Helena and Lewis & Clark National Forests

Forest Plan Assessment

Chapter 9, Renewable and Nonrenewable Energy, Mineral Resources and Geology

2015

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Renewable and Nonrenewable Energy, Mineral Resources and Geology

Introduction

The mineral resources assessment includes the geology of the forests because geology provides a foundational understanding of the reason for the mineral resources located on the forests. The inherent geology of the forest areas is also foundational to the development of and understanding of the soils, water quality and quantity, drainage development patterns, landforms, and vegetative patterns that occur on these landscapes. The location of hard rock mineral resources, in particular, is critical to understanding the landownership patterns found in mineralized portions of the forests where small, irregular clusters of private land are surrounded by National Forest System (NFS) lands. This landownership pattern is entirely due to patenting of these lands because of their mineral resources. In addition to the requirements of the planning rule, various laws and regulations require the Forest Service to consider and manage geologic resources such as caves and paleontological resources. In addition, the geology of the forests is tied to some of the unique and outstanding scenery and interesting geologic phenomenon found on the forests, as well as being one of the criteria for nomination of the Smith River as a Wild and Scenic River. Finally, the outstanding scenery, habitat, and historic landscapes of the Rocky Mountain Front has resulted in mineral withdrawal and recent federal legislation to designate much of this area as wilderness even though the area is a high value prospect for oil and gas resources.

Existing Information

This assessment of the geology, renewable, and nonrenewable mineral and energy resources of the Helena and Lewis and Clark National Forests (HLC NFs) is based on information from numerous resources, including statutes, laws, regulations, Forest Service manuals, State of Montana Natural Resource Information System (NRIS) data, Forest project and permit files, Montana Bureau of Mines and Geology publications and data, Montana Department of Natural Resources and Conservation (MTDNRC) information, Bureau of Land Management (BLM) minerals forecasts, U.S. Geological Survey (USGS) published documents and maps, U.S. Bureau of Mines published documents, Environmental Protection Agency (EPA) website and published documents, and other literature.

The information used to prepare this assessment of solar and wind energy in the plan area comes from the National Renewable Energy Laboratory (US Department of Energy NREL 2005). USFS staff from the Forest Service Geospatial Service and Technology Center in Salt Lake City, Utah, provided NREL with GIS-based data of Forest Service land boundaries, specially designated areas, and inventoried roadless areas. NREL's GIS team then produced GIS maps illustrating solar and wind energy resources, with an overlay of USFS National Forest and Grassland units. Other data used in the analysis included topographical data and data on transmission lines, major roads, and railroads.

For the mineral resources assessment, the best available science was used to inform the assessment. The data and reports provide background information on the current and historic water quality conditions across the Forests.

Regulatory and Management Framework

The authority to manage the exploration and development of mineral and energy resources within National Forest System (NFS) lands is jointly shared between the Secretary of Agriculture and the Secretary of the Interior. The administration of the general mining laws and the mineral leasing acts is primarily the responsibility of the Department of the Interior. Certain mineral leasing acts require the consent of the Secretary of Agriculture and are subject to such conditions prescribed to ensure the adequate utilization of the lands for the purposes for which they were acquired or are being administered.

The Forest Service has entered into interagency agreements with Interior Department agencies to cooperate and coordinate in managing federally owned minerals within NFS lands (FSM 2801.3). The Forest Service is responsible for managing the occupancy and use of the surface by persons conducting these activities and to manage the disposal of certain mineral materials. The primary laws for minerals management on federal lands include:

- General Mining Law of 1872 - authorized placer and lode mining claims, mill sites and tunnel sites of specific dimensions and a patenting process.
- Organic Administration Act of June 4, 1897 (30 Stat. 11, as amended; 16 U.S.C. 473-475, 477-482, 551). This act provides the Secretary of Agriculture the authority to regulate the occupancy and use of NFS lands. It provides for the continuing right to conduct mining activities under the general mining laws if the rules and regulations covering NFS lands are complied with. This act recognizes the rights of miners and prospectors to access NFS lands for all proper and lawful purposes, including prospecting, locating, and developing mineral resources.
- Mineral Leasing Act of 1920 as amended - provided that deposits of laterally extensive minerals such as coal, oil, gas, and phosphate could be acquired through competitive leasing systems.
- The Materials Act of 1947 provides for the disposal of mineral materials on the public lands through bidding, negotiated contracts, and free use.
- Mining Act of July 23, 1955 (69 Stat. 368; 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 also provides that rights under any mining claim located under the mining laws are subject to the right of the United States to manage and dispose of surface resources.
- Mining and Minerals Policy Act of December 31, 1970 (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.
- Title 36, Code of Federal Regulations, Part 228. 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, and mineral material disposal laws.
- The Geothermal Steam Act of 1970, as amended, established a competitive and noncompetitive system for leasing geothermal resources and associated by products.
- The Federal Land Policy and Management Act of 1976 required the recordation of unpatented mining claims with the BLM and authorized surface protection of the public lands.
- 2006 Tax Relief and Health Care Act, Public Law 109-432 Section 403(a) provided energy tax credits.
- Paleontological Resources Preservation subtitle of the Omnibus Public Land Management Act, 16 U.S.C. 470aaa to aaa-11 (2009)
- 1988 Federal Cave Resources Protection Act (FCRPA)

Portions of the assessment area are designated wilderness areas or wilderness study areas. These lands are legislatively withdrawn from mineral entry, subject to valid existing rights. This includes approximately 42% of the Lewis and Clark Forest area and 14% of the Helena Forest area, including the acres designated in 2014 National Defense Authorization Act (Public Law 113-291).

Minerals, Geology and the Forest Plans

The 1986 Forest Plans for both the HLC NFs (USDA Forest Service1986a&b) include forest-wide management direction as described in Goals, Objectives, and Standards, and management area specific direction. The Helena Forest Plan placed more emphasis on a management framework for locatable minerals and the Lewis and Clark Forest plan placed more emphasis on the management framework for leasable minerals. The only specific direction in the plans for a geologic feature is the Lewis and Clark Forest Plan objective for caves. This direction was modified by the 1993 Forest Plan Amendment 13 of the Lewis and Clark Forest Plan which provided specific direction for cave management.

Leasable mineral activity direction was modified in 1997 on the Lewis and Clark National Forest and 1999 on the Helena National Forest through oil and gas leasing Environmental Impact Statements and issuance of a Record of Decision accompanied by amendments to the forest plans (USDA Forest Service 1997; USDA Forest Service 1998). This is discussed in more detail below.

Land Status and Mineral Resources

The regulatory framework for mineral and energy resource exploration and extraction depends upon the type of commodity, the surface and mineral estate ownership, and the land status (public domain or acquired). The Forest Service has authorities to administer minerals on both public domain and acquired lands but they are not the same authorities. Public domain land is land that was originally under federal ownership/jurisdiction. These lands, unless they are subject to a mineral withdrawal, are open to mineral entry under the Mining Laws. Most of the lands of the plan area are public domain.

Acquired lands are those that have been brought into federal ownership through purchase, condemnation or exchange. Landownership can be transferred with both the surface and mineral estate or separately. Thus, the result is that some of the federal lands include only the surface estate or only the mineral estate. Lands where the Forest Service owns only the surface estate but not the mineral estate are referred to as lands with reserved minerals, or ‘outstanding mineral rights’. There are 37,500 acres of outstanding and reserved mineral rights on the Lewis and Clark portion of the planning area, mostly in the north end of the Crazies Geographic Area. There are about 20,000 acres of reserved and outstanding mineral rights on the Helena Forest portion of the planning area, primarily in the Big Belts Geographic Area. This is important because the owner of the mineral rights in this case may develop the mineral estate and typically the Forest Service cannot deny the exercise of those outstanding mineral rights. The Forest Service regulatory authorities for administering mineral activities on these lands are provided for in 36CFR251.15 and FSM 2830.

Acquired lands where the Forest Service has acquired both the surface and mineral estate have specific authorities with respect to mineral development, depending upon the authority used for the land acquisition. On acquired lands, locatable minerals become leasable. The BLM maintains records of the status of the federal mineral estate for the Forest Service.

Existing Condition

Geology

The National Forest System lands managed by the Helena and Lewis and Clark Forests 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 (USGS 2000). Complex and diverse geology characterizes these regions.

Rock Units

The following 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 very localized in their occurrence. However, the rock types are presented to give the sequence generally found from oldest to youngest in age. 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.

The Belt Supergroup consists of lowermost Neihart Quartzite, which has a limited occurrence only near the community of Neihart, and is overlain by Chamberlain Shale, Newland Limestone, Greyson Shale and Spokane Formation. The shales of the Belt Supergroup are typically thin bedded and range from grey to maroon in color. After deposition of the Belt sediments, uplift occurred, deposition ceased and the rock package was tilted and then eroded. Some 600 million years later the first Paleozoic sedimentary rocks were deposited unconformably over the Precambrian Belt rocks. These rocks include the basal Flathead Sandstone, marled and layered Cambrian limestones, Devonian Jefferson Dolomite, and the signature rock of the Paleozoic-the Madison Limestone Formation- which includes a thin basal shale layer. The Madison Formation is distinctive because it is about 1500 feet thick and is commonly cliff forming which provides for fantastic scenery across numerous locations on the forests. Atop the Madison formation, where exposed, is shale, red to tan sandstones of the Big Snowy group, and Amsden and Quadrant Formations respectively. The Mesozoic era is not well represented across the forest areas but does occur and includes the Jurassic Ellis Group and Morrison Formations, and Cretaceous shales and sandstones of the Kootenai, Colorado, Telegraph Creek, Eagle, Claggett, Judith River, and Bearpaw formations.

Near the end of the Mesozoic into the early Cenozoic era (about 65 million years ago), a massive granitic type magma body, the Boulder Batholith, was emplaced between Butte and Helena Montana and it spawned numerous smaller plutons that intruded into the older sedimentary rocks. Volcanic rhyolites and andesites were spewed over large portions of the plan area ahead of the batholith. As the region was uplifted and erosion occurred, most of the volcanic rocks were eroded leaving granitic rocks exposed at the surface in many areas. Somewhat younger igneous rocks occur in the eastern part of the forest areas. Dikes, sills, laccoliths, and stocks intruded into the sedimentary layers of the Little Belts, Highwoods, Castles and Crazy Mountains in the Tertiary (about 50 million years old) making them younger than the Boulder Batholith intrusive era (Woodward 2010; Weed and Pirsson 1896). The Crazy Mountains, in particular, were a large-scale volcanic feature with classic radial dikes emanating from the central igneous core of the mountain range. Even younger (30 to 35 million year old) basalt flows occur in the southern Little Belt Mountains. Younger Tertiary-aged sedimentary formations including mixed volcanic material, sands, gravels, lake bed deposits, and ash flow deposits occur as valley fill on the flanks of the forest's mountainous areas where the mountains grade into the valley areas.

At the end of the Tertiary and during the Quaternary period (the last 1.8 million years), large scale glaciers and ice sheets formed over much of North America. Continental scale ice sheets coursed southerly from Canada in several major pulses and covered much of northern Montana with glacial till and lake deposits. The ice sheets changed the flow patterns of the major rivers and streams of this area. Cordilleran glaciers covered most of the mountains of the plan area in whole or in part, depositing moraine and till materials, carving intricate, steep-sided

cliffs and broadened valleys. The glacial era, termed the Pleistocene, was also an era of much greater precipitation which led to increased erosion and creation of broad stream valleys. The youngest deposits in the forests include glacial moraines, tills, and outwash debris deposited during the Pleistocene era from about 125,000 years ago to the about 12,000 years ago. These deposits tend to occur in upper drainage areas and benches with the exception of the Blackfoot River valley where they are found throughout the valley and at higher elevations. There is evidence of glaciation in most all of the mountain ranges of the two forest areas (Woodward and Shumaker 2011).

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. Deformation started with an ancient, easterly trending, fault-bounded basin centered west of Helena which provided for the deposition of the thick wedge-shaped sequence of the Precambrian Belt Supergroup rocks. Following this long-standing depositional era was a period of uplift and erosion that led to tilting of the Belt series rocks and partial erosion. Then about 550 million years ago during the Paleozoic era, the area was once again a long-standing basin which found the western portion of Montana primarily a depositional marine basin. About 80 million years ago, continental plate collisions along the western margin of North America ended the depositional era. This tectonic activity resulted in the compression of the wedge-shaped sedimentary rock 'skin' of Precambrian and Paleozoic sedimentary rocks, leading to the development of the Cordilleran Fold and Thrust Belt. The Cordilleran Thrust Belt extends from Canada south to Mexico and is a zone of intensely folded and thrusted sedimentary rock plates where up to 60 miles of lateral translation to the east of the wedge-shaped rock package occurred. The Rocky Mountain Front and Upper Blackfoot areas exhibit exceptional overthrust - style structural deformation as a result of these plate collision events. An eastward bulge in the Cordilleran thrust belt occurs north and south of Helena and is known as the Helena Structural Salient. This feature results in complex deformed rocks along the northern edge -the Lewis and Clark Line - and the sourthern edge, the Perry line - and forms the concave-shaped Big Belt Mountains and the northwest trending Little Belt and Castle Mountain structures to the east. The Big and Little Snowy Mountains are also related to these structural features (Harris 1957, Tysdal et al. 1996).

Along with development of this hundreds-of-miles-long mountain belt was the emplacement of massive quantities of magma and volcanism including the emplacement of the Boulder Batholith and associated plutons, and the Crazy Mountains volcanics. This overall mountain-building event lasted for nearly 40 million years and is called the Laramide Orogeny. The sedimentary rocks as they have been structurally deformed and the igneous rocks of the Laramide Orogeny are the primary geological features underlying the planning area (Tysdal et al. 1996).

Near the end of the Laramide Orogeny a different type of deformation started in the western portion of North America. A relaxing of the compressed crust, possibly due to breaking of partially melted crustal plates at depth, resulted in an extensional tectonic period that continues to the present. The basins of the Missouri valley between the Elkhorns and Big Belts and the Smith River Valley were down-dropped in a blocky configuration that occurred as part of the crustal tearing. Normal faults, high angle faults, flank the western Big Belts, eastern Elkhorns, the Helena Valley, and portions of the Smith River valley. Scattered warm springs and periodic seismic activity are evidence that the crust is not entirely stable today.

Geologic Areas of Interest

As a result of the geologic events and processes described generally above, a variety of noteworthy scenic and/or geologically interesting, and geologically hazardous areas occur within the forest lands plan area of this assessment. Areas of geologically scenic and interesting areas are summarized below and several are described in more detail in the sections that follow.

Table 9.1 Geologic areas of scenic and academic interest in HLC NFs plan area

Geographic Area	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 - Wild and Scenic River	Scenery, nonmotorized Recreation river - designated in part for its unique geology	Popular floatable river that is administered by MFWP and permit system in cooperation with the Forest Service. Floaters start in Precambrian Belt sedimentary units and float 'upsection' into late Mesozoic sedimentary units - stunning cliffs and canyon scenery	Wild and Scenic River management restrictions
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 199?
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 travelors 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 and eight Nationally Significant caves on Helena Forest. Lewis and Clark Forest Plan amendment #13 on LCF provides management direction specific to the cave resource on the forest

Rocky Mountain Front Overthrust Belt

The Rocky Mountain Front is geologically renowned because of its 'larger than life' visibility of classic overthrust, or Cordilleran fold and thrust belt geologic structures. Fold and thrust belts are geologic terrains associated with crustal plate collisions and examples are scattered across the globe representing collisions during eras dating back to the earliest Precambrian area. The Rocky Mountain Front example is from the end of the Mesozoic era and it is unusual geologically because of its extreme exposure and visibility of these geologic structures which makes academic study of them relatively accessible. Geologists utilize these classic examples in their study to better understand deformation of the earth's crust. These types of geologic terrains are also geologically interesting because they can be favorable for the occurrence of oil and gas.

The Rocky Mountain Front overthrust belt is within the Rocky Mountain Front and eastern Blackfoot River plan areas for this forest plan assessment. The outstanding geology is also in part responsible for the wildlife habitat and unique recreational opportunities of the area. A result of the outstanding natural features of this area is a complex management history on the public lands, including the mineral estate, portion of this area.

Caves

Thrust faulting has shoved blocks of Paleozoic carbonate (limestones and dolomites) rocks eastward and on top of each other which in many instances has resulted in these rocks occurring on mountain ridges. These thick rock packages combined with the effects of glacial recessions and formerly cooler and wetter climates has favored the development of karst solution features, commonly referred to as caves. These areas include deeply dissected canyons now which resulted in the exposure of karst features at the surface. Caves are important and unique types of habitat for the plants and animals that utilize them, and for public recreation. These are discussed more in chapter 2, Terrestrial Ecosystems – wildlife sections – and chapter 7 Recreation Settings, Opportunities, Access, and Scenic Character.

There are numerous inventoried caves within the HLC NFs and several caves have been identified as significant. Administrative activities for the forests cave resources currently focuses on limited educational efforts and inventory activities. Management direction for caves is found in Forest Service Manual chapters 2356 and 2880.

Caves may provide crucial habitat for certain bat species, including the Townsend's big-eared bat, which is currently listed as a sensitive species in Region One and is identified as a potential Species of Conservation Concern in the terrestrial wildlife portion of this assessment. Most caves in the plan area have not been inventoried for bats.

Paleontologic 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 aaa-11 (2009; "the Act")) and in pending Forest Service regulations (36 CFR Part 291—proposed). Past practice in the FS in the absence of statutory authority and/or regulations has been to assign various levels of significance to fossil occurrences and to recommend management commensurate with significance. However, neither the Act nor the pending regulations recognize differing levels of significance of paleontological resources. Rather, 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.

The current forest plans for the HLC NFs do not currently have direction pertaining to paleontological resources and the forest areas have an abundance of occurrences of paleontological resources, particularly in the Mississippian limestone formations. There has not been interest in commercial collecting of these resources but recreational 'rock picking' does occur.

Geologic Hazards

Geologic hazards are part of the natural environment and backdrop of the forest plan area. Hazards can include unstable landforms such as landslide prone areas, cliffs or rockfall areas, potentially changing landforms due to the active seismicity of the area, as well as sinkholes that open unexpectedly. Freezing and thawing result in destabilizing steep slopes and creating rock falls. Geologic hazards are not generally problems unless associated with forest infrastructure and places where the public might be. There are no inventoried 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 (Helena National Forest, May 2011; Lewis and Clark National Forest, May 2011).

Mineral and Energy Resources

The geologic history, including the diversity of rock types and ages, is the reason for the occurrence and development history of the mineral resources found in the forest areas. Indeed, the occurrence of precious and base metal minerals is the backdrop for much of the cultural history of the forest areas, particularly the Helena National Forest 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. The towns of Helena, York, Elliston, Rimini, Neihart, Monarch, Belt, White Sulphur Springs, Radersburg, Winston, Toston, and Townsend were founded in the 1800's in whole or in part by miners and those following mining discoveries. The now gone historic communities such as Diamond City in Confederate Gulch in the Big Belt Mountains, Castletown in the Castle Mountains, and the Mike Horse mining camp east of Lincoln were once thriving centers of population and/or commerce as a result of mining activity.

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 area, 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 Mineral Resources

Locatable minerals are those valuable mineral deposits subject to exploration and development under the General Mining Law of 1872 as amended. The General Mining Law grants every U.S. citizen the right to prospect and explore lands reserved from the public domain and open to mineral entry. The right of access to explore for and develop these minerals on federal lands open to the location of mining claims is guaranteed and not a discretionary action. Locatable minerals are commonly referred to as 'hard rock minerals' and include resources such as gold, silver, copper, lead and zinc, platinum, palladium, tin, antimony, molybdenum, sapphires, and many other lesser known minerals or elements. There are two kinds of mining claims - lode and placer- and a nonmineral location for millsites.

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 Forest Service lands where the mineral estate has been separated from the surface estate. Approximately 86% or 850,000 acres of the Helena Forest area is open to the location of unpatented mining claims and approximately 58% or 1 million acres of the Lewis and Clark National Forest area is open to the location of mining claims. The Helena Forest areas have had substantially more mining claim and mining activity than the Lewis and Clark Forest areas owing to the inherent geology and occurrence of mineral resources.

A large proportion of the Helena National Forest is included in designated mining districts and also portions of the Jefferson Division of the Lewis and Clark National Forest plan area. 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 two forest areas include 1) historic and recent placer mining, and 2) historic and recent lode mining.

Historic and Recent Placer Mining

Activity

Placer mining includes the removal and washing of primarily valley bottom alluvial gravels or nearby terraces and benches where free milling gold can be found that has been liberated from bedrock through erosion and weathering processes. Placer mining started as early as the 1860's with hand equipment that quickly evolved to hydraulic mining, and dredges. Many gulches were mined out by 1900 only to be reworked and picked over by modern era heavy equipment mining methods in subsequent eras. Many drainage bottom areas have been patented as a result of this history. The estimated amount of gold mined from the gulches of the Helena National Forest is over 2.7 million ounces. The primary geographic areas 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 Geographic Area, 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. Modern era placer mining is a mere shell of its historic scope. Most of the currently permitted or permitted recent past operations are small scale, conducted by 1-2 individuals on a part time basis. These operations are at a hand scale, small equipment scale, or a mixture of both. Generally these operations individually result 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.

Impacts

Historic placer mining has resulted in significant disturbance of many stream corridors within NFS lands. Many of the most heavily-disturbed areas have been patented, which includes numerous stream bottom areas. Miles of stream and floodplain area were churned up and patented in the search for placer gold. Historic mining processes resulted in alteration of the channel configuration and gradient, removal of material, piling of unwanted oversize material in linear windrows in the floodplain which restricted channel movement, erosion, loss of channel fines and elimination of riparian soils and wet areas. Historic mining disturbance was exacerbated by significant flood events, particularly in areas where forest fires occurred subsequent to the mining activity and/or large flood events occurred. Placer mining impacted areas have been slow to heal naturally and resource issues persist to the present including noxious weed establishment, disrupted stream and floodplain areas, water quality impairment, loss of fish habitat, loss of public access due to patenting, private development, and others.

Historic and Recent Hard Rock Mining

Activity

Hard rock mining activity is the pursuit of locatable (valuable) 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 a legal identifying characteristic of mining claim location and mineral activity areas.

Locatable minerals on NFS lands are managed under the regulations at 36CFR228 Subpart A. These regulations recognize the miners' right to pursue a valuable mineral deposit while the agency works with its authorities and guidance's to minimize impacts to surface resources through evaluation of a mineral proposal. Mining projects, other than the categories for small scale work listed in the regulations, require a miner to submit a Plan of Operations for review and approval. Usually the process includes a review under the National Environmental Policy Act (NEPA), public notification, and some level of reclamation bond.

Big Belts Geographic Area

The Big Belt Mountains placer mining history and production, as discussed above, eclipses the lode deposit activity. Primary lode mines of the range include the Golden Messenger, Old Amber, Argo, Miller - Hummingbird, Bigler-Snowbank, and Porcupine mines. Primary work eras for the lode mines were before the turn of the century and little information is available for these mines. The Golden Messenger and Old Amber mines (gold) produced from a quartz diorite intrusive dike into Belt series rocks. The Argo (copper) mine in Hellgate Gulch was an important copper producer until the mid-late 1920's. By 1928 the mine and mill were idle. More recently, the Miller-Hummingbird mine area was the locus of extensive exploration drilling for gold from the 1970's through the 1980's. The Bigler-Snowbank mines are relatively recent, small, near-surface contact metamorphic gold mines at the head of Thompsen Gulch on the east side of the Big Belts. The Porcupine is a much older mine that has been reentered numerous times and was active until recently at a small scale. These mines exploited free milling gold deposited at the contact of the intrusive stocks of Boulder Baldy and Mount Baldy near the crest of the Big Belts. They have been continuously claimed and mined intermittently for the past 20 years (Townsend Ranger District, 2810 Project Files).

Castles Geographic Area

Mineral deposits in the Castle Mountains occur in metamorphosed sedimentary rocks (mostly in limestones) that have been locally altered by the intrusive granites and diorites. Minerals mined were primarily for silver and lead. However, some gold was produced from the Cumberland and Hensley mines. The Cumberland mine on the south side of the range in the upper reaches of Alabaugh Creek was the primary producer in the mountain range. At its height, this mine included a smelter, a mill and it was the primary producer of lead in Montana in 1891 (Weed and Pirsson 1896). The latest exploratory or development activity occurred in the late 1940's (Roby 1950). In 2001, the Montana Abandoned Mine Reclamation Bureau reclaimed the Cumberland mine site and no further mineral activity is projected. Most of the other mines of the Castle Mountain District have been abandoned, reclaimed, or are inaccessible since the 1950s (Roby 1950). A small exploration drilling project occurred near the Queen of the Castles mine in the 1980's (Forest Service 2810 Mineral Permit Files).

Divide Geographic Area

Little Blackfoot and Marysville - The Little Blackfoot area includes substantial historic lode mining activity in the upper reaches of Telegraph Creek and lower Little Blackfoot River, as well as in upper Ophir and Dog Creek and their tributaries. The productive lode mines of Telegraph and the Little Blackfoot River area included the Big Dick, Monarch, Julia, Ontario, Charter Oak, Third Term, and Telegaph Mines although there are

many more (Pardee and Schrader 1935). The area had a recorded production of $2.8 million prior to 1928 and the chief mineral products were gold, silver, lead, and copper. Silver and lead were the most valuable commodities.

The Marysville mining district is just east over the drainage divide in the upper reaches of Little Prickly Pear and Silver Creeks and is mostly on private and BLM lands. Production of gold and silver from this district was $31 million by 1928. Patented placer and lode claims extend into the upper drainage areas onto Forest Service administered lands. The Drumlummon mine was the largest producer of the area and its gold ores attracted miners to the nearby areas including Forest Service System lands. Recently, the Drumlummon mine reopened and began producing gold although it is shut down as of the writing of this assessment report (McClernan 1983).

Tenmile-South Helena - This area has the greatest concentration of historic lode and placer mines of the two forests. A result of this activity is the complex configuration of patented mining claims within the NFS boundary. Many of the patents are now seeing residential development. The area includes the mining districts of Helena, Clancy, and Rimini. The Helena mining district encompasses Last Chance, Grizzly, Oro Fino, Dry, and Nelson Gulches. The first miners were placer miners and all of the gulches south of the city were mined by placer methods, some still occurring today. The principal mining camp was Unionville. Lode mining activity in the district centered around the development of the Whitlatch-Union mine from whence the town of Unionville sprang up; later activity centered around the Spring Hill mine. The Spring Hill mine was second only to the Anaconda Company in gold production for Montana in 1929. A mill at the Spring Hill mine was built in 1925 and operated until it burned in 1932. It was replaced in 1934 and operated until the operation was shut down in 1940 (Pardee and Schrader 1933). The estimated total production of the Helena district to the end of 1928 is $22,500,000. This includes an estimated $16,000,000 for the placer deposits, $6,110,000 for the Whitlatch-Union and Big Indian lodes up to 1911, and $390,000 for production for all the other mines in the district, primarily the Spring Hill mine which in 1928 produced $62,502.84 (Pardee and Schrader 1933).

The Clancy mining district consists essentially of the drainages of Lump Gulch and Clancy Creek, both tributaries of Prickly Pear Creek. The district is directly south of Helena and was first developed by placer operations along Prickly Pear Creek around 1865. The gold placers did not prove to be very profitable, but rich silver lodes were discovered the next year. The Little Nell and Liverpool mines were once again active by 1908. They supplied the 20 ton Gold Crown Concentrator and in 1911 the Frohner 30-ton mill was constructed to handle the Lump Gulch ores. Total production from the district has amounted to somewhat more than $4,000,000 (MT DEQ, 2014a).

The Rimini district is about 13 miles east of Helena on the east side of the Continental Divide at the terminal point of a branch of the Northern Pacific Railroad. It is on Tenmile Creek with Red Mountain on the east and Lee Mountain on the west. It is probably the oldest lead-zinc camp in Montana. Mineral survey numbers 3, 4, and 5 were located on Red Mountain and survey 13 was located on Lee Mountain. The Lee Mountain Lode was discovered in 1864 and the Eureka Mine in 1865. However, little mining occurred until 1885 when the Northern Pacific spurline was constructed to the district. The ore deposits of Rimini occur in about 60 veins approximately 200 feet apart. The ore bodies are auriferous silver-lead deposits, the chief ore being galena, accompanied by sphalerite, pyrite, and in some lodes arsenopyrite. Some of these mines were opened to depths of up to 500 or 600 ft. One of the deepest, the Lee Mountain, has produced more than $1.5 million and the Valley Forge, which is 325 feet deep, has produced more than $200,000. The district shipped 400 tons of ore per week in 1891 with most of the ore being sent to the smelter at Wickes. A younger ore deposit consists of crushed altered rhyolite impregnated with fine gold to form large bodies of low-grade gold ore. The principal occurrence is in the southern part of the district at the head of Monitor Creek at the Porphyry Dike, Pauper's Dream and Carlson mines (MT DEQ 2014a). This mine is now the facility used as a centralized mine waste repository called the Luttrell Regional Repository for the Upper Tenmile Creek Mining Area Site, a federal superfund site administered by the Environmental Protection Agency.

The placers in the Upper Tenmile watershed contained large masses of rich tin ore. Numerous gulches that feed into Upper Tenmile each contain several lode mines and some had constructed mills. The repeal of the Sherman Silver Purchase Act in 1893 and the resulting low silver prices drove the miners out of the hills. By 1898 only the

Porphyry Dike mine was worked with any success. However, the combination of a railroad spurline to Rimini and the construction of the smelter in East Helena served to revive the district somewhat by 1900. By 1928 the district reportedly produced up to $7,000,000, most of the production occurred before 1900 as only $1,980,000 was produced between 1902 and 1958 (McClernan 1983). In 1929 the Montana Lead Company consolidated the Lee Mountain with the Red Mountain Mining Company's holdings. To explore the veins at depth, Montana Lead Co. drove a cross cut tunnel 1000 feet through Red Mountain. This tunnel's portal was on the east bank of Tenmile Creek half a mile south of Rimini. In 1936 the tunnel reached a length of 3,600 feet and tapped many of the districts significant veins at depth (Pardee and Schrader 1933).

Elkhorns Geographic Area

The Elkhorn Mountains area includes mining areas in upper Warm Springs Creek on the west side and the east flank from the Beaver Creek to Crow Creek drainages on the east side of the Elkhorns. A cluster of relatively small but fairly rich lode mines occur in upper Middle Fork Warm Springs Creek that produced an estimated $1 million in gold and silver by 1928. Small mines occur in the upper reach of McClellan Creek.

On the east flank of the Elkhorns the mines of the Winston to Park-Hassel mining districts included the silver and base metal producers of the East Pacific, Sunrise, January, Stray Horse, Kleinschmidt-Golden Age, Vosburg and Park-Marietta mines. More recently, the Diamond Hill mine in upper Indian Creek was mined for gold and the ore taken to the Montana Tunnels mill near Clancy. This mine has been mothballed since the late 1990s. These districts had an early day production era before 1907 and then several had recurring development and or production from the 1920's and again in the late 1940's until the 1950's including the Park-Marietta and East Pacific and Kleinschmidt mines. Production is estimated at $5.5 million before 1908 in gold, silver, lead, and zinc (Reed 1951).

Little Belts Geographic Area

Four significant historic mining districts occur in the Little Belt Mountains, including one that is seeing a resurgence of mining/mineral exploration activity currently. The historic mining districts include the Barker-Hughesville mining district in the upper reaches of the Dry Fork of Belt Creek, the Neihart Mining District in Carpenter, Snow and Belt Creeks near Neihart, the Yogo Creek Mining District on the northeastern side of the Little Belts, and the Tenderfoot-Sheep Creek Mining District on the southwestern end of the Little Belts.

The Barker/Hughesville Mining District, much of which is located on private land in the upper reaches of Galena Creek, was an important historic producer of lead and silver between the early 1880's to 1927. The Barker/Hughesville district produced 409,002 tons of ore from 1913 to 1948, most of it from the Block P mine. This ore yielded 3435.13 ounces of gold, 2,653,375 ounces of silver, 788,900 pounds of copper, 44,366,327 pounds of lead, and 17,939,544 pounds of zinc. In addition to the mines mentioned above, other important claims included the Dockter Kalloch, Manitoba, T. W., Magnolia, St. Louis, Fairplay, and Bon Ton (Robertson 1950 and Roby 1951). Modern era exploration occurred in the 1970's - 1980. However, the district has not seen considerable mining activity since its heyday before the 30's. Currently the Barker mining district is within a federal superfund site - The Barker-Hughesville Mining District Site.

The Neihart Mining District has a similar history to the Barker mining district. The remote location of the mining district affected early development, but with the construction of the Belt Mountain branch of the Great Northern Railroad which connected Neihart with Great Falls in 1891 many mines became viable. In addition, the smelter at Great Falls had been completed in 1888, providing a more accessible location for the processing of the district's ore (Schafer 1935). The hopes for continued growth and development in the district changed with the Panic of 1893, when the national demonetization of silver and the end of the United States government's mandatory silver purchases began to drive the silver prices down. Silver went from a high of $1.05 an ounce in 1893 down to $.53 an ounce by 1902. After the turn of the century, although activity in the district continued to be slow, several large mines were successfully developed. From 1916-1919 as silver prices rose, many mines in the area re-opened, including the Moulton and the Broadwater. The concentrating plant for this operation, which was

located at Neihart, was remodeled and improved to handle 150 tons of ore a day. In addition to the mill operating for the Moulton and Broadwater mines, several flotation plants were built during this period at or near the town of Neihart. These were operated during the time of higher silver prices and were closed when prices dropped again in 1919. During this period, the miners had to contend not only with dropping silver prices, but with declining silver values and increasing zinc values in the ore as they worked deeper into the mines (Schafer 1935).

In 1921, the Silver Dyke mine was purchased by the American Zinc, Lead and Smelting Company. One million tons of ore were blocked out and a 500 ton flotation mill was constructed on the site. This mine operated at capacity throughout the decade. In 1926, the capacity of the mill at the Silver Dyke was increased to 950 tons. Because of the type of deposits at the mine, work was by open pit methods, resulting in the digging of a glory hole on the site. The Silver Dyke operated until 1929, when the blocked-out ore was depleted and no new deposits could be found. During the time of its operation, the Silver Dyke was the largest producer of ore in the Neihart mining district and its silver production was second only to Silver Bow County in Montana (Schafer 1935).

Development since 1930 in the district has followed the pattern set earlier with increases in silver prices accompanying increases in activity and decreases in prices leading to a slowdown in activity and development. Increased silver prices, lasting from the late 1930s to 1945, brought about the last major revival of activity in the area. By 1949 development had again slowed and many mines had been permanently closed. Most of the mines in the district have not been reopened or have been operated on only an intermittent basis since 1949. The richness of the district is indicated in its total production up to 1900, which included 4,008,000 ounces of silver, $800,000 of gold and 10,000,000 pounds of lead (MT DEQ 2014a). Currently the district is within a federal superfund site- The Carpenter-Snow Creek Mining District site.

The Yogo-Running Wolf and Tenderfoot-Sheep Creek Mining Districts currently are active. Yogo Creek is the locus of historic placer gold mining and currently is the locus of intermittent small-scale gold placer and lode mining activity and is also home to the Yogo Sapphire Mine on NFS lands. The Yogo Sapphire Mine is an underground mine that produces the renowned Yogo Sapphire and is the only known source for this unique gemstone. The Yogo mine is currently mining at depth through underground mining methods; however, the sapphires are removed from the dike ore through mostly placer and gravity methods at the surface. The Running Wolf mining district centered on Running Wolf Creek was the locus of late 1900's era base metal mines with some gold. Currently the area has a limited amount of hand scale prospecting-exploration activites. Total production from the Yogo-Running Wolf Districts is relatively small.

The Tenderfoot - Sheep Creek Mining District includes two mineral deposits that are currently active on private lands in the Black Butte area about 20 miles north of White Sulphur Springs. These projects are discussed because they are near NFS lands. The Black Butte Iron mine seasonally produces gossan iron ore that is trucked directly to the Holcim Cement Plant near Trident, Montana. This mine has produced small (less than 10,000 tons/year) quantities for many years. Tintina Resources Inc. (Tintina) has been conducting exploration drilling on private land on their Black Butte Copper project near Sheep Creek for the past five years. They recently received authorization from Montana DEQ to conduct aquifer tests as part of collecting resources information in anticipation of submitting a mine development proposal. In 2014 Tintina requested to modify its exploration license to conduct aquifer tests on three new wells to better define water resource data including additional groundwater quality, water level, and aquifer properties for different hydrostratigraphic units in the area of the Black Butte Copper Project (MT DEQ 2014b).

Upper Blackfoot Geographic Area

The Upper Blackfoot area includes five major areas of historic to recent hard rock mining areas of significance. These areas are identified because there remains a known mineral resource.

Heddleston - The Heddleston Mining District is at the head of the Blackfoot River just west of Rogers Pass. The area includes numerous historic mines and was an important producer of lead and zinc during World War II. The area is now a Montana Department of Environmental Quality Comprehensive Environmental Cleanup

and Responsibility Act (CECRA) site and Forest Service Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) mine cleanup site and is currently being reclaimed with a $39 million settlement awarded to the agencies through bankruptcy proceedings by Asarco LLC. This is discussed in more detail below. A significant porphyry copper-molybdenum deposit was identified on federal and private lands within this mining district area through an exploration drilling program and removal of a bulk sample in the 1960's to 1970's.

Copper Creek/Cotter Creek - Stratabound copper-silver deposits occur near the head of Cotter and Copper Creeks, tributaries of the Landers' Fork of the Blackfoot River. These deposits are relatively small, disseminated occurrences of copper mineralization found within sedimentary rocks. Relatively small scale, localized mineral development in the past and prospect level activity currently occurs on several active unpatented mining claims in the area (Tysdal et al. 1996).

Lincoln Gulch - Lincoln Gulch includes gold placers worked mostly before the turn of the century and a low grade bedrock gold deposit near the mouth of Lincoln Gulch. Small scale placer projects have occurred intermittently in the last 30 years on NFS and private lands in the drainage. A portion of the federal lands in this area have been withdrawn from locatable mineral entry as part of the historic Lincoln Gulch townsite and cemetery.

Dalton-Poorman - This portion of the Blackfoot River area includes the Dalton 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 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.

Stemple-Gould-Virginia - The upper reaches of the Stemple-Gould Creek and Virginia Creek areas are underlain by the Silver Bell stock intruded into argillites and quartzites of the Belt series. This mineralization has resulted in historic mining of primarily gold and silver. There are numerous active unpatented mining claims in this area but little permitted mining activity on federal lands. Removal of old waste dumps for custom milling has occurred from several patented mining claims in this area.

McDonald Meadows-Hogum- Seven Up Pete – The McDonald Meadows mineralization area on private and state land occurs just north of Highway 200 between Hardscrabble and the Landers' Fork of the Blackfoot River. The Seven Up Pete mineralization area occurs south of Highway 200 on private and federal lands at the head of Seven Up Pete and Hogum Creeks. These mineral deposits are tied together through a mining development proposal that was submitted to the state for review and permitting in the 1990's. Exploration drilling activities resulted in the identification of 10 million tons of gold ore at the Seven Up Pete area and 8.2 million ounces of gold in the McDonald Gold project area. Ongoing low level exploration activities occur on the patented mining claims at Seven Up Pete project area.

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 National Forest System lands of the plan area. Modern era miners return to these historic mining areas because they contain known resources. However, the rich hard rock mining history of the plan area has also resulted in tremendous impacts to other natural resources. Water quality impairment is probably the single biggest issue resulting from historic mining and is discussed separately below. Many of the roads in the forest areas were constructed without the benefit of engineering during the mining eras and occur in drainage bottoms or at steep grades crossing slopes to

reach the mining camps. Numerous prospect holes, shafts, adits and other workings have carved up the landscapes of the mining areas and many remain open and in a collapsing condition rendering them unsafe for forest users.

In 1993 - 1994, The Montana Department of State Lands Abandoned Mine Reclamation Bureau (ARMB) 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. This inventory involved the investigation of 331 hard rock mine sites and the documentation of the findings of 276 of these sites was published in 1995 (MT DEQ 1995). In 1997 and 1998, the Montana Bureau of Mines and Geology conducted a similar inventory of abandoned and inactive mines on the Helena National Forest and published a two volume set of their findings, similar to the statewide effort conducted by AMRB (Metesh et al. 1998, 1999). The specific findings of these inventories included identification and prioritization of sites with significant hazardous mine openings and features, and environmental impacts. Subsequent to the publication of these findings, the Environmental Protection Agency (EPA) was requested to consider listing several areas of concentrated mine sites as federal superfund sites. These are discussed in more detail below.

Hazardous Mine Openings and Features

The inventories resulted in identification of numerous unsafe mining related features that occur across the mining landscapes of the plan area. The inventories augmented lists of features already known to the agency. These 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 Forest Service. Some features may provide habitat for bats, including species currently identified as sensitive in Region One. 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. Annually, the forests in the plan area have addressed 15 - 25 hazardous features over the past seven years.

Priority Hard Rock Mine Sites

The findings of the AMRB (MT DEQ 1995) and Metesh et al. (1998, 1999) mine site inventories/assessments also included documentation of metal contaminants and environmental issues. Metal contaminants and other hazardous substances were recorded where concentrations in mine wastes and water samples were three or more times greater than background concentrations, and where surface and groundwater quality standards were exceeded. Waste volumes were mapped and described, and volumes estimated. The 1995 AMRB inventory prioritized the identified sites based on a hazard ranking system and numerous sites within the plan area were ranked in the top 30 sites in the state. Other sites not on published inventories are known based on personal experience by forest minerals administrators. Table 9.2 is a summary table of the inventoried hard rock mine sites with resources issues by geographic area, including the number of reclaimed mine sites in those areas.

Table 9.2 Inventoried abandoned/inactive mine sites with resource issues by geographic area

Geographic Area	# of Inventoried Abandoned/Inactive Mine Sites	Status
Big Belts	5 sites	2 Reclaimed
Castles	2	1 Reclaimed
Crazies	0	

Geographic Area	# of Inventoried Abandoned/Inactive Mine Sites	Status
Divide	Little Blackfoot drainage, including north of US Highway 12 - 26 sites	9 Reclaimed
	Upper Tenmile Superfund watershed - numerous sites	In reclamation under EPA superfund process. Schedule to be completed and transitioned to operation and maintenance in 2020.
	Other Divide areas - 7	2 Reclaimed
Elkhorns	Includes the greater Elkhorn drainage area currently on Beaverhead Deerlodge NF - 16 sites	5 Reclaimed
Highwoods	0	
Little Belts	Barker-Hughesville Mining District Federal Superfund Site - Numerous sites	In reclamation under EPA Superfund process, 2 reclaimed. No timeline for completion of reclamation.
	Carpenter-Snow Creek Mining Area Federal Superfund Site - Numerous sites	In reclamation under EPA Superfund process, 4 reclaimed. No timeline for completion of reclamation.
	Other Little Belts Sites - 2	
Rocky Mountain Range	0	
Snowies	0	
Upper Blackfoot	Upper Blackfoot Mining Complex State CECRA Site - numerous mines	In Reclamation. Scheduled to be completed and transitioned to operation and maintenance in 2018.
	5 sites	1 Reclaimed

Note - sites include mines on federal land, mixed federal/private land, and sites on private land within the National Forest boundaries

Water Quality Impairment and Hard Rock Mining

Water quality impairments, as a result of historic hard rock mining, cause significant impacts to many surfaces and some groundwaters of the plan area. The impaired water characteristics include low pH, metal contaminants in the waters, 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, including the Blackfoot River, Little Blackfoot River, Tenmile Creek, Telegraph Creek, Weasel Creek, Lump Gulch, Middle Fork Warm Springs Creek, Carpenter Creek, Belt Creek, and the Dry Fork of Belt Creek headwaters. 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.

Abandoned Mine Reclamation

Many of the inventoried mines have been reclaimed in whole or in part by the Forest Service, State of Montana, EPA or jointly by the agencies. Reclamation of Forest Service sites with hazardous substances has been done under the agencies' CERCLA authority. The investigation of a mine sites' human health, environmental issues, alternatives, and costs is done through a Site Investigation (SI) and an Engineering Evaluation and Cost Analysis (EECA) as opposed to a NEPA evaluation. An important component of an EE/CA is the risk assessment which is an evaluation of the hazards, pathways, and potential receptors of the hazardous substances of the site. It guides whether the site cleanup will address human health and or ecological risks posed by the site. The risk assessment informs the decision for the site. The decision rendered through the Forest Service's CERCLA authority is for 'Removal Actions' and these actions are authorized by decisions made by the Regional Forester called 'Action Memorandums'.

State and Federal Superfund Listed Sites

As a result of the above described inventory results and other inventory/investigation efforts by the State, Forest Service and EPA, 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 (UBMC) 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 activity are described as follows.

The Upper Blackfoot Mining Complex (UBMC) is a state superfund facility located about 15 miles east of Lincoln. Seeps from the tailings and waste rock dumps along with acid mine drainage from old adits have contaminated surface water, sediments, soils, and groundwater. Additional contamination exists due to the 1975 failure of the Mike Horse dam that washed metals-laden tailings down the Beartrap Creek drainage and into the upper Blackfoot River. The site was listed on the state's priority list in 1998. In 2005, a U.S. Forest Service technical evaluation concluded that the Mike Horse dam was unsafe and recommended that it be removed from service. In July 2007, USFS released an Action Memorandum calling for the removal and disposal of the dam, mine tailings, and wastes. In 2008 the State of Montana and the U. S. Forest Service successfully reached a settlement with Asarco and Arco for environmental damages at the Mike Horse site. An agreement with the Montana Department of Environmental Quality (MT DEQ), the Natural Resource Damage Program, and the USFS, was reached soon after the settlement to coordinate cleanup activities at the site. MT DEQ is the lead agency coordinating the cleanup. The primary goal of the cleanup is to remove approximately 1 million cubic yards of tailings and mine waste and place these materials in an engineered waste repository, and restore the areas where waste has been removed (MT DEQ 2014a). Clean-up work was initiated in 2013 under MT DEQ lead and is expected to continue through 2018 at this site. The Forest Service cooperates in an oversight and guidance role with the State of Montana under the terms of a joint FS-DEQ-DOJ Watershed Restoration Agreement that was ordered as part of the Asarco bankruptcy resolution.

The Upper Tenmile Creek Mining Area Site (the Site) is a federal Superfund site located in the Rimini Mining District, southwest of Helena, Montana, and consists of numerous abandoned and inactive hard rock mine sites that produced gold, lead, zinc, and copper. The site was listed as a federal Superfund site in 1999 but work to remove mine waste contaminants was initiated in 1998. The site boundary includes the drainage basin of Tenmile Creek upstream of the Helena Water Treatment Plant and includes tributaries that supply water to the plant's five intake pipelines. EPA identified 150 individual mine sites within the watershed boundary. Many of these mine features are above the five City of Helena drinking water intakes which supply over 70 percent of the city's water. The watershed has many stakeholders, including landowners, local communities, local and state government, special interest groups, and several federal agencies, including EPA. The landownership of the site is approximately 80% NFS and 20% private.

To date, numerous mines have been reclaimed in the Site, most by EPA but some by the Forest Service, and over 500,000 cubic yards of wastes have been hauled to the Luttrell Regional Repository from the Site under an interagency shared use agreement. Remaining work after 2015 includes lower priority waste removals, addressing adit discharges, and closing the Luttrell Regional Repository. At the end of federal Superfund activities, the State of Montana will be responsible for operations and maintenance of any remaining features in the Site. The Forest Service, EPA, and MT DEQ conduct joint coordination efforts to ensure cooperative planning and implementation of agency projects. The Forest Service is also working with the EPA to update a cooperative agreement (MOU) for management and cost sharing of the Luttrell Regional Repository.

The Barker-Hughesville Mining District Site (the Site) is a federal Superfund site in the north central portion of the Little Belt Mountains in Cascade County. The site was listed in 2001. It contains approximately 46 abandoned mines strewn with waste rock dumps, tailings and seeping mine openings. The abandoned mines and associated contamination of the Site are dispersed throughout a 6,000 acre watershed. Most of the mine sites are in the Galena Creek drainage, near the historic town sites. About 80% of the lands of the site are NFS and the remainder are private lands. Most of the mine sites are located on private lands. The largest abandoned mines include the Block P Mill Tailings and Block P Mine Complex properties. Metals and arsenic contamination of soils, groundwater and surface water have been documented in several studies conducted at the site since 1990.

Sixteen abandoned mines in the Barker Hughesville district have been identified as water contamination sources because of their proximity to surface streams. Eroded wastes from these mines have eroded over the years and they are now dispersed throughout the Galena Creek watershed and the Dry Fork Belt Creek floodplain. Heavy metals and arsenic contamination of soils, groundwater and surface water have been documented in several studies conducted at the site since the 1990s. Dissolved zinc is the metal of greatest concern along with elevated levels of lead and cadmium. Ten discharging adits (horizontal mine openings) have also been identified. Scattered mine waste piles present both safety risks and health risks.

Galena Creek flows through the Barker Hughesville site. There is no fishery or aquatic insect life in Galena Creek because of the impact of mining wastes. However, there are isolated populations of westslope cutthroat trout in several clean tributaries that have been protected from hybridization by the mine-influenced waters. There is also a fishery in the upper reach of Dry Fork of Belt Creek; however, it is impacted by Galena Creek in its lower reach below the confluence of the streams.

The EPA, in coordination with the State and Forest Service, is working on completion of the Remedial Investigation effort with the expectation of a site decision(s) for remedy of the issues of the site in 2016. The Forest Service, EPA, and MT DEQ conduct joint coordination efforts to ensure cooperative planning and implementation of agency projects.

The Carpenter Snow Creek Mining District Superfund Site (the Site) is a federal Superfund site that lies in the Little Belt Mountains in Cascade County. The site encompasses approximately 9,000 acres with mine tailings, waste rock and mine-influenced waters present throughout the site, due to the many inactive and abandoned mines. The state of Montana's Abandoned Mine Bureau identified, inventoried and sampled these inactive mines in the Carpenter Snow Creek area in the early 1990s. Sampling showed the presence of a variety of metals in the area surface water and soils that are found in concentrations known to produce risk to human health and the environment. The Site was listed on the Superfund National Priorities List in 2001.

Approximately 21 mine sites of the Site have been identified as probable sources of waste contamination to surface water and 12 adits are discharging mine-influenced water, usually of poor quality with low pH and high concentrations of dissolved metals, into streams. Since 2001, EPA has been collecting soil/mine waste, surface water, sediment, and groundwater samples throughout the entire site, with expanded efforts in and around the town of Neihart and the Silver Dyke Mining Complex continuing in 2015.

Concentrations of lead and arsenic in soil that exceed the action levels specified in the 2009 Record of Decision, have been identified in residential yards and alleys throughout the town of Neihart. Sampling conducted since 2009 in the Carpenter Creek, Snow Creek, and Neihart slope drainages north of Neihart revealed elevated levels of lead and zinc in the surface water. Elevated levels of lead and zinc were also found in sediments and fluvial (adjacent stream) soils along Carpenter Creek and Belt Creek adjacent and below the various waste rock and tailings piles present in these watersheds. Sampling in 2012 and 2013 indicates that contaminated soils that were deposited in the floodplain during historic Belt Creek flood events, such as the 1953 and 1981 floods, extend all the way to Monarch. In addition, several adits that are discharging from abandoned mines continue to contribute to the degradation of the water quality throughout the mining district.

A removal action was undertaken by the EPA in summer 2014 to remove tailings from a steep sided tributary of Carpenter Creek and place them at a repository site. The EPA plans to continue waste removal efforts in the town of Neihart starting in 2015, depending on funding. The EPA in coordination with the state and Forest Service is working on completion of the Remedial Investigation effort with the expectation of a site decision(s) for remedy of the larger waste issues of the site in 2016. The Forest Service, EPA, and MT DEQ conduct joint coordination efforts to ensure cooperative planning and implementation of agency projects.

Saleable Mineral Resources

Saleable mineral resources include common varieties of sand, gravel, decorative and landscaping stone, cinders, and clay. These types of resources are administered under Forest Service regulations at 36CFR228, Subpart C which provides for disposal of mineral materials on public land through competitive sale, negotiated contracts, free use, and agency force account or contract (36CFR228.57). Saleable minerals disposal, unlike locatable minerals, is a discretionary action that can occur when the authorized officer determines that disposal is not detrimental to the public interest and the benefits exceed the cost and resources impacts.

Activity

Saleable mineral uses and developed pits are very common on the Jefferson Division of the Lewis and Clark portion of the plan area. They are largely pits related to road development and maintenance. This is due to the extensive, level 3 road network on the division and distance from commercial sources. The Helena Forest portion of the plan area has recurring salable minerals uses but at a much lower level and with very few developed pits.

The plan area has several desirable landscaping stone varieties, including rounded boulders in the Helena area, red slabby quartzite of the Flathead Sandstone in the Little Belts, and in the south Big Belts. As yet, these sources have not been extensively developed. 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. Theft of these resources occurs to a certain extent. Table 9.3 describes the salable material types by geographic area and relative level of activity.

Table 9.3 Salable mineral resources by geographic area - statistics and forecast

Geographic Area	# Salable Pits/ Rock Sources	#Acres in pits (est)	Special salable mineral material occurrences	Comments, Forecast
Big Belts	3	3	Flathead quartzite landscaping boulders in Timber Gulch. Attractive, porphyritic granite boulders occur in remnant glacial deposits between Camas and Birch Creek. Abundant washed cobble-boulder sized material on private land in	Pit run found readily along roadsides reduces need for imported material to conduct system road maintenance. Developed private material sources preclude need for

Geographic Area	# Salable Pits/ Rock Sources	#Acres in pits (est)	Special salable mineral material occurrences	Comments, Forecast
			Confederate Gulch due to placer mining.	large scale mining of these types of material from federal land.
Castles	10	3	Small pits used for pit run for road maintenance.	Little future need for mineral materials other than for limited system road maintenance.
Crazies	0	0	Material development limited to roadside borrow.	Little future need for mineral materials other than for limited system road maintenance.
Divide	5	5	Rounded boulders of Boulder Batholith desirable for landscaping.	Developed private material sources preclude need for large scale mining of these types of material from federal land. Luttrell regional repository area rock sources provide for many needs in Tenmile Superfund area.
Elkhorns	2	1	Low grade, shaley iron ore, andesite rip rap source, rounded landscaping boulders	Developed private material sources preclude need for large scale mining of these types of material from federal land.
Highwoods	1	0.5	Small pits used for pit run for road maintenance.	Little future need for mineral materials other than for limited system road maintenance.
Little Belts	61	64	Several good exposures of Flathead Quartzite have recurring small sales for landscape boulders or flagstone applications. Numerous personal use permits annually (5-10 avg/yr). Neihart quartzite large rip rap size boulders occur mostly in highway right of way making them inaccessible. Many developed pit areas for agency road surfacing and maintenance.	Federal Superfund activities will drive need for a variety of mineral material products including topsoil, cover soil, drain rock, rip rap. There is a need for some level of developed mineral pits for system road maintenance work across the division as there are few, local private sources. There is a need for cooperation in development and maintenance of material pits with Montana Department of Transportation and counties for the same reason.
Rocky Mountain Range	3	8	Boulder stockpile left from construction of Gibson Dam	This GA has limited road infrastructure and private construction activity. Old pits need final reclamation or pit plans to ensure resources issues addressed.

Geographic Area	# Salable Pits/ Rock Sources	#Acres in pits (est)	Special salable mineral material occurrences	Comments, Forecast
Snowies	2	0.5	Small pits used for pit run for road maintenance.	Little future need for mineral materials other than for limited system road maintenance.
Upper Blackfoot	3	5	Potential for low permeability clay material for industrial uses. Glacial deposits abundant. Material use needs may increase for State Superfund reclamation work.	Development potential limited due to high availability of developed pit materials from private land and limited construction activity.
TOTAL	87	90 acres		

Impacts

Salable mineral resources development in the plan area is largely tied to road development activities conducted by the agency. In particular, the Jefferson Division Geographic Areas (Little Belts, Castles, Crazies, Highwoods, and Snowies GAs) have about 80 inventoried material sites that were developed for road base and surfacing materials for the forests' system roads. Inventory results indicate that the pit areas collectively are about 75 acres of disturbance. Many of these sites have noxious weeds which is problematic for any future resources needs from these pits. Other problems, while not occurring on every pit, include dumping of yard trash, ATV use that disturbs reclaimed surfaces, and shooting activities. Several pits have been reclaimed in recent years and the minerals program is putting an emphasis on closure and final reclamation of unneeded pits and noxious weed management, particularly in the Little Belts area.

Leasable Mineral and Energy Resources, Nonrenewable and Renewable

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 the 1986 Forest Plans for the Helena and Lewis and Clark Forests, there was direction for managing leasable mineral resources in consideration of other resources through objectives, standards and stipulations. On the Lewis and Clark the direction was to facilitate/accommodate the growing oil and gas exploration and development activity that was occurring on the Rocky Mountain Front. The Lewis and Clark Forest Plan had two primary Management Standards - G-1 for seismic activity, and G-2 through G-4 for oil and gas leasing, exploration and development and production. This standard included a compact set of lease terms and stipulations. On the Helena Forest the direction was to accommodate the activity while providing for other resources needs. Lease stipulations were attached as an appendix N to the HNF Plan.

In 1986, on the Lewis and Clark National Forest, there were almost 400,000 acres under lease at the time of the Forest Plan and another 100,000 acres of lease requests that had not been issued. On the Helena National Forest, there had been a high level of seismic activity in the early 1980's and several hundred thousand acres were under lease.

In 1990, new Forest Service regulations for oil and gas resources were promulgated (36CFR228, Subpart E) which set forth the rules and procedures for the issuance of oil and gas leases. The regulations further directed

Forest Supervisors, in coordination with the BLM, to develop a schedule for analyzing lands that had not been already analyzed for leasing. The direction in the regulations specified the following:

1. 1. Identify lands that are legally unavailable for leasing (withdrawn lands, recommended wilderness, wilderness study areas, wilderness areas, and lands discretionarily unavailable),
2. 2. Identify lands open to oil and gas development with standard or constrained lease terms,
3. 3. Conduct alternatives analysis, 4. Prepare a Reasonably Foreseeable Development scenario,
4. 4. Notify and authorize the BLM to lease the lands available for leasing unless additional NEPA is needed for specific lands,
5. 5. Amend the Forest Plans if leasing is inconsistent with the Plan,
6. 6. Ensure conditions of lease occupancy are included in lease stipulations, and
7. 7. Determine that operations and development could be allowed on each proposed lease, except where stipulations prohibit all surface occupancy.

The agencies initiated separate oil and gas leasing analyses as a result and in August 1997 the Lewis and Clark National Forest finalized their oil and gas leasing FEIS and issued their Record of Decision. In 1999 the Helena National Forest finalized their oil and gas leasing FEIS, their Final Supplemental EIS and ROD for oil and gas leasing. The RODs 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 National Forest. On the Lewis and Clark National Forest there were several thousand acres of suspended leases on the Rocky Mountain Geographic Area.

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 9.4.

Table 9.4 Summary of acres for leasing as per EISs and RODs 1997 and 1999

Forest	Legally Unavailable acres	Discretionarily Unavailable acres	No Lease acres	NSO acres	CSU/TL or Both acres	Standard Lease Terms acres
LCF	614,458	0	356,111	363,033	528,851	0
HNF	144,500	185,100	0	384,700	258,700	24,700

NSO - no surface occupancy on the lease
CSU - controlled surface use on the lease
TL - timing limitation on the lease

Activity

Activity in the number of lease requests from industry and on issued leases is currently low in the plan area. There is no ongoing exploration or development activity on federal lands in the plan area.

Helena

There are 17 current leases totaling about 56,000 acres in the southern portion of the Big Belts Geographic Area that are set to expire by 2018 but there has been no activity or proposals for activity on these leases. There are eight lease requests that have been deferred (not processed/leased) 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.

Lewis and Clark

As a result of the 1997 ROD for Oil and Gas Leasing on the Lewis and Clark forest, most of the Rocky Mountain Range Geographic Area was identified as discretionarily unavailable for leasing, excluding the acres that were under lease at the time of the analysis and decision. Those leases were suspended at that time. In December 2006, as part of the Tax Relief and Health Care Act (2006), Congress withdrew from leasing any additional National Forest System lands on the Rocky Mountain Front. The suspended leases are not part of the withdrawal as they represent a prior existing right. These are discussed below. There are no other areas under lease on the Lewis and Clark portion of the plan area.

Currently, oil and gas leases in the Badger-Two Medicine (B2M) management area of the Rocky Mountain Range Geographic Area are all in suspension. There are two Applications for Permit to Drill (APD) in the B2M area. One of the APDs was approved after an EA was completed in 1985 and an EIS was completed on the same project in 1991. The agency was subsequently sued on the APD approval decision. The drilling approval and lawsuit were suspended while the Forest Service gathered information and conducted additional analysis. That situation remains through the present although the agency is currently being challenged through legal action by the lease owner to be able move forward on his APD approval.

Impacts

There are minor surface resource impacts from historic oil and gas activity on the Helena Forest plan 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 current 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 Geographic Area including unreclaimed 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.

There

Renewable, Leasable Mineral and Energy Resources

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

Geothermal

Geothermal resources are defined as all products of geothermal processes including indigenous steam, hot water or hot brines, steam and other gases, heat or other associated energy found in geothermal formations, and any byproducts (43CFR 3200). Renewable energy minerals on federal lands, including NFS lands, are made available through issuance of leases similar to nonrenewable energy resources. A nationwide programmatic EIS for identification of lands that would be made available for issuance of geothermal leases was prepared and a Record of Decision was issued by the BLM and the Forest Service in 2008 (USDI, USDA 2008). The analysis identified National Forest System lands that are legally open or closed to geothermal leasing in twelve western states, including the Helena National Forest and a small area of the Lewis and Clark Forest in Montana. On the Helena National Forest, 737,819 acres are available for geothermal leasing. On the Lewis and Clark National Forest, 31,730 acres near White Sulphur Springs are available for geothermal leasing. Most of the Lewis and Clark Forest

area would need a separate geothermal leasing analysis and decision as most of the forest areas were not included in the western states analysis.

Portions of the plan area have some favorability for the occurrence of geothermal resources and recreational hot spring areas have been developed, including the White Sulphur Springs, Broadwater Hot springs west of Helena, Alhambra Hot Springs south of Helena, and the Sun River Springs on the North Fork of the Sun River west of Gibson Reservoir. All of these features are on private land.

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, 2014c). 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 Forest plan area is deemed to be low. The Lewis and Clark National Forest 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 the Lewis and Clark plan area lands is deemed to be very low.

Wind and Solar

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 NREL 2005).

The results of the evaluation are in Table 9.5 below.

Table 9.5 Renewable energy potential, wind, solar, geothermal on the HLC NFs

	Maximum Development Potential – Wind (Acres, Megawatts) (from USDOE NREL, 2005)	**Maximum Development Potential - Solar (NREL, 2005)**
Helena National Forest	57,792 acres 1,169 MW*	0
Lewis and Clark National Forest	80,189 acres 1,623 MW*	0

* Assuming 1 megawatt per 50 acres

Trends and Drivers

Placer Mining

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. Generally, most of the drainages with historic gold placers have been picked over by one or more eras of mining due to changes in technology. Between the years of 2008 through 2013, the price of gold was extremely high but it did not result in a substantial increase in permitted placer mines on the Helena-Lewis and Clark areas. Thus, the price of gold does not appear to be a primary driving factor in new placer mining projects. Most of the notable, historic placer gold drainages have patented mining claims. Access to these lands for mining would need to be by landowner permission and would require various state and federal permits. Other than in the Alder Gulch and Ninemile Creek areas in Montana, there are few, large (greater than 5 acres) active private land placer operations in Montana. Private landownership appears to be a deterrent to new mining projects as many private patented mining claim landowners are interested in the property for other than mining purposes. Another deterrent may be the difficulty and cost in securing permits through the various agencies. However, perhaps the primary reason that placer mining is not occurring at a large

scale, and not expected to in the future is because the placer gold resource, generally, appears to be depleted in most areas of the forests based on review of Montana Bureau of Mines and Geology Gold Placers of Montana (Lyden 1987). Remnants of former gold bearing gravel benches or previously washed tailings may hold small amounts of gold for the small scale miner or prospector. However, the potential for a large, unworked, profitable gold bearing gravel resource appears to be unlikely.

Hard Rock Mining

Over the past 20-25 years, located mining claims across the forests have ranged from a high of tens of thousands of claims annually in the early to mid-1980's, to the current level in the 500-1,000 claims. A primary indicator of mining claim activity in the past has been the price of gold. However, in 1998 the voters of the State of Montana supported legislation that banned the extraction of gold using cyanide heap leach processes which resulted in a downturn of interest by the mining industry in Montana that has not rebounded since that time. Record high gold prices in the economic downturn from 2008-2013 did not result in a substantial increase in new exploration or mining proposals across the forests. Another factor that affected the number of located mining claims is mining claim rule changes and increases in fees charged by the Bureau of Land Management and counties for filing and recordation of mining claims in the past fifteen years which resulted in substantially fewer mining claims.

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 National Forest 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.

Locatable Minerals

Hard rock mineral activity in the next 5-10 years is projected to be approximately what is currently occurring, with a few exceptions, and includes the following: 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 Geographic Areas 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.

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 Geographic Area, near the UBMC State superfund area in the Upper Blackfoot Geographic Area, 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.

Leasable Mineral and Energy Resources

This forecast of potential for leasable mineral activity is based on the Reasonably Forseeable 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 2008). A small amount of the BLM Missoula Resources Area covers the western portion of the Upper Blackfoot Geographic Area; however, this plan area has not been updated since 1984. Thus the forecast for leasable mineral activity for this area is based on the Helena Forest's reasonably foreseeable development scenario as published in the 1998 forest leasing analysis (Helena National Forest 1998).

The reasonably foreseeable development (RFD) scenario is an analysis of the known and potential oil and gas and coal resources and geology of the plan area (occurrence) and a projection of the magnitude and trend of future leasable activity within the planning horizon (development potential) . The RFDs are prepared by agency geologists using a variety of research information, leasing statistics prepared by the BLM and the State of Montana, and information provided by industry. The RFD information is summarized in Table 9.6.

Table 9.6 Nonrenewable (oil and gas) mineral resources forecast

Geographic Area	Historic Activity	Potential for Occurrence of oil and gas resources	Forecast/RFD
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.
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-	High on very eastern edge of the area. Moderate to low westward.	No Activity* - area withdrawn from mineral entry and additional area added as

Geographic Area	Historic Activity	Potential for Occurrence of oil and gas resources	Forecast/RFD
	2014 non-wilderness portions of the area		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.

Renewable Leasable Mineral and Energy Resources

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 Geographic Area 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 20 years is unknown.

References

Environmental Protection Agency (EPA) 2014. http://www2.epa.gov/region8/superfund-sites-region-8

Glover, J. F. and D. P. Stilwell. 2014. Final Report, Reasonably Forseeable Development Scenario for Oil and Gas Activities in the Lewistown Planning Area, central Montana.

Hargrave, P.A., T.B. Bowler, J.D. Lonn, J.P. Madison, J.J. Metesh, and R. Wintergerst. 1998, *Abandoned-inactive mines of the Blackfoot-Little Blackfoot River Drainages, Helena National Forest:* Montana Bureau of Mines and Geology Open-File Report 368, 228 p.

Harris, S.A. 1957. The Tectonics of Mountains as Related to the Belt Series, in Billings Geological Society Eighth Annual Field Conference Guidebook.

Lyden, C.J. 1987. *Gold Placers of Montana*, Montana Bureau of Mines and Geology, Reprint 6, 98pp.

McClernan, H.G. 1983. Metallic Mineral Deposits of Lewis and Clark County, Montana, Montana Bureau of Mines and Geology Memoir 52.

Metesh, J.,J.Lonn, R. Marvin, P. Hargrave, and J. Madison. 1998. *Abandoned-Inactive Mines, Helena National Forest, Volume I – Upper Missouri River Drainage*, Montana Bureau of Mines and Geology, Open-File Report/MBMG 352, 189 p.

Montana Department of Environmental Quality (MT DEQ) 1995. Montana Department of State Lands, Abandoned Mine Reclamation Bureau: Abandoned Hard Rock Mine Priority Sites, Summary Report.

Montana Department of Environmental Quality. 2014a. Montana abandoned mine historic narrative website. <http://www.deq.mt.gov/abandonedmines/linkdocs/41tech.mcpx>

Montana Department of Environmental Quality. 2014b. Black Butte Copper Project website, <http://www.deq.mt.gov/ea/hardrock.mcpx>

Montana Department of Environmental Quality. 2014c. Marysville Geothermal Site website. <http://www.deq.mt.gov/energy/geothermal/sites/marysville.mcpx>

Pardee, J.T., and F.C. Schrader 1933. *Metalliferous Deposits of the Greater Helena Mining Region*, U.S. Geological Survey Bulletin 842, 318pp.

Reed, G.C. 1951 Mines and Mineral Deposits except fuels, Broadwater County, Montana, US Department of Mines Information Circular 7592

Robertson, A.F. 1951. Mines and Mineral Deposits except fuels, Cascade County, Montana, US Department of Mines Information Circular 7589.

Roby, R.N. 1950 Mines and Mineral Deposits, except fuels, of Meagher County, Montana, US Department of Mines Information Circular 7540.

Schafer, Paul A. 1935. Geology and Ore Deposits of the Neihart Mining District, Cascade County, Montana.

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

Tysdal, R.G., S. Ludington, and A.E. McCafferty. 1996. Mineral and Energy Resource Assessment of the Helena National Forest, West-Central Montana, U.S. Geological Survey Open File Report 96-683-A.

United States Department of Agriculture, Forest Service. Forest Service Manuals and Handbook. USDA Forest Service Headquarters, Washington D.C. Available online at; http://www.fs.fed.us/im/directives/.

United States Department of Agriculture, Forest Service. 1986. Helena National Forest Plan. <http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5352772.pdf>

United States Department of Agriculture, Forest Service. 1986. Lewis and Clark National Forest Plan. <http://www.fs.usda.gov/detail/lcnf/landmanagement/?cid=stelprdb5409100>

United States Department of Agriculture, Forest Service. 1997. Record of Decision, Oil and Gas Leasing, Lewis and Clark National Forest.

United States Department of Agriculture, Forest Service. 1998. Record of Decision, Oil and Gas Leasing Helena and Elkhorns portion of the Deerlodge National Forest.

United States Department of Agriculture, Forest Service. 2011. Helena National Forest May 2011. Hazard Assessment for Developed Recreation Sites.

United States Department of Agriculture, Forest Service. 2011. Lewis and Clark National Forest May 2011, Hazard Assessment for Developed Recreation Sites.

United States Department of Energy, National Renewable Energy Lab. 2005. Assessing the Potential for Renewable Energy on National Forest System Lands. NREL/BK-710-36759.

United States Department of the Interior, Bureau of Land Management. 2008. Resources Management Plan and Final Environmental Impact Statement, Butte Resources Area, Appendix M-Fluid Minerals.

United States Department of the Interior Bureau of Land Management and United States Department of Agriculture, Forest Service. 2008. Record of Decision and Resource Management Plan Amendments for Geothermal Leasing in the Western United States.

United States Department of the Interior and United States Department of Agriculture. 2008. Final Programmatic Environmental Impact Statement and Record of Decision for Geothermal Leasing in the Western United States.

U.S. Geologic Survey (USGS). 2000. A Tapestry of Time and Terrain, A Union of Two Maps, Geology and Topography.

Weed, W. H. 1900. “Geology of the Little Belt Mountains, Montana", U. S. Geological Survey, 20th Ann. Report, Pt. 3

Weed, W.H, and L.V. Pirsson. 1896. Geology of the Castle Mountain Mining District Montana, U.S. Geological Survey Bulletin 139.

Woodward, L.A. 2010. *Montana’s Island Ranges Recreation Geology and History*, Albuquerque, N.M.: Lee Woodward, 86 pp.

Woodward, L.A. and O.L. Schumacher. 2011. *Sapphires, Gold and Silver Field Guide to Little Belt Mountain*s, Running Wolf Press, Lewistown, Montana.