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by

J. David Aiken and Raymond J. Supalla

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GROUND WATER MINING AND WESTERN WATER RIGHTS LAW: THE NEBRASKA EXPERIENCE*

by J. DAVID AIKEN** AND RAYMOND J. SUPALLA***

Depletion of ground water supplies due to irrigation is one of the major water policy questions facing the western states. Traditional approaches have included ignoring the problem, or utilizing a supplemental water supply. Reducing ground water withdrawals through regulation has not been implemented because it is perceived as being too politically controversial. This article describes the Nebraska Ground Water Management Act of 1975 and its regulations, which are the first administrative attempts to significantly reduce ground water withdrawals.

INTRODUCTION

In 1975 eighty-three percent of the fresh water consumed in the United States was for crop irrigation.[1] In the western states[2] this figure was ninety-one percent.[3] Although the major source of irrigation water has been surface water, the use of ground water in irrigation has increased dramatically. Ground water constituted thirty-eight percent of the water used for irrigation in the western states in 1975,[4] compared with twenty-one percent in 1955.[5] In addition, the quantity of ground water used for irrigation in the western states increased from eighteen million acre feet[6] in 1955[7] to fifty-six million acre feet in 1975.[8]

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** B.A., 1972, Hastings College; J.D., 1975, George Washington University; Assistant Professor of Agricultural Economics (Water Law Specialist) at the University of Nebraska-Lincoln.

*** B.Ag.Bus.Ad., 1968, University of Minnesota; Ph.D., 1972, Michigan State University; Associate Professor of Agricultural Ecomonics at the University of Nebraska-Lincoln.

1. G. MURRAY & E. REEVES, ESTIMATED USE OF WATER IN THE UNITED STATES IN 1975 at 8 (U.S. Geological Survey Circular 765, 1977).

2. As used in this article, "the western states" refers to the seventeen contiguous western states that follow the doctrine of prior appropriation in allocating water resources. These states are: Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming.

3. Derived from Table 7, in MURRAY & REEVES, *supra* note 1, at 24-25.

4. *Id.*

5. Derived from Table 3 in K. MACKICHAN, ESTIMATED USE OF WATER IN THE UNITED STATES, 1955 at 6-7 (U.S. Geological Survey Circular 398, 1957).

6. An acre foot is enough water to cover an acre of land with one foot of water, or approximately 326,000 gallons.

7. MACKICHAN, *supra* note 5.

8. MURRAY & REEVES, *supra* note 1, at 25.

This increase in ground water use for irrigation has led to the mining of ground water in several western states.[9] Ground water mining occurs when withdrawals from an aquifer are made at rates in excess of net recharge. The problem becomes serious when ground water mining continues on a sustained basis over time. As ground water tables decline, the cost of withdrawing ground water increases. When the economic returns from irrigation no longer pay the costs of withdrawing ground water, economic depletion of the aquifer has occurred.[10]

Ground water mining is not inherently wrong. Economic problems will occur, however, when ground water is mined without considering its future value. If a ground water reservoir were not hydrologically interconnected with surface supplies, and if it were owned or controlled by a single entity, the decision to mine or not to mine could be left to the owner. Presumably the decision of whether to mine would be based on balancing benefits from present use with anticipated benefits from use in the future. But ground water reservoirs are often hydrologically related to surface supplies and other aquifers, and are rarely in a single ownership. Thus, ground water reservoirs are managed (or mismanaged) as "common pool" resources,[11] such that excessive use leads to premature exhaustion.[12]

Common pool resources are those in which the right to use the resource without charge is shared with others. Usually there is no significant ceiling on the amount each user may take. Since the resource is not priced, there is no private incentive by any user to reduce current consumption for use in the future. Any user who does so runs the risk that another user will take the resource for present use. There is no incentive to save for tomorrow, even though there is general agreement that the value of the resource may be greater in the future.[13] Two major social consequences

9. GENERAL ACCOUNTING OFFICE, GROUND WATER: AN OVERVIEW 5-15 (1977). Problems associated with ground water mining are discussed in NATIONAL WATER COMMISSION, WATER POLICIES FOR THE FUTURE 238-43 (1977).

10. The economic depletion of a ground water aquifer differs from physical depletion. The latter refers to when all the water has been pumped from an aquifer. When economic depletion of an aquifer occurs will depend on pumping costs and the price of irrigated crops. Economic depletion will occur, however, long before physical depletion. The question of economic depletion is the significant one for policy makers. G. SLOGGETT, MINING THE OGALLALA AQUIFER: STATE AND LOCAL EFFORTS IN GROUNDWATER MANAGEMENT 3 n.1 (Research Report P-761, Agricultural Experiement Stations, U.S. Dep't of Agriculture, Okla. State Univ., 1977).

11. The classical discussion of problems associated with allocating common pool resources is G. Hardin, *The Tragedy of the Commons*, 162 SCIENCE 1243 (1968).

12. NATIONAL WATER COMMISSION, *supra* note 9, at 239. For a general discussion of common pool problems *see* MANAGING THE COMMONS (G. Hardin & J. Baden eds. 1977).

13. It might seem that if all owners agreed to reduce withdrawals, that ground water mining could be addressed by voluntary agreement. If the number of overlying landowners is few, they could form a cartel to agree to restrict ground water withdrawals. Cartel agreements are usually unstable, however, as members can obtain short-run profit by cheating. E. MANSFIELD,

are: the resource is consumed at a faster rate than is desirable, and local and regional economies dependent on the resource may wither and die prematurely.[14]

Most economists believe that restrictions on ground water use will often lead to greater economic benefits than ground water mining.[15] Regulation of ground water mining, however, is not widespread in the western states. The major problem is political. Irrigators have traditionally been given a high degree of independence in determining how land and water resources are used in agricultural production. Government water use regulations are perceived as limiting this independence. Irrigators have incorrectly assumed that these regulations necessarily threaten their economic interests. This attitude is probably the single most important factor in preventing effective regulation of ground water mining.

States and the federal government have a common interest in addressing the ground water mining issue. States are interested in managing ground water mining to achieve the greatest economic benefit from ground water use. The economic impacts of depleting ground water reserves would be most significant at the state and local level. The federal interest in regulating ground water mining is somewhat different. If the economic depletion of a ground water reservoir is not planned for, the federal government is likely to be requested to furnish a supplementary water supply at taxpayer expense to sustain an established economy which developed on the improvident use of ground water.[16]

In most western states ground water use is subject to some degree of state regulation.[17] Significantly, however, in the three western states in which sixty percent of the ground water was withdrawn for irrigation in 1975—California, Texas, and Nebraska—meaningful state or local controls on ground water use

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MICROECONOMICS 335-40 (2d ed. 1975). Moreover, the instability of cartels tends to increase as the number of members rises. *Id.* at 337-38. Thus voluntary restrictions of ground water withdrawals are not likely to succeed.

14. NATIONAL WATER COMMISSION, *supra* note 9, at 239.

15. H. MAPP & V. EIDMAN, AN ECONOMIC ANALYSIS OF REGULATING WATER-USE IN THE CENTRAL OGALALLA FORMATION (Technical Bulletin T-141, Agricultural Experiment Station, Okla. State Univ., 1976). The authors concluded that if the amount of ground water available was not unlimited, establishing a graduated tax on ground water use would lead to higher net farm income than would unrestricted pumping or quantity limitations. *Id.* at 58-63.

16. NATIONAL WATER COMMISSION, *supra* note 9, at 232. This concern is not misplaced. In 1976 Congress authorized a federal study to examine

> the depletion of the natural resources of these regions . . . presently utilizing the declining water resources of the Ogallala aquifer, and *to develop plans to increase water supplies in the area* and report thereon to Congress . . . . In formulating these plans, the Secretary [of Commerce] is directed . . . to examine the feasibility of various alternatives *to provide adequate water supplies in the area . . . to assure the continued economic growth and vitality of the region. . . .*

42 U.S.C. § 1962d-18 (1976) (emphasis added).

17. *See* notes 45 to 54 *infra* and accompanying text.

historically have not existed.[18]

Nebraska has followed the pattern established by California and Texas of allowing virtually unlimited ground water development.[19] Since 1975, however, when the Nebraska Ground Water Management Act[20] was enacted, ground water regulations in Nebraska have been established by local governmental entities to limit ground water mining. Thus, Nebraska is the first of the three leading ground water-using states to attempt to deal with the ground water mining issue.

This article analyzes the Nebraska Ground Water Management Act as a mechanism for dealing with ground water mining. After surveying ground water control law in the western states, the article will describe the Nebraska Ground Water Management Act, its background, implementation and limitations. Particular emphasis is given to evaluating the various ground water control authorities granted under the Ground Water Management Act and how they have been combined in managing ground water declines associated with irrigation.

WESTERN STATE GROUND WATER RIGHT LAWS: AN OVERVIEW

Rights of Use

In making the initial determination of a landowner's right to use ground water, that is, how much ground water a landowner can pump for what uses, the state significantly affects how ground water development will occur and to what extent ground water mining will be a problem. Ground water mining will be aggravated by policies that place insignificant limitations on the quantity of ground water landowners are allowed to withdraw. Ground water mining may be avoided, however, by policies that restrict a landowner's right to withdraw ground water when total withdrawals exceed the long-term yield of the ground water reservoir.

Rights of landowners to use groundwater in the western states

18. In 1975, ninety percent of the ground water used for irrigation in the western states was withdrawn in seven states:

California	18 million acre feet
Texas	10 million acre feet
Nebraska	5.9 million acre feet
Kansas	5.2 million acre feet
Arizona	4.7 million acre feet
Idaho	3.9 million acre feet
Colorado	2.8 million acre feet

In 1975 ground water withdrawals in California, Nebraska, and Texas totaled 34 million acre feet, 60% of the 56 million acre feet withdrawn in total. MURRAY & REEVES, *supra* note 1. For a discussion of ground water law and management in California, Texas, and Nebraska, *see* notes 37 to 43, 51 to 54, and 66 *et seq. infra* and accompanying text.

19. Harnsberger, Oeltjen, & Fisher, *Groundwater: From Windmills to Comprehensive Public Management*, 52 NEB. L. REV. 179 (1973).

20. 1975 Neb. Laws, LB 577, NEB. REV. STAT. §§ 46-656 to -674 (Cum. Supp. 1976) as amended by LB 26 (1979).

are based on four legal theories: the doctrines of absolute ownership,[21] reasonable use,[22] correlative rights,[23] and prior appropriation.[24] While all the doctrines are common law in origin, prior appropriation has since been codified in the majority of western states.[25] The absolute ownership, reasonable use, and correlative rights doctrines all have as a major premise the notion that the right to use ground water is based on ownership of land overlying the ground water reservoir. These theories, which may be collectively referred to as land ownership based theories, differ primarily regarding the extent to which a landowner's right to withdraw ground water is restricted. Under the doctrine of prior appropriation, rights to use ground water are based not on land ownership but on the act of physically withdrawing ground water and using it beneficially.[26]

A. *Absolute Ownership*

The earliest of the variants of the land ownership based theo-

21. Corpus Christi v. Pleasanton, 154 Tex. 289, 276 S.W.2d 798 (1955); Houston & T.C. Ry. Co. v. East, 98 Tex. 146, 81 S.W. 279 (1904). Whereas the absolute ownership formerly was widely followed in the western states, it has been replaced by statutes extending prior appropriation to ground water. Texas is the only western state which still follows the absolute ownership doctrine. *See* notes 22, 23, and 25 *infra*.

22. Jarvis v. State Land Dep't, 104 Ariz. 527, 456 P.2d 385 (1964); Bristor v. Cheatham, 75 Ariz. 227, 255 P.2d 173 (1953); Olson v. City of Wahoo, 124 Neb. 802, 248 N.W. 304 (1933); Canada v. City of Shawnee, 179 Okla. 53, 64 P.2d 694 (1937). Arizona and Nebraska are the only western states still following the reasonable use doctrine. *See* note 21 *supra* and notes 23 and 25 *infra*. The Nebraska supreme court has suggested in dicta, however, that it would follow the correlative rights rule to resolve conflicts involving shortages of ground water. Prather v. Eisenmann, 200 Neb. 1, 261 N.W.2d 766 (1978). See note 35 *infra*. In Oklahoma, the common law doctrine of reasonable use is combined with a statutory system of prior appropriation of ground water. OKLA. STAT. ANN. tit. 60, § 60, (West 1971).

23. Katz v. Walkinshaw, 141 Cal. 116, 70 P. 663 (1903) *rev'd on rehearing*, 141 Cal. 116, 748 P. 766 (1903). *See* notes 38-45 *infra* and accompanying text. California is the only western state following the correlative rights dictrine per se. *See* notes 21-22 *supra* and note 25 *infra*. *But see* Prather v. Eisenmann, 200 Neb. 1, 261 N.W.2d 766 (1978), discussed in note 35 *infra*. South Dakota ground water statutes have incorporated elements of the correlative rights doctrine. S.D.C.L. § 46-6-6.2 (Supp. 1978).

24. Hinton v. Little, 50 Idaho 371, 296 P. 582 (1931); Volkmann v. City of Crosby, 120 N.W.2d 18 (N.D. 1963).

25. COLO. REV. STAT. §§ 37-90-101 to -141 (1973 & Supp. 1976); IDAHO CODE §§ 42-101 to -112 (1947); KAN. STAT. ANN. §§ 82a-701 to -730 (1977); MONT. REV. CODES ANN. §§ 89-2911 to -2936 (1947 & Supp. 1977); NEV. REV. STAT. ch. 534 (1957); N.M. STAT. ANN. §§ 72-12-1 to -28 (1978); N.D. CENT. CODE §§ 61-01-01 to -23 (1960); OKLA. STAT. ANN. tit. 82, §§ 1001 to -1019 (West 1970); OR. REV. STAT. §§ 537.505 to -.990 (1955); S.D.C.L. §§ 46-6-1 to -23 (1967 & Supp. 1978); UTAH CODE ANN. §§ 73-3-1 to -28 (1953 & Supp. 1977); WASH. REV. CODE ANN. §§ 90.44.010 to -.250 (1961); WYO. STAT. §§ 41-3-901 to -938 (1977). The major ground water using states of California, Texas, Nebraska, and Arizona do not, however, apply prior appropriation to ground water. *See* notes 21-23 *supra*.

26. Under common law appropriation this was sufficient to establish an appropriative right to use ground water. Under the modern statutory-administrative form of prior appropriation, a state permit must be secured before a well can be drilled and ground water is withdrawn. The requirements of actually withdrawing ground water and applying it to a beneficial use must be met, however, before an appropriative right vests. *E.g.*, COLO. REV. STAT. § 37-90-107(5) (1973).

ries of ground water use is the English rule of absolute ownership. Established in the famous 1843 English case of *Acton v. Blundell*,[27] the absolute ownership doctrine is based on two major premises: a landowner owns everything from the center of the earth to the heavens, and because its movement is not easily discernible, courts should not attempt to apportion ground water among overlying landowners. Consequently, a landowner is virtually unrestricted in his use of ground water. Under the absolute ownership doctrine a landowner is not liable if his use of ground water interferes with the ground water use of another unless he acts maliciously or negligently.[28] A landowner may therefore waste ground water, use it on lands not overlying the aquifer, or sell it.[29]

The so-called absolute ownership doctrine ironically affords a landowner little protection for the ground water under his land from a neighboring landowner with a deeper well or more powerful pump. The absolute ownership doctrine is essentially the law of capture under which every landowner has the right to pump as much ground water as he can without regard to the rights of others. The doctrine was once the rule in most states, but is being replaced by the rule of reasonable use in the eastern states, and has been replaced by appropriation in most western states. Texas, one of the largest users of ground water, however, continues to follow the absolute ownership doctrine.[30]

B. *Reasonable Use*

The American rule of reasonable use differs from the absolute ownership doctrine in two significant aspects: the quantity of ground water that can be used, and where ground water can be used. Under the reasonable use doctrine a landowner is entitled to the reasonable use of ground water. The concept of reasonableness does not involve the comparison of the relative utility of competing ground water uses.[31] Rather, when an action between landowners arises regarding rights to withdraw and use ground water, the withdrawals of either landowner are not restricted if the use of the ground water is reasonable. In this context, reasonable has a rather specific meaning. First, the quantity of ground water used must be reasonable, that is, not wasteful.[32] Second, the use of ground water must be reasonable in relationship to the use of the overlying land—the land where the ground water is withdrawn.

27. 152 Eng. Rep. 1223 (1843).
28. Huber v. Merkel, 117 Wis. 355, 94 N.W. 354 (1903).
29. *Id.*, City of Corpus Christi v. City of Pleasanton, 154 Tex. 289, 276 S.W.2d. 798 (1955).
30. Houston & T.C. Ry. Co. v. East, 98 Tex. 146, 81 S.W. 279 (1904). *See* City of Corpus Christi v. City of Pleasanton, 154 Tex. 289, 276 S.W.2d 798 (1955).
31. This is the concept of reasonableness used in the surface water law doctrine of riparian rights. *See* Trelease, *The Concept of Reasonable Beneficial Use in the Law of Surface Streams*, 12 WYO. L.J. 1, 15-16 (1957).
32. Harnsberger, *supra* note 19, at 205.

Any use of ground water on non-overlying land—land other than where the ground water was withdrawn—is unreasonable per se because it bears no relationship to the use of the overlying land.[33]

The reasonable use doctrine is more restrictive than the absolute ownership doctrine in theory, since it prohibits waste of ground water as well as its use on non-overlying land. In practice, however, waste or non-overlying uses may occur in reasonable use jurisdictions: a landowner's use of ground water must be interfered with before he has standing to challenge a wasteful or non-overlying use by another.[34] The reasonable use doctrine is followed in the major ground water using states of Nebraska[35] and Arizona.[36]

C. *Correlative Rights*

The California rule of correlative rights is a judicial extension of the reasonable use doctrine to resolve conflicts between landowners over rights to use ground water under conditions of ground

33. Jarvis v. State Land Dep't, 106 Ariz. 506, 479 P.2d 169 (1970).

34. Canada v. City of Shawnee, 179 Okla. 53, 64 P.2d 694 (1937).

35. Nebraska follows a combination of the reasonable use rule and preferences, although the supreme court has also indicated in *dicta* a willingness to follow the pro-rata sharing principle of the correlative rights doctrine. The reasonable use doctrine was adopted in Olson v. City of Wahoo, 124 Neb. 702, 248 N.W. 304 (1933), in which plaintiff's sand and gravel pit was drained by the defendant city's wells. The city argued that it was not liable for the interference under the absolute ownership theory. In rejecting this court adopted the reasonable use rule with the additional provision that "if the natural underground supply is insufficient for all [overlying land-] owners, each is entitled to a reasonable portion of the whole. . . ." *Id.* at 811, 248 N.W. at 308. *Olson* did not deal with apportioning ground water among competing users, however, so adoption of the correlative rights theory is *dicta*. *See* Harnsberger, *supra* note 19, at 192-96.

The Nebraska rule of reasonable use plus the correlative rights *dicta* was expanded to include ground water preferences in *Prather v. Eisenmann*, 200 Neb. 1, 261 N.W. 2d 766 (1978). Preferences are a legislative statement of which water uses are preferred, i.e. favored over other uses. *See* note 51 *infra* and accompanying text. In Nebraska, the use of ground water for domestic purposes is preferred over all other purposes. Neb. Rev. Stat. § 46-613 (1974). Use of ground water for agricultural purposes is preferred over manufacturing or industrial purposes. *Id.* In *Prather* the supreme court relied on the ground water preferences statute in holding an irrigator liable for causing the loss of artesian pressure in a domestic well. In doing so the court announced a three part test for resolving ground water use conflicts: (1) overlying landowners have a right to make a reasonable use of ground water, (2) conflicts among users in the same preference category would be resolved under a pro-rata sharing (or correlative rights) theory, and (3) conflicts among users in different preferences categories would be resolved on the basis of preferences. *Id.* at 9-10, 261 N.W. 2d at 771. The correlative rights portion of the *Prather* rule is still *dicta*, however, as neither *Prather* nor *Olson* dealt with conflicts among those using ground water for the same purpose. See Harnsberger, *supra* note 19, at 204-10.

36. Bristor v. Cheatham, 74 Ariz. 227, 255 P.2d 173 (1953). In addition legislation has been enacted which gives the State Land Department authority to declare "critical ground water areas" in which limitations on ground water withdrawals are authorized. Ariz. Rev. Stat. §§ 45-301 to -324 (1956 & Supp. 1978). The constitutionality of this legislation was upheld in Southwest Engineering Co. v. Ernst, 79 Ariz. 40, 291 P.2d 764 (1955). *See* also Jarvis v. State Land Dept., City of Tucson, 104 Ariz. 527, 456 P.2d 385 (1965).

water mining.[37] Correlative rights has a rather specific meaning under California law, dealing with correlating the rights of overlying and non-overlying landowners to use ground water[38] and with using an aquifer's storage capacity for storing water underground.[39] The more general meaning associated with the correlative rights doctrine is that when ground water mining is occurring, actions regarding ground water use conflicts will be resolved on the basis of a pro rata sharing of the available supply among all users.[40] For example, if total withdrawals of ground water must be reduced by thirty percent to prevent ground water mining, each ground water user within the basin will be required by court order to reduce his ground water withdrawals by thirty percent.

The correlative rights doctrine has not been used in California to address ground water mining per se, but rather, to establish rights to withdraw fixed quantities of ground water to permit conjunctive management of ground and surface water supplies.[41] Surface water is imported from northern California and Arizona to supplement ground water supplies in southern California. The imported surface water may be used to recharge aquifers which have been mined to some extent. The problem comes in determining how to pay for the imported surface water. This is resolved by adjudicating the ground water basin: a ground water user can withdraw his pro rata share of the "safe yield"[42] without charge. Any water withdrawn in excess of the "safe yield" figure is assumed to

37. Katz v. Walkinshaw, 141 Cal. 116, 70 P. 663 (1902), *aff'd on rehearing*, 141 Cal. 137, 74 P. 766 (1903). *See* II W. HUTCHINS, WATER RIGHTS LAWS IN THE NINETEEN WESTERN STATES 670-77 (1974).

38. Burr v. Maclay Rancho Water Co., 154 Cal. 428, 98 P. 260 (1908).

39. City of Los Angeles v. City of Glendale, 23 Cal.2d 68, 142 P.2d 289 (1943); City of Los Angeles v. City of San Fernando, 14 Cal.3d 199, 537 P.2d 1250, 123 Cal. Rptr. 1 (1975).

40. Pasadena v. Alabama, 33 Cal. 2d 908, 207 P.2d 17 (1949).

41. *See* A. SCHNEIDER, GROUNDWATER RIGHTS IN CALIFORNIA (Staff Paper No. 2, pp. 50-53, Governor's Comm'n To Review California Water Rights, 1977).

42. The California supreme court has defined *safe yield* to mean:

> "the maximum quantity of water which can be withdrawn annually from a ground water supply under a given set of conditions without causing an undesirable result." The phrase "undesirable result" is understood to refer to a gradual lowering of the ground water levels resulting eventually in depletion of the supply.

Id. at 99, citing Los Angeles v. San Fernando, 14 Cal. 3d 199, 278, 537 P.2d 1250, 1308, 123 Cal. Rptr. 1, 59 (1975). A related concept is that of *overdraft*, which has been defined as:

> the condition of a ground water basin where the amount of water withdrawn by pumping exceeds the amount of water replenishing the [ground water] basin over a period of time. *San Fernando* defined overdraft as the point at which "extractions from the basin exceed its safe yield plus any . . . temporary surplus."

Id., citing Los Angeles v. San Fernando, 14 Cal. 3d 199, 280, 537 P.2d 1250, 1309, 123 Cal. Rptr. 1, 60 (1975). *Temporary surplus* is defined as:

> the amount of water that can be pumped from a basin to provide storage space for surface water that would be wasted during wet years if it could not be stored in the basin.

Id. at 32.

be imported water for which the user must pay.[43] The correlative rights doctrine has not been used as a basis for allocating the costs of imported surface water used to recharge the gound water basin. The correlative rights doctrine is followed in California, and the Nebraska Supreme Court has indicated a willingness to adopt its feature of pro rata sharing when ground water mining occurs.[44]

D. *Prior Appropriation*

In most western states the doctrine of prior appropriation has been applied to ground water, even though the doctrine was originally developed to allocate surface water supplies.[45] Of the major ground water using states, only Kansas, Colorado, and Idaho apply prior appropriation to ground water. California, Texas, Nebraska, and Arizona instead follow some version of a land ownership based theory of ground water law.

An appropriative right to use ground water is based on obtaining a state permit to withdraw ground water, the physical withdrawal of ground water, and the use of ground water for some beneficial purpose.[46] The state permit may limit the quantity of ground water the appropriator is entitled to withdraw.[47] In most appropriation states a permit may be denied if its issuance would impair the rights of existing appropriators,[48] or if the ground water basin is "critical" or over-appropriated.[49]

Conflicts among appropriators regarding rights to withdraw ground water may be resolved not by seeking judicial relief, but through an administrative procedure. Priority is the basis for resolving ground water conflicts: the appropriator with the earliest date on his state permit (the "senior" appropriator) has the best claim to the ground water.[50] When conflicts arise among appropri-

43. Kreiger and Banks, *Groundwater Basin Management*, 50 CAL. L. REV. 56 (1962).

44. Prather v. Eisenmann, 200 Neb. 1, 261 N.W.2d 766 (1978). *See* note 35 *supra*.

45. I. HUTCHINS, *supra* note 37, at 157-80.

46. *E.g.*, COLO. REV. STAT. §§ 37-90-107 to -108 (1973 & Cum. Supp. 1978).

47. *E.g.*, OR. REV. STAT. § 537.620(4) (1977).

48. *E.g.*, WASH. REV. CODE ANN. § 90.44.070 (1962).

49. *E.g.*, MONT. REV. CODES ANN. § 89-2918 (Cum. Supp. 1977).

50. *E.g.*, COLO. REV. STAT. §§ 37-90-109(1), -110(1)(a)(1973 & Supp. 1978).

The principle of priority is easier to state than to apply. A major administrative difficulty is determining to what extent a junior ground water appropriator is actually interferring with a senior appropriator's ground water use. A state water administrator is likely to be given considerable discretion in administering ground water priorities. The Wyoming procedure is illustrative. A senior ground water appropriator may file a complaint with the State Engineer alleging interference from a junior appropriator. Wyo. Stat. § 41-128(b) (Cum. Supp. 1975). The complaint must be accompanied by $100, which is used to help defray the State Engineer's expenses in investigating the complaint. *Id.* The State Engineer conducts an investigation to determine whether the alleged interference does in fact exist, and issues a report to the parties which may discuss "various means for stopping, rectifying or ameliorating the interference or damage caused thereby." *Id.* The State Engineer's report may be appealed. *Id.* § 41-128(c). The considerable discretion granted to the State En-

ators withdrawing ground water for different purposes, however, priorities may be ignored and the conflict resolved on the basis of preferences. In appropriation states, preferences are a statutory enumeration of which uses are preferred or favored over other uses. Domestic uses and livestock watering typically enjoy the highest preference, followed by municipal uses, irrigation, mining, industrial, and commercial uses. In some appropriation states, compensation may be due the less preferred user if he is the senior appropriator.[51]

The suitability of all aspects of the appropriation doctrine to allocate rights to use ground water is not clear. State control of ground water is desirable if the state has ground water management objectives it wishes to effect. Elements of the appropriation doctrine, however, may not be as successfully applied to ground water allocation as they have been to the allocation of surface water supplies. For example, priority as a basis for resolving conflicts among ground water appropriators may be nonsensical where the senior appropriator's supply is virtually exhausted and the junior appropriator's supply is not.

Establishing an administrative system for allocating rights to use ground water, severing the right to use ground water from land ownership, limitations on withdrawals, and the use of priority as a basis for making allocation decisions are the principal differences between appropriation and the land ownership based theories of ground water allocation.

Policies Related to Ground Water Mining

The absolute ownership and reasonable use doctrines in theory do not directly address the issue of ground water mining. Under the absolute ownership doctrine, a landowner may withdraw ground water without regard to whether ground water is being mined. Under the reasonable use doctrine, a landowner's right to withdraw ground water will be restricted only if it is wasteful, the ground water is used on non-overlying lands, or both. Otherwise, a landowner may withdraw ground water without regard to whether ground water is being mined.

The correlative rights doctrine addresses mining of ground water in theory by prorating the "safe yield" of an aquifer among ground water users. In practice, correlative rights in California is part of the legal basis for conjunctive use of ground and imported surface water supplies, rather than a ground water mining policy.[52]

Approaches for dealing with ground water mining vary in appropriation states. The basic principle that a junior appropriator

gineer may significantly weaken the role of priority in resolving ground water disputes.

51. Trelease, *Preferences to the Use of Water*, 27 ROCKY MTN. L. REV. 133 (1955).

52. *See* notes 41 to 43 *supra* and accompanying text.

must stop using water when his withdrawals conflict with those of senior appropriators provides one method in theory for resolving disputes among appropriators, but does not itself necessarily prevent ground water mining. Similarly, a policy of restricting new ground water appropriations may protect existing ground water users, but will not itself necessarily prevent mining of ground water. In some appropriation states, the amounts of ground water withdrawn may be reduced in "critical" ground water areas,[53] a modification of the correlative rights doctrine with an administrative determination of the allowable level of ground water withdrawals. Historically, these practices have not been attempted in the major ground water using states of California, Texas, and Nebraska. In California, the adjudication of ground water basins is usually undertaken not to deal with ground water mining but as a prelude to conjunctive management of ground and surface water supplies. Texas has authorized the establishment of ground water conservation districts by local option.[54] The districts, however, have not addressed ground water mining per se, limiting their efforts to regulating well spacing distances and irrigation runoff.[55] Prior to the enactment of the Ground Water Management Act, Nebraska ground water law paralleled the Texas approach of ineffectual local control. We now turn to a consideration of ground water management in Nebraska.

HISTORY OF GROUND WATER DEVELOPMENT AND REGULATION IN NEBRASKA

The development of irrigation and associated ground water management policies is a complicated interaction of land and water resource availability with climatic, economic, technological, social, political, and administrative factors. Although the influence of each factor cannot be determined with precision, a description of these factors can help place in perspective the development of public policies to deal with ground water mining in Nebraska.

Physical Conditions

Nebraska has a wide range of climatic and geographic conditions. Rainfall varies from thirty-four inches average annual precipitation in the southeastern corner of the state to fourteen inches in the western panhandle region. Soil characteristics vary from deep heavy soils in the eastern and south central parts of Nebraska to the sandy soils of the north central sandhills and western panhandle regions. Nearly two billion acre feet of ground water are in storage, and well yields sufficient for irrigation can be

53. *E.g.*, OR. REV. STAT. § 537.735 (1955).
54. TEX. WATER CODE ANN. tit. 4 § 52.001 to -.401 (Vernon 1971 & Cum. Supp. 1978).
55. SLOGGETT, *supra* note 10, at 11.

obtained in most parts of the state.[56]

History of Irrigation Development

Early irrigation in Nebraska was associated with surface water development. Withdrawals of ground water for irrigation did not begin until the early twentieth century, when internal combustion engines became available to power low head centrifugal pumps. Because of limited pumping capacity, early ground water irrigation was limited to valley lands where ground water was available at shallow depths. Development and acceptance of the turbine pump in the 1930s allowed deep well irrigation to spread to the tablelands of western and south central Nebraska. However, not until the droughts of the 1940s and 1950s did major increases in ground water irrigation occur.[57]

Development of center-pivot sprinkler water distribution systems in the late 1950s revolutionized ground water irrigation in Nebraska. Much of Nebraska is unsuitable for traditional gravity irrigation methods either because the land is too hilly or the soil too sandy. The center-pivot has allowed development of these lands for irrigation in many parts of the state.[58] From 1950 to the present, the number of registered irrigation wells has increased from 8000 to over 60,000.[59] Currently nearly six million acres are irrigated with ground water in Nebraska.[60]

Regulatory History

Prior to the enactment of the Ground Water Management Act, Nebraska followed a laissez faire ground water control policy, in part because of its relative abundance of ground water. State restrictions were limited to well spacing requirements to prevent direct interference among wells,[61] and well registration.[62] Prior to 1969 ground water conservation districts could be formed upon petition of local landowners.[63] The conservation districts carried out educational programs and enforced ground water runoff regula-

56. NEB. SOIL & WATER CONSERVATION COMM'N, REPORT ON THE FRAMEWORK STUDY 15-24, 35-40 (1971).
57. Harnsberger, *supra* note 19, at 187-90, 193-202.
58. NEB. SOIL & WATER COMM'N, *supra* note 56, at 74; M. ELLIS & D. PEDERSON, GROUNDWATER LEVELS IN NEBRASKA 1977 at 92 (Neb. Water Survey Paper No. 45, Conservation & Survey Division, Univ. of Nebraska-Lincoln, 1978).
59. ELLIS & PEDERSON, *supra* note 58, at 94.
60. *Id.* at 92.
61. NEB. REV. STAT. §§ 45-609 to -612 (1974) as amended by LB 201 (1979).
62. *Id.* §§ 46-601 to -607 (1974).
63. *Id.* §§ 46-614 to -634 (1974). No new ground water conservation districts can be established after June 30, 1972. *Id.* § 46-614.01 (1974). In addition, existing ground water conservation districts are required to be dissolved by April 1, 1982. *Id.* § 46-634.01(1) (Cum. Supp. 1978). If the ground water conservation district lies within a ground water control area, the conservation district directors become advisory board members of the Natural Resources District. *Id.* § 46-634.01(2). For a discussion of ground water control areas *see* notes 74 to 99 *infra* and accompanying text. For a discussion of Natural Resources Districts *see* notes 68 to 73 *infra* and accompanying text.

tions, but did not directly regulate ground water withdrawals.[64] Judicial decisions related to ground water have dealt with conflicts among individual ground water users,[65] and have not addressed the conflicts resulting from ground water mining.

State Water Resources Agencies

Although the state does not presently regulate ground water allocation, the administration of surface water rights is a state responsibility in Nebraska as in the other western states. The Director of Water Resources performs this "state engineer" function in Nebraska.[66] The Department of Water Resources is also responsible for state oversight in administration of the Ground Water Management Act.[67]

Natural Resources Districts

The responsibility for regulating ground water mining in Nebraska is a local one. In the western states, where the local control approach was taken, this has meant the establishment of single purpose ground water conservation districts.[68] A common problem with single purpose local districts is that they often can neither afford a full time professional staff nor have adequate funding to support the staff they have. This was true of the local ground water conservation districts established in Nebraska. In 1969 the Nebraska Legislature ameliorated this problem by providing for the reorganization of soil and water conservation districts and a variety of watershed districts into larger, more comprehensive Natural Resource Districts (NRDs).[69] In 1972 approximately 150 single purpose districts were reorganized into twenty-four NRDs, which blanket the state.[70] The NRDs are organized generally along river basin boundaries.

The NRDs have broad natural resources responsibilities, in-

64. Harnsberger, *supra* note 19, at 242. For a discussion of the local management approach *see* Clark, *Groundwater Management: Law and Local Response*, 6 ARIZ. L. REV. 178 (1965).

65. Olson v. City of Wahoo, 124 Neb. 802, 248 N.W. 304 (1933), Prather v. Eisenmann, 200 Neb. 1, 261 N.W.2d 766 (1978). *See* note 35 *supra*.

66. NEB. REV. STAT. § 46-705 (1974).

67. Several other state agencies have water-related responsibilities. The Natural Resources Commission is responsible for state-wide water quantity and water quality planning, floodplain management, and administering state funds for local natural resources development. NEB. REV. STAT. §§ 2-1502 to -1582 (1977). The Department of Environmental Control is responsible for water quality regulation. *Id.* §§ 81-1501 to -1533 (1976). The Department of Health is responsible for regulating drinking water quality. *Id.* §§ 71-4301 to -5313 (1976). The University of Nebraska Conservation and Survey Division is responsible for collecting ground water quantiy and quality information. *Id.* § 85-163 (1976).

68. *See* Clark, *supra* note 64, at 202-08.

69. NEB. REV. STAT. § 2-3203 (1977).

70. For a general description of Natural Resource districts *see* R. Marlette & C. Williams, *Nebraska Multi-Purpose Resource Districts*, in LEGAL, INSTITUTIONAL AND SOCIAL ASPECTS OF IRRIGATION AND DRAINAGE AND WATER RESOURCES PLANNING AND MANAGEMENT 266 (1979).

cluding erosion control, flood control, soil conservation, water supply, ground and surface water conservation, pollution control, drainage, wildlife habitat management, recreation, and forestry and range management.[71] In addition, the NRDs have the sole authority to initiate ground water controls under the Ground Water Management Act.

The NRDs are governed by a locally elected board of directors,[72] who hire a professional manager, and are funded by a property tax.[73] One advantage of the multi-purpose NRDs is that they can concentrate their efforts and funds on the most pressing problems. The single purpose districts that they replaced did not have the financial resources and flexibility of the NRDs.

THE NEBRASKA GROUND WATER MANAGEMENT ACT

Increasing concern about ground water mining associated with irrigation development led to the enactment of the Ground Water Management Act of 1975.[74] The Act gives NRDs the option of regulating ground water use through the establishment of ground water control areas. Since the nearly six million acres irrigated with ground water were developed free of state or local ground water control, the fear of the consequences of ground water regulation was considerable. Fear of state regulation was so strong that a provision giving the Department of Water Resources authority to unilaterally establish ground water control areas was removed from the Act on the floor by the Legislature,[75] leaving the initiation of ground water control procedures to the sole discretion of the NRD board. Without the presence of NRDs to assume a regulatory function at the local level, a ground water control act probably could not have been enacted.

The Act, then, has a local control philosophy; whether controls are sought at all and what controls are imposed are NRD decisions. The state has substantial review and oversight responsibilities, however, making the Act a blend of local and state ground water control authorities.

Ground Water Control Authorities

If control area establishment is sought by an NRD and is designated by the Department of Water Resources, the NRD can exercise broad ground water control authorities. Ground water controls authorized by the Act include: (1) well spacing restrictions; (2) rotation of pumping restrictions; (3) allocation of ground water, that is, establishing what quantities of ground water

71. NEB. REV. STAT. § 2-3229 (1977).
72. *Id.* § 2-3313 (1977).
73. *Id.* § 2-3225(1) (1977).
74. 1975 Neb. Laws LB 577, NEB. REV. STAT. §§ 46-656 to -674 (Cum. Supp. 1978) as amended by LB 26 (1979).
75. Neb. Legis. Journal 4975-78 (1975).

may be withdrawn; and (4) well drilling moratoria.[76] In addition, an NRD may adopt other reasonable ground water controls not specifically authorized by the Act.[77] The regulations may be varied within a control area if warranted by differing climatic, hydrologic, geologic, or soil conditions.[78]

Once a ground water control area is designated, a permit from the Department of Water Resources is required to drill any well other than a domestic well.[79] The Director does not have independent authority to deny issuance of a permit, however, unless: (1) state well spacing requirements or NRD ground water regulations are violated,[80] or (2) the proposed use of ground water is not a beneficial use for domestic, agricultural, manufacturing, or industrial purposes.[81] In addition to the well permit requirements, once a control area is designated the NRD can levy up to an additional one-quarter mill against all land within the control area to defray the costs of ground water administration.[82]

The Act also requires all NRDs to establish and enforce regulations to control runoff from ground water irrigation, regardless of whether a control area has been established.[83] The objective of runoff regulations is to force the conservation of ground water by requiring each ground water user to prevent irrigation water from leaving his land.

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76. NEB. REV. STAT. §§ 46-666(1)(a) to -666(1)(c) (Cum. Supp. 1978) as amended by LB 26, § 4 (1979).

77. *Id.* § 46-666(1)(d).

78. LB 26, § 4 (1979), to be codified as § 46-666(3) (Supp. 1979); formerly codified as § 46-666(2) (Cum. Supp. 1978).

79. NEB. REV. STAT. § 46-659(1) (Cum. Supp. 1978).

The permit requirement applies to construction of "a well." *Id.* "Well" is defined, however, for purposes of issuing permits to exclude wells with a capacity of less than 100 gallons per minute which are used solely for domestic purposes. *Id.* § 46-657(3). A permit is required before a small-capacity domestic well is enlarged to a capacity of more than 100 gallons per minute. *Id.* § 46-659(2).

A permit to drill is valid for one year. *Id.* § 46-662. If the well is not drilled within a year of its approval the Director may withdraw the permit. *Id.* The permit may, however, specify a longer period for well construction. *Id.*

80. *Id.* § 46-660(1)(a).

81. *Id.* § 46-660(1)(b). On its face, this would exclude use of ground water for, *inter alia*, fish and wildlife purposes. Because the federal government operates wildlife refuges within the Upper Big Blue ground water control area, this raises potential conflicts under the federal supremacy clause. U.S. CONST. art. VI cl. 2. However, the apparent prohibition against granting permits for new wells used to supply water for wildlife purposes is not applicable to the federal government. Section 46-659(1) requires any "person" to obtain a permit before drilling a new well within a control area. "Person" is defined, however, to exclude by implication a federal agency. *Id.* § 46-657(1). Thus, the restriction of § 46-660(1)(b) would apply only to non-federal wells used to supply water for wildlife purposes.

82. NEB. REV. STAT. § 46-673 (Cum. Supp. 1978) as amended by LB 26, § 5 (1979). The additional levy can be used only for administration of the Act. *Id.* This mill levy is in addition to the basic NRD levy of one mill authorized by § 2-3225(1) (1974). A levy of more than one mill may be authorized by popular vote. *Id.*

83. *Id.* § 46-664 (Cum. Supp. 1978).

Procedures for Establishing Ground Water Controls

The first step in establishing a ground water control area is for the NRD board of directors to request the Department of Water Resources to hold a public hearing to determine whether a ground water control area should be established.[84] The Director of Water Resources is responsible for determining whether to designate a ground water control area after a request to hold a control area hearing has been made by the NRD.[85] If the Director of Water Resources determines ground water control area designation is not warranted he can refuse to make that designation regardless of the wishes of the NRD.[86]

A public hearing must be held within 120 days after the NRD makes its request for a hearing to consider whether a ground water control area should be established. [87] Testimony at the hearing is presented by the NRD, state agencies, and the public.[88] After the hearing, the Director of Water Resources determines whether a control area should be established.[89]

A ground water control area may be designated by the Director of Water Resources if the Director finds that the uncontrolled development or use of ground water has caused or is likely to cause one of two conditions: (1) an inadequate ground water supply to meet present or reasonably foreseeable needs; or (2) water quality degradation caused by dewatering of an aquifer such that the quality is insufficient to continue current ground water uses. [90] In addition, the Director must find either of the following: (1) that conflicts between ground water users are occurring or may be reasonably anticipated; or (2) that ground water users are experiencing, or will experience in the foreseeable future, substantial economic hardship as a direct result of current or anticipated ground water development or use.[91] If a control area is designated,

84. LB 26, § 1 (1979); to be codified as § 46-658(3) (Supp. 1979); formerly codified as § 46-658(2) (Cum. Supp. 1978).

85. LB 26, § 1 (1979); to be codified as § 46-658(4)(b) (Supp. 1979); formerly codified as § 46-658(3) (Cum. Supp. 1978).

86. *Id.*

87. LB 26, § 1 (1979); to be codified as § 46-658(4)(a) (Supp. 1979); formerly codified as § 46-658(3) (Cum. Supp. 1978).

88. The Nebraska Natural Resources Commission and University of Nebraska Conservation and Survey Division are required to testify at the hearing. LB 26, § 1 (1979), to be codified as § 46-658(4)(b) (Supp. 1979); formerly codified as § 46-658(3) (Cum. Supp. 1978). Presumably, the Commission testifies regarding whether establishing the control area would be consistent with development of the state water plan and the Division regarding the ground water hydrology of the area involved. *See* note 67 *supra*. In addition, the Director of Water Resources can make any additional investigations he deems necessary. LB 26, § 1 (1979), to be codified as § 46-658(4)(b) (Supp. 1979); formerly codified as § 46-658(3) (Cum. Supp. 1978).

89. *Id.* The Act was amended in 1979 to allow land within an NRD not requesting a control area hearing to be considered by the Director of Water Resources for inclusion in a proposed control area. *See* note 113 *infra*.

90. NEB. REV. STAT. § 46-658(1) (Cum. Supp. 1978) as amended by LB 26, § 1 (1979).

91. LB 26, § 1 (1979) to be codified as § 46-658(2) (Supp. 1979), formerly codified as § 46-658(1) (Cum. Supp. 1978).

the Director also delineates its boundaries in consultation with the NRD, Conservation and Survey Division, and Natural Resources Commission.[92]

After a ground water control area has been designated a public meeting must be held by the NRD to consider what ground water controls should be adopted.[93] The purpose of this meeting is for the NRD board to obtain public input regarding potential ground water control programs. Before regulations are formally adopted by the NRD, a public hearing must be held on the proposed regulations.[94] After the NRD has adopted ground water controls they must be approved by the Director of Water Resources before they take effect.[95] If controls are not adopted by the NRD within eighteen months after control area designation, ground water controls are established by the Director of Water Resources.[96] The ground water controls remain in effect until they are repealed or amended[97] except for well drilling moratoria, which last only one year.[98] A moratorium, however, may be renewed annually after a public hearing and with approval of the Director of Water Resources.[99]

The major role for implementing the Act lies with the NRD board. The role of the Department of Water Resources apparently is to prevent hasty or unreasonable action by an NRD. Within these broad limits the major decisions about ground water controls are made by the NRD board, which in turn is directly responsible to their constituents.

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92. LB 26, § 1 (1979), to be codified as § 46-658(4)(e) (Supp. 1979); replacing in part § 46-658(3) (Cum. Supp. 1978). *See* notes 67 and 88, *supra*. The order designating the ground water control area must define its geographic and stratographic (*i.e.*, geologic) boundaries. LB 26, § 1 (1979), to be codified as § 46-658(4)(e) (Supp. 1979); replacing in part § 46-658(3) (Cum. Supp. 1978). In addition, the Director must consider three factors in establishing control area boundaries: (1) the ground water supply or quality problem which led to the control area designation; (2) the effect on political subdivisions; and (3) the socio-economic and administrative factors directly affecting the ability of an NRD to implement a local ground water management and control program. LB 26, § 1 (1979), to be codified as § 46-658(4)(c) (Supp. 1979); formerly codified as § 46-658(3) (Cum. Supp. 1978).

93. NEB. REV. STAT. § 46-665(1) (Cum. Supp. 1978), as amended by LB 26, § 4 (1979).

94. LB 26, § 3 (1979), to be codified as § 46-665(2) (Supp. 1979). The text of the proposed regulations must be available to the public 30 days before the hearing is held. *Id.* Representatives of the Conservation and Survey Division and Natural Resources Commission are required to testify at the controls hearing. NEB. REV. STAT. § 46-665(1) (Cum. Supp. 1978), as amended by LB 26, § 4 (1979). *See* notes 67 and 88 *supra*.

95. LB 26, § 4 (1979), to be codified as § 46-666(2), replacing in part § 46-666(1) (Cum. Supp. 1979). The Director may hold a public hearing before approving or disapproving proposed ground water controls. *Id.*

96. LB 26, § 4 (1979), to be codified as § 46-666(7) (Supp. 1979), formerly codified as § 46-666(6) (Cum. Supp. 1978).

97. The procedure for repealing or amending ground water controls is the same as for adopting them. §§ 46-665 and -666 (Cum. Supp. 1978) as amended by LB 26, §§ 3 and 4 (1979).

98. LB 26, § 4, to be codified as § 46-666(4) (Supp. 1979), formerly codified as § 46-666(3) (Cum. Supp. 1978). An additional hearing is required before a well drilling moratorium can be imposed. *Id.*

99. *Id.*

Limitations of the Ground Water Management Act

The Act is primarily concerned with ground water mining. As such, it is the first major piece of legislation in Nebraska that squarely faces ground water management issues. Because it is a first step, however, the Act stops short of establishing a framework for comprehensive ground water management. For example, in many parts of the state ground and surface water supplies are physically interrelated. Under these circumstances, ground water mining can significantly impact surface supplies, resulting in conflicts among ground water users and surface water users. This problem is not addressed in the Act.[100]

Another aspect of ground water management not addressed by the Act is conjunctive management of ground and surface water. When ground water mining occurs, the depleted portion of the aquifer may be available to store water underground. The Act, however, does not grant the authorities necessary to conjunctively manage ground and surface water supplies to take advantage of

100. This is generally referred to as the subflow problem, the question being whether the subflow, *i.e.*, the ground water flow associated with a stream, is legally treated as surface water or ground water. The general approach followed in the West is the subflow of a stream is part of the stream, and subject to the same rights to use. Maricopa Co. Mun. Water Conservation Dist. No. 1 v. Southwest Cotton Co., 39 Ariz. 65, 4 P.2d 369 (1931); CAL. WATER CODE § 1200 (West 1970); Union Central Life Ins. Co. v. Albrethsen, 50 Idaho 196, 294 P. 842 (1930); KAN. STAT. § 42-306 (1973); Smith v. Duff, 39 Mont. 382, 102 P. 984 (1909); TEX. WATER CODE ANN. tit. 2, § 5.021 (Vernon 1970).

If prior appropriation is applied to interrelated ground and surface water, ground water users can be placed at a severe legal disadvantage. Because technological developments in well design, pumps, and water distribution systems have been relatively recent, ground water users will usually be in a "junior appropriator" status. This can mean that ground water development may be restricted in order to protect senior surface water rights.

The restriction on ground water development may not be extensive if the subflow is regulated as part of the stream. However, additional ground water that normally would reach a stream can be intercepted by wells. If this ground water, often called tributary ground water, is regulated as part of the stream, the impact on ground water development is greater than if only subflow were regulated.

In Colorado, tributary ground water is regulated as part of the surface water supply. COLO. REV. STAT. § 37-92-101 to -602 (1973 & Cum. Supp. 1976). The Colorado law recognizes that such an approach could significantly restrict ground water development and adopts several features to accommodate ground water users. Surface water users are permitted to transfer their priority date to a well, in effect substituting a more reliable ground water supply for a less dependable surface water supply but maintaing the earlier priority state. *Id.* §§ 37-92-102(1) and -301(3). In addition, ground water users are permitted to provide substitute water to surface water users to compensate for stream depletion by ground water withdrawals. Kuiper, *Colorado: the Problem of Underground Water*, 6 DEN. J. INT'L L. & POL'Y, 455 (1976); Harrison & Sandstrom, *The Groundwater-Surface Water Conflict and Recent Colorado Water Legislation*, 43 U. COLO. L. REV. 1 (1971). Finally, ground water users are not required to stop withdrawing ground water that depletes streamflow if the increase in streamflow will not occur soon enough to benefit the senior surface appropriator. COLO. REV. STAT. § 37-92-501(1) (1973).

The issue of how to resolve conflicts among ground and surface water users has not been resolved in Nebraska. *See* Harnsberger, *supra* note 19, at 210-25, 246-54; Holland, *Conflicts Between Private Appropriators of Stream Flows and Users of Ground Water in Nebraska*, 10 CREIGHTON L. REV. 592 (1977).

available underground storage capacity.[101]

A third issue not addressed by the Act is ground water transfers.[102] Ground water supplies may be abundant in areas where the overlying land is not suitable for irrigation. Ground water from these areas may be available to supplement water supplies in other areas. This issue is not addressed by the Act.[103]

A final issue not addressed by the Act is water quality. Use of ground water for irrigation may cause non-point pollution[104] of ground water, surface water, or both. Where light textured soils are irrigated, use of excessive amounts of ground water can result in the leaching of fertilizer into the aquifer. Where heavier textured soils are irrigated, use of excessive amounts of ground water can carry sediment and agricultural chemicals as runoff to a stream. In both situations the amount of ground water the irrigator is authorized to withdraw could be reduced to a level that would reduce or prevent water pollution. Although limitations on withdrawals are authorized by the Act, prevention of non-point water pollution is not specified as a ground water management objective.[105]

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101. Storing water underground has been a major activity in California. STATE OF CAL. DEPARTMENT OF WATER RESOURCES, BULL. NO. 118. CALIFORNIA'S GROUND WATER 119-21 (1975). Surface water imported from northern California and Arizona is stored underground in depleted ground water aquifers. Rights to withdraw naturally occurring ground water may be adjudicated to establish a basis for determining how to allocate costs for ground water recharge activities, although recharge and conjunctive management can occur without the benefit of a basin adjudication. SCHNEIDER, *supra* note 41, at 43-49. Rights to control withdrawals of water stored underground have been recognized in California by statute and court decision. CAL. WATER CODE §§ 60000 to -449 (West 1966 and Cum. Supp. 1978); City of Los Angeles v. City of Glendale, 23 Cal. 2d 68, 142 P.2d 289 (1943); City of Los Angeles v. City of San Fernando, 14 Cal.3d 199, 537 P.2d 1250, 123 Cal. Rptr. 1 (1975). *See* Krieger & Banks, *supra* note 43; Gleason, *Water Projects Go Underground*, 5 ECOLOGY L.Q. 625 (1976).

Washington statutes also recognize storage of water underground. WASH. REV. CODE ANN. ch. 90.44 (1962 & Supp. 1977). *See* Thorson, *Storing Water Underground: What's the Aqui-Fer?* 57 NEB. L. REV. 581, 606-09 (1978).

102. Nebraska statutes authorize the interbasin transfers of ground water by municipalities. NEB. REV. STAT. §§ 46-638 to -650 (1974). *See* Harnsberger, *supra* note 19, at 210-25. The legal status of ground water transfers in general, however, is unclear. *Id.*

103. *See* R. JOHNSON, MAJOR INTERBASIN TRANSFERS: LEGAL ASPECTS, NAT'L WATER COMM'N, U.S. DEP'T OF COMMERCE (Legal Study No. 7 (1971)); D. MANN, INTERBASIN WATER TRANSFERS: A POLITICAL AND INSTITUTIONAL ANALYSIS NAT'L WATER COMM'N, U.S. DEP'T OF COMMERCE (1973).

104. Non-point sources of pollution may be defined as any source of water pollution not associated with a descrete conveyance, such as a discharge pipe. W. ROGERS, ENVIRONMENTAL LAW § 4.4 (1977).

105. The Act does allow a control area to be established where ground water quality will be significantly changed if the aquifer is mined. LB 26, § 1 (1979), to be codified as § 46-658(1)(b) (Supp. 1979). *See* note 90 *supra* and accompanying text. This provision deals with problems of increasing mineralization of water resulting from ground water mining, rather than the non-point pollution problems described in the text accompanying this note.

Nebraska ground water statutes do contain other provisions addressing ground water quality. The first requires abandoned wells to be filled in accordance with regulations established by the Department of Water Resources. NEB. REV. STAT. § 46-602(3) (Cum. Supp. 1978). This prevents substances that could contaminate ground water supplies from entering the aquifer through an unfilled abandoned well. A second provision requires that if fertilizer or other

Procedural Limitations

In addition to the substantive limitation discussed above, some procedural limitations of the Act should be noted. The Act is indefinite regarding what objectives should be considered in an NRD's formulation of ground water controls.[106] This means that ground water management policies will be established by NRDs, not by the State. The Act is similarly indefinite regarding what criteria the Director of Water Resources should use in approving regulations proposed by an NRD.[107] This poses a somewhat different problem. Because the Director's discretion in this regard is undefined, the Director theoretically could dictate what ground water

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chemicals are added to ground water for use in irrigation, the well must be equipped with a check valve. *Id.* § 46-612.02, as amended by LB 4, § 1 (1979). This prevents the chemicals from being siphoned into the aquifer if the well pump stops. The Act authorizes NRDs to enjoin the use of wells in violation of these requirements. *Id.* §§ 46-657(8) and -663(6).

106. Sections 46-665 and 46-666 (Cum. Supp. 1978) as amended by LB 26, §§ 3, 4 (1979) are the only sections of the Act which deal with ground water controls. Both sections deal solely with procedural matters, other than enumerating what controls are authorized. This leaves the decisions regarding what controls are adopted and how they are used to the NRD.

General legislative guidance regarding ground water management objectives may be inferred, however, from the intent language of the Act:

> The Legislature finds, recognizes, and declares that the management and conservation of ground water and the beneficial use thereof are essential to the economic prosperity and future well-being of the state and that in geographic areas where ground water may be declining or where shortages of ground water may occur, the public interest demands the implementation of management practices *to conserve ground water supplies and to prevent the inefficient or improper use thereof.* To provide for an orderly management system, particularly in areas where changing ground water conditions require the designation of control areas with special regulation of future development and use, the Legislature recognizes the need for this act.

NEB. REV. STAT. § 46-656 (Cum. Supp. 1978) (emphasis added). This language does not establish state ground water management objectives, but does recognize the need for efficient use and conservation of ground water.

In addition, the Act does contain some specific guidance for NRDs in establishing ground water controls. An NRD may adopt ground water controls which vary within a control area, if the differences in the controls are based on varying climactic, hydrologic, geologic, or soil conditions. LB 26 § 4 (1979), to be codified as § 46-666(3) (Supp. 1979), formerly codified as § 46-666(2) (Cum. Supp. 1978).

107. LB 26, § 4 (1979), to be codified as § 46-666(2) (Supp. 1979); replacing in part 46-661(1) (Cum. Supp. 1978) is the only section in the Act dealing with the Director's approval of NRD ground water controls. The section does not establish criteria for the Director to consider in evaluating proposed ground water controls but is entirely procedural, authorizing the Director to hold a public hearing before he approves or disapproves the ground water controls. A requirement to consider whether the proposed ground water controls achieve efficient use of ground water and ground water conservation may be implied by § 46-656 (Cum. Supp. 1978), discussed in note 106 *supra*. In addition, the criteria for establishing ground water control area boundaries of LB 26, § 1 (1979), to be codified as § 46-658(4)(c) (Supp. 1979); formerly codified as § 46-658(3) (Cum. Supp. 1978), may be factors for the Director to consider in evaluating proposed ground water controls, although such consideration is not required by the Act. *See* note 92 *supra*. Finally, the Act clearly authorizes adoption of variable controls where justified by differing climactic, hydrologic, geologic, or soil conditions within a control area. LB 26, § 4 (1979), to be codified as § 46-666(3) (Supp. 1979); formerly codified as 46-666(2) (Cum. Supp. 1978).

controls are adopted by an NRD.[108] The major legal issue posed by these ambiguities is whether by not establishing administrative criteria, these portions of the Act may be unconstitutional delegations of legislative authority to administrative agencies.[109] This problem could be easily remedied, however, by general legislative directives which would not significantly limit administrative discretion.[110]

A more significant limitation is the bases for establishing a control area. Currently, inadequacy of ground water quantity or quality resulting from ground water mining are the only bases for establishing a ground water control area.[111] In other words, ground water mining must be occurring or reasonably foreseeable before the Act can be invoked, suggesting that ground water management should be delayed until mining occurs. This approach could appropriately be called ground water mismanagement. Ground water controls could be authorized before mining has occurred to prevent or lessen the degree of subsequent ground water mining.[112]

A final procedural issue relates to how ground water control areas are established. Currently, NRDs have sole discretion to initiate the ground water control area process.[113] If ground water

108. This could be accomplished by the Director's refusing to approve ground water controls until they satisfy him. The Act does not clearly indicate, however, whether the Legislature intended the Director to play such a role.

109. L. DAVIS, ADMINISTRATIVE LAW TEXT 36-41, § 2.06 (3d. ed. 1972).

110. *Id.* §§ 2.07-2.10, at 41-52.

111. NEB. REV. STAT. § 46-658(1) (Cum. Supp. 1978) as amended by LB 26, § 1 (1979).

112. The Act originally authorized the establishment of a ground water control area where "conditions. . . require the area to be designated as a control area for protection of the public welfare." *Id.* 46-658(1)(c) (Cum. Supp. 1978). Arguably this could have provided a legal basis for establishing ground water controls to prevent the development of future problems. This language, however, has been deleted. LB 26, § 1 (1979), to be codified as 46-658(2) (Supp. 1979).

113. *Id.*, to be codified as § 46-658(3) (Supp. 1979), formerly codified as 46-658(2) (Cum. Supp. 1978). This procedure was modified in 1979 to give the Director of Water Resources limited authority to consider whether a ground water control area should be extended into an NRD not making a request for a control area hearing. When an NRD files a request to hold a hearing to determine whether a ground water control area should be established, the NRD must include a general description of the area proposed to be included in the control area. *Id.* If the Director, on his own motion, believes that additional contiguous areas should be considered for inclusion in the proposed control area, he shall so notify the NRDs within which such areas are located. *Id.*, to be codified as § 46-658(4)(a) (Supp. 1979), formerly codified as § 46-658(3) (Cum. Supp. 1978). The Director also must include in the public notice for the control area hearing a description of all of the area identified by the Director and the NRD to be considered for inclusion in the proposed control area. *Id.* If the Director determines that a control area should include land within an NRD which did not join in the request for the control area hearing, the Director shall notify such NRD before the order establishing the control area is issued. *Id.*, to be codified as 46-658(4)(d) (Supp. 1979). The additional contiguous area shall not be included in the control area unless the NRD consents in writing to inclusion within 60 days after being notified by the Director of the proposed control area boundaries. *Id.* This procedure increases the Director's discretion in establishing control area boundaries, but preserves the prerogative of an NRD to decide whether it engages in a ground water control program.

mining is occurring but the NRD fails to initiate ground water controls, the Director of Water Resources could be authorized to initiate the control area process.[114]

Experience Under the Ground Water Management Act

As of July 1, 1979, five ground water control area hearings have been held pursuant to the Act. Two requests for ground water control area designation have been denied[115] and three have been granted. In two control areas, ground water control regulations have been established by the NRD and approved by the Director of Water Resources.

The first ground water control area was established in the Upper Republican NRD.[116] The Upper Republican NRD is in the southwest corner of Nebraska. The area included in the Upper Republican NRD historically has been used for wheat production and grazing but is now increasingly irrigated by center pivots. Corn is the major irrigated crop. Ground water declines within the control area of more than thirty-five feet have occurred with more substantial declines projected.[117] The control area covers 2600 square miles, including an estimated 2400 irrigation wells which irrigate nearly 310,000 acres within the control area. Ground water controls, discussed in detail below,[118] have been established and require the installation of meters on all high capacity wells by 1980 and provide for establishing an annual ground water allocation of

114. A provision which would have authorized this was removed on the floor of the Legislature. *See* note 75 *supra* and accompanying text.

115. The control area requests involved relatively small artesian aquifers. *In re* Request Filed by the North Platte Natural Resources Dist. for Creation of a Ground Water Control Area: Order Denying a Request to Create a Ground Water Control Area (Nebraska Dep't of Water Resources, January 7, 1977); *In re* Request Filed by the Lower Platte South Natural Resources Dist. for Creation of a Ground Water Control Area: Order Denying a Request to Create a Ground Water Control Area (Nebraska Dep't of Water Resources, March 30, 1978). Copies may be obtained from the Dep't of Water Resources, State Office Bldg., P.O. Box 94676, Lincoln, NE, 68509. In both cases irrigation development had caused temporary reductions in artesian pressure, which interferred with individual domestic wells. The Director of Water Resources concluded that the problem involved primarily a one-time adjustment to those changed circumstances, and that adequacy of the ground water supply was not threatened. North Platte Order at 2. In making his decision the Director relied heavily upon the inadequacy of supply criterion, even though conflicts among users were occurring. *Id.* at 3. The Director was influenced by court decisions requiring irrigators to bear the expense of replacing domestic wells affected by artesian pressure losses. *Id. See* Prather v. Eisenmann, 200 Neb. 1, 261 N.W.2d 766 (1978).

116. *In re* Request Filed by the Upper Republican Natural Resources Dist. for Creation of a Ground Water Control Area: Order Granting a Request to Create a Ground Water Control Area (Neb. Dep't of Water Resources, Aug. 1, 1977).

117. ELLIS & PEDERSON, *supra* note 58, at 40. Ground water levels are expected to fall as much as 140 feet by the year 2000 if ground water development for irrigation is not restricted. E. LAPALLA, QUANTITATIVE HYDROGEOLOGY OF THE UPPER REPUBLICAN NATURAL RESOURCES DISTRICT, SOUTHWEST NEBRASKA 2 (U.S. Geological Survey, Water Resources Investigations 78-38, 1978).

118. *See* notes 154-174 *infra* and accompanying text.

between fourteen and seventeen acre inches[119] per irrigated acre beginning in 1980. In addition, drilling of new wells is severely restricted within townships where annual withdrawals exceed one percent of the remaining saturated thickness of the aquifer.

The second control area was established in the Upper Big Blue NRD.[120] The Upper Big Blue NRD is in southeastern Nebraska where substantial ground water irrigation developed beginning in the 1940s. The control area encompasses 2700 square miles in nine counties, including 9400 irrigation wells irrigating 1.1 million areas. Corn is the major irrigated crop. Ground water regulations have been established for the Upper Big Blue control area.[121] The controls do not establish immediate limitations on ground water use.[122] If, however, the rate of ground water decline accelerates, (which is probable) an annual allocation of sixteen acre inches per certified irrigated acre could be established as early as 1982.[123] The controls encourage the installation of flow meters, installation of reuse pits, use of irrigation scheduling techniques, and other voluntary measures to control ground water level declines.[124]

The third ground control area was established in the Little Blue NRD on January 2, 1979.[125] The Little Blue control area is in south central Nebraska, where corn is the major irrigated crop. The control area includes 500,000 acres, sixty percent of which are irrigated from approximately 2500 irrigation wells. The control area lies in the Blue river valley, and is contiguous to the Upper Big Blue control area. Ground water regulations have not yet been established for the Little Blue ground water control area.

Evaluation of Controls Authorized by the Ground Water Management Act

The effectiveness of each ground water control option authorized by the Ground Water Management Act depends on what one wishes to achieve. As different parties desire different results, a ground water control is not necessarily good or bad—what is good for one individual may be bad for another. The analyst, therefore, can only assess the impact of each option on those decision variables with reference to evaluation criteria that have policy signifi-

119. An acre inch is enough water to cover an acre of land to a depth of one inch, or approximately 27,000 gallons.

120. *In re* Request of the Upper Big Blue Natural Resources Dist. for Creation of a Ground Water Control Area: Corrected Order Granting a Request to Create a Ground Water Control Area (Neb. Dep't of Water Resources, December 22, 1977).

121. *In re* Rules and Regulations for Groundwater Control for Adoption by the Upper Big Blue Natural Resources Dist.: Order of Approval (Neb. Dep't of Water Resources, January 9, 1979).

122. Control Area Rules and Regulations (Upper Big Blue Natural Resources District, December 26, 1978) Rules 2(I)(B), 2(II).

123. *Id.* Rule 3.

124. *Id.* Rule 2(I)(A).

125. *In re* Request of the Little Blue Natural Resources Dist. for Creation of a Ground Water Control Area: Order Granting a Request to Create a Ground Water Control Area (Neb. Dep't of Water Resources, January 2, 1979).

cance. Ground water decision makers in Nebraska appear to be most concerned about administrative feasibility of control options (including costs), economic efficiency[126] (including farm management flexibility), equity among irrigators, and water quantity impacts.[127] These criteria are the reference points for this evaluation of Nebraska's ground water management options.

The options to be evaluated are those discussed earlier: rotation of pumping, drilling moratoria, well spacing, and ground water allocation.[128] These options imply a rather narrow definition of ground water management, because they all are directed at allocating currently available ground water supplies among irrigators over time. Other aspects of ground water management, such as conjunctive use and artificial recharge, are not addressed by the Ground Water Management Act.[129] Each ground water control will be discussed separately before combinations of controls are evaluated.

Well Spacing

Under current statutes well spacing requirements are used to reduce direct interference among nearby wells.[130] In addition, well spacing can be a method of controlling the density of irrigation development and, indirectly, the amount of ground water withdrawals. Nebraska statutes require 600 feet spacing between irrigation wells[131] and 1000 feet between municipal, irrigation, and industrial wells.[132] The Ground Water Management Act gives NRDs broad authority to make these spacing requirements more stringent where a control area has been established.[133]

A. *Water Quantity Impacts*

Well spacing requirements affect only the density and the location of new wells. Current withdrawals are not affected, and future withdrawals are affected only to the extent that spacing restrictions preclude development that would otherwise have occurred. In areas where well development is dense but full development has not occurred, spacing can have a significant impact on future ground water withdrawals, providing it is not possible to es-

126. For a relatively complete discussion of the meaning and significance of economic efficiency as a resource allocation criterion *see* R. MCKEAN, EFFICIENCY IN GOVERNMENT THROUGH SYSTEMS ANALYSIS (1958).

127. *E.g.*, Groundwater Management (Upper Big Blue Natural Resources District, January 31, 1978).

128. *See* note 76 *supra* and accompanying text.

129. *See* notes 100-102 *supra* and accompanying text.

130. NEB. REV. STAT. § 46-608 (1974).

131. *Id.* §§ 46-609 to -611. Spacing requirements do not apply to irrigation wells owned by the same person. *Id.* § 46-611.

132. *Id.* §§ 46-651 to -655 as amended by LB 201, § 1 (1979). Protection of the spacing statute applies only to registered wells. *Id.* § 46-652. The spacing requirements do not apply to domestic wells, or to wells owned by the same person. *Id.*

133. *Id.* § 46-666(1)(c) (Cum. Supp. 1978).

cape the potential effect of spacing through the construction of higher yielding wells. The tendency to mitigate the water conservation impacts of spacing through development of larger wells can be prevented, however, by imposing greater spacing requirements on higher capacity wells.

B. *Administrative Considerations*

Well spacing regulations are perhaps the easiest of all the options to administer, except for possible legal complications. In a control area permits are required from the Department of Water Resources to drill new wells, excluding domestic wells.[134] In addition, most existing irrigation wells are registered with the Department.[135] Well spacing restrictions, therefore, could be efficiently enforced by the Department; permits would be granted only when the new well would not violate spacing requirements. Enforcement of well spacing relative to domestic or non-registered wells is more difficult, as the Department does not have information regarding their existence or location. This problem could be handled by requiring the well driller or ground water user to verify that his proposed well does not violate spacing requirements, with stiff penalties for noncompliance.

Enforcement of well spacing regulations could be difficult where the right to use ground water is based on land ownership, rather than being based on a state permit independent of land ownership. A landowner who is denied a right to drill a well because of a well spacing regulation might challenge the constitutionality of the regulation in court, arguing that the restriction prevented him from exercising a private property right without compensation.[136] This would cause only a temporary administrative problem. Once the courts ruled definitively on the issue, no further challenges would arise. If the courts invalidated well spacing requirements where they precluded additional development, the constitutionality of the approach could be established by legislation making rights to use ground water dependent on obtaining a state permit.[137]

C. *Economic Efficiency*

Well spacing regulations are a relatively efficient approach to ground water management because they place no restrictions on how the water is used—irrigators or industrial users can use the water to which they have access for its highest value and therefore

134. *Id.* § 46-659.
135. *Id.* § 46-608 to -611 (1974).
136. A similar situation arose in North Dakota, where the supreme court held that unexercised common law rights to withdraw ground water could constitutionally be abrogated by a prior appropriation statute. Baeth v. Hoisveen, 157 N.W.2d 728 (N.D. 1968).
137. For a general discussion of statutory regulation of common law water rights and the taking issue *see* Ausness, *Water Use Permits in a Riparian State: Problems and Proposals*, 66 KY. L.J. 191, 240-52 (1978).

its most efficient use. Economic inefficiency would occur only to the extent that well spacing forces the use of well location or well sizes that cause higher water access costs than would otherwise occur.

D. *Equity*

Well spacing requirements that prevent direct interference among nearby wells are a fair way of coping with a common problem. However, under circumstances where spacing becomes stringent enough to preclude development, severe inequities often result. Early developers get the water, while those who have not yet developed are denied access. This is particularly inequitable where denial of access to water through spacing restrictions reduces land values.

E. *Summary Assessment*

Well spacing is an efficient, equitable, and easily administered method of reducing well interference, but not an effective method for reducing ground water withdrawals. A withdrawal impact will occur only in cases where spacing requirements significantly reduce further development. The impact of such restrictions gives a considerable and perhaps unfair advantage to current water users.

Well Drilling Moratoria

Nebraska's Ground Water Management Act authorizes NRDs to declare annual moratoria on well drilling within all or part of a control area, subject to approval by the Director of Water Resources.[138] The Act suggests that this extreme measure should be used only on a temporary basis when other ground water controls alone are insufficient to protect the public interest.[139]

A. *Water Quantity Impacts*

A drilling moratorium that continues in effect for many years would substantially affect long-term ground water withdrawals in areas where substantial additional development would occur if no moratorium existed. The short term impact on withdrawals would be minimal, however, because a moratorium would do nothing to reduce the amount of water withdrawn from existing wells.

B. *Administrative Considerations*

This option could be administered by merely having the Director of Water Resources deny well drilling permits to anyone within

138. LB 26, § 4 (1979), to be codified as § 46-666(4) (Supp. 1979); formerly codified as § 46-666(3) (Cum. Supp. 1978).

139. *Id.* Permanent moratoria to protect existing ground water users is a power often granted to a state engineer in appropriation states. *E.g.*, IDAHO CODE § 42-233a (Cum. Supp. 1978); NEV. REV. STAT. § 534.110 (1973).

the area where the moratorium is desired. The only administrative problem involves the constitutional question regarding state authority to deny land owners access to ground water without compensation.[140]

C. *Economic Efficiency*

Well drilling moratoria are a reasonably efficient way of slowing increases in ground water withdrawals. All users are permitted to use their water in the most profitable (efficient) manner. If currently irrigated lands are generally more productive than potentially irrigable lands, which seems likely, drilling moratoria result in efficiently allocating water to its highest value uses.[141]

D. *Equity*

A permanent moratorium on drilling insures that ground water will be managed for current users only; those who were not using ground water could not do so in the future. This gives a considerable and perhaps unfair advantage to current users. A temporary moratorium would only postpone new ground water development, but would be less subject to criticism for penalizing those who have not yet developed ground water.

E. *Summary Assessment*

A drilling moratorium is the most extreme measure in the Ground Water Management Act. It is an easily administered and efficient but inequitable approach to ground water management. The inequities between current and potential users make long term or permanent moratoria unattractive and perhaps unconstitutional. A temporary moratorium, however, may be useful as a means of gaining time to develop more complete (and equitable) ground water regulations.

Rotation

The rotation option in the Nebraska Ground Water Management Act authorizes NRDs to control when a well may be pumped. The Act does not restrict this authority—a daily, weekly, monthly, or yearly pumping rotation, or some combination thereof, may be adopted.[142]

A. *Water Quantity Impacts*

Rotation of pumping is an indirect control on the amount of water pumped. The expected impact on withdrawals would de-

140. *See* notes 136-137 *supra* and accompanying text.

141. This presumes that irrigation is the only significant use of ground water. A drilling moratorium would lead to economically inefficient use of ground water, however, where it precluded the use of water for higher value purposes, such as industrial or municipal uses.

142. NEB. REV. STAT. § 46-666(1)(b) (Cum. Supp. 1978).

pend primarily on the time dimension of a rotation program. If irrigators were permitted to pump three out of four days, effect on withdrawals would be minimal. If the rotation period permitted pumping one out of four days every other year, however, the water quantity impact would be substantial. If the pumping period were severely limited, strong incentives would develop to increase well capacities, increase the number of wells, or to modify management techniques, for example, by irrigating in the fall prior to the year when pumping is prohibited. For these reasons, a rotation regulation may have only mixed success in limiting ground water withdrawals.

B. *Administrative Consideration*

Enforcement of a rotation system would be difficult for within season (daily or weekly) rotation schemes. Constant monitoring of when each well is being pumped, or spot checks with severe penalties for violators would be required to prevent violations. Annual rotation schemes would present fewer problems, because fewer checks would be necessary to determine if violations had occurred.

C. *Economic Efficiency*

A rotation period of less than one year would be an extremely inefficient way of managing ground water, since irrigators would be prevented from applying the optimum amount of water at the optimum time. Under a rotation system, the timing of water applications would not necessarily coincide with crop needs, resulting in unnecessary evaporative losses or yield reductions.

Annual rotation programs would be more efficient, because the irrigator could manage his water applications in optimum fashion during the years he could irrigate. Some inefficiencies would still result, however, since strong incentives would be created to over-irrigate during the last part of the irrigation season to carry over as much water as possible into the dryland year. This would reduce soil capacity to store precipitation that would occur in the following winter.

D. *Equity*

The inequitable impact of rotation is perhaps the most significant disadvantage associated with the option. The inequities between ground water users with high capacity and low capacity systems could make the approach politically unacceptable in many cases.

E. *Summary Assessment*

A rotation requirement is an inefficient, inequitable, and difficult to administer method of reducing ground water withdrawals,

especially for intra-year rotation schemes.[143]

Ground Water Allocation (Quantity Limitations)

The Ground Water Management Act gives NRDs broad authority to limit the amount of water withdrawn by ground water users. The Act uses the term "allocation" to refer to the wide range of methods by which the quantity of ground water withdrawn might be restricted and does not specifically limit the methods to be used.[144] Therefore, ground water allocations or, more precisely, limitations on withdrawals, could take several forms. Ground water allocations: (1) could have different bases; (2) could be for different time periods; (3) could either be uniform or vary according to crop needs and/or aquifer conditions; (4) could restrict where water is used; and (5) could be established at different quantity levels. Each variable will, therefore, be considered separately.

A. *Alternative Bases for Allocation*

Alternative bases for allocation include allocation per well, per irrigated acre, per irrigable acre, and by crop. A per well allocation approach consists of limiting the amount of ground water irrigators may withdraw from each of their wells to some amount per time period. The advantages of this approach are that total ground water withdrawals are easily estimated and administration is relatively simple: meter all wells and spot check them periodically. The principal disadvantage is that allocation per well is inefficient. Irrigators with high yielding wells would have an incentive to drill additional wells to obtain as much water as they had used prior to the regulations, which would increase the average cost per unit of irrigation water. Related to the efficiency problem is the inequity of allocation per well. An irrigator with two wells per quarter section would be much less affected than an irrigator with one well per quarter section.

Allocation on a per irrigated acre basis is defined here as giving each landowner an allocation for each contiguous tract of irrigated land equal to the number of irrigated acres in the tract multiplied by the per acre amount. This approach implicitly assumes that a ground water user could apply more than the per acre allocation to some acres within a tract and less to others.[145] A per irrigated acre approach is efficient because the ground water user may use his allocation where it is most productive. It is also easily

143. Rotation regulations may have some utility in managing artesian pressure variation. The Upper Big Blue control area regulations state that rotating the use of wells may be required in the future to deal with artesian head loss situations. Upper Big Blue Control Area Regulations, *supra* note 122, at 1.

144. NEB. REV. STAT. § 46-666 (1)(a) (Cum. Supp. 1978).

145. This approach raises questions regarding the legal status of ground water transfers, including the transfer and use of ground water on non-overlying land, and the transfer of ground water allocations between tracts. *See* notes 102 to 103 *supra*, and notes 148 to 151 *infra* and accompanying text.

administered since only total ground water withdrawals need be monitored. The only major difficulty involves defining what an irrigated acre is. If an irrigated acre is defined as any land upon which any quantity of irrigation water is applied, an irrigator could increase his allocation by, for example, applying an acre inch of water on his pasture and calling it irrigated land. This problem could be mitigated somewhat by defining an irrigated acre as any acre upon which a minimum amount of water is applied, or by calculating a total allocation based on all the irrigated crops being produced per tract.

The allocation per irrigable acre approach, on the other hand, would allocate to a ground water user an amount equal to the total number of irrigable acres he had multiplied by a specified acre inch limitation, with no restrictions on how the water is used within a tract. Whether or not he actually irrigated all his irrigable land would not affect his allocation. This approach would be more equitable and efficient than basing allocations on acres irrigated, but also presents administrative problems.

A per irrigable acre approach would be equitable, because it treats both current and prospective irrigators equally—a landowner would be granted an allocation for his irrigable land whether or not it had been developed. This approach also contributes to enhanced efficiency, because irrigators would have more flexibility regarding when and where they use water. For example, a farmer with 300 acres of irrigable land may find it financially advantageous to develop only part of it for irrigation and concentrate his allocation on fewer acres, or he may decide to delay development and accumulate unused rights for use in later years. No other basis for allocation permits this flexibility. This means, however, that a ground water user will not necessarily use his allocation judiciously. If he has sufficient undeveloped but irrigable land he would have little incentive to carefully ration the water used on his irrigated land.

The administrative problems associated with allocation on an irrigable acre basis are severe, but probably not insurmountable. The fundamental difficulty involves defining an irrigable acre. Historically, irrigability has been defined based upon soil type and slope,[146] but center-pivot distribution systems have made it possible to irrigate lands long believed to be non-irrigable. Furthermore, even if a set of irrigability criteria could be agreed upon by an NRD board, considerable room for debate and judgment would remain regarding which unirrigated lands met the criteria.

Finally, allocations could be based on crop needs. Under this approach, each ground water user would receive an allocation equal to some proportion of total crop needs times the number of acres of each crop produced. The crops produced would determine

146. NEB. SOIL & WATER CONSERVATION COMM'N REPORT ON THE FRAMEWORK STUDY, APPENDIX A: LAND INVENTORY 35-47 (1974).

the amount of the allocation, but the groundwater user would not be restricted regarding how much he applies to any given crop.[147] An allocation per crop would be fairly easy to administer as well as reasonably equitable and efficient, providing the ground water user was not restricted in where he used his total allocation within a given tract. The only serious problem with this approach is that the ground water user would have no incentive to produce lower water using crops, and therefore the desired impact on withdrawals might be difficult to achieve.

B. *Allocation Time Period*

Allocations could be made for one year or for several years. In addition, carryover of unused allocation for use in future allocation periods may or may not be allowed. A single year allocation, without carryover provisions, would mean that an irrigator would have to use his allocation during the year in which it is granted or lose it. The principal disadvantage of this approach is that it does not offer the irrigator any incentive to use less than his full allocation through more efficient irrigation practices or because of unusually high rainfall. It is also economically inefficient over the long run because irrigators are not given the opportunity to obtain maximum profits per unit of water consumed. For example, if an irrigator were allocated twelve acre inches per acre in years one and two, it might be more profitable to use ten acre inches in year one and fourteen acre inches in year two, due to rainfall variations, cropping changes, or other factors. A single year allocation without carryover provision would prevent this management choice. This could be avoided by permitting carryover of an unused allocation to future years.

A multi-year allocation would consist of giving irrigators some amount of water to use over several years. Such a program might consist of sixty acre inches per acre over four years, forty-five acre inches over three years, etc. Essentially, it would mean that irrigators could pump any amount they wanted per year until their total multi-year allocation was exhausted. This differs from single year allocation, with carryover provisions, primarily in that the multi-year approach would permit borrowing from future years. An irrigator granted fifteen acre inches per acre per year for each of the next five years (single year allocations) would not be permitted to use more than fifteen acre inches per acre the first year, thirty acre inches in the first two years, etc. However, if he were given a five year allocation of seventy-five acre inches per acre, he could use

147. Assume that 16 acre inches are allocated per acre of irrigated corn grown, and 8 acre inches are allocated per acre of irrigated grain sorghum. An irrigator who produced 100 acres of corn and 50 acres of grain sorghum would receive a total allocation equal to 100 × 16 acre inches plus 50 × 8 acre inches or a total of 2000 acre inches, but might choose to apply 17 acre inches per acre on his corn and 6 acre inches on his sorghum (100 × 7 plus 50 × 6 = 2000).

more than the annual average during any year until his total allocation had been consumed.

An additional difference between single year and multi-year allocation systems concerns the level of uncertainty with respect to future allocation levels. If single year allocations are not made several years in advance, irrigators would be unable to evaluate the relative value of carryovers, that is, determine whether they should use less this year and more next year. Multi-year allocations allow for advance planning, which would contribute substantially to economic efficiency.

C. *Variability of Allocation*

A ground water allocation could be uniform or varied because of different crop water requirements, different aquifer conditions, or both. The issue of uniformity involves numerous tradeoffs between ease of administration, equity, and impact on withdrawals. Uniform allocations would be easier to administer, but they could be considered inequitable to the extent that needs vary. Water needs depend on differing circumstances such as precipitation, type of water distribution system, and soil type. The impact of a uniform allocation on irrigators could vary widely and perhaps inequitably. However, it could also be argued that all landowners should have equal rights to use the available ground water supply regardless of their relative needs.

Allocations could also be varied according to aquifer conditions, with lower allocations in areas of the most severe depletion to reflect the reduced availability of ground water. Difficulties in defining where these "critical" areas exist, however, could make administration of variable allocations more difficult.

D. *Location of Use of Allocation*

The use of ground water allocation could be restricted to the land on which it is based.[148] Alternatively, allocations could be transferable in one of two ways: (1) an amount greater than that allocated per acre could be pumped for use on a particular tract by pumping and applying less on another ("pooling of allocations"), and (2) ground water could be physically transferred between tracts belonging to the same or to a different ownership unit.

The principal advantage of allowing pooling of allocations and ground water transfers is that they may substantially improve economic efficiency.[149] Pooling and transfers allow an irrigator to use

148. This is an element of the reasonable use doctrine, which is followed in Nebraska. Olson v. City of Wahoo, 124 Neb. 802, 248 N.W. 304 (1933). The question of limitations on ground water transfers, however, has not been litigated in Nebraska except with regard to municipal ground water transfers. Metropolitan Utilities Dist. of Omaha v. Merritt Beach Co., 179 Neb. 783, 140 N.W.2d 626 (1966). *See* note 102 *supra.*

149. For a general discussion of how transferable rights to use natural resources affects economic efficiency *see* B. BEATTIE, E. CASTLE, W. BROWN & W.

his allocation where it will be the most productive, which means increased profit per unit of water (farm-level economic efficiency) without any change in total water consumed. This generalization holds true for both pooling of allocations and water transfers because, unless there were some efficiency gains from transfers, they are not likely to occur.

The principal difficulty with permitting water transfers is that inequities may result. If permitting transfers results in irrigator X pumping more from well A and less from well B, landowners adjacent to well A may be adversely affected by the increased pumping, while landowners adjacent to well B are positively affected by the reduced pumping. Whether or not this inequity occurs would depend on the distance between well A and B and hydrologic characteristics of the aquifer.

An additional problem associated with ground water transfers is that their status has not been legally defined either in the Ground Water Management Act or by court decision. Courts have invalidated transfers in Arizona—the western state other than Nebraska that adheres to the reasonable use doctrine.[150] Without clear legislative direction, Nebraska courts might follow the Arizona precedent and restrict transfers.[151] A potentially attractive policy that would capture some efficiency gains while minimizing inequities might consist of permitting water transfers between lands or between wells that are close together.

E. *Quantity of Water Allocated*

The last issue involves determining how much water to allocate to irrigators over time. This issue could be approached in a number of ways, but the central question is what level of current economic returns are decision makers willing to sacrifice to prolong aquifer life. If no sacrifice is desired, the proper allocation level would consist of an amount that eliminates waste, but is sufficient to meet full irrigation demands. On the other extreme, if decision makers were willing to sacrifice any amount in order to prevent further ground water mining, the appropriate allocation would be that amount which prevents ground water mining.[152]

In practice, the selection of an allocation level is likely to be a continually evolving activity. The lack of information regarding economic and hydrologic impacts will probably mean that initial allo-

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GRIFFIN, ECONOMIC CONSEQUENCES OF INTERBASIN WATER TRANSFERS (Agricultural Experiment Station, Technical Bull. No. 116, Or. State Univ., 1971); Gardner, *Transfer Restrictions and Misallocation in Grazing Public Range*, 44 J. FARM ECON. 50 (1962).

150. Jarvis v. State Land Dep't, 106 Ariz. 506, 479 P.2d 169 (1970); Bristor v. Cheatham, 75 Ariz. 227, 255 P.2d 173 (1953).

151. The Nebraska Supreme Court has sustained the validity of a statute authorizing municipal ground water transfers. Metropolitan Utilities Dist. of Omaha v. Merritt Beach Co., 179 Neb. 783, 140 N.W.2d 626 (1966). *See* notes 102 to 103 *supra* and accompanying text.

152. *See generally* Bagley, *Water Rights Law and Public Policies Relating to Ground Water "Mining" in the Southwestern States*, 4 J.L. & ECON. 144 (1961).

cation levels will be rather high, that is, that they will seek to eliminate waste only, and may be followed by gradual reductions over many years. As allocations are gradually reduced, decision makers will learn more about the current economic cost of reduced withdrawals and the impact on ground water levels. This will enable them to make better informed, long-term decisions regarding the tradeoffs between prolonged aquifer life and reduction of short-term economic returns.

F. *Summary Assessment of Allocation*

Allocation is a powerful tool for managing ground water resources. Although none of the allocation options are simultaneously efficient, easily administered, and equitable, allocation appears quite favorable overall. The most desirable basis for making allocations appears to be irrigated acres. Allocation per well is inequitable, and allocation per irrigable acre would be difficult to administer.

The most desirable time period for allocations would be to make single year allocations several years in advance, permitting carryover of unused allocations to future years. This gives the ground water user the opportunity to use his allocation when it is needed most, and prevents exhaustion of the allocation before the end of the allocation period. The latter may be advantageous to prevent development of political pressures to relax allocation policies.[153]

Allocations could either be uniform or varied according to aquifer conditions. Varying allocations based on crop needs, however, would not provide incentives to grow crops that required less water. Pooling of allocations and ground water transfers would allow irrigators to use water where it was most productive. If pooling and transfers are allowed, however, safeguards should be developed to prevent interference between nearby wells.

Establishing what quantity of water to allocate depends on what ground water reservoir management policies are selected. Whether a ground water mining approach, a "safe-yield" approach, or intermediate approach is most desirable depends on the economic, hydrologic, geographic, and political factors of each ground water control area.

REGULATIONS ESTABLISHED UNDER THE GROUND WATER MANAGEMENT ACT

The Ground Water Management Act grants NRDs substantial powers to deal with ground water mining, with no recourse for NRD inaction. These powers, however, are not substantially differ-

153. NRD directors are elected for four-year terms, which gives them some insulation from immediate political pressure. NEB. REV. STAT. § 2-3214 (1977). NRD directors can, however, be removed from office by recall election. *Id.* §§ 2-3216, 23-2001 to -2012 (1977).

ent from those found in other western states. The success of the Act in dealing with ground water mining depends on how the Act is implemented by NRDs.

The Upper Republican is the first NRD to establish ground water control rules and regulations approved by the Director of Water Resources.[154] The regulations establish that allocation of ground water will be the primary ground water control mechanism. Allocation will be phased in to allow for the metering of existing high capacity[155] wells, with mandatory five year allocations for all ground water users beginning in 1980.[156] In addition, well spacing requirements will severely limit ground water development within "critical" townships where the aquifer depletion rate is greater than one percent per year.[157] Implementation of these controls should result in significant reductions in ground water withdrawals within the control area over time.

Metering of Wells

A successful allocation system requires metering to accurately measure ground water withdrawals. The regulations require metering of all new high capacity wells before they can be used for irrigation, and metering of all existing high capacity wells by 1980.[158] The meters must meet NRD specifications[159] and are required to be sealed by the NRD.[160] Violation of the metering requirements can result in a loss of up to one year's ground water allocation.[161]

Allocation of Ground Water

The regulations establish an allocation program for wells as they are metered.[162] Prior to 1980 the allocation is voluntary and no penalties are imposed for exceeding the allocation. Generous allocations, however, are coupled with provisions allowing a por-

154. Rules and Regulations for Ground Water Control: Order No. 1 (Upper Republican Natural Resources Dist., January 7, 1978); *In re* Rules and Regulations for Ground Water Control Proposed for Adoption by the Upper Republican Natural Resources Dist.: Order of Approval (Neb. Dep't of Water Resources, March 27, 1978). Copies may be obtained from the Dep't of Water Resources, State Office Bldg., P.O. Box 94676, Lincoln, Ne. 68509.

155. As used here, "high capacity well" refers to a well with a capacity of more than 100 gallons per minute. *See* note 79 *supra*.

156. Upper Republican Order No. 1, *supra* note 154, Rule 2(a). The ground water allocation is projected to be between 70 to 85 acre inches per certified irrigated acre for the allocation period 1980 to 1984, or an annual average of 14 to 17 acre inches per certified irrigated acre. *Id.* Rule 2(c).

157. *Id.* Rules 5(1), 1(d).

158. *Id.* Rule 3(b). Municipal wells are not required to be metered but industrial wells are. *Id.* Rule 1(p).

159. *Id.* Rule 3(a).

160. *Id.* Rule 3(1).

161. *Id.* Rule 3(c).

162. *Id.* Rule 3(d) to (f). Allocations are not established for municipal wells. *Id.* Rule 1(p). The regulations indicate that industrial allocations may be established in the future. *Id.*

tion of the unused allocation to be carried forward to the next allocation period to encourage early meter installation and use of water-saving irrigation scheduling techniques.[163]

Beginning in 1980, all ground water users will be subject to mandatory allocations. The current regulations establish the probable allocation range as seventy to eighty-five acre inches per irrigated acre for the period 1980 to 1985, an annual average of fourteen to seventeen acre inches per irrigated acre.[164] The regulations also establish as a general goal the rate of limiting ground water depletion to one percent of aquifer saturated thickness per year.[165]

Because irrigated acres are the basis for establishing an allocation, the regulations set forth the procedures for establishing what acres are irrigated,[166] which is to be determined by the NRD board.[167] Factors to be considered in making that decision include: Agricultural Stabilization and Conservation Service records, county assessor records, aerial photographs, and other evidence provided either by the ground water user or the NRD staff.[168]

Well Spacing Requirements

Well spacing requirements are established by the regulations to protect domestic wells within the control area and to restrict ground water development within "critical" townships. Any new high capacity well is required to be drilled at least 1320 feet from a stock or domestic well owned by another ground water user.[169]

The critical township spacing requirement approaches being a drilling moratorium in townships where the rate of ground water depletion exceeds one percent of the aquifer's saturated thickness per year.[170] Within these critical townships no high capacity well can be drilled within 3300 feet (200 rods) of any other high capacity well, including wells owned by the same ground water user.[171] The intent of this requirement apparently is to prevent further ground water development except in areas where current development is

163. *Id.* For example, if a landowner had installed a meter on his well when the regulations took effect, he was given a 40 acre inch allocation per irrigated acre for the period 1978 and 1979. The irrigator can carry forward the unused portion of his allocation up to ten acre inches per irrigated acre for use in the 1980-1984 allocation period. *Id.* Rule 3(a)(1). Since the five year allocation is projected to be between 70 to 85 acre inches per irrigated acre, or between 14 to 17 acre inches per year, the irrigator has some incentive to take advantage of the higher initial allocation and carryover provisions. *Id.* Rule 2(c).

164. *Id.*

165. *Id.* Rule 2(b). That is, if the average aquifer thickness in a township is 300 feet, an annual average decline of 3 acre feet within that township would be within the NRD goal. When this goal is not met the township is declared "critical" and more stringent spacing requirements take effect. Rules 1(d), 5(a).

166. *Id.* Rule 4.

167. *Id.* Rules 4(a), 4(d)(6).

168. *Id.* Rule 4(d).

169. *Id.* Rule 5(b). Well spacing requirements also apply to municipal and industrial wells. *Id.* Rule 1(p).

170. *Id.* Rule 1(d).

171. *Id.* Rule 5(a).

not dense.[172] The regulations designate twenty-three townships as being critical.[173]

Limitations on Ground Water Transfers

The regulations provide that regulation of ground water transfers and pooling arrangements will be established before 1980. In the interim, the regulations restrict ground water transfers and pooling of ground water.[174] "Transfers" refer to physical ground water transfers—withdrawing ground water from one tract for use on another. "Pooling arrangements" refer to transfer of an allocation, that is, using less ground water on one tract and more on another. Transfers and ground water pooling can occur only among existing wells owned by the same ground water user. Transfers or ground water pooling can involve land inside and outside a critical township only if the two tracts are contiguous. Transfers or ground water pooling cannot result in more ground water being withdrawn from within a critical township than the ground water user had been allocated for the irrigated acres within the critical township. All transfers and ground water must have the prior approval of the NRD board.

Evaluation of the Upper Republican Regulations

The ground water management regulations established by the Upper Republic NRD are the first attempt to combine the various ground water management controls authorized by the Act. As they utilize most of the controls authorized by the Act, evaluation of the Upper Republican regulations is an indication of the poten-

172. Land in Upper Republican control area is generally rough and sandy, and difficult to irrigate using traditional gravity irrigation methods. The center pivot distribution system is the major irrigation system associated with new development in the area. Center pivots are typically installed at or near the center of a quarter section. The system rotates around this "pivot point" and irrigates approximately 130 of the 160 acres of a quarter section. The irrigation well is usually located near or at the pivot point. The well can be located elsewhere in the field and the water piped to the pivot point, but this increases costs.

The distance between pivot points of adjacent parallel or perpendicular quarter sections is 2640 feet, or half a mile. The distance between pivot points adjacent diagonal quarter sections is 3734 feet. The critical township well spacing requirements of 3300 feet would preclude location of a new irrigation well at the pivot point of adjacent quarter sections parallel or perpendicular to a quarter section with an irrigation well at the pivot point. This does not preclude development of these quarter sections, as the well can be located outside the spacing requirement and the water piped back to the pivot point. The general effect of the spacing requirements, however, is to make new development within critical townships more expensive and more difficult.

173. Twenty one critical townships were designated in February, 1978. *Id.* Rule 1(d). Three additional critical townships were designated and one township removed from critical status in December, 1978. In Rules and Regulations for Ground Water Control Proposed for Adoption by the Upper Republican Natural Resources Districts: Order of Approval (Neb. Dep't of Water Resources, January 9, 1979); Rules and Regulations for Ground Water Control: Order No. 2 (Upper Republican Natural Resources Districts, January 2, 1979). In addition, the critical township designation remains in effect for a minimum of three years. *Id.* Rule 1(d).

174. Upper Republican Order No. 1, *supra* note 154, Rule 2(d).

tial success of NRDs in implementing the Act.

The regulations establish allocation of ground water as the primary ground water management tool.[175] This is appropriate because of all the controls authorized by the Act allocation appears to be the most practical, efficient, and fair method for reducing the level of ground water withdrawals. Actual allocation is delayed until meters can be installed on all wells, but incentives are created for participation in a voluntary allocation program. Delaying allocation until 1980 appears to be advisable for two reasons. First, with over 2400 irrigation wells in the control area, installation of meters will take time. Second, and perhaps more important, the phasing in of mandatory allocation will give local landowners additional time to adjust to the notion of ground water controls. This latter point is important, since a high degree of voluntary cooperation and political acceptance is necessary to make the ground water management program effective. If the NRD board moved too aggressively, a new board unsympathetic to the program may be elected to dismantle it.[176]

The ground water allocation is based on the number of irrigated acres owned by a ground water user.[177] The only aspect of this basis that creates problems is that the regulations impede concentrating (or "pooling") an allocation on a particular tract.[178] These restrictions prevent irrigators from using their allocation where it would be most productive. One advantage of this approach, however, is that determination of what constitutes an irrigated acre is simplified: an irrigated acre is simply an acre that is fully irrigated, since irrigators cannot use more water on some land and less on other.

The projected level of allocation for the initial allocation period is substantially lower than the average used by most irrigators within the NRD.[179] In addition, the NRD board established a goal of limiting annual declines to less than one percent of the remaining saturated thickness. This goal is apparently intended to apply only to isolated areas where relative ground water depletions are greatest, because on an area-wide basis, annual depletions currently amount to less than one percent of the remaining water in

175. The regulations do not establish mandatory allocations immediately, but state the intent of the NRD board to establish mandatory allocations to take effect in the 1980 irrigation season. *Id.* Rule 2(c).

176. *See* note 153 *supra* and accompanying text.

177. Upper Republican Order No. 1, *supra* note 154, Rule 2(c).

178. *Id.* Rule 2(d).

179. The average withdrawal of ground water for irrigation in the Upper Republic NRD for the 1978 irrigation season was an estimated 22-23 acre inches per irrigated acre. This is three to four acre inches higher than would be expected in an average year because of below-normal precipitation. Telephone interview with Mr. Rod Milner, General Manager, Upper Republican Natural Resources District, March 4, 1979.

storage.[180]

The period of allocation is five years.[181] A multi-year allocation was selected to give irrigators more flexibility in using their allocation. Under a multi-year allocation, irrigators can use their allocation in advance, as well as carry over unused allocation to another allocation period. A somewhat more restrictive policy that would give the irrigator flexibility would be to establish single year allocations for a given period. Irrigators would then be able to carry over unused allocations and plan their irrigation program for a multi-year period. Irrigators could not, however, use up their allocations before the end of the multi-year period. This may be advantageous to prevent development of political pressures to relax an allocation policy if a substantial number of irrigators come to the last one or two years of an allocation period with no allocation remaining.

The well spacing requirements may provide a hardship to some landowners.[182] Where a landowner has developed some of his land for irrigation, restrictions on further development may be reasonable if ground water supplies are being depleted. If a landowner has developed no land for irrigation, however, and is precluded from doing so by a well spacing regulation, he is being penalized for not having developed sooner. This could be avoided by giving the Director of Water Resources discretion to issue a permit for a new well in hardship cases.

The restrictions on ground water transfers may prevent the optimal allocation of ground water.[183] Physical transfers of ground water and transfers of allocations (withdrawal rights) among tracts could be permitted so that ground water will be used more productively. This would be especially important when allocation levels are substantially reduced.

The regulations established by the Upper Republican NRD provide the basis for the managed mining of an aquifer. While greater flexibility may be desirable regarding well spacing requirements, and regarding restrictions on transfers of ground water and ground water allocations, these and other modifications may be developed as the NRD board gains more experience in administering the management program.

180. Derived from E. LAPPALA, CHANGES IN THE WATER SUPPLY IN THE UPPER REPUBLICAN NATURAL RESOURCES DISTRICT, SOUTHWEST NEBRASKA, FROM 1952-75, Table 1 at 12 (U.S. Geological Survey Open-File Report 76-498, 1976). The reason for this is that much of the land within the control area has not been developed for irrigation. This suggests that ground water from undeveloped land is available to supplement supplies in critical areas, if legal problems regarding ground water transfers can be resolved. *See* notes 102-103 *supra* and accompanying text.

181. Upper Republican Order No. 1, *supra* note 154, Rule 2(c).

182. *Id.* Rule 5.

183. *Id.* Rule 2(d).

SUMMARY AND CONCLUSION

The use of ground water for irrigation in the West has increased dramatically in the last thirty years. In many states this has led to ground water mining—withdrawals of ground water significantly in excess of net recharge. If unchecked, ground water mining can lead to the premature economic exhaustion of ground water supplies, and the concomitant contraction of local and regional economies dependent on ground water based irrigation development.

Economists believe that restrictions on ground water use can lead to greater economic benefits than uncontrolled ground water mining. However, successful regulation of ground water mining is not widespread in the western states, primarily because irrigators incorrectly assume that ground water regulation threatens rather than enhances their economic interests.

Of the major ground water using states, Nebraska has been the most aggressive in addressing the ground water mining question. The Nebraska Ground Water Management Act permits ground water users to administratively impose ground water controls on themselves through local multi-purpose Natural Resources Districts. The crucial ground water control decisions—whether ground water control area designation will be requested and what ground water controls will be imposed—are made by a locally elected NRD board of directors. In a state where the right to use ground water free from governmental restraint is a jealously guarded tradition, the local control aspect is a crucial component of the Act. The state role is limited to the determination of whether a control area designation is justified, determination of control area boundaries, approval of NRD ground water controls, and issuance of permits to new wells drilled within a control area. The state cannot initiate the establishment of ground water controls.

The Act authorizes a variety of controls: well spacing regulations, rotation of pumping restrictions, allocation of ground water (limitations of withdrawals), and well drilling moratoria.

Well spacing requirements are an effective means of reducing or preventing interference among wells, but they do not have a significant impact on ground water withdrawals unless they severely limit the density of development. If well spacing requirements are strict enough to have an impact on withdrawals, they are inequitable in that ground water is being managed only for the benefit of present users.

Well drilling moratoria are not an attractive ground water control mechanism on equity grounds. If drilling of new wells is prevented, the ground water is being managed for the benefit of those who caused the problem—the present users. This unfairly discriminates against those who might use ground water in the future

if permitted to do so.

Rotation of pumping is another unattractive ground water control mechanism, primarily because it discriminates against ground water users with low capacity wells. In addition, rotation schemes will disrupt irrigation patterns if the rotation period is less than one year. Finally, administration of a rotational pumping scheme would be difficult.[184]

The most powerful ground water management tool is allocation—restricting ground water withdrawals. A wide range of allocation options are available. The most practical basis for allocation is per irrigated acre without restrictions regarding how much water is applied on each acre. A single year allocation with carryover provisions is the most attractive allocation period if allocations are made for several years in advance to give the irrigator some discretion in how he uses his allocation over time. Allocations could be varied or uniform, depending on aquifer conditions. Varying allocations based on crop needs, however, would not encourage growing crops that require less water. Pooling of allocations and ground water transfers should be allowed to permit the use of water where it is the most productive. Safeguards are necessary, however, to prevent interference between nearby wells. Establishing an allocation quantity depends on whether a mining, "safe-yield," or intermediate aquifer management approach is selected. This decision will vary depending on the economic, hydrologic, geographic, and political factors of each ground water control area.

The Act authorizes many controls to deal with ground water mining. The blend of local and state responsibilities has led to cooperation among state and local natural resource agencies and an increased awareness of the various aspects of ground water management. More significantly, the local control aspect has made the imposition of ground water controls possible in a state where it had been politically impossible for decades. In the Upper Republican control area in southwestern Nebraska, metering of all irrigation wells is the prelude to mandatory limitations on ground water withdrawals of between fourteen to seventeen acre inches per irrigated acre in 1980. A similar program is under way in the Upper Big Blue control area, although allocation is not likely to begin before 1982. While these actions alone will not resolve the mining issue, they are significant first steps in the evolution of policies to deal with ground water mining. The actions are particularly noteworthy as they represent the first significant steps to deal with ground water mining in a major ground water using state.

Because it authorizes the basic tools necessary to control ground water mining, the Act is a model that should be considered by states interested in ground water controls. Because it repre-

184. *But see* note 143 *supra.*

sents a first step toward total ground water management, however, the Act has some limitations. It does not address the problem of resolving conflicts among ground and surface water users where ground and surface supplies are interrelated. The Act also does not authorize conjunctive management of ground and surface water supplies, particularly with reference to storing water underground. The Act does not deal with the issues of ground water transfers or water quality.[185] In addition, ground water control areas can be established only when the supplies appear to be inadequate. This precludes establishing controls to reduce the chances of ground water mining occurring in the first place. Finally, the Act makes ground water control a local option. While this may have been politically necessary to enact any ground water control measure, some NRDs may not be willing to control ground water mining without the threat of state action.

In spite of these limitations, the Nebraska Ground Water Management Act represents a significant step in western state ground water management policy. Because of its emphasis on local control, and because local multi-purpose NRDs were given the capability to enforce it, the Act has resulted in establishment of controls on ground water use by irrigators. Although the local control approach is not a new aspect of ground water management, the ground water control actions taken by NRDs suggest that the Nebraska approach may prove to be the most successful variation established among the major ground water using states in the West.

185. The Act does address water quality problems resulting from ground water mining, but not regarding non-point water pollution resulting from irrigation. *See* notes 104 and 105 *supra* and accompanying text.