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Impacts of Potential Development on Groundwater Resources in the Community of Cutter, New Mexico.

Chance Coats

Impacts of Potential Development on Groundwater Resources in the Community of Cutter, New Mexico.

By

Chance Coats

Committee

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Committee Approval

The Master of Water Resources Professional Project Report of **Chance Coats**, entitled **Impacts of Potential Development on Groundwater Resources in the Community of Cutter, New Mexico**, is approved by the committee:

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Chair Date

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Acknowledgements

I would like to thank my committee for their guidance and support on this project. To Dr. Bruce Thomson, thank you for proving to me that there is no such thing as too busy. To Dr. Gary Weissmann, thank you for your patience and for challenging me in Hydrology and Hydrogeology. To Steve Finch, thank you for helping me to simplify my thoughts and for bringing this project to my attention. I would like to also thank my colleagues at John Shomaker & Associates, Inc., for the help they provided in answering my questions and for the data used as the framework for this project. Additional thanks to the New Mexico Office of the State Engineer for providing water level data.

To my family, you are my anchor in life that keeps me grounded and have supported me all the way. I wouldn't be here without you. To my Dad, Uncle, and late Grandfather, thank you for bringing me up in a world of pumps and water. To my wife, thank you so much for your support and patience through graduate school. I love you. And finally, to my little girl to be born in March, you already inspire me. I can't wait for you to get here.

Abstract

Commercial space flight from New Mexico is soon to become a reality. With Spaceport America soon to be in full operation, economic growth is expected to increase in the Jornada del Muerto Basin. A potential site for future development is located five miles north of the Spaceport, in the community of Cutter, New Mexico. This project discusses the groundwater resources available beneath the community of Cutter. Data from a pumping test performed on well LRG-10140 along with groundwater level measurements from the New Mexico Office of the State Engineer (NMOSE) and water level data provided by John Shomaker and Associates, Inc. (JSAI) was used to evaluate the system.

The hydrogeology of the system beneath Cutter is best defined as a fractured tub. It is bound on the east side by the Jornada Draw Fault and the south by series of Tertiary dikes. Recharge estimated at 80 ac-ft/yr (acre feet per year) comes from the northwest and flows to the southeast. The fractured sandstone units of the Mesaverde Formation provide for a low storage coefficient of 0.005 using the specific yield approach for calculating storage.

The Big Sky Village Subdivsion makes up the majority of developed land within the study area. Current demand in this area is estimated at 40.9 ac-ft/yr. The findings of this study estimate the system beneath Cutter can provide for a population of 200 people at a demand of 200 gallons per capita per day. At this population, the demand overtakes the recharge into the system and the aquifer is not sustainable. Drawdown at this demand will provide a groundwater supply for the community for 40 years into the future.

Introduction

Spaceport America (Spaceport) was constructed to support commercial spaceflight in New Mexico. This facility will be the first of its kind and provides for both manned and unmanned launches. With this new industry, jobs, economic growth, and commerce are expected to increase in the vicinity of the Spaceport. One nearby community is Cutter, New Mexico. Cutter is located approximately 25 miles southeast of Truth or Consequences, New Mexico, in the Jornada del Muerto Basin (Jornada) and lies only a few miles north of the Spaceport (Fig. 1, pg.2). It is the closest community to the Spaceport and may experience growth due to its proximity to the facility. However, growth is likely to be constrained by water availability.

The main focus of this project was to evaluate the groundwater resources beneath the community of Cutter. A preliminary evaluation was conducted for the use of the Romero well (LRG-10140) by contractors for temporary water supply during the early construction phases of the Spaceport. Early pumping and analysis raised questions about the resources in the aquifer. Drawdown in nearby wells was greater than first estimated. This suggested that there was less water in storage than was originally anticipated. While the amount of water pumped from LRG-10140 during construction far exceeds the usual diversions within this system, it does suggest that groundwater resources are limited. The objective of this project was to determine the availability of groundwater resources beneath Cutter, NM.

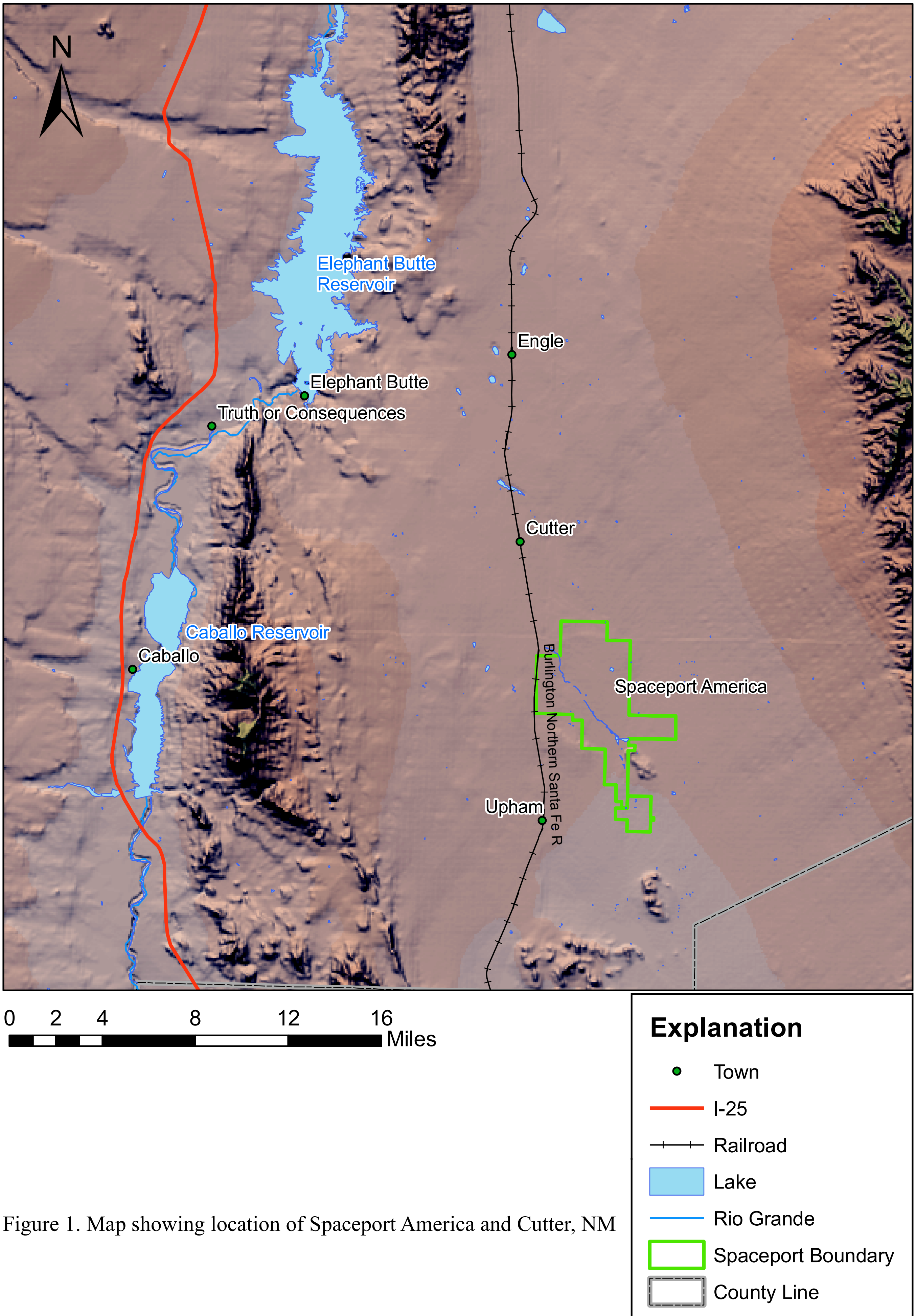


Figure 1. Map showing location of Spaceport America and Cutter, NM

Geologic Setting

The well log for LRG-10140 (Appendix A) describes alternating beds of shale and sandstone. Water is contained within the sandstone beds of the Mesaverde Formation, which are locally fractured. Recharge likely occurs west of LRG-10140, where sandstone beds crop out at land surface, and possibly from fractured volcanic rocks associated with Black Hill (Fig. 2, pg.7) (JSAI, 2009B).

The sandstone beds of the Mesaverde Formation are locally fractured due to the intrusion at Black Hill and faulting. The Jornada Draw fault is classified as a normal fault (Seager and Mack, 1995). Beds of the Mesaverde Formation dip 5 degrees to 15 degrees from east to southeast (Fig. 3 pg. 8). The thickness of the Mesaverde Formation mapped at the LRG-10140 site is 1,000 ft (Seager, 2007). Regional groundwater flows south to southeast (JSAI, 2009B).

Fault zones can act as either barriers to groundwater flow or as groundwater conduits, depending on the nature of the material in the fault zone. Impounding faults can occur in unconsolidated materials with clay present, as well as in sedimentary rocks where interbedded shales, which normally would not hinder lateral groundwater flow, can be smeared along the fault by drag folds (Fetter, 1988). The Jornada Draw fault acts as a barrier to groundwater flow in this localized system as will be discussed later.

Flow in fractured formation is difficult to understand and analyze. For one, the network and size of fractures are often not possible to predict unless surface manifestations are observed. Furthermore, flow in some larger fractures is turbulent as opposed to laminar, so Darcy's law should not be applied to these (Fitts, 2002). While it is safe to assume the majority of larger fractures within this area of the Mesaverde Formation are orientated parallel to the Jornada Draw fault (Fig. 2, pg. 7), their size and frequency are impossible to predict.

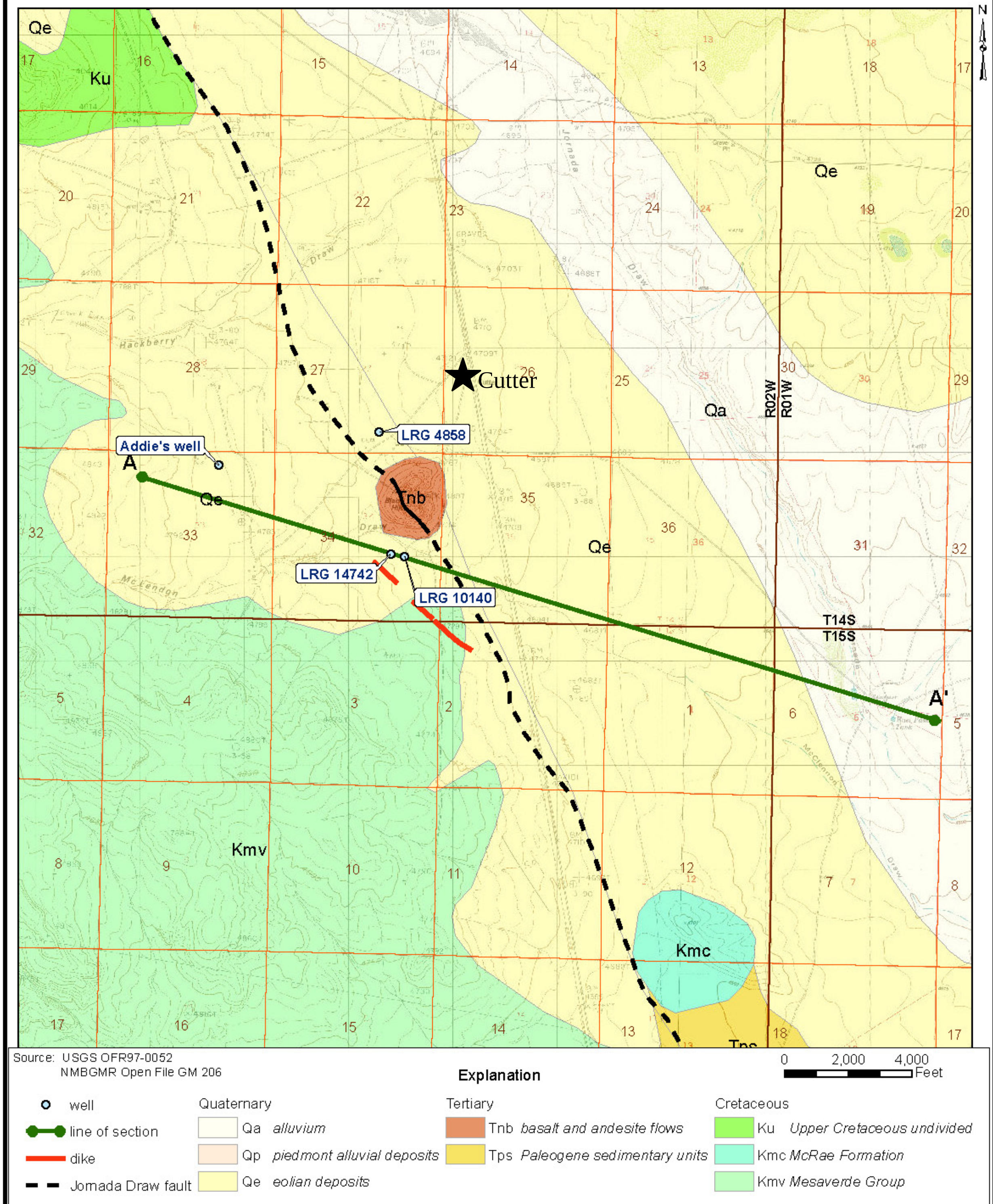


Figure 2. Surficial geology of the area surrounding Cutter, New Mexico (JSAI 2009B)

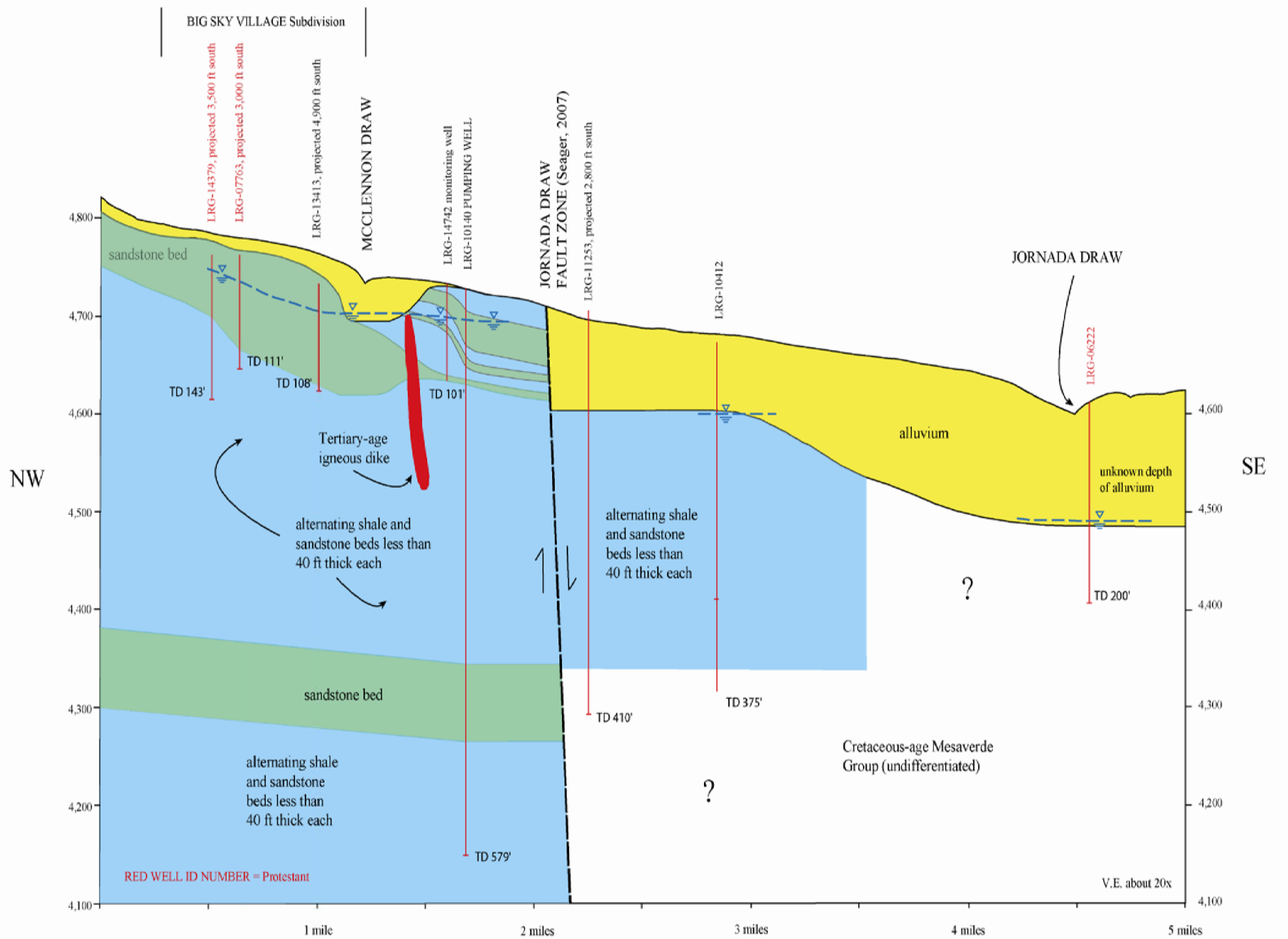


Figure 3. West to east hydrogeologic cross-section A-A', through well LRG-10140, Cutter, Sierra County, New Mexico.

Background

Cutter History

Cutter was founded in the early 1900s as a train stop on the Santa Fe Railroad running between El Paso and Albuquerque. The name Cutter is reported to have originated from the name of a Santa Fe railroad engineer. Mining of Vanadium in the nearby Caballo Mountains stimulated development in the area, as the ore was loaded in town and shipped out on the railway. It is estimated that, at its peak, the town of Cutter had a population of around 3,500 people (SCHS, 1979). The Victoria Chief Mining Company constructed a mill in Cutter to prepare the ore for shipment and employed about 300 men to run the operation. Several hundred other men were employed in the mines (Mitchell & Tooley, 1973). The mining boom did not last long for the area and when the mines closed in the early 1930s, most residents left. A few businesses remained for a short time afterwards, but would soon close down as well. The few that remained consisted of ranches and a Santa Fe depot which was used by the railroad to house employees. Once the Santa Fe changed over to diesel locomotives in the late 1940s, the stop was no longer necessary and Cutter was nearly completely abandoned.

Today, Cutter is an unincorporated area of subdivided land with approximately 40 residents. The Big Sky Village Subdivision, which was created in the early 1980s, makes up the majority of developed land and can be seen in Figure 4 (pg. 10). There are 42 wells that are identified in the NMOSE records in the Cutter area (Table 1). A map of these well locations is presented in Figure 5 (pg. 11).

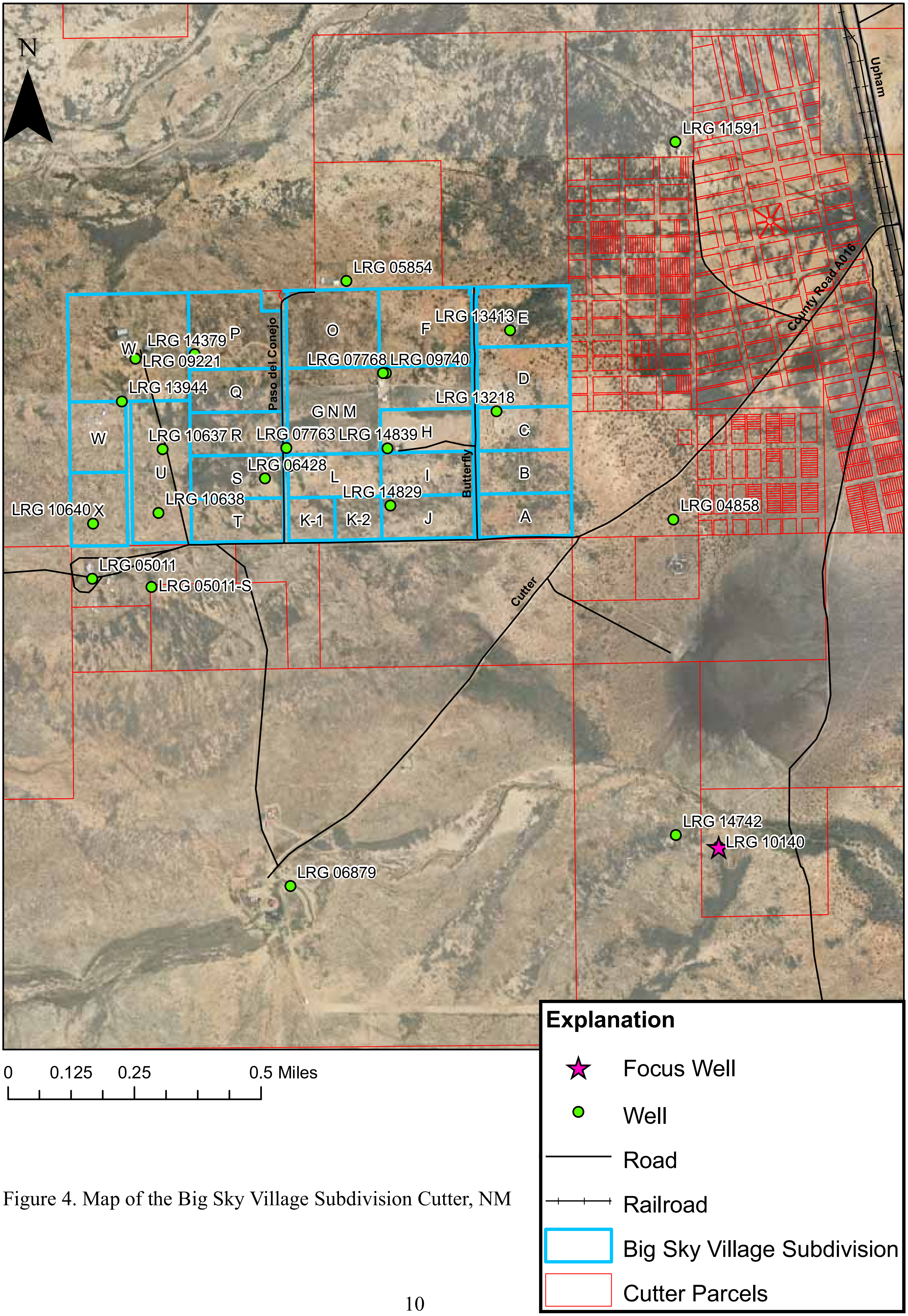
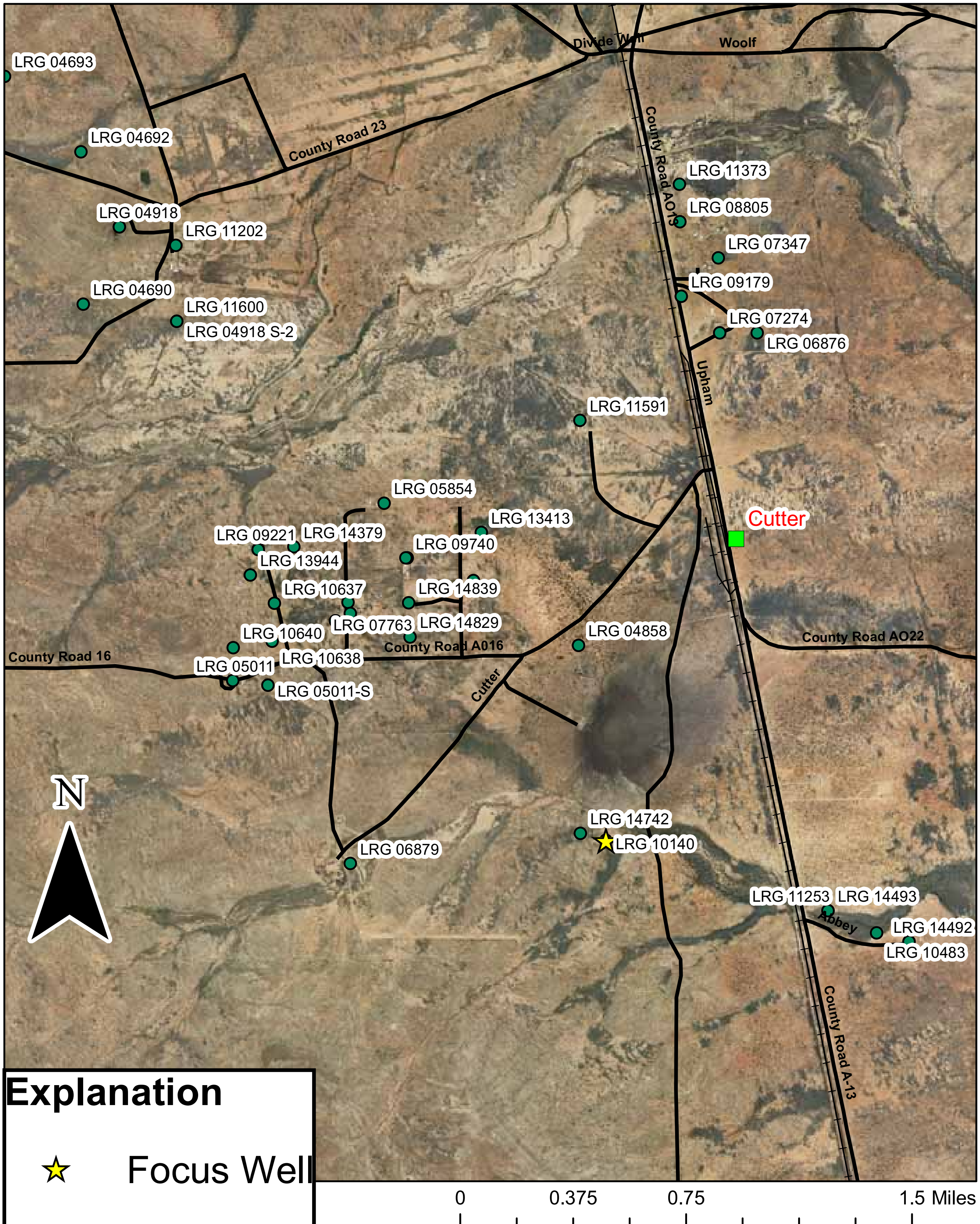


Figure 4. Map of the Big Sky Village Subdivision Cutter, NM



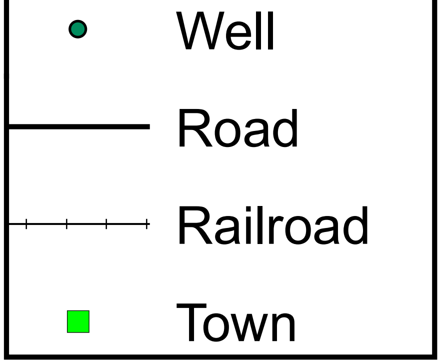


Figure 5. Map showing locations of wells in Cutter, NM area

Table 1. Permitted wells in Cutter and surrounding area (NMOSE, 2011).

WR File Nbr	Permitted Use	Permitted Diversion, ac-ft/yr	Owner	POD[1] Number	X, UTM83 Z13N, Meters	Y, UTM83 Z13N, Meters
LRG 04690	IRR	TBD	RIO GRANDE ALBQ & ACADEMY CORP	LRG 04690	307780	3661132
LRG 04692	IRR	TBD	GUARANTEED EQUITIES, INC.	LRG 04692	307789	3661945
LRG 04693	IRR	TBD	RIO GRANDE ALBQ & ACADEMY CORP	LRG 04693	307392	3662359
LRG 04858		15.5	CHARLES D GOETZ (CUTTER CATTLE CO.)	LRG 04858	310377	3659239
LRG 04918	IRR	TBD	BELL GROUP INC	LRG 04918	307985	3661538
				LRG 04918 S	307985	3661538
LRG 04918 S-2			BELL GROUP INC	LRG 04918 S-2	308278	3661027
LRG 05011	IRR	TBD	HAROLD & EUNICE D. MCCARTY	LRG 05011	308524	3659100
LRG 05011-S			HAROLD & EUNICE D. MCCARTY (ADDIE'S WELL)	LRG 05011 S	308711	3659069
LRG 05854	DOM	3	GARY DICKSON (CHRIST)	LRG 05854	309358	3660025
LRG 06243	DOM	3	ROD HILLE	LRG 06243	305333	3659179
LRG 06428	DOM	3	SHERRY LYNN EUNGARD	LRG 06428	309082	3659404
				LRG 06428 D-REP	309082	3659404
LRG 06876	STK	10	HOWE RANCH	LRG 06876	311376	3660880
LRG 06879	DOM	6	BARBARA BROWN	LRG 06879	309127	3658106
LRG 07274	STK	3	WALTER AND WANDA LEWIS	LRG 07274	311176	3660887
LRG 07347	STK	6	RUTH V BALDWIN	LRG 07347	311179	3661286
LRG 07763	IRR	TBD	H WAYNE JOHNSON	LRG 07763	309152	3659500
LRG 07763 S	IRR	TBD	H WAYNE JOHNSON	LRG 07763 S	309161	3659442
LRG 07768	IRR	TBD	JULIE MUNOZ	LRG 07768	309475	3659729
LRG 08805	DOM	3	WILLIAM W MCCORD	LRG 08805	310979	3661486
LRG 09179	DOM	3	LARRY G LEWMAN	LRG 09179	310976	3661087
LRG 09221	DOM	3	ARCHIE BAILEY	LRG 09221	308680	3659796
				LRG 09221 REP	308680	3659796
LRG 09740	DOM	3	GWYN E THURMAN	LRG 09740	309466	3659729

LRG 10140	COM	394.85	TOBY ROMERO	LRG 10140	310493	3658194
LRG 10412	DOM	3	LINDA ALLEN	LRG 10412	312099	3657609
LRG 10483	EXP	0	GREGORY A. ALLEN	LRG 10483	311926	3657659
LRG 10637	PMT	0	BOBBY R. & DAPHNE TRIBBLE	LRG 10637	308759	3659506
LRG 10638	PMT		BOBBY R. & DAPHNE TRIBBLE	LRG 10638	308740	3659304
LRG 10640	DOM	3	THOMAS WELLMAN	LRG 10640	308531	3659276
LRG 11202	DOM	3	RODERICK G HILLE	LRG 11202	308284	3661433
LRG 11253	DOM	3	DAVID C KUNZ	LRG 11253	311671	3657786
LRG 11373	DOM	3	LAWRENCE OTT	LRG 11373	310982	3661685
LRG 11591	DOM	3	JOE TURNER TRUST	LRG 11591	310416	3660439
LRG 11600	DOM	3	RODERICK G. HILLE	LRG 04918 S-2	308278	3661027
LRG 13218	DOM	1	QUANTUM LIZARD LLC (HOROSCHAK)	LRG 13218	309824	3659598
LRG 13413	DOM	3	DARLENE A GLADWELL ESTATE (WILLAMS)	LRG 13413 POD1	309873	3659855
LRG 13944	PDM	3	KIM TRIBBLE	LRG 13944 POD1	308633	3659662
LRG 14379	PDL	3	SANDRA TATE	LRG 14379 POD1	308869	3659805
LRG 14682	PDL	3	RODERICK G HILLE	LRG 14682 POD1	305979	3661983
LRG 14742	EXPL	0	TOBY ROMERO (OBSERVATION WELL)	LRG 14742 POD1	310358	3658235
LRG 14829	DOM	1	WILLIAM D. CRISP	LRG 14829	309478	3659307
LRG 14839	DOM	1	JAMES E. SMITH	LRG 14839 POD1	309474	3659490

[1] Point of Diversion

Romero Well History

Well LRG-10140 is the production well that is the subject of much of the analysis in this report. LRG-10140's early history is much like Cutter's history in that it was dependent upon the railroad. The well was drilled in 1921 by A.A. Riggs to supply water for locomotives. Known at the time as Well No.6, this steam powered system was reported to originally pump around 150 gallons per minute (gpm). A log of the well is attached in the appendices along with a diagram of the original pumping apparatus and train schedule that was used to estimate pumping rates from the well. The well was drilled to a total depth of 578 ft bgl and left as an open borehole. The well was pumped from 1921 to 1966 for railroad use and then again from 1992 to 1995 for livestock watering purposes. The present owner claims a diversionary amount of 394.85 ac-ft/yr based upon a calculation from the train schedules.

Mine production was used to estimate water use by the railroad. The maximum tonnage of ore from mining was 4,541,000 tons in 1944. The gross tons divided by 600 tons per train equals 630 trains per month. 630 trains per month multiplied by 17,000 gallons per train equals 10,721,805 gallons per month which is equivalent to 32.9 ac-ft per month or 394.85 ac-ft/yr (NMOSE, 2011). This permitted amount only applies to the well's original use for the railroad. This amount is not permitted for any other purposes. Today, the steam powered pump is on display at a nearby museum in Truth or Consequences, New Mexico.

When construction began for Spaceport, a temporary water source was needed while issues associated with water rights applications for the facility were resolved. LRG-

10140 was restored to service by FNF Construction (FNF) of Albuquerque, New Mexico. Before the well was put back into production, existing water rights from other wells were transferred to LRG-10140 and a pumping test was performed and evaluated by John Shomaker & Associates, Inc. (JSAI). Between October 1 and 3, 2009, a total of 583,300 gallons were pumped during a 48-hour constant-rate pumping test (JSAI, 2009B). The well was pumped at an average rate of 200 gpm during the test. Water levels in two monitoring wells were measured, one new well constructed for this test and one existing well, to assist in the evaluation. The new monitoring well (LRG-14742) was cased to a depth of 101 ft bgl and screen was set from 41-101 ft bgl. The following conclusions were made by JSAI (JSAI, 2009B).

- The shapes of the drawdown and recovery curves on Figures 6 through 9 (pgs. 17-18) indicate a bounded fractured aquifer of limited size. The limits of the fractured aquifer are best explained by the geologic boundaries surrounding LRG-10140 (Fig. 2, pg. 7), including the Jornada Draw Fault to the east, a series of dikes to the south and west, and the Black Hill intrusion to the north.
- Due to the aquifer characteristics, a traditional Theis analysis of the pumping test data is not valid.
- The observed drawdown and recovery demonstrates that the observation wells are hydraulically connected to the pumping well LRG-10140.
- The fractured system tapped by LRG-10140 appears to recharge and recover from pumping, as indicated by projecting late-time recovery shown on Figures 7 through 10 (pgs 17-19). The bounded, fractured aquifer may be connected to the area northwest of LRG-10140 between mapped dikes and Black Hill.

- At a pumping level of 350 ft below ground level (bgl), approximately 50 percent of the sandstone units would be dewatered around the well, and the yield would begin to decline significantly. Therefore, the maximum recommended pumping level is 350 ft bgl. Based on the analysis of the pumping data, continuous pumping at 200 gpm for five years would result in a pumping level of approximately 350 ft bgl. This equates to 320 ac-ft/yr for five years, or a total of approximately 1,600 ac-ft/yr in five years.
- Recharge to the localized aquifer supplying LRG-10140 is estimated at 50 gpm (80 ac-ft/yr) from water-level recovery trends. Therefore, pumping 1,600 ac-ft from LRG-10140 would take approximately 20 years to fully recover.
- All wells of other ownership are outside of the bounded fractured aquifer tapped by LRG-10140 (Figs. 2 and 5). Therefore, drawdown impacts propagating to neighboring wells is unlikely. There is a remote possibility the drawdown caused by LRG-10140 would propagate to the northwest.
- Using the test data and geologic relationships between LRG-10140 and LRG-14742 (monitoring well), it is estimated that the drawdown in the shallow sandstone units will not propagate much beyond 1,000 ft from LRG-10140 regardless of pumping rate or duration.
- There are no known wells of other ownership located 1,000 ft northwest of LRG-10140 (Fig. 5, pg.11). The closest known well of other ownership is LRG-4858, which is located approximately 3,500 ft northwest of LRG-10140 (Fig 5). The analysis results in no significant hydrologic impacts on known wells of other ownership (JSAI, 2009B).

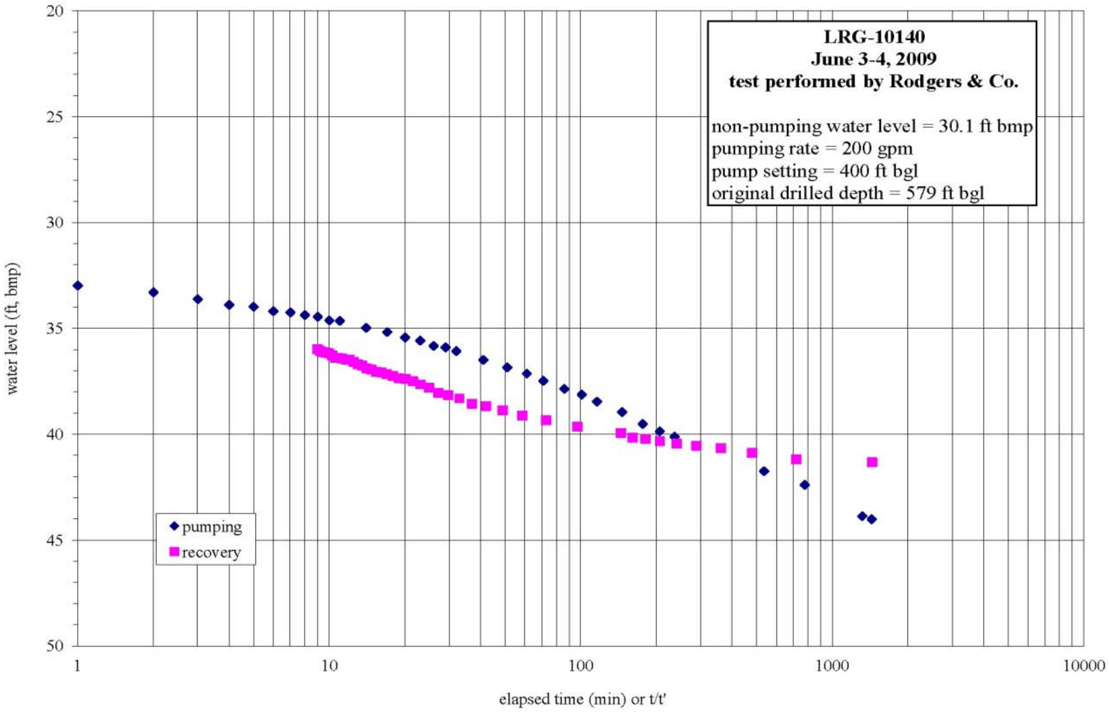


Figure 6. Semi-logarithmic graph of 24-hr constant-rate pumping test performed by Rodgers & Co, well LRG-10140, former Cutter Railroad Well, Cutter, New Mexico (JSAI, 2009B)

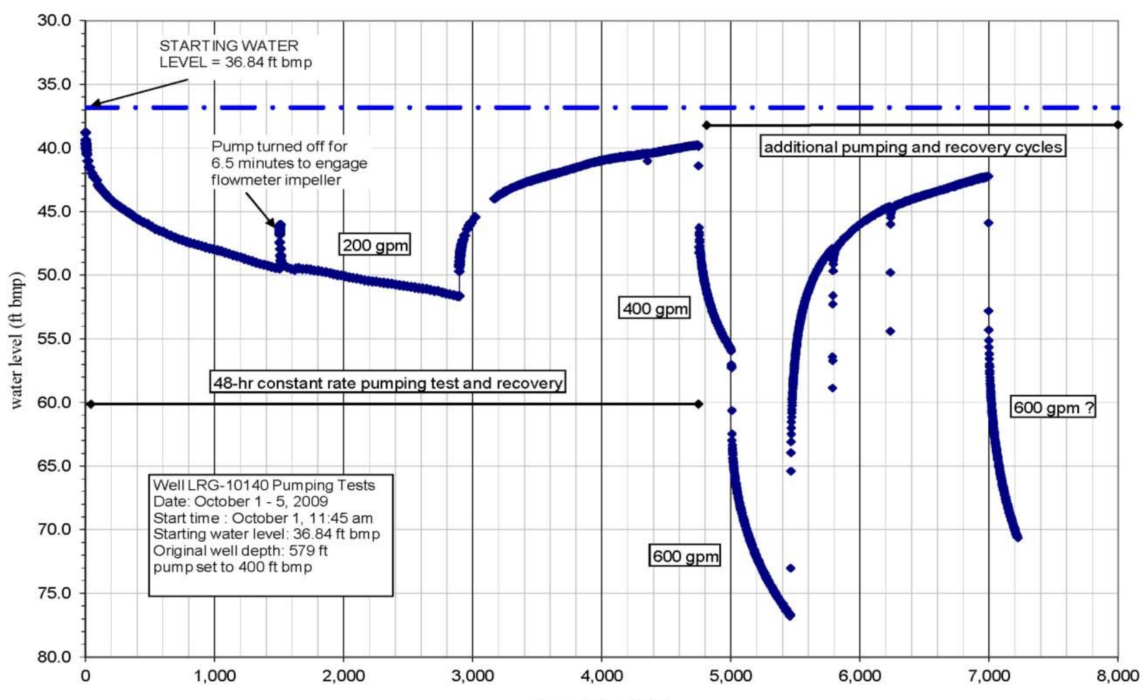


Figure 7. Graph of water level versus elapsed time during pumping tests performed on well LRG-10140, near Cutter, New Mexico (JSAI, 2009B).

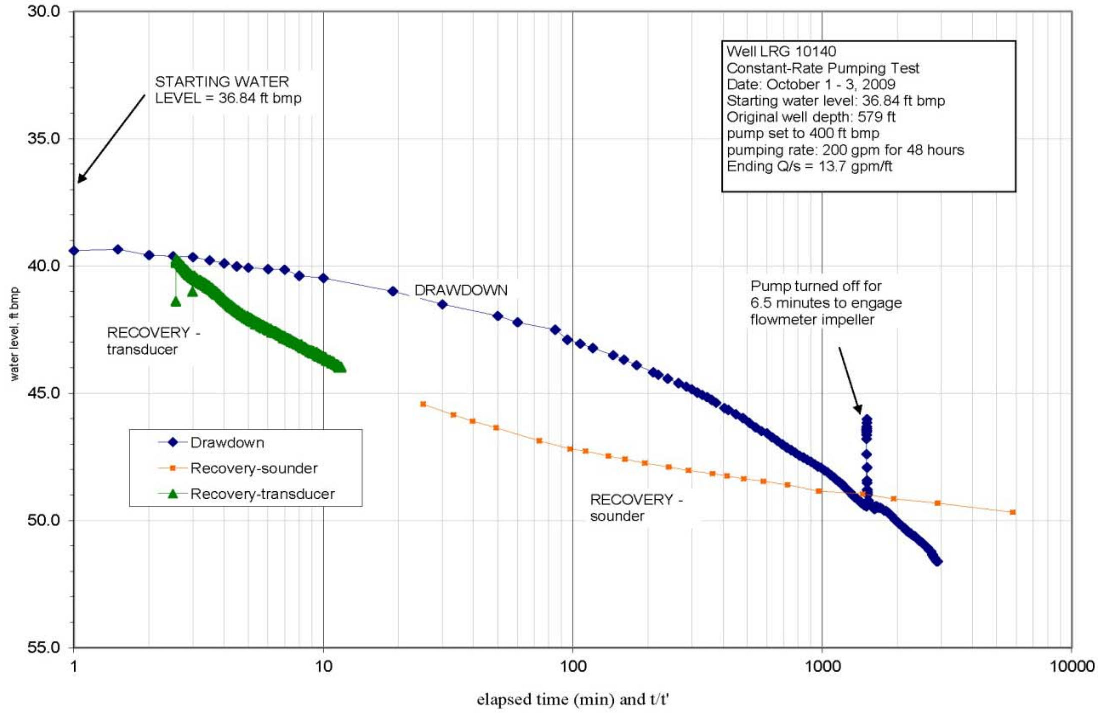


Figure 8. Semi-logarithmic plot of drawdown and recovery data from the 48-hour constant-rate pumping test performed on well LRG-10140, near Cutter, New Mexico (JSAI, 2009B)

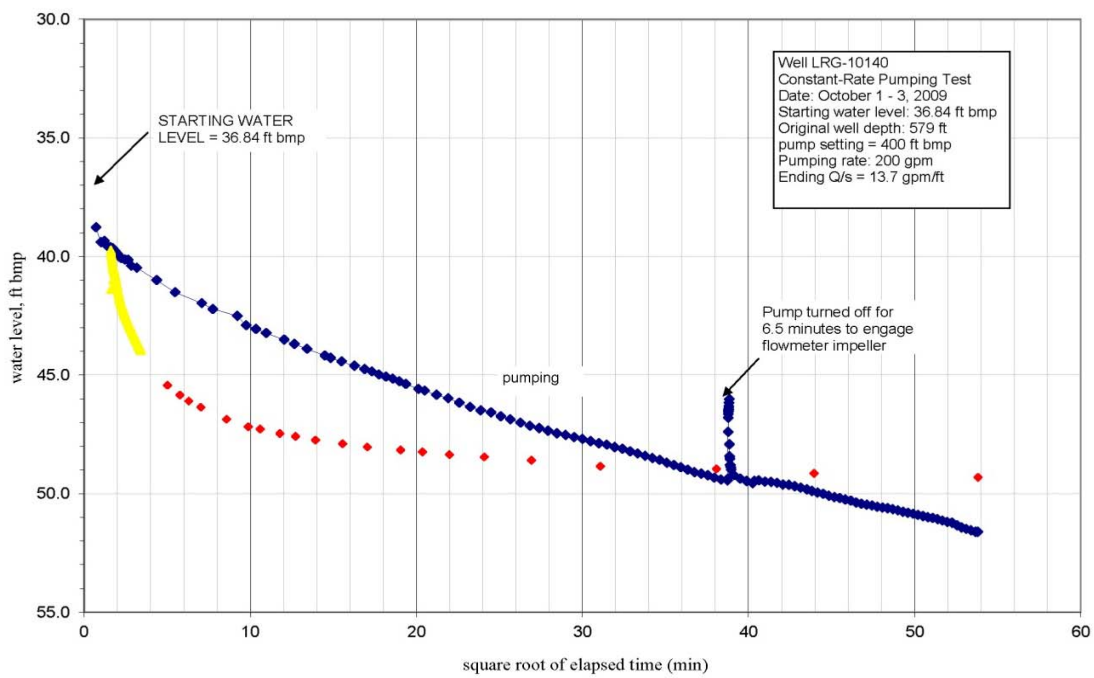


Figure 9. Graph of square root of elapsed time versus depth to water for 48-hour constant-rate pumping test performed on Well LRG 10140 near Cutter, New Mexico (JSAI, 2009B)

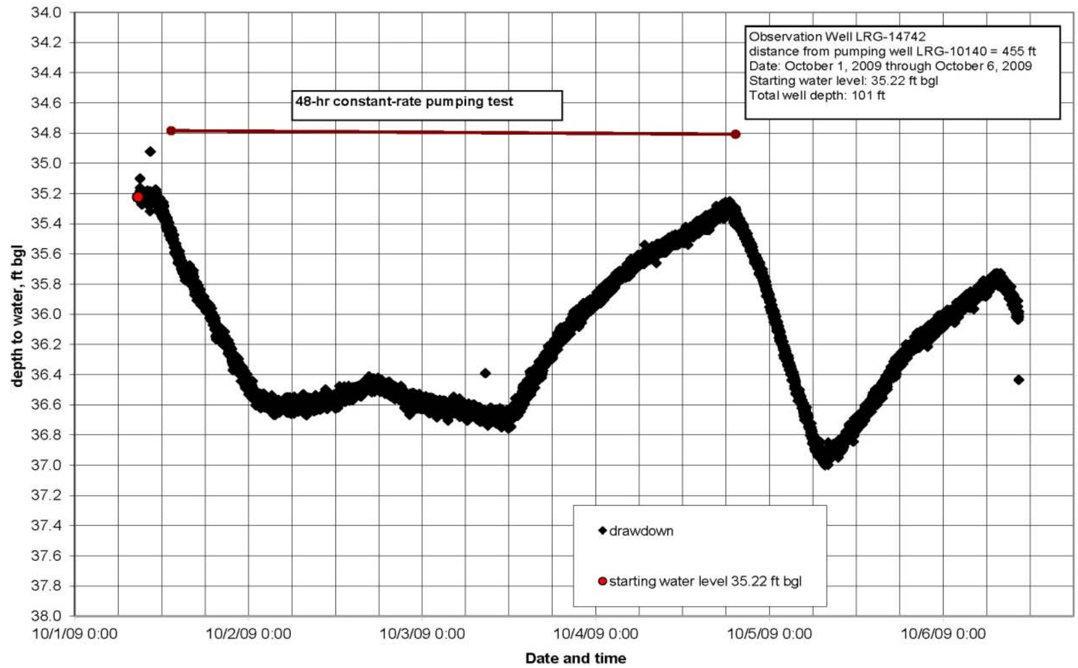


Figure 10. Graph of water level versus time for observation well LRG-14742, October 1 through 6, 2009, near Cutter, New Mexico (JSAI, 2009B)

After testing the well, it was put into service to provide water for construction at the Spaceport. Between September 2009, and June 2010, a total of 138 ac-ft were pumped (Finch, 2010). Around April 2010, residents in Cutter began to complain to the NMOSE about drawdown in domestic wells and wells gone dry. As a result, transducers were installed by FNF in LRG-10140, LRG-14742 (Observation Well), LRG-4858 (Cutter Well), and LRG-13218 (Horoschak). In addition to these wells, the NMOSE took hand measurements from LRG-5011-S (Addie's), LRG-13413 (Williams), LRG-5854 (Christ), LRG-7768 (Munoz), LRG-7763-S (Johnson), LRG-11591 (Turner Trust), LRG-14829 (Crisp), and LRG-9740 (Thurman), from May 2010, through March 2011. A map of the mentioned wells can be found in Figure 11 (pg. 20). The transducer data, along with the NMOSE measurements are available in Figures 12 through 16.

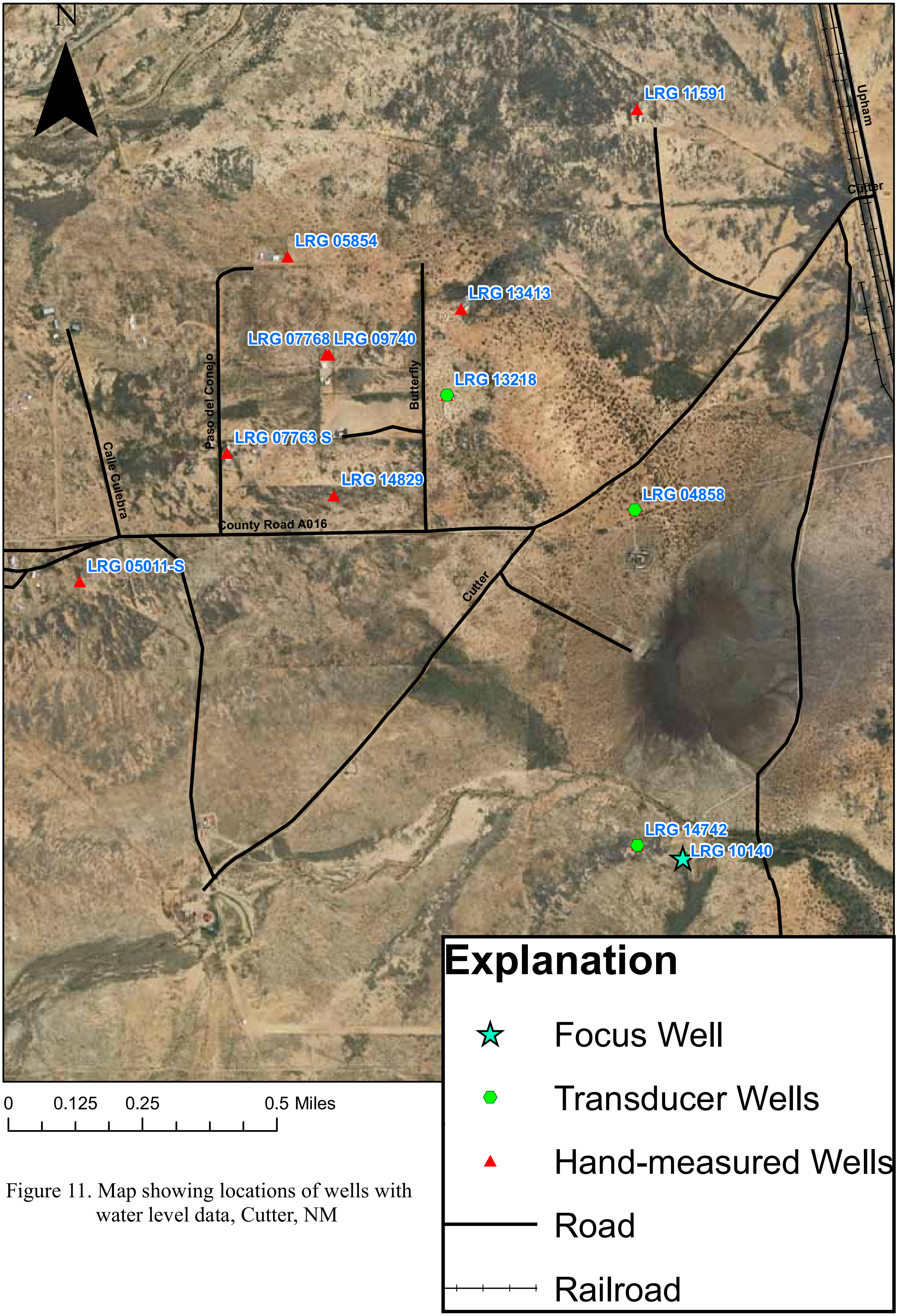


Figure 11. Map showing locations of wells with water level data, Cutter, NM

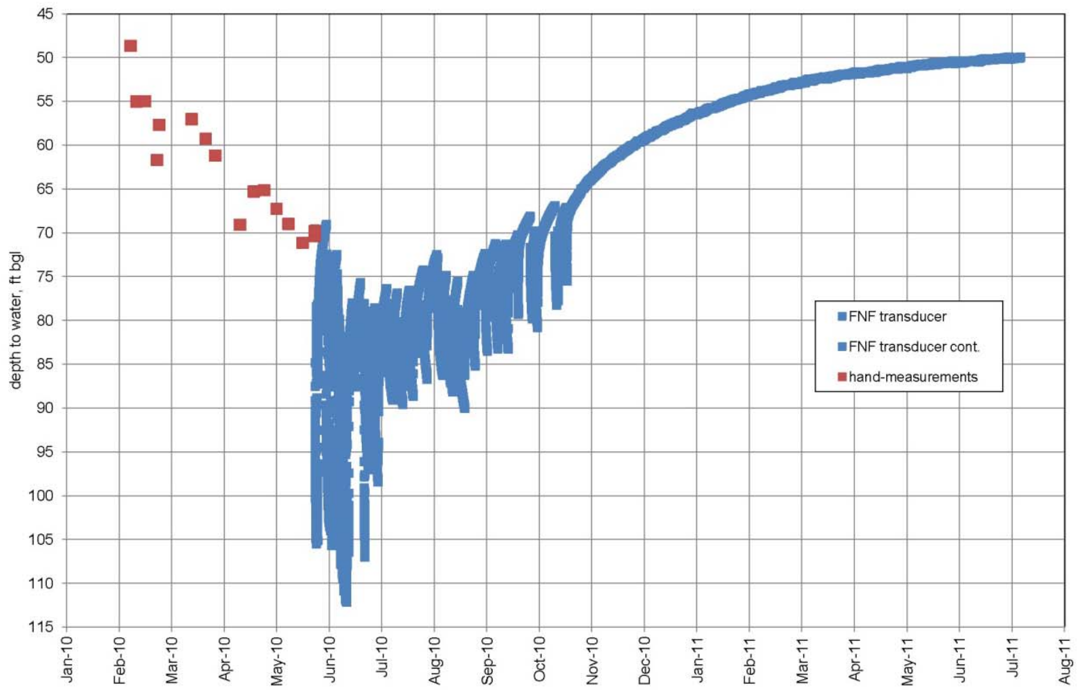


Figure 12. Pumping well (Romero) LRG-10140, hand-measured water levels and transducer data (JSAI, 2011).

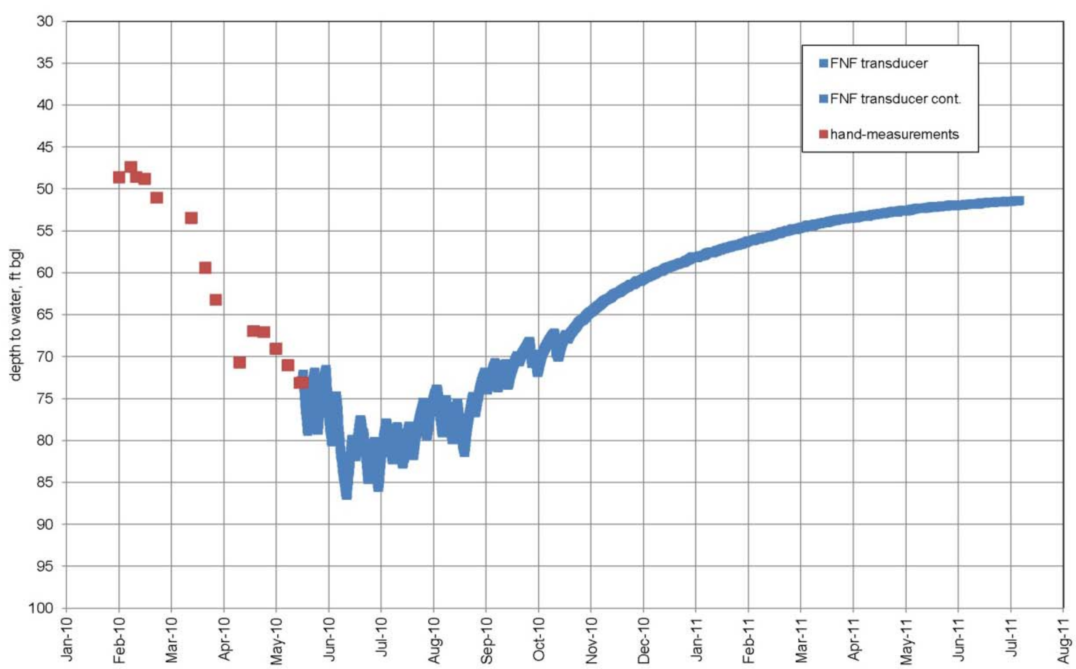


Figure 13. Observation well LRG-14742, hand-measured water levels and transducer data (JSAI, 2011).

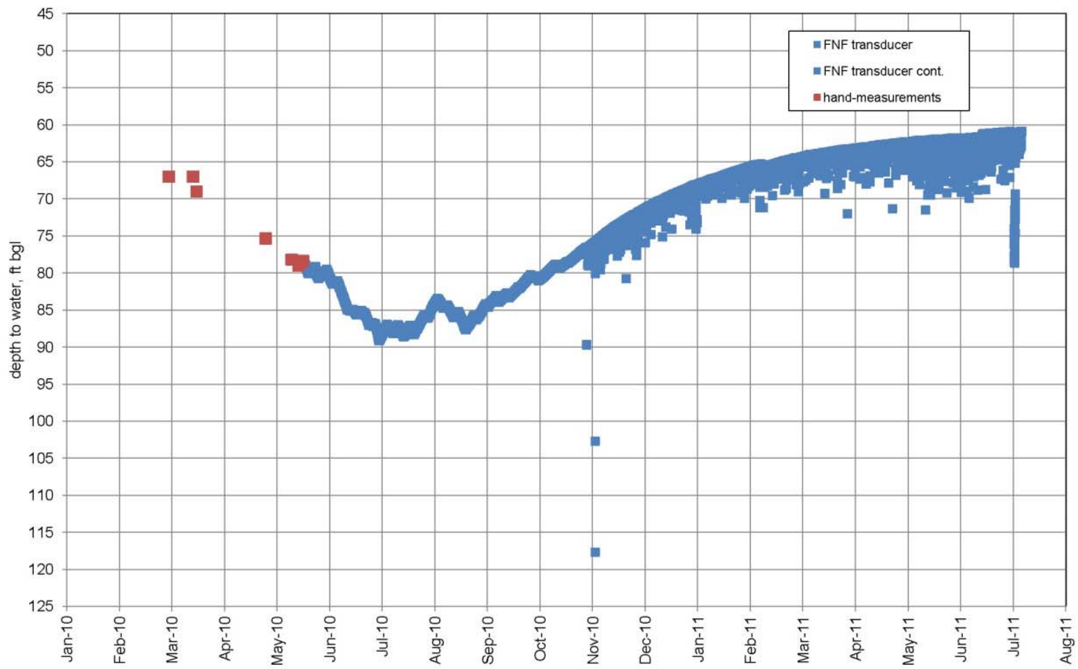


Figure 14. Horoschak well LRG-13218, hand-measured water levels and transducer data (JSAI, 2011).

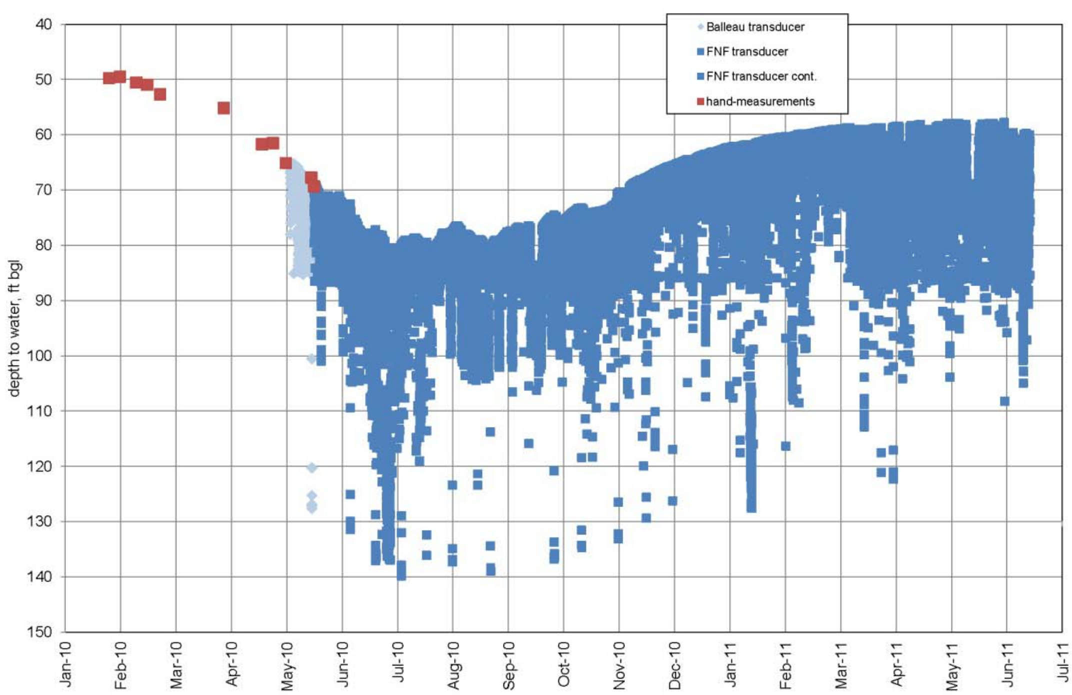


Figure 15. Cutter Cattle well LRG-4858, hand-measured water levels and transducer data (JSAI, 2011).

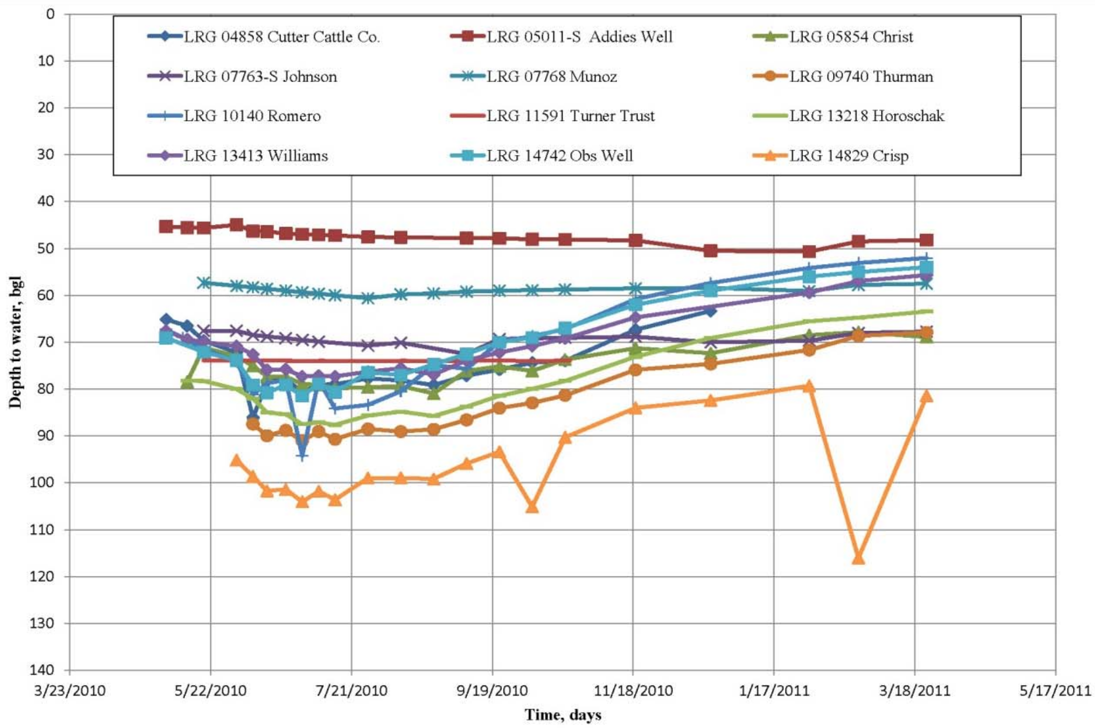


Figure 16. Depth to water measurements for study wells, Cutter, NM (NMOSE, 2011).

Original estimates of drawdown did not anticipate impacts that were observed in and around Cutter. As mentioned by JSAI (2009B), any possible drawdown impacts would propagate to the northwest but should not extend much beyond 1,000 ft. Drawdown impacts were noted at much greater distances meaning, the storage held within the system was much less than originally estimated. Areas of high transmissivity, due to fractures, were also apparent. This groundwater hydrology was proving to be more complex than originally expected.

Projected Water Demand

Understanding the geologic conditions of this aquifer system is one key element to determining the impacts of future development. Another key factor, is estimating the amount of water that is needed to support the community. While current literature contains various amounts of per capita water use on a daily basis (gpcd), limited studies have been conducted to estimate what residents with private wells, in arid rural settings, consume. Many believe that rural residents use greater amounts of water on a daily basis than residents in urban areas, while others argue those outside the city limits use less. For the purposes of this study, estimations based upon the following references were used.

The amount of water that can be pumped from a domestic well in New Mexico is only subject to limitations in areas considered "declared underground basins" by the State Engineer. After declaration, domestic wells, issued permits under § 72-12-1 (NMAC), were first limited to 3 ac-ft/yr (N.M.S.A. 1978 §§ 72-12-1.1 - 72-12-1.3, 2003). In 2006, the amount was reduced to 1 ac-ft/yr (N.M.A.C. 19.27.5). No public notice is required or protest allowed on domestic well applications. Domestic well applications may be approved, rejected, or approved with conditions by the NMOSE. Conditions may be imposed on a permit, such as; minimum distance from adjacent wells, metering and monitoring requirements, compliance with local ordinances, restrictions on purpose of use, or other conditions as the situation warrants. A permit may be cancelled if a permit holder fails to comply with conditions (Utton Center, 2009).

In 2000, the Hydrology Bureau of the NMOSE prepared a paper in response to a legislative initiative which estimated statewide average domestic-well diversions at 0.35 ac-ft/yr per residence, based on a demand of 114 gpcd and an average of 2.74 persons per residence (NMOSE, 2000). This paper was then updated with information from Wilson et al. (2003), which represented somewhat smaller per-capita use. For the purpose of estimating withdrawals for the self-supplied domestic population, in most counties an areawide average of 80 gpcd is used. In counties where water requirements for landscape irrigation and evaporative cooling are more prevalent, an areawide average of 100 gpcd is used (Wilson et al., 2003). In many instances, one domestic well serves several households. The Wilson report is designed as one well per household and, because of this, can be an underestimation of the actual amounts pumped.

The United States Geological Survey (USGS) has reported on self-supplied domestic water use. Table 2 is a compilation of data taken from the USGS on a state-by-state basis. The self-supplied domestic water use for the year 2000, and the population dependent upon it, is given for each of the western interior states. These estimates are generally taken from data gathered by state agencies, and for that reason probably reflect the assumptions of the state agencies rather than rigorous study by USGS (JSAI, 2009A).

Table 2. Estimates of self-supplied domestic diversion, by state, for year 2000, from USGS

State	Population supplied by domestic wells	Diversion, ac-ft/yr	Acre-feet per year per capita	Estimated annual withdrawal, gallons per capita per day
New Mexico	360,000	35,200	0.098	87.2
Arizona	265,000	32,400	0.122	108.8
Colorado	555,000	74,900	0.135	120.4
Idaho	366,000	95,600	0.261	232.8
Kansas	193,000	24,200	0.125	111.5
Montana	238,000	19,400	0.082	72.7
Nebraska	324,000	54,300	0.168	149.9
Nevada	124,000	25,200	0.203	181.1
Oklahoma	299,000	28,500	0.095	84.8
Texas	1,190,000	147,000	0.124	110.6
Utah	56,200	18,000	0.320	285.5
Wyoming	87,500	7,360	0.084	74.9
Entire U.S.	43,500,000	4,026,100	0.093	82.6

(JSAI, 2009A)

Data provided from metering related to FNF's pumping of LRG-10140 gives an actual amount for a resident in Cutter using a domestic well. Mr. Smith, owner of LRG-14839, had a meter placed on his domestic well. From February to June of 2011, Mr. Smith average daily use was 420 gallons for two residents in his household (210 gpcd). This provided a true value for water use and was used for calculations discussed later in the paper.

Methodology

Water Level Data

Much of the data analyzed in this project was from monitoring related to use of LRG-10140 and was provided by JSAI and the NMOSE. Transducers installed by FNF on wells LRG-10140, LRG-14742, LRG-4858, and LRG-13218, along with water levels collected by the NMOSE at wells LRG-5011-S, LRG-13413, LRG-5854, LRG-7768, LRG-7763, LRG-11591, LRG-14829, and LRG-9740, provided information that was used determine the extent of the aquifer taped by the Romero Well. Table 3, below, lists the wells for which groundwater measurements were recorded and Figure 11 (pg. 20), shows the locations of these wells.

Table 3. Wells with water level measurements.

WR File Nbr	Use	Diversion, ac-ft/yr	Well Name	X, UTM 83, Z13N meters	Y, UTM 83, Z13N meters	Well Depth, ft bgl	Surface Elevation, ft amsl
LRG 04858		15.5	CUTTER CATTLE CO.	310377	3659239	164	4737
LRG 05011-S	IRR	TBD	ADDIE'S WELL	308711	3659069	180	4783
LRG 05854	DOM	3	CHRIST	309358	3660025	190	4755
LRG 07763 S	IRR	TBD	JOHNSON	309161	3659442	111	4763
LRG 07768	IRR	3	MUNOZ	309475	3659729	152	4752
LRG 09740	DOM	3	THURMAN	309466	3659729	200	4752
LRG 10140	COM	394.85	ROMERO WELL	310493	3658194	578	4731
LRG 11591	DOM	3	TURNER TRUST	310416	3660439	170	4725
LRG 13218	DOM	1	HOROSCHAK	309824	3659598	135	4744
LRG 13413	DOM	3	WILLIAMS	309873	3659855	108	4738
LRG 14742	EXPL	0	OBSERVATION WELL	310358	3658235	100	4738
LRG 14829	DOM	1	CRISP	309478	3659307	240	4757

The 4 wells with transducers began logging water levels in May of 2010, and were programmed to take readings every 15 minutes. The NMOSE measurements also began in May of 2010, and were taken manually. These wells were measured at varying intervals. To compare the data, the dates on which NMOSE measurements were taken were used and compared to the transducer data on that corresponding day. Water levels from the transducer wells were selected by the highest, or most shallow, reading from that selected date. This was done to ensure that a pumping water level was not selected from the data set. It should be noted that some of the NMOSE hand measurements may be pumping water levels, or somewhere in the stage of well recovery. This is evident in Figure 17 with regard to the water level reading from LRG-14829 on October 2, 2010, and again on February 22, 2011.

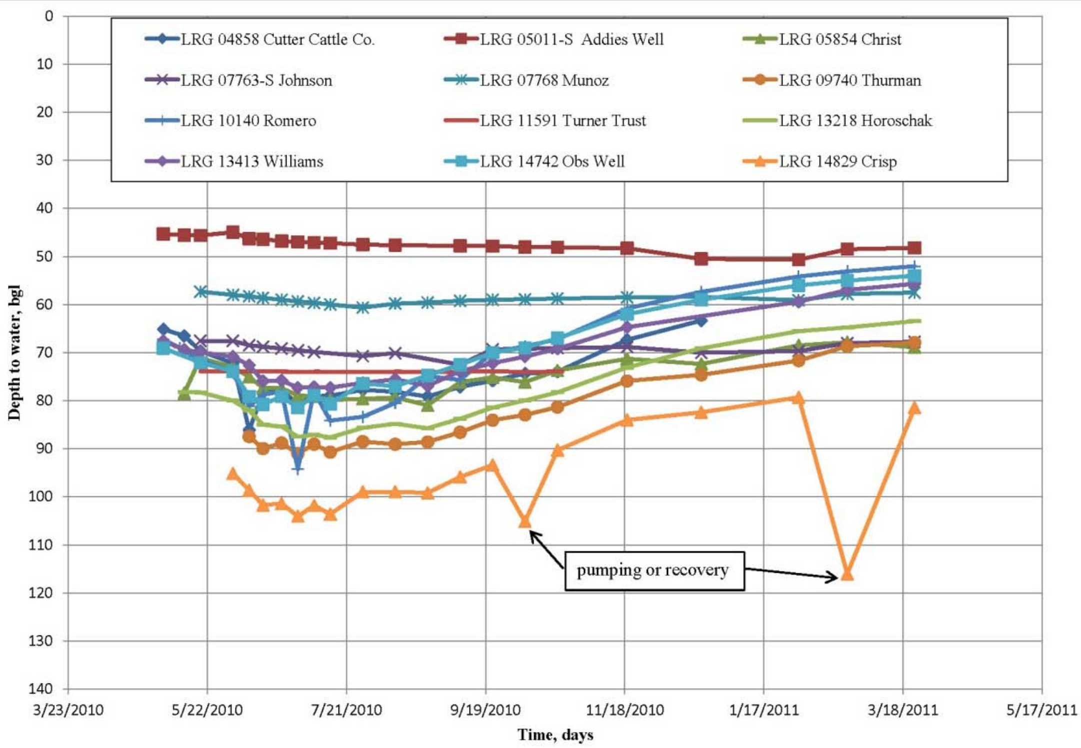


Figure 17. Depth to water measurements for study wells, Cutter, NM (NMOSE, 2011).

Once the water level readings were organized, surface elevations at well heads were referenced from satellite imagery using “Google Earth”. Surface elevations were recorded as feet above mean sea level (famsl). Figure 18 shows the results of organizing the water level data with relation to surface elevation.

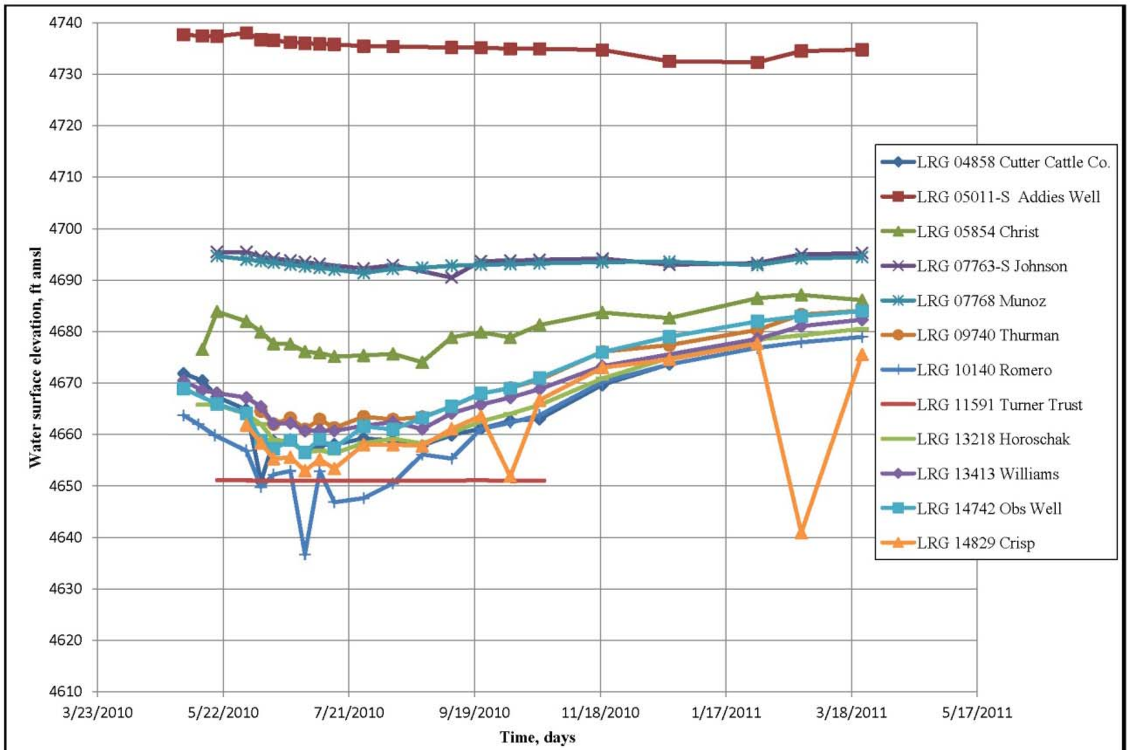


Figure 18. Water level measurements from study wells referenced to elevation, Cutter, NM (NMOSE, 2011).

Romero Well Pumping Data

The amount of water pumped from LRG-10140 was taken from meter readings provided on the NMOSE Water Administration Technical Engineering Resource System (WATERS) database. Meter readings began on June 30, 2009, and continued through November 2, 2010. Figure 19 is a graph of metered usage and Table 4 summarizes the amount pumped by calendar year.

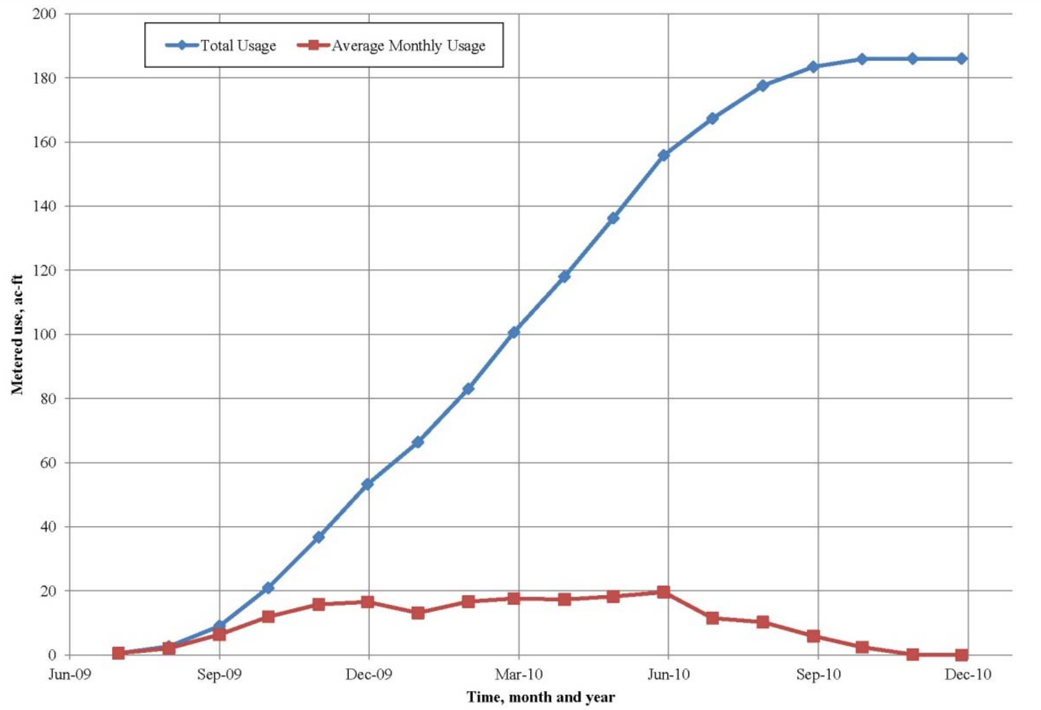


Figure 19. Graph of total use vs average monthly use by FNF Construction, Romero Well LRG-10140, Cutter, NM (NMOSE, 2011)

Table 4. Summary of water pumped from LRG-10140 by calendar year, NMOSE meter readings.

Calendar year	Amount pumped, ac-ft
2009	53.244
2010	132.753
Total	**185.997**

Current and Future Demand for Water

While the recent pumping from LRG-10140 far exceeded the usual demand for water in the Cutter area, it did give an indication of what future development could do to the aquifer. One large well pumping at a rate of 200 gpm is the same as 20 small wells pumping at a rate of 10 gpm.

For the purposes of this study, a value of 16.5 ac-ft/yr was given to LRG-07763-S designated TBD based on its use as an irrigation well. The NMOSE record shows an irrigated amount of 5.5 acres of land. 5.5 acres of land multiplied by 3 ac-ft/acre equals 16.5 ac-ft/yr. Since only a certain number of wells are assumed to be within the designated zone mentioned previously, the following information was used to estimate current and future demand.

There are 26 lots within the Big Sky Village (BSV) Subdivision (Fig. 4 pg. 10). Of the 26 lots within the subdivision, 13 have water-wells and there are three adjacent lots that also have wells. Table 5 summarizes information about the subdivision and includes the parcels that border the subdivision.

Table 5. Big Sky Village Subdivision and surrounding parcels, ownership and details.

Lot	Owner	Well Number	Permitted diversion, ac-ft/yr
A	Thomas & Jeannie Izzo	N/A	0
B	Roty LLC	N/A	0
C	Quantum Lizard LLC	LRG 13218	1
D	Brent & Melissa Ziarnick	N/A	0
E	Ronald Williams	LRG 13413	3
F	Alice Bryan	N/A	0
G	Julie Munoz	LRG 07768	3
H	James Smith	LRG 14839	1
I	Tressa Woolf	N/A	0
J	William & Juanita Crisp	LRG 14829	1
K-1	Bud Walters	N/A	0
K-2	Don Lowe	N/A	0
L	Hazel Johnson	LRG 07763-S	TBD
M	Maxine Thurman	N/A	0
N	Maxine Thurman	LRG 09740	3
O	Neidig & Brouse	N/A	0
P	John & Helen Tate	LRG 14379	3
Q	Freddie Torres	N/A	0
R	Randy Martin	N/A	0
S	Thomas Eungard	LRG 06428	3
T	Bud Walters	N/A	0
U	Evans & Katehakis	LRG 10638	0
V	Evans & Katehakis	LRG 10637	0
W	Tom Wellman	LRG 10640	3
X	Dean Revocable Trust	LRG 13944	3
	Bobby & Daphne Tribble	LRG 09221	3
	Robert Christ	LRG 05854	3
	Cutter Cattle Co.	LRG 04858	15.5
		Total	**45.5**

As the table shows, there are a number of lots in the subdivision with no well in place. Other lots have wells in place that have not been permitted to divert water because the lots are vacant and the required paperwork must be filed first. Many of these lots are 10 acres in size and have the potential to be divided up further, as Lot K represents. Table 6 compares the total diversions in the BSV Subdivision for present day demand and potential future demand based upon the following assumptions:

1. Only single-household domestic permits of 1 ac-ft/yr are issued for lots with no well or no assigned diversion.
2. The TBD value was assigned 16.5 ac-ft/yr water rights.
3. Lots sizes will remain the same preventing any further subdividing.

Table 6. Current diversions vs. future diversions, Big Sky Village Subdivision and surrounding lots.

Current total permitted diversions, ac-ft/yr	Future total permitted diversions, ac-ft/yr
45.5	76.0

While the information in Table 6 does represent what is, and possibly could be, appropriated in the Cutter area, current use of water is considerably less. As discussed previously, the amount of water used by individuals in such a rural setting is debatable. Estimates average around 100 gpcd. Using the averaged metered use of 210 gpcd from the data related to Mr. Smith (LRG-14839), the following information was calculated.

Current population near the Cutter area around 40 people and the majority of the population resides within the boundaries of the aquifer tapped by LRG-10140. Looking at Figure 4 (pg. 10) shows that the BSV Subdivision makes up the main concentration of the Cutter population with a few other developed parcels within the aquifer boundary. For this reason, a population of 25 people was used to calculate current water use for the community. For estimated future use, it was assumed that all of the lots within the subdivision had homes with an average of 2.5 residents per home. In addition to these estimates, diversions from the surrounding irrigation wells previously mentioned were added in full. Table 7 summarizes the demand for water based upon these assumptions.

Table 7. Current and future water use for the area of Cutter within the assumed aquifer boundary.

Current water use				Future water use			
Population	Use, gpcd	Total, gal/yr (domestic use)	Total, ac-ft/yr (plus irrigation rights)	Population	Use, gpcd	Total, gal/yr (domestic use)	Total, ac-ft/yr (plus irrigation rights)
25	210	1,916,250	40.9	60	210	4,599,000	49.6

Values are significantly impacted by irrigation rights like those associated with wells LRG-07768, LRG-07763, and LRG-04858. If future irrigation rights are issued within the aquifer boundary they will create greater impacts.

Estimated Aquifer Extent

In order to determine a storage coefficient for the aquifer that lies beneath Cutter, the extent of the aquifer is needed. While the exact area of the aquifer is not known, studying area wells and water level measurements can give an estimate to the extent of this system. The geologic characteristics, discussed earlier in this paper, were also used to set boundaries for the system. What resulted was an estimate for the extent of the aquifer tapped by LRG-10140.

Water levels were the first clue as to what wells in the community are connected to LRG-10140. There are definite impacts on wells LRG-4858, LRG-5854, LRG-9740, LRG-13218, LRG-13413, LRG-14742, and LRG-14829, are observed. Wells showing little to no response to pumping include LRG-5011-S, LRG-7763-S, LRG-7768, and LRG-11591 (Fig. 20, pg. 35). While LRG-7763-S, and LRG-7768, show little impacts from pumping, they are considered to be within the aquifer system. The absence of significant drawdown in these two wells can be attributed to their shallow depths, which are listed in Table 3. LRG-11591 showed no signs of drawdown impacts and is not connected because of the fact that it lies east of the Jornada Draw Fault boundary.

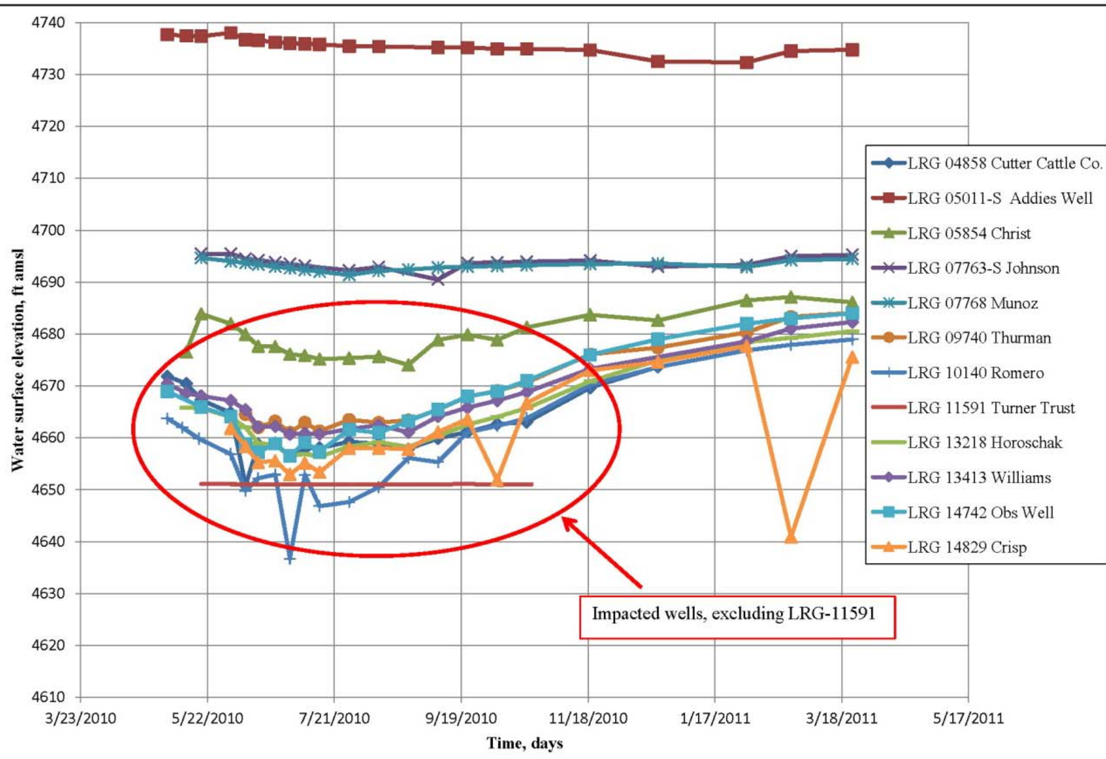


Figure 20. Wells impacted by LRG-10140, Cutter, NM (NMOSE, 2011).

While the exact location of the Jornada Draw Fault is not known, evidence from this study suggests that it lies to the east of LRG-4858 and LRG-13413, and to the west of LRG-11591. Original mapping, from the USGS, has the Jornada Draw Fault running in northwestern direction from the western side of Black Hill. However, wells that responded to pumping suggest the fault may be located farther to the east (Fig. 21, pg.36). The depth of the water table in LRG-11591 coupled with the constant water level help to confirm the fault location (Fig. 20).

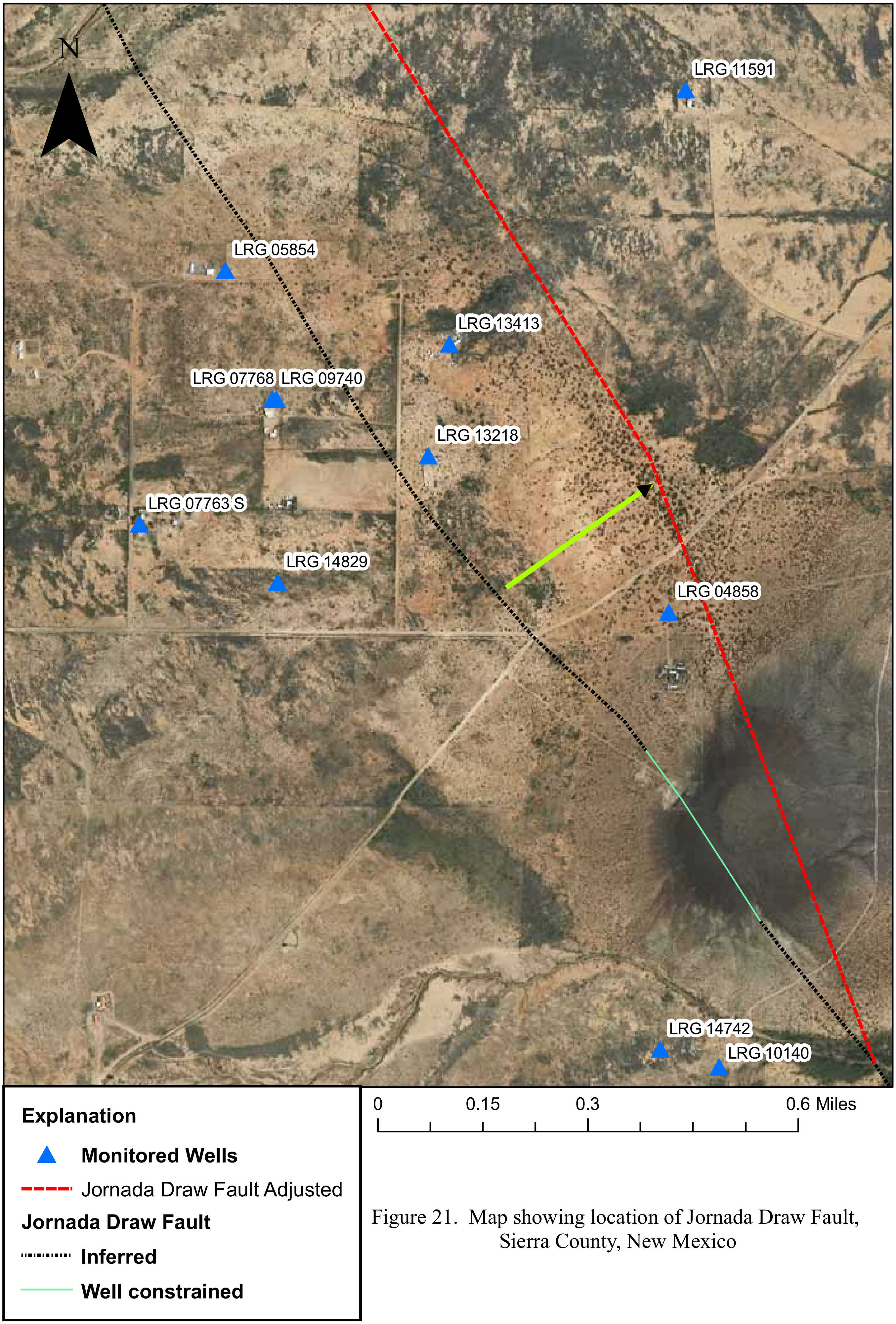


Figure 21. Map showing location of Jornada Draw Fault, Sierra County, New Mexico

Source: USGS, NMBGMR, 2006

The Jornada Draw Fault sets the eastern boundary for this system. The southern border is determined by the Tertiary-age igneous dikes mentioned in the JSAI, 2009B, report (Fig. 2 pg. 7). The western boundary lies east of LRG-5011-S as indicated by the water level data. The northern boundary extends to LRG-5854 due to the fact it is the farthest northern well with available data. Figure 22 (pg. 38) shows a map of the aquifer area based upon the above information. Table 8 summarizes the spatial attibutes.

Table 8. Summary of spatial attributes for the aquifer tapped by LRG-10140.

Area of aquifer, m^2	Area of aquifer, ft^2	Area of aquifer, acres
2,706,633	29,133,960	669

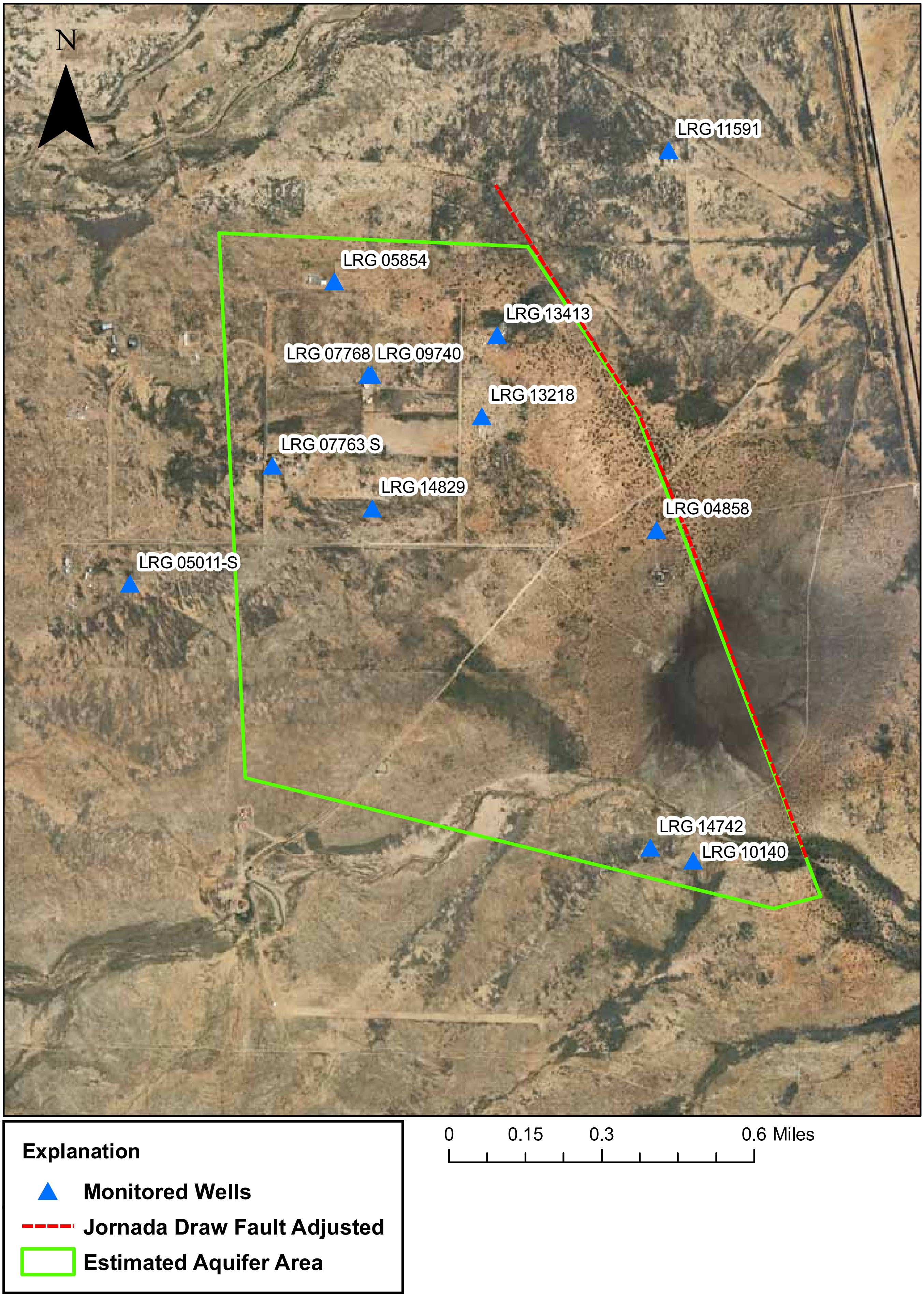


Figure 22. Map showing estimated area of the aquifer system beneath Cutter, NM

Storage Coefficient

In order to determine the effects of population growth on the aquifer beneath Cutter, a storage coefficient was calculated. Since the system is unconfined, Fitts, 2002, approach to specific yield was used to determine this coefficient. The formula is listed below.

Equation 1. Fitts, 2002, Specific yield equation.

$$dV_w = -S_y A dh$$

Where: dV_w = the amount of water removed
S_y = specific yield
A = area
dh = change in head

Solving for S_y results in the following:

$$S_y = \frac{dV_w}{Adh}$$

Values of water use were selected from the data included in previous sections. To determine a value for drawdown (dh), the hydrograph (Fig.13 pg. 21) for LRG-14742 was analyzed. From the hydrograph, the water level from July 15, 2010, of 82.85 ft bgl was selected. Taking the drawdown over this period, dh = 49.12 ft. The total volume pumped on that date is 161.948 ac-ft (dV_w). Using these values and the combining them with the estimated aquifer extent, the storage coefficient was calculated. Table 9 shows the result of the calculation.

Table 9. Specific yield value for estimated aquifer area.

Area, acres	dh, ft	dV_w, ac-ft	Sy
669	49.12	161.948	0.00493

The unconfined system beneath Cutter exhibits a storage coefficient value usually seen within confined systems. While the specific yield approach may not be the most accurate way of calculating an exact storage coefficient for this system, it does help to quantify the secondary porosity that exists in the fractures of the sandstone units. The primary porosity of the system is negligible due to its extremely low value.

Recharge

Recharge was estimated at 80 ac-ft/yr (50 gpm), in the JSAI, 2009B report. This number was calculated by JSAI using modeling software and is considered the best estimate for recharge to the system beneath Cutter. Judging from the recovery water level data on the study wells, the recharge is greater than what is currently being pumped (40.9 ac-ft/yr). Once LRG-10140 was shut off, the water levels in all the study wells began to recover. The value for current actual diversions from the aquifer is 25 gpm. The recharge value of 50 gpm matches the recovery trends in the study wells.

Analysis and Results

The main focus for this study was to determine the impact of growth on the aquifer system beneath Cutter. While there is no exact way to determine how many people will eventually move to the area due to the Spaceport, the methodologies described previously do provide accurate background for projections. The following section describes how the methodologies were combined to understand current and future impacts on groundwater resources beneath Cutter.

Estimated Drawdown

Taking the information from Table 7 (pg. 34), a current demand of 40.9 ac-ft/yr and a future demand of 49.6 ac-ft/yr were selected. The recharge value of 80 ac-ft/yr was included. A mass-balance calculation was performed to account for the amount of water (dVw) coming into ($Q_{recharge}$) storage (S) and the amount of water being removed (Q_{pumped}). The resulting volume of water calculated in the mass-balance equation was then entered into the specific yield equation and solved for *dh* (change in head). Results formulated using Equation 2 and 3 are shown in Table 10

Equation 2. Mass-balance equation solved for groundwater system.

$$S\frac{dV_w}{dt} = Q_{recharge} - Q_{pumped}$$

Equation 3. Fitts, 2002, Specific yield equation solved for change in head.

$$dh = \frac{dV_w}{-Sy\,A}$$

Table 10. Drawdown based upon current and future demand for water.

	Demand, ac-ft/yr	dV_w, ac-ft/yr	dh, ft/yr
Current	40.9	+39.1	+11.9
Future	49.6	+30.4	+9.2

Based upon the above calculations, the aquifer beneath Cutter will recover at a rate of 11.9 ft/yr at current demand and 9.2 ft/yr at future demand. What is apparent is the system's susceptibility to larger diversions seen with irrigation rights. Future irrigation diversions will create greater impacts on recovery and drawdown levels.

Hydrogeology

The system beneath Cutter is best described as a fractured tub. Recharge from the northwest flows south to southeast and is captured by the dikes to the south and the Jornada Draw Fault to the east. Water levels in this system will continue to recover until they reach levels above the boundaries. Once the water in the system fills the fractures above the sandstone units, it then leaks out of the system. Otherwise, water levels would continue to rise and Cutter would be a lake.

Given the above information, the aquifer is heavily dependent on recharge. Years of drought like 2011, greatly impact the aquifer and its ability to sustain a community. Prolonged drought will only curb water level recovery and growth for this area.

Water Availability

While the BSV subdivision is currently the only subdivision within the aquifer, future development could bring more growth than to just these selected lots. The storage value is incredibly low, meaning that the major factor for water availability is recharge. If demand in the focus area exceeds 80 ac-ft/yr, the aquifer will be mined. Once the aquifer is mined, the sustainability of the system decreases. Table 11, provides calculated drawdown based upon a range of demands.

Table 11. Estimated drawdown based upon a range of demands.

Population	Demand, gpcd	Irrigation rights, ac-ft/yr	Total demand, ac-ft/yr	dh, ft/yr
100	210	35	58.52	6.51
200	210	35	82.05	-0.62
300	210	35	105.57	-7.75

The calculations above indicated that the breaking point for the community population is around 200 people. This is assuming that no further irrigation, industrial, or livestock rights are to be permitted within the area. Figure 23 is a graphical representation of aquifer yield versus years of supply in the aquifer. As the figure illustrates, when the demand approaches the recharge constant of 80 ac-ft/yr, the years of supply increase towards infinity. The opposite is apparent when the demand greatly exceeds recharge. The error bars represent the uncertainty surrounding the analysis.

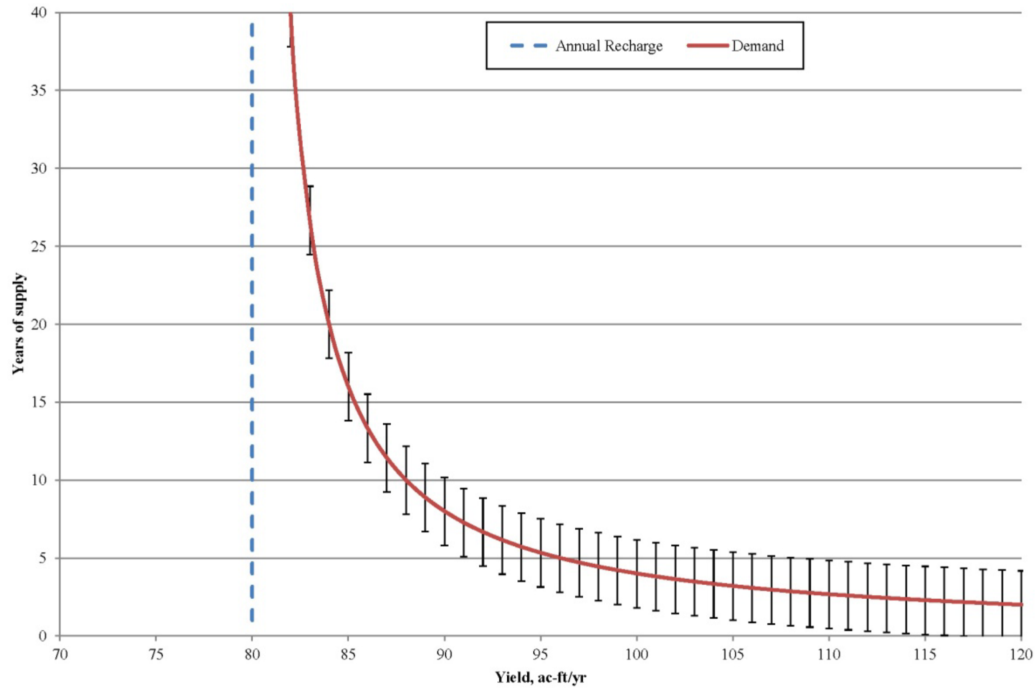


Figure 23. Graph illustrating years of supply vs aquifer yield based upon demand by the community of Cutter, NM.

Uncertainty

The analyses and conclusions drawn from this project do come with some uncertainty. While there was a substantial amount of data provided, assumptions were required to determine the aquifer extent. The northern boundary of the aquifer was assumed to reach only as far as the available water-level data. If the boundary extends farther to the northwest than suggested in this study, the storage coefficient will decrease. Further research into the extent of the system beneath Cutter will only help to better estimate impacts from future development.

<u>Conclusions and Recommendations</u>

Conclusion

It is evident from the data and analyses presented in this project that the aquifer system beneath the community of Cutter is limited. With Spaceport America near completion and further development rumored to be in the works, planners need to take a hard look at the groundwater resources available for this development. The estimates for growth put forth in this project represent the potential of impacts on groundwater resources for this community. Water levels will drop if demand exceeds the recharge.

The data provided from pumping related to construction at the Spaceport gives a strong indication of what the future may hold for this area. The fact that Cutter is one of the only communities within close proximity to the Spaceport indicates a strong potential for growth due to those employed at the facility. While time will only tell the true amount of economic impact the Spaceport will have, the availability of water resources may prove to be the ultimate factor in determining growth for the community of Cutter.

This analysis finds that the aquifer beneath Cutter on the west side of the Jornada Draw Fault could possibly support a community of 200 people. Mining of the aquifer will occur with the demand associated with this population. Drawdown over a 40 year horizon with this demand will lower the water table by 25 feet.

It should be reiterated that this analysis only takes into account the available water resources within the estimated boundary. Areas of Cutter on the east side of the Jornada Draw Fault may provide for further development than what is put forth in this analysis.

Recommendations

The following recommendations are provided to help alleviate problems that may occur from impacts due to drawdown in the aquifer system beneath Cutter.

Solution 1 Deepen domestic wells

Many of the wells in the community of Cutter are shallow. If drawdown impacts force homeowners to replace wells, the new wells should be drilled to depths closer to that of the Romero Well. A negative aspect of this solution is cost. The deeper the well the more it will cost to drill and equip the well. Due to this factor, it may not be a possible solution for some individuals.

Solution 2 Shared domestic wells

Sharing a domestic well between multiple residences can have its advantages. The cost of drilling a larger, deeper well, as mentioned above, is more obtainable because the costs are divided among more individuals. Also, maintenance costs are also divided among more individuals. Downsides to this recommendation are that the shared responsibility is not always as shared as it should be. Many agreements on a shared well can just be verbal in nature and make collecting payment from other parties difficult.

Solution 3 Use the Romero Well to serve as a municipal supply

LRG 10140 has proven itself to be a well capable of supplying water to the community of Cutter. It might be possible to purchase the well and water rights from the current owner and use the well as a municipal water supply. Infrastructure would have to be developed and the costs for this solution would be large. However, this would help to ensure a reliable water supply and prevent any hardships incurred by individuals on private domestic wells due to drawdown in the aquifer.

Solution 4 Limit development in the area

Limiting permits for agriculture and industrial development within the study will help to offset impacts from drawdown. These areas of economic development will increase demand for water more greatly than growth associated with residential development. Permits for this type of development would be best appropriated outside of the estimated system.

Solution 5 Require conservation

If the community of Cutter wants to plan for the future, smart water conservation practices should be a prominent part of the planning. The aquifer will support more development if household use is reduced. Low flow toilets, low water use landscaping, and rain water harvesting, are just a few examples of ways to reduce water use.

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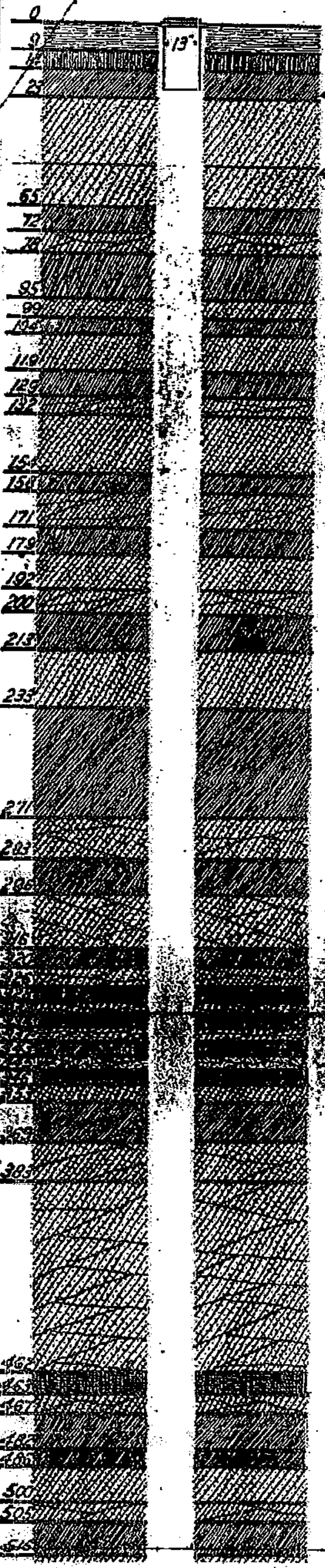
Appendices

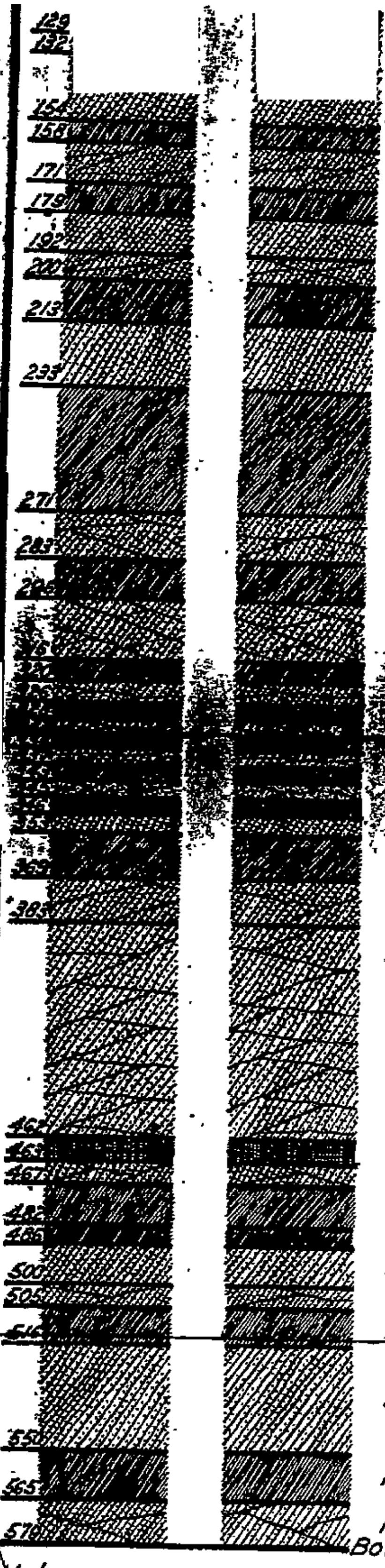
LOG OF WELL Nº 6

CUTTER

DRILLED DEC. 1921
BY A. A. RIGGS



9' Brown hard clay
5' Diorite.
9' Blue shale. - Good drilling.
42' Gray sand rock. - Hard drilling.
48' Normal water level.
7' Blue shale
6' Gray sand rock - Struck first water.
17' Blue shale.
4' Gray sand rock.
5' Blue shale.
15' Blue sand rock.
10' Blue shale.
3' Gray sand rock Good vein of water.
22' Blue sand rock.
4' Blue shale.
13' Gray sand rock. - Good vein of water.
8' Blue shale.
13' Gray sand rock.
8' White sand rock - Good vein of water.
13' Blue shale.
20' Gray sand rock - Good vein of water.
38' Blue shale.
12' White sand rock - Good vein of water.
13' Blue shale. - Hard drilling.
20' White sand rock - Good vein of water.
4' Blue shale.
6' Light blue sand rock - Good vein of water.
2' Blue shale
4' Light blue sand rock - Good vein of water.
[illegible] Blue shale
[illegible] Light blue sand rock - Good vein of water.
6' Blue shale.
2' Light blue sand & Water.
1' Vein of Coal.
7' Blue sand rock.
16' Blue shale.
14' Gray sand rock - Good vein of water.
79' White sand rock - Good vein of water.
1' Vein of Coal
4' White sand rock - Good vein of wate[r]
15' Blue shale.
4' Black shale - Hard to drill.
14' Gray sand rock.
5' White sand rock - Little water.
11' Blue shale.



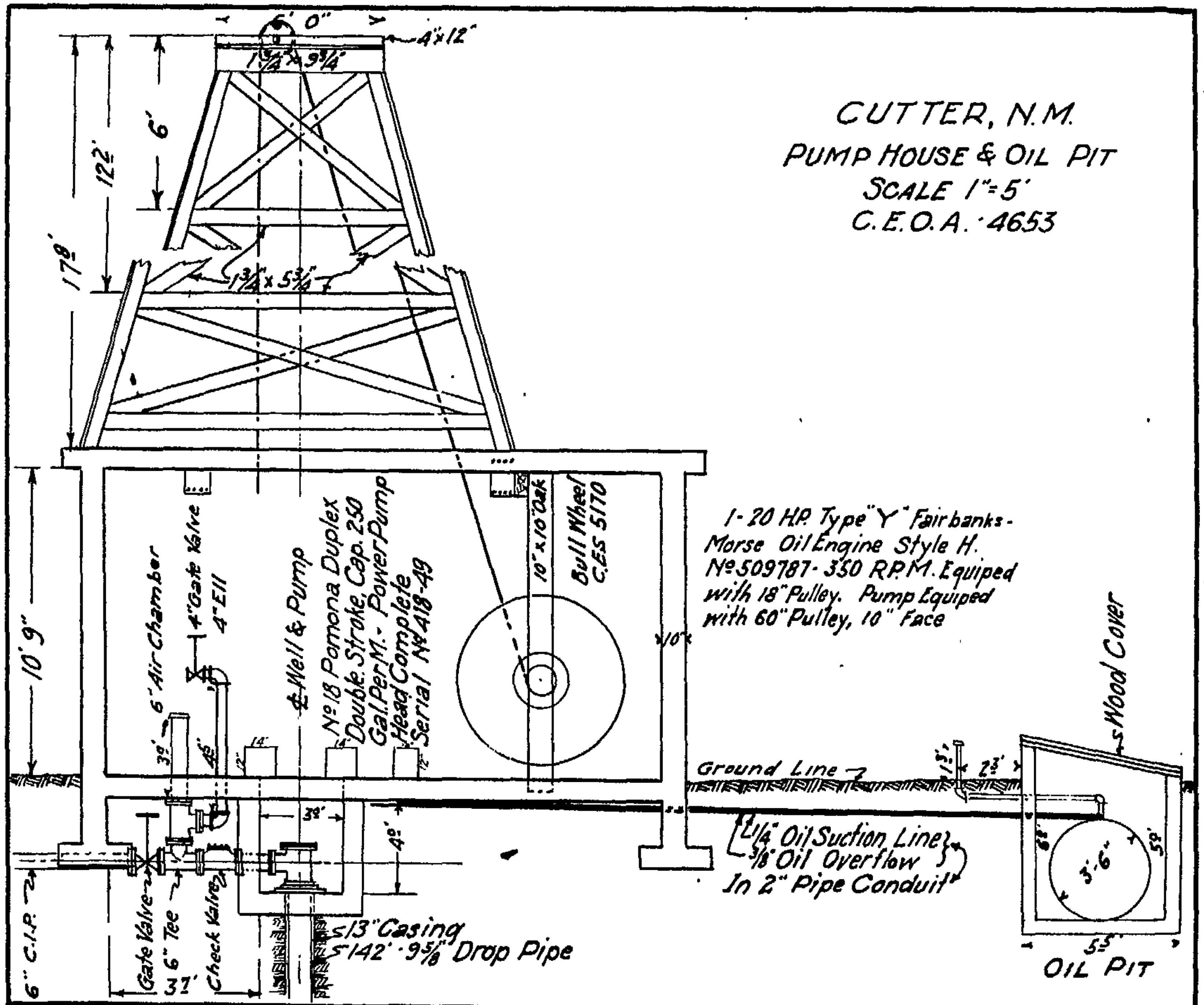
10' Blue shale.
3' Gray sand rock - Good vein of water.
22' Blue sand rock.
4' Blue shale.
13' Gray sand rock. - Good vein of water.
8' Blue shale.
13' Gray sand rock.
8' White sand rock - Good vein of water.
13' Blue shale.
20' Gray sand rock - Good vein of water.
38' Blue shale.
12' White sand rock - Good vein of water.
13' Blue shale. - Hard drilling.
20' White sand rock - Good vein of water.
4' Blue shale.
5' Light blue sand rock - Good vein of water.
[illegible] Blue shale.
[illegible] blue sand rock - Good vein of [illegible]
[illegible] Blue shale.
[illegible] blue sand rock - Good [illegible]
[illegible] Blue shale.
2' Light blue sand & water.
1' Vein of Coal.
7' Blue sand rock.
16' Blue shale.
14' Gray sand rock - Good vein of water.
79' White sand rock - Good vein of water.
1' Vein of Coal
4' White sand rock - Good vein of water.
15' Blue shale.
4' Black shale - Hard to drill.
14' Gray sand rock.
5' White sand rock - Little water.
11' Blue shale.
34' Gray sand rock.
15' Blue shale.
14' White sand rock - Fine water.
Bottom of Well.

Note:-

1-20' Joint of 13" pipe, top of pipe 12" above level of ground; run in 3' of cement around 13" pipe. Top of cement 4' 06" below top of ground. 13" pipe plugged.

Tested well with a 4¾" × 60" single acting working Barrel, at a depth of 283'. Pumped clear all the time no sand. After 28 hrs. of straight pumping there was 18" of fine sand and drill cuttings settled in bottom of well. Well pumped 55 gallons in 1 minute 8 seconds. Draw down 2'-10".

All measurements taken from Derrick floor, which is 18" above ground.



CUTTER, N.M.
PUMP HOUSE & OIL PIT
SCALE 1"=5'
C.E.O.A. 4653
6' 0"
4"x12"
1 3/4" x 9 3/4"
6'
12'
17' 8"
1 3/4" x 5 3/4"
10' 9"
6" Air Chamber
4" Gate Valve
4" Ell
℄ Well & Pump
No. 18 Pomona Duplex Double Stroke, Cap. 250 Gal. Per M. - Power Pump Head Complete Serial No. 418-49
10"x10" Oak
Bull Wheel C.E.S. 5170
1-20 H.P. Type "Y" Fairbanks-Morse Oil Engine Style H. No. 509787 - 350 R.P.M. Equiped with 18" Pulley. Pump Equiped with 60" Pulley, 10" Face
Wood Cover
Ground Line
1 1/4" Oil Suction Line
3/8" Oil Overflow
In 2" Pipe Conduit
13" Casing
142' - 9 5/8" Drop Pipe
6" C.I.P.
Gate Valve
6" Tee
Check Valve
3' 7"
3' 9"
4' 0"
3' 6"
5' 5"
5' 9"
OIL PIT

Sheet 2

THE A.T.&S.F.RY SYSTEM

MAIN LINE TRAFFIC DENSITY IN MILLIONS OF GROSS TONS

EXCLUSIVE OF LOCOMOTIVE

WESTERN LINES

DIVISION	FROM: TO	DI-REC-TION	1935 Freight	1935 Pass.	1935 Total	1936 Freight	1936 Pass.	1936 Total	1937 Freight	1937 Pass.	1937 Total	1938 Freight	1938 Pass.	1938 Total	1939 Freight	1939 Pass.	1939 Total
	Newton	E.B.	2.164	1.726	3.890	2.502	1.643	4.145	2.532	1.620	4.152	2.200	1.484	3.684	2.136	1.441	3.577
	Hutchinson	W.B.	1.861	1.725	3.586	2.050	1.694	3.744	2.006	1.700	3.706	1.617	1.536	3.153	1.660	1.491	3.151
	Hutchinson	E.B.	1.723	1.365	3.088	1.940	1.318	3.258	2.009	1.283	3.291	1.698	0.992	2.690	1.865	1.018	2.883
	Kinsley (via St John)	W.B.	1.429	1.314	2.743	1.536	1.319	2.855	1.498	1.317	2.815	0.601	1.053	1.654	0.245	1.062	1.307
WESTERN	Kinsley	E.B.	2.164	1.726	3.890	2.502	1.643	4.145	2.532	1.620	4.152	2.200	1.484	3.684	2.136	1.441	3.577
	Dodge City	W.B.	1.861	1.725	3.586	2.050	1.694	3.744	2.006	1.700	3.706	1.617	1.536	3.153	1.660	1.491	3.151
	Hutchinson	E.B.	0.442	0.361	0.803	0.562	0.325	0.887	0.523	0.337	0.860	0.503	0.493	0.996	0.271	0.424	0.695
	Kinsley (via Great Bend)	W.B.	0.432	0.411	0.843	0.514	0.375	0.889	0.508	0.383	0.891	1.017	0.483	1.500	1.415	0.429	1.844
	Dodge City	E.B.	1.670	1.579	3.249	1.937	1.505	3.442	1.976	1.492	3.468	1.508	1.356	2.864	1.532	1.319	2.851
	La Junta	W.B.	1.268	1.574	2.842	1.406	1.559	2.965	1.404	1.566	2.970	1.049	1.400	2.449	1.165	1.365	2.530
COLORADO	La Junta	E.B.	1.751	0.531	2.282	2.256	0.534	2.790	2.645	0.556	3.201	1.926	0.494	2.420	2.273	0.512	2.785
	Pueblo	W.B.	1.555	0.533	2.088	1.847	0.532	2.379	2.214	0.563	2.777	1.563	0.498	2.061	1.959	0.513	2.472
	Denver *	E.B. ①	0.799	0.458	1.257	0.862	0.470	1.332	0.980	0.500	1.480	0.881	0.416	1.297	1.037	0.426	1.463
	Pueblo	W.B. ①	0.682	0.457	1.139	0.697	0.470	1.16	[illegible]	0.508	1.278	0.716	0.421	1.137	0.752	0.421	1.173
	La Junta	E.B. ②	1.085	1.465	2.550	1.246	1.454	2.700	1.30[illegible]	1.408	2.709	1.015	1.271	2.286	1.138	1.237	2.375
	Albuquerque	W.B. ②	1.106	1.459	2.565	1.287	1.507	2.794	1.392	1.479	2.871	1.057	1.313	2.370	1.300	1.290	2.590
	Albuquerque	E.B.	1.040	1.552	2.592	1.158	1.510	2.668	1.420	1.502	2.922	1.191	1.422	2.613	1.371	1.384	2.755
	Isleta	W.B.	0.982	1.548	2.530	1.053	1.560	2.613	1.351	1.578	2.929	1.081	1.461	2.542	1.378	1.438	2.816
NEW MEXICO	Isleta	E.B.	0.770	0.222	0.992	0.890	0.208	1.098	1.148	0.217	1.365	1.004	0.188	1.192	1.190	0.176	1.356
	Rincon	W.B.	0.780	0.220	1.000	0.901	0.208	1.109	1.205	0.219	1.424	0.966	1.188	1.154	1.259	0.175	1.434
	Rincon	E.B.	0.517	0.209	0.726	0.585	0.180	0.765	0.841	0.182	1.023	0.785	0.165	0.950	0.868	0.150	1.018
	El Paso	W.B.	0.511	0.214	0.725	0.573	0.179	0.752	0.897	0.182	1.079	0.727	0.162	0.889	0.837	0.148	0.985
	Rincon	E.B.	0.270	0.070	0.340	0.370	0.003	0.373	0.655	0.002	0.657	0.430	0.002	0.432	0.604	0.008	0.612
	Deming	W.B.	0.265	0.070	0.335	0.366	0.002	0.368	0.637	0.002	0.639	0.421	0.003	0.424	0.641	0.007	0.648
PANHANDLE	Wellington	E.B.	4.308	0.427	4.735	4.844	0.522	5.366	5.374	0.692	6.066	5.216	0.706	5.922	5.346	0.774	6.120
	Waynoka	W.B.	3.705	0.433	4.138	4.363	0.488	4.851	4.855	0.666	5.521	4.120	0.699	4.819	4.396	0.748	5.144
	Waynoka	E.B.	4.217	0.422	4.639	4.741	0.525	5.266	5.129	0.697	5.826	5.079	0.711	5.790	5.183	0.775	5.958
	Canadian	W.B.	3.543	0.426	3.969	4.137	0.488	4.625	4.568	0.664	5.232	3.962	0.699	4.661	4.256	0.749	5.005
	Canadian	E.B.	4.192	0.430	4.622	4.782	0.523	5.305	5.103	0.692	5.795	5.001	0.712	5.713	5.176	0.778	5.954
	Amarillo	W.B.	3.590	0.429	4.019	4.166	0.487	4.653	4.637	0.660	5.297	4.072	0.704	4.776	4.355	0.750	5.105
PLAINS	Amarillo	E.B.	4.358	0.562	4.920	4.909	0.691	5.600	5.718	0.891	6.609	5.554	0.903	6.457	5.719	0.924	6.643
	Canyon Jct	W.B.	3.911	0.578	4.489	4.556	0.652	5.208	5.463	0.863	6.326	4.930	0.876	5.806	5.183	0.884	6.067
	Canyon Jct.	E.B.	3.762	0.324	4.086	4.123	0.477	4.600	4.578	0.657	5.235	4.490	0.672	5.162	4.702	0.720	5.422
	Farwell	W.B.	3.232	0.330	3.562	3.719	0.440	4.159	4.163	0.619	4.782	3.665	0.646	4.311	3.955	0.681	4.636
	Farwell	E.B.	4.749	0.472	5.221	5.433	0.670	6.103	5.909	0.884	6.793	5.723	0.850	6.573	6.127	0.870	6.997
	Clovis	W.B.	3.776	0.479	4.255	4.503	0.644	5.147	5.059	0.846	5.905	4.541	0.833	5.374	4.884	0.831	5.715
PECOS	Clovis	E.B.	4.228	0.293	4.521	4.828	0.535	5.363	5.15[illegible]	0.77[illegible]	5.929	4.910	0.726	5.636	5.167	0.757	5.924
	Belen	W.B.	3.455	0.305	3.760	4.106	0.503	4.609	4.41[illegible]	0.7[illegible]	5.152	3.882	0.701	4.583	4.193	0.724	4.917
	Texico	E.B.	0.608	0.143	0.751	0.786	0.193	0.979	0.903	0.215	1.118	0.864	0.195	1.059	1.026	0.157	1.183
	Lubbock	W.B.	1.029	0.142	1.171	1.261	0.183	1.444	1.377	0.214	1.591	1.299	0.193	1.492	1.597	0.157	1.754
	Lubbock	E.B.	1.168	0.366	1.534	1.485	0.399	1.864	1.840	0.438	2.278	1.788	0.413	2.201	1.994	0.352	2.346
	Slaton	W.B.	1.628	0.362	1.990	1.953	0.390	2.343	2.60[illegible]	0.438	3.039	2.445	0.413	2.858	2.856	0.351	3.207
SLATON	Slaton	E.B.	1.173	0.286	1.459	1.360	0.351	1.711	1.653	0.361	2.014	1.671	0.354	2.025	1.796	0.334	2.130
	Sweetwater	W.B.	1.425	0.282	1.707	1.814	0.340	2.154	[illegible]426	0.362	2.788	2.274	0.351	2.625	2.483	0.333	2.816
	Canyon Jct	E.B.	0.560	0.222	0.782	0.699	0.206	0.905	0.937	0.223	1.160	0.924	0.219	1.143	0.967	0.195	1.162
	Lubbock	W.B.	0.598	0.221	0.819	0.692	0.207	0.899	1.224	0.224	1.448	1.146	0.219	1.365	1.258	0.194	1.452

DIVISION	FROM: TO	DI-REC-TION	1940 Freight	1940 Pass.	1940 Total	1941 Freight	1941 Pass.	1941 Total	1942 Freight	1942 Pass.	1942 Total	1943 Freight	1943 Pass.	1943 Total	1944 Freight	1944 Pass.	1944 Total
	Newton	E.B.	2.237	1.497	3.734	3.123	1.551	4.674	3.717	1.887	5.604	4.416	2.828	7.244	4.798	3.134	7.932
	Hutchinson	W.B.	1.802	1.520	3.322	2.214	1.611	3.825	2.514	2.043	4.557	2.899	3.021	5.920	3.313	2.984	6.297
	Hutchinson	E.B.	1.934	0.980	2.914	2.445	1.219	3.664	2.550	1.661	4.211	2.469	2.553	5.022	2.831	2.861	5.692
	Kinsley (via St John)	W.B.	0.250	1.014	1.264	0.861	1.287	2.148	1.442	1.819	3.261	1.075	2.760	3.835	0.911	2.720	3.631
WESTERN	Kinsley	E.B.	2.237	1.497	3.734	3.123	1.551	4.674	3.717	1.887	5.604	4.416	2.828	7.244	4.798	3.134	7.932
	Dodge City	W.B.	1.802	1.520	3.322	2.214	1.611	3.825	2.514	2.043	4.557	2.899	3.021	5.920	3.313	2.984	6.297
	Hutchinson	E.B.	0.303	0.517	0.820	0.678	0.332	1.010	1.167	0.226	1.393	1.947	0.275	2.222	1.968	0.273	2.241
	Kinsley (via Great Bend)	W.B.	1.552	0.506	2.058	1.353	0.324	1.677	1.072	0.224	1.296	1.824	0.261	2.085	2.403	0.264	2.667
	Dodge City	E.B.	1.652	1.385	3.037	1.921	1.461	3.382	2.241	1.737	3.978	2.412	2.627	5.039	2.782	2.901	5.685
	La Junta	W.B.	1.280	1.403	2.683	1.558	1.513	3.071	1.763	1.881	3.644	1.881	2.800	4.681	2.386	2.775	5.161
COLORADO	La Junta	E.B.	2.667	0.433	3.100	2.864	0.517	3.381	3.689	0.606	4.295	3.620	0.809	4.429	3.947	0.885	4.832
	Pueblo	W.B.	2.393	0.431	2.824	2.765	0.494	3.259	3.839	0.598	4.437	3.766	0.906	4.672	3.980	0.890	4.870
	Denver *	E.B. ①	1.109	0.388	1.457	1.242	0.463	1.705	1.783	0.575	2.358	1.607	0.700	2.307	1.610	0.809	2.419
	Pueblo	W.B. ①	0.765	0.390	1.155	0.97[illegible]	0.457	1.428	1.337	0.526	1.863	1.531	0.770	2.301	1.730	0.821	2.551
	La Junta	E.B. ②	1.099	1.257	2.356	1.300	1.228	2.528	1.913	1.472	3.385	1.914	2.343	4.257	1.976	2.535	4.521
	Albuquerque	W.B. ②	1.155	1.261	2.416	1.248	1.290	2.538	1.591	1.630	3.221	2.035	2.447	4.482	2.218	2.383	4.601
	Albuquerque	E.B.	1.485	1.358	2.843	1.918	1.382	3.300	2.163	1.643	3.806	2.253	2.646	4.899	2.302	2.783	5.085
	Isleta	W.B.	1.307	1.356	2.663	1.952	1.434	3.386	1.746	1.802	3.548	2.034	2.689	4.723	2.097	2.611	4.708
NEW MEXICO	Isleta	E.B.	1.285	0.184	1.469	1.545	0.195	1.740	1.930	0.244	2.174	1.973	0.410	2.283	2.062	0.337	2.399
	Rincon	W.B.	1.175	0.182	1.357	1.309	0.203	1.512	1.419	0.252	1.671	1.515	0.348	1.863	1.838	0.304	2.142
	Rincon	E.B.	0.958	0.156	1.114	1.130	0.176	1.306	1.233	0.221	1.454	1.223	0.388	1.611	1.378	0.316	1.694
	El Paso	W.B.	0.827	0.152	0.979	0.956	0.183	1.139	0.892	0.230	1.122	0.989	0.317	1.306	1.320	0.278	1.598
	Rincon	E.B.	0.585	0.003	0.588	0.653	0.000	0.653	0.891	0.000	0.891	0.861	0.000	0.861	0.754	0.000	0.754
	Deming	W.B.	0.546	0.001	0.547	0.558	0.000	0.558	0.692	0.001	0.693	0.712	0.000	0.712	0.555	0.000	0.555
PANHANDLE	Wellington	E.B.	6.548	0.720	7.268	8.712	0.855	9.567	11.448	0.901	12.349	11.805	1.105	12.910	13.843	1.070	14.913
	Waynoka	W.B.	5.417	0.745	6.162	7.715	0.847	8.562	10.456	1.029	11.485	10.940	1.141	12.081	12.196	1.110	13.306
	Waynoka	E.B.	6.521	0.720	7.241	8.614	0.859	9.473	11.514	0.932	12.446	11.707	1.118	12.825	13.844	1.065	14.899
	Canadian	W.B.	5.266	0.746	6.012	7.602	0.847	8.449	10.615	1.051	11.666	11.046	1.144	12.190	12.743	1.099	13.842
	Canadian	E.B.	6.535	0.722	7.257	8.634	0.857	9.491	11.604	0.919	12.523	11.569	1.122	12.691	13.640	1.069	14.709
	Amarillo	W.B.	5.387	0.748	6.135	7.749	0.849	8.598	10.873	1.035	11.908	11.248	1.151	12.399	13.040	1.116	14.156
PLAINS	Amarillo	E.B.	7.175	0.893	8.068	9.630	0.902	10.532	12.809	1.035	13.844	12.769	1.353	14.122	14.636	1.270	15.906
	Canyon Jct	W.B.	6.188	0.890	7.078	9.288	0.878	10.166	12.311	1.238	13.549	13.355	1.437	14.792	15.307	1.479	16.786
	Canyon Jct.	E.B.	6.089	0.670	6.759	8.207	0.820	9.027	10.848	0.912	11.760	10.922	1.206	12.128	12.573	1.152	13.725
	Farwell	W.B.	5.063	0.691	5.754	7.462	0.792	8.254	10.388	1.095	11.483	11.336	1.303	12.639	13.193	1.325	14.518
	Farwell	E.B.	8.046	0.861	8.907	10.659	1.045	11.704	13.728	1.226	14.954	13.987	1.645	15.632	16.264	1.586	17.850
	Clovis	W.B.	6.345	0.884	7.229	9.504	1.012	10.516	13.351	1.573	14.924	15.239	2.090	17.329	18.509	1.852	20.[illegible]
PECOS	Clovis	E.B.	6.915	0.735	7.650	8.915	0.924	9.839	11.650	1.156	12.806	12.228	1.512	13.740	14.470	1.427	15.897
	Belen	W.B.	5.469	0.763	6.232	8.040	0.895	8.935	11.869	1.426	13.295	13.944	1.771	15.715	17.202	1.641	18.843
	Texico	E.B.	1.144	0.195	1.339	1.561	0.215	1.776	2.486	0.444	2.930	3.331	0.642	3.973	4.806	0.527	5.333
	Lubbock	W.B.	1.733	0.193	1.926	2.195	0.225	2.420	2.508	0.295	2.803	3.063	0.420	3.483	3.594	0.447	4.04[illegible]
	Lubbock	E.B.	2.096	0.383	2.479	2.759	0.307	3.066	4.095	0.557	4.652	4.889	0.761	5.650	6.639	0.660	7.299
	Slaton	W.B.	2.753	0.382	3.135	3.785	0.316	4.101	4.317	0.413	4.730	5.020	0.532	5.552	5.867	0.592	6.45[illegible]
SLATON	Slaton	E.B.	1.908	0.339	2.24[illegible]	2.446	0.339	2.785	3.554	0.576	4.130	3.996	0.768	4.764	5.527	0.687	6.214
	Sweetwater	W.B.	2.390	0.337	2.727	[illegible].098	0.346	3.444	4.018	0.432	4.450	4.705	0.549	5.254	5.161	0.614	5.775
	Canyon Jct	E.B.	0.952	0.188	1.140	1.198	0.092	1.290	1.609	0.113	1.722	1.558	0.119	1.677	1.834	0.133	1.967
	Lubbock	W.B.	1.020	0.189	1.209	1.590	0.091	1.681	1.809	0.118	1.927	1.957	0.112	2.069	2.275	0.145	2.420

1. Exclusive of C.&S. trackage between Denver and Pueblo (1[illegible] miles), which tonnage (in millions of gross tons, is as follows:

	Freight	Passenger	Total		Freight	Passenger	Total
1935:	1.477	0.360	1.837	1940:	2.251	0.329	2.580
1936:	1.838	0.348	2.186	1941:	2.573	0.343	2.916
1937:	2.177	0.375	2.552	1942:	2.689	0.495	3.184
1938:	1.393	0.358	1.751	1943:	2.816	0.576	3.392
1939:	1.836	0.345	2.181	1944:	3.296	0.621	3.917

(Note: No tonnage figures available for D.&R.G.W. between Denver and Bragdon)

2. Exclusive of C.&S. trackage between Pueblo and Denver (117 miles), which tonnage (in millions of gross tons) is as follows:

	Freight	Passenger	Total		Freight	Passenger	Total
1935:	1.247	0.357	1.604	1940:	1.550	0.324	1.874
1936:	1.487	0.348	1.835	1941:	2.002	0.334	2.336
1937:	1.673	0.366	2.139	1942:	2.011	0.470	2.481
1938:	1.118	0.356	1.474	1943:	2.670	0.564	3.234
1939:	1.318	0.343	1.661	1944:	3.550	0.606	4.156

(Note: No tonnage figures available for D.&R.G.W. between Bragdon and Denver).

3. Exclusive of D.&R.G.W. and C.&W. trackage between Trinidad and Jansen (1.8 miles).

Note: Sequence of towns in each case in second column is from east towards west (west bound, time table direction).

* E.B. equals N.B. of Employes' time table. W.B. equals S.B. of Employes' time table.

C.E.S. 50175-3.

THE A.T. & S.F. RY. SYSTEM
MAIN LINE TRAFFIC DENSITY IN MILLIONS OF GROSS TONS
EXCLUSIVE OF LOCOMOTIVE

WESTERN LINES

DIVISION	FROM: TO	DI-REC-TION	1945 FREIGHT	1945 PASS	1945 TOTAL	1946 FREIGHT	1946 PASS	1946 TOTAL	1947 FREIGHT	1947 PASS.	1947 TOTAL	1948 FREIGHT	1948 PASS	1948 TOTAL	1949 FREIGHT	1949 PASS.	1949 TOTAL
WESTERN	NEWTON	E.B	5.501	3103	8604	4 542	2 476	7018	5 858	2 250	8.108	5 938	2.476	8.414	5259	2559	7 818
	HUTCHINSON	W.B	3.387	3057	6.444	2 963	2.391	5354	3 539	2 278	5 817	3 442	2 437	5 879	3.453	2573	6026
	HUTCHINSON	E.B.	3.565	2866	6.431	3 125	1 913	5038	4656	1 693	6 349	4063	1 952	6 015	3.365	2014	5.379
	KINSLEY	W.B.	1 194	2.818	4012	1 363	1 818	3.181	1 519	1 695	3 214	1 437	1 902	3.339	1236	2028	3 264
	(via ST. JOHN)																
	KINSLEY	E.B	5501	3103	8.604	4 542	2.476	7018	5858	2 250	8.108	5 938	2 476	8 414	5259	2559	7 818
	DODGE CITY	W.B.	3.387	3.057	6444	2.963	2 391	5354	3 539	2 278	5 817	3 442	2 437	5 879	3453	2 573	6026
	HUTCHINSON	E.B.	1939	0237	2176	1 418	0 563	1 981	1 202	0 557	1 759	1 875	0 524	2 399	1 894	0 545	2.439
	KINSLEY	W.B.	2 196	0239	2435	1 601	0 573	2.174	2 020	0 583	2.603	2005	0.535	2.540	2217	0545	2.762
	(via GREAT BEND)																
COLORADO	DODGE CITY	E.B	3.134	2949	6083	2.627	2.348	4975	2.863	2 149	5 012	3204	2 400	5604	2981	2421	5402
	LA JUNTA	W.B.	2.421	2896	5.317	1.877	2 254	4 131	1 996	2 180	4176	1 967	2 351	4318	2148	2407	4.555
	LA JUNTA	E.B.	3.974	0802	4776	3 502	0.645	4 147	3 909	0 529	4.438	3 980	0.504	4484	4 154	0.545	4699
	PUEBLO	W.B.	4069	0721	4.790	3.353	0.597	3950	4 019	0 547	4 566	3 768	0.537	4305	3330	0 561	3 891
	DENVER *	E.B (1)	1.709	0.695	2404	1.613	0.616	2.229	1 658	0 522	2 180	1 507	0.500	2.007	1.595	0521	2 116
	PUEBLO	W.B (2)	1.642	0680	2322	1 385	0 598	1 983	1 485	0 521	2 006	1 2[illegible]	0 496	1 784	1.272	0500	1.772
NEW MEXICO	LA JUNTA	E.B (3)	2.063	2.586	4649	1 825	2 088	3913	1 914	1.934	3 848	1 844	2.105	3949	1.394	2130	3 524
	ALBUQUERQUE	W.B (3)	2064	2602	4666	1 621	2 057	3678	1 695	1955	3 650	1 603	2.079	3682	1690	2148	3 838
	ALBUQUERQUE	E.B.	3 437	2728	6.165	2.074	2.146	4 220	2.190	2 075	4 265	2224	2231	4455	1 865	2335	4 200
	ISLETA	W.B.	2614	2758	5372	1 653	2.119	3772	1 777	2 103	3 880	1678	2 178	3.856	1653	2.283	3.936
	ISLETA	E.B.	2681	0.249	.2930	1 890	0 182	2.072	2.069	0186	2.255	2.082	0.176	2 258	1.747	0.190	1.937
	RINCON	W.B.	1.757	0242	1999	1 468	0 186	1654	1 624	0 187	1 811	1557	0 175	1.732	1 513	0.188	1701
	RINCON	E.B.	2.308	0.225	2533	1 298	0.165	1 463	1.411	0 157	1 568	1.438	0 140	1 578	1.297	0150	1.447
	EL PASO	W.B.	1.333	0220	1553	0972	0.171	1 143	1 080	0 157	1 237	0 997	0.138	1 135	1.041	0.140	1181
	RINCON	E.B.	0.699	0000	0.699	0.631	0.000	0.631	0 768	0 000	0.768	0.785	0.000	0 785	0 579	0000	0.579
	DEMING	W.B	0622	0001	0.623	0524	0 000	0524	0.635	0 000	0.635	0683	0000	0683	0.557	0.000	0.557
PANHANDLE	WELLINGTON	E.B.	13789	1.583	15.372	12698	1 822	14520	14 087	1 070	15.157	13 460	1 113	14 573	12.154	1.125	13.279
	WAYNOKA	W.B.	11 372	1 577	12949	10 100	1 658	11 758	11 [illegible]80	1 020	12.100	10931	1 163	12.094	10 221	1112	11.333
PLAINS	WAYNOKA	E.B.	14.137	1.602	15739	12.842	1.875	14717	14 233	1049	15 282	13676	1 082	14 758	12 178	1064	13 242
	CANADIAN	W.B.	11798	1579	13.377	9975	1 683	11 658	10 824	0 993	11 817	10 767	1 101	11 868	10 044	1.062	11 106
	CANADIAN	E.B.	14038	1.622	15660	12756	1.871	14627	13 717	1 043	14.760	13 310	1 055	14.365	11.825	1.051	12 876
	AMARILLO	W.B.	12 077	1595	13672	10.130	1 678	11 808	10 696	0 979	11 675	10 796	1 076	11 872	10.043	1 031	11 074
	AMARILLO	E.B.	14745	1852	16597	13 396	2 086	15.482	14 166	1 107	15.273	14 016	1 116	15.132	12.495	1 090	13.585
	CANYON	W.B.	14566	1838	16404	11 691	1.778	13.469	12.080	1.053	13 133	12 105	1 136	13.241	11 785	1.061	12 846
	CANYON	E.B.	12.855	1729	14584	11 151	1 985	13 136	11 715	1 023	12.738	11.422	1 036	12.456	10.555	0.989	11.544
	FARWELL	W.B.	12.173	1733	13.906	9 334	1 701	11 035	9.540	0 962	10.502	9 340	1 [illegible]61	10.401	8 858	0 968	9826
	FARWELL	E.B.	16 587	2.379	19066	13845	2.585	16.430	14 729	1 306	16 035	14625	1 [illegible]66	15 891	14.185	1.348	15.533
	CLOVIS	W.B	17 944	2.344	20.288	11 588	2 035	13623	11 657	1 210	12 867	11 734	1 2[illegible]3	13 027	11 089	1304	12 393
PECOS	CLOVIS	E.B.	14.302	2.155	16464	11 290	2.380	13.670	11 895	1 140	13 [illegible]	11 8[illegible]	1 1[illegible]7	12.969	11 208	1.096	12.304
	BELEN	W.B.	16.414	2 177	18591	10.442	2 041	12.483	10 564	1 093	11 657	1069[illegible]	1 [illegible]65	11 862	10.035	1067	11 102
SLATON	TEXICO	E.B.	5 287	0611	5.898	2.259	0 478	2737	2 139	0 232	2.371	2.419	0.190	2.609	2.265	0281	2.546
	LUBBOCK	W.B.	3.833	0610	4443	2617	0 567	3 184	3 156	0 227	3 383	3 157	0.193	3 350	3.364	0 277	3 641
	LUBBOCK	E.B.	7094	0720	7.814	4.210	0.571	4791	4 521	0 323	4 84[illegible]	4905	0281	5 186	4 073	0360	4433
	SLATON	W.B.	6.127	0710	6837	4 902	0 660	5562	5 914	0 318	6 232	60[illegible]2	0.285	6 347	6.115	0358	6.473
	SLATON	E.B.	5978	0741	6719	3 582	0.620	4.202	3 758	0 387	4 145	3729	0348	4077	3.452	0.394	3 846
	SWEETWATER	W.B.	5 541	0725	6266	4 333	0.702	5.035	5 642	0 388	6 03[illegible]	5043	0 350	5 393	5.335	0.385	5.720
	CANYON	E.B.	1 810	0.109	1.919	2.022	0 093	2.115	2 382	0.091	2.473	2.486	0091	2 577	1 808	0.079	1 887
	LUBBOCK	W.B.	2.297	0 100	2397	2 285	0 093	2 378	2 758	0 091	2 849	2 905	0092	2.997	2751	0.081	2 832

DIVISION	FROM: TO	DI-REC-TION	1950 FREIGHT	1950 PASS	1950 TOTAL	1951 FREIGHT	1951 PASS	1951 TOTAL	1952 FREIGHT	1952 PASS.	1952 TOTAL	1953 FREIGHT	1953 PASS.	1953 TOTAL	1954 FREIGHT	1954 PASS.	1954 TOTAL
WESTERN	NEWTON	E.B	4551	2 428	6979	5.247	2335	7582	4976	2.421	7397	3957	2 391	6348	3841	2035	5876
	HUTCHINSON	W.B	3122	2475	5597	3425	2430	5855	3262	2425	5687	2972	2 370	5340	2670	2069	4739
	HUTCHINSON	E.B.	3 140	1878	5018	3468	1812	5280	3544	1889	5433	3 285	1880	5 165	3222	1.570	4792
	KINSLEY	W.B.	1317	1.935	3252	1542	1894	3436	2031	1.884	3915	1 749	1856	3 605	1814	1600	3.414
	(via ST. JOHN)																
	KINSLEY	E.B	4551	2428	6979	5247	2335	7582	4976	2421	7397	3957	2391	6 348	3841	2035	5.876
	DODGE CITY	W.B.	3 122	2475	5597	3425	2430	5855	3.262	2425	5687	2972	2 370	5340	2670	2069	4739
	HUTCHINSON	E.B.	1411	0550	1961	1779	0523	2302	1432	0 532	1964	0.672	0 511	1 183	0.619	0465	1084
	KINSLEY	W.B.	1.805	0.540	2345	1883	0.536	2419	1 195	0 541	1736	1 223	0 514	1.737	0856	0.469	1.325
	(via GREAT BEND)																
COLORADO	DODGE CITY	E.B	2.788	2264	5052	3063	2 252	5.315	2734	2 328	5062	2 429	2 285	4 714	2238	1959	4197
	LA JUNTA	W.B.	2076	2 334	4410	2313	2.323	4636	[illegible]113	2333	4446	1 890	2262	4 152	1657	1987	3644
	LA JUNTA	E.B.	4215	0.526	4741	4800	0584	5.384	4120	0551	4671	3725	0541	4 266	3340	0.491	3.831
	PUEBLO	W.B.	3628	0.529	4 157	4269	0.584	4853	3726	0524	4 250	3597	0.525	4 122	2805	0.486	3291
	DENVER *	E.B (1)	1719	0511	2230	2.167	0.554	2721	1.8[illegible]	0 500	2329	1 896	0.515	2 411	1814	0.474	2288
	PUEBLO	W.B (2)	1.495	0.490	1985	1949	0.537	2486	1 568	0.470	2038	1 467	0467	1 934	1244	0.457	1701
NEW MEXICO	LA JUNTA	E.B (3)	1 566	2092	3658	1853	2083	3936	1581	2.197	3778	1 573	2 143	3716	1134	1.857	2.991
	ALBUQUERQUE	W.B (3)	1661	2.163	3824	1977	2 195	4172	1719	2 210	3929	1 706	2 141	3847	1368	1891	3 259
	ALBUQUERQUE	E.B.	2.103	2303	4406	2257	2256	4513	2092	2353	4445	2 015	2 275	4 290	1802	1953	3755
	ISLETA	W.B.	1717	2.335	4052	2023	2354	4377	1849	2.362	4211	1 853	2236	4089	1583	1894	3477
	ISLETA	E.B.	2006	0.197	2203	2089	0196	2.285	2007	0183	2190	1 938	0167	2105	1769	0.132	1901
	RINCON	W.B.	1585	0 175	1.760	1864	0 197	2061	1773	0185	1958	1763	0 174	1 937	1539	0 114	1653
	RINCON	E.B.	1 312	0174	1.486	1287	0.167	1.454	1200	0 147	1347	1 314	0.132	1 446	1722	0.131	1.853
	EL PASO	W.B.	1041	0 135	1.176	1 141	0.160	1.301	1.025	0.138	1163	1 118	0 130	1 248	1479	0115	1594
	RINCON	E.B.	0.757	0 000	0.757	0.933	0.000	0933	0826	0.000	0826	0 572	0.000	0572	0433	0000	0.433
	DEMING	W.B	0611	0000	0.611	0795	0.000	0795	0780	0.000	0780	0613	0.000	0613	0534	0.000	0534
PANHANDLE	WELLINGTON	E.B.	13.321	1 145	14466	13.862	1.208	15070	14758	1200	15.958	15376	1.175	16 551	14 255	1162	15417
	WAYNOKA	W.B.	11 211	1.000	12211	11.587	1.123	12710	12644	1258	13902	13662	1.234	14 896	11 422	1 215	12 637
PLAINS	WAYNOKA	E.B.	13.370	1.111	14481	14036	1.178	15.214	14433	1192	15625	15 160	1 182	16 342	13883	1154	15037
	CANADIAN	W.B.	11.035	0.972	12007	11756	1.106	12862	12404	1237	13641	13.287	1 210	14 497	11 148	1194	12342
	CANADIAN	E.B.	12.964	1.107	14071	14036	1.178	15.214	14433	1192	15625	15160	1.182	16.342	13883	1154	15037
	AMARILLO	W.B.	10.956	0.956	11.912	11756	1.106	12862	12404	1237	13641	13 287	1 210	14497	11 148	1194	12342
	AMARILLO	E.B.	13 474	1 143	14617	14721	1.208	15929	14882	1204	16.086	16 184	1 173	17 357	14608	1220	15 828
	CANYON	W.B.	12.536	1023	13559	14046	1130	15 176	13850	1273	15.123	14.617	1.185	15 802	12585	1234	13.819
	CANYON	E.B.	11.370	1047	12417	12093	1.116	13.209	11931	1 1[illegible]7	13048	13 196	1.092	14 288	11953	1.118	13071
	FARWELL	W.B.	9663	0920	10.583	10512	1027	11539	10681	1 [illegible]73	11854	11.623	1 085	12 708	10013	1136	11.149
	FARWELL	E.B.	15 200	1.497	16697	16324	1.571	17895	15717	1 315	17232	17 649	1.524	19.173	15.981	1468	17449
	CLOVIS	W.B	12.497	1393	13.890	14 108	1.549	15.657	14205	16[illegible]	15824	15 599	1 529	17 128	13716	1492	15208
PECOS	CLOVIS	E.B.	12057	1 140	13 197	12809	1.268	14[illegible]	126[illegible]	12[illegible]9	13.916	13555	1 233	14 788	11572	1182	12.754
	BELEN	W.B.	11.297	1047	12344	12761	1199	13960	1280[illegible]	1[illegible]24	14.128	13719	1 224	14 943	11823	1194	13017
SLATON	TEXICO	E.B.	2.798	0409	3.207	3.329	0397	3726	3.084	0402	3486	3776	0 381	4 157	3.873	0.352	4225
	LUBBOCK	W.B.	3656	0.366	4022	4037	0404	4441	3745	0391	4.136	4 237	0.383	4 620	3638	0.356	3.994
	LUBBOCK	E.B.	4942	0490	5432	5221	0.471	5692	5.912	0476	6388	6.470	0.453	6 923	6.414	0.417	6831
	SLATON	W.B.	6636	0.146	7082	7606	0.478	8084	6.769	0.465	7254	7 153	0.458	7 611	6.504	0.424	6.928
	SLATON	E.B.	4 308	0 442	4750	4821	0.447	5.26[illegible]	4665	0.464	5 129	4 819	0.442	5 261	5666	0399	6065
	SWEETWATER	W.B.	6 151	0406	6557	6341	0441	678[illegible]	5685	0431	6.116	5 516	0.421	5937	4553	0.412	4965
	CANYON	E.B.	2 144	0.081	2.225	2592	0.074	2666	2.828	0.074	2902	2 694	0 072	2766	2.541	0.065	2606
	LUBBOCK	W.B.	2980	0.080	3060	3569	0.074	3643	3044	0073	3 118	2 916	0075	2991	2866	0068	2934

1. Exclusive of C.& S. trackage between Denver and Pueblo (117 miles), which tonnage (in millions of gross tons) is as follows:

1945 F	1945 P	1945 T	1946 F	1946 P	1946 T	1947 F	1947 P	1947 T	1948 F	1948 P	1948 T	1949 F	1949 P	1949 T	1950 F	1950 P	1950 T	1951 F	1951 P	1951 T	1952 F	1952 P	1952 T	1953 F	1953 P	1953 T	1954 F	1954 P	1954 T
2.639	0608	3247	2307	0.513	2.820	2588	0426	3014	2571	0392	2963	2462	0367	2729	2.332	0373	2705	2861	0414	3275	2520	0414	2934	2714	0420	3134	2470	0423	2893

(NOTE: No tonnage figures available for D.& R.G.W. between Denver and Bragdon).

2. Exclusive of C.& S. trackage between Pueblo and Denver (117 miles), which tonnage (in millions of gross tons) is as follows:

1945 F	1945 P	1945 T	1946 F	1946 P	1946 T	1947 F	1947 P	1947 T	1948 F	1948 P	1948 T	1949 F	1949 P	1949 T	1950 F	1950 P	1950 T	1951 F	1951 P	1951 T	1952 F	1952 P	1952 T	1953 F	1953 P	1953 T	1954 F	1954 P	1954 T
2.576	0582	3.158	1.976	0.490	2.466	2.326	0.436	2.762	2.200	0.392	2.592	1.953	0.374	2.327	2025	0374	2.399	2535	0.396	2731	2151	0.394	2545	2052	0.395	2.447	.736	0411	2147

(NOTE: No tonnage figures available for D.& R.G.W. between Bragdon and Denver).

3. Exclusive of D.& R.G.W. and C & W. trackage between Trinidad and Jansen (1.8 miles)

NOTE: Sequence of towns in each case in second column is from east towards west (west bound, time table direction).
E.B. equals N.B. of Employes' time table.
* W.B. equals S.B. of Employes' time table.

C.E.S. 50175-4 Sheet 5.