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Introduction

The Kinney County Groundwater Conservation District Board of Directors is very concerned and actively engaged with the current drought conditions and impacts occurring throughout the District, including at Las Moras Springs. Since the last drought (circa 2013), the District has worked diligently to develop an extensive groundwater monitoring network to further our understanding of the interaction between groundwater pumping, rainfall (and lack of rainfall), groundwater levels, and spring flow. This article is intended to update readers on the work the District is conducting to determine what, if anything, can be done to prevent the loss of spring flow and protect private property rights concerning groundwater.

Comanche Springs/Pecos County Parallels

An article in the Kinney County Post on July 28, 2022, drew parallels between Comanche Springs in Pecos County and Las Moras Springs in Kinney County. As described below, high pumping west of Comanche Springs is the primary cause of the elimination its flow. In contrast, Las Moras Springs in Kinney County, where pumping is much less, varies primarily due to wet and dry periods.

Comanche Springs dried up due to irrigation pumping that started in the 1950s in the Leon-Belding area west of the springs. Groundwater pumping in the Leon-Belding area peaked in the 1960s and 1970s. Groundwater production was not regulated at the time of well construction, and landowners operated under the Rule of Capture, which means that there was no legal recourse for the impacts associated with this pumping. Ultimately, the over-pumping of groundwater to the west of Comanche Springs resulted in the loss of flow from the spring and the elimination of the 6,000 irrigated acres to the east of the spring that relied on spring flow. The pumped groundwater, however, was used for irrigation on a larger number of acres west of the spring.

Estimates of the peak pumping in the Leon-Belding area range from **120,000 to 150,000** acre-feet per year. Since 2008, groundwater pumping in the Leon-Belding area has been about **50,000 to 60,000 acre-feet per year**. This groundwater currently irrigates about 13,000 acres of land, including about 2,800 acres of pecan orchards. Currently, Comanche Springs only flows about 4 to 10 cubic feet per second in the winter months (the non-irrigation season) when pumping is minimal. These winter flows are a relatively recent condition as pumping during the last 20 years has been lower than pumping in the 1980s and 1990s when there was essentially no flow at any time from Comanche Springs.

The article included a calculation of the amount of groundwater used for irrigation using the total capacity of all center pivots. The data from Pecos County can be used to provide a more common means of expressing groundwater use for irrigation. Dividing the total groundwater production by

the irrigated acreage yields an estimate of "irrigation duty". Under current conditions, the irrigation duty in the Leon-Belding area is between 3.85 to 4.62 acre-feet per acre.

The Middle Pecos Groundwater Conservation District, created in 1999 by the Texas Legislature, issued permits for existing and historic use. In the management zone that affects Comanche Springs, the current existing and historic use permits total about 74,000 acre-feet per year, which is more than the current pumping but less than the historical peak pumping in the 1960s and 1970s summarized above.

Kinney County Groundwater Pumping

Since the creation in 2001, the Kinney County Groundwater Conservation District issued existing and historical use permits in the Austin Chalk, Edwards BFZ, and Edwards-Trinity (Plateau) aquifers. Las Moras Springs is affected by pumping from the Edwards BFZ and Edwards-Trinity (Plateau) aquifers. From 1960 – 1991, known as the "historical period", the permitting process yielded an estimate of pumping for the Edwards BFZ and Edwards-Trinity (Plateau) of about 52,000 acre-feet per year. During the "existing period", defined as 1992 to 2003, the permitting process yielded an estimate of pumping for these aquifers of about 36,000 acre-feet per year. Based on these totals, the peak pumping occurred during the historical period while pumping during the existing period was considerably lower. The Post article claimed there was a large increase in pumping in these aquifers beginning in 1985, but that is not consistent with the information used to establish the property rights associated with existing and historical use permits in Kinney County.

Currently, pumping in Kinney County from relevant areas of the Edwards BFZ and Edwards-Trinity (Plateau) aquifers is estimated to be about 5,000 acre-feet per year, which is considerably less than pumping during both the existing and historical use periods. The estimated pumping is consistent with reported groundwater production from permittees and with estimates developed by the Texas Water Development Board. Efforts to improve the reporting process are ongoing and include accuracy, timeliness of reports, the granularity of reports, etc.

The article used an estimate of between 2 to 3 cubic feet per second for center pivot irrigation on a 200-acre parcel. Translating that capacity to irrigation duties yields an estimate of between 2.71 and 4.07 acre-feet per acre, which is similar to the irrigation duties in Pecos County described above. In fact, the Kinney County irrigation duty estimates are slightly lower than the estimated duty in Pecos County, which is expected since the average annual precipitation in Kinney County is greater than the average annual precipitation in Pecos County.

Using the irrigation duty numbers derived from the 2 to 3 cubic feet per second pivot capacity for 200 acres provided in the article suggests that current irrigated acreage in the Edwards BFZ and Edwards-Trinity (Plateau) aquifer area in Kinney County is between 1,000 and 2,000 acres (not 3,400 acres as stated in the article).

Las Moras Spring Flow

Turning to the recorded variations and causes of the variations in Las Moras Spring flow, from 1938 to 2016 (the period of record of the old gage), the end-of-month spring flow has been zero 12 times and between 0 and 1 cubic feet per second 8 times. These events occurred in 1964 (twice), 1967 (three times), 1971 (twice), 1972, 1980, 1983, 1996 (four times), 2004 (twice), 2005 (three times), and 2013. These data suggest that extremely low or zero spring flows have occurred in the past and are linked more directly to variations in rainfall.

Spring flow typically declines in months with low rainfall and increases in months with high rainfall. Peak groundwater pumping typically occurs in June. Here are three recent examples (2017, 2019, and 2021) of spring flow, precipitation, and pumping for April, May, and June, and July.

Year	Month	Las Moras Spring Flow (cfs)	Precipitation (in)	Estimated Groundwater Pumping (cfs)
2017	April	42.20	3.77	1.43
	May	42.70	3.33	11.61
	June	28.50	1.87	18.36
	July	12.40	0.77	15.51
2019	April	36.60	2.16	1.87
	May	34.30	2.95	12.71
	June	45.50	8.10	14.82
	July	44.30	0.08	0.36
2021	April	5.15	1.30	8.23
	May	8.55	3.06	10.22
	June	3.76	2.06	14.76
	July	3.86	2.23	10.59

Note: 1940 to 2021 average precipitation is:
April = 2.10 in
May = 3.10 in
June = 2.82 in
July = 1.89 in

Kinney County Groundwater Conservation District Current and Future Efforts

The above examples show the interconnected nature of rainfall, pumping, and spring flow. The Kinney County Groundwater Conservation District Board of Directors recognized the potential impacts if all permitted groundwater pumping was implemented concurrently. This concern was a major factor in implementing the monitoring program that began in 2013. The District's monitoring network now consists of 54 instrumented monitoring wells, 4 active county specific rainfall gages, 3 spring monitoring stations, including the new gage at Las Moras Spring. Low rainfall over the last few years has resulted in low groundwater levels characteristic of severe drought conditions.

The data from this monitoring network has now defined a cycle of dry-period/wet-period/dry-period over the last nine years that is being used to develop detailed and quantitative links between groundwater levels in monitoring wells, pumping, and spring flow. Since 2013, the District's

monthly meetings include a discussion summary of the recently collected monitoring data and the July 14, 2022, Board meeting included some preliminary model results. The District has developed new data to further characterize the relationship between drought conditions, groundwater pumping, and spring flow. These data are critical to the numerical groundwater model that has been in development since 2015. The numerical model is expected to be finalized within the next several months.

The work will culminate in the management plan update due in April 2023, and the subsequent rules update due one year after the adoption of the updated plan. The updated plan and rules will be based on a combination of the monitoring data, the technical analyses of that data (including the calibrated numerical model), and the Board's policy choices. The Board has already established an Advisory Group to help review the technical data and comment on potential policies.