Indicator	Greatest	to	Least	
Acres harvested[1]	A	BCD	E	
Area where commercial use of other forest products is allowed	E	A	BC	D

3.30 Geology, Energy, and Minerals

3.30.1 Introduction

Minerals management of NFS lands requires interagency coordination and co-operation. Although the FS is responsible for the management of surface resources of NFS lands, the BLM is primarily responsible for management of government-owned minerals. Since it is not possible to separate mineral operations from surface management, the agencies have developed cooperative procedures to accommodate their respective responsibilities.

There are three types of mineral and energy resources:

- Locatable minerals include commodities such as gold, silver, copper, zinc, nickel, lead, platinum and some nonmetallic minerals such as asbestos, gypsum, and gemstones. Lands that are open to location under the Mining Law of 1872 guarantee U.S. citizens the right to prospect and explore lands reserved from the public domain and open to mineral entry. The right of reasonable and appropriate access for exploration and development of locatable mineral is guaranteed.
- Leasable minerals include commodities such as oil, gas, coal, geothermal, potassium, sodium phosphates, oil shale, sulfur, and solid leasable minerals on acquired lands. Areas of the Forest are open to leasable minerals exploration, development and production. A leasing decision will not be a part of this plan. The disposal of these leasable minerals is discretionary.
- Salable minerals include common varieties of sand, stone, gravel, cinders, clay, pumice and pumicite. The FS has the authority to dispose of these materials on public lands through a variety of methods. The disposal of these materials is discretionary.

Analysis area and indicators

The analysis area is the NFS lands within the Forest. The key indicators for minerals are:

- Locatable minerals – acres unavailable for mineral entry (not withdrawn);
- Leasable minerals – acres unavailable for leasing proposals and proposed no surface occupancy stipulation acreages;
- Salable minerals-acres unavailable for disposal of mineral materials; and
- Timing and access restrictions that could affect all mineral development.

3.30.2 Regulatory framework

Weeks Law Act of March 1, 1911 (P.L. 61-435, 72 Stat. 1571, as amended, 16 U.S.C. § 480 et seq): This act authorized the federal government to purchase lands for stream-flow protection, and maintain the acquired lands as national forests.

Mineral Resources on Weeks Law Lands Act of March 4, 1917 (P.L. 64-390, 39 Stat. 1149, 16 U.S.C. § 520): This act authorizes the Secretary of Agriculture to issue permits and leases for prospecting, developing, and utilizing hard-rock minerals on lands acquired under the authority of the act. This authority was later transferred to the Secretary of the Interior.

Mineral Leasing Act of February 25, 1920 (P.L. 66-146, 41 Stat. 437 as amended, 30 U.S.C. § 181 et seq.): This act authorizes the Secretary of the Interior to issue leases for the disposal of certain minerals (coal, phosphate, sodium, potassium, oil, oil shale, gilsonite, and gas). The act applies to NFS lands reserved from the public domain, including lands received in exchange for timber or other public domain lands, and lands with minerals reserved under special authority.

Clarke-McNary Act of June 7, 1924 (P.L. 68-270, 43 Stat. 653 as amended, 16 U.S.C. § 505 et seq.): All lands to which title is accepted under section 7 of this act become NFS lands, subject to all laws applicable to the lands acquired under the Weeks Act of March 1, 1911.

Mineral Materials Act of July 31, 1947 (P.L. 80-291, 61 Stat. 681, as amended, 30 U.S.C. § 601 et seq.): This act provides for the disposal of mineral materials on the public lands through bidding, negotiated contracts, and free use.

Mineral Leasing Act for Acquired Lands of August 7, 1947 (P.L. 80-382, 61 Stat. 913, as amended, 30 U.S.C. § 351 et seq.): This act extends the provisions of the mineral leasing laws to federally owned mineral deposits on acquired NFS lands and requires the consent of the Secretary of Agriculture prior to leasing.

Multiple Use Mining Act of July 23, 1955 (P.L. 84-167, 69 Stat. 368, as amended, 30 U.S.C § 601 et seq.): This act requires the disposal of common varieties of sand, stone, gravel, pumice, pumicite, and cinders under the provisions of the Materials Act of July 31, 1947, and gives to the Secretary of Agriculture the authority to dispose of these materials. It provides that rights under any mining claim located under mining laws are subject to the right of the U.S. to manage and dispose of surface resources.

Geothermal Steam Act of December 24, 1970 (P.L. 91-581, 84 Stat. 1566, 30 U.S.C. § 1001-1025): This act provides the Secretary of the Interior the authority to lease NFS lands for geothermal steam development, subject to the consent and conditions the Secretary of Agriculture may prescribe.

Mining and Minerals Policy Act of December 31, 1970 (P.L. 91-631, 84 Stat.1876, 30 U.S.C. § 21a): This act states that the continuing policy of the federal government is to foster and encourage private enterprise in the development of economically sound and stable domestic mining and minerals industries and the orderly and economic development of domestic mineral resources.

Federal Coal Leasing Amendments Act of August 4, 1976 (90 Stat. 1083; 30 U.S.C. § 201 et seq.): This act amended the Mineral Lands Leasing Act of February 25, 1920 (para. 3) by specifying that coal leases on NFS lands may be issued only after the consent of the Secretary of Agriculture and adherence to conditions the Secretary may prescribe. The act also provides that no lease shall be issued unless the lands involved in the lease have been included in a comprehensive forest land and resource management plan and the sale is compatible with the Plan. The act authorizes the issuance of a license to conduct exploration for coal.

Surface Mining Control and Reclamation Act of August 3, 1977 (P.L. 95-87, 91 Stat. 445, 30 U.S.C. § 1201-1328): This act provides for cooperation between the Secretary of the Interior and states in the regulation of surface coal mining. It also restricts or prohibits surface coal mining operations on NFS lands, subject to valid existing rights and compatibility determinations.

Energy Security Act of June 30, 1980 (P.L. 96-294, 94 Stat. 611, 42 U.S.C. § 8855): This act directs the Secretary of Agriculture to process applications for leases and permits to explore, drill, and develop resources on NFS lands, notwithstanding the current status of the forest LRMP.

National Materials and Minerals Policy, Research and Development Act of October 2, 1980 (94 Stat. 2305; 30 U.S.C. §1601-1605): This act restates congressional intent to promote policies that provide for an adequate and stable supply of materials while considering long-term needs, a healthy environment,

and natural resource conservation. The act also requires the Secretary of the Interior to improve the availability and analysis of mineral data in federal land use decision making.

Omnibus Parks and Public Lands Management Act of 1996 (P.L. 104-333, 110 Stat. 4093, 16 U.S.C. § 497c): This act automatically withdraws from all forms of appropriation under the mining laws and from disposition under all laws pertaining to mineral and geothermal leasing all lands located within the boundaries of ski area permits.

Federal Onshore Oil and Gas Leasing Reform Act of 1987 (30 U.S.C. § 181 et seq.): This act expands the authority of the Secretary of Agriculture in the management of oil and gas resources on NFS lands. The BLM cannot issue leases for oil and gas on NFS lands over the objection of the FS. The FS must approve all surface disturbing activities on NFS lands before operations commence.

Energy Policy Act of 2005 (P.L. 109-58): Directs federal agencies to undertake efforts to ensure energy efficiency; and the production of secure, affordable, and reliable domestic energy.

Executive Order 13211 issued May 18, 2001: This executive order titled "Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use" requires federal agencies to prepare and submit a Statement of Energy Effects to the Office of Management and Budget describing the effects of certain regulatory actions on energy supply distribution, or use.

Executive Order 13212 issued May 18, 2001: This executive order titled "Actions to Expedite Energy-Related Projects" requires federal agencies to take actions, to the extent consistent with applicable law, to expedite projects that will increase the production, transmission, or conservation of energy.

The Reorganization Plan No. 3 of 1946 (60 Stat. 1097; 5 U.S.C. appendix): This transferred the functions of the Secretary of Agriculture with respect to permits and leases for hard-rock minerals on acquired Weeks Law land to the Secretary of the Interior. However, Secretary of Agriculture Consent to the issuance of permits or leases is required.

128 Stat. 3828 (P.L. 113–291—Dec. 19, 2014) SEC. 3063: North Fork Federal Lands Withdrawal Area. "To withdraw certain Federal land and interests in that land from location, entry, and patent under the mining laws and disposition under the mineral and geothermal leasing laws and to preserve existing uses" (see figure B-53). Nothing in this section prohibits the Secretary of the Interior from taking any action necessary to complete any requirement under the NEPA of 1969 (42 U.S.C. 4321 et seq.) or the ESA of 1973 (16 U.S.C. 1531 et seq.) required for permitting surface-disturbing activity to occur on any lease issued before the date of enactment of this Act.

36 CFR 228 — Minerals: These regulations set forth rules and procedures governing use of the surface of NFS lands in conjunction with operations authorized by the general mining laws, oil and gas leasing, and mineral material disposal laws.

36 CFR Part 251 — Land Uses; **Part 290**—Cave Resources Management; **36 CFR Part 291**—Paleontological Resources Preservation

43 CFR 2300 — Land Withdrawals

Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. 9605, as amended.

Resource Conservation and Recovery Act Regulations, 40 CFR 260-270

Executive Order 12580, signed January 29, 1987

7 CFR 2.60 Delegation of Lead Agency Authority to the Chief of the Forest Service

40 CFR 300 National Oil and Hazardous Substances Pollution Contingency Plan

29 CFR 1910.120 Occupational Safety and Health Administration

EM-2160-1, FS Guide to Comprehensive Environmental Response, Compensation, and Liability Act, January 1996

Montana Wilderness Study Act (Public Law 95-150)

Tax Relief and Health Care Act of 2006, Public Law 109-432 Section 403(a)

Omnibus Public Land Management Act (16 U.S.C. 470aaa to 470aaa-11 (2009; "the Act")

Interagency agreements

The FS has entered into interagency agreements with agencies within the U.S. Department of Interior to cooperate and coordinate in the management of federally owned minerals within NFS lands. The principal agreements include:

- November 8, 1946, agreement with the BLM detailing procedures for mineral leases and permits administered under section 402 of the President's Reorganization Plan No. 3 of 1946.
- May 18, 1957, memorandum of understanding with the BLM describing work procedures for land applications, mining claims, and patents.
- March 4, 1977, cooperative agreement with the U.S. Geological Survey concerning oil and gas operations.
- May 20, 1980, agreement with the BLM describing the coordination of activities under the federal coal management program.
- November 26, 1980, cooperative agreement with the U.S. Geological Survey for operations under solid mineral leases and permits.
- December 3, 1981, memorandum of understanding with the U.S. Geological Survey and the BLM for the geothermal steam leasing program.
- December 11, 1989 memorandum of understanding with the MTDEQ (formerly Department of State Lands) to promote efficiency and effectiveness in administration and regulation of mineral resources.
- July 31, 1990, memorandum of understanding with the Office of Surface Mining Reclamation and Enforcement describing the management of surface coal mining operations on NFS lands.
- November 11, 1991, interagency agreement with the BLM describing the procedures by which the FS could authorize the BLM to offer NFS lands for oil and gas leasing.
- November 19, 1991, interagency agreement with the BLM describing the procedures for coordinated administration of oil and gas operations on federal leases within the NFS.

3.30.3 Best available scientific information used

Information regarding the geology, renewable, and nonrenewable mineral and energy resources of the HLC NFs is based on information from numerous sources, including statutes, laws, regulations, FS manuals, State of MT Natural Resource Information System data, Forest project and permit files, Montana Bureau of Mines and Geology publications and data, MTDNRC information, BLM minerals forecasts, U.S. Geological Survey published documents and maps, U.S. Bureau of Mines published documents, Environmental Protection Agency website and published documents and other literature.

The BLM keeps official records on leasable minerals and unpatented mining claims on public lands. Current records are kept in the Legacy Rehost 2000 (LR 2000) database. These records are the source for the documentation of leasable minerals and unpatented mining claims on the HLC NF.

3.30.4 Affected environment

A variety of mineral deposit types and mineral resources, including gold, silver, and copper, occur within the boundaries of the Forest. With respect to NF management, mineral resources are divided into three groups: locatable minerals, leasable minerals, and mineral materials. The authority of the FS to influence and regulate the exploration, development, and production phases of mining operations varies with each group. As a result, the FS manages mineral resource programs that are specific to each group.

Geology

The NFS lands managed by the HLC NF lie within the Northern Rocky Mountain and the Missouri Plateau Physiographic regions as mapped by the U.S. Geologic Survey (USGS 2000). The plan area is mostly within the Rocky Mountain physiographic region, which includes the visually stunning Rocky Mountain Front area; southward to the Upper Blackfoot, Divide, Elkhorn and Big Belt Mountains; and eastward to the Little Belts, Castles and Crazy Mountains areas. The island mountain ranges including the Big and Little Snowies, and Highwoods, as well as the more moderate terrain draping the Rocky Mountain Front eastward, are included within the flat-topped and dissected plateau area of the upper Missouri River physiographic region (ibid). Complex and diverse geology characterizes these regions.

Rock units

Rock unit descriptions include formations or rock types found across the forests but not necessarily in every part of the forest. In fact, some rock types are localized in their occurrence. Both forest regions are primarily underlain either at the surface or at depth by a wedge-shaped sedimentary rock package that includes the Precambrian Belt Supergroup which is tens of thousands of feet thick in the western part of the forest areas and tapers to several thousand feet thick in the easternmost forest areas. One area of much older Precambrian crystalline metamorphic rocks occurs underlying the Belt Supergroup sedimentary rocks in the Little Belt Mountains, unique for its occurrence in central Montana. These very old rocks include metamorphosed diorite that is about 2.6 to 2.8 billion years old, some of the oldest rocks in Montana. Also in the Precambrian crystalline rocks are gneisses composed of quartz and feldspar, and an unusual rock called the Pinto Diorite which consists of white feldspar ovoids in a matrix of black hornblende (Weed 1900). These rocks occur in the Belt Creek canyon between Neihart and Monarch.

Structure and history

The visible rock units of the forest areas are the result of an interesting and complex uplift and erosion history in western Montana as well as throughout the Rocky Mountains of North America.

Geologic areas of interest

As a result of the geologic events and processes, a variety of noteworthy scenic and/or geologically interesting, and geologically hazardous areas occur within the forest lands plan area (Table 296). Areas of geologically scenic and interesting areas are summarized below.

Table 296. Geologic areas of scenic and academic interest in HLC NF plan area

GA	Feature	Type	Description	Management Framework
Big Belts	Gates of the Mountains	Scenery, Views of Gates of Mountains Wilderness area, motorized recreation river	Renowned scenery as a result of barren, steep limestone cliffs in a canyon setting. Geologic feature of academic interest because it is an outstanding, accessible example of overthrust style structural deformation	No special restrictions, motorized aquatic recreation dominated area
Little Belts	Smith River - WSR	Scenery, nonmotorized Recreation river - designated in part	Popular floatable river that is administered by Montana Fish Wildlife and Parks permit system in cooperation with the FS. Floaters	WSR management restrictions

GA	Feature	Type	Description	Management Framework
		for its unique geology	start in Precambrian Belt sedimentary units and float 'upsection' into late Mesozoic sedimentary units - stunning cliffs and canyon scenery.	
Little Belts	Kings Hill Scenic Byway to Sluice Boxes State Park along Belt Creek	Scenery, Exposed limestone cliff walls, unusual geologic occurrence of Precambrian crystalline rocks	Motorized driving corridor with views of numerous mountain ranges including rocky mountain front from Kings Hill pass, as well as exceptional rock formations and waterfalls exposed along corridor	Designated federal scenic byway
Rocky Mountain Range and northeastern portion of Upper Blackfoot	Rocky Mountain Front Overthrust Belt	Scenery, large scale with views of Bob Marshall and Scapegoat Wilderness areas; Geologic feature of academic interest	Stunning and renowned scenery as a result of barren, steep limestone cliffs carved by alpine glaciers juxtaposed abruptly adjacent to rolling foothills. Geologic feature of academic interest because it is an outstanding, accessible example of overthrust style structural deformation. Scenery accessible to highway travelers along the front area and to nonmotorized backcountry users in the backcountry portion of the area.	9/25/2000 - Forest Plan Amendment Mineral Withdrawal withdrawing 405,000 acres from location of mining claims and mineral development 12/31/2006 - Congressional act - Withdrawal of certain federal land and interests in certain federal land from location, entry, and patent under the mining laws and disposition under the mineral and geothermal leasing laws.
Rocky Mountain Range, Little Bels, Snowies, Divide, and Big Belts	Caves	Natural geologic features occurring in Devonian to Mississippian carbonate sedimentary rock units. Academic and scientific interest.	Natural geologic features many that have been inventoried. Several very popular with the public and publicly accessible. Most are less well known except to caving organizations.	Two Nationally Significant caves on Lewis and Clark NF and eight Nationally Significant caves on Helena NF. Lewis and Clark Forest Plan amendment #13 provides management direction specific to the cave resource on the forest.

Paleontological resources

Paleontological resources are broadly synonymous with "fossils," as defined by statute (the Paleontological Resources Preservation subtitle of the Omnibus Public Land Management Act (16 U.S.C. 470aaa to 470aaa-11 (2009; "the Act")) and in FS regulations (36 CFR Part 291). The Act and the regulations stipulate that all paleontological resources on NFS shall be managed by the Secretary of Agriculture using scientific principles and expertise.

Geologic hazards

There are no inventory of strictly geologic hazard features in the plan areas, however an evaluation of hazards associated with recreation sites was prepared in 2011 and about a third of the sites have some type of potential geologic hazard that is included as part of monitoring site conditions (USDA 2011e; USDA 2011f).

Mineral and energy resources

The occurrence of precious and base metal minerals is the backdrop for much of the cultural history of the forest areas, particularly the Helena NF portion of the plan area. These occurrences impact land management to the present day due to the patenting of hard rock mining claims, development of mining roads, and location of rural communities surrounding and within the forest areas.

Energy resources have been explored across much of the plan area since the late 1950's but are less of a factor in development in and around the forest plan area to date because significant resources have not been discovered and/or tapped. The Rocky Mountain Front GA, the area with the most potential for hydrocarbon deposits in the two-forest planning area, is unavailable for the exploration and development of hydrocarbons due to mineral withdrawal and congressional action. However, less well-explored areas that have hydrocarbon potential, albeit low, occur in other portions of the plan area. This includes the southern portions of the Elkhorn and Big Belt Mountains, the northern portion of the Big Belt Mountains, and the eastern portion of the Lincoln Ranger District. Wind energy and geothermal energy, in addition to oil and gas energy deposits, are found in the plan area. As technology improves, and if access to explore for these deposits expands due to changes in federal policies, the search for and discovery of significant resources may occur in the future. There has been no production of hydrocarbon, wind, or geothermal deposits to date on the federal lands of the plan area.

Mineral material resources include sand, gravel, building or dimension stone, and riprap or general pit run for construction and industrial purposes. The geology of the plan area lends itself to a variety and abundance of general construction use materials and decorative stone applications.

Locatable minerals

Locatable minerals are those valuable mineral deposits subject to exploration and development under the General Mining Law of 1872 as amended.

The forest areas have been the focus of locatable mineral activities, precious and base metal exploration and mining, since the 1860's. Most of the lands of the plan area are open to the location of unpatented mining claims with the exception of designated wilderness areas, other nonwilderness lands withdrawn from mineral entry and NFS lands where the mineral estate has been separated from the surface estate. Approximately 88% or 870,000 acres of the Helena Forest area is open to the location of unpatented mining claims and approximately 34% or 640,000 acres of the Lewis and Clark NF area is open to the location of mining claims. The Helena NF areas have had substantially more unpatented mining claims and mining activity than the Lewis and Clark NF areas owing to the inherent geology and occurrence of mineral resources.

A large proportion of the Helena NF is included in designated historic mining districts and also portions of the Jefferson Division of the Lewis and Clark NF. Primary mineral deposits that have been developed to date include placer gold, as well as lode deposits of gold, silver, copper, lead, zinc and sapphires. Types of locatable mineral activity occurring on the forest include 1) historic and recent placer mining, and 2) historic and recent hard rock (lode) mining.

Historic and recent placer mining

Many drainage bottom areas have been patented as a result of placer mining. The estimated amount of gold mined from the gulches of the Helena NF is over 2.7 million ounces. The primary GAs that have had historic placer mining include the Big Belts, Divide, and Blackfoot River areas. A relatively small amount of placer mining has occurred in the Little Belts GA, primarily on the east side of the range in the Yogo Creek drainage area.

Current placer mining areas are located in the drainages of the Elkhorns, Big Belts, Divide, and Blackfoot River areas as well as the eastern Little Belts. Most of the currently permitted or permitted recent past operations are small scale resulting in much less than an acre of disturbance on an annual basis. Annually the forests administer 25-40 small-scale placer projects which range from hand scale work to small scale equipment work.

Historic and recent hard rock (Lode) mining

Hard rock mining activity is the pursuit of locatable type minerals such as gold, silver, copper, lead, and zinc in mineralized areas where the minerals are found in bedrock. Most of the historic locatable mining activity involved the development of underground workings such as adits and shafts to exploit mineralized vein structures. Early in mining history, mining areas became divided into mining districts where the miners would organize and develop rules and structure for claim location, development, and marketing. Mining districts are still an identifying characteristic of unpatented mining claim location and mineral activity areas. Each GA has a unique hard rock mining history; more information is available in the specialist report. The Divide GA has the greatest concentration of historic lode and placer mines of the two forests.

Public safety and other impacts

Hundreds of prospect-level to developed mine sites, as well as public safety hazards and environmental impacts have been inventoried (MT DEQ 1995; Metesh et al. 1998) and are known to occur on NFS lands of the plan area. In 1993 - 1994, the MT Department of State Lands Abandoned Mine Reclamation Bureau conducted a state-wide inventory of abandoned and inactive mine sites to characterize and rank the extent of public safety and environmental problems associated with these sites. Subsequent to the publication of these findings, the Environmental Protection Agency was requested to consider listing several areas of concentrated mine sites as federal superfund sites. These are discussed in detail below.

- Hazardous mine openings and features include shafts, adits, ventilation openings, buildings, highwalls, glory holes, and collapsing piles. Many had caved over the years only to be reopened by erosive processes, or discovered when a fire burned through an area and removed its vegetative cover. Some have become dumping areas for garbage. Many of these features have been inventoried and addressed in the past 20 years as part of a national effort by the FS and other agencies. Some features may provide habitat for bats. Therefore surveys for bats are also carried out to help determine appropriate closure devices or methods. Response actions have included backfilling, grating, foam plugs, installation of gated culverts, and combinations of the above. More work remains due to the extensiveness of mining activity in the plan area. New sites are regularly discovered or reported by the public, field - going staff, and minerals administrators. The forests in the plan area typically address 20 - 30 hazardous features annually.
- Hard rock mine sites and associated metal contaminants and environmental issues are documented in the findings of the Montana Department of State Lands Abandoned Mine Reclamation Bureau (MT DEQ 1995) and Metesh and others (1998). The specialist report contains a summary of the inventoried hard rock mine sites with resources issues by GA, including the number of reclaimed mine sites in those areas.
- Water quality impairments, as a result of historic hard rock mining, cause impacts to many surface and some ground waters of the plan area. The impaired water characteristics typically include low pH, elevated metal contaminants, loss or reduction of aquatic life, stream sediments containing metal contaminants, loss of streamside vegetation, and localized impaired groundwater. In some primary drainages, these impairments extend for miles downstream. While inventory and reclamation efforts continue to work toward addressing impaired waters, the scope of this issue has not been well defined nor is there a management framework that places priority on addressing a primary resource issue such as this.
- Many of the inventoried mines have been reclaimed in whole or in part by the FS, State of Montana, Environmental Protection Agency or jointly by the agencies. Reclamation of FS sites with hazardous substances has been done under the agencies' Comprehensive Environmental Response, Compensation, and Liability Act authority.
- As a result of the inventory results and other inventory/investigation efforts by the State, FS and Environmental Protection Agency, several of the mining areas have become listed State or Federal

Superfund sites due to their mining-related impacts (EPA 2014). These include one State of Montana superfund site, the Upper Blackfoot Mining Complex site and three federal Superfund sites, the Upper Tenmile Creek Mining Area site, Barker-Hughesville Mining District site, and Carpenter-Snow Creek Mining District site. These sites and ongoing activities are described further in the specialist report.

Leasable minerals

Leasable mineral and energy resources include oil, gas, coal, geothermal, oil shale, and other solid minerals. Leasable public domain minerals are leased under authority of the Mineral Leasing Act of 1920, as amended. Acquired minerals are leased under the authority of the 1947 Mineral Leasing Act for Acquired Lands, as amended.

Nonrenewable energy minerals

In August 1997 the Lewis and Clark NF finalized their oil and gas leasing FEIS and issued their ROD. In 1999 the Helena NF finalized their oil and gas leasing FEIS, their final supplemental EIS, and their ROD for oil and gas leasing. The records of decision were signed by the Forest Supervisor and the State Director of the BLM. At that time there were few acres under lease on the Helena NF. On the Lewis and Clark NF there were several thousand acres of suspended leases on the Rocky Mountain Range GA. The leasing analyses and decisions followed the new regulations at 36 CFR228 Subpart E and included two components and a Forest Plan amendment. These decisions are the current situation for nonrenewable mineral resources and are summarized in Table 297.

Table 297. Summary of acres for leasing as per EISs and RODs 1997 and 1999

Forest	Legally Unavailable	Discretionarily Unavailable	No Lease	No Surface Occupancy	Controlled Surface Use, Timing Limitations, or Both	Standard Lease Terms
Lewis and Clark	614,458	0	356,111	363,033	528,851	0
Helena	144,500	185,100	0	384,700	258,700	24,700

Activity in the number of lease requests from industry is currently low in the plan area. There is no current exploration or development activity on NFS lands. A leasing decision will not be a part of this Forest Plan Revision. There is an interest in oil and gas leasing on the forest and there may be a need for a future oil and gas leasing decision as oil and gas leasing is part of the acceptable uses of the HLC NF. Until a leasing decision is completed no oil and gas exploration or development can take place.

- Currently, there are zero authorized oil and gas leases in effect for the Helena NF. There are eight lease requests, covering 15,259.13 acres that have been deferred pending the resolution of oil and gas leasing in roadless areas in the south Big Belts. These leases are believed to have been requested in connection with a gas drilling project that occurred in 2004 - 2006 near Ringling, MT.
- As a result of the 1997 ROD for Oil and Gas Leasing on the Lewis and Clark NF, most of the Rocky Mountain Range GA was identified as discretionarily unavailable for leasing, excluding the 19 leases that existed at the time of the analysis and decision. Of the 19 suspended oil and gas leases; 16 leases were cancelled by the BLM in 2016 and 2 leases remain in a suspended status pending outcome of litigation and will remain in an authorized status until litigation is resolved. There are zero pending oil and gas lease parcels for the Lewis and Clark NF.

There are minor surface resource impacts from historic oil and gas activity on the Helena NF area. A single well was drilled on Hogback Mountain in the 1980's that resulted in construction of a short (less than ¼ mile) access road and drill pad. The road and pad area have been reclaimed but the disturbance remains visually apparent. There are no apparent impacts from past seismic activities on the Helena NF.

There has been no impact from the current leases in the Big Belts because there has been no surface activity on these leases.

There are no surface resource impacts from oil and gas related activities on the Jefferson Division of the plan area. There are no impacts on the cancelled leases in the Badger-Two Medicine area because there has been no surface activity on these leases. There are lingering impacts from 1980's era oil and gas leasing and development on the Rocky Mountain Range GA including un-reclaimed roads and noxious weeds.

Coal and other non-renewable leasable minerals

There is very little occurrence of or potential for coal and other nonrenewable leasable minerals in the two-forest area due to the intrinsic geology and the limited number of acres of acquired lands.

Renewable, leasable mineral, and energy resources

Renewable, leasable mineral resources include geothermal, wind, and solar energy resources.

On the Helena NF, 737,819 acres are available for geothermal leasing. On the Lewis and Clark NF, 31,730 acres near White Sulphur Springs are available for geothermal leasing. Portions of the plan area have some favorability for the occurrence of geothermal resources.

There is a known geothermal resource area east of NFS lands in the Marysville vicinity with a capped exploration well that is being monitored (MT DEQ, 2014b). There are currently no exploration or development projects for geothermal energy resources in the plan area. There are no impacts on NFS lands from geothermal exploration or development activity. The forecast for leasing and potential exploration for geothermal energy on the Helena NF area is deemed to be low. The Lewis and Clark NF would have to undertake a geothermal leasing NEPA analysis prior to making most of the forest available for leasing, thus the forecast for activity on those lands is deemed to be very low.

The plan area was found to have potential for the development of wind energy due to the available resource and proximity to transmission lines. The plan area was not found to have potential for the development of solar energy (US Department of Energy 2005).

Salable minerals

These minerals include petrified wood, common varieties of sand, rock, stone, cinders, gravel, pumice, clay and other similar materials. Such common variety mineral materials include deposits that, although they have economic value, tend to be relatively widely available and do not have a distinct and special value. These minerals are most commonly used as building stone, landscaping, and constructions materials.

Saleable mineral uses and developed pits are very common on the Jefferson Division of the Lewis and Clark NF. The Helena NF portion of the plan area has recurring salable minerals uses but at a much lower level and with very few developed pits.

Annually the plan area issues about 10-20 free use mineral material permits and has about 10 in-service project uses. The average annual in service use is about 3,000-5,000 cubic yards combined of material of all types per year. Primary materials used include crushed aggregate, pit run and rip rap. Salable mineral resources development is largely tied to road development activities conducted by the agency.

3.30.5 Environmental consequences

Effects common to all alternatives

The right to access locatable mining operations is a provision of the 1872 mining law. Access to a mining operation on NFS must be reasonable as defined by law and statute. New roads, trails or other types of

access may be approved for a proposed mining operation as long as the proposal is incident to mining and within the scope of the next logical phase of mining development.

The Big Snowies and the Middle Fork Judith WSAs would be managed and regulated according to the direction provided in Public Law 95-150. This would continue to make 170,095 acres no longer compatible for mineral leasing and salable minerals, but still open to locatable mineral prospecting, exploration and development.

All IRA boundaries and acreages within the plan area were firmly established as a part of the 2001 Roadless Area Conservation Rule and would not change in any of the alternatives. Leasable and salable mineral development would not be compatible in these areas, but locatable mineral development is allowable within IRAs.

The current areas that are congressionally withdrawn from mineral entry would be carried forward in all alternatives. Since direction for wilderness management is detailed in law, regulation, and agency policy and in specific management plans, the effects to congressionally designated wilderness as a result of the revised plan do not differ by alternative. In all alternatives, the acres of the existing Bob Marshall, Scapegoat, and Gates of the Mountains Wilderness Areas would remain the same. Designated wilderness areas are withdrawn from mineral entry. Mining activities may still occur in designated wilderness areas as long as the proponent has demonstrated a valid existing right. Valid existing rights occur when unpatented mining claims on NFS lands i) Were properly located prior to an area being designated as a wilderness area; (ii) Were properly maintained thereafter under the applicable law; (iii) Were supported by a discovery of a valuable mineral deposit within the meaning of the U.S. mining laws prior to an area being congressionally designated as a wilderness area, which discovery has been continuously maintained since that date; and (iv) Continue to be valid.

There are many areas across the HLC NF that have been administratively withdrawn from mineral entry, including campgrounds, ranger stations, work stations, powerline corridors, and trailheads to name a few. These areas are not open to mineral entry and, therefore, locatable, leasable and salable minerals are not able to be developed in these areas.

Under all alternatives, forest plan components associated with access and recreation, vegetation, fire and fuels, watershed, soil, riparian, aquatic, lands, and special uses management would not result in any change in the lands available for locatable minerals, leasable minerals, or saleable minerals development.

Future placer mining activity

The future prospects of placer mining are related to the price of gold, accessibility of drainages to this type of mining activity, and available placer gold resource. The potential for a large, unworked, profitable gold bearing gravel resource appears to be low.

Future hard rock mining

Recently with the high prices of gold, companies have turned to removing old waste dumps and tailings piles to be reprocessed at custom mills. Several projects of this type have occurred annually on or around the Helena NF area in the past three years. This trend is expected to continue as long as gold prices remain strong and custom mills are available for processing the ore.

Future locatable minerals

Hard rock mineral activity in the next 10-15 years is projected to be approximately what is currently occurring, with a few exceptions which includes the: 1) hobby scale placer mining projects, 2) mine waste removals for reprocessing, 3) limited, small scale underground mine development on primarily gold prospects, and 4) continued exploration/development activities on deposits adjacent to forest lands such as the Black Butte Copper project adjacent to forest lands in the south Little Belts and exploratory activities

to seek nearby, similar mineralization, Seven-Up Pete deposit, and Marysville area deposits. The primary areas of this activity are likely the areas of the current activities including the Upper Blackfoot, Divide, Elkhorns, and Big Belts GAs due to the inherent mineralized character of these regions. Two areas in the Little Belts are also of interest including the Sheep Creek area which is just outside NFS lands, and the Big Ben deposit in Carpenter Creek.

There is always the potential for an unforeseen exploration project on a known or previously unknown mineralized area where geologists have projected a valuable resource that was not previously exploited. The primary target of this type of activity is likely gold and copper.

Future saleable minerals

Federal Superfund activities will drive the need for a variety of mineral material products including topsoil, cover soil, drain rock, and rip rap particularly in the Belt Creek drainage area of the Little Belts GA, near the State superfund area in the Upper Blackfoot GA, in the Upper Tenmile federal Superfund site, and Little Blackfoot areas. There is an ongoing need for a certain level of material pits for use in forest system road maintenance activities. These project activities may result in an increased, localized demand for mineral materials from NFS lands. Stream restoration projects often require specific and graded material types. Suitable materials of these types may be found on forest lands. Public demand and interest will also drive activity related to mineral materials in the future.

Future leasable mineral and energy resources

This forecast of potential for leasable mineral activity is based on the Reasonably Foreseeable Development Scenarios prepared by the BLM for their resources management revision efforts (Glover and Stillwell 2014). The project plan area is covered almost entirely within the BLM's Lewistown Planning area and Butte Resources Areas (USDI and USDA 2008). A small amount of the BLM Missoula Resources Area covers the western portion of the Upper Blackfoot GA; however, this plan area has not been updated since 1984. Thus the forecast for leasable mineral activity for this area (Table 298) is based on the Helena NFs reasonably foreseeable development scenario as published in the 1998 forest leasing analysis (USDA 1998).

Table 298. Nonrenewable (oil and gas) mineral resources forecast

GA	Historic Activity	Potential for Occurrence of oil and gas resources	Reasonably Foreseeable Development
Big Belts	Moderate - seismic activity and wells drilled on northeast flank of Big Belts and east of the southern Big Belts south of Highway 12.	Moderate - North end is part of Imbricate Thrust Zone play area which has favorable geology but no proven resource. Low-Moderate - Southeast end of range has overthrust geology.	Low - expectation of up to five wells drilled in planning period in the area, however only a portion of the area is federal land.
Castles	Low - no historic drilling activity on federal lands	Low - unfavorable geology	Very Low
Crazies	Low - no historic drilling activity on federal lands	Low - unfavorable geology except for very northwest portion of the federal lands which has moderate occurrence potential.	Very Low
Divide	Low - no wells, no leases in past 20 years	Low - unfavorable geology	Very Low
Elkhorns	Low - no wells, no leases in past 20 years. One deep well south of Johnny's Gulch in 1991.	Low - unfavorable geology except in very southern portion of the area and just west of the Limestone Hills	Very low. Area is not open to leasing.

GA	Historic Activity	Potential for Occurrence of oil and gas resources	Reasonably Foreseeable Development
Highwoods	Low - one historic well drilled on federal lands with no show of resources	Low - unfavorable geology	Very Low
Little Belts	Low - no historic drilling activity on federal lands	Low - unfavorable geology	Very Low
Rocky Mountain Range	High - numerous oil and gas exploration wells drilled in pre-2014 non-wilderness portions of the area	High on very eastern edge of the area. Moderate to low westward.	No Activity* - area withdrawn from mineral entry and additional area added as wilderness in 2014.*With the exception of the suspended leases in the Badger-Two Medicine area.
Snowies	Low - no historic drilling activity on federal lands	Low - unfavorable geology	Very Low
Upper Blackfoot	Low - limited leasing in past 20 years. All leases expired.	Low - area is within Thrust Belt but rock formations not favorable	Very Low - Most of area has No Surface Occupancy stipulation. Occurrence potential is low.

There are currently no request for leases, nor is there any historic or ongoing exploration or development projects for renewable energy resources (wind/solar) on the federal lands in the plan area. There are no known commercial solar energy installations in the plan area and none are expected unless there is a substantial change in the economic climate and government supports. There are wind developments on private lands south of the Highwoods GA and in the vicinity of Judith Gap, which is southwest of the Big Snowies, east of the Little Belts, and east of White Sulphur Springs between the Little Belts and Castle Mountains. The potential for new development of wind energy on federal land in the planning horizon of 15 years is unknown.

Effects common to all action alternatives

Effects from forest plan components associated with:

Eligible wild and scenic river management

During plan development, the HLC NF identified rivers as eligible for consideration as wild, scenic, or recreational rivers under the Wild and Scenic Rivers Act. Mineral activities within these eligible river corridors are still allowable.

Twenty four of these rivers are classified as wild, for a total of 215.8 miles of river segments. Upon designation, Federal lands within the boundaries of designated river areas (one-quarter mile from the bank on each side of the river) classified as wild would be withdrawn from appropriation under the mining and mineral leasing laws by Sections 9(a) and 15(2) of the Wild and Scenic Rivers Act. Existing valid claims or leases within the river boundary would remain in effect, and activities may be allowed subject to regulations that minimize surface disturbance, water sedimentation, pollution, and visual impairment. Reasonable access to mining claims and mineral leases would be permitted. Mining claims, subject to valid existing rights, could be patented only as to the mineral estate and not the surface estate, subject to proof of discovery prior to the effective date of designation. For river segments classified as wild, no new mining claims or mineral leases can be granted.

Federal lands within the boundaries of designated river areas classified as scenic or recreational are not withdrawn under the Act from the mining and mineral leasing laws. Therefore, designated river segments classified as scenic or recreational, the filing of new mining claims or mineral leases is allowed but is

subject to reasonable access and regulations that minimize surface disturbance, water sedimentation, pollution, and visual impairment.

Grizzly bear management

Habitat security requirements and other mineral mitigation measures for grizzly bear can be expected to affect locatable, leasable and salable mineral exploration and development. Where roads, and the access they provide, are necessary, limitations on road construction and operating seasons can be expected to have the effect of prolonging exploration or development work. Areas most affected would be bear management units in the NCDE primary conservation area (see standards FW-STD-E&M-01 thru 07 and guidelines (FW-GDL-E&M-01 thru 06). With alternative C, the no surface occupancy stipulation would apply to new oil and gas leases in all of the NCDE primary conservation area and zone 1. Although the potential on the Forest is very low, the no surface occupancy acreage proposed in alternative C would make it more costly, or infeasible to develop oil and gas resources within the primary conservation area and zone 1.

Canada lynx management

Locatable, leasable and salable mineral exploration and development is also likely to be affected in LAUs in occupied habitat. Guideline HU G12 in the NRLMD ROD gives direction that winter access should be limited to designated routes or designated over-snow routes.

Elk Management

EH-EMIN-GDL-01 and 02 may result in timing restrictions for mineral activities due to no surface occupancy requirements.

Alternative A, no action

The no-action alternative is represented by the existing 1986 Forest Plans, as amended. Law and regulation that have been adopted since the 1986 plans was analyzed as part of the No-action alternative (for example, the designation of IRAs).

Locatable minerals

Because alternative A recommends three wilderness areas, 34,265 acres would potentially be withdrawn from mineral entry under the U.S. General Mining Laws if these areas were to become designated. RWAs are open to mineral entry under the US mining laws until such time as they are congressionally withdrawn from mineral entry subject to valid existing rights. There would be no change to the miles of roads or trails available to motorized or mechanized transport or to the miles of open roads access to mineral or energy proposals.

Leasable minerals

Alternative A would continue to make 34,265 acres administratively unavailable for mineral leasing. There would be no change to the miles of roads or trails available to motorized or mechanized transport or to the miles of open roads for access to leasable proposals.

Salable materials

The three areas allocated as RWAs in alternative A (34,265 acres) would not be compatible for disposal of mineral materials. There would be no change to the miles of roads or trails available to motorized or mechanized transport or to the miles of open roads to access mineral materials.

Effects that vary by alternative

Locatable minerals

Alternative B recommends nine wilderness areas, totaling 213,076 acres that would potentially be withdrawn from mineral entry for locatable minerals. RWAs are open to mineral entry under the U.S. mining laws until such time as they are congressionally withdrawn from mineral entry subject to valid existing rights. Mining activities may still occur in designated wilderness areas as long as the proponent has valid existing rights. There would be 213 miles of roads or trails no longer available to motorized or mechanized transport and 12 miles of roads no longer open for access to mineral or energy proposals.

Alternative C would allow for increased access to mineral and energy projects compared to alternative B because the number roads or trails available to motorized or mechanized transport and miles of roads open is not restricted in those RWAs. Alternative C recommends nine wilderness areas, totaling 213,076 acres that would potentially be withdrawn from mineral entry for locatable minerals.

Alternative D would be the most restrictive alternative to mineral and energy development as it proposes the most acreage for RWAs. It also proposes the largest amount of roads or trails no longer available to motorized or mechanized transport and the most miles of roads no longer open that would cause access restrictions for mineral and energy development. Alternative D recommends sixteen wilderness areas, totaling 474,589 acres that would potentially be withdrawn from mineral entry for locatable minerals. There would be 430 miles of roads or trails no longer available to motorized or mechanized transport and 17 miles of roads no longer open for access to mineral or energy proposals.

Alternative E would be the least restrictive of all of the alternatives to energy and mineral development. This alternative does not propose any RWAs and does not propose any reduction in the miles of roads or trails available to motorized or mechanized transport or the number of miles of roads open. Because alternative E has no RWAs, no additional NFS lands are expected to be withdrawn from mineral entry for locatable minerals. There would be no change to the miles of roads or trails available to motorized or mechanized transport or to the miles of open roads access to mineral or energy proposals.

Nevada Mountain is a RWA in alternatives B, C and D. This area has been the location of historic and current mining activity. As of the writing of this report, there are over one hundred unpatented mining claims within the boundaries of this area. There is a very high potential for future mineral prospecting, exploration and development in this area. Mining activities could detract from the "wilderness character" of this area. This RWA includes the Nevada Mountain area and headwaters of Washington to Nevada Creeks, north and east including McClellan Gulch, and then easterly to upper Poorman Creek. This area is underlain by a granitic stock that has intruded into Belt series argillites and quartzites and has resulted in mineral deposits that have been prospected and mined by hard rock and placer mining methods. A potentially larger ore body at depth is suspected (Tysdal et al. 1996). McClellan Gulch was a very rich placer gold tributary of Poorman Creek. It has been estimated that $7,000,000 in gold came from the gravels of this gulch (Pardee & Schrader, 1933); McClernan 1983).

Leasable minerals

Alternative B would make 213,076 acres administratively unavailable for mineral leasing. There would be 213 miles of roads or trails no longer available to motorized or mechanized transport and 12 miles of roads no longer open for access to leasable proposals.

Under alternative C 213,076 acres would be administratively unavailable for mineral leasing.

Under alternative D, 474,589 acres would be administratively unavailable for mineral leasing. There would be 430 miles of roads or trails no longer available to motorized or mechanized transport and 17 miles of roads no longer open for access to leasable proposals.

Since there are no RWAs in alternative E, an additional 34,265 acres may be compatible for leasable materials. There would be no change to the miles of roads or trails available to motorized or mechanized transport or to the miles of open roads to access leasable materials. However, alternative E is affected by the IRA management regulations. Road construction or reconstruction associated with mineral leases may not occur in IRAs.

Salable materials

Areas allocated as RWAs would not be compatible for disposal of mineral materials. Alternative B would make 213,076 acres not compatible for the disposal of mineral materials. Access to salable minerals would decrease as there would be 213 miles of roads or trails no longer available to motorized or mechanized transport and 12 miles of roads no longer open for access to mineral proposals.

Under alternative C 213,076 acres would not be compatible for the disposal of mineral materials.

Under alternative D, 474,589 acres would not be compatible for the disposal of mineral materials.

Access to salable minerals would decrease as there would be 430 miles of roads or trails no longer available to motorized or mechanized transport and 17 miles of roads no longer open for access to mineral or energy proposals.

Since there are no RWAs in alternative E, an additional 34,265 acres would be compatible for the disposal of mineral materials. There would be no change to the miles of roads or trails available to motorized or mechanized transport or to the miles of open roads to access mineral materials.

Cumulative Effects

Cumulative effects evaluate the potential impacts to mineral resources from the action alternatives when combined with past, present, and reasonably foreseeable actions. All lands within the HLC NF GA boundaries form the geographic scope for cumulative effects. The temporal bound would be the life of the Forest Plan which is estimated to be a 15-year time span.

Requests for approval of small lode and placer mining operations may occur, but it is not possible to predict how many may be submitted in any given year, or how many might be approved. There is a high potential for locatable mineral development on most of the Forest. Since Congress has imposed a moratorium on patenting of mining claims, there would be no changes in the acres of patented lands unless Congress was to lift the moratorium.

Given the low probable occurrence of leasable minerals other than oil and gas on open/available lands on the HLC NF, the cancellation of the oil and gas leases on the Rocky Mountain Front by the U.S. Department of the Interior and the improbability of an EIS for oil and gas leasing being prepared in the next 15 years, there is little likelihood of mineral lease applications being made.

Mineral material use can be expected to continue for in-service needs (e.g., road maintenance and watershed improvement activities) and as a salable commodity to the public and would result in the further depletion of that non-renewable mineral resource from NFS lands.

Reclamation work is likely to occur on select abandoned mine sites as well as on mineral material sites that have reached the end of their useful life.

Portions of the HLCNF adjoin other NFs, each having its own forest plan. The HLCNF 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 revised forest plan are summarized in Table 299, for those plans applicable to energy and minerals.

Table 299. Summary of cumulative effects to energy and minerals 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 Energy and Minerals. Generally speaking, management of Energy and Minerals is consistent across all NFs due to law, regulation, and policy. The management of Energy and Minerals would be complementary and consistent. This includes specific adjacent landscapes that cross Forest boundaries, such as the Upper Blackfoot, Divide, Elkhorns, Crazies, and the Rocky Mountain Range.
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. Mineral and energy projects in the Rocky Mountain Range GA and would be consistent with these conditions.
BLM Resource Management Plans (RMP)	BLM lands near the HLC NF are managed by the Butte, Missoula, and Lewistown field offices. The Butte plan was recently revised (2009) while the existing plans for the Missoula and Lewistown areas are under revision. These plans contain components related to Energy and Minerals, and would be complementary to the draft plan.

Conclusions

Access to locatable, leasable and salable minerals, as well as, opportunities for mineral entry, mineral leasing and mineral disposal would vary by alternative. The variations across alternatives are due to differences in RWAs, motorized, and mechanized access, as well as plan components related to restricting surface occupancy on future mineral and energy projects. Alternative E offers the most opportunities for mineral-related activities, followed by alternatives A, C, B and D, in order of decreasing opportunities.

3.31 Carbon Sequestration

3.31.1 Introduction

Carbon sequestration and associated climate regulation have been identified as key ecosystem services provided by the Forest. The potential effects of alternatives are analyzed relative to carbon storage (sequestration) potential. Concerns with carbon, climate change, and associated ecosystem responses have been raised during the forest plan revision process. The relationship between climate change and other resources are addressed in the appropriate resource section. This section addresses carbon sequestration.

Concerns with carbon, climate change, and associated ecosystem responses have been raised during the forest plan revision process. Carbon sequestration is one way to mitigate greenhouse gas emissions by offsetting losses through capture and storage of carbon. The FS recognizes the vital role that our nation’s forests and grasslands play in carbon sequestration (USDA 2015).

The key indicators used are:

- The sequestration and storage of carbon pools (stocks) in terms of total ecosystem carbon (Tg, teragrams) and carbon in harvested wood products (MgC, megagrams of carbon)
- Natural/human- caused changes to landscape that influence carbon storage and sequestration (i.e., vegetation succession, vegetation treatments, fire, insect outbreaks, disease) – influence to carbon pools

Analysis area

The Forest has identified carbon sequestration (storage) and associated climate regulation as a key ecosystem service, and describes potential effects of the proposed action and alternatives at the scale of