



DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES

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**RECOMMENDATION OF CHIEF ENGINEER FOR WATER PERMIT
APPLICATION NO. 8165-3, Todd Swenson**

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. 8165-3, Todd Swenson, 38770 235th Street, Wessington Springs SD 57382.

The Chief Engineer is recommending APPROVAL of Application No. 8165-3 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 wells 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 wells authorized by Permit No. 8165-3 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. This Permit is approved subject to the irrigation water use questionnaire being submitted each year.

See report on application for additional information.

Jeanne Goodman, Chief Engineer
July 24, 2015

**REPORT TO THE CHIEF ENGINEER
ON
WATER PERMIT APPLICATION NOS. 8164-3 AND 8165-3
TODD SWENSON
JUNE 28, 2015**

Water Permit Application No. 8164-3 proposes to appropriate water from the Bad-Cheyenne aquifer for the purpose of irrigating 650 acres. The application proposes to divert water at a maximum rate of 5.33 cubic feet of water per second (cfs) from three wells (103, 170 and 147 feet deep respectively). The approximate location of the proposed well sites and acres to be irrigated are shown in Figure 1. The project is located approximately 8 miles northeast of Wessington Springs in Jerauld County.

Water Permit Application No. 8165-3 proposes to appropriate water from the Bad-Cheyenne aquifer for the purpose of irrigating 460 acres. The application proposes to divert water at a maximum rate of 5.33 cubic feet of water per second (cfs) from three wells (45, 46, and 45 feet deep respectively). The approximate location of the proposed well sites and acres to be irrigated are shown in Figure 1. The project is located approximately 8 miles northeast of Wessington Springs in Jerauld County.

AQUIFER: Bad-Cheyenne aquifer (BC)

GEOLOGY AND AQUIFER CHARACTERISTICS:

The three test well completion reports submitted with Application No. 8164-3 identify sand and gravel (glacial outwash) at depths ranging from 35 feet to 170 feet below grade (approximately 1,250-1,385 feet above mean sea level elevation (fmsl)). The test wells completed for Application No. 8165-3 identify glacial outwash at depths ranging from 14 feet to 46 feet below grade (approximately 1,289-1,338 fmsl). Hedges and others, (1982) correlated the outwash deposit in this area with that of the Bad-Cheyenne aquifer, an aquifer that extends northwest from this area (see Figure 2). Hamilton (1984) associated the outwash in this area with the West James management unit of the Warren aquifer which extends to the east from this area (see Figure 3). The South Dakota Geological Survey has produced a series of maps intended for use as a tool to aid in identifying areas underlain by aquifer material. A composite of the First Occurrence of Aquifer Materials in Jerauld County, South Dakota (Jensen, 2005), and the First Occurrence of Aquifer Materials in Beadle County, South Dakota (Schulz, 2003) for the vicinity of the well sites proposed by Water Permit Application Nos. 8164-3 and 8165-3, is shown in Figure 4. Incorporating additional data available through DENR-Water Rights Program Water Well Completion Report database with the work done by Jensen (2005) and Schulz (2003) produces an areal extent of the aquifer in this area as shown in Figure 5.



Figure 1. Approximate location of the well sites and irrigated acres proposed by Water Permit Application No. 8164-3 and 8165-3.

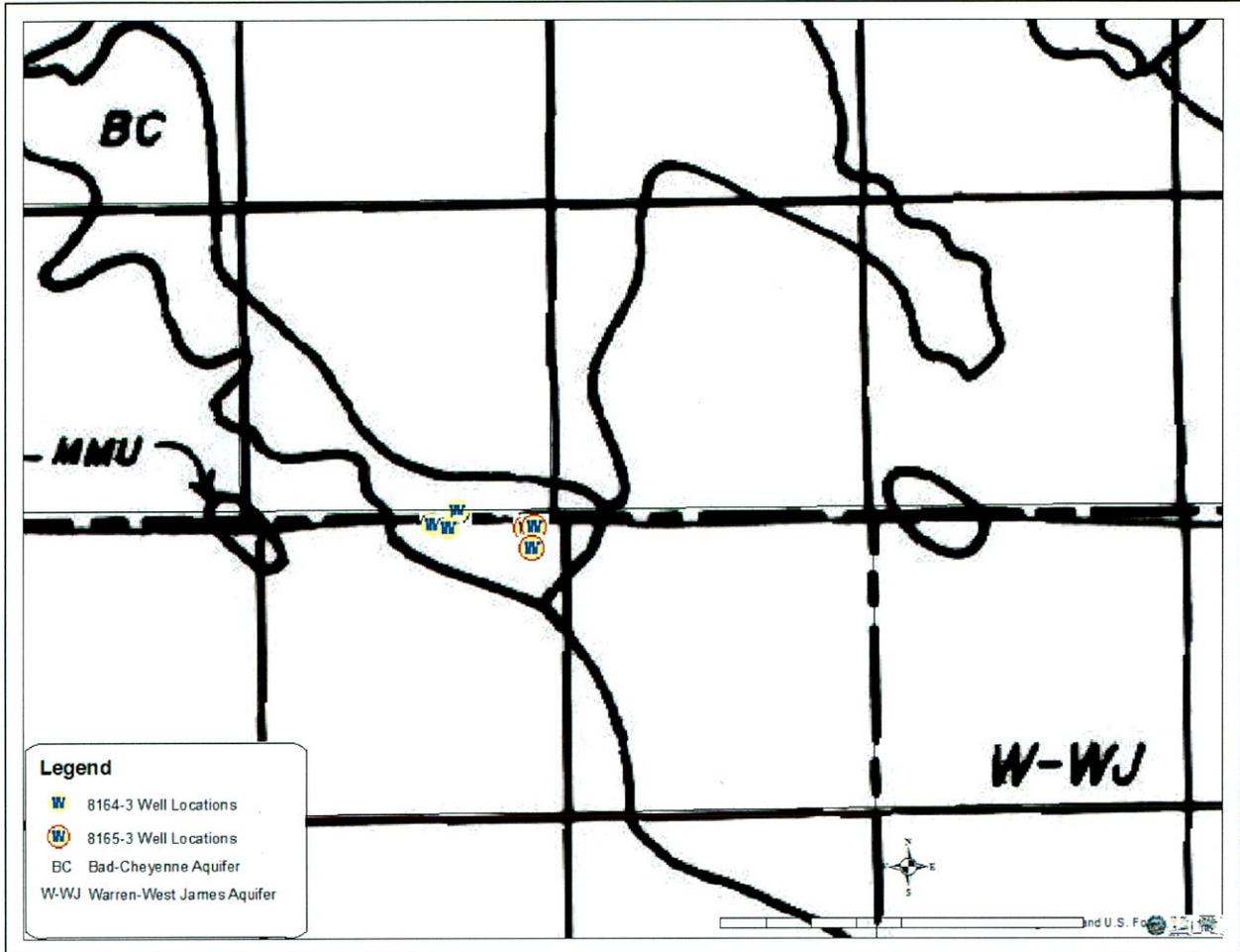


Figure 2. Glacial aquifers in the vicinity of the diversion points proposed by Water Permit Application Nos. 8164-3 and 8165-3 (modified from Hedges and others, 1982).

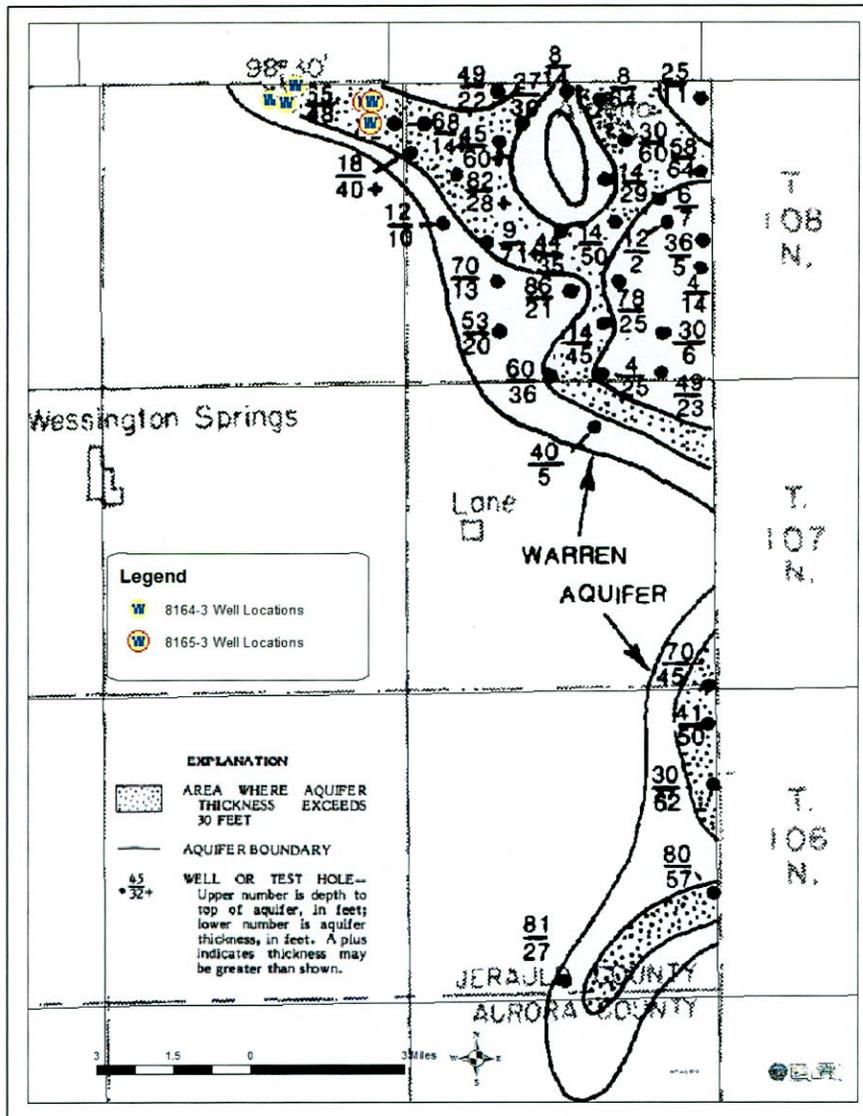


Figure 3. Glacial aquifers in the vicinity of the diversion points proposed by Water Permit Application Nos. 8164-3 and 8165-3 (modified from Hamilton, 1984).

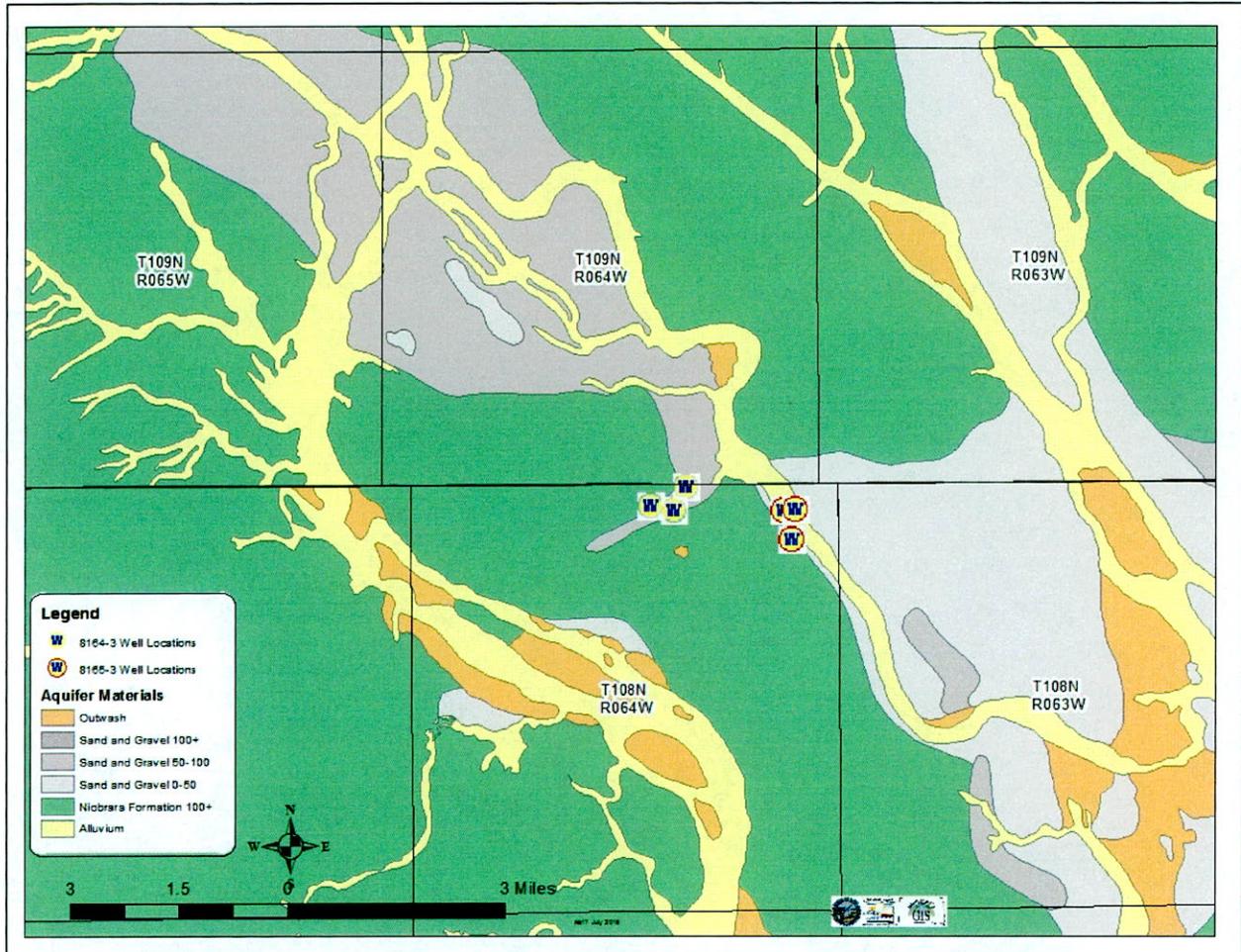


Figure 4. First Occurrence of Aquifer Materials in the vicinity of the well sites proposed by Water Permit Application Nos. 8164-3 and 8165-3. (Modified from (Schulz, 2003 and Jensen, 2005)).

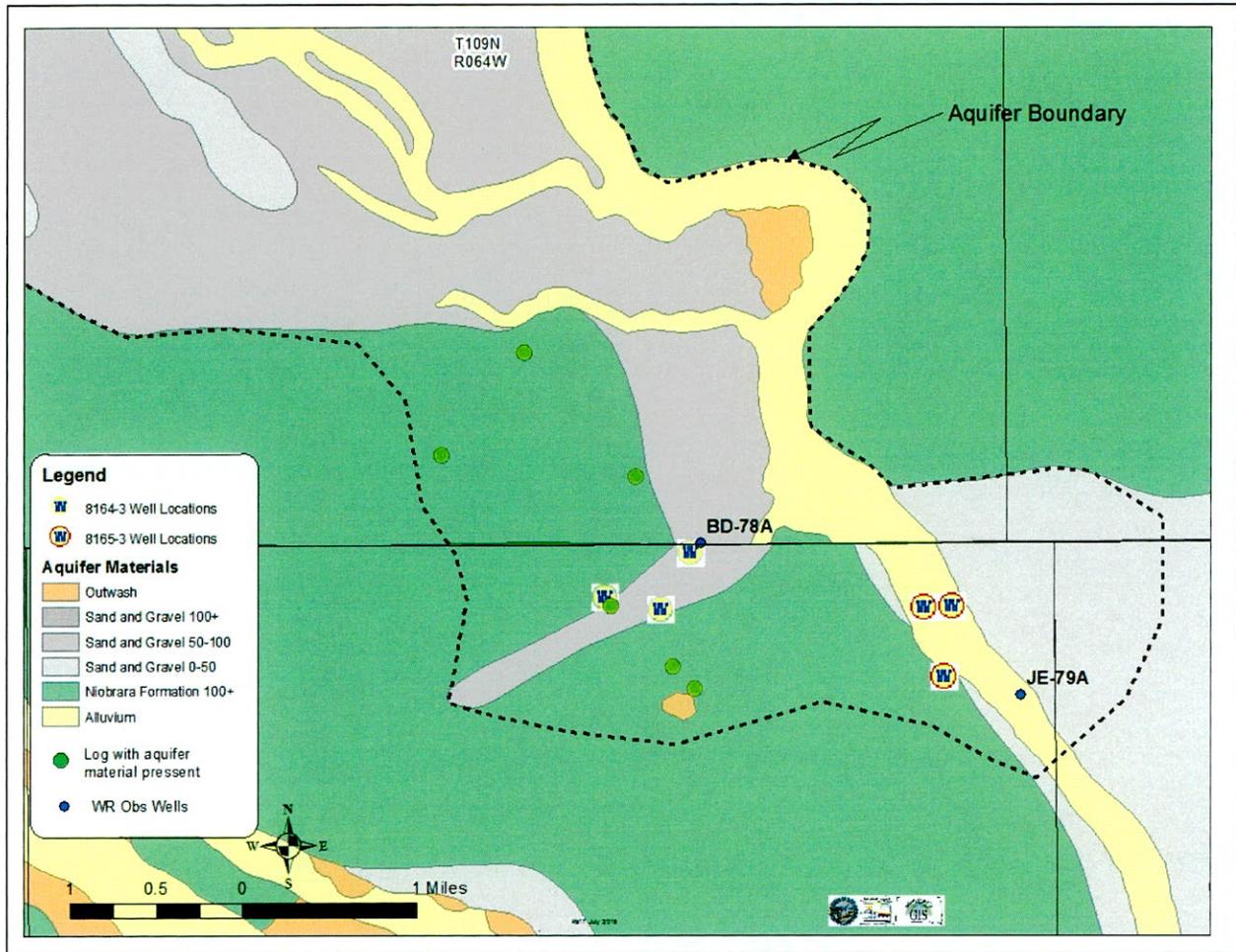


Figure 5. Approximate location of aquifer materials and DENR-Water Rights' observation wells in the vicinity of the well sites proposed by Water Permit Application Nos. 8164-3 and 8165-3. (Modified from (Schulz, 2003 and Jensen, 2005)).

The DENR-Water Rights Program has two observation wells in the immediate area of the diversion points proposed by these applications (see Figure 5) and for appropriate purposes considers this area a portion of the Bad-Cheyenne aquifer.

The Bad-Cheyenne aquifer consists of glacial outwash and alluvium sand and gravel buried in an interconnected system of pre-glacial and ice-marginal river channels (Koch, 1980). The top of the aquifer is between 14 and 71 feet below ground surface at the well sites proposed by these permit applications. Test well data submitted with Application No. 8164-3 reports November 2013 static water levels ranging from 71.6 to 78 feet below grade. The test well logs submitted with Application No. 8165-3 report February 2015 static water levels ranging from 3.5 to 5.4 feet below grade. The saturated thickness of the Bad-Cheyenne aquifer in this area is between 30 and 75 feet based on the test hole data submitted with this application. The aquifer is under confined conditions at the well sites proposed by Application No. 8164-3 and under unconfined conditions at the well sites proposed by Application No. 8165-3. Groundwater flow in this area is from northwest to southeast at a gradient of approximately 6.4 feet per mile (Water Rights, 2015a).

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:

Water Permit Application No. 8164-3 proposes to appropriate water for the irrigation of 650 acres. Application No. 8165-3 proposes to appropriate water for the irrigation of 460 acres. If both of these permits are approved, the average annual water use that can be expected under the appropriations is estimated to be less than 1010 ac-ft/yr. 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 a water distribution system has applied for a permit, 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.

Recharge versus Discharge:

Reliable recharge estimates are not available for the Bad-Cheyenne aquifer; therefore a hydrologic budget cannot be developed to directly compare average annual recharge with average annual withdrawal from the aquifer. "Interpretation of flow-net systems can provide insight into the recharge potential of a ground-water system." (Hedges and others, 1985). The amount of water flowing through an aquifer at any time can be calculated according to the equation:

$$Q=TIL$$

where:

Q= quantity in gallons per day

T= transmissivity in gallons per day per foot (gpd/ft)

I= hydraulic gradient in feet per mile

L= cross sectional length in miles

Hamilton (1984) estimated the transmissivity (T) of the aquifer in this area to be between 10,000 and 20,000 square feet per day (i.e. 74,800 to 149,600 gpd/ft). The hydraulic gradient (I) of the aquifer in this area, based on DENR- Water Rights Program observation wells has averaged 6.4 feet per mile since 1979 (Water Rights, 2015a). The cross sectional length of the aquifer perpendicular to the flow (L) (see Figure 5) is approximately 1.5 miles. Inputting the values above into the equation, groundwater outflow from this area is estimated to be 804-1,609 acre-

feet per year. Therefore, recharge to the aquifer in this area must exceed withdrawals from the aquifer by 804-1,609 acre-feet.

Observation Well Data:

Administrative Rule of South Dakota Section 74:02:05:07 requires that the Water Management Board shall 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 SD DENR-Water Rights Program monitors eight observation wells completed into the Bad-Cheyenne aquifer. Two of these observation wells, BD-78A and JE-79A are located in the vicinity of the well sites proposed by these applications, (see Figure 5). Hydrographs for BD-78A and JE-79A are shown in Figures 5 and 6 respectively. The hydrographs show that the water level of the aquifer responds to climatic conditions with rising water levels during periods when recharge exceeds withdrawals, and declining water levels during periods when withdrawals exceed recharge. The hydrographs document that water levels in this area are in general, stable or rising. Temporal well withdrawal of the aquifer is masked by climatic conditions, indicating that recharge to and natural discharge from the aquifer greatly exceeds well withdrawal, therefore water is available to capture for additional well withdrawals from the aquifer. The observation well data documents that unappropriated water is available from the Bad-Cheyenne aquifer to support these proposed appropriations.

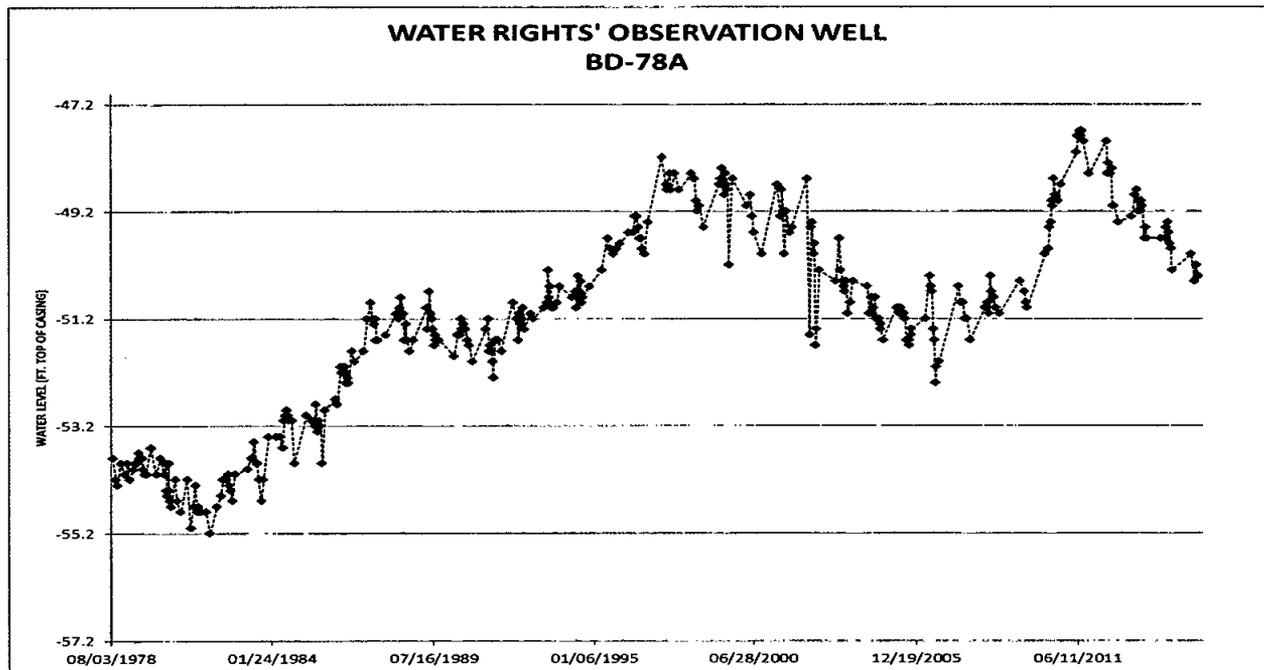


Figure 5. Hydrograph of DENR-Water Rights' Observation Well BD-78A

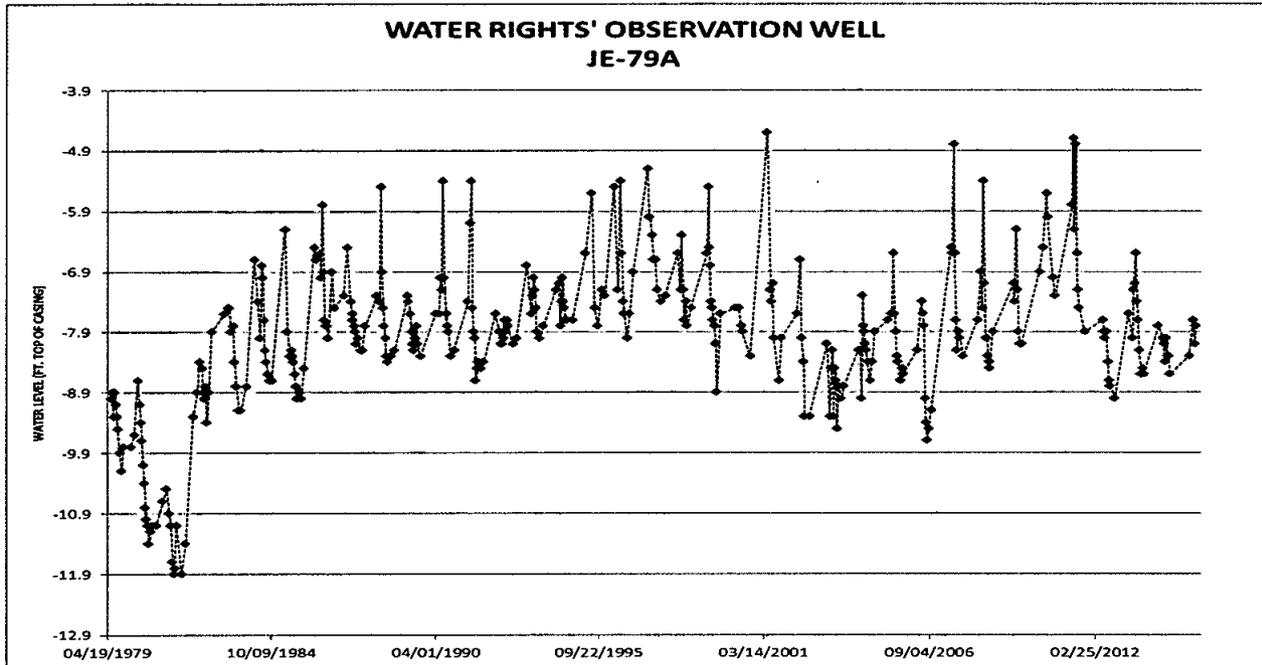


Figure 6. Hydrograph of DENR-Water Rights' Observation Well JE-79A

EXISTING WATER RIGHTS:

The nearest well supplying a Bad-Cheyenne aquifer water right to the well sites proposed by Application Nos. 8164-3 and 8165-3 is Water Right No. 4387-3, Kevin or Nicole VonEye, located approximately 5.75 miles and 7.25 miles respectively, to the northwest (Water Rights, 2015b). Considering the distances involved, well interference is not expected to be significant, and the existing water right will not be adversely impacted.

There are a number of completion reports on file with the DENR-Water Rights Program for domestic use wells that appear to be completed into the Bad-Cheyenne aquifer in this area (Water Rights, 2015c). There will be drawdown associated with the pumping proposed by these applications. However, the precise extent of the drawdown cannot be quantified without aquifer testing. The Water Management Board has consistently recognized that to place water to maximum beneficial use, drawdown will occur. South Dakota Codified Law 46-6-6.1 does not require protection of artesian head pressure as a means of delivery. However, the Supreme Court has ruled that consideration must be given to the maintenance of artesian head pressure in domestic wells before irrigation is allowed. To balance maintaining artesian head pressure as a method of delivery for domestic wells and placing water to maximum beneficial use, the Water Management Board has adopted minimum construction standards based upon the ability of a well to produce water independent of artesian pressure. South Dakota Well Construction Standard (ARSD) 74:02:04:20(7) defines an adversely impacted domestic well as:

“a well in which the pump intake was set at least 20 feet below the top of the aquifer at the time of construction or, if the aquifer is less than 20 feet thick, is as near to the bottom of the aquifer as is practical and the water level of the aquifer has declined to a level that the pump will no longer deliver sufficient water for the well owner’s needs”

Depending on the characteristics of the Bad-Cheyenne aquifer at the proposed well sites, and the distances involved, some existing well owners may need to lower their pumps to accommodate possible reduction of head pressure. There is a reasonable probability that any well interference experienced in adequate domestic wells will not be adverse or unlawful.

CONCLUSIONS:

1. Water Permit Application No. 8164-3-3 proposes to withdraw groundwater at a maximum diversion rate of 5.33 cfs from three wells to be completed into the Bad-Cheyenne aquifer for the irrigation of 650 acres.
2. Water Permit Application No. 8164-3-3 proposes to withdraw groundwater at a maximum diversion rate of 5.33 cfs from three wells to be completed into the Bad-Cheyenne aquifer for the irrigation of 650 acres.
3. There is a reasonable probability that unappropriated water is available from the Bad-Cheyenne aquifer to supply the proposed appropriation.
4. There is a reasonable probability that any possible well inference due to the proposed appropriation will not adversely or unlawfully impair existing users.



Ken Buhler
SD DENR-Water Rights Program

REFERENCES:

- Hamilton, L.J. 1985. Water Resources of Aurora and Jerauld Counties, South Dakota, U.S. Geological Survey Water-Resources Investigations Report 84-4030. Vermillion, South Dakota.
- Hedges, L.S., Burch, S.L., Iles, D.L., Barari, R.A., Schoon, R.A., 1982, Evaluation of Ground-Water Resources Eastern South Dakota and Upper Big Sioux River, South Dakota and Iowa, Task 1: Bedrock Topography and Distribution, Task 2: Extent of Aquifers, Task 3: Ground-Water Storage, Task 4: Computerized Data Base, Final Report; U.S. Army Corps of Engineers Contract DACW 45-80-C-0185
- Jensen, A.R., 2005, First Occurrence of Aquifer Materials in Jerauld County, South Dakota, South Dakota DENR-Geological Survey Aquifer Materials Map 21, Scale: 1:100,000
- Koch, N.C. 1980. Geology and Water Resources of Hand and Hyde Counties, South Dakota; Part II: Water Resources: South Dakota Geological Survey Bulletin 28, SD DENR-Geological Survey, Vermillion, South Dakota.
- Schulz, L.D., 2003, First Occurrence of Aquifer Materials in Beadle County, South Dakota: South Dakota Geological Survey Aquifer Materials Map 15, Scale: 1:100,000
- Water Rights. 2015a. Observation Well Files, SD DENR-Water Rights Program, Joe Foss Bldg., Pierre, South Dakota.

Water Rights. 2015b. Water Right/Permit Files, SD DENR-Water Rights Program, Joe Foss Bldg., Pierre, South Dakota.

Water Rights. 2015c. Water Well Completion Reports, SD DENR-Water Rights Program, Joe Foss Bldg., Pierre, South Dakota.