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Jackie McClaskey, Secretary

Governor Sam Brownback

July 15, 2016

Kathleen R. Dennis
Assistant Regional Director
U.S. Dept. of the Interior/Fish & Wildlife Service
PO Box 25486
Denver Federal Center
Denver, CO 80225-0486

Dear Ms. Dennis,

Attached is our final report for the impairment investigation requested by the U.S. Fish and Wildlife Service related to its Water Right File No. 7,571 for the Quivira National Wildlife Refuge.

No action will be taken based on our findings without the written request of the Service to secure water.

I understand the next meeting of the Service, Big Bend Groundwater Management District No. 5, the basin stakeholders and the Department will be July 27, 2016 in Wichita. We look forward to continuing to work with all in exploring options for resolving the underlying concerns.

Sincerely,

David W. Barfield, P.E.
Chief Engineer
Division of Water Resources

pc: Big Bend GMD No. 5
WaterPack

Final Report of the Chief Engineer

Prepared pursuant to K.A.R. 5-4-1

Concerning a Claim of Water Right Impairment

In the Matter of

Water Right File No. 7,571

Owned and operated by

U.S. Fish and Wildlife Service

July 15, 2016

David W. Barfield, P.E.
Chief Engineer
Division of Water Resources
Kansas Department of Agriculture

This final report provides the results of DWR's impairment investigation requested by the U.S. Fish and Wildlife Service related to their water right for the Quivira Refuge, Water Right File No. 7,571.

The United States Fish & Wildlife Service (Service) holds Water Right File No. 7,571; a surface water right near the bottom of the Rattlesnake Creek for its Quivira National Wildlife Refuge. The Refuge's water right entitles it to take water from Rattlesnake Creek at three points of diversion at a combined maximum diversion rate not in excess of 300 cubic feet per second and a quantity not to exceed 14,632 acre-feet of water per calendar year for recreational use. The Refuge is located along the Central Flyway and consists of 7,000 acres of wetlands. The Refuge uses water primarily to provide habitat for several hundred species of birds and other animals, including several federally protected endangered species.

Over the last three decades, the Service has alleged that junior groundwater pumping above the Refuge has resulted in periods of significant water shortages at the Refuge. For more than 15 years, the Service worked with the Rattlesnake Partnership, seeking to bring about voluntary reductions in use to improve its supply. On April 8, 2013, the Service requested this impairment investigation.

DWR reviewed existing records and gathered additional information on the Refuge's infrastructure, historical use and shortages, and the pattern of water needs at the Refuge as part of this investigation. DWR used the GMD 5 groundwater model to determine the magnitude and timing of streamflow depletions due to upstream, junior groundwater pumping on water availability at the Refuge. Finally, DWR compared the streamflows that would have been available but for the effects of junior groundwater pumping with the seasonal needs of the Refuge to estimate the magnitude and frequency of impairment in the record reviewed.

A technical report on the investigation and data analyses is attached hereto.

Based on our impairment investigation, I make the following findings and conclusions.

Findings

Upstream, junior groundwater pumping within the Basin is and has been significantly reducing water availability at the Refuge on the order of 30,000-60,000 acre-feet per year over the recent record (1995-2007). This does not mean that the Refuge is being impaired by 30,000-60,000 acre-feet per year, but rather that junior

groundwater pumpers are taking that much out of the stream; water that would have otherwise flowed through or past the Refuge.

In comparing the seasonal needs of the Refuge, within the scope of its water right, with water that would have been available at the Refuge but for the effect of junior pumping, I find that the Refuge's water supply has been regularly and substantially impacted by junior groundwater pumping (see Figures 5-8 and Figure 9 of the report). Over the 34 years reviewed, shortages — when junior groundwater pumping prevented the Refuge from exercising its water right — were greater than 3,000 acre-feet in 18 years, particularly during periods of limited water supply.

As evidenced by various scenarios reviewed in the modeling report, while it will take years, reductions in groundwater pumping will restore streamflow at the Refuge.

DWR's analysis of water right data, water use data, and groundwater modeling analysis indicates that, due to the relatively small amount of pumping adjacent to the stream and the multi-year lag between pumping reductions and streamflow enhancement, real-time administration of junior groundwater pumping (i.e. curtailment only during periods of shortage) is unlikely to restore streamflow quickly enough to prevent impairment at the Refuge. Long-term reductions in upstream, junior groundwater pumping and/or the use of augmentation appear to be the only practical physical remedies to the impairment of the Refuge's water right.

My finding of impairment is based on historical simulations using the GMD 5 groundwater model and a retrospective analysis of the Service's needs. While I find this sufficient to conclude that impairment has occurred in the past and will occur in the future, the actual magnitude and timing of future impairment will depend on the specific circumstances. For instance, the Service has acknowledged that significant drought periods, and the resulting water shortages, are part of the natural hydrologic cycle, and DWR's impairment analysis does not directly factor in the Service's use of storage in Little Salt Marsh, which, in practice, may help to reduce some shortages to a limited degree.

Based on the historical analysis, and assuming that the basin's hydrology will not significantly change, for better or worse, in the next several decades, it appears that, to relieve the impairment of the Service's water right, groundwater reductions and/or augmentation will be needed to increase available streamflow at the Refuge by 3,000-5,000 acre-feet on a regular basis.

Conclusion

Based on the results of this investigation, I conclude that upstream, junior groundwater pumping regularly and significantly impairs the Service's ability to use its Water Right File No. 7,571.

Further, I find this impairment is not substantially due to regional overall lowering of the water table, but is principally due to ongoing impacts of junior groundwater pumping and the associated reduction in outflows from the groundwater system to the stream system.

Pursuant to K.A.R. 5-4-1, this report is posted on the agency's website as of July 15, 2016: agriculture.ks.gov/quivira.

Technical Report

Prepared pursuant to K.A.R. 5-4-1

on a Claim of Water Right Impairment
In the Case of

Water Right File No. 7,571
owned and operated by

United States Department of the Interior
Fish & Wildlife Service
Quivira National Wildlife Refuge

July, 2016

Division of Water Resources
Kansas Department of Agriculture

i. Executive Summary

Quivira National Wildlife Refuge ("Refuge") is located in south-central Kansas and primarily gets its water supply from Rattlesnake Creek which runs into and through the Refuge. The Refuge is located midway along the Central Flyway and consists of about 7,000 acres of wetlands. The Refuge uses water primarily to grow feed crops and maintain wetlands at certain depths to provide habitat for several hundred species of birds and other animals, including several federally protected endangered species. The Refuge is owned and operated by the United States Fish & Wildlife Service (Service), a part of the United States Department of the Interior.

After nearly three decades of expressing concerns that junior groundwater appropriators upstream of the Refuge are depleting the streamflow in Rattlesnake Creek, and working with local water users and the groundwater management district to try to find solutions to their concerns, the Service lodged an impairment complaint with the Kansas Department of Agriculture Division of Water Resources (KDA-DWR) in an April 8, 2013, letter.

The Service owns Water Right File No. 7,571; which is senior in priority to about 95% of the water rights in the basin, and which entitles the Refuge to divert up to 14,632 acre-feet of surface water each year from Rattlesnake Creek, when water is available.

Results from KDA-DWR's simulations using a groundwater model commissioned by Big Bend Groundwater Management District #5 ("GMD5") and built by groundwater modeling consultants, show that junior groundwater pumping upstream of the refuge has significantly reduced streamflow available to the Refuge over the years.

Using the modeling results and the Service's operational guide, which lays out the Refuge's seasonal water needs, KDA-DWR finds that junior groundwater pumping in Rattlesnake Creek impaired the Refuge's water right, to varying degrees, in 26 of the 34 years 1974-2007. The results showed that the impairment was greater than 3,000 acre-feet in 18 of the 34 years. However, the results also showed that, because groundwater moves very slowly, shutting off junior groundwater pumping would take two or more years to significantly benefit streamflow.

Since there have been no substantial long-term changes to pumping levels or precipitation trends in the region of the basin closest to the Refuge, it is reasonable to conclude that the impacts to streamflow caused by pumping will continue into the foreseeable future.

ii. Procedure, Content and Nature of this Report

This report was developed pursuant to the duties and responsibilities of the chief engineer and KDA-DWR set forth in the Kansas Water Appropriation Act, including but not limited to K.S.A. 82a-702, 82a-706, 82a-706b, 82a-707, and 82a-711a, and the procedures set forth in K.A.R. 5-4-1.

This technical report was developed to support the initial report of the chief engineer as described in 5-4-1(c)(2).

This report is intended to present the facts analyses performed to inform the chief engineer's finding on water right impairment. This report is not intended to evaluate or prescribe any particular remedy or resolution of any impairment observed.

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1. Introduction and Background

After several decades of expressing concerns that junior groundwater pumpers were interfering with and harming the management operations of the Quivira National Wildlife Refuge (Refuge) by depleting the streamflow in Rattlesnake Creek which supplies the Refuge, in an April 8, 2013, letter, the United States Fish & Wildlife Service (Service) lodged an impairment complaint with the Kansas Department of Agriculture Division of Water Resources (KDA-DWR). This report summarizes KDA-DWR's resulting investigation. See Attachments 1 and 2.

In the late 1980s, the Service began to express concerns to KDA-DWR and Big Bend Groundwater Management District #5 (GMD5), that junior appropriators were reducing the flows in Rattlesnake Creek such that the Refuge was prevented from exercising its water right and its operations were being negatively impacted. In 1994, the Service entered into the Rattlesnake Creek Partnership (Partnership) with GMD5, KDA-DWR, and a group of local water users called the Water Protection Association of Central Kansas (WaterPACK) to find a way to address the Service's concerns. In 2000, the Partnership finalized a 12-year plan (Management Plan) to address USF&W's concerns and submitted the plan to the KDA-DWR's chief engineer who approved it. The Management Plan called for KDA-DWR to prepare and submit a report every four years on the progress made towards the plan's goals. Three four-year reviews of the Rattlesnake Creek Partnership Management Plan were prepared and are available at dwr.kda.ks.gov/impairment/RSC.Quivira/TechReport.Attachments/

Near the end of 2008, GMD5 began work on developing a hydrologic model of the district (GMD5 Model), including the Rattlesnake Creek Basin and the Refuge. KDA-DWR participated in the peer review of the model development. The GMD5 Model was completed in 2010.

In 2012, the last four-year review of the Management Plan was conducted by KDA-DWR and submitted to the Partnership for approval. KDA-DWR found that over the course of the Management Plan water savings from incentive-based programs and enhanced compliance and enforcement, yielded 2,804 acre-feet, just over 10% of the goal of 27,346 acre-feet of savings laid out by the Partnership. There was no significant reduction in irrigated acres and the amount of irrigation water applied per acre has remained generally constant when factoring in the effects of precipitation. GMD5 and WaterPACK did not accept KDA-DWR's 2012 review report.

After receiving the Service's 2013 impairment complaint, KDA-DWR began using the GMD5 Model to evaluate the historical impacts that junior appropriators have had on Rattlesnake Creek streamflow. Simulations using the GMD5 Model show that stream depletions (depletions to baseflow) caused by junior appropriators are on the order of approximately 30,000 acre-feet to 60,000 acre-feet per year for the period 1995-2007. This does not mean that the Refuge is being impaired by 30,000-60,000 acre-feet per year, but rather that junior groundwater pumpers are taking that much out of the stream; water that would have otherwise flowed through or past the Refuge.

A retrospective analysis added the streamflow depletions to the observed streamflow record gaged at Zenith to simulate how much streamflow would have been measured at the Zenith gage if there had been no pumping junior to the Service's right. Comparing the simulated "no junior pumping" record to the observed record and then evaluating how the seasonal needs of the Refuge within its water right would have been fulfilled in the simulated and observed cases shows that the Refuge's water right was impaired by upstream junior groundwater pumping in 26 of the 34 years of the simulation period 1974-2007. Further, the simulations also show that because of the relatively slow movement of groundwater, the time between when a pumping well is reduced or shut off and when the water that would have been streamflow but for the pumping is restored to the stream is on the order of two or more years, or even decades, depending on the well's distance from the stream.

2. Hydrogeologic Setting

The descriptions below are taken in large part from "A Computer Model for Water Management in the Rattlesnake Creek Basin, Kansas" (Kansas Geological Survey, The University of Kansas and Department of Civil Engineering, Kansas State University, 1997). Internal citations are omitted.

The Rattlesnake Creek basin is approximately 1,317 square miles in area and is located within the Great Bend Prairie of south-central Kansas. It is approximately 95 miles long and 18 miles wide with the long axis oriented in a southwest-to-northeast direction. Parts of Rice, Barton, Reno, Stafford, Pawnee, Edwards, Kiowa, Pratt, Ford, and Clark counties are included in the basin, with Stafford, Kiowa, and Edwards counties covering more than 82% of the watershed area.

The watershed is located in two physiographic regions. The upper 85% of the watershed is located in the Arkansas River lowlands (Great Bend Prairie region); it is a relatively flat alluvial plain characterized by sand-dune topography with moderate slopes and small hills separated by small basins. The upper 15% of the watershed belongs to the High Plains region, which is also a comparatively flat alluvial plain dissected by intermittent streams and exhibiting shallow depressions and gentle swells. Much of the sand-dune area of the watershed is covered by vegetation, and a large part of it is farmed; the watershed is primarily agricultural.

The watershed is drained by the Rattlesnake Creek, which is a meandering stream flowing from the High Plains region northeasterly into the Great Bend lowlands area where it empties into the Arkansas River. A number of smaller streams merge into the Rattlesnake Creek throughout its course from the highlands to the Arkansas River.

The primary source of recharge to the system is infiltration from precipitation, which varies spatially within the basin. Recharge varies with the soil type. The Rattlesnake Creek and its tributaries are a source of water to the ground-water system in the western parts of the watershed, where surface runoff into the stream eventually percolates into the subsurface. In the north-eastern parts of the watershed, the Rattlesnake Creek is essentially a gaining stream as recharge is discharged into the stream system from approximately Macksville downstream. The Quivira marsh in the lower reaches of the basin acts as a drainage outlet for the ground-water system.

Figure 1 illustrates the effect of groundwater pumping on streamflow.

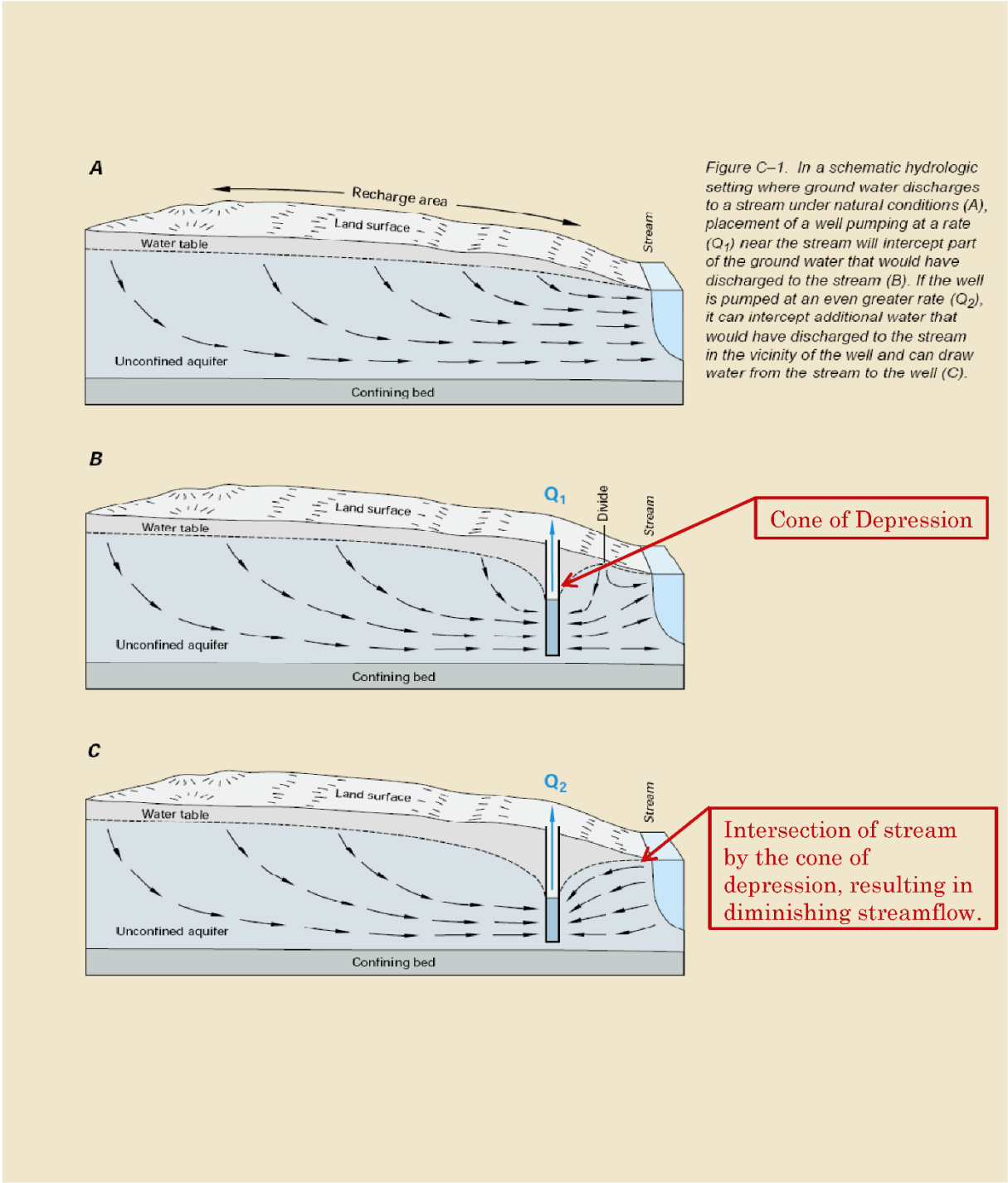

Figure C–1. In a schematic hydrologic setting where ground water discharges to a stream under natural conditions (A), placement of a well pumping at a rate (Q_1) near the stream will intercept part of the ground water that would have discharged to the stream (B). If the well is pumped at an even greater rate (Q_2), it can intercept additional water that would have discharged to the stream in the vicinity of the well and can draw water from the stream to the well (C).

Source: United States Geological Survey, Circular 1139, *Ground Water and Surface Water: A Single Resource* (1998), Figure C-1, p. 15 (Figure title and boxed annotations in red added).

Figure 1 - Effect of Groundwater Pumping on Surface Water

3. Water Use Summary

Year of record	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
# of Water Rights *												
Groundwater	1,680	1,680	1,680	1,680	1,680	1,680	1,680	1,680	1,680	1,680	1,680	1,680
Surface Water	10	10	10	10	10	10	10	10	10	10	10	10
Quivira (included in Surface	1	1	1	1	1	1	1	1	1	1	1	1
Junior to Quivira	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599	1,599
Senior to Quivira	90	90	90	90	90	90	90	90	90	90	90	90
# of Water Rights Reporting Use												
Groundwater	1,374	1,371	1,367	1,368	1,379	1,378	1,376	1,375	1,376	1,377	1,381	1,381
Surface Water	5	5	5	5	5	5	5	5	5	5	5	5
Quivira (included in Surface	1	1	1	1	1	1	1	1	1	1	1	1
Junior to Quivira	1,304	1,301	1297	1298	1,309	1,308	1,306	1,305	1,306	1,307	1,311	1,311
Senior to Quivira	74	74	74	74	74	74	74	74	74	74	74	74
Water Use (AF)												
Groundwater	208,499	167,241	169,229	200,386	152,764	175,749	169,163	190,372	251,259	212,251	172,422	174,368
Surface Water	1,747	9,701	4,591	4,907	31	3,329	1,766	8,539	3,351	2,275	2,728	2,199
Quivira (included in Surface	1,727	9,679	4,559	4,875	0	3,323	1,760	8,526	3,320	2,249	2,712	2,178
Total water use (AF)	210,246	176,941	173,820	205,293	152,795	179,078	170,929	198,911	254,610	214,525	175,150	176,567
Authorize Quantity (AF)*												
Groundwater	252,258	252,258	252,258	252,258	252,258	252,258	252,258	252,258	252,258	252,258	252,258	252,258
Surface	14,902	14,902	14,902	14,902	14,902	14,902	14,902	14,902	14,902	14,902	14,902	14,902
Quivira (included in Surface	14,632	14,632	14,632	14,632	14,632	14,632	14,632	14,632	14,632	14,632	14,632	14,632
Total	267,160	267,160	267,160	267,160	267,160	267,160	267,160	267,160	267,160	267,160	267,160	267,160
% of Authorized Quantity Used*												
Groundwater	83%	66%	67%	79%	61%	70%	67%	75%	100%	84%	68%	69%
Surface	12%	65%	31%	33%	0%	22%	12%	57%	22%	15%	18%	15%
Quivira (included in Surface	12%	66%	31%	33%	0%	23%	12%	58%	23%	15%	19%	15%
Total	79%	66%	65%	77%	57%	67%	64%	74%	95%	80%	66%	66%
# of Irrigated Acres												
Groundwater	160,692	161,606	157,722	160,660	158,168	160,400	160,129	160,867	161,316	160,274	158,510	158,765
Surface	21	0	0	0	0	0	0	0	0	0	0	0

Table 1 - Summary of Rattlesnake Creek Basin Water Rights

Table 1 summarizes the basin's water rights and water use information over 2003-2014. Over 98% of the water use in the basin is from groundwater. The Refuge's surface water right accounts for 98% of all the surface water appropriated in the basin and is senior in priority to about 95% of all the water rights in the RSC Basin — groundwater and surface water.

The Water Right Information System database from which Table 1 was compiled does not contain records of the years in which water rights were dismissed. Water rights dismissed during 2003-2014, if any, are not represented in Table 1. The same is true for authorized quantity associated with dismissed rights.

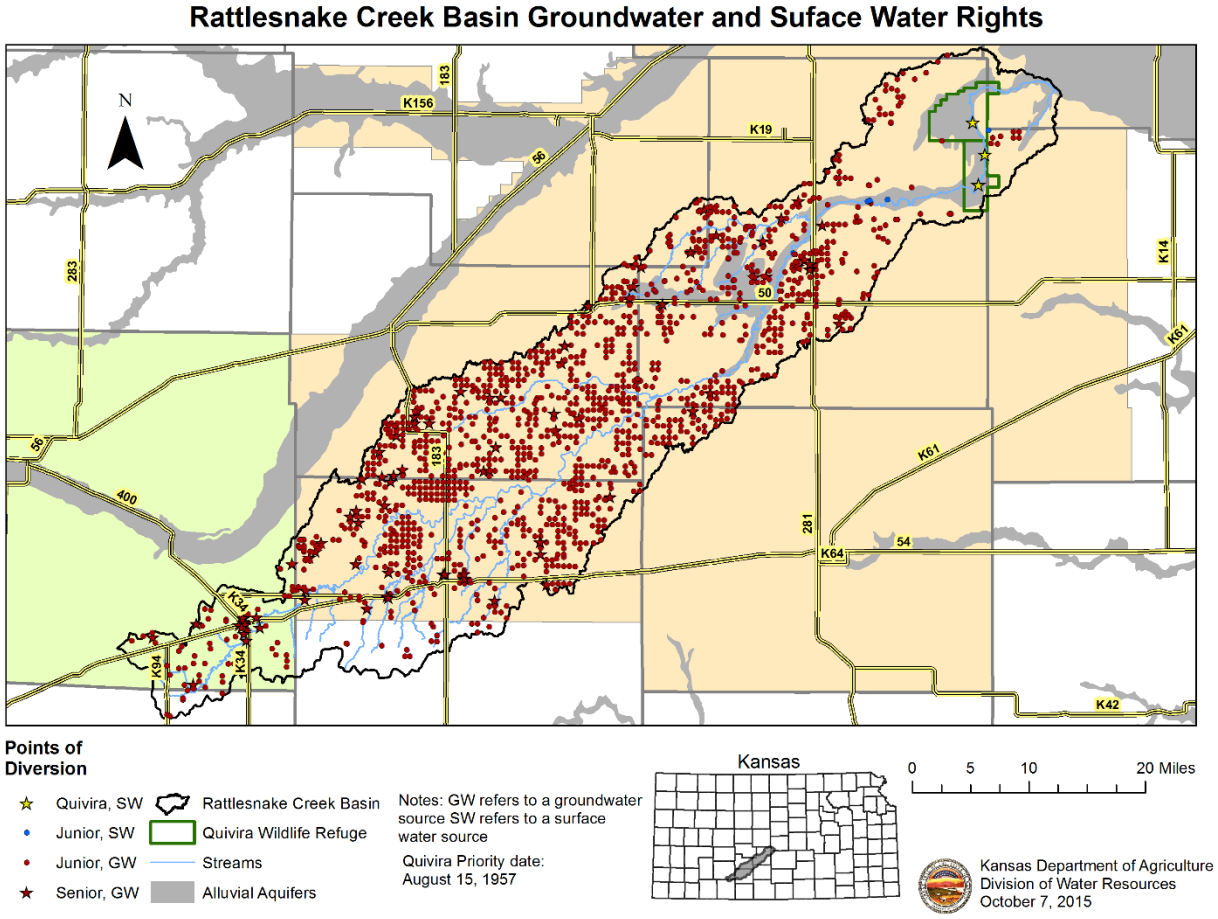

Figure 2 - Rattlesnake Creek Basin map of water rights

4. The Refuge's Water Right

The Refuge's Water Right File No. 7,571 was filed Aug. 15, 1957. The application requested 22,200 acre-feet at a diversion rate of 300 cubic feet per second. The Refuge's water right application was approved May 9, 1963, and specified a perfection date of Dec. 31, 1968. Citing ongoing construction and funding delays, on Nov. 29, 1968, the Service requested that the perfection period be extended to Dec. 31, 1973. This and the remaining documents referenced in this section are included in the electronic water right file available online at agriculture.ks.gov/quivira.

In a May 2, 1973, memorandum to the State Board of Agriculture, DWR Stafford Water Commissioner J. Maurice Street reported on a meeting held in St. John where an attorney representing the Service asserted that the Service held vested rights to some Rattlesnake Creek streamflow based in its acquisition of property from a gun club that had used water for recreational purposes prior to 1945.

In its July 17, 1973, letter, the Service described progress made in developing the Refuge and noted that the Refuge construction was 80% complete. The letter requested that the perfection period be extended to Dec. 31, 1978. In a March 20, 1974, letter the chief engineer noted that the Refuge was complete.

DWR notified the Service by March 20, 1974 letter that it considered the Refuge construction complete, that it had determined that the Refuge's 1971 water use report, along with the other documentation already compiled in the water right file was sufficient to fulfill the Notice and Proof requirements of K.S.A. 82a-714, and that the perfection period was extended to Dec. 31, 1978. The 1971 water use report showed that 10,063 acre-feet were used on the refuge.

Citing funding delays, the Refuge in its Dec. 22, 1978, letter requested the perfection period of its water right be extended to Dec. 31, 1983. DWR's receipt and approval of that request was not located in the paper file, nor was any subsequent request or approval for extending the perfection period to include the year of record 1987.

However, in order to catch up on a backlog of files pending certification, in August 1989, DWR implemented Administrative Policy 89-9 which, among other things, allowed for extensions of the perfection period for good cause shown for applications with a priority date on or before May 1, 1978. The perfection period of

the Refuge's water right was extended to 1978 under the guidelines of this policy whose principles later became regulation K.A.R. 5-8-7 and are still in force today.

DWR's certification memorandum of Feb. 8, 1993, which is excerpted below, explains why 1987 was chosen as the year of record and notes that an extension would need to be granted by DWR. K.A.R. 5-8-7 allows the Chief Engineer to extend the perfection period of a water right if other records or information are available for a period after the original perfection period that would reasonably represent the application of water to beneficial use in accordance with the terms, conditions, and limitations of the permit. A USGS gage was installed at Zenith in 1973. The Refuge's diversion works were not fully functional until 1978. The 10-year perfection period after 1978 was extended until 1987. The USGS gage at Zenith established a good, verifiable water flow record which was used in part to help quantify the Refuge's water right.

On Oct. 31, 1986, the Service sent a letter to DWR claiming that Rattlesnake Creek streamflow was declining due to junior diverters, especially groundwater development. The Service was especially concerned about the increasing lack of streamflow in late summer and early fall when there is the greatest need for water on the refuge. In its letter, the Service also references K.S.A. 42-306 which says, "No person shall be permitted to take or appropriate the waters of any subterranean supply which naturally discharge into any superficial stream, to the prejudice of any prior appropriator of the water of such superficial channel."

DWR issued the draft certificate and its Feb. 8, 1993, Certification Memorandum, File 7571 laid out the chronology of events that led to finalizing the Refuge's water right and summarized the process:

> *File 7571 was approved in 1963. During the time period 1963 to 1972 many of the water use reports were estimated and during that time the diversion works were reported to be only 80% complete. An actual water measurement program may not have been in place prior to 1973. In 1973, a year of torrential rainfall, the diversion works and control structures at Quivira were destroyed. It was not until 1978 that the damage was finally repaired. The year 1978 was, therefore, the first year that the diversion works were complete and ready to divert and store water according to management plans. Assuming that the water requirements of the refuge are best represented by years after 1978, the year 1987 has been selected as the year of record. Using 1987 will require that an extension of time to perfect be granted to that year.*

> *During 1987 the U.S. Fish and Wildlife Service reported that 10129.7 acre feet of water was diverted from the Rattlesnake Creek and that the refuge was "full all year." … the measurements do not reflect the amount stored and the subsequent evaporation in the Little Salt Marsh. Using an area of 950 acres in the Little Salt Marsh, and a capacity of 2260 acre feet, one would assume 2850 acre feet of evaporation during a calendar year (36 inches of net evaporation). The proposed certified quantity for file 7571 would then be the sum of the acre feet reported in 1987, the amount stored in the Little Salt Marsh: 10129.7 acre feet + 2260 acre feet + 2850 acre feet = 15240 acre feet. It is also proposed that all of the 15240 acre feet be shown as direct use and that the "quantity to be accumulated in reservoirs" as stated in the approval be dropped from the certificate.* (internal references omitted)

The Service's Nov. 12, 1993, letter raised several issues with DWR's draft certificate. The Service noted that the original application was for 22,000 acre feet of water and that hydrologic modeling performed by the Kansas Geological Survey (KGS Open File Report 93-7) estimated that by 1987, junior groundwater pumping — modeled at 70% of authorized — had depleted the streamflow in Rattlesnake Creek by at least 8,456 acre feet, some or all of which could have been used by the Refuge. As noted below, DWR has used the groundwater model developed by GMD5 to evaluate pumping impacts on Rattlesnake Creek streamflow. Figure 11 shows that the GMD5 model estimates that by 1987, junior groundwater pumping had depleted Rattlesnake Creek streamflow by about 38,000 acre-feet.

In a May 27, 1994, letter, Chief Engineer David Pope acknowledged the streamflow at the Refuge may have been reduced by groundwater pumping and that the Refuge may have been able to divert and beneficially use more water but for those reductions. However, DWR's position was that it was constrained by K.S.A. 82a-714 and K.A.R. 5-3-8 which, among other things, limits certification of a water right to no more than the amount actually diverted and used by the water user.

The Service and DWR exchanged several more letters over the next two years expressing their views on how the Refuge's water right should be certified. On April 10, 1996, DWR issued the final Certificate of Appropriation for File No. 7,571.

In a subsequent memorandum, KDA-DWR noted and recommended correcting a 45 acre-foot transposition error in the original certification memorandum. The corrected quantity was ultimately certified. See Attachment 3.

The Refuge's water right entitles it to take water from Rattlesnake Creek at three points of diversion at a combined maximum diversion rate not in excess of 300

cubic feet per second and a quantity not to exceed 14,632 acre-feet of water per calendar year for recreational use. This is the volume of water used in 1987 to operate the wetlands areas including filling Little Salt Marsh (1,865 acre-feet), evaporation from Little Salt Marsh (2,592 acre-feet), and filling the Refuge's management areas to meet wildlife feed crop demands (10,175 acre-feet). See Figure 3 below and Attachment 4.

Like all Kansas water rights, the Refuge's water right does not guarantee the availability of any certain amount of water, rather it entitles the Refuge to its authorized rate and quantity subject to prior and vested rights, and the natural availability of water. And, just like the water rights held by its irrigator neighbors, the Refuge's water right entitles it to divert the water at the times when it is most beneficial. Even though a quantity in excess of the Refuge's annual water right might pass by the Refuge's point of diversion in any given year, the test for whether the Refuge's water right has been diminished in value or utility — impaired — is whether the Refuge could have more fully exercised its water right if junior diverters had not taken the streamflow out of priority.

The owner of a water right can adjust the operation of his or her right once the right is perfected and certified, as long as the operation of the right stays within the terms, conditions, and limitations set forth in the certificate (use made of water, point of diversion, place of use, authorized quantity, etc.). The Refuge's water right was applied for, perfected, and has subsequently been exclusively used for recreational use, one of the authorized uses of water in Kansas. In the decades since it was established, the Refuge has adjusted the way it manages its habitat. Modifications to the operations of all water rights are to be expected as technology and best management practices change. For example, if someone perfected an irrigation water right on 160 acres of corn using a flood irrigation system in 1975, then modified their operation by installing a pivot, now watering 130 acres and growing wheat, that owner would not be required to reduce their property right as long as they stayed within the terms, conditions and limitations of the irrigation right. That water right owner would also have the right to go back to flood irrigating corn or another crop if they so choose to do. Likewise, a water right holder could perfect a stock watering right on 1500 head of cattle in a confined feeding operation. They could modify their operation by switching to 2000 head of hogs. No reduction would be required. They also could go back to 1500 head of cattle.

The Refuge water right was developed to manage approximately 7000 acres of wetlands within a refuge area of 22,135 acres (from 2014 CCP). In a letter dated November 12, 1993, the USFW stated that net evaporation based on DWR policy

84-1 using 36" of evaporation and a 6469.6 acres of marshes equates to 19,409 AF which does not include any water to fill the impoundments, which it estimated to be 13,246 AF. The Service recommended the certificate be issued for 20,021 AF year at 300 CFS. Based on managing approximately 7000 acres of wetlands, at 31 inches/year of net evaporation (average year, K.A.R 5-6-3), it would appear that the full authorized quantity could be used in most years, and substantially more than this in critical dry periods.

During both the perfection period and currently, the Refuge seeks to manage approximately 7000 acres in wetlands. As the use for the water and acres has remained the same, we see no evidence of expanded use.

5. The GMD5 Groundwater Model

In 2008, GMD5 commissioned Balleau Groundwater, Inc. to develop a numerical groundwater model of the district. The model was peer reviewed throughout its development by KDA-DWR and KDA-DWR's consulting expert, Steven P. Larson of S.S. Papadopoulos and Associates. The model was completed in 2010. The Model report and peer review report are available at dwr.kda.ks.gov/impairment/RSC.Quivira/TechReport.Attachments/.

The GMD5 model was built with seven layers, each layer representing a geologic formation at a range of depths below the surface of the ground. One of the principal reasons for using multiple layers in this model was so that the movement of water contamination plumes could be simulated and management strategies to contain those plumes could be evaluated. The complexity of the seven-layer model requires significant computer resources and time to run simulations.

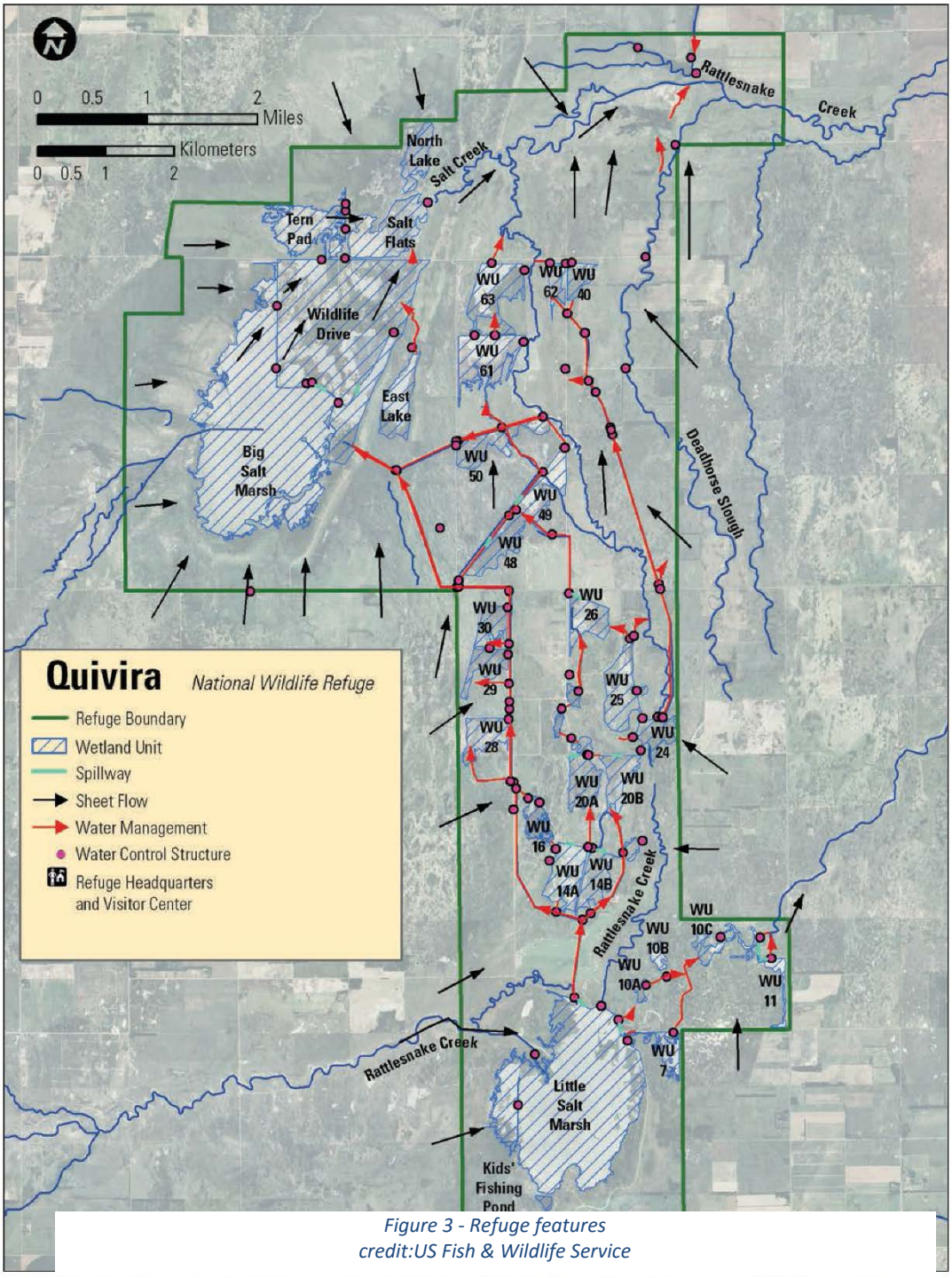

Figure 3 - Refuge features
credit:US Fish & Wildlife Service

To evaluate the effects of pumping on groundwater levels and the discharge of groundwater into the stream system, a one-layer model, if properly designed and calibrated, is sufficient. S.S. Papadopoulos and Associates simplified the GMD5 model by "collapsing" the original seven-layer model into a one-layer model so that it could be used to run scenarios in minutes instead of hours. The conversion from seven-layer model to one-layer model did lose the vertical resolution needed to

simulate how contaminant plumes move up towards the surface of the earth and down away from it, but by effectively averaging the aquifer properties across the seven layers, the way that the horizontal movement of water beneath the ground is simulated was not significantly altered.

Beginning in 2014, KDA-DWR used the original seven-layer GMD5 model, and the simplified, one-layer modification of the model to simulate how the Rattlesnake Creek streamflow would respond to several alternative historical pumping scenarios. For instance, one scenario simulated the effect of no pumping anywhere in the basin junior to the Refuge's water right. Another scenario simulated no junior pumping in a corridor along the stream. The work was intended to increase familiarity with and understanding of the model, to show that the original seven-layer model and the simplified one-layer version of the model were functionally equivalent for these kinds of scenarios, and to show the Basin community how and when groundwater pumping affects RSC streamflow.

KDA-DWR presented results for nine alternative historical scenarios at a public meeting in St. John on November 4, 2014. The Appendix documents KDA-DWR's modeling work presented at the meeting. The following observations from this work were made at the meeting:

1. The seven-layer GMD 5 model and the one-layer simplified version of it are functionally equivalent for the purpose of evaluating groundwater pumping impacts to streamflow in Rattlesnake Creek.

2. The GMD5 model shows that junior groundwater pumpers have caused significant reductions to the amount of groundwater that discharges to Rattlesnake Creek. Basin-wide, the depletions are on the order of 30,000-60,000 acre-feet over the period 1995-2007.

3. Pumping reductions near the stream provide the most immediate benefit to Rattlesnake Creek stream flow. However, only about 8% of the junior pumping takes place within two miles of the stream, and only about 3% is within one mile of the stream. This nearby pumping accounts for about 16% (2 miles) and 6% (1 mile) of the impacts to streamflow, respectively [averaged over years 1998-2007 as fractions of impact of scenario 2, from Appendix, Table A3].

4. Depending on the distance from the stream, it takes two or more years for pumping reductions to manifest as increased streamflow in significant amounts and longer to fully recover.

In comments on the First Draft of the Initial Impairment Investigation Report, Balleau Groundwater, Inc. noted what they agreed was a minor issue with the way that DWR's model simulations started — from a "transient" instead of a more correct "steady state" condition. DWR has developed revised model runs accordingly and found discrepancy between the transient and steady-state runs diminished over the period from 1940 to 2008, and were negligible for the purposes of this impairment analysis. Therefore, DWR has not redone the rest of this analysis. Documentation of the resulting work is included as an addendum to the Modeling Appendix of this Second Draft of the report.

Further descriptions and results of these simulations are available at dwr.kda.ks.gov/impairment/RSC.Quivira/TechReport.Attachments/.

6. Determination of Junior Groundwater Pumping Impacts at the Refuge

One of the fundamental elements of an impairment investigation is the determination of the impacts that junior diversions have had, are having, and will likely have on senior water rights. The GMD5 Model was used to evaluate the historical effects of junior groundwater pumping on Rattlesnake Creek streamflow at the Refuge. The results of the modeling analysis were presented at a public meeting in St. John, Kan., on Nov. 4, 2014, and are documented in the Appendix. Below is a summary of the results that are most relevant to this investigation.

To evaluate the effects that junior pumpers upstream of the Refuge have had on the flows of Rattlesnake Creek at the Refuge, two simulations of the model were compared. In one simulation, pumping in the basin junior to the Refuge's water right was "turned off," or omitted from the simulation, and the amount and timing of groundwater that discharged from the aquifer to the stream was observed. This simulation was called "no junior pumping." The other simulation, called the "baseline," simulates the effects on streamflow caused by the actual recorded historical pumping. The "baseline" results were subtracted from the "no junior pumping" results and the effects of junior pumping on Rattlesnake Creek simulated streamflow over time were observed. These simulations show that there would have been significantly more water in Rattlesnake Creek, often at times when the Refuge could have made use of the additional water, if there had been no pumping junior to the Refuge's water right. See Figures 5-9 and Figures A8 and A9 in the Appendix.

KDA-DWR performed other simulations with the GMD5 Model to evaluate how Rattlesnake Creek would respond to targeted pumping reductions close to the stream. The simulations showed that, because of the characteristics of the hydraulic connections between the stream system and the groundwater system, and because of the relatively low volume of pumping in the stream corridor, even targeted reductions close to the stream would take on the order of two to three years to produce significant increases in streamflow. Though such reductions would eventually restore streamflow, they would be ineffective in providing timely, same-year, much less same-season, relief from shortages caused by junior pumping. For example, if the Refuge needed water in August of 2016, restricting upstream pumping by junior water rights in the spring of 2016 would provide limited benefit to the Refuge until the summer of 2018. See Figures A6 and A7 in the appendix on page 43.

7. Observations From Comparing Model Simulations and the Refuge's Operational Water Needs

The Service has documented its management strategies and quantified its goals for providing seasonal habitat in its Comprehensive Conservation Plan. At KDA-DWR's request, Service staff prepared a document explaining the water needs and management at the Refuge and specifying time periods and amounts of water needed within those time periods to accomplish the Refuge's mission within the scope of its water right. An excerpt of the Service's Comprehensive Conservation Plan describing the management goals for Refuge's wetlands and the subsequent documentation of the Refuge's water seasonal needs is in Attachment 5, Table 4. The historical averages from Table 1 of the Refuge's document were not used in this analysis as they represent the Service's use from the significantly depleted supply which has been the focus of the Service's complaints for decades and which led to this impairment investigation. As noted in the section of the report on the Service's water right, it is reasonable to expect that most of the Service's water right will be needed in each year, particularly during critical, dry periods. The Service's complete Comprehensive Conservation Plan is available here: www.fws.gov/mountain-prairie/planning/ccp/ks/qvr/qvr.html.

KDA-DWR compared the modeled impacts of junior pumping with the seasonal water needs defined by the Service to determine if there have been times when the Refuge was prevented from exercising its water right because streamflow was taken by junior pumpers. Comments to the initial report were concerned about use of a schedule based on 14,632 acre-feet per year without making allowances for

evaporation and storage in Little Salt Marsh (LSM). The analysis compares the Service's schedule with flows at Zenith which is above LSM and thus could measure the water available to supply the storage and evaporation needs at LSM plus the diversion needs below it.

The analysis shows that junior groundwater pumping has prevented the Refuge from exercising its water right regularly in the past. Figures 6-7 show simulated seasonal streamflow that would have been in Rattlesnake Creek but for junior groundwater pumping and actual streamflow over time contrasted against the Refuge's seasonal water needs as defined by the Service in Attachment 5. The dark blue modeled pumping depletions are stacked on the light blue gaged streamflow to show how much streamflow would have been in Rattlesnake Creek but for junior pumping depletions. The green trace represents the Refuge's water needs, which is a repeating pattern over the time period illustrated. The red "impairment" trace shows where the dark blue modeled pumping depletions have intersected the green Refuge needs trace. The orange trace on the graphic shows the Refuge's reported historical diversions. The reported diversions are understated to varying degrees because they are measured after water from Rattlesnake Creek has been impounded and released from Little Salt Marsh, and therefore do not include evaporation from the Marsh, which would be counted as use. The surface area of the Little Salt Marsh is approximately 864 acres; 1,865 acre-feet of evaporation from the Marsh was assumed in the year of record for the certificate.

Note that the evaluation shows that the Refuge was impaired in 1987, the year of record for its water right certificate. The amount of simulated impairment is very small (220 acre feet); close to zero when compared to the amount of impairment simulated in other years, but it should be zero by definition. The small impairment simulated in 1987 is an artifact of imposing the Refuge's present operational plan on the historical record.

It is reasonable to assume that effects of the same magnitude seen in the year of record and caused by applying the Service's current operational plan to the historical record are present in all years in the simulation. No analysis was performed to compare differing management plans. Applying the Service's present operational plan on the historical record comes to within 1.5% of the seasonal and total water use in the year of record and indicates that the evolution of the Refuge's operations has not increased its water demand.

The historical impairment evaluation also does not explicitly take into account any mitigating effects that storage in Little Salt Marsh might have on the

Refuge's water needs. Figure 8, for instance, shows that in the two management periods May-June and July-September 1995, there is an abundance of water flowing at the Zenith gage. The expectation is that the Refuge would maximize their storage capabilities to the extent possible within the constraints of their primary mission to create and maintain habitat.

The historical impairment evaluation during dry periods such as 1990-1992 and 2001-2006 indicate that the pumping depletions to streamflow caused by junior groundwater pumping exceeded the actual measured streamflow, providing little to no opportunity to fill storage or fulfill the Refuge's water right. It is in these periods of pumping-induced shortages that the Refuge's water right was most severely impaired: 5730-8580 acre-feet in 1990-1992 and 4220-7930 acre-feet in 2001-2006. See Figure 10.

Unless groundwater pumping operations change significantly in the Rattlesnake Creek Basin, it is reasonable to assume that junior groundwater pumping will prevent the Refuge from exercising its water right regularly in the future.

Figure 4 below shows the method for determining the retrospective impairment illustrated in Figure 6-8.

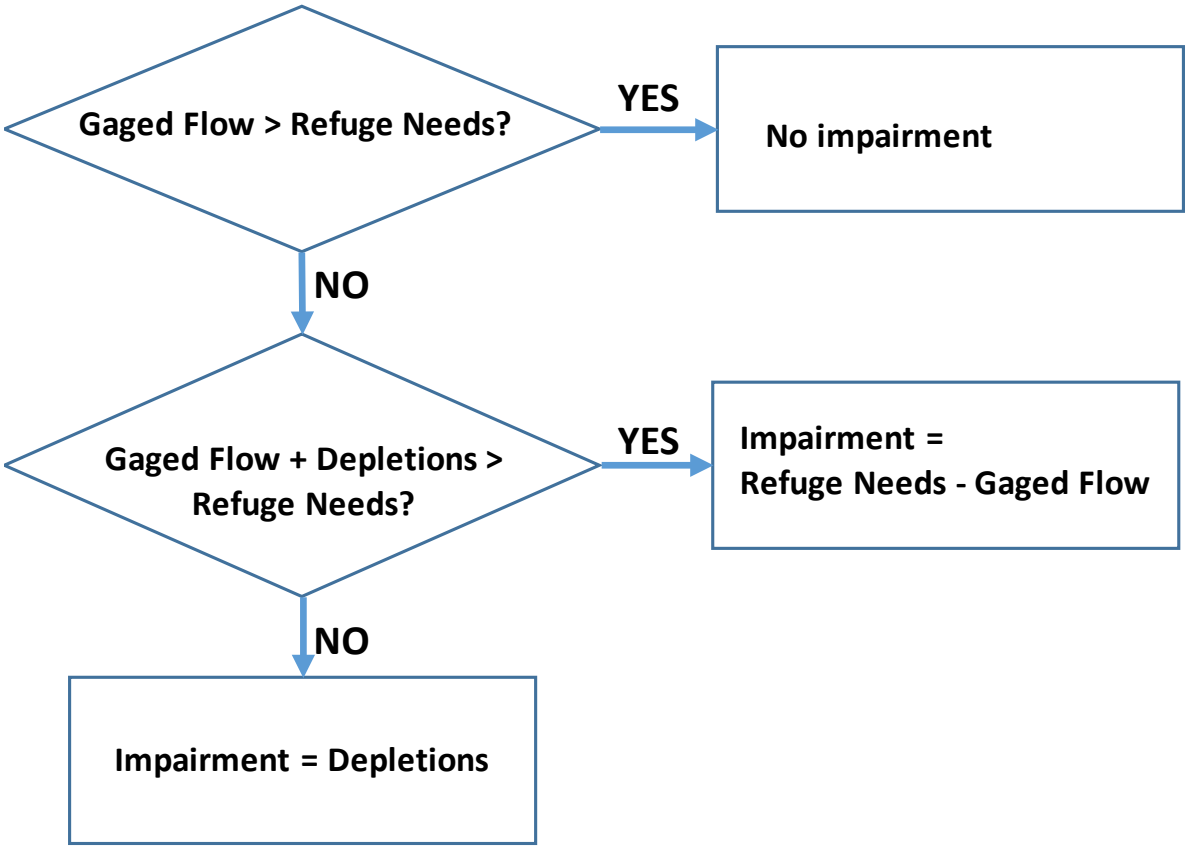

Figure 4 - Method for determining historical simulated impairment to the Refuge's water right based on the USGS gage at Zenith

USFW Management Period	Year	Zenith Gaged Flow	Modeled Impacts to RSC	Refuge Reported Diversions	Refuge Needs	Amount short of needs
Jan/Feb	2003	1860	7340	1180	1500	0
Mar/Apr	2003	4720	9640	320	3500	0
May/Jun	2003	2770	5690	0	2000	0
Jul/Aug/Sep	2003	650	4040	120	3500	2850
Oct/Nov	2003	840	4290	40	3600	2760
Dec	2003	540	2800	80	500	0
Jan/Feb	2004	1050	5140	970	1500	450
Mar/Apr	2004	2300	6270	2840	3500	1200
May/Jun	2004	1500	5430	370	2000	500
Jul/Aug/Sep	2004	2960	13070	4370	3500	540
Oct/Nov	2004	1690	7640	550	3600	1910
Dec	2004	1080	3220	580	500	0
Jan/Feb	2005	2490	7820	2130	1500	0
Mar/Apr	2005	2390	5630	130	3500	1110
May/Jun	2005	3000	7280	0	2000	0
Jul/Aug/Sep	2005	3620	8230	1660	3500	0
Oct/Nov	2005	900	5510	0	3600	2700
Dec	2005	740	2540	640	500	0
Jan/Feb	2006	1760	3710	1870	1500	0
Mar/Apr	2006	1940	4020	1240	3500	1560
May/Jun	2006	1060	4910	790	2000	940
Jul/Aug/Sep	2006	940	7970	750	3500	2560
Oct/Nov	2006	730	5150	220	3600	2870
Dec	2006	640	3650	0	500	0
Jan/Feb	2007	1670	7400	1690	1500	0
Mar/Apr	2007	10540	9530	1420	3500	0
May/Jun	2007	32510	14730	130	2000	0
Jul/Aug/Sep	2007	16420	14710	1720	3500	0
Oct/Nov	2007	2510	7580	1670	3600	1090
Dec	2007	3280	5240	830	500	0

Table 2 - Gaged flow, Refuge needs, and calculated shortfall

Table 2 above shows the recorded flow at the USGS gage at Zenith, the modeled groundwater pumping impacts to Rattlesnake Creek, the seasonal needs of the Refuge, and amounts, if any, that the pumping depletions impaired the Refuge's ability to execute its management plan. The table showing the entire simulation period from 1974-2007 is in Attachment 6.

The record shows that Rattlesnake Creek Basin experiences periodic dry cycles, when groundwater levels and streamflow decline, and wet periods when groundwater levels largely recover and streamflow is more plentiful. Figure 5 shows interpolated changes in water levels over the three review periods of the Rattlesnake Creek Management Plan. 2001-2004 was a dry period, but 2005-2008 saw widespread recovery to water levels. 2001-2012 shows declines in water levels on the order of 10 feet or more in the southwestern part of the basin, but in the northeastern part of the basin where the water table is shallower and more connected to the surface water system, declines are generally in the 0 ft. to -3 ft. range.

As demonstrated in the groundwater modeling work and the analysis above, water shortages to the Refuge are related to the impacts of junior groundwater pumping intercepting recharge which otherwise would show up as streamflow. These impacts are most pronounced during the dry periods.

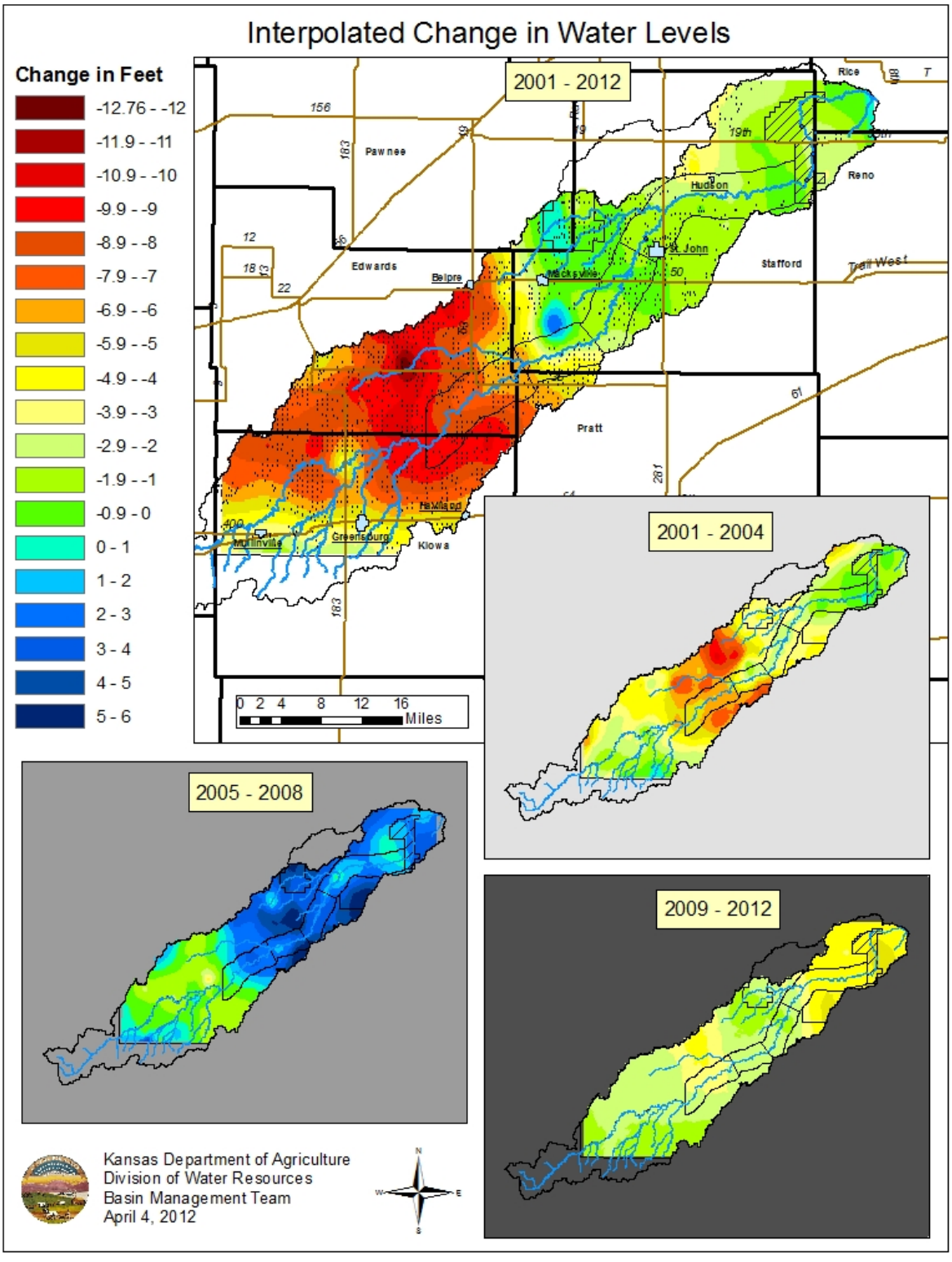

Figure 5 - Interpolated Change in Water Levels in Rattlesnake Creek Basin

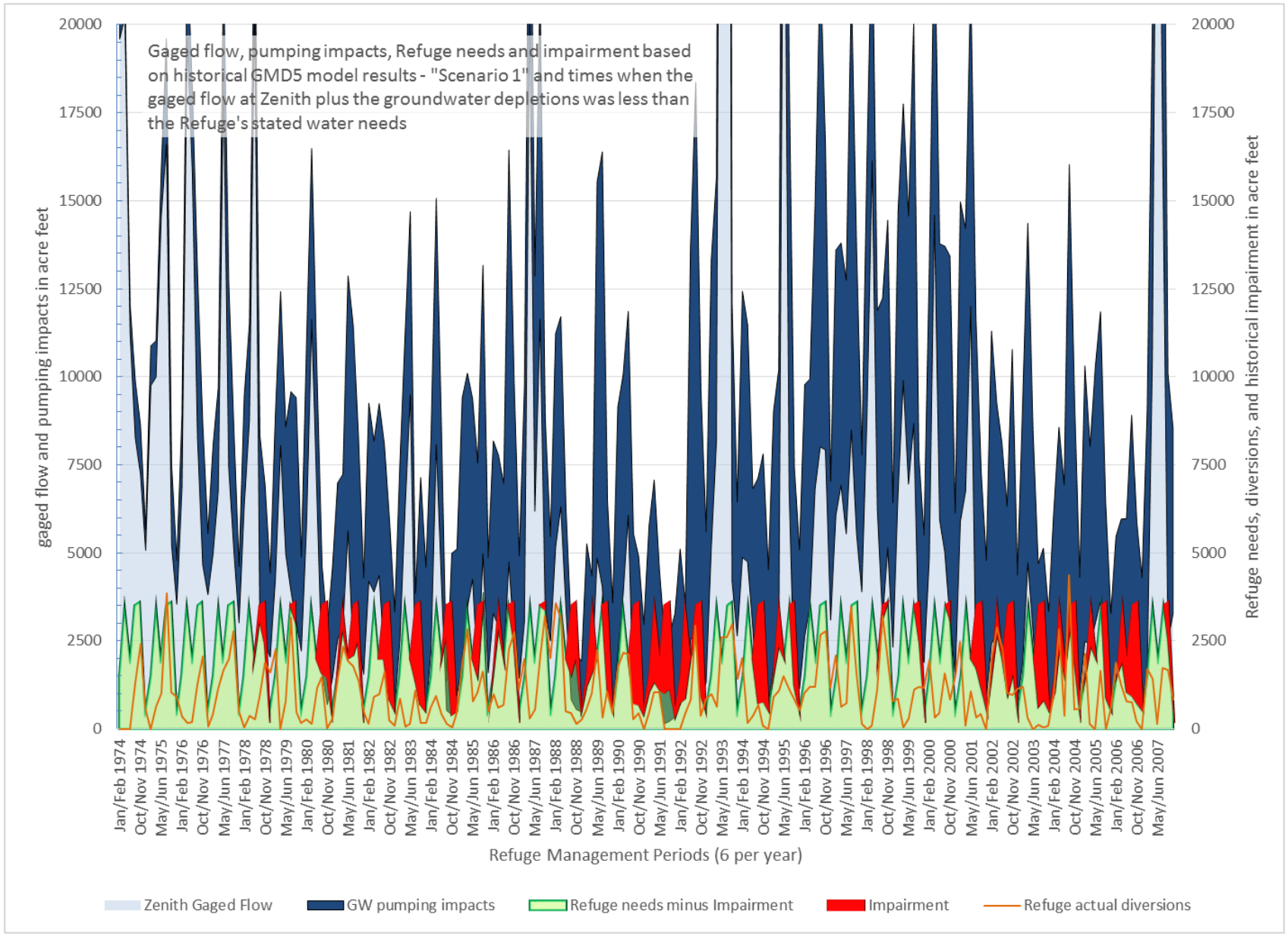

Figure 6 - Simulated evaluation of impairment to the Refuge's water right 1974 - 2007

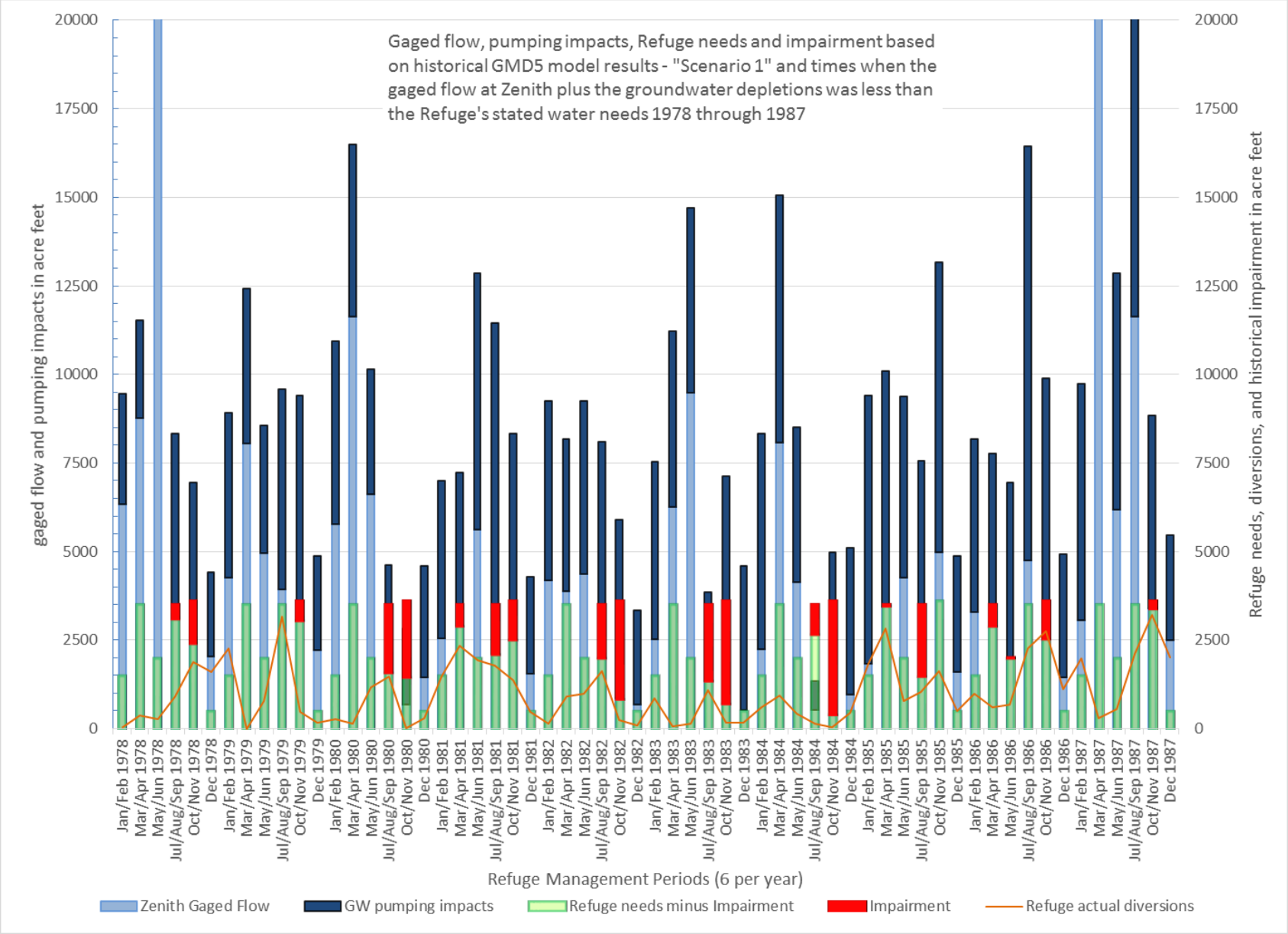

Figure 7 - Simulated evaluation of impairment to the Refuge's water right 1978 - 1987

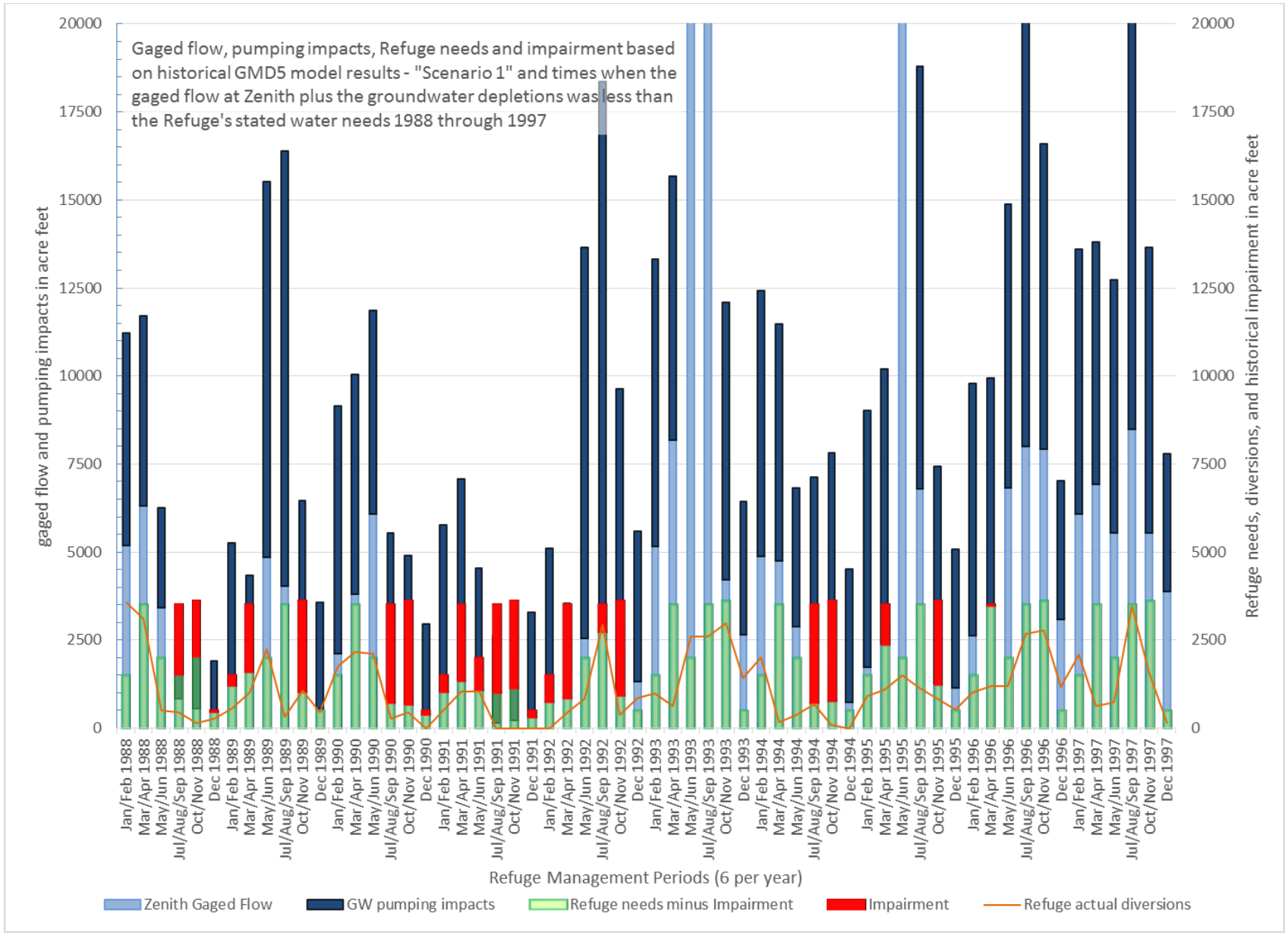

Figure 8 - Simulated evaluation of impairment to the Refuge's water right 1988 - 1997

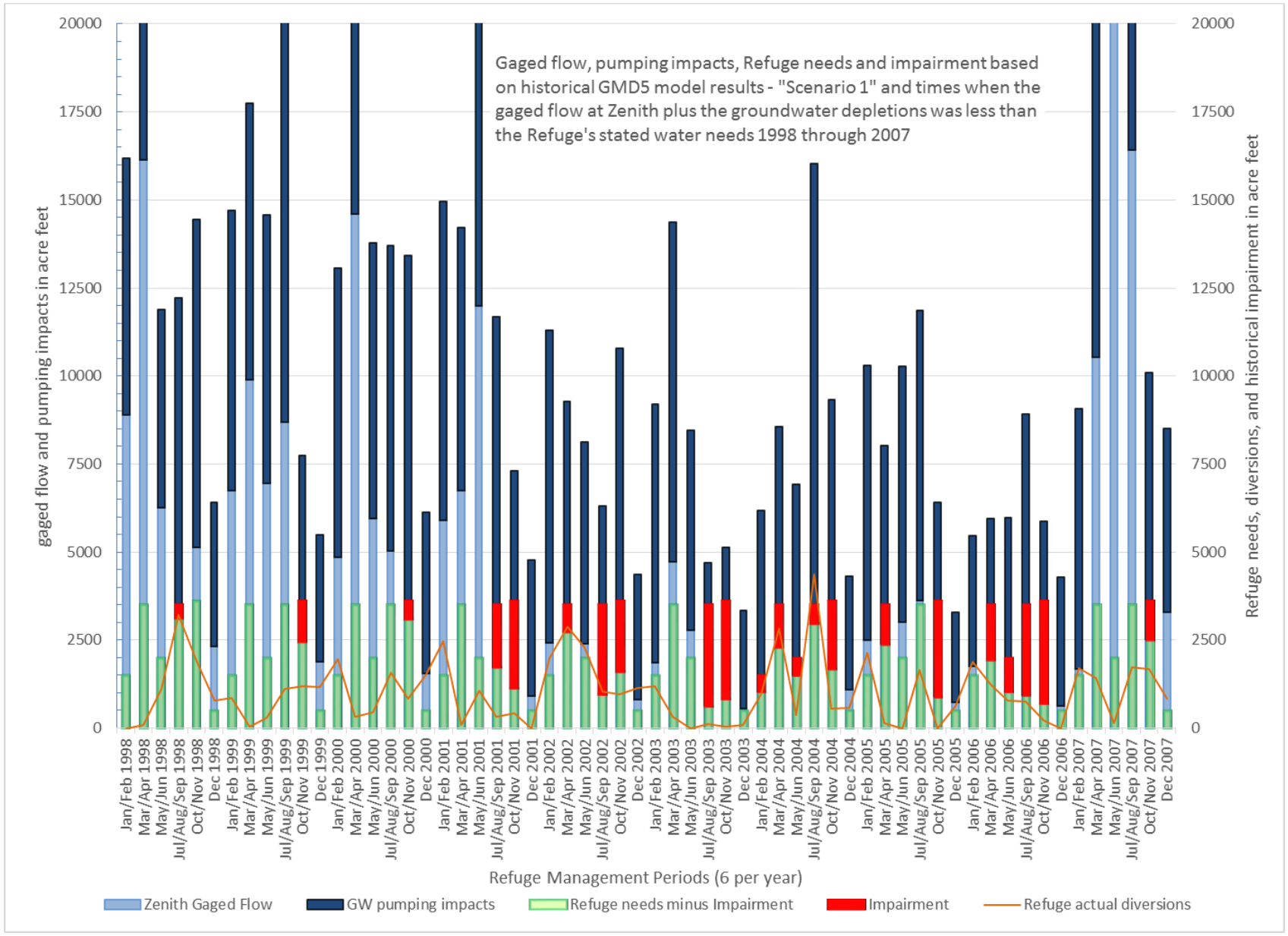

Figure 9 - Simulated evaluation of impairment to the Refuge's water right 1998 - 2007

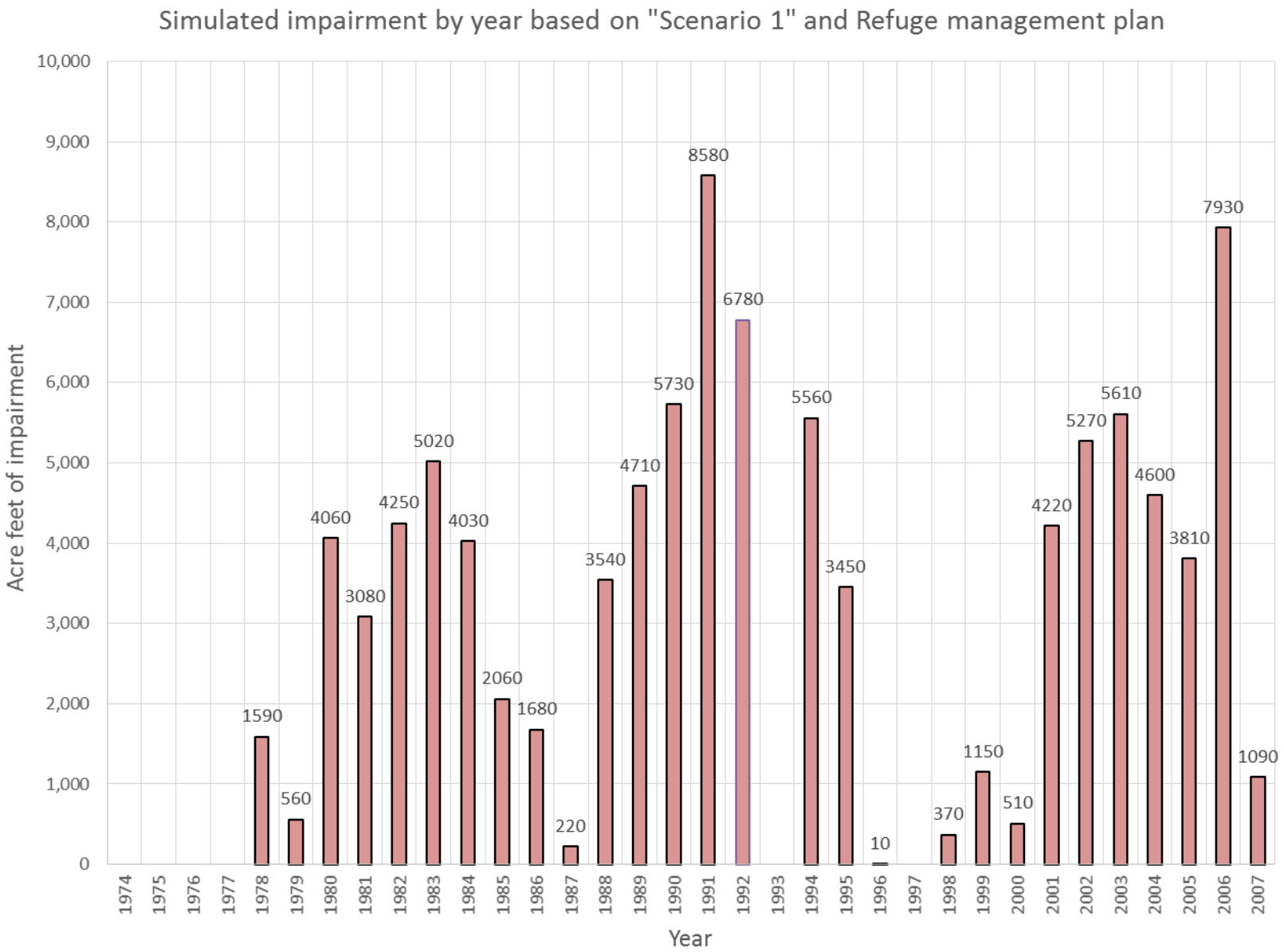

Figure 10 - Simulated amount of impairment to the Refuge's water right by year

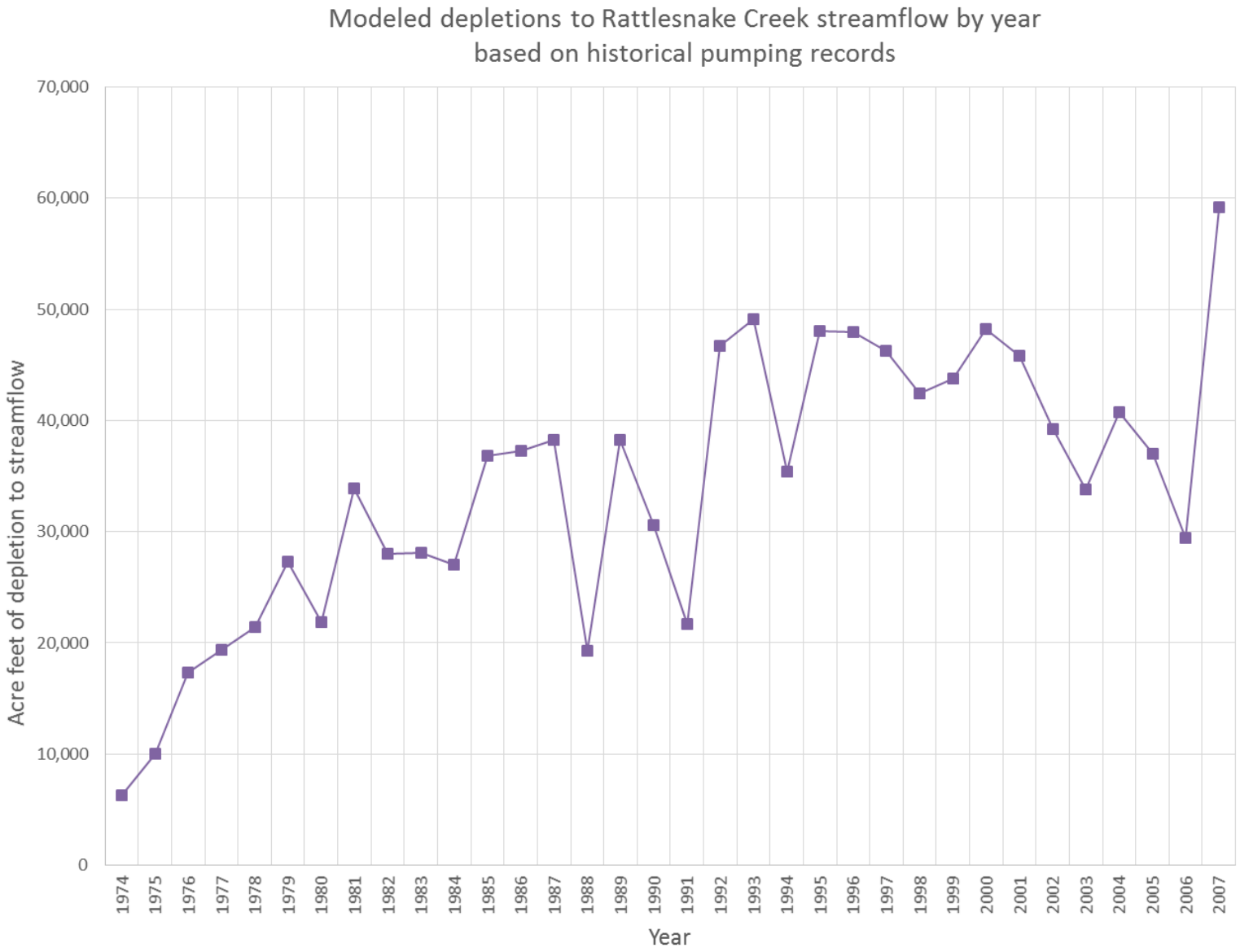

Figure 11 - Modeled depletions to Rattlesnake Creek 1974 - 2007

8. List of References

Kansas Statutes Annotated, Chapter 82a, Article 7
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Kansas Administrative Regulations, Chapter 5, Article 4
www.kssos.org

Kansas Department of Agriculture – Division of Water Resources, Rattlesnake Creek Third Four-Year Review of the Management Program 2009-2012, 2012

Kansas Department of Agriculture – Division of Water Resources, Rattlesnake Creek Second Four-Year Review of the Management Program 2005-2008, 2008

Kansas Department of Agriculture – Division of Water Resources, Addendum Rattlesnake Creek Four-Year Review of Management Plan, 2008

Balleau, Peter W.; Romero, David M.; Silver, Steven E.; *Hydrologic Model of Big Bend Groundwater Management District No. 5 and Appendices*, 2010

Larson, S. P.; *Big Bend GMD5 Model Peer Review*, 2011

9. List of Attachments

Appendix: November 2015 GMD5 groundwater model scenarios developed by KDA-DWR

Attachment 1: March 5, 2013, letter from United States Fish & Wildlife Service to Kansas Department of Agriculture Division of Water Resources

Attachment 2: April 8, 2013, letter from United States Fish & Wildlife Service to Kansas Department of Agriculture Division of Water Resources

Attachment 3: Feb. 8, 1993, Certification Memorandum, File 7571; Kansas State Board of Agriculture

Attachment 4: April 9, 1996, Certificate of Appropriation for Beneficial Use of Water; Water Right File No. 7,571; Priority Date August 15, 1957; Kansas Department of Agriculture – Division of Water Resources

Attachment 5: Oct. 23, 2013, Excerpt from Comprehensive Conservation Plan, Quivira Nation Wildlife Refuge; Unites States Fish & Wildlife Service

Attachment 6: December 2015 GMD5 Model; KDA-DWR Scenario 1 analysis results table; KDA-DWR

Modeling Appendix

GMD5 groundwater model scenarios developed by KDA-DWR
Sam Perkins and Ginger Pugh, KDA-DWR
November 12, 2015

Introduction

KDA-DWR staff developed and evaluated historical pumping scenarios with the Big Bend Groundwater Management District No. 5 (BBGMD5) groundwater model as part of this impairment investigation. The pumping scenarios are variations on pumping conditions specified for input to the historical simulation for the period 1940-2007. The purpose for developing the pumping scenarios was to quantify impacts of groundwater pumping within Rattlesnake Creek basin on Rattlesnake Creek streamflow, with a focus on inflow to the Quivira National Wildlife Refuge (Refuge) near the gage at Zenith, Kan.

Pumping impacts are defined as the difference between water budget terms for a given pumping scenario and baseline conditions specified for the calibrated model for the simulation period 1940-2007. Water budget terms with significant impacts in response to alternative groundwater pumping scenarios include groundwater storage, streamflow and evapotranspiration.

This Appendix parallels, in part, a presentation on Nov. 4, 2014, by the Chief Engineer and KDA-DWR staff to basin stakeholders in St. John, Kan., (Barfield and others, 2014). The Appendix also documents in greater detail than was presented in St. John, modeling results for Scenario 1, which were used in the impairment analysis. This scenario was run to calculate pumping impacts on streamflow by all groundwater rights upstream from the Rattlesnake Creek gage at Zenith, Kan., and junior to USFW Water-Right File No. 7,571 with priority date Aug. 15, 1957, a surface water right to diversions from Rattlesnake Creek to the Refuge (Refuge's right).

GMD5 groundwater model

Balleau Groundwater, Inc. (BGI), of Albuquerque, N.M. developed the regional groundwater flow model, referred to here as the BBGMD5 model (Balleau and others, 2010). The model extent includes all of GMD5 and a considerable region to the west of GMD5, including upstream basins drained by the Arkansas River and its tributaries, the Pawnee River and Rattlesnake Creek (Fig. A1). The model was calibrated to simulate transient groundwater flow for the historical period 1940-2007, with stress periods corresponding roughly to months and each stress period simulated with three equal time steps. The model extends 167.5 miles west to east, from near Garden City on the west to six miles east of the eastern GMD5 boundary, and 90 miles south to north on a regular grid of cells ½ mile on a side (335 x 180 cells). The BBGMD5 model is composed of seven layers representing hydrogeologic units from the land surface to bedrock, including river alluvium, Pliocene and Quaternary sediments, Cretaceous shales, Dakota, Cedar Hills sandstone and underlying Permian bedrock. The Cedar Hills sandstone is considered to be a source of significant saline water, and interest in tracing movement of saline water through the aquifers helped motivate development of the multilayer model. Runtime for the historical simulation

with the multilayer model ranged from five to twelve hours on KDA-DWR computers, depending on factors such as server response time.

A single-layer version of the multilayer model was developed by Steve Larson and staff at S.S. Papadopulos and Associates (SSPA). Mr. Larson served as peer reviewer for KDA-DWR and member of the Technical Advisory Committee (TAC) during development of the BBGMD5 model for KDA-DWR. His report documents the single-layer model version (Larson, 2011).

Conversion of the multilayer BBGMD5 model into a single-layer model involved primarily equating the aquifer property of transmissivity of the single-layer model to the sum of transmissivity over the seven layers of the BBGMD5 model. Evapotranspiration and recharge inputs for the single-layer model are the same as those for the BBGMD5 model. The single-layer model version was found to be a satisfactory substitute for the BBGMD5 model, based on comparisons of global water budgets, computed water levels and streamflow. It has the advantage of shorter run times of 30 to 60 minutes for the historical simulation on KDA-DWR computers. The single-layer model version was used to evaluate the pumping scenarios described here, one of which (Scenario 11, below) was run with both model versions to compare computed pumping impacts.

Mr. Larson (2011) also developed an alternative calibration of the single-layer model in which recharge was reduced by 20 percent and evapotranspiration was reduced by 40 percent, and for whose calibration performance was similar or improved on the BBGMD5 model. This alternative version of the single-layer model was not used by KDA-DWR in the analysis of pumping impacts under scenarios presented here.

Baseline and scenario pumping conditions

Baseline pumping and return flow conditions are specified for the historical simulation by an input file that is read by the MODFLOW Well package (Harbaugh and others, 2000). The data were prepared as described in the BBGMD5 model report (“Well and Water Management Operations,” p. 62-65) and summarized in the BGI report, Table 3, lines 20-34. Irrigation pumping is specified as an extraction from groundwater at grid cell containing the pd, and the corresponding return flow is specified as an injection into groundwater at the grid cell containing the place of use (pu). Pumping for non-irrigation use is similarly represented, but return flow is neglected; domestic pumping is excluded from the model.

The WELL package input file (pumping file) does not identify the type of water use or the water right associated with each pd or pu. Pumping scenarios developed as variations on the baseline pumping file. Consequently, the pumping scenarios were restricted to spatial and temporal variations of the baseline pumping file, and were applied without distinguishing type of water use. Input files for pumping scenarios were produced by preprocessors that read the baseline pumping file and wrote a pumping scenario file that included wells meeting the spatial and temporal criteria of the scenarios. The preprocessors are variations on one developed by Steve Larson that converted the historical pumping file for the multilayer model (file bbgmdmod_v6.wel) into one for the single-layer model (file bbgmdmod_v6_1Layer.wel).

Description of pumping scenarios

Pumping conditions and impacts for nine scenarios presented at the St. John meeting are described below, while additional scenarios that were examined are also identified. The nine scenarios include four basin-wide curtailments and five spatially focused curtailments, which are explained as follows.

The map in Fig. A2 identifies points of diversion for all groundwater rights in Rattlesnake Creek basin (dots) and distinguishes between those that are senior (solid) and junior (hollow) to USFW Water-Right File No. 7,571. Fig. A2 also identifies the Macksville and Zenith gaging stations along Rattlesnake Creek, which is typically gaining below the Macksville gage. The Zenith gage captures most flow generated in the basin and lies about two miles upstream from the first of three Refuge intakes (USFW File 7,571) from Rattlesnake Creek below the Zenith gage. Fig. A3 identifies these intakes and centers of the model's regular grid of cells that are ½ mile on a side.

Basin-wide pumping curtailments

The basin-wide scenarios curtail pumping to all wells in Rattlesnake Creek basin (Scenarios 1, 2, 2.5 and 2.75). Scenario 1 excludes all pumping at points of diversion within Rattlesnake Creek basin that lie upstream from the Quivira intakes and are junior to the date of the Refuge's water right, Aug 15, 1957. Pumping and return flow for these wells are shut down from the beginning of 1958 through the remainder of the simulation. All other scenarios are variations or subsets of this scenario.

For the purpose of the impairment analysis, the effect of pumping by rights junior to File 7,571 is represented by Scenario 1.

Scenario 2 applies to the same wells as Scenario 1, but excludes pumping and return flow beginning in 1990 instead of 1958, so that pumping under Scenario 2 is the same as baseline conditions until 1990.

Scenarios 2.5 and 2.75 apply to the same wells as Scenario 2, but instead of shutting the wells down beginning in 1990, pumping and return flow for those wells are multiplied by factors of 0.5 for Scenario 2.5 (a 50 percent reduction), 0.75 for Scenario 2.75 (a 25 percent reduction).

Targeted pumping curtailments

The targeted scenarios curtail pumping only within areas that are expected to produce faster streamflow response, based either on response zones reported by Balleau et al. (2011) or on distance to Rattlesnake Creek Scenarios.

Scenarios 7-9 are based on stream depletion response zones computed by Balleau et al. (2011), shown in Fig. A4 and in the Balleau report as Fig. 51. These scenarios shut off all junior pumping within computed areas of stream response exceeding 70 percent (Scenario 7), 40 percent (Scenario 8) and 20 percent (Scenario 9). Fig. A4 shows that, within the Rattlesnake Creek basin, all areas of depletion response exceeding 20 percent lie downstream of the Macksville gage.

Scenarios 10 and 11 shut off all junior pumping within one mile (Scenario 10) or two miles (Scenario 11) of Rattlesnake Creek. Fig. A5 maps these zones, and shows that they begin at the Macksville gage and proceed downstream. The Balleau response map suggests little would be gained by continuing these corridors upstream.

Scenario 11-ML identifies a version of Scenario 11 that was run with the multilayer BBGMD5 model version. Scenario 11 impacts under single- and multilayer model versions are compared below.

Other scenarios investigated

Other scenarios evaluated as part of the investigation of streamflow response to pumping curtailments, but not presented at the meeting in St. John include:

Scenario 3: 1-mi curtailment corridor for the entire length of Rattlesnake C.

Scenario 4: shut off junior pumping within Rattlesnake Creek alluvial extent as delineated by a GIS coverage from USGS within the state of Kansas. This alluvial extent is shown in Fig. A3 with a light blue shading, and in Fig. A4 for a smaller area in the vicinity of the Zenith gage and Quivira NWR. Fig. A3 shows that relatively few points of diversion lie within the alluvial extent, limiting the potential impact of curtailments.

Scenarios 5-6: These curtail pumping within preliminary versions of the Balleau response zones, and were superseded by Scenarios 7-9.

Scenarios delaying pumping curtailment until 2000.

Scenarios that were run using the single-layer model with the alternative calibration (recharge reduced by 20 percent and evapotranspiration reduced by 40 percent; Larson, 2011).

Model results

Scenario 1: Impact of pumping by rights junior to Water Right File No. 7,571 on streamflow

Impacts of pumping on Rattlesnake Creek streamflow as described in the Quivira Impairment Report and shown in Figs. 2 and 3 of the report are based on differences in the basin water budgets for Scenario 1 and a baseline model run for the historical period. The basin water budget refers to the water budget restricted to the Rattlesnake Creek basin as opposed to the global budget for the entire model domain. Some impacts of pumping from within Rattlesnake Creek basin by rights junior the Refuge Right eventually propagate outside the basin boundaries, so that baseflow impacts that pass through the Zenith gage are somewhat less than this total.

The Quivira Refuge management periods described in the Impairment Report are 1-3 months in duration. The baseflow impact for a given management period is the sum over impacts for corresponding time steps (about ten days each) according to the basin water budget. Budgets restricted to Rattlesnake Creek basin were extracted from model results for each year, but not for each simulated time step. Basin-only water budgets for each time step could be extracted from model output by

modifying a postprocessor and re-processing model results, but baseflow impacts within the basin for each time step can also be reasonably approximated by reducing global baseflow impacts for each time step by the ratio for the corresponding year of basin-only and global baseflow impacts. This approximation was used to represent baseflow impacts restricted to Rattlesnake Creek basin for each time step.

Table A1 compares annual pumping impacts on a water budget for Rattlesnake Creek basin with a global water budget, i.e. for the entire model domain, averaged over years 1998-2007. The Greek letter delta (Δ) symbolizes the change in a quantity for a given scenario with respect to the baseline, or calibrated historical model run. The comparison shows that for the averaged period 1998-2007, the baseflow impact restricted to the Rattlesnake Creek basin is only 74.4 percent of the impact over the entire model domain. The rightmost column is the ratio of baseflow impact to pumping reduction. The column labeled "Balance" is the sum over the four columns to its left (changes in storage, pumping, ET and baseflow). The water imbalance over the model domain of –116 acre-feet per year (afy) is attributed to impacts at constant heads (26 afy) and numerical error (90 afy). The balance, or sum over budget impacts restricted to Rattlesnake Creek basin is –8584 afy, and much larger than for the model domain.

Fig. A6 plots annual impacts on global water budget terms 1958-2007 for Scenario 1. Fig. A7 plots corresponding impacts restricted to Rattlesnake Creek basin. Comparison of the two figures shows that ET and baseflow impacts are reduced in Fig. A7 for the basin-only impacts, but show similar behavior in the two budgets; only storage impacts show significant differences. Fig. A8 shows baseflow impact from the global water budget for each stress period. Fig. A8 superimposes the annual ratio of basin-only and global baseflow impacts (right axis). As mentioned above, the basin-only impact on baseflow for each time step was approximated by the product of the global-budget baseflow impact and the ratio of basin-only and global baseflow impacts for the corresponding year (Fig. A8).

Fig. A9 plots Refuge flow deficiency (flow deficit) and baseflow depletion by the basin's junior water rights. The flow deficit is given by the Quivira refuge requirement (needs) minus Zenith gaged flow, when that difference is positive, and is otherwise zero. When a flow deficit exists, the deficit is exceeded by baseflow depletion in all management periods except six that occurred prior to 1992.

Table A2 lists selected management periods from a worksheet that calculates impairment based on baseflow depletions within the Rattlesnake Creek basin. Spreadsheet calculations behind Table A2 are expressed in the table headings. Table A2 lists results for two sets of management periods. (a) In the first six periods, Refuge flow deficit exceeds baseflow depletion, in which case the deficit is attributed to predevelopment flow conditions and not to depletion by pumping. This situation occurred in only six management periods, all predating 1992. (b) The last six periods are for 2007, and illustrate more typical conditions, when flow deficits are either zero or are less than baseflow depletions. In this case, any flow deficits are attributed to baseflow depletion. The summary of spreadsheet calculations at the bottom of Table A2 show that, for 1974-1991, 87.67 percent of Refuge flow deficits are attributed to pumping depletion in the basin, while 12.33 percent of deficits are due to low-flow conditions that would have existed with no depletion by pumping, i.e. predevelopment low-flow conditions. In the years since 1991,

however, all flow deficits are attributed to depletion by pumping, and none to predevelopment low-flow conditions.

Summary of results presented by Barfield and others (2014)

Pumping impacts on water budgets are first summarized as average change in water budget terms over years 1998-2007 in Table A3 for the basin-wide and targeted scenarios of interest, and in Table A4 for comparison of impacts under the single- and multilayer model versions for Scenario 11. An explanation of these tables is followed by graphs showing temporal response for some of the pumping scenarios. See Figs. A6 – A14. Streamflow response statistics of interest in these results include average baseflow increase for 1998-2007, the ratio of baseflow increase to pumping reduction (or bang for the buck), and response time, or lag between pumping reduction and significant baseflow increase, which is presented qualitatively in the graphs.

Tables A3 and A4 are shown below as they were presented in 2014. The table columns are first explained as follows.

Columns 1 and 2 summarize scenario descriptions given above. In the remaining column headings, the Greek letter, delta (Δ) is used to symbolize the change in a quantity for a given scenario with respect to the baseline, or historical conditions for the calibrated model. Column 3, Δpumping is the change in pumping (acre-feet/year) for each scenario, denoted as reduction by parentheses and red type. The remaining columns summarize the water budget response for each scenario. Columns 4, 7 and 8 are responses of the significant water budget terms corresponding to change in baseflow, evapotranspiration and groundwater storage (acre-feet/year). Column 5 expresses the baseflow response in cubic feet/sec, a unit conversion of Column 4. Column 6 is the ratio of the baseflow response (col. 4) to pumping reduction (col. 3), and quantifies the relative efficacy, or bang for the buck, of each scenario; for now, the term “relative baseflow yield,” or “relative yield” as shorthand will be used for column 6.

Tables A3 and A4 differ in the type of water budgets that they reference. Table A3 summarizes impacts on water budgets restricted to the Rattlesnake Creek basin. Water budget balances within basins are not enforced, and water budgets indeed do not balance within the Rattlesnake Creek basin. Water budget impacts within the basin were summarized with the intent of better characterizing the baseflow impact at the Zenith gage.

Table A4 summarizes global water budget impacts, which are based on balanced water budgets over the entire active model domain, and which are balanced as a result of convergence of the solution for computed heads for each time step. The distinction between global and basin-only budget impacts was discussed previously for Scenario 1 results. Table A4 compares global water budget impacts for Scenario 11 based on the single- and multilayer model versions instead of impacts limited to Rattlesnake Creek basin because the multilayer model output does not provide the necessary data for that comparison without modifying the model’s output control instructions.

Of the basin-wide pumping scenarios, Scenarios 1 and 2 show the same pumping reduction average over years 1998-2007; the scenarios differ only in the date when shutoffs are applied (1958 for Scenario 1 and 1990 for Scenario 2, both of which predate the impact averaging period). Scenario 1 quantifies baseflow depletion by rights in the basin junior to the Refuge's water right, and is used in the impairment analysis described in the report. Scenario 2 characterizes what might have happened had such management action been taken in 1990.

The basinwide pumping scenarios curtail far greater pumping than the targeted pumping scenarios but yield relatively little baseflow. Scenario 2.75 with 25 percent basinwide pumping reduction has the lowest relative yield, i.e. producing only about 15 acre-feet of baseflow for each 100 acre-feet of curtailment (delta baseflow / delta pumping, col. 6). Scenario 2.5 with 50 percent basinwide pumping reduction is a close second yielding only about 19 acre-feet per 100 acre-feet of curtailment.

The targeted pumping scenarios in Table A4 show relative baseflow yields ranging from 43 to 63 percent, which correspond to response zone curtailment scenarios 9 and 7, respectively. Relative baseflow yields for stream corridor curtailment scenarios 10 and 11 fall in the middle of the targeted pumping scenarios at 54 and 50 percent, respectively.

Scenario 11: Comparison of impacts for single- and multilayer model versions

Scenario 11 was selected to run with the multilayer model version for comparison because it shows a significant baseflow impact of 5,560 afy or 7.7 cfs and a high relative baseflow yield, 50 percent. Line 3 of Table A4 shows small differences in budget impacts between the model versions averaged over years 1998-2007. Based on the similarity of computed impacts for the single- and multilayer model versions for Scenario 11, we expect that multilayer model versions of the other scenarios would also compare closely with the single-layer model versions that we have depended on for comparing scenarios.

Temporal response of water budgets to pumping curtailment for selected scenarios

Annual response of Rattlesnake Creek water budget terms to pumping curtailments are shown for basinwide curtailment under Scenario 2 and for targeted curtailment under Scenarios 9 and 11.

The temporal response to basinwide shutoff of pumping in 1990 (Scenario 2) is plotted on an annual basis in Fig. A10 for global water budget terms, and in Fig. A11 for Rattlesnake Creek water budget terms. Comparison of the two graphs shows similar behavior between the two budgets except for storage; the dissimilarity for storage is attributed to an imbalance in the Rattlesnake Creek basin budget, whereas the global budget is balanced as part of the model solution. Both Figs. A10 and A11 show that despite a large, immediate change in pumping and corresponding change in storage in 1990, baseflow response is negligible in the first two years of the shutoff, and is significant only beginning in 1992.

Fig. A12 shows the annual response of global water budget terms under Scenario 9, which shuts off pumping within zones of 20 percent or greater response. Baseflow response in the first two years of shutdown is greater than for Scenario 2, but is significant only beginning in 1992.

Figs. A13 and A14 show annual response of global water budget terms under Scenario 11 for single- and multilayer model versions. Again, baseflow response in the first two years of shutdown is greater than for Scenario 2, but is significant only beginning in 1992. Comparison of Figs. A13 and A14 shows that the single- and multilayer model versions of Scenario 11 exhibit very similar responses on an annual basis.

Conclusions

The single and multi-layer models are functionally equivalent for determining pumping impacts on streamflow.

GMD5 model results for the pumping shutoff scenarios show that baseflow reductions due to junior pumping are significant.

Scenario 1, which shuts off all pumping junior to Water Right File No. 7,571 in Rattlesnake Creek basin beginning in 1958, quantifies baseflow reductions in the basin, which would appear at the Zenith gage were it not for the pumping by juniors.

Pumping reductions near the stream produce faster baseflow response. However, none of the pumping shutoff scenarios produce an effective baseflow response for two to three years.

Response to Technical Comment

This section describes modeling work and results in response to the only technical comment from Balleau Groundwater, Inc. on modeling work that could have a bearing on the report. To summarize, a correction was applied as suggested by Balleau Groundwater modelers such that the initial model solutions are treated correctly. Here we describe the correction and the model runs to test its effects, and show that the correction has negligible effects on stream depletion calculations that are referenced in the original report.

Technical comment number 5 [from the file 2016-05-13 GMD5 Comments Final.pdf] reads,

"**The starting head condition used in the model scenarios is not steady. Beginning the simulations with an initial condition that is not in steady state should be corrected.**"

Chris Beightel and Sam Perkins discussed this comment on Friday, May 20, with Dave Romero and Steve Silver of Balleau Groundwater, Inc. to clarify its meaning. Chris first verified in that discussion that the above comment was the only one related to model runs that underlie the report.

With respect to the above comment, Dave and Steve explained that the unsteady initial conditions would affect the model budget terms (i.e., storage, streamflow, ET, and flows at specified-head boundary cells), and that their comment applies to the single-layer model version, but not to the

multi-layer version, for which they said that initial conditions were represented correctly. The implication was that the model should be re-run with this correction to calculate stream depletion impacts of pumping by junior right holders in the Rattlesnake Creek basin under Scenario 1. Dave and Steve suggested that a simple way to correct this would be to extend the length specified for the first stress period from 30 days (more accurately, 365.25/12 days) to, say, ten billion days, or a little over 27 million years. By extending the first stress period length in this way, the change in storage for the first stress period should be drastically reduced in magnitude, so that even though the first stress period is transient, it should be a good approximation for steady state conditions, under which change in storage is zero. (More accurately, the equation that Modflow solves under steady state conditions does not include a storage term; i.e., there is no change in storage under steady state conditions.)

Two additional simulations were run in order to respond to technical comment number 5. These include re-running the base case and Scenario 1 with the initial stress period redefined to approximate steady state conditions as described in the preceding paragraph. We used the additional model runs to determine the discrepancy introduced by the original unsteady initial conditions on (a) the global water budget for the base case, and (b) the stream depletions due to pumping by junior water right holders in the Rattlesnake Creek basin under Scenario 1.

Results: Impact of initial transient conditions for historical base case (1-layer model):

Global budgets for the original and corrected versions of the base case were compared, and show that by extending the stress period length from 30 to ten billion days, the change in storage by the end of the first stress period is reduced from a flow rate of 399 ac-ft/day to 4.52e-7 ac-ft/day, which is approximately zero using single-precision calculations. That is, setting the length of the first stress period to ten billion days is a convenient way to closely approximate steady state conditions. (At the same time, this approach avoids possible convergence problems that arise sometimes when the first stress period is specified as steady-state.)

Figures A15 and A16 plot the budget impacts due to changing the initial stress period to give a steady-state solution. Figure A15 plots the budget impacts for each 10-day time step of the simulation 1940-2007; Figure A16 plots an annual summary of the same budget impacts. Both figures show large budget impacts of the unsteady conditions of initial heads for the single layer model, although the impacts slowly decay over time. The time period of interest for the pumping and augmentation scenarios, particularly for Scenario 1 with full basin shutoff of junior rights, is 1958-2007.

Global impact of pumping on streamflow under Scenario 1 based on model runs beginning with steady state conditions, and comparison with original calculations

Pumping impacts, in particular streamflow depletion, were then calculated for Scenario 1 based on the model runs beginning with the quasi-steady state stress period (length set to ten billion days in both base case and impact case), and were compared with depletions calculated for the original model runs.

Fig. A17 shows streamflow depletion based on model runs that begin with a quasi-steady state stress period (blue line), and the discrepancy in the original calculation of streamflow depletion (thin red line, right axis), i.e. the original streamflow depletion minus the recalculated value. The discrepancy lies within a range from -0.3 and +0.9 cfs for 1958-2007 (mean -0.16 cfs, std deviation 0.25 cfs), so the discrepancy is negligible.

This comparison shows that pumping impacts on streamflow for the original and corrected versions of Scenario 1 are nearly identical, as we interpret the differences shown in Fig. A17 to be negligible. Based on this interpretation, we conclude that the original depletions calculated for the impairment report under Scenario 1 are acceptable.

References

Balleau, W. Peter, Dave M. Romero and Steven E. Silver, 2010. Hydrologic model of Big Bend Groundwater Management District No. 5. Balleau Groundwater, Inc., Albuquerque, N.M.

Barfield, David, Sam Perkins and Ginger Pugh, 2014. Power Point presentation on Nov. 4, 2014, to Basin Stakeholders at the St. John, Kan., library (file GMD5.ModelingScenarios.KDA-DWR.pdf, referenced in the Quivira impairment report).

Harbaugh, A.W., Banta, E.R., Hill, M.C., and McDonald, M.G., 2000, MODFLOW-2000, the U.S. Geological Survey modular ground-water model -- User guide to modularization concepts and the Ground-Water Flow Process: U.S. Geological Survey Open-File Report 00-92, 121
p. Link: http://water.usgs.gov/nrp/gwsoftware/modflow2000/modflow2000.html

Larson, Steve, 2011. Big Bend GMD5 Model Peer Review. S.S. Papadopulos and Associates, Bethesda, Md.

Backup Excel spreadsheet file:
RS_pumping_impact_scenario_1_cbc_RSMask_cwb_20150923_sp_revised _2015_1112.xlsm

Tables

Table A1. Comparison of Scenario 1 pumping impacts on global and basin-only water budget (1998-2007 average).

budget extent	Δstorage	ΔPumping	ΔET	ΔBaseflow	Balance	ΔB/ΔP
RS Basin	70,505	(143,529)	22,387	42,053	(8,584)	29.3%
model (global)	61,464	(143,529)	25,426	56,523	(116)	39.4%
RS Bsn / model			88.0%	74.4%		

Table A2. Selected refuge management periods from the period of impairment analysis, 1974-2007.

refuge mgmt period	year	u: annual basin depl / global depl	v: Refuge Needs	w: Zenith Gaged Flow	x=max(0, v-w): inflow deficit (refuge needs > Zenith gaged flow), af	y: baseflow depletion (approx. basin budget)	z=max(0, v-(w+y)): predev flow deficit	aa=x-z: impaired by depletion af
Oct/Nov	1980	0.9084939	3600	690	2910	2150	760	2150
Jul/Aug/Sep	1984	0.8769227	3500	520	2980	830	2150	830
Jul/Aug/Sep	1988	0.8061852	3500	830	2670	1960	710	1960
Oct/Nov	1988	0.8061852	3600	550	3050	1560	1490	1560
Jul/Aug/Sep	1991	0.8473867	3500	150	3350	2470	880	2470
Oct/Nov	1991	0.8473867	3600	220	3380	2460	920	2460
Jan/Feb	2007	0.7499378	1500	1670	0	7400	0	0
Mar/Apr	2007	0.7499378	3500	10540	0	9530	0	0
May/Jun	2007	0.7499378	2000	32510	0	14730	0	0
Jul/Aug/Sep	2007	0.7499378	3500	16420	0	14710	0	0
Oct/Nov	2007	0.7499378	3600	2510	1090	7580	0	1090
Dec	2007	0.7499378	500	3280	0	5240	0	0
					sum(x)	sum(y)	sum(z)	sum(aa)
sum 1974-1991					56020	462860	6910	49110
sum 1992-2007					50360	693230	0	50360
volumetric fraction:							sum(z)/ sum(x)	sum(aa)/ sum(x)
1974-1991							0.1233	0.8767
1992-2007							0	1

From cols a:b and u:aa in sheet cwb_QNWRGrp, file RS_pumping_impact_scenario_1_cbc_RSMask_cwb_20150923_sp_revised_cwb_lookup_2015_1112.xlsm.

Table A3. Pumping impacts on water budget within Rattlesnake Creek basin (1998-2007 average) for basin-wide (Scenarios 1–2.75) and targeted (Scenarios 7–11) pumping curtailments.

scenario	Scenario definition	Δpumping	Δbaseflow	ΔB cfs	ΔB/ΔP	Δstorage	Δ et
1	basinwide shutoff from 1958 on	(143,529)	42,053	58.0	29.3%	70,505	22,387
2	basinwide shutoff from 1990 on	(143,529)	34,420	47.5	24.0%	76,837	18,007
2.5	basinwide 50% pumping	(71,765)	13,366	18.4	18.6%	34,019	8,662
2.75	basinwide 75% pumping	(35,882)	5,475	7.6	15.3%	18,200	4,265
7	response zone >70%	(1,059)	661	0.9	62.4%	77	253
8	response zone >40%	(9,701)	4,646	6.4	47.9%	1,442	2,597
9	response zone >20%	(19,604)	8,326	11.5	42.5%	3,350	4,975
10	RSC 1-mi corridor to Macksville	(3,932)	2,115	2.9	53.8%	410	1,094
11	RSC 2-mi corridor to Macksville	(11,230)	5,560	7.7	49.5%	1,396	3,086
Notes:	[1] Restrict selections to Rattlesnake C basin wells junior to Aug 15 1957 (USF&W File 7571).						
	[2] Scenario 1 selection begins Jan 1958 (str per 218); others begin Jan 1990 (str per 602).						
	[3] Scenarios are specified as input to preprocessor by scenario id and pump scaling factor.						

Table A4. Comparison of single- and multilayer model versions of Scenario 11: pumping impacts on global water water budget (1998-2007 average).

scenario id	Scenario definition [1,2,3]	Δpumping ac-ft/y	Δbaseflow ac-ft/yr	Δbaseflow cfs	ΔB/ΔP pct	Δstorage ac-ft/y	Δ ET ac-ft/yr
11	RSC 2-mi corridor to Macksville	(11,230)	5,729	7.9	51.0%	2,253	3,275
11 ML [4]	RSC 2-mi corridor to Macksville	(11,230)	5,464	8	48.7%	2,404	3,379
difference	[multi - single] layer versions	0	(265)	(0)	-2.4%	150	104

Figures

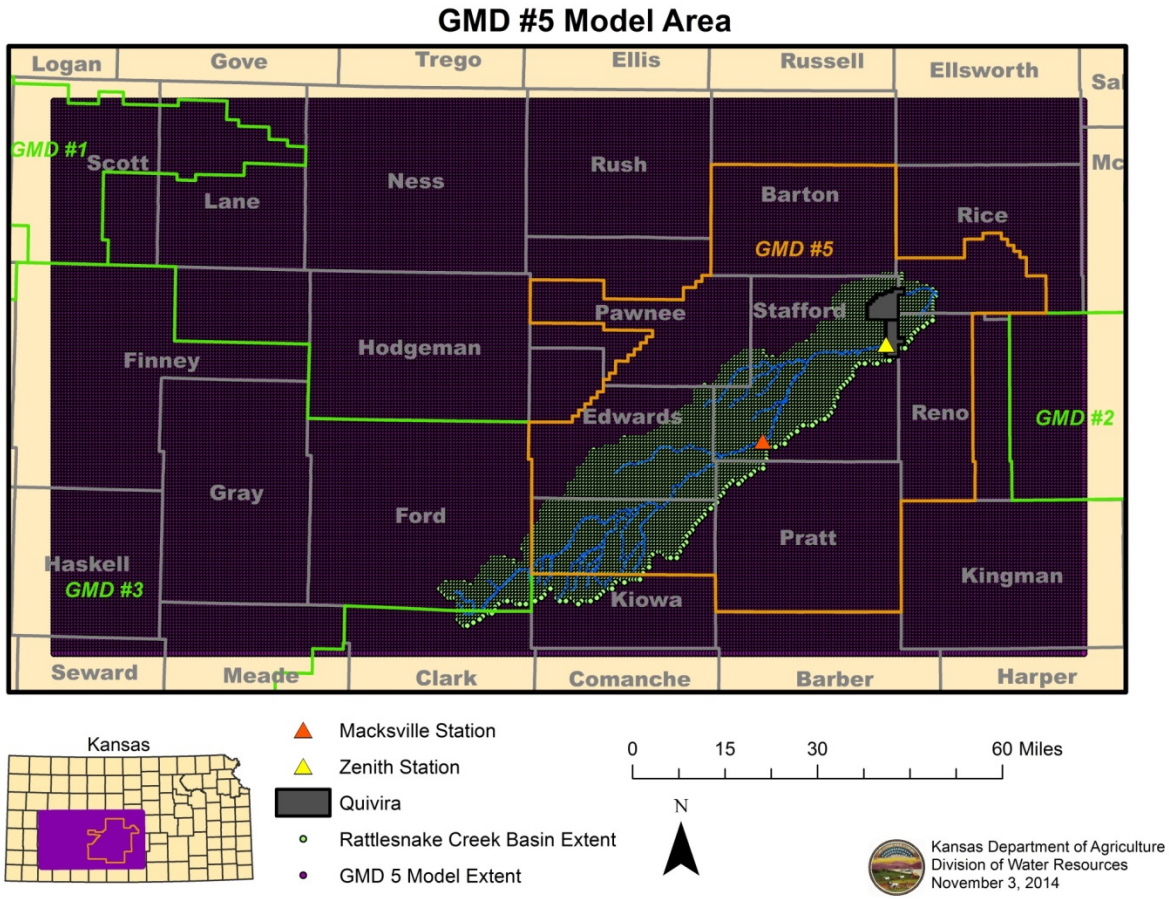


Fig. A1. GMD5 model extent. (Slide 6, Barfield et al., 2014)

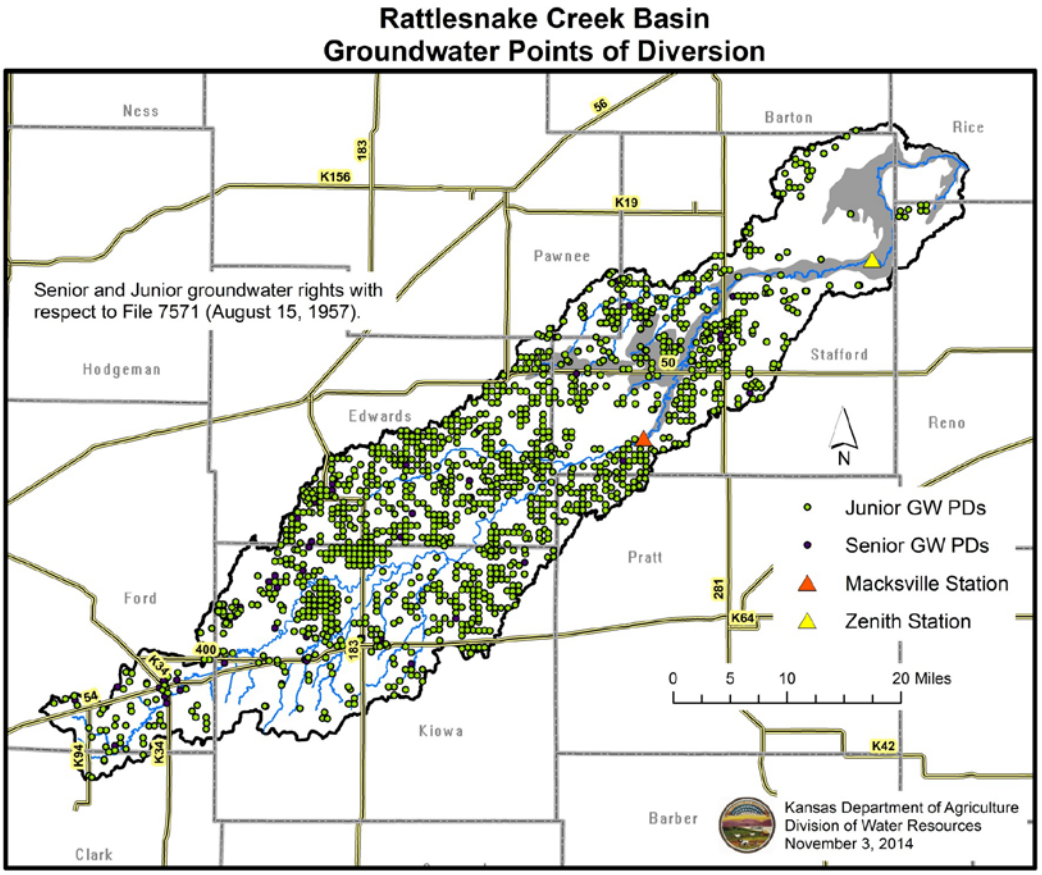


Fig. A2. Groundwater points of diversion in Rattlesnake Creek Basin. (Slide 7, Barfield et al., 2014)

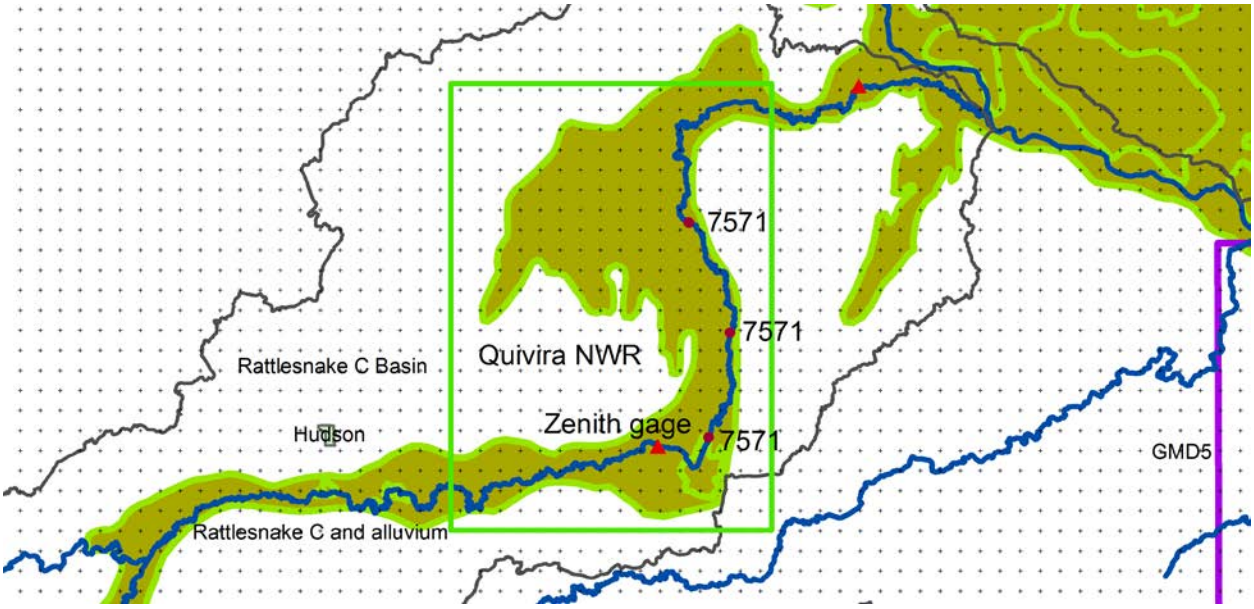


Fig. A3. Vicinity of Quivira National Wildlife Refuge and intakes from Rattlesnake Creek (USFW Water Right File No. 7,571) downstream from Zenith gage.

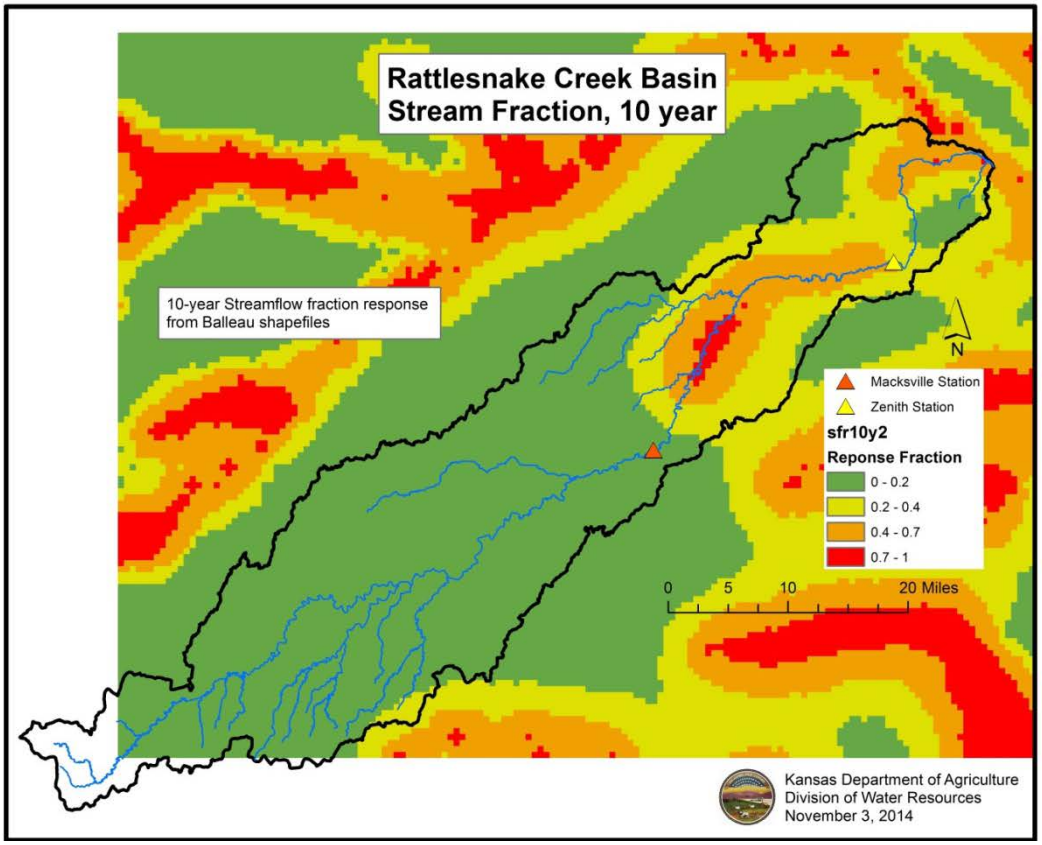


Fig. A4. Map of 10-year streamflow response, the fraction of Rattlesnake streamflow at the Zenith gage depleted by ten years of pumping, evaluated at each model grid cell within the mapped area. (See also Fig. 51, Balleau et al., 2010)

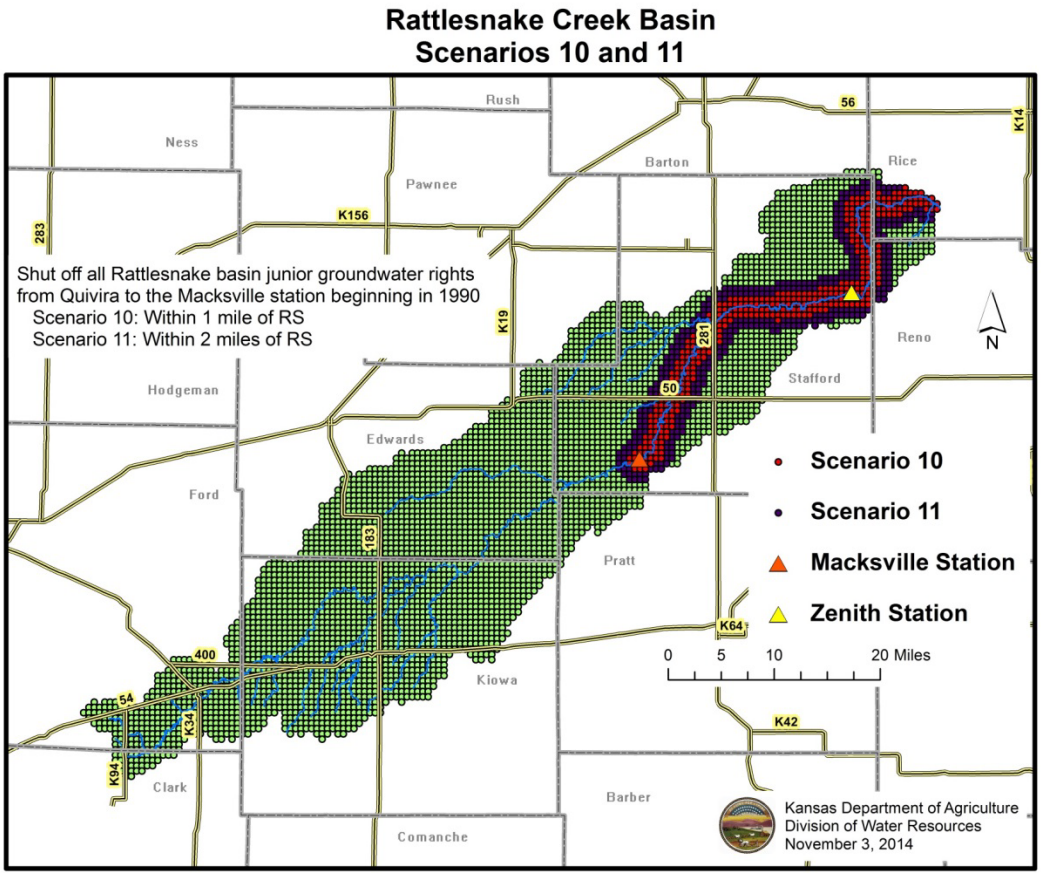


Fig. A5. Map showing one-mile and two-mile corridors along Rattlesnake Creek within which all junior pumping is shut off for Scenarios 10 and 11, respectively.

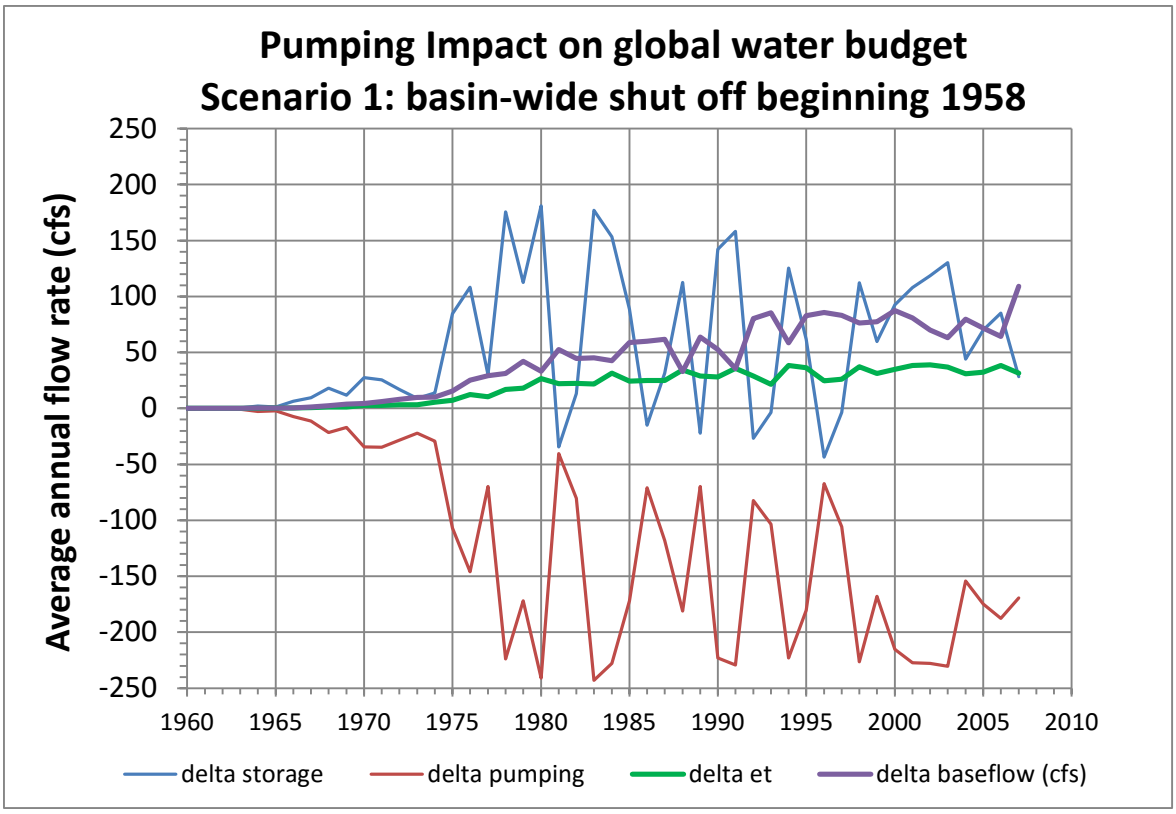


Fig. A6. Global water budget impacts 1958-2007 for Scenario 1 as flow rates, cu. ft/sec.

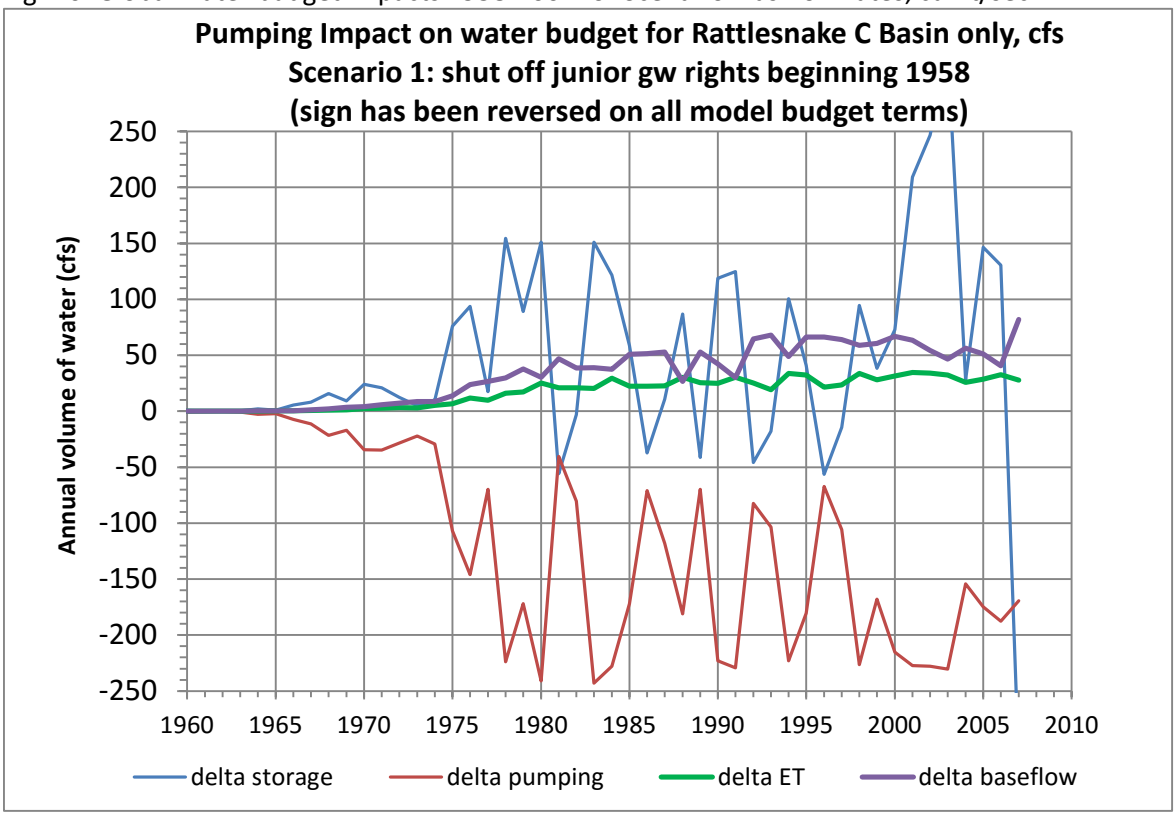


Fig. A7. Rattlesnake Creek Basin water budget impacts 1958-2007 for Scenario 1 as flow rates, cu. ft/sec.

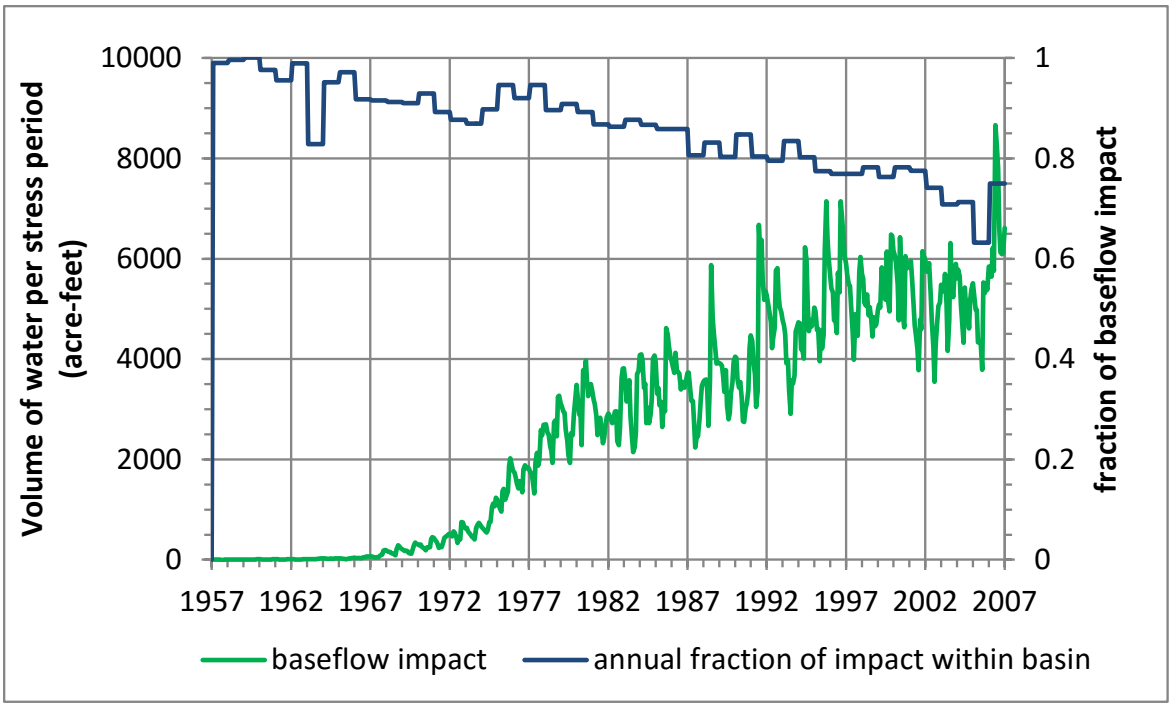


Fig. A8. Scenario 1 global pumping impact on baseflow per stress period, acre-feet (left axis) and annual fraction of global impact on baseflow within basin (right axis). Stress periods approximate months (365.25/12 = 30.4375 days). [Chart at AD822, Impacts_RS_wells_scenario_1_bgw, backup file]

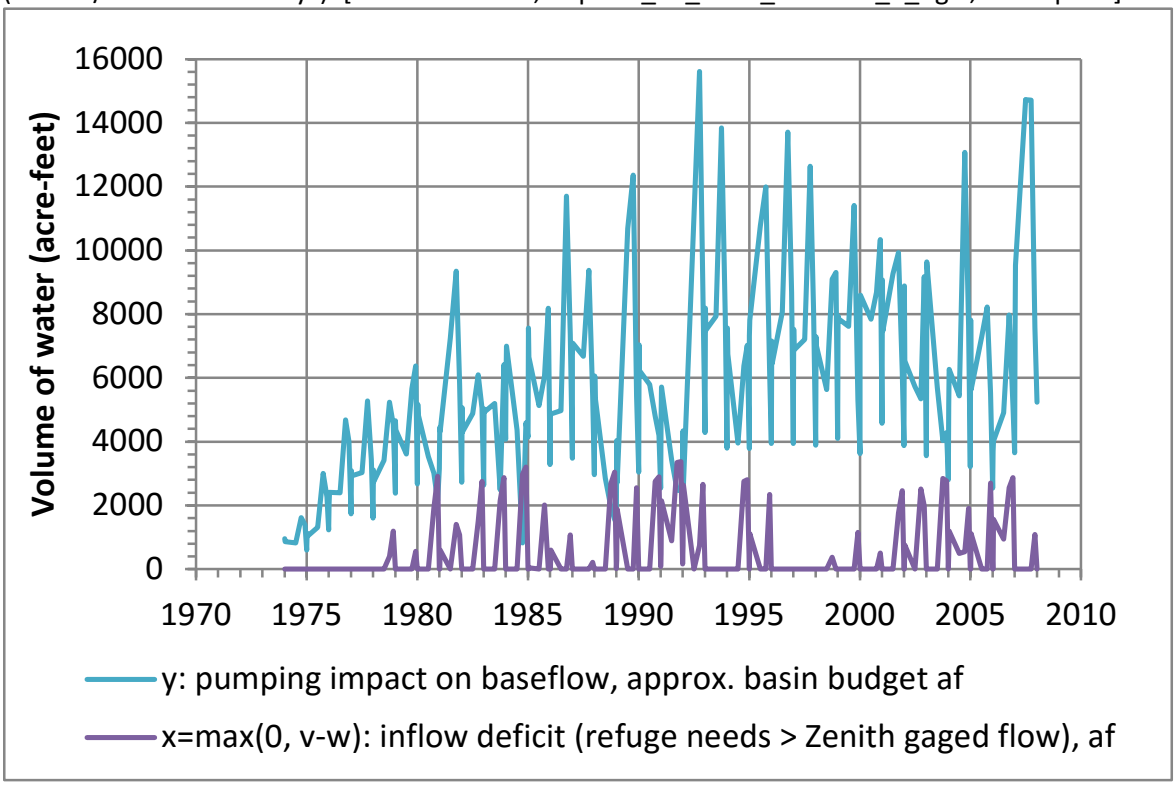


Fig. A9. Deficit in Refuge requirement (purple) and baseflow depletion by pumping (blue), for each Refuge management period. [Chart at w220 in sheet cwb_QNWRGrp of backup file]

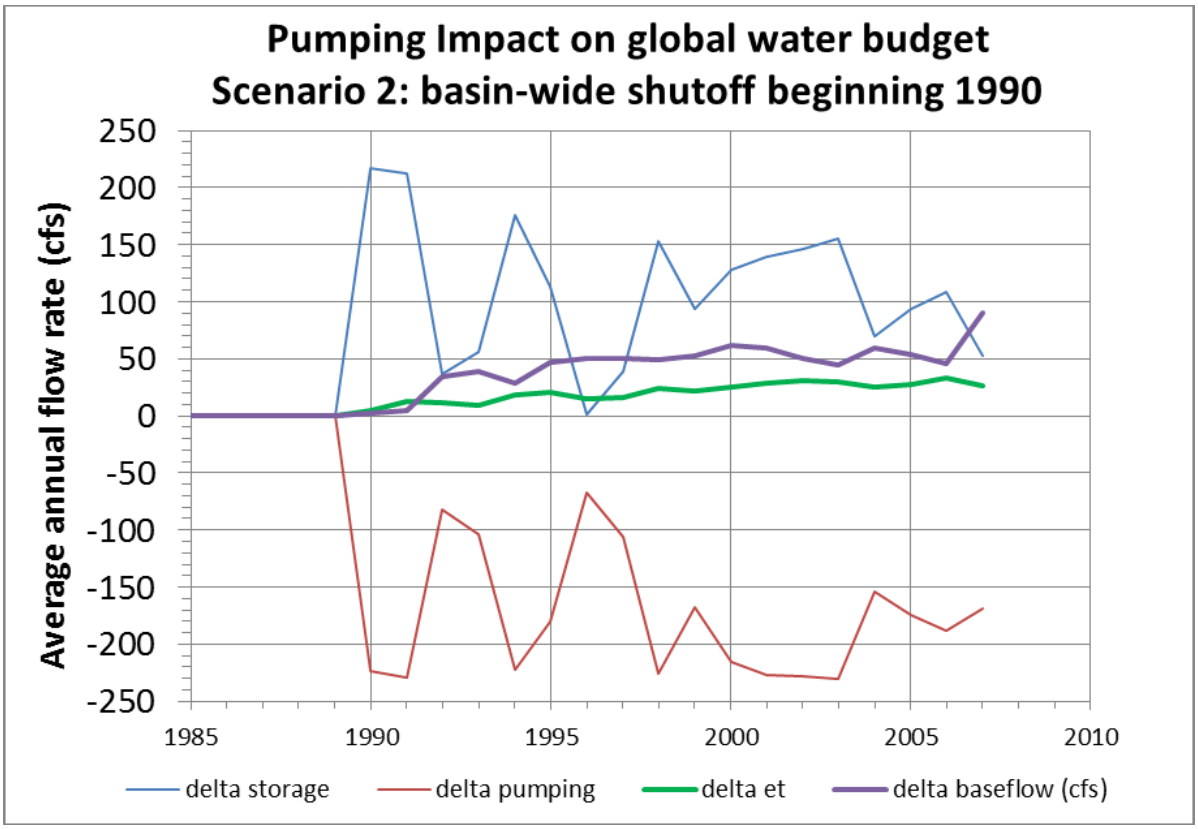


Fig. A10. Pumping impacts on global water budget for Scenario 2: basinwide shutoff beginning 1990.

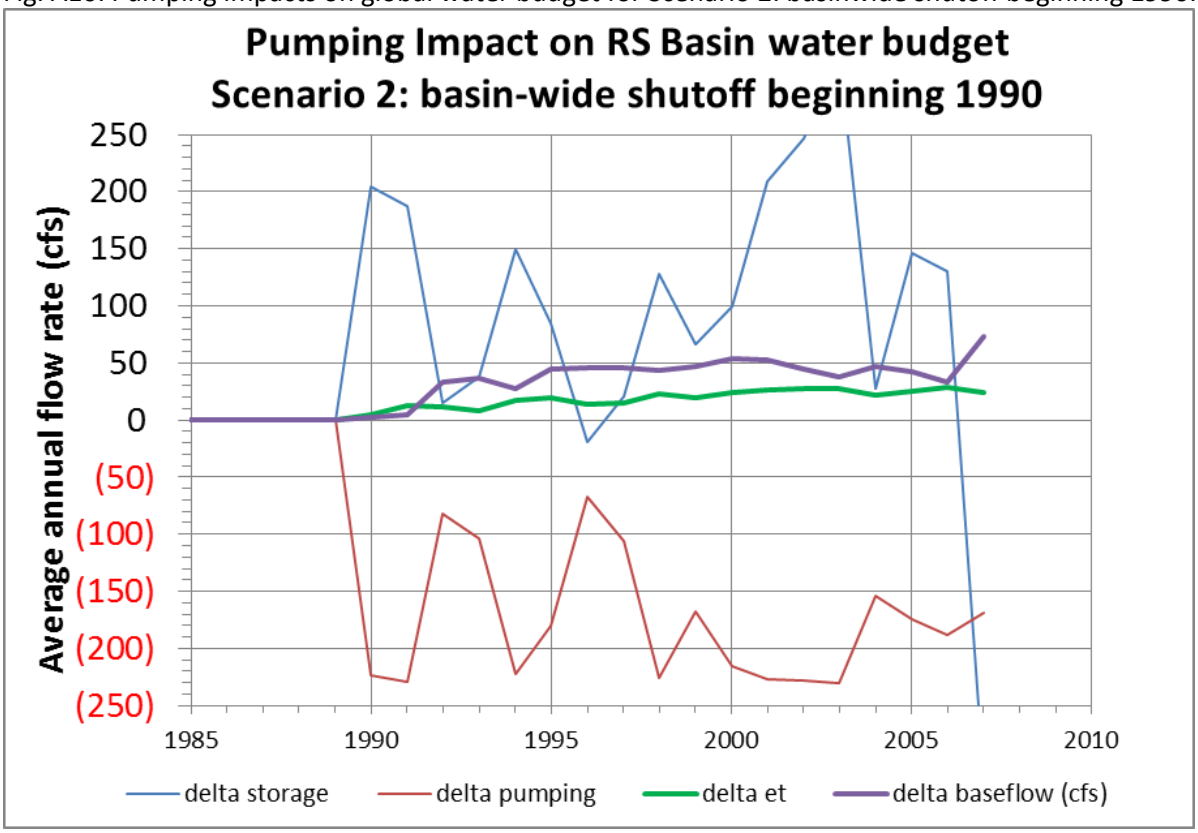


Fig. A11. Pumping impacts on RS Basin water budget for Scenario 2: basinwide shutoff beginning 1990.

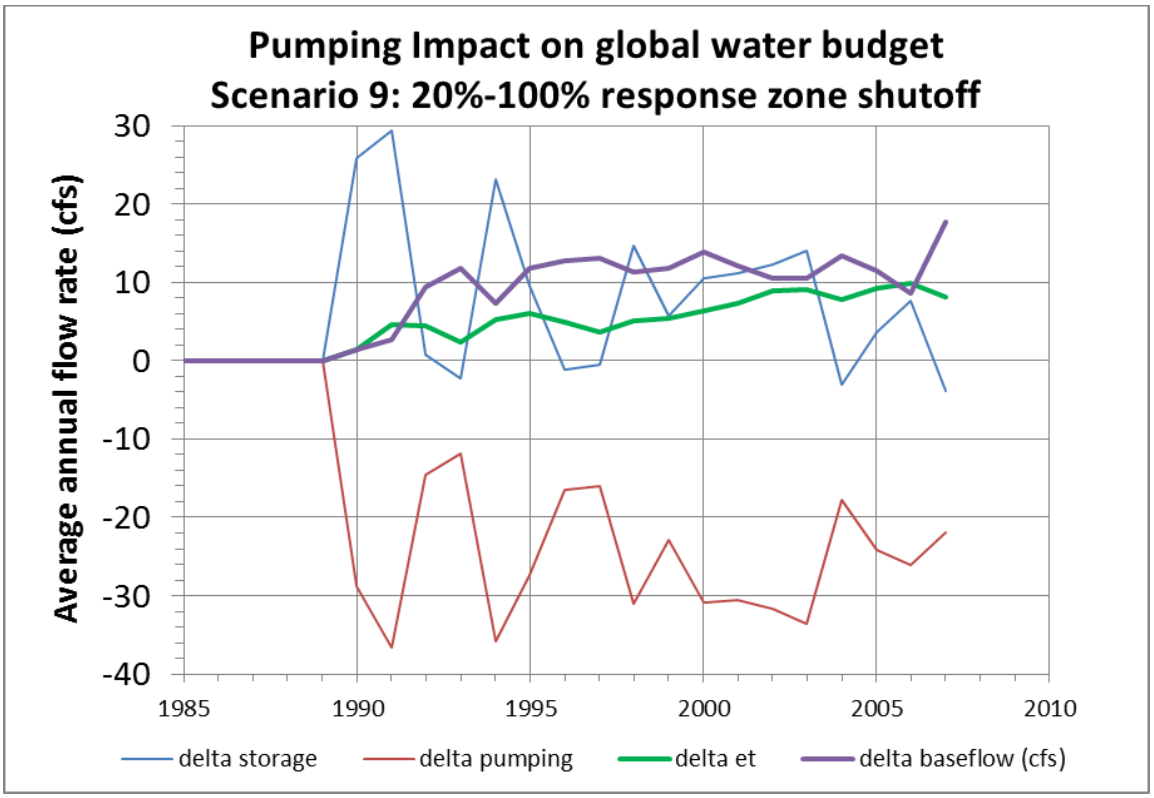


Fig. A12. Pumping impacts on global water budget for Scenario 9: targeted shutoff of wells within 20 percent or greater response zones beginning 1990. (response zones by Balleau and others, 2010)

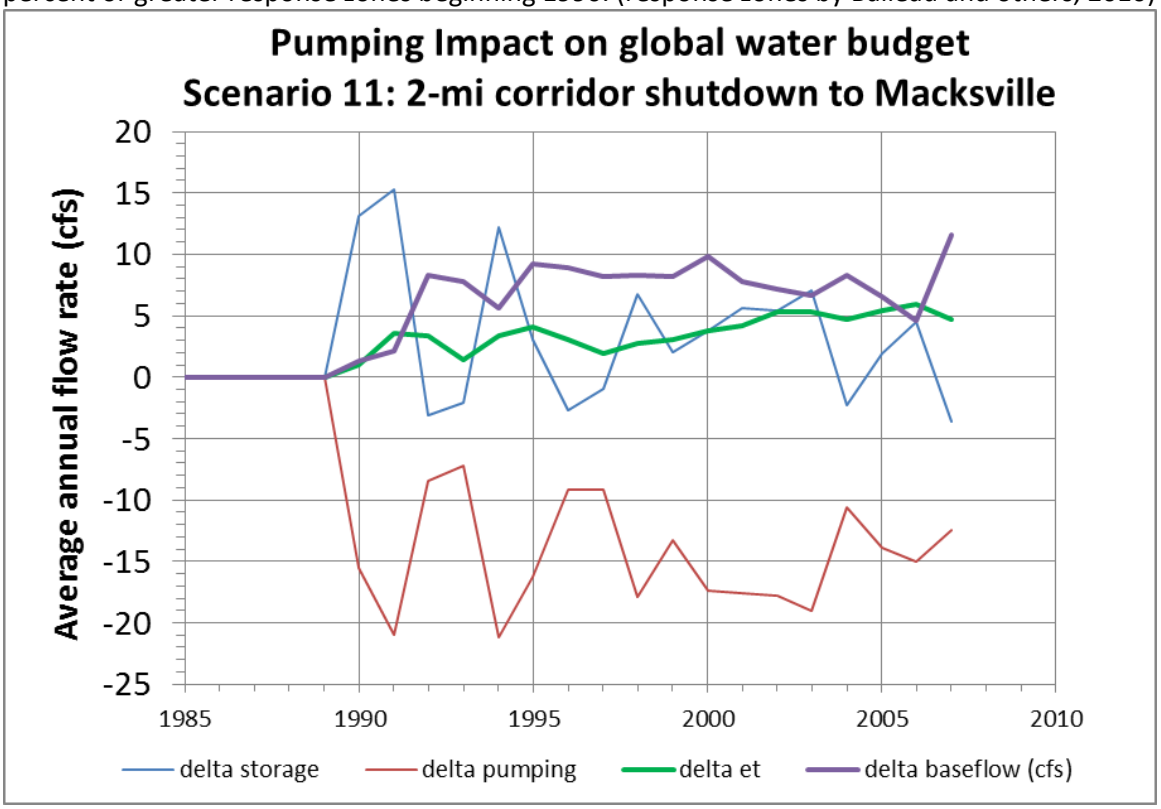


Fig. A13. Pumping impacts on global water budget for Scenario 11 (single-layer model version): targeted shutoff of wells within two miles of Rattlesnake Creek beginning 1990.

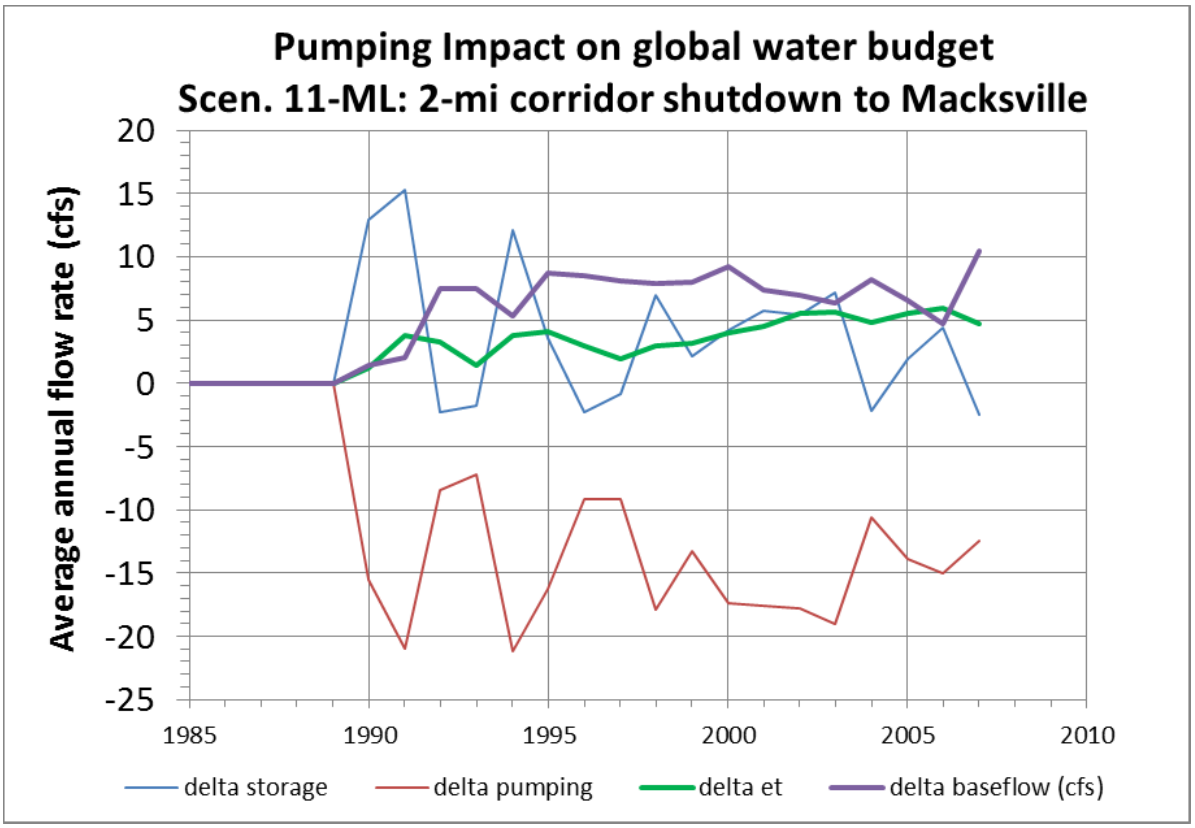


Fig. A14. Pumping impacts on global water budget for Scenario 11-ML (multilayer model version): targeted shutoff of wells within two miles of Rattlesnake Creek beginning 1990.

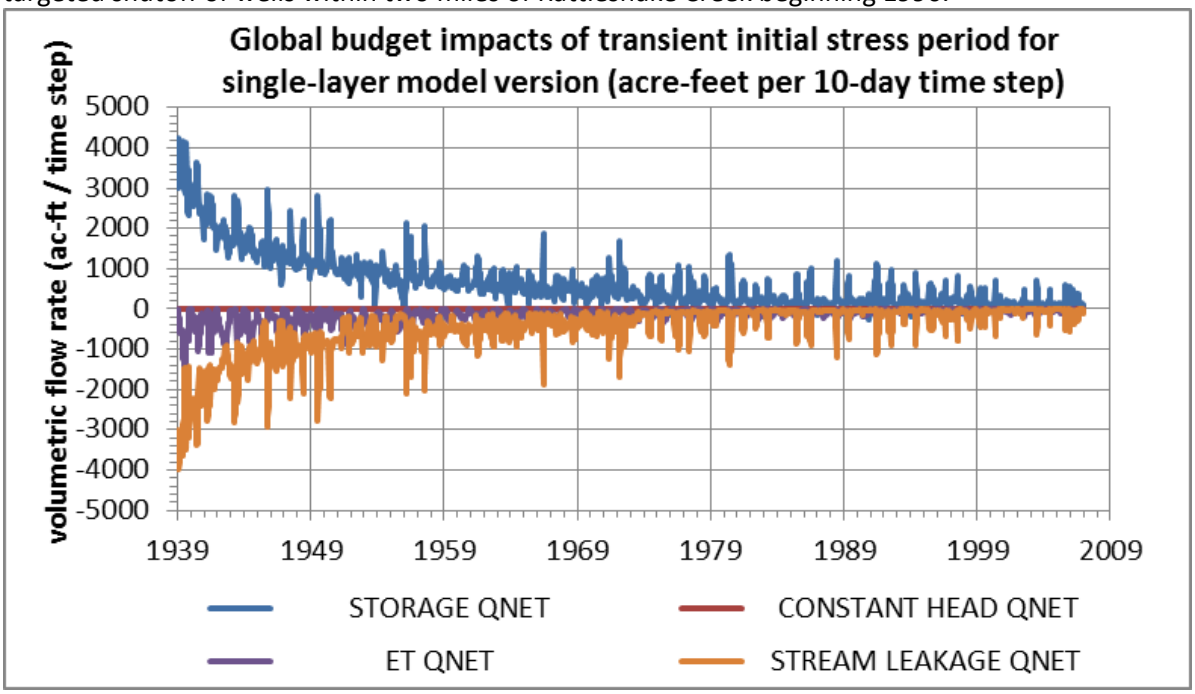


Fig. A15. Global budget impacts (acre-feet per ten-day time step) introduced by transient conditions in first stress period for the historical base case simulation 1940-2007 (single-layer model version).

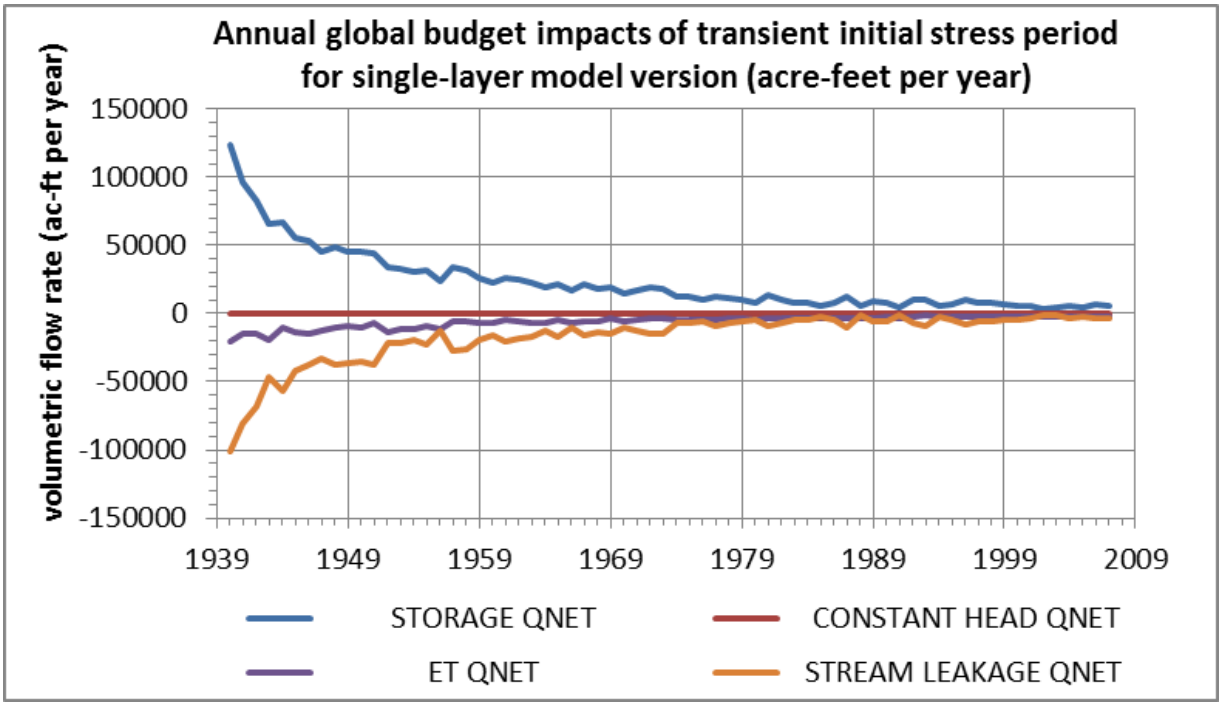


Fig. A16. Annual budget impacts (acre-feet per year) introduced by transient conditions in first stress period for the historical base case simulation 1940-2007 (single-layer model version).

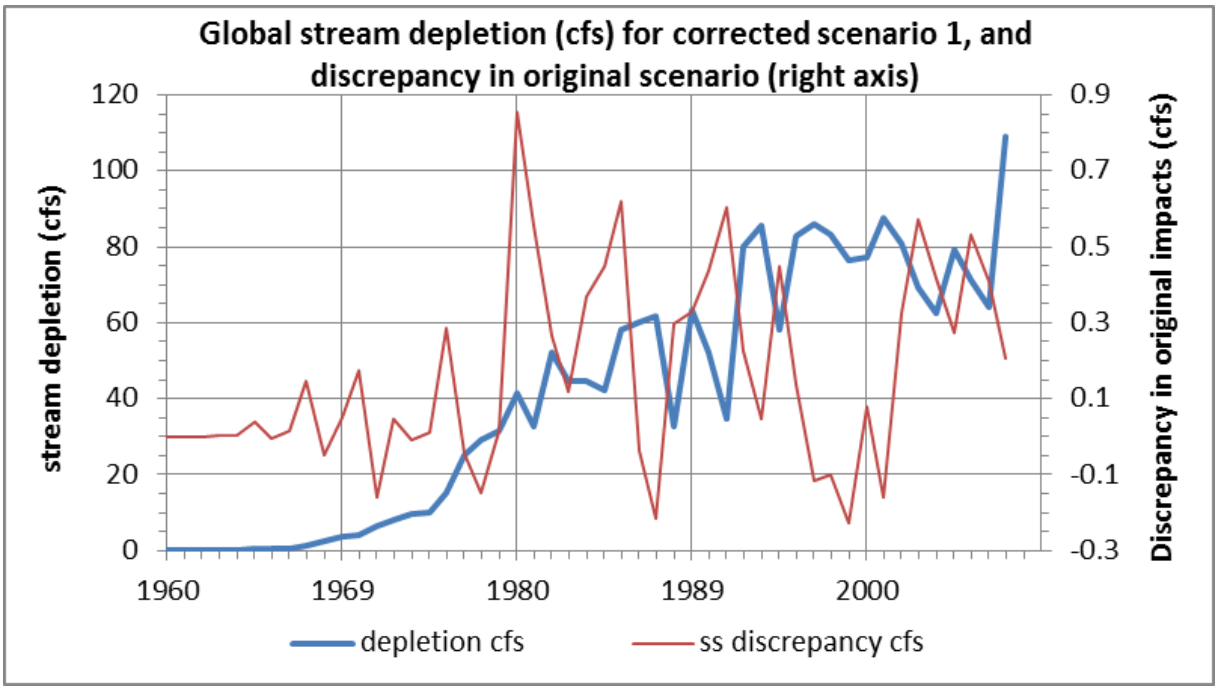


Fig. A17. Global stream depletion by Rattlesnake C Basin rights junior to File 7571 according to single-layer model runs beginning from steady state conditions as recommended by Balleau Groundwater, Inc., and discrepancy in original impact calculations (right axis).

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
WR KS
Mail Stop 60189

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

MAR 04 2014

David Barfield, Chief Engineer
Kansas State Board of Agriculture
Division of Water Resources
109 SW 9th Street, 2nd Floor
Topeka, Kansas 66612-1280

Dear Mr. Barfield:

Staff from Quivira National Wildlife Refuge (Refuge) and the U.S. Fish & Wildlife Service Region 6 Division of Water Resources (Service) recently attended the monthly board meeting for Big Bend Groundwater Management District No. 5 (GMD#5). At the request of the Service, they met with Jeff Lanterman and yourself afterwards to discuss the ongoing impairment investigation and impacts to the Refuge's senior surface Water Right, File No. 7571.

It appears that the investigation and report generation may take a considerable amount of time to complete. Kansas statutes do not address a specific time period that the Chief Engineer has to complete the investigation and report. The Service recognizes that your agency may be dealing with other water right or resource issues, however, the Service raised concerns as early as 1971 about potential impairment to our senior water right, and they have not been addressed to date. At the meeting, you requested that the Service answer questions contained in your October 21, 2013, letter regarding impairment. The Service indicated that much of the information you were seeking was contained in the 1998 Burns and McDonnell study, Quivira National Wildlife Refuge Water Resource Study. You indicated that you have not reviewed the report and the Service came away with the impression that your office has committed little focus to the impairment investigation. You suggested that we could provide you with the location of the information in the report that we believe provides information regarding your questions. The Service feels very strongly that answers to these questions have been provided numerous times over the past 25 years, both in letters and in reports paid for using Service resources. If the Service agrees to spend time and resources to review and mark up the Burns and McDonnell report, we expect you to make a commitment to a definite time period to complete the impairment investigation and report.

Both the Service and the water users continue try to plan for the future with great uncertainty concerning the availability of water. It is in the interest of all water users within the Rattlesnake

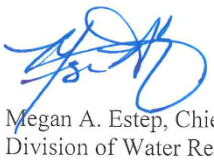
Creek Subbasin, the thousands of visitors to the Refuge, and the State of Kansas that progress be made toward reaching a long-term solution to protecting and sustaining water resources. During the February meeting of GMD#5, the Service first learned that GMD#5 submitted a proposal for a 5-year water management plan to your office. It was equally interesting to learn that WaterPACK is active again after years of being relatively inactive. The Service was proceeding under the impression that there is still a functioning Partnership. Under the terms of the Partnership, communication should be transparent and all partners should be kept informed concerning the activities of the other Partners.

The Service has been an active and patient partner as attempts were made to implement the programs identified in the 12-year Rattlesnake Creek Subbasin Management Plan. The 12-year review conducted by your office concluded that water reduction targets were not met, groundwater use has increased, groundwater levels continue to decline, the target flow for January for the Rattlesnake Creek at the USGS Zenith gage is not being met, and junior irrigators continue to pump. The Chief Engineer's office was a signatory to the Plan, as well as GMD#5 and WaterPACK. The Plan was not developed solely to address the impairment of the Refuge's water right, and the water use reductions identified were meant to address other issues such as the high decline areas. Section VIII. Alternative Action Management Strategies states: "If, after the 12-year time line, the goals have not been achieved, then sufficient reductions in water rights would be imposed to achieve the goals. Reductions in appropriations will be calculated by dividing the remaining amount of water use needed to reach the goal by 72%." This section goes on to describe the goals and present alternatives to put into effect if these reductions do not result in meeting these goals, including the possible establishment of an Intensive Groundwater Use Control Area. It has now been over 13 years since the Partners, including your office, signed this agreement. We respectfully request that the groundwater use reductions agreed to by all of the Partners be achieved now. The impairment investigation being conducted by your office can continue concurrently.

Enclosed are copies of Kansas Geological Survey Open-File Reports 92-6 and 92-37 that may assist you in the impairment investigation. These are examples of studies that were funded by the Service. We also strongly encourage you to schedule a visit to the Refuge to help you better understand how the Refuge operates and manages its water resources to support wildlife and its associated habitat for current and hopefully future generations.

If you have any questions, please contact me at meg_estep@fws.gov or call (303) 236-4491.

Sincerely,



Megan A. Estep, Chief
Division of Water Resources

Enclosures

Enclosures

cc: Project Leader, Quivira NWR
Refuge Supervisor, CO/KS/NE
Rocky Mountain Region Solicitor's Office
Water Commissioner, Stafford Field Office
Manager, Big Bend Groundwater Management District #5
WaterPACK

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
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STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228-1807

APR 0 8 2013

David Barfield, Chief Engineer
Kansas State Board of Agriculture
Division of Water Resources
109 SW 9th Street, 2nd Floor
Topeka, Kansas 66612-1280

Dear Mr. Barfield:

The U.S. Fish and Wildlife Service (Service) owns and manages the Quivira National Wildlife Refuge (Refuge). The Refuge holds Water Right No. 7571, priority date August 15, 1957, at a combined diversion rate not to exceed 300 cubic feet per second and a quantity not to exceed 14,632 acre-feet per calendar year for recreational use. Based on available studies and the results of the Rattlesnake Creek Subbasin Management Plan, the Service believes that our water right is impaired by junior well use. We hereby request that your office commence an impairment investigation.

The Refuge is important to natural resource conservation not only regionally and nationally, but globally as well. The Refuge is designated as a Western Hemisphere Shorebird Network site, a Wetland of International Importance (RAMSAR site), an Important Bird Area (American Bird Conservancy), and is critical habitat for federally endangered whooping cranes. The federally endangered piping plover and interior least tern also use the refuge and the State has designated refuge lands (waters) as critical habitat for the western snowy plover and Arkansas darter, both of which are state listed as threatened species.

Surface water originating from Rattlesnake Creek and groundwater discharge from the shallow, saline Precambrian bedrock are critical to sustaining Refuge wetlands that attract and support the vast variety of associated migratory and resident bird species. Without both of these components, groundwater upwelling or sufficient streamflow, the ecology of the entire system will change. The Refuge and its values will not be sustained unless the aquifer system is brought into balance.

Like a farmer, the Refuge needs water during critical time periods. The values of wetlands on refuge lands for migratory birds can only be sustained by providing flooded conditions at proper times during the year, particularly during spring and fall migration. Simply because 14,632 ac-ft

WATER RESOURCES
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is available on an annual basis in most years does not meet Refuge habitat management needs. Water is typically unavailable in the late summer and early fall when the Refuge is trying to flood migration habitat for birds. Irrigation pumping is usually greatest during this time as well. Water shortages typically occur during the months of July, August and September, when as little as a few hundred acre-feet may be available.

The Service has been patient as the 12-year Rattlesnake Creek Subbasin Management Plan was allowed to run its course. The Service was a supportive and sincere partner in the effort to utilize an incentive-based plan to reduce groundwater use. At the end of the 12 years, groundwater use has increased, groundwater levels have not improved, and streamflow goals have not been met. Streamflow continues to decline, and junior irrigators are allowed to continue to pump. We respectfully request that you conduct your investigation and take whatever administrative actions are necessary to protect the Service's senior water right and, we believe, the ability of the Rattlesnake Creek watershed to support all current land uses over the long term.

Please contact me at meg_estep@fws.gov or a call if you have any questions at (303) 236-4491.

Sincerely,

Megan A. Estep, Chief
Division of Water Resources

cc: Refuge Manager, Quivira NWR
Refuge Supervisor, CO/KS/NE
Rocky Mountain Region Solicitor's Office
Water Commissioner, Stafford Field Office
Manager, Groundwater Management District #5
Water Pack

CERTIFICATION MEMORANDUM, FILE 7571

The certification of application to appropriate water, File 7571 actually began in July of 1991. A tour of the refuge was made in the company of Patrick D. Gonzales, assistant manager of Quivira National Wildlife Refuge. Mr. Gonzales reviewed the basic operations at the refuge and detailed how water was used among the various management units within the refuge proper. Copies of missing water use reports (exhibit A) were obtained from the U.S. Fish and Wildlife Service in Denver. These reports filled in all the missing gaps in the water use history of the refuge. In February of 1992, contact was made with representatives from U.S. Fish and Wildlife Service (USFWS) headquarters. It was learned that a detailed survey of the refuge was to be conducted in the near future. The survey would include cross sections of each management pool in the refuge and more accurately define the total water holding capacity of the entire project. As of February 1, 1993, the survey has been completed, but the information has not been tabulated or made available for review. Since the new survey has not been completed in a timely manner, older information that was originally computed from aerial photos is being used to prepare the certificate. Much of this information was already in the files and additional information was obtained from USFWS itself (exhibit B).

The Water Resources Data of Kansas published yearly by the U.S. Geological Survey was consulted for the years 1963 through 1990. These publications give the streamflow values for permanent gaging stations on the Rattlesnake Creek at Macksville, Kansas and Raymond, Kansas. The Macksville station gives interesting results, but it is over 30 miles upstream from the diversion points authorized by this file. On a stream such as the Rattlesnake that is often gaining base flow in some areas and losing base flow to the aquifer in other areas, depending on the immediate section of the stream being analyzed, a gaging station over 30 miles away is not of much value as it relates to this project. The Raymond, Kansas gage was also analyzed. This gage should have been useful since it is situated at the outflow from Quivira Refuge. What complicates the readings from this gage is that artesian saltwater flows on the north edge of the refuge enter the stream (referred to as Salt Creek at this location) and are recorded at the gaging station. The result is that at times flow is recorded at the gage even when operations at Quivira are using the entire upstream flow of the Rattlesnake Creek. Flood flows, artesian groundwater, and occasionally normal streamflows reach the Raymond gage, unfortunately, it is impossible to distinguish where the recorded flows may have come from.

In May of 1973 a gaging station was put into service at Zenith, Kansas. This gage is approximately 11 miles upstream from the first diversion structure at Quivira Wildlife Refuge. This gage

has the potential to provide the most pertinent data in regards to the certification of File 7571. Since the Zenith gage was not installed until 1973 there is no actual data for that location during prior years. For that reason Jim Bagley, of the Division of Water Resources, prepared streamflow regression analysis charts (exhibit C). While these charts are definitely an asset in obtaining the total picture of past streamflow and appear to correlate exceptionally well with actual flow records at the other gaging stations, Mr. Bagley warns against depending on the regression analysis too much. On a related note, Marios Sophocleaus states in his KGS open file report 92-10 that 19625 acre feet is the average annual streamflow at the Zenith gage during the years 1981 through 1990.

Hydrographs were prepared (exhibit D) to visually display the monthly and annual flows recorded, in acre feet, at all of the above gaging stations from 1963 to 1990. The 1963 to 1973 flows estimated from regression analysis at the Zenith gage were also plotted. In addition, the annual reported quantity of water used at Quivira was plotted against the streamflow quantities. If nothing else, the hydrographs reveal that the water use reports submitted for Quivira do not exceed the quantity shown to have been provided by the Rattlesnake Creek.

Next, information from the area and capacity information (exhibit B) and the Annual Water Management Plan (exhibit E) were combined into one table. This table is titled "Typical Annual Water Use at Quivira Wildlife Refuge" (exhibit F). The purpose of the tabulation is to demonstrate the maximum amount of water the refuge might use if it had sufficient water available and it was able to fulfill all of the management options listed in its Annual Water Management Plan. The tabulation is actually less than the maximum water needs as it does <u>not</u> include unmanaged areas that are often flooded to a depth of two to three inches; it also does <u>not</u> include evapotranspiration by moist soil plants, seepage, lake evaporation through fall and winter months, or transit losses in canals or within the streambed itself. One other item that is not calculated is the fact that at certain times it may be beneficial to drain one management unit, utilizing the drained water into a second unit in need of water, although in most instances the units are allowed to evaporate naturally. Additionally, large salt flats at the north end of the refuge, and the northern end of the Big Salt Marsh itself, appear to receive a portion of their water supply from the artesian seeps and springs that flow into the refuge from the west.

Certification Memo, File 7571

Exhibit F demonstrates that when considering the permanent management pools only, operated under the guidelines of existing management plans, that the quantity of water reported since 1963 appears not only to have been reasonable, but also possible.

On December 21, 1992 and January 28, 1993, Mr Dave Hilley, Manager of Quivira Wildlife Refuge, was contacted for additional information concerning operations at the refuge. The methods used by the refuge to measure water flows were observed, tested, and recorded in a memorandum labeled exhibit G. This document outlines specifically what instrument is used to measure flows, how it works, how quantities are calculated for annual water use reports, and states the one discrepancy found in the water reporting method. That discrepancy was the fact that the quantity of water stored and evaporated from the Little Salt Marsh was not reflected in the refuge's reporting methods. The information obtained on both visits, combined with previously gathered data, were compiled to form exhibit H, which is a detailed map of each management unit, the canals connecting each unit, control structures used to move water within the refuge, and the diversion points on the Rattlesnake Creek.

SUMMARY

Based on the above information and attached exhibits a certificated of appropriation for file 7571 is proposed as follows:

File 7571 was approved in 1963. During the time period 1963 to 1972 many of the water use reports were estimated and during that time the diversion works were reported to be only 80% complete. An actual water measurement program may not have been in place prior to 1973. In 1973, a year of torrential rainfall, the diversion works and control structures at Quivira were destroyed. It was not until 1978 that the damage was finally repaired. The year 1978 was, therefore, the first year that the diversion works were complete and ready to divert and store water according to management plans. Assuming that the water requirements of the refuge are best represented by years after 1978, the year 1987 has been selected as the year of record. Using 1987 will require that an extension of time to perfect be granted to that year.
During 1987 the U.S. Fish and Wildlife Service reported that 10129.7 acre feet of water was diverted from the Rattlesnake Creek and that the refuge was "full all year." As pointed out above and in exhibit G, the [illegible] reported do not reflect the amount stored and the subsequent evaporation in the Little

Certification Memo, File 7571

Salt Marsh. Using an area of 950 acres in the Little Salt Marsh, and a capacity of 2260 acre feet, one would assume 2850 acre feet of evaporation during a calendar year (36 inches of net evaporation). The proposed certified quantity for file 7571 would then be the sum of the acre feet reported in 1987, the amount stored in the Little Salt Marsh, and the amount evaporated from the Little Salt Marsh: 10129.7 acre feet + 2260 acre feet + 2850 acre feet = 15240 acre feet. It is also proposed that all of the 15240 acre feet be shown as direct use and that the "quantity to be accumulated in reservoirs" as stated in the approval be dropped from the certificate.

It is proposed that the rate of diversion be certified as natural flows not needed for prior downstream diversions. The diversion should be limited to a maximum of 300 c.f.s. Flows of 300 cfs can be verified from streamflow records at the Zenith station (see exhibit I).

Finally, the description of the point of diversion noted as "diversion A" is being proposed differently than originally approved. The stream is not located in that ten acre tract. Therefore it is proposed to correct that description when the certificate is issued.

It is the recommendation of the Stafford Field Office that U.S. Fish and Wildlife Service be required upon issuance of this certificate to install a permanent metering system on the Rattlesnake Creek immediately downstream from their last diversion point and that a water conservation plan be prepared for the refuge, both to be completed by December 31, 1995.

FIELD INSPECTION, FILE 7571

LAND TO BE INCLUDED ON CERTIFICATE

The South 80 acres of the SE1/4 of Section 15; the S1/2 of Section 14; the NE1/4, SW1/4, and SE1/4 of Section 29; and all of Sections 13, 21 through 28, and 32 through 36 in Township 21 South, Range 11 West;

and all of Sections 1 through 5, 11 through 14, 23 through 26, and sections 35 and 36 in Township 22 South, Range 11 West;

and all of Sections 1 and 2 in Township 23 South, Range 11 West;

all in Stafford County, Kansas;

Section 18 in Township 21 South, Range 10 West, in Rice County, Kansas;

and Section 30 in Township 22 South, Range 10 West, in Reno County, Kansas.

PLACE OF USE DURING YEAR OF RECORD

Water was applied to and circulated among the various management units within the place of use described above. Those management units are depicted on the map accompanying this field inspection report.

THE STATE OF KANSAS

KANSAS DEPARTMENT OF AGRICULTURE
Alice A. Devine, Secretary of Agriculture

DIVISION OF WATER RESOURCES
David L. Pope, Chief Engineer

CERTIFICATE OF APPROPRIATION FOR BENEFICIAL USE OF WATER

Water Right, File No. 7,571
Priority Date August 15, 1957

WHEREAS, It has been determined by the undersigned that construction of the appropriation diversion works has been completed, that water has been used for beneficial purposes and that the appropriation right has been perfected, all in conformity with the conditions of approval of the application pursuant to the water right referred to above and in conformity with the laws of the laws of the State of Kansas.

NOW, THEREFORE, Be It Known that DAVID L. POPE, the duly appointed qualified and acting Chief Engineer of the Division of Water Resources of the Kansas Department of Agriculture, by authority of the laws of the State of Kansas, and particularly K.S.A. 82a-714, does hereby certify that, subject to vested rights and prior appropriation rights, the appropriator is entitled to make use of natural flows of Rattlesnake Creek to be diverted at three (3) points:

One (1) point located in the Southwest Quarter of the Southeast Quarter of the Northeast Quarter (SW¼ SE¼ NE¼) of Section 35, more particularly described as being near a point 3,100 feet North and 1,150 feet West of the Southeast corner of said section,

in Township 21 South, Range 11 West, Stafford County, Kansas, and

one (1) point located in the Southwest Quarter of the Northeast Quarter of the Northeast Quarter (SW¼ NE¼ NE¼) of Section 13, more particularly described as being near a point 4,450 feet North and 1,000 feet West of the Southeast corner of said section,

in Township 22 South, Range 11 West, Stafford County, Kansas, and

one (1) point located near the center of the Southwest Quarter (SW¼) of Section 25, more particularly described as being near a point 1,250 feet North and 3,850 feet West of the Southeast corner of said section,

in Township 22 South, Range 11 West, Stafford County, Kansas,

at a combined maximum diversion rate not in excess of 300 cubic feet per second and a quantity not to exceed 14,632 acre-feet of water per calendar year for recreational use. Such quantity can subsequently be stored and accumulated in marsh areas within the Quivira National Wildlife Refuge, to the extent perfected by December 31, 1987, located on the following described property:

The South 80 acres of the Southeast Quarter (SE¼) of Section 15; the South Half (S½) of Section 14; the Northeast Quarter (NE¼), Southwest Quarter (SW¼) and Southeast Quarter (SE¼) of Section 21 and 29; and all of Sections 13, 22 through 28, and 32 through 36 in Township 21 South, Range 11 West;

and all of Section 1 through 5, 11 through 14, 23 through 26, and Section 35 and 36 in Township 22 South, Range 11 West;

and all of Sections 1 and 2 in Township 23 South, Range 11 West,

all in Stafford County, Kansas, and

Section 18 in Township 21 South, Range 10 West, in Rice County, Kansas;

and Section 30 in Township 22 South, Range 10 West, in Reno County, Kansas.

The appropriator shall maintain in an operating condition, satisfactory to the Chief Engineer, all check valves installed for preventing chemical or other foreign substance likely to cause pollution of the water supply.

The appropriator shall maintain records from which the quantity of water actually diverted during each calendar year may be readily determined. Such records shall be furnished to the Chief Engineer by March 1 following the end of the previous calendar year.

The appropriation right shall be deemed abandoned and shall terminate when without due and sufficient cause no lawful beneficial use is made of water under this appropriation for three (3) successive years.

The right of the appropriator shall relate to a specific quantity of water and such right must allow for a reasonable raising or lowering of the static water level and for the reasonable increase or decrease of the stream flow at the appropriator's point of diversion.

IN WITNESS WHEREOF, I have hereunto set my hand at my office at Topeka, Kansas, this 9th day of April ,1996.

DIVISION OF WATER RESOURCES
DAVID L. POPE
CHIEF ENGINEER
KANSAS DEPARTMENT OF AGRICULTURE

David L. Pope, P.E.
Chief Engineer
Division of Water Resources
Kansas Department of Agriculture

State of Kansas, Shawnee COUNTY, SS

The foregoing instrument was acknowledged before me this 9th day of April , 1996, by David L. Pope, P.E., Chief Engineer, Division of Water Resources, Kansas Department of Agriculture.

DENISE J. ROLES
NOTARY PUBLIC
My Appt. Exp. 3-1-98
STATE OF KANSAS

Notary Public

My appointment expires:

(Record in the Office of Register of Deeds in the county or counties wherein the point of diversion is located)

CERTIFICATE OF APPROPRIATION
FOR BENEFICIAL USE OF WATER

STATE OF KANSAS

Water Right, File No. 7,571

STATE OF KANSAS, COUNTY, ss.

Filed for record this ____ day of ____, 19__

at ____ o'clock ____ m. and

recorded in Book ____ Page ____

Fee $ ____

Register of Deeds.

Table 17. Estimated greatest potential distribution of wetland habitat conditions (acres by unit and objective) for the proposed alternative for Quivira National Wildlife Refuge, Kansas.

		Mid-February through May spring migration			*May through July summer breeding*		*August–November fall migration*			*November–February winter*
		A1	A2	A3	B1	B2	C1	C2	C3	D
Wetland	*Acres*	Acres bare flats <25% vegetation, flood <6 inches	Acres >75% annual or meadow, flood <15 inches	Acres <25% emerging >20% submerged aquatic vegetation, flood 6–30 inches	Acres of bare flats <25% cover	Acres of 30–60% tall emerging, flood <10 inches	Acres of bare flats <25% vegetation, flood <6 inches,	Acres >75% annual or meadow, flood <15 inches	Acres <25% emerging >20% submerged aquatic vegetation, flood 6–30 inches,	Acres <25% emerging, flood 6–30 inches
Little Salt Marsh	931	181.2	0	662.9	3.8	87.3	181.1	0	662.9	931
Unit 7 (created)	62	15.8	40.5	5.6	15.8	0	15.8	40.5	5.6	62
Unit 10a (created)	19	12.9	12.9	6.3	0	6.3	0	12.9	0	19
Unit 10b (created)	14	0	0	10.3	0	0	3.9	0	10.3	14
Unit 10c (created)	7	6	6.1	0.8	6.1	0	0	6.1	0.8	7
Unit 11 (created)	30	11.9	12	16.3	0	0	0	12	6.3	30
Unit 12b (created)	12	8.8	8.8	2.9	0	11.5	0	8.8	2.9	12
Unit 14a (created)	100	15.5	73.9	0	27.3	0	15.6	73.9	0	100
Unit 14b (created)	45	43.1	43.1	1.7	0	1.7	0	43.1	1.7	45
Unit 16 (created)	14	0	5.8	8.5	0	14.2	0	5.8	8.5	14
Unit 20a (created)	69	60.3	60.4	8.5	0	8.5	0	60.4	8.5	69
Unit 20b (created)	66	0	62.2	3.7	0	3.7	0	62.2	3.7	0
Unit 21 (created)	11	3.9	0	5.9	3.8	1.5	3.8	0	5.9	11
Unit 22 (created)	12	0	0	12.1	0	12.1	0	0	12.1	12
Unit 23 (created)	14	0	0	14.1	0	14.1	0	0	14.1	14
Unit 24 (created)	54	0	0	54.1	0	54.1	0	0	54.1	54
Unit 25 (created)	54	0.6	53.4	0	0	0	0	53.4	0	54
Unit 26 (created)	69	69.1	69.1	0	0	0	0	69.1	0	69
Unit 28 (created)	61	60.8	60.9	0	0	0	0	60.9	0	61

Table 17. Estimated greatest potential distribution of wetland habitat conditions (acres by unit and objective) for the proposed alternative for Quivira National Wildlife Refuge, Kansas.

		Mid-February through May spring migration			*May through July summer breeding*		*August–November fall migration*			*November–February winter*
		A1	A2	A3	B1	B2	C1	C2	C3	D
Wetland	*Acres*	Acres bare flats <25% vegetation, flood <6 inches	Acres >75% annual or meadow, flood <15 inches	Acres <25% emerging >20% submerged aquatic vegetation, flood 6–30 inches	Acres of bare flats <25% cover	Acres of 30–60% tall emerging, flood <10 inches	Acres of bare flats <25% vegetation, flood <6 inches,	Acres >75% annual or meadow, flood <15 inches	Acres <25% emerging >20% submerged aquatic vegetation, flood 6–30 inches,	Acres <25% emerging, flood 6–30 inches
Unit 29 (created)	27	23.7	23.7	3.6	0	0	0	23.7	3.6	27
Unit 30 (created)	42	41.6	41.6	0	0	0	0	41.6	0	42
Unit 37 (created)	50	0	0	49.8	0	49.8	0	0	49.8	50
Unit 40 (created)	36	36.7	36.4	0	0	0	0	36.4	0	36
Unit 48 (created)	55	54.4	54.4	0.8	0	0	0	54.4	0.8	55
Unit 49 (created)	85	83.9	83.9	1.3	83.9	0	83.9	83.9	1.3	85
Unit 50 (created)	91	90.5	90.6	0	0	0	0	90.6	0	91
Unit 57 (created)	89	0	43.4	34.0	11.5	43.4	11.5	0	34	89
Unit 58 (created)	116	67.5	0	48.9	0	48.9	0	0	0	116
Unit 61 (created)	121	121.2	104.2	0	121.2	0	17.2	104.2	0	121
Unit 62 (created)	38	35.7	35.8	1.7	0	0	1.7	35.8	1.7	38
Unit 63 (created)	103	93	93	0	10	0	10.0	93	0	103
Unit 80 N. Lake	393	393.2	0	72.1	393.2	0	0	0	0	393
Marsh Road Meadow	494	267.6	226.2	226.2	267.6	0	0	0	0	0
Wildlife Drive (BSM)	801	723.2	0	107.3	697.1	0	25.1	0	0	801
Big Salt Marsh	1209	408.8	0	800.6	98.3	0	206.4	0	0	1209
Salt Springs	252	0	238.3	0	0	14.7	0	0	14.6	252
Total	5646	2930.9	1580.6	2160	1739.6	371.8	576	1072.7	903.2	5086

NOTE: Table does not include wetlands managed as part of the grassland habitat type.

Seasonal Rattlesnake Creek Water Need Estimates for Quivira National Wildlife Refuge, Prepared May 2015

Background

At the request of Kansas Department of Agriculture, Division of Water Resources (DWR), the U.S. Fish and Wildlife Service (Service) has provided information to increase understanding of *seasonal* water needs to accomplish management objectives of the Quivira National Wildlife Refuge (Refuge). The Refuge's current annual Water Right 7571 on Rattlesnake Creek is 14,632 ac-ft. There is no single estimate that accurately predicts seasonal surface water needs of the Refuge because various factors influence water needs within and among years, such as short- and long-term weather patterns, the timing of wildlife events (e.g., migration), and changing habitat conditions.

Approach

Scenario 1 – There was interest by DWR to evaluate the potential of using past water use records to quantify estimates of seasonal water needs to accomplish refuge management objectives. To accomplish this task, Refuge staff compiled 48 years of monthly water-use records and grouped months into seasons based on the life cycle events of waterbirds (timing of migration, relative abundances) and the lag time required to transfer water to wetlands through the ditch infrastructure (Table 1). For example, flooding a wetland to the appropriate depth can require days to weeks depending on location from the diversion, volume of water available, and existing soil moisture conditions (e.g., dry, saturated).

Table 1. Significant annual events largely considered in determining seasonal water needs to accomplish management objectives of Quivira National Wildlife Refuge.

Jan-Feb	Mar-Apr	May-Jun	Jul-Sep	Oct-Nov	Dec
MANAGEMENT TO SUPPORT WILDLIFE FOOD & COVER REQUIREMENTS					
Use water where needed to provide/maintain semipermanent wetland habitat.					
	Shallowly flood select units to saturate dry soils that will be used to produce wildlife foods.				
		Dewater select wetlands for suitable germination and growth of desired plants used for wildlife food and cover. Drawdown dates are based on scientific information.			
		Irrigate select wetland units to support survival, growth, and seed production of germinated wildlife food plants.	After seeds mature, gradually increase water levels in wetlands to coincide with the food and cover needs of target species.		
CHRONOLOGY OF SPECIES ANNUAL EVENTS OR WHEN LIFE REQUIREMENTS NEED TO BE AVAILABLE FOR SPECIES USE					
Waterfowl and bald eagle wintering habitat is provided when open water is available (generally where flooded deep and/or where flow prevents ice formation).	Peak spring waterfowl migration (habitat flooded <15 inches).	Main spring shorebird migration (habitat flooded <6 inches and mudflat).	Main fall shorebird migration (habitat flooded <6 inches and mudflat).	Peak fall waterfowl migration (habitat flooded <15 inches).	
	Endangered whooping crane spring migration (shoreline & habitat flooded <1 ft).	Breeding-related activities occur for several waterbirds that require flooded habitat for food and/or cover resources, such as for the state-threatened snowy plover, the endangered interior least tern, and for state species in need of conservation (e.g., black rail, black tern).		Endangered whooping crane fall migration (shoreline and habitat flooded <1 ft).	

After reviewing the water use records, Refuge staff made the determination to exclude years (n=28) when total annual water use did not exceed 7,000 ac-ft to prevent extreme bias in estimating seasonal water use due to

limited water availability and/or inappropriate timing of available water. For example, during low water years Refuge staff often receive and use water at less than optimal times (e.g., winter) to help increase the odds that at least some wetland habitat is flooded at critical times (e.g., spring waterbird migration). In this case, the average amount of water used during the winter season would be biased high. Conversely, it is common during low water years to not have sufficient water to maintain wetland vegetation, which results in low food production and sparse cover required by wildlife. In this case, the use of water during summer would be biased extremely low. The use of 7,000 ac-ft as a cutoff point was based on approximating 50% of the Refuge water right and, as such, is somewhat arbitrary.

For the 20 years of when total annual water use exceeded 7,000 ac-ft, water use for each year was partitioned into the appropriate seasons and the median, minimum, and maximum seasonal values across all years were calculated (Table 2).

Table 2. Seasonal median, minimum, and maximum water use (ac-ft) values, calculated using 20 years of data where annual use exceeded 7,000 ac-ft. Totals of the median and maximum seasonal water use values are respectively lower and higher than the current annual water right (14,632 ac-ft).

	Jan -Feb	Mar-Apr	May-Jun	Jul-Sep	Oct-Nov	Dec	Total
Median	986	1,115	1,062	2,117	1,781	684	7,746
Minimum	0	89	126	463	151	101	
Maximum	3,557	3,111	2,601	4,374	6,205	2,003	21,851

This Scenario 1 estimate is biased due to the following:

- Historic *use* does not accurately reflect water *needs* during any given year or season.
- Historic water use in a given season may not accurately reflect the volume of water that would have been used if water had been available during that season or, perhaps, previous to that season.
- The use of records that exceeded 7,000 ac-ft was arbitrary and only represents nearly half of the Refuge water right. As such, these estimates likely are biased low.

Scenario 2 **–**

Scenario 2 is based on achieving minimum requirements of CCP objectives following a drought year and water use was not constrained by the current water right (Table 3, Scenario 2). Unlike Scenario 1, seasons in Scenario 2 were defined by CCP habitat-based objectives, as approved in 2013. Data used to develop this scenario included area estimates and area-capacity curves developed by the Service for individual wetlands, published long-term precipitation and pan evaporation data (including the use of a coefficient to account for shallow wetlands), soil infiltration rates calculated based on information in NRCS soil survey data (SSURGO), LiDAR data to estimate volume of ditches, and aerial imagery to estimate surface area of water in the Big and Little Salt Marshes at the beginning of the scenario.

Table 3. Comparison of Rattlesnake Creek surface water use Scenarios 1 and 2 for Quivira NWR.

Scenario	Seasonal Water Use Estimates (Acre-Feet)												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	986		1,115		1,062		2,117			1,781		684	7,746
2	3,144		7,427		2,895		4,053				5,881		23,400

This Scenario 2 estimate is biased due to the following:

- Water loss due to plant transpiration was not included in water use estimates (which would increase water needs to meet objectives).
- Water loss due to soil infiltration in some wetlands was underestimated because values for the available water capacity of 2,300 acres of wetland soils were not available (which would increase water needs to meet objectives).

- Water loss due to horizontal seepage in ditches during initial flooding was not estimated (which would increase water needs to meet objectives).
- Estimate based on a "normal precipitation" year following a drought year (all units dry); thus, a large volume of water (3,144 acre-feet) is needed to initially flood the Little Salt Marsh before water can be diverted elsewhere on the Refuge. This volume would be lower in years not preceded by drought.
- Estimate based on initially flooding only units and infrastructure on the south end of the Refuge. If north portion of Refuge were flooded early in the year, water use estimates would increase.
- Seasons are based on habitat objectives and do not always reflect the water management activities/schedules (e.g., time required for water to travel from diversion to wetland of interest).

Results

The seasonal estimates in Table 4 were developed after considering Scenarios 1 and 2 described in the approach above.

Table 4. Seasonal Rattlesnake Creek surface water need estimates for Quivira NWR, given the current water right.

Seasonal Water Use (Acre-Feet)						
Jan-Feb	Mar-Apr	May-Jun	Jul-Sep	Oct-Nov	Dec	Total
1,500	3,500	2,000	3,500	3,632	500	14,632

Although Scenarios 1 and 2 were developed based on quantitative information; these estimates were constrained by limitations that precluded either scenario from being used to directly estimate seasonal water needs. In general, the estimate based on past water use is known to be flawed because the Refuge either did not receive its full annual right of 14,632 ac-ft and/or the seasonal availability of water was not available or lacking, which resulted in the use of water during suboptimal times that often limited or impeded the accomplishment of management objectives. In contrast, the Scenario 2 estimate, based on water needs following drought, exceeded the Refuge water right even though important factors (e.g., water infiltration in ditches, plant transpiration) that would have increased water needs were not included in the estimate. Therefore, the Service used information from both Scenario 1 and Scenario 2 to adjust water use so total annual use matches the current water right of 14,632 ac-ft (Table 4).

Attachment 6: GMD5 Model; KDA-DWR Scenario 1 analysis results table

USFW Management Period	Year	Zenith Gaged Flow	Modeled Impacts to RSC	Refuge Reported Diversions	Refuge Needs	Amount short of needs
Jan/Feb	1974	19590	960	0	1500	0
Mar/Apr	1974	20230	860	0	3500	0
May/Jun	1974	11220	820	0	2000	0
Jul/Aug/Sep	1974	8260	1620	1320	3500	0
Oct/Nov	1974	7240	1390	2430	3600	0
Dec	1974	5070	600	600	500	0
Jan/Feb	1975	9750	1130	0	1500	0
Mar/Apr	1975	9990	1040	630	3500	0
May/Jun	1975	14550	1310	1020	2000	0
Jul/Aug/Sep	1975	16600	3000	3840	3500	0
Oct/Nov	1975	5230	2270	1040	3600	0
Dec	1975	3540	1240	920	500	0
Jan/Feb	1976	6850	2060	340	1500	0
Mar/Apr	1976	19610	2410	180	3500	0
May/Jun	1976	15800	2390	190	2000	0
Jul/Aug/Sep	1976	8240	4680	1270	3500	0
Oct/Nov	1976	4650	4010	2060	3600	0
Dec	1976	3810	1740	70	500	0
Jan/Feb	1977	4990	3080	400	1500	0
Mar/Apr	1977	6780	2920	1140	3500	0
May/Jun	1977	18550	3030	1670	2000	0
Jul/Aug/Sep	1977	7450	5280	1980	3500	0
Oct/Nov	1977	5060	3440	2780	3600	0
Dec	1977	3010	1600	490	500	0
Jan/Feb	1978	6340	3110	50	1500	0
Mar/Apr	1978	8770	2750	360	3500	0
May/Jun	1978	20670	3410	260	2000	0
Jul/Aug/Sep	1978	3100	5240	910	3500	400
Oct/Nov	1978	2410	4540	1870	3600	1190
Dec	1978	2040	2380	1610	500	0
Jan/Feb	1979	4270	4660	2270	1500	0
Mar/Apr	1979	8050	4370	0	3500	0
May/Jun	1979	4960	3610	790	2000	0
Jul/Aug/Sep	1979	3920	5660	3150	3500	0
Oct/Nov	1979	3040	6370	470	3600	560
Dec	1979	2210	2670	180	500	0
Jan/Feb	1980	5780	5170	270	1500	0
Mar/Apr	1980	11630	4860	150	3500	0
May/Jun	1980	6620	3530	1160	2000	0
Jul/Aug/Sep	1980	1590	3020	1480	3500	1910
Oct/Nov	1980	690	2150	20	3600	2150
Dec	1980	1440	3150	300	500	0

USFW Management Period	Year	Zenith Gaged Flow	Modeled Impacts to RSC	Refuge Reported Diversions	Refuge Needs	Amount short of needs
Jan/Feb	1981	2540	4450	1480	1500	0
Mar/Apr	1981	2900	4330	2330	3500	600
May/Jun	1981	5630	7240	1940	2000	0
Jul/Aug/Sep	1981	2100	9350	1780	3500	1400
Oct/Nov	1981	2520	5820	1370	3600	1080
Dec	1981	1550	2730	470	500	0
Jan/Feb	1982	4190	5060	140	1500	0
Mar/Apr	1982	3890	4280	900	3500	0
May/Jun	1982	4360	4880	980	2000	0
Jul/Aug/Sep	1982	2000	6090	1620	3500	1500
Oct/Nov	1982	850	5050	240	3600	2750
Dec	1982	690	2640	80	500	0
Jan/Feb	1983	2520	5020	870	1500	0
Mar/Apr	1983	6270	4940	70	3500	0
May/Jun	1983	9490	5200	150	2000	0
Jul/Aug/Sep	1983	1350	2490	1080	3500	2150
Oct/Nov	1983	730	6410	180	3600	2870
Dec	1983	520	4070	180	500	0
Jan/Feb	1984	2230	6090	610	1500	0
Mar/Apr	1984	8080	6990	940	3500	0
May/Jun	1984	4140	4370	430	2000	0
Jul/Aug/Sep	1984	520	830	150	3500	830
Oct/Nov	1984	400	4590	30	3600	3200
Dec	1984	970	4140	460	500	0
Jan/Feb	1985	1840	7560	1840	1500	0
Mar/Apr	1985	3450	6650	2830	3500	50
May/Jun	1985	4250	5130	790	2000	0
Jul/Aug/Sep	1985	1490	6060	1040	3500	2010
Oct/Nov	1985	4980	8190	1630	3600	0
Dec	1985	1590	3280	510	500	0
Jan/Feb	1986	3280	4900	990	1500	0
Mar/Apr	1986	2900	4870	600	3500	600
May/Jun	1986	1990	4970	670	2000	10
Jul/Aug/Sep	1986	4740	11700	2260	3500	0
Oct/Nov	1986	2530	7370	2760	3600	1070
Dec	1986	1440	3480	1120	500	0
Jan/Feb	1987	3050	6700	1990	1500	0
Mar/Apr	1987	20610	7090	300	3500	0
May/Jun	1987	6180	6680	550	2000	0
Jul/Aug/Sep	1987	11640	9380	2120	3500	0
Oct/Nov	1987	3380	5450	3210	3600	220
Dec	1987	2500	2960	2000	500	0

Attachment 6: GMD5 Model; KDA-DWR Scenario 1 analysis results table

USFW Management Period	Year	Zenith Gaged Flow	Modeled Impacts to RSC	Refuge Reported Diversions	Refuge Needs	Amount short of needs
Jan/Feb	1988	5170	6060	3560	1500	0
Mar/Apr	1988	6310	5400	3110	3500	0
May/Jun	1988	3420	2840	490	2000	0
Jul/Aug/Sep	1988	830	1960	460	3500	1960
Oct/Nov	1988	550	1560	150	3600	1560
Dec	1988	480	1440	260	500	20
Jan/Feb	1989	1220	4040	550	1500	280
Mar/Apr	1989	1620	2720	1000	3500	1880
May/Jun	1989	4850	10680	2240	2000	0
Jul/Aug/Sep	1989	4030	12360	310	3500	0
Oct/Nov	1989	1050	5410	1060	3600	2550
Dec	1989	540	3040	440	500	0
Jan/Feb	1990	2110	7040	1750	1500	0
Mar/Apr	1990	3810	6240	2160	3500	0
May/Jun	1990	6070	5790	2110	2000	0
Jul/Aug/Sep	1990	750	4800	280	3500	2750
Oct/Nov	1990	700	4200	460	3600	2900
Dec	1990	420	2540	0	500	80
Jan/Feb	1991	1040	4720	510	1500	460
Mar/Apr	1991	1360	5710	1040	3500	2140
May/Jun	1991	1110	3430	1040	2000	890
Jul/Aug/Sep	1991	150	2470	0	3500	2470
Oct/Nov	1991	220	2460	0	3600	2460
Dec	1991	340	2940	0	500	160
Jan/Feb	1992	770	4340	0	1500	730
Mar/Apr	1992	860	2690	450	3500	2640
May/Jun	1992	2540	11120	830	2000	0
Jul/Aug/Sep	1992	2750	15610	2930	3500	750
Oct/Nov	1992	940	8690	360	3600	2660
Dec	1992	1320	4280	850	500	0
Jan/Feb	1993	5150	8180	990	1500	0
Mar/Apr	1993	8180	7500	640	3500	0
May/Jun	1993	46390	7930	2600	2000	0
Jul/Aug/Sep	1993	72440	13840	2590	3500	0
Oct/Nov	1993	4200	7900	2970	3600	0
Dec	1993	2640	3800	1420	500	0
Jan/Feb	1994	4870	7560	2000	1500	0
Mar/Apr	1994	4740	6740	160	3500	0
May/Jun	1994	2870	3950	370	2000	0
Jul/Aug/Sep	1994	750	6370	690	3500	2750
Oct/Nov	1994	790	7020	80	3600	2810
Dec	1994	740	3780	0	500	0

Attachment 6: GMD5 Model; KDA-DWR Scenario 1 analysis results table

USFW Management Period	Year	Zenith Gaged Flow	Modeled Impacts to RSC	Refuge Reported Diversions	Refuge Needs	Amount short of needs
Jan/Feb	2002	2410	8890	1990	1500	0
Mar/Apr	2002	2740	6530	2890	3500	760
May/Jun	2002	2390	5730	2280	2000	0
Jul/Aug/Sep	2002	980	5340	1050	3500	2520
Oct/Nov	2002	1610	9170	970	3600	1990
Dec	2002	810	3560	1150	500	0
Jan/Feb	2003	1860	7340	1180	1500	0
Mar/Apr	2003	4720	9640	320	3500	0
May/Jun	2003	2770	5690	0	2000	0
Jul/Aug/Sep	2003	650	4040	120	3500	2850
Oct/Nov	2003	840	4290	40	3600	2760
Dec	2003	540	2800	80	500	0
Jan/Feb	2004	1050	5140	970	1500	450
Mar/Apr	2004	2300	6270	2840	3500	1200
May/Jun	2004	1500	5430	370	2000	500
Jul/Aug/Sep	2004	2960	13070	4370	3500	540
Oct/Nov	2004	1690	7640	550	3600	1910
Dec	2004	1080	3220	580	500	0
Jan/Feb	2005	2490	7820	2130	1500	0
Mar/Apr	2005	2390	5630	130	3500	1110
May/Jun	2005	3000	7280	0	2000	0
Jul/Aug/Sep	2005	3620	8230	1660	3500	0
Oct/Nov	2005	900	5510	0	3600	2700
Dec	2005	740	2540	640	500	0
Jan/Feb	2006	1760	3710	1870	1500	0
Mar/Apr	2006	1940	4020	1240	3500	1560
May/Jun	2006	1060	4910	790	2000	940
Jul/Aug/Sep	2006	940	7970	750	3500	2560
Oct/Nov	2006	730	5150	220	3600	2870
Dec	2006	640	3650	0	500	0
Jan/Feb	2007	1670	7400	1690	1500	0
Mar/Apr	2007	10540	9530	1420	3500	0
May/Jun	2007	32510	14730	130	2000	0
Jul/Aug/Sep	2007	16420	14710	1720	3500	0
Oct/Nov	2007	2510	7580	1670	3600	1090
Dec	2007	3280	5240	830	500	0

Index of Comments Received Regarding Draft Versions of the Quivira Impairment Investigation Report

4/5/2016

To: David Barfield, P.E., and Chief Engineer

Kanas Division of Water Resources

From: Water PACK Board, and Members

Re: Quivira Impairment Comments

Mr. Barfield

As you are aware the board of Water PACK represents the majority of agricultural water users in Barton, Pratt, Pawnee, Stafford, Kiowa, and Edwards Counties. The outcome of this impairment process could have a catastrophic effect on the people and economies of these counties if not handled properly. We appreciate the opportunity to submit our comments on the initial draft of the impairment findings. We also look forward to continuing to work with your office, USFW, and GMD 5 to reach the best solution possible for all affected parties.

The official comments of the Water PACK organization are as follows:

1. Irrigators in the Rattlesnake Basin must continue to use water as conservatively as possible to protect the resource. They should also continue to look for new techniques in application, scheduling, and crop rotation to make the most efficient use of water possible.
2. Quivira should review their current methods of storing, moving, metering, and managing their water to see if there are any efficiencies that can be gained within their system.
3. Water Pack feels that augmentation holds the greatest promise to resolve the impairment. All other solutions will only result in incremental gains that will take years to positively impact streamflow. Augmentation needs to be modeled to determine the most effective plan possible.
4. At this time Water PACK feels that the refuge does not have adequate metering in place to account for water entering, exiting, and being diverted on the refuge. This needs to be resolved to obtain the best data possible for modeling before solutions can be explored. Accurate data is critical to this process. As a water right holder in GMD 5 the refuge should be held to the same metering and reporting standards as the rest of the water users in the district.
5. Water PACK does not agree that the upper Rattlesnake basin is a decline area. Over all the area from Macksville to the refuge is very stable in regards to groundwater levels. Many of the wells in the area are still at predevelopment levels.
6. Reduction in allocations from current levels would have a devastating economic effect on the people, and the communities in the Rattlesnake corridor. Reductions in allocation should not be a consideration.
7. The DWR model runs should be reviewed by Balleau to verify their accuracy. This will insure that we are working with the best data possible to reach a solution.
8. Water PACK supports the clearing of trees and brush from the creek. Clearing the stream bed from the refuge to the western border of Stafford County would reduce the riparian impact on stream flow benefiting the refuge.

9. In total there are four parties involved in this issue. US Fish and Wildlife, Kansas Division of Water Resources, the communities in and around the Rattlesnake corridor, and the agricultural water users. It is the responsibility of DWR, USFW, and the Ag water users to develop a long term sustainable solution without negatively impacting the economies, and quality of life in the fragile communities along the Rattlesnake corridor.

Thank you for taking the time to review this. Again Water PACK is very appreciative that you are giving such weight to our input.

Respectfully,

Pat Janssen

Water PACK Board Secretary

Water PACK Board of Directors

Kansas Farm Bureau
Helping Feed the World

Stafford County Farm Bureau Association
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May 3, 2016

David W. Barfield, P.E.
Chief Engineer
Division of Water Resources
Kansas Department of Agriculture
1320 Research Park Drive
Manhattan, Ks. 66502

Dear Mr. Barfield,

The Stafford County Farm Bureau is submitting written comments on the chief engineer's impairment findings on Quivira Wildlife Refuge. We understand the complexity of this issue, but we as a board disagree with your findings. We do not believe that the refuge has been impacted to the severity that you stated in your findings. We do not see severe cutbacks in groundwater usage as a solution; augmentation has to be seriously considered as a significant part of the solution.

Looking across Stafford County since the 1950's, noticeable changes have occurred. The moldboard plow and treeless plains used to be the norm. Today, we have abundant trees, strip tillage, no till, irrigation and thousands of acres of CRP ground. Conservation efforts have led to less soil erosion and less runoff from precipitation events. Streamflow has been affected by all these factors and the only way to return to the old days is to eliminate all the progress that has occurred since the 1950's. This is not a plausible solution; so therefore, we must be innovative and look to the future with great vision.

Stafford County has always been at the forefront when it comes to being willing to step forward and innovate and lead into the future. We are proud of the job past members and current members of our GMD#5 board have done. They were the first to cut back water appropriations during development, and then close the district to further appropriations in 1993. This was a great vision that began long before anyone else in the state of Kansas acted. Waterpack was formed in the 90's to lead efforts on the state and national level as a proactive organization and to lead for incentive based solutions rather than regulatory solutions. Stafford County KSU extension service is very active in promoting technologies to help agricultural producers conserve and be efficient users of our natural resources. Stafford County Farm Bureau board members continually promote agriculture in our county, the state of Kansas and on the national level. We promote agriculture in the classroom at our schools and have

supported Stafford County school children to visit Quivira Wildlife Refuge. We lobby legislators at both the state and national level. In the past, we have lobbied on behalf of Quivira Wildlife Refuge.

The first comment we would like to make is on the perfection year 1987. This is the year that set the record for Max daily discharge at the Zenith gauge. It was the eighth wettest year out of 100 years of data. Although we understand the concept of the perfection period and it being based on the year of maximum diversions, we wonder if this is a reflection on stream base flow perfecting water right #7571 or runoff from storms perfecting this water right.

Our next concern is the Services Operational Guide. It is our understanding that this operational guide was just developed by the service at the request of the chief engineer.

1. How does this compare to the original management plan that on page 872 of the Quivira document states, "To fully utilize the water available in Rattlesnake creek it is estimated that active storage capacity for 6000 acre feet or more must be provided"?
2. How does it compare to the plan developed by the refuge in 1993? It was to be done with the conservation officer in the Topeka office of DWR. Page 617 of the Quivira document.
3. Does the operational service plan reflect the wording in the transmittal letter to Cheryl Williss prepared 1/17/93 where it is stated "Please be aware the diversion rate and quantity of water defined in the Certificate of Appropriation are for maximum conditions. The available water in most years will not facilitate utilization of water to that extent. Management plans for the refuge area should be based on probable flows in Rattlesnake creek". Page 408 of the Quivira document.
4. Does the operational service plan resemble the conservation plan in 1995 in the certification memo on page 61 of the chief engineer's impairment finding?
5. April 10, 2000 wording in the Quivira Management plan states. "The water management currently done at the refuge consists of storing as much water as is available starting in February to create habitat for migrating waterfowl and shorebirds. Water is diverted into management units and the units are held as full as possible to offset the possibility that water will not be available to refill the units later in the summer and fall". Page 285 of the Quivira document.
6. Does the operational plan still maintain that "The Big Salt Marsh is also highly attractive to shorebirds, and in a normal year almost all water that is found in the Big Salt Marsh is a result of groundwater upwelling and local runoff."? Page 285 of the Quivira document.
7. Also stated in this same Quivira Management Plan. "From May until September, most units are managed so that they dry out gradually. It is impractical to attempt to maintain all the units during the hot summer months, except when precipitation is unusually high". Page 285 of the Quivira document.
8. Has the Wetland Restoration project, specifically the re-contouring process, increased the demands for water at different times of the year?

We are concerned that the Service operational plan is a change in management on the Quivira National Refuge. It appears that now we have seasonal Rattlesnake Creek surface water need estimates that have never existed until the last couple of years. We have gone from planning, managing and storing for the benefit of the refuge to, "We want our water when we want it." This raises these questions: has the water that is now being diverted been kept on the refuge and put to beneficial use and has consumptive use on the refuge increased under this new operational service plan? We would like to see the water that leaves the refuge monitored by meters at the point it exits the refuge. Without meters, there is no way to measure the following:

1.) "provided you do so within the constraints of the permit to proceed, it is also my duty to ensure that the consumptive use of water at the Refuge does not increase." Quoted text found on page 3 of David Pope's letter to Ralph Morgenweck dated May 27, 1994.
2.) "once this water has been diverted, provided it is retained on the authorized place of use (the Refuge) and not used in a wasteful manner, the water may be used in the manner required for the proper management of the Refuge." Quoted text found on page 2 of David Pope's letter to Ralph Morgenweck dated May 27, 1994.

At a minimum, we believe that the monitoring gauge at Raymond should be put back in service as a monitoring device of water leaving the refuge.

The next area we would like to comment on are the diversions that have been reported since 1967.

A. In the following years, these diversions were reported. Nov-Dec of 1994 and with Jan-Feb of 1995 total diversions of 901.5, Nov-Dec of 2003 and with Jan-Feb of 2004 total diversions of 1086.7, Nov-Dec of 2006 and with Jan-Feb of 2007 total diversions of 1714.1, Nov-Dec of 2012 and with Jan-Feb of 2013 total diversions of 0.00 occurred respectively. These four years all take the refuge from ¼ full Nov. 1st to full on March 1st. Does this imply that the 75% of the refuge water needs can be met with less than 1714.1 acre feet of diversions, the highest amount of the four years needed to fill the refuge?
B. In the year of 1999 diversions from March 1st to Nov 1st totaled 2181.10 acre feet. The year of 2002 diversions from March 1st to Nov 1st totaled 6474.90 acre feet. The refuge started both these periods at 75% full and ended at 75% full. What dynamics are at play here to need almost 300% more diversions in 2002 than was necessary in 1999?

In reviewing the certificate issued to Quivira Wildlife refuge we would like to comment on this section.

"The right of the appropriator shall relate to a specific quantity of water and such right must allow for a reasonable raising or lowering of the static water level and for reasonable increase and decrease of the stream flow at the appropriator's point of diversion."

It is our belief that Stafford County, as evidenced by the water level measurements of GMD#5 over time and the Great Bend Prairie Regional Planning Area Usable Lifetime of the High Plains Aquifer

map, is very close to equilibrium with regards to irrigation withdrawals and recharge rates in the county. Referring to this map, approximately 85% of Stafford county has over 250 years before saturated thickness reaches minimum thresholds. Analysis of annual water level measurements leads us to believe that a reasonable raising or lowering of the static water level is occurring in our county. There are irrigation wells that were established in the 60's that in 2010 were equal or exceeded the static water level of the day they were drilled.

How do we define what is a reasonable increase and decrease of the stream flow at the appropriators point of diversion? The components of this are many fold. We realize the effect the cone of depression from irrigation well has on the stream, but we also know that the year of perfection for this water right, the majority of irrigation wells affecting the stream were already present. Was this water right not perfected with irrigation already established? The other components are numerous. Changes in farming practices contribute to less runoff making it to the streambed. Millions of dollars have been invested by farmers in our county on technological advances to maximize efficiencies to conserve a precious natural resource. CRP acres are here by thousands of acres, therefore, runoff no longer occurs from these lands. Trees line streambeds that use to be barren. A mature cottonwood exceeds a thousand gallons of water use per day. We have hundreds of cottonwoods, cedars and other trees per mile now in our county. Amy Bickel at the Hutchinson News reported in Purging the Prairie, "Some people have seen it within a week – water flowing again in streams," referencing the killing of the red cedars in the massive wildfire in southern Kansas this spring and the effect on stream flow. Conservation efforts have been promoted, encouraged and paid for with programs directed by the Natural Conservation Resource Service that all are aimed at reducing runoff and keeping every inch of water that falls on the land where it falls. Looking in the near future, how will the new WOTUS program affect land next to the stream? It's a guess, but we feel it will decrease stream flow further.

Our next area of concern is the table that starts on page 69 of the chief engineer's impairment findings. We understand the table and how the amount short of needs is calculated. We provide these thoughts.

1A. Does the Seasonal Rattlesnake Creek surface water need estimates from Quivira NWR that is used to figure the amount short of needs column accurately reflect past management practices?

2A. Since it appears that no allowance has been made for evaporation and storage in the 14,587 acre feet that is permitted, should the beginning number for the diversions not be 10,129.7 acre feet? If not, then we suggest that an additional column for evaporation and storage needs to be added into the table. This number then needs to be added into the refuge reported diversions column so that an accurate number representing the amount short of needs can be calculated. We raise this question based on the fact that 10,129.7 acre feet were actually diverted; the balance to 14,587 acre feet in Quivira Refuge certificate was credit for evaporation and storage. To ask simply, if diversions of 14,587 acre feet are allowed at the Refuge diversion points, then if evaporation and storage are calculated, would not this be an over appropriation of the Refuge certified water right?

3A. In 1995, 2004 and 2005 there appear to be times when the refuge was full, however the amount short of needs column showed a shortage occurred.

4A. Why is the full appropriated water right being used to calculate the amount of need when the Refuge has been notified numerous times not to expect their full allotment every year as it is a maximum quantity perfected, not a guaranteed quantity every year?

Before we summarize our concerns we want to make it known we support the language that David Pope wrote on page four of the letter dated May 27, 1994 to Mr. Ralph Morgenweck.

"Even under pristine conditions, most of the streams in Central and Western Kansas are not continuously dependable sources of supply. Particularly in the case of very large water rights, such as the Quivira Refuge right, the water holder should not expect to be able to fully exercise the right each and every year. I should also point out that a certificate states the maximum quantity of water that may be diverted in any year. Because certificates are based on the maximum year of record, no water right holder should expect to need or have available the maximum authorized quantity every year."

The Stafford County Farm Bureau board appreciates the hard work put in on this impairment issue by you and your staff. We have raised several important issues in our minds that need addressed and look forward to your response. We do not believe the refuge is impaired to the extent that you have suggested in your preliminary findings. We have tried to detail why in this letter we feel that way. Severe cutbacks only destroy our local economy, county valuations, schools, businesses and forces individuals to look elsewhere for jobs as they become unemployed. Furthermore, severe cutbacks will not guarantee the Refuge water when they want it. The only realistic solution to this problem is augmentation, if impairment exists. We are more than willing to step forward and help in any way we can when it comes to design, planning and implementation of an augmentation plan. We support augmentation for the Quivira Wildlife Refuge, but in no way can we support severe cutbacks in ground water pumping when it destroys our county while not satisfying the Refuge water right. We also believe further reductions in ground water pumping can be achieved through incentive based programs that reward conservation of water. Several of these programs have just been finalized, and now are being promoted. We also would like to suggest that the possibility that the waste water treatment facility for St. John, Kansas that currently sets on the banks of the Rattlesnake Creek could be converted to return water to the stream.

Our vision for Stafford County as a Farm Bureau board is to sustain and conserve our natural resources for the benefit of the many generations to come after us. We are proponents of agriculture, communities, and conservation. We believe in our people of Stafford County and together we are willing to move forward with a sensible innovative solution to this issue. It is in all of our best interests to resolve this among Stafford County residents and the Quivira Refuge for the good of the county and the many generations to come in the future. We would again like to express our thanks for allowing us to respond to the impairment investigation findings.

Respectfully,

Justin K. Vosburgh	Stafford County Farm Bureau President
Shon Meschberger	Stafford County Farm Bureau Vice-President
Marlyn Spare	Stafford County Farm Bureau Secretary-Treasurer
Tyler Alpers	Stafford County Farm Bureau board member
Brian Dunn	Stafford County Farm Bureau board member
Cammie Vaupel	Stafford County Farm Bureau board member
Keith McNickle	Stafford County Farm Bureau board member

cc:

Jackie McClasky	Secretary of Kansas Department of Agriculture
Richard Felts	Kansas Farm Bureau President
Keith Miller	Kansas Farm Bureau
Kent Askern	Kansas Farm Bureau
Matt McCabe	Kansas Farm Bureau

Senator Pat Roberts
Senator Jerry Moran
Representative Mike Pompeo
Kansas Senator Mitch Holmes
Kansas Representative Greg Lewis
GMD#5
Waterpack
Stafford County Extension

KANSAS CORN GROWERS ASSOCIATION

To: David Barfield, Chief Engineer, Division of Water Resources

From: Greg Krissek, CEO, Kansas Corn Growers Association

Date: May 13, 2016

Re: Quivira National Wildlife Refuge Impairment Complaint

Thank you for the opportunity to provide written comments regarding the Quivira National Wildlife Refuge (the Refuge) impairment complaint. My name is Greg Krissek. I am providing these comments in my role as CEO of the Kansas Corn Growers Association (KCGA.) KCGA represents Kansas corn producers on a variety of issues that concern our members.

Kansas corn producers have a vested interest in the conversation about water quantity and quality in our state. Water quantity is a key issue for our growers as is protecting our water quality through improved farming practices, using best management practices for pesticides and fertilizers, employing conservation measures like reduced and no-till farming, and installing riparian buffers. By controlling sedimentation and pesticide runoff, we are also controlling our future access to crop protection tools and ultimately the use of our land to produce needed crops.

Farmers are always looking to the future, especially when we talk about water quantity. Irrigation has been key to growers in specific areas of the state, including the Rattlesnake Creek basin. This resource plays a key role in the economic well-being of Kansas. Examples of productive agriculture such as corn farming, cattle feeding, hog facilities, dairies, beef processing, grain handling, ethanol production, equipment and implement dealers, ag retailers, and transportation companies to move corn, cattle, pigs, meat, milk, ethanol, distiller's grains and a host of other products, have all contributed to build a thriving agribusiness complex in Kansas.

Most irrigators are already taking measures to conserve water as a practical business decision driven by economics. Corn farmers have made great strides in water conservation through improved farming practices, improved irrigation mechanics and technology, and continuing advances in the corn seed itself through breeding and biotechnology. As we continue down this path, we must remember that technological advances in corn and corn farming will continue to occur and improve the efficient use of water for this needed crop.

Impairment Report Issues

The Initial Report of the Chief Engineer Concerning a Claim of Water Right Impairment In the Matter of Water Right File No. 7,571 (Initial Report) contains many errors. The errors are so numerous as to make the findings of the report appear to be in error.

First, the entire impairment claim is based on a water schedule that the Refuge claims they need. The Refuge provides no proof showing that the water is needed at the specific times they have listed in their schedule. Furthermore, the water use that they have reported does not mirror the schedule at any point in the past 30 years. In fact, during most of the periods that show impairment in the analysis in Attachment 6 of the Initial Report, it appears the Refuge did not even utilize all of the water that was available. Using the Refuge's schedule, there was impairment in the year that the water right was certified. It would seem logically impossible to have impairment on the certification year. Furthermore, the use of the water during the certification year was not in line with the claimed needs of the refuge. Therefore, the Refuge's claim of impairment would not be valid since they were not utilizing the water that is available to them. Additionally, basing an impairment analysis on the "claimed" needs and timing of the complaining party without requiring any verification of those needs and timing is not the proper way to make a decision on impairment.

There also appear to be numerous potential problems with the perfection and certification of Water Right 7,571. In reviewing the water right file, it appears that the perfection and certification of the right should have occurred by December 26, 1982. The file for the Water Right 7,571 indicates that DWR had received a "Notice and Proof of Completion of Works for Diversion Works" on December 26, 1978. K.A.R. 5-8-6(a) makes it clear that a water right should be perfected within four years of the completion of the diversion works. Therefore, the water right should have been perfected and certified between 1979 and 1982. If the water right file is missing an extension of that time period, then many other issues may arise regarding what portions of the water right file are missing.

Finally, the permit for Water Right 7,571 states that the water right "must allow for the reasonable raising or lowering of the static water level and for the reasonable increase or decrease of stream flow at the appropriator's point of diversion." The Initial Report does not attempt to analyze whether the alleged impairment is caused by either a reasonable lowering of the static water level or a reasonable decrease of stream flow. Specifically, there is no analysis in the Initial Report regarding the Refuge's proposed water schedule and the reasonableness of that schedule with their historic use and the historic stream flow of the Rattlesnake Creek.

For the aforementioned reasons, the initial report is wholly lacking in finding impairment. The analysis of the impairment complaint should include a look at the reasonableness of the alleged water shortages as compared to the alleged needs of the Refuge. Additionally, a legal analysis should be completed to determine if 1987 was truly the proper year to certify and perfect the water right.

Augmentation

While there is still a valid question regarding whether an actual impairment exists in this situation, it is important to note that should impairment be found, augmentation should be utilized as the best method to satisfy the needs of the water right. Kansas Corn Growers Association and numerous other groups worked to ensure that augmentation can be a potential solution to impairment claims in the Rattlesnake Creek Basin. Therefore, we strongly encourage DWR to look at augmentation should an impairment be found in the future.

Kansas Dept. of Agriculture Division of Water Resources

5/13/2016

TO

DAVID BARFIELD
1320 RESEARCH PARK DRIVE
MANHATTAN KS, 66502

FROM

STAN E CHRISTIANSEN
640 NE 190th
HUDSON KS 67545

TOPIC

QUIVIRA NWR / RATTLESNAKE
CREEK IMPAIRMENT

5/13/2016

Mr David Barfield;

I live at 640 NE 190th Hudson Kansas 67545. The location is seven miles as a crow flies from the main lake. I have averaged crossing the mud flats once a day for the last 40 years. I have ground in Rice and Reno counties that borders the Refuge.

Dad was born in 1906 and hunted ducks and geese starting in 1919 or 1920. He passed away at 93. The first year there was a limit for ducks, the limit was 40 ducks a day.

The reason I bring this up is the first year he saw the main lake dry was 1980. That year there was no reason for it to be dry. The Refuge had the water flowing out of Rattlesnake when they could or should have put the water in the big marsh.

The Refuge had field planted Corn next on the north mud flats. Cattle were about to destroy the nests when I called the Refuge. Yates helped with the cattle and after talked with the Refuge manager. Asked why they were pumping water out the Rattlesnake creek instead of into the main lake to keep it from going dry. The next day the flow into the creek stopped.

It was too late to keep the lakes from drying up. The Refuge had the water, but just kept it flowing out.

I am 13 years old. I have been testifying water practices every year. They get the water every year.

There is I believe never a reason not to hold as much water as they can, except in a flood.

3

They can move the water through the impoundments and hold the water for further use instead of letting it flow out of the system.

They have spent all the money to build impoundments, let's use them for efficient water management.

In the 1980's when it started raining and they didn't have the boards in the inlets to hold the water, I put the boards in the inlets to hold the water. I also called them and told them I was doing it. They told me that if they caught me, they would arrest me.

That's when I told them to get out and put them in themselves. They didn't seem interested, so I kept putting them in.

(4)

Mr. Barfield, there are many more instances of waste water management, I have not mentioned. I would be glad to chat with you if you want.

Sincerely

Stan E Christiansen

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To: David Barfield, Chief Engineer, Division of Water Resources

From: John Donley, Legal Counsel, Innovative Livestock Services, Inc.

Date: May 13, 2016

Re: **Comments on the Initial Report of the Chief Engineer Concerming a Claim of Water Right Impairment in the Matter of Waater Right File No. 7,571 Owned and operated by U.S. Fish and Wildlif Service**

Thank you for the opportunity to provide written comments regarding the U.S. Fish & Wildlife Service (the "Service") impairment complaint. My name is John Donley. I am providing these comments in my role as Legal Counsel for Innovative Livestock Services, Inc. ("ILS"). ILS owns and operated numerous water rights in the Rattlesnake Creek Basin that is subject to this impairment investigation. ILS incorporates the comments of the Board of Directors for Big Bend Groundwater Management District #5 into these comments.

In reviewing the Initial Report of the Chief Engineer Concerning a Claim of Water Right Impairment in the Matter of Water Right File No. 7,571 (the "Initial Report"), many problems were found with the water right itself as well as the analysis used to determine impairment. Many of these issues will be addressed in these comments. The short time frame for comments made it difficult to conduct a complete analysis of the file and to study the model runs used in the initial report. The Division of Water Resources ("DWR") took 20 months to complete the impairment investigation and publish the Initial Report. For all interested parties to be expected to analyze the same issue and prepare comments in less than six months is grossly inadequate. Furthermore, Water Right File No. 7,571 was only available to review for less than four months. For these reasons, ILS affirmatively asserts that other issues may be raised in the future should litigation or further comments need to occur in order to reach a legal conclusion to this matter.

Issues discovered in reviewing Water Right File No. 7,571 and the Intitial Report

Upon review of the file, there are numerous problems regarding the perfection and certification of Water Right 7,571. It appears that the perfection and certification of the right should have occurred by December 26, 1982. The file indicates that DWR received a "Notice and Proof of Completion of Works for Diversion Works" on December 26, 1978. K.A.R. 5-8-6(a) states that a water right should be perfected within four years of the completion of the diversion works. Under this rule, the water right perfection period ended December 26, 1982. If the water right file is missing an extension of that time period, it raises the question as to what other documents are missing from the file.

The permit for Water Right 7,571 states that the water right "must allow for the reasonable raising or lowering of the static water level and for the reasonable increase or decrease of stream flow at the appropriator's point of diversion." The Initial Report does not attempt to analyze whether the alleged impairment is caused by either a reasonable lowering of the static water level or a reasonable decrease of stream flow. Specifically, there is no analysis in the Initial Report regarding the Service's proposed water schedule and the reasonableness of that schedule with their historic use and the historic stream flow of the Rattlesnake Creek.

The Service received notification from DWR multiple times regarding the fact that the full amount of the water right may not be reasonably available at all times. Specifically, DWR sent a letter to the service on August 19, 1993 stating that "it is quite probable that the natural flows of water to the full extent of the water right will not be available in ***most*** years." (emphasis added) In correspondence dated May 27, 1994, DWR again notified the Service that "no water right holder should expect to need or have available the maximum authorized quantity every year." Why didn't DWR utilize a reasonableness standard when drafting the initial report?

There is also a question regarding the inclusion of the evaporated amount as the amount diverted in 1987. The file never gives legal justification for including this amount. The water that was evaporated in 1987 was actually diverted in previous years. Therefore, the authorized quantity for File No. 7,571 should have been the actual amount diverted in 1987 (assuming DWR had extended the perfection period to include 1987), which was 10,129.7 acre feet. If the evaporated amount is to be included, why hasn't the service reported the evaporated amounts in their annual water use reports?

Another problem that exists in the Initial Report, is the fact that the entire impairment claim is based on a water schedule that was recently submitted by the Service. None of the Annual Water Management Plans contained in the file for the water right reference the water schedule submitted to DWR in the past. Those plans never reference anything close to the alleged needs submitted by the service in May 2015 (see Attachment 5 of the Initial Report). Why did DWR simply accept Scenario 3 found in Attachment 5 of the Initial Report? It seems that the application of Scenario 1 from the Attachment 5 or a similar historic use of the water would be more accurate than a subjective assessment that maximizes the Service's claim of impairment.

Furthermore, the water use that the Service has reported does not coincide with the schedule used in the Initial Report at any point in the past 30 years. In fact, during most of the periods that show impairment in the analysis in Attachment 6 of the Initial Report, it appears the Refuge did not even utilize all of the water that was available. Using the Refuge's schedule, there was impairment in 1987; the year that the water right was certified. It would seem logically impossible to have impairment on the certification year. Furthermore, the use of the water during the certification year was not in line with the claimed needs of the refuge.

There are multiple months where there is water available to meet the alleged needs of the service, and they do not even divert their alleged needs. Therefore, the Refuge's claim of impairment would not be valid since they were not utilizing the water that was available to them. Additionally, basing an impairment analysis on the "claimed" needs and timing of the complaining party without requiring any verification of those needs and timing is not the proper

way to make a decision on impairment. This portion of the analysis alone should require that DWR reevaluate this impairment claim.

For these and many other reasons, the initial report does not provide the legal or factual foundation to find impairment. A more thorough and accurate analysis of the impairment complaint should include a look at the reasonableness of the alleged water shortages as compared to the alleged needs of the Service. Furthermore, the alleged needs of the Service should be scrutinized. Finally, a legal analysis should be completed to determine if 1987 was truly the proper year to certify and perfect the water right.

Potential for Augmentation

While there is still a valid question regarding whether an actual impairment exists in this situation, it is important to note that should impairment be found, augmentation should be utilized as the best method to satisfy the needs of the water right. All potential options for augmentation should be analyzed to satisfy a call for water should impairment be found.

Conclusion

As stated earlier, the initial report does not provide the legal or factual foundation to find impairment. A more thorough and accurate analysis of the impairment complaint should include a look at the reasonableness of the alleged water shortages as compared to the alleged needs of the Service. The alleged needs of the Service should be scrutinized. A legal analysis should be completed to determine if 1987 was truly the proper year to certify and perfect the water right. Additionally, all questions raised in these and other comments should be answered before moving forward with a final report. Furthermore, should impairment be found, would any call for water be a futile call. Shutting down groundwater wells would not provide the relief necessary if the Service's right is being impaired as they allege. Therefore, it appears that augmentation would be the best alternative should impairment be found.

The Wildlife Society
The Kansas Chapter

Promoting Excellence in Wildlife Stewardship through Science and Education

13 May 2016

David W. Barfield. PE.
Chief Engineer
Division of Water Resources
Kansas Department of Agriculture
1320 Research Par Drive
Manhattan, KS 66502

Dear Mr. Barfield:

This letter constitutes comment by The Kansas Chapter of The Wildlife Society (KSTWS)—a professional society of wildlife biologists, land managers, researchers, and educators in the state of Kansas—on the "Claim of Water Right Impairment, In the Matter of Water Right File No. 7,571, Owned and operated by U.S. Fish and Wildlife Service." Our chapter strongly encourages the Kansas Department of Agriculture's Division of Water Resources (DWR) to adhere to all relevant regulations and water rights in fully restoring water flow in Rattlesnake Creek to provide sufficient flows to Quivira National Wildlife Refuge (QNWR), a site managed by the U.S. Fish and Wildlife Service (FWS). The FWS has senior water right priority to approximately 95% of the water rights in the Rattlesnake Creek Basin. Our chapter is troubled by your report concerning the claim that water supply for QNWR "has been regularly and substantially impacted by junior groundwater pumping."

Our concern is regarding the ability of the FWS to manage wetlands at QNWR that are vital to wetland-dependent wildlife in Kansas and continentally. Quivira National Wildlife Refuge has been recognized as a Wetland of International Importance by the 1988 Ramsar Convention on Wetlands. It is a major stopover site for migratory waterbirds (waterfowl, shorebirds, herons and egrets, rails, etc.). It has been estimated that most – if not all – of the individuals of some species of shorebirds stop over at the QNWR-Cheyenne Bottoms Wildlife Area wetland complex on their continental migrations. The site represents an expansive wetland, the type of which has become exceedingly rare in the modern world. Impairment of water flows to QNWR could contribute to a hemispherical degradation of migratory water birds, species which constitute major components of natural heritage for the people of Kansas and the United States of America.

Again, KSTWS strongly encourages the DWR to respect the senior water rights of FWS in the Rattlesnake Creek Basin by fully restoring water flow in Rattlesnake Creek through appropriate regulatory means.

Respectfully submitted,

William E. Jensen, Ph.D.
President
The Kansas Chapter of The Wildlife Society
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May 12, 2016

David Barfield, Chief Engineer
Division of Water Resources
Kansas Department of Agriculture
1320 Research Park Drive
Manhattan, Kansas 66502

Re: Initial Report of the Chief Engineer
Water Right Impairment

Dear Mr. Barfield:

Thank you for the opportunity to provide comments on the Initial Report (the "Report") of the Chief Engineer for the impairment investigation filed by your office on December 2, 2015. The Board of Directors for Big Bend Groundwater Management District #5 (the "District") appreciates the complexity of this investigation and has invested great time and consideration in preparing the following responses to the Report.

The District has, for the past 40 years, worked to fulfill the mission statement outlined in its first management program approved June 6, 1976:

> Big Bend Groundwater Management District No. 5 was organized through the efforts of concerned citizens to conserve, promote, and manage groundwater resources so that quality and quantity of that resource will be maintained for present and future needs. The Groundwater Management laws (K.S.A. 82a-1020-1035) establish the right of local landowners and water users to determine their own destiny with respect to the use of groundwater within the basic law of the State of Kansas.

Throughout the District's 40-year history, it has implemented numerous strategies to protect and conserve the Great Bend Prairie aquifer. These strategies have included strict monitoring of water use with water flow meters; well spacing requirements; waste of water enforcement; well movement limitations; and a restrictive safe yield policy. In October 1991, the District implemented a flow meter requirement for "diversion works of all vested rights, appropriation rights and approved applications for permit . . ." on or before January 1, 1993. In 1998, the District was formally closed to new appropriations through a revision to K.A.R. 5-25-4.

As a result of these management objectives, the Great Bend Prairie aquifer has not seen the dramatic water table declines that have occurred in other parts of the state. The District has noted declines in the water table during years in which precipitation was limited, but these declines have proven temporary. Due to the soil types that overlay the District and the relatively shallow depth to water, the aquifer recharges and recovers quickly.

On January 15, 2016, the Kansas Department of Agriculture – Division of Water Resources ("KDA–DWR") staff provided a copy of the entire file (the "Record") for Water Right File No. 7571 to give members of the general public an opportunity to review the process the United States Fish and Wildlife

Service (the "Service") and KDA–DWR followed to register and perfect this water right. The District's review of this process has brought to light several areas of concern that are the subject of the remainder of this letter.

Irregularities in the Certification of Water Right File No. 7571

According to the Record, the Service submitted an application for permit on August 15, 1957. On May 20, 1963, the Service received the permit to appropriate water for beneficial use (the "Permit") from KDA–DWR Chief Engineer R.V. Smrha. In this Permit, the KDA–DWR outlined the Service's deadline to complete construction of diversion works. The time frame in which an applicant must construct diversion works following the approval of an application to appropriate water is set out in K.A.R. 5-8-4.

The Permit further stated a deadline of December 31, 1968, for perfection of the appropriation, or within any authorized extension of time. The Service requested and received extensions of the completion deadline on two separate occasions, pursuant to K.A.R. 5-8-5(b)-(d). According to the Record, the Service received its final extension on March 20, 1974. Pursuant to this extension, the Service had until December 31, 1978, to complete the construction of the diversion works.

The Record includes a letter from KDA–DWR staff, dated December 26, 1978, acknowledging receipt of "Notice and Proof of Completion of Works for Diversion Works" for Water Right File No. 7571. K.A.R. 5-8-6 outlines the process an applicant must follow to perfect a water right. Subsection (a) states that the time period for perfection begins following the deadline for construction of the diversion works. There is no document in the Record indicating that the Service requested or received an extension of the deadline for the completion of diversion works beyond December 31, 1978. Therefore, the perfection period for Water Right File No. 7571 should have begun no later than that date.

Curiously, the Service submitted a letter to KDA–DWR on July 15, 1982, enclosing the Notice and Proof of Completion of Works for Diversion Works for Water Right File No. 7571. KDA–DWR then sent a letter in response noting that this document was unnecessary, as KDA–DWR had acknowledged receipt of this document already in March 1974, effective May 1972. This gap in the record leaves the District to question whether the Service received an extension of its deadline to complete construction of diversion works, and if so, whether any documentation of that extension has survived.

K.A.R. 5-8-6(a) states that a reasonable time to perfect a water right shall be no fewer than four full calendar years following the deadline for construction of the diversion works. Pursuant to K.A.R. 5-8-6(b), if the permit holder's time to construct the diversion works is extended, the perfection period shall also be extended to no fewer than four full calendar years beyond the final deadline to construct the diversion works. As noted earlier, KDA–DWR acknowledged receipt of the Notice and Proof of Completion of Works for Diversion Works document on December 26, 1978. There is no indication within the Record in regard to an extension beyond the minimum of four full calendar years. Therefore, the deadline to perfect Water Right File No. 7571 should be no later than December 31, 1982. Once again, if the Service received an extension on the deadline to perfect its water right through 1987, the record does not contain any documentation of that extension.

Based on the aforementioned irregularities, the District is concerned about the procedure followed to perfect the Service's water right.

The Service's Report of Annual Water Use is Incomplete

The Report repeatedly notes that the appropriated quantity of water for Water Right File No. 7571 is 14,632 acre-feet ("AF") per calendar year.

The Certification Memo (the "Memo") for Water Right File No. 7571 states its reliance on a table titled "Typical Annual Water Use at Quivira Wildlife Refuge." According to the Memo, this table was intended to demonstrate the maximum amount of water the Service might use if sufficient water was available to

fulfill all of the management options in its Annual Water Management Plan. Importantly, the Memo notes that the tabulation does not account for other items, such as several unmanaged areas often flooded to a depth of 2-3 inches; evaporation during winter months; or the drainage of management units. To account for this discrepancy, the Memo explains that the active diversions from the three points for the year of record, 1987, was added to the storage and evaporation from the Little Salt Marsh as shown below:

10,175 AF of active diversions + 1,862 AF storage + 2,595 AF evaporation

Each year, the Service includes water diversions in its water use report, but not the amount that evaporated from the Little Salt Marsh. Because the Service's water right was calculated using a method that factored in this evaporation, the District believes the water right certificate should be amended to note the two methods of accounting for water annually. If no amendment is made, the Service should be found in violation for failing to report the evaporation from the Little Salt Marsh annually.

The Holder of a Water Right Should Not Expect to Fully Exercise It Every Year

As stated previously, the Refuge water right was perfected in 1987. Not coincidentally, that year set the record for maximum daily discharge at the Zenith gage. In fact, it was the eighth wettest year out of 100 years of data. While the District understands the concept of the perfection period and its reliance on the year of maximum diversions, the District wonders whether these diversions are a reflection of stream base flow or simply runoff from storms. In any event, the Record contains multiple letters from the Service to KDA–DWR indicating concerns about water the Service claims would have been available if not for the groundwater pumping conducted by the holders of junior rights within the subbasin.

As a preliminary note, activities outside of the boundaries of Quivira National Wildlife Refuge (the "Refuge") are not within the jurisdiction of the Service. The Chief Engineer for KDA–DWR retains jurisdiction for the use of water throughout the State of Kansas and, in that capacity, granted the Service a permit to construct diversion works and perfected its water right. Then Guy Ellis, a hydrologist with KDA–DWR discussed the nature of that water right in an August 19, 1993, letter to the Service. He stated that "it is quite probable that the natural flows of water to the full extent of the water right will not be available in most years. Management plans for the Refuge area should be based on probable flows of Rattlesnake Creek." In May 1994, the Chief Engineer cautioned the Service again. He explained that:

> Even under pristine conditions, most of the streams in Central and Western Kansas are not continuously dependable sources of supply. Particularly in the case of very large water rights, such as the Quivira Refuge right, the water holder should not expect to be able to fully exercise the right each and every year. I should also point out that a certificate states the maximum quantity of water that may be diverted in any year. Because certificates are based on the maximum year of record, no water right holder should expect to need or have available the maximum authorized quantity every year.

This statement suggests that it is appropriate to account for a shortage in supply to the Refuge water right. Nevertheless, the Chief Engineer's Report has allowed the Service to determine its monthly water needs based on the assumption that it will fully exercise its water right every single year. This allowance is in direct conflict with the KDA-DWR's prior statement that no water right holder should expect to need or have available the maximum quantity authorized by the certificate for appropriation on a yearly basis.

Even the Service's own Quivira Management Plan acknowledges that "[f]rom May until September, most units are managed so that they dry out gradually. It is impractical to attempt to maintain all the units during the hot summer months, except when precipitation is unusually high". (Page 285 of the Quivira document.)

Clarification Needed Regarding "Normal" Conditions of the Subbasin

In an April 10, 1996, letter to the Service, the Chief Engineer stated that 41,056 AF of water passed the

USGS streamflow gage near Zenith (Zenith gage) in 1987 at a rate below 300 cfs, but notes that the Service did not divert this water. In light of this statement, the District requests clarification as to Water Right File No. 7571. Does KDA–DWR consider the 41,056 AF of water that passed the Zenith gage in calendar year 1987 below 300 cfs to be normal conditions of the subbasin? More specifically, what component of that amount can be attributed to baseflow versus excess runoff? As the KDA-DWR is aware, land practices throughout the region have changed dramatically over the past 30 years. These changes have minimized—perhaps even eliminated—the vast majority of the runoff coming from fields. In many cases, these land practices were motivated by state or federal incentive programs.

Errors in the Calculation of the Service's Water Use History

In September 1996, the Chief Engineer issued to the Service a document titled "Findings and Order". It required the installation of water flow measurement structures and devices, as well as a monitoring system sufficient to provide continuous, daily data relative to the diversion of natural flows of the Rattlesnake Creek.

The difficulty in designing and implementing an accurate metering system at the Refuge's diversions is acknowledged several times in the Record. As a result, the Service twice requested (on June 8, 2001, and again on January 22, 2003) that the Zenith gage be used as a "means of measuring the volume of water entering the Refuge." The Service requested this method of measuring volume in order to ensure the collection of accurate data that is logged in real time on the USGS website. As noted by the Service, this measurement location would also account for the filling and maintenance of water level in the Little Salt Marsh, in addition to the water diverted by the Service to fill the other water units at the Refuge. In March 2002, KDA–DWR responded with a letter that did not answer the Service's request to use the Zenith gage for measuring total volume entering the Refuge.

The Service was given a deadline of December 31, 1997, to meet these requirements. This order came five years after the District required water flow meter on the "diversion works of all vested rights, appropriation rights and approved applications for permit . . ." Subsequent to this order, the Service filed numerous requests for extensions and waivers from this requirement until it finally installed the necessary equipment in early 2012.

According to the Record, the Service used the Clausen Rule for estimating water use from 1978 through 2012. The District would like to know whether the KDA–DWR has completed a review of the water flow diversion history for Water Right File No. 7571 to validate the water use history—specifically, the accuracy of the water use history in comparison to water availability through the Zenith gage. Furthermore, if the KDA-DWR has completed such a review, the District is interested to learn the nature and extent of that study, as well as its conclusions.

On a related point, Exhibit G within the Record, dated December 21, 1992, details the correct application of the Clausen Rule for measuring flow. This same document notes that there may have been errors in the water use records due to personnel errors. However, after calling into question the accuracy of the Service's record-keeping, the KDA–DWR did not issue any penalties against the Service for failure to maintain an accurate water measuring device. This is another point of concern for the District, whose constituents are also held to strict measuring requirements.

The Effect of the Service's Shifting Management Strategy for the Refuge

In the same September 1996 "Findings and Order", the Chief Engineer also ordered the development of a water conservation plan to avoid waste of water, to minimize unnecessary losses, and to optimize efficient use of water for the Service's authorized purpose. This plan was to encompass the development of an operational plan for the improved conservation and management of water at the Refuge, including a drought contingency plan. Following the grant of several extensions, the Refuge submitted a water conservation plan that the KDA–DWR approved in 2000.

Attachment 5 to the Report describes the seasonal water need estimates for the Refuge as of 2015. This need is estimated based on the Refuge's water use records for the previous 20 years and the Comprehensive Conservation Plan adopted by the Service in 2015. The Service's 2015 water conservation plan differed in several important aspects from the 2000 plan. For instance, the 2000 plan acknowledged that streamflow in the Rattlesnake Creek is variable throughout the year. The Refuge's strategy was to store up as much water as was available in February and then allow drawdown in management units for habitat in late spring (March – May). The majority of the remaining management units would then be allowed to dry out gradually throughout the summer months (May – September).

This strategy outlined in the water conservation plan adopted in 2000 is in conflict with the 2015 water need estimate for the Refuge, which contemplates approximately 60% of the annual appropriation being diverted from the creek into the management units between March and September. In other words, the management demands of the Refuge seem to have shifted away from a cyclical management strategy that works in concert with water availability annually.

The concerning result of the Service's shift in management strategies for the Refuge is apparent when comparing diversions before and after the Service's new operational plan was adopted in 2000. For example, in 1999, Refuge diversions between March 1 and November 1 totaled 2181.10 AF. In 2002, Refuge diversions between March 1 and November 1 totaled 6474.90 AF. The Refuge began both of these periods at 75% full and ended at 75% full. The District is bewildered as to why the Service required almost 300% more diversions in 2002 than was necessary only a few years before.

Casting a wider net and examining Refuge diversions between 1994 and 2013 paints a cloudier picture still. During this time period, the following diversions were reported:

- Nov. – Dec. 1994 and Jan. – Feb. 1995 – total diversions of 901.5
- Nov. – Dec. 2003 and Jan. – Feb 2004 – total diversions of 1086.7
- Nov. – Dec. 2006 and Jan. – Feb. 2007 – total diversions of 1714.1
- Nov. – Dec. 2012 and Jan. – Feb. 2013 – total diversions of 0.00

Each of these four periods took the Refuge from 1/4 full on November 1 to full on March 1. The District's impression based on these numbers is that 75% of the Refuge's water needs can be met with less than 1714.1 AF of diversions—the highest amount of diversions needed to fill the Refuge in any one of the above years.

Technical Review and Comments by Balleau Groundwater, Inc.

When the Chief Engineer issued the Report on December 2, 2015, the District asked BGI to conduct a thorough technical review of the data collection and analysis presented in the Report. This technical review resulted in the following conclusions.

1. The Chief Engineer's approach to estimating flow in Rattlesnake Creek had junior pumping not occurred is technically sound. We see no apparent issues in the calculations comparing flow in Rattlesnake Creek with the water demand schedule provided by the Service.

2. Although the Chief Engineer's impairment analysis considers the water needed to fully supply the Service's demand schedule for the Refuge, it also recognizes that natural shortage is an occurrence during drought periods and that there are times when the Refuge will experience a water shortage. There are technical methods for assessing how that shortage could occur in administration of the Service's water right. Augmentation amounts would vary accordingly.

   The recognition of the natural shortages associated with the diversion of water from the Rattlesnake creek is documented in the August 19, 1993, letter to the Service from the Chief Engineer. According to the September 25, 1996, Findings and Order, the Chief Engineer explained that a water conservation plan was required for the Refuge because "the Rattlesnake

Creek may be insufficient, during times of drought, to provide a supply of water sufficient to meet the needs of all water users dependent upon the creek."

3. The Chief Engineer should indicate whether hydrologic effects from out-of-basin pumping have an implication on his finding of impairment.

   The Report as written is unclear on this point. Take, for example, the following statement on Page 37: "Some impacts of pumping from within Rattlesnake Creek basin by rights junior the Refuge Right eventually propagate outside the basin boundaries, so that baseflow impacts that pass through the Zenith gage are somewhat less than this total." The reverse impact of wells located outside the basin is expected to deplete flow from Rattlesnake Creek.

4. The Appendix of the Report details the modelling efforts conducted by KDA-DWR staff during this investigation. Several model scenarios were conducted using various versions of the hydrologic model. Scenario 11 compared the results from both the single-layer and the multi-layer model and indicates a difference in the change to Rattlesnake Creek flow of 2.4 percent. In comparing these two versions of the model for Scenario 1, as described in the Appendix, there is a difference of about 5 percent on the global stream budget. The difference in the magnitude of streamflow is generally 1-6 cfs. This indicates there are some differences between multi- and single-layer models that are sensitive to the magnitude of change in groundwater pumping. Perhaps the single-layer model could be used for scoping-level assessments and then the multi-layer model could be used for final calculations and conclusions.

5. The starting head condition used in the model scenarios is not steady. Beginning the simulations with an initial condition that is not in steady state should be corrected.

6. A comparison of flow at Zenith gage to the seasonal demand schedule developed by the Service for the Refuge indicates a number of times when river flow exceeds Refuge demand. Coordination with the Refuge on managing stored water in Little Salt Marsh may be an approach to facilitate the effectiveness of augmentation pumping. The degree of storage in the Refuge's operations is a question that may affect augmentation.

   As noted in the certificate of appropriation for Water Right File No. 7571, dated April 9, 1996, the Refuge is entitled to "a quantity not to exceed 14,632 acre-feet of water per calendar year for recreational use. Such quantity can be subsequently stored and accumulated in marsh areas . . ." The Record shows several references to the need for storage of water in recognition of the fluctuation in natural flows of the Rattlesnake Creek within a calendar year.

7. When comparing the water use history for the Refuge to the historical flow at the Zenith gage, the storage and evaporation from Little Salt Marsh should be added to the reported diversions, as this is the methodology used in certifying Water Right File No. 7571. When conducting this analysis, over the period 1974 through 2013, flow at Zenith gage exceeds the Service's water right in 28 out of 40 years, or 70 percent of the time; however, the reported water diversions (with evaporation added) are generally less than the amount certified. This indicates a possible failure to exercise the full water right. The effectiveness of full exercise of the Refuge water right is a question that may affect augmentation.

Strategies for Augmentation

In 2006, the Kansas Water Office ("KWO") produced a report titled "Stream Flow Augmentation of Rattlesnake Creek." In that report, the KWO calculated average augmentation needs over a three-month demand schedule of 1,146 AF of water (6.3 cfs) from a site near U.S. Highway 281. The augmentation plan described would pump this water into the Rattlesnake Creek channel for delivery to Water Right File No. 7571.

Water Right File No. 7571 is located at the downstream end of an intermittent stream which traverses approximately 35 miles across the District. The majority of the subbasin area has been classified as dry subhumid and is comprised of low bluffs of dune sand. Reliance on this stream as a sole source of water can be difficult, especially in years of limited precipitation such as 2011 and 2012.

Recently, the District conducted preliminary model scenarios to evaluate the impact of augmentation of streamflow from groundwater pumping from locations closer to the Refuge. This model work is still ongoing and is subject to adjustment depending on the water management at the Refuge within a calendar year.

Additionally, utilization of a trigger mechanism similar to those noted in both the Water Conservation Plan for the Refuge and the Program will help to limit the need to augment water in years of significant drought. Utilization of the Palmer Drought Severity Index from the Climate Prediction Center of the National Weather Service is one method to help establish such a trigger mechanism. Finally, augmentation water should never go unused on the current day, thus an adjustment to the target need based on actual performance of Refuge water use is reasonable.

...

Moving forward, the District requests that the Chief Engineer clarify the issues and answer the questions raised in these comments to the Report. This information is critical to analyzing the Service's impairment claim and to formulate a workable solution.

As previously recognized by KDA–DWR, no surface water right holder is guaranteed full exercise of its calendar year allocation every year. The model indicates the Service will receive its annual allocation in the vast majority of calendar years; therefore, there is no impairment.

The District will continue to be an active advocate for the proper management of the local aquifer to ensure that the future generations of Kansans will have a viable water source to provide for their families.

Sincerely,

Darrell Wood, President

Fred Grunder, Vice-President

John Janssen, Treasurer

Curtis Tobias, Secretary

Kent Lamb

Phil Martin

Tom Taylor

Justin Gatz

Bob Standish

Barfield, David

From: Benjamin Gray <benjamincgray@gmail.com>
Sent: Friday, May 13, 2016 2:46 PM
To: Barfield, David
Subject: Claim of Water Impairment re: Right File 7571

I'm writing to urge you to restore adequate water flow to Quivera National Wildlife Refuge.

Simply put, the refuge's water rights supercede the claims of other users.

The Division of Water Authority must act to preserve the National Wildlife .

Sincerely,

Benjamin Gray

Barfield, David

From: Janet T <gavelgoddess@gmail.com>
Sent: Friday, May 13, 2016 2:46 PM
To: Barfield, David
Subject: Quivira National Wildlife Refuge desperately needs protection.

I visit Kansas every year in the fall specifically to see the wildlife of Quivira, and I am appalled that you have allowed junior water rights holders to take water that legally should be going to the refuge. Tens of thousands of birds rely on the refuge, and Kansas is enhanced by its existence. How can you choose to side with illegal water theft over the protection of this critically important wetland? I am extremely disappointed in your management.

Janet Thew

Barfield, David

From: Beth Harshfield <Beth@exhibitarts.net>
Sent: Friday, May 13, 2016 3:14 PM
To: Barfield, David
Cc: Vernon Harshfield
Subject: Mange the water resources for Rattlesnake Creek !

Dear David -

Please see the attached article regarding our state's policy of not providing adequate water to Quivira's National Wildlife Refuge. This area is critical to migratory birds and our state's wildlife heritage. The information below was published by the Kansas Audubon Society. We do not want this National Wildlife Refuge compromised by politics!

Quivira's Water, Wetlands, and Wildlife in Jeopardy

Our inquiries regarding the situation have disclosed the following information which serves as an informed overview of this serious violation of water right protection that has resulted in severe damage to a nationally and internationally significant wildlife habitat resource critical to conservation of major migratory bird populations and to imperiled and endangered species. Needless to say, the Quivira National Wildlife Refuge is also critically important to what can be described as the state's wildlife heritage, and to the diverse recreational opportunities provided.

BACKGROUND/STATUS:

- In the mid-1980's, the Refuge Manager at Quivira National Wildlife Refuge (Quivira or Refuge) began submitting correspondence to the Regional Office of the U.S. Fish and Wildlife Service regarding what he believed was an issue with streamflow depletion. He felt that the vast number of irrigation wells that had been permitted and put into operation over the last decade was having an impact on the volume of water reaching Quivira. The Refuge has a senior surface water right with a priority date of 1957, perfected in 1996.

- From 1989 through 1991, a severe drought occurred. Refuge pools were virtually dry, greatly impacting the ability of the Refuge to supply habitat for migrating birds. During the same time period, several environmental groups raised concerns with the Kansas Division of Wildlife and Parks (KDWP) over their failure to assert and protect a water right on Walnut Creek that supplied the Cheyenne Bottoms State Wildlife Area located to the northeast of Quivira. The assertion made by these groups was that the junior irrigation wells were interfering with the volume of surface water reaching the Bottoms, impacting habitat for migratory birds.

- The Kansas State Engineer (Chief Engineer) heads the Kansas Division of Water Resources, and is responsible for administration of water rights throughout the state. The State is broken up into quasi-governmental Groundwater Management Districts that also have a certain degree of control over groundwater use in their district.

- In 1990, the Manager of Big Bend Ground Water District No. 5 (GMD#5) requested the Chief Engineer to initiate proceedings for the designation of an Intensive Groundwater Control Area (IGUCA) in the Walnut Creek Basin. These hearings consisted of testimony of a range of hydrologic and biologic experts, as well as individual water users that would be affected. The Chief Engineer concluded that the junior wells were interfering with the senior surface water right held by KDWP, and, in 1992, created an Intensive Groundwater Use Control Area. The IGUCA gave the Chief Engineer the authority to reduce the amount of junior water rights that he determined were impacting Walnut Creek.

- As a result of this case, a group of private irrigators formed a group called the Water Protection Association of Central Kansas (WaterPACK). WaterPACK and the Groundwater Management District #5 contacted the Service and several of the environmental groups who had been involved in the Walnut Creek process and formed a group called the Rattlesnake Creek Partnership in 1993. This group led to the development of an effort to lobby Congress for funding to study the water issue, and the formation of a group to try to develop a groundwater management plan. Concurrently, the Service began funding a series of contracts with the Kansas Geological Survey to determine the projected impact of existing groundwater pumping on the Refuge.

- The DWR recognized that there was significant over-appropriation of groundwater throughout the central and western portions of the State. The DWR began forming Subbasin Management Teams to work on addressing the issue from a State level. The Rattlesnake Creek Subbasin Management Team was eventually tasked with working with the other partners to develop a groundwater management plan for the Rattlesnake Creek Subbasin. The State identified two areas of high ground water decline, and these areas, as well as a portion of the stream corridor were targeted for the greatest reductions in groundwater use.

- The Service and the other partners met over a series of years to hammer out an incentive-based management plan. The goal of the plan was to reduce groundwater use to the extent that the Refuge water right was protected while ensuring that the agricultural economy was allowed to continue to function. The State committed funds to the development of an interactive surface water/groundwater model, which could be used to determine the amount of water use reduction that would be needed. At the end of 1999, WaterPACK and the GMD rejected the State's model, and the water use reduction targets that were agreed on were largely based on less robust methodology. A group of groundwater use programs were developed, and a plan was written and signed in 2000. The plan required the DWR to do a progress review at the end of each four-year period. There was never any intent by the Service to enter into any new agreement at the end of the 12-year period. The Program was supposed to address the problem of over-pumping, and ensure that the Service's senior water right was protected.

- To date, the only parts of the overall program that have been initiated are Water Banking and the End-Gun Removal Programs. There has been a lack of funding from the State. The water rights buy-back program has been largely unsuccessful because of a lack of funding, the tendencies of prospective sellers to ask very high prices, and the initial unwillingness of the Chief Engineer to permanently retire those rights.

- The State greatly reduced staffing for the Subbasin management teams, and the amount of turnover has been significant. The Subbasin Management Team for the Rattlesnake Creek Subbasin had its responsibility expanded to cover a much larger area. Although they have produced a report every four years on the "progress" of the Management Plan as required, they have spent a considerable amount of time and money developing a new groundwater model that covers the entire GMD#5. The report on this model greatly downplays the streamflow interference issue. However, the 4-year reports on the Management Plan consistently show that targets are not being met, both water use reduction targets, as well as aquifer and streamflow stabilization targets. Groundwater levels as well as streamflow have continued to decline despite many years of above-average precipitation.

- In 2015, there was a severe drought, the stream dried up. The State passed a bill allowing irrigators to pump more water than they hold water rights for, provided that they pump less in the future. The Refuge did not get any water, but junior pumpers got more water than they had a water right to take.

REPORTED POSITION OF GMD#5:

- The GMD#5 would like some certainty regarding water availability for the future, and believes some action needs to be taken. However, they would like the Service to accept the development of augmentation wells to provide water to the Refuge as the solution.

DEPARTMENT OF THE INTERIOR/FISH & WILDLIFE SERVICE PERSPECTIVE:

- There is currently no physical way to augment streamflow with pumping, and it would realistically take a decade to develop, as well as a huge investment of funds.

- The Service entered into the above-described agreement in good faith, has not asked for an administrative remedy during the agreed-upon 12-year term of the agreement, and expected the other Partners to meet their obligations under the agreement. This is not what has been happening, and the Service is being asked to continue to accept injury to the Refuge's senior water right while some new plan is developed.

- The Service is not asking to be treated any differently than any other water user in the State. The Service applied for, developed and perfected the Refuge water right in accordance with State law, and is asking that it receive the same consideration and protection as any other water user's right.

- The Service has asked that the current groundwater use reductions that were agreed to more than a decade ago be met.

ExhibitArts

Beth Harshfield, President

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Barfield, David

From: cathy catt <cmbcatt@hotmail.com>
Sent: Friday, May 13, 2016 3:13 PM
To: Barfield, David
Subject: water rights for Quivera

Dear Mr. Barfield,

Please do whatever is necessary to protect the future viability of the Quivera wetlands, an essential stopover for North American bird migrations.

Thank you for your efforts.

Sincerely,

Catherine Catt

Barfield, David

From: Gloria Holcroft <glorybks@gmail.com>
Sent: Friday, May 13, 2016 3:20 PM
To: Barfield, David
Subject: Quivira National Wildlife Refuge

Mr. Barfield -

I am very concerned about the Quivira National Wildlife Refuge wetlands, where thousands of migratory birds depend on that habitat. Junior water rights and their irrigation wells have severely depleted this precious area by pumping more water than they have rights to do, thus interfering with the senior surface water.

I would implore you to meet the requested U.S.Fish and Wildlife Service current groundwater use reductions, agreed to more than a decade ago, to help save this critical area in the central U.S. flyway.

Sincerely,

Mrs. Gloria Holcroft
11309 Grant St.
Overland Park, KS 66210

Barfield, David

From: rwlucas@pld.com
Sent: Friday, May 13, 2016 3:28 PM
To: Barfield, David
Subject: Quivira National Wildlife Refuge - File No. 7,571

Dear Mr. Barfield,

The U.S. Fish and Wildlife Service has senior water rights at Quivira and I and my family urge the Division of Water Resources to protect it from junior rights. The Quivira was opened 61 years ago and it is an internationally known bird area. It draws tourists and promotes Kansas' image of environmental goodwill. I first visited Quivira on a trip with my grandmother in 1974. I remember seeing on our drive many birds and mammals. Visiting Quivira has continued to be a highlight for me through the years. Please protect one of the Eight Wonders of Kansas.

Thank you for all you do,
Cathy Lucas
Sublette, Kansas

Barfield, David

From: Luke Harshfield <lukeharshfield@gmail.com>
Sent: Friday, May 13, 2016 4:04 PM
To: Barfield, David
Subject: Claim of water right impairment
Attachments: Restoring Quivira's water.pdf

Hello David,

I am contacting in you regards to restoring water flows into rattlesnake creek by tightening and enforcing regulations of irresponsible pump practices.

I have attached a letter from Ron Klataske. I fully support all that is being said with in the letter.

We need to make steps to cut the irresponsible pumping practices that need regulation. Restoring water to Quivira National wildlife refuge will not only benefit our current generation but it will protect a habitat for future generations to learn and grow from.

I am a 25 years old, and a native born Kansan. This is my home. If we do not begin to measures to protect our natural resources from debilitating human influences. I fear no one will until our impact is to vast. I write this for my children.

Please view this issue with an open heart and I hope this email reaches you in kindness.

Best,

Luke

David W. Barfield. PE.
Chief Engineer
Division of Water Resources
Kansas Department of Agriculture
1320 Research Par Drive
Manhattan, KS 66502

May 13, 2016

Dear Mr. Barfield:

The purpose of this letter is to comment on the "Claim of Water Right Impairment, In the Matter of Water Right File No. 7,571, Owned and operated by U.S. Fish and Wildlife Service."

Audubon of Kansas, Inc. urges the Kansas Department of Agriculture (KDA) Division of Water Resources (DWR) to implement all necessary measures, regulations and water rights to fully restore water flows in Rattlesnake Creek to provide the U.S. Fish and Wildlife Service (Service) with flows sufficient to provide for the senior water right for the Quivira National Wildlife Refuge (Refuge). As acknowledged in the Initial Report of the Chief Engineer, Prepared pursuant to K.A.R. 5-4-1 Concerning a Claim of Water Right Impairment, In the Matter of Water Right File No. 7,571, Owned and operated by U.S. Fish and Wildlife Service published December 2, 2015, the Service's water right is senior in priority to approximately 95 percent of the water rights in the Rattlesnake Creek Basin.

The report finds the Refuge's water supply "has been regularly and substantially impacted by junior groundwater pumping." According to the report, over the 34 years reviewed, shortages of greater than 3,000 acre-feet occurred in 18 years. Impairment of the Refuge's water right has become increasingly frequent and severe as hundreds of irrigation wells with junior water rights have been approved by the DWR, resulting in the cumulative lowering of groundwater levels and instream flows in the Rattlesnake Creek Basin.

Audubon of Kansas urges that the water right for the Quivira National Wildlife Refuge be fully protected and provided for prior to depleting consumption by junior water rights users.

Audubon of Kansas does not support the suggestion that the severe impairment of the Refuge water right (due to over-pumping of groundwater in the Rattlesnake Creek Basin) can be satisfactorily solved by pumping groundwater into the Refuge. In addition to the astronomical cost of installation and ongoing operations/maintenance, this approach would ignore the fact that depleting the groundwater and stream flows will further diminish ground water levels and adversely impact and/or destroy the stream, wetlands, wet meadows and other ecological values associated with the Refuge and other areas within the Rattlesnake Creek Basin.

The Quivira National Wildlife Refuge was established in 1955 to protect migratory waterfowl. Its 7,000 acres of wetlands attract hundreds of thousands of ducks and geese of thirty different species, shorebirds, wading birds (including tens of thousands of Sandhill Cranes, and Whooping Cranes) and water birds annually. Its location in the middle of the Central Flyway places it in the primary pathway for many species of migrating birds. Over 340 species of birds have been recorded at Quivira. It's 22,135 acres feature a unique combination of rare inland salt marsh and sand prairie.

In terms of protection of, and management for, species of concern, several official levels of Threatened and Endangered status are recognized within the United States and within the State of Kansas. An Endangered species is one that is in danger of becoming extinct; a Threatened species is one whose population levels are low enough where the species could become Endangered. A Federal Candidate species is one that is under review for listing as a Threatened or Endangered species. In several cases, Quivira has been designated as Critical Habitat for certain species, either at the national or state level (or both).

Whooping Cranes are an endangered species that consistently utilize Quivira as an important migratory habitat. The tallest North American bird, and one of the rarest, they once numbered as few as 16. Whooping Cranes occur regularly at Quivira each fall and spring. Fall migration use typically occurs from late October through late November, while spring migration occurs from late March through early April. Whooping Cranes utilize Quivira's shallow wetlands and lake borders for feeding and overnight roosting.

Inland populations of Least Terns are typically found along large river systems. Interior Least Terns have been declining and are classified as Endangered nationally and in the state of Kansas. Quivira hosts a nesting population of these birds, in both the Big and Little Salt Marsh areas. Least Terns occur at the Refuge during the spring, summer and early fall.

The Western Snowy Plover is classified as Threatened in Kansas. This small, whitish shorebird occurs at Quivira from spring through early fall, and nests regularly on sand flats, primarily in the Big Salt Marsh area. Their populations have suffered declines similar to those of the Interior Least Tern, with whom they share habitat.

Many other "Species of Greatest Conservation Concern" depend on habitat at Quivira. The Piping Plover, a small shorebird similar to the Snowy Plover, occurs at Quivira occasionally during migration. The State of Kansas recognizes Species in Need of Conservation (SINC) throughout the state. Species with that status that occur at Quivira include: Black Rail, Black Tern, Eastern Hognose Snake, Western Hognose Snake, Ferruginous Hawk, Golden Eagle, Long-billed Curlew, Short-eared Owl, and Southern Bog Lemming.

Tens of thousands of shorebirds—shorebirds of thirty different species --rely on the wetlands and water-associated habitats of the Quivira National Wildlife Refuge. Shorebirds are a large and diverse group of birds that typically feed on shorelines, mudflats, and in shallow water. The group includes, but is not limited to, plovers, sandpipers, phalaropes, yellowlegs, and snipe. Although located in the center of the Great Plains, Quivira is uniquely situated in the center of the Central Flyway, one of the busiest of North America's four migration pathways. An oasis in the prairie, Quivira attracts migrating shorebirds by the tens of thousands in aggregate both spring and fall.

Beginning as early as February, Greater and Lesser Yellowlegs, along with a few other sandpipers, begin appearing on their northward journey. Numbers of species and birds increase until a peak in mid-May, when shorebirds can be found just about anywhere there is water at Quivira. There is a short lull of just a few weeks during June, after which the "fall" southward migration begins for many species by early July. This period of shorebird occurrence typically peaks in late August and September.

Shorebirds do not just occur as migrants at Quivira. Several species use Quivira's wetlands to nest. These are extant breeding populations, where the next nearest breeding populations may be hundreds of miles from Quivira. Nesting species include Wilson's Phalarope, Snowy Plover, American Avocet, and Black-necked Stilt.

Inland Salt Marshes are rare in the United States. The presence of Inland Salt Marshes contributes to the uniqueness of Quivira. Quivira's wetlands are unique due to the high concentration of salt in many areas. Subterranean salt deposits are near enough to the surface in the Quivira area to affect the groundwater that percolates to the surface. Salinity (or salt) levels in the water varies depending on rainfall, runoff from rainfall, and the depth of the water.

Many areas have a high enough salinity to support salt-tolerant plant species such as inland salt grass (*Distichlis spicata*), alkali sacaton (*Sporobolus airoides*), and seepweed (*Suaeda caceoliformis*).

Once dotted with active sand dunes, Quivira is also home to a unique prairie community called Sand Prairie. In the pre-settlement era of Kansas, prairie covered most of the state. During this time, much of the area south of the "great bend" of the Arkansas River consisted of plains with scattered active sand dunes. Once inactive, these dunes were covered with prairie grasses and forbs. This Sand Prairie is a unique and uncommon ecosystem in North America.

The Quivira National Wildlife Refuge is among thirty **"Wetlands of International Importance,"** as designated under an international treaty signed in 1971. The Ramsar convention on wetlands, signed by 160 countries, provides the framework

for national action and international cooperation for the conservation and wise use of wetlands and their resources.

Quivira was also designated in 1994 as part of the **Western Hemisphere Shorebird Reserve Network.** The designation is based on the fact that Quivira supports more than 500,000 shorebirds annually. Shorebirds are among nature's most ambitious, long-distance migrants. But their numbers are dropping quickly with some species projected to go extinct within our lifetime. Protecting these birds is an important international conservation priority that requires proactive and coordinated efforts within each of the countries these birds fly through during their vast, nearly pole-to-pole migrations.

Quivira was also designated as a **Globally Important Bird Area** by the American Bird Conservancy in 2001.

It is critical that the State of Kansas recognizes that the Quivira National Wildlife Refuge is critically important for migratory birds from a state, national, international and global perspective. Restoring the Service's water rights and making flows available to the Refuge is a legal and ecologically essential responsibility of the Kansas Department of Agriculture, Division of Water Resources.

Sincerely,

Ron Klataske
Executive Director
Audubon of Kansas

Barfield, David

From: Stu Luttich <rangifer@windstream.net>
Sent: Friday, May 13, 2016 4:12 PM
To: Barfield, David
Subject: Quivira National Wildlife Refuge Impairment Complaint

Mr. Barfield:

While not a resident or landholder in the State of Kansas, I am a stakeholder with interests in the Quivira National Wildlife Refuge, and, am quite familiar with water management issues and agreements (and disagreements). I am an agriculture landowner with an irrigation well. The static water-levels within the Natural Resource District where the well is located are declining, with the static water-level in the well declining proportionately more than in the over-all District. The simple unhonored fact is that we are removing water from the system faster than it is being replaced. While we have been quite proficient in extracting water, we have been particularly deficient as well as derelict in replacing or replenishing what has been extracted – and this policy cannot, and, will not, continue in any sustainable manner. We are gradually killing the proverbial goose that lays the golden egg; and, it will probably be death by a thousand cuts. Unfortunately, repair, as per usual, will prove more costly than the gains made in the taking. Unfortunately, a large proportion of the landowners and people believe they have a special right to use the water until the last drop is taken. For them water is not a resource to be shared, but, it is their resource. Unfortunately, water has a habit of not respecting boundaries. When it flows in uncommon abundance, we act to hasten its departure into the oceans. Then when it fails to flow in a desired abundance we pump unsustainable amounts from subsurface reservoirs.

I fully support Audubon of Kansas's position on this issue, as outlined in a letter from Mr. Ron Klataske. We either act to honour our agreements in a civilized and honourable manner, or, we fight like the uncivilized reprehensible barbarians that we loath. Life needs water to exist; but, while more water is not being created to support life, more life is being created to need water, and, life is also compounding more needs for the water that does exist. I find it particularly disconcerting that the oil fracking industry is being allowed to remove water from the system, pollute that water, and, then discharge that tainted water into virtually unrecoverable geological depths below the Earth's surface. This is ignorance being personified at level that mystifies rational comprehension.

In any case, would appreciate interests in protecting and honouring the senior water-rights for the Quivira NWR.

Thanking your for time and consideration, I remain…

Stu Luttich
824 "K" Street
Geneva NE-USA 68361

Tele: 402-759-3597

Barfield, David

From: Ralph Hoover <r.hooov@gmail.com>
Sent: Friday, May 13, 2016 4:52 PM
To: Barfield, David
Subject: Quivira

I am watching to see if the water rights of Quivira National Wildlife Refuge are being protected as they should be. The wetlands are a treasure. Thank you.

Barfield, David

From: Karen Hall <showyouhome@gmail.com>
Sent: Friday, May 13, 2016 5:27 PM
To: Barfield, David
Subject: Quivera Water Rights

Dear Mr Barfield,

It is very important to improve the flow of water into Quivera. This is an incredible resource for Kansas.

Rattlesnake Creek should not be raided illegally. Water Rights should be enforced.

In the past Kansas sued Colorado when the flow of water was impeded.

Birds cannot sue. I am speaking out for them. And for future tourism dollars.

Thank you for your consideration.

David W. Barfield. PE. Chief Engineer
Division of Water Resources
Kansas Department of Agriculture
1320 Research Par Drive
Manhattan, KS 66502

May 13, 2016

RE: Claim of Water Right Impairment, In the Matter of Water Right File No. 7,571, Owned and operated by U.S. Fish and Wildlife Service.

Dear Mr. Barfield:

I urge you as the chief engineer for the Division of Water Resources for the Kansas Department of Agriculture to implement all necessary measures, regulations and water rights to fully restore water flows in Rattlesnake Creek to provide the U.S. Fish and Wildlife Service with flows sufficient to provide for the senior water right for the Quivira National Wildlife Refuge, which has been regularly and substantially impacted by junior groundwater pumping — which will not solve the problem.

In addition to the exorbitant cost of installation and ongoing operations and maintenance, pumping ignores the fact that depleting the groundwater and streamflows will further diminish groundwater levels and will adversely impact and/or destroy the stream, wetlands, wet meadows and other ecological values associated with the refuge and other areas within the Rattlesnake Creek Basin.

The Quivira National Wildlife Refuge was established to protect migratory waterfowl. Its 7,000 acres of wetlands attract hundreds of thousands of ducks and geese of thirty different species, shorebirds, wading birds (including tens of thousands of Sandhill Cranes, and Whooping Cranes) and water birds annually. Its location in the middle of the Central Flyway places it in the primary pathway for many species of migrating birds. Over 340 species of birds have been recorded at Quivira. It's 22,135 acres feature a unique combination of rare inland salt marsh and sand prairie.

Species of concern include several official levels of threatened and endangered status. Quivira has been designated as Critical Habitat for certain species, either at the national or state level or both for Whooping Cranes, Least Terns, Western Snowy Plover, Piping

Plover, Black Rail, Black Tern, Eastern Hognose Snake, Western Hognose Snake, Ferruginous Hawk, Golden Eagle, Long-billed Curlew, Short-eared Owl, and Southern Bog Lemming and many other "Species of Greatest Conservation Concern."

The Quivira National Wildlife Refuge is among 30 Wetlands of International Importance. Quivira was also designated in 1994 as part of the Western Hemisphere Shorebird Reserve Network. Quivira was also designated as a Globally Important Bird Area by the American Bird Conservancy in 2001.

It is of paramount importance that the State of Kansas recognizes that the Quivira National Wildlife Refuge is critically important for migratory birds from a state, national, international and global perspective.

Restoring the Service's water rights and making flows available to the refuge is a legal and ecological responsibility of the Kansas Department of Agriculture, Division of Water Resources.

Sincerely,

Madeline McCullough
810 Shadyway
Wichita, KS 67203

Barfield, David

From: Giessel/Voss <ecos@everestkc.net>
Sent: Friday, May 13, 2016 9:02 PM
To: Barfield, David
Cc: Yvonne Cather
Subject: Sierra Club Comments: In the Matter of Water Right File No. 7571, U.S. Fish and Wildlife Service

RE: Water Right Impairment In the Matter of Water Right File No. 7571, Owned and operated by U.S. Fish and Wildlife Service

Mr. Barfield:

Please accept the following comments from the Kansas Chapter of the Sierra Club regarding the above-referenced matter:

The Division of Water Resources of the Kansas Department of Agriculture (DWR) recognizes that there is significant over-appropriation of groundwater throughout the central and western portions of the State. DWR published an initial impairment investigation report on December 2, 2015, indicating that junior groundwater pumping has impaired the U.S. Fish and Wildlife Service (Service) from exercising its senior water right for the Quivira National Wildlife Refuge.

The Quivira NWR provides critical and unique wetland habitat in the Central Flyway. The refuge has been recognized globally for its importance for migratory birds, some species of which are listed under state and/or federal endangered species protection laws. Groundwater levels and streamflow have continued to decline in the area, impacting the quality of the wetlands.

The Service, in its formal complaint, stated that regular long-term augmentation of water without groundwater pumping reductions in GMD5 would increase concerns of water resource sustainability. The Service also expressed concern that water flow augmentation will lead to reduced water quality being delivered to the refuge during certain times of the year. The Service recommended increased focus on improving water use efficiencies and/or reduction of water use by junior appropriators that would benefit long-term sustainability of surface and ground water resources.

The Service applied for, developed and perfected the Refuge water right in accordance with State law. It should receive the same consideration and protection as any other water user's right. The Service has asked that the current groundwater use reductions that were agreed to more than a decade ago be met. K.S.A. 82a-706b of the Kansas Water Appropriation Act charges the chief engineer with the duty to regulate use to prevent such “impairment” of senior water rights by junior water rights.

The Kansas Chapter of the Sierra Club strongly supports protection of the Quivira NWR. The DWR must address the problem of over-pumping by junior water rights holders to ensure that the Service's senior water right is protected. The future of the Quivira NWR is at stake.

Please put me on your mailing list of interested parties for this matter. Thank you,

Elaine Giessel
Conservation Chair,
Kansas Chapter, Sierra Club

11705 W. 101st Terr.
Overland Park, KS 66214

--
C. Elaine Giessel
913-206-1180

Barfield, David

From: Joyce Wolf <rjjawolf@sunflower.com>
Sent: Friday, May 13, 2016 10:48 PM
To: Barfield, David
Subject: Quivira National Wildlife Refuge Water Rights

To: David Barfield, Chief Engineer
Division of Water Resources
KS Department of Agriculture

Dear Mr. Barfield:

Having participated in the Cheyenne Bottoms litigation process may years ago, and being aware that a very similar situation now exists at Quivira National Wildlife Refuge (NWR), in my opinion the established of an Intensive Groundwater Use Control Area (IGUCA) is warranted and needed in order to uphold and recognize the senior water right of the US Fish and Wildlife Service. Just like Cheyenne Bottoms Wildlife Area, Quivira NWR provides important habitat for many migratory species of birds.

Without question, the Refuge has a senior surface water right dating to 1957 and perfected in 1996. And it appears that the area has been permitted to become over-appropriated regarding the numbers and volume of water rights approved by DWR. Furthermore, I believe the Chief Engineer has the authority to make a finding of an impairment of a senior water right and also the authority to intercede and establish an IGUCA. I'm certain that you are fully aware of the following: An entity which applies to the Division of Water Resources of the Kansas Department of Agriculture for a water right (for a beneficial use) and is approved, those rights have precedence over subsequent or "junior" water rights' holders.

Furthermore, this principle is applied regardless of the type of use. K.S.A. 82a-707 provides; "….the date of priority of an appropriation right, *and not the purpose of use,* (emphasis added) determines the right to divert and use water at any time when the supply is not sufficient to satisfy all water rights that attach to it."

But one of the most significant results of the Cheyenne Bottoms IGUCA was that agricultural junior water rights owners, were not fully cut off from their supply, but a formula was applied that decreased the number of acre/feet that could be pumped. Recent analyses by agricultural economists have pointed out that after an initial reduction in income, most producers were able to recover and equal what they had been earning prior to the adoption and implementation of the IGUCA in the Wet Walnut Basin.

The US Fish & Wildlife Service is not seeking more than what is established by state water law in appealing to DWR to recognize its senior water right and take the necessary steps to ensure that the water right is upheld.

Therefore I see no reason to not move forward with the establishment of an IGUCA.

Thank you for your careful consideration of these comments.

Sincerely,

Joyce A. Wolf
1605 East 318 Road
Lecompton, KS 66050-4034

Barfield, David

From: Rolan & Kristen <schwavis@yahoo.com>
Sent: Friday, May 13, 2016 8:44 PM
To: Barfield, David
Subject: Claim of water right #7,571

Dear David Barfield,

Quivira National Wildlife Refuge is an important part of our state's natural beauty and heritage. Please preserve the water rights to protect it, for the sake of wildlife and future generations.

Sincerely,
Kristen Schweitzer
B.S. Biology, M.S. Curriculum Development Captured Moments Photography www.KSchweitzerphoto.com
Become a fan on Facebook to receive specials!
http://www.facebook.com/kschweitzerphoto

KANSAS WILDLIFE FEDERATION

The voice of outdoor Kansas

13 May 2016

David W. Barfield. PE.
Chief Engineer
Division of Water Resources
Kansas Department of Agriculture
1320 Research Par Drive
Manhattan, KS 66502

Dear Mr. Barfield:

This letter constitutes comment by the Kansas Wildlife Federation (KWF) — a 66-year old grassroots organization of hunters, anglers and concerned wildlife conservationists dedicated to the sustainable use, conservation, appreciation, and the restoration of our state's wildlife and natural environment — on the "Claim of Water Right Impairment, In the Matter of Water Right File No. 7,571, Owned and operated by U.S. Fish and Wildlife Service." The U. S. Fish and Wildlife Service (USFWS) owns the water right from the Rattlesnake Creek which flows through Quivira National Wildlife Refuge (QNWR), managed by the USFWS. Their water right, No. 7,571, is a senior water right priority, dated in 1957, to approximately 95% of the water rights in the Rattlesnake Creek basin. The KWF strongly urges the Kansas Department of Agriculture's Division of Water Resources (DWR) to adhere to all relevant regulations to fully restore the water flow in Rattlesnake Creek to meet QNWR's water rights.

KWF has been involved in the Quivira water rights issue for the last decade, yet we were not notified of the pending water right impairment issue. The recent report states that the water supply to QNWR "has been regularly and substantially impacted by junior groundwater pumping."

Quivira provides critical habitat for numerous species of wildlife, some of which are listed as Threatened or Endangered. QNWR has been recognized as a Wetland of International Importance by the 1988 Ramsar Convention on Wetlands. Quivira was also designated in 1994 as part of the Western Hemisphere Shorebird Reserve Network. Quivira was designated as a Globally Important Bird Area by the American Bird Conservancy in 2001. Endangered species utilizing QNWR are Whooping Cranes and inland populations of Least Terns, which nest at QNWR. Threatened species using QNWR include the Western Snowy Plover. Water, and its timely reception of that water for wetland manipulation, is critical to meet the habitat needs of

these and other species that utilize QNWR. QNWR is a major stopover site for migratory waterbirds such as waterfowl, shorebirds, herons and egrets and rails. It is estimated that 90% of 5 different species of migratory shorebirds pass through and utilize the QNWR-Cheyenne Bottoms Wildlife Area wetland complex while on migration. The impairment of QNWR's water rights has had a significant impact on the Threatened, Endangered and other species which utilize QNWR.

KWF was involved in the water rights issue and subsequent lawsuit regarding the Cheyenne Bottoms water rights. At that time many newspapers boiled the issue down to "ducks vs. crops." This was unfortunate as it was merely a senior water right holder versus junior water right holders.

The same premise holds regarding QNWR: it is a senior water right holder asking DWR to adhere to all relevant regulations to restore water flow in the Rattlesnake Creek basin to meet QNWR's water rights, which may (and should) require reducing water use by junior water right holders. The Kansas Wildlife Federation strongly urges DWR to utilize any and all regulatory means to ensue that Quivira National Wildlife Refuge receives its legal senior water right.

We request to be kept apprised in writing of the process and outcome of the issue regarding Quivira's water right. Thank you.

Sincerely,

Angela Anderson

Angela Anderson
President
Kansas Wildlife Federation

Barfield, David

From: The Yorke Powells <yorke.powell@gmail.com>
Sent: Monday, May 16, 2016 8:04 AM
To: Barfield, David
Subject: Quivira Refuge

Dear Mr. Barfield,

Please make sure KDA protects the water rights of Quivira National Wildlife Refuge, an amazing and essential place for wildlife, regionally and globally. Take time to go visit this refuge and honor the protected water rights and restore the flow.

Sincerely,

Mary Powell, Topeka

Kansas Dept. of Agriculture

Audubon of Kansas

Division of Water Resources

STATE OFFICE
Ron Klataske, Executive Director
210 Southwind Place, Manhattan, KS 66503
TEL: (785) 537-4385 FAX: (785) 537-4395
aok@audubonofkansas.org
Websites: www.audubonofkansas.org
www.niobrarasanctuary.org
Lana Micheel, On-site Sanctuary Coordinator

May 13, 2016

David W. Barfield. PE.
Chief Engineer
Division of Water Resources
Kansas Department of Agriculture
1320 Research Par Drive
Manhattan, KS 66502

Dear Mr. Barfield:

The purpose of this letter is to comment on the "Claim of Water Right Impairment, In the Matter of Water Right File No. 7,571, Owned and operated by U.S. Fish and Wildlife Service."

Audubon of Kansas, Inc. urges the Kansas Department of Agriculture (KDA) Division of Water Resources (DWR) to implement all necessary measures, regulations and water rights to fully restore water flows in Rattlesnake Creek to provide the U.S. Fish and Wildlife Service (Service) with flows sufficient to provide for the senior water right for the Quivira National Wildlife Refuge (Refuge). As acknowledged in the Initial Report of the Chief Engineer, Prepared pursuant to K.A.R. 5-4-1 Concerning a Claim of Water Right Impairment, In the Matter of Water Right File No. 7,571, Owned and operated by U.S. Fish and Wildlife Service published December 2, 2015, the Service's water right is senior in priority to approximately 95 percent of the water rights in the Rattlesnake Creek Basin.

The report finds the Refuge's water supply "has been regularly and substantially impacted by junior groundwater pumping." According to the report, over the 34 years reviewed, shortages of greater than 3,000 acre-feet occurred in 18 years. Impairment of the Refuge's water right has become increasingly frequent and severe as hundreds of irrigation wells with junior water rights have been approved by the DWR, resulting in the cumulative lowering of groundwater levels and instream flows in the Rattlesnake Creek Basin.

Audubon of Kansas urges that the water right for the Quivira National Wildlife Refuge be fully protected and provided for prior to depleting consumption by junior water rights users.

Audubon of Kansas does not support the suggestion that the severe impairment of the Refuge water right (due to over-pumping of groundwater in the

Rattlesnake Creek Basin) can be satisfactorily solved by pumping groundwater into the Refuge. In addition to the astronomical cost of installation and ongoing operations/maintenance, this approach would ignore the fact that depleting the groundwater and stream flows will further diminish ground water levels and adversely impact and/or destroy the stream, wetlands, wet meadows and other ecological values associated with the Refuge and other areas within the Rattlesnake Creek Basin.

The Quivira National Wildlife Refuge was established in 1955 to protect migratory waterfowl. Its 7,000 acres of wetlands attract hundreds of thousands of ducks and geese of thirty different species, shorebirds, wading birds (including tens of thousands of Sandhill Cranes, and Whooping Cranes) and water birds annually. Its location in the middle of the Central Flyway places it in the primary pathway for many species of migrating birds. Over 340 species of birds have been recorded at Quivira. It's 22,135 acres feature a unique combination of rare inland salt marsh and sand prairie.

In terms of protection of, and management for, species of concern, several official levels of Threatened and Endangered status are recognized within the United States and within the State of Kansas. An Endangered species is one that is in danger of becoming extinct; a Threatened species is one whose population levels are low enough where the species could become Endangered. A Federal Candidate species is one that is under review for listing as a Threatened or Endangered species. In several cases, Quivira has been designated as Critical Habitat for certain species, either at the national or state level (or both).

Whooping Cranes are an endangered species that consistently utilize Quivira as an important migratory habitat. The tallest North American bird, and one of the rarest, they once numbered as few as 16. Whooping Cranes occur regularly at Quivira each fall and spring. Fall migration use typically occurs from late October through late November, while spring migration occurs from late March through early April. Whooping Cranes utilize Quivira's shallow wetlands and lake borders for feeding and overnight roosting.

Inland populations of Least Terns are typically found along large river systems. Interior Least Terns have been declining and are classified as Endangered nationally and in the state of Kansas. Quivira hosts a nesting population of these birds, in both the Big and Little Salt Marsh areas. Least Terns occur at the Refuge during the spring, summer and early fall.

The Western Snowy Plover is classified as Threatened in Kansas. This small, whitish shorebird occurs at Quivira from spring through early fall, and nests regularly on sand flats, primarily in the Big Salt Marsh area. Their populations have suffered declines similar to those of the Interior Least Tern, with whom they share habitat.

Many other "Species of Greatest Conservation Concern" depend on habitat at Quivira. The Piping Plover, a small shorebird similar to the Snowy Plover, occurs at Quivira occasionally during migration. The State of Kansas recognizes Species in Need of Conservation (SINC) throughout the state. Species with that status that occur at Quivira include: Black Rail, Black Tern, Eastern Hognose Snake, Western Hognose Snake, Ferruginous Hawk, Golden Eagle, Long-billed Curlew, Short-eared Owl, and Southern Bog Lemming.

Tens of thousands of shorebirds—shorebirds of thirty different species --rely on the wetlands and water-associated habitats of the Quivira National Wildlife Refuge. Shorebirds are a large and diverse group of birds that typically feed on shorelines, mudflats, and in shallow water. The group includes, but is not limited to, plovers, sandpipers, phalaropes, yellowlegs, and snipe. Although located in the center of the Great Plains, Quivira is uniquely situated in the center of the Central Flyway, one of the busiest of North America's four migration pathways. An oasis in the prairie, Quivira attracts migrating shorebirds by the tens of thousands in aggregate both spring and fall.

Beginning as early as February, Greater and Lesser Yellowlegs, along with a few other sandpipers, begin appearing on their northward journey. Numbers of species and birds increase until a peak in mid-May, when shorebirds can be found just about anywhere there is water at Quivira. There is a short lull of just a few weeks during June, after which the "fall" southward migration begins for many species by early July. This period of shorebird occurrence typically peaks in late August and September.

Shorebirds do not just occur as migrants at Quivira. Several species use Quivira's wetlands to nest. These are extant breeding populations, where the next nearest breeding populations may be hundreds of miles from Quivira. Nesting species include Wilson's Phalarope, Snowy Plover, American Avocet, and Black-necked Stilt.

Inland Salt Marshes are rare in the United States. The presence of Inland Salt Marshes contributes to the uniqueness of Quivira. Quivira's wetlands are unique due to the high concentration of salt in many areas. Subterranean salt deposits are near enough to the surface in the Quivira area to affect the groundwater that percolates to the surface. Salinity (or salt) levels in the water varies depending on rainfall, runoff from rainfall, and the depth of the water.

Many areas have a high enough salinity to support salt-tolerant plant species such as inland salt grass (*Distichlis spicata*), alkali sacaton (*Sporobolus airoides*), and seepweed (*Suaeda caceoliformis*).

Once dotted with active sand dunes, Quivira is also home to a unique prairie community called Sand Prairie. In the pre-settlement era of Kansas, prairie covered most of the state. During this time, much of the area south of the "great bend" of the

Arkansas River consisted of plains with scattered active sand dunes. Once inactive, these dunes were covered with prairie grasses and forbs. This Sand Prairie is a unique and uncommon ecosystem in North America.

The Quivira National Wildlife Refuge is among thirty **"Wetlands of International Importance,"** as designated under an international treaty signed in 1971. The Ramsar convention on wetlands, signed by 160 countries, provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

Quivira was also designated in 1994 as part of the **Western Hemisphere Shorebird Reserve Network.** The designation is based on the fact that Quivira supports more than 500,000 shorebirds annually. Shorebirds are among nature's most ambitious, long-distance migrants. But their numbers are dropping quickly with some species projected to go extinct within our lifetime. Protecting these birds is an important international conservation priority that requires proactive and coordinated efforts within each of the countries these birds fly through during their vast, nearly pole-to-pole migrations.

Quivira was also designated as a **Globally Important Bird Area** by the American Bird Conservancy in 2001.

It is critical that the State of Kansas recognizes that the Quivira National Wildlife Refuge is critically important for migratory birds from a state, national, international and global perspective. Restoring the Service's water rights and making flows available to the Refuge is a legal and ecologically essential responsibility of the Kansas Department of Agriculture, Division of Water Resources.

Sincerely,

Ron Klataske
Executive Director
Audubon of Kansas

---------- Forwarded message ----------
From: **connie achterberg** <connieachterberg@yahoo.com>
Date: Fri, May 13, 2016 at 10:02 PM
Subject: Quivira
To: Ron Klataske <ron_klataske@audubonofkansas.org>

Attention: David W Barfield, Chief Engineer, Division of Water Resources:

I have no special position; but feel compelled to join the US Fish and Wildlife Service and Audubon of Kansas In their emergency appeal to restore sufficient water flows to provide for the senior water
Rights of Quivira. I do not have the scientific knowledge necessary to speak; but I do know that
the main creek (Bullfoot Creek) on my farm in Lincoln County, which I recently deeded to Audubon of Kansas (to create a "Wildlife Friendly Demonstration Farm" wildlife sanctuary, flowed continuously at a good rate when I was growing up. Now parts of it are dry in the summer so that the bullheads and sunfish can no longer survive. It appears that groups have met time after time over extended periods of time regarding the senior water Rights of Quivira to no avail. The Kansas Water Resources office must have the fortitude to enforce the
Senior water rights of Quivira immediately. Otherwise we will lose this world famous wetland and
Flyway. We'll only have one chance. the current groundwater use reductions agreed to long ago must be enforced.

Thank you for considering the conservation concerns.

Connie Achterberg
132 0verhill Road
Salina, Kansas 67401

Sent from my iPad

++++++++++++++++++++++++++

From: Ron Klataske [mailto:ron_klataske@audubonofkansas.org]
Sent: Monday, May 16, 2016 4:42 PM
To: Metzger, Susan
Subject: Fwd: Quivira

Susan, I received this email from Connie Achterberg on Friday night. As you will note, she wrote in a follow up email that she tried to send it to David Barfield so it would be received prior to midnight, but she couldn't get the emails to go through. --Ron

--
Ron Klataske
Executive Director
Audubon of Kansas

Barfield, David

From: Mike Higley <mike.higley@gmail.com>
Sent: Tuesday, May 17, 2016 9:41 AM
To: Barfield, David
Subject: Quivera National Wildlife Refuge Water Rights

Dear Mr. Barfield,

Regarding the claim of water right impairment by the U.S. Fish and Wildlife Service (File No. 7,571), I urge you to uphold the senior water rights of the Quivera National Wildlife Refuge over the junior water rights of irrigation wells in the Rattlesnake Creek Subbasin. Please do not allow for-profit users to continue to rob the refuge of its rightful share of water.

--
Mike Higley
1524 Vermont Street
Lawrence, KS

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:
BA WTR
KS WR
Mail Stop 60189

MAILING ADDRESS:
P.O. Box 25486, DFC
Denver, Colorado 80225-0486

STREET LOCATION:
134 Union Boulevard
Lakewood, Colorado 80228-1807

JUN 2 7 2016

David Barfield, P.E., Chief Engineer
Kansas Department of Agriculture
Division of Water Resources
1320 Research Park Drive
Manhattan, Kansas 66502

Dear Mr. Barfield:

The U.S. Fish and Wildlife Service (Service) appreciates all the work performed by the Kansas Division of Water Resources (DWR) regarding the impairment investigation. The Service entered into the Rattlesnake Creek Partnership Agreement (Partnership) in 2000 in good faith that impacts to the water rights at the Quivira National Wildlife Refuge (Refuge) would be addressed and a remedy would be legally enforced. After 12 years of the Partnership and more than 15 years of collaboration, very minor reductions in groundwater withdrawals were achieved, and the Service was informed that the stipulations from the Partnership would not be enforced. The Service consulted with the DWR and found we had no other choice but to file an impairment investigation to seek relief.

In reviewing the report, we recommend a correction on page 26. The following sentence cites information from a Certification Memo that was superseded.
"The surface area of the Little Salt Marsh is approximately 950 acres; 2,850 acre-feet of evaporation from the Marsh was assumed in the year of record for the certificate."

The full memo on pages 18 and 19 of the impairment report indicates that the Little Salt Marsh has a capacity of 950 acres and 2,850 acre-feet. However, the Service submitted area-capacity information in a November 12, 1993 letter that listed the Little Salt Marsh having a surface area of 864 acres and a capacity of 1,865 ac-ft. The correct capacity and resulting evaporation were listed in the impairment report on page 20. It should be made clear that the capacity and evaporation information that was used in the perfection of Water Right Certificate No. 7,571 are the amounts listed on page 20, and not the assumed amounts listed in the Certification Memo that were later superseded.

Going forward, we understand that the impairment report is the technical analysis determining if impairment occurred and that the next step is the remedy phase if impairment is found. However, many of the comments to the impairment report supported augmentation as the

only feasible solution. The Service believes there may be legal and technical challenges in using augmentation. The Kansas Legislature in 2015 passed Senate Bill 52 that allowed for augmentation of senior water rights in Rattlesnake Creek Basin if the water was given voluntarily and if it is available. We believe that water cannot be considered "available" in an over appropriated basin that is closed to new appropriations. Surface water and groundwater may be in excess of legal demands during portions of the year, but a water shortage will likely be in place when augmentation is needed.

Additionally, augmentation poses several technical challenges. The DWR conducted a series of model runs using the Big Bend Groundwater Manager District No. 5 funded Balleau Groundwater Inc. groundwater model looking at different augmentation scenarios. The results were presented in a webinar on November 4, 2014 and the presentation is posted on the DWR website. These hypothetical wells and augmentation of streamflow occurred about 13 miles upstream of the Refuge. The modeled results found that only about 50% of the water augmented to the stream actually reached the Zenith gauge due to infiltration back into the aquifer.

One of the options mentioned at the collaborative meetings was to locate augmentation wells closer to the Refuge to reduce the percentage of flow that infiltrates from the stream into the aquifer. The Service is concerned that the aquifer near the Refuge is not able to support large demands from pumping wells. The enclosed publications by Rubin and Buddemeier (2003) and Ma et al. (1997) indicate that there is abundant saline water located at the base of the Great Bend Prairie Alluvial Aquifer near the Refuge, and that high pumping demands lead to upconing of this saline water. Ma et al. (1997) recommended a maximum pumping rate of 525 gpm under normal climatic conditions to reduce saltwater upconing. Augmentation water would likely be needed most in times of drought, further reducing the safe pumping rate. Higher pumping rates during drier conditions could lead to salinization of the aquifer. This could permanently degrade water quality such that the aquifer is unsuitable not only for augmentation needs, but also for irrigation of crops in the vicinity of the augmentation wells.

Finally, the scale and capacity of augmentation is a general concern due to long term development, large up-front expenses, and perpetual operation and maintenance costs. The lack of availability of sufficient groundwater near the refuge, water quality concerns, the legal availability of water, and the potential adverse impacts to natural resources within the watershed should all be considered before choosing augmentation as a remedy. The Service does not desire on augmentation plan that ultimately leads to a temporary partial solution and further degradation of the watershed. The depletion of surface water flows in Rattlesnake Creek was caused by over-appropriation of groundwater. The Service has maintained that solving an issue of over-pumping with further pumping is not a sustainable solution.

Please contact Jaron Andrews of my staff at jaron_andrews@fws.gov or call at 303-236-4490 if you have any questions.

Sincerely,

Kathleen R. Dennis
Assistant Regional Director
Budget and Administration

Enclosures/References:

Ma, T. S., Sophocleous, M., Buddemeier, R.W. 1997. Modeling saltwater upconing in a freshwater aquifer in south-central Kansas. *Journal of Hydrology* 201, 120 – 137

Rubin, H., Buddemeier, R.W. 2003. Analysis of aquifer mineralization by paleodrainage channels. *Journal of Hydrology* 277, 280 - 304

Supplemental response to comments on initial report for the Quivira Impairment Investigation

June 10, 2016

Many comments on the first draft of the initial impairment report have been addressed in the second draft of the report. Comments that were not addressed in the second draft are addressed, either generally or specifically, below.

How much of the certified amount in 1987 was from runoff vs. baseflow?

We don't know how much runoff there was in 1987 or what portion of the Refuge's water supply came from runoff. However, the GMD5 groundwater model shows that in 1987, junior groundwater pumping reduced streamflow by 38,000 AF. While runoff may have been the source of a portion of the supply in 1987, it would have been available as baseflow without junior pumping effects.

Perfection year of 1987 set a record for max daily discharge at Zenith; 8th wettest on record.

See Report, Section 4

There is no legal justification for including evaporation in the certified amount as the water was diverted in previous years. The certificate should have been limited to 10,129.7 AF.

See Report, Section 4

There is no justification for granting extensions of time to perfect to 1987.

See Report, Section 4

As evaporation and storage in Little Salt Marsh (LSM) is part of certificate amount, shouldn't the beginning number for the diversions in the impairment analysis be 10,130 AF? Should the water available to the Refuge be limited to 10,130 AF?

See Report, Section 7

During many periods of alleged impairment, the Service did not use all of the water available. There appear to be times when Refuge was full but a shortage is shown (e.g.1995, 2004, 2005).

The impairment analysis considered all water available during the Service-defined management periods to meet the scheduled needs, even if not diverted. See Report, Section 7, which notes storage was not considered in our analysis and there may have been times, such as 1995 and others, when impairment may have been less to the degree that the Refuge's limited storage would mitigate such shortages.

DWR past statements evidence that every surface water right holder should expect shortages and thus not expect to have available their full authorized quantity every year. Why did DWR's analysis not consider this, applying a reasonableness standard of some sort, allowing for shortages?

See Report, Section 4. While it is true that a water right does not provide any guarantee that water will be available in every year, and in fact water may not be available in periods when there is a high

need for the water, the KWAA does ensure that a water right is entitled to protection from junior appropriators. DWR's statements were in observance of the shortages that result from natural hydrologic cycles and not meant to limit the expectation that senior water right holders are entitled to protection from junior appropriators.

Groundwater levels are not in decline in the upper basin; water levels are stable from Macksville downstream.

See Report, Figure 5, which shows the variation in groundwater level changes in the basin and over time. The groundwater model estimates stream-aquifer interactions, including the effects of well pumping on streamflow. The model demonstrates that groundwater pumping is significantly reducing streamflow at the Refuge (see Figure 11 of the report). In this system it does not take significant water level declines to intercept recharge destined for the stream. Water levels have declined from pre-development conditions, producing stream depletions that have and are occurring, and as demonstrated by the Model, will continue to increase over time.

Has the accuracy of the Service's records relied upon for the certificate been verified?

During a supplemental field inspection, of which the report is included in the online electronic water right file, field office staff compared the results of the use of the Clausen Rule with a DWR Pygmy flow measurement. The results showed an acceptable level of accuracy for measuring use at the Refuge with the Clausen Rule.

In reviewing reported diversion records, it is difficult to align them with the Service's reports on the percent of storage filled at various times.

Annually DWR has sent its standard water use report for surface water users which includes a section for reporting reservoir percent full. The report format presents some ambiguities to Refuge staff because it is not clear whether the storage referenced is all of the storage on Refuge or just LSM. It appears that Refuge managers over the years have reported reservoir storage values inconsistently. DWR will develop more specific and clear reporting requirements for the Refuge.

Most water rights do not need their full authorized quantity every year? Has the Service demonstrated that it needs its full authorized quantity in every year, as DWR's analysis seeks to accomplish?

See Report, Section 4. Water rights are certified on the maximum year of record, that is, the maximum amount of water put to beneficial use in a calendar year. For most water rights, average use is lower than the maximum authorized. For various reasons, some water rights are not fully perfected, meaning that during the perfection period, the maximum potential water use was not achieved, resulting in a "short" water right that can be expected to be fully used in most years. There is a clear record of the Service's objections to the draft certificate. The Service argued that junior pumping had diminished its water supply during the perfection period, preventing it from using enough water to meet its full needs. From this perspective, the Refuge's water right can be considered "short," and it is reasonable to expect that it could use its full water right in most years.

The entire impairment claim is based on a schedule recently submitted by the Service. Why did DWR accept Scenario 3 in Attachment 5 rather than Scenario 1?

See Report, Section 7. The Service has been claiming impairment for several decades. Groundwater modeling shows that the Refuge's supply has been substantially reduced over those decades. In light of this, the use of the historical record, as in Scenario 1, is unjustified and inappropriate.

How does the KWAA's language requiring an appropriator to allow for a reasonable increase or decrease in static water level and for a reasonable increase and decrease of streamflow at the appropriator's point of diversion relate to this investigation esp. in light of the relative equilibrium of regional groundwater levels? How is such reasonable increase or decrease in streamflow defined?

The language cited in the question is from the section of law governing approval of applications to appropriate water. However, even if we were to apply this standard in the context of the present impairment claim of the Service, the investigation has shown that a substantial amount of water that should have been available for diversion by the Service has been diverted by junior appropriators, beyond what could be considered reasonable. As the Service has the right pursuant to its senior water right to divert these flows, and are being prevented from doing so, we do not believe this statutory provision impacts our analysis

If wells are shut down, would it not be a futile call?

See Report, Section 6. KDA-DWR's modeling work demonstrates a direct link between groundwater pumping and water availability to the Refuge and that administration of junior appropriators would result in significant increases to available flows, increasing from a gain of 2 cubic feet per second after one year to over 10 cubic feet per second after three years. See Report, Modeling Appendix, Figure A12.

There was inadequate time to comment on the draft report.

The time frame for developing the report included time to obtain records from the Service, to perform groundwater modeling and report those modeling findings to basin stakeholders (provided December 2014), developing the impairment analysis and drafting the initial report. The time provided for review of the initial report was well beyond that required by regulation, and additional time for review is provided for the second draft. We believe the time frames for review are sufficient for this stage of the impairment investigation.

The impairment claim is based on a water schedule that the Refuge claims they need, without proof that they need it at the specific times listed on the schedule. There is no analysis of the reasonableness of the Service's schedule vs. their historic use and available streamflow.

See Report Section 4 and Section 7. The U.S. Fish & Wildlife Service is staffed with professionals who have training and experience in managing wildlife habitat and they are, therefore, best qualified to know the timing of the Refuge's needs. The Refuge's recent comprehensive review evidences thoughtful consideration of their water needs, including timing, which we have determined to be reliable.

The water right was perfected with groundwater depletion already in place.

This is true and the Service objected to the draft certificate based on that fact. The record is clear that the Service's water right was restricted to what was actually used from the available water supply, despite the Service's objections that more could have been perfected had those junior groundwater depletions not been in place.

Why does your impairment analysis show impairment in the year certified?

See Report, Section 7.

Model runs should be confirmed by Balleau.

See GMD 5 letter of comment that confirms this has been done. The only technical concern expressed by Balleau related to the modeling was addressed. See Report, Section 5 and Appendix.

Starting head conditions are not steady.

See Report, Section 5 and Appendix.

The single-layer model impacts are 2.4 to 5% different that the 7-layer model impacts. They recommend the 7-layer model be used for final calculations and conclusions.

We believe the accuracy of the one-layer model was sufficient for this impairment investigation.

Metering of water entering, exiting and diverted on the Refuge is inadequate. The Service's water use report does not include filling and evaporation from LSM. The certificate should be amended to split this use off or the Service should be found in violation of permit for failure to report this use.

We believe additional reporting should be required in the future for water administration purposes including estimates for evaporation and storage change at LSM. While we continue to work with the Refuge on improving data, esp. in light of potential future needs related to water administration, DWR believes the available records are sufficient for this investigation and it is not necessary to await refined data to craft solutions.

Do the seasonal needs used in the impairment analysis represent past management?

No; but they represent the Service's current management and thus are appropriate for this analysis.

Given that there are times of excess flows, the use of Refuge storage may facilitate the effective use of augmentation.

See Report, Section 7.

Has the consumptive use of water increased on the Refuge as a result of its changing management contrary to the chief engineer's requirements? The gage at Raymond should be restored to determine water leaving the Refuge.

See Report, Section 4. Consumptive use is typically a downstream concern; we don't see anyone affected downstream. It is unclear whether downstream measurement will be needed. This will be examined as specific actions to address the impairment are finalized.

Has the wetland restoration project including re-contouring increased the demand for water?

Our understanding is that re-contouring is done to allow for more efficient use of water.

How does the Service's operations compare with requirements of conservation plan of the mid-1990s?

Conservation planning of the period required certain water right holders to develop a conservation plan and a plan for implementation. The Service complied with these requirements.

Is the Service's water need estimate of 2015 in conflict with their year 2000 water operations plan? Does the current management strategy shift away from a plan that works in concert with water availability? Is the Service operating as efficiently as possible, holding water in units as long as possible? Do they allow units to dry in the summer when water is insufficient?

KDA-DWR is obligated to make sure that the Refuge is not wasting water and putting water to its intended use within the conditions of its water right. The Service has recently conducted a comprehensive review of its operations and updated its plan for operation. KDA-DWR has no evidence that the Refuge is wasting water or deviating from the terms and limitations of its water right.

Pursuant to the Service's year 2000 operations plan, is the use of Big Salt Marsh still an important part of its operation?

Big Salt Marsh is a natural depression that receives water from local runoff and groundwater upwelling and on occasions from diversions from the Rattlesnake via the Service's diversion works. Use from local runoff and groundwater upwelling is not considered use under Water Right File No. 7571. Use via the Refuge's distribution works is considered use under File No. 7571.

Clearing of trees and brush along the creek will reduce riparian impact, benefiting the Refuge.

These actions could lead to improved water supply conditions and could therefore help to reduce the frequency and magnitude of future impairment.

Streamflow has declined for many other reasons besides groundwater pumping: farming practices, trees, federal programs, etc.

While conservation practices do reduce streamflows by making more water available for crop use and recharge, the impairment determined by our analysis is caused by junior groundwater pumping as determined by the groundwater model.

All parties need to work toward solutions that will not negatively impact economies and quality of life. Basin stakeholders wish to develop a plan that avoids severe cutback to pumping that will devastate the local economy. We would like to explore augmentation, use of incentive-based programs, etc.

Local solutions are strongly encouraged and KDA-DWR stands ready to assist stakeholders in developing such solutions, but the law must be upheld. Tools available to local water users include augmentation, development of one or more local enhanced management areas (LEMAs), development of one or more water conservation areas (WCAs), and water right retirement, among others. To the extent local solutions are not available, tools available to the chief engineer include strict priority administration or the initiation of intensive groundwater use control area (IGUCA) proceedings.

Augmentation should be the preferred option to resolve the impairment. Augmentation needs to be modeled. Augmentation strategies should be evaluated including the consideration of trigger using the Palmer Drought Index.

Augmentation can be considered if the Basin stakeholders develop a plan. KDA-DWR is available to assist with the development and evaluation of an augmentation plan, but the law is clear that augmentation can only be voluntarily implemented and cannot be ordered by the state.

Reductions in allocations should not be a consideration due to the devastating effect on the economy of the area.

The basin has a variety of water management tools available and an opportunity to offer solutions to remedy the impairment.

Will out-of-basin groundwater pumping that affects the Refuge be administrated the same as in-basin?

This will be determined in the remedies phase of this investigation.

We encourage KDA-DWR to fully restore water flow in Rattlesnake Creek to provide sufficient flows to Quivira National Wildlife Refuge.

The impairment analysis quantifies the degree of impairment caused by upstream junior groundwater pumping. As mentioned above, the Refuge's water right does not guarantee water availability, but the Refuge is entitled to protection from junior appropriators.

The Refuge is a wetland of international significance, critical to migratory birds and Kansas wildlife heritage. KDA-DWR has been remiss in allowing junior users to impair its use for these decades.

KDA-DWR, along with the U.S. FWS, GMD5 and WaterPACK worked for many years to seek a solution to the Service's concerns. Now that the Service has claimed water right impairment, we have performed this impairment investigation and will work through the process to its conclusion.

The Service has complained for decades that its water right has been impaired and has patiently worked with the Rattlesnake Creek Partnership in its attempt to reduce groundwater pumping. Those efforts were unsuccessful. The Service should not be asked to continue to be injured due to junior groundwater pumping impacts.

While the Service has worked for many years with the Basin seeking a solution to its concerns, we must work through our process that was initiated with the Service's claim of water right impairment. We are working to ensure we are taking necessary and appropriate action to address these concerns.

We do not support the use of groundwater pumping (augmentation) to remedy this impairment as it will further deplete the groundwater and streamflows of the area and adversely affect streams, wetlands and other ecological values associated with the Refuge and other areas of the Basin. Augmentation could also lead to a reduction in water quality into the Refuge.

During the 2015 legislative session, state statutes were amended to allow the chief engineer to consider augmentation, if voluntarily offered, as a remedy for impairment. That said, any augmentation plan that is developed must consider the additional stream depletions created from the augmentation pumping. If an augmentation plan is offered, KDA-DWR will evaluate the augmentation pumping effects on streamflow with the GMD5 groundwater model.

While portions of the basin are significantly developed and experiencing water level declines, other parts of the basin and level are much less developed and are not seeing such declines. The Basin has been closed to new appropriation since 1998. To allow for augmentation supplies, either existing water rights will have to be changed to augmentation use or the GMD and chief engineer would have to agree to open the district to new water appropriations for this purpose. This would only be done if it is in an area that can sustain this use. For augmentation to be approved as a remedy for impairment, the quality of the water would have to meet the Refuge's needs as well as any applicable laws, rules, and regulations governing water quality in Kansas.

Like Cheyenne Bottoms, an Intensive Groundwater Use Control Area (IGUCA) should be established to make the appropriate cuts in pumping while allowing the level of irrigation use allowable without impairment to the Refuge's right.

The specific remedy for any impairment found in the final impairment report will be determined in the next phase of this process. First, basin stakeholders will be provided with an opportunity to develop a plan to remedy the impairment. If no plan is offered or the plan is inadequate, the IGUCA process is one alternative to address any remaining impairment.