Geothermal Regulations in Colorado—Land Ownership is the Key

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Keywords

Colorado, geothermal regulations, land ownership, regulatory jurisdiction, private land, state land, federal land, geothermal leasing, BLM, water rights

ABSTRACT

Geothermal resources in Colorado are separately classified as water on private land and as mineral on state and federally-administered lands. In addition, where classified as mineral, only the heat is classified as mineral, regardless of the land administration. Any water used to extract the heat is administered by the Colorado State Engineer through the Division of Water Resources. Rules and regulations for permitting geothermal exploration and development are most readily understood if considered separately for private, state-administered, and federally-administered lands. Many geothermal resources cover more than one of these types of land, but the permitting processes are not synchronized.

All well drilling associated with geothermal exploration and development requires permits from the Colorado Division of Water Resources. These permits and water use are the only regulatory activities that are the same on all types of land. On private land the scheduling of activities is primarily controlled by the land owner and permitting required by local authorities. Before any activity can take place on state-administered land, a Geothermal Exploration Lease is required. This lease can cover activities up to and including deep exploration test wells. On federally-administered land an approved Notice-of-Intent is required for activities up to and including temperature gradient wells. A competitively-bid Geothermal Lease is required for further exploration and development activities. An extensive environmental evaluation (typically taking at least12-18 months) is required before a Geothermal Lease Sale can occur. Exploration and development may therefore progress at different rates on different land types.

The Colorado Division of Natural Resources has signed a Memorandum of Understanding with the Colorado Office of the Bureau of Land Management to collaborate in resolving conflicts in jurisdiction with geothermal rules and regulations. The purpose of this agreement is to minimize inter-agency, regulatory delays in the administration of geothermal development.

Introduction

Colorado is a typical state in the western United States for permitting a geothermal resource. The resource is unlikely to be limited or restricted to one type of land ownership, private, state, or federal lands (Texas is perhaps the exception). Sovereign Native American lands are not included in this discussion because they represent a special category of lands. In geothermal exploration and development, a single set of rules and regulations that were universally applicable would be very desirable. However, no industry enjoys such a luxury, especially when working with overlapping authorities who have responsibilities and interests that range from local to national, and individuals whose interests range from personal to financial.

Geothermal benefits in Colorado date back to early use of hot springs by Native Americans for ceremonial, bathing, and medicinal uses. In 2012, there are strong indications that electrical power will be generated from geothermal energy for the first time in the state within the next 2 to 3 years. Potential sites have been selected for drilling geothermal tests wells. As financiers consider investing in these projects, they ask about the geothermal rules and regulations in Colorado. This contribution is the result of a compilation of those rules and regulations in an attempt to clarify the regulatory process and, if possible, remove unnecessary regulatory barriers to development.

Land Ownership/Administration and Geothermal Regulatory Jurisdiction

Geothermal resources are classified as water on private land in Colorado, but as mineral on state land. As in other states, on public land administered by the federal government (Bureau of Land Management (BLM), US Forest Service (USFS), *etc*.) geothermal resources are classified as mineral. The water associated with the resources, however, on all lands in Colorado is subject to Colorado's water rules and regulations derived from the Colorado

Revised State Statutes. The first task in navigating geothermal rules and regulations in Colorado is determining the ownership or administration of the land. Commonly more than one type of land may be included in a single resource.

Ownership of the geothermal resource may be made more complex by split estate lands where ownership or administration of the surface estate is different from that of the subsurface estate. The most common situation is private surface estate over federally administered subsurface estate, but other combinations exist. A further complication exists with Colorado's classification of geothermal as water and categorization of different types of water resources (Figure 1). Tributary water is groundwater with an effective hydrologic connection to a surface drainage system. It includes shallow bedrock aquifers and alluvial aquifers. All water in Colorado is considered to be tributary unless it has been designated otherwise by the State Engineer. If geothermal is associated with tributary groundwater, it is a public resource, apportioned by the State Engineer through the Division of Water Resources (DWR).

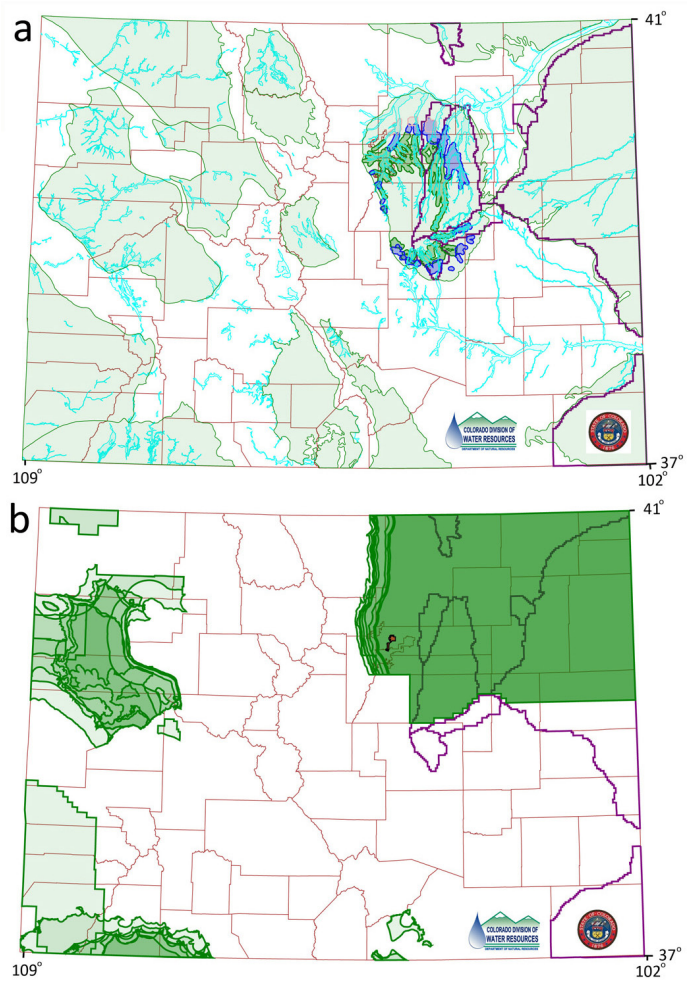

Figure 1. a. Colorado bedrock aquifers (light green), designated basins (purple outlines), not non-tributary aquifers (darker blue, green and pink fill and outlines) and alluvial aquifers (sinuous lighter blue fill and outlines). b. Colorado designated basins (purple outlines) and designated non-tributary aquifers (green outlines and light green fill). Non-tributary aquifers are individual aquifer units and may overlap geographically showing as a darker green shading on the map. Tributary aquifers may be over non-tributary aquifers except in areas of designated basins. Fine brown lines are county boundaries. These maps were produced using AQUAMAP on the Colorado Division of Water Resources web site (http://165.127.23.41:8000/aquamap100.svg, last accessed, 2012-5-1).

Other categories of groundwater in Colorado include non-tributary groundwater, designated basins, and not-non-tributary groundwater. Groundwater and geothermal resources in these categories are usually granted to the owner of the surface estate. Withdrawal of water from these resources is usually limited and regulated by the DWR. Non-tributary is groundwater in an aquifer that is not in effective hydrologic connection to a surface drainage system. A designated basin is an area in which extraction has historically exceeded recharge and is now regulated by a specific set of rules. Not-non-tributary is groundwater in a tributary bedrock aquifer connected to a designated basin and is subject to special rules associated with the basin. There is no advantage in petitioning DWR to place a geothermal resource into one of these groundwater categories so that the resource changes from a public resource (tributary water) to a private resource (other groundwater category). The rate at which water may be withdrawn from these other groundwater categories is always strictly limited and less than from a tributary water source

If a geothermal resource lacks sufficient geothermal fluid to transport commercial amounts of energy to the surface and is not in association with an economically useful groundwater resource, then it is defined as "Hot Dry Rock," and belongs to the owner of the surface estate (Colorado Revised Statutes, 2011). Table 1 shows a summary of regulatory jurisdictions for geothermal resources according to ownership and administration of the land associated with the resource and the type of groundwater related to the resource. In this table the assumption has been made that mineral rights over-rule geothermal rights, but this interpretation has not been legally challenged.

Table 1. Table showing geothermal resource regulatory jurisdictions for different possible land owners or administrators and related groundwater types in Colorado.

Land Ownership/ Administration[1]	Hydrothermal		Hot Dry Rock[2]
	Tributary Groundwater	Other Groundwater	
Private	Public[3]	Private[4]	Private[4]
State	State	State	State
Federal	Federal	Federal	Federal
Private/State	State	State[5]	State[5]
Private/Federal	Federal	Federal[5]	Federal[5]
State/Private	Public	State	State
State/Federal	Federal	Federal[5]	Federal[5]
Federal/Private	Public	Federal	Federal
Federal/State	State	State[5]	State[5]

[1] For split-estate lands the first owner listed is the surface owner.

[2] A geothermal resource without sufficient natural fluid for the energy to be brought to the surface economically.

[3] Public ownership indicates a resource that must be apportioned by the State Engineer through the Colorado Division of Water Resources.

[4] Private owner of the surface estate unless the geothermal resource has been specifically severed from the surface estate.

[5] Definition of geothermal as a mineral resource under federal and state land administration keeps the resource in these jurisdictions even when other rules would move the resource into surface ownership.

Permitting

There is no *one-size-fits-all* set of instructions for permitting geothermal exploration and development in Colorado. However, there are three major paths according to the land ownership/administration; private lands, state-administered lands, and federally administered lands. These lands are shown as separate columns in Figure 2 in which major administrative actions are listed at each basic stage of exploration and development. The one common factor in all lands is water. There is one group of regulations that apply to all water and geothermal wells drilled in Colorado.

Drilling and Water Use

All geothermal wells drilled for exploration, testing or development in Colorado must be permitted by the Colorado Division of Water Resources (DWR). There are two type of wells relevant to geothermal power exploration and development. Type A is a well not exceeding 2,500 feet in depth and having a temperature not exceeding 212°F. Type B is a well greater than 2,500 feet in depth and/or with a temperature greater than 212°F. Typically a type A well is a geothermal gradient well; a type B is a deep test, production, or injection well. Full rules and regulations describing these different well types are given in Geothermal Rules (2004). An important difference in processing applications for Type A and type B wells is that construction plans for type B wells are reviewed by the Colorado Oil and Gas Conservation Commission in addition to DWR. This additional review is for safety, and adds time to the review process. The well-permit, application form is the same for geothermal wells and water wells and is available online (http://water.state.co.us/DWRIPub/Documents/gws-45.pdf).

In addition to requiring a permit from DWR for drilling, regardless of land ownership or administration, DWR must also be contacted with respect to any water use. This applies if the heat is extracted using water in any form, DWR must approve, and in most cases apportion the water use even on state or federal land where the geothermal resource is classified as mineral. Colorado has complex water laws, but DWR has excellent staff to work with the intricate details that have developed during the history of these regulations. Groundwater in Colorado may be over-appropriated. However, over-appropriated is not the same as depleted. Water is generally available for non-consumptive use. Therefore, a binary power plant in which 100% of the hot water from the geothermal reservoir is re-injected back into the reservoir can be appropriated as a non-consumptive use in an area where the water is over-appropriated. Cold water from a shallow aquifer can even be used for direct (non-evaporative) cooling with 100% reinjection as long as there was no depletion of water delivered to senior (existing) water users.

Other drilling and water-use permissions may be required. On private land, the issuance of a DWR drilling permit does not grant surface access. This access is by permission of the owner. On state land, drilling must be included in the activities planned when the Geothermal Exploration Lease or Geothermal Development applications are made. The Geothermal Exploration Lease can include geothermal gradient wells and deep

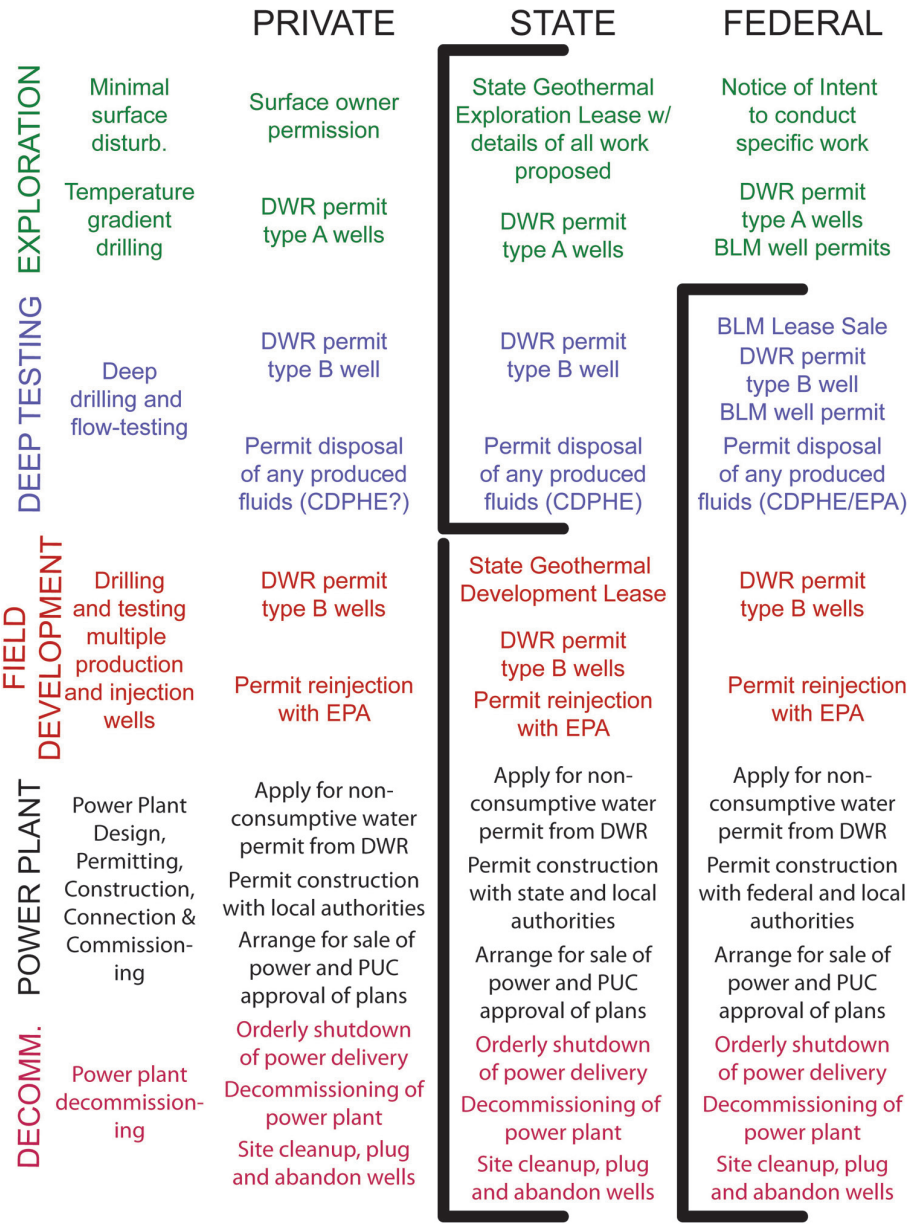

Figure 2. Basic stages in exploration and development of geothermal resources for electrical power generation in Colorado and corresponding major permit processes on different land types, as described in text. The heavy black brackets under "State" indicate the duration of the State Geothermal Exploration Lease and the State Geothermal Development Lease if all activities indicated are applied for and approved in the respective lease applications. The heavy square brackets under "Federal" indicate the duration of activities for which a Federal Geothermal Lease can last (also time limited), but each activity requires a separate application and approval. Abbreviations: DWR - Colorado Division of Water Resources; BLM - Bureau of Land Management; CDPHE - Colorado Department of Public Health and the Environment; EPA - Environmental Protection Agency; PUC - Colorado Public Utilities Commission.

drilling up to, and including, flow testing. However, if these plans are not specifically included in the lease application, then no permission is included in the lease. A DWR permit does not automatically grant permission for drilling on federal lands. A separate application must be made to the Bureau of Land Management (BLM) or US Forest Service (USFS), in addition to the DWR permit applications. Both permits must be approved before drilling may commence.

In areas of Colorado where the groundwater is non-tributary, groundwater associated with a geothermal resource may belong to the owner of the surface estate according to Colorado's water rules. In these situations, permission of the surface owner would be necessary for any activity associated with extracting geothermal heat associated with water. However, in many of these areas, although the water may be granted to the owner of the surface estate, the rate of extraction of water may be limited. DWR is the best source of information concerning ownership of groundwater and limits to the extraction of this water.

Private Land

If the geothermal resource is under private land and is associated with tributary groundwater (groundwater connected to surface water), it is a public resource administered by the DWR. A permit must be obtained from the DWR to extract heat from the resource (geothermal permit). A separate permit is required for use of any water involved in this extraction (water permit). A resource associated with other groundwater classifications (e.g. non-tributary) or hot dry rock is generally attached to the surface estate and is granted to the owner of this estate unless specifically severed from the surface estate. In this case, a water well permit will be required and there may be limitations on water use associated with the resource. No specific geothermal permit would be required to extract the heat from this resource. The Colorado Division of Water Resources should be contacted for information at each specific location. Land access, surface disturbance and other activities, and construction are by permission of the land owner subject to all applicable local, state, and federal laws.

State Administered Land

A geothermal exploration lease is required before any on-site, geothermal exploration is conducted on state land. This lease is obtained through the Office of the State Land Board (SLB). There are no set fees for geothermal leases on state land. Applications are considered individually by the SLB. The lease may cover all activities through drilling of deep test wells. A second lease, a geothermal development lease, is required for further development. Surface disturbance and other activities, construction and power plant development are by permission of the SLB and subject to applicable local, state and federal laws.

Federally Administered Land (BLM and USFS)

Minimal initial surface exploration with no surface disturbance *may* be allowed without a permit and without a *Notice of Intent* to the local BLM or Forest Service office. The phrase "*No Surface Disturbance"* is subject to interpretation by the local office. More extensive surface exploration requires an approved *Notice of Intent* from the local office of the BLM or USFS. Drilling shallow temperature gradient boreholes requires a permit from BLM or USFS (in addition to a permit from DWR). All further exploration, drilling, and development require a geothermal lease. Geothermal leasing of lands administered by the USFS is usually transferred to BLM, although the USFS remains active in the process. A federal geothermal lease is initiated by nomination of a parcel of land for lease. If a suitable environmental assessment for geothermal leasing is not in place, the BLM (and the USFS) is required to make an extensive study of the nominated land, including public input, in terms of its suitability for lease. If there are no circumstances that prevent geothermal development of the land at the leasing stage, the land parcel is approved for a lease sale. Stipulations restricting specified activities, access to parts of the land parcel, or activities during specified times of the year may be attached to the leasing. The land is then leased by BLM in an open, competitively-bid, lease sale. Following the lease sale, the successful bidder must apply to BLM for permission to conduct all proposed surface-disturbing activities. BLM will enforce all applicable federal laws. Local and state laws will apply in terms of access to the leased land and any activities that affect adjacent private or state lands.

Split-Estate Lands

Mineral law gives the owner of a sub-surface mineral resource the right of surface access to extract the resource. Thus, a lease holder for the geothermal resource on state or federally administered split-estate land (private surface estate) has a legal right of access to the surface. When accessing the resource the developer must cause minimum disturbance to the land surface and reimburse the surface owner for any reasonable economic losses or expenses and damages to the surface estate. There is no equivalent right where the resource is classified as water on private lands. However, access is unlikely to be an issue on private lands (Table 1), unless the geothermal resource has been severed from the surface estate. There are rights of access for geothermal exploration and development in this latter case if "adequate compensation is paid to the owner of the surface parcel for damages and disturbance ..." (Colorado Revised Statutes, 1011).

Disposal of Drilling and Other Fluids

Disposal of drilling fluids, geothermal fluids produced from a well or any produced gases or liquids are subject to state and federal controls regardless of the lands on which the fluids were produced. In general, release of fluids to the surface is under the jurisdiction of the Colorado Department of Public Health and the Environment. Release of gases to the atmosphere or injection of liquids to the subsurface is under the jurisdiction of the Environmental Protection Agency (EPA). Wells for the injection of geothermal fluids into the subsurface are generally classified as Class V injection wells by the EPA and may be authorized by rule if they meet certain standards. These standards include that they do not endanger underground sources of drinking water and that they comply with other components of the Underground Injection Control (UIC) Program (EPA, 1999). Analyses of hot spring water from Colorado indicate that generally they are free from contaminants (Barrett and Pearl, 1976; Cappa and Hem-

borg, 1995) and that responsible disposal of these fluids should not be difficult.

Local Authorities

For matters of health and safety, Colorado state government has delegated oversight to the county and city government level. A statute, including geothermal electricity production in these responsibilities was passed in 2010 (Colorado Revised Statutes, 2011). Most local authorities have not yet formulated final regulations for geothermal. However, many have existing regulations concerning land use to protect the safety of their residents and to prevent geologic hazards from being created through development. Land use permits are therefore required for any development on private land. The stage at which these are required varies among authorities and the relevant authority should be contacted at the beginning of a project to ensure compliance.

Public Utilities Commission

The Colorado Public Utilities Commission has regulations concerning the construction and licensing of electrical power plants. Together with the local power authority and owners of the power grid to which the plant is to be connected, they will assist with permits concerning the construction, permitting, and operation of the power plant.

Decommissioning

Whenever the useful life of a geothermal well is over, it must be properly plugged and abandoned and reported to the DWR. Thus, if production or injection wells are unsuccessful, or are abandoned during the life of a power plant, they must be plugged and abandoned according to prescribed DWR practices. At the end of the life of a power plant, all wells must be plugged and abandoned and reported to DWR.

Before a power plant is closed, arrangements must be made for the orderly transition of the power load from the plant, and arrangements for deconstruction of the plant and restoration of the site according to all local, state and federal rules and regulations.

State-Federal Cooperation

There is a potential for overlap in jurisdictions in managing geothermal resources on federally administered lands because the heat is under federal management but the water is under state administration. Potential conflicts from overlapping jurisdictions are not new. The traditional solution to resolve such conflicts is to take the problem through the appropriate court system and let the court resolve the conflict. The negative side of such a solution is that the conflict only arises when a developer hits a regulatory roadblock caused by the conflict. The developer must then spend time and money to take the conflict through the court system to resolve the problem. Such a solution is not fair on the developer who did not cause the conflict. Colorado has decided not to follow this path.

In 2010 the Colorado State Office of the BLM and the Colorado Department of Natural Resources signed a Memorandum of Understanding "Concerning Geothermal Leasing, Permitting, and Administration in Colorado." The bottom-line of this memorandum is that the agencies have agreed to resolve any potential differences in their common interest of reducing unnecessary delays in the administration of geothermal development. This cooperation is already evident because BLM references Colorado water regulations in some of its geothermal lease stipulations demonstrating a removal of barriers between federal and state rules.

Concluding Remarks

Colorado is a state rich in energy and minerals resources, but is somewhat late in coming to the game in geothermal electricity production. The development of any resource is not simple, particularly when development covers lands with different types of owners. The significance of water to geothermal is also a complicating factor. However, accepting that different rules apply on different types of lands, and that these rules apply at different stages of development are the keys to geothermal permitting, at least in Colorado.

The comments in this contribution are not a substitute for legal representation. They are written as a guide to de-mystify complex sets of rules and regulations that are generally presented separately by (at least) three agencies. Many details are omitted, but I hope that this guide will have you (and your legal representative) talking with the appropriate agency to explain these details as they arise.

Acknowledgements

Matt Sares is thanked for Figure 1a. Vince Matthews is thanked for constructive comments on a draft of this manuscript.

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