DEPARTMENT of ENVIRONMENT and NATURAL RESOURCES

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PIERRE, SOUTH DAKOTA 57501-3182

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RECOMMENDATION OF CHIEF ENGINEER FOR WATER PERMIT APPLICATION NO. 2748-2, Forrest Stewart

Pursuant to SDCL 46-2A-2, the following is the recommendation of the Chief Engineer, Water Rights Program, Department of Environment and Natural Resources concerning Water Permit Application No. 2748-2, Forrest Stewart, 29845 237th Avenue, Cody NE 69211.

The Chief Engineer is recommending APPROVAL of Application No. 2748-2 because 1) there is reasonable probability that there is unappropriated water available for the applicant's proposed use, 2) the proposed diversion can be developed without unlawful impairment of existing rights, 3) the proposed use is a beneficial use and 4) it is in the public interest with the following qualifications:

1. The well approved under this Permit will be located near domestic wells and other wells which may obtain water from the same aquifer. The well owner under this Permit shall control his withdrawals so there is not a reduction of needed water supplies in adequate domestic wells or in adequate wells having prior water rights.

2. The well authorized by Permit No. 2748-2 shall be constructed by a licensed well driller and construction of the well and installation of the pump shall comply with Water Management Board Well Construction Rules, Chapter 74:02:04 with the well casing pressure grouted (bottom to top) pursuant to Section 74:02:04:28.

3. Pursuant to SDCL 46-5-6 which allows a greater diversion rate if the method of irrigation, time constraints, or type of soils so requires, Permit No. 2748-2 authorizes a maximum diversion rate of 1.56 cfs for the irrigation of 75 acres with an annual volume not to exceed 2 acre feet of water per acre per year.

4. This Permit is approved subject to the irrigation water use questionnaire being submitted each year.

See report on application for additional information.

Jeanne Goodman

Jeanne Goodman, Chief Engineer
March 21, 2016

REPORT TO THE CHIEF ENGINEER
ON
WATER PERMIT APPLICATION NOS. 2746-2, 2747-2 AND 2478-2
FORREST STEWART
11 MARCH 2016

Water Permit Application No. 2746-2 proposes to appropriate water from the Ogallala aquifer for the irrigation of 160 acres located in the NE¼, E½NW¼, NW¼SE¼, and the NE¼SW¼ Sec. 19, T36N-R34W. The application proposes to divert water from a well located in the SE¼SE¼ Sec. 19, T36N-R34W at a maximum diversion rate of 2.45 cubic feet of water per second (cfs). The applicant is requesting a diversion rate greater than the statutory limit of 1 cfs per 70 acres.

Application No. 2747-2 proposes to appropriate water from the Ogallala aquifer for the irrigation of 64 acres located in the W½SE¼ and the SE¼SE¼ Sec. 30, T36N-R34W. The application proposes to divert water from a well located in the NW¼SE¼ Sec. 30, T36N-R34W at a maximum diversion rate of 1.34 cfs. The applicant is requesting a diversion rate greater than the statutory limit of 1 cfs per 70 acres.

Application No. 2748-2 proposes to appropriate water from the Ogallala aquifer for the irrigation of 75 acres located in the W½NW¼ Sec. 29, T36N-R34W and the SW¼SW¼ Sec. 20, T36N-R34W. The application proposes to divert water from a well located in the NW¼NW¼ Sec. 29, T36N-R34W at a maximum diversion rate of 1.56 cfs. The applicant is requesting a diversion rate greater than the statutory limit of 1 cfs per 70 acres.

AQUIFER: Ogallala aquifer (OGLL)

GEOLOGY AND AQUIFER CHARACTERISTICS:
The High Plains aquifer system underlies 174,000 square miles of the United States, extending from southern South Dakota to Texas (Gutentag and others, 1984). The High Plains aquifer is generally considered to be composed of the upper sandstone units of the Arikaree Formation, the overlying Ogallala and Sand Hills Formations, and any terrace or alluvial deposits, all of which are hydraulically connected (Kolm and Case, 1983). In South Dakota, the High Plains aquifer includes the Arikaree Group, Batesland Formation, Ogallala Group, and overlying alluvial and eolian deposits (Filipovic, 2011). For water management purposes, the South Dakota Department of Environment and Natural Resources-Water Rights Program, and the South Dakota Water Management Board have historically considered appropriations from the High Plains aquifer either from the Ogallala aquifer or from the Arikaree aquifer. The Ogallala aquifer is considered the source for this proposed appropriation.

The Ogallala Group consists of clays, silts, sands, and surface gravel deposits, and is the most productive part of the High Plains aquifer (Filipovic, 2011; Gutentag and others, 1984). The Ogallala aquifer is estimated to underlie 1,140,360 acres and contain 19,929,600 ac-ft of recoverable water in South Dakota (Allen and others, 1985). Allen and others, (1985) estimated the Ogallala aquifer to underlie 280,960 acres and contain 2,809,600 ac-ft of recoverable water in Bennett County. The test hole logs submitted with Application Nos. 2746-2 and 2747-2 indicate the base of the Ogallala is approximately 270 and 218 feet below grade, respectively.

The aquifer is under unconfined conditions and the water table was reported to be approximately 21-37 feet below grade in April 2015. Groundwater flow in this area is generally from the southwest to northeast but locally topographically controlled and is towards the Little White River (Filipovic, 2011).

SDCL 46-2A-9

Pursuant to SDCL 46-2A-9, a permit to appropriate water may be issued only if there is a reasonable probability that there is unappropriated water available for the applicant's proposed use, that the proposed diversion can be developed without unlawful impairment of existing rights and that the proposed use is a beneficial use and in the public interest. This report will address the availability of unappropriated water from the aquifer and the potential for impairment of existing rights.

WATER AVAILABILITY:

The probability of unappropriated water available from an aquifer can be evaluated by considering SDCL 46-6-3.1, which requires "No application to appropriate groundwater may be approved if, according to the best information reasonably available, it is probable the quantity of water withdrawn annually from a groundwater source will exceed the quantity of the average estimated annual recharge of water to the groundwater source." If the source of the water is older or lower than the greenhorn formation and the water is to be used by a water distribution system, the Board need not consider the recharge/withdrawal issue. Here, a water distribution system is not involved and the aquifer is not older or lower than the greenhorn formation therefore withdrawal/recharge issue must be considered.

These applications propose to authorize the irrigation of 299 additional acres from the Ogallala aquifer. The average annual diversion rate associated with this proposed appropriation can be expected to be less than 300 acre-feet per year.

Hydrologic Budget:

Recharge:

Recharge to the Ogallala aquifer occurs from precipitation on the outcrop areas. Estimates for the average annual recharge to the Ogallala aquifer are shown in Table 1.

Table 1. Average annual recharge estimates for the Ogallala aquifer

ESTIMATED AVERAGE ANNUAL RECHARGE	METHOD	SOURCE
2.2-3.4 inches/year	Observation Well Data	Hedges and Burch, 1985
1.88 inches/year	Base flow Recession Analysis	Hedges and Burch, 1985
1.3-1.8 inches/year	Digital Model	Kolm and Case, 1983
2.91 inches/year	Digital Model	Long and Putnam, 2010

Therefore, recharge to the Ogallala aquifer in South Dakota is estimated to range from 124,000 to 323,000 ac-ft/yr. Recharge to the portion of the aquifer in Bennett County ranges from 30,400 to 79,600 ac-ft/yr.

Discharge:
Discharge from the Ogallala aquifer occurs through evapotranspiration, seepage through springs and to streams and rivers such as the Niobrara and the Little White, and well withdrawals (Filipovic, 2011). There are currently 171 water rights/permits and three future use permits appropriating water from the Ogallala aquifer in South Dakota, with 45 water rights/permits in Bennett County (Water Rights, 2016b). In addition to appropriative users, there are a number of wells completed into the Ogallala aquifer that are used for self-supply domestic use and livestock watering. The reasonable domestic use that occurs through these wells does not contribute significantly to a hydrologic budget for the Ogallala aquifer. The Pine Ridge and Rosebud Indian Reservations tribal members operate a number of irrigation wells completed into the Ogallala aquifer. When investigating 2010 aerial photography for the area, the majority of the irrigation is authorized by SD DENR-Water Rights Program and the Water Management Board (Buhler, 2012).

The irrigation development of the Ogallala aquifer has remained relatively constant over the period of record of 1982-2015 (see Tables 2 & 3). Well withdrawals for irrigation have fluctuated over the years due to climatic and economic conditions. The average irrigation pumpage reported for the Ogallala aquifer in South Dakota over the period of record is 18,589.67 ac-ft/yr. Average irrigation pumpage from the Ogallala aquifer in Bennett County from 1982-2014 is 7390.8 ac-ft/yr (Water Rights, 1983-2015).

Table 2. Historic Irrigation use from the Ogallala aquifer in South Dakota (Water Rights, 1983-2015)

Year	Number of Permits Reporting	Appropriation (ac-ft/yr)	Pumpage Reported (ac-ft/yr)
1982	93	62475.95	9217.41
1983	101	66508.65	10175.49
1984	109	68087.95	13273.4
1985	108	56382.05	18536.5
1986	105	59270.95	12952.6
1987	104	59472.95	12347.9
1988	103	57456.1	16154.4
1989	104	56839.4	27261.5
1990	107	57288.4	16511.6
1991	108	56438.8	16049.54
1992	107	54197.5	11985.8
1993	105	53357.5	11099.9
1994	108	54664.2	16699.41
1995	107	54719.2	14276.9
1996	110	55713.2	21222.84
1997	111	55610.2	18707
1998	109	54106.8	13777.34
1999	110	54366.8	13733.72
2000	111	54686.8	16141.74
2001	110	54653.6	18121.82
2002	105	52218.8	24176.59
2003	105	51408.8	22085.21
2004	107	51877.8	23939.9
2005	108	52537.8	20131.74
2006	111	52953.7	25733.32
2007	114	52681.7	24051.2
2008	116	53095.7	24498.85
2009	116	53095.7	22130.45
2010	115	52529.7	21261.58
2011	116	52856.7	15294.73
2012	118	53238.7	33224.01
2013	129	57392.7	26527.51
2014	136	59732.7	22157.13
Max	**136**	**68087.95**	**33224.01**
Min	**93**	**51408.8**	**9217.41**
Average	**109**	**55693.3**	**18589.67**

Table 3. Historic Irrigation use from the Ogallala aquifer in Bennett County, SD (Water Rights, 1983-2015)

Year	Number of Permits Reporting	Appropriation (ac-ft/yr)	Pumpage Reported (ac-ft/yr)
1982	35	17457.3	2032.77
1983	37	18134.3	4259.07
1984	44	22288.2	4816.4
1985	42	19778	8022
1986	41	19935	4359.6
1987	40	19663	5624
1988	39	18063	6366.5
1989	41	18730	10212.6
1990	43	19248	7169
1991	43	19248	6270.2
1992	43	19248	5629
1993	43	19248	4447.5
1994	44	20500	7448.54
1995	42	20218	5936.46
1996	44	20204	6430.94
1997	44	19677	7069
1998	44	19697	5805.38
1999	44	19697	5745.8
2000	44	19697	6812.18
2001	43	18950.9	7149.91
2002	42	18950.9	8321.28
2003	44	19604.9	7164.72
2004	44	19529.9	9067.61
2005	44	19925.9	8563.55
2006	43	19529.9	10838.95
2007	45	19245.9	10468.27
2008	45	19267.9	9976.89
2009	45	19267.9	8283.03
2010	45	19157.9	7347.36
2011	45	19489.9	6289.23
2012	42	18463.9	13134.53
2013	50	21665.9	13568.44
2014	53	22885.19	9265.19
Min	**35**	**17475.3**	**2032.77**
Max	**50**	**22885.19**	**13568.44**
Average	**42.9**	**19036.5**	**7390.8**

The amount of water that can be expected to be withdrawn through water rights/permits authorizing water use for non-irrigation purposes at the current appropriation level can be estimated by assuming the following: water rights/permits limited by an annual volume will pump the entire volume appropriated, water rights/permits limited only by diversion rate will pump at the maximum permitted diversion rate 60 percent of the time, and future use permits can be fully developed. Therefore, withdrawal due to non-irrigation use water rights/permits and future use permits is expected to be less than 9,760 ac-ft/yr in South Dakota and 29 ac-ft/yr in Bennett County alone (Water Rights, 2016b).

Water Balance:
Currently, discharge from the Ogallala aquifer as a result of well withdrawals is estimated to be 28,350 ac-ft/yr for South Dakota, and 7,390 ac-ft/yr for Bennett County. These are both much lower than the lowest of the recharge estimates, indicating that at least 95,650 ac-ft/yr and 23,010 ac-ft/yr of unappropriated water is available in the Ogallala in South Dakota and Bennett County, respectively. Therefore, unappropriated water is available for the appropriations proposed by these permit applications.

Observation Well Data:
Administrative Rule of South Dakota Section 74:02:05:07 requires that the Water Management Board rely upon the record of observation well measurements in addition to other data, to determine that the quantity of water withdrawn annually from the aquifer does not exceed the estimated average annual recharge of the aquifer.

The DENR-Water Rights Program monitors 78 observation wells completed into the Ogallala aquifer, with 19 of these in Bennett County (Water Rights, 2016a). The locations of the three observation wells can be seen in Figure 1. Hydrographs for three of the nearest observation wells to the well sites proposed by these applications are shown in Figures 2-9.

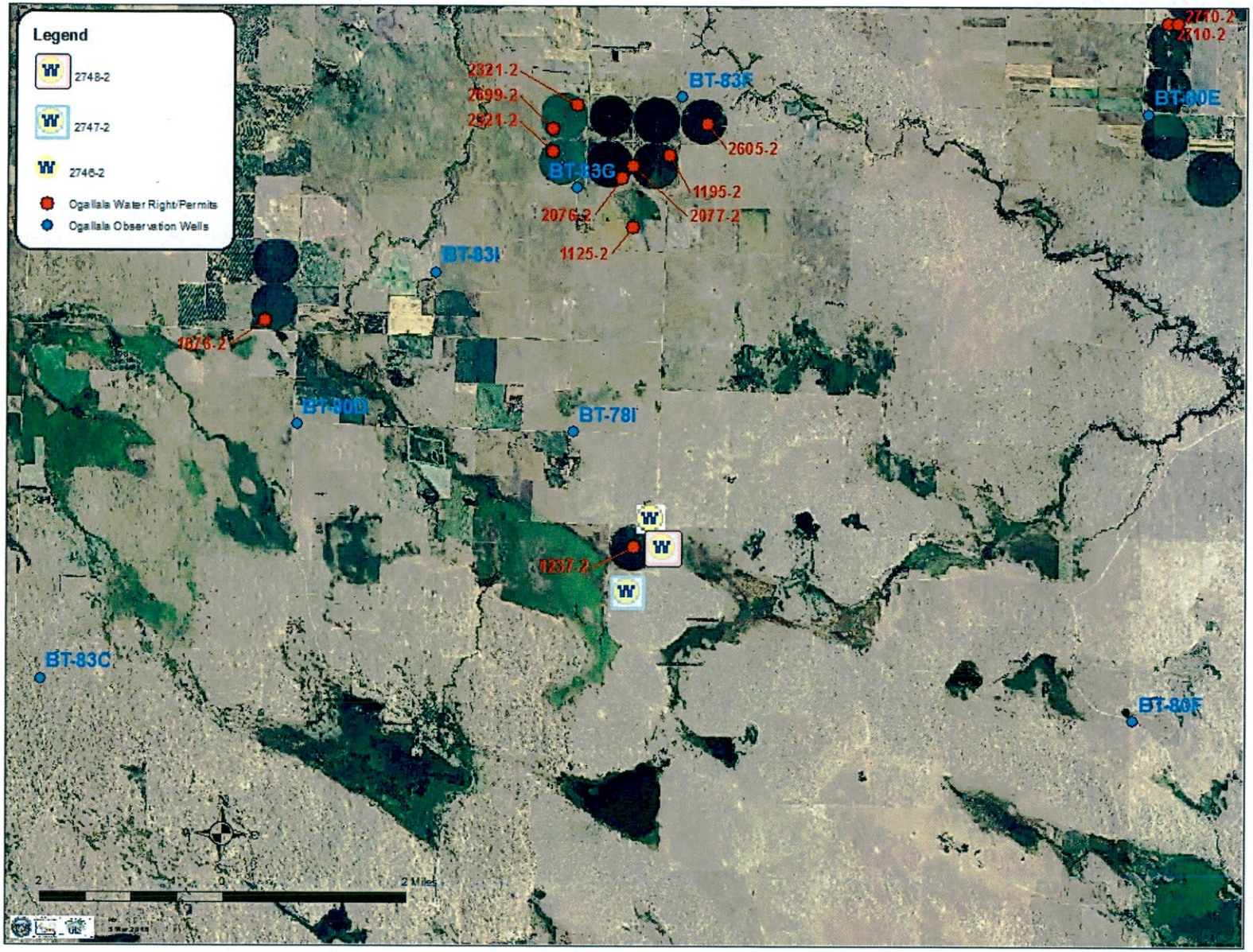

Figure 1. Aerial photo showing the location of: a) the well sites proposed by Application Nos. 2746-2, 2747-2 and 2748-2; b) Ogallala aquifer observation wells monitored by DENR-Water Rights Program; and c) Water rights/permits appropriating water from the Ogallala aquifer in the area.

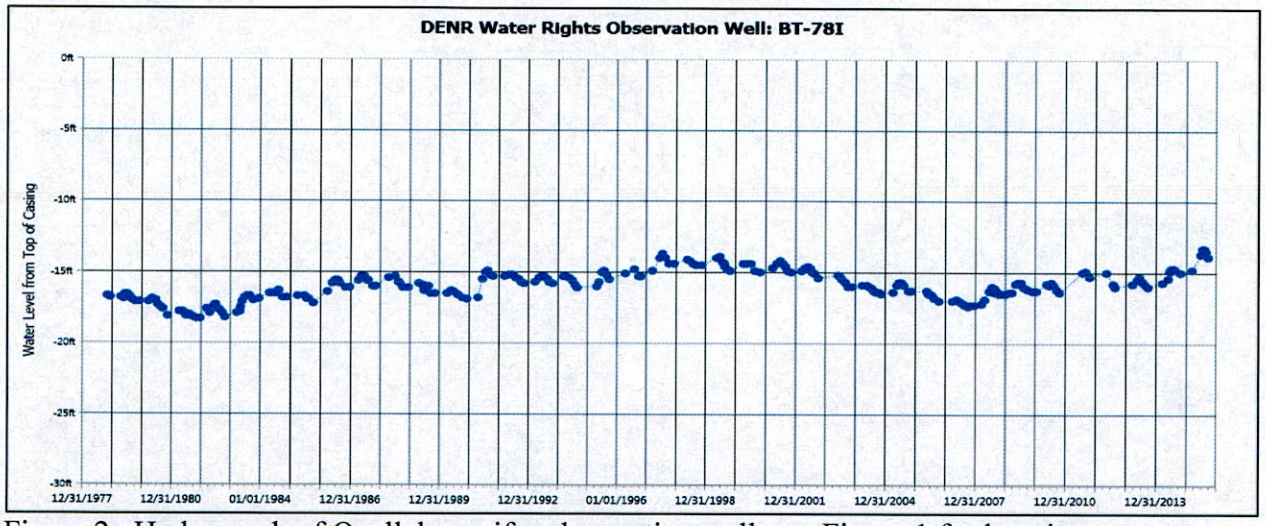

Figure 2. Hydrograph of Ogallala aquifer observation well, see Figure 1 for location.

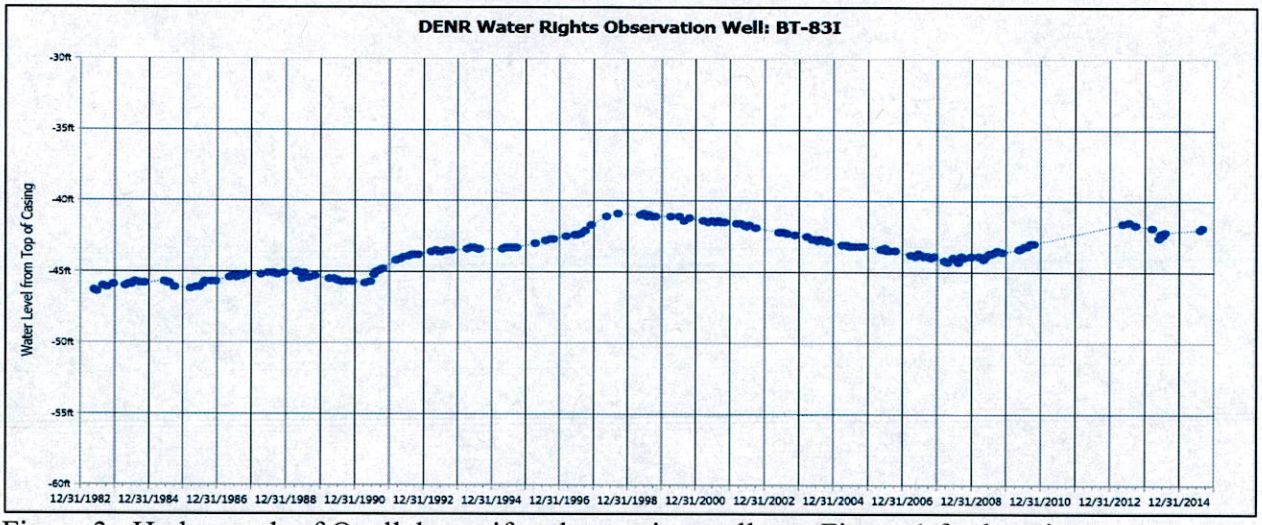

Figure 3. Hydrograph of Ogallala aquifer observation well, see Figure 1 for location.

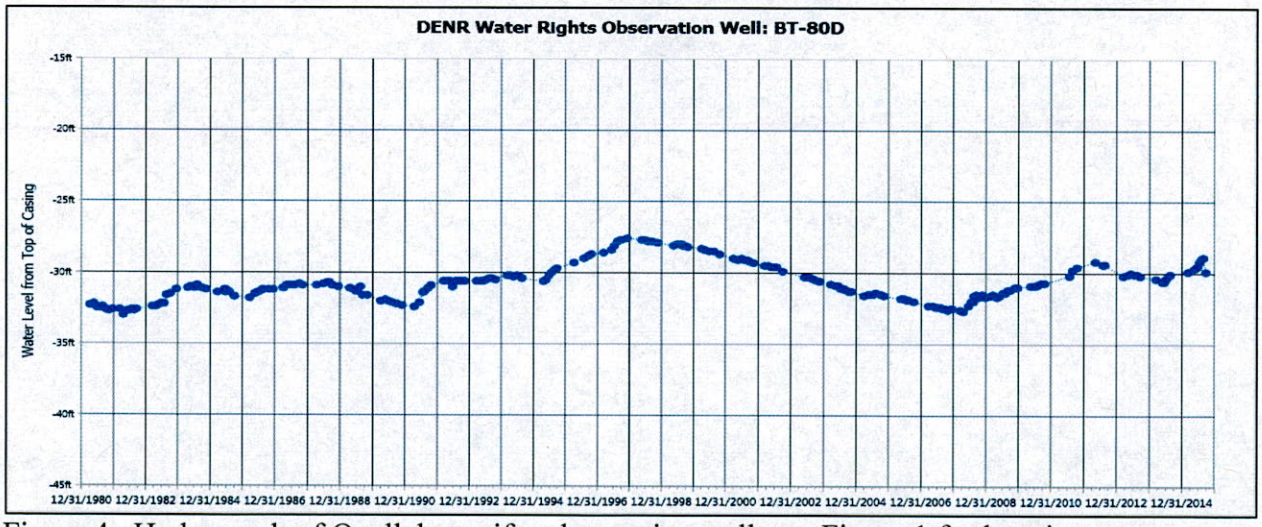

Figure 4. Hydrograph of Ogallala aquifer observation well, see Figure 1 for location.

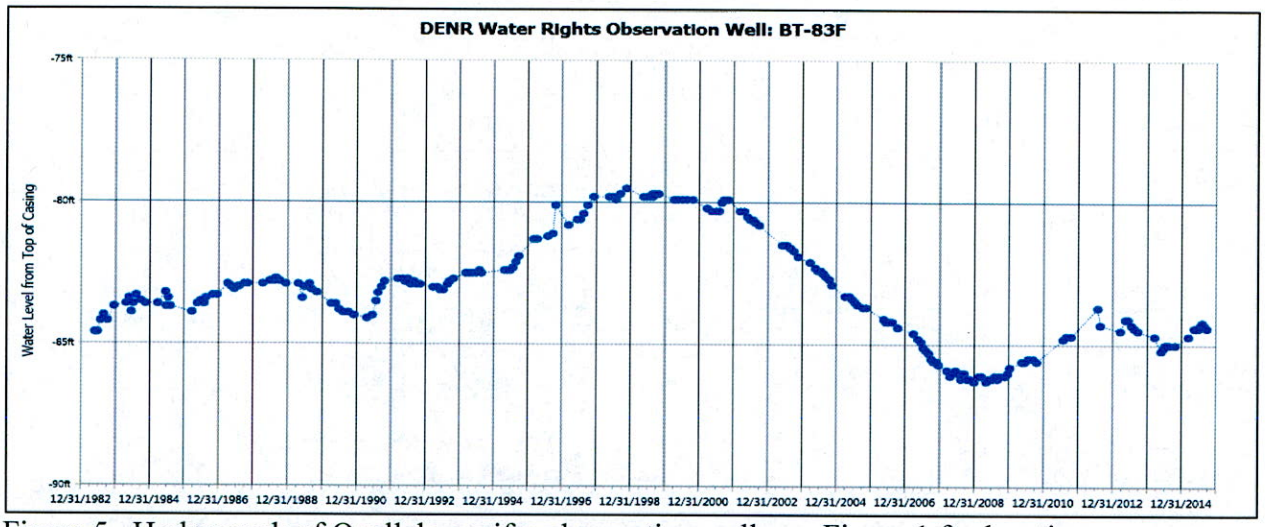

Figure 5. Hydrograph of Ogallala aquifer observation well, see Figure 1 for location.

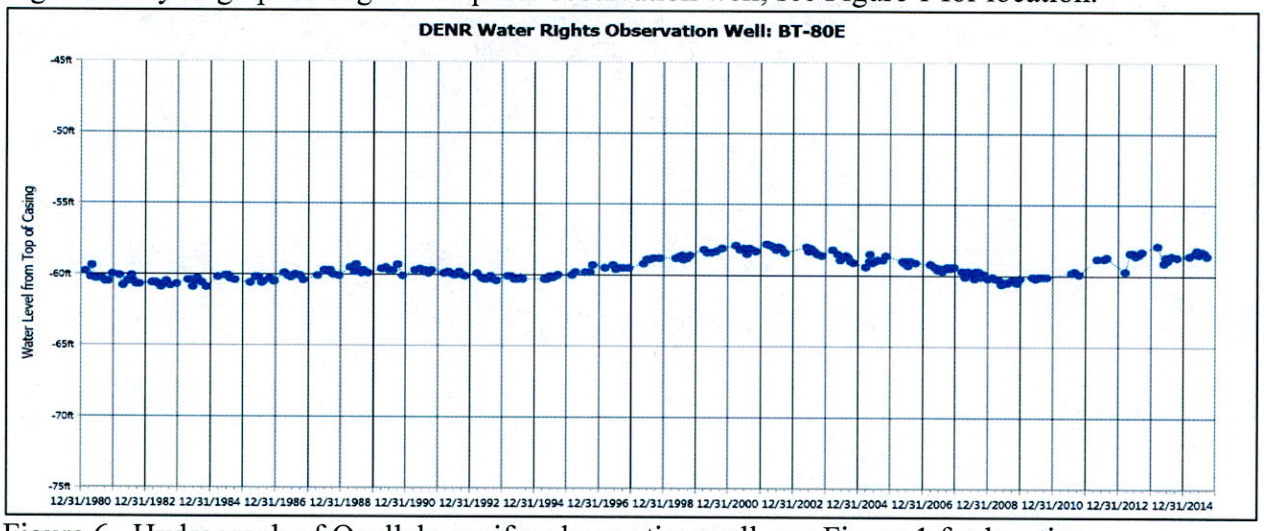

Figure 6. Hydrograph of Ogallala aquifer observation well, see Figure 1 for location.

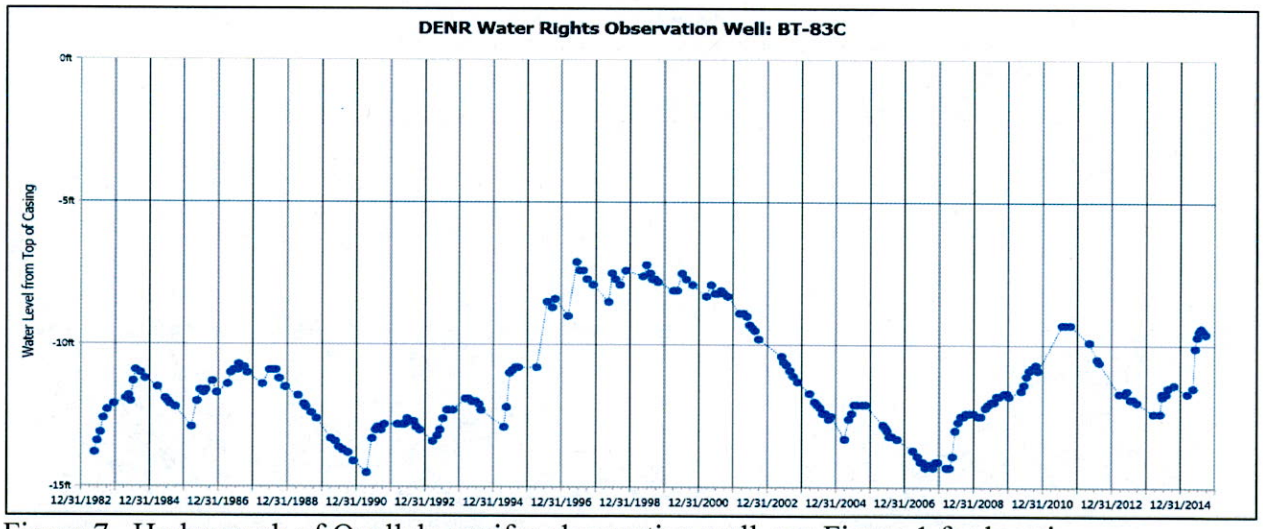

Figure 7. Hydrograph of Ogallala aquifer observation well, see Figure 1 for location.

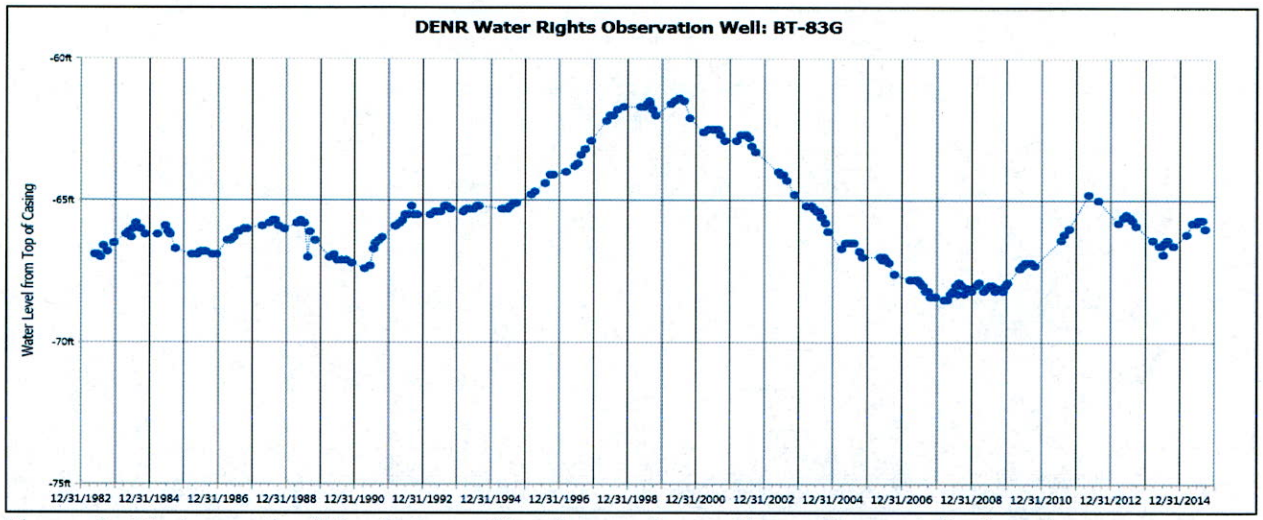

Figure 8. Hydrograph of Ogallala aquifer observation well, see Figure 1 for location.

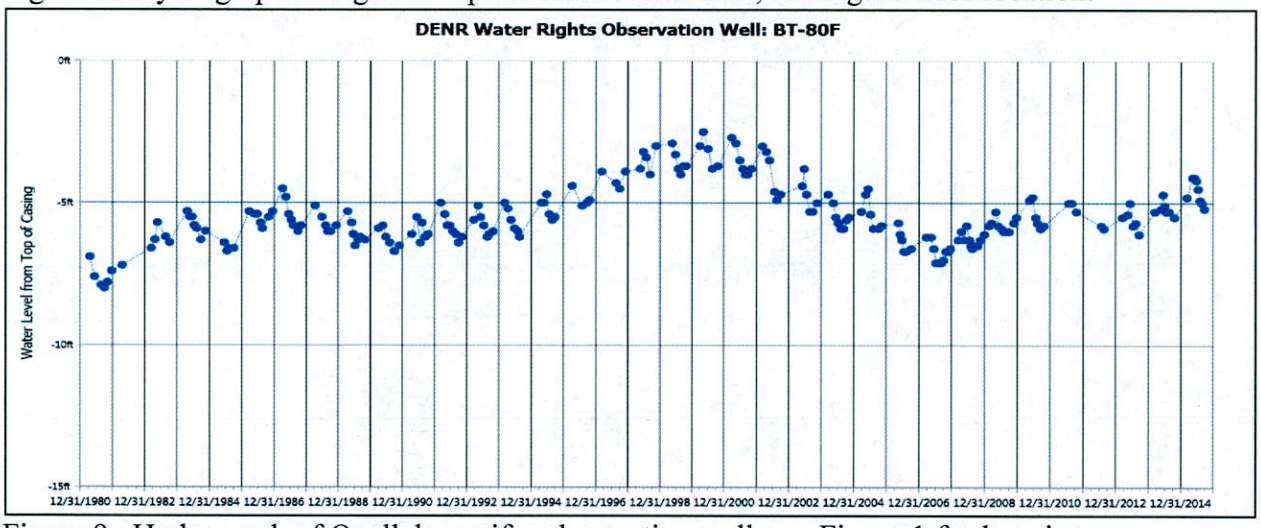

Figure 9. Hydrograph of Ogallala aquifer observation well, see Figure 1 for location.

The observation well data documents cyclic conditions of water levels, rising during wet years and declining during dry years. The climatic conditions mask the temporal effects of well withdrawals indicating that recharge to and natural discharge from the Ogallala aquifer greatly exceeds well withdrawal. Therefore, unappropriated water is available from the Ogallala aquifer to support these proposed appropriations.

EXISTING WATER RIGHTS:

There are a number of completion reports on file with the DENR-Water Rights Program for domestic wells in this area. The approximate location of diversion points authorized for existing water rights/permits in this area are shown in Figure 1 and identified in Table 4.

Table 4. Water Rights/Permits shown in Figure 1.

PERMIT NO	NAME	PRIORITY DATE	STATUS	USE	CFS	ACRES
1125-2	MARK/ILA MAE WALKER	10/02/1972	LC	IRR	2.67	246
1195-2	PLATTE HTTRN BRTH	07/05/1974	LC	IRR	1.44	132
1237-2	BILLY JOE KIRK	02/04/1975	LC	IRR	1.78	132
1676-2	GEORGE/ELSIE FARLEY	09/17/1976	LC	IRR	2	262
2076-2	PLATTE HTTRN BRTH	04/04/1989	LC	IRR	1.78	132
2077-2	PLATTE HTTRN BRTH	04/04/1989	LC	IRR	1.78	132
2321-2	PLATTE HTTRN BRTH	07/05/1974	LC	IRR	3.22	367
2605-2	PAUL FANNING	12/15/2006	LC	IRR	1.56	124
2699-2	PLATTE HTTRN BRTH	11/15/2012	PE	IRR	2.12	197
2710-2	O'NEILL CATTLE CO INC	03/11/2013	LC	IRR	5.12	591

The well that supplies Water Right No. 1237-2 is located within approximately one-half mile of the wells proposed by Application Nos. 2746-2, 2747-2 and 2748-2.

The unconfined conditions of the Ogallala aquifer dictate that drawdown due to pumping will not be significant far from the proposed well site. Observation well data (see Figures 2-9) documents minimal drawdown from withdrawals of fairly concentrated irrigation wells. Considering the saturated thickness of the aquifer in this area (approximately 200 feet), the proposed diversions are not expected to significantly lower water levels within the aquifer. Given adequate well construction, the resultant drawdown is not expected to be sufficient to cause impairment in existing wells.

The Water Management Board has consistently recognized that to place water to maximum beneficial use a certain amount of drawdown may occur. However, reasonable domestic use must be assured before irrigation use is allowed. Adequate well defined by ARSD 74:02:20(6) are not expected to be adversely or unlawfully impaired.

SDCL 46-5-6

Pursuant to SDCL 46-5-6, the diversion rate for an irrigation appropriation cannot be in excess of one cfs for every 70 acres, or "the equivalent thereof." The statute provides that the Water Management Board may allow a greater diversion if the method of irrigation so requires.

Water Permit Application No. 2746-2, proposes to divert 2.45 cfs to irrigate 160 acres, or the equivalent of 1.072 cfs per 70 acres. Water Permit Application No. 2747-2 proposes to divert 1.34 cfs to irrigate 64 acre, the equivalent of 1.466 cfs/70 acres, and Water Permit Application No. 2748-2 each propose to divert 1.56 cfs to irrigate 75 acres, the equivalent of 1.456 cfs/70 acres. The applicant has indicated that the soils in the area are very sandy and require higher application rates. In addition, Mr. Stewart indicated that in each case the irrigation equipment requires approximately the requested rate to operate correctly.

CONCLUSIONS

1. Water Permit Application No. 2746-2 proposes to divert water at a maximum diversion rate of 2.45 cfs to irrigate 160 acres.
2. Water Permit Application No. 2747-2 proposes to divert water at a maximum diversion rate of 1.34 cfs to irrigate 64 acres.

3. Water Permit Application No. 2748-2 proposes to divert water at a maximum diversion rate of 1.56 cfs to irrigate 75 acres.
4. There is a reasonable probability that unappropriated water is available from the Ogallala aquifer.
5. The applicant has requested diversion rates in excess of one cfs per 70 acres to properly supply the irrigation pivots.
6. There is a reasonable probability that these appropriations can be made without adversely impacting existing water rights or nearby wells.

Ken Buhler
DENR-Water Rights Program

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