Recommended Aquifer Test Procedures
Guidelines to accompany Section B: Water Well Permits of the Lower Platte South NRD Groundwater Rules and Regulations for Class 2 and 4 Permits (and Class 3 Permits if within 600 feet of a well with higher preference of use).

Hydraulic parameter information that should be reported:

- ☐ Geologic logs and well construction information for the pumping and observation wells
- ☐ Measurement of static water level in the pumping well and observation well prior to pumping
- ☐ Saturated thickness of the aquifer at the pumping well
- ☐ Pumping rate(s) during the constant rate aquifer test and depth to pump intake
- ☐ All water level data from the pumping and observation wells during the pumping and recovery portion of the test.
- ☐ Graphical presentation of the data as appropriate
- ☐ Transmissivity, hydraulic conductivity, and storativity or specific yield calculations for the producing aquifer
- ☐ Assessment of aquifer classification: unconfined, semi-confined, or confined
- ☐ Assessment of aquifer boundaries such as surface water bodies or no-flow boundaries
- ☐ Radius of influence calculation at t=24 hours
- ☐ Table listing:
  - the registration number of all registered wells within the radius of influence of the proposed new well
  - the estimated drawdown at those wells due to pumping the proposed new well
  - the depth to the pump intake in the existing registered wells
- ☐ Summary of existing groundwater uses in the area
- ☐ For Class 2 and Class 4 Permits: A discussion of the potential 20 year impact to the aquifer if the well is installed. The discussion should include:
  - Calculation of the volume of water pumped: pumping capacity*time pumped per year*20 years
  - Future plans to increase the volume pumped or amount of time the well is pumped
  - Potential for the surrounding property to be rezoned or more heavily developed
  - Likelihood that the water level in the aquifer will return to static between pumping intervals
  - Projected drawdown at the pumping well and area of influence after 20 years of operation. Provide a list of assumptions used to make the projection.

Aquifer Test Set-up

General

- A licensed geologist or professional engineer must stamp the aquifer test report. When selecting a professional, confirm that he or she has previous experience designing, performing and analyzing aquifer tests.
- Construct and develop an observation well that is screened in the same aquifer as the pumping well. Development involves pumping (and often times surging over the screened interval) until the discharged water has no visible silt and sand. Development increases the connection of the observation well to the aquifer.
- The observation well should be close enough to the pumping well so that drawdown is observed in the observation well, but not directly next to the pumping well. The actual distance depends on the site specific geology and is at the discretion of the professional geologist/engineer designing the test. A recommend range of distances is 50 to 100 feet away from the pumping well.

- If the pumping rate necessary to induce drawdown in the observation well while not dewatering the pumping well cannot be reliably estimated, a variable rate pump should be installed in the pumping well and a step test performed. A step test involves pumping at various rates starting at a relatively low rate and systematically increasing the pumping rate. At least three steps are recommended, each lasting for at least one hour. Allow the water level in the observation well to recover to 100% of static before performing the constant rate aquifer test. Step test data cannot be used to estimate aquifer properties of transmissivity and storativity/specific yield, but it can be used to determine the design pumping capacity for the permanent pump.

Two days before test

- Install a transducer in the observation well.
- Sync the transducer clock to the laptop/PDA clock
- Set the transducer to log on at least 1-hour increments to document static water level.
- Install a pump in the pumping well. The pump should be set to pump at 100% of the design rate and induce drawdown in the observation well but should not dewater the pumping well.

Day before the test (at least)

- Install a backflow valve on the pumping well (important for the recovery portion of the test).
- Lay out discharge piping to the discharge point. The discharge point should not be between the pumping well and the observation well or the pumping well and a known groundwater flow boundary.
- Install a totalizing flow meter on the discharge pipe 10 pipe diameters from the well head that reads in gallons/minute. A data logging flow meter is ideal, but not essential.
- Installing a valve ½ to ¾ open in the discharge line to minimize flow variations produced by the pump is suggested, but not essential.

Day of Constant Rate Test

- Sync wristwatches/stopwatches to the transducer clock.
- Record the static water level in the pumping well using a manual water level tape.
- Download the background data from the transducer.
- Reprogram the transducer for a start time and collection interval. Ideally, the transducer will collect data on a logarithmic time scale. If it does, a recommended collection interval for the end of the test is 1 hour. The transducer will automatically collect data on faster increments at the start of the test. If the transducer does not have logarithmic capabilities, set the collection increment to a short enough time increment to document the early time drawdown data. A suggested interval is 30 seconds.
- Station a person with a manual water level tape at the observation well to collect manual depth to water measurements for analysis in case the transducer malfunctions or the data is erased. Manual data may be collected less frequently than transducer data. Recommended intervals are:

Time since pumping started	Time intervals
0 to 5 minutes	every 30 seconds
5 to 15 minutes	1 minute
15 minutes to 1 hour	5 minutes
1 hour to 5 hours	30 minutes
5+ hours	1 hour

- Turn on the pump at the exact time the transducer is scheduled to start. The pump should be set to pump at 100% of the design rate. Try to maintain the pumping rate to within 10% variation so that the water level changes recorded in the observation well are a function of aquifer properties and not changing pumping rates. If the pumping rate varies by more than 10%, carefully document the rates and use the recharge data to calculate aquifer properties.
- Periodically record the discharge rate and total volume at the flow meter. A recommended interval is every 15 minutes for the first two hours of the test, and hourly thereafter.
- Periodically record the depth to water in the pumping well using a manual water level tape. A recommended interval is every 15 minutes for the first two hours of the test, and hourly thereafter.
- Allow the test to continue for 24-hours. If the transducers are confirmed to be working, manual measurements may be omitted overnight.

Day of Constant Rate Recovery

- After ~23 hours, download the transducer data to see if the depth to water in the observation well is stabilized. If the depth to water in the observation well is stabilized and the transducer can collect data on logarithmic scale, reset the transducer to start a new file at the top of the next hour. If the transducer is collecting data on a frequent (~30 second) interval linearly, allow the transducer to keep recording.
- Just before the 24 hour mark, collect water quality samples for analysis of sodium, chloride and total dissolved solids.
- If the drawdown in the observation well has not stabilized, keep pumping until stabilization has occurred.
- Record the discharge rate, depth to water in the pumping well, and depth to water in the observation well at as nearly the same time as possible. This information will be used to calculate the radius of influence.
- When stabilization has occurred (hopefully at 24 hours), shut off the pump at the top of an hour. Leave the pump in the well until after the recharge period is complete.
- Collect early time recovery data from the observation and pumping wells at the same time increments as in the early time pumping data. Recovery data can often times be better quality than pumping data because the recharge data is not subject to changes in the pumping rate (the system naturally recharges at the average rate that pumping occurred). Transducer data should again be verified with manual water level tape measurements.
- Collect recovery water level measurements until the water level in the observation well has recovered to 95% of the static water level (at least). This task will likely require another 24 hours.