INTRODUCTION

Within the planning area, geothermal energy development has been minor, and has occurred primarily in relation to springs for bathing and for low-temperature private and commercial space heating.

The BLM and the USFS manage mineral-related activities consistent with multiple-use management principles. The exploration, development, and production of geothermal energy is integrated with the use, conservation, and protection of other resources.

LEGAL AND ADMINISTRATIVE FRAMEWORK

LAWS

- ***The Mineral Leasing Act of 1920***: This act established the leasing system for the exploration and development of coal, phosphate, sodium, oil shale, oil, and gas.
- ***The Organic Act of 1944***: This act provides for the protection and management of resources within USFS lands.
- ***The Mineral Leasing Act for Acquired Lands of 1947***: This act extends the provisions of the mineral leasing laws to the mineral estate on lands acquired by the Federal government; it requires the consent of the Secretary of the Interior (BLM) or the Secretary of Agriculture (USFS) prior to leasing.
- ***The Geothermal Steam Act of 1970***: This act established the leasing system for geothermal energy.

REGULATIONS AND POLICIES

- ***Title 36 CFR, Part 228 E***: This provides guidance for the management of surface use of geothermal leases on USFS-administered lands.
- ***Title 43 CFR, Part 3200***: This provides guidance for management of geothermal leases on BLM-administered lands.

DESIGN CRITERIA

Management guidelines and design criteria describe the environmental protection measures that would be applied to all of the alternatives at the project level in order to protect, enhance, and, where appropriate, improve resources related to geothermal energy. Guidelines and design criteria are presented in Part 3 of Volume 2 of the DLMP/DEIS.

EXISTING CONDITIONS AND TRENDS

Geothermal energy is disposed of (managed) by leases issued by the BLM. The planning area contains 4 USGS Known Geothermal Resource Areas (KGRAs). These are:

- West Fork, Pagosa RD/FO (approximately 80,577 acres);
- Pagosa Springs, Pagosa RD/FO (approximately 26,300 acres);
- Dunton-Rico, Dolores RD/FO (approximately 132,109 acres); and
- Trimble-Pinkerton, Columbine RD/FO (130, 313 acres).

The potential recoverable energy contained within these KGRAs is small relative to the other fluid-energy sources (including oil and natural gas) within the planning area (Van Loenen et al. 1997; Gault Group 2006). Currently within the planning area, there are no geothermal leases. However, in 1974 and 1980, applications for leases for large tracts within the Dunton-Rico KGRA were filed (Neubert et al. 1992). These lease applications were later withdrawn by the applicant.

High-temperature geothermal resources are required for electricity generation. Extensive low- and moderate-temperature geothermal resources support agricultural, municipal, commercial, and residential uses. The geothermal fluid resources that occur within the planning area are of low or medium temperature. Geothermal fluid resources that occur within the planning area, as well as within the surrounding areas, are warm. They emanate from geysers, springs, and wells. Most warm springs are located near faults. These faults serve as conduits for the upward flow of ground water that has been heated by deep circulation from mainly volcanic sources.

Within the planning area, two types of geothermal resources are being commercially tapped: hydrothermal fluid resources and Earth energy. Hydrothermal fluid resources provide hot water for spa and pool use, as well as for space heating. Earth energy (the heat contained in soil and rocks at shallow depths) is excellent for direct use, as well as in connection with geothermal heat pumps. Direct-use applications require moderate temperatures; geothermal heat pumps can operate with low-temperature resources. A number of residences adjacent to, or near, the planning area, are using this resource in order to supplement space heating.

Widely separated areas within the region contain one or more thermal springs or artesian wells (Van Loenen et al. 1997). Except for the town of Pagosa Springs (where hot water from hot springs is currently used in order to heat buildings and public sidewalks), the thermal springs are currently either undeveloped or are developed for recreational and therapeutic uses in private and public pools. Geyser Spring, in the Dunton-Rico KGRA, is Colorado's only geyser. Eruptions, at approximately 30-minute intervals, are marked by fountaining to a height of about 1 foot above the resting level of the geyser pool.

Within the planning area, the potential for additional noteworthy development of known hydrothermal resources, as well as for locating the presence of undiscovered hydrothermal resources, are slight. Most of the thermal springs yield only moderately hot water, and in only relatively small quantities. Moreover, most are remote from markets. Only 3 springs are located within the planning : Geyser, Piedra, and Rainbow. Heating State-owned buildings in Durango with water piped in from thermal springs in the Animas River Valley was evaluated, and was found to be uneconomic (Meyer et al. 1981).

The low level of heat produced, as well as the small supply, would limit geothermal use in the plannign area to small-scale recreational, agricultural, and space-heating systems. As energy costs increase, however, the development of geothermal resources for these uses is expected to increase slightly during the planning period. Most demand would involve non-Federal lands, due to the proximity between the source of the energy and the facility to be supplied. The SJPLC would review, and approve, any Plans of Operation for geothermal development within the planning area, and would apply the appropriate environmental protection measures. They would also monitor for compliance.

ENVIRONMENTAL CONSEQUENCES

DIRECT AND INDIRECT IMPACTS

The environmental impacts related to the development of mineral resources would result, primarily, from their different methods of extraction. Fluid minerals, such as oil and gas and geothermal energy, are developed through the process of drilling. Within the planning area, the expected environmental impacts from current and projected mineral development activity levels are discussed in detail in specific resource program sections of this chapter. This section considers the impacts of implementation of other resource activities on the geothermal energy program.

Under each alternative, impacts are quantified based on the number of acres of land that would be restricted (requiring higher costs), or that would not be available for geothermal mineral operations (including well pads and support facilities, power generation facilities, equipment storage areas, water processing, and storage facilities), or for construction and use of pipeline and access road systems. Unlike typical solid-minerals development impacts (which are concentrated at the mine or mill facility requiring 1 or 2 access roads; and a utility corridor; and resulting in few, if any, disturbed areas away from the mine or mill) geothermal development impacts may include multiple well sites, connecting road systems, power-generation facilities, multiple support facilities, and pipeline networks spread over hundreds of acres. Future geothermal activity cannot be predicted as to specific location, scale, or timing; therefore, the most reasonable way to estimate the impacts related to the alternatives on this potential future activity is to consider the amount of land that is restricted or unavailable for possible use.

General Impacts

Within the planning area, impacts to the geothermal energy program resulting from the implementation of any of the alternatives may include the closure of areas to geothermal leasing (through formal withdrawal or administrative closure), and increased operating costs (through limitations on road and pipeline construction and use, facility placement, and operational constraints). These impacts may occur as the result of the requirements imposed by other resource programs, as well as as the result of the implementation of the specific MA direction. MA direction would not change current law or regulation for the development of geothermal energy within the planning area; however, it would, in some cases, affect the accessibility of lands for geothermal development. The opportunity to explore for, and develop, geothermal resources on public lands may also be impacted by management activities that limit or restrict motor vehicle access on existing roads and/or precludes new road or pipeline construction. Recommendations to not lease for geothermal energy, if later implemented, would preclude the exploration and the potential development of economic mineral resources, which, in turn, may result in lost Federal revenues and in the associated reduced returns to counties and States.

All of the alternatives vary by the number of acres that would be allocated to various MAs. MA 1s and 5s would be the predominant MAs applied to the management of SJPLC-administered lands, followed by MA 3s. MA 1s and 3s would also be the most restrictive, in terms of recommending withdrawal or closure of these areas to mineral development, or in terms of requiring limits or prohibitions on road access. MA 2s would require specific management plans, which may impose site-specific closures or restrictions on mineral activity. MA 4s would require mineral activity to be compatible with Management Area requirements, and may impose unacceptable site-specific costs. MA 5s and 7s would be generally compatible with mineral development. Table 3.17.1 summarizes the impacts by alternative, as further discussed below.

Table 3.17.1 – Environmental Impacts Related to Geothermal Energy by Alternative

	Alternative A (no-action alternative)	Alternative B (preferred alternative)	Alternative C	Alternative D
MA 1 Proposed Additional Wilderness Acres	0	0	132,109	0
MA 1 Roadless Acres	0	130,313	130,313	0
MA 3 Natural Landscape Acres	262,422	132,109	0	0

Under Alternative B, MA 1 and MA 3 acres would include acres allocated to MA 2s.

Table 3.17.1 is not intended to be read as offering absolute numbers. The areas most likely to be affected (impacted) by the implementation of any of the alternatives (due to the potential for geothermal resources) would be the KGRAs noted above. Not all acres within each KGRA have equal potential for geothermal development; specific potential areas within each KGRA have not been identified. For this reason, the total acreage for each KGRA is listed. The table indicates the relative restrictive nature of each alternative. Site-specific proposals would be required in order to make a more detailed estimate of impacts.

Currenlty, there are no geothermal leases or operations within the planning area, and the potential for future leasing or operations during the life of final approved LMP is low. Future activities would most likely involve small and local use of geothermal heat or steam for domestic and commercial heating, limited agriculture or aquaculture operations, or recreational and health-spa facilities.

DLMP/DEIS Alternatives:

- Under all of the alternatives, the West Fork KGRA would be within designated Wilderness; therefore, it would be withdrawn from mineral development. The Pagosa Springs KGRA is on private land; therefore, it is not subject to SJPLC regulation.
- Under Alternative A, the Dunton-Rico KGRA would be allocated to MA 3. However, hot springs use is a traditional practic in this area and, therefore, may be favored in future management decisions. The Trimble-Pinkerton KGRA is dominantly on private land; therefore, it is not subject to SJPLC regulation. Potential expansion areas within the planning area would be allocated to MA 3; however, no expected development is likely.

- Under Alternative B, the Dunton-Rico KGRA would be partly allocated to MA 2 (approximately 50%), which would require a special management plan. The remainder would be allocated to MA 3 (roadless management), which would limit development activities. However, hot spring use is a traditional practice in this area and, therefore, may be favored in future management. The portion (approximately 50%) of the Trimble-Pinkerton KGRA within the planning area would be allocated to MA 2 or 1; however, no expected development is likely.
- Under Alternative C , the portion of the Dunton-Rico KGRA within the planning area would be allocated to MA 1 (recommended additional Wilderness), which would result in withdrawal from future mineral activity. The portion of the Trimble-Pinkerton KGRA within the planning area would be allocated to MA 1 (roadless management); however, no expected development is likely.
- Under Alternative D, the Dunton-Rico KGRA would be allocated to MA 5, which would not restrict hot springs development. The portion of the Trimble-Pinkerton KGRA within the planning area would be allocated to MA 5; however, no expected development is likely.

Impacts Related to Wildlife and Fisheries Management

Impacts to the geothermal energy program related to wildlife and fisheries management may include higher operating costs and the possibility of areas being closed to geothermal operations. Wildlife management activities that may trigger these impacts are, primarily, related to management requirements under the Endangered Species Act (ESA). Protective measures applied to exploration and development activities may increase costs. The degree of the impacts would depend upon approved conservation strategies, critical habitat designations, and biological opinions mandating specific management requirements for all mineral exploration and development within the planning area. These requirements would not be known until specific project proposals were submitted and assessed.

DLMP/DEIS Alternatives: Based on its general level of restriction on development activities, Alternative C may result in moderate to minor impacts to geothermal energy. Alternatives B and D may result in minor to negligible impacts. Alternative A may result in no impacts.

Impacts Related to Travel and Wilderness Management

Impacts to the geothermal energy program related to travel and wilderness management may include higher operating costs and the possibility of areas being closed to geothermal operations. Public land roads and trails are used by those exploring for, and developing, mineral resources. Limiting use of existing roads and trails by timing or by vehicle type may restrict general or casual access. Limiting or foreclosing new road or pipeline construction may increase costs, and may preclude geothermal development activity. However, in most cases, geothermal exploration or development proposals may be accommodated with site-specific permits and protection measures.

The measurable indicator of impacts would be the total number of acres allocated to MA 1s and 3s. MA 1s (recommended additional Wilderness) would prohibit development. MA 1s (roadless management) would be administered in a manner that preserves the roadless character of the affected (impacted) lands. MA 3s would limit the construction of new roads, and would constrain the use of existing roads. All of these factors may increase the cost of exploration and development, which may, in turn, limit operational feasibility.

DLMP/DEIS Alternatives: Alternative C may result in moderate impacts to geothermal energy development. Alternatives B and A may result in minor impacts. Alternative D may result in no impacts.

Summary of Direct and Indirect Impacts by Alternative

Based on the total number of acres under the various MA designations that could limit the development of geothermal energy, Alternative C may result in moderate to minor impacts. This would be followed by Alternatives A and B, which may result in minor impacts. Alternative D may result in no impacts.

CUMULATIVE IMPACTS

Given the lack of current use, and the low expectations of future development, Alternative C may result in minor cumulative impacts to this resource. The other alternatives may result in negligible, to no, cumulative impacts.