http://www.ext.nodak.edu/extnews/spouts/

water spouts

No. 233 OCTOBER 2007

Mark Your Calendar
for these Irrigation Workshops

- **Dec. 6, 2007 – Bismarck Best Western Ramkota Hotel**
  This workshop will be in conjunction with the North Dakota Water Users annual convention. The Missouri Slope Irrigation Development Association, NDSU Extension Service and North Dakota Water Users sponsor this workshop. It will include an irrigation exposition where suppliers demonstrate their products and services. Topics include an update on Environmental Quality Incentives Program, U.S. Department of Agriculture Rural Development Grant Program, Web-based irrigation scheduling, irrigation economics, the North Dakota Agricultural Weather Network (NDAWN), managing fertilizer requirements, nontraditional irrigated crops, strip tillage, new developments in wireless controls and variable-frequency drives, livestock feed and feed alternatives, and growing irrigated and dryland corn.

- **Dec. 18, 2007 – Carrington Research Extension Center**
  This workshop is for new or potential irrigators. Topics to be covered include water permits, water quantity and quality, economics, suitable soils, irrigation water management and irrigation equipment. The contact is Mike Liane, (701) 662-1364, mliane@ndsuext.nodak.edu.

- **Dec. 19, 2007 – Ernie French Building, Williston Research Extension Center**
  This workshop will be for existing irrigators in the MonDak region with topics that are specific to this area. The NDSU Extension Service will host this workshop. Topics will include fertility management on alternative crops, profitability of alternative crops, irrigating alternative crops, Web-based irrigation scheduling, and benefits of NDAWN and USDA Rural Development programs. The contact person is Chet Hill, Extension area value-added specialist, Williston, (701) 774-4315, chill@ndsuext.nodak.edu.

More information about the workshops will be mailed in November. If you have any suggestions for topics to cover at the workshops, please give me a call or send an e-mail or letter.

Tom Scherer (701) 231-7239
NDSU Extension Agricultural Engineer
Thomas.Scherer@ndsu.edu

NDSU
Extension Service
North Dakota State University

Estimating the Amount of Pumped Water

If you have an irrigation water permit, sometime this winter you will receive a postcard from the North Dakota State Water Commission requesting a report of the amount of water your irrigation system(s) used this past growing season. If you have a working flow meter with a volume totalizer, filling out the postcard will be easy. The volume totalizer is a counter similar to the odometer in a car. Meters record the volume in hundreds or thousands of gallons. Determining which one usually is easy because the manufacturer will show zeros to the right of the counter. If hundreds of gallons are recorded, then the meter will have two extra zeros; it will have three zeros if it records thousands of gallons.

If you wrote down the numbers on the volume totalizer at the start of the season, then all you need to do is read the meter again and subtract the numbers to obtain the volume pumped. You can report water use in either gallons or acre-feet. Just remember, an acre-foot of water covers an acre 1 foot deep and is equal to 325,800 gallons. An acre-inch is equal to 27,150 gallons.

If you do not have a working flow meter, then you will have to estimate the amount of pumped water. For a center-pivot system, you can calculate an estimate if you use the hour meter in the pivot control panel and wrote down what it was reading at the beginning of the growing season. Subtract the current reading from the previous reading to get the number of hours the pivot operated this year. You then need to know the approximate flow rate to your center pivot. This can be obtained from the center pivot sprinkler chart. Now that you know the flow rate, use the following formula to calculate the acre-feet of water that were pumped:

$$\text{Volume pumped} = (\text{hours of operation} \times \text{gallons per minute}) / 5{,}430$$

For example, say your center pivot ran for 895 hours and the sprinkler flow rate is 800 gallons per minute. Then the volume pumped is approximately:

$$(895 \times 800) / 5{,}430 = 131.9 \text{ acre-feet}$$

You also can use this method if you have a diesel or gasoline engine with an hour meter or have an hour meter in the pump's electrical control panel and know the average flow rate being pumped.

If your system does not have a water meter or an hour meter, estimating the volume pumped can be difficult. However, for electrically driven water pumps, you can obtain an estimate of the number of hours of operation using the electric meter.

Modern electric meters not only record the total energy use in kilowatt-hours (kwh), but also other parameters such as peak kwh and average kwh use. You can estimate total hours the pump was operated by dividing the total used during the growing season by the average kwh. The seasonal total and average electric draw for each meter can be obtained from your electrical supplier.

For instance, say your pumping plant used a total of 43,937 kwh and the average draw was 43 kwh. Dividing 43,937 by 43 shows the pump operated for 1,021.8 hours. Again, you need an estimate of the flow rate to calculate the total volume used. The calculated hours will be correct even if the electrical meter is recording the electricity used by the pump and a center pivot or if it is recording electrical use of just the pump. The extra electrical load of the center pivot is recorded in both the average draw and the total so it doesn't affect the calculated hours of operation.

Estimating the volume of pumped water becomes very difficult when irrigation systems have one pump that supplies multiple pivots or multiple wells that supply a single or multiple center pivots. If you have difficulty estimating pumped water volume, consider installing a flow meter, or if you have a center pivot, recording the reading on the hour meter. You have other ways of estimating the volume of pumped water from electrical use, but they involve a few more calculations. Contact me if you have questions.

Tom Scherer (701) 231-7239
NDSU Agricultural Engineer
Thomas.Scherer@ndsu.edu

Well Development is Important

I often hear irrigators say they don't want to pay for the cost of development because it doesn't help with well performance. If the well isn't developed properly, that might be a true statement. However, if the well is properly developed at the time of construction, it will have less drawdown, save on pumping costs and have less trouble supplying water during high water-use periods. As energy costs increase, anything that reduces the drawdown in a well will pay big dividends in the future.

A well provides access to the aquifer where the water is located. During pumping, if a well is functioning properly, the water from the aquifer will enter the well screen with the lowest amount of restriction possible. Anything that restricts the flow of water into the well can affect energy costs and flow rate by increasing the drawdown.

The drawdown is the difference between the static water level and the pumping water level, Figure 1. From a hydraulic point of view, drawdown is the head (pressure) required for water to flow into the well. The greatest amount of drawdown occurs within a few feet of the well, where the velocity is the greatest.

Most irrigation wells are constructed with a rotary drilling rig that uses a high-viscosity fluid (often called "drilling mud") to keep the borehole open during the drilling process. Although necessary, the drilling mud seals the borehole and often penetrates into the surrounding aquifer formation. In addition to the drilling mud, the rotary drilling process also smears the borehole surface that compacts the natural material around the borehole. The most common drilling mud uses bentonite, a naturally occurring clay mined in Montana and Wyoming. If left in place after construction, the drilling mud will seal part of the aquifer and increase the drawdown.

After the casing and screen are set in the borehole, removing the drilling mud left in the aquifer formation is very important, Figure 2. This process is called well development. It is even more important with gravel-packed wells because the gravel pack is a barrier to removing the drilling mud. You have several methods for developing a well. They are, in order of effectiveness as well as cost: airlift pumping and agitation, surging and jetting. Development also is very important after a well has been rehabilitated.

Air lift pumping and agitation

Air lift pumping forces compressed air through an air line to the bottom of the well, Figure 3. As air bubbles rise, they create a surging effect that carries water and fines out of the well. Air lift pumping is alternated with short periods of no pumping, which forces water out into the formation to help break up sand bridging around the screen. Well development is effective only if the water is deep enough in the well to get the surging action. Air lifting does not work if lift to the surface is too great.

Mechanical surging

Surging alternately forces water into and out of the formation through the well screen openings, Figure 4. A pistonlike tool moves up and down in the well to create the surging action. The surging of the water through the well screen loosens the mud and fines in the borehole and draws them into the well to be removed by pumping or bailing. Surging is especially suited to cable tool drilling. While common for bridge or louvered well screens, surging is not very effective with very deep wells (in excess of 200 feet) or those with multiple screens.

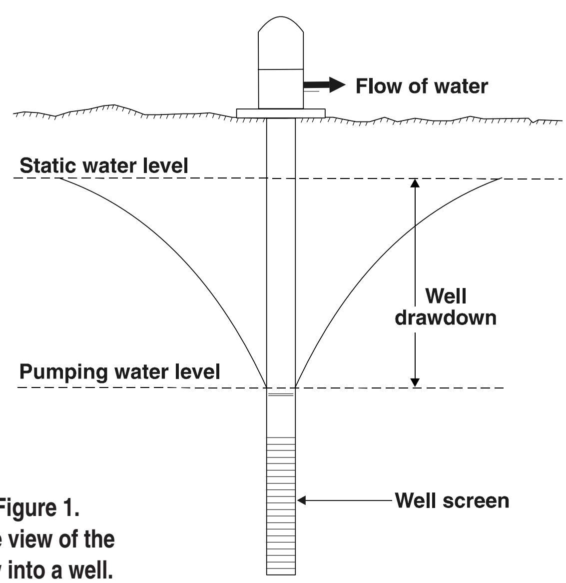


Figure 1. Side view of the flow into a well.

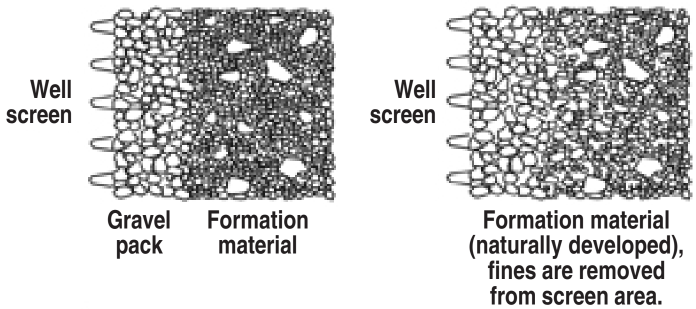


Figure 2. Side view of the materials just outside the well screen for a naturally developed and gravel pack well.

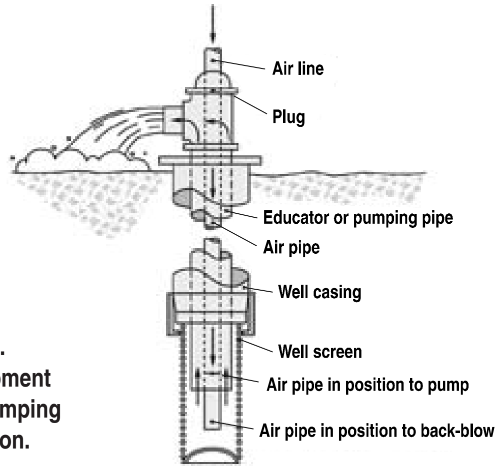


Figure 3. Well development with air lift pumping and agitation.

Jetting

The best well development method is high-pressure water jetting with simultaneous air lift pumping, Figure 5. High-velocity water jets through the screen and gravel pack into the formation to loosen and break down the fine materials. The jetting tool rotates slowly as it is moved up and down inside the well screen. Air lift pumping removes the loosened sand and mud as they enter the well screen. The jet stream can be directed at any part of the formation around the well for selective development. Cage-wound screen is best for jetting because its design allows the jet to impinge directly on the gravel pack or borehole. Well screens that use louvered or bridge openings do not respond to this type of development because the opening design interferes with the jet of water. Jetting often is the most costly development method.

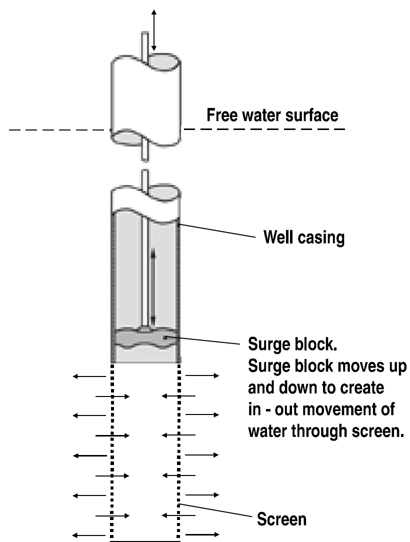


Figure 4. Well development by mechanical surging with a surge block.

Well Development Research

In the late 1970s, a well development research project was conducted at a research farm in Staples, Minn. The project had 10 wells constructed using different types of screens, drilling fluids and design parameters. After construction, each of the wells was developed first by overpumping. Then they were test pumped for 24 hours. Then each was developed by mechanical surging followed by another 24-hour test pump at the same flow rate as the first test pump. Then each was developed with water jetting and another 24-hour test pump was performed. The results for the properly constructed wells showed consistent improvement. For example, well 5 was pumped at 183 gallons per minute (gpm) for all three 24-hour pumps tests. The drawdown after overpumping was 12.1 feet, after surging it was 7.2 feet and after jetting it was 6.7 feet. Development cut the drawdown almost in half.

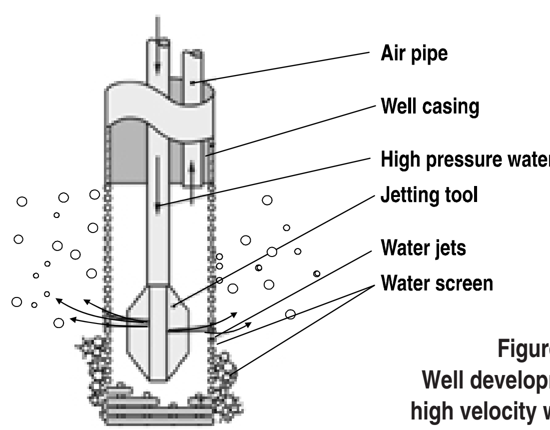
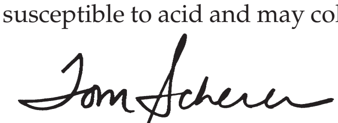


Figure 5. Well development using high velocity water jetting.

Redevelopment of Older Wells

As water flows into a well, it carries minerals with it. With use, these minerals can build up on the formation materials near the well screen because that is where the water velocity is the greatest. This may sound counter-intuitive, but some minerals will precipitate at the high velocities. Through time, the deposition of minerals can encrust the screen and formation, which increases the resistance to flow of water into the well. By adding a weak acid to the well, combined with agitation, these mineral deposits can be dissolved and removed.

By combining water jetting with acid, the well can be redeveloped and often can be brought back to almost new production. **Caution**: This method should be used only on stainless steel and plastic screen. Some older, iron screens are susceptible to acid and may collapse.



Tom Scherer (701) 231-7239
NDSU Extension Agricultural Engineer
Thomas.Scherer@ndsu.edu

North Dakota State University
Extension Service
PO Box 5437
Fargo ND 58105-5437

Non-Profit Org.
U.S. Postage
Paid
Permit No. 818
Fargo, N.D.

Index of 2007 Water Spouts Articles

April 2007

- Carrying Capacity of Pipes, Scherer
- Irrigated Crop Budgets Have Been Updated, Aakre
- Soil-water Compatibility Recommendations, Cihacek
- Be Safe When Starting Your Irrigation System, Scherer

May 2007

- Understanding Crop Water Availability, Scherer and Klinkebiel
- Irrigation System Maintenance and Recordkeeping, Scherer

June 2007

- Irrigation Field Day and Trade Show in Saskatchewan
- The Pressure Gage and Flow Meter – Important Tools, Scherer
- Crop Production Information on the NDSU Extension Web Site, Scherer
- Watch Your Soil Moisture – It Can Change Very Quickly, Scherer

July 2007

- Irrigated Field Day at Tappen, Secor
- Oakes Irrigation Research Site Field Day, Albus
- Irrigation Field Days in Manitoba, Tomasiewicz
- MSIDA Annual Irrigation Tour, Miller
- Devils Lake Basin Water Utilization Test Project, Steele

August 2007

- Irrigation and Onions the Focus of Final '07 Water Tour, Magstadt
- Irrigated Potato Field Day, Secor
- Potato Tour at CMCDC-Carberry in Manitoba, Tomasiewicz
- When Can You Stop Irrigating? Berglund
- Using the Irrigators' Formula for Water Management, Scherer

September 2007

- Applications for EQIP Due on Oct. 15
- Site-specific Irrigation Scheduling on the NDAWN Web Site, Scherer
- Soil Compatibility Web Site, Scherer
- Managing Center Pivot Wheel Tracks, Scherer

October 2007

- Upcoming Irrigation Workshops
- Estimating the Amount of Pumped Water, Scherer
- Well Development is Important, Scherer