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2021 LCDO Competitive Geothermal Lease Sale Nomination

Environmental Assessment

DOI-BLM-NM-L000-2021-0028-EA


Sierra County, New Mexico
Hidalgo County, New Mexico


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9/14/2021

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CHAPTER 1. INTRODUCTION

1.1 BACKGROUND

This Environmental Assessment (EA) documents the Bureau of Land Management (BLM) Las Cruces District Office (LCDO) review of three lease parcels (3,987 acres) nominated by Lightning Dock Geothermal HI-01, LLC and Matthew Barton Mattox. The parcels will be for competitive sale of public land for geothermal resources. Future exploration and development would require additional submission of applications to the BLM-LCDO, including site specific analysis. All parcels contain federal minerals managed by the BLM.

The legal lands descriptions are as follows:

Parcel #1 (Figure 1.1): Sierra County, New Mexico **T. 16 S., R. 01 E., NMPM**
sec. 20;

Parcel #2 (Figure 1.2): Hidalgo County, New Mexico **T. 25 S., R. 19 W., NMPM**
sec. 17, S2NE, S2;
sec. 18, E2SE;
sec. 20;

Parcel #3 (Figure 1.3): Hidalgo County, New Mexico **T. 25 S., R. 19 W., NMPM**
sec. 03, lots 1 thru 4;
sec. 04, lots 1 thru 4;
sec. 09;
sec. 10, W2;

Geothermal resources are defined as:

- all products of geothermal resources embracing indigenous steam, hot water, and hot brines;
- steam and other gases, hot water, and hot brines resulting from fluids artificially introduced into geothermal formations; and
- heat or other associated energy found in geothermal formations (as well as any byproduct derived from them) (30 United States Code [USC] 1001).

In October 2008, the BLM and the USFS completed a joint programmatic EIS (Geothermal PEIS) to analyze and expedite the leasing of geothermal resources on BLM- and USFS-administered lands in 12 western states with a high potential for geothermal resources (BLM 2008a). A ROD was issued in December 2008 (Geothermal ROD; BLM 2008b). The decision is as follows:

- 1) allocate BLM lands as either open or closed to consideration for geothermal leasing and under what conditions.
- 2) establish a detailed list of stipulations, best management practice, procedures to serve as consistent guidance for the future geothermal leasing and development on public lands.
- 3) The Geothermal ROD actions were implemented as amendments to BLM land use plans. The BLM decision maker will conclude issuing geothermal leases in conformance with the amended land use plans based on the analysis in the Geothermal PEIS. However, the Geothermal PEIS-2008 does not substitute as sufficient analysis in local District and Field offices.

- 1 Additional analysis and approval is required in accordance with NEPA; accordingly this EA is for
- 2 analyzing the sale of nominated lease parcels.

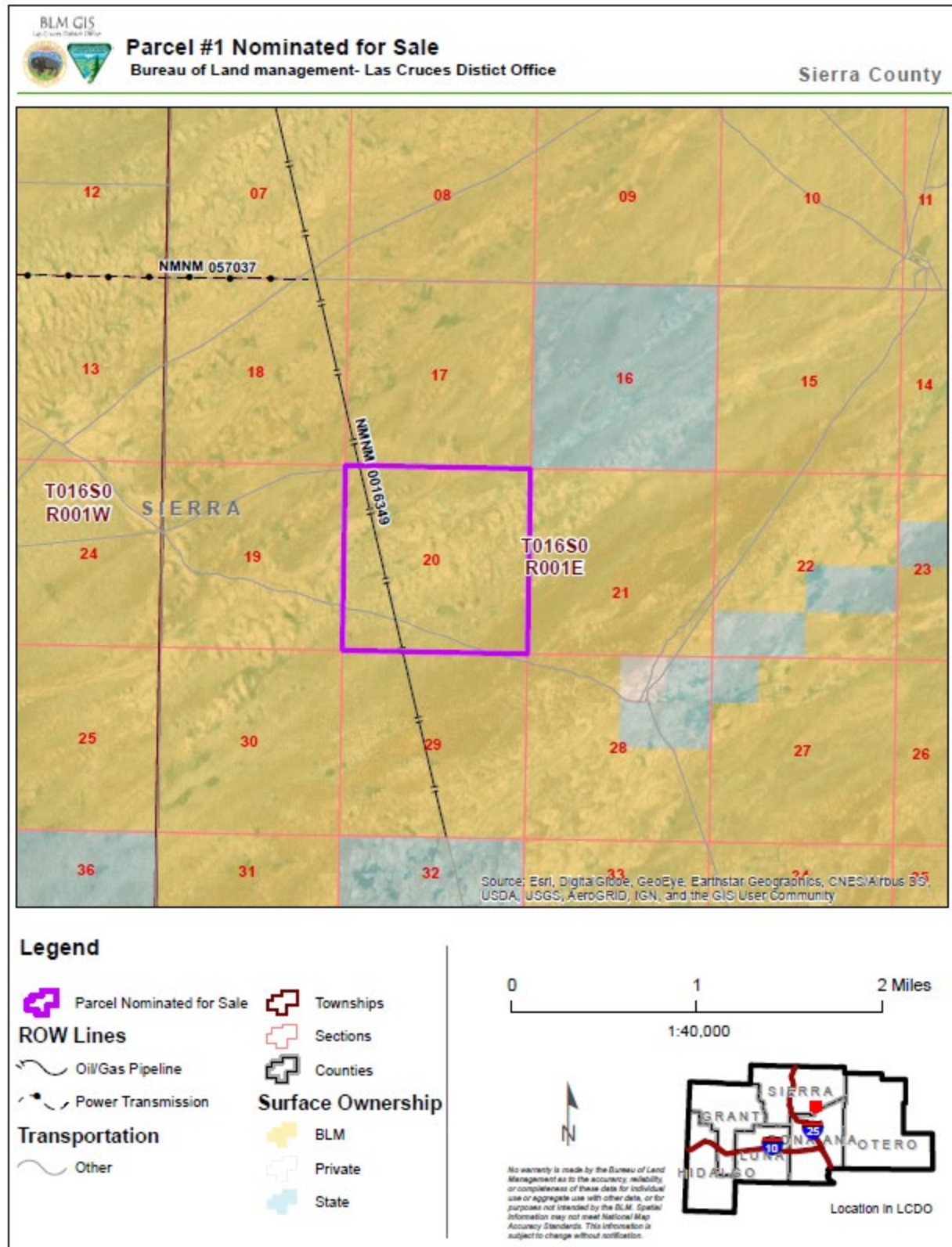


Figure 1.1. Parcels Nominated for Sale.

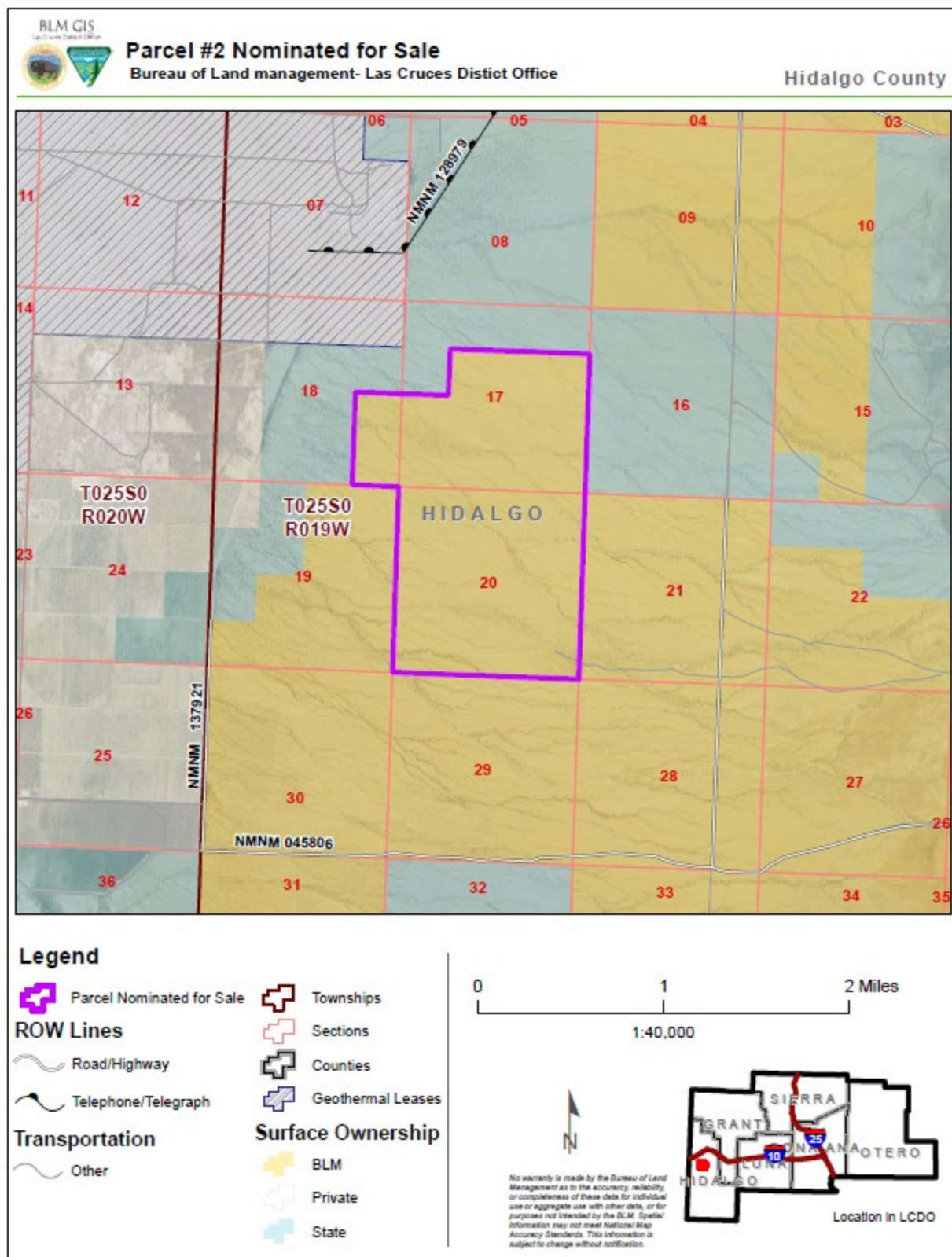


Figure 1.2. Parcels Nominated for Sale. (Cont'd)

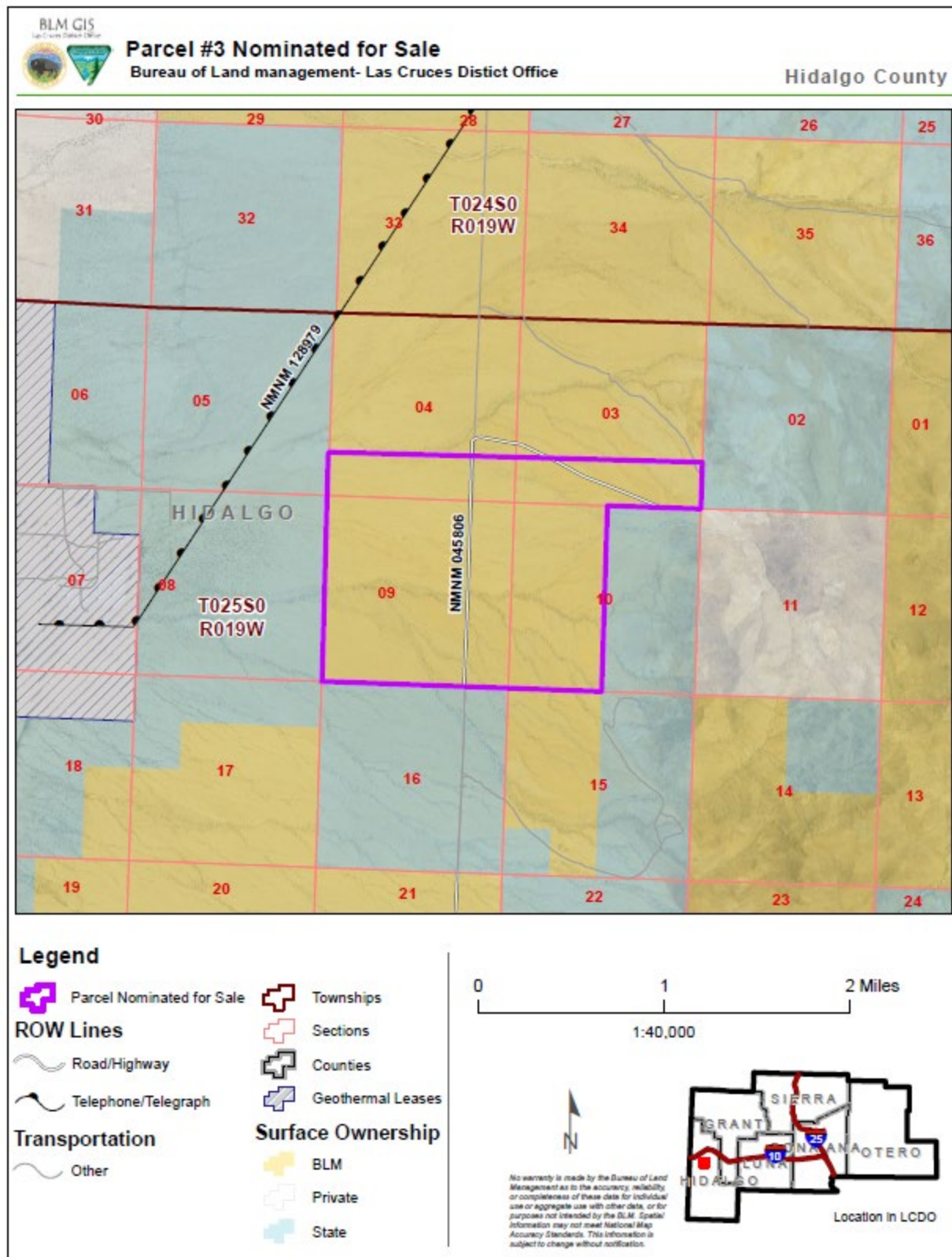


Figure 1.3. Parcels Nominated for Sale. (Cont'd)

1.2 PURPOSE AND NEED

The purpose of this BLM action is to respond to geothermal leasing nominations to explore for and produce geothermal resources on three nominated lease parcels totaling 3,987 acres of BLM-administered lands in Sierra and Hidalgo Counties, New Mexico. BLM is authorized to issue leases for the development of geothermal resources on public lands through the Geothermal Steam Act of 1970 (30 USC 1001–1025) and Geothermal Resource Leasing regulations (43 CFR 3200).

The Proposed Action, if approved, would assist the BLM in addressing the management objectives in Title II, Section 211 of the Energy Policy Act of 2005, which establishes a goal for the Secretary of the Interior to approve 10,000 megawatts (MWs) of electricity from non-hydropower renewable energy projects located on public lands. The Proposed Action, if approved, would also further the purposes of the March 11, 2009, Secretarial Order 3285A1 that establishes the development of environmentally responsible renewable energy as a priority for the U.S. Department of the Interior.

1.3 DECISION TO BE MADE

The BLM will decide whether to deny the competitive geothermal lease nominations or to approve the lease of such lands in whole or in part with appropriate lease stipulations as determined necessary to protect important affected resources. A decision to approve the geothermal lease nominations would not authorize surface disturbance from geothermal exploration or development activities. The BLM would conduct additional environmental analysis and make a new decision for each proposal that involves surface disturbance on a geothermal lease. If the Proposed Action is approved, BLM would offer the three parcels through a competitive lease sale. Exploration and development geothermal resources on the leased land for a term of 10 years, subject to renewal or extension. Once a lease is issued, the leaseholder would have the right to lease nominated parcels for geothermal resources.

This EA analysis includes the following geothermal leases nominated: (Table 1.1).

Table 1.1. Leases Nominated for Sale			
Serial No. (acres)	Surface Management	Lease Nominated (date)	Land Use Plan
NMNM141820 (640)	BLM	4/7/2020	(White Sands, 1986)
NMNM142268 (1,120)	BLM	8/14/2020	(Mimbres, 1993)
NMNM142267 (2,227)	BLM	8/14/2020	(Mimbres, 1993)
Total = 3 parcels, 3,987 acres			

1.4 CONFORMANCE WITH BLM LAND USE PLANS, OTHER STATUTES, REGULATIONS, AND PLANS

The BLM would issue leases for the exploration and development of geothermal resources on each parcel under the Geothermal Steam Act of 1970. This act states that geothermal leases convey the “exclusive right and privilege to drill for, extract, produce, remove, utilize, sell, and dispose of geothermal steam and associated geothermal resources” on the leased lands. To maintain this right, the lessee must “diligently explore the leased lands for geothermal resources until there is production in commercial quantities” applicable to each of these leases. The lessee must pay annual rentals to the federal government and has to

1 expend increasing dollars until the production of geothermal resources in commercial quantities is
2 achieved.

3 Energy production by geothermal resources on BLM land is regulated by 43 CFR 3000, 3200, and 3280.
4 These regulations establish procedures for processing leases, right-of-way (ROW) agreements,
5 geothermal unit agreements, and geothermal permits for activities relating to geothermal resource energy
6 production.

7 The Proposed Action is consistent with the Geothermal Steam Act of 1970 and with other federal laws
8 and regulations, including the promotion of renewable energy under the Energy Policy Act of 2005 (42
9 USC 15801 et seq.). BLM's regulations have been updated to comply with this law. The Proposed Action
10 is in accordance the BLM land use plans that cover the three lease parcels are the Mimbres 1993 –
11 RMP/ROD (Mimbres Land Use Plan, 1993) and the White Sands 1986 – RMP/ROD (White Sands Land
12 Use Plan, 1986). The Mimbres RMP/ROD manages geothermal resources in a similar manner to oil and
13 gas. There are three Known Geothermal Resource Areas (KGRAs) in the Resource Area. These include
14 Las Cruces (Tortugas Mountain), Radium Springs, and Animas (Lightning Dock). All lands within
15 KGRAs are open to competitive leasing. All other areas in the Resource Area are available for
16 noncompetitive leasing. All leases within the Resource Area are subject to special fluid leasing
17 stipulations. The White Sands RMP/ROD of 1986 indicate primary emphasis on making public land and
18 resources available for use and development. The principles of multiple-use and sustained yield would
19 have been observed, and environmental values protect to the extent required by applicable laws,
20 regulations, and policies. In general, public land within the Resource Area will be issued with only
21 standard stipulations. However, when applicable, special stipulations will be attached to protect sensitive
22 areas. In highly sensitive areas, where special stipulations are not sufficient, no surface occupancy
23 stipulations will be attached, or the lease will not be issued.

24 In accordance with CEQ regulations (40 CFR 1508.28, 40 CFR 1502.20)¹, this EA is tiered to the
25 Geothermal PEIS and the Geothermal ROD. Tiering uses coverage of general matters in broader NEPA
26 documents to inform subsequent narrower documents. It allows for analysis of a smaller range of
27 alternatives and limits the analysis focus to issues not already addressed (BLM 2008c). Portions of this
28 document incorporate information and analyses from the Geothermal PEIS and Geothermal ROD by
29 reference in accordance with 40 CFR 1502.21.

30 The issuing of leases for geothermal development would be processed and evaluated under BLM statutory
31 mandates and authority governing federal land leasing, and under other statutes, regulations, plans,
32 programs, and policies of affiliated tribes; other federal agencies, and state and local governments to the
33 extent practicable, including the following non-exhaustive list of statutes and regulations:

- 34 • 36 CFR 800 (Protection of Historic Properties)
- 35 • 43 CFR 3260 (Geothermal Drilling Operations - General)
- 36 • The Archaeological Resources Protection Act of 1979, as amended (16 USC 470aa et seq.)
- 37 • The Clean Water Act of 1977, as amended (33 USC 1251 et seq.)
- 38 • The Endangered Species Act of 1973 (ESA), as amended (16 USC 1531 et seq.)
- 39 • Executive Order 13186 of January 10, 2001 (Responsibilities of Federal Agencies To Protect
- 40 Migratory Birds)
- 41 • FLPMA of 1976, as amended (43 USC 1701 et seq.)
- 42 • NFMA of 1976 (16 USC 1600 et seq.)
- 43

¹ Regulation standards applicable due to parcels nominated before September 14, 2020 amendments.

- NEPA (43 USC 4321 et seq.)

The BLM must manage public lands and the resources therein for multiple uses in a way that will best meet the present and future needs of the public, and in accordance with FLPMA, which requires the BLM to develop Land Use Plans or Resource Management Plans (RMPs). Under FLPMA, the BLM must manage for multiple use of these public lands and their various resources in a combination that will best meet the present and future needs of the public. Specifically, this Proposed Action aligns with the following Las Cruces District Office RMPs/RODs:

1.4.1 Mimbres Resource Area

The December 1993 – Mimbres Resource Management Plan has been reviewed, and it has been determined that the proposed action conforms with the land use plan terms and conditions as required by 43 CFR 1610.5.

Land Use Plan: December 1993 – Mimbres Resource Management Plan

Date Approved: 1993

Objective: [Page 2-3] “The minerals program is to provide for the public use of leasable, locatable, and saleable minerals consistent with the laws that govern these activities and to minimize environmental damage.”

Continuing Management Guidance and Actions: [Page 2-3] “Geothermal resources are managed in a manner similar to oil and gas. There are three Known Geothermal Resource Areas (KGRAs) in the Resource Area. These occur in Las Cruces (Tortugas Mountain), Radium Springs, and Animas (Lightning Dock). All lands within KGRAs are open to competitive geothermal leasing.”

Decision: [Page 2-6] “About 65,000 acres are open to leasing with no surface occupancy (see Appendix B-2). The remainder of the Resource Area is open to mineral leasing, subject to standard terms and conditions: oil and gas, 3,532,300 acres; and geothermal and nonenergy leasable, 3,499,500 acres.”

1.4.2 White Sands Resource Area

The December 1986 – White Sands Resource Management Plan has been reviewed, and it has been determined that the proposed action conforms with the land use plan terms and conditions as required by 43 CFR 1610.5.

Land Use Plan: December 1986 – White Sands Resource Management Plan

Date Approved: 1986

General Management Guidance: [Page 18] “Oil, gas, and geothermal leasing in the Resource Area was analyzed in a programmatic EA completed in 1981. In general, public land is available for oil and gas and geothermal leasing.”

Specific Decisions: [Page 18-20] “By accepting this lease, the lessee acknowledge that the lands contained in this lease are being inventoried or evaluated for their wilderness potential by the BLM under Section 603 of the Federal Land Policy and Management Act of 1976, 90 Stat. 2743 (43 USC Sec. 1782), and that exploration or production activities which are not in conformity with Section 603 may never be permitted.”

1.5 PUBLIC INVOLVEMENT AND ISSUES

1.5.1 Internal Scoping

This project was presented to the Las Cruces District Office (LCDO) NEPA Interdisciplinary (ID) team on January 19, 2021, to identify resource issues that may be affected by the proposed action.

1.5.2 External Scoping

In a April 20, 2021 letter, the BLM-LCDO requested that Tribal Council be consulted with to review the three parcels nominated to provide consent for the lease sale and to identify any lease stipulations notices necessary to protect surface resources. In addition, the BLM-LCDO had a 30-day public notice requesting comment on the sale of the nominated parcels for geothermal resources were published on <https://eplanning.blm.gov/eplanning-ui/project/2014349/510> on July 14, 2021. (XXX) public comments have been received to date. A complete list of consultation is provided in Chapter #5 (Consultation and Coordination).

1.5.3 Draft EA Public Comment and Response

No comments or responses were submitted to the BLM-LCDO regarding the 2021 LCDO Competitive Geothermal Lease Sale Nomination.

1.5.4 Issues

The Council on Environmental Quality (CEQ) regulations state: “NEPA documents must concentrate on the issues that are truly significant to the action in question, rather than amassing needless detail” (40 CFR 1500.1(b)). The regulations at 40 CFR 1500.4(g) direct that the scoping process should be used “not only to identify significant environmental issues deserving of study but also to deemphasize insignificant issues narrowing the scope of the [NEPA] process accordingly.” The following resources or issues were identified as potentially impacted by the NEPA ID team.

Table 1.2. Issues Identified for Detailed Analysis for the Lease Sale

ISSUE	ISSUE STATEMENT	IMPACT INDICATOR
Issue 1	How would future potential exploration, development, and operations on the nominated lease parcels impact Native American, Tribal, and Religious Resources?	See Section 3.4.1
Issue 2	How would future potential exploration, development, and operations on the nominated lease parcels impact Cultural Resources?	See Section 3.4.2
Issue 3	How would future potential exploration, development, and operations of the nominated lease parcels impact future mineral and energy development?	Nominated parcels are within areas designated for geothermal resource development, future development would be dependent on exploration results.

Issue 4	How would future potential exploration, development, and operations of the nominated lease parcels impact future soils?	See Section 3.4.4
Issue 5	How would future potential exploration, development, and operations of the nominated lease parcels impact water quality and hydrology?	See Section 3.4.5
Issue 6	How would future potential exploration, development, and operations of the nominated lease parcels impact wildlife, including game and non-game species?	For example, human activity and surface disturbance could cause direct mortality to individuals, impede daily activities, displace individuals from normal habitat, or disrupt normal breeding behavior and breeding success. Portions of the project area are in crucial and/or substantial habitat for mule deer and pronghorn.
Issue 7	How would future potential exploration, development, and operations of the nominated lease parcels impact special status plant species?	For example, Parcel 2 and 3 contain suitable habitat for night-blooming cereus. In terms of impact, determination would be from amount of surface disturbance acreage.

Table 1-3. Potential issues were identified through internal scoping. These issues were considered and identified as not impacted by the Proposed Action or not present within the nominated parcels.

Considering these assessments, these issues were dismissed from further, detailed analysis in Chapter 3.

Table 1.3. Issues Considered and Dismissed from further Detail for the Lease Sale

NON-ISSUE STATEMENT	RATIONALE *
How would future potential exploration, development, and operations of the nominated lease parcels impact future air quality/Greenhouse Gas Emissions?	Leasing the parcels would not directly affect the air resource. However, under the reasonably foreseeable development scenario, any impacts to air quality from vehicles and equipment required for geothermal development are addressed in Appendix B of the 2008 Record of Decision and Resource Management Plan Amendments for Geothermal Leasing in the Western United States. Leasing the parcels would not directly affect greenhouse gases. However, under the reasonably foreseeable development scenario, greenhouse gasses are mostly anthropogenic with vehicle emissions comprising the largest percentage of the greenhouse gasses. The development of geothermal resources may have a minor short-term increase in greenhouse gasses but will decrease greenhouse gases in the long term.
How would future potential exploration, development, and operations of the nominated lease parcels impact future climate change?	Future development of geothermal resources associated with this lease sale would not produce a level of greenhouse gases that would alter climate change conditions.

NON-ISSUE STATEMENT	RATIONALE *
How would future potential exploration, development, and operations on the nominated lease parcels impact future livestock grazing?	Leasing parcels would not directly affect livestock grazing. However, under reasonably foreseeable development scenarios, any impacts to livestock grazing would occur during the drilling and production operations. Design features would be assigned at time of analysis of submission of future lease development proposals.
How would future potential exploration, development, and operations of the nominated lease parcels impact Visual Resources?	Future geothermal resource infrastructure from development and operations shall be painted to match surrounding landscape using one of the BLM standard environmental colors.
How would future potential exploration, development, and operations of the nominated lease parcels impact the introduction and/or spread of noxious weeds and invasive plants?	If noxious weeds are present, they would be controlled in accordance with the standard stipulations. The grazing permit holder has been treating an existing population of African rue within the work site while gravel mining operations have not been occurring. During proposed mining operations, this responsibility would shift to the mineral material permit holder to ensure continued control of this noxious weed population.
How would future potential exploration, development, and operations of the nominated lease parcels impact paleontological resources?	The three nominated parcels contain geologic units with unknown potential fossil yield, and the geologic units surrounding and within the parcels lack documented paleontological resource inventories. This necessitates that future ground disturbing activities would be subject to 100 percent pedestrian survey and possibly monitoring for paleontological resources. Use Stipulations NM-13-CSU and NM-14-LN. So long as the stipulations are followed, impacts to paleontological resources would be mitigated
How would future potential exploration, development, and operations of the nominated lease parcels impact dispersed public recreation?	Future development of geothermal resources associated with this lease sale would not produce a level of surface disturbance that would cause undue degradation to public recreation. Design features would be assigned at time of analysis of submission of future lease development proposals.
How would future potential exploration, development, and operations of the nominated lease parcels impact lands, access, and realty?	Ongoing exploration, development, and operations of geothermal resources would not cause interference or conflict to existing ROW holders; therefore, there would be no issues. The BLM would notify ROW holders of the project in the scoping process.

* Supporting documentation for these statements are included in the project record.

CHAPTER 2. PROPOSED ACTION AND ALTERNATIVES

2.1 PROPOSED ACTION

Under the Proposed Action, the BLM would approve the sale of three geothermal lease parcels (a total of 3,987 acres) containing federal minerals administered by the BLM-LCDO. The three parcels are described in Table 2.1. Leasing is expected to occur in November 2021. The parcels would be offered for lease through a competitive sale. The sale will be held online at <https://www.energynet.com>. Parcels will be available for approximately 10 business days after the posting of the sale notice on the BLM website. However, if not leased at the end of the competitive sale process, the parcels would then be available for noncompetitive leasing. This process is represented under regulations 43 CFR 3204, lands that do not receive a bid and are available for a 2-year period; beginning the first business day after auction. The noncompetitive offers are handled directly by the BLM and not through the internet leasing website. If you want to file a noncompetitive offer on an unsold parcel, you must file it with the BLM-NM State Office.

Table 0.1. Three Geothermal Lease Parcel Nominations

Parcel Number	Serial No.	Acreage	Surface Mgmt. Agency	County	LUP
1	NMNM141820	640	BLM	Sierra	White Sands
2	NMNM142268	1120	BLM	Hidalgo	Mimbres
3	NMNM142267	2227	BLM	Hidalgo	Mimbres
Total = 3 parcels		3987	-	-	-

Notes: Subsequent acreages used in the EA are derived or calculated from available GIS data; small discrepancies may exist between the title record acreage and total acres reported (derived from GIS data).

Appendix A provides a further description of each of the three parcels, including surface ownership, legal land description, and applicable stipulations and notices. Appendix C provides a summary of stipulations and lease notices.

Leasing the nominated lease parcels would not directly result in any exploration, development, and operations. However, these activities are a reasonably foreseeable outcome following leasing. As a result, even though the BLM is not considering an exploration or development proposal at this time the BLM's impact analysis is based on coarse estimates of future potential development described in Section 2.2.1 to ensure a complete and adequate analysis.

Geothermal resource exploration and production on the parcels would be subject to terms and stipulations presented in the Geothermal ROD and the Decision Record (DR) following this EA and would comply with all applicable federal and state laws. Subsequent proposals for exploration and development on specific parcels would be examined for conformance with the appropriate land use plan and must be analyzed as required by NEPA prior to implementation.

2.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, the BLM would not lease the nominated geothermal parcels. As a result, there would not be any development of the parcels. Parcels would have the potential to be nominated for leasing in the future and included in a future geothermal lease sale.

CHAPTER 3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

3.1 INTRODUCTION

This section describes the existing conditions relevant to the issues presented in Table 1.2 and discloses the potential direct, indirect, and cumulative impacts of the alternative on those issues. Cumulative actions incorporated into the analysis are described in Section 3.2, Cumulative Actions. This discussion is the analysis of reasonably foreseeable future actions (RFFAs) are enumerated here because they contribute to the cumulative impact analyses for each issue below.

3.2 CUMULATIVE IMPACTS

As defined in 40 CFR 1508.7, a cumulative impact is an impact on the environment that results from the incremental impact of the action when combined with the effects of past, present, and reasonably foreseeable future actions, regardless of which agency (federal or non-federal) or person undertakes such other actions. The following section outlines past, present, and reasonably foreseeable future actions that would affect the same resources as the Proposed Action and are within the temporal and geographic boundaries of the analysis. The BLM LCDO, which oversees all three parcels nominated for the lease sale, is the geographic scope of analysis (analysis area) for cumulative impacts in this EA. The LCDO considers 3987 acres within the planning area boundary. This includes BLM surface acres and acres of federal minerals.

Past and Present Actions. Development within the three nominated lease parcels includes, roads, trails, geothermal facilities, transmission lines, and mining. Other past and present actions in the cumulative impact analysis area have included wildfires, grazing, range improvements, and recreational activities.

Reasonably Foreseeable Future Actions. The reasonably foreseeable development (RFD) scenario used in this EA is based on the RFD scenario presented in the Geothermal ROD and serves as a basis for analyzing environmental impacts resulting from leasing and future development of the three geothermal lease parcel nominations listed above. The RFD in the Geothermal ROD is largely based on the Clean and Diversified Energy Initiative. Geothermal Task Force Report prepared for the Western Governors' Association (Western Governors' Association 2006). The BLM's review of the RFD's validity determined that neither geothermal exploration, development, and production technology and processes nor New Mexico geothermal resource estimates have changed since 2008.

A variety of factors influencing the demand for geothermal resources (e.g., economic, social, and political) are beyond government control. Variables include the estimation of unexplored geothermal resources, the development of geothermal technologies that may allow for extraction of resources currently unusable, the unknown nature of future energy markets, and the unknown future of regulatory and political climates. Because of these unknowns, the RFD scenario is a best professional estimate of what may occur if the three parcels are leased. It is not intended to be a maximum development scenario. It allows for a general evaluation of the types of impacts that may occur but cannot accurately predict the magnitude and extent of project impacts, due in part to uncertainty about timing, location, the distribution of geothermal resources, and the types of development. If future development eventually exceeds RFD predictions, the BLM would re-assess the resource impacts under the context of the analysis provided in the Geothermal PEIS, this EA, and relevant land use plans, and then determine if additional analysis is warranted.

Decisions, funding, or formal proposals that are either existing or are highly probable, based on known opportunities or trends. Known RFFAs on BLM lands include continued grazing, range improvement projects, vegetation treatments, mining, and invasive species management; however, these are unlikely to interact with the leasing of geothermal resources because such interactions would be avoided through project design and design features. Renewal of grazing permits is ongoing; new permits focus on meeting standards and guides for rangeland health for the sustainability of natural resources and ecological processes. In general, specific acreages and locations of RFFAs are not known at this time due to not having sufficient data to predict future development scenarios, including types development, timing, and location, the following impact analysis provides a general description of potential impacts on entire acreage of nominated parcels for geothermal resource development. Leasing nominated parcels would not create any surface disturbance, and current activities on BLM lands could continue as long as there is no interference with the rights of the geothermal lessee.

Table 0.1. Past, Present, and Reasonably Foreseeable Future Estimated Landscape Disturbance within the Analysis Area

Analysis Area		Acreage
Hidalgo and Sierra County		3,987
Cumulative Actions	Number of Wells	
Past and present geothermal development		
Reasonably foreseeable future geothermal development	8-24	159-1101
Other RFFAs (mining, land farms, and other infrastructure)		12-66
Total		
Contribution of future potential development under the Proposed Action		6-21

* Includes estimates of existing disturbance from past oil and gas development, as well as non-oil and gas development.

3.3 NO ACTION ALTERNATIVE FOR ALL ISSUES

Under the No Action Alternative, the BLM would deny the nomination for a geothermal lease sale. Potential impacts associated with the Proposed Action would not occur under this alternative, and current land and resource uses would continue. Geothermal development would continue leased land surrounding the lease parcels. A choice on the part of the BLM not to sell the nominated lease parcels would eliminate three geothermal development opportunities in the BLM LCDO. Reducing total geothermal development opportunities in the area is likely to incrementally reduce local and regional employment and revenue opportunities related to the geothermal and service support industries over time. This is because the geothermal sector of the economy relies on both ongoing operational activities (development of existing leases) and new development opportunities (acquisition and development of new leases and reinstatement of terminated leases) to continue to provide local and regional jobs and revenue on a sustained basis.

3.4 ISSUES ANALYZED

The issues identified for detailed analysis in this EA were developed in accordance with CEQ regulations and the guidelines set forth in the BLM NEPA Handbook H-1790-1 (BLM 2008b) using input from internal and external scoping. Issues were retained for detailed analysis if that analysis is necessary to make a reasoned choice between alternatives; to determine significance; if there is disagreement about the best way to use a resource; or if there is conflict between resource impacts or uses.

3.4.1 Issue 1: Native American, Tribal, and Religious Concerns

How would future potential exploration, development, and operations of the nominated lease parcels impact Native American, Tribal, and Religious Resources?

The BLM LCDO mailed out Tribal notification letters to the Comanche Nation, Kiowa Tribe, Mescalero Apache Tribe, White Mountain Apache Tribe, Ysleta del Sur Pueblo, Hopi Tribe, Isleta Pueblo, Navajo Nation, and the Fort Sill Apache Tribe. The White Mountain Apache Tribe responded on 5/5/21 that the proposed geothermal lease sale will "not have an adverse effect on the Tribe's cultural heritage resources and/or traditional cultural properties. No further consultation is necessary and/or required." The Ysleta del Sur Pueblo "does not have any comments nor does it request consultation on this proposed geothermal lease sale," dated 5/5/21. Navajo Nation responded on 5/12/21 that the "NNHHPD-TCP has determined that there are no Navajo TCP/s within the lease area and you may proceed without further consultation for this project". The Hopi Tribe responded on 4/30/21 that they "concur". BLM LCDO has not received a response from the Comanche Nation, Kiowa Tribe, Mescalero Apache Tribe, Isleta Pueblo or the Fort Sill Apache Tribe. There are no anticipated impacts to Native American Traditional Cultural and Religious Concerns.

The BLM will re-initiate consultation with Native American Tribes should any of the proposed parcels be sold and proposed for geothermal exploration and development. The BLM will review any future geothermal development plans under Section 106 as a separate action from leasing.

3.4.2 Issue 2: Cultural Resources

How would future potential exploration, development, and operations of the nominated lease parcels impact Cultural Resources?

The BLM conducted a literature search reviewing a one-mile buffer around each Nominated Parcel on February 18, 2021, using survey and site information from the New Mexico Cultural Resources Information System (NMCRIS), General Land Office (GLO) plat maps and Geographic Information Systems (GIS) layers to identify previous inventories conducted and sites located near or within the three geothermal lease parcels (BLM Cultural Project Number 030-21-041). The review indicated that less than 3 percent of each parcel has been previously surveyed for cultural resources. There were no known cultural resources noted within the Nominated Parcels.

During the review, three previously recorded archaeological sites were located outside the lease parcel, but within the one-mile buffer. LA 8913 is an unknown prehistoric site recorded in 1954, as containing "fire broken rock" and one mano, one metate, blade fragments and flakes, with "fire areas" listed as a feature on the site form. LA 8913 is currently Unevaluated for eligibility. LA 167487 is a prehistoric flaked-stone artifact scatter with ceramics and no features and classified as a Mogollon site dating to the Formative Period (A.D. 200 to A.D. 1400) as indicated by the presence of El Paso Brownware and Alma Plain. LA 167487 was previously determined Not Eligible in 2010 (Historic Preservation Division Log No. 91885). LA 161355 is an unknown prehistoric artifact scatter with no features consisting of lithic debitage, a bifacial core and tested cobble. LA 161355 has been recommended Eligible under criterion (d) by the recorder.

The lease sale would not authorize any new construction or ground disturbance within any of the proposed parcels. It would, however, potentially commit the area to future development somewhere within the lease area. Should any of the proposed parcels be sold and proposed for geothermal exploration and development, the BLM will review any such geothermal development plans under Section 106 as a separate action from leasing.

If any such property is identified through ongoing tribal consultation and/or the Section 106 process at the exploration and development stage, the BLM may require a lessee to modify exploration or development proposals or disapprove proposed activities that are likely to result in adverse effects that cannot be avoided, minimized, or mitigated. In consultation with consulting parties, BLM LCDO will determine appropriate mitigation or avoidance measure(s) for identified historic properties.

Prior to the approval of any geothermal development, a Class III cultural resources inventory, including a standard cultural buffer, will be conducted for the proposed footprint of disturbance including any new access roads.

The act of selling a lease does not involve or authorize any land disturbance or construction. Future undertakings associated with geothermal exploration and development on any sold leases will be handled through separate, future NEPA actions and NHPA – Section 106 processes prior to implementation. Therefore, the BLM determines a finding of No Historic Properties Affected for the proposed 2021 geothermal lease sale.

3.4.3 Issue 3: Mineral and Energy Development

How would future potential development of the nominated lease parcels impact future fluid and solid minerals, and energy development?

Depending on the success of geothermal well drilling, future potential development of the nominated lease parcels would include surface disturbance and would add acreage to the total amount of the LCDO analysis area that is leased. The nominated lease parcels would contribute geothermal production within the analysis area and is consistent with various laws, including FLPMA (43 United States Code [USC] Section 1701 et seq.), that mandate that the BLM administer for the exploration and development of these mineral resources on public lands for the benefit of the citizens of the United States.

The cumulative impact scenario would result in potential for development of an RFD scenario of numerous geothermal wells in addition to other mineral development. As with the Proposed Action, development of the RFD scenario is consistent with laws mandating development of mineral and energy resources on public lands. Impacts would vary depending on the area of future geothermal development within the parcels. Potential impacts would be analyzed at the site-specific development stage under a separate federal nexus to avoid and minimize unnecessary and undo degradation to federal lands.

3.4.4 Issue 4: Soils

How would future potential development of the nominated lease parcels impact soils?

SIERRA COUNTY

In Sierra County, there is one geothermal lease parcel, New Mexico Serial number NMNM141820 comprised of one 640-acre parcel located in Section 20, Range 1E, Township 16 South. Web Soil survey and ArcGIS® analysis techniques identified the soil map unit, acreage, surface ownership and the Natural Resources Conservation Service (NRCS) Erosion Hazard Off Road Off Trail Rating (See Below Table). The Erosion Hazard Off Road Off Trail indicate the hazard of soil loss from off-road and off-trail areas after disturbance activities that expose the soil surface. The ratings are based on slope, soil erosion factor K, and an index of rainfall erosivity (R). The soil loss is caused by sheet or rill erosion in off-road or off-trail areas where 50 to 75 percent of the surface has been exposed by logging, grazing, mining, or other kinds of disturbance. (Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online. Accessed 02/03/2021).

Leasing the parcel would not directly affect soils. However, using the reasonably foreseeable development (RFD) scenario, ground-disturbing activities (vehicle traffic, soil removal etc.) necessary to develop geothermal resources could affect soil properties (e.g., permeability, infiltration rates, and productivity). Changes in the soil properties could alter the surface water flow patterns, which could result in wind and water erosion occurring on the leased parcel.

Table 3.2. NEW MEXICO SERIAL NUMBER NMNM 141820.

Sierra County Soil Map Unit Symbol	Sierra County Soil Map Unit Name	BLM Surface Ownership Acreage	Erosion Hazard Off Road Off Trail Dominant Condition Rating
18	Berino Dona Ana complex, hummocky	192.00-acres	Slight
29	Cruces Cacique complex, hummocky	59.74-acres	Slight
31	Dona Ana complex, hummocky	318.43-acres	Slight
32	Dona Ana Tres Hermanos association, gently sloping	70.60-acres	Slight
Total		640.77	

All Soil Map Units occur on BLM Surface Ownership for this Sierra County Section 20 parcel. According to Web Soil Survey there are four soil map units in the Sierra County parcel and have a "slight" Erosion Hazard Off Road Off Trail Dominant Condition Rating (See Above Table). A rating of "slight" indicates that erosion is unlikely under ordinary climatic conditions. (Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online. Accessed 02/03/2021).

HIDALGO COUNTY

In Hidalgo County, there are two geothermal lease parcel nominations comprised of seven different sections. New Mexico Serial Number NMNM 142267 parcel is comprised of Section 3, Section 4, Section 9 and Section 10 of Range 19 West, Township 25 South. New Mexico Serial Number NMNM 142268 parcel is comprised of Section 17, Section 18, and Section 20 of Range 19 West, Township 25 South. Web Soil survey and ArcGIS® analysis techniques identified the soil map units, acreage, surface ownership and the Natural Resources Conservation Service (NRCS) Erosion Hazard Off Road Off Trail Ratings for the seven different sections (See Below Tables).

Leasing the two parcels would not directly affect soils. However, using the reasonably foreseeable development (RFD) scenario ground-disturbing activities (vehicle traffic, soil removal etc.) necessary to develop geothermal resources could affect soil properties (e.g., permeability, infiltration rates, and productivity). Changes in the soil properties could alter the surface water flow patterns, which could result in wind and water erosion occurring on the leased parcels.

Table 3.3. NEW MEXICO SERIAL NUMBER NMNM 142267.**Hidalgo County Section 3 Range 19 West Township 25 South**

Hidalgo County Soil Map Unit Symbol	Hidalgo County Soil Map Unit Name	BLM Surface Ownership Acreage	New Mexico State Land Surface Ownership Acreage	Erosion Hazard Off Road Off Trail Dominant Condition Rating
EB	Eba very gravelly loam, 1 to 15 percent slopes	215.07-acres		Slight
LH	Lehmans extremely rocky loam 10 to 25 percent slopes	106.87-acres		Moderate
NC	Nickel gravelly sandy loam 3 to 9 percent slopes	91.28-acres		Slight
TR	Tres Hermanos gravelly clay loam	224.66-acres		Slight
Total Acreage		637.88-acres**		

All Soil Map Units occur on BLM Surface Ownership for this Section 3 parcel.

**Due to ArcGIS® analysis, the ArcGIS® calculated acreage will be within plus or minus five acres of the geothermal lease parcel acreage.

Hidalgo County Section 4 Range 19 West Township 25 South

Hidalgo County Soil Map Unit Symbol	Hidalgo County Soil Map Unit Name	BLM Surface Ownership Acreage	New Mexico State Land Surface Ownership Acreage	Erosion Hazard Off Road Off Trail Dominant Condition Rating
EB	Eba very gravelly loam, 1 to 15 percent slopes	24.21-acres		Slight
MO	Mohave sandy clay loam, 0 to 3 percent slopes	97.28-acres		Slight
TR	Tres Hermanos gravelly clay loam	513.68-acres		Slight
Total Acreage		635.17-acres**		

All Soil Map Units occur on BLM Surface Ownership for this Section 4 parcel.

**Due to ArcGIS® analysis, the ArcGIS® calculated acreage will be within plus or minus five acres of the geothermal lease parcel acreage.

Table 3.3. NEW MEXICO SERIAL NUMBER NMNM 142267 cont.**Hidalgo County Section 9 Range 19 West Township 25 South**

Hidalgo County Soil Map Unit Symbol	Hidalgo County Soil Map Unit Name	BLM Surface Ownership Acreage	New Mexico State Land Surface Ownership Acreage	Erosion Hazard Off Road Off Trail Dominant Condition Rating
EB	Eba very gravelly loam, 1 to 15 percent slopes	12.31-acres		Slight
MO	Mohave sandy clay loam, 0 to 3 percent slopes	288.29-acres		Slight
TR	Tres Hermanos gravelly clay loam	342.53-acres		Slight
Total Acreage		643.13-acres**		

All Soil Map Units occur on BLM Surface Ownership for this Section 9 parcel.

**Due to ArcGIS® analysis, the ArcGIS® calculated acreage will be within plus or minus five acres of the geothermal lease parcel acreage.

Hidalgo County Section 10 Range 19 West Township 25 South

Hidalgo County Soil Map Unit Symbol	Hidalgo County Soil Map Unit Name	BLM Surface Ownership Acreage	New Mexico State Land Surface Ownership Acreage	Erosion Hazard Off Road Off Trail Dominant Condition Rating
EB	Eba very gravelly loam, 1 to 15 percent slopes	202.53-acres	103.56-acres	Slight
LH*	Lehmans extremely rocky loam 10 to 25 percent slopes		52.10-acres	Moderate
RU*	Rough broken land and Rock land		105.46-acres	Not Rated
TR	Tres Hermanos gravelly clay loam	118.62-acres	60.20-acres	Slight
Total Acreage		321.22**	321.22	

*Soil Map Unit LH and RU occur only on New Mexico State Land Surface Ownership for this Section 10 parcel.

**Due to ArcGIS® analysis, the ArcGIS® calculated acreage will be within plus or minus five acres of the geothermal lease parcel acreage.

According to Web Soil Survey there are six soil map units in the Hidalgo County NMNM 142267 parcel and have a "slight" to "moderate" Erosion Hazard Off Road Off Trail Dominant Condition Rating (See Above Tables). A rating of "slight" indicates that erosion is unlikely under ordinary climatic conditions. A rating of "moderate" indicates that some erosion is likely and that erosion-control measures may be needed (Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online. Accessed 02/03/2021).

Section 3, Section 4, Section 9 and Section 10, Range 19 West, Township 25 South are in area designated as fragile land. According to the 1993 Mimbres Resource Management Plan, fragile land areas will receive high priority for Allotment Management Plan (AMP) or other activity plan revision or development, allotment monitoring, land treatments, allotment recategorization, and possible reduction or exclusion of surface disturbing activities including range improvement development and livestock grazing use. Efforts will be directed towards improving range condition and reaching desired plant community objectives within these areas. Due to the fragile land designation additional environmental analysis and additional stipulations may be required for future potential exploration, development, and operations of New Mexico Serial Number NMNM 142267 nominated lease parcel. Additional stipulations, as well as best management practices that may be required will follow the guidance in the 2008 Record of Decision and Resource Management Plan Amendments for Geothermal Leasing in the Western United States.

Table 3.4. NEW MEXICO SERIAL NUMBER NMNM 142268

Hidalgo County Section 17 Range 19 West Township 25 South

Hidalgo County Soil Map Unit Symbol	Hidalgo County Soil Map Unit Name	BLM Surface Ownership Acreage	New Mexico State Land Surface Ownership Acreage	Erosion Hazard Off Road Off Trail Dominant Condition Rating
TR	Tres Hermanos gravelly clay loam	442.34-acres	201.00-acres	Slight
Total Acreage		442.34-acres**	2001.00-acres	

**Due to ArcGIS® analysis, the ArcGIS® calculated acreage will be within plus or minus five acres of the geothermal lease parcel acreage.

1 Hidalgo County Section 18 Range 19 West Township 25 South

Hidalgo County Soil Map Unit Symbol	Hidalgo County Soil Map Unit Name	Private Surface Ownership Acreage	BLM Surface Ownership Acreage	New Mexico State Land Surface Ownership Acreage	Erosion Hazard Off Road Off Trail Dominant Condition Rating
Ma*	Maricopa loamy sand	13.99-acres	3.92-acres	82.66-acres	Slight
Me ^{*1}	Mimbres and Glendale silty clay loam, alkali	119.44-acres		0.28-acres	Slight
Sr ^{*1}	Stellar sandy clay loam	116.24-acres		171.15-acres	Slight
Th*	Tres Hermanos gravelly clay loam	22.98-acres	70.48-acres	23.22-acres	Slight
TR	Tres Hermanos gravelly clay loam	2.15-acres	5.73-acres	3.18-acres	Slight
Total Acreage		274.803	80.13-acres**	280.49-acres	

2 *High Intensity Soil Map Unit

3 ¹Soil Map Unit Me and Sr do not occur on BLM Surface Ownership for this Section 18 parcel.4 **Due to ArcGIS® analysis, the ArcGIS® calculated acreage will be within plus or minus five acres of
5 the geothermal lease parcel acreage.

6 Hidalgo County Section 20 Range 19 West Township 25 South

Hidalgo County Soil Map Unit Symbol	Hidalgo County Soil Map Unit Name	BLM Surface Ownership Acreage	New Mexico State Land Surface Ownership Acreage	Erosion Hazard Off Road Off Trail Dominant Condition Rating
TR	Tres Hermanos gravelly clay loam	643.52-acres		Slight
Total Acreage		643.52-acres		

7 All Soil Map Units occur on BLM Surface Ownership for this Section 20 parcel.

8 **Due to ArcGIS® analysis, the ArcGIS® calculated acreage will be within plus or minus five acres of
9 the geothermal lease parcel acreage.

10 According to Web Soil Survey there are five soil map units in the Hidalgo County NMNM 142268 parcel
11 and have a "slight" Erosion Hazard Off Road Off Trail Dominant Condition Rating. (See Above Tables).
12 A rating of "slight" indicates that erosion is unlikely under ordinary climatic conditions. (Soil Survey
13 Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil
14 Survey. Available online. Accessed 02/03/2021).

15 Section 20, Range 19 West, Township 25 South is in area designated as fragile land. According to the
16 1993 Mimbres Resource Management Plan, fragile land areas will receive high priority for Allotment
17 Management Plan (AMP) or other activity plan revision or development, allotment monitoring, land
18 treatments, allotment recategorization, and possible reduction or exclusion of surface disturbing activities
19 including range improvement development and livestock grazing use. Efforts will be directed towards
20 improving range condition and reaching desired plant community objectives within these areas. Due to
21 the fragile land designation additional environmental analysis and additional stipulations may be required
22 for future potential exploration, development, and operations of this section in New Mexico Serial
23 Number NMNM 142268 nominated lease parcel. Additional stipulations, as well as best management
24 practices that may be required will follow the guidance in the 2008 Record of Decision and Resource
25 Management Plan Amendments for Geothermal Leasing in the Western United States.

3.4.5 Issue 5: Hydrology, Water

How would future potential exploration, development, and operations of the nominated lease parcels impact future groundwater quality?

The sale of parcels and issuance of geothermal leases is strictly an administrative action and site-specific project environmental analysis would address direct and indirect effects of any future exploration, development or production. Leasing and future potential development of the nominated lease parcels would result in geothermal activities, including well pad construction, drilling, and completion of wells. All wells would be vertical wells that would employ standard industry practices related to well completion (i.e., perforation). Types of chemical additives used in well completion activities may include acids, hydrocarbons, thickening agents, gelling agents, lubricants, and other additives that are operator- and location-specific.

Potential future impacts of developing a lease may include degradation of water quality and drawdown of existing water levels through short term use during drilling. Water quality issues may arise from either underground or surface contamination. The primary cause of underground degradation would be from improperly functioning well casings, or surface activities, particularly from sumps and spills, that allow contaminants to infiltrate groundwater. Areas with shallow groundwater levels would be at greater risk. All future activities would be subject to State and Federal Regulations. Site-specific COAs and BMPs would be an integral part of the approval of any GDP. Site-specific surveys would be performed as a preventative measure to establish baseline data needed to assess changes to groundwater levels and water quality. Standard BMPs and COAs include the use of lined pits with secondary containment and monitoring features for any flow-back or produced fluids which are designed to prevent any infiltration or other contamination of groundwater or surface water resources.

If the proposed parcels are drilled, a well would most likely pass-through usable groundwater aquifers currently or potentially supplying stock, residential, and/or irrigation water. If proper cementing and casing programs are not followed, there may be a loss of well integrity, surface spills, or loss of fluids in the drilling and completion process that may result in large volumes of high concentrations of chemicals reaching groundwater resources. If contamination of usable water aquifers (resulting in total dissolved solids greater than 10,000 parts per million [ppm]) from any source occurs, springs and water wells that are sourced from the affected aquifers could be subject to decreased water quality. Clearing, grading, and soil stockpiling could alter short-term overland flow and natural groundwater recharge patterns, but in most cases, these potential impacts can be mitigated by better location siting and engineering controls. The BLM may move a proposed well site up to 200 meters at its discretion to mitigate impacts, and the requirements of the Clean Water Act may necessitate relocating the well further.

Water use in New Mexico is administered by the New Mexico Office of the State Engineer. Protection of surface water and groundwater is enforced in concert with the State of New Mexico and any other applicable entities with jurisdiction (e.g., tribal entities or the U.S. Environmental Protection Agency [EPA]), and mitigation of any water contaminating event would occur in addition to the enforcement of applicable regulations. If impacts were to occur, lessees and operators would be obligated by the standard terms of the lease, as well as the approved APD and applicable BLM and NMOCD regulations to report, respond to, and mitigate the spill or release. Additionally, all injection wells permitted by the NMOCD (including injection wells, producing wells, and all related surface facilities) are subject to a surface injection pressure limitation. Wells are required to be equipped with a pressure-limiting device, which ensures that the maximum surface injection pressure is not exceeded.

The cumulative impact scenario provides a quantitative overview of cumulative actions within the analysis area. The parcels up for lease are not located near surface water, springs, seeps, wetlands, riparian, or playa and would not contribute to cumulative impacts to these resources. When combined

with other current and potential future area activities, there could be an increased potential for impacts to groundwater quality. Mining, geothermal exploration and development, and recreation activities could affect water quality in areas of accumulation of surface water runoff. Surface waters evaporate and leave residual salts that could be high in minerals extracted from mining. Potential impacts to groundwater temperature and quantity would be avoided or minimized through the use of BMPs for well construction and through implementation of Water Monitoring Plans. Drilling and well construction would be conducted in accordance with state and federal permit requirements. Percolation of geothermal fluids from well testing could have a temporary local impact on groundwater quality and water levels but would be minimized through the use of BMPs (i.e., bentonite clay lining of surface impoundments). Potential impacts to down gradient surface water would be temporary and local, and avoided or minimized through the use of BMPs.

3.4.6 Issue 6: Wildlife, Special Status Species

How would future potential exploration, development, and operations of the nominated lease parcels impact wildlife, including special status species?

The analysis area contains populations of game species, non-game species, migratory birds, and BLM sensitive species. Game species include mule deer (*Odocoileus hemionus*), white-tail deer (*Odocoileus virginianus*), scaled quail (*Callipepla squamata*), and mourning dove (*Zenaida macroura*). Nearby trail cameras from adjacent mountain ranges indicate presence of javelina (*Tayassu tajacu*), coyote (*Canis latrans*), mountain lion (*Puma concolor*), ringtail (*Bassariscus astutus*), bobcat (*Lynx rufus*), grey fox (*Urocyon cinereoargenteus*), badger (*Meles meles*), spotted skunk (*Spilogale gracilis*), hog-nosed skunk (*Conepatus mesoleucus*), cottontail (*Sylvilagus* spp.), jackrabbit (*Lepus* spp.), and a high diversity of both migratory and resident birds.

The nominated lease parcels fall within the North American Bird Conservation Initiative Bird Conservation Region (BCR) BCR 35 (Chihuahuan Desert) (Partners in Flight 2020a; USFWS 2020a). The New Mexico Avian Conservation Partners developed two conservation lists (Level 1 and Level 2) based on distribution, threats, global population size, New Mexico population trend, and importance of New Mexico to breeding or wintering (Partners in Flight 2020a, 2020b). The two lists contain species that are of the highest conservation concern in New Mexico. Species of highest conservation concern found in BCR 35, which require desert scrub and grassland habitats, include Aplomado falcon (*Falco femoralis*), prairie falcon (*Falco mexicanus*), scaled quail (*Callipepla squamata*), Bendire's thrasher (*Toxostoma bendirei*), wintering Sprague's pipit (*Anthus spragueii*), and wintering McCown's longspur (*Rhynchophanes mccownii*) (New Mexico Avian Conservation Partners 2016). Parcels 2 and 3 fall within 5 to 10 miles from playa habitat, which is an important stop-over region for migratory birds due to ephemeral standing water.

Four BLM sensitive species may occur in Parcels 2 and 3: Bendire's thrasher, Sprague's pipit, McCown's longspur, and Burrowing owl. The area is a hotspot for Bendire's thrasher, which has undergone global population declines of up to 90 percent in the last 40 years (BirdLife International 2017). Bendire's thrasher selects for dense shrub sites where nests can be concealed in mesquite (*Prosopis* spp.), sumac (*Rhus* spp.), and yuccas (*Yucca* spp.). Food sources consist of a mix of insects and berries. Potential food sources within Parcels 2 and 3 include prickly pear cactus (*Opuntia* spp.), little leaf sumac (*Rhus microphylla*), wolfberry (*Lycium berlandieri*), gray thorn (*Ziziphus obtusifolia*), and juniper (*Juniperus* spp.) (Salas and Desmond, 2019). The North American Bird Conservation Initiative lists the biggest threats to Bendire's thrasher as climate change, desertification, overgrazing, and habitat fragmentation. Potential future development of Parcels 2 and 3 will contribute to habitat fragmentation.

Under the Proposed Action, the BLM would lease all three parcels, and future potential development of the nominated lease parcels would result in surface disturbance. These disturbances include construction and drilling, human presence, traffic, heavy equipment, and noise associated with lease development activities. Disturbance from future potential development of the nominated lease parcels can result in direct and indirect impacts to multiple species. Mortality of small mammals, birds, and lizards may be incurred from destruction of nests and burrows. Indirect impacts may occur at each stage of potential future development, such as loss of forage, cover, associated habitat fragmentation from initial surface disturbance, and increased anthropogenic disturbance during operational phases. This may result in avoidance from some species and an effective loss of habitat which can be measured in the potential acreage to be developed; bird species not tolerant of these activities may leave and avoid the area altogether for the duration of construction or move into nearby undisturbed habitat patches. Some species may have lessened survival and face increased competition from those which may be better adapted to fragmented landscapes, particularly from cow birds. Development may also increase raptor habitat and thus increase predation of other birds and small mammals.

Stipulations may lessen the impact of the lease sale to wildlife species. Pre-disturbance surveys would be required at the time of proposed lease development in accordance with standard terms and conditions of the lease. The surveys would analyze potential impacts on game and non-game species habitat, including special status species. Avoidance, minimization, and/or mitigation measures would also be determined at that time. The BLM has the authority under standard terms and conditions to attach COAs at the site-specific level to minimize adverse impacts on resource values at the time operations are proposed. Examples of potential mitigation measures include: design modifications to avoid or minimize impacts to sensitive habitats; limiting the number of well pads under simultaneous construction; seasonal restrictions; limiting the number of proposed roads, reclaiming old and/or unnecessary roads; minimizing truck traffic; noise-buffering measures; pre-development surveys; or use of special construction techniques to minimize surface disturbance to sensitive areas.

Compliance with the Migratory Bird Treaty Act would be required for any future potential developments and would follow the BLM LCDO Migratory Bird Policy, which could include constraints on developments within the nominated lease parcel during migration and nesting seasons. The BLM's authority under standard terms and conditions would result in the application of measures to mitigate effects on migratory birds at the lease development level. Developmental constraints during spring and fall migrations and nesting seasons, as well as nest surveys, may be required prior to implementation of lease development activities. Some of these include the application of netting over open tanks, raptor-safe power line construction standards, and sound mufflers. In addition, avoidance of active avian nests and burrows or delays of development activities may be required. Additional avian protection measures on top of MBTA may be required, including, but not limited to, avoidance of sensitive species nests and adequate buffers to limit disturbance during vulnerable time periods, surveys for stick nest activity, and avoidance of active nests.

Game Management Units (GMUs) are subdivisions used to manage big game species in the state. These GMUs are designated and mapped by the NMDGF and are readily available through its annual hunting proclamation and website (<http://www.wildlife.state.nm.us/hunting/maps/big-game-unit-maps-pdfs/>). The NMDGF has provided a set of guidelines that are useful to guide oil and gas development statewide. Specifically, these guidelines can be applied in areas where potential conflicts occur between geothermal development and the various wildlife species present (NMDGF 2007).

The BLM LCDO planning area contains year-round habitat for big-game species including mule deer and white-tail deer. Currently, there are no mapped migration corridors within the BLM LCDO planning area (NMDGF 2019). In accordance with SO 3362, the NMDGF has identified priority areas for further research within their New Mexico State Action Plan (NMDGF 2019), and these priority areas were based

on big game units. The NMDGF is currently conducting research on movement routes and/or defined wintering areas for mule deer and white-tail deer. Regarding development, both mule deer and white-tail deer have been observed moving out of an area during construction phases of oil and gas development; however, individuals move back into an area once projects reach general operation phases with decreased disturbance (Sherman 2019). The only mapped migration corridor in New Mexico is within the Farmington Field Office (reflected in the NMDGF New Mexico State Action Plan [NMDGF 2019]), which is outside of the analysis area (NMDGF 2019). Additionally, stipulation SENM-S-54-NSO is applied entirely to nominated lease parcel(s) XX (see Appendices A and C) for LPC habitat, that may provide protection to general wildlife and game species.

The cumulative impact scenario provides a quantitative overview of cumulative actions within the analysis area. The resulting acreage impacts across the landscape would cumulatively contribute to additional potential for wildlife, game and non-game species, special status species, and migratory bird habitat loss and fragmentation. Habitat loss impacts would be long term, and, in some cases, reclamation would not fully rehabilitate habitat to pre-development conditions.

3.4.7 Issue 7: Botany, Special Status Plant Species

How would future potential exploration, development, and operations of the nominated lease parcels impact botany and special status plant species?

Parcel 2 has suitable habitat for night-blooming cereus. In surveys of similar areas on the alluvial fans surrounding the Pyramid Mountains, Peloncillo Mountains, and Sierra Rica, we have found that night-blooming cereus is more abundant on soils with more gravel closer to the mountains, and usually present but sparse in sites similar to Parcel 2, with 1-3 individuals found per section. For comparison, 78 plants have been found in the most densely populated section known, while finding 10-25 individuals per section is more typical within occupied habitat near the bases of mountains. A total of about 800 plants have been found in LCDO. The distribution of night-blooming cereus extends south to the state of Zacatecas in Mexico, but outside LCDO we know very little about its abundance and can't verify the existence of more than about 100 individuals. Leasing Parcel 2 would result in the loss of between 0 and 1120 acres of habitat in which we expect night-blooming cereus to be present and sparse, while a decision not to lease Parcel 2 would affect 0 acres of this habitat.

Parcel 3 also has suitable habitat for night-blooming cereus. The description above for Parcel 2 also applies to approximately the western half of this parcel, about 1114 acres. Approximately the eastern half of Parcel 3, about 1113 acres, is more similar to gravellier sites near the base of mountains where we have found relatively dense populations of night-blooming cereus, typically in the range of 10-25 individuals found per section. Leasing Parcel 3 would result in the loss of between 0 and 1114 acres of habitat where we expect night-blooming cereus to be present and sparse, and between 0 and 1113 acres of habitat where we expect night-blooming cereus to be present and, by the standards of this plant, relatively dense. A decision not to lease Parcel 3 would affect 0 acres of this habitat.

The impact on habitat will depend on how much acreage is ultimately developed on these parcels and is difficult to predict at this stage in the process. If the lease sale is approved, future decisions on whether or not to authorize ground disturbance in these parcels will include an analysis of impacts based on the actual acreages of proposed projects. Future ground disturbance should avoid individual plants within these parcels to the extent this is feasible. However, we should expect that the long-term potential population size is determined by the amount of available habitat and not by the number of individuals present at a particular prior point in time. Consequently, a reduction in available habitat is expected to result in a decline in the night-blooming cereus population that is proportional to the loss of habitat, even if all individual plants are avoided.

CHAPTER 4. CONSULTATION AND COORDINATION

The following consultation and coordination efforts with tribes, individuals, organizations, and agencies were conducted for the proposed lease reinstatement actions.

4.1 TRIBAL CONSULTATION

On 4/20/21 BLM LCDO mailed out Tribal notification letters to the Comanche Nation, Kiowa Tribe, Mescalero Apache Tribe, White Mountain Apache Tribe, Ysleta del Sur Pueblo, Hopi Tribe, Isleta Pueblo, Navajo Nation, and the Fort Sill Apache Tribe. The White Mountain Apache Tribe responded on 5/5/21 that the proposed geothermal lease sale will "not have an adverse effect on the Tribe's cultural heritage resources and/or traditional cultural properties. No further consultation is necessary and/or required." The Ysleta del Sur Pueblo "does not have any comments nor does it request consultation on this proposed geothermal lease sale," dated 5/5/21. Navajo Nation responded on 5/12/21 that the "NNHHPD-TCP has determined that there are no Navajo TCP/s within the lease area and you may proceed without further consultation for this project". The Hopi Tribe responded on 4/30/21 that they "concur". BLM LCDO has not received a response from the Comanche Nation, Kiowa Tribe, Mescalero Apache Tribe, Isleta Pueblo or the Fort Sill Apache Tribe.

4.2 STATE HISTORIC PRESERVATION OFFICE AND TRIBAL HISTORIC PRESERVATION OFFICE CONSULTATION

On 5/10/21, the BLM LCDO sent the New Mexico Historic Preservation Division (NM HPD) a consultation letter requesting concurrence with our finding of No Historic Properties Affected for the proposed geothermal lease sale. On 5/19/2021 the NM State Historic Preservation Office (SHPO) concurred with the recommendations as proposed (HPD Log Number 115160).

CHAPTER 5. LIST OF PREPARERS

Error! Reference source not found. contains a list of individuals that contributed to preparation of this EA.

Table 5.1. List of EA Preparers and Reviewers

Name	Title and/or Area of Expertise
Isaiah Sedillo	Project Lead/Minerals
Patrick Alexander	Botany
Rachel Burke	Wildlife Biology
Colin R. Dunn	Paleontology
Corey Durr	Hydrology
Anthony Hom	Supervisor of Lands and Minerals
Gordon Michaud	Soils
Trinity Miller	Archaeology/Cultural Resources
Steven Torrez	Planning & Environmental Coordinator

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APPENDIX A. LEASE PARCELS NOMINATED FOR SALE FOR LAS CRUCES DISTRICT OFFICE

Table A.1. Description of Lease Parcels Nominated for Sale in Las Cruces District Office

Serial No. (acres)	Surface Ownership	Legal Description	Lease Notices and Stipulations Applicable at Time of Lease Issuance	New Lease Notices and Stipulations with Lease Sale
NMNM 141820 (640)	BLM	T. 16S., R. 01E., NMPM Sec. 20; All 640 acres Sierra County, NM	NM-11-LN SPECIAL CULTURAL RESOURCE LC-19 VISUAL RESOURCE MANAGEMENT0005SE C.	All applicable notices and stipulations will be applied after additional NEPA analysis is complete and approved for surface disturbance.
NMNM 142268 (1120)	BLM	T. 25S., R. 19W., NMPM Sec. 17: S2NE, S2; Sec. 18: E2SE; Sec. 20: All 1120 acres Hidalgo County, NM	NM-11-LN SPECIAL CULTURAL RESOURCE	All applicable notices and stipulations will be applied after additional NEPA analysis is complete and approved for surface disturbance.
NMNM 142267 (2227)	BLM	T. 25S., R. 19W., NMPM Sec. 03, Lots 1-4; Sec. 04, Lots 1-4; Sec. 09; All Sec. 10, W2; 2227 acres Hidalgo County, NM	NM-11-LN SPECIAL CULTURAL RESOURCE	All applicable notices and stipulations will be applied after additional NEPA analysis is complete and approved for surface disturbance.

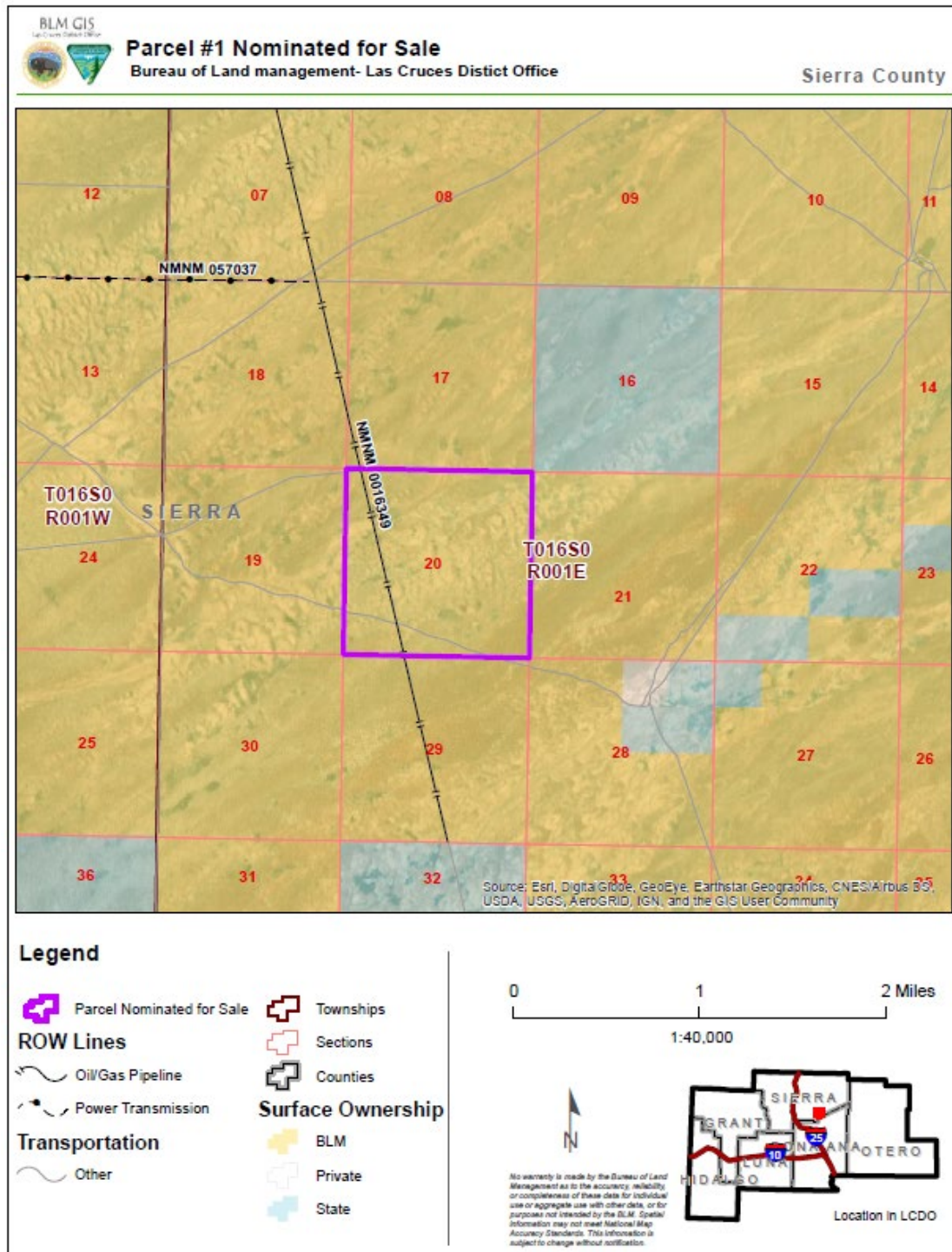
1 **APPENDIX B. MAPS**

Figure B.1. Detail map of lease parcel 1 nominated for sale analyzed in this EA within the BLM LCDO (map 1 of 3).

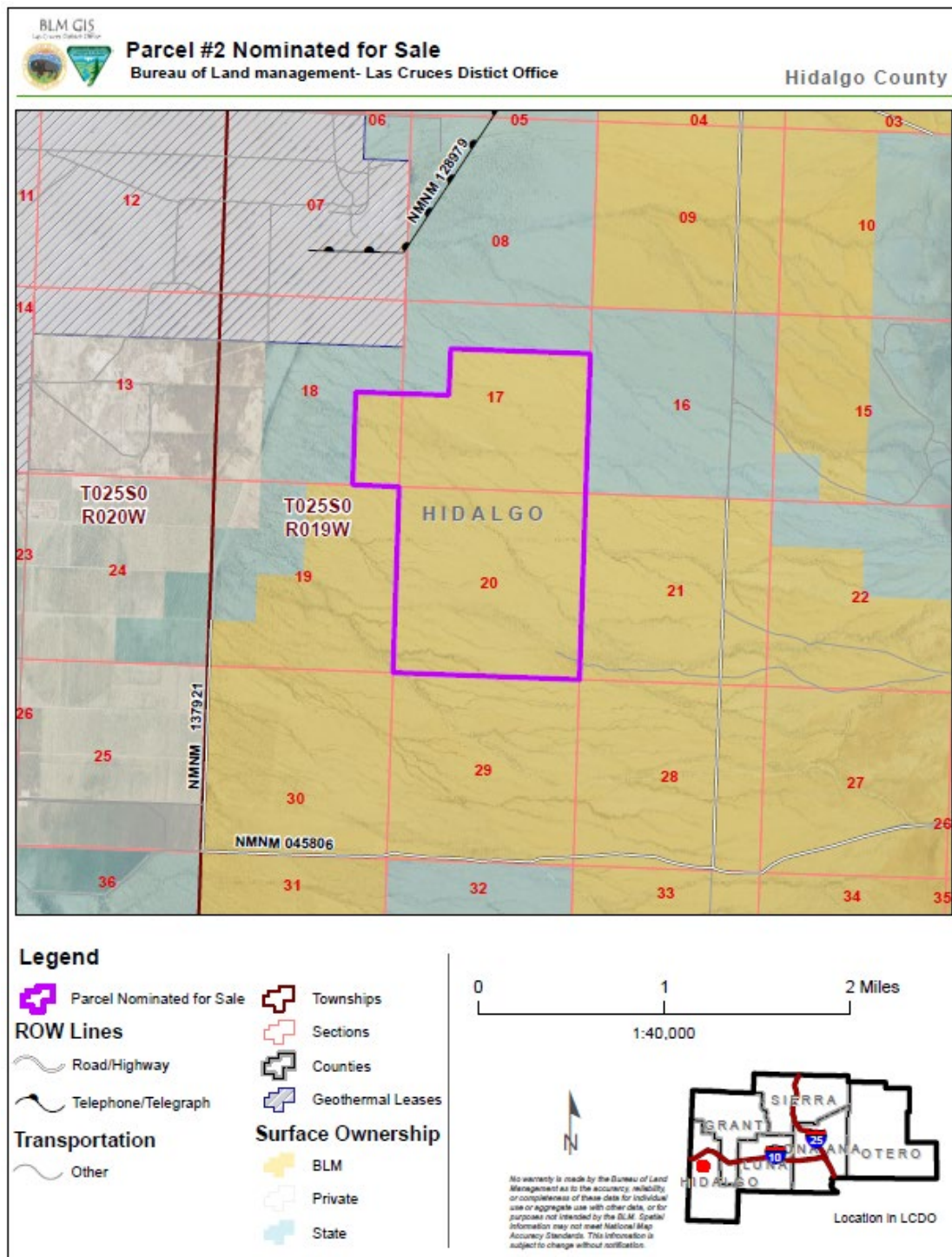


Figure B.2. Detail map of lease parcel 2 nominated for sale analyzed in this EA within the BLM LCDO (map 2 of 3).

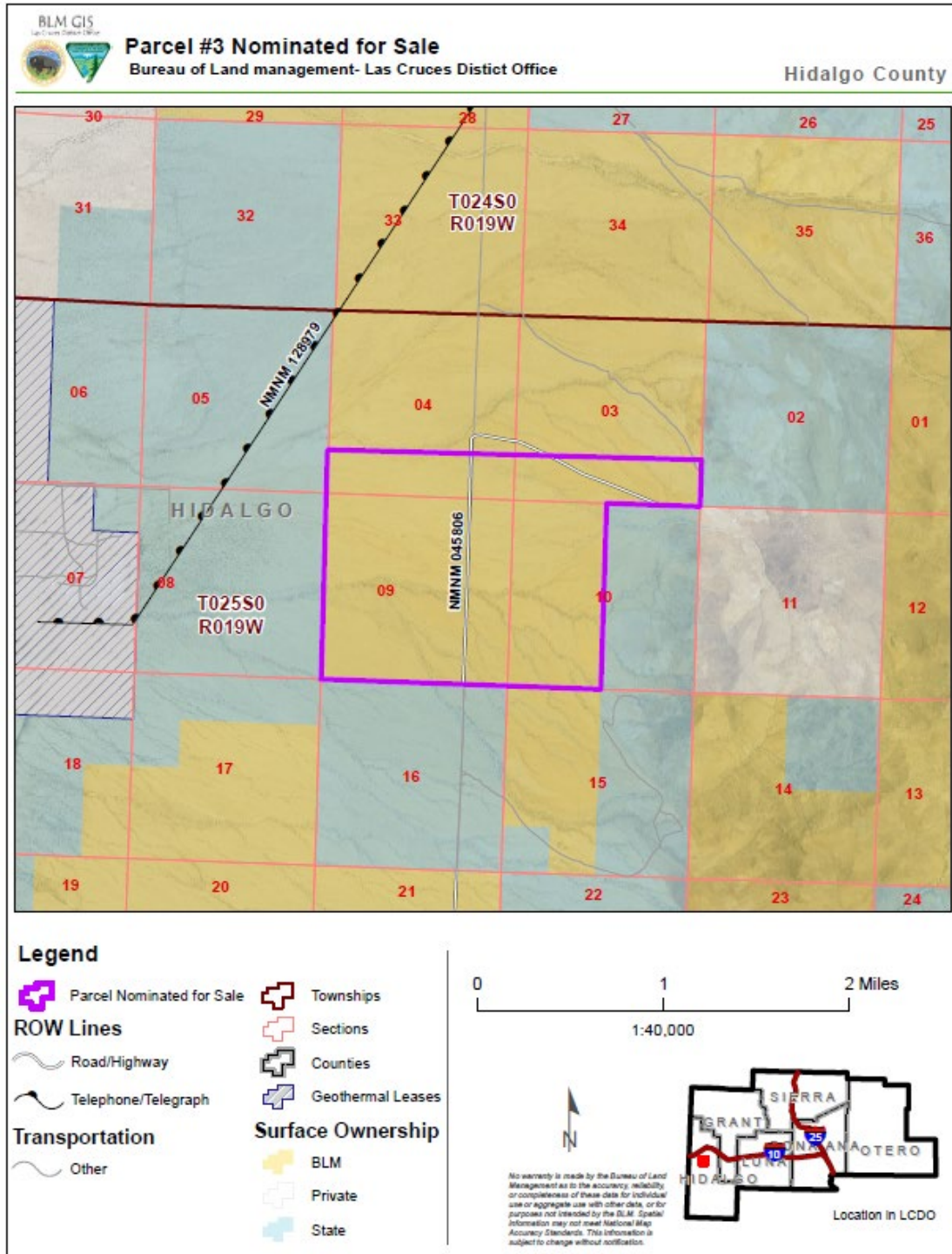


Figure B.3. Detail map of lease parcel 3 nominated for sale analyzed in this EA within the BLM LCDO (map 3 of 3).

APPENDIX C. LEASE STIPULATION AND LEASE NOTICE SUMMARY

Table C.1. Lease Stipulations and Lease Notices Applicable at Time of Lease Issuance

Stipulation	Description/Purpose
NM-11-LN	LEASE NOTICE – SPECIAL CULTURAL RESOURCES All development activities proposed under the authority of this lease are subject to compliance with Section 106 of the NHPA and Executive Order 13007. The lease area may contain historic properties, traditional cultural properties (TCPs), and/or sacred sites currently unknown to the BLM that were not identified in the Resource Management Plan or during the lease parcel review process. Depending on the nature of the lease developments being proposed and the cultural resources potentially affected, compliance with Section 106 of the NHPA and Executive Order 13007 could require intensive cultural resource inventories, Native American consultation, and mitigation measures to avoid adverse effects—the costs for which will be borne by the lessee. The BLM may require modifications to or disapprove proposed activities that are likely to adversely affect TCPs or sacred sites for which no mitigation measures are possible. This could result in extended time frames for processing authorizations for development activities, as well as changes in the ways in which developments are implemented.
LC-19	VISUAL RESOURCE MANAGEMENT 0005SEC.

Table C.2. New Lease Stipulations and Lease Notices with Sale

Stipulation	Description/Purpose
NM-11-LN	LEASE NOTICE – SPECIAL CULTURAL RESOURCES All development activities proposed under the authority of this lease are subject to compliance with Section 106 of the NHPA and Executive Order 13007. The lease area may contain historic properties, traditional cultural properties (TCPs), and/or sacred sites currently unknown to the BLM that were not identified in the Resource Management Plan or during the lease parcel review process. Depending on the nature of the lease developments being proposed and the cultural resources potentially affected, compliance with Section 106 of the NHPA and Executive Order 13007 could require intensive cultural resource inventories, Native American consultation, and mitigation measures to avoid adverse effects—the costs for which will be borne by the lessee. The BLM may require modifications to or disapprove proposed activities that are likely to adversely affect TCPs or sacred sites for which no mitigation measures are possible. This could result in extended time frames for processing authorizations for development activities, as well as changes in the ways in which developments are implemented.

Stipulation	Description/Purpose
NM-13-CSU	<p>CONTROLLED SURFACE USE STIPULATION—PROTECTION OF PALEONTOLOGICAL RESOURCES</p> <p>All development in this lease will be subject to compliance with the Paleontological Resources Preservation Act (PRPA), the National Environmental Policy Act (NEPA), and the Federal Land Policy and Management Act (FLPMA). Surface occupancy or use is subject to the following special operating constraints:</p> <ul style="list-style-type: none"> • Motorized vehicle use associated with lease operations are restricted to approved roads. Prior to approved operations, any vehicle use necessary for well stakings and surveys should be constrained to existing roads and trails when possible. • A pedestrian survey must be conducted for paleontological material, using a qualified permitted paleontologist determined by the BLM as part of the permit application for the proposed lease activity in geologic units that are classified on the BLM's Potential Fossil Yield Classification (PFYC) scale as a PFYC U- Unknown, 4 or 5. A survey is also required in areas that are known to contain fossil localities. The survey and report will be used to determine the presence of paleontological material exposed on the surface, and if necessary, the appropriate mitigation of ground disturbing activities such as monitoring, avoidance, project re-design, data recovery, stabilization, protective barriers and/or signs. • The lessee shall immediately notify the BLM Authorized Officer (AO) of any paleontological resources discovered as a result of approved surface disturbing operations. The lessee shall suspend all activities in the vicinity of such discovery until notified to proceed by the AO and shall protect the discovery from damage or looting. The AO will evaluate, or will have evaluated, such discoveries after being notified and determine, after consulting with the operator and the BLM Regional Paleontologist, the appropriate measures to mitigate adverse effect to significant paleontological resources. Upon approval of the AO, the operator will be allowed to continue construction through the site, or will be given the choice of either <ul style="list-style-type: none"> ○ following the AO's instructions for stabilizing the fossil resource in place and avoiding further disturbance to the fossil resource, or ○ following the AO's instructions for mitigating impacts to the fossil resource prior to continuing construction through the project area. The lessee is responsible for any cost associated for mitigating paleontological resources discovered as a result of their activities. <p>On the following lands: <LEGAL DESCRIPTION></p> <p>For the purpose of: Protecting paleontological resources to ensure that sensitive paleontological resources are not inadvertently damaged, destroyed, or removed from public ownership.</p>

Stipulation	Description/Purpose
NM-14-LN	<p>LEASE NOTICE—PALEONTOLOGICAL RESOURCES</p> <p>All development in this lease will be subject to compliance with the Paleontological Resources Preservation Act (PRPA), the National Environmental Policy Act (NEPA), and the Federal Land Policy and Management Act (FLPMA). The lessee shall immediately notify the BLM Authorized Officer (AO) of any paleontological resources discovered as a result of approved surface disturbing operations. The lessee shall suspend all activities in the vicinity of such discovery until notified to proceed by the AO and shall protect the discovery from damage or looting. The AO will evaluate, or will have evaluated, such discoveries after being notified and determine after consulting with the operator and the BLM Regional Paleontologist, the appropriate measures to mitigate adverse effect to significant paleontological resources. Upon approval of the AO, the operator will be allowed to continue construction through the site, or will be given the choice of either</p> <ul style="list-style-type: none"> • following the AO's instructions for stabilizing the fossil resource in place and avoiding further disturbance to the fossil resource, or • following the AO's instructions for mitigating impacts to the fossil resource prior to continuing construction through the project area. The lessee is responsible for any cost associated for mitigating paleontology resources discovered as a result of their activities. <p>In addition, surface occupancy or use may be subject to, but not limited to, the following special operating constraints:</p> <ul style="list-style-type: none"> • Motorized vehicle use associated with lease operations may be restricted to approved roads. • A pedestrian survey for paleontological resources is generally required in areas that have been classified as Potential Fossil Yield Classification (PFYC) U-Unknown, 4 or 5, and in areas that are known to contain fossil locations. However, a pedestrian survey may be required in other areas that are not classified as PFYC U, 4 or 5, but have been identified by the Authorized Officer as having the potential for paleontological resources. A qualified permitted paleontologist determined by the BLM as part of the permit application for the proposed lease activity, is required to complete the survey. The survey and report will be used to determine the presence of paleontological material exposed on the surface, and if necessary, the appropriate mitigation of ground disturbing activities such as monitoring, avoidance project re-design, data recovery, stabilization, protective barriers and/or signs.
LC-19	VISUAL RESOURCE MANAGEMENT 0005SEC.
WO-ESA-7	<p>ENDANGERED SPECIES ACT SECTION 7 CONSULTATION</p> <p>The lease area may now or hereafter contain plants, animals, or their habitats determined to be threatened, endangered, or other special status species. BLM may recommend modifications to exploration and development proposals to further its conservation and management objective to avoid BLM-approved activity that will contribute to a need to list such a species or their habitat. BLM may require modifications to or disapprove proposed activity that is likely to result in jeopardy to the continued existence of a proposed or listed threatened or endangered species or result in the destruction or adverse modification of a designated or proposed critical habitat. BLM will not approve any ground-disturbing activity that may affect any such species or critical habitat until it completes its obligations under applicable requirements of the Endangered Species Act as amended, 16 U.S.C. § 1531 et seq., including completion of any required procedure for conference or consultation.</p>
WO-NHPA	<p>CULTURAL RESOURCES AND TRIBAL CONSULTATION</p> <p>This lease may be found to contain historic properties and/or resources protected under the National Historic Preservation Act (NHPA), American Indian Religious Freedom Act, Native American Graves Protection and Repatriation Act, Executive Order 13007, or other statutes and executive orders. The BLM will not approve any ground-disturbing activities that may affect any such properties or resources until it completes its obligations (e.g., State Historic Preservation Officer (SHPO) and tribal consultation) under applicable requirements of the NHPA and other authorities. The BLM may require modification to exploration or development proposals to protect such properties or disapprove any activity that is likely to result in adverse effects that cannot be successfully avoided, minimized, or mitigated.</p>

Stipulation	Description/Purpose
2008 ROD Sec. B1.6	The operator will coordinate with the [State Air Quality Division] to develop and implement an air quality monitoring plan.
2008 ROD Sec. B2.2	<p>An access road siting and management plan will be prepared incorporating existing Agency standards regarding road design, construction, and maintenance such as those described in the BLM 9113 Manual and the Surface Operating Standards for Oil and Gas Exploration and Development (i.e., the Gold Book, 4th Edition, 2007).</p> <p>No new roads and pad sites will be constructed without agency authorization. If new roads and pad sites have been authorized, they will be designed and constructed by the operator to the appropriate agency standard, no higher than necessary to accommodate their intended function. Roads and pad sites will be routinely maintained by the operator maintain public safety and to minimize impacts to the environment such as erosion, sedimentation, fugitive dust, loss of vegetation</p>
2008 ROD Sec. B2.6	The operator will prepare and submit to the agency an Equipment Emissions Mitigation Plan for managing diesel exhaust. An Equipment Emissions Mitigation Plan will identify actions to reduce diesel particulate, carbon monoxide, hydrocarbons, and nitrogen oxides associated with construction and drilling activities
2008 ROD Sec. 2.10	The operator will prepare a habitat restoration plan. The plan will identify revegetation, soil stabilization, and erosion reduction measures that will be implemented to ensure that all temporary use areas are restored

APPENDIX D. SUMMARY OF THE TYPICAL PHASES OF GEOTHERMAL DEVELOPMENT

INTRODUCTION

This RFD for geothermal resource use involves four sequential phases: (1) exploration, (2) drilling, (3) utilization, and (4) reclamation and abandonment. The success or failure of each phase affects the implementation of subsequent phases, and, therefore, subsequent environmental impacts. Development of geothermal resources is unique to the industry, but many activities are similar in scope to other fluid minerals (e.g., oil and gas), such as surveying, drilling, site development (well pads and roads), and reclamation and abandonment. The following four phases serve for analysis future environmental impacts that may result from development following BLM issuance of leases for geothermal resources within the identified area of geothermal potential. It should be noted that the RFD scenario permits a general evaluation of the types of impacts that may occur but cannot accurately predict the magnitude and extent of these impacts. This is due in part to the uncertainty about the timing, location, distribution of the geothermal resources, and the likely types of development. Acreages are not provided for the Reclamation and Abandonment phase since this phase involves the return of previously disturbed lands to their existing conditions. The total potential amount of area disturbed under the utilization phase includes development activities. Much of the land would be reclaimed after exploration, drilling, and construction; in turn, the actual amount of land occupied during operation, would be less. A typical development generally requires several leases or the use of private or other adjacent lands. The details of each phase of development are described below.

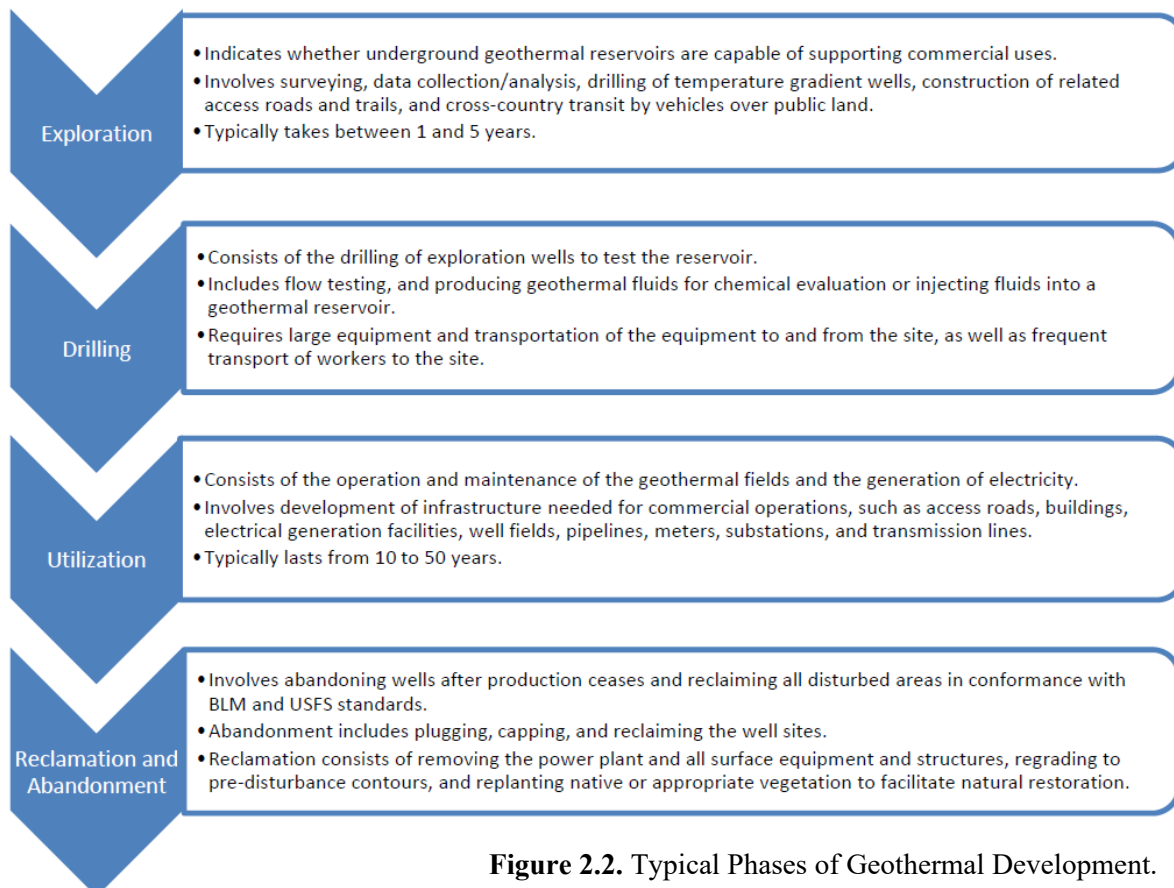


Figure 2.2. Typical Phases of Geothermal Development.

EXPLORATION

Before geothermal resources are developed, a geothermal resource developer explores for evidence of geothermal resources on leased or unleased land. Exploration includes ground disturbance but does not include the direct testing of geothermal resources or the production or utilization of geothermal resources. Exploration operations include, but are not limited to, geophysical operations, drilling temperature gradient wells, drilling holes used for explosive charges for seismic exploration, core drilling or any other drilling method, provided the well does not reach the geothermal resource. It also includes related construction of roads and trails, and cross-country transit by vehicles over public land. Exploration involves first surveying and then drilling temperature gradient wells. It generally takes between one and five years to complete exploration. Surveying includes conducting or analyzing satellite imagery and aerial photography, volcanological studies, geologic and structural mapping, geochemical surveys, and geophysical surveys of leasable areas that could support geothermal resource development.

While not widely used for geothermal surveys, seismic surveys have the greatest survey impact on the local environment. These surveys typically involve setting up an array of geophones and creating a pulse or series of pulses of seismic energy. They may be installed on the ground's surface, in small excavations made specifically for burying the geophones, and/or in existing wells. These surveys are typically undertaken over the course of a few days. Minor, temporary disturbances are associated with each site for the burial of sensors (BLM 2007b).

The second step of the exploration phase is to drill temperature gradient wells on leased or unleased land. This process confirms a more precise location of high temperature gradients. Temperature gradient wells can be drilled using a truck-mounted rig and range from 200 feet to over 4,000 feet deep. The number of gradient wells also varies, depending on the geometry of the system being investigated and the anticipated size of power development. Geologists examine either rock fragments or long cores of rock that are brought up from deep within the well. Water samples are taken from any groundwater encountered during drilling. Also, temperatures are measured at depth. Both well temperatures and the results of rock sample analyses are used to determine if additional exploration is necessary to identify the presence and characteristics of an underground geothermal reservoir. After collecting the desired materials and data, the wells are completed with sealed, water-filled tubing from surface to bottom, often with cement around the tubing (BLM 2007b). Most temperature gradient wells are drilled with a small rotary rig (often truck-mounted) like that used for drilling water wells, or a diamond-coring rig, similar to that used for geologic sampling in mineral exploration and civic works projects. Neither rig of this size requires construction of a well pad or earth moving equipment unless the site is sharply graded. Support equipment is needed, including water trucks, tanks for mixing and holding drilling fluids, personnel and supply transport vehicles, and sometimes a backhoe for earthmoving activities is needed to prepare the drilling site. A temperature gradient drilling operation can be run by about three on-site personnel and others traveling to the site periodically with materials and supplies (BLM 2007b). Temperature-gradient well drilling requires road access. Whenever possible, a driller would access the temperature gradient well site using existing roads. When existing roads are not available, new access roads may need to be constructed for the truck-mounted rig to reach the site. Preparing the site for drilling could include leveling the surface and clearing away vegetation. Several temperature gradient wells are usually drilled to determine both the areal extent of the temperature anomaly and where the highest temperature gradient occurs. Each drill site could disturb approximately 0.10 acres, and the drill rig could be approximately 60 feet tall. Drilling may last for several weeks. The specific fluids and additives depend on a variety of factors, including the geologic formations being penetrated and the depth of the well. The risk of spills of other fluids is similar to that of any other project involving the use of vehicles and motorized equipment (BLM 2007b).

1 All surface disturbances would be reclaimed to the satisfaction of the BLM. If a temperature gradient well
2 were unsuccessful, it would be abandoned, and the drill site would be reclaimed. Abandonment will be
3 further discussed in its section below.

4 **DRILLING OPERATIONS**

5 Once exploration has confirmed a viable prospect for development, drilling for exploration wells to test
6 the reservoir include flow testing, producing geothermal fluids for chemical evaluation or injecting fluids
7 into a geothermal reservoir. Drilling operations require large equipment (e.g. drill rig). Generally,
8 activities always need 10 to 15 people on-site, with more people coming and going periodically. If a
9 reservoir is discovered, characteristics of the well and the reservoir are determined by flow testing it. If
10 the well and reservoir are sufficient for development, production equipment will be installed. Excess
11 geothermal fluids are stored in temporary pits or sumps. Any water that is left to evaporate and any sludge
12 is removed and properly disposed.

13 **UTILIZATION AND PRODUCTION OPERATIONS**

14 Utilization and production are the next phases in geothermal development after a viable reservoir is
15 identified. This includes infrastructure for commercial operations, including access roads, production, and
16 electrical generating facilities, drilling and developing well fields, and installing pipelines, transmission
17 lines, and substations. The utilization phase could last up to 50 years and involves operation and
18 maintenance of the geothermal fields. The type of development that occurs is based on size and
19 temperature of the reservoir. They are separated by low, moderate, and high. However, with newer
20 technologies, lower gradient geothermal resources are proving to be more sufficient. High temperature
21 reservoirs are most suitable for commercial generation of electricity. Activities associated with operation
22 and maintenance and energy production would involve managing waste generated by daily activities,
23 managing geothermal water, landscaping, and the maneuvering of construction and maintenance
24 equipment and vehicles associated with these activities.

25 **ABANDONMENT AND RECLAMATION**

26 This phase involves abandoning the well after production ceases and reclaiming all disturbed areas in
27 conformance with BLM standards and regulations. Abandonment includes plugging, capping, and
28 reclaiming the well site. Reclamation includes removing the power plant and all surface equipment and
29 structures, regading the site and access roads to pre-disturbance contours, and replanting native or
30 appropriate vegetation to facilitate natural restoration.

31 **LITERATURE CITED**

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