Greetings

This is the beginning of the 45th year Water Spouts has been published and distributed to the irrigators of North Dakota. In 1973, when the first issue of Water Spouts was published, North Dakota had about 73,000 irrigated acres. During the 2016 growing season, more than 306,000 acres were irrigated. As the 2017 growing season begins, we seem to be having a “normal” growing year. The planting dates and amount of planted acres appear to be following the five-year averages.

Below is a graph showing the acres of the top irrigated crops every other year from 2006 to 2016. The U.S. Department of Agriculture’s Farm Service Agency compiled the irrigated acres for each crop. Note the sharp increase in irrigated soybean acres but the relative stability of the acres for the other crops. You almost can tell which crop had the best price and economic return based on the number of irrigated acres each year.

Have a great growing season and remember to take care of your irrigation system.

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Irrigation Scheduling Spreadsheet for North Dakota and Minnesota

With a new growing season upon us, you soon will need to plan how to manage irrigation water to optimize crop production and minimize losses of water and nutrients.

Irrigation scheduling is the process of determining how much and when to apply water to crops. Irrigation scheduling tools available to farmers in North Dakota and Minnesota include:

- Each state’s bulletin, “Irrigation Scheduling by the Checkbook Method”
- The “Irrigation Scheduler” application on the North Dakota Agricultural Weather Network (NDAWN) website
- Crop water use tables and maps on the NDAWN website
- A spreadsheet version of the “Checkbook Method” publications

Links to these resources are at the end of this article.

The irrigation scheduling spreadsheet was introduced in the June 2011 issue of Water Spouts. Updates since then include the addition to the charts of a scroll bar chart and management-allowed depletion lines, updates in the users manual, and various editorial changes to improve the clarity of the spreadsheet and users manual.

The spreadsheet uses look-up functions to retrieve water use or evapotranspiration (ET) estimates for the following crops in each state:

<table>
<thead>
<tr>
<th>North Dakota Crops</th>
<th>Minnesota Crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>Alfalfa</td>
</tr>
<tr>
<td>Barley</td>
<td>Corn</td>
</tr>
<tr>
<td>Corn</td>
<td>Soybeans</td>
</tr>
<tr>
<td>Pinto beans</td>
<td>Field beans</td>
</tr>
<tr>
<td>Potatoes</td>
<td>Potatoes</td>
</tr>
<tr>
<td>Soybeans</td>
<td>Spring wheat</td>
</tr>
<tr>
<td>Sugar beets</td>
<td>Sugar beets</td>
</tr>
<tr>
<td>Sunflowers</td>
<td>Any other crops at full canopy</td>
</tr>
<tr>
<td>Spring wheat</td>
<td></td>
</tr>
</tbody>
</table>

The user needs to supply the following inputs for the spreadsheet:

- Daily maximum air temperature
- On-site irrigation and rainfall dates and amounts
- Soil texture for the profile at the location of interest
- Crop type and emergence date
- Periodic in-season corrections to the soil water deficit

The spreadsheet calculates the following items:

- Weeks past emergence
- Evapotranspiration
- Soil water deficit
- Water losses to deep percolation
- Root zone depth advance through time
- Available water-holding capacity of the soil to the current root zone depth
- Cumulative totals of ET, rain, irrigation and water losses

The soil water deficit is calculated two ways:

1) as a depth equivalent of rainfall to indicate the amount of irrigation needed to refill the soil profile and
2) as a percent of depletion of available soil water to indicate the dates on which irrigation should be applied. Users can see all the formulas; the spreadsheet contains no macros.

The spreadsheet can be used with forecasted weather data to examine the effects of different scenarios of expected daily maximum air temperatures, irrigation dates and irrigation amounts on the soil water deficit several days into the future. It contains charts of soil water deficit, rainfall and irrigation vs. time.

One of the charts is for the full growing season and the other is a user-adjustable chart that can span a week, two weeks (as shown in Figure 1), a month or another user-specified time interval. The worksheets or spreadsheet file can be copied easily for use with multiple locations within a field or multiple fields and crops. The file can be saved as a record of irrigations applied to a particular field each year.

The spreadsheet has the advantage of not requiring an internet connection, but this comes with the disadvantage of not automatically retrieving weather and soils data from online sources as is done by the “Irrigation Scheduler” application on the NDAWN website.
**Links to Irrigation Scheduling Resources**

Excel spreadsheet file, users manual, technical article and more:

www.ag.ndsu.edu/extension-aben/irrigation/irrigation-scheduling

Checkbook bulletin for Minnesota:

www.extension.umn.edu/agriculture/irrigation/irrigation-management/irrigation-scheduling-checkbook-method/

North Dakota Agricultural Weather Network:

https://ndawn.ndsu.nodak.edu/

Click on the Applications link on the left-hand side of the NDAWN home page to access the Crop Water Use tables and maps and the “Irrigation Scheduler” application.

Best wishes for a successful growing season.

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A Common Question From Irrigation Permit Holders
Here is a common question from irrigation permit holders:

"My permit is approved for a volume to provide 18 inches per acre, but I only use half. Can I put up a new pivot and double my acreage?"

Staff of the Water Appropriations Division of the state engineer’s office frequently hear this question. The short answer is “no.”

Irrigation permits are issued based on acreage, not water quantity, and the annual volume of water approved is a maximum amount that can be used, but not exceeded, in rare drought conditions. Appropriation division aquifer management strategy assumes that water permit holders will be efficient and have lower irrigation use in most years.

Statewide Water Use Trends
The division has been keeping track of annual water use for irrigation since 1977. The statewide average inches of water applied per acre decreased fairly steadily from a high of 16 inches in 1980 to a low of 6.8 inches in 1993. Since 1993, annual irrigation water use generally has fluctuated between 8 and 10 inches. The decline from pre- to post-1993 reflects a wet period in much of the irrigated portions of the state and increased efficiency of irrigation systems.

Why Expansion of Acreage is Not Allowed
North Dakota water rights are administered under the prior appropriation system. Beneficial use of water is the basis, measure and limit of the right to use water in the state. A water permit is issued for the amount of water that can be used beneficially for the purpose stated in the permit application.

Each type of water use has a standard for determining how much water can be put to beneficial use. Irrigation permits are issued for the number of acres to be irrigated. The allocation is the volume of water required to fully irrigate those acres in a drought year. Determination of how many inches of water per acre are required in a drought year can be based on location, soil type, irrigation type, crop type, etc.

The state engineer is limited to issuing permits for no more water than can be used beneficially, specifically up to 24 inches per acre. For limited circumstances up to 36 inches per acre can be allowed. Most irrigation permits are approved for 12 to 18 inches of water per acre of maximum drought-year use.

When irrigation permit applications are being reviewed, division hydrologists evaluate the effects on existing appropriators and the sustainability of the water source as a whole. Hydrologists examine the potential seasonal interference for existing well owners and the long-term effects of water withdrawal. Then they project the effects caused by average annual use and use in droughts.

Under average annual use scenarios, irrigators are using less water than the maximum amount allocated in their permits and are expected to do so. Hydrologists assume irrigators will irrigate efficiently and not waste water.

New appropriations are recommended to the state engineer for approval when the effects are determined to be acceptable under average annual use scenarios and short-term dry or drought conditions. What is important for irrigators to understand is that in long-term extreme or possibly unforeseen drought conditions, permitted water use may need to be curtailed using the prior appropriation system.

Allowing an irrigator to irrigate more acres than permitted to use the maximum dry-case volume of water approved would undercut the basis for issuance of the permit and dramatically increase, possibly double, the water use under the permit each year. The average annual use would exceed the amount accounted for when the permit was issued. If this
occurs for multiple permits on an aquiferwide basis, it would cause irrigation within the aquifer to become unsustainable.

Use by junior permit holders eventually would be curtailed because of the increased use by senior appropriators, who effectively would be cutting in line in the prior appropriation system with their additional irrigation use, which was not accounted for in the original water permit evaluation.

In addition, if irrigators expand acreage to use the full volume of water approved under their permit in an average year and an unexpected drought occurs, they strongly will be tempted to apply more water than is approved to save their crops. This would put them in violation of state law and would cause further damage to aquifer sustainability.

The Takeaway
Irrigators must understand the assumptions underlying the system by which their water rights are administered. Irrigation permits are issued based on irrigated acres, with the assumption that much less water than the maximum approved volume will be used on a year-to-year basis. Disregarding these assumptions and changing the system to allow increases in acreage would threaten the sustainability of state’s groundwater sources and create an incentive for permit holders to exceed their water rights in drought events.

For more information on water permits and the Water Appropriations Division, see the Office of the State Engineer website:


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Starting the Irrigation System: A Checklist

- Make sure the main breaker is turned off, then open and check all electrical control panels and motor openings for damage, especially from rodents, before starting the irrigation system.
- Measure and record the static water level in all wells.
- Visually inspect the piping system, especially above-ground pipe.
- Check all air-release valves to make sure they are working.
- Fill pipelines slowly; make sure all the air is out of the system.
- Replace broken or old pressure gauges.
- Walk along the center pivot and check the sprinkler system for damage.
- Make sure all portable aluminum or PVC pipe sections have gaskets installed.
- Check gearboxes on center pivot towers for water accumulation. Drain water and replace with oil.
- Check the tire pressure on center pivots.
- With the center pivot running, visually check each sprinkler head to make sure it is working properly.

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