Kansas Geological Survey

Kansas River Alluvial Aquifer Index Well Program: 2019 Annual Report

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Kansas River Index Well Network – August 2020



Shawnee County Index Well 1 (SN01)

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KANSAS GEOLOGICAL SURVEY OPEN-FILE REPORT 2020-14

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Executive Summary

The Kansas River alluvial aquifer index well program is directed at developing a better understanding of the aquifer and its relationship to flow in the Kansas River. Projections indicate that the Kansas River corridor from Junction City to Kansas City will continue to be a major area of population and economic expansion in the coming decades and that groundwater will help fuel that expansion. Thus, we need to be able to reliably assess how water levels in the aquifer and the Kansas River will respond to increased groundwater pumping. The Kansas Legislature charged the Kansas Geological Survey (KGS) with improving our knowledge of the aquifer and its interactions with the Kansas River. A major task of that effort is the establishment of a network of monitoring ("index") wells in the Kansas River alluvial aquifer (KRAA) that is patterned after the KGS index well network in the High Plains aquifer. The establishment of the KRAA network is the focus of this report. The Kansas River alluvial aquifer program is supported by the Kansas Water Office (KWO) and has benefited from assistance from personnel of the Kansas Department of Agriculture, Division of Water Resources, and past funding support by the U.S. Geological Survey's National Groundwater Monitoring Network program.

The project began with the installation of a monitoring well near the Lawrence Airport in late summer 2017. The network now consists of 11 wells from west of Manhattan to just north of Lake Quivira in the Kansas City metropolitan area. Each well is equipped with a transducer for continuous monitoring of water levels, and the transducers are connected to telemetry equipment to allow real-time viewing of well conditions on the KGS website (http://www.kgs.ku.edu/Hydro/KansasRiver/index.html). The vision of the program is that these wells, and others that will be added over time, will be monitored for the long term. The ultimate objective is to gather sufficient information through water-level monitoring and the additional activities of this program so that a groundwater model of the aquifer and its relationship to the Kansas River can be constructed and then improved over time.

This report provides a concise description of conditions as of June 2020. The report consists of a description of each of the 11 well sites, an initial interpretation of the well hydrographs, and a summary of the additional activities that have been performed at the sites. The COVID-19 pandemic has significantly slowed progress on a number of project activities, particularly on the installation of additional wells and the completion of the hydrostratigraphic framework portion of the project.

The major accomplishments of the index well program to date are as follows:

- 1. The network has been built from scratch and now consists of 11 wells spanning the length of the Kansas River corridor;
- 2. Telemetered data from all 11 wells are served on the KGS website;
- 3. We have initially analyzed hydrographs from all 11 wells and have begun to develop an understanding of the major mechanisms that produce water-level changes at each well.

The focus of activities for the remainder of 2020 and 2021 will be on the continuation of monitoring at all program wells; a more detailed analysis of hydrographs from all wells with a particular emphasis on teasing out the role of precipitation and river-stage changes; installation of an additional five wells to fill in gaps in the network and create transects from the river to the valley wall; the completion of a hydrostratigraphic analysis of the alluvial aquifer; and the chemical analysis of groundwater samples from all network wells.

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1 Introduction and Background

The Kansas River corridor is projected to continue to be a major area of population and economic expansion in the coming decades, and pumping of groundwater from the Kansas River alluvial aquifer (KRAA) will undoubtedly increase to help support that expansion. Currently, we have insufficient information to reliably assess how water levels in the aquifer and the Kansas River will respond to increases in the pumping of groundwater. That information is essential for, among other things, management of groundwater storage in the aquifer in conjunction with management of reservoir system storage.

The Kansas Legislature charged the Kansas Geological Survey (KGS) with improving the understanding of the aquifer and its relationship to Kansas River flow and provided funding for the project through the Kansas Water Office. A major task of the project is the establishment of an index well network in the KRAA that is similar to the KGS index well network in the High Plains aquifer (Butler et al., 2020). The first phase of this task consisted of the establishment of a 10-well network from upstream of Manhattan to the Kansas City metropolitan area either through the installation of new wells or the equipping of existing wells for real-time monitoring of water levels. Five of these wells were installed with funding through the KGS participation in the USGS National Groundwater Monitoring Network Program (Wilson, 2019). All 10 wells are now in operation and provide continuous water-level records that are accessible in real time through the KGS website

(http://www.kgs.ku.edu/Hydro/KansasRiver/index.html). The second and third phases of the task involve the addition of six wells to the network to fill in gaps in the coverage and to complete transects of wells across the floodplain from the river to the edge of the aquifer; one of those wells is now in operation and provides continuous water-level records that are accessible through the KGS website. Concurrent with these phases are additional activities focused on obtaining information about the hydrostratigraphic framework of the aquifer and the hydraulic conductivity and water chemistry in the vicinity of each well; those activities are in varying degrees of progress. The ultimate objective is to gather sufficient information through water-level monitoring and additional activities so that a groundwater model of the aquifer and its relationship to the Kansas River can be constructed.

This report provides a concise description of conditions as of June 2020. The report consists of a description of each of the 11 well sites, an initial interpretation of the well hydrographs, and a summary of the additional activities that have been performed at the sites. The COVID-19 pandemic has significantly slowed progress on a number of project activities, particularly the installation of additional wells and the completion of the hydrostratigraphic framework portion of the project.

2 Overview of Aquifer Characteristics

Whittemore et al. (2019) provide a description of the general characteristics of the KRAA from which the following is drawn. The aquifer is composed of the unconsolidated sediments that fill the Kansas River valley. These alluvial sediments can be more than 80 ft in thickness in the deepest areas. The underlying bedrock consists primarily of limestone and shale, although some short sections of the valley are underlain by sandstone. The sediments in the deeper part of the alluvial aquifer are generally

coarse sand and gravel and overlain by finer-grained deposits (sand, silt, and silty clay) (Davis and Carlson, 1952; Dufford, 1958; O'Connor, 1960, 1971). Where the alluvial deposits are of substantial thickness, the aquifer has a high transmissivity and can commonly yield more than 1,000 gpm to large-capacity vertical wells (Fader, 1974). The quality of the water is fresh, although it is hard due to groundwater flow passing through the calcareous bedrock underlying the aquifer and in the valley walls. High iron and manganese occur in some portions of the alluvium as a result of chemically reducing conditions probably generated by organic matter in sediment in buried meander cutoffs and overbank deposits (Whittemore et al., 2014).

3 Program History

The Kansas River alluvial aquifer index well program began in late summer 2017 with the installation of a transducer- and telemetry-equipped well in Douglas County near the Lawrence Municipal Airport (Douglas County Index Well 1 [DG01]). This site was chosen so that we could build upon the 63-year record of monitoring from a previous well at the site. Over the next two years, an additional nine new wells were installed and an existing well was converted to an index well. The current network consists of 11 wells. All wells are equipped with a transducer to measure the position of the water level every hour and with telemetry equipment so that the measurements can be transferred to the KGS and viewed in real time on the KGS website. When possible, site locations were chosen, as with DG01, to build on previous monitoring efforts. In addition, when possible, an effort was made to site wells close to a USGS stream gage to develop a better understanding of the relationship between the river and the alluvial aquifer. The existing well that was incorporated into the network is at the edge of the floodplain in Douglas County and was chosen to be part of a transect that will run from the river to the edge of the floodplain.

Figure 1 shows the 11 wells that make up the current network. The next phase will be to add three new wells: one to fill the gap between WB01 and SN01, one to fill the gap between JF01 and DG01, and one to complete the transect that currently consists of DG01 and GEMS4-1. An additional two wells will be added to the network after completion of the hydrostratigraphic analysis and assessment of water-use patterns.



Figure 1—The Kansas River alluvial aquifer index well network as of early June 2020. The shaded area is the extent of the aquifer. GEMS4-1 is the previously existing well at the edge of the floodplain that was incorporated in the network as part of a transect that runs from the river to the edge of the floodplain.

4 Overview of Index Well Sites and Monitoring Data

This section describes the installation of the 11 index wells currently in operation and provides a brief discussion of the hydrographs from those wells. The duration of monitoring ranges from more than three years of hourly measurements at the first installed well (DG01) to a little more than half a year at the most recently added wells. The water-level data from the Kansas River network has very different characteristics from the data from the High Plains aquifer (HPA) index well network (Butler et al., 2020). In the HPA, the major drawdown in water level occurs during the summer when the aquifer is significantly stressed to provide water for irrigated agriculture. After cessation of irrigation pumping, water levels typically will increase until the start of the next pumping season; other than in the eastern portions of the HPA in south-central Kansas, stream-aquifer interactions are essentially negligible. In the KRAA, irrigation plays a more limited role than in the HPA, particularly in the eastern half of the network. In addition to irrigation pumping, which primarily occurs during the summer, the major mechanisms that produce changes in water level are precipitation recharge, stream-stage changes, and pumping for public water and industrial supplies, all of which can occur at any time during the year. As a result, the annual water-level change for an individual well is computed from the difference in the average water level from one year to the next, and not, as in the HPA network, from the difference in an annual water level measurement taken during the winter, three to four months after cessation of irrigation pumping.

In the following subsections, the installation, characteristics, and hydrograph of each well are discussed. The wells are organized by their location with respect to Topeka; wells in and to the west of Topeka are in the western reach of the network, while those east of Topeka are in the eastern reach. Details on the methods used for well installation and for subsequent slug tests can be found in the appendix. The Kansas River is also known as the "Kaw," so that more succinct term will be used for the Kansas River in the aerial photos.

4.1 Western Reach – West of Manhattan to Topeka

Five index wells are located in this reach of the Kansas River alluvial aquifer (fig. 2). These wells were drilled between May and October of 2018. Tables 1 and 2 summarize the characteristics of the wells.

Site	Average	Average	Bedrock	Screened	2018 water use (ac-ft) ^b			
	2019 WL elev. (ft) ^a	2019 saturated thickness (ft) ^a	depth (estimated ft below land surface)	interval (ft below land surface)	1 mi radius	2 mi radius	5 mi radius	
RL01	1,018.13	31.38	50.25	45–50	195.30 ^d	438.13°	1,758.87 ^f	
RL02	981.78	19.98	37.2	27–37	46.24	1,148.52 ^g	5,233.25 ^h	
WB01	961.99	34.99	44 ^c	22–37	326.42	1,605.23 ⁱ	5,136.33 ^j	
SN01	908.51	27.01	46.5	36.5–46.5	484.78	1,796.01 ^k	5,277.11 ^k	
SN02	870.72	32.22	71.5°	44–64	831.99 ⁱ	1,420.28 ^m	6,790.78 ⁿ	

^a Averaging period is the full year unless stated otherwise:

RL01 3/22/19 - 12/31/19

WB01 3/2/19 - 12/31/19

SN02 1/11/19 – 12/31/19.

^b Irrigation use unless noted

^c Well did not reach bedrock, so value is the average of the two closest wells that reached bedrock.

^d Includes 5.78 ac-ft of industrial water.

^e Includes 65.33 ac-ft of industrial water.

^fIncludes 145.26 ac-ft of industrial, 148.20 ac-ft of municipal, and 699.25 ac-ft of other water.

^g Includes 0.50 ac-ft of recreational water.

^h Includes 19.73 ac-ft of industrial, 1,985.65 ac-ft of municipal, and 0.50 ac-ft of recreational water.

¹ Includes 38.42 ac-ft of industrial, 122.19 ac-ft of municipal, and 2.14 ac-ft of stock water.

^j Includes 38.42 ac-ft of industrial, 778.37 ac-ft of municipal, and 2.14 ac-ft of stock water.

^k Includes 98.67 ac-ft of municipal water.

¹ Includes 1.41 ac-ft of industrial and 526.25 ac-ft of municipal water.

^m Includes 14.25 ac-ft of industrial and 784.30 ac-ft of municipal water.

ⁿ Includes 2,440.93 ac-ft of industrial, 1,946.22 ac-ft of municipal, and 10.99 ac-ft of other water.

Site	Distance	Width of	Nearby	Nearby	Nearby previous monitoring			
	from Kansas River (miles)	floodplain (miles)ª	weather station ^b	stream gage ^c	Nearby previous well?	Distance from index well (ft)	Monitoring period	
RL01	0.20	1.86	Manhattan Airport	None	Yes	<450 ft	9/65–12/83	
RL02	0.36	2.91	None	None	Yes	<30 ft	12/66–3/04	
WB01	0.45	2.75	Wamego	06887500	Yes	<900 ft	6/66–3/04	
SN01	1.00	4.82	Rossville	06888700 ^d	Yes	<30 ft	6/78–3/04	
SN02	1.20	2.55	None	06888990	Yes	<30 ft	7/50–3/04	

Table 2-Additional characteristics of the western wells in the Kansas River alluvial aquifer index well network.

^aDistance perpendicular to valley axis using the Kansas Biological Survey's FLDPLN (floodplain) model.

^bName of the weather station within 5 miles of well.

°USGS ID# of the stream gage within 5 miles of well.

^dStream gage is on Cross Creek at Rossville; well is 0.40 miles from Cross Creek.

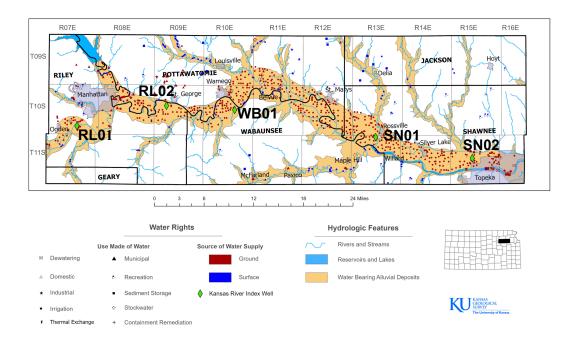


Figure 2—Map of index wells in the western reach of the Kansas River network; data from these wells can be viewed in real time on the KGS website (http://www.kgs.ku.edu/Hydro/KansasRiver/index.html).

4.1.1 Riley County Index Well 1

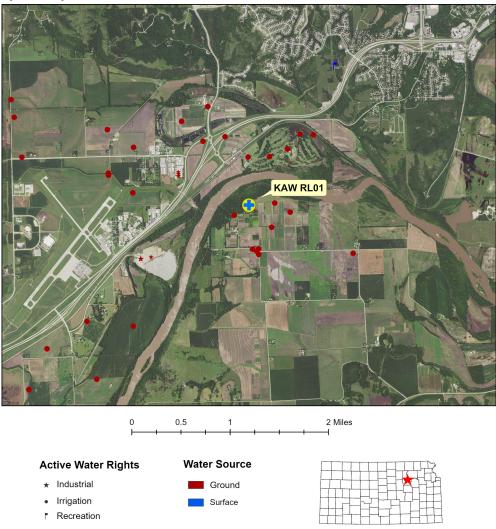


Figure 3—Aerial view of Riley County index well 1 (RL01) and nearby points of diversion. The Manhattan Regional Airport is to the west of the well, and the city of Manhattan is to the north and northeast.

Figure 3 is an aerial view of the Riley County index well 1 site (T. 10 S., R. 07 E., 34 BAA 01) at a scale that shows the site of the index well, the Kansas River, and nearby wells that have active water rights. The well was installed on 7/18/18 with a 5 ft screen at the bottom of the aquifer. The aquifer consists of sand with minor silt lenses (see Appendix for WWC-5 report and associated direct-push electrical conductivity log). The well was developed (hand bailed 3.5 well volumes) and monitoring began on 3/21/19; telemetry equipment was installed on 1/6/20. Slug tests were performed on 9/18/19; test results indicate a reasonable connection to the aquifer with a hydraulic conductivity value of 20–25 ft/d. Previously, water levels were monitored (6 to 16 times per year prior to 1971, quarterly thereafter) from September 1965 to December 1983 at a well (USGS ID # 390841096380802) about 450 ft south of the index well.

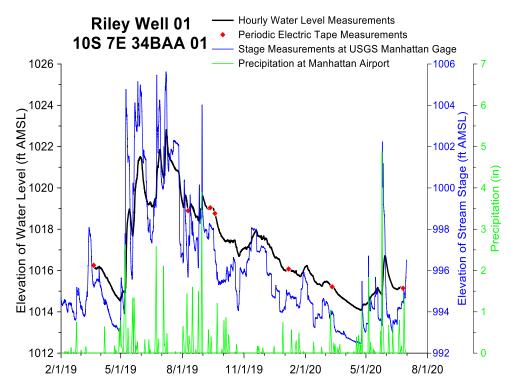


Figure 4—Riley County index well 1 hydrograph with stream stage and precipitation data—total data run to 6/25/20. A water-level elevation of 1,016 ft corresponds to a depth to water of 21 ft below land surface (lsf). The top of the screen is 45 ft below lsf (elevation of 992 ft), and the bottom of the aquifer is 50.2 ft below lsf (elevation of 986.8 ft). The screen terminates 0.2 ft above the bottom of the aquifer. Electric-tape measurements are in good agreement with transducer. Manhattan Airport weather station is across the river from the well (less than 2 miles); Manhattan gage is 8 miles downstream from the well.

- Water-level changes appear to be primarily driven by changes in stream stage. The aquifer responds relatively rapidly to changes in stream stage, but responses are dampened with respect to those changes.
- Given the strong relationship with stream stage, it is difficult to discern the relationship between precipitation and water-level changes.
- The influence of nearby pumping wells is not discernible.
- Well does not appear to have a discernible response to changes in barometric pressure, which is consistent with the shallow depth to water and the sandy vadose zone (determined from electrical conductivity logging).

4.1.2 Riley County Index Well 2

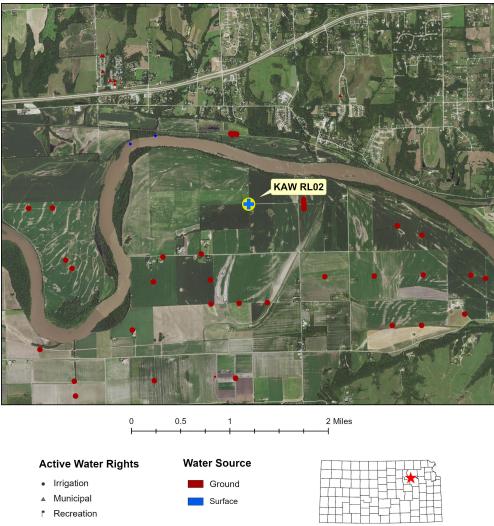


Figure 5—Aerial view of Riley County index well 2 (RL02) and nearby points of diversion. The city of St. George is across the river to the north, and the city of Manhattan is about 4 miles to the west.

Figure 5 is an aerial view of the Riley County index well 2 site (T. 10 S., R. 09 E., 17 BDD 01) at a scale that shows the site of the index well, the Kansas River, and nearby wells that have active water rights. The well was installed on 5/15/18 with a 10 ft screen at the bottom of the aquifer. The aquifer consists of sand with minor silt lenses (see Appendix for WWC-5 report and associated direct-push conductivity log). The well was developed (hand bailed 5.8 well volumes), a sensor and telemetry equipment were installed, and monitoring began on 8/15/18. Slug tests were performed on 9/18/19; test results indicate a good connection to the aquifer with a hydraulic conductivity value of 400–500 ft/d. Previously, water levels were monitored (2 to 12 times per year) from December 1966 to March 2004 at a well (USGS ID #391055096261701) within 30 ft of the index well.

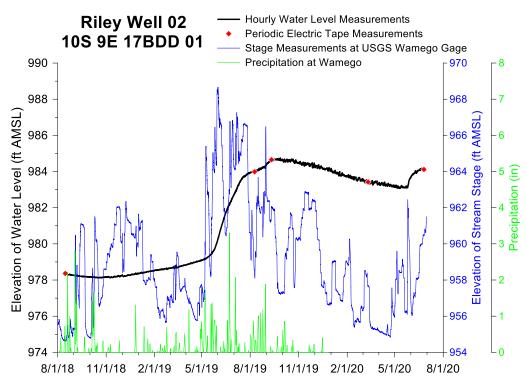


Figure 6—Riley County index well 2 hydrograph with stream stage and precipitation data—total data run to 6/25/20. A water-level elevation of 984 ft corresponds to a depth to water of 15 ft below land surface (lsf). The top of the screen is 27 ft below lsf (elevation of 972 ft), and the bottom of the aquifer is 37.2 ft below lsf (elevation of 961.8 ft). The screen terminates 0.2 ft above the bottom of the aquifer. Electric-tape measurements are in good agreement with transducer. Wamego gage is 10 miles downstream from the well. Precipitation measured at Wamego, approximately 6.5 miles to the east of the well; precipitation record ended on 12/27/19.

- Water levels exhibit a very muted and lagged response to stream-stage changes, despite being within 0.4 mi of the river. This indicates that there is a low-permeability interval limiting the connection between the river and the portion of the aquifer in the vicinity of the well.
- Water levels have an extremely muted response to precipitation, despite being within 20 ft of the land surface. This indicates a low permeability layer above the water table, which is consistent with the results of electrical conductivity logging.
- The influence of nearby pumping wells is difficult to discern, likely as a result of the very small water use within a 1 mi radius of the well.
- Water levels fluctuate more after slug tests on 9/18/19 (shortly after third electric tape measurement on plot), likely as a result of further well development produced by the slug tests.

4.1.3 Wabaunsee County Index Well 1

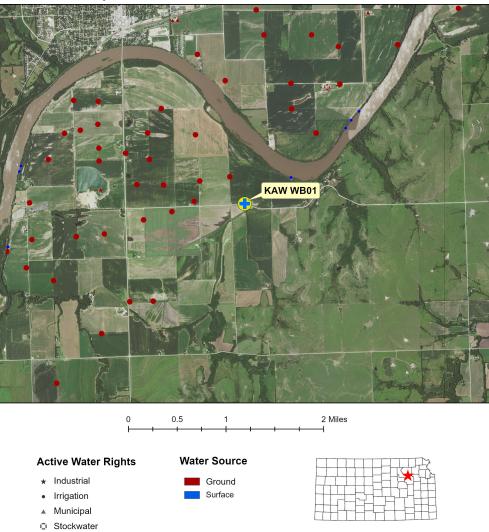


Figure 7—Aerial view of Wabaunsee County index well 1 (WB01) and nearby points of diversion. The city of Wamego is about 2 miles to the northwest.

Figure 7 is an aerial view of the Wabaunsee County index well 1 site (T. 10 S., R. 10 E., 15 DDC 01) at a scale that shows the site of the index well, the Kansas River, and nearby wells that have active water rights. The well was installed on 5/10/18 with a 15 ft screen terminating approximately 7 ft above the bottom of the aquifer. The aquifer consists of sand with a few thin silt lenses (see Appendix for WWC-5 report and associated direct-push conductivity log). A sensor was placed in the well and monitoring began on 3/1/19. The well was developed (hand bailed 4.4 well volumes) on 3/20/19, and telemetry equipment was installed the following day (3/21/19). Slug tests were performed on 10/17/19; test results indicate a good connection to the aquifer with a hydraulic conductivity value of 120–160 ft/d. Previously, water levels were monitored (2 to 12 times per year) from June 1966 to March 2004 at a well (USGS ID #391029096171301) within 900 ft of the index well.

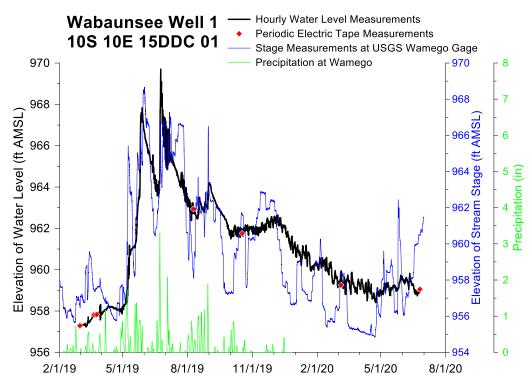


Figure 8—Wabaunsee County index well 1 hydrograph with stream stage and precipitation data—total data run to 6/25/20. A water-level elevation of 960 ft corresponds to a depth to water of 11 ft below land surface (lsf). The top of the screen is 22 ft below lsf (elevation of 949 ft), and the bottom of the aquifer is estimated to be 44 ft below lsf (elevation of 927 ft). The screen terminates 7 ft above the bottom of the aquifer. Electric-tape measurements are in good agreement with transducer. Wamego gage is 2 miles upstream from the well. Precipitation measured at Wamego, about 2.5 miles to the northwest of the well; precipitation record ended on 12/27/19.

- Water levels clearly respond to precipitation and, to a lesser extent, changes in stream stage.
- Anomalous apparent water-level fluctuations occur intermittently in the first half of the record and nearly continuously in the second half. These fluctuations are artifacts produced by water blocking the vent tube of the gauge transducer; transducer and cable were replaced while this report was being prepared.
- There is no indication of nearby pumping of groundwater.

4.1.4 Shawnee County Index Well 1

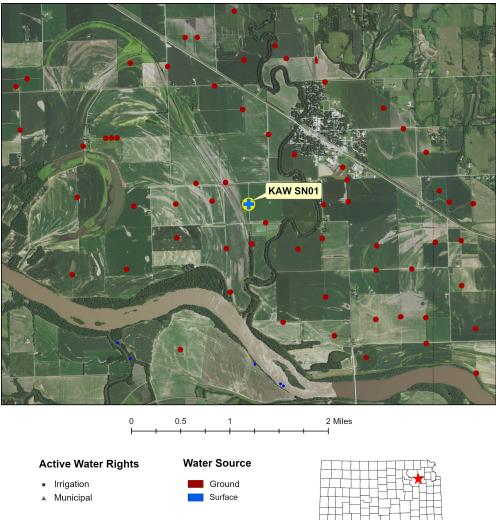


Figure 9—Aerial view of Shawnee County index well 1 (SN01) and nearby points of diversion. The city of Rossville is about a mile to the northeast. Cross Creek is within the dark green, sinuous line of vegetation to the east of the well.

Figure 9 is an aerial view of the Shawnee County index well 1 site (T. 11 S., R. 13 E., 04 AAD 01) at a scale that shows the site of the index well, the Kansas River, and nearby wells that have active water rights. The well was installed on 5/16/18 with a 10 ft screen terminating at the bottom of the aquifer. The aquifer consists of sand with some silt lenses and is overlain by clay and silty sands (see Appendix for WWC-5 report and associated direct-push conductivity log). The well was developed (hand bailed 5.7 well volumes) on 8/13/18, and sensor and telemetry equipment were installed on the same day. Slug tests were performed on 9/18/19; test results indicate a good connection to the aquifer with a hydraulic conductivity value of 180–240 ft/d. Previously, water levels were monitored (once to four times per year) from June 1978 to March 2004 at a well (USGS ID # 390731095575801) within 30 ft of the index well.

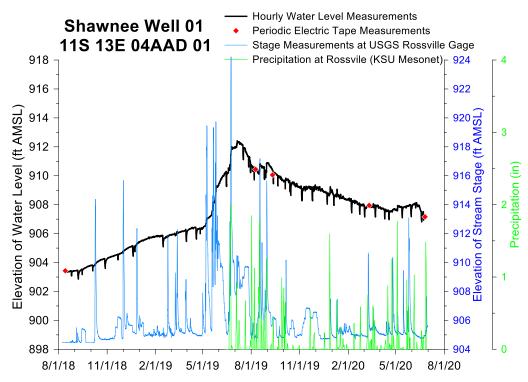


Figure 10—Shawnee County index well 1 hydrograph with stream stage and precipitation data—total data run to 6/25/20. A water-level elevation of 908 ft corresponds to a depth to water of 20 ft below land surface (lsf). The top of the screen is 36.5 ft below lsf (elevation of 891.5 ft), and the bottom of the aquifer is 46.5 ft below lsf (elevation of 881.5 ft). The screen terminates at the bottom of the aquifer. Electric-tape measurements are in good agreement with transducer. USGS gage is on Cross Creek at Rossville about 1 mile from well; there is no USGS gage on the Kansas River within 17 river miles of the well. The well is about 0.4 miles from Cross Creek and 1 mile from the Kansas River. Rossville precipitation records began on 6/13/19 (weather station slightly more than a mile from well).

- Water levels appear to respond to both stream-stage changes and precipitation. Response to stream stage appears somewhat muted.
- Water levels fluctuate more after slug tests on 9/18/19 (shortly after third electric tape measurement on plot), likely as a result of further well development produced by the slug tests.
- A clear pumping signal is observable on the graph, but pumping is not restricted to the growing season; periodic pumping occurs throughout the year. Water use within a 2 mi radius of the well is the highest of any of the wells in the western reach.

4.1.5 Shawnee County Index Well 2

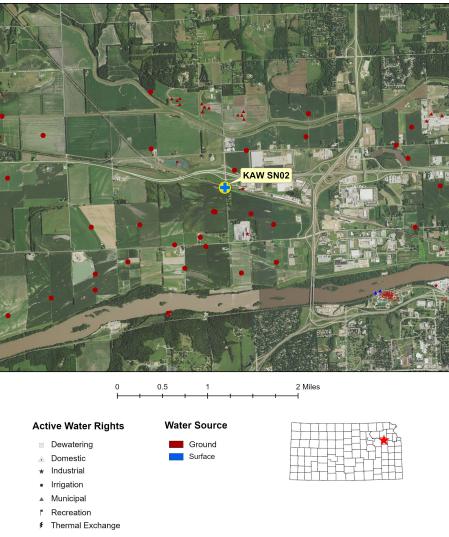


Figure 11—Aerial view of Shawnee County index well 2 (SN02) and nearby points of diversion. The city of Topeka is to the south and east. Just to the north of the well is a major rail line.

Figure 11 is an aerial view of the Shawnee County index well 2 site (T. 11 S., R. 15 E., 16 DCA 02) at a scale that shows the site of the index well, the Kansas River, and nearby wells that have active water rights. The well was installed on 10/18/18 with a 20 ft screen terminating approximately 7.5 ft above the bottom of the aquifer. The aquifer consists of sand with some silt lenses and is overlain by a thick (27.5 ft) interval of clay and silt (see Appendix for WWC-5 report and associated direct-push conductivity log). A sensor was placed in the well and monitoring began on 1/10/19. The well was developed (hand bailed 4.0 well volumes) on 3/20/19, and telemetry equipment was installed the following day (3/21/19). Slug tests were performed on 9/16/19; test results indicate a good connection to the aquifer with a hydraulic conductivity value of 220–360 ft/d. Previously, water levels were monitored every five days from July 1950 to October 1980 and then once to twelve times per year in most years to February 2004 at a well (USGS ID #390519095445301) within 30 ft of the index well.

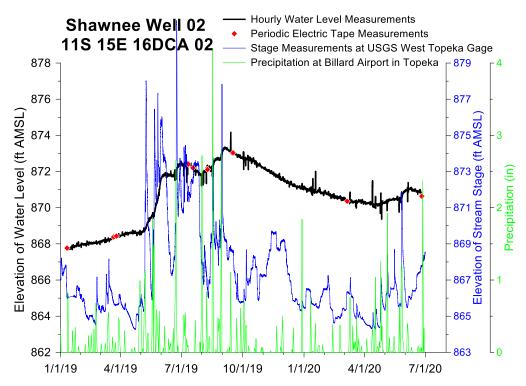


Figure 12—Shawnee County index well 2 hydrograph with stream stage and precipitation data—total data run to 6/25/20. A water-level elevation of 870 ft corresponds to a depth to water of 30 ft below land surface (lsf). The top of the screen is 44 ft below lsf (elevation of 856 ft), and the bottom of the aquifer is estimated to be 71.5 ft below lsf (elevation of 828.5 ft). The screen terminates 7.5 ft above the bottom of the aquifer. Electric-tape measurements are in good agreement with transducer. USGS gage is 3 miles downstream from well. Precipitation measured at Billard Airport, which is approximately 7 miles to the east of the well.

- Water levels appear to respond to both stream-stage changes and precipitation. Response to stream stage are muted.
- The spikes in the water-level record, which appear to be related to nearby rail and heavy truck traffic, indicate a confined aquifer, consistent with the electrical conductivity log.
- A pumping signal is small but discernible on the graph; periodic pumping occurs throughout the year.

4.2 Eastern Reach — East of Topeka to Kansas City

Six index wells are located in this reach of the Kansas River alluvial aquifer (fig. 13). The GEMS4-1 well, which is on the long-term Geohydrologic Experimental and Monitoring Site (GEMS), was drilled in 1990, while the five other wells were drilled between August 2017 and July 2018. Tables 3 and 4 summarize the characteristics of these six wells.

Site	Average	Average 2019	Bedrock depth	Screened	2018 water use (ac-ft) ^b		
	2019 WL elev. (ft)ª	saturated thickness (ft)ª	(estimated ft below land surface)	interval (ft below land surface)	1 mi radius	2 mi radius	5 mi radius
JF01	845.1	29.8	46.7	33–43	329	3,118°	4,370 ^d
DG01	816.8	50.8	68	46.5–66.5	188	2,090 ^e	3,313 ^f
GEMS4-1	809.5	54.5	70	39.5–69.5	389 ^g	1,041 ^g	2,969 ^f
DG02	795.1	52.1	74	55–70	39	131 ^h	2,089 ⁱ
LV01	765.4	45.6	66.2	45–65	7,392 ^j	8,827 ^k	12,571 ¹
WY01	731.6	33.6	69	50–65	808 ^m	875 ⁿ	1,005°

Table 3-Characteristics of the eastern wells in the Kansas River alluvial aquifer index well network.

^a Averaging period is full year unless stated otherwise:

DG02 1/10/19 - 12/31/19.

^b Irrigation use unless noted.

^c Includes 2,064 ac-ft of industrial and 358 ac-ft of municipal water.

^d Includes 2,064 ac-ft of industrial, 642 ac-ft of municipal, and 23 ac-ft of recreational water.

^e Includes 451 ac-ft of industrial and 809 ac-ft of municipal water.

^f Includes 456 ac-ft of industrial, 871 ac-ft of municipal,13 ac-ft of recreational, and 100 ac-ft of other water.

^g Includes 26 ac-ft of industrial and 363 ac-ft of municipal water.

^h Includes 5 ac-ft of industrial and 50 ac-ft of municipal water.

ⁱ Includes 430 ac-ft of industrial, 583 ac-ft of municipal, and 100 ac-ft of other water.

^j Includes 7,389 ac-ft of municipal water.

^k Includes 4 ac-ft of industrial and 8,820 ac-ft of municipal water.

¹ Includes 67 ac-ft of industrial and 12,451 ac-ft of municipal water.

^m Includes 1 ac-ft of industrial and 807 ac-ft of municipal water.

ⁿ Includes 68 ac-ft of industrial and 807 ac-ft of municipal water.

° Includes 141 ac-ft of industrial, 807 ac-ft of municipal, and 57 ac-ft of other water.

Site	Distance	Width of	Nearby	Nearby	Nearby previous monitoring			
	from Kansas River (miles)	floodplain (miles)ª	weather station ^b	stream gage°	Nearby previous well?	Distance from index well (ft)	Monitoring Period	
JF01	0.35	2.53	None	None	Yes	<30 ft	6/66–3/04	
DG01	0.84	3.10	Lawrence Airport	06891080	Yes	<30 ft	2/52–5/15	
GEMS4-1	2.10	3.00	Lawrence Airport	06891080	No	NA	NA	
DG02	1.61	3.55	Eudora	06891080	Yes	<30 ft	5/66–7/89	
LV01	0.20	2.12	None	06892350	No	NA	NA	
WY01	0.09	1.10	Shawnee	06892518	Yes	<850 ft	3/67–12/99	

Table 4—Additional characteristics of the eastern wells in the Kansas River alluvial aquifer index well network.

^aDistance perpendicular to the valley axis using the Kansas Biological Survey's FLDPLN (floodplain) model.

^bName of the weather station within 5 miles of well.

°USGS ID# of the stream gage within 5 miles of well.

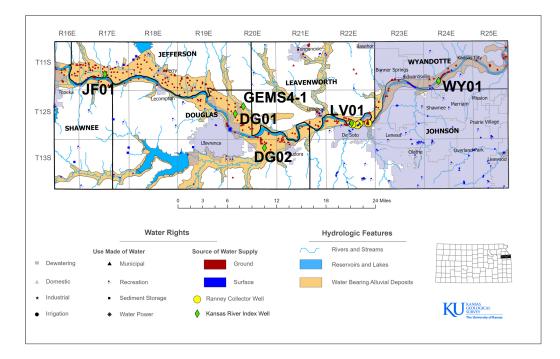


Figure 13—Map of index wells in the eastern reach of the Kansas River network; data from these wells can be viewed in real time on the KGS website (http://www.kgs.ku.edu/Hydro/KansasRiver/index.html).

4.2.1 Jefferson County Index Well 1

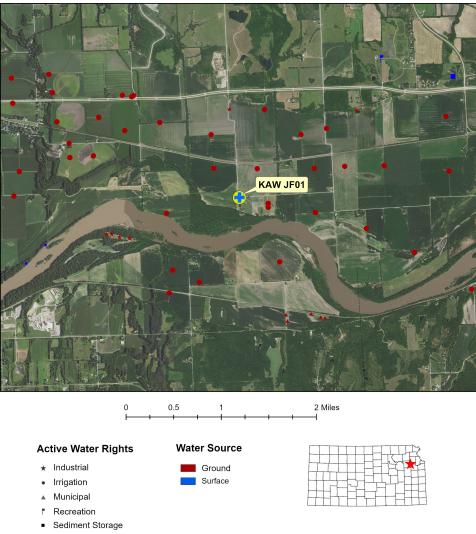


Figure 14—Aerial view of Jefferson County index well 1 (JF01) and nearby points of diversion. Perry Lake is approximately 5 miles northeast of the well.

Figure 14 is an aerial view of the Jefferson County index well 1 site (T. 11 S., R. 17 E., 27 BBB 01) at a scale that shows the site of the index well, the Kansas River, and nearby wells that have active water rights. The well was installed on 5/14/18 with a 10 ft screen that terminates 3.6 ft above the bottom of the aquifer. The aquifer consists of sand with minor silt lenses and is overlain by clay and silt (see Appendix for WWC-5 report and associated direct-push electrical conductivity log). The well was developed (hand bailed 6.1 well volumes) on 7/27/18, and sensor and telemetry equipment were installed on 8/10/18. Slug tests were performed on 9/16/19; test results indicate an excellent connection to a highly permeable aquifer with a hydraulic conductivity value of 140–190 ft/d. Previously, water levels were monitored (two to four readings per year) from June 1966 to March 2004 at a well (USGS ID #390407095310901) 30 ft south of the index well.

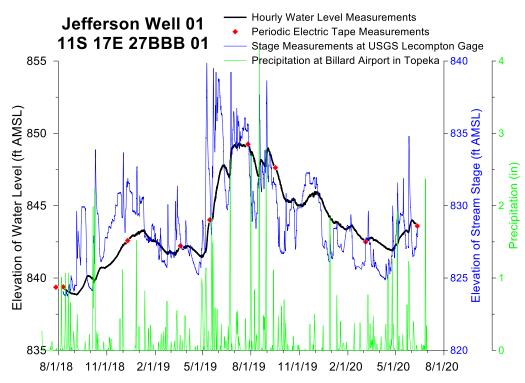


Figure 15—Jefferson County index well 1 hydrograph with stream stage and precipitation data—total data run to 6/11/20. A water-level elevation of 845 ft corresponds to a depth to water of 17 ft below land surface (lsf). The top of the screen is 33 ft below lsf (elevation of 829 ft), and the bottom of the aquifer is 46.6 ft below lsf (elevation of 815.4 ft). The screen terminates 3.6 ft above the bottom of the aquifer. Electric-tape measurements are in good agreement with transducer. USGS gage is 9 miles downstream from well. Precipitation measured at Billard Airport, which is approximately 6 miles to the west of the well.

- Water-level changes appear to be primarily driven by changes in stream stage, although the aquifer response to stream-stage changes is muted and shifted in time.
- Given the relationship between water levels and stream stage, it is difficult to discern the effect of precipitation.
- The effect of nearby pumping wells on water levels appears very small despite the amount of pumping in the area.
- Well response to barometric pressure appears to depend on position of water level. Responses below an elevation of 842 ft are difficult to discern; responses at higher elevations appear to be consistent with a confined aquifer.

4.2.2 Douglas County Index Well 1

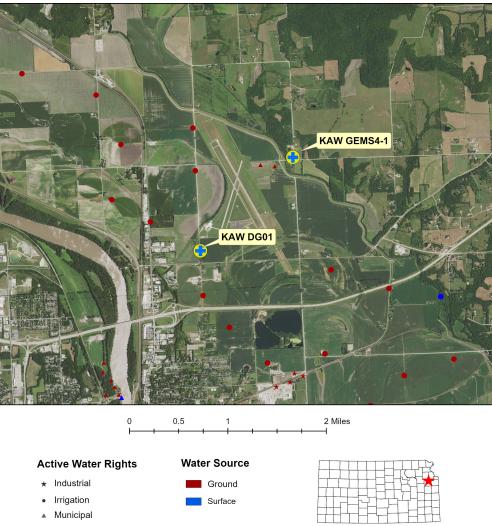


Figure 16—Aerial view of Douglas County index well 1 (DG01), GEMS4-1 index well, and nearby points of diversion. The Lawrence Municipal Airport is to the immediate east of the well, and the city of Lawrence is to the south and west.

Figure 16 is an aerial view of the Douglas County index well 1 site (T. 12 S., R. 20 E., 17 CCBC 01) at a scale that shows the site of the index well, the GEMS4-1 index well, the Kansas River, and nearby wells that have active water rights. The well was installed on 8/11/17 with a 20 ft screen that terminates 1.0 ft above the bottom of the aquifer. The aquifer consists of sand and gravel from 30 to 67.5 ft below land surface and is overlain by clay and silt (see Appendix for WWC-5 report and associated direct-push electrical conductivity log). The well was developed (surging followed by hand bailing of 3.2 well volumes), a sensor was installed, and monitoring began on 8/15/17; telemetry equipment was installed on 9/7/17. Slug tests were performed on 9/11/19; test results indicate an excellent connection to a highly permeable aquifer with a hydraulic conductivity value of 190–330 ft/d. Previously, water levels were monitored (readings reported every five days until 2000, less regularly after that) from February 1952 to May 2015 at a well (USGS ID #390006095132301) less than 30 ft south of the index well.

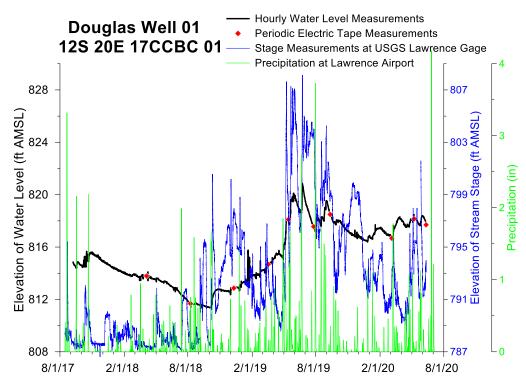


Figure 17—Douglas County index well 1 hydrograph with stream stage and precipitation data—total data run to 6/11/20. A water-level elevation of 816 ft corresponds to a depth to water of 18 ft below land surface (lsf). The top of the screen is 46.5 ft below lsf (elevation of 787.5 ft), and the bottom of the aquifer is 67.5 ft below lsf (elevation of 786.5 ft). The screen terminates 1.0 ft above the bottom of the aquifer. Electric-tape measurements are in good agreement with transducer. USGS gage is approximately 2 miles downstream from well, but the river is within 0.85 miles of the well upstream of the gage. Precipitation measured at Lawrence Municipal Airport, which is a short distance northeast of the well.

- Water-level changes appear to be primarily driven by precipitation.
- Given the relationship between water levels and precipitation, it is difficult to discern the effect of stream-stage changes.
- The effect of nearby pumping wells on water levels appears very small, consistent with the relatively small amount of pumping within a mile of the well.
- Well response to barometric pressure appears to be consistent with a confined aquifer.

4.2.3 GEMS4-1 Index Well

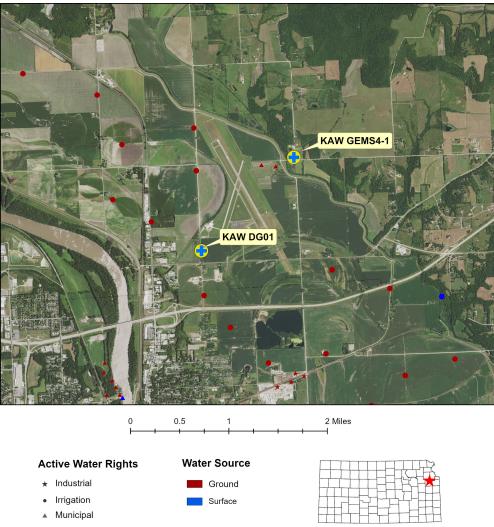


Figure 18—Aerial view of GEMS4-1 index well, Douglas County index well 1 (DG01), and nearby points of diversion. The Lawrence Municipal Airport is to the west of the well, and the city of Lawrence is to the south and southwest.

Figure 18 is an aerial view of the GEMS4-1 index well site (T. 12 S., R. 20 E., 08 DDD 01) at a scale that shows the site of the index well, Douglas County index well 1, the Kansas River, and nearby wells that have active water rights. The GEMS4-1 well was installed on 6/25/90 with a 30 ft screen that terminates less than 1.0 ft above the bottom of the aquifer. The aquifer consists of sand and gravel from 38.5 to 70.3 ft below land surface and is overlain by clay and silt (see Appendix for direct-push electrical conductivity log from a nearby [within 30 ft] location). Sensor and telemetry equipment were installed on 11/5/18. An initial round of slug tests was performed on 9/13/19; test results indicate the presence of a well skin of low hydraulic conductivity. The well was developed (surge block with suction pump moving in 2 ft increments along the screen) on 11/19/19. A second round of slug tests on 11/20/19 indicates a reasonable connection to a highly permeable aquifer with a hydraulic conductivity value of 70–140 ft/d. There was no previous monitoring at this site.

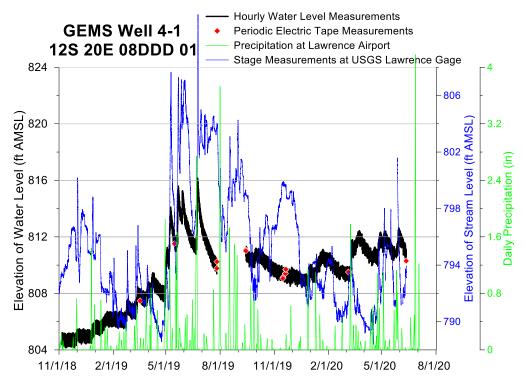


Figure 19—GEMS4-1 index well hydrograph with stream stage and precipitation data—total data run to 6/11/20. A water-level elevation of 810 ft corresponds to a depth to water of 15 ft below land surface (lsf). The top of the screen is 39.5 ft below lsf (elevation of 785.5 ft), and the bottom of the aquifer is 70.3 ft below lsf (elevation of 754.7 ft). The screen terminates less than 1 ft above the bottom of the aquifer. Electric-tape measurements are in good agreement with transducer. USGS gage is 3.2 miles from the well but the river is within 2.1 miles of the well upstream of the gage. Precipitation measured at Lawrence Municipal Airport, which is 0.9 miles southwest of the well.

- Water-level changes appear to be primarily driven by precipitation.
- The band in the water-level record (approximately 1 ft in width) is created by nearby (a short distance to the west) supply wells for a rural water district turning on and off two to three times per day.
- The impact of stream-stage changes in the Kansas River appears very small. However, the role of a nearby stream, Mud Creek, has yet to be clarified.
- The form of the water-level responses to pumping indicates a confined aquifer, consistent with the direct-push electrical conductivity profile.

4.2.4 Douglas County Index Well 2

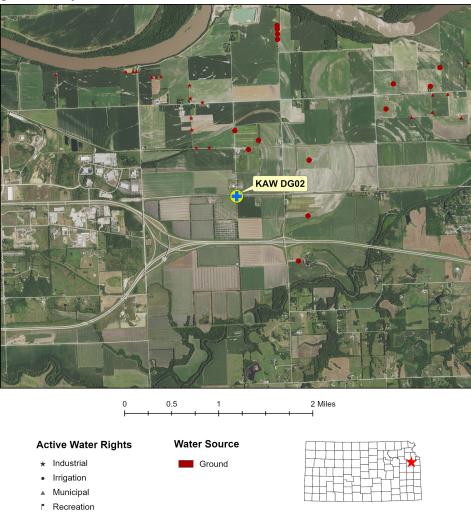


Figure 20—Aerial view of Douglas County index well 2 (DG02) and nearby points of diversion. The eastern edge of the city of Lawrence is to the west of the well, and the western edge of the city of Eudora is just visible to the east.

Figure 20 is an aerial view of the Douglas County index well 2 site (T. 13 S., R. 20 E., 11 BAA 02) at a scale that shows the site of the index well, the Kansas River to the north, the Wakarusa River to the south, and nearby wells that have active water rights. The well was installed on 7/17/18 with a 15 ft screen that terminates 4.0 ft above the bottom of the aquifer. The aquifer consists of sand and gravel from 37 to 62 ft below land surface and sand and gravel with silt from 62 to 74 ft below land surface. The aquifer is overlain by clay and silt (see Appendix for WWC-5 report and associated direct-push electrical conductivity log). The well was developed (surging followed by hand bailing of 5.0 well volumes) on 7/25/18. A sensor was installed and monitoring began on 8/15/17; telemetry equipment was installed on 9/7/17. Slug tests were performed on 9/13/19; test results indicated an excellent connection to a highly permeable aquifer with a hydraulic conductivity value of 100–180 ft/d. Previously, water levels were monitored (readings reported every five days until October 1974, then three to eight times a year after that) from May 1966 to July 1989 at a well (USGS ID #385624095093701) to the north (within 30 ft) of the index well.

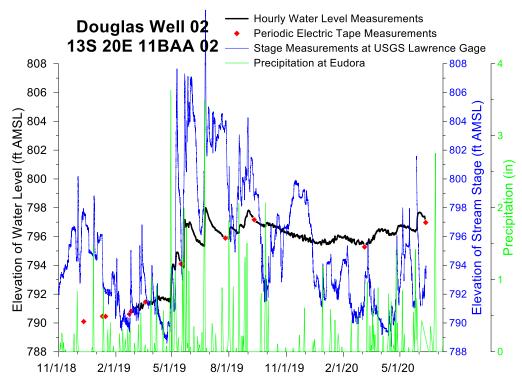


Figure 21—Douglas County index well 2 hydrograph with stream stage and precipitation data—total data run to 6/11/20. A water-level elevation of 796 ft corresponds to a depth to water of 21 ft below land surface (lsf). The top of the screen is 55 ft below lsf (elevation of 762 ft), and the bottom of the aquifer is 74 ft below lsf (elevation of 743 ft). The screen terminates 4 ft above the bottom of the aquifer. Electric-tape measurements are in good agreement with transducer. Well is 1.6 miles from the Kansas River channel, and the USGS gage is 3.5 miles upstream from that point. Well is 1.0 mile from the Wakarusa River channel. Precipitation measured at NOAA station in Eudora, which is 3.6 miles east of the well.

- Water-level changes appear to be primarily driven by precipitation.
- Given the relationship between water levels and precipitation, it is difficult to discern the effect of stream-stage changes in either the Kansas or Wakarusa rivers.
- There is no detectable signal of nearby pumping, consistent with the lowest amount of pumping within a 2 mi radius for any of the network wells.
- Well response to barometric pressure appears to be consistent with a confined aquifer.

4.2.5 Leavenworth County Index Well 1

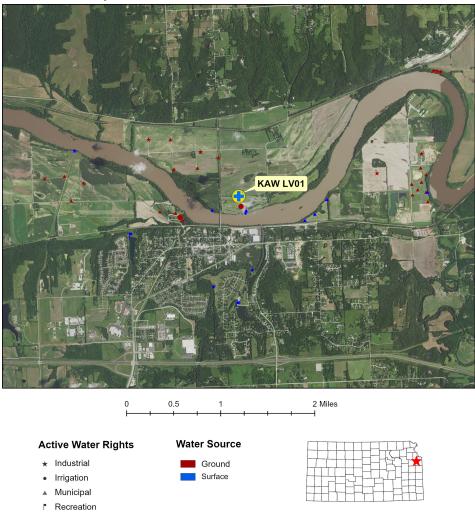


Figure 22—Aerial view of Leavenworth County index well 1 (LV01) and nearby points of diversion. The city of De Soto is south of the well.

Figure 22 is an aerial view of the Leavenworth County index well 1 site (T. 12 S., R. 22 E., 27 BBA 01) at a scale that shows the site of the index well, the Kansas River, and nearby wells that have active water rights. The well was installed on 5/8/18 with a 20 ft screen that terminates 1.1 ft above the bottom of the aquifer. The aquifer consists of sand from 27 to 66 ft below land surface. The aquifer is overlain by sand with intermittent sandy silt layers (see Appendix for WWC-5 report and associated direct-push electrical conductivity log). The well was developed (hand bailing of 4.0 well volumes) on 7/25/18, and a sensor and telemetry equipment were installed on 8/6/18. Slug tests were performed on 9/11/19; test results indicate an excellent connection to a highly permeable aquifer with a hydraulic conductivity value of 190–270 ft/d. There is no record of previous monitoring in the vicinity of this site; site was primarily chosen because of its proximity to the USGS stream gage at the De Soto bridge.

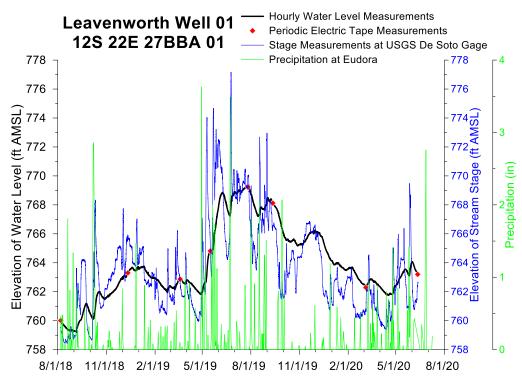


Figure 23—Leavenworth County index well 1 hydrograph with stream stage and precipitation data—total data run to 6/11/20. A water-level elevation of 764 ft corresponds to a depth to water of 22 ft below land surface (lsf). The top of the screen is 45 ft below lsf (elevation of 741 ft), and the bottom of the aquifer is 66.1 ft below lsf (elevation of 719.9 ft). The screen terminates 1.1 ft above the bottom of the aquifer. Electric-tape measurements are in reasonable agreement with transducer. Well is 0.2 miles from the Kansas River channel, and the USGS gage is 0.2 miles upstream from that point; at an approximate elevation change of 2 ft/mi along the river channel, the river stage perpendicular to the well would need to be shifted about a half foot lower to be comparable to the water-level elevation in the graph. Precipitation measured at NOAA station in Eudora, which is 7.9 miles southwest of the well.

- Water-level changes appear to be primarily driven by changes in stream stage.
- The effect of precipitation appears small.
- The effect of nearby pumping wells on water levels appears very small despite the large amount of municipal pumping in the area. This may be an indication that most of the pumped water is being drawn from the river.
- Well response to barometric pressure is small.
- The relative changes in the elevation difference between the water level in the well and that in the river suggest that the general groundwater flow direction down the river valley shifted somewhat such that the component directed toward the river was greater after the high flows of mid-2019 than before.

4.2.6 Wyandotte County Index Well 1

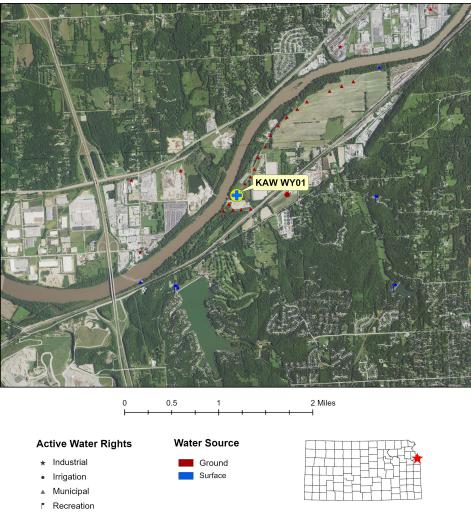


Figure 24—Aerial view of Wyandotte County index well 1 (WY01) and nearby points of diversion. The city of Lake Quivira is to the immediate south of the well.

Figure 24 is an aerial view of the Wyandotte County index well 1 site (T. 11 S., R. 24 E., 29 DDC 03) at a scale that shows the site of the index well, the Kansas River, and nearby wells that have active water rights. The well was installed on 5/9/18 with a 15 ft screen that terminates 4 ft above the bottom of the aquifer. The aquifer consists mainly of sand from 38.5 ft below land surface to bedrock at approximately 69 ft below land surface with some silt near the bottom. The aquifer is overlain by layers of clay, sand, and silt (see Appendix for WWC-5 report and associated direct-push electrical conductivity log). The well was developed (hand bailing of 5.2 well volumes) and sensor and telemetry equipment were installed on 8/9/18. Slug tests were performed on 9/13/19; test results indicate an excellent connection to a highly permeable aquifer with a hydraulic conductivity value of 260–430 ft/d. Previously, water levels were monitored (readings reported 4 to 12 times a year) from March 1967 to December 1999 at a well (USGS ID #390319094460802) to the southwest (within 850 ft) of the index well.

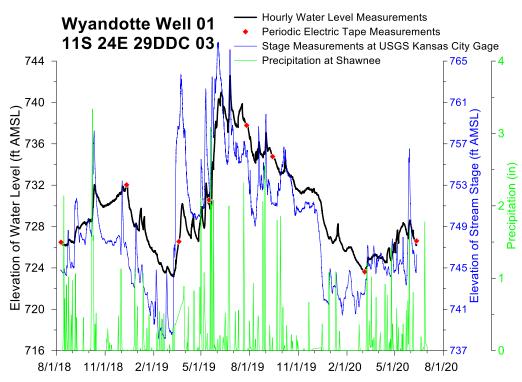


Figure 25—Wyandotte County index well 1 hydrograph with stream stage and precipitation data—total data run to 6/11/20. A water-level elevation of 732 ft corresponds to a depth to water of 35 ft below land surface (lsf). The top of the screen is 50 ft below lsf (elevation of 717 ft), and the bottom of the aquifer is 69 ft below lsf (elevation of 698 ft). The screen terminates 4 ft above the bottom of the aquifer. Electric-tape measurements are in reasonable agreement with transducer. Well is 0.09 miles from the Kansas River channel, and the USGS gage is approximately 1.6 miles upstream from that point; at an approximate elevation change of about 2 ft/mi along the river channel, the river stage perpendicular to the well would need to be shifted about 3 ft lower to be comparable to the water-level elevation in the graph. Precipitation measured at Shawnee, which is 3.75 miles south-southwest of the well.

- Water-level changes appear to be primarily driven by changes in stream stage.
- The effect of municipal pumping wells very close to the index well is clear; numerous cusp-shaped features are indications of pumps turning on and off.
- The effect of precipitation appears small.
- Well response to barometric pressure is small.
- The river stage appears to be substantially higher than the water level in the aquifer at all times, suggesting that pumping in the vicinity of the well is inducing flow away from the river.

5 Summary of Phase One Accomplishments and Future Plans

5.1 Phase One Accomplishments

- Selected 10 sites for new monitoring wells in the Kansas River corridor from west of Manhattan to near the junction with the Missouri River in Kansas City.
- Obtained direct-push electrical conductivity logs at all 10 well sites; logs were used to understand site hydrostratigraphy and to select the screened intervals for each well.
- Drilled and constructed all 10 wells. Installed sensors and telemetry equipment and initiated monitoring at all of the wells.
- Converted an existing well into a monitoring well by the installation of a sensor and telemetry equipment.
- Served telemetered data from 11 wells on the KGS website in real time. Visited each well quarterly to take manual measurements of water levels and download data from sensors.
- Compared water-level responses to stream-stage changes and precipitation, and completed an initial interpretation of hydrographs from all 11 wells.
- Developed all 11 wells to ensure a good connection between the well and the aquifer; performed and analyzed slug tests at all 11 wells to confirm that connection.
- Selected sites for three additional monitoring wells.

5.2 Planned Activities, Remainder of 2020 and 2021

- Continue monitoring and processing water-level data from all wells in the network. Visit each well quarterly to take manual measurements of water levels and download data from sensors.
- Collect and analyze groundwater samples at all 11 wells.
- Obtain electrical conductivity profiles, select intervals for well screens, and install wells at the three new sites. Install sensors and telemetry equipment and initiate monitoring at these wells.
- Obtain direct-push electrical conductivity logs at another 16 locations (in four to five traverses from the river to the valley wall) at sites along the corridor.
- Using the results of the direct-push logging and the WWC-5 database, perform a hydrostratigraphic analysis of the Kansas River alluvial aquifer.
- Based on the previous work of the project, select two additional sites for monitoring wells.
- Obtain electrical conductivity profiles, select intervals for well screens, and install wells at these two additional sites. Install sensors and telemetry equipment and initiate monitoring at both wells.
- Develop the five new wells and then perform and analyze slug tests at each.
- Collect and analyze groundwater samples at the five new wells.
- Perform a detailed analysis of hydrographs from all wells involved in the program with a particular emphasis on the relationship between the Kansas River and the aquifer.

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- Whittemore, D. O., Wilson, B. B., and Butler, J. J., Jr., 2019, Kansas River alluvial aquifer: Water use and real-time monitoring: Kansas Geological Survey Open-File Report 2019-18, 30 p. <u>http://www.kgs.ku.edu/Hydro/Publications/2019/OFR19_18/index.html</u>
- Wilson, B. B., 2019, Maintenance of the Kansas Geological Survey's data services to the National Groundwater Monitoring Network and establishment of a trend well network in the Kansas River alluvial aquifer: Kansas Geological Survey Open-File Report 2019-17, 20 p. <u>http://www.kgs.ku.edu/Hydro/Publications/2019/OFR19_17/index.html</u>

7 Appendix — Field Methods, Well Completion Reports, and Direct-Push Logs

7.1 Field Methods

7.1.1 Well Installation

All 10 of the new wells discussed in this report were installed with the KGS Geoprobe directpush unit. Direct-push technology uses hydraulic rams supplemented with the vehicle weight to rapidly advance small-diameter pipe into the subsurface; material is not removed as in traditional drilling methods but is displaced to the side by the advancing pipe (Liu et al., 2012). The technology can be used for advancing small-diameter sensors to obtain high-resolution information about the subsurface as well as for well installation. In this work, it was used for both purposes. Once a site had been selected and land owner approval had been obtained, the KGS team advanced small-diameter pipe with an electrical conductivity probe (Schulmeister et al., 2003) at its lower end from the surface to the bottom or near bottom of the aquifer to obtain high-resolution (≈ 0.05 ft) information about the hydrostratigraphy at the site and, in particular, the distribution of coarse materials (sands and gravels) versus fines (clays and silts). The electrical conductivity log was then used to create the geologic log for the site and to select the screened interval for the well.

The well was installed by advancing larger diameter pipe with a plug at the lower end and overdrilling the hole created by the direct-push electrical conductivity logging. Upon reaching the bottom, a 2" Sch. 40 well string (casing and screen) was installed down the center of the pipe. The well string was then used to push the plug out the bottom of the direct-push pipe and the pipe was withdrawn while leaving the well string in place. The formation quickly collapsed against the screen and casing except in the upper portions of the hole. The annulus in the upper section was then filled with bentonite pellets to the land surface. A steel well protector was placed around the casing extending above the surface. Each well was later developed as described in the main text.

The previously existing well (GEMS4-1) was installed with hollow-stem augers using standard drilling methods. A WWC-5 well completion report does not exist for that well, so we used a direct-push electrical conductivity log obtained within 20 ft of the well to create the geologic log included here. The well was developed for this project as described in the main text.

7.1.2 Slug Tests

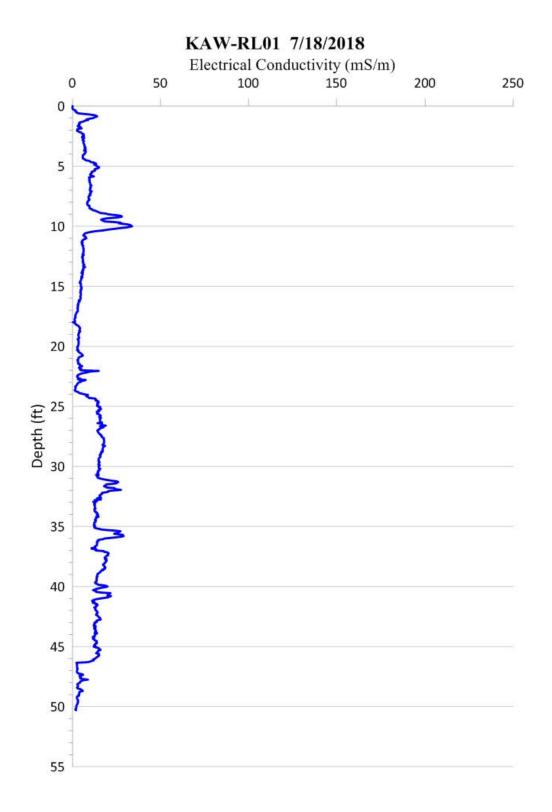
Slug tests were performed at all 11 wells using the pneumatic method for test initiation and the field guidelines outlined in Butler (2019). Test data were analyzed using the Aqtesolv software (HydroSOLVE, Inc., 2007) to obtain a hydraulic conductivity (K) estimate for the screened interval. The three models used for the analyses were the KGS model, the high-K form of the Hvorslev model, and the Butler and Zhan model; details of the analysis procedures for all three are given in Butler (2019).

7.2 Well Completion Reports and Direct-Push Electrical Conductivity Logs

In this section, the well completion (WWC-5) reports and the corresponding electrical conductivity logs are given for each of the 11 wells discussed in the report. The well order is from west to east as in the report.

Riley County Index Well 1 – WWC-5 Form

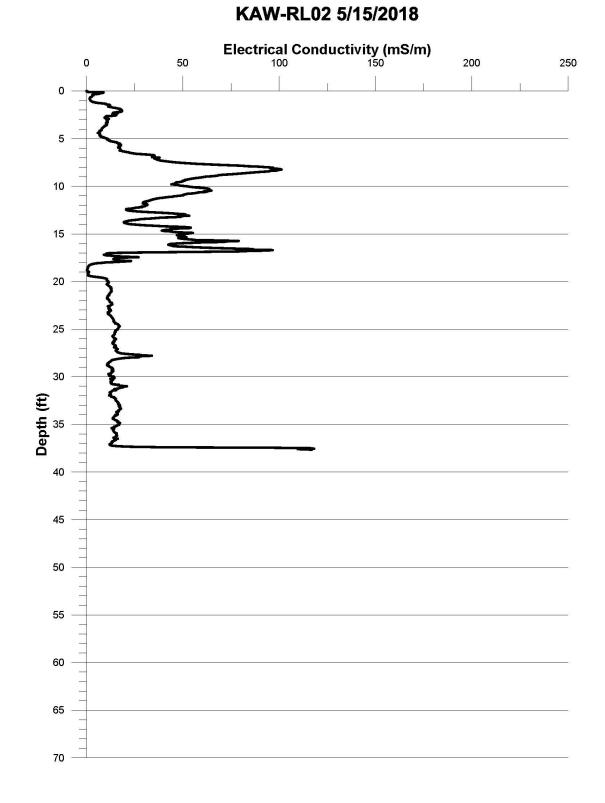
	WELL R		Form V	WWC-5 e in Well Use	Division of Water Resources App. No. Well ID						
	FION OF W			Fraction	Section Number Township Number Range Number						
	y: Riley			NE 1/4 NE 1/4 NW 1/2	44 Z21.5	34	T 10 S	R 7 ∎E □W			
	OWNER: L Kansas G			First:	Street or Rural Address where well is located (if unknown, distance and direction from nearest town or intersection): If at owner's address, check here:						
Address:	University	of Kansas	ui ve y								
Address: City:	1930 Con Lawrence		State: KS	ZIP: 66047	3800 S. 20th St., Manhattan, KS						
<u> </u>	E WELL				<u> </u>		20 1 /52	27			
WITH '	X" IN			IPLETED WELL: Encountered: 1)				27(decimal degrees) 193(decimal degrees)			
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ΙIΤ				ater was		🗆 La	nd Survey 🗌 Topogr	aphic Map			
W	Е	after		pumping vater was		Or 🔲	lline Mapper: GOOGIE	e Earth Pro			
SW	SE		hours	pumping			· 1037 a	. 🔳 Ground Level 🔲 TOC			
	s	Estimated Y	/ield:	gpm 3.25 _{in to} 50	ft and	Source	\Box Land Survey \Box	GPS Topographic Map			
	s nile	DOLE HOLE		in. to	ft.			ar Data			
	WATER TO			10 Kal		<u></u>					
1. Domestic				ter Supply: well ID g: how many wells? .			Field Water Supply: 1 ole: well ID	ease			
	& Garden						sed Uncased				
□ Livest				echarge: well ID g: well IDKAV			ermal: how many bore				
2. □ Irrigat 3. □ Feedlo			nvironmenta] Air Sparge	al Remediation: well I e □ Soil Vapor			sed Loop 🔲 Horizon en Loop 🗖 Surface D	tal 📋 Vertical ischarge 🔲 Inj. of Water			
4. 🗌 Indust] Recovery	☐ Injection							
		0		itted to KDHE?	Yes 🔳 No	If yes, date	sample was submitte	ed:			
Water well	disinfected?	Ves	No		CACE			d 🔲 Welded 🔳 Threaded			
Casing dian	neter 2	in to	50 ft	C ∐ Other Diameter	in to	nG JOINTS: ft Diam	☐ Glued ☐ Clampe	d 🗌 Welded 🔳 Threaded			
					981bs./ft.	Wall thick	eter in. to	1 40			
TYPE OF Steel	SCREEN OF	R PERFORA nless Steel	TION MA			D Oth	r (Spacify)				
□ Brass		anized Steel		-	used (open hole		a (speeny)				
이 아파가 집안한 가슴을 위한 것을 하는 것을 수 있다.	OR PERFOR										
- Louve	nuous Slot ered Shutter	■ Mill Slot	hed 🗖 W	ire Wrapped \Box S	aw Cut □ N	Jone (Open Ho	ole)				
SCREEN-I	PERFORATI	ED INTERV	ALS: From	1.45 ft. to 50	ft., From .	ft. to	ft., From	ft. to ft.			
G	RAVEL PAG	CK INTERV	ALS: From	n 20 ft. to 50	ft., From .	ft. to	ft., From	ft. to ft.			
Grout Interv	als: From	0 ft. to	20	ft., From	ft. to	ft., From .	ft. to	ft.			
Nearest sou	rce of possibl	e contaminat	ion:								
Septic	Tank Lines		Lateral Line		9000m 🔳	Livestock Per	is ∐ Insecti □ Aband	cide Storage oned Water Well			
U Water	ight Sewer Li	nes 🗌	Seepage Pit	☐ Sewage L □ Feedyard		Fertilizer Stor	age 🗌 Oil We	ell/Gas Well			
Direction fr	(Specify)	uthwest		Distance from p			age ☐ Aband age ☐ Oil We				
10 FROM	TO]	LITHOLOG	GIC LOG	FROM	TO	LITHO. LOG (cont.) o	r PLUGGING INTERVALS			
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8.5 10.5		Silt Sand									
20	45 \$	Sand with N	linor Silt le	inses							
45	50.25	Sand									
50.25		Bedrock - R	efusal (Lir	nestone)	Notes: S	ee Attached E	lectrical Conductivity Lo)g			
					-						
	11 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was 🗐 constructed, 🗌 reconstructed, or 🗌 plugged										
Kansas Wa	under my jurisdiction and was completed on (mo-day-year) .05-15-2018 and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No										
under the b	usiness name	e of Kansas	s Geologia	al Survey	Si	gnature					
Mail	1 white copy alo	ong with a fee of	\$5.00 for eac	h constructed well to: Ka	ansas Department	of Health and H	Environment, Bureau of W e for your records. Telepl	ater, GWTS Section,			
	p://www.kdheks			sserg root, wan one to	KSA 82a-12		e tot your records. Telepi	Revised 7/10/2015			



Riley County Index Well 1 – Electrical Conductivity Log

Riley County Index Well 2 – WWC-5 Form

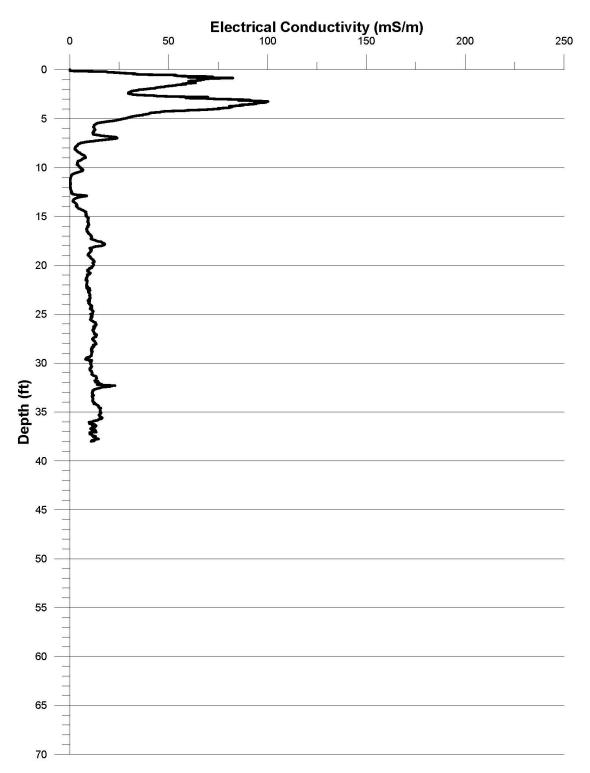
			RECORD	Form	WWC-5 e in Well Use		ivision of Water sources App. No		Well ID KAW-RL02			
	LOCAT	TION OF V	VATER WE		Fraction	S	ection Number	Township Numb	per Range Number			
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			Last Name: Geological S	Survey	First:				r's address, check here:			
	Address:	Universit	v of Kansas			4400 Rive						
	Address: City:		nstant Ave	State: KS	ZIP: 66047	4400 Rive	riku					
		Lawrenc				07	ă.	20 4 9 4 2	00			
	WITH "				IPLETED WELL:		ft. 5 Latitud	le: 39.1813	89(decimal degrees)			
		N BOX:			Encountered: 1) 3) ft., or 4)				(decimal degrees)			
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	I			Well v	vater was	ft.		ine mapper				
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_ L	_	S	Estimated Bore Hole	Yield:	3.25 in to 37	ft and	Source:	□ Land Survey □	GPS			
]-]-		nile	Dore more		in. to				arth Pro			
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	Domestic				ter Supply: well ID				ease			
] Housel	hold & Garden	0. 7	Dewaterin	g: how many wells? .		. II. Test Ho	ele: well ID				
	Livesto		8.	Monitorin	echarge: well ID g: well IDKAV	V-RL02	12. Geother	mal: how many bore				
] Irrigati		9.1	Environmenta	al Remediation: well I	D	a) Clos	ed Loop 🔲 Horizon				
] Feedlo] Industi			Air Sparge		Extraction			ischarge 🔲 Inj. of Water			
				Recovery	204 C			· · · ·	. 1			
			? 🗌 Yes 📕		itted to KDHE?	Yes 🔳 No	II yes, date s	ample was submitte	ed:			
8 1	EVPE C	DE CASINO	USED .	Steel DV	C 🗆 Other	CAS	ING IOINTS	□ Glued. □ Clampe	d 🔲 Welded 🔳 Threaded			
Cas	ing diam	eter 2	in. to	37 ft.,	Diameter	. in. to	ft., Diamet	er in. to				
						98 lbs./ft	Wall thickne	ess or gauge No. Sch	1.40			
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	Brass		vanized Steel			used (open ho		(specify)				
			RATION OP			. 1						
		nuous Slot	Mill Slot									
					Tire Wrapped □ S				ft. to ft.			
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					. ft., From	. ft. to	ft., From	ft. to	ft.			
	rest sou Septic		ole contamina	tion: Lateral Line	s 🗌 Pit Privy		Livestock Pens	□ Incecti	cide Storage			
							Fuel Storage	☐ Aband	oned Water Well			
] Waterti	ight Sewer L	ines 🗌	Seepage Pit	□ Sewage L □ Feedyard	Ľ] Fertilizer Stora	ge 🗌 Oil We	ell/Gas Well			
Die] Other (Specify)	orth		Distance from v	350		A				
10	FROM	TO TO		LITHOLOG		FROM	TO L	ITHO. LOG (cont.) o	r PLUGGING INTERVALS			
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17		18	Silt									
18.	-	27.5	Sands									
27.5 28	2	28 37.2	Silt Sand				+					
37.2	2	01.2	Shale - Ref	usal		Notes:	See Attached Ele	ectrical Conductivity Lo	g			
								, -	-			
11	CONT	RACTOR'	S OR LAND	OWNER'S	S CERTIFICATIO	N: This wat	er well was	constructed, \Box rec	onstructed, or 🗌 plugged by knowledge and belief.			
Ka	nsas Wa	ter Well Co	ind was compontractor's Li	cense No		ater Well Ro	ecord was com	bleted on (mo-dav-v	ear) 05-22-2018			
unc	ler the b	usiness nan	ne of Kansa	s Geoloaid	al Survey		Signature	······································	ear) .05-22-2018			
					h constructed well to: Ka							
Vis			st., Suite 420, To s.gov/waterwell		66612-1367. Mail one to	KSA 82a-1		tor your records. Telepi	Revised 7/10/2015			
	and areas of	in the second of										



Riley County Index Well 2 – Electrical Conductivity Log

Wabaunsee County Index Well 1 – WWC-5 Form

WATER WELL R			WWC-5 e in Well Use	Division of Water Resources App. No. Well ID				
1 LOCATION OF WA	ATER WEI		Fraction	Section Number Township Number Range Numb				
County: Wabaunse			SW 1/4 SE 1/4 SE 1/4					
2 WELL OWNER: La Business: Kansas Ge	st Name: eological St	urvey	First:	Street or Rural Address where well is located (if unknown, distance and direction from nearest town or intersection): If at owner's address, check here:				
Address: University	of Kansas						Rd and W Boundary Rd	
Address: 1930 Cons City: Lawrence	stant Ave	State: KS	ZIP: 66047	on North sid			ta ana w Boandary i ta	
3 LOCATE WELL	4 DEPTH	OF CON	IPLETED WELL:		5 Latitu	e 39.1742	23 (decimal degrees)	
WITH "X" IN SECTION BOX:	Depth(s) Gr	oundwater	Encountered: 1)	ft.	Longit	ude: -96.282	614 (decimal degrees)	
N			3) ft., or 4) TER LEVEL:			<u>tal Datum:</u> 🔳 WGS 8 for Latitude/Longitude	4 🗆 NAD 83 🗆 NAD 27	
	below 1	and surface	, measured on (mo-day	/-yr) 05-10-18	□GP		۽)	
NW NE			, measured on (mo-day vater was			(WAAS enabled?		
W			s pumping			id Survey □ Topogr ine Mapper: .GOOgle	e Earth Pro	
SW SE	. A an		vater was				*	
	T () 1 T		s pumpinggpm	C 1	6 Elevati	on: .972	. 🔳 Ground Level 🔲 TOC	
S	Bore Hole I	Diameter:	3.25 in to	ft. and	Source:	□ Land Survey □ ■ Other Goodle E	GPS 🔲 Topographic Map arth Pro	
7 WELL WATER TO	BE USED /		in. to	П.		Ould .HARAGAR	8087.008	
1. Domestic:	5. 🗆] Public Wa	ter Supply: well ID				ease	
☐ Household □ Lawn & Garden			g: how many wells? .			ole: well ID ed □Uncased □		
Livestock			echarge: well ID g: well ID KAW		12. Geothe	rmal: how many bore	s?	
2. ☐ Irrigation 3. ☐ Feedlot		nvironment] Air Sparg	al Remediation: well I e □ Soil Vapor			sed Loop 🔲 Horizon	tal 🔲 Vertical ischarge 🔲 Inj. of Water	
4. Industrial		Recovery		Exauction			isenarge 📋 ng. or water	
Was a chemical/bacteri	0		nitted to KDHE?	Yes 🔳 No	If yes, date :	sample was submitte	ed:	
Water well disinfected? 8 TYPE OF CASING				CASE	IC IONITS.			
Casing diameter	in. to	37 ft.	Diameter	CASII	ng JOINTS: ft., Diame	ter in. to	a 📋 welded 🔳 Inreaded	
				98 1bs./ft.	Wall thickn	ess or gauge No. Sch	1.40	
TYPE OF SCREEN OR ☐ Steel ☐ Stain	PERFORA. less Steel	FiDN MA			🗆 Othe	r (Specify)		
🗌 Brass 🔲 Galva	nized Steel	Conc	rete tile 🗌 None	used (open hole		(openny)		
SCREEN OR PERFORA	ATION OPE Mill Slot			orch Cut 🗖 E	milled Uplac	Other (Specify)		
Louvered Shutter	Key Puncl	hed 🔲 W	'ire Wrapped 🛛 🗌 S	aw Cut 🛛 🗋 N	lone (Open Ho	le)		
SCREEN-PERFORATE	D INTERV.	ALS: From	n .22 ft. to .37	ft., From .	ft. to	ft., From	ft. to ft.	
9 GROUT MATERIA	K IN I E K V.	ALS: From	n	\dots Π , From .	П. Ю)ther	π., From	ft. to ft.	
9 GROUT MATERIA Grout Intervals: From	0 ft. to	16.5	ft., From	. ft. to	ft., From	ft. to	ft.	
Nearest source of possible		i on: Lateral Line	es 🗌 Pit Privy		Livestock Pen	a 🗆 Insecti	cide Storage	
Sewer Lines		Cess Pool	Sewage L	agoon 🗌	Fuel Storage	🗌 Aband	oned Water Well	
☐ Sewer Lines ☐ Watertight Sewer Line ☐ Other (Specify) .Cre	es □;	Seepage Pit	☐ Feedyard		Fertilizer Stora	ıge □ Oil We	ell/Gas Well	
Direction from well? Sou	th		Distance from v	vell? 400				
10 FROM TO		ITHOLO	GIC LOG	FROM	TO I	ITHO. LOG (cont.) o	r PLUGGING INTERVALS	
- 00 0	oils ands							
				Notes: S	ee Attached El	ectrical Conductivity Lo	pg	
				_				
11 CONTRACTOR'S	OR LAND	OWNER'S	S CERTIFICATIO	N: This wate	r well was 🔳	constructed, 🗌 reco	onstructed, or 🗌 plugged	
under my jurisdiction an Kansas Water Well Cont								
under the business name	of Kansas	Geologia	al Survey	Si	gnature			
Mail 1 white copy alor	g with a fee of	\$5.00 for eac	th constructed well to: Ka 66612-1367. Mail one to	ansas Department	of Health and E	vironment, Bureau of W	ater, GWTS Section,	
Visit us at http://www.kdheks.			Soor2-1507. Wall olic to	KSA 82a-12		Tor your records. Telepi	Revised 7/10/2015	

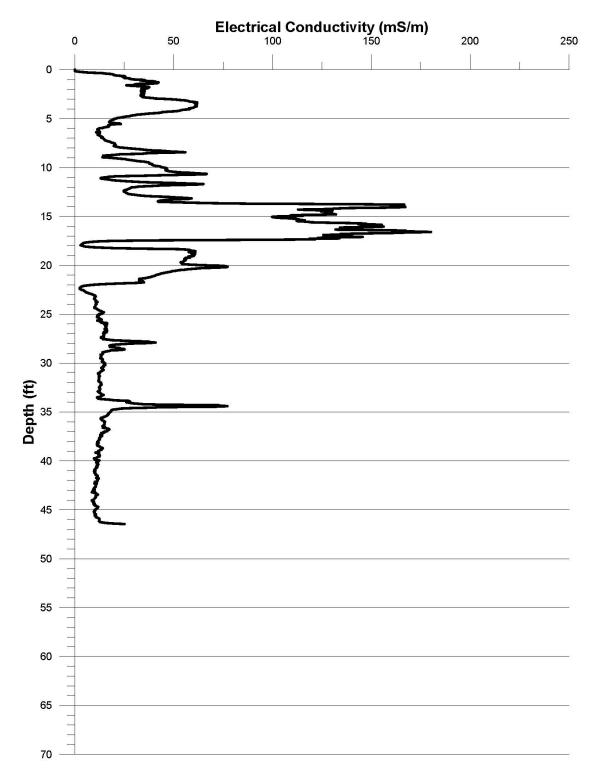


KAW-WB01 5/10/2018

Shawnee County Index Well 1 – WWC-5 Form

		Correction		WWC-5 ge in Well Use	Division of Water Resources App. No. Well ID KA					
1 LOCA	FION OF V	VATER WEI		Fraction	Section Number Township Number Range Number					
	y: Shawne			SE 1/4 NE 1/4 NE 1/						
	OWNER: Kansas (Last Name: Geological St	Irvev	First:	Street or Rural Address where well is located (if unknown, distance and direction from nearest town or intersection): If at owner's address, check here:					
Address:	Universit	v of Kansas			4431 NW (
Address: City:	Lawrenc	nstant Ave e	State: KS	ZIP: 66047		Supported				
	E WELL			IPLETED WELL:	46.5	T T maters	39 1265	24 (decimal degrees)		
WITH '	'X" IN DN BOX:			Encountered: 1)		Longit	ude -95,965	556 (decimal degrees)		
2012/2112/2012/2012/2012/2012/2012/2012	N BOA:	2)	ft. 🗄	3) ft., or 4)	Dry Well	Horizon	<u>ntal Datum:</u> 🗖 WGS 8	4 🗆 NAD 83 🗆 NAD 27		
		WELL'S S.	ATIC WA	TER LEVEL:	2.4ft. /-vr) 05-16-18		for Latitude/Longitude	2:		
NW	NE	above 1	and surface	, measured on (mo-day	r-yr)		(WAAS enabled?			
Ĩ	1	1		vater was s pumping			nd Survey			
W	E	alter		vater was		∎ On	line Mapper:	e Earth Pro		
SW	SE			s pumping	. gpm	6 Flevat	ion 929 f	. 🔳 Ground Level 🔲 TOC		
	S	Estimated Y Bore Hole I	ield: Diameter:	3.25 in to 46.5	ff and	Source	□ Land Survey □	GPS 🔲 Topographic Map		
1	mile		52	in. to			■ Other Google E	arth Pro		
		O BE USED				10 🗖 0''		Summer to an		
1. Domestic				ater Supply: well ID ag: how many wells? .			ole: well ID	ease		
	& Garden			echarge: well ID g: well ID			ed 🗌 Uncased 🔲	Geotechnical		
2. ☐ Livest				g: well ID NAV al Remediation: well I			rmal: how many bore sed Loop □ Horizon			
3. G Feedlo] Air Sparg					ischarge 🔲 Inj. of Water		
4. 🗌 Indust] Recovery							
		0		nitted to KDHE?	Yes 🔳 No	If yes, date	sample was submitte	ed:		
8 TVPF (DE CASING	? 🗌 Yes 🔳	NO teel D V	C 🗖 Other	CAS	NG IONTS:	Glued Clampa	d 🔲 Welded 🔳 Threaded		
Casing dian	neter2	in. to	46.5 ft.,	, Diameter 1. Weight0.6	in. to	ft., Diame	ter in. to	u weideu inicadeu		
					98 1bs./ft.	Wall thickr	less or gauge No. Sch	<u>1,40</u>		
		R PERFORAT	Fiber			🗆 Othe	r (Specify)			
🗆 Brass	🗖 Gai	lvanized Steel	Conc	rete tile 🗌 None	used (open ho					
	OR PERFOI nuous Slot	RATION OPE			orch Cut	Drillad Uolae	C Other (Specify)			
Louv	ered Shutter	Key Puncl	ned 🗌 W	/ire Wrapped 🛛 🗌 S	aw Cut 🛛	None (Open Ho	le)			
SCREEN-	PERFORAT	ED INTERV	ALS: From	n 36.5 ft to 46.5	ft., From	ft. to	ft., From	ft. to ft.		
	RAVEL PA	$AI \cdot \square Neet$	ALS: From	$n \dots 20 \dots \text{ ft. to } \dots 79$	\mathcal{A} ft., From	It. to Other	ft., From	ft. to ft.		
Grout Interv	als: From	0 ft. to	20	ft., From	. ft. to	ft., From .	ft. to	ft.		
Nearest sou	rce of possil	ole contaminati	on:							
□ Septic	Lines		Lateral Line Cess Pool	es ☐ Pit Privy □ Sewage L	agoon [] Livestock Pen] Fuel Storage	S ☐ Ilisecu ☐ Aband	cide Storage oned Water Well		
U Water	ight Sewer L	ines 🔲	Seepage Pit	Sewage L Feedyard	Ē] Fertilizer Stor	age 🗌 Oil We	ell/Gas Well		
Direction fr	(Specify) Po m well? So	ond outhwest		Distance from v	vel12 350		Ĥ			
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5	8 13.5	Sands			_					
o 13.5	17.5	Silty Sands Clay								
17.5	18.3	Sands								
18.3	21.9	Silty Sands		V10						
21.9 46.5	46.5	Sands with s Bedrock - Re		S	Notes:	See Attached E	ectrical Conductivity Lo	bg		
40.0		DEUTOCK - RE	siusdi							
	11 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was constructed, reconstructed, or plugged under my jurisdiction and was completed on (mo-day-year) .05-16-2018 and this record is true to the best of my knowledge and belief.									
Kansas Wa	ater Well Co	intractor's Lice	ense No	This W	ater Well Re	cord was com	pleted on (mo-day-y	(ear) 05-22-2018		
under the b	ousiness nan	ne of Kansas	Geologia	cal Survey	S	ignature				
				ch constructed well to: Ka 66612-1367. Mail one to			- 1877 - 1877 - 1877 - 1877 - 1877 - 1877 - 1877 - 1877 - 1877 - 1877 - 1877 - 1877 - 1877 - 1877 - 1877 - 187			
1000 a 100 a 200 a 200 a 200 a 200 a		ss.gov/waterwell/i			KSA 82a-1		,	Revised 7/10/2015		

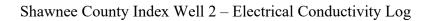
Shawnee County Index Well 1 – Electrical Conductivity Log

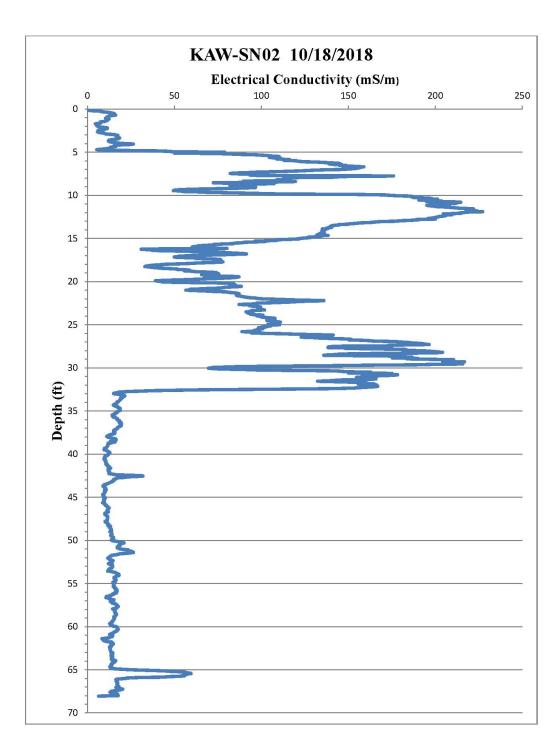


KAW-SN01 5/16/2018

Shawnee County Index Well 2 – WWC-5 Form

	WELL R	ECORD	Form V			Division of Wat esources App. 1		Well ID KAW-SN02		
1 LOCA	A STREET AND A STREET AND A STREET	ATER WEI		Fraction NE ¹ / ₄ SW ¹ / ₄ SE ¹	Section Number Township Number Range Number 5 ¼ ¼ 16 T 11 S R 15 ■ E □ W					
2 WELL	OWNER: L	ast Name:		First:	Street or Rural Address where well is located (if unknown, distance					
Business: Address:		Seological Su of Kansas	lrveγ				The second s	er's address, check here:		
Address: City:	1930 Cor	istant Ave	State: KS	ZIP: 66047	260 Feet	South of NV	/ 24th St on West s	ide of NW Menoken Rd		
	Lawrence			IPLETED WELL:	64.2	A	39 0880	763 (decimal degrees)		
WITH "	X" IN DN BOX:	Depth(s) Gr	oundwater	Encountered: 1)	ft.	Long	ude: -95.74	8469 (decimal degrees)		
TATAL REAL REAL REAL PROPERTY OF A SUB	N BOA.	2)	ft. 3	3) ft., or 4) 3^{2}	Dry Well	Horiz	ontal Datum: WGS	84 🗆 NAD 83 🗆 NAD 27		
WELL'S STATIC WATER LEVEL: 33.15 ft. below land surface, measured on (mo-day-yr)10/18/18 above land surface, measured on (mo-day-yr)										
NW	□ Yes □ No)									
w	Е			vater wass pumping			and Survey 🔲 Topog Online Mapper: .GOOgl	graphic Map le Earth Pro		
SW	SE	offer		vater was s pumping						
		Estimated Y	'ield'	onm	-	6 Eleva	tion: 898	ft. 🔳 Ground Level 🔲 TOC		
	S nile			3.25 in to 64.5		Source	e: □ Land Survey □ Other Google E] GPS 🔲 Topographic Map Earth Pro		
) BE USED A		in. to	It.					
1. Domestic				ter Supply: well ID				lease		
□ House	hold & Garden			g: how many wells? . echarge: well ID			Hole: well ID ased □ Uncased □			
Livest	ock			echarge: well ID g: well ID KAV			hermal: how many bor	es?		
2. ☐ Irrigat			nvironmenta 1 Air Sparge	al Remediation: well l e 🛛 🗌 Soil Vapor			losed Loop 🔲 Horizo men Loop 🗖 Surface I	ntal 🔲 Vertical Discharge 🔲 Inj. of Water		
4. Indust] Recovery	-	Lituation					
				itted to KDHE?] Yes 🔳 N	o If yes, dat	e sample was submit	ted:		
Water well	disinfected?	Yes 📕	No	C 🗖 Other	CA	ING IONTS		ed 🔲 Welded 🔳 Threaded		
Casing dian	eter2	in. to	64.2 ft.,	Diameter	. in. to	ft., Diar	neter in. to kness or gauge No. SC	ft.		
					981bs./:	t. Wall thic	kness or gauge No. SC	h 40		
TYPE OF □ Steel		R PERFORAT				ΠOt	her (Specify)			
□ Brass	Galv	vanized Steel	Conc.	rete tile 🗌 None	used (open l					
이 이 지 않는 것을 다 있는 것을 알려요. 이 것을 들었다. 이 것을 못 하는 것을 못 같이 않다. 이 것을 것 같이 않다. 이 것을 것 같이 않다. 이 것을 못 하는 것이 않다. 이 것을 것 같이 않다. 이 것을 못 하는 것이 않다. 이 것을 것 같이 않다. 이 것 같이 않다. 이 것 같이 않다. 이 것 않다. 이 것 않다. 이 것 않다. 이 것 같이 않다. 이 것 같이 않다. 이 것 같이 않다. 이 것 않다. 이 것 같이 않다. 이 것 않다. 이 것 않다. 이 것 같이 않다. 이 것 않다. 이 것 같이 않다. 이 것 않았다. 이 것 않다. 이 있다. 이 것 않다. 이 것 않다. 이 것 않다. 이 있다. 이	OR PERFOR nuous Slot	ATION OPE			orch Cut	Drilled Holes	Other (Specify)			
	ered Shutter	Key Puncl	hed 🔲 W	'ire Wrapped 🛛 🗆 S	aw Cut 🛛 🗌] None (Open I	Hole)			
SCREEN-I	PERFORAT	ED INTERV.	ALS: From	1.44ft.to.64	ft., From	n ft. t	o ft., From	ft. to ft. ft. to ft.		
9 GROUT	MATERIA	$\mathbf{L}: \square \text{ Neat } \mathbf{C}$	cement \Box	Cement grout	entonite Γ	1 Other	<u>o n., Fioni</u>			
Grout Interv	als: From	0 ft. to	. 33 –	. ft., From	. ft. to	ft., From	ft. to	ft.		
Nearest sou		le contaminati	on: Lateral Line	s 🗌 Pit Privy		Livestock P	ens 🗆 Insect	ticide Storage		
□ Sewer	Lines		Cess Pool	□ Sewage L	agoon	🗌 Fuel Storage	e 🗌 Aban	doned Water Well		
Watert	ight Sewer Li: Specify)	nes 🔲 :	Seepage Pit	☐ Feedyard		🗌 Fertilizer St	orage 🗌 Oil W	/ell/Gas Well		
Direction fro	om well? . NC	orth		Distance from v	vell? .20		1	ft.		
10 FROM 0.0	TO 5.0	I Soils	ITHOLOG	GIC LOG	FROM	TO	LITHO. LOG (cont.)	or PLUGGING INTERVALS		
5.0		Solis Heavy Clay	with Strea	aks of Slit	_	-				
15.5	26.0	Silty Clay								
26.0 32.5		Heavy Clay Sand & Grav		aks of Slit						
65.0		Silty Sand L								
66.0		Sand			Notes:	See Attached	Electrical Conductivity L	.og		
					Replace	s Well 3905190	95445301			
11 CONT	RACTOR'S	S OR LANDO	OWNER'S	S CERTIFICATIO	N: This wa	ter well was	constructed, 🗌 red	constructed, or 🗌 plugged		
under my j	urisdiction a	nd was compl	leted on (m	10-day-year)		nd this record	is true to the best of i	my knowledge and belief.		
under the b	usiness nam	e of Kansas	Geologic	al Survey		Signature	inpreted on (mo-day-	year) 10/19/2018		
Mail	1 white copy alo	ong with a fee of	\$5.00 for eac	h constructed well to: K	ansas Departm	ent of Health and	Environment, Bureau of Vone for your records. Tele	Water, GWTS Section,		
		s.gov/waterwell/i		00012-1307. Wall offe to	KSA 82a		ne for your records. Tele	Revised 7/10/2015		

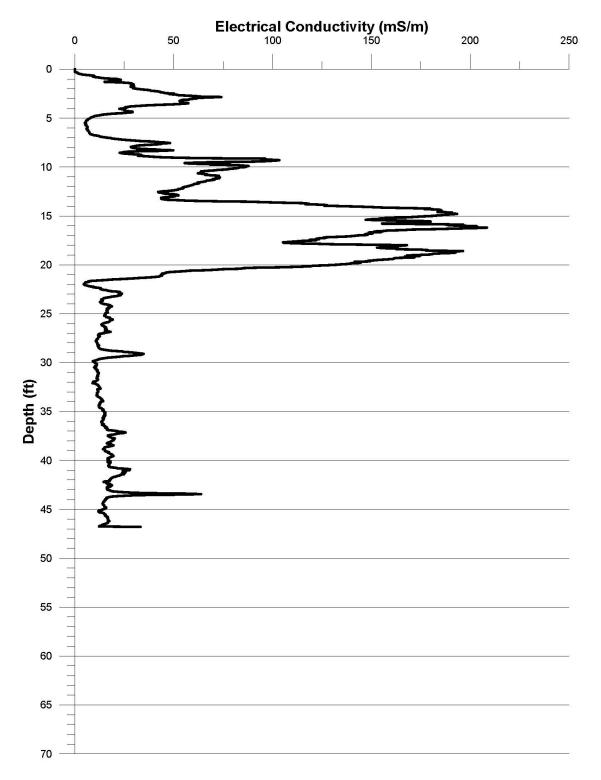




Jefferson County Index Well 1 – WWC-5 Form

WATER WELL	RECORD Form	n WWC-5	Division of Water Resources App. No. Well ID				
1 LOCATION OF	WATER WELL:	Fraction	Section Number Township Number Range Number				
County: Jefferso 2 WELL OWNER:		NW 1/4 NW 1/4 NW 1/2 First:	14 4 27 T 11 SR 17 \blacksquare E \square WStreet or Rural Address where well is located (if unknown, distance and				
Business: Kansas	Geological Survey	FIISC				r's address, check here:	
	ty of Kansas Instant Ave		50 feet Eas	t of the inters	ection of Decatur	Rd and 17th St, South	
City: Lawrence		S ZIP: 66047	side of road				
3 LOCATE WELL	4 DEPTH OF C	OMPLETED WELL:		5 Latitud	e: 39.07166	66	
WITH "X" IN SECTION BOX:		ter Encountered: 1)		Longitu	ıde: -95.518	797 (decimal degrees)	
N		3) ft., or 4) WATER LEVEL:			t <u>al Datum:</u> ■ WGS 84 or Latitude/Longitude	4 🗆 NAD 83 🗆 NAD 27	
	below land surf	ace, measured on (mo-day	/-yr). 05-14-18	GPS		·	
NW NE		àce, measured on (mo-day 11 water was		2	(WAAS enabled?		
w	1	ours pumping		□ Lan	d Survey 🔲 Topogra	Earth Pro	
SW SE		ell water was				<u>~</u>	
I I I I I	Estimated Yield	ours pumping		6 Elevati	on: 862	🔳 Ground Level 🔲 TOC	
S	Bore Hole Diameter	- 3.25 in to 47		Source:	□ Land Survey □ (GPS	
1 mile 7 WELL WATER T		in. to	tt.				
1. Domestic:		Water Supply: well ID		10. 🗖 Oil I	Field Water Supply: 16	ease	
Household		ering: how many wells?.			le: well ID		
□ Lawn & Garden □ Livestock	8. M Monite	r Recharge: well ID pring: well ID KAV	V-JF01		d 🗌 Uncased 🔲 (mal: how many bores		
2. Irrigation	9. Environm	ental Remediation: well I	D	a) Clos	ed Loop 🔲 Horizont	tal 🔲 Vertical	
3. ☐ Feedlot 4. ☐ Industrial	□ Air Sp □ Recov	- ·	Extraction			scharge 🔲 Inj. of Water	
			Yes No		, 1 , ,	:d:	
Water well disinfected	l? 🗌 Yes 📕 No				•		
8 TYPE OF CASIN	G USED: 🗆 Steel 🔳	PVC Other	CASI	NG JOINTS:	□ Glued □ Clamped	l 🗌 Welded 🔳 Threaded	
Casing diameter	1 surface 36	ft., Diameter in. Weight0.6	. 111. to 981bs./ft.	ft., Diamet Wall thickne	er in. to ess or gauge NoSch	ft. 40	
TYPE OF SCREEN C	OR PERFORATION N	ATERIAL:					
	ainless Steel Ivanized Steel C		used (open hol		(Specify)		
SCREEN OR PERFO			used (open nor	5)			
Continuous Slot	Mill Slot	Gauze Wrapped					
SCREEN-PERFORA	□ Key Punched □ FED INTER VALS: F	From .33 ft. to .43.	aw Cut ⊔ P ft From	Ione (Open Hol ft to	e) ft From	ft to ft	
GRAVEL PA	ACK INTERVALS: F	rom	3 ft., From .	ft. to .	ft., From	ft. to ft.	
9 GROUT MATER	IAL: Neat cement	Cement grout 🔳 B	entonite 🔲 🤇	Other			
Grout Intervals: From . Nearest source of possi		ft., From	. ft. to	ft., From	ft. to	ft.	
Septic Tank	🗌 Lateral I			Livestock Pens		cide Storage	
Sewer Lines	ines Cess Po	ol 🗌 Sewage L Pit 🗖 Feedward	agoon 🗌	Fuel Storage Fertilizer Stora		oned Water Well Il/Gas Well	
Other (Specify)		Pit Feedyard	L		_		
Direction from well?	outh	Distance from v	rell? 1600 FROM	TO L	ft.	PLUGGING INTERVALS	
10 FROM TO 0 4	Soils	LOGIC LOG	46.65		edrock - Refusal	TLUGGING INTERVALS	
4 7	Sands						
7 13	Silts & Sands						
13 20.5 20.5 28.5	Clay Sands						
28.5 29.5	Silt Lens						
29.5 43	Sands		Notes: S	ee Attached Ele	ctrical Conductivity Lo	g	
43 44	Silt Lens						
44 46.65 11 CONTRACTOR	Sands S OR LANDOWNE	R'S CERTIFICATIO	N: This wate	r well was 🔳	constructed, 🔲 reco	onstructed, or 🗌 plugged	
under my jurisdiction	and was completed or	(mo-day-year) 05-14	-2018 and	this record is	true to the best of m	v knowledge and belief.	
Kansas Water Well Counder the business part	ontractor's License No ne of Kansas Geolo	o This W ogical Survey	ater Well Rec	ord was comp enature	oleted on (mo-day-y	ear) 05-22-2018	
Mail 1 white copy :	along with a fee of \$5.00 for	each constructed well to: Ka	insas Department	of Health and Er	vironment, Bureau of W	ater, GWTS Section,	
1000 SW Jackson Visit us at http://www.kdhe		usas 66612-1367. Mail one to 11	Water Well Own KSA 82a-12		for your records. Teleph	none 785-296-5524. Revised 7/10/2015	

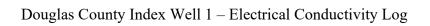
Jefferson County Index Well 1 – Electrical Conductivity Log

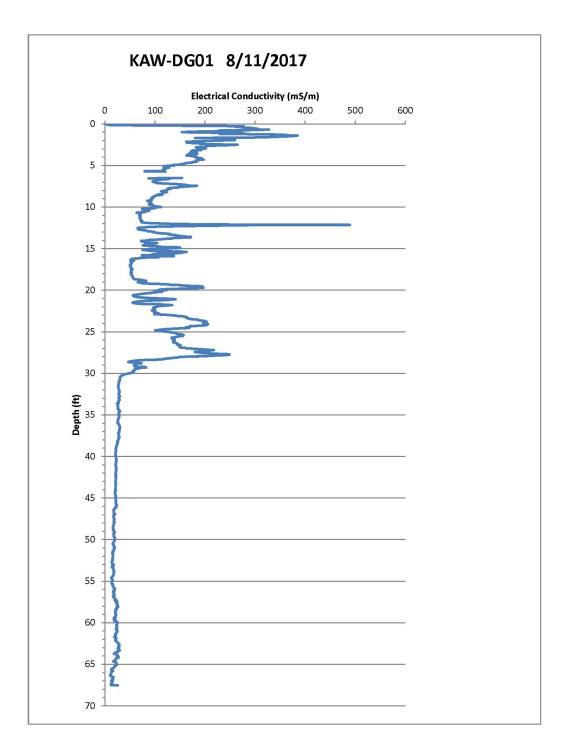


KAW-JF01 5/14/2018

Douglas County Index Well 1 – WWC-5 Form

WATER W			Form V			rision of Water ources App. No		Well ID KAW-DG01		
1 LOCATIO County: D	N OF WA		<u> </u>	Fraction SW 1/4 NW 1/4 SW 1/2	Section Number Township Number Range Number					
2 WELL OW	VNER: La			First:	Street or Rural Address where well is located (if unknown, distance and					
Address: U	niversity	eological Su of Kansas	irvev		direction from nearest town or intersection): If at owner's address, check here:					
	930 Cons awrence		State: KS	ZIP: 66047	Lawrence,	and the second se	Ionth of Intersectio	n with 03 Highway 40		
3 LOCATE W WITH "X"				IPLETED WELL:						
SECTION I				Encountered: 1) 3) ft., or 4)				993 (decimal degrees) 4 □ NAD 83 □ NAD 27		
		WELL'S ST	TATIC WA	FER LEVEL:	9.3 ft.	Source f	or Latitude/Longitude			
NW 1		above 1	and surface,	measured on (mo-day	-yr)		(WAAS enabled? □]Yes 🗌 No)		
w	E		hours	ater was	. gpm	Lan	d Survey ☐ Topogr ne Mapper: .Google	aphic Map Earth Pro		
SW	SE	after		ater was						
		Estimated V	ield [.]		01	6 Elevation	n: 833	. Ground Level TOC GPS Topographic Map		
1 mile-			100	in. to			Other Google Ea	arth Pro		
7 WELL WA 1. Domestic:	TER TO			ter Supply: well ID		10. 🗖 Oil I	ield Water Supply: 16	ease		
☐ Household ☐ Lawn & G				g: how many wells?			le: well ID d □Uncased □			
Livestock				echarge: well ID g: well ID KAW		12. Geother	mal: how many bores	s?		
2. ☐ Irrigation 3. ☐ Feedlot		Γ] Air Sparge			b) Ope		scharge 🔲 Inj. of Water		
4. Industrial	al/hastani] Recovery		V NI-			:d:		
Water well dis	infected?	🗌 Yes 📕	No				•			
8 TYPE OF C	CASING 1	USED: □ S	teel ■ PV 66.5 _	C 🗌 Other	CASI	NG JOINTS:	Glued Clamped	d 🔲 Welded 🔳 Threaded		
				Diameter Weight 0.69	98lbs./ft.	Wall thickno	ss or gauge No. Sch	40		
TYPE OF SCF		PERFORA. less Steel				🗌 Other	(Specify)			
Brass SCREEN OR I		anized Steel			used (open hol	e)				
Continuou	us Slot	📕 Mill Slot	🗌 Ga							
SCREEN-PER	FORATE	DINTERV	ALS: From	46.5 ft. to 66.5	ft., From	ft. to .	ft., From	ft. to ft.		
GRA'	VEL PAC	K INTERV.	ALS: From	130 ft. to66.	5 ft., From	ft. to .)ther	ft., From	ft. to ft.		
				. ft., From	. ft. to	ft., From	ft. to	ft.		
Nearest source	of possible k	contaminati	on: Lateral Line	s 🗌 Pit Privy		Livestock Pens	🗌 Insectio	cide Storage		
Sewer Line	es Sewer Line	es 🗆	Cess Pool Seepage Pit	☐ Sewage L ☐ Feedyard	agoon 🗌	Fuel Storage Fertilizer Stora	🗌 Abando	oned Water Well ell/Gas Well		
Other (Spe	cify)		1 8 1	Distance from v	 vell2					
10 FROM	TO	I	ITHOLOG	GIC LOG	FROM	TO L	THO. LOG (cont.) or	PLUGGING INTERVALS		
0 3 3 16		ioils Clays & Silts	1							
16 19	S	ilt								
19 30 30 67		lays & Silts ands			+					
					Notore	Attached 5	atriaal Canduativity ! -			
						See Attached Ele	ctrical Conductivity Lo 06095132301	y		
11 CONTRA	CTOR'S	OR LANDO	OWNER'S	CERTIFICATIO				onstructed or I plugged		
under my juris	11 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was ■ constructed, □ reconstructed, or □ plugged under my jurisdiction and was completed on (mo-day-year) .08/11/2017 and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No									
under the busir	ness name	of Kansas	Geologic	al Survey	ater wen Ke	gnature	neted on (mo-day-y	tai) .99(44/491.1		
				h constructed well to: Ka 66612-1367. Mail one to						
Visit us at http://w					KSA 82a-12			Revised 7/10/2015		

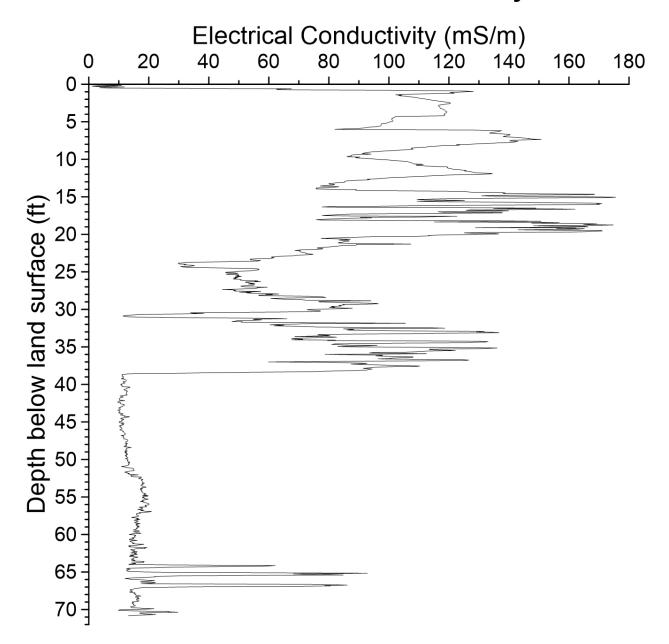




GEMS4-1 Index Well – WWC-5 Form

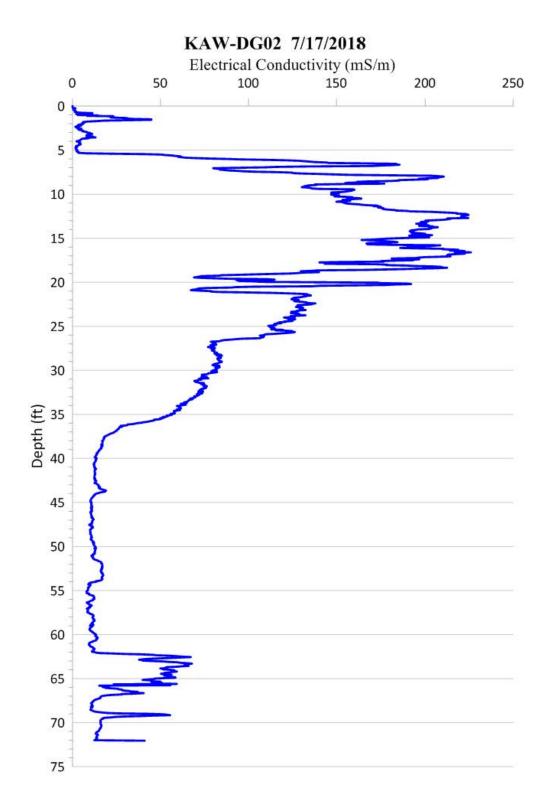
	WELLR		Form			vision of Water		GEMS_4-1		
		ATER WEI		e in Well Use Fraction	Resources App. No. Well ID Well ID Section Number Township Number Range Num					
	: Douglas	ALEK WEI	illi:	SE ¹ / ₄ SE ¹ / ₄ SE						
	OWNER: I	ast Name [.]		First:				(if unknown, distance and		
		eological Si	urvev	1150				er's address, check here:		
		of Kansas			115 feet N	W Center of	ntersection of N10	000 Rd and E1600 Rd.		
Address: City:	1930 Cor		State: KS	ZIP: 66047	Lawrence.		Increased on or Nat			
3 LOCAT	Lawrence	1.00	40 42 0 3 C - C - C - C - C - C - C - C - C - C		COLOR STATE		20.0455	22		
WITH "				IPLETED WELL:				33(decimal degrees)		
A COLORADO A	N BOX:			Encountered: 1) 3) ft., or 4)		Longit	ude:	856 (decimal degrees)		
1	A.			TER LEVEL:			tal Datum: 🔳 WGS 8 for Latitude/Longitude	4 🗆 NAD 83 🗆 NAD 27		
■ below land surface, measured on (mo-day-yr)										
NWNE □ above land surface, measured on (mo-day-yr) (WAAS enabled? □ Yes □ No)										
Pump test data: Well water was ft. Land Survey Topographic Map										
W E after hours pumping gpm Well water was ft.										
SW	SE	after		s pumping		i terretaria car	000	5		
		Estimated Y	field:					. Ground Level 🗌 TOC		
	S	Bore Hole I		7.25 in to 70.8		Source:		GPS Topographic Map		
1 r		DE LICED		in. to	Ít.			Marting		
1. Domestic		D BE USED		ater Supply: well ID			Field Water Supply: 1	ease		
☐ House				ig: how many wells?			ole: well ID			
Lawn .				echarge: well ID g: well IDGE			ed 🗌 Uncased 🔲			
□ Liveste							rmal: how many bore			
2. Irrigati				al Remediation: well			ed Loop 🗌 Horizon			
3. □ Feedlo 4. □ Industr] Air Sparg] Recovery		Extraction			ischarge 🔲 Inj. of Water		
17.80 . 0 .00.00008	5963 C.	57			1.57 • 1.57	san sina a si ana	na interaction de la contraction de la			
		riological sai		utted to KDHE?	Yes 🔳 No	If yes, date	sample was submitte	ed:		
8 TVPF C	FCASING	USED: DS	teel 🔳 PV	C 🗆 Other	CAS	NG IOINTS:	Glued Clampe	d 🔲 Welded 🔳 Threaded		
Casing diam	eter 2	in. to	70.80 ft	Diameter	in. to	ft Diame	ter in. to .	ti 🗋 weided 📠 riffeaded		
Casing heigh	nt above land	surface	19.8 in	n. Weight 0.6	98 lbs./ft.	Wall thickn	ess or gauge No. Sch	n 40		
TYPE OF S	SCREEN OF	R PERFORA	FION MA	TERIAL:						
		nless Steel	🗌 Fiber				r (Specify)			
Brass	2000-000	vanized Steel	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		used (open ho	le)				
24	nuous Slot	Mill Slot			Forch Cut	Drilled Holes	Other (Specify)			
☐ Louve	red Shutter	Kev Punc	hed □W	Vire Wrapped	aw Cut	None (Open Ho	le)			
SCREEN-H	PERFORAT	ED INTERV.	ALS: From	n 40.80 ft to 70.8	30ft., From	ft. to	ft., From	ft. to ft.		
G	RAVEL PA	CK INTERV.	ALS: From	n 30 ft. to70.	80. ft., From	ft. to	ft., From	ft. to ft.		
9 GROUT	MATERIA	L: Neat	cement] Cement grout 🔳 H	Bentonite	Other				
				ft., From	ft. to	ft., From	ft. to	ft.		
Septic		le contaminati	on: Lateral Line	es 🗌 Pit Privy		Livestock Pen		cide Storage		
			Cess Pool	Sewage I] Fuel Storage	AN AND A REAL PROPERTY OF A REAL	oned Water Well		
□ Watert	ight Sewer Li	nes 🔳	Seepage Pit	☐ Feedyard	C] Fertilizer Stor	ige 🗌 Oil We	ell/Gas Well		
Other (Specify)	orth			110 / 50					
				Distance from				DI LICODIC DITEDUALO		
10 FROM 0	то 4	Soils	ITHOLO	GIC LUG	FROM	TO I	11HO. LOG (cont.) o	r PLUGGING INTERVALS		
	21	Clays & Silts			70					
21		Silt								
28		Clays & Silts								
38		Sands	76							
64		Sand with S	ilty Clay S	Stringers						
67.5	70.8	Sands			Notes:	See Attached El	ectrical Conductivity Lo	og		
70.8		Limestone E	Bedrock							
	11 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was 🔳 constructed, 🗋 reconstructed, or 🗋 plugged under my jurisdiction and was completed on (mo-day-year) .06/25/1990 and this record is true to the best of my knowledge and belief.									
Kansas Wa	Kansas Water Well Contractor's License No									
under the b	usiness nam	e of Kansas	Geologia	cal Survey	S	ignature				
Mail	1 white copy ale	ong with a fee of	\$5.00 for eac	ch constructed well to: K	ansas Departmer	nt of Health and E	nvironment, Bureau of W	Vater, GWTS Section,		
		20		66612-1367. Mail one to			for your records. Telepl			
Visit us at http	o://www.kdhek	s.gov/waterwell/	index.html		KSA 82a-1	212		Revised 7/10/2015		

HP6ec - within 20 ft of GEMS4-1 - July 2002



Douglas County Index Well 2 – WWC-5 Form

	WELL F		Form	WWC-5 e in Well Use		vision of Water ources App. No.		Well ID KAW-DG02	
1 LOCA	29 Seller 29 (Selling Seller)	ATER WE		Fraction NE ¹ / ₄ NE ¹ / ₄ NW ¹ / ₂	Section Number Township Number Range Number				
2 WELL	OWNER: I			First:		21 21	T 13 S here well is located	$\begin{array}{c} R & 20 \blacksquare E \square W \\ \text{(if unknown, distance and} \end{array}$	
Business: Address:	Kansas C	Seological S / of Kansas	urvev		direction from nearest town or intersection): If at owner's address, check here:				
Address: City:	1930 Cor	nstant Ave	State: KS	ZIP: 66047	100 feet so	uth of interse	ction of N 1400 R	D and E 1850 Rd	
	Lawrence			IPLETED WELL:	70 f	5 Tuesday		11(decimal degrees)	
WITH "	X" IN DN BOX:	Depth(s) G	roundwater	Encountered: 1)	ft.	Longitu	de: -95.158	266 (decimal degrees)	
Sama Rougersee hold	N			3) ft., or 4) TER LEVEL:			al Datum: Ш WGS 8 or Latitude/Longitude	4 🗆 NAD 83 🗆 NAD 27	
		below	land surface	, measured on (mo-day	-yr)	· GPS	(unit make/model:)	
NW	NE	Pump test	data: Well w	, measured on (mo-day /ater was	ft.	□ Land	(WAAS enabled? □ l Survey □ Topogr	aphic Map	
w	Е	after		s pumping vater was		🔳 Onli	ne Mapper: Google	Earth Pro	
SW	SE		hours	s pumping		6 Elevatio	.n. 818 ft	. 🔳 Ground Level 🔲 TOC	
	s	Bore Hole	Yield: Diameter:	3.25 _{in. to} 70	ft. and	Source:	Land Survey	GPS 🔲 Topographic Map	
	nile WATED TO		22	in. to			Other Google Ea	arth.Pro	
1. Domestic		5.[] Public Wa	ter Supply: well ID				ease	
□ House	hold & Garden			g: how many wells? echarge: well ID			e: well ID d □Uncased □		
Livest	ock			echarge: well ID g: well ID KAW		12. Geother	nal: how many bore	s?	
2. ☐ Irrigat 3. ☐ Feedlo			Air Sparge	al Remediation: well I e 🛛 🗌 Soil Vapor			ed Loop 🔲 Horizon 1 Loop 🔲 Surface Di	tal 📋 Vertical scharge 🔲 Inj. of Water	
4. 🗌 Indust			Recovery				1 ,,		
		riological sa ? 🔲 Yes 📕		itted to KDHE?	Yes 🔳 No	If yes, date s	ample was submitte	:d:	
8 TYPE C	DF CASING	USED:	Steel 🔳 PV	C 🔲 Other	CASI	NG JOINTS: [Glued 🗌 Clamped	d 🔲 Welded 🔳 Threaded	
Casing dian	eter	in. to surface		Diameter Weight0.69	. in. to 98 1bs/ft	ft., Diamete Wall thickne	er in. to ss or gauge No. Sch	ft. 1 40	
TYPE OF	SCREEN OI	R PERFORA	TION MA	TERIAL:					
□ Steel □ Brass		nless Steel vanized Steel			used (open hol		(Specify)		
이 이 지 않는 것을 다 있는 것을 알려요. 이 것을 들었다. 이 것을 못 하는 것을 못 같이 않다. 이 것을 것 같이 않다. 이 것을 것 같이 않다. 이 것을 못 하는 것이 않다. 이 것을 것 같이 않다. 이 것을 못 하는 것이 않다. 이 것을 것 같이 않다. 이 것 같이 않다. 이 것 같이 않다. 이 것 않다. 이 것 않다. 이 것 같이 않다. 이 것 같이 않다. 이 것 않다. 이 것 같이 않다. 이 것 않다. 이 것 같이 않다. 이 것 않다. 이 것 않다. 이 것 같이 않다. 이 것 않다. 이 있다. 이 것 않다. 이 것 않다. 이 것 않다. 이 있다. 이 것 않다. 이 것 않다. 이 것 않다		ATION OPI	ENINGS A	RE:		··			
	nuous Slot ered Shutter	Mill Slot	ched 🔲 W	'ire Wrapped 🛛 🗆 S	aw Cut 🛛 🗋 🛛	None (Open Hole	e)		
SCREEN-I	PERFORAT	ED INTERV	ALS: From	1.55ft. to .70	ft., From	ft. to	ft., From	ft. to ft. ft. to ft.	
9 GROUT	MATERL	$AL: \square$ Neat	cement	Cement grout 🔳 B	entonite			ft.	
		0ft. t le contaminat		ft., From	. ft. to	ft., From	ft. to	ft.	
Septic	Tank		Lateral Line			Livestock Pens		cide Storage	
Sewer	Lines ight Sewer Li	nes 🗆	Cess Pool Seepage Pit	☐ Sewage L □ Feedvard	agoon	Fuel Storage Fertilizer Storage	ne ☐ Aband ne ☐ Oil We	oned Water Well ell/Gas Well	
Di Other	(Specify)			☐ Feedyard Distance from v					
10 FROM	TO TO	an meor	LITHOLOG	GIC LOG	FROM	TO LI	THO. LOG (cont.) or	r PLUGGING INTERVALS	
0.0		Soils		the of Olit					
21.0		Heavy Clay Clay with Si		aks of SIII					
27.0	37.0	Silt with Sar	nd, Fining	Upwards					
37.0 62.0		Sand & Gra Sand & Gra		ilts					
02.0	12.0				Notes: 3	Bee Attached Ele	ctrical Conductivity Lo	g	
					Replaces	Vell 3856240950	93701		
								onstructed, or Dplugged	
under my j Kansas Wa	urisdiction a iter Well Co	nd was comp ntractor's Lic	pleted on (m cense No	10-day-year) 	and ater Well Re	this record is t cord was comp	rue to the best of m leted on (mo-dav-v	y knowledge and belief. ear)	
under the b	usiness nam	e of Kansa	s Geologic	al Survey	S Department	gnature	wironment Pursou of W	ear)	
1000) SW Jackson S	t., Suite 420, To	peka, Kansas	66612-1367. Mail one to	Water Well Ow	ner and retain one		none 785-296-5524.	
Visit us at htt	o://www.kdhek	s.gov/waterwell	/index.html		KSA 82a-12	212		Revised 7/10/2015	



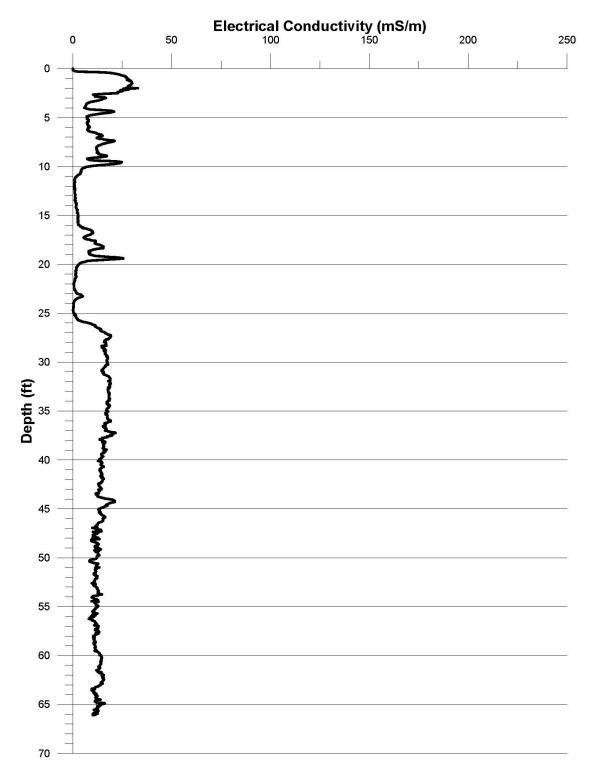
Douglas County Index Well 2 – Electrical Conductivity Log

Leavenworth County Index Well 1 – WWC-5 Form

	WELL F	RECORD		WWC-5 te in Well Use		vision of Water sources App. No		Well ID KAW-LV01	
1 LOCA	FION OF W	ATER WE	1	Fraction	Section Number Township Number Range Number				
	y: Leavenw OWNER: I			NW 1/4 NE 1/4 NW 1/ First:		27 Iral Address w	T 12 S	R 22 ■ E □ W (if unknown, distance and	
Business	Kansas G	Seological S		11150.				r's address, check here:	
Address: Address:		/ of Kansas			7909 Wyai	ndotte St, De	Soto, KS 66018		
City:	Lawrence		State: KS	ZIP: 66047			0.872 -		
3 LOCAT WITH '	E WELL	4 DEPTI	H OF COM	IPLETED WELL:		t. 5 Latituc	le: 38.9855	78(decimal degrees)	
	ON BOX:			Encountered: 1) 3) ft., or 4)				118 (decimal degrees)	
	N	WELL'S S	TATIC WA	TER LEVEL: 16	6.6 ft.	Source	tal Datum: ■ WGS 8 for Latitude/Longitude	4 \square NAD 83 \square NAD 27	
				, measured on (mo-day		GP:	S (unit make/model:	-	
NW	NE			, measured on (mo-day vater was		1203	(WAAS enabled? □ d Survey □ Topogr		
w	Е	after		s pumping	CI	Onl	ine Mapper: Google	e Earth Pro	
SW	SE	after.		vater was s pumping			700		
		Estimated	Viald	anm	C.	6 Elevati	on: . / 88	□ Ground Level □ TOC GPS □ Topographic Map	
	S nile			3.25 in to 65				arth Pro	
) BE USED		III to					
1. Domestic				ter Supply: well ID				ease	
☐ House	noid & Garden			g: how many wells? echarge: well ID			ed Uncased		
Livest	ock			echarge: well ID g: well ID KAW			rmal: how many bore	s?	
2. ☐ Irrigat 3. ☐ Feedlo			Environmenta	al Remediation: well I e □ Soil Vapor			ed Loop 🔲 Horizon	tal 🔲 Vertical ischarge 🔲 Inj. of Water	
4. Indust			Recovery		EAutouon				
		0		nitted to KDHE? 🗆	Yes 🔳 No	If yes, date s	sample was submitte	ed:	
Water well	disinfected	Yes	No		CAS			d 🔲 Welded 🔳 Threaded	
Casing dian	neter 2	in to	Steel ∎ PV 65 ft	Diameter	in. to	ING JOINTS: ft Diame	Glued Clampe	d 📋 Welded 📕 I hreaded	
				Diameter . Weight	98 1bs./ft.	Wall thickn	ess or gauge No. Sch	<u>1 40</u>	
TYPE OF Steel		R PERFORA nless Steel				□ Othe	(Specify)		
□ Brass		vanized Steel			ised (open ho		(opeeny)		
이 아파가 집안한 가슴을 위한 것을 하는 것을 수 있다.		ATION OPI			10.0	D '11 1 1 1			
	nuous Slot ered Shutter	Mill Slot				None (Open Holes			
SCREEN-	PERFORAT	ED INTERV	ALS: Fron	n .45 ft. to .65	ft., From	ft. to .	ft., From	ft. to ft.	
G	RAVEL PA	CK INTERV	ALS: Fron	n 29 ft to 69	ft., From	ft. to .	ft., From	ft. to ft.	
Grout Interv	als: From	0 ft. t	$_{0}$ 25	. ft., From	ft. to	ft., From	ft. to	ft.	
Nearest sou	rce of possib	le contaminat	tion:						
□ Septic □ Sewer	Linoa		Lateral Line Cess Pool	C Somoro L	acon	Livestock Pens Fuel Storage	Abond	cide Storage oned Water Well	
U Water	ight Sewer Li	nes 🗌	Seepage Pit	Distance from w] Fertilizer Stora	ge 🗌 Oil We	ell/Gas Well	
Direction fr	(Specify)			Distance from w	rel12 100		Ĥ		
10 FROM	10		LITHOLOG	GIC LOG	FROM	TO L	ITHO. LOG (cont.) o	r PLUGGING INTERVALS	
0		Soil							
2.5		<u>Silty Sand</u> Sand				+			
16		Sand Silty Sand							
20	26	Sand							
26	66.1	Sands			Notos	See Attached El	actrical Conductivity L		
						See Allached Ele	ectrical Conductivity Lo	y y	
								onstructed, or \square plugged v knowledge and belief.	
Kansas Wa	iter Well Co	ntractor's Lic	cense No	This W	ater Well Re	cord was com	pleted on (mo-day-y	ear) .05-21-2018	
under the b	usiness nam	e of Kansa	s Geologia	cal Survey	S	ignature	wironment Durson of u	later GWTS Section	
				66612-1367. Mail one to					
Visit us at htt	p://www.kdhek	s.gov/waterwell	/index.html		KSA 82a-1	212		Revised 7/10/2015	

Leavenworth County Index Well 1 – Electrical Conductivity Log

KAW-LV01 5/8/2018



Wyandotte County Index Well 1 – WWC-5 Form

	WELL R		Form			rision of Water ources App. No		Well ID KAW-WY01			
1 LOCAT	TION OF W	ATER WEI		Fraction	Section Number Township Number Range Num						
-	Vyandotte OWNER: La			SW 1/4 SE 1/4 SE 1 First:	$E \frac{1}{4}$ $\frac{1}{4}$ 29 T 11 S R 24 $E \Box V$ Street or Rural Address where well is located (if unknown, distance and						
Business:	Kansas Ge	eological Su	urvev	rns.				er's address, check here:			
Address: Address:	University 1930 Cons				1300 feet S	E on gravel	drive off S 78 St, 1	1900 feet SE of Douglas			
City:	Lawrence		State: KS	ZIP: 66047	Ave and S	78 St					
3 LOCAT WITH "	E WELL V" IN	4 DEPTH	OF COM	IPLETED WELL:		5 Latituc	le: 39.0588	12 (decimal degrees)			
	SECTION BOX: Depth(s) Groundwater Encountered: 1)										
N 2) ft. 3) ft. or 4) □ Dry Well N WELL'S STATIC WATER LEVEL: 45.2 ft. Source for Latitude/Longitude:											
		below 1	and surface.	, measured on (mo-day	y-yr) 05-09-18	GP	S (unit make/model:	-			
NW	NE			, measured on (mo-day vater was		5.5	(WAAS enabled? [d Survey] Topogr				
w	E		hours	pumping	gpm		ine Mapper: Google	e Earth Pro			
SW	SE	after		vater was s pumping							
		Estimated V	Gold.	anm		6 Elevati	on: 769 fi	. 🖪 Ground Level 🗌 TOC			
1 n	S nile			3.25 in to 65				GPS			
	WATER TO			in. to	II.						
1. Domestic:		5. 🗆] Public Wa	ter Supply: well ID				ease			
	hold & Garden			g: how many wells? .			ele: well ID d Uncased D				
Livesto		8.	Monitorin	echarge: well ID g: well ID KAW	/-WY01		mal: how many bore				
2. ☐ Irrigati 3. ☐ Feedlo			nvironmenta] Air Sparge	al Remediation: well I e 🛛 🗌 Soil Vapor			ed Loop 🔲 Horizon	tal 🔲 Vertical ischarge 🔲 Inj. of Water			
4. Industr		2.	Recovery		Exuacuon						
Was a cher	mical/bacteri	ological sar	nple subm	itted to KDHE?	Yes 🔳 No	If yes, date s	ample was submitte	ed:			
Water well	disinfected?	🗌 Yes 📕	No								
8 TYPE O	OF CASING	USED: \Box S	teel 🔳 PV 65 п	C Other	CASI	NG JOINTS:	Glued Clampe	d 🗌 Welded 🔳 Threaded			
Casing heigh	nt above land s	urface	36 in	Diameter	981bs./ft.	Wall thickn	ess or gauge No. Sch	n 40			
	SCREEN OR						10.5				
□ Steel □ Brass		less Steel mized Steel	☐ Fiber □ Conc		used (open hol		(Speciry)				
SCREEN C	OR PERFORA	ATION OPE	NINGS A	RE:							
		Mill Slot		auze Wrapped 🛛 🕁 T 'ire Wrapped 🗖 S	orch Cut	Drilled Holes	Other (Specify)				
SCREEN-F	PERFORATE	D INTERV.	ALS: Fron	1.50 ft to 65	ft., From	ft. to .	ft., From	ft. to ft.			
GI	RAVEL PAC	K INTERV.	ALS: Fron	n 41 ft to 65	5 ft., From	ft. to .	ft., From	ft. to ft.			
9 GROUT	MATERIA	L: D Neat of	cement 🗌] Cement grout 🛛 🔳 B ft., From	entonite	Other	ft to	Ĥ			
	rce of possible							It.			
	Tank		Lateral Line			Livestock Pens	Insecti	cide Storage			
□ Sewer I □ Waterti	Lines ight Sewer Lin	es □;	Seepage Pit	☐ Sewage L ☐ Feedyard Distance from v	agoon	Fuel Storage Fertilizer Stora	ge ☐ Oil Wa	oned Water Well ell/Gas Well			
Other (Specify) Kar	isas River.		_ ,			-				
10 FROM	m well? .!N⊑. TO	I	ITHOLOG	GIC LOG	FROM	TO L	ITHO. LOG (cont.) o	r PLUGGING INTERVALS			
0	4.5 S	oils									
		ands									
12 16		ilt & Clay and									
29.5		lay with Sa	nd Streak	(S							
33	37.5 S	and									
37.5		ilty Lens			Notes:	See Attached Ele	ectrical Conductivity Lo	bg			
38.5	67.9 S	and			-						
								onstructed, or 🗌 plugged			
Kansas Wa	ter Well Cont	ractor's Lice	ense No	This U	ater Well Re	ord was com	pleted on (mo_day_v	y knowledge and belief.			
under the b	usiness name	of Kansas	Geologia	al Survey		gnature					
Mail 1	1 white copy alor	g with a fee of Suite 420 Tor	\$5.00 for eac	h constructed well to: K: 66612-1367. Mail one to	ansas Departmen	t of Health and Er	ivironment, Bureau of W	Vater, GWTS Section,			
	o://www.kdheks.				KSA 82a-1		your records. releps	Revised 7/10/2015			

Wyandotte County Index Well 1 - Electrical Conductivity Log

KAW-WY01 5/9/2018