodland

Habitat types classified by Hansen and Hoffman (1988):

- Aspen / Oregon grape habitat type (Sioux and Ashland Ranger Districts)
- Habitat types/community types classified by Hansen et al. (1995):

Northern Great Plains (Sioux and Ashland Ranger Districts)

- Quaking aspen/creeping Oregongrape habitat type
- Quaking aspen/red-osier dogwood habitat type
- Quaking aspen/ western sweet cicely habitat type

- Quaking aspen/Kentucky bluegrass community type

Rocky Mountains, Foothills, and Intermountain Valleys (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)

- Quaking aspen/red-osier dogwood habitat type
- Quaking aspen/bluejoint reedgrass habitat type
- Quaking aspen/western sweet-cicely habitat type
- Quaking aspen/Kentucky bluegrass community type

Northern Region Broad Potential Vegetation Type Riparian/ Wetland

Northern Region Habitat Type Group Riparian Deciduous Tree

Habitat types/community types classified by Hansen et al. (1995)

Northern Great Plains (Sioux and Ashland Ranger Districts)

- Great Plains cottonwood/recent alluvial bar community type
- Great Plains cottonwood/herbaceous community type
- Great Plains cottonwood/red-osier dogwood community type
- Great Plains cottonwood/western snowberry community type
- Black cottonwood/recent alluvial bar community type
- Black cottonwood/herbaceous community type
- Black cottonwood/red-osier dogwood community type
- Black cottonwood/western snowberry community type
- Narrow-leaf cottonwood/recent alluvial bar community type
- Narrow-leaf cottonwood/herbaceous community type
- Narrow-leaf cottonwood/red-osier dogwood community type
- Narrow-leaf cottonwood/western snowberry community type
- Peach-leaf will community type
- Russian olive community type

Rocky Mountains, Foothills, and Intermountain Valleys (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)

- Great Plains cottonwood/recent alluvial bar community type
- Great Plains cottonwood/herbaceous community type
- Great Plains cottonwood/red-osier dogwood community type
- Great Plains cottonwood/western snowberry community type
- Black cottonwood/recent alluvial bar community type
- Black cottonwood/herbaceous community type
- Black cottonwood/red-osier dogwood community type
- Black cottonwood/western snowberry community type
- Narrow-leaf cottonwood/recent alluvial bar community type
- Narrow-leaf cottonwood/herbaceous community type

- Narrow-leaf cottonwood/red-osier dogwood community type
- Narrow-leaf cottonwood/western snowberry community type
- Peach-leaf will community type
- Russian olive community type

Northern Region Broad Potential Vegetation Type Riparian/ Wetland

Northern Region Habitat Type Group Riparian Shrub

Habitat types/community types classified by Hansen et al. (1995):

Willow Communities – Northern Great Plains (Sioux and Ashland Ranger Districts)

- Yellow willow/beaked sedge habitat type
- Yellow willow/bluejoint reedgrass habitat type
- Yellow willow community type
- Bebb willow community type
- Sandbar will community type

Non-willow Communities – Northern Great Plains (Sioux and Ashland Ranger Districts)

- Shrubby cinquefoil/tufted hairgrass habitat type
- Silver sagebrush/western wheatgrass habitat type
- Black greasewood/western wheatgrass habitat type
- Thorny buffaloberry community type
- Succulent hawthorn community type
- Salt cedar community type
- Common chokecherry community type
- Woods rose community type
- Western snowberry community type

Willow Communities – Rocky Mountains, Foothills, and Intermountain Valleys (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)

- Yellow willow/beaked sedge habitat type
- Yellow willow/bluejoint reedgrass habitat type
- Yellow willow community typeefoil/tufted hairgrass habitat type
- Drummond will/beaked sedge habitat type
- Drummond will/bluegoint reedgrass habitat type
- Drummond willow community type
- Geyer willow/beaked sedge habitat type
- Geyer willow/bluejoint reedgrass habitat type
- Geyer willow community type
- Planeleaf willow/water sedge habitat type
- Hoary willow/beaked sedge habitat type
- Wolf's willow/water sedge habitat type

- Wolf's willow/tufted hairgrass habitat type
- Pacific willow community type
- Bebb willow community type
- Sandbar willow community type

Non-willow Communities – Rocky Mountains, Foothills, and Intermountain Valleys (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)

- Bog birch/beaked sedge habitat type
- Small-leaved laurel/Holm's Rocky Mountain sedge habitat type
- Shrubby cinquefoil/tufted hairgrass habitat type
- Silver sagebrush/Idaho fescue habitat type
- Rocky Mountain juniper/red-osier dogwood habitat type
- Black greasewood/western wheatgrass habitat type
- Water birch community type
- Mountain alder community type
- Sitka alder community type
- Thorny buffaloberry community type
- Succulent hawthorn community type
- Salt cedar community type
- Common chokecherry community type
- Red-osier dogwood community type
- Douglas's spiraea community type
- Woods rose community type
- Western snowberry community type

Northern Region Broad Potential Vegetation Type Riparian/ Wetland

Northern Region Habitat Type Group Wetland Graminoid

Habitat types/community types classified by Hansen et al. (1995):

Sedge Communities – Northern Great Plains (Sioux and Ashland Ranger Districts)

- Beaked sedge habitat type, including beaked sedge phase; water sedge phase, and tufted hairgrass phase;
- Water sedge habitat type with water sedge phase and tufted hairgrass phase
- Slender sedge habitat type
- Nebraska sedge community type

Non-sedge Communities – Northern Great Plains (Sioux and Ashland Ranger Districts)

- Common cattail habitat type
- Hardstem bulrush habitat type
- Common reed habitat type
- Reed canarygrass habitat type

- Norrthern mannagrass habitat type
- Prairie cordgrasss (or alkali cordgrass) habitat type
- Alkali bulrush (or American bulrush) habitat type
- Common spikesedge (or need spike-rush) habitat type
- Inland saltgrass habitat type
- Western wheatgrass habitat type
- American licorice community type

Seral or Human Disturbance community types - Northern Great Plains (Sioux and Ashland Ranger Districts)

- Water smartweed
- Red glasswort
- Fowl bluegrass
- Smooth brome
- Baltic rush
- Redtop
- Foxtail barley
- Kentucky bluegrass

Sedge Communities – Rocky Mountains, Foothills, and Intermountain Valleys (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)

- Beaked sedge habitat type, including beaked sedge phase; water sedge phase, and tufted hairgrass phase;
- Water sedge habitat type with water sedge phase and tufted hairgrass phase
- Mud sedge habitat type
- Slender sedge habitat type
- Holm's Rocky Mtn sedge habitat type
- Nebraska sedge community type

Non-sedge Communities - Rocky Mountains, Foothills, and Intermountain Valleys (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)

- Common cattail habitat type
- Hardstem bulrush habitat type
- Common reed habitat type
- Reed canarygrass habitat type
- Water horsetail habitat type
- Northern mannagrass habitat type
- Common spikesedge habitat type
- Few-flowered spikesedge habitat type
- Bluejoint reedgrass habitat type
- Inland saltrass habitat type
- Western sheatgrass habitat type

Seral or Human Disturbance community types - Rocky Mountains, Foothills, and Intermountain Valleys (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)

- Arrowleaf groundsel community type
- Red glasswort community type
- Fowl bluegrass community type
- Smooth brome community type
- Baltic rush community type
- Redtop community type
- Foxtail barley community type
- Kentucky bluegrass community type

Northern Region Broad Potential Vegetation Type Riparian/ Wetland

Northern Region Habitat Type Group Riparian Deciduous Tree

Habitat types/community types classified by Hansen et al. (1995):

Rocky Mountains, Foothills, and Intermountain Valleys (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)

- Great Plains cottonwood/recent alluvial bar community type
- Great Plains cottonwood/herbaceous community type
- Great Plains cottonwood/red-osier dogwood community type
- Great Plains cottonwood/western snowberry community type
- Black cottonwood/recent alluvial bar community type
- Black cottonwood/herbaceous community type
- Black cottonwood/red-osier dogwood community type
- Black cottonwood/western snowberry community type
- Narrow-leaf cottonwood/recent alluvial bar community type
- Narrow-leaf cottonwood/herbaceous community type
- Narrow-leaf cottonwood/red-osier dogwood community type
- Narrow-leaf cottonwood/western snowberry community type
- Peach-leaf will community type
- Russian olive community type

Potential Vegetation Type Classification for Alpine Habitats

Northern Region Broad Potential Vegetation Type Alpine

Northern Region Habitat Type Group Alpine Herbaceous and Alpine Shrub

Alpine Communities from Cooper et al. (1997)(Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts)

- Alpine shrublands;
- Alpine turf;

- Alpine grassland;
- Cushion plant communities;
- Alpine slope communities;
- Snowbed communities;
- Alpine wetlands

Alpine Plant Associations of the Beartooths classified by Williams (2012) (Beartooth Ranger District)

- Eight-petal mountain-avens (*Dryas octopetala var. hookeriana*)/rock sedge
- *Dryas octopetala var. hookeriana/Carex rupestris*
- *Helianthela uniflora-Astragalus alpinus*
- *Salix planifolia/Carex scopulorum*
- *Geum rossii var. turbinatum-Silene acaulis var. subacaulescens*
- *Carex phaeochephala/Sibbaldia procumbens*
- *Salix glauca var. villosa/Geum rossii var. turbinatum*
- *Salix reticulata var. nana/Polygonum viviparum*
- *Deschampsia cespitosa-Carex microptera-Carex macloviana*
- *Antennaria lanata-Hieracium triste var. gracile*
- *Picea engelmannii-Pinus albicaulis/Carex nardina*
- *Carex nigricans/Veronica wormskjoldii*
- *Senecio triangularis-Mertensia ciliata*
- *Senecio fremontii-Draba incerta*

Alpine Communities of Line Creek Plateau classified by Lesica, (1993) (Beartooth Ranger District)

- Festuca idahoensis/Geum rossii community type
- Carex elynoides community type
- Carex scirpoidea/Geum rossii community type
- Dryas octopetala/Carex rupestris community type
- Juncus drummondii/Antennaria lanata community type
- Salix glauca/Deschampsia caespitosa community type
- Salix planifolia/Carex paysonis community type
- Deschampsia caespitosa/Caltha leptosepala community type

Potential Vegetation Type Classification for Sparsely Vegetated Habitats

Northern Region Broad Potential Vegetation Type Sparse

Northern Region Habitat Type Group Sparse

Common plant associations of Great Plains Badlands (Sioux and Ashland Ranger Districts) from Montana Natural Heritage Program online database for Ecological Systems include:

- Greasewood (Sarcobatus vermiculatus)

- Gardner's saltbush (Atriplex gardneri)
- Few-flowered buckwheat (Eriogonum pauciflorum)
- Threadleaf snakweed (Gutierrezia sarothrae).

Graminoid cover is very sparse, but may include:

- Western wheatgrass (*Pascopyrum smithii*),
- Bluebunch wheatgrass (*Pseudoroegneria spicata*), and
- Indian ricegrass (*Achnatherum hymenoides*).

Common forbs include:

- Few-flowered buckwheat (*Eriogonum pauciflorum*),
- Threadleaf snakweed (*Gutierrezia sarothrae*),
- Hooker's sandwort (*Arenaria hookeri*),
- Bud sagebrush (*Picrothamnus desertorum*),
- Curlycup gumweed (*Grindelia squarrosa*),
- Longleaf wormwood (*Artemisia longfolia*), and
- Nutall's povertyweed (*Monolepis nuttalliana*).

Other shrubs that may be present include:

- Wyoming big sagebrush (Artemisia tridentata ssp. wyomingensis),
- Silver sagebrush (Artemisia cana),
- Rabbitbrush (Chrysothamnus viscidiflorus and Ericameria nauseosa), and
- Saltbush (Atriplex species).

Common plant associations of Rocky Mountain Cliff, Canyon and Massive Bedrock (Beartooth, Yellowstone, Gardiner, Bozeman, and Hebgen Lake Ranger Districts) from Montana Natural Heritage Program online database for Ecological Systems include:

- This system usually consists of scattered trees or shrubs such as Douglas-fir (*Pseudotsuga menziesii*), Ponderosa pine (*Pinus ponderosa*), limber pine (*Pinus flexilis*), aspen (*Populus tremuloides*), or subalpine fir (*Abies lasiocarpa*).
- Juniper (*Juniperus* spp.) is common at lower elevations.
- Shrubs adapted to xeric growing conditions and rocky soils are typically present, such as currant (*Ribes* species), common ninebark (*Physocarpus malvaceus*), wild rose (*Rosa* species), common juniper (*Juniperus communis*), Lewis mock orange (*Philadelphus lewisii*), creeping Oregon grape (*Mahonia repens*), three leaf sumac (*Rhus trilobata*), American wild raspberry (*Rubus idaeus*) or serviceberry (*Amelanchier alnifolia*).
- Woody colonizing vegetation is usually limited to the toeslopes of talus and scree slides or in protected pockets beneath cliff faces.
- Herbaceous plants inhabit both the talus and scree slides and fractures in the cliff faces.
- Forbs may include penstemon (*Penstemon species*), buckwheat (*Eriogonum species*), western sagewort (*Artemisia ludovicana*), Michaux's sagewort (*Artemisia michauxiana*), and spotted saxifrage (*Saxifraga bronchialis*).
- Graminoids may include slender wheatgrass (*Elymus trachycaulus*) and bluebunch wheatgrass (*Pseudoroegneria spicata*).

- Mosses and xeric-adapted ferns such as cliff fern (*Woodsia* species), holly fern (*Polystichium lonchitis*), and fragile fern (*Cystopteris fragilis*) occur in fractures of the bedrock, cliff faces or in toeslopes of unstable talus slides.
- Lichen cover can be high on larger size talus.

Table 11 provides the proportion of each Northern Region broad potential vegetation type that occurs within the geographic areas on the Custer Gallatin National Forest. There is variation in the proportion of each geographic area in the Northern Region broad potential vegetation type groups, which provides insight into the unique pattern of environmental, site, and vegetation conditions within each geographic area, and how they differ from one another.

Table 11. Percentage of broad potential vegetation types on National Forest System lands on the Custer Gallatin National Forest and by geographic area, in percent of area[1]

Northern Region Broad Potential Vegetation Type	Total Percentage Custer Gallatin	Ashland Percentage	Sioux Percentage	Pryor Mountains Percentage	Bridger / Bangtail and Crazy Mountains Percentage	Absaroka Beartooth Mountains Percentage	Madison, Gallatin and Henrys Lake Mountains Percentage
Warm Dry Forest	23	50	41	43	29	15	13
Cool Moist Forest	21	0	0	17	33	20	35
Cold Forest	21	0	0	0	10	28	32
Non-forest Potential Vegetation Types	35	50	59	40	28	37	20

1. Data is from Northern Region Vegetation Map (Brown 2016).

Table 12 shows the classification for cover types, based on Reid et al. (2018).

Table 12. Vegetation cover type classification for Northern Region dominance types

R1 Cover Type	Species included	DomMid40[1]	Dom Group 6040[1]
Ponderosa Pine	Ponderosa pine with components Douglas-fir, limber pine, juniper.	MX-PIFL2, MX-PIPO, or MX-JUNIP[2]	PIFL2, PIFL2-Imix, , PIFL2-Tmix, PIFL2-Hmix, PIPO, PIPO-Imix, PIPO-Tmix, PIPO-Hmix, JUNIP-Hmix, JUNIP-Tmix, or JUNIP- Imix[2]
Dry Douglas-fir[3]	Dry Douglas-fir (potential components of ponderosa pine, limber, and juniper).	(IMIX or MX-PSME) ***AND (Jones PVT = pifl, pipo, psme1, or psme) or (R1 Habitat type Group = Hot Dry or Warm Dry)***	(PSME, PSME-Imix, PSME-Hmixor IMIX) ***AND (PVT = pifl, pipo, psme1, or psme3) or (R1 Habitat type Group = Hot Dry or Warm Dry)***

R1 Cover Type	Species included	DomMid40[1]	Dom Group 6040[1]
Mixed Mesic Conifer[3]	Moist Douglas-fir, cedar, white pine, grand fir, western hemlock (potential components of lodgepole pine, spruce, subalpine fir).	MX-ABGR, MX-PIMO3, MX-THPL, MX-TSHE, MX-TSME, TMIX or [(MX-PSME or IMIX ***AND (PVT NOT pifl, pipo, psme1, or psme3) or (R1 Habitat Type Group is NOT Hot Dry or Warm Dry)***	ABGR, ABGR-Imix, ABGR-Tmix, ABGR-Hmix, PIMO3, PIMO3-Imix, PIMO3-Tmix, PIMO3-Hmix, PSME- Tmix, THPL, THPL-Imix, THPL-Tmix, THPL-Hmix, TSHE, TSHE-Imix, TSHE-Tmix, TSHE-Hmix, TSME, TSME-Imix, TSME-Tmix, TSME-Hmix, Tmix, or [(PSME, PSME-Imix, PSME-Hmix, or IMIX) ***(PVT NOT pifl, pipo, psme1, or psme3) or (R1 Habitat Type Group NOT Hot Dry or Warm Dry)***
Lodgepole Pine	Lodgepole pine (other minor components)	MX-PICO	PICO, PICO-Imix, PICO-Tmix, PICO-Hmix
Spruce/fir	Subalpine fir, Engelmann spruce (minor lodgepole component)	MX-ABLA,MX-PIEN, or MX- TABR2	ABLA, ABLA-Imix, ABLA-Tmix, ABLA-Hmix, PIEN, PIEN-Imix, PIEN- Tmix, PIEN-Hmix, TABR2, TABR2-Imix, TABR2-Tmix, TABR2-Hmix
Whitebark pine	Whitebark pine	MX-LALY or MX-PIAL	LALY, LALY-Imix, LALY-Tmix, LALY- Hmix, PIAL, PIAL-Imix, PIAL-Tmix, PIAL-Hmix
Aspen/Hardwood[4]	Aspen, green ash, cottonwood, birch (other minor conifer components)	MX-BEPA, HMIX, MX-FRPE, MX-POPUL, or MX- POTR5	BEPA, BEPA-Imix, BEPA-Tmix, BEPA-Hmix, Hmix, FRPE, FRPE-Imix, FRPE-Tmix, FRPE-Hmix, POPUL, POPUL-Imix, POPUl-Tmix, POPUL- Hmix, POTR5, POTR5-Imix, POTR5-Tmix, POTR5-Hmix
Riparian Grass/Shrub	Willow, alder, deciduous shrub mix; mountain brome; smooth brome; dry sedge; Wet sedge/spikerush/ juncus	Grass-Wet	Grass-Wet
Mesic Shrub	chokecherry, plum; rose; snowberry; huckleberry; mallow ninebark; white spirea; buffaloberry; evergreen shrub	Shrub-Mesic	Shrub-Mesic
Dry Shrub	sagebrush; antelope bitterbrush; skunkbush sumac; curl-leaf mountain mahogany; greasewood; rabbitbrush; Saltbush, spineless horsebrush; soapweed yucca	Shrub-Xeric; MX-CELE3	CELE3, CELE3-Imix, CELE3-Tmix, CELE3-Hmix
Dry Shrub	Juniper shrub	MX-JUNIP, JUNIP	JUNIP

R1 Cover Type	Species included	DomMid40[1]	Dom Group 6040[1]
Grass	Forb mixes; Idaho fescue; western wheatgrass; bluebunch wheatgrass, needle-and- thread grass; tufted hairgrass; little bluestem; prairie sandreed; green needlegrass; Timothy; crested wheatgrass; blue grama; Kentucky bluegrass; cool season short grass mix; cool season mid grass mix; warm season mid grass mix; warm season short grass mix; mixed grass	Grass-Dry; Grass-Bunch; Grass-Singlestem	Grass-Dry; Grass-Bunch; Grass- Singlestem
Sparsely Vegetated	Sparsely vegetated	Sparse	Sparse

1. See (Barber, Bush and Berglund 2011) for a description of DomMid40 and DomGroup6040 classifications
2. The JUNIP dominance 6040 type is included in the dry shrub cover type given its common association with grass/shrub. However, juniper dominance types that include a mix of other tree species (JUNIP-Imix, JUNIP-Hmix, JUNIP-Tmix) include components of ponderosa pine, limber pine, or Douglas-fir, and are therefore included in the Ponderosa Pine cover type.
3. Potential vegetation type information must be used to split the PSME dominance groups to distinguish between the dry Douglas-fir and the Mixed Mesic Conifer cover types.
4. Aspen is also depicted in potential vegetation associated with riparian types. It is included as a forested cover type to account for upland aspen that occurs outside of riparian areas.

Natural Range of Variation

The natural range of variation represents the distribution of conditions under which ecosystems developed -- it gives context for understanding resiliency, evaluating the integrity of current conditions, and identifying important compositional, structural, and functional elements that may warrant restoration. The intent of desired conditions for vegetation is to manage for ecological integrity and resiliency. Desired conditions are deeply informed by our best understanding of the natural range of variation but may also include appropriate adjustments made to incorporate additional considerations including expected future climates, long-term resilience to disturbances, sustainability of important wildlife habitats, and social and economic factors.

The factors and rationale applied in the development of natural range of variation for nonforested vegetation was derived through a review and synthesis of available information relevant to the plan area and selected key ecosystem characteristics including composition, ground cover, and effects of stressors and how they are likely to have affected ecosystem integrity. Information used included scientific journal articles, historical records and photographs, and descriptions of reference areas.

The SIMPPLLE model (Simulating Patterns and Processes at Landscape Scales) was used to generate the natural range of variation analysis for forested vegetation. This model was developed in Northern Region to answer landscape level management questions. It is a spatially explicit, dynamic landscape model used for projecting temporal changes in the spatial distribution of vegetation in response to insects, disease, wildland fire, and other disturbances (Chew, Moeller and Stalling 2012). The SIMPPLLE model provides for interaction between disturbance processes and vegetative patterns and is designed to provide a balance between incorporating enough complexity to provide an acceptable level of realism while making enough simplifications to be a useful management tool in planning processes. The model and its results are a simplified portrayal of complex ecosystem dynamics. As such, the results should not be considered an exact representation of a historical landscape, but are a good attempt at approximating

vegetation change over time in response to various disturbances and stressors, including historic climate and fire and insect regimes. The model provides useful insight into the complicated dynamics of our ecosystem over time and space, and strengthens our scientific understanding. It provides insight and a frame of reference for the evaluation of ecological integrity and conditions that have sustained the current complement of wildlife and plan species on the Custer Gallatin National Forest.

For the natural range of variation analysis, the SIMPPLLE model grows vegetation through time with parameters that reflect historic climates and disturbances. For this analysis, thirty simulations were run for 1000 years each to provide a range of possible outcomes based on stochastic disturbance events. See appendix B of the DEIS for additional detail on natural range of variation model development, parameterization and results.

Notably, additional pathways and processes in the model were calibrated to accurately reflect forested conditions on the Custer Gallatin National Forest, including:

- Successional Pathways: Successional pathways are state and transitional models for each vegetation type that provide the foundation for the model. The existing data was reviewed, and pathways for both forested and non-forested vegetation types were added or modified based on expert judgment and successional theory literature to ensure the model depicted the conditions found on the Custer Gallatin National Forest.
- Wildfire Processes: Wildfire processes, including the probability of ignition, fire sizes, fire regimes (severities), weather ending events, and effects to successional pathways are key drivers in the model. Wildfire processes were calibrated using local fire history data, applicable fire history studies and publications, previous modeling efforts, and expert judgment. Most notably, an extensive analysis of historic fire regimes using LANDFIRE reference data (Rollins and Frame 2006) was used to help parametrize historic fire regimes in SIMPPLLE.
- Insect and Disease Processes: The probability and effects of key insect and disease processes (bark beetles, defoliators, and root diseases) were also calibrated using the latest science regarding insect hazard and mortality trends, local data, and expert judgment.

The factors and rationale applied in the development of natural range of variation for forested vegetation and associated wildlife habitat in the Custer Gallatin National Forest Revised Forest Plan addressed:

- Forest Composition: Forest dominance type, tree species presence
- Forest Structure: forest size class, forest density class, forest vertical structure class, large live trees
- Landscape Pattern: patch size distribution and configuration
- Disturbance: extent, severity, and frequency

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