IN RE: NON-BINDING ARBITRATION PURSUANT TO THE FINAL SETTLEMENT STIPULATION, *KANSAS v. NEBRASKA AND COLORADO*, NO. 126 ORIGINAL

BEFORE MARTHA O. PAGEL, ARBITRATOR

EXPERT REPORT OF JAMES E. SLATTERY, P.E.

I, James E. Slattery, state the following:

(1) I understand that my role as an expert, both in preparing this report and in giving evidence, is to assist the arbitrator to understand the evidence or to determine facts in issue. The opinions expressed in my report are my own professional opinions.

(2) I have endeavored in my report and disclosures to be accurate and complete, and have addressed matters that I regard as being material to the opinions expressed, including the assumptions that I have made, the bases for my opinions, and the methods that I have employed in reaching those opinions.

(3) I have been advised by the attorney for the State of Colorado of the disclosure requirements of the rules of the arbitration, and I have provided in my report the information required by those rules. I have not included anything in my report and disclosures that has been suggested by anyone, including the attorney for the State of Colorado, without forming my own independent judgment on the matter.

(4) I will immediately notify, in writing, the attorney for the party for whom I am giving evidence if, for any reason, I consider that my existing report requires any correction or qualification; and, if the correction or qualification is significant, will prepare a supplementary report or disclosure to the extent permitted by the applicable rules of the arbitration.

(5) I have used my best efforts in my report and disclosures, and will use my best efforts in any evidence that I am called to give, to express opinions within those areas in which I have been offered or qualified as an expert by the arbitrator, and to state whether there are qualifications to my opinions.

(6) I have made the inquiries that I believe are appropriate and, to the best my knowledge, no matters of significance that I regard as relevant have been withheld from the arbitrator.

(7) I have disclosed any financial or pecuniary interest that I have in the results of this lawsuit or in any property or rights that are the subject of the lawsuit for which my report and disclosures are being submitted.

(8) I base the following opinions on my general knowledge of the Republican River Basin and the Compact Compliance Pipeline, the RRCA Groundwater Model, and my modeling knowledge and expertise. Any specific data that I considered for this report will be posted at http://www.prinmath.com/ccp/

(9) My qualifications, a list of all publications authored by me in the previous 10 years, a list of all other cases in which, during the previous four years, I have testified as an expert at trial or by deposition are attached to my report.

(10) My rate of compensation is my standard hourly billing rate of $145/hour. My compensation is not dependent upon nor affected by the outcome of this matter.

Dated this 24th day of May, 2010.

James E. Slattery

James E. Slattery, P.E.

COLORADO REGISTERED
JAMES E. SLATTERY
26797
5-24-09
PROFESSIONAL ENGINEER

James E. Slattery

Slattery & Hendrix Engineering LLC
Water Resources, Water Rights and Computer Modeling

Expert Report on the Colorado Compact Compliance Pipeline

Prepared by
James E. Slattery
for
The State of Colorado

May 24, 2010

8357 Windhaven Drive
Parker, CO 80134
(303) 309-0061

CONTENTS

1.0 Introduction.....1

2.0 Background.....1

3.0 Colorado Compact Compliance Pipeline.....3

4.0 Groundwater Rights Acquired for the Compact Compliance Pipeline.....5

5.0 Proposed Augmentation Plan and Related Accounting Procedures.....6

6.0 Operation of the Compact Compliance 8

7.0 Why the Compact Compliance Pipeline is Needed 9

8.0 Opinions…….....11

9.0 James Slattery's Qualifications.....12

10.0 Data or Other Information Considered in Forming the Opinions 14

Figure	Title
1	Republican River Basin……..……16
2	High Plains Aquifer and Republican River Basin…,,,……..……..17
3	Colorado Republican River Basin….……18
4	Location of Compact Compliance Wells and Historically Irrigated Lands Dried up for the Compact Compliance Pipeline……..……..19
5	Projected North Fork of the Republican River Stream Depletions versus Compact Compliance Pipeline Deliveries……..20
6	Acres Irrigated by Groundwater Pumping in the Colorado Republican River Basin……..21
7	Amount Colorado Exceeded Compact Allocation..…….…..22

8 Components of Historical Consumptive Use in Colorado……..……....23

9 Projected Compact Compliance under Current Pumping and No Pumping Conditions……...……..……..24

10 Projected Compact Compliance with Compact Compliance Pipeline in Operation..……...……..……...25

Table	Title
1	Republican River Water Conservation District Water Activity Enterprise Water use Fees……..…..…….26
2	Compact Compliance Pipeline Construction Schedule……..…..…….27
3	Rights to Designated Groundwater……..……..…..……28
4	James E. Slattery's Resume……..……..…..……30
5	List of Court Cases in the last 4 years which James E. Slattery Testified as an Expert Witness at Trial or Deposition……..……..…33

1.0 INTRODUCTION

In March 2008, the State of Colorado submitted an application to the Republican River Compact Administration (RRCA) requesting approval of an augmentation plan and revisions to the RRCA Accounting Procedures pursuant to Subsection III.B.1.k of the Final Settlement Stipulation (FSS) for a pipeline project to deliver groundwater to the North Fork of the Republican River. The purpose of the project is to offset stream depletions so that Colorado can comply with its Compact Allocations.

In August 2009, Colorado submitted a resolution to the RRCA to approve an augmentation plan and proposed revisions to the RRCA Accounting Procedures, subject to terms and conditions based on negotiations with Nebraska and Kansas. The RRCA did not approve the resolution, but the vote was not unanimous. Colorado then invoked non-binding arbitration pursuant to the FSS. Colorado and Nebraska have now resolved Nebraska's concerns with the resolution.

This report describes the background of the Colorado Compact Compliance Pipeline project (CCP), the wells and groundwater rights acquired for the CCP, the proposed accounting procedures for the CCP to account for deliveries to offset stream depletions, how the CCP will be operated, and why the CCP is needed. The report also presents my expert opinions.

I have previously been qualified and accepted to testify as an expert by various courts in the areas of hydrology, groundwater hydrology, water resources engineering, surface water modeling, and groundwater modeling. My opinions in this report are in these same areas of expertise.

2.0 BACKGROUND

The Republican River rises in the high plains of northeastern Colorado and western Kansas and Nebraska. The river flows in a generally easterly direction and encompasses approximately 24,900 square miles within the watershed. A map of the basin is shown in Figure 1. The Republican River Basin is underlain by the Ogallala aquifer except for the lower portion of the basin in eastern Kansas, as shown in Figure 2. The Ogallala aquifer, also referred to as the High Plains Aquifer, is a highly productive aquifer that covers a portion of eight mid-west states. See Figure 2. In most areas in Colorado, Nebraska, and Kansas, the aquifer will support wells in the 400 to 1,800 gpm range. There was significant development of irrigation wells in the High Plains Aquifer in Colorado, Nebraska, and Kansas beginning in the late 1950's.

Colorado, Kansas, and Nebraska entered into the Republican River Compact (Compact), which became operative in 1943, to allocate the waters of the Republican River Basin. The Compact makes allocations of water for beneficial consumptive use to each State derived from the computed average annual virgin water supply for designated drainage basins (sub-basins).

In 1959, pursuant to Article IX of the Compact, the RRCA was formed to administer the Compact. Each State appoints one member to the RRCA, but the RRCA requires unanimity to take any action. Each year, the RRCA retrospectively calculated the virgin water supply of each sub-basin and the beneficial consumptive use in each State to determine whether each State had stayed within its allocation during the previous year.

Following the formation of the RRCA, the States debated whether the Compact included ground water in the water supply allocated for beneficial consumptive use. The States were unable to resolve this dispute, and in 1997 Kansas filed a motion for leave to file a bill of complaint against Nebraska with the U.S. Supreme Court claiming that Nebraska was violating the Compact by permitting excessive pumping of groundwater. In January 1999, the Supreme Court granted Kansas' motion. Kansas made no claims against Colorado in its initial complaint, but Colorado was named a party to the suit because it is a party to the Compact.

A special master was appointed and the States briefed the issue of whether and to what extent the Compact included ground water in the allocations of water for beneficial consumptive use. In his First Report, Special Master Vincent L. McKusick concluded that the Compact restricts a State's consumption of ground water to the extent such consumption depletes stream flows in the Republican River Basin.

Special Master McKusick then urged the States to consider a negotiated settlement of the case, and settlement negotiations resulted in a Final Settlement Stipulation as of December 15, 2002 (FSS). In the FSS, the States agreed to (1) a dismissal of all claims against each other with respect to activities or conditions occurring before December 15, 2002; (2) a moratorium on the construction of all new wells in the basin upstream of Guide Rock, Nebraska, with certain exceptions listed in the FSS; (3) the development of a groundwater model to determine stream flow depletions caused by well pumping and the credit for water imported into the basin; (4) revised accounting procedures to determine Compact compliance; and (5) a procedure to resolve disputes relating to Compact administration. The Special Master

recommended that the U.S. Supreme Court approve the FSS, and the Court approved the FSS in 2003.

Subsection III.A of the FSS imposed a moratorium on the construction of all new wells in the basin upstream of Guide Rock, Nebraska, with exceptions listed in Subsection III.B of the FSS. As a practical matter, the moratorium only applied to Nebraska, because Colorado and Kansas had effectively imposed a moratorium on the issuance of new groundwater rights before the FSS was approved. Under Subsection III.B.1.k of the FSS, the moratorium does not apply to wells acquired or constructed for the sole purpose of offsetting stream depletions in order to comply with a State's Compact Allocations. Subsection III.B.1.k states, however, that such wells shall not cause any new net depletion to stream flow either annually or long-term. It further states that the determination of net depletions from these wells will be computed by the RRCA Groundwater Model and included in the State's Computed Beneficial Consumptive Use.

3.0 Colorado Compact Compliance Pipeline

In 2004, the Republican River Water Conservation District ("RRWCD") was created to assist Colorado in complying with Compact. The RRWCD is located in northeastern Colorado and includes all of Yuma and Phillips Counties and those portions of Kit Carson, Lincoln, Logan, Sedgwick, and Washington Counties that overlie the Ogallala aquifer. Figure 3 is a map showing the boundary of the RRWCD, the boundaries of the local groundwater management districts, and the location of the CCP. Currently, with the exception of less than 2,000 acres irrigated by surface water, virtually all the acreage in the RRWCD is irrigated with groundwater from the Ogallala aquifer.

The RRWCD established a water activity enterprise (the RRWCD WAE) as authorized by Colorado statute. In 2008, the RRWCD WAE obtained a $60.6 million loan from the Colorado Water Conservation Board and has purchased groundwater rights diverted from wells in the Republican River Basin for use in the CCP. This loan will be repaid from water use fees.

The RRWCD WAE imposed a water use fee on the diversion of water in the District to raise revenues to assist Colorado in complying with the Compact. The fee structure is shown in Table 1. The RRWCD WAE has used revenues from use fees to retire approximately 35,000 acres that were historically irrigated in the District. In addition, revenues have been used to purchase and lease surface water rights in the

District to reduce beneficial consumptive use in Colorado by approximately 3,000 acre-feet per year. However, most of revenues from the fee increase in 2008 are being applied toward the CCP.

To date, the RRWCD WAE has spent approximately $49 million to acquire groundwater rights and easements for the CCP and another $2 million for engineering, legal, and design costs related to the CCP, for a total expenditure of $51 million. It is estimated that approximately an additional $20 million will be expended to complete the CCP, for a total expenditure of $71 million. The difference between the $60.6 million loan and the total $71 million CCP cost will be paid for directly from water use fees.

The groundwater rights acquired by the RRWCD WAE for the CCP were historically used for irrigation in the Republican River Basin in Colorado. The RRWCD WAE applied to change the use of these groundwater rights and to consolidate them at eight existing wells (Compact Compliance Wells) that will be used to pump groundwater from the Ogallala aquifer to the North Fork of the Republican River. An additional seven existing wells will be alternate points of diversion for the eight Compact Compliance Wells that could be brought into production in the future as needed. The location of the CCP, including the Compact Compliance Wells, is shown in Figure 4. The historical consumptive use of the groundwater rights that will be diverted at the Compact Compliance Wells was determined based on irrigation system and pump efficiency tests, power records, and crop records as discussed in Section 4.0.

The eight Compact Compliance Wells are designed to have a pumping capacity of 1,500 to 1,800 gallons per minute per well. New motors, pumps and a valve vault with control and measurement valves will be installed at each well. PVC collector pipe will connect the wells to a 250,000 gallon control tank. Water will then be delivered from the storage tank to the river by gravity through 12 miles of 42” to 30” diameter pipe at rates up to 40 cfs. At the outlet near the river, water will be discharged through a multiple-orifice valve located in a partially buried concrete outlet structure, which will dissipate the pressure head before the water is discharged into a rip-rap lined outlet channel and then enters the river.

Surge control and flow measurement will be provided at the outlet structure, along with a measurement flume located in the outlet channel. The CCP will be initially capable of delivering 15,000 acre-feet per year. However, the capacity of the CCP can be increased to 25,000 acre-feet per year in the future if additional wells are connected to the system and additional groundwater rights are acquired. As shown in Table 2, the construction schedule to complete the CCP is approximately 18 months.

4.0 Groundwater Water Rights Acquired for the Compact Compliance Pipeline

The RRWCD WAE has purchased groundwater rights for the CCP that were historically used for irrigation of lands north of the North Fork of the Republican River in Colorado. Pumping from the Compact Compliance Wells will be limited to the average annual historical consumptive use of these groundwater rights. The Compact Compliance Wells and the lands historically irrigated by the groundwater rights that will be dried up for the CCP are shown in Figure 4. The average annual historical consumptive use was determined for the period 1998-2007 from historical cropping records, pumping estimated from power consumption records and a power coefficient that converts the kilowatt-hours to acre-feet pumped, irrigated acreage, and climate records. The crop irrigation requirement use was determined using the same procedures used in the RRCA Accounting Procedures.

Nebraska and Kansas reviewed the average annual historical consumptive use calculations for the groundwater rights to be used in the CCP. Nebraska provided comments, and Colorado revised the average annual historical consumptive use amounts based on Nebraska's comments. The revised historical consumptive use amounts of the groundwater rights are shown in column (6) of Table 3, which are based on the 1998-2007 average annual amounts.

The final historical consumptive use amounts of the groundwater rights for the CCP will be determined by the Colorado Ground Water Commission pursuant to its rules and regulations, but Colorado agreed as a term and condition of the augmentation plan submitted to the RRCA that the average annual historical consumptive use of the groundwater rights shall not exceed the amounts shown in Table 3. Pumping from the Compact Compliance Wells will be metered using totalizing flow meters and included in the RRCA Groundwater Model in accordance with Subsection III.B.1.k of the FSS.

As a term and condition of the change of the groundwater rights to the Compact Compliance Wells, the RRWCD WAE agreed that diversions from any individual Compact Compliance Well shall be limited to no more than 2,500 acre-feet per year, and this term and condition was included in the Colorado resolution. This limit was included to address concerns that the future drawdowns under the CCP operations might be significantly different than the historical drawdowns.

Colorado also proposed that banking of groundwater be permitted in accordance with the rules and regulations of the Colorado Ground Water Commission, subject to a limit on Augmentation Water Supply Credit set forth in paragraph 4 of the resolution, which includes a minimum annual delivery of 4,000 acre-feet. Under the Colorado Ground Water Commission rules and regulations, the RRWCD WAE can be authorized to use a three-year banking reserve, which would allow the RRWCD WAE to initiate a banking reserve for consumptive use water that is not pumped, subject to limits in the Commission's rules and regulations. The amount of water in the banking reserve is then available for withdrawals in future years, but the banking reserve is limited to an amount equal to three times the difference between the maximum annual permitted appropriation and the average annual historical withdrawal.

For the CCP groundwater rights, the banking reserve would be limited to 30,996 acre-feet (23,391 ac-ft – 13,059 ac-ft x 3), but the amount that could be withdrawn in any year is limited to the maximum annual appropriation of 23,391 acre-feet per year. While in theory that much could be withdrawn from the banking reserve in any year, Colorado agreed that the Augmentation Water Supply Credit would be limited as set forth in paragraph 4 of the resolution.

5.0 Proposed Augmentation Plan and Related Accounting Procedures

Groundwater pumped by the Compact Compliance Wells will be delivered through collector pipelines to a storage tank and then by a main pipeline to the North Fork of the Republican River a short distance upstream from the streamflow gage at the Colorado-Nebraska state line (USGS gaging station number 06823000, North Fork Republican River at the Colorado-Nebraska State Line). The location of the Compact Compliance Wells, the collector pipelines, the main pipeline, and the outfall structure are shown in Figure 4.

Colorado's proposed revisions to the RRCA Accounting Procedures for the CCP provide that the discharge will be measured and subtracted from the gaged flow of the North Fork of the Republican River to calculate the Augmentation Water Supply Credit to the North Fork of the Republican River in Colorado. The proposed revisions to the RRCA Accounting Procedures further provide that the amount of the discharge to the North Fork of the Republican River from the CCP will be the Augmentation Water

Supply Credit for the purpose of offsetting stream depletions to comply with the Colorado's Compact Allocations.

The CCP deliveries that Colorado has proposed to make to the North Fork of the Republican River at the stream gage at the Colorado-Nebraska state line are less than the stream depletions in Colorado above that stream gage, as shown in Figure 5. Therefore, it is appropriate to account for the CCP deliveries as offsetting stream depletions calculated at that stream gage.

This accounting is appropriate for CCP water because this gage is located where the annual Virgin Water Supply of the North Fork of the Republican River in Colorado sub-basin and stream depletions in Colorado above that gaging station are calculated. In addition, the Arikaree sub-basin joins the North Fork of the Republican River a short distance downstream and the South Fork of the Republican River joins the river downstream at Benkelman, Nebraska. While CCP deliveries are not expected to exceed the stream depletions to the North Fork of the Republican River calculated at the streamflow gage at the Colorado-Nebraska state line, the CCP deliveries could also offset stream depletions in another sub-basin, provided the CCP deliveries are not used to offset the use of water by Colorado in a sub-basin that would impair the ability of another State to use its sub-basin allocation within that same sub-basin. (FSS, § IV.B.2)

As shown in Figure 4, the CCP outfall is less than a half mile upstream of the stream gage on the North Fork at the Colorado-Nebraska state line. The ability to locate the outfall in close proximity to a stream gage used in the RRCA Accounting Procedures for the calculation of stream depletions is a major reason why the RRWCD WAE chose to construct the CCP where it did. For example, the RRWCD WAE ruled out constructing the CCP to the South Fork of the Republican River because the compact accounting stream gage for the South Fork of the Republican River sub-basin is located at Benkelman, Nebraska, approximately 40 miles downstream of where the South Fork crosses the Colorado-Kansas state line. There would have been very large transit losses on the delivery of this water through Kansas to the compact accounting stream gage, which is where stream depletions for the South Fork of the Republican River sub-basin are calculated in the RRCA Accounting Procedures.

6.0 Operation of the Compact Compliance Pipeline

Based on Colorado's resolution and the delivery schedule agreed to with Nebraska, the CCP will be operated as follows:

1. Accounting for deliveries will start January 1 of each year.
2. Colorado will begin deliveries on January 1 and will make the minimum annual delivery of 4,000 acre-feet provided for in the Colorado resolution during the months of January through March.
3. Colorado will calculate and provide notice of the Projected Delivery, as defined in the Colorado resolution, to the Kansas and Nebraska RRCA Members by April 1 as provided in the Colorado resolution. Unless Colorado determines by April 1 that it will not be able to deliver any remaining Projected Delivery in the months of October through December, Colorado shall stop deliveries at the end of March. If Colorado anticipates that deliveries in the months of November and December will not be sufficient for Compact compliance, Colorado will maximize deliveries first in January, then sequentially in the months of February, March, and April. Only if there is reason to believe that additional deliveries in the months of October through December will not be sufficient for Compact compliance will deliveries extend into the month of May.
4. By September 1st, Colorado will gather provisional hydrologic data for the months of January through August of the year and will estimate the amount of deliveries needed for Compact compliance for the remainder of the year after accounting for the deliveries earlier in the year. Colorado will then maximize any additional water deliveries first in the month of December, then sequentially in November, and October.

For the present time, deliveries will average about 25 to 30 cubic feet per second (25 cfs is 11,200 gpm or 7 wells running at 1,600 gpm). The operation described above will provide a reasonable method to estimate the amount of augmentation water needed to offset stream depletions to keep Colorado in Compact compliance. The final accounting for determining Compact compliance is done after the compact year is completed, so Colorado cannot know the precise amount of augmentation water needed in any given year, but this method of operating the CCP will avoid large over or under deliveries in any given year.

As with the operation of any facility of this size, there will be years when operational and structural problems could prevent the CCP from operating in the precise manner described above, but Colorado has agreed to consult with Nebraska prior to December 31st of the year preceding the scheduled deliveries and Colorado and the RRWCD WAE together have agreed to consult with Nebraska as needed to coordinate the timing and volume of deliveries to the North Fork of the Republican River.

7.0 Why the CCP is Needed

In the FSS, the States agreed that all claims against each other relating to the use of waters of the Basin pursuant to the Compact with respect to activities or conditions occurring before December 15, 2002, shall be dismissed, but the dismissal would not preclude a State from seeking enforcement of the Compact, the FSS, or the proposed Consent Judgment with respect to activities or conditions occurring after December 15, 2002.

At the time the FSS was negotiated, the Republican River Basin in Colorado was in a severe drought. Colorado's water officials were aware that Colorado's stream depletions from groundwater pumping calculated with the groundwater model that the States had agreed to develop were likely to exceed Colorado's Statewide Compact allocations in 2003 and 2004, but they also believed that stream flows in the basin in Colorado would improve when the drought ended and that Colorado's Compact allocations would then increase. Thus, they believed that Colorado would be in compliance with its Compact allocations for a decade or more until stream depletions due to past pumping increased to the point that the CCP was required. Colorado officials supported legislation to establish the RRWCD in 2004 and, after the RRWCD was created and the Board of Directors appointed, recommended that the RRWCD Board of Directors provide financial assistance for the retirement of irrigated acreage in the District.

Acting on the advice of the Colorado officials and with the State's active support, the RRWCD Board of Directors provided cost-sharing for federal programs to convert irrigated acreage in the District to non-irrigated uses. These programs included the Republican River Conservation Reserve Enhancement Program (CREP) and the Environmental Quality Improvement Program (EQIP). Approximately 35,000 irrigated acres in the District have been permanently retired under these programs.

In late 2007, when preliminary results of Compact compliance for 2006 became available and showed that Colorado's Compact allocations were not increasing sufficiently to bring Colorado into Compact compliance, the RRWCD Board of Directors voted to prepare an application to the Colorado Water Conservation Board for a loan for the CCP. Absent a dramatic change in the hydrology of the basin in Colorado, the only way for Colorado to get into Compact compliance for decades is to build the CCP. Even if Colorado eliminated all beneficial consumptive uses in the basin, including all groundwater pumping, Colorado would not be in compliance with the Compact for many

years. And, if Colorado were to eliminate all goundwater pumping in the basin, it would have a devastating impact on the agricultural economy of the basin and eliminate the use fee revenues necessary to repay the loans used to purchase the groundwater rights and easements for the CCP and to lease surface water rights to reduce beneficial consumptive use in Colorado. Currently, there are approximately 500,000 irrigated acres within the boundaries of the RRWCD.

The details of the compact accounting can be complicated, but the basic concept is relatively straight forward. The virgin water supply for each designated drainage basin (referred to as sub-basins) is calculated. A percentage of this virgin water supply is then allocated to Colorado, Nebraska, and/or Kansas for beneficial consumptive use based on the allocations set out in the Compact. While the States are allowed some flexibility in the use of water in excess of a State's specific sub-basin allocations, a State's beneficial consumptive use is limited to its statewide allocations of the virgin water supply.

When the Compact was signed in 1942, only a small number of acres were irrigated by groundwater in the Colorado portion of the basin. However, starting in the early 1960's, there was a large increase in the number of irrigated acres as shown in Figure 6. This increase was due to an increase in groundwater use and is a similar pattern seen in many areas of the western United States including areas in Kansas and Nebraska underlain by the Ogallala Aquifer. The increased use of groundwater for irrigation is generally attributable to three factors. First, after World War II, turbine pump technology evolved to the point that it was economically and technically feasible to lift groundwater from depths of several 100 feet or more. Second, electricity became available in the rural areas as a relatively cheap source of power to lift the water. Third, in the late 1960's center pivot sprinkler technology was developed to the point that it became one of the most efficient methods of irrigation, especially in relatively sandy soils.

Although the RRCA has not approved the final accounting for all of these years, the approximate amount that Colorado exceeded its Compact allocations for the years 2003-2008 is shown in Figure 7. Figure 8 shows the components of Colorado's average annual computed beneficial consumptive use for the years 2003-2007. As shown in Figure 8, stream depletions from groundwater pumping are the largest component of Colorado's average annual computed beneficial consumptive use.

Figure 9 shows a projection of the annual amounts Colorado's statewide Compact allocation is exceeded for two scenarios, with current pumping and eliminating

all pumping. As shown in the graph, Colorado's computed beneficial consumptive use exceeds Colorado's Statewide Compact allocations 25 years in the future even when all pumping is eliminated.

Figure 10 shows how Colorado can achieve Compact compliance with the CCP. In addition to the CCP deliveries, Figure 10 shows the effect of other actions Colorado and the RRWCD WAE have or could take to assist with Compact compliance. The projection of the amounts Colorado's Compact allocation is exceeded with current pumping is the same as shown on Figure 9. The annual bars on Figure 10 show the effects of 1) the elimination of beneficial consumptive use from irrigation with surface water rights, 2) the result if Bonny Reservoir were no longer actively storing water, which would eliminate the beneficial consumptive use resulting from evaporation of water stored in the reservoir and seepage losses to the Ogallala Aquifer, and 3) the operation of the CCP. Colorado can achieve Compact compliance under the projection made for this scenario with the combination of actions shown in Figure 10. However, as shown in Figure 9, Colorado cannot achieve Compact compliance in the next 25 years without the CCP, absent a dramatic change in the hydrology of the basin in Colorado.

8.0 Opinions

The following are my expert opinions. The basis for these opinions is the information in sections 4 through 7 above:

Opinion 1: The average annual historical consumptive use of the groundwater rights that have been acquired for the CCP for the period 1998-2007 is 13,059 acre-feet per year, as shown in Table 3. This is a representative period to determine the average annual historical consumptive use of the groundwater rights.

Opinion 2: Limiting annual groundwater diversions to the average annual historical consumptive use of the rights, except for banking of groundwater in accordance with rules and regulations of the Colorado Ground Water Commission, will prevent any new depletion to stream flow.

Opinion 3: Limiting diversions from any individual Compact Compliance Well to 2,500 acre-feet per year will prevent any large change in the overall drawdown pattern in the Ogallala Aquifer.

Opinion 4: The calculation of the projected augmentation water supply delivery for the upcoming accounting year to estimate the volume of augmentation water supply that will be delivered from the CCP during the accounting year, the minimum annual delivery of 4,000 acre-feet, the delivery schedule agreed to with Nebraska, and the limit on the augmentation water supply credit proposed by Colorado in the August 12, 2009 resolution are reasonable to estimate the volume of CCP deliveries needed annually, will prevent large over or under deliveries, and will give Nebraska prior notice of the timing and amount of the deliveries.

Opinion 5: The proposed revisions to the RRCA Accounting Procedures proposed by Colorado in its August 12, 2009 resolution are the appropriate method to account for deliveries from the CCP. CCP deliveries are made in close proximity to the stream gage used in the RRCA Accounting Procedures for the calculation of stream depletions to the North Fork of the Republican River in Colorado sub-basin and will be less than the stream depletions in Colorado above that stream gage. Even if the deliveries exceeded the stream depletions above that gage, it would still be an appropriate location to replace stream depletions from other sub-basins in Colorado.

Opinion 6: Allowing the RRWCD WAE to acquire additional groundwater rights to be pumped through the Compact Compliance Wells upon the terms and conditions of the August 12, 2009 resolution is reasonable and gives Nebraska and Kansas an opportunity to object to the addition of such groundwater rights.

Opinion 7: Absent a dramatic change in hydrology in the basin in Colorado, the only way to assure Colorado will achieve Compact compliance within the next 25 years is the CCP.

9.0 James Slattery's Qualifications

My resume is included as Table 4 and Table 5 list Court Cases in the last 4 years which I testified as an expert witness at trial or deposition. I have not authored any publications in the last 10 years. I graduated from Colorado State University with a Bachelor of Science degree in Civil Engineering in 1984. I obtained a Master of

Science degree in Civil Engineering from Colorado State University in 1986. I am a registered professional engineer in Colorado and have worked for 24 years in the consulting engineering field specializing in groundwater and surface water modeling, water rights, and water resource engineering.

I was a member of a team of experts for the State of Colorado in the Arkansas River Compact litigation (*Kansas v. Colorado*, No. 105, Original, U.S. Supreme Court). I testified as an expert witness before the Special Master appointed by the U.S. Supreme Court on estimates of pumping based on power records during the liability phase and testified to the quantification of depletions to useable Stateline flows due to groundwater pumping during the damages phase. During the final phase of the litigation, I evaluated and modified the Hydrologic Institutional model used to determine depletions to state line flows from groundwater pumping in Colorado. Since 1995, I have been a consultant to the Lower Arkansas Water Management Association (an association of well users in the lower Arkansas River basin in Colorado) to assist them in developing replacement plans to offset well depletions to senior Colorado water users and to the state of Kansas.

I was an engineering consultant to the United States Bureau of Reclamation in the North Platte decree litigation (*Nebraska v. Wyoming and Colorado*, No. 108, Original, U.S. Supreme Court). I evaluated the effects of various operations on the Bureau of Reclamation reservoirs in Wyoming.

I was retained as a consultant by the State of Colorado for the Republican River Compact litigation (*Kansas v. Nebraska and Colorado*, No. 126, Original, U.S. Supreme Court) and was one of three members designated to represent Colorado on the groundwater modeling committee that developed the RRCA Groundwater Model. After the Republican River Water Conservation District was formed in 2003, I was retained as an engineering consultant to the District and have assisted the District in investigating options to assist Colorado with Compact compliance.

I have been a consultant for Applicants or Objectors in approximately 50 water court cases in Colorado involving issues including the evaluation of historical consumptive use from groundwater and surface water supplies, exchange potential, and evaluation and formation of augmentation plans.

I have worked on and/or developed basin scale surface water or groundwater models in 26 different basins throughout the United States. Many of the groundwater

modeling projects involved an evaluation of the surface water flow interaction with the surface streams through various forms of accounting.

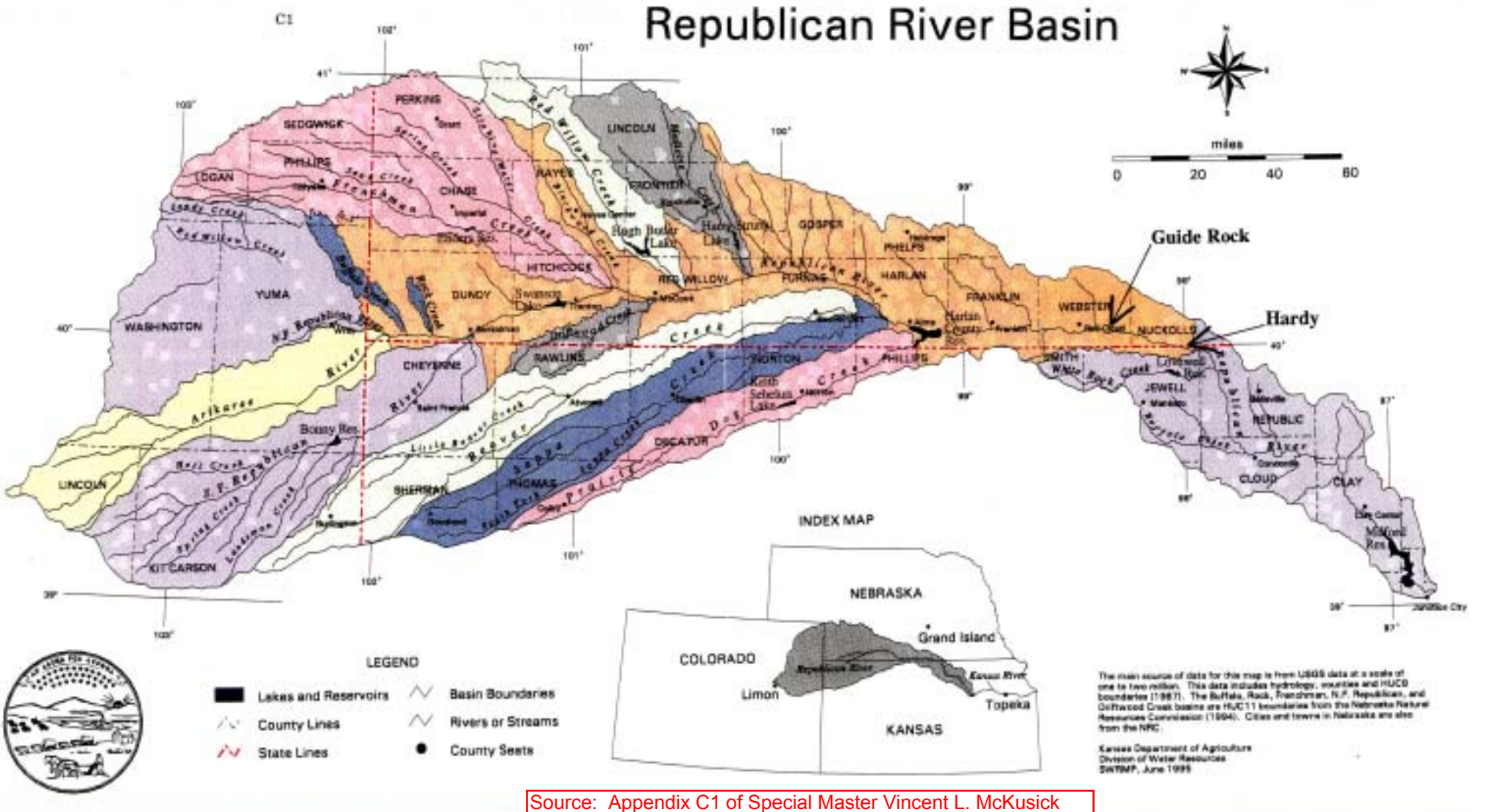
10.0 Data or Other Information Considered in Forming the Opinions

1. RRCA Compact accounting for the 2003-2008 period, including supporting RRCA groundwater model runs.
2. Hydrologic data and analysis included in spreadsheet entitled “Figures and Tables for JES May 2010 Expert Report”.
3. Final Settlement Stipulation and attached appendices.
4. Series of groundwater model runs used to project future compact compliance performed by Principia Mathematica.
5. Colorado’s Resolution regarding approval of Colorado’s augmentation plan and related accounting procedures submitted under Subsection III.B.I.k of the Final Settlement Stipulation dated August 12, 2009, and exhibits.
6. Reports of the Special Master, *Kansas v. Nebraska and Colorado*, No. 126, Original.
7. Rules and Regulations of the Colorado Ground Water Commission.
8. Memorandum dated August 8, 2006 entitled “2005 Irrigated Acreage Analysis – Republican River Basin in Colorado”.
9. Memorandum dated February 25, 2008 entitled “Application for a Change of Type of Use of Rights to Designated Ground Water in the Northern High Plains Designated Ground Water Basin, Changes of Well Location, and a Change to Allow Wells to be Alternate Point of Diversions by the Republican River Water Conservation District, acting by and through its Water Activity Enterprise”.
10. Memorandum dated October 22, 2008 entitled “Addition of 7 well permits - Supplement to February 25, 2008 Memorandum for the Application for a Change of Type of Use of Rights to Designated Ground Water in the Northern High Plains Designated Ground Water Basin, Changes of Well Location, and a Change to Allow Wells to be Alternate Point of Diversions by the Republican

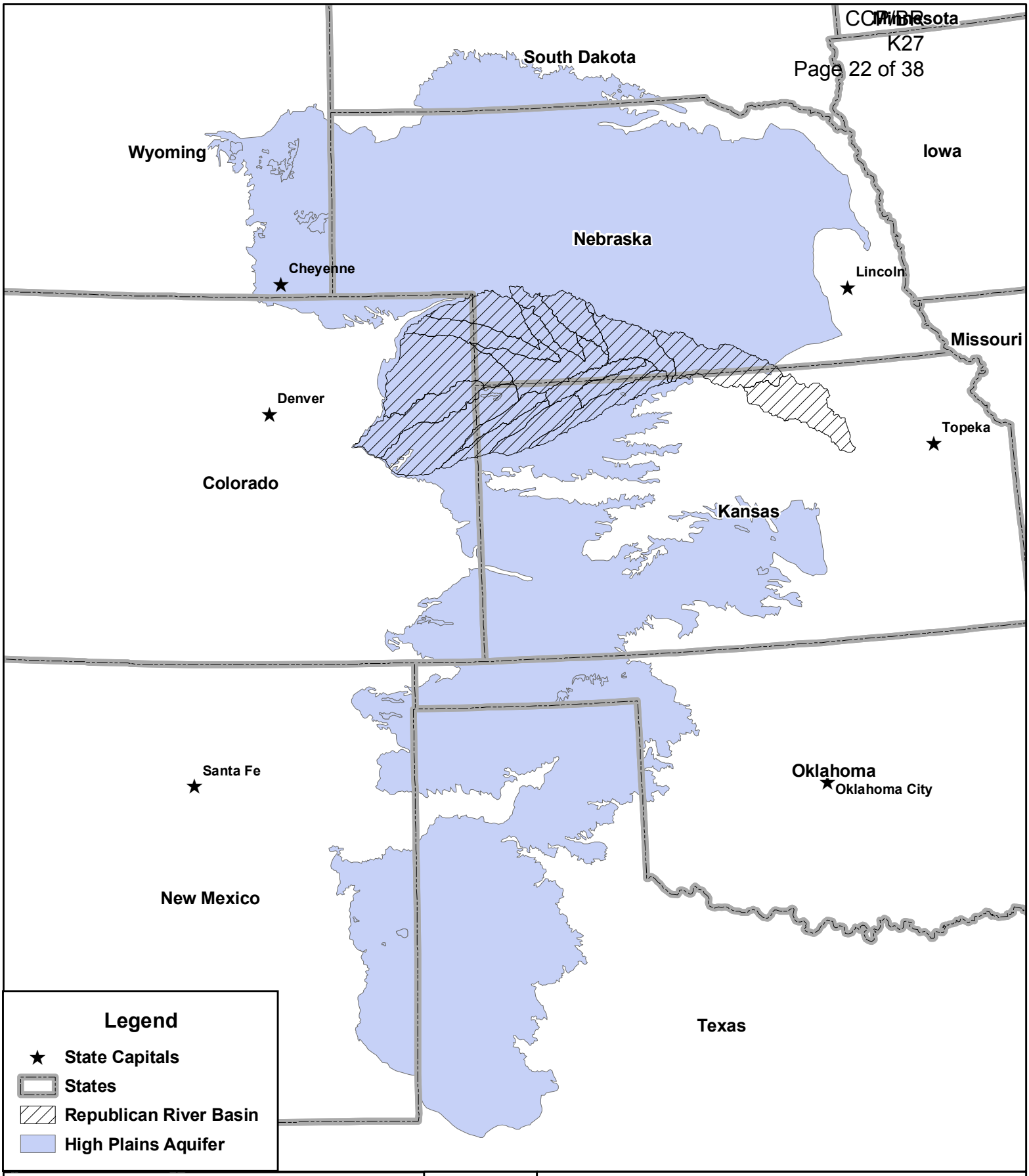
River Water Conservation District, acting by and through its Water Activity Enterprise".

11. Memorandum dated May 14, 2008 entitled "Revisions to Crop Irrigation Requirement Use Estimates included in March 2008 RRCA Submittal for the Republican River Compact Compliance".

Figure 1



Source: Appendix C1 of Special Master Vincent L. McKusick
April 15, 2003 Second Report of the Special Master



0 50 100 200
Miles

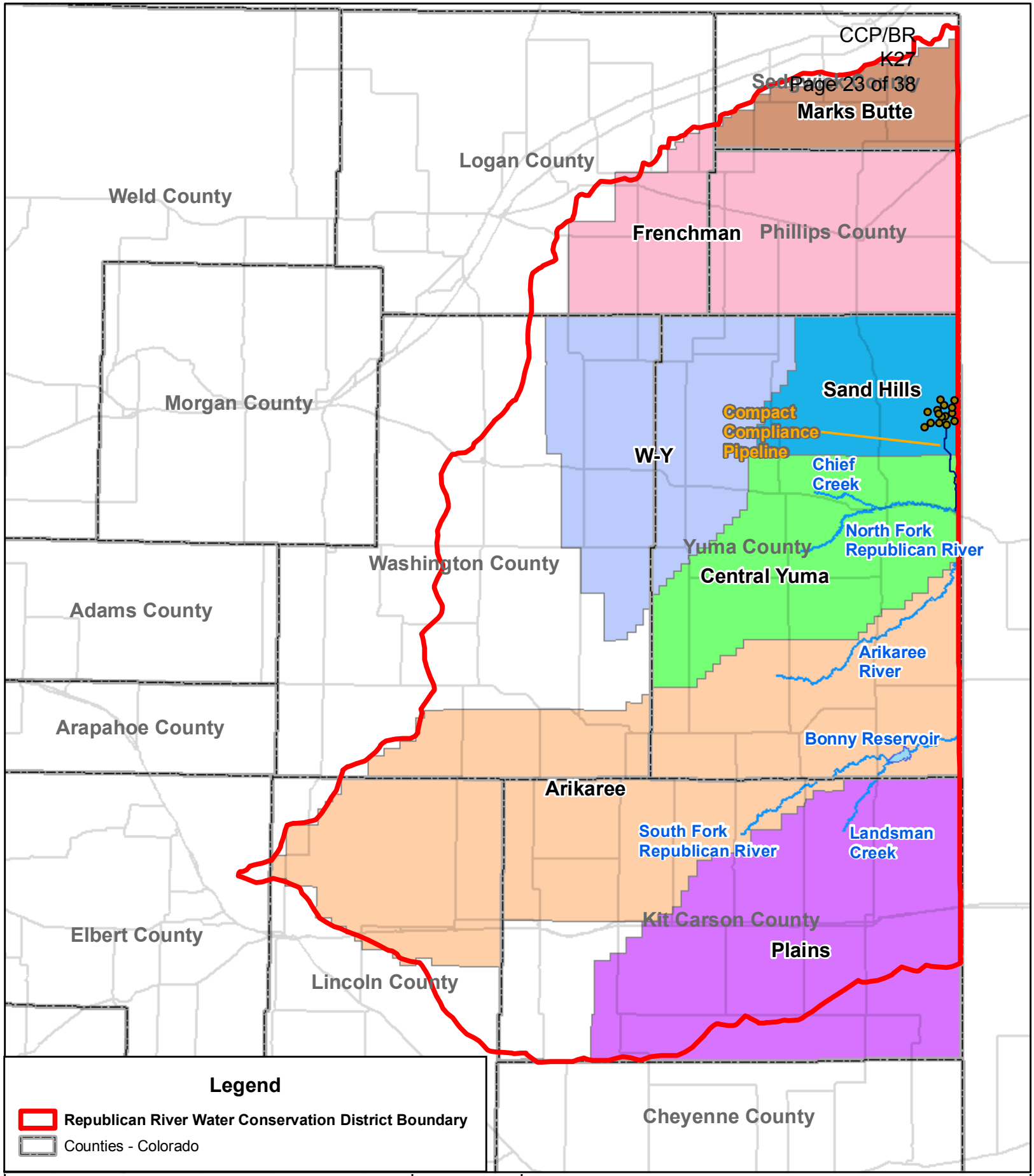
N W E S

Slattery & Hendrix Engineering LLC

Job No.	P2501
File:	Fig 2 - RRB.mxd
Date:	05/17/10
Prepared For:	RRWCD

Figure 2

High Plains Aquifer and Republican River Basin



0 7.5 15 30
Miles

N W E S

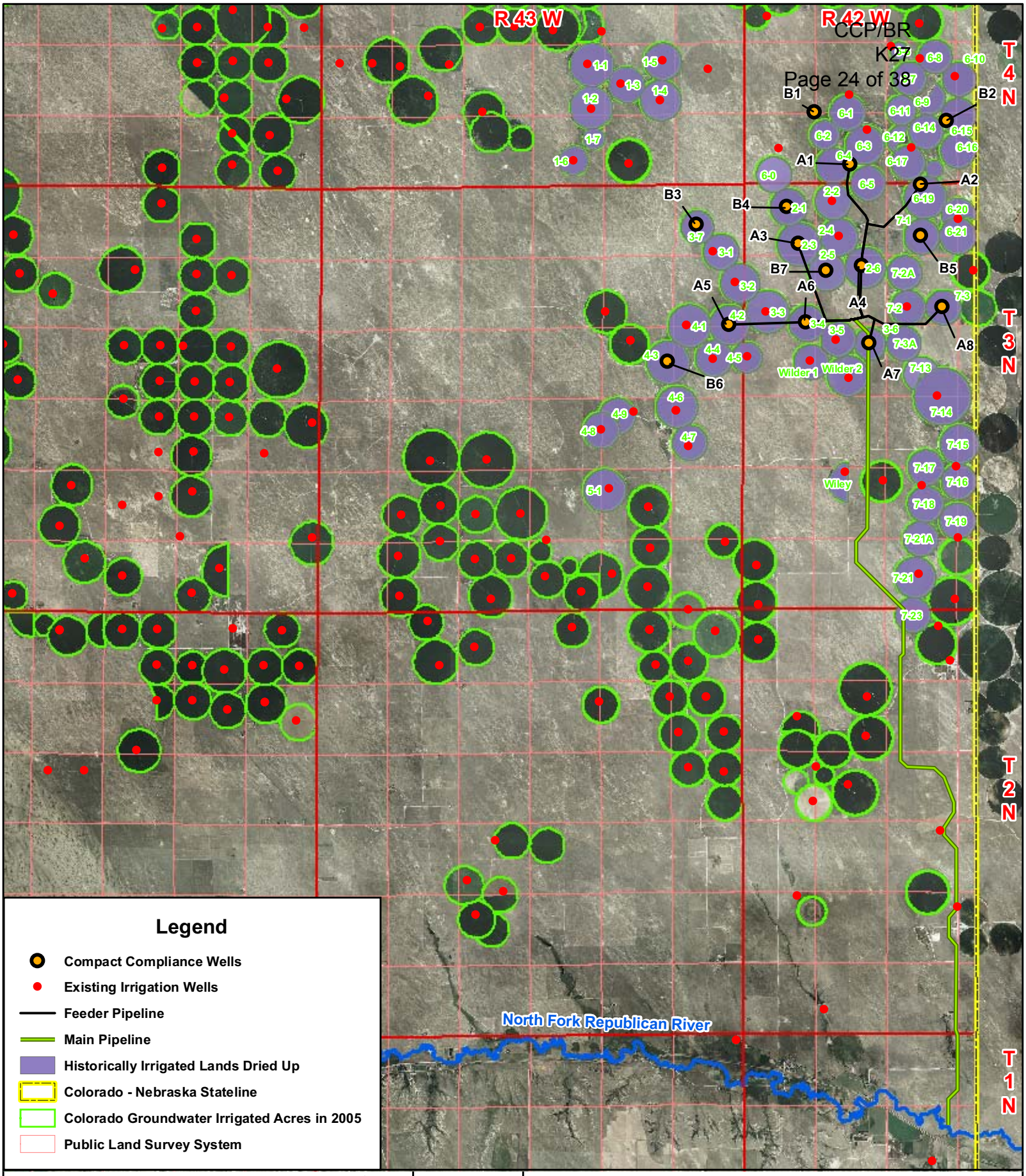
Slattery & Hendrix Engineering LLC

Job No. P2501
File: Figure 3 RRB.mxd
Date: 05/19/10
Prepared For: RRWCD

Figure 3

Colorado Republican River Basin

Republican River Water Conservation District and Groundwater Management Distrtict Boundaries



Slattery & Hendrix Engineering LLC

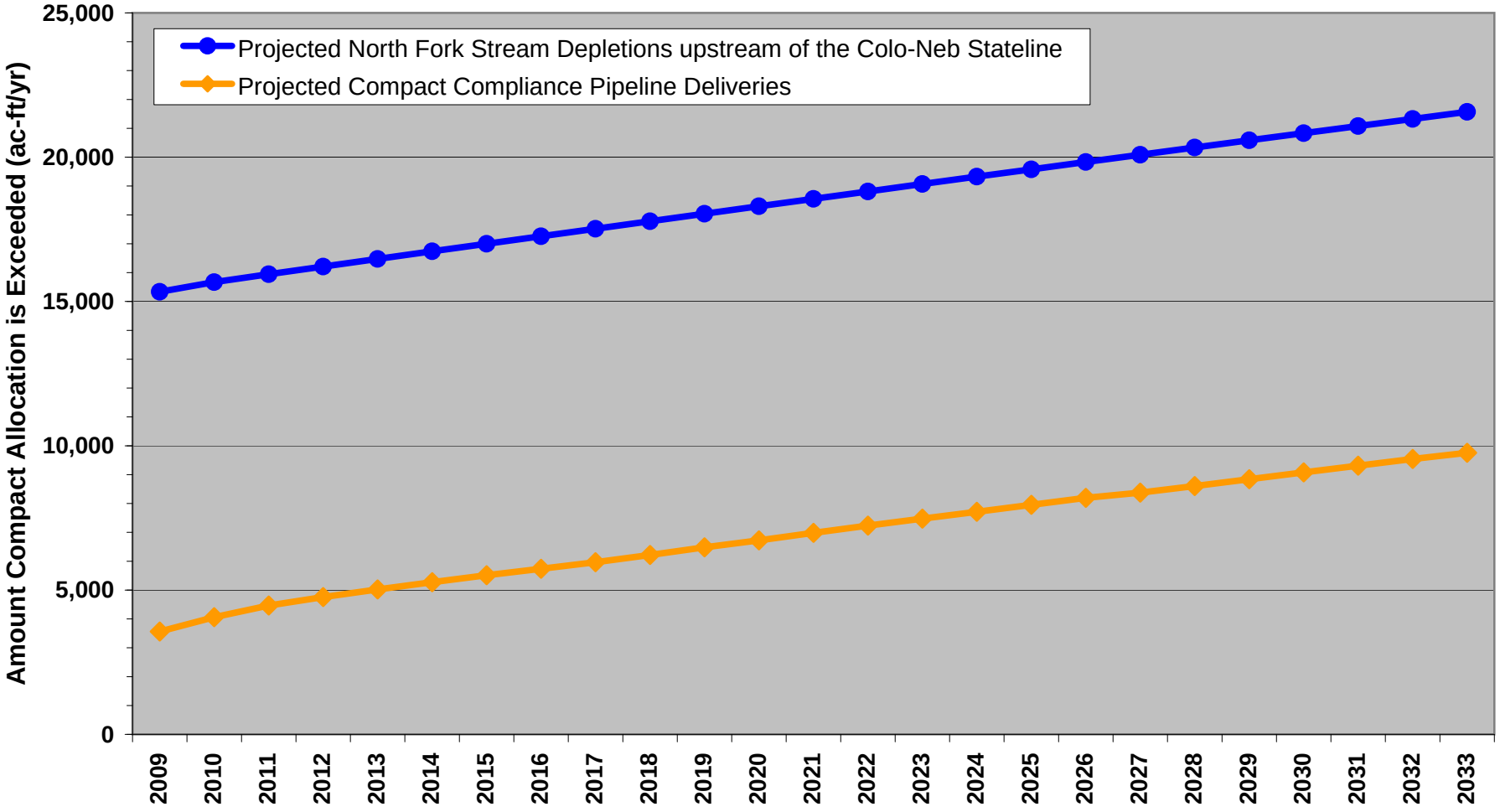
Job No.	P2501
File:	Figure 4 RRB.mxd
Date:	05/18/10
Prepared For:	RRWCD

Figure 4

Location of Compact Compliance Wells and Historically Irrigated Lands Dried Up for the Compact Compliance Pipeline

Figure 5

Projected North Fork of the Republican River Stream Depletions versus Projected Compact Compliance Pipeline Deliveries



Note: The projected North Fork stream depletions assume the projected pumping conditions are equal to the average pumping for the 1999-2008 period and the precipitation recharge is equal to the 1918-2008 average. See Figure 10 for the derivation of the projected compact compliance pipeline deliveries.

Figure 6

Acres Irrigated by Groundwater in the Colorado Republican River Basin

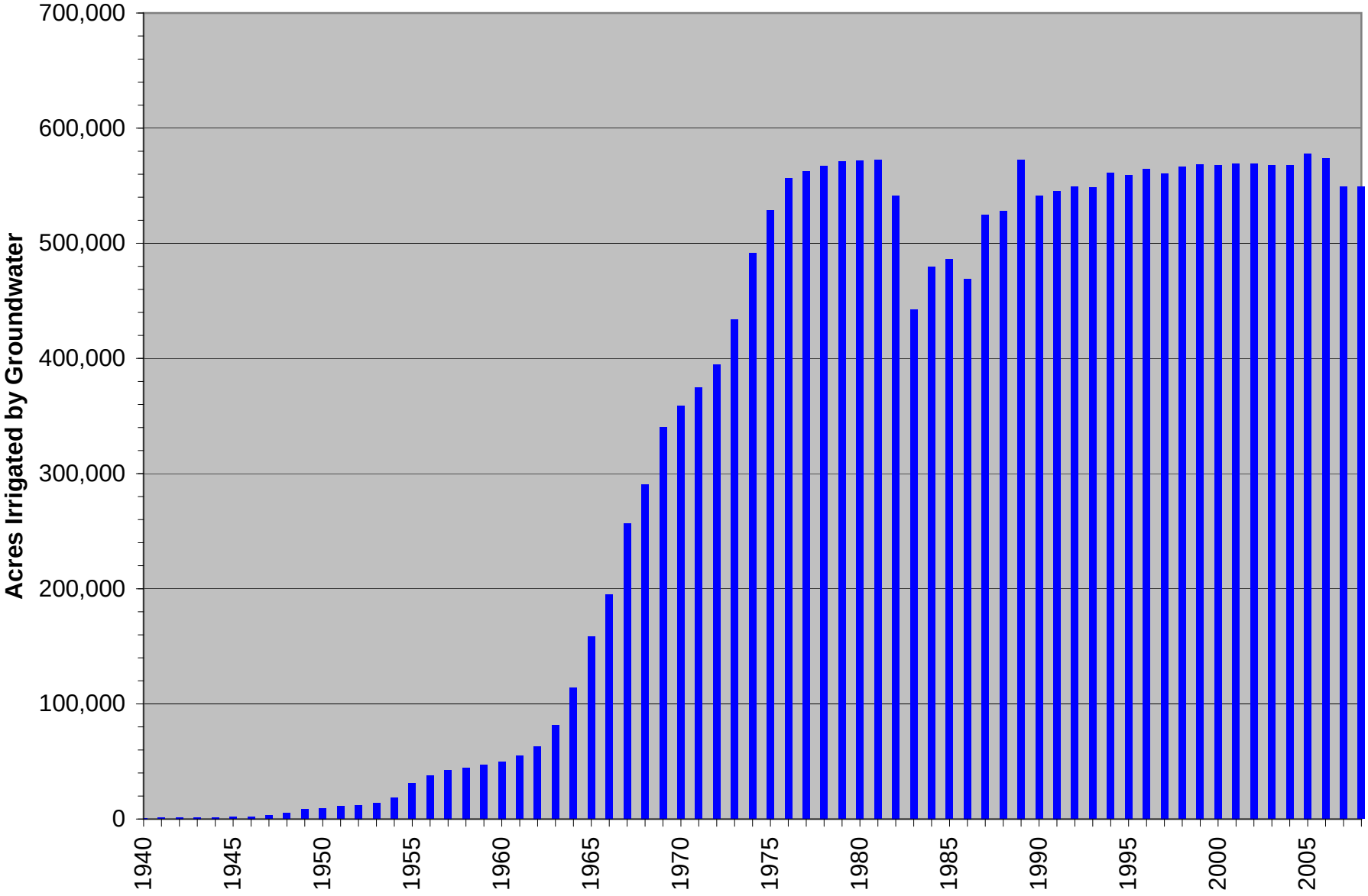


Figure 7
Amount Colorado Exceeded Compact Allocation

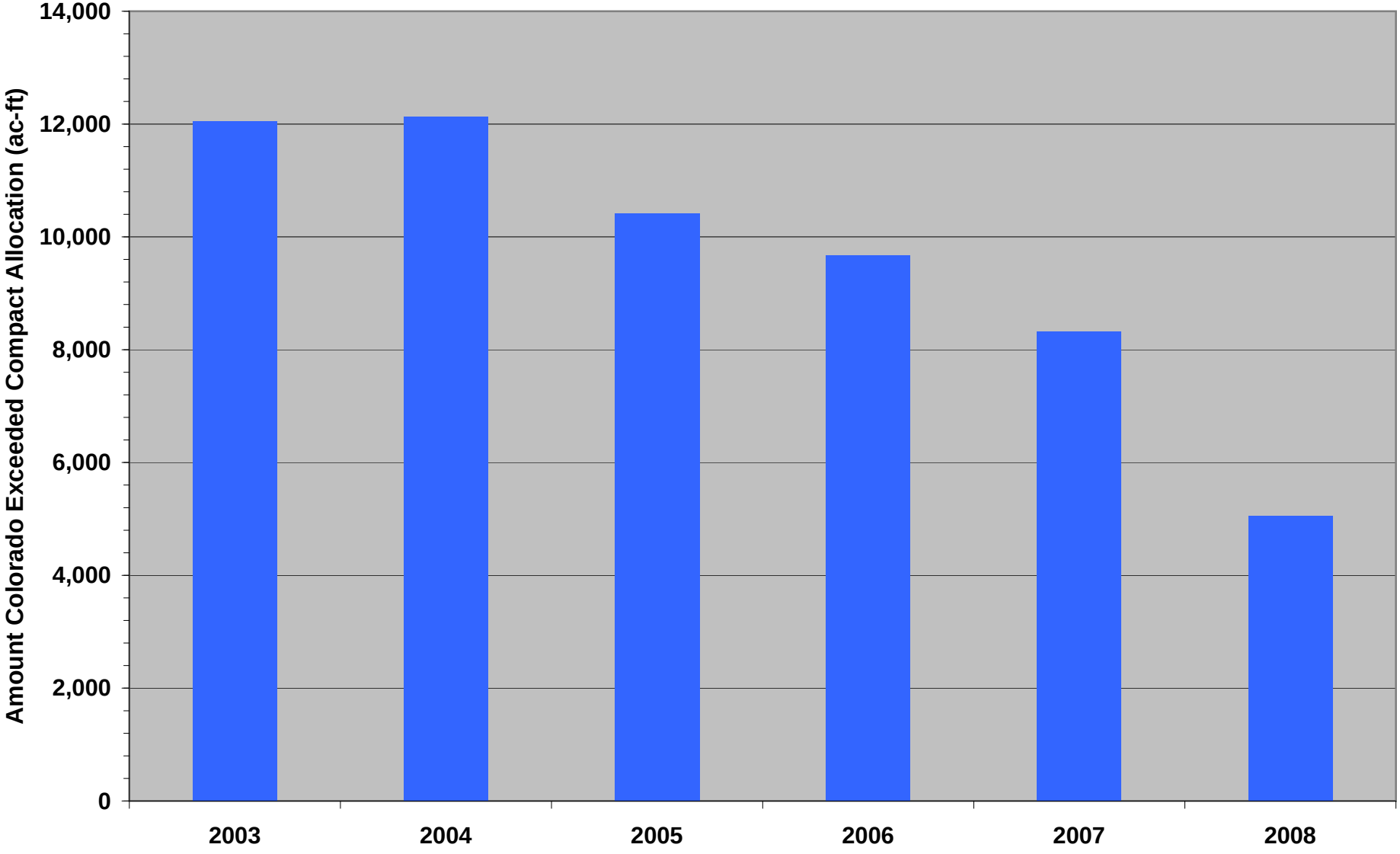


Figure 8
Components of Historical Consumptive Use In Colorado
(Average for 2003-2007)

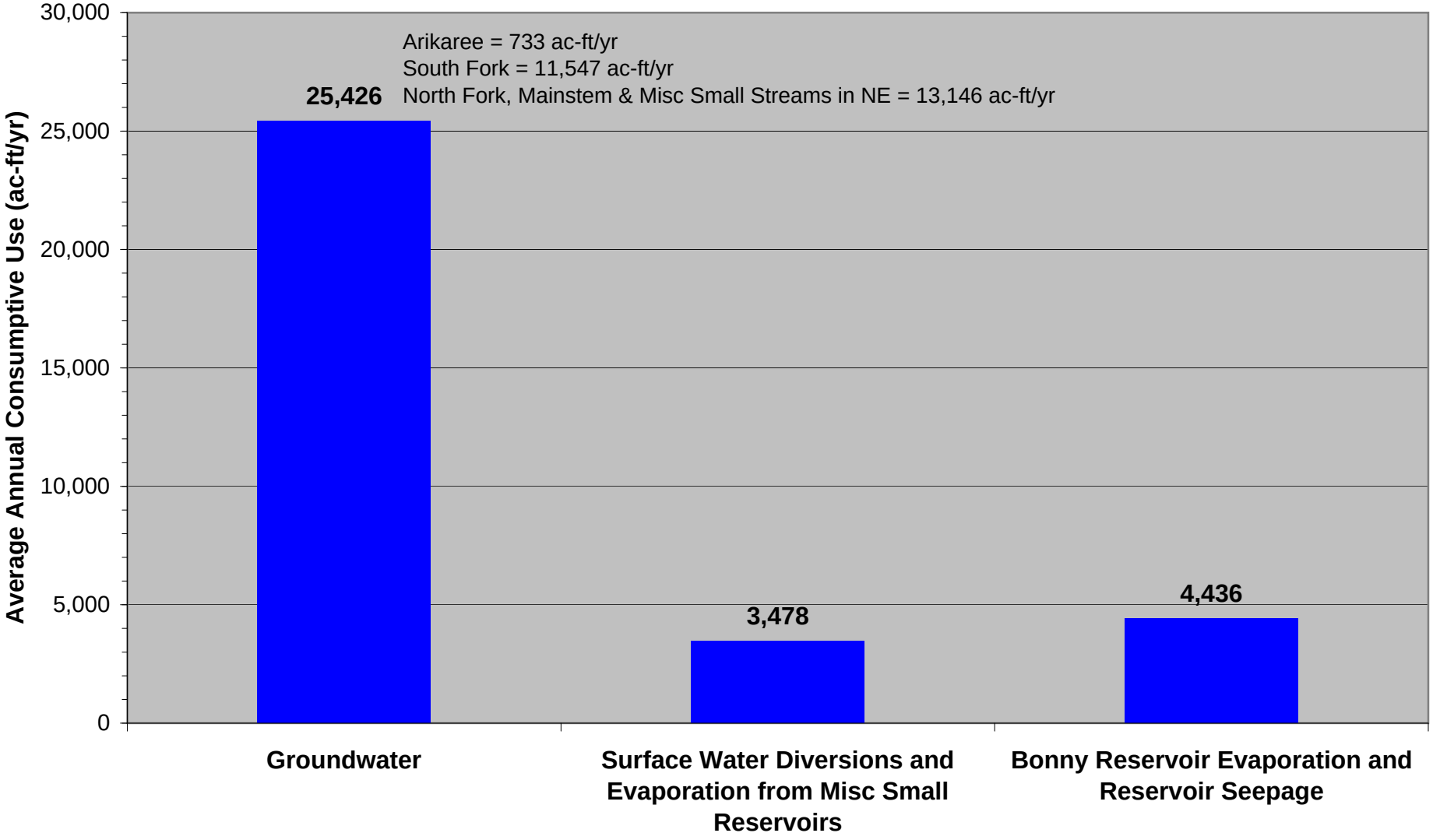
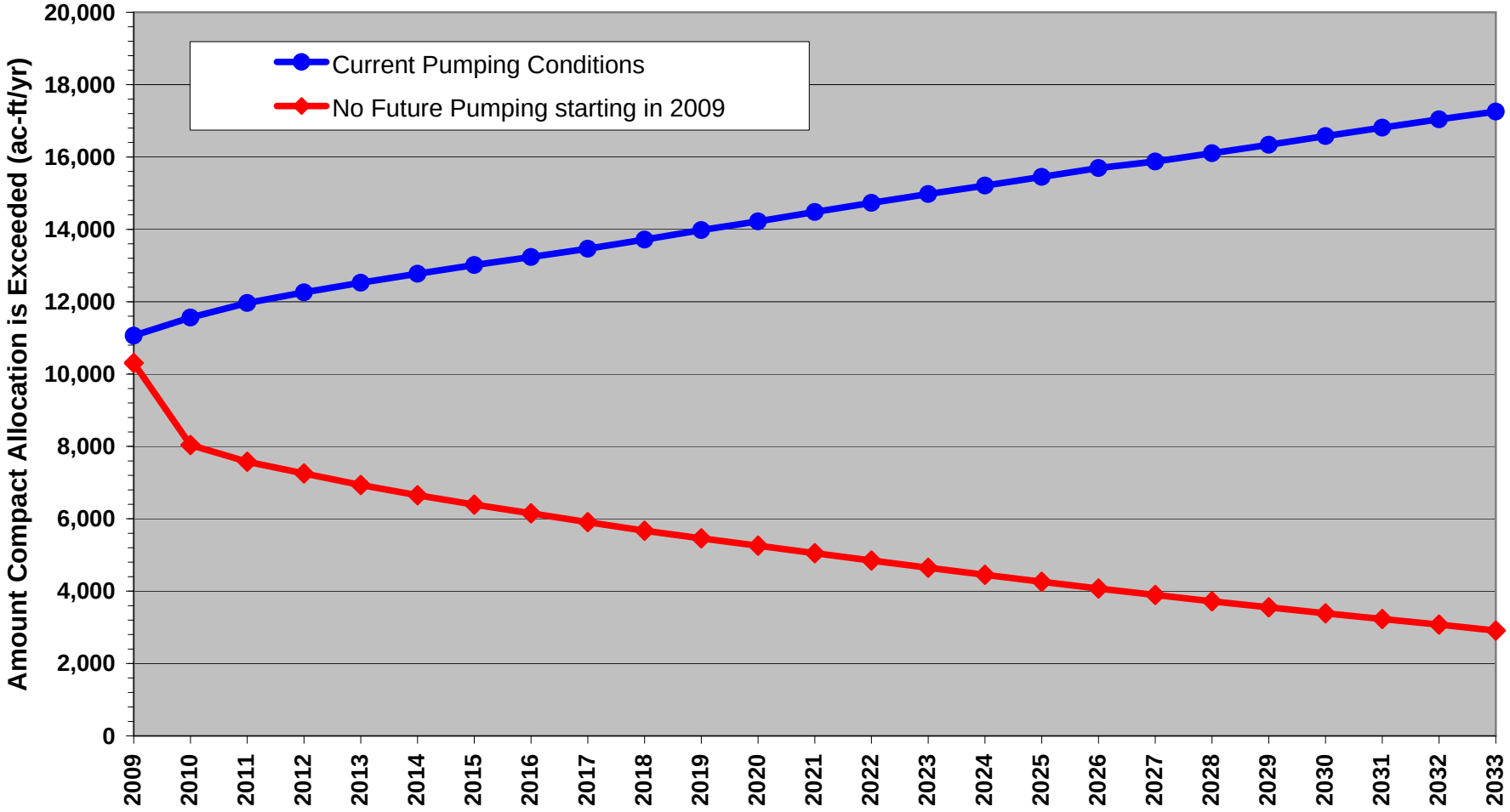


Figure 9

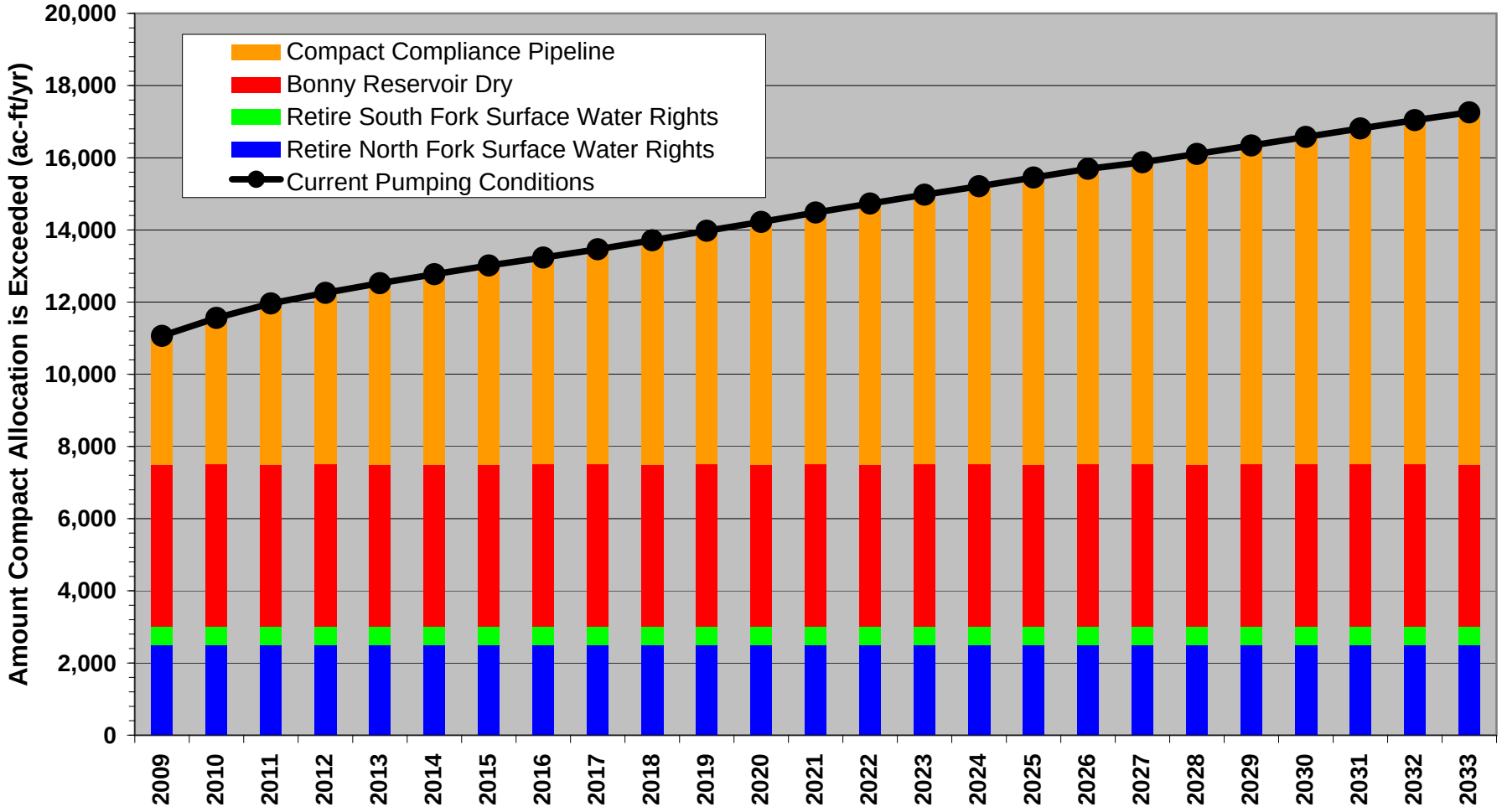
Projected Compact Compliance under Current Pumping and No Pumping Conditions



Note: The current pumping conditions projection assumes projected pumping conditions are equal to the average pumping for the 1999-2008 period and the precipitation recharge is equal to the 1918-2008 average. The amount the compact allocation is exceeded is based on the average value for the 2003-2007 period and does not reflect the 2,500 ac-ft/yr reduction in Colorado's consumptive use from the surface water rights purchased by Colorado.

Figure 10

Projected Compact Compliance with Compact Compliance Pipeline in Operation



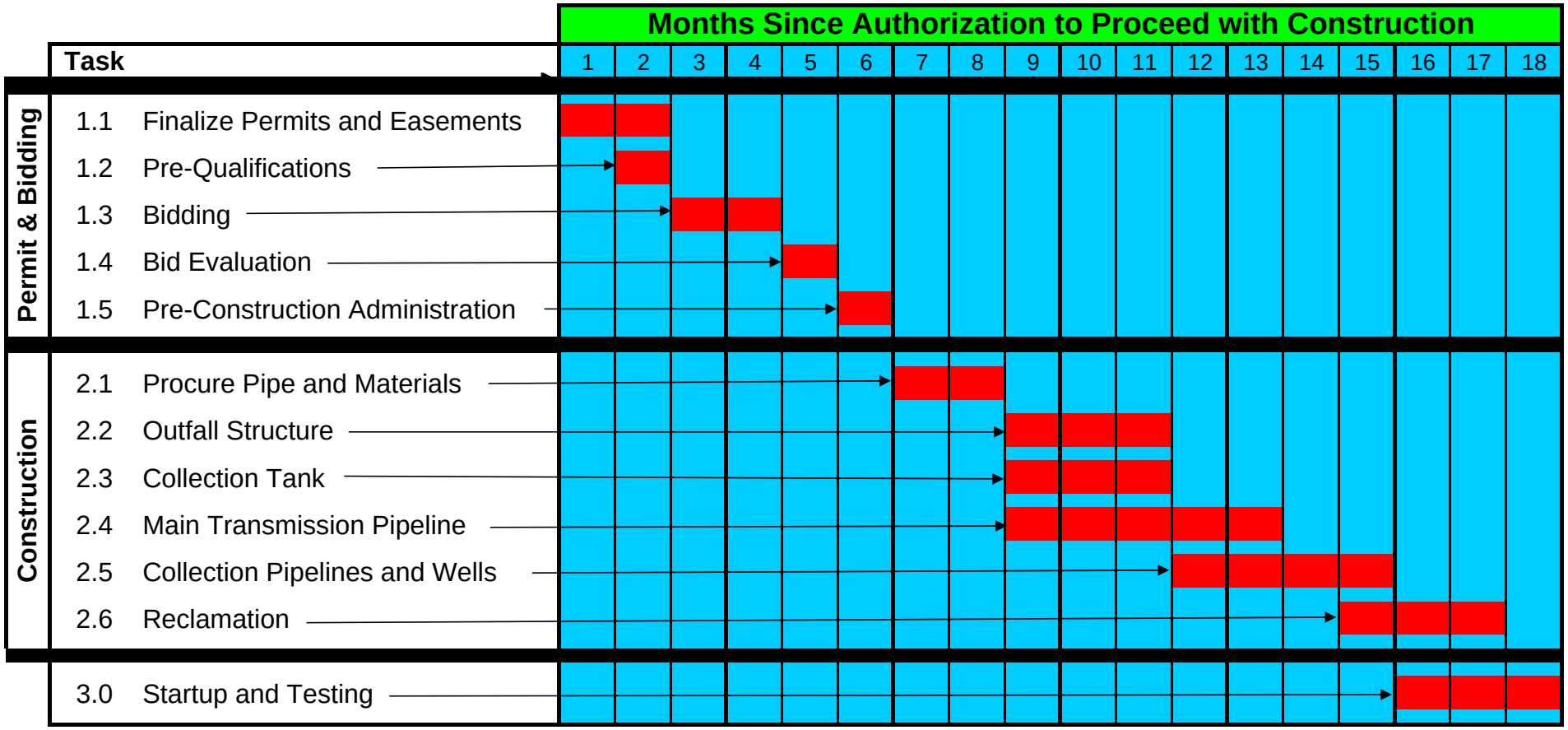
Note: The current pumping conditions projection assumes projected pumping conditions are equal to the average pumping for the 1999-2008 period and the precipitation recharge is equal to the 1918-2008 average. The amount the compact allocation is exceeded under current pumping conditions is based on the average value for the 2003-2007 period and does not reflect the 2,500 ac-ft/yr reduction in Colorado's consumptive use from the surface water rights purchased by Colorado.

Table 1

Republican River Water Conservation District
Water Activity Enterprise
Water Use Fees

TYPE OF USE	2004	2008
Irrigation	$5.50 per acre	$14.50 per acre
Commercial/Municipal	$4.40 per acre-foot	$11.60 per acre-foot
Surface Water Consumptive Use	$5.10 per acre-foot	$13.45 per acre-foot

Table 2
Compact Compliance Pipeline Construction Schedule



Note: Final Design specifications and drawings were completed by GEI Consultants in November 2009 at a cost of $1.2 million.

Table 3
Rights to Designated Groundwater

Field Number	Permit #1	Permit #2	Acreage in Change of Use Form	Colorado Groundwater Commission Historical Consumptive Use (ac-ft/yr)	Corrected Historical Consumptive Use (ac-ft/yr)	Maximum Annual Volume of Appropriation (ac-ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1-1	12967-FP	16920-FP	194	345	333	493
1-2	14403-FP		181	279	279	458
1-3	14019-FP		133	217	206	338
1-4	14018-FP		164	252	234	418
1-5	19372-FP		136	218	211	340
1-6 and 1-7	18780-FP		127	192	192	345
Subtotal			**935**	**1,502**	**1,455**	**2,392**
2-1	14396-FP		130	192	180	325
2-2	13858-FP		133	228	206	333
2-3	13859-FP	16069-FP	188	270	260	473
2-4	13857-FP		147	229	217	365
2-5	14398-FP		144	240	230	360
2-6	13856-FP	16067-FP	164	249	249	413
Subtotal			**906**	**1,408**	**1,342**	**2,269**
3-1	14397-FP		127	192	184	315
3-2	14027-FP		153	251	237	385
3-3	14022-FP		180	289	255	450
3-4	14023-FP		133	219	197	333
3-5	14600-FP		124	197	187	315
3-6	15285-FP		98	161	140	243
3-7	20896-FP		107	169	168	265
Subtotal			**922**	**1,479**	**1,369**	**2,306**
4-1	13513-FP	16074-FP	186	302	257	468
4-2	14028-FP		146	218	202	365
4-3	14753-FP		185	310	267	463
4-4	13522-FP		135	204	189	343
4-5	14024-FP		93	141	129	235
4-6	13509-FP	16075-FP	179	284	273	448
4-7	13511-FP		123	192	173	310
4-8	18781-FP		128	216	206	320
4-9	21476-FP		88	144	139	220
5-1	18783-FP		173	273	273	400
Subtotal			**1,437**	**2,285**	**2,108**	**3,572**
6-0	19004-FP		82	141	141	700
6-1	19005-FP		124	178	174	335
6-2	18966-FP		94	172	172	900
6-3	18018-FP		148	230	218	400
6-4,6-5	18017-FP	19001-FP	245	361	353	800
6-6, 6-7	23222-FP		148	230	230	200
6-8	18019-FP		107	173	163	400
6-9, 6-10	18014-FP		176	259	247	400
6-11,12,13,14	18013-FP		250	350	350	400
6-15, 6-16	18011-FP		244	431	421	900
6-17, 6-18, 6-19	18015-FP		329	549	497	900
6-20, 6-21	18012-FP	19000-FP	208	322	317	582

Field Number	Permit #1	Permit #2	Acreage in Change of Use Form	Colorado Groundwater Commission Historical Consumptive Use (ac-ft/yr)	Corrected Historical Consumptive Use (ac-ft/yr)	Maximum Annual Volume of Appropriation (ac-ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Subtotal			**2,155**	**3,397**	**3,283**	**6,917**
7-1	13813-FP	16923-FP	126	206	203	400
7-2, 7-2A	13814-FP		219	334	323	480
7-3, 7-3a	13815-FP		197	291	311	480
7-13, 7-14	14718-FP		358	526	526	800
7-15, 7-16	14121-FP		285	437	420	800
7-17, 7-18	14719-FP		263	455	424	800
7-19 [a)]	14122-FP		131	215	204	400
7-21, 7-21A	12589-FP		251	376	372	560
7-23	12567-FP		126	201	201	315
Subtotal			**1,957**	**3,041**	**2,983**	**5,035**
Wiley	4319-FP	4922-FP	65	75	75	125
Wilder1	20198-FP		124	194	194	325
Wilder2	20196-FP		163	249	249	450
Subtotal			**352**	**518**	**518**	**900**
Total			**8,664**	**13,630**	**13,059**	**23,391**

a) Permit allows for irrigation of parcels 7-19 and 7-20. Only the portion of permit historically used to irrigate parcel 7-19 is included in this table.

Explanation of Columns

(1) Field Number as shown on Figure 4.

(2) Final permit for the Northern High Plains Designated Ground Water Basin. See permit for well location, priority date, and other information, including any allowable commingling with other

(3) Second permit associated with the permit shown in column 2. Typically, these are permits for additional acreage, but see permit for details.

(4) Average acreage reported in change of use form submitted to the Colorado Groundwater

(5) Historical consumptive use determined from irrigated acreage, crop records and power records. For permits in February 25, 2008 application the values are from the March 19, 2008 DWR Publication letter. For permits in October 22, 2008 submittal the values are from the December 8, 2008 DWR Publication letter.

(6)

In April of 2008 Marc Groff, a consultant for the State of Nebraska, identified an error in the consumptive use calculations made in the February 25, 2008 submittal to the Colorado Groundwater Commission. This error was documented by the State of Colorado in a memorandum provided to the State of Nebraska and the State of Kansas entitled "Revisions to Crop Irrigation Requirement Use Estimates included in March 2008 RRCA Submittal for the Republican River Compact Compliance" dated May 18, 2008. This error was corrected and was not included in the October 22, 2008 submittal. The Consumptive Use values shown in Column 7 are the corrected February 25, 2008 values and the October 22, 2008 values.

(7) Amount of annual permitted withdrawal determined from well permit. This information is used to set the water banking limitations by the Colorado Groundwater Commission.

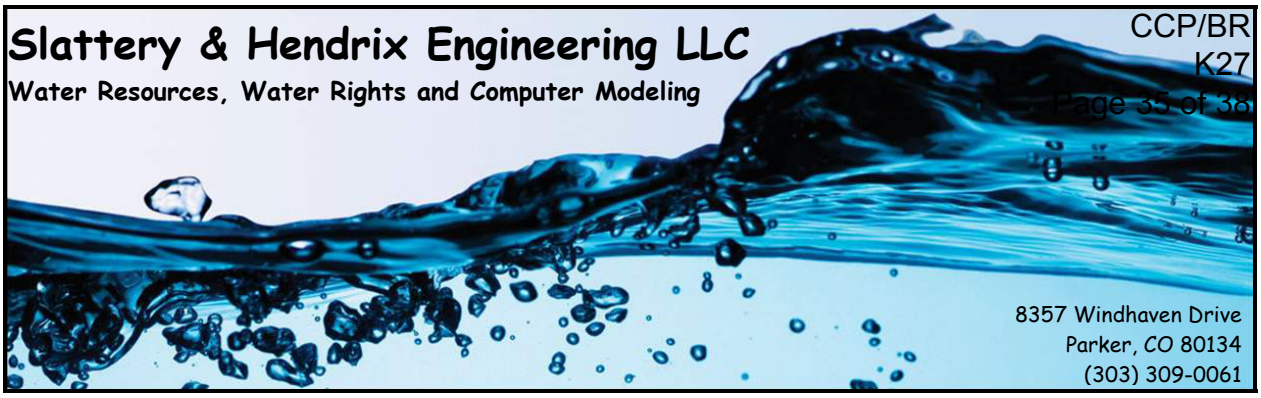


Table 4 – Resume of James E. Slattery

EDUCATION:
Colorado State University - B. S. Civil Engineering, 1984
Colorado State University - M.S. in Civil Engineering - Ground Water Modeling, 1986

SOCIETIES: American Society of Civil Engineers

REGISTRATION: Registered Professional Engineer in Colorado

EXPERIENCE:

2007- **Slattery Aqua Engineering LLC and Slattery & Hendrix Engineering LLC, Parker, Colorado – Member**

Water Engineer for the Republican River Water Conservation District responsible for evaluating various water supply alternatives to assist the State of Colorado to get into compact compliance with the Republican River Compact Administration. Responsible for the evaluation and transfer of approximately 15,000 ac-ft of consumable water from irrigation to compact compliance. District's engineering representative in the design of a $21 million pipeline system to collect and deliver well field water to the North Fork of the Republican River. Provided expert testimony for the State of Colorado in two Arbitration hearings regarding compact compliance issues on the Republican River.

Represent a range of clients throughout Colorado in water resource matters including the Upper Gunnison River Water Conservancy District, the City of Westminster, the State of Colorado, the Rio Grande Water Users Association, the State of Colorado, the Denver Water Department, the Evergreen Metropolitan District, and the Republican River Water Conservancy District. Worked on variety of water rights transfer cases involving, expert witness court testimony, development of surface water and groundwater models, evaluation of replacement supplies, and the evaluation of historical consumptive use.

Developed accounting spreadsheets to document the use of water rights and return flow obligations for the City of Woodland Park, the City of Manitou Springs, the City of Westminster, and the Evergreen Metropolitan District. Prepared expert reports for Denver Water concerning water right diligence applications in the Williams Fork basin and in the Blue River Basin.

Worked on behalf of the Rio Grande Water Users Association to determine and develop necessary water supplies to replace well depletions. Since 2003, participated in a peer review committee to update and refine the MODFLOW groundwater model developed as part of the Rio Grande Decision Support System. Testified as an Expert Witness in two separate court cases regarding the use and application of the groundwater model to estimate stream depletions from confined and unconfined aquifer pumping in the San Luis Valley.

1995-2006 **Helton & Williamsen, P.C., Englewood, Colorado**

Vice President – Responsible for projects involving water supply, water requirements, water rights, reservoir operation, and basin-wide planning. Experienced in the analysis of databases and in developing computer models to solve water resource problems.

Performed consumptive use studies to determine water use patterns for both surface and ground water supplies. Representative assignments include the development of a spreadsheet model of the Bear Creek basin, engineering analyses and expert testimony in the second phase of Kansas v. Colorado in the U.S. Supreme Court, development of a daily basin planning model for the Clear Creek basin, and development of a monthly spreadsheet model of the Upper Gunnison basin. Testified as an expert witness in Case No. 2004CW24 concerning rules and regulations for new wells in the confined aquifer in the San Luis Valley.

Performed a needs and storage assessment for the Upper Gunnison River Water Conservancy District. Modified and enhanced the HI model of the lower Arkansas River Basin as part of the Kansas v. Colorado U.S. Supreme Court case on the Arkansas River. Appointed to the 3 member team to represent Colorado in the Kansas v. Nebraska v. Colorado U.S. Supreme Court Case concerning litigation in the Republican River basin. Involved in numerous Colorado water court cases concerning the transfer of use water from agricultural to municipal purposes.

Developed or reviewed various MODFLOW groundwater models in Colorado including a groundwater model for the sandstone and granite aquifers in the vicinity of Woodland Park. Member of the peer review committee for the MODFLOW model developed by the Colorado Department of Water Resources for the San Luis Valley. Testified as an expert witness in Case No. 2004CW24 regarding the inflow and outflow components for the MODFLOW groundwater model of the San Luis Valley.

Developed augmentation plans to cover various water uses throughout the state of Colorado including the augmentation plan for the Lower Arkansas Water Management Association to augment well depletions from approximately 700 wells in Case No. 02CW181.

1986-1995 **Boyle Engineering Corporation, Lakewood, CO.**

(1992-1995) Project Manager. Managed a wide range of water resource and computer modeling projects, including the development of PACSM a comprehensive computer model representing the operation of Denver Water's

water supply system. This model simultaneously represents the operation of Denver Water's facilities in both the South Platte and the Colorado River basins using a daily time step and a 45-year study period. Another model was developed to evaluate the monthly operation of the water supply system for the City of San Diego. Served as technical reviewer for numerous other computer modeling projects and water resource studies including ground water models in North Carolina, Florida, Colorado, and California. Analyzed and reviewed numerous ground water pumping tests throughout the United States for unconfined, confined, and leaky-confined aquifers.

(1986-91) Water Resources Engineer. Responsible or assisted in the development of water supply, water rights, surface water, and ground water studies, and for surface water and ground water modeling projects. Specific tasks included numerous applications of the USGS three-dimensional MODFLOW model to ground water basins throughout the United States. Also, applied a three-dimensional finite element model to evaluate surface water-ground water conditions and interactions in the Central Valley of California. Served as an expert for the State of Colorado in Kansas v. Colorado in the U.S. Supreme Court. Responsible in this case for developing the ground water pumping estimates used to assess the impacts of ground water pumping on historical streamflows.

Table 5

List of Court Cases in the Last 4 years which James E. Slattery Testified as an Expert Witness at Trial or Deposition

Date	Type	Case No.	Description	Client
June 3, 2008	Court Testimony	Case No. 04CW24	Testified via telephone concerning engineering cost to prepare expert report and to provide expert witness testimony in Case No. 04CW24.	Rio Grande Water Users
November 19, 2008	Deposition	Case No. 04CW24	Deposition regarding expert report and opinions in water rights diligence case concerning the Roberts Tunnel direct flow water right.	Denver Water
March 18, 2009	Arbitration Testimony	Kansas v. Nebraska v. Colorado Arbitration	Testimony regarding proposed changes to the compact accounting procedures of the Republican River Compact Administration	State of Colorado
October 5-6 and 8, 2009	Testimony	Case No. 06CV64 & 07CW52	Testimony in the matter Concerning the Office of the State Engineer's approval of the plan of water management for Special Improvement District No. 1 of the Rio Grande Water Conservation District.	Rio Grande Water Users