Chapter 3. Affected Environment and Environmental Consequences (Part 1)

3.1 Introduction

This chapter presents the existing environment of the HLC NF plan revision area and the potential consequences to that environment that may be caused by implementing the alternatives described in chapter 2. Within each resource section the boundaries of the area used for the resource analysis are disclosed. The discussions of resources and potential effects use existing information included in the Assessment, other planning documents, resource reports and related information, and other sources as indicated. Where things have changed since the assessment was published, updates have been included. The environmental consequences discussions in this chapter allow a reasonable prediction of consequences on the Forest. However, this document does not describe every environmental process nor condition.

Numbers such as acres, miles, and volumes are approximate due to the use of geographic information system (GIS) data and rounding.

This FEIS is a programmatic document, disclosing affected environments and environmental consequences at a planning level scale, not at the site-specific project-level scale. Therefore, this FEIS does not predict what would happen each time the proposed plan components are implemented. Land management plans do not have direct effects. They do not authorize or mandate any site-specific projects or activities (including ground-disturbing actions). However, there may be implications, or longer-term environmental consequences, of managing the NFs under this programmatic framework. As a result, all effects discussed in this section are considered indirect effects, unless otherwise noted. The environmental effects of those site-specific projects depend on the environmental conditions of each project site, the plan components applied, and implementation.

3.2 Best available scientific information

The 2012 Planning Rule requires the responsible official to use the best available scientific information (BASI) to inform the development of the revised plan including plan components, the monitoring program, and plan decisions. The foundation from which the plan components were developed for the proposed action was provided by the Assessment of the HLC NF, the BASI, and analyses therein. From this foundation, specialists used several resources that included peer-reviewed and technical literature, databases and data management systems, modeling tools and approaches, information obtained via participation and attendance at scientific conferences, local information, workshops and collaborations, and information received during public participation periods for related planning activities. Resource specialists considered what is most accurate, reliable, and relevant in their use of the BASI. The BASI includes the publications listed in the literature cited sections of the Assessment and FEIS as well as those that may be found in specialists reports in the project record. Literature submitted by the public is addressed in appendix G.

3.3 Regulatory framework

The Forest will follow all laws, regulations, and policies that relate to managing NFS land. Several important laws and policies form the regulatory framework applicable to managing the HLC NF. The forest plan is designed to supplement, not replace, direction from these sources. Other FS direction, including laws, regulations, policies, executive orders, and FS directives (manual and handbook), are not repeated in the forest plan or EIS. The regulatory framework applicable to each resource is included by section, with some of the overarching framework listed below.

3.3.1 Federal law

1895 Agreement with the Indians of the Blackfeet Indian Reservation in Montana: The Blackfeet Nation retained reserved rights in an area that includes the Badger-Two Medicine Area, in the northern portion of the Rocky Mountain Range GA. These include the right to extract timber, hunt, and fish subject to the applicable laws of the State of Montana. The federal government has trust responsibilities to Native Americans under a government to government relationship to ensure that the reserved rights are protected.

2012 Planning Rule (36 CFR § 219): Sets out the planning requirements for developing, amending, and revising land management plans for units of the NFS, as required by the Forest and Rangeland Renewable Resources Planning Act of 1974, as amended by the NFMA of 1976 (16 U.S.C. 1600 et seq). This subpart also sets out the requirements for plan components and other content in land management plans. This part is applicable to all units of the NFS as defined by 16 U.S.C. 1609 or subsequent statute. The planning rule contains detailed requirements that guide the development of the 2020 Forest Plan for all resources and provided the framework for all of the analyses presented in the FEIS. The planning rule can be found at https://www.fs.usda.gov/planningrule.

Antiquities Act of 1906 (16 USC 431) states "That any person who shall appropriate, excavate, injure, or destroy any historic or prehistoric ruin or monument, or any object of antiquity, situated on lands owned or controlled by the Government of the United States, without the permission of the Secretary of the Department of the Government having jurisdiction over the lands on which said antiquities are situated, shall, upon conviction, be fined in a sum of not more than five hundred dollars or be imprisoned for a period of not more than ninety days, or shall suffer both fine and imprisonment, in the discretion of the court." This act also defines the need for a permit for the examination of ruins; excavation of sites and/or the gathering of objects of antiquity on public lands is only to be done by scientific or educational institutions and for the purpose of knowledge, public viewing and permanent preservation.

Bald and Golden Eagle Protection Act prohibits unauthorized take of bald and golden eagles, as defined through subsequent regulations.

Continental Divide National Scenic Trail Act (S.2660 — 95th Congress (1977-1978)): Amends the National Trails System Act to establish the Continental Divide National Scenic Trail within Federal lands located in Montana, Idaho, Wyoming, Colorado, and New Mexico. Directs the Secretary of Agriculture to consult with relevant State and Federal officials in the administration of the lands designated under this act.

Endangered Species Act (ESA) of 1973, as amended: This act provides requirements for federal agencies with regard to species listed under the act. Section 2 requires all federal agencies to "seek to conserve endangered species and threatened species", and Section 7 requires federal agencies to support biotic sustainability by requiring that they utilize their authorities to carry out programs for the conservation of endangered and threatened species; and to ensure that actions authorized, funded, or carried out by them are not likely to jeopardize the continued existence of any threatened or endangered species or result in the destruction or adverse modification of their critical habitats.

Federal Cave Resources Protection Act of 1988: The purpose of this act is to protect and preserve significant caves and cave resources (including animal and plant life occurring naturally in caves) on federal lands and to foster cooperation and exchange of information between governmental authorities and those who use caves for a variety of purposes. A list of significant caves is to be maintained, and those caves are to be "considered in the preparation or implementation of any land management plan".

Federal Clean Air Act of 1955 (as amended in 1967, 1970, 1977, and 1990): This act requires federal agencies to ensure that actions they undertake in nonattainment and maintenance areas are consistent with federally enforceable air quality management plans for those areas. It provides for the protection and improvement of the nation's air resources and applies to the effects of prescribed fire and can help inform wildfire response. The act is a legal mandate designed to protect public health and welfare from air pollution. Although this policy creates the foundation for air quality regulation, states and counties are often responsible for implementation of the air quality standards. The task of identifying National Ambient Air Quality Standards is assigned by the Clean Air Act to the Environmental Protection Agency. The Environmental Protection Agency evaluates and updates these standards every 5 years.

Federal Land Policy and Management Act of 1976 (Public Law 94-579, as amended) provides authority to control weeds on rangelands as part of a rangeland improvement program. This act declares (per Sec. 102) that "…the public lands be managed in a manner that…will provide for outdoor recreation and human occupancy and use." Title V authorizes the Secretary of Agriculture to issue permits, leases, or easements to occupy, use, or traverse NFS lands. It directs the United States to receive fair market value unless otherwise provided for by statute and provides for reimbursement of administrative costs in addition to the collection of land use fees (43 U.S.C. 1764(g)). This act also establishes policy for exchange of lands under uniform procedures and that the lands exchanged be consistent with the prescribed mission of the Agency. This act also defines procedures for the withdrawal of lands from mineral entry. It reserves to the United States the rights to prospect for, mine, and remove the minerals in lands conveyed to others and requires the recordation of claims with the BLM.

Federal Water Pollution Control Act (Clean Water Act), 33 U.S.C. 1321(c)(2), 1948, as amended. This law was revised by amendments in 1972 that gave the act its current form and spelled out programs for water quality improvements. Direction is intended to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Sections 303, 319, and 404 apply to forest management. Section 208 of the 1972 amendments mandates identification and control of nonpoint source pollution resulting from silvicultural activities. There are five required elements: 1) Compliance with state and other federal pollution control rules; 2) No degradation of instream water quality needed to support designated uses; 3) Control of nonpoint source water pollution using conservation or "best management practices."; 4) Federal agency leadership in controlling nonpoint sources pollution from managed lands; and 5) Rigorous criteria for controlling discharge of pollutants into the nation's waters. 1987 amendments added Section 319 to the act, under which States are required to develop and implement programs to control nonpoint sources of pollution, or rainfall runoff from farm and urban areas, as well as construction, forestry, and mining sites; and Section 303(d), which requires states to identify pollutant-impaired water segments and develop "total maximum daily loads" that set the maximum amount of pollution that a water body can receive without violating water quality standards, a water quality classification of streams and lakes to show support of beneficial uses, and anti-degradation policies that protect water quality and stream conditions in systems where existing conditions exceed standards.

Forest and Rangelands Renewable Resources Planning Act (1974) provides for the maintenance of land productivity and the need to protect and improve soil and water resources. This act declares (per Sec. 10) that "…the installation of a proper system of transportation to service the NFS ….shall be carried forward in time to meet anticipated needs on an economical and environmentally sound basis…"

Granger-Thye Act of 1950 provides for issuance of grazing permits for a term of up to 10 years. It also provides for the use of grazing receipts for range improvement work. Section 7 authorizes special-use permits not to exceed 30 years duration for the use of structures or improvements under the administrative control of the FS and for the use of land in connection therewith, without acreage limitation.

Migratory Bird Treaty Act of 1918 and Executive Order 13186: This act provides for conservation of migratory birds, through prohibition of unauthorized take as defined through subsequent regulations. In a 2008 MOU (U.S. Department of Agriculture, Forest Service & U.S. Department of the Interior, 2008) with the USFWS, the FS agreed to "address the conservation of migratory bird habitat and populations when developing, amending, or revising management plans for NFs and grasslands, consistent with the NFMA, ESA, and other authorities."

Multiple-Use Sustained-Yield Act of 1960: This act confirms the FS' authority to manage the NFs and grasslands "for outdoor recreation, range, timber, watershed, and wildlife and fish purposes" (16 U.S.C. § 528) and does so without limiting the FS' broad discretion in determining the appropriate resource emphasis or levels of use of the lands of each NF and grassland. The Act states that renewable surface resources (such as forests) shall be administered for multiple use and sustained yield to best meet the needs of the American people without impairment of the productivity of the land.

National Environmental Policy Act of 1969: This act requires that all environmental analyses consider a full range of reasonable alternatives to a proposed action. Reasonable alternatives are those that address the significant issues and meet the purpose and need for the proposed action. Requires analysis of projects to ensure the anticipated effects upon all resources within the project area are considered prior to project implementation (40 CFR § 1502.16). This act declares that it is a federal policy to "preserve important historic, cultural, and natural aspects of our national heritage". It requires federal agencies to use a systematic and interdisciplinary approach that incorporates the natural and social sciences in any planning and decision making that may impact our environment.

National Forest Management Act (NFMA) of 1976: Requires NFs and grasslands to create land management plans. The Act directs the FS to manage for a diversity of habitats to support viable populations. This act directs consultation and coordination of NFS planning with Indian tribes. This act states that the Secretary of Agriculture shall "promulgate regulations" under the principles of the Multiple-Use Sustained-Yield Act of 1960, to "provide for the diversity of plan and animal communities based on the suitability and capability of the specific land area", and to maintain tree species diversity within the context of multiple-use objectives. It directs that NFS lands shall be maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth, and conditions of stand designed to secure the maximum benefits of multiple use sustained yields.

National Forest Roads and Trails Act of 1964 (16 U.S.C. 532-38): This act authorizes road and trail systems for the NFs. This act declared that an adequate system of roads and trails be constructed and maintained to meet the increasing demand for recreation and other uses. This act authorizes the Secretary of Agriculture to grant temporary or permanent easements to landowners who join the FS in providing a permanent road system that serves lands administered by the FS and lands or resources of the landowner. It also authorizes the grant of easements to public road agencies for public roads that are not a part of the federal-aid system. It authorizes imposition of requirements on road users for maintaining and reconstructing roads, including cooperative deposits for that work.

National Trails System Act of 1968 (P.L. 90-543, 82 Stat.919, as amended): This act establishes the National Trails System and authorizes planning, right-of-way acquisition, and construction of trails established by Congress or the Secretary of Agriculture. The purpose was "to promote the preservation of, public access to, travel within, and enjoyment and appreciation of the open-air, outdoor areas and historic resources of the Nation." This act authorized three types of trails: 1) National Scenic Trails, 2) National Recreation Trails, and 3) connecting-and-side trails. In 1978 National Historic Trails were also added to the national trail system. National Scenic Trails and National Historic Trails may only be designated by Congress. National Recreation Trails may be designated by the Secretary of Interior or the Secretary of Agriculture. Through designation, these trails are recognized as part of America's National Trail System.

National Parks and Recreation Act of 1978 (Public Law 95-625)**:** This law amended the National Trails System Act of 1968 (Public Law 90-543) to include National Historic Trails.

Organic Administration Act of 1897 (16 U.S.C. 477-482, 551)**:** Provides the main statutory basis for the management of forest reserves. States that the intention of the forest reserves (which later were called national forests) was to "improve and protect the forest" and to secure "favorable conditions of water flows" and provide a "continuous supply of timber for the use and necessities of citizens of the United States." This act also authorizes the Secretary of Agriculture to designate experimental forests and ranges. This act is the basic authority for authorizing use of NFS lands for other than rights-of-way.

Secure Rural Schools and Community Self-Determination Act of October 30, 2000 (P. L. 106-393, 114 Stat. 1607; 16 U.S.C.500 note): This act provides provisions to make additional investments in, and create additional employment opportunities through, projects that improve the maintenance of existing infrastructure, implement stewardship objectives that enhance forest ecosystems, and restore and improve land health and water quality. This act was designed to stabilize annual payments to state and counties containing NFS lands and public domain lands managed by the BLM. Funds distributed under the provisions of this act are for the benefit of public schools, roads, and related purposes.

Sikes Act of 1960 provides for carrying out wildlife and fish conservation programs on Federal lands including authority for cooperative State-Federal plans and authority to enter into agreements with States to collect fees to fund the programs identified in those plans. The act states that FS policies recognize the fact that state agencies and Indian tribes are responsible for management of animals, whereas NFs manage wildlife habitats in cooperation with those entities.

Wilderness Act (1964) (16 U.S.C. 1131-1136): This act provides the statutory definition of wilderness and management requirements for these congressionally designated areas. This act established a National Wilderness Preservation System to be administered in such a manner as to leave these areas unimpaired for future use and enjoyment as wilderness. Both the Bob Marshall and the Gates of the Mountains Wilderness Areas were established by this law. The act identified management goals related to airsheds in wilderness. It also provides that livestock grazing, and the activities and facilities needed to support grazing, are allowed to continue when such grazing was established before the wilderness was designated. Subject to valid rights existing prior to January 1, 1984, wilderness areas are withdrawn from all forms of appropriation and disposition under the mining and mineral leasing laws. The act provides for reasonable access to valid mining claims and other valid occupancies inside wilderness. It establishes requirements for special use authorizations in designated wilderness areas for temporary structures, commercial public services and access to valid mining claims and nonfederal lands.

3.3.2 Regulation and policy

All resources have numerous applicable FS manuals and handbooks that are part of the regulatory framework for analysis. These manuals and handbooks provide resource management direction that would be followed under any alternative. Additional details for manuals and handbooks that were specifically referenced in the resource analyses are provided in the regulatory framework sections of the specialist reports but are not necessarily included in the body of the FEIS or the literature cited setion. Where language from manuals and handbooks are cited within the resource sections below, they are noted as FSM (Forest Service Manual) or FSH (Forest Service Handbook).

The final directives for the planning rule, 2015 (FSH 1909.12) applies to all resources and was used to develop the 2020 Forest Plan. The analysis for all resources draws upon the guidance provided in this document. The directives can be found at: https://www.fs.usda.gov/planningrule.

All FS manuals can be obtained at https://www.fs.fed.us/im/directives/dughtml/fsm.html.

All FS handbooks can be obtained at https://www.fs.fed.us/im/directives/dughtml/fsh_1.html.

3.4 Monitoring plan

Under all action alternatives, monitoring would occur as listed in appendix B of the 2020 Forest Plan. The monitoring elements are designed to enable the Forest to determine if a change in plan components or other plan management guidance may be needed, forming a basis for continual improvement and adaptive management. The monitoring plan would have the effect of improving the HLC NF's ability to move toward the desired conditions for each resource area, by providing the information needed to assess change through time and support adaptive management actions.

The 1986 plans (alternative A) also included detailed monitoring plans. These 1986 monitoring plans are different than what is included in the action alternatives of this FEIS, although some elements are similar. In general, the monitoring plan under the action alternatives would better provide the information needed to inform adaptive management and ecosystem integrity than the no-action alternative.

The monitoring plan included in the action alternatives would impact each resource area as follows:

- Aquatic ecosystems monitoring would reduce uncertainty related to the impacts of forest management on instream physical habitat, wetlands, riparian management zones, and soil productivity; and reduce uncertainty in the expected effects of climate and disturbance regimes.
- Air quality-monitoring would demonstrate whether air quality is maintained per law and policy.
- Fire and fuels monitoring would improve our understanding of the role fire plays on the landscape; reduce uncertainty surrounding the expected effects of climate on fire processes; and demonstrate the efficacy of hazardous fuel reduction treatments to help improve fuel management strategies.
- Terrestrial vegetation monitoring would demonstrate whether vegetation conditions trend toward the desired conditions; improve our understanding of whether vegetation conditions and habitat can support the natural diversity of plant and animal species ("coarse filter"); reduce uncertainty surrounding the expected effects of climate and disturbances on terrestrial vegetation; demonstrate the efficacy of treatments to improve vegetation resilience; and improve our understanding of the health and condition of specific vegetation communities.
- Old growth, snags, and downed wood monitoring would demonstrate whether these attributes are maintained at desired levels, and reduce uncertainty related to the impacts of forest management, climate, and disturbances on these key habitat elements.
- Plant species at risk monitoring would determine if habitat conditions support the recovery and persistence of at-risk plant species, determine which species require at-risk plant status, and reduce the uncertainty associated with the location and status of rare plant species. Whitebark pine monitoring would demonstrate the ability of the forest to contribute to the recovery of this candidate species.
- Pollinator monitoring would reduce the uncertainty surrounding the abundance and condition of habitat available to support pollinators.
- Invasive plant monitoring would improve our understanding of the extent of nonnative plant species on the forest and reduce uncertainty in the efficacy of invasive plant treatments as well as the impacts of invasive plant treatments on plant species at risk.
- Monitoring related to wildlife habitat would improve our understanding of the trend in and impacts of forest management on habitat for at-risk species; demonstrate the efficacy of specific management actions to reduce human-wildlife conflicts and to maintain specific habitat conditions of interest; improve our understanding of the impacts of forest management on habitat connectivity at some scales; and improve our understanding of how habitat conditions on NFS lands may influence opportunities to hunt some big game species.

- Recreation opportunity monitoring would determine the condition and status of facilities at developed recreation sites; determine the status of social and resource conditions at dispersed recreation sites; and study the progress of meeting developed recreation objectives in the plan.
- Recreation special use monitoring would follow the status of recreation special use permits over time. Designated wilderness monitoring would focus on the effect of management activities and natural processes on the wilderness character of each wilderness area.
- Monitoring recommended wilderness and wilderness study areas would determine how management activities affect social and ecological wilderness characteristics.
- Grandview Recreation Area monitoring would determine the effects of mechanized means of transportation in the primitive ROS in this area and determine whether unauthorized trails are being created by mechanized means of transportation users.
- National recreational trail monitoring would demonstrate the maintenance provided on these trails.
- The core area of the Elkhorns mountain range would be monitored to determine whether mechanized means of transportation (including mountain bikes) affect the primitive ROS.
- Mechanized means of transportation within the Badger Two Medicine area would be monitored to determine whether these uses affect the primitive recreation opportunity spectrum in this area.
- Cultural, historical, and tribal areas of importance monitoring would demonstrate whether progress is made toward the preservation and conservation of important cultural resources.
- Lands monitoring would demonstrate the degree to which road and trail easements are established.
- Infrastructure monitoring would improve our understanding of the status and condition of the transportation system.
- Public information, interpretation, and education monitoring would demonstrate the extent to which the Forest provides opportunities for the public to connect with the natural resources on the Forest.
- Livestock grazing monitoring would reduce the uncertainty regarding the efficacy of livestock grazing management actions to move rangelands and riparian areas toward desired conditions.
- Timber and other forest products monitoring would demonstrate the degree to which the Forest contributes timber and other forest products to the local community; improve our understanding of the influences of natural disturbances on lands suitable for timber production; and demonstrate the degree to which timber harvest contributes to desirable patch sizes on the landscape.
- Fish and wildlife monitoring would demonstrate the degree to which habitat conditions and management actions on the forest support wildlife and fish related activities; and improve our understanding of the public demand for those opportunities.

3.4.1 Focal species

Under the action alternatives, focal species were selected in a manner consistent with FSH 1909.12, Chapter 30, 32.13c. Focal species are not selected to represent every ecological condition. Rather, they are indicators of ecological integrity and provide insight into the integrity of and risks to the specific ecological systems on which they depend or that they influence. Selections are made considering the ability for the species to be a more effective measure of ecological characteristics than other indicators; the ability of the species to provide data for multiple purposes; and the agency's ability to effectively and efficiently monitor the species within its technical and financial capabilities.

Invasive annual grasses have been selected as the focal species for monitoring under all action alternatives, which would help improve the Forest's understanding of the integrity of grasslands, shrublands, and other non-forested vegetation types across the HLC NF. The monitoring questions, indicators, and measures are specified in appendix B of the 2020 Forest Plan.

Invasive annual grasses

Species of invasive annual grasses are extremely competitive, crowding out native vegetation, and have exhibited the ability to rapidly expand in multiple habitat types. Once annual grasses establish, they present a direct threat to ecosystem function by decreasing native plant community diversity, altering fire return intervals, diminishing the quality of wildlife habitat, and reducing livestock carrying capacity. Species such as downy brome (*Bromus tectorum*), Japanese brome (*Bromus japonicu*s), and ventenata (*Ventenata dubia*) are present or have been recently found in the plan area. Medusahead rye (*Taeniatherum caput*) is another species of concern that could alter ecosystem function if the species were to establish. Many other invasive grass species are also present in the Pacific Northwest, with a high likelihood of eastern expansion. Monitoring for invasive annual grasses can gauge native vegetation communities' resistance from invasion and resiliency after disturbance.

3.5 Aquatic Ecosystems and Soils

3.5.1 Introduction

This section considers numerous physical and biological resources such as: water quality, native and nonnative desirable species, and aquatic habitats. Managing for high quality soil, water and hydrologic function are fundamental in maintaining and restoring watershed health. Soil is the primary medium for regulating the movement and storage of energy and water and for regulating cycles and availability of plant nutrients (Interior Columbia Basin Ecosystem Management Project, 1997). The physical, chemical, and biological properties of soils determine biological productivity, hydrologic response, site stability, and ecosystem resiliency.

Analysis area

The analysis area for the watershed, soils and aquatic species include all the lands within the boundary of the HLC NF and connected waterways. The connected river systems are included because migratory bull trout and westslope cutthroat trout that emerge from forest streams move downstream to reach sexual maturity and then return to their natal streams to complete the spawning cycle and depend on connectivity for their survival.

The Forest Plan area is located within two hydrologic unit code (HUC2) regions:

- The Missouri Region (HUC = 10) is on the eastern side of the Continental Divide. Within this region, the plan area is located in 3 subregions: Missouri Headwaters (HUC=1002), Missouri-Marias (HUC=1003), and Missouri-Musselshell (HUC=1004). Within these subregions, the plan area is located in 14 fourth level watersheds. Within these fourth level watersheds the plan area is located within 88 fifth level watersheds which are further broken down into 301 sixth level watersheds.
- The Pacific Northwest Region (HUC = 17) drains to the west. Within this region, the plan area is located in one subregion, the Kootenai-Pend Oreille- Spokane (HUC=1701). Within this subregion, the plan area is located in two fourth level watersheds: Upper Clark Fork and Blackfoot River. Within these fourth level watersheds, the plan area is within 16 fifth level watersheds which are further broken down into 72 sixth level subwatersheds.

The analysis scale varies by resource and uses the fourth (HUC8), fifth (HUC10) and sixth level (HUC12) watershed scales to assess current conditions across the HLC NF.

The FS commonly evaluates how proposed management activities meet the requirements of the Clean Water Act from a holistic perspective that considers land management activities occurring throughout the watershed and their effects on water quality and aquatic habitat integrity. The goal of the Clean Water Act is "to restore and maintain the chemical, physical, and biological integrity of the nation's water". Listings of waterbodies and development of Total Maximum Daily Loads (TMDLs) under Section 303(d) of the

Act are symptomatic of the effects from historical and some ongoing management activities. Maintaining healthy watersheds and restoration of degraded watersheds would contribute towards the de-listing of impaired waterbodies and to the survival and recovery of aquatic species.

Productivity of soil and vegetation, proximity to water, and the general attractiveness of riparian and aquatic systems continue to make these areas ideal for many land uses managed by the FS. Conflicts between some human uses and the resources dependent on resilient riparian conditions may continue unless management provides for sufficient land use limitations and resource protection that maintain the disturbance processes and pathways associated with resilient riparian conditions (Lake, 2000; Lee et al., 1997; Poff, Koestner, Neary, & Henderson, 2011; Reeves, Benda, Burnett, Bisson, & Sedell, 1995). The revision of both 1986 Forest Plans is designed to provide direction that addresses, if not resolves, these conflicts.

The variety of landscapes and associated aquatic ecosystems on the Forest support an array of different aquatic, terrestrial, and botanical species. Population sizes and distribution of some species, such as bull trout, have declined in most locations across its range in recent decades, with special protection granted under the ESA. Across the range of bull trout, reasons for the decline of some populations are many (Allendorf, Leary, Spruell, & K., 2001; Lee et al., 1997; Martinez et al., 2009). Aquatic species viability is dependent upon maintaining an array of desirable, well-connected habitat conditions. Past activities throughout the planning area, federal and private lands have contributed to fragmentation and degradation of habitat for fish and other riparian-dependent species. Humans have caused changes in habitat conditions through such activities as timber management, livestock grazing practices, road and facility construction, recreation uses, and introduction of nonnative species. Future management activities have the potential to impact or restore habitat for species associated with aquatic and riparian ecosystems. For aquatic species, this analysis looks at how the management alternatives proposed in the forest plan either contribute to or mitigate common threats to aquatics within FS authority and capability of lands to sustain native species.

The diverse lithology, structure, and climate over time have resulted in a spatially complex pattern of landforms and soils across the forest that responds differently to management activities. Most management activities and natural processes, such as recent wildfires, affect soil resources to varied extents. Impacts or indicators of stress include: surface erosion, compaction, and nutrient loss through removal of coarse woody debris, high severity burns, flooding or landslides. These effects may be in the uplands or within streams. Soil effects or stresses are not always detrimental or long lasting. In order to maintain and where necessary restore the long-term quality and productivity of the soil, detrimental impacts to the soil resource must be managed within tolerable limits.

Measurement indicators

The primary effects to aquatic ecosystems to be analyzed would result from the implementation of the 2020 Forest Plan (alternatives B-F) compared to alternative A. Comparison is made between alternatives based on their relative ability to move the resources toward desired conditions for:

- Watershed resources
- Water quality
- Riparian areas
- Stream Function
- Aquatic Habitat
- Soils

Changes between draft and final

Comments received since the proposed action and DEIS were published have been used where appropriate to improve the 2020 Forest Plan and have helped inform this FEIS. Multiple minor changes were made for the FEIS; all changes are within the scope of the FEIS analysis, and address issues that the public has had an opportunity to comment on. With respect to Aquatic Ecosystems and Soils, there were changes to the plan components, both additions and deletions that were driven from commenters and internal Forest Service suggestions. Also, through the comment period, there was development of an additional alternative (alternative F). Analysis of the preferred alternative F for Aquatic Ecosystems and Soils is similar to all action alternatives.

In the 2020 Forest Plan and action alternatives, additional management direction has been included to address aquatic and riparian ecosystem integrity and connectivity. Components have been added to the proposed action that increase attention for watersheds identified for conservation (see appendix E of the 2020 Forest Plan).

3.5.2 Regulatory framework

Federal Law

Safe Drinking Water Act of 1977 and amendments (1996) - In 1996, the Safe Drinking Water Act was amended with requirements to identify "*Source water protection areas*" and to assess their susceptibility of contamination. This provides states with more resources and authority to enact the Safe Drinking Water Act. This amendment directs the state to identify source water protection areas for public water supplies that serve at least 25 people or 15 connections at least 60 days a year. In terms of relative size and scope, while an individual NF unit may have 4 designated municipal watersheds, there may be over 100 source water protection areas that intersect with that NFS lands managed by that unit.

Source water protection areas have been established to protect public water systems from contamination. Public water systems are defined as entities that provide "water for human consumption through pipes or other constructed conveyances to at least 15 service connections or serves an average of at least 25 people for at least 60 days a year" and the term "public" in "public water system" refers to the people drinking the water, not to the ownership of the system (www.epa.gov/sourcewaterprotection). These systems can be dependent on any type of water source, including streams, lakes, reservoirs, springs, wells, or infiltration galleries, and includes systems used either year-round or only seasonally.

State governments were given the option to accept primacy or responsibility for delineating and developing assessments for these source water protection areas. The State of Montana has accepted this responsibility and should be contacted for the most up-to-date information regarding the source water protection delineations, assessments, and management requirements or goals.

Regulation and policy

Municipal Watersheds – 36 CFR 251.9 authorizes the Chief of the FS to enter into agreements with municipalities to restrict the use of NFS lands from which water is derived to protect the municipal water supplies (FS Manual 2542).

Executive orders

Executive Order 11988: Directs federal agencies take action on federal lands to avoid, to the extent possible, the long-and short-term adverse impacts associated with the occupancy and modification of floodplains. Agencies are required to avoid the direct or indirect support of development on floodplains whenever there are reasonable alternatives and evaluate the potential effects of any proposed action on floodplains.

Executive Order 11990, as amended: Requires federal agencies exercising statutory authority and leadership over federal lands to avoid to the extent possible, the long- and short-term adverse impacts associated with the destruction or modification of wetlands. Where practicable, direct or indirect support of new construction in wetlands must be avoided. Federal agencies are required to preserve and enhance the natural and beneficial values of wetlands.

Executive Order 12962 (June 7, 1995): Acknowledges the recreational value of aquatic biota by stating the objectives "to improve the quantity, function, sustainable productivity, and distribution of U.S. aquatic resources for increased recreational fishing opportunities by: "(h) evaluating the effects of federally funded, permitted, or authorized actions on aquatic systems and recreational fisheries and document those effects relative to the purpose of this order".

Executive Order 13112 and Executive Order 13751 (2016) - Directs federal agencies whose actions may affect the status of invasive species to (1) prevent the introduction of invasive species, (2) detect and respond rapidly to and control populations of such species in a cost effective and environmentally sound manner, as appropriations allow.

State of Montana

Montana ARM 16.20.603 - This states that BMPs are the foundation of water quality standards for the State of Montana. The FS has agreed to follow BMPs in a Memorandum of Understanding with the state. Many BMPs are applied directly as mitigation at the project level. Implementing and effectiveness monitoring for BMPs are routinely conducted by contract administrators and during other implementation and annual monitoring events.

Montana State's Nondegradation policy MCA 75-5-303 and ARM 17.30.701 states that existing and anticipated uses and the water quality necessary to protect those uses must be maintained and protected. Many land management activities on NFS lands are considered nonsignificant activities under state law as long as reasonable land, soil, and water conservation practices are applied to protect existing and anticipated beneficial uses. State-defined nonsignificant activities are found in Montana Code Annotated (MCA) 75-5-317.

Stream Protection Act (SPA 124) – This is the State of Montana's stream permitting system to protect and preserve fish and wildlife resources, and to maintain streams and rivers in their natural or existing state. It applies to any agency or subdivision of state, county, or city government proposing a project that may affect the bed or banks of any stream or its tributaries in Montana. It is a required process for any project including the construction of new facilities or the modification, operation, and maintenance of an existing facility that may affect the natural existing shape and form of any stream or its banks or tributaries. The FS and the State of Montana have entered into a Memorandum of Understanding that commits the Forest to comply with the Stream Protection Act for all road planning and construction and water or hydraulic projects.

3.5.3 Assumptions

Legacy effects from past livestock grazing, timber harvest, mining, and other human-caused disturbances continue to effect watershed health and the aquatic ecosystem. Generally, under the direction of the 1986 Helena and the Lewis and Clark Forest Plans the intensity and the risks associated with new and ongoing developments and human-induced disturbances has been, and would continue to be, reduced as compared to the last several decades. Effects from these activities are likely to continue to occur but are expected to be less than prior to the 1986 plan. The 1986 Forest Plan directions for the east side of the Continental Divide, as well as the 1996 amendment by the Inland Native Fish Strategy (INFISH) on the west side (U.S. Department of Agriculture, Forest Service, 1995b; U.S. Department of Agriculture, Forest Service & U.S. Department of Interior, 1995), reduces the risk to watersheds and aquatic biota from new and ongoing activities. For some resources on the west side of the divide, the INFISH contain additional general direction for repairing past damage from land management associated with roads, grazing, and recreation activities. Since the 1980s, improvements in soil productivity have occurred through an increase in protections resulting in a reduction in adverse impacts and continued restoration efforts.

3.5.4 Best available scientific information used

The most important change in water resource direction between the 1986 Forest Plans for the HLC NF and the 2012 Planning Rule (36 CFR 219.8) is the requirement to establish RMZ widths. The 2012 Planning Rule directed that during plan revision efforts, riparian management areas shall be established in all NFS lands. The 2012 Planning Rules states that the:

> (ii) Plans must establish width(s) for RMZs around all lakes, perennial and intermittent streams, and open water wetlands, within which the plan components required by paragraph (a)(3)(i) of this section will apply, giving special attention to land and vegetation for approximately 100 feet from the edges of all perennial streams and lakes.
>
> > (A) RMZ width(s) may vary based on ecological or geomorphic factors or type of water body; and will apply unless replaced by a site-specific delineation of the riparian area.
> >
> > (B) Plan components must ensure that no management practices causing detrimental changes in water temperature or chemical composition, blockages of water courses, or deposits of sediment that seriously and adversely affect water conditions or fish habitat shall be permitted within the RMZs or the site-specific delineated riparian areas.

Best available scienctific infomation was used to determine effects of implementing the 2020 Forest Plan as compared to the 1986 Forest Plans across aquatic ecosystems. A full report of the aquatic ecosystems BASI is in appendix C.

3.5.5 Affected environment

Watershed condition

Watersheds are described across the planning area and the Watershed Condition Framework is used to describe conditions in GAs. Water quality, source water protection areas and groundwater resources are also discussed. Aquatic ecosystems are described by GA, focusing on habitat for bull trout west of the Continental Divide, and habitat for westslope cutthroat trout west and east of the divide. Management effects are described by GA, and system drivers and stressors of water resources and aquatic ecosystems are detailed together. The soil resources section details information and considerations for soils in the planning process.

Watershed condition framework

The primary hydrologic unit upon which watershed condition has been assessed is the sixth-level hydrologic unit, or subwatershed, which is a watershed of about 10,000-40,000 acres. To evaluate baseline watershed conditions across the analysis area, a watershed condition rating was determined for each subwatershed. This characterization estimated the existing condition based on physical characteristics (e.g., hydrologic, geomorphic, landscape, topographic, vegetative cover, and aquatic habitat) and human-caused disturbances (e.g., livestock grazing, road construction and vegetative treatments).

Watershed condition classification ultimately ranks watersheds in one of three discrete categories (or classes) that reflect the level of watershed health or integrity. Watershed health and integrity are considered conceptually the same (Regier, 1993). Watersheds with high integrity are in an unimpaired condition in which ecosystems show little or no influence from human actions (Lackey, 2001).

Within this context, the three watershed condition classifications are directly related to the degree or level of watershed functionality or integrity:

- Class 1 – Functioning Properly
- Class 2 – Functioning at Risk
- Class 3 – Impaired Function

The watershed condition framework (U.S. Department of Agriculture, Forest Service, 2011d) characterizes a watershed in good condition as one that is functioning in a manner similar to natural wildland conditions (Karr & Chu, 1999; Lackey, 2001). A watershed is considered to be functioning properly if the physical attributes are adequate to maintain or improve biological integrity. This consideration implies that a class 1 watershed that is functioning properly has minimal undesirable human impact on its natural, physical, or biological processes, and it is resilient and able to recover to the desired condition when disturbed by large natural disturbances or land management activities (Yount & Niemi, 1990). 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 return the watershed to a properly functioning condition.

Watershed conditions vary across the planning area with conditions ranging from those unaffected by direct human disturbance to those exhibiting various degrees of modification and impairment. The Forest completed the first round of watershed condition classification in the summer of 2011 (U.S. Department of Agriculture, Forest Service, 2011d). In summary, 103 watersheds were rated as functioning properly, 159 were rated as functioning at risk, and 34 were rated as impaired. The common sources of ratings 'at risk' or 'impaired' in the planning area were found to be from roads, grazing, and mining. These conditions would be reassessed in the future to observe any changes and help guide recommendations.

Mineral extractions and ancillary mining-related activities have left a history of impacts to watersheds and water quality in a number of watersheds across the planning area. Historic mining of minerals including gold, silver, lead and zinc has occurred in many of the GAs; notably the Little Belts, Big Belts, Elkhorns, Castles and Divide GAs. Water quality is impacted from acid mine drainage and heavy metals contaminated runoff from mined materials. Streambanks and riparian habitats have been degraded through large and small placer operations. Many of these watershed and water quality impacts have been or are currently being addressed through response actions conducted by federal agencies in accordance with delegated authorities under the Comprehensive Environmental Response Compensation and Liability Act, as amended. FS actions taken under this act to date across the planning area have been largely individual mine site focused or area specific, while the Environmental Protection Agency's actions under the National "Superfund" Program have sought to address impacts by defining "Sites" at the watershed scale. The forest is also addressing mining impacts through restoration of streambanks and riparian areas. Watersheds that support bull and westslope cutthroat trout are an emphasis for restoration using the priority watershed designation under watershed condition framework as well as the 2020 Forest Plan Conservation Watershed Network (CWN). Bull trout are a listed species and a goal under the Bull Trout Conservation Strategy. The Recovery Unit Implementation Plan goal is to improve habitat conditions of the five-Class 2 watersheds found in the Divide and Upper Blackfoot GAs.

Geographic areas

Watershed conditions by GA range from those unaffected by direct human disturbance to those exhibiting various degrees of modification and impairment. According to the watershed condition framework, 40 percent of watersheds within the planning area are in watershed condition class 1 and "exhibit high geomorphic, hydrologic and biotic integrity relative to their natural potential condition" (U.S. Department of Agriculture, Forest Service, 2011c). The summary by GAs of the results are displayed in Table 14, and Tables 9 and 10 in appendix E of the 2020 Forest Plan, Watershed Condition Class

Framework. To find more information about the individual watershed ratings, please visit the Watershed Classification and Tracking Tool website (https://apps.fs.usda.gov/wcatt).

Table 14. Summary of sixth level watersheds by GA rated in each category under the WCC

GA	Class 1 Functioning Properly	Class 2 Functioning at Risk	Class 3 Impaired Function	Grand Total
Big Belts	3	35	7	45
Castles	2	9	1	12
Crazies	5	5	0	10
Divide	1	13	14	28
Elkhorns	1	18	2	21
Highwoods	3	4	0	7
Little Belts	21	39	4	64
Rocky Mountain Range	40	13	1	54
Snowies	15	3	0	18
Upper Blackfoot	12	20	5	37
Total	103	159	34	296[1]

[1].8 watersheds are within 2 GAs, making the total 296 rather than 288.

Stream channels

Streams carry water, sediment, dissolved minerals, and organic material derived from hillsides and their vegetation cover. The shape and character of stream channels constantly and sensitively adjust to the flow of this material by adopting distinctive patterns such as pools-and-riffles, meanders, and step-pools. The vast array of physical channel characteristics combined with energy and material flow, provide diverse habitats for a wide array of aquatic organisms.

Varied topography coupled with the irregular occurrences of channel-affecting processes and disturbance events such as fire, debris flows, landslides, drought, and floods, result in a mosaic of river and stream conditions that are dynamic in space and time under natural conditions. The primary consequence of most disturbances is to directly or indirectly provide large pulses of sediment and wood into stream systems. As a result, most streams and rivers undergo cycles of channel change on timescales ranging from years to hundreds-of-years in response to episodic inputs of wood and sediment. The types of disturbance that affect the morphology of a particular channel depends on watershed characteristics, size, and position of the stream within the watershed. Many aquatic and riparian plant and animal species have evolved in concert with stream channels. They develop traits, life-history adaptations, and propagation strategies that allow persistence and success within dynamic landscapes.

Human uses have altered some stream channels in the last century. Stream channels have changed as a result of channelization, livestock grazing, placer and hard rock mining, road building, logging, splash dams, the extirpation of beaver and their habitat, and indirectly by altering the natural incidence, frequency, and magnitude of disturbance events such as wildfire. Some characteristics of channels commonly measured to help identify changes caused by management include frequency and depth of large pools, the width-depth ratio of stream channels, and the percent of fine sediment contained in substrate (Al-Chokhachy, 2010). Low gradient (less than 2%) stream channels show the most response to land management activities. Lower pool frequencies and higher fine sediment concentrations are most obvious in watersheds with higher road densities such as the Little Belts, Big Belts and Divide GAs. Placer and hard rock mining have altered stream morphologies in streams throughout most of the planning area notably in the Big Belts, Upper Blackfoot, Elkhorn, Little Belts, Castles and Divide GAs. Placer mining reshapes and straightens as well as removes fine sediment from stream channels. Hard rock mining changes the morphology of the streams by adding mine waste to stream channels and altering groundwater flows regimes. These findings are consistent with observations that indicate past road construction/maintenance, grazing, mining, and timber harvest practices altered sediment delivery and routing, and potentially other habitat components, which in turn has led to fewer pools, higher fine sediment resulting in stream aggradation, as well as the lack of fines as resulting from placer mining.

Consequently, watersheds, stream channels, and aquatic habitats in many locations on the forest are now subject to continued compounding effects of watershed disturbance. This contrasts with a more pulse-like pattern of disturbance under which most streams and associated species evolved. Consequently, many stream channels are less than optimal for aquatic and riparian-dependent species, which evolved in environments that had more high-quality habitat areas spread across the landscape. These degraded conditions are prevalent on many of the GAs throughout the HLC NF and are represented in the WCF as Impaired Function (see Table 14).

Water quality

Impaired and threatened water bodies

Water quality is regulated under the authority of the Clean Water Act, and the state of Montana assesses the waters within its jurisdiction and identifies stream segments and other water bodies whose water quality is "impaired" or generally not meeting water quality standards for beneficial uses. Individual stream segments, lakes, and other water bodies have been listed as "Water Quality Limited Segments" (i.e., "impaired") by the state of Montana (Montana Department of Environmental Quality, 2014) and are described in subsection 303(d) of the Clean Water Act as waters that do not meet state standards; a broad term that includes water quality criteria, designated uses, and anti-degradation policies. The 2018 Montana list of impaired waterbodies indicated the planning area includes 313 miles of streams on the forest that were listed as impaired due to sedimentation/siltation; 113 miles of stream segments listed for nutrients and 277 miles listed for metals.

According to the 2018 State 303(d) list, 87 stream segments or 497 miles within the planning area are not meeting water quality standards (Montana Department of Environmental Quality, 2016), Montana State 303(d) Listed Water Quality Impaired Streams). The two largest contributors to the impairments are mining and livestock. 48 segments (251 miles) are listed for mining related impacts, 47 segments (293 miles) are listed for livestock or grazing impacts, and there are additional impacts from forest roads or habitat quality issues. Many of the segments have multiple impairments, as can is seen in the mining and livestock combined numbers.

The Montana Department of Environmental Quality (MTDEQ) develops total maximum daily loads (TMDLs), which is the maximum amount of a pollutant a waterbody can receive and still meet water quality standards. They are submitted the U.S. Environmental Protection Agency for approval. The Montana Water Quality Act requires its Department of Environmental Quality to develop TMDLs for streams and lakes that do not meet, or are not expected to meet, Montana water quality standards. TMDLs provide an approach to improve water quality so that streams and lakes can support and maintain their state-designated beneficial uses.

TMDL assessments have been prepared and are being implemented for several sub-basins in the planning area, including those in the Little Belts, Castles, Crazies, Divide, Elkhorns, and Upper Blackfoot GAs. The streams with mining related issues are also discussed in the minerals and geology section of this FEIS.

To understand the current conditions of water quality within the planning area, the amount of currently listed waterbodies needs to be put into context. Many streams within the Forest's administrative boundary have not yet been assessed. There are approximately 9,033 miles of streams on National Forest System lands within the Forest's administrative boundary, and of those there are approximately 6,170 miles (68.3 percent) that are in currently protected areas (Wilderness, WSA, RWA, IRA, RNA), and the total in actively managed areas of approximately 2,863 miles (31.7 percent). The MTDEQ has assessed approximately 621 miles (6.9 percent) of streams within the Forest's administrative boundary (Montana Department of Environmental Quality, 2016). Within the actively managed areas there are approximately 426 miles (14.9 percent) of completed assessments. Within the protected areas there are approximately 195 miles (3.2 percent) of completed assessments, and of those 91 miles (46.8 percent) support beneficial uses. All waterbodies are assigned to a category, which defines the status of the waterbody.

The breakdown of the categories of the assessed streams in the planning area are:

- Category 1: 12.5 percent (77.6 miles) of the waterbody's assessed were found to be fully supportive of all beneficial uses.
- Category 2: 3.2 percent (20.1 miles) of the waterbody's assessed had information that showed some, but not all, of the beneficial uses are supported.
- Category 3: 4.2 percent (25.8 miles) insufficient data prevents assessing the use support of any beneficial use for the waterbody.
- Category 4A: 26.1 percent (161.9 miles) of the waterbody's assessed were required to have TMDLs, which have subsequently been prepared and approved by the U.S. Environmental Protection Agency.
- Category 4C: 4.1 percent (25.3 miles) of the waterbody's assessed are impaired in pollution categories such as dewatering or habitat modifications, and thus a TMDL is not required.
- Category 5: 42.5 percent (263.9 miles) of the waterbody has at least one impaired or threatened use, but a required TMDL or other control program is not in place.
- Category 5N: 7.5 percent (46.4 miles) of the waterbody's has at least one standard that is not met, and available data/information indicates that the cause could be a natural condition (i.e.no human-cause source have been identified).

Habitat quality monitoring methodologies, such as Proper Functioning Condition (PFC) (Dickard et al., 2015) assessments and channel stability index (Pfankuch, 1975) have been conducted across the forest. The current trends in stream conditions and aquatic habitat have been documented to be stable or not meeting desired conditions in a timely manner.

The results are not indicative of actual water quality, as the MTDEQ focuses its assessment on impaired water. Most of the healthy stream miles have not been assessed and entered into Montana's Waterbody System (Montana Department of Environmental Quality, 1998).

On the Forest, the MTDEQ determined that sediment continues to impair aquatic life. The MTDEQ provided sediment TMDLs for those waterbody segments. Many impaired waterbodies in need of TMDLs exist on the HLC NF and the most current information can be obtained on the MTDEQ website.

For the streams with sediment TMDL, excess sediment may be limiting their ability to support aquatic life. Water quality restoration goals for sediment were established on the basis of fine sediment levels in trout spawning areas and aquatic insect habitat, stream morphology and available in-stream habitat as it related to the effects of sediment, and the stability of streambanks. The MTDEQ believes that once these water quality goals are met, all water uses currently affected by sediment will be restored. The MTDEQ's water quality assessment methods for sediment impairment are designed to evaluate the most sensitive use, thus ensuring protection of all designated uses. For streams in western Montana, the most sensitive use assessed for sediment is aquatic life.

Groundwater

Ground water-dependent ecosystems are communities of plants, animals, and other organisms whose extent and life processes depend on ground water (Glasser et al., 2007). The following are examples of some ecosystems that may depend on ground water:

- Wetlands in areas of ground water discharge or shallow water table
- Terrestrial vegetation and fauna, in areas with a shallow water table or in riparian zones
- Aquatic ecosystems in ground water-fed streams and lakes
- Caves and Karst systems
- Aquifer systems, and
- Springs and seeps

Groundwater is an important resource in Montana, and it will likely become more important in the future as the State's population and industries grow. More than half of Montanans depend on groundwater for their primary water supply. Water generated in the mountains of the Forest is an important source of recharge for valley aquifers and is therefore an important Forest function and ecosystem balance.

Because of limited supply and lack of development opportunities, beneficial use of Forest groundwater is generally low. Consumption is limited to special-use permits and FS campgrounds or administrative sites with domestic wells. Off-Forest, groundwater is used extensively for pump irrigation and drinking water wells in the prairies/mountain valleys. There are very few natural sources of groundwater contamination. Most threats to groundwater quality are linked directly or indirectly to a variety of human activities. Groundwater contamination on forest has occurred in areas of past mining activities. Large areas of acid mine drainage are present in the Little Belts, Divide, Upper Blackfoot, and Castles GAs. Particular threats to groundwater in the planning area include facility and road development, grazing impacts, contamination from roads, and clearing of vegetation.

Bull trout are present in streams on the west side of the Continental Divide in the Upper Blackfoot and the west side of the Divide GAs. Bull trout are highly dependent on groundwater areas that influence spawning and winter habitat conditions.

Aquatic habitat condition

The most comprehensive and consistent data set on stream channel conditions is provided by the Pacfish/Infish Biological Opinion (PIBO) monitoring program, which is a highly organized monitoring effort that collects data systematically across NFS and BLM lands throughout the Interior Columbia River Basin and Upper Missouri River basin. PIBO monitoring was developed to determine if components in PACFISH/INFISH were effective at preventing further habitat degradation at the scale of the entire Columbia River Basin. This monitoring program collects reach-level stream habitat, temperature, macroinvertebrate, sediment, and riparian data to evaluate if key biological and physical components of aquatic and riparian communities are being degraded, maintained or restored. With over a decade of consistently collected data and improvements in data analysis, comparisons between managed and reference watersheds can now be scaled down to conditions on an individual NF. Currently, PIBO monitoring provides rigorously collected local data that can be statistically compared to reference conditions in the same geophysical province.

Monitoring began on the NFs west of the Continental Divide in 2001. The program was expanded to the east side of the Continental Divide to the Upper Missouri River Basin in 2006. Over a 5 year period, 1,300 sub-watersheds are sampled in the Columbian River basin and 250 sub-watersheds in the Missouri River basin, which equates to about a third of the sub-watersheds managed by the BLM and the FS within the study area. Once three sampling rotations have been completed, this program allows for the evaluation of status and trends comparison of the reference and managed conditions. An analysis of stream habitat conditions using the PIBO data can be found in the project files. As of 2017 all of the west side sites have been sampled at least three times and the third rotation of sampling has been initiated on the east side.

Two types of data comparison are made with PIBO data, "status", and "trend". Status compares conditions between a group of managed stream reaches against a group of unmanaged stream reaches (unmanaged reaches have little or no road development, mining, timber harvest, grazing, recreation development, etc.) Because of a century plus of management in what is now the HLC NF, it has been difficult to find reference reaches on the HLC NF, so comparisons are made at the larger ecoregion scale (ecoregions are defined to be areas of relative homogeneity in ecological systems). Trend comparisons look at conditions for a group of reaches measured at least 3 time intervals, usually about 5 years apart. Looking at how conditions change for a group (either managed or reference) and how a group of managed sites compares to reference sites over that time allows managers to judge the trend in conditions in managed sites and whether or not managed site conditions are moving towards the desired conditions described in the 2020 Forest Plan.

In addition to a forest-scale analysis, PIBO data was grouped into drainages and/or individual units to provide trend information for more discrete areas. Regardless of how the HLC NF PIBO sites are broken down, trend data show fewer trends in the desired direction for habitat attributes for managed sites or reaches when compared to all PIBO managed reaches monitored in Region 1. The overall index score of integrator sites (located at the lowermost, low gradient reach occurring on federal land, which are influenced by the watershed area upstream, and considered the most sensitive area to sediment and flow regimes) is also lower for all areas on the HLC NF for managed areas when compared to Region 1 as a whole. Additionally, the overall index score for integrator sites located in the HLC NF west of the Continental Divide are higher than for those in the HLC NF east of the Continental Divide. When compared to the overall index scores for reference sub-watersheds from the within the appropriate ecoregion, the managed areas scores were statistically lower. Ecoregions are defined to be regions of relative homogeneity in ecological systems or in relationships between organisms and their environments. The comparison between reference and managed reaches are not meant to be used as goals to be attained in managed reaches, but rather an indication of management-induced disturbance. Although this suggests that measures implemented west of the Continental Divide have improved habitat conditions somewhat more than east of the Continental Divide, managed areas on both sides would still need to be improved to meet desired conditions.

PIBO data show streams in managed sub-watershed across the planning area have lower median values or habitat conditions for many of the measured metrics (Archer & Ojala, 2016, 2017). The PIBO site selection methodology selects managed sites based on a rigorous and repeatable methodology. The PIBO program selects random low gradient reaches in the selected sub-watersehds. Managed sites in grazed sub-watersheds are considered representative of grazing impacts typical for low gradient habitat in that pasture. When we have qualitatively compared PIBO data sets to forest collected data, many areas have shown that livestock impacts to streams and riparian areas continue to occur.

Benefits to people

Watersheds across the planning area provide many benefits to people that include clean water for drinking, high quality habitat for fish and sport fishing, wildlife, livestock, and agricultural irrigation. FS-managed lands include the headwater tributaries for a large percentage of source (drinking) water protection areas in the U.S. High quality water and habitats provides high elevation refugia for fish across the planning area in a warming environment. Watersheds provide many agricultural benefits for local rural communities in the form of grazing forage for livestock, and agricultural irrigation water on and downstream of the forest.

Drinking water

Water draining off NFS lands is often used for drinking water supplies. A lot of confusion exists around current agency policies to protect drinking water supplies and their importance during Forest Plan revision efforts. The following discussion will provide an overview of Municipal Supply Watersheds and Source Water Protection Areas, which are two separate constructs for drinking water protection that are applicable to NFS land management.

Municipal supply watersheds

The 1986 Forest Plans currently recognize 4 municipal supply watersheds diverting surface water from streams within or just downstream of the HLC NF and are recognized in accordance with 36 CFR 251.9. Big Spring Creek watershed provides drinking water for the City of Lewistown and would be identified as a new municipal watershed under the 2020 Forest Plan. Together, these 5 municipal supply watersheds serve approximately 36,690 people, including some travelers, i.e. transients.

- The town of Neihart, population of 50, uses O'Brien Creek and Shorty Creek. Both of these are within Belt Creek-Carpenter Creek sixth level watershed in the Little Belts GA. Neihart has had some issues with turbidity in O'Brien Creek not meeting EPA Safe Drinking Water Standards, so it installed an infiltration gallery in Shorty Creek to use during those times when waters do not meet the standard. The City received a State Treasure State Endowment Program planning grant in 2015 and has applied for a project grant to improve their overall system.
- The City of Helena uses Tenmile Creek in the Divide GA (Management Areas H1 and H2 in the existing Helena Forest Plan) and its tributaries as its primary source of drinking water for a population of around 28,190. Streams in the lower portion of the Tenmile watershed do not meet drinking water quality standards, but above the diversions, water quality does generally meet standards. Diversions are located in Tenmile Creek above Rimini and near the mouths of Beaver Creek, Minnehaha Creek, Moose Creek, and Walker Creek. Water from all diversions is carried to the Tenmile Water Treatment Plant in a common buried pipeline. In addition, the City of Helena stores water from several tributaries in Scott and Chessman Reservoirs (in the upper part of the watershed) when streamflow is high. The Red Mountain Flume carries water from some of these tributaries to Chessman reservoir. Vegetation treatment efforts are occurring in the watershed under the Red Mountain Flume Chessman Reservoir Project. This project has treated the areas around the flume and reservoir to reduce hazardous fuels. Further treatments in the rest of the watershed are inclued in the Tenmile South Helena Project. The primary objective of this project is to reduce the risk for a high intensity wildfire and associated adverse post-fire watershed effects in the watershed.
- The city of White Sulphur Springs, population of 984, uses Willow Creek (part of the Smith River-Trout Creek sixth level watershed). The Willow Creek municipal watershed is located in the Castles GA. The Castle Mountains landscape assessment of 2012 described conditions within the municipal watershed as good. Specifically, the watershed is fenced out and with the exception of few trespass cows, livestock access is nonexistent. It has a healthy riparian area with a great diversity of plants including cottonwood, aspen, dogwood, alder, and willow. Mixed conifers adjacent to the channel provide an excellent source of large woody debris which forms numerous log jams along the profile. A boulder dominated channel bed, less-prone to degradation when compared to other project area channels within the GA, dissipates the 500 year flood energy efficiently and shows no detrimental effects from the natural event. The overall condition of the watershed is excellent but hillslopes surrounding the creek have high fuel loading (dead lodgepole pine) which could potentially trigger a wildfire. Vegetation treatments under the Castles Restoration Project are planned in the watershed, which include thinning and prescribed burning.
- Also included in the 1986 Helena NF Plan is the municipal watershed for the City of East Helena, population of 2,074 (2016). The city uses McClellan Creek, located in the Elkhorn GA for one source of municipal water. This source is an infiltration gallery located approximately five miles

south of East Helena, in the McClellan Creek drainage, downstream of the forest boundary. The infiltration gallery draws water into two collection systems installed into alluvium near the creek. Recharge to McClellan Creek occurs in the Elkhorn Mountains on the Forest.

- Not included in the Lewis and Clark NF 1986 plan is the city of Lewistown's source water protection area. This municipality receives its water from Big Spring Creek. The recharge area for Big Spring Creek extends into the Madison limestone within the Snowies GA to the south. The designated municipal watershed would include approximately two thirds of the Big Snowies (including all the watersheds that flow to the north out of the Snowy Mountains above the forest boundary). (Please see 2020 Forest Plan, Appendix A, Map S-2).

Source water protection areas

Source water protection areas protect public water systems from contamination in accordance with the 1996 amendments to the Safe Drinking Water Act. Public water system intakes on surface water sources, i.e. streams, are the most susceptible to contamination from land management activities within the HLC NF. The City of Helena is the only public water system diverting surface water from streams within the HLC NF, specifically from Beaver Creek, Minnehaha Creek, and Moose Creek in the Tenmile Creek watershed. The source water protection areas of these surface water intakes includes a "Spill Response" area that is buffered along each source stream measuring a maximum of 10 miles in length, 1/2 mile from both streambanks, and 1/2 mile downstream from the surface water intake and is confined to the extent within the contributing watershed. These spill response regions are to be managed to prevent releases of contaminants where they can be drawn directly into a water intake with little lag time. In addition to the City of Helena's surface water intakes, 2 other communities have Spill Response areas that overlap the HLC NF, specifically the Town of Neihart's surface water intake on O'Brien and Shorty Creeks and the City of White Sulphur Springs intake on Willow Creek.

In addition to the spill response region, the rest of the contributing watershed upstream of each surface water intake is the "watershed region" part of the source water protection area, in which management is to maintain and improve the long-term quality of surface water used by the public water system. In addition to the 3 spill response regions that overlap the HLC NF, 12 public water systems located downstream of the forest have watershed regions that extend up into the forest. All 15 of these surface public water systems collectively serve approximately 100,000 people.

Groundwater sources also supply drinking water in and around the HLC NF. There are 9 public water systems withdrawing groundwater at 12 locations within HLC NFS lands, coming from 9 wells and direct from 3 springs. Montana's Source Water Protection Program states that areas located within 100 feet of these ground water sources is the "control zone" for each intake, and this area is to be managed to protect sources from damage and to prevent direct introduction of contaminants into sources or the immediate surrounding areas. These 9 public water systems withdrawing groundwater at 12 locations on NFS lands are the only control zones that intersect the HLC NF.

Beyond the 100 foot control zones, the areas within 1 mile of each ground water public water system source are typically designated as "inventory regions" by MTDEQ that will be managed to minimize susceptibility to contamination. The delineation of these inventory regions can also be defined using other methodologies than a simple 1-mile buffer depending on the information available and circumstances, and these areas are delineated by MTDEQ. Management in these inventory regions will be focused on pollution prevention activities where water is likely to flow to a public water system well intake within a specified time-period. These inventory regions have various degrees of delineation on the Forest and management in these inventory regions will be considered at the site-specific project level. BMPs can be implemented to control nonpoint sources of contamination in these areas (Montana Department of Natural Resources and Conservation, 1999).

Riparian areas

Riparian areas

The vegetation composition and structure, and the pattern of the riparian and wetlands across the planning area are highly diverse. Plant communities may be dominated by grasses with few shrubs and trees, or they may be heavily forested. Riparian vegetation on the west side of the divide may be dominated by broadleaved trees, particularly black cottonwood, or by coniferous species. Spruce and subalpine fir are most common, with other species such as Douglas-fir, lodgepole pine and a rare occurrence of larch in the Blackfoot GA, are also present in many riparian areas. Forbs and grass-like plants that occupy these sites are quite diverse. East of the Continental Divide, riparian species may consist of broadleaved trees including black, narrow-leaved cottonwood or aspen. Spruce and subalpine fir are most common in high elevations and Douglas-fir and lodgepole pine on cooler slopes and in many riparian areas. Shrubs include alder, rocky mountain maple, willow species, red-osier dogwood, elderberry, buckthorn, thimbleberry, twinberry honeysuckle, common chokecherry and hawthorn. The vegetative structure may include many decayed and dead trees, and multiple layers of vegetation that include submerged vegetation along open water margins, as well as plants that grow in conditions with variable amounts of soil saturation. Patterns of riparian and wetland ecosystems vary from relatively narrow strips of land along perennial and intermittent streams in deeply incised, steep mountain valleys, to marshes and adjacent wetlands within the wide valleys of the major river bottoms. They may be interconnected in a linear fashion down hillsides and in valleys, they may occur in clusters, or they may occur as isolated microsites in other ecosystems. Riparian areas are widely distributed across the planning area and occur at all elevations. Refer also to the Terrestrial Vegetation section for additional information regarding riparian and wetland vegetation.

The effects of livestock can be seen across the planning area, particularly in riparian areas where they concentrate. Historical grazing and agricultural activities such as irrigation has led to riparian vegetation changes. Various allotments have seen improvements through BMPs and updated allotment management plans, however riparian and aquatic habitat improvements within grazing allotments continue to be a challenge across the planning area. Most allotments managed under a season long as well as some deferred grazing stratigies continue to impact RMZs.

Across the forest, road encroachment into riparian areas and wet meadows are found in all GAs. Runoff from roads in the proximity of riparian areas deliver sediment. Dispersed camping across the forest has also resulted in compacted soils and removed riparian vegetation.

Natural disturbance processes

In the ecosystems of the HLC NF, primary natural disturbances that affect riparian areas include flooding, fire, insects, disease, and weather events (i.e., windstorms). These disturbances are an integral part of the creation, maintenance and renewal of forests.

Periodic flooding in wide, low-gradient drainages maintains a diverse mosaic composed of vegetation patches of varying compositions and structures, interspersed with sloughs and wetlands. Flooding is much less of a factor in moderate or steep gradient streams or for wetlands farther removed from rivers and streams. Fire and other disturbances play a larger role.

Fire has shaped the vegetation conditions across the planning area for millennia, influencing forest ages, structure, plant species composition, productivity, carbon storage, water yield, nutrient retention, and wildlife habitat across all areas of the forest, including riparian areas. Other natural disturbances that historically influenced the forests within riparian areas are insects, disease and weather events, such as windstorms and blowdown. These effects cause varying amounts and extent of tree mortality, from nearly all trees killed (such as in a mountain pine beetle epidemic in a lodgepole pine dominated stand), to only scattered trees killed. As with fire, forest structure is affected, including changes/decreases in forest density and canopy closure and increased amounts of dead wood. Reduced canopy closure may stimulate growth of understory grasses, forbs and shrubs, as well as improve growth on remaining live trees. Tree species compositions may change.

Wetlands

Wetlands and other ground water-dependent ecosystems are communities of plants, animals, and other organisms whose extent and life processes depend on ground water (Glasser et al., 2007). The following are examples of some ecosystems that may depend on ground water:

- Wetlands in areas of ground water discharge or shallow water table
- Terrestrial vegetation and fauna, in areas with a shallow water table or in riparian zones
- Aquatic ecosystems in ground water-fed streams and lakes
- Caves and Karst systems
- Aquifer systems, and
- Springs and seeps

These areas contain ecological resources that potentially are highly susceptible to permanent or long-term environmental damage from contaminated or depleted ground water. Ground water extraction by humans modifies the pre-existing hydrologic cycle. It can lower ground water levels and alter the natural variability of these levels. The result can alter the timing, availability, and volume of ground water flow to dependent ecosystems. Ground water-dependent ecosystems vary in how extensively they depend on ground water, from being wholly dependent to having occasional dependence. Unique ecosystems that depend on ground water, such as fens or bogs for example, can be entirely dependent on ground water, which makes them very susceptible to local changes in ground water conditions (Glasser et al., 2007). Particular threats in the planning area include facility and road development, grazing impacts, contamination from roads, and clearing of vegetation.

Riparian and wetland vegetation types are mapped on over 70,000 acres of the HLC NF's administrative area, less than 3% of the total planning area. Forests adjacent to wetlands have historically been influenced by the natural disturbance processes characteristic of this ecosystem. These include fires, insects, disease, and weather events (e.g., windstorms). These disturbances caused various amounts of tree mortality, altering forest structures, species and densities. Periodic high severity fires would revert older forests to early successional stages where grass, forbs, shrubs, tree seedlings and snags dominated. Mixed severity fires would have some areas burned at high severity, some burned at moderate severity, and some areas at low severity or unburned. All these fire severities may occur in the forested lands immediately adjacent to wetlands, depending upon forest conditions, moisture levels, and weather.

Fisheries, aquatics and CWNs

Watershed condition is the state of the physical and biological characteristics and processes within a watershed that affect the soil and hydrologic functions supporting aquatic ecosystems. Broadly speaking, watershed condition can range from natural pristine (functioning properly) to degraded (impaired). The FS Manual (FSM 2500) defines watershed condition in terms of 'geomorphic, hydrologic, and biotic integrity' relative to 'potential natural condition.' In this context, integrity relates directly to functionality.

Within the planning area, the trends for the viability of individual populations of aquatic species are mixed. The analysis focuses on two prominent native fish species on the HLC NF: westslope cutthroat trout and bull trout. Habitat conditions for these species are indicative of habitat conditions for many other native species. Therefore, habitat conditions for these species will be used to assess the indirect effects of the 2020 Forest Plan

Several populations of westslope cutthroat trout are at imminent risk of hybridization and/or extirpation through predation or replacement by nonnative species (L. Nelson et al., 2011). With recovery efforts, the number of known westslope cutthroat trout populations has remained constant at best; populations added through recovery projects have roughly equaled those lost in areas where greater protection wasn't feasible or invasion by nonnative species was not expected. Populations are mostly small isolates while the meta-population sized objectives outlined in the restoration goals (Montana Fish Wildlife and Parks, 2007) have yet to be achieved. Efforts underway in the Dry Fork of Belt Creek in the Little Belt Mountains would create over 20 miles of connected habitat and move towards partial achievement of meta-population objectives. Other proposed projects west of the divide, such as removal of hybridized fish in the headwaters of the North Fork Blackfoot River, would also provide meta-populations that have greater probabilities for long-term persistence. This opportunity exists because several somewhat rare basin characteristics combine to allow for a probability of success that isn't readily available in most other locations.

Bull trout express two life histories within this planning area, resident and migratory. Resident populations in tributaries are mostly known to be displaying stable trends based on monitoring survey efforts. There are long-term concerns with smaller, isolated populations, since habitat patch-size is known to be a determining factor in viability even under natural disturbance regimes influenced by conditions such as wildfire and climatic change (Eby, Helmy, Holsinger, & Young, 2014; Rieman et al., 2007). Bull trout also express a fluvial life history in the Blackfoot River and historically in the Little Blackfoot River drainages.

The USFWS now considers the fluvial life-form to be extirpated from the Little Blackfoot River. Surveys conducted by MFWP personnel have been negative for occurrence in the Little Blackfoot. Personnel from the Forest located a few fluvial-sized bull trout in tributaries to the Little Blackfoot River about ten years ago and observed one angler catch more recently. The most recent genetic test of remnant fluvial-sized fish documented hybridization. Even though bull trout are considered extirpated in the Little Blackfoot, recent sampling utilizing the environmental DNA technique verified that bull trout persist in the drainage (Young et al., 2017). Environmental DNA proves a useful tool for inventory and monitoring of rare species such as bull trout (McKelvey et al., 2016).

The viability of the fluvial life-history form of bull trout in the upper Blackfoot River basin, which correlates well with the boundaries of the NF, is believed to be at low risk under current and forecasted climatic change conditions (Isaak et al., 2017). The same survey and assessment efforts put the viability of fluvial populations at high risk lower in the Blackfoot River drainage. Tributaries on the Forest are known to contribute fluvial fish to lower portions of the Blackfoot River.

Native species west of the Continental Divide whose range includes the Blackfoot and Little Blackfoot River drainages include mountain whitefish (*Prosopium williamsoni*), largescale sucker (*Catostomus macrocheilus),* longnose sucker *(Catostomus catostomus),* longnose dace *(Rhyinichthys cataractae)* and sculpin (*Cottus sp.*). Native species found in lakes include*,* Northern pikeminnow (*Ptychocheilus oregonensis),* Peamouth chub *(Mylocheilus caurinus),* and Redside shiner *(Richardsonius balteatus).* Many of these species are found at lower elevations in the drainages or in lake systems off forest.

East of the divide mountain sucker *(Catostomus platrhynchus),* longnose sucker *(Catostomus catostomus),* white sucker *(Catostomus commersoni)* burbot *(Lota lota),* stonecat (*Noturus flavus*), longnose dace *(Rhyinichthys cataractae*and), and sculpin (*Cottus sp.*) are also native species in the planning area. Arctic grayling *(Thymallus arcticus*) were also a native salmonid in the Missouri River drainage above the Great Falls and now largely absent from the planning area except in some mountain lakes.

Amphibians whose range overlaps with the planning area include tailed frogs (*Ascaphus montanus*), boreal chorus frog (*Pseudcris maculata*), northern leopard frog (*Lithobates pipiens),* Columbia spotted frog (*Rana luteiventris*), western toad (*Anaxyrus or Bufo boreas*), plains spadefoot (*Spea bombifrons),* long-toed salamander (*Ambystoma macrodactylum*), and western tiger salamander (*Ambystoma mavortium)*.

Non-native brook trout (*S. fontinalis*), rainbow trout (*O.mykiss*), and brown *trout (Salmo trutta)* are also present within the planning area, as is the nonnative cyprinid, the common carp *(Cyprinus carpio).* Warmwater sport fish species including northern pike (*Esox lucius*), perch (*Perca flavescens*), and walleye (*Sander vitreus*) can be found in some lakes, rivers and reservoirs primarily in the Missouri River Reservoir complex or at lower elevations off forest. These nonnative sport fish are desired by some anglers and provide recreational angling opportunities.

Conservation Watershed Network (CWN)

CWNs are intended to identify important areas needed for conservation and/or restoration, maintain multi-scale connectivity for at-risk fish and aquatic species, and to ensure ecosystem components needed to sustain long-term high-quality water and persistence of species. The proposed CWN included in the action alternatives in the 2020 Forest Plan is designed to provide that long-term conservation strategy to conserve native fish in watersheds that are expected to be long-term cold water refugia in the face of climate change (Isaak, Young, Nagel, Horan, & Groce, 2015). CWNs are further described in the environmental consequences section of this document along with Appendix E of the 2020 Forest Plan.

Aquatic at risk species

The 2012 Planning Rule states that, where plan components designed to provide for ecosystem integrity do not sustain the ecological conditions required by an at-risk species, species-specific plan components may be needed. For some at-risk species, specific components have been included in the 2020 Forest Plan in order to sustain the ecological conditions (including but not limited to specific amount or distribution of habitat features, protection from human disturbance, etc.) required by that species. Federally listed and proposed species will be analyzed in a Biological Assessment for consultation with the USFWS. At the time this report was prepared, there are three at-risk aquatic species found on the HLC NF. Those species are as follows:

- Federally listed, proposed, or candidate species:
    - Bull Trout – Threatened
- Species of Conservation Concern:
    - Western Pearlshell Mussel
    - Westslope Cutthroat Trout

Bull trout (threatened species)

In November 1999, the USFWS listed all populations of bull trout within the coterminous U.S. as a threatened species pursuant to the ESA of 1973, as amended (Act) (U.S. Department of the Interior, Fish and Wildlife Service, 1999). The 1999 listing applied to one distinct population segment of bull trout within the coterminous U.S. The Forest is in the Columbia Headwaters recovery unit. Two core areas of the Columbia Headwaters recovery unit are within HLC NF Lands; they are the Blackfoot River Core Area (Number 31) and that portion of the Clark Fork River (Section1) Core Area (Number 34) in the upper Little Blackfoot River drainage. Recovery actions for bull trout (U.S. Department of the Interior, Fish and Wildlife Service, 2015b), developed in cooperation with Federal, State, tribal, local, and other partners, fall generally into four categories:

- Protect, restore, and maintain suitable habitat conditions for bull trout.
- Minimize demographic threats to bull trout by restoring connectivity or populations where appropriate to promote diverse life history strategies and conserve genetic diversity.
- Prevent and reduce negative effects of nonnative fishes and other nonnative taxa on bull trout.

- Work with partners to conduct research and monitoring to implement and evaluate bull trout recovery activities, consistent with an adaptive management approach using feedback from implemented, site-specific recovery tasks, and considering the effects of climate change.

The Northern Region of USDA FS also developed a Bull Trout Conservation Strategy for Forests in western Montana, including that portion of the HLC NF in 2013. In addition to the recovery plan, the USFWS also released the Columbia Headwaters Recovery Unit Implementation Plan (U.S. Department of the Interior, Fish and Wildlife Service, 2015a) in 2015.

Two basic life history forms of bull trout are known to occur: resident and migratory. Resident bull trout spend their entire lives in their natal streams, while migratory bull trout travel downstream as juveniles to rear in larger rivers (fluvial types) or lakes (adfluvial types). The populations in the Blackfoot River drainage include both residents and fluvial life history form, where juveniles remain in their natal stream or move downstream to rearing streams, and then returning around age 6 to spawn.

Extensive sampling from 2008-2010 suggests that bull trout are nearly extinct in the Little Blackfoot drainage (R. W. Pierce, Podner, & Carim, 2013). It is hypothesized that up to 1,000 bull trout redds may have been historically present in the Blackfoot River Core Area. As with most bull trout populations, overall numbers were likely highly variable from year to year, based on natural climatic and disturbance patterns. Bull trout populations in the Blackfoot River were likely first exposed to mining-caused impacts in the late 1800's in the form of small scale mining. The mining method was often an instream "placer" type operation that directly disrupted fish habitat and stream functions. Once disturbed in this fashion after being moved and straightened, streams rarely have the ability or the power to naturally recover to their predisturbance condition.

Western pearlshell mussel (SCC)

Western pearlshell (*Margaritifera falcate*) is a state species of special concern in Montana (S2) and is a species previously identified as sensitive on the Region 1 Sensitive Species (RFSS) list (U.S. Department of Agriculture, Forest Service, 2011a). Montana's populations of *M. falcata* have substantially declined over the last century in Montana and have become less viable with stream-decreased flows, warming, and degradation. Previously reported mussel beds in the larger rivers (Smith, Blackfoot, Big Hole, Bitterroot, Clark Fork,) have been extirpated or decreased to such low densities that long-term viability is unlikely.

In the plan area, historic mining and resultant metals introduced into the stream environment are likely one of the more important threats that have reduced populations in the Blackfoot River (D. Stagliano, personal communication). In a 2015 report updating for the Montana Natural Heritage Program that updated the status of pearlshell mussels in Montana, climate warming and loss of native host fish populations of WCT are singled out as important reasons for continued decline. In the 2015 report, 10 of 11 Blackfoot River populations surveyed for status were still present. Surveys in the Missouri River downstream of Canyon Ferry Reservoir did not detect any pearlshell mussels. They are now considered extinct in the Missouri downstream of Canyon Ferry (Stagliano, 2015).

Westslope cutthroat trout (SCC)

Westslope Cutthroat Trout were listed as a "State Species of Concern" by the Montana Department of Fish, Wildlife and Parks (MFWP) in 1972 due to the steep decrease in genetically pure populations and extensive loss of habitat range. A petition was made to list the westslope cutthroat trout status as threatened under the Endangered Species Act in 1997. In 1999, a Westslope cutthroat trout Conservation Agreement was developed by Montana with the assistance of a technical committee (formed in 1994) and a steering committee (formed in 1996), and this agreement was signed by state, federal, and non-government associated organizations. In 2000, a plan was implemented to complete the goals of the agreement and restore westslope cut trout in northcentral Montana (Tews et al. 2000). This plan was updated in 2007 (MFWP 2007) to refocus goals and to ensure the objectives of the agreement could be met in an adaptive manner. The Forest Service in cooperation with MFWP and other signators of the westslope cutthroat trout Conservation Agreement Memorandum of Understanding (Montana Fish Wildlife and Parks, 2007) will continue to cooperate to achive the goals of the Westslope cutthroat trout Conservation Agreement.

The USFWS was petitioned by interested parties to include the westslope cutthroat trout under the protection of the ESA. In 2003, the USFWS determined that the listing was not warranted due to wide species distribution, available habitat on public lands, and conservation efforts underway by state and federal agencies. The planning area headwater streams are considered a stronghold for westslope cutthroat trout throughout its range (Shepard, May, & Urie, 2005).

A Federal Challenge Cost Share Agreement was established in 2001 between MFWP and the United States Forest Service (USFS) to implement and fund the westslope cutthroat trout restoration project (Tews et al. 2000) as outlined by the westslope cutthroat trout agreement. Funding for the 2015 westslope cutthroat trout restoration project was provided by the Environmental Protection Agency and the State Wildlife Grants program. Beginning in 2016, Northwestern Energy (formerly Pacific Power and Light Montana), Resource Development Grant Program, and the Future Fisheries Program provided additional funding for westslope cutthroat trout restoration.

The primary reasons for this species' decline are similar to those discussed above for the bull trout. Habitat loss is considered a widespread problem. Cutthroat trout have declined across their range due to poor grazing practices, historic logging practices, mining, agriculture, residential development, and the lingering impact of forest roads. Locally on forest, grazing, logging and associated road building have had the greatest impact upon habitat for westslope and populations. In addition, fish have been unable to use some spawning habitat due to barriers created by dams and road culverts. Genetic introgression with rainbow trout threatens long-term persistence of westslope cutthroat trout, and is most likely the greatest threat (Hitt, Frissell, Muhlfeld, & Allendorf, 2003). Climate change may likely exacerbate the rate of introgression (Muhlfeld et al., 2014). Efforts of a wild trout restoration and conservation initiative have been underway since 1988 in the Blackfoot River drainage and is an iterative tributary-based priority-driven process whereby the scope and scale of restoration expands as information and stakeholder cooperation is generated (R. Pierce & Podner, 2006). Restoration methods include enhancing flows in rearing areas, preventing adult and juvenile fish loss to irrigation in migration corridors, reconstructing damaged streams, fencing livestock from spawning areas, and expanding similar actions in adjacent tributaries to address human-induced limiting factors when opportunities allow. The primary geographic focus of stream improvement activities had been bull trout "core area" streams and tributaries downstream from the North Fork Blackfoot until early in this decade However, restoration and conservation measures have now expanded to streams in the Lincoln valley and headwater areas on the HLC NF. Conservation actions in the headwaters of the Blackfoot River are especially important because this large GA harbors genetically pure native westslope cutthroat trout and may hold the highest potential for native cutthroat trout conservation based at the sub-basin scale. Electrofishing and genetic status monitoring of westslope cutthroat trout is also expected to continue in cooperation with MFWP and other signators of the westslope cutthroat trout Conservation Agreement Memorandum of Understanding (Montana Fish Wildlife and Parks, 2007).

Non-native fish

The Columbia Headwaters Recovery Unit Implementation Plan for Bull Trout Recovery Plan (U.S. Department of the Interior, Fish and Wildlife Service, 2015a) identified action items that included suppression of nonnative fish invaders to protect the intact native species assemblages as in the Copper Creek/Landers Fork drainage on the HLC NF. Brown trout may be simply replacing bull trout in areas where habitat quality has declined or they may be actively displacing bull trout. However, additional study is required before definitive conclusions can be made regarding their interactions and their level of threat to bull trout.

Genetic introgression with rainbow trout threatens long-term persistence of westslope cutthroat trout, throughout the planning area, and is most likely the greatest threat (Hitt, Frissell, Muhlfeld, & Allendorf, 2003). Hybridization reduces reproductive success of westslope cutthroat trout and can lead to a loss of the species and genetic material (Muhlfeld et al., 2009). Efforts are ongoing to reduce hybridization. Habitat enhancement in streams with native fish assemblages continues to be a priority. In the upper Missouri Subbasin, only 3.3% of the historic distribution is known to be occupied by genetically unaltered westslope cutthroat (L. Nelson et al., 2011). Conservation populations, those less than 10% genetically introgressed, that reflect the Lewis and Clark portion of the planning unit in northcentral Montana only occupy approximately 10% of the historic range (Montana Fish Wildlife and Parks, 2014). Temperature may play a key role in reducing hybridization between the two species with westslope cutthroats favoring colder water, thus climate change is a concern in the long term.

Soils

Originally adopted in 1986, the Helena and the Lewis and Clark Land Resource Management Plans are the primary documents that establish management standards and guidelines governing activities on NFS lands within the boundaries of the HLC NF. The 1986 Forest Plans provide a sparse variety of management direction and options related to the soil resource. Since 1999, physical soil disturbance has been the focus of soil management on NFS lands. FSM Chapter 2550 Region 1 Soil Management Supplement provides a benchmark that indicates when changes in soil properties and conditions may result in a notable change or impairment of soil quality. Not all soil disturbance results in substantial or permanent impairment of productivity. The R1 FSM defines levels of soil disturbance (compaction, displacement, rutting, severe burning, surface erosion, loss of surface organic matter, and soil mass movement) that are considered detrimental (of a great enough magnitude to potentially cause substantial impairment). No more than 15% of an activity area may have detrimental soil disturbance. This low level of detrimental soil disturbance allows recovery to occur between management activities. The NFMA states that management activities on NFS lands will not produce substantial and permanent impairment of productivity. The agency assures that productivity is maintained by establishing soil quality standards.

In 2010, FSM Chapter 2550 Soil Management was revised at the national level. The emphasis of soil management was changed to include long-term soil quality and ecological function. The FSM defines six soil functions: soil biology, soil hydrology, nutrient cycling, carbon storage, soil stability and support, and filtering and buffering. The objectives of the national direction on NFS lands are 1) to maintain or restore soil quality, and 2) to manage resource uses and soil resources to sustain ecological processes and function so that desired ecosystem services are provided in perpetuity.

The 2012 Planning Rule broadened soil management direction, requiring plans to maintain or restore terrestrial ecosystems, put more succinctly in terms of ecosystem services. The FS manual outlines these services as soil biology, soil hydrology, nutrient cycling, carbon storage, soil stability and support, and filtering and buffering. For the purposes of repeatablility and reliability in measurement of the soil quality indicators in the field, only four of the six functions listed in the FS manual meet this requirement. These include soil biology, soil hydrology, nutrient cycling, and soil stability.

Land use practices, such as grazing, logging, and mining, have been occurring on the HLC NF since their inception. Activity impacts are evident on the landscape today. Dynamic soil characteristics may be indicators of impaired productivity. Compaction may restrict plant rooting, may lower water-holding capacity, and may decrease infiltration. Loss of surface soil through displacement and mixing may decrease soil productivity. Displacement occurs during temporary road construction, excavation of skid trails and landings, and displacement of soils during ground-based harvest. Areas with ground disturbance may become more favorable for weed invasion, which can reduce overall soil productivity and quality.

Since soil function is difficult to measure in the field, instead associated indicators that can be readily observed are measured. These factors include disturbance to surface organic matter and disturbance to topsoil. Most management activities affect surface organic matter that can rebound relatively quickly as surface leaf litter and roots in the soil rebuild organic matter stocks. In contrast, the mineral topsoil could be considered a summation of a site's potential to support growth based on bedrock, terrain, climate, and rate of soil development. When management activities displace or remove portions of the topsoil, this impact involves a longer-term recovery than disturbance. These consequences can vary depending on the soil depth and the place in the landscape. Topsoil disturbance on drought prone sites could proportionally affect the soil's ability to provide water to trees more than on wet sites where seasonal moisture stress is less.

Management can also use soil function to inform prescriptions (Craigg, Adams, & Bennett, 2015). Managers often refer to historic range of variation as an analogue to manage for tree species composition and structure. Soils provide a historic record of vegetation distribution with grassland types and deciduous trees creating darker top soils than sites dominated by forests and shrubs. Soil characteristics of depth, texture and even the accumulation of ash laden loess can indicate areas most able to provide water through the summer. These characteristics inform managers of where best to plant species requiring high summer water and where trees have the best growing conditions.

Existing condition

The Forest has a wide diversity of soil types from the minimally-developed, nutrient poor soil and rock complexes of the steep mountain slopes and ridges to the deep, fertile soils of the lower valleys. Steep terrain prone to intermittent surface movement combined with recent ablation of glaciers have limited soil development. Soil provides ecosystem services through thermoregulation, nutrient cycling, and water purification and storage. It also contributes to provisioning ecosystem services by providing wildlife habitat, plant-growth media, and fill (construction).

The diverse and productive soils of the HLC NF are described, characterized, and classified in the Soil Survey of Helena NF Area, and Soil Survey of Lewis and Clark NF Area respectively.

Soil productivity relies on soil organic matter, which is influenced by fire, harvest activities, decomposition, and accumulation rates. The organic component of soil is a large reserve of nutrients and carbon and is the primary site for microbial activity. Forest soil organic matter influences many critical ecosystem processes, including the formation of soil structure. Soil organic matter is also the primary location for nutrient recycling and humus formation, which enhances nutrients, water storage, and overall fertility. Soil organic matter depends on inputs of biomass (e.g., vegetative litter, fine woody debris) to build and maintain the surface soil horizons, support soil biota, enhance water-holding capacity, and prevent surface erosion. Much of the nutrient capitol on soils on the HLC NF depends on forest floor, coarse wood debris and organic matter in the topsoil.

Sensitive soils

Disturbance from wildfire and active management can have a disproportionate effect on soils with poor recovery or high value for ecosystem services. The following soils types have sensitive characteristics: riparian and hydric soils, mollic soils, ash and loess influenced soils, granitic soils, shallow soils, and landslide prone areas.

Riparian-Wetland soils: These bottomland soils provide vital ecosystem services and habitat despite occurring on only 1 to 3 percent of the landscape. These soils help to attenuate floods, tend to have higher organic matter accumulation for carbon storage and water holding capacity, and provide a habitat medium that attenuates temperature and humidity for vegetation and aquatic species. Riparian-Wetland soils form under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part of the soil profile (U.S. Department of Agriculture, Natural Resources Conservation Service, 2018). These soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophilic flora. Riparian-Wetland soils occur across the landscape in areas along stream channels, on floodplains, and in isolated springs and seeps. Riparian-Wetland soils are a primary indicator of wetlands and are used in the assessment of FS compliance with Executive Orders 11988 and 11990, directives relative to the management and disposition of floodplains and wetlands. Riparian-Wetland soils have wet conditions prone to rutting and compaction.

Mollic soils: Range, meadow, and savannah pine have higher rates of organic matter accumulation in soil from rich understory grass and forb production. The deciduous leaves in aspen groves can also develop deep organic rich mineral soils. The organic matter accumulation develops mollic conditions whereby dark topsoil reaches below 8 inch depth. This soil type is common across the HLC NF at 745,949 acres (23 percent) and highly important due to the high productivity that creates forage for wildlife and livestock uses. These soils help identify where to thin conifer encroachment into savannahs and reduce shrubs on transitory range. The organic matter accumulation rates are on the order of 10,000 years so once lost this productive potential remains impaired. Risks relate to rutting, compaction and erosion.

Ash and loess soils: Soils with surficial volcanic ash and loess (wind) deposits are another group of sensitive soils on the HLC NF that add productivity to the forest and rangeland. These soils extend across the Upper Blackfoot, Divide, Elkhorn, and the central section of the Big Belts GAs of the Helena NF, covering approximately 64,293 acres (2 percent) of the forest. Ash and loess soils have silt loam and loam soil texture and form a productive topsoil that increases water holding capacity and cation exchange capacity. The loess has higher nutrient value than pure ash deposits to the west. The redeposited wind transported sediments typically having more minerals than the volcanic glass deposition. The main risk for these soils are compaction, erosion, and soil mixing. Losing ash and loess soils would permanently reduce productivity since these are irreplaceable on human timescales. Volcanic ash origin was primarily Mt. Mazama 7,700 years ago and loess were transported during the glacial periods (10-16k years ago).

Granitic soils: Grussic soils typically weather from igneous bedrock of which granitic commonly occurs. This bedrock can weather to many fine, gravel-sized particles of weakly consolidated rock. Approximately 281,663 acres (9 percent) of the HLC NF has granitic or other igneous bedrock that can produce to grussic soils, especially in the Divide, Castles and Elkhorn geographic areas. These soils are typically noncohesive and coarse textured. Bared or disturbed granitic soils easily erode and are highly susceptible to soil sloughing and surface erosion. Once exposed the loose substrate does not revegetate readily. Though not as prone to compaction, the loose aggregate produces extremely well drained conditions that creates droughty soils and poor fertility. On granitic soils the forest floor and thin topsoil holds a higher proportion of the nutrient capitol than typical forest soils.

Shallow and infertile soils: Within the elevation range where forest management commonly operates, soils on the HLC NF can be shallow, infertile and lithic. These soils cover approximately 136,517 acres (4 percent) of the forest area. Lithic soils are defined as less than 20 inches to bedrock. These soils develop on slopes controlled by geologic bed orientation; steep where strata is dipping, and forming outcrop bluffs where it is horizontal. The Belt Metasediments that compose these strata are relatively resistant to weathering. Similarly, the upper elevation intrusive igneous have inherently low weathering rates supporting only thin soils. These soils lack topsoil and soil volume that leads to poor nutrient and water holding capacity. The main risk is soil loss from erosion. When soil is shallow, runoff can infiltrate to the bedrock layer and run along that layer, carrying the overlying shallow soil with it.

Landslide prone areas: Landslide prone describes slides, slumps, soil creep, debris flows, topples, and falls of soil and rock. Landslides most likely re-occur in the same location because of geologic bedrock orientation and contacts. In the oversteepened topography throughout the HLC NF, soil mass movement is a natural disturbance process. Though periodic, powerful summer storms and wet springs have the potential to induce mass movement in stand replacing burns and inherently unstable terrain. Operational risks occur where forest management destabilizes landslide prone areas by removing trees, building roads and compacting soils. Inherent unstable terrain was identified in The Lewis and Clark NF Soil Resource

Inventory (Holdorf 1981) as clayey glacial deposits, glacial drift and old mudflows mostly associated with shale bedrock. The Helena NF landtype survey maps these areas as landslide landforms. Convergent and steep topography that concentrate water along with slump scarps are typical signs of unstable terrain. Levels of risk for failure depends heavily on site specific evaluations.

3.5.6 Environmental consequences

Watershed condition and soils

Effects common to all action alternatives

There is a need to update what was intended to be interim INFISH Plan components in place west of the Continental Divide and to improve aquatic habitat management elsewhere in the 2020 Forest Plan and FEIS to remain consistent with strategies in place across public lands in the western United States. The HLC NF plan revision is being completed under the 2012 Planning Rule so text and style of original INFISH component standards and guidelines have been adjusted to be compliant with the current Planning rule.

The 2020 Forest Plan would maintain the use of PIBO monitoring data collected at a subset of sites on the forest every year to evaluate trends towards desired conditions. While the 2020 Forest Plan does not contain numerical Riparian Management Objectives like INFISH did, descriptive desired conditions contained in the 2020 Forest Plan would be used to guide project location, development, and actions. Because of the lag time between projects and effects, as well as the tremendous variability that can result from localized weather events, PIBO data analyzed at the Forest scale is actually a more rigorous method to ascertain whether or not plan components designed to protect and restore the aquatic environment are effective. All of this information would enable the Forest to adapt its management strategies and adjust project decisions in the future, if needed, based upon what has been learned.

One possible management approach to achieve the desired conditions of the 2020 Forest Plan would be a multi-scale analysis strategy as described in appendix E of the 2020 Forest Plan. Multi-scale analysis, a refinement of watershed analysis, has been a widely applied methodology that was first required for use by the USFS in the Pacific Northwest Region (Henjum et al., 1994). It was also described and recommended for use in the interior Columbia Basin key and priority watersheds by PACFISH and INFISH Strategies (1995b) and is recommended for inclusion in plan revisions by the Interior Columbia Basin Ecosystem Management Project (2014) strategy. The multi-scale analysis strategy described in appendix E of the 2020 Forest Plan has been simplified and clarified to aid with integration and implementation.

Traditionally, ground-based logging on the Helena-Lewis and Clark National Forest has been limited to slopes of 35% or less. Advances in harvesting machine technology in recent decades, primarily the graduation from wheeled to tracked machines with self-leveling cabs, have presented an opportunity to explore alternative harvest approaches, including ground-based treatments on slopes greater than 35%. Tracked machines have lower ground pressures than wheeled machines and self-leveling cabs shift the overall center of gravity, thereby improving weight distribution over the track (Cambi, Certini, Neri, & Marchi, 2015; Visser & Stampfer, 2015). Given similar soil and environmental conditions, activities accomplished with modern tracked machinery is expected to cause less extensive and intense soil disturbance than those accomplished with traditional wheeled machinery.

One option for harvesting on slopes greater than 35% is a combination approach pairing ground-based felling and bunching with cable extraction. This harvest method would allow for increased harvest efficiency and operator safety and has been applied in Region 1 on slopes up to 50% with positive results. For example, steep slope combination operations on the Idaho Panhandle National Forest (IPNF) using tracked feller-bunchers resulted in no more than 5% DSD one year following implementation (Rone,

2008) . Despite the differences in geology, landforms, and climate between the IPNF and the Helena-Lewis and Clark National Forest, performing similar types of activities on this landscape is expected to result in DSD levels within this range, which is well within R1 Soil Quality Standards. Literature on this topic asserts that wheeled and tracked machines can operate on slopes up to 45% and 60%, respectively, without causing unacceptable levels of soil disturbance (Heinimann, 1999). Thus, a slope limitation of 45% will be applied to areas proposed for combination treatment and site-specific conditions will be evaluated to determine which units are best suited for this approach. For example, because soils with a high bearing strength – a physical property related to texture and moisture content – are more resistant to soil disturbance, treatment areas having soils with low bearing strength should not be considered for alternative harvest approaches. In all instances, ensuring the maintenance of 85% of the landscape in a fully productive state will remain the priority when determining areas eligible for all proposed treatment types.

Harvesting with ground-based equipment and extracting with cable would allow for increased harvest efficiency and operator safety and has been applied in Region 1 on slopes up to 50% with positive results. For example, steep slope combination operations on the Idaho Panhandle National Forest (IPNF) using tracked feller-bunchers resulted in no more than 5% DSD one year following implementation (Rone, 2008). Despite the differences in geology, landforms, and climate between the IPNF and the Helena-Lewis and Clark National Forest, performing similar types of activities on this landscape is expected to result in DSD levels within this range, which is well within R1 Soil Quality Standards. Literature on this topic asserts that wheeled and tracked machines can operate on slopes up to 45% and 60%, respectively, without causing unacceptable levels of soil disturbance (Heinimann, 1999).

Watershed condition in geographic areas

The largest change of the 2020 Forest Plan to GAs would be the implementation of plan direction for RMZs. All action alternatives would adopt RMZs required plan direction across all GAs (FW-RMZ-STD-01). The 2020 Forest Plan direction would result in additional protection for riparian areas with the adoption of RMZs forestwide. The inner and outer riparian zone plan directions would provide increased aquatic habitat and water quality protection which would maintain or move riparian resources towards desired conditions. These effects would be most dramatic on the east side of the Continental Divide. In the planning areas west side of the Continental Divide (15 percent of the planning area), the RMZs would largely not lead to different outcomes from current INFISH directions in alternative A.

All previous 1986 plan components for municipal watershed were brought forward into the 2020 Forest Plan. The addition of the Lewistown municipal watershed in the Snowies GA would affect management actions with those watersheds. Forest plan directions will be more restrictive to maintain high quality drinking water for the city. See discussion on individual municipal watershed in their respective GAs.

General watershed condition

Many land management activities carried out on the forest have the potential to adversely affect watershed and water quality resources to some degree, particularly those activities that disturb the ground in close proximity to water resources. Table 15 provides a summary of 2020 Forest Plan components for aquatic ecosystems.

All streams with assigned TMDLs would receive special emphasis to improve water quality conditions under all alternatives due to the FS's legal obligation to meet requirements under the Clean Water Act. For the action alternatives, this obligation has been emphasized with a forestwide guideline to comply with the TMDL implementation plans (FW-WTR-GDL-01).

Table 15. Summary of plan components for aquatic ecosystems – action alternatives

Plan Component(s)	Summary of expected effects
FW-WTR-DC, GO, OBJ, STD, and GDL	Forestwide watershed plan components provide extensive direction to guide management actions to maintain and enhance watershed conditions across the Forest. Collectively, they would potentially improve stream channel function, water quality, groundwater and enhance aquatic habitat. They would help to provide resiliency in the face of warming climate.
FW-RMZ-DC, GO, OBJ, STD, and GDL	Implementation of the RMZ standards and guidelines include directions for management actions within RMZs would potentially improve riparian, floodplain, water quality and stream channel conditions across the planning area. The new riparian zone widths would increase width and would have a limiting effect of management actions that could occur with RMZs. The exception would be the west side of the divide as there would be little difference between (Amendment 14) INFISH and proposed RMZ widths. They would help to provide resiliency in the face of warming climate.
FW-FAH-DC, GO, OBJ, STD, and GDL	Implementation of the fish and aquatic habitat standards and guidelines include directions for management actions within streams, riparian and wetlands areas that would potentially benefit habitat conditions.
FW-CWN-DC, GO, OBJ, STD, and GDL	Implementation of the CWN standards and guidelines include directions for management actions within native fish populated watersheds would potentially improve habitat and provides additional protection to maintain the viability of the populations. They would help to provide resiliency in the face of warming climate.
FW-SOIL-DC, GO, OBJ, STD, and GDL	Soil standards, guidelines and desired conditions provide management directions that would potentially avoid detrimental soil conditions and maintain soil organic material.

FW-WTR-STD-03 requires the use of project specific BMPs to be incorporated in all land use and project planning as the principle mechanism for controlling nonpoint source pollution to meet watershed desired conditions, and to not impare water quality. Implementation and effectiveness monitoring of BMPs are performed primarily through three administrative processes: the biennial Montana State Forestry Practices BMP review, forest plan monitoring, and the FS's National BMPs (U.S. Department of Agriculture, Forest Service, 2012a) annual reviews. During the 2018 Montana BMP review, forest BMPs applied on federal lands, including NFS and BLM lands, were found to be 95.7% effective at preventing impacts to water quality (Ziesak, 2018) . Most of the issues with NFS lands and BMP effectiveness is related to legacy roads, not specific contemporary projects. Implementation and effectiveness monitoring of watershed conservation practices, and forest plan standards and guidelines can be carried out by a variety of personnel including timber sale administrators, contract officer representatives, resource specialists, and line officers. Systematic monitoring and adjustment of land management activities, where necessary, would ensure the highest possible level of BMP implementation and effectiveness which would help to minimize potential impacts to the watersheds during any form of implementation.

Municipal supply watersheds and drinking water, source water protection

Table 16 provides a summary of 2020 Forest Plan components for municipal watershed sources. FW-WTR-DC-06, requires that water quality meet or exceed state water quality standards and fully support designated beneficial uses, and water is of sufficient quality to support surrounding communities. FW-WTR-STD -01 ensures management activities conducted in source water protections areas would be consistent with source water protections and activities in source water protection areas support long-term benefits to aquatic resources and water quality.

The current four municipal watersheds and their current 1986 Forest Plan directions (Management Area J on the Lewis and Clark and MA H-1 for the Helena NF) were brought over to the 2020 Forest Plan. Drinking water systems receive additional protections under the current legal framework than just the FS designation of being a municipal watershed. Lewistown municipal watershed was not recognized in the 1986 Forest Plan and would be designated by the 2020 Forest Plan. Lewistown uses Big Spring Creek in the Snowy Mountain GA. Specific plan direction for individual municipal watershed are listed under the appropriate GA.

Activities that alter the quantity, timing, or quality of water resources have the greatest potential for adverse effects, and that risk generally decreases as the distance away from streams or wetlands increases. Some land management actions would be undertaken with the explicit purpose of improving water quality, such as streambank restoration, riparian planting, installing bridges or larger capacity culverts in roads, or undertaking road storage or decommissioning. Actions that are intended to improve water quality often result in short-term adverse effects (generally five years or less) to water quality, specifically if the implementing actions occur within a water body. Short-term adverse effects are anticipated and considered acceptable when activities are needed to provide long-term protection or improvement of water quality (FW-WTR-STD-01 and FW-WTR-GDL-04).

The greatest change in the 2020 Forest Plan with respect to watershed, aquatic and water quality would be the adoption of plan components for activities that occur inside RMZs (FW-RMZ-STD-01). The 2020 Forest Plan components were based on INFISH guidance with modifications and would be implemented across the planning area to move watershed, aquatic habitat, and riparian areas towards desired conditions. Desired conditions are meant to provide for "healthy, functioning watersheds, riparian areas, and associated fish habitats." 2020 Forest Plan direction would result in additional protection for watersheds and riparian areas by implementing RMZ widths. Plan directions would also provide increased aquatic habitat and water quality protection which would maintain or move watershed resources towards desired condition. These effects would be most dramatic on the east side of the Continental Divide since management in riparian areas currently do not have a fixed width. The widths are determined based on "geographic boundaries of riparian areas by onsite characteristics of water, soil, and vegetation." Vegetation management buffers on the Forest are currently primarily constrained by Montana State SMZs and desired conditions are better defined in the 2020 Forest Plan. See Riparian areas, environmental consequences section for detailed discussion on riparian plan components.

Table 16. Summary of plan components for municipal watershed sources, action alternatives

Plan Component(s)	Summary of expected effects
FW-WTR-STD-01 thru 03 and GDL-01 thru 04, FS-RMZ-STD and GDL, FW-FAH-STD and GDL	Standards and guidelines include direction that would continue to maintain or improve water quality and aquatic resources. All 1986 Forest Plan components for existing municipal watersheds have been revised, updated, and carried forward into the 2020 Forest Plan. Lewistown would be added to the proposed plan and will be included on the municipal water supply map and be subject to the municipal watershed components.

Alternative A, no action

There are currently three guiding documents providing management directions within the planning area. The Lewis and Clark NF is currently under the management directions in their 1986 Forest Plan (U.S. Department of Agriculture, Forest Service, Lewis and Clark National Forest, 1986). The Helena NF is at present under management direction in their 1986 Forest Plan (U.S. Department of Agriculture, Forest Service, 1986) and for areas west of the Continental Divide, INFISH (U.S. Department of Agriculture, Forest Service, 1995b) amended to the forest plan (Amendment 14) in 1996. All current management activities follow the 2011 National Core BMPs and the State of Montana Streamside Management Rule (Montana Department of Natural Resources and Conservation, 2006) for timber management. Also required throughout the planning area is the Montana Stream Nondegradation Act which assures that all reasonable land, soil, and water conservation practices are applied and existing and anticipated beneficial uses would be fully protected.

The current 1986 Forest Plans are not consistent with the 2012 Planning Rule, since they do not contain the direction "water resources in the planning area, including lakes, streams, and wetlands; ground water; public water supplies; sole source aquifers; source water protection areas; and other sources of drinking water (including guidance to prevent or mitigate detrimental changes in quantity, quality, and availability)." Table 17 displays the effects of 1986 Forest Plan components for aquatic ecosystems.

Table 17. Effects of plan components for aquatic ecosystems, alternative A

Plan component(s)	Summary of expected effects
Helena NF	
Forestwide Fisheries Standards II/22.	This section provides standards that would guide and/or limit management activities. Water quality, habitat for fish and riparian areas receive the maximum protections for spring and fall spawning habitats. See below for INFISH amendment.
Forestwide Watershed, Soil, & Air Standards II/24-26.	This section provides standards that would guide and/or limit management activities. These standards are generally more qualitative and less specific than the 2020 Forest Plan components found in the action alternatives.
Forestwide Riparian Standards, II/34-36	These standards would limit activities in riparian areas and are less quantitative than the plan components found in the 2020 Forest Plan.
Management Areas (III/2-III/93)	Management area guidance describes management standards and goals providing protections for watershed, soil, water quality, fisheries and riparian areas.
1996 INFISH amendment: west side of the Continental Divide: Amendment 14	INFISH standards and guidelines impose directions for management actions within riparian habitat conservation areas. These have been effective at improving and maintaining riparian habitats and water quality on the west side of the Continental Divide.
Lewis and Clark NF	
F-3, Soil, Water and Air Protection (2-51 and 52)	This section provides standards that guide and/or limit management activities. This standard includes components that guide management actions to maintain water quality, sustaining soil and site productivity and prompted revegetation of disturbed areas.
Management Areas MA-R (3-88 thru 95)	This section provides standards for specific to riparian areas that guide and/or limit management activities. Management area guidance describes special considerations for the minimization of activities in riparian areas, standards for stream crossings, and measures to avoid stream contamination.

As discussed under the affected environment section, there are source water protection areas as delineated by MTDEQ on and downstream of NFS Lands. The greatest concern is with surface water intakes. It has been found that pollution impacts on water quality from forestry activities are generally local in nature, short-lived, less frequent, and are less extensive in nature than activities related to either agricultural or urban activities (Dissmeyer, 2000).

The Lewis and Clark and Helena 1986 Forest Plans have directions for the protection and management of municipal watersheds and water quality (Table 18). The Lewis and Clark 1986 Forest Plan includes management direction for municipal watershed under MA-J. Forestwide directions specific to riparian areas (MA-R) for soil and watershed protections during all management actions and includes directions to implement BMPs, meet state water quality standards and revegetate disturbed areas. The Helena 1986 Forest Plan includes general watershed guidelines for protection of water quality during management actions. The Helena NF 1986 Forest Plan also includes directions to delineate riparian areas prior to any management activities and includes a riparian buffer of 100 feet from the edge of all perennial streams. Both plans require the adherence to the State of Montana water quality standards and the State of Montana Streamside management zone (SMZ) laws during timber harvest. Additionally, the forest would be required to design and implement mitigation measures through the use of the 2012 National BMPs to control erosion and protect water quality.

Table 18. Summary of plan components for municipal watershed sources, alternative A

Plan Component(s)	Summary of expected effects
Helena 1986 Forest Plan: Municipal Watershed Guidance's	Numerous Municipal directions would continue to maintain water quality.
Lewis and Clark 1986 Forest Plan: MR-1 Municipal Watershed Guidance's	Numerous Municipal watershed directions would continue to maintain water quality. Lewistown (Big Springs Creek) would not be allotted additional protections under alternative A.

Unchanged from its original wording in alternative A, INFISH amended (Amendment 14) the Helena Forest Plan in 1996 and currently only affects planning areas west of the Continental Divide; the west side of the Divide and all of the Upper Blackfoot GAs. INFISH reduced the risk to watersheds, riparian and aquatic resources by improving riparian habitat conservation area protections. There are riparian management objectives and goals to protect and restore water quality, stream channel integrity, instream flows, meadow and wetland standards, riparian plant, and aquatic habitat. Included are numerical riparian management objectives that include pool frequency, water temperature, large woody debris, bank stability, lower bank angle, and width/depth ratio. INFISH includes management directions for timber, roads, grazing, recreation, minerals, and fire management.

Riparian areas

Effects common to all alternatives

Certain sections of the road network on the Forest affects water and aquatic resources on both a short and a chronic, long-term basis. There are motorized roads open to the public as well as administrative use within the forest administrative boundary, including roads managed by other entities such as state highways, a variety of county roads, federal/state land management agencies, and private timber companies. Many roads and motorized trail are located within RMZs that may also include stream crossings. Routes located closest to water resources potentially provide a background level of disturbance that contributes to direct and indirect effects on aquatic and riparian resources. Trails function similar to roads in regard to soil disturbance; however, impacts are generally substantially less as there is less disturbed surface area.

Past culvert failures and road slumps have impacted water quality of the HLC NF, particularly at the site-level scale. Forest roads that are maintained on an annual basis are typically those roads that have the most administrative and visitor use. The majority of the road network on the HLC NF is stable and providing minimal compromise to water quality.

Effects common to all action alternatives

No significant adverse impacts on wetlands or floodplains are anticipated. Wetlands values and functions would be protected in all action alternatives through the implementation of the RMZs and by following the FS's National BMPs for Water Quality Management on NFS Lands.

2020 Forest Plan components have been designed to conserve riparian areas and protect floodplains under the action alternatives.

Protective measures for riparian areas would include the delineation of RMZs around all water resources and the extent of unstable areas. Management activities within the RMZ would comply with all proposed direction, as well as the previously mentioned national and state BMPs and other state water quality regulations. Floodplains would be managed by locating critical facilities outside of floodplains or by using structural mitigation measures. Further protections would be provided in forestwide standards and guidelines for management of RMZs.

Livestock grazing in the planning area has the most potential impacts to wetlands. Livestock grazing can degrade wetland habitat through vegetation removal, bank trampling and hoof damage to wetland substrates. The removal of organic material and increase in water surface area has resulted in the loss or reduction in the size of many wetlands throughout the forest. There are many guidelines in the 2020 Forest Plan that would help avoid adverse effects to wetlands across all action alternatives (FW-RMZ-GDL-03, FW-GRAZ-GDL-01, and 02).

All action alternatives include 2020 Forest Plan direction that would establish designated widths of an inner and outer RMZ bordering streams, lakes, wetlands and other water features, as well as requires plan direction for management actions within the inner and outer RMZs. The width of the RMZs for all action alternatives would be delineated as defined in the 2020 Forest Plan (FW-STD-RMZ-01).

In order to achieve watershed desired conditions, the RMZ would be broken into two areas called the inner and outer zones (Table 19). As noted in footnotes of the table, the inner RMZ width can be extended beyond the length in the table in some special cases to whatever is greatest of the following: the top of the inner gorge, the outer edges of the 100-year floodplain, to the outer edges of riparian vegetation, or to a distance equal to the height of either one or two site-potential trees. Some activities would be prohibited or restricted in the inner zone, whereas more active management would be allowed in the outer zone. RMZs are not intended to be “no touch zones,” but rather “carefully managed zones” with an increase in protections in close proximity to water resources.

Table 19. Widths[1] of inner and outer areas within RMZs included as standards for all action alternatives

Stream type/habitat feature	Inner RMZ width (ft)	Outer RMZ width (ft)	Total RMZ width (ft)
Category 1 – Fish bearing stream	100[2]	200	300[1]
Category 2 – Perennial, nonfish bearing Stream	100[2]	50	150[1]
Category 3 – Natural Lakes and ponds, Constructed Ponds and Reservoirs, and wetlands greater than 1 acre	100	50	150
Category 4a – Intermittent steep (>35% side slope)	100[3]	0	100[1]
Category 4b – Intermittent flat (<35% side slope) Disconnected intermittent MT State SMZ Class 3 and wetlands <1 acre.	50	50	100[1]

1. Widths listed are for each side of the stream, total width would be double the numbers listed.
2. Inner RMZ widths extend on each side of the stream extending from the edges of the active stream channel either to the distance listed or to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of two site-potential trees, whichever is greatest.
3. Inner RMZ widths extend on each side of the stream extending from the edges of the stream channel either to the distance listed or to the top of the inner gorge, or to the outer edges of riparian vegetation, or to a distance equal to the height of one site-potential tree, whichever is greatest.

RMZs are portions of watersheds where riparian associated resources receive primary emphasis, and management activities would be subject to specific plan components including standards and guidelines. In order to achieve watershed desired conditions, some activities would be prohibited or restricted in the inner RMZ, whereas more active management would be allowed in the outer RMZ.

As compared to current standard INFISH widths west of the Continental Divide, RMZ total widths remain the same for Category 1, 2 and 3 habitat features while all Category 4 habitat features would have a 100 foot RMZ width in contrast to some INFISH features which had only a 50 foot width. The inner RMZ, which is the most restrictive area, would be at least 100 feet on either side of the edge of the active channel for all stream and waterbodies except those in Category 4b (intermittent flat streams <35% slope, disconnected intermittent MT State SMZ Class 3 streams and wetlands <1 acre), where it remains a 50 foot width. With properly implemented BMPs, best available scienctific infomation information indicates the inner RMZ widths are the minimum required to protect aquatic habitat and water quality.

East of the Continental Divide, fixed widths for RMZs would be established on each side of the stream or river from the edges of the active channel to 150 feet on nonfish bearing, perennial streams, and 300 feet on each side for fish bearing streams. For riparian areas east of the Continental Divide the adoption of RMZs would increase the area protected by plan components (Table 20). This change expands protections from one hundred feet from the edge of all perennial streams, lakes, and other bodies such as aquatic ecosystems, floodplains, and areas dominated by riparian vegetation on the Helena portion of the combined HLC NF. On the Lewis and Clark portion of the HLC NF, the change would be substantive since standards only require adherence to state water quality standards and to maintain soil productivity. In addition, all areas would continue to comply with State SMZ rules. The additional plan directions would provide protection to riparian areas and move them towards desired conditions. The adoption of RMZs would substantially increase protection of water quality and habitat conditions. In the planning area west side of the Continental Divide, which is 13 percent of the area within the HLC NF, adoption of RMZs would not be expected to provide largely different outcomes than from current INFISH directions in alternative A.

Table 20. Comparison of RMZs across the HLC NF

	West of Continental Divide, Helena	East of Continental Divide, Helena	East of the Continental Divide, Lewis and Clark
Percentages of lands, old Forest boundaries	34%	66%	100%
Percentages of Lands, HLC Combined Forest	13% of entire HLC	25% of entire HLC	62% of entire HLC
Alternative A (1986 Forest Plans)	subject to INFISH Widths	subject to 100’ buffers, plus State SMZ rules for Timber, 50’	Buffers unspecified, TBD on the ground, plus SMZ rules for Timber, 50’
Action alternatives B-F	RMZs, not a significant change, increase in flexibility with inner/outer rules	RMZs, more significant change	RMZs, most significant change

The direction change in action alternatives for RMZs is based on research in recent years that documented that in some cases active RMZ management can advance riparian condition while preserving the functional attributes for riparian, aquatic, and water resources. The RMZ plan components were designed to improve riparian vegetation within the RMZs, while limiting activities that create long-term degradation, such as road building and clearcutting. Treatments would be designed to reflect the composition, structure and pattern of vegetation that would be consistent with the NRV, as described in the desired conditions. The RMZ standards in all action alternatives would establish a differentiation between the inner and outer portions of RMZs with regard to limitations on vegetation management (FW-STD-RMZ-01, 03, 04). Management of the outer RMZ would allow for other management objectives such as the reduction of uncharacteristic fire as long as treatments did not create long-term degradation to riparian and aquatic condition. The standards were developed to explicitly recognize that RMZs can benefit from active management and that the areas closest to water have greater importance for protection of water quality and aquatic resources based on the best available scienctific infomation.

Table 21 displays the estimated size of RMZs in acres. This was estimated from MFWP fish distribution data for only perennial fish bearing streams east and west of the Continental Divide. The information can be used to provide a programmatic comparison of changes in the size of areas across alternatives.

Table 21. Stream type/habitat feature acres by GAs included as standards in all action alternatives[1]

GA	Category 1	Category 2	Category 3	Category 4	Total
Big Belts	15,055	5,291	3,155	27,852	51,352
Castles	2,258	3,098	2,078	2,975	10,408
Crazies	1,585	3,278	918	2,244	8,025
Divide	11,923	5,769	4,611	6,814	29,117
Elkhorns	7,058	3,892	1,959	4,919	17,828
Highwoods	3,257	568	27	1,953	5,806
Little Belts	43,733	11,261	12,591	47,197	114,783
Rocky Mountain Range	37,387	34,005	7,720	26,236	105,349
Snowies	3,610	367	596	8,134	12,707
Upper Blackfoot	24,323	4,633	8,979	12,729	50,665
Grand Total	150,189	72,162	42,635	141,053	406,039

1. See RMZ section of 2020 Forest Plan for category descriptions

While implementation of inner RMZs east of the Continental Divide under the action alternatives essentially doubles the existing comparative widths on some, but not all, streams, the largest change in action alternatives east of the Continental Divide would be in the outer RMZ area, which is also the area where greater flexibility for management activities would be maintained. The acreages are calculated non-inclusive, meaning that the outer RMZ area does not include the inner RMZ (Table 22). For comparative purposes, 80,620 acres would be the estimated size of the outer RMZs for perennial fish bearing stream reaches east of the Continental Divide for all action alternatives, and 20,630 acres west of the divide for a total of 101,250 acres forestwide. The acreage estimated west of the Continental Divide represents greater flexibility for management when compared to alternative A, due to the RMZ outer buffer width. While this example for fish bearing streams examines just a single subset of the RMZ categories, it provides a relative comparison of action alternatives with the existing condition. This comparison does not include other categories than fish bearing streams and it includes areas on the HLC NF that cannot be harvested as well as areas within current or RWAs.

Table 22. Estimated size (acres) of Inner and Outer RMZs for only perennial fish bearing streams (minimum SMZ east of divide and INFISH Category 1 west of the divide)

Planning area location	Alternative A	Alternatives B,C,D,E, F 100 foot Inner RMZ	Alternatives B,C,D,E, F 200 foot Outer RMZ
East of the Continental Divide	20,240[1]	40,450	80,620
West of the Continental Divide	30,870[2]	10,340	20,630
Total	51,110	50,790	101,250

1. Represents the minimum State SMZ size
2. Category 1 fish bearing streams

The 2012 Planning Rule emphasizes integration of management direction in recognition of ecological sustainability and the interdependence of ecological resources, and the proposed RMZ areas would also contribute to wildlife habitat connectivity and protection of plant species and animal communities associated with wetlands. RMZ direction under all action alternatives was refined through plan components to guide appropriate management based upon best available scienctific infomation. The entire RMZ is classified as not suitable for timber production, based on the determination that a scheduled flow of commercial timber products using a rotation age could not be expected to occur on these lands due to management requirements and desired conditions for other resources. However, timber harvest is allowable, with restrictions as specified in the 2020 Forest Plan, such as to meet the RMZ desired conditions. Other vegetation management activities that may occur and are expected to occur to maintain riparian conditions include prescribed fire, thinning, planting of trees or shrubs, and fuel reduction. Vegetation management in the inner RMZs for categories 1, 2, 3, 4a and 4b could occur expressly for the purposes to restore or enhance riparian, fish and aquatic resources (FW-STD-RMZ-03), with specific exceptions. Vegetation management in the outer RMZ (FW-STD-RMZ-04), would allow more opportunity to manage vegetation resources to achieve desired vegetation and riparian conditions so long as conditions in the inner RMZ were not adversely affected and wildlife needs were met to achieve desired conditions (FW-RMZ-DC-01 and 02). Refer also to later section on effects to riparian areas from timber and vegetation management.

Fire is a natural disturbance process that has historically influenced the forests within watersheds, including riparian areas and forests adjacent to water features. The natural role of fire, as well as other natural disturbances, in creating the diversity of successional stages, species compositions and structures in riparian areas is incorporated into the design of the desired forest and vegetation conditions outlined in the plan (FW-RMZ-DC-01 through 02). In areas where use of fire (including wildfire) or other natural disturbances is limited or not feasible, vegetation treatments could be applied where determined appropriate to achieve desired conditions within riparian areas.

Alternative A, no action

Alternative A does not incorporate a watershed approach to the management of hydrology and watershed processes; there would not likely be watershed scale consideration and protection of hydrologic and riparian area/wetland processes and functions. 1986 Forest Plan directions do not establish fixed RMZs widths for the eastside of the divide with the exception of the Montana SMZ rule for Timber harvest. The 1986 Forest Plans also do not have guidelines or desired conditions for riparian areas. Areas west of the divide include RHCA standards. 1986 Forest Plans include riparian grazing standards and would likely result in the continued maintenance of areas currently in satisfactory condition and areas currently in unsatisfactory would remain unchanged.

The 1986 Forest Plans would be unchanged in alternative A. Forestwide direction in the 1986 Forest Plans address water quality, stream channel integrity, and other features associated with aquatic and riparian areas that provide protection for the riparian-associated resources and values. East of the Continental Divide, the Lewis and Clark NF riparian areas are currently protected by 1986 Forest Plan direction (Management Area R), which requires adherence to State of Montana water quality standards, Montana SMZ laws during timber vegetation management, and FS National BMPs. Riparian areas are delineated and evaluated prior to implementing any project activity. On the east side of the divide, there are currently no fixed riparian widths. The widths are determined based on “geographic boundaries of riparian areas by onsite characteristics of water, soil, and vegetation.” For vegetation management the Montana SMZs widths (Table 23) are required statewide for timber management only and do not affect many activities occurring on the forest, like recreation, grazing, and wildfire suppression. These directions and BMPs (i.e. upsizing and replacing old culverts, and upgrading and eliminating roads in riparian areas) during timber harvest have prevented adverse impacts to riparian habitats in close proximity to water resources.

Table 23. Widths of SMZs in Montana

Stream type	Inner (ft)	Total width (ft)
Class 1 and 2 Streams <35 percent slope	50	50
Class 1 and 2 Stream > 35 percent slope	100[1]	100[1]
Class 3 Streams and other bodies of water	50	50
Wetlands	**Edge of wetland**	

1. Management zone widths extend from both sides of streams and rivers from the Ordinary High Water Mark

The Inland Native Fish Strategy (INFISH) (U.S. Department of Agriculture, Forest Service, 1995b), as it was amended to the Helena NF 1986 Forest Plan in 1996, would be unchanged from its original wording in alternative A. This amendment only affects the GAs west of the Continental Divide; the Upper Blackfoot and west portions of the Divide GAs. INFISH reduced the risk to watersheds, riparian and aquatic resources by improving riparian zone protections.

Riparian habitat conservation areas (RHCAs) are established as management zones bordering streams, wetlands and other water features (Table 24). The RHCA direction from INFISH was added in addition to all other direction in the 1986 Forest Plans. The delineation of RHCAs is completed at the project site specific level on the ground (i.e. identified in the forest based on site characteristics) and the methods for delineating RHCAs is described in the amendment, including their minimum widths. INFISH PIBO monitoring results have shown statistically notable improvements in the majority of stream habitat attributes, including the overall index at the Regional scale since the standards and guidelines were implemented in 1996.

Table 24. Widths defining INFISH RHCAs[1] by stream category or water body, alternative A, west side of the Continental Divide on the HLC NF

Stream type/habitat feature	Width on each side of stream (ft)
Category 1 – Fish bearing streams	300[1]
Category 2 – Perennial, nonfish bearing streams	150[1]
Category 3 – Natural Lakes and ponds, constructed ponds and reservoirs, and wetlands greater than 1 acre	150[1]
Category 4a – Intermittent or seasonal streams and wetlands <1 acre in Priority Watersheds[2]	100
Category 4b – Intermittent or seasonal streams and wetlands <1 acre in not in Priority Watersheds	50

1. RHCA widths extend either to the distance listed or to the top of the inner gorge slope break, or to the outer edges of the 100 year floodplain, whichever is greater.
2. Priority on HLC include Copper Creek in the Blackfoot River Drainage and the Little Blackfoot River upstream of the confluence with Dog Creek and includes Dog Creek.

Under alternative A, 1986 Forest Plan directions for riparian, water quality, and wetlands would continue on the east side of the Continental Divide. The plan has directions to define riparian areas on the project level with onsite characteristics of vegetation and soils. With the exception of the Montana SMZ rule for timber management actions, there are no fixed riparian widths. For areas on the west side of the divide, 1986 Forest Plan directions would continue to apply as well as incorporated INFISH standards and guidelines that protect or minimize effects to riparian and aquatic resources. Current trends in riparian area across the planning area would be expected to continue.

Alternative A is not consistent with the 2012 Planning Rule, since the 1986 Forest Plans do not establish RMZs around all lakes, perennial and intermittent streams, and open water wetlands, specifically on the old Lewis and Clark NF.

Wetlands

Effects common to all alternatives

Under all alternatives, stewardship projects could result in funds being available for restoration. It is expected that temporary and short-term impacts to fish, stream channels, water quality, etc. from culvert removals, in-channel restoration, and habitat surveys would still occur. It is also expected that long-term positive effects would occur from these restoration activities.

Removing aggrading substrate behind placed stream-structures can reduce the low-flow wetted channel width and the width-to-depth ratio, increase sinuosity and meander pattern, and over time restore floodplain connectivity. Installing woody debris structures can stabilize stream channels over the long term and make them more resistant to erosion by dissipating stream energy during periods of high runoff. Gravel bars typically revegetate with riparian species such as alder or willow, ultimately leading to channel narrowing and stabilization. Restoration of floodplain connectivity over time would result in more frequent inundation of the floodplain, fostering the creation of side channels, seasonally flooded potholes, and other kinds of off-channel habitats.

Placement of large wood can chage sediment routing patterns while creating more physically complex fish habitat. The stability or longevity of this wood within streams is strongly linked to its size, orientation to flow, channel dimensions, watershed area above the structure, and the percentage of the log that is in the active channel. Eventually some movement downstream would take place. Pieces that move can become incorporated in larger wood complexes or hang up on streamside trees or other channel features.

Effects common to all action alternatives

Groundwater dependent ecosystems, which include wetlands, springs, seeps, fens, and wet meadows maintain important biological diversity on the HLC NF. Groundwater also helps to maintain water quality at a level that sustains the biological, physical, and chemical integrity of aquatic systems and the survival, growth, reproduction, and mitigation of native aquatic species. When proposed projects have the potential to withdraw water, mainitaing the water table level, and water quality, for all groundwater dependent ecosystems is a priority in the 2020 Forest Plan (FW-WTR-STD-01).

Plan components would also promote watershed restoration projects to improve the long-term ecological integrity of ecosystems and conserve genetic integrity of native species (FW-WTR-GDL-04). The highest priority for restoration actions would be within the CWN (FW-CWN-OBJ-02) to benefit native fish. Riparian areas in these watersheds would receive the greatest benefits and actions would focus on stream crossings. The benefit of re-establishing riparian vegetation at these sites would not vary between alternatives.

For riparian areas east of the Continental Divide, the adoption of RMZs would increase the area protected by plan components. Therefore, the adoption of RMZs would provide more protection for water quality and riparian resources. The planning areas west side of the Continental Divide RMZs would largely not lead to different outcomes from current INFISH directions in alternative A.

The restoration directions under the 2020 Forest Plan include guidance to promote the long-term ecological integrity of ecosystems and conserve the genetic integrity of native species (FW-WTR-STD-04). The objective for restoration work is 1 to 5 acres of groundwater dependent ecosystems with a focus on priority watersheds as determined in the watershed condition framework (FW-FAH-OBJ-01) and CWNs have the highest priority for restoration actions for the aquatic environment (FW-CWN-OBJ-02).

Alternative A, no action

There are no specific requirements to monitor or protect groundwater dependant ecosystems. They availabitly of these unique ecosystems would have no impact on project proposals, and the likelihood of degredation would remain high.

A wide variety of watershed restoration activities may occur throughout the life of this plan. These activities may include, but not limited to instream restoration projects, including the installation of large woody debris, riparian planting, fish barrier installations, and road restoration projects, including road relocation projects, road decommissioning, and fish passage projects.

The 1986 Lewis and Clark and Helena Forest Plans do not specifically have plan directions for restoration projects. However, INFISH amended the 1986 Helena NF plan for those planning areas on the west of the Continental Divide and includes four guidelines for restoration. Restoration actions since that time have primarily focused on culvert removals, road decommissioning, road relocation and slump stabilization. These activities resulted in improved fish passage and sediment reduction. These activities would continue under alternative A. Stewardship funding is currently a tool often used for restoration projects as well as appropriated dollars for watershed and fisheries and would likely continue under alternative A.

Many of the restoration efforts in the planning area have been focused in riparian areas to restore mining and grazing impacts. Restoration activities have included planting, fencing, bank stabilization, and stream restoration. These activities have resulted in benefits to riparian functions and stream processes. Future benefits from these restoration projects are expected to continue under alternative A. On the west side of the divide, the INFISH amendment to the Helena 1986 plan includes four guidelines for fisheries and wildlife restoration (FW-1 thru FW-4) and two general watershed and habitat restoration guidelines (WR-1 and 2). These directions include instructions to design and implement restoration projects that promote long-term ecological integrity of ecosystems, conserve the genetic integrity of native species and contributes to the attainment of the riparian management objectives. Restoration actions since that time have primarily focused on culvert removals, road decommissioning, road relocation and slump stabilization.

Fisheries, aquatics and conservation watershed networks

Effects common to all alternatives

Many watersheds in the Rocky Mountain Range and Upper Blackfoot GAs that support the healthiest populations of native trout already have their headwaters protected through lands managed as Congressionally designated wilderness areas (Bob Marshall and Scapegoat Wilderness), Inventoried Roadless, or the HLC NF's eligible wild and scenic rivers. These special places are the building blocks of a conservation network as naturally functioning headwaters have a large influence on the function of downstream reaches.

Effects common to all action alternatives

The greatest benefit to aquatic species occurs where nonnative species do not negatively impact native populations. The effects of the 2020 Forest Plan components on aquatic species do not vary between alternatives. Proposed estimated acres of wilderness would vary by alternative. However, the proposed acres are generally located in IRAs. Therefore, the difference in roaded acres would not change substantially.

The most notable change between action alternatives and the 1986 Forest Plans (alternative A), is the incorporation of forestwide standards and guidelines that are specifically designed to protect aquatic resources. The impacts to aquatic resources from all action alternatives would provide a greater level of protection for aquatic and riparian resources than alternative A.

The plan components of the 2020 Forest Plan were developed to protect the strict habitat requirements of westslope cutthroat trout (*Oncorhynchus clarki lewisi*) and bull trout (*Salvelinus confluentus*) that require colder and cleaner water. The coarse scale components are designed to protect riparian habitat. If these measures are found to be insufficient, fine scale components are developed to protect these habitat requirements. The 2020 Forest Plan components developed for aquatic habitat and dependent species would provide stream habitat conditions suitable for not only bull trout and westslope cutthroat, but also for numerous other aquatic organisms including sculpins, mountain whitefish and amphibians.

Additional riparian protection would also be provided since the RMZ would be increased to 100’ for intermittent streams in all watersheds. There would also be a 300’ RMZ on all ponds and wetlands regardless of size which is a change from alternative A. RMZs are not exclusion zones, but forest management is allowed to occur with greater flexibility in the outer portion of RMZs. Guidelines (FW-RMZ-GDL-01 and 02) are designed to protect riparian and aquatic resources by taking a multi-scale, multi-resource hard look at stream habitat and riparian conditions prior to entry. The greater protection provided by plan components, including RMZs and CWNs, in the action alternatives east of the Continental Divide would maintain and enhance habitat for aquatic species, including SCC, more rapidly than the no-action alternative.

Standard FW-FAH-STD-01 and guideline FW-FAH-GDL-01 assure when improving stream diversion or constructing new diversions and associated ditches they are designed and screened to prevent fish capture. FW-FAH-GDL-04 guides the development of allotment management plans to be designed to maintain water quality by minimizing disturbance from livestock grazing in active allotments. FW-FAH-GDL-05 states that all construction activities within the ordinary high-water mark that may result in adverse effects to native or nonnative aquatic species would be limited to times outside of spawning and incubation periods.

Restoration activities would focus on “storm proofing” the existing road network in light of climate change. Maintaining migratory life histories is an important element of conservation. Selecting numerous watersheds rather than a select few provides the greatest opportunity to maintain connectivity and a migratory life history. Watersheds occupied by both bull trout and westslope cutthroat trout populations, which are, or are nearly genetically pure, correspond well with the primary conservation area for grizzly bears, which would also limit the road network.

Spread and introduction pathways are inherent to most projects and types of forest use. Thus, components of the 2020 Forest Plan require mechanisms for addressing aquatic invasive species. More general or universal objectives and procedures, such as using current best practices for equipment washing before and after entering an area, are recommended for inclusion in the fish and aquatic wildlife sections of the document. This better assures that these components are included as resource protection measures at the project level. These activities would include but aren’t limited to transporting water across drainage boundaries for fire suppression, constructing stream fords, operating equipment in a riparian area and near a water course, and the use of pumps and sumps for fire suppression, or construction related dewatering activities.

All action alternatives would emphasize RMZs and would facilitate management of multiple ecological goals and long-term ecological sustainability on a landscape basis. Updated aquatic and riparian desired conditions, objectives, standards, and guidelines would be applied in a consistent manner across the forest. The action alternatives would provide a mechanism to effectively prioritize activities and weigh multiple risks to various resources.

Under all action alternatives, the Conservation Watershed Network (CWN) (appendix E of the 2020 Forest Plan) provides a network of watersheds designed to emphasize conservation of westslope cutthroat and bull trout by protecting and restoring components, processes, and landforms that provide quality habitat. The objective for selecting conservation watersheds is to contain the largest intact populations and provide long-term protection to bull and westslope cutthroat trout populations across the Forest. All occupied or expected to be occupied bull trout streams were designated CWNs. An objective of the CWN is to identify and conserve watersheds that would have cold water to support native fish into the future in the face of climate change.

A key strategy in these watersheds is no net increase in the road network and stream crossings as identified in guideline, FW- CWN-GDL-01. Reducing roads would reduce potential sediment inputs, benefit aquatic species, and improve ecological function.

The effects of implementing the CWN plan components would be similar across all action alternatives. All CWN priority watersheds on the east side of the divide are new for the 2020 Forest Plan. West of the Continental Divide, priority watersheds were identified in 1996 after adoption of INFISH. Additional watersheds have been included in the 2020 Forest Plan as part of the action alternatives where native salmonids are present. These plan components provide direction that makes these watersheds a priority for restoration (FW-CWN-OBJ-02). Across the planning area, aquatic habitats and water quality within CWNs would receive additional protection from plan components that limit net increases in stream crossings and road lengths within RMZs (FW-CWN-GDL-01) and CWNs would receive priority for road closures or other strategies to reduce sediment (FW-CWN-GDL-02). Livestock grazing management would be subject to plan components designed to minimize damage to aquatic ecosystems, vegetation and streambanks (FW-CWN-GDL-03). The action alternatives would provide additional protection to native species assemblages throughout the planning area compared to the no-action alternative.

The effects on fisheries and aquatics from other resources such as restoration, wilderness, noxious weeds, wildlife management, and recreation are the same as the riparian section since wetlands are a type of riparian area and can be found in those sections.

Many watersheds in the Rocky Mountain and Upper Blackfoot GAs that support the healthiest populations of native trout already have their headwaters protected from large-scale management actions, through lands managed as Congressionally designated wilderness areas (Bob Marshall and Scapegoat Wilderness). These special places are the building blocks of a conservation network as naturally functioning headwaters have a large influence on the function of downstream reaches. See additional CWN information in appendix E of the 2020 Forest Plan.

Aquatic at risk species

Bull trout (threatened species)

Many activities allowed within the Upper Blackfoot and Divide GA west of the continental divide in the 2020 Forest Plan have the potential to indirectly affect bull trout and their habitats in a beneficial or negative manner. Land management activities that disturb the soil surface or require added use of already disturbed features such as road prisms have a greater potential to interact and potentially cause adverse effects. Activities that have the greatest potential to disturb soils and indirectly affect bull trout habitat include some activities associated with vegetation management, fuels management, livestock grazing, roads, and recreation. While the cause-and-effect relationships from land management activities are not linear and are often indirect, results from PIBO monitoring over the past 19 years has shown that with standards and guidelines applied consistently across the interior Columbia Basin, habitat degradation has been arrested and habitat conditions on nearly all National Forests are trending in a positive direction (Roper, Saunders, & Ojala, 2019; C. Thomas, Chatel, Roper, Jacobson, & Hanson, 2018).

With INFISH components updated and mostly carried forward in the proposed action, bull trout habitat in the plan area is expected to continue on a similar improving trend if the standards and guidelines continue to be applied as they have in the last two decades. While larger vegetation restoration projects involving extensive road reconditioning and haul are likely to contribute fine sediment to streams at crossings and in locations where the road is close to and paralleling the stream, the active delivery is relatively short term, and in most instances, a relatively small amount is delivered when compared against management that occurred prior to INFISH. With culvert replacement and BMP use occurring before and during project work, and road storage applied when projects conclude, roads likely contribute less sediment than they otherwise would have before use. Of equal and likely greater importance, the sediment caused by current road use and harvest methods can't be compared to the types of roads being built, the amount being built, and their location prior to INFISH. The standards and guides in this plan revision are expected to continue the passive restoration occurring across much of the Interior Columbia Basin (Roper et al., 2019). Also, the identification of a CWN and objectives to reduce the interactions between roads and streams meets much of the intent of the unsigned ICEBMP that was expected to refine INFISH (U.S. Department of Agriculture, Forest Service, 1995b). Active restoration in key locations based on WCF and the CWN are expected to further contribute to improving habitat conditions in managed portions of watersheds on federal lands. See Table 25 for the plan components and the summary of expected effects for bull trout.

Species of Conservation Concern:

Western pearlshell mussel (SCC)

Many activities allowed within the 2020 HLC Forest Plan have the potential to indirectly affect western pearlshell westslope and their habitats in a beneficial or negative manner. Land management activities that disturb the soil surface or require added use of already disturbed features such as road prisms have a greater potential to interact and potentially cause adverse effects. Activities that have the greatest potential to disturb soils and indirectly affect western pearlshell westslope habitat include some activities associated with vegetation management, fuels management, livestock grazing, roads, and recreation.

With INFISH components updated and mostly carried forward in the proposed action, and extended to portions of the forest east of the continental divide, pearl shell mussel habitat in the plan area is expected to be on a similar improving trend across the entire forest as habitat as the rest of the forest service habitat in the Columbia Basin (Roper et al, 2019). While larger vegetation restoration projects involving extensive road reconditioning and haul are likely to contribute fine sediment to streams at crossings and in locations where the road is close to and paralleling the stream, the active delivery is relatively short term, and in most instances, a relatively small amount is delivered when compared against management that occurred prior to INFISH. With culvert replacement and BMP use occurring before and during project work, and road storage applied when projects conclude, roads likely contribute less sediment than they otherwise would have before use. Of equal and likely greater importance, the sediment caused by current road use and harvest methods can't be compared to the types of roads being built, the amount being built, and their location prior to INFISH. The standards and guides in this plan revision are expected to continue the passive restoration occurring across much of the Interior Columbia Basin (Roper et al. 2019). The 2020 Forest Plan is more explicit on aquatic ecosystems protections, connectivity in riparian habitats, groundwater-dependent systems, and specifically expands the RMZs east of the Continental Divide beyond state guidelines and best management practices in the 1986 plans. Table 25 presents the plan components and the summary of expected effects for pearl shell mussels.

Westslope cutthroat trout (SCC)

Many activities allowed within the 2020 HLC Forest Plan have the potential to indirectly affect westslope cutthroat trout and their habitats in a beneficial or negative manner. Land management activities that disturb the soil surface or require added use of already disturbed features such as road prisms have a greater potential to interact and potentially cause adverse effects. Activities that have the greatest potential to disturb soils and indirectly affect westslope cutthroat trout habitat include some activities associated with vegetation management, fuels management, livestock grazing, roads, and recreation.

While larger vegetation restoration projects involving extensive road reconditioning and haul are likely to contribute fine sediment to streams at crossings and in locations where the road is close to and paralleling the stream. The increase in the width of RMZ where management activity is limited, will likely directly benefit westslope cutthroat trout in the plan area. Active restoration in key locations based on WCF and the CWN are expected to further contribute to improving habitat conditions in managed portions of watersheds on federal lands. The 2020 Forest Plan is more explicit on aquatic ecosystems protections, connectivity in riparian habitats, groundwater-dependent systems, and specifically expands the RMZs east of the Continental Divide beyond state guidelines and best management practices in the 1986 plans. Table 25 presents the plan components and the summary of expected effects for westslope cutthroat.

Table 25. Summary of plan components for aquatic at-risk-species, action alternatives

At-risk aquatic species plan components	Component language and summary of expected effects for at-risk aquatic species
FW-WTR-DC-01	This desired condition (DC) provides for the distribution, diversity, and complexity of landscape-scale features including natural disturbance regimes and the aquatic, wetland, and riparian ecosystems which will benefit at-risk-species.
FW-WTR -DC-02	This DC would promote spatial connectivity between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, groundwater, wetlands, upslope areas, headwater tributaries, and intact habitat refugia. These network connections provide chemically and physically unobstructed routes for at-risk species.
FW-WTR -DC-03	This DC would maintain the timing, variability, and duration of floodplain inundation which may indirectly benefit at-risk species
FW-WTR -DC-04	This DC would promote improvements to streams and floodplains that are in a highly altered state and promote moving these systems towards stability to provide for the long-term persistence of at-risk species.
FW-WTR -DC-06	This DC would ensure water quality, including groundwater, meets or exceeds applicable state water quality standards and fully supports beneficial uses, and fully support beneficial uses, and meet the ecological needs of at-risk species.
FW-WTR -DC-07	This DC would benefit at-risk species by ensuring streams meet Montana's water quality standards.
FW-WTR -DC-08	This DC would provide benefit at-risk species by ensuring sediment regime within water bodies within the plan area are within the natural range of variation.
FW-WTR -DC-10	Would maintain natural flow regime to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, and duration of peak, high, and low flows are retained, which will benefit at-risk aquatic species.
FW-WTR -DC-13	Would provide benefits to at-risk-species by ensuring all stream crossing structures afford capacity for Q100 discharge and are properly aligned with the stream channel which will reduce the likelihood of stream crossing structure failures and the associated input of sediment to streams.
FW-WTR-OBJ-01	This Forest wide objective will improve conditions for aquatic at-risk species within at least four priority watersheds.
FW-RMZ-STD-01 FW-RMZ-STD-02 FW-RMZ-STD-03 FW-RMZ-STD-04 FW-RMZ-STD-06 FW-RMZ-GDL-01 FW-RMZ-GDL-02 FW-RMZ-GDL-04 FW-RMZ-GDL-05 FW-RMZ-GDL-06 FW-RMZ-GDL-09 FW-RMZ-GDL-11 FW-RMZ-GDL-12	Implementation of the RMZ standards and guidelines include directions for management actions within RMZs would potentially improve riparian, floodplain, water quality and stream channel conditions across the planning area. The new riparian zone widths would increase width and would have a limiting effect of management actions that could occur with RMZs. The exception would be the west side of the divide as there would be little difference between (Amendment 14) INFISH and proposed RMZ widths. They would help to provide resiliency in the face of warming climate.

At-risk aquatic species plan components	Component language and summary of expected effects for at-risk aquatic species
FW-FAH-GO-02, FW-FAH-GO-03	These Forest wide goals will benefit at-risk-species by increasing coordination between the Forest Service and Montana Fish Wildlife and Parks and other interested parties to expand westslope cutthroat population east of the continental divide and protect bull trout thru out its present range.
FW-FAH-OBJ-03	This objective will benefit at-risk-species by improving connectivity.
FW-FAH-STD-01, FW-FAH-GDL-02	These standards and guidelines would protect at-risk-species by minimizing the likelihood of them being entrained in diversions or pulled into pumps during drafting activities.
FW-FAH-GDL-04	These guidelines would protect at-risk-species by limiting activities within the high-water mark during spawning season to reduce the likelihood of sediment inputs to streams.
FW-CWN-DC-01	Conservation watershed networks provide benefits to at-risk-species by providing functionally intact ecosystems that provide high-quality water and contribute to and enhance the conservation and recovery of threatened or endangered fish species and aquatic species of conservation concern
FW-CWN-OBJ-01 FW-CWN-OBJ-02	These Forest wide objectives will benefit at-risk-species by repairing road/stream crossing and promote stormproofing of road networks to decrease sediment inputs and improve overall aquatic habitat.
FW-CWN-GDL-01 FW-CWN-GDL-02 FW-CWN-GDL-03	These guidelines with promote improvements that will benefit at-risk-species in the conservation watershed network streams, by minimizing construction of new roads and prioritizing the elimination or relocation of roads that are delivering sediment to streams

Alternative A, no action

East of the Continental Divide the Helena and the Lewis and Clark 1986 Forest Plans are unchanged from their original wording in alternative A. The plans have directions for the protection and management of watersheds and water quality. The 1986 Lewis and Clark Forest Plan includes forestwide directions specific to riparian management areas (MA-R) for soil and watershed protections during all management actions and includes directions to revegetate disturbed areas. The Helena Forest Plan also includes general watershed guidelines for protection of water quality during the management actions. Included are directions to delineate riparian areas prior to any management activities and includes a riparian buffer of 100 feet from the edge of all perennial streams. Both plans require the adherence to the State of Montana water quality standards and the State of Montana SMZ standards would still apply during timber harvest. All management actions would continue to require design and implantation of mitigation measures through the use of the 2012 National BMPs to control erosion and protect water quality.

The INFISH implemented west side of the Continental Divide, as it was amended to the Helena Forest Plan in 1996, is unchanged from its original wording in alternative A. INFISH reduced the risk to watersheds, riparian and aquatic resources by improving riparian zone protections to protect habitat and populations of native fish. INFISH has standards and guidelines for timber, roads, grazing, recreation, minerals, and fire management that have improved water quality and stream habitat within the Upper Blackfoot GA and the western portion of the Divide GA. The continued implementation of INFISH direction, TMDL plan implementation, BMPs, reduction of road construction, and a reduction of timber harvest along streams due to riparian habitat conservation areas likely helped and continue to reduce sediment delivery to streams from roads, mining related impacts, and other actions.

As protection measures outlined in the 1995 INFISH BO continue to be implemented on the west side GAs (Divide and Upper Blackfoot), the goal of improving habitat conditions as well as benefitting designated critical habitat and stabilizing or increasing populations of TES would have a greater probability of success.

For the east side GAs, continued efforts to restore, enhance and stabilize riparian ecosystems would continue. The implementation of the State's streamside management law during timber management would continue in both east and west side GAs. Efforts directly related to protecting and maintaining the viability of existing populations of sensitive species in east side GAs would continue.

Under alternative A, it is anticipated that the level of diversity for the water quality indicator macroinvertebrate assemblage across the entire planning unit would be at least maintained, at current proportions. The discussion of effects of forestwide direction on water quality and INFISH also apply to the effects alternative A would have on aquatic threatened and endangered species and sensitive species.

At the time of the FEIS, bull trout were listed as threatened while westslope cutthroat trout and western pearlshell mussels were sensitive species known to occur on the HLC NF. East of the Continental Divide, alternative A would not provide as much protection for fisheries and aquatics as the action alternatives and may provide for less and more gradual movement towards desired conditions.

The no-action alternative does not consider impacts from nonnative and invasive species and plan components such as FW-CONNECT- GDL-01 that would help educate the public about aquatic invasives species.

CWNs are only delineated under the 2012 Planning Rule and are not included in the 1986 Forest Plans east of the Continental Divide. West of the divide, CWN adopted INFISH priority watersheds would maintain their status under alternative A.

Alternative A does not incorporate a watershed approach to the management of hydrology and watershed processes; there would not likely be watershed scale consideration and protection of aquatic habitat and riparian area functions. This would result in the continued protection of areas currently in satisfactory condition and areas currently in unsatisfactory would remain unchanged.

Effects of plan components associated with:

Recommended wilderness

Effects common to all action alternatives

Plan components for RWAs would be beneficial for water resources. The amount of RWAs varies by alternative; alternative D includes the most, followed by B/C, then F, and lastly E which includes no RWAs (Table 26). The overall effect of RWAs in the 2020 Forest Plan are expected to be beneficial to water quality and quantity because of the limitation on land management activities within RWAs. However, the proposed RWAs are already, for the most part, located in IRAs which impose limitations on management actions (i.e. roads building, vegetation management) within those areas. Only 3 to 7 percent of the RWAs in the action alternatives are outside of the IRAs. Therefore, the magnitude of the positive effects to water resources of the action alternatives relative to the no-action alternative are anticipated to be small. Alternative E includes no RWAs therefore no additional protection outside of IRAs would apply. Recommending these areas as wilderness would ensure that wilderness characteristics are maintained and would provide protection of habitat conditions. If Congress were to designate the RWAs, activities that would negatively impact wilderness character, such as road building or timber harvest, would likely not occur.

Table 26. Summary of RWA acres in IRAs by alternative

Alternative	Total RWA (Ac)	Total Acres of RWA within IRA	Percent of RWA in IRA
A	34,265	33,760	98
B and C	213,076	207,404	97
D	474,589	441,042	93

Alternative	Total RWA (Ac)	Total Acres of RWA within IRA	Percent of RWA in IRA
E	0	0	0
F	153,325	150,686	98

RWAs are anticipated to confer beneficial effects on riparian areas. However, these acres are largely IRAs and there is currently little active management in most of these areas. Recommending these areas would ensure that wilderness characteristics are maintained and protected and active management of RMZs limited to prescribed fire or use of wildfire. 2020 Forest Plan components for the protection and management of riparian management areas would be the same for all action alternatives and provide the same level of plan direction.

The best remaining trout habitat conditions are found in wilderness and unroaded landscapes (Hitt & Frissell, 2000; Kershner, Bischoff, & Horan, 1997; Rhodes, McCullough, & Espinosa, 1994). Across the west, roadless areas tend to contain many of the healthiest of the few remaining populations of native trout, which are crucial to protect (Kessler, Bradley, Rhodes, & Wood, 2001). Most of the RWAs would be located in areas already designated IRAs. These areas are a source of high quality water essential to the protection and restoration of native trout. The high quality habitats in roadless areas help native trout compete with nonnative trout, because degraded habitats can provide nonnatives with a competitive advantage (Behnke, 1992). Roadless areas tend to have the lowest degree of invasion of nonnative salmonids (Huntington, Nehlsen, & Bowers, 1996). Areas of low road density also act as the foundation for the needed restoration of larger watersheds.

A majority (98-93%) of RWAs are already situated in IRAs and RNAs which already have limited management direction that minimizes disturbance in those areas. See Table 26 above. Therefore, the magnitude of the potential differences to water resources based on RWAs is relatively small at the programmatic level.

Alternative A, no action

The 1986 Helena NF plan as amended include 34,226 acres of RWAs. The RWAs identified in the 1986 Lewis and Clark NF plan have been legislatively incorporated in the Bob Marshall and Scapegoat wilderness areas. Many of the RWAs are located at high elevation and would protect headwater habitats that would provide cold clean water downstream to fish and habitat and natural conditions would be maintained in the RWAs. Under the current plan, 98% of the RWAs are currently in IRAs and already have a high degree of protection from management activities which further protects water quality.

Wildfire and fuels

Effects common to all alternatives

Fire is a natural disturbance process that has historically influenced the forests within watersheds, including riparian areas and forests adjacent to water features (see Riparian areas and wetlands affected environment, natural disturbance processes). Fire is expected to continue to function as a natural process across the planning area, especially within designated wilderness and unroaded lands. Wildfires can affect water chemistry, water quantity, and stream channel structure through changes in transpiration, infiltration, ground water recharge, erosion and mass wasting, riparian shading, and the recruitment and delivery of coarse debris (Benda & Dunne, 1997; Gresswell, 1999; Moody & Martin, 2001a, 2001b; Wondzell, 2001). Potential post-wildfire risks from floods, landslides, and debris flows to human life, property, and/or municipal supply watersheds are an increasing concern across the western United States (Moody & Martin, 2001a).

Climatic events following wildfire can trigger surface erosion or mass failures (landslides), which in turn can deposit sediment that alters stream channel structure and function. Severe wildfire can result in large expanses of blackened areas that have a high potential for generating runoff and delivering sediment to streams during intense rainstorms. When wildfire burns through riparian areas, streams may be left with no shade leading to an increase in water temperatures and direct fish mortality.

These large and intense fires, which were historically rare, can greatly impact aquatic habitat and fish communities. Although catastrophic at times, there are environmental factors that determine the resiliency of aquatic ecosystems and fish communities after wildfire. Often fire burns in a mosaic of intensity, where broadly distributed suitable habitat can provide refuge for fish populations. (Rieman, Lee, Chandler, & Myers, 1997) found habitat and fish recovery can be dynamic after wildfire with complete elimination of fish populations in several headwater streams in central Idaho. However, well connected-complex habitat and a migratory life-history component allowed a quick recovery of trout populations (1-3 years).

The Forest has experienced an increase in large fires over the last two decades. Aquatic ecosystems and fish communities across the Forest have responded differently to these large wildfire events. For example, bull trout redd counts demonstrated a strong increase following the Snow-Talon Fire in 2003 in the Copper Creek drainage. An increase in fish production or juvenile recruitment is another possible response that persists after wildlife (Rieman et al., 1997). The increase of adult bull trout to Copper Creek after the Snow-Talon fire is an example of this.

Overall, fire is beneficial to fish as fish have evolved with fire over the last 10,000 years, except for the last century due to fire suppression. Impacts to fish are largely a result of fire suppression activities due to increases in sediment, misapplication of retardant, withdrawing water if proper screens are not in place, and other actions. Standards and guidelines for fire management were first adopted with INFISH on the west side of the divide and are included across the planning area in this plan. Plan components do not differ between alternatives and the effects would be the same across alternatives: wildfires may result in short-term impacts with long-term benefits due to nutrients while suppression activities result in impacts that should be mitigated with plan components.

Managing prescribed fire and wildfire for resource benefit poses temporary risk for erosion/ deposition post fire, depending on remaining groundcover, slope stability, and soil properties. After fire, the blackened ground stabilizes as plant cover and roots secure the surface, and loose exposed soil transports downslope. These effects are largely anticipated to fall within the natural range of variability for sediment budgets.

Effects of wildfire on stream runoff, sedimentation and nutrients are largely beyond the forest planning scope because we cannot predict when and where wildfires will burn.

Effects common to all action alternatives

All action alternatives would have similar direction for fire management. The action alternatives more expressly recognize and encourage fire’s natural role on the landscape and support a broad range of potential fire management decisions (e.g., FW-FIRE-DC-01, FW-FIRE-GDL-01 and 02). Fire suppression would occur to some degree under the action alternatives. Specific plan directions to limit impacts from fire suppression activities include:

- RMZs and habitat may still be impacted in certain circumstances when no other suitable locations for incident bases, camps, heli-bases, staging areas, etc., exists (FW-RMZ-GDL-08).
- RMZs would have limited exposure to fire retardant (FW-RMZ-GDL-09)
- Fuels treatments often require the use of ground-based equipment, the Forest would apply the same mitigation as for timber harvest to limit soil disturbance. The same guidelines for timber would also apply for retaining minimum levels of soils organic matter and ground cover (FW-SOIL-GDL-05). The levels may vary depending on the fire risk, site type, and soil condition (FW-VEGF-GDL-06).
- Only allow location of temporary fire facilities in rare circumstances (FW-RMZ-GDL-07)

- New direction strengthens protection against adverse impacts from fire suppression activities across the entire planning area to riparian zones.
- Fire line construction and use of heavy machinery would be conducted to minimize impacts to riparian areas (FW-RMZ-GDL-05).
- Storage of fuels or other toxicants would not be allowed except in rare circumstances, under which the approval of an aquatic or resource specialist is required (FW-RMZ-STD-03 and 06).
- Areas of high risk would be mapped to improve the communication of where aerial operations need to avoid dropping fire retardant (FW-RMZ-GDL-10).

Standards and guidelines would mitigate general fire management effects under all action alternatives. There are no differences in effects between alternatives because it is nearly impossible to predict the extent and location of large wildfires. However, it is assumed that impacts to riparian areas would still occur where fire management activities, primarily suppression efforts take place. Impacts to RMZs and habitat may still occur in certain circumstances when no other suitable locations for incident bases, camps, helibases, staging areas, etc., exists. Delivery of chemical retardant, foam, and other additives near or on surface waters may occur when there is imminent threat to human safety and structures or when a fire may escape causing more degradation to RMZs, than would be caused by addition of chemical, foam or additive delivery to surface waters in RMZs. Conversely, where management treatments are used to reduce wildfire hazard, positive long-term effects to riparian areas by not burning may be realized.

Wildfire suppression and prescribed fire tactics can affect watershed resources through the process of building fire line and large fuel-breaks, using fire retardant, causing soil disturbance, and removing vegetation. Ground-disturbance from wildfire suppression can cause a net decrease in effective ground cover that no longer resists rainfall runoff. These activities can route sediment to streams from compacted machine paths and linear features that channels runoff. Rehabilitation efforts after fire would mitigate these effects across the fire area. The action alternatives would minimize these effects by limiting fire suppression activities away from the most sensitive areas, RMZs (FW-RMZ-GDL-05 and 06). The action alternatives carry forward forest plan components to locate fire camps away from riparian areas where risk of sedimentation and risk of degradation to water quality are highest (FW-RMZ-GDL-08). The action alternatives would have stronger language to avoid degrading water quality from suppression activities by minimizing suppression activities in RMZs (FW-RMZ-GDL-06 and 11), and with specific direction to avoid prescribed fire ignition in RMZs without site specific analysis (FW-RMZ-STD-03).

All action alternatives include plan direction that supports the role of fire and its use across the Forest to a greater degree compared to current plan direction (see Fire and Fuels section). Managing fire (both planned and unplanned ignitions) for resource benefit would promote ecological processes by allowing low and moderate severity fire to burn within riparian areas at a more natural rate. It would also help create desired forest compositions and structures. Use of fire as a tool within RMZs would likely occur to a similar extent under all action alternatives, because of the potential ecological benefits and ability to help maintain or achieve desired vegetation conditions within RMZs.

The proposed riparian directions for fire management within riparian areas would be more restrictive on the east side of the divide (approximately 85 percent of the planning area) than the current forest plans. They would aid in the maintenance of water quality and riparian desired conditions from fire management. There would be no difference in fire management effects of plan components on the west side of the divide as the proposed plan components were adapted from INFISH standards.

All action alternatives would increase the area where fire may be used as a tool for resource benefit when compared to current direction under alternative A. Managing fire (both planned and unplanned ignitions) for resource benefit could increase incidents of sediment deposits, but would promote ecological processes by allowing low and moderate severity fire at a more natural rate. The number of acres burned across all action alternatives are relatively small and the effects would not vary. Therefore, the effects to water quality and quantity would not vary by alternative.

Alternative A, no action

Prior to year 2000, fuels treatment was primarily a connected action to timber treatment. With the National Fire Plan passed in 2000, fuels treatment intensified steadily in tandem with commercial harvest and as a separate treatment. Fuels treatment also involves managing wildfire for resource benefit since many areas on the forest have not been subjected to fire over the last 100 years.

The 1986 Lewis and Clark NF and Helena NF plans includes plan directions for fire in riparian areas (Table 27). On the west side of the divide, INFISH standards include:

- FM-1 to design fuels treatments and fire suppression as not to prevent attainment of riparian management objectives.
- FM-2 has specific requirements for locating bases, helibases, staging areas and other centers for incident activities outside of Riparian Habitat Conservation Areas.
- FM-3 avoid delivery of chemical retardant, foam, or additives to surface water.
- FM-4 design prescribed burn project to contribute to the attainment of the riparian management objectives.
- FM-5 Develop a rehabilitation treatment plan to attain riparian management objectives and avoid adverse effects on inland native fish whenever RHCA are damaged.

Table 27. Effects of plan components for prescribed fire and wildfire for aquatic ecosystems – alternative A

Plan Component(s)	Summary of expected effects
Helena NF Forestwide Prescribed fire Standards II/33.	This section provides standards that would guide and/or limit prescribed management activities. Prescribed fire would not exceed natural fire intervals. Soil surveys would be used to assist with site selections to avoid potential soil and watershed degradation. See below for INFISH amendment.
Lewis and Clark NF Management Areas MA-R (3-91)	This section provides standards for specific to riparian areas that guide and/or limit management activities. Management area guidance describes special considerations for the minimization of activities in riparian areas, standards for active fuels reduction methods and planned ignitions for the enhancement and maintenance of riparian areas resources.

Invasive Plant treatments

Effects common to all alternatives

Invasive plants are often treated using an integrated approach, with a combination of control methods that include mechanical, biological agents, and herbicides. The effects of some of these methods are discussed here.

Effects from chemical application depend on the type, extent, and amount of herbicide that is used, the sites' proximity to a stream or wetland, a stream's ratio of surface area to volume, and whether transport from the site is runoff or infiltration controlled. Chemical persistence in the soil profile and surface water depends on the potential for the chemical to leach through groundwater, the size of the treatment area, velocity of streamflow, and hydrologic characteristics of the stream. Herbicide use on the forest abides by MCA 75-5-605 and Section 402 of the Clean Water Act.

Mechanical treatments can result in localized soil disturbance as plants are pulled. Increased sediment to streams along road cuts and fills within riparian areas is possible, but the increase would likely be undetectable due to several factors. First, not all vegetation in a treated area would be pulled, so some ground cover would still be in place. Second, not all sediment from pulling weeds along roads would reach a stream because many relief culverts divert ditch flow onto the forest floor away from streams. Finally, hand pulling is very labor intensive and costly; thus, only a few acres per year could be treated using this technique across a watershed.

Effects common to all action alternatives

Although many threats to water quality from chemical application may be reduced by applying BMPs, they cannot be eliminated. The 2020 Forest Plan include specific directions for invasive weed treatment in and around RMZs to protect water quality. Standard FW-STD-RMZ-05 would apply to RMZs to minimize effects to water quality by allowing the use of alternatives to chemicals for treatments within RMZs, thus reducing leaching or drift from chemicals into the water.

Alternative A, no action

The 1986 Forest Plans have directions to apply soil and conservation and BMPs to protect water quality. The Lewis and Clark NF 1986 plan emphasizes preventing noxious weeds by reseeding, and adherence to state water quality standards (Soils and Water Management Standards F-3) as required in the Clean Water Act. The 1986 Helena NF plan has the following specific directions for the use of chemicals within riparian areas, "will be minimized to the extent feasible, and will be coordinated with wildlife, watershed, and fisheries personnel and a certified pesticide applicator."

Wildlife habitat management

Wildlife habitat management activities that could affect water quality may include road decommissioning, vegetation management, and stream and riparian restoration. The effects on water quality from those activities are discussed in the timber, RMZ, restoration, motorized travel, infrastructure and other appropriate sections.

Recreation

Effects common to all alternatives

General effects from recreational use, construction of facilities, and maintenance of facilities and sites to watershed resources can include undesirable changes to: (1) upland and riparian soil and vegetation conditions, causing increased erosion and runoff, decreased soil-hydrologic function, loss of vegetative cover and wood recruitment, and reduced water quality; (2) stream morphology, water quality, streamflow, and substrate; and (3) water quality from spills of fuel, oil, cleaning materials or human waste associated with equipment, and the pumping of toilets.

Trail maintenance can affect large wood recruitment and function that influences stream channel morphology and aquatic habitat. Bucking out fallen trees can reduce the tree's length and sever the bole from its root wad. Smaller tree lengths are not likely to contribute as much to stream channel stability and are more likely to be washed out during high stream flow events. Smaller instream wood would also delay the recovery of channel features needed to maintain habitat for aquatic species, including overhead cover and low-velocity refugia during high-flow events.

Impacts from trails may include rutting, erosion, and loss of ground cover from user-created trails, trampling of vegetation, vegetation removal, and soil compaction of streamside and upland sites. Rutting may increase surface erosion associated with heavily used trails. High-use campsites may cause root damage in trees resulting in reduced vigor and mortality. In combination, these activities can lead to increased erosion and a reduction in water quality. Increases in recreational visitors increase risks to aquatic communities. The greatest threat from recreation is introduction of aquatic nuisance species. These species include any nonnative plant or animal species and disease which threaten the diversity or abundance of native species, the ecological stability of infested waters, or commercial, agricultural, or recreational activities dependent on such waters. The Montana Aquatic Nuisance Technical Committee (2002) identifies over 70 nuisance species. Some, well known in Montana, include the New Zealand mudsnail, curley-leaf pondweed, whirling disease, and nonnative fish. While nonnative fish like brook and rainbow trout are desirable in many locations, there are places where they are not. An environmental assessment by the MFWP is now required before fish introductions can legally occur.

Most of the pathways of introduction and spread of aquatic nuisance species are related to human activities, both accidental and intentional. The New Zealand mudsnail and whirling disease can be accidentally transported and spread by way of recreational boats and wading boots. The Forest would continue to cooperate, and support measures taken to limit the spread of aquatic invasive species. Streambank trampling, camping along the stream's edge, heavy sport fishing, and wheeled motorized vehicle use on designated routes and areas usually result in the loss of vegetation within riparian areas. Loss of vegetation from shorelines, wetlands, or steep slopes can cause erosion and water pollution problems (Burden & Randerson, 1972).

MFWP enforces laws, rules and regulations that are designed to prevent over-exploitation of fish populations through angling with catch and release fishing or low daily and possession limits for westslope cutthroat trout throughout most of the forest. All waters are closed to angling for bull trout and all fish must be release immediately. There is some incidental mortality to fish when they are caught and released. Habitat alteration from recreational camping and day use sites may cause site-specific impacts but should not extensive enough to measurably limit fish populations. Localized impacts to vegetation and banks in riparian areas occur at lakes with trout and at river access sites. Effects would be the same between all alternatives. Unmeasurable effects on aquatic and riparian resources from fishing are to be expected.

In general, people who recreate in NFs participate in activities such as driving, hiking, horseback riding, hiking, and camping in the vicinity of lakes and streams. Recreational use is anticipated to increase in the coming decades. Projected increases in recreational use are commensurate with all alternatives. Implementation of current forest plan direction and BMPs to protect aquatic and riparian resources notwithstanding, impacts to these resources would likely increase given increased public use because stream and lake environments would continue to attract forest users.

Effects common to all action alternatives

Table 28 summarizes the effects of 2020 Forest Plan components for recreation on aquatic ecosystems. The 2020 Forest Plan includes guidance to manage developed recreation facilities to be responsive to environmental changes such as water flow, fish and wildlife habitats (FW-REC-GDL-01). Plan components in all action alternatives direct the placement of new developed recreation facilities to avoid the inner RMZ to protect fishery resources and riparian-associated plant and animal species (FW-REC-GDL-03 and 04). The Forest should consider relocating recreation facilities that are currently located within RMZs that have documented degradation of aquatic or riparian resources (FW-REC-GDL-05). Forestwide guideline (FW-REC-GDL-06) would protect water resources by guiding new and reconstruction of sanitary waste facilities outside of the inner RMZ.

There are no differences in effects between action alternatives as all would adopt the RMZ plan components across the planning area. For riparian areas east of the Continental Divide, the adoption of RMZs would increase management directions within these areas. Therefore, the adoption of RMZs would provide more protection of water quality over the existing forest plan. On the west side of the Continental Divide RMZs would largely not lead to different outcomes from INFISH directions in alternative A.

Table 28. Effects of plan components for recreation on aquatic resources – all action alternatives

Plan Component(s)	Summary of expected effects
FW-REC-GDL 01	Forestwide direction for developed recreation facilities should be responsive to environmental changes including stream flow, fish and wildlife habitats and vegetation.

Plan Component(s)	Summary of expected effects
FW-REC-GDL 03, 04, and 05	These directions restrict the location and placement of facilities outside riparian areas, groundwater dependent ecosystems, wetlands, channel migration zones. These new guidance's would have a limiting effect of management actions that could occur with these areas and would maintain or enhance habitats and water quality. The exception would be the west side of the divide as there would be little difference between (Amendment 14) INFISH and proposed RMZ widths. They would help provide resiliency in the face of warming climate.
FW-REC-GDL-05	This guideline provides directions where existing facilities within RMZs and are degrading aquatic or riparian resources they would be considered for relocation and the site restored. This would have a benefit to water quality and aquatic habitat.

Alternative A, no action

The Lewis and Clark NF 1986 Forest Plan includes direction that protects riparian resources (MA-R) during the management of recreation. Riparian areas are delineated during project development. The plan provides direction to avoid construction of recreation facilities to protect riparian areas (i.e. roads, trails). The Helena 1986 Forest Plan east of the divide provides similar protections that discourage concentrated use in riparian areas, as well as the construction of roads in riparian areas.

The current 1986 Forest Plans have forestwide direction to adhere to state water quality standards. On the west side of the Continental Divide, the INFISH provides additional standards and guidelines for recreation management mainly relocating or constructing new developed and dispersed sites outside of riparian areas. Many sites have been identified where excessive sediment from these sites are a concern. Dispersed sites typically do not have toilet facilities and concentrations of human waste at some locations have been found. Dispersed and developed sites are often located within riparian areas; the ground is often hardened, and ground vegetation may have been removed. Trees have been felled for safety reasons in campgrounds and would continue to be felled. Under current direction, these trees would be removed or used as firewood and would not contribute to instream bank stability, thermal regulation, or fish habitat needs. Throughout the planning area, many developed recreation sites have been relocated due to adverse impacts to riparian management objectives and fish.

Motorized trails, travel management, and roads

Effects common to all alternatives

The road network on the Forest affects water and aquatic resources on both a short and a chronic, long-term basis. There are motorized roads open to the public as well as administrative use within the forest administrative boundary, including roads managed by other entities such as state Highways, a variety of county roads, federal/state land management agencies, and private timber companies. Many roads and motorized trail are located within RMZs that include many road-stream crossings. Routes located closest to water resources potentially provide a background level of disturbance that contributes to direct and indirect effects on aquatic and riparian resources. Motorized trails function similar to roads in regard to soil disturbance however impacts are generally less as there is less disturbed surface area.

Past culvert failures and road slumps have impacted water quality of the HLC NF, particularly at the site-level scale. Forest roads that are maintained on an annual basis are typically those roads that have the most administrative and visitor use. Closed roads receive less maintenance, and not all of these roads were put into proper long-term storage or had their culverts removed. There are stream crossings located on administratively closed FS roads with some culverts remaining that do not receive regular maintenance. Inspection and monitoring of culverts is a monitoring item to address this concern and provide maintenance.

A potential source for nutrients is phosphorus bonded to sediment (Ballantine, Walling, Collins, & Leeks, 2008; Wood, Heathwaite, & Haygarth, 2005). Detachment of soil particles and associated phosphorus is often linked to soil erosion, which provides a physical mechanism for mobilizing phosphorus from soil into waters (Wood et al., 2005). The greatest input of sediment is from roads.

Effects common to all action alternatives

Forestwide direction includes guidance that would alter road management on the Forest to address the detrimental effects of roads on water quality, wetlands, riparian areas, and aquatic species. The 2020 Forest Plan includes continued directions that transportation infrastructure, including road maintenance along open roads would include BMPs to minimize adverse impacts on water quality (FW-WTR-SD-03). This desired condition along with those under other resource areas are intended to focus future road management to address the impacts of roads on water quality, aquatic, and riparian resources.

Many 2020 Forest Plan directions that directly affect water quality related to routes and/or road management are the same or modified slightly from current direction, including:

- FW-RT-GDL-01, which is comparable to INFISH RF-2d, requires the Forest to minimize sediment delivery to streams from roads and road drainage to be routed away from potentially unstable channels, fills, and hillslopes. This guideline would reduce the amount of sediment delivered to streams both directly off road and from gullies and mass failures associated with unstable areas adjacent to streams.
- FW-RT-GDL-05, which is comparable to standards Facilities, Road Standard 3 under the Helena and Facilities L4 (22) under the Lewis and Clark forest plans (1986), requires that new and relocated roads, trails and other linear features should avoid lands with high mass wasting potential. This standard is intended to reduce road-related mass wasting and sediment delivery to watercourses and is expected to prevent degradation of water quality at individual sites.
- FW-RT-STD-08, which is comparable to INFISH RF-2f, requires minimizing side casting into or adjacent to waterbodies when blading roads and plowing snow. This guideline is intended to prevent sediment and debris that are mobilized through blading and plowing from reaching streams and affecting water quality (suspended sediment) and fish habitat.
- FW-RT-GDL-11 requires that the transportation infrastructure should maintain natural hydrologic flow paths, (e.g., streams should be kept flowing in original channels). This guideline would ensure streams are not routed down ditches and into other stream channels in an effort to maintain current discharge and streamflow patterns and not increase erosion in roadside ditches.

Several plan components are modified slightly from current direction to have increased benefits for water quality and aquatic resources, including:

- FW-RT-STD-02, which is comparable to INFISH RF-4 and a new requirement carried over to the east side, requires that new, replacement, and reconstructed stream crossing sites accommodate at least the 100-year flow, including associated bedload and debris. This standard addresses stream crossing structures installed on roads and trails, including bridges and culverts, in order to, at a minimum, pass the 100-year flow plus associated bedload and debris, which would reduce the likelihood of blockages and mass failures at stream crossing sites. This standard differs from previous direction in that it applies more broadly to road and trail crossing structures, whereas INFISH RF-4 only required installation of a 100-year crossing structure where “a substantial risk to riparian conditions” exists.
- FW-RT-STD-04 prohibits side casting fill material when reconstructing or constructing new road segments within or adjacent to RMZs, which is comparable to the second part of INFISH RF-2f. This standard would apply across the entire forest, whereas the INFISH RF-2f standard only applies to INFISH priority watersheds. This standard is intended to expand benefits to riparian and water resources across all GAs, thereby reducing the likelihood of road failures and mass wasting into waterbodies across the entire forest.

Several plan components are new or expand upon concepts and benefits, such as:

- FW-RT-GDL-06 requires that roads that are to be decommissioned, made impassable, or stored would need to be left in a hydrologically stable condition. This standard would apply the concept of leaving a road in a stable condition if it is expected to no longer receive routine maintenance, including roads that are actively/newly stored, closed, or made impassable on the forest. Similarly, FW-RT-GDL-03 requires that travel routes that are to have a physical barrier blocking future access are first assessed for drainage features and treatments must be completed to avoid future risks to aquatic resources. In effect, this standard would require the forest to assess and treat drainage features on roads, skid trails, temporary roads, and trails prior to blocking off vehicular traffic to ensure the road is left in a hydrologically stable condition. The combination of these two standards would improve water quality downstream and adjacent to roads as a result of reducing the likelihood of sediment delivery from road failures where unmaintained culverts have become blocked and have failed.
- FW-RT-GDL-01 requires that the water drainage systems on roads, skid trails, temporary roads and trails should be hydrologically disconnected from surface waterbodies to prevent the delivery of sediment and pollutants and maintain the hydrologic integrity of watersheds. This guideline is a critical element to reduce nonpoint source pollution from forest roads and trails and is expected to have the greatest impact to maintain current water quality, prevent increased peak flows and water elevation in waterbodies, and maintain current hydrologic regimes across the forest. Under this guideline, water that is collected on hardened surfaces or in road ditches would be routed to the forest floor and allowed to infiltrate subsurface water systems in stable areas.
- FW-RT-GDL-04 requires that new or redesigned stream crossing sites should be designed to prevent diversion of streamflow out of the channels in the event that the crossing becomes plugged or experiences more water than the crossing was designed to handle. Under this guideline, effort would be taken when designing and installing stream-crossing structures to route high flows directly over the top of the road at that site to prevent water from running down the ditch or road surface, which can exacerbate more road failures and sediment delivery to streams. This guideline could be considered similar to INFISH RF-2e, which requires each existing or planned road to avoid disrupting natural hydrologic flow paths.
- FW-CWN-GDL-01 requires that subwatersheds included in the CWN allow no net increases in stream crossings or road lengths (similar to the HNF road standard 1) within RMZs unless the net increase improves ecological function in aquatic ecosystems. This net increase is to be measured from beginning to end of each project. The no net increase of road lengths within RMZs is also expected to reduce the impacts of roads on water quality, as there would be less likelihood for road failures and mass wasting in the RMZ that could deliver sediment to streams.
- Relocation of current roads within riparian areas would be a priority for watershed restoration which would greatly improve riparian conditions and floodplain processes. There would be no net increase in the road network and stream crossings inside of RMZs for watersheds within the CWN (FW-CWN-GDL-02).
- FW-RMZ-GDL-04 requires that new road construction, including temporary roads, is avoided in RMZs except where necessary to cross streams, a road relocation contributes to attainment of aquatic and riparian desired conditions, or FS authorities are limited by law or regulations. This guideline is consistent with and similar to the requirements of Montana's SMZ law, which only allows road construction within the SMZ to cross streams, but the RMZs under the proposed plan are more comprehensive than the state-mandated SMZs. This guideline is expected to maintain water quality by reducing the likelihood for road failures and mass wasting in the RMZ that could deliver sediment to streams.
- FW-SOIL-STD-04 requires that soil function be restored when temporary roads are no longer needed and existing roads are decommissioned. The exact treatments necessary at any site would be

determined based on site-specific characteristics, but in many cases, these standards would result in these road surfaces being decompacted and available slash would be applied. If the road has already revegetated and is found to already be in a hydrologically stable condition, these roads may not receive further treatment so as not to prevent disruption of the natural restoration process that has begun. But in the case when roads are decompacted and covered in slash, rainfall and water drainage is expected to infiltrate into the ground and no longer be delivered to waterbodies, which would reduce the likelihood of concentrating flow and improve water quality.

- FW-WTR-STD-03 and FW-SOIL-STD-03 require the use of BMPs to protect water quality.

Due to the programmatic nature of the FEIS, it is difficult to determine the effects of alternatives with respect to the use of roads during timber harvest. The effect on log hauling on aquatic resources is dependent upon a number of variables, such as, but not limited to: road surface, miles to access harvest units, number of stream crossings, proximity of a road to a stream, and amount of timber removed. These types of impacts are evaluated on a project-specific basis. Plan direction relative to roads is expected to minimize effects on aquatic resources.

The removal of stream-crossing culverts and reestablishment of a natural stream grade is expected to have the greatest impact on water quality and aquatic habitat in the action alternatives. As mentioned previously, Cook and Dresser (2007) found that stream-crossings that were restored through decommissioning delivered only 3 to 5 percent of the amount of fill material that was originally located in the road prism at the stream-crossing location. The action alternatives would sequentially improve crossings and reduce the risk of failure as funding is available across the forest and particularly in the CWN, which would decrease the amount of sediment delivery to streams that would result from potential road failures. These reductions would also result from the application of BMPs that prevent gully formation and downcutting through newly excavated stream channels, such as establishing a stream bed that mimics the natural stream gradient above and below the crossing, placing cobble-size rock in newly excavated streambeds, and distributing any uprooted vegetation and slash across stream-adjacent disturbed areas. Overall, all action alternatives are expected to provide a decrease in stream turbidity in forest waterbodies and streams, as well as an improvement of bedload size distribution and channel morphology over the long term.

The 2020 Forest Plan direction as well as the adoption of the RMZ directions would result in additional protection for riparian areas forestwide. The inner and outer riparian zone plan directions would also provide increased aquatic habitat and water quality protection which would maintain or move riparian resources towards desired condition. These effects would be most dramatic on the east side of the Continental Divide as indicated previously. Planning areas west side of the Continental Divide (approximately 421,000 acres or 15 percent of the planning area), the RMZs would largely not lead to different outcomes from current INFISH directions in alternative A.

Alternative A, no action

Management on both east and west sides of the Continental Divide would continue to be subject to the 1986 Forest Plan directions and the application of national BMPs, all of which have shown to be effective at reducing the effects from roads on water quality.

The 1986 Lewis and Clark NF plan has direction for riparian areas (Management R). Standards include the adherence to State water quality standards and maintaining soil productivity. It also requires the use of flood proofing or alternative locations outside of flood plains. Soil and water standards specific to riparian areas require adherence to state water quality standards as well as inclusion of resource protections and watershed analysis to protect water quality. They also require the design of roads and trails to mitigate damage to soil, watershed, and fish by road restrictions and other road management actions as necessary. Road and other facilities must be located generally no closer than 100 feet and constructed to protect riparian areas and to control erosion. The 1986 Lewis and Clark NF Plan also has restrictions for crossing of riparian areas and the operation of heavy equipment in streams.

The 1986 Helena NF plan has road standards for road density and resource protection. The 1986 Forest Plan requires that a specialist in soils, watershed and fisheries to identify potential soil erosion, water quality, and fisheries problems and provide input to developing road design standards and maintenance. Unacceptable damage to soils, watershed, fisheries, wildlife, would be mitigated by road restrictions or other road management actions.

INFISH directions for GAs on the west side of the divide, require that all water bodies affected by existing or planned roads meet Riparian Management Objectives (RF-2) and a suite of protective measures, such as:

- Minimize road and landing locations in RHCA (RF-2b).
- Route road drainage away from potentially unstable stream channels, fill and hillslopes (RF-2d2)
- Avoid the disruption of the natural hydrologic flow paths. (RF-2e)
- Avoid side cast materials. (RF-2f).

RF-3 requires the influence of each road on the Riparian Management Objectives to be determined and to meet RMO and avoid adverse effects to inland native fish. Directions for the construction of new and improvements to existing culvert, bridges, and other crossings to accommodate a 100 year flood (RF-4) including associated sediment and debris and to provide, and maintain fish passage at all road crossings of existing and potential fish-bearing streams (RF-5).

In summary, outside of the INFISH areas, east of the Continental Divide, road building would continue to be allowed in riparian areas that surround water resources. Where new roads are constructed, including temporary roads, vegetation would be removed, the ground would become compacted, and gravel would be dumped to make a drivable surface for passenger vehicles. The amount of road building in riparian areas west of the divide would be constrained do to INFISH standards but would be unconstrained on the east side of the divide.

Road maintenance is expected to continue at similar levels or slightly decreased levels compared to more recent management. Portions of the road network would be treated to repair and improve drainage structures, improve the running surface of the road, and to clear vegetation along roadsides. Short-term increases of sediment delivery to streams and waterbodies is expected as a result of road surface grading, and culvert and ditch cleaning near waterbodies.

Portions of the road system that are in particularly poor condition or are currently closed and in long-term storage would be reconstructed periodically, particularly in connection with land management activities, such as timber harvest projects. Road reconstruction includes application of surface rock, replacing damaged or poorly functioning culverts, adding stream-crossing or ditch relief culverts where necessary, some road widening, and removing roadside vegetation that is encroaching on the road surface and preventing vehicular passage. Again, these activities are expected to create some turbidity increases in nearby waterbodies, but BMPs would be employed to minimize erosion and sediment transport to waterbodies.

Watershed restoration actions within the HLC NF over the years have primarily focused on culvert removals/upgrade, road decommissioning, and road relocation. Under alternative A, road removal would continue to occur as funding allows. Water resources benefit from this decommissioning in the long term depending upon the proximity and extent of road near water. As described in the general effects, there would be some short-term impacts to water quality from the sediment delivery during excavation activities in or adjacent to waterbodies.

Proper decommissioning or storing a road can eliminate long-term effects from roads. Culverts that are not maintained or are undersized may become blocked with sediment and debris, eliminating its ability to pass water, bedload and debris downstream and increasing the likelihood of road failure and mass wasting. Many roads found during road decommissioning surveys were found to still contain culverts at stream-crossings. Most culvert found during these surveys have been removed. There would be no requirement to reduce stream crossing numbers and the lengths of roads in RMZs within the CWN, as required in the action alternatives (FW-CWN-GDL -01).

Motorized and nonmotorized winter recreation

Effects common to all alternatives

Nonmotorized winter uses may include but are not limited to cross country and alpine skiing, snowshoeing, and ice fishing. Motorized winter uses include motorized over-snow vehicle use, such as snowmobiling. Damage to vegetation and soil erosion may occur if there is inadequate snowpack to protect these resources. Also, winter motorized activities can result in compacted snow from grooming which often forms barriers that alter spring runoff patterns which can result in soil erosion and gullies.

Contamination by petroleum products such as motor oil and gasoline may degrade water quality in waters adjacent to areas of concentrated use such as parking lots and snowmobile staging areas. The likelihood and magnitude of the these impacts due to these activities are dependent on site-specific factors such as average slope, aspect, elevation, vegetation, weather conditions, available facilities, and the amount of use. Because site conditions vary, and because these sites are relatively small in area and widely dispersed, it is reasonable to assume that cumulative impacts would not be measurable at the forestwide scale.

Effects common to all action alternatives

The minimal impacts that are currently occurring are expected to continue for all action alternatives. Damage to vegetation and soil erosion may occur if there is inadequate snowpack to protect these resources. Also, winter motorized activities could result in compacted snow from grooming which often forms barriers that alter spring runoff patterns which can result in soil erosion and gullies.

Alternative A, no action

The Forest has identified very few impacts from winter recreation on riparian areas while implementing the two 1986 Forest Plans as amended.

Hiking and stock (nonmotorized)

Effects common to all alternatives

Hiking and stock trails are popular among forest users on the forest, though trail networks and trail use can adversely affect water quality. Given the popularity of trails among forest users, and the expected increase in recreation use, it is reasonable to expect demands by the public for additional hiking trails over the coming decades. It is expected that any new trail will be constructed to minimize impacts to natural resources.

Nonmotorized trails typically have very little impact on water resources relative to roads. Sediment from trails generally gets routed onto the forest floor with no impact to water quality. However, there are locations where sediment is routed to streams at crossings, and some trails proximity to the stream can increase sedimentation. There are times when trails have slumped into streams due to their location paralleling a stream and not due to their use. Wildfires as well as high flow events have washed out trails both inside and outside of wilderness areas. These are temporary, localized impacts which would not result in watershed scale impacts.

Effects common to all action alternatives

Forestwide guidelines FW-GDL-RT-01, 03, 04, 05, 06, 07, 09, 11, and 12 are designed to maintain the hydrologic integrity and water quality from the delivery of sediments and pollutants to water. This guidance would provide for drainage systems to minimize sediment input by assuring that water bars are in place, stream crossings are hardened, and the risk of slumps has been reduced. By doing so, any potential pollutants such as sediment, nitrogen and phosphorus would be routed to the forest floor rather than the stream network. Protection and direction for riparian areas includes limiting activities in RMZs to those would protect key riparian processes, including maintenance of streambank stability, input of organic matter, temperature regimes and water quality (FW-RMZ-GDL-13). To maintain hydrologic integrity of watersheds trails would be hydrologically disconnected from delivering water, sediment and pollutants to water bodies (FW-RT-GDL-01, 07, 11).

The 2020 Forest Plan directions result in additional protection for riparian areas by adopting RMZs. The inner and outer riparian zone plan directions would also provide increased aquatic habitat and water quality protection which would maintain or move riparian resources towards desired conditions. These effects would be most dramatic on the east side of the Continental Divide as indicated above. In the planning areas west side of the Continental Divide (421,000 acres or 15 percent of the planning area), the RMZs would largely not lead to different outcomes from current INFISH directions in alternative A.

Alternative A, no action

The Lewis and Clark and the Helena 1986 Forest Plans include directions for resource protections to mitigate unacceptable damage to soils and watersheds. The plans direct the Forest to design and construct trails to protect riparian areas and control erosion. This does not provide for hydrologic integrity or offer protections outside of the riparian areas.

Livestock grazing

Effects common to all alternatives

Approximately 1,733,332 acres (60%) of the HLC NF are classified as capable for cattle grazing, while 483,150 acres (17%) are suitable. A total of 234 grazing permittees operate on 240 active allotments in the planning area. In addition, 12 allotments are vacant and 23 allotments are closed. Over 90,000 head months are annually permitted on the HLC. The forest plan alternatives do not propose changes to allotment boundaries or use.

Livestock grazing has the potential to impact soil and water resources, particularly along water courses and in riparian areas. Soil trampling can cause decreased infiltration, greater soil compaction, and loss of vegetation cover on both upland and riparian sites. Reduced infiltration by soil compaction can lead to overland flow of sediment. Soil and water quality can be indirectly affected by the resulting increased soil runoff and erosion, and sediment delivery to riparian areas and streams.

Impacts are often greater in riparian zones because they are preferred by livestock due to the availability of shade, water and more succulent vegetation. Overgrazing in riparian zones can reduce bank stability through vegetation removal and bank trampling, it can compact soil, increase sedimentation, cause stream widening or down cutting and often changes riparian vegetation, resulting in insufficient overhead cover for fish (Platt, 1991). Livestock grazing near streams can result in changes in channel morphology (A. J. Belsky, Matzke, & Uselman, 1999). Livestock trailing, chiseling, and general soil displacement along stream bank areas can result in collapse of undercut bank areas and an overall increase in bank angle, loss of bank cover, and stream widening along the entire stream reach. Over long time periods, loss of riparian habitats by stream channel widening or degradation, and lowering of water tables through channel degradation may occur. Fecal wastes can increase bacterial concentrations in water through direct introductions into live water or riparian areas.

Removal of riparian vegetation through livestock management can influence the amount of solar radiation and alter water temperature regimes. Greater temperature fluctuations (diurnal and seasonal) can occur when riparian vegetation is removed or decreased. These changes can ultimately lead to shifts in dissolved oxygen and pH. In addition, removal of riparian vegetation and increased temperatures combined with increased nitrate levels can increase undesirable or nuisance biological production in water.

The effects of livestock can be seen across the planning area, particularly in riparian areas. Historical grazing and agricultural activities such as irrigation, led to riparian vegetation changes and stream channel degradation on streams. Various allotments have seen improvements through BMPs and updated allotment management plans. However riparian and aquatic habitat improvements within grazing allotments continue to be a challenge across the planning area. Most allotments managed under a season long grazing strategy continue to have impacts to RMZs.

The severity of the effects of livestock grazing on aquatic wildlife populations can be expected to increase under warmer climatic conditions with lower summer flows. Within current conditions, these impairments impact population sizes and recruitment success at levels of occurrence. These impacts can accelerate the replacement of native species with nonnative populations. However, effects are not limited solely to native trout and char species. Several recreational fisheries are limited by habitat loss and lower recruitment rates.

PIBO monitoring data show streams in managed sub-watershed across the planning area have lower median values or habitat conditions for many of the measured indexes (Archer & Ojala, 2016). The methodology selects managed sites that are representative of managed conditions for that portion of the planning unit. Managed sites in grazed sub-watersheds are considered representative of grazing impacts typical for low gradient habitat in that pasture. Qualitative comparisons of PIBO data sets to data collected by the forest collected data show that livestock impacts in riparian areas and streams continue to occur.

Effects common to all action alternatives

Table 29 summarizes the effects of 2020 Forest Plan components for livestock grazing on aquatic ecosystems. Existing grazing permits would continue to be administered under current allotment management plans. However, they would be required to meet or be moving towards desired conditions for riparian areas as outlined in the 2020 Forest Plan, as well as all other plan components. When allotment plans are revised, or updated, they would need to be adapted to meet or move toward RMZ desired conditions FW-RMZ-DC-01and 02, FW-FAH-DC-01 through 04, and 07, and FW-GRAZ-DC-02 and 03. The 2020 Forest Plan direction would also be incorporated into new term grazing permits, with all permits on the forest following direction within the first decade.

Forestwide plan components would protect and minimize the effects of grazing on riparian resources in all action alternatives. Standards specific to grazing, FW-GRAZ-STD-01, 02, 03 and 04 require authorization of new and existing management plans to avoid, minimize, or mitigate adverse effects to riparian habitats. Indicators such as forage use, bank alteration or riparian stubble height would be used to move rangeland vegetation, riparian function and wildlife habitat towards desired conditions. Forestwide guidelines would limit management activities inside RMZs (FW-RMZ-GDL-01 through 13 and FW-GRAZ-GDL-03 through-07). Specifically, all activities within RMZs, including grazing, should protect key riparian processes, including maintenance of streambank stability, input of organic matter, temperature regimes, and water quality (FW-RMZ-GDL-13).

Effects to fisheries would be similar to alternative A west of the divide, as the RMZ plan components generally meet the intent of the standard and guidelines from INFISH. East of the Continental Divide, the RMZ plan components for grazing provide additional protection to riparian areas compared to the current plans. There are no differences in effects between the action alternatives as all would adopt the RMZ standards and guidelines. Regional PIBO monitoring indicates that implementation of grazing standards adopted from INFISH led to improving trends to some monitoring indicators. That trend is projected to continue in the west side GAs and is expected to occur within eastside GAs as RMZ plan directions would be adopted forestwide. The 2020 Forest Plan would provide directions to move RMZs towards desired conditions under all action alternatives.

Implementation of these RMZ plan directions would result in an improving water quality trend under all action alternatives. There are no differences in effects between action alternatives, as all would adopt the RMZ plan components across the planning area. For riparian areas east of the Continental Divide, the adoption of RMZs would increase management directions within these areas. Therefore, the adoption of RMZs provide more protection of water quality. As the proposed forest plan directions are incorporated into allotment management plans and implemented, it is concluded that degraded riparian areas would move toward desired conditions. West side of the Continental Divide RMZs would lead to similar outcomes from current INFISH directions in alternative A.

Table 29. Effects of plan components for livestock grazing on aquatic resources– all action alternatives

Plan Component(s)	Summary of expected effects
FW-GRAZ-DCs	Desired conditions for livestock grazing emphasize sustainable grazing, stable soils, diverse vegetation and native plant communities, as well as riparian and wetland health. Movement toward these desired condition will be achieved through implementation of the standards and guidelines for grazing as well as the other resource areas. Changes toward meeting DCs on some allotments would likely not be realized until implementation of new allotment management plan/project are completed.
FW-GRAZ-STDs and GDLs	Generally would affect how allotment planning is implemented. Collectively with the additional WTR, FAH and RMZ plan components, the allotment management planning process will be guided by this direction so that future grazing management will move resource conditions within allotments toward desired conditions.

Alternative A, no action

The 1986 Lewis and Clark NF plan includes forestwide standards for the management of livestock in riparian areas. Management Standard D-3 is specific to protecting riparian areas, water quality, and soils. D-3 (2) requires the use of BMPs to minimize livestock damage to soil, stream sides and other fragile areas. D-3 (3) necessitates the use of offsite water away from riparian areas, fencing springs, and directing salt blocks to be located away from riparian areas. The 1986 Forest Plan also includes measurement indicators of livestock damage to aquatic habitats adjacent to low gradient (less than 2%) streams, including: total physical bank damage on key areas in excess of 30%, poor reproduction survival of streamside shrubs, and excessive grass/forb use. If these standards "are not effective at keeping livestock use of riparian areas within management objectives, the plan directs the FS to construct and maintain fencing as necessary to achieve these objectives". The plan also includes limitations of livestock use in municipal watersheds and research natural areas (RNAs). PIBO data indicates there are fewer metrics trending in the desired direction on the HLC NF than in Region 1 as a whole, which suggests less movement towards desired conditions. Effects from the livestock grazing components are discussed in the watershed effects of plan components above and in the livestock grazing section.

Grazing is a major component of land management within the planning area and would continue to occur across all GAs. Livestock grazing management has been and continues to have a major impact on watershed, riparian, and water quality throughout the planning area. Livestock management has only slightly changed since the last planning period and livestock rates are less than or equal to historical levels. The1986 Lewis and Clark and the Helena NF Plans include standards to manage livestock grazing as well as riparian grazing standards to incorporate the use of BMPs and requisites to meet state water quality standards as required in the Clean Water Act. The plans also have requirements to maintain current soil productivity. A breakdown for grazing within specific GAs is provided in the Livestock Grazing section.

On the east side of the divide current forest plan components for water quality, riparian areas and wetlands would continue to apply. Monitoring of allotments by the forest over the last decade has shown impacts to stream banks and streamside vegetation. Geomorphic changes (i.e. increasing width depth ratio, and decrease in sinuosity) have also been observed. Management under alternative A would continue to have an effect on riparian areas as a whole with continued reduction in stubble height, impacts to streambank vegetation, and shrub components may continue to occur unless management changes occur.

On the west side of the Continental Divide, INFISH standards and guidelines that protect or minimize effects to riparian and aquatic resources from livestock grazing include modifying grazing practices, locating new facilities outside of RHCAs, relocating or closing facilities, and limiting livestock handling efforts (INFISH GM-1, 2, and 3).

The 1986 Helena NF Plan includes a forestwide standard that grazing management "will protect soils and water resources, riparian areas and threatened and endangered species." Where analysis shows range damage, the cause would be identified, and corrective action would be initiated through allotment management plans. Allotment management plans would specify utilization standards of key plant species needed to protect the soil and water quality.

For areas on the west side of the divide, current forest plan directions would continue to apply, and INFISH standards and guidelines that protect or minimize effects to riparian and aquatic resources from livestock grazing would also apply. Existing grazing permits would continue to be administered under current allotment management plans and new plans would be adopted as funding allows.

As indicated above, livestock grazing impacts are substantial throughout the planning area resulting in habitats and water quality that do not meet desired conditions on many streams and riparian areas. It is expected that the current trends in watershed conditions across allotments would continue.

Timber and vegetation management

This section focuses on the effects of the action alternatives in respect to harvest of forest canopy and skidding systems, fuel reduction activities, and prescribed fire. Effects from roads are treated separately due to their higher risk for affecting water quality and quantity.

Effects common to all alternatives

Differences in potential effects on water quantity between the alternatives may be subtle since the extent of timber harvest within a watershed is typically limited by many factors including forest plan direction/limitations associated with other resources and physical constraints such as terrain and access. Effects of timber harvest on water yield and peak flows and associated indirect effects on stream channel morphology and aquatic habitat, are routinely assessed during project planning required by the National Environmental Policy Act (NEPA). Both 1986 Forest Plans directs the use of a water yield analysis as an assessment tool when water yield is an issue or concern. This has been accomplished primarily by doing an Equivalent Clearcut Area (ECA) analysis. Under the 2020 Forest Plan alternatives, water yield analysis would be directed by a defined management approach methodology which utilizes a weight-of-evidence approach to determine whether a) water yield and/or peak flows may detectably change as a result of proposed forest management activities and b) whether that change may be of concern from a water quality and/or aquatic habitat perspective. This management approach would incorporate the use of a screening process to evaluate the potential effects on water yield and/or peak flows and corresponding effects on stream channel morphology and aquatic habitat. The approach would also allow the use of more effective water yield/balance assessment methodologies, which are likely to be developed during the effective "lifetime" of the revised forest plan.

The impacts from prescribed burning would be minor since burning is designed to result in low and moderate severity that has low potential for delivering sediment. The effects of prescribed burning are generally insignificant with regard to a wide range of hydrologic and water quality variables (Robichaud, 2000).

All alternatives would comply with NFMA and include standards that prohibit timber harvest on lands where irreversible watershed effects may occur or where soil stability is a concern.

For the past twenty years fuels were treated with a combination of mechanical treatment, underburning, and broadcast burning. Broadcast burning removes slash and understory vegetation to facilitate reforestation and consumes the forest floor and groundcover simulating a natural disturbance similar to wildfire. Underburning, on the other hand, results in low and moderate burn severity that retains soil groundcover and forest floor. It is also used in conjunction with whole tree yarding that removes fuel even before burning. A tradeoff of whole tree yarding, however, is the export of nutrients offsite by removing foliage.

For the next planning period, the Forest would continue to treat fuels using a mixture of pile burning, mechanical removal and burning. The treatment type affects soil condition by removing vegetation that would otherwise decompose in soil and build up soil carbon. The loss of vegetation by treating fuels is not far removed from natural processes since fire regularly removed vegetation. However, the impacts may vary by site type. In some areas, treating fuels aligns with ecological processes and the soils have a higher proportional amount of organic matter in the mineral soils to buffer the removal. For other moist types, the fuels treatment may not directly align with natural cycles. Treating fuels temporarily removes dense growth but the moist conditions favor quick regrowth. In the wetter areas, repeated removal of vegetation to mitigate fire hazard would be out of sequence with the long periods between fires that these vegetation communities typically experienced. These treatments would reduce vegetation leaf and root litter contributions to soil with overall impacts depending on soil fertility. Adverse effects would be largely mitigated or avoided through implementation of specific project design features during implementation.

Effects common to all action alternatives

The effects related to timber harvest and prescribed burning would vary only slightly by alternative, based on modeling of expected prescribed burning and harvest acres. Given a reasonably foreseeable future budget, Alternative E would result in the fewest harvest and prescribed burning acres and associated impacts as compared to the alternatives A, B, C, and D. Alternative F would result in more harvest and burning than A, B, C, and D, but less than E.

The action alternatives would not increase risk for impairing water quality over the current direction. For uplands, the 2020 Forest Plan directions continue using BMPs to reduce offsite transport of sediment to streams from either timber harvest area or prescribed burn slopes. Standard FW-WTR-STD-03 re-enforces this commitment. Additional improvements in water quality may offset past impacts with FW-OBJ-WTR-01 and 02 that directs restoration activities to priority watersheds and CWNs. The effectiveness of BMPs for avoiding sediment was reviewed in a contemporary study in California. Out of 220 units examined, sixteen instances were found where skid trails delivered sediment to streams (Litschert & MacDonald, 2009). The authors concluded that in most cases the BMPs were effective. Surface roughness on skid trails was one of the factors that was found to alleviate overland flow and sediment delivery. The HLC NF uses slash in addition to waterbars to stem overland flow and reduce sediment delivery. Also, the belt rock geology of the Forest would have less potential for producing sediment than the granitics in the Litschert and MacDonald (2009) study area based on findings from Sugden and Woods (2007).

The action alternatives would carry on similar protections using BMPs to stabilize skid trails and landings and disconnect these from road ditch and stream networks drawing from Region 1 Soil and Water Conservation Practices (FSH 2509.22, Region 1/Region 4 Amendment No. 1). The effects would reduce risk for runoff and sediment. As discussed above, protections were strengthened in the 2020 Forest Plan by increasing widths of RMZs (FW-RMZ-STD-01) and limiting designated skid trails and landing constructions in RMZs.

Effects from timber harvest on nutrient loads in streams would not vary measurably across alternatives. However, the use of wider RMZs on the east side of the divide (FW-RMZ-STD-01) would substantially reduce to potential for increased nutrient loading from adjacent harvest areas. There would be minimal changes on the west side of the divide due to current INFISH widths.

Stream temperatures would likely not vary by alternatives from vegetation management actions. The established RMZs would preserve streamside vegetation, and vegetation management would only be allowed in the inner RMZ in order to restore or enhance aquatic and riparian-associated resources (FW-RMZ-STD-03). In the outer RMZ, vegetation management to meet desired conditions for fuel loading and silvicultural desired conditions are allowed as long as they do not prevent attainment of desired conditions (FW-RMZ-STD-04). The Forest would not clear-cut forest within RMZs (FW-RMZ-GDL-12).

2020 Forest Plan direction and the adoption of RMZs forestwide would result in additional protection for RMZs. The inner and outer riparian zone plan directions would also provide increased aquatic habitat and water quality protection, which would maintain or move riparian resources towards desired condition. These effects would be most dramatic on the east side of the Continental Divide as indicated previously. In the planning areas west of the Continental Divide (15 percent of the planning area), the RMZs would largely not lead to different outcomes from current INFISH directions in alternative A. The action alternatives would also provide a greater level of protection for aquatic and riparian resources than alternative A. The adoption of the plan components for RMZs would increase RMZ widths more than the current required SMZ widths across the planning area.

The 2020 Forest Plan includes standards and guidelines that serve to reduce risk of impacts that might occur with vegetation management. This direction includes the following:

- A standard that controls the use of herbicides, pesticides and other toxic chemicals, with exceptions only if necessary for restoration and when aquatic and riparian resources are maintained (FW-RMZ-STD-05).
- For timber harvest treatments, FW-RMZ-GDL-02, 03, 04, 05, 07, 08, and 12 control activities, including temporary roads and landings, that may disturb soils or result in ground disturbance that may result in sediment input to streams or wetlands. Guidelines for treatments in RMZs are designed to avoid ground-disturbances that may deliver sediment to streams and wetlands (FW-RMZ-GDL-04, 09, and 13; FW-RT-STD-02, 03 and 04). New and temporary road construction and new landing construction would not be allowed within the entire width of category 1, 2 and 3 RMZs, except where needed to cross streams or when site-specific analysis and mitigation measures are determined appropriate by an aquatic resource specialist to protect resources (FW-RMZ-GDL-11).
- FW-RMZ-GDL-09 restricts logging and yarding methods that may cause ground disturbance in category 1, 2 and 3 RMZs.
- These same restrictions on road and landing construction and logging methods would apply to the inner portion of category 4a and 4b RMZs (FW-RMZ-STD-01). The character and terrain typical of wetlands and pond features is different from stream features. Establishing higher level of restrictions on ground disturbance in the inner RMZ, in combination with the other plan direction, would be adequate to protect the ecological values associated with category 4a and 4b. Other plan direction includes all the RMZ desired conditions, standards, and guidelines that would guide and influence the type and extent of treatments that may occur in RMZs. For example, desired conditions describe

the diverse vegetation structure, habitat connectivity and other key ecological conditions to maintain or move toward in RMZs; guidelines specify criteria for leaving live trees, snags and wildlife cover. Other plan direction also includes the forest plan standards and guidelines associated with soil disturbance (FW-SOIL-STD-01 and 02, FW-SOIL-GDL-01, 02 and 03), and with road construction, reconstruction and maintenance in the infrastructure section (FW-RT-STD-01, 02; FW-RT-GDL-01, 03 through 13).

- Tree canopy would be retained, as described earlier, with retention of live trees in harvest areas (e.g., no clearcutting) and retention of forest cover to meet wildlife connectivity needs (FW-RMZ-GDL-11 and 12. The use of prescribed fire, particularly under burning, may be desirable in RMZs to restore natural ecosystem function, reduce forest density or fuel loadings. FW-RMZ-DC-01 promotes the use of prescribed fire consistent with natural fire regimes.

RMZs are not exclusion zones but areas where vegetation management is allowed to occur, guided by the desired conditions for vegetation and aquatic resources associated with RMZs. 2020 Forest Plan components were developed to reduce risk of potential effects to riparian and aquatic resources. An inner RMZ area is defined with greater restrictions on treatments, to provide a higher level of protection to the most critical areas closest to the stream or wetland (FW-RMZ-STD-03). FW-RMZ-STD-04 provides more management flexibility in the outer RMZ, recognizing the role that active management (i.e., thinning, harvest, fuel treatments, and prescribed fire) could achieve in some areas and landscapes, as long as those treatments promote desired conditions within the inner RMZ. Vegetation management inside of RMZs would consider condition of the riparian vegetation as well as stream conditions. Site specific, interdisciplinary analysis at multiple scales would occur before actions proceed within RMZs.

One aspect of vegetation management is fuel reduction, primarily within the wildland-urban interface. FW-FIRE-DC-02 “Within the wildland-urban interface and around high value resources, surface fuel loading and crown spacing provide conditions for low severity surface fire that minimizes threats to values,” is designed to maintain the natural function of fire to mitigate the effects of wildfire. To achieve this desired condition, fuel reduction activities could be conducted in portions of the WUI. Standard FW-STD-RMZ-01 is designed to protect riparian and stream related function and processes by restricting vegetation management activities within the inner RMZ. However, exceptions are made for the nonmechanical treatments of prescribed fire and sapling thinning, which may be a tool used to achieving desired ecological conditions. Guidelines FW-RMZ-GDL-05, 06, 08, 10, and 11 would apply to any treatments occurring within RMZs. These guidelines provide direction on the implementation of ground-disturbing management activities within RMZs. Based upon the very small proportion of the RMZs that might be affected by the exception, allowing mechanical fuel treatments, and the direction within these guidelines, the potential impacts to RMZs under the action alternatives should be minimal from mechanical fuel treatments.

2020 Forest Plan direction provides protection for soils that would also protect aquatic habitats and values associated with riparian areas. Project-specific BMPs shall be incorporated into road maintenance activities (FW-WTR-STD-03) which would protect riparian values.

The 2020 Forest Plan direction would result in additional protection for riparian areas with the adoption of RMZs forestwide. The inner and outer riparian zone plan directions would also provide increased aquatic habitat and water quality protection which would maintain or move riparian resources towards desired condition. These effects would be most dramatic on the east side of the Continental Divide since vegetation management buffers on the forest are primarily constrained by Montana State SMZs. Vegetation management in the inner RMZ would be limited and only occur in order to restore or enhance aquatic and riparian-associated resources. Plan directions for the outer RMZ would not prevent vegetation management in that zone as long as those actions would not prevent attainment of desired conditions of the inner RMZ. The west side of the divide has been using INFISH standards and the effects would be the same as current vegetation management as the new RMZ were developed from the INFISH (RHCA) standards.

The direction for FS management of soil directly tiers to the NFMA (16 USC 1604) which stipulates to "ensure…evaluation of the effects of each management system to the end that it would not produce substantial and permanent impairment of the productivity of the land." The past forest plan standards along with current guidance from the Regional and Washington offices interpret NFMA's direction to manage for sustained soil productivity. The 2020 Forest Plan would continue to manage for long-term soil and site productivity on lands designated for growing vegetation. Areas dedicated to infrastructure such as administration sites, mines, system roads and campgrounds are not part of the productive land base.

The 2020 Forest Plan includes requirements to design and implement management activities that conserve soils physical, chemical, and biological function and improve these functions if they are impaired (FW-SOIL-STD-01). Current regional direction includes the requirement that all vegetation management activities shall not create detrimental soil conditions on more than 15 percent cumulatively of an activity area (FW-SOIL-STD-02) and the requirement to incorporate project specific BMPs and design features to protect soil resources (FW-SOIL-STD-03). These standards are currently required on the forest and would be continued to provide protections to soil quality and function.

Management guidelines specific to timber management include direction that ground-based equipment should only operate on slopes less than 45 percent (FW-SOIL-GDL-01) and should not occur on landslide prone areas to protect and maintain soil stability and quality. Guidelines are included that would require maintenance of 85 percent effective groundcover (FW-SOIL-GDL-04) and maintain organic matter for soil functions (FW-SOIL-GDL-05). Organic matter as groundcover retains soil moisture, supports soil development, provides nutrients, and reduces soil erosion.

2020 Forest Plan leaves flexibility for coarse wood levels to vary at the project level depending on the fire risk, site type, and soil condition, but guidelines range between 5 to 30 tons per acre. See Snags and Downed Wood section, FW-VEGF-DC-09 and FW-VEGF-GDL-06, coarse wood debris components. The retention of coarse woody debris, which is material greater than 3 inches in diameter, would contribute soil organic matter and provide microsites that enhances soil productivity with cooler temperature and higher moisture; coarse wood debris is vital for sustainable forest ecosystems (Russell T. Graham et al., 1994). It is recognized that managing of coarse wood debris for soils productivity can conflict with fuel hazard objectives. The coarse wood ranges identified fall within the optimum ranges prescribed by (J. K. Brown, Reinhardt, & Kramer, 2003) to balance fuels and soils needs.

Standard practices in addition to new reclamation measures would contain offsite erosion. FW-SOIL-GDL-04 would lessen surface soil erosion by ensuring management activities maintain at least 85 percent cover. As determined through use of Disturbed WEPP, a soil erosion model amended for forested environments, soil erosion rarely occurs if groundcover exceeds 85 percent cover (Elliot, Hall, & Graves, 1999). Use of slash on skid trails is one measure adopted more commonly that increases groundcover and facilitates vegetation regrowth on disturbed soil surfaces.

The 2020 Forest Plan has, as a desired condition, management activities that do not de-stabilize areas with highly erodible soils or mass failure potential. Most of the erosion issues from road failures associate with either decommissioned or abandoned roads. Due to current engineering techniques and harvest equipment, the risk would be less than the initially proposed jammer logging in the 1970's. The main triggers for road failure are not related to any management direction, they involve localized disturbance from climatic instability (i.e. saturating rain on snow events, microbursts, convective storms, etc.). FW-SOIL-GDL-03 guides management to avoid landslide-slump prone areas.

Forest reduction in system roads has increased reliance on temporary roads to access timber. Most temporary roads are historical routes that have existing prisms. Direction for temporary roads continues to evolve, although once the forest removes the roads from administrative infrastructure then these areas become part of the productive landbase. Soil function would be restored on temporary roads when management completes activities that use these roads. Restoration treatments shall be based on site characteristics and methods that have demonstrated to measurably improve soil productivity (FW-SOIL-STD-04). The standard applies to both newly constructed and reused templates.

Standard mitigation techniques to limit soil damage from ground-based equipment would be carried forward into this next planning cycle. Standard practices limit equipment operation on steep slopes (FW-SOIL-GDL-01) and control seasonal operation when soils are more vulnerable to compaction and displacement (FW-SOIL-STD-03). However, the plan does not stipulate operation restrictions to particular conditions. Such limitations would be evaluated on a project basis due to variable soil properties.

The 2020 Forest Plan further addresses potential soil damage by avoiding certain sensitive soils in the mapping of lands suitable for timber production. First, poor growth areas were eliminated from the suitable timber base since harvest operations could produce irreversible soil damage and reforestation is uncertain. The areas were selected using mapping from the Helena-Lewis and Clark NF (U.S. Department of Agriculture, Forest Service, 2017d) , R1 Potential Vegetation Type (PVT) Layer, and a "greenness" index from Landsat data over 30 years of growing season to identify poor growth. Second, sensitive soil types are flagged when proposing and conducting forest management. These include soils with the following characteristics: (1) riparian and hydric, (2) mollic, (3) ash and loess, (4) granitic, (5) shallow and infertile, and (6) landslide prone. The 2020 Forest Plan specifically addresses landslide prone risk with guidance that ground-disturbing management activities should not occur on landslide prone areas (FW-GDL-SOIL-03).

Alternative A, no action

1986 Helena NF and Lewis and Clark NF Forest Plan direction for water quality includes the requirement to incorporate BMPs and to follow Montana Streamside Management rules to ensure state water quality standards are met or exceeded. Current vegetation management activities have been restricted under the state of Montana streamside management laws since 1991. These laws prohibit certain forest practices along stream channels and directs suitable streamside management practices. These forest practices also included slope limitations, buffer widths, hauling and broadcast burning. These laws have been the main mechanism to regulate forest practices along streams in the NF. Timber management action include the requirement to meet state water quality standards per CWA (33 U.S.C. 1232) and memorandums of understanding. Also, standards include requirements to complete project analysis of watersheds that would involve substantial vegetation removal and the prerequisite not increase water yield or sediment delivery beyond acceptable limits.

The 1986 Helena NF and Lewis and Clark NF plans include vegetation management directions for riparian areas. The Helena 1986 Forest Plan includes management area directions to maintain water quality, stream bank stability and not to increase runoff that would result in long-term stream channel degradation. Also included are directions that limit when and what age class would be harvested within riparian areas. The Lewis and Clark 1986 Forest Plan includes direction within riparian areas; management area R (MA-R). Management area R direction includes type and age of trees and the type of logging systems allowed in riparian areas while maintaining or enhancing other resource values. Both plans require the adherence to the State water quality standards and current soils productivity.

The GAs west of the Continental Divide, approximately 15 percent of the planning area, have had limited riparian harvest since 1996 when INFISH amended (Amendment 14) the Helena 1986 Forest Plan. Under alternative A timber harvest within riparian habitat conservation areas except for salvage or where silvicultural practices were needed to attain Riparian Management Objectives would continue to be limited. Monitoring data from PIBO demonstrates that stream habitat conditions (temperature, LWD, pool frequency, etc.) associated with riparian protections have trended in desired directions for some indicators.

Road access would largely dictate timber harvest since the HLC NF continues to reduce the road network to a manageable level. The costs of road maintenance and managing for habitat were also factors in the Forest's decision to decrease the road template.

Within an activity area, typically defined as a treatment unit, timber harvest over the next planning cycle may impact soils at the same disturbance intensity as over the last ten years. HLC NF soil monitoring over a section of this period found logging systems resulted in detrimental soil disturbance, on a percent area basis, of 8 percent average for ground based, 4 percent average for skyline, and 4 percent for hand treatments based on HLC NF Soil Monitoring data from 2012-2016 (see project record). Historical timber harvest (pre 1999) and site preparation practices left up to 30 percent of the soil area severely impacted (Clayton, 1990; Klock, 1975) at least twice the disturbance area of contemporary harvest practices.

Minerals, oil, and gas

Effects common to all alternatives

Historically, there have been hundreds of locatable mineral mining operations across the forest, having occurred both on patented and unpatented mining claims. The largest historic mining areas identified on the Forest with severe water quality impacts include the Upper Little Blackfoot River as well as the upper reaches of the Blackfoot River in the vicinity of the Upper Blackfoot Mining Complex in the Upper Blackfoot GA, the Upper Tenmile Creek including their tributaries drainages in the Divide GA, the Dry Fork Belt and Carpenter Creek, in the Little Belts GA.

Recreational mining activities such as panning (gold and/or sapphires), metal detecting, hand-sample collection, and the use of small-scale sluice or suction dredge systems occur across the forest, particularly in areas of historic lode or placer mining activities. Unless an authorized officer determines that an activity is or will cause a significant disturbance to surface resources, a Plan of Operations is not likely to be required. Recreational activities, to include suction dredging, often do not require a FS authorization in advance, however factors such as access, scale and duration may dictate otherwise. Suction dredging is regulated by federal and State mining laws and regulations. MTDEQ has seasonal restrictions on suction dredging and other in-stream mining activities on many of the forest's bull trout and cutthroat streams, therefore impacts to those species will likely not be seen in those streams. Large increases in mining activity are not anticipated for the future but cannot be ruled out. In accordance with laws governing locatable minerals activities on NFS lands (the 1872 General Mining Law, the Organic Administration Act of 1897, the Mining and Minerals Policy Act of 1970, et al.), the public has a statutory right to conduct locatable mineral exploration and development activities, provided such activities are reasonably incidental to mining and comply with all other Federal laws and regulations. The FS role as directed by Federal regulations (36 CFR 228A) is to ensure that mining activities minimize adverse environmental effects to surface resources and comply with all applicable environmental laws. Congress has not given the FS authority to unreasonably circumscribe or prohibit reasonably necessary activities under the 1872 General Mining Law that are otherwise lawful.

Salable minerals include common varieties of sand, stone, gravel and decorative rocks. The FS salable mineral material policy (FSM 2850) states that disposal of mineral material will occur only when the authorized officer determines that the disposal is not detrimental to the public interest and the benefits to be derived from proposed disposal will exceed the total cost and impacts of resource disturbance. The forest uses gravel, riprap, and crushed aggregate for maintenance and new construction of roads, recreation sites and repair of damages caused by fire, floods and landslides. These materials come from FS developed pits and quarries. The type, volume, and source location of in-service mineral material varies year-by-year and according to need.

There are no active oil and gas leases on the forest and therefore no effect to watersheds, fish or riparian areas from any of the alternatives.

There are no effects to fish, watersheds, or riparian areas from any of the alternatives from free-use permits issued to the general public for the collection of limited volumes of rock for personal uses (i.e., noncommercial).

Effects common to all action alternatives

Table 30 summarizes the effects of 2020 Forest Plan components for minerals, oil and gas on aquatic ecoystems. The effects of additional RWAs would not be changed from alternative A. Generally, gravel pits would be situated away from riparian areas. FW-RMZ-GDL-07 would exclude gravel pits and sand operations from RMZs. Hauling of gravel, rocks and materials from these sites may impact water quality along haul routes and would be the same for all alternatives. FW-EMIN-GDL-01 and 02 are designed to minimize effects on water quality through guidance's of mineral and energy authorization and development in RMZs. The effects of minerals management would be the same for all action alternatives.

Table 30. Effects of plan components for geology, energy, and minerals on aquatic resources – all action alternatives

Plan Component(s)	Summary of expected effects
FW-EMIN-GDL-01 and 02	Direction would minimize adverse effect to aquatics and riparian resources. Mineral operations would avoid RMZs or would ensure operations take all applicable measures to maintain, protect and rehabilitate water quality.
FW-RMZ-GDL-07	This guideline excludes gravel pits and sand operations from RMZs. This would benefit water quality and riparian habitats.

Alternative A, no action

The 1986 Lewis and Clark NF plan includes directions (G-1) to avoid unnecessary damage to improvements, and prevent pollution of soil, water and air resources. It also requires the soil and water protection as outlined in forestwide Soil and Water Management Standard F-3. No surface occupancy stipulations are required to be applied to drainages supporting populations of westslope cutthroat trout that are considered either "managed-as-pure (98-100% genetically pure) or "indicator" (90-70% genetically pure). The 1986 Helena Forest plan has directions to maintain water quality and bank stability.

Lands and special uses

Effects common to all alternatives

Management activities that result in ground disturbance near streams and other bodies of water have the potential to affect water quality. These potential increases are based on site-specific factors such as slope, soil types, proximity to waterbodies, residual ground cover, revegetation, etc. Conversely, soil erosion, loss of long-term soil productivity, stream sediment, and turbidity can increase due to increased road activity from issuance of road use permits or granting of right-of-ways.

Effects common to all action alternatives

The proposed guidelines (FW-LAND USE-GDL-03 and 04) would require new authorizations or reauthorizations of exciting facilities to include conditions to avoid or minimize adverse effects to fish, water, and riparian resources. Potential impacts on RMZs would strive to improve conditions or site them outside of RMZs. New hydropower support facilities would be sited outside of RMZs to reduce effects to fish, water, and riparian resources. Support facilities include any facilities or improvements (e.g., workshops, housing, switchyards, staging areas, transmission lines) not directly integral to its operation or necessary for the implementation of prescribed protection, mitigation, or enhancement measures. Some riparian vegetation could be removed or curtailed from re-establishing at the site-specific scale due to clearing of power lines, outfitter camps, etc., but that the cumulative effect is minor and would not affect riparian processes. Acquisition of areas along designated WSRs would continue to be a priority for land exchanges. The guidelines are similar for each action alternative as they were modified from alternative A, which adopted the INFISH guidelines in 1996 under an amendment to the Helena 1986 plan and would be implemented across the HLC NF. Permitted power and telephone line construction and maintenance would continue under all alternatives. Clearing brush and trees in riparian areas may increase solar radiation to streams and the forest floor, increasing water temperature. The limbing, topping, or removal of hazard trees near utility lines can also reduce in-channel wood. The very nature of power and telephone lines would result in riparian vegetation to be reduced where they cross and/or adjacent to the stream network. The permitting process for new authorizations would look at options to minimize this effect.

However, it is assumed that temporary and short-term impacts would still occur where special uses are allowed or mandated. Actions may also occur where the risk of short-term effects is worth taking because there would be notable benefits to watershed resource conditions over the long term. Where facilities cannot be located outside of RMZs, effects would be minimized to the greatest extent possible, but not completely eliminated.

Alternative A, no action

The Helena NF and the Lewis and Clark NF 1986 Forest Plans have standards that govern activities that would impact soils and water resources. In the Lewis and Clark NF plan, new land use permits must not conflict with the goals of the management area (MA-R). The Lewis and Clark 1986 Forest Plan standards J3 (5 and 6) require all new special uses to avoid riparian areas if possible and all special uses protect soil and water resources. The Helena NF 1986 Forest Plan, as amended by INFISH, includes four plan components on the area west side of the Continental Divide, specifically LH-1 through LH-4. These require riparian resources to be restored, and new hydroelectric ancillary facilities to be located outside of RHCAs. This would avoid effects that would retard or prevent attainment of the riparian management objective. Land acquisitions, exchanges, and conservation easements would meet riparian management objectives.

Ski facilities

Effects common to all alternatives

All alternatives would continue to permit the existing ski areas as well as cross country ski areas.

Two special use downhill ski areas, Showdown located in the Little Belt GA and Teton Pass Ski Resort located in the Rocky Mountain Range GA operate under special-use permits. Both ski areas are in the east side of the Continental Divide. Both areas contain many RMZs within their permitted areas. Showdown is in the headwaters of Sheep Creek and includes approximately 1.5 miles of stream corridor. The permitted area also has many springs and seeps. Teton Pass Ski area is located in the headwaters of Waldron Creek, a tributary to the West Fork Teton River, and includes riparian areas along streambanks and springs.

Ski area development can lead to increased runoff and erosion through timber clearing for lifts, runs and other facilities. Ski areas and snow resorts typically remove forest vegetation from much of the area, which would no longer be allowed in RMZs under the action alternatives. Snowmelt runoff is increased, especially when cleared areas are compacted. Substantial amounts of such disturbances can increase the size and duration of spring high flows. Maintenance roads on the ski slopes can route runoff and sediment to streams and wetlands. Stream channel damage can result from increased runoff that leads to erosion. Ski areas also typically disturb soils throughout cleared areas. Erosion and sediment can result from these cleared areas, especially from soils that are near streams, unstable, or highly erodible. Aquatic habitat can be damaged as a result. In addition, these uses can also degrade wetlands and riparian areas by draining or filling them or by altering their vegetation.

Effects common to all action alternatives

The 2020 Forest Plan would require the adoption of the RMZs directions which would result in an increase in widths over current plan directions. Management directions for riparian areas would also be more restrictive. Under the 2020 Forest Plan standards, RMZs standards would be required. Extra protection for wetlands, fens, peatlands, and other groundwater dependent ecosystems (FW-RMZ-GDL-03) would be protected by a RMZ measuring 100 feet from management activities that disturb or compact soil, vegetation, and/or alter water chemistry. Plan directions would establish 300 feet RMZ for (FW-RMZ-STZD-01) fish bearing streams. Management actions would be limited to protect key riparian processes (FW-RMZ-GDL-14).

Because the ski areas are both located east of the Continental Divide, the RMZ plan components would provide more protection for water resources under the action alternatives than under alternative A.

Alternative A, no action

Under the 1986 Lewis and Clark Forest Plan riparian widths are not designated within the special use permit areas. The 1986 Forest Plan standards required riparian areas to be delineated and considered at the project planning stage and the state of Montana SMZ laws are required during timber management actions within permit areas.

Past effects have been identified with regards to operation of developed winter sites. For example, high sediment deliveries from large runoff events have been documented on both permitted ski areas. Showdown Montana uses groomers that have concentrated snow in the headwater tributaries of Sheep Creek. Impacts from these types of activities are localized. These effects are few in nature, but they can and do occur at times and can be prevented through proper monitoring and road maintenance. Current size of riparian areas during harvest are currently managed under the state SMZ rules. Effects associated with potential increases in water yield from clearing for ski runs would be the same as effects for timber harvest as discussed in that section.

Cumulative effects

Cumulative effects to water quality can only be described in terms of potential to generally affect trends on a subwatershed to basin scale. In other words, the cumulative effects of a program at the forest plan scale as opposed to the effects from a project at the project scale can only be discussed in terms of general programmatic tendencies either toward improved or declining water quality or fisheries habitat at no specific site.

Other Plans

Portions of the HLC NF adjoin other NFs, each having its own forest plan. The HLC NF is also intermixed with other ownerships. Some GAs contain inholdings of such lands, while others are more un-fragmented. The GAs which are island mountain ranges are surrounded by private lands.

Some adjacent lands are subject to their own resource management plans. The cumulative effects of these plans in conjunction with the HLC NF 2020 Forest Plan are summarized in Table 31.

Table 31. Cumulative effects to aquatics and soils from other resource management plans

Resource plan	Description and summary of effects
Adjacent National Forest Plans	The forest plans for NFS lands adjacent to the HLC NF include the Custer-Gallatin, Lolo, Flathead, and Beaverhead-Deerlodge NFs. Management of watersheds is consistent across NFs due to law, regulation, and policy. The cumulative effect would be that watershed management is generally complementary. This includes GAs that cross Forest boundaries, such as the Upper Blackfoot, Divide, Elkhorns, Crazies, and the Rocky Mountain Range.
Montana Statewide Forest Resource Strategy (2010)	This plan guides forest management on state lands. It includes many concepts that are complementary to 2020 Forest Plan components for the HLC NF, for example promoting forest resilience, providing wildlife habitat, and reducing hazardous fuels.
Bureau of Land Management Resource Management Plans (RMP)	Bureau of Land Management lands near the HLC NF are managed by the Butte, Missoula, and Lewistown field offices. The Butte and Lewistown plans were recently revised, while the existing plans for the Missoula area is under revision. These plans contain components related to watershed function and health and would likely be complementary to the plan components for the HLC NF.
National Park Service - Glacier National Park General Management Plan 1999	The general management plan for Glacier National Park calls for preserving natural vegetation, landscapes, and disturbance processes. Broadly, the watershed and aquatic characteristics in this area are therefore likely similar to the wilderness areas in the adjacent Rocky Mountain Range GA and would likely complement these conditions.
Montana Army National Guard – Integrated Natural Resources Management Plan for the Limestone Hills Training Area 2014	This plan is relevant to an area adjacent to NFS lands in the Elkhorns GA. The Limestone Hills area is primarily nonforested and calls for managing for fire-resilient vegetation as well as restoration of native vegetation including mountain mahogany specifically. This plan would be generally complementary to the HLC NF most especially in promoting the health of native vegetation.
Montana State Parks and Recreation Strategic Plan 2015-2020	These plans guide the management of state parks, some of which lie nearby or adjacent to NFS lands. State park management of watershed and aquatic resources is complimentary to the 2020 Forest Plan, especially in realtion to recreation.
Montana's State Wildlife Action Plan	This plan describes a variety of vegetation conditions related to habitat for specific wildlife species. This plan would likely result in the preservation of these habitats on state lands, specifically wildlife management areas. This plan would interact with the Montana Statewide Forest Resource Strategy (above). The terrestrial and riparian conditions (and connectivity) described would be complementary to the conditions being managed for with the HLC NF 2020 Forest Plan.
County wildfire protection plans	Some county wildfire protection plans map and/or define the wildland urban interface. The HLC NF notes that these areas may be a focus for hazardous fuels reduction, and other plan components (such as Northern Rockies Lynx Management Direction) have guidance specific to these areas. Overall, the effect of the county plans would be to influence where treatments occur to contribute to desired vegetation conditions.
City of Helena Montana Parks, Recreation and Open Space Plan (2010)	This plan is relevant to an area that lies adjacent to national forest system lands in the Divide GA, in proximity to the City of Helena. The plan emphases forest management and wildfire mitigation. This would be generally complementary and additive to management on some HLC NF lands, specifically the South Hills Special Recreation area (alternatives B, C, D and F).

Other federal agency plans were reviewed. These include: Glacier National Park, Blackfeet Nation, BLM and Bureau of Reclamation. Glacier National Park borders the north end of the Rocky Mountain Range GA. There would be little to no cumulative effects from park management actions as most areas are managed to protect ecological values. East of the Rocky Mountain GA, the Blackfeet tribal lands are located downstream therefore there would be no effects from management actions on these lands. The BLM lands are also located downstream of the planning area and would have little effect on the forest. The Bureau of Reclamation manages large dams across the planning area, i.e. Gibson and Swift.

Non-federal land management policies would be likely to continue affecting riparian and aquatic resources. The cumulative effects in the planning area are difficult to analyze, considering the broad geographic landscape covered by the GAs, the uncertainties associated with private actions, and ongoing changes to the region's economy. Whether those effects would increase or decrease in the future is a matter of speculation. However, based on the growth trends and current uses identified in this section, cumulative effects could increase.

State owned school trust lands managed by the MTDNRC in the State Forests, would continue to support a variety of uses from livestock grazing to mining, timber harvest and recreational fishing and hunting. A host of activities would occur on private lands within the planning area. These include, water diversion; irrigation; livestock grazing; farming with varied cash crops; timber harvest, mining, water-based hunting, outfitted and nonoutfitted angling, establishment of sub- divisions, housing and commercial development, building and stocking of private fish ponds, treatment of noxious weeds, flood control and stream channel manipulation, and hydropower management. The effects of these activities on federal lands would likely be minimal as they are mostly located downstream from the forest. Impacts to streams in known fisheries may have impacts to migration and spawning habitats downstream.

Stream systems in the planning area originate in high elevation headwater drainages and flow downstream through the planning area onto some lands owned or administered by entities other than the FS. The streams ultimately flow into three major river systems; the Missouri, Blackfoot or Clark Fork Rivers. Many fish populations, whether they move off-forest as part of their life cycle or are resident populations, require interconnectivity of these streams to survive as a population. For most all species, genetic interchange between subpopulations is necessary to maintain healthy fish stocks. The more wide-ranging a species such as bull trout is, the more critical interconnectivity may be in order to access important habitat components. Thus, activities off-forest that disrupt fish migration corridors can have notable impacts to fish populations upstream on the HLC NF.

The potential for introduction of disease and aquatic nuisance species exists on all lands within the cumulative effects analysis area. The extent of influence exerted by disease or exotic species is often determined by an area's suitability. If conditions are favorable enough to promote and perpetuate them, then effects are determined by the fishery's susceptibility to be influenced. The effects of these introductions could range from extreme to negligible, based upon the species.

MFWP is the responsible agency for managing fish populations throughout the planning area. Regulations would most likely continue to allow angling and harvest of fish, with variations on fishing limits and times when angling can occur and some gear restrictions. The Upper Blackfoot and Divide GAs are critical to maintaining bull trout in the Blackfoot and Clark Fork river systems. The east side GAs are as important for maintaining westslope cutthroat trout populations in headwater streams of the upper Missouri River basin. For the most part, fish populations within the planning area are isolated with little connectivity in upper headwater tributaries. MFWP is also responsible for administrating water quality requirements under the Clean Water Act for instream restoration work and construction activities.

The most complex cumulative effects are related to the restoration of bull trout and westslope cutthroat trout habitats within the planning area. The complexity of these life histories have exposed them to many factors affecting their abundance and viability. Cumulative effects to native fish include: (1) predation, hybridization, and competition with nonnative fish; (2) destruction or degradation of spawning and rearing habitat from logging, livestock grazing, placer mining, road construction/maintenance and urban development on private and other nonfederal lands; (3) degraded water quality as a result of polluted runoff from urban and rural areas; (4) heavy-metals contaminated or acidic mine drainage and runoff; and (5) migration barriers that result from roads on private or other nonfederal lands.

Conclusions

Alternative A is not consistent with the 2012 Planning Rule (36 CFR Part 219.8(3)(ii)), since the 1986 Forest Plans do not establish RMZs around all lakes, perennial and intermittent streams, and open water wetlands. Alternative A does not incorporate a watershed approach to the management of hydrology and watershed processes; there would not likely be watershed scale consideration and protection of hydrologic and riparian area/wetland processes and functions. As such, alternative A has been described herein to establish the baseline from which all action alternatives would be compared against.

All action alternatives would emphasize a watershed approach to the management of hydrology and watershed processes as well as a CWN to identify important watersheds to conserve native fish. These alternatives put emphasis on RMZs and would facilitate management of multiple ecological goals and long-term ecological sustainability on a landscape basis. Updated watershed, riparian, and aquatic desired conditions, objectives, standards and guidelines would be applied in a consistent manner across the Forest to provide a mechanism to effectively prioritize activities and weigh multiple risks to various resources to move watersheds to a desired condition.

The biggest change in the 2020 Forest Plan would be that all action alternatives would adopt forest plan direction that would establish designated widths of an inner and outer RMZ (RMZ) bordering streams, lakes, wetlands and other water features, as well as require plan direction for management actions within the inner and outer RMZs. The width of the RMZs for all action alternatives are delineated in the RMZ section above. The new standards and guidelines would limit management actions within these areas. These new directions would have the beneficial effect and increase protections for water quality and aquatic habitats, particularly east of the Continental Divide. CWNs and those riparian areas currently not in desired conditions would receive priority for restoration.

Municipal watersheds for the Cities of Helena, Neihart, East Helena, and White Sulphur Springs would continue to receive special forest plan directions to protect water quality as all 1986 Forest Plans directions were brought into the new plan, as well as additional directions to insure attainment of water quality standards. The municipal watershed for the city of Lewistown would be added to the 2020 Forest Plan.

The following key points summarize the conclusions for the soil resources:

- The 1986 Forest Plans do not sufficiently address current soil related issues on the Forest.
- The 2020 Forest Plan would address these soil functions: soil biology, soil hydrology, nutrient cycling, carbon storage, soil stability and support, and filtering and buffering.
- The action alternatives contain desired conditions and standards that would help to ensure that the soil functions listed are maintained to greater extent than the 1986 Forest Plans.
- Soil is the foundation of the ecosystem; in order to provide multiple uses and ecosystem services in perpetuity these functions must be maintained.

Table 32 provides a summary of the relative contribution of aquatic ecosystem desired conditions by alternative. The land use categories are ranked in descending order of existing and potential impact to uplands and riparian resources.

Table 32. Comparison of alternatives by resource issue - relative contribution toward indicators

Resource Area	Indicator	Relative contribution toward meeting the indicator Most → Least				
		1	2	3	4	5
Watersheds	Water Quality	BCDF	E	A		
	Water Quantity	ABCDEF				
	Movement toward desired conditions	BCDF	E	A		
Municipal Supply watersheds, drinking water and source water protection	Water quality	BCDEF	A			
Riparian areas	Riparian desired condition	BCDEF	A			
Watershed and stream restoration projects	Stream function	BCDEF	A			
Fish and Aquatics	Habitat	BCDF	E	A		
Soils	Riparian	BCDEF	A			
	Uplands	D	BCF	A	E	

Aquatic species

The analysis in the FEIS of existing habitat conditions based upon PIBO monitoring form the basis of the desired conditions in the plan, as well as the effects that may occur with implementation of the plan. The 2020 Forest Plan includes plan components that would provide the ecological conditions necessary to maintain, improve and restore ecological conditions within the planning area that maintain viable populations of at-risk aquatic species. Based on the analysis of alternatives, other interrelated and interconnected activities, and the cumulative effects of other federal and nonfederal activities within the planning area, the implementation of the plan components would support recovery of bull trout.

The USFWS (U.S. Department of the Interior, Fish and Wildlife Service, 2015a) released the final Bull Trout Recovery Plan in September 2015. That plan outlines the conservation actions needed to recover bull trout. The overarching goal of the recovery plan is to conserve bull trout so that the fish are geographically widespread with stable populations in each of the six recovery units. Accordingly, the plan's recovery criteria focus on effective management of known threats to bull trout. The Coastal, Columbia Headwaters, Klamath, Mid-Columbia, Saint Mary and Upper Snake are the six designated recovery units that are home to the threatened population in the lower 48 states. That portion of the HLC NF west of the Continental Divide is in the Columbia Headwaters recovery unit. The Columbia Headwaters Recovery Unit Implementation Plan has identified threats and recovery actions. The habitat threats to bull trout identified on the Forest by the Recovery Unit Implementation Plan were upland/riparian land management and water quality (U.S. Department of the Interior, Fish and Wildlife Service, 2015b). The Recovery Unit Implementation Plan listed actions to address habitat threats that included these that are applicable to the HLC: 1) Prioritize Blackfoot River Tributaries for restoration, 2) Improve habitat through BMPs (BMPs) and conservation easements, 3) Protect and improve water quality, and 4) supply cold water. In addition, there are other actions identified under demographic threats and nonnative species that the Forest would need to work cooperatively with our partners to address.

A CWN would conserve bull trout and genetically pure stocks of westslope cutthroat trout by identifying areas where cold water is expected to occur into the future. A CWN is a 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 CWNs, which 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 and benefit aquatic systems as part of the action alternatives.

Coarse filter plan components primarily related to watersheds, RMZs, CWN, and road management would improve ecological conditions for bull trout, westslope cutthroat trout, and other aquatic species and maintain persistence of the species across the planning area. The CWN protects a network of connected aquatic species populations in cold water refugia by reducing effects associated with roads. The 2020 Forest Plan adds an active restoration component through desired conditions, objectives, guidelines, and standards that would supplement the retained passive components of INFISH and expands those protections forestwide. The 2020 Forest Plan would also help move projects and activities towards the desired conditions and improve aquatic habitats.

As part of the revision process, the forest will consult with the USFWS on the plan's effects. A biological assessment will disclose the effects of the 2020 Forest Plan on the threatened bull trout and designated bull trout critical habitat.

3.6 Air Quality

3.6.1 Introduction

There are two primary types of air quality effects concerning the Forest and forest operations. First is the effect of regional air pollution on forest natural resources and human health. Second is the effect of forest emissions on forest natural resources, human health, and regional air sheds.

Air quality on the HLC NF is dependent on the type and amount of pollutants emitted into the atmosphere, those that currently exist, or are in the "background" in the atmosphere, the size and topography of the airshed, and the prevailing meteorological and weather conditions. Sources of pollution within the Forest may include particulates and ozone precursor gases generated from timber and mining operations, prescribed and wildland fire, forest administrative operations, and recreational use.

The focus of this section is on smoke and how the various alternatives could affect smoke production through the use of prescribed fire, the management of naturally caused wildfires. Of all potential sources of air pollution from management activities that occur on the Forest, smoke is the most substantial contributor to air quality and visibility. Smoke can exacerbate human health conditions as well as reduce the ability to view the scenery on the Forest. However, as discussed in the "Fire and Fuels Management" and "Terrestrial Vegetation" sections, there is an established need to use fire to maintain and restore the fire-adapted ecosystems on the Forests and to reduce hazardous fuels in the wildland-urban interface.

Changes between draft and final

The acreages shown in the Air Quality section changed between the draft and final and are the same acreages that are presented in the "Fire and Fuels Management" section. Overall air quality effects remain similar to or the same as in the draft.

3.6.2 Regulatory framework

Federal law, regulation and policy

1999 Regional Haze Rule: The 1999 Regional Haze Rule mandates that states address control of man-made air pollution that impacts visibility in designated Class I airsheds (such as the Bob Marshall

Wilderness area). The goal is to return visibility conditions in Class I areas to natural background conditions by the year 2064.

Prevention of Significant Deterioration: The Clean Air Act requires federal land managers, "…to preserve, protect, and enhance the air quality in national parks, national wilderness areas, national monuments, … and other areas of special national or regional natural, recreational, scenic, or historic value." Prevention of Significant Deterioration addresses resource protection through the establishment of ceilings on additional amounts of air pollution over base-line levels in "clean" air areas, the protection of the air quality-related values of certain special areas, and additional protection for the visibility values of certain special areas.

State law, regulation and policy

The Montana Ambient Air Quality Standards: The Administrative Rules of the State of Montana, Chapter 17.8, Subchapter 2, Ambient Air Quality, state air quality requirements. Montana's standards are as stringent as, or more stringent than, the national ambient air quality standards. Some of the state standards have different averaging periods or have been converted from concentration units (ppm) to mass units (µg/m3) using different standard conditions.

Montana State Implementation Plan: The collection of Environmental Protection Agency-approved programs, policies and rules that the State of Montana uses to attain and maintain the primary and secondary National Ambient Air Quality Standards.

Other documents that guide specific actions in the planning area

- Montana/Idaho Airshed Group Operations Guide (Montana/Idaho Airshed Group 2010)

3.6.3 Assumptions

Climate trends will continue to be warmer and drier than historical conditions. It is expected that these warmer and drier conditions will result in an increase in insect and disease that will contribute to increased fire activity. Additionally, under warmer and dryer conditions, it is anticipated that large fire activity will continue in the future and that fire seasons will be longer than historically observed. Drier conditions may also contribute to more dust and other pollutants for roads and agriculture.

3.6.4 Best available scientific information used

The air quality analysis relies on existing and most current analysis, research, and planning documents. Information from several government, academic and private partnership consortiums that have conducted air quality emissions inventories, modeled pollution impacts and worked on air quality planning on a regional scale in and around the HLC NF area was used.

3.6.5 Affected environment

The HLC NF typically has good air quality across the entire planning area. Annual data from the air quality monitoring sites were evaluated for all available years. The major source of pollution is $PM_{2.5}$ emissions in the planning area include: 1) fires (including wildfires, prescribed fires, and agricultural field burning), 2) dust (road dust and construction dust), and 3) agriculture (crop and livestock dust). Fires tend to contribute a higher proportion of total particulate matter emissions in the western part of the planning area while agriculture contributes a higher proportion in the eastern part of the planning area.

Sources of air pollution and effects

In addition to the major nonpoint or area sources of particulate matter, emissions including fires, dust, and agriculture, there are also five point, or stationary sources of pollution contributing to particulate matter emissions in the planning area. They include electricity generated via combustion, industrial facilities, a petroleum refinery, a chemical plant, and a cement plant. The HLC NF is also subject to long-distance transport of emissions from sources to the west in Idaho, Oregon, Washington, and California, most notably wildfire smoke as it tends to be the most visible.

The Environmental Protection Agency classifies local air quality using the air quality index. The air quality index provides information on air quality to the general public as well as people with health concerns or target age groups.

The historical profile for Lewis and Clark County indicates periods in 2007 and 2010 when the air quality index was rated as unhealthy (red) for the general population. However, there are periods almost every year when the air quality index is rated as unhealthy for sensitive groups. The majority of days rated as unhealthy and unhealthy for sensitive groups occur in December and January with a small occurrence in September (U.S. Environmental Protection Agency, 2014). For both Lewis and Clark and Cascade counties, prescribed fire or wildfire smoke could contribute to ratings of unhealthy or unhealthy for sensitive groups in August and September but would not contribute emissions in December or January.

The daily particulate matter air quality index for Cascade and Lewis and Clark counties for ten years from 2007 to 2016 shows relative improving air quality over time. However, wildfires and winter time conditions consistently increase particulate pollution and cause infrequent exceedances.

Wilderness air quality related values

Mandatory Class I federal areas have additional protection mandated by amendments to the Clean Air Act in 1977. There are three designated mandatory Class I federal areas, within the planning area wholly or partially managed by the HLC NF - the Bob Marshall, Scapegoat, and Gates of the Mountains Wilderness Areas. The FS has the responsibility to protect the air quality related values.

Snowpack chemistry

Snow chemistry is monitored at three sites within the planning area as part of the Rocky Mountain Regional Snowpack Chemistry Monitoring Project. This project aims to identify the sources of acid deposition that may affect mountain watersheds (U.S. Department of the Interior, Geological Survey, 2017).

Regional haze and visibility

The 1977 amendments to the Clean Air Act recognized the importance of reducing haze and protecting visibility in national parks and wilderness areas.

In 2017, the MTDEQ reported overall, visibility on the clearest days in a given year has improved at all Class I areas in Montana. This is because clear days are primarily affected only by very low levels of haze caused by manmade air pollution and emissions of visibility-impairing pollutants have decreased over time.

On the other hand, the MTDEQ reports visibility on the haziest days in a given year has worsened at all but two of Montana's Class I areas. Analysis shows that the haziest days are primarily caused by wildfire activity both in and outside the state. At most Class I areas in Montana, these haziest days usually occur during wildfire season in the summer and fall when air monitors record high variability of organic and elemental carbon particles in the air. Wildfire activity is considered natural and is not something the state can control with regulatory measures or technology.

By contrast, the MTDEQ stated the measured contribution to haze that is associated with manmade pollutants, like sulfates and nitrates, has decreased at all but one Class I area on these same poor visibility days. In other words, although visibility on the haziest days has worsened over time, monitoring data suggests that this is due to increasing wildfire events and not increasing manmade air pollution. This conclusion reflects the same general downward trend in manmade emissions that has contributed to visibility improvement on the clearest days.

Visibility is measured by an air-monitoring network called Interagency Monitoring of Protected Visual Environments. The MTDEQ reports that at all of these monitors have shown improved visibility on the 20% best days. Every Montana Class I area is currently meeting its 2018 reasonable progress goal for the best days. This suggests that Montana's clean air strategies were sufficient to not only protect visibility on the best, clearest days, but also improve it.

The MTDEQ reports that despite seeing improvements in visibility on the best days, most Montana Interagency Monitoring of Protected Visual Environments sites did not see improvement on the worst days.

The MTDEQ found that the conclusion that visibility did not improve at six of eight Interagency Monitoring of Protected Visual Environments sites does not necessarily mean that the Montana's clean air strategies were insufficient. As discussed above, many factors contribute to visibility impairment. In addition, the initial regional haze implementation period covers the years 2008-2018, with progress goals set for the end of the ten-year period. The Montana plan was not published until late 2012 and polluting stationary sources were given five years to install controls and comply with the prescribed emission limits.

Management of forest emissions

The potential effects of activities proposed on NFS lands must be assessed as directed by the NEPA, including effects to air quality. The MTDEQ often works collaboratively to measure air pollutants associated with activities such as prescribed burning using mobile air quality sensors. The NFMA directs agencies to protect and improve the quality of air resources, in addition to soil and water.

The HLC NF Forest Plan Revision is a programmatic level decision document and will not serve to authorize the implementation of individual air pollution emitting projects or forest operations. Subsequent site-specific environmental analysis would occur in order to implement future projects and general conformity would be addressed in the project level analysis.

3.6.6 Environmental consequences

Effects common to all alternatives

Smoke from wildfire is anticipated to be the primary source of pollutants and associated impacts to air quality on the forest, as it has been historically. There is limited ability to alter or control the location or extent of this effect, due to the unpredictable nature of wildfire. Wildfires have the greatest potential to influence short-term air quality and visibility in local areas.

The Forest will continue to adhere to the current state smoke management plan and obtain required permits and approval from the MTDEQ to conduct prescribed burning operations and implementation of wildfires used for resource benefit. These controls provide for protection of public health and welfare by mitigating the impacts of air pollution, while still allowing fire to be used in maintaining healthy ecosystems.

Anthropogenic emissions

The MTDEQ reports that continued implementation of air pollution control measures make it likely that anthropogenic emissions of visibility-impairing pollutants would continue to decrease with time. On and off-road fuel standards as well as fleet turnover are likely to continue to reduce nitrogen oxide emissions from mobile sources. In addition, pollution control technology is constantly evolving as research, new emission standards, and litigation push for further reductions from point sources (Montana Department of Environmental Quality, 2017).

Clean air would continue to be produced and filtered through the forests. The major impact to air quality in the planning area is fine particulate matter ($PM_{2.5}$), from agriculture, wildfires, and prescribed fires, dust, and residential wood smoke. Agricultural burning and prescribed burning are regulated throughout the planning area and residential wood smoke is regulated in certain areas including Lewis and Clark County (Lewis and Clark County (2011). Guidelines governing these sources may become even more stringent in the future.

Wildfire and prescribed fire emissions

The HLC NF and adjacent communities generally have very good air quality. December and January tend to register the highest $PM_{2.5}$ concentrations during the winter months. The months of July, August, and September are likely to register increases in $PM_{2.5}$. During these months, wildfires, prescribed fires, agricultural burning, and agriculture dust can adversely impact air quality, although pollutants do not generally reach unhealthy levels based on the air quality sensors. Much of the planning area is sparsely populated and subject to transport winds that serve to disperse pollutant emissions but high-pressure systems common in the summer can stall dispersion and impact air quality. Smoke from agricultural, personal debris burning, prescribed burning, or wildfires can settle for days, producing unhealthy conditions in valley bottoms. Usually, these conditions only occur for a few days at a time. However, the fine particles associated with smoke from wildland fires can be especially problematic for those with ongoing health problems and for the elderly and children, increasing their risk of hospital and emergency room visits or even the risk of death (U.S. Environmental Protection Agency, 2003). The MTDEQ and counties regulate open burning throughout the year while working with the Montana/Idaho Airshed Group to coordinate projects and potential air quality impacts from each prescribed burn.

Air quality impacts from wildfires may intensify in the future if these fires occur with greater frequency or the amount of burned area increases. Many climate projection scenarios indicate warmer temperatures in the planning area (Wear, Huggett, Li, Perryman, & Liu, 2013) which could lengthen the wildfire season. If warmer temperatures indeed occur, the window for available burning by wildfires may broaden which would affect fire frequency in mid to upper elevation areas where fuel moisture and burning conditions during summer months currently inhibit fire spread in many years. Spracklen et al. (2009) indicate that increases in emissions from wildfires may increase organic carbon concentrations by 40 percent and elemental carbon concentrations by 20 percent over the western U.S. by 2050. Large fires will continue to occur on the the Forest, driven by climate, weather, and fuel conditions, including the influence of the Pacific Decadal Oscillation, El Niño Southern Oscillation, and the Atlantic Multidecadal Oscillation (Kitzberger, Brown, Heyerdahl, Swetnam, & Veblen, 2007).

National direction for FS management actions would continue to have a profound effect on how wildfires and fuels are managed across the HLC NF. Fire budgets may impact available suppression efforts, prescribed fire implementation, hazardous fuels planning, and wildland fire management. National direction will also continue to provide forests with guidance in the management of wildland fires and fuels on the landscape. National direction would likely continue to focus on increasing the occurrence of fires managed for restoration, resiliency and resource benefit objectives; hazardous fuels reduction; and accelerated restoration and resiliency objectives.

Effects from plan components associated with:

Designated wilderness

Under all alternatives, the Bob Marshall, Scapegoat, and Gates of the Mountains Wilderness Areas would be maintained as Class I Air Quality Areas. This is reflected in FW-WILD-DC-07 in the 2020 Forest Plan (all action alternatives), but is also required by law, and therefore the 1986 Forest Plans (alternative A) would result in the same effect.

Recommended wilderness, wilderness study areas, inventoried roadless areas

RWAs, WSAs, and IRAs all represent lands that are primarily influenced by natural forces, rather than active management. WSAs and IRAs do not vary by alternative. Although RWAs do vary by alternative, by in large these areas overlap with WSAs and/or IRAs, and therefore the effects are similar across alternatives. In general, these areas cover large expanses of relatively remote land, where plan components under all alternatives emphasize natural processes such as wildfire. Therefore, wildfires and prescribed fires may be more likely to occur than in other areas, along with air quality impacts. However, applicable air quality laws and plan components would apply to decisions within FS control related to fires in these areas.

Effects common to all action alternatives

A summary of expected effects from air quality plan components under all action alternatives is shown in Table 33.

Table 33. Summary of 2020 Forest Plan components for air quality

Plan component(s)	Summary of expected effects
FW-AQ-DC-01	This DC would ensure that projects would be designed to provide for good air quality, which in return would result in desirable conditions relative to visibility, human health, quality of life, economic opportunities, quality recreation, and wilderness values.
FW-AQ-GO-01	This GO would result in the FS continuing to coordinate with the state of MT regarding prescribed fires and management responses to wildfires, to help achieve FW-AQ-DC-01.

Air quality under the action alternatives would experience short and long-term effects under proposed management alternatives. Continued use of prescribed fire has the potential to influence short-term air quality and visibility in local areas. All action alternatives must meet air quality standards established by the Environmental Protection Agency and MTDEQ through requirements of State Implementation Plans (concerning National Ambient Air Quality Standards) and the state smoke management plan. Use of prescribed fire under the all alternatives would be restricted by how much vegetation, (i.e. fuel loading/acre, acres that can be burned per day), when and where burns can occur and budget constraints. These constraints limit the use of prescribed fire and affect the rate of emissions and volume of smoke and particulates, which in turn limits impacts to human health and visibility.

Alternative A, no action

Current plan direction is to coordinate all FS management activities to meet the requirements of the State Implementation Plans and State Smoke Management Plan (Montana/Idaho Airshed Group (Montana Department of Environmental Quality, 2010), and Federal and State air quality standards.

Under the fire management program, direction is to conduct prescribed fire objectives under constraints established by the Montana/Idaho Airshed Group. Air quality is to be maintained at adequate levels as described by state, county, and federal direction, and all prescribed burns conducted on the HCL NF will be governed by this direction and meet this objective.

The airsheds of the Bob Marshall, Scapegoat and Gates of the Mountains Wilderness Areas are managed as Class I areas. The forest areas outside the Class I areas are managed as Class II.

Effects that vary by alternative

Wildfire and prescribed fire emissions

Air quality under the no-action alternative would experience continued short and long-term effects under current management, both from wildfire and prescribed fire. Continued use of prescribed fire has the potential to influence short-term air quality and visibility in local areas. The current management direction requires meeting air quality standards established by federal and state agencies through requirements of state implementation plans and smoke management plans. Current direction limits the use of prescribed fire by restricting how much vegetation can be burned and when and where burns can occur. The costs of conducting prescribed fires also increase as a result of burning regulations, which also constrains the number of acres that are burned. Limited use of prescribed fire affects the rate and volume of smoke and particulate emissions, which in turn limits impacts to visibility.

Under alternatives B, C, and D, the amount of prescribed burning in forested ecosystems is anticipated to be about the same as it has been in the recent past. Alternative F would have less and Alternative E the least amount of prescribed burning. The Forest would be treating nonforested ecosystems as well. However, nonforest areas were not modeled in appendix H. In the 2020 Forest Plan there is an objective to treat a minimum of 15,000 acres per decade within the WUI which would be a mix of prescribed fire and mechanical treatments. In addition, the current Forest fuels treatment target is over 11,000 acres a year, again a mix of mechanical treatments and prescribed fire. Wildfire used for resource benefit purposes may contribute to national targets. Adherence to required air quality regulations is expected to minimize adverse effects to air quality due to prescribed burning, and thus minimize impacts to public health and visibility.

Effects from plan components associated with:

Fire and fuels management

The fire and fuels plan components under the 2020 Forest Plan (action alternatives) emphasize the natural role of wildfire on the landscape, whereas the 1986 Forest Plans (alternative A) were more suppression-oriented. In this respect, there may be a higher likelihood of increased burning, smoke, and associated air quality impacts under the action alternatives, particularly in the short term. However, the 2020 Forest Plan also emphasizes hazardous fuels treatments and long term conditions that reflect resilient landscapes and more self-limiting fires; in this respect, large uncharacteristic fires that emit large volumes of smoke may eventually be more unlikely under the action alternatives.

Cumulative effects

Under all alternatives, in addition to smoke emissions from land management activities, climate change would affect smoke emissions. Decreasing snowpack, earlier spring time conditions and snow melt, and longer, warmer fire seasons would increase the frequency and area burned by wildfires.

Most impacts to air quality and visual quality are related to the contribution of smoke from areas to the south and west of the Forest including all the way to the west coast. Historically, when there are not large fires providing additional smoke to the area, prescribed fires and most wildfires have not produced long-term decreases in air quality or visibility. Occasionally, smoke from Canada also contributes to decreased air quality in the area. Currently, there is no coordination across the border regarding smoke management.

Some adjacent lands are subject to their own resource management plans. The cumulative effects of these plans in conjunction with the 2020 Forest Plan are summarized in Table 34, for those plans applicable to air quality.

Table 34. Cumulative effects to air quality from other resource management plans

Resource plan	Description and summary of effects
Adjacent National Forest Plans	The forest plans for NFS lands adjacent to the HLC NF include the Custer-Gallatin, Lolo, Flathead, and Beaverhead-Deerlodge NFs. All plans address fire and fuels. Management of fire and fuels is consistent across all NFs due to law, regulation, and policy. The cumulative effect would be that the management of fire and fuels would be generally complementary. This includes specific adjacent landscapes that cross Forest boundaries, such as the Upper Blackfoot, Divide, Elkhorns, Crazies, and the Rocky Mountain Range.
Montana Statewide Forest Resource Strategy (2010)	This plan guides fire and fuels management on state lands. It includes many concepts that are complementary to the 2020 Forest Plan components for the HLC NF, for example state direction is for suppression of wildfires. While specific desired conditions are not stated in the same terms as the HLC NF, it is likely that some elements such as provide for firefighter and public safety would be similar. State forest lands may be actively managed to a greater degree than NFS lands and would likely contribute to achievement of desired fire and fuels conditions across the landscape.
BLM Resource Management Plans (RMP)	BLM lands near the HLC NF are managed by the Butte, Missoula, and Lewistown field offices. The Butte and Lewistown plans were recently revised while the existing plan for the Missoula area is under revision. These plans contain components related to fire and fuels and would therefore likely be complementary to the plan components for the HLC NF.
National Park Service - Glacier National Park General Management Plan 1999	The general management plan for Glacier National Park calls for preserving natural vegetation, landscapes, and disturbance processes. Broadly, the fire and fuels characteristics in this area are therefore likely similar to the wilderness areas in the adjacent Rocky Mountain Range GA and would likely complement these conditions.
Montana Army National Guard – Integrated Natural Resources Management Plan for the Limestone Hills Training Area 2014	This plan is relevant to an area adjacent to NFS lands in the Elkhorns GA. The Limestone Hills area is primarily nonforested and calls for managing for fire and fuels. This plan would be generally complementary to the HLC NF through direct fire suppression outside the impact zone and the potential for the use of prescribed fire.
Montana State Parks and Recreation Strategic Plan 2015-2020	These plans guide the management of state parks, some of which lie nearby or adjacent to NFS lands. Fire/fuels is a component of these parks, although not always the primary feature. Specific fire and fuels conditions would not necessarily contribute to the desired conditions as described for the HLC NF.
Montana's State Wildlife Action Plan	This plan describes a variety of vegetation conditions related to habitat for specific wildlife species. This plan would likely result in the preservation of these habitats on state lands, specifically wildlife management areas. This plan would interact with the Montana Statewide Forest Resource Strategy. The vegetation conditions described would be complementary to the conditions being managed for with the 2020 Forest Plan.
County wildfire protection plans	Some county wildfire protection plans map and/or define the WUI. The HLC NF notes that these areas may be a focus for hazardous fuels reduction, and other plan components (such as NRLMD) have guidance specific to these areas. Managing for open forests and fire adapted species may be particularly emphasized in these areas. Overall, the effect of the county plans would be to influence where treatments occur to contribute to desired vegetation conditions.
City of Helena Montana Parks, Recreation and Open Space Plan (2010)	This plan is relevant to an area that lies adjacent to NFS lands in the Divide GA, in proximity to the City of Helena. The plan emphases forest management and wildfire mitigation. This would be complementary to management on some HLC NF lands, specifically the South Hills Special Recreation area (alternatives B, C, D, and F).

Portions of the HLC NF adjoin other NFs, each having its own forest plan. Management of vegetation is similar across all NFs due to law, regulation, and policy. In addition, the HLC NF is intermixed with lands of other ownerships, including private lands, other federal lands, and state lands. Some GAs contain fragmented inholdings of such lands, while others are less fragmented. The GAs which are island mountain ranges are typically surrounded by private lands.

Table 35 displays estimated acres of wildfire and prescribed fire for all alternatives based on modeled future projections. Future estimates are derived from a modeling analysis explained in appendix H.

Table 35. Projected average acres of wildfire and prescribed fire in forested types by alternative

Indicator	Alternative A	Alternative B/C	Alternative D	Alternative E	Alternative F
Average wildfire acres burned over 5 decades	194,841	189,076	197,254	187,529	195,555
Average prescribed fire acres per year – Decade 1	3,018	3,072	3,108	3,019	3,165
Average prescribed fire acres per year – Decade 2	4,264	4,247	4,015	2,813	3,656

Conclusions

The air quality in and around the HLC NF is generally good and the state of Montana forecasts improving air quality conditions across the state and improving visibility in wilderness areas. However, air quality is compromised during winter months in communities where wood smoke causes health standard exceedances, and during fire season months when wildfires causes exceedances across broad portions of the state. Prescribed fires, agricultural burning, and agriculture dust can adversely impact air quality, although the pollutants do not generally reach unhealthy levels.

The 2020 Forest Plan incorporates legal and policy direction that implements actions designed to enhance and maintain ecosystem resiliency and sustainability and protect values at risk of damage from wildfires. These actions include vegetation and fuels management practices that require the use of prescribed fire and the management of wildfires used for resource benefit. The 2020 Forest Plan would maintain current levels of the use of prescribed fire and the management of wildfires used for resource benefit, and increase smoke emissions, compared to current forest plan direction. Based on the estimated wildfire acres produced by the modeling analysis in appendix H, implementation of the 2020 Forest Plan would reduce wildfire acreages and corresponding smoke emissions by about 3% under alternatives B, C, and E, and increase about 1% under alternative F. However, climate change effects could reverse the forecasted trend and increase the frequency of large wildfires and increase smoke impacts.

The Forest would continue to adhere to the state of Montana smoke management plan and obtain required permits and approval from MTDEQ to in order to conduct prescribed burning operations and implementation of wildfires used for resource benefit purposes.

Therefore, the results of implementing the preferred alternative upon air quality would meet the purpose and need because the expanded use of prescribed fire and wildfires used for management for resource benefit would improve ecosystem sustainability and resiliency, and protect values at risk from damaging wildfires, while meeting air quality requirements mandated by the Clean Air Act. Adverse effects of increased smoke emissions would be mitigated by the Forest's adherence to following the legal framework that regulates air pollution sources in the state of Montana.

3.7 Fire and Fuels

3.7.1 Introduction

Fire is a critical ecological function across the HLC NF that plays a central role in providing quality habitat for both plant and wildlife species. Wildland fire includes both wildfire (unplanned ignitions) and prescribed fire (planned ignitions). Fire management includes the strategies and actions used both before and during wildland fire. Management of wildland fire influences whether fire effects create beneficial or negative impacts to values such as water quality, air quality, habitat, recreation areas, or communities. Wildfire management includes a spectrum of responses from protection objectives to resource objectives. Suppression is a management strategy used to extinguish or confine an unwanted wildfire.

Manipulation of vegetation to change fire characteristics when it burns is called "fuels management". Fuels reduction treatments result in a change in the amount, configuration, and spacing of live and dead vegetation, with the purpose of creating conditions that result in more manageable fire behavior and reduced severity from wildfires.

Several indicators and measures are considered.

- The primary indicator is future vegetation treatments, measured in acres of projected harvest, mechanical and prescribed fire activities in forested types. Estimated acres treated provides an indication of potential movement toward desired vegetation conditions. Potential treatments relative to the wildland-urban interface (WUI) are considered as part of the measurement of acres.
- Another key indicator is flexibility for fire management is measured by the distribution of land allocations that influence the flexibility to carry out mechanical and prescribed fire treatments. Land designations that influence this management flexibility include wilderness, RWAs, and IRAs. Designated wilderness has the most restrictive requirements for mechanical and prescribed fire fuels management activities. Areas that limit mechanical treatment will result in a cascading effect on other fire and fuel treatment options. Without mechanical treatments, the use of prescribed fire would be reduced. Mechanical treatments are often necessary as an initial entry to modify existing fuels structure prior to burning. Mechanical treatments help reduce hazard(s) and provide more favorable conditions for conducting prescribed fires. With reduced mechanical treatments and prescribed fire near high valued resources and assets, managing unplanned natural ignitions would be reduced due to the lack of buffer areas treated prior to a natural ignition. The primary measure for this indicator is the acres of recommended wilderness by alternative.
- Finally, expected future wildfires and fire regimes are an indicator of how vegetation change and other factors over time may influence fire's role on the landscape, which in turn would influence fire regimes. The measurement for this indicator is projected acres of wildfire burned by fire type.

The effect of fire on the landscape was raised as an issue by many members of the public, including an interest in allowing fire to play its natural role in the ecosystem, as well as concerns about the effects of large wildfires on other resources including water quality and quantity and scenery.

Changes between draft and final

SIMPPLLE modeling was re-done and outputs were updated based on this new analysis. Additionally, the NRV analysis was also re-done. See the Terrestrial Vegetation section for more detailed description and explanation of changes related to modeling and the NRV analysis. Primary changes in the modeling include a more realistic depiction of the role of fire in the NRV, as well as the expected amount of future wildfire on the landscape. Updated wildfire acres by GA and fire cause data through 2018.

Analysis was added for alternative F.

Plan components were updated based on public comment these include:

- FW-FIRE-DC-01 was reworded to better capture fire being acceptable across the landscape including wilderness.
- Adding FW-FIRE-DC-03 back in from the initial proposed action.
- FW-FIRE-GO-03 was added based on public comment.

Additional analysis is added for a variety of concepts in response to public comment including:

- Mechanical treatments of vegetation are often needed as a first step to create favorable conditions for using prescribed fire.
- Recognizing the purpose of fuels treatments which is to change crown fire potential and fire intensity.
- The value of fuels treatments in wildfire scenarios under extreme weather conditions
- Included fire history information through 2018
- Include discussion on plan components and expected effects.
- Vegetation treatments can increase fuel loading. Due to this follow-up treatments are needed to address this consequence.

3.7.2 Regulatory framework

2002 President's Healthy Forest Initiative: Emphasizes administrative and legislative reforms to expedite fuels treatments and post-fire rehabilitation actions.

Federal Wildland Fire Management Policy of 1995 (updated January 2001): Guides the philosophy, direction, and implementation of wildland fire management on federal lands.

Guidance for Implementation of Federal Wildland Fire Management Policy 2009: Guidance for consistent implementation of the 1995/2001 Federal Fire Policy.

Healthy Forest Restoration Act of 2003 (HR 1904): Aimed at expediting the preparation and implementation of hazardous fuels reduction projects on federal land; encouraging collaboration between federal agencies and local communities; requiring courts to balance effects of action versus no-action prior to halting implementation; and requires federal agencies to retain large trees under certain conditions.

Interagency Standards for Fire and Fire Aviation Operations (NFES 2724): Documents the standards for operational procedures and practices for the FS fire and aviation management program.

Interagency Prescribed Fire Planning and Implementation Procedures Guide 2017 Provides standardized procedures associated with the planning and implementation of prescribed fire.

National Cohesive Wildland Fire Management Strategy (2014): The National Cohesive Wildland Fire Management Strategy is a strategic push to work collaboratively among all stakeholders and across all landscapes, using best avalible scienctific information, to make meaningful progress towards the three goals: 1) Resilient Landscapes; 2) Fire Adapted Communities; and 3) Safe and Effective Wildfire Response.

National Fire Plan, August 2000: Outlines a plan of action for federal agencies in order to protect wildland-urban interface and be prepared for extreme fire conditions.

"**Urban Wildland Interface Communprescribed fire near high valued resources and assetities within the Vicinity of Federal Lands That Are at High Risk from Wildfire" Federal Register** Vol. 66, No. 3, 2001: List of communities in the vicinity of federal lands that are at high risk from wildfire.

Wildfire Suppression Assistance Act of April 7, 1989 (HR 4936)

3.7.3 Assumptions

Climate trends will continue to be warmer and drier than historical conditions. It is expected that these warmer and drier conditions will result in an increase in insect and disease that will contribute to increased fire activity. Additionally, under warmer and dryer conditions, it is anticipated that large fire activity will continue in the future and that fire seasons will be longer than historically observed.

Naturally ignited wildfire will continue to be the largest contributor to fuels management. The use of wildland fire as a tool may occur on all acres in all alternatives so long as those fires are moving the landscape towards or helping maintain the desired condition. Prescribed fire and other vegetation treatments will continue to contribute to fuels management as budgets and conditions allow.

Development in the WUI will continue. With additional development in the WUI, boundaries identified in Community Wildfire Protection Plans will also change over the life of the plan. As the WUI expands, there will be an increased need to focus fuels treatments in these areas. Associated with increased wildland urban interface is the increase in human caused ignitions.

Modeled fire occurrence and fuels treatments provide a reasonable representation of future conditions. Refer to the timber section, terrestrial vegetation section, and appendix H for information on modeling and other aspects of the analysis that also apply to fire and fuels.

3.7.4 Best available scientific information used

This analysis draws upon the best available literature citations that were found to be relevant to the ecosystems on the HLC NF. Literature sources that were the most recent; peer-reviewed; and local in scope or directly applicable to the local ecosystem were selected. Uncertainty and conflicting literature was acknowledged and interpreted when applicable. In addition, local studies and anecdotal information that is not peer-reviewed is included where appropriate to provide context.

Best available information was used to build the fire suppression logic and assumptions within the SIMPPLLE model, including corroboration with actual data, and professional experience and knowledge. Refer to appendix H and the Terrestrial Vegetation section for detailed discussion on model development and outputs associated with fire and resulting vegetation changes.

For the HLC NF analysis, the WUI is mapped based on County Wildland Protection Plans (CWPPs) where available, and standard Hazardous Fuels Reduction Act (HFRA) definitions where CWPP maps are unavailable. The WUI will change over time as human developments and land use change.

Incomplete and unavailable information

Terrestrial ecosystems are highly complex and contain an enormous number of known and unknown living and non-living factors that interact with each other, often in unpredictable ways. For this reason, we acknowledge that there are gaps in available information and knowledge about ecological functioning, and an inability to even evaluate what those gaps may be. This gap in our information may lessen over time as new information or methodology is devised. Our ability to predict fire or other disturbances into the future is limited, and is subject to uncertainty. The level of uncertainty depends on how predictable such factors as natural disturbances, climate change, or human-caused influences may be.

3.7.5 Affected environment

Wildland fire management

Wildfires that reduce fuels and improve ecosystem conditions are characterized as "managed fires (or portions of them) to meet resource objectives". These fires tend to have effects that are similar or trend toward desired future conditions. Managing wildfires to meet resource objectives is a strategic choice to use unplanned natural ignitions to achieve resource management objectives and ecological purposes. The benefits of managing wildfires to meet resource objectives may include reducing fuels so that future fires burn in that area with lower intensity, lower impacts, reduced smoke, and are more manageable and pose less threat to communities. Benefits may also include creating a diversity of wildlife habitats, cycling nutrients back into the soil, or reducing forest density to favor fire resistant species such as ponderosa pine. Managing wildfires to meet resource objectives allows fire to resume its natural role in the ecosystem under pre-identified objectives and conditions. By allowing this to occur, the results could be a more resilient ecosystem.

Effective management of wildfire addresses the nature of wildfire and its contributing factors, recognizes the positive and negative consequences of fire, addresses uncertainty, and develops responses that reduce the chances of catastrophic losses (U.S. Department of Agriculture & U.S. Department of the Interior, 2011). Forest and fire managers need to manage risk, both short and long term. If the potential positive and negative consequences of fire are recognized, and management actions to obtain positive outcomes are matched, then in the long term the risk to communities and assets will be reduced; fire will be restored as an ecosystem function to the landscape; and smoke impacts to communities will be reduced.

All wildfires are managed on a continuum between meeting protection objectives and resource objectives, and the mix of these objectives are based both on the location of a wildfire (or a portion of) and the condition under which it is burning. These objectives come from the Forest Plan mainly in the form of desired conditions. The burning conditions change through the season and from year to year, providing both the opportunities and the restrictions.

Forest Service policy dictates that every wildfire has some aspect of a protection objective in a fire management response (National Interagency Fire Center, 2017). This response can vary from monitoring the fire under conditions that are conducive to obtaining resource benefits to an aggressive suppression effort to protect communities and natural resources from potential damages. Human-caused wildfires require a direct and aggressive suppression strategy.

Wildfires are not allowed to just burn; firefighter and public safety, risk to property, fire resource availability and national/regional priorities, costs, and potential resource benefits are all factors in all wildfire management decisions.

Fire on the landscape is considered a natural process and many fires on the Forest are started by lightning. However, humans have also been a source of fire on the landscape for centuries, and intentional or not, have influenced vegetation successional dynamics. Fire is not a simple process, and many factors influence its character, including fuel loadings, climatic and weather conditions, topography, vegetation structure and composition, and elevation.

Fires on the forest generally move from west to east with prevailing winds. Dry cold fronts also produce northwest wind flows that move fires from northwest to southeast. Without wind as the driving mechanism, terrain and diurnal temperature changes are large influences on fire movement. Fire generally moves uphill faster than downhill.

Fire suppression

The successful suppression of wildland fire is dependent on many factors: fuels, weather and topography, suppression resource availability, or time of year. The alignment of these factors (e.g., hot, dry, windy, August) created the remarkable events of 1910, 1929, 1988, 2003, 2007, 2015, and 2017. When these factors are not aligned (e.g., plenty of resources, cool moist, late season) it is rare, that fires are not successfully managed. Even with cooperative efforts of local firefighting resources from all levels of government, these remarkable years require significant assistance from outside the area. When national level activity precludes the supplementation of local resources, fires will exceed local capacity and values at risk will be threatened.

Fuels management

Fuels reduction treatments include prescribed fire and mechanical treatments. Prescribed fires are fires intentionally ignited by management actions in accordance with applicable laws, policies, and regulations to meet specific objectives. Mechanical treatments include the use of equipment, such as feller-bunchers, to perform activities that change vegetation composition and structure and alter fuels to reduce hazard. Mechanical treatments are often followed up with prescribed burning. One focus of fuels management has been on modifying fuel conditions to meet various objectives including reducing threats to values at risk by increasing suppression success by minimizing crown fire likelihood and decreasing fire intensity.

Fuels reduction treatments result in a change in the amount, configuration, and spacing of live and dead vegetation. The costs, environmental impacts, and effectiveness of different fuel treatment types vary. Desired outcomes of fuels treatments include more manageable fire behavior and reduced severity during wildfires (Reinhardt, Keane, Calkin, & Cohen, 2008). Finney suggests “that fire growth and severity of a large wildfire under extreme weather conditions were mitigated by fuel treatments that included prescribed burning” (Finney, McHugh, & Grenfell, 2005). Additional benefits include minimizing impacts to values at risk, and reducing fire spread to other ownerships. Strategically located fuels treatments would also provide opportunities to proactively manage the size and costs of future wildfires. In addition to modifying fire behavior, fuels treatments can achieve multiple resource benefits, such as contribute to meeting desired vegetation conditions, creating desired wildlife habitat, and producing timber products.

As the public moves into the wildland-urban interface they have entered a vegetation matrix that will carry fire when the conditions permit. The wildland-urban interface designation affects all fire management decisions in those interface areas. Although a wide variety of fire management strategies are available to implement, these options are usually narrowed down due to concerns that fire may move from federal to private lands. Hazardous fuels treatments in the wildland-urban interface are focused on manipulating the vegetation to enhance the success of fire suppression activities.

Natural fire regimes and NRV

A fire regime represents the periodicity and pattern of naturally occurring fires, described in terms of frequency, biological severity, and aerial extent (Anderson, 1982). Coarse-scale definitions for natural fire regimes were developed by (Hardy, Keane, & Stewart, 2000) and Schmidt and others (Schmidt, Menakis, Hardy, Hann, & Bunnel, 2002) with additional interpretations for fire and fuels management provided by Hann and Bunnell (2001). The natural fire regime is a classification of the role fire would play across a landscape in the absence of modern human intervention but including the influence of aboriginal fire use (Hann et al., 2008). Five natural fire regimes are classified based on the average number of years between fires (fire frequency or mean fire interval) combined with severity (the amount of vegetation replacement) and its effects to the dominant vegetation (ibid). The fire regimes on the HLC NFs are mapped using LANDFIRE data. Table 36 illustrates fire regimes found on the HLC NF.

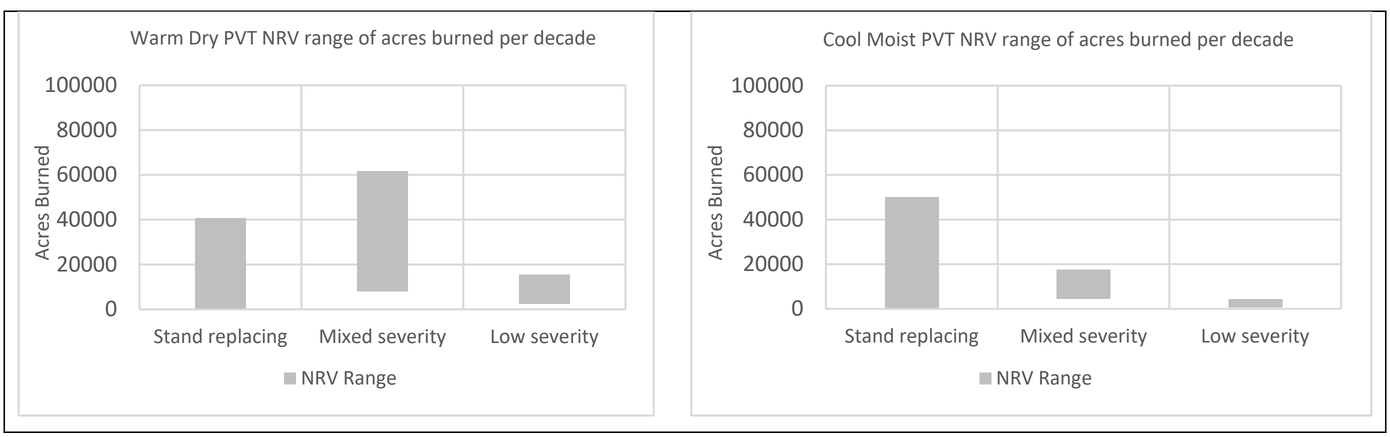
Table 36. Fire regimes on the HLC NF

Fire Regime[3]	Definition[3]	Existing Vegetation Types[1, 3]	Approximate Acres[2]	Proportion (%)
I	0- to 35-year frequency; low / mixed severity	Mountain sagebrush; Ponderosa pine; Dry Douglas-fir; Wooded draws/ravines	1,214,264	38
II	0- to 35-year frequency; replacement (high severity)	Grasslands; Mixed-grass prairies; Great Plains shrubland	213,263	7
III	35- to 200-year frequency; mixed / low severity	Wyoming big sagebrush ; Low sagebrush; Riparian systems (cottonwood); Limber pine/Rocky Mtn juniper; Dry lodgepole pine; Moist Douglas-fir; Whitebark pine	686,748	21
IV	35- to 200-year frequency; replacement (high severity)	Aspen; Moist lodgepole pine; Subalpine fir Engelmann spruce	937,182	29
V	Greater than 200-year frequency; any severity	Poor-site lodgepole pine; Subalpine forbs and grasses	56,960	2
Sparsely Vegetated	National Land Cover Database (NLCD) class	N/A	15,441	<1
Barren	NLCD class	N/A	81,250	3
Snow/Ice	NLCD class	N/A	172	<1
Water	NLCD class	N/A	3,249	<1

[1]Vegetation types are not the same as existing vegetation types discussed elsewhere in this chapter.
[2] Acre summaries in this section may differ slightly due to the data source (raster versus vector GIS data).
[3]Table information is adapted from Barrett et al. 2010

Fire history records prior to 1940 are variable. For the Helena National Forest side of the HLC NF, fire point data from the 1920's and 1930's indicates that over 12,000 acres burned during that period. On the Lewis and Clark National Forest side of the HLC NF, fire history data indicate that over 300,000 acres burned from 1800 to 1940 ((U.S. Department of Agriculture, Forest Service, Northern Region, 2015)). Additional information regarding historic fire is provided in landscape assessments, boundary reports, and fire history studies, as described in appendix I.

Figure 3 displays the NRV as derived from SIMPPLLE for the average range acres burned by decade, by fire type, by broad PVT. This shows the wide range of natural variability in wildfire events. The warm dry broad PVT tended to burn with mixed severity, while cool moist and cold sites tended to burn with stand replacing severity. Fires in non-forested PVTs are typically classified as stand replacing in the model, which are often grass fires that kill the existing grasses, forbs, and shrubs.



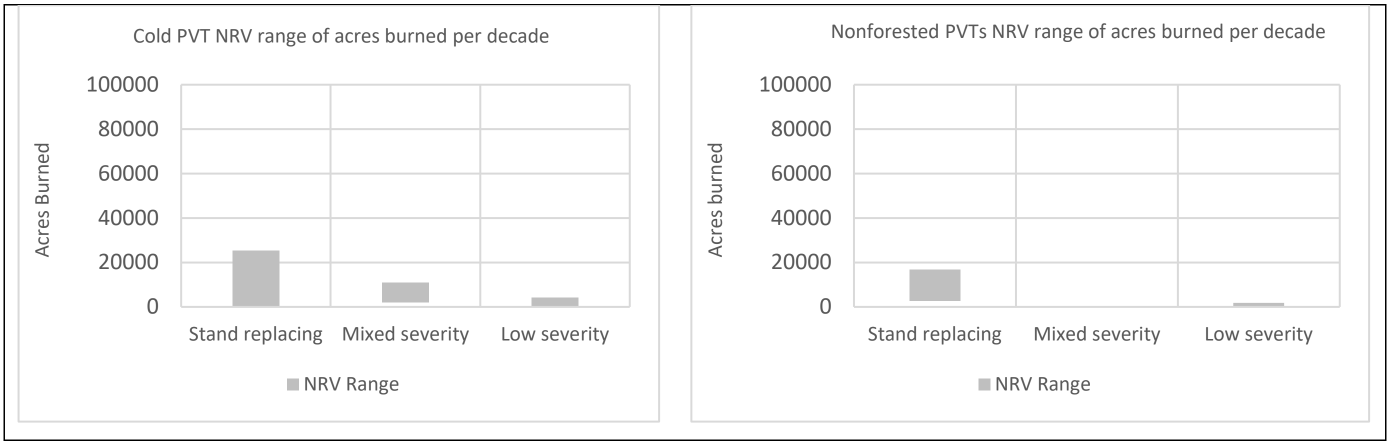


Figure 3. NRV range of acres burned per decade forest wide by PVT

Recent wildfire history and trends

Fire data in the forest geographic information system database shows wildfire areas burned since 1940. In this dataset, the earliest records may not be complete and often include only large fires or active fire years, creating the potential to underestimate the quantity and extent of older fires. The data is based on fire start records on NFS lands, and does not include ignitions that went out prior to being detected.

Large fires have occurred across the plan area since 1940. The decade that saw the most acres burned was 1980-1989, during which over 500,000 acres burned on the HLC NFs. Acres burned and the number of large fires appears to have increased since 1980, as shown in Figure 4. The increase in burned area may be in part due to 1) fuel buildup caused by fire exclusion (especially in low severity regimes), 2) climatic conditions, 3) the influence of a warm/dry climate on vegetation, fire behavior, and effectiveness of suppression, 4) recent fire policies that have allowed natural fires to burn, and 5) more complete record-keeping processes. The increase in acres burned is consistent with other observations in the northern Rockies. Westerling and others (2006), attribute increase in wildland fire frequency over the last twenty years to alterations in fire regimes due to climate changes.

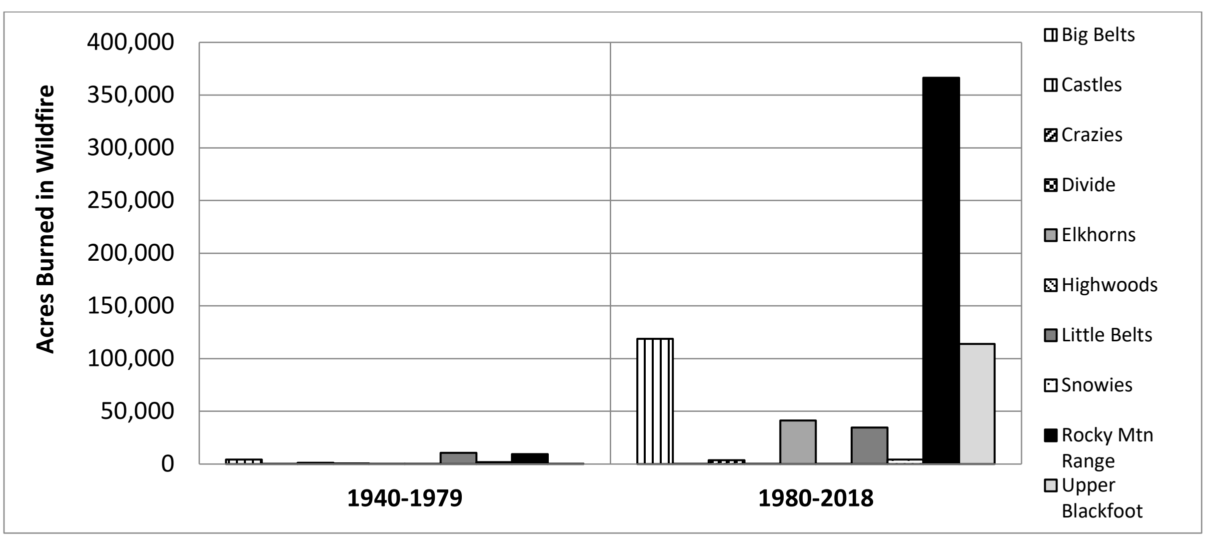


Figure 4. Wildfire acres burned by GA, 1940-1979 and 1980-2018

Figure 5 displays the average acreage burned per decade by GA, compared to the existing condition. The existing condition is represented by the acres burned from 1985 to 2015. Since 1940 most GAs have had only a fraction of their area burn in any given decade. Some, such as the Elkhorns, burned substantially in earlier decades. Several GAs have had periods within the natural range of variation. From 2005-2015, several GAs were at the low end of the NRV (Castles, Crazies, Divide, Elkhorns, Highwoods, Little Belts, Snowies, and Upper Blackfoot). A comparison with fire acreages burned and modeled climate periods shows that stand replacing and mixed severity fires were at the higher end of their range in terms of the percent area burned during warm and dry climate periods. This may indicate that in the future, with expected warm and dry conditions, acres burned may be at the upper end of the NRV. See appendix I for more information.

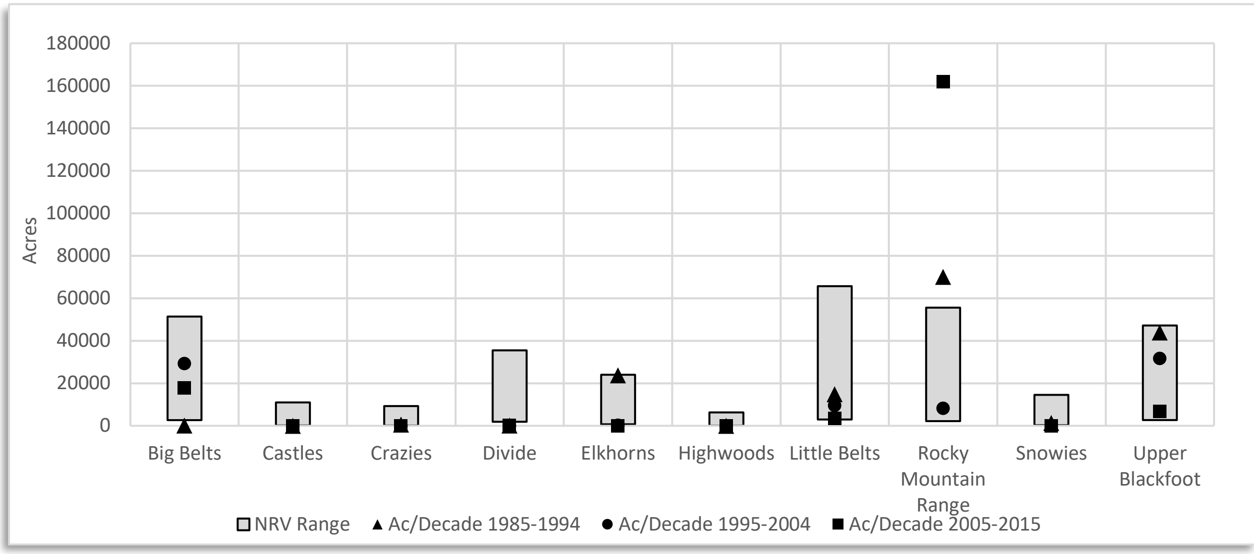


Figure 5. Acres burned per decade compared to acres burned 1985-2015, by GA

In areas that have burned recently, future fires may be somewhat self-limiting in extent because of the variability in residual vegetation conditions. Along with many other factors, the fire history of each GA has influenced the quantity and pattern of recent fires and will influence potential effects of future fires.

Naturally ignited wildfires have been used to meet resource objectives since the approval of the 1986 Forest Plans (Table 37). In recent years, including 2017 specifically, several fires burned into past wildfire footprints. It was observed that fire activity and spread was substantially reduced when fires burned into areas that have burned within the past two decades.

Table 37. Wildfire acres managed for resource benefit[1] by decade

1980-1989	1990-1999	2000-2009	2010-2018
89,735	5,723	79,121	160,980

1. Data obtained from Forest Activity Tracking System (FACTS) includes; Wildfire-Fuels Benefit, Wildfire-Natural Ignition, and Wildland Fire Use

There are many ignitions across the HLC NF every year and most are suppressed or are extinguished naturally. Over 5,000 detectable ignitions have been mapped since 1940. The number of ignitions is not necessarily proportionate to burned area. For example, fire starts were not especially numerous in the 1980's but the fires that escaped suppression grew to large sizes. Most fires are caused by lightning, but some by human causes such as campfires, smoking, vehicle or railroad sparks, or arson. The west side of the HLC NF (Helena NF portion) has shown a slight trend of an increasing proportion of human-caused fires, commensurate with urban development and recreation. Lightning strikes appear to be concentrated in some areas due to weather patterns and topography.

3.7.6 Environmental consequences

Effects common to all alternatives

Climate change

Of all the ongoing and foreseeable future actions that have the potential to affect fire, especially unwanted wildfire, climate change is likely to be the single most important factor. Regardless of alternative, the effects of climate change would likely combine with some of the effects that result from implementing the alternatives, to produce cumulative impacts. In general, the fire seasons are expected to become longer, large wildfires are expected to occur more often, and total area burned is expected to increase (J. E. Halofsky et al., 2018a). By increasing the amount of prescribed fire use, the action alternatives would be expected to partially offset predicted effects from climate change (Wiedinmyer & Hurteau, 2010). The more fire use (S. A. Parks, Miller, Abatzoglou, et al., 2016) (and mechanical treatments) that occurs as a result of the action alternatives, the greater the fuels will be reduced and the forest vegetation restored to more resistant and resilient conditions, which could mitigate climate change effects on wildfire behavior. The windows for prescribed fire may become longer with a warmer climate.

A recent comprehensive synthesis of the science surrounding climatic change and ecosystems (Walthall et al., 2012) concluded that all fire regimes in western forest ecosystems would experience some increase in fire risk. More fires occur in all forests because of longer fire seasons and higher human populations (Vose, Peterson, & Patel-Weynand, 2012). Fire intensity and severity would probably be higher as well because of more extreme fire weather (i.e., hotter temperatures) and higher fuel loadings (i.e., tree mortality, increased forest densities). In moderate (mixed) severity regimes, more frequent fires could convert lands to more of a low severity fire regime, where frequent fires favor more open stand conditions and tree species resistant to fire damage. Increased fire risk and fire sizes in high severity fire regimes could have substantial local effects, especially where close to human population centers. Not well articulated in the climate change discussion is that risk also increases because of increased occupation of the wildland environment.

Flexibility for fire management

Key considerations of fire management are that, in general, there are a very large number of burnable acres of NFS lands that cannot be actively managed by mechanical means. Additionally, policy prohibits the use of mechanical treatments and places limits on the application of prescribed fire within areas designated as wilderness. Appropriately managing wildfire in places with an opportunity to obtain resource benefits and a low risk of potential damages may be the only way in many areas to increase the pace and scale of ecosystem restoration activities. Informed management using wildfire, prescribed fire or mechanical methods would also be needed to maintain areas once restoration has occurred (Russel T. Graham, 2003). Parks (S. A. Parks, Miller, Holsinger, Baggett, & Bird, 2016) found that within the Northern Rockies fire occurrence creates a “self-regulating effect of wildland fire on subsequent ignitions” These effects were found to generally last up to 20 years.

The alternatives vary from the fuels management perspective on the allocation of acres to different designated areas. The primary designated areas that impact fuels management are RWAs; this varies by alternative and is addressed in the section below. Within RWAs for each alternative it is expected there would be very little change in the occurrence of human caused fires. This is a result of very few fires being caused by vehicles within the HLC NF. From 1970 – 2016 there were 95 fires caused by equipment (about 3%). During the same span of time there were 534 fires caused by campfires (about 17%). The largest cause is lightning with 2,005 (about 64%).

Other management limitations apply to all alternatives. In IRAs, there are limitations on road construction and timber cutting, relating to the purpose and location of treatments in relation to identified WUI. Additionally, the implementation of the NRLMD (U.S. Department of Agriculture, Forest Service, 2007e) constrains treatments in lynx habitat outside the WUI where multi-storied hare habitat or stand initiation hare habitat is present.

The use of prescribed fire within the WUI is a high-risk action and is often more expensive. Additionally, impacts from smoke emissions adjacent to homes for extended periods limit the number of acres that can be treated. Within the WUI, there is an increased need to rely on mechanical and hand treatments rather than fire. In addition, social issues (i.e., effects of treatments on scenery, air quality, noise, and wildlife viewing) can be more contentious. Under any alternative, the extent of WUI is expected to be similar or increase relative to the existing condition, as human developments continue to expand, and therefore these effects would be similar to or greater than what is present today.

Future wildfire and fire regimes

Fire has been a fundamental part of the Northern Rockies forests for thousands of years, whether naturally ignited (i.e., lightning) or human induced (i.e., by Native Americans). Fire, fuels, and climate are closely inter-related. Natural, long-term variations in temperature and precipitation patterns have resulted in continuously changing fire regimes (Whitlock et al., 2008), and thus continually changing forest conditions. This past climatic variability has had major effects on the timing, frequency, intensity, severity, and extent of wildland fires, as would future changes in climate. The effect may be due to direct climate-related factors, such as increased temperature and greater drying of forest fuels; or indirectly, related to potential changes in forest composition and structure due partly to climate change. These climate-induced changes in fire regimes could have substantial impacts on ecosystems, with associated effects to communities and economies (McKenzie, Peterson, & Littell, 2009). It is readily apparent that vegetation, fire, climate and weather are closely interconnected, and the relationship between the multiple aspects of each is extremely dynamic and complex.

Simulation modeling (SIMPPLLE) was used to estimate wildfire activity on the HLC NF for five decades into the future. Best available information was used to build the fire suppression logic and assumptions within the model, including corroboration with actual data, and professional experience and knowledge. Refer to appendix H for detailed discussion on model development and outputs. The model predicts that wildfire will continue to a similar degree under all alternatives because of both natural and human caused ignitions and an expansive fuel source. Modeling shows only subtle differences in the predicted number of acres burned by alternative; generally the differences between alternative is likely due to inherent modeling uncertainty rather than a measurable change on the ground. There are also subtle difference between the amount and type of fire within and outside the WUI by alternative, as shown in Table 38. The expected results are similar across alternatives.

Table 38. Average acres burned over 5 decades, by alternative, inside and outside the WUI

Fire Type	Location	Alternative A	Alternative B/C	Alternative D	Alternative E	Alternative F
Light severity	WUI	2,246.6	2,169	2,219.2	2,268.4	2,207
	Non-WUI	3,688.8	3,598.4	3,830.6	3,619.6	3,622.4
Mixed severity	WUI	32,010.8	33,107.4	31,851.6	3,3012	32,832.8
	Non-WUI	45,568.6	44,730.6	46,495.8	43,178.2	45,053.8
Stand-replacing	WUI	36,796.4	35,994	36,538.2	35,659.8	37,853.4
	Non-WUI	74,529.6	69,476.6	76,318.8	69,791.4	73,985.6
Total acres		194,840.8	189,076	197,254.2	187,529.4	195,555

The efficacy of fuels treatments on the ground is not well-represented by the programmatic modeling with respect to expected fire acres burned. First, the treatments included in the model were limited to forested types, and therefore additional treatments in non-forested types, especially in the WUI, are not represented. Further, the planned harvest and prescribed fire treatments included were planned based on several simplistic timber modeling objectives (species composition and size class). Additional desired conditions that may be applied relative to fuel conditions, such as reduced densities, reduced ladder fuels, surface fuels, and the like did not help drive the management solution. Objectives related to fuel conditions would in reality have a bearing on the amount, type, and location of treatments especially in the wildland urban interface. Finally, it is important to note that non-forested "grass fires" are categorized as stand-replacing in the model; therefore, the level of stand-replacing fire is especially high in the low elevation wildland urban interface areas may seem misleading.

The efficacy of fuels treatments can be demonstrated by other information sources, besides SIMPPLLE modeling. Fires on the HLC NF between 2012 through 2017, as documented in the Fuels Treatment Effectiveness Database, that have burned into past fuel treatment areas have been evaluated for treatment effectiveness. During this period, there were 33 instances where a fire burned into a previously treated area. Treatments that occurred include mechanical, prescribed fire and/or past wildfires. Of these 33 occurrences, all but one assisted in the control of the fire and/or changed fire behavior. The one incidence where the treatment did not aid in control or changing fire behavior was a result of only a part of the treatment being completed. In this case, understory had been cut and left to cure for the season for prescribed burning the following spring. Had all phases of the treatment been completed it is likely fire intensity would have been reduced and there would have been additional opportunities to use this areas to assist in controlling the fire. Based on documented effectiveness of past fuels treatments we see that when all phases of fuels treatments are completed there is an observed beneficial change in fire behavior and the assistance with the control of fires.

Effects from plan components associated with:

Air quality management

The consequences to fire from air quality are the same for all alternatives. All alternatives have the same plan components to meet air quality standards established by federal and state agencies. The FS would meet the requirements of state implementation plans and smoke management plans. Laws and regulations on smoke emissions can limit opportunities to conduct prescribed burning. These limitations are most frequently encountered in high population density areas that reduces the use of prescribed fire in and around the WUI.

Canada lynx management

The NRLMD (U.S. Department of Agriculture, Forest Service, 2007e) would be implemented under all alternatives. This direction recognizes the importance of fuel treatments within the WUI as designated by the Healthy Forest Restoration Act. However, opportunities to conduct vegetation treatments, including prescribed fire or mechanical fuels reduction treatments, outside the WUI are limited under current lynx management direction. Restrictions on treating within these forest conditions is likely to reduce the ability and effectiveness of achieving desired forest and fuel conditions outside the WUI.

Lynx management direction restrictions on treatments in multi-story hare habitat and young seedling/sapling forests have the most impact. These forest conditions are widespread and common across the HLC NF, due to the dominance of subalpine fir-spruce forests and of fire as a natural disturbance process, creating large areas of seedling/sapling forest. Thinning of dense sapling stands is typically designed to create future forests composed of larger trees and desired species (such as fire resistant Douglas fir). These forests are more resilient in the face of future wildfire events, and may burn less severely, reducing potential future impacts to values at risk. Thinning in these young stands is constrained by lynx management direction.

Prescribed fire is often the only feasible management tool available across much of the HLC NF. Typically, the objective of prescribed fires is to reduce stand densities by removal of the understory, and in some forest types (such as subalpine fir and lodgepole dominated forests), removal of portions of the overstory to create patches of more open forest conditions across the landscape. Prescribed fire management with these objectives would not be able to occur in multistory hare habitat, limiting the ability to manage landscape patterns and fuel conditions to achieve desired conditions. Use of wildfire (unplanned ignitions) to achieve desired conditions is frequently infeasible due to seasonal changes weather and fuel conditions.

Effects common to all action alternatives

All action alternatives contain plan components that articulate the role fire on the landscape. Management direction recognizes that risks to important values change depending on seasonal changes in weather and fuels, providing the opportunity to use fire as a management tool when conditions are conducive to meeting various plan objectives. The 2020 Forest Plan recognizes that with certain weather, fuels, and topography fires can be managed with minimal risk to values. Table 39 addresses the effects associated with each plan component for fire and fuels.

Table 39. Summary of 2020 Forest Plan components for fire and fuels

Plan component(s)	Summary of expected effects
FW-FIRE-DC-01, 03	These desired conditions recognizes the importance of wildfire's role on the landscape and would encourage managers to utilize fire to meet resource objectives.
FW-FIRE-DC-02	This component would ensure that management moves toward minimizing fire threats to values at risk.
FW-FIRE-GO-01, 02, 03	These goals and guideline will ensure the FS works with partners and local communities, including tribes, regarding fire and fuels.
FW-FIRE-OBJ-01	This objective would help ensure that hazardous fuels treatments are conducted on the landscape.
FW-FIRE-STD-01	This standard would result in promoting safety and cost efficiency in fire suppression activities.
FW-FIRE-GDL-01, 02	These guidelines supports DC-01 and 03 by guiding vegetation management treatments and fire management strategies to promote desirable fuel conditions that allow for natural fire occurrences on the landscape.
FW-FIRE-GDL-03	This guideline would ensure that there is communication and collaboration with tribes when wildfires occur that may impact tribal values or resources.
FW-FIRE-GDL-04	This guideline would result in altering fire suppression tactics within specific areas to help maintain the wild character of those areas.

Alternative A, no action

The 1986 Helena and Lewis and Clark NF plans, as amended, are the existing management direction being used by the HLC NF to address fire and fuels management. Under the no-action alternative, management of fire and fuels would continue following the 1986 Forest Plans. Because the no-action alternative is the baseline to which the action alternatives are compared, it is important to understand what actions would continue under the no-action alternative (Table 40).

The 1986 Helena and Lewis and Clark NF Forest Plans include management area direction relating to fire and fuels management. Both 1986 plans specifically call for fire to be permitted in wilderness and for prescribed fire to maintain healthy and stable ecosystems (1986 HLF Plan appendix R and 1986 LCF Plan, appendix P). The 1986 Forest Plans emphasize mechanical treatments, which would continue and tend to be focused around values at risk. Therefore, use of unplanned ignitions to meet resource objectives would continue to be used, lending the opportunity to treat critical areas prior to an unplanned ignition resulting in an increase in favorable forest structure.

Table 40. Alternative A summary of forest plan components for fire and fuels

Summary of plan components	Expected effects
Helena: This Forest Plan addresses fire and fuels forest-wide with an objective to limit the area burned by wildfire to an annual average of 390 acres or less and incorporates Fire Management Direction (1985). There are also Forest-wide standards and guidelines related to prescribed burning that include limitations related to burning prescriptions, not exceeding the natural frequency of fire, avoiding air quality issues and soil degradation, and working with MFWP. For each management area, the Plan also discusses the appropriate wildfire suppression response and whether prescribed fire or other fuel reduction methods are permissible.	Reduced opportunity for restoring fire to the landscape due to five management areas directing control of all fires. Additionally, the goal of only allowing 390 acres of wildfire on an annual basis potentially limits ensuring fire remains a critical ecological process.
Lewis and Clark: This Forest Plan addresses fire and fuels forest-wide with an expected annual average of 1,330 acres burned in unplanned wildfires. The plan directs the use of wildfire with the wilderness to the maximum extent possible. There are also Forest-wide standards and guidelines related to prescribed burning that include limitations related avoiding air quality issues and soil degradation. For each management area, the Plan also discusses the appropriate wildfire suppression response and whether prescribed fire or other fuel reduction methods are permissible.	Reduced opportunity for restoring fire to the landscape due to five management areas directing control of all fires. The plan recognizes the important role of fire in ecosystems and provides direction of permitting fire in wilderness to the maximum possible is consistent with all action alternatives.

Effects that vary by alternative

Future vegetation treatments

Vegetation treatments can increase fuel loadings resulting in higher severity fire (C. Hanson, 2010). Follow-up treatments including prescribed fire are essential to reducing natural or activity fuels; (Reinhardt et al., 2008) found that it is possible to craft treatments that achieve both ecological restoration and fire hazard reduction, but ecological restoration will also include reintroducing fire and other active management. The most effective ecosystem treatments should include prescribed fire (Reinhardt et al., 2008). Additionally, (Finney et al., 2005) suggest “that fire growth and severity of a large wildfire under extreme weather conditions were mitigated by fuel treatments that included prescribed burning.”

In all alternatives, prescribed fire and wildfire would continue to be used to move the forest toward desired future conditions. The amount of anticipated prescribed fire within forested areas varies by alternative as shown in Table 41. Alternative E is projected to result in the least amount of prescribed fire within forested vegetation types, due to an emphasis on timber production. Additional potential treatments in nonforested vegetation types are not reflected in the projections.

Table 41. Average prescribed fire acres[1] per year in forested vegetation types by alternative.

Time period	Alternative A	Alternative B/C	Alternative D	Alternative E	Alternative F
Decade 1	3,018	3,072	3,108	3,019	3,165
Decade 2	4,264	4,247	4,015	2,813	3,656

[1.] Acres are from the PRISM model and only include forested areas. Non-forested area is not included in these figures. Figures include areas both inside and outside the WUI.

Harvest treatments can also be used to achieve fuel management objectives, such as reducing forest densities and favoring fire-resistant species. Relative to impacts to fire and fuels, treatments that may occur in the WUI may be the most important. Each alternative results in differing amounts of projected harvest treatments inside the WUI, as shown in Table 42. Alternative E emphasizes harvesting in high productivity forests, whereas alternatives A, B, C, and D focus treatments on dry vegetation sites that are most departed from desired conditions. Preferred alternative F provides a blend of those objectives. Alternative E would be the least responsive in obtaining desired fuel conditions within the WUI in the first two decades. However, all action alternatives are relatively similar.

Table 42. Average harvest acres per year[1] in the WUI by alternative

Time period	Alternative A	Alternative B/C	Alternative D	Alternative E	Alternative F
Decade 1	880	1,022	966	1,220	1,005
Decade 2	1,544	1,448	1,430	1,055	1,336

[1] PRISM model, average acres per year for decade 1 and 2, all harvest types, projected to occur in the WUI.

Flexibility for fire management

The alternatives vary from the fuels management perspective on the allocation of acres to different designated areas. The primary designated area that impacts fuels management is RWAs due to limitations on both mechanical treatments and prescribed fire (e.g., FW-RECWILD-SUIT-01, 03). In RWAs, initial limitations would be for mechanical treatment of fuels. Wildfire would be used to meet resource objectives, with an emphasis on nonmechanical treatments and limited use of prescribed fire as allowed on these acres. There would be additional limitations on prescribed fire in these areas if RWAs become designated wilderness.

Within RWAs, there would be an additional focus on the natural role of fire. However, fuel management would be dependent upon the use of unplanned ignitions and the risk assessment associated with each season and event that may require suppression actions instead. The ability to use wildfire for resource benefit would likely be reduced due to constraints on mechanical treatments. This would limit opportunities to pretreat areas that would serve as buffers for naturally ignited wildfires. Additionally, the location of the ignition would weigh heavily on decisions relating to suppression. Table 43 displays the total amount of RWAs by alternative, and the acres of RWAs that occur within the WUI.

Table 43. Acres of WUI[1] in RWAs by alternative

Alternative A	Alternatives B/C	Alternative D	Alternative E	Alternative F
4,551	31,694	97,189	0	53,325

[1]WUI will change over time as population growth continues.

Alternative B would have more acres of RWAs compared to alternative A. The use of motorized/mechanized means for access and management would be restricted in RWAs. The use of prescribed fire and mechanical treatments could be expected to be less relative to alternatives A, E and F, but greater than alternative D. Alternative C is the same as alternative B with respect to RWAs, except that it would allow existing motorized use to continue in those areas. This would add flexibility allowing for some mechanical treatments and increased use of prescribed fire as compared to alternative B. A result of increased mechanical and prescribed fire activities would lead to increased flexibility to manage unplanned natural ignitions.

Alternative D includes the greatest amount of RWAs, especially in the WUI, and restricts motorized/mechanized access in those areas. Alternative D provides for the least flexibility for fire suppression and fuels management, resulting in the fewest opportunities of mechanical and prescribed fire treatments. This alternative may result in reduced flexibility for unplanned natural ignitions used to meet Forest Plan desired conditions. This alternative would require greater dependence upon the use of unplanned natural ignitions to meet Forest Plan desired conditions. However, with less flexibility in conducting associated fuel management activities, unplanned natural ignitions may require suppression actions instead.

Alternative E provides for the most flexibility for fire suppression due to no RWAs, resulting in the greatest opportunities for mechanical treatments and prescribed fire. Other existing constraints, however (such as IRAs), would result in similar fuel treatment opportunities as in alternative A. Access would be less restricted in this alternative compared to B, C and D. Alternative E would likely result in more opportunities for prescribed fire, increased opportunities for unplanned ignitions being used to meet Forest Plan desired conditions, and an increase in mechanical treatments. However, as shown in the future vegetation treatment discussion, an emphasis on timber production with this alternative could actually result in moving fewer acres toward desired future conditions within the WUI with fuels treatments.

Alternative F would have more acres of RWAs compared to alternatives A and E, but less than B, C, and D. The use of motorized/mechanized means for access and management would be restricted in RWAs. The use of prescribed fire and mechanical treatments could be expected to be less relative to alternative A and E, but greater than alternatives B, C and D. Alternative C is the same as alternative B with respect to RWAs, except that it would allow existing motorized use to continue in those areas. This would add flexibility allowing for some mechanical treatments and increased use of prescribed fire as compared to alternatives B, D and F.

Effects from plan components associated with:

Recommended wilderness

Plan components for RWAs include limitations to access as well as the use of mechanical equipment, as discussed in the *Effects common to all alternatives*, *Flexibility for fire management* section. This effect would be most pronounced under alternative D, with some impact, though much less, under alternatives B, C and F. There would be little change under alternative A. Alternative E would have no effect as there are no RWAs.

It is possible that RWAs could be designated by Congress as wilderness at some point in the future. Wilderness designation would result in reduced flexibility and options for vegetation and fuels management to achieve desired conditions. Use of prescribed fire is typically not suitable within designated wilderness areas, and the ability to use unplanned ignitions (wildfire) as a tool would likely be limited within some of the RWAs due to proximity to the WUI. This is because of the small size and/or in locations that likely have to be aggressively suppressed to protect identified values (i.e., private lands).

General wildlife habitat management

Wildlife habitat management direction has low impact on fire and fuels management, especially within the WUI, because management direction recognizes the importance of managing vegetation to modify fire behavior. Fire on the landscape is an important part of the natural function of the ecosystem, and as such helps create and maintain habitat conditions for native wildlife species.

Specific plan components for wildlife habitat may limit fuels management activities. For example, all alternatives include plan components that would limit disturbance to some species during critical times, such as nesting or calving, in specific areas. Such timing restrictions may result in missed prescribed fire windows at times.

The HLC NF has incorporated the “Forest Plan Amendments to Incorporate Habitat Management Direction for the Northern Continental Divide Ecosystem Grizzly Bear Population” into the 1986 Helena NF and Lewis and Clark NF plans. Management direction in this amendment has been retained in the 2020 Forest Plan. Associated plan components may limit access and disturbances such as prescribed burning within the primary conservation area, which would apply to the Upper Blackfoot and Rocky Mountain Range GA.

In addition, there are plan components that specify specific habitat conditions such as thermal cover, security, or hiding cover for species such as elk. These components are the most specific and limiting with alternative A. The action alternatives contain plan components with more flexibility related to elk habitat conditions. Alternatives C and D are the least limiting related to elk habitat, because no specific guidelines for elk security are included, whereas A, B, E and F do have guidelines related to elk security.

Watershed, soil, riparian and aquatic management

Consequences from Forest Plan components on the ability to restore or maintain ecosystems or reduce hazardous fuels would be generally similar for all alternatives. In order to meet the plan direction associated with these resources there would likely be occasions where prescribed or natural fires cannot be used due to potential negative effects that those activities could have on these resources. Fuels management activities occasionally require some soil disturbing activities or road construction, which may be limited to meet other plan components. Although it is difficult to quantify the effects, all the alternatives have components that would limit fire for ecosystem maintenance or fuels treatments in certain circumstances.

All alternatives would contain components that limit equipment use on steep slopes. However, the action alternatives also include guidelines that require a minimum amount of organic matter to be present following treatments, which may be difficult to achieve following prescribed fire in some cases. The 2020 Forest Plan also contains guidelines for the retention of coarse woody debris which would also factor in to prescribed burning prescriptions. Finally, the action alternatives include the adoption of RMZs, which are greater in size from the Streamside Management Zones (SMZs) currently identified for streams east of the Continental Divide. The plan components associated with RMZs would also influence prescribed burning prescriptions and techniques.

In summary, all alternatives include plan components for the protection of water, soil, and aquatic resources. The components for the action alternatives (B, C, D, E and F) are more specific and potentially limiting to prescribed fire operations than those in the no-action alternative (A).

Timber management

Vegetation treatments are typically designed and implemented to achieve multiple resource, social and economic objectives, including those associated with fuels management. Where fuels reduction is an identified objective, the timber management program supports the accomplishment of that objective.

Under alternative A, the 1986 Forest Plan directs suppression of all wildfires in some Management Areas where timber production is an objective. The action alternatives do not have this limitation but recognize that not all fire is detrimental to timber production. Therefore, there is opportunity to allow wildfires to burn and help maintain/restore fire adapted ecosystems.

Access and recreation management

Potential reductions in road access are the most under alternative D and least for alternative A, as a function of RWAs. Alternatives B, C, and F have a moderate change in access due to additional RWAs compared to alternative A and less RWAs than in alternative D. Alternative E would likely have the greatest access due to the most land suitable for timber production and no RWAs (refer to Recreation and Access section). This would influence fire management activity access and remove it where roads are decommissioned. Alternative means of treating fuels may be more expensive and thus prohibitive.

Cumulative Effects

Human population increases and/or shifts towards wildland-urban interface

For the last several decades there has been more human development occurring around the "edges" of lands administered by the Forest. This trend is expected to continue in the future and is likely to have effects on the forest vegetation that are similar to those discussed above under the item titled "National Fire Plan, Healthy Forest Initiative, and Healthy Forest Restoration Act." In addition, with a greater number of people living and recreating in these WUI areas, there is a greater probability of more human-caused wildfire ignitions that could have effects on the forest vegetation, in spite of efforts to suppress human-caused fires.

WUI has become the focus of suppression resources when large wildfires occur (Gude, Rasker, & Van den Noort, 2008). The future increase in WUI will continue to challenge wildfire management during large fire events as "Firefighters will likely have to protect dispersed housing over an extremely large area of fire-prone forest."(Gude et al., 2008). To work individually with property owners is costly and creates a patch work of defendable properties among those that are not.

The current trend of rural fire department staffing is on the decline, leading to limitations on their ability to support fire suppression and/or structure protection in their jurisdictions. This may lead to increased spread of fire from off forest.

To the extent that plan components (such as those related to soils and wildlife) limit the implementation (or increase the complexity) of prescribed fire, the ability for fire managers to use this tool for landscape fuels management in the WUI may be lessened.

Increased regulation and concern over smoke emissions

The ability to use fire to maintain and/or restore the fire-adapted ecosystems on the Forest, or to use fire to reduce hazardous fuels in the wildland-urban interface, is dependent upon air quality regulations. Therefore, to the extent that air quality regulations may become more stringent in regard to the quantity and timing of smoke emissions, there could be substantial effects on the ability of the Forest fire management program to utilize these fire tools. If past trends of increasing regulations and decreasing burn opportunities continue, the effects could be substantial and would likely result in not being able to use fire enough to make meaningful improvements to forest and fuel conditions and meet objectives.

Timber product manufacturing infrastructure and economics

The ability of the Forest to positively affect forest vegetation is partially dependent upon the ability to sell forest products to manufacturing companies and to use harvesting process (including the residual slash disposal activities) as a means to positively affect the forest vegetation and reduce hazardous fuels. If the forest products industry declines in areas surrounding the Forest to the degree that it is difficult to sell forest products or "stumpage prices" decrease substantially, it would affect how many acres could be treated and fuels reduced. While some treatments could be accomplished by using prescribed burn-only, it is generally very risky in the WUI and expensive, leading to fewer acres treated.

Other plans

Since they were developed, national level plans, initiatives, and acts such as the National Fire Plan, Healthy Forest Initiative, and Healthy Forest Restoration Act (these are called "other plans" for the rest of this discussion) have influenced the vegetation and fuel management programs on the Forest. Therefore, they have had some effects on hazardous fuels and it is anticipated that they will continue to do so for the foreseeable future. In general, these plans have resulted in more vegetation treatments being implemented near wildland-urban interface areas with the objective of reducing hazardous fuels, and fewer vegetation treatments being conducted in areas located away from communities. In addition, the types of fuel treatments that are being used in response to these other plans are often more expensive due to the need to rely on mechanical and hand treatments rather than fire. Additionally, social issues can be more contentious. Therefore, higher public involvement, planning and implementation expenses are likely to lead to fewer acres being treated within a given budget level. Not only do these other plans emphasize the need to reduce hazardous fuels in the WUI, but they also stress the need to restore the natural fire regimes and forest conditions to the larger NF landscape. These plans encourage the development of more resistant and resilient forest vegetation that would be less susceptible to large undesirable wildfires and/or insect outbreaks.

Portions of the HLC NF adjoin other NFs, each having its own Forest Plan. The HLC NF is also intermixed with lands of other ownerships, including private lands, other federal lands, and state lands. Some adjacent lands are subject to their own resource management plans. The cumulative effects of these plans in conjunction with the HLC NF 2020 Forest Plan are summarized in Table 44, for those plans applicable to fire and fuels.

Table 44. Cumulative effects to fire and fuels management from other resource management plans

Resource plan	Description and Summary of effects
Adjacent National Forest Plans	The Forest Plans for NFS lands adjacent to the HLC NF include the Custer-Gallatin, Lolo, Flathead, and Beaverhead-Deerlodge NFs. All plans address fire and fuels. Management of fire and fuels is consistent across all NFs due to law, regulation, and policy. The cumulative effect would be that the management of fire and fuels would be generally complementary by creating resilient landscapes, fire adapted communities, and safe and effective wildfire response. This includes specific adjacent landscapes that cross forest boundaries, such as the Upper Blackfoot, Divide, Elkhorns, Crazies, and the Rocky Mountain Range.
Montana Statewide Forest Resource Strategy (2010)	This plan guides fire and fuels management on state lands. It includes some concepts that are complementary to the 2020 Forest Plan components for the HLC NF, for example, state direction is for suppression of wildfires which addresses safe and effective wildfire response. While specific desired conditions are not stated in the same terms as the HLC NF, it is likely that some elements such as provide for firefighter and public safety would be similar. State forestlands may be actively managed to a greater degree than NFS lands and would contribute to achievement of desired fire and fuels conditions across the landscape.
BLM Resource Management Plans (RMP)	BLM lands near the HLC NF are managed by the Butte, Missoula, and Lewistown field offices. The Butte and Lewistown plans were recently revised (2009 and 2019 respectively) while the existing plan for the Missoula area is under revision. These plans contain components related to fire and fuels and are complementary to the plan components for the HLC NF by creating resilient landscapes, fire adapted communities, and safe and effective wildfire response.
National Park Service - Glacier National Park General Management Plan 1999	The general management plan for Glacier National Park calls for preserving natural vegetation, landscapes, and disturbance processes. Broadly, the fire and fuels characteristics in this area are therefore likely similar to the wilderness areas in the adjacent Rocky Mountain Range GA and would likely complement these conditions.
Montana Army National Guard – Integrated Natural Resources Management Plan for the Limestone Hills Training Area 2014	This plan is relevant to an area adjacent to NFS lands in the Elkhorns GA. The Limestone Hills area is primarily nonforested and calls for managing for fire and fuels. This plan would be generally complementary to the HLC NF through direct fire suppression outside the impact zone and the potential for the use of prescribed fire.
Montana State Parks and Recreation Strategic Plan 2015-2020	These plans guide the management of state parks, some of which lie nearby or adjacent to NFS lands. Fire/ fuels is a component of these parks, although not always the primary feature. Specific fire and fuels conditions relating to protection of values through treatments within the WUI and through safe and cost-effective suppression of wildfires contribute to the desired conditions as described for the HLC NF.
Montana's State Wildlife Action Plan	This plan describes a variety of vegetation conditions related to habitat for specific wildlife species. This plan would likely result in the preservation of these habitats on state lands, specifically wildlife management areas. This plan would interact with the Montana Statewide Forest Resource Strategy (above). The vegetation conditions described would

Resource plan	Description and Summary of effects
	be complementary to the conditions being managed for with the HLC NF 2020 Forest Plan.
County wildfire protection plans	Some county wildfire protection plans map and/or define the WUI. The HLC NF notes that these areas may be a focus for hazardous fuels reduction, and other plan components (such as NRLMD) have guidance specific to these areas. Managing for open forests and fire adapted species may be particularly emphasized in these areas. Overall, the effect of the county plans would be to influence where treatments occur to contribute to desired vegetation conditions.
City of Helena Montana Parks, Recreation and Open Space Plan (2010)	This plan is relevant to an area that lies adjacent to NFS lands in the Divide GA, in proximity to the City of Helena. The plan emphases forest management and wildfire mitigation. This would be generally complementary and additive to management on some HLC NF lands, specifically the South Hills Special Recreation area (alternatives B, C, and D).
Wildland Fire Management Plan for Blackfeet Nation	This plan covers topics such as fire management units and wildland fire operational guidance for the Blackfeet Indian Reservation (located near the Rocky Mountain Range GA), and is analogous to strategic fire planning that is conducted for National Forests, under the guidance of a broader land management plan. This indicates that fire management responses would likely be complementary across ownership boundaries and would not conflict with the broad guidance provided in the 2020 Forest Plan.

Conclusions

Fire is a critical ecological function across the HLC NF that plays a central role in providing quality habitat for both plant and wildlife species. All alternatives would ensure fire remains a part of the ecological system and would move the forest toward desired future conditions. This is achieved through a variety of management actions including wildland fire and mechanical treatments. There are subtle differences between the alternatives. The alternatives vary as follows for the measurement indicators.

- *Future vegetation treatments:* Over the first 2 decades of the modeling period, given a constrained budget Alternative E would achieve the least amount of harvest and prescribed fire in forested areas, including in WUI areas, due to focusing more intensive harvest on fewer acres to maximize timber production. Alternatives A, B, C, D and F would tend to treat more dry forest types in WUI areas. However, there are also other factors that affect the number of acres treated to meet Forest Plan desired conditions relating to fire and fuels management. Some of these factors include budget allocation, climate and seasonal weather variation, and wildfire occurrence. Budget directly affects how much we are able to treat mechanically and with prescribed fire. Climate and seasonal weather variation affect the ability to conduct prescribe burns. Wildfire occurrence activity locally uses personnel and other resources that would be used for implementing mechanical and prescribed fire treatments.
- *Flexibility for fire management:* Different management designations, specifically recommended Wilderness, affect where different management tools, such as mechanical treatments and prescribed fire can be used. In many cases mechanical treatments are needed as a first step to modify fuels to obtain the desired fire behavior when conducting prescribe burns to meet Forest Plan desired conditions. Where the use of prescribed fire is reduced because of limitations on mechanical treatments, the management of unplanned natural fire ignitions will also likely be reduced, resulting in reduced ability to meet Forest Plan desired conditions. Alternatives B, C, D and F would limit mechanical treatment options within recommended wilderness areas, with D having the most area restricted. If these areas became designated wilderness then additional constraints on prescribed burning would exist. Under Alternatives B, C, D and F there may be increased opportunities and need to manage natural wildfire to move toward desired future conditions because of the limitations on mechanical activities which would affect the use of prescribed fire. Alternative E has the greatest flexibility for fire and fuels management, but conversely may reduce the use of prescribed fire and wildfire managed for resource benefit because of the emphasis on timber production.

- *Future wildfire and fire regimes*: The projected levels of future wildfire, and their subsequent impact on fire regimes, is generally the same across alternatives. This is because vegetation over time is generally the same for all alternatives, and projected future treatments are also similar. Factors such as climate have a greater bearing on vegetation change and potential wildfire activity. The efficacy of potential fuels treatments is not well represented by the modeling tools available.

3.8 Terrestrial Vegetation

3.8.1 Introduction

This report addresses coarse filter characteristics of terrestrial vegetation on the HLC NF, including forested and nonforested communities. As required by the 2012 Planning Rule, the forest plan uses the concept of ecological integrity as a guiding framework to plan for social, ecological, and economic sustainability. The rule defines ecological integrity as the quality or condition of an ecosystem when its dominant ecological characteristics (e.g., composition, structure, function and connectivity) occur within the natural range of variation (NRV) and can withstand and recover from most perturbations imposed by natural environmental dynamics or human influence (36 CFR 219.19).

Key ecosystem characteristics are defined in the 2012 Planning Rule as "the dominant ecological components that describe ecosystems and are relevant to ecosystem condition and integrity as well as land management concerns". Desired conditions for each key ecosystem characteristic of vegetation were developed to provide for the ecological integrity of HLC NF ecosystems, based on an analysis of the NRV while also considering current and future stressors. Standards, guidelines and objectives were developed to move toward or maintain desired conditions. The desired condition for each characteristic in Table 45 and its relationship to the current and potential future conditions form the basis for this analysis.

Table 45. Terrestrial vegetation key ecosystem characteristics on the HLC NF

Key ecosystem characteristic	Indicator(s)	Measure
Role of insects and diseases	Hazard ratings for mountain pine beetle, Douglas-fir beetle, western spruce budworm, and root disease	Percent of area
Dominant vegetation	Cover types (forested and nonforested)	Percent of area
Tree species presence	Presence of at least 1 tree per acre	Percent of area
Forest size	Classes based on basal area weighted diameter	Percent of area
Large tree structure	Presence of a set minimum trees per acre	Percent of area
Forest density	Classes based on canopy cover	Percent of area
Vertical structure	Classes based on canopy layers	Percent of area
Landscape pattern: early successional forest	Average patch size	Acres

Several issues were identified through public scoping, and are also used to frame the analysis:

- Climate change
- Natural range of variation
- The role and effects of large fires
- The role of vegetation management (timber harvest, fuel reduction, restoration, and salvage)
- The importance of large trees
- The condition of specific plant species or types (whitebark pine, aspen, sagebrush, nonforested plant communities, spruce/fir)

Separate sections address additional vegetation characteristics and issues, including snags and downed wood, old growth, plant species at risk, pollinators, invasive plants, fire and fuels, and carbon storage and sequestration.

Coarse filter/fine filter approach to terrestrial ecosystem conservation

The coarse filter conservation strategy in the 2012 Planning Rule emphasizes a functional approach to provide native ecosystem diversity, rather than relying on representation to be provided in protected areas (J. Haufler & Mehl, 2015). The latter strategy, wherein a network of protected areas (such as wilderness areas) are identified to provide biodiversity, does usually not meet the needs for representation and adequacy; for example, because protected areas typically represent a disproportionate amount of rock and ice, and not enough productive ecosystems (ibid). Instead, using the framework provided in the 2012 Planning Rule, the HLC NF applies a coarse filter approach across managed and unmanaged landscapes. The fundamental assumption of this approach is that if the full range of historical conditions and processes can be maintained or restored (i.e., ecological integrity), then all of the native ecosystems that supported biodiversity at all scales will be present (J. Haufler & Mehl, 2015). It is assumed that by maintaining these conditions, critical ecological and evolutionary processes such as nutrient and sediment transport, biotic interactions, dispersal, gene flow and disturbance regimes, will also be maintained and provide the necessary environmental conditions for climate adaptation (Beier & Brost, 2010).

(Wurtzebach & Schultz, 2016) outline some key characteristics and assumptions associated with the ecological integrity framework. They note that ecological integrity:

- Emphasizes the importance of ecological processes such as natural disturbance regimes that provide the structures and functions on which the full complement of species in an ecosystem depend.
- Assumes that ecological systems that retain their native species and natural processes are more resistant and resilient to natural and anthropogenic stresses over time (including climate change).
- Emphasizes the intrinsic value of native biodiversity, beyond its functional role in supporting the renewal and reorganization of ecosystem function and structure over time.
- Uses the NRV as a reference point for promoting resilience.

Resilience is defined as the ability of an ecosystem and its component parts to absorb, or recover, from the effects of disturbances through preservation, restoration, or improvement of its essential structures and functions and redundancy of ecological patterns across the landscape (FSH 1909.12). It can be more simply stated as the degree to which ecosystems can recover from one or disturbances without a major shift in composition or function (J. E. Halofsky et al., 2018a).

The adequacy of the coarse filter approach is dependent upon fully representing native ecosystem diversity as defined by abiotic conditions and disturbance processes, in appropriate amounts, sizes, and distributions, and for each ecosystem to have the appropriate characteristics in terms of its composition, structure, function, and connectivity (J. Haufler & Mehl, 2015). This requires the use of an appropriate vegetation classification system, which must be sufficiently detailed to incorporate the environmental gradients and disturbances that occurred historically (ibid). The HLC NF uses broad-level potential vegetation types (PVTs) and an array of individual ecosystem attributes (Table 44) to capture ecosystem diversity at the forest planning level; this framework is consistent across Region 1, and is quantifiable using the best available vegetation classification tools. Other large-scale project assessments in the Region have defined ecosystem diversity in more detail, including the Blackfoot-Swan Landscape Restoration Project (J. B. Haufler, Mehl, & Yeats, 2016), which encompasses a portion of the HLC NF (the Upper Blackfoot GA). The findings of this assessment are consistent with the conclusions reached in the HLC NF NRV analysis and subsequent development of desired conditions.

The 2012 Planning Rule applies a secondary analysis of fine filter or species assessment component to complement the coarse filter; these include assessments of at-risk species (e.g., threatened, endangered, and candidate species under the ESA, and species of conservation concern). These fine-filter assessments provide a check on the assumptions and proper functioning of the coarse filter or ecosystem diversity component (J. Haufler & Mehl, 2015), and are addressed in the wildlife and at-risk plants sections.

Changes between draft and final

Multiple changes were made for the FEIS; all changes are within the scope of the FEIS analysis, and address issues that the public has had an opportunity to comment on. This section details the key changes between the draft and final analysis for terrestrial vegetation. See the timber section also, as the modeling changes between these resources are interconnected.

Analysis was added for preferred alternative F. With respect to vegetation, this alternative is similar to alternatives B/C, with one distinction being in the objective functions used in the timber scheduling model (PRISM), as described in the timber section and appendix H. To respond to public comments and allow for brevity in the body of the EIS, several appendices have been added: appendix H provides detailed vegetation methodologies and model results; appendix I summarizes the NRV analysis; and appendix J addresses climate adaptations relevant to the HLC NF.

Several vegetation plan components were updated based on public comment, modeling, and BASI.

- The suite of vegetation desired conditions (FW-VEGT-DC, FW-VEGF-DC, and FW-VEGNF-DC) were updated based on the new NRV and other BASI, as described in appendix H. These adjustments are within the range of effects disclosed in the DEIS because the desired condition ranges overlap; the adjustments result in slightly wider ranges or a slight shift in the range.
- GA-level desired conditions for cover type, size class, and density class were added. These plan components are a quantified refinement of the narrative plan components that were reflected in the DEIS, and therefore the effects of these components are within the scope of that analysis.
- The large trees per acre desired condition was eliminated, because large trees are effectively provided for with large-tree structure desired condition (FW-VEGF-DC-04). The terminology for this plan component was changed from “large tree concentrations” to “Large-tree structure” based on finalization of the regional description of this attribute (Milburn, Carnwath, Fox, Henderson, & Bush, 2019).
- FW-VEGF-DC-08 was updated to describe the desired pattern and patch sizes across the landscape narratively, rather than specifying desired patch sizes of early successional forests.

Additional analysis is added for a variety of concepts in response to public comment, including:

- The potential effects and BASI regarding salvage harvest.
- Additional analysis and discussion related to forests at risk to drought and climate change (and associated disturbances) is included in this section and in appendices H and J.
- Describing the trends of vegetation on the “managed landscape” versus the “unmanaged landscape”, as well as wildland urban interface (WUI) areas versus nonWUI areas.
- The rationale and impacts of selecting limber pine as a focal species
- How large trees and large size classes can be promoted with vegetation treatments; and the effects of large tree guideline FW-VEGF-GDL-01.
- The expected trends of aspen, ponderosa pine, and whitebark pine relative to desired conditions.
- The appropriateness of desired conditions based on NRV, and explanation regarding why the desired condition range is not projected to be achieved in all cases.
- Description of vegetation conditions that remain or trend outside of the desired ranges during the planning period, and the associated impacts to ecosystem integrity and future management.

- More description of the impacts of a potentially "unconstrained budget" management scenario with respect to timber harvest.
- More description of the impacts of the opening size exception for even-aged regeneration harvest (FW-TIM-STD-08), and how these areas are similar or dissimilar to the patches created by insects and fire with respect to snags, patches of hiding cover, and other characteristics.
- Clarification regarding the modeled predictions of increasing larger size classes despite continued fire suppression, which would promote the retention of small trees.
- Discussion on the expected impacts of disturbances in land designations where vegetation management is limited.
- Additional discussion on the native ecosystem diversity framework used to support the coarse filter approach to biodiversity conservation was added to the introduction.

The NRV analysis (appendix I) was redone with the SIMPPLLE model to capture key improvements that were made based on internal and external comments. These improvements included:

- Revised western spruce budworm logic based on Regional entomologist input.
- Updated fire spread logic and version that allows fire to move realistically across boundaries.
- Updated geographic extent to reduce model run-time and summarize results on NFS lands.
- Updated/corrected wildlife habitat queries.

Vegetation desired conditions were adjusted based on new NRV results. Several desired conditions were also adjusted based on internal and public comments, utilizing BASI. The methods and rationale for desired condition development are detailed in appendix H.

To simplify the analysis, the dry Douglas-fir and mixed mesic conifer cover types were combined into a single Douglas-fir cover type. Both of these types are dominated by Douglas-fir on the HLC NF, and it is appropriate to combine them for a programmatic analysis; the variances in site productivity and moisture regimes can be distinguished more accurately at the project level. Similarly, the low/medium density classes (10-39.9% canopy cover) have been combined with the nonforested density class (<10% canopy cover) because the split between these classes cannot be consistently separated in the data sources. It was determined that VMap is the best data source for the existing condition of density class (canopy cover); this data source is used to display the existing condition in the plan and FEIS.

The SIMPPLLE modeling for all alternatives was redone, to capture the model improvements described for NRV, and to incorporate updated PRISM results (which used updated desired conditions, maps of lands suitable for timber production, and other changes as described in the timber section). In addition, the SIMPPLLE modeling uses an improved input file calibrated to correct the broad PVT classification between cold and cool moist; be more similar to FIA with respect to size and density; and reflect vegetation conditions that changed due to recent fires or harvest. Another key improvement was incorporating a range of future fire scenarios to better capture a range of variation and the uncertainty associated with a warming climate, as described in appendix H. Based on the suite of updates made to the modeling process, the trend of some vegetation attributes changed (Table 46). In all cases, the magnitude of change relative to the resource condition is within the scope of effects disclosed in the DEIS.

Table 46. Key changes in vegetation model predictions between DEIS and FEIS

Attribute	Assessment of effects
Root disease	Root disease did not feature prominently in the DEIS. In the FEIS, it was not predicted to occur. Root disease can be difficult to detect and is not common on the HLC NF. In both analyses, the effects are largely qualitative and consistent.
Nonforested cover types in	The FEIS finding is that the nonforested cover type is just above the desired range in the warm dry PVT. In the DEIS, this type trended below the desired range. This is because the

Attribute	Assessment of effects
the warm dry PVT	desired condition was lowered (although there is overlap in the ranges). The predicted trend is similar in that the abundance in the warm dry PVT remains close to 5%, and the effects over time are the same.
Ponderosa pine presence in the cool moist PVT	In the DEIS, there was a small amount of ponderosa pine presence in the cool moist PVT; it was a fraction of a percent and did not change over time, remaining below the desired condition (1-5%). In the FEIS, ponderosa pine presence was not predicted in this PVT. The magnitude of difference between the analyses is very small (<1%) and the effects are consistent in that ponderosa pine is a rare component on the cool moist PVT. The desired condition range does not change and reflects the known presence of ponderosa pine, and to allow for potential promotion of the species as a result of warm and dry climates.
Limber pine presence forestwide	The position of limber pine presence in relation to the desired condition has changed. The DEIS predicted the presence of this species to be just below the desired range. However, its position is now within the lower bound. The magnitude of change is very small, and a result of a shift of the lower bound of the desired condition by 1%. Both analyses are consistent in that the predicted the trend of this attribute is fairly static, staying at roughly 10% forestwide over time.
Aspen cover type and presence forestwide	The FEIS modeling detects slightly more of the aspen cover type than the DEIS; but the magnitude of change is less than 2% and the expected trend is similar over time. Aspen presence shows a slightly more favorable trend in the FEIS. This was due to the lower bound of the desired range being updated slightly (reduced by 1%). The magnitude of this change is very small, and both analyses are consistent in that the estimated presence of aspen remains under 3% forestwide.
Douglas-fir presence in the cold PVT	The DEIS estimated that Douglas-fir was present on about 15% of the cold PVT (where it remained static and above the desired range of 1-5%). The FEIS estimated the same abundance and trend, but found that this was within the desired condition, based on an updated range. The effects analyses are consistent because the trend over time is the same and the desired ranges overlap substantially.
Lodgepole pine cover type in the cold PVT	In the DEIS, the expected trend of the lodgepole pine cover type fluctuated at the high end to above the desired range. In the FEIS, this cover type increases within the desired range. Both bounds of the desired condition were increased about 10%. In both cases, the actual existing condition (based on FIA) varies from the model starting point, due to inherent inaccuracy in classifying cover type in SIMPPLLE. Both the DEIS and FEIS project abundance of the lodgepole pine cover type between 30 and 45%, with similar effects.
The spruce/fir cover type in the cold PVT	In the DEIS, the expected trend of the spruce/fir cover type in the cold PVT was to increase slightly to about 27-37% over time, at the upper end and above the desired range (20-30%). In the FEIS, the desired range was increased to 40-45%, and the model predicts a steady decline to represent about 17-27%, below the desired range. This condition was affected by the correction of the cold PVT classification, and as a result of this error more of these forests were included in the trends for the cool moist PVT in the DEIS. The trends are consistent across analyses forestwide, which incorporates the distinction between cool moist and cold PVTs.
Whitebark pine cover type in the cold PVT	In the DEIS the whitebark pine cover type was estimated to stay fairly static, around 11% of the cold PVT, and below the desired condition. The desired condition was lowered for the FEIS, and the expected trend is an increase within the desired range, within 5% of the DEIS. The magnitude of this change is small. In addition, other BASI is used to analyze the effects to whitebark pine, due to the model limitations.
Subalpine fir presence in the cold PVT	In both the DEIS and FEIS, the expected trend of the presence of subalpine fir in the cold PVT is to decline about 10%. The desired condition ranges changed but overlap. Based on the DEIS desired condition, the expected trend is just below the range; while in the FEIS it is within (at the low end). The magnitude of this change is small and the expected trend the same over time.
Engelmann spruce presence in the cool moist PVT	In the DEIS, Engelmann spruce is predicted to increase slightly (about 5%) to be well above (by about 20%) the desired range in the cool moist PVT. In the FEIS, the trend is also about a 5% increase and above the desired range; the change is that the desired range was shifted up so that it is not as far departed. The overall trend and relationship to desired condition, however, is consistent.

Attribute	Assessment of effects
Early successional patch size trends	In the DEIS, it was estimated that the average patch size of early successional forests was declining over time within the NRV forestwide and in all PVTs. In the FEIS, average patch size is also estimated to decline, but is estimated to be just above or at the upper end of the desired ranges. The desired condition ranges were adjusted based on the new NRV but there is substantial overlap. The existing condition changed, based on an updated spatial file. The overall trend, however, is similar related to the effects disclosed in the DEIS.

3.8.2 Regulatory framework

Please refer to the introductory regulatory framework section of this chapter (3.3).

3.8.3 Assumptions

This analysis assumes that tree species evolved with fire frequencies that have been disrupted by fire exclusion over the last century. Relationships between climate, disturbances such as wildfire and insects, and human activities such as timber harvest and fire suppression are synergistic. The analysis relies on analytical vegetation models. By necessity, these models use assumptions to simplify ecosystem processes and potential silvicultural treatments as described in appendix H. Prescriptions would be applied site specifically, and therefore would be more variable in application and resulting vegetation conditions.

Climate change presents uncertainty in future disturbance regimes and vegetative responses. Specific changes in ecosystem components due to expected climate change are difficult to predict, and are highly uncertain, especially in the diverse terrain of the northern Rocky Mountain region. Therefore, taking a broad approach to management of the HLC NF is prudent, focusing on strategies that increase the resilience of vegetation to allow adaptation to whatever changes the future may bring. The analysis assumes that future climates will be warm and dry; climate and future fire assumptions are integrated into the SIMPPLLE model using BASI, as described in appendix H.

The desired conditions for terrestrial vegetation are developed with an underlying assumption that the NRV provides context for future conditions, particularly those that occurred during warm, dry climate periods of the past. Assumptions associated with the NRV modeling, and the development of desired conditions, are detailed in appendices I and H respectively.

3.8.4 Best available scientific information used

A variety of well documented data and analysis tools are used; these are summarized below, and more information is found in appendix H.

- The data used to quantify existing vegetation is from Forest Inventory and Analysis plots (FIA) and intensified grid plots. FIA provides a statistically-sound representative sample to provide unbiased estimates at broad- and mid-levels. In addition to quantifying the existing condition, FIA plots and intensified plot data are used to corroborate vegetation maps and modeling. It is also the primary data used for monitoring and evaluation. These data are summarized in the R1 Summary Database.
- The Region 1 existing vegetation mapping system (R1 VMap) (Barber, Bush, & Berglund, 2011) is the vegetation map used. R1-VMap is derived from National and Regional remote sensing protocols, with refinement through field sampling. The product has a known and quantifiable level of uncertainty. The R1-VMap version used was produced in 2014 using 2011 imagery, and is our best spatial depiction for vegetation lifeform, dominance type, size class, and density class.
- The Forest Activity Tracking System (FACTS) is the source of information on past vegetation treatments. This database stores information associated with the activities, and the activities can be spatially displayed across the forest.

- The Plan-level foRest actIvity Scheduling Model (PRISM) was used to project forest management scenarios, schedule vegetation treatments and provide outcomes, based upon a variety of parameters.
- The SIMulating Patterns and Processes at Landscape scaLEs model (SIMPPLLE) was used to simulate disturbances over time, and their interaction with vegetative succession and treatments. SIMPPLLE provides a spatial analysis of management scenarios scheduled by PRISM.

This analysis draws upon BASI that is relevant to the ecosystems on the HLC NF. Literature sources that were the most recent; peer-reviewed; and/or directly applicable to local ecosystems were selected. Studies and anecdotal information that are not peer-reviewed are included where appropriate to provide context. Terrestrial ecosystems are complex and contain an enormous number of known and unknown factors that interact with each other, often in unpredictable ways. There are gaps in available information about ecological functioning. Vegetation is dynamic, changing constantly, and our ability to predict changes in the future is limited. The level of uncertainty depends on how predictable such factors as disturbances, climate change, or human activities may be.

3.8.5 Affected environment

A primary purpose of the 2020 Forest Plan is to provide for ecological integrity and sustainability, supporting the full suite of native plant and animal species, while providing for the social and economic needs of people. This section begins by describing primary ecosystem processes and disturbances, and then addresses vegetation composition and structure. *Composition* is the type and variety of the vegetation, while *structure* is the physical form of vegetation, i.e. the vertical and horizontal arrangement of plants. Finally, *landscape pattern* is addressed. Landscape pattern could include a nearly infinite number of attributes; for this analysis, we focus on early successional forests. Appendix I displays the current condition and NRV for the vegetation attributes described below. The desired conditions enumerated in the 2020 Forest Plan, and addressed in the Environmental Consequences section, are generally consistent but are not always the same as the NRV; the desired conditions and the rationale for their development is detailed in appendix H.

Ecosystem processes and disturbances

Vegetation is constantly changing due to drivers such as climate, succession, fire, insects and diseases. The interactions of these processes over centuries resulted in the vegetation that exists today. Since the late 1990's, national disturbance rates have been influenced primarily by natural disturbances (rather than anthropogenic ones), and increasing rates for forest decline have been concentrated in the western U.S. where extended droughts have coupled with increasingly high temperatures to create increasingly stressed and vulnerable forests (Cohen et al., 2016).

Vegetative succession

Vegetative succession is the sequential process of long-term plant community development. It entails the change in the composition, structure and function of plant communities over time. The successional process follows a pathway with each major step referred to as a seral or successional stage. The classical model of succession culminates in the climax community, a state of relative stability in composition, structure and function, with all existing species able to perpetuate themselves without disturbance.

Plant species are often distinguished as playing either an early or late successional role. Species with traits that enable rapid colonization of a site after a disturbance are early successional. They are less shade tolerant, able to flourish under full or nearly full sunlight, and have rapid early height growth. Ponderosa pine, lodgepole pine, aspen, and whitebark pine are early successional tree species on the HLC NF. In nonforested communities, early seral plants include grasses or forbs that resprout quickly such as bluebunch wheatgrass. Late successional, or climax, species are typically shade tolerant, capable of reproducing and growing in shady conditions. Douglas-fir, Engelmann spruce, and subalpine fir are climax tree species on the HLC NF. Late seral nonforested species include woody shrubs that reseed more slowly, such as sagebrush. Species can play multiple successional roles depending on site conditions and species associations. This is true of Douglas-fir on the HLC NF.

In disturbance-prone ecosystems such as the HLC NF, the climax state may rarely be achieved because succession is interrupted by disturbances such as wildfire. Therefore, long-lived, fire tolerant early successional species are influential. They may survive wildfires to grow large and become prominent features of the overstory canopy, providing structural components of late successional forest.

Wildland fire

Fire is a primary ecological process that has created, maintained, and renewed vegetation on the HLC NF. This disturbance fulfills many ecological functions, including carbon and nutrient recycling, snag and tree cavity creation, and stimulating seeding and sprouting of vegetation. See the Fire and Fuels section for more information. Table 47 briefly describes the fire regimes of the HLC NF (National Interagency Fuels, 2010).

Table 47. Fire regimes on the HLC NF (adapted from National Interagency Fuels, 2010)

Fire regime	Severity, frequency, and vegetation type	Fire effects on vegetation of the HLC NF
I	Low severity, 0-35 years, ponderosa pine and dry-site Douglas-fir	Open forest, woodland, shrub and savanna structures are maintained by frequent nonlethal fire. Mixed severity fire creates a mosaic of age classes. Mean fire return interval can be greater than 35 years. Low severity fires result in minimal overstory mortality (<25% of dominant overstory) and small patch size (Agee, 1998; Arno, 2000; Hessburg, Agee, & Franklin, 2005). The forests that adapted to these fires were often dominated by ponderosa pine or Douglas-fir; fire maintained these species and promoted open, often uneven-aged, structures. These species reforest gaps through the survival of fire-resistant seed-bearing trees. These fires also maintained open, dry forest savannas and a shifting distribution of dry limber pine/juniper ecotones.
II	Stand-replacing, 0-35 years, Drier grasslands and cool-site sagebrush	Shrub or grasslands are maintained or cycled by frequent fire; fire typically removes nonsprouting shrubs, tops of sprouting shrubs and most tree regeneration. These fires are important in vegetation communities such as big mountain sagebrush.
III	Nonlethal and mixed severity, 35-100+ years, Interior dry-site shrub communities; moist-site Douglas-fir and lodgepole pine	A mosaic of ages, early to mid-seral forest stages, and shrub and herb dominated patches is maintained by infrequent fire. Mixed severity fires kill a moderate amount of the overstory, replacing <75% of the overstory. Highly variable patch sizes are created, with a mosaic of effects (Agee, 1998; Arno, 2000). This creates an irregular pattern with an abundant amount of edge. Fire tolerant species often survived fire, with large, old trees becoming overstory components. These fires also resulted in unburned patches that could become dominated by shade tolerant species.
IV	Stand-replacing, high intensity, 35-100+ years, lodgepole pine	Large patches of similar aged forests are cycled by infrequent fire. Stand replacing fires kill most trees (>75%) over a large area and create an intermediate amount of edge (Agee, 1998; Arno, 2000). Lodgepole pine regenerates large areas by storing serotinous cones on trees and in the soil that open when heated. Mature lodgepole pine on the HLC NF generally exhibit a high degree of serotiny. Fire return intervals are generally long; however, shorter intervals also occur (Barrett, 1993; U.S. Department of Agriculture, Forest Service, Northern Region, 1990) and forests may reburn after dead trees have fallen. Lodgepole pine produces open cones at a young age to reseed reburned or understocked patches. Serotiny in fire-prone ecosystems is typically expressed from 30-60 years of age so that seed is available after the next fire.
V	Stand replacing, high intensity, 200+ years,	Variable size patches of shrub and herb dominated structures, or early to mid to late seral forest occur depending on the biophysical environment

Fire regime	Severity, frequency, and vegetation type	Fire effects on vegetation of the HLC NF
	boreal forest and high elevation conifer forest	and are cycled by rare fire. These forests often have complex structures influenced by small gap disturbances and understory regeneration. Fires may result in the regeneration of lodgepole pine but also provide suitable sites for the establishment of whitebark pine at the highest elevations. Many sites become dominated by subalpine fir at the later stages of succession.

Climate influences fire regimes. Historically, extended periods of warm and/or dry conditions tended to be associated with larger, higher severity, and more widespread fires. Shade intolerant, fire resistant species may have developed into mid and late successional stages where low severity regimes were maintained, as did shade tolerant species in areas spared from fire. Periods of cool and/or moist climatic conditions tended to be associated with smaller and less severe fires. Long time intervals (e.g., 100 years or more) between major fire events were common during such periods, which allowed more shade intolerant forests to develop into the mid and later stages of succession. For much of the last century, wildfire area burned diminished relative to the historic condition. This was due to fire exclusion, forest management, and climate (Hessburg & Agee, 2003; Hessburg et al., 2005; Westerling et al., 2006). Roads, railroads, grazing, urbanization, agriculture, and rural settlement all influenced fire exclusion (Hessburg et al., 2005). Since 1940 most GAs on the HLC NF had a fraction of their area burn in any given decade. The consequences of this departure include:

- Fire in many dry forests shifted from low-intensity, high frequency to less frequent, moderate and high-severity, with increases in uncharacteristic large-scale stand-replacing fires (Lehmkuhl et al., 2007). In some cases, fire cycles were missed and fuels built up to an uncharacteristic level. Fires of higher intensity can kill seed bearing trees to affect reforestation. Some studies question the low-severity, high frequency fire historic paradigm in these types, and associated inferences for vegetation conditions typified by open-grown forests and large trees (W. L. Baker, 2015; William L. Baker, Veblen, & Sherriff, 2007), however, abundant other literature supports these conclusions (e.g., (Peter Z. Fule et al., 2013).
- In higher elevation moist forests, changes to the natural regime (long return interval of high severity fires) were less pronounced. However, at the landscape scale, fire suppression in lodgepole pine may induce mosaic homogeneity in forests that previously contained a heterogeneous mix of fire-initiated age classes (Barrett, 1993; U.S. Department of Agriculture, Forest Service, Northern Region, 1990). In these areas fire suppression had the effect of decreasing acreage burned in normal fire seasons and reducing the variability in landscape patterns. As a result, larger, contiguous blocks of uniform stands are subject to beetle outbreaks and fires (ibid).
- Mixed severity fire regimes experienced changes described for both low and high severity regimes. Fire exclusion reduced stand- and landscape diversity in subalpine forests so that vegetation aged more uniformly and become less diverse, resulting in stand replacing fires that regenerate extensive areas that were mosaics historically (Barrett, Arno, & Menakis, 1997). While the adaptation of lodgepole pine to stand replacing events has long been acknowledged, some lodgepole forests also burned in low to mixed severity fire to create variable landscape patterns (Hardy et al., 2000).
- Fire regimes in nonforested areas changed due to conifer encroachment that has resulted from fire exclusion, grazing, and climate (Heyerdahl, Miller, & Parsons, 2006). The mosaic of sagebrush-grasslands with stable islands of Douglas-fir savanna that dominated by the past have been replaced by Douglas-fir forest in some areas (ibid). Further, extended periods of dry summers can enhance conifer encroachment into grasslands by favoring drought-tolerant sagebrush over less-tolerant grasses and forbs, which acts as nurse plants for Douglas-fir (ibid).

Many forested areas in the western U.S. continued to experience a fire deficit from 1984 to 2012, while nonforested regions experienced a fire surplus due to introduced grasses and human-caused ignitions (S. A. Parks et al., 2015). However, since the 1980s, fire activity has been increasing due to a warming climate. More frequent fires are burning for extended periods of time compared to infrequent fires lasting less than one week that were common prior to the mid-1980s (Westerling et al., 2006). On the HLC NF increasingly large fires have been occurring since 1980 due to: 1) fuel buildup in low severity regimes; 2) the influence of a warm/dry climate on vegetation, fire behavior, and suppression; and 3) fire policies that have allowed natural fires to burn in some areas. The increase in acres burned is consistent with the Regional climate shift (Marlon et al., 2012), and a trend of acres burned occurring throughout the West. Several GAs have had recent periods within the NRV for fire acres burned, including the Elkhorns, the Rocky Mountain Range, and the Upper Blackfoot.

Forest insects and diseases

There are many insects and diseases that affect forest vegetation. Most are native and usually exist at low population levels. Some insects can cause dramatic effects; but, more often, changes occur gradually.

Bark beetles, western spruce budworm, and root disease

The insects and diseases that have the most notable impacts on the HLC NF include bark beetles (mountain pine beetle and Douglas-fir beetle), western spruce budworm, and root disease. The NRV analysis (appendix I) found that mountain pine beetle and western spruce budworm infestations from 2000-2009 were well above the natural range, while Douglas-fir beetle was at the lower end. Insect events are expected to be cyclic in nature with a wide range of variability.

Mountain pine beetle is the most aggressive native bark beetle on the HLC NF. Host species include lodgepole pine, ponderosa pine, limber pine, and whitebark pine. Lodgepole pine is the most widespread host, and tends to grow in large, often nearly pure stands of similar size trees. Because regeneration is more episodic in ponderosa pine than lodgepole pine, ponderosa pine ecosystems may be less resilient to infestations (Briggs, Hawbaker, & Vandendriesche, 2015). In all forest types affected, tree mortality increases the quantity of snags and down woody material (Hansen, Johnson, Bentz, Vandygriff, & Munson, 2015; Russel G. Mitchell & Preisler, 1998). Several mountain pine beetle outbreaks were recorded on the Helena NF between 1916 and 1944, and to a lesser extent on the Lewis and Clark NF (Jenne & Egan, 2019). Across the HLC NF, a severe mountain pine beetle outbreak occurred recently, peaking in 2009 when nearly a million acres were infested. This outbreak was fueled by a warm climate and vast areas of susceptible forest.

Douglas-fir beetle is a chronic mortality agent in Douglas-fir forests. Outbreaks occur periodically, typically after disturbances or where large areas of weakened trees exist. Large diameter trees are the most vulnerable. Typically only the largest individuals or groups are killed, creating large snags, downed woody debris, and canopy gaps to create a structurally diverse stand. Douglas-fir beetle has been endemic across the HLC NF over the last decade, although a spike in infestation occurred following large wildfires of 2000 and 2007 as the insect capitalized on fire-weakened trees.

Warming temperatures have directly influenced bark beetle-caused mortality, and climate changes are likely to have an effect (J. E. Halofsky et al., 2018b). Beetle populations may be favored by warm temperatures due to increased survival and increased stress of host species. Beetle outbreaks can lead to changes in fire behavior (Hansen, Johnson, et al., 2015; Jenkins, Hebertson, Page, & Jorgensen, 2008); these changes vary in post-outbreak stands depending upon when they occur. Even in the “gray phase” of mortality, crown ignition and crown fire propagation can occur in beetle-killed stands (Moriarty, Cheng, Hoffman, Cottrell, & Alexander, 2019). Quantity and types of biological legacies differ among disturbances leading, in turn, to widely varying starting points for stand structural development (Franklin et al., 2002). Some of the differences between bark beetles and fire include residual vegetation and downed woody debris which influence forest development. Ecosystem response following a mountain pine beetle outbreak seems to be slower than to fire, with seedlings establishing over several decades (Axelson, Alfaro, & Hawkes, 2009).

Western spruce budworm is a native defoliator that historically has caused widespread damage on dry forests east of the Continental Divide, affecting Douglas-fir, subalpine fir, and Engelmann spruce on the HLC NF. Damage includes top-killing of trees, growth reduction, and mortality mostly in saplings and seedlings. On the HLC NF, western spruce budworm outbreaks are chronic. As forests become dense with a higher composition of Douglas-fir, budworm outbreaks become more frequent and severe (U.S. Department of Agriculture, Forest Health Protection, 2004). Defoliation has been widespread on the HLC NF over the last decade due to warm, dry climate and the availability of dense, layered forests of host species. In several areas, defoliation caused extensive mortality of mature trees (Kegley & Sturdevant, 2006).

The most common root pathogens known to occur on the HLC NF include armillaria root disease and schweinitzii root and butt rot. Douglas-fir and subalpine fir are the most susceptible species. At high infection levels, or over time, root diseases can kill trees. Other stressors such as bark beetles, secondary beetles, or drought often contribute to mortality. In most cases root diseases kill individuals and groups of trees gradually, favoring more tolerant species over time. Once established on a site, root disease can be essentially permanent (Hagle, 2006). To the best of our knowledge, the current level of root disease is within the NRV. Root disease is not prevalent due to the dry environment east of the Continental Divide.

Hazard ratings were reported in the Assessment for the 2020 Forest Plan; these ratings describe the conditions of a susceptible forest and are indicators of potential future insect activity.

- Where mountain pine beetle hazard exists in ponderosa pine, it is mostly moderate. Moderate and high hazard areas exist on the greatest proportions of the Big Belts, Little Belts, and Snowies GAs. Of particular interest are the ponderosa pine forests in the Snowies, which were largely untouched by the recent outbreak. Lodgepole pine forests are extensive on the HLC NF, and most have moderate to high hazard to mountain pine beetle. This is in part due to lodgepole on the east side of the forest sustaining light infestation during the recent outbreak. The areas that sustained high mortality in the recent outbreak, such as the Divide, Big Belts, and Upper Blackfoot, now have small percentages of moderate or high hazard. It will be decades before the affected forests develop susceptible conditions. Conversely, GAs that still support extensive areas of mature pine, such as the Castles, Highwoods, and Little Belts have moderate to high hazard.
- Where susceptible Douglas-fir are available, the hazard to Douglas-fir varies from low to high. This may indicate a limited potential for a large scale outbreak; however, localized outbreaks are possible especially where disturbances cause elevated risk. The Highwoods GA in particular has a high proportion of its area at high hazard. Some amount of moderate to high hazard is present in most GAs. This along with warm/dry climate and stress caused by western spruce budworm give Douglas-fir beetle the potential to impact forests.
- About three-quarters of the planning area contains hosts susceptible to western spruce budworm, and on these sites there is a fairly even distribution of high, moderate, and low hazard conditions. Due to the widespread distribution of Douglas-fir and dense stand conditions, defoliator hazard is prevalent on all GAs. The Crazies and Highwoods GAs contains the least hazard.

White pine blister rust

White pine blister rust is a nonnative disease that affects whitebark pine and limber pine on the HLC NF. It also infects *Ribes* species, louseworts and Indian paintbrush, which are alternative hosts required for the disease to complete its life cycle. As blister rust has moved into fragile, high-elevation ecosystems, successional pathways have been altered, hastening conversion to species such as subalpine fir. Blister rust progresses from infections at needle fascicles that expand down the branch to the bole, or directly enter the bole through a needle killing trees of all sizes. The interaction of warming climates, mountain pine beetle, fire exclusion (which has allowed shade tolerant species to establish), and blister rust has resulted in a bleak outlook for whitebark pine. Because it is nonnative, all levels of blister rust infection are outside the NRV. There is no known method for eradicating the disease. 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. Based on field experience white pine blister rust is generally present wherever five-needled pines are found on the HLC NF. Many of these forests have become dominated by snags, with only a few seed-bearing survivors. However, in many areas, seedlings and saplings are still present as well.

Balsam woolly adelgid

Balsam woolly adelgid is a non-native pest of true fir species that was detected in the Upper Blackfoot and Divide GAs in 2011. Susceptibility of true fir species to this insect varies widely within and among species. Of the native western North American fir species, subalpine fir is the most susceptible. Within five years of infestation, up to 90% of stands dominated by subalpine fir died in western Oregon and Washington (Russel G. Mitchell & Buffam, 2001). Five years after balsam woolly adelgid was first detected in Idaho, nearly 60% of the subalpine fir died and within 18 years of infestation about 95% died (Lowrey, 2016). Host susceptibility is probably influenced by genetic variation within species and environmental effects on the host-agent interaction (Newton & Hain, 2005). Generally, larger and faster growing trees on preferred growing sites may be infested before suppressed subalpine fir (R. G. Mitchell & Wright, 1967). There is a signature for balsam woolly adelgid damage and mortality visible during aerial detection surveys and it has not been recorded during the surveys of the HLC NF to date. However, this pest is often not detectable from the air until 30 – 50% of the stand is damaged.

Management options are limited for this pest. Biological control attempted between 1957 and 1964 (R. G. Mitchell & Wright, 1967) may not have controlled populations because of possible confusion about the actual origin of this pest and less effective predators may not have been introduced (Montgomery & Havill, 2014). Insecticides are effective at controlling balsam woolly adelgid; however, they are generally limited to urban forests or developed areas and not a realistic option at landscape scales. Silvicultural options have not proven effective management for balsam woolly adelgid, possibly because this insect can reproduce on true fir of all age classes and disperses passively by wind, birds and mammals.

Climate and drought

Climate strongly influences vegetation and ecosystem processes. Temperature and moisture patterns dictate what plants are able to establish and grow and also influence growth rates and density. Drought can alter vegetation directly by killing plants, or indirectly, by increasing the frequency and/or severity of disturbances or rendering forests more susceptible to insect and disease. Over geologic time, changes in climate are natural; even so, as a consequence of climate change, forests may face rapid alterations in the timing, intensity, frequency, and extent of disturbances (Dale et al., 2001).

Vegetation treatments

Human interventions such as timber harvest and prescribed harvest change vegetation (Table 48).

Table 48. Description of vegetation treatment types and effects

Treatment	Description
Even-and two-aged regeneration harvest	Even-aged regeneration harvest includes clearcuts, seedtree, and shelterwood cuts with or without reserves. These cuts remove the majority of overstory trees. The size class changes to seedling/sapling, in a single or two-storied structure, initially with low canopy cover. Cover type and species presence may change. Woody material (i.e., downed wood, snags) may change. Natural regeneration and/or tree planting influence species composition and forest density. Later, precommercial thinning may occur in sapling stands, reducing densities and affecting species compositions and structure.

Treatment	Description
Uneven-aged regeneration harvest	Single or group selection establish a new seedling size class and may change species composition. The conversion of the existing stand occurs gradually over decades, creating a multi-age and multi-size stand. Small openings are created with each entry. For example, a stand could have a treatment every 20 years, creating openings on 20% each time, resulting in the entire stand being treated over 100 years. Reforestation and stand tending may occur to affect species composition and structure. Changes to downed wood and/or snags may occur.
Intermediate harvest	Intermediate harvests are designed to enhance growth, quality, vigor, and/or composition of a stand. Treatments in this category include commercial thinning, liberation harvest, sanitation/salvage, and improvement cutting. These treatments leave a forest that is dominated by trees larger than saplings. Tree density is reduced, and species compositions and size class may change. Tree growth is typically accelerated. Changes to downed wood and/or snags may occur.
Prescribed fire and fuel reduction	Prescribed fires are planned ignitions that apply fire to the landscape. In the past, prescribed fire and fuel treatments generally occurred after harvest to reduce woody fuels and/or prepare the site for reforestation. Today, fire is also used to restore ecosystem processes, improve resilience, reduce fire risk, and/or to improve wildlife habitat, and may be implemented as a stand-alone treatment. Outcomes of prescribed fire can vary widely. Typically, more open forest structures and shade intolerant species compositions are enhanced. Other vegetation manipulations such as slashing and piling of fuels may also occur in conjunction with prescribed fire.

Harvest activities prior to the 1940's were associated with homesteading, mining, and railroad building. These activities were concentrated in easily accessible and productive forests. In some cases, forests were cleared, while in others only selected removal of the largest trees occurred. No data are readily available to quantify early harvests. Since the 1940's, harvest has impacted roughly 5% of the HLC NF. Table 49 shows the acres of treatments conducted by decade since 1980, during the life of the 1986 Forest Plans.

Table 49. Acres of vegetation treatments by decade, 1980-2017[4]

Decade	Harvest[1]	Prescribed Fire[2]	Fuel Reduction[3]
1980-1989	23,525	32,211	44,387
1990-1999	30,775	51,460	95,418
2000-2009	10,680	51,826	52,473
2010-2017	9,564	23,964	65,010

1. Harvest activities include even-aged, uneven-aged, and intermediate harvest treatments.
2. Includes overlap of burning in harvested stands. Prescribed fire activities include broadcast burning, jackpot burning, site preparation burning, and underburning. See the Fire and Fuels section for information on wildfires, including those used for resource benefit.
3. Fuel reduction treatments include burning of piled material, chipping, compacting/crushing, fuel break, misc. treatment of natural fuels, piling, rearrangement, and thinning of hazardous fuels.

Source: FACTS database, acres completed by fiscal year, up to April of 2017.

Salvage harvest

The term *salvage* generally indicates that the trees being removed were killed by natural disturbance, most commonly wildfire or insects, and that one purpose is to capture their economic value. Salvage typically only occurs on lands suitable for timber production but may occur on other lands as well. Salvage is not modeled as a vegetation treatment as part of the potential forest management solution, because it is unpredictable and would not contribute to the timber outputs defined in the planning directives. In practice, the term salvage is only used when the treatment is intermediate; that is, a fully stocked stand remains in place after the cutting. In the case of stand-replacing disturbance, cutting results in an even-aged regeneration silvicultural system, and is termed as such depending on the availability of desirable live trees (i.e., clearcut, seed tree, or shelterwood). Acres of "salvage", both intermediate salvage and regeneration harvest, are included in the acres of harvest listed in Table 49. As described in the Timber section, salvage has occurred on approximately 2% of the wildfire acres burned since 1986.

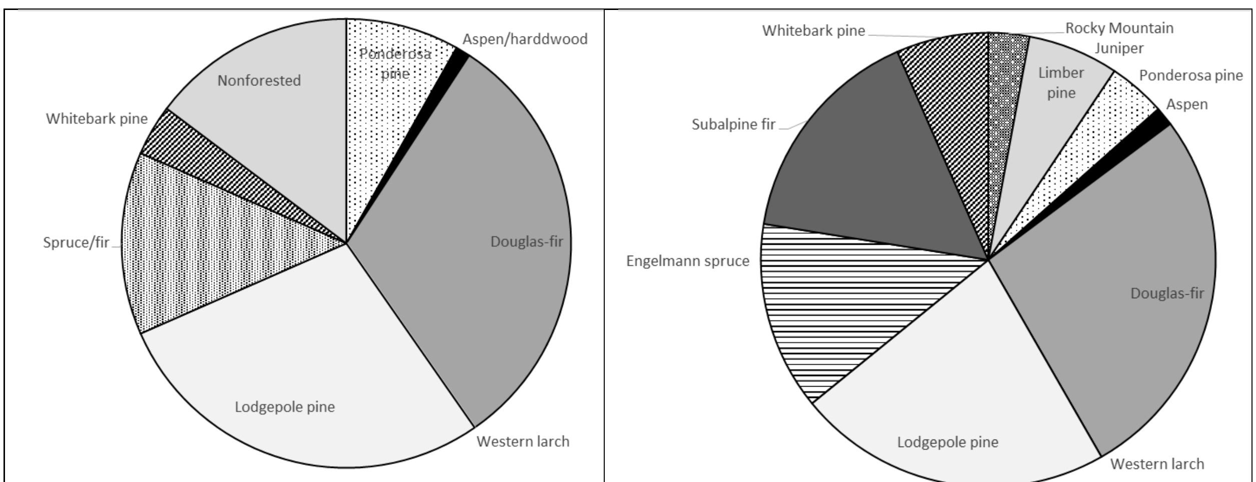
Vegetation composition

The coarse filter for vegetation composition is portrayed by cover type (forested and nonforested) and tree species presence. Areas that are categorized as "sparse" (those containing little vegetation, such as scree slopes) or nonvegetated (such as lakes or urban areas) are excluded from the composition analysis.

Cover types are groupings of dominance types, which describe the most common plant species present (Barber et al., 2011). A description of cover types is found in Milburn and others (2015) and appendix D of the 2020 Forest Plan. There are seven coniferous cover types on the HLC NF and four nonforested types: grass, dry shrub, riparian grass/shrub, mesic shrub, ponderosa pine, Douglas-fir, Western larch mixed conifer, lodgepole pine, aspen/hardwood, spruce/fir, and whitebark pine.

Tree species presence indicates the proportion of an area where there is at least one live tree per acre of a given species. This measure gives an indication of how widely distributed a species is, although not necessarily dominant or even common. Most stands are composed of more than one species. Cover types are named for the dominant species (i.e., the ponderosa pine cover type). However, ponderosa pine as an individual species may also be found in other cover types. Therefore, the estimates for a cover type are not the same as the distribution of the individual tree species for which it is named. There are eleven native tree species on the HLC NF: Rocky mountain juniper, limber pine, ponderosa pine, Douglas-fir, lodgepole pine, western larch, aspen, cottonwood, Engelmann spruce, subalpine fir, and whitebark pine.

The current proportion of these types forestwide is shown in Figure 6. Nonforested cover types are not classified in plot data; therefore, for the analysis all these types are grouped together. The western larch mixed conifer cover type is only present in the Upper Blackfoot GA (in negligible amounts).



Cover types | **Tree Species Presence**

Figure 6. Existing distribution of cover types and tree species presence forestwide (% of NFS lands)

The abundance of aspen, ponderosa pine, and whitebark pine cover types and individual species presence tend to be below the NRV, while Douglas-fir tends to be above. The warm dry broad PVT is the most departed from historical conditions. The following sections provide a summary of the ecological role of each species and type on the HLC NF relative to the NRV. Xeric ecotones and savannas, areas which straddle forested and nonforested potential vegetation types, are also addressed. Refer to appendix H for a detailed description of the desired conditions for each of these attributes.

Ponderosa pine cover type and presence of ponderosa pine, Rocky mountain juniper, and limber pine

The ponderosa pine cover type includes forests dominated by ponderosa pine, Rocky mountain juniper, and/or limber pine. It occurs most often in the warm dry PVT. This type is below the NRV range Forestwide and in the warm dry PVT, as well as in all the GAs.

Ponderosa pine

Ponderosa pine is a long-lived, windfirm early successional tree that often grows in association with Douglas-fir, limber pine and/or juniper. On the driest sites and in ecotones, it may grow at very open densities. As the most drought and fire tolerant species on the HLC NF, it is capable of surviving low to moderate severity fire even at a young age and can regenerate on bare soils with high temperatures. As a large tree, it provides important wildlife nesting/feeding habitat, both when live and dead. Compared to associate species such as Douglas-fir, it is less vulnerable to root disease and other pathogens. It is shade intolerant and without disturbance is often replaced by Douglas-fir.

Ponderosa pine does not occur or is very limited in the Rocky Mountain Range, Highwoods, and Crazies GAs. The Little Snowies mountain range within the Snowies GA supports a genetically unique ponderosa pine dominated community. Ponderosa pine features prominently in the northern part of the Elkhorns and southern part of the Divide GAs, and is present in the Upper Blackfoot, Little Belts, and Big Belts GAs. The distribution and structure of ponderosa pine has been affected by fire exclusion and mountain pine beetle. The NRV analysis indicates that the ponderosa pine presence is well below its natural range across most landscapes, except the Rocky Mountain Range, Crazies, and Snowies GAs. In GAs that have little to no existing ponderosa pine, the species could only be promoted through planting.

Ponderosa pine decline relative to the NRV has been due to a combination of factors, including fire exclusion and harvesting. Fire exclusion has contributed to denser forests with greater competition for resources, higher stress and greater risk of insect attack and stand-replacing fire (Pollet & Omi, 2002; Sala, Peters, McIntyre, & Harrington, 2005). Stand structure has changed from open park-like stands to densely stocked areas undergoing stand conversion to more shade-tolerant species such as Douglas-fir (Gruell, 1983; Pollet & Omi, 2002; H. Y. Smith & Arno, 1999). High density also increases tree stress and decreases resistance to insect attack (Kolb, Holmberg, Wager, & Stone, 1998). The recent mountain pine beetle outbreak has also caused changes shifts in composition from ponderosa pine to Douglas-fir, reductions in density, and reductions in average tree size.

Limber pine

Limber pine is a relatively long-lived five-needled pine which grows primarily east of the Continental Divide. It is a key species on ecotones and rocky areas as well as in alpine communities, and on the HLC NF its presence is often correlated to limestone substrates. Limber pine grows at the widest elevational range of any conifer in the Rocky Mountains (Means, 2011). Lower treeline limber pine woodlands serve as ecotones between sage/grass and forest/woodlands biomes; their expansion and contraction is due to dynamic relationships among vegetation, climate, and wildland fire (ibid). On more mesic sites where limber mixes with other species, mixed to high severity fires probably occurred; however, lower treeline limber pine woodlands and isolates are thought to have a more frequent disturbance regime (ibid).

Limber pine is most prevalent in the warm dry broad PVT. Forestwide and in all PVTs, the distribution is within the NRV. By GA, it is generally at the low end or below the natural range except for the Snowies and Little Belts. It is particularly below the NRV in the Castles and Crazies GAs. Limber pine is present in all GAs, but does not feature prominently in the Elkhorns, Divide, or Highwoods.

The natural fire regime, and the alteration thereof, is an important influence on the abundance and health of limber pine. The decline in health and mortality of this species has been observed throughout central and eastern Montana due to disease, winter damage, drought, and competition from other conifers, as noted in the Assessment. While it tended to increase historically during warm/dry periods, some sources indicate that limber pine expanded in some areas due to fire exclusion, and may be less viable on the driest sites in drought conditions (J. E. Halofsky et al., 2018a).

Rocky mountain juniper

Rocky mountain juniper is a common component of xeric ecotones and dry forests. It provides wildlife habitat, but also contributes to fire risk by functioning as a ladder fuel under forest canopies. Juniper may also become abundant in the later stages of succession in nonforested cover types. Wildfire usually kills juniper periodically. Although juniper dominance types are included in the ponderosa pine cover type, they are uncommon. While the NRV analysis estimated that juniper abundance is generally within the natural range, this species tends to decline during the warm/dry periods, in favor of nonforested species. This species is essentially absent from the Crazies and Highwoods GAs, and in the other areas is present on small proportions of the landscape. Juniper is most prevalent (and above the NRV) in the Big Belts.

Aspen/Hardwood cover type and presence of aspen and cottonwood

Persistent hardwood-dominated plant communities are uncommon but provide important habitat for birds and other wildlife. Aspen may occur as a persistent community in riparian areas or as a transitional community in uplands. These communities often dominate in the early stages of succession immediately after disturbance. Aspen historically relied on fire or disease to remove the overstory, kill encroaching conifers, and stimulate suckers from the existing clone root system (Shepperd, 1990). Without periodic self-regeneration, aspen stands become decadent and deteriorate; mature clones can also decline due to repeated animal herbivory (Shepperd, Bartos, & Mata, 2001). Aspen may coexist with conifers for decades after a disturbance, but as conifers become more numerous and dense, aspen gradually declines. On the HLC NF, cottonwood is confined to riparian areas with fluctuating water tables and is more common on private lands outside of the forest boundary. It is poorly represented by available data.

Forestwide, the NRV analysis indicates that the aspen/hardwood cover type and aspen species presence is within its natural range for abundance at most scales, but below in some GAs (Big Belts, Snowies). The Divide, Highwoods, and Rocky Mountain Range contain more aspen than the other GAs. The highest levels of aspen correlated with past warm/dry climate periods. Rangewide, aspen is less common than it was historically because of encroachment and overtopping by conifers, overgrazing by cattle and large native herbivores, and the absence of fire in many locations (Kaye, Binkley, & Stohlgren, 2005; Shepperd et al., 2001).

Douglas-fir cover type and presence of Douglas-fir

Douglas-fir is one of the most common species on the HLC NF. It is of high economic value for wood products. It is fairly tolerant of drought, moderately tolerant of shade, and capable of establishing and persisting in the dense forest conditions. Older, larger Douglas-fir are tolerant of fire, though less so than ponderosa pine. Trees can live for many centuries and grow to large diameters which provide wildlife habitat. Douglas-fir is one of the most susceptible conifer species to damage from insect and diseases, including Douglas-fir bark beetle, western spruce budworm, and root disease.

Forestwide, the NRV analysis showed that the Douglas-fir cover type is generally at the high end or above its natural ranges of abundance, as is the species presence. This trend holds true for all GAs except the Big Belts, Elkhorns, Highwoods, and Rocky Mountain Range. Douglas-fir abundance was at the lowest end of its natural range of variation during warm and dry climate periods. Relative to the NRV, fire exclusion has favored the expansion of Douglas-fir particularly on dry forest sites. The higher stand densities that have resulted also increase tree stress, which contributes to greater susceptibility to insects and diseases. Where dense Douglas-fir has filled in dry forest canopies, forest resilience is reduced and conditions support higher severity fires.

Lodgepole pine cover type and presence of lodgepole pine

Lodgepole pine is capable of growing under a wide range of conditions. It is shade intolerant and short lived compared to other conifers. Over time (without disturbance) it is replaced by more shade tolerant species. Lodgepole is thin-barked and easily killed by fire. In fire-prone ecosystems such as the HLC NF, it has adapted by producing open cones at a young age to reseed reburned or understocked patches, and then producing serotinous cones by the middle stages of development to ensure that seed is available after the next stand-replacing event. This abundant seed production allows for rapid recolonization of burned areas. Lodgepole pine has a rapid early growth rates and is capable of surviving in dense conditions.

Forestwide and in the warm dry PVT, the NRV analysis indicated that the abundance of the lodgepole pine cover type is above the natural range. It is similar to the natural range in the cool moist PVT, and below the range in cold. In the Crazies and Snowies GAs, this cover type is well below the natural range of abundance, whereas in the Divide, Highwoods, and Little Belts GAs it is above the range. Tree species distribution of lodgepole shows that it is naturally a major component of most landscapes. The presence of lodgepole is above the NRV Forestwide, in the warm dry and cool moist PVTs, as well as in the Divide, Highwoods, Little Belts, Rocky Mountain Range, and Upper Blackfoot GAs. It is below the natural range in the Snowies, and similar to the natural range in the cold PVT and all other GAs.

Western larch cover type and presence of western larch

On the HLC NF, western larch is only found in the Upper Blackfoot GA, at the eastern end of its natural distribution. It grows primarily on the cool moist broad PVT. It is of high value for its contribution to species diversity, forest structure, and ecosystem resilience. It has high resistance to many forest insects and pathogens. When mature, it is one of the most tolerant species to fire and regenerates well under mixed and high severity fire regimes, with light seed that can spread far into a burned areas and establish on bare soil of high temperatures. It is very intolerant of shade. Unless a disturbance occurs, it is replaced over time by more shade tolerant species. In the Upper Blackfoot GA, the western larch cover type is not detected, but western larch is present on less than 1% of the area.

Spruce/fir cover type and presence of subalpine fir and Engelmann spruce

Spruce/fir forests provide valuable wildlife habitat and are important components of riparian areas, and in the absence of disturbance can persist to an old age. Forests dominated by subalpine fir and spruce tend to support higher severity fires, due to the low fire tolerance, high tree densities, multiple canopy layers, and greater litter depths and fuel loads. The multi-story conditions that typically develop in subalpine fir and spruce forests are susceptible to damage from western spruce budworm as well. Subalpine fir and Engelmann spruce fulfill similar ecological roles, require similar site conditions, and often coexist. The current amount of the spruce/fir cover type is below the NRV forestwide as well as in the cool moist and cold PVTs, and in the Big Belts, Little Belts, Rocky Mountain Range, and Upper Blackfoot GAs. It is above the NRV in the Elkhorns, and similar to the range in all other GAs.

Subalpine fir

Subalpine fir is common on high elevation sites across the HLC NF. It is shade tolerant, and commonly abundant in mid and understory canopy layers. It is intolerant of drought and fire, with shallow roots, thin bark, and crowns that extend to the ground. Though it may regenerate into opening created by fire, it has a slow growth rate. Its shade tolerance allows it to persist indefinitely and over time they will dominate the site unless there is a disturbance. The presence of subalpine fir is similar to the NRV forestwide and in the cool moist PVT, and above the range in the cold PVT, where it may compete with whitebark pine. It is also above the NRV in most GAs except the Highwoods, Rocky Mountain Range, and Snowies.

Engelmann spruce

Engelmann spruce is more limited than subalpine fir, confined to riparian areas and moist sites. Its ecological characteristics are similar to that of subalpine fir. The presence of Engelmann spruce is above the NRV forestwide, in the warm dry and cool moist PVTs, and similar to or slightly below the range in the cold PVT. It is above the NRV range particularly in the Snowies, Little Belts, Elkhorns, and Divide GAs; below the range in the Big Belts and Highwoods; and similar to the NRV in all other GAs.

Whitebark pine cover type and whitebark pine presence

Whitebark pine is a candidate species for listing under the ESA. It is a five-needled pine that is a key ecosystem component at the highest forested elevations in cold, windy, snowy, and moist climatic zones (Arno & Hoff, 1989). These areas are limited in species diversity, and whitebark pine historically competed the best to achieve dominance on the harsher, exposed sites. It occurs in association with subalpine fir, spruce, and sometimes lodgepole pine and limber pine on the HLC NF. As the most fire resistant and long-lived species in these forests, it plays an important role in the stability of high elevation ecosystems and wildlife habitat. Its tolerance to cold, superior hardiness on harsh microsites, unique method of seed dispersal, and resistance to lower intensity fires allows it to compete successfully in the upper subalpine zone. On productive sites, whitebark is a seral species that is eventually replaced by more shade tolerant species; but in harsh upper subalpine forests and at treeline it can dominate as climax vegetation (Keane et al., 2012). This tree provides food and shelter to squirrels, bears and other animals, aiding in the protection of soil and water quality in the sensitive high basins, acting as a "nurse tree" for other conifers, and filling a host of other roles in harsh, cold environments (Tomback & Kendall, 2001).

Whitebark pine is present on all GAs except the Highwoods. The NRV analysis indicated that the whitebark pine cover type is slightly above the NRV forestwide, in the cold PVT, and in many Gas, but the analysis concluded that there was uncertainty regarding the model limitations to classify this cover type (see appendix I). Whitebark species presence was found to be below the NRV range in the cold PVT. Whitebark pine tended to be at the higher end of its NRV during warm/dry climate periods.

Rangewide, whitebark pine is less abundant than it was historically due to fire exclusion, mountain pine beetle, climate shifts, and white pine blister rust. The species has experienced extensive mortality over the past few decades, at both broad and local scales (Retzlaff, Leirfallom, & Keane, 2016). Though whitebark pine still occurs, most trees are seedlings or saplings. This has reduced its regeneration potential, although the percentage of whitebark that are resistant to blister rust may increase slowly through the process of natural selection (Tomback, Arno, & Keane, 2001). The loss of whitebark has altered the structure, composition and pattern of high-elevation ecosystems, and threatened their long-term stability and integrity.

Nonforested Vegetation

Persistent nonforested plant communities are widespread on many of the GAs on the HLC NF, maintained by site conditions or frequent fire that precludes establishment of trees. The most common communities found on the HLC NF are grasslands and shrublands, but wetlands, riparian areas, and alpine communities are also present. In some places, grass/forb/shrub communities occur as a transitional type in the earliest stages of forest succession. The island mountain ranges on the HLC NF are separated by prairies. On private valley-bottom lands adjacent to the forest, the trend has been to convert native grasslands to crop lands, rangelands for grazing, and developed lands, leading to the disruption of processes, such as fire, that played a role in maintaining them. Connectivity of grassland/herbaceous ecosystems has also been affected by development at these at lower elevations. Nonforested vegetation communities are less explicitly represented with available data than forested types.

As discussed in the Assessment, nonforested cover types have declined relative to the historical condition, including declines in fescue, bunchgrass, sagebrush, and native forb cover types, largely attributable to agricultural development but also encroachment of woodland types and exotic weeds. Grazing and associated reduction in fire frequency (due to the loss of fine fuels) are the primary causes of woodland expansion although climate change is also suggested as a contributing factor (Hessburg & Agee, 2003). Fire exclusion and drought have allowed conifers and/or sagebrush to invade grasslands, and altered the mosaic of conifer savannah and sagebrush steppe (Barrett, 1997; Heyerdahl et al., 2006). Invasive plants also are a primary threat to grass/forb/shrub communities. Historical and current grazing practices have contributed to shifts to nonnative species in these types. For example, rough fescue is highly palatable throughout the grazing season. This type has been replaced by native oatgrass under moderate or heavy grazing pressure in some areas; and long-term heavy grazing on moister sites has resulted shifts to a nonnative Kentucky bluegrass/timothy/smooth brome type. High elevation grassland/herbaceous types are less likely to be substantially altered from historic conditions because factors such as grazing, agricultural development, and invasive plants are less common due to inaccessibility.

Nonforested cover types are collectively above the NRV range forestwide and in all PVTs, as well as in several GAs including the Big Belts, Highwoods, Rocky Mountain Range, and Upper Blackfoot. With the exception of the Highwoods, this condition is due to recent large fire areas, and may not well-reflect the condition of true nonforested vegetation types as opposed to forested types that have not regenerated.

Xeric and mesic grasslands

Slope and moisture regimes divide grasslands into two general types in the planning area. Mesic grasslands on the moister north and east facing slopes, or at higher elevations, are generally dominated by Idaho fescue and rough fescue. Xeric grasslands on drier sites are dominated by Idaho fescue and bluebunch wheatgrass. Grasslands range in size from small patches to large open parks located on montane to foothill zones, and are typified by colder winters, shorter summers, and younger soils derived from alluvial materials. They are dominated by cool-season perennial bunchgrasses and forbs, with sparse shrub and/or tree representation. Various shrub and tree species may occur with low cover.

Mesic and xeric shrubland/woodlands

Mesic shrublands are often associated with coniferous forests and occur as large landscape patches on moister sites or in smaller patches within grasslands. These shrublands can be very productive and favored by wildlife. Xeric shrubland plant communities occur on drier sites, and overstory species vary by location and site type. For example, low sagebrush tends to occupy the lower, drier and hotter sites with shallow soils whereas basin big sagebrush typically dominates sites with deeper soils and more plant available moisture. Xeric woodlands are typically hot and dry or are steep, with shallow, skeletal soil. The dominant overstory species varies but includes Rocky Mountain juniper and mountain mahogany. Mountain mahogany occurs in much lower amounts than juniper and is restricted to steep rocky soils and rock outcrops. The shrub species described in Table 50 are of particular importance in shrublands.

Table 50. Important shrub species in xeric and mesic shrublands

Species	Description
Mountain big sagebrush *Artemisia tridentata subsp. vaseyana*	Mountain big sagebrush dominates much of the shrub-steppe plant community on the HLC NF. It generally occupies open dry sites at elevations below montane forests where winters are cold and dry, spring and early summer months receive most precipitation, and drought is expected from mid-summer through the fall (J. G. Cook & Irwin, 1992; A. D. Smith, 1940; Welch, 2005; Whitlock & Bartlein, 1993). This shrub is sensitive to encroachment by conifers (Grove, Wambolt, & Frisina, 2005; Gruell, Brown, & Bushey, 1986). Periodic Douglas-fir expansion into these areas reflects natural ecotone dynamics, but overgrazing, climate changes, and fire suppression have caused more encroachment than would be present naturally.
Curl-leaf Mountain Mahogany *Cercocarpus ledifolius*	Curl-leaf mountain mahogany generally occurs on limestone or sandstone stony slopes, cliffs, and rock outcrops from valleys to montane zones across the HLC NF. It provides an important food and cover source for a variety of wildlife year-round. Traditional cultures have used it for fuel, dyes, and many important medicinal purposes. With more frequent high severity fires, often related to increased fine fuel loads from exotic annual grasses, populations are declining in many areas throughout its range (C. L. Hanson, Wight, Slaughter, Pierson, & Spaeth, 1999).

Species	Description
Antelope Bitterbrush *Purshia tridentata*	Antelope bitterbrush occurs on stony or sandy soil of grasslands, shrub-steppe, and open ponderosa-pine forest on the HLC NF. It provides an important food and/or cover source for wildlife. Traditional cultures also use it for medicinal purposes. The abundance and distribution of bitterbrush is influenced by climate and fire regimes. Seed caches from rodents and ants also play a vital role in dispersal regeneration. As a shade intolerant, nitrogen-fixing shrub, bitterbrush is an early colonizer on disturbed sites. The invasion of nonnative annual grasses has increased fine fuel loads, causing more frequent high severity fires during which bitterbrush is often killed, although it may sprout following light-severity fires in the spring (Zlatnik, 1999). In Montana, bitterbrush has experienced declines of 10-30% in population size, range extent, and/or occupied area during the past 30 years due to habitat conversion, alteration, and more high severity fires.

Riparian/wetland vegetation

This section discusses the existing and desired vegetation characteristics of riparian areas and wetlands. Refer to the Watershed section for information on the hydrologic function of riparian areas and wetlands.

Riparian systems occur along creeks and rivers and occupy floodplains, streambanks, islands in rivers, narrow bands in steep channels, and backwater channels. This system is dependent on a hydrologic regime that has annual to episodic flooding. Riparian vegetation should be comprised of a mosaic of plant communities dominated by species which tolerate periodic flooding and an associated seasonally high water table. Trees may be present along with riparian shrubs and herbaceous species. Threats to the riparian system include heavy grazing, invasive species, drought, recreation and climate change. Wetlands are characterized by dominant vegetation adapted to saturated (anaerobic) soil conditions. The vegetation complex should be represented by a mosaic of herbaceous and woody plant communities that provide erosion control. Low willow species, bog birch and bog blueberry are often the representative woody species in a wetland system. Threats to wetlands include alteration of the original hydrology or hydric soils (i.e. diversion, draining, development, road construction, heavy grazing, etc), invasive species, and climate change.

Willows (*Salix spp*) are of particular interest in riparian and wetland plant communities because of their habitat value, limited extent, and pressures exerted by factors such as grazing and fire exclusion. Willows require a seasonally high water table and free water in the soil to survive and regenerate. Most species are shade-intolerant and those species that occur along streams in narrow steep valleys will likely not persist if conifers overtop them. Browsing pressure by both native and domestic ungulates can lead to loss of vigor and eventually death. There are two main categories of willows:

- *Tall willows*, including various species of tall-statured (typically up to 20 to 30 feet tall), occur along streams in broad valley bottoms at low to mid elevations. They occur as a mosaic with various other riparian shrubs, graminoids and forbs in the understory, forming a riparian complex. Tall willow species include (but are not limited to): Booth's (*Salix boothii*), geyer (*S. geyeriana*), bebb (*S. bebbiana*), coyote (*S. exigua*), drummond (*S. drummondiana*) and whiplash (*S. lasiandra*) willow.
- *Low willows*, including low-statured (typically up to 4 feet tall) willows occur in higher elevation valleys, usually associated with subalpine forests. They occur as a riparian strip along streams and also as a complex either associated with sinuous streams or in wet meadows or fens in wide, flat valleys associated with standing water. Low willow species include (but are not limited to): planeleaf (*S. planifolia*), wolf (*S. wolfii*), and mountain (*S. eastwoodiae*) willow. Bog birch (*Betula pumila*) and bog blueberry (*Vaccinium uliginosum*) may also be present in the low willow complex. Riparian/wetland graminoids and forbs can be present with high cover.

Alpine and rocky habitats

Alpine ecosystems occupy harsh high elevation sites, resulting in short stature and relatively slow growth for both shrubs and herbaceous species. Wetland communities are present in snowloaded depressions, and support various willow species, along with wetland herbaceous species. Alpine ecosystems are mostly treeless, although some conifers may be present with minor cover, often with a krummholz growth form. Rocky habitats are often associated with the alpine potential vegetation type, including rock outcrops and scree. Vegetation is sparse or largely lacking. Bryophytes and lichens often occur in crevices and flourish on open rock surfaces where the competition from vascular plants is absent. Rock outcrop and scree habitats may also be found at lower elevations. Rocky habitats are often fragile systems.

Xeric ecotones and savannas

Ecotones are the boundaries between ecosystems and/or biomes (Allen & Breshears, 1998). On the HLC NF, the xeric ecotone represents the transition from nonforested xeric grass and shrub communities to dry forest communities. Scattered trees and shrubs including limber pine, ponderosa pine, Douglas-fir, Rocky Mountain juniper, sagebrush, mountain mahogany, and bitterbrush may be common. Herbaceous cover may be low due to limited soil development and dry conditions. Xeric ecotones are complex because they overlap forested and nonforested PVTs. Plant communities may shift between grass, shrub, and sparse conifers based on climate and disturbances (mainly fire). The overall desired extent of these plant communities is encompassed within the desired range of nonforested cover types; however, some of these areas may be included in ponderosa pine or Douglas-fir cover type where dense conifers have established.

Savannas are a particular forest structure within xeric ecotones. For this analysis, they are defined as communities found on either nonforested or the warm dry broad PVTs which contain very open tree cover (5 to 10% canopy cover), and a dominance of xeric grasses and/or shrubs. Historically, frequent fire would have maintained the dominance of grasses and shrubs while promoting the development of large, widely scattered individual or patches of ponderosa pine, Douglas-fir, limber pine or juniper and limiting the establishment of small conifers. However, fire exclusion has resulted in the shift of some areas to more densely forested areas, often with development of ladder fuels, and a decrease in grass and shrub vigor as well as an increase in fire risk. As this occurs, the large, old trees of the savanna become vulnerable to mortality from uncharacteristic fire effects. Expected warm and dry climate conditions should promote the open character of forest savannas and a dominance of grass and shrub communities.

Forest structure

Forest size class

Tree size is an indicator of the structure and age of forests across the landscape. Forest size classes are defined based on the predominant tree diameter in the stand (basal area weighted average diameter). The five size classes defined for this analysis are described in appendix D of the 2020 Forest Plan. The existing abundance of forest size class forestwide is shown in Figure 7.

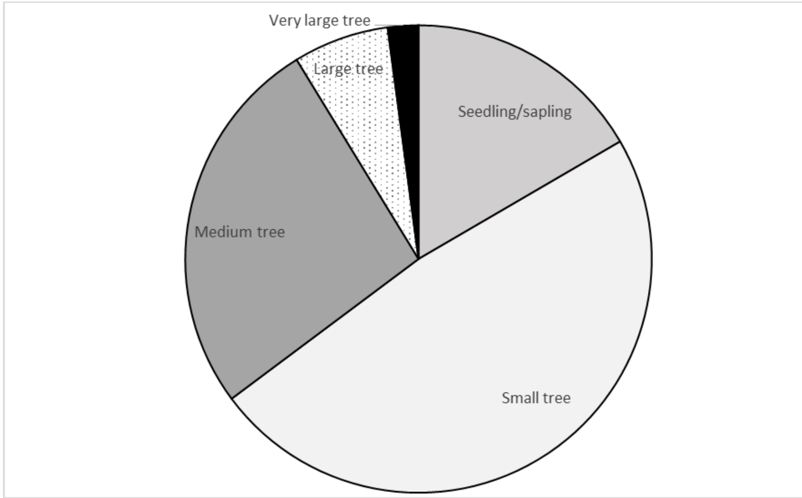


Figure 7. Existing distribution of forest size classes (% of NFS lands)

Most GAs are similar to the forestwide depiction of the proportion of size classes. Some, such as the Castles GA, have a higher proportion of the seedling/sapling tree class. Others, such as the Upper Blackfoot GA, have a more balanced proportion of all size classes. The large and very large tree classes are the least common classes on all GAs and are most prevalent in the Crazies, Castles, Divide, Big Belts, and Little Belts. The comparison of size class abundance to the NRV condition is summarized as follows:

- *Seedling/sapling:* The pattern and abundance of the seedling/sapling class is linked to stand-replacing disturbance regimes, and is most abundant in the cool moist broad PVT. The existing abundance of this class is at the upper end of the NRV forestwide and in the warm dry PVT, but within the range in cool moist and cold. Most GAs contain existing proportions of the seedling/sapling size class within or at the higher end of the NRV. The exceptions are the Highwoods GA, which contains essentially no seedling/sapling forests; and the Rocky Mountain Range GA, which is above the NRV range due to recent wildfires.
- *Small:* Forestwide and in all GAs, the small size class is above the NRV, most dramatically in the Big Belts, Castles, Divide, Little Belts, and Snowies GAs. Some of these were the hardest hit by the mountain pine beetle outbreak, which killed larger trees. High stand densities resulting from fire exclusion also contribute to the small size class by limiting the ability of stands to grow larger, or allowing small trees to dominate stands with large tree components.
- *Medium:* The medium size class is at the upper end of its NRV range Forestwide; it is above the range in the warm dry PVT, but within the NRV ranges in cool moist and cold PVTs. For most GAs, the existing proportion of the medium tree size class is within the NRV. The exceptions are the Big Belts, Highwoods, and Little Belts GAs, where the medium tree size class is more abundant than the NRV. Many of these forests are those that were established following large fires and harvest at the turn of the last century, which are progressing through succession.
- *Large:* The large tree size class is underrepresented forestwide and in all GAs as compared to the NRV. The disparity is especially notable in the Divide, Highwoods, Little Belts, Snowies, and Upper Blackfoot GAs, and in the warm dry broad PVT. The mountain pine beetle outbreak recently killed many large trees. In some areas, the lack of low-intensity disturbances in long-lived cover types caused a decrease in the large and very large size classes by perpetuating high densities where individual tree growth is inhibited.
- *Very large:* Forestwide and in most GAs, the very large tree size class is rare but currently less abundant than in the NRV. Several GAs, however, are either within or very near the natural range (the Castles and Crazies). In many places, the species and growing sites inhibit tree growth to a large

size. A limited amount of the very large forest size class is possible based on the species and growing conditions found on the HLC NF. Many forest stands will never achieve a very large size class, due to growing conditions and/or disturbances.

Modeling indicates that large and very large size classes were at the lower end of their NRV during warm/dry periods such as those expected in the future; however, this level still exceeds the existing condition. The NRV range of seedling/sapling forests is wide according to the size and frequency of stand replacing disturbances. Substantial proportions of the forest should be in the mid-successional stages of development (small to medium size classes), where they can remain for long time periods. Less dense forests or forests on more productive sites may transition up to large size class relatively quickly (e.g., 100 years from fire event), while higher density forests or those on harsh growing sites may take much longer. Some forest types (such as lodgepole pine), or those where high density inhibits tree growth, may remain in the small and medium classes their entire lifespan.

Large-tree structure

Large (15”+) and very large (20”+) diameter trees are important ecosystem components, whether they occur at low or high densities. In addition to providing important wildlife habitat structure, seed sources, timber products, future snags and downed wood, they also sequester more carbon as compared to smaller trees (Stephenson et al., 2014), and are desirable from an aesthetic viewpoint.

Large and very large fire tolerant ponderosa pine and Douglas-fir are particularly valuable. These trees can survive low to moderate fire to promote resilience via long-term structural diversity and recovery of the forest (seed). Where present in sufficient numbers they contribute to late successional forest and, in some cases, old growth. They can be of high economic value for wood products, and provide important wildlife habitat, both as live trees and when they die as snags and downed wood. The decay and snag traits of these species are conducive to cavity formation and long-term snag persistence. Large trees of intolerant species tend to develop where frequent disturbance maintains low density, and/or on productive sites which provide ample moisture and nutrients for individual tree growth.

Large and very large trees of species other than ponderosa pine and Douglas-fir are also valuable. Engelmann spruce and subalpine fir can be long-lived and contribute to late successional and old growth structures, but are intolerant of fire, more susceptible to insect and disease, and less persistent as a snags. Large trees of these species tend to develop in areas protected from disturbance. Lodgepole pine only rarely reaches large sizes and is not fire tolerant. Aspen is not common as a large tree, and is generally short-lived, but when it does reach a large size it provides unique habitat for cavity nesting wildlife. Whitebark pine and limber pine can grow to large diameters, although generally short in height, to provide these structures on the harshest growing environments on the forest.

The large and very large forest size classes include areas where large and very large trees occur in relative abundance. However, because forest size class is based on the basal area weighted average diameter of trees, it does not indicate all potential occurrences of large and very large trees. These trees may occur in forests dominated by smaller trees. Therefore, an additional indicator of “Large-tree structure” is included. Large-tree structure categories are defined by the presence of certain minimum quantities of large or very-large trees (Milburn et al., 2019), as described in appendix D of the 2020 Forest Plan. Large-tree structure may occur in any forest size class and reflect quantities of trees that would be meaningful to wildlife habitat and represent a substantial influence on forest structure and process (such as providing seed). If a stand or plot contains the minimum trees required, it is categorized as either large or very large; if a stand contains both sufficient large and very large trees, it is categorized as very large.

Similar to size class, the Large-tree structure is less abundant across the landscape than it was historically. For all PVTs, the existing condition of large category is below the NRV. Except in the cold PVT, the existing distribution of very large category is also below the NRV, but not to a great extent as these trees tend to be rare on the HLC NF. In all GAs, the trends for the large category are generally consistent with the forestwide averages, although the range around the existing condition estimate approaches the lower bound of the NRV in the Highwoods GA. For the very large category, the Castles, Crazies, and Elkhorns GAs have existing levels similar to the NRV, and all other GAs are below the NRV. The mechanisms that have caused the Large-tree structure to be less than the NRV are the same as described for the large and very large size classes. There are more acres with Large-tree structure than there are acres in the large and very large forest size classes. This is because large and very large trees are scattered irregularly across the landscape, including in stands dominated by smaller trees.

Forest density and vertical structure

Forest density describes the area occupied by trees. Tree density can influence tree growth and vigor; susceptibility to drought, insects and diseases, wildfires, and windthrow; and the rate of forest succession. Canopy cover is used as the measure of density. *Canopy cover* is the percentage of ground covered by a vertical projection of the outermost perimeter of the tree crowns, considering trees of all heights. Canopy cover is grouped into three broad density classes: nonforested/low/medium (0-39.9% canopy cover); medium/high (40-59.9%) and high (60%+). These classes and associated vertical structures are described in appendix D of the 2020 Forest Plan. Figure 8 shows the existing distribution of density class forestwide. Most of the forests on the HLC NF are currently considered single-storied (60% of the warm dry PVT; 54% of the cool moist PVT; and 58% of the cold PVT).

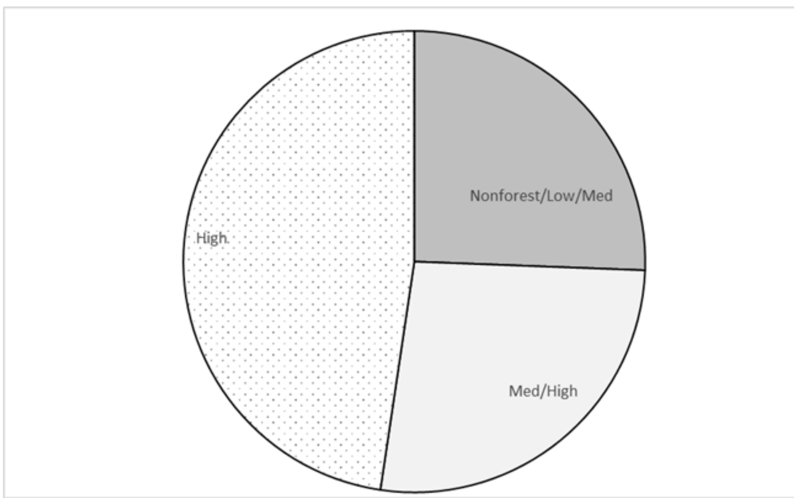


Figure 8. Existing distribution of forest density classes, forestwide (% of NFS lands)

Forest density influences wildlife habitat, forest resilience, timber productivity, and fire hazard. More open densities tend to be more resilient or resistent to fire as well as insects and promote the growth of large trees. Moderate densities tend to maximize timber production. Higher densities provide valuable wildlife habitat conditions particularly in the cool moist broad PVT.

Canopy cover is low when the stand is in the earliest stage of succession. As trees grow, crowns expand to fill up growing space, and canopy cover increases. Disturbances and competition-based mortality can limit tree density. Site productivity also affects canopy cover, with more productive, moist sites supporting higher densities than harsh sites with poor soils. Frequent fire, particularly in the warm dry PVT, can maintain low canopy covers at all stages of succession. Forest density influences tree species composition and vice versa. For example, ponderosa pine and lodgepole pine are intolerant of shade and cannot survive in lower canopy layers. Shade tolerant species, such as subalpine fir and spruce can prosper in dense stand conditions. Some cover types, such as lodgepole pine, naturally grow at high density. Others, such as ponderosa pine, typically grow at more open densities.

The NRV analysis indicated that the nonforested/low/medium density class is within the NRV forestwide, while the medium/high class is below and the high class is above, likely due in part to fire exclusion. These trends are consistent in the cool moist PVT and cold PVTs, but abundance of density classes is within the NRV ranges in the warm dry PVT. The nonforested/low/medium class is within the NRV in most GAs, although at the lower bound in the Divide, Highwoods, Little Belts, and Snowies GAs; and is below the NRV in the Elkhorns GA. The medium/high class is at the low end or below the NRV in most GAs, except the Castles (where it is at the upper bound) and the Divide (where it is in the middle of the range). The high density class is at the upper end or above the NRV range in most GAs, except the Big Belts, Divide, and Upper Blackfoot (where it is in the middle of the range); and the Castles, where it is at the lower bound. Low/medium density forests were at the higher end of their NRV during warm/dry periods, whereas medium/high and high density forests were at the lowest end. In pine dominated forests, the mountain pine beetle outbreak may have recently caused changes in the forestwide averages.

Vertical structure does not have quantitative desired conditions; rather, it is imbedded in the descriptions of general terrestrial vegetation desired conditions. *Vertical structure* is categorized as single-storied (one canopy layer), two-storied (two canopy layers), or multistoried (three or more canopy layers). Vertical structure is driven by succession, individual species traits, and disturbances. Some cover types, such as spruce/fir, naturally develop a continuous canopy made up of multiple layers of shade tolerant species. Other types, such as lodgepole pine, tend to grow in dense, single-storied stands. The NRV analysis indicates that single-storied forests are more common than they were historically, while multi-storied forests are less common, especially in the warm dry and cold broad PVTs.

Landscape patch and pattern

The spatial pattern of vegetation can affect ecological processes, including wildlife and plant habitat and dispersal; disturbance risk, spread and size; reforestation; watershed health; carbon storage; wildlife habitat quality; and aesthetic values. Connectivity can be affected by natural factors such as topography, soils, variation in precipitation, and wildfire but also by human developments and activities. It is also one of the most complex attributes of ecosystems to quantify. The goal of assessing connectivity and pattern is to better understand the mosaic of conditions that make up a resilient landscape.

Heterogeneity is the quality of consisting of dissimilar elements, as with mixed habitats or cover types on a landscape (Turner, Gardner, & O'Neill, 2001). Heterogeneity on forest landscapes may occur as mosaics of patches generated by many events, but also may be created by single large events that occur infrequently (Kashian, Turner, Romme, & Lorimer, 2005). The ecological, social, and economic values that forests provide are heavily influenced by spatial patterns on the landscape (Turner, Donato, & Romme, 2013). Connectivity and pattern also influence the genetic flow of plant material, which has implications for the adaptability of vegetation. Seed dispersal strategies will depend on spatial heterogeneity and the suitability of future site conditions. Maintaining a robust genetic base is a primary foundation of resilience.

Generally, a resilient landscape is made up of a mosaic of age classes, composition, and successional stages because this ensures that not all areas are equally susceptible to the same drivers, such as wildfire and insects, at the same time. The spread of wildfires and the potential for large fire growth can be limited by reducing fuel continuity (Ager, Valliant, & Finney, 2010; Collins et al., 2008; Finney, 2003; Finney et al., 2007; Hessburg, Reynolds, Keane, James, & Salter, 2007; S. L. Stephens et al., 2009). Large landscapes where wildfires have been allowed to burn can develop such fuel heterogeneity; therefore, future fires could be limited in size relative to landscapes that have more homogeneous fuels (Bollenbacher, 2010; Collins et al., 2008; Rollins, Morgan, & Swetnam, 2002; Van Wagtendonk, 2004). Similarly, large expanses of forests with susceptible characteristics can create higher potential for bark beetle outbreaks (Fettig et al., 2007; Samman & Logan, 2000). For bark beetles, the severity of outbreaks and tree mortality can be reduced in extent by increasing the diversity of stand ages, size classes, and tree species (Bentz et al., 2010; Fettig et al., 2007).

It is not feasible to effectively analyze all of the possible metrics of landscape pattern, or to capture all of those that would be meaningful for all wildlife in the planning area. The abundance, average, and range of sizes of *early successional forest patches* (transitional and seedling/sapling size classes) have been identified as the key ecosystem characteristics to represent landscape pattern because this condition is quantifiable, represents likely patterns of older forests, and is meaningful for many species. Openings are created after a stand-replacing disturbance and are the most distinct and easily detectable structural conditions in a forested landscape because they are dominated by grass, forbs, shrubs, and short trees. They are meaningful to many wildlife species because of their distinctive composition and openness which affects the growth and survival of plants that wildlife depend on, and strong contrast to adjacent mid or late successional forest (e.g.“edge”). They also represent the initiation point in forest development, the foundation upon which rests the pattern of the future forest.

Table 51 compares results of the NRV with the current condition of early successional forest patches. In the first two rows of the table, a patch was included in the calculation for as long as it remained in the seedling/sapling size class. This provides the ecological picture of the extent and duration of forest openings. In the following two rows, the calculation includes seedling/sapling patches only for the first period (10 years) after their creation. The latter calculation was done to inform appropriate even-aged harvest openings, because NFMA requires that limits be placed on the maximum sizes allowed. In this context, a seedling/sapling patch would be considered a timber opening temporarily until regeneration is established. Please refer to the *Timber section 3.28.6, Effects common to all action alternatives*, for additional discussion on maximum even-aged timber harvest openings.

Table 51. Existing condition and NRV of average early successional forest patch size[1]

	Forestwide	Warm dry	Cool moist	Cold
NRV – average size	78 (45-119)	45 (30-70)	64 (44-84)	59 (39-84)
NRV – area weighted mean[2]	3,824 (160-12,973)	646 (46-2,703)	930 (142-2,664)	496 (73-1,482)
NRV – average size; 1 decade duration	82 (30-151)	43 (27-77)	67 (28-110)	51 (0-93)
NRV – area weighted mean[2]; 1 decade duration	3,066 (40-14,051)	406 (34-1,695)	804 (31-2,864)	346 (0-1,357)
Existing Condition – average size	163	91	133	76

[1]Patches had a minimum size threshold of 10 acres. Source: SIMPPLLE modeling.
[2]The area weighted mean patch size calculation is based on each patch getting a weight based on the size of the patch, with the bigger patches getting more weight.

The NRV analysis showed that there was rarely if ever a decade historically when there weren’t early successional forest patches created by disturbances. The majority of these disturbances were relatively small (as indicated by the arithmetic average); however, when large disturbances did occur, they were fairly large (as indicated by the area weighted mean). The large disturbances (e.g., fire and bark beetles) or series of disturbances within a one or two decade period would typically be associated with extended warm climatic periods and drought conditions.

The current average patch sizes are larger than the NRV ranges for average patch size. This is attributable to recent disturbances affecting large contiguous areas, particularly on the Rocky Mountain Range GA (wildfire) and Divide GA (bark beetles) respectively, whereas past disturbances were modeled to be smaller and more scattered. The Forestwide average patch size may be largely influenced by these disturbances that have occurred on only one or two GAs. This may indicate that in these areas in the past, forest conditions were more heterogeneous and disturbances tended affect smaller areas. However, there is also a body of literature that indicates broadly in the West, landscape fragmentation (caused by influences such as timber harvest, roads, and urban developments), and fire exclusion (caused by influences such as grazing and fire suppression) have generally resulted in fewer disturbances and smaller landscape patch sizes (USDA 2003). This condition is likely prevalent in those GAs that have had little recent disturbance. Please refer to the wildfire discussion in the NRV analysis (appendix I) for more context on the role of disturbances compared to the existing condition for each GA. The current average patch sizes are at the low end of the estimated ranges for area weighted mean patch size, which is an indicator of the largest patches that occurred in the NRV period. Forestwide, fire will continue to be the primary activity that creates early successional forest openings, particularly large openings.

When broken down by PVT, average sizes are smaller, which is partly a modeling artifact of large contiguous patches being broken apart by the finer mosaic of PVTs. Early successional patches in the warm dry and cold broad PVTs are smaller than in cool moist, due to a more frequent low severity disturbance regime which causes a complex mosaic of within-stand structures including small patches and canopy openings. Patches in the cool moist broad PVT tend to be larger, due to a preponderance of lodgepole pine and infrequent, high severity disturbances.

Benefits to people

Terrestrial vegetation contribute directly to several multiple uses and key ecosystem services identified for the HLC NF, including timber products, forest products, and wood for fuel. The vegetation on the landscape also provides the ecological basis for other more intrinsic services, such as water quality and quantity, clean air, outdoor recreation, scenery, fish and wildlife, carbon sequestration, flood control, and erosion control. Please refer to the ecosystem services specialist report for more information about multiple uses, key ecosystem services, and benefits to people.

3.8.6 Environmental consequences

Effects common to all alternatives

Most effects to terrestrial vegetation indicators are generally similar for all alternatives. Climate and drought coupled with natural disturbances have the potential to impact ecosystems much more so than human interventions, although management within that context may be important to reduce the potential for forest decline and/or ease transitions into new, more resilient states (Cohen et al., 2016; Golladay et al., 2016; J. Halofsky & Peterson, 2016; Millar & Stephenson, 2015). All alternatives were modeled with a similar climate regime and levels of disturbance. Disturbance regimes are the primary influences on vegetation, due to the extent of "unmanaged areas" (e.g. wilderness, RWAs, and IRAs). While vegetation treatments result in modified characteristics where they occur, the impacts are outweighed by other influences when the key indicators are summarized at broad scales.

Under all alternatives, fire suppression would continue to alter successional processes, although vegetation treatments may mitigate this influence where it occurs. Fire exclusion would tend to favor shade-tolerant species, small to medium size classes, and denser forests. Conversely, when they occur, fires may reduce density, return sites to an early successional stage, promote large tree growth, and/or favor fire tolerant species. Warmer, drier climates would influence species distributions and successional processes in complex and uncertain ways. For example, species better adapted to warm, dry conditions such as ponderosa pine may gain a competitive advantage, and drought may inhibit tree growth in some areas. Spatial heterogeneity would play important roles for the production of wildlife habitat, with thresholds in habitat quality, habitat connectivity, and/or patch size (Turner et al., 2013).

The effects section compares existing to desired conditions which are enumerated in the 2020 Forest Plan and appendix H of the EIS. The desired conditions reflect our best understanding of resilient forest conditions based in large part on the NRV analysis, and take into account future climate by adjusting for past trends demonstrated during warm/dry climate periods.

Ecosystem processes and disturbances

Vegetative succession

Under all alternatives, successional processes would continue to cause vegetation change, as described in the *affected environment* section.

Wildland fire

Under all alternatives, wildland fire would continue to affect the landscape under all alternatives, causing vegetation change as described in the *affected environment* section; specific projected acres are provided in the *Effects that vary by alternative* section.

Forest insects and diseases

Under all alternatives, forest insects and diseases would continue to affect the landscape, causing vegetation change as described in the *affected environment* section. There would be continued damage and mortality from native pests and pathogens currently present on the HLC NF (e.g., mountain pine beetle, Douglas-fir beetle, western spruce budworm, root disease). Specific hazard ratings and projected acres of activity by these native pests are provided in the *Effects that vary by alternative* section.

There is also likely to be continued activity of known non-native agents such as the balsam woolly adelgid and white pine blister rust. Given that the presence of balsam woolly adelgid has been noted in several GAs, it is likely that this pest may become more active and spread into additional GAs in the future, with an associated risk of damage and mortality to subalpine fir forests. The level of potential damage is not known, although mortality from this pest in Oregon, Washington, and Idaho has been extensive as discussed in the *affected environment* section.

There would also be the potential for new insects and pathogens not currently present to enter the planning area. It is not known if, where, and when such insects may become active on the HLC NF, and potential future activity is unquantifiable.

Climate and drought

In the western U.S., it is likely that water balance and disturbance dynamics will be more important than increased temperature in affecting vegetation. Longer, warmer growing seasons may increase growth rates; however, greater soil water deficits and increased evapotranspiration in the summer may offset this. Growing sites on the HLC NF are generally moisture-limited as opposed to energy-limited. Therefore, warm/dry climatic periods result in slower growth and decrease the ability of a site to support vegetation. Tree stress can also lead to higher mortality rates indirectly through susceptibility to insects or disease. Increasing soil water deficits can cause eventual shifts in species presence as they become less able to regenerate or survive; species located on sites at the margin of their optimal range would be most vulnerable. Species extent and distribution would be consequently impacted. East of the Continental Divide on the HLC NF planning area, the tree species most vulnerable to climate change include ponderosa pine, limber pine, quaking aspen, and cottonwood (J. E. Halofsky et al., 2018a). West of the Divide, Engelmann spruce, subalpine fir, and lodgepole pine are also considered relatively vulnerable (ibid).

Nonforested communities would also be affected by climate and drought. Climate change may increase growing season length and net primary production in these systems (J. E. Halofsky et al., 2018b). In grasslands, drier and hotter droughts are unlikely to drive a state change; however, woodland and savanna systems are more likely to undergo a state transition due to drought and/or associated disturbances (Breshears et al., 2016). Potential shifts from shrublands to grasslands would most be the result of drought interactions with disturbance, and not drought alone (ibid). Grasslands may become more dominant as shrublands and lower montane conifer forests are unable to regenerate; this may also lead to the expansion of invasive species into grasslands (J. E. Halofsky et al., 2018b). Responses and vulnerabilities would vary by vegetation type; for example, big sagebrush species may expand as habitat suitability increases, but may decrease in many locations due to increased fire activity (ibid). Invasive species control and grazing management will be important in maintaining and increasing the resilience of nonforested vegetation communities to climate change (ibid).

Climate changes are also expected to affect disturbances, although there is a high degree of uncertainty with extrapolation to local sites. Studies of potential effects of climate change on fire and insects/disease suggest the following may occur across the western U.S (J. E. Halofsky et al., 2018b): longer fire seasons, more days of high fire danger, increased frequency of ignitions, more frequent large fires, more episodes of extreme fire behavior, and increased average annual area burned; and elevated levels of native insects because they are able to migrate to new environments at a faster rate than trees. Mid-elevation forests are projected to have a high risk of climate-induced increase in fire, and increases in the area burned by fire are likely in lower and middle elevations of mountainous areas; however, in areas that are fuel-limited, fires may become more infrequent where there is insufficient moisture for fine fuel accumulation (ibid). Whether it is invasive species, drought, uncharacteristic wildfires, elevated native insects and disease levels, unusually high forest densities, or some other agent or combination of agents that serves to stress trees and forest ecosystems; recent research suggests that climate change will likely exacerbate those stressors and "stress complexes" will manifest themselves (J. E. Halofsky et al., 2018b).

Increasing air temperature, through its influence on soil moisture, is expected to cause gradual changes in the abundance and distribution of tree, shrub, and grass species throughout the Northern Rockies, with drought tolerant species becoming more competitive (J. E. Halofsky et al., 2018b). In the eastern zone of the Northern Rockies Adaptation Partnership area, these shifts may include trends such as the retraction of ponderosa-pine/Douglas-fir forests; expansion of lodgepole pine/aspen forests, sagebrush and woodland communities; and little change in abundance of whitebark pine/spruce/fir forests (figure 6A.3 and 4 in (J. E. Halofsky & Peterson, 2018). The projections for distribution changes are highly uncertain due to uncertainties of interactions among species and disturbance. Despite potential shifts in overall abundance and location, all of these types are predicted to remain on the landscape. The vulnerabilities of ponderosa pine and Douglas-fir specifically are related to the potential loss of seed sources from large and intense wildfires, although drought might also result in competitive advantages for these species on some sites (ibid).

There is a body of science that indicates there are risks to the persistence of forests presented by climate change, drought, and disturbances. It is not possible to predict with precision the timing and magnitude of potential species shifts or forest decline on the HLC NF; managing to support the full range of diversity indicated by the NRV and emphasizing forest resilience is the best strategy to enable vegetation communities to respond and adapt to climate changes over time, as described in appendix H. The action alternatives address these uncertainties by establishing a suite of desired conditions and other plan components designed to promote forest resilience, along with a monitoring plan and emphasis on adaptive management concepts. The following sub-sections provide a more detailed discussion of climate-related risks to forest vegetation persistence, which are present under any alternative.

Drought and megadisturbances

There is a body of science that indicates there are risks to the persistence of forests presented by climate change, drought, and disturbances. The magnitude of this risk on the HLC NF is uncertain; however, this section provides a discussion of those risks, which are present under any alternative.

Altered temperature and/or precipitation regimes are expected to result in substantial changes in forest composition, structure and function; these changes are likely to occur most rapidly when facilitated by disturbances (Rother & Veblen, 2016). Drought alters ecosystem processes in ways that are not yet well understood (Vose, Clark, Luce, & Patel-Weynand, 2016). Decreases in summer precipitation and associated summertime aridity increases will likely lead to more burned area across the Western U.S (Holden et al., 2018). There is potential for amplified tree mortality due to drought and heat in forests; however, scientific uncertainties currently prevent reliable determination of actual mortality trends (Allen et al., 2010). Forest growth rates (and carbon sequestration capacity) may be negatively impacted by climate stress (Charney et al., 2016). In some systems, reduced resilience of forest ecosystems to the impacts of climate warming and wildfire may suggest that shifts from forest to nonforested vegetation may be underway (Stevens-Rumann et al., 2017).

There is an increasing potential for "megadisturbances" due to persistent drought combined with high temperatures; such disturbances would be capable of driving tree mortality of a spatial extent, severity, and frequency surpassing that recorded during recent human history (Abella & Fornwalt, 2014; Millar & Stephenson, 2015) (Wong & Daniels, 2016). Such events can result in shifts in forest structure and function, including shifts to nonforested vegetation when seed sources are removed from large areas and/or climate conditions are not conducive for seedling establishment ((Wong & Daniels, 2016). Further, the concept of a "hotter drought" (a drought accompanied by warmer temperatures) has been used to predict greater forest vulnerability, based on the concept that mortality can occur faster relative to the growth intervals needed for forest recovery (Allen, Breshears, & McDowell, 2015). Also, because of the stress caused by drought, tree mortality from fire may increase even if fire behavior remains constant (van Mantgem et al., 2013). However, tree mortality may be mediated by prefire stand conditions and tree vigor, supporting the idea that resilience to disturbances may be encouraged by lowering stand densities and reducing fuels to ameliorate fire severity (Abella & Fornwalt, 2014; van Mantgem, Falk, Williams, Das, & Stephenson, 2018).

Further, Abella and Fornwalt (2014) note that while extreme perturbations can devastate some ecosystem components, others can be benefited; examples could include increases in species richness of forbs and shrubs, and reduced density of regenerated forests. While extreme climatic events may trigger vegetation shifts, there is also evidence of stabilizing processes that minimize and counteract the effects of these events, reinforcing community resilience (Lloret, Escudero, Iriondo, Martínez-Vilalta, & Valladares, 2012). Stabilizing processes can include those that mitigate mortality; and those that compensate for mortality. Plant response to extreme climatic events is variable and does not necessarily result in the replacement of established vegetation (ibid). Still, vegetation change could occur, particularly if new climate/disturbance conditions remain pervasive (ibid). More research is needed to identify thresholds for potential vegetation shifts given stabilizing processes.

Regeneration dynamics

Given that increases in wildfire size and severity are expected, preservation of forest ecosystem functions will increasingly depend on regeneration (Dodson & Root, 2013). In other words, forest resilience is dependent on tree regeneration. Two critical variables in the success of regeneration are site climate and distance to seed source, both of which are influenced by climate, drought and disturbances (Davis et al., 2019). A key component in forest decline (the progressive and widespread decrease in forest health from the cumulative effects of multiple abiotic and biotic factors) is the failure to regenerate after disturbance Forest decline can result from novel disturbances; such declines have been reported in the American west, as in the case of whitebark pine and aspen (Wong & Daniels, 2016). Because there are strong links between moisture availability and tree regeneration for many conifer species, climate warming may decrease the frequency of seedling establishment events (Andrus, Harvey, Rodman, Hart, & Veblen, 2018). As compared to the 20th century, Stevens-Rumann and others (2017) found that post-fire regeneration in both moist and dry forests across the West declined in the 21st century, and that the key driver was warmer and drier climate conditions. In the Northern Region specifically, projected climate changes will probably result in smaller and more ephemeral microsites for regeneration; the size, distribution, and duration of suitable microsites may vary more each year (J. E. Halofsky et al., 2018a).

The ability of dryland forests to persist in their current ranges and to colonize new habitats may decline as the prevalence and rate of disturbance increases (Petrie et al., 2017). Particularly in dry coniferous forests, moisture stress is a critical factor limiting regeneration after stand-replacing fire (Dodson & Root, 2013). Given the predicted increases in drought in the coming century, strongly moisture-limited forested sites may fail to regenerate for extended periods (ibid). Climate change may restrict dryland forest persistence by the end of the 21st century by reducing the likelihood of successful regeneration (Petrie et al., 2017);(Stevens-Rumann et al., 2017). Davis and others (2019) found that there were distinct thresholds for recruitment in low-elevation ponderosa pine and Douglas-fir forests based on vapor pressure deficit, soil moisture, and maximum surface temperature; and that climate conditions have become increasingly unsuitable for regeneration, which may lead to ecosystem transitions. Increases in fire severity in dry forests exacerbates the regeneration issue because post-fire seed sources become more limited. Wildfires may also catalyze vegetation change by killing adult trees that could otherwise persist in climate conditions no longer suitable for seedling establishment and survival (Davis et al., 2019). Regeneration success is also influenced by other physiological and environmental factors, some of which can be manipulated through active management to a degree (such as thinning to improve availability of growing space while not increasing surface temperatures).

In the example of ponderosa pine across the western U.S., Petrie and others (2017) found that forest regeneration potential may increase from 2020-2059, but continued higher temperatures and lower moisture availability will limit seedling survival and reduce regeneration potential in 2060-2099; and, in fact, the *scopularum* variety (as is found on the HLC NF) may be more likely to experience range constriction than the other varieties. Dodson and Root (2013), found a lack of ponderosa pine regeneration at low elevations after a severe fire area in Oregon, while seedling establishment improved at higher elevations where moisture was more available. Similarly, Rother and Veblen (2016) found that ponderosa pine and Douglas-fir post-fire regeneration in Colorado was most limited in xeric settings; and Stevens-Rumann and others (2017) found similar trends. Such findings underscore the importance of restoration treatments which can reduce fire severity, thereby increasing the chances that seed trees will survive to provide seed and shade to reduce moisture stress (Dodson & Root, 2013).

In some cases, the establishment of lower seedling densities may be consistent with long-term restoration goals related to lower stand densities, and may reduce the future hazard of high severity fire (Rother & Veblen, 2016). However, some dry forest sites may convert to nonforested plant communities for a substantial amount of time, or permanently, following fires, especially in xeric settings or where no nearby seed source remains (Rother & Veblen, 2016); (Stevens-Rumann et al., 2017). Such an example has already occurred in the northern Big Belts GA, where a severe fire in the 1980's (followed by a reburn decades later) resulted in conversion of some ponderosa pine sites to grasslands.

The risk of changing regeneration dynamics is not limited to dry forests. Several studies have found that post-fire seedling establishment of moist and subalpine forests may decline due to drought and wildfire (Andrus et al., 2018; Harvey, Donato, & Turner, 2016; Stevens-Rumann et al., 2017). Stevens-Rumann and others (2017) found that moist forests may be more likely to experience a shift in forest structure or species composition, rather than a shift to a nonforested state. Similarly, Urza and Sibold (2016) found that post-fire regeneration in Glacier National Park showed shifts from multi-species to more single-species and that drier-than-average post-fire climate conditions favored regeneration by species such as lodgepole pine. Kueppers and others (2016) found that Engelmann spruce may retract rather than move higher in elevation, because of the effects of warming on seedling recruitment, whereas limber pine was less sensitive to warming and may become a more important component of subalpine forests.

Regeneration declines may occur because some species in moist forests, such as Engelmann spruce and subalpine fir, have "pulses" of establishment that occur in years with above-average snowpack with relatively cool and wet summers; as such conditions become more rare, seedling establishment for these species may be negatively impacted, resulting in reduced density or a shift in vegetation type (Andrus et al., 2018). Because these species are long-lived, longer intervals between establishment events may be insignificant in some cases. However, increases in tree mortality in combination with declining establishment events may drive novel changes in some subalpine ecosystems (ibid). Even though subalpine forests are adapted to regenerating after stand-replacing fire, successful establishment may be compromised if the burned patch size exceeds seedling dispersal distances; and/or climate conditions do not align with seeding events or inhibit survival of germinants. Harvey and others (2016) found that regeneration of subalpine forests after stand-replacing fire declined with post-fire drought severity and with greater distance to seed sources, except for lodgepole pine (due to serotinous seed).

The net effect of climate warming and increased fire activity may include decreases in tree densities in subalpine forests (Harvey et al., 2016). This does not necessarily indicate that the forest will disappear. Species compositions may shift; for example, lodgepole pine would be expected to fare better than Engelmann spruce and fir. Where post-fire seedling establishment of subalpine species is reduced, establishment may increase for upper treeline or montane species. Other species that occur in these areas, such as Douglas-fir, whitebark pine, and aspen appeared to be relatively unaffected by post-fire drought severity in terms of post-fire seedling establishment; and other factors such as microsites and topography would also influence establishment (ibid). Still, in some cases the future post-fire seedling establishment may decrease, and lead to some conversions from forest to nonforest vegetation.

Vegetation treatments

Vegetation treatments such as prescribed fire and timber harvest can directly influence vegetation conditions and help move towards desired conditions. Vegetation treatments would be consistent with all plan components and be designed to achieve stated objectives and desired conditions. Some treatments may be neutral relative to achieving vegetation desired conditions, where other plan desired conditions are emphasized (e.g., removing vegetation along utility lines), but would not preclude the potential to achieve any desired condition at the broader scale. Altering vegetation conditions can also influence the susceptibility of stands or landscapes to disturbances such as wildfire and forest insects. Severity or extent of these disturbances could be reduced by treatments that increase the resistance or resilience of vegetation, such as favoring certain species, more open stand densities, certain size classes, and/or reducing surface and ladder fuels (e.g., (Agee et al., 2000; Amman & A., 1998; Egan, Kegley, Blackford, & Jorgensen, 2014; Hessburg et al., 2005; Shore, Safranyik, Riel, Ferguson, & Castonguay, 1999).

Vegetation composition and structure

The trend of existing conditions relative to the desired conditions over time is the primary analysis tool for terrestrial vegetation. Due to the long lifespan of tree species, it is not expected that all desired conditions be achieved during the modeling timeframe (50 years). The primary causes of vegetation change summarized at the broad scale are natural disturbances and processes.

Appendix H provides matrices that compare the position of existing conditions versus conditions in 50 years to the desired conditions. Each combination of attribute (e.g., cover type, tree species presence, size class, density class, large-tree structure, vertical structure, and patch size) and scale of interest (e.g. forestwide, by broad PVT, or by GA) is included, for a total of 344 unique factors that are above, below, or within the desired condition range. The positions of these factors relative to the desired condition range can be compared to assess the degree of movement towards or away from desired conditions over the 50 year analysis period (Table 52). The model predicted other subtle shifts relative to desired conditions, but the magnitude was not sufficient to shift the position; e.g., a condition that may have moved closer to the range but remained outside of the range would still be counted as outside the desired range. The model predicted an overall improvement in the similarity of composition and structure to desired conditions in 50 years. Based on 2018 conditions, 48% of the composition and structure attributes are within the desired range, or at the upper or lower bound. In 50 years, the model projects that 63% would be within the desired range or at the upper or lower bound.

Table 52. Position of vegetation attributes (number of unique combinations) relative to desired conditions

Relative position to desired condition	Existing	50 years
Within the desired range	101	118
At lower or upper bound threshold	64	97
Outside the desired range	179	129

Potential trends away from desired conditions

Despite an overall improvement in composition and structure, there are attributes predicted to move away from the desired condition (although in some cases wide confidence intervals make this determination uncertain). These trends are similar for all alternatives. The projected trends that vary from desired conditions are not a result of FS management; rather, they are caused by natural disturbances and processes. Model predictions are based on potential future fire scenarios; the actual size, timing, and location of disturbance events is uncertain, and therefore results should not be considered to be precise prediction of the future. The predicted trends represent a risk that some components would trend away from the desired condition. This risk is mitigated by the following factors:

- The 2020 Forest Plan for the action alternatives is constructed to provide ecological integrity, by enumerating desired conditions that are based on the NRV and other BASI informing future resilience. All management actions within FS control would be designed to move towards desired conditions; and be consistent with all other plan components.
- Implementation of the plan would be based on monitoring of actual conditions as compared to the desired condition, and management practices could be adjusted if needed based on that information.

Table 53 lists the attributes that do not move towards desired conditions during the modeling timeframe and identifies the plan components under the action alternatives that would ensure FS management actions would be designed to move towards them. Alternative A does not contain analogous components.

Table 53. Vegetation attributes predicted to move away from desired conditions

Attribute	Predicted trends away from desired conditions	Relevant plan components
Nonforested cover type	The mean abundance increases above the desired range in the warm dry PVT, and in the Crazies, Divide, Little Belts, Snowies, and Upper Blackfoot GAs. Relevant plan components are those that describe the desired proportions of forested versus nonforested cover types; and those that ensure reforestation after harvest or natural disturbances.	FW-VEGT-DC-01; 02 FW-VEGT-GDL-02; 03 FW-VEGNF-DC-01; 03 FW-VEGNF-GDL-01 FW-TIM-STD-02 DI, SN, UB-VEGNF-DC-01
Presence of Rocky Mountain juniper	The mean abundance increases above desired ranges Forestwide, in the warm dry PVT, and in the Big Belts, Elkhorns, and Highwoods GAs. Relevant plan components are those that describe fire and fuel conditions; the desired presence of juniper; and nonforested vegetation.	FW-FIRE-DC-02 FW-VEGT-DC-01 FW-VEGF-DC-01 FW-VEGNF-DC-03 FW-VEGNF-GDL-01 BB, EH, HI-VEGF-DC-01 BB, EH, HI-VEGNF-DC-01 SN-VEGF-DC-04
Douglas-fir cover type and species presence	The mean Douglas-fir cover type abundance stays below the desired range in the Highwoods GA. The mean presence of Douglas-fir decreases below the desired range in the warm dry PVT and in the Highwoods GA but increases above the desired condition in the Snowies GA. Relevant plan components are those that describe cover type and tree	FW-FIRE-DC-02 FW-VEGT-DC-01 FW-VEGF-DC-01 FW-VEGNF-DC-03 FW-VEGNF-GDL-01 HI-VEGT-DC-01

Attribute	Predicted trends away from desired conditions	Relevant plan components
	species presence and those for fire/fuels and nonforested vegetation types where Douglas-fir is encroaching.	HI, SN-VEGF-DC-01 HI, SN-VEGNF-DC-01
Lodgepole pine cover type and species presence	The cover type mean abundance increases above the desired range in the cool moist PVT. Both the cover type and species presence remain static and above the desired range in the Divide GA; and decreases away from the desired range in the Snowies. Relevant plan components are those that describe cover type and tree species presence at those scales.	FW-VEGT-DC-01 FW-VEGF-DC-01 DI, SN-VEGT-DC-01 DI, SN-VEGF-DC-01
Spruce/fir cover type and species presence of subalpine fir and Engelmann spruce	The cover type abundance decreases away from desired range in cold PVT and Upper Blackfoot GA; and stays static below the desired range in the Little Belts and Rocky Mountain Range GAs. The presence of subalpine fir increases above the desired range Forestwide, in the cool moist PVT, and in the Big Belts and Little Belts GAs; and declines below the desired range in the cold PVT. The presence of Engelmann spruce increases above desired condition in cool moist PVT; declines below desired range in the Crazies; and remains static above the desired range in the Elkhorns, Little Belts, and Snowies GAs. Relevant plan components are those that describe cover type and tree species presence; as well as those for lynx habitat.	FW-VEGT-DC-01 FW-VEGF-DC-01 BB, CR, EH, LB, RM, SN, UB-VEGF-DC-01 LB, RM, UB-VEGT-DC-01 DI, RM, UB-WL-DC-01 Appendix F
Seedling/sapling size class	Mean abundance remains above the desired condition forestwide; and increases above the desired range in warm dry PVT, and the Big Belts, Castles, Divide, Elkhorns, and Little Belts GAs. Relevant plan components include those for desired size classes and those for even-aged regeneration harvest openings and landscape pattern.	FW-VEGT-DC-01 FW-VEGF-DC-02, 08 FW-TIM-STD-08, 09 BB, CA, DI, EH, LB-VEGF-DC-02
Medium size class	Mean abundance remains below the desired range in the Big Belts, Castles, Crazies, Elkhorns, Highwoods, and Little Belts GAs. Increases above the desired range in the Rocky Mountain Range GA; and remains above the desired range in the Snowies GA. Relevant plan components include those for desired size classes.	FW-VEGT-DC-01 FW-VEGF-DC-02 BB, CA, CR, EH, HI, LB, RM, SN-VEGF-DC-02
Very large size class	Mean abundance remains static and below the desired range at all scales of analysis. Relevant plan components include those related to desired size classes forestwide and in the GAs, as well as those associated with large-tree structure and retention of large trees.	FW-VEGT-DC-01 FW-VEGF-DC-02 FW-VEGF-DC-04 FW-VEGF-GDL-01 BB, CA, CR, DI, EH, HI, LB, RM, SN, UB-VEGF-DC-02
None/low/medium density class	Mean abundance increases above the desired range forestwide, in warm dry PVT, and in the Big Belts, Castles, Crazies, Divide, Little Belts, and Upper Blackfoot GAs. Relevant plan components include those for desired density classes as well as those for nonforested vegetation.	FW-VEGT-DC-01 FW-VEGF-DC-03 FW-VEGNF-DC-01; 03 FW-VEGNF-GDL-01 BB, CA, CR, DI, LB, UB-VEGF-DC-03
Medium/high density class	Mean abundance remains or moves below desired range Forestwide, in the warm dry PVT, and in the Big Belts Castles, Crazies, and Upper Blackfoot GAs. Relevant plan components include those for desired density classes.	FW-VEGT-DC-01 FW-VEGF-DC-03 BB, CA, CR, UB-VEGF-DC-03
High density class	Mean abundance decreases below the desired range in the warm dry PVT, and in the Castles, Crazies, and Highwoods GAs. Relevant plan components include those for desired density classes.	FW-VEGT-DC-01 FW-VEGF-DC-03 CA, CR, HI-VEGF-DC-03

Effects from forest plan components associated with:

Air quality

Under all alternatives, prescribed fire operations would adhere to federal and state air quality regulations and smoke management plans. To the extent that this limits the potential to apply fire to the landscape, it may hinder the achievement of vegetation desired conditions in some locations as well as increase costs. This potential effect would be the same for all alternatives.

Invasive plants

Under the no-action alternative, the 1986 Forest Plans include plan components designed to limit the extent and spread of invasive plants. These components would encourage invasive plant control activities that in turn promote the health of native vegetation, especially in nonforested plant communities. The action alternatives note the desire for healthy terrestrial plant communities by limiting the impacts from nonnative invasive plants (FW-INV-DC-01, 02, 03), which would benefit terrestrial vegetation. FW-INV-STD-01 would require that appropriate mitigation measures for invasive plants be implemented for all projects, which would increase the cost of vegetation management activities (such as harvest); however, this effect would be outweighed by the positive effects of limiting the influence of invasive plants. Although plan components vary, the effect to terrestrial vegetation is similar for all alternatives.

Grizzly bear habitat management

The HLC NF has incorporated the "Forest Plan Amendments to Incorporate Habitat Management Direction for the Northern Continental Divide Ecosystem Grizzly Bear Population" into the 1986 Helena NF and Lewis and Clark NF plans. Management direction in this amendment has been retained in the 2020 Forest Plan. Management for grizzly bears may affect terrestrial vegetation as a result of components that limit the miles of road access and duration of project activities such as timber harvest and prescribed fire. However, as shown in the Timber section, habitat management for grizzly bears would have a very small influence on timber harvest. Further, it would not have an impact on reforestation or prescribed burning associated with harvest, because exceptions apply to allow access to perform these activities. Some specific project design elements would be applied to all vegetation management, such as reducing the risk of human-bear conflicts and retaining cover along a portion of grass/forb/shrub openings, riparian wildlife habitat, or wetlands. These design elements would not preclude achievement of desired conditions for terrestrial vegetation. Overall, the extent to which timber harvest and prescribed fire may be used to achieve desired terrestrial vegetation conditions is not greatly affected by habitat management for grizzly bears.

Recreation access and infrastructure

All alternatives provide for access to the forest. There are minimal effects to terrestrial vegetation from the system of roads and trails, other than the removal of vegetation on the routes themselves; this removal does not substantially impact vegetation conditions at the broad scale. Roads may also contribute to altering landscape patterns to the degree that they influence or constrain disturbances such as wildfire. The introduction of noxious weeds and facilitation of public activities (such as camping and firewood cutting) that impact vegetation would also cause potentially negative effects near roads, trails, and facilities. A positive effect is that road access increases the feasibility of treatments to manage vegetation to move towards desired conditions. Conversely, limits related to road access on existing roads as well as construction of new roads (permanent and temporary) could have an impact on the ability to conduct vegetation treatments that require road access, particularly mechanical treatments, across portions of the forest. All alternatives are similar in terms of access and infrastructure effects to vegetation.

Designated wilderness and wilderness study areas

Plan components in all alternatives for designated wilderness and wilderness study areas support the laws that created these designations, which are beyond the scope of forest planning. No vegetation management would generally occur (FW-WILD-SUIT-03; FW-WSA-SUIT-01). To the extent that this limits the application of timber harvest or prescribed burning, these designations would limit the potential to contribute to vegetation desired conditions. This limitation would also apply to activities such as tree planting, which results in an inability to accelerate post-disturbance reforestation, or to conduct restoration planting for species such as whitebark pine. However, despite the potential for some fire suppression to occur, natural disturbances would have the potential to impact these areas to a large degree, which may also move landscapes towards desired conditions if those disturbances occur at a scale and severity within the NRV. It is also possible that disturbances may delay movement toward desired conditions in some cases, if they occur outside of the bounds of the natural regime, or because natural recovery after disturbances may take a long time. These effects would be prominent specifically in the Rocky Mountain Range and Snowies GAs, where these designations make up a majority of the acres, and also influence the Little Belts and Big Belts GAs. It is unclear the magnitude of the net value of these effects (positive or negative) relative to terrestrial vegetation desired conditions as a whole; but would be the same for all alternatives.

Inventoried roadless areas

Plan components in the action alternatives for IRAs are consistent with the executive order that created them. Although alternative A does not include plan components for IRAs, the limitations specified in the Roadless Area Conservation Rule would apply; therefore, the effects are the same for all alternatives. Limits to vegetation management apply; while some harvest may occur, it is limited to certain purposes and sizes of trees (FW-IRA-SUIT-01). To the extent that this limits the application of timber harvest (as described in the timber section), this designation would limit the potential to contribute to vegetation desired conditions using harvest. Prescribed fire may also be used, however (FW-IRA-SUIT-03), and there are no limitations for activities such as tree planting, which could occur to accelerate post-disturbance reforestation or to restore species such as whitebark pine. In addition, while fire suppression may occur, natural disturbances would have the potential to impact these areas, and these events may also serve to move landscapes towards desired conditions, if those disturbances occur at a scale and severity within the NRV. It is also possible that disturbances may delay movement toward desired conditions in some cases, if they occur outside of the bounds of the natural regime. These effects would be prominent in portions of all the GAs. It is unclear the magnitude of the net value of these effects (positive or negative) relative to terrestrial vegetation desired conditions as a whole.

National recreation trails, Lewis and Clark Historic Trail, Continental Divide National Scenic Trail

Under the no-action alternative, the 1986 plan components for the Continental Divide National Scenic Trail point to the comprehensive management plan for the trail and emphasizes visual quality; but the other national and historic trails are not explicitly addressed. 2020 Forest Plan components address all of these trails in more detail and include considerations for vegetation management to ensure it is conducted in a manner consistent with the values of each trail (e.g. FW-NRT-GDL-01, FW-LCHT-GDL-02, FW-CDNST-GDL-02, 03). These components would not preclude treatments such as harvest or prescribed fire, although other land designations along the trails may. Rather, the plan components for these trails would alter the design of site-specific treatments immediately adjacent to them. Designing treatments to meet the guidelines associated with these trails would not necessarily be inconsistent with desired vegetation conditions, and in many cases would be complementary. Therefore, potential for movement towards terrestrial vegetation desired conditions in areas adjacent to nationally recognized trails would not be substantially limited by plan components under any alternative.

Tenderfoot Creek Experimental Forest

The Tenderfoot Creek Experimental Forest is designated under all alternatives, and while the plan components are articulated differently, the effect of them is the same. It is included in management area K in the 1986 Lewis and Clark NF plan, alternative A. The standards and guidelines in management area K are consistent with those in the 2020 Forest Plan alternatives, which include:

- LB-TCEF-DC-01 specifies that this area should provide the vegetation conditions and management opportunities to support research and demonstration activities; therefore, this area would not necessarily contribute to terrestrial vegetation desired conditions at the broader scale.
- LB-TCEF-SUIT-04 states this area is not suitable for livestock grazing; this is a positive effect to nonforested vegetation and complementary to nonforested vegetation plan components.

King's Hill Scenic Byway

With the no action alternative, the area around the scenic byway is included in management area A (1986 Lewis and Clark NF plan), which emphasizes high scenic values. The King's Hill Scenic Byway is designated as an emphasis area in the 2020 Forest Plan action alternatives. LB-KHSB-DC-01 ensures the lands visible from this highway are natural-appearing with high scenic quality; and LB-KHSB-GDL-01 ensures that management activities would be consistent with a scenic integrity objective of high or better, as well as protect and enhances the historically relevant natural and cultural resources of the area. To a small degree these components may limit certain types of vegetation management but would not necessarily be inconsistent with the desired conditions for terrestrial vegetation, and not likely to preclude their achievement at the broad scale.

Rocky Mountain Front Conservation Management Area

The no-action alternative does not contain plan components for the Rocky Mountain Front Conservation Management Area; however, this area was established by law in 2014, and therefore the management guidance in that law would apply to all alternatives. The action alternatives include plan components to support the values of the area, designed to conserve, protect, and enhance recreational, scenic, historical, cultural, fish, wildlife, roadless, and ecological values (RM-CMA-DC-01). RM-CMA-DC-02 specifies that the vegetation and forest conditions provide for public health and safety, recreational settings and user experiences, enhance scenic values, and protect facilities and infrastructure. RM-CMA-SUIT-01 specifies that the areas is not suitable for timber production although harvest may occur. The considerations in the law, and the action alternative plan components, are generally consistent with terrestrial vegetation desired conditions, and at a minimum would not preclude their achievement at the broader scale. Other designations that overlap with this area may have more of an impact on the terrestrial vegetation (e.g., IRAs).

Cultural, historic, and tribal resources

There would be negligible effects to terrestrial vegetation from plan components associated with cultural, historic, and tribal resources. Under all alternatives, plan components for these resources may influence the design of projects at a site-specific scale but potential limitations with regards to manipulating vegetation to meet desired conditions would be small.

Land status, ownership, and uses

All alternatives include plan components associated with land status, ownership, and uses. The timber section discusses these components relative to access to conduct vegetation management; this discussion also applies to the resulting ability to move terrestrial vegetation towards desired conditions. In addition, plan components that encourage the acquisition of lands within or adjacent to NFS lands would have the potential to improve landscape pattern and connectivity of terrestrial vegetation. This effect would be similar for all alternatives.

Livestock grazing

In all alternatives, livestock grazing would occur in allotments on the HLC NF. Grazing and trampling can negatively affect terrestrial vegetation by causing compaction or erosion; damaging native plants and aspen; damaging tree seedlings (which may affect reforestation success); and/or increasing the spread of invasive plants. Grazing can also influence vegetation by altering fire regimes and behavior. In some cases, the reduction in fine fuels caused by grazing could be beneficial to maintaining low fire hazard. In others, grazing can contribute to fire exclusion and increase the opportunity for conifer encroachment in nonforested plant communities.

However, all alternatives include plan components to mitigate the risks of these impacts and emphasize adaptive management with respect to grazing practices. The 1986 Forest Plans include forestwide standards which provide guidance to promote the health of native vegetation and protect riparian areas, soils, and water quality. Plan components under the action alternatives would ensure that grazing is managed to promote sustainable and vigorous native plant communities, especially nonforested and riparian areas (FW-GRAZ-DC-02, FW-GRAZ-STD-02, and all FW-GRAZ-GDLs). Further, there is also a plan component that would ensure grazing does not adversely impact the regeneration of forests or reseeding of nonforested areas with desirable native vegetation (FW-VEGT-GDL-02). Further, EH-WL-GDL-03 would enhance nonforested vegetation health by limiting livestock animal unit months to no higher than existing levels in the Elkhorns and would be reduced if needed to address impacts to wildlife forage or wildlife habitat. Based on these plan components, livestock grazing likely has a neutral effect on the potential to achieve terrestrial vegetation desired condition at the broad scale, although there is potential for site-specific negative impacts to occur especially to aspen and nonforested plant communities, including riparian areas. Although plan components for grazing vary across alternatives, the resulting effects to terrestrial vegetation are similar across alternatives.

Mining and mineral extraction

Generally, the impacts to terrestrial vegetation from mineral extraction are localized (such as the removal of incidental trees on a small scale), and minor at the forestwide scale with respect to terrestrial vegetation desired conditions. The 1986 Forest Plans included a suite of components designed to protect resources from potential damage associated with mining activities. Similarly, under the action alternatives, plan components include FW-EMIN-DC-07 and FW-EMIN-GDL-01 and 02 which would help ensure that the desired conditions of riparian vegetation can be met or not precluded. The combination of existing law, regulation, and policy and plan components for mining results in a similar level of protections for terrestrial vegetation across all alternatives.

Effects common to all action alternatives

A summary of expected effects from terrestrial vegetation plan components under all action alternatives is shown in Table 54.

Table 54. Summary of 2020 Forest Plan components for terrestrial vegetation

Plan component(s)	Summary of expected effects
FW-VEGT-DC-01	The description of desired vegetation conditions for all broad PVTs summarizes function, composition, structure, and pattern; states that vegetation should support at-risk species; and addresses connectivity and climate change. This guidance would ensure that all projects, activities, and prescriptions share a vision of desired vegetation.
FW-VEGT-DC-02; FW-VEGF-DC-01, 02, 03; and BB, CA, CR, DI, EH, HI, LB, RM, SN, UB-VEGT-DC-01; VEGF-DC-01, 02, 03.	These plan components enumerate the desired conditions of cover type, tree species presence, size class, and density class forestwide, by broad PVT, and GA. Collectively, the effect is that vegetation would be managed to achieve or move towards the desired conditions, and therefore provide for ecological integrity and the coarse filter of wildlife habitat, based on concepts of the NRV and resilience, with considerations for climate change vulnerabilities and adaptation options, based on the BASI for the HLC NF.
FW-VEGT-DC-03	This desired condition emphasizes the coarse-filter role of vegetation to support terrestrial and aquatic species. This would ensure that project analyses would consider specific habitat needs when determining appropriate actions on the landscape, within the context of the coarse filter.

Plan component(s)	Summary of expected effects
FW-VEGT-DC-04, FW-VEGF-DC-08	These desired conditions would ensure that landscape patch, pattern, and connectivity are considered during forest plan implementation.
FW-VEGT-DC-05	This desired condition recognizes that vegetation within certain permitted or designated areas may be unique to those areas and would ensure these considerations are applied during forest plan implementation.
FW-VEGT-DC-06	This desired condition would ensure that managers recognize and consider the importance of bryophytes, algae, lichen, and fungi.
FW-VEGT-OBJ-01	This component specifies a minimum desired level of vegetation management to help move conditions toward the desired condition and would ensure that active management occurs on the landscape.
FW-VEGT-GDL-01, 02, 03, 04	These guidelines would ensure that protection, maintenance and/or establishment of desirable vegetation occurs after activities or disturbances.
FW-VEGF-DC-04	This component would result in large-tree structures being retained at appropriate levels during plan implementation.
FW-VEGF-DC-05, 06, 07; and GDL-02, 04, and 05	These components provide the desired condition and guidelines to ensure retention of old growth, snags, and coarse woody debris. They are complementary to the other desired conditions for forested vegetation.
FW-VEGF-DC-09, 10	These components would ensure that insects and disease are accepted as desirable within their natural role on the landscape; but also allows that mortality should be at the lower end of the natural end in certain areas where fire hazard or human safety is of concern. This would encourage some projects to alter stand or landscape susceptibility to insects or disease at an appropriate scope/scale, while also ensuring that such actions do not attempt to exclude these important agents of change from the ecosystem.
FW-VEGF-DC-11	This desired condition would ensure that the diversity and health of understory plants in forests are considered during plan implementation. This would complement plan components related to invasive plants and grazing.
FW-VEGF-GDL-01	This guideline prescribes minimum retention of large and very large live trees for vegetation management projects and would ensure that these activities contribute or do not preclude movement towards FW-VEGF-DC-04. This guideline would not prohibit all cutting of large trees, because such removal may be appropriate in some circumstances (e.g., stand density must be lowered to improve the resilience of other large trees; large trees are diseased or otherwise not viable; or the site is better suited to provide for the desired conditions for other species/structures). This flexibility is not inconsistent with the desired condition, because minimum amounts would be retained. In addition, all projects would consider the desired condition; in some areas this would result in retention above the minimum requirement.
FW-VEGF-GDL-03	This guideline would result in consistent management in tree improvement areas to ensure regional breeding program needs are met. This would benefit the HLC NF in terms of ensuring appropriate tree stock is available for reforestation and contribute to research to inform potential adjustments to seed zones or other adaptation strategies in response to climate change.
FW-VEGNF-DC-01, 02	These components enumerate desired conditions for nonforested plant communities. The effects are similar as described for FW-VEGT-DC-01.
FW-VEGNF-DC-03	This desired condition specifically addresses fire-maintained nonforested communities, and very open forest savannas, and would ensure that projects are designed to minimize conifer encroachment in such areas.
FW-VEGNF-GDL-01	This guideline would inform where treatments in nonforested plant communities occur and would ensure that dry forested PVTs are considered in this context, to help achieve or move towards FW-VEGNF-DC-03.
BB-VEGNF-DC-01, CA-VEGNF-DC-01, 02 DI-VEGNF-DC-01 EH-VEGNF-DC-01	These desired conditions identify specific nonforested plant communities or plant species of interest in GAs, in some cases to support specific wildlife species, and would ensure these communities are considered during project development in those areas.

Plan component(s)	Summary of expected effects
HI-VEGNF-DC-01 SN-VEGNF-GDL-01 UB-VEGNF-DC-01	
RM-VEGF-DC-04 SN-VEGF-DC-04 UB-VEGF-DC-04	These desired conditions identify forested habitat conditions of interest in GAs to support specific wildlife species (Canada lynx or big game) and would ensure these communities are considered in project development.

Effects associated with climate adaptations

Under all action alternatives, the 2020 Forest Plan acknowledges issues related to carbon sequestration and climate change. Applicable climate adaptations that would be supported by the plan are described in appendix J. Many plan components provide flexibility related to potential future changes due to climate, and some call out these possibilities explicitly (e.g., FW-VEGT-GDL-03). For example, assisted migration actions may not necessarily mean moving plants far distances, but rather moving genotypes, seed sources, and tree populations to areas with predicted suitable climatic conditions with the goal of avoiding maladaptations (Williams & Dumroese, 2016). In another example, thinning ponderosa pine can increase near-surface moisture availability without increasing surface temperatures to promote seedling survival and germination (Petrie et al., 2017). This may lead managers to adjust prescriptions to promote regeneration by leaving more residual trees. The plan does not preclude such actions to help the forest adapt to climate, if supported by BASI and law, policy, and regulation.

Effects associated with monitoring of focal species

Monitoring of invasive annual grasses (such as but not limited to cheatgrass) would help enhance our understanding of the condition and trends of nonforested systems, including those used for livestock grazing. Invasion of these grasses is a primary threat to some nonforested plant communities. The increasing dominance of these grasses has created a positive feedback cycle characterized by frequent fire and increased dominance of annual grasses, which further creates fuel conditions that facilitate combustion; and these conditions are exacerbated by the wetter and warmer winters which are projected throughout the Region (J. E. Halofsky et al., 2018b).

Alternative A, no action

The 1986 Forest Plans do not quantify desired vegetation conditions; rather, there are qualitative descriptions. The plan content relevant to terrestrial vegetation is summarized in Table 55.

Table 55. Summary of plan components for terrestrial vegetation –1986 Forest Plans

Section	Summary of expected effects
HNF – Desired Future Condition	The desired conditions for the HNF are general. The plan would not necessarily guide the forest toward conditions similar to those described in this analysis; although it would also not preclude this opportunity.
HNF – Forestwide Standards – Revegetation	These standards prescribe seeding disturbed areas and would ensure the re-establishment of native vegetation following natural disturbance or management.
HNF – Forestwide standards – Protection	Components would emphasize silvicultural treatments for insects and disease. Components for wildfire and prescribed fire would contribute to movement towards vegetation desired conditions.
HNF and LCNF – Management Area Direction	The existing plan mapped management areas, each with a unique management emphasis, and included standards for recreation, visuals, wildlife and fisheries, range, timber, water and soils, minerals, lands, facilities, protection, and riparian resources. This guidance would influence the treatments allowed to achieve desired conditions.

Section	Summary of expected effects
LCNF – Forestwide Objectives and Desired Future Condition	The objectives and desired condition for the LCNF are described in terms of timber and forage outputs, and do not describe vegetation over time. The plan would not necessarily guide the forest toward conditions similar to those described in this analysis, although it would not preclude this.
LCNF – Forestwide standard P-1, Protection	This standard would guide the Forest toward harvesting stands at high risk to mountain pine beetle and other insects and diseases, and to utilize prescribed fire to achieve management goals.

Effects that vary by alternative

This section includes effects that vary by alternative. The first sections discuss expected trends for terrestrial vegetation indicators (disturbances, treatments, composition, and structure) for a 50-year modeling period. In many cases, the effects are similar across alternatives; however, in some cases there is some variation, and therefore these indicators are included in this section. Charts, additional data, and discussions are provided in appendix H.

All alternatives were run in SIMPPLLE using the PRISM outputs. PRISM ran all alternatives with and without a budget constraint; therefore, the budget-unconstrained scenario is described for all alternatives for metrics from that model (e.g., wildfire and insect hazard and vegetation treatments). Only alternative F was run without a budget constraint in SIMPPLLE, and because all alternatives are so similar, the results are used to represent an unconstrained budget scenario with respect to the outputs generated with that model (composition, structure, and landscape pattern).

The latter sections discuss the effects from other plan components on terrestrial vegetation, for those components that have different effects across alternatives (generally, alternative A as compared to the action alternatives).

Ecosystem processes and disturbances

Wildfire and fire hazard

Wildfires are expected to have substantial influence on vegetation. The expected acres of wildfire are generated by SIMPPLLE based on assumptions for fire suppression, future climate, vegetation conditions, and treatments. The differences in land allocations or management emphasis across alternatives resulted in only subtle variation in projected wildfire acres across alternatives and decades. Though our best understanding of how fire behaves and its effects on vegetation were used to inform the model, there is a high degree of uncertainty; we cannot predict with accuracy where and when fires will occur. Average wildfire acres projected do not imply an “even flow” of acres burned over time. In addition, the acres affected could overlap through time (e.g., “reburns”).

As shown in appendix H, the estimated mean levels of fire activity are below the NRV for low severity fires, but within the NRV for mixed severity and stand replacing fires. The total acres expected to burn per decade is between 150,000 and 200,000 acres, depending on alternative, with stand-replacing fires being the most common type. Alternatives E and F (unconstrained) tend to have the least acres burned, due to higher levels of harvest. A higher percentage of “managed” lands and WUI lands burn as compared to unmanaged lands and non-WUI lands, likely because managed and WUI lands tend to be in more fire-prone landscapes (low elevation, warm and dry sites). Treatments would tend to be focused here, as well as fire suppression; it is possible that fire behavior is altered in these areas although total area burned is not changed. In addition, a substantial proportion of unmanaged lands are represented by the wilderness in the Rocky Mountain Range GA, where recent fires have impacted the landscape to a relatively large degree, and which may limit the extent of future disturbances in that area. All GAs are predicted to burn less than 18% of their total area in any given decade, although some are predicted to burn less than 5% in any given decade (Crazies, Little Belts, and Rocky Mountain Range).

The hazard of stand replacing fire was estimated in the yield tables used for PRISM, which were developed using the fire and fuels extension of the Forest Vegetation Simulator. The results do not include the iterative modeling with climate and disturbances that SIMPPLLE provides. In all alternatives the model projects that the number of forested acres with a high hazard of stand replacing fire decreases over the 5-decade modeling period, to a similar degree (roughly 8%) under all alternatives, with and without a budget constraint. This metric does not indicate fire risk or fire acres burned which depend upon many other factors such as ignition sources, weather, fire suppression efforts, and topography.

Insect and disease activity and hazard

Insects and disease will also cause vegetation change over the next five decades, based on the presence and susceptibility of host species, other disturbances, and warm climate conditions. As with wildfire, the projected acres infested per decade do not imply an "even flow" of acres over time, and there is a high degree of uncertainty in outbreak events. The acres affected could overlap through time.

Root disease is known to occur on the HLC NF but was not predicted in the modeling. It is estimated at low levels in the existing condition and the NRV. The expected future role of root disease is likely to be similar or less than the historic condition, as it would be less favored by warm climates and the increase in shade intolerant species. Halofsky and others (2018b) predict little change in root disease in the future; and further projected zero basal area losses from root diseases on most national forests east of the Continental Divide. On the limited sites where it occurs, root disease may cause reductions in tree growth, gradual tree mortality, and increase susceptibility to bark beetles, secondary beetles, drought, or windthrow. These effects are not expected to substantially alter the vegetation effects as predicted by SIMPPLLE, due the limited extent to which these pathogens occur.

In all alternatives, insect infestations decline over time. Infestation by this western spruce budworm is expected to decrease from roughly 600,000 acres in decade 1 to 325,000 acres in decade 5. Mountain pine beetle remains active on the landscape but generally below 100,000 acres per decade. An outbreak of Douglas-fir beetle is predicted to occur in decade 2 (affecting nearly 200,000 acres) and then decline (less than 50,000 acres per decade). Managed and WUI lands tend to have higher levels of infestations total than unmanaged ones, likely due to the western spruce budworm which is more prevalent in low elevation, dry forests. The estimated mean acres affected by Douglas-fir beetle and mountain pine beetle are projected to be within the NRV for the entire modeling period, with alternative F (unconstrained) showing slightly lower acres affected by mountain pine beetle in the later decades. The levels of western spruce budworm are currently above the NRV but are projected to decline through time and be within the natural range within 50 years. The Douglas-fir beetle is projected to be most active in the Big Belts and Little Belts GAs. The mountain pine beetle is projected to be the most prevalent in the Castles. The GAs expected to be most impacted by insects overall include Big Belts, Castles, Highwoods, Little Belts, and Snowies.

Hazard to insects was estimated in the yield tables used for PRISM, which were developed using the Forest Vegetation Simulator and the same rating system applied to the existing condition (Randall & Bush, 2010). The modeling suggests that in all alternatives, the hazard to western spruce budworm and mountain pine beetle in lodgepole pine will steadily decrease to a similar degree, with and without a budget constraint. This suggests the various management scenarios have little effect. Hazard to mountain pine beetle in ponderosa pine is more sensitive to the alternatives and is higher with alternative E in decade 5 with a constrained budget. The alternatives are more similar with an unconstrained budget. This suggests that the treatments scheduled in ponderosa pine with alternatives A, B/C, D, and F under constrained budgets (driven by the objective functions to attain desired conditions) have some positive effect on mountain pine beetle hazard. In all alternatives, an unconstrained budget scenario results in lower hazard to mountain pine beetle in ponderosa pine as compared to the constrained budget scenario. Hazard to Douglas-fir beetle also varies by alternative and budget scenario and, unlike the other pests, increases through time, as a result of increases in the availability of large trees and local disturbances.

Both with and without a budget constraint, alternative E followed by F tends to have the lowest hazard to this pest by decade 5, perhaps related to the impacts of harvest on stand susceptibility (lower densities). In all alternatives, an unconstrained budget scenario results in lower hazard to Douglas-fir beetle as compared to the constrained budget scenario.

Vegetation treatments

Timber harvest

Where they occur, harvest and prescribed burning would alter the condition of vegetation (Table 48). PRISM was used to develop a treatment schedule for the 5-decade modeling period, based on vegetation desired conditions. The variance in acres treated is a result of the objective functions applied to each alternative. Alternative E is calibrated to maximize timber production and achieves this goal by harvesting fewer acres of productive forests assuming a constrained budget; but does less to achieve the desired conditions than the other alternatives. Alternatives A, B/C, and D were calibrated to maximize desired condition attainment, while alternative F was designed to blend the objectives of timber production and desired condition attainment.

In the first decade of the plan, the alternatives would result in a range of 2,072 (alternative A) to 2,279 (alternative F) average acres of harvest per year with a constrained budget. With an unconstrained budget, the total harvest ranges from 4,252 (alternative A) to 5,464 (alternative E) acres per year in decade 1. As shown in the timber section, however, across all 5 decades, the average acres harvested per year is greatest with alternatives A, B/C, and D (about 3,000 acres per year), followed by F, and then E (just over 2,000 acres per year. With an unconstrained budget, the average acres harvested over the 5-decade period is highest with E (about 5,000 acres per year), followed by B/C, D, and F, and A resulting in the least.

All alternatives would treat more of the landscape with even-aged regeneration harvest than with other types of harvest. This proportion changes over time, with more intermediate and uneven-aged harvests occurring in decades 2, 4, and 5 depending on alternative. Even-aged regeneration harvest are driven by the desired condition to alter species composition (e.g., to increase ponderosa pine); whereas other types of harvest may be more related to altering forest structures (e.g., to increase large size classes). Regeneration harvest would alter size class, resulting in seedling/sapling forests. Other harvests (e.g., thinning) reduce tree density, may increase size class (when smaller trees are removed), and/or change composition. Uneven-aged harvest tends to maintain or increase shade tolerant species, but can also promote uneven-aged stands of intolerant species. The projected harvest acres and vegetation changes produced by PRISM are incorporated into SIMPPLLE, and therefore their influence on terrestrial vegetation are reflected in the results shown throughout this report.

With a constrained budget in alternatives A, B/C, and D, followed by F, PRISM selected more warm dry forests for harvest to best meet the desired conditions, while alternative E selected to treat cool moist forests as well (lodgepole pine and spruce/fir) to achieve more volume production. With a constrained budget, alternatives A, B/C, and D followed by F would do more to achieve desired conditions than alternative E. With an unconstrained budget, the alternatives are similar with regards to desired condition attainment, with alternative E the best followed by B/C, D, and F, and lastly alternative A.

Salvage

Under any alternative, salvage harvest may occur in burned areas or those infested with insects or disease, removing dead trees for purposes that include (but not limited to) the recovery economic value. This activity is not included in projected timber metrics or harvest scheduling. In practice the term salvage is only applied to intermediate harvest; in the case of stand replacing disturbance the cutting of dead trees is termed as a clearcut, seed tree, or shelterwood harvest as appropriate. However, the term “salvage” for this discussion is used broadly to indicate any post-disturbance harvesting, or “postfire logging.”

The majority of the HLC NF is in wilderness, RWA, or IRAs where harvest, including postfire logging, would be prohibited or highly constrained. Wildfires in these areas would create burned forest conditions that recover naturally over time. Salvage would most commonly occur when fires burn in lands suitable for timber production but is not prohibited in other lands where harvest is suitable. Relative to terrestrial vegetation, the impacts of salvage would broadly be consistent with a "green" harvest in terms of trees removed. However, there would be key differences to other ecosystem components such as the presence of burned woody material, soil and hydrology influences, and wildlife habitat components, to name a few.

Postfire logging is a controversial management approach; there is a high degree of public interest and opposing scientific views. Some studies have found that there is no ecological need for immediate intervention on the post-fire landscape; and that substantial damage can occur from such activities to ecosystem components and processes including but not limited to aquatic habitat, nutrient cycling, soil stabilization, wildlife habitat, and regeneration success (Beschta et al., 1995; Beschta et al., 2004; DellaSala et al., 2006; Karr et al., 2004).

The ecological effects of postfire logging are influenced by combinations and intensities of the fire and management activities that affect (1) ground disturbance by equipment and road use; (2) number of living and dead trees and their spatial pattern following harvest; (3) postharvest fuel treatment; and (4) in some cases, grass seeding and placement of various structures and materials to mitigate the effects of fire and logging (Peterson et al., 2009). Postfire logging may fit into an effective restoration strategy if management pathways for attaining desired combinations of species, forest structure, and ecological functions are specified (ibid). The extent to which logging exacerbates soil, sediment, and hydrological problems in postfire landscapes depends on site characteristics, site preparations, logging method, and whether new roads are needed; of these, road building and continued use of roads are probably the biggest potential contributors to postfire erosion (McIver & Starr, 2000). The timing of treatment also influences some effects, such as reforestation; if logging occurs after seedling establishment, significant seedling mortality can occur (ibid). Postfire logging would remove merchantable trees, thereby affecting habitat for certain species of wildlife and reducing intermediate-term fuel loadings (ibid). Some positive impacts may be observed, as well, such as encouraging the establishment of a unique array of plant species, although along with this comes the risk of nonnative plant establishment (ibid). Post-fire logging enhances habitat for some wildlife species and diminishes it for others (ibid).

Some studies offer considerations or recommendations for the design of postfire logging, which include provisions related to leaving standing dead as well as live trees, avoiding ecologically sensitive areas, and avoiding the creation of new roads (Beschta et al., 1995; Karr et al., 2004); that proper recovery and rehabilitation techniques by managers may be capable of mitigating soil loss and erosion problems; leaving logging residue may decrease erosion; and that reforestation problems are less likely to occur if logging is conducted prior to seedling germination (McIver & Starr, 2000). Such considerations are not precluded by the plan components under any alternative and would be encouraged based on the suite of plan components related to soils, wildlife, and other resources. The potential effects of postfire logging would be expected to occur on a small subset of wildfire acres burned, although the amount is unpredictable. These potential effects would be the same for all alternatives. The suite of plan components in place to protect soil, watershed, fisheries, vegetation, and wildlife resources would be applied to the design and application of postfire logging. See also the discussion in the timber and old growth/snag/downed woody debris sections.

Prescribed burning

PRISM includes projected prescribed burning, as described in the timber and fire/fuel sections. PRISM only reflects prescribed burning in forested types; additional burning in nonforested types would occur. In the model, prescribed burning was applied as maintenance treatment in harvested stands and as a stand-alone prescription. The ability to achieve burning on the ground is dependent upon many factors including weather. When constrained by budget, prescribed burning is estimated to occur on roughly 3,000 to 5,000 acres per year, with alternative E resulting in the lowest levels followed by F and then A, B/C, and D. With unconstrained budgets, the levels increase to 5,000 to 10,000 acres per year, with all alternatives similar but alternative E the highest by a small margin, followed by F, B/C, D, and then A. However, the unconstrained prescribed fire acres from PRISM only reflect potential burning without a budget limitation up to a 10,000 acre/year cap. This cap is based on operational limitations that indirectly include budget with respect to available personnel and equipment. Therefore, this cap effectively introduces a budget limitation once the 10,000-acre threshold is reached. A fully unconstrained budget scenario would likely result in higher prescribed burning acres than modeled – potentially roughly 30,000 acres/year based on local experience (including nonforested vegetation types).

The effects from prescribed fire depend on the vegetation type. For example, low severity underburning would be generally applied in the warm dry broad PVT. The results would be more open forests of fire tolerant species, and larger size classes as the smaller trees are killed by fire. Moderate to high severity burns would be applied in the cool moist and cold broad PVTs; the result may be creation of seedling/sapling size classes, reduced densities, altered species composition, and/or increased size class. In nonforested vegetation types, fire would maintain the dominance of grass and shrubs by killing conifer encroachment, while promoting large scattered trees in savannas. It would also stimulate the growth and vigor of fire-adapted plants, while others would be killed in the short term.

Vegetation composition

Vegetation composition is expected to change through time. Appendix H contains charts showing the model results. The expected trends are usually similar but not always identical across all alternatives.

Ponderosa pine cover type and presence of ponderosa pine, Rocky mountain juniper, and limber pine

Ponderosa pine cover type

The ponderosa pine cover type includes areas dominated by ponderosa pine, limber pine, and/or juniper. This type is expected to steadily increase through time under all alternatives, with an abundance in 50 years trending towards but below the desired range. The increases occur forestwide, as well as in the warm dry and cool moist broad PVTs, due to warm climate, wildfire, and vegetation treatments that favor ponderosa over competitors such as Douglas-fir. In the cool moist broad PVT, this cover type is likely to be dominated by limber pine. This cover type also increases in all GAs, although it remains rare on the Rocky Mountain Range GA. The desired condition ranges are achieved in the Castles, Crazies, Highwoods, Little Belts, Rocky Mountain Range, and Snowies GAs. At the GA scale, all alternatives are similar, although in the Castles alternative E results in slightly less. The abundance of this cover type increases particularly in unmanaged lands and non-WUI lands.

Ponderosa pine species presence

The presence of ponderosa pine is expected to increase forestwide and in the warm dry broad PVT (but remain below the desired range). The increases are more gradual and to a smaller magnitude than the increases in the ponderosa pine cover type. This indicates that cover type increases may be due to a shift in dominance in areas where ponderosa pine is already present. Ponderosa pine is a rare and/or minor species on several GAs, where it is present on less than 1% of the area (the Crazies, Highwoods, and Rocky Mountain Range). The NRV modelling indicated that it was more prevalent in the past, and the desired condition reflects the historic and potential future condition. In all GAs, ponderosa pine presence is expected to increase slightly except in the Snowies (where it remains within the desired range). The magnitude of increases is most prominent in the Big Belts, and the desired ranges are achieved in the Crazies and Rocky Mountain Range. In contrast to the ponderosa pine cover type, the presence of ponderosa pine is greater in managed and WUI lands, indicating that the increases in this cover type in unmanaged lands may reflect forests that are dominated by limber pine, or those where ponderosa pine is present as a minor component and shifts in dominance. While ponderosa pine is highly drought tolerant, it may also be subject to future declines if fires are too frequent (killing established regeneration before it can grow above lethal scorch height), or if increasing fire severity and occurrence eliminates mature trees that provide critical seed sources (J. E. Halofsky et al., 2018a).

Limber pine

The presence of limber pine is expected to remain fairly static forestwide and in all PVTs, at the low end but within desired ranges. By GA, the presence of limber pine is expected to remain static or increase slightly. This trend is below or at the lower end of the desired condition range in the Big Belts, Castles, Crazies, Divide, Elkhorns, Highwoods, and Rocky Mountain Range. The trend is at the upper end of the desired condition range in the Little Belts and Snowies, and within the desired range in the Upper Blackfoot. There is some differentiation among alternatives in the Castles GA from decades 3 to 5, where alternative E results in the highest presence (and closest to the desired range), while alternative F (unconstrained by budget) results in the least. This species can represent encroachment in nonforested and savanna areas, but conversely be a desirable component of ecotone and forested areas. The presence of limber pine is more prevalent in non-WUI than in WUI areas throughout the projection. There is slightly more limber pine in managed landscapes versus unmanaged landscapes; and there is some variation in alternatives with Alts E and F having more limber pine in managed landscapes in later decades than the other alternatives.

Limber pine is subject to multiple threats. While the isolated locations and climate conditions of limber pine woodlands may have provided them some protection in the past, these lower treeline woodlands are just as, or more, susceptible to white pine blister rust infections and mountain pine beetle (Means, 2011). Limber pine's position on the lower treeline and foothills in semi-arid climate systems is predicted to be particularly vulnerable to climate change (Means, 2011). However, some limber pine areas were established relatively recently due to fire exclusion ("encroachment"), and the mortality of trees in these areas due to increased temperatures and decreased water availability may not constitute a management concern; a notable example of this phenomenon is the limber pine expansion along the Rocky Mountain Front (J. E. Halofsky et al., 2018a).

Rocky mountain juniper presence

The presence of juniper is projected to increase and move away from the desired condition ranges forestwide and in the warm dry PVT (while remaining static in the cool moist PVT and not present in cold). The expansion of this species is inconsistent with the expected effects of increased fire occurrence on the landscape. Interpretation of the results for this species is problematic because the SIMPPLLE spatial file does not match the FIA existing condition closely. The FIA value is the most accurate depiction, because juniper can often be found in the understory and not well-detected by remote sensing. The extent of juniper is higher on managed and WUI lands than on unmanaged or non-WUI lands, and remains so throughout the projection, because those areas correspond to the low elevation dry sites where this species thrives. The presence of this species also trends above the desired ranges in the Big Belts, Elkhorns, and Highwoods GAs. It is likely that this trend is due to expansion into grass/shrubland areas. The presence of this species appears to remain within the desired ranges in all other GAs. There is some differentiation across alternatives in the Castles GA, with alternative F resulting in the lowest levels and alternative D in the highest levels at decade 5. The presence of juniper is more prevalent in WUI areas than in non-WUI areas and remains so throughout the projection; this may be the inverse of the cover type trend because of these trees being present in nonforested and/or Douglas-fir cover types at low elevations. The presence of juniper is more commonly found in the managed landbase, due to its location at lower elevations; this indicates that forest management has potential to influence this species.

Best available scientific information indicates that Rocky Mountain juniper is more prevalent than it was historically, particularly on lands that were maintained in a nonforested condition due to frequent fire; and future climate/fire regimes may promote nonforested communities (Kitchen, 2010). Although it is an important component of the ecosystem and provides structure for wildlife habitat, juniper expansion can lead to the decline of grass and shrublands and result in altered fire regimes in both nonforested and forested vegetation communities.

Aspen/hardwood cover type and presence of aspen and cottonwood

Aspen/hardwood cover type

This cover type represents areas dominated primarily by aspen and other hardwood species such as cottonwood. Individual species presence is limited to aspen, which is combined with cottonwood in the modeling file because cottonwood is rare on NFS lands and not well-detected by the data sources.

Forestwide, the expected trend of the aspen/hardwood cover type is to increase with all alternatives. The increase would trend toward but remain below the desired range by the end of the modeling period forestwide and in the cool moist PVT, but may be within the lower bound of the desired range in the warm dry PVT. The proportion of this type is higher in unmanaged and non-WUI areas and remains thus throughout the projection and to the same degree with all alternatives. The same trend and magnitude of change is expected in all GAs, with the exception of the Highwoods, where there is some differentiation across alternatives in the middle of the projection; however, all alternatives are similar by decade 5. The desired ranges are achieved in the Castles, Highwoods, and Rocky Mountain Range.

Increases in aspen are mostly due to wildfire, because the projected treatments are focused in conifer forests. Research indicates that while aspen decline may become widespread due to drought, the indirect effects of climate change such as insects and wildfire favor aspen; therefore future aspen trends depend on the net result of these effects (Kulakowski, Kaye, & Kashian, 2013). The recent mountain pine beetle outbreak has reduced competition to aspen in pine stands. Similarly, wildfires have stimulated suckering, although other factors such as insects, disease, animal herbivory and genetics will play a role in long-term success (Shepperd et al., 2001). The influence of a warming climate might be to increase the extent and severity of disturbances which could reduce the cover of conifers. However, dry conditions may also render some sites unsuitable for aspen. Cottonwood has also likely been reduced from historic conditions, and may suffer further in drought conditions (J. E. Halofsky et al., 2018a). The model does not include the potential impacts of other factors such as ungulate browsing or livestock grazing.

Aspen species presence

The presence of aspen is expected to increase slightly over time to achieve the desired range forestwide, and in the warm dry and cool moist PVTs. The proportion of aspen presence is more even across managed/WUI areas versus unmanaged/non-WUI areas than the aspen/hardwood cover type, due to areas where it is present but not dominant. Increases in the extent of aspen are expected to be pronounced in the Elkhorns and Highwoods GAs. No decreases in the extent of aspen presence are predicted. Aspen is maintained within or achieves the desired condition range in the Big Belts, Divide, Elkhorns, Highwoods, Rocky Mountain Range, and Upper Blackfoot GAs. It remains below or at the lower bound of the range in the Castles, Crazies, Little Belts, and Snowies GAs. There is differentiation in alternatives in the Highwoods GA, where alternative F achieves the highest levels and alternative A the lowest. At the broader scale, aspen is a species that may experience both gains and losses under future climate, depending on local site conditions, particularly soil moisture (J. E. Halofsky et al., 2018a). Cottonwood is likely to decline, due to changes in streamflows that affect germination and establishment, as well as conifer competition and browsing pressure (ibid).

Douglas-fir cover type and presence of Douglas-fir

Douglas-fir cover type

The Douglas-fir cover type is expected to decrease through time to a similar degree with all alternatives, and would likely achieve the desired ranges forestwide, and in the warm dry and cool moist PVTs. It will remain fairly rare and static in the cold PVT. It would remain more prevalent in managed landscapes; however, it would be less prevalent in WUI lands. This may be because it dominates the mid to higher elevations within managed lands, whereas the lower elevation portions of those lands that correspond to

WUI are more dominated by other species such as ponderosa pine and nonforested types. The cover type decreases in all GAs and results in attainment of the desired ranges by decade 5, or substantial movement towards it, in the Big Belts, Castles, Crazies, Divide, Elkhorns, Little Belts, Rocky Mountain Range, Snowies, and Upper Blackfoot GAs. The Highwoods GA is unique in that the desired conditions call for an increase; and interpretation of results is problematic because the spatial depiction of the existing condition is departed from the FIA estimated condition. The FIA condition is more accurate in this case, because cover type is one of the more uncertain classifications in the spatial file due to the assumptions that must be made to assign cover type to SIMPPLLE species groups. Based on this, the Douglas-fir cover type is likely to be maintained below the desired range in the Highwoods GA.

Douglas-fir species presence

The presence of Douglas-fir is also expected to decrease slightly forestwide. This decrease is more subtle than the decrease in the cover type because Douglas-fir would remain a minor component in other cover types. The decrease in Douglas-fir presence occurs primarily in the warm dry broad PVT, where it may trend slightly below the desired range. The presence of Douglas-fir in the cold PVT is projected to remain within the desired condition. A higher proportion of the WUI contains Douglas-fir as opposed to non-WUI areas. This is the inverse of the cover type proportions, likely due to minor Douglas-fir presence in dry forests (e.g. ponderosa pine) and nonforested areas. Managed landscapes contain a higher proportion of Douglas-fir presence than unmanaged landscapes. Douglas-fir presence decreases or remains static in all the GAs, and is maintained, moves towards, or achieves the desired ranges in the Big Belts, Castles, Crazies, Divide, Elkhorns, Little Belts, Rocky Mountain Range, and Upper Blackfoot GAs. The presence of Douglas-fir may be decreasing below the desired range in the Highwoods GA; and trending up away from the desired condition in the Snowies GA.

The modeling indicates the potential that warm and dry climate conditions, natural disturbances, and management may decrease the abundance of Douglas-fir, although it would remain a common component on the landscape. Douglas-fir may be promoted with future drought on moist sites where it tolerates drought better than lodgepole pine, spruce, or subalpine fir, but conversely may retract on the dry sites where it competes with ponderosa pine. At higher elevations east of the Continental Divide, specifically, Douglas-fir has a generalist adaptive strategy which can survive over a broad range of environments, and should fare better than its counterparts in a changing climate (J. E. Halofsky et al., 2018a).

Lodgepole pine cover type and presence of lodgepole pine

Lodgepole pine cover type

This cover type represents areas dominated by lodgepole pine and has more variable results than most types. It is predicted to remain fairly static Forestwide, just above the desired range; decrease slightly in the warm dry PVT to approach the desired range; increase slightly in the cool moist PVT to be above the desired range; and increase into the desired range in the cold PVT. The decrease in the warm dry PVT could be in part attributable to warm, dry climate conditions that promote other cover types like ponderosa pine. These trends are the same for all alternatives.

In the Big Belts, Castles, Elkhorns, Little Belts, Rocky Mountain Range, and Upper Blackfoot GAs the amount of the cover type is relatively static and within the desired range. This type increases toward the desired condition in the Crazies GA and decreases toward the desired condition in the Highwoods. The lodgepole pine cover type decreases away from the desired condition range in the Snowies, with some slight differentiation in alternatives (alternative D retains the most and is the closest to the desired range). The cover type remains static and above the desired range in the Divide GA. A substantially higher proportion of non-WUI areas contain this cover type as compared to WUI areas, because lodgepole pine tends to grow at higher elevations. Similarly, a substantially higher proportion of unmanaged landscapes contain this cover type as compared to managed areas.

Lodgepole pine species presence

Forestwide and in the warm dry and cool moist PVTs, the presence of lodgepole pine trends downward toward the desired ranges. The presence also declines in cold to move from the upper end to the lower end of the desired range. The presence of lodgepole pine remains relatively static (slight increases or decreases) within or at the upper end of the desired range in the Big Belts, Castles, Crazies, and Elkhorns GAs. In the Divide, the presence of lodgepole pine remains static and above the desired range. In the Highwoods, Little Belts, Rocky Mountain Range, and Upper Blackfoot GAs it decreases toward the desired range. In the Snowies, the presence of this species also decreases but this movement is away from desired conditions. Non-WUI areas initially have a slightly higher proportion with lodgepole pine, but over time this shifts and at the end of the projection WUI areas have a higher proportion, with some variance by alternative. This may indicate that the declines in lodgepole pine presence occur primarily in non-WUI areas. Managed landscapes contain a higher presence of lodgepole pine than unmanaged landscapes; this is the converse of the cover type relationship, indicating that lodgepole pine is a common minor component in other cover types in managed landscapes (likely mixed with Douglas-fir).

Although it is not particularly drought tolerant, future climates may promote lodgepole pine on moist, high elevation sites where fire promotes it over shade tolerant species such as spruce and fir. Conversely, the species retracts from drier sites where Douglas-fir is more drought tolerant. Lodgepole pine distribution tended to be at the higher end of its range of abundance during warm/dry climate periods. The modeling indicates that on the HLC NF the future may bring decreases in lodgepole pine in some places, but overall it would remain a major component on the landscape. At the broader scale, lodgepole pine is expected to both expand and contract in range, but as long as fire remains on the landscape, it is likely to maintain its presence in the Northern Rockies at roughly the same proportions as during the last 100 years, albeit in different areas (J. E. Halofsky et al., 2018a).

Western larch cover type and presence of western larch

This cover type is rare on the HLC NF, and is limited by its natural distribution range to the westernmost drainages in the Upper Blackfoot GA. The desired ranges call for maintenance or increase of this species. In the Upper Blackfoot GA, the cover type is not detected although individual species presence is recorded in low amounts in FIA. Modeling predicts that with all alternatives, the presence of western larch is anticipated to remain static, at the lower bound of the desired condition range. Across its range, western larch is less abundant than it was historically due to fire exclusion and vegetation succession that favors more shade tolerant species such as subalpine fir and spruce. Western larch may be vulnerable to decline with warming climatic conditions, as it is less drought tolerant with poor water use efficiency as compared to its associates such as Douglas-fir. In some areas it may become limited to higher elevation, moist sites. Even with increases in fire and the presence of a seed source, warmer conditions may make some sites too harsh for larch seedlings to survive. However, larch is less vulnerable to many of the insects and diseases that may also increase with warming conditions.

Spruce/fir cover type and presence of subalpine fir and Engelmann spruce

Spruce/fir cover type

The spruce/fir cover type is made up of areas dominated by Engelmann spruce and/or subalpine fir. Forestwide, the expected trend is fairly static and within the desired range. The existing condition is below the desired ranges in both the cool moist and cold PVTs, indicating a desire to promote this cover type on those landscapes. The type trends slightly upward in cool moist, toward the desired range; this increase may be due to the reforestation of burned areas and/or natural succession in areas where fire does not occur. Spruce/fir forests on the cool moist PVT are of particular importance for Canada lynx habitat. The spruce/fir cover type trends down in cold, away from the desired range. This is consistent with literature that indicates that the spruce/fir cover type would be expected to be maintained on the wettest sites but possibly decline overall given expected warm climates and fire activity (J. E. Halofsky et al., 2018a). Both Engelmann spruce and subalpine fir were at the low end of their ranges during warm/dry climate periods in the NRV analysis.

In the Big Belts and Castles GAs, the trend of the cover type is fairly static, within the desired condition. This type declines in the Crazies, likely within but approaching the lower bound of the desired range; there is some differentiation in alternatives, with alternative F-unconstrained resulting in the lowest amount. In the Divide and Highwoods GAs, the cover type stays static and within the desired range. In the Elkhorns GA the type decreases to be within the desired condition. In the Little Belts and Rocky Mountain Range GAs, the type stays fairly static and is below the desired range based on the FIA existing condition. The type stays within desired conditions in the Snowies, with some increases or decreases toward the end of the projection depending on alternative. The type decreases in the Upper Blackfoot GA and appears to be trending away from the desired conditions; there is some slight differentiation in alternatives, with alternative F-unconstrained slightly below the other alternatives. A much higher proportion of non-WUI lands contain the spruce/fir cover type than WUI lands, primarily due to the high elevations where these species tend to occur. For the same reason, a much higher proportion of unmanaged lands contain the spruce/fir cover type than managed lands.

The model did not include potential activity from the non-native insect balsam woolly adelgid, which can cause mortality of subalpine fir, as discussed in the *affected environment* section. There is potential for this insect to spread in the GAs where it has currently been noted (Upper Blackfoot and Divide), as well as additional GAs. There is therefore a risk that the spruce/fir cover type may be less prevalent in the future than indicated by model results; however, the potential impact of this insect is not known.

Subalpine fir species presence

Forestwide and in the cool moist PVT, presence of subalpine fir increases slightly to remain above the desired range. In contrast, in the cold PVT, presence of subalpine fir declines to be within or possibly just below the desired range. In the Big Belts and Little Belts GAs, subalpine fir presence increases slightly to be at the upper end or above the desired range. In the Castles, Crazies, Elkhorns, and Upper Blackfoot GAs, this species decreases toward or within the desired range; alternative F results in the lowest amount in the Castles GA. In the Divide GA, subalpine fir presence remains similar to the existing condition, above the desired range. In the Highwoods and Rocky Mountain Range GAs, subalpine fir presence remains static within the desired range. In the Snowies GA, the presence of this species increases to approach the upper bound of the desired range. A higher proportion of non-WUI and unmanaged lands contain presence of subalpine fir than WUI and managed lands throughout the projection. At the broad scale, the trend of subalpine fir will depend on wildfire and climate, and is likely to be a species that shifts across the high mountain landscape, with gains in expansion balancing losses of contraction (J. E. Halofsky et al., 2018a).

As noted for the spruce/fir cover type, there is potential for balsam woolly adelgid to cause mortality in this species that is not reflected in model estimates, but the timing, location, and magnitude of this damage are unknown.

Engelmann spruce species presence

Forestwide and in the warm dry PVT, the presence of Engelmann spruce stays fairly similar to the existing condition and is within or at the upper end of the desired condition range. In the cool moist PVT, the presence of this species increases slightly, moving away from the desired condition. In the cold PVT, it declines slightly to stay within or at the lower end of the desired range. In the Big Belts GA, Engelmann spruce presence increases slightly within the desired range. Presence of this species remains fairly static, within the desired range in the Castles and Rocky Mountain Range GAs. In the Crazies GA, Engelmann spruce declines and appears to be trending away from the desired range. In the Divide GA, the presence of this species remains fairly static and within the desired range. In the Elkhorns, Little Belts, and Snowies GAs spruce presence remains fairly static but appears to be above the desired range. In the

Upper Blackfoot GA, it declines but remains in the desired condition bound. Consistent with cover type trends, a higher proportion of non-WUI and unmanaged lands contain presence of Engelmann spruce than WUI and managed lands throughout the projection. At the broad scale, Engelmann spruce is highly sensitive to climate but likely to persist because of its ability to seed into new areas, especially burned areas (J. E. Halofsky et al., 2018a).

Whitebark pine cover type and presence of whitebark pine

Whitebark pine cover type

Forestwide and in the cool moist PVT, the trend of the whitebark pine cover type is predicted to be fairly static, just below or within the lower bound of the desired range. In the cold PVT, the whitebark pine cover type increases slightly to achieve the desired range. However, due to the width of the confidence intervals, it cannot be stated with certainty whether whitebark pine will move within the desired condition range during this time period; or, for that matter, if it will measurably increase from the existing condition. While wildfire and vegetation treatments may promote it in some areas, it will also continue to face threats from mountain pine beetle, blister rust, and climate changes. In most GAs, the trend of the whitebark pine cover type is fairly static and remains just below or at the lower bound of the desired range. The exceptions include the Castles GA, where this cover type is within the desired condition range and remains there; and the Crazies GA, where it is predicted to increase above the upper bound of the desired condition with some differentiation in alternatives. However, the box/whisker plot for the Crazies (project file) shows that the error bars around the estimate extend into the desired range. There is also some differentiation alternatives in the Upper Blackfoot GA. Due to its location in high elevation remote areas, a much higher proportion of non-WUI and unmanaged areas contain the whitebark pine cover type and very little is found in WUI or managed areas.

Whitebark pine species presence

The Forestwide trend of whitebark pine presence is fairly static and within the desired condition range; this is not surprising given that some whitebark pine seedlings and saplings are present even in stands with high mortality in the overstory. In the cool moist PVT, the presence of whitebark pine is predicted to decrease very slightly and remain within the desired range. In the cold PVT, it is predicted to be fairly static and below the desired range. The presence of this species decreases slightly but remains within the desired range in the Big Belts, Crazies, Divide, Elkhorns, Little Belts, Rocky Mountain Range and Upper Blackfoot GAs. In the Snowies GA, the presence of whitebark pine decreases slightly, trending away from the desired range. In the Castles GA, it remains static and at the upper end of the desired range. As with the whitebark cover type, the presence of whitebark pine in non-WUI and unmanaged areas is substantially higher than in WUI and managed areas.

Whitebark pine summary

Specifically, on the cold broad PVT, where whitebark pine would be most expected to thrive, the model estimates that the cover type would increase slightly to be within the desired range; whereas the tree species presence would remain fairly static and just below the desired range. These expected trends initially appear encouraging and are likely in part due to the extent of fire expected to occur on the landscape. However, the model does not account for the lower threshold of tree density necessary for successful seed dispersal (McKinney, Fiedler, & Tomback, 2009). Further, it does not reflect the vigor and health of those areas where whitebark remains present or dominant; nor does it incorporate the likely future trends of white pine blister rust. Finally, the NRV condition of whitebark may be somewhat underrepresented due to the way cover types are classified. Therefore, there are still substantial concerns over the ability of whitebark pine to regenerate and persist in the future.

A large body of literature indicates that whitebark pine has and will continue to experience declines. Halofsky and others (J. E. Halofsky et al., 2018b) predict that white pine blister rust infection frequency and severity may see a little to moderate increase due to climate change, but there will always be high infections regardless of climate. The greatest decline of whitebark pine within its range has occurred in the Northern Continental Divide Ecosystem of the Rocky Mountains, resulting from complex interactions among predisposing, inciting, and contributing factors such as climatic variation, bark beetles, and nonnative blister rust (Wong & Daniels, 2016). At a broad scale, the decline in whitebark pine is expected to continue, and restoration activities are needed (U.S. Department of the Interior, Fish and Wildlife Service, 2010). Future climates and disturbances may promote the whitebark pine cover type on the coldest, driest sites where it is hardier than other species, but the success of whitebark pine will also depend on interactions with white pine blister rust and restoration efforts.

At the broad scale, whitebark pine is not expected to do well under future climates, because of the major declines from white pine blister rust that preclude its immediate regeneration into burned areas; moreover, the declines from blister rust and mountain pine beetle have reduced populations to low levels so that the Clark's nutcracker may act more as a seed predator than a seed disperser (J. E. Halofsky et al., 2018a). The species has the genetic capacity to overcome both white pine blister rust and new climates, but only with extensive restoration efforts (ibid).

Nonforested vegetation, xeric ecotones, and forest savannas

Nonforested cover types include all nonforested plant communities, including grasslands, shrublands, open savannas, and recently disturbed areas where forest cover has not re-established. Riparian, wetland, and alpine areas are also included. The desired condition includes maintaining the dominance of nonforested plant communities on nonforested PVTs, as well as on some forest PVTs - primarily the driest sites found in the warm dry broad PVT. Such areas would have been maintained in a nonforested condition, or one with very sparse tree cover by frequent fire. The model predicts that nonforested cover types collectively increase slightly and stay within the desired range forestwide, but trend above the desired range in the PVTs and most GAs, likely due to increased fire. The Rocky Mountain Range GA is the only landscape where decreases in this type are expected, as recent fire areas reforest. The proportion of nonforested areas is much higher in unmanaged landscapes versus managed landscapes; and the proportion of nonforested areas is substantially and consistently higher in non-WUI areas versus WUI areas; these proportions remain static through time. In most cases, all alternatives are similar.

The model results are consistent with the expected effects of future warm, dry climate and drought that include the maintenance or expansion of nonforested communities (particularly xeric types) as sites become too dry or frequently disturbed to support forest cover. However, the increase in nonforested cover types above the desired ranges is most likely due to the conditions caused by large fires prior to reforestation rather than expansion of true grass and shrublands; it is problematic that the model cannot be used to adequately separate those conditions. Factors such as fire exclusion also play a role, and conifer encroachment into grass and shrublands has and is expected to continue to decrease the extent and vigor of many grass and shrublands.

The *xeric ecotone* encompasses the transition between forested and nonforested types, and therefore includes nonforested cover types and forest savannas growing on nonforested PVTs or the warmest/driest portions of the warm dry PVT. These areas fluctuate between forest and nonforest cover depending on disturbance and climate regimes. The expected trend of forest savannas and the xeric ecotone is included in the model results for both nonforested cover types and nonforested density classes. Xeric ecotones are among the most sensitive ecosystems to climate change (Means, 2011). Lower treeline woodlands are often thought to be "invading" desirable sagebrush and grass types due to fire suppression and grazing; however, ecotones also naturally move elevationally based on the dynamics of vegetation, climate and fire (ibid). Studies done near the HLC NF found that areas of mosaic sagebrush-grasslands with stable islands of Douglas-fir savannah have become dominated by Douglas-fir (Heyerdahl et al., 2006). Drivers of this trend include fire exclusion which would have killed encroaching trees when they were of a small size; grazing which reduced fine fuel loads and further influenced fire exclusion; and summer droughts that enhanced sagebrush which functioned as nurse plants for establishing conifers (ibid). Threats to the xeric ecotone include loss of tree species to disease, insects, and fire as well as shifts in warming and/or drying patterns as a result of climate change.

Forest structure

Forest size class

Forest size class is expected to change through time. The expected trends are similar across alternatives, and at most scales of analysis the size class distribution would generally move towards the desired condition, including increases in the large tree size class and decreases in the small and medium classes, although all classes remain well-represented. These shifts may result in enhanced resilience to disturbance, structural diversity, and providing the array of successional stages as indicated by the NRV.

Seedling/sapling size class

The seedling/sapling size class Forestwide is at the upper end of the desired range, and over time is predicted to fluctuate to be slightly above or within the upper bound of the desired range. In the warm dry PVT, the abundance of seedling/sapling is predicted to increase and eventually trend above the desired condition. In the cool moist PVT, this condition increases above and then falls into the desired range. In the cold PVT, seedling/sapling fluctuates through time within the desired range. The cyclic nature of this size class is related to stand replacing disturbances and has the most variable trend based on when large disturbances occur. The seedling sapling abundance is expected to trend above the desired range in the Big Belts, Castles, Divide, Elkhorns, and Little Belts GAs. There is some differentiation in alternatives in the Castles GA, with only Alternative E remaining in the desired range. In the Crazies, Highwoods, and Snowies GAs, the abundance of this condition increases but remains within the desired range. The Rocky Mountain Range GA is unique in that seedling/sapling forests decline to achieve the desired range, as recently burned areas recover and grow. In the Upper Blackfoot GA, abundance of seedling sapling forests initially increases and then falls within the upper bound of the desired range by the end of the projection. The proportion of WUI versus non-WUI lands that contain the seedling/sapling size class fluctuates through time; initially it is more common in non-WUI areas but becomes more common in WUI lands by the end of the projection. The proportion of managed versus unmanaged lands that contain the seedling/sapling size class also fluctuates; initially it is more common in unmanaged areas but becomes more common in managed lands.

Small tree size class

The small tree size class shows consistent decreases through time to approach or achieve desired ranges, as these young forests (which are currently over-represented) grow into larger size classes (or, in some cases, are replaced by fire). Small tree size classes can shift into medium or large classes as a result forest succession, or low/mixed severity disturbance or vegetation management that removes smaller trees thereby increasing the average size. Reductions in density that occur with disturbance or management, or drought-related mortality, can also promote shifts into larger size classes by promoting individual tree growth. Most scales of analysis show a temporary increase in this class in Decade 3; this probably occurred because a pulse of seedling/sapling stands reached this size. The decreases in this class in the warm dry broad PVT correspond to increases in the larger size classes. In the cool moist broad PVT, the decreases in this class are more subtle; the small tree size class is more prominent on this type due to the preponderance of lodgepole pine. On the cold PVT, the decrease in this class is pronounced and achieves the desired range; this shift is relatable to increases in the medium size class. In the Big Belts, Divide, Highwoods, and Little Belts GAs the abundance of the small tree size class decreases through time to approach the desired range. In the Castles and Snowies GAs, this condition also decreases and moves within the desired range. A similar trend occurs in the Crazies, Elkhorns, Rocky Mountain Range, and Upper Blackfoot GAs. The proportions of WUI and managed lands versus non-WUI and unmanaged lands that contain the small tree class are generally similar, within 5% of each other. This class is slightly more common in non-WUI lands currently; this switches in Decades 1-4 and the proportions are nearly identical in Decade 5.

Medium tree size class

The common pattern with the medium size class is a temporary increase (as small stands grow) followed by a decline (as these stands shift into the large class), generally toward or within desired ranges. This decline corresponds to increases in the seedling/sapling and larger tree size classes, balanced by increases that occur as younger forests mature into this size class. Forestwide, and in the warm dry and cool moist PVTs, there is a temporary uptick in this size class followed by a decline towards or within the desired condition. In the cold PVT, the abundance of this size class fluctuates but generally increases; this increase may be within or just above the upper boundary of the desired range. A decline in the medium tree size class was identified as particularly desirable on the warm dry broad PVT, where this class represented a mid-seral "bulge" that developed in large part due to fire exclusion. It is this trend that most substantially influences the decline noted at the forestwide scale and is probably due to forest succession as well as disturbances or management that reduce tree densities to promote larger tree growth and/or remove smaller trees to increase the average tree size. In the Big Belts, Castles, Crazies, Elkhorns, Highwoods, Little Belts GAs the pattern is similar to Forestwide, with an initial increase followed by a decrease that results in conditions within or below the desired condition. In the Divide and Upper Blackfoot GAs, the medium size class declines gently and remains the desired range. In the Rocky Mountain Range GA, the pattern is unique, increasing steadily above and away from the desired range (as forests from recent fires regrow). The Snowies GA shows a sharp increase in the medium size class in Decade 1 which levels off but remains above the desired range. The proportion of WUI and managed lands versus non-WUI and unmanaged lands that contain the medium size class fluctuates through time; initially it is more common in WUI and managed areas but becomes more common in non-WUI and unmanaged lands by the end of the projection.

Large and very large tree size class

Forestwide, in all PVTs, and in all GAs, the large size class increases toward the desired condition to a similar degree under all alternatives. These increases correspond to the reductions in the smaller size classes, attributable to natural succession as well as disturbances and, to a lesser degree, vegetation management. Small trees would remain present, if not dominant, in many of these forests, and where present may create an uneven-aged forest that is resilient to disturbance. Managed and WUI lands contain a higher proportion of this size class than non-WUI and unmanaged lands, in part due to the forest types present at lower elevations that are more likely to reach large sizes (ponderosa pine and Douglas-fir). The very large tree size class remains relatively rare over time, below the desired range to a small degree. Some increases could be expected beyond the model period as more large trees become available to progress into this size class. A higher proportion of WUI and managed areas contain this size class than non-WUI and unmanaged area; although the overall amount is very small.

Fire suppression has a general effect of increasing smaller tree size classes in many areas, due to the establishment and maintenance of young trees that would otherwise be periodically removed by fire. However, while fire suppression will continue to occur, large size classes are nevertheless predicted to increase because of other factors such as expected fire on the landscape, forest succession in small/medium forests, and management practices such as prescribed fire and thinning. Management actions and natural disturbances can increase large size classes by reducing stand densities to promote individual tree growth and/or thinning or killing smaller trees while retaining larger trees (thereby increasing the average stand diameter). Management strategies, particularly in shade intolerant cover types, may also include retaining undisturbed areas where trees can grow to larger sizes, particularly in shade tolerant cover types.

Large-tree structure

Large-tree structure differs from size class because it is based on certain minimum trees per acre of large and/or very large diameter trees, rather than the average diameter of the stand (see appendix D of the 2020 Forest Plan and appendix H). Large-tree structure can occur in any of the size classes and is broken down into two categories; large and very large. These categories follow the same trends as the large and very large size classes respectively, except that more of the landscape is predicted to contain large-tree structure. The difference in abundance between Large-tree structure and the large/very large size classes highlights areas that contain large tree components but have smaller average stand diameters due to an abundance of smaller trees. Especially dry forest types this may be a result of fire exclusion, and these areas could benefit from restoration treatments to remove some or all of the small trees.

Forest density and vertical structure

Forest density class and vertical structure are expected to change through time in a similar fashion across alternatives. There is a common trend to increase the low/moderate density class and reduce the high-density class too much. This is related to increases in nonforested areas (as seen in the nonforested cover type) as well as increases in low-density forests. Reductions in the high-density class are expected to improve forest resilience because, in general, it would also indicate reductions in fuel quantity and continuity that would support fast moving intense crown fires. Lower forest densities are desired near communities or other values at risk to fire. In addition, as the density increases, a deficit of soil moisture develops and trees lose their ability to withstand attacks by insects, pathogens, and parasites (Safranyik, Nevill, & Morrison, 1998). Lower densities support individual tree growth, and therefore the expected shifts contribute to the increases in large size classes and large-tree structure.

Nonforested/low/medium density

These classes encompass a broad range of conditions including nonforested areas (0-5% canopy cover), savannas (5-10% canopy cover), and low-density forests (10-39.9% canopy cover). Forestwide, this class increases over time to be above the desired range. This also occurs in the warm dry PVT to a greater extent; this PVT is the most likely to include nonforested cover types. In the cool moist PVT, it briefly exceeds the desired range but then decreases within the range (presumably as burned forests regenerate). This density class increases to the upper bound of the desired range in the cold PVT. The increases in this density class may be due to natural disturbances, drought-related or competition based mortality, as well as vegetation treatments to a lesser degree. In the Big Belts, Castles, Crazies, Divide, Little Belts, and Upper Blackfoot GAs the amount of this density class increases steadily above the desired range. In the Elkhorns, Highwoods, and Snowies GAs the amount of this density class increases but stays within the upper bound of the desired range. In the Rocky Mountain Range GA, this class increases briefly above the desired range, then decreases to be within the desired condition range by the end of the projection. At the beginning of the projection, non-WUI and unmanaged areas have a higher proportion of this density class; but over time this shifts (as recent fire areas in remote locations reforest), and WUI and managed areas have a higher proportion by Decade 5.

Medium/high density

This density class includes forests that are 40-59% canopy cover. Forestwide this density class temporarily decreases but rebounds and remains similar to the existing condition, just below or at the low end of the desired range. In the warm dry PVT, the abundance of this class decreases to below the desired range. This decrease likely corresponds to the increases in the nonforested/low/medium density class. In contrast, in the cool moist and cold PVTs, the abundance of this density class increases toward the desired condition, achieving the desired range in cool moist. Most forest types on these sites would naturally grow in this density condition at least in the later stages of stand development, and the trend likely corresponds to reductions in the high-density class. The Big Belts GA follow a similar trend as Forestwide. In the Divide, Elkhorns, and Highwoods GAs, the medium class decreases below the desired range temporarily but rebounds to be at or within the lower bound of the range. In the Castles and Upper Blackfoot GAs, the abundance of this class decreases steadily and goes below the desired range, with some small variance by alternative in the Castles GA. In the Crazies GA, this class initially increases then decreases to just below the desired range by the end of the projection. The Little Belts, Rocky Mountain Range, and Snowies GAs are unique in that this class increases toward or within the lower bound of the desired condition range. Initially, a higher proportion of non-WUI areas contain the medium density class; over time this relationship switches, but the proportions are within about 5% of each other. In contrast, initially a higher proportion of managed areas contain this density class, but over time this becomes closely balanced between managed and unmanaged areas.

High density

This density class includes forests 60% canopy cover and greater. At all scales of interest this density is predicted to decrease through time with little variance across alternatives. Forestwide and in the cool moist and cold PVTs, the trend is to decrease steadily and achieve the desired range by the end of the projection. In the warm dry PVT, the class decreases to be just below the desired range at the end of the projection. The decreases in the high-density class likely correspond to the increases in the low/medium class, influenced by drought and expected future disturbances, as well as the increases in the medium/high class in the cool moist PVT. In the Big Belts, Little Belts, and Upper Blackfoot GAs the high-density class decreases through time to be at the low end of the desired condition bound. In the Divide, Elkhorns, Rocky Mountain Range, and Snowies GAs, the decreases result in conditions in the mid-range of the desired condition. In the Castles, Crazies, and Highwoods GAs, the decreases in this class move below the desired range. The proportion of WUI versus non-WUI, and managed versus unmanaged lands, that contains this density class fluctuates but is relatively balanced through time. The reductions of the high-density class could result in higher forest resiliency to disturbances in many cases and result in promoting large trees and shade-intolerant species. Conversely, in some cases shifts to lower densities could equate to the loss of habitats of interest (such as dense spruce/fir for lynx habitat).

Vertical structure

Vertical structure classes do not have desired conditions, as they are inherent within the mix of species composition, size classes, and density classes. This attribute is one of the most uncertain in terms of model classification. Three classes are included: single-storied, two-storied, and multi-storied; and are assessed relative to their NRV ranges.

- The single storied vertical structure class often, but not always, occurs in stands in the higher density classes. Seedling/sapling forests are combined with the single-storied class, as young regenerating forests are predominantly in this condition. This structure is predicted to decline through time in all PVTs, to likely move into the upper end of the NRV in the cool moist and cold PVTs, but not in the warm dry PVT. This will remain a common structure on the landscape, and the reductions are likely due to a diversification of structures that accompanies reduction in tree density and/or species composition. WUI and non-WUI areas contain a fairly similar proportion of single storied stands. Managed landscapes contain a substantially higher proportion of single storied stands than unmanaged areas; perhaps due to the expanses of lodgepole pine found in the suitable timber base.
- Two-storied vertical structures are uncommon, and the model predicts an increase over time. In the warm dry PVT, the trend is to increase and then decrease, but remain above the NRV. In the cool moist PVT, the trend is to increase and then decline but remain above the NRV. This class will also increase in the cold PVT, likely above the NRV range. This condition can develop in stands where the overstory canopy is opened up by disturbance and a new age class of trees becomes established. These stands may progress into a multi-storied condition over time. WUI and non-WUI areas contain a fairly similar proportion of 2-storied stands as do managed and unmanaged areas.
- Multistoried vertical structures increase toward but remain below the NRV ranges in all PVTs. An increase in this condition, particularly in the cool moist and cold PVTs, may indicate reforestation of high elevation areas after wildfire, as well as establishment and growth of understory canopy layers in the absence of fire in mature forests. Where associated with spruce/forests, this would be a positive impact related to the potential development of multistoried lynx habitat. In the warm dry PVT, the increase may be due to increases in ladder fuels in high density forests or reflect new age

classes that are recruited from disturbances that open up forest canopies. WUI and non-WUI areas contain a fairly similar proportion of multi-storied stands, as do managed and unmanaged areas.

Landscape patch and pattern (early successional forest patches)

The average size of early successional forest patches is assessed as an element of landscape pattern. Forestwide patches are larger than patches in PVTs because PVT mapping causes patches to be summarized separately. For example, a large fire patch that crosses multiple PVTs may essentially create one large patch, but be calculated as several smaller patches for each PVT. The expected trends are similar across all alternatives. There are no quantitative desired conditions for patch size (as discussed in appendix H); results are discussed relative to the NRV condition.

Across the 50-year modeling timeframe in all alternatives, patch size of early successional forests shows a declining trend forestwide and in the cool moist PVT, from roughly 160 acres to 120 acres and 133 to 80 acres respectively, which are at the upper bounds of the NRV ranges. In the warm dry PVT, patch size remains similar to the existing condition (roughly 90 acres), which is slightly above the NRV, and may indicate that fires burn with higher severities over larger areas than they did historically. In the cold PVT, patch size declines only slightly from the existing condition of 76 acres, which is within the NRV range. Patch sizes in the cool moist PVT are larger than in the other PVTs, in part because lodgepole pine forests commonly found on this type are adapted to reforesting large openings following disturbances. A finer grained mosaic of patch sizes could provide for the maintenance of shade tolerant species such as spruce and fir in some areas.

A reduction in early successional forest patch size may appear inconsistent with the expected trend of increasing disturbances on the landscape due to climate change and drought. The trend of reduced patch size may in part be due to modeling limitations and the uncertainty of when, where, and how disturbances will move across the landscape, but also potentially due to the recovery of recently created large patches along with an increase in landscape heterogeneity in the future, such that large disturbances may result in a mosaic of post-disturbance conditions.

The Elkhorns, Rocky Mountain Range, and Upper Blackfoot GAs have the largest patch sizes currently; these larger patch sizes are perpetuated into Decades 1 and 2, and then decrease by decades 4 and 5, likely as a function of successional processes after recent large fires. The Highwoods, Little Belts, and Snowies GAs display a smaller patch size mosaic across all decades. In the Castles, Crazies, and Divide GAs, the current patch sizes are fairly small, and increase in the future. The Big Belts GA has a moderate average patch size currently which is generally sustained throughout the projection. Average patch size of early successional forests is initially higher in WUI areas as compared to non-WUI areas; but over time the average patch size becomes similar across all areas and only slightly larger in WUI areas. Average patch size of early successional forests is initially higher in unmanaged landscapes as compared to managed landscapes; but over time becomes similar.

Fire would continue to be the primary event that creates early successional forest openings. The pattern of openings intermixed with mid and late successional forest would be ever-changing. The primary cause of decreasing patch size of early successional forests is the regrowth of patches created by disturbance, coupled with projected disturbances affecting the landscape in a finer grained mosaic. Timber harvest and prescribed burning also create early successional patches, to a lesser extent; patches created by timber harvest would be subject to size limits as discussed *Effects from forest plan components associated with timber management*. The decrease in patch size is not likely due to landscape fragmentation associated with development or road building, because the pattern of NFS lands is expected to be maintained (not converted to other ownerships or uses), and little new permanent road building is anticipated. At the broad scale, landscape heterogeneity may increase if climate-mediated changes in disturbance regimes increase (J. E. Halofsky et al., 2018a).

Effects from forest plan components associated with:

Watershed management

All alternatives contain plan components that guide or limit vegetation management to protect watershed values. Watershed plan components may encourage some forms of vegetation management, such as prescribed fire and tree planting, to maintain vegetation conditions that reduce erosion potential and/or mitigate the risk of severe wildfire. These components may result in project level design considerations; for example, retaining higher density forests where stability is needed; or conversely, managing for lower densities where fire risk is a concern. These considerations would likely fit within the desired ranges for terrestrial vegetation at the broader scale. The action alternatives also contain specific plan components that would benefit nonforested cover types to a greater degree than the no-action alternative, including:

- FW-WTR-DC-05 describes the desired condition that nonforested areas in and surrounding wetlands contribute to wetland ecological and habitat diversity.
- FW-WTR-DC-09 and FW-WTR-GDL-01 would promote wetland and riparian health by encouraging beaver populations and habitat conditions.

Under all alternatives, law, regulation, and policy may limit vegetation management activities as needed to benefit source water protection areas. This may influence project design but would not materially impact the potential to move towards vegetation desired conditions; and, in fact, may be complementary with respect to forest cover.

All alternatives include plan components that guide the management of municipal watersheds, to provide high quality and quantity of water. The 1986 Helena NF plan includes forest-wide direction and includes the Tenmile watershed in management area H-1, which is unsuitable for timber production. The 1986 Lewis and Clark NF plan includes municipal watersheds in management area J, which also restricts where timber harvest can occur; the Snowies municipal watershed was not included. The management direction in the action alternatives recognize more flexibility for management in municipal watersheds than the no-action alternative, and include the following components:

- Desired conditions (CA-WTR-DC-01, DI-WTR-DC-01, EH-WTR-DC-01, LB-WTR-DC-01, and SN-WTR-DC-01) note the need to provide clean water supplies in the Castles, Divide, Elkhorns, Little Belts, and Snowies GAs.
- Guidelines (CA-WTR-GDL-01, DI-WTR-GDL-01, EH-WTR-GDL-01, LB-WTR-GDL-01, SN-WTR-GDL-01) would ensure that management activities in municipal watersheds emphasize restoration and resiliency. This is compatible with the desired conditions and guidelines for terrestrial vegetation.
- CA-WTR-GDL-02 and LB-WTR-GDL-02 would positively impact nonforested vegetation by limiting livestock grazing in the municipal watersheds within the Castles and Little Belts GAs.

These components may limit vegetation treatments in municipal watersheds but in general would not likely affect (and possibly, benefit) movement towards terrestrial vegetation desired conditions. Municipal watershed guidance would apply to a greater area in the action alternatives as compared to the no-action alternative, but the effect is minor because the additional area (in the Snowies GA) is in a landscape that is largely unmanaged due to other land designations.

In summary, all alternatives would result in similar results to terrestrial vegetation because of plan components that ensure best management practices are followed and that the effects to watersheds are included in project design. These components would either complement or not preclude the achievement of the terrestrial vegetation desired conditions. To the extent that these components limit timber harvest (see the timber section), they also limit the potential to achieve desired conditions in certain areas.

Riparian management areas

Riparian areas are narrow, linear features that help provide for wildlife habitat connectivity, late successional forest features, and refugia for seed sources; plan components that encourage the retention of forest structure in these areas would complement terrestrial vegetation desired conditions. Measures to protect aquatic habitat and riparian areas would apply under all alternatives. Riparian management zones are defined differently depending on the alternative, as described in the *Watershed, Fisheries and Aquatic, Soil, Riparian, Conservation Watershed Networks and Wetlands* section.

Riparian management area plan components would limit the type, amount and location of vegetation treatments, as well as requiring retention of trees and other forest components. West of the continental divide, alternative A is similar to the action alternatives with respect to sizes and management direction applied to riparian areas, although guidance for vegetation management in outer RMZs is more flexible with the action alternatives. East of the continental divide (the majority of the HLC NF), the action alternatives would establish larger RMZs than alternative A.

To the extent that plan components limit potential timber harvest, they also limit the potential to achieve desired vegetation conditions in certain areas. However, in the context of vegetation conditions at the Forestwide, or even GA, scale, this influence is minor. The 1986 Helena NF plan includes forestwide standards for riparian areas that provide for their delineation and considerations such as providing vegetative cover adjacent to streams. The 1986 Lewis and Clark NF plan, they are incorporated as management area R, which also provides for riparian area protections and specifies that uneven-aged management would be used when harvesting in these areas. In contrast, the action alternatives more broadly recognize that vegetation treatments, including harvest prescribed fire, within riparian management zones may be beneficial and needed to achieve desired conditions (FW-RMZ-STD-02, 03; FW-RMZ-SUIT-01), while also providing for adequate protections. Because riparian vegetation conditions are encompassed within terrestrial vegetation desired conditions, in general riparian management area plan components are beneficial to the achievement of those desired conditions.

Fisheries and aquatic habitat, and Conservation Watershed Network

CWN plan components only exist for the action alternatives. These components would have little effect on terrestrial vegetation, except indirectly via considerations that may inform project design. These components would also complement desired vegetation conditions in riparian and wetland areas (e.g., FW-FAH-DC-03). It is not likely these plan components would change the ability of management to move vegetation towards desired conditions to a measurable degree. This effect would be similar for all alternatives.

Soils

Under all alternatives, plan components related to soils would benefit terrestrial vegetation by ensuring that soil productivity is maintained in the long term to support desirable vegetation. Standards and guidelines related to soils may limit vegetation management activities, such as timber harvest and prescribed fire, in cases where those activities may be detrimental to soils (FW-SOIL-STD-01 through 03, FW-SOIL-GDL-01 through 08). The action alternatives provide greater specificity in the standards and guides for soils than alternative A, particularly with respect to allowable detrimental disturbance (FW-SOIL-STD-02), slopes where equipment can operate (FW-SOIL-GDL-01), and post-treatment ground cover and organic matter requirements (FW-SOIL-GDL-04, FW-SOIL-GDL-05). These limitations may impede direct intervention in some locations to change vegetation; however, by protecting soil productivity and stability, they would also protect the site's ability to support vegetation. In addition, the action alternatives are more specific in the desire to maintain soil conditions that support the desired conditions for terrestrial vegetation (FW-SOIL-DC-01); this would have a positive effect on the potential to achieve desired terrestrial vegetation conditions.

Fire and fuels management

Fire and fuels management tools (such as prescribed fire), as well as naturally-ignited wildland fire can help achieve vegetation desired conditions, and usually results in positive impacts to terrestrial vegetation. Prescribed fire can be the only feasible management option in some landscapes where mechanical treatments are not allowed or restricted. All alternatives include plan components that guide the application of prescribed fire and other fuels management techniques; plan components under all alternatives are permissive to the use of prescribed fire. The action alternatives more directly address the WUI and the need to manage fuel loadings to minimize threats to values (FW-FIRE-DC-02); and that fuel treatments allow for natural fire occurrences over time (FW-FIRE-DC-03). The desire for fuel treatments is reflected in FW-FIRE-OBJ-01, and plan components would also influence the design of vegetation projects (FW-FIRE-GDL-01, FW-FIRE-GDL-02, and FW-FIRE-GO-03).

The 1986 plans placed a heavier emphasis on fire suppression levels in management areas; in contrast, the action alternatives include components that more broadly recognize the natural role of wildfire (FW-FIRE-DC-01), and therefore may encourage fire management decisions that result in more wildfire on the landscape. Because these decisions would be made in conjunction with all other plan components, the effect of this would generally be positive with respect to attainment of terrestrial vegetation desired conditions. However, there could also be specific risks or negative effects from fire, such as the loss of whitebark pine stands, or the creation of an "over-abundance" of seedling/sapling stands in some GAs.

In the WUI or near other values at risk, to achieve desired fuel conditions (FW-FIRE-DC-02) there may be areas where forest conditions are managed over the long term at lower densities, with fewer canopy layers, and/or dominated by fire resistant tree species. This would be consistent with the natural disturbance regime found on many sites, and therefore complement movement towards desired conditions, such as in the warm dry PVT. However, in cases where cool moist or cold PVTs are found in the WUI, the desired fuel conditions could be different than what would occur under natural disturbance regimes. Such actions would not preclude the eventual attainment of desired terrestrial vegetation conditions at the broader scale but may delay movement towards them in specific locations; or change the spatial pattern of those conditions (for example, focusing on more dense forests in areas farther away from values at risk). The cool moist and cold PVTs contain 523,663 acres (18% of all NFS lands on the HLC NF) of land in the WUI, where this plan direction may affect the design and implementation of prescribed fire, hand treatments, and/or timber harvest. The no-action alternative does not include components specific to the WUI but also does not preclude such considerations, and in practice would likely be similar to the action alternatives.

At-risk plants and pollinators

Under the action alternatives, FW-PLANT-DC-02, GO-01, and OBJ-01 would ensure that restoration treatments occur for whitebark pine, and that key whitebark pine areas support the long-term recovery of this species; these components directly complement the desired conditions for the whitebark pine cover type and tree species presence. This beneficial effect would apply only to the action alternatives; the 1986 plans do not contain any plan direction specific to whitebark pine.

With the action alternatives, FW-PLANT-DC-01 and FW-PLANT-GDL-01 would influence project design in order to promote or protect at-risk plant species, and therefore could influence vegetation management that occurs in forested and nonforested types; however, these considerations are not likely to measurably change the potential to move toward terrestrial vegetation desired conditions. The 1986 plans also include direction relative to sensitive plant species. The at-risk plant species that would be adopted with the action alternatives are not the same as the sensitive plant species that apply to the 1986 Forest Plans, although there are many species in common. In general, the magnitude of potential effect with regards to terrestrial vegetation by virtue of guiding or limiting vegetation management opportunities are the same or similar for all alternatives, although the effects to some specific plant species may vary.

There are no plan components for pollinators in the 1986 Forest Plans (alternative A). The action alternatives include plan components for these important insects. FW-POLL-DC-01 is designed to provide for pollinator habitat, including diverse grass, forb, shrub, and tree species as well as snags and downed wood. This desired condition is complementary to the desired conditions for terrestrial vegetation and would not result in limitations to moving towards those desired conditions.

Big game and general wildlife habitat plan components

Wildlife habitat plan components under all alternatives would influence terrestrial vegetation. In the 1986 Forest Plans, wildlife habitat plan components for big game include forestwide standards that affect terrestrial vegetation, including but not limited to:

- Maintaining adequate thermal and hiding cover on important summer and winter range, including specific percentages (both Forests) and using certain minimum patch sizes (Helena NF).
- Following the MT Cooperative Elk-Logging Study recommendations (both Forests).
- Maintaining or improvement big game security by implementing specific ratios of hiding cover to open road density levels (Helena NF).
- Implementing motorized closures during certain periods in elk calving grounds and winter range (Helena NF)

These components would result in vegetation management limitations and would not necessarily be consistent with terrestrial vegetation desired conditions in all landscapes (for example, the hiding cover percentages may not align with the desired abundance of nonforested or open forest conditions on landscapes dominated by warm and dry PVTs). In some areas the standards may not be achievable given disturbances, site capability, and climate. Collectively, wildlife plan components with the no-action alternative may delay or preclude achievement of some desired conditions in specific areas, although they may not preclude eventual achievement at the broader scale. Other components, such elk security standards, may limit the potential feasibility of some vegetation projects.

Under the action alternatives, the big game habitat management guideline may limit the potential for vegetation treatments and achievement of desired vegetation conditions in alternatives B, E, and F but not C or D. In alternatives B, E, and F, the potential constraints to management or influence on vegetation conditions would be based on BASI to provide for big game habitat management determined on a project-specific basis. In contrast to alternative A, all action alternatives are more flexible with respect to big game habitat mangement.

Collectively, several other big game or general wildlife plan components may limit vegetation management but would generally be consistent with terrestrial desired conditions based on the flexibility to determine quantitative habitat needs at the project scale, which would be appropriate to the conditions of the site. These components include the following:

- FW-WL-DC-01, 02, and 03 specifically tie to vegetation components.
- FW-WL-DC-04 and 07 address specific habitat features but are not quantitative and provide for flexibility to determine the appropriate levels at the project scale.
- FW-WL-GDL-05, 09, and 10 would meet the intent of limiting activities during sensitive periods and locations for wildlife, but do not prescribe exact dates.
- FW-WL-GDL-06 would limit vegetation management as needed to ensure the habitat quality of big game winter range, but does not prescribe quantitative ratios of habitat conditions.

Several GAs also include plan components that call out more specific wildlife habitat needs that may influence terrestrial vegetation in the action alternatives, as follows:

- BB-WL-DC-02; DI-WL-DC-02; EH-WL-DC-03, and UB-WL-DC-02 would ensure that large ponderosa pine and Douglas-fir trees and snags are available for flammulated owls, in a mosaic of closed-canopy forest and shrub-dominated openings, in the Big Belts, Divide, Elkhorns, and Upper Blackfoot GAs. This complements large-tree structure and forest size/density desired conditions.
- BB-WL-DC-03, CR-WL-DC-01, DI-WL-DC-01, EH-WL-DC-02, RM-WL-DC-01, SN-WL-DC-01, and UB-WL-DC-01 call out the importance of habitat connectivity for wide-ranging species. Connectivity for wildlife is also emphasized in the Divide and Upper Blackfoot GAs (DI-WL-GDL-01 and UB-WL-GDL-01) by requiring that vegetation management activities provide for wildlife hiding cover in certain areas. Connectivity is emphasized in the Highwoods and Little Belts GAs (HI-WL-DC-01, LB-WL-DC-01) by requiring that the system of ridges in this GA be connected by nonforested vegetation communities or open forest habitats. These components would complement the landscape patch and pattern plan components (FW-VEGT-DC-01, FW-VEGF-DC-08).
- EH-WMU-GDL-01 ensures that maintenance, enhancement, and restoration of wildlife habitats are the priority for resource management in this area.
- RM-WL-GDL-02 and UB-WL-GDL-02 would require that timber harvest be avoided on or adjacent to known harlequin duck breeding streams during the brood-rearing period in the Rocky Mountain Range and Upper Blackfoot GAs. This may influence terrestrial vegetation by limiting timber activities, but this impact would be minor based on the extent of these streams.
- SN-VEGF-DC-04 calls out the need to minimize juniper recruitment into mule deer and elk summer range in the Little Snowies portion of the Snowies GA; and SN-VEGNF-GDL-01 would ensure that vegetation management enhances and maintains high quality forage on big game summer range, particularly on the northern slopes of the Big Snowy Mountains. These components would inform where certain vegetation desired conditions are focused on (for example, juniper) in those GAs.

Canada lynx

All alternatives would retain the Northern Rockies Lynx Management Direction (U.S. Department of Agriculture, Forest Service, 2007f) which would influence vegetation management and desired conditions in potential lynx habitat (roughly 51% of the HLC NF). Although the management constraints are only required in occupied lynx habitat, the NRLMD specifies that its guidance should be considered in unoccupied habitat. Currently, the Upper Blackfoot, Divide, and Rocky Mountain Range GAs are considered occupied. However, because the guidance would be considered on all GAs, and there is potential for occupied habitat to become occupied, this analysis applied the NRLMD across the entire HLC NF for forest planning purposes. Several objectives in the lynx direction complement the terrestrial vegetation plan components, by describing a desired condition to approximate natural succession and disturbance processes (#1) and provide a mosaic of habitat conditions through time (#2). Further, objective #4 points to the opportunity to utilize vegetation management to promote the development of habitat characteristics. The constraints of the lynx management direction were incorporated into PRISM, and therefore their influence is incorporated into the results in this report.

The action alternatives would have a slightly higher influence on terrestrial vegetation with respect to Canada lynx than the no-action alternative, by including FW-WL-DC-09, which notes the habitat needs of lynx which would generally complement terrestrial vegetation desired conditions, and may result in management towards the upper or lower bound of the desired range of certain attributes in some locations. In addition, GA-specific plan components (DI-VEGF-DC-04, RM-VEGF-DC-04, and UB-VEGF-DC-04) emphasize providing vegetation conditions to support the recovery and persistence of Canada lynx. These components would ensure consideration is given to lynx habitat, particularly stand initiation structural stage and mature multistory structural stage, which may be limited. For the most part this would occur during project level design, and at the GA scale may result in management targeting the upper end of the desired ranges for the components of these habitats (e.g., the seedling/sapling size class and/or the spruce/fir cover type).

Under all alternatives, several standards (VEG S1, VEG S2, VEG S5, and VEG S6) in the NRLMD retained in the 2020 Forest Plan may impact the management of mapped lynx habitat (specific types of terrestrial vegetation). These standards include an exemption for fuel treatment projects in the WUI, and exceptions for the use of precommercial thinning (VEG S5) and/or projects that reduce snowshoe hare habitat in multi-story mature or late successional forests (VEG S6) to benefit other resources. The acres affected for VEG S1, VEG S2, VEG S5, and VEG S6 cumulatively must occur on no more than 6% of mapped lynx habitat on the Forest. The number of acres that may be treated in the WUI by exemption and/or for other resource benefit by exception are determined in consultation between the Forest and the U.S. Fish & Wildlife Service. The total number of acres that use exemptions and/or exceptions are annually reported. Since the adoption of the NRLMD, the exemption and/or exceptions to vegetation standards have been applied to only a very minor amount of occupied lynx habitat.

Northern Rockies Lynx Management Direction standard VEG-S1 and S2

Standards VEG S1 and S2 would limit the amount of regeneration harvest that may occur in areas where the abundance of stand initiation habitat is above thresholds described in the NRMLD. This habitat condition is most likely found in forests classified in the seedling/sapling size class, which may be particularly abundant after stand replacing disturbances but can also be created by regeneration harvest. After large disturbances in particular, it is likely that the desired vegetation conditions would be consistent with not creating additional regenerating forest patches. Therefore, these standards should generally be complementary, or at a minimum not likely to preclude, the potential future achievement of terrestrial vegetation desired conditions.

Northern Rockies Lynx Management Direction standard VEG-S5

Standard VEG S5 does not allow precommercial thinning that reduces snowshoe hare habitat in the stand initiation structural stage until the stands no longer provide winter snowshoe hare habitat, except in limited situations. This standard can be assessed, in part, relative to seedling/sapling forests to provide a general analysis, although other structural stages and mosaics may apply. All seedling/sapling stands are not necessarily stand initiation structural stage winter snowshoe hare habitat because other characteristics (such as density) would influence whether tree crowns have lifted above the snow level to achieve this habitat condition as described in the NRLMD.

VEG-S5 may reduce the effectiveness of achieving desired vegetation conditions across portions of the forest. Although high density may be desired in some seedling/sapling stands, in others a lower density would better trend forests towards desired composition, densities, size classes, improved resilience over time, and timber growth especially in lands suitable for timber production. Early thinning can be more cost effective at achieving density goals than waiting until the trees are more difficult to dispose of.

Table 56 shows the potential magnitude of the effect of standard VEG S5 on precommercial thinning opportunities in seedling/sapling forests by displaying the lands suitable for timber production that are currently in a seedling/sapling state, and whether or not they are located in the WUI. The distinction in acres on WUI and outside the WUI is useful because exemptions may be applied to treat within the WUI. The acres vary by alternative based on the changes to lands suitable for timber production.

Table 56. Seedling/sapling forests in potential lynx habitat in lands suitable for timber production

	Acres within the WUI	Acres outside the WUI	Total acres
Alternative A	6,194	6,339	12,532
Alternative B/C	5,207	4,497	9,704
Alternative D	5,133	4,315	9,448
Alternative E	5,273	4,694	9,967

	Acres within the WUI	Acres outside the WUI	Total acres
Alternative F	5,250	4,646	9896

1 Seedling/sapling forests are defined as those less than 5” average diameter. Stand initiation habitat is most likely to occur as a subset of this structural class, but would also include additional characteristics as defined in the NRMLD (appendix I of the 2020 Forest Plan), and in appendix H. Refer to the Canada lynx analysis 3.14.7 for a detailed examination of lynx habitat, forest structural stages therein, and associated effects.

In Table 56, the proportion of the lands suitable for timber production in a seedling/sapling size class, in potential lynx habitat and outside WUI, represent the lands where precommercial thinning action would most likely be foregone or delayed by VEG-S5. This area comprises less than 1% of NFS lands in all alternatives currently. This condition will change over time as forest conditions change. Precommercial thinning in these areas could not occur until the stands no longer provide winter showshoe hare habitat, i.e. after the trees self-prune. Hand thinning is the most cost-effective method. Therefore, delaying treatment may render the action infeasible and the opportunity to improve stand quality could be foregone. The number of acres in this condition is highest in alternatives A and E, but all alternatives are similar.

However, these effects represent a conservative picture of the largest potential impacts; in reality, only a subset of these seedling/sapling stands would meet the habitat criteria for stand initiation winter snowshoe hare habitat; and further, not all would necessarily require precommercial thinning to achieve desired vegetation conditions. Precommercial thinning may not be feasible or needed in all of these stands, depending on the site conditions, nor would current or anticipated budget levels support thinning all these acres, so the actual impact to potential management would likely be less than shown in Table 56.

Northern Rockies Lynx Management Direction standard VEG-S6

Standard VEG S6 does not allow vegetation management that reduces winter snowshoe hare habitat in multi-story mature or late successional forests, with some exemptions/exceptions. This habitat condition most commonly develops on the cool moist and cold broad PVTs. VEG S6 notes that timber harvest could be used to create openings to improve hare habitat in stands with poorly developed understories. Multi-story mature habitat is fairly uncommon, and while it is predicted to increase slightly forestwide, it may decrease in some GAs (see appendix H). Therefore, this standard is likely to be limiting to vegetation management, to the greatest extent in potential lynx habitat outside of the WUI (31% of the HLC NF).

VEG-S6 would potentially reduce or delay the ability to achieve desired vegetation conditions in some areas, such as increasing the abundance and resilience of whitebark pine. The inability to apply vegetation management in whitebark pine stands where fire exclusion has allowed spruce/fir canopy layers to develop would result in foregoing restoration opportunities. In addition, achieving resiliency by promoting early seral species (such as lodgepole pine) or more open densities could not occur in multi-story mature stands. The standard is generally consistent with terrestrial vegetation desired conditions, which call for the maintenance or increase in the spruce/fir cover type in most GAs; but would limit the flexibility to manage for lower levels within the desired ranges to provide for other desired conditions such as whitebark pine.

Multi-story mature habitat is likely to be susceptible to high severity fire and damage from western spruce budworm, bark beetles, and other agents. Therefore, vegetation management to promote the development of future multi-story mature habitat, as allowed in VEG-S6, may be warranted in some areas. This guidance would influence the types of prescriptions selected in some projects (i.e., selecting uneven-aged management to promote the development of spruce/fir multi-storied stands, rather than another vegetation treatment that would promote other structures or species).

Multi-story mature forest is an important piece of the desired vegetation mosaic. VEG-S6 would not necessarily preclude a trend towards other terrestrial vegetation desired conditions, in large part because vegetation treatments are predicted to influence a relatively minor proportion of the landscape. Still, this standard may impact the potential to achieve desired conditions related to lodgepole pine and whitebark pine in specific areas. The vegetation modeling included parameters that did not allow timber harvest or prescribed fire within existing multi-story mature stands in potential lynx habitat, and it varies by GA as to whether this habitat condition is predicted to increase, decrease, or stay the same. In some areas, VEG S6 may become increasingly limiting in the future and represent some tradeoffs with other desired conditions. Under any alternative, the achievement of desired vegetation conditions and lynx habitat would require thoughtful integration of plan components.

Recreation opportunity spectrum settings

Recreation opportunity settings (ROS) are defined for the action alternatives but do not apply to the no-action alternative. ROS settings of primitive, semi-primitive nonmotorized, and semi-primitive motorized include guidelines related to vegetation conditions and management (FW-ROS-GDL-03; FW-ROS-GDL-05; and FW-ROS-GDL-07 respectively), which denote varying degrees of natural vegetation conditions. These components are broadly consistent with the desired conditions for terrestrial vegetation. To the extent that ROS settings influence suitability for motorized access, the feasibility of conducting timber harvest to influence vegetation may be affected as described in the Timber section.

Recreation, recreation special uses, and special uses

Under the no-action alternative, developed recreation sites are included in management area R-2 in the Helena NF plan (which requires that tree removal would only occur for safety or to maintain healthy and diverse vegetation in these areas); and in management area H in the Lewis and Clark NF plan (which states that un-programmed timber harvest may occur). Under the action alternatives, recreation plan components more specifically address the desired vegetation conditions in these areas, and may result in vegetation conditions in small, isolated areas to be managed in ways that do not contribute toward the attainment of desired conditions due to other considerations such as public safety (e.g., FW-REC-DC-06, FW-REC-GDL-02, FW-REC-SUIT-01, and FW-RSUP-DC-05). The overall influence of this would be minor, and similar across alternatives due to the small scope and scale of these areas, and because in some cases the desired vegetation conditions would be consistent with terrestrial vegetation desired conditions. See also the Showdown and Teton Pass Ski Areas section below.

Scenery

Under all alternatives, plan components associated with scenery may affect terrestrial vegetation through their influence on allowable vegetation treatments. The magnitude and type of vegetation treatment (particularly timber harvest) in areas with higher scenic values may be limited. Effects to scenery are typically localized and would be determined in project-level analysis; in some landscapes scenery plan components may align with terrestrial vegetation desired conditions, while in other landscapes these components may influence the timing of meeting desired vegetation conditions. However, because both vegetation and scenery objectives emphasize conditions that are consistent with natural processes, at the broad scale plan components related to scenery and visual quality would not likely preclude the achievement of desired conditions for terrestrial vegetation. Alternative A uses visual quality objectives to define scenery management, whereas the action alternatives use scenic integrity objectives (SIOs). SIOs offer greater flexibility and recognition of natural disturbance regimes and vegetation conditions. Alternative D is most potentially limiting to vegetation management activities, as it has the greatest amount of high and very high SIOs as a result of having the most RWAs, while Alternative E is the least limiting.

Recommended wilderness areas

The alternatives vary in the quantity and location of RWAs, ranging from none in alternative E, to 16 areas (nearly 475,000 acres) in alternative D, with preferred alternative F incorporating 7 areas totaling just over 153,000 acres. In these areas, no harvest could occur (e.g., FW-RECWILD-SUIT-04 for the action alternatives). RWAs by in large overlap IRAs. Although limited, some harvest could occur in IRAs; therefore, while generally small, there is an additive impact of restricting harvest with the RWA allocation, and thus the potential to contribute to vegetation desired conditions with timber harvest, as described in the timber section. However, this designation does not preclude other restoration treatments such as prescribed fire and tree planting, so long as the ecological and social characteristics that provide the basis for wilderness recommendation are maintained (FW-RECWILD-SUIT-02; FW-RECWILD-DC-01). This may include the restoration of high elevation ecosystems, and whitebark pine forests, as well as other desired forest structure and compositions, or to restore desired landscape patterns. In this respect, the RWA is less limiting than designated wilderness, although the feasibility of prescribed fire treatments may be lessened. Future wilderness designation of RWAs could be anticipated. Designation as wilderness would result in reduced flexibility and options for vegetation management to achieve desired conditions, as described under the *Effects of plan components associated with designated wilderness*.

As noted in the timber section, several RWAs pose additional tradeoffs because they are located on landscapes where the HLC NF has identified a need for active management (e.g., the Colorado Mountain and Camas RWAs in alternative D). If alternative D were selected, opportunities to utilize timber harvest (to the extent consistent with IRA and other plan components) would be precluded, which may reduce the ability to treat those landscapes in a manner that most efficiently moves toward desired conditions and/or meets the purpose and need of projects, including those in the Tenmile Municipal Watershed.

Under alternatives A and C, existing motorized and mechanized means of transportation would be suitable in RWAs, whereas these uses would be unsuitable in alternatives B, D, and F. This distinction would have little to no effect on terrestrial vegetation. Existing motorized uses are generally on trails (not roads), which would cause negligible impacts to vegetation, and provide little benefit in terms of access for management. The presence of mechanized means of transportation (e.g., mountain biking) would have little to no effect on vegetation.

Public comments were received that requested more analysis of the potential for natural disturbances to affect vegetation (and achievement of desired conditions) in "unmanaged lands" as opposed to "managed lands." The designated areas considered "unmanaged" in this analysis are those subject to law, regulation, policy, and/or forest plan components that exclude or limit management interventions such as logging and prescribed fire. These areas would include designated wilderness, WSAs, RNAs, IRAs, and RWAs. Of these, wilderness areas, WSAs and IRAs are established outside of the forest planning process. RNAs vary only slightly by alternative. RWAs do vary substantially by alternative and therefore are the focus of the following discussion.

The effects of natural disturbances in RWAs could be positive in terms of terrestrial vegetation desired conditions, if those disturbances occur at a scope and severity within the NRV; the net effect to terrestrial vegetation desired conditions is unknown. It can be hypothesized that natural disturbances may influence unmanaged lands differently than managed lands. On one hand, logging and prescribed in managed lands may lessen the susceptibility of forests to severe wildfire and insect outbreaks, by lessening fuel loadings and/or altering stand densities (Agee et al., 2000; Amman & A., 1998; Egan et al., 2014; Hessburg et al., 2005; Shore et al., 1999). Other studies have concluded that at a broad scale, beetle outbreak outcomes or fire severities are not lessened in managed lands (Bradley, Hanson, & DellaSala, 2016; Six, Biber, & Long, 2014). The SIMPPLLE model indicates that fire and insect disturbances would be more extensive proportionately on managed lands versus unmanaged lands on the HLC NF. However, it cannot be concluded that the cause of this trend is vegetation management, and therefore the tradeoff of designating RWAs is unclear. There are complicating factors that influence future disturbances, such as:

- The effects of prescribed burning, which can occur in unmanaged lands, including IRAs and RWAs; as well as timber harvest, which is limited but can occur on IRAs;

- Recent disturbances may impact the conditions in unmanaged lands in a way that lessens disturbance extent or severity; for example, the large amount of recent fire activity on the Rocky Mountain Range GA, which constitutes a high proportion of unmanaged lands on the HLC NF.
- There are inherent differences in these lands, such as vegetation type (dry forests tend to occur on managed landscapes, which would burn more frequently) and topography.

Specific to bark beetle outbreaks, the limitation on harvest in RWAs (and other unmanaged lands) is unlikely to affect the outcome of a widespread outbreak like the one that occurred in the late 2000's. Direct control treatments are not likely to succeed in suppressing a severe infestation (Egan et al., 2014; Jenne & Egan, 2019). However, indirect control methods may be implemented prior to infestations to enhance tree survival and resilience (ibid); such treatments may increase the resilience of treated areas to bark beetle outbreaks in unmanaged stands, and therefore while the extent of an outbreak may be unchanged, there could be lower mortality in managed lands as compared to unmanaged areas.

Due to the small scale and scope where management activities such as logging occurs, these effects and tradeoffs between managed and unmanaged lands (such as RWAs) are not revealed in the programmatic analysis, although undoubtedly the susceptibility of managed stands and landscapes to various disturbances would be altered.

Eligible wild and scenic rivers

In the no-action alternative, the 1986 plans identify eligible WSRs (via amendment) based on a 1989 eligibility study, and include direction for the management of those rivers, with the goal of protecting the outstanding and remarkable values of these areas until suitability studies are complete. Under the action alternatives, a greater number of eligible WSRs are identified, and plan components for these rivers include limitations for vegetation management (which vary by the classification) in a 1/4 mile corridor, (wild, scenic, or recreational) (FW-WSR-GDL-01). These ¼ mile corridors are unsuitable for timber production, but some harvest could be allowed for specific purposes (unless precluded by other overlapping land allocations such as RWA). By in large, little vegetation management would be expected to occur. Plan components under all alternatives that provide interim protection measures for eligible WSR corridors may delay or prevent some site-specific locations from being managed toward vegetation desired conditions, but due to their shape and position on the landscape (next to rivers which overlap RMZs) these components would not substantially add to or subtract from movement toward the desired conditions for vegetation at the broad scale. The eligible WSR corridors in the action alternatives total 113,007 acres, compared to 43,291 acres in the alternative A.

Research natural areas

A variety of RNAs are included or proposed under all alternatives, with alternatives A, B, C, and E containing roughly 16,870 acres, alternative D roughly 21,375 acres, and alternative F roughly 18,447 acres. The additions in D and F are based on two different delineations of a new proposed RNA, Poe-Manley in the Elkhorns GA. The 1986 Forest Plans explicitly prohibit harvest in these areas. With the action alternatives, vegetation management would be limited unless specifically used to maintain the natural conditions of these areas as outlined in establishment records (FW-RNA-SUIT-01). No establishment records currently allow for harvesting. The effect would be to preclude (alternative A) or limit (action alternatives) the potential to directly manipulate vegetation in these areas, but the impact of this limitation is likely minor because natural processes may achieve or maintain desired conditions; and these areas are often located within other land designations that are restrictive to active management, such as IRAs, WSAs, and/or RWAs. By contributing to a Regional network of RNAs that help improve our understanding of natural processes, plan components for these areas would complement the overall achievement of terrestrial vegetation desired conditions across the landscape.

Public information, interpretation, and education

Under the no-action alternative, the 1986 Forest Plans do not address public information, interpretation and education. In contrast, the action alternatives include CONNECT plan components that encourage opportunities to enhance the public's knowledge and appreciation of the natural resources on the HLC NF. These components would indirectly influence terrestrial vegetation to the extent that they may result in public understanding of and participation in project design and development.

Timber management and other forest products

Timber harvest is one of the tools available to change vegetation for purposes of maintaining or moving towards desired vegetation conditions. Forest plan direction guiding timber harvest is provided in all alternatives. The 1986 Forest Plans and the 2020 Forest Plan contain a suite of components to ensure harvest is conducted in accordance with the NFMA (such as assurance of reforestation, limiting the use of clearcut harvest, and not causing irreversible damage to soils), and all alternatives are similar in this regard. The standards and guidelines would ensure the resilience and sustainability of harvested areas, and therefore help ensure desired vegetation conditions can be provided in the long term.

All alternatives also identify lands suitable for timber production; alternative E has the most, while alternative D has the least. These are lands where harvest would be used to the greatest extent, although the alternatives also include other lands where harvest can occur for other purposes. The difference between alternatives in terms of timber suitability is minor. PRISM was used to generate the best solution for applying timber harvest. The acres projected to be harvested are relatively small (2,000-5,000 average acres/year depending on alternative and budget scenario) compared to natural disturbance processes (e.g., wildfire expected to burn an average of 15,000-20,000 acres per year). Because harvest would be designed to achieve vegetation desired conditions, the impact is expected to be positive, and would occur to the greatest degree with alternatives A/B/C/D/F, and to the least with alternative E in a constrained budget scenario; or E and A respectively, with an unconstrained budget scenario.

All alternatives include even-aged harvest opening size limits that would influence the landscape patch and pattern of early successional forests. Under the no-action alternative, the 1986 plans refer to a 40-acre limit. This is more limiting than the action alternatives, which specify a 75-acre maximum (FW-TIM-STD-08). Under the action alternatives, the 75-acre limit is more similar to the NRV range, which was estimated based on the outcomes of natural disturbance and insect regimes. As shown in the *Landscape pattern: early successional forest openings* section and appendix H, average patch sizes are projected to decrease over time, particularly in the cool moist broad PVT, to approach the NRV range. The 75-acre limit is smaller than the existing condition of the average size of early successional forest patches in all PVTs except cold, where it is similar. To the extent that timber harvest affects the landscape, the 75-acre patch limit would allow for patches larger than 40 acres to be more consistent with the NRV. Therefore, the action alternatives would be more beneficial than the no-action alternative in terms of timber harvest activities contributing to desired terrestrial vegetation conditions related to landscape pattern and connectivity (e.g., FW-VEGF-DC-08). This opening size could be exceeded, with Regional Forester approval, if a site-specific analysis supports it, as allowed by FW-TIM-STD-09. The ecological importance of patches larger than 75 acres is indicated by the NRV 95th percentile range of the average patch size (up to 151 acres forestwide) as well as the area weighted mean patch size (up to 14,051 acres Forestwide).

Patches created by harvest would be similar in size and forest size class as those created by disturbances; however, other key ecosystem components could differ, such as the amount of dead wood on the ground, the amount of standing snags, and residual patches of surviving trees that may provide structure for wildlife habitat. Timber harvest could be designed to leave similar legacy structures on the landscape in even-aged regeneration harvest openings if needed to meet the needs of all resources.

There are also several GA-level timber plan components that would influence terrestrial vegetation:

- EH-TIM-GDL-01 would require that timber harvest in elk winter range would only occur during the nonwinter season in the Elkhorns GA. The effect would be to alter the design and potentially the feasibility of harvest in these areas; however, this would not cause substantial impacts or delays in the potential to move towards terrestrial vegetation desired conditions.
- SN-TIM-GDL-01 would ensure that vegetation management would emphasize ponderosa pine, wildlife habitat, hazardous fuels reduction, protection of communities and values at risk, and/or providing for public safety in the Snowies GA. This may be limiting to timber harvest opportunities to a small degree, but would directly benefit the terrestrial vegetation desired conditions in this GA.

Carbon sequestration

Under the action alternatives, the desired condition (FW-CARB-DC-01) would complement the terrestrial vegetation plan components by supporting the need for resilient forests on the landscape. The no-action alternative does not contain any plan components related to carbon sequestration.

Missouri River and Smith River Corridors

These river corridor areas are not included in the no-action alternative, and therefore there is no effect to terrestrial vegetation from plan components associated with them, although to some degree the recreation values in these areas may inform or limit vegetation management. The action alternatives designate these river corridors and include plan components to protect their recreational and other resource values. These include guidelines that require high scenic quality (LB-SMITH-GDL-01; BB-MISCOR-GDL-01). The areas are unsuitable for timber production, but timber harvest may occur to provide public safety and to enhance recreational or aesthetic values (LB-SMITH-SUIT-01; BB-MISCOR-SUIT-01). These values are generally consistent with terrestrial vegetation desired conditions; however, recreational and safety values would be the priority. Therefore, with the action alternatives, management of these river corridors may not always contribute substantially to terrestrial vegetation desired conditions; but also would not preclude achievement of them at the broader scale.

South Hills Recreation Area

This emphasis area encompasses more than 50,000 acres in the Divide GA, and is found in alternatives B, C, D, and F but not A or E. DI-SHRA-GDL-01 would influence potential vegetation management and in general is consistent with the terrestrial vegetation desired conditions. The effect would be that treatments would provide for other resource needs (e.g., visitor safety, recreation experiences, forest resilience, and reducing hazardous fuels), which may result in projects that target the lower end of the desired density ranges and the higher end of fire-resistant species composition (e.g., ponderosa pine). DI-SHRA-SUIT-01 specifies that the area is unsuitable for timber production, but that vegetation management may be conducted to achieve these desired conditions.

Showdown and Teton Pass Ski Areas

These two ski areas are recognized in management area H in the 1986 Lewis and Clark NF plan for the no-action alternative where the standards and guidelines do not describe the desired vegetation condition. Under the 2020 Forest Plan action alternatives, plan components specifically address vegetation. LB-SHOWSKI-DC-02 and RM-TETONSKI-DC-02 require that the vegetation conditions provide for public health and safety, recreational settings and user experiences, enhancing scenic values, and protection of facilities and infrastructure. In addition, other plan components provide flexibility and exceptions to meet the desired safety and recreational desired conditions (e.g. FW-VEGF-GDL-01, large live trees; and FW-VEGF-GDL-02, snags). Under all alternatives, the recreational values in ski areas are generally consistent with desired vegetation conditions, but these areas would not be required to be managed in a way that contributes substantially to those conditions. Nevertheless, the plan components and management in ski areas would be subject to all of the terrestrial vegetation plan components and would not preclude achievement or movement towards terrestrial vegetation desired conditions at the broader scale.

Badger Two Medicine

This area is described in the 1986 Lewis and Clark NF plan as the North End Geographic Unit (RM-1) where the Blackfeet Nation's treaty rights were recognized. This area is designated as a special emphasis area in the action alternatives. Based on RM-BTM-SUIT-01, this area is unsuitable for timber production under all action alternatives, but harvest may occur to provide for other multiple use values such as habitat restoration, hazardous fuels reduction, and to support tribal treaty rights. Other land allocations, such as IRAs, also apply to large portions of this area. The additive effect of plan components associated with the Badger Two Medicine area are negligible to the potential to achieve desired vegetation conditions, and similar to inventoried roadless areas would largely be a result of natural processes.

Green Timber Basin-Beaver Creek Emphasis Area

This emphasis area is only included in alternative F, and its establishment protects a unique population of rare orchids. It contributes to plant diversity on the HLC NF and is complementary to the coarse filter plan components for terrestrial vegetation. Plan components may limit vegetation management activities when needed to avoid degradation of the botanical resources of the area (RM-GB-GDL-01). However, management is limited by other land allocations such as the Rocky Mountain Conservation Management Area. The small additional loss of opportunity to actively manage vegetation is offset by the benefit to biodiversity provided by maintaining the botanical features of this area.

Grandview Recreation Area

This special emphasis area is only included in alternative F. However, plan components exist under all the action alternatives that guide overlapping land allocations (e.g., WSAs, IRAs, RWAs, ROS settings); these components would result in similar management on the ground across alternatives. In alternative F, plan components specifically describe the desired recreation values of this area, and SN-GVRA-SUIT-01 states that this area is unsuitable for timber production, but the portions of it that are outside the WSA are suitable for timber harvest.. There would be little to no effect to terrestrial vegetation based on this designation, beyond the effect already considered with the other land allocations in the area.

Cumulative Effects

The effects of past activities were discussed in the "Affected Environment" section and are reflected in the current condition. Additional present and foreseeable future activities that could affect vegetation are summarized below.

Changing human populations

A stressor which may increase in the future is increasing population levels, locally and nationally, with resulting increasing demands and pressures on public lands. Locally, at present populations are increasing in the counties on the west side of the planning area, but declining or stable in other areas (refer to the Social and Economics Specialist Report). These changes may lead to increased demands for commercial and noncommercial forest products, elevated importance of public lands in providing for habitat needs of wildlife species, and changing societal desires related to the mix of uses public lands should provide.

Management of adjacent lands

Portions of the HLC NF adjoin other NFs, each having its own forest plan. The HLC NF is also intermixed with other ownerships. Some GAs contain inholdings of such lands, while others are more un-fragmented. The GAs which are island mountain ranges are surrounded by private lands.

Grazing, urbanization, agricultural developments, and timber harvest on lands adjacent to NFS lands alter the condition, pattern, and connectivity of native nonforested and forested vegetation communities. Vegetation management on other lands would not necessarily be conducted to meet the same desired conditions as those outlined in the 2020 Forest Plan. Vegetation conditions on adjacent lands may influence the extent or intensity of disturbances on NFS lands, and vice versa, for example fuel conditions/fire hazard or the spread of insect and invasive plant populations. In this context, NFS lands are important for their contribution to maintaining biodiversity and ecosystem services at the broad landscape scale.

Some adjacent lands are subject to their own resource management plans. The cumulative effects of these plans in conjunction with the HLC NF 2020 Forest Plan are summarized in Table 57.

Table 57. Cumulative effects to terrestrial vegetation from other resource management plans

Resource plan	Description and summary of effects
Adjacent National Forest Plans	The forest plans for NFS lands adjacent to the HLC NF include the Custer-Gallatin, Lolo, Flathead, and Beaverhead-Deerlodge NFs. Management of vegetation is consistent across NFs due to law, regulation, and policy. The cumulative effect would be that vegeation management is generally complementary. This includes GAs that cross Forest boundaries, such as the Upper Blackfoot, Divide, Elkhorns, Crazies, and the Rocky Mountain Range.
Montana Statewide Forest Resource Strategy (2010)	This plan guides forest management on state lands. It includes many concepts that are complementary to 2020 Forest Plan components for the HLC NF, for example promoting forest resilience, providing wildlife habitat, and reducing hazardous fuels. While desired conditions are not stated in the same terms as the HLC NF, it is likely that some elements such as increasing large trees, early seral species, and open forests would be similar. State forest lands may be actively managed to a greater degree than national forest system lands and would likely contribute to achievement of desired vegetation conditions across the landscape.
Bureau of Land Management Resource Management Plans (RMP)	Bureau of Land Management lands near the HLC NF are managed by the Butte, Missoula, and Lewistown field offices. The Butte and Lewistown plans were recently revised, while the existing plans for the Missoula area is under revision. These plans contain components related to resilient terrestrial vegetation and would be complementary to the plan components for the HLC NF.
National Park Service - Glacier National Park General Management Plan 1999	The general management plan for Glacier National Park calls for preserving natural vegetation, landscapes, and disturbance processes. Broadly, the terrestrial vegetation characteristics in this area are therefore likely similar to the wilderness areas in the adjacent Rocky Mountain Range GA and would likely complement these conditions.
Montana Army National Guard – Integrated Natural Resources Management Plan for the Limestone Hills Training Area 2014	This plan is relevant to an area adjacent to NFS lands in the Elkhorns GA. The Limestone Hills area is primarily nonforested and calls for managing for fire-resilient vegetation as well as restoration of native vegetation including mountain mahogany specifically. This plan would be generally complementary to the HLC NF most especially in promoting the health of native vegetation.
Montana State Parks and Recreation Strategic Plan 2015-2020	These plans guide the management of state parks, some of which lie nearby or adjacent to NFS lands. Terrestrial vegetation is a component of these parks, although not always the primary feature. Specific vegetation conditions would not necessarily contribute to the desired conditions as described for the HLC NF.
Montana's State Wildlife Action Plan	This plan describes a variety of vegetation conditions related to habitat for specific wildlife species. This plan would likely result in the preservation of these habitats on state lands, specifically wildlife management areas. This plan would interact with the Montana Statewide Forest Resource Strategy (above). The vegetation conditions described would be complementary to the conditions being managed for with the HLC NF 2020 Forest Plan.
County wildfire protection plans	Some county wildfire protection plans map and/or define the wildland urban interface. The HLC NF notes that these areas may be a focus for hazardous fuels reduction, and other plan components (such as Northern Rockies Lynx Management Direction) have guidance specific to these areas. Managing for open forests and fire adapted species may be

Resource plan	Description and summary of effects
	particularly emphasized in these areas. Overall, the effect of the county plans would be to influence where treatments occur to contribute to desired vegetation conditions.
City of Helena Montana Parks, Recreation and Open Space Plan (2010)	This plan is relevant to an area that lies adjacent to national forest system lands in the Divide GA, in proximity to the City of Helena. The plan emphases forest management and wildfire mitigation. This would be generally complementary and additive to management on some HLC NF lands, specifically the South Hills Special Recreation area (alternatives B, C, and D).

Conclusions

Broadly, the desired conditions for terrestrial vegetation on the HLC NF are characterized by increases in large trees and large forest size classes; more open forest densities; vigorous nonforested plant communities; increasing early-seral shade tolerant species; and maintaining the full suite of native biodiversity on the landscape. The desired conditions are consistent with our understanding of the NRV and are most likely to be resilient in the future given expected drivers such as climate change, drought, vegetation succession, wildfire, insects and disease, and the demands of people.

All alternatives allow for active management and have similar expected natural disturbances. The action alternatives are the most beneficial to terrestrial vegetation because they contain a suite of quantitative desired conditions based on BASI that are consistent with the NRV and likely to be resilient in the future. However, the expected trends for terrestrial vegetation attributes show little variance across alternatives at the scales analyzed, due to the limited scope and impact of vegetation management treatments compared to the effects of natural disturbances. Similarly, the differences in attributes in managed versus unmanaged lands, and in WUI versus nonWUI lands, is a function of the inherent qualities and site capabilities of those lands rather than the differences in management emphasis or actions. The results of an unconstrained budget scenario for timber harvest is generally similar at the broad scale, with some key variances discussed in Table 58.

Under all alternatives, there is a general improvement in moving the landscape towards vegetation desired conditions over time, in large part due to natural processes. Most plan components are complementary or at a minimum do not preclude the opportunity to achieve vegetation desired conditions. The effects of plan components for other resources are generally positive. Plan components that are most limiting to potential movement towards desired conditions are those that limit vegetation management opportunities, many of which apply to land designations beyond the scope of the forest plan (e.g., designated wilderness, WSA, and IRAs).

The comparison of alternatives for terrestrial vegetation indicators is shown in Table 58, below.

Table 58. Comparison of alternatives for terrestrial vegetation indicators

Key ecosystem characteristic	Relative Contribution toward the Indicator Most	→		Least
Hazard to stand-replacing wildfire	ABCDEF			
Hazard to western spruce budworm	ABCDEF			
Hazard to mountain pine beetle in lodgepole pine	ABCDEF			
Hazard to Douglas-fir beetle	E	F	BCD	A
Hazard to mountain pine beetle in ponderosa pine, constrained by budget	F	BCD	A	E
Hazard to mountain pine beetle in ponderosa pine, constrained by budget	BCDEF	A		

Key ecosystem characteristic	Relative Contribution toward the Indicator Most	→		Least
Movement towards DCs based on timber harvest, constrained by budget	ABCD	F	E	
Movement towards DCs based on timber harvest, unconstrained by budget	E	BCDF	A	
Prescribed fire on the landscape to move vegetation towards DCs, constrained by budget	ABCD	F	E	
Prescribed fire on the landscape to move vegetation towards DCs, unconstrained by budget	E	BCDF	A	
Cover type, tree species presence, size class, large-tree structure, density class and vertical structure.	BCDEF	A		
Landscape pattern: early successional forest	BCDEF	A		
Overall movement toward desired conditions of terrestrial vegetation	BCDEF	A		

Despite an overall improvement, some attributes do not achieve or trend towards the desired conditions due to the long timeframes needed for natural successional processes to occur and/or the outcomes of disturbance events in the short term. There are concerns that this may indicate either the desired conditions are not appropriate; or that the plan does not contain the components necessary to provide for ecological integrity of the ecosystems of the HLC NF. However, predicted trends are primarily due to natural disturbances and processes, rather than management intervention or other factors within FS control. Appendix H contains detailed information regarding the scientific validity of the desired conditions, including the NRV and BASI used to develop them. Further, modeling is done primarily to compare alternatives, and contains a high degree of uncertainty regarding the key drivers of vegetation change (wildfire and insects). The predicted wildfire or outbreak events may not actually occur, or vary in location, timing, and magnitude. Therefore, monitoring (appendix B of the 2020 Forest Plan) is key to ensure that actual conditions are assessed, and management decisions adjusted accordingly to keep moving towards or not precluding all desired conditions.

3.9 Old Growth, Snags, and Coarse Woody Debris

3.9.1 Introduction

Old growth, snags, and downed wood are structural components of forested vegetation that have been identified as key ecosystem characteristics for the HLC NF forest plan revision. The abundance, location, condition, and management of these attributes were raised as issues internally and externally.

Old growth is a structural condition that may exist during the late successional stage of forest development. Old growth provides wildlife habitat, biological diversity, and other ecosystem functions such as carbon storage. It also contains seed sources that contribute to landscape resilience. The concept of old growth involves not only tree age but also characteristics such as trees size and spacing, large dead standing and fallen trees, broken and deformed tops, bole and root rot, multiple canopy layers, canopy gaps and understory patchiness, cessation in height growth of oldest trees, near zero net productivity, and biochemistry of secondary metabolic products in old trees (Johnson, Miyanishi, & Weir, 1995). This condition is not static and as old growth dies it is replaced by younger forests as they age; therefore, the distribution of old growth across the landscape changes over time. The HLC NF uses structural attributes to define old growth based on the best available scientific information (BASI) (Pat Green et al., 2011).

Dead wood occurs as standing dead trees (snags) and as fallen trees or other woody material on the ground (downed wood). A dead tree, from the time it dies until it is decomposed, contributes to many ecological processes (J. K. Brown et al., 2003). Snags and dead wood contribute to biodiversity by providing habitat for wildlife feeding, reproduction and shelter, and play an important role in protecting the soil, enhancing soil development, and maintaining soil productivity over the long term. Although all dead wood has value, large snags and downed wood are particularly important. Snags 10" in diameter and greater, and *coarse woody debris* (downed wood greater than 3" in diameter) are included in this analysis. Snags are created at broad scales, ranging from single-tree mortality to high-quantity pulses that result from wildfires or insect infestations. While smaller snags are abundant due to recent fire and insect disturbances, large snags are relatively rare.

The scale of analysis for old growth is forestwide and by broad potential vegetation type (PVT). The indicator and measure for the existing condition is the estimated abundance (acres or percent of the area) of old growth on the landscape, which can be measured from plot data. Old growth cannot be modeled into the future with current analysis tools. The indicator used to compare the effects of the alternatives is large-tree structure, estimated by the SIMPPLLE model.

The scale of the analysis for snags is forestwide by snag analysis group. *Snag analysis groups* are similar to broad PVTs, except that lodgepole pine cover types are split out due to their unique ecological characteristics. The key indicators are snags per acre by size class (medium, 10-14.9", large 15-19.9", and very large 20"+); and snag distribution (percent of area with snags by size class). The scale of analysis for coarse woody debris is forestwide and by PVT. The indicator and measure for the existing condition is the average tons per acre of woody debris greater than 3" diameter. Snags and coarse woody debris cannot be modeled through time with SIMPPLLE. While the PRISM model can track snags via yield tables, the results are not representative because snags are not carried into new "regeneration" stands following disturbance. Therefore, the analysis relies on the expected trend of harvest, wildfire, bark beetles, and prescribed fire to describe likely trends of snags and coarse woody debris.

Changes between draft and final

Multiple changes were made for the final EIS; these changes are within the scope of the DEIS analysis, and address issues that the public has had an opportunity to comment on. This section details the key changes between the draft and final analysis for old growth, snags, and coarse woody debris. See the terrestrial vegetation and timber sections also, because this analysis draws upon information provided for those resources.

Analysis for the new (preferred) alternative F was added. The old growth and snag plan components were revised based on public and internal comments. The updated natural range of variation (NRV), timber, and vegetation modeling results as described in the Terrestrial Vegetation and Timber sections, and appendix H, are incorporated. Additional discussions to respond to issues raised in comments were added:

- The impacts of vegetation treatments in old growth and supporting science related to whether treatments are appropriate to maintain or develop of old growth.
- The historic patch size and distribution of old growth.
- Clarification of the extent to which plan components would conserve old growth.
- The definition and role of fire "refugia" as potential old growth.
- Clarify how tree size can be modeled but old growth cannot.
- The effects of activities that may be exempt from old growth, snags, and woody debris guidelines.
- The distribution of coarse woody debris in "unmanaged" areas as compared to the NRV.
- Description of the differences between alternative A and the action alternatives for snag retention requirements.

3.9.2 Regulatory framework

USDA FS Position Statement on National Forest Old Growth Values 1989 (P. Green et al., 1992) recognizes the many values associated with old growth forests, such as biological diversity, wildlife and fisheries habitat, recreation, aesthetics, soil productivity, water quality, and industrial raw material. Old growth on the NFs will be managed to provide the foregoing values for present and future generations. Decisions on managing existing old growth forest to provide these values will be made in the development and implementation of forest plans. These plans shall also provide for a succession of young forests into old growth forests in light of their depletion due to natural events or harvest.

3.9.3 Assumptions

- Ecosystems are dynamic, and natural processes such as succession result in a proportion of mid to late successional forests becoming old growth over time. Old growth is not static; stands are killed by insects, disease, wind-throw, and wildfire, and are replaced by other stands.
- With expected warm and dry climate, old growth will be subject to increased disturbances and therefore represents important areas for the retention of biological legacies, seed sources, late successional forest habitat features, and carbon storage.
- The best available indication of the natural range of variability (NRV) for snags is the abundance of snags found in wilderness and roadless areas, where natural processes have by in large been allowed to occur (Bollenbacher, Bush, Hahn, & Lundberg, 2008).
- Future climate will be warm and dry, and therefore increases in disturbances that create snags, such as wildfire and insect outbreaks, are expected to occur and possibly increase in frequency, extent, and/or severity across the landscape.

3.9.4 Best available scientific information used

The HLC NF has adopted definitions of old growth developed by the Regional Old Growth Task Force and documented by Green and others (1992, errata corrected 2011) as the BASI. This work contains measurable criteria to consistently define old growth based on a national definition that old growth forests are distinguished by old trees and related structural attributes (Pat Green et al., 2011). The old growth definitions are specific to forest type and habitat type group. Key attributes include age, numbers and diameter of the old tree component within the stand and stand density. Minimum thresholds have been established for these attributes. Associated characteristics are also defined such as probabilities of coarse woody debris, number of canopy layers, and number of snags over 9 inches diameter at breast height.

The work of Bollenbacher and others (2008) and Bush & Reyes (2020) is the BASI for describing the conditions of snags in Region 1. This work provides snag quantity and distribution estimates for all NFs in eastern Montana. Updated data were queried in 2017 to augment this publication with the most current information available.

The best available scientific information for coarse woody debris on the HLC NF is found in two publications. Brown et al (2003) was used to inform our understanding of the NRV and development of the desired conditions found in the 2020 Forest Plan, while Graham et al (1994) was used to inform the development of a guideline for coarse woody debris retention in vegetation management areas.

Old growth, snags, and coarse woody debris are estimated with Forest Inventory Analysis (FIA) and FIA intensified grid plots. Please refer to appendix H for a more detailed description of these datasets.

Incomplete and unavailable information

The minimum criteria specified in Green et al (1992, errata corrected 2011) can be applied to plot data to provide estimates of old growth. However, the authors state, “because of the great variation in old growth stand structures, no set of numbers can be relied upon to correctly classify every stand…do not accept or reject a stand as old growth based on the numbers alone; use the numbers as a guide.” Therefore, as the forest plan is implemented, the determination of old growth patches would be made at the project level.

There is no comprehensive forestwide map of old growth, although some old growth has been mapped during project level analysis. Because the plots used to estimate old growth at the broad scale are designed to represent areas on a grid basis, polygons (or stands) of old growth cannot be delineated. Field inventories are necessary to accurately identify old growth stands. However, it is infeasible to maintain a stand examination inventory that covers every acre in a large analysis area. This type of inventory may occur at the project level, where site specific identification of old growth may be necessary.

There is no quantitative estimate of the NRV of old growth. It is difficult if not impossible to determine quantitatively the NRV because the specific stand characteristics required to classify as old growth cannot be estimated with the model used (SIMPPLLE).

The data used for analysis represents the latest available, which includes FIA base grid plots with the most recent measurements in 2011; and intensified grid plots the most recent measurements in 2016.

3.9.5 Affected environment

Old growth

Topography can influence the probability of old growth development; areas protected from wildfire (such as riparian areas or rock features) may support vegetation legacy components. Such forest patches that survive wildfire may be referred to as “refugia” and can represent important biological legacies that contribute to future seed and biodiversity and may eventually develop into old growth patches in an otherwise “young” forest landscape. In high elevation forests, the majority of the landscape would not have been very old at a given time due to fire cycles (Johnson et al., 1995). Drier ponderosa pine and Douglas-fir types developed under a more frequent disturbance regime (Arno, Scott, & Hartwell, 1995; Tesch, 1981) while higher elevation lodgepole types were largely established from stand-replacement events (Arno, Reinhardt, & Scott, 1993).

From an early successional seedling stage, it would take 150 to 200 years for a forest to become old growth. Wildfire influences old growth development. The likelihood of a particular forest stand to experience wildfire within 100 to 150 years would be high across many parts of the forest. Therefore, long-lived, early successional, fire tolerant tree species play a critical role in the development of old growth. These trees have a chance of surviving wildfires and persisting well into the late successional stages, and include ponderosa pine, Douglas-fir, and whitebark pine. They become the large diameter, old trees that are key features of the old growth forest. Old growth dominated by shade tolerant trees such as Engelmann spruce also occur particularly in riparian areas or other sites protected from disturbance.

Currently about 11% of the HLC NF is in an old growth condition (roughly 315,000 acres) (Figure 9). A lower proportion of the warm dry PVT is old growth as compared to cool moist and cold. Refer to appendix D of the 2020 Forest Plan and appendix H of the EIS for definitions of PVT.

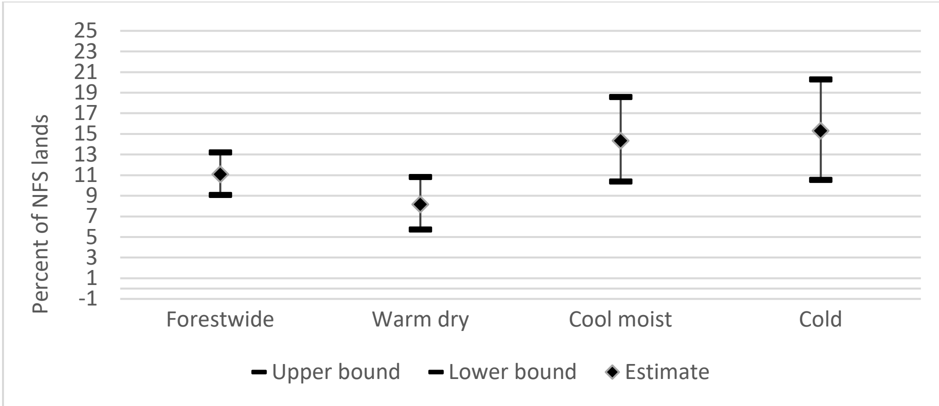


Figure 9. Old growth forestwide and by R1 broad PVT

R1 Summary Database, Hybrid 2011 dataset. 90% confidence interval.

The existing old growth across the HLC NF represents an array of cover types (Figure 10). Douglas-fir being the most common, followed by lodgepole pine. The lodgepole old growth is particularly vulnerable to mortality from insects and fire. The cover type noted as “none” reflects plots where the dominant species could not be classified.

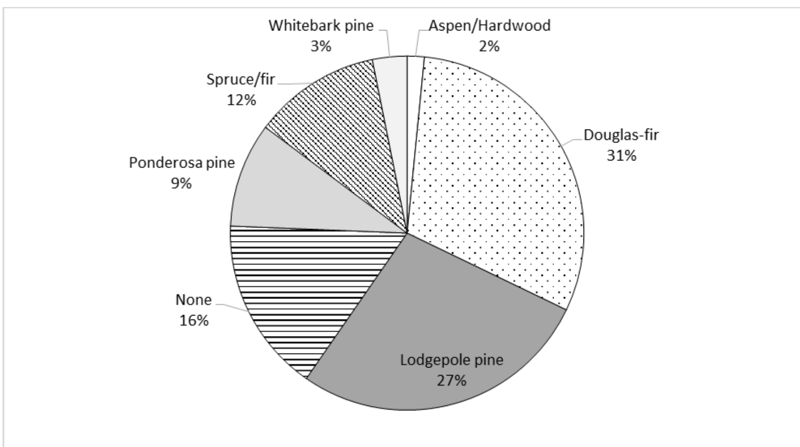


Figure 10. Cover type distribution of old growth on the HLC NF

R1 Summary Database, Hybrid 2011 dataset

The mosaic of structures available on some GAs to provide old growth is limited because factors such as climate, fire history, and human intervention have resulted in homogeneity. For example, the Highwoods is dominated by young forests because the entire GA burned at the beginning the previous century. In the short term few old forests exist to become old growth. However, in the long term, a high proportion of forests could become old growth (barring disturbance). Conversely, GAs with a greater heterogeneity in age class and structure, such as the Upper Blackfoot, may provide a more constant mix of old growth. The estimated percentage of old growth by GA is shown in Figure 11. With the exception of the Highwoods, 5 to 15% of each GAs is old growth.

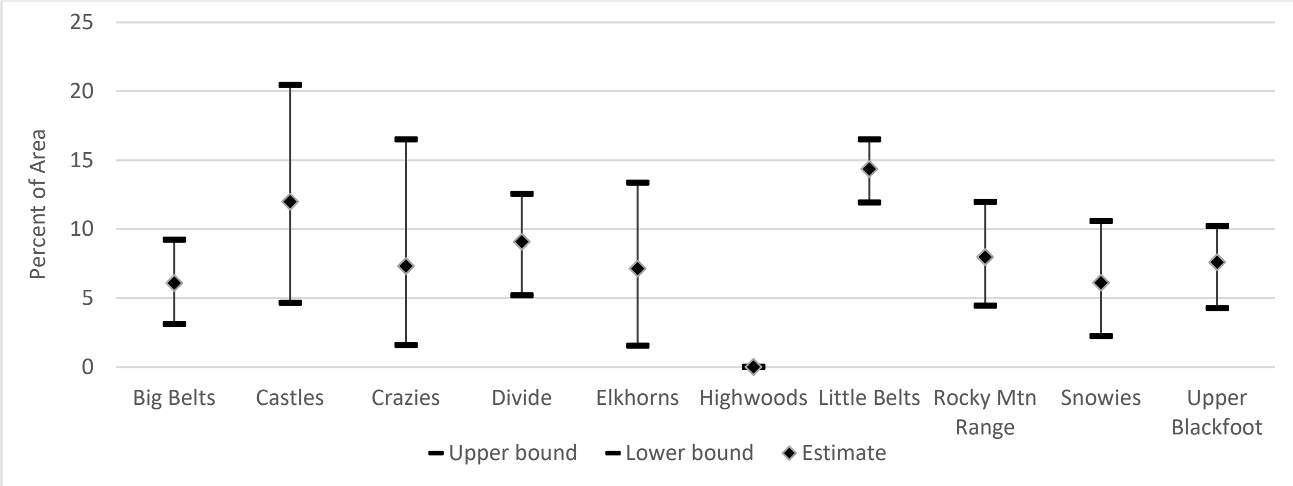


Figure 11. Percent old growth by GA on the HLC NF

R1 Summary Database, F12_F15_Partial_IntGrid_4X_Hybrid_2016 and Hybrid 2011. 90% confidence interval

Figure 12 shows total acres of old growth by GA. The largest GAs (Rocky Mountain Range and Little Belts) have the most old growth acres. All other GAs have less than 25,000 acres of old growth each.

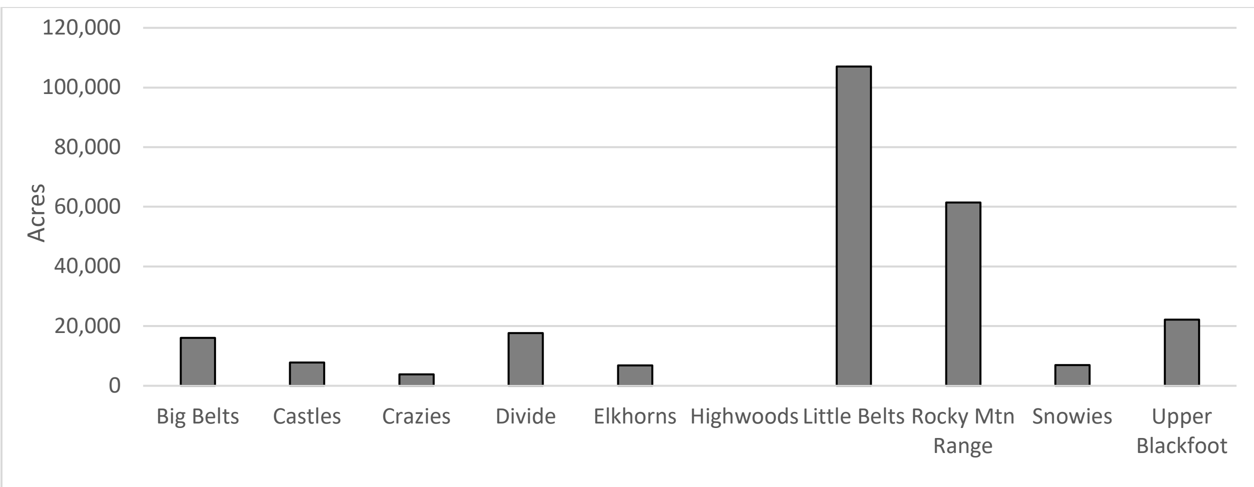


Figure 12. Estimated acres of old growth by GA

R1 Summary Database, F12_F15_Partial_IntGrid_4X_Hybrid_2016 and Hybrid 2011.

The abundance and distribution of old growth is influenced by the disturbance history of each GA. The recent mountain pine beetle outbreak has had an effect on pine-dominated old growth, and small island ranges are susceptible to fires that spread from the surrounding prairie. In contrast, old growth in the Little Belts is abundant; this GA has experienced less wildfire recently. A substantial proportion of the old growth in this GA is the lodgepole pine type which may be susceptible to insect or fire mortality.

Old growth cannot be modeled because the definition requires information which is only available in plot or stand-level field inventory; such data is not mapped across the Forest, nor can it be derived with SIMPPLLE. Therefore, there is no means to determine a quantifiable estimate of the NRV for old growth amount, patch size, or distribution. The historic condition must be inferred from other attributes. Unlike old growth, tree size class can be reliably estimated using FIA and R1-VMap. Because old growth definitions are based in part on the presence of large trees, a correlation can be drawn with the presence of large-tree structure. The definition of large-tree structure was developed using the minimum large tree criteria found in old growth definitions as a reference point (Pat Green et al., 2011; Milburn et al., 2019). These areas are the most likely to contain sufficient large trees to be old growth.

The NRV analysis estimated a mean of about 51% (range 44 to 57%) of the landscape had large-tree structure. Not all of these areas would actually have been old growth, because factors such as tree age and density are not reflected. To estimate a possible proportion, the current relationship between large-tree structure and old growth is explored. About 44% of the FIA plots that currently have large-tree structure on the HLC NF classify as old growth. If this proportion were applied to the NRV estimates of large-tree structure, then it can be postulated that a natural range of old growth forestwide may have been 20-25%. Based on this, it is reasonable to conclude that there was likely more old growth present historically than there is today. This conclusion is supported by the finding that the existing abundance of large-tree structure and size classes are lower than the NRV, especially in the warm dry broad PVT.

Fire exclusion, particularly in low elevation warmer sites, has altered vegetation structure and composition. Increasing tree densities, canopy layers, and shade tolerant species have increased tree stress and vulnerability to insects, disease, and wildfire. Old growth that may have existed on non-NFS lands has probably been removed over the past 100 to 120 years through harvest or conversion of lands to other uses, such as agriculture. Spatial arrangement and patch size are important characteristics of old growth. The average size of remaining old growth patches on all land ownerships are likely less than they were in the more recent past, particularly in areas where large patches were fragmented by harvest or development patterns.

Old growth conditions vary depending on the site capabilities and on other factors, such as disturbance history. Brief descriptions of the composition and structure of old growth defined for the HLC NF are shown in Table 59, based on the old growth types and criteria from Green et al (2011). The crosswalk between the habitat type groups used for old growth and the R1 broad PVT is imperfect.

Table 59. Old growth[1] stand conditions on the HLC NF

		Minimum old growth criteria			R1 Broad PVT[2]	Description
Old growth type	**Habitat type group**	**Large tree age**	**TPA/ DBH**	**Basal area (ft^2/ac)**		
1 -DF	A	200	4 ≥ 17”	60	Warm dry	Dominated by large diameter, old Douglas-fir or ponderosa pine; rarely lodgepole or subalpine fir. A relatively open overstory exists, but Douglas-fir can be dense in the mid and understory canopy layers with lack of disturbance. When this occurs, the large trees become more susceptible to bark beetle-caused mortality.
2 –DF	B, C	200	5 ≥ 19”	60		
4 –PP	A, B, C	180	4 ≥ 17”	40		
5 –PF	A, B	120	6 ≥ 9”	50		
6 -LP	A, B, C	150	12 ≥ 10”	50		
7 –SAF	C	160	12 ≥ 17”	80		
2 –DF	D, E, F, H	200	5 ≥ 19”	60	Cool moist	Douglas-fir, Engelmann spruce, subalpine fir, or lodgepole pine are the dominant old trees; rarely whitebark pine. Lodgepole pine may be single-storied, or support a developing understory of spruce and fir. Spruce and fir old growth is typically dense, with multi-canopy layers, with subalpine fir and spruce common in the understory.
3 –DF	G	180	10 ≥ 17”	80		
6 -LP	D, E, F, G, H	150	12 ≥ 10”	50		
8 –SAF	D, E	160	7 ≥ 17”	80		
9 –SAF	F, G, H	160	10 ≥ 13”	60		
11 –WBP	D, E, F, G, H	150	11 ≥ 13”	60		
6 -LP	I	150	12 ≥ 10”	50	Cold	Engelmann spruce, subalpine fir, and whitebark pine are the large, old trees. Tree growth is slower and old trees are smaller than in old growth at lower elevations.
9 –SAF	I	160	10 ≥ 13”	60		
10 –SAF	J	135	8 ≥ 13”	40		

		Minimum old growth criteria			R1 Broad PVT[2]	Description
Old growth type	**Habitat type group**	**Large tree age**	**TPA/ DBH**	**Basal area (ft^2/ac)**		
11 –WBP	I	150	11 ≥ 13”	60		There are typically multi-canopy layers, though density may be low. Subalpine fir and spruce dominate the unerstory.
12 -WBP	J	135	7 ≥ 13”	40		

[1.]The old growth types, groups, and descriptions provided are based on those found in Green et al (1992). Crosswalk shows the most dominant relationship between old growth habitat type group and R1 broad PVT.

Snags

Snags are created over time by disturbances and succession. They provide habitat for a variety of wildlife species and are key components of old growth and other late successional forests. Snag densities, sizes and distribution are influenced by the disturbance history and pre-existing forest conditions. Snag longevity varies by factors such as tree size, species, cause of death, age of tree at death, rate of decay, and site conditions (L. J. Lyon, 1977; Russel G. Mitchell & Preisler, 1998; Russell, Saab, Dudley, & Rotella, 2006; Michael J. Wisdom & Bate, 2008); (Hansen, Johnson, et al., 2015).

A report on snags in eastern Montana forests was completed by Bollenbacher and others (2008) using FIA data; the data queries described in that publication were recently updated (Bush & Reyes, 2020). Medium snags are the most prevalent; relatively few large or very large are present and tend to occur in the cool moist broad PVT. In areas dominated by lodgepole pine, early seral stands have the most snags due to a greater proportion of stand-replacing fires and species intolerance to fire. The warm dry broad PVT has a more even distribution of snags into later seral stages because of a more frequent, less severe fire regime. All broad PVTs show fewer mid-seral stage snags as snags transition to coarse woody debris. Snags occur in a clumpy manner, and in all groups the larger the snag the less common it is. This is due to: 1) fewer trees living to an old age; 2) as trees age, they grow slower, never reaching large diameters; and 3) the inability of systems to contain large old trees and snags due to disturbances (Bollenbacher et al., 2008).

Most of the existing large and very large snags on the HLC NF are Douglas-fir. Less common large and very large snags are ponderosa pine, subalpine fir, whitebark pine, and Engelmann spruce. Ponderosa pine and Douglas-fir snags have the longest longevity due to their deep roots. Medium-sized snags are often lodgepole pine, which is the most common tree species on the HLC NF and one that does not tend to reach a large size. The lodgepole pine cover type has the highest density of snags due to the recent mountain pine beetle outbreak.

Snag distribution is measured by the proportion of the area that contains snags. Snags are naturally unevenly distributed across the landscape. Snag recruitment is dependent on the pattern and frequency of fire, insects and including human activities, as well as the variation in forest composition and size class. High snag densities, or “pulses”, are the result of high severity disturbances which vary widely in time and space. Low densities of snags also occur, such as where low severity fires occur frequently or where fire has been excluded; and in areas with greater human access where snags can be removed through activities such as firewood cutting. Because of the naturally wide variation in snag conditions spatially and temporally, snags are analyzed at broad scales. Maintenance of species diversity requires a landscape perspective and a strategy that considers diversity of habitat structures (L. J. Lyon, Huff, & Smith, 2000; Tobalske, Shearer, & Hutto, 1991).

Desired conditions for snags are shown in appendix H and are designed to reflect the conditions that would be expected to occur under natural disturbance regimes. Snags present in wilderness and roadless areas provide the basis for the desired condition because they reflect a more natural condition where human management is limited (although fire suppression has occurred). Overall, existing mean snag quantities at a forestwide scale are similar to what might occur under natural regimes. At smaller scales of analysis (such as project level), timber harvest and human access can have substantial impacts on snag density, distribution and longevity (Michael J. Wisdom & Bate, 2008). Presence of localized disturbances could also have substantial influence on snag conditions at smaller scales.

Figure 13 and Figure 14 show the existing abundance and distribution of snags forestwide, and for each GA. Conditions at the GA scale vary due to the topography, site potential, and disturbance history of each area. The GAs are represented by more abundant and recently measured data (FIA intensified grid) than the forestwide estimates. The Rocky Mountain Range and Upper Blackfoot GAs contain the most abundant snags per acre and snag distribution. GAs that have experienced little recent disturbance, such as the Highwoods and Snowies, contain fewer snags. The Big Belts, Castles, Elkhorns, and Upper Blackfoot contain the most very large snags, whereas these snags are absent from the Highwoods and Snowies.

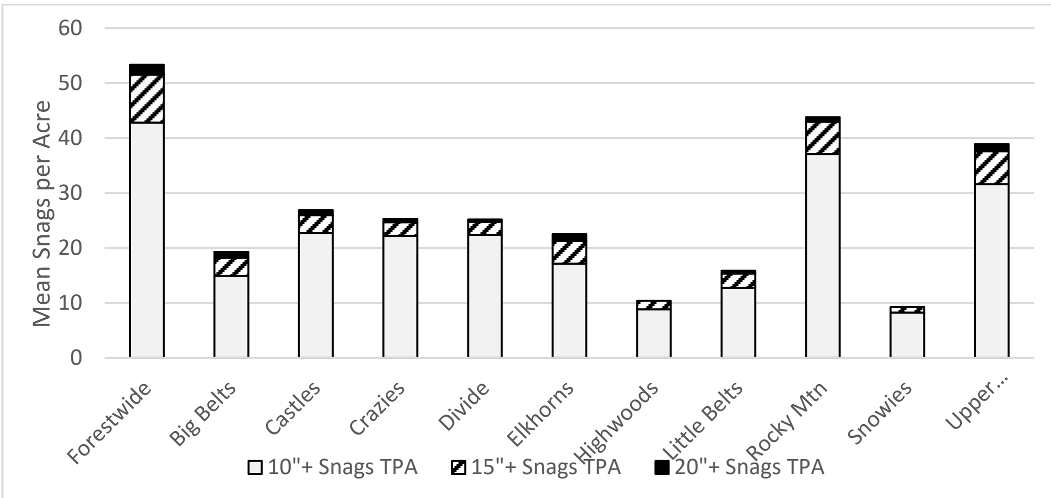


Figure 13. Snags per acre across all snag analysis groups, forestwide and by GA

Source: R1 Summary Database: Hybrid 2011 (forestwide and Rocky Mountain Range GA); 4x 2016 (all other GAs).

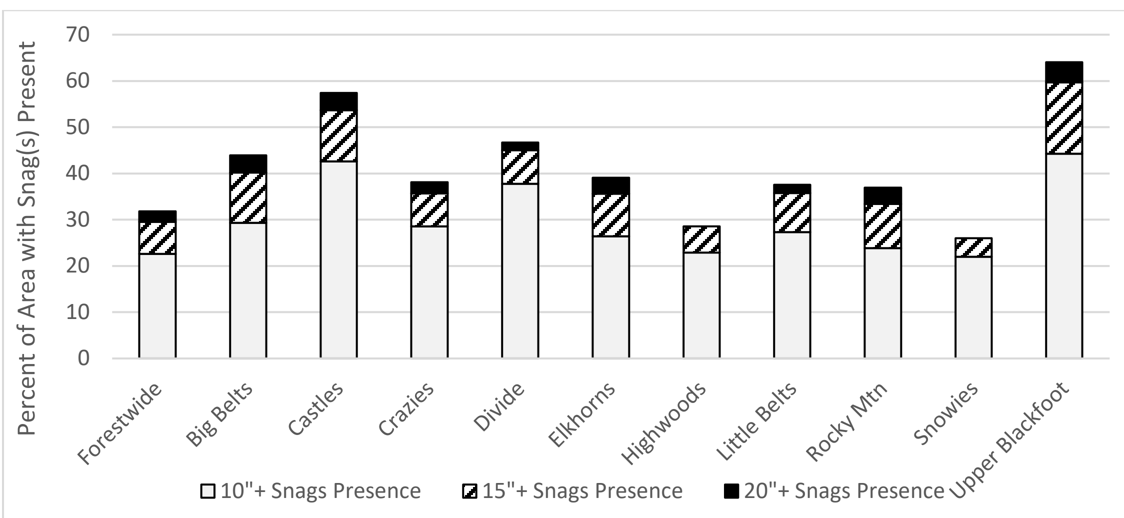


Figure 14. Snags distribution across all snag analysis groups, forestwide and by GA

Source: R1 Summary Database: Hybrid 2011 (forestwide and Rocky Mountain Range GA); 4x 2016 (all other GAs).

Quantitative desired conditions for snags were not developed for the GA scale for several reasons. First, there is a lack of data available to represent the NRV with confidence at that scale (i.e., fewer data points in roadless and wilderness areas). In addition, the application of GA-level desired conditions could be problematic in small GAs that may be subject to periodic disturbances that create a boom-and-bust situation (i.e., the scale is too small to encompass the natural temporal variability of snag conditions). However, it may be appropriate to consider GA-level snag trends when designing projects.

Coarse woody debris

Coarse woody debris is derived from snags, as well as from parts of trees, that fall to the ground. This material provides habitat structures and contributes to ecosystem functions such as nutrient cycling, moisture retention, microsites for tree regeneration, and substrate for soil micro-organisms. Long, larger diameter pieces of downed wood are more valuable because they can be used by a greater range of species, provide a stable and persistent structure, and provide better protection from weather extremes. Downed wood is highly variable in amount, size, species, and stages of decay. Recent fires and the mountain pine beetle have increased the amount of snags in many areas. As snags fall, there will be a period of time when downed wood is elevated in these areas until decomposition occurs.

The desired condition for coarse woody debris is to maintain amounts that contribute to forest structural diversity, soil ecological function, and habitat, focusing on coarse woody debris. Coarse woody debris is defined as pieces that are 3 inches in diameter and greater based on the best available information to describe natural and desired conditions (J. K. Brown et al., 2003). No information is readily available to quantify the existing and desired levels of coarse woody debris larger than this size. Rather, BASI was used to develop the desired conditions, as described in appendix H. At all scales, the current estimated amount of coarse woody debris is within the desired condition.

Figure 15 shows the existing condition of coarse woody debris. Conditions at the GA scale vary due to the unique topography, site potential, and disturbance history of each area, but in all cases the average tons/acre of coarse woody debris is less than 15 tons/acre. The Elkhorns and Upper Blackfoot GAs contain the most average coarse woody debris per acre. GAs that have experienced little recent disturbance, such as the Highwoods, have less coarse woody debris.

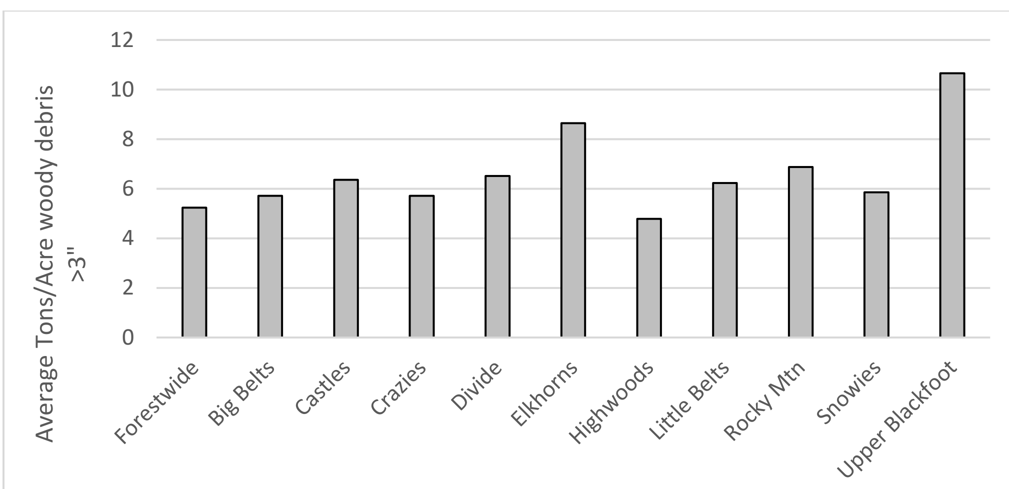


Figure 15. Coarse woody debris average tons/acre across, forestwide and by GA

Source: R1 Summary Database: Hybrid 2011 (forestwide and Rocky Mountain Range GA); 4x 2016 (all other GAs).

Benefits to people

Old growth is not identified as a key ecosystem service of the HLC NF. However, this forest condition provides benefits to people. Old growth contributes to wildlife habitat and therefore to wildlife interaction opportunities. These historic forest remnants are valued by people, and are often where people enjoy hiking or other recreational activities, due to the large tree trees that provide shade and other aesthetic qualities. Finally, old growth helps provide for clean air, water, and other broad scale ecosystem services.

Some snags provide a direct economic benefit to people. This may occur with commercial timber sales and salvage projects, or when dead trees are removed as wood for fuel under firewood permits. Snags and coarse woody debris retained on the landscape also provide benefits to people, by providing terrestrial and aquatic wildlife habitat and creating opportunities for wildlife interactions including bird viewing and fishing. Dead wood also contributes to watershed function and therefore contributes to other key ecosystem services such as clean air and water. Dead wood contributes to site productivity, which supports vegetation that may be used for timber products as well as contributes to the intrinsic enjoyment of the natural landscape. In addition, plan components that describe the appropriate levels of dead wood are also of importance to fire risk and potential impacts of fires to values at risk, which include private property as well as other values that people have, such as a desire to recreate in green forests.

3.9.6 Environmental consequences

Effects common to all alternatives

Natural disturbances and succession

Under all alternatives, the majority of the HLC NF is in wilderness or IRAs, where natural disturbances predominate, and vegetation treatments are precluded or limited. Natural disturbances would also be prevalent on “managed” lands, as discussed in the terrestrial vegetation section.

Old growth amounts and distribution would be dynamic and variable over time. Stand-replacing disturbance would be the main reason for loss of old growth, while succession and low to mixed severity disturbances would be the primary means by which old growth is formed. Endemic bark beetle activity may enhance old growth by adding to the snag and coarse woody debris components; but outbreaks (widespread or localized) could remove old growth stands. Vegetation treatments that promote the long-term development of old growth (such as thinning in young stands to promote tree growth) are management tools available over a relatively small portion of the Forest.

Old growth abundance and distribution cannot be quantified with available modeling tools. However, the expected trend of large-tree structure is likely indicative of the trend of old growth. Charts in appendix H show the anticipated trend of large-tree structure over time, forestwide, and by broad PVT. All alternatives are nearly identical with respect to this metric, with the presence of this structure increasing from about 5% to 20% of NFS lands forestwide and in the cool moist PVT; from 5 to 25% in the warm dry PVT; and from just a trace to 15% in the cold PVT. Old growth should increase as well on a proportion of those areas.

There is uncertainty surrounding climate change and its effect on old growth. As described in the climate, carbon, and terrestrial vegetation sections, climate change will likely exacerbate stressors. Increased disturbances may remove old growth, and an increased focus on the resilience of old growth stands will be increasingly crucial. To the extent that future forests may be at-risk to climate change, drought, and megadisturbances, old growth structures are also at risk. Predictions for warmer springs and warm, dry summers suggest that forests of the northern Rockies and the western U.S. will experience longer fire seasons, with larger and potentially more severe fires. Fire exclusion can alter structure and composition of old growth and may make these stands more vulnerable to fire. Particularly on the warm dry broad

PVT, increasing tree densities, canopy layers, and proportions of Douglas-fir have increased tree stress and vulnerability to mortality from insects, pathogens, and high intensity crown fires.

Under all alternatives, snag and coarse woody debris conditions would be dynamic, variable and unevenly distributed. Dead wood would be created by fire, insect, disease, and succession. Decomposition and fire are the primary ecological processes that would remove dead wood. Wildfire would create snags in the short term, most often of the smaller size classes, although some snags and coarse woody debris could be consumed. Bark beetle activity would create snags (and future coarse woody debris) in the largest size classes available. The highest amounts of dead wood would be present where fire or insect/disease outbreaks occur. Recent fire and insect outbreaks on the HLC NF have created a pulse of snags. In the short-term medium snags, especially lodgepole pine, would be abundant. In the long term, these snags will be lost to natural attrition, and the material will accumulate on the forest floor as woody debris until it decomposes into the soil. The timing of when dead trees fall varies, but studies suggest that the range of when most trees fall is usually between 3 and 15 years after death (L. J. Lyon, 1977; Russel G. Mitchell & Preisler, 1998; Russell et al., 2006; U.S. Department of Agriculture, Forest Service, Northern Region, Snag Protocol Team, 2000; Michael J. Wisdom & Bate, 2008);(Hansen, Amacher, Van Miegroet, Long, & Ryan, 2015).

To some degree, fire exclusion would continue to affect the landscape under all alternatives, which could limit snag creation in areas that would otherwise have burned. Conversely, over the long term, fire exclusion can increase fuel loadings and stand densities that predispose areas to large stand-replacing events that create snag pulses. The creation of large and very large snags is dependent upon the development of large live trees. High stand densities that may develop due to fire suppression or other factors limits the potential for individual large tree growth. Homogenous landscapes yield snag pulses followed by periods with few snags. Because of pulse events, snags may not always be well-distributed spatially or temporally.

Lands where active vegetation management would occur cover a minority of the Forest under all alternatives. Many of the forests in areas suitable for timber production and in wildland urban interface (WUI) areas would be managed to maintain vigorous trees and limit losses due to insects, disease and fire. This would tend to result in less tree mortality, and a potentially lower density of snags and coarse woody debris over time as compared to areas less influenced by human actions. On the other hand, vegetation management provides the opportunity to manage for species and larger size classes that would contribute to larger snags and coarse woody debris. Lower amounts of snags and coarse woody debris would tend to occur in developed sites, areas where concern for fire hazard is elevated and in areas closer to communities and accessible to firewood cutting.

Climate change is anticipated to increase tree mortality on the landscape. Therefore, it will impact snags and coarse woody debris, generally by creating more but also potentially reducing it in some areas, such as where fire burns repeatedly. Climate change may also influence decay rates, resulting in coarse woody debris remaining present on the landscape longer. While decay of this material may be somewhat slower in warm and dry conditions, conversely an increase in expected fire activity may consume coarse woody debris, thereby emphasizing the importance of retaining it in situations under FS control to contribute to soil nutrient cycling and wildlife habitat.

Effects from forest plan components associated with:

Watershed management

All alternatives contain direction that protect watershed values; watershed plan components would either complement or not preclude the achievement of the old growth, snag, and coarse woody debris desired conditions. Watershed components help guide the type, amount, and location of vegetation treatment activities that may occur, as described in the terrestrial vegetation and timber sections. To the extent that watershed components limit vegetation management, they may also contribute to the retention of old growth, snags and coarse woody debris; FW-WTR-DC-10 specifically includes mention of desirable woody material in stream channels. Watershed plan components would encourage retention of vegetation cover to reduce erosion potential, and therefore support the retention of old growth. Plan components related to mitigating fire risk in municipal watersheds may result in reductions in snags and woody debris, but this loss would be mitigated through the application of FW-VEGF-GDL-02 and 05.

Air quality

Under all alternatives, prescribed fire operations would adhere to federal and state air quality regulations and smoke management plans. To the extent that this limits the potential to apply fire to the landscape, it may lessen potential impacts to old growth, snags, and coarse woody debris from prescribed fire (described below in *Effects that vary by alternative*). This potential effect would be the same for all alternatives.

Invasive plants

Under the no-action alternative, the 1986 Forest Plans include plan components designed to limit the extent and spread of noxious weeds. These components would encourage weed control activities that in turn promote the health of native vegetation, especially in nonforested plant communities. The action alternatives note the desire for healthy terrestrial plant communities by limiting the impacts from nonnative invasive plants (FW-INV-DC-01, 02, 03), which would indirectly benefit old growth by promoting desirable, native understory plants. The potential effects to snags and coarse woody debris from management direction for invasive plants are negligible. Although plan components vary, the effect to old growth, snags, and coarse woody debris is similar for all alternatives.

Wildlife habitat management

For the most part, under all alternatives plan components for wildlife would be neutral or beneficial to old growth, snags, and coarse woody debris and vice versa. Plan components that may have the greatest influence on old growth, coarse woody debris, and snags are those that would influence terrestrial vegetation and vegetation management; these would include those for big game, Canada lynx, and grizzly bear. Plan components for Canada lynx and grizzly bear are the same for all alternatives and are described in this section. The effects of big game plan components are addressed in the *Effects that vary by alternative* section.

Wildlife plan components may result in limitations to the amount, type, and/or duration of vegetation management in specific areas. To the extent that vegetation management is limited, the potential to retain existing old growth, snags, and coarse woody debris, as well as to allow natural old growth development to occur may be enhanced. Conversely, in some cases limiting vegetation management may reduce the potential to increase forest resilience to maintain old growth, especially in dry forest types, and reduce the potential to treat younger stands in a manner that could help them develop old growth characteristics more rapidly. Specifically:

- Lynx standard VEG S5 does not allow precommercial thinning that reduces stand initiation hare habitat (which is typically found in seedling/sapling size stands) outside the WUI except in limited situations.
- Lynx standard VEG S6 does not allow vegetation management to reduce winter snowshoe hare habitat in mature multi-story forests outside the WUI except in limited situations.
- Access and road use limitations would apply in areas identified as grizzly bear secure core, in the Rocky Mountain Range and Upper Blackfoot GAs, which may limit vegetation management.

Lynx guideline Veg G11 specifies that denning habitat should be distributed in each lynx analysis unit in the form of pockets of large amounts of large woody debris. This direction may result in project design features that retain concentrations of coarse woody debris in some areas.

Recreation access and infrastructure

All alternatives are similar in terms of road access and infrastructure. Where access is permitted along roads adjacent to or bisecting old growth, activities such as camping or firewood cutting could alter old growth stand conditions. New road or temporary road construction could remove strips of old growth. Old growth that occurs in areas with limited access would not be subject to these impacts. However, limited access to conduct desired vegetation treatments would affect the ability to utilize vegetation treatments to enhance or promote future old growth. Access on existing roads as well as construction of roads could have an impact on the presence of snags and woody debris, primarily as a function of firewood gathering that usually reduces snags adjacent to roads, but conversely can increase coarse woody debris in these areas as branches and debris are left behind.

Designated wilderness and wilderness study areas

Plan components in all alternatives for designated wilderness and wilderness study areas are consistent with the laws that created them, which are beyond the scope of forest planning. No vegetation management would generally occur (FW-WILD-SUIT-03; FW-WSA-SUIT-01). To the extent that this limits timber harvest or prescribed burning, this would limit the potential to impact old growth, snags, and coarse woody debris either positively or negatively (refer to the discussion on vegetation treatments under *Effects that vary by alternative)*. Despite the potential for fire suppression, natural disturbances would have the potential to impact these areas to a large degree, which would promote a natural mosaic of old growth, snag, and coarse woody debris conditions, if those disturbances occur at a scale and severity within the NRV. These effects would be prominent specifically in the Rocky Mountain Range and Snowies GAs, where these designations make up a majority of the acres, and also influence the Little Belts and Big Belts GAs.

Inventoried roadless areas

Plan components in the action alternatives for IRAs are consistent with the executive order that created them, which is beyond the scope of forest planning. Although alternative A does not include plan components related to IRAs, the executive order and Roadless Area Conservation Rule would apply; therefore, the effects are the same for all alternatives. Vegetation management would be limited; while some harvest may occur (where these lands do not overlap other designations such as RWAs) it is limited to certain purposes and sizes of trees (FW-IRA-SUIT-01). To the extent that this limits harvest, it would limit the potential to impact old growth, snags, and coarse woody debris either positively or negatively (refer to the discussion on vegetation treatments under *Effects that vary by alternative)*. Prescribed fire (FW-IRA-SUIT-03) and natural disturbances would have the potential to promote a natural mosaic of old growth, snag, and coarse woody debris conditions, if those disturbances occur at a scale and severity within the NRV. Given expected climate, more wildfire and insect activity are likely to occur, and IRAs are likely to contain ample snags and coarse woody debris. These effects would be prominent in portions of all the GAs.

Tenderfoot Creek Experimental Forest

The Tenderfoot Creek Experimental Forest is designated under all alternatives, and while the plan components are articulated differently, the effect of them is the same. It is included in management area K in the 1986 Lewis and Clark NF plan; the standards in this management area are consistent with those in the action alternatives. Specifically, LB-TCEF-DC-01 states that this area should provide the vegetation conditions and management opportunities to support research and demonstration activities. While the plan components for old growth, snags, and coarse woody debris would need to be met during these activities, it would not necessarily be managed to promote them.

King’s Hill Scenic Byway

While the plan components for the King’s Hill Scenic Byway vary by alternative, the effects of them on old growth, snags, and coarse woody debris are generally the same. With the no-action alternative, the area around the scenic byway is included in management area A, which emphasizes high scenic values. The King's Hill Scenic Byway is designated as an emphasis area in the action alternatives. LB-KHSB-DC-01 ensures lands visible from this highway are natural-appearing with high scenic quality; and LB-KHSB-GDL-01 ensures that management activities would be consistent with a scenic integrity objective of high and the other historic and cultural values of the byway are protected. To a small degree these components may limit certain types of vegetation management, and in general would support the retention of old growth which is usually visually desirable; but may allow for some reductions in snags and coarse woody debris. These components would not affect a large area, and overall would have minimal effect to old growth, snags, or coarse woody debris.

Rocky Mountain Front Conservation Management Area

The no-action alternative does not contain plan components for the Rocky Mountain Front Conservation Management Area; however, this area was established by law in 2014, and therefore the management guidance in that law would apply to all alternatives. The action alternatives include plan components to support the values of the area, designed to conserve, protect, and enhance recreational, scenic, historical, cultural, fish, wildlife, roadless, and ecological values (RM-CMA-DC-01). RM-CMA-DC-02 specifies that the vegetation and forest conditions provide for public health and safety, recreational settings and user experiences, enhance scenic values, and protect facilities and infrastructure. RM-CMA-SUIT-01 specifies that the areas is not suitable for timber production although harvest may occur. The considerations in the law, and the action alternative plan components, would likely promote the retention of old growth, snag, and coarse woody debris components on the landscape.

Cultural, historic, and tribal resources

Under all alternatives, plan components to protect cultural, historical, and tribal resources may influence the design of projects at a site-specific scale but potential (positive or negative) effects to old growth, snags, or coarse woody debris would be negligible.

Land status, ownership, and uses

All alternatives include plan components associated with land status, ownership, and uses. The timber section discusses these components relative to access to conduct vegetation management; this discussion also applies to the resulting potential to influence old growth, snags, or coarse woody debris (as described in the vegetation management discussion in *Effects that vary by alternative)*.

Livestock grazing

In all alternatives, livestock grazing would occur in allotments on the HLC NF. Grazing and trampling can affect vegetation and alter fire regimes as described in the terrestrial vegetation section. Livestock grazing and old growth are not generally closely associated, as old growth stands would usually not provide the abundant forage, and where present in livestock allotments these forests are likely to provide only transitory range due to tree density. However, old growth and livestock uses may be juxtaposed in some areas, particularly riparian areas or in dry, open old growth stands. All alternatives include plan components to mitigate the risks of impacts and emphasize adaptive management with respect to grazing practices. The 1986 Forest Plans include forestwide standards which provide guidance to promote the health of native vegetation and protect riparian areas. Plan components under the action alternatives would ensure that grazing is managed to promote sustainable and vigorous native plant communities, especially riparian areas (FW-GRAZ-DC-02, FW-GRAZ-STD-02, and all FW-GRAZ-GDLs). Based on these plan components, livestock grazing likely has a neutral effect on the potential to move towards old growth desired conditions. There is likely no measurable impact to snags or coarse woody debris due to plan components for livestock grazing.

Mining and mineral extraction

Generally, the impacts to terrestrial vegetation from mineral extraction are localized (such as the removal of incidental trees), and not measurable at the broad scale with respect to old growth, snags, or coarse woody debris. The 1986 Forest Plans included components designed to protect resources from potential damage. Under the action alternatives, plan components include FW-EMIN-DC-07 and FW-EMIN-GDL-01 and 02 which would help ensure that the desired conditions of riparian vegetation in particular (where some old growth may be found) can be met or not precluded. The combination of existing law, regulation, and policy and plan components for mining results in similar protections for vegetation (and by extension old growth, snags, and coarse woody debris) across all alternatives.

Effects common to all action alternatives

All action alternatives include the same old growth, snag, and coarse woody debris plan components, as described in Table 60.

Table 60. Summary of 2020 Forest Plan components for old growth, snags, and coarse woody debris

Plan component	Expected effects
FW-VEGF-DC-07	This desired condition is specific to old growth. It recognizes the dynamic nature of old growth over time; the desire to increase resilience of old growth; and to increase the size of old growth patches. Qualitative descriptions of desired conditions are provided, including species mixes and structures by each broad PVT. The effect is that management decisions would be designed to increase the amount of old growth on the landscape to the extent within FS control. This DC also describes snags and woody debris in old growth, and therefore complements snag and coarse woody debris plan components.
FW-VEGF-GDL-04	This component emphasizes several purposes for which treatment could occur in old growth related to restoration and resilience. This guideline would ensure that when management is done, as many old growth characteristics are retained as possible. The result would be that treatments in old growth would not result in the stand no longer meeting the definition of old growth, unless specific exceptions apply. Therefore, minimal loss of old growth should occur as a result of vegetation management. The effect of the exceptions are analyzed below.
FW-VEGF-DC-08	The desired condition for snags includes numbers and distribution of snags and would provide for adequate snags at the broad scale, which may be achieved with a combination of natural disturbances and management. While the 1986 Forest Plans do provide snag retention requirements for harvest units, they do not point to a quantitative broad scale desired condition for snags.
FW-VEGF-GDL-02	The guideline requires the retention of snags during vegetation management and would ensure that snags are retained in project areas to contribute to the desired condition. The potential effect of exceptions to this guideline are analyzed below.
FW-VEGF-DC-09	The desired condition describes the appropriate abundance and distribution of coarse woody debris and would provide for adequate coarse wood at the broad scale, through a combination of natural disturbances and management.
FW-VEGF-GDL-05	The guideline specifies woody debris retention during vegetation management and would ensure that sufficient coarse woody debris is retained in managed areas to contribute to the desired condition. The potential effect of the exceptions to this guideline are analyzed below.

The old growth plan components do not quantify a desired patch size or distribution of old growth. The NRV conditions of these factors is unknown. Further, the minimum patch size, distribution, and connectivity of old growth on the landscape necessary to meet various ecological needs such as seed dispersal or habitat for a variety of wildlife species would vary (Warren, 1990). The functionality of old growth patches for wildlife habitat would also vary depending on the surrounding landscape and activities that may create an "edge effect" (L. D. Harris, 1984). For example, to provide functional habitat, old growth patches in highly disturbed or fragmented landscapes may need to be larger than those that are intermixed within a forest matrix. These considerations would be explored at the project level where the landscape context and specific wildlife species affected may be ascertained. The plan components qualitatively address patch size, connectivity, and distribution. The largest and most contiguous patches available would be the most desirable.

All action alternatives have plan components that direct retention of snags and coarse woody debris in timber harvest units; the no-action alternative has standards for snags; however, the Helena NF 1986 plan does not mention woody debris, and the Lewis and Clark NF plan only qualitatively describes keeping downed trees for wildlife feeding sites (2-36). The components in the action alternatives are designed to address the distribution of snags and coarse woody debris across the forest and support the active role that is needed to achieve desired conditions in actively managed landscapes.

Exceptions to FW-VEGF-GDL-04 (old growth)

Old growth guideline FW-VEGF-GDL-04 describes two exceptions where FS management may result in losses of old growth. The potential effect of these exceptions is analyzed as follows:

- Old growth may be removed "where needed to mitigate imminent hazards to: (1) public safety in campgrounds, other designated recreation sites, administrative sites, and permitted special use areas; or (2) infrastructure that is essential to community welfare (e.g., utilities, communications, and where fire modelling shows a risk to evacuation routes)". The removal of old growth allowed by this exception is expected to be minor for several reasons. First, in many cases, the vegetation in these areas would already have been altered based on the developments present, and old growth is not likely to commonly occur. In addition, projects in these areas would be required to be consistent with the desired condition for old growth (FW-VEGF-DC-07) by not precluding the achievement of an increasing abundance of old growth at the broad scale. This would result in projects being designed to remove only the minimum amount of old growth necessary to meet the purpose and need and could consider other design features such as the promotion other old growth stands.
- Old growth may also be removed "Where project analysis has identified a need to remove a proportion of lodgepole pine old growth to achieve a diversity of age classes." This exception is included to allow for the treatment of large, homogenous landscape areas where lodgepole pine old growth is abundant, and the removal of some would achieve other objectives and provide for younger stands that may become old growth in the future. The project would provide the analysis and BASI necessary to determine the appropriate abundance and distribution of old growth on the landscape, as well as ensure that it is consistent with FW-VEGF-DC-07. It is not expected that this exception will be used frequently, but it could result in the short-term reduction of old growth in some landscapes. However, these reductions would not be to the degree that they preclude achievement of FW-VEGF-DC-07, and in the long term may provide for more old growth by creating more mosaic conditions in lodgepole pine dominated landscapes.

Exceptions to FW-VEGF-GDL-02 (snags)

Snag guideline FW-VEGF-GDL-02 describes areas where FS management may not adhere to the stated minimum snag retention requirements*: "…where there are issues of human safety in designated campgrounds and developed recreation sites, permitted ski areas, utility lines, prescribed burn control lines, and immediately adjacent to open roadways or private infrastructures."* The removal of snags allowed by this exception is expected to be minor because snags in these areas would already be minimal due on the developments present; and the areas included make up a fairly small acreage. Projects would also be required to be consistent with the desired condition for snags (FW-VEGF-DC-08).

Exceptions to FW-VEGF-GDL-05 (coarse woody debris)

Coarse woody debris guideline FW-VEGF-GDL-05 describes areas where minimum coarse wood levels may not be met, "*…where there is elevated concern with fire risk (recreation sites, areas adjacent to infrastructure or private ownerships, Wildland Urban Interface areas, utility lines, etc.), as supported by site-specific analysis."* This exception would be most commonly used for harvest and prescribed fire in the WUI, in forested vegetation types, because these are the areas where elevated concern for fire risk most commonly occurs. Potential losses of coarse woody debris in recreation sites and utility lines are not quantified because coarse woody debris is likely already sparse due to these developments; and they represent fairly small, discreet acreages on the landscape.

To assess the general impact of this exception, the projected acres of harvest (which may also include prescribed burning) and acres of ecosystem burning (not associated with harvest) from the PRISM model are summarized for forested vegetation types on WUI lands. Other treatments in WUI areas would occur in nonforested vegetation types, where the guideline does not apply because coarse woody debris would naturally not be present. While the alternatives vary slightly due to differences in harvest and prescribed burning acres (as reported in the timber section), these differences are slight with respect to the WUI.

Depending on alternative, under a constrained budget scenario PRISM projects a total of about 64,000 to 75,000 acres harvested in the WUI during the 5-decade modeling period. This equates to 2% of all NFS lands on the HLC NF, impacted over a span of 50 years. In an unconstrained budget scenario, harvest in the WUI would total 4 to 5% of NFS lands over the next 50 years. In these areas, ecosystem burning is projected to occur on a total of about 3,000 to 10,000 acres (less than 1% of all NFS lands) with a constrained budget; and 64,000 to 92,000 acres (2-3% of all NFS lands) with an unconstrained budget. Therefore, the combination of harvest and ecosystem burning in forested types in the WUI over the next 50 years is projected to impact 3% of NFS lands on the HLC NF in a constrained budget scenario, or 6-8% in an unconstrained budget scenario, depending on alternative.

Not all of these areas would have elevated concern with fire risk, but some subset of them may have less coarse wood remaining after treatment than the level specified in the guideline. Some acres could be included in the totals twice; for example, where a commercial thin is followed by a regeneration harvest later in the modeling period, or where more than one ecosystem burn was applied. Therefore, this analysis represents a high estimate of the potential areas where this exception may be applied; and the areas affected comprise a very small percentage of NFS lands on the HLC NF. In addition, projects would be designed to meet desired condition FW-VEGF-DC-07 at the broader scale. Based on this information, it is unlikely that the exception provided in FW-VEGF-GDL-05 would result in measurable negative impacts to the ecosystem functions provided by coarse woody debris on the landscape.

Alternative A, no action

Under the No Action alternative, the 1986 Forest Plan old growth, snag, and woody debris plan components would apply, as described in Table 61. In contrast to the action alternatives, the no-action alternative does not specify landscape level desired conditions for these ecosystem attributes.

Table 61. Alternative A summary of 1986 Forest Plans for old growth, snags, and coarse woody debris (1986 plans)

Plan component	Expected effects
Helena National Forest forestwide standards II/20: 5% of each third order drainage should be managed for old growth. The priority for old growth acres within each drainage is: first, land below 6,000 feet in elevation; second, riparian zones and mesic drainage heads; and third, management areas emphasizing wildlife habitat. These areas will normally be managed on a 240 year rotation and	Both plans adopted the Green et al (1992) definition of old growth via amendment. Plan components would result in a static amount of land being designated for old growth management. In drainages or compartments dominated by nonforested communities this amount may be unachievable, while in other

Plan component	Expected effects
will range from 10 acres to several hundred acres. Management areas other than T-1 through T-5 will be the primary source for old growth. However, if adequate old growth area cannot be achieved then T management areas will be considered to meet old growth objectives.	landscapes the amount may be too low. The Helena NF plan does not require that the stands selected actually be old growth, although the Forest has consistently chosen stands that are old growth or the “next best thing.” Not all of the Helena NF is delineated as a third order drainage, and therefore this standard would not necessarily be applied to all NFS lands. For both forests, it is unknown whether the quantity (5%) or scale (third order drainage or timber compartment) is representative of natural conditions or wildlife habitats. These plans would result in stands of a certain minimum size being selected as old growth (10 acres or 20 acres). These plans do not address a desire to increase the amount of old growth, nor do they reflect variation in landscapes and site capabilities. The amount of old growth prescribed does not have a clear tie to the NRV or landscape resilience.
Lewis and Clark National Forest 2-16: Old growth forest inventory – there is currently no inventory of timber stands on the Forest which meet the old growth forest definition. These stands will be identified as a part of resource program and project level wildlife inventories and evaluations…2-44, E-4 (9): A minimum of 5% of the commercial forest land within a timber compartment should be maintained in an old growth condition. A minimum stand size of 20 acres is recommended for old growth management. In management areas included in the regulated timber harvest base…a rotation of at least 200 years is recommended on the 5% of the commercial forest land to be maintained in an old growth condition. Appendix A: Silvicultural treatment recommendations for old growth.	
Helena NF Forestwide standard II/21: This standard requires minimum retention of an average level of snags across each third order drainage (2/acre). The primary areas where snags would be retained are those where timber management is not an emphasis. The standard specifies minimum snags or replacement trees by size class that should be left in cutting units if the average cannot be met otherwise, with the exception of units that are pure lodgepole pine. The plan does not include any quantitative guidance for coarse woody debris.	The standard would result in retaining a minimum average number of snags per acre across each third order drainage; snags would not necessarily be left in treatment units. Not all of the Forest is delineated as a third order drainage, and therefore this standard would not necessarily be applied to all NFS lands. This plan component does not recognize the variability in snag distribution nor the unique qualities and disturbance regimes of PVTs. It is not consistent with BASI for the natural condition of snags on the landscape. The management of coarse woody debris would be guided by other law, regulation, or policy.
Lewis and Clark NF Forestwide standard C-4: In summary, this standard quantifies desired snags and as wildlife trees, defining hard versus soft. All soft trees are to be retained. Recommended sizes and numbers of hard snags to retain across varying scales are specified by vegetation type and wildlife species. The desired distribution of snags is described as is leaving live deformed trees for snag recruitment. C-4(11) mentions, but does not quantify, downed trees for wildlife feeding sites. *Standard E-1* also mentions informing the public on the importance of snags.	The standard would result in retention of minimum numbers of hard snags in the sizes and vegetation types described, which are not necessarily consistent with the BASI. The management of coarse woody debris would generally be guided by other law, regulation, or policy.

Effects that vary by alternative

Disturbances and vegetation treatments

Old growth, snags, and coarse woody debris can be promoted, or removed, by disturbances and management activities. These influences are at play under all alternatives, but the magnitude varies due to land allocations that affect the type and amount of vegetation management that can occur. Natural disturbances would likely result in snag and coarse woody debris conditions that remain within the desired ranges; and may contribute to the development of old growth when they occur with low and mixed severity. Natural processes would influence old growth, snags, and coarse woody debris more so than management activities.

It is impossible to model the nuances in project design that would result from implementing the old growth, snag, and coarse woody debris plan components through time. This analysis relies on the expected magnitude of processes that influence these features to compare alternatives: wildfire, bark beetles, prescribed burning, and timber harvest (Figure 16). At the programmatic level the differences in alternatives are slight. If budgets were not constraining, there would be more prescribed fire and harvest on the landscape, as represented by alternative F-unconstrained. Figure 17 shows the relative importance of each factor by decade, with all constrained alternatives averaged.

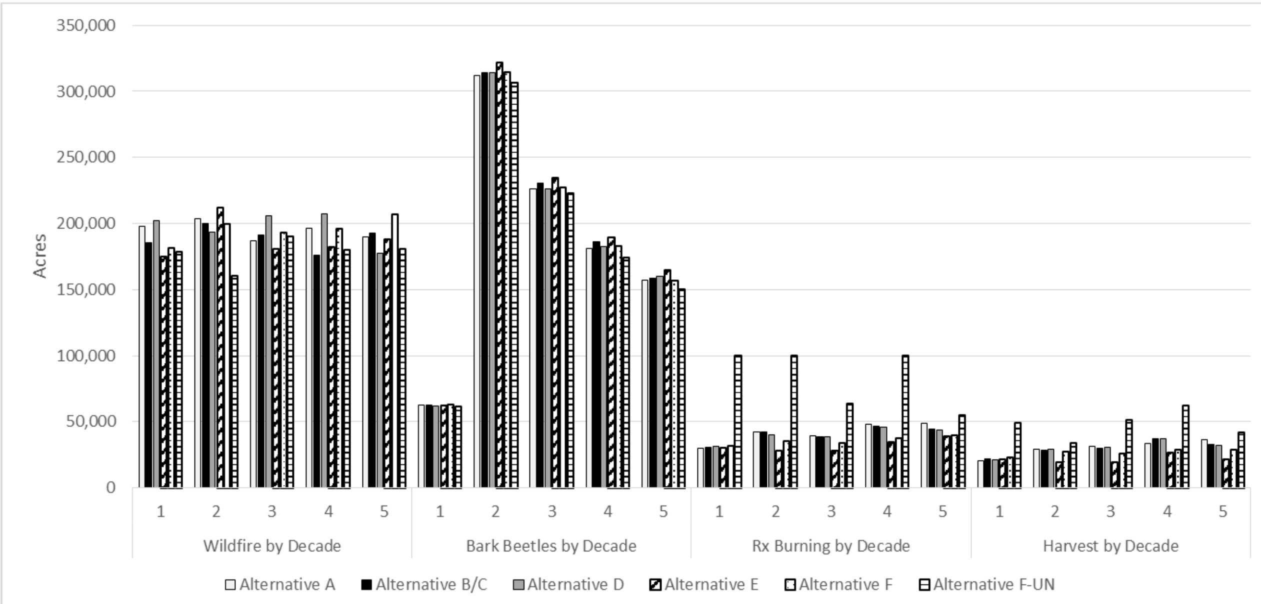


Figure 16. Processes and activities that influence old growth, snags, and coarse woody debris by alternative

Wildfire and bark beetle acres are from the SIMPPLLE model. Harvest and prescribed burning are modeled by PRISM for forested lands. Actual accomplishment of burning would vary depending on operational considerations such as weather. Alternatives A-F are shown with a constrained budget scenario. Alternative F-UN represents alternative F with an unconstrained budget. The unconstrained prescribed fire acres from PRISM reflect potential burning without a budget limitation, up to a 10,000 acre/year cap. This cap is based on operational limitations that indirectly include budget with respect to available personnel and equipment. Therefore, this cap effectively introduces a budget limitation to prescribed fire predictions once the 10,000 acre threshold is reached. A fully unconstrained budget scenario would likely result in higher prescribed burning acres than shown –roughly 30,000 acres/year based on local experience.

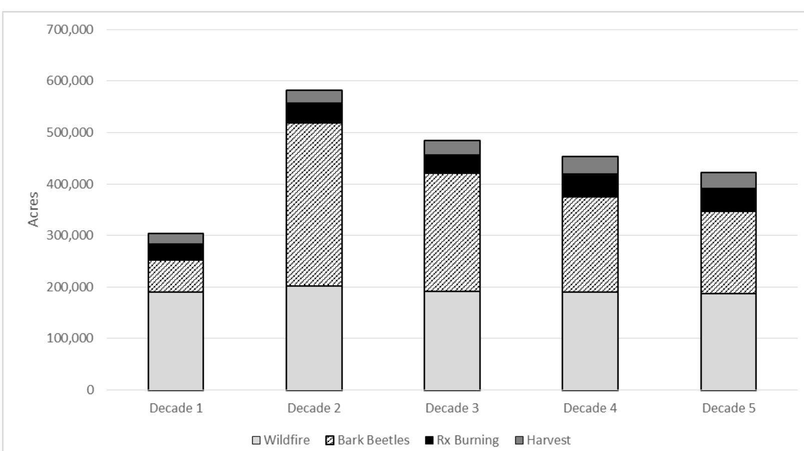


Figure 17. Projected mean area affected by decade by wildfire, bark beetles, prescribed fire, and harvest on the HLC NF over 5 decades; average of all alternatives

Effects of fire and fuels treatments, and from forest plan components associated with fire and fuels management

All alternatives include plan components that guide the use of prescribed fire and other fuels management techniques. Prescribed fire in particular can emulate natural disturbance and be the only management option in landscapes where mechanical treatments are not allowed or are infeasible. Plan components under all alternatives are permissive to the use of prescribed fire. However, the action alternatives more directly address fuel treatments that allow for natural fire occurrences over time (FW-FIRE-DC-03, FW-FIRE-GDL-01, 02). Also, the 1986 plans emphasize fire suppression tactics for each management area; in contrast, the action alternatives more broadly recognize the natural beneficial role of wildfire (FW-FIRE-DC-01), and therefore may encourage fire management decisions that result in more wildfire on the landscape. Decisions related to fire and fuels management would be consistent with all other plan components, and therefore the effect would be positive or neutral with respect to attainment of vegetation desired conditions, and by extension generally beneficial or neutral to old growth, snags, and coarse woody debris.

Old growth plan components in the action alternatives would ensure that fire and fuels activities do not remove existing old growth, with limited exceptions. Fire and fuels activities that may occur in warm, dry old growth types would likely improve resilience of those stands. These activities are less likely to occur in cool, moist old growth types because the purposes stated in FW-VEGF-GDL-04 are less likely to apply.

Snags and coarse woody debris may be created by prescribed fire or rearrangement of fuels (e.g., slashing or thinning), often in smaller size classes. However, it is also plausible that some snags may be lost in fuels treatment areas that include the cutting of trees to create desired fuel loading conditions or to improve worker safety. In addition, coarse woody debris may be reduced because it is consumed by the fire, or because it is piled and burned to meet the project purpose and need of the project. As discussed in the *Effects common to all action alternatives*, areas that have a high fire risk concern may have less coarse woody debris left than the levels prescribed in FW-VEGF-GDL-05; and snags retention may not apply in certain areas such as prescribed burn control lines (FW-VEGF-GDL-02). However, these activities would be designed to not preclude the attainment of the desired conditions for snags and coarse woody debris. The reductions of snags and coarse woody debris in treatment areas would occur on a relatively small percentage of the land base, when compared to the areas affected by disturbances that create snags and coarse woody debris. The no-action alternative does not include quantitative coarse woody debris guidelines, and therefore the action alternatives are likely to result in more beneficial effects to this resource.

Effects of timber harvest, salvage, and forest plan components associated with timber management and other forest products

Timber harvest is one of the tools available to maintain or move towards desired vegetation conditions. Forest plan direction for timber harvest is provided in all alternatives, including components to ensure harvest is conducted in accordance with the NFMA. Standards and guidelines would ensure the resilience and sustainability of harvested stands, and therefore the future potential of those stands to contain snags, coarse woody debris, and develop into old growth. The acres projected to be harvested are relatively small (2,000-5,000 average acres/year depending on alternative and budget scenario) compared to natural disturbance processes (e.g., wildfire expected to burn an average of 15,000-20,000 acres per year). Some of the acres where harvest occurs could be in old growth stands, as allowed by FW-VEGF-GDL-04.

The alternatives approach old growth management differently, as shown in Table 59 and Table 60. Alternative A requires that a certain proportion of the landscape be managed as old growth, and old growth in excess of this amount could theoretically be removed. In contrast, plan components in the action alternatives would ensure that timber harvest does not remove existing old growth from the landscape regardless of how abundant it is, except in limited situations. Therefore, minimal loss of old growth would occur under the action alternatives due to harvest (or other actions under FS control). All alternatives would have a similar potential for harvest and other forms of vegetation management to be used in younger stands to promote future old growth.

As discussed in the *Affected Environment* section, snags are likely to be less abundant in previously harvested areas and along open roadways where firewood cutting has occurred. Coarse woody debris may be more or less abundant in these areas, depending on the design of the logging treatment, and whether branches and tops were cleaned up after firewood cutting. The effects of past logging and firewood cutting on snags and coarse woody debris are taken into account by the existing condition estimates, which are based on the latest available FIA data.

All alternatives include plan components that require retention of certain minimum numbers of snags. The potential loss of snags in timber harvest areas is less than the potential creation of snags from disturbances and prescribed fire. Snag removal is usually minor and incidental when they are scattered in "green" harvest units. Further, snags with decay that are most valuable to wildlife would have little utilization for timber products, and therefore there is no incentive to cut them unless they pose a specific safety hazard.

The removal of snags can occur more extensively in salvage harvest projects; please refer to the terrestrial vegetation and timber sections for additional discussions on salvage (post-fire logging). The HLC NF harvested approximately 2 percent of acres of lands that burned from 1986 to 2017. Although the amount is unknown, postfire logging may occur in the future. Under the action alternatives, in addition to the minimum snag retention guideline that applies to all harvest (FW-VEGF-GDL-02), FW-TIM-GDL-03 ensures that clusters of burned trees would be retained to provide habitat for wildlife species associated with burned habitats when salvage activities are conducted. The component does not quantify this retention, because it would vary based on site specific analysis. Some literature cautions the application of post-fire logging on the basis of the ecological importance of snags (Hutto & Gallo, 2006). When contemplating post-fire logging opportunities, at the project level the forest could consider the snag retention guidance from variety of literature to design projects to meet the intent of FW-TIM-GDL-03 (Bollenbacher et al., 2008; R. B. Harris, 1999; Russell et al., 2006). The no-action alternative does not include plan components related to burned-tree retention, aside from the minimum snag retention standards that apply to all harvests. Therefore, the action alternatives would have the effect of encouraging more snag retention with post-fire logging projects than the no-action alternative.

Depending on the design of harvest treatments, coarse woody debris may be increased or decreased in treated areas. Harvest activities create coarse woody debris, to varying degrees depending on the harvest method. For example, tops and limbs may be left on the site if trees are processed within the stand. Conversely, whole-tree yarding is commonly conducted, where the entire tree is removed and processed at the landing. The latter method results in less woody debris in the stand, although some broken tops and limbs would be left. Following the logging activity, subsequent activities are done to achieve the desired woody debris levels, such as piling and burning if a decrease is desired or pulling slash back into the unit if an increase is desired.

The action alternatives address coarse woody debris in several plan components, including those that cite or infer the retention of coarse woody debris (e.g., FW-VEGT-GDL-05, FW-SOIL-DC-01, FW-SOIL-GDL-05), and those that indicate low levels are desired in some cases (e.g., FW-FIRE-DC-02). A balance between these components would be achieved to meet the purpose and need of the project. The coarse woody debris retained after treatment would be a minimum of 5 or 10 tons based on FW-VEGT-GDL-05, but there may be variability based on other factors and exceptions provided in the guideline. Under the no-action alternative, the results of harvest would be guided by other policy and regulation. Specifically, the R1 supplement to the soils manual (FSM-2550, 2554.1(2)) points to the use of guidelines in Graham et al. 1994 for minimum coarse woody debris retention. This publication is also used as the basis for FW-VEGF-GDL-05, and therefore in practice similar minimum amounts of coarse woody debris would be left under alternative A.

Summary of vegetation treatment effects in old growth

Perpetuating old growth in dynamic landscapes requires a combination of conditions within stands that enhance resilience, as well as a redundancy of conditions across landscapes (Salwasser, 2009). Forests moving through succession into older stages need to be present to replace old growth that dies. Recognizing that old growth losses may be exacerbated by climate change, all action alternatives emphasize managing for resilience at the landscape and stand level. A more resilient old growth stand may have the capability to restore previous composition and structure after a disturbance. Actively managing younger (non-old growth) stands to increase the potential of those stands to become old growth (for example, lowering densities and retaining fire-tolerant species may increase resilience and encourage large-tree growth) may increase the probability that there would continue to be new old growth, possibly at faster rates. Treatments in stands adjacent to existing old growth may also facilitate larger patch sizes of old growth in the future; facilitate the development of an adjacent buffering canopy to old growth; and/or to help modify the severity of disturbances that enter old growth. Conversely, some treatments adjacent to old growth could result in an increase in "edge effects" to the old growth that may reduce its effective size. These considerations would vary by site and be addressed at a site-specific level.

Applying vegetation treatments within existing old growth stands is a controversial approach. Some literature has concluded that carefully designed silvicultural treatments may be a valid approach in specific situations where needed to restore forest composition and structure so that fire can play its characteristic role (Noss, Franklin, Baker, Schoennagel, & Moyle, 2006; Salwasser, 2009). Often it is the drier forest types that need treatment most, because fire exclusion has created uncharacteristically high tree density and risk of high severity fire. These types of old growth would occur primarily in the warm dry PVT. Treatments to restore resilience could include reducing density with thinning in mid and understory tree layers or selective removal of overstory shade tolerant trees, while retaining large, old fire-tolerant trees. These activities could reduce risk of high severity fire, provide for growth of younger trees, and create gaps in canopy that allow establishment of new seedlings of fire-resistant species (Agee & Skinner, 2005; Fiedler, 2002; Franklin, Mitchell, & Palik, 2007; Spies, Hemstrom, Youngblood, & Hummel, 2006). A number of studies also suggest that forest resilience can be improved with silvicultural treatments, while retaining diversity of plant and animal species (P. Z. Fule, Crouse, Roccaforte, & Kalies, 2012; Lindh & Muir, 2004; Metlen & Fiedler, 2006; Ritchie, Wing, & Hamilton, 2008; Scott Lewis Stephens, 1998; S. L. Stephens & Moghaddas, 2005; Youngblood, Metlen, & Coe, 2006; Zhang, Ritchie, & Oliver, 2008). Further, treatments can maintain sufficient stand structure in old forests to provide habitat requirements for cavity nester species and a diversity of birds and small mammals, as well as maintain or improve understory plant diversity (Metlen & Fiedler, 2006; Steeger & Quesnel, 2003; Steventon, MacKenzie, & Mahon, 1998). However, uncertainty associated with treatment of old growth for the purpose of improving forest conditions and resilience is also documented (William L. Baker & Ehle, 2003; DellaSala et al., 2013).

Several old growth stands were treated on the neighboring Flathead National Forest in 2010 and 2011 with a selective cut and understory prescribed fire, with the objectives of reducing density, promoting large trees, and reducing the potential for stand replacing fire and susceptibility to insect and disease, while maintaining old growth forest characteristics. The monitoring report (Bush, 2015) indicates that treatment objectives were largely achieved. An open forest condition dominated by large trees was created with all but one plot maintaining old growth forest characteristics.

Effects from forest plan components associated with:

Riparian management zones

RMZs are linear features near streams and wetlands; they are likely to contain more old growth, snags, and coarse woody debris than the rest of the landscape based on natural disturbance regimes. Plan components that encourage the retention of forest structure in these areas would generally result in positive effects to old growth, snags, and coarse woody debris. The plans differ in how these areas are addressed; however, in all alternatives, the limitations on treatments in RMZs would complement the old growth, snag, and coarse woody debris plan components.

The 1986 Helena NF plan includes forestwide standards for riparian areas that included considerations such as providing vegetative cover adjacent to streams. The 1986 Lewis and Clark NF plan, management area R provides for riparian area protections and specifies that uneven-aged management would be used when harvesting in these areas. Under alternative A, areas west of the continental divide would also be guided by riparian habitat conservation area direction found in the Inland Native Fish Strategy (U.S. Department of Agriculture, Forest Service, 1995b); these areas are limited to portions of the Divide GA and most of the Upper Blackfoot. The remainder of the forest would be subject to state streamside management law and best management practices. This direction would ensure the retention of dead wood, snags, and a proportion of live trees immediately adjacent to streams. Streamside management zones vary in size based on the type of stream but are generally smaller than RMZs defined for the action alternatives.

With the action alternatives, all areas of the HLC NF would be subject to guidance for RMZs, which include inner and outer boundaries. East of the continental divide, these RMZs constitute a larger area managed for riparian characteristics than the no action alternative. It is expected that vegetation management would be less common in RMZs than in other areas on the landscape; however, the action alternatives recognize that vegetation treatments within RMZs may be beneficial and needed to achieve desired conditions. In addition, with the action alternatives FW-RMZ-GDL-01 would result in large woody debris not being cut or removed from stream channels except in limited situations.

Fisheries and aquatic habitat, and Conservation Watershed Network

All alternatives include plan components related to fisheries and aquatic habitats; the 1986 plans contain relatively little detail although do note the importance of cutthroat trout. The action alternatives contain more detailed plan components, which in general would result in positive effects to old growth, snags, and woody debris as described for RMZs. In addition, the action alternatives include several components that would specifically promote and complement the desired conditions for coarse woody debris:

- FW-FAH-DC-02 references desired large woody material in stream habitats.
- FW-FAH-OBJ-01 mentions the placement of large woody debris as one potential activity to improve habitat quality and hydrologic function of aquatic habitat.

CWN plan components only exist for the action alternatives. These would have little effect on old growth, snags, or woody debris.

Soils

Under all alternatives, soil plan components would benefit old growth (and would provide for future snags) by ensuring that soil productivity is maintained in the long term. The effects of these components are vary by alternative for coarse woody debris. Standards and guidelines related to soils may limit vegetation management activities; the action alternatives provide greater specificity than alternative A, particularly with respect to allowable detrimental disturbance, slopes where equipment can operate, and post-treatment ground cover and organic matter requirements. These limitations would soil productivity and stability, and the site's ability to support vegetation. Plan components in the action alternatives more specifically complement coarse woody debris plan components. FW-SOIL-DC-01 and FW-SOIL-GDL-

05 reference woody material needed to provide nutrient cycling for soil productivity and would complement the quantitative desired condition FW-VEGF-DC-07.

Terrestrial Vegetation

The action alternatives contain detailed desired conditions for terrestrial vegetation at the Forestwide and GA-level, including cover types, tree species presence, size class, and density class. Although these desired conditions are not enumerated in the existing 1986 Forest Plans, in practice HLC NF could be managed toward these conditions. As a coarse filter, the full suite of forested vegetation components in the action alternatives would provide for a natural diversity of forest conditions that should support the development of an appropriate array of old growth across the landscape. This direction would indirectly contribute to the development of old growth structures by providing for the appropriate array of species compositions, size classes, density classes, and other components on the landscape. The no-action alternative does not quantify the coarse filter of vegetation across the landscape.

Under the action alternatives, the desired condition for large-tree structure (FW-VEGF-DC-04) complement old growth plan components by providing for desired levels of large trees across the landscape. The large tree guideline (FW-VEGF-GDL-01) ensures that retention of these trees would occur within vegetation treatment units, which contributes to future old growth development. Large-tree structure also represents future large and very large snags and eventually woody debris. The guideline would ensure that future snags and coarse woody debris are available in managed areas. The no-action alternative does not contain plan components specific to providing large trees on the landscape.

The action alternatives also more specifically recognize the important natural role of insects and disease play in creating structures such as snags and coarse woody debris (FW-VEGF-DC-11), which would contribute to maintaining the desired conditions for these features (FW-VEGF-DC 08 and 09). The no-action alternative allows that endemic insect and disease activity may be acceptable but notes the need to mitigate or suppress outbreaks in most management areas.

At-risk plants and pollinators

With the action alternatives, FW-PLANT-DC-01 and FW-PLANT-GDL-01 would influence project design to promote or protect at-risk plant species, and therefore could influence vegetation management; however, these considerations are not likely to change the potential to affect old growth, snags, or coarse woody debris. The 1986 plans also include direction relative to sensitive plant species. The at-risk plant species that would be adopted with the action alternatives are not the same as the sensitive plant species that apply to the 1986 Forest Plans, although there are many species in common. In general, the magnitude of potential effect is similar for all alternatives. There are no plan components for pollinators in the 1986 Forest Plans. With the action alternatives, FW-POLL-DC-01 is designed to provide for pollinator habitat, including snags and coarse woody debris. This desired condition is complementary to the desired conditions for snags and coarse woody debris.

Wildlife habitat management

Under the action alternatives, several GAs contain wildlife plan components that promote the presence of large trees and snags in ponderosa pine forests, for the purposes of flammulated owl habitat (BB-WL-DC-02, DI-WL-DC-02, EH-WL-DC-03, and UB-WL-DC-02). These components may complement and encourage desired old growth and snag conditions in these GAs, within ponderosa pine dominated forests. This effect would not apply to alternative A.

Recreation opportunity spectrum settings

Recreation opportunity settings (ROS) are defined for the action alternatives but do not apply to the no-action alternative. ROS settings of Primitive, Semi-primitive nonmotorized, and semi-primitive motorized include guidelines related to vegetation conditions and management (FW-ROS-GDL-03; FW-ROS-GDL-05; and FW-ROS-GDL-07 respectively), which denote varying degrees of natural vegetation conditions.

Alternative D is most limiting to vegetation treatments while Alternative E is the least limiting. These components are consistent with the desired conditions for terrestrial vegetation and are consistent with other land allocations that influence vegetation management, such as wilderness, RWAs, and IRAs. In areas where vegetation treatment is precluded as described for those designations, natural processes would be the primary influence on old growth, snags, and coarse woody debris.

Recreation, recreation special uses, and special uses

Under the no-action alternative, developed recreation sites are included in management area R-2 in the Helena NF plan (which requires that tree removal would only occur for safety or to maintain healthy and diverse vegetation in these areas); and management area H in the Lewis and Clark NF plan (which states that un-programmed timber harvest may occur). Under the action alternatives, recreation plan components more specifically address the desired vegetation conditions in these areas, and may result in vegetation conditions in small, isolated areas to be managed in ways that emphasize considerations such as public safety (e.g., FW-REC-DC-06, FW-REC-GDL-02, FW-REC-SUIT-01, FW-RSUP-DC-05). While snags, coarse woody debris, and old growth may be present in recreation and special use areas, these areas would not necessarily be managed to emphasize these resources. Snags and coarse woody debris in particular are likely to be lower in these areas due to concerns for public safety and other activities such as firewood gathering, and specific exceptions to old growth, snag and coarse woody debris guidelines exist in these areas (FW-VEGF-GDL-01, 02, and 05). The no-action alternative does not provide similar exceptions and may result in more snags and coarse woody debris being retained in some of these sites such as ski areas. The spatial extent of these areas is small in all alternatives and managing them to emphasize recreational values would not preclude the attainment of desired conditions for old growth, snags, or coarse woody debris at the broader scale.

Scenery

Alternative A uses visual quality objectives (VQOs) to define scenery management, which focus on the effects of vegetation management and do not explicitly recognize the value of natural disturbances (or treatments that mimic the effects of natural disturbance). The action alternatives employ the Scenery Management system, and designate SIOs which offer greater flexibility and recognition of natural disturbance regimes. Under all alternatives, the magnitude of vegetation treatments (and associated positive and negative effects on old growth, snags, and coarse woody debris) in areas with higher SIOs (or VQOs) would be limited. Alternative D is most limiting to vegetation management activities, as it has the most high and very high SIOs, while Alternative E is the least limiting. SIOs are consistent with other land allocations (such as wilderness, RWAs, IRAs and ROS settings), and as such the additive effects to old growth, snags, and coarse woody debris are minimal. Where vegetation management occurs in old growth, SIOs would have little impact because treatments that would meet old growth guidelines would also by default meet all but the “very high” SIO category. For the action alternatives in particular, SIOs emphasize consistency with natural processes, so at the broad scale would not preclude the achievement of desired conditions for old growth, snags, or coarse woody debris.

Recommended wilderness areas

The alternatives vary in the quantity and location of RWAs, ranging from none in Alternative E, to 16 areas (nearly 475,000 acres) in Alternative D, with preferred alternative F incorporating 7 areas (just over 153,000 acres). In these areas, no harvest could occur (FW-RECWILD-SUIT-04). RWAs by in large overlap IRAs, where some harvest could occur; therefore, while small, there is an additive impact of restricting harvest with the RWA allocation, and thus the potential to affect old growth, snags, and coarse woody debris with timber harvest. However, this designation does not preclude restoration treatments such as prescribed fire, so long as the ecological and social characteristics that provide the basis for wilderness recommendation are maintained (FW-RECWILD-SUIT-02; FW-RECWILD-DC-01). In this respect, the RWA is less limiting than designated wilderness, although the feasibility of treatments may be lowered. Generally speaking, natural processes would be the primary driver of old growth, snag, and coarse woody debris impacts in these areas, with the positive and negative effects as described in the *Disturbances and vegetation treatments* section. It is expected that snags and coarse woody debris in particular may be abundant given expected future disturbance, although the quantity and distribution may be cyclic especially where stand-replacing events occur. Future wilderness designation of RWAs could be anticipated, in which case the effects to old growth, snags, and coarse woody debris would be consistent with those described for designated wilderness in the *Effects common to all alternatives* section.

Eligible wild and scenic rivers

In the no-action alternative, the 1986 plans identify eligible wild and scenic rivers (WSRs) via amendment based on a 1989 eligibility study, and include direction for the management of those rivers, with the goal of protecting the outstanding and remarkable values of these areas until suitability studies are complete. Under the action alternatives, similar components for eligible WSRs include limitations for vegetation management in a 1/4 mile corridor, which vary by the classification (wild, scenic, or recreational) (FW-WSR-GDL-01). By in large, little vegetation management would be expected to occur in these areas. Due to their shape and position on the landscape (next to rivers which overlap riparian management zones) WSR plan components may contribute to the retention of old growth, snags, and coarse woody debris on the landscape. There are more eligible WSRs in the action alternatives (corridors totaling 43,291 acres), than the no-action alternative (corridors totaling 113,007 acres).

National recreation trails, Lewis and Clark National Historic Trail, Continental Divide National Scenic Trail

Under the no-action alternative, the 1986 plan components for the Continental Divide National Scenic Trail point to the comprehensive management plan for the trail and emphasizes visual quality. 2020 Forest Plan components address all of these trails in more detail, and include considerations for vegetation management to ensure it is conducted in a manner consistent with the values of each trail (e.g. FW-NRT-GDL-01, FW-LCHT-GDL-02, FW-CDNST-GDL-02, 03). These components would not preclude treatments such as harvest or prescribed fire, although other land designations along the trails may. The plan components would alter the design of site-specific treatments where they are allowed and would likely encourage the retention of old growth structures because they are often visually desirable, but may reduce snags and coarse woody debris in the vicinity of the trails due to public safety concerns. These effects would be spatially limited and negligible to old growth, snag, and coarse woody debris at the broad scale.

Research natural areas

A variety of research natural areas (RNAs) are included or proposed under all alternatives, with alternatives A, B/C, and E containing roughly 16,870 acres, alternative D roughly 21,375 acres, and alternative F containing roughly 18,447 acres. The 1986 plans prohibit timber harvest in these areas (management area N-1 in the Helena NF plan; and management area M in the Lewis and Clark plan), although some prescribed burning could occur. With the action alternatives, vegetation management (including harvest and burning) would be limited unless used to maintain the natural conditions as outlined in establishment records (FW-RNA-SUIT-01). The effect would be to preclude (alternative A) or limit (action alternatives) the potential to manipulate vegetation in RNAs with associated positive and negative impacts to old growth, snags, and coarse woody debris; however, these areas are often located within other land designations that are restrictive to active management where natural disturbances would be the primary influences with effects as described in the *Disturbances and vegetation treatments* section.

Public information, interpretation, and education

Under the no-action alternative, the 1986 plans do not address public information, interpretation and education. With the action alternatives, this suite of plan components encourages opportunities to enhance the public's knowledge and appreciation of the natural resources on the HLC NF. These components would indirectly influence old growth, snags, and coarse woody debris to the extent that they result in public participation and understanding in project design and development.

Carbon sequestration

Under the action alternatives, the desired condition (FW-CARB-DC-01) would complement the old growth plan components by supporting the need for resilient forests on the landscape to contribute to the aboveground living carbon pool, as well as components such as snags and coarse woody debris that contribute to carbon sequestered in dead material and eventually in forest soils. The no-action alternative does not contain any plan components related to carbon sequestration.

Missouri River and Smith River Corridors

These river corridor areas are not included in the no-action alternative. The action alternatives designate these corridors and include plan components to protect recreational and resource values. Timber harvest may occur to provide public safety and to enhance recreational or aesthetic values (LB-SMITH-SUIT-01; BB-MISCOR-SUIT-01). These components would encourage the retention of old growth but may encourage or allow the reduction of snags and coarse woody debris in areas of high public use. Due to the limited scale on which activities would occur to reduce snags and coarse woody debris, however, these plan components are not likely to have a measurable impact on conditions at the broader scale.

South Hills Recreation Area

This emphasis area encompasses more than 50,000 acres in the Divide GA, and is found in alternatives B/C, D, and F but not A or E. In the alternatives where it exists, this recreation area may have some impact to old growth, snags, and woody debris based on the resource emphasis related to vegetation management. DI-SHRA-GDL-01 emphasizes the importance of recreation experiences, visitor safety, and hazardous fuels reduction. This component may encourage treating dry forest old growth types to improve resilience and would complement FW-VEGF-GDL-04. Based on FW-VEGF-GDL-04, some exceptions could apply to result in a loss of old growth (e.g., in designated recreation sites and along evacuation routes); the beneficial effect of improving old growth resilience may outweigh this potential loss, but the net effect is uncertain because it is not known where all of the old growth exists in relation to the other resource values. Due to the emphasis on fuels reduction, this component would also encourage vegetation treatments to reduce snags and coarse woody debris to mitigate fire risk. Snag and coarse woody debris guidelines would apply, although the exception within the coarse woody debris guideline (that allows for lower levels to be retained where fire risk is of concern) might apply in this special recreation area more commonly than on the landscape as a whole. Nevertheless, all projects would still be required to not preclude achievement of the desired conditions for old growth, snags, and coarse woody debris.

Showdown and Teton Pass Ski Areas

The Showdown and Teton Pass ski areas are recognized in management area H in the 1986 Lewis and Clark NF plan for the no-action alternative; the standards and guidelines do not describe the desired vegetation condition. Under the action alternatives, LB-SHOWSKI-DC-02 and RM-TETONSKI-DC-02 require that the vegetation provide for public health and safety, recreational settings and user experiences, enhancing scenic values, and protection of facilities and infrastructure. Plan components that provide flexibility to meet these desired conditions (e.g. FW-VEGF-GDL-01, large trees; FW-VEGF-GDL-02, snags; and FW-VEGF-GDL-05, coarse woody debris) would likely result in lower amounts of old growth, snags, and coarse woody debris being present in these areas. Nevertheless, these are small areas in the context of the HLC NF, and these plan components would not preclude achievement or movement towards old growth, snags, and woody debris desired conditions at the broad scale. Old growth, snags, and coarse woody debris are also likely to be less than in the general landscape in the no-action alternative, but to a lesser degree than the action alternatives because specific exceptions to snag and old growth plan components are not provided in the 1986 Forest Plans.

Badger Two Medicine

This area is described in the 1986 Lewis and Clark NF plan as the North End Geographic Unit (RM-1); this area was not included in lands suitable for timber production and the Blackfeet Nation's treaty rights were recognized. This area is designated as a special emphasis area in the action alternatives. Based on RM-BTM-SUIT-01 and 02, timber harvest and restoration activities may occur to provide for values such as habitat restoration, hazardous fuels reduction, and to support tribal treaty rights; therefore, both the positive and negative effects of vegetation management would apply. However, due to access and other land allocations, such as IRAs, harvest activities in particular would be limited in extent, and natural processes would be the primary drivers of old growth, snag, and coarse woody debris conditions. Refer to the *Disturbances and vegetation treatments* section.

Green Timber Basin-Beaver Creek Emphasis Area

This emphasis area is only included in alternative F and would result in the protection of a unique population of rare orchids. The plan components for this area contribute to plant diversity on the HLC NF. Plan components may limit vegetation management activities when needed to avoid degradation of botanical resources (RM-GB-GDL-01). However, this area is relatively small, and management is limited by other land allocations such as the Rocky Mountain Conservation Management Area; therefore, there is little to no additive effect (positive or negative) from these plan components to old growth, snags, or coarse woody debris.

Grandview Recreation Area

This area is only included in alternative F. However, plan components exist under all the action alternatives that guide overlapping land allocations (e.g., WSAs, IRAs, RWAs, recreation opportunity spectrum settings); these components would result in similar management on the ground across alternatives. In the portions of the area outside the WSA, some vegetation management could impact old growth, snags, and coarse woody debris, particularly in high recreation use areas. However, within the WSA, natural processes would be the primary drivers of these conditions. Based on the other land allocations in this area, there is little to no additive effect from the plan components associated with this area for old growth, snags, or coarse woody debris.

Cumulative effects

The effects that past activities have had on old growth, snags, and coarse woody debris are reflected in the current condition. Present and foreseeable future activities are summarized below.

Portions of the HLC NF adjoin other NFs, each having its own forest plan. Generally speaking, management of vegetation is similar across all national forests due to law, regulation, and policy. In addition, the HLC NF is intermixed with lands of other ownerships, including private lands, other federal lands such as the BLM, Bureau of Reclamation, and state lands. Some GAs contain inholdings of such lands, while others are more unfragmented in terms of ownership. The GAs which are island mountain ranges in particular are typically surrounded by private lands. Harvesting or conversion of forests on adjacent private and state lands would affect vegetation conditions at the landscape level, changing forest composition and structures. Old growth forest, large trees, snags, and coarse woody debris may be removed on non-NFS lands, increasing the importance of retention on NFS lands. Old growth, snags, and coarse woody debris on adjacent private and other non-NFS lands are likely to be less abundant.

Some adjacent lands are subject to their own resource management plans. The cumulative effects of these plans in conjunction with the HLC NF 2020 Forest Plan are summarized in Table 62.

Table 62. Summary of cumulative effects to old growth, snags, and coarse woody debris from other resource management plans

Resource plan	Description and Summary of effects
Adjacent National Forest Plans	The forest plans for national forest system lands adjacent to the HLC NF include the Custer-Gallatin, Lolo, Flathead, and Beaverhead-Deerlodge NFs. All of these forests have adopted the Green et al. 1992 definition for old growth. While specific plan components vary, all plans address the retention of old growth, snags, and coarse woody debris. The cumulative effect would be that these features are present across NFS lands at a scale broader than the HLC NF, and old management of them would be generally complementary. This includes specific adjacent landscapes that cross forest boundaries, such as the Upper Blackfoot, Divide, Elkhorns, Crazies, and the Rocky Mountain Range.
Montana Statewide Forest Resource Strategy (2010)	This plan guides forest management on state lands. It includes many concepts that are complementary to the plan components for the HLC NF, for example promoting forest resilience, providing wildlife habitat, and reducing hazardous fuels. This plan does not explicitly mention old growth, snags, or coarse woody debris. It is possible that these features would not be a focus on these lands, thereby increasing the importance of providing them on nearby NFS lands.
Bureau of Land Management Resource Management Plans (RMP)	Bureau of Land Management lands near the HLC NF are managed by the Butte, Missoula, and Lewistown field offices. The Butte and Lewistown plans were recently revised and includes management goals for old forest, snags, and coarse woody debris. The existing plan for the Missoula area, the Garnet RMP, includes requirements to manage for a certain amount of old growth on noncommercial lands. This plan is under revision. It is uncertain the degree to which old growth management would be specifically applied in these plans, but it is likely some components related to old forest, snags, and coarse woody debris may be included. It is likely that management of these resources would be complementary to that of the HLC NF.
National Park Service - Glacier National Park General Management Plan 1999	The general management plan for Glacier National Park does not mention old growth, snags, or old growth explicitly, but calls for preserving natural vegetation, landscapes, and disturbance processes. Old growth, snags, and coarse woody debris are likely present in this area to a similar degree, and subject to similar ecosystem processes, as the wilderness areas in the adjacent Rocky Mountain Range GA and would likely complement this habitat condition found on NFS lands.
Montana Army National Guard – Integrated Natural Resources Management Plan for the Limestone Hills Training Area 2014	This plan is relevant to an area adjacent to NFS lands in the Elkhorns GA. The Limestone Hills area is primarily nonforested, although the plan does call for managing for fire-resilient vegetation. The plan does not have provisions related to old growth, snags, or coarse woody debris; therefore, it should be assumed that these lands would not contribute to a landscape abundance and distribution of these components associated with the Elkhorns GA.
Montana State Parks and Recreation Strategic Plan 2015-2020	These plans guide the management of state parks, some of which lie nearby or adjacent to NFS lands. Old growth, snags and coarse woody debris are not specifically mentioned .While they may be present, it is unlikely that these features would be a focus in these areas. These lands would not contribute to a landscape abundance and distribution of old growth, snags, or coarse woody debris.
Montana's State Wildlife Action Plan	This plan describes old growth, snag, and coarse woody debris habitat where important for wildlife. This plan would likely result in the preservation of these habitats on state lands, specifically wildlife management areas. This plan would interact with the Montana Statewide Forest Resource Strategy (above) and should help ensure that old growth, snags, and coarse woody debris exist on state-owned lands and therefore would be complementary to the HLC NF forest plan.
County wildfire protection plans	Some county wildfire protection plans map and/or define the WUI. The HLC NF notes that these areas may be a focus for hazardous fuels reduction, and other plan components (such as Northern Rockies Lynx Management Direction) have guidance specific to these areas. Old growth in the WUI may be more likely to have treatments conducted to improve resiliency to fire. In addition, existing old growth may be more likely to be protected from wildfire mortality as fire suppression is often more aggressively applied in these areas. The snag and coarse woody debris plan components in the 2020 Forest

Resource plan	Description and Summary of effects
	Plan specifically allows that these areas would have fewer snags and coarse woody debris.
City of Helena Montana Parks, Recreation and Open Space Plan (2010)	This plan is relevant to an area that lies adjacent to NFS lands in the Divide GA, in proximity to the City of Helena. The plan does not mention old growth, snags, or coarse woody debris, and emphases forest management and wildfire mitigation. While old growth may be present, it would not necessarily be maintained on these lands and should not be expected to contribute to the landscape abundance and distribution of old growth for the Divide GA. It is likely that there would be relatively few snags and coarse woody debris in this area due to its recreation emphasis, thereby increasing the importance of these components in other areas of the Divide GA.

Conclusions

Old growth, snags, and coarse woody debris are important habitat features and components of vegetation diversity on the landscape. Old growth is likely less abundant today than it was historically, whereas snags and coarse woody debris are likely similar to historic conditions. The desired conditions are to increase the abundance and patch size of old growth and maintain the overall abundance and distribution of snags and coarse woody debris. In all alternatives, fire and other natural disturbances would influence old growth, snags, and coarse woody debris substantially more so than vegetation treatments. This is due to the vast areas of the HLC NF which would have minimal human influence, such as inventoried roadless areas (IRAs) and designated wilderness. The amounts and distribution of these features would remain highly dynamic and variable over time.

Old growth takes hundreds of years to develop. A viable old growth strategy includes retention of existing old growth (to the extent practicable with natural disturbance regimes), as well as providing younger forests that may develop into old growth. Under all action alternatives, the 2020 Forest Plan contains plan components designed to increase and enhance old growth. These components would ensure that management actions within FS control do not remove old growth, with limited exceptions. The 1986 Forest Plans (no-action alternative) contain standards related to old growth which do not preclude the removal of some old growth but do specify quantitative minimum amounts. Under all alternatives, the amount of large-tree structure is expected to increase over time. A subset of these areas are expected to be old growth, and therefore it is anticipated that old growth would be maintained or increased as well.

Medium snags are abundant on many landscapes due to the recent mountain pine beetle outbreak; these snags will decrease over time as they fall to the forest floor, with a corresponding increase in coarse woody debris. Bark beetle outbreaks are expected to create snags and coarse woody debris. Wildfire would create snags and coarse woody debris, as well as consume some coarse woody debris; the net effect would depend on site-specific conditions and burn intensity. The action alternatives contain plan components that would ensure that snags 10” and greater in diameter and coarse woody debris are present in quantities and distributions consistent with our best understanding of natural conditions. The action alternatives also provide more flexibility to design the best snag habitat strategy by allowing that snag retention may apply to the entire project area, if sufficient data is available to do so, so that the best snags and linkages can be retained. The no-action alternative also contains specific quantitative snag standards that would provide for minimum numbers of snags within certain scales, but have no components related to down woody debris. While management may reduce snags and coarse woody debris in specific areas, particularly those where fire risk is of concern, the overall abundance and distribution of these features will be increased or maintained due to natural processes.

3.10 Plant Species at Risk (threatened, endangered, proposed, and candidate plant species and plant species of conservation concern)

3.10.1 Introduction

This section addresses plant species that are recognized as at-risk species by the Endangered Species Act or by the Regional Forester of the Forest Service. This designation is defined by species recognized as threatened, endangered, proposed, or candidate species under the Endangered Species Act by the United States Fish and Wildlife Service (USFWS) and species of conservation concern (SCC), which are species other than federally recognized species that are known to occur in the planning area and for which the Regional Forester has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long-term in the planning area. At the time of the preparation of this forest plan, only whitebark pine (*Pinus albicaulis)* falls under the Endangered Species Act, as a candidate species and thirty-one plant species are SCC. This section will also address Regional Forester's Sensitive Species (RFSS) for the previous Helena and Lewis and Clark National Forests' Plans that were not included as SCC under the new planning rule but are considered under the existing 1986 plans. These species are included under the umbrella of at-risk for the purposes of this analysis though these species are not considered plant species at-risk under the 2020 Forest Plan.

The geographic scope of the analysis for effects to at-risk plant species and RFSS in the planning area is the lands administered by the HLC NF. The specific range of each at-risk species may extend beyond the forest boundary, however the lands administered by the Forest represent the area where changes may occur to these species or their habitats from activities that might be allowed under the alternatives. In some cases, the BASI for at-risk species' ecological relationships originated outside the analysis area. The full range of each species was considered to evaluate the viability and importance of each species' habitat within the planning area, but only indicator measurements from within the analysis area was used in making conclusions.

Changes between draft and final

Multiple changes were made for the FEIS; however, all changes are within the scope of the FEIS analysis, and address issues that the public has had an opportunity to comment on. Analysis was added for preferred alternative F. With respect to at-risk plants, this alternative is similar to alternatives B/C, with variation in the number of populations occurring within different management areas (e.g wilderness). The analysis layer that was used for whitebark pine was adjusted to better represent existing conditions and updated at-risk plant GIS data was used to update the analysis. An additional guideline for at-risk plants was added. Additional discussion was provided in response to comments on the description of Regional Forester Sensitive Species versus Species of Conservation Concern.

3.10.2 Regulatory framework

Please refer to the introductory regulatory framework section of this chapter (3.3).

3.10.3 Assumptions

Assumptions in this analysis are based on the ESA (that applies to all alternatives) and the FSH direction (that applies to alternative A). The revised FSH policy regarding SCC is forthcoming and the changes and impacts are not known.

Relevant considerations to the analysis that are common to all alternatives include (1) designated wilderness would continue to be managed as such, (2) there would be a general increase in recreational demand as the human population size increases, (3) weeds and weed seeds would continue to be deposited and spread onto and within the planning area, and (4) climate change trends would continue as projected, with warming temperatures and variable precipitation.

Management actions may contribute to or detract from the availability or quality of habitats that support at-risk plant species.

At-risk species occupy specific habitats on the landscape. There is limited data regarding trends for many at-risk plant species, so monitoring would be essential to determine the impacts of project activities and management direction.

3.10.4 Best available scientific information used

Federally recognized species (as threatened, endangered, proposed or candidate species) typically have published information on species population trends, viability, threats, and conservation strategies. Primary information sources for at-risk plant species and their occurrences on the Forest are the FS Natural Resource Manager database, Montana Natural Heritage Program Element Occurrence database and online Montana Field Guide, NatureServe database, and the Consortium of Pacific Northwest Herbaria. The majority of at-risk plant species that are not federally listed do not have the same level of scientific data available as federally listed species. Though there may be uncertainties and gaps in data and knowledge about rare plant species, the best available information is used in this analysis to assess the designated condition and determining potential effects between alternatives.

The HLC NF botany program maintains a forestwide inventory of known sensitive species occurrences. This inventory includes information on population size, viability and potential threats known to populations collected by trained botanists. Most information on these plants are derived from expert opinion and/or panel consensus, specifically at biannual meetings held by the Montana Native Plant Society in conjunction with the Montana Natural Heritage Program. There is little published information about most rare plant species concerning their viability, biology, habitat, population dynamics, and occurrences. Information gaps relevant to at-risk species may be filled in through future inventories, plan monitoring program results, or research, and this information would be integrated into the databases as it becomes available.

3.10.5 Affected environment

A total of 32 at-risk plant species were identified on the HLC NF, composed of one candidate species and 31 SCC (see appendix D). The 12 species that were RFSS were not included as SCC but were analyzed as a part of this document. The selection of SCC was a separate analysis conducted by the Regional Office; the selection of SCC is a Regional Forester decision. Updated information regarding the evaluation and scientific information used to determine species included and excluded as SCC for the HLC NF can be found on the Northern Region webpage referenced in Table 62. Sensitive species not selected as SCC through this process were determined not have to substantial concern regarding their long-term persistence in the planning area. Although some hotspots of diversity can be identified on the NF (like the high alpine species found on the Rocky Mountain Front GA, or the east side of the Little Belts range GA), at-risk plant species and/or habitat can be found in all floristic geographic subdivisions, and in all ecosystem types.

Threatened, endangered, and candidate species

While no federally listed species are currently known to occur on the HLC NF, there is one candidate species: whitebark pine (*Pinus albicaulis*). The USFWS determined in 2011 that whitebark pine is a candidate species, with listing as threatened or endangered warranted but precluded by higher priority actions (FR 76(138): 42631-42654). As a result, Region 1 added whitebark pine to the RFSS list in 2011. The USFWS initially assigned whitebark pine a listing priority number of 2, indicating the threats were imminent and of high magnitude. The listing priority number was changed to 8 (threats imminent but of moderate magnitude) in 2015 (FR 80(247): 80584-80614).

Whitebark pine is a key ecosystem component growing at the highest forested elevations in cold, windy, snowy, and generally moist climatic zones (Arno & Hoff, 1989) that are difficult areas for plants and animals to inhabit. These areas are naturally limited in species diversity, and whitebark pine is an important component of this diversity where it can successfully dominate as climax vegetation. Whitebark pine also occurs on productive upper subalpine sites, where it is the major seral species that is eventually replaced by more shade tolerant species, mainly subalpine fir and occasionally Engelmann spruce on the HLC NF.

According to Forest Inventory and Analysis (FIA) data, whitebark pine is present on roughly 12% of the HLC NF, or about 333,350 acres. It is dominant on far fewer acres; the whitebark pine cover type occurs on only 4%. This is because in some areas whitebark is a minor component in areas dominated by other species such as subalpine fir. Whitebark pine primarily occurs on the cold broad PVT. Whitebark pine is present on most GAs except the Highwoods. Although plot data (FIA) provides the best estimate of whitebark pine occurrence, maps of whitebark pine must also be used to facilitate a spatial analysis. It is difficult to map all areas where whitebark is present, because trees present in the understory or those that are a minor component in the overstory cannot be detected with remote sensing techniques, and there is no comprehensive field inventory on the HLC NF (such as stand exams). The R1 VMap is generally the best source of spatial data for vegetation using the R1 Vegetation Classification System. This layer depicts dominance types across the landscapes. However, this layer did not fully represent the total area where whitebark pine is known to occur (based on FIA estimates) because minor occurrences or understory presence of whitebark pine cannot be detected with remote imagery. The whitebark pine layer used to analyze the effects of the 2020 Forest Plan alternatives is the final input layer used for vegetation modeling (SIMPPLLE). This layer was built using VMap as a base, and then attributing detailed vegetation information (including minor species components) to all polygons using FIA data. The species labels applied to the modeling layer were derived by relating VMap dominance type information to detailed plot information from FIA. This layer also was updated to capture the changes caused by wildfires and land management that occurred since the remotely sensed imagery was gathered. This layer maps a total of 309,348 acres of whitebark pine across the Forest on NFS Service lands, which closely resembles the FIA estimates. This is the best available spatial information to analyze whitebark pine on the HLC NF.

The interrelated threats to whitebark on the HLC NF that raise concerns about the long-term viability of whitebark ecosystems include fire suppression, white pine blister rust, mountain pine beetle, and climate change.

Plant species of conservation concern

Table 63 lists the plant species that are currently determined to be SCC by the Regional Forester on the HLC NF. Table 64 lists the plant Regional Forester sensitive species that are not included on the SCC list. Additional information on these species can be found in appendix D. In addition, information regarding the rationale for identifying these species as SCC can be found on the Region 1 SCC web page at: http://bit.ly/NorthernRegion-SCC.

Table 63. Plant SCC

SCC	Conservation categories[1]	Distribution and abundance in the planning area
Musk-root (*Adoxa moschatellina*)	SCC, RFSS, SOC, G3	One occurrence along the Smith River in the Smith River Wild and Scenic byway, a second occurrence in the northern Little Belts GA.

SCC	Conservation categories[1]	Distribution and abundance in the planning area
Round-leaved orchis (*Amerorchis rotundifolia*)	SCC, RFSS, SOC, Adjacent SCC	36 mapped areas in the Rocky Mountain Front GA, mostly outside of wilderness; occurrences clustered near center of GA
Short-styled columbine (*Aquilegia brevistyla*)	SCC, RFSS, SOC, S2	82 occurrences occur on the east side of the Little Belts GA, in the Judith RD
Lesser rushy milkvetch (*Astragalus convallarius*)	SCC, SOC	Much of the species' range occurs in the valley near Helena, between the Big Belt, Elkhorns and the Divide GA's. Twenty-one occurrences are mapped in the Big Belts GA and Divide GA. More are likely.
Lackschewitz's milkvetch (*Astragalus lackschewitzii*)	SCC, SOC, RFSS, S2, G2	There are 34 mapped occurrences in 4 areas of the Rocky Mountain GA; species is endemic to the Rocky Mountain GA
Wavy moonwort (*Botrychium crenulatum*)	SCC, RFSS, SOC, G3	Two occurrences known on the Divide GA.
Peculiar moonwort (*Botrychium paradoxum*)	SCC, RFSS, SOC, G3, Adjacent SCC	Four occurrences in the Plan Area; one in the Divide GA and three in the Rocky Mountain GA.
Low northern rockcress (*Braya humilis* or (*Neotorularia humilis*)	SCC, SOC, S2 (S1 Nature Serve)	Big Snowies (2 mapped occurrences), Rocky Mountain GA (1 occurrence)
Kerry's paintbrush (Castilleja kerryana)	SCC, SOC, G3	Newly described species, endemic to MT on Scapegoat Plateau in the Straight Creek and South Fork of the Sun River.
Small yellow lady's slipper (*Cypripedium parviflorum*)	SCC, RFSS, S3	Occurs in one drainage on Rocky Mountain GA; one additional occurrence is adjacent to Divide GA
Sparrowegg lady's slipper (*Cypripedium passerinum*)	SCC, RFSS, SOC, S2, Adjacent SCC	Rocky Mountain Front - 18 mapped occurrences.
Limestone larkspur (*Delphinium bicolor ssp. Calcicola*)	SCC, T3 (variety equivalent to G3)	Three occurrences in the Big Belt GA.
Denseleaf draba (*Draba densifolia*)	SCC, SOC, S2	Fifteen occurrences in the Blackfoot, Divide and Rocky Mountain GAs.
English sundew (*Drosera anglica*)	SCC, RFSS, SOC	Two occurrences in the Indian Meadows RNA in the Upper Blackfoot GA. Habitat is limited in Plan Area.
Slenderleaf sundew (*Drosera linearis*)	SCC, RFSS, SOC, S2, Adjacent SCC	Known from two occurrences in the Indian Meadows RNA in the Upper Blackfoot GA. Habitat is limited in Plan Area.
Beaked spikerush (*Eleocharis rostellata*)	SCC, RFSS, SOC, Adjacent SCC	Two occurrences mapped in the Little Belts GA and the Rocky Mountain Front.
Northern wildrye (*Elymus innovatus*)	SCC, RFSS, SOC, S2	Known from four mapped occurrences at two locations in the Rocky Mountain and Little Belts GAs.
Giant helleborine (*Epipactis gigantea*)	SCC, RFSS, SOC, S2, Adjacent SCC	Rocky Mountain GA, one occurrence.
Fan-leaved fleabane (*Erigeron flabellifolius*)	SCC, SOC, G3	Crazies GA.
Macoun's fringed gentian (*Gentianopsis macounii*)	SCC, RFSS, SOC, S2	Two mapped occurrences in the Rocky Mountain GA
Northern rattlesnake plantain (*Goodyera repens*)	SCC, RFSS, SOC	Little Belts and Snowies GA. 211 mapped occurrences.
Howell's gumweed (*Grindelia howellii*)	SCC, SOC, RFSS, G3, S2, Adjacent SCC	One large occurrence mapped in the Divide GA.

SCC	Conservation categories[1]	Distribution and abundance in the planning area
Treelike clubmoss (*Lycopodium dendroideum*)	SCC, RFSS, SOC, S2	One occurrence is mapped in the Blackfoot GA.
Missoula phlox (*Phlox kelseyi var. missoulensis*)	SCC, RFSS, SOC, G3	58 mapped occurrences across the Little Belts, Big Belts, Divide, and Blackfoot Gas.
Austin's knotweed (*Polygonum austiniae or Polygonum douglasii var. austiniae*)	SCC, RFSS, SOC	49 mapped occurrences in the Big Belts, Rocky Mountain, and Little Belts Gas.
Bluntleaf pondweed (*Potamogeton obtusifolius*)	SCC, RFSS, SOC	Two occurrences in Rocky Mountain GA.
Northern buttercup (*Ranunculus pedatifidus*)	SCC, SOC	Two known occurrences in the Rocky Mountain GA; historical collection from Little Belts.
Water bulrush (*Schoenoplectus subterminalis*)	SCC, RFSS, SOC	One occurrence on the Upper Blackfoot GA, Indian Meadows RNA
Scorpidum moss (*Scorpidium scorpioides*)	SCC, RFSS, SOC, S2, Adjacent SCC	Rocky Mountain GA, one occurrence.
Fringed bogmoss (*Sphagnum fimbriatum*)	SCC, SOC, S1	Upper Blackfoot GA, two occurrences.
Letterman's needlegrass (*Stipa lettermanii*)	SCC, SOC, S1	One occurrence in the Crazies GA.

RFSS = Regional Forester Sensitive Species; SCC = species of conservation concern; SOC = species of concern; S1 = state ranking 1; S2 = state ranking 2; G3 = global ranking 3.

Table 64. Plant Regional Forester's sensitive species that are not included as SCC

RFSS	Conservation categories[1]	Distribution and abundance in the planning area
Glaucus beaked sedge (*Carex rostrata)*	RFSS, SOC, S2S3	Little Belts and Rocky Mountain Range GAs - both with two mapped locations.
Lackschewitz' Fleabane *(Erigeron lackschewitzii)*	RFSS, SOC, G3	Rocky Mountain Range GA
Hall's rush *(Juncus hallii)*	RFSS	Divide and Big Belts GAs. More habitat available in planning area
Stalked-pod Locoweed *(Oxytropis podocarpa)*	SO RFSS, SOC, S1 C	Rocky Mountain Range GA
Five-leaf Cinquefoil *(Potentilla nivea var. pentaphylla)*	SOC, RFSS	One occurrence located in the Plan Area in the Rocky Mountain Range GA.
Upward-lobed Moonwort (*Botrychium ascendens*)	SOC, G3	One historical occurrence last documented 1948 in the Rocky Mountain Front GA
Creeping Sedge (*Carex chordorrhiza*)	RFSS, SOC, Adjacent SCC	Not known to occur in the planning area.
Storm Saxifrage (*Micranthes tempestiva*)	SOC, G2G3, S2S3, RFSS	Not known to occur in the planning area.
Barratt's Willow (*Salix barrattiana*)	SOC, S2, RFSS	Not known to occur in the planning area.

RFSS	Conservation categories[1]	Distribution and abundance in the planning area
Alpine Meadowrue (*Thalictrum alpinum*)	RFSS, S2, SOC	Not known to occur in the planning area.
Tufted Club-rush (*Trichophorum cespitosum*)	SOC, RFSS, S2, Adjacent SCC	Not known to occur in the planning area.
California False-hellebore (*Veratrum californicum*)	SOC, S2, RFSS	Two historic occurrences last documented in 1914

RFSS = Regional Forester Sensitive Species; SCC = species of conservation concern; SOC = species of concern; S1 = state ranking 1; S2 = state ranking 2; G3 = global ranking 3.

Species guilds

Plant species have been grouped for purposes of analysis, based on broad similarity of habitat they occupy. Though there may be variation in specific habitat needs for species within a guild, the potential stressors and associated conservation strategies for the species in the habitat guild would be very similar, allowing for more efficient analysis and identification of relevant information pertaining to the species.

The list of plant species previously identified as sensitive and known to occur on the HLC NF, and their associated habitats, is in appendix D. There is a total of 35 species previously identified as sensitive. 13 species from the Regional Foresters sensitive species list would not be designated by the Regional Forester as SCC (Table 64) and 9 additional species would be added that were not previously identified as at-risk species. Of the 13 plant species previously identified as sensitive, 7 are not currently known to occur within the planning area or occur only historically. These species are ‘suspected, but not currently known’ and thus do not meet the criteria for SCC. This group includes *Botrychium ascendens, Carex chordorrhiza, Micranthes tempestiva, Salix barrattiana, Thalictrum alpinum, Trichophorum cespitosum*, and *Veratrum californicum*. These suspected species will not be considered further in this document. Also, *Pinus albicaulis* is not a SCC because it is addressed as a candidate threatened and endangered species under the ESA. The remaining 5 species, which are known to occur within the planning area, fall within habitat groups that are also associated with the identified plant SCC. This group includes *Carex rostrata, Erigeron lackschewitzii, Juncus hallii, Oxytropis podocarpa,* and *Potentilla nivea var. pentaphylla*. Stressors and effects to these species would be similar to those disclosed for the SCC in their respective habitat guilds.

SCC and Regional Foresters sensitive species found on the HLC NF were placed in one or more of the following guilds:

- Peatlands
- Wetland-riparian
- Alpine
- Grasslands
- Mesic-Montane-Disturbance-Talus
- Aquatic

Benefits to people

Rare plants contribute to diversity on the landscape and recreation opportunities for rare plant enthusiasts. Please refer to the ecosystem services section for more information about multiple uses, key ecosystem services, and benefits to people.

3.10.6 Environmental consequences

Effects common to all alternatives

At the scale of the entire HLC NF, it is difficult to assess the impacts of Plan direction to 31 SCC, 1 candidate species, and 12 RFSS. Plant species may be rare due to evolutionary history, changes in climate, basic population ecology, historic or current human activities, or more likely, a complex combination of these factors. Human activities may or may not be responsible for the current distribution and abundance of the at-risk plant species. An important assumption in this analysis is that certain management actions may contribute or detract from the availability or quality of habitats that support at-risk plant species.

Threatened, endangered, proposed, or candidate species have special management requirements for all FS management activities. The ESA section 7 guidelines and recovery objectives would be followed if potential habitat for any threatened or endangered plant species were to occur on the Forest. For RFSS, policy to ensure the diversity of sensitive plant communities or their habitat are already in place and would continue under the No-action alternative. This policy would not continue under the new 2012 Planning Rule, but current and future policy for SCC would be followed. Known SCC would receive site-specific protection under the 2020 plan components when overlapping with treatments and negative effects would be minimized. RFSS that are not listed also as SCC would not receive protection in these areas under the 2020 Forest Plan. Botany surveys and monitoring would continue to occur with the 2020 Forest Plan components for at-risk species as needed to maintain species viability in the plan area. Management strategies are described in appendix C of the 2020 Forest Plan. Without these components and strategies, it is likely that several at-risk species would decline in the planning area.

In addition, all of the alternatives (including alternative A) retain Montana Statewide riparian area protection and riparian management objectives for habitat conservation areas and a comprehensive set of standards and guidelines related to what kind of activities may or may not occur within the riparian areas. Although they were not specifically designed to do so, many of these standards and guidelines serve as protection measures for rare plants that are associated with aquatic and/or riparian habitats.

Climate change

Anthropogenic caused increases in temperatures and changes in precipitation are likely to impact both ecosystem structure and ecosystem processes (Intergovernmental Panel on Climate Change, 2007). Climate controls many ecosystem processes including species distribution and abundance, regeneration, vegetation productivity and growth, and disturbance all of which could affect at-risk species on the HLC NF. While there is some uncertainty regarding the scale, rate, and direction of future climatic conditions in the western United States and Montana some general observation regarding past changes and expected future changes, the majority of published science suggests that climate changes may strongly influence the frequency, intensity, and size of disturbances (such as fire and extensive insect outbreaks) in coming decades on areas of the HLC NF. Changes in disturbance prompted by climate change are likely as important as incremental changes in temperature and precipitation for affecting ecosystem productivity and species composition. Recent research indicates that these risks may be particularly acute for forests of the Northern Rockies. Conservative future climate scenario models predict that the effects of climate change result in a growing season lengthened, the number of days with snow on the ground decreased, peak snow occurred earlier, and water stress increased for all sites in the study, which represent temperature and precipitation spectrum in the forests of the Rocky Mountain region (Boisvenue & Running, 2010).

All habitat guilds for at-risk species are expected to be impacted by climate change. Peatland, aquatic, wetland-riparian, grasslands, and montane-mesic-disturbance-talus guilds may increase the rate of desiccation due to increased and prolonged summer temperatures and/or drought conditions, although due to uncertainty, the opposite could be true, and all guilds could see an increase in precipitation. Available habitat in the alpine habitat guild for at-risk species may decrease as a result of climate change and an upward shift of lower alpine habitats. Increased fire severity or frequency may also affect all habitat guilds except the aquatic guild, especially those found outside of rocky areas, either favorably or detrimentally depending upon their habitat requirements.

Increases in the severity of disturbances, combined with projected climatic changes, may limit habitat for at-risk species. Rare and uncommon species, disjunct populations and species at the edge of their known range are expected to experience a number of barriers when adjusting to a rapidly changing climate because of the combination of a small number of occurrences, narrow elevation ranges, and requirements of specific soils types. Some at-risk species with potential habitat in project area are known to occur on restricted and/or limited areas within the forest. Plants confined to outcrops of special soils are generally expected to have a far lower chance of successful migration to new suitable sites and thus far greater risks of extinction in the face of climate change, than plants that are soil generalists (Harrison, Damschen, & Going, 2009). Because of the uncertainty in scale, direction, and rate of climate change, management of at-risk species on the HLC NF focuses on maintaining viable populations throughout the species known range in the planning area.

Whitebark pine population trend

The USFWS has concluded that there is an ongoing pattern of substantial decline of whitebark pine on the majority of its range (U.S. Department of the Interior, Fish and Wildlife Service, 2011a). They predict whitebark pine forests may become extirpated and its ecosystem functions rendered obsolete in the foreseeable future. As discussed in the forest plan assessment, analysis at the Regional scale indicates that the abundance of live whitebark pine has decreased. Specifically, on the cold broad PVT, where whitebark pine would be most expected to thrive, the vegetation model (appendix H) predicts that the cover type would increase slightly to be within the desired range; whereas the tree species presence would remain fairly static and just below the desired range. Whitebark pine presence is expected to increase in some GAs, and decrease in others, as influenced by factors such as climate, disturbances, succession, and vegetation management. These expected trends initially appear encouraging and are likely in part due to extent of fire expected to occur on the landscape, however, for the NRV there is a model weakness due to the methodology used to assign cover types (based on relationships with existing VMap dominance types) which may underrepresent whitebark pine in the historic condition. For this reason, and the preponderance of other scientific literature documenting the decline of whitebark pine, the NRV analysis concluded that whitebark pine was likely further below its natural abundance than shown by the modeling. Due to factors discussed in the whitebark pine analysis in the Terrestrial Vegetation section, there are still substantial concerns over the ability of whitebark pine to regenerate and persist in the future with documented declines due to various factors across the Region and in the Plan Area.

The loss of whitebark has dramatically altered the structure, composition and pattern of high-elevation ecosystems, and threatened their long-term stability and integrity. This impacts hydrological processes and wildlife habitat values. Restoration activities are needed to address the threats to whitebark pine (U.S. Department of the Interior, Fish and Wildlife Service, 2011a). The percentage of whitebark that are resistant may increase slowly through the process of natural selection, if 5-needled pines are given a chance to regenerate (Tomback et al., 2001).

The 1986 Forest Plans do not contain specific standards or guidelines related to maintaining whitebark pine. The 2020 Forest Plan components include specific targets for treatments acres of whitebark pine. The 1986 and 2020 Forest Plans have opportunities to restore whitebark pine and are expected to contribute to this species' persistence in the planning area despite the current population trend.

Current stressors in habitat guilds

Peatlands

Threats to peatlands include land uses surrounding fens that can potentially alter the hydrology, water quality or nutrient inputs of these systems, thus changing their underlying processes (i.e. diversion, draining, development, road construction, and heavy grazing). Increased land use within 100 meters has been found to be correlated with increased nutrient levels in peatlands in Montana, suggesting that setbacks should be 100 meters or more for adequate protection (Jones, 2004). Draining, heavy cattle use, and irrigation practices can also alter hydrology and result in the loss of species diversity. Localized peat mining may occur on private lands.

Wetland-riparian

Wetlandand riparian habitats are dependent on consistent moisture to maintain healthy plant communities. Disturbance that is able to disrupt the hydrologic conditions, cause ground disturbance, or change the plant composition in or adjacent to these habitats could result in invasive species infestation, drought, or alteration of the original hydrology or hydric soils that change the habitat to such an extent that at-risk plants are no longer supported by the environments. The management activities that have the potential to disturb soils and vegetation within riparian areas or adjacent to wetlands, include road construction, reconstruction, and maintenance; diversion, draining, and development; livestock use; disturbances/exclusion as they change vegetation conditions in riparian areas and vegetation adjacent to wetlands, invasive plant treatments, recreation use, trails, visitor trampling, and camping in riparian areas.

Alpine

Alpine habitats are often fragile systems due to limited growing season and soil development. Although recreation and road construction are threats to rocky habitats, disturbance is often limited due to inaccessibility. Radio structures, mining, trail construction and recreation and are the main management related disturbance. Changes in fire patterns and severities, and associated effects on vegetation succession may be a stressor in some environments. Grazing has the potential to negatively impact these habitats, but this activity rarely occurs in these habitats due to low forage cover.

Grasslands

Threats to grasslands include fire suppression, agricultural conversion, heavy grazing, noxious species invasion, conifer encroachment, off-trail recreation (e.g. all-terrain vehicles, bicycles) and human development. In the absence of natural fire, periodic prescribed burns and appropriate grazing management practices can be used to maintain this system. The spread of nonnative grasses species has reduced native species diversity in all GAs in the planning area.

Mesic-montane-disturbance-talus

Stressors and ecological processes that influence upland forested habitats apply to all species to varying degrees. These include vegetation treatments (such as logging and prescribed fire), fire disturbances and fire exclusion/suppression, natural succession, cattle grazing, trampling, construction of roads and other developments, mining activities, recreational activities, such as trails, camping and off-road vehicle use, that could disturb or trample plants, and invasive plant species and treatment of infestations.

Aquatic

Stressors to these species would be similar to those associated with fens and wetlands, including changes in hydrology or water quality that might occur either from natural or human caused sources. Threats include alteration of the original hydrology or hydric soils (such as diversion, draining, development, road construction, and heavy grazing). Invasive species also pose a threat to wetland plant communities.

Effects from forest plan components associated with:

Recommended wilderness

The alternatives vary in the quantity and location of RWAs, ranging from none in alternative E, to 16 areas in alternative D. RWAs would protect at-risk plant habitat from ground disturbing threats and development, and these areas would be managed allowing natural fire regimes to contribute to a mosaic of different seral stages and diversity habitats as much as possible. An increase in RWAs decreases threats to at-risk plants overall from ground disturbing activities (i.e. vegetation projects, some motorized/mechanized access) while promoting a naturally managed system that has the potential to improve the mosaic pattern on the landscape for the life of the plan, approximately 15 years. Since the guidelines for RWAs are similar to IRAs, and the bulk of each RWA overlaps with IRAs, the decrease in threats overall are minimal in these areas. Areas proposed as RWAs that were not previously identified as IRA would see a more substantial decrease in threats. See the administratively and congressionally designated areas sections for more details on the management differences between RWAs and IRAs.

All action alternatives would have the same level of ability to achieve desired vegetation conditions within recommended wilderness areas through the use of vegetation treatments within recommended wilderness. All have forest plan direction that allow restoration activities to occur as long as the ecological and social characteristics that provide the basis for wilderness recommendation are maintained and protected. Anticipated vegetation treatment activities would largely be associated with the restoration of high elevation ecosystems, and whitebark pine forest communities in particular. There may be other treatments occurring to achieve restoration objectives outlined in the plan components.

Lands suitable for timber production

Timber harvest is most likely to occur on lands identified as suitable for timber production, though it can occur in other areas. Harvest increases some threats to at-risk species but also can create a mosaic pattern on a landscape and promote early successional stands with some treatments, such as regeneration harvest. Vegetation treatments can also increase forest resiliency by treating insect and disease and reducing fuel loads, improving for health in the long term. Individual occurrences and suitable habitat could be directly impacted in the short term by mechanized equipment and incidental damage from felling trees when species' habitat overlaps with treatment units. Site disturbance and increased weeds could also indirectly negatively impact habitat requirements. Known at-risk species, as defined by the alternative, would receive project level consideration and appropriate mitigation under all alternatives.

Motorized and mechanized means of transportation

Motorized and mechanized means of transportation impact at-risk plant occurrences within road prisms and parking areas and remove habitat in these areas. Vehicles that travel off-road can crush at-risk plant occurrences and compress soil, eliminating habitat along designated travel routes and roads open to motorized use. Reduced suitability of motorized and mechanized means of transportation would correspond to reduced threats to at-risk species. Each alternative would continue to use designated travel plans.

Canada lynx management

All alternatives would retain the Northern Rockies Lynx Management Direction (NRLMD) (U.S. Department of Agriculture, Forest Service, 2007f), which would influence vegetation management and how desired conditions are applied in potential lynx habitat (51% of the HLC NF). Refer to appendix F of the 2020 Forest Plan for the lynx plan components. Although the management constraints are only required in occupied lynx habitat, the NRLMD specifies that its guidance should be considered on all lands. Currently, the Upper Blackfoot, Divide, and Rocky Mountain Range GAs are considered occupied. However, because the guidance would be considered on all lands, and there is potential for occupied habitat to change, this analysis applied the NRLMD across the entire HLC NF for forest planning purposes.

Several of the objectives of the lynx direction complement the at-risk plant plan components, by describing a desired condition to first manage vegetation to approximate natural succession and disturbance processes and second to provide a mosaic of habitat conditions through time. These components would contribute to the maintenance of habitat for at-risk species in the grasslands, wetland-riparian and mesic-montane-disturbance-talus habitat guilds. Standard VEG-S6 may potentially impact the management of terrestrial vegetation and could affect whitebark pine by limiting the opportunity for some restoration activities. Standard VEG S6 does not allow vegetation management that reduces winter snowshoe hare habitat in mature multi-story forests. This habitat condition most commonly develops on the cool moist and cold broad PVTs and overlaps with areas of whitebark pine that are being impacted by competition from other conifer species. VEG S6 does not include an exception for whitebark pine restoration treatments similar to the exception that is listed in VEG-5. An estimated 214,039 acres of mapped whitebark pine overlaps with lynx habitat, which equates to 69% of mapped stands in the planning area. This amount would fluctuate over time, as vegetation conditions are changed by disturbance and succession. Much of this area is located in IRAs, RWAs, or designated wilderness areas where the majority or all of vegetation treatments that could occur would be prescribed fire. VEG S6 would potentially reduce or delay the ability to achieve desired vegetation conditions in some areas. The inability to apply vegetation management in whitebark pine forests where fire exclusion has allowed spruce/fir canopy layers to develop would result in foregoing some whitebark restoration opportunities.

Effects common to all action alternatives

All action alternatives contain 2020 Forest Plan components that explicitly state the desired conditions for each aspect of forest condition, such as vegetation composition, structure, and pattern, livestock grazing, and timber harvest. The components that are likely to have an effect on at-risk plants species habitat guilds are summarized in the following sections. Individual species are not addressed for forestwide plan components – see supplemental botany report in the project file for more information.

Plan components that are relevant to at-risk plants are the same for each action alternative (Table 65). The management direction recognizes the need to maintain or improve occurrences and habitats of plant SCC. Appendix C of the 2020 Forest Plan describes possible strategies for achieving desired conditions and objectives for at-risk plants and provides strategies for gathering data and including additional species that warrant inclusion, such as previous Regional Foresters Sensitive Species. These strategies include evaluating areas proposed for vegetation management activities for the presence of occupied or suitable habitat for at-risk species, focusing botanical surveys on increasing known information about other plant species (such as Montana state species of concern and newly discovered species), and monitoring known occurrences of at-risk species. More details are provided in appendix C of the 2020 Forest Plan.

Table 65. 2020 Forest Plan components for at-risk plant species

At-risk plant plan components	Component language and summary of expected effects for at-risk plants
FW-PLANT-DC-01	This desired condition would maintain or restore at-risk plant species occurrence viability, habitat quality and provide opportunities to reduce threats in habitat guilds.
FW-PLANT-DC-02	This DC would promote rust-resistance populations of whitebark pine in the planning area, which is one of the recommendations by Keane at al (2012).
FW-VEGT-DC-03	This DC would maintain or restore vegetation conditions that support at-risk plant species, which supports species' viability, habitat quality and provides opportunities to reduce threats in all habitat guilds.
FW-PLANT-GO-01	This goal would maintain or restore at-risk plant species occurrence viability, habitat quality and provide opportunities to reduce threats in all habitat guilds.
FW-PLANT-OBJ-01	This objective would improve whitebark pine population viability, habitat quality and reduce threats in all habitat guilds.
FW-PLANT-GDL-01	This GDL reduces threats for at-risk species and provides opportunities for habitat and occurrence restoration by designed project activities to provide for the long-term persistence of at-risk species.

At-risk plant plan components	Component language and summary of expected effects for at-risk plants
SCC	There are unknowns about future SCC policy; RFSS had defined policy but FS handbook policy is not yet available for SCC. A management policy is expected to become available. No nation-wide direction is currently available except the above plan components.

As a result of these plan components, at-risk plant populations in all habitat guilds are expected to be maintained and continue supporting at-risk plant species with opportunities to restore sites if conditions warrant. RFSS that are not currently on the proposed SCC list would no longer be considered at the project level once the 2020 Forest Plan is implemented. The dropped RFSS are expected to be unaffected by project activities due to various reasons (e.g. disturbance tolerance), occur in habitats with either infrequent project activity (e.g. alpine habitat guild) or in sensitive habitats protected by current plan standards (e.g. peatlands, wetland-riparian habitat guilds). The strategies in appendix C of the 2020 Forest Plan include recommended actions to review additional information as it becomes available and gather data during field work. If new pertinent information becomes available indicating a potential threat to loss of viable populations in the planning area these species would be reconsidered, and the SCC list may be adjusted.

The 2020 Forest Plan components include components specific to whitebark pine that are expected to enhance restoration efforts. Due to widespread decline of this species, these plan components focus on restoration of healthy populations for this species. Appendix C of the 2020 Forest Plan describes possible strategies for whitebark pine treatment.

Population viability for SCC is expected to remain stable for all species in the planning area because the plan components would maintain and restore habitat for these species. Habitat quality would improve for whitebark pine under the action alternatives at a faster rate than the no-action alternative, though both provide benefits and support long-term persistence in the planning area. The action alternatives include additional opportunities for restoration activities than the no-action alternative. Habitat quality is expected to improve under these alternatives at a faster rate for all at-risk plant species than the no-action alternative. Threats remain similar between the no-action and action alternatives for at-risk plant plan components.

Effects from forest plan components associated with:

Recommended wilderness

Under all action alternatives vegetation conditions would have the same potential to move towards desired conditions within RWAs through the use of vegetation treatments. All action alternatives include direction that allow restoration activities to occur as long as the ecological and social characteristics that provide the basis for wilderness recommendation are maintained and protected. Anticipated vegetation treatment activities would largely be associated with the restoration of high elevation ecosystems, and whitebark pine forest communities in particular. There may be other treatments occurring to achieve restoration objectives outlined in the plan components. The most likely treatment would be prescribed burning (planned ignition), in some cases followed by limited planting of conifer seedlings. Objectives would include restoration of desired forest structure and compositions, and to restore desired landscape patterns.

Big game plan components

Big game plan components, including one desired condition (FW-FWL-DC-01) and one guideline (FW-FWL-GDL-01) are designed to influence big game distribution to provide big game hunting opportunities on NFS lands during both the archery and rifle hunting seasons. These components would guide managers to provide for security if it is determined to be needed, which could potentially affect one or more actions that could include restricting motorized access, managing hiding cover, adjusting livestock grazing, or other methods. Some vegetation management activities could be constrained in some areas to maintain or provide additional hiding cover. These components are included in B, E, and F and are *not* included in alternatives C and D. A number of at-risk species may occur where habitat is managed to provide for big game security, but no at-risk species are known to specifically rely on the habitat characteristics that provide security. Big game guidelines are not expected to influence sensitive plant populations in the planning area for any alternative.

Habitat connectivity

Habitat connectivity would be improved under four of the action alternatives (alternatives B, C, D, and F) by the prioritization of certain areas of RWA and/or nonmotorized ROS settings which create uninterrupted habitat corridors. These areas would receive minimal disturbance and increase habitat quality for at-risk plants. The focus on habitat connectivity improves the selection of wilderness areas to increase effectiveness of the naturally managed areas to support diverse natural ecosystems.

Aquatic ecosystems

There are four habitat guilds that overlap with aquatic ecosystems. There are threats to at-risk species in aquatic ecosystems, including changes to hydrologic and nutrient alternations. Mechanical vegetation treatments, off-road vehicles, roads and trails, livestock grazing, and catastrophic wildfires are some of the actions that affect the hydrologic regimes or nutrient inputs. At-risk plant species, populations, and communities in these guilds are uniquely adapted to the distribution, diversity, and complexity of landscape-scale features that must be managed at a landscape scale.

The 2020 Forest Plan is more explicit on aquatic ecosystems protections, connectivity in riparian habitats, groundwater-dependent systems, and specifically expands the RMZs east of the Continental Divide beyond state guidelines and best management practices in the 1986 plans. The aquatic ecosystem components address these habitat guilds within the appropriate scale of entire watersheds and subwatersheds. Habitat quality would improve for all at-risk species in the peatlands, wetland-riparian, mesic-montane-disturbance-talus, and aquatic habitat guilds under the plan components in the action alternatives. Threats would be reduced for at-risk plants in these four wetland guilds in the action alternatives. These guilds are expected to be maintained and continue supporting all at-risk plant species that occur in these habitats.

Soil

All habitat guilds depend on soil quality and productivity within their respective habitats. USFS activities that lead to soil compaction or soil contamination with toxic materials have the potential to negatively impact at-risk plant habitat. Some activities that can threaten soil quality include mechanized vegetation treatments, roads and trails, recreation, grazing and off-road vehicles.

All habitat guilds are expected to maintain soil quality and productivity as a result of these plan components, which would contribute to stable at-risk plant populations in the planning area. This plan provides similar protections and guidelines for soil productivity which would support sensitive plant habitats and populations and includes a desired condition that supports biological soil crusts that is not in the no-action alternative. This component is expected to provide additional protection for bryophytes, lichens, and other flora that could exist in the planning area on dry habitats. Habitat quality would improve for all habitat guilds in the action alternatives. Threats would remain similar to the no-action alternative.

Fire and fuels management

All alternatives use fire as a tool to accomplish management goals and objectives. The objectives for fuel reduction are usually complementary to the other desired vegetation conditions, including those beneficial to at-risk species, and especially as related to forest resiliency. There are several factors that are important to consider with regard to at-risk plants. One factor that is important to some plant species is the timing and placement of prescribed burns. For example, the use of prescribed fire in the spring has potential to impact some species that are not adapted to fire at this time of year and spring burning can interfere with flowering, fruiting, pollinator availability, and other physiological impacts. Other at-risk species benefit from spring burning events due to the limited litter build-up that reduces fire intensity and increases survival over fall burns when species have more acumulated litter. Consideration of at-risk species during the planning process of prescribed burns is expected to ensure that the timing and placement of prescribed burns is used to maintain at-risk plant populations as much as possible. The RFSS not included as SCC, and therefore not receiving project level consideration prior to burn treatments, are not considered to be at risk of negative impact due to fire activity due to their alpine or wetland habitat or positive response to fire.

Another factor is the risk of high intensity wildfire as a result of high fuels. The current condition is overall a high risk of high intensity burns in many areas within the planning area due to high fuels load, which has resulted from various causes, such as fire suppression and the recent outbreak of bark beetle infestation. Many species tolerate, and in fact require, frequent fire to maintain populations on the landscape. Fire has historically been more frequent in many areas with varied fire intensity in the Plan Area, depending on vegetation type. Though within the NRV, stand-replacing fires have the potential to kill at-risk plants and reduce or eliminate seed banks, making reestablishment difficult or even impossible without additional seed sources brought in. When these types of fires occur at an above average frequency there is higher risk of impacts to plant species that occur infrequently on the landscape, such as at-risk plants. Some species may not be able to recolonize an area if there is no available seed source in the area. Without some prescribed fire introduced to mitigate the threat of high intensity fire, at-risk species populations are susceptible to being eliminated in areas of the landscape in all habitat guilds.

A third factor to consider is that some at-risk species require regular fire to maintain early successional conditions that supports known occurrences. This includes species in the wetland-riparian, grassland, mesic-montane-disturbance-talus guilds, and could potentially incorporate additional habitat guilds in the future depending on species specific requirements, which can change depending on new best available scientific information and adjustments to the SCC list. These species require fire, typically low intensity fire to maintain sensitive habitats. The lack of fire has reduced the amount of available habitat. In general, most native plant species would benefit by the restoration of more historical fire regimes. For those at-risk plants that thrive in open areas created by fires, using fire to help restore a more natural fire regime could benefit those species in the long-term. There are also impacts to plants associated with wildfire suppression activities, such as fire line construction and other mechanical activities, reforestation following fire, and the increased potential for the spread of noxious weeds.

Sensitive plants have various reactions to fire. As a result of these plan components, all habitat guilds are expected to be maintained and continue supporting at-risk plant species, including the species that are currently on the RFSS list but that would not be specifically protected as a SCC once the new plan is implemented. Analysis prior to implementation would omit populations and habitat that could be detrimentally impacted to the extent feasible, and overall habitats on the HLC NF benefit from fire occurring on the landscape similar to historic fire regime conditions. Emphasis in the new plan to allow natural fire to function in its ecological role would likely benefit native plant species as a whole, with few exceptions. This would contribute in the long-term to stability of at-risk plant populations in the planning area, though increased short-term risk would likely occur. Habitat quality would improve for all at-risk species habitat guilds that require frequent fire to maintain desired seral stage under the plan components in the action alternatives by allowing natural fire to play a larger role in the planning area. Threats currently exist from large, high intensity fire and also from fire suppression tactics. The minimum impact strategy for fire suppression in some locations would reduce threats to at-risk plant species in those habitats. Threats from suppression in locations where minimum impact strategies are not used and threats from catastrophic fire events would remain.

Terrestrial vegetation

All habitat guilds are impacted and supported by the action alternative vegetation desired conditions. Broadly, the desired conditions for terrestrial vegetation on the HLC NF are characterized by increases in large trees and large forest size classes; more open forest densities; vigorous nonforested plant communities; increasing early-seral shade tolerant species; and maintaining the full suite of native biodiversity on the landscape. More information is available in the terrestrial vegetation section. The desired conditions are consistent with our understanding of the NRV and are most likely to be resilient in the future given expected drivers such as climate change, drought, vegetation succession, wildfire, insects and disease, and the demands of people. Desired conditions for vegetation support native species and habitats within their NRV, including at-risk species.

These vegetation plan components are expected to maintain and continue supporting known poppulations and habitat for at-risk plant species in the planning area. Habitat quality would improve for at-risk species in all habitat guilds under the plan components in the action alternatives. Threats would remain similar for at-risk plants in regard to vegetation plan components.

Invasive species

Invasive species have a major impact on at-risk species in the planning area. Introduced, invasive plant species can displace at-risk species through competitive displacement. Potential impacts from treatments include incidental misapplied herbicide spraying and damaged plants due to mechanical ground disturbance to control noxious weeds once they gain a foothold. Competition from invasive plant species and noxious weeds can result in the loss of habitat, loss of native pollinators, and decreased at-risk plant species viability. Roads, trails, livestock, and canopy reduction can provide ideal pathways for the introduction of exotic and nonnative species.

As a result of invasive species plan components, all habitat guilds are expected to benefit from the reduction of invasive species, particularly the wetland-riparian, grasslands, and mesic-montane-disturbance-talus guilds. This would contribute to stable at-risk plant populations in the planning area. The 2020 Forest Plan provides similar protections and guidelines for invasive species treatment as the 1986 Forest Plans; however additional plan components specify treatment of weeds in at-risk plant habitats. This is expected to increase the opportunities for at-risk plant restoration in the planning area. Habitat quality would improve for all habitat guilds in the action alternatives. Threats would remain similar in the no-action alternative. The 2020 Forest Plan includes language specifically to emphasize appropriate treatments within populations of at-risk plant species and would likely provide additional protection to sensitive native plant populations when compared to the two older plans. Habitat quality would improve for at-risk species in all habitat guilds under the plan components in the action alternatives. Threats would be reduced for at-risk plants by the action alternatives plan components for invasive species.

Recreation, designated areas, and infrastructure

Recreation activity has the potential to impact at-risk plants and habitat. Roads, trails, and developed recreation facilities contribute to plant impacts, as these developments make more areas accessible and concentrate use. Dispersed camping and recreation have similar impacts, which are more difficult to monitor. Parking areas, particularly undesignated areas, pose similar impacts to plants. In addition, there can be long-term impacts of bisecting at-risk plant populations with a road or similar feature and affecting the reproduction and/or plant dispersal. Other recreational impacts include off-road vehicle use, which can also disturb soil, affecting both habitat and potential habitat. Roads and trails can contribute to the spread of noxious weeds and increase the accessibility of areas to livestock as well as native ungulates, which in turn can increase the impacts of trampling, herbivory, and congregation. Transportation infrastructure can increase the amount of the planning area that is available for restoration, fire or timber treatments.

Designated areas include wilderness, wilderness study areas, wild and scenic rivers, and research natural areas. These areas are managed in a way to allow ecological processes and disturbance to play a larger role in ecological composition, structure and vegetation. Many activities that are suitable in other portions of the plan area are not suitable in these designated areas, such as motorized and mechanized means of transportation, timber production and timber harvest, new commercial communication sites and new utility corridors, road construction or reconstruction, new developed recreation sites and/or facilities or new or expanded livestock grazing allotments. Wilderness areas have far fewer activities that can negatively impact at-risk plant species. The alternatives vary in the acreage proposed for wilderness, but each alternative has the same rules applicable to wilderness areas. All habitat guilds occur in wilderness areas and benefit from the reduced threats due to wilderness guidelines. There are fewer opportunities for restoration in wilderness areas and some species, notably whitebark pine, would potentially be negatively impacted in areas where restoration is limited.

Restoration activities (such as management ignited fires, active weed management) may be used in recommended wilderness areas to protect and/or enhance the wilderness characteristics of these areas and motorized and mechanized equipment (such as chain saws to clear trails) may be used to accomplish restoration activities or to accomplish administrative work. Wilderness study areas, wild and scenic river corridors, and research natural areas have similar guidelines that limit project activity and human influence on the landscape, thereby protecting at-risk plant population from impacts. Whitebark pine is expected to benefit from these guidelines by reduced threats from project activities not associated with restoration, and habitat quality improvements from fire and other restoration activities.

The plan components for recreation, designated areas, and infrastructure are expected to contribute to the maintenance of viable at-risk populations in the planning areas by including additional ecosystem protections associated with recreation opportunities. Threats are reduced for at-risk species in all habitat guilds by multiple plan components. Aquatic guilds are protected from recreational related damages by other components, reducing risk for species that occur in with these habitats. There is additional resource protection language and components allowing restoration activities to be completed in wilderness areas. Wilderness areas and WSRs are still protected under national guidance and similar land management direction would continue from the 1986 Forest Plans. Habitat quality would remain similar between the action and no-action alternatives for at-risk species in all habitat guilds under the recreation plan components. Threats would be reduced for at-risk plants by the action alternatives plan components for recreation.

Livestock grazing

Livestock grazing has the potential to greatly impact riparian habitats and at-risk plant habitat, particularly when habitat is over-grazed. All habitat guilds except alpine have the potential to be impacted by livestock grazing, which can cause hydrologic conditions to change, trampling to individual species, and habitat degradation through invasive species introduction. The 2020 Forest Plan components include adaptive management and native vegetation protections to manage for sustainable rangelands in the land area.

As a result of these plan components, grasslands, peatlands, wetland-riparian, aquatic and mesic-montane-disturbance-talus habitat guilds are expected to be maintained and to continue supporting at-risk plant species in livestock allotment. There would be opportunities in the future to restore habitats that have become degraded over time. The language in the 2020 Forest Plan is more explicit than the 1986 Forest Plans, but management direction to preserve habitat quality is generally similar. Habitat quality would improve with the action alternatives for at-risk species in all habitat guilds under the livestock grazing plan components due to increased monitoring and active management. Threats would be reduced for at-risk plants by the action alternatives plan components for livestock grazing.

Timber

The alternatives have varying amounts of land suitable for timber production, but the impact of timber plan components on at-risk species is consistent between action alternatives. All habitat guilds can be impacted by timber production, even if habitats guilds, such as aquatic, alpine or grassland, are not directly harvested for timber. Mechanical activities include vegetation management treatments, whether for restoration or to meet timber production objectives. Activities, such as logging, can have impacts to plants and plant habitat through canopy removal, soil disturbance and erosion, and stream sedimentation. In addition, mechanical activities for vegetation treatment may require road building. Roads increase access to sensitive habitats and can fragment habitat, thus, providing an avenue for invasive plant species. Reconstruction and maintenance of designated roads can directly or indirectly affect plant populations by introducing competitive weeds and altering availability of light, nutrients, and moisture. Sudden changes in seral stage, or an abundance of early seral stages, also reduce the available habitats for those plants that require mid-to-late seral stages. However, those species that prefer openings, early-seral stages, or some ground disturbance, could benefit from moderate levels of mechanical activities. The restoration of historical fire regimes and conditions within the NRV (with a range of seral stages for different potential vegetation groups) may benefit some at-risk species in the long-term.

As a result of these plan components, at-risk species and their respective habitats would be considered during vegetation projects and grasslands, peatlands, wetland-riparian, aquatic and mesic-montane-disturbance-talus habitat guilds are expected to be maintained and continue supporting at-risk plant species despite the potential for impacts in areas used for timber production. The 2020 Forest Plan is more explicit regarding resource protections, though similar guidelines applied under the 1986 Forest plans. Habitat quality would remain similar between the no-action and action alternatives for at-risk species in all habitat guilds under the timber plan components. Threats would be reduced for at-risk plants by the action alternatives plan components by including additional language to protect sensitive habitats. The RFSS not included as SCC and therefore not receiving project level consideration prior to timber treatments, are not considered to be at high risk of negative impact due to timber activity due to their remote habitat or disturbance tolerance.

Alternative A, no action

Effects from forest plan management direction

The no-action alternative is represented by the designated 1986 Forest Plans, as amended. Law and regulation that have been adopted since the 1986 plans would be analyzed as part of the No-action alternative (for example, the designation of IRAs). The 1986 Forest Plans were developed over 30 years ago under a different planning rule and paradigm, a direct comparison to the 2020 Forest Plan is difficult. The plan content in the 1986 Forest Plans relevant to at-risk plants are summarized in Table 66.

Table 66. Helena NF and Lewis and Clark NF 1986 plants at risk plants plan components

Resource	Lewis and Clark NF forestwide standards	Helena NF forestwide standards
Threatened and Endangered Plants	• Standard C-2 (1): Comply with law, regulation, and policy regarding threatened and endangered. • Standard C-2 (2): This evaluation would determine whether or not informal or formal consultation with the USFWS on T&E species is appropriate.	The Forest Plan refers to Section 7 of the ESA
Sensitive Plants	• Standard C-2 (2): Conduct a biological evaluation for each Forest prohect or activity which would determine whether or not informal or formal consultation with the USFWS on T&E species is appropriate.	Species of Special Concern Eight Species of Concern are identified. There are habitats on the Forest where these species of special concern may be found. If any of these species are verified on the Helena Forest, appropriate

Resource	Lewis and Clark NF forestwide standards	Helena NF forestwide standards
	• Standard C-2 (3): Identify and evaluate cumulative effects as part of each biological evaluation. This evaluation may result in specific management recommendations in addition to those above. • Standard C-2 (13): Assessments of suitable habitats for sensitive plants would be conducted before surface disturbing activities are permitted.	measures, pursuant to Section 7 of the Endanger(ed) Species Act, would be taken.

The FS manual 2670 and ESA policy is followed under both plans. No threatened and endangered species are currently known to occur in the planning area. The combination of FS handbook policy for RFSS and the existing two plans provide protections that are similar to the 2020 Forest Plan's components. The 1986 Forest Plans differ from each other and the 2020 Forest Plan: the Helena NF Plan calls out species of special of concern that warrented inclusion based on 1986 data, but are not necessarily included in the current RFSS lists based on current BASI and the HNF plan relies on FS handbook policy to support RFSS plant species in the planning area; the Lewis and Clark NF plan included direction in a 1995 amendment with explicit direction for sensitive species that repeats FSM direction.

The separate 1986 Helena and the Lewis and Clark Forest Plan standards have led to the current condition of the affected environment for sensitive plants. These plans have specifically called out at-risk species in several cases; northern rattle snake plantain (*Goodyera repens*) in the minerals section of the Lewis and Clark NF Plan, and the sensitive species listed in the threatened and endangered species section in the Helena NF Plan, though additional information has removed several of the Helena Plan species from protected status. Whitebark pine is not specifically mentioned. These plans would ensure that at-risk species persist in the planning area. These plans have fewer opportunities for restoration and less of a focus on native vegetation improvements than the new plan components.

Population viability is expected to remain stable for all at-risk species in the planning area with these plan components. Habitat quality has the potential to improve, however there are fewer plan components promoting restoration and there are inconsistencies between the two forest plans. The no-action alternative is expected to maintain similar habitat quality for at-risk plant species in all habitat guilds. Threats would remain similar to current conditions for at-risk plants.

Effects of plan components associated with:

Recommended wilderness areas

There are 34,211 acres proposed as RWAs under this alternative. Mechanized means of transportation and limited motorized uses are suitable in RWAs. Undeveloped areas are provided by designated wilderness, IRAs, and RNAs. Designated wilderness does not change between alternatives; however, this analysis considers all occurrences for each species that are within either designated or recommended wilderness to assess and quantify what percentage of occurrences occur in areas with reduced threats and the relative value of including more in recommended wilderness. Frequently, occurrences that are known within RWAs currently overlap with IRAs. Threats only minimally decrease in these areas; threats decrease to a greater degree in areas that were not previously designated as IRAs.

There are 14 at-risk species with known occurrences in designated or RWAs. There are 119 at-risk plant occurrences in designated wilderness areas and 7 additional at-risk plant occurrences in RWAs. The RWAs include suitable habitat in all habitat guilds. The at-risk species that have known occurrences within the RWAs include *Astragalus convallarius, Botrychium spp*, *Delphinium bicolor ssp. calcicola, Juncus hallii, Phlox kelseyi var. missoulensis* and *Polygonum austiniae.* There are 4,560 acres of whitebark pine within RWAs in this alternative, approximately 1% and 65,588 acres of whitebark pine is outside of the management-limiting conditions of wilderness, RWA, and lynx habitat under this alternative. More suitable habitat for these species, and additional species, are present under the RWAs under alternatives B, C, D and F and less suitable habitat under Alternative E.

SCC that are not currently designated as RFSS that have known occurrences in designated wilderness or RWAs include *Astragalus convallarius, Braya humilis, Castilleja kerryana, Delphinium bicolor ssp. calcicola* and *Ranunculus pedatifidus.* Threats to at-risk species and habitats in RWAs are would remain consistent with the 1986 Forest Plans and there would be no additional protections (e.g. permissible restoration activity, limited access to motorized vehicles) for at-risk plant occurrences. SCC that are not also RFSS would not be considered during project activities. Habitat quality and threats would remain consistent with 1986 Forest Plans.

Land suitable for timber production and habitat connectivity

There are 414,936 acres suitable for timber production in the 1986 Forest Plans. The emphasis on timber production in these areas increases threats to at-risk species from timber related activity. Some remaining acres are unsuitable for timber production where harvest may occur for other reasons, but these areas do not have a management emphasis on timber production and are therefore not considered in as much detail. These areas would be subject to the plan components listed above, and since there is no specific emphasis on timber production, these areas were not considered separately in this analysis. There are 225 known sensitive plant populations in areas suitable for timber production. This number is inflated due to the greater number of surveys that occur in project areas, such as vegetation projects. There is suitable habitat for at-risk species outside of lands suitable for timber production.

Species that do not occur in lands suitable for timber production include *Amerorchis rotundifolia, Astragalus convallarius, Astragalus lackschewitzii, Botrychium ascendens, Botrychium crenulatum, Braya humilis, Castilleja kerryana, Cypripedium parviflorum, C. passerinum, Delphinium bicolor ssp calcicola, Drosera anglica, D. linearis, Epipactis gigantea, Erigeron flabellifolius, E. lackschewitzii, Gentianopsis macounii, Oxytropis podocarpa, Potamogeton obtusifolius, Potentilla nivea var pentaphylla, Ranunculus pedatifidus, Schoenoplectus subterminalis, Scorpidium scorpioides* and *Sphagnum fimbriatum.* These species populations and suitable habitat may still occur within forest projects, including vegetation projects, and subject to potential direct and indirect effects.

That at-risk species that overlap with lands suitable for timber production are *Adoxa moschatellina, Aquilegia brevistyla, Botrychium paradoxum, Carex rostrata, Draba densifolia, Eleocharis rostellata, Elymus innovatus, Goodyera repens, Grindelia howellii, Juncus hallii, Lycopodium dendroideum, Phlox kelseyi var. missoulensis, Pinus albicaulis, Polygonum austiniae* and *Stipa lettermanii*. The RFSS species would be protected by the 2670 FSM guidelines and current forest standards during vegetation project work to prevent listing, as listed above. SCC not included on the current 2011 RFSS list would not be considered during project activities under this alternative and protective mitigations might not occur for *Draba densifolia* and *Stipa lettermanii*.

Alternatives B and C

Effects of forest plan components associated with:

Recommended wilderness areas

These alternatives recommend nine RWAs totaling 213,170 acres. Mechanized means of transportation and limited motorized uses would not be suitable in RWAs under Alternative B, would be suitable under Alternative C.

There are 20 at-risk species with known populations in designated or RWAs. There are 119 occurrences in designated wilderness areas and 26 additional at-risk plant occurrences in RWAs. The RWAs include suitable habitat in all habitat guilds. The species with known occurrences within the recommended wilderness under this alternative includes *Astragalus convallarius, Botrychium spp*, *Braya humilis,* *Delphinium bicolor ssp. calcicola, Draba densifolia, Drosera anglica and D. linearis, Goodyera repens, Juncus hallii, Phlox kelseyi var. missoulensis, Polygonum austiniae* and *Schoenoplectus subterminalis*. More suitable habitat for these species, and additional species, are present under the RWAs under alternative D while less is available is available under Alternatives E and F.

RFSS that would not be carried forward as species of conservation concern that have known occurrences in designated wilderness or RWAs includes *Botrychium ascendens, Carex rostrata, Erigeron lackschewitzii, Juncus hallii* and *Oxytropis podocarpa*. Habitat for *Erigeron lackschewitzii* and *Oxytropis podocarpa* occurs almost entirely within wilderness with relatively few known threats to existing occurrences. Threats to at-risk species and habitats in RWAs are reduced due to the reduction of ground disturbing activities, restriction of the suitability of motorized and mechanized means of transporation in some cases, and the authorization of restoration activities. There are 29,801 acres of whitebark pine is within RWA in this alternative, approximately 9% and 54,673 acres of whitebark pine is outside of the management-limiting conditions of wilderness, RWA, and lynx habitat under this alternative.

Land suitable for timber production and habitat connectivity

There are 356,633 acres of land suitable for timber production in these alternatives. Habitat connectivity was addressed as several areas identified as being narrow fragments of remaining connectivity in the Upper Blackfoot GA were excluded from lands identified as suitable for timber production. Some harvest may occur in these areas for purposes other than timber production, where consistent with other plan components. Some remaining acres are unsuitable for timber production where harvest may occur for other reasons. These areas would be subject to the plan components listed above, and since there is no specific emphasis on timber production, these areas were not considered separately in this analysis. There are 171 known at-risk plant populations in areas suitable for timber. This number is inflated due to the greater number of surveys that occur in project areas, such as vegetation projects. There is suitable habitat for at-risk species outside of lands suitable for timber production.

Species that do not occur in lands suitable for timber production under these alternatives include *Amerorchis rotundifolia, Astragalus lackschewitzii, Botrychium crenulatum, Braya humilis, Castilleja kerryana, Cypripedium passerinum, C. parviflorum, Delphinium bicolor ssp. calcicola, Drosera anglica, D. linearis, Epipactis gigantea, Erigeron flabellifolius, E. lackschewitzii, Gentianopsis macounii, Oxytropis podocarpa, Potamogeton obtusifolius, Ranunculus pedatifidus, Schoenoplectus subterminalis, Scorpidium scorpioides,* and *Stipa lettermanii.* These species populations and suitable habitat may still occur within forest projects, including vegetation projects, and subject to potential direct and indirect effects.

The species that occur on lands suitable for timber production includes SCC *Adoxa moschatellina, Aquilegia brevistyla, Astragalus convallarius, Botrychium paradoxum, Draba densifolia, Eleocharis rostellata, Elymus innovatus, Erigeron flabellifolius, Goodyera repens, Grindelia howellii, Lycopodium dendroideum, Phlox kelseyi var. missoulensis, Pinus albicaulis, Polygonum austiniae* and *Stipa lettermanii* and RFSS *Carex rostrata* and *Juncus hallii.* The SCC species would be protected by the 2020 Forest Plan components during vegetation project activities. RFSS not included on the SCC list would not be protected under this alternative. Both of the RFSS not included as SCC occur within wetland habitats and would be excluded from units by habitat association, therefore the overlap with lands suitable for timber production is not expected to negatively impact these species.

Alternative D

Effects of forest plan components associated with:

Recommended wilderness areas

There are sixteen RWAs totaling 474,657 acres. These include the nine from the alternatives B and C, plus seven additional areas. Motorized and mechanized means of transportation would no longer be suitable in RWAs.

There are 24 at-risk species with known populations in designated or RWAs. There are 119 plant occurrences in designated wilderness areas and 87 additional at-risk plant occurrences in RWAs. The species with known occurrences within the RWAs includes *Aquilegia brevistyla, Astragalus convallarius, Botrychium spp*, *Braya humilis, Delphinium bicolor ssp. calcicola, Draba densifolia, Drosera anglica and D. linearis, Elymus innovatus, Erigeron flabellifolius, Goodyera repens, Juncus hallii, Phlox kelseyi var. missoulensis, Polygonum austiniae, Schoenoplectus subterminalis* and *Stipa lettermanii.* The additional RWAs include suitable habitat in all habitat guilds. This alternative includes additional suitable habitat and a greater number of at-risk species than all other alternatives. More suitable habitat for these species, and additional species, are present under the RWAs under alternative D.

RFSS that would not be carried forward as species of conservation concern that have known occurrences in designated wilderness or RWAs includes *Botrychium ascendens, Carex rostrata, Erigeron lackschewitzii, Juncus hallii* and *Oxytropis podocarpa*. Habitat for *Erigeron lackschewitzii* and O*xytropis podocarpa* occurs almost entirely within wilderness with relatively few known threats to existing occurrences. Threats to at-risk species and habitats in RWAs are reduced due to the reduction of ground disturbing activities, restriction of the suitability of motorized and mechanized means of transportation in some cases, and the authorization of restoration activities. There are 58,661 acres of whitebark pine is within RWA in this alternative, approximately 19% and 50,301 acres of whitebark pine is outside of the management-limiting conditions of wilderness, RWA, and lynx habitat under this alternative.

Land suitable for timber production and habitat connectivity

There are 348,585 acres suitable for timber production in this alternative. Habitat connectivity was addressed as additional recommended wilderness, and primitive and semi-primitive nonmotorized ROS areas. Some remaining acres are unsuitable for timber production where harvest may occur for other reasons. These areas would be subject to the plan components listed above, and since there is no specific emphasis on timber production, these areas were not considered separately in this analysis. There are 171 known at-risk plant populations in areas suitable for timber. This number is inflated due to the greater number of surveys that occur in project areas, such as vegetation projects. There is suitable habitat for at-risk species outside of lands suitable for timber production.

Species that do not occur in lands suitable for timber production include *Amerorchis rotundifolia, Astragalus convallarius, Astragalus lackschewitzii, Botrychium crenulatum, Braya humilis, Castilleja kerryana, Cypripedium passerinum, C. parviflorum, Delphinium bicolor ssp calcicola, Drosera anglica, D. linearis, Epipactis gigantea, Erigeron flabellifolius, E. lackschewitzii, Gentianopsis macounii, Oxytropis podocarpa, Potentilla nvea var pentaphylla, Ranunculus pedatifidus, Schoenoplectus subterminalis, Scorpidium scorpioides,* and *Stipa lettermanii.* These species populations and suitable habitat may still occur within forest projects, including vegetation projects, and subject to potential direct and indirect effects.

The species that occur on lands suitable for timber production includes SCC *Adoxa moschatellina*, *Aquilegia brevistyla, Astragalus convallarius, Botrychium paradoxum, Draba densifolia, Eleocharis rostellata, Elymus innovatus, Erigeron flabellifolius, Goodyera repens, Grindelia howellii, Lycopodium dendroideum, Phlox kelseyi var. missoulensis, Pinus albicaulis, Polygonum austiniae* and *Stipa lettermanii* and RFSS *Carex rostrata* and *Juncus hallii*. The SCC species would be protected by the 2020

Forest Plan components during vegetation project activities. RFSS not included on the SCC list would not be protected under this alternative. Both of the RFSS not included as SCC occur within wetland habitats and would be excluded from units by habitat association, therefore the overlap with lands suitable for timber production is not expected to negatively impact these species.

Alternative E

Effects of forest plan components associated with:

Recommended wilderness areas

There are no RWAs in this alternative. There are 10 at-risk species with known populations in designated wilderness. There are 119 plant populations in designated wilderness areas. More at-risk plant occurrences and suitable habitat for these species are present under the RWAs under alternatives A, B, C, D and F. No acres of whitebark pine is within RWA in this alternative and 66,454 acres of whitebark pine is outside of the management-limiting conditions of wilderness, RWA, and lynx habitat under this alternative.

RFSS that would not be carried forward as species of conservation concern that have known occurrences in designated wilderness or RWAs includes *Botrychium ascendens, Carex rostrata, Erigeron lackschewitzii* and *Oxytropis podocarpa.* Habitat for *Erigeron lackschewitzii* and *Oxytropis podocarpa* occurs almost entirely within wilderness with relatively few known threats to existing occurrences. Threats to at-risk species and habitats in RWAs are reduced due to the reduction of ground disturbing activities, restriction of the suitability of motorized and mechanized means of transportation in some cases, and the authorization of restoration activities.

Land suitable for timber production and habitat connectivity

There are 384,199 acres suitable for timber production. Habitat connectivity was not addressed as a part of this alternative. Some remaining acres are unsuitable for timber production where harvest may occur for other reasons. These areas would be subject to the plan components listed above, and since there is no specific emphasis on timber production, these areas were not considered separately in this analysis. There are 175 known sensitive plant populations in areas suitable for timber. This number is inflated due to the greater number of surveys that occur in project areas, such as vegetation projects. There is suitable habitat for at-risk species outside of lands suitable for timber production.

Species that do not occur in suitable timber include *Amerorchis rotundifolia, Astragalus lackschewitzii, Botrychium crenulatum, Braya humilis, Castilleja kerryana, Cypripedium parviflorum, C. passerinum, Delphinium bicolor ssp calcicola, Drosera anglica, D. linearis, Epipactis gigantea, E. lackschewitzii, Gentianopsis macounii, Oxytropis podocarpa, Potamogeton obtusifolius, Potentilla nivea var pentaphylla, Ranunculus pedatifidus, Schoenoplectus subterminalis, Scorpidium scorpioides* and *Sphagnum fimbriatum.* These species populations and suitable habitat may still occur within forest projects, including vegetation projects, and subject to potential direct and indirect effects.

The species that occur on lands suitable for timber production includes SCC *Adoxa moschatellina, Aquilegia brevistyla, Astragalus convallarius, Botrychium paradoxum, Draba densifolia, Eleocharis rostellata, Elymus innovatus, Erigeron flabellifolius, Goodyera repens, Grindelia howellii, Lycopodium dendroideum, Phlox kelseyi var. missoulensis, Pinus albicaulis, Polygonum austiniae and Stipa lettermanii* and RFSS *Carex rostrata* and *Juncus hallii*. The SCC species would be protected by the 2020 Forest Plan components during vegetation project activities. RFSS not included on the SCC list would not be protected under this alternative. Both of the RFSS not included as SCC occur within wetland habitats and would be excluded from units by habitat association, therefore the overlap with lands suitable for timber production is not expected to negatively impact these species.

Alternative F

Effects of forest plan components associated with:

Recommended wilderness areas

This is the preferred alternative and it recommends seven RWAs totaling 153,325 acres. Motorized and mechanized use would no longer be suitable in RWAs.

There are 20 at-risk species with known populations in designated or RWAs. There are 119 occurrences in designated wilderness areas and 21 additional at-risk plant occurrences in RWAs. The RWAs include suitable habitat in all habitat guilds. The species with known occurrences within the recommended wilderness under this alternative includes *Astragalus lackschewitzii, Botrychium spp, Braya humilis, Delphinium bicolor ssp. calcicola, Draba densifolia, Drosera anglica, D. linearis, Goodyera repens, Juncus hallii, Phlox kelseyi var. missoulensis, Polygonum austiniae* and *Schoenoplectus subterminalis.* More suitable habitat for these species, and additional species, are present under the RWAs under Alternatives B, C and D while less is available is available under Alternative E.

RFSS that would not be carried forward as species of conservation concern that have known occurrences in designated wilderness or RWAs includes *Botrychium ascendens, Carex rostrata, Erigeron lackschewitzii, Juncus hallii* and *Oxytropis podocarpa*. Habitat for *Erigeron lackschewitzii* and *Oxytropis podocarpa* occurs almost entirely within wilderness with relatively few known threats to existing occurrences. Threats to at-risk species and habitats in RWAs are reduced due to the reduction of ground disturbing activities, restriction of suitability of motorized and mechanized means of transportation in some cases, and the authorization of restoration activities. There are 22,946 acres of whitebark pine is within RWA in this alternative, approximately 7% and 57,731 acres of whitebark pine is outside of the management-limiting conditions of wilderness, RWA, and lynx habitat under this alternative.

Land suitable for timber production and habitat connectivity

There are 368,814 acres of land suitable for timber production in this alternative. Some harvest may occur in other areas for purposes other than timber production, where consistent with other plan components. These areas would be subject to the plan components listed above, and since there is no specific emphasis on timber production, these areas were not considered separately in this analysis. There are 172 known sensitive plant occurrences in areas suitable for timber. This number is inflated due to the greater number of surveys that occur in project areas, such as vegetation projects. There is suitable habitat for at-risk species outside of lands suitable for timber production.

Species that do not occur in suitable timber include *Amerorchis rotundifolia, Astragalus lackschewitzii, Botrychium crenulatum, Braya humilis, Castilleja kerryana, Cypripedium parviflorum, C. passerinum, Delphinium bicolor ssp calcicola, Drosera anglica, D. linearis, Epipactis gigantea, E. lackschewitzii, Gentianopsis macounii, Oxytropis podocarpa, Potamogeton obtusifolius, Potentilla nivea var pentaphylla, Ranunculus pedatifidus, Schoenoplectus subterminalis, Scorpidium scorpioides* and *Sphagnum fimbriatum.* These species populations and suitable habitat may still occur within forest projects, including vegetation projects, and subject to potential direct and indirect effects.

The species that occur on lands suitable for timber production includes SCC *Adoxa moschatellina, Aquilegia brevistyla, Astragalus convallarius, Botrychium paradoxum, Draba densifolia, Eleocharis rostellata, Elymus innovatus, Erigeron flabellifolius, Goodyera repens, Grindelia howellii, Lycopodium dendroideum, Phlox kelseyi var. missoulensis, Pinus albicaulis, Polygonum austiniae and Stipa lettermanii* and RFSS *Carex rostrata* and *Juncus hallii*. The SCC species would be protected by the 2020 Forest Plan components during vegetation project activities. RFSS not included on the SCC list would not be protected under this alternative. Both of the RFSS not included as SCC occur within wetland habitats and would be excluded from units by habitat association, therefore the overlap with lands suitable for timber production is not expected to negatively impact these species.

Cumulative effects

Increasing human populations

Additional stressors that may increase in the future are increasing population levels, both locally and nationally, with resulting increasing demands and pressures on public lands. At present, local populations are increasing in the counties on the west side of the planning area but are declining or stable in other areas. As related to forest and vegetation conditions, these changes may lead to increased demands for commercial and noncommercial forest products, elevated importance of public lands in providing for habitat needs of wildlife species, and changing societal desires related to the mix of uses public lands should provide. The plan components are adequate to support viable at-risk plant populations and habitat in the planning area as human populations and demands increase. Activities known to be threats to at-risk plant habitat guilds as described in the effects common to all alternatives section above that occur or originate on other ownership land can impact populations and habitat in the planning area.

Adjacent lands and other management plans

Portions of the HLC NF adjoin other NFs, each having its own forest plan. The HLC NF is also intermixed with lands of other ownerships, including private lands, other federal lands, and state lands. Some adjacent lands are subject to their own resource management plans. The cumulative effects of these plans in conjunction with the HLC NF 2020 Forest Plan are summarized in Table 67, for those plans applicable to at-risk plants. Activities known to be threats to at-risk plant habitat guilds as described in the effects common to all alternatives section above that occur or originate on other ownership land can impact populations and habitat in the planning area.

Table 67. Cumulative effects to at-risk plant species from other resource management plans

Resource plan	Description and summary of effects
Adjacent National Forest Plans	The forest plans for NFS lands adjacent to the HLC NF include the Custer-Gallatin, Lolo, Flathead, and Beaverhead-Deerlodge NFs. All plans address at-risk plant species. Generally speaking, management of vegetation is consistent across all NFs due to law, regulation, and policy. The cumulative effect would be that the management of at-risk plants and habitats would be relatively consistent and provide adequate protection to prevent species from decline. This includes specific adjacent landscapes that cross Forest boundaries, such as the Upper Blackfoot, Divide, Elkhorns, Crazies, and the Rocky Mountain Range.
Montana Statewide Forest Resource Strategy (2010)	MT conducted a Statewide assessment of forest resources and identified issue-based focus areas with implementation strategies and deliverables for each including Focus area 1: Forest Biodiversity and Resiliency. Strategies include managing ecosystem and biotic composition to achieve ecological integrity through recovery of species diversity, water quality and quantity, soil quality and function by implementing best available scienctific infomation and adaptive management; and increasing terrestrial carbon sequestration and soil carbon sinks. The maintenance of native vegetation and emphasis on diversity is expected to benefit at-risk plant species that often occur in rare or sensitive habitats. This management is complementary, though some impacts to populations could occur.
BLM Resource Management Plans (RMP)	BLM lands near the HLC NF are managed by the Butte, Missoula, and Lewistown field offices. The Butte and Lewistown plans were recently revised (2009 and 2019 respectively) while the designated plan for the Missoula area is under revision. These resource management plans are equivalent to a forest plan. The primary issues included special status and priority plant and animal species and are complementary to the HLC NF 2020 Forest Plan in terms of managing for multiple uses and sustaining healthy and functional ecosystems. Broadly speaking the plan would likely contribute toward similar desired conditions as the HLC NF and much of the management guidance has similar intent with respect to resource protections and monitoring.

Resource plan	Description and summary of effects
National Park Service - Glacier National Park General Management Plan 1999	The general management plan for Glacier National Park calls for preserving natural vegetation, landscapes, and disturbance processes. Broadly, the terrestrial vegetation characteristics in this area and guidance toward at-risk plant species are therefore likely similar to the wilderness areas in the adjacent Rocky Mountain Range GA and would likely complement these conditions.
Montana Army National Guard – Integrated Natural Resources Management Plan for the Limestone Hills Training Area 2014	This plan is relevant to an area adjacent to NFS lands in the Elkhorns GA. The Limestone Hills area is primarily nonforested, and calls for managing for fire-resilient vegetation, restoration of native vegetation including mountain mahogany specifically, identify special plants, and survey and manage for weeds including bio control. This plan would be generally complementary to the HLC NF most especially in promoting the health of native vegetation.
County wildfire protection plans	Some county wildfire protection plans map and/or define the WUI. The HLC NF notes that these areas may be a focus for hazardous fuels reduction, and other plan components (such as NRLMD) have guidance specific to these areas. Managing for open forests and fire adapted species may be particularly emphasized in these areas. Overall, the effect of the county plans would be to influence where treatments occur to contribute to desired vegetation conditions. Species in the grasslands guild in these areas would likely benefit from open forest habitat.
City of Helena Montana Parks, Recreation and Open Space Plan (2010)	This plan is relevant to an area that lies adjacent to NFS lands in the Divide GA, in proximity to the City of Helena. The Mount Helena City Park is being managed as a “natural park”, which ensures its natural character in perpetuity. The plan emphases forest management, wildfire mitigation and noxious weed management. This would be complementary and additive to management on some HLC NF lands, specifically the South Hills Special Recreation area (alternatives B, C, D and F) and maintain the native vegetation composition. Heavy recreation use and high noxious weed density could impact sensitive plant populations in these areas, but in general this management plan supports at-risk populations by reducing threats and maintaining quality habitat.
Bureau of Reclamation Canyon Ferry Shoreline Management Plan 2012; Canyon Ferry Reservoir Resource Management Plan 2003	These plans cover the management of the Canyon Ferry Reservoir, which lies between the Big Belts and Elkhorns GAs. The shoreline plan includes resource considerations such as (but not limited to) recreation access, erosion control, hunting and fishing, off road vehicle use and weed management. The Canyon Ferry Wildlife Management Area was transferred to MT Fish Wildlife & Parks for management. The plan includes direction for campgrounds, weed control, fire rehabilitation, fisheries, habitat improvement on the wildlife management area; heritage resources; integrated pest management; and water quality monitoring. Habitats for a few at-risk plants would be maintained in these areas.
Natural Resources Conservation Service – Montana Soil Health Strategy 2015	Plan briefly outlines goals related to promoting soil health and conservation, primarily on agricultural lands. Soil quality is expected to good, but these areas not likely to support at-risk plant populations on agricultural lands. These areas are considered to put sensitive plants in the grassland habitat guild at greater risk for impacts with little to no suitable habitat available compared to historic conditions.
County Growth plans (Broadwater, Cascade, Choteau, Jefferson, Judith, Lewis and Clark, Meagher, Ponderosa, Powell, Teton counties)	No at-risk plant protection provided as a part of these plans. Would work with FS to enhance communities. At-risk plant on private lands are considered to be at greater risk of local extirpation due to lack of protections. The county plan generally aims to maintain native vegetation communities and reduce noxious weeds. The preservation of native habitats would maintain habitat for at-risk species where they occur though some weed treatments are detrimental to native species.
Blackfeet Nation’s Integrated Resource Management Plan	Integrated Resource Management Plans there are guidelines for rangeland management to maintain or improve ecological functions in rangeland habitats and eradicate noxious weeds when feasible. They comply with the ESA on tribal lands. There is no information available on at-risk species management, though there is information on preserving native plant communities. In areas managed as natural systems it is likely that at-risk plant species would persist and receive some level of protection; in developed areas there is a high likelihood of eradication of at-risk species.

Conclusions

All action alternatives include language to ensure that SCC and federally listed species are considered during vegetation-disturbing project activities. The RFSS that would no longer be covered under a protected designation with the 2020 Forest Plan have been individually evaluated and determined not to be at risk of declining in the planning area.

Federally listed plants

Due to the lack of federally listed plant species within the planning area, and on the Forest in general, implementation of any of the proposed alternatives would have no impacts on threatened, endangered or proposed plants.

Candidate for listing: whitebark Pine (Pinus albicaulis)

Indirect and cumulative effects for all alternatives were considered. Whitebark pine is currently trending downwards due to stressors not under NFS control (e.g. disease, climate change) and stressors under NFS control (e.g. fire suppression). This species is expected to benefit from each of the action alternatives by restoration treatments designed to improve habitat. Threats exist in the planning area and would persist under all alternatives. Changes in proposed management designations, such as proposed recommended wilderness acres and lands suitable for timber production, adjust the benefits for whitebark pine by the acres feasible for restoration treatments and incidental negative impacts resulting from project activities. The comparison between alternatives is largely qualitative and each subsequent decision would evaluate impacts to this species.

Beneficial restoration treatments and management actions could occur under all alternatives. The 2020 forest plan sets the framework for whitebark pine restoration through its plan components and designated areas. It emphasizes restoration treatments for whitebark pine through the detailed vegetation and at-risk plants plan components and promotes an increase in natural fire, thereby reducing the impacts of fire suppression. Some limitations on restoration treatment opportunities is expected due to designated areas, but overall, the plan direction presented in the acton alternatives represents a benefit to whitebark pine, by specifically addressing it under vegetation and at-risk plant plan components, including an objective for whitebark restoration treatments. Lynx plan direction, as well as designated wilderness and inventoried roadless area direction, limits restoration opportunities to a degree in many whitebark pine areas; however, this direction applies to all alternatives as well. The inclusion of recommended wilderness areas in alternatives A, B, C, D, and F represents a relatively minor degree of increased limitations on restoration treatment opportunities. While some management designations impose limitations on treatment, these limitations would not prevent the HLC NF from reaching the objective to treat 4,500 acres over the life of the plan in high priority areas.

Species of conservation concern

Indirect and cumulative effects for plant SCC were analyzed using habitat guilds to compare plan components and impacts of habitat management. There are 6 habitat guilds: peatlands with 6 species, wetland-riparian with 8 species, alpine with 3 species, grassland with 5 species, mesic-montane-disturbance-talus with 7 species, and aquatic with 2 species. Alternative A provides the least direction to protect habitats for SCC, though the at-risk plant species plan components are adequate to maintain viable populations of all SCC in the plan are in conjunction with FS manual guidance. All action alternatives (alternatives B-F) include additional plan components to maintain at-risk plant habitat in the plan and are expected to provide additional beneficial impacts to habitat quality for at-risk plant species in the planning area. The comparison between alternatives is largely qualitative and subsequent project decisions would evaluate impacts to these species while they are designated as SCC.

These species were also considered individually between alternatives to determine the impacts of wilderness designation and lands suitable for timber production. The threats are similar for all alternatives in regard to proposed lands suitable for timber production due to consistent proposed acres and overarching FS manual and at-risk plant components protecting these species during project activities. Threats to SCC are reduced in alternative D due to the highest number of RWA acres. Alternatives B and C provide the second highest acreage, followed by Alternative F and Alternative E provides the least. All action alternatives provide additional opportunities for at-risk plant restoration. In alternatives A, C and E, motorized and mechanized means of transporation are suitable in RWAs, which increases threats to at-risk plant species. In alternatives B, D and F motorized and mechanized means transportation are not suitable, and therefore threats are reduced in these areas.

Regional Forester's sensitive plants species

Indirect and cumulative effects for RFSS were analyzed using habitat guilds to compare plan components and impacts of habitat management. *Carex chordorrhiza, Micranthes tempestiva, Salix barrattiana, Thalictrum alpinum, Trichophorum cespitosum* and *Veratrum californicum* are not known to occur in the planning area, therefore no indirect or cumulative impacts are expected. The remaining species and habitat were analyzed with the SCC and associated habitat guilds. All species that are being removed from the list that overlap with lands suitable for timber production occur in habitats that would be omitted during project activities (e.g. peatlands and wetland-riparian habitats). Habitat would be maintained in the planning area for all species and threats are not considered to pose a risk to decreased viability in the planning area for these species based on BASI and revised plan components that protect specific habitat requirements. As new information becomes available or additional threats become known, these species would be reconsidered for the SCC designation. The comparison between alternatives is qualitative. Additional information on species-specific responses to threats is available in the project record.

3.11 Pollinators

Invertebrate pollinators are crucial components of functioning ecosystems. There is evidence that many species may be in decline due to a variety of factors. Broadly, the desired conditions in the action alternatives increase habitat quality for invertebrate pollinator species and decrease threats with the revised plan components. All alternatives provide habitat for pollinator species in the planning area with native plant species, a variety of habitats, and large areas without the habitat fragmentation that has become characteristic of agricultural and developed land. All action alternatives include plan components specific to pollinators. Those components coupled with the plan components for other resources that improve habitat for pollinators in the planning area contribute more to increases in habitat quality under the action alternatives. Please see the project record for the full specialist report.

3.12 Invasive Plants

3.12.1 Introduction

While invasive plants are often adapted to habitats where they are not native, they lack the natural controls (insects, disease) they may have evolved within their native ranges. As a result, they tend to spread aggressively and reduce overall native community diversity, and generally disrupt the natural processes of the environment. They displace native plants or reduce forage for some animal species, degrade natural communities, change hydrology, change microclimatic features, increase soil erosion, alter wildfire intensity and frequency, and cost millions of dollars in treatments and fire suppression to land management agencies and governments (U.S. Department of Agriculture, Animal and Plant Health Inspection Service, 2001). Invasive plants are capable of successfully expanding their populations into new ecosystems beyond their natural range and can create lasting impacts to native plants.

The geographic scope of the analysis for nonnative invasive plants are the NFS lands of the HLC NF. This area represents the lands where changes may occur to vegetation as a result of management activities or natural events. For cumulative effects, the analysis area also includes the non-NFS lands within and adjacent to the administrative boundary of the HLC NF.

Measurement Indicators

The following are indicators used for the analysis of invasive species:

- Acres of timber harvest, measured as a qualitative correlation between acres treated or harvested and the potential for ground disturbance at risk for weed invasion.
- Areas suitable to motorized road and trail use, measured as miles of roads and motorized trails that could serve as pathways for invasive plant introduction and spread.
- Acres affected by management changes to livestock grazing, measured as a qualitative assessment of potential changes in disturbance from livestock grazing projects and practices.
- Acres disturbed by fire activity, measured as acres burned by prescribed or wildfire events.

Changes between draft and final

Additional analysis for invasive plants forAlternative F was inserted into this section. One guideline for invasive plant species was added, which would direct land managers to consider potential effects to native pollinatros and develop measures to reduce non-target impacts when conductoing weed management activities (see FW-INV-GDL 02).

3.12.2 Regulatory framework

Federal law

The Carlson-Foley Act of 1968 (Public Law 90-583) authorizes and directs heads of Federal Departments and Agencies to permit control of noxious plants by State and local governments on a reimbursement basis in connection with similar and acceptable weed control programs being carried out on adjacent nonfederal land. In other words, this act permits county and state officials to manage noxious weeds with herbicides on Federal lands and to be reimbursed for that management, given that other applicable laws such as the National Environmental Policy Act are also met.

The Federal Insecticide Fungicide and Rodenticide Act (Public Law 92-516) requires all pesticides to be registered with the Environmental Protection Agency. It also states that it is unlawful to use any registered pesticide in a manner inconsistent with its labeling.

The Federal Noxious Weed Act of 1974 states that each federal agency shall establish and adequately fund an undesirable plant management program; complete and implement cooperative agreements with state agencies regarding the management of undesirable plant species on federal lands under the agency's jurisdiction; and establish an integrated management system to control or contain undesirable plant species targeted under cooperative agreements.

Executive orders

Executive Order 13112 directs federal agencies to prevent the introduction of invasive species; detect and respond rapidly to and control populations of such species in a cost-effective and environmentally-sound manner; to monitor invasive species populations accurately and reliably; to provide for restoration of native species and habitat conditions in ecosystems that have been invaded; to conduct research on invasive species and develop technologies to prevent introduction; to provide for environmentally sound control of invasive species; and to promote public education on invasive species and the means to address them. Federal agencies are also called to collaborate with Federal, State, and local partners to address invasive species that can spread from adjacent lands. All of these actions are subject to the availability of appropriations. The desired condition inferred from Executive Order 13112, FSM 2900 and the national strategy is the prevention of new infestations (within the area where activities would occur or from the use of travel routes associated with those activities) and to manage the infestations currently established on the forest through control measures. For all forests, management goals for invaders are to:

- Potential invaders—prevent establishment, and if found, promptly eradicate
- New invaders—for small infestations, eradicate, and for larger infestations, reduce
- Widespread invaders—contain areas that are already infested and reduce plant populations.

State and local law

The State of Montana County Noxious Weed Management Act states that it is unlawful for any person to permit any noxious weed to propagate or go to seed on the person's land, except that any person who adheres to the noxious weed management program of the person's weed management district or who has entered into and is in compliance with a noxious weed management agreement is considered to be in compliance with this section.

Other regulation, policy, and guidance

The FS National Strategic Framework for Invasive Species Management (2013c**)** provides broad and consistent strategic direction on the prevention, detection, and control of invasive species and incorporates the Invasive Species Systems Approach to respond to threats over the next 5 to 10 years. This policy directs the FS to: 1) Determine the factors that favor establishment and spread of invasive plants; 2) Analyze invasive species risks in resource management projects; and 3) Design management practices that reduce these risks.

3.12.3 Assumptions

It is assumed that the establishment of new, undocumented weed infestations has likely occurred, and are not reflected in the existing condition description for invasive plant infestations.

3.12.4 Best available scientific information used

The HLC NF utilizes the Montana Noxious Weed List (2017) to identify which invasive species to manage across the forest, as well as project specific invasive plant risk assessments (risk assessments). Risk assessments help identify threats to native vegetation as a result of project related ground disturbance and invasive species within or near the project area. They also prescribe mitigation measures to reduce these threats. As project areas are surveyed, new infestations are inventoried. These data are entered into the Natural Resource Manager’s Threatened, Endangered, and Sensitive Plants, and Invasive Species database, a system of database tools for managing Agency data across the forest. Invasive plant infestation data (spatial and tabular) is stored and can be retrieved for later reference and analyses. This database has been continually updated with inventoried infestations with a special emphasis on correcting geospatial data.

Invasive plant treatments are also recorded and entered into the Natural Resource Manager system, which allows the HLC NF to track invasive plant treatment accomplishments.

3.12.5 Affected environment

Land use and land-cover change has undoubtedly been the underpinning for the successful establishment of invasive plant species (C. G. Parks et al., 2005). Locally, the rate of establishment and spread has been influenced by timber harvest, road building, grazing, and recreation. Most of these activities began on a large scale in the 1950s and 1960s on the HLC NF.

Current invasive plant infestations

As of December 23, 2014, 142,052 acres (5%) of the HLC NF had been inventoried as having invasive species present. The number of currently recorded invasive plant species is 26. A majority of recoded infestations on the HLC NF are associated with past disturbances. Approximately 98 percent of the current inventoried invasive plant infestations occur within ½ mile of major transportation routes (system roads and trails). 15 percent of the inventoried infestations on the HLC NF are within 30 feet of major system roads and trails. The main pathway for spread are road maintenance equipment, logging vehicles, all-terrain or off-highway vehicles, and passenger cars and trucks. Seeds of many species are also wind or animal dispersed (wildlife and livestock). Many roadless areas remain relatively weed free because of healthy undisturbed native plant communities where few mechanisms exist to spread invasive species.

The most abundant invasive plant species on the HLC NF are spotted knapweed (*Centaurea maculosa*), oxeye daisy (*Leucanthemum vulgare*), dalmation toadflax *(Linaria dalmatica*), musk thistle (*Carduus nutans*) Canada thistle (*Cirsium arvense*), houndstongue (*Cynoglossum officinale*), and leafy spurge (*Euphorbia esula*). The species of highest priority for treatment are spotted knapweed, leafy spurge, toadflax (yellow and dalmatian), orange and meadow hawkweed (*Hieracium spp.*) and those species that are on the state noxious list but not currently present on the HLC NF (e.g., yellow starthistle). These species are known to be highly aggressive (e.g., spotted knapweed) or are not currently established on the HLC NF (e.g., yellow starthistle). Reduction of particular aggressive species is critical for the protection of intact plant communities and associated habitats. Avoiding the establishment of additional species is equally important in the maintenance of healthy landscapes within the HLC NF. Eradication is likely not feasible for many of the invasive species on the HLC NF. Although there are large infestations of species such as Canada thistle and houndstongue, these species are not considered high priority due to their abundance, both on the forest, in the state, and in the West at large. They are still considered a priority to treat but due to the level of infestation of these species on NFS lands, they are targeted for control instead of eradication (some exceptions may apply to specific project areas depending on local conditions).

Disturbance and invasive plant species

Disturbance is widely recognized as a primary influence on plant community composition and is frequently implicated in the spread of invasive exotic plants (Hobbs & Humphries, 1995). Disturbance is defined as “any relatively discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment” (Picket & White, 1985). Parks et al. (2005) examined the patterns of invasive plant diversity in northwest mountain ecoregions and found an overwhelming importance of disturbance in facilitating the establishment of nonnative plants. Disturbances can occur as a result of natural events such as floods, wind events and animal disturbances. Disturbance can also result from human activities such as construction of roads and trails, livestock grazing, features common to logging activities such as skid-trails and landings, and off-road vehicle use. Fire suppression efforts can also result in disturbances. Fire-line disturbances create suitable conditions for many nonnative species to become established (C. G. Parks et al., 2005).

Even as fire is considered a factor in modifying sites and leading to suitable conditions for weeds, it can also be used to control weeds to an extent (DiTomaso et al., 2006). Considering the fire-prone nature of the HLC NF during the time when these plants would need to be burned (mid- to late-summer), fire is not a practical control tactic. It is useful, however, to remove thatch left behind by dead plants to allow herbicide access to fresh shoots at ground level. This approach could be conducted during the fall or spring burning windows.

Treatments such as manual, mechanical, biological, and chemical methods are used to treat infestations and are typically focused on those species included on the Montana state noxious weed list. Containment tactics are employed when eradication is not feasible. Containment tactics combine prevention and treatment actions with the objective of limiting the spread of an existing infestation, reducing the acres of existing infestations by treating around the perimeter of the infestation and increasing the resiliency of threatened ecosystems to mitigate the impacts of the invading species.

Treatment of identified infestations is accomplished through herbicide applications and biological control, from this point forward referred to as "treatments." The HLC NF has a strong commitment to weed control efforts and cooperates with a variety of partners (such as nongovernmental organizations, counties, and state agencies) to accomplish these treatments.

Over the past 5 years, a total of 56,842 acres of invasive plants have been treated on NFS lands on the HLC NF. The average acres treated per year is approximately 9,473 acres. A typical year would result in the treatment of six to seven thousand acres as large aerial projects on the Helena NF have increased the average. Specific treatment levels vary depending on funding levels and project priorities. Treatments include both herbicide and biological control methods and are accomplished by FS employees, counties (through agreements), volunteers (cooperative spray days) and other partners.

Criteria for determining order of treatment priority are influenced by the species to be controlled, its rate of spread, infestation size, habitat, and location. Species vary in their reproduction methods, and weeds that reproduce vegetatively require different treatment methods than species that only reproduce by seed.

Areas of high public use, such as roads, trails, campgrounds, trailheads and other recreation sites are a high priority since these areas receive a lot of visitor use and are typically at greater risk of invasion and/or function as pathway into less infested areas. Other areas that are remote and/or are less disturbed and considered natural areas (e.g., wilderness and RNAs) and areas considered to be weed free are also a high priority for treatment. These areas are a high priority due to the effort needed to access and treat the areas as well as the fact that they are presumably not yet heavily infested or are weed free. There is a far greater chance for eradication and equally lower costs associated with management when infestations are detected and treated early.

Removal of roads and trails can lead to an increased risk of invasion or expansion of existing weed infestations. The HLC NF has implemented mitigation measures such as pre-and post-treatments as well as seeding of decomished roads to improve desirable species cover and reduce invasive species infestations. Desirable nonnative mixes of grasses and forbs have primarily been used in the past. Native grasses and forbs have been used only recently. Observations of some of the temporary roads constructed in the last 30 to 40 years indicate some success in the prevention of invasive plant invasion within the road corridors. Sun-loving species, such as knapweed, are not as abundant as the native and nonnative grass and forb seed mixes on these old roads. However, shade-tolerant species, such as Canada thistle, houndstongue and musk thistle are often abundant along these legacy roads. There is no information on the design and construction of these legacy roads or subsequent early rehabilitated efforts. As such, it is difficult to infer specifics of how invasive species became established along the legacy road beds. Observations of historic roads (built over 50 years ago) indicate that plant communities on some roads may naturally recover as the road prism is filled in by forest vegetation. Most legacy roads were constructed to support harvest operations. Prevention measures were most likely not implemented during these older harvest operations.

The HLC NF now implements an integrated invasive species management process for all approved management actions. Methods used to prevent invasive species from being introduced and spreading into new areas include closing infested areas to travel, washing vehicles and equipment upon entering an area, requiring use of weed-free hay for pack animals, and using weed-free seed and straw mulch for revegetation. Treatments such as manual, mechanical, biological, and chemical methods are generally limited to localized areas and those species on the Montana state list. Containment combines prevention and treatment with the objective of limiting spread of an existing infestation and reducing the acres of existing infestations by treating around the perimeter of the infestation. Invasive weed management in cooperation with private and agency partners, county weed districts and others is important in all of these treatment activities. Seeding of temporary roads as a conservation measure to reduce invasive species infestations has been occurring on NFs for many years. Desirable nonnative mixes of grasses and forbs have primarily been used in the past. Native grasses and forbs have been used more in recent years.

Infestations in some sites have been reduced by these measures. However, in spite of these control efforts, existing infestations continue to invade disturbed areas as well as intact plant communities. Changes to the landscape with warmer temperatures, associated drier conditions, and more severe or frequent droughts, may lead to more frequent fires and may increase the ability of invasive plants to out-compete native plants in the future.

3.12.6 Environmental consequences

Effects common to all alternatives

Invasive species will continue to have a presence on the HLC NF landscape, with existing infestations and continual introductions of new invaders. Some invasive species have become almost "naturalized" to vegetation communities on the HLC NF, and some level of their presence will persist in all alternatives. Other invasive species have become well-established and continue to increase in dominance within native plant communities. Canada thistle, cheatgrass, houndstongue, Kentucky bluegrass, smooth brome, and timothy are all examples of invasive species that have spread to herbaceous plant communities across the Forest. Management under all alternatives would attempt to slow the spread and introductions of new invaders as well as prevent existing weed species from establishing to new noninfested areas. The HLC NF will continue to conduct weed treatments with the most effective options (chemical, mechanical, and biological) as they become available and to implement mitigations such as the weed-free forage program, and vehicle washing/inspections for contract work.

Development of additional management direction for noxious weeds has occurred under the 1986 Forest Plans and implementation may continue based on this direction under all alternatives. In 1994, the Lewis and Clark NF signed a ROD for the Noxious Weed Control FEIS, which implemented an integrated pest management approach to treat 1,787 acres of NFS lands, as well as providing the ability to apply herbicide in wilderness areas. The analysis also evaluated the use of new herbicides and imposed new environmental safeguards. However, the analysis (1994) underestimated future invasive species problems and limits weed managers on available tools.

The Helena NF issued a ROD for Noxious Weed Treatment in May of 2006. The document authorized a more aggressive noxious weed control approach by permitting additional types of herbicides, adopting adaptive management, and broadening herbicide application methods to include aerial treatment options. Existing and newly approved biological agents could also be introduced to infestations where appropriate. The selected alternative contained environmental protection measures to reduce nontarget species exposure to herbicides caused by spray drift through wind speed restrictions during application, buffering of sensitive areas, weather monitoring, boundary marking, and restrictions on areas to be sprayed, and use of drift reduction agents.

Under all alternatives, management of invasive species would continue following Noxious Weed Control EIS documents (1994, 2006). Both Noxious Weed analysis documents provide acceptable invasive species management options while being flexible to budget constraints but are not quickly adaptable to adopt new technology and treatment options.

All alternatives contain multiple use resource management objectives, with varying degrees of forest vegetation management. Timber production, livestock grazing, and farming activities continue to provide endpoints for introduction and subsequent seed dispersal, as well as the environmental disturbance that enhances germination and establishment of nonnative plants (Toney, Rice, & Forcella, 1998).

Invasive species have substantially increased across the HLC NF, with a present infestation level of approximately 142,000 acres. Assuming that the national average annual rate of spread of 8 to 12 percent applies, the HLC NF can expect to encounter an increase in invasive plant infestations at a rate of up to approximately 11,000 to 17,000 acres per year (when applying the range of 8% to 12% rate of spread to the current combined inventory of 142,052 acres). Initial data review suggests that the rate of spreads is greater on the western portions of the HLC NF (Helena NF) and less rapid on the eastern portion (Lewis and Clark NF) due to differences in precipitation and habitat types.

Of equal importance is the current and predicted continuation of globalization, or the free movement of goods, capital, services, people, technology, and information. Globalization processes will most likely significantly affect the State of Montana, especially as the human population continues to grow. Globalization facilitates and intensifies the spread of invasive alien species (Meyerson & Mooney, 2007). As a result, the extent and density of invasive plant infestations as well as the number of invasive plant species has the potential to increase on NFS lands within the planning area.

Climate change

Climate change is likely to result in differing responses among invasive plant species, due to differences in their ecological and life history characteristics. Climate change could result in either range expansion or contraction of an invasive species (J. E. Halofsky & Peterson, 2018; J. E. Halofsky et al., 2018b). For example, modeling indicates that leafy spurge is likely to contract, and spotted knapweed is likely to shift in range. Invasive species are generally adaptable, capable of relatively rapid genetic change, and many have life history strategies (e.g., prolific seed production, extensive deep roots) which can enhance their ability to invade new areas in response to changes in ecosystem conditions. Warmer temperatures, and associated drier conditions, more severe or frequent droughts, and more favorable conditions for wildland fire may increase the ability of invasive plants to establish and out-compete native plants. These changes may provide more opportunities for invasive plants to gain an advantage over native species and spread within and beyond the HLC NF's boundaries. This potential effect is common to all alternatives.

Studies have shown that elevated carbon dioxide levels can lead to a reduction in herbicide efficacy (Archambault, 2007; Ziska & R., 2000). Reduced treatment effectiveness coupled with the potential for increased opportunities for growth and vigor has the potential for invasive plants to gain an even greater advantage over native species.

The effects of climate change on species' distributions are likely to be complex given the potentially differing climatic controls over upper and lower distribution limits (Harsch & Ris Lambers, 2015). Some studies predict a movement in some invasive plant species range closer to the poles or upward in elevation (Chen, Hill, Ohlemuller, Roy, & Thomas, 2011). Pauchard et al. (2009) suggest that the threat posed to high-elevation biodiversity by invasive plant species is likely to increase because of globalization and climate change. Other studies, such as Harsch and Lambers (2015) suggest that distribution shifts in response to recent climate change could occur in either direction (upward or downward).

Fire is another factor affected by climate change. When combined with climate change, fire/invasive plant relationships may be exacerbated leading to greater invasive species populations and spread. Other disturbances or shifts in historical patterns may be affected by climate change and in turn affect the spread of invasive species. As the agency responds to climate change by new, different, or more land and vegetation management actions, those disturbances could provide suitable conditions for invasive plants.

Effects from plan components associated with:

Infrastructure

In all alternatives, inadvertent seed spread could decrease areas that are either closed to motorized access or are more difficult to access. During road closure/decommissioning activities that require short-term ground disturbance, there could be short-term invasive plant establishment until invasive weed treatments are applied to the disturbed area. Additionally, road closures and/or decommissioning make administrative access more difficult to treat invasive species in some areas of the forest. Many of the roads and trails previously closed to motorized vehicles have invasive species present within the trail corridor. These infestations, known and yet to be discovered, are a concern for weed managers under all alternatives.

Road obliteration projects for travel management purposes also can create ideal conditions for invasive species to establish. Road obliteration would occur under all alternatives.

Road maintenance, reconstruction and construction can contribute to the establishment and spread of invasive plants. Gravel pits can oftentimes become infested with weeds if not routinely checked and treated. Weed seeds can be spread onto lands far from the gravel pit when gravel is used for road surfacing or other purposes. This potential for this effect would be the same under all alternatives; however, plan components are in place to mitigate this. Management direction to address invasive plant species is in place for all alternatives and would continue to be followed. Gravel pits and main road corridors would be priorities to consider for weed management and treatments.

Fire

Fire can result in an increase in nonnative species diversity and cover, whether it is a prescribed burn or a wildfire (Zouhar, Kapler Smith, Sutherland, & Brooks, 2008). Invasive species such as cheatgrass may alter fire regimes in drier forests, shrublands and grasslands which comprise much of the HLC.

Wildfires would occur in the future under all alternatives, although uncertainty exists as to extent and location. Weather and climatic factors along with fuels conditions would affect intensity and spread of a fire event. Effects of wildfire on invasive species spread potential is the same across alternatives. Generally, prescribed fire implementation would be similar under all alternatives as well. There is potential for establishment and spread of invasive plant species within burned areas, depending largely upon site-specific conditions, such as fire location, vegetation types that were burned, presence of weed infestations prefire, potential pathways, and fire characteristics. Weed infestations within burned areas would be addressed following forest plan management direction, which is similar for all alternatives.

Recreation

Recreational activities, including motorized and nonmotorized, are vectors for potential seed establishment and dispersal. Recreational areas receive concentrated and frequent use which results in continuous ground disturbance. Generally, wilderness areas and large un-roaded lands are less likely to contain invasive weeds due to less widespread public access, especially via motorized means. However, these large un-roaded areas are still vulnerable to weed infestation and spread from recreational uses. Seed transport happens inadvertently, by humans, dogs, and pack stock. Trails that receive high uses, including those in wilderness areas, are vulnerable to invasive weed infestation. Mountain bike, horse, and motorized trails may be at higher risk of introduction, spread and establishment of weeds compared to hiking trails. Areas of high use and ground disturbance occur within wilderness areas and are as vulnerable to weed infestation as developed sites outside wilderness. Frequently, infestations are found around trailheads, trails, campgrounds, and other developed recreation sites. These seed sources pose a risk of further spread into wilderness and undeveloped lands. Areas located immediately adjacent to and surrounding developments tend to experience the most disturbance, while the peripheries of these areas are less disturbed and less likely for invasive species establishment and persistence.

Methods used to help prevent invasive species from being introduced and spreading into recreation areas include public education and requirements for use of weed-free hay for pack stock. Public education efforts, such as the Play Clean Go campaign, have helped raise invasive species awareness for many recreational activities. Lack of public knowledge, combined with limited enforcement and/or monitoring options for recreational activities is a concern for weed introductions, and would be similar for all alternatives.

Wildlife

Invasive species expansion is most likely occurring to some degree with transport of seed from wildlife. Several satellite patches of noxious weeds are located in the HLC NF that are far from roads and trails, have no possible livestock or pack animal access, and are far from any know infestation. Native ungulates can move seeds from infested areas and relocate them in remote or off-the-grid areas. Hounds tongue has been and will continue to be on the move throughout the forest, but other species such as spotted knapweed and toadflax species are showing up in unexplainable places. Birds could be a major transporter of Dalmatian toadflax on the Helena and Townsend Ranger Districts. These transport issues from wildlife will continue under all alternatives.

All alternatives retain standards and guidelines from the 2018 Forest Plan Amendments to Incorporate Habitat Management Direction for the Northern Continental Divide Ecosystem Grizzly Bear Population. These components are not expected to create un-due hardship to noxious weed control efforts for the Forest as treatments are already limited in time and space within the primary conservation area, as weed infestations are generally lower as compared to other areas of the HLC NF. Budget constraints, topography, and lack of personnel also already hinder weed treatment options within the primary conservation area. Weed treatments generally occur as opportunities allow in the backcountry.

Effects common to all action alternatives

A primary difference between the action alternatives as compared to the no-action alternative is their targeted management direction, including treatment objectives and more clarity regarding treatment strategies, priorities and methods. Management direction under all the action alternatives for nonnative invasive plants includes a guideline and treatment objective to obtain desired conditions of invasive species control and maintenance of natural ecological functions. Targeted objectives for invasive plant control are an administrative change that promotes measurable objectives and accountability to the program toward reaching desired conditions. The objective was chosen to be responsive toward desirable conditions while also being flexible to uncertain yearly budgets, which is the program's primary operating constraint.

While preference for use of low-leaching chemical treatments is currently exercised under the no-action alternative, the action alternatives formalize this practice, and promote effective long-term treatments that are compatible with other resources. Consideration of technological advances in weed treatments is emphasized, if they are shown equivalent to, or more effective than, existing treatments. Preference is stated regarding the use of low-leaching chemical treatments and application methods to minimize ground and subsurface drift effects. Additionally, the ability to evaluate and incorporate new chemical treatments, if equivalent or more effective than existing treatments, to the integrated pest management program is also current program practice. Thus, the action alternatives update the 1986 Forest Plans by formalizing current invasive species management practices that prevent or decrease the spread or densities of noxious weeds and invasive plans and enhance native plant communities.

Effects of plan components associated with:

Watershed, aquatic habitat, riparian areas, and soils

Plan components and activities related to watershed, soil, riparian, and aquatic habitat would have effects on invasive plant management. The plan components that would have the greatest influence are those associated with RMZs. With the action alternatives, east of the Continental Divide (the majority of the HLC NF), RMZs would be adopted and result in more acres being subject to riparian area plan components as compared to the no-action alternative, in which SMZs would be used. West of the Continental Divide, the area influenced by riparian plan components is the same across all alternatives because RMZs would be defined the same way as riparian habitat conservation zones are in the no-action alternative. Please refer to the RMZ section.

With the action alternatives, the use of herbicide treatments within RMZs would be used only to maintain, protect, or enhance aquatic and riparian resources or to restore native plant communities (FW-RMZ-STD-05). Further, peatlands, fens, and other groundwater dependent ecosystems would be buffered 100 feet from management activities that alter water chemistry, unless site-specific information supports a smaller or larger buffer (FW-RMZ-GDL-03). These components may limit the treatment methods for some invasive plants in riparian areas and near groundwater dependent ecosystems; for example, hand pulling may be required instead of herbicide use. The herbicides selected for use in these areas would be those that would not alter water chemistry.

Alternative A, no action

The 1986 Helena and Lewis and Clark Forest Plans, as amended, are the existing management direction being used by the HLC NF to address nonnative invasive plants. This direction represents the no-action alternative. However, because the no-action alternative is the baseline to which the action alternatives are compared, it is important to understand what actions would continue under the no-action alternative.

The existing Helena NF Plan (1986) and Lewis and Clark NF Plan (1986) include forestwide objectives that emphasized the need to control noxious weeds through an integrated pest management approach utilizing chemical, biological, and mechanical methods. The 1986 Helena NF Plan specifically called for spot herbicide treatment of identified weeds and considering biological control as it became available (1986 HNF Plan, II-22). The 1986 Lewis and Clark NF Plan discussed in even lesser detail the need to control noxious weeds through an integrated pest management strategy. At the time of these forest plans' publication, the extent and magnitude of ecological issues invasive species would create for the HLC NF was unforeseeable.

The 1986 Forest Plans lack specificity in plan direction for noxious and invasive species management. The no-action alternative as amended with Noxious Weed Control FEIS documents (U.S. Department of Agriculture, Forest Service, 1994; U.S. Department of Agriculture, Forest Service, Helena National Forest, 2006) encompasses current management practices on the Helena NF, but is outdated and limits managers on Lewis and Clark NF.

Effects that vary by alternative

Effects of plan components associated with:

Timber and vegetation management

Ground-disturbing activities, equipment transport and use associated with management activities such as timber harvesting, fire treatments and fire suppression, or other authorized uses are a common pathways influencing the expansion of noxious weeds. Most of these risks are minimized with localized site restoration and rehabilitation, as well as the use of weed control measures during implementation (e.g., contract clauses to wash equipment).

Vegetation management activities such as timber harvest, the use of skidders and mechanical harvest techniques and equipment have contributed to the introduction, spread, establishment and persistence on the landscape. Contract specifications help prevent introduction of weed seed to units from outside NFS lands by requiring cleaning of equipment. Other weed BMPs include pre- and post-implementation spraying of haul routes, as well as seeding disturbed areas after implementation to prevent establishment of infestations.

Lands suitable for timber production are where the majority of timber harvest activities and associated road access could be expected to occur. It could be assumed that a larger amount of area suitable for timber production may result in more areas where timber harvest or active management could occur. In actuality, acres harvested are not necessarily directly tied to the amount of suitable lands, but also to the treatment type that may be applied. Timber harvest may also occur on lands unsuitable for timber production. For analysis of potential of invasive species spread, projected harvest acres were used to assume the amount of ground disturbance expected to occur. The direct correlation between ground disturbance and potential of invasive species to establish in those areas was used to differentiate effects between alternatives. Table 68 provides a comparison of lands suitable for timber production and the projected harvest by alternative.

Table 68. Acres of lands suitable for timber production and projected harvest by alternative

	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F
Acres of land suitable for timber production	414,936	356,633	356,633	348,586	384,199	368,814
Projected acres of timber harvest (decade 1)[1]	2,072	2,176	2,176	2,101	2,134	2,279

[1] projected average acres of timber harvest per year in the first decade, constrained by a reasonably foreseeable budget

The potential ground disturbing activities associated with projected acres of timber harvest (decade 1) would be similar for all alternatives, and therefore, potential weed spread would also be similar. Alternative F has the highest acreage of projected acres of timber harvest in decade 1, but does not present weed managers with an unmanageable workload for invasives monitoring or treatment relating to timber management activities over the other alternatives.

Motorized use and ROS settings

A main pathway for seed spread is vehicle use (Taylor, Brummer, Taper, Wing, & Rew, 2012). Many existing infestations can be found along, or have originated from, roadsides because vehicle traffic provides ideal means for noxious weed spread. Primitive two-track roads also provide opportunity for noxious weeds to become established on areas of bare soil and disturbance. Once invasive species establish on road or trailside prism, the threat of spreading into adjacent native plant communities has a high likelihood if vigilant monitoring and treatments do not occur. An even greater threat for spread of invasive species is from unauthorized cross-country travel. Infestations can go undetected for years, resulting in a well-established population that oftentimes are difficult to access.

Transportation of weed seed by contractor or special use vehicles, or equipment, on NFS roads is managed to a degree. Contract stipulations are used to require specific actions, e.g., vehicle and equipment washing, to lessen the possibility of weed transport to reduce the risk of new infestations. Recreational use of roads and motorized trails as well as unauthorized cross-country travel by the general public presents a greater risk, because of the lack of control measures and the lack of knowledge about invasive species spread.

Summer motorized uses pose the greatest risk of invasive weed transport. Because of the site-specific localized nature of weed infestation and spread, changes in weed infestations estimated at the programmatic level would be difficult to predict. In general, the potential for invasive plant species introduction and/or spread would be highest under alternatives with greater numbers of routes suitable for summer motorized travel. The action alternatives vary slightly in the suitability of motorized use of roads and trails, with the primary differences being the number of recommended wilderness areas and the suitability for motorized and mechanized means of transporation within them.

Alternative D would be the most favorable to limit the spread of invasive species from motorized use because it has the most area in RWAs, and has the least amount of areas suitable to motorized and mechanized means of transporation, followed by alternatives B, F, and C. Conversely, Alternative D could also create issues for detection of existing weed infestations as there could be less human presence in these areas. Alternatives A and E would have a higher potential to increase the spread of invasive species through motorized transportation. However, based on ROS settings and the amount of recommended wilderness alone, no alternative would significantly reduce the spread of invasive plant species as these areas already have low amounts of road and trail mileage.

Livestock grazing

Invasive species expansion may also occur with the transport of seed by livestock from infested areas. Seeds can be spread through livestock feces, fleeces, and hooves, and many can pass through an animal's digestive system and retain the ability to germinate (A. Joy Belsky & Gelbard, 2000). Native grazers such as mule deer, bighorn sheep and elk, and some birds such as mourning doves and starlings (Carr, 1993), can also perform this same method of seed spread. Conversely, domestic livestock grazing (in a process known as prescribed grazing) has also been shown to be an effective method in managing some large invasive plant infestations while assisting the ecological succession process (Jacobs, 2007).

Localized areas where congregation can occur, such as water developments and supplement locations, contribute to reduced ground cover and can become potentially susceptible to invasive plant establishment. All alternatives could have equal impacts from domestic livestock grazing relating to invasive species establishment on acres where disturbance results in reduced native plant vigor and cover. Action alternatives include plan components that should enhance rangeland vegetation communities, which would be more resistant to invasive species. Options to adjust livestock grazing management in the future may involve more range improvement infrastructure, thus increasing acres disturbed by construction activities in the short run. Some initial ground disturbance from new off-site water development and fencing may cause some ground disturbance, and therefore, provide a niche for invasive plants to establish. In the long term, action alternatives should improve livestock grazing management, which increases the resistance and resilience of native plant communities. Plan components in the action alternatives also pursue the best available invasive species management options while maintaining multiple uses like livestock grazing.

Fire and fuels

Site-specific projects are evaluated under the NEPA for the impact of invasive species and generally projects have requirements to prevent their spread as mitigations for project implementation. Burn areas are susceptible to invasive species introduction and establishment. Addressing burned areas, whether from wildfire or prescribed burns, may change treatment priorities for the invasive species management program under all alternatives.

Projected prescribed burning acres are similar for alternatives A, B, C, D, and F, with less treatments occurring in alternative E. All alternatives have plan components and best management practices in place that would limit potential spread of invasive species from fuels management activities. If fuels reduction work was not performed, the likelihood of catastrophic wildfire would increase. Large wildfires could cause an increase of invasive plant species spread on a landscape scale, which can become very difficult o control and manage. Action alternatives combined with plan components for invasive species all provide adequate measures to address or limit weed infestations associated with prescribed fire and fuels treatments.

Cumulative Effects

Invasive species spread without regard to administrative boundaries. As such, the cumulative effects of the HLC NF invasive species management under any alternative, including the no-action alternative, may negatively or beneficially impact adjacent federal, state and private lands depending upon the specific site treatment or lack thereof. Adjacent or nearby landowners specific site conditions and invasive plant treatment efforts also would affect conditions and treatments on NFS lands. Over 327,895 acres of individual and other private entity lands lie within the boundaries of the planning areas of the Forest, though not all these lands are directly adjacent to NFS lands. Under all of the alternatives, coordination with state and local agencies and communication with the public would continue to combat the spread of undesirable nonnative invasive species.

Portions of the HLC NF adjoin other NFs, each having its own forest plan. The HLC NF is also intermixed with lands of other ownerships, including private lands, other federal lands, and state lands. Some adjacent lands are subject to their own resource management plans. The cumulative effects of these plans in conjunction with the HLC NF 2020 Forest Plan are summarized in Table 69, for those plans applicable to invasive species management.

Table 69. Cumulative effects to invasive species from other resource management plans

Resource plan	Description and Summary of effects
Adjacent National Forest Plans	The forest plans for NFS lands adjacent to the HLC NF include the Custer-Gallatin, Lolo, Flathead, and Beaverhead-Deerlodge NFs. All plans address invasive species management. Generally speaking, management of invasive species is consistent across all NFs due to law, regulation, and policy. The cumulative effect would be that the management of invasive plants would be generally complementary. This includes specific adjacent landscapes that cross Forest boundaries, such as the Upper Blackfoot, Divide, Elkhorns, Crazies, and the Rocky Mountain Range.
BLM Resource Management Plans (RMP)	BLM lands near the HLC NF are managed by the Butte, Missoula, and Lewistown field offices. The Butte and Lewistown plans were recently revised (2009 and 2019 respectively) while the existing plan for the Missoula area is under revision. These plans contain components related to invasive species and would therefore be complementary to the plan components for the HLC NF. Weed control efforts on BLM lands have great potential to influence spread on invasives to Forest lands.
National Park Service - Glacier National Park General Management Plan 1999	The general management plan for Glacier National Park calls for preserving natural vegetation, landscapes, and disturbance processes. Broadly, the plan shares common goals and desired conditions to reduce invasive species in this area, which is similar to the wilderness areas in the adjacent Rocky Mountain Range GA. This plan would be complementary to the goals of the HLC NF concerning invasive species.
Montana Army National Guard – Integrated Natural Resources Management Plan for the Limestone Hills Training Area 2014	This plan is relevant to an area adjacent to NFS lands in the Elkhorns GA. The Limestone Hills area is primarily nonforested and calls for managing invasive species that is generally complementary to efforts on the HLC NF.
Montana State Parks and Recreation Strategic Plan 2015-2020	These plans guide the management of state parks, some of which lie nearby or adjacent to NFS lands. Invasive species management is a component of these parks, although not always the primary feature. Management of invasive species in these areas would help control the spread to other areas, as visitors to these parks would most likely visit the HLC NF at some point. Goals for invasive species management would be largely complimentary to the goals of the HLC NF.
Montana's State Wildlife Action Plan	This plan describes a variety of vegetation conditions related to habitat for specific wildlife species. This plan would likely result in the preservation of these habitats on state lands, specifically wildlife management areas. This plan would interact Forest Plans and be complementary to the efforts to manage invasive weeds.
County noxious weed control agreements	Most counties within the planning area have agreements with the HLC NF which coordinate noxious weed treatment areas and roads as well as provide a mechanism for the in which the Forest can financially fund county weed control efforts on NFS lands and other priority areas in order to help preserve native plant communities at the landscape level. These weed agreements are consistent with goals and objectives of the HLC NF.

Conclusions

Alternatives B, C, D, E, and F update the 1986 Forest Plans for management of nonnative invasive plants by formalizing current, effective invasive species management practices. Plan components in action alternatives should have positive effects to slow the spread of invasive plants as well as manage existing infestations by moving towards using the best tools and practices available in the future. These practices are administrative in nature and result in no adverse effects to the invasive species management program.

Plan components regarding livestock grazing should generally have positive effects on rangeland vegetation condition. In turn, acres within grazing allotments should have more resistant and resilient plant communities that can compete with invasive species to a certain degree. Small, localized areas of disturbance relating to range improvement construction may be vulnerable to weed infestation and will need monitoring and treatment actions built into project design. However, these improvements should help improve vegetation condition and grazing management that will benefit rangeland vegetation in the future.

All alternatives have potential to create similar amounts of disturbance relating to timber harvest. Alternative E may be the most favorable as far as limiting the total harvest footprint on the Forest under a constrained budget. Concerning vegetation management projects, all alternatives have plan components that prescribe BMPs that should limit the introduction of invasive species and implement proactive treatment options if they are found.

Alternative D would be the most favorable to limit the spread of invasive species from motorized use because it has the most area in RWAs, and has the least amount of areas suitable to motorized and mechanized means of transporation, followed by alternatives B, F, and C. However, based on ROS settings and the amount of recommended wilderness alone, no alternative would significantly reduce the spread of invasive plant species as these areas already have low amounts of roads and trails.

Ultimately, consequences to nonnative invasive plants from forest plan components associated with other resource programs or revision topics are similar under both the no-action and action alternatives. An aggressive integrated pest management approach must continue and adapt in order to keep invasive species from expanding beyond existing infestation levels.

3.13 Terrestrial Wildlife Diversity

3.13.1 Introduction

The 2012 Planning Rule (U.S. Department of Agriculture, Forest Service, 2012b) provides direction to maintain diversity of animal communities and the persistence of native species through emphasis on a coarse filter approach (FSH 1909.12 23.11 (1) (c)) (U.S. Department of Agriculture, Forest Service, 2015). As described in the Rule and in the Directives, plan components developed for ecosystem integrity and ecosystem diversity are expected to provide for ecological conditions necessary to maintain the persistence or contribute to the recovery of native species within the plan area (FSH 1909.12, sec 23.11).

By design, this section relies on the coarse-filter information in the terrestrial vegetation section. Plant communities discussed in the terrestrial vegetation section are discussed here as vegetation groups or as plant communities that generally provide for the needs of several wildlife species.

The Rule recognizes that for some at-risk species (i.e. threatened, endangered, proposed, or candidate species or those identified as SCC), coarse-filter plan components may not be sufficient to ensure recovery or persistence of those species within the plan area. Where that is the case, species-specific plan components that would contribute to the recovery of listed species or maintain the viability of SCC within the plan area (219.9 (b) (1)) (U.S. Department of Agriculture, Forest Service, 2012b) are included in the plan.

This section addresses wildlife as contributors to biological diversity and ecosystem integrity, and as components of “the diversity of plant and animal communities” and addresses “persistence of most native species in the plan area” (36 CFR 219.9). Wildlife also provide benefits to humans, through viewing, hunting, trapping, and other activities or in support of various human values. Those concerns are addressed in the plan separately from other wildlife-related plan components; analysis related specifically to elk (and other big game species) availability for hunting on NFS lands is addressed in section 3.15 of this FEIS.

Organization of the terrestrial wildlife section

This section is organized by key ecosystems or groupings of vegetation systems or their characteristics, such as size or structural class, that provide habitat for associated wildlife species. Although all wildlife species ultimately rely on vegetation, various aspects of that vegetation are the key components of habitat. Some species are associated with a particular cover type or group of cover types, whereas others may be associated with a structural stage (e.g. early seral openings, large dead trees, etc.), or with a combination of type and structure. Some species are more strongly associated with certain landscape features, such as cliffs, streams, or caves. For the purposes of analyzing how the alternatives provide for the ecological conditions required by terrestrial wildlife species, this section discusses wildlife species in the context of the vegetation group, structural stage, or landscape feature most often associated with their requirements or that contributes to a key or critical part of their life history. That discussion provides an analysis of the ecological conditions (coarse filter) expected to maintain the diversity of native wildlife species.

Most native wildlife species' needs are evaluated in the context of the habitat groupings as described in the above paragraph, so most wildlife species are not discussed individually. For some species, however, species-specific or habitat-specific plan components were considered necessary to mitigate potentially negative impacts of management actions or activities occurring on NFS lands. The effects of those plan components are described within the section where the species is discussed, even where that section may not relate to the species-specific components. For example, bighorn sheep are discussed under the section "Species Associated with Grass and Shrub Habitats", because that vegetation type is critical for bighorn sheep foraging and movement. The 2020 Forest Plan includes components for separation of bighorn sheep from domestic sheep; those components are not related to the vegetation group, but the consequences of those components are discussed within the section "Species Associated with Grass and Shrub Habitats" because that is where bighorn sheep are otherwise addressed. Similarly, species currently designated by the Regional Forester as sensitive (RFSS) are discussed briefly in the section for the vegetation or landscape feature group with which they are associated. Additional analysis and discussion of potential effects to species currently listed as sensitive resulting from the 2020 Forest Plan is provided in a separate biological evaluation (BE) in the project file.

The sections that address species associated with specific vegetation groups, structural stages, or landscape features are followed by a discussion about the potential effects of plan components guiding management of specific resources or broad programs (e.g., livestock grazing, recreation, minerals and energy development, etc.).

Changes between draft and final

There have been several changes to terrestrial wildlife plan components and/or analysis between the DEIS and FEIS, based on public and internal comments:

- A desired condition was added for large, unroaded areas that provide seclusion and low levels of disturbance by humans (FW-WL-DC-04).
- The desired condition FW-WL-DC-05 was updated to include all "key seasonal habitats", and a definition for that term was added to the glossary to facilitate implementation.
- FW-WL-DC-09 was added to address lynx habitat at a forestwide scale (refer to lynx analysis in the at-risk species section).
- FW-WL-DC-10 was added regarding disease transmission between domestic animals and wildlife.

- A goal was added for specific cooperative work the MFWP.
- A goal was added regarding work with the caving community to limit disease spread in bats.
- Several guidelines were updated to clarify intent and to facilitate implementation.

As described above, the terrestrial vegetation plan components and analysis provide and underpinning for the wildlife analysis. There were some key modeling improvements, plan component updates, and other analysis changes with regard to terrestrial vegetation between the DEIS and FEIS (see the Terrestrial Vegetation; Old Growth, Snags, and Coarse Woody Debris; and Timber sections for more details). The Terrestrial Wildlife Diversity analysis has been updated as a consequence of these changes.

3.13.2 Regulatory framework

Please refer to the introductory regulatory framework section of this chapter (3.3).

3.13.3 Assumptions

The primary assumption underlying the analysis in this section is based on the 2012 Planning rule and the directives for implementing the rule: that plan components developed for ecosystem integrity and ecosystem diversity would provide for ecological conditions necessary to maintain the persistence or contribute to the recovery of native species within the plan area (FHS 1909.12, 23.13). Therefore, we assume that effects to vegetation systems and characteristics as described in the terrestrial vegetation section provide the basis for understanding most of the potential effects to wildlife species associated with those systems. The Federal Register (volume 77, number 68, p. 21212) states that "The premise behind the coarse-filter approach is that native species evolved and adapted within the limits established by natural landforms, vegetation, and disturbance patterns prior to extensive human alteration. […] These ecological conditions should be sufficient to sustain viable populations of native plant and animal species considered to be common or secure within the plan area. These coarse-filter requirements are also expected to support the persistence of many species currently considered imperiled or vulnerable across their ranges or within the plan area."

The directives for implementing the planning rule state that "ecological conditions include habitat and the effects of human uses (for example, recreation, grazing, and mining)" (FHS 1909.12, 23.13). We have incorporated this assumption into this section.

The analyses discussed in the terrestrial vegetation section rely on two analytical models, SIMPPLLE and PRISM, which are described in that section and in appendix H. Those models "use numerous assumptions to simplify ecosystem processes as well as treatment implementation". The assumptions that are a part of the vegetation analysis are inherently part of the analysis of impacts to wildlife species using those vegetation systems.

3.13.4 Best available scientific information used

A thorough review of the scientific information was completed, and the BASI was used to inform the planning process and develop plan components. Key information on the population, life history, and status of animal species on the HLC NF was obtained from the Montana Field Guide (http://fieldguide.mt.gov) as well as from other sources listed in the references section of this document and in the project file. Published, peer-reviewed articles and data in which reliable statistical or other scientific methods were used, where those were available. For best relevance, studies conducted in north-central or north-western Montana, western North America, or other areas with habitat conditions similar to those in the planning area where used, where those were available. When not available, articles that considered ecological processes or conditions similar to those in the planning area were used. The planning rule acknowledges that the BASI may include expert opinions, inventories, or observation data prepared and managed by the FS or other agencies, universities, reputable scientific organizations, and data from public and governmental participation. Those sources of information were relied upon when published, peer-reviewed information was not available or when needed to provide additional information specific to the planning area. Where needed in the assessment and in this section, specific discussion may be included regarding contradictory science, why some information is used to the exclusion of others, and regarding areas for which scientific information is lacking.

Because there are more than 300 terrestrial wildlife species (amphibian, reptile, bird, and mammal) present on the HLC NF, it is not feasible nor useful to summarize here the large body of current scientific literature or other information available for each species or even group of species. Sources that were used regarding the presence, distribution, requirements, or impacts to various species are cited throughout the text of this section. Because of the programmatic level of this analysis, however, detailed discussion of the life histories and drivers of terrestrial wildlife species and populations are generally not provided. The information in this analysis relies on information in the Assessment of the Helena and Lewis and Clark National Forests (U.S. Department of Agriculture, Forest Service, Northern Region, 2015) regarding both terrestrial wildlife species and vegetation. That document contains extensive citations and bibliographies of the science used to determine life history, status, presence and distribution, threats, and drivers of terrestrial wildlife species and terrestrial vegetation. Other science used in development of plan components and in this analysis is cited in the text where used, is is found in appendix G, or in other supporting materials in the project file.

Please also refer to the terrestrial vegetation and aquatic ecosystems sections. Analysis for those resources forms the foundation of analysis of terrestrial wildlife species considered in this section.

3.13.5 Affected environment

Species associated with aquatic, wetland, and riparian habitats, affected environment

This vegetation group includes the riparian/grass shrub cover type along with aquatic and wetland environments where that cover type occurs, and some associated forested areas. Riparian associated vegetation and systems are identified and categorized in a variety of ways, making description of the affected environment somewhat complex. The affected environment for the riparian/grass shrub cover type is described in the terrestrial vegetation section and as a component of the nonforested cover type. Additional description of the riparian/wetland habitat type is provided in the assessment (U.S. Department of Agriculture, Forest Service, Northern Region, 2015) in the Riparian Species Guild section.

Aquatic, wetland, and riparian habitats are inherently limited in the plan area. Estimates vary depending on the data sources used. Slightly more than 20,000 acres of riparian/wetland habitat type occur on the HLC NF (U.S. Department of Agriculture, Forest Service, Northern Region, 2015). River or riverine systems make up 1% or less of the administrative area in each GA, except for the Highwoods, where they make up over 5% (ibid).

Many wildlife species use aquatic, wetland, or riparian habitats during all or a portion of their life cycle, and riparian areas can be of particular importance in maintaining connectivity within watersheds. Examples of terrestrial wildlife species that are dependent on these habitats for all or part of their life cycle and that occur on the HLC NF include several amphibian species such as garter snakes and western toads, a variety of waterfowl, shorebirds, and migratory birds, several bat species, various small mammal species, and others including beavers, mink, and moose. Low-elevation riparian areas may be important to black and grizzly bears, particularly during spring or during hot dry periods in the summer months.

Species that are currently identified as RFSS and that rely on aquatic, wetland, or riparian habitats for all or part of their life cycle include bald eagle (forages and nests near rivers and lakes), harlequin duck (breeds on fast-moving, low-gradient mountain streams), northern bog lemming (found mainly in peatlands and wet meadows with sphagnum component), northen leopard frog, and western toad (breeds in shallow, silt-bottom ponds with emergent vegetation).

Stressors under Forest Service control

Stressors to these systems that can be influenced by FS management actions include livestock grazing, invasive species, pattern and timing of motor vehicle use, draining or diversion, administrative or recreational facility development, harvest of adjacent timber, and prescribed fire. Not all of these processes or actions are stressors to all species using these habitats.

Stressors not under Forest Service control

Threats to these systems that are not under control of FS management include drought, climate change, alterations to hydrology occurring on connected or adjoining non-NFS lands, and alterations to water chemistry resulting from pollution, sedimentation, or other inputs originating outside of FS control. Threats to terrestrial wildlife species using these habitats may include those as well as some types of human disturbance.

Species associated with grass and shrub habitats, affected environment

This vegetation group comprises the grass, dry shrub, and mesic shrub cover types described in the terrestrial vegetation section. The affected environment for this cover type is described in the terrestrial vegetation section, and as a component of the nonforested cover type. Although the grass and shrub cover types are included within the nonforested type for the purposes of vegetation analysis, wildlife species using these habitats may also use adjacent forested areas.

In general, the nonforested cover type represents less than 15% of the area on the HLC NF, with the grass and shrub types representing less than that. Many grassland or grass/shrub areas occur at or near the boundary of HLC NF lands, extending onto adjoining private and other lands that comprise a larger extent of these cover types.

Many wildlife species use these habitats during all or a portion of their life cycle. Grass and shrub vegetation types may be important to some species for forage, particularly in winter. Many species dependent on grasslands or shrub habitats are not yearlong residents on HLC NF lands. Terrestrial wildlife species that are dependent on grass or shrub cover types for at least a part of their life cycle include elk, mule deer, and pronghorn, all of which depend more heavily on these habitats during winter, and all of which may spend a portion of winter on lower elevation, non-NFS lands. Elk and mule deer are found in all GAs. Gray wolves, currently listed as RFSS, rely on ungulate prey and so are indirectly dependent on the habitats that support big game. Additional factors, such as legal hunting and trapping, and depredation-related mortality on non-NFS lands also influence gray wolf numbers and distribution. Other species depending on these habitats include several migratory bird species (for foraging and/or nesting), several small mammal species, red foxes, coyotes, and others. Mesic shrub types may be important to both black and grizzly bears, providing forage in early spring before other foods are available, and berries as a key food source during summer months.

Bighorn sheep, currently listed as a RFSS, use primarily nonforested habitats, with some use of savannahs or open forest where visibility is good and in proximity to escape terrain (generally cliffs or steep, rocky hillsides). This species occurs in a metapopulation structure, with herds scattered throughout western and central Montana, connected by occasional movement of individual sheep among separate herds. Bighorn sheep herds currently occur on the Rocky Mountain Range, Big Belts, and Elkhorns GAs. Bighorn sheep occupied the Little Belts GA historically, and have been observed there again recently after a prolonged absence (Pers. Comm. D. Kemp, 2018 filed in project record). The Elkhorns herd was reduced to fewer than 20 animals as a result of a disease-related die-off in 2008, with current estimates around 50 bighorn (Kuglin, 2020). Respiratory disease epidemics are a primary limiting factor for bighorn sheep populations. Abundant evidence suggest that domestic sheep have been the primary source of pathogens causing respiratory disease in bighorn sheep across the West (T. E. Besser et al., 2012; Wehausen, Kelley, & Ramey, 2011; Western Association of Fish and Wildlife Agencies (WAFWA), 2012). Domestic goats can also transmit respiratory pathogens to bighorn sheep, and although there has been less research, the frequency and severity of resulting disease appears to be lower (ibid; (Thomas E. Besser, Cassirer, Potter, & Foreyt, 2017; Cassirer, Manlove, Plowright, & Besser, 2017; U.S. Department of Agriculture, Forest Service, 2020b). Transmission from native ungulates and other domestic ungulates such as cattle, horses and llamas present a negligible risk to bighorn sheep (Besser et al. 2012). Once infected, bighorn sheep may spread the pathogens among themselves for many years. Separation from domestic and wild sheep is considered an effective strategy to minimize the risk of new disease outbreaks in wild sheep (Western Association of Fish and Wildlife Agencies (WAFWA), 2012).

Stressors under Forest Service control

Threats to grass/shrub vegetation types that may be affected by FS management activities include grazing impacts to native plant communities, fire management (including fire exclusion), and invasive exotic plant species. Note that management of invasive exotic plants is likely affected by FS management only to a limited degree in many areas. Although not a stressor to the habitat group discussed here, transmission of respiratory pathogens from domestic sheep and goats to bighorn sheep is a stressor to bighorn sheep whereever they occur.

Stressors not under Forest Service control

Threats outside of FS management influence that may affect grass/shrub vegetation types include habitat conversion and alteration and climate change. Stressors such as fire management (including fire exclusion) and grazing that occur off-NFS lands may also impact these vegetation types where they occur on adjoining NFS lands. Transmission of respiratory pathogens from domestic sheep and goats to bighorn sheep on private lands is a stressor to bighorn populations, as is transmission among bighorn sheep after initial infection occurs.

Species associated with hardwood tree habitats, affected environment

As noted in the terrestrial vegetation section, persistent hardwood-dominated plant communities are rare on the HLC NF. Aspen and cottonwood are by far the main hardwood tree species. Aspen may occur as a persistent community in riparian areas, or it may be a transitional stage in upland sites, where it may dominate the early stages of succession following major disturbance. As such, aspen-dominated habitats may vary widely in location, spatial extent, and overall distribution over time. Cottonwood is confined to riparian areas on the HLC and is more common on lower-elevation private lands outside the forest boundary. Cottonwood exists to a very limited extent on the HLC NF.

Although hardwood habitats make up a small proportion of the vegetation communities on the HLC NF, these habitats are important for a variety of wildlife species, including several woodpecker species (Lewis's woodpecker, a SCC on the HLC NF, is discussed in the at-risk species section), other migratory birds, several bat species, black bears, ruffed grouse, Merriam's wild turkey, flying and red squirrels. Ungulate species such as elk, moose, and deer may forage on young aspen during certain times of year, as well. Aspen, and to a larger extent cottonwood communities, in riparian areas may provide habitat connectivity within drainages, as well as across the forest boundary onto adjoining lands, by providing a complex vegetation structure and composition to support animals transitioning across otherwise unsuitable habitats.

Stressors under Forest Service control

Threats that may be affected by FS management actions include grazing and fire exclusion.

Stressors not under Forest Service control

Threats outside FS control include climate change, insect infestations, disease, forest succession (conifer encroachment), changes in groundwater or stream flows, excessive herbivory by ungulates, and human development.

Species associated with dry conifer habitats, affected environment

This group of habitats includes the cover types identified in the terrestrial vegetation section as ponderosa pine, some dry Douglas-fir, and some xeric ecotones and savannahs. Dominant tree species tend to be ponderosa pine, limber pine, and some Douglas-fir, with Rocky Mountain juniper and interspersed dry shrub in some areas (see terrestrial vegetation section). These vegetation types generally occur at lower elevations or on south and west-facing aspects that maintain lower snow levels during winter, providing key winter habitat for a number of ungulate species. In some areas these habitats form the transition from conifer forest to grass/shrub or grassland types, and as such may be relatively rich in wildlife diversity. Savannahs may be important foraging areas for bighorn sheep where they occur in proximity to escape terrain (cliffs and rocky outcrops). Flammulated owls and Lewis's woodpeckers, both identified as SCC (flammulated owls are also currently identified as a RFSS), use stands of large-diameter ponderosa pine and occasionally Douglas-fir (refer also to the at-risk species section). Clark's nutcrackers forage on seeds from ponderosa pine and limber pine. Other species using these vegetation types include numerous migratory bird species including a wide variety of songbirds and several types of hawks and owls, small mammals, mountain lions, bobcats, and wolves. Dry conifer habitats may be important foraging and daytime roosting areas for fringed myotis, a bat species currently identified as a RFSS. Limber pine is often found in the area of transition from mid-elevation conifer forest to low-elevation grasslands, which means it is also often present at the transition of NFS lands to adjoining lands under other ownership. As such, limber pine forests may be an important transitional habitat used by grass/shrub associated wildlife species as well as by montane conifer forest associated wildlife species. Intact limber pine forest in some areas may provide important connectivity between NFS and other lands.

Stressors under Forest Service control

Fire exclusion may influence the abundance, distribution, and composition of dry conifer types. Vegetation management practices may also influence this vegetation group through selection of species or size classes for harvest.

Stressors not under Forest Service control

Climate change, wildfire, beetle infestation, and disease are all processes that can influence the abundance, distribution, and composition of dry conifer forests.

Species associated with mixed conifer habitats, affected environment

This vegetation group encompasses a broad array of habitats occurring in the montane conifer environment, which is the dominant land cover on the HLC NF. It includes habitats within the warm dry, cool moist, and cold broad PVTs. Cover types (see terrestrial vegetation section) include Douglas-fir (this cover type may also be included in the dry conifer group discussed above), western larch mixed conifer, lodgepole pine, spruce-fir, and to some extent whitebark pine (but see section on species associated with high elevation habitats, below). The trend in amount and distribution of these cover types, as well as trend in structural characteristics such as tree size and density, varies by type as shown in the terrestrial vegetation section. In general, forested cover types have increased compared to their historic range, with greater tree density and smaller average tree size for many cover types (U.S. Department of Agriculture, Forest Service, Northern Region, 2015).

In addition to the varied mix of tree species and corresponding understory, wildfire, insects, and disease have historically created a variety of seral stages, structures, and mix of species within the broad area of coniferous forest. Coniferous forest on the HLC NF is often intermixed with open grasslands/shrublands, wetlands and riparian areas, creating a mosaic of habitat types. Therefore, this vegetation group provides a diversity of habitats used by a correspondingly wide diversity of wildlife species. Wildlife species that use mixed conifer habitats for all or part of their life cycle include ungulates (deer, elk, and moose), marten, a variety of hawks and owls including northern goshawk, Cooper's hawk, sharp-shinned hawk, and great gray owls, a variety of small mammal species including snowshoe hare and red squirrel, a diversity of migratory birds, and several bat species, including three that are currently identified as RFSS: fringed myotis, long-eared myotis, and Townsend's big-eared bat.

Canada lynx, currently listed as threatened under the ESA, are dependent on boreal forests that provide their primary prey species (snowshoe hare), secondary prey (red squirrel), and have deep, fluffy snow during the winter. Lynx rely largely on the spruce/fir cover type. Canada lynx are discussed separately in the at-risk species section.

Fisher are currently listed as a RFSS that could be found on the HLC NF. There have been two observations of fisher on the Rocky Mountain Range GA, possibly of the same individual, and four in the Upper Blackfoot GA, three of which were harvested. Recent mapping, however, has shown that very little fisher habitat exists on the HLC NF, likely not enough to support a fisher population or enough individuals to contribute to supporting a fisher population in Montana (U.S. Department of Agriculture, Forest Service, 2014a).

Stressors under Forest Service control

Stressors to mixed conifer habitat are similar to those described for dry conifer habitat. Fire exclusion may influence the abundance, distribution, and composition of conifer forests directly and by influencing the size and severity of future fires. This vegetation group is the focus of most of the harvest activity that occurs on NFS lands; therefore, vegetation management practices may also influence this vegetation group through selection of species or size classes for harvest, fuels reduction, or other management activity.

Stressors not under Forest Service control

Climate change, wildfire, insect infestation, and disease are all processes that can influence the abundance, distribution, and composition of mixed conifer forests.

Species associated with high elevation habitats, affected environment

High elevation habitats are those generally occurring in the subalpine and alpine zone, characterized by the alpine and herbaceous shrub habitat type group described in the assessment (U.S. Department of Agriculture, Forest Service, Northern Region, 2015). This habitat also includes expanses of nonvegetated area, and the whitebark pine cover type. Alpine herbaceous types have minimal soil development and consequently sparse vegetation, generally in the form of grasses, forbs, and some low shrubs, with trees occurring in some protected and moist microsites. These habitats are usually affected by climate and weather, with wind, extreme temperatures, unstable rock, and avalanches all shaping habitat. High elevation habitats are often within designated wilderness or IRAs, in part because of their relatively inaccessible nature and location with respect to historic resource extraction efforts, as well as a lack of merchantable timber. Most ecosystems that occur at high elevations are not substantially altered from historic conditions, with the exception of declines in whitebark pine. Whitebark pine is an important component of some high elevation ecosystems, with mature trees producing seeds that are a key food for species such as Clark's nutcrackers and grizzly bears. Whitebark pine has experienced extensive mortality due to a variety of factors, including white pine blister rust and mountain pine beetle, and consequently occurs less frequently and as younger trees than it historically occurred throughout much of its range. The species is a candidate for listing under the ESA (for more information refer to the terrestrial vegetation and at-risk plants sections).

Species that use high elevation habitats for all or part of their life cycle include mammals such as pika, golden-mantled ground squirrel, hoary marmot, mountain goat, and wolverine (refer to terrestrial wildlife species at risk section), and birds such as white-tailed ptarmigan, and various migratory bird species including black rosy finch and gray-crowned rosy finch. In addition to feeding on caches of whitebark pine seeds, grizzly bears may also feed on army cutworm moths found in high elevation rock and talus. Some wildlife species, such as wolverine, have evolved to rely on high-elevation snowpack for shelter, cover, or denning.

Stressors under Forest Service control

Most habitats occurring at high elevations are not substantially influenced by forest management. Recreation can impact habitat through motorized uses, stock, and foot travel impacting thin, fragile soils and disturbing or displacing wildlife.

Stressors not under Forest Service control

Climate change may play the most important role in affecting high-elevation habitats by altering the timing and levels of snowfall and snowmelt. Whitebark pine is affected by blister rust, which may have a profound effect on the amount and distribution of that cover type on the HLC NF and throughout Montana.

Species associated with late successional forest including large trees and old growth, affected environment

Large and very large trees, late successional forest, and old growth provide habitat for a variety of wildlife species. Much of the literature regarding wildlife associated with old growth habitats originates from west of the continental divide, often in the wetter, milder, more productive forests of the northwestern United States. In the northern Rocky Mountains, wildlife species usually associated with old growth habitat may be associated with individual components of old growth (e.g., very large live, decayed, dead or downed trees) in stands or areas that do not meet identified old growth criteria in their entirety. This may be particularly true on the HLC NF, the majority of which occurs east of the Continental Divide, where there is relatively low annual precipitation and a short growing season, and where wind and frequent fire are important factors shaping vegetation.

Wildlife species associated with large or very large trees include pileated woodpeckers and northern flickers, which may excavate cavities used by birds such as Lewis's woodpeckers, and flammulated owls. Barred owls, and several migratory songbird species use standing large diameter trees or rely on the multi-layered canopy often associated with late-successional stage forest. Marten, various small mammal species, salamanders and other amphibians use downed and decaying large trees for cover and forage, particularly in late-successional and old growth stands.

Stressors under Forest Service control

Harvest or other vegetation management can remove large trees, alter stand characteristics and dynamics, and fragment large tree and late-successional forest habitat. Fire exclusion can also influence stand characteristics and development and alter natural fire regimes. Other stressors may include other fire management activities, road construction, recreation site development, and firewood gathering.

Stressors not under Forest Service control

Existing old growth and late-successional forest is vulnerable to moderate or high severity fire, insect infestations, and disease.

Species associated with snags, affected environment

Dead, dying, and decaying trees provide nesting sites for a variety of birds; these include several woodpecker species such as pileated woodpecker, northern flicker, northern three-toed woodpecker, and Lewis's woodpecker (see terrestrial wildlife species at risk species section), a large number of migratory songbird species such as mountain bluebird, brown creeper and others, and various owl species such as flammulated owl (see at-risk species section), screech owl, boreal owl, and others. Snags also provide foraging habitat for a number of bird species that include many of those above, as well as black-backed woodpecker (currently listed as a RFSS), nuthatch, and others. A variety of bat species, including long-eared myotis (currently identified as a RFSS), silver-haired bat and others use snags for roosting, either in cavities or under loose bark. Other species that use or rely on snags and snag habitats include northern flying squirrel, short-tailed weasel, marten and others. Various wildlife species tend to prefer specific sizes and species of snags, as well as different stages of hardness or decay. Therefore, a variety of species, sizes, densities, and conditions of snags is needed to provide for the needs of the wide variety of wildlife species that use them.

The Old Growth, Snags and Coarse Woody Debris section (3.9) provides estimates of current snag abundance by size class, GA, and wilderness vs. nonwilderness. It notes that snags are a dynamic resource influenced by numerous factors both natural and human-related, and in an ongoing state of development and loss. Historic or natural snag abundance can only be estimated currently by inference, comparing snag abundance in wilderness areas with that of nonwilderness. It appears that snags may be more abundant in wilderness overall, possibly as a result of recent large fires. Aside from the influence of fire, it is not clear whether snags are more or less abundant now than they were historically. The difference between wilderness and nonwilderness does not exist for large and very large snags, which may be naturally rare on the HLC NF (Bollenbacher et al., 2008).

Stressors under Forest Service control

Salvage logging can be a primary influence on snag presence in some areas, reducing abundance and altering distribution of snags following fire or insect infestation. Fire exclusion may also reduce snag abundance and distribution. Other stressors that have impacts in more localized areas include firewood cutting, hazard tree management, and certain vegetation management practices.

Stressors not under Forest Service control

Climate and weather may degrade snags or cause them to fall, while fire may consume previously existing snags. Climate change may impact snag development, abundance and distribution by altering fire regimes, and influencing precipitation cycles.

Species associated with coarse woody debris, affected environment

Coarse woody debris is defined as wood of three or more inches in diameter that is on the ground. Coarse woody debris, particularly debris of larger diameter, may be an important habitat component for some wildlife species. This habitat feature is present in a variety of vegetation types and situations; debris that has greatest value to wildlife is more often associated with late successional stages and less often associated with dry forest types. Discussion of the various vegetation groups and structural stages that create woody debris will not be repeated here (refer to section 3.9), nor will discussion of plan components noted above that would ensure the appropriate distribution and abundance of various tree species, size classes, densities, or successional stages. Coarse woody debris is a product of processes that are the same as or similar to those that create snags.

Wildlife that use coarse woody debris varies according to the size, structure, and habitat in which the debris occurs. Amphibians such as salamanders may use rotten and hollow logs that retain moisture. Small mammals such as certain voles and shrews, as well as mid-sized mammals such as squirrels use this habitat for cover and sometimes food caching, and mammals such as weasel and marten may use it for both cover and foraging. Canada lynx (see terrestrial wildlife species at risk section), mountain lion, and black bear may use piles of woody debris for denning.

The snags and downed wood section provides information on the estimated status of coarse woody debris by GA. There is currently no way to estimate the NRV of this type of habitat. The trend for downed wood is tied to the disturbances and drivers that affect vegetation, and therefore will vary according to those factors.

Stressors under Forest Service control

Timber harvest, and fuels management may reduce the amount of coarse woody debris in some areas and can create pulses in debris by creating even-aged stands. Fire exclusion may also impact the amount and distribution of this habitat, increasing it in some areas and vegetation types.

Stressors not under Forest Service control

Insect and disease outbreaks may create dead trees that eventually become coarse woody debris. Fire can create this habitat by weakening or killing trees. Conversely, intense fires may reduce this habitat by consuming existing debris on the ground or removing trees entirely. Fire can create pulses of debris by killing large numbers of trees in an area and by creating even-aged stands in some areas.

Species associated with cave, cliff, rock or other geologically-determined habitats, affected environment

Cliff, cave, and rock habitats are created and changed primarily by geologic forces, although subsurface mineral extraction and associated mining activities can create underground structures that may function as habitat for some wildlife species. Use of these habitats by wildlife depends on the structure of the site and its associated characteristics, as well as by proximity to habitat required for activities such as foraging. This section will address only those aspects of these habitats or the species that use them that could be affected by NF management. The portion of this habitat that is comprised of rock and scree is represented by the "sparse" areas mapped in VMap. This type occurs on roughly 2% of the administrative area. The majority of the "sparse" type occurs on the Rocky Mountain Range GA. Although many caves have been identified on the HLC NF, a complete inventory of caves and of mines or associated structures that may provide habitat for wildlife species does not exist, and therefore the distribution, abundance, and characteristics of cave and cave-like habitats on the HLC NF is not known. Similarly, no estimate exists for the amount, distribution, or characteristics of cliff habitats.

Cliff habitats may be used by birds such as peregrine falcon (currently listed as a RFSS) and golden eagle for nesting, and by bighorn sheep (currently listed as a RFSS) and mountain goat for escape terrain and as general habitat. Rocky habitats such as boulder and talus fields and slopes may be used by species such as pika, golden mantled ground squirrel, hoary marmot, bushy-tailed woodrat and wolverine (see at-risk species section for detailed discussion of this species) for shelter, hibernation, or denning. Caves and some mines or related structures may be used by a number of bat species, including fringed myotis, long-eared myotis, and Townsend's big-eared bat (all three species are currently listed as RFSS), for roosting, hibernation, and maternity habitat. Several bat species, particularly those in the genus Myotis, are vulnerable to a disease (White-Nose Syndrome) that is caused by a fungus that can be transmitted by other bats as well as by humans visiting caves where bats are roosting. Grizzly bears may feed on army cutworm moths found in high elevation rock and talus.

Stressors under Forest Service control

Removal of rock from surface areas for personal or commercial use by humans could impact some localized areas. Cave and mine habitats may also be impacted by changes in temperature or humidity caused by the creation or alteration of openings to the surface, or by changes to actual structure. Although not a stressor to the habitat itself, human activities that disturb bats or that introduce the fungus associated with White Nose Syndrome may be substntial stressors to bats using caves or mines on NFS lands. Recreational use of NFS lands by the public is not regulated by forest plans, although procedures exist for managing those uses in specific situations.

Stressors not under Forest Service control

Cave, cliff and rock habitats are physically affected primarily by natural, geologic forces. Species that use these habitats may also be affected by changes to adjacent or nearby vegetation, caused by the various stressors discussed in the vegetation group sections above. Bats may be affected by transmission of diseases from other bats travelling among different roosts. Pikas, wolverines, hoary marmots, and other species that use rock habitats at high elevations may be affected by alterations in seasonal temperature and precipitation associated with climate change (see also "species associated with high-elevation habitats" section above).

3.13.6 Environmental Consequences

Effects common to all alternatives

Aquatic, wetland, and riparian habitats

Aquatic, wetland, and riparian habitats are characterized by a combination of hydrology, geology, and vegetation and as such would continue to occur in the same amount and distribution under all alternatives.

Grass and shrub habitats

The terrestrial vegetation section notes that predicted warm and dry climate, which may be affected by climate change, along with vegetative succession, wildfires, and insect and disease activity would be the primary shapers of vegetation under all alternatives. Under all alternatives, nonforested vegetation, particularly in the xeric vegetation types, is expected to initially increase and then decline slightly, with overall abundance slightly higher over the next five decades than current abundance at the forestwide scale. That trend is not consistent across all GAs, with increases largely occurring in the Castles, Divide, Elkhorns, and Little Belts GAs, Snowies, and Upper Blackfoot GAs. Some decreases relative to current levels are predicted in other GAs, with the largest decrease predicted in the Rocky Mountain Range GA.

Plan components in the Grizzly Bear Amendment, which would be incorporated into all alternatives, require no increase in the number of active sheep allotments in the primary conservation area and in zone 1 (Rocky Mountain Range and Upper Blackfoot GAs), and guide managers to reduce the number of open or active sheep grazing allotments in that area. Although these components are intended to reduce potential conflicts with grizzly bears, their effect would also be to limit or reduce the risk of disease transmission from domestic to wild sheep.

Hardwood tree habitats

Broad-scale modelling predicts that both the aspen/hardwood and cottonwoodcover type and individual species presence would increase slightly over time under all alternatives (terrestrial vegetation section), with some variation among GAs. The most notable increases in these habitats is predicted to occur in the Elkhorns and Highwoods GAs; the other GAs show either very subtle increases or neutral trends.

Dry conifer habitats

Broad-scale modelling estimates that under all alternatives, the ponderosa pine cover type (which includes areas dominated by ponderosa pine, limber pine, and/or Rocky mountain juniper) cover types would increase over time especially in the warm dry broad PVT, and in all GAs. The dry Douglas-fir cover type found on the warm dry PVT would decrease but it would remain above the NRV at the end of the modeling period with some variation among GAs. The trends in both ponderosa pine and Douglas-fir would achieve or move towards the desired ranges, with the exception of Douglas-fir in the Highwoods

GA which is predicted to remain below the desired range for that GA (see Table 53). These trends could benefit some species that rely on the dry conifer forest type and would ensure that this habitat continues to exist in the planning area.

Mixed conifer habitats

Broad-scale modelling predicts that the mixed mesic coniferDouglas-fir cover type found on the cool moist PVT would likely decrease over time across the HLC NF under all alternatives to approach the natural range of variation, with some variation among GAs (see appendix H). However, this cover type is predicted to remain within or above the estimated NRV. The lodgepole pine cover type is predicted to remain relatively unchanged at the Forestwide scale, with some decreases on the warm dry PVT and increases on the cool moist PVT, and variations across GA share a similar trend, remaining below the estimated NRV only within the Crazies and Rocky Mountain Range GAs. Lodgepole pine trends toward desired conditions in all areas except the Snowies GA (see Table 53). The spruce/fir cover type is predicted to increase slightly and remains relatively unchanged at the Forestwide scale under all alternatives, and remain above within the estimated NRV, with some slight increases in the cool moist PVT toward the desired range. However, in all GAs the type stays within or is neutral or trending towards the NRV condition, with the exception of the Upper Blackfoot GA (see Table 53). Because the cover types comprising this habitat group would contine to be within or near the estimated NRV in most areas, they would continue to provide habitat for wildlife species that use them for all or part of their life cycle.

High elevation habitats

Because the primary influences on this type of habitat are climate, weather, geology and topography, most forest management actions are not expected to have substantial influence on these habitats or on the species that use them. Under all alternatives, whitebark pine is estimated to remain fairly static over time, just below or within the lower bound of the desired range, with some variation among GAs. The whitebark pine cover type is predicted to increase slightly specifically within the cold PVT. However, as noted in the terrestrial vegetation analysis, the expected trend for whitebark pine is uncertain due to a host of other factors indicated by BASI that are not well-captured by modelling, and there remains substantial risk to the persistence of this at-risk species. Clark’s nutcrackers may be affected by current or future declines in whitebark pine under all alternatives, but on the HLC NF ponderosa pine and limber pine provide alternate food sources. Wolverine are thought to be affected primarily by climate-caused changes in the amount and distribution of snowpack that remains throughout the spring, which would be the same under all alternatives. The availability of both whitebark pine seeds, and army cutworm moths as food sources for some bears could change as a result of changing climate, or in the case of moths, as a result of agricultural practices occurring in other areas during other phases of their life cycle. Refer to the terrestrial wildlife species at risk section for a more detailed discussion of wolverine and grizzly bear.

Late successional forests

Broad-scale modelling estimates that under all alternatives the large tree size class would increase in abundance, as would concentrations of large trees, while the very large size class would remain relatively static, below the estimated natural range. Multistoried structure, which in some cover types can be a component of late-successional stage forest and old growth, would likely increase over time toward the NRV range under all alternatives, particularly in some cover types and broad potential vegetation groups. Although it is not possible to effectively model old growth, proxy indicators described in the old growth section lead to predictions that old forests would likely increase over time under all alternatives.

Snags

The majority of the HLC NF is in wilderness, RWAs, or IRAs where harvest, including salvage, would be prohibited or greatly limited and natural disturbances would be predominant, including fire that creates abundant burned forest conditions. Based on the expected levels of future disturbance, the vegetation analysis concluded that the snag resource will likely remain abundant but shift in location and size depending on a host of factors (see the Old Growth, Snags, and Coarse Woody Debris section 3.9).

Coarse woody debris

The majority of the HLC NF is in wilderness, RWAs, or IRAs where natural processes, including those acting on the amount and distribution of coarse woody debris, would predominate. Based on the expected levels of future disturbance, the vegetation analysis concluded that downed wood will likely remain abundant but shift in location and size depending on a host of factors (see also the Old Growth, Snags, and Coarse Woody Debris section 3.9).

Cave, cliff, rock or other geologically-determined habitats

The majority of the HLC NF is in wilderness, RWAs, or IRAs where disturbance to species using cave, cliff and rock habitats would be minimal. The Federal Cave Resources Protection Act of 1988 would provide assurance under all alternatives that caves listed as significant would be protected and maintained, through cooperation with other entities, and through participating in research, protecting information about the location of significant caves, and mapping and evaluating significant caves.

Effects common to all action alternatives

Aquatic, wetland, and riparian habitats

All action alternatives include direction to establish RMZs, intended to protect the integrity and function of riparian ecosystems. Although vegetation management, livestock grazing, or other activities could occur within riparian habitats, these activities would be constrained by plan components designed to protect watershed integrity, riparian habitats, and hydrologic function. RMZs are identified as not suitable for timber production. The adoption of RMZs would substantially increase protection of water quality and habitat conditions, particularly in areas east of the continental divide, where existing INFISH guidance does not apply. Establishment of RMZs would also be expected to increase the total acreage of riparian-influenced area in which protections for water and habitat quality would apply as compared to the no-action alternative. Management direction for RMZs would contribute to wildlife habitat connectivity and protection of plant species and animal communities associated with wetlands.

Direction for RMZs in the action alternatives is more comprehensive regarding vegetation management in riparian areas compared to the no-action alternative. This would allow for more likelihood in achieving desired conditions for vegetation associated with these areas. The plant species at risk section also provides a brief summary of potential effects to wetland-riparian, peatland, and aquatic vegetation guilds, noting that the 2020 Forest Plan provides more explicit protections for aquatic ecosystems than provided by the existing plans. Habitat quality is expected to improve for at-risk plant species in the peatland, wetland-riparian, and aquatic habitats under these alternatives. Those improvements in habitat quality would also likely represent improvements in habitat quality for terrestrial wildlife species that rely on those habitats.

Under all action alternatives, plan components describing specific desired conditions for aquatic, wetland, and riparian habitats would improve the likelihood of maintaining their integrity, resiliency, and connectivity. Delineation of RMZs (FW-RMZ-STD-01), clear and specific management constraints for those zones (FW-RMZ-STD-02-06), plan components for maintaining key habitat components (FW-RMZ-GDL-01, 02), and components for minimizing impacts to riparian and aquatic habitats (FW-RMZ-GDL-03-12) all would maintain or contribute to the long-term persistence of species dependent on these habitats.

All action alternatives include some species-specific or habitat-specific (fine-filter) plan components that would minimize impacts to certain wildlife species or groups of species using aquatic habitats. Table 70 displays those plan components and includes a brief description of the component and its effect on terrestrial wildlife species or habitats. For the exact wording of each component, refer to the 2020 Forest Plan.

Table 70. 2020 Forest Plan components that would affect terrestrial wildlife species associated with aquatic, wetland, and shrub habitats

Plan component	GA where applies	Summary of expected effects
FW-WL-GDL-03	Forestwide	Would protect western toad breeding sites from livestock trampling, and would direct livestock management so that emergent vegetation would be retained at those sites. This plan component would help maintain the integrity of these sites for western toads and for other species, including amphibians, birds, and small mammals.
FW-WL-GDL-04	Forestwide	Would help prevent the spread of pathogens to and among western toad breeding sites.
FW-WL-STD-01	Forestwide	Would ensure chemicals are not applied within 100 meters of known western toad breeding sites.
FW-WL-GDL-13	Forestwide	Would minimize the risk of impacts to amphibians from use of piscicides for fisheries management.
FW-WTR-DC-09; FW-WTR-GDL-01	Forestwide	Would direct managers to retain, where possible, beaver presence and complexes to maintain watershed and wetland habitat and resilience. Many wildlife species, such as moose, swans, migratory songbirds, amphibians, waterfowl, and others use habitats created and maintained by beavers.
RM-WL-DC-03; RM-WL-GDL-02; UB-WL-DC-03; UB-WL-GDL-02	Rocky Mountain Range; Upper Blackfoot	Would minimize management-related disturbance to and displacement of harlequin ducks on known breeding streams

Grass and shrub habitats

All action alternatives include desired conditions to generally maintain or increase the nonforested cover types to within the estimated natural range (FW-VEGT-DC-01, FW-VEGNF-DC-01, and FW-VEGNF-DC-03) with most of that increase in the grassland or shrubland cover types. All action alternatives also include plan components that emphasize the use of fire to achieve some vegetation objectives, and in some areas allowing fire to play more of its natural role as a process shaping ecosystems (FW-FIRE-DC-01, 03 and FW-FIRE-GDL-02). Fire is an important process in maintaining many grasslands and some shrublands, through removal of tree encroachment, and rejuvenation or restoration of some grass and shrub species. All action alternatives include plan components stating that "forage use by livestock should maintain or enhance the desired structure and diversity of plant communities on grasslands, shrub lands…" (FW-GRAZ-GDL-02), and include components that constrain grazing where not compatible with vegetation desired conditions, maintaining forage for wildlife, or other resource objectives.

All action alternatives include a guideline to emphasize restoration of sagebrush where it historically occurred (FW-VEGNF-GDL-01), which may benefit several bird species, including Brewer's sparrow. This emphasis would help to maintain or restore key winter habitats for use by elk, mule deer, and bighorn sheep where they occur. Emphasis on sagebrush may also benefit wintering mule deer. Additional specific desired conditions for nonforested types are also provided in all GAs except the Crazies and Rocky Mountain Range.

All action alternatives include some species-specific or habitat-specific plan components that would minimize impacts to certain species or groups of species using grass and shrub habitats. FW-WL-DC-06 and FW-WL-GDL-05 establish desired conditions and guidelines to minimize disturbance to big game on winter ranges, and FW-WL-DC-07 and FW-WL-GDL-06 call for maintaining or improving the availability of cover on or adjacent to big game winter ranges. FW-WL-GDL-01 calls for livestock management to maintain forage for wildlife use, and FW-WL-GDL-14 guides the Forest to manage identified seasonal habitat on NFS lands consistently with similar identified habitat on adjoining lands managed by other agencies, when those adjoining lands are managed for wildlife values. In general, this guideline is intended to foster consistent and coordinated management on big game winter ranges that consist of a mix of NFS land and state-owned wildlife management areas.

Forestwide standards FW-GRAZ-STD-03 and 04 require managers to apply BASI and up-to-date recommendations to achieve effective separation between domestic sheep and bighorn sheep. Wildlife plan components for the Big Belts, Elkhorns, Little Belts, and Rocky Mountain Range GAs include a standard to determine and establish the means with which to achieve effective separation between bighorn sheep and domestic sheep and goats. Plan component RM-WL-STD-01 for the Rocky Mountain Range GA prohibits domestic sheep or goat grazing on NFS lands, in order to minimize risk of disease transmission and to prevent potential conflicts with grizzly bears. These plan components, along with those discussed above that would maintain or restore grass and shrublands, would maintain bighorn sheep presence on NFS lands to the extent that NFS management actions are able to do so. Introduction of disease pathogens could still occur as a result of bighorn sheep coming into contact with domestic sheep and goats off NFS-lands, such as nearby or inholded private lands.

Hardwood tree habitats

The amount of hardwood tree habitat, which includes mainly aspen and cottonwood on the HLC NF, is lower than it likely was historically in some GAs. The desired condition is to maintain, or in some areas increase, the amount of these vegetation types. The desired condition specific to aspen is to generally increase its presence throughout the planning area, with more emphasis in some GAs (e.g. the Big Belts, Little Belts, and Snowies GAs) that are less in line currently with the historic range or where increasing aspen has been identified as desirable for other reasons, such as improving the quality and diversity of wildlife habitat. Modelling predicts a slight increase in aspen over time forestwide. Hardwood tree habitats on the HLC NF are often associated with wetlands and riparian areas; refer to the watershed section and to the section above on species associated with aquatic, wetland, and riparian habitats for a discussion of how plan components in the 2020 Forest Plan would maintain or restore function and resilience of aquatic, wetland, and riparian habitats.

As a result of components that would maintain or restore function in wetland and riparian habitats, and those that would maintain or restore hardwood (particularly aspen) types, habitat for wildlife species using this vegetation group would continue to be provided in the planning area, and is predicted to increase slightly at a forestwide scale. Refer to the terrestrial wildlife species at risk section for information about Lewis's woodpeckers; refer to sections below on snags for information pertaining to cavity-nesting birds, as that section includes consideration of all cover types, including aspen.

Dry conifer habitats

All action alternatives include components that identify desired conditions for the cover types that are included in the dry conifer habitat group. Forestwide and GA level desired conditions are to generally increase ponderosa pine and decrease Douglas-fir, as well as to increase the amount and distribution of large and very large trees in the warm dry broad PVT (e.g., FW-VEGT-DC-01, FW-VEGF-DC-01, FW-VEGF-DC-02, and FW-VEGF-DC-04). All action alternatives include plan components to allow fire to play a more natural role, where possible, in shaping ecosystems (FW-FIRE-DC-01, 03, and FW-FIRE-GDL-02). Ultimately, those components might allow fire to occur in a manner that promotes and maintains open-understory, mature ponderosa pine and limber pine forests in areas where those types historically occurred. This would improve habitat for species such as flammulated owl, Lewis's woodpecker (refer also to the at-risk species section), and other species that rely on mature, open-understory ponderosa pine as well as on snags. Increasing this type of habitat, as well as maintaining the amount of limber pine, could also increase the amount of transitional and winter range for ungulates such as elk and mule deer, and could improve connectivity between escape terrain and foraging areas in some areas for bighorn sheep. Maintaining or increasing limber pine at lower elevations may maintain or improve habitat for a wide variety of wildlife species associated with either grassland or montane conifer habitat types. Maintaining or increasing the amount and distribution of ponderosa pine and limber pine would provide a food source for Clark's nutcrackers that could be of increasing importance if whitebark pine continues to decline as a result of blister rust and mountain pine beetle (refer to high-elevation habitat discussion below).

Modelling of the estimated trend of limber pine, ponderosa pine, and Rocky Mountain juniper shows an increase in these cover types and tree species presence under these alternatives that would be likely indistinguishable from the trend estimated for the no-action alternative, although estimated trend varies somewhat by GA (see appendix H).

In summary, specific desired conditions for the cover types and tree species that comprise the dry conifer forest habitats would be more likely to result in moving the abundance and distribution of this type toward the historic or NRV. Plan components specifically aimed at maintaining or increasing dry conifer types, particularly ponderosa pine and limber pine, would result in maintaining or increasing available habitat for species that use dry conifer vegetation types.

Mixed conifer habitats

All action alternatives include components that identify desired conditions for the cover types that are included in the mixed conifer habitat group. Forestwide and GA level desired conditions provide specific direction to move toward the historic or NRV for conifer types (e.g. FW-VEGT-DC-01, FW-VEGF-DC-01, and FW-VEGF-DC-02) and structure within those types (e.g. FW-VEGF-DC-02, FW-VEGF-DC-03, FW-VEGF-DC-04, FW-VEGF-DC-05, and others) would provide conditions that allow populations of species dependent on mixed conifer forest to persist over the long term. Some species, such as marten, Canada lynx (see also at-risk species section), red squirrel, and others that rely on certain structural or seral stages, cover types, or combinations of those would be affected by trends in those specific habitat components. The 2020 Forest Plan identifies desired conditions for some key structural components, which are addressed separately (see below regarding large and very large trees, old growth, snags, and downed woody debris). In summary, specific desired conditions for the cover types and tree species that comprise the mixed conifer forest habitats would be more likely to result in moving the abundance and distribution of these types toward the historic or NRV. Consequently, the range of habitats would be maintained that support the full variety of wildlife species using mixed conifer forest for all or part of their life history.

High elevation habitats

All action alternatives include Forestwide and GA-level desired conditions for nonforested vegetation types, which includes alpine ecosystems (e.g., FW-VEGT-DC-01 and FW-VEGNF-DC-01). The desired conditions describe the components of healthy, resilient alpine ecosystems and the desired prevalence of nonforested types, providing the Forest with clear direction for restoring or maintaining these systems. The 2020 Forest Plan also includes desired conditions for whitebark pine (FW-VEGF-DC-01, FW-VEGF-DC-02, FW-PLANT-DC-01, 02 and FW-PLANT-GDL-01), and an objective (FW-PLANT-OBJ-01) for treating whitebark pine, providing clear direction to maintain or restore functional whitebark pine systems. These plan components would ensure that habitat continues to be available for species that are associated or dependent on alpine ecosystems.

Late successional forests

Unlike the no-action alternative, the action alternatives include specific desired conditions for large tree structure, at the forestwide scale as well as by broad PVT (FW-VEGF-DC-04); and desired conditions for the large and very large size class Forestwide and in all GAs (e.g. FW-VEGF-DC-02). The 2020 Forest

Plan includes guidelines (FW-VEGF-GDL-01) that provide specific information for retaining large and very large trees in order to contribute to achieving desired conditions. The same is true for snags based on size and vegetation group (FW-VEGF-DC-06 and FW-VEGF-GDL-02). Those desired conditions would be more effective than the current plans in maintaining or restoring large and very large trees as habitat on the HLC NF. The 2020 Forest Plan also includes desired conditions for old growth that are based on broad PVT (FW-VEGF-DC-05), recognizing that not all areas or vegetation types have the inherent capability to produce large and very large trees, or old growth as defined by BASI (refer to the glossary in the 2020 Forest Plan). The 2020 Forest Plan includes a guideline for old growth (FW-VEGF-GDL-04) designed to retain or enhance existing old growth and to promote development of old growth in the future. Thus, rather than trying to meet a numeric standard that may not be applicable in a particular area or vegetation type, the 2020 Forest Plan ensures that stands meeting the criteria for old growth are retained; management actions may only occur for the purpose of maintaining or restoring old growth characteristics or processes or to increase stand resilience. Only very specific, limited exceptions would be allowed and active management is therefore likely to impact only a very small fraction of old growth stands on the HLC NF.

The desired distribution of old growth is not specified in the 2020 Forest Plan, due to the uncertainty and variability associated with future disturbance processes; there is no literature available that quantifies the appropriate distribution for the old growth type and landscape conditions on the HLC NF, and the SIMPPLLE model NRV cannot be used for this purpose. The optimal distribution of old growth to provide for wildlife habitat varies by species and landscape, as well as by vegetation type. The 2020 Forest Plan provides the flexibility to recognize and adapt management practices to provide for a range of old growth patch sizes, while emphasizing that larger patches are desirable.

In sum, management identified in the 2020 Forest Plan would conserve existing old growth and promote the development of old growth in the future, which would be more effective at maintaining old growth habitat than management under the 1986 Forest Plans. 2020 Forest Plan components for large and very large trees and for old growth would ensure that large and very large trees, both alive and dead, along with late successional forests and old growth would continue to move toward desired conditions that include providing habitat for all wildlife species native to the plan area. In turn, adherence to the plan components, and movement toward desired conditions for these structure types would ensure that these habitats would continue to be available at current levels or in greater abundance than currently in the planning area.

Snags

All action alternatives have desired conditions and guidelines that direct management of snags during vegetation management projects. These are designed to retain snags in amount and pattern based on broad PVT and size (FW-VEGF-DC-06 and FW-VEGF-GDL-01), and guidance for distribution and retention of snags in vegetation management project areas (FW-VEGF-GDL-02) at an appropriate scale and pattern to facilitate use by wildlife. This guideline is specific to size class as well as vegetation type, recognizing that some size classes may be key but less abundant naturally, and that different vegetation types or groups naturally have differing snag abundance. Limited exceptions would be allowed to protect human safety in specified areas or situations. By providing clear direction, these exceptions would help to limit the situations and the extent to which snags may be removed for safety reasons, thus ensuring a relatively conservative approach to maintaining snag habitat for wildlife. FW-TIM-GDL-03 guides managers implementing salvage harvest to retain clusters of burned trees of a variety of sizes to provide habitat for wildlife.

These plan components, in addition to the fact that much of the HLC NF is in designated wilderness or inventoried roadless areas and therefore would be continue to be subject to natural forces such as wildfire, insect and disease (see effects common to all alternatives above), would ensure that adequate numbers, distribution, and variety of snags would continue to exist throughout the planning area, providing habitat for species that use snags for all or part of their life history requirements.

Coarse woody debris

All alternatives have desired conditions and guidelines that direct management of coarse woody debris during vegetation management projects. These are designed to retain downed woody debris in amount and pattern based on broad PVT (FW-VEGF-DC-07) recognizing that certain vegetation types have different inherent capability to produce woody debris. FW-VEGF-GDL-05 establishes the minimum amount of coarse woody debris that should be retained during vegetation management projects, with emphasis on larger debris that has higher value for wildlife. The guideline includes exceptions to provide for management of fire risk in specified areas after site-specific analysis.

Specific desired conditions for coarse woody debris and the guideline emphasizing retention of large-diameter debris for wildlife, in combination with the large amount of area on the HLC NF in which natural processes predominate, would ensure that this habitat continues to be available for wildlife species that use it for a portion of their life history needs.

Cave, cliff, rock or other geologically-determined habitats

The action alternatives include several components that provide direction for management of and relating to caves and cave habitats. The following plan components are relevant to this habitat:

- FW-WL-DC-08 establishes the desired condition that caves, mines, and underground habitats are relatively free of human disturbance.
- FW-WL-GDL-10 guides managers to avoid disturbing roosting, hibernating, or pup-rearing bats.
- FW-WL-GDL-11 guides managers to use measures to prevent disease spread in caves or mines used by bats.
- FW-WL-GDL-12 guides managers to not create new views of caves or access to caves known to be used by bats.
- FW-EMIN-DC-07 and FW-EMIN-OBJ-01 establish a desired condition and an objective for the number of abandoned mines to be reclaimed.
- FW-EMIN-GDL-03 states that seismic or other surveys or actions that use explosives not be carried out over or close to caves known to be used by bats.
- FW-BRDG-GDL-01 guides managers to time bridge removal or reconstruction to minimize impacts to nesting or roosting wildlife.

These plan components increase the likelihood that cave habitats would continue to support populations of bats and other species that rely on them.

The 2020 Forest Plan also includes a plan component (FW-WL-GDL-09) guiding managers to avoid disturbance at known raptor nesting and fledging areas, which would include cliffs used by peregrine falcons, golden eagles, prairie falcons, and other birds associated with those cliff habitats.

These plan components, combined with the fact that cave, cliff, and rock habitats are relatively inaccessible, and are affected primarily by geologic forces, and the large amount of area on the HLC NF that is in relatively inaccessible condition (e.g., designated wilderness, IRA, primitive or semi-primitive non-motorized ROS) would result in these habitats continuing to be available for species that use them for all or part of their life cycle. The plan components listed above would provide more protections for species using these habitats than would be provided under the no-action alternative.

Effects of forest plan components associated with:

Aquatic ecosystems and soils

The effects of these plan components are discussed under the section "species associated with aquatic, wetland, and riparian habitats" above.

Fire and fuels management

Plan components for fire and fuels management are intended to achieve the desired condition to maintain and enhance resources and allow fire to function in its natural ecological role (FW-FIRE-DC-01). Specific plan components are designed to provide for public and firefighter safety, reduce risk to high value resources such as adjacent communities, and minimize impacts to designated wilderness, recommended wilderness, and other areas that are managed to allow natural processes to predominate. Terrestrial wildlife species on the HLC NF evolved in ecosystems largely shaped by fire, so allowing fire to play its natural role, to the extent possible, would be expected to sustain ecosystem components and characteristics on which they depend. Some fire management activities could affect individual animals or local populations of some species that have small home ranges or use areas, through temporary displacement from areas where and when activities (such as fire suppression or fuels reduction) are taking place.

Terrestrial vegetation; plants at risk, and invasive plant species

Plan components for management of terrestrial vegetation are largely designed to maintain or move toward the NRV for ecosystem composition, structure, and function, and to maintain resilience in the face of disturbance (FW-VEGT-DC-01). Vegetation-related plan components also are intended to "provide habitat requirements to support populations of… native and desired nonnative species… based on the inherent capability of lands" (FW-VEGT-DC-03) and to "provide connectivity and allow genetic interchange to occur" (FW-VEGT-DC-04). Specific objectives, standards, and guidelines for vegetation, including forested and nonforested vegetation types, are designed to maintain or move toward desired conditions within the NRV for cover types, species or community presence, and vegetation structure; these are incorporated into and discussed in the specific habitat sections above. Plant species at risk, including whitebark pine, are to be recovered or sustained. Invasive plant species would be contained, controlled, suppressed, or eradicated (FW-INV-DC-01, 02, and 03). In sum, plan components for management of vegetation would sustain healthy, resilient plant communities on which terrestrial wildlife species depend for food, cover, breeding/nesting/denning, and movement among different habitats, use areas, or seasonal ranges.

Terrestrial wildlife habitat management

Most of the plan components relating to terrestrial wildlife are discussed in the sections above. In general, desired conditions would guide managers to provide for a diversity of wildlife habitats that would support most native species within the planning area, provide for connectivity among and within NFS parcels in the planning area, and provide for seasonal or other important wildlife habitats. Goals relating to terrestrial wildlife would encourage coordination with MFWP and other agencies that manage wildlife or habitats, which would facilitate effective management across administrative boundaries and throughout the ranges of many species. Standards and guidelines in the 2020 Forest Plan and action alternatives would limit or mitigate potential impacts to wildlife or habitats of a variety of management actions.

Recreation settings, opportunities, access, and scenery

Certain recreation activities have the potential to impact terrestrial wildlife species by the simple fact of humans recreating in their habitat. Plan components in the action alternatives do not directly constrain public uses, but set desired conditions, guides placement of recreation facilities, place constraints on permitted recreation activities, and establishe the general types of recreational uses allowed or expected to occur in specified portions of the planning area. Certain types of human recreational activities have the potential to affect various wildlife species, but impacts depend on the type of activity, species present, species' habitat needs and life history factors, etc. Plan components that guide management of recreation activities have the potential to affect the degree to which recreation could impact wildlife, in both positive and negative ways. Table 71 shows the plan components that have some relevance to wildlife or habitats, and a brief summary of the potential effects of those components on wildlife or habitats.

Table 71. 2020 Forest Plan components for management of recreation that could affect terrestrial wildlife species or habitats

Plan Component	Description	Potential Effect to Wildlife or Habitat
FW-ROS-DC-01 to 13; STD-01 to 05; GDL-01 to 10; and SUIT 01-34.	Desired distribution of ROS classes, desired condition within those classes and standards and guidelines to meet desired conditions	More than half of HLC NF is in the two nonmotorized categories that would provide large amount of habitat with no potential disturbance or displacement by motorized travel. Vegetation conditions would be largely determined by natural processes, and developed recreation would be minimal. Over half the HLC NF lands would provide habitat with minimal human influence. Other ROS classes have defined desired conditions and varying impacts to wildlife depending on site-specific factors within those areas.
FW-REC-DC-03; FW-REC-DC-04; FW-REC-DC-06; FW-REC-DC-07;	Desired conditions for developed recreation sites and facilities and dispersed recreation camping sites	Establishes desired conditions that help concentrate developed recreation, minimize impacts to threatened and endangered wildlife and to vegetation, and minimize conflicts with other resources. However, providing for recreation opportunities potentially brings humans into wildlife habitat.
FW-REC-OBJ-02	Remove or relocate number recreation facilities out of RMZs	Would improve riparian habitat at those sites and in vicinity; also may improve connectivity within and among riparian habitats
FW-REC-GDL-01	Management of developed recreation is responsive to environmental changes	Directs management to address issues that may arise regarding various factors, potentially including changes in amount, distribution, or location of wildlife habitats or other wildlife-related issues.
FW-REC-GDL-03; FW-REC-GDL-04; FW-REC-GDL-05	Constraints on developed recreation facilities and impacts related to groundwater-dependent ecosystems and riparian zones	Components would maintain water quality and flows, and reduce impacts to riparian areas. Would maintain or improve habitat in or associated with those sites, may improve riparian habitat connectivity.
FW-REC-GDL-07	Use native seed for plantings	Would minimize potential of wildlife to be attracted to nonnative vegetation and potentially come into conflict with humans near access roads and developed sites; also maintains native vegetation and minimizes risk of potentially invasive plant species.
FW-RSUP-DC-01; FW-RSUP-DC-02; FW-RSUP-DC-03	Provide for opportunities, experiences, services, and jobs	Providing for recreation special uses potentially brings humans into wildlife habitat.
FW-RSUP-GDL-01	Recreation special uses mitigates conflicts with other resources	Would minimize or reduce potentially negative impacts occurring to wildlife or habitats.
FW-ACCESS-DCs (all); FW-ACCESS-GO-01; FW-ACCESS-GDL-02	Provides system of roads, trails, and airstrips for public access to NFS lands	Providing access to humans potentially brings humans into wildlife habitat. Total mileage, density, and other characteristics of access routes would have varying potential impacts to wildlife species and habitats that vary according to site, area, species, and type of habitat. Refer also to grizzly bear section of At-Risk Species section for details regarding impacts of motorized access to bears.
FW-ACCESS-GDL-01	Rehabilitation of unauthorized routes	Would restore habitat and remove human impacts on a site-specific basis.

Plan Component	Description	Potential Effect to Wildlife or Habitat
DI-SHRA-DC-01, DI-SHRA-DC-02	Provides for dispersed, non-motorized recreation in the South Hills Recreation Area (SHRA)	Provides for recreation opportunities in proximity to the city of Helena that potentially brings humans into wildlife habitat
DI-SHRA-GDL-01	Constrains vegetation management in the SHRA	Emphasis on visitor safety and fuels reduction could result in some impacts to wildlife habitat
DI-SHRA-SUIT-02	SHRA not suitable for off-trail mechanized transportation	Would limit some potential impacts of specific recreation activities to established roads and trails, thus limiting some potential for disturbance of wildlife
SN-GVRA-DC-01 SN-GVRA-DC-02 SN-GVRA-DC-03	Provides for developed and dispersed non-motorized recreation in the Grandview Recreation Area (GVRA)	Provides for recreation opportunities that potentially bring humans into wildlife habitat
SN-GVRA-SUIT-01	GVRA is suitable for mechanized transportation only on established roads and trails and within established WSA limits	Would limit some potential impacts of specific recreation activities to established roads and trails, thus limiting some potential for disturbance of wildlife
SN-GVRA-SUIT-03	GVRA is suitable for motorized over-snow travel as established by travel planning	Provides for motorized recreation opportunities in winter that could potentially bring humans into wildlife habitat and has the potential to disturb wildlife in those habitats

In summary, plan components for management of recreation would potentially result in some impacts to some individual animals where specific facilities exist or activities occur, but would minimize impacts to individual animals and to wildlife populations by including constraints designed to reduce conflicts, disturbance, displacement, or negative impacts to habitat. Some components would improve wildlife habitat by moving facilities out of sensitive areas such as riparian areas, and by rehabilitating unauthorized access routes. These plan components would be supported by components in the wildlife section that are designed to minimize impacts to wildlife in key habitats and/or at specific times of year.

Designated areas, including recommended wilderness

Plan components for designated areas vary in potential effects on wildlife and habitats, depending not only on species and habitat but also on type of designated area. Plan components for designated wilderness areas (FW-WILD) support the provisions of the Wilderness Act of 1964, providing areas free of mechanized and motorized uses, where natural processes would be the primary forces affecting vegetation. FW-WILD-DC-03 establishes the desired condition that designated wilderness areas would contribute habitat and connectivity for wildlife species with large home ranges. FW-WILD-GDL-01 would protect aquatic and riparian habitats from recreational livestock use, and FW-WILD-GDL-02 would ensure that caves (which may provide habitat for bats) would be protected from exploitation by recreational users.

Plan components for RWAs are similar to those for designated wilderness; FW-RECWILD-DC-02 establishes that these areas would have a natural environment where ecological process are the primary forces affecting the environment, and FW-RECWILD-SUIT-02 through 08 identify activities, such as timber production and harvest, commercial uses, and road construction that should not occur in these areas. FW-RECWILD-SUIT-01, which is included in alternatives B, D, and F, states that mechanized and motorized uses are not suitable in RWAs, but some such uses may be allowed for specified purposes or if already existing in these areas. This could result in a somewhat lower potential for disturbance or displacement of certain wildlife species in those alternatives compared to alternatives C and E. In alternative C, existing motorized and mechanized uses would be suitable in RWAs, while in the other alternatives those uses would be unsuitable. The amount and distribution of RWAs would also vary by alternative (refer to recommended wilderness section on Designated Areas). In general, however, plan components for RWAs would provide for wildlife habitats similar to that described above for designated wilderness areas. Furthermore, because RWAs overlap with IRAs (see below), the differences among alternatives would likely be slight.

Plan components for IRAs support the provisions of the FS Roadless Area Conservation Rule (U.S. Department of Agriculture, Forest Service, Washington Office, 2001). Plan components establish IRAs as large, undisturbed, unfragmented areas of land (FW-IRA-DC-01) where natural processes predominate (FW-IRA-DC-02). As such, these areas provide for wildlife habitats similar to that described above for designated wilderness areas and RWAs.

Plan components for eligible WSRs are intended to support or maintain the outstanding remarkable values for which the segment is identified. Plan components vary according to those values (FW-WSR-GDL-01), which include wildness, scenic value, or recreational value. Whether wildlife habitat would be emphasized for eligible WSR segments depends on the segment, each of which is described in the 2020 Forest Plan. Where the primary emphasis is recreation, wildlife habitat value would not be emphasized but that does not mean wildlife habitat values could not be maintained or improved (refer to discussion of effects of plan components for management of recreation, above). Where the primary emphasis is fish or wildlife, maintaining or improving those habitats would likely be a primary management emphasis. Effects to wildlife or habitats would primarily occur at a site-specific level or at the scale of the river segment and would depend on the species and habitat present or potentially present in the area.

Plan components for national recreation trails, the Continental Divide Scenic Trail, the Lewis and Clark Historic Trail, and the Lewis and Clark Interpretive Center all support the specific purposes of those trails and the interpretive center. The management emphasis of these designations is specific recreational or interpretive opportunities, which potentially brings humans using these areas into wildlife habitat. Management of recreation occurring in these areas would be subject to the plan components discussed above (refer to discussion of effects of plan components for management of recreation, above). Plan components for the Continental Divide National Scenic Trail provide for minimizing human impacts and evidence of modern human activities, including motorized travel, but the presence and management of this trail also attracts a substantial number of forest visitors using portions of the trail. Therefore, impacts of plan components that manage for these characteristics would likely have mixed impacts to wildlife that would vary according to location, habitat, species, and level of human activity.

Plan components for management of RNAs support the purposes for which these areas are designated, which vary by individual area but that emphasize research, education, and/or maintenance of biological diversity. Most RNAs are relatively small in size, but often support unique or unusual plant communities that may provide correspondingly unique or uncommon habitat features. Plan components constrain management actions to ensure that natural processes predominate in these areas with limited human influences (FW-RNA-DC-01). Therefore, these areas contribute relatively undisturbed habitat for the species that inhabit them, which varies by area (refer to the 2020 Forest Plan).

Cultural, historic, and tribal resources

Few plan components for these resources would have effects to terrestrial wildlife species or habitats. FW-OFP-DC-01 establishes a desired condition of “healthy, sustainable, and harvestable populations of culturally significant flora and fauna are available to ensure the rights reserved by Native Americans”. This plan component would provide for maintaining those plant and animal species or habitat of cultural importance but would also provide for harvest of some of those species.

Land status and ownership and land uses

Plan components for these resources include providing public access to NFS lands (FW-LAND-DC-02 and FW-LAND-OBJ-01), which could potentially bring humans into wildlife habitats, depending on the location of the access points. FW-LAND-DC-03 guides managers to protect wildlife habitat, riparian areas, and other natural resource values when managing lands. Plan components for Land Uses accommodate the needs for various uses such as utility and energy corridors and road uses, all of which could have impacts to wildlife depending on their location relative to specific habitats and the nature and timing of activities in those areas. Guidelines for land uses direct managers to maintain riparian habitat conditions (FW-LAND USE-GDL-03 through 06), as well as to consolidate utility infrastructure and activities that would potentially reduce impacts of land use activities on wildlife species and habitats.

Infrastructure

Desired conditions for infrastructure are to provide for a safe and effective transportation system that is sustainable and has minimal impacts on other resources. Other components establish objectives for decommissioning some roads while maintaining, reconstructing, or improving others. Standards and guidelines establish or constrain certain management practices for the purposes of limiting impacts to riparian and aquatic systems, soils, and some wildlife habitats. Roads and other infrastructure may impact wildlife by occupying former habitat. Activity associated with roads, bridges, and other infrastructure may displace wildlife and may inhibit connectivity. Standards and guidelines regarding placement, decommissioning, and other management of roads, bridges, and other infrastructure may help to limit those impacts.

Livestock grazing

Desired conditions for livestock grazing are to provide for sustainable grazing opportunities while supporting stable soils, diverse plant species composition, and wildlife habitat and forage needs. Standards and guidelines for grazing management would maintain or improve riparian and aquatic habitats, consider the forage and other habitat needs of wildlife species, and support coordination with MFWP. Although livestock grazing can impact wildlife through direct competition for forage or through displacement from some habitats, plan components for management of grazing would help to ensure that adequate forage and other habitat needs for native wildlife species would be met.

All alternatives would preclude reauthorization of domestic sheep allotments without a site-specific risk assessment for potential contact of domestic sheep and goats with bighorn sheep. The risk of contact associated with existing stocked allotments is low because these allotments are approximately 10 or more air miles from the nearest existing bighorn sheep occupied habitat, which likely provides effective separation.

Across the plan area, bighorn sheep occur in 4 GAs. There is currently one active domestic sheep allotment, which occurs in the Big Belts GA. The risk of contact between domestic sheep and bighorn sheep in the Big Belts GA is low because the nearest bighorn sheep occupied habitat is approximately 10 air miles from the active allotment. The other three GAs with known bighorn sheep populations (Rocky Mountain Range, Little Belts, and Elkhorns) have vacant, non-stocked domestic sheep allotments, as do the Big Belts and Snowies GAs. The Upper Blackfoot GA, which does not have occupied bighorn sheep habitat, has one active domestic sheep allotment; this allotment is also approximately 10 or more air miles from existing occupied bighorn sheep habitat occurring in other GAs. Grazing with domestic goats for weed control purposes has occurred sporadically across multiple GAs in recent years.

Currently, the risk of contact between domestic sheep and goats and bighorn sheep in the Little Belts GA is low because the domestic sheep allotments in the GA have been vacant for many years. Bighorn sheep have been observed on summer range that overlaps with at least one of these vacant allotments. If new proposals are brought forward during the life of the plan to restock these allotments, an updated site-specific risk assessment would be prepared to evaluate the risk of that proposal in order to ensure domestic sheep or goat grazing activities do no pose a risk to the persistence of bighorn sheep on NFS lands. Plan components for grazing intended to protect bighorn sheep from disease transmission would be supported by plan components retained from the Grizzly Bear Amendments intended to minimize potential conflict between grizzly bears and domestic sheep in the primary conservation area and Zone 1.

Timber harvest

Desired conditions for timber harvest are to contribute to sustainable harvest, improve resilience of the timber resource, and contribute to local and area economies. Objectives establish anticipated sale quantities by alternative, with alternative E generally offering more timber and wood sale quantity than the other alternatives. Standards and guidelines for management of timber harvest would constraint harvest activities to protect soils and watersheds, promote restocking, limit clearcutting and even-aged harvest, manage opening sizes, and promote the achievement of vegetation desired conditions. Although timber harvest, and activities associated with timber harvest (temporary road construction, increased human presence, noise, etc.) may displace wildlife or degrade or alter certain wildlife habitat components, plan components relating to timber harvest would limit some impacts to wildlife, particularly those tied to certain harvest practices that create openings or even-aged stands. Plan components for timber harvest would also move vegetation toward desired conditions including those for openings and even-aged stands that are generally consistent with the estimated NRV and therefore similar to openings or disturbances resulting in even-aged stands caused by natural processes such as insects and wildfire. Plan components for some terrestrial wildlife would constrain some management activities, including potentially the size and distribution of harvest-created openings or of even-aged harvest. These components would be applied at the project scale but analyzed in the context of appropriate species or other analysis units and cumulative to other activities occurring on the landscape.

Special Uses

Plan components for special uses support authorizing uses of NFS lands and resources for public benefit. The impacts of these components would vary in their effects to wildlife or habitats, depending on the type and nature of uses authorized. Most activities associated with special use permits would also be subject to additional plan components relating to the specific activity authorized.

Geology, energy and minerals

Plan components relevant to wildlife and relating to management of caves and mines are discussed above in the section on species associated with cave, cliff, and rock habitats.

Desired conditions for management of energy and minerals include contributions to the economy as well as contributing to the supply of mineral and energy resources. Standards and guidelines direct management of superfund sites and constrain management actions to minimize impacts to aquatic and riparian resources and wildlife habitats. Extraction or production of minerals or energy resources could impact wildlife or habitats through direct displacement due to infrastructure or activities associated with those activities, but plan components for managing minerals and energy resources would help to limit those impacts.

Alternative A, no action

Aquatic, wetland, and riparian habitats

The aquatic ecosystems section summarizes the management direction for aquatic and riparian systems in the 1986 Helena NF and Lewis and Clark NF plans, and discusses potential impacts to aquatic and riparian systems of continuing to implement those plans. Briefly, the 1986 Lewis and Clark NF Plan includes forestwide direction for riparian management areas (MA-R); MA-R is not specifically delineated nor mapped and would likely continue to be identified and managed on a site-specific basis during project planning. The 1986 Lewis and Clark NF Plan also includes standards that would guide or limit certain management actions in order to maintain water quality, sustain soil and site productivity, and revegetate some disturbed areas. The 1986 Helena NF Plan includes general guidelines to delineate and buffer riparian areas on a site-specific basis prior to management activities; west of the continental divide (the Upper Blackfoot GA and a portion of the Divide GA) the INFISH would continue to apply. Management Areas established in the 1986 Helena NF Plan include standards and goals for protecting watershed, soil, water quality, and fisheries and riparian areas.

Under alternative A aquatic, wetland, and riparian habitats would mostly be identified and managed on a site-specific basis, because the existing plans do not incorporate a watershed approach to management of hydrology and watershed processes. Desired conditions for these habitats would not be as clearly identified as in the action alternatives. The likely result of continuing to implement these plans would be the continued protection of areas currently in satisfactory condition, while areas in unsatisfactory condition would likely remain unchanged. Lack of watershed-level desired conditions and plan components could lead to disruptions in existing connectivity, or to not restoring connectivity within and among these habitats. These two factors would likely result in variability in the long-term integrity of these types of habitats. West of the Continental Divide, direction provided under INFISH would provide somewhat more protection for water quality and riparian habitat conditions than areas east of the divide.

Plan components for managing identified riparian areas, implementation of existing BMPs, and plan components for protecting some wildlife species and sensitive habitats would likely minimize impacts on a project-by-project basis, with the result that species dependent on aquatic, wetland, and riparian habitats would persist over the long term, as they have during the more than thirty years of implementing the 1986 Forest Plans.

Grass and shrub habitats

Standards, guidelines, and recommendations to minimize impacts of various human activities on identified big game winter range, which includes this vegetation type, are found throughout the 1986 Forest Plans. Both 1986 Forest Plans identify certain management areas where management emphasis is on maintaining big game winter range or other foraging habitat, both of which include the grass/shrub vegetation type. The 1986 Forest Plans, however, lack specific desired conditions or objectives for the amount and distribution of the grass/shrub vegetation type, that could result in variability or unpredictability in the degree to which these types would be maintained or restored in the future. During the more than thirty years in which the 1986 Forest Plans have been in place, grass and shrub types appear to have decreased somewhat in overall acreage from the historic condition due at least in part to lack of specific desired conditions for this type, and lack of emphasis on certain natural processes, such as fire, that historically maintained this type. Conversely, a warming climate could result in an increase in grass and dry shrublands in some areas.

Both the 1986 Helena NF and the Lewis and Clark NF plans include standards and guidelines intended to ensure presence of big game, especially elk, during the hunting season. These plan components are largely aimed at providing hiding cover or other security from disturbance by humans in order to maintain hunting opportunities. A detailed discussion of the effects of these plan components on elk can be found in the elk section.

Gray wolves, listed currently as a RFSS, would continue to be considered sensitive under this alternative. Wolves may prey on a variety of mammals found in a variety of habitats, but ungulate prey and social tolerance are likely key to wolf persistence across the planning area. Under this alternative, the continued presence of ungulate species, supported in part by grass and shrub habitats, would continue to support wolves in the planning area.

Bighorn sheep are identified as a RFSS and would continue to be considered as such under the no-action alternative. The 1986 Forest Plans do not have components specific to bighorn sheep; there are no standards or guidelines regarding separation of bighorn sheep from domestic sheep and goats. Although site specific direction could be created to address this issue, the lack of plan standards or guidelines could make it less likely that effective separation of bighorn sheep and domestic sheep is created or maintained, presenting a slightly higher risk of disease transmission and consequent impacts to bighorn sheep herds than that of the action alternatives. Plan components retained from the Grizzly Bear Amendments intended to minimize potential conflict between grizzly bears and domestic sheep in the primary conservation area and Zone 1 could provide some protection for bighorn sheep in those areas.

Hardwood tree habitats

The 1986 Forest Plans lack specific desired conditions or objectives for the amount and distribution of the hardwood tree vegetation types, which could result in variability or unpredictability in the degree to which these types would be maintained or restored in the future. Aspen and other hardwood tree habitats appear to be below historic levels, particularly in some GAs (Big Belts, Little Belts, Snowies, and Upper Blackfoot), although the wide variance in the estimated NRV makes this determination somewhat uncertain. Forestwide, aspen and cottonwood distribution is at the lower bound of the NRV, and particularly below the NRV in the warm dry PVT and especially in the Little Belts, Snowies, and Upper Blackfoot, Highwoods, and Snowies GAs. These declines relative to historic levels have likely occurred over a long time period but have included the time in which current plans have been in place. The estimated declines in aspen and hardwood types have likely been a result of fire exclusion, reduction in scouring stream flows, and changing climate, but the absence of desired conditions or plan components for this vegetation type does not provide the Forest with specific guidance to maintain or restore hardwood habitats. Species that use this habitat group for all or part of their life cycle continue to exist in the planning area, and habitat would continue to be provided, albeit possibly at lower levels than under other alternatives.

Dry conifer habitats

Mature ponderosa pine appears to have declined over time relative to its historic presence (refer to the terrestrial vegetation section), although this trend likely began well before the 1986 Forest Plans were implemented. The 1986 Forest Plans lack specific desired conditions or objectives for the amount and distribution of the dry conifer vegetation types, which could result in variability or unpredictability in the degree to which these types would be maintained or restored in the future. The lack of specific desired conditions for certain cover types also could result in continued declines in some tree species (such as ponderosa pine or limber pine) or certain age or size classes of some species within this group. Modelling of the estimated trend of limber pine, ponderosa pine, and Rocky Mountain juniper shows a slight increase in these cover types and tree species presence under this alternative that would likely be indistinguishable from the trend estimated for the action alternatives, although estimated trend varies somewhat by GA.

Species that use this habitat group for all or part of their life cycle continue to exist in the planning area, and habitat would continue to be provided. Refer to the terrestrial wildlife species at-risk section for a discussion of impacts of the alternatives to flammulated owls and to Lewis's woodpeckers.

Mixed conifer habitats

The lack of specific desired conditions for certain cover types in the 1986 Forest Plans could result in forest composition and structure that is not reflective of the historic or natural range. Some cover types in this group, such as lodgepole pine and spruce/fir, are above or below the natural range for those types depending on the GA; refer to terrestrial vegetation section and the assessment (U.S. Department of Agriculture, Forest Service, Northern Region, 2015) appendix H, and the terrestrial vegetation section. Without specific desired conditions or other direction to move these types toward the NRV, this trend could continue. Management would not be compelled to guide these habitats toward the NRV, even though modelling predicts little variation across alternatives because natural disturbances impact vegetation conditions to a much greater extent than management activities. This could benefit some species that rely on this vegetation group but would potentially decrease habitat for species relying on other types, such as dry conifer forest or open grasslands and shrublands.

Species that use this habitat group for all or part of their life cycle continue to exist in the planning area, and habitat would continue to be provided. Refer to the terrestrial wildlife species at-risk section for a discussion of impacts of the alternatives to Canada lynx.

High elevation habitats

The 1986 Forest Plans do not have specific desired conditions for nonforested habitat types such as alpine ecosystems or whitebark pine. Nevertheless, high elevation habitats are relatively uninfluenced by forest management. Therefore, habitat would continue to be available for species that use high-elevation ecosystems.

Late successional forests

In addition to the estimated trend of size class and vertical structure predicted under all alternatives, the 1986 Forest Plans include components for managing large trees and old growth. The 1986 Forest Plan for the Helena NF requires a percentage of each third-order drainage to be maintained in old growth, whereas the 1986 Forest Plan for the Lewis and Clark NF requires a percentage of the commercial forest in each timber compartment to be maintained in old growth. Evaluation of compliance with this requirement occurs during project-level analysis, because old growth is most accurately identified in the field. Future modelling or estimation of old growth is not possible because of the complexity of characteristics that define old growth stands. Therefore, under alternative A the total amount and distribution of old growth would continue to be measured and applied on a site-specific basis, without an overall desired condition based on historic range or on ability of a GA or vegetation type to produce old growth. Compliance with forest plan standards would continue to be difficult to measure, and therefore it could be difficult to predict the amount and spatial arrangement of these habitats that would occur under this alternative. Nevertheless, modelling of some of the components of old forest, as described in the old growth section, indicates that old forest may increase over time under this alternative.

Snags

The 1986 Forest Plans have specific standards or guidelines for retention of snags. The 1986 Helena NF Plan specifies the number of snags per acre to be achieved by third-order drainage, identifies preferred species to be retained as snags, and provides numeric standards for snag retention in “cutting units”. The 1986 Helena NF Plan also recommends that snag standards be met on lands other than those identified for timber production. The Lewis and Clark 1986 Forest Plan recommends the number of snags per acre to be achieved within specified size classes and timber types and provides guidance about the distribution and location of snags to be retained during harvest or vegetation management activities. Although these plan components provide direction that requires stand retention and management, they have been found to be difficult to implement due to lack of clarity regarding scale of the requirements. Components regarding snag management in the existing plans also are in conflict with plan components or other requirements regarding safety management and desired conditions for certain developed recreation sites. Nevertheless, snag management under the 1986 Forest Plans has helped to retain snags where management activities occur that could reduce or eliminate snags. In combination with the fact that much of the HLC NF would continue be subject to natural forces such as wildfire, insect and disease (see effects common to all alternatives above), continued implementation of the 1986 Forest Plans would ensure that snag habitat would continue to be available in the planning area.

Coarse woody debris

The 1986 Helena NF Plan does not include components specifically regarding coarse woody debris. The 1986 Lewis and Clark NF Plan includes only one forestwide standard related to coarse woody debris as wildlife habitat, providing general recommendations for retaining “down trees” for wildlife. Without specific guidance to retain coarse woody debris, the abundance and distribution of this habitat may continue to be driven primarily by other resource needs (i.e., soil development and fuels management) without specifically addressing wildlife habitat values. As noted above, however, the large proportion of the HLC NF that is in areas where natural processes would predominate would likely ensure that coarse woody debris continues to occur throughout the planning area, providing habitat for those species that use this habitat feature for all or a portion of their life history needs.

Cave, cliff, rock or other geologically-determined habitats

The 1986 Helena NF Plan includes a component requiring managers to identify nesting territories and roosting sites for peregrine falcons and to protect them from “habitat alteration”. The plan also includes a requirement that powerlines constructed within peregrine falcon nesting habitat be designed to “protect raptors from electrocution”. Plan components for mineral development (including hard rock mining) include only general references to protection of resources, and there are no plan components that specifically address mines as habitat, mine closures, or caves. Under this alternative, therefore, on the Helena NF portion of the HLC NF, there would continue to be lack of specific guidance regarding these habitats, particularly cave and cave-like habitats that may be used by bats.

The 1986 Lewis and Clark NF plan includes a standard requiring managers to maintain peregrine falcon “essential habitat (currently unoccupied)”; at the time the plan was written, peregrine falcons were listed as threatened under the ESA but have since recovered, reoccupied many former habitats, and been removed from that list. The 1986 Lewis and Clark NF plan also includes standard requiring inventory and evaluation of found “caves, sinkholes, and other connected geological features”, with protections “based on their resource values and classification”. The plan requires development of individual cave management plans for caves classified as significant, and evaluation of those caves before ground-disturbing activities to determine effects on “the cave structure and its ecosystem”. The plan includes a standard stating that caves with high resource values may be withdrawn from mineral entry. The cave-related standards on the Lewis and Clark NF portion of the HLC NF would increase the likelihood of caves used by bats being identified and those habitats potentially protected, as compared to the Helena NF portion.

Current standard practice on the Helena NF portion of the HLC NF is to conduct bat monitoring surveys (e.g., visual, acoustic, or live trapping) at individual inventoried abandoned mine features before closure, to determine whether RFSS (fringed myotis, long-eared myotis, and Townsend’s big-eared bat) may be present. Similar surveys on the Lewis and Clark NF side are often, but not always carried out. The type and extent of survey conducted by Forest staff is dependent on factors such as extent of mine workings, timing of mine activity, proximity to water and forage opportunities, timing of closure, method of closure (i.e., grate, culvert, hard closure) and review of past area or site specific bat surveys. These practices, although not mandated by current plans, would likely continue under this alternative.

Because most cave, cliff and rock habitats are relatively inaccessible, and are affected primarily by geologic forces, habitat for species that use them for all or a portion of their life history needs would likely continue in the planning area under this alternative.

Cumulative Effects

The cumulative effects analysis area for terrestrial wildlife diversity considers management of adjoining lands. Portions of the HLC NF adjoin other NFs, each having its own forest plan. The HLC NF is also intermixed with lands of other ownerships, including private lands, other federal lands, and state lands. Some adjacent lands are subject to their own resource management plans. The cumulative effects of these plans in conjunction with the HLC NF 2020 Forest Plan are summarized in Table 72, for those plans applicable to terrestrial wildlife diversity.

Table 72. Cumulative effects to terrestrial wildlife diversity from other resource management plans

Resource plan	Description and Summary of effects
Adjacent National Forest Plans	The forest plans for NFS lands adjacent to the HLC NF include the Custer-Gallatin, Lolo, Flathead, and Beaverhead-Deerlodge NFs. The Flathead plan has recently been revised and the Custer-Gallatin plan is currently being revised under the 2012 Planning Rule; plan components are similar and complementary to the 2020 Forest Plan, with components to maintain wildlife species diversity. The existing plans for all adjacent forests provide for wildlife diversity and include components specific to particular wildlife species or habitats, depending on concerns or needs specific to those areas.
BLM Resource Management Plans (RMP)	BLM lands near the HLC NF are managed by the Butte, Missoula, and Lewistown field offices. The Butte and Lewistown plans were recently revised (2009 and 2019 respectively) while the existing plan for the Missoula area is under revision. Primary issues for the Butte area plan included vegetation communities, wildlife and wildlife habitat, wildlife and plan species with special status or identified as priority for management, travel and access management, recreations, and special designations. Components for the revised Missoula plan are expected to be similar to those in the Butte plan but specific to needs of that resource management area.
National Park Service - Glacier National Park General Management Plan 1999	The general management plan for Glacier National Park calls for preserving natural vegetation, landscapes, and disturbance processes. The philosophy is to manage for the wild character and integrity of the natural heritage of the park, while providing for visitor services and facilities in areas managed for those uses. Management for natural vegetation and processes on lands that are immediately adjacent to lands on the Rocky Mountain Range GA of the HLC NF provides relatively consistent management of wildlife habitat across a large area.
Natural Resources Conservation Service – Montana Sage Grouse Initiative 2016	Portions of the eastern part of the HLC NF adjoin identified general habitat for sage grouse. Conservation focus is on private lands. Primary threats include cultivation of grazing lands, exurban development, grazing, nonnative plants, range management infrastructure, mesic area loss and degradation, conifer encroachment, and fence collisions. Conservation of sage grouse habitat also provides habitat for grass/shrub associated species that use HLC NF lands for part of life history needs.
Montana Statewide Forest Resource Strategy (2010)	MT conducted a Statewide assessment of forest resources and identified issue-based focus areas with implementation strategies and deliverables for each. Focus areas include biodiversity and resilience, including management and recovery of species diversity. Strategies supporting this focus area are consistent with management to provide for native species diversity on adjoining or nearby NFS lands. Focus areas also include changing ownership patters, and include strategies to minimize fragmentation of habitat, by prioritizing “at-risk” areas for management. This would complement HLC NF 2020 Forest Plan components to work with other entities to maintain or restore connectivity among landscapes.
Montana State Parks and Recreation Strategic Plan 2015-2020	These plans guide the management of state parks, and are generally focused on specific recreational, historic, cultural, or scenic values, depending on the specific park. Goals include managing for those values in a manner consistent with available resources; these goals could be consistent with maintaining wildlife diversity on NFS lands, but would not necessarily contribute to the desired conditions as described for the HLC NF.
Montana’s State Wildlife Action Plan	Identifies community types, focal areas, and species in Montana with significant issues that warrant conservation attention. Communities include aquatic and terrestrial habitats. Specific regional focus areas found in proximity to the planning area include the North Fork of the Blackfoot (Scapegoat Wilderness). Several of the amphibian, bird, fish, mammal, and reptile species identified of greatest conservation need that may be found in the HLC NF planning area. This plan is complementary to, and provides information in support of desired conditions to maintain wildlife diversity, and supports recovery and conservation of species identified as ‘at-risk’ in the HLC NF plan.
County wildfire protection plans	Some county wildfire protection plans map and/or define the WUI. The HLC NF notes that these areas may be a focus for hazardous fuels reduction, and other plan components (such as NRLMD) have guidance specific to these areas. Managing for open forests and fire adapted species may be particularly emphasized in these areas. Overall, the effect of

Resource plan	Description and Summary of effects
	the county plans would be to influence where treatments occur to contribute to desired vegetation conditions.
County Growth Policy Plans	The HLC NF comprises 10 counties, each of which has individual growth plans of varying complexity. In general, most include support for recreation and tourism opportunities, many of which are based on natural landscapes and resources, including wildlife resources. Some plans include focus on access to public lands, and some focus on economic development through resource extraction. As such, plans may support some aspects of wildlife diversity while potentially having a negative impact on others.

Conclusions

Under the action alternatives, desired conditions for a variety of vegetation systems would bring habitat conditions throughout the HLC NF closer to the estimated NRV, and would provide a diversity of habitats used by native wildlife species. Plan components for aquatic ecosystems and for terrestrial vegetation would maintain, restore, or enhance the key ecosystems and characteristics required to maintain the diversity animal communities in the plan area and support all non-at-risk species on the landscape. Species-specific or group-specific plan components would limit potential impacts of certain management actions or human activities, further supporting the presence and persistence of native and desired non-native wildlife species in the plan area. Plan components for management of other resources would limit impacts to wildlife species and habitats by constraining certain activities that could have negative impacts on wildlife or habitats. Components in the 2020 Forest Plan (action alternatives) provide more specific desired conditions and other more updated and relevant guidance that would better help managers achieve those conditions than components in the 1986 Forest Plans and alternative A.

3.14 Terrestrial Wildlife Species at Risk

3.14.1 Introduction

This section addresses the impacts of the 2020 Forest Plan, including alternatives, to at-risk species. The directives (U.S. Department of Agriculture, Forest Service, 2015) for implementing the 2012 Planning Rule define 'at-risk species' as federally recognized threatened, endangered, proposed, and candidate species, and SCC (FSH 1909.12, Chapter 20, 23.12).

The planning directives describe the context for assessing plan components affecting at-risk species: "Plan components that provide for ecological conditions for ecosystem integrity and ecosystem diversity…are the primary context for the evaluation of at-risk species". For most species, the only practical quantitative evaluation of their required ecological conditions is an assessment of habitat conditions. Additional information is provided in the terrestrial wildlife section, organized by vegetation groups.

The 2012 Planning Rule states that, fine-filter, or species-specific components are "intended to provide a safety net for those species whose specific habitat needs or other influences on their life requirements may not be fully met under the coarse filter provisions."(U.S. Department of Agriculture, Forest Service, 2012b). For some at-risk species, specific components have been included in the draft plan in order to sustain the ecological conditions (including but not limited to specific amount or distribution of habitat features, protection from human disturbance, etc.) required by that species.

At the time this report was prepared, there are five at-risk terrestrial wildlife species found on the HLC NF. Those species are as follows:

- Federally listed, proposed, or candidate species:
    - Grizzly bear – Threatened

- Canada lynx – Threatened, Designated Critical Habitat
- Wolverine – Proposed threatened

- Species of Conservation Concern (identified by the Regional Forester):
  - Flammulated owl
  - Lewis's woodpecker

Federally listed and proposed species have been analyzed in a Biological Assessment for Endangered Species Act section 7 consultation with the USFWS (see project file).

Changes between draft and final

In the 2020 Forest Plan, a desired condition was added (FW-WL-DC-09) regarding lynx habitat forestwide. Analysis relating to this plan component has been added to this section. The analysis of potential effects to Canada lynx has been updated to be consistent with information in Biological Assessment (BA) prepared for ESA Section 7 consultation with USFWS. Not all information from the BA has been included; please refer to the BA document for additional details. Updates include discussion about the potential effects of recreation, minerals and energy development, and domestic livestock grazing on lynx, potential lynx habitat, and designated critical habitat.

Plan components from the *2018 Forest Plan Amendments to Incorporate Habitat Management Direction for the NCDE Grizzly Bear Population* have been added directly into the body of the 2020 Forest Plan, but they were retained unchanged. Additions have been made to the glossary in the plan to incorporate information needed for implementation of the grizzly bear related plan components.

Much of the analysis of potential effects to grizzly bears has been updated to be consistent with information in BA prepared for ESA Section 7 consultation with USFWS. Not all information from the BA has been included; please refer to the BA document for additional details. Some refinements of and additions to analysis are also in response to public comments received on the Draft EIS. Updates to this document include:

- Additional discussion and context regarding habitat security and motorized route density;
- Replacement of GA-scale motorized route density information with Grizzly Bear Analysis Unit-scale analysis of secure habitat. Updated information is a more appropriate scale and type for evaluating potential effects to grizzly bears outside the recovery zone/primary conservation area.
- Added Bear Management Unit Subunit and Grizzly Bear Analysis Unit-scale analysis of area designations that may contribute to secure habitat. Updated information is at a more relevant scale ant type for evaluating potential impacts to grizzly bears.
- Additional discussion on potential effects of developed recreation, other recreational activities, livestock grazing, vegetation management, and energy and minerals exploration and development. Discussion of effects of ROS categories moved to section addressing impact of other recreational activities.

3.14.2 Regulatory framework

Please refer to the introductory regulatory framework section of this chapter (3.3).

3.14.3 Assumptions

A key assumption in this section is rooted in the 2012 Planning rule and the directives for its implementation: "Plan components developed for ecosystem integrity and ecosystem diversity … are expected to provide for ecological conditions necessary to maintain the persistence or contribute to the recovery of native species within the planning area, including at-risk species identified in [the] assessment. … Ecological conditions include habitat and the effects of human uses (for example, recreation, grazing, and mining).” (FHS 1909.12, 23.13). The directives also state that “Plan components that provide for ecological conditions for ecosystem integrity and ecosystem diversity are the primary context for the evaluation of at-risk species.” (FSH 1909.12, 23.13). We assume that the plan components for maintaining or restoring terrestrial ecosystems as described in the terrestrial vegetation section will provide for the basic habitat needs (foraging, denning, breeding, movement) of at-risk species, as they do for most terrestrial wildlife species (refer to the terrestrial wildlife diversity section). That information will be summarized or referred to as needed in this section.

The Rule also states that species-specific plan components must be included when the coarse-filter plan components described in the above paragraph are insufficient to ensure conservation or recovery of at-risk species (U.S. Department of Agriculture, Forest Service, 2012b).

3.14.4 Best available scientific information used

This section relies primarily on information in the scientific literature, and in published and unpublished reports regarding the presence, distribution, and requirements of at-risk wildlife species and potential impacts on them of existing and proposed management actions. Because of the programmatic level of this analysis, life histories and drivers of at-risk wildlife species and populations are generally not discussed in detail. Information provided here is relevant to the factors that put these species at risk, and that are the focus of plan components. The information in this analysis relies in part on information in the Assessment (U.S. Department of Agriculture, Forest Service, Northern Region, 2015), which contains extensive citations and bibliographies of the science used to determine life history, status, presence and distribution, threats, and drivers of at-risk wildlife species. Additional discussion of science regarding at-risk wildlife species is found in supporting materials in the project file. The BASI used in development of the Northern Continental Divide Ecosystem Grizzly Bear Conservation Strategy *(*U.S. Department of Agriculture, Forest Service, 2013d*)* and in development and implementation of the NRLMD (U.S. Department of Agriculture, Forest Service, 2007e) are incorporated in this analysis both directly and indirectly through reference to those documents and their supporting materials.

Where needed in the assessment and in this section, specific discussion may be included regarding contradictory science, why some information is used to the exclusion of others, and regarding areas for which scientific information is lacking.

The terrestrial wildlife diversity and terrestrial vegetation sections also provide information about the BASI used for those resource areas. Analysis for those resources forms the foundation of the coarse-filter level of analysis referenced in this section. Appendices H and D contain more BASI for grizzly bear and Canada lynx.

3.14.5 Grizzly bear, affected environment

Scale and Scope of Analysis

Most impacts of the 2020 Forest Plan and alternatives to the 2020 Forest Plan are discussed at the scale of the planning area (entire HLC NF), because most plan components are to be applied forestwide. However, the HLC NF amended both 1986 Forest Plans with the “*Forest Plan Amendments to Incorporate Management Direction for the Northern Continental Divide Ecosystem Grizzly Bear Population*” (Grizzly Bear Amendments) (U.S. Department of Agriculture, Forest Service, 2018)and has retained that direction in the 2020 Forest Plan. The Northern Continental Divide Ecosystem Grizzly Bear Conservation Strategy (Northern Continental Divide Ecosystem Subcommittee, 2019), hereafter referred to as the Conservation Strategy, and the Grizzly Bear Amendments describe management zones that have specific expectations regarding occupancy by grizzly bears. These management zones are based on available habitat, patterns of land ownership and management, proximity to the recovery zone and source population, existing grizzly bear distribution, and other factors. Therefore, the management zones provide an appropriate scale and reference point for describing some impacts to grizzly bears, particularly those that relate to components in the amendments. Some impacts may also be discussed at the scale of the GA, or at the scale of Bear Management Unit Subunits (within the Recovery Zone/Primary Conservation Area) or Grizzly Bear Analysis Units (Zones 1, 2, and 3).

The biology and ecology of grizzly bears in the Northern Continental Divide Ecosystem and on the HLC NF have been described extensively in several other documents (Northern Continental Divide Ecosystem Subcommittee, 2019); (U.S. Department of Agriculture, Forest Service, Northern Region, 2015);(U.S. Department of the Interior, Fish and Wildlife Service, 2017a), as has information on habitat use and availability specific to the NCDE and the HLC NF. We will briefly summarize key information from those sources, focusing on basic elements of grizzly bear life history and those that are relevant to the analysis of the potential impacts to grizzly bears of the 2020 Forest Plan and alternatives to the 2020 Forest Plan.

Status

The grizzly bear is currently listed as a threatened species under the ESA. There are six Grizzly Bear Recovery Zones identified in the Grizzly Bear Recovery Plan (U.S. Department of the Interior, Fish and Wildlife Service, 1993): North Cascades, Selkirk, Cabinet-Yaak, Bitterroot, Greater Yellowstone, and Northern Continental Divide. All of the recovery zones except the Bitterroot are currently considered occupied (Cecily M. Costello, Mace, & Roberts, 2016). In September 2017 the USFWS determined that, for the purposes of ESA Section 7 consultation, the grizzly bear “may be present” on the portion of the Bitterroot National Forest that is east of Highway 93, outside of but immediately adjacent to the Bitterroot recovery zone. The Rocky Mountain Range GA and the northern half of the Upper Blackfoot GA on the HLC NF are within the NCDE recovery zone.

Distribution

Grizzly bears occur throughout northwestern North America, from Alaska and northern Canada south into the Northern Rocky Mountains and North Cascades. Grizzly bears are widely distributed throughout the NCDE, which lies in northwestern and north central Montana, and includes Glacier National Park, portions of the Flathead, Kootenai, Lolo, and Helena-Lewis and Clark NFs, and part of the Blackfeet Indian Reservation. This ecosystem includes the Bob Marshall Wilderness Complex, and the recently designated Rocky Mountain Front Conservation Management Area. The Cabinet-Yaak Ecosystem recovery zone is adjacent to the northwestern portion of the NCDE, which is also contiguous with Canada and grizzly bear populations there.

The NCDE has been occupied by grizzly bears continuously since they were listed under the ESA in 1975. The population in 2015 was estimated at over 900 bears (Cecily M. Costello et al., 2016), and as of 2017 was estimated to be over 1,000 based on MFWP unpublished data (Northern Continental Divide Ecosystem Subcommittee, 2019). The NCDE grizzly bear population has been expanding geographically as well (ibid), with bears increasingly observed in prairie and agricultural landscapes more than 50 miles east of the recovery zone. Costello and others (C. M. Costello & Roberts, 2019) estimate that 35% of the occupied range of grizzly bears associated with the NCDE currently occurs outside of the the combined primary conservation area and Zone 1, which is the area where population trend and other demographic information is monitored. Costello and others (C. M. Costello & Roberts, 2019) also estimate that the current distribution represents a 42% increase from 2004 and a 25% increase from 2010.

The most marked expansion of bears from the NCDE appears to be occurring to the southwest, and to the east onto the short-grass prairie on non-NFS lands (Mace & Roberts, 2012; Northern Continental Divide Ecosystem Subcommittee, 2019). Grizzly bears have been observed occasionally in the Divide GA, and based on recent observations of grizzly bears in the Big Belt Mountains and on private land between the

Little Belt and Highwoods mountain ranges, the FWS has indicated that grizzly bears 'may be present' throughout the most of the HLC NF, with the exception of the Snowies, Crazies, and Castles GAs and the portion of the Big Belts GA that lies south of U.S. Highway 12 (USFWS map dated October 2018, project file).

The Conservation Strategy (Northern Continental Divide Ecosystem Subcommittee, 2019) and the Grizzly Bear Amendment describe expected occupancy by grizzly bears of the identified grizzly bear management zones. The primary conservation area, which is the same area as the existing recovery zone, is expected to continue to function as a source population with continual occupancy by grizzly bears. The Rocky Mountain Range GA and the north half of the Upper Blackfoot GA fall within this area. In zone 1 (south half of the Upper Blackfoot GA on the HLC NF) continual occupancy is expected, but at lower densities than in the primary conservation area. Grizzly bears in zone 1 are considered part of the NCDE population for the purposes of demographic monitoring. Zone 2 includes the Divide, Big Belts, and Elkhorns GAs, and has an objective of maintaining existing resource management and recreation activities while maintaining the opportunity for grizzly bears to move between the NCDE and other ecosystems to the south and southwest. Occupancy by grizzly bears may occur in zone 2, but at lower densities than in zone 1 and in the primary conservation area, and management would be focused almost entirely on conflict prevention. Zone 3 includes the Highwoods, Little Belts, Castles, and Crazies GAs and large areas of private and other lands. Long-term survival and occupancy of grizzly bears is not expected in zone 3, due to lack of sufficient suitable habitat (Northern Continental Divide Ecosystem Subcommittee, 2019; U.S. Department of the Interior, Fish and Wildlife Service, 2013d). A large portion of the HLC NF lies between the NCDE and GYE recovery zones and may have potential to provide genetic and/or demographic connectivity between those ecosystems.

Population trend

Research in 2004 (Kendall et al., 2009) estimated a total of 765 bears in the NCDE as a whole. MFWP (Cecily M. Costello et al., 2016) estimates the population has been increasing at a rate of 2.3 – 3% annually since that time, leading to an estimate in 2016 of between 950 and 1,090 grizzly bears in the ecosystem.

Females in the NCDE first reproduce between ages 3 and 8, with an average age of first reproduction of 5.7 (Cecily M. Costello et al., 2016). Reproductive success is correlated with female body condition in fall (Belant, Kielland, Follmann, & Adams, 2006; Robbins, Lopez-Alfaro, Rode, Tøien, & Nelson, 2012) and with the availability of high-energy summer foods (McLellan, 2015; Schwartz et al., 2006).

In species such as grizzly bears that are long-lived and have low reproductive rates, adult female survival may be a key factor influencing population trend. McLellan (2015) and Proctor (2018)discussed the relative influences of high-energy foods, grizzly bear population density, and human access that both directly and indirectly contribute to grizzly bear mortality. They observed that the relative contributions of these factors to individual bear reproduction and survival as well as to population trend overall varied widely across years and study areas.

Food and Habitat Requirements

Grizzly bears use a wide variety of habitats within the NCDE, and on the HLC NF. Grizzly bears are generalists that use a wide variety of habitats ranging from alpine meadows to montane conifer forests to low elevation foothills and prairie grasslands. Use of habitats by grizzly bears is influenced by food availability and by various human activities and human-created features on the landscape; availability of food and forage has not been identified as a key issue with respect to viability of grizzly bears or their recovery in the HLC NF portion of the NCDE.

Grizzly bears range from high-elevation denning sites to low elevation spring habitat in meadows and riparian areas, using all elevations during summer and fall, including low elevation foothills and prairie landscapes east of the HLC NF.

Detailed information about grizzly bear life history can be found in the Assessment (U.S. Department of Agriculture, Forest Service, Northern Region, 2015) and in other documents cited there and in this section. Factors that affect grizzly bears are addressed in more detail below and include discussion of those factors in the context of current management in the plan area.

Key drivers and stressors

In 1975 the FWS identified habitat destruction and modification as major contributing factors leading to the listing of the grizzly bear as a threatened species under the ESA (U.S. Department of the Interior, Fish and Wildlife Service, 1975a). The listing identified decreases in historical range, the isolated nature of remaining populations, building of roads and trails in formerly secure grizzly bear habitat, and livestock grazing practices as factors contributing to the need for the listing. Since that time, habitat management for grizzly bears has focused primarily on providing secure habitat (U.S. Department of the Interior, Fish and Wildlife Service, 2011b) and on reducing both direct and indirect sources of mortality (Northern Continental Divide Ecosystem Subcommittee, 2019; U.S. Department of the Interior, Fish and Wildlife Service, 1993, 2011b, 2013d). Grizzly bear population recovery in portions of the U.S. and Canada has been at least in part an outcome of legal protection and cessation of excessive killing in the form of unregulated hunting and government-established bounty systems (McLellan, 2015).

The Conservation Strategy (Northern Continental Divide Ecosystem Subcommittee, 2019) identifies and provides management guidance for several factors that influence grizzly bears through direct and indirect mortality risk, as well as potential disturbance and displacement from habitat. This section focuses on those factors with emphasis on those that are affected by management of NFS lands: food/attractant management, habitat security/motorized access (both summer and winter), developed recreation, other recreational activity including hunting, connectivity, livestock grazing, vegetation management (including fuels management), and minerals and energy uses. This section provides brief discussion of the specific risk factors, followed by a summary of current management direction and status of each risk factor on HLC NF lands.

Connectivity it is not considered an indicator of the recovery or persistence of the grizzly population in the Northern Continental Divide Ecosystem (Northern Continental Divide Ecosystem Subcommittee, 2019) or on the HLC NF. Nevertheless, connectivity is a key factor in ensuring distribution of grizzly bears throughout the NCDE, as well maintaining genetic health of the NCDE and other grizzly bear populations (e.g., the GYE).

The degree to which plan components address the issues of mortality, habitat security, and connectivity serves as indicators to how well the draft plan and alternatives achieve desired conditions related to grizzly bears, and contribute to recovery and long-term persistence of the population on the HLC NF.

Food and attractant management

Survival of reproductive females is one of the most important issues in maintaining a stable or increasing population trend and in recovery and persistence of grizzly bears, and human-caused mortality is the most significant factor influencing grizzly bear survival (Cecily M. Costello et al., 2016; Mace et al., 2012). In the NCDE as a whole, the leading cause of grizzly bear mortality since at least 2004 has been agency removal (Cecily M. Costello et al., 2016) roughly half of which has occurred outside the primary conservation area (Cecily M. Costello et al., 2016), usually associated with livestock or other attractants on private and other non-NFS lands where food storage orders are not in use (Northern Continental Divide Ecosystem Subcommittee, 2019; U.S. Department of the Interior, Fish and Wildlife Service, 2013a). Bears may be drawn to unsecured attractants, resulting in conflict and subsequent removal of those bears. Food storage orders on public lands can ensure that food and other attractants are stored so that grizzly bears cannot obtain access to them, preventing potential food-conditioning of bears and reducing the risk of conflict. Food storage orders are considered to be "the single most effective way to prevent bears from becoming food conditioned" (U.S. Department of Agriculture, Forest Service, 2013d) (U.S. Department of the Interior, Fish and Wildlife Service, 2013d) on public lands.

To minimize the risk of conflicts related to food and attractants, food storage orders have been implemented on most NFS lands in the NCDE, including on the entire HLC NF. Information regarding food storage requirements is readily available at all FS offices and at trailheads and parking areas, as well as on the HLC NF website. Signs informing visitors of the existence of food storage requirements are posted at all NF public entry points on the Rocky Mountain Range GA and are being added elsewhere on the HLC NF as funding allows. All permits issued for activities occurring on lands administered by the HLC NF require adherence to food storage orders.

Information regarding violations of food storage orders is not available, but most violations do not result in bear-related incidents and are instead known because of consistent enforcement efforts. On the HLC NF portion of the NCDE, since implementation of the first food storage order on a portion of the Forest in the late 1980s, there has been only one known incidence of a management removal or death of a grizzly bear because of the bear obtaining improperly stored attractants.

Bear-human conflicts on private lands due to livestock depredation and due to conflicts related to attractants on private lands continues to be a primary source of mortality in the NCDE, but is outside of NFS control.

Habitat security and motorized access

Summer motorized travel

The Conservation Strategy (Northern Continental Divide Ecosystem Subcommittee, 2019) (U.S. Department of the Interior, Fish and Wildlife Service, 2013d)and the 5-year review of grizzly bear status (U.S. Department of the Interior, Fish and Wildlife Service, 2011b) identified habitat security as a key issue in recovery. Secure habitat is important to the survival and reproductive success of grizzly bears (Northern Continental Divide Ecosystem Subcommittee, 2019; U.S. Department of the Interior, Fish and Wildlife Service, 1993, 2011b), with motorized access commonly identified as a stressor that may have a negative impact on the availability of secure habitat for bears (Boulanger & Stenhouse, 2014; Mace, Waller, Manley, Lyon, & Zuuring, 1996; McLellan, 2015; Michael F. Proctor et al., 2018). In general motorized access has the potential to affect bears by increasing human interaction which increases potential for habituation or conflict, displacing bears from important habitats, and increasing energetic requirements related to disturbance by humans (U.S. Department of the Interior, Fish and Wildlife Service, 2011b). The amount and pattern of motorized access and of secure habitat in grizzly bear habitat can be influenced by FS management of NFS lands; the stressors associated with motorized travel also occurs on private lands that are not influenced by FS management.

Several research projects in the NCDE and other portions of the northern Rocky Mountains have reported varied information about the effects of motorized travel on grizzly bears. These studies have each asked slightly different questions, and measured access and impacts to bears differently. Cumulatively, however, they provide an outline of the potential for motorized access to impact bears. The following is a brief synopsis of some of the key research that has occurred regarding this issue over the past three decades.

Mace and others (Mace et al., 1996) found that in their western Montana study area female grizzly bears occupied home ranges with lower total road densities than unused areas. They found that a total (open plus closed) road density "of < 6 km/km^2 [9.65 mi/mi^2] differentiated the used from unused areas" (ibid), with road density calculated using a moving-windows type methodology. Use by bears of habitats near roads was influenced by traffic volume and road type as well as by individual, sex, and season, and was also likely related to the spatial and seasonal availability of certain bear foods. Some limitations of the study include relatively small sample sizes that precluded certain analyses and inferences, and that bear locations were obtained only twice a week and usually during morning hours when flight conditions were best, potentially influencing results by excluding other times of day when bear habitat use could have differed.

Other research has added to the understanding of potential impacts of motorized travel on grizzly bears. In 1988 McLellan and Shackleton published results (McLellan & Shackleton, 1988) of the initial years of a multi-decade study in an area where a high level of resource extraction work and concomitant road building and use was occurring. They found that most bears in their study used habitats within 100m of roads less than expected, and they documented temporal patterns of avoidance, with areas near roads used at night but avoided during the day. Contrary to the later findings of Mace et al. (1996), McLellan and Shackleton found that yearlings and females with cubs used areas near roads more than other bears, possibly as a strategy to avoid encounters with adult male bears.

In 2015 McLellan published results (McLellan, 2015) that included analysis of data used in the 1988 publication along with data gathered in subsequent years. In his updated work, McLellan found that industrial activities in his study area, including use by the public of roads originally built for resource extraction, did not have a clear negative effect on population trend. The location of motorized routes relative to bear food sources appeared to be more important in McLellan's study area than the density of routes. McLellan recommended that managers should attempt to maintain or enhance high-energy foods, the location of which may change over time in response to natural and human-caused vegetation changes, and reduce human access into areas where and when those foods are abundant. This recommendation is similar to suggestions made by the NCDE technical committee in 1998 to identify seasonally secure areas based on habitats used by bears at key times of year (M. F. Proctor et al., 2018). McLellan's study (McLellan, 2015) was carried out in an area where grizzly bear hunting is legal, and where both public recreational use and industrial activities may have differed from those occurring in the Mace and others (Mace et al., 1996) research.

Boulanger and Stenhouse (2014) carried out research on the impact of roads on grizzly bears in Alberta, Canada east of McLellan's study area and north of the NCDE. They identified road densities above which negative population trend could occur, and they recommend a threshold of 0.75 km/ km road density (1.2 mi/mi^2) in areas identified within their study area as core grizzly bear conservation areas, in order to ensure a viable grizzly bear population. A key aspect of the Boulanger and Stenhouse study was that road density was not measured in fixed units, but rather within a 300m radius of each bear observation. Although this method provided a "real time" picture of road density in an area actually being used by a bear at the time it is observed, it is not directly comparable to measures of road density in other areas that are made in fixed units and calculated by different methods. As in McLellan's study area and unlike in the NCDE, bear hunting was allowed in Boulanger and Stenhouse's study area. The authors also noted that they lacked information about traffic volumes and about habitat quality and quantity, which they suggested are likely to influence the mortality risk, reproductive rate, and disturbance/displacement from roads that occurs and therefore that they observed. This research focused specifically on road density and did not address any potential role or influence of secure habitat areas.

In a comprehensive review of research into the relationships between motorized access and grizzly bears, Proctor and others (2018) cited research findings (e.g., (Nielsen et al., 2004; Proctor, Lamb, & Machutchon, 2017) similar to McLellan's (McLellan, 2015), emphasizing distance to roads and location of roads in relation to certain habitats rather than measures of road density in understanding impacts to bears. Proctor et al. also noted that the spatial arrangement of motorized routes and security areas may be critically important in terms of the degree to which bears may be affected by motorized access. They stated, "…evenly spaced roads, even at an otherwise acceptable road density, can provide very little security in patches within the range of average daily movements" (M. F. Proctor et al., 2018). In other words, the key to limiting impacts of roads on bears is tied to availability, location, and distribution of secure habitat that is a function of not simply numeric density of motorized routes, but the spatial arrangement in which they occur. In its updated Motorized Access Taskforce Report (Interagency Grizzly Bear Committee, 1998), the Interagency Grizzly Bear Committee stressed that evaluation of open motorized route density alone does not provide a complete measure of the effects of motorized access on use of habitats by grizzly bears, but that measures of the presence of "core areas" free of high levels of human use are also important. Most studies on the effects of motorized access on bears have reported on the importance to bears of having a minimum percentage of their home range in blocks secure from the influence of motorized travel (e.g., (Mace et al., 1996; Proctor et al., 2017; Schwartz, Haroldson, & White, 2010; Wakkinen & Kasworm, 1997). Measures and recommendations of the appropriate size of secure habitat patches have varied based on study area, research questions, research methods, the stated purpose of providing security (e.g., to limit direct mortality risk versus to limit displacement from foraging habitat) and other factors.

Motorized access management guidance in the NCDE

Based on preliminary reports (Mace & Manley, 1993) from the Mace et al. research discussed above, the Interagency Grizzly Bear Committee Taskforce on Motorized Access recommended that thresholds be established for motorized access route density and for "core" (i.e. secure) habitat in grizzly bear recovery zones (Interagency Grizzly Bear Committee, 1994). In response to a lawsuit and in order to complete consultation on their Forest Plan, the Flathead NF developed Forest Plan Amendment 19 (U.S. Department of Agriculture, Forest Service, 1995a) establishing motorized route density and core area standards that were based on an unpublished review of those preliminary results (Mace, 2004). Similar recommendations were incorporated into interim guidelines for motorized access management for the NCDE (Northern Continental Divide Ecosystem (NCDE) Access Task Group, 1995). In 1998 the Interagency Grizzly Bear Committee taskforce updated its guidance on motorized access management (Interagency Grizzly Bear Committee, 1998) after considering additional research, analysis, and several years of implementation of the 1994 guidelines. The NCDE taskforce group recommended adjustments to NCDE motorized access direction in 1998 (Interagency Grizzly Bear Committee, 1998)and 2002 (IGBC Motorized Access Taskforce unpublished report in project record).

The 1998 Interagency Grizzly Bear Committee taskforce recommended the use of the moving windows method for analyzing motorized access within recovery zones (Interagency Grizzly Bear Committee, 1998). They also recommended that rather than reporting linear route densities, managers should report the percent of an analysis unit (Bear Management Unit Subunit) within a specified route density category and the percent meeting criteria of secure habitat. This method provides a more accurate indication of the spatial mix of motorized routes and secure habitat than do other methods, and was therefore incorporated as a required protocol into the Flathead NF Amendment 19 (U.S. Department of Agriculture, Forest Service, 1995a), the NCDE Grizzly Bear Conservation Strategy (Northern Continental Divide Ecosystem Subcommittee, 2019), and the Forest Plan Amendments to Incorporate Habitat Management Direction for the Northern Continental Divide Ecosystem Grizzly Bear Population (see PCA-NCDE-STD-01) (U.S. Department of Agriculture, Forest Service, 2018).

The degree to which access management on NFS lands, as described above, has contributed to the observed population increase in the NCDE is unknown, since it has been applied only in portions of the ecosystem and at the same time as implementation of food storage orders, cessation of grizzly bear hunting and aggressive predator control efforts, and other efforts to reduce grizzly bear mortality and increase human tolerance of bears.

Motorized access management and status of secure habitat in the action area – recovery zone/primary conservation area and zone 1

Prior to adoption of the Grizzly Bear Amendments in 2018, the existing (1986) LCNF plan did not contain motorized route management standards or guidelines specific to grizzly bears. The Interim Motorized Access Management Direction for the NCDE recovery zone (Northern Continental Divide Ecosystem (NCDE) Access Task Group, 1995) was used in project planning and guidance on the NCDE recovery zone portion of the LCNF; consideration of seasonal habitat security as recommended in the 2002 proposed updates to that direction was applied to planning and analysis of travel management in the recovery zone portion of the NCDE (U.S. Department of Agriculture, Forest Service, 2007h, 2009).

The 1986 Helena NF plan includes standards to maintain road densities in "occupied grizzly habitat", mapped in the plan as the north half of the Lincoln Ranger District (Upper Blackfoot GA), at the 1980 density of 0.55 mi/mi^2. The Interim Motorized Access Management Direction for the NCDE (Northern Continental Divide Ecosystem (NCDE) Access Task Group, 1995) and the Interagency Grizzly Bear Committee Motorized Access Task Force Report recommendations (Interagency Grizzly Bear Committee, 1998) have been used as guidance for management and analysis of motorized access in the HLC NF portion of the NCDE recovery zone.

The Grizzly Bear Amendments adopted by the HLC NF and other forests in 2018 established that in the primary conservation area (which is the same area as the recovery zone) the levels of open motorized route density and total motorized route density are not allowed to increase above the 2011 baseline, nor are levels of "secure core" (calculated slightly differently than "core" discussed above) allowed to decrease below the 2011 baseline (PCA-NCDE-STD-03), except under certain conditions detailed in the Grizzly Bear Amendments (PCA-NCDE-STD-02, PCA-NCDE-STD-03, PCA-NCDE-STD-04, PCA-NCDE-STD-05). Motorized route densities and amount of secure core in the Bear Management Unit Subunits within the HLC NF portion of the NCDE recovery zone are shown in Table 73, as reported in the most current biennial motorized access report required by the Grizzly Bear Amendments and NCDE Conservation Strategy (Subcommittee, 2017) for the Rocky Mountain Range GA, and for the Upper Blackfoot GA as reported in the Biological Opinion on the Effects of the Blackfoot Non-Winter Travel Plan on Grizzly Bears (U.S. Department of the Interior, Fish and Wildlife Service, 2016a), to reflect full implementation of the travel plan in that area. Information in Table 73 includes all lands within the Subunits, per the reporting methodology and requirements established in the Grizzly Bear Amendments (U.S. Department of Agriculture, Forest Service, 2018) and the NCDE Conservation Strategy (Northern Continental Divide Ecosystem Subcommittee, 2019).

Table 73. Total motorized route density and open motorized route density by GA and Bear management Unit Subunit in the HLC NF portion of the NCDE recovery zone[1]

GA	Bear Management Unit	Subunit	≥75% NFS lands	Total Motorized Route Density percent > 2 mi/mi2	Open Motorized Route Density percent >1 mi/mi2	Secure core percent of area
Rocky Mtn. Range	BATM	Badger	no	0	0	73
		Heart Butte	no	0	1	61
		Two Medicine	no	1	2	78
	BITE	Birch	no	0	0	93
		Teton	no	5	11	71
	DELK	Falls Creek	no	0	0	85
		Scapegoat	no	1	5	78

GA	Bear Management Unit	Subunit	>75% NFS lands	Total Motorized Route Density percent > 2 mi/mi2	Open Motorized Route Density percent >1 mi/mi2	Secure core percent of area
	NFSR	Lick Rock	yes	0	0	100
		Roule Biggs	yes	0	0	100
	SUBW	South Fork Willow	yes	3	14	81
		West Fork Beaver	yes	5	17	80
	TESR	Deep Creek	no	3	9	67
		Pine Butte	no	2	7	64
Upper Blackfoot[2]	MLFK	Alice Creek	no	10	12	74
		Arrastra Mountain	yes	17	16	75
		Red Mountain	yes	21	21	63

[1]Source: 2017 Biennial Report of Motorized Access Baseline within the Primary Conservation Area, NCDE. Unpublished report prepared by Kathy Ake, Flathead NF/NCDE, November 2019.

[2]Source for Subunits in Upper Blackfoot GA: Biological Opinion on the Effects of the Blackfoot Non-Winter Travel Plan on Grizzly Bears (U.S. Department of the Interior, Fish and Wildlife Service, 2016a), to reflect status after full implementation of the plan.

The Grizzly Bear Amendment to the HNF plan requires that in the area identified as zone 1, which is outside the recovery zone and therefore does not have Bear Management Unit subunits established, linear motorized route density as measured over the entire HLC NF zone 1 area must be maintained at or below the 2011 baseline (Z1-NCDE-DC-01). Temporary routes are not included as changes to motorized route density in the HLC NF portion of Zone 1. The amendment allows the 2011 baseline to be adjusted for activities or projects occurring after that time that have received consultation. The 2011 baseline was adjusted after consultation and signing of the Record of Decision for the Blackfoot Non-Winter Travel Management Plan in 2016 (U.S. Department of Agriculture, Forest Service, 2017c; U.S. Department of the Interior, Fish and Wildlife Service, 2016a). The motorized route density in the entire area outside the Recovery Zone (primary conservation area), corresponding to Zone 1, after full implementation of the travel plan is 1.1 mi/mi^2 [p. 28 of the Biological Opinion on the Effects of the Blackfoot Non-Winter Travel Plan on Grizzly Bears (U.S. Department of the Interior, Fish and Wildlife Service, 2016a)].

Motorized access management and status of secure habitat in the action area – outside the recovery zone (zones 1, 2 and 3)

The 2018 Grizzly Bear Amendments to the 1986 Helena NF and Lewis and Clark NF plans do not require motorized access management in Zones 2 and 3. As discussed above, managers and researchers have recognized the importance of secure areas to grizzly bears (Northern Continental Divide Ecosystem (NCDE) Access Task Group, 1995; U.S. Department of the Interior, Fish and Wildlife Service, 1993, 2011b); (Interagency Grizzly Bear Committee, 1998) (Mace et al., 1996); (McLellan, 2015) (McLellan & Shackleton, 1988) (Michael F. Proctor et al., 2018). Therefore, measures of secure habitat in the areas outside the NCDE recovery zone (Zones 2 and 3) where grizzly bears may be present provide some indication of the potential for impacts of human activities on bears that may use those areas.

The 1986 Helena NF and Lewis and Clark NF plans include components that limit or prohibit motorized access in some areas (e.g., for elk security, RWAs, and others), creating secure habitat that may be used by grizzly bears. Areas such as Designated Wilderness, WSAs, and IRAs, all of which are established by law or executive order, effectively limit or prohibit motorized access in some areas and thereby contribute to secure habitat that could be used by grizzly bears.

The amount of secure habitat potentially available to bears in Zones 1, 2, and 3 is displayed in Table 74 below. The acreage of secure habitat is reported for individual Grizzly Bear Analysis Units, which we delineated in Zones 1, 2 and 3 on the HLC NF for the purposes of analyzing potential impacts to bears of various forest management activities. For this analysis secure habitat includes areas that are ≥ 500m from any motorized route and that are ≥2500 acres in size. Documentation of the process for delineating Grizzly Bear Analysis Units and for calculating secure habitat is available in the project file. Table 74 displays only secure habitat and total acres of NFS lands and does not include any private lands (inholdings) that may occur within Grizzly Bear Analysis Units. While the Grizzly Bear Amendments require no net change to the baseline linear density of motorized routes in Zone 1 as described above, the spatial location of routes could change, which could in turn change the amount and quantity of secure habitat within those Grizzly Bear Analysis Units. Therefore, we report in Table 74 the amount of potentially secure habitat available in the two Grizzly Bear Analysis Units in Zone 1 in in order to facilitate future analysis and comparison.

Table 74. Acreage and percent of potentially secure habitat by Grizzly Bear Analysis Units, NFS lands only

Grizzly bear management zone	Geographic area	Grizzly Bear Analysis Unit	Total NF Acres in Grizzly Bear Analysis Unit	Acres of potentially secure habitat	Percent of Grizzly Bear Analysis Unit that is potentially secure habitat	Number potentially secure habitat areas[1]
Zone 1	Upper Blackfoot	Dalton Mountain	82,276	31,191	38%	2
		Humbug	66,966	15,703	23%	2
Zone 2	Elkhorns	Boulder River BDNF	30,973	7,725	25%	1
		Casey Peak	60,455	32,847	54%	2
		Crow Creek	69,822	27,967	40%	2
	Divide	Lazyman	64,415	11,891	18%	2
		North Divide	72,195	16,484	23%	2
		Spotted Dog	66,723	18,942	28%	2
	Big Belts	Middle Big Belts	70,743	24,853	35%	2
		North Big Belts	171,431	75,085	44%	6
		South Big Belts	67,118	18,048	27%	2
Zone 3	Little Belts	Dry Wolf	74,307	23,277	31%	5
		Elephant	199,743	44,208	22%	10
		Pilgrim	72,942	39,615	54%	4
		Middle Fork Judith	110,601	65,619	59%	5
		Sheep Creek	127,729	5,039	4%	2
		Tenderfoot-Smith	113,449	60,276	53%	4
		Upper Belt Creek	103,762	33,158	32%	8
		Highwoods	42,290	26,368	62%	3
		Castles	69,708	7,325	11%	2
		Crazies HLC	57,667	22,154	38%	1

[1]Some patches of secure habitat cross Grizzly Bear Analysis Unit boundaries and therefore may be counted in both Grizzly Bear Analysis Units. Secure habitat patches or areas are shown here for each GBAU in which they occur, in order to indicate the potential for each Grizzly Bear Analysis Unit to provide habitat security.

We chose to use 2,500 acres, the convention adopted in the NCDE, as a minimum patch size for secure habitat. In some other areas (e.g., the GYE) a minimum patch size of 10 acres is used. We also chose to buffer all routes existing in the HLC NF route database, regardless of whether they are legally open or closed to public travel. The HLC NF database lacks information in for many closed routes regarding the method of closure (e.g., gate, berm, partial or total revegetation, etc.), as well as whether or not routes are currently passable by vehicle. Therefore the estimates of secure habitat in Table 74 above are in most cases underestimates of actual secure habitat that exists on the ground, because an unknown number of routes that are physically impassable to motor vehicle use were buffered and excluded from secure habitat polygons.

The secure habitat amounts that we report above are useful mainly as a broad index of what may be available to bears that use these areas; actual bear use of any areas within Zones 2 and 3, and the degree to which they might be affected by motorized travel or other human uses or activities is dependent on many factors as described throughout this analysis.

Winter motorized travel

The impacts of winter activities on denning bears are not well studied (Teisberg, Madel, Mace, Servheen, & Robbins, 2015). Teisberg and others (2015) assessed the distribution of grizzly bear dens in the NCDE with respect to areas open or closed to motorized over-snow use. They found no apparent avoidance by grizzly bears of areas open to winter over-snow use, and den distribution was similar to the availability of habitat. Linnell and others (2000) reported that bears will den within 0.6-1.2 miles of areas of human activity, and appear to be undisturbed by most activities occurring at distances greater than 0.6 miles of dens. Additional anecdotal evidence (Hegg, Murphy, & Bjornlie, 2010) and monitoring data (U.S. Department of Agriculture, Forest Service, 2006) did not document abandonment of dens as a result of motorized over-snow travel in the vicinity of dens in the GYE. Litter abandonment due to snowmobiling activity has not been documented in the lower 48 states (Hegg et al., 2010), nor have adverse effects to bears from snowmobiling been substantiated (Mace & Waller, 1997b). Despite this information, however, bear research scientists and managers have suggested that in the period shortly before or after den emergence in the spring, females with cubs could be vulnerable to disturbance by snowmobiles because of limited mobility of cubs and high energetic needs of lactating females (Haroldson, Ternent, Gunther, & Schwartz, 2002; Mace & Waller, 1997a, 1997b).

More than half (approximately 56%) of the HLC NF portion of the primary conservation area is within designated wilderness, where over-snow motorized travel is prohibited. On the Rocky Mountain Range GA portion of the primary conservation area, winter over-snow motorized travel is allowed only on main access roads, none of which are within modelled denning habitat, and on approximately 30,000 acres (of which about 8,000 acres overlap with modelled denning habitat). Snowmobile travel in that area is prohibited after March 31 (U.S. Department of Agriculture, Forest Service, 2007h, 2009). On the Upper Blackfoot GA, snowmobiling is allowed on approximately 6,400 acres of modelled denning habitat in of the primary conservation area, where it is prohibited after March 31 except in the Copper Bowls play area where snowmobile use is allowed until May 31 (U.S. Department of Agriculture, Forest Service, 2013a). The Grizzly Bear Amendments include a plan component requiring no net increase in the percent of area or miles of trail available to motorized over-snow travel in modelled denning habitat within the primary conservation area (U.S. Department of Agriculture, Forest Service, 2018).

In Zones 1-3, motorized over-snow travel is allowed in areas and at times specified in winter travel plans that are not affected by plan components in the Grizzly Bear Amendments. Grizzly bear denning habitat has been modelled in those areas, but no grizzly bears have yet been known to den in Zones 2 and 3.

Many areas on the HLC NF are relatively dry, and snow can be intermittently present, so not all areas legally open to over-snow motorized travel are actually available during the entire time they are open.

Other indicators of habitat security

Another indication of existing habitat security for bears is the amount of area having designations that limit or restrict human activities, including motorized travel. Congressionally-designated wilderness areas, WSAs, IRAs, the conservation management area, and RWAs may all provide some measure of habitat security for bears by prohibiting or largely restricting motorized and mechanized travel, and by limiting other activities such as timber harvest, development of recreation sites, and others. The overlap of some these designations (e.g., IRAs and RWAs) in portions of the HLC NF creates multiple layers of management requirements or guidance that cumulatively ensure these areas remain relatively free of human disturbance, providing substantial habitat security for grizzly bears and other wildlife.

Of the 12 Bear Management Unit Subunits on the HLC NF in the primary conservation area, five are not entirely within designated wilderness, IRA, conservation management area, or combinations of those. Of those five, 3 subunits in the Upper Blackfoot GA (Arrastra, Red Mountain, and Alice Creek) have between 23% and 38% of their area not in any of the above categories. Two subunits on the Rocky Mountain Range GA (Badger and Two Medicine) are not entirely within one of the above categories, with approximately 10% to less than 50% of NFS lands within the subunit not within one of those categories. All of the above subunits are within the primary conservation area, however, and are therefore protected by standards in the Grizzly Bear Amendments from any loss in the baseline amount of “secure core”.

Table 75 shows the acreage and percent of each Grizzly Bear Analysis Unit in designated wilderness, WSAs, and/or IRAs, all of which are established by law and are not affected by Forest Plans or their implementation, for Zones 1-3.

Table 75. Acreage of habitat by Grizzly Bear Analysis Unit, and percent of total NFS lands in Grizzly Bear Analysis Units that are in designated wilderness, WSA, or IRA

Grizzly bear management zone	Geographic area	Grizzly Bear Analysis Unit	Total NF Acres in Grizzly Bear Analysis Unit	Acres (%) of Grizzly Bear Analysis Unit in designated wilderness	Acres (%) of Grizzly Bear Analysis Unit in WSA	Acres (%) of Grizzly Bear Analysis Unit in IRA
Zone 1	Upper Blackfoot	Dalton Mountain	82,276	0	0	46,096 (56%)
		Humbug	66,966	0	0	40,164 (60%)
Zone 2	Elkhorns	Boulder River BDNF	30,973	0	0	0
		Casey Peak	60,455	0	0	37,596 (62%)
		Crow Creek	69,822	0	0	37,153 (53%)
	Divide	Lazyman	64,415	0	0	18,207 (28%)
		North Divide	72,195	0	0	16217 (22%)
		Spotted Dog	66,723	0	0	29,697 (45%)
	Big Belts	Middle Big Belts	70,743	0	0	40,267 (57%)
		North Big Belts	171,431	28,440 (17%)	0	83,354 (49%)
		South Big Belts	67,118	0	0	23,335 (35%)
Zone 3	Little Belts	Dry Wolf	74,307	0	0	52,872 (71%)

Grizzly bear management zone	Geographic area	Grizzly Bear Analysis Unit	Total NF Acres in Grizzly Bear Analysis Unit	Acres (%) of Grizzly Bear Analysis Unit in designated wilderness	Acres (%) of Grizzly Bear Analysis Unit in WSA	Acres (%) of Grizzly Bear Analysis Unit in IRA
		Elephant	199,743	0	647 (0.3%)	91,196 (46%)
		Pilgrim	72,942	0	0	55,693 (76%)
		Middle Fork Judith	110,601	0	79,104 (72%)	95,669 (76%)
		Sheep Creek	127,729	0	0	19,284 (15%)
		Tenderfoot-Smith	113,449	0	0	78,123 (69%)
		Upper Belt Creek	103,762	0	0	46,933 (45%)
		Highwoods	42,290	0	0	39,634 (94%)
		Castles	69,708	0	0	29,382 (42%)
		Crazies HLC	57,667	0	0	37,551 (65%)

Both motorized and mechanized travel are prohibited in Congressionally-designated Wilderness Areas ("Wilderness Act - Public Law 88-577 (16 U.S. C. 1131-1136)," 1964). Motorized travel is minimized in WSAs and is generally restricted to what was allowed prior to the area's designation. The federal regulations governing IRAs prohibits activities that are likely to alter and fragment landscapes and that would cause loss or roadless characteristics, and it prohibits permanent road construction and reconstruction.

RWAs, identified in forest plans, provide areas where the influence of humans is minimal. RWAs largely overlap with IRAs, but carry additional restrictions on human activities, including motorized and potentially mechanized travel. Table 76 shows the acreage and percent of Grizzly Bear Analysis Unit in RWAs in the 1986 Forest Plans. Because there are very few RWAs, Table 76 includes only those Grizzly Bear Analysis Unit where RWA occurs.

Table 76. Acreage of habitat by Grizzly Bear Analysis Unit, and percent of total NFS lands in Grizzly Bear Analysis Unit that are in RWA in 1986 Forest Plans

Grizzly bear management zone	Geographic area	Grizzly Bear Analysis Unit	Total NF acres in Grizzly Bear Analysis Unit	Acres (%) of Grizzly Bear Analysis Unit in RWA
Zone 2	Divide	Spotted Dog	66,723	16, 653 (25%)
	Big Belts	North Big Belts	171,431	9,105 (5%)
		South Big Belts	67,118	8,420 (13%)

Management of RWAs in the 1986 Forest Plans allowed existing uses, including motorized travel, if those uses did not conflict with the goal of protecting wilderness characteristics. Decisions about whether to retain existing motorized travel in RWAs were made in travel management plans that included those areas. New construction of temporary or permanent routes is not currently permitted in RWAs.

As the grizzly bear population expands, the availability of secure habitat outside NFS boundaries that is not heavily influenced by agriculture or other human activities may become an increasingly important driver of grizzly bear distribution and persistence outside the NCDE and in management zones 2 and 3.

Developed sites

Human developed sites have been identified as a potential stressor (U.S. Department of the Interior, Fish and Wildlife Service, 2011b) by contributing to habituation and food conditioning that may result in direct mortality of bears. Management of developed recreation sites on NFS lands is under FS control, but the activities occurring outside NFS boundaries are not.

Developed sites are sites or facilities that accommodate human use; on NFS lands, the term is used to denote sites with features that are intended to accommodate use by the public and includes campgrounds, trailheads, rental or permit cabins, lodges, ski areas, and others (Northern Continental Divide Ecosystem Subcommittee, 2019) (U.S. Department of the Interior, Fish and Wildlife Service, 2013d). Developed sites on public lands are associated with frequent and/or prolonged human use that may include continuous or frequent presence of food and attractants. Although developed sites on NFS lands have been associated with very few management removals in the NCDE and only one known removal on the HLC NF, they represent an ongoing potential for conflict and possible grizzly bear mortality. The potential impact of developed sites on grizzly bears is tied to the effective implementation of food storage orders (see section above on food and attractant storage).

The HLC NF has a total of 215 developed recreation sites (not including permit cabins and lodges) spread across the action area. The Grizzly Bear Amendment (U.S. Department of Agriculture, Forest Service, 2018) limits increases in the number and capacity of developed overnight recreation sites allowed in the primary conservation area, in order to limit the potential for grizzly bear-human conflicts. In the HLC NF portion of the primary conservation area there are currently a total of 27 developed recreation sites that allow overnight use (e.g., rental cabins, campgrounds, permitted lodges) and 98 permitted recreation residence cabins (U. S. Department of Agriculture, 2019). Across the entire plan area, users of all developed recreation facilities are required to adhere to existing food storage orders. Holders of permits for developed recreation sites (e.g., recreation residences, permit lodges, etc.) can face both legal violations and permit consequences for failure to comply with food storage orders and other requirements.

Recreational activities, including big game hunting

Recreation can have an impact on grizzly bears by increasing the potential for encounters with humans that may therefore increase the potential for conflict situations. Recreation may also create disturbance and displacement of bears from some habitats in response to the presence of humans. Recreation activities that involve overnight stays (e.g. at developed sites, as described in the section above, as well as dispersed camping and other activities) may increase the risk of bears encountering human food or other attractants and becoming food conditioned. The likelihood of bears encountering humans or being affected by human recreation activities depends on many factors, including the amount, pattern, and type of recreation, whether it occurs in or near areas used by bears, the availability of secure habitat, etc.

Hunting for big game (e.g., elk, deer, black bears, mountain lions, and other species) occurs on NFS lands. Hunting of grizzly bears is illegal in Montana but hunting for other species may result in mortality of grizzly bears through illegal kills, mistaken identity, and defense of life. Hunting-related grizzly bear mortalities accounted for 16% of human-caused grizzly bear mortalities in the NCDE between 1998 and 2017 (Northern Continental Divide Ecosystem Subcommittee, 2019). The numbers and timing of hunters in grizzly bear habitat is influenced by the type and number of animals that can be harvested and the timing and duration of hunting seasons, all of which are regulated by MFWP. The FS influence on hunting is limited to managing the timing (including season) and location of motorized travel allowed on NFS system roads and trails. The FS also issues permits for outfitting and guiding activities, much of which occurs specifically to provide backcountry hunting opportunities. Decisions regarding travel management and about outfitting and guiding permits are not made at the level of forest plans.

ROS categories provide some indication of the overall amount of area in which general types of recreation are allowed. Although ROS categories are not included in the 1986 Forest Plans, they are used to describe the general settings created by implementation of those plans, in turn providing some idea of the potential for effects to bears of human recreational activity. Detailed descriptions of ROS categories are provided in the 2020 Forest Plan and are discussed in the Recreation Settings section of this FEIS. For general reference, primitive and semi-primitive non-motorized settings are where motorized travel does not occur, human density is low, and if vegetation management occurs it emphasizes restoration of natural conditions and disturbance regimes. Semi-primitive motorized occurs where motorized travel occurs on existing routes, and humans remain relatively dispersed, whereas roaded natural describes areas where some developed sites and a well-defined road system occur. Rural is often close to communities and includes developed recreation sites designed to accommodate relatively large numbers of humans.

Table 77 displays the current acreage of each ROS by GA. Only NFS lands are included here because any intervening private or other non-NFS lands may have different characteristics than the adjacent or surrounding NFS lands.

Table 77. Acreage of recreation opportunity setting by GA

GA	Total GA acres (NFS lands only)	Primitive acres (% of GA)	Semi primitive nonmotorized acres (% of GA)	Semi primitive motorized acres (% of GA)	Roaded natural acres (% of GA)	Rural acres (% of GA)
Big Belts	315,199	48,389 (15%)	107,470 (34%)	37,029 (12%)	112,754 (36%)	9,556 (3%)
Castles	69,709	0	16,876 (24%)	16,343 (23%)	36,490 (52%)	0
Crazies	57,667	0	33,899 (59%)	15,126 (26%)	8,642 (15%)	0
Divide	202,642	16,653 (8%)	84,469 (42%)	22,500 (11%)	70,212 (35%)	8,808 (4%)
Elkhorns	161,251	0	94,394 (59%)	6,450 (4%)	57,541 (36%)	2,853 (2%)
Highwoods	42,291	0	29,906 (71%)	8,219 (19%)	4,165 (10%)	0
Little Belts	804,657	64,792 (8%)	225,659 (28%)	222,239 (28%)	288,729 (36%)	3,239 (<1%)
Rocky Mountain Range	778,022	453,091 (58%)	269,357 (35%)	24,553 (3%)	27,796 (4%)	3,226 (<1%)
Snowies	118,172	88,845 (75%)	3,977 (3%)	6,904 (6%)	17,770 (15%)	676 (1%)
Upper Blackfoot	333,617	86,733 (26%)	159,694 (48%)	7,090 (2%)	79,619 (24%)	481 (<1%)

GAs that are within the NCDE Recovery Zone (Rocky Mountain Range and portion of Upper Blackfoot GA) are predominantly in non-motorized settings where human density is anticipated to be low. These GAs include the primary conservation area, approximately 91% of which is in non-motorized settings with low human density and little or no human development. Although zone 1 (south portion of the Upper Blackfoot GA) includes almost no primitive ROS, the majority (>61%) of that zone on the HLC NF is non-motorized with low human density and little development. In Zone 2 (Divide, Big Belts, and Elkhorns GAs), which may be important for genetic connectivity with the GYE, more than half (roughly 52%) of NFS lands are in primitive or semi-primitive non-motorized settings, with no motorized travel and relatively low density of human presence and activity. In Zone 3 slightly less than 40% of NFS lands meet that description.

In addition to areas designated as non-motorized through area designations and travel management plans and as described by ROS categories, the 1986 Forest Plans include direction to manage motorized travel during the hunting season in some areas in an effort to provide security for big game species. In the 1986 Helena NF plan, which applies to the Upper Blackfoot, Divide, Elkhorns, and Big Belts GAs, standards currently require management of open road density of between 0.1 mi/mi^2 and 2.4 mi/mi^2, depending on available hiding cover, during the big game hunting season. The 1986 Lewis & Clark NF plan, which covers the remaining GAs, does not include similar requirements but directs managers to "manage motorized use… to reduce effects on wildlife during periods of high stress (hunting seasons…)". These management strategies may limit the potential for hunting season-related impacts to grizzly bears by limiting hunter access and by providing areas of relative security that may be used by wildlife (e.g., grizzly bears) other than big game.

Livestock grazing

The presence of livestock operations can benefit the long-term conservation of grizzly bears by maintaining large blocks of rangeland, and habitats that support a variety of wildlife species (Dood, Atkinson, & Boccadori, 2006). However, "… livestock use of surrounding national forests" was identified by the FWS as detrimental to bears at the time they were listed as threatened under the ESA (U.S. Department of the Interior, Fish and Wildlife Service, 1975b). Approximately 13% of known human-caused grizzly bear mortalities in the NCDE between 1998 and 2017 were due to management removals associated with livestock operations, although those occurred on non-NFS lands, primarily private lands along the Rocky Mountain Front (Northern Continental Divide Ecosystem Subcommittee, 2019). Some potential for human-bear conflict could occur at livestock carcass sites or during activities associated with livestock management. The presence of livestock may displace grizzly bears from some preferred habitats.

Livestock grazing is an important use on the HLC NF; there are currently 240 active grazing allotments on the HLC NF. Specific numbers of animals grazing on any given allotment, along with timing and duration of use, are established annually in Annual Operating Plans, and vary from year to year. Annual Operating Plans must comply with regulations and with Forest Plan direction, and are based on a permittee needs, range condition, and other resource considerations.

Although the presence of cattle grazing has not resulted in mortalities on NFS lands in the NCDE, the NCDE Conservation Strategy (Northern Continental Divide Ecosystem Subcommittee, 2019) and the Grizzly Bear Amendments (U.S. Department of Agriculture, Forest Service, 2018) recognized the potential for some impacts to bears due to this use of NFS lands. Plan components for the primary conservation area and Zone 1 in the amendments focus on reducing the potential for impacts to bears through permit requirements to reduce the risk of bear-human conflicts, requiring reporting of livestock carcasses, and capping the number of active cattle allotments. The amendments also guide managers and permittees to incorporate measures in the primary conservation area to protect key grizzly bear food production areas from conflicting/competing use by livestock.

Recognizing that grazing by small livestock, such as sheep, goats, and llamas present a greater potential for conflict with bears than do cattle (Northern Continental Divide Ecosystem Subcommittee, 2019), the amendments included standards in the primary conservation area and Zone 1 to limit the number of sheep and sheep grazing allotments and the use of small livestock for purposes such as weed control. The amendments also guide managers to reduce the number of active sheep grazing allotments in the primary conservation area if the opportunity arises with willing permittees. There are currently 5 active sheep grazing allotments on the HLC NF. Two are in the Big Belts GA (zone 2), totaling 2400 ewe/lab pairs, and three are in the Upper Blackfoot GA (primary conservation area/Zone 1), totaling 2600 ewe/lamb pairs.

Vegetation management

Vegetation management on public lands has the potential to affect grizzly bears through road building and use, which is discussed in the Habitat Security section above. Vegetation management can result in negative effects to bears through removal of cover, alteration of forage, disturbance or displacement caused by management activities (such as cutting, stacking, thinning, piling, burning, etc.), and increased risk of conflict with humans carrying out activities related to vegetation management (Northern Continental Divide Ecosystem Subcommittee, 2019). Vegetation management, including both prescribed and naturally-ignited fire, can have positive effects by maintaining or enhancing bear foods in certain habitat types (Kerns, Alexander, & Bailey, 2004; McLellan, 2015; Northern Continental Divide Ecosystem Subcommittee, 2019; Zager, Jonkel, & Habeck, 1983).

The 1986 Helena NF and Lewis & Clark NF plans provide vegetation management guidance in a variety of forms. Both plans encourage the use of vegetation treatment, including prescribed fire, to improve habitat for various wildlife species and groups, and both plans include standards for maintaining hiding cover to benefit big game and other species. The Grizzly Bear Amendment that is incorporated into both plans includes guidance to reduce the risk of disturbance to bears during or as a result of vegetation management activities and to maintain or increase habitat and cover where possible. Vegetation management projects must adhere to other grizzly bear related guidance, including standards regarding motorized route density where applicable, and adherence by contractors and other personnel to food storage orders.

Minerals and energy development

Mineral development refers to surface and underground hardrock mining and coal production, which on NFS lands are regulated by permits. Oil and gas production are conducted through a leasing process. All these types of development have the potential to impact grizzly bears through construction and use of motorized access routes (discussed in the Habitat Security section above), potential displacement from habitat and/or permanent habitat loss, potential for human-bear encounters and conflicts, and potential for food conditioning from exposure to food or attractants associated with minerals or energy operations (Northern Continental Divide Ecosystem Subcommittee, 2019).

Lands on the HLC NF are generally available for both locatable and leasable minerals exploration and development, with the exception of designated Wilderness areas, and areas that are either administratively or Congressionally withdrawn from those uses. Administratively withdrawn areas include such things as campgrounds, administrative sites, or other identified developed sites. The Elkhorns Wildlife Management Unit in the Elkhorns GA (Zone 2) is also administratively withdrawn from oil and gas leasing, but could be available for other types of leasable minerals exploration and development. The entire Rocky Mountain Range GA, which is entirely within the primary conservation area, is withdrawn by act of Congress from future locatable or leasable minerals exploration or development.

Locatable mineral uses are managed through Plans of Operation and Notices of Intent that are developed at the time that specific plans for minerals exploration or development are submitted. The HLC NF averages roughly 30 active Plans of Operation or Notices of Intent in a given year, each of which generally disturbs less than one acre. The only commercial hardrock mining rights within the primary conservation area on the HLC NF are for the Cotter Mine, on the Upper Blackfoot GA. There is currently no mining activity at that site.

There are two existing leases on the Rocky Mountain Range GA (primary conservation area) that are currently suspended pending the outcome of litigation, eight lease parcels in the Big Belts GA (Zone 2) that are on hold (not yet leased) pending further review and decision, and one lease shared with the Custer-Gallatin NF in the Crazies GA (Zone 3) that is suspended. The Rocky Mountain Range GA, entirely within the primary conservation area, is unavailable for future oil and gas exploration and development because of Congressional actions.

The 1986 Lewis & Clark NF plan includes guidance for oil and gas development in grizzly bear habitat that would constrain helicopter flights and seismic activity and guide other aspects of exploration and development to reduce the risk of negative impacts to grizzly bears. The Grizzly Bear Amendments include additional standards and guidelines to further reduce the potential for impacts to bears of mining, and oil and gas exploration and development. These include measures to reduce or mitigate potential impacts to bears, require bear safety training for personnel involved in minerals and energy development activities, and require no surface occupancy for new leases within the primary conservation area.

These requirements and guidelines are focused on the primary conservation area and Zone 1, where management goals include recovering and sustaining recovery of the grizzly bear population. Plans for exploration for or development of minerals or oil and gas elsewhere on the HLC NF (e.g. in zones 2 and 3), should they occur, would currently be guided by site-specific analysis that would include consideration of wildlife, including grizzly bear habitat needs to the extent allowed by legal mineral rights.

Habitat connectivity

Human activities such as roads and developments are the primary causes of grizzly bear habitat fragmentation (Servheen, Waller, & Sandstrom, 2001), which can limit grizzly bear movement within and among habitats, and has the potential to limit the degree to which grizzly bear populations in Montana and the U.S. are both genetically and demographically connected. Servheen and others (Servheen, Waller, & Sandstrom, 2003) found that fragmentation of grizzly bear habitat in Montana is largely associated with human development occurring on private lands in valley bottoms. They indicated that most public lands had "minimal" or "low" potential for impact to grizzly bear habitat connectivity; where public lands were not continuously distributed across the landscape the potential impact rose to "moderate". Although their model did not consider habitat quality as an important factor governing bear movements, Mace and others (Mace, Waller, Manley, Ake, & Wittinger, 1999) documented strong associations between locations of radio-collared bears and certain broad categories of vegetation type. Effective 'linkage zones' between populations are areas that will support low density populations at certain times of year (Servheen et al., 2001); therefore, they must contain habitat elements necessary for the survival of those animals during that time period.

Kendall and others (Kendall et al., 2009) concluded that there are few geographical barriers to the movement of grizzly bears within the ecosystem, and that the NCDE grizzly bear population does not suffer from a lack of genetic diversity. Occupancy by grizzly bears of lands outside the NCDE is not identified as a recovery or management goal, but isolation of existing populations (U.S. Department of the Interior, Fish and Wildlife Service, 1993) and the potential for ongoing fragmentation have been identified as concerns with respect to the health and recovery of grizzly bear populations in some ecosystems (U.S. Department of the Interior, Fish and Wildlife Service, 2011b). The Conservation Strategy for the Grizzly Bear in the NCDE notes that although connectivity to the west and south is not required for a healthy NCDE population, it would benefit other grizzly bear populations in the lower 48 states (Northern Continental Divide Ecosystem Subcommittee, 2019).

The NCDE Conservation Strategy (Northern Continental Divide Ecosystem Subcommittee, 2019) identifies zone 2, which is entirely on the HLC NF and borders the south end of the NCDE, as having potential value for genetic connectivity between the NCDE and the GYE. Peck and others (Peck et al.,

2017) support that conclusion, noting that the area including the Upper Blackfoot and Divide GAs (i.e. portions of Zones 1 and 2) and adjoining areas to the west may be more important to grizzly bears moving south from the NCDE to the GYE than the reverse. Largely because of existing blocks of HLC NF lands with few or no roads, such as IRAs, the only management specific to Zone 2 called for in the NCDE Conservation Strategy and the Grizzly Bear Amendments is to reduce potential for grizzly bear-human conflict by implementing food storage orders. Food storage orders were implemented throughout this area beginning in 2018.

The portion of the NCDE Recovery Zone within the action area includes large areas of designated wilderness areas and IRAs, and as such is relatively unlikely to experience fragmentation due to human activities. As discussed in the sections above on habitat security and on recreation, over half (57%) of Zone 1, nearly half (47%) of Zone 2 and well over half (64%) of Zone 3 is in designated wilderness, WSA, or IRA. Table 74 in the Habitat Security section above displays the amount of each Grizzly Bear Analysis Unit that is in potentially secure habitat (blocks ≥2500 acres that are ≥500m from any existing road). To sum that information in a way that reflects on the existing potential for connectivity within each area:

- Zone 1: between 23 and 38 percent of each Grizzly Bear Analysis Unit is in potentially secure habitat, with about 31% of the total NFS acreage in the zone in four blocks of potentially secure habitat, one of which is contiguous with a large block of secure habitat in Zone 2 (map available in project file).
- Zone 2: between 18 and 54 percent of each Grizzly Bear Analysis Unit in zone 2 is potentially secure habitat with about 34% of the total NFS acreage in the zone in potentially secure habitat. Existing blocks of secure habitat are contiguous with secure habitat in Zone 1 and with public lands to the southwest and are well distributed throughout the GAs that comprise Zone 2.
- Zone 3: between 4 and 62 percent of each Grizzly Bear Analysis Unit in zone 3 is potentially secure habitat, with roughly 34% of the total NFS acreage in the zone in potentially secure habitat. Existing blocks of secure habitat are distributed throughout most of Zone 3, with some contiguous with lands administered by the Custer-Gallatin NF in the Crazy Mountains.

Although effective genetic or demographic connectivity between and among areas is more complex than simply absence of roads or motorized travel, those measures provide the best index we have available to describe the potential for those areas to allow for movement of bears across the action area and between the NCDE and the GYE.

3.14.6 Grizzly bear, environmental consequences

As discussed in the terrestrial wildlife diversity section and under the heading 'assumptions', plan components to maintain ecosystem integrity and diversity provide for most of the needs (foraging, denning, breeding, and movement) of grizzly bears on the HLC NF. The effects of these coarse-filter components in supporting recovery and sustaining recovered grizzly bear populations will be discussed under the effects of alternatives, because plan components differ between the no-action and action alternatives.

The 2012 Planning Rule states that species-specific, or fine-filter plan components may be required where coarse-filter plan components may not be adequate to ensure conservation or recovery of at-risk species. Fine filter plan components that guide management of grizzly bear habitat and activities that could impact grizzly bears are incorporated into the 2020 Forest Plan, and are retained in all alternatives as the Amendment to Incorporate Management Direction From the Northern Continental Divide Ecosystem Grizzly Bear Conservation Strategy into the Helena, Lewis and Clark, Kootenai, and Lolo NFs (Grizzly Bear Amendment) (HLC NF 2020 Forest Plan). The plan components found in the Grizzly Bear Amendment focus on minimizing human-caused mortality and on providing security from disturbance by humans and are discussed under the 'effects common to all alternatives' section below. The potential consequences to grizzly bears of additional fine filter plan components are discussed for the alternatives in the appropriate sections below.

Effects common to all alternatives

Retained Direction from the Forest plan Amendments to Incorporate Habitat Management Direction for the Northern Continental Divide Ecosystem Grizzly Bear Population

All alternatives, including the no-action alternative, retain the direction in the 2018 Forest Plan Amendments to Incorporate Habitat Management Direction for the Northern Continental Divide Ecosystem Grizzly Bear Population into the existing Helena NF and Lewis and Clark NF plans (Grizzly Bear Amendment). All plan components from the amendments are retained in all alternatives, addressing the key issues of mortality, security and connectivity; discussion of the consequences of that management direction as a whole is summarized here, with additional detail provided under appropriate headings below.

A full analysis of the potential impacts of implementing the management described in the Grizzly Bear Amendment can be found in the Final Environmental Impact Statement, Volume 3: Forest Plan Amendments to incorporate habitat management direction for the Northern Continental Divide Ecosystem Grizzly Bear Population (U.S. Department of Agriculture, Forest Service, 2017e) and summarized in the Record of the Decision (U.S. Department of Agriculture, Forest Service, 2018). The analysis in the 2017 FEIS for the amendments is separate for the Helena NF and the Lewis and Clark NF because two separate forest plans were amended. The BA (U.S. Department of Agriculture, Forest Service, 2017b) for the amendments also provided detailed analysis of the potential impacts of implementing the management direction in the amendments, and determined that implementing the amendments may affect, and is likely to adversely affect the grizzly bear.

Discussion of the effects of plan components from the amendments that relate to specific issues and resources is provided in the Affected Environment section above and summarized as needed in issue-specific sections below. As a whole, the implementation of the grizzly bear plan components retained from the amendments under all alternatives would contribute to maintaining a well-distributed grizzly bear population across the Forest (U.S. Department of Agriculture, Forest Service, 2017b) . In its Biological Opinion (U.S. Department of the Interior, Fish and Wildlife Service, 2017b), the FWS concluded that implementation of the amendments is not likely to jeopardize the continued existence of the grizzly bear. The FWS determined that implementation of the amendments would "result in conditions that support grizzly bear use of NFS lands in the NCDE", and "will not appreciably reduce the likelihood of both the survival and recovery of the NCDE grizzly bears" {Warren, 2017, Biological assessment for threatened`, endangered`, and proposed species forest plan amendments—Incorporating habitat management direction for the NCDE grizzly bear population into the Helena`, Lewis and Clark`, Kootenai`, and Lolo National Forest Plans.

Mortality

Plan components retained from the Grizzly Bear Amendments under all alternatives support implementation of food storage orders and practices that would minimize the risk of bears becoming food-conditioned. These include a requirement to implement food storage orders in the primary conservation area, Zone 1, and Zone 2, as well as requirements to include food and attractant storage requirements and consequences in special use permits and operating plans for various activities. Proper storage and management of food and attractants has been demonstrated to be an effective tool to reduce grizzly bear mortality risk {Northern Continental Divide Ecosystem Subcommittee, 2019 #16441}. The effect to grizzly bears of the above plan components would be to continue or decrease the existing relatively low risk of bears becoming food-conditioned or of conflicts developing as a result of human foods or attractants in the plan area.

Habitat security

Summer motorized travel

Table 75 in the Affected Environment section above displays the status of motorized route densities and secure core in the primary conservation area and zone 1, where reporting of open and total motorized route densities is carried out according to requirements and methodologies described in the Grizzly Bear Amendments. Table 76 in the Affected Environment section above displays the amount of potentially secure habitat currently present in Zones 1-3. The mileage, location, and timing of public motorized travel across the HLC NF is determined by travel plans, which are in place across the HLC NF, and will not change under the 2020 Forest Plan or any of the alternatives.

Based on past practices, we anticipate that up to 15 miles of permanent roads could be constructed across the Forest over the next 15 years under any of the alternatives. This estimate is based on the assumption that the Forest could construct up to 1 mile of permanent road per year to address various resource or public transportation issues. Permanent road construction within grizzly bear subunits in the primary conservation area and Zone 1 is limited by the aforementioned standards such that changes to secure core in the primary conservation area are precluded and changes to secure habitat in Grizzly Bear Analysis Units in Zone 1 are unlikely. In Grizzly Bear Analysis Units elsewhere across the Forest new permanent roads are likely to replace old roads that would subsequently be obliterated; and existing roads that are no longer needed would continue to be removed from the landscape. Therefore it is likely that we would see a decrease in miles of permanent roads under any alternative, and secure habitat for grizzly bears would be maintained or increased.

Under all alternatives, vegetation management (timber harvest, fuels treatments, etc.) may occur and could require temporary use of existing motorized routes that are currently closed, or construction of new temporary motorized routes in order to allow implementation of those vegetation management activities. Within the primary conservation area, plan components retained from the Grizzly Bear Amendments would limit those changes in each Bear Management Unit to no more than a 5% temporary increase in open motorized route density, no more than 3% temporary increase in total motorized route density, and no more than 2% temporary decrease in secure core (PCA-NCDE-STD-02).

In Zones 1-3, an analysis of 8 years of vegetation management projects planned and/or implemented in Zones 1-3 involved 98 miles of temporary roads, with all but 4 miles occurring outside mapped secure habitat areas. Based on analysis of those projects, we estimate that secure habitat as currently measured could be temporarily affected by an average of 2.5%, and no more than 7% in any individual Grizzly Bear Analysis Unit over the next 15 years under any alternative, as a result of temporary motorized routes used to implement vegetation management projects. Temporary reduction in effectiveness of secure habitat occurring during implementation of these projects would likely occur in no more than 6 Grizzly Bear Analysis Units in total during that time, and likely in no more than 2 Grizzly Bear Analysis Units concurrently. The minor reductions in the effectiveness of secure habitat would be localized and likely in widely separate areas but could result in minor disturbance or displacement of bears using those areas during project implementation time periods.

It is possible that temporary routes used for vegetation management could affect polygons of secure habitat so that the effective size of a secure habitat polygon is less than 2,500 acres during project implementation. As discussed in the Affected Environment section above, the method we are currently using to estimate potentially secure habitat likely underestimates the amount of secure habitat that is actually present on the HLC NF. Therefore, it is possible that some secure habitat polygons may in fact be larger than we estimated and may continue to provide habitat security for grizzly bears despite the influence of temporary roads in some portions of them.

Our analysis showed that most temporary roads tend to occur in proximity to existing motorized routes and not within 500 meters of mapped secure habitat patches. The effects of those temporary routes would likely not be separate or distinguishable from the effects of existing motorized routes already on the landscape, as discussed in the Affected Environment section.

The effects to bears in the primary conservation area and Zone 1 of the plan components retained from the Grizzly Bear Amendments would be as described in the BA (U.S. Department of Agriculture, Forest Service, 2017b) for those amendments: some adverse effects possible to individual bears in areas of relatively high motorized route densities or where temporary roads are constructed or used. Conditions in Zone 1 would be maintained that have been compatible with a stable to increasing grizzly bear population that has been expanding south of highway 200 (ibid).

The effects of motorized route access and of secure habitat in areas where grizzly bears may be present but have not been documented on a recurring basis are expected to be generally similar to those described for bears in the primary conservation area and Zone 1 and in the scientific literature (see section 3.14.5, Affected Environment, section on Habitat Security). As discussed in that section, the impacts of motorized routes on bears depends on numerous factors, including the type, timing, and amount of motorized travel, proximity of motorized routes to important habitat areas and food sources (which vary over time), whether bears are part of a hunted population, density of the bear population, and other factors. On the HLC NF, in the near future bears using portions of Zones 2 and 3 are likely to have traversed large expanses of human-dominated areas in order to reach NFS lands in those areas. In doing so those individuals may have learned either avoidance or tolerance of human activities. Individual bears moving into areas new to them are likely to initially be naïve to the availability and distribution of food sources, hazards, and secure habitat. Grizzly bears establishing home ranges in areas with few or no other established bears presumably have different choices available to them regarding use or avoidance of areas with motorized routes or other human uses than do bears using areas where other bears are already established. Therefore we cannot assume that thresholds or values for motorized route density and secure habitat derived from and used to analyze effects to bears in areas that have established populations would apply in areas that do not.

Winter motorized travel

The mileage, acreage, location, and timing of winter motorized over-snow travel across the HLC NF is determined by travel plans, which are in place across the HLC NF and would not change as a result of any alternatives. All alternatives retain the standard in the primary conservation area that prohibits net increases in the percent of area of miles of trail open to motorized over-snow use during the den emergence time period in modeled denning habitat. The effects to grizzly bears of winter motorized over-snow travel on the HLC NF are likely to be minimal. As discussed in the Affected Environment section, there is little evidence that over-snow motorized travel affects choice of denning location or causes negative impacts to bears during the den emergence timeframe. Nevertheless, there is some potential for grizzly bears to experience adverse effects from late-season over-snow motorized vehicle use in some areas, particularly where such use is allowed after March 31. Bears using those areas could experience disturbance at a time when their body condition is poor and food resources are limited.

Over-snow-motorized use is allowed after March 31 across the Forest with the exception of most of the primary conservation area within which over-snow-motorized use is not allowed after March 31. Snowmobile use past March 31 in the primary conservation area is allowed in the Copper Bowls area in the Upper Blackfoot through May 31. See the Winter Motorized Travel section in the Existing Condition and in the BA for the Grizzly Bear Amendments (U.S. Department of Agriculture, Forest Service, 2017b) for more details.

Other indicators of habitat security

Under all alternatives, the amount and distribution of designated Wilderness, WSAs, and IRAs would remain the same. These areas would continue to provide habitat security for grizzly bears and other wildlife as described in the Affected Environment section (3.14.5).

Developed Recreation

Standard PCA-NCDE-STD-06, retained from the Grizzly Bear Amendments, limits the number and capacity of developed recreation sites on NFS lands that are designated and managed for overnight use by the public during the non-denning season to one increase above the baseline per decade per Bear Management Unit in the primary conservation area (same as NCDE-STD-AR 05 in the Grizzly Bear Amendment). The combination of implementation of food storage orders and the relatively low number and limited capacity of developed recreation sites within the primary conservation area portion of the HLC NF means that the risk of mortality for grizzly bears related to developed recreation sites would remain relatively low within the primary conservation area under all alternatives. Refer to the FEIS (U.S. Department of Agriculture, Forest Service, 2017e) and BA (U.S. Department of Agriculture, Forest Service, 2017b) for the Forest Plan Amendments to Incorporate Habitat Management Direction for the Northern Continental Divide Grizzly Bear Population (U.S. Department of Agriculture, Forest Service, 2018) for additional details.

Vegetation Management

Desired conditions retained in all alternatives from the Grizzly Bear Amendments guide vegetation management with respect to grizzly bears and their habitat. PCA-NCDE-DC-04 and 05 establish the desired condition to support vegetation conditions that would sustain grizzly bear recovery and provide for grizzly bear habitat needs over the long term. Several guidelines would limit the duration of activities related to vegetation management, and reduce risk of disturbance and would maintain or improve grizzly bear habitat when vegetation treatments in the primary conservation area are planned and designed. As described in the FEIS (U.S. Department of Agriculture, Forest Service, 2017e) and BA (U.S. Department of Agriculture, Forest Service, 2017b) for the Forest Plan Amendments to Incorporate Habitat Management Direction for the Northern Continental Divide Grizzly Bear Population (U.S. Department of Agriculture, Forest Service, 2018), these plan components would minimize potential impacts to bears of vegetation management activities within the primary conservation area, and would help to maintain forage and cover in grizzly bear habitat.

Livestock Grazing

Plan components for management of livestock grazing are retained from the Grizzly Bear Amendments, and would continue to apply to the primary conservation area under all altnernatives. These include standards to incorporate requirements into new or reauthorized grazing permits to reduce the risk of grizzly bear-human conflict, prohibit increases in the number of active cattle grazing allotments and the number of sheep allotments or permitted sheep animal unit months above the baseline, and reduce the number of open or active sheep allotments when opportunities arise. Additional components would constrain use of small livestock for weed control or other uses in order to prevent conflict with grizzly bears. The effect of these plan components would be to limit the risk to bear of conflicts related to livestock grazing. Use of existing livestock grazing allotments have been compatible with an increasing grizzly bear population, and based on a lack of conflicts, the risk of mortality related to livestock grazing on the HLC NF appears to be low. Refer to FEIS (U.S. Department of Agriculture, Forest Service, 2017e) and BA (U.S. Department of Agriculture, Forest Service, 2017b) for the Forest Plan Amendments to Incorporate Habitat Management Direction for the Northern Continental Divide Grizzly Bear Population (U.S. Department of Agriculture, Forest Service, 2018), for additional details.

Oil and Gas Exploration and Development

Plan components for energy and minerals development are retained in the proposed plan from the Grizzly Bear Amendments would allow no surface occupancy for new leases in the primary conservation area. In the primary conservation area and Zone 1, measures to reduce or mitigate potential impacts to bears would be required in new permits, leases, and operating plans. Several guidelines provide specific methods by which to reduce or mitigate disturbance or displacement from minerals and energy activities. All contractors, lessees, and their employees associated with minerals and energy operations would be required to complete bear safety training. These plan components would help to minimize potential impacts to bears. Although the Rocky Mountain Range GA, which makes up the majority of the primary conservation area within the action area, is legally unavailable for new minerals leasing, the requirement for no surface occupancy provides an additional measure of certainty that impacts to bears from this use would not occur in the primary conservation area. Refer to FEIS (U.S. Department of Agriculture, Forest Service, 2017e) and BA (U.S. Department of Agriculture, Forest Service, 2017b) for the Forest Plan Amendments to Incorporate Habitat Management Direction for the Northern Continental Divide Grizzly Bear Population (U.S. Department of Agriculture, Forest Service, 2018), for additional analysis.

Effects common to all action alternatives

Coarse filter

Under all action alternatives, plan components would guide managers to move most vegetation types toward the NRV identified for each type. This would move habitats toward conditions that have historically sustained a population of grizzly bears.

As discussed in the terrestrial vegetation section, the predicted trend for most vegetation types and structural stages does not differ among alternatives. Vegetation management, livestock grazing, and other activities would be constrained by plan components designed to protect watershed integrity, riparian habitats, and hydrologic function, thereby moving riparian habitats toward desired conditions that support functioning and resilient riparian and wetland ecosystems. Identification and management of RMZs, as well as CWNs, is likely to maintain or improve connectivity on NFS lands within and among these habitats.

Under all action alternatives, the vegetation types within grass/shrub, hardwood tree, and mixed conifer habitats would generally move toward the estimated NRV and toward desired conditions (refer also to the section below on plan components associated with vegetation management). These habitats currently provide sufficient food and other resources required by grizzly bears where grizzly bears exist and would be expected to continue to do so under all action alternatives. Specific plan direction for whitebark pine in all action alternatives would conserve and potentially restore this grizzly bear food source in some areas, although the degree to which this occurs would be affected by the prevalence and spread of disease, as well as potential changes in climate.

Mortality

In addition to retaining food storage orders in the primary conservation area, Zone 1 and Zone 2, all action alternatives contain plan components to minimize the potential for impacts to wildlife resulting from various resource management activities or uses (e.g. FW-REC-DC-04, FW-RT-DC-04, and RM-WL-STD-01) and to reduce wildlife-human conflicts (FW-WL-DC-05, FW-WL-GDL-02, and FW-RSUP-GDL-01). These plan components would add to the benefits of the existing food storage orders by further reducing the risk of bear-human conflicts that may result in grizzly bear mortality.

Habitat security

Summer motorized access

In addition to plan components related to motorized access described nabove in the section on Effects of All Alternatives, all action althernatives access to NFS lands is a desired condition (e.g., FW-LAND-DC-01), but a number of forestwide plan components would limit or reduce the number or mileage of roads or minimize their impacts to wildlife, including grizzly bears:

- FW-RT-DC 02, FW-RT-OBJ-01 and FW-RT-GDL-12 state that roads that are not needed to serve administrative and public needs are not present, and guide managers to decommission at least 50 miles of roads over the life of the plan, to address resource damage and to benefit fish and wildlife habitat, enhance the desired ROS settings and recreation opportunities, and/or create a more cost-efficient transportation system.
- FW-RT-GDL-13 guides managers to avoid building roads in key seasonal wildlife habitats, which includes grizzly bear spring habitat. Therefore, the risk of disturbance or displacement of grizzly bears from spring habitats as a result of new permanent or temporary road construction and use would be less than in summer and fall habitats.
- FW-RT-DC 04 Sets a desired condition for the transportation system to have minimal impacts on resources including all wildlife, heritage and cultural sites, water quality, and aquatic species.
- FW-ACCESS-GDL-01 adds to the plan components discussed above by guiding managers to rehabilitate unauthorized recreation routes and restore landscapes to natural conditions.
- FW-LAND-USE-GO-01 encourages the establishment of road user associations in order to limit the number of roads needed to access private land inholdings.

In addition to the above plan components, some plan components specific to GAs constrain motorized access (e.g., EH-ACCESS-DC-01, EH-RT-STD-01, EH-RT-STD-02, and EH-ACCESS-GDL-01). The amount of secure habitat could increase on the HLC NF based on the above plan components that set objectives for and otherwise guide managers to decommission roads that are not used. Specific roads to be decommissioned would be identified in project-specific planning, and effects analyzed at that time.

The effects to grizzly bear habitat security of plan components related to motorized access in the action alternatives would be as described under the section above on Effects Common to All Alternatives. Plan components described above for all alternatives would limit impacts of motorized travel, and guide managers to consider wildlife, including grizzly bear, habitat needs and potential impacts when managing motorized access on the HLC NF.

Winter motorized travel

The effects of winter motorized travel on grizzly bear habitat security would not be different in the action alternatives from the effects described above for all alternatives. Specific changes to winter over-snow motorized travel would occur based on site-specific planning that would adhere to forest plan components, and would be analyzed at the time that plans are developed.

Other indicators of habitat security

The amount of designated wilderness, WSA, and IRA would remain the same as described in the Affected Environment section (3.14.5). Additional plan components for those designations found in all action alternatives that may influence grizzly bear habitat security are summarized below:

- FW-WILD-DC-03 establishes the desired condition that large remote areas within designated wilderness areas contribute habitats for species with large home ranges such as wide-ranging carnivores (e.g., grizzly bear), and that habitat in wilderness contributes to wildlife movement within and across the Forest. FW-WILD-SUIT-02 states that these areas are not suitable for motorized or mechanized means of transportation.

- FW-WSA-SUIT-04 and 08 state that WSAs are suitable for motorized and mechanized means of transportation, subject to travel plans or other designations, but FW-WSA-SUIT-05 states that new road construction or reconstruction is not suitable in WSAs.
- FW-IRA-DC 01 establishes the desired condition that IRAs provide large, undisturbed, and unfragmented areas of land and provide for secure habitats for a variety of fish and wildlife species that are dependent upon those conditions. Motorized routes that are managed as part of the existing forest transportation system are suitable in IRAs (FW-IRA-SUIT 02).

Forest Plans establish RWAs, which could become designated wilderness in the future, should Congress decide to do so. RWAs may also contribute to habitat security for grizzly bears and other wildlife. All action alternatives except alternative E would include several RWAs, with the amount and location varying by alternative. Table 78 displays the amount of RWA in each alternative as compared to that 1986 Forest Plans (Alternative A). Alternative A, which also represents the existing condition, is included to facilitate comparison among all alternatives.

Table 78. Acres and percent of grizzly bear management zones in RWA by alternative

Grizzly bear management zone[1]	Alterntive A	Alternatives B and C	Alternative D	Alternative E	Alternative F
Primary conservation area	0	30,246 (3%)	30,246 (3%)	0	0
Zone 1	0	23,315 (17%)	25,315 (17%)	0	17,133 (21%)
Zone 2	34,226 (5%)	47,726 (7%)	98,227 (15%)	0	33,412 (11%)
Zone 3	0	14,490 (1%)	225,501 (23%)	0	0
TOTAL	34,226	115,777	379,289		50,545

[1.] The primary conservation area includes the Rocky Mountain Range GA and the north half of the Upper Blackfoot GA. Zone 1 includes the south half of the Upper Blackfoot GA. Zone 2 includes the Divide, Elkhorns, and Big Belts GAs. Zone 3 includes the Highwoods, Little Belts, Castles, and Crazies GAs.

The main difference among alternatives is that alternative E would have no RWAs, which is less than the no-action alternative, and Alternative F would have the least acreage in RWA of the action alternatives. These differences have limited impact to grizzly bear habitat security, however. RWAs largely overlap with existing IRAs, with little or no motorized travel and significant constraints on other management activities that could reduce their value as secure habitat. Alternatives B, C, D, and F also include a RWA not shown in Table 78, because it occurs in the Big Snowy Mountains in the Snowies GA, which is outside both Zone 3 and the current area identified where grizzlies may be present. The RWA in the Snowies GA largely overlaps with the Congressionally designated WSA in that GA, with restrictions on motorized travel and other management activities that would remain the same under anly alternative.

Currently, travel management plans provide direction for the amount, distribution, timing, and specific routes where motorized travel is or is not suitable in areas identified in the alternatives as RWA. In alternatives B, D, and F both motorized and mechanized means of transportation would be unsuitable in RWAs. Implementing any of those alternatives would result 11.8 miles (alternative B) or 82.2 miles (alternative D), or 8.1 miles (alternative F) of motorized roads or trails becoming unsuitable for motorized travel. Similarly implementing any of those three alternatives would also result 205.7 miles (alternative B) or 360.2 miles (alternative D) or 135 miles (alternative F) of nonmotorized trails becoming unsuitable for mechanized means of transportation, including travel by mountain bikes. These impacts are not large relative to the entire HLC NF, but could somewhat increase the value of those RWAs as secure habitat.

The combined effect of designated wilderness, WSAs, IRAs, and RWAs would be to maintain those acreages as largely secure habitat and increase potential long-term security in areas designated as RWAs. These areas may limit or reduce the potential for bears to experience disturbance or displacement or be involved in bear-human conflicts as a result of certain types of human uses.

The amount of primitive and semi-primitive nonmotorized recreation setting under each alternative provides one means to measure and compare potential habitat security and connectivity for grizzly bears and other wildlife. The amount of those settings that would occur under the action alternatives is shown in Table 79. Alternative A (no action) is included in this table to facilitate comparison.

Table 79. Acres and percent of total management zone of combined summer primitive and semi-primitive recreation settings (nonmotorized categories) by grizzly bear management zone by alternative

Grizzly bear management zone[1]	Alternative A	Alternatives B and C	Alternative D	Alternative E	Alternative F
Primary conservation area	878,470 (91%)	884,018 (92%)	884,018 (92%)	878,472 (91%)	880,244 (92%)
Zone 1	90,464 (61%)	93,387 (63%)	93,387 (63%)	90,427 (61%)	86,156 (58%)
Zone 2	348,582 (52%)	349,705 (52%)	356,127 (53%)	341,374 (51%)	348,255 (52%)
Zone 3	378,849 (39%)	378,940 (39%)	419,669 (43%)	378,805 (39%)	374,040 (38%)

[1.] The primary conservation area includes the Rocky Mountain Range GA and the north half of the Upper Blackfoot GA. Zone 1 includes the south half of the Upper Blackfoot GA. Zone 2 includes the Divide, Elkhorns, and Big Belts GAs. Zone 3 includes the Highwoods, Little Belts, Castles, and Crazies GAs.

There is not much difference among alternatives in terms of the amount or proportion of area in nonmotorized recreation setting in total or by management zone. Most of the primary conservation area would remain nonmotorized and therefore relatively secure for grizzly bears because it occurs largely on the Rocky Mountain Range GA within the overlapping layers of Congressionally-designated wilderness, IRA, and conservation management area. Appropriately, the amount of potential habitat secure from motorized use in all alternatives is less in the zones moving further from the primary conservation area. Zone 3, where continued occupancy by grizzly bears is not expected, however, would still have more than one third of its area in nonmotorized recreation settings.

Additional plan components not already discussed above that would contribute to security for wildlife in general that would also contribute to grizzly bear habitat security are listed in Table 80 along with where they would apply. Descriptions in Table 80 paraphrase the actual components, to briefly illustrate how they may influence habitat security. Please refer to the 2020 Forest Plan for the actual text of plan components.

Table 80. Plan components in all action alternatives that would contribute to providing habitat security for grizzly bears and other wildlife

Plan component	Grizzly bear management zone where applies	Description
FW-WL-DC-07	All	Low elevation nonforested provides forage intermixed with cover for wintering big game
FW-WL-DC-08	All	Nest and den sites relatively free of human disturbance
FW-WL-GDL-06	All	Vegetation management on big game winter range improves forage and retains cover
FW-LAND-DC-03	All	Land adjustments enhance or protect resources including habitat for wildlife
FW-LAND USE-DC-03; GDL-03 and 07	All	Utility corridors, communication sites and the like occur within already disturbed areas, obsolete ones are removed, and authorizations are consistent with ecosystem desired conditions
BB-WL-DC-03	Zone 2	Big Belts GA – manage lands to maintain or improve connectivity
CR-WL-DC-01	Zone 3	Crazies GA – manage lands to maintain or improve connectivity

Plan component	Grizzly bear management zone where applies	Description
DI-WL-GDL-01	Zone 2	Divide GA - manage lands to maintain or improve security and connectivity; vegetation management provides hiding cover, no increase in motor access, location of new trails doesn't impact wildlife habitats
DI-WL-GO-01	Zone 2	Divide GA - Acquire ownership and easement to intermingled lands for connectivity and security
EH-WL-DC-01	Zone 2	Elkhorns GA- Habitat provides for species requiring seclusion
EH-WL-GDL-01	Zone 1	Elkhorns GA – maintenance, enhancement, and restoration of wildlife and their habitats are the priorities for management…management activities and permitted uses would be compatible with wildlife…
EH-WL-GDL-02	Zone 2	Elkhorns GA- Permitted activities have conditions to reduce potential impacts to wildlife, including timing or other restrictions
RM-WL-DC-01	Primary conservation area	Rocky Mountain Range GA – provides habitat connectivity for wide-ranging species.
RM-BTM-DC-02	Primary conservation area	Rocky Mountain Range GA - Maintains values of Badger-Two Medicine as large, undeveloped landscape
RM-CMA-DC-03	Primary conservation area	Rocky Mountain GA – Conservation Management Area allows primarily nonmotorized recreation providing primitive and semi primitive recreation opportunities
RM-CMA-STD-01	Primary conservation area	Rocky Mountain Range GA – In the Consevation Management Area, no new or temporary roads except very limited purposes near other roads
RM-CMA-STD-02	Primary conservation area	Rocky Mountain Range GA – In the Consevation Management Area, temporary roads must be restored within 3 years of project completion
UB-WL-DC-01	Primary conservation area and Zone 1	Upper Blackfoot GA – provides habitat connectivity for wide-ranging species
UB-WL-GDL-01	Primary conservation area and Zone 1	Upper Blackfoot GA- Resource management activities in west-central and east-central should maintain or enhance wildlife habitat, movement areas, and connectivity; vegetation management provides cover, no increase in motorized use, locate new trails only where minimal impacts occur to wildlife

The combined effects of plan components discussed in this section would be, under any of the action alternatives, to maintain or increase habitat security for grizzly bears. This would occur through 1986 Forest Plan components retained from the Grizzly Bear Amendments (refer to analysis under the section titled "Effects common to all alternatives"), added to plan components that require management of the transportation system with minimal impacts to wildlife, management of a number of designated areas with minimal motorized or no motorized access, and retaining large portions of the forest in primitive and semi-primitive non-motorized recreation settings.

Connectivity

As discussed in the Affected Environment section, a large portion of the NCDE recovery zone encompassing the plan area includes designated wilderness areas and IRAs, and as such is relatively unlikely to experience fragmentation due to human activities. These areas would not change under the 2020 Forest Plan. Plan components in the action alternatives that would maintain habitat security, including establishing RWAs and ROS categories as described in the previous section would contribute to maintaining the potential for connectivity between and among areas on the HLC NF.

The Upper Blackfoot and Divide GAs are likely potential routes for movement of bears that may provide genetic connectivity between the NCDE and the GYE system (Peck et al., 2017). Areas such as the Highway 200 corridor through the Upper Blackfoot GA (primary conservation area and Zone 1), and the Highway 12 corridor through the Divide GA (Zone 2), in addition to private lands in those areas may provide some impediments to grizzly bear movements through those landscapes, and could limit connectivity between the NCDE and the GYE. Although the majority of fragmentation and impacts to connectivity in those areas occur on non-NFS lands that are not affected by FS management actions, the action alternatives include plan components for the Divide and Upper Blackfoot that identify specific areas where habitat security should be maintained or improved for grizzly bears and other wide-ranging wildlife species to maintain connectivity among public lands in northern Montana and those in south and southwestern Montana:

- DI-WL-GDL-01 provides guidance to manage lands in the Divide GA (within Zone 2) to maintain or improve security and connectivity and do so through ensuring that vegetation management provides hiding cover, motorized access is not increased, and the location of new trails will not impact wildlife habitats.
- DI-WL-GO-01 establishes a goal to work cooperatively to acquire ownership and easement to intermingled lands within the Divide GA (within Zone 2) for the purposes of connectivity and security.
- UB-WL-GDL-01 provides guidance to manage lands in the west-central and east-central portions of the Upper Blackfoot GA (within the primary conservation area and Zone 1) to maintain or enhance wildlife habitat, movement areas, and connectivity; and do so through ensuring that vegetation management provides cover, motorized access is not increased, and the location of new trails only where minimal impacts occur to wildlife.

The action alternatives also include plan components for other GAs that emphasize maintaining connectivity for wide-ranging species such as grizzly bears:

- BB-WL-DC-03, CR-WL-DC-01, EH-WL-DC-02, and RM-WL-DC-01, state that the Big Belts, Crazies, Elkhorns, and Rocky Mountain Range GAs provide habitat connectivity for wide-ranging species … between public lands in northern Montana and those in south and southwestern Montana…

The action alternatives include plan components that would maintain, enhance, or restore connectivity while managing other resources such as watersheds, vegetation, and wildlife:

- FW-WTR-DC-02; FW-RMZ-DC-01; FW-RMZ-STD-03; and FW-RMZ-GDL-04, 07, 08, 09, 11, and 12 would maintain the integrity of riparian habitats. Grizzly bear movements are often associated with riparian habitats, particularly in dry forest types or open areas.
- FW-VEGT-DC-04 establishes the desired condition that vegetation patterns provide connectivity.
- FW-VEGF-DC-08 establishes the desired condition that forest patches of different …conditions form a landscape pattern that contributes to …habitat connectivity.
- FW-WL-DC-03 establishes the desired condition that vegetation composition, structure, and distribution allow wildlife to move within and between NFS parcels in response to life history needs and habitat changes.
- FW-WL-DC-04 establishes the desired condition that large, unroaded areas are distributed and connected forestwide, providing for species with large home ranges.
- FW-RT-GO-03 guides managers to partner with highway managers and others to implement wildlife crossings.

The location of RWAs in alternative D and to some extent in alternative F was informed by assessing which areas might provide potential connectivity among island mountain ranges, where habitat on NFS land remains relatively intact and intervening lands either provide minimal disturbance or distances between island mountain ranges are shortest. Alternative D, and to a lesser extent alterntive F,would therefore have slightly increased potential to maintain connections among separate GAs for some wildlife species, although that potential would continue to be greatly affected by land management and uses on intervening non-NFS lands.

In summary all action alternatives include plan components that would maintain or enhance the potential for connectivity at varying scales. Connectivity is specifically emphasized in several components at the patch, watershed, GA, and forest scales. Although effective genetic or demographic connectivity between and among areas may be more complex than simply absence of roads or motorized travel, the measures of habitat security described above provide the best means we have available to describe the potential for those areas to allow for movement of bears (and other wildlife) across the action area and between the NCDE and the GYE. The effects of these area designations and plan components on the ability of individual grizzly bears to move between and among habitats is very difficult to assess, particularly at the scale of this framework programmatic action. We estimate that, added to existing designations for wilderness, WSAs, and IRAs that would not change under any alternative, increases in total acreage of recommended wilderness in any action alternative as compared to the existing condition would be an added factor in maintaining or increasing potential connectivity where those areas occur. We also estimate that plan components identifying areas where risk of fragmentation is relatively higher (e.g. in the Divide and Upper Blackfoot GAs) and that direct managers to maintain habitat characteristics and minimize activities that could further fragment those areas would result in maintaining or increasing the ability of individual grizzly bears to move through those landscapes. Other plan components that emphasize connectivity would add to that effect.

By providing plan components that facilitate connectivity, identifing specific areas where management actions should be constrained in order to maintain connectivity, and by identifying the desired condition for several GAs to providing habitat for and connectivity among populations of wide-ranging species such as grizzly bears, the action alternatives would support the presence and movements of grizzly bears in and among currently separate grizzly bear populations in Montana.

Effects of plan components associated with:

Aquatic ecosystems

Plan components for management of aquatic ecosystems support desired conditions to "provide the distribution, diversity, and complexity of landscape-scale features including natural disturbance regimes and the … ecosystems to which native species, [and] populations are uniquely adapted" (FW-WTR-DC-01), to maintain spatial connectivity within and among watersheds (FW-WTR-DC-02), sustain the ecological function of aquatic and riparian ecosystems, and retain their resilience in the face of disturbance (FW-FAH-DC-01). Most of the plan components relating to aquatic ecosystems provide constraints to maintain or enhance aquatic, riparian, wetland, and associated upland habitats. The effect of these plan components would be to maintain or enhance habitats that are used periodically by grizzly bears, particularly during the early spring and late summer periods.

Fire and fuels

Plan components for fire and fuels management are intended to achieve the desired condition to maintain and enhance resources and allow fire to function in its natural ecological role (FW-FIRE-DC-01). Specific plan components are designed to provide for public and firefighter safety, reduce risk to high value resources such as adjacent communities, and minimize impacts to designated wilderness, RWAs, and other areas that are managed to allow natural processes to predominate. Grizzly bears evolved in ecosystems largely shaped by fire, so allowing fire to play its natural role, to the extent possible, would be expected to sustain ecosystem components and characteristics on which grizzly bears depend. Some fire management activities could affect individual bears, through temporary displacement from areas where and when activities (such as fire suppression or fuels reduction) are taking place.

Terrestrial vegetation; plants at risk, and invasive species

Plan components that address composition, structure, and function of vegetation communities represent the coarse filter management described above under the heading "Coarse Filter". Terrestrial vegetation desired conditions are designed to maintain and enhance ecological integrity, diversity, function, and resiliency while contributing to social and economic sustainability as required by the 2012 Planning Rule. Desired conditions are based on an analysis of the natural range of variation for key ecosystem characteristics.

Plan components for management of terrestrial vegetation that could have some effects on grizzly bears are as follows:

- FW-VEGT-DC-01 establishes the desired condition to have vegetation maintain or move toward the NRV for ecosystem composition, structure, and function, and to maintain resilience in the face of disturbance.
- FW-VEGT-DC-03 and FW-VEGT-DC-04 establish the desired conditions for vegetation to provide the "habitat requirements to support … threatened or endangered species… based on the inherent capability of lands" and "provide connectivity and allow genetic interchange to occur".
- Specific objectives, standards, and guidelines for vegetation, including forested and non-forested vegetation types, are designed to maintain or move toward desired conditions within the NRV for cover types, species or community presence, and vegetation structure (see 2020 Forest Plan for details).
- FW-PLANT-DC-01, FW-PLANT-GDL-01, and FW-PLANT-OBJ-01 direct managers to recover and sustain plant species at risk, including whitebark pine.

All action alternatives establish active vegetation management as an appropriate tool with which to achieve desired vegetation and habitat conditions in the action area. Activities associated with implementing vegetation management have the potential to result in adverse effects to individual bears through displacement or disturbance associated with roads used to access and implement projects; management of roads would be subject to plan components the effects of which are discussed in the Habitat Security section above. Disturbance and displacement or loss of cover as a result of activities at project sites could affect some individual bears, depending on the location, timing, and type of activity and other factors, all of which would be analyzed and consulted on when specific projects are planned. Vegetation management could, however, have beneficial effects by enhancing and maintaining some food sources. Beneficial effects would also depend on the specific location and treatment type and would be analyzed when specific projects are planned. The plan components above would sustain healthy, resilient plant communities on which grizzly bears depend for food and cover and would minimize the potential for adverse effects resulting from activities associated with project implementation, and from changes in vegetation. Some components discussed above could result in beneficial effects when used to plan vegetation projects that would maintain or enhance grizzly bear food species.

Refer to FEIS (U.S. Department of Agriculture, Forest Service, 2017e) and BA (U.S. Department of Agriculture, Forest Service, 2017b) for the Forest Plan Amendments to Incorporate Habitat Management Direction for the Northern Continental Divide Grizzly Bear Population (U.S. Department of Agriculture, Forest Service, 2018) for additional discussion.

Wildlife Habitat Management

All action alternatives include plan components related to management of wildlife habitats, most of which would contribute to maintaining habitats used by grizzly bears, and would help to limit potential disturbances. Several plan components for managing wildlife habitat have been discussed in other sections, as they pertain to habitat security, connectivity, conflict reduction, and other issues. Other plan components add to coarse filter support for wildlife habitat by establishing desired conditions for habitats to support the needs of native wildlife species and provide for life history requirements of those species (e.g., FW-WL-DC-01 through 03). Desired conditions that key seasonal habitats are relatively free of human disturbance would support grizzly bear use of those areas. Plan components specific to grizzly bears are discussed under "Effects Common to All Alternatives" in the section on retained direction from the Forest Plan Amendments to Incorporate Habitat Direction for the Northern Continental Divide Ecosystem Grizzly Bear Population (U.S. Department of Agriculture, Forest Service, 2018).

Recreation settings, opportunities, access, and scenery

The effects of plan components relating to recreation on NFS lands are discussed in part under the headings "Effects of alternative A - no action" and "effects of action alternatives" above; discussion of the effects of recreation settings are incorporated into the Habitat security section above.

All action alternatives include desired conditions to have developed recreation sites and facilities as follows (refer to the 2020 Forest Plan for complete wording):

- FW-REC-DC-03: Sustainable levels of developed recreation sites … exist … to accommodate concentrations of recreation use.
- FW-REC-DC-04; Recreation facilities and their use have minimal impacts on resources including at-risk species.
- FW-REC-GDL-01: Management of developed recreation facilities should be responsive to environmental changes such as … wildlife habitats.
- FW-REC-GDL-07: guides managers to avoid using seed mixes or other vegetation plantings that could attract bears to roads and developed sites.

All action alternatives also includes forestwide components to rehabilitate or relocate developed recreation sites or facilities that are having negative impacts on other resources (e.g., FW-REC-OBJ-01 and 02), but also include guidance to refurbish developed sites to meet current and future demands (FW-REC-OBJ-04).

The presence of developed sites, particularly those that experience frequent, prolonged, or overnight use may increase the risk of human-bear interaction or conflict largely through the presence of human foods and other attractants. Food storage orders are in place across the HLC NF, but the presence of attractants could bring some bears into proximity with humans and increase the risk of interaction and potential conflict. Bears may avoid areas with concentrations of human activity, such as developed recreation sites, which could result in displacement from some habitats. Developed recreation sites are often associated with other recreational activities (see below), that could have impacts to bears or their habitat. The standards listed above that guide managers to minimize impacts to wildlife and that limit increases in overnight developed site number and capacity in the primary conservation area would reduce the potential for conflicts forestwide and would limit the overall potential for impacts, including displacement, in the primary conservation area. Nevertheless, the presence of over 200 developed recreation sites on the HLC NF creates potential for impacts to individual bears through potential conflict or displacement.

Plan components related to recreation not directly associated with developed sites include:

- FW-REC-DC-07 states that the HLC NF will provide opportunities for dispersed camping.
- FW-RSUP-DC-01 through 03 establish the desired condition of providing recreation opportunities that address demands for certain activities, enhance visitor experience, and contribute to local economies.
- FW-RSUP-GDL-01 guides managers to ensure that recreation special use operations should mitigate conflicts with other uses and resource, including use of education to reduce human-wildlife conflicts.

Plan components address access to and within NFS lands for recreation purposes and constrain some access to prevent or minimize negative impacts to wildlife or other resources. These plan components, because they address travel, are discussed above in the section on Habitat Security.

Alternatives B, C, D, and E designate a new Recreation Area, the South Hills Recreation Area in the Divide GA (Zone 2); alternative F also designates the Grandview Recreation Area in the Snowies GA (not in a grizzly bear management zone and outside the area where grizzly bears may be present). Both areas include desired conditions to offer dispersed non-motorized recreation opportunities. In the South Hills Recreation Area mechanized means of transportation (such as mountain bikes) would be suitable only on established roads and trails (DI-SHRA-SUIT-02). The majority of the Grandview Recreation Area overlaps with an existing WSA in which motorized recreation is not suitable.

All action alternatives include components that recognize the desire to provide hunting opportunities and access on NFS lands, balanced against the need to maintain wildlife habitat and security (FW-FWL-DC 03 and 04).

Human presence in bear habitat can have a wide variety of potential impacts to bears, from little or no effect, to adverse effects resulting from encounters, food conditioning, direct mortality, and disturbance or displacement. Effects depend on location, timing, activity, individual bear response, and other factors. By establishing a desired condition to provide a variety of recreational opportunities that include motorized access, hunting, and other activities, the action alternatives support activities that could potentially have negative effects to individual bears. Plan components that establish areas of relatively low human presence (i.e. primitive and semi-primitive ROS categories) would help to limit the potential for encounters or adverse effects of recreation on bears in those areas. Potentially negative effects to individual bears may be more likely in areas where motorized travel or greater human presence is anticipated (i.e. areas identified as roaded natural or rural ROS categories). Some activities, such as hunting, that are allowed on NFS lands, could have beneficial impacts to bears by providing additional sources of late-season food via gut piles or wounded animals, but could also have adverse impacts through potential food-conditioning, bear-human conflicts, and mortality caused by mistaken identity or defense of life. Plan components that guide managers to balance hunting access and opportunity against the need for wildlife security could mitigate some of the risk of mortality associated with hunting.

Overall, plan components for management of recreation would potentially result in some impacts to some individual bears where specific facilities or activities occur but would minimize impacts to individual bears and to the grizzly bear population by including constraints designed to reduce conflict and potential displacement of bears. Refer also to analysis in the Forest Plan Amendments to incorporate relevant direction from the Northern Continental Divide Ecosystem Grizzly Bear Conservation Strategy (U.S. Department of Agriculture, Forest Service, 2017e, 2018) for discussion of additional plan components for management of access and of developed recreation.

Designated areas

Potential impacts of plan components for management of designated areas are incorporated into the discussion under “effects of alternative A - no action” and “effects of action alternatives”.

Land status and ownership, and land uses; infrastructure-roads and trails, bridges and facilities

Potential impacts of plan components for management of land and of infrastructure are incorporated into the discussion under “effects of alternative A - no action” and “effects of action alternatives”.

Public information, interpretation, and education

Plan components for public information would overall increase forest users’ understanding of forest policies, activities, services, and issues (FW-CONNECT-DC-02), including regulations and safety practices for recreating in grizzly bear habitat.

Livestock grazing

None of the action alternatives would change number and location of livestock allotments nor the number and type of animals allowed to graze on those allotments. The latter are determined during permit evaluation and development of annual operating plans. The location, size, or management of grazing allotments would not be affected by the action alternatives, and any changes to those would be addressed through site or area-specific range analyses.

All alternatives management direction that would be used when annual operating plans are developed, when grazing permits are issued or re-issued, and when allotment management plans are revised or developed.

In addition to the plan components retained from the Grizzly Bear Amendments that apply to the primary conservation area and Zone 1, the action alternatives include the following plan components that may have an influence on grizzly bears or their habitat:

- FW-GRAZ-DC-02 states vegetation in grazing allotments supports healthy and resilient plant communities that "provide for wildlife habitat and forage needs in addition to providing forage for domestic livestock".
- FW-GRAZ-GO-01 calls for coordination with MFWP biologists during allotment planning and permitting processes to ensure that wildlife habitat and forage needs will be met.
- Several guidelines provide management direction to minimize impacts to riparian and other vegetation resources.

Livestock grazing in bear habitat can have adverse effects on individual grizzly bears through potential for conflicts related to depredation, encounters during livestock management activities, displacement of bears from areas used by livestock, and potentially competition for or impacts of livestock on some types of forage. The potential for effects depends on the extent, timing, and location of livestock use relative to bear use of a given area.

Refer also to analysis in the Forest Plan Amendments to incorporate relevant direction from the Northern Continental Divide Ecosystem Grizzly Bear Conservation Strategy (U.S. Department of Agriculture, Forest Service, 2017e, 2018) for discussion of additional plan components for management of access and of developed recreation.

Timber

Plan components for the management of timber are intended to support the production of timber on lands identified as suitable for that use, as well as to manage timber harvest for other purposes. Standard FW-TIM-STD-04 would limit clearcutting and require interdisciplinary review of site-specific conditions and desired conditions for habitat before clearcutting could be used. Standard FW-TIM-STD-08 would limit the maximum opening size of harvest units, and FW-TIM-GDL-01 would guide harvest activities to "contribute to ecological sustainability and ecosystem health" and to achieve desired vegetation conditions. Timber harvest activities have the potential to temporarily displace individual bears, but plan components would minimize impacts, and would move vegetation conditions toward desired conditions discussed in the terrestrial vegetation section. Some timber harvest could result in improved or increased foraging opportunities for grizzly bears. Refer to the timber section for information on projected harvest acres by alternative.

Benefits to Humans, Fish and wildlife

These plan components pertain to the management of hunting, fishing, viewing, and other recreational opportunities provided by fish and wildlife on NFS lands. Plan components are designed to influence distribution and availability of wildlife for hunting and other uses, while balancing those opportunities with "desired conditions for wildlife populations and habitat security" (FW-FWL-DC-04). Management of habitat to influence distribution of wildlife is focused on minimizing displacement of elk and other big game species from NFS lands during hunting seasons. Implementation of guidelines intended to achieve that desired condition could involve limiting motorized access during hunting season in specific areas, managing for hiding cover and other aspects of habitat security, or other measures that would likely contribute to habitat security for grizzly bears.

Energy and minerals

Plan components for the management of energy and minerals are focused on the desired condition of "supplying mineral and energy resources while assuring that the sustainability and resiliency of other resources are not compromised or degraded" (FW-EMIN-DC-01). Refer also to analysis in the FEIS, Volume 3: Forest Plan Amendments to incorporate relevant direction from the Northern Continental Divide Ecosystem Grizzly Bear Conservation Strategy (U.S. Department of Agriculture, Forest Service, 2017e) for discussion of additional plan components for management of energy and mineral resources.

Alternative A, no action

Discussion of the potential effects of implementing alternative A is limited to those effects that differ from or are not already discussed above under the section 'effects common to all alternatives'.

Coarse filter

Grizzly bears are habitat generalists that use a wide variety of vegetation types and structures to obtain food, find mates, rear young, and den. Refer to the terrestrial vegetation section for a comprehensive discussion of the predicted trend and status of habitat and vegetation types under this alternative.

Grizzly bears rely on foods that may occur in any number of habitat types, with key foods in spring often found in low elevation riparian areas and forest openings, as well as on private lands outside of the NF boundary. Under this alternative, riparian and wetland habitats would persist, although a lack of watershed-level desired conditions and plan components could have a negative impact on connectivity within and among these habitats. 1986 Forest Plan components for managing identified riparian areas, as well as those for wildlife species and sensitive habitats would likely minimize impacts on a project or site-specific basis, thereby maintaining habitat for species, including grizzly bears, that use or depend on riparian and wetland habitats. Refer also to the aquatic ecosystems, terrestrial vegetation (nonforested vegetation), plants at risk (riparian guilds), and the terrestrial wildlife diversity (species associated with aquatic, wetland, and riparian habitats) sections of this FEIS.

Summer foods may include berries found in a variety of forest types, as well as small mammals, insects, and other foods not confined to any particular vegetation type. These habitats would be maintained under this alternative, although specific desired conditions for particular vegetation types would not guide management toward or away from the natural range or any other abundance or distribution of key habitats. Refer to the terrestrial vegetation section for discussion of specific vegetation types, and to the terrestrial wildlife diversity report for discussion of impacts to species associated with grass/shrub, hardwood tree, mixed conifer, and high elevation habitats, all of which likely provide some elements of grizzly bear spring, summer and fall habitat.

Bears have been documented denning in high-elevation areas with steep slopes and deep snow, but historically bears also denned in the foothills and prairies, where some denning activity has been recently documented. As discussed in the terrestrial wildlife diversity section, high elevation habitats are relatively un-influenced by forest management, so species dependent on this type of habitat would be expected to persist over the long term in the planning area, as they have under the 1986 Forest Pplans.

Habitat Security

Under Alternative A, the Forest Plan Amendments to Incorporate Habitat Management for the Northern Continental Divide Grizzly Bear Population (U.S. Department of Agriculture, Forest Service, 2018) would continue to apply, as described above under "Effects Common to All Alternatives". In addition plan components from the amendments, the following management direction for grizzly bears would continue from the the 1986 Helena NF plan (refer also to Appendix 2 in the Record of Decision for the Grizzly Bear Amendments, (U.S. Department of Agriculture, Forest Service, 2018)):

- Some 1986 forest plan management that is based on the Interagency Grizzly Bear Guidelines (Interagency Grizzly Bear Committee, 1986).
- Specific, numeric standards for management of secure areas for elk.
- Identification of individual management areas, some of which specify limits on open road density.
- A standard stating that new developed recreation facilities would generally not be constructed.
- Direction to reduce livestock impacts and to minimize grizzly bear– livestock conflicts on NFS lands in the recovery zone (primary conservation area).
- Standards and guidelines related to timber harvest and other vegetation management.
- Standards requiring no surface occupancy for minerals or energy leases in the recovery zone (primary conservation area).

Similar direction would be retained in the 1986 Lewis and Clark NF plan. Differences from or additions to the direction in the 1986 Helena NF plan described above that would be continued under Alternative A are as follows (refer also to Appendix 2 in the Record of Decision for the Grizzly Bear Amendments, (U.S. Department of Agriculture, Forest Service, 2018)):

- Standards requiring adherence to the Interagency Rocky Mountain Front Wildlife Guidelines with respect to managing developed recreation and to avoid or mitigate impacts associated with road construction and use.
- Standards that control the type and intensity of activities, including road management and vegetation harvest activities, to benefit grizzly ears on the Rocky Mountain Range GA, and other wildlife species such as elk, particularly in the Little Belts, Highwoods, Castles, and Crazies GAs (Zone 3).
- A standard requiring that livestock grazing that affects grizzly bears and/or their habitat would be made compatible with grizzly bear needs or be eliminated, in addition to continuing to apply the Rocky Mountain Front Wildlife Monitoring/Evaluation program recommendations specific to grizzly bears and livestock grazing.
- Surface occupancy for minerals and energy development in the recovery zone (primary conservation area) could be allowed, but standards constrain exploration and development activities, and require application of the Rocky Mountain Front Wildlife Monitoring/Evaluation program recommendations specific to oil and gas exploration and development.

The distribution and timing of motorized travel that is allowed on the HLC NF is regulated by travel management plans. Travel plans were completed for most portions of the HLC NF between 2007 and 2017. Although travel planning is a site-specific decision tiered to forest plans, the pattern of motorized use in current travel plans defines the recreation settings in alternative A. The amount and distribution of nonmotorized recreation settings, which provide potential habitat security for grizzly bears, would remain as shown in Table 74 above (refer to the 'Affected Environment' section under 'habitat security').

Habitat connectivity

The 1986 Forest Plans do not provide specific direction regarding connectivity, although as described under the 'affected environment' section, the mix of IRAs, conservation management area, and other unroaded or lightly roaded areas likely provides some potential for grizzly bears and other large, wide-ranging species to move among daily and seasonal habitats and potentially across larger landscapes.

Areas such as the Highway 200 corridor through the Upper Blackfoot GA, and the Highway 12 corridor through the Divide GA, in addition to private lands in those areas may provide some impediments to grizzly bear movements through those landscapes, and may limit connectivity between the NCDE and the GYE. Without specific plan components to retain habitat security on NFS lands adjacent to those and other areas, connectivity through them could remain limited. However, the majority of fragmentation and impacts to connectivity in those areas occur on non-NFS lands that are not affected by FS management actions.

Cumulative Effects to Grizzly Bears

Table 81 summarizes the cumulative effects to grizzly bears from other resource management plans.

Table 81. Summary of cumulative effects to grizzly bears from other resource management plans

Resource plan	Description and summary of effects
Adjacent National Forest Plans	The forest plans for NFS lands adjacent to the HLC NF include the Custer-Gallatin, Lolo, Flathead, and Beaverhead-Deerlodge NFs. The Flathead NF plan has been recently revised under the 2012 Planning Rule. The Flathead NF Plan included management direction identical to that in the Forest Plan Amendments to Incorporate Habitat Management Direction for the Northern Continental Divide Ecosystem Grizzly Bear Population (U.S. Department of Agriculture, Forest Service, 2018), making it consistent with management for grizzly bears on the HLC NF. The Lolo NF plan has recently been amended to also incorporate that direction. Therefore, management of grizzly bear habitat throughout NFS lands in the Northern Continental Divide Ecosystem will be consistent across NF boundaries. Plans for the Beaverhead-Deerlodge and Custer-Gallatin NFs have been amended to incorporate the Greater Yellowstone Ecosystem Grizzly Bear Conservation Strategy, which provides adequate regulatory mechanisms to sustain a recovered grizzly bear population in the Greater Yellowstone Ecosystem. The cumulative effects of these forest plans would be to recover and sustain a recovered grizzly bear population in the Northern Continental Divide Ecosystem, while providing for connectivity among grizzly bear populations and recovery ecosystems throughout Montana.
BLM Resource Management Plans (RMP)	BLM lands near the HLC NF are managed by the Butte, Missoula, and Lewistown field offices. The Butte and Lewistown plans were recently revised (2009 and 2019 respectively) while the existing plan for the Missoula area is under revision. These plans contain components consistent with those identified in the Northern Continental Divide Ecosystem Grizzly Bear Conservation Strategy (Northern Continental Divide Ecosystem Subcommittee, 2019), for BLM lands, and would therefore be complementary to the plan components for the HLC NF, and provide consistency in management of federal lands within the Northern Continental Divide Ecosystem to support recovery and sustain a recovered grizzly bear population.
National Park Service - Glacier National Park General Management Plan 1999 and National Park Service – Glacier National Park Bear Management Plan 2010	The general management plan for Glacier National Park calls for preserving natural vegetation, landscapes, and disturbance processes. Glacier National park makes up 20% of the Northern Continental Divide Ecosystem, and is within the primary conservation area. Goals of the Bear Management Plan are to provide for long-term survivability of the grizzly bear in the park and in the Northern Continental Divide Ecosystem, which are consistent with those in the Northern Continental Divide Ecosystem Grizzly Bear Conservation Strategy (Northern Continental Divide Ecosystem Subcommittee, 2019) , which includes recommended management for grizzly bears in Glacier National Park. Management of grizzly bear habitat in Glacier National Park is expected to be complementary to and consistent with management on the HLC NF, and would support recovery and sustaining a recovered grizzly bear population.
Blackfeet Nation's Integrated Resource Management Plan (in progress)	In development – documentation not available. The Blackfeet Nation participated in development of the Northern Continental Divide Ecosystem Grizzly Bear Conservation Strategy (Northern Continental Divide Ecosystem Subcommittee, 2019) , including recommended management of grizzly bears and habitat on the Blackfeet Indian Reservation adjacent to the Rocky Mountain Range GA of the HLC NF. Intent during development of the Conservation Strategy was to provide management on Blackfeet lands that is consistent with grizzly bear management throughout the Northern Continental Divide Ecosystem as identified for those lands in the strategy.

Resource plan	Description and summary of effects
Montana Statewide Forest Resource Strategy (2010)	MT conducted a statewide assessment of forest resources and identified issue-based focus areas with implementation strategies and deliverables for each. Focus areas include such varied things as achieving ecological integrity through recovery of species diversity, managing for wildfire and public safety, supporting forest products infrastructure, and addressing changing forest ownership patterns. Management for these focus areas on state lands would adhere to management plans for specific state-owned lands; within the NCDE most state lands incorporate measures related to management for grizzly bear habitat.
Montana State Parks and Recreation Strategic Plan 2015-2020	These plans guide the management of state parks, some of which lie nearby or adjacent to NFS lands. Goals include managing significant, relevant, and accessible parks and programs in a manner consistent with available resources, as well as emphasizing visitor experience, partnerships, and awareness of the state parks system. These goals are compatible with or do not preclude management for a sustained population of grizzly bears.
Montana's State Wildlife Action Plan	This plan describes a variety of vegetation conditions related to habitat for specific wildlife species. This plan would likely result in the preservation of these habitats on state lands, specifically wildlife management areas. This plan would interact with the MT Statewide Forest Resource Strategy (above). The vegetation conditions described would be complementary to the conditions being managed for with the HLC NF 2020 Forest Plan.
Montana State Wildlife Management Areas	Plans are specific to management areas and their established purpose. Most in the planning area were established to conserve big game winter range, with goals to maintain forage, cover, and security during winter use periods. Management is generally compatible with grizzly bear management. Some areas have implemented food storage orders and compliance with management outlined in the NCDE Grizzly Bear Conservation Strategy (Northern Continental Divide Ecosystem Subcommittee, 2019) .
County wildfire protection plans	Some county wildfire protection plans map and/or define the WUI. The HLC NF notes that these areas may be a focus for hazardous fuels reduction, and other plan components (such as NRLMD) have guidance specific to these areas. Managing for open forests and fire adapted species may be particularly emphasized in these areas. Overall, the effect of the county plans would be to influence where treatments occur to contribute to desired vegetation conditions.
City of Helena Montana Parks, Recreation and Open Space Plan (2010)	The City of Helena manages 1,718 acres of open space that lie between the city limits and NFS lands in the Divide GA. The plan includes goals and recommendations for recreation use and trail management; noxious weed management; forest management; interpretive opportunities; wildfire mitigation; wildlife protection; and boundary identification. Could contribute to connectivity in zone 2, but may also contribute to bear-human encounters through management for recreation activities.

Conclusions

Alternative A, no action

Continued implementation of the 1986 Helena and Lewis and Clark NF Plans as amended by the Grizzly Bear Amendments was analyzed in detail in the FEIS for the amendments (U.S. Department of Agriculture, Forest Service, 2017e); that analysis captures this Alternative A, in which 1986 plan direction, including the Grizzly Bear Amendments, would continue into the future. The FEIS for the Grizzly Bear Amendments (U.S. Department of Agriculture, Forest Service, 2017e) concluded that although some activities could have minor effects on individual bears, implementing the preferred alternative along with 1986 forest plan direction would contribute to sustaining a recovered population and would provide the necessary regulatory mechanisms to potentially allow grizzly bears to be removed from listing under the ESA. The information here that we have added to that analysis supports that conclusion.

Action alternatives

The FEIS for the Grizzly Bear Amendments (U.S. Department of Agriculture, Forest Service, 2017e) stated that implementation of the Grizzly Bear Amendments, which would occur under all action alternatives, would contribute to sustaining a recovered grizzly bear population. In addition to the Grizzly Bear Amendments, plan components included in all action alternatives would:

- contribute to reducing grizzly bear-human conflicts;
- provide specific desired conditions and other guidance for management of designated areas such as RWAs, IRAs, and the Conservation Management area as relatively intact, un-fragmented landscapes where natural processes predominate;
- provide clear constraints on road-building and clear direction for removing unneeded roads;
- identify specific areas in the Upper Blackfoot and Divide GAs to manage for habitat security and potential connectivity; and
- maintain or increase total area in nonmotorized recreation settings as compared to the existing situation.

The sum of that management direction would be to provide additional reduction in mortality risk and increased habitat security that would contribute to grizzly bear recovery and to sustaining a viable recovered grizzly bear population. The increased area in nonmotorized recreation settings as compared to the existing situation and no-action alternative would be largest in Zone 3, potentially providing more security for grizzly bears than may be available currently on HLC NF lands there. Alternatives B, C, D, and F provide more acres of RWA, but because those areas largely overlap with existing IRAs, there would likely be very little difference among alternatives in terms of potential habitat security. In alternatives B, D, and F, habitat security would be enhanced by identifying motorized travel as unsuitable in RWAs. Alternatives B, D, and F could, therefore, contribute slightly more to grizzly bear recovery and to sustaining a recovered grizzly bear population than the other alternatives. A BA submitted to the US Fish and Wildlife Service determined the 2020 Forest Plan under alternative F *May Affect, and is Likely to Adversly Affect* individual grizzly bears (see project file).

3.14.7 Canada lynx, affected environment

Scale and scope of analysis

As discussed in the terrestrial wildlife diversity section, ‘assumptions’, plan components to maintain ecosystem integrity and diversity provide for most of the needs (foraging, denning, breeding, and movement) of Canada lynx on the HLC NF. Species-specific plan components for management of Canada lynx habitat and activities that could directly impact Canada lynx are incorporated into all alternatives as the NRLMD (hereafter referred to as the Lynx Direction) (U.S. Department of Agriculture, Forest Service, 2007f). The plan components found in the Lynx Direction focus on maintaining sufficient amount and distribution of boreal forest habitat of the type and structural stage that provide foraging habitat for Canada lynx. A full analysis of the potential impacts of implementing the management described in the Lynx Direction can be found in the NRLMD Final Environmental Impact Statement (U.S. Department of Agriculture, Forest Service, 2007g), Biological Opinion (U.S. Department of the Interior, Fish and Wildlife Service, 2007) associated with it, and the Biological Assessment (U.S. Department of Agriculture, Forest Service, 2017a) and the Biological Opinion (U.S. Department of the Interior, Fish and Wildlife Service, 2017a) regarding Designated Critical Habitat for Canada lynx. This report will refer to those analyses and incorporate them into evaluation of the potential consequences to Canada lynx, and its designated critical habitat, of the HLC NF 2020 Forest Plan and alternatives.

The biology and ecology of Canada lynx in the Northern Rocky Mountains and on the HLC NF have been described extensively in several other documents (Ruediger et al., 2000; U.S. Department of

Agriculture, Forest Service, 2014b; U.S. Department of the Interior, Fish and Wildlife Service, 2003, 2006, 2009, 2014b)

Ecology and management

Distribution

The planning area is within the Northern Rocky Mountains Geographic Area for lynx; note that this use of the term "Geographic Area" is different from that used within the 2020 Forest Plan, and refers to a broad region that encompasses all lynx habitat throughout several states in the northern Rocky Mountains of the United States (Interagency Lynx Biology Team, 2013). In Montana, lynx are primarily restricted to northwestern Montana. The majority of the planning area is outside of the current known distribution.

In the planning area, Canada lynx occur as a resident population throughout the Rocky Mountain Range GA, Upper Blackfoot GA, and in the northern portion of the Divide GA. This portion of their range within the Northern Rocky Mountain Range GA is considered to be within the Northwestern Montana/Northeastern Idaho core area (Interagency Lynx Biology Team, 2013), (U.S. Department of the Interior, Fish and Wildlife Service, 2005). A "core area" is an area "with the strongest long-term evidence of the persistence of lynx populations supported by a sufficient quality and quantity of habitat" (U.S. Department of the Interior, Fish and Wildlife Service, 2005), which consists of boreal forests with dense horizontal cover supporting snowshoe hare populations (refer to 'Habitat Status and Connectivity' section for a detailed description of lynx habitat). More specifically, core areas have verified evidence of long-term historical and current presence of lynx populations that are persistent despite periodic fluctuations, have evidence of reproduction within the past 20 years, and have boreal forest vegetation types, as described above, of the quality and quantity to support lynx and snowshoe hare (ibid). The northwestern Montana/northeastern Idaho area coincides with the area in which Canada lynx Critical Habitat has been designated and is protected under the ESA.

According to the Lynx Conservation and Assessment Strategy (Interagency Lynx Biology Team, 2013) and the Recovery Outline (U.S. Department of the Interior, Fish and Wildlife Service, 2005), the remainder of the planning area occurs within secondary areas, with the exception of the Highwoods and Snowies GAs, which are considered peripheral. Secondary areas are defined as having "fewer and more sporadic current and historical records of lynx", and no documentation of reproduction (ibid). Peripheral areas have sporadic historical records of lynx, generally corresponding to cyclic population highs in populations in Canada (ibid), and have no records or evidence of reproduction. Both these areas "may contribute to lynx persistence by enabling successful dispersal and recolonization of core areas, but their role in sustaining lynx populations remains unknown" (Interagency Lynx Biology Team, 2013).

The Rocky Mountain Range, Upper Blackfoot, and Divide GAs are currently considered 'occupied' habitat per an amendment (U.S. Department of Agriculture, Forest Service & U.S. Department of the Interior, 2006) to the Canada Lynx Conservation Agreement (U.S. Department of Agriculture, Forest Service & U.S. Department of the Interior, 2005). The island mountain ranges, comprising the remaining seven GAs, are currently considered 'unoccupied' by lynx (see appendix A, maps). An area is considered occupied when there are at least two verified observations or records since 1999 of individuals that are not transient, or by evidence of reproduction (U.S. Department of Agriculture, Forest Service & U.S. Department of the Interior, 2006). This distinction differs from the 'may be present' determination made by the USFWS, which reflects the possibility of individual lynx occurring as either transients or as resident individuals, for the purpose of consultation under the ESA.

Most of the research on lynx in Montana has occurred west of the Continental Divide, so more detailed information regarding lynx distribution in the occupied portion of the planning area is not available. More work has been done to delineate lynx habitat within the planning area, as described under "Habitat Status and Connectivity."

Population trend

No reliable information is available regarding the number of lynx or trend of the lynx population in the planning area or region-wide. Efforts in the region to maintain lynx populations have focused on maintaining habitat (see “Habitat Status and Connectivity” section).

Key drivers and stressors

Food habits

Snowshoe hares are the primary prey of lynx throughout their range (Mowat, Poole, & O'Donoghue, 1999) (Interagency Lynx Biology Team, 2013). Summer diets may contain a broader range of prey species, based on their availability (John R. Squires, Decesare, Kolbe, & Ruggiero, 2010). Red squirrels are an important secondary prey species in many areas, while grouse, northern flying squirrel, ground squirrels, porcupine, beaver, mice, voles, shrews, weasels, fish, ungulates, and ungulate carrion have all been reported in the diets of lynx in various portions of their range (Interagency Lynx Biology Team, 2013). Lynx diets are limited primarily to snowshoe hare in winter due to snow characteristics and to the ecology of various alternate prey species.

Habitat status and connectivity

Lynx use habitats where their primary prey species are available. Broadly, Canada lynx habitat is defined as boreal forest. More specifically, snowshoe hares occur in boreal forests with dense horizontal cover that reduces their exposure to predators and provides access to food and thermal protection (Interagency Lynx Biology Team, 2013). In western Montana, winter snowshoe hare density was highest in dense, mature forests, and in summer was highest in both dense young and dense mature forest (ibid). Habitat types in the Northern Rockies capable of dense horizontal cover on the forest floor provide habitat for snowshoe hare ; (Interagency Lynx Biology Team, 2013); (John R. Squires et al., 2010);(Holbrook, Squires, Olson, Lawrence, & Savage, 2017; Ruediger et al., 2000), and consist of cover types that include Engelmann spruce, subalpine fir, mixed spruce-fir, mixed aspen and spruce-fir, mixed lodgepole and spruce-fir, and lodgepole pine. Generally, snowshoe hare and lynx do not use drier habitats, including lodgepole pine habitat types occurring on drier sites, or dry Douglas-fir habitat types, because these do not provide dense horizontal cover. Habitat used by red squirrels, an important secondary prey species, overlaps snowshoe hare habitat extensively but does not generally extend to young forests that are not yet producing cones. Recent research (Holbrook et al., 2018; Holbrook et al., 2019; J. D. Holbrook et al., 2017; Megan K. Kosterman, Squires, Holbrook, Pletscher, & Hebblewhite, 2018) further describes Canada lynx use of available habitat.

Lynx habitat maps for the planning area have been created to serve a number of purposes and have used existing vegetation data derived from remote sensing, aerial photo interpretation, stand exams, or combinations thereof. Those maps were inconsistent across the planning area due to the varied availability of data sources, as well as to slightly different methodology, between and even within the two forests. In 2010 the east-side Forests of the Northern Region (Helena, Lewis and Clark, Custer, and Gallatin NFs) began collaborating on a uniform method to map lynx habitat, along with habitat for some other species. This effort, referred to as the “East Side Assessment”, was intended to develop reliable, consistent habitat mapping and modelling protocols that could be used for mid to large scale assessments of forest and habitat conditions.

Using the methods established in the East Side Assessment but updated to incorporate Regional direction (Northern Region, 2016)) and the most recent vegetation data available, Canada lynx habitat was mapped for the planning area (refer to project file for details on mapping methods). Specific vegetation types were selected as potential lynx habitat (also known as mapped lynx habitat, see also NRLMD Record of Decision, appendix F of the 2020 Forest Plan) across the planning area. Mapping also included information on recent disturbances, using assumptions developed by the East Side Assessment team regarding the impacts of those disturbances on lynx habitat. The mapping effort and subsequent data used in Table 82 provide an approximation of the overall amount of Canada lynx habitat in the planning area and the relative amounts in the GAs comprising the planning area. This gives a broad picture of the ability of the planning area and GAs to potentially sustain lynx. This also gives a general idea of the amount of habitat forestwide and within each GA to which the standards and guidelines of the Northern Rockies Lynx Management Direction apply.

Table 82 displays for each GA, and forestwide, the total amount of mapped potential lynx habitat, and the amount by current, modeled vegetative structural stage. Acreages of total potential lynx habitat (second column) are derived from the most recent (2018, updated 2020) lynx map described above. Acres of habitat in each structural stage category are derived from vegetation data sources as well as harvest and fire data. The numbers in Table 82 are broad scale estimates intended to provide an overall picture of the current status of lynx habitat on the HLC NF and are not intended to represent the level of precision needed for project level planning or analysis.

Table 82. Canada lynx potential habitat on the HLC NF

Geographic Area	Lynx analysis unit total acres	Total potential lynx habitat acres[1]	Stand initiation[2] acres (%)	Early stand initiation[3] acres (%)	Multistory[4] acres (%)	Other[5] acres (%)
Occupied						
Rocky Mountain Range	737,322	468,177	36,375 (9)	130,922 (32)	81,770 (20)	218,307 (46)
Upper Blackfoot	338,689	250,890	21,863 (9)	65,249 (27)	67,705 (29)	94,612 (37)
Divide	202,642	111,309	3,557 (3)	1,770 (2)	38,782 (35)	69,140 (60)
Total Occupied	1,278,653	830,376	61,796 (7)	197,940 (24)	188,257 (23)	382,059 (46)
Unoccupied						
Big Belts	159,531	81,724	3,683 (4)	5,640 (7)	23,807 (29)	48,580 (59)
Castles	35,093	28,946	68 (0)	624 (2)	5,989 (21)	22,266 (76)
Crazies	55,466	37,058	969 (3)	2,291 (7)	20,916 (61)	12,882 (34)
Elkhorns	161,232	71,895	9,015 (14)	2,221 (3)	18,221 (27)	42,377 (58)
Highwoods[6]	N/A	N/A	N/A	N/A	N/A	N/A
Little Belts	564,110	429,486	16,810 (4)	14,641 (4)	194,997 (47)	202,966 (47)
Snowies	100,009	29,433	399 (1)	488 (2)	9,301 (33)	19,223 (65)
Total Unoccupied	1,075,441	649,351	30,337 (5)	23,444 (4)	267,980 (41)	340,703 (52)
Forestwide Total	**2,354,094**	**1,479,969**	**92,132 (6)**	**221,393 (15)**	**456,237 (31)**	**721,887 (48)**

The slight difference in acres (1,359 acres) between the total potential lynx habitat and the structural stages is an artifact of mapping processes. Potential lynx habitat modelled August 26, 2018.

2 Stand initiation structural stage that may provide year-round snowshoe hare habitat because the trees have grown tall enough to protrude above the snow in winter depending on site-specific stand conditions and horizontal structure.

3 Stand initiation structural stage where the trees have not grown tall enough to protrude above the snow in winter but can provide snowshoe hare habitat during the non-winter months and is typically moving toward year-round snowshoe hare habitat.

4 Multistory structural stage with many age classes and vegetation layers that may provide year-round snowshoe hare habitat via dense horizontal cover depending on site-specific stand conditions and horizontal structure.

5 Any stand that does not fall into one of the above categories, to include Other, NFV and SE. Stands in this column may or may not provide foraging habitat for lynx and require ground validation at the project planning scale.

6 Does not contain enough mapped potential habitat to delineate an LAU (U.S. Department of Agriculture, Forest Service, 2020a).

The amount of area required to sustain persistent occupation of a female lynx year-round depends on a variety of factors, including the structural quality and arrangement of habitat within the home range, abundance of hares, cycling of hare populations, availability of alternate prey species, and others. Female lynx home range size estimates vary from less than 10 mi^2 (6,400 acres) in northern Minnesota, to over 50 mi^2 (32,000 acres) in the southern Canadian Rockies (Interagency Lynx Biology Team, 2013), with female home range size in northwestern Montana estimated at over 40 mi^2. The Lynx Strategy (ibid) suggests that in the western U.S. at least 10 mi^2 (6,400 acres) of primary vegetation (e.g., spruce/fir habitat types) must be present to support a female home range.

The Castles, Crazies, and Elkhorns GAs fall within the broadly drawn 'secondary area' in the Lynx Recovery Outline (U.S. Department of the Interior, Fish and Wildlife Service, 2005). Secondary areas contain boreal forest, but it may be inherently patchier and/or drier, and have snow or habitat conditions that are not favorable to lynx (ibid). In peripheral areas, such as the Snowies and Highwoods GAs, habitat may occur in small patches not well connected to larger patches of high quality habitat (ibid), such as in island mountain ranges (Interagency Lynx Biology Team, 2013). Peripheral areas "are considered to be incapable of supporting self-sustaining populations of lynx" (ibid). It is possible that secondary and peripheral areas may play a role in sustaining lynx populations during times of population fluctuation (ibid), but that possibility remains unclear and speculative. All of the above GAs are also considered currently unoccupied by lynx (U.S. Department of Agriculture, Forest Service & U.S. Department of the Interior, 2006).

The Little Belts GA, also within the secondary area (U.S. Department of the Interior, Fish and Wildlife Service, 2000b), contains more potential lynx habitat than the other GAs that occur east of Interstate 15, but this GA is also an isolated mountain range, and the nearest neighboring mountain ranges (Big Belts and Castles) do not appear capable of sustaining persistent lynx presence. The patchiness, amount, and arrangement of foraging habitat at any given time makes it unlikely that lynx would persist over the long term in the Little Belts GA. The Little Belts GA is currently considered unoccupied.

Most of the lynx habitat in the Divide GA occurs west of the Continental Divide and is contiguous with the Upper Blackfoot GA and adjoins the Garnet Range, which has the southernmost lynx habitat in Montana known to be currently occupied (Interagency Lynx Biology Team, 2013). The Rocky Mountain Range, Divide, and Upper Blackfoot GAs are within the core area as identified in the Recovery Outline (U.S. Department of the Interior, Fish and Wildlife Service, 2005), and together contain more lynx habitat than any other GAs in the plan area. These GAs are well connected to large areas of Canada lynx habitat on the Flathead and Lolo NFs to the west, and Glacier National Park to the north. The combined Rocky Mountain Range, Upper Blackfoot, and Divide GAs provide most of the lynx habitat on the Forest, are connected to lynx habitat to the north and west and may provide some level of connectivity with the identified core area in the Greater Yellowstone area to the south. The Divide, Upper Blackfoot, and Rocky Mountain Range GAs are all currently considered occupied and occur, in part, in Canada lynx designated critical habitat unit 3 (U.S. Department of Agriculture, Forest Service & U.S. Department of the Interior, 2006).

The primary factor causing Canada lynx to be federally listed as threatened was the lack of guidance for conservation of lynx and snowshoe hare habitat in NF Land and Resource Plans and BLM Land use plans, since a large amount of lynx habitat occurs on lands managed by those agencies (U.S. Department of the Interior, Fish and Wildlife Service, 2000a). Consequently, NFs in Region One amended their forest plans with the NRLMD (U.S. Department of Agriculture, Forest Service, 2007c), which applies to NFs that are considered occupied by lynx (U.S. Department of Agriculture, Forest Service & U.S. Department of the Interior, 2006) (U.S. Department of Agriculture, Forest Service & U.S. Department of the Interior, 2005). The purpose of the NRLMD is to "incorporate management direction in land management plans that conserves and promotes recovery of Canada lynx, by reducing or eliminating adverse effects from land management activities on NFS lands" (U.S. Department of Agriculture, Forest Service, 2007c). The NRLMD established standards, guidelines, and objectives for managing lynx habitat and for managing projects or activities that occur within occupied lynx habitat. The NRLMD also includes objectives and standards to maintain habitat connectivity within lynx analysis units (LAUs) as well as within and among linkage areas. Potential linkage areas were identified in the NRLMD (U.S. Department of Agriculture, Forest Service, 2007e), and included areas connecting the GAs where lynx are found or that are considered either core or secondary areas. Linkage areas between GAs may be somewhat limited by the type of habitat and extent of human development existing between these GAs. Discussion of the relative connectedness or isolation of the GAs within the planning area is incorporated into the paragraphs above.

Forests having lynx habitat in Region One delineated lynx analysis units (LAUs) per direction in the original Lynx Conservation Assessment and Strategy (Ruediger et al., 2000) to facilitate project-level assessments and impact analyses. LAUs approximate the size of a female home range and were drawn using original habitat maps for each forest, capturing enough year-round habitat (approximately 10 mi^2 or roughly 6,430 acres of primary vegetation, such as spruce-fir forest) to support one female lynx. As a result of the 2018 updated potential habitat map, the HLC NF adjusted LAUs according to guidance in the Lynx Conservation Assessment and Strategy (Ruediger et al., 2000);(Interagency Lynx Biology Team, 2013) and in compliance with NRLMD Standard LAU S1 (U.S. Department of Agriculture, Forest Service, 2007f). Although the most recent Lynx Conservation Assessment and Strategy (Interagency Lynx Biology Team, 2013) notes that LAUs need not be established in secondary/peripheral areas, the HLC NF has continued to delineate LAUs in those areas to aid in analysis of effects to potential lynx habitat, particularly when considering use of the NRLMD standards and guidelines in currently unoccupied areas.

Changes to LAU boundaries based on updated mapping

Canada lynx was listed as a Threatened species under the ESA in March 2000. In August of that same year, the Canada Lynx Conservation Assessment and Strategy (Ruediger et al., 2000) was published. In compliance with the Conservation Strategy, NFs mapped lynx habitat using available vegetation information, and delineated lynx analysis units (ibid). At the time LAUs were delineated the HLC NF were separate forests, and the vegetation information available for mapping lynx habitat varied in quality and availability across both forests. To provide an up–to-date and uniform lynx habitat map across the entire combined HLC NF, lynx habitat was remapped in 2017. The remapping used the same habitat descriptions from the Lynx Conservation Assessment and Strategy (ibid) as the original mapping, but used updated vegetation mapping (VMAP 2014, from 2011 satellite imagery) and the potential vegetation layer developed by Jones (2004).

As described in the Lynx Conservation Assessment and Strategy (Ruediger et al., 2000) , the NRLMD ((U.S. Department of Agriculture, Forest Service, 2007c), and multiple documents (J. D. Holbrook et al., 2017); (Ruediger et al., 2000), (J. R. Squires, Olson, Turner, DeCesare, & Kolbe, 2012) (John R. Squires et al., 2010); (Megan Katherine Kosterman, 2014), lynx habitat on the east side of the Continental divide is composed of subalpine fir forests (primary vegetation) dominated by cover types of spruce/fir, Douglas-fir, and seral lodgepole pine. Moist Douglas-fir habitat types (secondary vegetation) may contribute to lynx habitat where intermingled and immediately adjacent to primary vegetation. The HLC NF queried our current vegetation map product (VMAP 2014) and identified all subalpine fir and Engelmann spruce habitat types (abla1, abla2, abla3, abla4, and picea) as primary vegetation, and moist Douglas-fir types (psme2) within 300 meters of primary vegetation as secondary.

After mapping the habitat, we reviewed the existing LAU boundaries for consistency with the conservation measures identified in Chapter 7 of the original Lynx Conservation Assessment and Strategy (Ruediger et al., 2000) and Chapter 5 of the 3rd Edition (Interagency Lynx Biology Team, 2013), which states that LAUs should: 1) be 16,000 to 25,000 acres in size (larger in less contiguous habitat), 2) follow watershed boundaries, and 3) contain at least 6,400 acres of primary vegetation. The guidance regarding LAU boundaries also suggests that their spatial arrangement be evaluated and LAUs with insignificant amounts of lynx habitat may be discarded or the habitat may be incorporated into neighboring LAUs.

Based on the updated lynx map and following the guidance for evaluating LAUs as described above, the HLC NF has adjusted LAU boundaries as follows (see maps by GA in appendix A). These adjustments follow Standard LAU S1 of the NRLMD (U.S. Department of Agriculture, Forest Service, 2007b). The standards and guidelines found in the NRMLD, and incorporated into Forest Plan direction, apply to lynx habitat within LAUs.

- Removed DR-01 in the Big Belts Geographic Area from the plan area LAUs. There were only 18 acres of primary vegetation in this LAU on private land, and neighboring LAUs were separated by nonforested areas and were not close enough to this small area of habitat to incorporate it into those LAUs.
- Removed BB-03 within the Big Belt Geographic Area and incorporated the habitat into BB-02. LAU BB-03 had only 4,739 acres of mapped primary vegetation. That primary vegetation was closest to BB-02. In addition, redrew BB-02 boundaries to align with watersheds and excluded areas with patchy or no primary vegetation. This brought the amount of primary vegetation in BB-02 to 17,564 acres and reduced the size of the LAU from 248,195 acres (the combined BB-02 and BB-03) to 125,383 acres. LAU BB-04 now 52,166 acres, with 22,940 acres of primary vegetation. Twenty-five of those acres had previously occurred in BB-03.
- Removed HW-01 in the Highwoods Geographic Area from the plan area LAUs. There were only 1,092 acres of primary vegetation in this LAU, and 1,317 acres in the entire Geographic Area. The Highwoods Geographic Area is completely isolated from other Geographic Areas by intervening low-elevation private lands that are not lynx habitat, so it was not possible to incorporate the small acreage of primary habitat in this Geographic Area into the nearest LAUs.
- Within the Rocky Mountain Range Geographic Area, incorporated approximately 1000 acres of primary vegetation in the Jones Creek area that was not originally within an LAU into the RM-09 LAU.
- Removed SM-02 and SM-04 within the Snowies Geographic Area. Incorporated the habitat into SM-01 and SM-03, and adjusted the boundary between the two to provide approximately 6400 acres of primary vegetation in each of the remaining two LAUs. There are only 13,007 acres of primary vegetation within the Snowies Geographic Area, therefore only two LAUs should be delineated.
- Within the Little Belt Geographic Area, there was over 41,000 acres of primary vegetation outside the current LAU boundary. In some areas that primary vegetation was isolated; however, in a number of areas there were concentrated patches near existing LAUs. Created a new LAU in the northeast area, and adjusted the boundaries of the new LAU LB-22 and LB-11 to follow watershed boundaries. LB-11 originally incorporated 17,038 acres of primary vegetation. With the addition of LB-22 the two LAUs would incorporate 28,966 acres of primary vegetation. In addition, several other LAUs (LB-03, LB-05, LB-06, LB-12, LB-15, and LB-19) were expanded to capture primary vegetation near their existing boundaries.
- In all LAUs, boundaries were adjusted to match current watershed boundaries or in some instances to the administrative boundary. This is primarily a mapping cleanup exercise intended to remove slivers in the GIS mapping. In a few cases, the boundary adjustment resulted in changes of less than 100 acres where the watershed boundaries used in the current mapping effort differed slightly from those used in 200 for the original habitat and LAU maps. LAU boundaries were not adjusted to incorporate all primary vegetation. Scattered and isolated pockets of primary vegetation in adjacent watersheds, where there are not enough acres to create another LAU, were not incorporated in existing LAUs.

The changes in LAU boundaries occur in all Geographic Areas, as boundaries were adjusted to match watershed boudnaries. Approximately 38,867 acres of primary vegetation would be added into new or existing (adjusted) LAUs; although the total acres within LAUs would decrease by 92,371 acres by removing areas of non-lynx habitat. Roughly 10,900 acres on the Rocky Mountains GA are added into LAUs. The Rocky Mountain Range GA is the only GA where adjustments are being made that is currently considered “occupied habitat” (U.S. Department of Agriculture, Forest Service, 2007d); (U.S. Department of Agriculture, Forest Service & U.S. Department of the Interior, 2006), and is within designated Critical Habitat. An additional 29,019 acres of mapped lynx habitat, and 46,435 acres total, will be incorporated into LAUs in the Little Belts, which is currently considered "unoccupied habitat" (ibid.). The management direction in the NRMLD would apply to the added acres on the Rocky Mountain Range GA, and would be considered in all planning and management proposed on the added acres in the Little Belts GA. Slightly more than 1,099 acres of mapped habitat spread across two widely separated GAs (Big Belts and Highwoods) would no longer be within a LAU. These acres occurred within habitat considered "unoccupied" (ibid.), are identified by the USFWS as occurring within secondary and/or peripheral areas (U.S. Department of the Interior, Fish and Wildlife Service, 2005), and are in isolated areas not connected to other lynx habitat.

Mapped lynx habitat that is not within a LAU (secondary vegetation and limited amounts of primary vegetation) would be managed as described in the terrestrial vegetation report, to achieve desired conditions that include components regarding species composition and forest structure (refer to the draft plan components for Terrestrial Vegetation, and to the terrestrial vegetation section). Most desired conditions for vegetation would move forest composition and structure toward or within the estimated NRV. Management to achieve those desired conditions would maintain the ecological conditions necessary to support native wildlife species, including lynx and their prey.

Canada lynx designated critical habitat

Canada lynx is the only federally listed terrestrial wildlife species on the HLC NF that also has designated critical habitat. The Rocky Mountain Range and Upper Blackfoot GAs, and the northern portion of the Divide GA, are within Unit 1 of designated Canada lynx Critical Habitat (U.S. Department of the Interior, Fish and Wildlife Service, 2014a). Critical habitat receives protection under Section 7(a)(2) of the ESA. Areas identified as critical habitat contain the primary constituent elements, which are specific biological or physical features that provide for a species' life history processes and are essential to the conservation of the species (U.S. Department of the Interior, Fish and Wildlife Service, 2014a). The primary constituent element (PCE) for lynx is boreal forest landscapes supporting a mosaic of differing successional forest stages and containing:

a) Presence of snowshoe hares and their preferred habitat conditions, which include dense understories of young trees, shrubs, or overhanging boughs that protrude above the snow, and mature multistoried stands with conifer boughs touching the snow surface;
b) Winter conditions that provide and maintain deep fluffy snow for extended periods of time;
c) Sites for denning with abundant coarse woody debris, such as downed trees and root wads; and
d) Matrix habitat…that occurs between patches of boreal forest in close juxtaposition (at the scale of a lynx home range) such that lynx are likely to travel through such habitat while accessing patches of boreal forest within a home range.

The Assessment (U.S. Department of Agriculture, Forest Service, Northern Region, 2015) discusses each of the components above to some extent. Component (a) is addressed in the 'habitat status and connectivity' section and is modelled as described above. Component (b) is less well-defined and not something that can be realistically modelled. Lynx may use a wide variety of habitats for travel among more suitable patches, depending on proximity to patches of foraging habitat, size, shape, and topography of intervening patches, quality of nearby foraging habitat, etc. Component (c) is not discussed or modelled here but is addressed broadly in the snags and downed wood section. Component (d) is highly variable in some portions of the planning area (refer to the terrestrial vegetation sections on vertical structure, density, and forest pattern), and may be changing due to climate change (refer to chapter 4, climate change and baseline assessment of carbon stocks) (ibid).

Stressors under Forest Service control

Vegetation management and wildand fire management

Canada lynx rely on snowshoe hare, which require boreal forest that contains dense, horizontal cover. Therefore, disturbances that alter or remove horizontal cover or convert forest from structural stages that provide snowshoe hare habitat to stages that do not have the potential to impact Canada lynx. These disturbances include vegetation management and fire, which can be considered as both stressors and drivers of Canada lynx habitat. In general, treatments used in vegetation management remove trees and/or reduce horizontal cover through thinning or burning. Wildland and prescribed fires may also have this effect, to varying degrees depending on fire intensity and severity.

Fire and certain types of vegetation management can also promote development of Canada lynx habitat by returning a stand or area to an earlier successional stage that may eventually provide habitat (such as dense, young regenerating forest), or by creating openings within existing forest canopies that promote development of multiple canopy layers. Therefore, maintaining a habitat mosaic of different successional stages within the forest types likely to be used by lynx is a key strategy for maintaining lynx presence. Squires et al. (2010) state, "Managers should prioritize retention of a habitat mosaic of abundant and spatially well-distributed patches of mature, multilayer spruce-fir forests and younger forest stands". Vegetation management activities, including prescribed fire, can be designed to increase potential future lynx habitat, to promote or restore connectivity among patches of existing lynx habitat, and to create a mosaic of successional stages as recommended by Squires et al.(2010). Fires that burn with varying intensity and severity also help to perpetuate the mosaic of stages. Vegetation management can be used as a tool to help manage future wildfires by creating breaks or inconsistencies in fuels, thereby altering fire spread rate and direction. Care must be taken in core areas to maintain enough habitat to support a reproductive population of lynx. Managing vegetation within delineated LAUs, as described above and in the Lynx Conservation Assessment and Strategy (Interagency Lynx Biology Team, 2013), helps to realize that management goal. The NRLMD specifies the degree to which lynx habitat can be altered in an area.

Recreation

The Lynx Conservation Assessment and Strategy notes that if effects to lynx occur from recreation, they are incompletely understood and may depend on the type and context of activity (Interagency Lynx Biology Team, 2013). It further states that the primary impacts to lynx and lynx habitat from recreation are from 1) habitat alternation to maintain health and human safety of recreation sites and areas, which may reduce or degrade lynx and snowshoe hare habitat; 2) displacement of lynx due to summer and winter motorized activity, human presence, and access; and 3) the potential for incidental trapping of lynx resulting from access to preferred habitats via allowable motorized use or development. Recent work from Squires and others (2019) further describes winter recreation's potentially limited degree of effect on lynx, depending on the spatial juxtaposition of occupied lynx habitat and types and degrees of winter recreation in that habitat.

Minerals and energy development

Currently, mineral and energy resources are potentially available for use across the planning area, or are currently being exploited. While there is potential for negative effects to lynx and lynx critical habitat to result from those actions, the potential effects are wide-ranging. Such effects could result from changing or eliminating native vegetation used by lynx and snowshoe hare, fragmenting habitat through the development of associated roads, powerlines, and pipelines, and other infrastructure. The amount or degree of impact can vary based on the size, type, and location of such activity. As such, these effects can range from no effect to potentially adverse, depending on the type, location, size, and other aspects of activities associated with a specific mineral or energy development. The degree of potential effect that could result from such developments or explorations is difficult to anticipate or predict at this time largely because specific proposals for minerals or energy development vary widely in their nature, scope, location, and type of proposed activity.

Livestock grazing

Livestock grazing is not generally considered detrimental to lynx, since competitive interaction for herbaceous forage between livestock and snowshoe hare can be rather limited. Where such competition occurs, it can reduce available habitat for snowshoe hare, impacting snowshoe hare habitat and critical habitat PCE 1a.

Stressors not under Forest Service control

Illegal and incidental mortality

Currently, trapping and snaring of lynx is prohibited across the contiguous U.S., including Montana. Incidental trapping may still occur, although it appears to have declined since 2000 (Montana Fish Wildlife and Parks, 2016). A total of three lynx were reported captured between 2008 and 2015 by trappers targeting other species, and all were released uninjured. Overall, lynx mortality related to trapping averaged 1.6 lynx per year, and declined to 0.4 per year after 2008, when more protective regulations were put in place (Montana Fish Wildlife and Parks, 2016).

Wildfire

Wildfire is one of the primary forces that historically shaped the structure and composition of vegetation on the HLC NF. The HLC NF fire history (refer to fire and fuels section) discusses the amount of fire that occurred historically on each GA since the 1800s. The NRV range of acres burned varies by PVT. The cool-moist type, which includes most lynx habitat, appears to average nearly 200,000 acres of stand-replacing fire, over 50,000 acres of mixed severity fire, and over 25,000 acres of low severity fires per decade forestwide. In recent years, fires have occurred with increasing frequency, size, and severity. Fires can alter lynx habitat by removing canopy or vegetation completely or partly, and by ‘resetting’ succession such that young regenerating forests occur within a period of years after certain fires. Size, pattern, severity, and vegetation type all play a role in determining the degree to which a given fire may impact lynx habitat. Therefore, fire can be a stressor or a driver of lynx by altering habitat to reduce the quality of snowshoe hare habitat and lynx foraging habitat to generating conditions that will improve the mosaic and juztapostion of structural stages that provides for quanitites of snowshoe hare where lynx can effectively forage for them. The Forest can influence fire size, location and severity through a variety of practices that include suppression and fuels management, with the result that many ignitions have been suppressed or extinguished. Many, however, are not suppressed or extinguished, and burn largely influenced by weather/climate, vegetation, and terrain. Furthermore, the location of wildfire starts is entirely outside NF control.

Climate change

The Lynx Conservation Assessment and Strategy (Interagency Lynx Biology Team, 2013) addresses several possible effects of climate change on lynx. These include potential shifts in lynx distribution in terms of elevation and latitude, changes in hare population cycles, reductions in the amount of lynx habitat due to changes in snow suitability and persistence, and changes in the frequency and severity of disturbances such as wildfire and insects that impact habitat. Rates and magnitude of these changes and the manner in which they may interact are difficult or impossible to predict.

Specific to the HLC NF, tree species that are key components of snowshoe hare, and therefore lynx habitat, including Engelmann spruce and subalpine fir, may decrease at lower elevations, possibly expand upward in elevation, and potentially become less resilient to disturbance (U.S. Department of Agriculture, Forest Service, Northern Region, 2015). This, combined with likely increased fire frequency and duration, may result in overall decreases in, or changes in spatial distribution of, lynx habitat. For the HLC NF, on the edge of current and historic lynx distribution, lynx habitat could decrease to the point that portions of the planning area that currently support lynx either permanently or as transients are no longer capable of doing so. Areas where habitat is limited or marginal, such as at the edge of a species’ distribution are often the first areas to become uninhabited (J. H. Brown, Stevens, & Kaufman, 1996).

3.14.8 Canada lynx, environmental consequences

Effects common to all alternatives

Discussion regarding recent science related to Canada lynx

During the comment period after the publication of the draft environmental impact statement, several comments were received regarding new research related to Canada lynx (Holbrook et al., 2018; Holbrook et al., 2019; Holbrook, Squires, Olson, DeCesare, & Lawrence, 2017; Megan K. Kosterman et al., 2018) and the 2020 Forest Plan. The discussion below will outline the summary findings of that research, by paper, and how that research was incorporated or considered in the 2020 Forest Plan, FEIS analysis, and the NRLMD (U.S. Department of Agriculture, Forest Service, 2007b) standards, objectives, and guidelines being retained in the Plan.

Holbrook et al., 2017

This paper assessed functional responses in lynx habitat use to characterize habitat relationships, predicted lynx habitat, and assessed behavioral differences with changing environmental conditions within the existing, suspected distribution of Canada lynx in the Northern Rockies. Through use of resource selection function analyses of 86 unique individual lynx (38 females and 48 males) in the study area, this paper developed predictions of lynx habitat and lynx habitat condition within northwestern Montana. By assessing functional responses and habitat selection across scales and seasons, the study indicated that:

- Canada lynx used more mature, spruce-fir forest than any other structural class or species. This determination was also indicated in Squires et al. 2010, the science from which provided the impetus and rational for Standard VEG S6 in the Northern Rockies Lynx Management Direction (NRLMD).
- Intermediate snow depths and the distribution of snowshoe hares were the strongest predictors of where lynx selected their home ranges.
- Young regenerating forests generally provided the most abundant snowshoe hares, while mature forest is where lynx appear to hunt efficiently. Standards VEG S5 and VEG S6 emphasize retention of young regenerating stands and multistoried mature stands, respectively that provide habitat for snowshoe hares.
- Within their home ranges, female and male lynx increasingly used young regenerating forest structures as they became more available (up to a maximum availability of 40%). NRLMD standard VEG S5 emphasizes retention of young regenerating stands and prohibits any stand modifications that reduce snowshoe hare habitat until stands “self-prune” and no longer provide habitat for snowshoe hares during winter.
- Vegetation management actions may be used to promote development of young regenerating forests that provide habitat for snowshoe hare (e.g., regeneration harvest treatments); however, because young regenerating forest conditions initiate from the early seral stand initiation structural stage, such management actions will result in lower quality snowshoe hare habitat for twenty or more years post treatment.
- Female lynx exhibited decreasing use of stand initiation structures (up to a maximum availability of 25%). Stand initiation structures as defined in this paper include very young stands (generally 5 years old and younger) with very few trees and open canopies resulting from recent disturbances such as timber harvest and/or severe fire. Standard VEG S1 limits disturbances from timber harvest or fire that results in the stand initiation (SI) structural stage not yet providing snowshoe hare habitat during winter to no more than 30% of mapped lynx habitat within a Lynx Analysis Unit (LAU). However, SI structures as defined in this paper and the SI structural stage defined in the NRLMD are not the same; stands in the SI structural stage as defined in the NRLMD (and that apply to standard VEG S1) approach 20 - 25 years of age before moving to young regenerating stands that provide

snowshoe hare habitat during winter. Thus, the SI structure class defined in this paper is but a subset of the SI structural conditions used in NRLMD standard VEG S1 to establish the 30% SI condition threshold.

- Mature forest structures were used in proportion to availability. Sixty-six percent of female home ranges contained >50% mature forest. Through the use of resource selection function modeling, researchers determined that lynx within their study area used more mature spruce-fir forest than any other structure class or species, and increasingly used advanced regeneration forest structures as they became more available within their home ranges. The study concluded that advanced regeneration generally provides the most abundant snowshoe hares, while mature forest is where lynx appear to hunt efficiently. These findings were based on lynx habitat use of four forest structural classes derived from satellite imagery, and include sparse forest, stand initiation, advanced regeneration, and mature forest. All four classes are described in the paper using metrics from the USDA Forest Service Forest Inventory and Analysis (FIA) program. Although the definition for mature forest is mid-seral stands >40 years of age arranged in a multi-storied structure with a mixed species composition, the range of stand conditions described for the mature class (i.e. tree sizes, stem densities, and canopy closures, etc.) is quite broad, indicating a variety of overstory and understory stand conditions, a range of structural conditions as defined in (Oliver & Larson, 1996) (including the young forest and understory re-initiation multistoried structural stages), and a mix of high and low horizontal cover values capable of supporting varying degrees of habitat quality for snowshoe hares. Thus, the value of the mature forest component as foraging habitat for lynx (within home ranges in this study) is likely highly variable and dependent on existing horizontal cover values at the local scale.

The structural classes and resource selection function modeling processes used in the Kosterman Thesis (2014) and in Kosterman et al. 2018 to describe habitat use by lynx are very similar to those used in this paper, and the findings in all three papers are similar as a result. However, forest structural classes described in those two papers, and the classes described in this Holbrook et al. 2017 paper (sparse, stand initiation, advanced regeneration, and mature are not the same as those structural classes used to define and develop objectives, standards and guidelines in the Northern Rockies Lynx Amendment (NRLMD). Forest structural classes used in the NRLMD are based on structural stages defined by (Oliver & Larson, 1996), and do not “crosswalk” well with structural classes used in this study, or those in the Kosterman Thesis (2014) or Kosterman et al. 2018. Staff in the R1 Regional office are working with research scientists at RMRS to better interpret structure classes used in these studies and how they compare with those used in the NRLMD.

Standard VEG S6 prohibits vegetation management actions that reduce snowshoe hare habitat within existing multistoried mature forest structures; the standard allows an exemption for treatments within the Wildland Urban Interface (WUI) and provides for a limited amount of exceptions to benefit other resources. However, the standard only provides for existing levels of multistoried snowshoe hare habitat within LAUs, and does not require retention of other mature forest structures with potential to develop into multistoried snowshoe hare habitat in the future; nor does it provide guidance or recommendations for the amount of multistoried snowshoe hare habitat necessary to support a lynx home range. Thus, the findings in Holbrook et al. 2017 suggest that, in addition to retaining existing multistoried forest structures with dense understories that provide snowshoe hare habitat within LAUs (per VEG S6), vegetation management planning should consider retention or intermediate silvicultural treatments of multistoried forest structures currently lacking dense horizontal cover to promote multistoried snowshoe hare habitat in the future within LAUs where less than 50% of existing lynx habitat is in the multistoried structural stage.

Guideline VEG G1 promotes vegetation management treatments that recruit high densities of conifers, hardwoods, and shrubs where such habitat is scarce or not available; priority for treatment should be given to stem exclusion, closed canopy structural stage stands to promote development of multistoried structures with high horizontal cover for snowshoe hares. Implementation of this guideline would be most beneficial in LAUs where less than 50% of lynx habitat is in the multistoried structural stage that provides habitat for snowshoe hares.

This paper also predicted lynx habitat within the suspected distribution of Canada lynx in the Northern Rockies; based on resource selection function and satellite imagery modeling processes described previously and a set of appropriately scaled covariates, Holbrook et al. 2017 developed lynx habitat maps that predict probability of use for lynx in western Montana. Because these maps are based on habitat selected by lynx in the study area, they reflect current habitat conditions and provide an informed measure of current lynx habitat quality in western Montana. These maps were derived by assessing lynx habitat use within all land areas within their home ranges, and thus, the resulting predictive probability maps do not coincide with lynx habitat maps developed by Forests as directed in the Lynx Conservation Assessment and Strategy and NRLMD. Regardless, these maps provide a science-based map of current habitat quality, and a valuable tool for planning and assessing effects at the project level.

Plan component FW-WL-DC-09 provides for an appropriate mosaic of structural conditions within LAUs that support lynx conservation forest-wide at the programmatic scale. Plan components DI-VEGF-DC-04, RM-VEGF-DC-04, and UB-VEGF-DC-04 provide for the quality habitats necessary to support reproduction success and long-term persistence of lynx populations within occupied habitats on the Forest at the programmatic scale. These plan components provide direction for incorporating findings and recommendations in “new science” that best support the desired conditions for lynx and lynx habitat on the Forest. The findings in Holbrook et al. 2017 that suggest 50% or more of lynx habitat within LAUs should be in the multi-storied structural stage to promote use and reproduction success of female lynx will be considered, and incorporated when appropriate, at the project planning scale.

Holbrook et al., 2018

The objective of this study was to evaluate the spatial and temporal responses of Canada lynx to differing silvicultural treatments. The study analyzed occupancy and intensity of lynx use of treatment areas, time since treatment, and the landscape context of treatments. Occupancy considers whether a particular type of habitat is used by lynx whereas intensity considers how much a particular type of habitat is used. The study utilized an extensive GPS dataset that included 66 Canada lynx (i.e., 164,593 locations) collected during 2004–2015 in NW Montana. The Forest Service FACTS database was used to identify 1,293 vegetation treatments that occurred within the lynx home ranges identified in Holbrook et al., 2017 over a temporal gradient of 1–67 years following treatment. The study identified three different silvicultural treatment groups that included 25 unique silvicultural activity types. The three treatment groups included: (1) regeneration cuts (combined regeneration cut with natural regeneration and regeneration cut with plantings; n=791), (2) selection cuts (combined group selection and liberation cut; n=71), and (3) thinnings (combined improvement cut and precommercial thinning; n=431).

By assessing functional responses and habitat selection across scales and seasons, the study indicated that:

- Lynx used silvicultural treatments (regeneration, thinning and selection cut harvests) post-harvest, but there was little use by lynx during the first 10 years following treatments; thus, there is a ~10 year cost of implementing any treatment (thinning, selection, or regeneration harvest) relative to resource selection by lynx. This temporal cost is associated with lynx preferring advanced regenerating and mature structural stages (J. D. Holbrook et al., 2017; John R. Squires et al., 2010) and is consistent with previous work demonstrating a negative effect of precommerical thinning on snowshoe hare densities for ∼10 years following treatment.
- Cumulative use by lynx (in both summer and winter) occurred sooner following thinning treatments than either regeneration or selection harvest treatments; thinning treatments required ∼20 years post

treatment to reach 50% lynx use, while regeneration harvest and selection harvest treatments required 34 years and 39 years respectively.

- Lynx appeared to use regeneration and selection cuts similarly over time, suggesting that the difference in vegetation impact between these treatment methods make little difference relative to potential impacts to lynx.
- In areas of past vegetation management actions assessed in this study, both the vegetation recovery time following silvicultural treatments and existing forest structures (presence or absence of lynx foraging stands) interacted to influence lynx behavior. Lynx tended to avoid silviculturally treated stands (regardless of time since treatment) when preferred structural stages (e.g., mature multi-storied forest or advanced regeneration) were abundant in the adjacent, surrounding landscape, and in areas with low amounts of mature forest in the neighborhood, lynx use of recovering silvicultural treatments was higher than in treatments surrounded by an abundance of mature forest.

The findings in Holbrook et al. 2018 emphasize that spatial arrangements and compositions, as well as recovery times following vegetation treatments, are important to balancing silvicultural actions and Canada lynx conservation. However, conclusions in Holbrook et al. 2018 do not directly address or contradict management direction provided in the NRLMD or lynx-related desired condition plan components FW-WL-DC-09 and DI/RM/UB-VEGF-DC-04 in the 2020 Forest Plan. The findings of Holbrook et al. 2018 will be considered, and incorporated when appropriate, at the project planning scale.

Kosterman et al., 2018

This publication investigated the relationship between reproduction success and forest structural compositions and arrangements within the annual core use areas of 36 radio collared female lynx on the Kootenai and Lolo National Forests previously studied and described in the Kosterman Thesis (2014). This paper found a relationship between forest structure and reproductive success in Canada lynx consistent with an income breeding strategy, where forest structure supplied the income important for successful reproduction. The forest characteristics that defined high reproduction success within the core use areas of female lynx home ranges included (1) abundant and connected mature forest and (2) intermediate amounts of small-diameter regenerating forest. This study focused on forest structures within 50% core use areas because they were more strongly related to demographic responses than were 90% home ranges; fixed-kernel density methods were used to estimate core and home range areas. Analysis methods and the most significant findings in this paper are discussed below in relationship to how they relate to current management direction provided in the NRLMD.

Structural Classes

The structural classes used in the Kosterman et al. (2018) paper to describe habitat use by lynx are similar to those used in the Kosterman Thesis (2014) and in Holbrook et al. 2017. But the classes described in all three papers are not the same as structural classes used to define and develop objectives, standards and guidelines in the Northern Rockies Lynx Management Direction (NRLMD). Forest structural classes used in the NRLMD are based on structural stages defined by (Oliver & Larson, 1996), and do not “crosswalk” well with structural classes used in the Kosterman Thesis (2014), in Holbrook et al. 2017, or in Kosterman et al. (2018). Thus, direct comparisons are difficult. Staff in the R1 Regional office are working with research scientists at RMRS to better interpret structure classes used in these studies and how they compare with those used in the NRLMD.

Core Use Areas, Home Ranges and Lynx Analysis Units

Forest structure and reproduction success relationships addressed in Kosterman et al. (2018) are based on core use areas selected by female lynx in the study area, and represent those portions of their total home range area that provided relatively high quality habitat when the home range was occupied. The mean values of structural conditions within core use areas of the 36 female lynx included in their study were:

- Mature forest => 49% +/- 13% SD
- Med-diameter forest => 24% +/- 18% SD
- Small-diameter forest => 13% +/- 6% SD
- Sparse forest => 10% +/- 7% SD
- Open forest => 4% +/- 4% SD

Structural conditions described above are defined in Table 1 of Kosterman et.al. (2018).

The NRLMD directs development and use of LAUs that represent a theoretical female lynx home range for implementing Standards and Guidelines in the NRLMD. LAUs approximate the size of a female lynx home range in the Northern Rockies (25 to 50 sq. miles) and contain at least 10 sq. miles of lynx habitat on AF/ES habitat types (Ruediger et al., 2000; U.S. Department of Agriculture, Forest Service, 2007b). Since LAUs represent female lynx home ranges and are not the same as core use areas identified in this study, structural conditions that support reproduction success within core use areas are not directly comparable to structural conditions within LAUs used to address management guidance in the NRLMD. Staff in the R1 Regional office are working closely with research scientists at RMRS to better interpret, understand, and identify desirable structural conditions that support reproduction success within female lynx home ranges, which would be more comparable to habitat conditions at the LAU scale.

Forest characteristics that defined high reproduction success within the core use areas of female lynx home ranges included 1) abundant and connected mature forest and 2) intermediate amounts of small-diameter regenerating forest. This study concluded that reproduction success was largely associated with forest structure and configuration, and that "mature forest in a connected configuration creates an energetically efficient context for lynx to acquire snowshoe hares and successfully reproduce". In core areas with high connectivity of mature forest, the probability of producing a litter increased significantly as the proportion of small-diameter regenerating forest increased from ~5% to ~10%; litter production probability remained consistently high in core use areas with up to ~20% of small-diameter regenerating forest, and then declined when amounts of small diameter regenerating forest exceeded 20%. The probability of producing a litter was highest for females in core-use areas with ~12-20% of small diameter regenerating forest and increased with increasing connectivity of mature forest. However, the study also indicated that the amount of small-diameter regenerating forest that is optimal for female lynx is dependent on the landscape context; that is, the optimal quantity broadens as mature forest becomes more connected. But, despite the mature to small diameter forest relationship, mature forest in a connected configuration is particularly important for core use areas of lynx, which aligns with landscape-level habitat selection described in (John R. Squires et al., 2013) and Holbrook et al. (2017); the Kosterman Thesis (2014) also addressed lynx reproduction success at both the home range and core use scales, and concluded that, females that produced litters had home ranges with intermediate amounts of young regenerating forest, greater connectivity of mature forest, and greater edge density between mature and young regenerating forest than home ranges of females that did not produce litters.

Objective ALL O1 and Standard ALL S1 in the NRLMD provide management guidance for maintaining connectivity between and within LAUs. However, the purpose of connectivity guidance in the NRLMD is to provide cover to accommodate day to day travel movements within LAUs and longer migratory movements between LAUs. It does not address mature forest connectivity in the context of reproductive success. Thus, in addition to addressing ALL O1 and ALL S1 at the project level, vegetation management planning should consider maintaining and/or improving connectivity of mature, multistoried habitat within the LAU. The mature forest class described in Kosterman et al. 2018 (Table 1) is "multistoried stands with substantial understory and horizontal cover", which is comparable to the multi-storied conditions addressed by VEG S6.

Plan component FW-WL-DC-09 provides for an appropriate mosaic of structural conditions within LAUs that support lynx conservation forest-wide at the programmatic scale. And, plan components DI-VEGF-DC-04, RM-VEGF-DC-04, and UB-VEGF-DC-04 provide for the quality habitats necessary to support reproduction success and long-term persistence of lynx populations within occupied habitats on the Forest at the programmatic scale. These plan components provide direction for incorporating findings and recommendations in "new science" that best support the desired conditions for lynx and lynx habitat on the Forest. Thus, the forest characteristics described in Kosterman et. al 2018 that defined high reproduction success within the core use areas of female lynx home ranges (including abundant, well-connected mature forest and intermediate amounts of small-diameter regenerating forest) will be considered, and incorporated when appropriate, at the project planning scale.

Holbrook et al., 2019

This paper evaluated and characterized habitat mosaics that contribute to reproduction success and the probability of female lynx to produce litters within core use and home range areas in northwestern Montana. The researchers integrated findings of previous research by Holbrook and others as well as Kosterman and others, and utilized a spatially extensive dataset that included snowshoe hare data (1340 plots collected in 2013) and time-series forest structural classes derived from remote sensing (1972-2013) to assess habitat use and reproductive success of Canada lynx (32 female lynx over 92 lynx years from 1999-2013).

Forest structural classes used to assess habitat mosaics in this study were derived from remote sensed modeling (Savage et al., 2018); modeling metrics were further described in the paper using subplot data from the USDA Forest Service Forest Inventory and Analysis (FIA) program. Structural classes included:

- Stand initiation- "stands with few large or small trees and an open canopy (median basal area weighted DBH of 0 inches, 8% canopy cover, and median estimated tree height of 1 foot)".
    - This structural class is most consistent with the NRLMD description of the early stand initiation structural stage.
- Sparse forests- "sparse overstory with low canopy cover, which could be naturally present or mechanically created".
    - This structural class tends to be most consistent with the NRLMD description of the early stand initiation structural stage but could also describe other stages depending on the amount of larger trees in the overstory.
- Advanced regenerating forests- "e.g., revegetated stands from past forest harvest with mid-sized trees that provide dense horizontal and canopy cover".
    - This structural class is consistent with the NRLMD description of the stand initiation structural stage.
- Mature forests- "e.g., stands with many trees and a multi-layered canopy that are older and more complex than advanced regeneration".
    - This structural class is consistent with the NRLMD description of the mature, multi-story structural stage.

The structural classes used in Holbrook et al. 2019 (described above) are similar to those used in the Kosterman Thesis (2014), in Holbrook et al. 2017 and in Kosterman et al. (2018). However, the classes described in all four papers are not the same as those structural classes used to define and develop objectives, standards and guidelines in the Northern Rockies Lynx Management Direction (NRLMD). Forest structure classes used in the NRLMD are based on structural stages defined by Oliver and Larson (1996), and do not "crosswalk" well with structural classes used in the Kosterman Thesis (2014), in Holbrook et al. 2017, in Kosterman et al. (2018), or in Holbrook et al. (2019). Thus, direct comparisons are difficult. Staff in the R1 Regional office are working with research scientists at RMRS to better interpret structure classes used in these studies and how they compare with those used in the NRLMD.

The most significant findings in Holbrook et al. 2019 relative to forest management are summarized below.

- The abundance and arrangement of structural classes strongly influenced reproductive success for female Canada lynx, but the probability of a female producing kittens was most associated with the connectivity of mature, multistoried forest (composed of mostly spruce-fir). Although litter production also varied substantially among females, variation in litter production was more sensitive to the connectivity of mature forest rather than the abundance of stand initiation.
- In core use areas of high quality females (i.e., females that produced kittens most frequently), mature forest was 17% more abundant (i.e., ≈60% of the total core area), more connected, less clumpy, and exhibited 2.25-times larger patch sizes than the core areas of low quality females. At the home range extent, patterns were less pronounced while the abundance of mature forests remained high (≈50%) for high quality females.
- The study also demonstrated that the relative density of snowshoe hares was ≥2.8 times higher in advanced regenerating forests compared to all other structural classes, including mature forest. Advanced regenerating forests accounted for ≈18–19% of the core area and home range of high-quality female lynx.
- Combined, study results suggest that a high-quality structural mosaic for female lynx contains about 50-60 percent well connected mature forest and 18-19 percent advanced regenerating forest at the home range scale (18-66 km2). The study used FIA data to characterize the approximate age distribution of advanced regeneration and mature forest and found that advanced regeneration was about 20 to 80 years old, while mature forest was about 50 to 200+ years old. Values are approximate and (as with all models) include error from the initial modeling of forest structural classes in Savage et al. 2018.

The findings in Holbrook et al. 2019 describing habitat quantities and arrangements that best support reproduction success is consistent with the findings in Holbrook et al. 2017 and Kosterman et al. 2018 relative to the amount of well-connected mature forest structure and advanced regeneration forest structure that provides high-quality habitat for female lynx. And thus, the same vegetation management consideration recommendations previously discussed in this paper in the Holbrook et al. 2017 and Kosterman et al. 2018 assessments also apply to findings in Holbrook et al. 2019 Specifically; 1) in addition to retaining existing multistoried forest structures with dense understories that provide snowshoe hare habitat within LAUs (per NRLMD Standard VEG S6), vegetation management planning should consider retention or intermediate silvicultural treatments of multistoried forest structures currently lacking dense horizontal cover to promote multistoried snowshoe hare habitat in the future within LAUs where less than 50% of existing lynx habitat is in the multistoried structural stage; and 2) in addition to providing connectivity within and between LAU’s (per NRLMD Objective ALL O1 and Standard ALL S1), vegetation management planning should consider maintaining and/or improving connectivity of mature, multistoried habitat within the LAU.

Forest Plan components DI-VEGF-DC-04, RM-VEGF-DC-04, and UB-VEGF-DC-04 provide for the quality habitats necessary to support reproduction success and long-term persistence of lynx populations within occupied habitats on the Forest at the programmatic scale. Hence, the habitat mosaics that provide for high quality habitats and reproduction success described in Holbrook et al. (2019) will be considered, and incorporated when appropriate, at the project planning scale.

Discussion summary

The findings of (Holbrook et al., 2018; Holbrook et al., 2019; J. D. Holbrook et al., 2017; Megan K. Kosterman et al., 2018) and other best available scientific information, would be considered, and incorporated where appropriate, at the project level when site-specific actions are carried out as allowed under the 2020 Forest Plan during project planning and analysis.

Northern Rockies Lynx Management Direction

All alternatives, including the no-action alternative, retain the NRLMD. The amendment incorporates goals, objectives, standards, and guidelines into 18 National Forest plans, including the HLC NF Plans that conserve and promote recovery of Canada lynx. The direction applies to lynx habitat that is considered occupied by Canada lynx (U.S. Department of Agriculture, Forest Service & U.S. Department of the Interior, 2006) as described in the section above on habitat status and connectivity. Areas currently occupied are the Rocky Mountain Range, Upper Blackfoot, and northern portion of the Divide GAs. The remaining lynx habitat in the planning area is considered unoccupied (ibid), where lynx management direction provided in the NRLMD is to be considered when designing management actions. The lynx direction addresses risk factors affecting lynx productivity (timber management, wildland fire management, livestock grazing, recreational uses, forest backcountry roads and trails, and other human developments) (U.S. Department of Agriculture, Forest Service, 2007e), as originally identified in the Lynx Conservation Assessment and Strategy (Ruediger et al., 2000) .

A full analysis of the potential impacts of implementing the NRLMD can be found in the FEIS (U.S. Department of Agriculture, Forest Service, 2007c), the associated BA (U.S. Department of Agriculture, Forest Service, 2007a), and the recently completed BA for Canada Lynx Designated Critical Habitat: NRLMD (U.S. Department of Agriculture, Forest Service, 2017a) . The analyses will not be repeated here, but key parts are summarized here as they relate to the analysis of consequences of the HLC NF 2020 Forest Plan and alternatives to the 2020 Forest Plan.

Under all alternatives the lynx direction would conserve habitat within the planning area and ensure sufficient habitat through time by limiting vegetation management actions that result in newly regenerated forest (Standard VEG S1 and Standard VEG S2). Snowshoe hare habitat is conserved through limits on precommercial thinning and treatment in multi-story mature or late successional hare habitat (Standard VEG S5 and Standard VEG S6). Exemptions to these standards for fuel treatment within the WUI are limited to 6 percent of the lynx habitat in the planning area.

The Forest has updated its estimate of acres that may be treated and that would be subject to the NRLMD exemptions and exceptions. This estimate considered objectives in the proposed action (FW-FIRE-OBJ-01), management constraints in the plan (including standards and guidelines in the NRLMD), and the amount of potential lynx habitat occurring in the WUI as identified by Community Wildfire Protection Plans. Not all acres to be treated in the WUI would occur in occupied potential lynx habitat. The 15,000 acres identified in FW-FIRE-OBJ-01 is a minimum objective to be treated per decade; the Forest estimates that up to 39,823 acres of occupied potential lynx habitat could be treated in the WUI using the exemptions in the NRLMD over the life of the plan (Table 80), which is expected to be 15 years. Similarly, the Forest estimates that up to 40,732 acres of unoccupied habitat in the WUI could be treated over the life of the plan.

The 2020 Forest Plan also includes an objective (FW-PLANT-OBJ-01) to treat a minimum of 4,500 acres to sustain or restore whitebark pine; treatments could include pre-commercial thinning, as described in the exception to NRLMD Standard VEG S5. This number could be higher, as the objective is a minimum that would be accomplished over the life of the plan. Managers estimate that an additional 3,500 acres could be treated using the exception to NRLMD standard VEG S5 for the following purposes 1) Within 200 feet of administrative sites, dwellings, or outbuildings 2) for research studies or genetic tree tests evaluating genetically improved reforestation stock 3) Based on new information that is peer reviewed and accepted by the regional level of the FS, and state level of FWS, where a written determination states that a project is not likely to adversely affect lynx or is likely to have short term adverse effects on lynx or its habitat, but would result in long-term benefits to lynx and its habitat 4) for conifer removal in aspen, or daylight thinning around individual aspen trees, or where aspen is in decline. The forests anticipate the large majority of acres of lynx habitat treated using VEG S5 would be for the purposes of restoring or sustaining whitebark pine and aspen. Since aspen is difficult to geospatially predict or map, and- thus to enumerate in acres across the action area, we assume that the majority of the additional 3,500 acres described above would be available for the treatment of aspen, with a minor amount of acres treated for the remaining reasons detailed above as allowed under VEG S5. The exact number of acres treated for each purpose is not currently known and would be determined as projects are developed according to identified, site-specific needs.

The total use of the exceptions to VEG S5 are not anticipated to exceed 4,800 acres in areas occupied by lynx. We estimate that within areas occupied by lynx 2,700 acres of lynx habitat may be treated for the purposes of restoring whitebark pine, and 2,100 acres for restoring aspen. Since the forest cannot anticipate at this time how many acres of habitat would be treated using the other exceptions to VEG S5 (detailed above, not including whitebark pine and aspen), the Forest will not exceed 4,800 acres treatment of habitat occupied by lynx using VEG S5 for any purpose throughout the life of the plan (Table 80).

Similarly, the total use of the exceptions to VEG S5 are not anticipated to exceed 3,200 acres in areas unoccupied by lynx. We estimate that within areas unoccupied by lynx 1,800 acres of lynx habitat may be treated for the purposes of restoring whitebark pine, and 1,400 acres for restoring aspen. Since the forest cannot anticipate at this time how many acres of habitat would be treated using the other exceptions to VEG S5 (detailed above, not including whitebark pine and aspen), the Forest will not exceed 3,200 acres treatment of habitat unoccupied by lynx using VEG S5 for any purpose throughout the life of the plan.

Table 83 shows the maximum acres and percent of occupied potential lynx habitat anticipated for treatment, based on objectives in and analysis for the 2020 Forest Plan, in which exceptions for pre-commercial thinning and exemptions for fuels treatment projects in the WUI could be used.

Table 83. Acres of occupied potential lynx habitat anticipated for treatment using exceptions to and exemptions from the NRLMD.

Total acres potential lynx habitat	Acres occupied potential lynx habitat	Total acres potential lynx habitat in WUI	Acres occupied potential lynx habitat in WUI	Current balance acres from 2017 ITS	Acres anticipated treatment for all alternatives	
					WUI exemption	Resource benefit exception
1,479,727	830,376	570,694	200,969	46,428	45,023	4,800

The acres of anticipated treatments shown in Table 83 are a maximum that could be treated over the anticipated life of the plan (15 years) in habitat currently identified as occupied. Although the 2020 Forest Plan includes numeric objectives for fuels and other vegetation treatments, it does not plan nor authorize those treatments. Specific projects to achieve numeric objectives, as well as desired conditions would be planned and analyzed and would undergo appropriate section 7 consultation. The objectives in the proposed action, and the estimates in Table 83, provide a means to estimate the amount of lynx habitat on which such projects could potentially be planned over the life of the plan.

Fuels treatments and other actions described above would occur on less than 1% of potential lynx habitat across the entire action area, distributed in small acreages over a large area, and would occur incrementally over the life of the plan. The acres anticipated for treatment in Table 83 are greater than the minimum objective identified in the proposed action, which is a forestwide objective that includes both occupied and unoccupied lynx habitat. The Service noted that the Forest Service had not come close to treating the entire number of acres allowed in the previous incidental take statement (ITS). Similarly, it is reasonably likely that the HLC NF would not treat the entire acreage shown in Table 83 during the anticipated life of the plan.

Approximately 200,969 acres (24% of the Forest's total) of occupied and 371,393 acres (55% of the Forest's total) of unoccupied potential lynx habitat on the HLC NF is within the WUI. Fuels treatment would occur in unoccupied lynx habitat; the Forest estimates that up to roughly 40,727 acres of unoccupied potential lynx habitat could be treated in the WUI over the life of the plan. Because the NRLMD is to be considered in unoccupied habitat but its application is not required there, potentially negative impacts to lynx habitat may not be limited to those resulting from use of exemptions and exceptions to the NRLMD standards and guidelines. The FWS stated in its 2017 amended ITS (U.S. Department of the Interior, Fish and Wildlife Service, 2017c), however, that "lynx habitat in unoccupied secondary areas is often of inherently lower quality" and those areas are "relatively isolated from other blocks of lynx habitat". They concluded that "The incidental take of lynx… in currently unoccupied secondary habitat would be low to none." (ibid), indicating that the amount and type of vegetation management occurring to date in those areas was insignificant and/or discountable to lynx. When planning projects in unoccupied lynx habitat, however, the standards and guidelines in the NRLMD would be considered; to date the HLC NF has applied those components to all vegetation management projects in unoccupied habitat. Additionally, all other forestwide plan components described above would be applied during the planning and implementation of any vegetation management projects in lynx habitat regardless of whether it is considered occupied or unoccupied. Thus, the 2020 Forest Plan, through its emphasis on desired conditions to achieve NRV, and forestwide plan components regarding at-risk species (e.g., FW-VEGT-DC 03) and specifically Canada lynx (FW-WL-DC-09), provides more direction for managers to conserve lynx habitat in unoccupied as well as occupied areas than is present in the 1986 Forest Plans.

The BO and amended incidental take statement issued to Region 1 USFS by the Service in March 2017 shows a combined amount of treatment that could be carried out under the NRLMD at the project level by both the former Helena and former Lewis and Clark NFs, totaling 47,625 acres (U.S. Department of the Interior, Fish and Wildlife Service, 2017c). The Forest (now combined) anticipates these treatments as allowed under the exemptions and exceptions to vegetation standards in the NRLMD to total 49,823 acres of occupied lynx habitat. This represents an increase in the amount of treatment by 2,198 acres, or an increase of approximately 0.05 % from the combined forest's acres in the March 2017 amended incidental take statement. Considering the amount of occupied lynx habitat that would not be available for treatment using these exemptions and exceptions (approximately 780,553 acres), and the very minor amount of occupied habitat that has been treated by the Forest since the first issuance of an ITS for use of the NRLMD (3,853 acres), this increase represents only a very small portion of occupied potential lynx habitat available for treatment. While this increased treatment in occupied habitat could be adverse to individual lynx through the removal of snowshoe hare habitat, the overall effect of this increase in anticipated treatment across the action area would be insignificant because of the small proportion of habitat available for treatment, not all of which would be treated at any one time or place. Nonetheless, the updated figure means that there would be slightly more lynx habitat anticipated for treatment throughout the life (estimated 15 years) of the 2020 Forest Plan.

Effects to designated critical habitat are similar to those described for lynx. Primary Constituent Element 1a (snowshoe hare habitat) would be adversely affected as a result of implementing WUI exemptions and limited exceptions from vegetation management standards VEG S5 and VEG S6 (Table 84). Effects to Primary Constituent Element 1b (deep, fluffy snow), 1c (denning habitat) and 1d (matrix habitat) would be insignificant because expansion of areas of snow compaction are limited, and activities that increase snow compaction are discouraged; denning sites have been located in a wide variety of habitat conditions and does not appear to be limited on the landscape; and matrix is not thought to be limiting to lynx (U.S. Department of the Interior, Fish and Wildlife Service, & U.S. Department of Commerce, 2014). Habitat connectivity within and between patches of lynx habitat are controlled by Standard ALL S1 and Standard LINK S1. There are also a number of guidelines that provide for alternate prey species and denning habitat, managing grazing to be compatible with maintaining lynx habitat, and managing human use projects to maintain lynx and snowshoe hare habitat, habitat connectivity, and limit snow compaction. In its BO regarding critical habitat and the NRLMD (U.S. Department of the Interior, Fish and Wildlife Service 2017) (Table 7, adapted), the Fish and Wildlife Service identified a combined acreage of treatments that may occur in critical habitat between the Helena and Lewis and Clark NFs. This combined acreage amounted to 41,756 acres of treatment, having been adjusted for critical habitat, using the WUI exemptions and other resource benefit exceptions to the NRLMD vegetation standards. The Forest now anticipates treatments using the WUI exemptions and other resource benefit exceptions to the NRLMD vegetation standards to occur on 42,499 acres of critical habitat PCE 1a. This represents an increase of 743 acres (<0.02%) in the anticipated amount of treatment that may occur over the life of the Plan (15 years).

Table 84. Acres of Canada lynx designated critical habitat PCE 1a anticipated for treatment using exceptions to and exemptions from the NRLMD.

Critical habitat			Acres anticipated for treatment critical habitat	
Acres potential lynx habitat	Acres WUI	Acres potential lynx habitat in WUI	WUI exemption	Other resource benefit exception
715,695	259,107	148,675	38,142	4,357

The NRLMD results in beneficial effects for lynx by providing for and conserving lynx and snowshoe hare habitat in occupied areas (U.S. Department of Agriculture, Forest Service & U.S. Department of the Interior, 2006). The direction is also considered in currently unoccupied areas, thereby conserving habitat across the planning area. However, the exceptions and WUI exemptions described previously would result in reductions in snowshoe hare habitat and temporary adverse effects on up to 6 percent of lynx habitat acres in the planning area and within designated critical habitat.

Effects common to all action alternatives

There are several components in the 2020 Forest Plan that would affect lynx habitat. These plan components are consistent through all the action alternatives. Most of the plan components complement the standards and guidelines of the NRLMD to protect and provide for lynx and snowshoe hare habitat.

Effects of plan components associated with:

Aquatic ecosystems

The desired conditions for RMZs (FW-RMZ-DC-01, 02) provides benefits to lynx and lynx critical habitat by providing for habitat needs for lynx, which would include providing snowshoe hare habitat where the potential exists and providing movement corridors both within and between potential habitat (Primary Constituent Element 1d, matrix habitat).

Fire and fuels

Plan components include a desired condition for surface fuel loadings in the WUI, with an objective to treat a minimum of 15,000 acres of hazardous fules in the WUI per decade. This objective would be met, in part, by using the WUI exemptions to the NRLMD on up to six percent of occupied lynx habitat. Because we consider the NRLMD in unoccupied lynx habitat, up to six percent of the unoccupied habitat could also be treated. These exceptions allow for temporary reductions of snowshoe hare habitat following treatments in the WUI, which can result in reduced prey availability in the area, affecting both lynx and Primary Constituent Element 1a of designated critical habitat. The reduction in available habitat would be temporary, with summer hare habitat re-establishing within 5-10 years, and winter hare habitat re-establishing within 15 to 40 years, depending on tree species and site condition. The acres of prescribed burning by decade and alternative are displayed in appendix H.

Terrestrial vegetation

Forestwide vegetation desired conditions and other components in all action alternatives would guide managers to move toward vegetation conditions that are consistent with the estimated NRV. These include components regarding the amount and distribution of cover types (FW-VEGT-DC-01), tree species presence (FW-VEGF-DC-01) , size class (FW-VEGF-DC-02, FW-VEGF-DC-04, FW-VEGT-GDL-01), density (FW-VEGF-DC-03), and structure (FW-VEGF-DC-08, FW-VEGF-DC-09, FW-VEGF-GDL-05). Plan components for individual GAs would guide managers to move toward vegetation composition and structure that is consistent with the estimated NRV for those GAs (refer to the 2020 Forest Plan), which differ in some respects from forestwide conditions.

Allowbale uses in the 2020 Forest Plan implemented to allow progress toward achievement of desired conditions for vegetation could result in adverse impacts to lynx habitat and designated critical habitat, depending on site-specific resource conditions where those activities occur. Although, they may be offset by requirements of the NRLMD that would limit the scope and scale of potential impacts of forest management, particularly vegetation management actions. The forestwide desired conditions include maintaining or increasing the spruce/fir cover type (FW-VEGT-DC-02) and maintaining the Engelmann spruce and subalpine fir tree species presence (FW-VEGF-DC-01). For most of the GAs, the desired condition is to maintain or increase the abundance of the spruce/fir cover type, maintain or increase the presence of Engelmann spruce, and maintain or decrease subalpine fir species presence. The Elkhorns GA is unique in that it calls for the maintenance or reduction of the spruce/fir cover type (EH-VEGT-DC-01) as well as decreasing the presence of both Engelmann spruce and subalpine fir, relative to the existing condition (EH-VEGF-DC-01). The desired conditions for the Little Belts, Rocky Mountain Range, and Upper Blackfoot also differ from the other GAs, in that they call for an increase in the spruce/fir cover type (LB/RM/UB-VEGT-DC-01) while generally maintaining the extent of Engelmann spruce and subalpine fir (LM/RM-VEGF-DC-01), except in the Upper Blackfoot, which calls for a reduction in the extent of subalpine fir (UB-VEGF-DC-01). Desired conditions for the Divide, Rocky Mountain Range, and Upper Blackfoot GAs, which are the three occupied GAs that are also within designated critical habitat for lynx, also include plan components that specifically call for providing the amount, distribution, and structural conditions of spruce and subalpine fir to ensure that lynx habitat continues to be present (DI/RM/UB-VEGF-DC-04). The progress towards achievement of desired vegetation conditions will account for the requirments of lynx at the project scale when activites are planned and carried out under the 2020 Forest Plan.

The desired conditions described above generally call for the maintenance of the spruce fir cover type, maintaining the presence of Engelmann spruce, and often decreasing the extent of subalpine fir presence. However, theresults of modelling (appendix H) indicate that these conditions may not be met in all GAs in the five decades modelled; see also Table 53 in the terrestrial vegetation section. Specifically, the spruce/fir cover type abundance decreases away from desired range forestwide in the cold PVT and Upper Blackfoot GA; and stays static below the desired range in the Little Belts and Rocky Mountain Range GAs. The presence of subalpine fir increases above the desired range Forestwide, in the cool moist PVT, and in the Big Belts and Little Belts GAs; and declines below the desired range in the cold PVT. The presence of Engelmann spruce increases above desired condition in cool moist PVT; declines below desired range in the Crazies; and remains static above the desired range in the Elkhorns, Little Belts, and Snowies GAs.

As noted in the terrestrial vegetation section, the projected trends that vary from desired conditions are not a result of FS management; rather, they are caused by natural disturbances and processes. Model predictions are based on potential future fire scenarios; the actual size, timing, and location of disturbance events is uncertain, and therefore results should not be considered to be precise prediction of the future. Rather, the predicted trends represent a risk which is mitigated by multiple factors, including: 1) all management actions within FS control would be designed to move towards desired conditions, which are generally beneficial for lynx habitat; 2) all management actions would be consistent with all other plan components, including those specifically designed to provide lynx habitat; 3) implementation of the plan would be based on monitoring of actual conditions as compared to the desired condition; and 4) management practices could be adjusted if needed based on that information.

Terrestrial wildlife

The wildlife desired condition plan components are beneficial to lynx and lynx critical habitat. The desired conditions are for lynx habitat to be available throughout the species potential natural range so that life history requirements are met and movement within and between NFS parcels is allowed. The forestwide goal that interagency identified linkage areas facilitate wildlife movement compliments the NRLMD Standard ALL S1, Objective LINK 01, Standard LINK S1, Guideline LINK G1 and Guideline LINK G2.

Recreation and recreation special use permits

Plan components for the management of recreation are intended to support recreation settings and opportunities across the planning area. Recreation setttings and opportunities most likely to affect lynx include the following: motorized and nonmotorized recreation activities, permitted ski areas, permitted recreation special uses, dispersed and developed campgrounds and sites, and designated recreation areas. The Lynx Conservation Assessment and Strategy (Interagency Lynx Biology Team, 2013) states that the primary impacts to lynx and lynx habitat from recreation are from 1) habitat alternation to maintain health and human safety of recreation sites and areas, which may reduce or degrade lynx and snowshoe hare habitat; 2) displacement of lynx due to summer and winter motorized activity, human presence, and access; and 3) the potential for incidental trapping of lynx resulting from access to preferred habitats via allowable motorized use or development. Effects to lynx associated with recreation settings and opportunities are not anticipated to be adverse. Where vegetation management associated with "recreation sites and special use permit improvements, including infrastructure within permitted ski area boundaries" (NRLMD) occurs, adverse effects may occur to lynx.

Designated areas

Designated areas with plan components that affect lynx and designated critical lynx habitat include IRAs, designated wilderness, RWAs, and WSAs.

Desired conditions for IRAs include providing large, undisturbed, and unfragmented areas of land...where natural ecological processes and disturbances are the primary focus affecting vegetation (FW-IRA-DC-01, 02). Within IRAs no permanent roads or trails would be allowed to be constructed. However, temporary roads and maintenance and reconstruction of existing roads and trails may be allowed. Vegetation treatment would be allowed in limited circumstances, and prescribed fire is allowed (FW-IRA-SUIT-01, 03). There would be no changes in IRA boundaries from the existing condition, and effects to lynx and designated critical habitat would be as described for the NRLMD (U.S. Department of Agriculture, Forest Service, 2007d); (U.S. Department of the Interior, Fish and Wildlife Service, & Office, 2007), (U.S. Department of Agriculture, Forest Service, 2017a; U.S. Department of the Interior, Fish and Wildlife Service 2017).

The desired condition for WSAs (FW-WSA-DC-01) benefit lynx and lynx habitat because natural processes are the primary forces; vegetation management is generally not conducted in the WSA. Plan components for the WSA would not affect designated critical habitat as the WSA does not occur in critical habitat.

Both the desired condition (FW-WILD-DC-02) and the legal requirements for managing designated wilderness would benefit lynx, lynx habitat, and designated critical habitat because they require that natural forces are the primary factors affecting vegetation. Vegetation management activities would not be allowed, except that prescribed fire may be used as a tool in limited circumstances. Prescribed fire could affect snowshoe hare habitat by reducing horizontal cover.

The acres of RWA vary by alternative, as described below. The desired conditions are constant in all alternatives, and like wilderness and WSA, natural processes are the primary forces at work (FW-RECWILD-DC-02). Effects to lynx and habitat would be the same as in wilderness.

Land status and ownership; land uses; infrastructure – roads and trails, bridges and facilities

The plan component goal to cooperate with highway managers and other landowners to implement wildlife crossings where needed (FW-RT-GO-03) benefits lynx and PCE 1d by maintaining habitat connectivity and linkage. There are approximately 2,600 miles of existing motorized and nonmotorized roads and trails in the action area that are used for a variety of purposes; one of their primary roles is to provide recreation access on NFS lands. Plan components (FW-RT-DC-01; DC-04; GDL-12) provide for maintaining habitat and limiting transportation system impacts to threatened and endangered species. The 2020 Forest Plan establishes a goal (FW-RT-GO-03) to facilitate cooperation between the Forest and highway and landowners to implement wildlife crossings that contribute to wildlife and public safety where needed. The presence of a motorized transportation system may impact lynx and lynx habitat by 1) direct habitat loss from the road prism; 2) potential for collisions between vehicles and lynx; 3) reductions in potential available denning habitat if accessible roads, denning habitat, and breeding lynx occur in close spatial proximity; 4) providing human access to preferred lynx habitat where incidental non-target trapping may occur during legal trapping activities; and 5) snow compaction from winter motorized recreation.

The effects to lynx from a transportation system, for recreational or other purposes, as allowable in the revised plan, will be insignificant and discountable to lynx because 1) direct habitat loss would be averted in occupied lynx habitat due to the presence of plan components and provisions in the NRLMD; 2) the potential for collisions between vehicles and lynx is extremely low (Interagency Lynx Biology Team, 2013), therefore, it is discountable; 3) losses to denning habitat that could occur ancillary to the transportation system (such as access to harvestable timber ground where timber management activities degrade or remove denning habitat) will not reduce the overall availability of denning habitat across the action area for use by breeding lynx due to the preponderance of occupied lynx habitat occurring in areas with designations that preclude vegetation management; 4) the likelihood forest access roads would result in nontarget incidental lynx trapping is extremely unlikely, therefore, it is discountable; and 5) any potential effects to lynx from winter motorized recreation that compacts snow are anticipated to be insignificant and discountable, based upon findings by Squires and others (John R. Squires et al., 2010; John R. Squires et al., 2013) and Kolbe and others (2007). Recent work from Squires and others (2019) further describes winter recreation's potentially limited degree of effect on lynx, depending on the spatial juxtaposition of occupied lynx habitat and winter recreation in that habitat.

The impacts of maintaining or building specific motorized routes will be analyzed during planning for those projects. Management of the motorized transportation system is guided by travel management plans, which are analyzed and undergo appropriate consultation when they are updated or revised.

Livestock grazing

Livestock grazing would continue to be available by permit within the action area (FW-GRAZ-DC-01), at the same or similar levels as currently allowed (see Livestock 3.27). The 2020 Forest Plan includes components that would be applied when permits and annual operating plans are developed, and that guide the Forest and permittees to provide for the retention of healthy native plant communities (FW-GRAZ-DC-03) and long-term riparian area vegetation (FW-GRAZ-STD-02) within grazing allotments. The objectives and guidelines in the NRLMD regarding livestock grazing would continue to apply to grazing permits and activities in occupied lynx habitat and be considered in unoccupied habitat, as described in the existing condition section. When applied to permits and operating plans, these plan components would to reduce competition between cattle and snowshoe hare for certain habitat components (i.e., herbaceous forage and woody browse) where such habitat overlaps and would limit some potential negative effects to lynx habitat of grazing. Effects to lynx from livestock grazing are anticipated to be insignificant and discountable due to the plan components that would limit the potential for competitive interaction, in addition to the unlikelihood that any effects would occur from the continuation of livestock grazing.

Timber

Plan components for the management of timber are intended to support the production of timber on lands identified as suitable for that use, as well as to manage timber harvest for other purposes. Standard FW-TIM-STD-04 would limit clearcutting and require interdisciplinary review of site-specific conditions and desired conditions for habitat before clearcutting could be used. Standard FW-TIM-STD-08 would limit the maximum opening size of harvest units, and FW-TIM-GDL-01 would guide harvest activities to "contribute to ecological sustainability and ecosystem health" and to achieve desired vegetation conditions. Timber harvest activities have the potential to reduce Canada lynx habitat and temporarily displace individual lynx, but plan components, including the NRLMD, would minimize impacts. Timber harvest activities would move vegetation conditions toward desired conditions. Some timber harvest could result in decreased snowshoe hare habitat, and therefore reduced foraging opportunities for lynx. Timber harvest may also contribute to habitat fragmentation, although it is anticipated these effects will be localized, not widespread, and would be discouraged. The acres of timber harvest by decade and alternative are displayed in the timber section and appendix H. The amount of lynx habitat that occurs in areas identified as suitable for timber harvest or timber production are displayed in Table 85, Table 86, and Table 87 for demonstrative puposes and not to display the amount of timber actitivty anticipated to occur. Rather, they describe where those uses could occur in relation to lynx habitat.

Effects by alternative

The primary difference between alternatives is the acres of RWAs and the activities that are suitable to occur within the RWAs, and the designation of the South Hills and Grandview Recreation Areas (Table 85, Table 86, and Table 87). The vast majority of lands selected for RWAs are in IRAs. Therefore, regardless of alternative, natural disturbances are the primary drivers of vegetation change on these lands. Prescribed fire may occur in RWAs but may be constrained by access as well as limitations on preburn fuel preparation techniques and is therefore somewhat less likely to occur in these areas than if they are not in RWAs. Some harvest of small trees is permissible in IRAs but would not be suitable in RWAs. Alternative D contains the most RWAs, followed by alternatives B/C and A. Alternative E contains no RWAs. Prescribed burning and harvest activities would therefore be most likely to occur in these areas under alternative E. However, they would be constrained by IRA regulations. Because of this, in the case of timber harvest especially, the difference in potential effects across alternatives in these areas is small.

Table 85. Designated areas and acres of occupied potential lynx habitat by alternative.

	Acres occupied potential lynx habitat					
Designated area	**Alt A**	**Alt B**	**Alt C**	**Alt D**	**Alt E**	**Alt F**
Congressionally Designated						
Wilderness areas	361,680	361,680	361,680	361,680	361,680	361,680
Wilderness study areas	0	0	0	0	0	0
Inventoried roadless areas	322,164	322,164	322,164	322,164	322,164	322,164
Conservation management area	68,442	68,442	68,442	68,442	68,442	68,442
Administratively designated in preferred alternative						
Recommended wilderness areas	13,553	64,825	64,825	80,532	0	51,441
Research natural areas	2,246	2,246	2,246	2,246	2,246	2,246
South hills recreation area	0	17,880	17,880	17,880	17,880	17,880
Grandview recreation area	0	0	0	0	0	0
Green timber botanical area	0	0	0	0	0	214

Table 86. Designated areas and acres of unoccupied potential lynx habitat by alternative.

	Acres unoccupied potential lynx habitat					
Designated area	**Alt A**	**Alt B**	**Alt C**	**Alt D**	**Alt E**	**Alt F**
Congressionally Designated						
Wilderness areas	10,032	10,032	10,032	10,032	10,032	10,032
Wilderness study areas	77,973	77,973	77,973	77,973	77,973	77,973
Inventoried roadless areas	410,242	410,242	410,242	410,242	410,242	410,242
Conservation management area	0	0	0	0	0	0
Administratively designated in preferred alternative						
Recommended wilderness areas	8,036	36,395	36,395	186,914	0	27,713
Research natural areas	3,232	3,232	3,232	3,232	3,232	4,536
South hills recreation area	0	0	0	0	0	0
Grandview recreation area	0	0	0	0	0	8,932
Green timber botanical area	0	0	0	0	0	0

Table 87. Designated areas and acres of lynx designated critical habitat by alternative.

	Acres lynx designated critical habitat					
Designated area	**Alt A**	**Alt B**	**Alt C**	**Alt D**	**Alt E**	**Alt F**
Congressionally Designated						
Wilderness areas	520,911	520,911	520,911	520,911	520,911	520,911
Wilderness study areas	0	0	0	0	0	0
Inventoried roadless areas	463,101	463,101	463,101	463,101	463,101	463,101
Conservation management area	129,598	129,598	129,598	129,598	129,598	129,598
Administratively designated in preferred alternative						
Recommended wilderness areas	0	69,677	69,677	75,005	0	53,011
Research natural areas	3,283	3,283	3,283	3,283	3,283	3,283
South hills recreation area	0	13,726	13,726	13,726	13,726	13,726

Timber harvest is generally most likely to occur on lands suitable for timber production but may also occur on other lands. The acres suitable for timber production vary slightly by alternative (Table 88, Table 89, and Table 90). Modeling to show differences in timber outputs by alternative were influenced by the acres of land suitable for timber production as well as other land allocations and the theme of the alternative. The timber and other forest products section displays the acres of lands suitable for timber production within potential lynx habitat by alternative. Alternative A contains the most acres of land suitable for timber production that overlaps with potential lynx habitat, followed by alternative E, F, B/C, and D. The overall difference across alternatives is relatively small; regardless of alternative, at least half of the land suitable for timber production lies in potential lynx habitat. The timber and other forest products section describes how lynx management would influence the types and amounts of harvest that may occur in those areas.

Table 88. Allowable uses and acres of occupied potential lynx habitat by alternative.

	Acres occupied potential lynx habitat					
Allowable uses	**Alt A**	**Alt B**	**Alt C**	**Alt D**	**Alt E**	**Alt F**
Timber harvest	338,604	306,242	306,242	291,971	364,626	318,107
Timber production	70,653	61,095	61,095	59,618	65,490	62,480
Livestock grazing	178,134	178,134	178,134	178,134	178,134	178,134
Wheeled motorized	130,464	124,318	124,318	120,940	131,562	133,419
Over-the-snow motor vehicle	203,590	192,410	192,409	185,035	203,535	193,951

Table 89. Allowable uses and acres of unoccupied potential lynx habitat by alternative.

	Acres unoccupied potential lynx habitat					
Allowable uses	**Alt A**	**Alt B**	**Alt C**	**Alt D**	**Alt E**	**Alt F**
Timber harvest	422,213	439,113	439,113	331,694	449,095	448,488
Timber production	156,619	124,265	124,265	120,192	124,971	126,953
Livestock grazing	356,816	356,816	356,816	356,816	356,816	356,816
Wheeled motorized	348,549	340,403	340,403	310,155	341,962	347,360
Over-the-snow motor vehicle	329,375	317,535	308,972	278,453	322,207	316,692

Table 90. Allowable uses and acres of lynx designated critical habitat by alternative.

	Acres lynx designated critical habitat					
Allowable uses	**Alt A**	**Alt B**	**Alt C**	**Alt D**	**Alt E**	**Alt F**
Timber harvest	481,464	448,411	448,411	445,181	509,056	463,051
Timber production	74,086	59,052	59,052	56,952	65,226	61,024
Livestock grazing	270,305	270,305	270,305	270,305	270,305	270,305
Wheeled motorized	153,801	144,208	144,208	141,698	155,108	155,354
Over-the-snow motor vehicle	235,739	218,614	218,613	214,352	234,709	220,960

Modeling was done to project future vegetation conditions. The modeling showed very little variance in future vegetation conditions across alternatives because the primary driver of change is natural disturbances. Figure 18, Figure 19, and Figure 20 display the projected proportion of lynx habitat structural stage forestwide, as an average of all alternatives across five decades in the future, based on this modeling. Figures in appendix H display this data by GA, and display the habitat categories over time by alternative, compared to the NRV. As noted in the terrestrial vegetation section, alternative “F-UN” represents the preferred alternative F run with a timber harvest schedule that is unconstrained by a reasonably foreseeable budget.

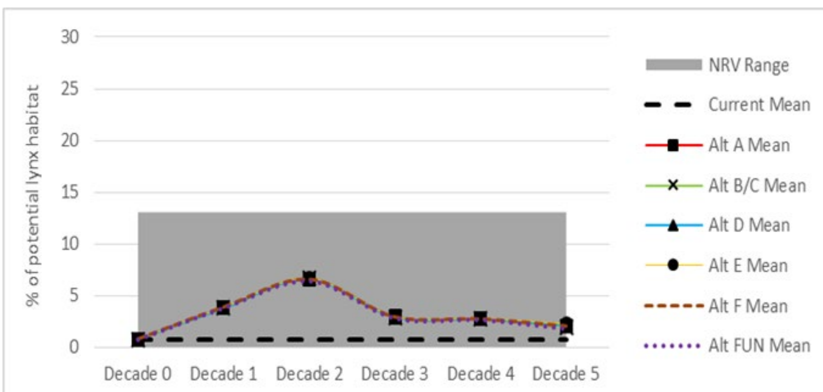


Figure 18. Forestwide proportion of stand initiation habitat within potential lynx habitat, by alternative and decade, compared to the NRV condition

Stand initiation habitat is currently at the low end of the NRV and is predicted to fluctuate through time while remaining within this natural range. The creation of this habitat is limited by expected warm/dry climate conditions because the model tends to establish reforestastion following disturbances at lower densities given warm/dry climate parameters.

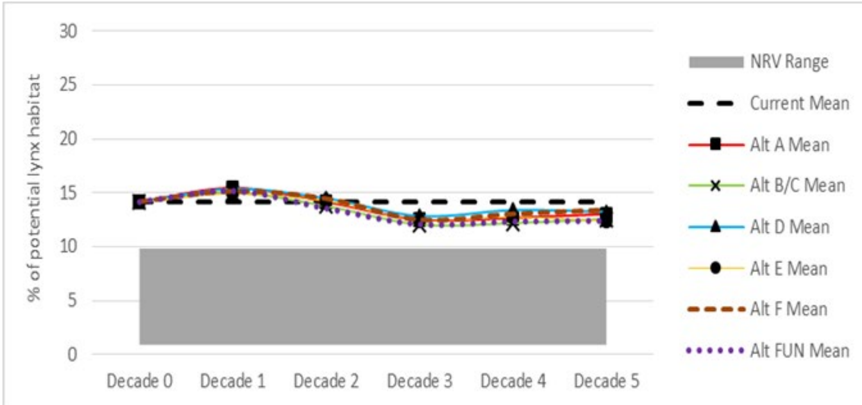


Figure 19. Forestwide proportion of early stand initiation habitat within potential lynx habitat, by alternative and decade, compared to the NRV condition

Early stand initiation habitat is expected to remain above the NRV and similar to the existing condition throughout the projection, due to expected large disturbances (primarily wildfire). This habitat condition is favored by warm/dry climate conditions, in which regenerating forests are expected to establish with densities that are more open than required by stand initiation habitat criteria.

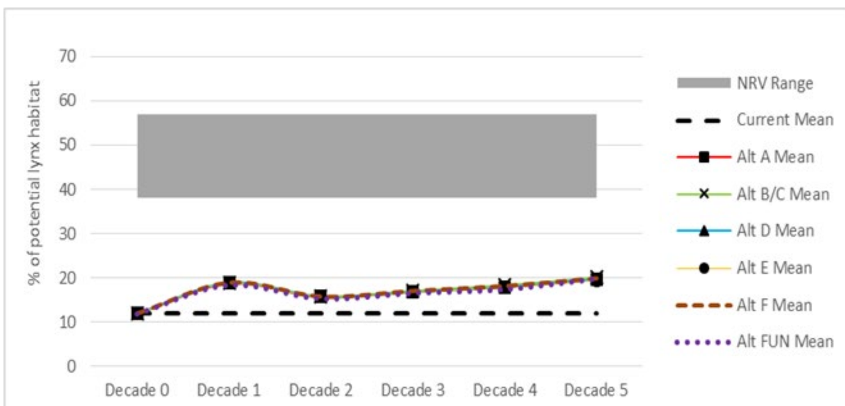


Figure 20. Forestwide proportion of mature multistory habitat within potential lynx habitat, by alternative and decade, compared to the NRV condition

Mature multistory habitat is projected to increase slightly over the next 5 decades, as existing forests age and develop canopy layers in the absence of disturbance; however, projected levels remain well below the NRV range at the Forestwide scale and in GAs occupied by lynx.

Within the occupied GAs (the Rocky Mountain Range, Divide, and Upper Blackfoot), the model predicts similar trends for stand initiation habitat as the forestwide trends shown above. However, the trend for early stand initiation habitat is unique in the Rocky Mountain Range GA; it declines substantially to achieve the upper end of the NRV range. This trend is likely due to the projected establishment of reforestation in recently burned areas. The mature multistory habitat condition also increases more substantially in this GA than the forestwide trend, although the NRV range is still not achieved by the end of the projection. The Upper Blackfoot also shows a declining trend for early stand initiation habitat, to a lesser degree, and displays some differentiation across alternatives during decades 3 and 4, although the alternatives become similar by the end of the projection. Mature multistory habitat is predicted to remain similar to the existing condition, below the NRV range, in this GA similar to the forestwide trend. See appendix H for all of the GA-specific charts for lynx habitat trends. In the Divide GA, early stand initiaon habitat is modelled to increase across all alternatives through the decades, projected to exceed the upper range of the NRV. There is little modelled change in mature multi-story habitat in the Divide GA between alternatives and across the 5 decades, remaining below the NRV.

Model results are used to indicate how vegetation may change over time. Models are one tool to help inform the analysis and are useful for understanding relative differences between alternatives. These models are for comparative value and are not predictive. For this analysis, SIMPPLLE modeling shows that the differences between alternatives are very small and are within the model output variability. The modelling also shows that in all alternatives the amount of early stand initiation habitat decreases over time, while the amount of snowshoe hare habitat in the form of stand initiation structural stage and mature, multistory structural stage increases over time. Differences by alternative are described below.

Alternative A, no action

Alternative A includes few RWAs (three areas totaling just over 34,000 acres). Table 91 shows the proportion of each structural stage by decade from SIMPPLLE habitat modeling. Figures in appendix H display this information by GA.

Table 91. Alternative A proportion of potential lynx habitat by structural stage by decade (%)

	Decade 0	Decade 1	Decade 2	Decade 3	Decade 4	Decade 5
Stand Initiation	1	4	7	3	3	2
Early Stand Initiation	14	16	14	13	13	13
Multistory	12	19	16	17	18	20
Other	73	61	63	67	66	65

Alternatives B and C

In alterantives B, C, D, and F, the South Hills Recreation Area in the Divide GA is proposed (see Alt F for discussion). Alternatives B and C include 9 RWAs totaling just over 213,000 acres. Table 92 shows the proportion of each structural stage by decade from SIMPPLLE habitat modeling. Figures in appendix H display this information by GA.

Table 92. Alternatives B and C proportion of potential lynx habitat by structural stage by decade (%)

	Decade 0	Decade 1	Decade 2	Decade 3	Decade 4	Decade 5
Stand Initiation	1	4	7	3	3	2
Early Stand Initiation	14	15	14	12	12	13
Multistory	12	19	16	17	18	20
Other	73	62	63	68	67	65

For effects regarding the South Hills Recreation Area in the Divide GA, see Alternative F.

Alternative D

In alterantives B, C, D, and F, the South Hills Recreation Area in the Divide GA is proposed (see Alt F for discussion). Alternative D has the most RWA, with almost 474,000 acres in 16 areas. These areas were chosen considering large scale connectivity and could facilitate movement of lynx across the landscape. Table 93 shows the proportion of each structural stage by decade from SIMPPLLE habitat modeling. Figures in appendix H display this information by GA.

For effects regarding the South Hills Recreation Area in the Divide GA, see Alternative F.

Table 93. Alternative D proportion of potential lynx habitat by structural stage by decade (%)

	Decade 0	Decade 1	Decade 2	Decade 3	Decade 4	Decade 5
Stand Initiation	1	4	7	3	3	2
Early Stand Initiation	14	15	15	13	13	13
Multistory	12	19	16	17	18	20
Other	73	62	62	67	66	65

Alternative E

Alternative E does not include any RWAs. Table 94 shows the proportion of each structural stage by decade from SIMPPLLE habitat modeling. Figures in appendix H display this information by GA.

Table 94. Alternative E proportion of potential lynx habitat by structural stage by decade (%)

	Decade 0	Decade 1	Decade 2	Decade 3	Decade 4	Decade 5
Stand Initiation	1	4	7	3	3	2
Early Stand Initiation	14	15	14	12	13	12
Multistory	12	19	16	17	18	19
Other	73	62	63	68	66	67

Alternative F

Table 95 shows the proportion of each structural stage by decade from SIMPPLLE habitat modeling. Figures in appendix H display this information by GA.

Table 95. Alternative F proportion of potential lynx habitat by structural stage by decade (%)

	Decade 0	Decade 1	Decade 2	Decade 3	Decade 4	Decade 5
Stand Initiation	1	4	7	3	3	2
Early Stand Initiation	14	15	14	13	13	13
Multistory	12	19	16	17	18	20
Other	74	62	63	67	66	65

In alterantives B, C, D, and F, the South Hills Recreation Area in the Divide GA is proposed. The Grandview Recreation Area in the Snowies GA is proposed only for alternative F. The Grandview Recreation Area (32,296 acres) would be in secondary unoccupied habitat where lynx may be present. The South Hills Recreation Area (50,181 acres total area) would include 17,880 acres of potential lynx habitat, some of which is core and designated critical habitat and some of which is secondary unoccupied. Plan components for management of each area would limit some uses that could negatively impact lynx. Both areas would emphasize non-motorized recreation (DI-SHRA-DC-01 and SN-GVRA-DC-03); mechanized means of transportation (i.e. mountain bikes) would be limited to established roads and trails (DI-SHRA-SUIT-02 and SN-GVRA-SUIT-02), thereby potentially limiting displacement to lynx resulting from motorized travel.

Timber production would not be suitable in either area, although timber harvest could be used for resource management purposes (DI-SHRA-SUIT-01 and SN-GVRA-SUIT-01). When vegetation management is planned in the South Hills Recreation Area, plan components would guide the Forest to meet vegetation desired conditions, emphasize safety and recreation experiences, and reduce the risk of high-severity wildfire (DI-SHRA-GDL-01). The standards and guidelines in the NRLMD would apply to any vegetation management planning in the South Hills Recreation Area. The area includes approximately 17,240 acres of potential lynx habitat that is also in the WUI, where exemptions to the NRLMD vegetation standards could be applied when planning and implementing fuels treatment projects. The combination of WUI and emphasis on safety and on reduction of wildfire risk could result in some negative impacts to lynx habitat in the South Hills Recreation Area that may result from vegetation management (see vegetation management above for discussion of such effects). These impacts would be analyzed and consulted on when specific vegetation management projects are planned and would only occur upon implementation of those projects. The NRLMD standards and guidelines would be considered when planning management actions in the Grandview Recreation Area.

Cumulative effects

Table 96 summarizes the cumulative effects to Canada lynx from other resource management plans.

Table 96. Summary of cumulative effects to Canada lynx from other resource management plans

Resource plan	Description and Summary of effects
Adjacent National Forest Plans	The forest plans for NFS lands adjacent to the HLC NF include the Custer-Gallatin, Lolo, Flathead, and Beaverhead-Deerlodge NFs. All plans were amended to include the NRLMD in 2007. Management of Canada lynx and lynx Designated Critical Habitat is consistent across all NFs. The cumulative effect would be that the management of lynx and lynx critical habitat would be the same, and effects would be similar. This includes specific adjacent landscapes that cross Forest boundaries, such as the Upper Blackfoot, Divide, Elkhorns, Crazies, and the Rocky Mountain Range.
MTDNRC Forested State Trust Lands Habitat Conservation Plan (HCP) 2010.	The HCP applies to state trust lands in areas occupied by Canada lynx (the Upper Blackfoot GA) and includes a Lynx Conservation Strategy (MTDNRC and U.S. Fish and Wildlife Service 2010b, pp. 2-45–2-61) consisting of a suite of lynx habitat commitments that apply to all lands in the HCP project area supporting lynx habitat and additional commitments that apply to Lynx Management Areas. This strategy minimizes impacts of forest management activities on lynx. The goal of the lynx conservation strategy is to support federal lynx conservation efforts by managing for habitat elements important for lynx and their prey that contribute to the landscape scale occurrence of lynx, particularly in key locations for resident populations. This plan provides protection to important components of lynx habitat and cumulative benefits lynx and lynx habitat. These lands are not included in designated critical habitat.
Montana's State Wildlife Action Plan 2015	The SWAP identifies community types, Focal Areas, and species in Montana with significant issues that warrant conservation attention. The plan is not meant to be an MFWP plan, but a plan to guide conservation throughout Montana. The SWAP does not identify lynx as a species of greatest conservation need. However, *Conifer-dominated Forest and Woodland (xeric-mesic)* is identified as a Terrestrial Community Type of Greatest Conservation Need within the Ecoregion that includes the Forest. This plan describes a variety of vegetation conditions related to habitat for specific wildlife species. This plan would likely result in the preservation of these habitats on state lands, specifically wildlife management areas. This plan would interact with the Montana Statewide Forest Resource Strategy. The vegetation conditions described would be complementary to the conditions being managed for with the HLC NF 2020 Forest Plan.
BLM Resource Management Plans (RMP)	BLM lands near the HLC NF are managed by the Butte, Missoula, and Lewistown field offices. The Butte and Lewistown plans were recently revised (2009 and 2019 respectively) while the existing plans for the Missoula area is under revision. These plans contain components related to lynx, primarily following guidance found in the Canada Lynx Conservation Assessment and Strategy (Interagency Lynx Biology Team, 2013), and would therefore likely be complementary to the plan components for the HLC NF.

Resource plan	Description and Summary of effects
National Park Service - Glacier National Park General Management Plan 1999	The general management plan for Glacier National Park calls for preserving natural vegetation, landscapes, and disturbance processes. Broadly, the lynx habitat and critical habitat characteristics in this area are therefore likely similar to the wilderness areas in the adjacent Rocky Mountain Range GA and would likely complement these conditions.
Montana Army National Guard – Integrated Natural Resources Management Plan for the Limestone Hills Training Area 2014	This plan is relevant to an area adjacent to NFS lands in the Elkhorns GA. The Limestone Hills area is primarily nonforested, and therefore does not contain much if any lynx habitat.
Montana State Parks and Recreation Strategic Plan 2015-2020	These plans guide the management of state parks, some of which lie nearby or adjacent to NFS lands. Due to their location and elevation, lynx habitat does not occur as a component of these parks and would not contribute to the desired conditions as described for the HLC NF.
County wildfire protection plans	Some county wildfire protection plans map and/or define the WUI. The HLC NF notes that these areas may be a focus for hazardous fuels reduction, and the NRLMD has guidance specific to these areas. Managing for open forests and fire adapted species may be particularly emphasized in these areas. Overall, the effect of the county plans would be to influence where treatments occur to contribute to desired vegetation conditions.
City of Helena Montana Parks, Recreation and Open Space Plan (2010)	This plan is relevant to an area that lies adjacent to NFS lands in the Divide GA, in proximity to the City of Helena. The plan emphases forest management and wildfire mitigation. Due to the location and elevation, lynx habitat does not occur as a component of this area and would not contribute to the desired conditions as described for the HLC NF.

Vegetation management and wildland fire management actions on other land ownerships (state, private, other federal) in and near the plan area may occur throughout the life of the plan. While the quality of lynx habitat in these areas is not known (Table 97), some portion of these areas may be used by lynx or incorporated into home ranges of individual lynx. Where quality lynx habitat on NFS lands and private lands is contiguous, management of vegetation and of wildland fire on private lands could add to the effects of project-level vegetation management on NFS lands, if management activities occur in close spatial and temporal proximity. Non-federal lands within LAUs totals less than 2% of the overall action area, so the effects to lynx of actions on those lands is likely to be minimal. Nevertheless, vegetation and wildland fire management activities on private lands within the action area have the potential to be cumulatively adverse to individual lynx when added to management activities with similar effects occurring on adjacent NFS lands.

Table 97. Potential lynx habitat across the plan area, non-USFS.

Ownership	Acres	Acres LAU	Acres potential lynx habitat	Percent of total potential lynx habitat
Other Federal	555	40	0	0%
State	13,800	12,248	5,066	<1%
Private	310,727	153,118	57,285	4%
County	53	28	18	<1%
City	734	734	415	<1%
TOTAL	325,314	166,128	62,784	4%

Nature-based recreation (i.e. recreation occurring in or associated with natural settings) has been increasing and is likely to continue to do so (U.S. Department of Agriculture, Forest Service, Northern Region, 2015). There may be needs or desires to increase recreation developments or facilities on NFS lands to accommodate more forest visitors (ibid). Recreation occurring on private or other lands adjacent to NFS lands where lynx habitat occurs may spill over onto NFS lands as the overall number of recreationists increases. Increases in human disturbance occurring within lynx habitat on NFS lands could cause portions of NFS lands with less human disturbance to become more important for lynx.

The state of Montana allows hunting and trapping of a variety of big game and furbearing species in the action area. While it is not legal to hunt or trap Canada lynx, the incidental trapping or harvest of lynx may occur in the process of trapping or harvesting legal target species.

Conclusions

Alternative A, no action

The NRLMD provided management direction that conserves and promotes the recovery of Canada lynx while preserving the multiple use direction in existing forest plans (U.S. Department of Agriculture, Forest Service, 2007d). The direction applies to mapped lynx habitat occupied by Canada lynx, and is to be considered when designing management actions in unoccupied mapped lynx habitat. The NRLMD provided the regulatory mechanism to alleviate the main threat to lynx; “the lack of guidance for conservation of lynx and snowshoe hare habitat in NF Land and Resource Plans and BLM Land Use Plans” (U.S. Department of the Interior, Fish and Wildlife Service, 2000a). The BA completed for the NRLMD concluded that while management direction would provide for lynx conservation, the plans amended by the NRLMD would still be likely to adversely affect lynx because individuals could be adversely affected as a result of the exemptions and exceptions to the vegetation standards for fuel treatment projects and precommercial thinning (U.S. Department of Agriculture, Forest Service, 2007d).

Action alternatives

The action alternatives all include the NRLMD, which would continue to conserve and promote recovery of Canada lynx by reducing or eliminating adverse effects from land management activities on NFS lands. In addition to the NRLMD, plan components included in all action alternatives would:

- contribute to maintaining spruce/fir habitat on the forest;
- provide specific desired conditions and other guidance for management of designated areas such as RWAs, IRAs, and the conservation management area as relatively intact, un-fragmented landscapes where natural processes predominate;
- identify specific areas in the Upper Blackfoot and Divide GAs to manage for potential connectivity across landscapes; and
- increase the amount of available snowshoe hare habitat over time in the GAs.

The sum of that management direction would be to provide additional protections for lynx habitat and promote habitat conditions that provide for snowshoe hare. Alternatives B, C, and D provide more RWAs, which could limit potential treatments in lynx habitat more than in the alternatives A and E.

Based on the anticipated amount of treatment that could occur in occupied lynx habitat and desinated critical habitat over the life of the 2020 Forsest Plan using exemptions to NRLMD vegetation standards VEG S1 and VEG S2, and exceptions to NRLMD vegetation standards VEG S5 and VEG S6, a biological assessment submitted to the US Fish and Wildlife Service determined the 2020 Forest Plan under alternative F *May Affect, and is Likely to Adversly Affect* Canada lynx and Canada lynx designated critical habitat.

3.14.9 Wolverine, affected environment

Status and distribution

In North America, wolverine are distributed mostly in northern Canada and Alaska but extend southward in the mountainous western portion of North America into Montana, Idaho, and the northern portion of Wyoming. The distinct population segment of wolverine in the contiguous United States is currently proposed as threatened under the Endangered Species Act (U.S. Department of the Interior, Fish and Wildlife Service, 2016b). Wolverine have been documented in all GAs of the action area except the Highwoods and Snowies, although the Elkhorns, Crazies and Castles each have only one old (>25 years) record. Not all of the areas with wolverine records are thought to have potential to support reproduction (see Habitat section below).

Population trend

Wolverines were nearly extinct in Montana during the early 1900s, primarily due to intense predator control efforts, but have been increasing in numbers and range since. Wolverines likely exist as a metapopulation, with intermittent exchange of individuals among semi-isolated subpopulations that maintains genetic diversity and possibly demographic function. Because of their food and space requirements, wolverines appear to exist at naturally low densities. Wolverines were recently estimated to be at population capacity within the Northern Continental Divide Ecosystem portion of the northern United States Rocky Mountains (Inman, Brock, et al., 2013)(Robert Michael Inman, 2013). This includes the Bob Marshall Wilderness Area, where most of the HLC NF habitat is (i.e., in the Rocky Mountain Range and Upper Blackfoot GAs).

Food habits and habitat use

Wolverines are food generalists, preying on small animals and birds, scavenging carrion, and consuming fruits, berries, and insects (Banci, 1994; Hornocker & Hash, 1981). Wolverines require a great deal of space, with home ranges in Montana (Glacier National Park) and northern Wyoming (Yellowstone National Park) estimated at 55 to 128 square miles for females, and 193 to 311 square miles for males. Wolverines use a wide variety of habitats, with their primary requirement apparently being areas with enough winter precipitation to reliably maintain deep, persistent snow into late spring, during the denning period (Copeland et al., 2010). Therefore, in Montana, at the southern periphery of their range, wolverines are generally restricted to high elevations where deep snow persists, resulting in the metapopulation structure described above. Wolverines appear to choose areas of high structural diversity for dens, including components such as logs or boulders.

Two separate models were developed to map wolverine habitat in Region One. One is based on “primary” and “maternal” habitats used by adult radio-collared wolverine in the Greater Yellowstone Ecosystem (Inman, Brock, et al., 2013; Inman et al., 2012). The second (persistent snow model) is based on broader research showing that wolverine appear to require snow cover that persists into May for successful reproduction (Copeland et al., 2010).

The first model suggests the HLC NF has about 1 million acres of primary habitat and 358,000 acres of maternal habitat Table 98. Most of this in Wilderness and other congressionally designated areas. For example, 65% of maternal habitat and 41% of primary habitat is within Wilderness Areas. The Rocky Mountain Range GA is of particular importance for both primary and maternal habitats (Table 93). The largest acreage of potential primary wolverine habitat is on the Rocky Mountain Range GA, almost entirely within designated wilderness or conservation management area. Only the Rocky Mountain Range and Upper Blackfoot GAs appear to have snow that reliably (every year for 7 or more years in a row) persists through May. These two GAs are also connected to the Flathead NF and Glacier National Park, both of which also contain wolverine habitat.

The other GAs on the HLC NF do not reliably have persistent snow, suggesting that wolverine may not be consistently present or be reproducing in those areas. The Highwoods, Snowies and Castles GAs may not have enough potential habitat to support even a single wolverine, in addition to being isolated from larger GAs with more habitat. This is corroborated by the lack of records in those areas. Based on habitat models the role of GAs other than the Rocky Mountain Range and Upper Blackfoot in contributing to the larger wolverine population is questionable, other than for use by occasional dispersing individuals.

Key drivers and stressors

Factors not under FS Control

Loss of or reduction in size of areas with persistent spring snow as a result of climate change is likely the most important threat to wolverine populations (U.S. Department of the Interior, Fish and Wildlife Service, 2013c).

Harvest, usually in the form of trapping, can be a key factor affecting wolverine survival (Banci, 1994; Hornocker & Hash, 1981; John R. Squires, Copeland, Ulizio, Schwartz, & Ruggiero, 2007), and consequently could affect population trend. Wolverine trapping in all four wolverine management units in Montana is currently closed (Montana Fish Wildlife and Parks, 2017). Mortality of wolverines caught incidental to trapping for other species may occur.

Factors affected by FS management

Wolverine do not appear to be dependent on specific vegetation or habitat features that may be altered by land management activities and may not be heavily affected by recreation activities (U.S. Department of the Interior, Fish and Wildlife Service, 2013c)). Heinemeyer et al. (2019; 2017), however, found that although wolverine home ranges may include areas with high levels of winter recreation, some wolverines may be displaced from portions of their home range by recreational activities, and that displacement may reduce the total amount of habitat available to them. FS management actions do not threaten wolverines or their primary habitat, and activities on NFS lands do not appear to pose a threat to the long-term persistence of the species (U.S. Department of the Interior, Fish and Wildlife Service, 2013c), although population-level impacts of recreation on wolverines are not yet fully understood (K. S. Heinemeyer et al., 2017) .

Habitat loss due to factors other than climate change is less likely to occur, largely because much of wolverine habitat in the contiguous U.S, is in a management status, such as designated wilderness, IRA, or national park, that provides some protection from management, industrial, and certain recreational activities (U.S. Department of the Interior, Fish and Wildlife Service, 2013c). Maintaining those large blocks of un-fragmented wolverine habitat could help mitigate, to some extent, habitat fragmentation caused by climate change. Specific vegetation conditions appear to be relatively unimportant to this species, so although there may be some avoidance of vegetation management activities while they are being implemented, vegetation management in general is unlikely to have measurable effect on wolverines.

Table 98 shows the acreage of mapped wolverine habitat on the HLC NF currently in conservation management area, IRA, or designated wilderness. Acreages in conservation management area, which only occurs on the Rocky Mountain Range GA, overlaps with acreage in IRAs. Habitat was mapped following both the Inman et al methodology (Inman, Brock, et al., 2013; Inman et al., 2012), which incorporates topographic features, and the Copeland methodology (Copeland et al., 2010), which focuses on areas of persistent spring snow. Percentages shown are the proportion of the total of each type of mapped habitat that is within the designated area type. For example, 7% of all mapped wolverine primary habitat on the HLC NF is within the Conservation Management Area, and 1% of all areas mapped as having persistent spring snow in seven out of seven years is within the Conservation Management Area.

Table 98. Acres in conservation management area, IRA, and designated wilderness by wolverine habitat category and percent of total habitat on HLC NF

Wolverine habitat category[1]	Total in action area	Wilderness area	Inventoried roadless area[2]	Conservation management area[2]
Primary	1,010,243	412,363 (41%)	503,504 (50%)	73,643 (7%)
Maternal	357,795	231,837 (65%)	123,442 (35%)	12,720 (4%)
Persistent Spring Snow 1 of 7 years	393,880	101,349 (26%)	217,978 (55%)	39,087 (10%)
Persistent Spring Snow 7 of 7 years	46,672	35,664 (76%)	11,164 (24%)	252 (1%)

[1.] Primary and maternal habitats were mapped using methods described by Inman (Inman, Bergen, & Beckman, 2013); spring snow habitat was mapped using methods described by Copeland (Copeland et al., 2010) and includes areas with persistent snow in at least 1 of 7 years, and in 7 of 7 years, to display a possible range.

The relatively large percent of areas with persistent spring snow in at least one of seven years that are also in designated areas compared to the percent of areas with persistent spring snow in all seven years, is largely a function of the relatively larger amount of area with snow persisting in at least one year. In other words, the total area with spring snow in only one year (over 395,000 acres, see project file) is much larger than the total area with spring snow in seven years (47,000 acres, see project file). That makes is more likely that areas with snow persisting for only one of seven years will overlap with a designated area. The areas of mapped wolverine habitat and persistent spring snow that are within designated areas varies by GA, with the majority on the Little Belts and Rocky Mountain Range GAs, as well as on the Upper Blackfoot GA.

Wolverines in Idaho were found to use use drainage bottoms, riparian areas, and forested edge habitats, and appear to use those more in winter than in summer (K. S. Heinemeyer et al., 2017). Bowman et al. (2010) reported that in their study area in northern Ontario, areas of large-scale logging and associated roads were negatively associated with aerial survey detections of wolverine. They suggested that in their study area, maintenance of large roadless areas with natural fire regimes may be important for conserving several species, including wolverine. In the northern Rocky Mountains of the United States, maintaining landscapes that are relatively un-fragmented by human development between areas of high-elevation wolverine habitat may be important to maintain wolverine use of an area and help to maintain both genetic and demographic connectivity among wolverine sub-populations.

3.14.10 Wolverine, environmental consequences

Effects common to all alternatives

Climate change and its predicted impacts on high-elevation, persistent spring snow are not likely to be affected by management actions on the HLC NF. Management of HLC NF lands will also not impact trapping-related mortality.

Under all alternatives the acreage and distribution of Congressionally designated wilderness, conservation management area, and IRA would not change from the existing situation. These areas all provide large acreages that are undeveloped and occur in relatively contiguous large blocks, and where natural processes predominate. These areas also remain relatively undisturbed by human development and by many types of human activity. The acreage of these areas that overlap with mapped wolverine habitat would be as shown in Table 98 above. Outside of identified wolverine habitat, these areas may also contribute to potential connectivity among wolverine subpopulations within the planning area and with adjoining areas.

Under all alternatives, the plan components in the Grizzly Bear Amendment for management of grizzly bear habitat would result in limits on motorized access and on developed recreation sites in the Rocky

Mountain Range and Upper Blackfoot GA. These limits could benefit wolverine by minimizing the potential for impacts due to motorized travel and human activities associated with overnight developed recreation sites.

Effects of alternative A, no action

Management of HLC NF lands under this alternative would not have an impact on high-elevation, persistent spring snow, nor would it affect potential trapping-related mortality.

The 1986 Helena NF and Lewis and Clark NF plans contain a number of plan components that provide general direction for maintenance of wildlife habitat values while carrying out other management actions. Among those that influence management of habitat used by wolverines are, in the Lewis and Clark NF plan:

- C-1(10): Cooperate with other entities to implement programs for land acquisition, exchanges, and easements;
- C-1 (6) and L-4: Manage motorized use through travel plans to reduce impacts to wildlife during periods of high stress, and generally minimize impacts of roads on wildlife;
- C-2: Several standards requiring consultation, analysis, research, coordination and contributions to recovery of listed species; would apply to wolverine if they become listed;
- C-5: Monitor populations of Management Indicator Species, including wolverine. Although Management Indicator Species will no longer be identified under the 2012 Planning Rule, identification of them in the Lewis and Clark NF plan would likely mean continued adherence to applicable standards and guidelines.;
- G-1 and G-2: Standards requiring stipulations to minimize potential disturbance and displacement of wildlife during oil and gas exploration and development operations.

Plan components in the 1986 Helena NF plan that relate to management of habitats used by wolverines include:

- Standards requiring consultation, analysis, research, coordination and contributions to recovery of listed species; would apply to wolverine if they become listed;
- Standards primarily relating to grizzly bear, but that require minimizing impacts of roads on wildlife; and
- Standards requiring analysis and mitigation of potential impacts to wildlife of oil and gas exploration and development operations.

Both plans include components for maintaining areas of secure habitat for elk and other big game; these areas could benefit wolverine by providing areas with minimal human disturbance in which to travel between areas of high-elevation preferred habitats.

The 1986 Forest Plans do not provide specific direction for wolverine habitat, and much of the direction relating to management activities occurring in wolverine or other wildlife habitat is somewhat general. The plans refer to the need to minimize impacts to wildlife when carrying out travel management planning but are not specific regarding over-snow travel in high-elevation areas used by wolverines. Plan direction to maintain habitat security in some areas, and to minimize the potential impacts to wildlife from roads and other management may provide some benefit to wolverines. Nevertheless, FS management actions and activities occurring on NFS lands are unlikely to have impacts to wolverine populations (U.S. Department of the Interior, Fish and Wildlife Service, 2013c), which will continue to be affected primarily by the effects of climate change on the amount and distribution of persistent spring snow.

Effects of the action alternatives

Management of HLC NF lands under these alternatives would not have an impact on high-elevation, persistent spring snow, nor would it affect potential trapping-related mortality.

Plan components for terrestrial vegetation (e.g., FW-VEGT-DC-01 through 04) are intended to maintain the integrity of alpine ecosystems, and to provide vegetation conditions that would support at-risk species and provide connectivity. These plan components provide the coarse filter that would maintain the integrity of systems on which wolverine are dependent.

Maintaining large blocks of un-fragmented wolverine habitat could help mitigate, to some extent, habitat fragmentation caused by climate change. Primitive and semi-primitive nonmotorized recreation settings are areas in which motorized travel would not occur, and in which human development and the influence of humans is minimal. Similarly, RWAs also provide blocks of unfragmented habitat where natural processes predominate, and human influence is minimized. Table 99 shows the amount of modeled wolverine habitat that would occur in the combined primitive and semi-primitive nonmotorized recreation settings, and in RWAs, by alternative. Alternative A is included in the table to provide comparison with the no-action alternative.

Table 99. Acres of RWAs, and combined primitive and semiprimitive nonmotorized ROS, by wolverine habitat category by alternative

Area designation or category	Wolverine habitat category[1]	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F
Recommended Wilderness[2]	Primary	11,792 (1%)	85,226 (8%)	85,229 (8%)	160,862 (16%)	0	61,071 (6%)
	Maternal	1,384 (<1%)	16,031 (4%)	16,031 (4%)	29,058 (8%)	0	6,845 (2%)
	Persistent Snow 1 of 7 years	6,407 (2%)	24,485 (6%)	24,485 (6%)	61,262 (16%)	0	22,415 (6%)
	Persistent Snow 7 of 7 years	0	3,007 (6%)	3,007 (6%)	3,007 (6%)	0	837,598 (83%)
Combined Primitive and Semi-Primitive Non-Motorized Recreation Setting (Summer)	Primary	840,639 (83%)	841,742 (83%)	841,742 (83%)	849,509 (84%)	840,765 (83%)	837,598 (83%)
	Maternal	339,847 (95%)	339,928 (95%)	339,928 (95%)	340,368 (95%)	339,867 (95%)	339,457 (95%)
	Persistent Snow 1 of 7 years	288,118 (73%)	289,151 (73%)	289,151 (73%)	295,405 (75%)	288,643 (73%)	287,817 (73%)
	Persistent Snow 7 of 7 years	46,479 (100%)	46,479 (100%)	46,479 (100%)	46,479 (100%)	46,479 (100%)	46,479 (100%)
Combined Primitive and Semi-Primitive Non-Motorized Recreation Setting (Winter)	Primary	799,915 (79%)	809,155 (80%)	811,536 (80%)	820,458 (81%)	800,840 (79%)	811,932 (80%)
	Maternal	327,485 (92%)	328,796 (92%)	328,857 (92%)	329,926 (92%)	327,637 (92%)	328,477 (92%)
	Persistent Snow 1 of 7 years	291,923 (74%)	296,264 (75%)	298,532 (76%)	305,032 (77%)	291,574 (74%)	298,144 (76%)
	Persistent Snow 7 of 7 years	44,925 (96%)	44,925 (96%)	44,925 (96%)	44,925 (96%)	44,995 (96%)	44,925 (96%)

1. Primary and maternal habitats were mapped using methods described by Inman (Inman, Bergen, et al., 2013); spring snow habitat was mapped using methods described by Copeland (Copeland et al., 2010).

2. A zero means that data showed there were not 7 sequential years with modeled persistent spring snow in any of the RWAs for that alternative. There may have been up to 6 sequential years; see project file for model

details. Some of the values in Alternatives A-E vary slightly from what was presented in the DEIS due to GIS corrections.

Alternative D, which features the largest number and acreage of RWAs, has the most area of modeled wolverine habitat of most categories in RWAs, while alternative E has the least (Table 99). The only exception is areas with persistent snow 7 out of 7 years, which are equally high in Alternatives B, C and D. Note that an even larger acreage and proportion of modeled wolverine habitat and areas of persistent snow are within IRAs (Table 98), and that most RWAs overlap with IRAs. RWAs, however, would be managed specifically to maintain a natural environment where ecological processes function as the primary forces affecting the environment (FW-RECWILD-DC-02). The location of RWAs in alternative D was informed by assessing which areas might provide potential connectivity among island mountain ranges, where habitat on NFS land remains relatively intact and intervening lands either provide minimal disturbance or distances between island mountain ranges are shortest. Alternative D would therefore have slightly increased potential to maintain connections among separate GAs for some wildlife species, including wolverine, although that potential would continue to be greatly affected by land management and uses on intervening non-NFS lands.

While lower than Alternative D, The Preferred Alternative F would maintain a high proportion of the plan area's wolverine habitat in protective land status categories and designations, and thus continue to provide large areas with relatively low disturbance levels that are typically associated with wolverine habitats. This would occur primarily through nonmotorized recreation settings, but also to a lesser extent through RWAs (Table 99). These would be in addition to maintaining the large amount of habitat already encompassed by designated wilderness areas, IRAs, and Conservation Management Areas, which would not change under any alternative.

About 6% of all primary wolverine habitat in the plan area would become RWA under alternative F. Most RWAs overlap with IRAs. However, RWAs would be managed specifically to maintain a natural environment where ecological processes function as the primary forces affecting the environment (FW-RECWILD-DC-01, 02, 03), which aligns well with wolverine needs.

The large majority of wolverine habitats would continue to be within either primitive or semi-primitive non-motorized settings under the preferred alternative (Table 99). For example, 96% of the action area having modeled persistent spring snow 7 out of 7 years would be overlapped by non-motorized winter recreation settings. This high overlap reflects the relatively inaccessible nature of most key wolverine habitat. Plan components for the two non-motorized recreation settings stress limited presence and evidence of human activity (FW-ROS-DC 02, 03, 04, and 05 and associated standards and guidelines. The largest area of habitat that is relatively free of human disturbance occurs on the Rocky Mountain Range GA (refer to project file for acreages by GA). This GA also has the highest amount of mapped potential wolverine habitat (Table 93, above), and it is highly connected to wolverine habitat on the Flathead NF and in Glacier National Park.

Collectively, these area designations and categories provide high assurance that wolverine habitats in the action area remain largely free from human activities and disturbances. Maintaining large areas with these conditions would help mitigate, to some extent, habitat fragmentation caused by climate change. While some human activity would still occur that could cause some avoidance by wolverines (e.g., vegetation management, recreation), in general they would be unlikely to have a measurable effect on wolverines, based on analysis displayed in the listing proposal (U.S. Department of the Interior, Fish and Wildlife Service, 2013b) (U.S. Department of the Interior, Fish and Wildlife Service, 2013c).The amount of primitive, and semiprimitive nonmotorized recreation settings in wolverine habitat would not be markedly different among alternatives, and the large majority of wolverine of all habitats is and would continue to be within either primitive or semi-primitive nonmotorized settings under all alternatives, including the no action. That is a reflection of the relatively inaccessible nature of most key wolverine habitat. Plan components for these two recreation settings stress limited presence and evidence of human activity (FW-

ROS-DC 02, 03, 04, and 05 and associated standards and guidelines. The largest area of habitat that is relatively free of human disturbance occurs on the Rocky Mountain Range GA (refer to project file for acreages by GA), which also has the most mapped potential wolverine habitat and also is contiguous with wolverine habitat on the adjoining Flathead NF, and is adjacent to wolverine habitat in Glacier National Park.

Cumulative Effects

Table 100 summarizes the cumulative effects to wolverines from other resource management plans.

Table 100. Summary of cumulative effects to wolverines from other resource management plans

Resource plan	Description and Summary of effects
Adjacent National Forest Plans	The forest plans for NFS lands adjacent to the HLC NF include the Custer-Gallatin, Lolo, Flathead, and Beaverhead-Deerlodge NFs. The Flathead NF Forest Plan has recently been revised under the 2012 Planning Rule. All forest plans must adhere to requirements of the ESA, as amended, for species listed as threatened or endangered and those identified as proposed or candidate species for listing. Wolverines on the HLC NF are likely part of a connected population extending across NF boundaries. Plans on adjoining NFs include varying amount and pattern of winter motorized use that could have varying effects on wolverine, potentially displacing some wolverines where motorized use is concentrated in wolvering habitat.
BLM Resource Management Plans (RMP)	BLM lands near the HLC NF are managed by the Butte, Missoula, and Lewistown field offices. The Butte and Lewistown plans were recently revised (2009 and 2019 respectively) while the existing plan for the Missoula area is under revision. The Butte plan includes components that are similar and complementary to the HLC NF 2020 Forest Plan; components in the plans under revision are anticipated to be similar to those in the Butte plan. BLM lands near the HLC NF include likely relatively small amounts of wolverine habitat. All land use plans must adhere to requirements of the ESA, as amended, for species listed as threatened or endangered and those identified as proposed species for listing.
National Park Service - Glacier National Park General Management Plan 1999	Similar in scope to a forest plan. Philosophy is to manage the park for its wild character and integrity of natural heritage, while traditional visitor services and facilities remain. Guiding principles include providing for such things as biosphere reserve, proposed wilderness, interpretive, educational, and outreach programs, preservation of natural and cultural resources. Winter recreation in the park is limited to nonmotorized travel, providing large expanses with little or no potential human disturbance.
Montana Statewide Forest Resource Strategy (2010)	MT conducted a statewide assessment of forest resources and identified issue-based focus areas with implementation strategies and deliverables for each. Focus areas include such varied things as achieving ecological integrity through recovery of species diversity, managing for wildfire and public safety, supporting forest products infrastructure, and addressing changing forest ownership patterns. Management for these focus areas on state lands would adhere to management plans for specific state-owned lands.
Montana State Parks and Recreation Strategic Plan 2015-2020	These plans guide the management of state parks, some of which lie nearby or adjacent to NFS lands. Goals include managing significant, relevant, and accessible parks and programs in a manner consistent with available resources, as well as emphasizing visitor experience, partnerships, and awareness of the state parks system. State parks near or adjacent to the HLC NF likely contain very little wolverine habitat.
Montana's State Wildlife Action Plan	This plan describes a variety of vegetation conditions related to habitat for specific wildlife species. This plan would likely result in the preservation of these habitats on state lands, specifically wildlife management areas. This plan would interact with the Montana Statewide Forest Resource Strategy (above). The vegetation conditions described would be complementary to the conditions being managed for with the HLC NF 2020 Forest Plan.
Montana State Wildlife Management Areas	Plans are specific to management areas and their established purpose. Most in the planning area were established to conserve big game winter range, with goals to maintain forage, cover, and security during winter use periods. Likely very little wolverine habitat on these lands, but they could contribute to large-scale connectivity.

Conclusions

It is unlikely that forest plan direction has the potential to impact recovery or persistence of wolverine in the planning area or in Montana (U.S. Department of the Interior, Fish and Wildlife Service, 2013c). The most serious threat to wolverine is reduction in the abundance, distribution, and persistence of late spring snow as a result of climate change, which would not be affected by FS management actions. Harvest of wolverines, although currently closed in Montana, has the potential to impact survival, which could affect population trend if at high enough levels. FS management does not affect harvest nor does it affect potential mortality related to trapping for other species.

All alternatives provide some area of relatively un-fragmented habitat in the form of designated wilderness and IRAs, as well as RWAs and primitive and semi-primitive nonmotorized ROS settings, where natural processes predominate or where human influence is minimized. All of these areas, where they overlap with wolverine habitat, would prevent fragmentation of existing wolverine habitat. Elsewhere, these areas could contribute to maintaining connectivity among wolverine sub-populations in Montana. The largest area of mapped wolverine habitat on the HLC NF, on the Rocky Mountain Range GA, is within designated wilderness or the overlapping management designations of Conservation Management Area and IRA. This habitat would remain connected, to the extent it is not reduced or altered by climate change, to wolverine habitat on the adjoining Flathead NF and Glacier National Park. All alternatives would contribute to maintaining persistence of wolverines in the planning area.

3.14.11 Species of conservation concern

The Regional Forester has identified two SCC for the HLC NF: flammulated owl and Lewis's woodpecker. This list remains the same as that identified in the Draft Plan and DEIS; rationale for identifying these species as SCC and other information related to SCC can be found on the Region 1 SCC web page at: http://bit.ly/NorthernRegion-SCC.

The 2012 Planning Rule states that if plan components to maintain ecosystem integrity and diversity are insufficient to provide ecological conditions to "maintain a viable population of each SCC within the planning area", then additional species-specific plan components are to be included to provide such ecological conditions. The rule acknowledges that it may be beyond FS authority or the inherent capability of the planning area to maintain or restore ecological conditions that would maintain a viable population of a species in the planning area. In such cases, the FS must document the basis for that determination, and include plan components that would provide ecological conditions to contribute to maintaining a viable population of the species within its range.

This section uses the BASI to demonstrate how the plan components (species-specific or otherwise) of each alternative would provide the ecological conditions to maintain those species in the planning area over the long term. Analysis of the effects of the alternatives is provided for each SCC. Analysis of the impacts of plan components for management of other resources, as well as cumulative effects, are discussed for both species together at the end of this section.

Flammulated owl, affected environment

Status and distribution

The breeding range of flammulated owls extends from southern British Columbia southward into Mexico (MHP-MTFWP), corresponding strongly with the distribution of ponderosa pine and Jeffrey pine (M. D. Nelson, Johnson, Linkhart, & Miles, 2009). A 2006 evaluation (Samson, 2006) found no evidence of population decreases on NFS lands in Montana. However, there are ongoing concerns about the availability and trend of stands of large, open ponderosa pine in the planning area. Flammulated owls have been detected both historically and recently in the Upper Blackfoot, Divide, Big Belts and Elkhorns GAs (Cilimburg, 2006), but not elsewhere on the HLC NF. The planning area crosses the eastern edge of the mapped distribution of flammulated owls in Montana (Montana Natural Heritage Program, 2014), with the Little Belts, Highwoods, Castles, Crazies, and Snowies GAs outside the known range of the species. The Rocky Mountain Range GA of the LCNF is included in coarse scale map of flammulated owl distribution in Montana (Montana Natural Heritage Program, 2014), but lacks ponderosa pine. There are no historic records of flammulated owls on the Rocky Mountain Range GA, and flammulated owls were not detected during surveys for several owl species (G.Frye, Rocky Mountain Front Institute of Natural History, Pers. Com., filed in project record) between 2000 and 2005.

Habitat Use

Detailed information about flammulated owl habitat use can be found in the Assessment (U.S. Department of Agriculture, Forest Service, Northern Region, 2015), and in literature cited there and in this section. In this section we will summarize information directly relevant to analysis of the consequences of the 2020 Forest Plan on flammulated owls.

Flammulated owls appear to prefer dry, open, mature and old growth forests usually with ponderosa pine or Jeffrey pine (McCallum, 1994; M. D. Nelson et al., 2009). In Montana, flammulated owls are associated with mature and old growth xeric ponderosa pine and ponderosa pine/Douglas-fir stands (U.S. Department of Agriculture, Forest Service, 2011b). These birds require large snags with cavities, commonly excavated by pileated woodpecker, northern flicker, or sapsuckers (Climburg, 2006).

Flammulated owls have relatively small home ranges (Linkhart & McCallum, 2013) and often nest in groups, possibly due at least in part to the often clumped distribution of snags. The amount of current habitat on the HLC NF would likely provide for persistence of flammulated owls in the plan area. Maintaining habitat on the HNF portion of the HLC NF may be important to preventing contraction of the species' range in Montana.

Nelson and others (M. D. Nelson et al., 2009) estimated that that there were about 18,533 mi^2 of potential breeding habitat in the United States. Samson (Samson, 2006) mapped flammulated owl habitat habitat throughout the Region and by NF; Bush and Lundberg (Bush & Lundberg, 2008) updated Samson's mapping and estimated that there are approximately 10,200 acres of potential flammulated owl nesting habitat on the HNF, and approximately 8,800 acres on the LCNF (total of roughly 19,000 acres on the combined HLC NF). Using the same queries with updated vegetation data, estimates were made using in 2015 for the planning area by GA as shown in Table 101. The SIMPPLLE model was used to estimate the NRVand existing condition of a variety of vegetation characteristics and several wildlife habitats (refer to terrestrial vegetation section and appendix H) and to estimate the amount of currently existing habitat. The SIMPPLLE model uses somewhat different methods and parameters than those used by Samson (Samson, 2006) and Bush and Lundberg (Bush & Lundberg, 2008); the estimates of existing habitat and NRV are also displayed in Table 101. Refer to the Assessment (U.S. Department of Agriculture, Forest Service, Northern Region, 2015) for a summary of the methodology and data used to estimate habitat for that assessment, and to appendix H for information about the methods and data used in the SIMPPLLE model.

Table 101. Estimated flammulated owl nesting habitat on the HLC NF, by GA with 90% confidence interval

GA	2015 Estimated Habitat Acres: Mean (Range)[1]	2019 SIMPPLLE Estimated Current Habitat Acres	SIMPPLLE Estimated NRV: Min-Max
Big Belts	9,525 (4,098 – 15,757)	1,6701,180	13,045 – 124,49711,900-60,030
Divide	4,608 (1,158 – 8,666)	6,1704,230	2,446 – 22,7571,610-22,130

GA	2015 Estimated Habitat Acres: Mean (Range)[1]	2019 SIMPPLLE Estimated Current Habitat Acres	SIMPPLLE Estimated NRV: Min-Max
Elkhorns	1,828 (0 – 5,330)	2,5002,050	833 – 25,974760-17,140
Upper Blackfoot	9,284 (3,963 – 15,263)	3,2102,850	2,123 – 51,2952,670-24,910
Total[2]	25,245 (9219 – 45,016)	28,18129,780	18,447 – 224,52332,440-216,210

1.2015 estimate made using the parameters and methodology of Samson (Samson, 2006)
2 Total HLC NF acres of flammulated owl habitat, including habitat found on GAs outside of the historic and/or current range of the species.

The 2015 estimates differ in some GAs from the SIMPPLLE estimates for current habitat based on differences in model parameters and in methodologies. For most GAs the NRV is fairly broad, reflecting variability in model outcomes that may represent large-scale disturbances, such as fire, climate, and insect infestation, over time. For the GAs within known flammulated owl distribution, the amount of estimated current habitat by either method is at the lower end, or in the case of the Big Belts GA, below the low end of the estimated NRV. This parallels the current estimates for both ponderosa pine and large and very large diameter trees (refer to appendix H and the terrestrial vegetation section), both of which are components of flammulated owl habitat, forestwide and in the Big Belts GA. With the exception of the Little Belts GA it appears that the GAs with the least potential habitat currently and by estimated NRV correspond to areas where flammulated owls have not been detected. Elsewhere on the HLC NF (primarily in the Little Belts GA but including some in the Castles, Highwoods, and Snowies GAs) there are just under 20,000 acres of area with ponderosa pine that do not appear to be current or historic range, and that may continue to be unoccupied in the future.

Key drivers and stressors

Although habitat appears to be well-distributed and relatively abundant in Region One, ponderosa pine forests have decreased in abundance and distribution, and their structure has changed over the last century. Changes in flammulated owl habitat may be due to factors affected by FS management, as well as those not under FS management control.

The ponderosa pine cover type is less prevalent on the HLC NF than the dry Douglas-fir and lodgepole pine cover types, and is probably less abundant than it was historically (U.S. Department of Agriculture, Forest Service, Northern Region, 2015); see also the terrestrial vegetation section, appendix H, and appendix I. Nelson et al. (M. D. Nelson et al., 2009) noted that logging and wildfire exclusion, both of which can be affected by FS management, have resulted in a loss of ponderosa pine forest habitat. Fire exclusion allows growth of young Douglas-fir and may reduce the amount of open understory needed for flammulated owl foraging (Samson, 2006). A lack of low-intensity disturbance may have caused a decrease in the larger size classes of trees in some cover (U.S. Department of Agriculture, Forest Service, Northern Region, 2015) in the planning area. Samson (Samson, 2006) stated that "[t]imber management is an insignificant influence on the landscape in comparison to suppression of fire", in terms of its influence on flammulated owl habitat.

Ponderosa pine has been impacted by recent heavy insect infestation on the HNF. While insect infestations may be influenced indirectly by factors related to forest management, they are a stressor that is not under FS management control. Similarly, human settlement and development on non-NFS lands may reduce mature ponderosa pine habitat through direct removal of habitat.

Flammulated owl, environmental consequences

This analysis focuses on potential impacts to the specific combination of vegetation type (tree species) and structural stage that appears to be required for nesting by flammulated owls.

Effects common to all alternatives

A general discussion of the ecological conditions that support flammulated owls (i.e. the coarse filter analysis of the species' needs) is incorporated into the terrestrial wildlife diversity sections (Species Associated with Dry Conifer Habitats and Species Associated with Snags). Forestwide over the next five decades, ponderosa pine is predicted to increase under all alternatives (but refer to action alternatives section below, including discussion of trend by GA). The large tree size class as well as large-tree structure would also likely increase under all alternatives. The very large size class would likely remain relatively static.

Estimates made using the SIMPPLLE model (refer to appendix H) predict that at a forestwide scale, the average acreage of flammulated owl habitat forestwide would remain similar to the existing condition over the five decades modelled, just below the lower end of the estimated NRV.

Effects of alternative A, no action

The effects of alternative A on the ecological conditions that support flammulated owls are discussed in the terrestrial vegetation section regarding ponderosa pine and large and very large trees, and are summarized from there into the terrestrial wildlife diversity section, in the sections on dry conifer habitats, and late successional forests.

The 1986 Forest Plans do not include desired conditions or other plan components specific to ponderosa pine forests, large and very large trees, or management of flammulated owl habitat. Without specific desired conditions for this forest type and tree size there is no guidance for management of habitat conditions required by flammulated owls. Existing plan standards for retaining snags, particularly large snags, would provide some habitat for flammulated owls where large and very large snags occur in ponderosa pine habitats. This species is currently listed as a RFSS, so it would continue to be considered in forest management planning and implementation at a site or project specific level.

As discussed above under 'effects of all alternatives', modelled estimates of flammulated owl habitat at a forestwide scale show little change from the existing condition at the forestwide scale under this alternative, and would be predicted to remain just below the estimated NRV for the next 5 decades. Results by GA are discussed in the section below along with the action alternatives to facilitate comparison.

Effects of the action alternatives

All action alternatives include several plan components that set desired conditions for vegetation management that would maintain or improve potential flammulated owl habitat (Table 102) or the ecological conditions (coarse filter) required to support flammulated owls. Plan components for GAs are included only for those where flammulated owls have been observed or that are within the known distribution of flammulated owls. Additional plan components that may directly or indirectly maintain or improve potential habitat for flammulated owls may also be included in other GAs. Descriptions in Table 102 paraphrase the actual components, to briefly illustrate the manner by which they may influence habitat. Please refer to the 2020 Forest Plan for the actual text of these components.

Table 102. 2020 Forest Plan components that would contribute to providing habitat for flammulated owls

Plan Component	Area Where Plan Component Applies	Brief Description of Plan Component
FW-VEGT-DC-02	Forestwide	Distribution of cover types, based on NRV includes increasing ponderosa pine and maintaining or increasing nonforested inclusions. See HLC NF 2020 Forest Plan for details by broad PVT; and see individual GAs.
FW-VEGF-DC-01	Forestwide	Distribution of tree species presence, based on NRV: includes increasing ponderosa pine. See HLC NF 2020 Forest Plan for details by broad PVT, and see individual GAs.
FW-VEGF-DC-02	Forestwide	Distribution of size classes, based on NRV: includes increasing abundance and distribution of large and very large size classes. See HLC NF 2020 Forest Plan for details by broad PVT, and see individual GAs.
FW-VEGF-DC-03	Forestwide	Distribution of density classes, based on NRV: includes increasing low/medium density class and decreasing high density class. See HLC NF 2020 Forest Plan for details by broad PVT, and see individual GAs.
FW-VEGF-DC-06	Forestwide	Desired conditions of snags by size class, including large and very large snags; see HLC NF 2020 Forest Plan for details.
FW-VEGF-GDL-01	Forestwide	Guideline to retain a minimum amount of large and very large trees based on DC. See HLC NF 2020 Forest Plan for details.
FW-VEGF-GDL-02	Forestwide	Guideline to retain a minimum amount of snags, specified by size and R1 Broad PVT. See HLC NF 2020 Forest Plan for details.
BB-VEGT-DC-01; VEGF-DC-01 and 02	Big Belts	Desired distribution of cover type, tree species presence, and size class, based on NRV: includes increasing ponderosa pine cover type as well as species presence of limber pine, ponderosa pine, and aspen; and increases in the large and very large size classes.
DI-VEGT-DC-01; VEGF-DC-01 and 02	Divide	Desired distribution of cover type, tree species presence, and size class, based on NRV – includes increasing the ponderosa pine cover type as well as species presence of limber pine and ponderosa pine while maintaining the abundance of aspen; and increases in the large and very large size classes.
EH-VEGT-DC-01; VEGF-DC-01 and 02	Elkhorns	Desired distribution of cover type, tree species presence, and size class based on NRV - includes increasing the ponderosa pine cover type as well as the species presence of limber pine and ponderosa pine while maintaining aspen; and increasing the large and very large size classes.
UB-VEGT-DC-01; VEGF-DC-01 and 02	Upper Blackfoot	Desired distribution of cover type, tree species presence, and size class based on NRV – includes increasing the ponderosa pine cover type as well as the species presence of ponderosa pine and aspen while maintaining limber pine; and increasing the large and very large size classes.

In addition to the coarse-filter plan components listed above that would provide ecological conditions needed by flammulated owls, the 2020 Forest Plan includes a component specific to flammulated owls that would be applied in the Upper Blackfoot, Divide, Big Belts, and Elkhorns GAs. These GAs are within the known distribution of flammulated owls and have documented observations. The species-specific plan component for flammulated owls is as follows: "Ponderosa pine-dominated forests contain large-tree structure (see glossary) comprised of ponderosa pine and/or Douglas-fir trees and snags with relatively open canopy available for nesting by flammulated owls. These areas occur within a larger mosaic of closed-canopy forest and shrub-dominated openings that serve as flammulated owl roosting and foraging areas. (BB-WL-DC-02, DI-WL-DC-02, EH-WL-DC-03, UB-WL-DC-02)."

Although elements of this plan component are also addressed in the plan components for terrestrial vegetation, the purpose of the desired condition is to ensure specific effort to provide for the mix of vegetation components (ponderosa pine, large-diameter trees and snags, open understory, in proximity to other habitats) that characterize flammulated owl habitat. This desired condition would ensure that lands managed by the HLC NF would provide conditions necessary for persistence of flammulated owls in the planning area over the long term.

Estimates of flammulated owl habitat under all alternatives by GA were made using the SIMPPLLE model (refer to appendix H) for those GAs within the known distribution of flammulated owls in Montana. The predicted acreage of flammulated owl habitat would increase in the Big Belts over the modelled five decades, to approach the lower end of the estimated NRV by the fifth decade. The predicted acreage of flammulated owl habitat would decrease in the Divide and Elkhorns GAs, however, moving to the lower end of the estimated NRV by decade 5. For the Upper Blackfoot GA, the model estimates that flammulated owl habitat is currently at the lower bound of the NRV, and would decrease over the five decades modelled, and trending below the lower end of the estimated NRV. The predicted trends for flammulated owl habitat in all GAs are generally the same for all alternatives, including the no-action alternative.

The modelling process is complicated and involves a large number of assumptions (refer to appendix H), which make some outputs difficult to specifically interpret. Although ponderosa pine is predicted to increase and large/very large trees are predicted to increase or remain near current abundance under all alternatives, flammulated owl habitat is predicted to decrease in three of the four GAs within its distribution. The reason for this modelled outcome is not clear but may be due to the structural components of that habitat as modelled. Tree density is predicted to decrease in the warm dry potential vegetation group (refer to appendix H and the terrestrial vegetation section). Some of that decrease in density could occur in the ponderosa pine type in those GAs, bringing it below the range identified in the scientific literature and incorporated into the model as used by flammulated owls. The species-specific plan component for flammulated owls (BB-WL-DC-02, DI-WL-DC-02, EH-WL-DC-03, and UB-WL-DC-02) could help offset the predicted habitat trend by guiding managers to promote development of the specific mix of habitat components required by flammulated owls. As discussed in the terrestrial vegetation section, modelled predictions are based largely upon large disturbances that may or may not occur.

Cumulative effects

Cumulative effects for flammulated owls would be the same as those addressed for other wildlife species in the terrestrial wildlife diversity section. Please refer to that section.

Conclusions

The HLC NF appears to have enough habitat currently to maintain persistence of the species in the planning area, based on the density and home range size reported for this species in the literature. The 2020 Forest Plan includes components designed to maintain or increase the presence and distribution of habitat components (stands of large, old ponderosa pine trees and large snags) used by flammulated owls.

Because of its location crossing the edge of the known distribution of this species, the HLC NF makes a key contribution to flammulated owl habitat by potentially preventing or reducing range contraction of the species. All alternatives would contribute to maintaining flammulated owls in the planning area. By including desired conditions for the habitat components and ecological conditions required by flammulated owls, and by including species-specific desired conditions for flammulated owls, the action alternatives) would likely provide greater assurance of flammulated owls persisting in the planning area over the long term than would be provided under the no-action alternative. Given the relatively minimal differences among alternatives in terms of the trend and amount of predicted habitat, it seems likely that flammulated owl habitat may be affected at the forestwide and GA scales more by natural processes (fire and insects) than by management actions.

Lewis's woodpecker, affected environment

Status and distribution

Lewis's woodpeckers have been detected in recent years only in the Big Belts GA and on private land adjacent to the Elkhorns and Divide GAs. A few historic records exist from the Divide, Little Belts, Castles, and Highwoods GAs. The planning area occurs at the eastern edge of the mapped distribution of Lewis's woodpecker (Montana Natural Heritage Program & Montana Fish Wildlife and Parks) with the Snowies GAs at the northeastern edge of the known range of the species in Montana. Concern over declines in mature to old ponderosa pine forest as well as large, old riparian cottonwood, combined with the impact of long-term fire exclusion on availability of large, soft snags has led to some concern about the long-term persistence of this species in Montana.

Habitat use

Detailed information about Lewis's woodpecker habitat use can be found in the Assessment (U.S. Department of Agriculture, Forest Service, Northern Region, 2015). Briefly, Lewis's woodpeckers are not good primary excavators and rely on other woodpeckers to create cavities they use for nesting, or they use snags in advanced stages of decay (Abele, Saab, & Garton, 2004). They glean insects from shrubs or on the ground, therefore requiring open-canopy forest that allows for development of an understory that will maintain certain insect populations (Abele et al., 2004). Lewis's woodpeckers also use stands of large, old cottonwood in riparian areas (Abele et al., 2004; Montana Natural Heritage Program & Montana Fish Wildlife and Parks). Distribution of this species is strongly associated with fire-maintained old growth ponderosa pine, and they appear to favor areas that have experienced fire in the past 2-20 years (Abele et al., 2004; Saab & Dudley, 1998). Their requirement for stands of large, old, fire-maintained open ponderosa pine stands overlaps with requirements for flammulated owls.

Habitat for Lewis's woodpecker on the HLC NF has been estimated using modelling techniques similar to those used for flammulated owl. The SIMPPLLE model (see appendix H, and the project file for detailed information about habitat models and techniques) estimated nearly 19,000 acres of Lewis's woodpecker habitat forestwide. The majority of modelled habitat is in the Little Belts and Upper Blackfoot GAs, with over 5,000 acres estimated in each. The model estimated slightly more than 2,000 acres each in the Big Belts and Divide; roughly 1,500 acres each in the Castles and Elkhorns GAs; and less than 200 acres each in the Crazies, Highwoods, Rocky Mountain Range, and Snowies GAs. Most GAs appear to be at the lower end or below the estimated NRV currently. The forestwide NRV is estimated between 91,110 acres and 488,220 acres. Note that the model may not estimate the cottonwood component of habitat very accurately, because this tends to be limited along lower elevation riparian areas.

Key drivers and stressors

Although habitat appears to be well-distributed and relatively abundant in Region One, ponderosa pine forests have decreased in abundance and distribution, and their structure has changed over the last century. Changes in Lewis's woodpecker habitat are due to factors affected by FS management, as well as those not under FS management control.

The ponderosa pine cover type is less prevalent on the HLC NF than the Douglas-fir and lodgepole pine cover types, and is probably less abundant than it was historically (U.S. Department of Agriculture, Forest Service, Northern Region, 2015); see also the terrestrial vegetation section, appendix H, and appendix I. In their work on flammulated owls, which also rely on stands of large old ponderosa pine, (M. D. Nelson et al., 2009) Nelson and others noted that logging and wildfire exclusion, both of which can be affected by FS management, have resulted in a loss of ponderosa pine forest habitat. Fire exclusion allows growth of young Douglas-firs and may reduce the amount of open or shrub-dominated understory used by Lewis's woodpeckers for foraging. A lack of low-intensity disturbance may have caused a decrease in the larger size classes of trees in some cover (U.S. Department of Agriculture, Forest Service, Northern Region, 2015) in the planning area. With respect to the prevalence of large-diameter, open-understory ponderosa pine, Samson (Samson, 2006) stated that "[t]imber management is an insignificant influence on the landscape in comparison to suppression of fire".

Ponderosa pine has been impacted by recent heavy insect infestation on the HNF. While insect infestations may be influenced indirectly by factors related to forest management, they are a stressor that is not under FS management control. Similarly, human settlement and development on non-NFS lands may reduce both mature ponderosa pine habitat and large old cottonwood stands through direct removal of habitat.

Stands of large old cottonwood are less prevalent on NFS lands, occurring in lower elevation riparian areas. These areas tend not to be included in vegetation management activities, although in some localized areas individual cottonwoods may be removed as hazard trees where they occur in close proximity to campsites or recreation residences. Prevalence of cottonwood stands may be most influenced by drought and changes in hydrology, particularly off NFS lands where stream flows may be regulated by dams and irrigation practices.

Lewis's woodpecker, environmental consequences

Effects common to all alternatives

The terrestrial vegetation and terrestrial wildlife diversity sections summarize the ecological conditions required by Lewis's woodpeckers (i.e. the coarse filter analysis of the species' needs). Ponderosa pine would increase over the course of five decades under all alternatives, as would aspen/cottonwood (these species were modeled together due to limitations in data sources and modeling). The large tree size class as well as concentrations of large- tree structures would also likely increase over that timeframe under all alternatives. The very large tree size class would likely remain static. The increase in large ponderosa pine and in cottonwood would provide additional or improved habitat for Lewis's woodpeckers.

The SIMPPLLE model estimates that at a forestwide scale, Lewis's woodpecker habitat would increase over the five decades modelled to achieve a midpoint in the NRV range by decade 2, with no substantial differences among alternatives. The total forestwide acreage of habitat would move into the lower end of the estimated NRV during the fourth decade modelled. Predicted habitat in most GAs also appears to increase to within the lower end of the estimated NRV as well (see below).

Effects of alternative A, no action

The effects of alternative A on the ecological conditions that support Lewis's woodpeckers are discussed in the terrestrial vegetation section regarding ponderosa pine, hardwoods, and large and very large trees, and are summarized from there into the terrestrial wildlife diversity section, in the sections on dry conifer, hardwood, and riparian habitats, and late successional forests.

The 1986 Forest Plans do not include desired conditions or other plan components specific to ponderosa pine forests, large and very large trees, or management of Lewis's woodpecker habitat. Without specific desired conditions for this forest type and tree size there is no guidance for management of habitat conditions required by this species. Existing plan standards for retaining snags, particularly large snags, would provide some habitat for Lewis's woodpeckers where large and very large snags occur in ponderosa pine or cottonwood habitats. The SIMPPLLE model (see terrestrial vegetation section) estimates that the aspen/hardwood cover type, which includes cottonwood, would increase slightly over the next 50 years. The section also cautions, however, that the presence of cottonwood is not well-represented by plot data or modeling.

As discussed above under 'effects of all alternatives', modelled estimates of Lewis's woodpecker habitat at a forestwide scale show increases under this alternative (refer to appendix H for charts of this trend). Results by GA are discussed in the next section, for ease of comparison.

Effects of the action alternatives

All action alternatives include several plan components that set desired conditions for vegetation management that would maintain or improve potential Lewis's woodpecker habitat (Table 103) or the ecological conditions (coarse filter) required to support Lewis's woodpeckers. Descriptions in Table 103 paraphrase the actual components, to briefly illustrate the manner by which they may influence habitat. Please refer to the 2020 Forest Plan for the actual text of these components.

Table 103. 2020 Forest Plan components that would contribute to providing habitat for Lewis's woodpeckers

Plan Component	Area where plan component applies	Brief description of plan component
FW-VEGT-DC-02	Forestwide	Distribution of cover types, based on NRV includes increasing ponderosa pine and aspen/hardwood cover types, and maintaining or increasing nonforested inclusions. See HLC NF 2020 Forest Plan for details by broad PVT, and see individual GAs.
FW-VEGF-DC-01	Forestwide	Distribution of tree species presence, based on NRV: includes increasing ponderosa pine, aspen, and cottonwood. See HLC NF 2020 Forest Plan for details by broad PVT, and see individual GAs.
FW-VEGF-DC-02	Forestwide	Distribution of size classes, based on NRV: includes increasing abundance and distribution of large and very large size classes. See HLC NF 2020 Forest Plan for details by broad PVT, and see individual GAs.
FW-VEGF-DC-03	Forestwide	Distribution of density classes, based on NRV: includes increasing low/medium density class and decreasing high density class. See HLC NF 2020 Forest Plan for details by broad PVT, and see individual GAs.
FW-VEGF-DC-06	Forestwide	Desired conditions of snags by size class; see HLC NF 2020 Forest Plan.
FW-VEGF-GDL-01	Forestwide	Vegetation management projects would retain a minimum amount of large and very large trees based on DC. See HLC NF 2020 Forest Plan.
FW-VEGF-GDL-02	Forestwide	Vegetation management projects should retain a minimum amount of snags, specified by size and R1 Broad PVT. See HLC NF 2020 Forest Plan.
FW-FIRE-DC-01	Forestwide	Wildfire is allowed, as nearly as possible, to function in its natural ecological role.
BB/CA/CR/DI/EH/HI/ LB/RM/SN/UB-VEGT-DC-01; VEGF-DC-01, 02, and 03	All GAs, specific, quantified DCs identified for each GA	Distribution of cover types, tree species presence, size classes, and density classes for each GA based on NRV: generally includes increasing ponderosa pine and increasing or maintaining aspen/cottonwood, and increasing large size classes. Note that on Rocky Mountain Range GA there is little or none).
BB-WL-DC-02; DI-WL-DC-02; EH-WL-DC-03; UB-WL-DC-02	Big Belts, Divide, Elkhorns, Upper Blackfoot	Desired large, open, ponderosa pine and Douglas fir trees and snags within mosaic of other vegetation to provide nesting habitat for flammulated owls.

There are no species-specific plan components for Lewis's woodpecker. The plan components specific to flammulated owls (BB-WL-DC-02, DI-WL-DC-02, EH-WL-DC-03, and UB-WL-DC-02) would help to ensure habitat is managed in some areas for Lewis's woodpeckers, because the "landscape level-needs of the flammulated owl would probably accommodate any habitat-area needs of Lewis's woodpeckers" (Casey, 2000; Montana Natural Heritage Program & Montana Fish Wildlife and Parks). Site-specific habitat components, including interspersed shrubby understory, would be addressed appropriately at the project planning level.

The combined effects of the desired conditions for increasing abundance of large, old ponderosa pine and cottonwood stands, along with plan components that would guide managers to allow fire to play its natural role to the extent possible in some areas, and the site-specific plan components for flammulated owl, would ensure that lands managed by the HLC NF would contribute to persistence of Lewis's woodpeckers in the planning area over the long term.

Although Lewis's woodpeckers have been documented in recent years only in the Big Belts GA and on private land immediately adjacent to the Elkhorns and Divide GAs, the distribution of this species as mapped by the Montana Natural Heritage Program (Montana Natural Heritage Program & Montana Fish Wildlife and Parks) includes the entire HLC NF, with the possible exception of the Snowies GA. Estimates of Lewis's woodpecker habitat under all alternatives by GA were made using the SIMPPLLE model. As shown in appendix H, habitat is projected to increase over time to achieve a midpoint in the NRV in the Big Belts, Divide, Elkhorns, Highwoods, Little Belts, Rocky Mountain Range, Snowies, and Upper Blackfoot. Habitat increases in the Castles and Crazies to the upper end of the NRV range by decade 5. There is some differentiation in the rate and degree of habitat increases across alternatives which varies by GA. In all GAs, the model predicts a fairly rapid increase in habitat through decade 2, which levels off to a more gradual increase in decades 3 through 5.

Cumulative Effects

Cumulative effects for the Lewis's woodpecker would be the same as those addressed for other wildlife species in the terrestrial wildlife diversity section. Please refer to that section.

Conclusions

The 2020 Forest Plan includes components designed to maintain or increase the presence and distribution of habitat components (stands of large, old ponderosa pine trees and large snags used by Lewis's woodpeckers. Because of its location along the eastern/northeastern edge of the known distribution of this species, the HLC NF makes a key contribution to Lewis's woodpecker habitat by potentially preventing or reducing range contraction of the species. All alternatives would likely contribute to maintaining Lewis's woodpeckers in the planning area. By including desired conditions for the habitat components and ecological conditions required by Lewis's woodpeckers, and by including species-specific desired conditions for flammulated owls that would also provide for Lewis's woodpeckers, the action alternatives (alternatives B, C, D, E, and F) would likely provide greater assurance of Lewis's woodpeckers persisting in the planning area over the long term than would be provided under the no-action alternative (alternative A). Given the apparent lack of measurable differences among alternatives in terms of the trend and amount of predicted habitat, it seems likely that Lewis's woodpecker habitat may be affected at the forestwide and GA scales more by natural processes (fire and insects) than by management actions.

3.15 Elk

3.15.1 Introduction

This section addresses the status of elk in the planning area and the ability of the 2020 Forest Plan to provide habitat for elk on NFS lands primarily in the context of their availability for hunting, wildlife viewing, and other human uses and benefits. The 2012 Planning Rule (U.S. Department of Agriculture, Forest Service, 2012b) requires that NFs maintain or work toward restoring the ecological integrity of the planning area. Doing so includes maintaining the diversity of plant and animal communities within the planning area. For most wildlife species, including elk and other ungulates, a "coarse filter" approach of maintaining key vegetation communities and characteristics also provides for habitat required to maintain a species or animal community. Viability of elk and the persistence of elk populations in Montana and in the planning area are not of concern in Montana or on the HLC NF (U.S. Department of Agriculture, Forest Service & Montana Fish Wildlife and Parks, 2013). Information regarding the coarse filter ecological conditions in the planning area that would continue to support elk populations is described in the terrestrial wildlife diversity section (section 3.13). Maintaining elk presence on NFS lands for hunting, viewing, and other human-related purposes is dependent on maintaining elk for their contributions to the diversity of ecological communities as required by the 2012 rule, but requires an additional, more specific approach. This section provides information about elk and elk habitat management and components in the 2020 Forest Plan that will address that need. The analysis in this section also serves as a proxy for assessing the availability of habitat for some other big game species, such as white-tailed deer and mule deer that have broadly similar requirements and importance to the public.

The planning rule requires that NFs provide for ecosystem services and multiple uses, which include habitat for fish and wildlife communities, as well as opportunities for recreation and other uses. Elk are socially and economically important in Montana and in the planning area for a variety of reasons. Elk and the management of elk populations and habitat generate a great deal of public interest, and management of elk and elk habitat has generated comparable attention from land and wildlife managers. The MFWP manages elk populations, largely through establishing hunting seasons and limits. The FS manages some of the habitat used by elk. Forest management activities therefore have the potential to influence elk numbers or distribution, or elk hunting and viewing opportunities.

The planning rule acknowledges that some species, particularly those considered 'at-risk' species (federally listed threatened, endangered, proposed, and candidate species, and SCC), may require additional, species-specific plan components to ensure that the ecological conditions that provide for their persistence in the planning area are maintained or restored. Elk are not an at-risk species, but there is a great deal of public and agency interest in the distribution of elk and their availability on NFS lands, especially related to hunting opportunities. Public and agency concern has focused for many years on elk vulnerability to hunting, and more recently on elk use of adjoining private lands and availability for public hunting, all of which are related to management goals set by Montana Fish, Wildlife and Parks. Therefore, we will briefly discuss these management issues and evaluate the effects of the 2020 Forest Plan and alternatives on elk distribution and availability for recreation opportunities, including hunting. For more detailed information regarding elk status and management issues on HLC NF lands, refer to the Elk Status Report in the project file.

Changes between draft and final

The elk population trend data and associated maps, as well as data on hunter-days have all been updated to reflect more recent information collected by MFWP.

There is additional information clarifying use of terms such as 'elk security' and 'secure' areas, and added discussion regarding how these terms and concepts are used in this analysis. Additional context regarding use of hunter-days as an indicator has been provided as a result of comments received on this topic.

As described in the terrestrial vegetation and the terrestrial wildlife diversity sections, the terrestrial vegetation plan components and analysis provide and underpinning for the wildlife analysis. There were some key modeling improvements, plan component updates, and other analysis changes with regard to terrestrial vegetation between the DEIS and FEIS (see the Terrestrial Vegetation; Old Growth, Snags, and Coarse Woody Debris; and Timber sections for more details) that are referred to as needed in this section. There were also updates and corrections made to the modelling of elk hiding cover and elk winter cover that resulted in changes to those numbers between the DEIS and FEIS. Refer to Appendix H and the project file for details about the modelling inputs and processes.

3.15.2 Regulatory framework

Please refer also to the introductory regulatory framework section of this chapter (3.3).

The 1986 Helena NF Plan (U.S. Department of Agriculture, Forest Service, 1986) provides standards that set the framework for current management of elk on the portion of the HLC NF that was formerly the Helena NF. Forest-wide standards providing direction for elk habitat management there are identified on pages II/17 – II/21 of the Plan. The 1986 Lewis and Clark NF Plan (U.S. Department of Agriculture, Forest Service, Lewis and Clark National Forest, 1986) provides standards that set the framework for current management of elk on the portion of the HLC NF that was formerly the Lewis and Clark NF. Forest-wide standards for elk habitat management there are identified on pages 2-30 to 2-31.

3.15.3 Assumptions

The primary assumption underlying the analysis in this section is based on the 2012 Planning rule and the directives for implementing the rule: that plan components developed for ecosystem integrity and ecosystem diversity will provide for the ecological conditions necessary to maintain persistence of or contribute to the recovery of native species within the planning area (FHS 1909.12, 23.13). Therefore, we assume that effects to vegetation systems and characteristics as described in the terrestrial vegetation section provide the basis for understanding most of the potential effects to wildlife species, including elk, of the programmatic direction in the 2020 Forest Plan and alternatives. We also assume that the coarse filter approach as described in the Introduction above, and as discussed in the vegetation (section 3.8) and terrestrial wildlife diversity (section 3.13) analyses in this document, will retain representative habitats and seral stages needed for use by elk and other big game species.

The analyses discussed in this section rely on an analytical model (SIMPPLLE), which is described in the terrestrial vegetation section and in appendix H. The SIMPPLLE model uses “numerous assumptions to simplify ecosystem processes as well as treatment implementation” (terrestrial vegetation section, Assumptions section). We have also relied on a set of parameters established by the FS and MFWP to estimate existing elk habitat (U.S. Department of Agriculture, Forest Service, 2013b).

In this analysis, we assume that elk habitat is best modeled using what scientific literature and field examination identify as “typical” habitat for elk. Although our habitat models are simplifications of complex biological systems and therefore cannot be perfectly predictive, we expect that use of these general models will be applicable across all geographic areas and that they will be useful in determining elk/habitat interactions related to the plan and alternatives to it. Refer to appendix H for a full description of the model habitat parameters and processes used to estimate and predict elk habitat for this analysis.

We assume that there are relationships among management of elk habitat, elk population trend and distribution, and elk hunting opportunity, although these relationships are complex and changing. Because the focus of this analysis is on maintaining elk presence and distribution on NFS lands for hunting, viewing, and other human uses, we use hunter-days as one indicator of whether hunting opportunity is maintained (see “Elk, affected environment” section, “Indicators and scale of analysis” subsection below for more detail). Estimates of hunter-days are only available on a statewide scale; we assume those numbers provide a rough index for hunting opportunity on the HLC NF. Although hunter-days may increase up to a point if hunters are unsuccessful in encountering elk or other big game (an individual spends more time in search of game), we assume that occurs only as long as hunters anticipate a reasonable chance of success, i.e. if elk are known to be available and accessible. We also assume that when the opportunity to encounter or harvest an animal is or is perceived to be low, hunter-days are expected to be lower or decrease on average compared to when those opportunities are greater or perceived to be greater. Hunter-days are also affected both locally and statewide by many factors not related to forest management, but they are the only measure we have available for assessing hunting opportunity at any scale.

Elk population numbers are available only by hunting district; we assume that those numbers provide some indication of habitat conditions on NF lands within those hunting districts, where NF lands support elk for at least a portion of the year. Additional discussion of these indicators, assumptions, and relevance to the issues analyzed is provided below in the section titled "Indicators and scale of analysis", and in the analysis sections themselves.

Last, we assume that the discussion and analyses related to the Helena NF plan address the Elkhorn portion of the Beaverhead-Deerlodge NF that are included in this revision effort. Habitat data for those herd units that occur on the Beaverhead-Deerlodge NF portion of the Elkhorns are included.

3.15.4 Best available scientific information used

We have thoroughly reviewed the best available scientific information used it to inform the planning process and to develop of plan components. We used key information on the population, life history, status, and management issues of elk on and adjacent to the HLC NF from sources listed in the references section of this document, and in the Elk Status Report in the project file. Published, peer-reviewed articles and data in which reliable statistical or other scientific methods were used, where those were available. For best relevance, we relied on studies conducted in north-central or north-western Montana, western North America, or other areas with habitat conditions similar to those in the planning area, where those were available. When not available, we referred to information that considered conditions and/or issues similar to those in the planning area. The planning rule acknowledges that the best available scientific information may include expert opinions, inventories, or observation data prepared and managed by the FS or other agencies, universities, reputable scientific organizations, and data from public and governmental participation. We relied on those sources of information when published, peer-reviewed information was not available or to provide additional information specific to the planning area. Where needed in the assessment and in this section, specific discussion may be included regarding contradictory science, why some information is used to the exclusion of others, and regarding areas for which scientific information is lacking.

The information in this analysis uses information in the Assessment of the Helena and Lewis and Clark National Forests (U.S. Department of Agriculture, Forest Service, Northern Region, 2015) and in the Elk Status Report (project file), updated to consider applicable new information from monitoring and research.

3.15.5 Elk, affected environment

Indicators and scale of analysis

The issue being considered in this section is the extent to which the 2020 Forest Plan provides habitat on NFS lands to support elk for hunting and wildlife viewing. The analysis in this section supports and is supported by the analysis in section 3.13 regarding the importance of terrestrial wildlife species, including elk, as a contributor to ecological diversity and to animal communities per the 2012 Planning Rule (U.S. Department of Agriculture, Forest Service, 2012b). This issue (elk availability for human uses) also serves as a proxy for assessing the availability of habitat for some other big game species with broadly similar requirements and importance to the public, such as white-tailed deer and mule deer.

The most direct measure of the effectiveness of elk habitat management on NFS lands would be an evaluation of trends in elk numbers on NFS lands relative to specific measures of the quality and availability of seasonal habitats and specific habitat characteristics on those lands. However, these data do not exist at a scale where those comparisons can be made, nor across the planning area as a whole. Information on elk numbers and population trend are available at statewide and hunting district scales; data from hunting districts that overlap with the HLC NF are used here as a general indicator of the current overall health of the elk population and potential availability of elk in those areas.

Hunter-days were identified in the analysis for the 1986 Helena NF plan as one indicator of success in providing for desired opportunities identified in the plan. Hunter-days by hunting district for those districts that include NFS lands are used here as a general indicator of the existing opportunity to hunt elk (refer to the discussion in section 3.15.3 regarding Assumptions, above, and the section titled "Relationship to existing forest plans" below for more details about use of this indicator). Hunter-days and elk population trend both depend on complex interactions among habitat, climate and weather, hunting pressure and success rate, predation, elk behavior, human behavior, management of adjacent lands, and other factors.Therefore these indicators are only useful to describe the existing condition, and cannot be estimated nor predicted for the purpose of comparing alternatives in this analysis.

The terms 'elk security' and 'security area' have both been used as general concepts as well as to describe very specific habitat conditions defined for specific areas. To promote consistency in use of terms, Lyon and Christensen (1992) define 'elk security' as "the protection inherent in any situation that allows elk to remain in a defined area despite an increase in stress or disturbance associated with the hunting season or other human activities". They define 'security area' as "any area that will hold elk during periods of stress, because of geography, topography, vegetation, or a combination of those features" (ibid). The traditional concept of elk security habitat is aimed at providing adequate adult male elk survival while not limiting elk hunter opportunity (Kelly M. Proffitt, Gude, Hamlin, & Messer, 2013). Elk security in the 1986 Helena NF plan is a management concept that has established specific, numeric objectives for specified landscape features (combinations of vegetation structure and motorized access) to try to influence the outcome of hunting season. The areas managed under those parameters are usually referred to as 'security areas'. For the purposes of general discussion we will use the term as defined by Lyon and Christensen (1992). For the purposes of indicating existing condition relative to compliance with standards in the 1986 Helena NF plan (see Table 104) and accompanying discussion below), 'security areas' will refer to areas meeting the numeric parameters called for in that plan. For this analysis, the amount of area meeting the 1986 Helena NF plan criteria is used as one indicator of habitat condition that may contribute to the existing distribution and availability of elk on lands managed by the HLC NF. Secure areas that meet the parameters of the 1986 Helena NF are established when specific projects are planned and according to needs identified at that time. Therefore the amount and distribution of secure areas that might exist under the 2020 Forest Plan or alternatives cannot be estimated (refer also to discussion in the Environmental Consequences, section 3.15.6).

Hiding cover and winter/thermal cover are elements of habitat security that may be affected by components of the draft plan and could vary by alternative. These measures are discussed in this section as an indicator of habitat components that are contributors to the distribution and availability of elk on lands managed by the HLC NF. Hiding cover and winter/thermal cover can be estimated at a broad scale through the use of models to predict potential changes that could occur under the 2020 Forest Plan or alternatives.

Elk population size and trend

Elk population numbers are dynamic, but throughout Montana elk have generally increased in numbers and spatial extent since the early to mid-1900s (Montana Fish Wildlife and Parks, 2004), and have continued to do so since the 1986 forest plans were written. Statewide, elk numbers have increased from 8,000 in 1922 to 55,000 in 1978 to about 160,000 in 2004 (Montana Fish Wildlife and Parks, 2005). Approximately 134,447 elk were observed during counts in 2019 (http://fwp.mt.gov/fishAndWildlife/management/elk/).

Elk are counted by elk hunting districts or by elk management units, for which population and habitat objectives have been set (Montana Fish Wildlife and Parks, 2004). The HLC NF is within 40 elk/deer hunting districts, all of which extend to varying degrees beyond the NF boundaries. Although elk counts include non-NFS lands, they represent the best available estimates of elk numbers and, cumulatively over time, of the trend in numbers of elk using NFS lands. Elk counts are generally conducted as aerial surveys that are not intended to be complete counts but are designed to provide a minimum estimate of numbers, relative between-year comparison of total elk seen, and an indication of specific demographic segments.

Table 104 displays elk counts from 2019, by GA and by hunting district and elk management units, which are delineated in the Montana Statewide Elk Management Plan (Montana Fish Wildlife and Parks, 2004) and are the basis for population management and analysis used by MFWP. The table also indicates whether each unit is at, above, or below the established population objective.

Table 104. 2019 Estimated elk population and trend by (Montana Fish Wildlife and Parks, 2019b)

GAs included	Elk management unit	Hunting district(s)	Elk plan objective (observed elk)	2019 or most recent number elk observed	Status: over, at or below objective
Rocky Mountain Range	Bob Marshall	415	200	319	Over
		422[1]	500	983	Over
		424, 425, 442	2,500	2,107	At
		441	500	568	At
Elkhorns	Elkhorn	380	2,000	2,086	At
Big Belts	West Big Belt	392	400	289	Below
	Bridger	390	900	1,803	Over
		391	975	1,539	Over
	East Big Belt	446	950	2,184	Over
	Devils Kitchen	445, 455	2,500	4,029	Over
Crazies	Crazy Mountains	315	1,000	1,085	At
		580	975	4,170	Over
Castles	Castle Mountains	449, 452	600	1,207	Over
Little Belts	Little Belt	413	500	485	At
		416	475	819	Over
		418	150	298	Over
		420, 448	1,200	1,104	At
		432	325	384	At
		454	250	121	Below
		540	600	1,915	Over
Highwoods	Highwood	447	700	1,781	Over
Snowies	Snowy	W 411[3], 511	400	580	Over
		E 411, 530	400	6,624	Over
Upper Blackfoot	Bob Marshall	281	500-700	370	Below
	Granite Butte	293[3]	750	272	Below
		339, 343	1,400	1,695	Over
	Garnet	298[4]	600	865	Over
	Birdtail Hills	421, 423	500	661	Over
Divide	Deer Lodge	215	1400	2,650	Over
		318	500	562	At

GAs included	Elk management unit	Hunting district(s)	Elk plan objective (observed elk)	2019 or most recent number elk observed	Status: over, at or below objective
		335	600	780	Over
	Granite Butte	343[5]	1,400	1,695	Over

1. HD 422 includes part of Upper Blackfoot GA but is listed only once, under the Rocky Mountain Range GA, which includes the majority of HD 422.
2. HD 530 is now included in 411
3. HD 293 includes part of the Divide GA but is listed only once, under the Upper Blackfoot GA, which includes the majority of HD 293. Also, data for HD 293 include HD 284.
4 HD 298 inlcudes HD 290 with a combined population objective and count.
5. Data for HD 343 and 339 are combined in the Statewide Elk Trend Estimates data.

Population objectives for hunting districts or units are established by considering the history of long-term trend counts in an area, estimates of forage and other habitat capacity, input from the public, land managers, and community working groups, landowner tolerance, desired type of harvest, accessibility of elk to harvest, and other factors. Of 32 units that overlap HLC NFS lands and in which elk are counted and numeric objectives have been established, 20 (62.5%) are above objective, 8 (25%) are at objective, and 4 (12.5%) are below objective. Figure 21 shows the status of elk populations relative to established objectives for the entire state of Montana, by hunting district, for 2019.

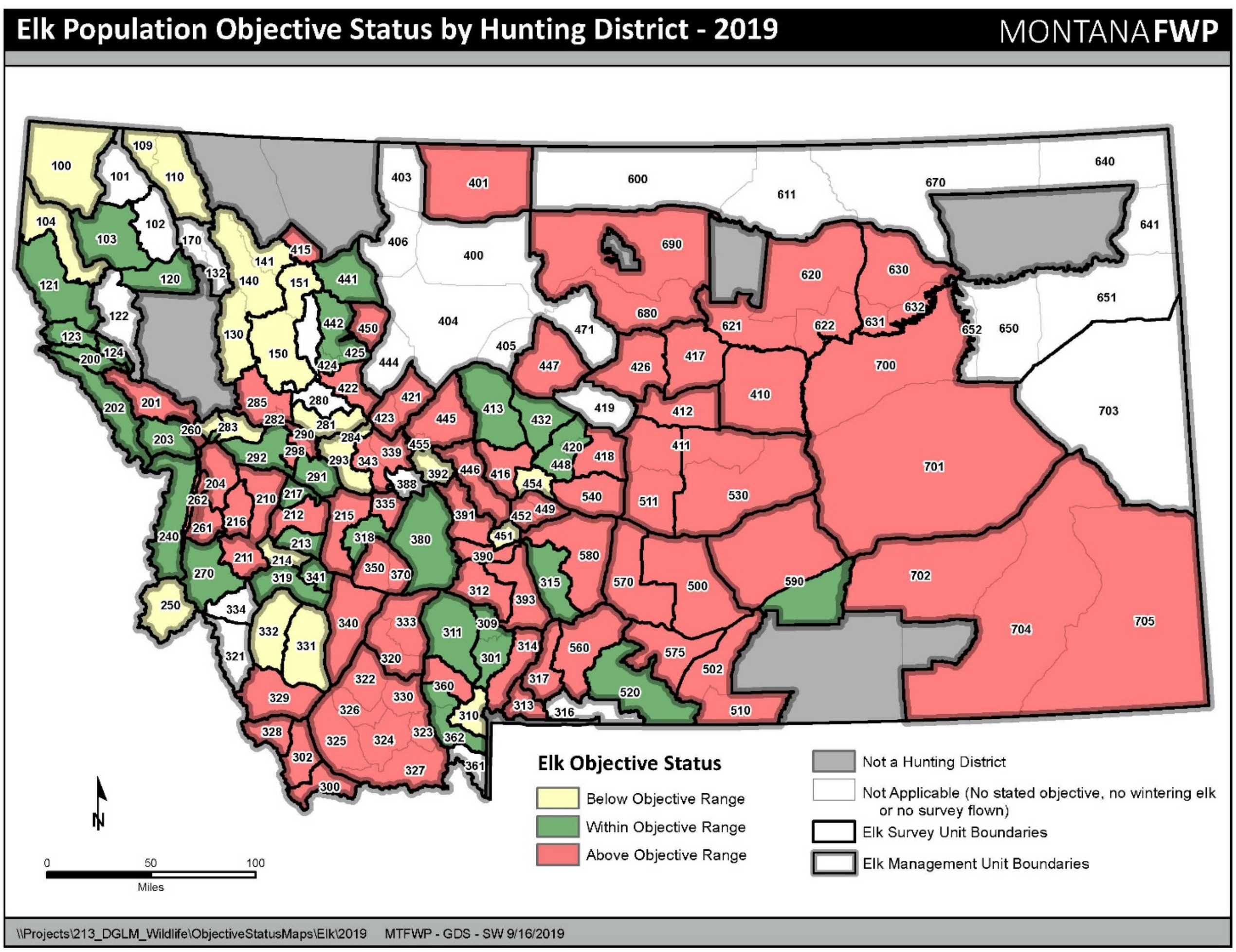


Figure 21. Elk population objective status by hunting district in 2019 (Montana Fish Wildlife and Parks, 2019c)

Elk populations in most of Montana are at or over objectives with a few areas, primarily in western and northwestern Montana, that are below objective. Elk populations that are significantly above established objectives pose management issues that are different but no less important than populations that are below (Montana Fish Wildlife and Parks, 2004). Consequently, since 2015 Montana has had elk shoulder seasons (a firearms hunting season that occurs outside the 5-week general firearms and archery hunting seasons) on private lands within some hunting districts in an effort to bring elk numbers in line with population objectives. Statewide, 57 (34%) of 165 hunting districts had elk shoulder seasons scheduled for the 2019-2020 period. Across the plan area, 18 of 40 (45%) hunting districts had shoulder seasons for the 2019-2020 period (Montana Fish Wildlife and Parks, 2019a). Refer to the "Relationship to 1986 Forest Plans" section below for more discussion about the role of private lands in elk management issues.

Relationship to 1986 Forest Plans

The existing (1986) Helena NF and Lewis and Clark NF plans identified elk population potential as a major issue during plan development and discussed elk populations relative to hunting opportunity. The elk population potential identified for both plans was based on population goals identified in the Northern Regional Plan (U.S. Department of Agriculture, Forest Service, 1981), which were in turn based on the 1978 Montana Statewide Comprehensive Outdoor Recreation Plan (Montana Fish Wildlife and Parks, 1978). The latter included goals of protecting and perpetuating "elk and their habitat and to increase the supply of available, harvestable elk to meet demands for hunting and nonhunting recreation" (Montana Fish Wildlife and Parks, 1978). All of these plans were developed at a time when elk numbers were markedly lower than they are currently (roughly 30%-40% of current numbers statewide), logging was increasing on NFS lands particularly in western Montana, and concerns were being raised by the public and biologists about the potential impacts to elk of logging and of roads created for logging and used by hunters.

The elk population capacity of lands under management of the Helena NF at the time the 1986 plan was written was estimated at 6,300 elk in summer and 3,300 in winter, with a maximum capacity estimated at 8,500 for both seasons (U.S. Department of Agriculture, Forest Service, 1986). The elk population capacity of lands under management of the Lewis and Clark NF at the time the 1986 plan was written was estimated at a maximum of 12,500 elk (U.S. Department of Agriculture, Forest Service, Lewis and Clark National Forest, 1986). The estimate of elk using Helena NF lands around the time of the 1986 plan was roughly 5,000 elk, and using Lewis and Clark NF lands in 1984 was 8,500 elk. Analysis for both plans predicted the same (Lewis and Clark NF) or slightly fewer (Helena NF) elk would use NFS lands in summer by the end of five decades after implementation. The Helena NF plan predicted that the number of elk wintering on NFS lands would increase over time.

Summarizing from Table 104 above, MFWP counts in 2019 showed over 17,000 elk within the hunting districts that largely overlap the Helena NF, and over 28,000 elk within the hunting districts that overlap the Lewis and Clark NF. Not all of those elk use NFS lands, but those estimates indicate that elk numbers have exceeded the targets and maximum capacities identified in the analyses for the 1986 Forest Plans.

The 1986 Helena NF plan used hunter-days as an indicator of how well the plan might achieve objectives for elk harvest opportunity. The 1986 Helena NF plan estimated nearly 48,000 hunter-days were available at that time; the 1986 Lewis and Clark NF plan did not estimate hunter-days at that time. Table 105 shows the estimated number of hunter days by GA since 2004; hunter days shown in the table are calculated by hunting districts, which usually include some amount of non-NFS lands.

Table 105. Estimated elk hunter days by GA 2004-2018 (Montana Fish Wildlife and Parks, 2019b)

GA (hunting districts included)	Average hunter days 2004-2018	Range of hunter days 2004-2018	Trend
Big Belts (390, 391, 392, 445, 446)	38,850	27,141 – 54,328	Stable to increasing
Divide (215, 318, 335, 343)	46,193	33,023 – 59,568	Stable to increasing
Elkhorns (380)	24,553	17,384 – 31,786	Increasing
Upper Blackfoot (281, 284, 293, 298, 339, 343, 421, 423)	46,450	36,275 – 50,603	Stable
Former HNF portion Subtotal	*156,046*	*na*	*na*
Castles (449,452)	6,872	4,341 – 11,237	Increasing
Crazies (315, 580)	14,041	10,203 – 18,640	Increasing
Highwoods (447)	4,707	3,023 – 7,441	Stable to Increasing
Little Belts (413, 416, 418, 420, 432, 448, 454, 540)	41,935	30,315 – 51,593	Stable to Increasing
Rocky Mountain Range (424, 425, 441, 442)	17,258	12,010 – 20,834	Stable to Increasing
Snowies (411, 511, 530)	11,949	6,092 – 19,532	Increasing
Former LCNF portion Subtotal	*96,762*	*na*	*na*

The 1986 Helena NF plan projected 43,100 hunter-days per year by the fifth decade (i.e., beginning in 2026) of implementation (U.S. Department of Agriculture, Forest Service, 1986). Elk hunter-days on hunting districts that include the Helena NF have increased to approximately 173,521 days in 2018 (see project record and http://fwp.mt.gov/hunting/planahunt/harvestReports.html), and have averaged over 156,047 hunter days annually between 2004 and 2018. The 1986 Lewis and Clark NF plan projected 63,700 hunter-days per year by the fifth decade (beginning in 2026) of implementation. Elk hunter-days on hunting districts that include the Lewis and Clark NF have increased to approximately 109,368 days as of 2018 (ibid) and have averaged over 96,763 hunter days annually between 2004 and 2018. Not all of these hunter-days occur on HLC NF lands; as described in the "Assumptions" section above (section 3.15.3), hunter days may increase if game is more difficult to obtain, but only up to the point where hunters continue to perceive that game are available and accessible. Total hunter-days are also influenced by other factors (refer to section 3.15.3, Assumptions), but as an indicator of the recreational opportunity associated with elk hunting, they show that this opportunity has increased beyond what was anticipated in the analyses for the existing plans.

Elk habitat status

In management and literature, the discussion of the potential impacts to elk from land management practices, hunting, wildlife viewing, and the presence of people in elk habitat has generally focused on seasonal habitat needs. Therefore, we have organized this section by seasonal habitat categories.

Elk summer habitat

Elk summer habitat includes a mix of cover and foraging areas, often including riparian areas (Ward Thomas, Black, Scherzinger, & Pedersen, 1979). Elk may use a variety of vegetation types, including conifer and hardwood forests, grasslands, alpine zones, and stream and valley bottoms. Some research suggests that the quality of summer forage may be the most important variable in determining annual variation in herd growth (J. G. Cook, 2002; J. G. Cook et al., 1996; K. M. Proffitt, Hebblewhite, Peters, Hupp, & Shamhart, 2016; Stewart, Bowyer, Dick, Johnson, & Kie, 2005).

Generally, the resources that elk need to thrive on summer range are well distributed across mid to high elevation habitats on NF lands across western and central Montana. Elk summer habitat on the HLC NF has not been specifically mapped or quantified because of the generalist nature of elk summer habitat use. Elk, as most wildlife species, may not find all habitat and resources equally available at all times, due to a variety of factors that include disturbance or displacement from nearby habitats, competition from domestic livestock, and changing vegetation patterns. Hiding cover, defined as "vegetation capable of hiding 90 percent of a standing adult elk from the view of a human at a distance equal to or less than 200 feet" (J. L. Lyon & Christensen, 1992) has often been used as an indicator of summer habitat quality (J. W. Thomas, 1979), assuming that adequate hiding cover may increase the ability of elk to use summer habitat by providing areas where they can rest, forage, and regulate body temperature without disturbance or displacement caused by humans or predators. Some research has pointed to the importance of forage quality and availability on summer and fall elk range as key to elk reproduction and year-round survival (J. G. Cook, Irwin, Bryant, Riggs, & Thomas, 2005; DeVoe, Proffitt, Mitchell, Jourdeonnais, & Barker, 2018). Various sources have recommended managing for a variety of mixtures of hiding cover, thermal cover, and foraging areas, depending on characteristics of the area under consideration (J. W. Thomas, 1979). However, habitat relationships on summer range are far more complex than can be defined by cover/forage ratios (Leege, 1984), making management recommendations for specific cover/forage ratios difficult and of questionable value.

Elk fall habitat and habitat security

Habitat used by elk in fall is variable and is dependent on annual and seasonal changes in forage availability, weather and climate, hunting pressure, predation, and other factors. For those reasons, it is not useful to attempt mapping specific fall habitat for elk on the HLC NF. Instead, elk habitat management during the fall has generally attempted to achieve a balance between conditions that allow elk to be available to hunters, and conditions that provide elk with habitat security that minimizes their risk of displacement by or mortality from hunters. Elk security has been defined as "the protection inherent in any situation that allows elk to remain in a defined area despite an increase in stress or disturbance associated with the hunting season or other human activities" (J. L. Lyon & Christensen, 1992). The concept of elk security habitat as applied in practice is usually aimed at providing adequate adult male elk survival while not limiting elk hunter opportunity (Kelly M. Proffitt et al., 2013).Security may be affected by vegetation, topography, road density, distance from roads, size of vegetation blocks, hunter density, season timing, and land ownership, as well as road use type and levels, weather, and other factors.

Management concerns in the past have been related to elk vulnerability to hunting as a result of logging activity and human access created by logging roads on NFS lands. Concerns about those impacts emerged largely from western Montana and some other western states during a time in which elk populations were lower than desired or were perceived to be declining in those areas (L. J. Lyon et al., 1985). During that same period, the pace and scale of logging activity had increased on NFS lands, and there was concern that logging and the access created by roads associated with logging were increasing elk vulnerability to harvest to potentially unacceptable levels. Concerns focused on elk distribution and movements on a drainage or watershed scale.

Research from several areas in Montana addressed the potential for logging roads and activity on them to disturb or displace elk and increase their vulnerability to harvest, and provided recommendations for management of elk habitat on NFS lands where logging was occurring (L. J. Lyon et al., 1985). Several studies since then have documented effects of roads on habitat providing elk security, as well as on elk population structure and hunter success (Edge & Marcum, 1991; Gratson & Whitman, 2000; Gucinski, Furniss, Ziemer, & Brookes, 2001; Leptich & Zager, 1991; Unsworth & Kuck, 1991). Those studies found that open roads can influence elk distribution during the hunting season, and that targeted road closures can lower the elk harvest rate in some areas. Other research (Preisler, Ager, & Wisdom, 2006;

Kelly M. Proffitt et al., 2013; M. J. Wisdom et al., 2005) (DeVoe et al., 2018; Preisler et al., 2006; Kelly M. Proffitt et al., 2013; M. J. Wisdom et al., 2005) has indicated that factors such as topography, cover, forage quality and quantity, and hunting pressure on adjoining lands can all affect the degree to which roads and road management influence elk movements and distribution on public lands.

The role of hiding cover as a component of elk security varies depending on other characteristics of an area, as well as on both elk and human behavior patterns. Some studies have emphasized cover as a key habitat component for elk in the fall and have attempted to quantify its contribution to security as a counterweight to open road density (L. J. Lyon, 1979); Perry and Overly 1976). Most managers and researchers, however, have concluded that the influence of cover can easily be outweighed by hunting pressure on public lands, by the availability of un-hunted or very lightly hunted areas ("refuges") nearby, by the availability of high quality forage nearby, or by a combination of those factors (Christensen, Lyon, & Unsworth, 1993; Henderson, Sterling, & Lemke, 1993; J. L. Lyon & Canfield, 1991; J. L. Lyon & Christensen, 1992; Kelly M. Proffitt et al., 2013; Skovlin, Zager, & Johnson, 2002; Ward Thomas et al., 1979) (DeVoe et al., 2018; Montana Fish Wildlife and Parks, 2015).

The abundance, distribution, and importance of hiding cover is less well understood in the less forested elk ranges across much of central and eastern Montana as compared to the dense forest environments of western Montana and northern Idaho (Hillis et al., 1991) where much of the research on elk security and hiding cover has taken place. Most research and recommendations regarding elk security, hiding cover, and managing elk vulnerability during the hunting season cautions against applying results and recommendations from any one area too broadly, and most scientists and managers recommend analysis specific to the site or area that considers the many factors influencing elk vulnerability in a given area (Hillis et al., 1991; L. J. Lyon et al., 1985).

The movement of elk early in the fall from accessible NFS lands to remote areas or to adjoining private lands that receive little or no early hunting pressure has been an increasing concern in MT with respect to hunter success rate throughout the fall, and with respect to elk population objectives and other issues(Montana Fish, 2015) (Montana Fish, Wildlife and Parks, 2015). Some studies in Montana have concluded that many elk move to private land that is lightly hunted or not hunted, rather than remain in security areas (defined as areas that hold elk during periods of stress (J. L. Lyon & Christensen, 1992)) or other areas on public land (Burcham, Edge, & Marcum, 1999; Kelly M. Proffitt et al., 2013). Ranglack et al. (2017) found that hunter access and effort were primary factors influencing elk movement and distribution during hunting season in their study area in southwest Montana, and that availability of nutritional resources may also be important to female elk distribution at that time. Devoe et al. (DeVoe et al., 2018) found that availability of high-quality forage on private agricultural lands may be a driving factor in elk movement to those lands during archery hunting season in their study area in SW Montana. In north-central Montana, private lands near or adjacent to lands managed by the HLC NF may provide high quality forage in the form of irrigated cropland, hay stores, etc., in addition to experiencing little or no public hunting pressure, all of which likely influence elk movement and distribution. Although Ranglack et al. (2017) suggest that public land managers can attempt to manipulate hunter access, hunter effort, canopy cover, and motorized routes in order to influence elk distribution during hunting season, they acknowledge that increases in hunter effort or use of motorized routes during hunting season "may encourage elk to select for areas that restrict public hunter access and result in a redistribution of elk away from public lands." Elk appear to be moving in increasing numbers to private land refuges and are doing so regardless of the level of security provided on NFS lands (Montana Fish, 2015). Population increases and elk numbers over objective, as discussed earlier in this section, appear to be caused in part by the inability of elk harvest on public lands to reduce elk numbers sufficiently to reduce population growth (Kujala, Q., and Gude, J. MFWP, Pers. Comm. 2017 filed in project record).

Elk winter habitat (winter range)

Traditionally, the availability of suitable winter range has been seen as the key limiting factor for most elk populations (Polfus, 2011) (J. L. Lyon & Christensen, 2002). Winter ranges are usually smaller than summer ranges, supply less forage, provide less forest cover, often lie closer to sources of human disturbance, are often grazed by domestic livestock, and are occupied by elk when temperatures are low and snow may limit access to forage. Winter ranges have been identified and mapped by both the FS and by MFWP, but areas used by elk in winter vary over time and based on factors such as forage availability, snow depth and characteristics, disturbance by humans, and characteristics of adjacent private lands. Managing for wintering areas with minimal human activity and adequate forage can help reduce energy costs associated with over-winter survival (Skovlin et al., 2002). On the other hand, recent studies suggest that even though natural mortality is usually higher on winter ranges than for other seasonal habitats, the probability of elk surviving a given winter is directly linked to the quality of nutrition on spring, summer, and fall habitat (J. G. Cook, 2002). In other words, elk over-winter survival may be tied as much or more to the condition of elk as they enter the winter months than to the quality or abundance of forage available to sustain them during the winter.

For several decades, thermal cover and forage have been the two habitat elements of greatest management concern on big game winter ranges. In winter, forested patches curtail snow accumulation, block wind, and can moderate microsite temperature. However, although thermal cover was widely accepted as a key component of elk winter range in the 1970s and 1980s (J. W. Thomas, 1979) (Beall 1976) more recent research (Skovlin et al., 2002) has concluded that thermal cover as traditionally defined may not be a critical factor to elk on most winter ranges in Montana. Thompson and others (2005) indicate that general forest cover on Montana elk winter ranges may be important in some areas to reduce elk energy expenditure and improve access to forage during times when deep or crusted snow have made higher quality forage unavailable. Forest cover as described by Thompson and others (2005) is not defined as a specific type and amount of canopy cover as thermal cover has traditionally been defined, but rather is described generally as a cover/forage mosaic.

Relationship to 1986 Forest Plans and seasonal habitat status in the planning area

Elk summer habitat

The 1986 Helena NF and Lewis and Clark NF Plans both use hiding cover as the primary determinant of summer habitat capability. The 1986 Helena NF Plan includes a standard requiring that hiding cover is to be maintained at or above 35 percent (measured by ground surveys) or 50 percent (measured using crown closure) of the elk summer range within each herd unit (U.S. Department of Agriculture, Forest Service, 1986) with a 40 acre minimum patch size. The 1986 Lewis and Clark Plan requires that “effective hiding cover” as defined in that plan be maintained within a drainage or herd unit when implementing projects involving significant vegetation removal (U.S. Department of Agriculture, Forest Service, Lewis and Clark National Forest, 1986).

Table 106 summarizes the status of hiding cover by GA, which reflects the scale at which the ability of the 2020 Forest Plan (and alternatives) to provide hiding cover is measured in the “Environmental Consequences” section (3.15.6). Methods for calculating hiding cover are described in the project file. Two estimates of hiding cover are shown. The first is calculation using the same methods that have been used for project-level analysis. The second is using the SIMPPLLE model, to allow comparisons with predictions made for hiding cover under the 2020 Forest Plan and alternatives (see environmental consequences section). Although both estimates are based on methods outlined in the USFS and MFWP Collaborative Recommendations for Big Game Habitat Management on the Custer, Gallatin, Helena, and Lewis and Clark National Forests (U.S. Department of Agriculture, Forest Service & Montana Fish Wildlife and Parks, 2013), the project-type calculation uses basic queries of vegetation data whereas the SIMPPLLE model estimates are based on a more complex interaction of parameters (see project file, terrestrial vegetation section, and appendix H for information about SIMPPLLE). Estimates of hiding cover differ based on the method of calculation and are provided solely for the purpose of comparison rather than as established amounts of hiding cover and therefore should not be used for purposes other than the general comparisons made in this section.

Table 106. Elk hiding cover by geographic area

GA	Total acres - all ownerships	Total acres hiding cover - all ownerships (% of GA) map calculation	Total acres hiding cover - all ownerships (% of GA) SIMMPPLE model calculation
Big Belts	452,292	130,595 (29%)	52,950 (12%)
Castles	79,862	32,716 (41%)	79,892 (26%)
Crazies	70,036	17,658 (25%)	9,120 (13%)
Divide	232,890	76,015 (33%)	61,960 (27%)
Elkhorns	175,259	65,876 (38%)	19,670 (11%)
HIghwoods	44,495	3,251 (7%)	6,250 (14%)
Little Belts	900,961	554,599 (62%)	125,470 (14%)
Rocky Mountain Range	782,986	263,367 (34%)	59,770 (8%)
Snowies	121,897	68,862 (56%)	12,930 (11%)
Upper Blackfoot	348,185	127,697 (37%)	125,460 (36%)

Both 1986 plans apply measures of hiding cover at an elk herd or drainage scale, which is the recommended scale for planning and analysis (U.S. Department of Agriculture, Forest Service & Montana Fish Wildlife and Parks, 2013). The information in Table 106 is provided here for the purpose of evaluating the existing condition at a scale appropriate for analysis of the programmatic level 2020 Forest Plan and alternatives. Information about the existing status of hiding cover at the scale of elk analysis units (Helena NF portion of the HLC NF) or drainage (Lewis and Clark portion of the HLC NF) is in the Elk Status Report in the project file.

The role of hiding cover within each GA in retaining elk on public land is not known and depends on a numerous local or site-specific conditions, as discussed in the sections above.

Elk fall habitat and security

Elk hiding cover is generally calculated for the spring/summer/fall period. Concerns regarding hiding cover are generally expressed in terms of elk vulnerability during the fall hunting season, although as noted previously hiding cover is likely not an accurate indicator of functional elk security or vulnerability. Nevertheless, compliance with 1986 Forest Plan standards is one way to characterize the current status of this habitat component. Estimates of hiding cover made according to protocols identified in the 1986 Lewis and Clark plan indicate that 54 of 75 (72%) of 6th code hydrologic units and 109 of 144 (76%) of 7th code Hydrologic Units on the Lewis and Clark portion of the HLC NF meet existing summer/fall hiding cover numeric standards (refer to the Elk Status Report in the project file for details). These calculations were made for the entire Lewis and Clark NF portion, although the hiding cover standard in the 1986 Lewis and Clark NF Plan states that it applies only to "projects involving significant vegetative removal", or in specific Management Areas unless the area is inherently incapable of meeting hiding cover standards (U.S. Department of Agriculture, Forest Service, Lewis and Clark National Forest, 1986). Nevertheless, these numbers provide an indication of the existing condition of hiding cover across the Lewis and Clark NF portion of the HLC NF.

The 1986 Helena NF Plan includes a standard for managing elk vulnerability during the hunting season [big game standard 4a (U.S. Department of Agriculture, Forest Service, 1986))] using an index that combines open road density and hiding cover. The Lewis and Clark 1986 Plan does not include a combined hiding cover/open road density requirement, although it refers to and includes as an appendix the 1982 Montana Fish and Game Commission Road Management Policy (U.S. Department of Agriculture, Forest Service, Lewis and Clark National Forest, 1986), which includes guidance of that nature.

Table 107 displays the amount of area in each GA that meets criteria for 'secure areas' used by the Helena NF portion of the HLC NF for project planning and analysis under the 1986 plan and as defined by Hillis et al (Hillis et al., 1991): areas that are at least 250 acres in size and at least one-half mile from roads that are open to the public during the archery and rifle general hunting season (between September 1 and December 1). In practice, the size and specific characteristics of areas that are effective in providing security for elk varies by elk herd unit based on a number of factors (U.S. Department of Agriculture, Forest Service & Montana Fish Wildlife and Parks, 2013)), and scientists and managers emphasize that "strict adherence to the guidelines should be avoided" (Hillis et al., 1991). The estimates in Table 107 are provided not as an absolute estimate of secure habitat, but as an index of the amount of habitat that has some potential to provide security to elk and other big game on the HLC NF currently.

Table 107. Elk secure areas by geographic areas

GA	Total acres (all ownerships)	Secure area[2] acres	Percent in secure areas
Big Belts	452,292	116,977	26%
Castles	79,862	15,796	20%
Crazies	70,036	26,240	37%
Divide[1]	232,890	69,224	30%
Elkhorns	175,259	73,629	42%
HIghwoods	44,495	25,713	58%
Little Belts	900,961	281,663	31%
Rocky Mountain Range	782,986	608,475	78%
Snowies	121,897	82,607	68%
Upper Blackfoot[1]	348,185	187,255	54%

[1] Both the Divide and Upper Blackfoot GAs have used different methods to measure and manage for secure areas, developed through coordination with MFWP during the respective travel planning revision efforts. For the purposes of analysis, the basic Hillis methodology is used here.

[2] 'Secure areas' here are measured using the convention of areas that are ≥250 acres in size and ≥ ½ mile from a road open during the archery and general rifle hunting seasons.

Percentages of secure areas range from 20% of the Castles GA to 78% of the Rocky Mountain Range GA. The high percentage of secure habitat in the Rocky Mountain Range is to be expected given the preponderance of designated wilderness and the lack of roads within that GA.

The 1986 Helena NF plan's standard for big game security (standard 4a) is based on a ratio of hiding cover and road density calculated and applied at an elk herd unit scale. Of 40 elk herd units (37 on the Helena NF and 3 on the Beaverhead-Deerlodge portion of the Elkhorns GA that is included in the planning area), 15 (38%) currently meet the 1986 Helena NF plan standard for big game security during the fall hunting season. As discussed above, the purpose of the standard is to achieve a specific harvest outcome; level of security on public lands has not proven to be a reliable indicator of overall elk availability or distribution on public lands during the hunting season where private land 'refuges' are available (Burcham et al., 1999; Montana Fish, 2015; Kelly M. Proffitt et al., 2013; Ranglack et al., 2017).

Another measure of potential habitat security for elk is the amount of area with certain management designations that limit motorized travel or other uses that can disturb or displace elk. Section 3.16.6, Recreation Settings (Table 112) describes the amount of each GA that is currently categorized in Recreation Opportunity Settings (ROS) that are non-motorized. Between 24% (Castles GA) and 93% (Rocky Mountain Range GA) of individual GAs is in primitive, or semi-primitive non-motorized ROS categories. The location and distribution of areas with these categories at the elk herd unit or drainage scale is important at the level of on-the-ground planning and management, but the information provided in Table 112 provides another index of the existing status of potentially secure habitat for elk on the HLC NF.

Elk winter range

The 1986 Helena NF Plan requires that thermal cover on winter range be maintained at 25 percent in blocks of at least 15 acres. Thermal cover is described as stands of trees greater than or equal to 40 feet high with at least 70 percent canopy closure (J. L. Lyon & Christensen, 1992) and that presence of forest cover in general may adequate. For that reason, general forest cover on winter range was modelled the SIMPLLE model and based on a broader definition of winter cover (refer to Appendix H and the project file for details) to get an estimate of forest cover that may provide some benefit to elk, as described by more recent research and review.(J. G. Cook et al., 2005)

Table 108 summarizes the status of thermal cover as defined in the 1986 Helena NF plan, and winter cover as modelled using SIMPPLLE, for mapped winter range by GA. Although winter range extends outside of the NF boundary, only the portion within the boundary is considered in this analysis. Private land on winter range within the forest boundary (i.e. inholdings) is included in the calculations. Thermal cover was calculated using the same methods as for project-level analysis. The SIMPPLLE model estimates for winter cover were made using parameters identified in the MFWP/FS collaborative recommendations for elk habitat on the east-side forests (Montana Fish Wildlife and Parks, 2013); refer to Appendix H and to the terrestrial vegetation section for more information about SIMPPLLE. The SIMPPLLE model estimates allow comparisons with predictions made for winter cover under the 2020 Forest Plan (see environmental consequences section, appendix H, and the Elk Status Report in the project file).

Table 108. Elk thermal and winter cover on winter range by geographic area

GA	Total acres (all ownerships)	Total acres winter range (all ownerships)	Total acres thermal cover winter range (all ownerships)	Percent thermal cover on winter range (all ownerships)	Total acres winter cover estimated by SIMPPLLE model	Percent winter cover on winter range (SIMPPLLE model)
Big Belts	452,292	223,000	85,466	19%	75,640	33%
Castles	79,862	25,892	10,889	14%	10,320	40%
Crazies	70,036	40,378	22,927	33%	15,550	39%
Divide	232,890	130,005	96,503	41%	92,640	71%
Elkhorns	175,259	90,136	50,629	29%	37,840	42%
HIghwoods	44,495	40,619	25,778	58%	28,550	70%
Little Belts	900,961	152,694	87,937	10%	64,950	43%
Rocky Mountain Range	782,986	167,150	71,568	9%	97,210	58%
Snowies	121,897	11,775	8,938	7%	8,620	73%

GA	Total acres (all ownerships)	Total acres winter range (all ownerships)	Total acres thermal cover winter range (all ownerships)	Percent thermal cover on winter range (all ownerships)	Total acres winter cover estimated by SIMPPLLE model	Percent winter cover on winter range (SIMPPLLE model)
Upper Blackfoot	348,185	131,825	99,910	29%	112,810	86%

The standard for thermal cover in the 1986 Helena NF plan is calculated and applied at the scale of the elk herd unit. Estimates of thermal cover provide a reference to assess compliance of the existing condition of this specifically defined habitat component with the 1986 Helena NF plan on the former Helena NF portion of the planning area. Of the 24 total elk herd units (21 on the Helena NF and 3 on the Beaverhead-Deerlodge portion of the Elkhorns GA that is included in the planning area) that include identified winter range, none currently meet the standard for thermal cover (refer to the Elk Background Report in the project file for estimates of thermal cover by herd unit). For most areas this is due to vegetation and site characteristics and reflects the lack of inherent capability of those areas to provide thermal cover that meets the specific characteristics derived from other areas. Using the more general definition of winter cover, however, it appears that most GAs have significant amounts of forest cover on winter range that may provide thermal relief and other needs for wintering ungulates.

Stressors under FS control

Vegetation management can influence elk distribution and potentially elk numbers in a given area by affecting both forage and cover. Livestock grazing can affect forage, and some research has suggested that elk may be displaced from some habitats by the presence of domestic livestock (M. J. Wisdom et al., 2005). Motorized travel on roads and trails can displace elk from some habitats and can increase vulnerability of elk to hunting mortality by allowing greater access by hunters into elk habitat. Non-motorized travel can also disturb or displace elk in some areas, depending on a variety of factors related to both the type and amount of travel/use, characteristics of habitat, time of year, and others (e.g., (Naylor, Wisdom, & Anthony, 2009)).

Stressors not under FS control

Insects, disease and fire can all affect vegetation characteristics in elk habitat and lead to changes in cover and forage. Those forces often increase the amount and palatability of forage by opening forest canopy but can reduce available cover. Conversely, extensive blowdown associated with fire, insects, and disease can provide 'cover' by making areas inaccessible to hunters. Both weather and climate affect the availability and quality of forage. Management of non-NFS lands, particularly those adjoining NFS boundaries, can affect elk distribution by providing refuges from hunting and by providing high-quality forage in the form of hay and irrigated cropland. Those factors can in turn affect elk population trend by increasing growth rates and/or reducing vulnerability to hunters and other predators.

3.15.6 Elk, environmental consequences

Effects common to all alternatives

The terrestrial vegetation section shows that vegetation conditions for those types used by elk would likely move toward more open forest densities under all alternatives. Because elk are a habitat generalist, and because distribution of elk is driven by the varying and complex interactions among forage availability, weather and climate, and hunting and other predation pressure, the number and distribution of elk on NFS lands is unlikely to differ among alternatives. All alternatives would provide forage and cover for elk to a similar degree, as discussed in the terrestrial wildlife diversity section on species associated with grass/shrub, dry conifer, and mixed conifer vegetation types. Under all alternatives, mortality of elk would continue to be influenced primarily by hunting and in some areas by predation, neither of which would differ by alternative.

A great deal of management and public attention has been focused on the concept of elk security and its potential effect on elk distribution and on hunting opportunity (Burcham et al., 1999; Christensen et al., 1993; Hillis et al., 1991; L. J. Lyon et al., 1985; Montana Fish, 2015). As described in the affected environment section above, hiding cover can be one component of security, which also may depend on topography, road density, distance from roads, timing and use level of roads, hunter density, season, forage availability and other factors. The HLC NF manages vegetation, which can affect hiding cover (see below), and access via roads. The pattern (density), timing, and season of use of roads on the HLC NF are determined by travel management, which is a site or area-specific decision that occurs separately from forest planning. The 2020 Forest Plan and alternatives, including the no-action alternative, do not differ in terms of the amount, density, or timing and season of use of open roads.

Spring/summer/fall hiding cover

As discussed above in the affected environment section, hiding cover has been considered an important component of elk habitat because it allows elk to use areas for bedding, foraging, thermal relief, and other functions (J. L. Lyon & Christensen, 1992) with reduced potential for disturbance or displacement . Because hiding cover has been the focus of management in the past, and because it is considered to be an important habitat element used by elk, we used the SIMPPLLE model to estimate potential hiding cover under all alternatives. Cover in winter was modelled separately from that for spring/summer/fall, following guidance described in the collaborative FS and MFWP recommendations for elk management (U.S. Department of Agriculture, Forest Service & Montana Fish Wildlife and Parks, 2013). Estimates of hiding cover are based on vegetation characteristics, with predicted natural disturbance incorporated into the model, as well as predicted vegetation management under each alternative (details of the model parameters and process are available in appendix H and in the project file). Plan components related to management for elk habitat security or distribution during the hunting season (Alternatives A, B, D, and F) would be applied at the time projects or activities are planned and may or may not affect management of vegetation that provides hiding cover. Therefore the size, location, and type of potential actions cannot be predicted at the framework programmatic scale of this analysis and cannot be incorporated into the SIMPPLLE model. Results are displayed in the figures below. Although some results vary by alternative, most are similar across all alternatives. Therefore, all alternatives are shown below in order to facilitate comparison.

Figure 22 shows the predicted average spring/summer/fall hiding cover by alternative and GA, including the estimated NRV for hiding cover in each GA. This figure displays the average hiding cover estimated currently, and the average predicted across all five decades modelled.

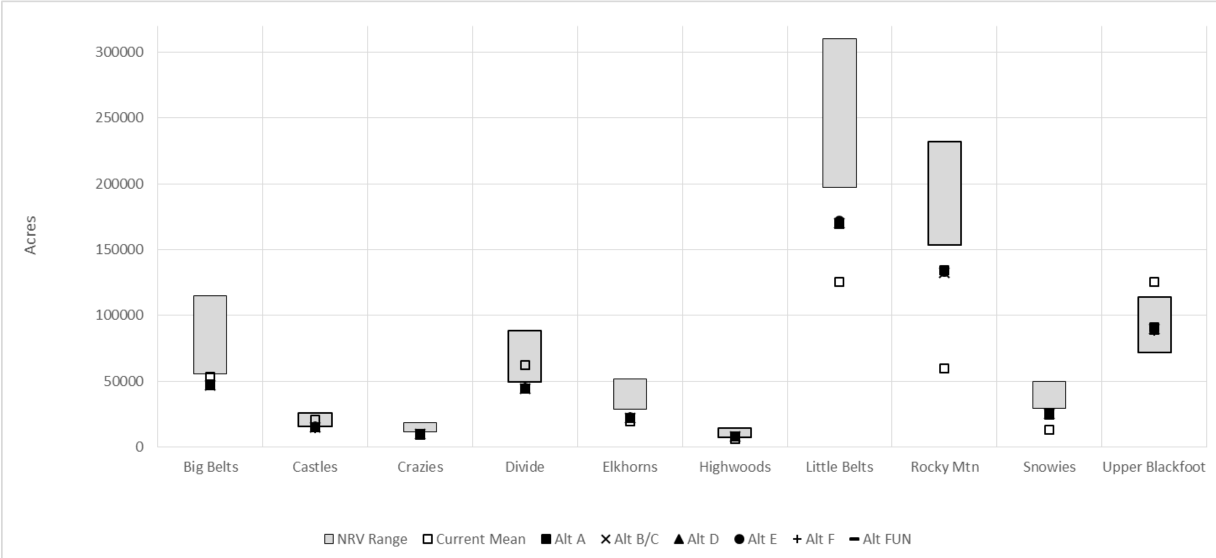


Figure 22. Predicted elk spring/summer/fall cover by GA, average over 5 decades by alternative, compared to the NRV

It appears that on average, modelled hiding cover in the Big Belts, Castles, Crazies, Divide, and Highwoods GAs is currently below or at the low end of the estimated NRV, and is predicted to remain within or at the lower bound of the NRV range on average over the next 5 decades. The model estimates that the existing level of hiding cover is below the NRV in the Little Belts, Rocky Mountain Range, and Snowies, but is predicted to move nearer to the lower bound of the NRV range on average over the next 5 decades. The Upper Blackfoot is unique in that the estimated current level of hiding cover is above the NRV, but is predicted to decrease to within the NRV on average for the next 5 decades and is predicted to remain so under all alternatives.

The estimates in Figure 22 are averages over the five decades modelled, and don't provide information about trend, which is useful for evaluating progress toward a desired condition or toward the estimated NRV. Figure 23 shows the predicted forestwide trend of spring/summer/fall hiding cover for all alternatives. As noted in the terrestrial vegetation section, alternative "F-UN" is a depiction of alternative F with a timber harvest schedule that is unconstrained by budget.

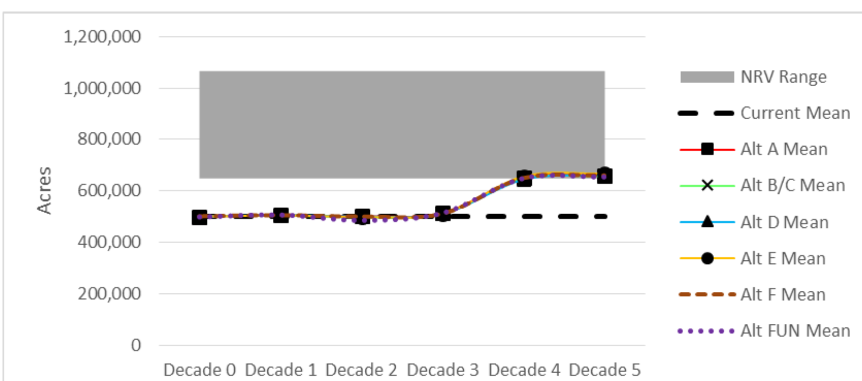


Figure 23. Predicted trend in forestwide elk spring/summer/fall cover over 5 decades by alternative

Because all alternatives showed a very similar trend and pattern over time, the lines and symbols for each alternative are stacked directly on top of one another and are indistinguishable in the graphic. The estimated forestwide spring/summer/fall elk hiding cover increases to the lower end of NRV by the fourth decade modelled, after a small decline in the second decade.

Similar graphs are provided in appendix H for each GA. Several GAs are predicted to have general increasing trends in spring/summer/fall hiding cover habitat that are neutral or positive in terms of movement within or toward the NRV range (Elkhorns, Highwoods, Little Belts, Rocky Mountain Range, and Snowies). Others are predicted to have slight fluctuations up and/or down, but ultimately are predicted to have conditions similar to the existing levels by the 5th decade, to remain just below the NRV range (Big Belts and Crazies). The Upper Blackfoot is unique in that hiding cover is predicted to decrease over time, but this is a positive trend in terms of achieving the NRV range. The Castles and Divide GAs are the only GAs where predicted declines in hiding cover result in estimated levels that remain or move below the NRV range by the 5th decade.

As discussed in the affected environment section, cover is most appropriately evaluated and managed at the scale of the elk herd unit (U.S. Department of Agriculture, Forest Service & Montana Fish Wildlife and Parks, 2013). Habitat was modelled at the level of the elk herd unit (Big Belts, Castles, Divide, Elkhorns and Upper Blackfoort GAs) or elk analysis unit (Castles, Crazies, Highwoods, Little Belts, Rocky Mountain Range, and Snowies GAs). The results involve a large amount of data that is difficult to display, so it is summarized here. Full results and trend charts for each elk herd or analysis unit are available in the project file.

Table 109 displays the status of elk herd or analysis units by GA, indicating whether they are within the NRV currently, whether they are predicted to be within the NRV under any alternatives, and whether they are predicted to experience increase or decrease in hiding cover as compared to the current estimated amount.

Table 109. Estimated elk spring/summer/fall hiding cover trend by GA

GA	Total number of elk herd/analysis units in GA	Status of hiding cover currently relative to NRV	Predicted status of hiding cover in alternatives, relative to NRV	Predicted status of hiding cover in alternatives, relative to estimated current amount
Big Belts	18	A11 herd units within NRV 7 herd units below NRV	A10 herd units within NRV 8 herd units below NRV	2 units increase 8 units decrease 8 units remain approximately the same
Castles	3	3 units in or above NRV	1 unit within NRV 2 units just below NRV	2 units decrease 1 unit remains approximately the same
Crazies	2	1 unit within NRV 1 unit below NRV	Both units below NRV	1 unit increases slightly 1 unit decreases slightly
Divide	7	5 units in NRV 1 unit below NRV 1 unit above NRV	3 units in NRV 4 units below NRV	2 units increase 5 units decrease
Elkhorns	9	2 units within NRV 6 units below NRV 1 unit above NRV	4 units within NRV 5 units below NRV	4 units increase 2 units decrease 3 units remain approximately the same
Highwoods	3	2 units below NRV 1 unit within NRV	All units within NRV	2 units increase 1 unit slightly decreases
Little Belts	22	15 units at lower end or below NRV 6 units within NRV	10 units below NRV 12 units within NRV	14 units increase 4 units decrease

GA	Total number of elk herd/analysis units in GA	Status of hiding cover currently relative to NRV	Predicted status of hiding cover in alternatives, relative to NRV	Predicted status of hiding cover in alternatives, relative to estimated current amount
		1 unit above NRV		4 units remain approximately the same
Rocky Mountain Range	14	1 unit within NRV 13 units below NRV	13 units within NRV 1 unit below NRV	12 units increase 1 unit decreases 1 unit remains approximately the same
Snowies	6	All units below NRV	1 unit just below NRV 5 units within NRV	All units increase
Upper Blackfoot	9	1 unit within NRV 4 units below NRV 4 units above NRV	3 units within NRV 6 units below NRV	2 units increase 5 units decrease 2 units remain approximately the same

The NRV for hiding cover provides an approximate idea of the range of conditions under which elk evolved and that allowed them to be present in historic distribution and numbers across what is now the HLC NF. The role of hiding cover in affecting elk behavior or distribution, however, continues to depend on site-specific conditions including the amount and nature of human activity and hunting pressure in an area relative to other areas accessible to those elk. The information in Table 109 serves mainly to demonstrate the degree to which the planning area currently approximates the NRV, and the degree to which hiding cover on the HLC NF may increase or decrease relative to current conditions and to the NRV under each alternative. Those estimates do not vary measurably among the different alternatives. The predicted changes in hiding cover are driven primarily by natural successional processes and disturbances, rather than FS management; refer to the terrestrial vegetation section for additional discussion regarding the driving forces behind vegetation changes over time. The actual location, timing, severity, and extent of natural disturbances in the future is highly uncertain. Furthermore, the amount and trend of hiding cover at a forestwide, GA, or elk herd/analysis unit scale has not proven to be an indicator of elk distribution or of the availability of elk for hunting or other uses on NFS lands.

Winter cover

We modelled winter cover on mapped elk winter ranges in order to compare these habitat elements across alternatives. Guidance established in the 2013 cooperative FS and MFWP recommendations paper (U.S. Department of Agriculture, Forest Service & Montana Fish Wildlife and Parks, 2013) was used to estimate winter cover using the SIMPPLLE model (refer to appendix H for more information about parameters). Figure 24 shows the current condition and estimated future winter cover by GA, for the portion of winter ranges on NFS lands managed by the HLC NF, averaged over the 5 decades that were modelled.

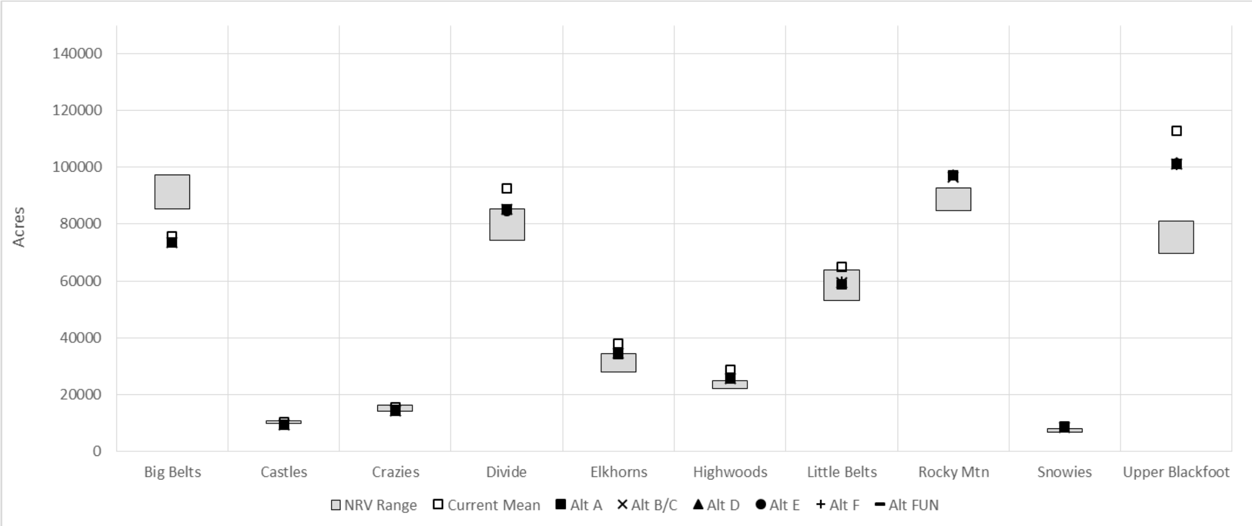


Figure 24. Predicted elk winter cover by GA, averaged over 5 decades by alternative, compared to the NRV

Because all alternatives showed a similar trend and pattern over time, the symbols for each alternative are stacked directly on top of one another and are indistinguishable in the graphic. The Big Belts GA is the only GA estimated to have current levels of winter cover below the NRV, and the amount is predicted to decrease slightly. In all GAs except the Big Belts, the average level of winter cover over the next 5 decades is predicted to be similar or slightly lower than the current amount, resulting in conditions within or above the NRV. Note that the estimated NRV for winter cover is a narrow range in some GAs, reflecting the fact that a relatively small acreage of winter range occurs on lands administered by the HLC NF.

The estimates above are averages over the five decades modelled, and don't provide information about trend, which is useful for evaluating progress toward a desired condition or toward the estimated NRV. The figure below (Figure 25) shows the predicted forestwide trend of winter hiding cover for all each alternative over time. As noted in the terrestrial vegetation section, alternative "F-UN" is a depiction of alternative F with a timber harvest schedule that is unconstrained by budget.

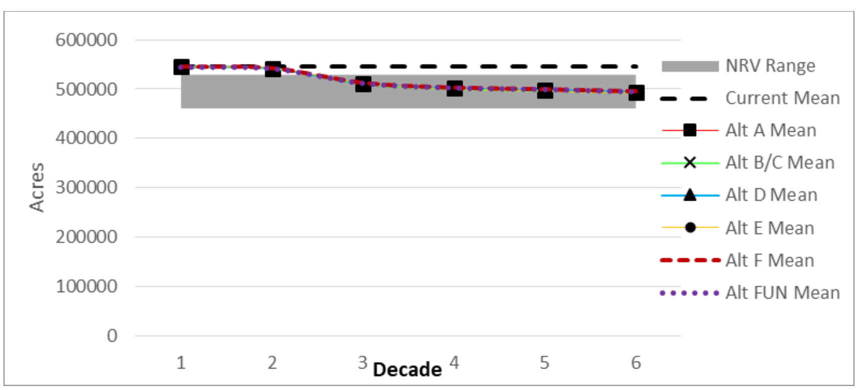


Figure 25. Predicted trend in elk winter cover over 5 decades by alternative

At the Forestwide scale, winter hiding cover is expected to decrease slightly over time but remain within the NRV. Similar graphs are provided in appendix H for each GA. In all of the GAs, winter cover is predicted to decrease slightly or remain similar to the existing condition for all alternatives. In some GAs, this trend results in conditions just above or within the NRV (Divide, Elkhorns, Highwoods, Little Belts, Rocky Mountain Range, and Snowies). Conditions remain more substantially above the NRV in the Upper Blackfoot. In the Big Belts, Castles, and Crazies, however, the slight downward trend results in conditions just below the estimated NRV by decade 5. Refer to the project file and to appendix H for more detail regarding modelled estimates of winter cover.

Effects common to all action alternatives

The 2020 Forest Plan includes several components that could potentially impact elk habitat, as well as habitat for other ungulate species. A summary of those components and their expected effects is shown in Table 110. Please refer to the 2020 Forest Plan for the complete text of listed components.

Table 110. Summary of plan components pertinent to elk and elk habitat management

Plan component(s)	Summary of expected effects
General habitat management	
FW-WL-GDL-14 FW-WL-DC-01; 02 FW-VEGT-DC-01; 02, 03 FW-VEGT-OBJ-01 FW-VEGF-DC-01-03; 08 FW-LAND-DC-03 FW-WILD-GO-01	These plan components all address general aspects of habitat, guiding managers to provide habitat for native wildlife species, provide vegetation conditions consistent with NRV, move toward vegetation desired conditions, and manage consistent with adjoining lands that are managed for wildlife values. The effects of implementing these components would be to assure that the vegetation conditions that support the life history requirements for elk are met through consideration of habitat needs and managing for appropriate vegetation condition. These components represent coarse-filter management of elk habitat.
Components that support forage	
FW-WL-DC-02; 07 FW-WL-GDL-01; 06 FW-VEGNF-DC-01-03 FW-GRAZ-DC-02 FW-GRAZ-STD-02 FW-GRAZ-GDL-04 FW-TIM-GDL-01, 02 SN-VEGNF-GDL-01 EH-WL-GDL-02, 03 SN-VEGNF- GDL-01 HI-WL-DC-01 LB-WL-DC-01	These plan components guide managers to provide for the natural history requirements of native wildlife species, to provide forage for big game on winter range, and to manage livestock and coordinate grazing allotment planning and permitting with Montana Department of Fish, Wildlife and Parks to ensure wildlife forage needs are addressed. Some components are only for certain GAs, where specific wildlife or big game forage needs (e.g., enhancing summer big game forage in the Snowies GA, managing for high quality big game winter range in a portion of the Castles, etc.) are addressed. The effects of implementing these components would be to assure that management activities, including livestock grazing, either maintain or enhance forage for elk and other wildlife species, particularly on key seasonal ranges.
Components that support cover (thermal and hiding)	
FW-WL-DC-02; 03 FW-WL-GDL-06 FW-FWL-GDL-01 FW-TIM-STD-04 FW-TIM-STD-08-09 BB-WL-DC-03 CR-WL-DC-01 DI-WL-GO-01 DI-WL-DC-01, GDL-01 UB-WL-DC-01, GDL-01	These plan components guide managers to provide for the life history requirements for all parts of the life cycle of native wildlife species, as well as to intermix forage species with hiding and thermal cover for big game on winter range and elsewhere, to maintain or increase elk security, to use clearcuts only where wildlife habitat needs allow, and set a limit on maximum opening size created by timber harvest. Some components are specific to GAs, guiding managers to maintain or improve wildlife habitat connectivity for wide-ranging species, as well as to acquire, if possible, lands in one GA (Divide) to enhance both security and connectivity for wide-ranging species. The effects of implementing these components would be to maintain or manage for cover where it is needed, which may contribute to habitat security.
Components that limit disturbance by humans	
FW-WL-DC-04; 07 FW-WL-GDL- 05 FW-FWL-DC-07 FW-RSUP-GDL-01	These plan components guide managers to minimize disturbance on winter range and other key habitats, balance access needs with needs for wildlife security, decommission unneeded roads when doing so would benefit wildlife, and concentrate human activities in space and time to minimize impacts to wildlife. GA-specific components would limit certain activities in the Elkhorns on winter range and

Plan component(s)	Summary of expected effects
FW-IRA-DC-01 FW-RT-GO-03 FW-RT-GDL-12, 13 EH-TIM-GDL-01	other seasonal habitats. The effects of implementing these components would be to limit or prevent certain types of disturbance, particularly in seasonal habitats, which is in turn likely to minimize the potential for elk to be displaced by certain human activities.
Aquatic Ecosystems	This section includes components wherein the vegetation condition helps achieve the desired conditions for these resources, such as water quality and quantity, riparian ecosystems, fish habitat, and soil condition. These components complement those enumerated in the vegetation sections. Some components also specifically guide or limit vegetation management.
Fire and Fuels Management	This section describes the role of natural fire and fire management which are primary drivers of change in terrestrial vegetation. These components complement the achievement of desired conditions especially related to wildland fire management strategies and hazardous fuels treatments.

Alternative A, no action

The 1986 Forest Plans include components requiring evaluation and management of elk security (Helena NF plan) or hiding cover (Lewis and Clark NF plan) when carrying out certain management activities. These standards would remain in place under this alternative. Implementation of the 1986 Forest Plans has resulted in achievement of plan standards for hiding or thermal cover or security on portions of the HLC NF but not across the entire forest (refer to the Affected Environment section). The inherent characteristics of vegetation and topography, as well as insect, disease, and fire related mortality contribute to limiting the extent to which standards can be met (refer to discussions hiding and winter cover in “Effects Common to All Alternatives” section above). Standards relating to elk habitat on the former Lewis and Clark NF portion of the planning area are applied only for projects “involving significant vegetative removal”, so application of standards is limited to those times and areas where such actions take place. On the former Helena NF portion of the planning area, 1986 plan standards and guidelines are applied during vegetation management actions or during travel management and may or may not affect management of vegetation that provides hiding cover. Therefore, the size, location, and type of potential actions cannot be predicted at the framework programmatic scale of this analysis and therefore cannot be predicted for comparison with other alternatives. Neither 1986 plan includes specific desired conditions for vegetation or for elk habitat. Therefore, implementation of standards or guidelines for elk habitat would continue to be driven largely through of projects developed to address other purposes or needs (e.g., targets or outputs), rather than focusing on achievement of desired vegetation and habitat conditions. There would continue to be inconsistency between the two portions of the combined HLC NF, with a focus on secure areas and thermal cover on the Helena NF portion, and consideration of hiding cover on the Lewis and Clark NF portion.

Effects common to all action alternatives

Spring/summer/fall habitat

Refer to Figure 21 and Figure 23 and Table 109 above for a display of predicted impacts to spring/summer/fall cover by GA for all alternatives. The similarity in outcomes modelled for all alternatives indicate that it is likely that all alternatives would result in similar amount and distribution of hiding cover by GA, largely as a result of natural processes. Although the levels of vegetation management vary slightly by alternative, the terrestrial vegetation analysis concluded that the impacts of vegetation management would have little impact on predicted vegetation conditions at the GA or forestwide scales.

A key difference between the action alternatives as a group and the no-action alternative (alternative A) is the focus on achieving desired conditions, and recognition of the intent of other plan components.

Alternatives B, E, and F include guidelines for managing elk habitat related to providing habitat security and/or the desired condition of influencing elk distribution during the hunting season. Guidelines in Alternatives B and E direct managers to retain existing security areas and not allow new motorized routes to reduce existing habitat security in areas where there is concern about lack of secure habitat. The intent of these guidelines is to reduce potential for displacement of elk and other big game species from NFS lands during the hunting season. Alternative F includes a single guideline (FW-FWL-GDL-01) directing managers to identify methods by which to achieve that intent prior to any "management actions that would increase or change the location, timing, mileage, or density of wheeled motorized routes" open during the hunting seasons.

Plan components discussed above for alternatives B, E, and F guide managers to assess NFS lands managed by the HLC NF according to the BASI, such as the "Collaborative overview and recommendations for elk habitat management on the Custer, Gallatin, Helena, and Lewis and Clark National Forests" (U.S. Department of Agriculture, Forest Service & Montana Fish Wildlife and Parks, 2013), to determine where additional measures to maintain or create elk security would help achieve the desired condition of having elk "present and potentially available to hunters on NFS lands during both the archery and rifle hunting seasons" (FW-FWL-DC-01 in the 2020 Forest Plan). Although Alternatives C and D do not include guidelines related to management of elk or big game habitat security, all action alternatives contain desired conditions regarding big game presense on NFS lands during the hunting season, along with plan components (e.g., FW-WL-DC-01 through 04) to maintain habitat components, including hiding cover, to provide for presence and persistence of native wildlife species, including elk and other big game. As displayed in Figure 22, Figure 23, and Table 109, hiding cover appears to be influenced primarily by natural processes rather than by estimated levels of timber harvest or other vegetation management. Plan components FW-FWL-DC-01, or FW-FWL-GDL-01 and 02 in alternatives B and E or FW-FWL-GDL-01 in alternative F would be applied when habitat or vegetation management projects, travel management projects, or other site-specific plans are developed. Potential adjustments to or constraints on vegetation management, motorized access management, or other activities would occur at a site-specific scale, are not possible to predict at this programmatic planning level and would be analyzed as projects or actions are planned.

The action alternatives all include goals (i.e., FW-WL-GO-01, 02) directing managers to work with MFWP to "evaluate management direction" and to "recommend potential adjustments to management" of NFS lands. Under any of the action alternatives, biologists from both agencies would be expected to identify wildlife habitat management concerns during project planning and to develop plans, using BASI, for habitat projects or project design features that would help to achieve desired conditions. Refer to appendix C of the 2020 Forest Plan for more information about methods and actions that could potentially be used to assess habitat security needs and implement these guidelines.

In addition to elk security, which is specifically defined (J. L. Lyon & Christensen, 1992) as applying to elk during hunting season, the action alternatives differ slightly in terms of overall habitat security. Habitat security, generally speaking, refers to habitat characteristics that allow wildlife to forage, rest, move among habitats, rear young, and carry out other life requirements without disturbance (usually by humans) that would cause them to be displaced from key habitats or disrupt normal activities. Areas that are remote and have minimal use by humans, particularly minimal motorized use, usually have higher value as secure habitat than areas with a greater human presence. Areas such as IRAs, RWAs, designated wilderness, and Conservation Management Areas all provide some degree of security for wildlife using those areas.

Under all alternatives, the acreage and distribution of IRAs, designated wilderness, and conservation management area would not change. Alternatives B and C both include over 213,000 acres of RWAs, with alternative B making motorized uses unsuitable in RWAs, which would affect existing motorized use on 12 miles of road as well as 0.1 miles of motorized use on trails. Alternative D would include more than twice as much RWAs (over 474,000 acres) and would affect existing motorized use on 23 miles of road and 59 miles of trail by making motorized use unsuitable in RWAs. Alternative F would include more than 153,000 acres of recommended wilderness and would affect existing motorized use on 12 miles of road and 0.1 miles of trail. In contrast, alternative E would have no RWAs, although many areas that are recommended in other alternatives overlap partly or entirely with IRAs. Nevertheless, it is likely that alternative D would provide the largest amount of general habitat security for elk and other wildlife, followed by alternative B. The relative impacts of alternatives C and F are difficult to determine, as alternative F affects more motorized routes (that would become unsuitable use), but alternative C would result in more acres designated as RWA. Nevertheless, all action alternatives would result in greater amounts of general habitat security than under the existing condition (Alternative A).

Winter habitat

Figure 24 shows that at the Forestwide scale, predicted winter cover would decrease very slightly over time under all alternatives, but would achieve the estimated NRV. That predicted trend appears to have no discernable differences among alternatives at the GA or forestwide scale. In each GA, the level of winter habitat either slightly declines or remains similar to the existing condition (refer to appendix H and project file) but remains within the NRV in all GAs except the Big Belts. Given the uncertainties in modelling processes and in estimating parameters, the similarity in outcomes modelled for all alternatives indicate that it is likely that all alternatives would result in similar amount and distribution of winter cover by GA, primarily as a result of natural processes.

Effects of forest plan components associated with:

Aquatic ecosystems, fire and fuels management, infrastructure, livestock grazing, and timber harvest

The effects of these plan components are in Table 110 above.

Terrestrial vegetation; plants at risk, and invasive species, terrestrial wildlife, cultural, historic, and tribal resources, land status and ownership and land uses, special uses, and energy and minerals

The effects of these plan components are discussed in the terrestrial wildlife diversity section.

Recreation settings, opportunities, access, and scenery

The effects of these plan components are mostly discussed in the terrestrial wildlife diversity section.

The 2020 Forest Plan does not directly constrain public uses, but it does set desired conditions, placement of recreation facilities, and puts constraints on permitted special uses. As discussed in the environmental consequences section above, recreation access via roads can have an effect on elk distribution and therefore on elk availability on the HLC NF. Some recreation special uses, such as permitted outfitter and guide operations that provide hunting opportunities, may impact elk numbers and distribution in concert with other factors (including forage, weather, other hunters, etc.).

Plan components for management of recreation could result in some impacts to elk and other big game species where specific facilities exist or activities occur, but would minimize impacts to individual animals and to the population as a whole by including constraints designed to reduce conflicts, disturbance, displacement, or negative impacts to habitat. Some components would improve wildlife habitat by moving facilities out of sensitive areas such as riparian areas, and by rehabilitating unauthorized access routes.

Designated areas, including RWAs

The effects of these plan components are discussed in the terrestrial wildlife diversity section, and in the environmental consequences section above.

Cumulative effects

Portions of the HLC NF adjoin other NFs, each having its own forest plan. The HLC NF is also intermixed with lands of other ownerships, including private lands, other federal lands, and state lands. Some adjacent lands are subject to their own resource management plans. The cumulative effects of these plans in conjunction with the 2020 Forest Plan are summarized in the terrestrial wildlife diversity section for wildlife species, including elk.

Conclusions

Under all alternatives, seasonal elk habitat would continue to be widely available across the entire HLC NF. All alternatives would provide for similar amounts of spring/summer/fall hiding cover and winter cover both forestwide and by GA. Under all action alternatives, the desired condition of providing habitat for native wildlife species across their range (FW-WL-DC-01), and providing vegetation composition, structure, and distribution that would fulfill elk life history requirements (FW-WL-DC-02) would be supported, allowing elk to continue to be present in the planning area in support of the planning rule requirement to maintain the diversity of native wildlife species.

The prevalence of spring/summer/fall hiding cover under all alternatives is a good indication that hiding cover, which contributes to elk security, would be present and available with and without specific plan components to manage for it.

Plan components for security and cover in alternative A would require managers to evaluate and provide for very specific amounts of security and thermal cover on the Helena NF portion of the planning area, and hiding cover on the Lewis and Clark NF portion of the planning area. This would result in ongoing inconsistencies in elk and big game habitat management between two major portions of the planning area. Management under Alternative A would continue to focus on the “tools” (i.e. certain amounts of specifically defined habitat components) rather than on the desired condition the tools are intended to achieve. Application of updated science and recommendations may continue to be difficult where it does not align with the very prescriptive standards and guidelines in Alternative A. Alternative A also lacks desired conditions that reflect the current management issues regarding elk distribution during the hunting season, and would not guarantee that elk remain on NFS lands during fall hunting seasons.

Components for evaluating and managing for elk security and/or influencing fall elk distribution in alternatives B, E, and F would provide greater consistency in approach than under the current plans or under alternative A, but would not guarantee that elk remain on NFS lands, particularly were private land refuges are available. Alternatives C and D, without specific components to manage for elk security, would likely have less constraint on vegetation management projects, would potentially have different impacts on the amount and distribution of secure habitat for elk, but would meet or move toward the desired condition for elk to be available on HLC NF lands.

The alternatives with larger amounts of RWA (D, followed by B, C and then F) could provide greater general security than the existing plans (alternative A) or Alternative E. However, on the ground the difference may be minimal because of the presence of IRAs in alternative E similar to that of the other alternatives. Furthermore, it is not possible to predict whether the differences in the amount and location of RWAs, or the differences in whether motorized travel is suitable or not would have any measurable impact on elk presence or distribution.

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