

Planning To Irrigate: A CHECKLIST

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Installing an irrigation system on a piece of land requires a great deal of planning and a significant financial investment. Before any irrigation equipment, including drilling the production well, can be placed on the land you will need a water permit from the North Dakota State Department of Water Resources.

On most farms, the number of irrigated acres is usually much less than the dryland acreage. Therefore, irrigation must be integrated into the total farm enterprise. Irrigation requires intensive fertility management, improved weed and insect control, timely identification of disease problems and above all accurate record keeping. Allocating the time for managing the irrigation system is a key factor in the success of any irrigation project. The need for information and assistance from both public and private sources becomes more critical under irrigation.

When considering an investment in irrigation, one of the first questions to be asked is, "Why do I want to irrigate?" **The primary reason should be to increase net farm income over dryland production.** Increased income may result from the ability to grow longer-season crops or a high value specialty crop, provide an assured forage supply for animal operations or improve crop rotations. Irrigating as insurance against insufficient rainfall, just because the water is available or because you have fields with irrigable soils are poor reasons. The higher yields possible with irrigation require greater management skills and inputs in the form of fertilizer, seed and possibly pest control.

When you have decided that irrigation will fit into your farming enterprise, use the checklist below to guide the irrigation development process.

STEPS TO FOLLOW

1. **Determine if your soils are irrigable.**
2. **Determine the quantity and quality of water required.**
3. **Determine the availability of power and type of irrigation equipment.**
4. **Does irrigation pay in your farm enterprise?**
5. **Can you obtain financing?**
6. **Select and manage your irrigated crops.**

✓ Step 1: Determine if Your Soils are Irrigable

Not all soils can be irrigated due to various physical problems such as too much slope, low infiltration rates or poor internal drainage that may cause salt buildup. Soils are classified as either irrigable, conditional or non-irrigable and are defined in the following way:

- **Irrigable soils** have no restrictions for sustained irrigation using proper application rates, amounts and water quality.
- **Conditional soils** have restrictions for sustained successful irrigation due to such factors as water table elevation, layers of low permeability, potential for salinization, steep slopes and other problems. Some restrictions can be corrected with drainage. Conditional soils should have a detailed field level soil survey conducted, ideally by a registered soil classifier, before irrigation is developed.
- **Nonirrigable soils** have severe restrictions to irrigation and should only be developed where they are minor inclusions into irrigable soils.

Sources for soils information:

- The Natural Resource Conservation Services (NRCS) online Websoil Survey at <http://websoilsurvey.nrcs.usda.gov/> is the official source of soil survey information.
- Published county soil survey books in the Extension or Natural Resource Conservation Service (NRCS) offices are useful but may not have the latest soils information.
- NDSU Extension publication AE1637 Compatibility of North Dakota Soils for Irrigation. Available from county Extension offices or online at: www.ndsu.edu/agriculture/ag-hub/ag-topics/crop-production/irrigation-tiling-drainage.

When you know the name of all the soil series in the field to be irrigated, use Extension publication AE1637 to determine the irrigability classification.

✓ Step 2: Determine the Quantity and Quality of Water Required

The water supply is the heart of any irrigation development and a water permit is required for all water appropriations **except** domestic use, including livestock, and non-commercial lawn and garden irrigation of five acre or less. The amount of water you will need is about **six gallons per minute (gpm) per irrigated acre** during July and August. For example, if you want to irrigate 100 acres, you will need a water source that can produce about 600 gallons per minute.

Where does this recommendation come from? The average peak daily crop water use of most irrigated crops in North Dakota is about 0.27 inches per day under well-watered conditions (no water stress) and that translates to about 6 gpm of water use applied over a 24-hour period to replace the water the crop has transpired.

A water permit must be obtained before constructing a well or any device for capturing water from a surface source and installing an irrigation system. The application form and instructions for an irrigation water permit can be obtained from the Appropriations Division of the Department of Water Resources (www.swc.state.nd.us/reg_approp/waterpermits/). You may need to fill out the permit application with the help of a local surveyor or a consulting engineer. When a water permit is first issued it is called a conditional permit, which is good for three years. Within the three-year period, the water source must be developed and the irrigation system installed. It will then be inspected by a representative of the Appropriations Division. If approved, the conditional permit will be changed to a *perfected* permit.

If surface water is the source (pond, lake, river, etc.), you must determine if there will be sufficient water available during the summer months or extended dry periods. If groundwater is the source, use aquifer information from the North Dakota Water Resources Department (see sources of information at end of this section) to determine the location, size and potential production capacity of the aquifers at the location of field to be irrigated.

Small aquifers may exist that are not shown in the county ground water surveys. Drilling test holes is the only sure way to determine if sufficient water is available from the aquifers in these areas. A permit is not required to drill test holes. *However, before drilling test holes, it would be wise to consult a groundwater hydrologist with the Appropriations Division.* If there is sufficient water, one or two of the test holes should be developed as observation wells to monitor the effect of irrigation pumping on the aquifer water levels and assist in diagnosis of production well problems should they occur in the future.

Both ground water and surface water chemistry should be determined to make sure it is suitable to apply to the soil in the field of interest. A water sample can be sent to the NDSU Soil and Water Testing Laboratory or private testing companies for analysis. The location of the field should

be included with the water sample sent to NDSU to obtain a soil-water compatibility recommendation. Soil-water compatibility is very important **because the soil type will determine the quality of water** that can be used.

Sources of information for water:

- County Extension or Natural Resource Conservation Service (NRCS) offices.
- Appropriations Division of the North Dakota Department of Water Resources (www.swc.state.nd.us/) for general information on the water permitting process (phone: 701.328.2754). For online GIS-based water resource information go to <http://mapservice.swc.nd.gov/>.
- NDSU Soil and Water Testing Laboratory (www.ndsu.edu/snrs/services/soil_testing_lab/)
- Irrigation water analysis form: www.ndsu.edu/agriculture/ag-hub/publications/irrigation-water-sample-analysis

✓ Step 3: Determine the Availability of Power and Type of Irrigation Equipment

Power Source

If available, electricity is generally the preferred source of power. However, if existing power lines are more than a mile from the pump site, it may be more economic to use an internal combustion engine. Electricity has some advantages over engines such as lower pumping costs, less maintenance, reliability and ease of operation. Construction costs and repayment for extension of power lines vary with each electrical provider. An estimation of annual power use, costs and construction repayment is necessary to determine the most economical power source.

For electric pumps, three-phase power is preferred but often is it not available or too expensive to bring to the pump site. Variable frequency drives (VFD's) and rotary or static phase converters will transform single phase to three-phase power. Early contact with the power supplier is necessary to allow time to plan and construct facilities.

Equipment

Select an irrigation system (pump, motor, pipeline, water application equipment) that fits your needs relative to water supply, irrigated acreage, crop rotations, labor requirements and the power supply. Irrigation system pressure requirements and sprinkler selection should be based on soil and topography. Remember, this equipment will have a useful life of 30 to 35 years or more.

Visit irrigators with similar systems; listen to their experiences and opinions to determine the advantages and disadvantages of their systems. Select a dealer who is well established, capable of designing a good system and has a good service record. Buy as much as possible of the entire system from one dealer. This may help eliminate problems of responsibility and installation plus, when an emergency happens during the growing season (lightning strike, tornado, strong winds, etc.), timeliness of repair is crucial.

The pump and motor should be adequately sized to fit the flow capability of the well or water supply and meet the pressure requirements of the irrigation system. The pipe size and wall thickness should be selected to match flow rate and pressure requirements. After installation, pump and motor information along with irrigation system specifications should be furnished by the dealer and/or well driller and filed for future reference. Typical equipment costs are shown on the last page.

For information on irrigation equipment and power requirements:

- NDSU Extension publication AE91 Selecting a Sprinkler Irrigation System. Available online at: www.ndsu.edu/agriculture/ag-hub/publications/selecting-sprinkler-irrigation-system
- Contact irrigation dealers, other irrigators in the area, licensed well drillers and the local electric power supplier.

✓ Step 4: Does Irrigation Pay in Your Farm Enterprise?

Detailed crop budgets covering economic and cash costs should be prepared for the proposed irrigated cropping system. If the budgets show an adequate return to labor, capital and management, then a total enterprise analysis should be made to determine how irrigation will fit into the farming operation.

For example, irrigation of grass or hay may not bring a big return by itself, but coupled with a livestock operation, may increase net returns and lend stability to the farm enterprise. Irrigation alone does not assure financial success. It requires planning and good management on the part of the farm operator.

For information on crop budgets:

- Irrigated crop budget worksheets and Excel files can be obtained online at: www.ndsu.edu/agriculture/ag-hub/ag-topics/farm-management/crop-economics/projected-crop-budgets

✓ Step 5: Can You Obtain Financing?

Irrigation manufacturing companies represented by most irrigation dealers have financing programs for new equipment. In addition, the Bank of North Dakota has an interest buy down program for investment in new irrigation equipment when certain criteria are met. This program originates with the local banker.

Proper planning prior to contacting a financial institution can minimize the problem of adequate financing. Success in irrigation depends largely on your management ability. An indication of that ability can be expressed to your credit supplier in the form of farm records, profit and loss statements, net worth statements, and cash flow statements. In addition to these records,

you should be prepared to supply your credit agency with an estimation of the potential payback capacity of the irrigation investment. This is where the crop budgets and total enterprise analysis is very helpful.

Information on irrigation financing:

- Contact irrigation dealers, other irrigators in the area, banks and other farm financial organizations.
- The Ag Pace irrigation financing program through the Bank of North Dakota can be found online at: http://banknd.nd.gov/lending_services/. Look under the loan tab for information about Ag Pace

✓ Step 6: Select and Manage Your Irrigated Crops

Crops selected for irrigation should produce an economic yield increase. This means the average yearly yield increase over dryland production must be great enough to pay for the investment in irrigation and increased production costs as well as some additional profit. Historically, irrigating corn (for silage or grain), alfalfa, sugarbeets, potatoes and dry edible beans has been profitable for good irrigation managers.

Irrigation provides an environment conducive to increased plant production for long season crops; however, it also provides a favorable environment for disease, insects and weeds. The irrigator must know how to manage the irrigation system and crop rotations to minimize potential problems. By scouting the field on a regular basis and using Integrated Pest Management methods and Best Management Practices, the irrigator should be able to manage the irrigation system profitably. The irrigator must be aware of agronomic practices that favor irrigation and are crop specific such as proper hybrid selection, row widths, appropriate plant populations, higher fertilizer requirements and split applications of fertilizer to minimize leaching potential.

Irrigated crop water management is extremely important to prevent yield loss due to moisture stress, minimize pumping costs and prevent leaching of nutrients. A method of irrigation scheduling must be used. Soil moisture monitoring by the feel method is commonly used, but there are more accurate methods such as the checkbook method. Whichever method is used, it will require increased management skills and additional time. During the growing season, irrigation scheduling is a daily process.

Information on irrigated crop production:

1. Irrigation scheduling methods are available online at: www.ndsu.edu/agriculture/ag-hub/ag-topics/crop-production/irrigation-tiling-drainage/irrigation-scheduling
2. Irrigated crop research and variety trials are available in the annual reports from the Carrington (includes the Oakes reports) and Williston Research Extension Centers. These reports are available online at: vt.ag.ndsu.edu. Variety trial data for past years is available at www.ag.ndsu.edu/varietytrials/.

3. Other irrigation information can be found at:
www.ndsu.edu/agriculture/ag-hub/ag-topics/crop-production/irrigation-tiling-drainage

Advance Planning

To make the transition from dryland to irrigated production a success, the equipment should be installed and operational prior to the growing season. Take time to decide on the system you want and allow time — several months — for delivery and set up. Give serious consideration to fall delivery of equipment so it can be assembled during the fall or winter and be operational **prior** to the cropping season. Attempts to rush the process may prove costly in both capital outlay and development that may not fit your needs over the 30- to 35-year life of the system.

Irrigation Equipment Costs

The following example development costs are for a new center pivot irrigation system covering 128 acres. A new well about 100 feet deep with 20 feet of screen is located in the field corner nearest the road or power line to provide an adequate water supply of 700 to 800 gallons per minute for the system.

- 1. Irrigation System:** \$105,000 to \$115,000 for a new, quarter-section center pivot system (approximately 1,280 feet) with a concrete pivot pad and setup in the field. Included in this cost estimate are a check valve, flow meter, shutoff valve, pressure gage and fittings along with air and pressure relief valves at the well site.
- 2. Pipeline:** A pipeline from the well to the pivot must be at least 8 inches in diameter to reduce friction loss and provide sufficient carrying capacity. For this example, the pipeline will be about 1,300 feet. If the pipeline crosses hills or ridges, air relief valves must be located at the high points. If the low point of the pipeline is not at the pivot or well, a pump-out must be provided to remove water from the pipeline prior to winter. Pipe cost can vary significantly, so check with local supplier. For this example, the installed cost for 8-inch PVC pipe with electric and control wires is about \$15 per foot or \$20,000. If the well is located near the pivot point, the pipeline cost would be much reduced but running a power line to the well would increase the electrical costs.

3. Power and Control: \$13,000 to \$20,000 for electrical control panels, wire, electrician costs, etc. Does not include the cost to get power to the site by the power supplier. For this example, a 50-horsepower motor is needed to power the pump. Some electric utilities require a soft-start Variable Frequency Drive (VFD) for motors over 35 horsepower, which can add another \$8,000 to \$10,000 to the electrical costs. An electric safety circuit must be connected between the well and the pivot control panel. This provides protection in case of pivot or pump failure.

- a) Electric drive pivot — Electrical lines must be run from the local electric supplier to the control panel and then to the pivot. Three-phase power is preferable if economically available. An engine with a generator can also supply power.
- b) Hydraulic drive pivot — Either electric or engine-driven hydraulic pump is required.

4. Well Costs: \$35,000 to \$45,000. Includes test hole(s), production well site selection, drilling, testing and developing, screen and casing. Typical costs range from \$300 to \$450 per foot for a completed production well.

5. Pump and Motor: Costs depend on the flow rate, pumping water level, system pressure requirements, elevation differences and length of pipeline. Electric powered pumps may be about \$20,000. A comparable diesel-powered pump may cost about \$24,000, which includes the right-angle gear head, fuel tank and other accouterments.

The following table shows the approximate capital costs of a typical quarter section center pivot irrigation system on a per acre basis:

	New Cost	Estimated Life
Irrigation System	\$ 105,000	35 years
Pipeline	\$ 20,000	35 years
Power (electrical)	\$ 15,000	25 years
Deep Well	\$ 40,000	25 years
Pump and Motor	\$ 20,000	25 year
TOTAL	\$200,000	

Total capital investment per acre = \$200,000/128 acres = \$1,563

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