La Cienega Groundwater Level Monitoring, Santa Fe County, New Mexico: 2019 Summary of Findings

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AQUIFER MAPPING PROGRAM

Open-file Report 604
November 2019

CONTENTS

Project Funding

Funding for this project is from El Rancho de las Golondrinas and with the support of the community of La Cienega. Additional support in terms of staff time and instrumentation came from the New Mexico Bureau of Geology and Mineral Resources, Aquifer Mapping Program.

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I. INTRODUCTION

As a follow up to hydrogeologic research performed by the New Mexico Bureau of Geology and Mineral Resources in recent years (summarized in Johnson, et al., 2016), a groundwater monitoring network was implemented around La Cienega, Santa Fe County, New Mexico beginning in the fall of 2015. The primary aquifer in La Cienega is within the Ancha Formation, overlying the Tesuque Formation. The Ancha Formation aquifer exists as buried valleys of coarse sediments that are highly transmissive set within and connected to the Tesuque Formation (Figure 1). Figure 2 shows the locations of the current wells in the monitoring network, with symbols color coded to the formation in which the wells are completed.

Previous hydrogeologic research by Johnson, et al. (2016) indicates that the groundwater in this region is highly susceptible to regional influences such as pumping, drought, and land use changes. The groundwater levels in many wells in the primary aquifer around La Cienega have steadily dropped since the 1970s (Figure 3).

Groundwater level monitoring provides an essential tool in groundwater management. The data are used in the development of more accurate groundwater models, and can help with protection of groundwater resources. Measurements of changing groundwater levels also directly reflect changes in groundwater storage.

The monitoring network that was established in 2015 was composed of two overlapping groups; 23 wells that were measured every six months and 14 wells that had been measured approximately 10 years prior. The initial sampling schedule and distribution was useful to confirm the seasonal trends experienced throughout the area. The twice annual monitoring frequency was intended to reflect the local seasonal highs (April) and lows (October),

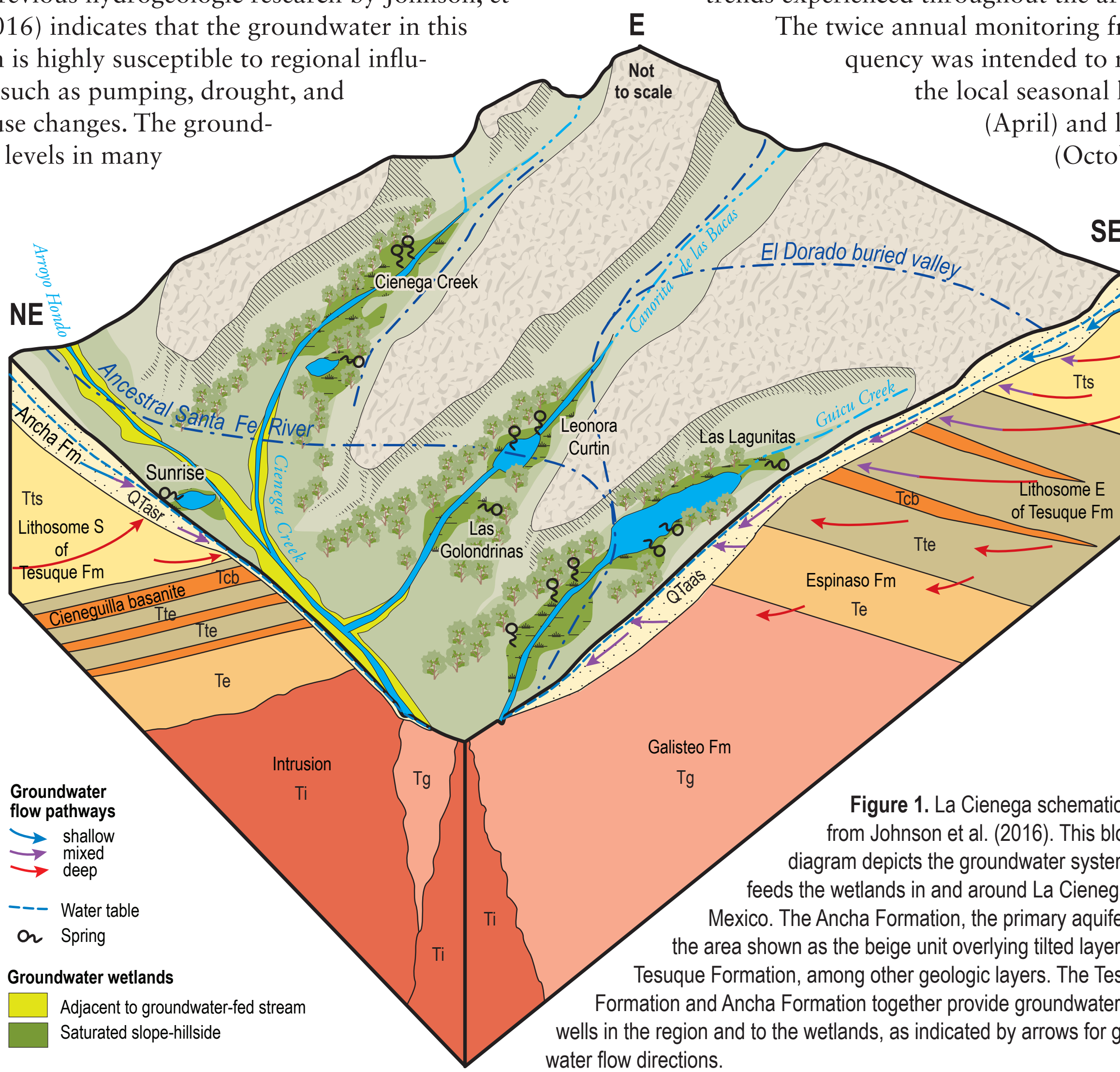
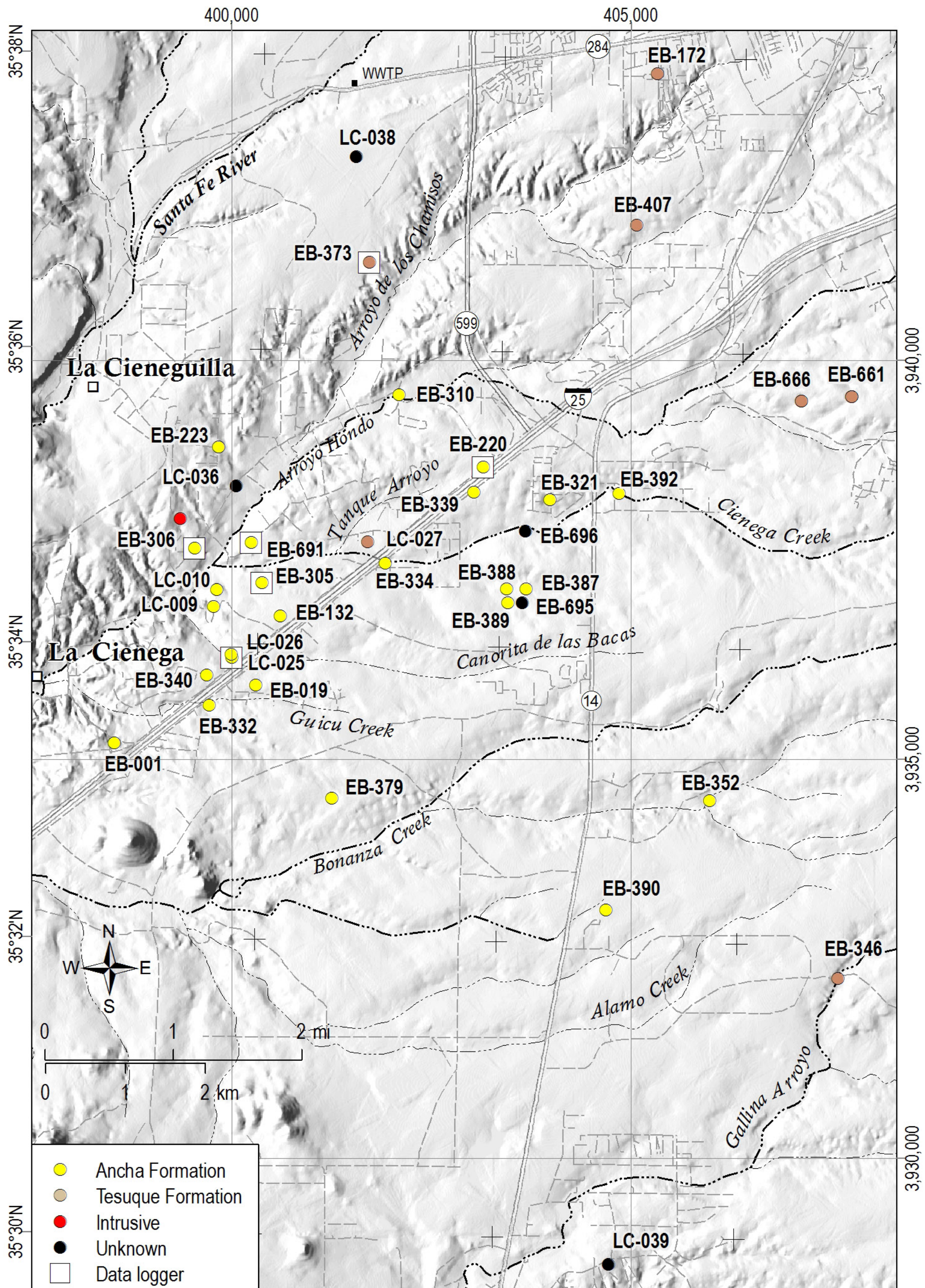


Figure 1. La Cienega schematic model from Johnson et al. (2016). This block diagram depicts the groundwater system that feeds the wetlands in and around La Cienega, New Mexico. The Ancha Formation, the primary aquifer for the area shown as the beige unit overlying tilted layers of Tesuque Formation, among other geologic layers. The Tesuque Formation and Ancha Formation together provide groundwater to wells in the region and to the wetlands, as indicated by arrows for groundwater flow directions.

relating to the impact of the growing season on the water table. The grouping of wells that had previously been measured 10 years prior was intended to capture long term trends affecting the local aquifers.

From 2015–2017, the monitoring network of 23 wells was measured six times, twice annually. The long-term monitoring network was restructured in the spring of 2018 to more efficiently monitor the groundwater, while still collecting valuable, useable data. The monitoring network is currently being visited once every year in late spring. As has been demonstrated in the previous monitoring reports, sampling during the spring period represents the maximum groundwater level in the wells. In addition to changing the monitoring frequency in 2018 the spatial coverage of the monitoring network was expanded to the north and south, which now includes 43 wells. The majority of the wells that were added to this monitoring network were measured previously in 2015 as part of the larger '10 year' repeat measurement group. This report is a brief summary of 2019 groundwater level monitoring activities in La Cienega.

Figure 2. Location of wells monitored for this project. Well points are color coded with the primary aquifer producing water. Most wells in this study are providing groundwater from the Ancha Formation, with a few on the margins of the study that produce water from the Tesuque Formation. In this region, groundwater is generally flowing toward the southwest.



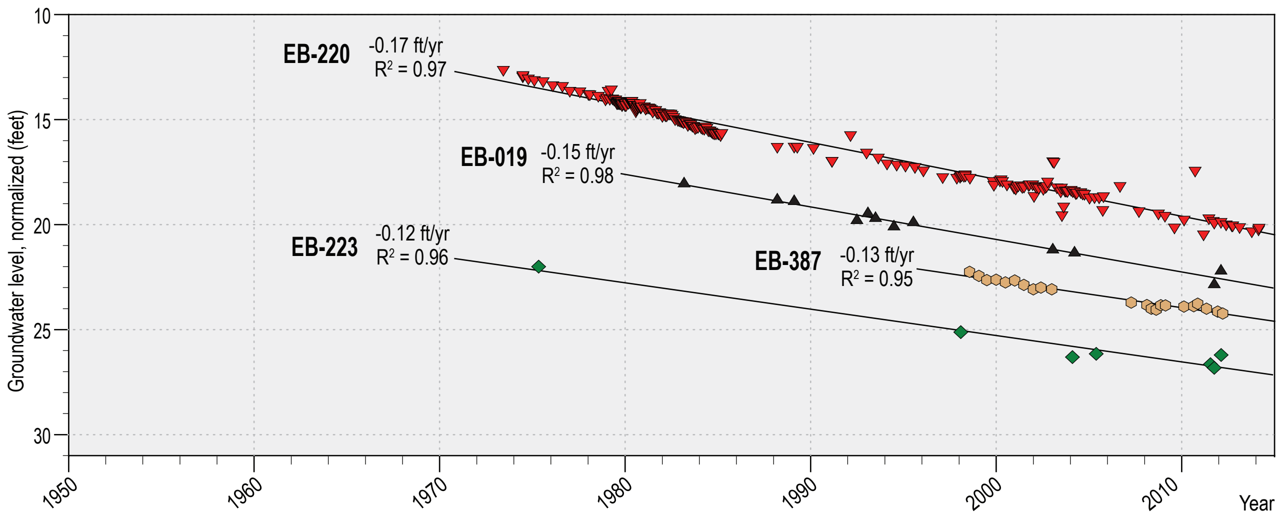


Figure 3. Modified figure from Johnson et al. (2016) that shows decline in groundwater hydrographs from shallow wells in the La Cienega over the past several decades. The rate of groundwater decline (ft/yr) is the slope of the regression line.

II. METHODS

In April of 2019, the expanded long-term monitoring network for La Cienega was re-measured (Figure 2, Table 1). This was the second time the expanded long-term monitoring network of wells has been measured. For the purpose of this monitoring project, groundwater level measurements are made in existing domestic wells (with pumps), and open/unused wells (without pumps). For domestic wells, water level measurements were made after the well had been off for at least 1 hour. Water levels were measured

Table 1. Inventory of wells that are part of the annual monitoring network, including location information and well construction. *Indicate wells that were added to the network from the previous bi-annual monitoring group. MP = Measuring point ("-" = below ground). NA = no data available.

Site ID	Elevation (ft)	UTM easting NAD83	UTM northing NAD83	Well depth (ft)	MP height (ft)	Screen top (ft)	Screen bottom (ft)	Formation
EB-001*	6068	398529	3935208	221	0.5	47	221	Ancha Formation
EB-019	6139	400304	3935932	80	1	50	80	Ancha Formation
EB-132	6173	400609	3936794	135	-6.2	60	90	Ancha Formation
EB-172*	6459	405330	3943594	493	0.9	353	470	Tesuque Formation
EB-220	6259	403153	3938661	161	0.65	125	161	Ancha Formation
EB-223	6157	399840	3938918	100	0	40	95	Ancha Formation
EB-305	6121	400377	3937211	75	2	20	75	Ancha Formation
EB-306	6086	399537	3937647	43	1.8			Ancha Formation
EB-308*	6140	399358	3938016	103	2.6	73	103	Intrusive
EB-309*	6234	399896	3939990	300	1	120	280	Tesuque Formation
EB-310*	6176	402100	3939571	307	2.2	47	267	Ancha Formation
EB-321*	6261	403986	3938251	180	0.5	140	180	Ancha Formation
EB-332	6089	399720	3935678	160	0.45	80	140	Ancha Formation
EB-334	6146	401921	3937456	140	1.5	60	120	Ancha Formation
EB-339	6263	403035	3938347	200	2.09	160	200	Ancha Formation
EB-340	6136	399686	3936057	155	0.8			Ancha Formation
EB-346*	6340	407590	3932255	366	0.52	185	365	Tesuque Formation
EB-352*	6292	405988	3934482	152	1.29			Ancha Formation
EB-373	6262	401729	3941231	300	0.6			Tesuque Formation
EB-379*	6213	401253	3934512	227	0.67	137	227	Ancha Formation
EB-387	6225	403690	3937134	115	1.24			Ancha Formation
EB-388	6214	403442	3937136	91	1.43			Ancha Formation
EB-389	6234	403458	3936959	121	1.98			Ancha Formation
EB-390*	6302	404686	3933111	500	1.7	200	460	Ancha Formation
EB-392*	6262	404853	3938331	220	1.73	160	200	Ancha Formation
EB-407*	6369	405069	3941697	247	0.5			Tesuque Formation
EB-661*	6482	407765	3939546	620	2.75	580	620	Tesuque Formation
EB-662*	6482	407765	3939546	1140	2.74	1020	1140	Tesuque Formation
EB-663*	6482	407765	3939546	1580	2.79	1500	1580	Tesuque Formation
EB-666*	6418	407135	3939493	450	2.77	430	450	Tesuque Formation
EB-667*	6418	407135	3939493	1400	2.98	680	1360	Tesuque Formation
EB-691	6113	400249	3937717	180	1.75			Ancha Formation
EB-695	6242	403641	3936964	125	1.89			Unknown
EB-696	6216	403679	3937857	117	2.51			Unknown
LC-009	6084	399771	3936914	180	0.5			Ancha Formation
LC-010	6101	399811	3937131	180	0.9	160	180	Ancha Formation
LC-025	6086	400000	3936280	18	-0.35			Ancha Formation
LC-026	6086	399995	3936316	8	-0.5			Ancha Formation
LC-027*	6155	401705	3937727	102	-7.7			Tesuque Formation
LC-036	6111	400055	3938426		-6.1			Unknown
LC-038*	6323	401562	3942555	186	1.93	166	186	Unknown
LC-039*	6231	404716	3928667	295	-6.32	215	275	Unknown
LC-040*	6526	407004	3944472		1.47			Unknown

Table 2. Wells in La Cienega Area and manual water level measurements collected during three measurement periods. Depth to water is ft below land surface. * Indicate wells that were added to the network from the previous bi-annual monitoring group.

	Early 2000s		2015		2018		2019		
Site ID	Date measured	Depth to water (ft)	Date measured	Depth to water (ft)	Date measured	Depth to water (ft)	Date measured	Depth to water (ft)	Water Level Change (early 2000s to late 2010s)
EB-001*	3/24/04	48.41	4/14/15	48.03	4/9/18	48.03	4/17/19	48.02	-0.39
EB-016*	3/24/04	228.06	2/11/15	228.04					-0.02
EB-019	3/23/04	43.34	4/14/15	44.46	4/10/18	44.51	4/17/19	44.42	1.08
EB-102*	3/31/04	60.35	2/18/15	62.07					1.72
EB-115*	3/14/06	215.06	2/11/15	215.77					0.71
EB-132	2/10/04	67.56	4/14/15	68.30	4/10/18	68.39	4/17/19	68.37	0.81
EB-171*	3/31/05	347.26	2/20/15	344.53					-2.73
EB-172*	3/31/05	305.00			4/11/18	303.10	4/30/19	300.22	-4.78
EB-218*	3/25/04	264.03	2/11/15	232.12					-31.91
EB-220	3/18/04	131.39	2/11/15	133.15	4/9/18	132.85	4/17/19	132.79	1.40
EB-222*	2/11/04	131.32	2/11/15	132.10					0.78
EB-223	2/11/04	46.31	4/14/15	45.42	4/9/18	45.31	4/18/19	45.32	-0.99
EB-240*	5/12/05	435.49	2/17/15	437.12					1.63
EB-305	1/9/04	22.17	4/13/15	22.78	4/9/18	22.78	4/17/19	22.81	0.64
EB-306	2/10/04	19.40	3/16/15	18.97	4/9/18	18.72	4/18/19	18.74	-0.66
EB-308*	2/11/04	52.54	4/16/15	52.22	4/9/18	51.97	4/16/19	51.95	-0.59
EB-309*	2/11/04	106.50	4/16/15	104.76			4/16/19	104.48	-2.02
EB-310*	2/11/04	38.07	4/16/15	37.49	4/9/18	37.27	4/30/19	37.24	-0.83
EB-315	2/10/04	19.91	4/14/15	20.47					0.56
EB-321*	2/20/04	132.89	4/13/15	132.17	4/10/18	132.10	4/16/19	132.02	-0.87
EB-332	2/21/04	30.00	4/14/15	8.83	4/10/18	8.75	4/17/19	8.62	-21.38
EB-334	2/27/04	38.42	4/13/15	39.65	4/10/18	39.63	4/17/19	39.61	1.19
EB-336*	5/14/04	209.57	3/23/15	208.83					-0.74
EB-337*	5/14/04	203.87	3/23/15	201.21					-2.66
EB-338*	5/14/04	185.47	3/23/15	186.77					1.30
EB-339	4/29/04	136.53	4/14/15	137.72	4/9/18	137.60			1.07
EB-340	4/29/04	51.53	4/14/15	52.41	4/9/18	52.40	4/16/19	52.34	0.81
EB-346*	6/3/04	151.77			5/4/18	132.37	4/16/19	132.83	-18.94
EB-352*	7/14/04	138.10	4/13/15	141.58	5/4/18	140.76	4/16/19	141.54	3.44
EB-373	6/18/04	127.10	3/16/15	116.38	4/10/18	116.30	4/18/19	116.31	-10.79
EB-379*	6/24/04	101.77	4/13/15	103.15	4/11/18	103.33	4/17/19	103.34	1.57
EB-387	4/12/07	98.47	4/13/15	98.95	4/9/18	98.87	4/16/19	98.64	0.17
EB-388	4/12/07	88.95	4/13/15	88.99	4/9/18	88.92	4/16/19	88.81	-0.14
EB-389	4/12/07	107.94	4/13/15	108.39	4/9/18	108.31	4/16/19	108.10	0.16
EB-390*	7/1/04	157.85			4/10/18	160.70	4/17/19	160.86	3.01
EB-392*	7/15/04	125.21	4/13/15	125.26	4/9/18	125.21	4/16/19	125.23	0.02
EB-407*	3/23/04	217.60	4/14/15	214.98	4/10/18	213.57	4/18/19	213.17	-4.43
EB-607*	3/28/06	198.65	3/26/15	200.18					1.53
EB-661*	8/24/06	291.45	4/13/15	292.07	5/4/18	292.56	4/16/19	292.53	1.08
EB-662*	8/24/06	290.70	4/13/15	290.58	5/4/18	290.78			0.08
EB-663	8/24/06	286.71	4/13/15	282.67	5/4/18	280.05			-6.66
EB-666*	8/24/06	231.53	4/13/15	237.62	5/4/18	235.21	4/16/19	244.62	13.09
EB-667*	8/24/06	246.62	4/13/15	245.20	5/4/18	245.55			-1.07
EB-691			3/16/15	23.21	4/10/18	23.10	4/17/19	23.02	
EB-695			4/13/15	110.54	4/9/18	110.43	4/16/19	110.17	
EB-696	4/12/07	89.75	4/13/15	91.55	4/9/18	91.57	4/16/19	91.56	1.81
LC-009			4/14/15	15.79	4/9/18	16.07	4/16/19	14.42	
LC-010			4/14/15	16.10	4/9/18	16.05	4/16/19	16.28	
LC-025			3/16/15	7.87	4/9/18	7.97	4/17/19	7.90	
LC-026			3/16/15	8.02	4/9/18	6.44	4/17/19	6.48	
LC-027*					4/10/18	40.57	4/17/19	40.50	
LC-036			4/14/15	11.24	4/9/18	11.44	4/18/19	11.60	
LC-038*					4/9/18	171.18	4/18/19	171.93	
LC-039*					4/10/18	137.76	4/17/19	138.26	
LC-040*							4/18/19	363.94	

following U.S. Geological Survey protocols for a steel tape measurement device with repeat measurements to within 0.02 feet. Open wells were measured using an electronic sounder probe, also with repeated measurements within 0.02 feet. All measurements reported are in units of feet, and are reported from below ground surface (bgs). Manual water level measurements from wells in the monitoring network are provided with this report in Table 2. Hydrographs showing the water level measurements over time are found in the Appendix 1.

Pressure transducers monitoring continuous changes in groundwater levels have been deployed in several wells since 2011 (EB-220, -306, LC-025, -026) (Table 3). Additional sites were instrumented in 2014 and 2015 (EB-305, -339, -373, -691). These instruments are VanEssen brand (Divers), and provide pressure readings, which are converted to water level measurements collected every 12 hours. These are lengthy data records, and are available upon request. Images produced from these records are discussed below. As these instruments age and reach the end of their lifetime, the data loggers have begun to fail, this has occurred in wells EB-339,EB-220, EB-306, EB-373, and LC-026. When possible we have managed to replace the data loggers with spare units from other projects the NMBG has completed.

Table 3. Point locations with continuous data recorders, and date of installation. See Figure 2 for locations.

Site ID	Date installed	Notes
EB-220	10/4/11	Running, Replaced September 2019
EB-305	6/4/15	Running
EB-306	10/6/11	Running , Replaced September 2019
EB-339	6/1/15	Lost from well April 2016, not replaced
EB-373	10/2/12	Running , Replaced September 2019
EB-691	5/27/14	Running , Replaced April 2019
LC-025	10/4/11	Running , Replaced April 2019
LC-026	10/4/11	Instrument failed October 2017, not replaced

III. RESULTS

Continuous Data Records

As noted in Table 3, there were originally eight locations with pressure transducers monitoring groundwater level changes every 12 hours, there are 5 remaining presently. These records are displayed in Figures 4–9. Locations of these wells are shown on Figure 2.

LC-025 is a shallow monitoring well that is 18 feet deep, and completed in the shallow Ancha Formation (Figure 1–2). The hydrograph shows a distinct seasonal fluctuation related to the growing season that is seen in numerous wells in the area, varying by ~4 feet (Figure 4). Water levels begin to recover after plants go dormant later in the fall, typically by mid-November. This well sees rapid recharge as noted in late 2013, where water levels rose 6 feet following a large storm event. When this data logger was visited in April 2019 the device could not communicate with the computer. Fortunately, the manufacturer was able to extract the data from the device. This unit was replaced with a used data logger in April 2019.

EB-373 is 300 feet deep, located near the Santa Fe airport, and is completed in the Tesuque Formation (Figure 2). This is the only well instrumented with a data logger with a consistent upward trend in the groundwater level (Figure 5) since the well was instrumented in late 2012. Wells in the area of the Santa Fe Airport were shut down in the mid-1990s, when the airport was connected to the City of Santa Fe water supply, which may be influencing the water level rise in the well. From 2012, when a pressure transducer was first deployed in the well, through mid-2016, water levels were rising at approximately 0.4 ft/yr. Since 2016, water level changes have remained steady. Where previously there was no noticeable seasonality to the water level trend there is now a very slight seasonality to the water level fluctuation, likely due to the depth of the well, and the water table in the area being out of reach of tree

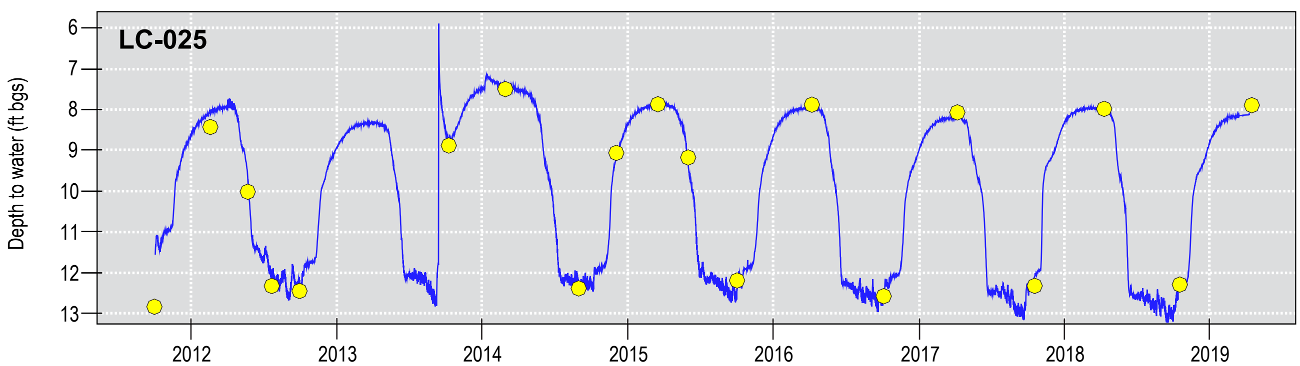


Figure 4. LC-025 is a shallow, 18 ft deep monitoring well, completed in the Ancha Formation. The spike in water level that occurs in September 2013 coincides with a significant precipitation event.

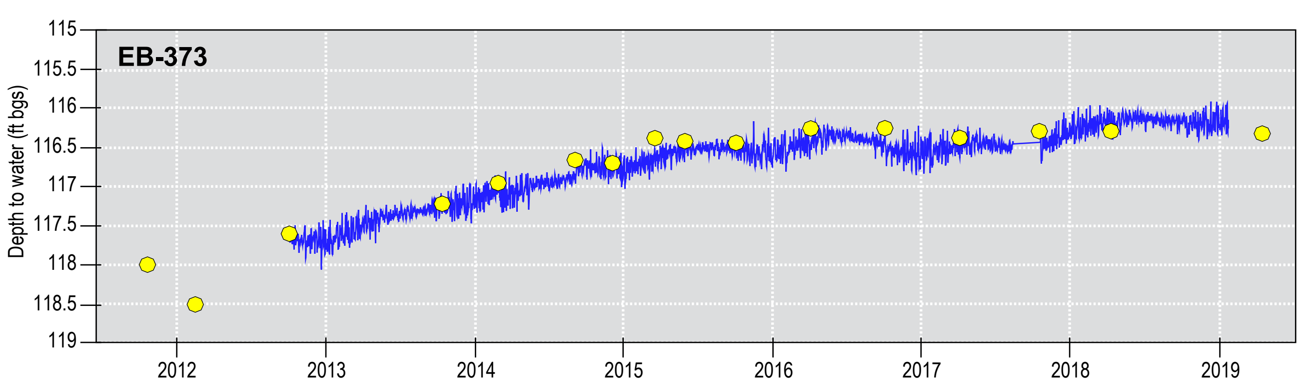


Figure 5. EB-373 is 300 ft deep, located near the Santa Fe airport, and completed in the Tesuque Formation.

roots. The muted seasonal trend is likely the result of summer pumping or evapotranspiration affecting the aquifer up or down gradient of the well. The data logger in this well also began to malfunction in January of 2019. The well was re-instrumented with a spare NMBGMR data logger which became available in September 2019.

EB-306 is a 43 foot deep well that is completed in the Ancha Formation (Figure 2). The water level time series recorded in this well shows a distinct seasonal fluctuation in the shallow water table likely related to evapotranspiration (Figure 6). The winter recovery following the growing season generally occurs at the end of September and since 2014 water levels have returned to approximately 18.8 feet below land surface. Once the growing period begins in late spring/early summer, the groundwater levels drop approximately 0.8 feet. The instrument in this well was replaced in September of 2019 because the battery in the previous data logger was getting low.

EB-220 is a well completed in the Ancha Formation, with a total depth of 161 feet (Figure 2). This well has a long record of decline since the 1970s, on the order of roughly 0.2 ft/yr (Johnson et al., 2016). Beginning in 2013, the water level has begun to recover. The peak winter water levels between 2013 and 2016 were consistently 0.1 feet higher each year (Figure 7). This recovery trend faltered in 2017, as the winter high was 0.1 feet lower than the previous year. Both 2018 and 2019 have seen the recovery trend continue.

This well also shows a muted water level response to seasonal changes; typically rising and falling approximately 0.25 feet. The seasonal fluctuation in this well is different from other wells in the area that respond quickly to the growing season. The signal in this well appears to be more muted or offset, likely related to the greater depth of the well and groundwater level. Typically the water level in this well does not fully recover until June, and doesn't full decline until early January. The instrument in this well was replaced in September of 2019 as the battery in the previous data logger was getting low.

EB-691 is a 180 foot deep pumping well completed in the Ancha Formation (Figure 2). Records of water levels measured when the well was pumping are shown by the dips in water levels (longer vertical lines), with water levels reaching 36 feet below land surface (Figure 8). The overall trend in the static water level of this well, as indicated by the level that the water level recovers to after pumping, shows that this well has a seasonal fluctuation of approximately 1 foot. Static water levels are close to 23 feet below land surface in the winter months, and approximately

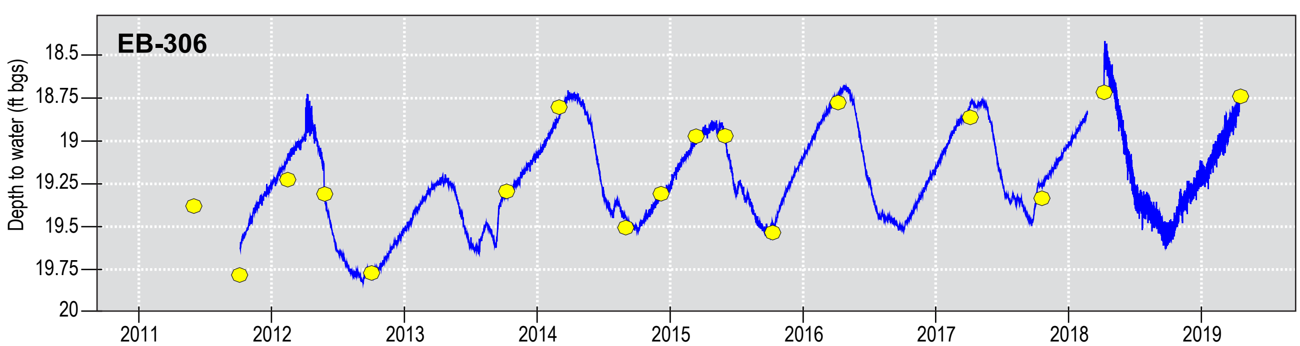


Figure 6. EB-306 is a 43 ft deep well completed in the Ancha Formation.

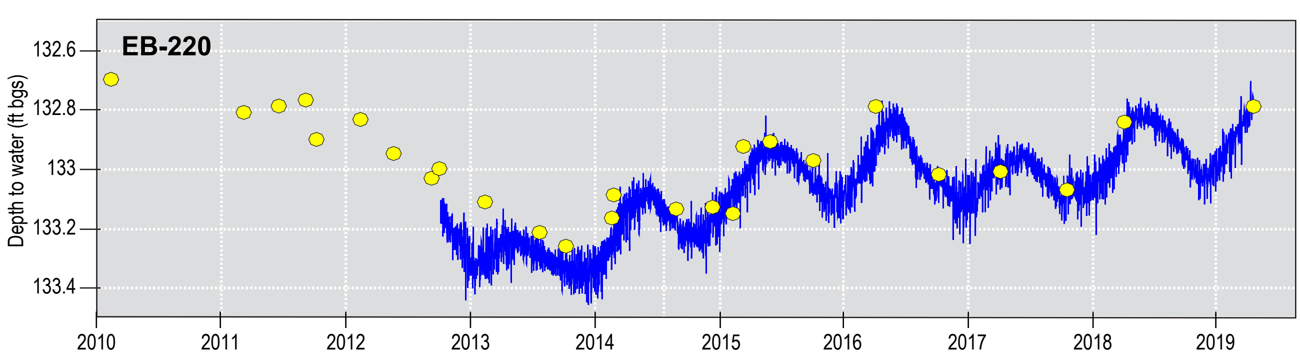


Figure 7. EB-220 is a well completed in the Ancha Formation, with a total depth of 161 ft.

24 feet below land surface during summer months. The data logger in this well died in August of 2018 and was replaced with a spare data logger when it was visited in April of 2019.

EB-305 is a 75 foot deep well completed in the Ancha Formation. The overall trend of water level change in this well reflects the seasonal decline common in other shallow Ancha Formation wells in the region; rising and falling 1 foot between summer and winter seasons (Figure 9). A previous water level measurement from this well in January 2004 was 22.1 feet below land surface. This well has seasonal fluctuations, but there has been a long term decline in the overall water level at this well since it was measured in 2004. At present the well appears to be stable; recovering to approximately the same levels in the spring and decreasing to same levels in the fall.

Long-term Trends

La Cienega area water levels have been monitored over the past several decades. Most wells in the monitoring network have records dating back 10 or more years. As was noted by Johnson et al. (2016), since the 1950s when some of the wells were first measured, water levels have been declining, between 0.12 and 0.23 ft/yr. On the hydrographs that were presented in Johnson et al. (2016) it was noted, however, that at the very end of the data collection period, early 2014, that there did appear to be a slight rise in water levels (Figure 3). With the continued collection of data over the past three years the previously published hydrographs have been updated. Starting between 2010 and 2013, there has been a change in water level trends in most wells in the La Cienega area and water levels are now stable or rising at several locations (Figure 10).

Local Water Table Update

Johnson et al. (2009), published a water table map of that area that extended from the Buckman well field to Lamy in the southeast. The map was produced using water levels measured from 2000 to 2005 and included La Cienega area. The water table in the La Cienega area was further refined by Johnson et al., (2016) with measurements collected in 2012. As the long-term monitoring network in the area has

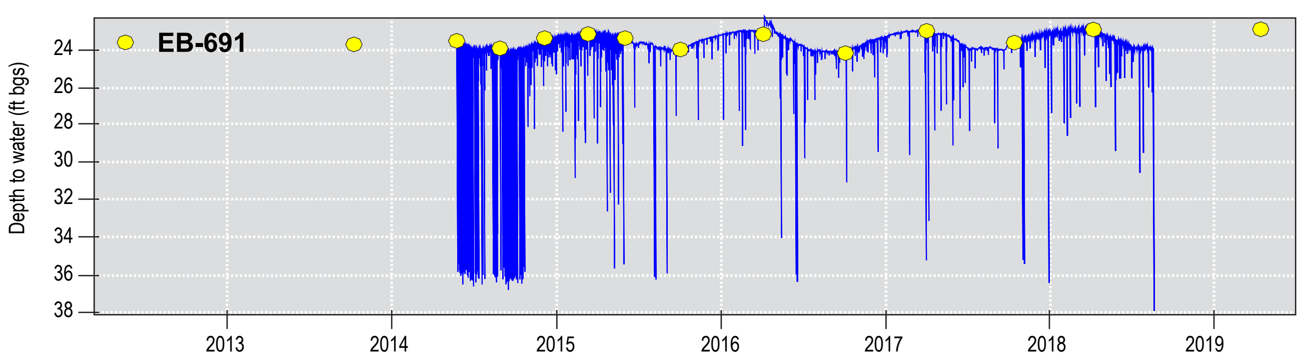


Figure 8. EB-691 is a 180 ft pumping well completed in the Ancha Formation. Water levels measured when the well was pumping are dramatically lower than the static water level, with water levels reaching 36 ft below land surface. The overall trend in the static water level of this well, indicated by the blue line of points, shows that this well reflects a seasonal fluctuation of approximately 1 ft.

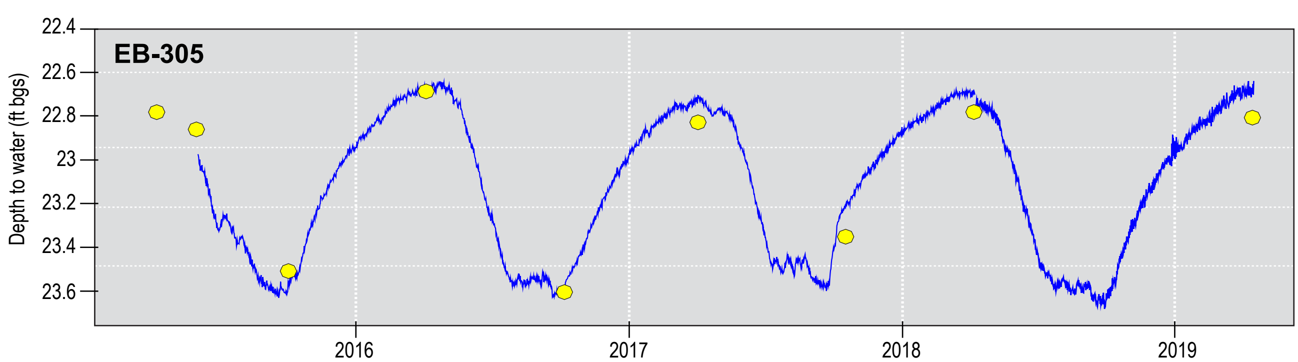
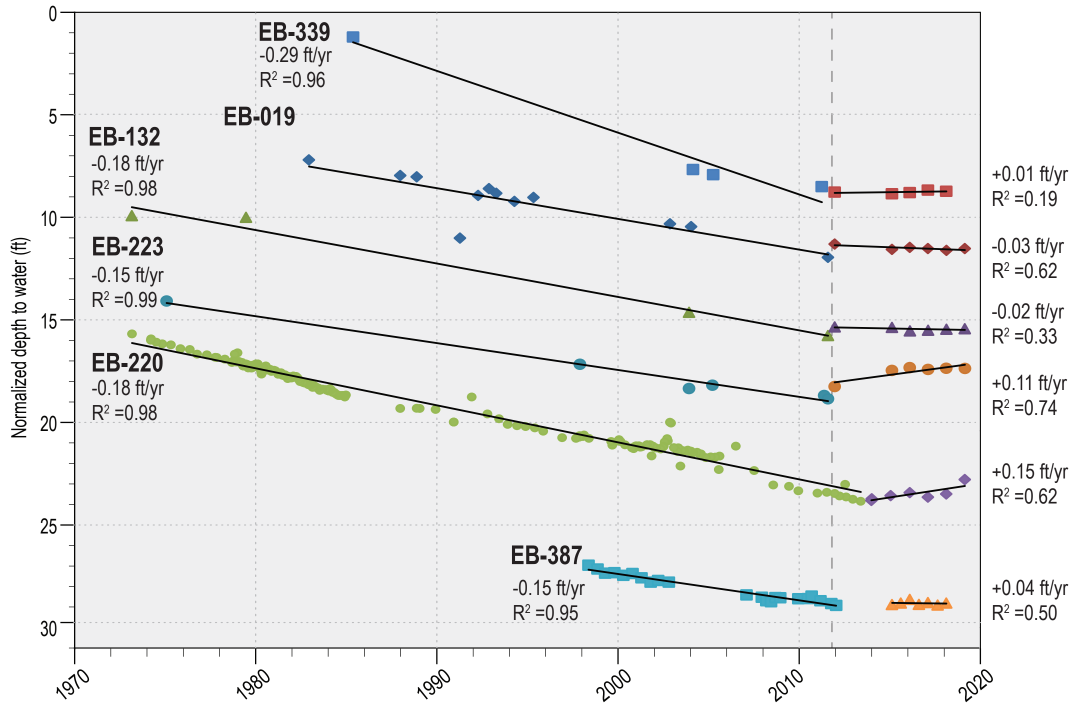


Figure 9. EB-305 is a 75 ft deep well completed in the Ancha Formation. Installed in June 2015.

Figure 10. Groundwater hydrographs from four wells in the study area that show significant decline for several decades; between 0.29 and 0.15 ft per year. Starting in 2012 the rate of decline was significantly reduced in these wells; between 0.04 ft decline and 0.15 ft per year of recovery.



expanded spatially, we determined that an updated water table map could be contoured for La Cienega using water level data collected for this project's monitoring efforts. Using the the 2012 water table map as a starting point, we adjusted the water table elevation contours to fit the 2015–2019 dataset (Figure 11). The most significant changes have taken place in the region of the airport in the north. Water levels in this region have significantly recovered. For the most part the water table has not significantly changed with only small adjustments. New flow paths for the region have been redrawn to reflect the changes to the local water table.

Discussion of other Regional Datasets

Within the hydrologically up-gradient proximity to La Cienega, the U.S. Geological Survey maintains continuous data recorders in several nested piezometer well sets; Jail Well, NMOSE County and NMOSE Fairgrounds (Figures 12–16). Nested piezometers consist of a group of three wells that are drilled within close proximity to each other. Each well that is part of the nested piezometer grouping is completed at different depths; a shallow, a middle, and a deep well. This allows for analysis of the vertical gradient in an aquifer; the measure of groundwater flow in the 'Z' direction, up or down. The shallowest of these wells can be compared to the sites monitored in La Cienega. The results show that regional groundwater levels in the Tesuque Formation aquifer are largely declining, with small seasonal rises superimposed on the overall downward trend (Figures 13–16). While the majority of the wells in La Cienega are screened in the Ancha Formation, the underlying Tesuque Formation is hydrologically connected to the Ancha in this area (Johnson et al., 2016), so tracking trends in both formations is essential.

The "Jail Well shallow piezometer" is 340 feet deep, and is completed in both the Ancha Formation and Tesuque Formation aquifers. This well shows a groundwater decline from 2006 to 2014 of roughly 0.23 ft/yr (Figure 13). From 2014–2018, water levels have remained steady. The "Jail Well middle piezometer" is 640 feet deep, and was completed in the Tesuque Formation aquifer. It shows consistent groundwater decline since 2009, approximately 0.4 ft/yr (Figure 14). This set of nested piezometers shows an upward vertical gradient of 0.13.

The "NMOSE County shallow piezometer" is 460 feet deep and was completed in the Tesuque Formation aquifer. It has a continuous decline from 2006 to 2018, dropping approximately 0.27 ft/yr (Figure 15). This set of nested piezometers shows a slightly downward vertical gradient of 0.01. The "NMOSE Fairgrounds shallow piezometer" is 540 feet deep, completed in the Tesuque Formation aquifer. This well has a consistent groundwater decline of approximately 0.3 ft/yr (Figure 16). This set of nested piezometers shows a slightly downward vertical gradient of 0.04.

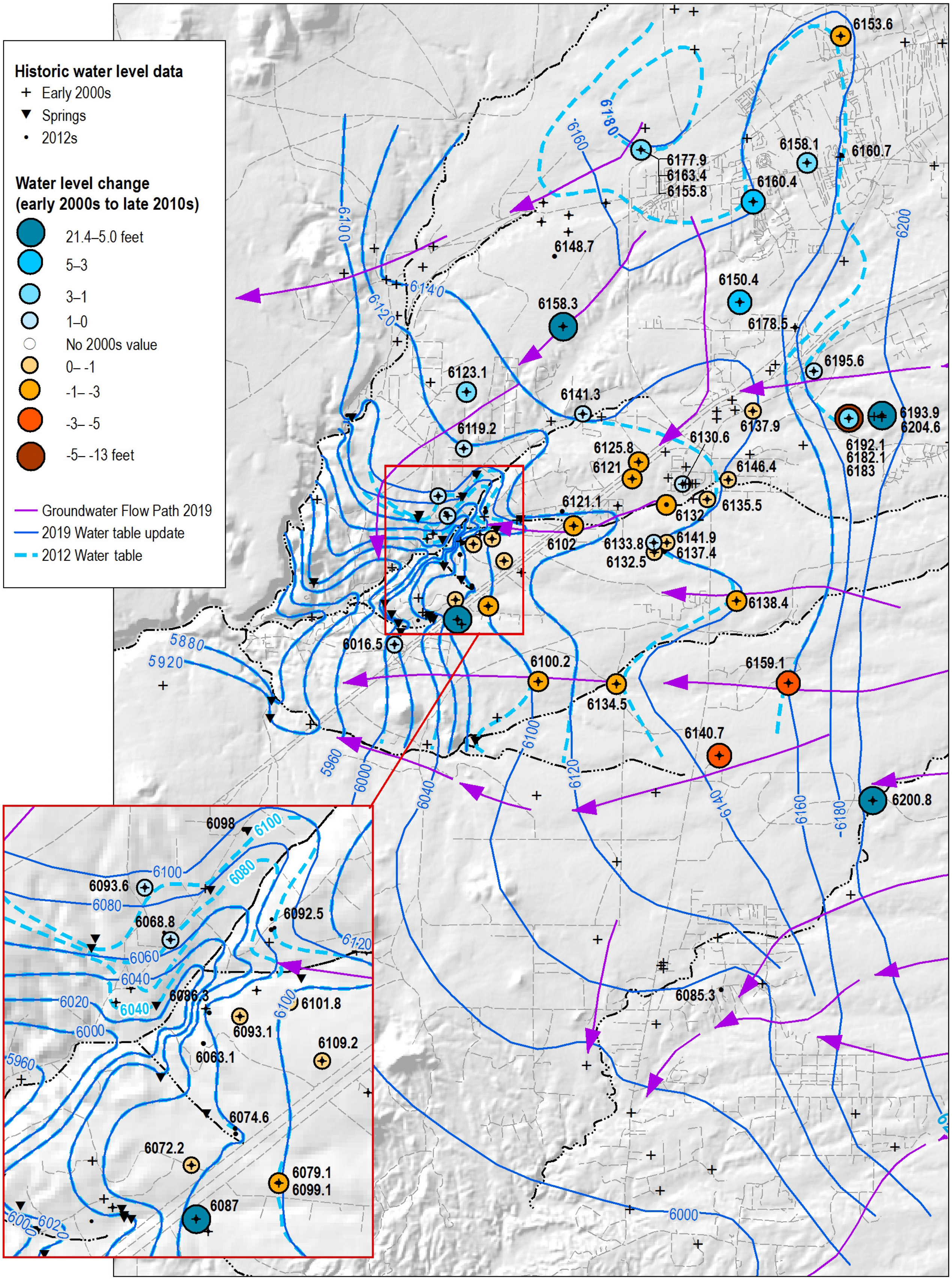


Figure 11. Updated water table map of the La Cienega area using water levels collected between 2015 to 2019. Modified from the water table map published by Johnson (2009) using water level data collected from 2000 to 2005.

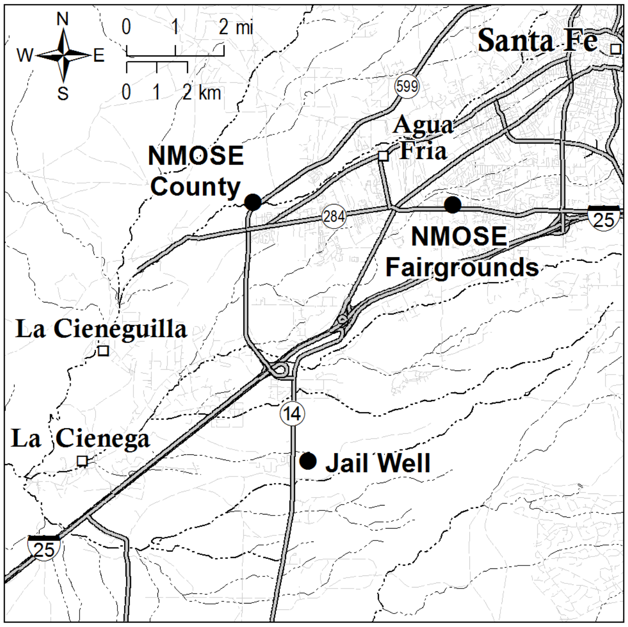


Figure 12. Map showing location of U.S. Geological Survey piezometer well sets. Wells discussed here include Jail Well, NMOSE County, and NMOSE Fairgrounds.

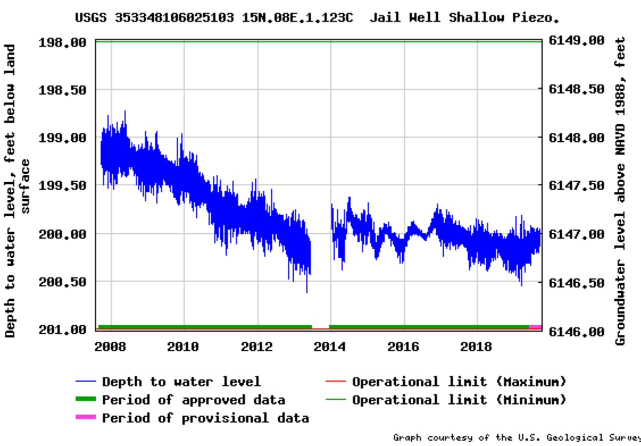


Figure 13. Jail Well Shallow piezometer. This well is 340 ft deep, completed in the bottom of the Ancha Formation and Tesuque Formation aquifers.

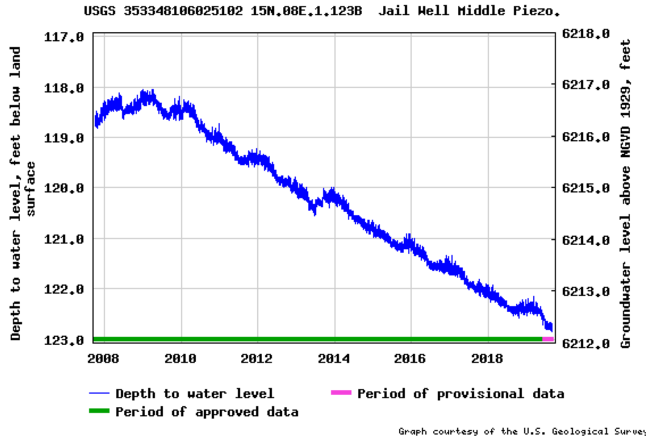


Figure 14. Jail Well middle piezometer. This well is 640 ft deep, completed in the Tesuque Formation aquifer.

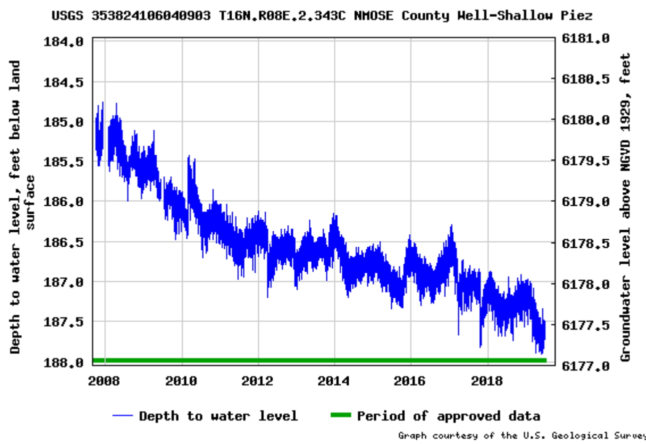


Figure 15. NMOSE County shallow piezometer. This well is 460 ft deep, completed in the Tesuque Formation aquifer.

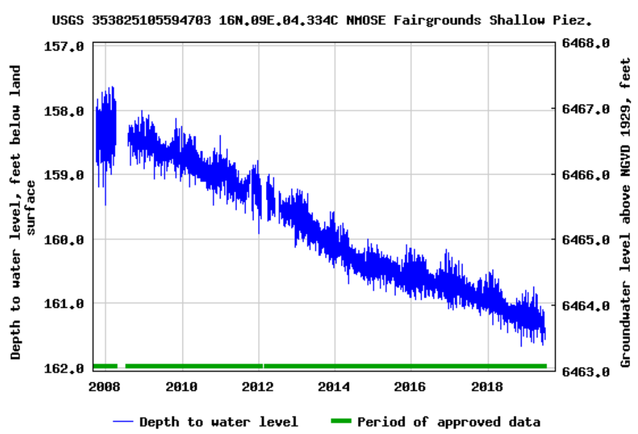


Figure 16. NMOSE Fairgrounds shallow piezometer. This well is 540 ft deep, completed in the Tesuque Formation aquifer.

IV. CONCLUSIONS

Results of this monitoring project in La Cienega highlight the importance of continued monitoring of groundwater levels in the region. The complexity of the groundwater system in and around La Cienega is indicated by the variety of results. As previous work (Johnson et al., 2016) and deeper groundwater monitoring sites in the Tesuque and Ancha Formation aquifers (i.e. USGS piezometers) have shown, there has been an overall trend of declining groundwater levels around La Cienega. Many of these declining trends have been ongoing since the 1970s. Superimposed on this trend, we also observe shallow groundwater fluctuations on a daily and seasonal time scale. Interestingly, in several of the shallow wells measured in this project that have extended water level records, we see a trend toward stabilizing water levels (i.e. EB-132) and even some recovery that started in the early 2010s (i.e. EB-223) (Appendix 1). We also see a rise in the Tesuque Formation aquifer at the Santa Fe Airport well (EB-373) (Appendix 1). This contradicts the NMOSE County shallow piezometer, which is also completed in the Tesuque Formation (though it is screened 260 feet deeper than EB-373 at the airport). At the NMOSE County shallow piezometer, the water level has dropped 3 feet since 2007. Measures to reduce the amount of groundwater pumping from the Ancha and Tesuque Formation aquifers, maintaining Santa Fe River flows, and other water conservation practices may be responsible for the observed slowing and changing rates of groundwater decline.

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