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Mr. Orrin Feril
Manager
Big Bend Groundwater Management District 5
125 S Main St
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Subject: Hydrologic Issues Pending for LEMA (Local Enhanced Management Area) to Remedy Quivira Impairment

Dear Mr. Feril:

Several hydrologic questions remain to be clarified to support administrative approvals in remedying the impairment at Quivira National Wildlife Refuge. This letter outlines some pending issues and the hydrologic rationale for proceeding on the Big Bend Groundwater Management District 5 (GMD5) management plan presented as a LEMA. The Quivira water right is certified at 14,632 acre-feet of water per calendar year, with the water to be stored and accumulated in marsh areas within the Refuge. The priority date is 1957 and is senior to many of the Rattlesnake Creek basin's farm-well dates. The Refuge has released a demand schedule calling for that volume to be diverted from the watercourse to the Refuge facilities at rates ranging up to 30 cubic feet per second (cfs) in spring and fall seasons or lesser rates of 8 to 12 cfs in winter.

Agency Guidance on Impairment and Basin Health

In January, the KDA (Kansas Department of Agriculture) summarized their views on this matter in a paper "Resolving the Quivira Impairment, Q&A"[1], where KDA found that *"… an augmentation project, along with modest reductions in groundwater use… will resolve the impairment…"*. Impairment means *"diminished in value or utility"* the test for which is *"whether the Refuge could have more fully exercised its water right…"*.[2] KDA supports augmentation of streamflow with wellfield discharge to relieve the impairment, but holds that cutbacks in farm pumping to maintain lower levels of water use are also necessary,

[1] Resolving the Quivira Impairment, KDA, January 11, 2019
[2] Final Impairment Report, KDA-DWR (Division of Water Resources), July 15, 2016

based on reasons given in a technical memorandum, *"because the current level of groundwater pumping, if not reduced, will dry up the reliable part of the streamflow that comes from the aquifer…and the hydrologic health of the basin continues to deteriorate."*[3] The KDA projects (absent any cutbacks in farm pumping) that the LEMA proposed 15 cfs nominal augmentation rate would be inadequate to remedy over 3000 of the 14,632 acre-feet Refuge demand in some future dry years, while most years would have a lesser shortfall, and in some wetter years Refuge demand would be fully satisfied. The LEMA proposal by GMD5 includes a measure of cutbacks in pumping that would reduce that reported shortage for Refuge demand.

Effect of End-Gun Removal

Another hydrologic matter of concern is the accounting of water from end guns on center-pivot sprinkler systems. The LEMA proposes to remove end guns in the enhanced management area. Based on acreage reduction, a saving of water is estimated by GMD5 at about 14,750 acre-feet per year. The savings on farms show up in two ways, mostly as a relative rise in water-levels in the aquifer, and secondly as a much-reduced fraction of the savings that appears in the flow of Rattlesnake Creek in response to the rising water levels. The DWR responds that water might be saved by removing end guns, but not necessarily so if the acreage reduction is less and if equivalent use is added as water applied and consumed on remaining center-pivot water-deficit acreage. On the other hand, the historical farm-water application has been shown to be explained 98 percent by a match with consumptive-irrigation requirements, which suggests both that additional water on existing acreage would not be much consumed and that historical farm-water operations are highly efficient.

GMD5 Information on Baseflow

Information has been exchanged between KDA and GMD5 on these points and GMD5 has the pertinent technical exhibits that display the data. As GMD5's consultant, my office has looked more closely at the streamflow pattern from the headwaters of Rattlesnake Creek to the Zenith gaging station near the Refuge boundary. We re-examined future baseline conditions using the groundwater model applied by all parties for making such projections. The model details show that Rattlesnake Creek loses water to the ground as reported in the DWR technical memorandum above, but shows also that some of that groundwater returns to feed the Creek above Zenith station, with the result that the reliable part of the streamflow that comes from the aquifer is not dried up in the future. Baseflow remains available to support Refuge diversions.

[3] Memo on Sufficiency of GMD 5's Augmentation-Only Plan to Resolve Quivira Impairment, KDA, January 7, 2019

GMD5 Information on the Effect of Cutbacks in Farm Pumping

The LEMA scenario includes end gun and focused-area curtailment of almost 19,000 acre-feet per year in terms of reduced use of farm water. Some of that estimated saving is doubted by DWR, so we examined the model again to see how sensitive the total flow at Zenith is to that factor. The LEMA pumping cutback causes about a 10 percent response at Zenith station in the future, so around 2000 acre-feet per year appears as increased streamflow due to the simulated LEMA cutback. But only half of that is helpful to the supply for Refuge demand because the rest is bypassed during times of no shortage and no need on the Refuge. Thus, the proposed 19,000 acre-feet per year of cutbacks in farm pumping generate only about 1000 acre-feet per year of help to offset impairment. Cutbacks are the least effective way to aid the remedy for impairment. If the scenario were to model less-effective cutbacks as DWR presumes them to be, then we would expect that a roughly proportional less-helpful response would be seen at Zenith. Baseflow, though, would remain characteristically positive.

Status of the Basin Health

On the question of the deteriorating long-term health of the basin hydrology, the DWR has received model runs that show conditions stabilize without progressive depletion of Rattlesnake Creek after about year 2050. Depletion of Rattlesnake Creek streamflow results from the water table being lowered by farm wells and feeding less water to the stream. Thus, a LEMA plan that accommodates depletion for another 30 years, would also be expected to perform satisfactorily in the longest term. The LEMA as proposed can reasonably perform in that way.

Cutbacks Not Critical

Calculations of future hydrologic conditions involve assumptions about scenarios to be played out and assumptions of standards of performance to be met. Model calculations have inherent error which can cut either way, but must be allowed-for in planning. In this case, the degree of benefit from end-gun removal is estimated at different levels by GMD5 and by DWR, but is found not to be critical to the action because of its relatively small contribution (up to 1000 acre-feet per year) to the impairment offset. A similarly small-proportional impact would be seen under mandatory cuts in pumping rates. Augmentation pumping has sufficient flexibility to make up the small benefit that cutbacks generate under either assumption. A moderate increase above the nominal 15 cfs wellfield capacity could produce thousands of acre-feet per year to deal with any such remedial gaps.

GMD5 on Drought, Storage, and Need

The standard of performance for an acceptable remedy is not clear cut. Further consideration of the role of drought, storage, and need leads GMD5 to the view that an

effective full supply will be available to the Refuge with the LEMA in place, offsetting any future impairment.

Natural supply (without farm pumping) has in the past and necessarily will in the future include drought times of insufficient supply for the Refuge's modern demand curve. Such a shortage is not due to impairment and reasonably would not require augmentation.

The Refuge water-right impairment analysis authored by the Chief Engineer[4] was quantified by including filling Little Salt Marsh with 1865 acre-feet per year (about 13 percent of the total right). Storage provides some flexibility in timing for Refuge operations and can soften the peak rate requirement for augmentation. That volume is equivalent to a large part of the peak period of demand scheduled for Refuge use, thus release from storage added to 15 cfs of wellfield augmentation would be able to make up peak demands for 2 months with no other sources. We expect that augmentation will serve direct uses, but will not be called upon to fill storage, under the principle that the senior right should utilize its own sources, including storage, before calling for augmentation. Filling storage is best done by natural flows. (If not filled and released, storage might be not an operating demand at all, since an additional right serves lake evaporation.) One scenario of the future with storage and drought operated this way shows that 15 cfs of wellfield capacity remedies the impairment even to a betterment of the natural supply.

The LEMA proposal provides that the real-time operation of Refuge diversions is to be met by augmentation, but it is not firmly-known what those rates and amounts may be in practice. Actual future diversions might be either more or less than anticipated. Past diversion reports compared to gaged flow shows that the Refuge's historical exercise of diversion is appreciably under 100 percent of available supply. The Refuge operations have not availed themselves of the full amount of the supply. Refuge operations are pertinent to the test for impairment given above as to whether the Refuge could (or would) have more fully exercised its water right. It is plausible that the available water was not needed. The practical need for water has been and might in future be less than scheduled. Nevertheless, the LEMA pledges to *"…deliver a make-up flow to the stream depending on conditions of streamflow and diversion requirement as observed…* and*…proposes that the delivery rate be set weekly in coordination with Refuge requests and KDA-DWR staff review…".* GMD5 has the means to match augmentation deliveries to reviewed and agreed requirements as they may prove to be.

Hydrologic Uncertainties

These uncertainties in hydrologic planning are usually addressed by a factor of

[4] Final Impairment Report, DWR, July 15, 2016

safety. The nominal 15cfs of augmentation wellfield capacity is reported by DWR to be inadequate, but with allowance for historic drought, storage operations, and consideration of past practice regarding need, it is thought by GMD5 to be fully adequate. The shortfall foreseen by DWR is a few thousand acre-feet in some years and nil in other years. The nominal 15cfs can deliver up to 10800 acre-feet per year. Some redundancy necessarily will be part of the wellfield capacity. If called upon to do so, an incremental increase in wellfield cfs and acre-feet is practical. On the other hand, over-building capacity that is finally unused constitutes waste. Thus, an augmentation project staged to deliver the water required as pledged in the LEMA is hydrologically reasonable and is thought by GMD5 to be better insurance of performance than are pumping cutbacks or rate controls. The DWR preference for modest reductions in groundwater use would produce less benefit to the Refuge at greater cost to farms. Although, I understand that there may be considerations distinct from Refuge impairment, such as regional hydrologic status of the basin, in the DWR position.

Conclusion

Thank you for requesting this summary statement of the hydrologic factors in current consideration as I understand them. I conclude that flexible augmentation would be a preferred means of satisfying impaired supply at the Refuge. Please let me know if more information or discussion is needed.[5]

Very truly yours,

BALLEAU GROUNDWATER, INC.

W. Peter Balleau, CPG, P.Hg.

WPB/tb

[5] W. Peter Balleau is a career ground-water geologist, a licensed Geologist in Kansas (686), certified by the American Institute of Hydrology, with over 10 years of study in the Rattlesnake Creek Basin.