General Aquifer Test Procedures

These guidelines accompany the Lower Platte South NRD's Ground Water Rules and Regulations (Revised Effective Date: 1/1/2017) Section C: Water Well Permits. Typically, they will apply to Class 2 and 4 Permits but may apply to Class 1 Permits if required by the District, and Class 3 Permits if the proposed well is within 600 feet of a well with higher preference of use.

For the purposes of LPSNRD's Ground Water Rules and Regulations, an aquifer test may be required to estimate aquifer parameters in order to determine the effect of a permitted well on preexisting wells in the vicinity, and to demonstrate that an adequate ground water supply is present for the well to be permitted. Aquifer parameters such as transmissivity, hydraulic conductivity, storativity/specific yield, etc. can generally be adequately estimated using a single well drawdown/recovery test (i.e. using drawdown and recovery observations in the production well) by constant-rate pumping, slug testing, or step-drawdown tests; numerous software programs are available for these estimates. If further refinements of these parameters are necessary, installation of one or more dedicated observation well(s) or utilization of appropriate nearby existing wells can be considered.

General

A licensed geologist or professional engineer must oversee the aquifer test and stamp the aquifer test report. When selecting a professional, confirm that he or she has previous experience designing, performing and analyzing aquifer tests.

If an additional observation well is used, it 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. A recommended range of distances is 50 to 100 feet away from the pumping well.

If the desired pumping rate produces significant dewatering in the pumping well (i.e. if the pumping water level is within the screened interval), 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. Step test data can then be used to determine the design pumping capacity for the permanent pump. Similarly, if the professional overseeing the aquifer test has experience in slug-testing, that method can be used if appropriate.

Hydraulic parameter information that should be reported:

- Geologic log and well construction information for the well
- Measurement of static water level in the well prior to pumping
- Saturated thickness of the aquifer at the well
- Pumping rate(s) during the constant rate aquifer test and depth to pump intake
- All water level data from the well 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 and location 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
- Keep in mind existing LPSNRD requirement that no well requiring a LPSNRD permit can be located within 600' of a preexisting well of higher preference of use except for well(s) owned by the same owner or properly permitted replacement wells.

- Summary of existing ground water 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 X time pumped per year X 20 years
  - Future plans to increase the volume pumped or amount of time the well is pumped
  - 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.

Procedure Checklist-Traditional Drawdown/Recovery Test

- Document static water level in the pumping well and observation well (if used). This can most easily be done by installing a transducer and setting it to take readings on 1-hour (or less) intervals for at least 24 hours prior to the aquifer test. If this is not done, take multiple manual water levels during the period at least 24 hours prior to the aquifer test.
- 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 (if used) but should not dewater the pumping well.
- 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 that reads in gallons/minute on the discharge pipe 10 pipe diameters from the well head. 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.
- As noted above, water levels, drawdown and recovery in the pumping well and observation well (if used) should be documented by installation of a transducer. 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.

Drawdown Test

- At the beginning of the aquifer test, ensure that the pump and the transducer start at the same time. 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 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.
- Provide documentation of constant pumping rate. Most commonly, this should be done by periodically recording the discharge rate and total volume at the flow meter.
- Allow the test to continue for 24 hours, periodically ensuring that the pump and transducer(s) are functioning correctly.

Recovery Test/Water Quality Sampling

- After ~23 hours, download the transducer data to see if the depth to water has stabilized. If the depth to water has 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 has not stabilized, keep pumping until stabilization has occurred.
- 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