

103G.281 Water use prohibited without measuring quantities.

Subdivision 1. **Measuring and records required.** The state, a political subdivision of the state, a person, partnership, public or private corporation, or association may not appropriate or use waters of the state without measuring and keeping a record of the quantity of water used or appropriated as provided in section 103G.271 or 103G.275.

Subd. 2. **Measuring equipment required.** An installation for appropriating or using water must be equipped with a flow meter to measure the quantity of water appropriated within the degree of accuracy required by rule. The commissioner can determine other methods to be used for measuring water quantity based on the quantity of water appropriated or used, the source of water, the method of appropriating or using water, and any other facts supplied to the commissioner.

Subd. 3. **Report.**

(a) Records of the amount of water appropriated or used must be kept for each installation. The readings and the total amount of water appropriated must be reported annually to the commissioner on or before February 15 of the following year on forms provided by the commissioner.

(b) The records must be submitted with the annual water use permit processing fee in section 103G.271.

HIST: 1990 c 391 art 7 s 29; 1990 c 597 s 66

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103G.271 Appropriation and use of waters.

Subdivision 1. **Permit required.**

(a) Except as provided in paragraph (b), the state, a person, partnership, or association, private or public corporation, county, municipality, or other political subdivision of the state may not appropriate or use waters of the state without a water use permit from the commissioner.

(b) This section does not apply to use for a water supply by less than 25 persons for domestic purposes.

(c) The commissioner may issue a state general permit for appropriation of water to a governmental subdivision or to the general public for classes of activities that have minimal impact upon waters of the state. The general permit may authorize more than one project and the appropriation or use of more than one source of water. Water use permit processing fees and reports required under subdivision 6 and section 103G.281, subdivision 3, are required for each project or water source that is included under a general permit, except that no fee is required for uses totaling less than 15,000,000 gallons annually.

Subd. 2. **Permits must be consistent with state and local plans.** A water use permit may not be issued under this section unless it is consistent with state, regional, and local water and related land resources management plans if the regional and local plans are consistent with statewide plans.

Subd. 3. **Permit restriction during summer months.**

The commissioner must not modify or restrict the amount of appropriation from a groundwater source authorized in a water use permit issued to irrigate agricultural land under section 103G.295, subdivision 2, between May 1 and October 1, unless the commissioner determines the authorized amount of appropriation endangers a domestic water supply.

Subd. 4. **Minimum use exemption and local approval of low use permits.**

(a) Except for local permits under section 103B.211, subdivision 4, a water use permit is not required for the appropriation and use of less than a minimum amount prescribed by the commissioner by rule.

(b) Water use permits for more than the minimum amount but less than an intermediate amount prescribed by rule must be processed and approved at the municipal, county, or regional level based on rules adopted by the commissioner.

(c) The rules must include provisions for reporting to the commissioner the amounts of water appropriated under local permits.

Subd. 4a. **Mt. Simon-Hinckley aquifer.** (a) The commissioner may not issue new water use permits that will appropriate water from the Mt. Simon-Hinckley aquifer in a metropolitan county, as defined in section 473.121, subdivision 4, unless the appropriation is for potable water use, there are no feasible or practical alternatives to this source, and a water conservation plan is incorporated with the permit.

(b) The commissioner shall terminate all permits authorizing appropriation and use of water from the Mt. Simon-Hinckley aquifer for once-through systems in a metropolitan county, as defined in section 473.121, subdivision 4, by December 31, 1992.

Subd. 5. **Prohibition on once-through water use permits.**

(a) The commissioner may not, after December 31, 1990, issue a water use permit to increase the volume of appropriation from a groundwater source for a once-through cooling system using in excess of 5,000,000 gallons annually.

(b) Once-through system water use permits using in excess of 5,000,000 gallons annually, must be terminated by the commissioner by the end of their design life but not later than December 31, 2010, unless the discharge is into a public water basin within a nature preserve approved by the commissioner and established prior to January 1, 2001. Existing once-through systems must not be expanded and are required to convert to water efficient alternatives within the design life of existing equipment.

Subd. 5a. **Maintenance of surface water levels.**

Except as provided in subdivision 5, paragraph (b), the commissioner shall, by January 31, 1994, revoke all existing permits, and may not issue new permits, for the appropriation or use of groundwater in excess of 10,000,000 gallons per year for the primary purpose of maintaining or increasing surface water levels in the seven-county metropolitan area and in other areas of concern as determined by the commissioner. This subdivision does not apply until January 1, 1998, to a municipality that, by January 1, 1994, submits a plan acceptable to the

commissioner for maintaining or increasing surface water levels using sources other than groundwater.

Subd. 6. **Water use permit processing fee.** (a) Except as described in paragraphs (b) to (f), a water use permit processing fee must be prescribed by the commissioner in accordance with the schedule of fees in this subdivision for each water use permit in force at any time during the year. The schedule is as follows, with the stated fee in each clause applied to the total amount appropriated:

(1) \$101 for amounts not exceeding 50,000,000 gallons per year;

(2) \$3 per 1,000,000 gallons for amounts greater than 50,000,000 gallons but less than 100,000,000 gallons per year;

(3) \$3.50 per 1,000,000 gallons for amounts greater than 100,000,000 gallons but less than 150,000,000 gallons per year;

(4) \$4 per 1,000,000 gallons for amounts greater than 150,000,000 gallons but less than 200,000,000 gallons per year;

(5) \$4.50 per 1,000,000 gallons for amounts greater than 200,000,000 gallons but less than 250,000,000 gallons per year;

(6) \$5 per 1,000,000 gallons for amounts greater than 250,000,000 gallons but less than 300,000,000 gallons per year;

(7) \$5.50 per 1,000,000 gallons for amounts greater than 300,000,000 gallons but less than 350,000,000 gallons per year;

(8) \$6 per 1,000,000 gallons for amounts greater than 350,000,000 gallons but less than 400,000,000 gallons per year;

(9) \$6.50 per 1,000,000 gallons for amounts greater than 400,000,000 gallons but less than 450,000,000 gallons per year;

(10) \$7 per 1,000,000 gallons for amounts greater than 450,000,000 gallons but less than 500,000,000 gallons per year;

and

(11) \$7.50 per 1,000,000 gallons for amounts greater than 500,000,000 gallons per year.

(b) For once-through cooling systems, a water use processing fee must be prescribed by the commissioner in accordance with the following schedule of fees for each water use permit in force at any time during the year:

(1) for nonprofit corporations and school districts, \$150 per 1,000,000 gallons; and

(2) for all other users, \$200 per 1,000,000 gallons.

(c) The fee is payable based on the amount of water appropriated during the year and, except as provided in paragraph (f), the minimum fee is \$100.

(d) For water use processing fees other than once-through cooling systems:

- (1) the fee for a city of the first class may not exceed \$250,000 per year;
- (2) the fee for other entities for any permitted use may not exceed:
 - (i) \$50,000 per year for an entity holding three or fewer permits;
 - (ii) \$75,000 per year for an entity holding four or five permits;
 - (iii) \$250,000 per year for an entity holding more than five permits;
- (3) the fee for agricultural irrigation may not exceed \$750 per year;
- (4) the fee for a municipality that furnishes electric service and cogenerates steam for home heating may not exceed \$10,000 for its permit for water use related to the cogeneration of electricity and steam; and
- (5) no fee is required for a project involving the appropriation of surface water to prevent flood damage or to remove flood waters during a period of flooding, as determined by the commissioner.

(e) Failure to pay the fee is sufficient cause for revoking a permit. A penalty of two percent per month calculated from the original due date must be imposed on the unpaid balance of fees remaining 30 days after the sending of a second notice of fees due. A fee may not be imposed on an agency, as defined in section 16B.01, subdivision 2, or federal governmental agency holding a water appropriation permit.

(f) The minimum water use processing fee for a permit issued for irrigation of agricultural land is \$20 for years in which:

- (1) there is no appropriation of water under the permit; or
- (2) the permit is suspended for more than seven consecutive days between May 1 and October 1.

Subd. 6a. **Payment of fees for past unpermitted**

appropriations. An entity that appropriates water without a required permit under subdivision 1 must pay the applicable water use permit processing fee specified in subdivision 6 for the period during which the unpermitted appropriation occurred. The fees for unpermitted appropriations are required for the previous seven calendar years after being notified of the need for a permit. This fee is in addition to any other fee or penalty assessed.

Subd. 7. **Transfer of permit.** A water use permit may be transferred to a successive owner of real property if the permittee conveys the real property where the source of water is located. The new owner must notify the commissioner immediately after the conveyance and request transfer of the permit.

HIST: 1990 c 391 art 7 s 27; 1990 c 594 art 1 s 49; 1990 c 597 s 63-65; 1991 c 214 s 6; 1991 c 234 s 1; 1991 c 354 art 10 s 5; 1992 c 366 s 1; 1992 c 601 s 1; 1993 c 186 s 3-5; 1994 c 557 s 15; 1995 c 218 s 10; 1997 c 104 s 1; 1998 c 401 s 38; 1999 c 231 s 128; 2001 c 160 s 1-3; 2003 c 128 art 1 s 116,117

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6115.0110 ANNUAL WATER APPROPRIATION PROCESSING FEE.

Subpart 1. **In general.** An annual water appropriation processing fee shall be submitted for each water appropriation permit in force at any time during the year. The fees are required whether or not the permittee appropriated or used any water as authorized by permit during the year.

Subp. 2. **Fee schedule.** The fee shall be based on the following schedule:

A. for irrigation permits, \$15 for the first permitted 160 acres or portion thereof, and \$25 for each additional permitted 160 acres or portion thereof;

B. for all other permits, \$5 for each permitted 10,000,000 gallons or portion thereof;

C. the annual water appropriation processing fee shall not exceed a total fee of \$500 per permit.

Subp. 3. **Billing and payment.** A notice of the fees owed will be mailed to the permittee, with the reporting forms, by the commissioner.

The fee, with accompanying report, for the calendar year's appropriation or use of water, shall be sent to the commissioner no later than February 15 of the following year.

Failure to pay the fee shall be sufficient cause for terminating a permit 30 days following written notice by the commissioner.

The effective date of this part is August 1, 1985.

STAT AUTH: MS s 105.44 subd 10

HIST: 10 SR 236

Current as of 01/31/05





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Water use permits

Requirements

A water use (appropriation) permit from DNR Waters is required for all users withdrawing more than 10,000 gallons of water per day or 1 million gallons per year.

There are several exemptions to water appropriation permit requirements:

- domestic uses serving less than 25 persons for general residential purposes,
- test pumping of a ground water source,
- reuse of water already authorized by a permit (e.g., water purchased from a municipal water system), or
- certain agricultural drainage systems (check with your area hydrologist for applicability).

Permit Application

To apply for a water appropriation permit, download and print one of the following application forms or request that a form be sent to you by mail. Complete the form furnishing all requested information and supporting documents. Mail the forms to your regional DNR office. Please do not submit fees with the permit application, you will be billed separately (usually \$75). Minnesota Statutes allow local units of government 30 days to review permit applications and submit comments to DNR Waters.

Permit Application Forms to download and print:

Irrigation [Water Appropriation Permit Application Form](#) [PDF](#) (163Kb)

Non-Irrigation [Water Appropriation Permit Application Form](#) [PDF](#) (177Kb)

Temporary Projects General Permit 97-0005

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This general permit authorizes temporary water appropriations for construction dewatering, landscaping, dust control, and hydrostatic testing of pipelines, tanks, and wastewater ponds.

To be included under General Permit 97-0005 the project must meet the following criteria:

- Projects must have a minimal potential for causing adverse environmental impacts,
- Water appropriations cannot exceed 50 million gallons per year,
- Water appropriations must be completed within one year from the start of pumping,
- The Area Hydrologist for the county in which the project is located must be notified at least five days prior to the start of pumping. The information packet below has a form that can be used to satisfy notification requirements,
- Water volumes must be measured and reported upon completion of the project. A \$101 water use report processing fee is required for projects that exceed 15 million gallons.

For more information please download the following packet of information which includes the complete text of the permit language:

[Temporary Water Appropriations General Permit 97-0005 - Information Packet](#) [PDF](#) (336Kb)

Animal Feedlots and Livestock Operations General Permit 2004-0275

This general permit authorizes groundwater appropriations up to 5 million gallons per year for livestock watering and sanitation purposes.

To be included under General Permit 2004-0275, animal feedlots and livestock operations must comply with all conditions and limitations of the permit and meet the following criteria:

- Operations must have a minimal potential for causing adverse environmental impacts,
- Water appropriations cannot exceed 5 million gallons per year,
- This permit is only valid for animal feedlot and livestock operations that are in compliance with all feedlot rules and regulations required by the Minnesota Pollution Control Agency and county feedlot programs,
- If requested by the Department, a permit notification form must be submitted in order to determine if an operation

- qualifies for authorization under this permit,
- Records of monthly and annual water appropriation volumes must be maintained and submitted to the Department upon request.

For more information please download the following packet of information which includes the complete text of the permit language:

Animal Feedlots and Livestock Operations General Permit 2004-0275 - Information Packet [PDF](#) (401Kb)

Water Use Reporting

All active water appropriation permit holders are required to measure monthly water use with an approved measuring device to an accuracy of 10 percent and report water use yearly. Permit holders receive water use reporting forms each year to report their water use. Completed forms and processing fee are due by February 15 of each year.

Water Use Report Directions 2003 [PDF](#) (49KB)
Metering Brochure [PDF](#) (20KB) (included with application forms)

Water Use Fees

Minnesota Statutes were amended in 2003 to increase annual water use fees to the following fee schedule. Permit holders received the following letter [PDF](#) in June 2003.

Answers to questions about the new fee rates

Permit Amendments

Permit holders must request to amend their permits if changes are made to their water systems, including:

- number of installations (wells, pumping stations),
- pumping rate,
- volume of water required, or
- number of acres irrigated or irrigated area.

All amendment requests should be submitted in writing. A \$75 fee is required to request a permit amendment (subject to fee exemptions listed below).

Transfers

Requests for transfers of permits to new land owners should be submitted in writing. State the name of the new owner, contact information, and date of the sale or transfer. Proof of the new ownership is required, which can be a copy of the deed, tax document, lease agreement, or other suitable instrument. A \$75 fee is required to request transfer of a permit (subject to fee exemptions listed below).

Termination

Permit holders who no longer require their water use permits should request termination in writing. Water use reports and fees are due for each year in which a permit is active. A fee is **not** required to terminate a permit.

Fee Exemptions

Minnesota Rules 6115.0120 state the following amendment or transfer fee exemptions:

- a change in mailing address;
- a change of authorized agent when land ownership has not changed;
- an assignment of a permit within the immediate family;
- a change in pump location on surface water sources for the same operation;
- an addition of a new well that replaces an old well for the same permitted operation and that is completed at a similar depth in the same aquifer;
- a decrease in the permitted pumping rate, amount of water authorized, or irrigated acreage;
- an increase in the permitted pumping rate within 10 percent;
- an increase in the permitted appropriation within ten percent of the annual authorization for non-irrigation permits; and
- an increase of less than 30 acres in the number of permitted irrigated acres.

Permit Suspensions Due to Dry Conditions

In order to safeguard water availability for natural environments and downstream higher priority users, Minnesota law requires the DNR to limit consumptive appropriations of surface water under certain low flow conditions. Should conditions warrant, DNR Waters may suspend surface water appropriation permits as determined by its Surface Water Appropriation Permit Issuance and Suspension Procedures [PDF](#) (1.67MB).

Discussion of conditions that can lead to permit suspensions:

- [Notice to Surface Water Users, December 2000 PDF](#) (441KB)

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Water use fee rates

Rates for annual report of water use

Volume Appropriated	Fee for each permit
0 to 50 million gallons	\$101 minimum fee
50 to 100 million gallons	\$3.00 for each million
100 to 150 million gallons	\$3.50 for each million
150 to 200 million gallons	\$4.00 for each million
200 to 250 million gallons	\$4.50 for each million
250 to 300 million gallons	\$5.00 for each million
300 to 350 million gallons	\$5.50 for each million
350 to 400 million gallons	\$6.00 for each million
400 to 450 million gallons	\$6.50 for each million
450 to 500 million gallons	\$7.00 for each million
Above 500 million gallons	\$7.50 for each million

Minimum annual water use fee for agricultural irrigation

Agricultural irrigation permittees that did not appropriate any water during the year or had their permit suspended for more than seven days pay a *minimum fee* of \$20 per permit.

Maximum annual water use fees

\$750 for any single agricultural irrigation permit
\$50,000 total for an entity with 3 or less permits
\$75,000 total for an entity with 4 to 5 permits
\$250,000 total for an entity with more than 5 permits
\$250,000 total for a city of the first class
\$10,000 for a municipality that furnishes electric service and cogenerates steam for home heating.

Once-through heating and cooling systems only

A separate annual water use fee schedule exists for once-through heating and cooling (HVAC) systems. Non-profit corporations and school districts pay \$150 per million gallons and all other entities with once-through heating and cooling systems pay \$200 per million gallons. There is no maximum fee for once-through systems.

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Processing Fee Exemptions

State and federal agencies are exempt from annual water use fees.

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Measuring Water Use & Flow Meter Requirements

Flow Meter Requirements

Minnesota Statutes § 103G.281, Subdivision 2, requires all installations for appropriating water to be equipped with a flow meter to measure the quantity of water appropriated within the degree of accuracy required by rule (10%). The commissioner may approve alternate methods of measurement based on the quantity of water used, the method of appropriating or using water and any other information supplied by an applicant.

Why require Flow Meters ?

The law is aimed at improving the accuracy of water use reporting and has many benefits. Careful monitoring of water withdrawals can be used to provide valuable information for management of the resource, detect well and pump problems, improve irrigation efficiency, and determine pumping plant efficiency. As a management tool, accurate flow monitoring can help to conserve both energy and water resources. Accurate data is necessary to evaluate the capability of the resource to sustain water withdrawals and is also important for investigation of well interference complaints.

Does everyone need a flow meter ?

All new permitted installations will be required to have flow meters unless prior DNR approval has been given for an alternate method. Existing systems may be allowed to use an approved alternate method. Depending upon the type of system, water use and quantity of water used, the commissioner may approve alternate methods for measuring water use. Requests for approval of alternate methods must be submitted in writing to DNR Waters. Proper record keeping is required for all approved methods of determining water use.

When is a flow meter required ?

Flow meters are required when alternate methods cannot provide an accurate measurement of water use. Flow meters will be required where the following circumstances exist:

1. Systems with widely fluctuating discharge rates or when variable speed pumps are used.
2. Systems with alternating zone coverage, such as golf course irrigation systems.
3. Instances where the permit holder has a history of providing inaccurate pumping reports or has failed to submit water use fees and reports.
4. Situations where the adequacy of the resource is a concern or there is a history of well interference problems.

What methods are approved ?

The following methods are approved for measuring water use:

1. Flow meters with a totalizer.
2. Flow rate meters used with timing devices. † ‡
3. Timing devices (hour meters and electric meters). † ‡
4. Vehicle gallon capacities (i.e. water trucks). †

† Daily records of water use and time pumped must be kept for these methods.

‡ Methods 2 and 3 are required to have a constant pumping rate.

What if I am using a gravity flow system ?

Special instructions regarding gravity flow operations are available by calling DNR Waters at (651)296-4800 and requesting the "Measuring Appropriations from Gravity Flow Installations" information sheet.

Which methods are not approved ?

The following methods are not approved for measuring water use:

1. Rain gauges or other methods using application rates, such as irrigation systems that are set to apply a certain amount of water per acre or pass.
2. Buckets used to measure discharge rates.
3. Fuel consumption by gasoline or diesel engines.
4. Estimates using a set volume of water per person or animal.

How do I get my method approved ?

Each year permittees are required to sign an affidavit of compliance on the water use report indicating compliance with the law requiring a flow meter or an approved measuring device. The affidavit of compliance and the annual report of water use are due by February 15 of each year.

Permittees using a method of measurement that has not been approved must submit a written request for approval of an alternate method. Requests should include a detailed description of the proposed method (i.e. diagrams, calculations). Requests for approval of an alternate method should be sent to DNR Waters, Permits Unit, 500 Lafayette Road, St. Paul, MN 55155-4032. Only methods that measure water use within 10 percent accuracy will be considered for approval. Records of water use must be kept for all methods of water use.

Failure to have an approved method is a violation of Minnesota Statutes and permit conditions and is punishable as a misdemeanor with fines up to \$700 and/or 90 days in jail.

General

To obtain information about the purchase and/or installation of a flow meter, contact a licensed well driller, irrigation equipment dealer or plumbing supply company.

(continued on next page)

Minnesota DNR Waters

This information is available in an alternative format upon request

Calculating Monthly Water Use

To calculate monthly water use from:

A. **Flow Meter:** Subtract the reading at the beginning of the month from the reading at the end of the month. If the meter is in cubic feet, multiply the monthly use by 7.48 to convert the usage into gallons.

B. **Timing Device:** Multiply the hours pumped for the month by the pump rate (in gallons per minute, gpm) times 60 (minutes). [Example: 150 hrs x 800 gpm x 60 min/hr = 7,200,000 gallons].

Hourly timing device options:

1. An hourly time clock connected directly to irrigation pumping plant system.
2. Kilowatt Hours: Monthly hours of pumping determined by dividing monthly electric usage by electric meter's monthly power demand rate (Kw). [Example: 3000 Kw/h of electricity was used in the month of June and the electric meter recorded a peak demand for the month of 25 Kw, then the total hours pumped is found by dividing 3000 Kw/h by 25 Kw, which yields 120 hours pumped for the month. To find water use take 120 hrs x 300 gpm x 60 min/hr = 2,160,000 gallons].

* Approved Alternatives for Estimating Water Pumping Rate from Agricultural Irrigation Systems

The following alternate methods are approved by the Department for agricultural irrigation systems.

- Pumping flow rate test.
- Center pivot/linear system's manufacturers nozzling chart.
 - for a center pivot with a corner swing unit, refer to the following section.
- Traveling gun nozzling chart.
- Lateral line irrigation systems nozzling chart.

- $\frac{\text{gpm}}{\text{feet/100}} = \text{gph per 100' of trickle tube}^*$
- Open discharge pump's manufacture curve.

ESTIMATING DISCHARGE OF A CENTER PIVOT WITH CORNER UNIT

A good average discharge flow rate estimate for a center pivot with a corner arm can be determined by taking the average of the discharge rate when the corner arm is fully extended and fully retracted.

The water discharge from a center pivot with a corner swing arm varies depending on the position of the swing arm, usage of flow control/regulators, and the slope of the pump performance curve.

STEPS TO ESTIMATE GPM FOR A TRAVELING GUN

1. Determine nozzle size to nearest 1/100th of an inch and nozzle type (bore or ring): [ex: 1-1/4" = 1.25 inches taper & bore nozzle].
2. Determine average operating pressure at the base of the sprinkler. If pressure varies between first and last travel runs, take the average between the first and last runs: [ex: 1st run = 95 psi, last run = 85 psi, average = (95 + 85)/2 = 90 psi].
3. Select the appropriate discharge table (bore or ring nozzle) listed below and find the estimated gpm for your nozzle size and average operating pressure or use gun manufacturer's published discharge table.

If your nozzle size or operating pressure values follow between the table numbers, make an interpolation between the smaller and larger numbers to get a more accurate estimate of flow: [ex: have 1.25" bore nozzle @ 90 psi; table gives at 90 psi 405 gpm @ 1.2" and 545 @ 1.4"; then to estimate the gpm for 1.25" nozzle calculate as follows:

$$\begin{aligned} \text{gpm} &= 405 \text{ gpm} + [(1.25" - 1.2") / (1.4" - 1.2")] * (545 \\ &\quad \text{gpm} - 405 \text{ gpm}) \\ &= 405 + (0.05/0.20) * 140 \\ &= 405 + 0.25 * 140 \\ &= 405 + 35 = 440 \text{ gpm} \end{aligned}$$

Typical Discharges for Single Large Nozzle Sprinkler Guns

Sprinkler Pressure (psi) Straight or taper bore nozzle sizes (inches)

60 70 80 90 100 110 120

0.8 1.0 1.2 1.4 1.6

Sprinkler Pressure (psi)	0.8	1.0	1.2	1.4	1.6
60	145	225	330	445	585
70	155	245	355	480	630
80	165	260	380	515	675
90	175	275	405	545	715
100	185	290	425	575	755
110	195	305	445	605	790
120	205	320	465	630	825

Ring Nozzle Sizes (inches)

0.9 1.1 1.3 1.5 1.7

Sprinkler Pressure (psi)	0.9	1.1	1.3	1.5	1.7
60	110	185	275	385	510
70	120	200	295	410	550
80	130	215	310	435	585
90	135	225	325	460	620
100	140	240	340	485	655
110	150	250	350	510	690
120	155	260	360	530	720

Table Sources: Nelson Irrigation Corp. - sprinkler charts. Rain Bird, Agri Products Division - sprinkler charts. SCS National Sprinkler Irrigation Book - Chapter 15.

*Prepared by: Jerry Wright, Extension Agricultural Engineer, University of Minnesota, 1990.

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The DNR Information Center phone numbers:

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 MN Toll Free: 1-888-646-6367 (or 888-MINNDNR)
 Telecommunication Device for the Deaf:
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 1-800-657-3929 MN Toll Free