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A COMPARISON OF STATE GROUNDWATER LAWS

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I. INTRODUCTION

Groundwater is estimated to constitute twenty-five percent of the nation's water use.¹ With the increasing demands being placed on public water suppliers under amendments to the Clean Water Act, it is expected that this reliance will increase. Additionally, groundwater provides the base flow of many surface stream regimes. Therefore, it is surprising that many states fail to regulate groundwater withdrawals, ignore the relationship to surface streams, or continue to apply a "reasonable use" standard² that neither quantifies water use, nor provides the security of quantification and priority to protect investments in groundwater production.³

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1. DAVID A. FRANCKO & ROBERT C. WETZEL, *TO QUENCH OUR THIRST: THE PRESENT AND FUTURE STATUS OF FRESHWATER RESOURCES OF THE UNITED STATES* 23 (1983) [hereinafter *QUENCH OUR THIRST*].

2. A reasonable use standard originated from the riparian doctrine governing surface water, which is applied primarily in the eastern United States. Under the riparian doctrine, legal rights to water are in ownership of land abutting a water course or overlying groundwater. All riparians share the right to make reasonable use of the water abutting or under their land. What constitutes reasonable use will vary in different states. Generally, a reasonable use standard creates uncertainty as to the extent of a water right because the amount and use of the water may vary depending on the landowner's needs. This water management method tends to impair planning and efficient use of water in areas with inadequate water supplies. GEORGE VRANESH, *COLORADO WATER LAW* 43 (1987).

3. In a state which itself fails to regulate all groundwater withdrawals, the California Supreme Court stated, "Uncertainty concerning the rights of water users has pernicious effects . . . it inhibits long range planning and investment. . . ." *In re Waters of Long Valley Creek Stream System*, 599 P.2d 656, 666 (Cal. 1979).

In order to illustrate the importance of state regulation of groundwater, this article provides a brief overview of groundwater law in four jurisdictions: Oklahoma, Arizona, California and Colorado. Colorado, having the most developed surface and groundwater legislation, is sometimes referred to as the "pure appropriation" state with free transferability of water rights, complete integration of surface and groundwater (despite the 100 year rule),⁴ and an active state water market and water transfer environment.⁵

Arizona applies the appropriation standard for surface water, has a complex groundwater permitting process within heavily used groundwater areas (Active Management Areas), and a reasonable use/riparian standard for groundwater withdrawals outside of active groundwater management areas.⁶ Moreover, the Arizona system is becoming increasingly restrictive on use and transfer of groundwater; not so much as a direct relationship to the physical condition of aquifers or the wisdom of their use, but as a sobering recognition of the pending repayment obligations of the Central Arizona Project ("CAP").⁷ Arizona now has a surplus of surface water through CAP at costs which are not always competitive with groundwater production. Therefore, there is a move in Arizona legislation to preclude groundwater use in favor of CAP use to fund CAP repayment obligations.

California has three different methods of allocating water resources: the appropriation and riparian doctrines and pueblo water rights (the latter being derived from Spanish rights).⁸ California has

4. In Colorado, nontributary groundwater is defined as groundwater located outside designated groundwater basins, the withdrawal of which will not, within 100 years, deplete the flow of any natural stream at an annual rate greater than one-tenth of one percent of the annual rate of withdrawal. COLO. REV. STAT. § 37-90-103(10.5) (1990).

5. COLO. REV. STAT. §§ 37-83-101 to -105 (1990).

6. Where the Arizona Groundwater Code does not apply Arizona common law of groundwater, reasonable use of groundwater applies. A landowner also owns the percolating groundwater beneath the land and has the right to put the water to reasonable and beneficial use on the land from which it is withdrawn. *Bristor v. Cheatham*, 255 P.2d 173 (Ariz. 1953).

7. The Central Arizona Project was designed to divert water from the Colorado River for agricultural use to population centers in Phoenix and Tuscon. Colorado River water is allocated based on the Colorado River Compact, the Upper Colorado River Compact and the Colorado River Basin Project Act, 43 U.S.C. §§ 1501-56 (1968). The Supreme Court decision in *Arizona v. California*, 373 U.S. 546 (1963), awarded Arizona 2.8 million acre feet annually from the Colorado River. Arizona could not physically divert and transport this water to Phoenix and Tuscon, where the water was needed most, without diversion structures.

8. For a discussion on California's use of the appropriation, riparian and pueblo water rights doctrines, see *infra* notes 142-43 and accompanying text.

no permitting requirements for groundwater except for waters identified as "subterranean streams,"⁹ adjudicated watersheds¹⁰ or designated groundwater basins.¹¹ The California system is also the leading jurisdiction in implementation of the public trust doctrine, and the jurisdiction from which Oklahoma appears to draw precedent.¹²

Oklahoma law applies the appropriation doctrine to groundwater that is tributary to a surface stream and applies a version of the riparian doctrine to groundwater that is "outside the cut bank of any definite stream."¹³ Recent amendments to Oklahoma groundwater laws have relaxed the definition of reasonable use of groundwater from a conservation approach to one of utilization of the groundwater resource.¹⁴ Under current law, use or non-use of groundwater neither increases nor decreases the proportionate share of groundwater available to a landowner. While the amount of groundwater available for withdrawal is based on hydrologic surveys of the basin, as well as the amount of land owned that overlies the basin, Oklahoma groundwater law does not recognize the hydrologic conditions that define the interconnection between ground and surface water.¹⁵

II. INTEGRATION OF GROUNDWATER AND SURFACE WATER

In order to fully appreciate the need for integration between groundwater and surface water, it is important to understand the nature of groundwater. Water that penetrates the earth's surface is characterized as groundwater. Groundwater may be pulled back to the surface by capillary action and evaporated, or may be absorbed by plant life and returned to the atmosphere by transpiration. Groundwater which is neither attracted to the surface by capillary action nor utilized in the transpiration process, and which percolates deep

9. Underflow and water in underground steams is appropriated like surface water. CAL. WATER CODE § 1200 (West 1971).

10. There are 450 mapped groundwater basins or watersheds in California. A number of these are adjudicated. An adjudication defines the priority of rights to use groundwater within a given basin. Groundwater rights are often initiated when there are insufficient groundwater supplies in a given basin leading to shortages and disputes over resource allocation. See *Wright v. Goleta Water Dist.*, 174 Cal. App. 3d 75 (1985).

11. CAL. WATER CODE § 1200 (West 1971).

12. *Franco-American Charolaise v. Oklahoma Water Resources Bd.*, 855 P.2d 568, 751 (Okla. 1990). Vice Chief Lavender provides an excellent dissenting opinion regarding Oklahoma's precedent gathered from the California Court. *Id.* at 583.

13. OKLA. STAT. tit. 82, § 1020.1 (Supp. 1993).

14. See *infra* pp. 129-30.

15. OKLA. STAT. tit. 82, § 1020.1 (Supp. 1993).

enough to reach a zone of saturation, provides a groundwater source for withdrawals.

Because groundwater is not seen, it has been treated with some suspicion and misunderstanding by physical scientists and legislators. Early English law, which is still applied in some jurisdictions, takes the position that groundwater flows in veins or underground streams which are distinctly separate from surface water.¹⁶ Actually, this is rarely the case. Groundwater is largely dictated by geology, thus, an understanding of geology and hydrogeology is fundamental to an understanding of the proper regulation of groundwater.

Groundwater occurs and is stored in voids or open spaces within rock materials. The ratio of the volume of open spaces to the total volume of rock is defined as porosity, which is a function of a rock's ability to absorb, hold and yield water. As pore space within rock declines, molecular attraction becomes more important since it provides a larger surface area to which water can adhere. Rock with sufficient void spaces, which allows water to move by gravity, is more permeable than rock which holds water merely by molecular attraction. Thus, groundwater movement is a function of permeability of the rock material, which is sometimes defined as the capacity of the medium to transmit water. When groundwater is not under pressure, either by artesian influence¹⁷ or other considerations, it is known as groundwater occurring in water table conditions.¹⁸ Under these conditions groundwater is usually recharged locally, more responsive to precipitation, and will often bear a greater immediate connection to surface stream regimes.

An obvious example of interconnection between groundwater and surface water occurs when a river or stream flows through water table conditions. If a stream is located below an adjacent water table, water will flow directly to the stream. The stream is sometimes referred to as a gaining stream (see Figure 1). Conversely, when a stream surface is above an adjacent water table, water may flow from the stream to the groundwater aquifer, and the stream will sometimes

16. LEONARD RICE & MICHAEL WHITE, *ENGINEERING ASPECTS OF WATER LAW* 17 (1987).

17. Artesian influence is the pressure found in a confined aquifer that is sufficient to support a flowing well. This term applies when the static water level in a well rises above where it was first encountered in the aquifer due to hydrostatic pressure.

18. Water table conditions in an aquifer define the upper limit of the completely saturated material in an aquifer.

be regarded as a losing stream (see Figure 1). Groundwater production from wells which are tributary to a losing stream can directly influence the rate at which water is lost from the surface stream. The same principle is found in a gaining stream, in which water is intercepted before reaching the stream, therefore impairing the stream's live flow. The condition becomes more complicated when the rate of production or delayed effect of production of groundwater withdrawals is measured in years rather than hours, weeks, or months.¹⁹

What constitutes a sufficient hydrologic connection between ground and surface water is largely determined by legislation in each state. For example, in Colorado all water is presumed to be tributary to a stream system.²⁰ In order to overcome this presumption, an applicant seeking to withdraw groundwater must demonstrate, by clear and convincing evidence, that water pumped from a well will not deplete the flow of a natural stream within 100 years of the time of pumping, to the extent of 0.1% of the annual rate allowed to be pumped.²¹

California has no statutory definition for empirically assessing whether groundwater is sufficiently connected to a surface stream. In Oklahoma, groundwater is defined as water under the surface (regardless of the geologic structure) that is outside the "cut bank of any definite stream."²² Such water is treated entirely separate from surface water. This definition, however, does not account for water outside the cut bank of a stream that is hydrologically connected to surface water (see Figure 2).

Arizona groundwater law defines groundwater as water under the surface (regardless of the geological structure) that is flowing outside of ascertainable beds and banks.²³ Subflow is a class of groundwater that is treated like surface water under Arizona's prior

19. Groundwater withdrawal that affects surface streams and that is measured in years creates uncertainty as to the timing and amount of the hydrologic effect of groundwater pumping on surface water flow.

20. COLO. REV. STAT. §§ 37-90-137(2), (3), 37-92-302(2) (1990); *Whitten v. Coit*, 385 P.2d 131 (Colo. 1963); *Comstock v. Ramsay*, 133 P. 1107 (Colo. 1913); *Three Bells Ranch Assocs. v. Cache La Poudre Water Users Ass'n*, 758 P.2d 164 (Colo. 1988).

21. COLO. REV. STAT. § 37-90-103(10.5) (1990) (enacted as part of Senate Bill 5 on June 6, 1985). See *Kuiper v. Lundvall*, 529 P.2d 1328 (Colo. 1974).

22. OKLA. STAT. tit. 82, § 1020.1(1) (Supp. 1993).

23. ARIZ. REV. STAT. ANN. § 45-101.5 (Supp. 1994).

appropriation system.²⁴ The test used to determine subflow was reaffirmed in *Gila River*.²⁵

This recent Arizona Supreme Court decision concerning the Gila River System overturned the 50%/90 day rule used to determine whether certain groundwater wells withdraw water (subflow) that is hydrologically connected to surface water.²⁶ The court instead affirmed the test articulated in *Southwest Cotton*, which was used to determine the connection between surface and groundwater.²⁷ The new test requires the Department of Water Resources to determine whether drawing off subsurface water tends to "diminish appreciably and directly" the flow of the surface stream.²⁸ The Court refused to redefine "subflow", leaving that task to the Legislature.

Thus, legislatures and courts have primarily defined the requisite interconnection between groundwater and surface water to allow the integration of withdrawal laws. The Oklahoma Supreme Court has recently reaffirmed the modified common law riparian doctrine of the "reasonable use" of a stream.²⁹ However, in addition to segregating groundwater withdrawals as being separate and distinct from surface water withdrawals, the court went on to hold that the Oklahoma Water Resources Board may disregard altogether the groundwater resources of an applicant for a surface withdrawal permit in assessing the applicant's need for water.³⁰ In *Franco-American*, the court stated that "[t]he Legislature's interpretation of Section 105.12(2) is consistent with state policy recognizing groundwater as a limited and dwindling supply which should not be depleted needlessly."³¹

This language would appear to indicate a belief and philosophy that groundwater is not, in fact, integrated or hydraulically connected

24. *In re* General Adjudication of All Rights to Use Water in the Gila River System, 857 P.2d 1236, 1247 (Ariz. 1993); Maricopa County Mun. Water Conservation Dist. No. One v. Southwest Cotton Co., 4 P.2d 369, 380 (Ariz. 1931).

25. *Gila River*, 857 P.2d at 1247.

26. Wells are determined to pump appropriable subflow if:

As to wells located in or close to that younger alluvium, the volume of stream depletion would reach 50% or more of the total volume pumped during one growing season for agricultural wells or during a typical cycle of pumpage for industrial, municipal, mining, or other uses, assuming in all instances and for all types of use that the period of withdrawal is equivalent to 90 days of continuous pumping for purposes of technical calculation.

Id. at 1239.

27. *Id.* at 1247.

28. *Id.*

29. *Franco-American Charolaise v. Oklahoma Water Resources Bd.*, 855 P.2d 568 (Okla. 1993).

30. *Id.* at 580.

31. *Id.*

with surface streams. Of course, this determination is based upon the specifics of the surface stream and groundwater aquifer in question. The language in the case is disturbing in that it appears to perpetuate the philosophy of the 1800s and early twentieth century that groundwater is somehow distinctly separate from surface watercourses.³²

III. SYNOPSIS OF GROUNDWATER LAW IN FOUR JURISDICTIONS

A. *Oklahoma Groundwater Law*

1. A Historical Summary of Oklahoma Groundwater Law

Oklahoma's groundwater laws have changed dramatically since 1949. The 1949 Oklahoma Groundwater Law had two central features. It adopted a conservation orientation that allowed withdrawal of the safe annual yield of a groundwater basin as measured by its average annual recharge³³ and it applied the appropriation doctrine to Oklahoma tributary groundwater sources.³⁴ However, a property owner owned the water flowing under its surface that did not form a definite stream.³⁵ Instead of the appropriation doctrine, a reasonable use standard was applied to groundwater that fit this definition.³⁶ The historical reasonable use standard required overlying landowners to use water only in association with reasonable uses on overlying lands.³⁷

Groundwater is defined in the Oklahoma statutes as "water under the surface of the earth, regardless of the geologic structure in which it is standing or moving, outside the cut bank of any definite stream."³⁸ Under this definition, a groundwater basin may lie under and within the cut bank of a definite stream, but not be hydrologically connected to it, while another basin may lie outside the cut bank of a

32. LEONARD RICE & MICHAEL WHITE, *ENGINEERING ASPECTS OF WATER LAW* 12-19 (1987).

33. 1949 Okla. Sess. Laws, tit. 82, ch. 11, §§ 2, 3, 7, 15 at 642-45.

34. 1949 Okla. Sess. Laws, tit. 82, ch. 11 §§ 5, 6, 13, at 642-45.

35. Groundwater not tributary to a stream was owned by the overlying landowner and was regulated by court-made law. OKLA. STAT. tit. 60, § 60 (1991); *See* *Canada v. City of Shawnee*, 64 P.2d 694 (Okla. 1937).

36. The 1961 amendments to the Groundwater Laws changed the definition of groundwater to remove the exclusion of water flowing in underground streams with ascertainable beds and banks; water moving in an alluvium changed from water available for public appropriation to groundwater available only to overlying landowners. OKLA. STAT. tit. 82, § 1200 (1991).

37. *See* *City of Shawnee*, 64 P.2d at 694; 1949 Oklahoma Groundwater Law, Okla. Stat. tit. 82, §§ 1001, 1002, 1005, 1006, 1013 (Supp. 1949) (repealed 1972); *See also* 1965 Okla. Sess. Laws § 471; 1967 Okla. Sess. Laws § 391 amendments.

38. OKLA. STAT. tit. 82, § 1020.1(1) (Supp. 1993).

definite stream yet be a major source of its water supply.³⁹ Thus, in Oklahoma, the law does not acknowledge a hydrologic interface between surface and groundwater resources unless the groundwater lies beneath "the cut bank" of a surface stream.⁴⁰

Oklahoma's Groundwater Law of 1972 altered the historical reasonable use standard for groundwater. The new groundwater policy of Oklahoma, as articulated in the 1972 Groundwater Law, is to *utilize* (as opposed to conserve) the groundwater resources of the state and provide reasonable regulations for the allocation of water for a reasonable use.⁴¹ Use or non-use of groundwater by one landowner neither decreases nor increases the proportionate share of groundwater available to another landowner.⁴² Contrary to the 1949 Groundwater Law, groundwater users may now take water even though it will result in depletion above the average annual rate of recharge.⁴³

2. Groundwater Allocation

At present, the amount of groundwater that can be allocated and authorized by permit is based on the amount of land owned or leased that overlies a groundwater basin and by the amount of groundwater available based on hydrologic surveys of the basin.⁴⁴ Hydrologic surveys of groundwater basins and subbasins determine appropriate restrictions on groundwater production.⁴⁵ Under this policy, the Water Resources Board must establish a maximum annual yield for basins or subbasins based on: (1) the total land area overlying the basin or subbasin; (2) the amount of water in storage in the basin or subbasin; (3) the rate of natural recharge and total discharge from the basin or subbasin; (4) transmissibility of the basin or subbasin; (5) the possibility of pollution from natural sources; and (6) a presumed minimum basin or subbasin life of twenty years.⁴⁶ Once hydrologic

39. Eric B. Jensen, *The Allocation of Percolating Water Under the Oklahoma Ground Water Law of 1972*, 14 TULSA L.J. 437, 445-46 (1979).

40. OKLA. STAT. tit. 82, § 1020.1(1) (Supp. 1993).

41. OKLA. STAT. tit. 82, § 1020.2 (1991).

42. Oklahoma Water Resources Bd. v. Texas County Irrigation and Water Resources Ass'n, 711 P.2d 38, 41-42 (Okla. 1984).

43. *Id.* at 42-43.

44. OKLA. STAT. tit. 82, §§ 1020.9, 1020.11(D) (Supp. 1993); Ricks Exploration Co. v. Oklahoma Water Resources Bd., 695 P.2d 498 (Okla. 1984). *See also* OKLA. STAT. tit. 82, § 1020.21 (1991) (stating a municipality has authority to regulate or permit drilling of wells within its corporate boundaries).

45. OKLA. STAT. tit. 82, § 1020.2 (1991).

46. OKLA. STAT. tit. 82, § 1020.5 (Supp. 1993).

surveys are completed, the Board makes a determination as to the maximum annual yield of water allocated to each acre of land overlying a basin or subbasin.⁴⁷ Overlying landowners and their lessees may be granted permits to withdraw a proportionate share of the maximum annual yield "equal to the percentage of land overlying the . . . groundwater basin or subbasin which he owns or leases."⁴⁸ Any landowner has a right to take groundwater from land owned by him for domestic use without a permit.⁴⁹ Further, wells for domestic use are not subjected to well spacing requirements, but owners may be sanctioned for water waste.⁵⁰ Permits are required for uses other than domestic uses before a landowner takes a proportionate share of groundwater from a basin.⁵¹ An application for a permit to remove groundwater can be approved if: (1) the applicant owns or leases the land; (2) the land owned or leased overlies the groundwater basin; (3) the proposed use of the groundwater is beneficial; and (4) no waste will occur as a result of the proposed use.⁵²

There are three types of groundwater permits issued by the Water Resources Board.⁵³ A regular permit requires an authorization to put groundwater to a beneficial use for other than domestic purposes.⁵⁴ The regular permit is granted only after completion of a hydrologic survey and determination of maximum annual yield of the basin.⁵⁵ Prior to completion of the hydrologic survey and determination of maximum annual yield, a landowner wishing to take water from a basin may only receive a temporary permit.⁵⁶ Under a temporary permit, the applicant is entitled to take water for a set term of years and may take two acre feet annually per overlying acre owned or leased unless neighboring landowners object.⁵⁷ In addition, overlying landowners must re-establish annually that the land owned or leased overlies the groundwater basin or subbasin, that the water is put to a

47. OKLA. STAT. tit. 82, § 1020.6 (Supp. 1993).

48. OKLA. STAT. tit. 82, § 1020.9 (Supp. 1993).

49. OKLA. STAT. tit. 82, § 1020.3 (1991).

50. *Id.*

51. OKLA. STAT. tit. 82, § 1020.15(1) (Supp. 1993).

52. OKLA. STAT. tit. 82, § 1020.9 (Supp. 1993); Oklahoma Water Resources Bd. v. Texas County Irrigation and Water Resources Ass'n, 711 P.2d 38, 47 (Okla. 1984) (stating waste means waste by depletion and waste by pollution); Lowery v. Hodges, 555 P.2d 1016 (Okla. 1976).

53. OKLA. STAT. tit. 82, § 1020.11(A) (Supp. 1993).

54. *Id.*

55. OKLA. STAT. tit. 82, § 1020.11(A) (Supp. 1993).

56. OKLA. STAT. tit. 82, § 1020.11(B) (Supp. 1993).

57. *Id.*

beneficial use, and that no waste will occur.⁵⁸ Failure to do so may result in cancellation of the permit. A special permit may be granted for quantities of water in excess of the amount allocated based on maximum annual yield of the groundwater basin or subbasin.⁵⁹

Any groundwater right may be terminated if the Board determines that the user is committing waste,⁶⁰ for example, by drilling a well and taking or using groundwater without a permit (except for domestic use).⁶¹ Other forms of waste include taking more groundwater than is authorized by permit, taking or using groundwater in a manner so that the water is lost for beneficial use, transporting or using (inefficiently) groundwater in such a manner so that there is excessive loss, and/or polluting groundwater within a basin or subbasin.⁶²

B. *Arizona Groundwater Law*

1. The Arizona Groundwater Management Act

Arizona groundwater law is set forth in the 1980 Arizona Groundwater Management Act (the AGMA).⁶³ The groundwater code states that it is the public policy of the state "to conserve, protect and allocate" the use of groundwater resources of the state and to provide for the comprehensive "management and regulation" of rights to use groundwater.⁶⁴ This declaration of policy evidences an intent to displace the previous common law basis of Arizona groundwater law with a system of statutory regulation. The 1980 Act replaced the traditional reasonable use doctrine that permitted virtually unlimited use of groundwater.⁶⁵ In 1992, the legislature substantially amended the 1980 Act to include statutes addressing groundwater transportation, improved access to renewable supplies for remote portions of Active Management Areas (AMAs),⁶⁶ aquifer recharge and recovery, and creation of new water districts.⁶⁷

58. *Oklahoma Water Resources Bd. v. Texas County Irrigation and Water Resources Ass'n*, 711 P.2d 38, 41-42 (Okla. 1984).

59. OKLA. STAT. tit. 82, § 1020.11(C) (Supp. 1993).

60. *Texas County*, 711 P.2d at 38; *Lowery v. Hodges*, 555 P.2d 1016 (Okla. 1976).

61. OKLA. STAT. tit. 82, § 1020.15(1) (Supp. 1993).

62. OKLA. STAT. tit. 82, § 1020.15 (Supp. 1993).

63. ARIZ. REV. STAT. ANN. §§ 45-401 to -704 (1994).

64. ARIZ. REV. STAT. ANN. § 45-401.B (1994).

65. *See supra* note 2.

66. An Active Management Area is a geographical area which has been designated as requiring active management of groundwater. ARIZ. REV. STAT. ANN. § 45-402.2 (1994).

67. *See* S. 1380, 40th Leg., 2d Sess. 1992; S. 1285, 40th Leg. 2d Sess. 1992 (codified at ARIZ. REV. STAT. ANN. §45 ch.2 (Supp. 1992)); The 1991 Groundwater Transportation Act, 1991 Ariz. Sess. Laws 212.

Water authorities were created to help achieve the safe yield and assured water supply goals in the AGMA.⁶⁸ For example, the Tucson Active Management Area Water Authority⁶⁹ has the power to construct, maintain and operate water augmentation projects.⁷⁰ It may enter into contracts to acquire, deliver, exchange, treat, store or recharge water with “operating units,” which are entities with whom the Authority has a contractual arrangement.⁷¹

The AGMA is divided into 15 articles. These articles cover administration, AMAs, groundwater rights and uses in general, grandfathered groundwater rights in AMAs, groundwater rights and uses within service areas, groundwater withdrawal permits, transportation and management of groundwater, etc. The groundwater code characterizes groundwater as “[w]ater under the surface of the earth regardless of the geologic structure in which it is standing or moving.”⁷² This definition excludes “water flowing in underground streams with ascertainable beds and banks.”⁷³ Surface water is defined as “waters of all sources flowing in streams, canyons, ravines or other natural channels or in definite underground channels . . . [that] belong to the public and are subject to appropriation and beneficial use”⁷⁴ Included in this definition is groundwater that is characterized as subflow.⁷⁵

2. Active Management Areas

The state groundwater code created AMAs and imposed significant restrictions and regulations on the use of groundwater within these areas.⁷⁶ However, even groundwater uses occurring outside of the AMAs are governed by the AGMA.⁷⁷ AMAs are geographical

68. ARIZ. REV. STAT. ANN. §§ 45-1901 to -2019 (1994).

69. *Id.*

70. ARIZ. REV. STAT. ANN. § 48-4853 (Supp. 1993-1994).

71. ARIZ. REV. STAT. ANN. §§ 45-1901.5, 48-4853, 48-4855 (Supp. 1993-1994).

72. ARIZ. REV. STAT. ANN. § 45-101.4 (1994).

73. *Id.*; See *Pima Farms Co. v. Proctor*, 245 P.2d 369 (Ariz. 1926).

74. ARIZ. REV. STAT. ANN. § 45-141.A (1994).

75. *In re* General Adjudication of All Rights to Use Water in the Gila River System, 857 P.2d 1236, 1247 (Ariz. 1993).

76. ARIZ. REV. STAT. ANN. §§ 45-561 to -578 (1994).

77. See, e.g., ARIZ. REV. STAT. ANN. § 45-453 (1994) (outside AMAs, a person may “withdraw and use groundwater for reasonable and beneficial use,” with certain exceptions). Arizona’s common law groundwater law will apply only where the Code does not. See, e.g., ARIZ. REV. STAT. ANN. § 45-451 (1994) (in an active management area a person may “[w]ithdraw and use groundwater only in accordance with articles 5 through 12 of this chapter.”); ARIZ. REV. STAT. ANN. § 45-452 (1994) (there shall be no new land irrigated with groundwater from AMAs).

areas which have been designated for active management of groundwater.⁷⁸ They tend to be regions of extensive groundwater use in highly populated areas. There were four initial AMAs when the Groundwater Management Act was passed in 1980.⁷⁹ These AMAs include Tucson, Phoenix, Prescott, and Pinal.⁸⁰

In the initial four AMAs, only land which is capable of being irrigated, which has not been retired from irrigation for a non-irrigation use and for which the irrigated grandfathered right has not been conveyed for a non-irrigation use, may be irrigated with any groundwater, effluent, diffused water on the surface or surface water.⁸¹ Technically, this prohibition does not apply to irrigation with surface water used pursuant to a decreed or appropriative right established before June 12, 1980.⁸² However, if such surface water is mixed with groundwater the entire water use is regulated.

Groundwater uses within AMAs are subject to further regulation in the management plans promulgated by the director of the Department pursuant to Article 9 of the Code.⁸³ Additional AMAs may be established at any time for any of the following reasons: preservation of existing groundwater supply for future needs, land subsidence, water quality degradation, or by petition/election.⁸⁴ Areas are managed to achieve specific goals set for each AMA.⁸⁵ For example, the management goal for the Tucson, Phoenix and Prescott AMAs is "safe yield."⁸⁶ "Safe yield" is a groundwater management goal that attempts "to achieve and thereafter maintain a long-term balance between the annual amount of groundwater withdrawn within an active management area and the annual amount of natural and artificial recharge in the active management area."⁸⁷ The management goal of the Pinal AMA is planned depletion—"to allow development of non-irrigation uses and to preserve existing agricultural economies in the AMA for as long as feasible, consistent with the necessity to preserve future water supplies for non-irrigation uses."⁸⁸

78. ARIZ. REV. STAT. ANN. § 45-402.2 (1994).

79. ARIZ. REV. STAT. ANN. § 45-411.A (1994).

80. *Id.*

81. ARIZ. REV. STAT. ANN. § 45-452.A (1994).

82. *Id.* For additional exceptions, see ARIZ. REV. STAT. ANN. §§ 45-452, 45-465.01, 45-465.02 (1994).

83. ARIZ. REV. STAT. ANN. §§ 45-561 to -581 (1994).

84. ARIZ. REV. STAT. ANN. §§ 45-412 to -415 (1994).

85. ARIZ. REV. STAT. ANN. § 45-562 (1994).

86. *Id.*

87. ARIZ. REV. STAT. ANN. § 45-561.8 (1994).

88. ARIZ. REV. STAT. ANN. § 45-562.B (1994).

The management goal for each AMA is achieved by individualized "management plans."⁸⁹ Such plans are divided into five year periods and are designed to achieve a reduction in groundwater withdrawals.⁹⁰ Management plans are mandatory and are enforceable against groundwater users.⁹¹ Such plans include conservation requirements, such as a duty of water requirement⁹² for agricultural sectors (which becomes more stringent with each successive management plan period).⁹³ In addition, municipal users are expected to achieve increasing reduction in per capita use.⁹⁴

No groundwater withdrawal or use is allowed in an AMA other than as provided by the Code.⁹⁵ The Code permits four methods of groundwater withdrawal within AMAs: withdrawals from exempt wells, grandfathered groundwater rights, withdrawals made pursuant to a permit, and withdrawals by cities, towns, private water companies or irrigation districts within their service areas.

The AGMA provides for exemptions of withdrawals from certain wells.⁹⁶ Exempt wells include: (1) withdrawal of groundwater for non-irrigation uses from wells having pumps with a capacity of 35 gallons per minute or less; (2) two or more wells used to serve the same non-irrigation use that do not exceed 56 acre-feet per year; (3) wells with 35 gallon per minute capacity or less drilled after April 28, 1983, for which notice of intention to drill was on file as of that date, and for withdrawals for non-irrigation uses other than domestic purposes or stock watering uses, not to exceed 10 acre-feet per year; and (4) withdrawal treatment and re-injection of groundwater that occur as part of and on the site of a Comprehensive Environmental Response Compensation Liability Act remedial action.⁹⁷

Certain groundwater withdrawals and uses in existence on the date of designation of an AMA are grandfathered rights.⁹⁸

89. ARIZ. REV. STAT. ANN. §§ 45-564 to -568 (1994).

90. ARIZ. REV. STAT. ANN. § 45-563 (1994).

91. ARIZ. REV. STAT. ANN. §§ 45-635 to -636 (1994).

92. The water duty is the quantity of water reasonably required to irrigate the crops historically grown in a farm unit and assumes conservation methods are being used. ARIZ. REV. STAT. ANN. § 45-564.A.1 (1994).

93. ARIZ. REV. STAT. ANN. §§ 45-564.A.1, 45-565.A.1, 45-566.A.1. (1994).

94. ARIZ. REV. STAT. ANN. §§ 45-564.A.2, 45-565.A.2, 45-566.A.2 (1994).

95. ARIZ. REV. STAT. ANN. § 45-451.A.1 (1994).

96. ARIZ. REV. STAT. ANN. § 45-454 (1994).

97. *Id.*

98. A grandfathered irrigation right, for example, allows all those already withdrawing groundwater for irrigation purposes, to continue the activity even if it would be illegal under a new law. ARIZ. REV. STAT. ANN. § 45-402.18 (1994).

Grandfathered rights include: irrigation rights, non-irrigation rights associated with retired irrigated lands, and non-irrigation rights not associated with retired irrigated land.⁹⁹ The irrigation grandfathered right is claimed by a person who owns land which was legally irrigated with groundwater during the five years preceding January 1, 1980, has the right to use groundwater for irrigation purposes based on a duty of water.¹⁰⁰ This right is appurtenant to each irrigated acre, and is owned by the owner of the land to which it is appurtenant, and may be leased along with the land for irrigation use.¹⁰¹

Non-irrigation grandfathered rights associated with retired irrigated land are appurtenant to lands which were retired from irrigation after January 1, 1965, but prior to the designation of the initial AMA, provided the land has been in the "same ownership" since it was retired and a development plan for the non-irrigation use existed at the time the land was retired.¹⁰² This right protects three acre feet per acre per annum.¹⁰³ Grandfathered rights not associated with retired irrigated lands may withdraw and use the maximum amount of groundwater that was withdrawn in any one of the five years preceding the date of the designation of an AMA.¹⁰⁴ This right may be leased but groundwater may be withdrawn only in the AMA for which the right was first issued.¹⁰⁵

The AGMA recognizes the following groundwater withdrawal permits: dewatering, industrial use, mineral extraction,¹⁰⁶ poor quality groundwater withdrawal,¹⁰⁷ temporary dewatering,¹⁰⁸ drainage, hydrological testing,¹⁰⁹ and groundwater replenishment district withdrawal.¹¹⁰ For example, dewatering permits are authorized where dewatering is necessary for the construction or structural integrity of improvements on the land from which the groundwater is to be withdrawn.¹¹¹ Industrial use permits may be issued only for withdrawals outside of the service area of a city, town or private water company.¹¹²

99. ARIZ. REV. STAT. ANN. § 45-462 (1994).

100. ARIZ. REV. STAT. ANN. §§ 45-402.21, 45-465.A, 45-465.B.3, 45-465.B.4 (1994).

101. ARIZ. REV. STAT. ANN. § 45-465 (1994).

102. ARIZ. REV. STAT. ANN. § 45-463.A (1994).

103. *Id.*

104. ARIZ. REV. STAT. ANN. § 45-464 (1994).

105. ARIZ. REV. STAT. ANN. § 45-464.G (1994).

106. ARIZ. REV. STAT. ANN. § 45-514 (1994).

107. ARIZ. REV. STAT. ANN. § 45-516 (1994).

108. ARIZ. REV. STAT. ANN. § 45-518 (1994).

109. ARIZ. REV. STAT. ANN. § 45-519.01 (1994).

110. ARIZ. REV. STAT. ANN. §§ 45-519.02, 45-520 (1994).

111. ARIZ. REV. STAT. ANN. § 45-513 (1994).

112. ARIZ. REV. STAT. ANN. § 45-515 (1994).

A permit must be issued if water sources are not available at certain designated costs.¹¹³

Service area withdrawal rights allow cities, towns, private water companies and irrigation districts to withdraw groundwater only under the service area withdrawal provisions of the Code.¹¹⁴ These entities are strictly limited in the types of groundwater withdrawals they may make.¹¹⁵ Cities, towns and private water companies have the right to withdraw and transport groundwater within their service areas for the benefit of landowners and residents in their service areas.¹¹⁶ A city, town or private water company cannot withdraw groundwater outside of its service area.¹¹⁷ Irrigation districts which were withdrawing, delivering and distributing groundwater as of January 1, 1977, have the right to continue doing so.¹¹⁸ Irrigation districts which were not withdrawing water on that date are limited to withdrawing groundwater for irrigation purposes only.¹¹⁹

3. Assured Water Supply

A fundamental concept of the AGMA is that of the "Assured Water Supply,"¹²⁰ which places limitations on the ability to subdivide land in the absence of an assured water supply.¹²¹ In an AMA, a person proposing to offer subdivided or un-subdivided land must obtain a Certificate of Assured Water Supply¹²² prior to presenting a plat for approval and filing a notice of intention to offer such lands with the real estate commissioner (except in service areas designated as having assured water supplies).¹²³ The certification of assured water supply

113. *Id.*

114. A "service area" is the area of land actually being served water for a non-irrigation use plus additions to such area which contain an operating distribution system used primarily for the delivery of water for a non-irrigation use. ARIZ. REV. STAT. ANN. § 45-402.26(a), (b) (1994).

115. ARIZ. REV. STAT. ANN. § 45-491 (1994).

116. ARIZ. REV. STAT. ANN. § 45-492 (1994).

117. ARIZ. REV. STAT. ANN. § 45-402.26 (1994).

118. ARIZ. REV. STAT. ANN. § 45-494 (1994).

119. ARIZ. REV. STAT. ANN. § 45-494.2.(d) (1994).

120. ARIZ. REV. STAT. ANN. § 45-576 (1994).

121. *Id.*

122. A certificate is granted if (1) sufficient groundwater, surface water, or effluent of adequate quality will be continuously available to satisfy the water needs of the proposed use for at least 100 years; (2) the projected groundwater use is consistent with the management plan and achievement goal for the active management area; (3) the financial capability has been demonstrated to construct the delivery system and any treatment works necessary to make the supply available. ARIZ. REV. STAT. ANN. § 45-576.L (1994).

123. *Id.*

depends partially on whether the particular district involved is a replenishment district.¹²⁴

In 1991, one year after the Arizona legislature authorized the creation of Augmentation Authorities,¹²⁵ it passed a bill authorizing the creation of a groundwater replenishment district in the Phoenix AMA.¹²⁶ Replenishment districts have the powers to develop, acquire, own, lease and operate all facilities and property necessary to store, augment, conserve, transport, treat, or replenish water for the benefit of district members.¹²⁷ The replenishment district may hold permits for groundwater recharge projects,¹²⁸ for aquifer replenishment,¹²⁹ or for groundwater storage and recovery.¹³⁰ The district may acquire and treat outflow from a sanitary wastewater treatment plant in order to add water to an aquifer, deliver water to district members, or exchange treated water for another source of water.¹³¹ It may also limit the amount of groundwater withdrawn by members and compute each member's replenishment obligation as reflected in each member's replenishment account.¹³² In cases within a replenishment district, groundwater supply is considered to be sufficient for the proposed use if the applicant's withdrawals over 100 years will be of adequate quality and, in combination with other withdrawals in the district, will not exceed a depth of 1000 feet or the bottom of the aquifer, whichever is less.¹³³

Assured Water Supply, in cases not involving a replenishment district, means that: (1) sufficient groundwater, surface water or effluent of adequate quality will be continuously available to satisfy the water needs of the proposed use for at least 100 years; (2) the proposed groundwater use must be consistent with AMA management

124. ARIZ. REV. STAT. ANN. § 45-576.L.1 (1994).

125. ARIZ. REV. STAT. ANN. §§ 45-1901 to 45-2019 (1994). Augmentation authorities were formed to develop a new institutional approach for dealing with the requirements of Arizona's groundwater code. A board of directors appointed by the governor formulates a plan of permanent operation which includes a water resources augmentation plan and identification of augmentation projects for specific management areas. ARIZ. REV. STAT. ANN. §§ 45-1906.13, 45-1907 (1994).

126. ARIZ. REV. STAT. ANN. § 48-4401 (Supp. 1993-1994).

127. ARIZ. REV. STAT. ANN. § 48-4462 (Supp. 1993-1994).

128. ARIZ. REV. STAT. ANN. § 45-652 (1994).

129. ARIZ. REV. STAT. ANN. § 45-672 (1994).

130. ARIZ. REV. STAT. ANN. § 45-804 (1994).

131. ARIZ. REV. STAT. ANN. § 48-4462 (Supp. 1993-1994).

132. ARIZ. REV. STAT. ANN. §§ 48-4463.B.3, 48-4464 (Supp. 1993-1994).

133. ARIZ. REV. STAT. ANN. § 45-576.M.1 (1994).

plans and goals; and (3) financial capability to construct necessary water systems must be demonstrated.¹³⁴

Other requirements to obtain a certificate of assured water supply include: availability of water, adequate water quality, adequate notice and hearing of proposed water supply, review of supply plan, and annual reports and payment of fees.¹³⁵

4. Transporting Groundwater

Regulations on transporting groundwater were enacted in the 1991 Groundwater Transportation Act (the GTA).¹³⁶ This Act came about because cities and speculators began transporting groundwater out of rural basins, subbasins and the Pinal AMA (not a safe yield basin) into other AMAs. The GTA severely limits groundwater transportation in several respects. For example, the Parker and Little Colorado River Plateau groundwater basins are closed to all new transportation of groundwater from those basins.¹³⁷ All transportation of groundwater, whether direct or indirect, from areas outside initial AMAs into the initial AMAs is prohibited.¹³⁸ The GTA imposes other limitations on permitted transportation and provides for the payment of a groundwater transportation fee for transportation out of the counties in which withdrawal occurs.¹³⁹

C. *California Groundwater Law*

1. Correlative Rights System

California does not have a comprehensive statewide groundwater management statute or program. Much of California's groundwater law has been developed by the judiciary and management policies regarding groundwater resources are devised as needed to resolve conflicts on a local or regional basis. The California legislature has not granted the State Water Control Board jurisdiction over groundwater,

134. ARIZ. REV. STAT. ANN. § 45-576.L. (1994).

135. See Assured and Adequate Water Supply Rules, Arizona Department of Water Resources, Aug. 4, 1994 (to be codified at R12-15-701 through R12-15-725). The proposed Assured and Adequate Water Supply Rules have been approved by the Governor's Regulatory Review Council, and are scheduled for public rule making hearings on September 6th (Tucson) and 7th (Phoenix), 1994.

136. The 1991 Groundwater Transportation Act, 1991 Ariz. Sess. Laws 967.

137. ARIZ. REV. STAT. ANN. § 45-544.B (1994). For exceptions see ARIZ. REV. STAT. ANN. §§ 45-544, 45-544.C.2. (1994).

138. ARIZ. REV. STAT. ANN. § 45-551.B (1994). For exceptions see ARIZ. REV. STAT. ANN. §§ 45-552 to -555 (1994).

139. ARIZ. REV. STAT. ANN. § 45-556 (1994).

even though groundwater may be interconnected with surface water. This is because groundwater is presumed to be percolating water or water not flowing in definite underground streams.¹⁴⁰

Water in subterranean streams flowing through known and definite channels is subject to appropriation.¹⁴¹ Groundwater is defined in California as water not flowing in known and definite channels. Groundwater not identified as flowing in definite streams is governed by the rules of reasonable use or overlying rights and appropriative rights under a correlative rights system.¹⁴² Water defined as surface or groundwater may also be subject to the Pueblo rights doctrine.¹⁴³

California courts rejected the common law rule that landowners own all groundwater beneath their land, and can use such water at their discretion.¹⁴⁴ Instead, owners of tracts that overlie a common supply of percolating water have correlative rights in the common supply. Under the generally accepted version of correlative rights doctrine, the rights of competing uses can be weighed and balanced to determine which uses are proper. The exercise of one's correlative

140. *Vineland Irrigation Dist. v. Azusa Irrigating Co.*, 58 P. 1057, 1059 (1899).

141. CAL. WATER CODE § 1200 (West 1971). California courts will use a correlative rights analysis when adjudicating competing rights to groundwater which may be both appropriated and used according to the riparian, reasonable use doctrine. *See City of Pasadena v. City of Alhambra*, 207 P.2d 17, 28-30 (1949).

142. Originally, groundwater rights were allocated based upon the common law concept that a property owner had an absolute right to use all the resources below the surface of his or her land. *Hanson v. McCue*, 42 Cal. 303, 309 (1871). The common law system was subsequently abandoned in favor of the more community oriented correlative rights system. *Katz v. Wilkinshaw*, 74 P. 766 (Cal. 1903) (restricting all groundwater withdrawals by landowners during times of water scarcity to a fair and just proportion of the supply). The doctrine of reasonable use is set forth in the California Constitution and limits a groundwater user to the amount of water reasonably needed for beneficial purposes. CAL. CONST. art. X, §2. Use of groundwater on non-overlying lands is subject to the appropriation doctrine. The requirements necessary to perfect an appropriative right include: (1) an intent to apply water to an existing or contemplated beneficial use; (2) an actual diversion from the water course; and (3) a diligence requirement or an application of water within a reasonable time. WELLS A. HUTCHINS, *THE CALIFORNIA LAW OF WATER RIGHTS* 40-67 (1956).

143. Pueblo water rights are derived from Spanish and Mexican law. In the 1848 Treaty of Guadalupe Hidalgo, between Mexico and the United States, the United States agreed to recognize pueblo water rights in assuming jurisdiction over former Mexican territories. The pueblo water right is the paramount right of the city, as successor to the pueblo, to use water occurring within old pueblo limits for the use of the city and its inhabitants. *See Los Angeles Farming & Millin Co. v. City of Los Angeles*, 217 U.S. 217 (1910); *Vernon Irrigation Co. v. City of Los Angeles*, 39 P. 762, 764-66 (Cal. 1895), *overruled on other grounds by Beckett v. Petaluma*, 153 P. 20 (1915); *City of Los Angeles v. City of San Fernando*, 537 P.2d 1250 (Cal. 1975).

144. *Katz v. Wilkinshaw*, 74 P. 766 (Cal. 1903).

right entitles a reasonable use of the water for the benefit of the overlying land.¹⁴⁵ Landowners must proportionally cut back groundwater withdrawals in times of shortage.¹⁴⁶

No permit is required for initiation and exercise of overlying rights to groundwater. Correlative rights to groundwater do not depend on use and such rights are not lost by nonuse.¹⁴⁷ In adjudicating competing claims to groundwater, a trial court cannot subordinate an unexercised overlying right to a present appropriative use.¹⁴⁸

Appropriative groundwater rights are analogous to appropriative rights to surface water (the right to take water in priority). Such a right is initiated by taking water from the basin and beneficially using it on non-overlying lands or for municipal service to overlying communities.¹⁴⁹ No permit is required for initiation and exercise of appropriative rights to groundwater.¹⁵⁰ However, it is possible to petition the Board of Water Resources for a statutory adjudication of a river system that includes groundwater supplies (not flowing through known and definite channels, but that nevertheless are hydraulically connected) within a determination of surface water rights.¹⁵¹

2. Groundwater Basin Management

There is no legislative guidance for groundwater basin management regimes. However, modern approaches to groundwater basin management focus on the combined purposes of managing water quantity and quality. Management of groundwater basins include adjudicated and unadjudicated basins.¹⁵² Adjudicated basins are managed by a court-appointed water master.¹⁵³ Unadjudicated basins are managed by special districts or under the authority of joint powers

145. *Id.*

146. *Tehachapi-Cummings County Water Dist. v. Armstrong*, 122 Cal. Rptr. 918, 924 (1975); *City of Pasadena v. City of Alhambra*, 207 P.2d 17, 28 (Cal. 1949).

147. *Wright v. Goleta Water Dist.*, 174 Cal. App. 3d 74 (1985).

148. *Id.*

149. *Tehachapi-Cummings County Water Dist. v. Armstrong*, 122 Cal. Rptr. 918 (1975).

150. There is no current monitoring or enforcement mechanism for groundwater withdrawals.

151. CAL. WATER CODE §§ 2500-2503 (West 1971 & Supp. 1994). Groundwater rights are not quantified unless the groundwater basin is adjudicated. Adjudication authority exists concurrently in state courts and the State Water Resources Control Board.

152. Local governments may create groundwater management plans in unadjudicated groundwater basins. CAL. WATER CODE §§ 10,750-10,755 (West 1992 & Supp. 1994). Local control may also be through water replenishment districts. CAL. WATER CODE §§ 60,000-60,449 (West 1966 & Supp. 1994).

153. CAL. WATER CODE §§4025-4032 (West 1971).

agreements.¹⁵⁴ Some goals of groundwater basin management include: conjunctive use of groundwater and surface water supplies, control of overdrafting, and protection of water quality from runoff, seawater intrusion and artificially introduced water supplies.

More than one agency may act to manage groundwater. Some of the institutional arrangements available include joint powers agencies, cooperative agreements among groundwater producers and overlying communities, special district acts, and court imposed solutions. Joint powers agencies can serve as water resources management agencies and as forums for dispute resolution.¹⁵⁵ For example, the Santa Ana Watershed Project Authority (SAWPA) exists to plan, finance, construct, and operate projects which relate to water quality and quantity management basin-wide.

Groundwater management districts are empowered by special district acts to regulate, by ordinance, the amount of groundwater that can be extracted and to limit its place of use. Local water user agencies may have similar powers, by ordinance or resolution, to manage and regulate groundwater withdrawals in certain basins subject to critical conditions of overdraft.¹⁵⁶

California courts have the authority to limit production of groundwater to protect supply and prevent onset of overdraft.¹⁵⁷ Courts may also quantify rights to extract water from a groundwater basin,¹⁵⁸ and may impose solutions for operation of specific groundwater basins through appointment of a watermaster. Court imposed solutions, however, have the drawback of being costly and difficult to change.

California's policy for the management of groundwater resources evidences an interest in the correction and prevention of irreparable damage to, or impaired use of, groundwater basins caused by critical conditions of overdraft, depletion, sea water intrusion or degraded water quality.¹⁵⁹ Furthermore, there is a legislative intent to vest in

154. CAL. GOV'T CODE §§ 6500, 10755.2, 35571 (West 1994).

155. CAL. GOV'T CODE § 6500 (West 1994).

156. For example, the Orange County Water District has been authorized by the legislature to manage groundwater use and storage. CAL. WATER CODE §§ 40-45 (West 1971 & Supp. 1994); SAN BERNARDINA COUNTY CODE §§ 33.0630-.0645 (Jan. 18, 1988).

157. *California Water Service Co. v. Edward Sidebotham & Son*, 37 Cal. Rptr. 1, 6 (1964).

158. *Wright v. Goleta Water Dist.*, 219 Cal. Rptr. 740, 753 (1985).

159. CAL. WATER CODE § 12922 (West 1992). There are 450 groundwater basins in California. The boundaries of these basins are defined in both geologic and political terms—there is no established rule.

the Water Resources Control Board expansive powers to safeguard the state's scarce water resources.¹⁶⁰

D. Colorado Groundwater Law

1. Tributary vs. Nontributary Groundwater

Colorado groundwater law is set forth in the 1965 Groundwater Management Act (the CGMA).¹⁶¹ The administration of groundwater in designated basins has been removed from the jurisdiction of the State Engineer and the Water Court to the Ground Water Commission.¹⁶² Groundwater is subject to designation if: (1) groundwater in its natural course would not be available to and required for the fulfillment of decreed surface rights and (2) it is not adjacent to a continuously flowing natural stream, wherein groundwater withdrawals have constituted the principal water usage for at least 15 years prior to the date of the first hearing on proposed designation of the basin, and which in both cases is within geographic boundaries of a designated groundwater basin.¹⁶³ Designated groundwater basins are legal-political boundaries and are not necessarily coincident with hydrologic boundaries. Upon designation of a basin, a water management district may be formed, well permits are required from the Commission, and all disputes are settled through the Commission first.¹⁶⁴

The Water Right Determination and Administration Act of 1969, which governs the administration of water rights and embodies the prior appropriation doctrine, declares it public 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 waters of the state.¹⁶⁵ State policy acknowledges that the future welfare of the people of the State of Colorado

160. *People v. Shirokow*, 605 P.2d 859 (Cal. 1980).

161. Currently codified as amended at COLO. REV. STAT. §§ 37-90-101 to -142 (1990 & Supp. 1993).

162. COLO. REV. STAT. § 37-90-103(6.5)(a) (1990); see *Hayes v. State*, 498 P.2d 1119 (Colo. 1972) (interpreting statute provision and upholding the designation of an area as a groundwater basin).

163. COLO. REV. STAT. § 37-90-103(6.5)(a) (1990).

164. COLO. REV. STAT. § 37-90-106 (1990). The Commission is normally entitled to decide first, before the water court, whether a particular well is pumping designated groundwater, so as to be within its jurisdiction, rather than non-designated groundwater, which is the jurisdiction of the State Engineer. See *State ex rel. Danielson v. Vickroy*, 627 P.2d 752 (Colo. 1983); *Pioneer Irrigation Dists. v. Danielson*, 658 P.2d 842 (Colo. 1983). But see *Ground Water Comm'n v. Shanks*, 658 P.2d 847 (Colo. 1983).

165. COLO. REV. STAT. §§ 37-92-101 to -602 (1990).

depends on a sound and flexible integrated use of all waters of the state.¹⁶⁶

Within the CGMA, a distinction is made between tributary and nontributary groundwater. Groundwater hydraulically connected to a natural stream is considered tributary and is administered as part of the stream system in accord with the laws of prior appropriation.¹⁶⁷ Groundwater not hydraulically connected to a natural stream is considered nontributary and is administered based on overlying land ownership.¹⁶⁸ Colorado groundwater law has also created designated groundwater basins which are administered on the basis of prior appropriation and modified to permit full economic development of the designated groundwater.¹⁶⁹ The various legal definitions for groundwater will be further elaborated on below.

Tributary groundwater is found in an "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."¹⁷⁰ Groundwater is considered legally tributary if it is non-designated and so situated that a pumped well will deplete the flow of a natural stream within 100 years of the time of pumping to the extent of one-tenth of one percent of the annual rate of withdrawal.¹⁷¹ There is a rebuttable presumption that all groundwater in Colorado is tributary.¹⁷²

Tributary groundwater is subject to the normal rules of the prior appropriation doctrine. The Colorado Constitution states that "the right to divert unappropriated waters of any natural stream to beneficial uses shall never be denied."¹⁷³ Priority of appropriation shall give the better right as between those using the water for the same purpose.

166. COLO. REV. STAT. § 37-92-102(1), (2) (1990).

167. The prior appropriation system is the establishment of a water right by the diversion and beneficial use of surface or groundwater. A court adjudication of the diversion and beneficial use of water establishes the priority date of the appropriation. COLO. REV. STAT. § 37-92-103(3)(a) (1990).

168. COLO. REV. STAT. §§ 37-90-103(10.5), 37-90-137(4) (1990); *See State v. Southwestern Colo. Water Conservation Bd.*, 594 P.2d 1294 (Colo. 1983).

169. COLO. REV. STAT. §§ 37-90-107 to -109; *State ex rel. Danielson v. Vickroy*, 627 P.2d 752 (Colo. 1981).

170. COLO. REV. STAT. § 37-92-103(11) (1990).

171. COLO. REV. STAT. § 37-90-103(10.5) (1990).

172. *See supra* note 20.

173. COLO. CONST. art. XVI, § 6 (1990).

Nontributary groundwater is water located outside designated groundwater basins, which is not hydrologically connected to "natural streams" according to the 100 year/.01% test described above.¹⁷⁴ The determination of whether groundwater is nontributary is based on aquifer conditions existing at the time of the permit application.¹⁷⁵ The doctrine of prior appropriation does not apply to nontributary groundwater.¹⁷⁶ Such water is allocated on the basis of ownership of overlying land.¹⁷⁷ The prior appropriation system has not been applied to the Dawson, Denver, Arapahoe, and Laramie-Fox Hills aquifers even if water is withdrawn from tributary portions of the aquifers.¹⁷⁸

2. Administration of Tributary & Nontributary Wells

The administration of tributary wells is integrated within the prior appropriation system, and such groundwater rights are given priorities along with surface diversions. Since May 17, 1965, no new wells can be constructed outside the boundaries of designated groundwater basins; nor can the supply of water from existing wells outside designated basins be increased or extended unless the user makes an application in writing to the State Engineer for a permit to construct and operate a well.¹⁷⁹ An application to construct a well must include aquifer location, use, quantity of water to be withdrawn, a finding of no material injury to other water users, and a finding that unappropriated water is available.¹⁸⁰ Evidence that water is placed to beneficial use or notice of well completion is required before expiration of the well construction permit and prior to operating the well.¹⁸¹

174. COLO. REV. STAT. § 37-90-103(10.5) (1990).

175. Except in recognition of the *de minimis* amount of water discharging from the Dawson, Denver, Arapahoe, and Laramie-Fox Hills aquifers into surface streams due to artesian pressure, it shall be assumed that the hydrostatic pressure level in each such aquifer has been lowered at least to the top of the aquifer. COLO. REV. STAT. § 37-90-103(10.5) (1990).

176. COLO. REV. STAT. § 37-92-305(11) (1990).

177. COLO. REV. STAT. § 37-90-137(4) (1990).

178. State Dept. of Natural Resources v. Southwestern Colo. Water Conservation Dist., 671 P.2d 1294 (Colo. 1983), *cert. denied*, 466 U.S. 944 (1984). The Colorado state legislature determined that the economic importance of the groundwater in these aquifers required a presumption that water table conditions exist in the basin. COLO. REV. STAT. § 37-90-103(10.5) (1990).

179. COLO. REV. STAT. § 37-90-137(1) (1990).

180. COLO. REV. STAT. § 37-90-137(1), (2) (1990); *see* Hall v. Kuiper, 510 P.2d 329 (Colo. 1973) (involving interpretation of "material injury" and "unappropriated water is available").

181. COLO. REV. STAT. § 37-90-137(3)(a)(I), (II) (1990) (requiring statement of beneficial use and well completion report); *see* Danielson v. Milne, 765 P.2d 572 (Colo. 1988) (actual beneficial use, rather than mere filing of statement of beneficial use, is the touchstone to perfecting a well permit).

Wells can be decreed for absolute or conditional water rights.¹⁸² However, since many streams in Colorado are over-appropriated, a majority of well permits cannot be issued unless the well is included in a plan for augmentation or other change of water right proceeding.¹⁸³ Under such plans, replacement water is made available to satisfy senior rights. Junior groundwater appropriators can be ordered to cease groundwater pumping, if necessary, to ensure a supply for senior surface rights.¹⁸⁴

Certain small-capacity wells are exempted from the Water Rights Determination and Administration Act and are allowed to pump without an augmentation plan, regardless of their priority.¹⁸⁵ The following types of wells are statutorily exempt:

1. Wells not exceeding fifteen gallons per minute of production and used for ordinary household purposes, fire protection, stockwatering (of domestic animals), and for the irrigation of not over one acre of home gardens and lawns, but not used for more than three single-family dwellings;¹⁸⁶
2. Wells not exceeding fifty gallons per minute which are in production as of May 22, 1971 and were and are used for the purposes listed above;¹⁸⁷ and
3. Wells not exceeding fifteen gallons per minute of production and used for drinking and sanitary facilities in individual commercial businesses, and wells used solely for fire-fighting purposes.¹⁸⁸

Exempt wells filed after May 8, 1972, require a permit from the State Engineer upon a finding of no material injury.¹⁸⁹ There is a presumption of no material injury for a well under (1) above if: (1) such a well is the only well on a residential site; (2) it will not be used for irrigation or will be the only well on a tract of land of thirty-five acres or more; (3) it will be used for the other purposes listed in (1) above; and (4) where the return flow from such uses is returned to the same stream in which the well is located.¹⁹⁰ Exempt wells must be for the

182. COLO. REV. STAT. § 37-90-137 (1990).

183. COLO. REV. STAT. § 37-92-302 (1990).

184. *See City of Colorado Springs v. Bender*, 366 P.2d 552 (Colo. 1961) (a senior well is entitled to have junior wells, withdrawing from the same aquifer, curtailed during times of shortage only if the senior diverter has made a reasonable means of effectuating his diversion).

185. COLO. REV. STAT. § 37-92-602 (1990).

186. COLO. REV. STAT. § 37-92-602(1)(b) (1990).

187. COLO. REV. STAT. § 37-92-602(1)(e) (1990).

188. COLO. REV. STAT. § 37-92-602(1)(c),(d) (1990).

189. COLO. REV. STAT. § 37-92-602(3)(b)(I) (1990).

190. COLO. REV. STAT. § 37-92-602(3)(b)(II)(a) (1990).

ultimate user (personal use); a developer cannot obtain exempt permits for a subdivision. Additionally, the cumulative effect of exempt permits may be considered and result in loss of an exemption.

Requirements for well permits for withdrawal of nontributary groundwater are the same as for well permits under the prior appropriation system except that: (1) the amount of such groundwater available for withdrawal is that quantity of water underlying the land owned by the applicant or underlying land owned by another (who has given proper consent); (2) material injury to vested nontributary groundwater rights are not deemed to result from the reduction of either hydrostatic pressure or water level in the aquifer; and (3) the annual amount of withdrawal allowed under a well permit may be determined by Court decree and may be adjusted to conform to actual aquifer characteristics.¹⁹¹ The test for the allowed average annual amount of groundwater withdrawal for all wells on overlying land cannot exceed one percent of the total amount of water recoverable from a specific aquifer.¹⁹²

III. RELATING THE LEGAL FRAMEWORK TO REALITY

The physical realities of groundwater must be carefully understood. Myths of separate subterranean streams, hidden veins of water and a failure to recognize the relationship between groundwater and surface stream regimes must be discarded before proper groundwater administration can occur. Simply stated, a system of laws that does not track physical science and actual groundwater conditions is doomed to failure or, worse, litigation and subsequent failure. To appreciate such statements, a summary of two actual case studies which were litigated in the Colorado integrated groundwater/surface water context will be helpful. Additionally, the standards found in segregated groundwater/surface water legal frameworks will be applied to the case studies. These two studies include two Applications for Approval of a Plan for Augmentation and Exchange.¹⁹³ These case studies help to explain modelled delayed groundwater impacts to surface streams and delayed irrigation return flows, respectively.

191. COLO. REV. STAT. § 37-90-137(4) (1990).

192. Statewide Nontributary Groundwater Rules, 2 COLO. CODE REGS. 402-7, Rule 8(A) (1986).

193. Application for Approval of Plan for Augmentation Including Exchange, Case No. 92CW179 (Water Div. No. 4, Apr. 15, 1994); Application for Change of Water Rights and Approval of Plan for Augmentation and Appropriate Exchange, Case No. 93CW326 (Water Div. No. 5, filed Dec. 31, 1993).

A. *Modelled Delayed Groundwater Impacts to Surface Streams*

Development of independent legal water supply plans is required where supplies for projects cannot readily be served from municipal or district service areas, or where water needs are for irrigation, mining or manufacturing demands and potable treated water deliveries are cost prohibitive. More often than not, such plans take the shape of physical water being provided through wells either due to proximity to surface streams or water quality considerations. Because wells are presumed to be tributary to surface stream regimes in Colorado,¹⁹⁴ (a fact, more often than not, clearly shown by empirical analysis),¹⁹⁵ water supply plans must be developed which reflect a hydrogeological connection between surface and groundwater. Methods to develop such supply plans are, therefore, designed to protect both surface water and groundwater supplies.

For example, in 1992, Colorado and California investors sought to develop a mixed residential, commercial and golf course development midway between Telluride and Montrose, Colorado.¹⁹⁶ The development was to consist of light commercial uses, a health club facility, a championship eighteen-hole golf course and approximately 427 single family and multi-family dwellings. For brevity, only the golf course water supply will be discussed herein.

The area in question is located on a high mesa with surface streams which were not perennial due to an extremely limited watershed. Along the valley floors on two sides were heavily over-appropriated and critically short watercourses known as Dallas Creek and the Uncompaghre River. Geological conditions showed limited groundwater potential above 400 feet with groundwater sources restricted to the Dakota Burro Canyon geological formation encountered between 400 and 750 feet. Below 1,100 feet were dipping sandstone formations, known as the Entrada, which no one had previously attempted to explore.

194. See *supra* note 20.

195. See *Danielson v. Castle Meadows Inc.*, 791 P.2d 1106 (Colo. 1990); *State Dept. of Natural Resources v. Southwestern Colo. Water Conservation Dist.*, 671 P.2d 1294 (Colo. 1983), *cert. denied*, 466 U.S. 944 (1984) (citing for analysis of stream systems and not for the case holding); *Kuiper v. Well Owners Conservation Ass'n*, 490 P.2d 268 (1971), *overruled by In re Protection of Water Rights for Both Surface and Underground Water in Rio Grande and Conejos River Basins*, 674 P.2d 914 (1983) (citing for analysis of stream systems and not for the case holding); *Colorado Statewide Nontributary Ground Water Rules*, 2 COLO. CODE REGS. §402-7 (1986).

196. Application for Approval of Plan for Augmentation Including Exchange, Case No. 92CW179 (Water Div. No. 4, Apr. 15, 1994).

All surface water sources were analyzed to determine if a cost effective source of water could be developed from surface water sources.¹⁹⁷ After careful analysis it was determined that groundwater withdrawals would have to be relied upon, in substantial part, for golf course supplies.¹⁹⁸ Nonetheless, significant political and environmental opposition was raised by landowners within a radius of approximately 10 miles which sought to oppose the development not only through political and land use forums, but in the Water Court arena as well. Geological conditions were mapped by geophysical monitoring, core drilling and investigation of available United States Geological Survey data.¹⁹⁹ Formations dipped from the southwest to the northeast in the general direction of a downstream Bureau of Reclamation Reservoir, known as Ridgeway Reservoir, located along the main-stream of the Uncompaghe River. Normally, dry ravines which accreted groundwater along their course flowed into Ridgeway Reservoir. Along two of these creeks (which generally flowed only during the spring-time or from limited spring-fed sources) were water rights which were senior to any water rights owned by the developers.²⁰⁰

Appropriations for new wells were sought in 1992 with an adjudication date also in that year,²⁰¹ therefore, the developer's wells were extremely junior in priority to other water rights (with an appropriation date senior to 1992). Since Colorado follows the law of prior appropriation, or is a "first-in-time, first-in-right" state,²⁰² it was expected that the wells would only be able to pump a few weeks per year. This was an unacceptable condition for the full year-dry year requirement necessary for installation and preservation of golf course landscaping. Additionally, since the wells were located (at the closest) approximately 6,300± feet from the intermittent creeks and approximately 16,500± feet from the Uncompaghe River to the north and

197. *Id.*

198. *Id.*

199. *Id.*

200. *Id.*

201. Generally, in Colorado, those water rights applications that are filed in water court in a given calendar year are junior to every water right filed for confirmation in the water court in previous calendar years. As between water rights decreed in the same calendar year, the date of initiation of appropriation—which is when an applicant develops both an intent to appropriate a water right to beneficial use and takes some open notorious step on the ground designed to evidence such intent to the world—determines the relative priority within a calendar year. COLO. REV. STAT. § 37-92-401(1)(b) (1990).

202. The prior appropriation system provides that the first person to take and to use water from a stream is entitled to continue his use in spite of any subsequent demand for water from that stream system.

7,000± feet to Dallas Creek to the south, groundwater modelling was developed using an accepted procedure known as the Glover Analytical Stream Depletion Model.²⁰³ This model takes into consideration saturated thickness, specific yield, transmissivity, permeability and pumping rates to determine groundwater movement and the delayed impacts of groundwater pumping on adjacent surface streams.²⁰⁴ While Dallas Creek was in close proximity to the south, the geological formations dipped from south to north with the water-bearing aquifer formations located above Dallas Creek in elevation. The Uncompaghre River lay down-gradient,²⁰⁵ and water produced from the wells would, over time, have an impact upon the Uncompaghre River.

The Glover model demonstrated that groundwater pumping would begin to have an impact on the Uncompaghre River in approximately five years from the commencement of pumping, and equilibrium would not be reached until years forty or forty-one. Hence, the wells could not be characterized as non-tributary in nature, and the Uncompaghre River had to be protected against depletions from the junior wells used for the golf course.²⁰⁶ Water rights were acquired at slightly above fair-market rates from Ridgeway Reservoir on the Uncompaghre River. Because the facility impounded water, water could later be released to match the time and amounts of depletion to the Uncompaghre River caused by groundwater pumping. Since groundwater pumping would occur primarily during the months of April through September for golf course irrigation (with no groundwater pumping during the winter), depletions were not uniform to the Uncompaghre River and hence, releases had to be tailored to match the actual depletive effect to the river over time. To complicate matters, one surface water right located on an intermittent stream (Fisher Creek) between the wells and the Uncompaghre River had to be mapped and modeled. Water rights had to be used for replacement to this senior surface water right. Geological and hydrological mapping was developed to show that the outcropping water accreting to the

203. Dewayne R. Schroeder, *Analytical Stream Depletion Model*, Groundwater Software Publication No. 1, Office of the State Engineer, Colorado Division of Water Resources, Sept. 1987.

204. *Id.*

205. The Uncompaghre River normally receives the benefit of groundwater flow because the water table is above the adjacent stream system.

206. COLO. REV. STAT. §37-90-103(10.5) (1990).

surface stream occurred above the point at which groundwater pumping impacted the intermittent stream, thus, showing no injury to that surface water right.

Had the above case study occurred within a segregated groundwater-surface water state, under a riparian reasonable use standard, it is highly doubtful that the water users on the Uncompaghe River and, in particular, the surface diversion on Fisher Creek, would have received any protection from the depletive effect of the wells which had been empirically demonstrated. Alternatively, if the development was required to demonstrate that the use was reasonable in relation to objecting domestic uses of other well owners in the area, there is a possibility that the use of water for a golf course amenity could be characterized as an unreasonable use in relation to competing domestic users. This may be the case despite the fact that steps could be taken to ensure that injury would not occur to those water users. One would hope, however, that even under the reasonable use standard for groundwater withdrawals, an analysis of the aquifer would have demonstrated that geological conditions resulted in no injury to other groundwater users.

B. *Delayed Irrigation Return Flows*

Another example of the direct relationship between surface and groundwater use is found in a concept known as delayed irrigation return flow.²⁰⁷ In the western United States, as well as portions of Oklahoma, irrigation is required for crop production. Irrigation can come either from groundwater withdrawals or surface water diversions. A common problem associated with changing uses from agricultural to domestic, commercial, municipal or industrial uses is that the application of water by an applicant for an irrigation use historically resulted in a given pattern of water use, diversions, time of depletions and location of return flows of water not completely consumed by the irrigation use. The new use caused by the retirement of irrigated land and development of other industries or uses (i.e., subdivisions, factories, cities) can result in a change of these historic patterns to the injury of surface or groundwater users. Without getting into the issues of delivery requirements or ownership of the water

207. Delayed irrigation return flow is applied irrigation water which is not consumptively used and which returns to a surface water or groundwater supply through seepage or other means at some later point in time.

right previously used for irrigation purposes, it is informative to track the hydrogeologic effect of retiring land from irrigation.²⁰⁸

While it is possible to limit irrigation by means of advanced sprinkler or drip irrigation methods so only a limited amount of water is consumed within the root zone or evaporation, nearly all irrigation anticipates that a portion of the water will be lost by evaporation, crop transpiration, and surface runoff. A portion of the water applied for irrigation will also escape the root zone by gravity and percolate to a groundwater table. If this groundwater table is hydraulically connected to a surface stream, cessation of that irrigation use may change, in location, time and/or quantity, water accruing to the surface stream.

If one represents a groundwater extractor down-gradient from the place where historic return flows began to accrue to the water table of a surface stream, or a surface water diverter downstream of the point at which return flows have historically accreted to the stream, the cessation of irrigation or change in irrigation practices can seriously affect the amount of water available to those users. Under an integrated water law theory of surface and groundwater, these points of diversion can be protected by the placement of administrative or judicial limitations on the ability to transfer or change water rights to other uses by requiring water to be replaced in time, location and quantity equal to the portion of applied irrigation water that can be characterized as irrigation return flow.²⁰⁹ Under a completely segregated groundwater legal system, the rules of capture or correlative rights would support the legal theory that the owners of the groundwater well or the surface diversion would be without protection from this alteration in the use of a surface water right.

C. *Conjunctive Use*

Finally, conjunctive use, or the coordinated management of ground and surface water, has elevated the issue of surface/groundwater integration to a position of importance. As reservoir construction becomes increasingly difficult due to funding options, environmental restraints and overlying land costs, more jurisdictions are acknowledging that the use of underground storage may be a viable, aesthetic, economical and environmentally conscious alternative.

208. See *Farmers High Line Canal Reservoir Co. v. Wolff*, 131 P. 291 (Colo. App. 1913); *Monte Vista Canal Co. v. Centennial Irrigation Ditch Co.*, 135 P. 981 (Colo. App. 1913); *City of Grand Junction v. Kannah Creek Water Users Ass'n*, 557 P.2d 1169, 1172 (Colo. 1976); *Rominiecki v. McIntire Livestock Corp.*, 633 P.2d 1064 (Colo. 1981).

209. See *supra* note 207.

The states of Colorado, California and Arizona support conjunctive water use within their legislative framework and/or by judicial decision, and have operating conjunctive use projects. Conjunctive use projects require an analysis of the geological and hydrological condition of the aquifer which is being recharged, the interconnection between that aquifer and surface streams, and water quality considerations.

Colorado supports conjunctive water use and aquifer recharge and storage as a matter of public policy.²¹⁰ However, there is no statutory law that specifically addresses aquifer storage and recovery. The Colorado State Engineer has devised procedures to manage artificial recharge of an aquifer by temporary permit.²¹¹ The permits require: (1) compliance with Colorado's Water Well Construction and Pump Installation rules;²¹² (2) groundwater withdrawal of recharged water into confined aquifers according to C.R.S. § 37-90-137(2); (3) water to be stored for up to five years; and (4) record keeping of amounts and rates of recharge and withdrawals.²¹³ The temporary permit is used essentially for withdrawal of recharged water. There is no state permit requirement for injection of recharge water into the aquifer. Injection of water into an aquifer requires a Federal Class V injection well permit, which primarily controls water quality.²¹⁴ Judicial confirmation of the recharge arrangement is recommended.

Aquifer recharge in California is managed locally and regionally by groundwater management agencies. Two landmark cases affirm a public entity's right to store water underground and to later recapture the stored water.²¹⁵ Both *Niles* and *San Fernando* established: (1) The right to store water in a natural underground basin without compensation to overlying landowners; (2) the right to protect the stored water from expropriation by others; (3) the right to recapture the stored

210. See COLO. CONST. ART. XVI § 6; COLO. REV. STAT. §§ 37-90-102, 37-92-102 (1990); See *City of Denver v. Consolidated Ditches*, 807 P.2d 23, 24 (Colo. 1991).

211. Permit for Well Change/Expansion of Use, No. 042138 (Mar., 1993) (Willows Water District); Permit for Well Change/Expansion of Use, No. 042137 (Mar., 1993) (Centennial ASR Project).

212. 2 COLO. CODE REGS. §402-2 (1988).

213. See *supra* note 211.

214. 40 C.F.R. §§ 144.24, 144.25 (1993). The Safe Drinking Water Act establishes national standards for drinking water quality and controls some aspects of waste disposal into groundwater aquifers through the Underground Injection Control Program (UIC). The UIC established well construction, operation, and reporting requirements.

215. *Alameda County Water Dist. v. Niles Sand and Gravel Co.*, 112 Cal. Rptr. 846 (1974), *cert. denied*, 419 U.S. 869 (1975); *City of Los Angeles v. City of San Fernando*, 537 P.2d 1250 (Cal. 1975).

water when it is needed; and (4) the public's priority to store water underground when there is a shortage of underground storage space.

Since enactment of the Arizona Groundwater Management Act, a number of statutes have been passed in Arizona that define and manage artificial aquifer recharge.²¹⁶ The statutes authorize the Director of the Water Resources Board to grant permits to operate aquifer recharge projects. These statutory sections, however, do not authorize the withdrawal of recharged water.²¹⁷ Permits are also available in Arizona for underground storage and recovery.²¹⁸ Such projects may be operated only if the applicant is technically and financially capable of operating the project; the applicant has a right to use the proposed water source; the project is hydrologically feasible; and the project will not cause unreasonable harm to land or water users in the area of hydrologic impact.²¹⁹ Water may be recovered from an underground storage and recovery project from wells located in the area of hydrologic impact.²²⁰ Alternatively, if the permittee is a city, town, private water company or irrigation district, water may also be recovered from outside the area of hydrologic impact but within its service area.²²¹ The Director of the Water Resources Board must establish a storage account for each underground storage and recovery project.²²² The storage account receives a credit for only the recoverable amount of water stored by the project during the calendar year.²²³

The Arizona legislature also enacted a measure authorizing indirect groundwater storage and recovery projects.²²⁴ Rather than pumping water out of the ground for direct use, a recharger may leave the water in the ground and displace their groundwater right with surface water that would not otherwise be used.²²⁵

IV. CONCLUSION

Jurisdictions which fail to recognize the direct interrelationship between surface and groundwater resources are only postponing the

216. ARIZ. REV. STAT. ANN. §§ 45-651 to -655 (1994).

217. ARIZ. REV. STAT. ANN. § 45-651.5 (1994).

218. ARIZ. REV. STAT. ANN. § 45-802.6 (1994).

219. ARIZ. REV. STAT. ANN. § 45-804.B (1994).

220. ARIZ. REV. STAT. ANN. § 45-807.A (1994).

221. *Id.*

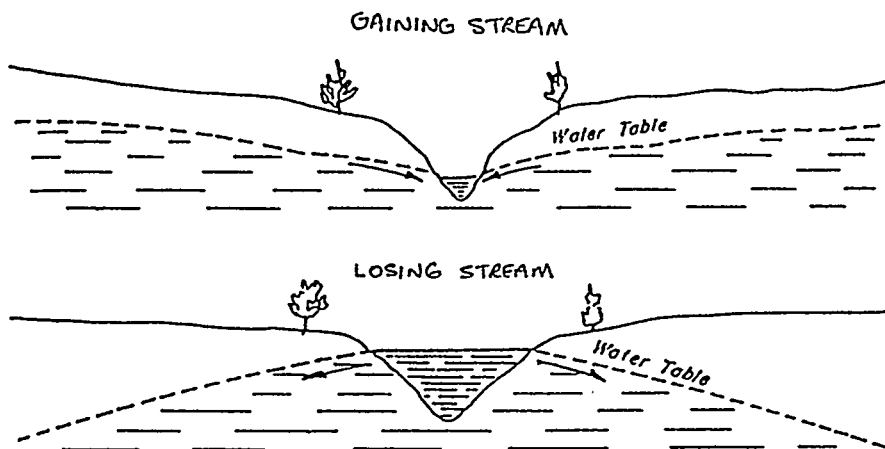
222. ARIZ. REV. STAT. ANN. § 45-809.A (1994).

223. ARIZ. REV. STAT. ANN. § 45-809.D (1994).

224. ARIZ. REV. STAT. ANN. §§ 45-851 to -867 (1994).

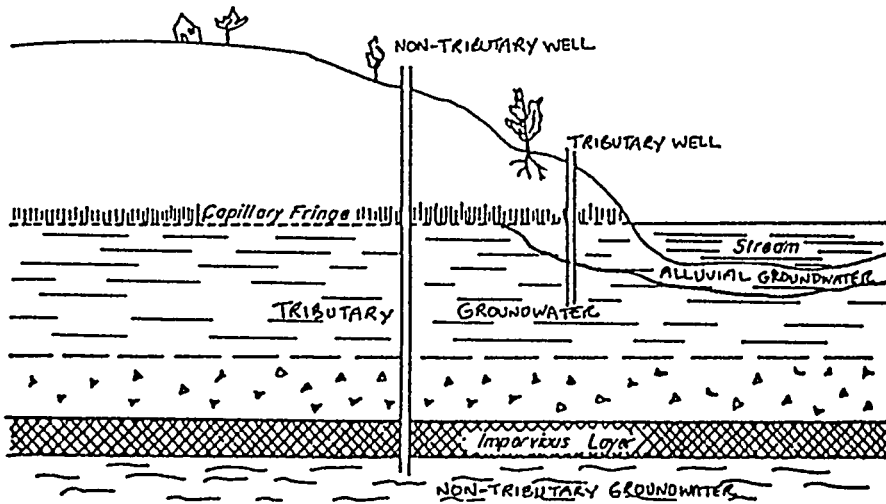
225. ARIZ. REV. STAT. ANN. §§ 45-851 to -851.4 (1994).

inevitable requirement to regulate the two sources as an integrated system. As reliance on groundwater resources increase, impact on surface water users will dictate an integrated regulatory framework.²²⁶ Such a regulatory framework must recognize that hydrogeologic conditions, rather than legal prose, define the level of integration.



“Figure 1. Water table conditions (below or above a stream) help determine the effect of groundwater pumping on a surface stream.”

226. See Kevin B. Pratt, *Kansas v. Colorado* Draft Decision, *Water/Environment Bulletin* (Feb. 17, 1994), in which post 1948 groundwater wells which historically depleted approximately 16,200 a.f. were factored into the Arkansas River Compact litigation as a deduct from the Colorado entitlement. Since depletions (consumptive use) represented about 17-20% of well pumping, this could have the effect of an annual debit to Colorado of 150,000 a.f. of well pumping.



“Figure 2. Water outside the ‘cut bank’ of a stream may, nevertheless, be hydrologically connected to the stream.”