

REGULATION
OF
GEOThERMAL ENERGY DEVELOPMENT IN COLORADO

by

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INTRODUCTION

The development of geothermal energy in Colorado is regulated by government in order to ensure the protection of the health, safety and property of residents and property owners. Accordingly, laws demand that a geothermal developer must have a legal right to use of the resource. He may own all rights or he may lease them from private owners or from the state or federal governments. The extent and type of geothermal leases required will depend to some extent upon the magnitude and type of proposed geothermal development. Thus far, geothermal developers, who have concentrated upon the development of the energy for electrical power generation, have often obtained geothermal leases on wide areas to assure adequate control of any resource discovery. Where lands are "checkerboarded", or alternating federal, state, and private ownership, obtaining several types of leases may be the only way to control sufficient amounts of acreage. In addition, not necessarily the case, however, that leasing large amounts of acreage will be necessary for comparatively small, direct thermal geothermal developments.

The steps necessary for obtaining leases vary depending upon what entity owns the land and the minerals. Where ownership is private, leases are obtained simply through to a \$40 filing fee for the permit, the applicant must pay negotiation and contractual agreement with the owner. The transaction is then usually reported by the lessee to the county clerk of the county or counties in which leases are located. State and federal leasing procedures are described in subsequent sections.

Existing law protects the resource against encroachment and promotes its maximum recoverability by requiring the regulation of well drilling. Water law assures that prior water rights will be protected from damage by geothermal development. Laws protect, too, against water and air pollution from geothermal

This handbook attempts to clarify the regulatory system in an easy-to-follow format to help guide geothermal energy development; information must be reviewed by the engineering staff participants through it. Over time, requirements and procedures may change as experience and/or new legislation requires, and before the permit can be issued by the division. The process those procedures not yet

specifically delineated will become more systematic.

PRINCIPAL STATE AGENCIES

The State agencies that have the primary responsibility for regulating and providing information for geothermal energy development and related activities are listed below. The names of the directors and those staff persons that geothermal development participants would most likely contact are also indicated. The section entitled Applicable State Regulations describe their functions in detail.

Colorado State Board of Land Commissioners

Anthony Sabatini, Administrator
Thomas E. Bretz, Minerals Director
Room 620, 1313 Sherman Street
Denver, CO 80203
(303) 839-3451

Issues geothermal leases on state-owned property, surface or sub-surface

Colorado Oil and Gas Conservation Commission

Douglas V. Rogers, Director
Frank Prio, Deputy Director/Secretary
Room 721, 1313 Sherman Street
Denver, CO 80203
(303) 839-3531

Regulates all geothermal well drilling within the State

Colorado Division of Water Resources

Dr. Jeris Danielson, Director
Room 818, 1313 Sherman Street
Denver, CO 80203
(303) 839-3587

Administers water rights within the State.

Colorado Geological Survey

John Rold, Director

Richard H. Pearl, Chief, Groundwater Investigations Section

Room 715, 1313 Sherman St.

Denver, CO 80203

(303) 839-2611

Conducts research concerning geothermal resources and development.

Colorado Public Utilities Commission

Harry Galligan, Jr., Executive Secretary

Ray Garrison, Chief of Rates,

Room 500, 1525 Sherman Street

Denver, CO 80203

(303) 839-3181

Regulates rates, services and the construction of public utility facilities.

Colorado Department of Health, Water Quality Control Division

Gary Broetzman, Director

4210 East 11th Avenue

Denver, CO 80220

(303) 320-6231

Issues permits for the discharge of pollutants into surface or subsurface waters.

Colorado Department of Health, Air Pollution Control Division

Gene Lednts, Director

4210 E. 11th. Avenue

Denver, CO 80220

(303) 320-4180

John Clouse, Air Pollution Control Specialist

Rm. 106, 1101 Bellaire St.

Denver, CO 80220

(303) 320-4180

John Clouse, Air Pollution Control Specialist
Rm. 106, 1101 Bellaire St.
Denver, CO 80220
(303) 320-4180

Responsible for controlling point-source air emmissions. Issues emission permits or waivers.

APPLICABLE STATE LEGISLATION

Legislation regarding geothermal energy development and related activities for Colorado is briefly described in the following section.

"Geothermal resources" are defined in the Colorado Geothermal Act of 1973 (Colorado Revised Statutes C.R.S. 1973, 34-70-104) as including but not limited to:

- (1) Indigenous steam, other gases, hot water, hot brine, and all other products of geothermal processes;
- (2) Steam, other gases, hot water, hot brine, and all other products of geothermal processes resulting from water, brine, steam air, gas, or other substance artificially introduced into subsurface formations; and
- (3) Natural heat, steam energy, and other similar thermal energy in whatever form found in subsurface formations.

"Geothermal by-products" means any substances which remain after thermal energy has been removed from geothermal resources, including but not limited to cooled waters, solution minerals, chemical compounds, extractable salts, rare earths, and other mineral substances (C.R.S. 1973, 34-70-104).

Under Colorado law geothermal resources are specifically excluded from the mineral classification (C.R.S. 1973, 38-35-121). The statute states, "Reference to minerals in any conveyance shall be presumed not to include

geothermal resources unless specific reference is made to such resources in the conveyance".

Leasing

Article IX, Sections 9 and 10 of the Constitution of Colorado mandates the establishment of the State Board of Land Commissioners to direct, control and dispose of the public land, and describes the duties of the Board. C.R.S. 1973-1-112 provides the specific legal basis for the leasing of geothermal resources on State lands.

Exploration and Development

The Geothermal Act (C.R.S. 1973, 34-70-101-110) establishes the authority of the Oil and Gas Conservation Commission to regulate geothermal well drilling. The Commission issues permits to drill observation, exploration and development wells. As indicated in C.R.S. 1973, 37-90-however, no well may be constructed without a finding by the State Engineer that such a well will not injure the water rights of others. Permits for wells in a designated groundwater basin must be approved by the Groundwater Commission (C.R.S. 1973, 37-90-104).

Water Rights

If the water in a geothermal system is tributary and the geothermal fluid is to be reinjected after it is used water rights may not be necessary. a decree must be obtained from the district water court if the water will diverted (C.R.S., 1973, 37-82-104).

Environmental Protection

The Colorado Water Quality Control Act (C.R.S., 1973, 25-8-501-508) establishes the jurisdiction of a Water Quality Control Commission over the prevention and abatement of water pollution throughout the State. Accordingly, the Commission has classified the water quality of streams and rivers within the State and has adopted regulations for the control of water quality. Any geothermal by-product disposal, including thermal discharges, into state water, surface or subsurface, requires a discharge permit.

C.R.S. 1973, 25-7-180 mandates the Air Pollution Control Commission to achieve and maintain air quality in Colorado. Accordingly, they have established mandatory air quality standards. A prospective geothermal energy developer needs to obtain either an emission permit or a waiver prior to drilling an exploratory well.

Utility Regulation

The Public Utilities Law, C.R.S. 1973, 50-1-101, created the Public Utilities Commission (P.U.C.) which regulates rates, service and construction of transportation and fixed utility facilities. To engage in regulated activities, Public Utilities Commission permission is required, except that municipal facilities entirely within municipal boundaries are excluded.

Municipalities are authorized under C.R.S. 1973, 31-32-201 to acquire public utilities. The statute requires that a plan for acquisition be adopted by ordinance. The ordinance must be approved at a special or general election.

Land Use

The Colorado Land Use Act (C.R.S. 1973, 34-65-101-404), commonly referred to as H.B. 1041, mandates the preparation by the Land Use Commission of a land-use planning program for the State, but requires the Commission to recognize that decision-making authority should rest at the lowest possible level of government. Temporary emergency power is granted to the Commission, however, to be exercised when a proposed or occurring land activity which would constitute a danger to the public health, welfare or safety was not remedied by the appropriate local officials. Local governments are encouraged by the statute to identify and designate specified land areas and activities so that subsequent activity will be regulated by the local governments.

Local Government Land Use Control Enabling Acts of 1974, C.R.S. 1973, 29-20-101-107, permits local governments to plan for and regulate land use and development within their jurisdictions.

County Planning and Building Codes, C.R.S. 1973, 30-28-101-209 - Requires counties to create planning commissions, and to adopt subdivision regulations.

The planning commissions are authorized to make and adopt master plans and zoning regulations. Further, the statute specifies that, once a plan is adopted, no public building or utility may be constructed prior to approval by the county or regional planning commission.

C.R.S. 1973, 31-23-101-Planning and Zoning - Assigns powers to municipalities similar to those assigned to counties by C.R.S. 1973, 30-28.

C.R.S. 1973, 31-32-201 and 31-12-101 - Establish the conditions for acquisition of utility systems by municipal governments. Approval by the voters of the municipality for such acquisition is required, except in some cases for waterworks.

Tax Incentives

During the 1979 legislative session, two bills were enacted that provide tax incentives for developing alternative energy systems. S.B. 321 allows for an adjustment of gross individual income on state income tax for the "design and construction costs which are in excess of conventional design and construction costs" of an energy system. The adjustment may be used whether the taxpayer is taking a standard deduction or is itemizing.

S.B. 316 provides a property tax break for alternative energy systems. This bill waives the property tax assessment on the energy system for the years 1980 to 1989. Once the deduction for the cost of the alternative energy system is taken, however, the system cannot be depreciated (Bill Speckman, pers. comm., 1979).

APPLICABLE STATE REGULATIONS

The State regulations and requirements for geothermal energy development are as follows. The procedures for compliance with them are described to provide a guide that will allow the participant in geothermal development to anticipate and coordinate the necessary activities.

Leasing

State Board of Land Commissioners: All geothermal leases on state-owned property are issued by the State Board of Land Commissioners. To obtain a state lease, an application is submitted to the Board. Notice of the requested lease is then sent to the county commissioners and planners, state and federal agencies for comment. This notice must be publicly posted for at least thirty days before the award of the lease is contemplated.

The Board reserves the right to award leases on either a competitive or non-competitive basis. Should there be competition for a state lease, a public auction must be held. Leases have been issued on a non-competitive basis thus far because of the lack of interest in geothermal development. A minimum of two months is required to obtain a geothermal lease. The primary term (usually for 10 years) and annual rent are set by the Board. Currently there are no acreage limitations. The filing and service fee is \$75.00 (T. E. Bretz, pers. comm., 1979).

Before an exploration well can be drilled on state property, the Lessee must apply to the Board for an exploration permit. The Board defines an exploration well as one used to obtain geological and hydrological information only (the type of well classified as an "observation well" by the Oil and Gas Conservation Commission) (T. E. Bretz, pers. comm., 1979).

To apply for an exploration permit, the Lessee must post an exploration bond for a minimum of \$2,000 per well to guarantee compliance with the Board's requirements for restoring the surface. Maps and other information concerning the planned exploration may also be requested by the Board. All drilling activity must be conducted in a manner that precludes contamination of fresh waters of the area or hazards to persons or livestock. The surface of each drill site must be restored to a condition that satisfies the Board before the developer will be released from liability under the exploration bond. A log of each well drilled on the leased land must be submitted to the Board and must contain the following information:

- 1) The location, elevation, description of the formations bisected;

- 2) The depth at which each formation was reached;
- 3) The number of feet of each size casing set in each well and where it was set;
- 4) The total depth of each well, and;
- 5) Additional information must be made available upon the Board's request. The Lessee must inform the Board of any proposed development.

Prior to drilling a well for the production of geothermal resources, the developer is required to post a development bond in an amount set by the Board. Should the well become a geothermal production well, royalties must be paid to the Board the minimum royalty rate. It would be 10% of the gross well head values, before transporation, monthly (T.E. Bretz, pers. comm., 1979). To date, no production well has been checked or State property.

The flow chart that follows (Fig. 1) shows the leasing and regulatory procedures of the State Land Board.

Exploration and Development

Oil and Gas Conservation Commission: Prior to the drilling of any geothermal well within the state, regardless of depth, a permit must be obtained from the Oil and Gas Conservation Commission (Colorado Oil and Gas Rules and to the drilling of an observation well, "a well used solely for informational purposes", as well as to exploration and production wells. The application for a permit to drill is filed with the Director, along with a filing and service fee of \$75.00. An accurate plat or map showing the location of the well must also be submitted.

The developer is also required to post a plugging bond to insure that the well, upon abandonment, will be plugged in accordance with the commission's rules and regulations. Bond is set at \$10,000 per well or a \$50,000 blanket bond to cover all wells, but this bond would be waived where a bond has been filed in accordance with Federal or Indian lease requirements. An observation well

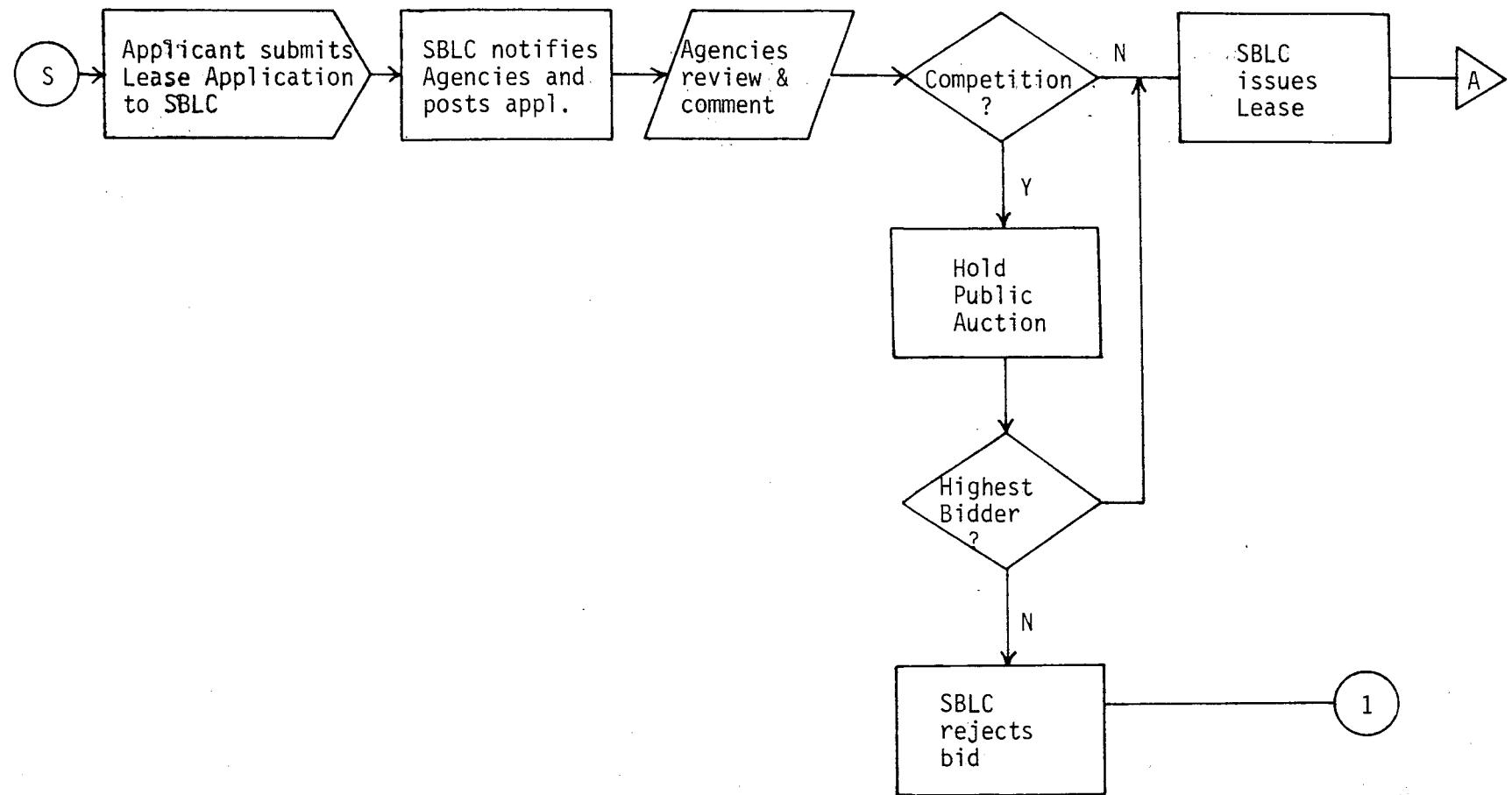


Figure 1 - Leasing and Permitting Procedures for State Property.

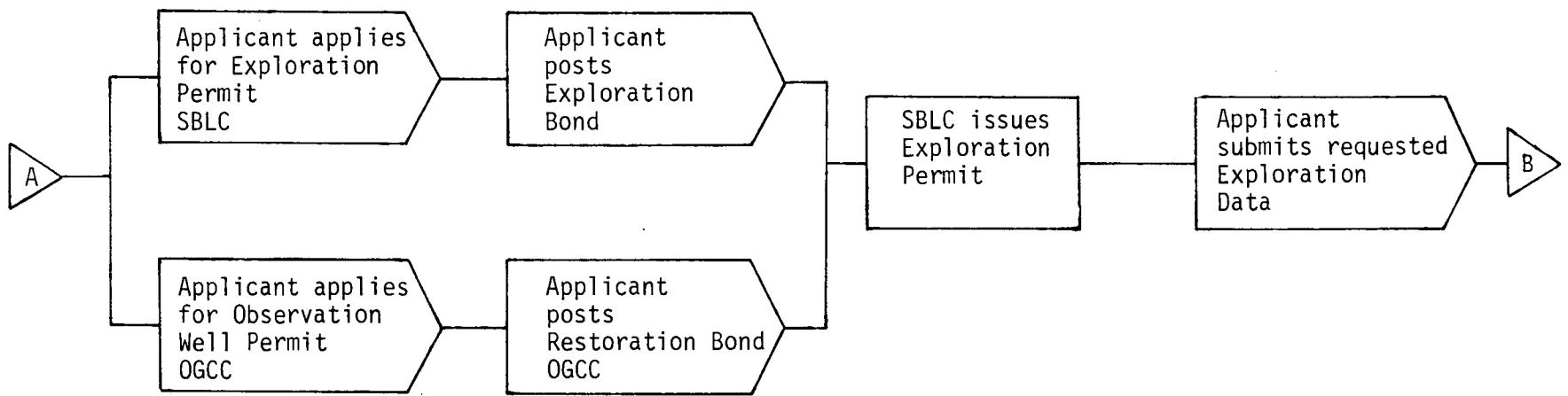


Figure 1 Contd. - Leasing and Permitting Procedures for State Property.

permit may be processed in two weeks, although the law allows 60 days (Frank Piro, pers. comm., 1979)

Additional drilling, following an observation well, requires another permit. A written statement based upon data obtained from the observation well or from "similarly situated geothermal resource areas" must be submitted. It must include the following information:

- 1) Names and addresses of the owner, operator, and designated agents of both;
- 2) Location of the wells and proposed depth thereof;
- 3) Description of the lease;
- 4) Amount and extent of surface development anticipated;
- 5) Measures taken to protect against land subsidence, contamination of surface and ground waters and the air, and excessive noise levels;
- 6) Proposed methods of geothermal by-product disposal and geothermal by-product recovery;
- 7) Mineral and chemical composition of any brine and associated gassers of the geothermal resource;
- 8) Proposed casing program;
- 9) Any other information requested by the Commission.

Additionally, the developer must secure public liability insurance commensurate with the scope of the application (Frank Piro, pers. comm., 1979).

The Commission submits the application and geological data to the Colorado Division of Water Resources for review and comment. If the proposed exploration well is located in a designated groundwater basin or has

hydrological connections to a surface spring, the Division must determine that the construction of the well will not interfere with the water rights of others.

A permit must also be obtained from the Oil and Gas Conservation Commission to excavate a retaining pit to store any substances produced from a well. Permission to plug a completed well or abandon a well must also be obtained. Within 30 days after recompletion, plugging back, abandonment, formation fracturing or other similar operations, the developer must submit a report to the Commission containing the following information:

- 1) A detailed account of the work done and the manner in which such work was performed;
- 2) The daily production of geothermal fluids and gases both prior to and after the operations;
- 3) The size and type of perforations;
- 4) The quantity and type of materials used in the operation;
- 5) Any other pertinent information or operations which affect the original status of the well.

All retaining pits must be filled and the location cleared and restored to the satisfaction of the Director before the plugging report will be approved. Upon completion of the well, a Completion Report must be filed within 60 days. This form may be obtained from the Commission. (Frank Piro, pers. comm., 1979). The chart that follows shows the procedure for obtaining permits from the Oil and Gas Conservation Commission (Fig. 2).

Colorado Division of Water Resources, Office of State Engineer: It is the responsibility of the State Engineer to administer water rights within Colorado (C.R.S. 1973, 37-90-137). Consequently, prior to the issuance of a permit, the State Engineer must determine that the construction of a geothermal exploration or development well would not interfere with the water rights of others. As previously described, after the well application and the geological data are

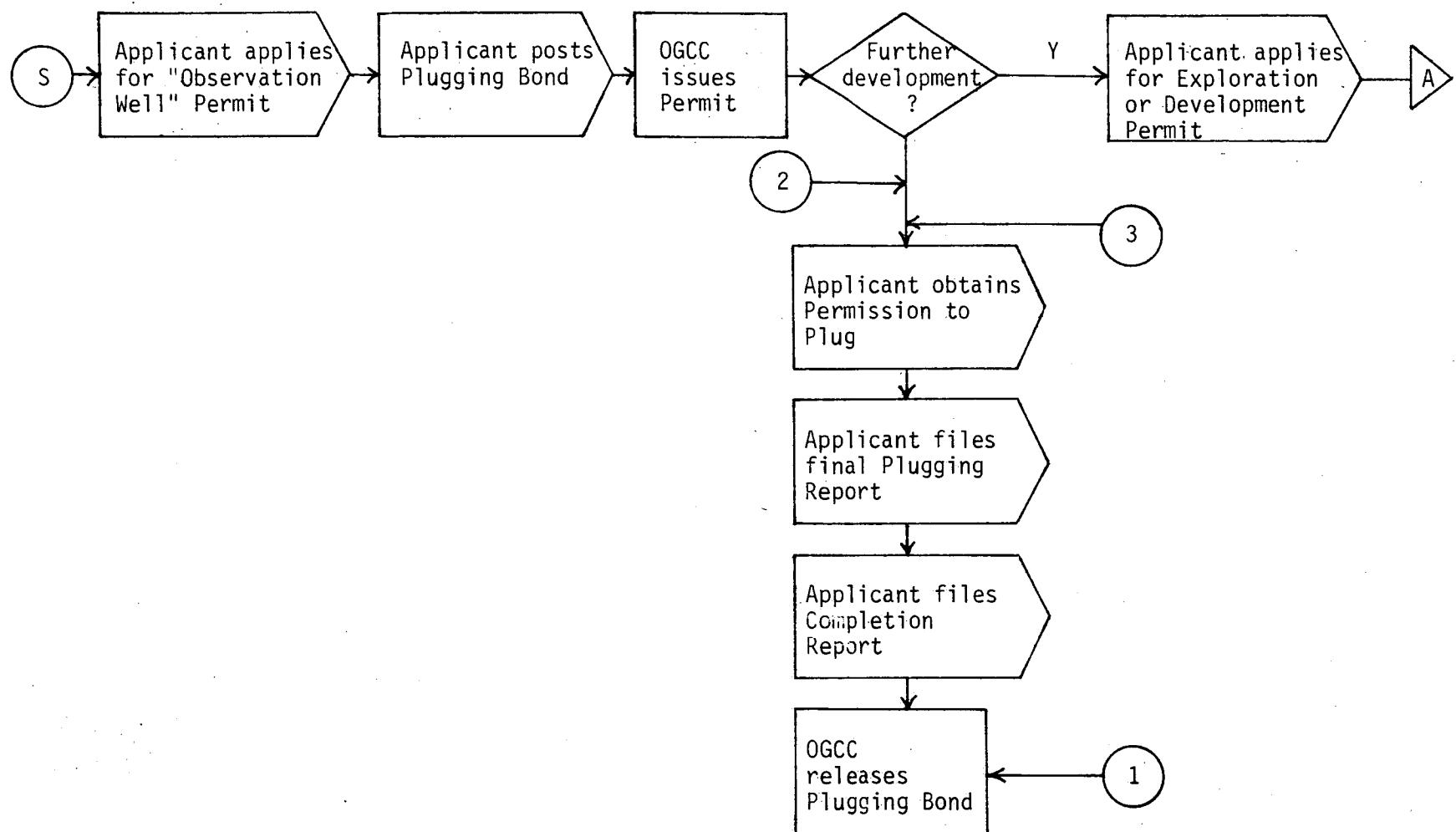


Figure 2 - Permitting Procedures for All Geothermal Wells in Colorado.

reviewed by the Oil and Gas Conservation Commission, the application is sent to the State Engineer for comment. The proposed geothermal well may be hydrologically connected to a groundwater basin or a surface water source, in which case the question of water rights must be resolved before the permit can be approved. Tributary groundwater or surface streams are subject to appropriation (C.R.S. 1973, 37-92-0). Applications for water rights to tributary water must be filed in the division water court. If the geothermal fluids are to be reinjected after they are used, the well permit can be approved without a water right. A decree must be obtained from the court if the water will be diverted for other uses.

If the proposed well is in a designated groundwater basin, the permit must be approved by the Groundwater Commission. The use of non-tributary groundwater cannot deplete the water supply of prior rights. In accordance with the law, a maximum of 1/100th of the water supply in the formation can be removed each year (C.R.S. 1973, 37-90-137).

The permit review process shown on Figure 3 requires a maximum of 60 days from the date of application (Bill Smith, pers. comm., 1979).

Environmental Protection

Water Quality Control Commission: The Water Quality Control Commission was mandated to adopt regulations for the state discharge permit system, designed to be in conformity with the Federal Water Pollution Control Act Amendments of 1972 and the Clean Water Act of 1977 (C.R.S. 1973, 25-8-501 through 508). Any geothermal by-product disposal, including thermal discharges, into state waters requires a discharge permit. There are two kinds of discharge permits; one for surface water, the other for subsurface water. The filing fee may vary from \$10 to \$250, depending upon the extent of the proposed development. A minimum of 180 days must be allowed for the application to be processed (Frank Rozich, pers. comm., 1979).

Information about the location of the proposed discharge is published in a Fact Sheet which is circulated for comment among various agencies and interested parties. Should any objections be filed, a public hearing must be held. The applicant will be required to pay for an expert's evaluation of the proposal if

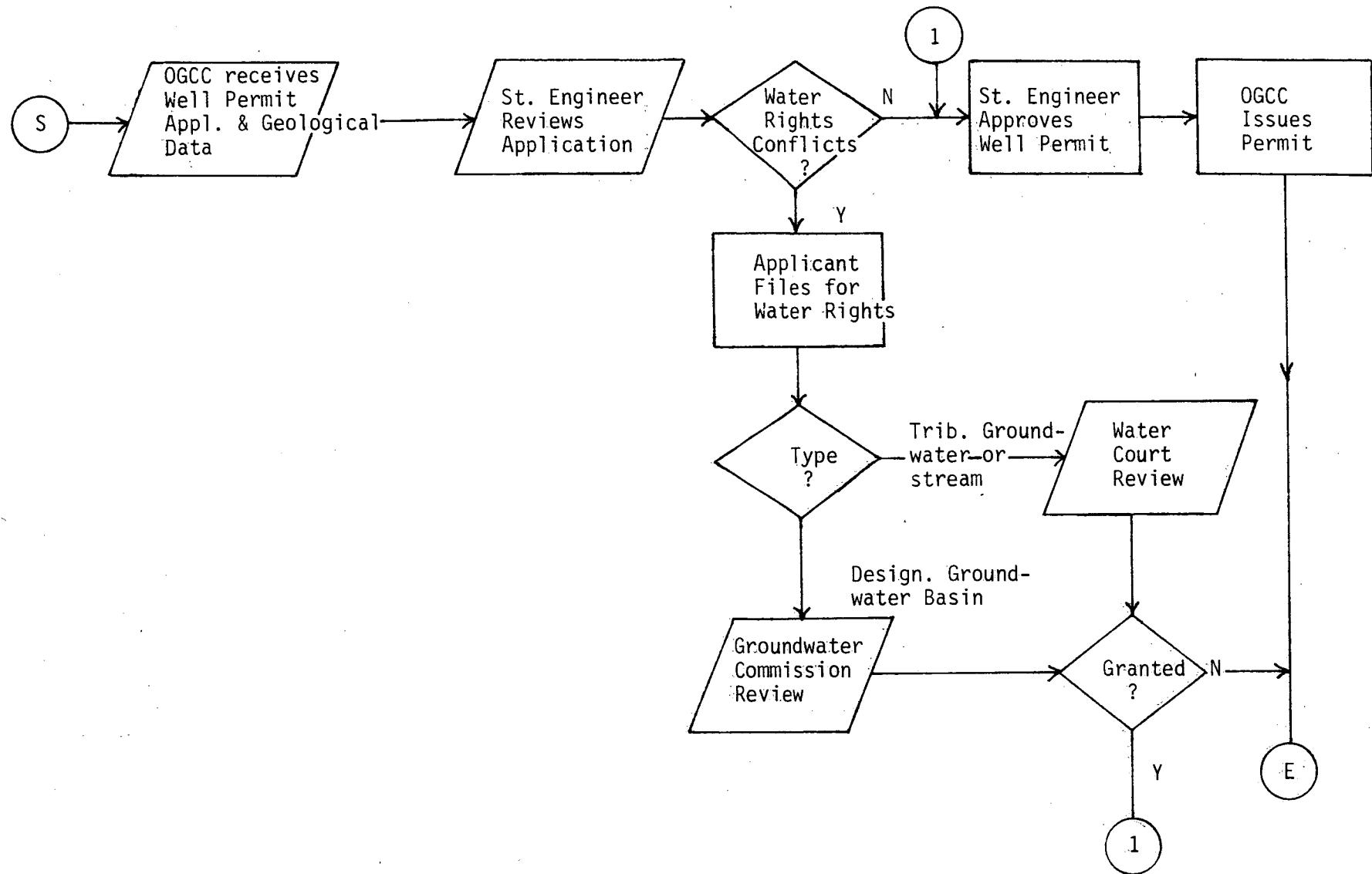


Figure 3 - Procedures for Evaluation of Geothermal Well Permits Application by State Division of Water Resources.

the discharge is to be injected into subsurface water. For surface-water discharge, applications must be reviewed by the Environmental Protection Agency, but for subsurface injection, such review is not required. (Frank Rozich, pers. comm., 1979).

The pollution standards may be waived by the Commission for a proposed subsurface injection disposal. Determining the pollution standards for a development may vary under certain circumstances. For surface disposal, whenever the water quality of a stream is higher than a standard, the higher quality standard is to be maintained. The average stream flow is also taken into consideration (Frank Rozich, pers. comm., 1979). Figure 4 shows the process for obtaining a water disposal permit.

Air Pollution Control Commission: Authorized to achieve and maintain the air quality in the state (C.R.S. 1973, 25-7-108), the Air Pollution Control Commission has established mandatory air quality standards. Either an emmisions permit or a waiver should be obtained prior to drilling an exploratory well. If it can be demonstrated that any hydrogen sulfide emission would be insignificant, the Commission will award a waiver. In addition to a \$40 filing fee for the permit, the applicant must pay for an expert opinion on the estimated emission level. This information must be reviewed by the engineering staff before the permit can be issued by the Division. The process requires approximately 20-90 days, depending upon the scope of the geothermal development. Emission measurements must be taken periodically (John Clouse, pers. comm., 1979).

Geothermal System Development

Public Utilities Commission: Created to have "exclusive jurisdiction over all public utilities", the Public Utilities Commission regulates rates, services and construction permits (C.R.S. 1973, 40-3-102) for public utility systems except those owned by municipalities and providing service within their boundaries.

To construct a power generation facility, a developer must apply for a certificate of Public Convenience and Necessity. Preliminary approval of the certificate will be based upon the commission's determination that there are

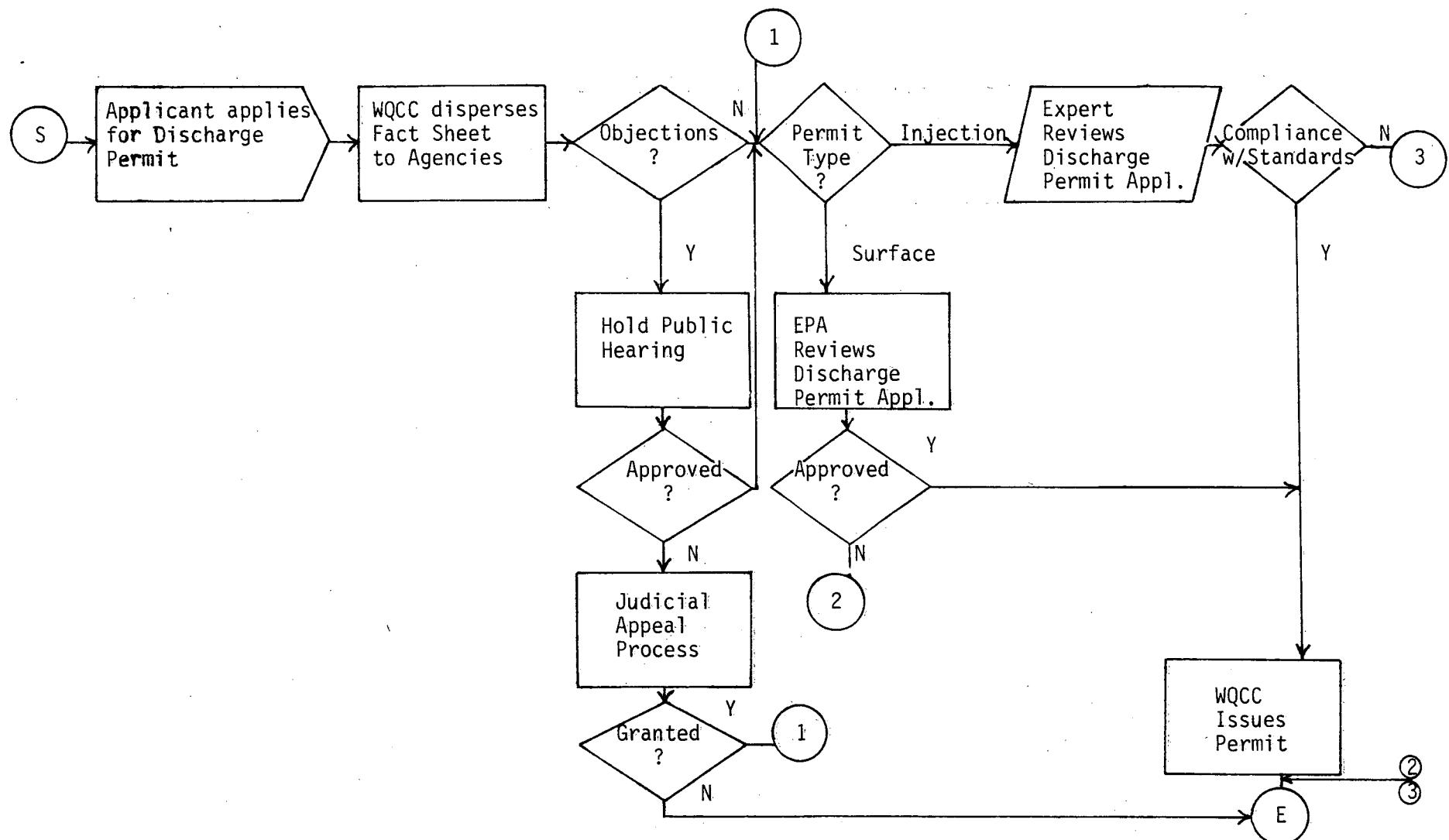


Figure 4 - Application Process for Water Drainage Permit.

sufficient financial resources for operations, existing utilities are unable to provide the power, and that is beneficial for the State. Public hearings are then held. The developer must obtain the approval of the State Health Department, the State Land Use Commission, and the County Commissioners before final approval for construction. Although it is difficult to estimate the amount of time that would be required for approval, the last permit application required 1 1/2 years for approval (Ray Garrison, pers. comm., 1979).

The Public Utilities Commission's jurisdiction extends to the sale of public utility services to retail customers outside a municipality. In some instances where electricity and natural gas are sold wholesale, the utility company is under the jurisdiction of the Federal Energy Regulatory Commission. Construction of a geothermal power generating facility which would provide federal services on a wholesale basis may require the approval of both the state and federal governments (Ray Garrison, pers. comm., 1979). The Commission regulates heating plants, but has not determined whether geothermal heating systems would fall under its jurisdiction (Archibald, pers. comm., 1979).

Land Use

State Land Use Commission and Local Government: The State Land Use Commission was created to develop a statewide land use planning program and has temporary emergency power to halt development if it would constitute a danger to the public health, welfare or safety. The burden for planning and regulation of land use, however, rests with local government. Counties are mandated to adopt subdivision regulations. Both counties and municipalities may plan for and regulate the use of land. The manner in which this is done varies among jurisdictions but will usually be either through zoning regulations or a permit system or both. In any case, however, construction of a utility must be approved by the Planning Commission for that jurisdiction.

LOCAL AGENCIES AND REGULATIONS

As indicated above, counties and municipalities are responsible for the regulation of the use of land and other activities within their jurisdictions.

In those counties and municipalities that have a planning staff, the planning director will usually be the initial contact for information and issuance of the necessary permits for development of geothermal energy. Elsewhere, other officials would be the appropriate sources. The addresses of contacts in selected local jurisdictions are listed in Tables 1 and 2 in Appendix A.

Local Regulations

State legislation permits both counties and municipalities to regulate numerous activities, including geothermal development, within their boundaries, but such authority must be specifically implemented by adopting regulations. Residential, commercial, industrial, agricultural, or utility development that was planned to use geothermal energy would usually be subject to regulation by the local government in which it is located.

Municipalities are authorized to acquire and operate public utilities. To acquire a utility, the municipality must prepare a plan for acquisition and adopt it by ordinance. The ordinance must then be approved at a regular or general election (C.R.S. 1973 -31-32-201). no specific authority is indicated for geothermal systems.

Although the details differ, the procedures for regulation are similar in various jurisdictions. Following is a description of the procedures required by one county that regulates geothermal resource development.

Alamosa County: Alamosa County has included in their subdivision regulations mineral regulations that specifically refer to geothermal resources. To obtain county approval to develop a geothermal resource, the developer first meets with the planning commission or staff informally about the specific requirements. He then prepares and submits a proposal that is circulated to various agencies for review and comment. After comments have been received, the application goes through final review by the planning commission, which recommends denial or approval. Then the proposal is submitted to the Board of County Commissioners, which holds a public hearing to allow interested parties to comment. The Commissioners then decide whether or not to allow the activity.

It is expected that the time required to obtain permission for exploration activity would be at least two months. For development activity, six months would probably be required for acquiring the necessary permits (Alamosa Planning Office, 1977).

The following table summarizes state and local geothermal regulations.

TABLE 3
Summary of State and Local Regulations

<u>Agencies</u>	<u>Permit</u>	<u>Required Prior to:</u>	<u>Estimated Time For Issuance</u>	<u>Comments</u>
Board of Land Commissioners	Lease, State lands exploration permit	use of lands, exploration of land	2 mo. 2-8 wks.	May be competitive bidding or non-competitive
Oil & Gas Conservation Commission	Observation well permit/ exploration well permit/ development well permit	drilling well; deepening observation well; drilling development well	2-8 wks; approx. 8 wks; approx. 8 wks.	
Water Quality Control Comm.	Surface discharge permit; injection discharge permit	disposal of fluid discharge	6 mos.	In conjunction with EPA review
Air Pollution Control Comm.	Emission permit	discharge air pollutants	20-90 days	Developer may obtain a waiver or permit
District Water Court	Appropriation of water	use of water		Most water rights overappropriated in state. Can submit plan of augmentation.
Groundwater Commission	Appropriation in designated ground water basin	use of water		

TABLE 3 CONT.

Agencies	Permit	Required Prior to:	Estimated Time For Issuance	Comments
Highway Dept.	Utility permit	use of state highway for utility or pipelines	1 week	Would be necessary for use of or crossing of state highway w/utility or pipelines
Public Utility Comm.	Certificate of Convenience of a power and Necessity plant - sale of electricity and heating plants			Approval of St. Health Dept., St. Land Use Comm., and County Commissioners required for power plant construction
County Planning Dept.	Rezoning or permit if necessary	Depends on county zoning ordinances	variable	Subdivision regulations in all counties

FEDERAL AGENCIES AND REGULATIONS

Those federal agencies that regulate geothermal energy exploration and development activities in areas where either the land or mineral rights are under federal jurisdiction are listed below:

Director
 Bureau of Land Management
 U.S. Department of the Interior
 Branch of Public Affairs
 Room 700, Colorado State Bank Building
 1600 Broadway
 Denver, CO 80202
 Telephone: (303) 837-4481

Responsible for issuance of leases where land or mineral rights are under federal jurisdiction.

Geothermal Coordinator
United States Geological Survey
U.S. Department of the Interior
345 Middlefield Road
Menlo Park, CA 94025
Telephone: (415) 323-8111

Responsible for issuance of permits for exploration and development activities.

Regional Forester
U.S. Forest Service
U.S. Department of Agriculture
Box 25127 - 11177 West 8th Avenue
Lakewood, CO 80227
Telephone: (303) 234-3711

The Geothermal Steam Act of 1970, P.L. 91-581, assigns the responsibility for leasing geothermal energy and regulating geothermal activities on federal property to the U.S. Department of the Interior. Regulations implementing this act define the following requirements and procedures:

Leasing

A developer who wishes to conduct geothermal exploration or development activities in areas where either the land or mineral are under federal jurisdiction must obtain a geothermal lease from the Bureau of Land Management (BLM) (43 CFR 3210.2). The procedures for obtaining leases vary, depending upon whether or not the area has been designated a Known Geothermal Resource Area (KGRA) by the federal government. This classification, based upon an evaluation of the commercial value of a geothermal area, imposes upon an area the requirement that all leasing be by competitive bid.

Before offering such lands for leases, the impacts of development are assessed, the comments of appropriate agencies and organizations are solicited and public hearings held. A lease sale is then advertised and held, with the leases being awarded to the bidder offering the highest bonus bid, if it is above the minimum acceptable bid (Kenneth Bull, pers. comm., 1978).

If the area is not a KGRA, an applicant may file for leases with the BLM. The application is reviewed by the surface management agency, which is the BLM, the U.S. Forest Service (USFS), or the Bureau of Indian Affairs (BIA). They, in consultation with the U.S. Geological Survey (USGS), assess the probable environmental impacts and determine the necessary mitigation procedures, which are added to the lease application. The Menlo Park, California, USGS office reviews the lease stipulations for adequacy and for compatibility with development of the lease. The USGS also investigates to ensure that the area has not been classified as a KGRA following submittal of the application. The lease is then sent to the applicant who may accept or refuse the lease with its stipulations (Paul Summers, pers. comm., 1978).

Lease applications may also be rejected by the BLM in the event the environmental analysis indicates that critical environmental considerations and mitigation measures cannot be implemented (43 CFR 3210.4).

Leases are issued for a tract of a minimum of 640 acres for a 10 year term. A filing fee of \$50.00 is required with the application. If the lease is issued, a rental of \$1.00 per acre per year for the first five years will be charged. After the first five years, the rental will increase by \$1.00 per acre per year. Royalties of not less than 10 percent nor more than 15 percent of the value of energy sold or used by the lessee are assessed as well (Evelyn Axelson, pers. comm., 1979).

Exploration and Development

The USGS is responsible for regulating geothermal operations where the land or minerals are under federal jurisdiction (30 CFR, 270.10). Some preliminary exploration and "casual" uses that do not disturb the land, improvements or resources may be done without obtaining leases (43 CFR 3209.0).

If leases are held, approval may be obtained from the surface management agency of a "Notice of Intent and Permit to Conduct Exploration Operations," in order to conduct such activities as geochemical and geophysical surveying and drilling of shallow gradient holes (43 CFR 3209.0). Usually, permission can be granted in less than 30 days (Kenneth Bull, pers. comm., 1978).

Any drilling other than thermal gradient holes may be done only by the lessee or his agent on his own leases. Prior to conducting activities, a Plan of Operations must be submitted to and approved by the USGS. A Plan of Operations may cover one or a combination of activities, as follows: exploration, collection of baseline data, development, injection, production, and utilization. All require an environmental analysis, which is reviewed by numerous organizations and individuals (60 in Colorado, at this time) (Kenneth Bull, pers. comm., 1978).

The Plan of Operations must include, in addition to a description of the primary activities, a description of the measures to be taken for protecting the environment, for disposal and reclamation, and for monitoring. If the Plan of Operations is for production, disposal or utilization plans, baseline data are required, including air and water quality, noise, seismic and land subsidence and ecological systems covering a period of one year (30 CFR 270-35). The baseline data may be obtained from other sources if available. After the environmental analysis is conducted by the USGS, it is reviewed by the surface management agency and must be jointly approved by the two agencies. Interested parties, including state and local governments, are invited to comment. The entire process usually requires a minimum of from three to six months (30 CFR 270.35).

Plans of Operation are reviewed by a geothermal advisory panel. If the area is a newly identified geologic area or if the operation is unusual, the panel may hold a public hearing, extending the review process to about nine months' time. A full environmental impact statement (EIS) may be required for any plan if considered to be necessary by Washington offices of the responsible agencies. An EIS usually adds about two years to the process (Kenneth Bull, pers. comm., 1978).

A geothermal operator on federal leases must file reports periodically, including the following information:

1. Report of significant effect on the environment or industrial accident.
2. Log and well history.

3. Monthly report of operations.
4. Monthly report of sales and royalties.
5. Annual report of compliance with environmental protection requirements.
6. Annual report of expenditures for diligent exploration operators.

Production royalties are determined by the area supervisor of the USGS (30 CFR 270.02).

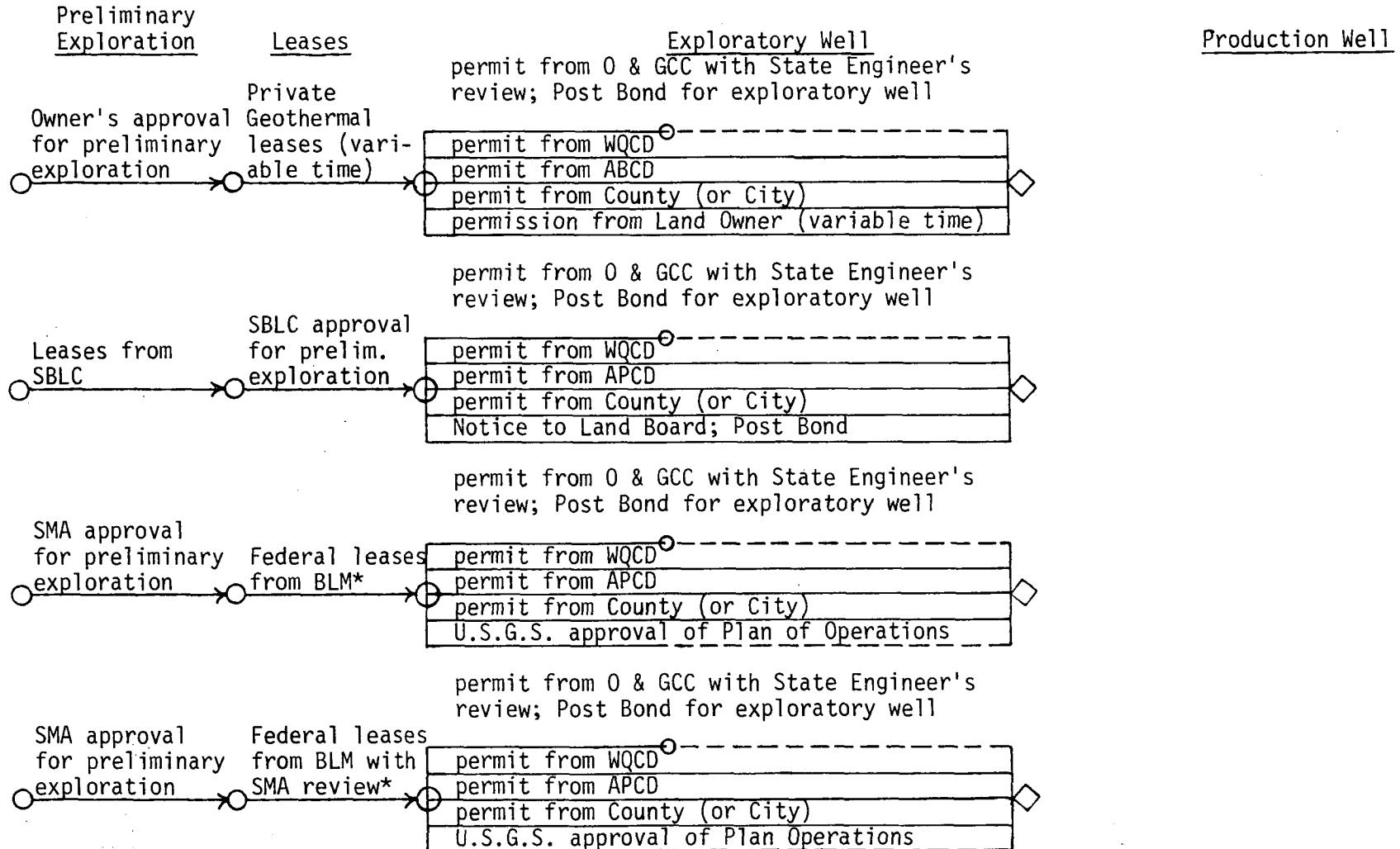
Figure 5 shows the procedures required for obtaining leases and permits, along with the time required for each activity.

It is hoped that this handbook helps to clarify the procedures necessary for legally developing geothermal energy in Colorado. Although some legal questions may remain and some procedures may be refined in the future, Colorado government has, unlike some states, created a system to allow for geothermal development.

Cumulative
Months for
Institutional
Procedures

	1	2	3	4	5	6	7	8	9	10	11	12	
--	---	---	---	---	---	---	---	---	---	----	----	----	--

Private Land
and/or
Minerals



* No mandated time, varies

Figure 5 - Geothermal Regulatory Procedures for All Jurisdictions in Colorado.

INFORMATION SOURCES

Technical Studies

This section is included in this report to provide guidance to those who may wish to obtain additional information.

Following is a list of some of the technical studies that have been compiled on geology, engineering feasibility, economic analysis, environmental effects and institutional aspects of geothermal energy and development.

Barrett, J.K., and Pearl, R.H., 1978, An appraisal of Colorado's geothermal resources, Bull. 39, Colorado Geological Survey, Denver, Co.

1978, Hydrogeological data of thermal springs and wells in Colorado, Inf. Ser. 6, Colorado Geological Survey, Denver, CO.

Coe, B.A., 1978, Geothermal resource development in Colorado: Processes, Promises and Problems, Inf. Ser. 9, Colorado Geological Survey, Denver, CO.

EG&G Idaho, Inc., 1979, Hydrothermal commercialization baseline for State of Colorado: EG&G Idaho Inc., Idaho Falls, ID.

1978, Rules of Thumb for Geothermal Direct Applications: EG&G Idaho Inc., Idaho Falls, ID.

Engen, I.A., and Donovan, L.E., 1977, A preliminary conceptual design for geothermal space heating conversion of School District 50, joint facilities at Pagosa Springs, CO: EG&G Idaho Inc., Idaho Falls, ID. Idaho Inc., Idaho Falls, ID.

Geo-Heat Utilization Center, 1979, Quarterly Bulletin: Oregon Institute of Technology, Vol. 4, No. 2, Klamath Falls, OR.

Geothermal Resources Council, 1979, K.G.R.A. Special: Geothermal Resources Council, Vol. 8, No. 3, Davis, CA.

Harris, Rutherford, C., 1979, State government workshop on barriers and incentives of geothermal energy resources: National Conference of State Legislators, Denver, CO.

International Geothermal Energy Newsletter, 1979, Vol. 5, Issue 17: The Geyser, Santa Monica, CA.

Koulet, Kim G., and Armstrong, James A., 1978, The drilling and production testing of an exploratory geothermal well in Pagosa Springs, Colorado: Denver Research Institute, Denver, CO.

Kunze, J.F., Lofthouse, J.H., Stoker, R.C., 1977, The potential for utilizing geothermal energy for space heating in reconstructed Sugar City, Idaho: EG&G Idaho Inc., Idaho Falls, ID.

Long, William P., 1975, Economic utilization of low-temperature geothermal energy with emphasis on greenhouse heating: Colorado School of Mines, Golden, CO.

Lienau, Paul J., 1978, Agribusiness geothermal energy utilization potential of Klamath and Western Snake River Basins, Oregon: Geo-heat utilization center, Klamath Falls, OR.

Muffler, J.P., ed., Circular 790, Assessment of geothermal resources of the United States - 1978: U.S. Geol. Survey, Geol. Survey, Reston, VA

Nannen, L.W., Kreith, F., and West, R.E., 1975, An investigation of the technical and economic feasibility of using low temperature geothermal sources in Colorado: Env. Consulting Services Inc., Boulder, CO.

Nasr, Louise H., 1978, Geothermal Loan Guaranty program and its impact on exploration and development: Colorado School of Mines, Golden, CO.

Pearl, R.H., 1972, Geothermal resources of Colorado, Spec. Pub. 2, Colorado Geol. Survey, Denver, CO.

1974, ed., Proceedings of a symposium on geothermal energy in Colorado Bull. 35, Colorado Geol. Survey, Denver, CO.

Swink, D.G., and Schultz, R.J., 1976, Conceptual study for total utilization of an intermediate temperature geothermal resource: Aerojet Nuclear Co.

VTN-CSL, 1977, Economic study of low temperature geothermal energy in Lassen and Modoc Counties, California, Job 217S-3: VTN Consolidated Inc. and CSL Associates Inc.

Water Quality Control Commission, Colorado Dept. of Health, Water quality regulations, 1978, Denver, CO.

White, D.E., and William, D.L. 1975, ed., Circular 726, Assessment of geothermal resources of the United States, 1975, U.S. Geol. Survey, Reston, VA.

Woodward-Clyde Consultants, 1978, Impact prediction manual for geothermal development: Woodward-Clyde Consultants, San Francisco, CA

AGENCIES AND INDIVIDUALS

Agencies

The following are some of the agencies and individuals who can provide information about geothermal energy and its development requirements. Those agencies listed previously in this report may also be of assistance.

Bureau of Land Management
U.S. Department of the Interior
Branch of Public Affairs
Room 700
Colorado State Bank Building
1600 Broadway
Denver, CO 80202
Telephone for general information: (303) 837-4481

Colorado Geological Survey
Groundwater Investigations Section
Room 715
1313 Sherman
Denver, CO 80203
(303) 839-2611

EG&G Idaho Inc.
Bob Schultz
P.O. Box 1625
Idaho Falls, ID 83415
(208) 526-9887

U.S. Department of Energy
Idaho Operations Office
550 Second Street
Idaho Falls, ID 83401
(208) 526-1668

U.S. Forest Service
Department of Agriculture
Regional Forester
Box 25127 - 11177 West 8th Ave.
Lakewood, CO 80225
(303) 234-3711

Geothermal Coordinator
U.S. Geological Survey
345 Middlefield Road
Menlo Park, CA 97025

Individuals

Axelson, Evelyn
U.S. Bureau of Land Management
Room 700
Colorado State Bank Building
1600 Broadway
Denver, CO 80202

Bretz, Thomas E.
Colorado State Board of Land Commissioners
Room 620, 1313 Sherman Street
Denver, CO 80203

Bull, Kenneth
U.S. Geological Survey
Salt Lake City, Utah

Clouse, John
Air Pollution Control Division
Colorado Department of Health
1101 Bellaire Street
Denver, CO 80220

Garrison, Ray
Colorado Public Utilities Commission
Room 500, 1525 Sherman Street
Denver, CO 80203

Piro, Frank
Colorado Oil and Gas Conservation Commission
Room 721, 1313 Sherman Street
Denver, CO 80203

Rozich, Frank
Water Quality Control Commission
Colorado Department of Health
4210 E. 11th Ave.
Denver, CO 80220

Smith, William
Colorado Division of Water Resources
Room 818, 1313 Sherman Street
Denver, CO 80203

Summers, Paul
U.S. Bureau of Land Management
Room 700, Colorado State Bank Building
1600 Broadway
Denver, CO 80202

APPENDIX A
TABLE 1

COUNTY PLANNERS OR CLERKS FOR SELECTED COLORADO COUNTIES

Alamosa
Planning Commission
P.O. Box 639
Alamosa, CO 81101

Archuleta
Land Use Administrator
P.O. Box 631
Pagosa Springs, CO 81147

Bent
Planning Director
P.O. Box 350
Las Animas, CO 81054

Boulder
Planning Director
P.O. Box 471
Boulder, CO 80302

Chaffee
Planning Director
P.O. Box 669
Salida, CO 81201

Clear Creek
Clerk
Georgetown, CO 80444

Conejos
Planning Director
P.O. Box 127
Conejos, CO 81129

Custer
Planning Director
P.O. Box 102
Westcliffe, CO 81252

Delta
Delta County Planning Dept.
Courthouse Annex
Delta, CO 81416

Dolores
Room 303 Montezuma County
Court House
Cortez, CO 81321

Eagle
Eagle County Planning Dept.
P. O. Box 789
Eagle, CO 81631

Fremont
Planning Director
P. O. Box 349
Canon City, CO 81212

Garfield
Garfield County Planner
2014 Blake Street
Glenwood Springs, CO 81601

Gilpin
Planning Director
Eureka St.
Central City, CO 80427

Grand
Grand County Planning Department
Grand County Courthouse
Hot Sulphur Springs, CO 80451

Gunnison
Gunnison County Planner
Gunnison County Courthouse
200 East Virginia St
Gunnison, CO 81230

Hinsdale
County Clerk
P. O. Box 107
Lake City, CO 81235

Jackson
Jackson County Planning Comm.
P. O. Box 1019
Walden, CO

Lake
Planning Director
500 Harrison Ave.
P. O. Box 917
Leadville, CO 80461

La Plata
Regional Planner
Animas Regional Planning Comm.
Durango, CO 81301
County Clerk

Mesa
Director
Development Department
P. O. Box 897
Grand Junction, CO 81501

Mineral
County Clerk
P. O. Box 70
Crede, CO 81130

Moffat
Moffat County Planning Department
Moffat County Courthouse
Craig, CO 81625

Montezuma
Planning Coordinator
Dolores and Montezuma Counties
Room 303 Montezuma County Courthouse
Cortez, CO 81321

Montrose
Montrose County Planner
Montrose County Courthouse
107 South Cascade Street
Montrose, CO 81401

Ouray
Ouray County Planner
Ouray County Courthouse
Ouray, CO 81427

Park
County Clerk
Box 128
Fairplay, CO 80440

Pitkin
Aspen/Pitkin Planning Dept.
130 South Galena St.
Aspen, CO 81611

Saguache
County Clerk
P. O. Box 176
Saguache, CO 81149

San Juan
Land Use Administrator
P. O. Box 71
Silverton, CO 81433

San Miguel
San Miguel County Planner
Telluride, CO 81435

Summit
Summit County Planning Dept.
P. O. Box 68
Breckenridge, CO 80424

Teller
Planning Director
P. O. Box 248
Cripple Creek, CO 80813

TABLE 2

MUNICIPAL PLANNERS, MANAGERS OR MAYORS
FOR SELECTED COLORADO MUNICIPALITIES 1977Municipal Contacts

Alamosa Alamosa Co.
Planning Director
425 Fourth St.
Alamosa 81101

Alma-Park Co.
Mayor
Alma 80420

Antonito-Conejos Co.
Mayor
P.O. Box 86
Antonito 81120

Aspen-Pitkin Co.
Planning Director
130 S. Galena
Aspen 81161

Basalt-Eagle Co.
Mayor
Box 1046
Basalt 82621

Blue River-Summit Co.
302 So. Main
Breckenridge 80424

Bonanza City-Saguache Co.
Mayor
Bonanza 81155

Boone-Pueblo Co.
Mayor
P.O. Box 13
Boone 81025

Boulder-Boulder Co.
Planning Director
P. O. Box 791
Boulder

Breckenridge Summit Co.
Planning Director
P. O. Box 168
Breckenridge 80424

Buena Vista-Chaffee Co.
Manager
P.O. Box B
Buena Vista 81211

Canon City-Fremont
Planning Director
P.O. Box 711
Canon City 81212

Carbondale-Garfield Co.
Planning Director
P.O. Box 608
Carbondale 81623

Cedaredge-Delta Co.
Mayor
P.O. Box 396
Cedaredge 81413

Center-Saguache Co.
Manager
Box 400
Center 81125

Central City-Gilpin Co.
Planning Director
P.O. Box 247
Central City 80427

Coal Creek - Fremont Co.
Mayor
P.O. Box 36
Coal Creek 81221

Durango - La Plata Co.
Planning Director
P.O. Box 221
Durango 81301

Craig - Moffat Co.
Mayor
P.O. Box 425
Craig 81625

Eagle-Eagle Co.
Mayor
P.O. Box 609
Eagle 81631

Crawford-Delta
Mayor
P.O. Box 4
Crawford

Empire-Clear Creek Co.
Mayor
Box 187
Empire 80438

Creede-Mineral Co.
Mayor
P.O. Box 206
Creede 81130

Fairplay-Park Co.
Mayor
P.O. Box 267
Fairplay 80440

Crested Butte-Gunnison Co.
P.O. Box 39
Crested Butte 81224
Cedaredge 81413

Glenwood Springs-Garfield Co.
Planning Director
P.O. Box 19
Delta 81416

Crestone-Saguache Co.
Mayor
Crestone 81131

Granby-Grand Co.
Mayor
P.O. Box 17
Granby 80446

Del Norte-Rio Grande Co.
Manager
P.O. Box M
Del Norte 81132

Grand Lake-Grand Co.
Mayor
Box 6
Grand Lake 80447

Delta-Delta
Manager
Box 19
Delta 81416

Grand Valley-Garfield Co.
Mayor
Box 217
Grand Valley 81635

Dillon-Summit Co.
Mayor
Box 8
Dillon 80435

Gypsum-Eagle Co.
Mayor
Box 237
Gypsum 81637

Dinosaur-Moffat Co.
Mayor
Box 108
Dinosaur 81610

Hayden-Routt Co.
Manager
P.O. Box 190
Hayden 81639

Dolores-Montezuma Co
Box 621
Dolores 81323

Hooper-Alamosa Co.
Manager
P.O. Box 1
Hooper 81136

Hotchkiss-Delta Co.
Mayor
P. O. Box 368
Hotchkiss 81419

Hot Sulphur Springs-GrandCo.
Mayor
P.O. Box 116
Hot Sulphur Springs 80451

Idaho Springs-Clear Creek Co.
Mayor
Box 907
Idaho Springs 80452

Ignacio-La Plata Co.
Mayor
P.O.Box 457
Ignacio 81137

Jamestown-Boulder Co.
Mayor
Box 273
Jamestown 80455

Kremmling-Grand Co.
Mayor
P.O. Box 532
Kremmling 80459

Lafayette-Boulder Co.
Manager
201 E. Simpson St.
Lafayette 80026

La Jora-Conejos Co.
Manager
P.O. Box 273
La Jora 81140

Lake City-Hinsdale
Mayor
Box 544
Lake City 81235

Leadville-Lake County
Mayor
P.O. Box 923
Leadville 80461

Longmont-Boulder Co.
Planning Director
Civic Center Complex
Longmont, 80501

Louisville-Boulder Co.
Planning Director
749 Main St.
Louisville 80027

Lyons-Boulder Co.
Planning Director
Box 49
Lyons 80540

Manassa-Conejos Co.
Mayor
Manassa 81141

Marble-Gunnison Co.
Mayor
Box 69K
Marble Star Route

Minturn-Eagle Co.
Manager
Box 381
Minturn 81645

Moffat-Saguache Co.
Mayor
P.O. Box 116
Moffat 81143

Monte Vista-Rio Grande Co.
Manager Director
P. O. Box 431
Monte Vista 81144

Montrose-Montrose Co.
Planning Director
433 S. 1st St.
Montrose 81401

Mt. Crested Butte-Gunnison
Manager
P.O. Box 699
Crested Butte 81224

<u>Nederland-Boulder Co.</u> Mayor P.O. Box 396 Nederland 80466	<u>Pueblo -Pueblo Co.</u> Mayor P.O. Box 1427 Pueblo 81003
<u>New Castle-Garfield Co.</u> Mayor P.O. Box 166 New Castle 81647	<u>Red Cliff-Eagle Co.</u> Mayor Town Hall Red Cliff 81649
<u>Norwood-San Miguel Co.</u> Mayor P.O. Box 127 Norwood 81423	<u>Rico-Dolores Co.</u> Mayor P.O. Box 242 Rico 81332
<u>Oak Creek-Routt Co.</u> Mayor P.O. Box 128 Oak Creek 80467	<u>Ridgeway-Ouray Co.</u> Mayor Box 242 Ridgeway 81432
<u>Ophir-San Miguel Co.</u> Mayor P.O. Box 683 Ophir 81426	<u>Rifle-Garfield Co.</u> Planning Director P.O. Box 1908 Rifle 81650
<u>Orchard City-Delta Co.</u> Mayor Box 21 Austin 81410	<u>Rockvale-Fremont</u> 510 Railroad St. Rockvale 81244
<u>Ouray-Ouray Co.</u> Mayor P.O. Box 468 Ouray 81427	<u>Romeo-Conejos Co.</u> Mayor Box 398 Romeo 81148
<u>Pagosa Springs-Archuleta Co.</u> P.O. Box 265 Pagosa Springs 81147	<u>Rye-Pueblo Co.</u> Mayor P.O. Box 316 Rye 81069
<u>Paonia-Delta Co.</u> Manager P.O. Box 460 Paonia 81428	<u>Saguache-Saguache Co.</u> Mayor P.O. Box 417 Saguache 81149
<u>Pitkin-Gunnison Co.</u> Mayor 3rd & Main Pitkin 81241	<u>Salida-Chaffee Co.</u> Mayor P.O. Box 417 Salida 81201
<u>Poncha Springs-Chaffee Co.</u> Mayor P.O. Box 56 Poncha Springs 81242	<u>Sanford-Conejos Co.</u> Mayor Box 6 Sanford 81151

San Luis-Costilla Co.

Mayor
P.O. Box 56
San Luis 81152

Silt-Garfield Co.

Mayor
P.O. Box 174
Silt 81652

Silver Plume-Clear Creek

Mayor
P.O. Box 456
Silver Plume 80476

Steamboat Springs-Routt Co.

Planning Director
Box 1174
Steamboat Springs 80477

Superior-Boulder Co.

Mayor
206 W. Coal Creek Dr.
Superior Rte.
Louisville 80027

Telluride-San Miguel Co.

Mayor
P.O. Box 902
Telluride 82435

Victor-Teller Co.

Mayor
Box 86
Victor 80860

Walden-Jackson Co.

Mayor
P.O. Box 337
Walden 80480

Walsenburg-Huerfano Co.

Planning Director
122 E. 6th
Walsenburg 81089

Ward-Boulder Co.

Mayor
Columbia St.
Ward 80481

Westcliffe-Custer Co.

Mayor
Box 283
Westcliffe 81252

Williamsburg-Fremont Co..

Mayor
Box 227
Florence 81226

Woodland Park-Teller Co.

P.O. Box G
Woodland Park 80863

Yampa-Routt Co.

Mayor
Yampa 80483