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THE IMPACT OF STATE AND FEDERAL LAW ON
DEVELOPMENT OF GEOTHERMAL RESOURCES IN TEXAS

✓
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✓
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I. INTRODUCTION

Recent geological studies indicate that Texas is potentially a major producer of geothermal energy. One of the impediments to the development of this resource, given the very sizable commitments of capital entailed, is the uncertain legal status of geothermal resources. This report attempts to locate geothermal resources within the general framework of Texas property law and to determine whether these resources can be developed under the law as it now exists.

II. GEOTHERMAL RESOURCES UNDER TEXAS PROPERTY LAW: OWNERSHIP, DEVELOPMENT, AND REGULATION

A. The Nature of Geothermal Resources in Texas

The significant geothermal resource in Texas consists of enormous reservoirs of hot, geopressed water, which formed along the Gulf Coast when water-laden sediments were deposited between surrounding impermeable features, so that the water which would otherwise have been forced out of the sediments was unable to escape. These deposits exist under tremendous pressure which is created by the weight of the overburden. Unlike the more common dry steam and wet steam geothermal sources found in the Western states, where water is heated by direct contact

with hot rocks, a geopressure source absorbs heat indirectly, because the geopressured deposits create an insulating barrier that traps and absorbs the thermal energy of the underlying magma. The water from a geopressure source will not be as hot as water from a dry steam or wet steam source, but the quantity of water available is enormous, and the water pressure itself would be an additional energy source in conjunction with the thermal energy. The water within these beds may be fresh, or very nearly so, and it will probably contain significant amounts of recoverable methane gas in solution. It may be possible to utilize the water pressure, thermal energy, and the methane gas to generate electricity in relatively small power plants located on the recovery site, and the water that has been passed through the turbines and heat exchangers may be a valuable byproduct in itself, depending on its quality and regional demands for agricultural and industrial purposes.

Who has the right to develop this resource, and how would this right be limited by the correlative rights of others and the regulatory power of the state? The resource itself is complex, since it consists of water, methane gas, thermal and kinetic energy, and possibly other

mineral byproducts. This complexity may become relevant if the question involves the drafting or construction of a statute or lease.¹ But in practice the right to make use of the resource will necessarily depend on the right to drill for and dispose of the waters in which the thermal and kinetic energy is contained, so that Texas water law would seem to be the necessary point of departure for any legal analysis in this area. Existing rights in geothermal resources must be presumed to be effectively defined by existing water rights; and since these water rights are vested rights in Texas, any consideration of the alternatives for state action with regard to geothermal resources must begin by taking this fact into account.

B. Geothermal Resources as Ground Water: The Rule of Capture

Surface waters and ground water are treated very differently under Texas law, and the difference is highly significant insofar as the development of geothermal resources is concerned. Surface waters in Texas are held by the state in trust for the people,² and their use is governed by a statutory system of appropriation rights. Under this system a water user acquires and perfects rights to a definite amount of water from a specific source by diverting the water and complying with the requirements of the permit system administered by the Texas Water Rights Commission.³ The Water Code sets up priorities to guide the Commission in granting permits, but once a user has received a permit, any conflict with other users is settled under the rule that first in time is first in right.⁴ The system protects prior appropriators from later users, who must curtail

their use in time of scarcity to the extent that it interferes with the senior appropriator's right to a fixed amount of water.

The appropriation system in Texas was superimposed on the common law system of riparian rights, which arise solely from ownership of lands contiguous to a watercourse or other body of water. Traditionally, the riparian owner was allowed to make reasonable use of the water, and the right was not subject to loss by disuse, nor was it limited to any specific amount, so long as the riparian did not unreasonably diminish the quality or quantity of water available to other riparians.⁵ In 1926, the Texas Supreme Court held the appropriation system constitutional to the extent that it did not impair the vested rights of riparians to the ordinary flow and underflow of the watercourse.⁶ However, under the Water Rights Adjudication Act, existing riparian rights have, in effect, been converted into appropriation rights, and if this Act survives a constitutional challenge, there would be some indication that the potential power of the Legislature to deal with vested water rights is much greater than previous Texas decisions would suggest.⁷

Both the riparian system and the appropriation system are essentially methods of adjusting correlative rights between competing users; and both systems involve rights to the use of water, rather than ownership of the water itself. Ground water in Texas, on the other hand, is treated as if it were a part of the soil, and the owner of the soil owns the water within it. This ownership has been recognized by the Legislature,⁸

and the statutory declaration concerning waters held in public trust has no application here. Ground water rights in Texas arise from the ownership of land, but they are not limited by the correlative rights of other landowners. Certain limited statutory regulations are imposed on the withdrawal of ground water under the police power of the state to prevent waste, but the owner of land in Texas is free, within his own vertical boundaries, to withdraw water without liability for any drainage of water from beneath the land of other owners.

The origins of this rule are to be found in the English case of Acton v. Blundell,⁹ decided in 1843, in which the English courts refused to recognize correlative rights in underground water and held that the reasonable use restrictions of the riparian system did not apply:

We think the present case, for the reasons above given, is not to be governed by the law which applied to rivers and flowing streams, but that it rather falls within that principle, which gives to the owner of the soil all that lies beneath his surface; that the land immediately below is his property, whether it is solid rock or porous ground, or venous earth, or part soil, part water; that the person who owns the surface may dig therein, and apply all that is there found to his own purposes at his free will and pleasure; and that if, in the exercise of such right, he intercepts or drains off the water collected from underground springs in his neighbor's well, this inconvenience to his neighbor falls within the description of *damnum absque injuria*, which cannot become the ground of an action.¹⁰

In 1904, in a case of first impression, the Texas Supreme Court adopted the English rule in Houston and T. C. Ry. Co. v. East.¹¹ The defendant in East, a railroad, owned a well from which it was withdrawing water to supply its maintenance shops. The plaintiff claimed that the railroad's withdrawals had dried up his own domestic well and sued for the damage. The trial court found that the railroad's use was unreasonable by the standards applied to the use of surface waters, but rendered judgment for the defendant anyway. The Supreme Court reversed the Court of Civil Appeals and affirmed the trial court's judgment on the basis of the above quoted language from Acton. The court noted that the rule was founded in public policy, because of the uncertainties involved in tracing the movements of water underground and determining the effect of its withdrawal, and because any recognition of correlative rights in ground water would interfere with material progress. The implication is that, if the water is withdrawn for a beneficial use, whether domestic, agricultural, or industrial, both the rate of withdrawal and the effect of withdrawal on other land are legally irrelevant.

The East rule applies to "percolating ground water," which in practice means that it applies to all water under ground. Certain language in East and subsequent opinions indicates that a different rule might be applied to underground streams with definite and ascertainable boundaries, but ground water is presumed to be percolating unless proved otherwise, and no litigant in Texas has yet been able to avoid the effect of the

East rule by establishing the existence and boundaries of such a stream.¹² Rights in ground water are treated as an interest in real estate, and they can be severed from the land and sold like any other interest in real property.¹³ One significant question left unanswered in East was whether the rule permitted unlimited withdrawals of water for wasteful uses or for commercial sale or use on other lands.¹⁴ But in Corpus Christi v. City of Pleasanton,¹⁵ the Texas Supreme Court reaffirmed the East rule, in a divided opinion, and indicated that, at least in the absence of an effective statutory control, a landowner's right to dispose of the water is effectively unlimited.¹⁶

The principle embodied in the East decision is known as the rule of capture. In practice it means that, while every landowner above a common pool may theoretically own the water in place beneath his land, the only way that each can assert his rights is by reducing the resource to possession. In contrast to the "American" rule applied in many Eastern states, which protects domestic and agricultural uses of ground water by prohibiting certain industrial and commercial uses as unreasonable uses, the East rule permits every ground water user to produce as much water as he can use, without protecting some types of use against other types. Some commentators have protested the anomaly of developing an energy resource under water law,¹⁷ but the rule of capture principle that would govern the development of geothermal resources under Texas water law is the same as the rule of capture principle that applies to oil and gas.

In fact, both the East and Acton cases were often cited as primary authority in early cases defining the nature of property rights in oil and gas.¹⁸ The fundamental similarity between the law of ground water and the law of oil and gas does not necessarily mean that geothermal law should follow the pattern of oil and gas law, but it does provide a strong indication that an extractive resource can be developed within the present framework of Texas property law, and that there are no insuperable legal obstacles to geothermal development.

C. Alternative Models for Development and Regulation

The property law status of geothermal resources would inevitably affect the manner in which the resource is developed, and, together, property law and the pattern of development would largely determine the goals and limits of a state program of regulation. The history of the petroleum industry illustrates this interrelationship between law, development, and regulation. During the early years of the industry, the rule of capture resulted in a race to produce that glutted the market and damaged the oil-bearing strata, because the mineral owner's only protection against drainage under the rule was the self-help remedy of drilling an offset well. Acting through the Railroad Commission, the state has imposed proration and spacing restrictions to prevent wasteful overproduction and the drilling of unnecessary wells. However, when the state limits the mineral owner's right to drill or his production, it prevents him from protecting his own rights, and so the state assumes the duty of protecting correlative rights

when it imposes these restrictions. The constitutional standard for regulation in Texas is that it must not prevent the mineral owner from recovering the resource in place beneath his land, or from receiving its equivalent in kind.¹⁹ In practice, the most serious difficulties here have arisen in connection with the enforcement of spacing regulations, because even the owner of a very small tract has the right to recover his share of the resource. Spacing exceptions did not provide a satisfactory solution, because it was often impossible to grant a production allowable for a small tract that would permit recovery of drilling costs without resulting in drainage from the larger tracts in the unit. The most significant solution to the problem has been voluntary or compulsory pooling and unitization, which allows the small tract owner to share in the production of the unit without drilling a well and without giving him more than his due.²⁰

Arizona,²¹ California,²² Idaho,²³ New Mexico,²⁴ and Oregon²⁵ have now enacted fairly comprehensive provisions for the regulation of geothermal energy production, and all of them except Idaho seem to have assumed that the general pattern of oil and gas development will be repeated in the development of geothermal resources and have provided the rudimentary framework for a system of regulation similar to the one described above. California has created a special Geothermal Resources Board,²⁶ composed of the heads of various other state agencies, while the other states have simply placed geothermal resources within the regulatory jurisdiction of the state agency primarily responsible for regulating oil

and gas. In general, these statutes require a geothermal driller to obtain certain permits and operating bonds, to file certain reports, and to keep certain records. Standards are prescribed for the drilling and abandonment of geothermal wells, and certain restrictions are imposed for the protection of other resources and the environment. Each state has delegated broad rule-making powers to the agency in question, requiring it to act for the prevention of waste or the encouragement of maximum economic recovery of the resource,²⁷ and all of the statutes provide for some form of voluntary or compulsory pooling and unitization.²⁸ It should be noted that none of the four states has attempted to define the property law status of geothermal resources, and although Arizona and New Mexico do not recognize private ownership of ground water,²⁹ neither has gone beyond the regulatory limits that would apply to a privately owned resource. Idaho has defined geothermal resources as "sui generis," neither water nor mineral,³⁰ but the statute follows the appropriation model of the state's ground water system and provides rules for determining priorities between permits for withdrawals of geothermal waters and existing permits for ground water withdrawal.³¹ Two other states, Utah and Wyoming, have provided for development of geothermal resources within the framework of the existing ground water appropriation system, and in these states the water control agencies have the power to promulgate regulations for geothermal drilling and the withdrawal of geothermal waters.³²

For a variety of reasons, it is not likely that any of these statutes would be useful as a model for Texas. The geopressured deposits in Texas differ greatly from the geothermal sources found in these other states, and California is the only Western state that recognizes any form of private ownership of ground water that could be said to resemble the law in Texas.³³ Most of these states will not have to resolve, and none has so far attempted to resolve, the practical problems and legal issues that will be involved in the development of geothermal resources in Texas. Moreover, it is probable that much of the existing pattern of oil and gas regulation, from which most of these statutes were derived, will be inadequate or simply irrelevant as a means of coping with the regulatory needs of the geothermal industry in Texas. Oil and gas regulation has been shaped primarily by the need to prevent overproduction, but the major problem in connection with geothermal resources, at least for the foreseeable future, is more likely to be under-utilization than overproduction. The rising demand for energy and the increased costs of traditional fuels may have brought geothermal development within the realm of economic feasibility, but the building of a geothermal generating plant will be a sizeable undertaking. Wildcat development here would seem to be out of the question. A second factor that differentiates geothermal resources from familiar mineral resources is the geothermal developer's particular need for some form of practical or legal assurance that the resource basis upon which his plant depends will be secure in the

face of the competing demands of later developers. Reduced output from an oil well simply slows the rate at which drilling costs and then profits are recovered, at least until the reduced output no longer justifies the costs of recovery. But reduced output from a geothermal well would make continued operation of a generating plant impossible at some point, so the geothermal developer must have a reasonable degree of certainty that the resource available at a particular site will support a generating plant for a sufficient number of years to justify the investment. Oil and gas regulation is concerned with limiting and apportioning the production of an indefinite number of producers, but geothermal regulation might have to concern itself with insuring a certain minimum period of undiminished production for a limited number of users.

One obvious solution to this problem would be for the state to impose compulsory pooling within a framework of very large drilling units, whose size would be determined on the basis of the minimum requirements of a generating plant over a fixed period of time, rather than on the basis of efficient drainage. This raises another problem, however, because such a unit would probably be very large, and the geothermal developer would face enormous difficulties in acquiring leasing rights over such a large area. This would be a heavy burden in terms of effort and paperwork, and the benefit to the owner of any particular parcel within the unit would be small, because the value of the resource in place will probably be much less than the value of a comparable mineral leasehold. These considerations

suggest that the whole pattern of direct leasing that prevails in the petroleum industry may prove to be unworkable in connection with the development of geothermal resources. The discussion which follows is simply an indication of some of the policy alternatives, and some of the limits on policy, that will have to be considered in choosing a model for the development of geothermal resources.

To begin with, many of the possible problems discussed above might be resolved if geothermal resources were developed under some form of public ownership. The appropriation system that Texas applies to surface waters, and which most of the Western states apply to all types of water, provides a workable method of limiting competing uses for the protection of prior investments, and the problem of securing rights over a very large area would be eliminated. However, the imposition of an appropriation system on ground water in general, or upon geothermal waters in particular, would raise serious constitutional issues in Texas. There is precedent elsewhere for such a solution, because a number of states have created appropriation systems by statute, notwithstanding the impairment of what had previously been recognized as vested rights.³⁴ And as noted above, Texas riparian rights have been limited under the Water Rights Adjudication Act; but these are essentially rights to the use of water, and the Act protects existing riparian uses if they are registered.³⁵ The Legislature could simply declare that geothermal resources in Texas are "sui generis," rather than water or mineral resources, and that they may only be developed by appropriation under a state permit system. But it is difficult to say what

weight such a declaration would carry in a court of law. Clearly the Legislature could not extend the statutory definition of water so as to include oil and thereby bring oil within the existing appropriation system. Yet, if the water in a geopressured deposit that lies under privately owned land is not distinguishable from other ground water, then subjecting it to appropriation would raise the same questions with regard to the taking of private property as the example of the oil. There are some good reasons for making distinctions between geopressured deposits and other forms of ground water, but the effect of statutory definitions on property rights is highly unpredictable.

A legislative assertion of direct public ownership of geothermal resources might create as many legal uncertainties as it resolved. But if we assume, for the moment, that the practical and economic difficulties involved in geothermal development would prevent overproduction and competition between users from becoming a problem, then the operation of the rule of capture might result in something very much like public ownership. The state protects correlative rights in regulating oil and gas production, because it has placed restrictions on drilling and production. If overproduction did not make such restrictions necessary, then the state would have no duty to protect correlative rights. Under these circumstances, private ownership would be meaningless, because most "owners" would be unable to make their theoretical rights effective by reducing the resource to possession. Under this possible model for development, the

geothermal developer would have to acquire surface rights and drilling rights on the particular sites where he drilled, but the rule of capture would permit him to drain a much larger area with impunity. State regulation in this case might only be concerned with the prohibition of practices that were directly wasteful or harmful to the environment.³⁶ There would be an element of unjust enrichment in this for the developer, even though the loss to the other geothermal owners would have been essentially the loss of a windfall gain. However, it should also be remembered that geothermal development will provide cheaper energy for local consumption, and that the state would have the power to make this quasi-public ownership more effectively "public" through the regulation of utility rates and the imposition of a severance tax on the developer.

This hypothetical model for development and regulation is open to at least two objections. First of all, it is only as good as the assumptions upon which it is based. We cannot predict that overproduction and competing use would not eventually become a serious problem, particularly in areas where energy demands are highest. And second, a state policy of not imposing controls on production and competing users might conceivably discourage maximum utilization of the resource, because developers might be unwilling to make heavy capital investments in areas where competing use was most likely to become a problem without some actual legal assurance that later users would be restricted. The Legislature would undoubtedly have the same power to limit later development, under TEX. CONST. art. XVI,

§ 59,³⁷ that it now has to limit the production of oil and gas. Any such limitations, however, would require the protection of correlative rights, and this would make it necessary to find some solution to the problem of acquiring rights within a very large unit.³⁸ The creation of the unit itself could be based on the traditional drilling unit concept, or on some form of public utility licensing, but the effect in either case would be to insure the necessary minimum of protection for as many geothermal developers as possible. Constitutional standards would be satisfied by imposing compulsory pooling within the unit so that all owners could share in production, and the problem of securing rights within the unit could be avoided by reversing the usual leasing process and requiring the individual landowners within the unit to come forward and claim their share of the pool. The geothermal developer could be required to establish a royalty fund, based on the value of the geothermal water withdrawn from the unit, less costs and a fair return on capital investment and management efforts. The fund would operate like a flexible class award in a class action. The developer could be required to give adequate notice, perhaps periodically, to the landowners within the unit, and any landowner who came forward and confirmed his right would be entitled to continuing participation in the fund. The unclaimed royalty for any royalty period would eventually revert to the developer, but just as in the case of the quasi-public model for development described above, the element of unjust enrichment could be counterbalanced through utility rate regulation and a severance tax.

III. THE EFFECT OF PRIOR MINERAL CONVEYANCES

If geothermal resources are classified as ground water, a landowner would be able to sever and convey rights in these resources, but serious questions are raised if there has been a prior conveyance of oil and gas. First, because of the catchall reference to "other minerals," which lessees normally insert in their forms, it is conceivable that a court would hold that geothermal resources had passed under the mineral conveyance. Such a holding would be highly unlikely, but even if the mineral conveyance did not effect a transfer of the geopressured deposit as such, the presence of natural gas in the deposit will inevitably create uncertainties with regard to the relative rights of the geothermal and mineral owners. The first of these questions is not primarily a matter of determining the property law status of geothermal resources; rather, the problem is to determine the intentions of the parties to the mineral conveyance. What is determinative here is not the literal meaning of the terms of the conveyance, but what the parties intended it to mean.³⁹ Oil, for example, is not a mineral in the technical sense, but it has long been established that a conveyance of "minerals" should be construed to include rights to oil and gas. Various rules of construction are invoked by the courts as decisional bases for the interpretation of conveyances,⁴⁰ but the soundest test for deciding this type of issue is the rule announced in Fleming Foundation v. Texaco:

We are of the opinion that in deciding whether or not in a particular case exceptional substances are minerals that

the true test is what that word means in the vernacular of the mining and mineral industry, the commercial world and the landowners at the time of the grant, and whether the particular substance was so regarded as a mineral.⁴¹

In United States v. Union Oil Co.,⁴² which is now on appeal in the Ninth Circuit, a federal district court applied this test in determining whether the United States had retained rights in geothermal resources on land sold under a reservation of "coal and other minerals" and held that geothermal resources were not a mineral under the terms of such a conveyance. In reaching this decision, the court first rejected the government's contention that the act under which the land in question was sold had effected a total severance of the surface and sub-surface estates; it then went on to hold that geothermal resources were essentially water, and that water was not one of the class of "other minerals" that had been reserved.⁴³

No state court has yet ruled in this question in connection with geothermal resources, but in Robinson v. Robbins Petroleum Co.,⁴⁴ the Texas Supreme Court recently held that ground water rights did not pass under a general mineral conveyance. The general weight of opinion has always supported the proposition that water rights are not affected by a mineral conveyance,⁴⁵ except for the mineral owner's express and implied rights to use whatever water is reasonably necessary to develop the mineral estate.⁴⁶ Prior to Robinson, however, there was some indication that salt water, and perhaps any ground water that was not suitable for

domestic or agricultural purposes, might be held to fall within the terms of such a conveyance.⁴⁷ The plaintiff in Robinson had taken a grant of "the surface only," subject to a prior mineral lease under which his grantor had conveyed "all oil, gas and/or mineral rights of every kind and nature belonging to said land." The suit was to recover the value of the salt water that the lessee had withdrawn for the purpose of waterflooding the entire unit. The lessee defended on the basis of his express and implied rights to use the water for operations under the lease, but he also claimed actual ownership of the water under the general mineral conveyance in his own lease and the reservation in the plaintiff's grant. The trial court and the Court of Civil Appeals granted summary judgment to the defendant on the basis of the express and implied rights.⁴⁸ The Supreme Court reversed on this issue, because the water was being used for operations under other leases, and held that the surface owner's water rights were not affected by the prior conveyance of "other minerals." It rejected any rule based on the mineral content of the water, although it emphasized the significance of the fact that the ownership of the salt itself was not in issue:

It is the water with which these parties are concerned and not the dissolved salt. If a mineral in solution or suspension were of such value or character as to justify production of the water for the extraction and use of the mineral content, we would have a different case. The substance extracted might well be the property of the mineral owner, and he might be entitled to use the water for purposes of production of the mineral . . . In either case the water itself is an incident of surface ownership in the absence of specific conveyancing language to the contrary.⁴⁹

Under the Robinson rule, a Texas court will not interpret a general mineral conveyance as indicating an intention to convey rights in ground water, and a mineral lessee who attempted to assert rights in geothermal resources would have to convince a court that a geopressured deposit was not water, even before he attempted to show that the resource was a mineral under the type of test applied in Fleming.

A prior mineral conveyance, therefore, would almost certainly not preempt a later conveyance of geothermal rights. But the natural gas within a geopressured deposit would still presumably be a part of the mineral estate. The separate properties of the geothermal and mineral owners would be inextricably intermingled, and it is difficult to say how the rights of each would affect the other. This sort of problem is rare, because mineral lessees normally acquire rights to all valuable substances that are likely to be intermingled, but one Texas case has dealt with a similar situation in which one party owned the oil rights and the other party owned the gas rights. In Guffey v. Stroud, the plaintiff gas owner sued for an injunction against the defendant oil owner, who had drilled a well that was producing gas but no oil. The Commission of Appeals granted the injunction and rejected the defendant's contention that he should be reimbursed from the gas production for the expense of drilling the well:

Undoubtedly Guffey and his associates had the right to drill the land in their quest for oil. The right to take the oil carried with

it by implication the right to tap the gas pockets and to bring to the surface so much of the gas as was necessary in the proper drilling for oil. . . . But the well having been a failure as an oil well, plaintiffs in error have no right to use it as a means, or permit it as an occasion, for the taking of defendant in error's gas. 50

Under the Guffey rule, a mineral owner would not be permitted to operate a geothermal plant under the guise of producing natural gas, but neither Guffey nor Robinson really deals with the problem of a well producing two valuable substances, and one of the big uncertainties with regard to geothermal resources is the amount and value of the natural gas that would be produced along with the water. 51

If the value of the gas would not justify production for its own sake, then it would seem that the prohibition of the Guffey rule ought to prevent the mineral owner from developing the resource, although the geothermal developer would presumably have a duty to account for the value of the gas. On the other hand, if the value of the gas would justify production for its own sake, should the mineral owner be permitted to develop the gas without making use of the water, and could he operate a geothermal plant in connection with the development of the gas? The first of these questions is essentially a policy issue for the Legislature to resolve, but such a practice would clearly seem to constitute waste within the meaning of TEXAS CONST. art. XVI, §59, and the state would have the power to prohibit this form of development absolutely, without assuming

any duty to protect correlative rights.⁵² As to the second possibility, a court might apply the rule that governs the rights of co-tenants in the same resource, which permits one co-tenant to develop the resource against the wishes of the other if he properly accounts for the profits.⁵³ However, to permit a gas owner to operate a geothermal plant under this principle would seem to be a case of the tail wagging the dog, since the production of the gas would still be a relatively minor aspect of the operation of the plant as a whole. Therefore, it is arguable that the Guffey rule should apply here too, even though the development of the gas would be something more than simply a guise for producing the geothermal resource.

It may well be that these difficulties will prove to be less serious than the foregoing discussion would indicate. In practice, the existence of a prior mineral conveyance may simply mean that the geothermal developer will have to negotiate with an additional party when he secures a drilling site. If there had not been a prior conveyance on a particular site, the developer would of course be careful to secure the right to the minerals within a geopressured deposit.⁵⁴ If there had been a prior conveyance, the geothermal lessee and the mineral lessee would have strong incentives to come to terms with one another, particularly if the state enacted a prohibition against any development of the components of the resource that would result in waste of the other components. Under either of the possible models for development which have previously been

described, geothermal development would probably not be prevented by the clashing interests of the two parties. The assumptions upon which the quasi-public model for development was based would include the assumption that either the economics of drilling or a statutory prohibition against waste would prevent the gas from being developed for its own sake. In this case, the operation of the rule of capture in oil and gas law would be the same as in water law, and the geothermal developer would drain the gas along with the water. The only question here would be the effect of existing regulations on the production of gas, and this will be discussed in a following section. On the other hand, if development followed the second model described above, with regulation based on compulsory pooling within large units, then existing mineral rights within the geopressured deposit might be pooled along with the water rights, and the gas owners could be compensated through the same type of royalty fund as the owners of the water rights.

IV. THE LEGAL STATUS OF GEOTHERMAL RESOURCES ON STATE LANDS

Known deposits of geopressured water are mostly centered beneath the coastlines of Texas and Louisiana, so that in Texas the state itself will be the largest single owner of geothermal resources. Texas retained title to the public domain of the Republic of Texas when it entered the

Union, including the waters, beds, and shores of the Gulf of Mexico, from the line of high tide out to the three-league limit.⁵⁵ These lands are set aside for the benefit of the permanent free school fund.⁵⁶ Much of this area is now subject to oil and gas leases, but the state would have clear title to geothermal resources even in the event that they were held to be mineral resources, because state mineral leases are limited to rights in specific minerals. On the other hand, the state might have a claim to reserved geothermal rights on land sold under mineral classification, because the state has reserved rights in all minerals and has released only rights in specific minerals.⁵⁷

The development of a geothermal leasing program in Texas should be carefully planned. Under present law, there is no statutory provision that would authorize the Commissioner of the General Land Office to convey rights in geothermal resources, and any attempt to operate such a program in the absence of express authority would seriously affect the value of the leases that were granted.⁵⁸ At this time, at least seven other states and the federal government have provided for geothermal development on public lands, and their accumulated experience under these programs may be extremely valuable in drafting a statute for Texas.⁵⁹ Some of the more important questions to be considered in this process are protection of the coastal environment; procedures for bidding and for determining the size and boundaries of particular leases; lease

provisions for primary term, royalties, and delay rentals; and the manner in which prior mineral lessees would be compensated for the use of the natural gas that will be produced.

Due to the present inadequacy of our knowledge in this area, any state leasing program at this time would have to be extremely flexible, and perhaps the enactment of any leasing program at all would be unrealistic prior to the completion of a successful demonstration project. If this were the case, the state might be able to encourage some types of preliminary exploration and experimentation, without committing itself to any particular form of leasing program, by making it possible for developers to engage in such activities with some assurance of priority when a particular site was opened up for full development. Existing programs generally provide for competitive bidding for leases within a "KGRA," a known geothermal resource area, and bidding under the federal program at least has been surprisingly high.⁶⁰ But all of the existing programs involve a type of geothermal source with a proven potential, and aside from the technological problems that remain to be solved in developing geopressured sources in general, the development of state owned geopressured sources will probably involve the solution of special problems if such resources are to be developed through off-shore drilling. At the present stage of development in Texas, competitive bidding for leases with a long primary term, during which no development was required, might not generate significant revenue for the state, and it would probably result

in the acquisition of leaseholds by speculators who were primarily interested in holding the leases for eventual resale, rather than with developing the resource. For this reason, the state should consider requiring a short primary term on all leases, or perhaps a somewhat longer term with a fairly heavy delay rental clause.⁶¹ Until we have some practical experience with regard to the economics of geothermal production, leases could also be drafted so as to provide for periodic renegotiation of royalty rates, in order to permit upward revision if justified by the performance of the resource.⁶² The state might also consider the use of royalty bidding, instead of bonus bidding, because this procedure favors the use of capital for development, rather than initial investment, and it increases the potential number of operators who would be able to participate in exploration and development.⁶³ And the basis for calculation of royalties itself will require a good deal of thought, because the resource will probably be used at the site rather than sold.⁶⁴

The power of the state to shape the development and use of geothermal resources on state lands is not limited by the constitutional factors affecting the regulation of privately owned resources, because the state can act directly through its control over the terms under which it leases. Thus, the problem of competing uses could be dealt with directly by determining minimum lease sizes in such a manner that one developer would not interfere with other users. Wherever geothermal

leases overlapped with existing mineral leases, the state can presumably require pooling with regard to the gas within the geopressed deposits.⁶⁵ Moreover, because geothermal energy will be produced and consumed within a single locality, state energy policy in connection with the use of these resources will be very little affected by federal regulatory programs that have limited state policy in connection with the use of its oil and gas resources. For obvious reasons, geothermal energy is not readily adaptable as an alternative energy source during a short term energy crisis like the recent Arab oil embargo. Supplies of geothermal energy cannot be shifted from one region of the state to another in time of crisis. But for this very reason, this energy will remain within the state that produces it and will not have to be shared with non-producing states. This combination of state ownership and policy-making autonomy will permit Texas to make use of the potential availability of energy and water from geothermal resources to plan for regional development on a long term basis.

V. REGULATION OF GEOTHERMAL PRODUCTION UNDER EXISTING STATE LAW

A geothermal well would be both a gas well and a water well, as these terms are defined in various statutes. Because of this, geothermal production under existing law would fall under the regulatory jurisdiction of a number of state agencies, although no agency would presently have the authority for effective regulation.

A. The Railroad Commission

Any well which produced methane gas in conjunction with water would be a "gas well" within the meaning of TEX. REV. CIV. STAT. ANN. art. 6008, § 1(d),⁶⁶ and the Commission's power to make and enforce rules under § 6 of this article would apply to anyone who drilled or operated such a well. All of the permits, records, and precautions that would be required in the case of an ordinary gas well would apply to a geothermal well.⁶⁷ The Railroad Commission would also be the state agency responsible for enforcement of state water quality standards and the regulation of any discharges of mineralized water from a geothermal well that might lower the quality of surface and sub-surface waters, because under TEX. REV. CIV. STAT. ANN. art. 6029a, the Commission is charged with this duty ". . . in connection with the drilling of exploratory wells and wells for oil or gas or any purpose in connection therewith." And aside from the geothermal developer's activities in drilling for and producing the resource, any use of a pipeline that brought it within the "public utility" provisions of art. 6050 would also bring it within the Commission's power to regulate rates under art. 6053.⁶⁸

Under present law, the Commission would have the power to prevent waste of geothermal resources, but only insofar as the practice in question involved the waste of natural gas. Any practice that merely wasted the potential energy of the water in a geopressured deposit would apparently not be subject to the Commission's regulation. As the law now stands,

the Commission might have the power to impose proration on the production of geothermal wells by imposing proration on the gas within the resource, but the question whether the Commission would have both the power and the duty to impose proration on the production of such gas would seem to depend upon whether this gas is properly to be included in the Commission's computation of daily reasonable market demand.

TEX. REV. CIV. STAT. ANN. art. 6008, §10 provides that:

The Commission shall prorate and regulate such production for the protection of public and private interest:

(a) In the prevention of waste as "waste" is defined herein;

(b) In the adjustment of correlative rights and opportunities of each owner of gas in a common reservoir to produce and use or sell such gas as permitted in this Article.

This section, however, is qualified by section 11, which states that the Commission shall exercise its authority under subsection (a) when there is evidence to support a finding of imminent waste, and under subsection (b) when:

evidence introduced at a hearing to be held as herein provided will support a finding made by the Commission that the aggregate lawful volume of the open flow or daily potential capacity to produce of all gas wells located in a common reservoir, is in excess of the daily reasonable market demand for gas from gas wells that may be produced from such common reservoir, to be utilized as permitted in this Article.

The provisions in section 12 for determining monthly allowables apply only if the findings required in section 11 have been made, and arguably such findings ought not to be made in the case of a geothermal well, because the production of gas from a geothermal well involves no form of prohibited waste, and the production of gas that was to be used on the site would have nothing to do with the market demand for the natural gas being produced from other sources. It now seems to be settled that the Commission's power (as opposed to its duty) to protect correlative rights is not strictly limited to situations involving waste,⁶⁹ but the Texas Supreme Court has held that the Commission cannot attempt to protect correlative rights by limiting the allowable production of a reservoir to less than the reasonable market demand, except where the regulation is necessary for the prevention of waste.⁷⁰ If the Commission were able to limit the allowable production from a geothermal well and chose to exercise this power in order to protect existing mineral rights against drainage by a geothermal well, the development of geothermal resources might be impossible without affirmative action by the Legislature.⁷¹ In this case, the state might have to choose between limiting the Commission's power with regard to the protection of correlative rights in geothermal resources, so as to permit the production of geothermal energy under a system of minimal regulation, such as the quasi-public model for development described above, or providing for some sort of geothermal regulation within a framework of very large drilling units and compulsory pooling as described in the second hypothetical model for geothermal development.

B. The General Land Office

Any exploration for or production of geothermal resources on state lands would be subject to the terms of the leases granted and to the power of the Commissioner of the General Land Office to promulgate rules and regulations for the protection of the environment.⁷² Violation of the Commissioner's rules, or the conditions under which a permit is granted, is a misdemeanor offense and may result in forfeiture of rights that have been granted.⁷³ Geothermal wells on state lands would be subject to the Railroad Commission's power to prevent waste to the same extent as other natural gas wells, but the enforcement of water quality standards on these lands would presumably be the responsibility of the Land Office, which in the past has generally followed the same policies as the Railroad Commission with regard to the regulation of discharges from oil and gas wells.

C. Regulation Under the Texas Water Code

Under the Texas Water Code, the Water Quality Board would probably be the only agency directly involved in the regulation of geothermal energy production, although the Texas Water Rights Commission and the Underground Water Districts provided for under TEX. WATER CODE § 52.101 et seq. have potential powers that might affect the development of geothermal resources. In addition, certain general provisions pertaining to the drilling of artesian wells would apply to the drilling of a geothermal well, including section 5.202, which states that

the owner of an artesian well is required to control its flow if the water contains substances injurious to vegetation or to agriculture.⁷⁴ Under section 21.075, the Water Quality Board has sole authority to determine water quality standards for the state, and any discharge of waste that would affect the quality of water within the state is subject to regulation under the permit system administered by the Board.⁷⁵ As noted above, however, the Legislature has placed the enforcement of water quality standards in connection with oil and gas production in the hands of the Railroad Commission, so the Board's responsibility here under present state law would be limited to the establishment of standards. But the Board's power to affect the development of geothermal resources is not determined solely by the provisions of state law, because the federal Water Pollution Control Act Amendments of 1972 make the enforcement of federal standards very largely dependent on the standards set by state water pollution control agencies, and the standards to be formulated in Texas will include standards for specific "point sources" of water pollution, among which geothermal wells will presumably be included.⁷⁶

There is presently no effective statewide regulation of ground water production,⁷⁷ although TEX. WATER CODE § 23.002 states that the Water Rights Commission shall

make and enforce rules and regulations for conserving, protecting, preserving, and distributing underground, subterranean, and percolating water located in this state, and shall do all other things necessary for these purposes.

The Water Rights Commission has never attempted to exercise this power for any general regulation of ground water production and presumably would not do so in connection with geothermal resources. In practice, the only approach to actual regulation here has been through the creation of Underground Water Districts, which were intended to permit the users of water within a specific ground water reservoir to regulate themselves. The districts have the power to regulate the spacing and production of water wells, in order to minimize drawdown of the water table, reduced artesian pressure, subsidence, and waste.⁷⁸ They have not been particularly successful, even for the purposes for which they were intended, and they would not provide a suitable vehicle for regulation of geothermal energy production. Less than a dozen of these districts are now in existence, and none are located in South Texas or along the coastlines where geopressured deposits are known to exist. Moreover, even if a geopressured deposit lay within the boundaries of an existing district, these boundaries would have been determined on the basis of the boundaries of some other deposit of ground water, and the powers of the district would presumably be limited to matters affecting the particular reservoir that it was created to manage.⁷⁹

D. Present Requirements for Adequate Regulation

Until we know enough about the resource and its potential to resolve the policy issues involved, any comprehensive program of regulation would probably be unrealistic. Aside from the overlapping requirements for

permits and reporting, the most serious defects in the present law are the absence of any effective standard for waste of ground water and the possibility that the present rules for spacing and prorating production of natural gas wells might be applied. For present purposes, the state could provide for whatever regulation is necessary by giving the Railroad Commission, which already has the machinery and procedures for enforcement, the power to make rules and regulations for the prevention of any practice that would result in damage to other resources, or to the environment, or waste of geothermal resources, including any practice that significantly limited the maximum recovery of the energy potential of the resource. Any permits that were required could be issued by the Commission, and it could require whatever records and reports were necessary. Perhaps the most difficult policy issue that will have to be resolved in the long run is whether correlative mineral and water rights should be protected by the state, or if regulation of competing uses is required, the manner in which these rights would have to be protected. Until these issues can be resolved, geothermal wells should not be regulated under present rules for spacing and proration. For this reason, the Legislature should also amend the definition of "gas well" in art. 6008, so as to exclude geothermal wells from the operation of these rules. If the Legislature desired to provide protection for mineral owners who would be affected by this change, it might require geothermal developers to establish a fund based on the value of the gas removed at the wellhead, less the proportionate cost of producing the gas. The money could be placed in an escrow account

for a specific number of years, after which it would revert to the developer, unless prior to that time some general or private plan for pooling had been adopted, at which point the money would be divided among those parties who would have shared in production if the plan had been in effect from the beginning. Mineral owners who would have been unable to drill anyway would have lost nothing by this procedure, whatever regulatory policy is eventually adopted. And if the resource is widely developed during this period of minimum regulation, then some form of spacing restrictions and pooling would have to be imposed, and the mineral owners would be placed in the same position that they would have been in if the restrictions had been imposed at an earlier date.

VI. RELEVANT FEDERAL LAW

A. Federal Subsidies for Geothermal Research and Development

Aside from the legal confusion affecting geothermal development, there will be enormous practical difficulties in financing geothermal exploration and research. The federal government has attempted to meet these difficulties with a loan guaranty program embodied in the Geothermal Energy Research, Development, and Demonstration Act of 1974 (P. L. 93-410), which became law on September 3, 1974. This Act authorizes the Secretary of the Interior to enter into commitments to guarantee financial institutions against loss of principal or interest on loans made to qualified borrowers "for the purpose of acquiring rights in geothermal resources and performing exploration, development, and construction and operation

of facilities for the commercial production of energy from geothermal resources." Private developers would have to secure private financing, but the government would guarantee principal up to 75 percent of the aggregate cost of a project on loans made at prevailing interest rates with a period of repayment of thirty years or less. The maximum loan for any single project would be \$25 million, and the limit for any single borrower would be \$50 million. The Secretary is also authorized to make payments on interest charges if a borrower is in default and the probable net cost to the government would be less than that which would result in the event of a complete default. The Act provides for the creation of a Geothermal Resources Development Fund and authorizes \$50 million annually for the next ten years. Title II of the Act provides for the creation of a Geothermal Energy Coordination and Management Project,⁸⁰ under which the Federal Energy Administration, the Department of the Interior, the AEC, NASA, and the National Science Foundation would attempt to encourage and assist private industry to construct pilot plants and develop the technology needed to exploit the various types of geothermal resources. The AEC, in particular, is authorized in section 208 of the Act to enter into cooperative agreements with other governmental and non-governmental entities for the construction of demonstration projects, with a maximum federal investment of \$10 million on any single project.

B. Taxation

Geothermal energy will have to compete with other energy sources in terms of cost. It will also have to compete with other industries in attracting private investment capital. The federal loan guaranty program

will make it easier for geothermal developers to borrow, but it would not make investment itself more attractive. Aside from the risks involved in developing a new resource, one of the factors which places geothermal energy at a disadvantage in competing with other energy sources for investment capital is the highly favored tax treatment which has long encouraged investment in the petroleum industry. One element of this favorable treatment is percentage depletion under section 611 of the 1954 Code. This section allows a reasonable deduction for depletion in the case of "mines, oil and gas wells, other natural deposits, and timber." Under section 613, this deduction is computed as a fixed percentage, which varies according to the particular resource, of the gross income from the property, less any rents and royalties, and not in excess of fifty percent of gross income. There is a specific provision for a deduction of twenty-two percent in the case of "oil and gas wells" and a residual provision of fourteen percent for all other minerals not specifically listed; but certain substances, including water and minerals derived from an inexhaustible source, are specifically excluded from the residual classification. The second favorable element is the provision for deduction of intangible drilling costs under section 263(c), which creates a general exception for oil and gas wells to the general rule that improvements are to be treated as capital expenditures. The driller of an oil or gas well can treat his expenditures for assets that have no salvage value as expenses and use them immediately as an offset against current income, so that he gets an immediate return from his investment in the form of tax savings.

In Arthur E. Reich,⁸¹ the Tax Court permitted the drillers of geothermal wells in California to take both types of deductions, based

on findings that the taxpayers' wells were producing steam; that steam was a "gas" within the meaning of both sections of the Code; and that the geothermal deposits from which the steam was being produced were exhaustible. Reich was affirmed by the Ninth Circuit, but the Commissioner has not acquiesced in this holding. Geothermal developers in Texas will undoubtedly attempt to claim the same benefits as the taxpayers in Reich, but the significance of that case for Texas producers may be limited by two factors. First, it is possible that percentage depletion for oil and gas wells will be phased out in the course of the next few years; and second, the Commissioner will probably attempt to argue that geopressured wells are not "gas" wells, because they will produce more water and less steam than the wells involved in Reich, an argument that would limit the availability of the deduction for intangible drilling costs under section 263(c) as well as percentage depletion. The latter provision would become significant only when a geothermal well began to produce income, but the other section provides a strong incentive for exploration and development. It would be extremely unfortunate if the Reich holding was not followed in other circuits, because there is a real need to encourage private investment in geothermal energy production, and the policy considerations behind the present taxation of oil and gas production activities would seem to apply just as clearly in the case of geothermal resources.

C. Federal Energy and Environmental Regulation

Geothermal energy production will probably not be significantly affected by federal energy regulation, because the production of natural gas and the generation of electricity for local consumption would not trigger the jurisdictional provisions of the various federal acts.⁸² Federal environmental regulation would affect geothermal energy production just like any other source of potential pollution. The law in this area is too complex for detailed treatment within the scope of this report, but two federal statutes deserve special mention. First of all, the 1972 amendments to the federal Water Pollution Control Act⁸³ have greatly extended the federal government's role in defining and enforcing national standards of water quality against particular industries. The Act speaks in terms of "navigable waters," but the Committee Reports indicate that the Act is intended to push this concept as far as the commerce clause will permit, and the Environmental Protection Agency has given notice that it will read the Act as applicable to any waters capable of affecting interstate commerce, including any waters which affect an industry in interstate commerce.⁸⁴ The second federal statute which deserves special mention here is the National Environmental Policy Act,⁸⁵ which requires the preparation of an environmental impact statement prior to any major federal action that would significantly affect the environment.⁸⁶ Both the demonstration projects and the loan guaranty program provided for under the Geothermal Energy Research, Development,

and Demonstration Act would presumably fall within the impact statement criteria in NEPA, so that the environmental effect of geothermal energy development in Texas might have to be assessed before any federal money became available for research and development.⁸⁷

FOOTNOTES

1. See, e.g., the definition found in the Geothermal Steam Act of 1970, 30 U.S.C. §1002(c) (Supp. 1972): "geothermal steam and associated geothermal resources means (i) all products of geothermal processes, embracing indigenous steam, hot water and hot brines; (ii) steam and other gases, hot water and hot brines resulting from water, gas, or other fluids artificially introduced into geothermal formations; (iii) heat or other associated energy found in geothermal formations; and (iv) any byproduct derived from them."
2. TEX. WATER CODE ANN. § 5.021 (1972).
3. TEX. WATER CODE ANN. §§ 5.023, 5.025, 5.026, 5.030 (1972).
4. TEX. WATER CODE ANN. §§ 5.024, 5.027 (1972).
5. See W. HUTCHINS, THE TEXAS LAW OF WATER RIGHTS 300 (1961).
6. Motl v. Boyd, 116 Tex. 82, 286 S.W. 458 (1926). In general, riparian rights in Texas are limited to lands that passed from the state before 1895, the year of the first state-wide appropriation statute.
7. Under the Water Rights Adjudication Act, TEX. WATER CODE ANN. § 5.301 et seq. (1972), all riparian claims, except claims on water used for domestic purposes or to water livestock, had to be registered with the Water Rights Commission before the final cut-off date of September 1, 1974. In future, only registered claims will be recognized, and the registered claim will be limited to the maximum amount of water that the claimant put to beneficial use in any one year between 1963 and 1967 inclusive.
8. TEX. WATER CODE ANN. §§ 5.339, 21.004, 52.002-.003 (1972).
9. 112 M.&W. 324, 152 Eng. Rep. 1223 (Ex. 1843).
10. 152 Eng. Rep. at 1235.
11. 98 Tex. 146, 81 S.W. 279 (1904).
12. See, e.g., Pecos Cty. Water Control and Improvement Dist. v. Williams, 271 S.W.2d 503 (Tex. Civ. App. --El Paso 1954, writ ref'd n. r. e.).

13. Texas Co. v. Burkett, 117 Tex. 16, 296 S.W. 273 (1927); Evans v. Ropte, 128 Tex. 75, 96 S.W.2d 973 (Tex. Comm'n App. 1936, opinion adopted).
14. Most American jurisdictions never adopted the English rule in its pure form. Except for California, see Katz v. Wilkinshaw, 141 Cal. 116, 74 P. 766 (1903), most states follow the English rule in refusing to attempt a judicial apportionment between competing users; but under the "American" rule, certain uses are eliminated as unreasonable, most notably the withdrawal of water for commercial sale. This prevents a city from supplying its needs by pumping ground water far in excess of what its fair share would be on the basis of surface ownership. See, e.g., Forbell v. City of New York, 164 N.Y. 522, 58 N.E. 644 (1900); Hanks and Hanks, The Law of Water in New Jersey, 24 RUTGERS L. REV. 621, 630-639 (1970).
15. 154 Tex. 289, 276 S.W.2d 798 (1955).
16. This was a suit for an injunction to prevent the city of Corpus Christi from pumping water from the Carrizo sands. The city transported the water from the wells by allowing it to flow through more than a hundred miles of open watercourse, so that as much as 74 percent of the water was being lost in transit. At issue were the city's rights as a landowner under the English rule and the construction of what is now TEX. WATER CODE ANN. §5.205 (1972), the only statutory provision generally applicable to waste of ground water. The Texas Supreme Court rejected the possible limitations on wasteful uses suggested in Cantwell v. Zinser, 208 S.W.2d 577 (Tex. Civ. App. --Austin 1948, no writ history), and held that the statute applied only to unlawful uses.
17. See, e.g., O. Olpin, The Law of Geothermal Resources, ROCKY MTN. 14th ANN. MIN. L. INST. 123 (1968); J. Brooks, Legal Problems of the Geothermal Industry, 6 Nat. Res. J. 511 (1966); D. Allen, Legal and Policy Aspects of Geothermal Resource Development, reprinted in Hearings on H.R. 8628 and H.R. 9658 Before the Subcommittee on Energy of the House Committee on Science and Astronautics, 93d Cong., 1st Sess., at 157 (1973). Except for California, the Western states with geothermal resources generally apply the appropriation doctrine to ground water, so the state can make whatever provision is necessary for developing geothermal resources. For an example of a state water law that might interfere with geothermal development, see [1973] COLO. SESS. LAWS ch. 441. Because of the very large amount of federal land in these states, and because of the active

federal geothermal leasing program under the Geothermal Steam Act of 1970, there could be serious problems if the regulation of geothermal resources becomes embroiled in the continuing federal-state conflict over water rights and regulatory power. See E. Morreale, Federal-State Conflict Over Western Waters, 20 RUTGERS L. REV. 423, 431 (1966).

18. See, e.g., Brown v. Humble Oil and Refining Co., 126 Tex. 296, 83 S.W.2d 935, 940 (1935); Stephens Cty. v. Mid-Kansas Oil & Gas Co., 113 Tex. 160, 245 S.W. 290, 292 (1923). See also Higgins Oil & Fuel Co. v. Guaranty Oil Co., 145 La. 233, 82 So. 206 (1919); Jones v. Forest Oil Co., 194 Pa. 379, 44 A. 1074 (1900); A. Walker, Jr., Theories of Ownership of Oil and Gas Compared with Those of Ground Water, Univ. of Tex. Proceedings on Water Law 121 (1956).
19. Halbouty v. Railroad Comm'n, 163 Tex. 417, 357 S.W.2d 364 (1962); Atlantic Refining Co. v. Railroad Comm'n, 162 Tex. 274, 346 S.W.2d 941 (1962); Marrs v. Railroad Comm'n, 142 Tex. 293, 177 S.W.2d 941 (1944).
20. See Mineral Interest Pooling Act, TEX. REV. CIV. STAT. ANN. art. 6008c (Supp. 1974); R. Hardwicke and M. Woodward, Fair Share and the Small Tract in Texas, 41 TEX. L. REV. 75 (1962).
21. ARIZ. REV. CIV. STAT. ANN. §27-651 et seq. (Supp. 1973).
22. CAL. PUB. RESOURCES CODE §3700 et seq. (1972).
23. IDAHO CODE §42-001 et seq. (Supp. 1973).
24. N.M. STAT. ANN. §65-3-11.2 (Supp. 1973). The New Mexico statute simply gives the State Oil and Gas Commission the same powers, with respect to geothermal resources, that it exercises over production of oil and gas.
25. ORE. REV. STAT. §522.010 et seq. (1971), as amended [1973] ORE. LAWS ch. 388.
26. CAL. PUB. RESOURCES CODE §3742 (1972).
27. See, e.g., CAL. PUB. RESOURCES CODE §3714 (1972); ARIZ. REV. CIV. STAT. ANN. §§27-651.9, - 652 (Supp. 1973); ORE. REV. STAT. §§522.012-.014 (1971); N.M. STAT. ANN. §65-3-11.2 (Supp. 1973): "The oil conservation commission is hereby vested . . . with the authority and duty of conserving and preventing

waste of geothermal resources within this state in the same manner, insofar as is practicable, as it regulates, conserves and prevents waste of natural or hydrocarbon gas."

28. See, e.g., CAL. PUB. RESOURCES CODE §3756 (1972) (voluntary); ORE. REV. STAT. §522.041 (1971) (voluntary); ARIZ. REV. CIV. STAT. ANN. §§27-664, -665, -666 (Supp. 1973) (voluntary unitization with compulsory pooling within a drilling unit); IDAHO CODE §42-4013 (Supp. 1973) (voluntary and compulsory unitization).
29. See Southwest Engineering Co. v. Ernst, 79 Ariz. 403, 291 P.2d 764 (1955); State v. Dority, 55 N.M. 121, 225 P.2d 1007 (1950).
30. IDAHO CODE §42-4002(c) (Supp. 1973): "Geothermal resources are found and hereby declared to be sui generis, being neither a mineral resource nor a water resource, but they are also found and hereby declared to be closely related to and possibly affecting and affected by water and mineral resources in many instances."
31. See IDAHO CODE §§42-4002, -4003, -4004, -4005 (Supp. 1973). Geothermal resources are regulated by the State Department of Water Administration through a permit system. The Department may refuse to grant a permit if the drilling of well in question would be against the public interest. If the use of the waters involved would affect rights under existing water permits, the operator would be required to obtain a water permit as well as a geothermal well permit.
32. See UTAH CODE ANN. §73-1-20 (Supp. 1973); the Wyoming Ground Water Act, as amended WYO. STAT. §41-121(b) (Supp. 1973). Two other states, Montana and Colorado, have introduced geothermal legislation during the last year. The Montana bill, which failed of passage, would have regulated the resource as ground water. The Colorado bill follows the oil and gas pattern of regulation, but would not modify the effect of existing water law on geothermal resources, so that withdrawals from a geothermal deposit would be limited to one percent of the deposit per year. For a discussion of these bills and state and federal geothermal regulation in general, see P. Schlauch and T. Worcester, Geothermal Resources: A Primer for the Practitioner, 9 LAND & WATER L. REV. 327 (1974). Although it is no longer completely up to date, the status of geothermal legislation in the Western states is summarized in a chart reprinted in Hearings, supra note 17, at 104.
33. See generally, W. HUTCHINS, THE CALIFORNIA LAW OF WATER RIGHTS (1956); R. Moses, The Law of Ground Water, ROCKY MTN.

11th ANN. MIN. L. INST. 276 (1966); Clark, Ground Water Legislation in the Light of Experience in the Western States, 22 MONT. L. REV. 42 (1960). California recognizes private ownership subject to equitable apportionment in times of scarcity. Some states defer to private ownership in theory, but regulate in practice on an appropriation basis; see, e.g., In re Willow Creek, 74 Ore. 592, 144 P. 505 (1915).

34. See, e.g., Knight v. Grimes, 80 S.D. 517, 127 N.W.2d 708 (1964); compare State ex. rel. Emery v. Knapp, 167 Kans. 546, 207 P.2d 440 (1949), with State ex. rel. Peterson v. State Bd. of Agriculture, 158 Kans. 603, 149 P.2d 604 (1944). See also R. Harnsberger, Nebraska Ground Water Problems, 42 NEB. L. REV. 721, 744 (1963); O'Connell, Iowa's New Water Statute: The Constitutionality of Regulating Existing Uses of Water, 47 IOWA L. REV. 549 (1962).
35. Rights like appropriation rights which are based on use may be subjected to forfeiture for non-use; see Texas Water Rights Comm'n v. Wright, 464 S.W.2d 142 (Tex. 1971). But ground water rights in Texas are neither based on, nor limited to, the beneficial use of water, and Texas courts have traditionally limited state encroachments on vested water rights; see, e.g., Mud Creek Irr., Agric., & Mfg. Co. v. Vivian, 74 Tex. 170, 11 S.W. 1078 (1889).
36. This is not to say that the state would not have the power to pursue a policy of protecting correlative rights if it wished to do so. But as a matter of police power, the state could regulate an economic activity that affected the public interest, prohibiting all developers and potential developers alike from doing certain things, without assuming the duty to adjust correlative rights. If every owner had the right to drill and produce, and most chose not to exercise this right, or were unable to find anyone who wished to acquire it from them and use it, there would be a serious question whether any owner had an interest that the state ought to protect.
37. This is the so-called "conservation amendment," which declares that the "conservation and development of all the natural resources" of this state is a public right and duty, and that the Legislature is empowered to "pass all such laws as may be appropriate thereto."
38. A program of geothermal regulation similar to the following was recommended to Governor Edwards of Louisiana by Dean George W. Hardy III, of the University of Kentucky School of Law, in a memorandum on geothermal energy problems prepared in 1973.

39. It should be noted that, on the basis of cases involving uranium and other exotic resources, it is clear that geothermal resources could fall within the general class of substances that the parties intended to be conveyed, even though neither party knew of the geothermal resources at the time. See, e.g., Cain v. Neumann, 316 S.W.2d 915, 922 (Tex. Civ. App. --San Antonio 1958, no writ history).
40. Among the most significant of these is the rule that a grant will be construed against the grantor, except in the case of a grant by the state, which is construed against the grantee; and the principle of ejusdem generis, under which the specific terms in a grant will be read as limiting and defining the general terms that precede them. See, e.g., Vogel v. Cobb, 193 Okla. 64, 141 P.2d 276 (1943) (excluding water from a mineral conveyance, because specific references to oil and gas limited the meaning of the general reference to minerals).
41. 337 S.W.2d 846, 852 (Tex. Civ. App. --Amarillo 1960, writ ref'd n. r. e.) (mineral conveyance did not include ground water).
42. 369 F.Supp. 1289, 1297 (N.D. Cal. 1973). In the Geothermal Steam Act of 1970, 30 U.S.C. §1001 et seq. (Supp. 1972), Congress instructed the Attorney General to test the federal government's claim to geothermal rights on lands previously sold under a mineral reservation; 30 U.S.C. §1020(b) (Supp. 1972). The question whether geothermal resources were minerals had been much debated prior to passage of the Act, because the Department of the Interior had refused to permit leasing for geothermal development under any of the federal provisions for mineral leasing.
43. 369 F.Supp. at 1293-95, 1297-98. The mineral reservation in question was part of the Stock Raising Homestead Act, 43 U.S.C. §299 (1970), under which some 40 million acres of land have been sold. For a critique of the decision see Bjorge, The Development of Geothermal Resources and the 1970 Geothermal Steam Act--Law in Search of Definition, 46 COLO. L. REV. 1 (1974).
44. 501 S.W.2d 865 (Tex. 1973).
45. See, e.g., Fleming Foundation v. Texaco, Inc., supra, 337 S.W.2d at 846; Mack Oil v. Lawrence, 389 P.2d 955 (Okla. 1964); 1 H. WILLIAMS & C. MEYERS, OIL & GAS LAW §219.6 (1972).
46. Sun Oil v. Whitaker, 483 S.W.2d 808 (Tex. 1972); Stradley v. Magnolia Petroleum, 155 S.W.2d 649 (Tex. Civ. App. --Amarillo 1949, writ ref'd).

47. See, e.g., Ambassador Oil Corp. v. Robertson, 384 S.W.2d 752 (Tex. Civ. App. --Austin 1964), writ ref'd n.r.e. per curiam, 390 S.W.2d 472 (1965); L. Hudson, Salt Water Is a Mineral, 50 TEX. L. REV. 448 (1972).
48. 487 S.W.2d 794 (Tex. Civ. App. --Tyler 1973).
49. 501 S.W.2d at 867. See also Stephen Hays Estate v. Togliatti, 85 Utah 137, 38 P.2d 1066 (1934) (water containing copper in solution).
50. 16 S.W.2d 527 (Tex. Comm'n App. 1929, opinion adopted).
51. In 1973, Dr. Robert Rex suggested, in testimony before the House Committee on Science and Astronautics, that state and county ad valorem taxation had resulted in an underestimation of the amounts of methane gas present in geopressed deposits, because oil companies were reluctant to confirm the existence of large reserves of gas that might not be economically recoverable at current gas market prices. Dr. Rex also predicted that, in some areas of Texas, existing technology and power needs would result in use of the gas and water only, without utilization of the thermal and kinetic energy except for compression of the gas and reinjection of salt. See Hearings, supra note 17 at 142-53.
52. See, e.g., the various direct prohibitions of wasteful methods and uses in the Oil and Gas Title.
53. Cox v. Davison, 397 S.W.2d 200 (Tex. 1965); White v. Smyth, 147 Tex. 272, 214 S.W.2d 967 (1948); Rosse v. Northern Pump Co., 353 S.W.2d 287 (Tex. Civ. App. --Austin 1962, writ ref'd n.r.e.).
54. This would not necessarily mean that the geothermal lessee would have to acquire all the mineral rights in the property. A geothermal conveyance could be drafted so as to include rights in gas only below a certain horizon, or only gas as defined by some other limitation that would exclude all minerals except those within a geopressed deposit.
55. TEX. REV. CIV. STAT. ANN. arts. 5415, 5415a (1962); see United States v. Louisiana, 363 U.S. 1, 36 (1960); Submerged Lands Act, 43 U.S.C. §§ 1301-1315 (1970).
56. TEX. REV. CIV. STAT. ANN. art. 5415a, §3, and art. 5421c-3 (1962).

57. See TEX. REV. CIV. STAT. ANN. arts. 5367 and 5421c, §4 (1962). But in the light of United States v. Union Oil Co., *supra*, there is no reason to believe that the state would be successful in asserting such a claim, and most of the lands sold under mineral classification are not within the areas where geopressured deposits are known to exist.
58. The Commissioner's leasing authority with regard to gulf lands is found under TEX. REV. CIV. STAT. ANN. art. 5421c, §8 (1962). However, even if the Commissioner had sufficient discretionary power to lease for geothermal development under the present law, there would be a potential conflict with the Coastal Public Lands Management Act of 1973, TEX. REV. CIV. STAT. ANN. art. 5415e-1 (Supp. 1973), which places control of the leasing of the surface estate in tidewater lands in the hands of the School Land Board. Any possibility of confusion here should be eliminated when the state enacts a leasing statute.
59. The seven states are Alaska, California, Idaho, New Mexico, Oregon, Utah, and Wyoming. All underground water in Wyoming belongs to the state, *see* WYO. STAT. §41-2 (1957); but the state has made no attempt to secure royalties for the use of geothermal resources. In Utah, which also treats the resources like ground water for purposes of regulation, the State Land Board will lease surface rights in state land for geothermal development *see* Schlauch, Geothermal Resources, *supra* note 32 at 356. The other five states have provided for leasing on state lands and the collection of royalties by the state. *See* ALASKA STAT. §38.05.181 (1971); CAL. PUB. RESOURCES CODE §6902 *et seq.* (Supp. 1973); CAL. ADMIN. CODE §2250 *et seq.* (Supp. 1973); IDAHO CODE §47-1601 *et seq.* (Supp. 1973); N.M. STAT. §7-15-1 *et seq.* (Supp. 1973); ORE. REV. STAT. §522.415 (1971). It should be noted that Arizona apparently has a regulatory program, but no leasing program, while Alaska provides for regulation only with regard to geothermal development on state lands. It should also be remembered that the federal government owns the greater part of the undeveloped land in the Western states, so that the bulk of geothermal development in these states will probably be under the federal program.
60. *See, e.g.*, 30 U.S.C. §1003 (Supp. 1972); N.M. STAT. §7-15-6 (Supp. 1973).
61. The federal act provides for a ten year primary term, with a five year extension if drilling has commenced within the primary term. There would also be a fixed minimum yearly rental of one dollar

per acre. 30 U.S.C. §§ 1004, 1005 (Supp. 1972). But cf. N.M. STAT. § 5-15-11 (Supp. 1973) (five year primary term with renewal for succeeding five year terms). California provides alternative procedures for prospecting under a three year permit or bidding for leases with a twenty year primary term. CAL. PUB. RESOURCES CODE §§ 6910, 6918 (Supp. 1973).

62. The federal act provides for renegotiation at the end of a period of 35 years and every 25 years thereafter. 30 U.S.C. § 1007(b) (Supp. 1972). This is probably much too long. Cf. CAL. PUB. RESOURCES CODE § 6912(e) (Supp. 1973) (first renegotiation after 20 years and every 10 years thereafter; N.M. STAT. § 7-15-9 (Supp. 1973) (state can waive, suspend, or reduce royalties at any time); ALASKA STAT. § 38.05.181(m) (1971) (royalties subject to revision every ten years).
63. The advantages of permitting royalty bidding for oil and gas leases are discussed in L/R-5 at part V, which suggests that this procedure encourages active exploration by smaller operators.
64. It may be impossible to base royalties on any simple percentage of market price if the lessee uses the resource to generate electricity. The federal act provides for a royalty of 10 to 15 percent of the value of the resource sold or converted, plus not more than 5 percent of the value of any byproducts. 30 U.S.C. § 1004 (Supp. 1972). The calculation of this "value," however, is likely to involve a number of difficulties.
65. The present Mineral Interest Pooling Act, supra note 20, does not apply to lands leased from the state, but this is because the Legislature wished the Commissioner of the General Land Office to be able to exercise discretionary approval with regard to any pooling that would affect the interests of the state, and not because mineral rights under state leases stand on any different footing than mineral rights under private leases.
66. This section states that a "gas well" is any "well . . . which produces natural gas not associated with crude petroleum at the time of production . . ." See also art. 6008, § 1(f) ("dry gas").
67. See, e.g., TEX. REV. CIV. STAT. ANN. arts. 6004, 6005, 6010, 6014, 6015, 6016 (1962).
68. A pipeline becomes a gas utility, under TEX. REV. CIV. STAT. ANN. art. 6050, § 2, if it acquires a right of way under any public road or highway. Aside from pipeline regulation, public utility

regulation in Texas is very limited, although a geothermal plant that supplied electricity to a municipality would be subject to municipal rate-making regulation.

69. Corzelius v. Harrell, 143 Tex. 509, 186 S.W.2d 961 (1945).
70. Railroad Comm'n v. Woods Exploration & Producing Co., 405 S.W.2d 313 (Tex. 1966); see also 21 SW L. J. 368 (1967).
71. Conceivably, pooling of natural gas rights in a geopressured deposit could be imposed to a limited extent under present law. The Mineral Interest Pooling Act, supra note 20, is primarily intended to encourage voluntary pooling within an existing or proposed unit. The Commission can impose pooling if the driller has rejected a fair offer to pool with others in the unit. The Act, however, could only be invoked by a mineral owner if the Commission had already determined that its spacing regulations were applicable to geothermal wells, and the largest unit that could be pooled by order of the Commission would be 640 acres.
72. TEX. REV. CIV. STAT. ANN. arts. 5307, 5351, 5366, and 5382b, § 4 (1962).
73. TEX. REV. CIV. STAT. ANN. arts. 5351, 5372, and 5382b, § 7 (1962).
74. TEX. WATER CODE ANN. §§ 5.201 -.205 (1972).
75. TEX. WATER CODE ANN. §§ 21.061 - .095 (1972); see also Current Problems: Water Pollution Control in Texas, 48 TEX. L. REV. 1029 (1970). In addition to other types of pollution, the Board can promulgate standards that would also prohibit thermal pollution.
76. 33 U.S.C.A. § 1251 et seq. (Supp. 1973). In particular, see § 1456 and the enforcement procedures generally under Title III of the Act.
77. TEX. WATER CODE ANN. § 5.205 (Supp. 1973) makes it a misdemeanor for any person to "willfully cause or knowingly permit" the water from an artesian well to run off the land of its owner, unless the water "is used for a purpose and in a manner in which it may be lawfully used on the owner's land." As noted above, in Corpus Christi v. City of Pleasanton, supra note 16, the Texas Supreme Court read this language as defining waste in terms of unlawful uses, and there are no unlawful uses that would give the statutory prohibition any significant content.

78. TEX. WATER CODE ANN. §52.001 et seq. (1972); see Comment, Ground Water Management: A Proposal for Texas, 51 TEX. L. REV. 289 (1973); Comment, The Texas Groundwater District Act of 1949, Analysis and Criticism, 30 TEX. L. REV. 862 (1952). The provision for control of subsidence in §52.021 was added by amendment in 1973. No other regulatory entity in Texas has the specific authority to deal with subsidence, but geothermal subsidence might be subject to private attack in a civil action. See R. Steelhammer & J. Garland, Subsidence Resulting from the Removal of Ground Waters, 12 S. TEX. L.J. 201 (1970); RE-STATEMENT (SECOND) OF TORTS §818 (Tentative Draft No. 15).
79. See TEX. WATER CODE ANN. §52.023 (1972); See also §52.118(d), which would apparently preclude any district regulation of a well drilled under a Railroad Commission permit.
80. The functions of the Project would be taken over by the Energy Research and Development Administration if Congress passes S. 2744, which is now in the hands of the Conference Committee. This bill, the Energy Reorganization Act of 1974, would create a new federal agency to coordinate energy research and development.
81. 52 T.C. 700 (1969), aff'd 454 F.2d 1157 (9th Cir. 1972); a companion case is George D. Rowan, 28 T.C.M. 797 (1969). These cases involved section 613 and percentage depletion; but section 611 also permits cost depletion, which is not necessarily limited by the exclusion of certain materials under 613. Withdrawal of ground water from a depleting reservoir can be subject to cost depletion. United States v. Shurbet, 347 F.2d 103 (5th Cir. 1965). See generally S. Eisenstat, Tax Treatment of Exploring and Developing Geothermal Resources, 22 OIL & GAS TAX QUARTERLY 76 (1973).
82. See, e.g., the Natural Gas Act, 15 U.S.C. §717 et seq. (1970). The regulatory jurisdiction of the FPC is discussed in some detail in L/R-5, part X. A supplemental memorandum on legal questions affecting state policy with regard to geothermal resources on public lands is now being prepared.
83. 33 U.S.C.A. §1251 et seq. (Supp. 1973).
84. The EPA's policy statement is reprinted in 4 ENVIRONMENTAL L. REPTR. 46318 (1974).
85. 42 U.S.C. §4321 et seq. (1970).

86. 42 U.S.C. §4332(C) (1970).

87. The impact statement prepared in connection with the federal leasing program provides some indication of the kind of effort that might be entailed. See United States Dep't of the Interior, FINAL ENVIRONMENTAL STATEMENT FOR THE GEOTHERMAL LEASING PROGRAM, 4 vols. (1973).