WATER POLICIES THAT STOOD THE TEST OF TIME: A MATTER OF PERSPECTIVE

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ABSTRACT

This paper examines the effectiveness of several water policies in Kansas: 1) limiting appropriation of water to safe yield quantities (and a closely related policy of closing fully appropriated areas); 2) monitoring water use through metering points of diversion and requiring annual water use reporting; and 3) providing the opportunity to manage groundwater through Intensive Groundwater Use Control Areas, in which corrective controls can be tailored to address specific problems.

These policies were selected on the basis of their profound effects on water resource management; their adoption more than 10 years ago, which provides a suitable period of record to judge their performance; and the ability to assess their performance in quantifiable ways. (In addition, these policies are likely to be of interest to individuals attending an irrigation conference.) The policies were evaluated and deemed to have continued relevancy, a record of accomplishing their objectives, and public acceptance.

INTRODUCTION

The importance of water for all human endeavors and the natural world cannot be overstated. Since there are competing demands for finite water supplies, government policies are necessary to ensure fair allocation and protection of water resources.

Three principal water policies of the state of Kansas are examined in this paper, with the objective being to determine if the policies have “stood the test of time”, that is, if they have achieved their purposes and continue to be useful.

The following sections describe the methodology, analysis, and conclusions of this evaluation.

Disclaimer: The opinions and statements expressed in this paper are the personal opinions and statements of the author. Although informed by the author’s work for the Kansas Department of Agriculture’s Division of Water

Resources, the opinions and statements expressed herein do not necessarily reflect the agency's official policy or position on these issues.

METHODOLOGY

Scope of Examination

Merriam-Webster's Online Dictionary contains several definitions for the word "policy"; the meanings that appear to be most relevant to this discussion are:

> *2 a: a definite course or method of action selected from among alternatives and in light of given conditions to guide and determine present and future decisions;*
> *b: a high-level overall plan embracing the general goals and acceptable procedures especially of a governmental body*[1]

These definitions reflect the purposeful nature of policies. Water policies, then, are deliberate courses of action adopted by entities to achieve objectives involving water.

Entities establishing water policies range from the United Nations to sovereign nations, states, local governments, corporations, other organizations, and individuals. An example of federal water policy is EPA drinking water standards. An example of individual water policy is the decision to install low-flow fixtures in one's home (assuming it is optional and not mandated by government).

Water is a very broad subject. There are many different facets to consider, including supply and demands, quality, ecosystems, infrastructure, various uses, and so on. Due to the author's particular role in state government, this paper focuses on Kansas' water resources policies, that is, policies guiding the management of surface water and groundwater.

There is some debate over what constitutes an official policy, or when a policy must be followed. For example, some argue that policies set by an appointed body such as the Kansas Water Authority (KWA) do not have the same weight as statutes passed by the state Legislature, and as such are not mandatory. Others point to the makeup of KWA – which consists of voting members appointed by the Governor and Legislative leadership – and that its recommendations may effectively become law if/when the Legislature approves the State Water Plan budget, which is designed to implement KWA's policies.

This paper does not attempt to settle the aforementioned debate. Instead, it will focus on water policies implemented through state statutes, regulations, or

[1] http://www.merriam-webster.com/dictionary/policy

agency decisions under the statutes and regulations. Most people seem to accept these as enforceable water resources policy.[2]

Basis for Selection

Several criteria were used to select water resources policies for an examination as to whether they have "stood the test of time":

- First, the policies must have significant implications. It would not be worthwhile to spend time on trivial considerations.

- Second, the policies must have been in place for at least 10 years. Ten years may be the minimum span of time necessary to assess a water resource policy given the multi-year time frame ordinarily required for implementation and some noticeable response, and considering the normal variability in precipitation (i.e., 10 years is usually considered to be the minimum period of record needed to include representative wet, dry, and average years).

- Third, the policies must be measureable in some objective manner. Although it is beyond the scope of this paper to comprehensively quantify the effects of water policies, it is the author's intent to examine policies that have quantifiable effects.

The Kansas Water Appropriation Act (K.S.A. 82a-701 *et seq.*) and the Groundwater Management District Act (K.S.A. 82a-1020 through 1040) would seem to present the best opportunities to identify policies for this examination since as state laws governing water resources they unquestionably represent state water policy. Some of the policies established in these statutes (and their associated regulations) are listed below:

- Safe yield
- Ogallala mining
- Water conservation plans
- Waste of water
- Minimum desirable streamflow
- Well spacing
- Metering
- Water use reporting
- Water banking

[2] Article X in the Bill of Rights effectively grants states authority over management of water resources. According to the Tenth Amendment, since the U.S. Constitution does not ascribe that power to the federal government nor specifically withhold it from the states, it is delegated to the states (that is, the people). "*The powers not delegated to the United States by the Constitution, nor prohibited by it to the states, are reserved to the states respectively, or to the people". (Article X, Bill of Rights)*

- Intensive Groundwater Use Control Areas (IGUCAs)

Some policies established in other state laws, which seem to have objectives related to the above-listed policies, include the following:

- Grants for irrigation efficiency improvements
- Incentive payments for water right retirements
- Water marketing
- Water assurance districts

These lists are not intended to be exhaustive, and are just a selection of some of the more obvious choices for policies to examine.

Of the policies listed above, three were selected for further examination in this paper, for the reasons noted below:

1. Safe yield – This is a fundamental principle mentioned once in the Kansas Water Appropriation Act[3] and nearly 50 times in the associated rules and regulations.[4] *"'Safe yield' means the long-term sustainable yield of the source of supply, including hydraulically connected surface water or groundwater."*[5] For example, safe yield of an aquifer is typically regarded as the annual average recharge of the aquifer by the portion of precipitation that percolates into the ground and replenishes the aquifer. It has been a standard criterion in the issuance or dismissal of water appropriation applications since 1993, with some exceptions.[6] Some "Administrative Policies" which preceded the regulations required the application of safe yield principles in certain watersheds as early as 1983.[7] The policy of limiting appropriations to safe yield obviously has had profound effects on water resources in Kansas. One can estimate the quantitative and qualitative effects of this policy through analysis of water appropriation trends before and after the policy was adopted. One can also judge the effects of this policy by considering locations where a safe yield policy was not adopted in as timely a manner.

2. Metering/water use reporting – Measuring the amount of water used and reporting the amount of water used are closely related, and are therefore considered together in this paper. Both requirements are addressed in the

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[3] K.S.A. 82a-711(b): *"In ascertaining whether a proposed use will prejudicially and unreasonably affect the public interest, the chief engineer shall take into consideration...(2) the area, safe yield and recharge rate of the appropriate water supply."*
[4] K.A.R. 5-1-1 *et seq.*
[5] K.A.R. 5-1-1(ttt).
[6] Exceptions to safe yield include appropriations approved prior to adoption of safe yield policy; appropriations in some Groundwater Management Districts which use an allowable depletion approach; as well as domestic use, some temporary permits, and some term permits.
[7] Policies and Procedures of the Chief Engineer, Kansas Department of Agriculture, Division of Water Resources.

Kansas Water Appropriation Act[8] and the associated rules and regulations. These requirements date from 1957 (meters) and 1988 (water use reports), respectively. Without these tools, it would be much more difficult to effectively regulate and manage Kansas' water resources. As a result of its metering and water use reporting policy, Kansas is widely regarded as having very good water use data on which to base regulatory decisions. One can estimate the quantitative and qualitative outcomes of this policy by considering the impacts on water use when meters are installed, as well as the amount of water involved in enforcement activities that rely on data obtained through metering and water use reporting. One can also judge the effects of this policy by considering other states that do not have equivalent policies.

3. IGUCAs – In recent years, the chief engineer's authority to establish Intensive Groundwater Use Control Areas has come under increased scrutiny by stakeholders, agencies, and the state legislature. This apparently resulted from dissatisfaction with the Pawnee Valley IGUCA proceedings of 2007, although it may stem from a more general opposition to increased regulation of groundwater. In any case, the IGUCA authorities[9], which were added to the Groundwater Management Act in 1978, significantly increased the options for managing groundwater resources in Kansas. IGUCAs provide flexibility and the ability to tailor solutions to a wide variety of groundwater resource problems. One can estimate the quantitative and qualitative outcomes of this policy by considering the number of water rights curtailed by IGUCAs as compared with the number that would have been curtailed to achieve the same objectives (e.g., delivering water to a senior water right holder) if first in time, first in right administration under the Kansas Water Appropriation Act had been the only option. (The resource may also be better protected under an IGUCA than with priority administration; however, this paper will not analyze this hypothesis.) One can also judge the effects of this policy by considering other states that do not have equivalent policies.

Basis for Evaluation

Several criteria were used to evaluate whether the selected water resources policies have "stood the test of time":

- First, is the policy still relevant and still applied? It would not be worthwhile to examine antiquated laws which are no longer enforced.

- Second, does the policy accomplish its objectives? This presupposes a clear intent which, if not explicitly stated, should be readily apparent.

[8] Measuring water use: K.S.A. 82a-706c; reporting water use: K.S.A. 82a-732.
[9] K.S.A. 82a-1036 through 1040.

- Third, do a majority of people agree with the policy? This may be difficult to assess quantitatively without the benefit of a proper survey, but one can at least gauge public opinion based on comments from stakeholders and legislators.

An evaluation of the three selected policies is provided in the next section of this paper.

ANALYSIS

The following analysis of the three selected policies applies the metrics noted above under "Basis for Selection" and the criteria listed above under "Basis for Evaluation":

1. Safe yield – As illustrated in Figure 1 below, the number of water rights and the cumulative authorized quantity of water rights in Kansas grew exponentially from the mid-1940s through about 1980. From about 1980 through present the growth was linear, at a significantly slower rate.

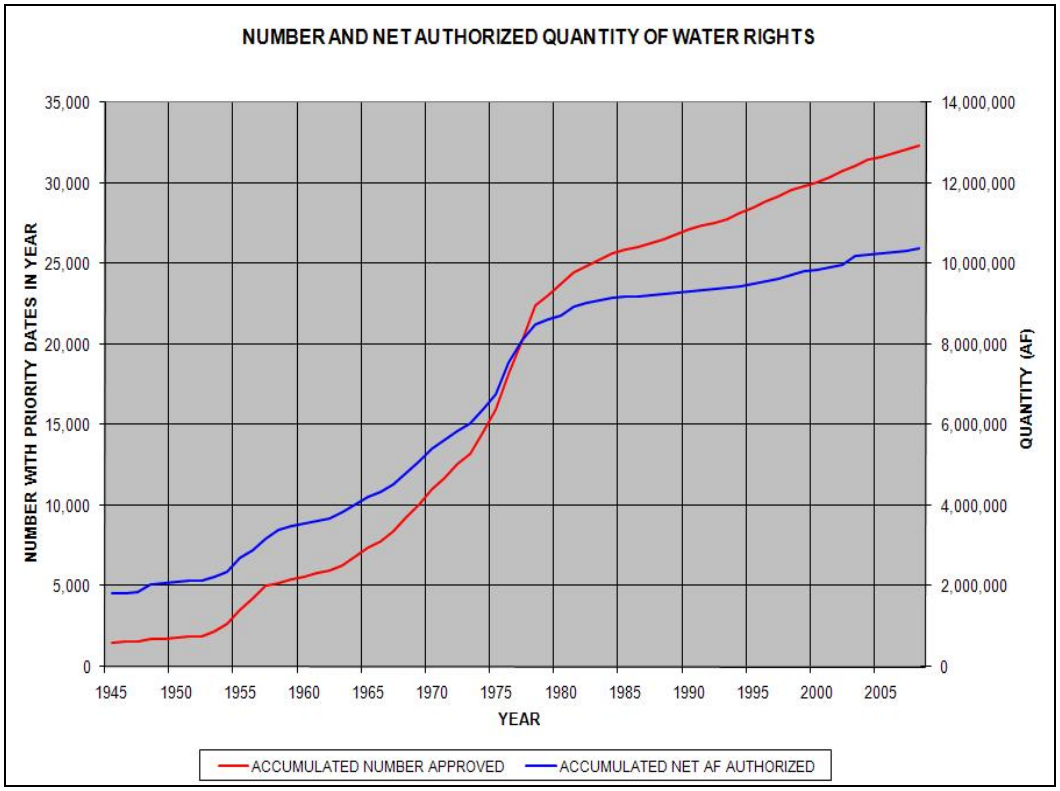
   There are several main reasons for the shape of the graph in Figure 1. Water rights that were developed prior to 1945, when the Kansas Water Appropriation Act was enacted, became "vested rights" with a priority date of June 28, 1945. The increasing use of irrigation systems during the 1950s-1970s fueled much of the growth in water use, as did population growth and industry to lesser extents. In 1978, the Kansas Water Appropriation Act was amended making it mandatory for individuals to apply for water appropriation permits, whereas previously it had been optional. And in the early 1980s, the chief engineer began closing some areas of the state to new appropriation and establishing safe yield requirements for areas still open to appropriation (with some exceptions previously noted).

   Since the decelerated growth of the volume of appropriated water in the 1980s was due both to closing areas to new appropriations and limiting appropriations to safe yield quantities, it is difficult to quantify the amount of deceleration attributable to safe yield – at least, based solely on the information in Figure 1. Based on the fact that most "closed" areas were locations where the majority of water right development and water use occurred (Ogallala-High Plains aquifer and alluvial valleys), it may be that closing areas to new appropriations had the greater effect on reducing the rate of water appropriation.

   However, in a way the closing of these areas was akin to implementing a safe-yield policy, since either approach is grounded in the recognition of a finite resource and would have the effect of eliminating most additional appropriations of water in fully developed areas. From Figure 1, it

appears that the cumulative total authorized quantity of water rights would have been at least double its present value if the growth rate of the mid-to-late 1970s were linearly extrapolated, that is, if the safe yield/closure policy had not been applied when it was.

Figure 1: Historical Development of Water Rights in Kansas



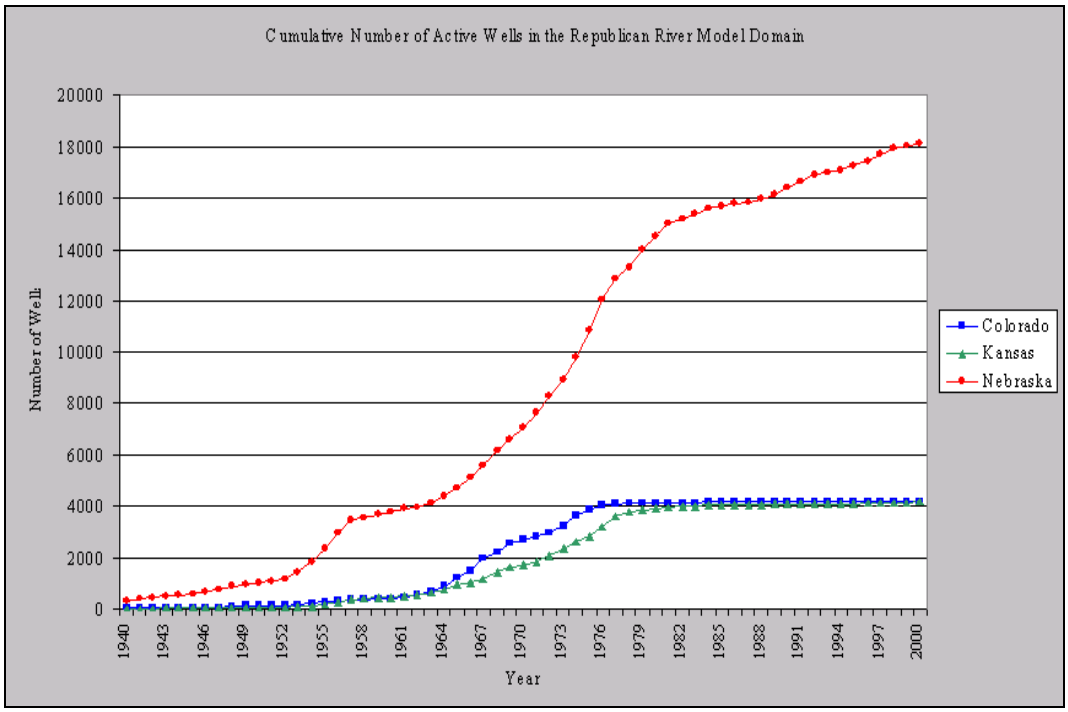
(Source: Kansas Department of Agriculture, Water Rights Information System Database, 2008)

Obviously, there is a finite amount of renewable water supply in Kansas. If safe yield (and its relative, closing over-appropriated areas) had not been implemented, and had water appropriation continued to grow at 1970s rates, it is probable that groundwater declines and streamflow depletions would have accelerated and the adverse impacts on vested/senior water rights and the public interest would be substantially greater than they are today.

A striking example of what could have happened in Kansas is the growth of wells in Nebraska's Republican River Basin long after Kansas and Colorado closed areas to new appropriation and established safe yield requirements. As shown in Figure 2 below, approximately 4,000 additional wells (a 30% increase) were installed in Nebraska's portion of the basin after 1980, whereas the number of wells leveled out in the other states' portions of the basin. A consequence of this continued development of the water resource is that Nebraska has been unable or

unwilling to comply with the Republican River Compact, which may end up costing the state tens of millions of dollars in litigation, restitution and penalties as well as significant challenges in curtailing groundwater use to achieve compact compliance in the future.

Figure 2: Historical Development of Wells in the Republican River Basin



(Source: Kansas Department of Agriculture, 2008)

Clearly, Kansas' safe yield policy and its closely-related closure of over-appropriated areas have had profound effects on the management of water resources. This policy is still relevant and applied today.

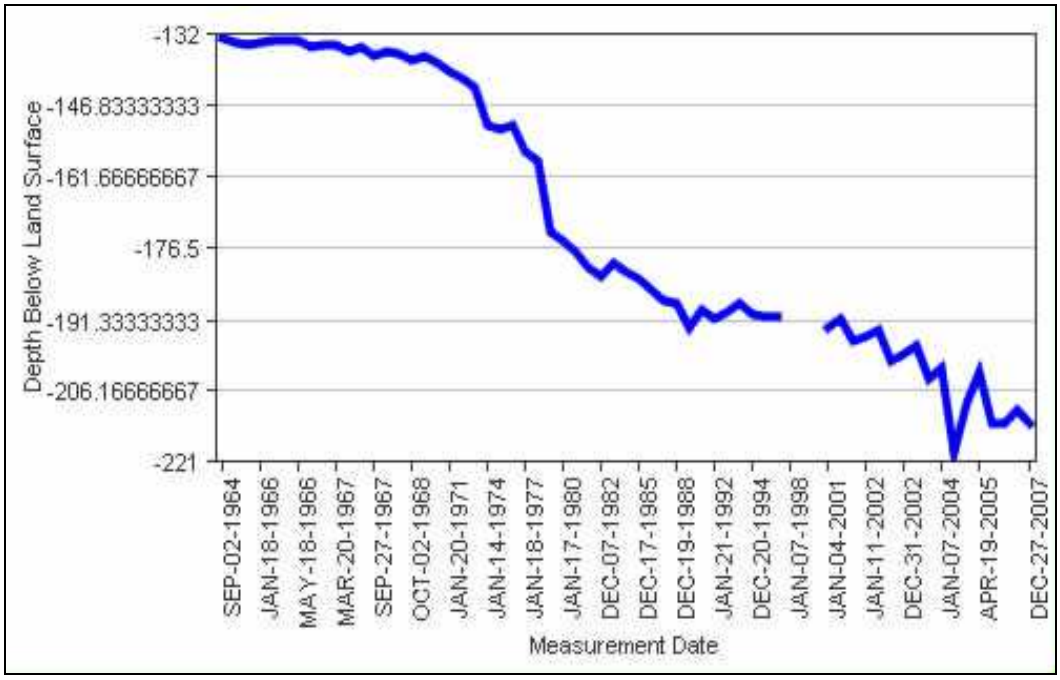
The intent of the policy, based on the statutory and regulatory language, is presumed to be preventing over-appropriation of water resources. Stated another way, in the classical mass balance equation inflows minus outflows equals change in storage; the intent of the safe yield policy is to have long-term average inflows equal outflows (including pumping) so that the long-term average change in storage is negligible.

Based on streamflow records and groundwater measurements exhibiting stable water supplies, it appears that the safe-yield policy has been successful in accomplishing this objective in areas of the state where it was applied before over-appropriation occurred. In other areas that were closed to new appropriation of water, the policy has not reversed the trend of groundwater declines or streamflow depletions but has apparently kept

the rate of declines from accelerating further and in some cases has led to decreasing rates of decline.

Figure 3 below shows an example of this. Rates of groundwater decline accelerated dramatically during the period of heavy development during the late 1960s and 1970s, and then became more gradual in the 1980s and subsequent decades. The well hydrograph illustrated in Figure 3 is in a high-decline area of Sheridan County.

Figure 3: Groundwater Level Changes in a High Plains Aquifer Well (Well No. 392210100384601, Sheridan County)



(Source: Kansas Geological Survey, WIZARD Water Well Database, 2009)

It should be noted that while this well exhibits the expected trends as previously described, hydrographs from other wells in the same area show different trends over time – from a uniform rate of decline over the period of record to increasing rates of decline through present or in some cases increasing water levels. This underscores an important fact that the Ogallala-High Plains aquifer is not homogeneous – local conditions can vary considerably.

The data presented above suggest that the safe yield/closure policy has been effective in accomplishing its objectives of balancing supply and demand, or avoiding increases in imbalances that may have prefigured the policy in some areas of the state.

Based on anecdotal evidence many stakeholders, organizations, officials and legislators agree with the safe yield/closure policy as evidenced in comments at meetings and hearings and the lack of any noticeable effort to repeal the policy. It is generally considered a fair and prudent policy for stewardship of the resource and protection of existing water rights.

However, there are examples of some discontent with the policy. For instance, Big Bend Groundwater Management District No. 5 has indicated that it wants to review whether some areas of the district could be opened to new appropriations. A hydrologic model is being developed that will help answer this question. This may not reflect disagreement with the safe yield policy per se, so much as a desire to revisit previous decisions applying the policy using more comprehensive data and analytical tools available today.

Another example involves water appropriation applications filed before certain townships in Southwest Kansas Groundwater Management District No. 3 were closed to new appropriation. In a number of cases the chief engineer has ruled that the applications cannot be approved on the basis of allowable appropriation specified in the regulations at the time of filing, or that the additional appropriations would impair existing water rights. These considerations are corollaries to safe yield. Some of the applicants appealed these rulings, signifying that at some level they disagree with the safe yield policy although ostensibly the appeal may be based on questioning the specific facts and analyses.

2. Metering/water use reporting – Studies have confirmed an intuitive outcome – the accuracy of water use reporting increases when meters are installed. This came about because the requirement to report water use in many cases pre-dated the requirement to install meters, although the authority to require meters pre-dated the requirement for water use reporting (see citations under Basis for Selection, item 2).
Typically, meter requirements have been imposed for various areas through orders of the chief engineer or through permit conditions. In fact, this process is still ongoing today. Most of the water rights in the western half of Kansas are fully metered, and meter requirements for the eastern half continue to be issued.

   Since the majority of water use in Kansas (about 85%) is for irrigation, and the majority of irrigation occurs in the western half of Kansas, most water use in Kansas is already metered. In addition, most of the large municipal and industrial uses in eastern Kansas are already metered for other reasons even if the chief engineer has not ordered it.

   The most common method for estimating water use without a meter is to track the hours of pumping and multiply it by the pumping rate. However,

the hours and rate method was shown to significantly underestimate or overestimate the actual amount of water pumped for irrigation, in some cases by as much as 30%.[10]

Meters and water use reports are essential for accurate enforcement of water rights, management of the state's water resources, interstate compact compliance, and other purposes. In 2008, the Kansas Department of Agriculture performed thousands of compliance inspections for a number of reasons including to determine if authorized points of diversion were acceptably metered and to ascertain whether water use was within the authorized quantities. A total of 65 civil penalty orders were issued for over-pumping and meter violations. As part of the civil penalties, these water rights were assessed reductions in their 2009 authorized use totaling nearly 2,000 acre-feet. These penalties will be enforceable in part because of the meters installed on these points of diversion. (Faulty meters identified in the compliance checks will be repaired or replaced with acceptable meter installations.)

A 2008 preliminary analysis indicated that it would cost approximately $376,000 per year to monitor consumptive use of water on irrigated farmland in Kansas using Landsat thermal imagery.[11] Based on a 2005 cost estimate, the Kansas Department of Agriculture's water use monitoring program – which relies on meters or estimation methods, annual water use reports, compliance inspections and enforcement – costs the state about $170,000 per year, less than half the cost of the alternative method.

Not only is Kansas' water metering/water use reporting policy cost effective, it is widely recognized as a model for other states. Time and again Kansas water resources officials have heard from their counterparts in other states about their desire to have a water use monitoring program as efficient and effective as Kansas'. The author has heard similar statements from U.S. Geological Survey staff, which compiles water use data from all 50 states in a national report.[12] They have to estimate water use in states that do not collect this data as Kansas does, and even in states that collect water use data it is often not as comprehensive and useful as Kansas'.

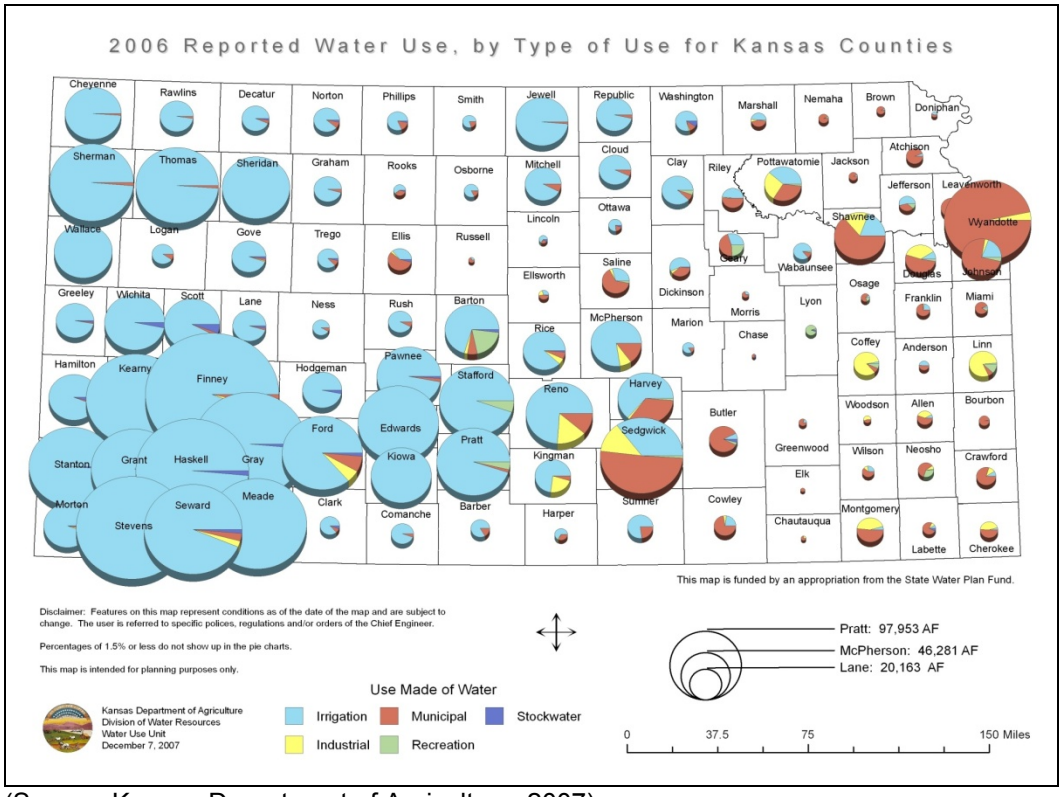
In 2007, the Western States Water Council asked member states (the 18 states from North Dakota to Texas and westward) to complete a survey of

[10] *1997 Kansas Irrigation Water Use*; Kansas Water Office and Kansas Department of Agriculture; pp. 45-47 and Table 16.
[11] "Cost Estimate for Monitoring Consumptive Use of Water from Irrigation Wells in Kansas"; Idaho Department of Water Resources (May 9, 2008).
[12] *Estimated Use of Water in the United States in 2000*, U.S. Geological Survey Circular 1268 (2004). According to USGS' website their 2005 water use report is due to be issued in 2009.

their water supplies and demands. Several states were unable to provide meaningful responses because they do not collect this type of information. Kansas was able to provide detailed information in response to the survey.

Figure 4 below illustrates the type of data available to the state for water resource management as a result of metering and water use reporting.

Figure 4: Reported Water Use by County and Type of Use, 2006



(Source: Kansas Department of Agriculture, 2007)

Attached in Appendix A is Kansas' response to a 2008 survey from the Western States Water Council on methods and costs to monitor water use from irrigation wells. This provides additional details on Kansas' water use monitoring program and puts in perspective the magnitude and importance of the data collected. Also, the data provided in the survey response may be of interest to attendees at this conference.

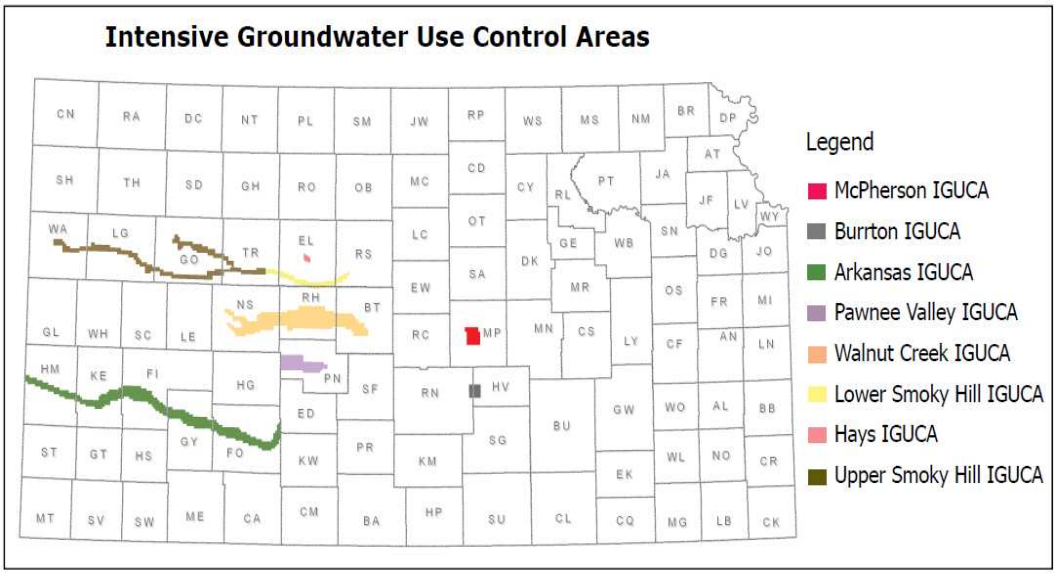
Besides the benefits to state and federal agencies charged with managing water resources, the Kansas policy on monitoring water use also directly benefits water users by enabling them to actively manage their own water use and avoid violations. In some cases, irrigators and other users have installed sophisticated equipment to remotely monitor their use and make adjustments in real-time from their office computers in response to

changing weather conditions, changing demands, and coordination of multiple irrigation systems and water rights.

Kansas' water use monitoring policy remains a viable and necessary practice that accomplishes the state's objectives including water right compliance and enforcement, water resource management, interstate compact compliance, and other purposes. While some individual water right holders or groups might object to the costs of metering and water use reporting, by and large there is round support for this policy due to the recognition that without this data the state's efforts to manage our precious water resources, including administration of the Kansas Water Appropriation Act, would be severely impeded.

3. IGUCAs – Eight intensive groundwater use control areas (IGUCAs) have been established in Kansas and are still in effect. These are shown on Figure 5 below.

Figure 5: Intensive Groundwater Use Control Areas in Kansas



(Source: Kansas Department of Agriculture, 2009)

These IGUCAs were established for a number of reasons including groundwater declines, deteriorating groundwater quality, and other public interest issues. IGUCAs are designed to address a variety of groundwater problems with customized solutions. An example of a specific solution is the City of Hays IGUCA which requires city residents with domestic water wells to comply with the city's summer lawn watering ordinance in order to avoid waste of water.

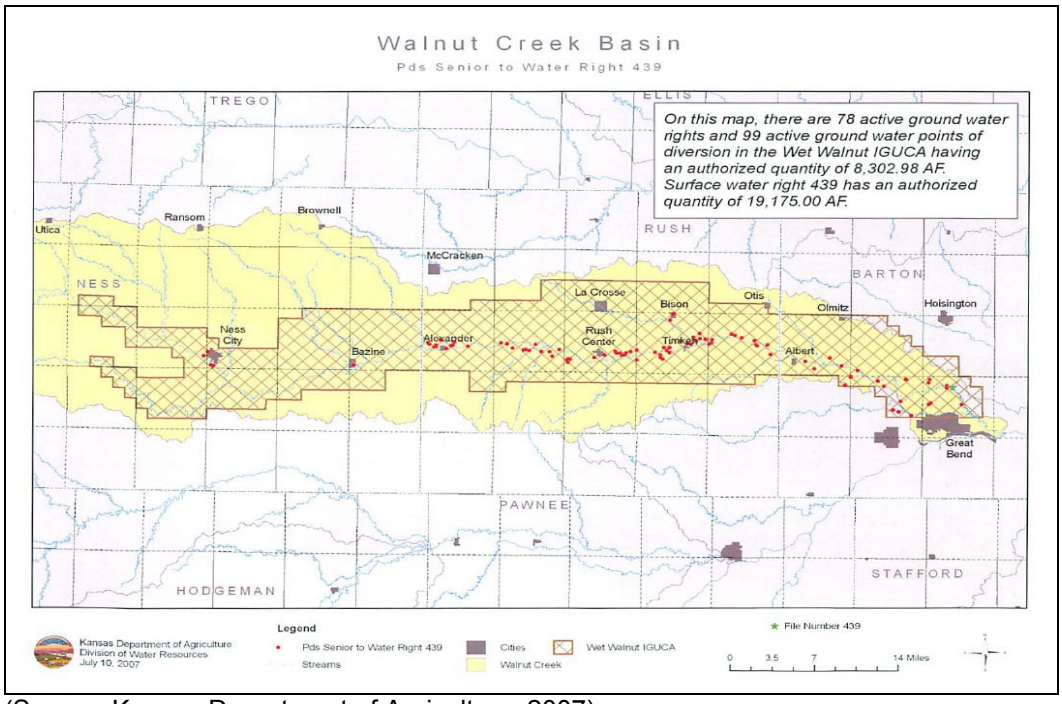
Two examples vividly illustrate the benefits of IGUCAs: the Walnut Creek IGUCA in Kansas, and by contrast a case in Colorado, which lacks

IGUCA-type authority and flexibility, where the curtailment of irrigation under priority administration of water rights over a large area had devastating effects.

One of the main impetuses for initiation of the Walnut Creek IGUCA was the possibility of a call for administration of water rights by the Kansas Department of Wildlife and Parks in the event their early water right for Cheyenne Bottoms would become impaired. (Cheyenne Bottoms is a wetland wildlife refuge that is a major stopover for migratory birds and an important recreational attraction for Kansas.) Figure 6 below illustrates this scenario. In concept, 78 groundwater rights (17% of total) senior to the Cheyenne Bottoms surface water right would not be curtailed; conversely, 389 groundwater rights (83% of total) could be curtailed in this scenario – with presumably disastrous effects on the local economy and livelihood of the agricultural community.

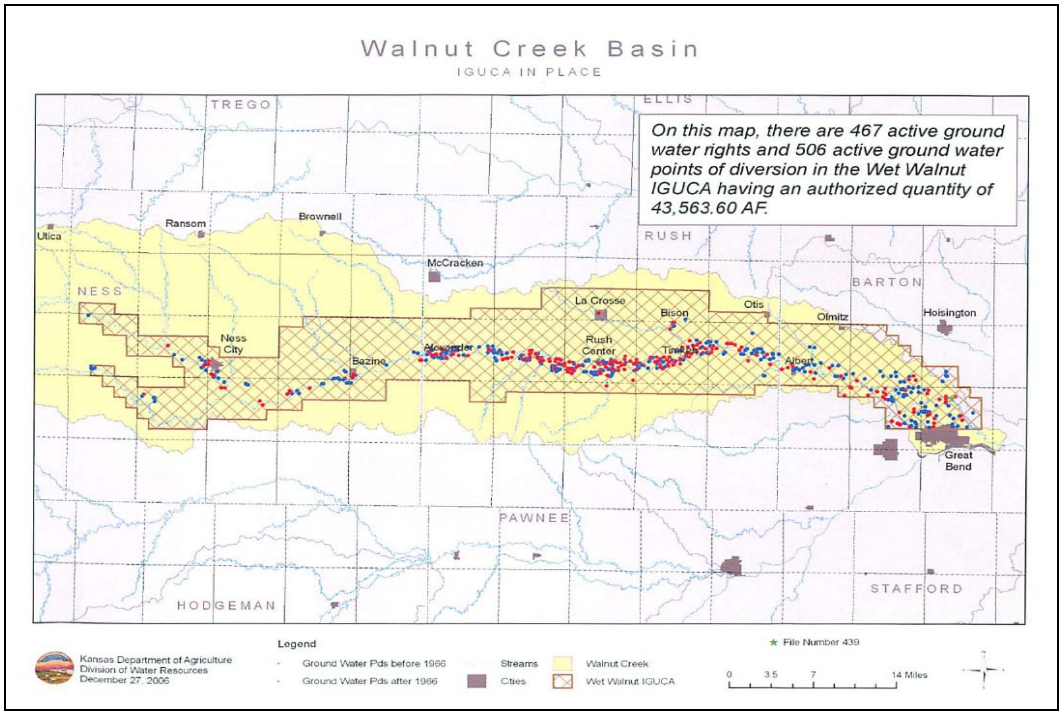
Among the principle findings in the Walnut Creek IGUCA hearing was quantification of the long-term sustainable yield of the basin as 22,700 acre-feet of groundwater. Rights developed before the date when 22,700 acre-feet of water was appropriated in the basin were considered “senior rights” while those that were developed after that date were defined to be “junior rights”. The corrective controls apportioned 22,700 acre-feet among the existing groundwater rights: vested rights were allotted their full authorized quantities; senior rights were allotted reasonable use (12 inches to 14 inches per year for irrigation rights); and junior rights were allotted 44% of the senior right allocations (5.25 inches to 6.25 inches for irrigation rights). Five year allocations were developed so that junior irrigators could meet reasonable needs at least two or three out of five years. While this approach resulted in partial curtailment of many water rights in the basin, remarkably it allowed all water rights to continue operating. Figure 7 below illustrates this scenario.

Figure 6: Active Water Rights Under Hypothetical Water Right Administration by Priority



(Source: Kansas Department of Agriculture, 2007)

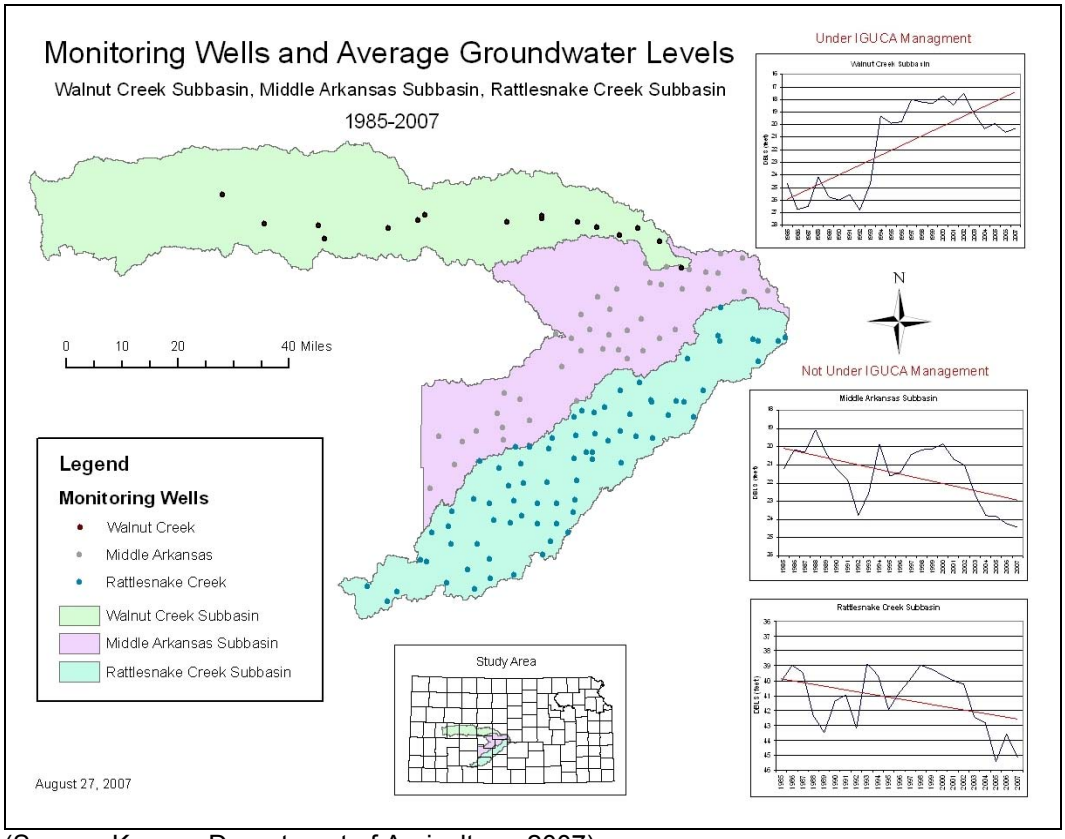
Figure 7: Active Water Rights Under IGUCA Corrective Control Provisions



(Source: Kansas Department of Agriculture, 2006)

Over the years since the Walnut Creek IGUCA was established, groundwater levels have risen with an overall trend of about one foot per three years. This represents a return to a hydrologic system with a reasonable balance between recharge and withdrawals. Water users can rely on the long-term sustainability of the aquifer because rising groundwater levels in wetter years will offset declining water levels in drier years. Surface water users dependent upon discharge from the aquifer to the stream again have a relatively reliable source from which to exercise their rights. Figure 8 below contrasts the Walnut Creek basin with two neighboring basins that continue to exhibit long-term declining groundwater trends.

Figure 8: Groundwater Trends in Three Basins



(Source: Kansas Department of Agriculture, 2007)

A recent situation in Colorado underscores the value of IGUCAs. In May 2006, Colorado ordered more than 400 irrigation wells shut down to protect senior water rights on the South Platte River. This affected 200 farms that had already planted crops. Farmers estimated their potential losses in the hundreds of thousands of dollars. Also shut down were two drinking water wells for a trailer park with about 300 residents.[13] A

[13] "Farmers Sweat Lack of Water"; Rocky Mountain News (May 10, 2006).

newspaper article included in Appendix B of this paper provides more details about this curtailment of water rights and its adverse effects.

In 2008, the Kansas Department of Agriculture conducted an informal survey of western states to determine which ones have authorities for groundwater management tools similar to IGUCAs. Of the 18 western states (not including Hawaii), 10 have authorities for groundwater management options similar to IGUCAs in varying degrees.

Colorado is one of the 10 states that have authority for special management of groundwater areas, called Designated Ground Water Basins. However, it appears that Colorado's rules for Designated Ground Water Basins focus on aspects such as allowable appropriation, metering and operating plans, and apparently do not provide the flexibility for creative solutions such as IGUCAs in Kansas.[14] Hence, Colorado seems to have no other option than administration (curtailment) of junior water rights in times of shortage.

Kansas' IGUCA policy continues to serve as a viable tool for implementing groundwater management strategies tailored to address specific problems. As described above for one of the eight existing IGUCAs, this policy has been exceptionally effective, particularly when contrasted with the severe water use curtailment in states such as Colorado which do not have the IGUCA alternative.

IGUCAs remain timely because they can be modified over time as necessary to adjust for changing conditions or better data. In fact, five of the eight IGUCAs have been amended at least once. The Walnut Creek IGUCA has been amended three times since it was initially established in 1992.

The most recent IGUCA proceeding was in 2007, related to possible expansion of the Pawnee Valley IGUCA. During the hearing, several parties expressed opposition to expanding the IGUCA. Some organizations and legislators also expressed opposition to the IGUCA expansion, for various reasons.

However, during the 2007 IGUCA proceedings and in the legislative hearings and stakeholder meetings that followed it, there has been widespread support by virtually all groups and individuals involved that the IGUCA policy is fundamentally sound and must be preserved so that creative solutions can be applied in areas where strict administration of

[14] *Rules and Regulations for the Management and Control of Designated Ground Water*; State of Colorado Ground Water Commission (Amended December 30, 2008). http://www.water.state.co.us/cgwc/rules-regs/DBRulesWithFigs.pdf

water rights by priority would have more severe adverse impacts on the community and economy.

The above analysis indicates a positive finding that the three policies in question have indeed stood the test of time based on their continued effectiveness and public acceptance. This naturally leads to the follow-up question: Are there examples of water policies which have not stood the test of time? The answer is yes. Several examples are noted below for consideration:

- Not limiting appropriations, etc: This is the opposite of the safe yield policy including closure of fully-appropriated or over-appropriated areas. Since evidence presented in this paper (and common sense) suggests that the safe-yield/closure policy is a prudent action for stewardship of resources and protection of water rights, it stands to reason that the opposite policy is antiquated and ineffective. The same rationale would suggest that policies to not monitor water use or not provide appropriate groundwater management alternatives would be counter-productive. On the other hand, there are always exceptions to the rule. There may be instances when it makes sense not to limit appropriations, monitor water use, or have alternatives to first-in-time/first-in-right administration.

- Irrigation efficiency improvements as a means to reduce water use: Until a couple of years ago, the state of Kansas had a cost-share program to promote irrigation efficiency improvements. A main purpose of the program was to reduce water use in areas with declining water resources. However, over time it became apparent that improving the efficiency of irrigation did not appreciably conserve water, but rather improved crop yields.[15] While efficiency is important and to be encouraged, the state decided to discontinue this type of cost-share program since it was not achieving a reduction in water use.

- Non-conjunctive management of water resources: Kansas has recognized the interconnected, interdependent nature of groundwater and surface water since at least 1945 when the Kansas Water Appropriation Act was passed, regulating both sources in a coordinated manner. However, to this day there are still states that do not routinely manage groundwater

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[15] *Effects of Irrigation Practices on Water Use in the Groundwater Management Districts Within the Kansas High Plains, 1991-2003*; Scientific Investigations Report 2006-5069; U.S. Geological Survey (2006). "The best estimator of irrigation water use incorporated total acres irrigated and annual average or March–October regional precipitation. A conclusion that can be drawn from the trend analyses described in this report is that, although irrigation water use for all GMDs showed no statistically significant trend, an apparent increased efficiency of center pivots irrigation systems with drop nozzles has allowed more water-intensive crops to be grown on more irrigated acres." (Abstract, p.1)

and surface water conjunctively, that is, together. Nebraska is a notable example of non-conjunctive management – the state of Nebraska is responsible for management of surface water resources while Natural Resource Districts are supposed to manage groundwater. In practice, it appears that the two have largely operated independently. One of the most dramatic outcomes of this disconnect is Nebraska's current noncompliance with the Republican River Compact. Their violations stem from overuse of groundwater which in turn led to streamflow depletions. The outcome of this has not been determined, but the matter is in non-binding arbitration and if that fails to resolve the violations could return to the U.S. Supreme Court. The consequences of Nebraska's dichotomous regulation of groundwater and surface water could be severe sanctions such as monetary reparations and shutting down hundreds or thousands of wells.

CONCLUSIONS

The objective of this exercise was to evaluate whether some of the more prominent water resource policies in Kansas have "stood the test of time" as signified by their continued relevance, effectiveness, and public acceptance. By these measures, based on the analyses herein, the author concludes that the three policies listed below have indeed met this standard:

- Limiting appropriation of water to safe yield quantities, and closure of fully-appropriated or over-appropriated areas
- Monitoring water use through metering and water use reporting
- Establishing intensive groundwater use control areas where necessary to implement creative solutions to groundwater problems

By observation, some of the key attributes of these time-tested water policies include:

- Consistent with basic laws of nature, e.g., conservation of mass
- Reasonable, in the public interest
- Provides essential data for resource management
- Provides flexibility rather than a one-size-fits-all approach

A well-known saying is, "Laws are like sausages – it is better not to see them being made", referring to the often messy process. Nevertheless, public policy makers usually try to make sure that laws are designed for long-term applicability and effectiveness. Reflecting on laws that have achieved time-tested status is one way to identify characteristics and principles which can be applied in crafting new policies for achieving present and future objectives.

Appendix A

Kansas' Response to a 2008 Survey on Irrigation

Western States Water Council

Survey on the Methods and Costs to Monitor Pumping from Irrigation Wells

1. State: **Kansas**

2. Do you agree with the numbers in table 1, below, for your state? **No. Based on information from annual water use reports compiled in the Water Rights Information System (WRIS) maintained by the Kansas Department of Agriculture's Division of Water Resources, as of March 20, 2008 the requested quantities are as follows:**

   1995 Total water use (MGD): 3,946
   1995 Irrigation water use (MGD): 3,364
   1995 Irrigation as percent of total water use: 85
   2003 Number of irrigation wells: 27,770
   2003 Total irrigated acreage: 3,151,754 (3,078,034 from groundwater; 73,720 from surface water)

3. Is there a program in your state to monitor pumpage from irrigation wells? **Yes**

   a. If yes

      i. How many irrigators participate in the program? **6,511 (2005 data)**
      ii. How much does the average irrigator spend on the program? **Cost of a postage stamp per year**
      iii. How much does the state spend on the program? **$170,000 per year (2005 estimate)**
      iv. How many wells are monitored by flow meters? **21,054 (2005 data)**
         1. what is the average cost of a flow meter? **$1,000**
         2. what is the average lifespan of a flow meter? **8 years (repairs can extend it)**
         3. what is the cost to install a flow meter? **$300 to $2,000 (depending on difficulty)**
         4. what is the cost to calibrate a flow meter? **$400 average**

v. How many wells are monitored by power consumption? **Data not available; anecdotally relatively few use this method**
vi. How many wells are monitored by some other method? **5,887 (hours x rate)**
vii. How long does it take before a year's data are analyzed? **1 to 2 years**
viii. How does the state use the pumpage data? **A partial list follows:**

- **Safe yield analyses in processing water appropriation applications**
- **Certification of water rights**
- **Compliance & enforcement of water rights**
- **Abandonment determinations**
- **Impairment investigations**
- **Water use accounting**
- **Compact administration**
- **Administration of water right flex accounts and water banking**
- **Basin planning**
- **Hydrologic modeling**
- **Water management**
- **Technical assistance**
- **Conservation plans**
- **National water use reporting**
- **Technical reports**
- **Property valuation**
- **Irrigation efficiency evaluation**

ix. What are the three things you would most like to change about the way pumpage data are gathered, reported, and processed, without regard to the cost or practicality of making the changes?

- **Statewide metering of all non-domestic points of diversion by 2015 (significant progress has been made and work continues)**
- **Online water use reporting (development of web-based reporting is underway); eventually real-time reporting through data loggers and telemetry (at least in areas with active water rights administration)**
- **Electronic reporting in the future is anticipated to reduce dependence on**

manual data entry and allow improved quality- control

b. If no, would such a program be useful?

4. Can you provide a paragraph or two summarizing the program?

Regulations under the Kansas Water Appropriation Act (http://www.ksda.gov/appropriation/statutes) establish requirements for:

- **Installation of a water flowmeter or other suitable water measuring device**
- **Water flowmeter specifications**
- **Water flowmeter installation specifications**
- **Water flowmeter maintenance**
- **Water use reporting**
- **Other criteria**

The Kansas Department of Agriculture's Division of Water Resources and several groundwater management districts share responsibility for compliance & enforcement of these requirements. Meters are inspected following installation, tested for accuracy, and readings are checked for water right compliance and other reasons.

All non-domestic water right holders are required to annually report their water use to the Division of Water Resources. DWR receives approximately 15,000 paper reports each year, many of which include information for multiple water rights. These data are manually entered into the Water Rights Information System (WRIS) database, quality-control checked, and used for a variety of purposes (see 3.a.viii above). More information on Kansas' water use reporting is available at http://www.ksda.gov/appropriation/content/116.

State	Total Water Use (million gal/day) 1995[1]	Irrigation Water Use million gal/day 1995[2]	Irrigation as Percent of Total Water Use	Number of Irrigation Wells 2003[2]	Total Irrigated Acreage 2003[3]
Alaska	25	0.3	1	57	2,252
Arizona	3,830	3,180	83	5,149	836,587
California	25,200	23,500	93	67,637	8,471,936
Colorado	5,230	4,910	94	11,793	2,562,329
Idaho	4,340	4,310	99	6,924	3,126,857
Kansas	3,620	3,220	89	19,526	2,543,950
Montana	1,960	1,820	93	1,810	2,131,955
Nebraska	7,020	6,740	96	71,506	7,516,171
Nevada	1,340	1,060	79	1,986	639,310
New Mexico	1,980	1,680	85	8,430	769,787
North Dakota	105	181	58	1,734	207,772
Oklahoma	716	401	56	4,540	508,842
Oregon	3,210	3,070	96	7,855	1,731,660
South Dakota	249	175	70	1,872	390,406
Texas	10,500	8,140	77	63,602	4,947,745
Utah	2,200	1,930	88	2,632	1,082,213
Washington	3,080	2,800	91	5,626	1,806,782
Wyoming	2,800	2,660	95	985	1,415,037
TOTAL	**77,405**	**69,777.03**		**283,664**	**40,691,591**

Table 1. Comparison of total water use and irrigation water use for the 18 member states of the Western States Water Council in 1995 and the number of irrigation wells in 2003. Both dates are the most recent available.

1 http://water.usgs.gov/watuse/pdf1995/pdf/summary.pdf
2 http://water.usgs.gov/watuse/pdf1995/pdf/irrigation.pdf
3 http://www.agcensus.usda.gov/Publications/2002/FRIS/tables/fris03_14.pdf
4 http://www.agcensus.usda.gov/Publications/2002/FRIS/tables/fris03_02.pdf

Appendix B

Article about Colorado Curtailing Water Use

Farmers sweat lack of water
Growers mop brows after state edict to shut down wells

Jerd Smith, Rocky Mountain News
Published May 10, 2006 at midnight

The state ordered more than 400 powerful irrigation wells shut down this week to protect the South Platte River, triggering a crisis for about 200 farms from Brighton to Fort Morgan.

"It's the toughest decision I've ever had to make," said State Engineer Hal Simpson, Colorado's top water regulator.

Farmers who've already planted this year say they stand to lose hundreds of thousands of dollars as a result of Simpson's ruling. The decree may mean bankruptcy for some. But others, such as La Salle potato grower Harry Strohauer, are gearing up for battle.

"I'm going to fight like crazy," Strohauer said.

Strohauer is losing the use of 14 wells that normally irrigate 1,100 acres of potatoes and onions. He's invested $700,000 in seed and fertilizer so far this spring.

"To get hit with this ruling after we've all planted is ludicrous," Strohauer said.

A spokesman for Gov. Bill Owens said the state may declare an emergency in the counties affected by the shutdown.

But the shutdown was precipitated by a new state law that requires farmers who use deep irrigation wells - which draw down the aquifer that also nourishes the river - to replace that water.

The law is meant to stabilize the river by reducing the impact of deep wells.

The law was passed after the 2002 drought, when farmers who relied solely on the river's surface water for irrigation saw their fields burn up, while well-dependent farmers continued irrigating.

Surface-water farmers and some cities successfully sued the state for allowing the deep wells to harm the river.

Under the new law, well-dependent farmers were given several years to find additional water supplies, either by securing water leases or with permanent purchases of water.

In 2002, roughly 5,000 irrigation wells were operated in the South Platte basin. Under the new law, more than 1,500 have already been shut down, while the users of several hundred others have developed new water plans that allow them to legally operate their wells.

But Simpson's ruling signals that time is up for farmers who have been unable to line up sufficient new water supplies.

"This is a wreck," said Tom Cech, manager of the Central Water Conservancy District.

The district has been working frantically since 2003, raising property taxes to lease and buy water and to build small reservoirs to aid this last group of farms. All told, the district has raised $21 million to help comply with the new law, Cech said, but the lingering drought and competition for water between fast-growing Front Range cities and farmers has made water scarce and expensive.

Cech said the district had projected it would have enough water this year to operate the wells at 15 percent of their capacity.

But the state engineer's decision, prompted by a dry spring and the district's loss of several key water leases, doomed the farmers' efforts just as the new growing season got under way.

The law also stipulates that farmers must show they have enough incoming water to cover future water debts to the river.

Because of the lingering dry spell, the state required that they use a worst-case drought scenario to calculate future needs, which meant finding more water.

"It's a brutal standard," Cech said.

Bob Sakata is a veteran vegetable grower in Brighton and an elder statesman on the South Platte River.

Sakata already has spent $264,000 planting 300 acres in onions, broccoli, sweet corn and carrots. The three wells he planned to use on that land won't operate this year, and the crops in the ground probably won't survive.

Sakata is a large grower, with 19 other wells and the rights to river water. Still, he said he was caught off guard by the ruling.

Farmers had expected to be able to use their wells at least for a short period of time this summer. But to be shut down completely was a surprise.

"There has to be a better solution than this," Sakata said. "I've put out calls to the governor, to the commissioner (of agriculture) and director of natural resources. There's just got to be a way."

North of Brighton, two wells that supply drinking water to Page's Trailer Park will also be shut down as a result of the ruling.

Bernie Pagel, who has owned the park since 1969, said about 70 families live there and depend on the wells for 90 percent of their water.

"I'm just wondering what we're supposed to do," Pagel said.

He's talking to other nearby water providers to see if he can purchase water.

"We're also wondering if there's any emergency exemption," he added, noting that more than 300 residents will be without water if the wells are shut off.

Glen Kobobel is a corn grower outside Wiggins. He, too, had expected to have at least a small amount of well water to use on his crops this summer. Tuesday afternoon, he had yet to finish calculating how much money he will lose as those crops dry out.

"Our family will be able to survive this shutdown," Kobobel said. "I don't know about next year, though. And I just can't figure out why the state is doing this to us. I think we're so few in number, our voices mean nothing."

Simpson, the state engineer, had a different take. "There just wasn't enough water in their plan," he said of the farmers' efforts to comply with the new law.

"We're very sorry it came to this."

How trouble got started

The crisis in the South Platte River basin took root more than 70 years ago, when hundreds of farm families from Brighton to Fort Morgan started digging wells in a shallow aquifer that also supplies the river.

Water engineering was in its infancy, and state agriculture and water officials encouraged the drilling, hopeful that the wells would drought-proof the lush, irrigated high plains region.

No one understood back then that the wells were pulling water from the same aquifer that helped supply the river. By 1969, the science was clear. The wells were depleting the river. The state began requiring farmers to put back into the river some of what their wells had drawn down.

Under the new law, farmers must put about 80 percent of the total water they pump from the ground back into the river. Previously, their obligation had been as low as 5 percent in some years.

http://www.rockymountainnews.com/news/2006/may/10/farmers-sweat-lack-of-water/