water spouts

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

Mark Your Calendar for These Irrigation Workshops

- **Dec. 7, 2006 – Bismarck Best Western Ramkota Hotel**
  This workshop will be held 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. The convention will include an irrigation exposition where suppliers demonstrate their products and services.

- **January 2007 – Sidney, Mont. (details later)**
  Both Montana State University Extension and North Dakota State University Extension will host this workshop. The contact person is Chet Hill, Extension area value-added specialist, Williston, (701) 774-4315, chill@ndsuext.nodak.edu.

- **Jan. 11, 2007 – Park River**
  This workshop is being held because of the interest in irrigation in the surrounding area and Devils Lake. The contact is Mike Liane, (701) 662-1364, mliane@ndsuext.nodak.edu.

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

New Web Site to Determine Soil Compatibility for Irrigation

Irrigation increases the productivity and consistency of crop production, but not all soil is suitable for irrigation. "The North Dakota Irrigation Guide" was developed in the early 1980s as a joint project involving many government agencies to classify soils for irrigation that every agency could use. This allowed them to provide consistent information to the public.

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County Commissions, North Dakota State University and U.S. Department of Agriculture cooperating. Duane Hauck, Director, Fargo, North Dakota. Distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914. We offer our programs and facilities to all persons regardless of race, color, national origin, religion, gender, disability, age, veteran's status or sexual orientation; and are an equal opportunity institution. This publication will be made available in alternative formats for people with disabilities upon request, (701) 231-7881.

In the guide, soils were classified as irrigable, nonirrigable and conditional. Irrigable soil can be irrigated with a suitable quality of water under most circumstances. A conditional soil can be irrigated under a high degree of management that will vary, depending on the water quality and soil properties. Nonirrigable soils should not be irrigated. However, sometimes nonirrigable soils are small inclusions in a larger tract of irrigable land and may be irrigated if managed very closely.

Recently, the soil classifiers with the Natural Resources Conservation Service office in Bismarck updated the soil irrigability classifications for all soil series in North Dakota. NDSU Extension used the updated irrigability classifications, along with the digitized soil survey database, to create a Geographic Information System (GIS)-based Web site that allows you to look up the soil classification of any location in North Dakota. The Web site address is *www.ageng.ndsu.nodak.edu/irrigation/index.htm*.

On the Web site, the opening page has a map of North Dakota showing the irrigability classifications of the soil. Nonirrigable soils are shown in red, irrigable soils are shown in green and conditional soils are amber. Clicking on the GIS interactive map link will bring up a map where you can zoom into any location in the state (the download time may be a couple of minutes if you have a modem).

When you zoom in on this map, roads, aquifers and irrigation diversion points also will be displayed on the map. To zoom in or out in the view screen, use either the + or – magnifying glass icons on the left side. You also can obtain specific information about the soil in a particular location.

After you zoom in on an area about the size of a township, "Detailed Irrigability" layers will appear at the bottom of the list of items under the Layers heading on the right side. The one marked "Map East" is for the eastern half of North Dakota and the other, marked "Map West," is for the western half. If you are in the eastern half of the state, select the radio button next to the "Map East" to make it active. Then go to the left side and select the "i" icon with the black circle around it. Now you can click on any soil shown in the view screen and it will give you the name, number of acres of the soil at that location and the irrigability classification.

This Web site was designed for people interested in developing irrigation and those who want to determine the amount of irrigable soil in a particular part of the state. Check it out and e-mail me if you have any questions.

Centrifugal Pumps: Reducing Cavitation and Impeller Wear

If you are pumping from an open water source and your pump sounds as though it is pumping gravel, chances are that is due to cavitation. Cavitation is caused by water going from a liquid to a vapor state. A centrifugal pump operates by creating a partial vacuum (pressure less than atmospheric) at the inlet or "eye" of the impeller. When the vacuum at the eye of the impeller reaches the vapor pressure of water, vapor bubbles form. As the vapor bubbles pass through the vanes of the impeller, the pressure increases and the bubbles implode. Usually the implosions occur near the vanes of the impeller and knock off bits of metal. Through time, cavitation will cause the impeller to look as though it is riddled with pockmarks and holes, similar to Swiss cheese.

Cavitation will cause the following to occur:

1. The pump will sound as though it is pumping gravel.
2. The pump may vibrate excessively.
3. Vibration can cause bearings to fail and affect the motor or engine.
4. The packing gland leaks excessively and requires constant adjustment.
5. The flow rate and pressure will decrease.

Reduced flow rate can cause irrigation set times to be longer, resulting in more time to complete an irrigation cycle. It certainly will result in more energy consumption and reduced pumping plant efficiency, along with lower irrigation application efficiency.

Cavitation is serious enough to spend some time preventing it from happening. Here are some rules to follow:

1. Use a suction pipe that is at least one nominal diameter larger than the pump suction. Larger suction pipe diameters mean lower water velocity and less friction loss.
2. Place the pump as near the water source as possible.
3. Use an eccentric reducer on the pump inlet so no air is trapped at the pump inlet.
4. Do not obstruct the suction pipe with valves or constrictions. However, a foot valve in the water at the end of the suction pipe does not create problems.
5. The suction pipe should take the most direct route to the water. A straight length of pipe from the water to the pump inlet is best.
6. Use a screened inlet of sufficient area to allow water to enter freely. A small screen area will result in higher entrance velocity, which can cause vortexing, entrain air and pull more debris to the screen.

Silt, sand and rocks can cause impeller wear. If you have to pump dirty water, make a sump as long as possible to allow silt and sand to settle before the water reaches the pump intake. Screen the sump to exclude rocks and debris.

The packing gland is where the shaft from the motor or engine enters the pump at the rear of the volute case. It is there to keep the shaft reasonably watertight, cooled and lubricated. Most packing assemblies have a gland, lantern ring and packing rings. The gland needs to drip water at a steady rate when the pump is running to lubricate and cool the pump shaft. It should be checked whenever the pump is started to insure it is dripping properly. Never overtighten the gland and cut off the water flow.

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Selecting the Right Size Pipe for Irrigation

When designing or retrofitting the pipeline and fittings needed to supply water to an irrigation system, one of the key decisions is picking the proper diameter of pipe for the desired flow rate. The best pipe size is not always the one with the lowest initial cost. With rising energy costs, the friction loss in the pipe at a given flow rate can affect the long-term cost of the pipeline. The objective of selecting the right size pipe is to minimize the sum of the initial capital investment and the annual energy costs.

In general, the cost to install an irrigation pipeline consists of capital costs and the annual operating, or variable, cost. The capital cost is determined by the installed purchase price of the pipe and fittings, along with the service life of the pipe. PVC pipe installed below ground should last at least 40 years. The annual cost of the pipe can be found by amortizing the purchase price over the service life of the pipe and fittings. Amortization is similar to repayments on a loan. Actually, if a loan were taken out to purchase the pipe and fittings, the annual cost would be the loan repayment.

The annual operating cost of a pipeline depends on the number of hours pumping water and the friction loss in the pipeline at the design flow rate. At a given flow rate, smaller diameter pipe and fittings will have greater friction loss than larger diameter pipe. The friction loss depends on the pipe diameter, pipe material, length of pipeline and the flow rate passing through the pipeline.

An example of using economics and engineering to select an appropriate pipe diameter is shown in Figure 1. The example uses the following conditions:

1. Flow rate is 800 gallons per minute.
2. The electric motor and pump run for 900 hours during the growing season.
3. The cost of electricity is 7 cents per kilowatt hour (includes annual and demand charges).
4. The length of the PVC pipeline is 1,500 feet.
5. Pumping plant wire to water efficiency is 65 percent.
6. Life expectancy of the buried PVC pipe is 40 years.
7. The interest rate is 8 percent.

From figure 1, you can see that both 8- and 10-inch-diameter pipe would be economical choices for this example. Pipe less than 8 inches in diameter obviously has much greater energy costs, and pipe larger than 10 inches in diameter has higher investment costs. But which diameter pipe would you choose for this example?

If you expect energy costs to increase in the future, as the price of diesel fuel has in recent years, and you could afford the higher capital investment costs, the 10-inch-diameter pipe would be the best choice. Additionally, the 10-inch pipe would reduce energy costs if you decided to extend the pipeline to an additional center pivot in the future. However, if you expect energy costs to stay relatively constant in the next few years, as electrical costs have done, then the 8-inch-diameter pipe may be the best choice.

Table 1. Optimal pipe diameters for various flow rates.

Flow Rate	Most Economical Pipe Diameter
(gallons per minute)	(inches)
200	4
400	6 or 8
600	8
800	8 or 10
1,000	10
1,200	10
1,400	10 or 12
1,600	10 or 12

I did a survey of irrigation dealers to get the current installation costs for different diameter of PVC pipe used in this example. However, these costs can change because the price of PVC pipe can vary significantly, depending on the price of petroleum, availability of resins, production capacity of pipe manufacturers and transportation costs.

So many variables influence the economic selection of pipe that I created a spreadsheet in Microsoft Excel to explore how they affect pipe size selection. In general, the two most important factors affecting the most economical pipe selection are the flow rate and cost of energy for pumping. I used the spreadsheet to generate the most economical pipe diameters based on capital investment costs and pumping energy costs. Using the pipe-sizing spreadsheet, the optimal pipe sizes for various flow rates are shown in Table 1. If you would like a copy of the spreadsheet to explore pipe-sizing options for yourself, contact me.

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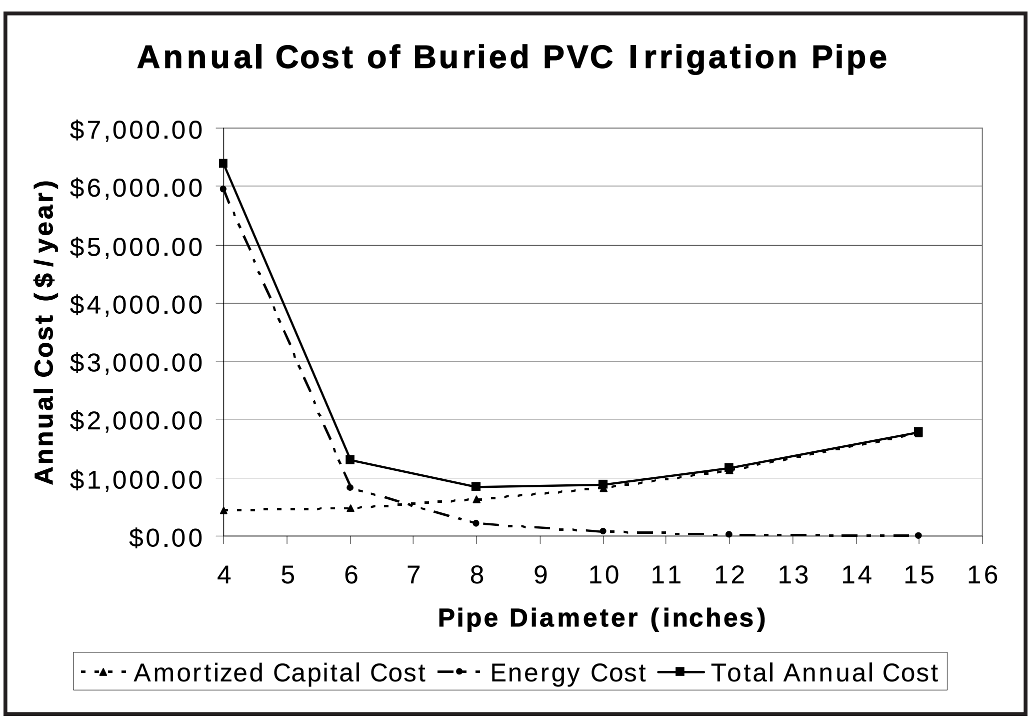

Figure 1.
Annual irrigation pipeline cost for various diameter pipe using the example conditions in the text. Costs will change if the flow rate or interest rates change.

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Energy Estimator Tools

Although irrigation rates for electricity have stayed about the same, those irrigators who use diesel have seen their pumping costs increase dramatically. This summer was quite dry, requiring increased pumping time to meet crop water demands.

The Natural Resources Conservation Service (NRCS) has developed three online energy calculator tools designed to help farmers analyze their energy use so they can reduce their overall energy requirements. One of the tools can be used to assess the irrigation pumping costs. These energy estimator tools can be found at *http://energytools.sc.egov.usda.gov* .

These tools are designed to increase energy awareness in agriculture, and help farmers and ranchers identify where they can reduce energy costs. The results the energy estimator tools generate are based on NRCS models and illustrate the magnitude of savings for different scenarios.

The energy estimator tool for irrigation enables you to estimate the potential savings associated with pumping water for irrigation. NRCS technical specialists developed this model to integrate general technical information for crops grown in a specific region, based on energy prices and pumping requirements. This tool does not provide field-specific recommendations.

The 2003 Farm and Ranch irrigation survey (*www.nass.usda.gov/census/census02/fris/fris03.htm)* reports that about 27 million acres of irrigated crops use sprinkler irrigation. About 80 percent of those acres use center pivot systems. The conversion of high-pressure systems to low-pressure systems could save about $41 per acre in energy costs each year. If the acres under medium pressure were converted to low pressure, the annual energy savings per acre could be around $9 per acre. Diesel-powered pumps are used to supply water to about 10 million acres of irrigated land. A 10 percent improvement in water use efficiency could reduce diesel fuel consumption by 8 gallons per acre.

The other energy estimators at this Web site are the tillage energy estimator that will calculate the diesel fuel usage and costs associated with various tillage practices. The nitrogen energy estimator helps identify potential nitrogen cost savings for your cropping pattern.

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