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COLORADO'S LAW OF "UNDERGROUND WATER": A LOOK AT THE SOUTH PLATTE BASIN AND BEYOND

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I. INTRODUCTION

In 1969 Colorado acted to clarify its law with respect to "underground water" — that is, the water in alluvial aquifers hydraulically connected to surface waters.¹ Increasingly this so-called "tributary" groundwater was becoming an important source of supply, especially for irrigation.² Yet, its development had proceeded virtually unregulated until 1965.³

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1. The statutory definition of "underground water" is "water in the unconsolidated alluvial aquifer of sand, gravel, and other sedimentary materials, and all other waters hydraulically connected thereto which can influence the rate or direction of movement of the water in that alluvial aquifer or natural stream." COLO. REV. STAT. § 37-92-103(11) (1973).

2. The U.S. Geological Survey has estimated that Colorado's alluvial aquifers contain as much as 157 million acre-feet of water. Cited in MARTZ, *The Groundwater Resource*, in WATER AND THE AMERICAN WEST 91 (D. Getches ed. 1988). The average water flows from all surface streams in Colorado are estimated to be about 14.7 million acre-feet per year. Total average annual depletions are estimated at about 5.3 million acre-feet per year. Getches, *Meeting Colorado's Water Requirements: An Overview of the Issues*, in TRADITION, INNOVATION AND CONFLICT: PERSPECTIVES ON COLORADO WATER LAW 4 (L. MacDonnell ed. 1987).

According to state engineer records nearly 22,000 wells in Colorado provide irrigation water. Communication from Richard A. Bell, Division of Water Resources (Feb. 12, 1988). Statistics compiled by the Economic Research Service indicate that wells supply about 37 percent of all irrigation water used in Colorado. Economic Research Service, U.S. Department of Agriculture, Agricultural Irrigation and Water Supply 19 (Agriculture Information Bulletin 532, Oct. 1987).

3. In 1965 the Colorado legislature passed the Ground Water Management Act. 1965 Colo. Sess. Laws, ch. 319 (codified at COLO. REV. STAT. §§ 37-90-101 to -142 (1973 & Supp. 1987)). This Act established a ground water commission and empowered it to designate ground water basins. Development of groundwater in such designated basins requires approval of the commission and may be denied if the commission finds that no unappropriated water is available or that the requested appropriation "would unreasonably impair existing water rights from such source or would create unreasonable

To facilitate the use of this valuable, renewable resource the legislature in 1969 declared a policy "to integrate the appropriation, use, and administration of underground water tributary to a stream with the use of surface water in such a way as to maximize the beneficial use of all of the waters of this state."⁴ This paper examines Colorado's experience in integrating the use of tributary groundwater with surface water.

It begins with a discussion of the physical relationship between ground and surface water. A brief summary of groundwater development in the South Platte basin then is provided. Next there is an overview of the legal framework governing tributary groundwater. The experience in integrating ground and surface water in the South Platte basin then is presented through three case studies. Finally the paper concludes with an assessment of tributary groundwater law in Colorado and suggestions for improvements to promote optimal utilization of Colorado's related ground and surface water resources.

II. THE RELATIONSHIP BETWEEN SURFACE WATER AND GROUNDWATER

Many western streams are underlain with substantial alluvial aquifers containing water resources which, in some cases, far exceed the surface flows. The water in these alluvial aquifers supports the surface flows and is, in turn, recharged by these flows. In effect, the water in these aquifers is a slowly migrating storage reservoir.⁵ By developing the surface and subsurface water resources in a coordinated or conjunctive manner it is possible to improve the total available supply of water and the efficiency with which that supply is used.⁶ For example,

waste. . . ." COLO. REV. STAT. § 37-90-104(4) (Supp. 1987). This paper does not address the administration of designated groundwater.

In that same session the legislature enacted a bill directing the state engineer to administer the use of tributary groundwater in accordance with the priority system. 1965 Colo. Sess. Laws ch. 318, § 1. See the discussion *infra* in text accompanying note 22.

4. COLO. REV. STAT. § 37-92-102(1) (1973 & Supp. 1987). This same "declaration" explicitly recognized that Colorado laws had given "inadequate attention to the development and use of underground waters of the state." It further recognized that the use of these waters is "necessary to the present and future welfare of the people of this state." Finally it recognized that the "future welfare of the state depends upon a sound and flexible integrated use of all waters of the state." COLO. REV. STAT. § 37-92-102(2) (1973).

5. Useful, non-technical discussions are provided in Comment, *Appropriation and Colorado's Ground Water: A Continuing Dilemma?*, 40 U. COLO. L. REV. 133 (1967); and Harrison & Sandstrom, *The Groundwater-Surface Water Conflict and Recent Colorado Water Legislation*, 43 U. COLO. L. REV. 1 (1971) [hereinafter Harrison & Sandstrom]. See also the discussion by the Colorado Supreme Court in *Kuiper v. Wellowners Conservation Ass'n*, 176 Colo. 119, 132-34, 490 P.2d 268, 274-75 (1971).

6. Trelease provides a useful general definition of conjunctive use: "Conjunctive use is the name applied to several different practices and processes employed to coordinate the use of ground and sur-

in drought years additional water can be drawn from the underground aquifer. Then, in high flow years, recharge projects can be used to resupply the reservoir.

As an alluvial well is pumped the water table surrounding the well is gradually lowered, creating a cone of depression. Over time this cone reaches the stream itself and depletes the stream flow, either by reducing the groundwater flow (baseflow) to the stream or by inducing movement of stream water into the aquifer. As pumping continues the drawdown near the stream increases, causing ever greater depletions; when pumping ceases the water table gradually recovers, reducing depletions. A principal feature of conjunctive use management is to take advantage of the time lag between the start of pumping and the onset of appreciable depletive effects on surface flows.⁷

The physical relationship between groundwater pumping and stream flows was well understood by the 1940s.⁸ However, the devel-

face water in order to get the maximum economic benefits from both resources." Trelease, *Conjunctive Use of Groundwater and Surface Water*, 27 ROCKY MT. MIN. L. INST. 1853, 1854 (1982).

7. Mathematical expressions have been developed to quantify these effects. Jenkins, *Techniques for Computing Rate and Volume of Stream Depletions by Wells*, 6 GROUNDWATER 37 (1968). Unfortunately, the equations are complex, and exact solutions were either very tedious or impossible. As a result, simplifying assumptions and graphical solutions were proposed and found to be rather effective in analyzing the interactions between the alluvial aquifer and streams.

One of the graphical solution methods widely used in Colorado today is the "stream depletion factor" (sdf). The sdf describes "the time from the beginning of steady pumping within which the volume of stream depletion is 28 percent of the volume pumped." *Id.* at 38. The sdf incorporates the aquifer properties of transmissibility and specific yield and the distance between the well and the stream into one parameter. Thus a well with 100 day sdf will have caused stream depletions of 28 percent of the volume of water pumped from the well during 100 days of pumping; and the rate of depletion after 100 days will be 48 percent, i.e., nearly half of the water pumped in any time period will be coming from the stream. Contour maps displaying this relationship can be developed with computer models and aquifer tests which will indicate the effects on stream flows of wells in given locations.

Computer models now exist to solve the complex equations and allow exact solutions. These models can simulate the complex interactions between the surface and subsurface resources and predict how the aquifer and stream will respond to varying stream inflows, diversions, and groundwater use anywhere within the modeled area. See, e.g., Morel-Seytoux, Illangskare, Bittinger & Evans, *Potential Use of a Stream-Aquifer Model for Management of a River Basin: Case of the South Platte River in Colorado*, 13 WATER SCIENCE AND TECHNOLOGY 175 (1981). The model described in this paper will be used by the division engineer responsible for administration of the South Platte River.

At this point, a major limitation on the use of these models is the difficulty in acquiring accurate data regarding the aquifer and water usage within the system. As such models are further developed and tested, they could help lead the way to more integrated management of the water resource. Grigg, *Voluntary Approaches to Basinwide Water Management*, in TRADITION, INNOVATION, AND CONFLICT: PERSPECTIVES IN COLORADO WATER LAW 209 (L. MacDonnell ed. 1987).

8. Certainly by the 1940s the technical aspects were well understood. A remarkably clear-headed description of the issues raised by groundwater development in Colorado can be found in a document prepared in 1952 in connection with the effort underway at that time to draft groundwater legislation. Memorandum from Royce J. Tipton to Judge Stone (Sept. 15, 1952) (in the Stephen H. Hart Library, Colorado Historical Society, Denver, Colorado) [hereinafter Tipton Memorandum]. In recognition of the interrelationship between groundwater and surface water the memorandum states:

opment and use of these resources continued to proceed as if they were separate and unrelated. No serious problems arose in Colorado until, with the dramatic growth in groundwater pumping in the 1950s and 1960s, it became evident that surface flows were being directly impaired.⁹

III. DEVELOPMENT OF TRIBUTARY GROUNDWATER IN THE SOUTH PLATTE BASIN

The South Platte River drains the most populous and most agriculturally productive region of Colorado. The river and its major tributaries head in the high mountains of the Front Range of Colorado and drain northeast into the high plains. Intensive use of this modest river during the past 120 years has radically altered its flow patterns. Native water supplies, largely from high mountain snowmelt, are about 1.4 million acre-feet in an average year. Historically, surface water flows reaching into the plains area peaked with the snowmelt, declining thereafter so that by late summer the riverbed often was completely dry—especially at greater distances from the mountains. Annual precipitation in this region of Colorado is very limited—about 10 to 14 inches per year.

Much of the South Platte River, especially that downstream from Denver, is underlain by permeable material such as sand and gravel long ago deposited in channels carved in bedrock. Over time, portions of this alluvial fill became permeated by seepage from surface flows. Substantial additional areas of alluvial fill underlying land adjacent to surface streams have become saturated with water as a consequence of seepage from irrigation water spread over the surface year after year. Eventually the water table in this alluvial aquifer became higher than the river bed. The resulting return flows to the river brought about year-round surface flows. The alluvium in the reach of interest (down-

Along a water course where the dependable surface supplies are utilized for irrigation and other purposes to the fullest practicable extent, the maximum beneficial utilization of the total water resource will result from an intelligent coordinated use of the ground water and surface water supplies both of which are intimately inter-related, and the proper utilization of ground-water storage capacity. Utilization of the ground-water storage capacity will be for the above-average surface water supplies, which will provide an increment of stored ground water to be withdrawn during periods of below-average surface water supplies.

Tipton Memorandum at 5.

9. In the Arkansas River valley there were an estimated 40 irrigation wells in 1940 pumping about 2,500 acre-feet of water. By 1972 the number of wells had increased to 1,477 and annual pumping had grown to about 208,000 acre feet. Office of the State Engineer, State of Colorado, *STREAM DEPLETION BY WELLS IN THE ARKANSAS RIVER BASIN — COLORADO*, tables 6, 7 at 19, 22 (Mar. 1975) [hereinafter *Arkansas Stream Depletions*]. Similar growth occurred in the South Platte. See text accompanying notes 11-13.

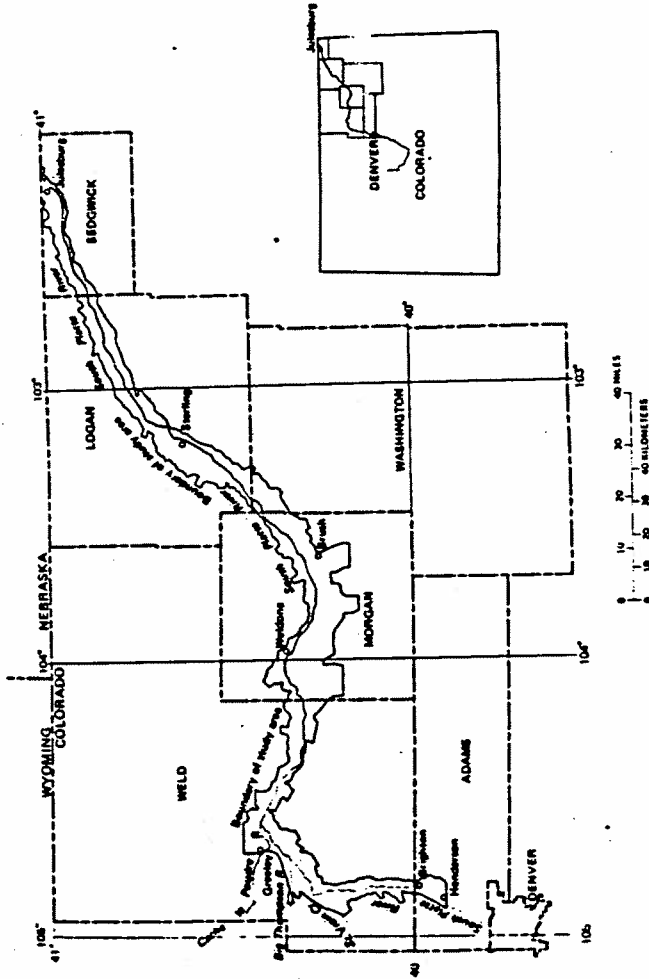


FIGURE 1. MAP OF GROUNDWATER STUDY AREA OF THE SOUTH PLATTE RIVER IN COLORADO.

Source: Colorado Water Resources Circular No. 28, U.S. Geological Survey and Colorado Water Conservation Board, 1975, p.3.

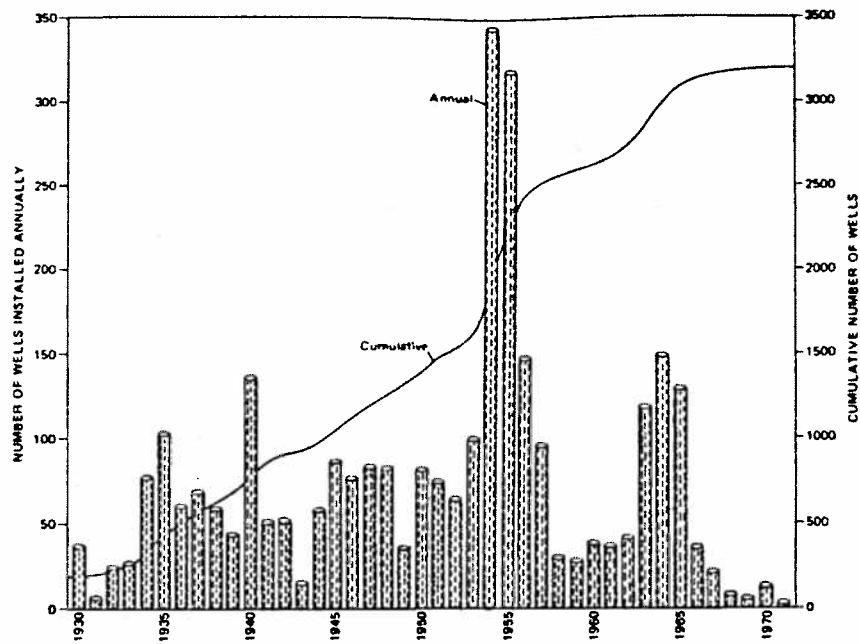


FIGURE 2. ANNUAL INSTALLATION AND CUMULATIVE TOTAL OF LARGE-CAPACITY IRRIGATION WELLS IN THE SOUTH PLATTE VALLEY

Source: Hurr, Schneider & Minges, *Hydrology of the South Platte River Valley, Northeastern Colorado*

Colorado Water Resources Circular No. 28 (1975).

stream from about Henderson, Colorado) (shown in Figure 1) varies in width from about one mile to over ten miles. The aquifer in this reach is estimated to contain as much as eight million acre-feet of water.¹⁰

As early as the 1890s farmers began to draw water from this underground source to supplement their surface diversions.¹¹ As shown in Figure 2, the number of wells increased gradually at first, reaching about 250 by 1933, then grew rapidly to 3,200 in 1970.¹² Major bursts of growth occurred in the 1930s and 1950s as a result of periods of drought. Improvements in well technology and the increased availability of low cost electricity supported the growing use of wells during this period. Groundwater development proceeded without control until the mid 1960s. Of the 1.4 million acre-feet of water estimated to have been diverted for irrigation as an annual average between 1947 and 1970, groundwater supplied an estimated 420,000 acre-feet or about 30 percent of the total.¹³

The growth in groundwater withdrawals caused a reduction in the annual groundwater discharges to the South Platte, declining from about 800,000 acre-feet in 1947 to about 550,000 acre-feet in 1970.¹⁴ The expected corresponding reduction in surface flows did not appear, however, apparently because of concurrent increases in transmountain diversions adding new water to the basin and because of decreases in surface diversions from the river.¹⁵ In the late 1950s the Colorado-Big Thompson Project began adding over 200,000 acre-feet of water per year into the system. In addition, direct diversions from the river decreased about 130,000 acre-feet on an annual basis from 1947 to 1970.¹⁶

Although overall surface flows were not substantially reduced by groundwater development, problems were developing in certain ar-

10. Woodward-Clyde Consultants, SOUTH PLATTE RIVER BASIN ASSESSMENT REPORT 27 (Aug. 1982) [hereinafter South Platte Study].

11. Hurr, *Effects of Water-Management Practices on the Flow of the South Platte River, Colorado* in SCIENCE COUNCIL OF JAPAN AND INTERNATIONAL ASS'N OF HYDROLOGICAL SCIENCE, INTERNATIONAL SYMPOSIUM ON HYDROLOGIC CHARACTERISTICS OF RIVER BASINS 613 (Dec. 1975) (held in Tokyo, Japan) [hereinafter Hurr].

12. *Id.*

13. South Platte Study, *supra* note 10, at 41. Bredehoeft and Young point out that the amount of installed well capacity in the South Platte Valley in 1970 substantially exceeded that necessary to "maximize expected net benefits" from agriculture. They conclude that this "overcapacity" is a form of insurance which farmers determined to be worthwhile to assure a dependable water supply. Bredehoeft & Young, *Conjunctive Use of Groundwater and Surface Water for Irrigated Agriculture: Risk Aversion*, 19 WATER RESOURCES 1111, 1118 (1983).

14. Hurr, *supra* note 11, at 613.

15. *Id.*

16. *Id.* at 614.

eas—especially in smaller tributaries to the South Platte where irrigation had become almost completely dependent on the use of wells.¹⁷ Moreover, it was widely recognized that groundwater development was reducing discharges to the river, thereby affecting surface flows. A similar pattern of rapid development of groundwater in the Arkansas also was underway. The need for legislative attention to this issue was obvious.

IV. THE LEGAL BACKGROUND

The prior appropriation doctrine developed to govern the allocation of surface water resources in the West. It is a priority system in which senior rights must be fully satisfied before any junior rights can be used. The water right is established through the appropriation of water—that is, by a diversion of water and the application of that water to a beneficial use. Reliable surface flows of water in rivers like the South Platte in Colorado were fully appropriated before the turn of the century.

The development of groundwater occurred slowly, accelerating with the availability of low cost energy which made the cost of pumping the water economically attractive and with the improvement in drilling and pumping technologies. In Colorado there was essentially no control of this development. While the appropriation of surface water was first subjected to legal control in 1879, no attempt was made to regulate groundwater development until the 1950s. Colorado courts long had held that groundwater “tributary” to a surface stream is governed by the doctrine of prior appropriation.¹⁸ However, relatively few wells had ever been adjudicated. Thus, although wells drawing water from underground sources tributary to surface flows were subject to the priority system very few actually operated under a decreed right.

Legislation enacted in 1957 required that permits for new wells be obtained from the state engineer.¹⁹ However, the legislation also stated that: “The priority date of a ground water appropriation shall not be postponed to a time later than its true date of initiation by

17. Bittinger, *Colorado's Ground-Water Problems—Ground Water in Colorado*, COLO. ST. U. EXPERIMENT STATION BULL. 504-5 at 21 (1967).

18. This general principle was recognized by a Colorado court as early as 1893. *McClellan v. Hurdle*, 3 Colo. App. 430, 33 P. 280 (1893). It was further developed in the context of return flows in the case of *Comstock v. Ramsay*, 55 Colo. 244, 133 P. 1107 (1913). In *Nevius v. Smith*, 86 Colo. 178, 279 P. 44 (1929), the Colorado Supreme Court held that “seepage and percolation belong to the river . . .”, not the overlying landowner. *Id.* at 181, 279 P. at 45. This general principle was strongly reaffirmed by the supreme court in *Safronek v. Lemon*, 123 Colo. 330, 228 P.2d 975 (1951).

19. Ground Water Law of 1957, 1957 Colo. Sess. Laws, ch. 289, § 5 (codified at COLO. REV. STAT. § 148-18-2 (1963)).

reason of failure to adjudicate such right in a surface water adjudication."²⁰ In 1965 the state engineer took the position that he had no authority to regulate well pumping in order to protect surface rights.²¹ The legislature responded in that same year with a bill directing the state engineer to "execute and administer the laws of the state relative to the distribution of the surface waters of the state including the underground water tributary thereto in accordance with the right of priority of appropriation. . . ."²²

Pursuant to this directive the state engineer ordered 39 wells in the Arkansas River Valley to cease operations because of adverse effects on senior surface diverters. In *Fellhauer v. People*,²³ the Colorado Supreme Court upheld the authority of the state engineer under the 1965 Act to regulate such wells in order to protect vested senior rights from material injury, but found this particular exercise of that authority to be unsupported by any rational plan and so a violation of equal protection. The court proceeded to spell out three requirements for any well regulation scheme: (1) that the regulation be done pursuant to a plan which is implemented through rules and regulations; (2) that the regulation must, in fact, result in a "reasonable lessening of material injury to senior rights"; and (3) that an effort should be made to determine if conditions could be placed on well operation in a manner that would permit continued use of groundwater without material injury to senior users.²⁴ By way of emphasizing its interest in encouraging the use of groundwater the court then stated:

It is implicit in these [Colorado] constitutional provisions that, along with *vested rights*, there shall be *maximum utilization* of the water of this state. As the administration of water approaches its second century the curtain is opening upon the new drama of *maximum utilization* and how constitutionally that doctrine can be integrated into the law of *vested rights*.²⁵

At this point it was settled in Colorado that (1) tributary groundwater was subject to the prior appropriation system, that (2) its use was to be administered in conformity with the priority system, but that (3) wells were to be regulated only if their operation caused mate-

20. COLO. REV. STAT. § 148-18-9 (1963), repealed by COLO. REV. STAT. § 37-90-109 (1973) (effective May 17, 1965).

21. See Hillhouse, *Integrating Ground and Surface Water Use in an Appropriation State*, 20 ROCKY MTN. MIN. L. INST. 691, 697 (1975) [hereinafter Hillhouse].

22. Act of May 3, 1965, 1965 Colo. Sess. Laws, ch. 318, § 1.

23. 167 Colo. 320, 447 P.2d 986 (1968).

24. *Id.* at 334, 447 P.2d at 993.

25. *Id.* at 336, 447 P.2d at 994.

rial injury to senior rights.²⁶ The need for a better understanding of the problem led the legislature to fund several engineering studies to examine both the South Platte and Arkansas basins.²⁷

Strict application of the priority system in accordance with the 1965 act would have required large numbers of wells with junior priorities to be shut down. The agricultural economy in the South Platte and Arkansas valleys had by this time become significantly dependent on well irrigation. It was important not to curtail pumping unnecessarily, but it was also important to protect senior water rights. Clearly, integration of the use of these closely related resources was necessary.

In 1969 the Colorado Legislature passed the Water Right Determination and Administration Act²⁸ which contained a number of provisions aimed specifically at facilitating the integration of groundwater and surface water. The 1969 Act begins with a legislative declaration stating that "it is the policy of this state to integrate the appropriation, use, and administration of underground water tributary to a stream with the use of surface water in such a way as to maximize the beneficial use of all of the waters of this state."²⁹ Water rights are still to be administered in accordance with the priority system, but with the important modification that curtailments in junior diversions are to be made only when there is "material injury" to senior water rights.³⁰ A separate section specifically addresses groundwater diversions, stating that such diversions "shall not be curtailed nor required to replace water withdrawn, for the benefit of surface right priorities, even though such surface right priorities be senior in priority date, when, assuming the absence of ground water withdrawal by junior priorities, water would not have been available for diversion by such surface right under the priority system."³¹ This provision recognizes the fact that there is a time lag between well water withdrawals and depletive effects on surface flows. Shutting down wells may not benefit surface right holders in a timely manner. Thus wells are only to be regulated in circumstances where actual injury to senior surface rights will be avoided.

26. In addition, the *Fellhauer* case clarified that it was not necessary to demonstrate that a specific well's operation injures a specific senior surface right, only that a "reasonable lessening of material injury to senior rights must be accomplished by the regulation of the wells." *Id.* at 334, 447 P.2d at 993.

27. See *Hillhouse*, *supra* note 21, at 700 n.25.

28. COLO. REV. STAT. §§ 37-92-101 to 37-97-602 (1973 & Supp. 1987).

29. COLO. REV. STAT. § 37-92-102(1)(a) (Supp. 1987).

30. COLO. REV. STAT. § 37-92-502(2) (1973 & Supp. 1987). This provision also states that "[t]he materiality of injury depends on all factors which will determine in each case the amount of water such discontinuance will make available to such senior priorities at the time and place of their need." *Id.*

31. COLO. REV. STAT. § 37-92-501(1) (1973).

The 1969 Act also sought to encourage well owners to adjudicate their rights, thereby bringing these rights into the administrative system. It did this by providing a three-year period during which previously undecreed well rights could be adjudicated with a priority date as of the date of actual appropriation of the water.³²

Many well owners also held more senior surface rights. To encourage integration of these rights the 1969 Act authorized the state engineer to permit the use of wells as an alternate point of diversion for the surface water right.³³ The state engineer and the courts were directed to use "the widest possible discretion to permit [this] use of wells. . . ."³⁴

Finally the 1969 Act provided a more general vehicle for facilitating integration called a "plan for augmentation." Defined as a "detailed program to increase the supply of water available for beneficial use,"³⁵ it provides a highly flexible tool enabling new uses of water without strict regard for the priority system, so long as existing rights are not injuriously affected.³⁶ The statute cites numerous ways this may be accomplished, including "the development of new or alternate means or points of diversion, by a pooling of water resources, by water exchange projects, by providing substitute supplies of water, by the development of new sources of water or by any other appropriate means."³⁷ Such augmentation plans must be approved by the water court.³⁸

In a companion bill passed the same session the legislature authorized water users to provide a "substituted supply of water" to senior appropriators to satisfy their priorities.³⁹ So long as it is of a "quality and continuity to meet the requirements of use to which the senior appropriation has normally been put,"⁴⁰ the senior appropriator must accept this substituted supply.⁴¹ Approval of the state engineer but not the water court is required for such programs.⁴² Voluntary arrangements of this sort had existed previously in Colorado. Now,

32. COLO. REV. STAT. § 37-92-306 (1973).

33. COLO. REV. STAT. §§ 37-92-102(2)(C) and -301(3) (1973 & Supp. 1987).

34. COLO. REV. STAT. § 37-92-301(3)(d) (1973).

35. COLO. REV. STAT. § 37-92-103(9) (1973).

36. See MacDonnell, *Plans for Augmentation: A Summary*, in TRADITION, INNOVATION, AND CONFLICT: PERSPECTIVES ON COLORADO WATER LAW 137 (1987).

37. COLO. REV. STAT. § 37-92-103(9) (1973).

38. COLO. REV. STAT. § 37-92-301(2) (Supp. 1987).

39. COLO. REV. STAT. § 37-80-120(2) (1973).

40. COLO. REV. STAT. § 37-80-120(3) (1973).

41. See COLO. REV. STAT. § 37-80-120(2) (1973).

42. See COLO. REV. STAT. § 37-80-120(1) (1973).

however, such practices do not require the approval of senior right holders.⁴³

In the meantime the state engineer continued to try to develop regulations governing tributary groundwater use. Regulations issued for the 1969 irrigation season were upheld by the Colorado Supreme Court against an attack by well owners in the South Platte Basin.⁴⁴ Nevertheless, the state engineer decided to abandon this approach. Draft rules were issued in 1972 and subsequently were approved by the water court as amended in 1974.⁴⁵ The approach taken in these rules was to phase out all groundwater pumping over a three-year period, except from wells operating under a decreed plan for augmentation or otherwise able to operate without impairing senior water rights.⁴⁶

V. CONJUNCTIVE USE ACTIVITIES IN THE SOUTH PLATTE VALLEY: THREE CASE STUDIES

As a consequence of the legislative decision that rights to tributary groundwater be governed by the general priority system, groundwater users in the South Platte and Arkansas valleys faced the possibility that their junior wells would have to shut down. The case studies which follow illustrate approaches taken to integrate tributary groundwater uses in the South Platte with the general appropriative water rights system.

A. Groundwater Appropriators of the South Platte River

In 1972 a group of well owners in the South Platte Valley, with the active encouragement of the state engineer, established an association "to provide remedy to any legitimately determined injury which may result to prior vested rights" as a result of pumping from its members' wells.⁴⁷ In its 1972 letter of intent to the state engineer, this

43. See COLO. REV. STAT. § 37-80-120(2) (1973).

44. *Kuiper v. Well Owners Conservation Ass'n*, 176 Colo. 119, 490 P.2d 268 (1971). These regulations are discussed in greater detail *infra* at text accompanying notes 100-101.

45. In the Matter of the Rules and Regulations Governing the Use, Control, and Protection of Surface and Ground Water Rights Located in the South Platte River and Its Tributaries (March 15, 1974) [hereinafter South Platte Rules and Regulations].

46. *Id.* Final rules were adopted for the Arkansas River Basin in 1973 limiting well pumping to no more than three days per week. In 1974 the state engineer proposed an amendment phasing out well pumping over three years in the same manner as with the South Platte. The Colorado Supreme Court disallowed this amendment because it was not based on adequate proof that it would make additional water available for senior priorities. *In re Arkansas River*, 195 Colo. 557, 581 P.2d 293 (1978). No new rules have been issued for this area.

47. Letter from Ground Water Appropriators of the South Platte to State Engineer Clarence Kuiper (Apr. 5, 1972).

nonprofit corporation, called Ground Water Appropriators of the South Platte (GASP), described its efforts already underway to provide replacement water through such means as exchanges and augmentation of supply to offset any such injury to prior vested rights. To avoid curtailment of its members' well pumping, GASP proposed to make replacement water available to the state engineer. It promised to provide a list of its members to the state engineer, as well as an estimate of the amount of groundwater its members would be withdrawing from the tributary aquifer in the coming season and an accounting of the amount actually withdrawn the preceding year. The state engineer warmly greeted the formation of GASP. His letter of reply indicates that his primary concern was that the GASP projects be able to supply replacement water that might be needed "during a time of call" to prevent injury to senior rights.⁴⁸

GASP now has about 1,400 members operating more than 3,000 wells within the South Platte River Basin—all the way from Fairplay to Julesburg. Most of these wells supply irrigation water, although there are also member wells supplying water for municipal and industrial uses.⁴⁹ The vast bulk of its member wells are located in the South Platte basin below Greeley.

GASP members pay annual fees based on the amount of water that the well owner expects to pump each year.⁵⁰ For each 100 acre-feet of water pumped, or fraction thereof, one unit of membership must be purchased. The per unit fee is set by the board of directors

48. Letter from State Engineer Clarence Kuiper to GASP (Apr. 11, 1972). According to the minutes of a GASP Board of Directors meeting on June 6, 1972, State Engineer Kuiper stated that the replacement water to be made available by GASP should equal eighteen percent of the amount pumped from member wells.

49. GASP uses four types of contracts. Class 'A' contracts apply generally to pre-1969 wells adjudicated prior to December 31, 1972, and located in areas where replacement water is available. In 1981, Class 'A' contracts covered 2907 out of a total of 3040 wells in GASP. Class 'B' contracts apply to new wells, which must provide 100 percent replacement water. Class 'C' contracts apply to existing wells which, for some reason, do not meet the requirements for Class 'A' contracts. Such wells must provide five percent replacement water. Class 'D' contracts apply to wells seeking membership only for one year. Such wells are to be covered by the replacement water supplied by GASP.

50. In 1981 the number of wells of each type and their estimated total pumping was as follows:

	No. of Wells	Estimated Pumping (AC-FT)
Commercial	134	9,700
Industrial	15	2,200
Municipal	155	18,800
Irrigation	2,736	369,974
Total	3,040	400,674

Letter from Donald Brazelton, Colorado Division of Water Resources to Earl Phipps, Northern Colorado Water Conservancy District (May 27, 1981).

each year. The original unit fee in 1972 was \$15; by 1986 it had increased to \$90. To join GASP as a new member a special fee representing the cumulative unit charges for each year since 1972 must be paid. In subsequent years the unit charge is the same as for other members.⁵¹ Membership payments are used to purchase and lease the replacement water needed to offset any injury arising from the pumping of member wells.

The GASP program operates under authority of the Colorado substitute supply provision.⁵² This provision permits a junior appropriator to use water traditionally taken by a senior appropriator so long as adequate replacement water is provided. Only the approval of the state engineer is required. However, unlike a court-decreed plan for augmentation, substitute supply plans must be reviewed and approved annually.

The GASP approach has been characterized as "call management."⁵³ GASP obtains rights to "replacement" water which it makes available to the division engineer and the water commissioners to use as they deem necessary. There is no clear policy governing the amount of replacement water that is needed. According to the 1974 Amended Rules and Regulations for the South Platte issued by the state engineer, the amount of replacement water an augmentation plan should make available to the division engineer is to equal "5 percent of the projected annual volume of a ground water diversion. . . ."⁵⁴ The Rules also state that if such replacement is shown not to be adequate then actual stream depletions caused by a well are to be calculated using the "Glover method" or some approved variant thereof.⁵⁵

It is evident that this so-called "five percent rule" has never been the basis for GASP's plan of operation. Nor does it appear that there has been any complete analysis of the stream depletions caused by the well operations of GASP members.⁵⁶ Instead, emphasis has been placed on developing a supply of replacement water adequate enough

51. Thus in 1986 the fee for new members was \$720 per unit. This policy is intended to recover indirect benefits GASP has provided to nonmember pumpers since it started providing replacement water to the basin in 1972.

52. COLO. REV. STAT. § 37-80-120(2) (1973).

53. Rudeen, *Ground Water Management in the South Platte Basin of Colorado*, Proceedings of 1987 Regional Meetings on Water Management, U.S. Committee on Irrigation and Drainage 313 (1988).

54. South Platte Rules and Regulations, *supra* note 45, Rule 3(1).

55. South Platte Rules and Regulations, *supra* note 45, Rule 4(1). See also Glover, *The Pumped Well*, TECHNICAL BULLETIN 100, COLO. ST. UNIV. EXPERIMENT STATION (September 1968).

56. No basis has been found for the eighteen percent replacement water figure quoted by State Engineer Kuiper. See *supra* note 48. Nor did we find this figure cited anywhere other than in the GASP Board minutes.

and strategically situated so as to satisfy senior appropriators. The measure of need is not some calculation of the stream depletions but the existence of a valid senior call on the river at a time when historically there would have been adequate surface flows.⁵⁷

As shown in Figure 3, the total supply of replacement water made available by GASP to the division engineer has increased from about 12,000 acre-feet in 1973 to more than 50,000 acre-feet in 1986.⁵⁸ A unique feature of this replacement supply is that more than half of it is itself provided by wells. Thus groundwater from new wells is used to offset depletions caused by other wells.

GASP wells are used to provide replacement water directly to senior surface water rights which, because of their seniority, rate and volume of diversion, and location, historically have placed a call on the river in low flow periods. In 1973 GASP installed wells directly adjacent to the Sterling Number 1 ditch.⁵⁹ This ditch, with its headgate located several miles upstream of Sterling, had an 1873 priority for 114 cubic feet per second and historical diversions of 25,000 acre-feet per year. Calls placed by this right often extended many miles up the river forcing numerous junior appropriators to cease diversions until the call was satisfied. GASP wells now can supply more than 50 cubic feet per second of groundwater directly into the ditch, thereby helping to keep the call off the river.⁶⁰ Subsequently, GASP has installed wells

57. In approving the South Platte Amended Rules and Regulations, the Water Court for Division One stated:

To avoid a deprivation of water to some senior appropriator, ground water appropriator, shall make replacement water available for delivery as reasonably required by the Division Engineer, in a quantity, during a period, and at a place so as to prevent a deprivation of water to a senior appropriator caused by such ground water diversion. The Division Engineer shall use valid senior water calls as the normal criteria for requiring such replacements.

In re South Platte River, Case No. W-7209, (Water Division No. 1, Colorado, March 15, 1974) reprinted in Radosevich, 1 Colo. Water Laws IV-8(23) (1979) [hereinafter Radosevich].

58. Jack Odor Engineering Services, Feb. 25, 1987.

59. In 1972 when GASP was forming, the Sterling Number 1 had placed a call on the river that required a number of upstream juniors to cease diversions, including the Weldon Valley system located upstream of Fort Morgan, with its 1881 priority right to 165 cubic feet per second. Weldon Valley resisted the order to stop diverting and demanded that the state engineer instead shut down the more junior irrigation wells. The Division One water court upheld the state engineer's request for an injunction to require Weldon Valley to close its headgate, but also directed the state engineer to regulate well pumping under his proposed regulations that limited such pumping to three days a week. This explosive situation was defused by the installation of wells able to provide water sufficient to keep this call off the river.

60. Control of the wells is exercised by the division engineer and the water commissioner. GASP paid for the installation of the wells and also pays for their operation and maintenance. Apparently, because of their location, most of the depletions resulting from their operation reach the stream after the irrigation season. So far no injury to other downstream appropriators appears to have resulted from the operation of these wells.

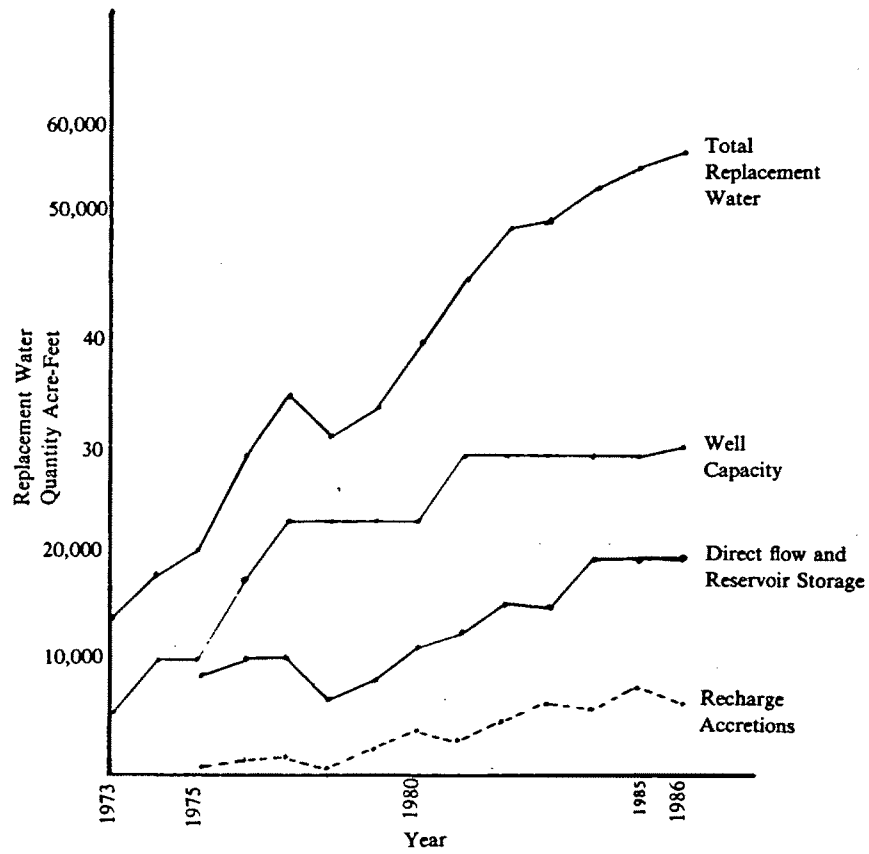


FIGURE 3. GASP REPLACEMENT WATER AVAILABLE
TOTAL BY SOURCE

Source: Jack Odor Engineering Service 2/25/87

at several other key locations where such a physical solution appeared possible.⁶¹

Reservoir storage and direct flow rights comprise the other major source of replacement water provided by GASP. Most of this water is leased on an annual basis, but GASP does own some reservoir shares as well as surface rights.⁶² Reservoir rights provide a highly flexible supply of replacement water and generally are quite reliable. However, the limited storage space along the South Platte between Henderson and Julesburg makes it difficult to have the replacement water near the point of injury.⁶³

The final source of replacement water relied on by GASP is obtained through recharge projects. Recharge projects generally involve the diversion of water into a specially prepared area with high infiltration rates so that the maximum possible amount of water is stored in the underlying aquifer. GASP does not operate its own recharge projects. Instead, it purchases excess credits for accretions supplied to the river by the recharge projects of others.⁶⁴ This method of augmentation is especially attractive because it usually involves taking water that would not otherwise be diverted (for example, during periods of low demand and high supply) and storing it underground so that it is available at times of need.

Information provided by GASP indicates that it replaced (or had the capacity to replace) about 20 percent of the total quantity of well water pumped by its members in 1985, compared to about 13.5 percent in 1981.⁶⁵ This change is due both to an increase in available replacement water and a decrease in the amount of groundwater pumped.

61. For an excellent discussion of the "physical solution" concept, see Dunning, *The Physical Solution in Western Water Law*, 57 U. COLO. L. REV. 445 (1986).

62. GASP's 1987 plan of operation filed with the state engineer indicated total reservoir rights of about 9,000 acre-feet, roughly fourteen percent of which (about 1,250 acre-feet) was owned by GASP. Direct flow rights (with some reservoir support) totalled about 10,800 acre-feet, twenty-four percent of which (about 2,600 acre-feet) was owned by GASP.

63. Another limitation on the use of storage water for replacement is that the state engineer now requires that two acre-feet of such water be released for every one acre-foot of replacement credit sought. This ruling apparently is based on court decisions holding that a change in use of storage water must be limited by the historical consumptive use of the water. See *Southeastern Colo. Water Conservancy Dist. v. Fort Lyon Canal Company*, 720 P.2d 133 (Colo. 1986). Reservoir water previously used for irrigation is assumed to have been fifty percent consumed.

64. For a description of recharge activity in the South Platte basin generally and a discussion of the projects in which GASP is involved see Warner, Sunada, & Hartwell, *Recharge as Augmentation in the South Platte River Basin*, COLORADO WATER RESOURCES RESEARCH INSTITUTE COMPLETION REPORT No. 144 (Nov. 1986).

65. Jack Odor Engineering Services, Feb. 25, 1987. Total groundwater pumped in 1981 was about 335,000 acre-feet, while replacement water totalled about 45,500 acre-feet. In 1985 total water pumped was about 275,000 acre-feet, while replacement supplies were 56,000 acre-feet.

The modest cost to GASP members (essentially 90 cents per acre-foot of groundwater pumped) has been made possible in part by the informal way in which GASP operates. Only relatively recently has GASP been providing much of the data it promised to the state engineer in 1972. In addition to the amount of groundwater pumped during the preceding period, the amount of acreage irrigated, and a projection of the amount of groundwater to be pumped during the next period, the state engineer now wants GASP to provide detail regarding cropping patterns and other information to enable a more complete analysis of the effect of GASP members' groundwater pumping.

B. The Fort Morgan Plan for Augmentation

Rather than operate under the GASP umbrella some well owners in the South Platte Valley have opted to protect their well operations by means of a plan for augmentation. Such an approach places these appropriations directly and permanently within the state priority system. An example of this approach is provided by the plan for augmentation developed by the Fort Morgan Reservoir and Irrigation Company ("Fort Morgan") and approved by the Division One Water Court in 1985.⁶⁶

The Fort Morgan Reservoir and Irrigation Company is a mutual ditch company providing water to about 11,000 acres of farm lands in Morgan County, Colorado.⁶⁷ Fort Morgan has a direct flow decree for 323 cubic feet per second with a priority date of October 18, 1882. In addition it owns 1,030 shares (of the 1,550 total) of the Jackson Lake Reservoir Company, a mutual company which owns and operates Jackson Lake Reservoir. The storage capacity of this reservoir is about 30,000 acre-feet.

Members of the Fort Morgan Company also use wells as a part of their irrigation water supply. Most of these wells were adjudicated in 1974 but because of their junior status could not operate except under some kind of augmentation plan. Under a provision then available in the law these wells were permitted to operate under a "temporary" plan for augmentation.⁶⁸ During this period Fort Morgan collected

66. *In re* Fort Morgan Reservoir and Irrigation Company, No. W-2692 (Water Division No. 1, Colorado, April 22, 1985) [hereinafter Fort Morgan Decree].

67. The background information provided here comes from the engineering study performed by HRS Water Consultants, Inc., Fort Morgan Reservoir and Irrigation Company Plan for Augmentation, (January 1985) [hereinafter Fort Morgan Report].

68. Temporary augmentation plans were authorized by a 1974 law, S.B. 7, 1974 Colo. Sess. Laws 440, ch. 111. The state engineer was given authority to approve such temporary plans pending final court action. This section was repealed in 1977 by S.B. 4, 1977 Colo. Sess. Laws 1702, ch. 483, § 6,

data on its total water demand to grow crops, its surface supply, and members' groundwater use. It also implemented its program for providing augmentation water. By 1985 Fort Morgan thought it had the data necessary to support its request for a final plan for augmentation.

The court decree approving this augmentation plan is viewed by many as providing a model for bringing irrigation wells into the priority system. There are two critical aspects to this plan: calculation of depletions to the stream attributable to the pumping of Fort Morgan member wells, and operation of the replacement scheme to offset those depletions. To calculate depletions, the analysis in support of the plan first calculated the average annual irrigation water requirement for the Fort Morgan lands between 1960 and 1980.⁶⁹ Using diversion records for direct flow and reservoir deliveries the annual surface water supply was then determined.⁷⁰ Groundwater use represented the difference between surface supplies and crop requirements.⁷¹ The effect to the river from this pumping was calculated using the "stream depletion factor" value for each well. This factor indicates both the amount of loss to the stream from well pumping and the timing of that loss.⁷²

The Fort Morgan replacement plan is based primarily on a recharge program. Under this program, water is diverted from the South Platte under a 1972 priority and carried to several recharge locations.⁷³ Surface flows brought into these recharge areas are measured on a daily basis. Evaporation losses are calculated as well as any flows out of the recharge sites. The difference is considered to recharge the groundwater aquifer.

Accretions to the stream from these recharge efforts are then measured against depletions to the stream resulting from groundwater pumping.⁷⁴ The result is the "net stream effect." For the recharge program to fully offset the effects of well pumping, accretions must at

codified at COLO. REV. STAT. § 37-92-305(8) (1973). See MacDonnell, *Plans for Augmentation: A Summary*, in *TRADITION, INNOVATION, AND CONFLICT: PERSPECTIVES ON COLORADO WATER LAW* 147 (L. MacDonnell ed. 1987).

69. Crop records as well as acreage involved are maintained by Fort Morgan. The Blaney-Cridle method was utilized to calculate the water requirements for these crops. Fort Morgan Report, *supra* note 67, at 3.

70. Surface supplies were further adjusted to account for water losses between the headgate at the river and application to the crop. Fort Morgan Report, *supra* note 67, at 4.

71. Actual groundwater pumping appears to be nearly twice the consumptive use amount calculated. Pumping between 1977 and 1980 was reported to be 6,752 acre-feet per year; the calculated groundwater use for this period was 3,811 acre-feet per year. Fort Morgan Report, *supra* note 67, at 5.

72. See the discussion of the stream depletion factor, *supra* note 7.

73. Those sites include the Fort Morgan canal itself, a generally dry streambed known as Badger Creek, and several ponds. The total recharge capacity of these sites is estimated to be 13,000 acre-feet per year. Fort Morgan Report, *supra* note 67, at 5.

74. The stream depletion factor also is used to analyze accretions to the stream.

least equal depletions to the stream at any time when a senior priority would be injured by the unavailability of that water.

The water court essentially adopted the analytical approach suggested by Fort Morgan. The decree requires the well owners to report crop and acreage information each year by May 1st. Fort Morgan then is to analyze the "net groundwater extractions" applicable to each well.⁷⁵ Also by May 1st, Fort Morgan is to "project the net effect on the South Platte River in the upcoming year resulting from prior and projected pumping and from prior recharge operations under Fort Morgan's system."⁷⁶ Monthly updates are required.

If the recharge accretions are inadequate to prevent material injury, Fort Morgan is committed to use supplies from its Jackson Lake Reservoir or, if necessary, to bypass diversion of its direct flow rights.⁷⁷ Recharge credits beyond that needed to offset depletions may be used by Fort Morgan for other purposes, or they may be sold. The decree provides for retained jurisdiction for five years to assure no injury to vested water rights. As stated in the decree:

This plan for Augmentation will allow the [Fort Morgan] wells . . . to be pumped at times and in amounts which would not otherwise be permitted under Colorado law. The Plan for Augmentation, if operated and administered in accordance with the Decree entered herein, will prevent injury to vested water rights or decreed conditional water rights by replacing out of priority depletions resulting from the consumptive use of water diverted from the wells. . . .⁷⁸

In summary, the Fort Morgan approach involves full replacement of well depletions to the stream, primarily by means of an off-irrigation season recharge program.

C. Central Colorado Water Conservancy District — Groundwater Management Subdistrict

The Central Colorado Water Conservancy District (CCWCD) was formed in 1965 with the objective of helping provide water supplies to members within the district boundaries (see Figure 4). The CCWCD encompasses the area along the South Platte River from

75. Two methods are provided. If actual well pumping is measured then the net extraction is to be based on 65 percent of the total amount pumped. If pumping is not measured then the groundwater use is to be calculated based on estimated crop requirements less estimated deliveries of surface water. Evaporation losses from sprinkler systems are assumed to be five percent of water use. Fort Morgan Decree, *supra* note 66, at 5.

76. *Id.* at 6.

77. Credit for releases of reservoir water is specifically limited to account for historic use constraints.

78. Fort Morgan Decree, *supra* note 66, at 3.

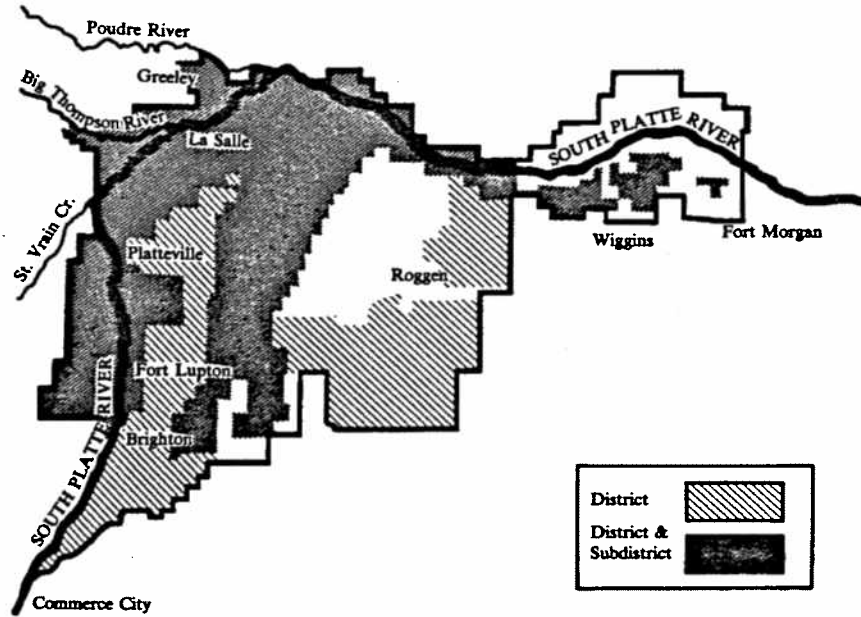


FIGURE 4. THE CENTRAL COLORADO WATER CONSERVANCY DISTRICT/GROUNDWATER MANAGEMENT SUBDISTRICT

Brighton to Fort Morgan and includes about 460,000 acres (720 square miles) in parts of Weld, Morgan, and Adams counties. In 1973 the Groundwater Management Subdistrict (Subdistrict) was established to help integrate existing groundwater pumping of the wells within its area into the water rights system. About 196,000 acres, a little over 42 percent of the CCWCD area, is included within the Subdistrict.

Initiated in the same year as GASP, the Subdistrict took a different approach to integrating groundwater development. Rather than operate on a year-to-year basis under the supervision of the state engineer, the Subdistrict decided to seek water court approval of a plan for augmentation. Under a statutory provision then in effect, the state engineer gave the Subdistrict "temporary" approval pending the development of a permanent plan that could pass water court muster. As discussed in connection with the Fort Morgan plan for augmentation, this requires proof of ability to replace all depletions caused by the pumping from wells involved in the plan.⁷⁹

The Subdistrict has been operating under its temporary plan for augmentation on the basis of replacing five percent of the water pumped each year by member wells. This approach was authorized by the 1974 Rules and Regulations.⁸⁰ The number of wells involved in the Subdistrict plan has varied from year to year, but the average has been about 870 between 1983 and 1987, irrigating an average of about 62,000 acres.⁸¹ The anticipated annual pumping from these wells averaged about 106,000 acre-feet. Replacement of five percent of this pumping meant providing about 5,280 acre-feet of water per year.

Table 1 shows the distribution of well pumping and depletions within the Subdistrict in 1986. About 60 percent occurs in the area along the South Platte River and Box Elder Creek from Platteville north to Kersey. Finding replacement water in this heavily used area of the South Platte has been difficult and expensive. Table 2 shows the availability and use of replacement water between 1981 and 1986. In contrast to GASP, which relies heavily on augmentation wells, the Subdistrict relies largely on surface water. Table 3 gives a detailed breakdown of the replacement water identified in the Subdistrict's 1987 plan. As shown, the Subdistrict itself owns about 864 acre-feet of water rights. It leased another 672 acre-feet from CCWCD, its parent organization, and it leased an additional 3,636 acre-feet from a variety

79. See *supra* notes 75-78 and accompanying text.

80. South Platte Rules and Regulations, *supra* note 45, Rule 3(1).

81. Groundwater Management Subdistrict, Plan of Operation (1983-1987) (on file, Division One Engineer's Office, Greeley, Colorado).

TABLE 1
 CCWCD — Groundwater Management Subdistrict
 1986 Distribution of Depletions

River Reach (S. Platte)	Location	Well Pumping (acft)	Depletions 5% of Pumping	% of Total Depletions in each reach
84,88	Littleton to Brighton (approx. 30 miles)	11,260	563	10.4%
85,82,77	Brighton to Platteville (approx. 20 miles)	8,150	408	7.5%
75,70	Platteville to LaSalle includes confluence with St. Vrain Creek (approx. 13 miles)	9,240	462	8.5%
62,57	LaSalle to Kuner includes confluence with Cache la Poudre (approx. 15 miles)	31,600	1,580	29.1%
54	Kuner to Bijou Headgate includes Box Elder Drainage (approx. 8 miles)	34,790	1,739	32%
51,48	Bijou to Weldon Valley Headgate (approx. 5 miles)	0	0	0
46,42	Weldon Valley to Narrows includes Kiowa Creek Drainage (approx. 15 miles)	13,620	681	12.5%
TOTAL		108,660	5,433	100%

Source: CCWCD Master Plan 1987-1992

of other sources. Municipal effluent represented most of this leased supply.

Since 1979 the Subdistrict has been actively pursuing the use of recharge projects to provide replacement credits. Over 9,500 acre-feet of water have been recharged to the aquifer in five separate locations between 1979 and 1986.⁸² This recharged water provided an estimated 2,503 acre-feet of possible replacement credits in 1987.

The Subdistrict owns sixteen wells between Fort Lupton and Brighton, capable of pumping 20 cubic feet per second to the river via a short ditch. Apparently, depletion to the river caused by pumping

82. CENTRAL COLORADO WATER CONSERVANCY DISTRICT AND GROUNDWATER MANAGEMENT SUBDISTRICT, MASTER PLAN, 1987-1992, 9-11 (Jan. 20, 1987) [hereinafter Master Plan].

TABLE 2
 CCWCD Subdistrict Replacement Water
 Availability and Actual Releases
 (in acre-feet)

Item	1981	1982	1983	1984	1985	1986
Replacement Water Available in Plan	6400	6145	7568	6356	6811	8472
Length of River Call	76	85	5	10	48	61
	days	days	days	days	days	days
Actual Replacement Water Released	3638	2976	73	249	3313	2940
Release as % of Availability	57%	48%	1%	4%	49%	35%
Sources of Replacement Water Released						
Surface Rights (includes effluent)	2354	2629	0	249	2916	2439
CBT/Windy Gap	830	85	0	0	175	0
Reservoir Releases	0	0	73	0	84	338
Augmentation Wells (net credits)	854	250	0	0	0	0
Recharge Projects (credits)	0	12	0	0	138	163

these wells occurs not long after pumping begins, so this source is used only at the end of a long call period.⁸³ These wells were not used as a replacement source between 1983 and 1986.

As a unit of the CCWCD the Subdistrict has taxing authority⁸⁴ and, in 1985, it received property tax revenues of \$227,288.⁸⁵ The other major source of revenue available to the Subdistrict is known as Class D assessments, the charge levied against each acre-foot of well water pumped by Subdistrict members. The per-acre-foot charge increased from \$7.50 in 1981 to \$11.50 in 1985. These assessments generated \$130,000 in 1985. The assessments are one-year contracts which essentially pay the Subdistrict for providing replacement water to cover for the depletions caused by the pumping from members' wells.⁸⁶

83. *Id.*

84. COLO. REV. STAT. § 37-45-121 (1973).

85. The levy was two mills and the assessed valuation of the 196,000 acres of land within the Subdistrict was about \$115 million. See Master Plan, *supra* note 82, at 6, and Table 2.

86. The Subdistrict has eight types of Class I contracts. Irrigation users are distinguished primarily according to their dependence on groundwater. About 95 percent of the contracts serve irrigation wells decreed prior to July 8, 1972. The remaining contracts serve wells decreed as an alternate point of diversion, wells decreed after July 5, 1972, and wells used for non-irrigation purposes. Assessments

TABLE 3
 CCWCD — Groundwater Subdistrict
 1987 Replacement Water
 (Source: Master Plan & 1987 Plan of Operation)

<u>Surface Water:</u>	
[includes direct flow and reservoir (unadjusted for historic consumptive use)]	
Owned by Subdistrict	864 acft
Leased from CCWCD	672 acft
Leased for year	3636 acft
<u>Augmentation Wells:</u>	
Owned by Subdistrict	1500 acft
<u>Recharge Projects:</u>	
Accretions from Recharge Occurring during 1987 South Platte Anticipated Calls	2503 acft
TOTAL ALL SOURCES 1987 REPLACEMENT WATER	9175 acft

In 1987 the Subdistrict announced that it no longer would pursue its application for a single permanent plan for augmentation for all wells in its area. Instead, it intends either to operate as a substitute supply plan, or to seek court approved augmentation plans for logical units of wells on a river-reach-by-river-reach basis.⁸⁷

The major problem facing the Subdistrict is to find adequate sources of permanent replacement water at a cost it can afford. Between 1981 and 1986 the Subdistrict purchased water rights yielding about 851 acre-feet at a cost of \$571,260, or about \$671 per acre-foot.⁸⁸ Such purchases sorely press the financial capacity of the Subdistrict and are not a financially feasible option for providing the large additional replacement water requirements. The most cost effective strategy to date has been the recharge program, but this option is not available in all reaches where depletions must be offset.

D. An Evaluation of the South Platte Experience

Widespread irrigation activity in the South Platte Basin beginning in the 1860s caused the alluvial material underlying the irrigated lands to gradually fill with water, changing the surface flows of the South Platte River in the downstream reaches from intermittent to year-

vary according to the type of contract held. Groundwater Management Subdistrict, Plan for Augmentation Status Report 4-6 (May 1988) [hereinafter Subdistrict Status Report].

87. Subdistrict Status Report, *supra* note 86, at 35. In either case, the Subdistrict intends to obtain the water supplies and prepare all information necessary to satisfy the requirements for plans for augmentation.

88. See Master Plan, *supra* note 82, at 12, and Table 6.

round flows. Essentially this irrigation activity can be viewed as an unintended recharge program, storing large quantities of water in the alluvial aquifer. The slow return of these stored waters to the stream made surface flows available at times when normally little or no water had been in the stream. Senior water rights were made more reliable and junior rights became usable. A rough equilibrium between water recharged through irrigation and return flows to the South Platte River was reached by about 1930.⁸⁹

This equilibrium was altered by the rapid development of groundwater from these alluvial aquifers beginning at about this time. The water table was drawn down, causing a decline in groundwater discharges to the river.⁹⁰ The effect of these groundwater withdrawals on surface flows was largely masked by the imported water being added to the South Platte system by transmountain diversions. Between 1941 and 1981, transmountain diversions have added an average of about 259,000 acre-feet of water per year.⁹¹ An analysis of calls placed on the river by senior rights below Denver during the critical irrigation period shows a clear reduction in the number and duration in recent years.⁹² In all likelihood the availability of this imported water, coupled with the fact that many surface diverters also utilized substantial groundwater, eased concern about the impacts of groundwater development.

As illustrated by these case studies, the approaches taken to integrate tributary groundwater development in the South Platte basin have varied considerably. GASP operates on a year-to-year basis under state engineer approval. No effort is made to quantify the depletions to the stream caused by the pumping of member wells. Instead, emphasis is placed on offsetting injury by providing replacement water targeted in substantial part at keeping the call off the lower part of the river where most of the GASP wells are located. Much of the replacement water is provided by GASP-installed wells apparently able to operate without injury to downstream users. Without question,

89. Bittinger, *Colorado's Groundwater Problems*, COLO. ST. U. EXPERIMENT STATION BULL. 504-S, 21 (Mar. 1967).

90. One source calculated total depletions from well pumping in the South Platte basin to be about 266,000 acre-feet per year. Glover, *South Platte River Flow Correlation*, J. OF THE IRR. & DRAINAGE DIVISION, ASCE (Vol. 101, No. 3) 175, 182 (1975). See also Hurr, Schneider, & Minges, *Hydrology of the South Platte River Valley, Northeastern Colorado*, COLORADO WATER RESOURCES CIRCULAR No. 28 (1975) which reports a decline in accretions to the river of about 250,000 acre-feet per year between 1947 and 1970.

91. Blatchley Associates, Inc., 'Tunnel Vision': An Analysis of River Call Data in the South Platte River Basin, Table 4, at 11 (July 1984). Transmountain diversions have been substantially greater between 1964 and 1981, averaging 362,000 acre-feet per year.

92. *Id.* at 15.

GASP has benefited from its primary location on the portion of the river where replacement water supplies are available at reasonable costs and where return flows from upstream uses supported by transmountain importations have substantially increased since the 1960s. Under the GASP approach injury is not measured by depletions to the stream but by the existence of calls on the river. The advent either of prolonged drought or a major increase in use of return flows from imported water⁹³ could tighten supplies in the lower South Platte, thereby raising issues about the adequacy of the GASP approach.

The Fort Morgan approach specifically analyzes depletions to the stream caused by each well. It is a true augmentation scheme in that it diverts and recharges flows available in periods of low demand. Analysis of the Fort Morgan system and operation of its plan for augmentation are greatly facilitated by the fact that these wells irrigate lands linked together as part of one mutual ditch company. About 90 wells are involved, pumping less than 7,000 acre-feet per year on average.

In contrast, the Groundwater Management Subdistrict is located in an area of intense water use. There are about 870 wells, pumping an average of 106,000 acre-feet per year. The Subdistrict has given up on its effort to obtain a single augmentation plan under which all these wells would operate, and instead is planning to segment the system into logical units and seek separate decrees for each of these units.

VI. CONJUNCTIVE USE IN COLORADO: WHERE DO WE STAND?

Colorado has moved cautiously into the brave new world of conjunctive use. It is now twenty years since the Colorado Supreme Court sounded the trumpet call of "maximum utilization" and urged elevation of this goal to the same status as protection of vested rights.⁹⁴ In 1969 the legislature sought to provide some guidelines with respect to tributary groundwater. The state engineer also has established rules regarding tributary groundwater use in the South Platte, Arkansas, and Rio Grande basins. This final section of the paper turns to a detailed assessment of the law that has developed as an outcome of the legislative enactments and administrative efforts. It concludes with some thoughts about possible courses for Colorado to follow in this area.

93. Under Colorado law imported water may be 100 percent consumptively used by the importer. *City and County of Denver v. The Fulton Irrigating Ditch Co.*, 179 Colo. 47, 506 P.2d 144 (1972) and COLO. REV. STAT. § 37-82-106 (Supp. 1987).

94. *Fellhauer v. People*, 167 Colo. 320, 447 P.2d 986 (1968).

A. Assessment of Tributary Groundwater Law

1. Integrating Groundwater Use Through Administration

In a prescient student note published in 1967, Clarold Morgan pointed out the problems of applying surface water allocation rules to groundwater.⁹⁵ The Colorado legislature had, of course, commanded this result in 1965, tempered only by language establishing a rebuttable presumption that wells already in operation at that time, and not taking water directly underlying a surface stream, are not causing injury to other vested rights.⁹⁶ The *Fellhauer* decision clarified that existing wells may be regulated by the state engineer without specific evidence connecting injury to pumping from individual wells.⁹⁷ However, the decision also emphasized that such regulation must in fact result in "reasonable lessening of material injury to senior rights."⁹⁸ The degree of legislative schizophrenia concerning the issue is apparent in the legislature's 1969 directive to the state engineer:

It is the legislative intent that the operation of this section shall not be used to allow ground water withdrawal which would deprive senior surface rights of the amount of water to which said surface rights would have been entitled in the absence of such ground water withdrawal, and that ground water diversions shall not be curtailed nor required to replace water withdrawn, for the benefit of surface right priorities, even though such surface right priorities be senior in priority date, when, assuming the absence of ground water withdrawal by junior priorities, water would not have been available for diversion by such surface right under the priority system.⁹⁹

95. Comment, *Appropriation and Colorado's Ground Water: A Continuing Dilemma?* 40 U. COLO. L. REV. 133, 138-41 (1967).

96. COLO. REV. STAT. § 148-11-22 (Supp. 1965) (repealed 1969).

97. *Fellhauer v. People*, 167 Colo. 320, 329, 447 P.2d 986, 991 (1968):

However, we hold that, whenever a court or water administration official can make a finding that the pumping of a junior well materially injures senior appropriators who are calling generally for more water, there exists a legitimate and constitutional ground and reason for the regulation of the well, and a showing of a call against that well by a particular senior user is not necessary.

This point was specifically affirmed in *Alamosa-LaJara Water Users Protection Ass'n v. Gould*, 674 P.2d 914, 931 (Colo. 1983) ("The purpose of the materiality of injury requirement is to prevent the futile curtailment of underground water diversions, not to erect a procedural roadblock to effective regulation of wells.").

98. *Fellhauer*, 167 Colo. at 334, 447 P.2d at 993. As Harrison and Sandstrom point out, *supra* note 5, at 22, this requirement was not justified by any statutory basis. Rather it derived from a court-made concept known as the "futile call" doctrine, and from the Colorado Supreme Court's interest in promoting "maximum utilization" of water.

99. COLO. REV. STAT. § 37-92-501(1) (1973)

In other words, follow the priority system, but only in circumstances where you really have to.

Under the *Fellhauer* directive that a rational plan of regulation be established, the state engineer first developed a "zone" concept whereby wells along the South Platte and Arkansas rivers were categorized according to the time by which the effect of their pumping would be felt by the stream.¹⁰⁰ Apparently the concept was that all wells would be regulated if there were calls from senior appropriators. Regulation would mean curtailment of pumping up to four days a week. Regulation of those wells farthest from the river would end first, since their pumping took longer to affect the river. Thus, Zone C wells (affecting the river in 30 to 75 days) would cease being regulated by September 1st, while Zone A wells (those affecting the river in less than 10 days) would continue under regulation until October 10th.

This approach was an admirable effort to reflect the hydrologic realities of groundwater and was rewarded with approval by the Colorado Supreme Court.¹⁰¹ Administratively, however, such a scheme would be difficult to implement and enforce. More importantly, it would have the unfortunate effect of rendering those wells nearest the river, often those installed the earliest and on the best land, least valuable. Presumably in recognition of these shortcomings, the state engineer abandoned this approach without ever applying it.

New draft rules for the South Platte were issued in 1972. As amended and finalized in 1974, the rules required that all groundwater diversions were to be curtailed except from wells (1) operating under a decreed plan for augmentation, (2) operating pursuant to a decree as an alternate point of diversion or a changed point of diversion for a surface water right, or (3) operating "under its priority without impairing the water supply to which a senior appropriator is entitled. . . ."¹⁰² Wells operating under a temporary plan for augmentation were required to provide replacement water equalling, at a minimum, five percent of the projected total pumping. If the division engineer finds this amount of water inadequate, he can require additional amounts based on specific calculations of stream depletions caused by the pumping from the well.

In approving these rules, which had been stipulated to by the par-

100. State Engineer, Rules and Regulations, July 14, 1969, attached as Appendix A in *Kuiper v. Well Owners Conservation Ass'n*, 176 Colo. 119, 150-56, 490 P.2d 268, 284-87 (1971). Under these rules, pumping was deemed to affect the stream when the loss to the stream equalled five percent of the *consumptive* use of water appropriated by the well. *Id.* at 155, 490 P.2d at 286.

101. *Id.* at 119, 490 P.2d at 268.

102. South Platte Rules and Regulations, *supra* note 45, Rule 2(b)(2). The curtailment was phased with wells permitted to operate two days a week in 1974 and one day a week in 1975.

ties, the water court noted that junior groundwater diversions in the South Platte had reduced surface flows "which might otherwise have been available to senior surface appropriators."¹⁰³ It also recognized that generally there is adequate water available so that any harm to seniors can be effectively remedied by junior well appropriators.¹⁰⁴ Thus groundwater appropriators must be able to provide "replacement water . . . in a quantity, during a period, and at a place so as to prevent a deprivation of water to a senior appropriator caused by such ground water diversion."¹⁰⁵ The need for such replacement water is to be triggered by "valid senior water calls."¹⁰⁶

This approach avoids the problem that curtailing groundwater pumping to cease injury to surface diverters usually will not produce needed water until too late. Pumping can continue so long as other water can be found to offset injury at the time and place of need. The decision to pump then becomes one based purely on economics: is the use of the groundwater valuable enough to justify not only the direct costs associated with that pumping but also the cost of supplying replacement water?

The problem of determining depletion to the river is eased by establishing a presumption that replacement of five percent of total water pumped will be adequate. In recognition that actual depletions may vary according to specific conditions, the option to calculate specific depletions from a well also is available.

The matter of linking depletions from well pumping to injury to senior water rights was addressed only in a general way by indicating that replacement water would be used by the division engineer in response to "valid senior water calls." Injury is presumed to be indicated by the existence of calls. Considerable discretion rests with the division engineer in deciding how to respond to calls, and how much responsibility to attribute to groundwater pumping.

The difficulties in establishing clear links between well pumping and injury to senior rights were well illustrated by litigation concerning an amendment to the state engineer rules and regulations in the Arkansas River Valley. Rules adopted in 1973 restricted well pumping to only three days a week in the Arkansas Valley. Following the approach taken in the South Platte, the state engineer then sought to phase out all well pumping, except for those wells either in a court-

103. Radosevich, *supra* note 57, at IV-5.

104. "Ordinarily, river conditions are such that provisions can be made by the ground water appropriator to provide to seniors the amount of any deprivation due to ground water diversions." *Id.* at IV-6.

105. *Id.* at IV-8.

106. *Id.*

approved augmentation plan, or decreed as an alternate or changed point of diversion.¹⁰⁷ In 1978, the Colorado Supreme Court ruled that the state engineer had not demonstrated that this approach was, in fact, necessary to satisfy senior rights.¹⁰⁸ Apparently the court was concerned that there had not been adequate time to analyze whether injury from well pumping had been alleviated by the curtailment of pumping for four days a week. Absent such an analysis, and in the face of determined opposition to such additional regulation, the court focused on the uncertainties in determining the harm caused by groundwater pumping:

When water in the aquifer is brought to the surface by a well and there is a consumptive use of that water by evaporation and evapotranspiration of phreatophytes, generally the surface supply is depleted by the amount of such consumptive use. The evidence and findings in this case demonstrate, however, that the restriction of wells does not necessarily result in a comparable increase in the supply of surface water. There are counter effects which offset or modify the depletive use of well water. Some of these are: variations in the amount of river flow; winter irrigation; reduction in evaporation and phreatophyte losses as a result of lowering of water tables; changes in ground water storage; extent of alluvium recharge occurring during wet cycles or as a result of widespread winter irrigation practices; and increased irrigation efficiencies.¹⁰⁹

Groundwater pumping in the Arkansas basin remains unrestricted for three days a week.

Apparently benefiting from his experience in the Arkansas Val-

107. The 1973 rules called for curtailment of well pumping up to four days a week. The amendment sought to increase curtailment in 1974 to five days, six days in 1975, and total curtailment in 1976. Wellowners in the Arkansas Valley have joined in associations for purposes of supplying replacement water for depletions caused by well pumping. The Colorado Water Protective and Development Association includes about 700 wells located above John Martin Reservoir. Apparently operating by approval of the state engineer under the substitute supply provision, this association relies primarily on leases of transmountain return flows, including water from the Frying Pan-Arkansas Project. The Lower Arkansas Water Management Association, located below John Martin Reservoir, includes about 400 wells. The major method of protecting these wells was provided by the state-supported Buffalo Canal Demonstration Project, which involved construction of wells adjacent to the Buffalo Canal to provide replacement water needed to satisfy the substantial senior rights held by this irrigation company. These wells have the capacity to provide more than thirty cubic feet per second to the Buffalo Canal. Simons, Li & Assoc., Preliminary Assessment — Development and Administration of Water Resources of the Arkansas River, 4.29 (Feb. 1984).

108. *Kuiper v. Atchison, Topeka & Santa Fe Ry.*, 195 Colo. 557, 581 P.2d 293 (1978). The March 1975 report prepared by the state engineer's office, "Stream Depletions by Wells in the Arkansas River Basin — Colorado," was unequivocal in its conclusions: "The increasing use of ground water for irrigation in the Arkansas River basin since 1950 has affected stream flows in such a way as to deprive senior water users of a portion of their lawful water supply." *Arkansas Stream Depletions*, *supra* note 9, at 53.

109. *Kuiper v. Atchison, Topeka & Santa Fe Ry.*, 195 Colo. 557, 561, 581 P.2d 293, 295 (1978).

ley, the state engineer fared better with the supreme court in litigation concerning proposed regulation of groundwater pumping in the San Luis Valley.¹¹⁰ The regulations proposed in 1975 would have phased out well pumping over a five-year period, except for those wells shown not to cause injury or to have remedied that injury through participation in an approved augmentation plan. In support of these proposed regulations, the state engineer presented evidence showing that the groundwater development in the Valley caused annual depletions totalling about 34,000 acre-feet to the Rio Grande and Conejos rivers.¹¹¹ However, no analysis of effects of these depletions on senior rights was provided, nor were the depletions tied to specific wells — failures which the water court found fatal. The Colorado Supreme Court reversed, following its holding in *Fellhauer* that material injury need not be proved in relation to each well.¹¹² Indeed the court offered another simplifying presumption: "However, where, as here, streams are over-appropriated and underground water diversions from an aquifer have been found to significantly affect stream flow, it may be presumed that each underground water diversion materially injures senior appropriators."¹¹³

The decision in the San Luis Valley litigation raises some interesting possibilities concerning regulatory approaches. The water court concluded that there may be a duty on the part of surface appropriators to take their water from tributary groundwater, if necessary, to satisfy their water rights. This position is based, in part, on statutory language stating:

The existing use of ground water, either independently or in conjunction with surface rights, shall be recognized to the fullest extent possible, subject to the preservation of other existing vested rights, but, at his own point of diversion on a natural watercourse,

110. *Alamosa-La Jara Water Users Protection Ass'n v. Gould*, 674 P.2d 914 (Colo. 1983).

111. *Id.* at 928.

112. *Id.* at 930-31. The water court relied on language in COLO. REV. STAT. § 37-92-502(2) (Supp. 1987), which states that, in considering whether material injury is being caused to senior priorities such that the junior diversions should be curtailed, the division engineer is to "determine in each case the amount of water such discontinuance will make available to such senior priorities . . ." Moreover, "[e]ach diversion shall be evaluated and administered on the basis of the circumstances relating to it . . ." (emphasis added).

113. *Alamosa-La Jara*, 674 P.2d at 931. See also *Hall v. Kuiper*, 181 Colo. 130, 134, 510 P.2d 329, 331 (1973): "whenever a court or water administration official can make a finding that the pumping of a junior well materially injures senior appropriators who are calling generally for more water, there exists a legitimate and constitutional ground and reason for the regulation of the well, and a showing of a call against that well by a particular senior well is not necessary." Since both the South Platte and the Arkansas are "over-appropriated," and since groundwater development has been found to deplete surface flows in both basins, this presumption should also apply there. Of course, the method of regulation to offset this injury remains subject to review.

each diverter must establish some reasonable means of effectuating his diversion. He is not entitled to command the whole flow of the stream merely to facilitate his taking the fraction of the whole flow to which he is entitled.¹¹⁴

This provision reflects the holding in *City of Colorado Springs v. Bender*,¹¹⁵ which involved the relative rights of two groundwater diverters. There the court suggested that the senior appropriator's inefficient wells may be protected only if it is beyond his "economic reach" to make improvements.

The 1983 supreme court decision specifically affirmed the holding of the water court that "under certain circumstances, surface stream appropriators may be required to withdraw underground water tributary to the stream in order to satisfy their surface appropriations."¹¹⁶ It affirmed the potential value of the reasonable-means-of-diversion doctrine in achieving the maximum utilization goal, but left to the state engineer the determination of how best to achieve that goal.

Among the possible options suggested by the water court and the supreme court were: improvements in irrigation practices, improvements in drainage, development of additional supplies through the Closed Basin Project¹¹⁷ and new storage, and development of a systematic augmentation plan.¹¹⁸ With respect to the economic reach issue, the supreme court suggested having junior appropriators pay the costs of making needed improvements to seniors' diversions.¹¹⁹ Certainly the clear implication here is that the state engineer has extremely broad authority under his rule-making power to require appropriators to operate in a manner that will advance the principle of optimum use.¹²⁰ Indeed, the court has invited the state engineer to

114. COLO. REV. STAT. § 37-92-102(b) (1973).

115. 148 Colo. 458, 366 P.2d 552 (1961).

116. *Alamosa-La Jara*, 624 P.2d at 935. The court eliminated a potential roadblock to this approach by overruling language in *Kuiper v. Well Owners Conservation Ass'n*, 176 Colo. 119, 490 P.2d 268 (1971), suggesting that a calling senior surface appropriator could not be compelled to use groundwater to satisfy that call, even if the surface right holder also holds a right to groundwater as an alternate point of diversion. "[I]t is not the present state of the law that the State Engineer is required to compel a person with a senior surface priority to use his ground water to apply on that priority before he makes a call." *Id.* at 148-49, 490 P.2d at 283. In *Alamosa-La Jara*, the court stated: "Therefore, to the degree *Well Owners* precludes consideration of a reasonable-means-of-diversion requirement as a method of maximizing utilization of integrated underground and surface waters, we overrule *Well Owners*." 674 P.2d at 934-35 (footnote omitted).

117. The Closed Basin Project is being constructed by the U.S. Bureau of Reclamation and involves utilization of over 100 shallow wells to draw water trapped by a natural hydraulic barrier and not beneficially used. See *Closed Basin Landowners Ass'n v. Rio Grande Water Conservation Dist.*, 734 P.2d 627 (Colo. 1987).

118. *Alamosa-LaJara*, 674 P.2d at 935 n.37.

119. *Id.* at 935.

120. See COLO. REV. STAT. § 37-92-501(2)(e) (1973): "All rules and regulations shall have as

consider broadening the manner in which groundwater and surface water may be integrated to include a system-wide review of water management practices. To date the state engineer has declined this invitation.¹²¹

The state engineer has made extensive use of the substitute supply provision to allow out-of-priority use of tributary groundwater. The only statutory requirement concerning such substituted supplies is that they be "of a quality and continuity to meet the requirements of use to which the senior appropriation has normally been put."¹²² Apparently the state engineer has not developed any administrative guidelines concerning such substituted supplies.¹²³

A common use of this provision is to allow new wells seeking court approval of a plan for augmentation to operate during the period of court review. These are short-term situations, and the ability to allow such limited use provides admirable flexibility in the system. Somewhat more troubling is the use of this provision to authorize what are effectively permanent substitute supply plans. Certainly the statute does not limit the use of this provision in this way. Indeed, there is no explicit requirement that there be state engineer review of substitute supply operations.¹²⁴

GASP satisfies the requirements of this provision in the view of the state engineer by providing enough replacement water to minimize the call on the lower portion of the South Platte River. In recent years this appears to represent replacement supplies of about 20 percent of total pumping. Central's Groundwater Subdistrict has been operating on the basis of five percent replacement. Fort Morgan, under its decreed augmentation plan, now must replace all depletions to the stream caused by its well pumping. The legal basis for these differences is not clear.

GASP apparently is willing to live with the uncertainty of obtaining year-to-year approval by the state engineer.¹²⁵ Its success to

their objective the optimum use of water consistent with preservation of the priority system of water rights."

121. He may be hoping that the "technical fix" promised by the Closed Basin Project will take care of the problem. See Vol. 18, No. 1, Water L. Newsl. 4 (Rocky Mt. Mineral Law Fdn. 1985).

122. COLO. REV. STAT. § 37-80-120(3) (1973).

123. Presumably, the rules which had applied to state engineer approval of temporary augmentation plans provide some guidance. South Platte Rules and Regulations, *supra* note 45. The statutory provision authorizing temporary augmentation plans no longer is in effect. Apparently the state engineer simply shifted the basis of his authority to review and approve such plans to the substitute supply provision.

124. There is a requirement for state engineer approval of out-of-priority storage in the first subsection of this provision, but there is no mention of such approval in the following two subsections dealing with substituted supplies. Compare COLO. REV. STAT. § 37-80-120(1) with -(2) and -(3) (1973).

125. In recent years, at least, this official approval has not been forthcoming until after the end of

date in being able to supply the needed replacement water provides some basis for its confidence that it will receive approval. However, the absence of any real analysis of how GASP wells affect the stream and the effectiveness with which the replacement sources offsets any adverse effects makes GASP potentially vulnerable should water supplies in the Platte become less available for any reason.

2. Integrating Groundwater Use Through Adjudication

a. Alternate and Changed Points of Diversion

At least since 1969, if not before, it has been clear that appropriations of tributary groundwater must be decreed in the same manner as a surface right.¹²⁶ The 1969 Act sought to assure that the actual date of appropriation of such groundwater would be recognized. Thus it provided:

with respect to water rights which are diverted by means of wells, the priorities for which have not been established or sought in any decree or proceeding, if the person claiming such a water right files an application for determination of water right and priority not later than July 1, 1972, and such application is approved and confirmed, such water right, . . . , shall be given a priority date as of the date of actual appropriation . . .¹²⁷

However, as Hillhouse points out:

This provision effected the legal integration of ground and surface water uses in the limited sense of bringing them into the same record-keeping system for purposes of administration, but did little to encourage the use of groundwater, since most wells are relatively junior in time and rarely would be permitted to divert under a system of strict priority.¹²⁸

In 1967, the legislature encouraged integration of well use with surface rights by authorizing the use of wells as alternate points of diversion for surface rights.¹²⁹ The 1969 Act developed this approach in greater detail. It explicitly recognized that a well owner either could use that well to take water associated with "its own appropriation," or to satisfy a surface appropriation right to "water from the same stream system."¹³⁰ To accomplish the latter, the statute pro-

the irrigation season, and appears to be based on an evaluation of operating experience during the season.

126. See cases cited note 18, *supra*.

127. COLO. REV. STAT. § 37-92-306 (1973).

128. Hillhouse, *supra* note 21, at 704-05.

129. 1967 Colo. Sess. Laws, ch. 427, § 1 repealed by 1969 Colo. Sess. Laws, ch. 373, § 20.

130. COLO. REV. STAT. § 37-92-301(3)(a) and (b) (1973).

vides that the "owner may secure the right to have such well, or more than one if he has more than one such well, made an alternate point of diversion to said surface right" ¹³¹ Again a three-year grace period was permitted to allow well owners to obtain such a decreed alternate point of diversion. ¹³² Legislative intention to encourage this approach is indicated by the following provision: "In authorizing alternate points of diversions for wells, the widest possible discretion to permit the use of wells shall prevail." ¹³³

Concern was expressed in 1969 that this provision would be used to allow diversions of groundwater in excess of that available under surface decrees. ¹³⁴ In a 1977 decision, the Colorado Supreme Court approved a water court decree allowing the use of the wells as alternate points of diversion for previously decreed surface rights. ¹³⁵ The water court decree specifically limited the use of the wells only to the time at which the surface decrees would be in priority. ¹³⁶ On appeal it was argued that the surface rights had been abandoned. The irrigation water used since at least 1948 was not diverted through the decreed point of diversion on the South Platte River; rather, the water came from seepage from adjacent ditches, from natural sub-irrigation, and from wells installed in 1944 and 1951. Moreover, it was argued that since the water used came from seepage and sub-irrigation, the requirement not to divert directly from the river when taking water from the wells simply amounts to an increase in the water right to the injury of the downstream water rights. The majority, however, in upholding the water court's finding of no intent to abandon the water right, also upheld the decree granting the use of wells as alternate points of diversion. Thus, since the original decree could still be used to take water at the headgate, allowing the use of wells "would leave more water in the river and thus aid, rather than injure, junior appropriators." ¹³⁷ Although a difficult case factually, the decision clearly

131. COLO. REV. STAT. § 37-92-301(3)(b) (1973).

132. COLO. REV. STAT. § 37-92-301(3)(c) (1973).

133. COLO. REV. STAT. § 37-92-301(3)(d) (1973).

134. See Colorado Legislative Council, PROPOSED AMENDMENTS TO 1969 WATER LEGISLATION 3 (Research Pub. No. 147) (1969): "The law was interpreted by some water users as permitting old surface rights from which water had never been obtained with any regularity, to be used to give the owners of such rights an unfair advantage in the priority system, especially over persons having only wells." quoted in, Greer, *A Review of Recent Activity in Colorado Water Law*, 47 DEN. L.J. 181, 185 (1970).

135. *Orr v. City and County of Denver*, 194 Colo. 125, 572 P.2d 805 (1977).

136. Although not a case involving groundwater, *Rominiecki v. McIntyre Livestock Corp.*, 633 P.2d 1064 (Colo. 1981), illustrates the general rule that water taken at an alternate point of diversion must be limited to that available at the original point of diversion.

137. *Orr*, 194 Colo. at 129, 572 P.2d at 807.

favors use of groundwater as a means of expanding the use of the available resource.

A 1981 decision by the supreme court also shows a willingness to allow use of groundwater in the absence of evidence of resultant injury.¹³⁸ Again the court upheld a water court decree granting the use of a well as an alternate point of diversion, in this case for a recently established water right on a small tributary of the Arkansas River. The protestant argued that the Arkansas River was over-appropriated; any new water right was out-of-priority, so that no alternate point of diversion could be granted to take water which would not be available to the surface right. The court first upheld the water court finding that no increased use of water would result, so there was no injury associated with the change. It then noted that the division engineer is charged with discontinuing diversions causing material injury and that, through his water commissioner, he was aware of the original diversion, but had not acted to limit it. The court concluded: "Under such circumstances we hold that the diversions made pursuant to the water right for Riches' Pond and Infiltration Gallery, though not in priority, can be considered as establishing historical use for the purpose of the change of water right proceeding here in question."¹³⁹ Colorado courts have recognized the right of an appropriator to change his point of diversion since at least 1883.¹⁴⁰ Such changes in water rights will be approved so long as no injury will result to holders of other water rights.¹⁴¹ A holder of a surface right wanting to use a well to satisfy that right may either seek a change in the point of diversion, or to have the well decreed as an alternate point of diversion. With the well as an alternate point of diversion, he retains the flexibility of being able to divert at either point. However, he may be required to use the well if necessary to satisfy the surface right.¹⁴² In both cases the procedure constitutes a change of a water right.¹⁴³ If a permanent change in the place of use is contemplated, then a change in the point of diversion would seem necessary.¹⁴⁴

138. *Southeastern Water Conservancy Dist. v. Rich*, 625 P.2d 977 (Colo. 1981).

139. *Id.* at 982. In a footnote to this statement the court added: "Contrary to the District's contentions, this holding does not authorize out-of-priority diversions or limit in any way the future acts of the state engineer in administering diversions pursuant to the priority system." *Id.* at 982 n.5.

140. *Sieber v. Frink*, 7 Colo. 148, 2 P. 901 (1883). This right was recognized by the legislature in 1899. 1899 Colo. Sess. Laws 235.

141. COLO. REV. STAT. § 37-92-305(3) (1973). See also *Weibert v. Rothe Bros., Inc.*, 200 Colo. 310, 618 P.2d 1367 (1980), and cases cited therein. *Id.* at 315-16, 618 P.2d at 1371.

142. See COLO. REV. STAT. § 37-92-502(2) (Supp. 1987).

143. See, e.g., *Southeastern Colo. Water Conservancy Dist. v. Rich*, 625 P.2d 977, 979 (Colo. 1981): "A change from a fixed point of diversion to an alternate point of diversion constitutes a change of water right, as does a change in the means of diversion."

144. *But see Orr v. City and County of Denver*, 194 Colo. 125, 572 P.2d 805 (1977) where the

The question of whether there may be a duty on the part of those with inefficient surface diversion facilities to satisfy their rights from tributary wells, at least to the degree this is within their economic reach, has been discussed above.¹⁴⁵ At a minimum the supreme court has made it clear that the state engineer, in establishing regulations governing administration of water rights, may include such a requirement as a means of improving the efficient utilization of the state's water resources.¹⁴⁶

b. Plans for Augmentation

The other major means of integrating groundwater development into the existing water rights system included in the 1969 Act is the plan for augmentation. As defined in the statute, a plan for augmentation is

a detailed program to increase the supply of water available for beneficial use in a division or portion thereof by the development of new or alternate means or points of diversion, by pooling of water resources, by water exchange projects, by providing substitute supplies of water, by the development of new sources of water, or by any other appropriate means.¹⁴⁷

As illustrated by the Fort Morgan case study, the plan for augmentation provision has been utilized to integrate groundwater development. However, the difficulties in utilizing this approach to integrate large numbers of wells are evidenced in the experience of the Groundwater Subdistrict of the CCWCD.

A major use of augmentation plans has been to permit new development of groundwater to occur — groundwater use that, strictly speaking, is out of priority. A 1973 Colorado Supreme Court decision had made it clear that new groundwater development in over-appropriated basins like the South Platte could be prohibited because of the resultant reduction in water to established right holders.¹⁴⁸ However,

water from the wells, as alternate points of diversion, was being used to irrigate lands not irrigable under the original ditch rights.

145. See *supra* notes 114-116 and accompanying text.

146. *Alamosa-LaJara Water Users Protection Ass'n v. Gould*, 674 P.2d 914, 924 (Colo. 1983).

147. COLO. REV. STAT. § 37-92-103(9) (1973). For a detailed discussion of plans for augmentation, see MacDonnell, *Plans for Augmentation: A Summary* in *TRADITION, INNOVATION AND CONFLICT: PERSPECTIVES ON COLORADO WATER LAW* (L. MacDonnell ed. 1987). Apparently the legislature envisioned a massive rush by well owners to file augmentation plans, so it created a special set of procedures. These included requiring that the water judge rather than the referee review all applications; that the judge hold hearings concerning all pending applications and consider their effects together; and that, until such determination is made, the state engineer be authorized to administer "temporary" augmentation plans. COLO. REV. STAT. 37-92-307 (1973), *repealed by* 1977 Colo. Sess. Laws 1704.

148. *Hall v. Kuiper*, 181 Colo. 130, 510 P.2d 329 (1973). In this case the state engineer had

in a pair of decisions issued in 1976, the supreme court indicated a clear willingness to permit new groundwater development as part of a plan for augmentation.¹⁴⁹

Both of these cases involved the use of well water to supply domestic needs associated with new housing developments. The basic concept was to fully offset any depletive effects resulting from the new groundwater development and use by providing an equivalent amount of replacement water from other sources.¹⁵⁰

Opponents argued that unless the well appropriations were fully replaced they would violate the priority system by allowing these new users to step ahead of junior appropriators unable to satisfy their rights from normal surface flows. Presented with the kind of device for promoting maximum utilization of water resources envisioned in *Fellhauer*, the court easily reached a very important conclusion: "that under the plans for augmentation involved water is available for appropriation when the diversion thereof does not injure holders of vested rights."¹⁵¹

These decisions resolved much of the uncertainty concerning augmentation plans. The legislature responded by codifying these clarifications in 1977:

In reviewing a proposed plan for augmentation and in considering terms and conditions which may be necessary to avoid injury, the referee or the water judge shall consider the depletions from an applicant's use or proposed use of water, in quantity and time, the amount and timing of augmentation water which would be provided by the applicant, and the existence, if any, of injury to any

denied permits to drill two wells on land thirteen miles from the Cache La Poudre River, a tributary of the South Platte River. The evidence showed that depletions to the river from pumping these wells would not be felt for many years. However, because eventually the depletions would materially reduce the already over-appropriated supply of water, the court upheld the denial of these permits.

149. *Cache La Poudre Water Users Ass'n v. Glacier View Meadows*, 191 Colo. 53, 550 P.2d 288 (1976), and *Kelly Ranch v. Southeastern Colo. Water Conservancy Dist.*, 191 Colo. 65, 550 P.2d 297 (1976).

150. *Glacier View Meadows* acquired storage rights, and dedicated some to replacing water consumptively used by the new development. *Kelly Ranch* proposed to cease using its water rights for irrigation and apply them instead to offset losses to the stream resulting from the new uses of water.

151. *Cache La Poudre Water Users Ass'n v. Glacier View Meadows*, 191 Colo. 53, 61, 550 P.2d 288, 294 (1976). *Justice Groves* specifically noted the unwillingness of the Colorado Supreme Court in a previous decision to reach the conclusion that water is available if there is no injury. *Southeastern Colorado Water Conservancy Dist. v. Shelton Farms*, 187 Colo. 181, 529 P.2d 1321 (1974). That case involved an effort to obtain a water right based on removal of phreatophytes. The court viewed the water losses caused by the phreatophytes as belonging to the stream. Here, however, with full replacement of depletions to the stream, "the stream will be the same, irrespective of the well diversions." Therefore, "[u]nder the circumstances of this case, there is no significant difference between the prior appropriation doctrine, and the lack of injury doctrine." *Cache La Poudre Water Users Ass'n v. Glacier View Meadows*, 191, Colo. 53, 61, 550 P.2d 288, 294 (1976).

owner of or person entitled to use water under a vested water right or a decreed conditional water right. A plan for augmentation shall be sufficient to permit the continuation of diversions when curtailment would otherwise be required to meet a valid senior call for water, to the extent that the applicant shall provide replacement water necessary to meet the lawful requirements of a senior diverter at the time and location and to the extent the senior would be deprived of his lawful entitlement by the applicant's diversion.¹⁵²

Further clarification was provided in *Weibert v. Rothe Brothers, Inc.*,¹⁵³ a 1980 decision involving an application for a new irrigation well, a change in the point of diversion and place of use from a well thirty miles upstream, and a plan for augmentation. First, with respect to the change in point of diversion and place of use, the Colorado Supreme Court distinguished the decreed right from the amount of water that may be transferred, and emphasized that this amount may not exceed the "duty" of water as limited by actual historical use.¹⁵⁴ Concerning the augmentation plan, the supreme court noted that the water court should have evaluated the adequacy of the replacement water rights to insure no injury to the other water right holders. Failure to do so was held to be error.¹⁵⁵ Error also was found in the failure of the water court to include an explicit reference to reconsideration on matters of injury in that provision of its decree concerning continuing jurisdiction.¹⁵⁶ This decision also is notable because of its emphasis on protection of the stream rather than primarily on the depletive effects of the new use as evidenced in *Glacier View Meadows*.¹⁵⁷

152. 1977 Colo. Sess. Laws 1703, § 4 (codified at COLO. REV. STAT. § 37-92-305(8) (Supp. 1987)).

153. 200 Colo. 310, 618 P.2d 1367 (1980).

154. The water court apparently granted this transfer of water equal to the presumed "duty" of water — that is, the amount which, properly applied, would produce the maximum amount of crop. No evidence was taken regarding actual historical use even though "[h]istorical use could be less than the optimum utilization represented by the 'duty of water' . . . because the Furrow well could not physically produce at the decreed rate on a continuing basis, the well has been used historically only to supplement other rights, or for other reasons." *Id.* at 316-17, 618 P.2d at 1372 (footnote omitted). The water court had taken this approach because it felt bound by the adjudicated right awarded the well in 1974. The supreme court, however, held that *res judicata* did not apply because historical use was not at issue in the 1974 proceeding. *Id.* at 318, 618 P.2d at 1372-73.

155. *Id.* at 318, 618 P.2d at 1373.

156. *Id.* at 319-20, 618 P.2d at 1373. The statute now requires that the decree approving a change of water right or a plan for augmentation "shall include the condition that the approval of such change or plan shall be subject to reconsideration by the water judge on the question of injury to the vested rights of others for such period after the entry of such decision as is necessary or desirable to preclude or remedy any such injury." COLO. REV. STAT. § 37-92-304(6) (Supp. 1987).

157. *Cache La Poudre Water Users Ass'n v. Glacier View Meadows*, 191 Colo. 53, 550 P.2d 288 (1976).

This concern is even more evident in *Southeastern Colorado Water Conservancy District v. Fort Lyon Canal Co.*, a 1986 Colorado Supreme Court decision.¹⁵⁸ This case involved applications by the Fort Lyon Canal Company and the Colorado Division of Wildlife to change storage rights in three reservoirs and an application by Fort Lyon for a plan for augmentation to change three direct flow rights from wintertime irrigation to storage and subsequent summer irrigation use. The change in storage rights involved a change in point of diversion, in place of storage, and in nature of use (from storage for subsequent irrigation use to storage as a permanent pool for fish, wildlife, and recreation). One of the main issues on appeal was whether the water court decree approving these applications had properly accounted for reductions in return flows. The supreme court found that it had not, stating

In the present case there is overwhelming and undisputed evidence that the applicants' change of storage rights and plan for augmentation will cause increased consumptive use and diminished return flows, thereby injuring the vested rights of the objectors and other appropriators on the Arkansas River.¹⁵⁹

On remand, the water court was to "enter specific, detailed factual findings of the various quantities and ways that the applications will diminish or change the patterns of historical consumptive use and return flows" and "impose conditions and modifications in its decrees to offset the injuries to other appropriators."¹⁶⁰

In a series of three cases, the Colorado Supreme Court has firmly established the rule that no new water use likely to injure existing water rights may be permitted except as part of an approved plan for augmentation. Thus, in *Bohn v. Kuiper*¹⁶¹ the water court had granted a conditional decree for a well that would use tributary groundwater in the South Platte basin for irrigation. Although the water court had awarded this conditional decree because it noted that injury could be avoided by providing replacement water, no such replacement plan had been presented by the applicant. In this case, the

158. 720 P.2d 133 (Colo. 1986).

159. *Id.* at 147.

160. *Id.* at 150. Relying on *City of Westminster v. Church*, 167 Colo. 1, 445 P.2d 52 (1968), the water court had determined that storage rights can be transferred to alternate places of storage without considering diminished return flows caused by the change in historical use. The supreme court stated that historical use in that case had meant amounts of water historically diverted. Return flows associated with the actual historical use had not been considered. Thus the court here held that "diminished return flows, whether due to change in direct-flow or storage rights, must be considered when calculating the amount of injury to other appropriators." *Southeastern Colo. Water Conservancy Dist. v. Fort Lyon Canal Co.*, 720 P.2d 138, 146-47 (Colo. 1986).

161. 195 Colo. 17, 575 P.2d 402 (1978).

supreme court made it explicit that decrees in circumstances like these may only be awarded in conjunction with an approved replacement plan: "Before being awarded such a decree, the applicant must submit a plan of augmentation for approval or show that he has joined an organization which has an approved plan of augmentation."¹⁶² The other two cases were in the Arkansas River basin and involved applications for conditional rights — one for storage and the other for a surface right.¹⁶³ In both cases the supreme court, noting the likelihood of injury because of the over-appropriated status of the Arkansas, required an approved augmentation plan.

B. Next Steps

Recognizing the importance of Colorado's tributary groundwater resources, the legislature and the courts have taken steps to permit their development and use. Curtailment of the groundwater pumping which had developed prior to the 1969 Act (hereinafter "pre-1969 act wells") has been avoided. Presumably all these pre-1969 act wells have now been adjudicated and are operating either under their own priority, if senior enough; as an alternate or changed point of diversion for a surface right; as part of a plan for augmentation; or under a substitute supply plan. By this very pragmatic measure, Colorado's efforts to integrate use of tributary groundwater have been successful.

Nevertheless, two fundamental and interrelated questions remain: first, have these wells been integrated on a rational basis that will ensure their future protection? and second, do the laws and practices applying to tributary groundwater encourage optimum use of the related surface and groundwater resource? The differences in the standards applying to tributary wells have been mentioned in connection with the South Platte case studies. GASP wells operate on a year-to-year basis under an informal approach which appears to be protected by their ability to supply as much as twenty percent replacement water. Injury is measured not by depletions but by the existence of a call. Groundwater Subdistrict wells have been operating on the basis of providing five percent replacement water. Fort Morgan wells provide replacement for all depletions. In addition, it appears that the pre-1969 act wells in the Arkansas Valley are only required to provide replacement water for pumping in excess of three days a week. Wells in the San Luis Valley apparently are completely unregulated.

162. *Id.* at 19, 575 P.2d at 403.

163. *Lionelle v. Southeastern Colo. Water Conservancy Dist.*, 676 P.2d 1162 (Colo. 1984) involved an application for a conditional water storage right in conjunction with a plan to enlarge an existing reservoir. *Southeastern Colo. Water Conservancy Dist. v. City of Florence*, 688 P.2d 715 (Colo. 1984) concerned an application for a conditional surface water right.

Of course, there are important differences among and even within basins which should be reflected in requirements attaching to groundwater use. Indeed, the 1969 Act specifically recognizes this fact and directs the state engineer, in developing rules and regulations, to be guided by the "[r]ecognition that each water basin is a separate entity, that aquifers are geologic entities and different aquifers possess different hydraulic characteristics even though such aquifers be on the same river in the same division, and that rules applicable to one type of aquifer need not apply to another type."¹⁶⁴ However, the differences now present do not reflect the kind of rational analysis suggested in this legislative directive. Rather, they reflect variations in the outcome of litigation and in the attitudes of water right holders in the basins.

The real objective of the 1969 Act was to allow the large number of irrigation wells already in existence to continue to operate so long as means could be found to protect senior surface rights. The state engineer actively encouraged cooperative efforts by well owners to protect senior rights. Emphasis was placed on call management — keeping those seniors most likely to complain about well usage happy by assuring adequate supplies through additional wells or other means. In the South Platte and Arkansas valleys this approach benefited from the transmountain water which, especially since the 1960s, substantially augmented native flows each year, thereby helping to reduce calls. Simplifying assumptions like the five percent replacement requirement were developed, based on a generalized analysis that reflected the increased surface flows from transmountain water and return flows from irrigation recharge of the alluvial aquifer. There appears to have been considerable ambivalence as to whether these associations of wells would have to obtain a court-approved plan for augmentation. During the period when the state engineer could approve temporary augmentation plans there probably was little difference. However, as the standard applying to court-approved augmentation plans became clearly established as requiring that depletions to the stream from out-of-priority well pumping be measured and fully offset by reliable replacement supplies, it was obvious that call management would not pass court muster. Consequently, there is now a clear dichotomy between state-engineer-approved substitute supply plans and court-approved plans for augmentation.

The incongruity of this approach is apparent in a place like Beebe Draw, a narrow valley with no natural surface flows, adjacent to the South Platte River downstream from Denver. There are wells operating in Beebe Draw under the GASP umbrella, and other wells operat-

164. COLO. REV. STAT. § 37-92-501(2)(a) (1973).

ing as part of Central's Groundwater Subdistrict.¹⁶⁵ Neither GASP nor Central replace water to the alluvial aquifer underlying Beebe Draw though, of course, they do provide replacement to the South Platte with which this alluvial aquifer is connected. Now the Farmers Reservoir and Irrigation Company (FRICO) is seeking court approval of an augmentation plan that would include additional well development in Beebe Draw. FRICO is being required not only to show that its recharge program will fully replace depletions to the South Platte, but also that the pumping from its new wells will not interfere with pumping from existing wells.

Perhaps the implicit rationale here is an assumption that, in general, pre-1969 act wells do not harm senior rights because they are drawing from the water stored over many years in the alluvial aquifer as a result of infiltration from irrigation, and because of the "extra" water available in the South Platte and Arkansas from transmountain diversions. The importance of these wells to the economies of these areas and the absence of any clear rules governing such groundwater development until 1969 argue strongly for making this implicit rationale explicit. Thus, as to wells installed prior to the 1969 act and decreed as required thereafter, the state engineer should be directed to develop rules of operation with clear standards by which evidence of no harm can be measured. He should be given considerable flexibility in the kinds of rules developed and clear authority to implement these rules. Conditions on the river and between aquifers can vary enormously so no single set of rules can be devised. The key to these rules is that they be able to provide a more rational basis for the operation of those wells that will provide greater certainty for them while assuring protection of senior rights. Legislative intent to accord great deference to the findings of the state engineer in establishing these rules should be clearly noted.¹⁶⁶ As to post-1969 act wells, it should be made clear that they must seek court approval as part of a plan for augmentation. Of course, owners of pre-1969 act wells wishing to follow this approach may do so as well. The use of recharge programs as a means of replacing depletions from new well pumping should be encouraged. Though not without its problems, recharge of the substantial alluvial aquifers found in Colorado offers considerable opportunities for fuller use of available water resources.

This leads directly to our second question concerning optimum

165. Interview with John P. Akolt, III, in Denver, Colorado (Apr. 26, 1988).

166. Clyde O. Martz has suggested a number of possible elements to such an approach. See *The Groundwater Resource*, in *WATER AND THE AMERICAN WEST* 99-101 (D. Getches ed. 1988) [hereinafter Martz].

conjunctive use. There are those who believe we are still underutilizing the tributary groundwater resource, in part because of overly restrictive regulations of its use.¹⁶⁷ Almost certainly if the surface and groundwater resources were managed in a more unified manner than under the existing highly fragmented system, overall use of the water resource could be substantially improved. This suggests the importance of moving in the direction of integrated management. The value of a basinwide perspective generally is appreciated.¹⁶⁸ At the same time, the difficulties with broad-based approaches are apparent.¹⁶⁹

The impetus to improve utilization of the interrelated surface and groundwater resource could come from several different directions. New users wanting to take additional water from the tributary aquifer have the most obvious interest in expanding the availability of that resource. In recent years the major source of demand probably has come from residential and commercial development outside existing water service areas. However, the quantities of water involved in such development are typically relatively small, and the cost of complying with the plan for augmentation requirements generally is a small part of the overall development costs. Conceivably, however, urban areas seeking more substantial quantities of water could initiate major recharge projects and other activities that would extend use of the total available resource. Such large-scale management programs may at some point prove more economic than other sources of raw water supply. If the economic picture for agriculture were to change, this sector could once again become a major source of new demand for water, thereby accelerating the need for better use of the resource.

Less positively, the impetus could come as a consequence of legal actions. One possible source of litigation is from those installing new wells who feel that the plan for augmentation requirements imposed on them are unfairly restrictive, especially in comparison with the requirements applying to wells operating under substitute supply plans. Another possible source of litigation is from junior appropriators faced with reduced surface supplies, either as a consequence of a drought or more extensive reuse of transmountain return flows. Interstate issues provide still another source of legal action. Litigation concerning the Rio Grande Compact focused attention on surface and groundwater

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167. See, e.g., Martz, *supra* note 166.

* 168. See, e.g., Colorado Water Resource Research Institute, VOLUNTARY BASINWIDE WATER MANAGEMENT — SOUTH PLATTE RIVER BASIN, COLORADO, Completion Report No. 133 (May 1987).

169. A Colorado statute authorizing river basin management authorities was repealed in 1987. COLO. REV. STAT. § 37-93-101 et seq. (1973), repealed 1987 Colo. Sess. Laws 1307, § 1.

development in the San Luis Valley.¹⁷⁰ Similarly, the action by Kansas against Colorado concerning the Arkansas River almost certainly will involve an evaluation of the ways in which use of surface and groundwater in Colorado affect the availability of water in Kansas. Water quality issues, especially those associated with control of nonpoint sources, represent another possible source of litigation that could motivate action in this area.¹⁷¹

As illustrated in the South Platte case studies, there are a number of activities already in use which serve to better manage the resource. These include the use of strategically located groundwater wells to supply certain senior surface water rights which may drive the system in an inefficient way, the purchase and lease of senior surface and storage rights which can be utilized to provide needed replacement water, and the development of recharge projects which can store unused flows of water at certain times and at locations that both resupply the aquifer and provide return flows to the stream at a later time when these flows are needed. The San Luis Valley litigation also highlights issues concerning existing diversion and irrigation practices. An inefficient means of diversion may not be legally protectable. Nor may inefficient irrigation practices.

Whatever approach is taken, the following set of general principles is offered for consideration:

1. The goal is optimum utilization of Colorado's related surface and groundwater resources;
2. Optimum use must be determined with full regard for "all significant factors, including environmental and economic concerns";¹⁷²
3. Vested rights are protected as to the duty of water, historically available at the time and place of need, and in the quality needed. Inefficient means of diversion and inefficient usage practices are not protected;
4. Groundwater use should be permitted to the fullest extent feasible, consonant with protection of preexisting rights;
5. Actual injury to existing rights from pre-1969 act wells must be found to exist as a matter of fact, not simply presumed because there are depletions and the river is "overappropriated"; and
6. Post 1969 act wells should be required to show no injury to

170. *Alamosa-La Jara Water Users Protection Ass'n v. Gould*, 674 P.2d 914 (Colo. 1983).

171. The 1987 Water Quality Act suggests that pollution from nonpoint sources will be receiving much closer scrutiny than in the past. See 33 U.S.C.A. § 1329 (West Supp. 1987) Pub. L. No. 100-4, 1987 U.S. Code Cong. & Admin. News (101 Stat.) 53.

172. *Alamosa-La Jara Water Users Ass'n v. Gould*, 674 P.2d 914, 935 (Colo. 1983).

existing rights either by replacing all depletions to the stream relied on by senior appropriators or through other means able to prevent injury.

In many respects, Colorado has been the leader among the western states in integrating use of tributary groundwater with surface water. Perhaps uniquely, Colorado has grasped the fact that the essence of the prior appropriation system is not simply priority but the protection of senior rights from injury. As our understanding of this fundamental concept develops, a logical outgrowth should be a management system for water enabling fuller, more effective use of our interrelated surface and groundwater resources.