

## Agricultural Research

**N**EARLY EVERY FARM in Minnesota today shows some practical result of the work done by the Agricultural Experiment Station. This unit of the Institute of Agriculture of the University of Minnesota carries on research in many widely varied fields. On the one hand, it seeks to develop new and better farm or home practices, crops, and animals. On the other, it seeks to increase our basic knowledge of nature, an end invaluable in itself.

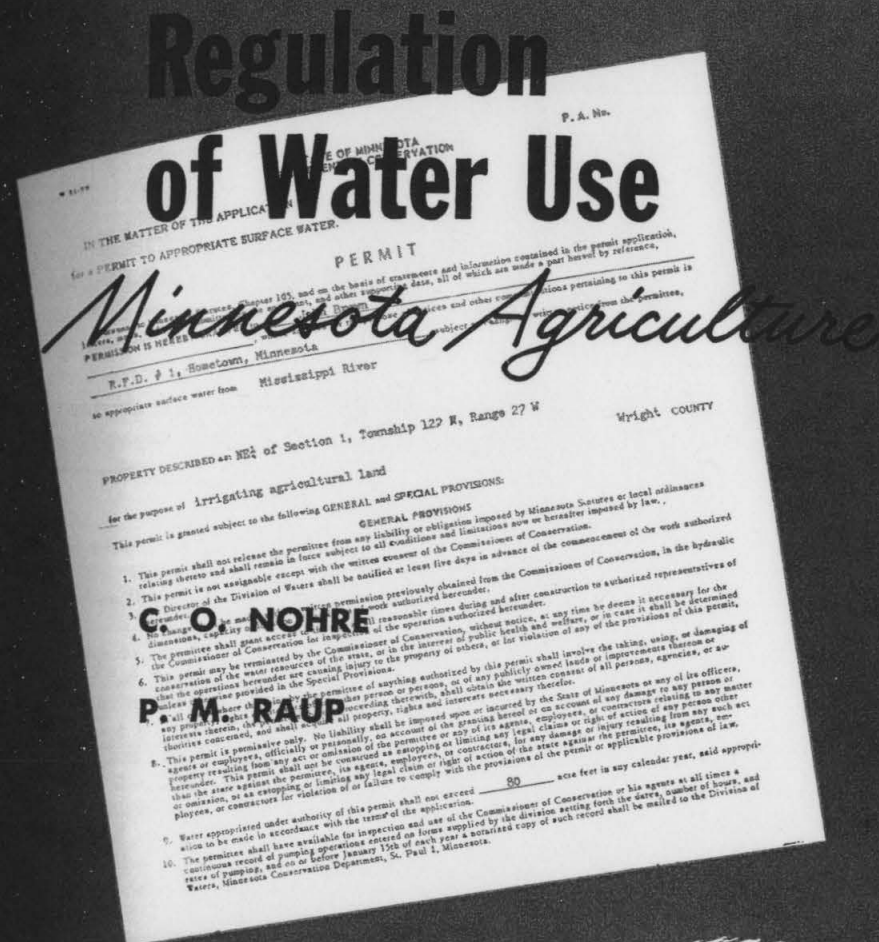
The Experiment Station has about 300 research projects, ranging from improved diets for the family to better use of the products of our forests, and from a study of disease in plants or animals to the discovery of new markets for agricultural products. Results of this research are made available to the public through resident teaching facilities on campus, or through the off-campus work of the Agricultural Extension Service and its county agent organization.

The research is carried on at many places in the state. Some of it takes place in the laboratories and fields of the University's St. Paul Campus. Some is conducted at the Agriculture Experiment Station at Rosemount, or at the branch experiment stations—Waseca, Morris, Crookston, Grand Rapids, Lamberton, and Duluth.

Specialized research is carried on at the Fruit Breeding Farm, Excelsior; at the Potato Breeding Farm, Castle Danger; at the Forest Research Center, Cloquet; at the Hormel Institute, Austin; and at the Biological Station, Itasca State Park. In addition, hundreds of Minnesota farmers each year cooperate with the Station in experiments on their own farms, either as individuals or in groups that may represent several counties.

Agricultural research in Minnesota has a broad scope. And its results underlie every major advance we make in modern agricultural knowledge or practice.

This publication is one of the many research reports issued by the University of Minnesota Agricultural Experiment Station. These reports—some more technical in nature—are distributed through your County Extension Agent or the Bulletin Room, University of Minnesota, Institute of Agriculture, St. Paul 1.



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# Regulation of Water Use in Minnesota Agriculture

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MINNESOTA IS RICHLY ENDOWED with water resources. Famed as the land of 10,000 lakes and the source of the Mississippi, the state also possesses valuable ground-water reserves. The most notable is the Jordan sandstone basin centered in the Minneapolis and St. Paul area. Virtually no surface waters flow into the state. In common with a small minority of states (Colorado, Wyoming, Wisconsin), Minnesota plays a major water supply role for neighboring areas.

Despite this wealth in water, some areas and users face periodic water shortages. The growth of cities and the attraction that the state offers for recreation and to industries demanding large supplies of water have combined with traditional agricultural uses to focus attention on the adequacy of current and future supplies.

The dry years of the middle 1930's demonstrated that water is not always plentiful throughout Minnesota. Dry lake beds and falling ground-water levels showed the need for planning to avoid more widespread shortages. As

a result, the Legislature established a water-use permit system. Under this system, users of water, with some important exceptions, must obtain written permission from the Department of Conservation through its Division of Waters.

This bulletin discusses the policies, procedures, and some of the problems that have emerged in administering this permit system. While permits are required for a variety of purposes, this bulletin places primary emphasis on those that authorize the withdrawal or "appropriation" of water for irrigation.

## *Minnesota Water Supply*

### SOURCES OF WATER

**Precipitation**—Rain, snow, and accumulations of runoff contribute a substantial portion of the Minnesota

water supply. Precipitation is generally heavier in the eastern and southern parts of the state and lighter in the northern and western parts (figure 1). The average annual precipitation ranges

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The authors gratefully acknowledge the assistance given by the Division of Waters, Minnesota Department of Conservation; Attorney General's office; and the Department of Agricultural Engineering and the Law School, University of Minnesota.



Fig. 1. This map shows the lines of equal annual precipitation

Source: *Hydrologic Atlas of Minnesota*, Minnesota Conservation Department, Division of Waters, Bulletin No. 10, 1959, p. 2.

from 32 inches in the extreme southeast to 20 inches in the northwest corner of the state. Seasonal distribution modifies the effectiveness of this moisture in promoting plant growth and replenishing the surface and underground reservoirs. Surface runoff is sometimes substantial, particularly in eastern Minnesota. Although runoff reduces the benefit of rainfall on the ground on which it falls, this water accumulates in lakes, ponds, etc. where it is available for use.

**Ground Water**—Perhaps the least understood source of supply is underground water. The abundance or scarcity of this water depends broadly on the type of underground rock formation in the particular area. The two subsurface characteristics of interest are the capacity to hold water (porosity) and the capacity to transmit water (permeability). The combination of these characteristics determines the value of the rock formation as a source of ground water.

The uppermost layer of the earth's crust from which it is possible to draw water is known as glacial drift. The glacial drift covers almost the entire state but varies widely in depth from an average of 150 feet. In many places it can hold enough water to support wells. The shaded areas in figure 2 show known deposits of shallow water-bearing sand and gravel which are potential sources of water for irrigation and other agricultural uses.

Deep wells are often necessary when large quantities of water are needed, as may be true for industrial and municipal purposes. The availability of water from this source also varies greatly in different parts of the state (figure 3). Southeastern Minnesota is underlain with rock formations containing porous aquifers which are excellent sources of water. Other areas are less well endowed and deep groundwater supplies are moderate to poor.

**Natural Watercourses**—Streams and lakes provide a substantial amount of the water used in Minnesota. Some

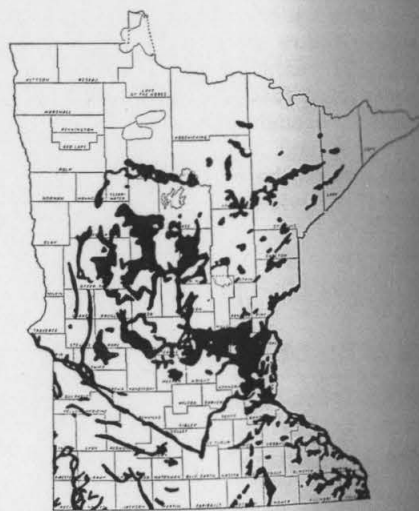


Fig. 2. Location of shallow water-bearing sand and gravel deposits in Minnesota

Source: E. R. Allred, G. R. Blake, and C. L. Larson, *Planning for Irrigation in Minnesota*, Minn. Agr. Ext. Bul. 288, April 1958, p. 16.

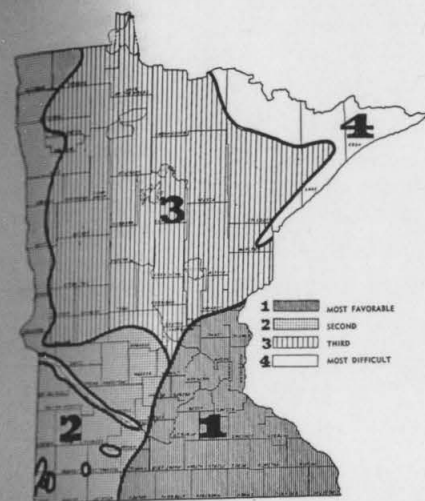


Fig. 3. Groundwater supplies from deep wells in order of availability

Source: E. R. Allred, G. R. Blake, and C. L. Larson, *Planning for Irrigation in Minnesota*, Minn. Agr. Ext. Bul. 288, April 1958, p. 16.

towns and cities depend on this source. In addition, industrial users rely heavily on surface water and most of the water used for irrigation comes from natural watercourses.

### ESTIMATED FUTURE WATER USE

Minnesota's water supply situation is generally favorable, but its water resources are not unlimited. The use of water has been increasing rapidly in recent decades and will increase more rapidly in the future.

It is estimated that the total water used in Minnesota will increase about 50 percent from an average rate of 424 million gallons per day in 1950 to 626 million by 1975. Table 1 shows expected trends in the relative importance of various types of uses.

By 1975, industrial use (including mining) is expected to increase more than 100 percent, municipal use 10 percent, and total agricultural use 12 percent. The increase in agricultural use is expected to be due to a large extent to more irrigation.

### COMPETING USES

There appears to be no acute shortage anywhere in the state at the present time. However, the expected increase in water use could very likely result in severe shortages in some localities. In addition, conflicts between competing uses will become more common even in areas with liberal supplies.

Since a good share of water use is concentrated in towns and cities, shortages usually occur there first. Some cities, particularly in southwestern Minnesota, experience periodic shortages at which time nonessential uses are discouraged. Some have ordinances giving city officials authority to ban certain uses while others depend on community spirit to impose restraint. In either case public support provides the most effective enforcement.

It is difficult to ascertain the extent to which current "water problems" foreshadow long-range shortages and

Table 1. Estimated total water use in Minnesota, 1950 and 1975

Purpose	1950		1975	
	Million gallons per day	Percent of total	Million gallons per day	Percent of total
Agriculture (except irrigation)	100	24	105	16.8
Irrigation	8	2	16	2.6
Municipal	145	34	160	25.6
Mining	21	5	130	20
Other industrial	150	35	215	35
Total	424	100	626	100.0

Source: *An Estimate of the Total Water Use in Minnesota*, Minnesota Department of Conservation, Division of Waters, Bul. No. 7, April 1952.

how much of current municipal shortages are merely growing pains. Temporary deficits may be due to a lack of storage facilities, water mains that are too small, or inadequate pumping capacity. However, the water level is falling in the wells of some cities in southwestern Minnesota and it is becoming necessary to be more selective in locating new wells.

Although cases of a falling groundwater level are more commonly found in southwestern and western Minne-

sota, the possibility of depletion in other areas cannot be ignored. This suggests a need for planning and for developing a more comprehensive policy containing some criteria for resolving problems as they arise. Efforts in this direction include the collection of data on water supply and use and the development of administrative procedure for regulating water use. The state agency primarily responsible for work in this area is the Division of Waters of the Department of Conservation.

## *Administration of the Permit System*

Minnesota is one of the few states in the eastern half of the United States to make use of a permit system in regulating water use. This system with recent modification, has been in operation since July 1, 1937. It is comprehensive in that it requires a permit to use either underground or surface water for any purpose requiring substantial amounts of water.

### **ORIGIN AND DEVELOPMENT**

As a result of the severe drought of 1934-36, the 1937 Minnesota Legislature passed a statute making it illegal to use any waters of the state, with a few important exceptions, without first obtaining written permission from the Commissioner of Conservation. In addition, permits were required before public or private interests could change the course or cross section of public waters or construct, modify, remove, or abandon structures on or affecting these waters. In 1947 this statute was replaced with new legislation incorporating substantially the same features. The Commissioner of Conservation was again given the authority to grant permits. He has delegated the permit-issuing responsibility to the Division of Waters while retaining final approval for himself.

The 1959 Legislature amended the statute dealing with appropriation permits by removing the exemption which formerly existed for uses within municipalities. This will be discussed further when exemptions are considered.

### **PURPOSES REQUIRING PERMITS**

The overall objective, as stated in Minnesota Statutes, Chapter 105.38, is "to conserve and utilize the water resources of the state in the best interests of the people of the state and for the purpose of promoting the public health, safety, and welfare."

To accomplish this the law states that "Subject to existing rights all waters in streams and lakes within the state which are capable of substantial beneficial public use are public waters subject to the control of the state." Control is exercised by requiring a permit to work in the beds of public waters, and to remove and use surface or underground water. Work in the beds of public waters includes beach improvement, construction of piers and wharfs, navigation improvement, shore protection, and power development. This bulletin is confined to procedures and policies followed in issuing appropriation permits—withdrawing or taking and using

water—especially for irrigation. These permits may be for some form of industrial use, municipal water supply, or irrigation of agricultural crops. Appropriation permits may, therefore, be referred to as irrigation, industrial, or municipal permits, depending on the use to be made of the water.

Permits to appropriate water are required under Minnesota Statutes Chapter 105.41 which states that, "It shall be unlawful for the state, any person, partnership, or association, private or public corporation, county, municipality, or other political subdivision of the state to appropriate or use any waters of the state, surface or underground, without the written permit of the commissioner, previously obtained upon written application therefor to the commissioner. The commissioner may give such permit subject to such conditions as he may find advisable or necessary in the public interest. Nothing in this section shall be construed to apply to the use of water for domestic purposes serving at any time less than 25 persons or to any beneficial uses and rights, outside the geographical limits of any municipality in existence on July 1, 1937, or to any beneficial uses and rights, within the geographical limits of any municipality, in existence on July 1, 1959."

### **USES EXEMPT FROM PERMITS**

The major exemption included in the present law is the exclusion of the appropriation of water for "domestic uses" from the permit requirement. The statute does not define "domestic use" but limits it to a use "serving at any time less than 25 persons." The term generally includes the use of water for drinking, ordinary household uses, sanitation, and watering of livestock. The common household uses of water are, therefore, not regulated and permits are not needed for private wells intended to supply the usual farm and home uses. Motels, apartment houses,

hospitals, or other establishments where more than 25 persons may be served are required to obtain a permit if they wish to develop their own water supply.

In the case of irrigation the Division of Waters has ruled that the irrigation of 5 acres or less is a "domestic use" and that no permit is required. On occasions in the past, permits have been issued for the irrigation of 5 acres or less but the usual practice is to inform the applicant that no permit is needed.

The rule of 5 acres as the maximum that can be irrigated without a permit was based on the estimate that this amount of irrigation would involve about the same amount of water as 25 persons would ordinarily use in their everyday activity. In reaching this estimate it was assumed that irrigation would involve 6 inches or one-half an acre-foot of water per acre per year. This "one-half acre-foot" norm is the standard currently used in determining allowable appropriations for irrigation throughout the state.

Occasionally a request has been received at the Division for a permit to appropriate a relatively small amount of water for some purpose. If the total amount requested is less than 2½ acre-feet yearly, the usual policy is to inform the applicant that no permit is needed because the use falls within the domestic exemption provision.

The classification of stock watering as a domestic use is widely accepted. A question may arise in the future as to how much water can be used for this purpose and still be regarded as a domestic use. To date no explicit limit exists and the Division of Waters has regarded all consumption by livestock as domestic use. With the trend toward increasing size of agricultural enterprises, large-scale cattle feeding operations, dairy-cow pools, and other large commercial livestock operations the amount of water consumed becomes substantial. In some instances it may approach the water required to irrigate 5 to 10 acres or more. In this event the

Division may rule that the domestic classification no longer applies and may require a permit for large appropriations of water for livestock.

To date there has been no specific consideration of a limit on the amount of water that can be used for stock watering under the domestic exemption. The possibility of setting a limit is an open question. The criterion used to determine when a permit is needed for irrigation suggests one possible answer. The present rule is that a permit is required when more than 2½ acre-feet of water are used per year. This is 814,627 gallons or an average of 2,232 gallons per day. Common estimates of water requirements are 12 gallons per day for beef cattle and 25 gallons daily for dairy cows.<sup>2</sup> Using these estimates, a herd of 185 beef animals or 90 dairy cows would be expected to require approximately 2½ acre-feet of water annually. It is possible that permits may eventually be required for water to supply herds in excess of these approximate sizes. Alternative estimates of daily requirements will, of course, result in some variation in the size of

herd that can be sustained on 2½ acre-feet annually.

Until July 1, 1959, the use of water for any purpose originating within a municipality was exempt from the permit requirement. With the exception of a few industries, such as mining companies and firms that process sand and gravel, most industrial users are located within cities. Consequently, a substantial amount of water use was not regulated.

It is generally agreed that the removal of the exemption in 1959 improved the statute and is a forward step in the development of a more consistent water policy.

The permit requirement is not retroactive. That is, it does not apply to an appropriation of water that was in existence when the law was enacted. For example, any use started prior to July 1, 1937 could be continued without a permit. Of greater importance in terms of the amount of water involved are the uses that were in existence on July 1, 1959 within municipalities. For this reason a large amount of water is still used outside the permit system for industrial and municipal purposes.

## Obtaining A Permit

Requests for permits must be made on a standard application form for each type of activity planned. These can be obtained from the Division of Waters, Room 355, Centennial Building, St. Paul 1. The different forms are for requests to appropriate water, to work on the beds of public waters, or to cross state land or public waters. The application must be made in the name of the landowner. The permit is issued to him even though a tenant will actually use the water.

### APPLICATION

The application to appropriate water requires the following information:

(1) Source of water, that is, surface or underground. If the appropriation is to be from a surface body of water the applicant must name the source and indicate if it's a lake, pond, river, marsh, or drainage ditch. If an existing well is to provide the water, data are required regarding the depth and formation from which the water will be

<sup>2</sup> Ryan, D. M., *Sewage Disposal and Water Systems on the Farm*, Minnesota Agricultural Ext. Bulletin 247, Revised June 1956, p. 14.

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Rev. 4/57

### MINNESOTA CONSERVATION DEPARTMENT Division of Waters

#### APPLICATION FOR PERMIT TO APPROPRIATE WATER

To: Commissioner of Conservation, State Office Building, St. Paul 1, Minnesota

The undersigned applies herewith for a permit to appropriate or use  ground  surface water for  irrigation  industrial purposes from  wells  surface water sources upon which the undersigned has rights by  fee title  all in accordance with the data which follows (and is attached hereto).

#### I. SOURCE:

- A.  Surface Water. Name \_\_\_\_\_
- B.  Existing Wells: Number \_\_\_\_\_, Diameter \_\_\_\_\_ inches, Depth \_\_\_\_\_ feet.
- C.  New Wells: Number \_\_\_\_\_, Diameter \_\_\_\_\_ inches, Depth \_\_\_\_\_ feet.
- D.  Other (specify) \_\_\_\_\_

#### II. MANNER OF APPROPRIATION:

- A.  Gravity.  Channel Bottom \_\_\_\_\_ Bank Slopes \_\_\_\_\_  Pipe Dia. \_\_\_\_\_ "X" Sectional Area \_\_\_\_\_ Sq.Ft.
- B.  Pumping. Number of Pumps \_\_\_\_\_ Rate of Delivery \_\_\_\_\_ gpm each.
- C.  Other (specify) \_\_\_\_\_

#### III. LOCATION:

- A. Point of Taking.  
Fract. Sec. or Govt. Lot \_\_\_\_\_, Sec. \_\_\_\_\_, Twp. \_\_\_\_\_, Range \_\_\_\_\_, County \_\_\_\_\_.
- B. Area of Use.  
Fract. Sec. or Govt. Lot \_\_\_\_\_, Sec. \_\_\_\_\_, Twp. \_\_\_\_\_, Range \_\_\_\_\_, County \_\_\_\_\_.

#### IV. USE:

- A.  Irrigation of \_\_\_\_\_ acres.
- B.  Industrial for  Cooling.  Processing.  Washing.  Other (specify) \_\_\_\_\_
- C. Time (Estimated maximum):  
\_\_\_\_\_ Hours per Day, \_\_\_\_\_ Days per Month, \_\_\_\_\_ Hours per Year.  
 Continuous,  Seasonal from \_\_\_\_\_ to \_\_\_\_\_
- D. Total for year: \_\_\_\_\_ Million gallons, \_\_\_\_\_ Acre feet.

The applicant declares that the information submitted herewith and the statements made herein are true and a correct representation of the facts, and that the filing of this application and information with the Commissioner of Conservation is prima facie evidence of the correctness thereof.

Dated this \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_

Applicant \_\_\_\_\_

Authorized Signature \_\_\_\_\_ (Print or Type Name)

Address \_\_\_\_\_ (Title)

#### AFFIDAVIT

State of Minnesota )  
County of \_\_\_\_\_ ) ss

On this \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_, before me personally appeared \_\_\_\_\_ who being first duly sworn and to me known to be the person who executed the foregoing application, acknowledges that the statements, maps, plans, documents, and other supporting data are true and correct according to \_\_\_\_\_ best knowledge and relief and that \_\_\_\_\_ executed the same as \_\_\_\_\_ own free act and deed.

Notary Public \_\_\_\_\_ County  
My Commission expires \_\_\_\_\_, 19\_\_\_\_

withdrawn, drillers log, pumping tests, type of construction, and the name and address of the driller. The Division has a form for this information which can be obtained by requesting it along with the regular application blank.

(2) Manner of appropriation, which will usually be by pumping but may be by gravity. If pumps are to be used the rate of delivery in gallons per minute must be indicated.

(3) Location of point of taking and area of use. A complete legal description of the land is required together with a map or diagram showing the location relative to a section or quarter-section corner. If the water is to be pumped from a lake, stream, or other surface source the applicant's land abutting the source should be clearly indicated. If a well is to supply the water its location must be designated.

(4) The use for which the applicant wishes to appropriate the water. If it is to be used for irrigation, the number of acres to be irrigated must be stated.

(5) The rate of use and amount of water desired. The rate is given in terms of the capacity of the pump, the estimated maximum pumping hours per day, days per month and hours per year, and the total amount in terms of million gallons and acre-feet. The applicant is also required to state whether the use is to be continuous throughout the year or seasonal.

(6) When the application is completed it must be notarized and sent to the Division of Waters.

When the Division of Waters receives the application, they may (1) approve it as submitted, (2) amend it to include restrictions or limitations, or (3) deny the application. Rarely is a permit denied. There is always a limitation placed on the amount of water use authorized and occasionally other restrictions are added. For example, pumping may be limited to certain times of the year or authorized only when the water exceeds a certain level.

Permits are usually processed in a few days unless insufficient information has been provided. In that event the Division sends a letter requesting the necessary information.

### AMOUNT OF WATER TO REQUEST

Many applications contain data that are not consistent. An applicant may request one amount of water in one place on the application and a different amount in another section. This inconsistency probably results from confusion as to what information is required and how the terms are related. An example may help show the relationship.

It is necessary to know beforehand the rate of delivery of the pump in gallons per minute. If irrigation is involved, the farmer will probably know the amount and size of equipment needed for the acreage he wants to irrigate. The Division limits the appropriation to 6 inches per acre per year. This sets a limit on the total amount of water when the acreage is known. A third fact that must be known to complete the application is the conversion of acre-feet to gallons. An acre-foot is the volume of water needed to cover 1 acre to the depth of 1 foot. This is 325,851 gallons, which for purposes of convenience can usually be rounded to 325,000 gallons. In the case of requests for very large amounts of water the exact conversion ratio should probably be used. To illustrate the calculation involved assume the following conditions:

Acres to be irrigated	30
Therefore, the maximum amount of water	15 acre-feet
Rate of delivery of pumps (gallons per minute)	250 gpm
This information permits the following calculations:	
Rate of delivery of pump, in gallons per hour (250 × 60)	15,000 gph
Amount of water in gallons (15 × 325,000)	4.9 million gallons
Hours of pumping required (4,900,000 ÷ 15,000)	325 hours

These hours can be distributed over the months in which the irrigating is to be done. Actually, the amount of water used in a particular month will depend on rainfall but it is most convenient for the applicant to divide it equally among the months. Assuming a distribution over 5 months, this would mean about 64 hours per month which could be accomplished by pumping 8 hours per day for 8 days per month. The irrigator does not have to follow this distribution and may pump when he wishes if he stays within the yearly total.

Exact calculations are not required but it is to the applicant's advantage to be consistent throughout the form. For example, gallons per minute X 60 X hours per year should be approximately equal to the gallons requested per year. If the two calculations do not agree he may be granted a permit for the smaller amount.

### PROCEDURE ON ISSUING

When a permit application is received, the normal procedure is for the personnel of the Division of Waters to check the application for completeness and accuracy. If the water is to be taken from a surface source, the map or diagram and the description of the land as given in the application are checked against the government land office map. This is the procedure used to determine whether or not the parcel described in the application is riparian (abutting the lake or stream) and therefore eligible for irrigation from

this source in accord with Division policy. It is then considered by the Director and his staff and usually granted, although the amount of water requested may be changed and other conditions attached.

### PUBLIC HEARINGS

Public hearings on permit applications are provided for by law. At the Commissioner's discretion this provision may be waived and the application granted or denied. In practice, hearings are rarely held unless the request involves a substantial amount of water for municipal or industrial use. Although the volume of water involved in requests of these types is the primary reason for holding public hearings, it is not usually the sole or even the most important issue considered. The fact that there is no limit that can logically be applied to industrial and municipal uses generally makes adjustment in volume impractical. The issue in dispute may be the determination of the best source, or the conditions that should be added to the permit to prevent pollution. It is rare for controversy to arise over the amount to be used.

If the application is denied or the permittee is dissatisfied with the conditions imposed, he may demand a hearing. The request for a hearing must be made within 10 days after the date the permit or notice of denial is mailed to the applicant. Upon request for a hearing the original order no longer applies and the new decision is based on the results of the hearing.

## General Provisions of Appropriation Permits

Appropriation permits are usually issued on a standard permit form. Since most provisions are common to all appropriation permits they are printed on this standard form.

### ASSIGNMENT

The permit specifies that written consent must be obtained from the Commissioner of Conservation before it can

be assigned. In the case of irrigation this might be desired if land is transferred. Because of the small number of permits for irrigation in Minnesota relative to the number of farms, assignment has not been common. If it is desired, consent to assign is usually obtained without difficulty.

### CONDITIONS FOR TERMINATION

The Commissioner of Conservation has broad authority to terminate the permit if he considers it necessary for the conservation of water resources, or in the interest of public health and welfare.

Operations of the permittee that cause injury to the property of others or violation of any of the provisions of the permit may also be causes for cancellation.

### MAXIMUM WATER ALLOTMENT

All appropriation permits include a limit in acre-feet of water to be used in any calendar year. This is usually the only provision that varies from one permit to another. In the case of municipal or industrial uses it is usually the amount requested by the applicant, but for irrigation there may be some adjustment.

### PUMPING RECORDS

The permittee is required to keep a continuous record of pumping operation and to hold this record available for inspection. A form is provided to be used for keeping this record. Farmers or others who irrigate are not required to have metering devices on their pumps though this may be necessary for municipal and industrial appropriation. A record must be kept of the dates, number of hours, and rates of pumping. This form must be completed, notarized, and submitted to the

Division of Waters annually. If no pumping is done in a particular year, this fact should be noted on the form and the form submitted as usual. Failure to make the annual report results in a reminder from the Division. If not heeded, it is followed by cancellation of the permit.

### PERMITS TO IRRIGATE AGRICULTURAL LAND

The statute on procedure to be followed under the permit system (M.S.A. 105.44) includes special provisions relating to irrigation. The Commissioner is to grant the permit to an eligible applicant unless he finds that it would be against the public interest or would deprive another of the share of public water to which he is entitled. If no ruling is made or hearing set within 30 days after filing the application or within 20 days after filing any additional information which may have been requested, the applicant may consider the permit granted.

Another provision peculiar to permits for the irrigation of agricultural lands is that they are subject to cancellation upon the recommendation of the supervisors of the soil conservation district within which the irrigated land is located. Presumably this could occur if an erosion hazard resulted from irrigation. No recommendation of this nature has ever been recorded.

### Water Allotment

For irrigation of agricultural lands the Division of Waters has adopted a policy of allowing a maximum of 6 inches (one-half an acre-foot) per year for each acre of land to be irrigated. If the size of the field is 80 acres the maximum becomes 40 acre-feet of water yearly. In most instances the limit is placed at 6 inches per acre per year regardless of the amount requested. There are cases, however, where the

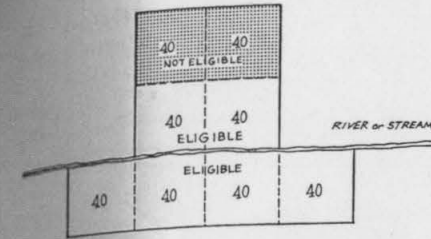


Fig. 4. Land eligible for irrigation with surface water

applicant has requested less and the maximum has been set at this smaller amount.

### Land Eligible for Irrigation

A farmer may be granted a permit to irrigate any land he wishes if the source of water is a well. However, the acreage of land that can be irrigated from lakes or streams is limited by Division policy. The Division grants permits for water use only on the 40-acre tracts or government lots abutting the source. In other words, a farmer owning a square 160 acres with a river running along one side of his farm may get a permit to irrigate only the two 40-acre tracts adjacent to the river. If the four 40s or government lots are in a line along the river they may all be irrigated. The application of this policy is illustrated in figure 4.

The volume of irrigation water requested from surface sources has frequently been adjusted on the permit to one-half acre-foot for each acre considered eligible by this criterion. As of January 1, 1960, only five applications

to appropriate water for irrigation have been denied and in each case the land to be irrigated was not in the 40-acre tract or government lot abutting the source of water.

### ENFORCEMENT

The violation of any of the provisions of the permit system is by law a gross misdemeanor. It has been the policy of the Division, however, to strive for cooperation and compliance with the requirement rather than to prosecute for violation. If a report is received that water is being appropriated without a permit the person is notified of the need for a permit and ordered to stop using the water until a permit is granted.

The Game Warden Service serves as the enforcement agency for most types of permits other than appropriation. These are primarily the permits for work on the beds and shorelines of lakes and streams. Game wardens were formerly responsible for the enforcement of appropriation permits but this practice has been discontinued unless the water is to be used for some purpose directly connected with the regular duties of the warden.

The Division maintains contact with appropriation permit holders through its requirement that an annual report be submitted on the amount of water used. Since cancellation of the permit will result from failure to comply, this requirement serves as a principal method of enforcement of appropriation permits.

### Distribution of Permits

The Minnesota permit system has been in operation for over 23 years. In that time a large number of applications has been processed. The files of the Division of Waters indicate that by

July 1, 1959 a total of 4,512 permit applications of all types had been received. Of this total, 288 were later withdrawn, 93 were denied, and 130 applicants were informed that a permit

was not needed. A total of 3,866 permits were issued of which 652 were for the appropriation of water.

### GEOGRAPHICAL DISTRIBUTION

The number of permit applications per county varies considerably over the state. To January 1960 there had been only two applications from Stevens County, while there were 10 counties with more than 100—ranging from 106 from Ottertail to 696 from Hennepin County. Permits for shoreline improvement, channel change, dam construction, and utility and highway bridges crossing state water are included as well as those for the appropriation of water. Figure 5 shows the distribution of permit applications during the period from July 1, 1937 to December 31, 1959. Many of the permit applications originate in the central lake region, as requests for permission to improve beaches and construct boating facilities.

Appropriation permits have a more limited distribution and in seven coun-

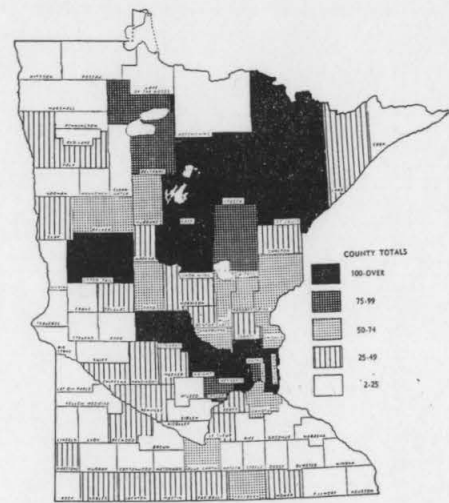


Fig. 5. Total number of permit applications by county—July 1, 1937 to December 31, 1959

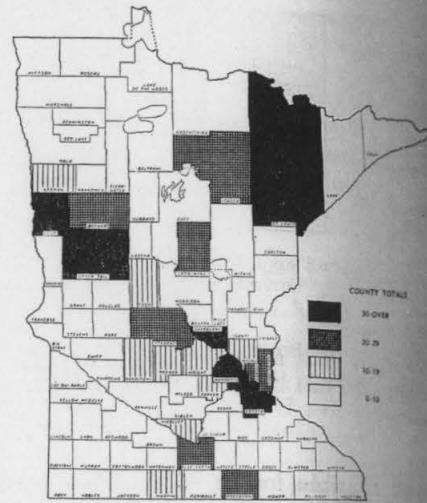


Fig. 6. Number of appropriation permit applications by county—July 1, 1937 to December 31, 1959

ties none have been issued. The majority of the appropriation permits are in the metropolitan area and in the counties to the northwest (figure 6). Other counties with 20 or more appropriation permits include St. Louis, Itasca, and Crow Wing where the permits for use of water in mining operations are concentrated. Nicollet, Martin, Blue Earth, and Freeborn also have 10 or more applications for water appropriation.

Permits to appropriate water for irrigation are distributed in a similar southeast-northwest pattern extending from Washington County to Polk County. The area included has numerous lakes and streams enabling a relatively larger number of farmers to obtain surface water for the irrigation of agricultural crops. In addition the water table is frequently near the surface and ground water can be obtained without expensive pump installation. In southern Minnesota, only Faribault, Freeborn, Lyon, Martin, and Mower Counties have five or more irrigation permits (figure 7).

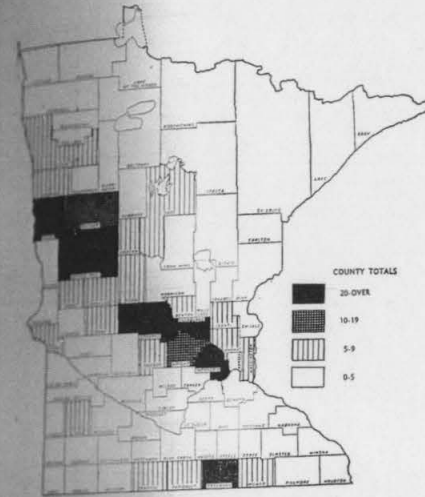


Fig. 7. Number of irrigation permit applications by county—July 1, 1937 to December 31, 1959

### DISTRIBUTION OVER TIME

The number of permits has increased substantially since the early years of the permit system. After an initial climb to 280 for the year July 1, 1938 to June 30, 1939, the number of applications for permits of all kinds dropped to a low of 16 each for the years ending June 30, 1942 and June 30, 1943. The number increased gradually after World War II to a high of 793 applications in the year ending June 30, 1959.

Permits for the use of water have followed a pattern similar to that for all permits over the history of the system. Almost half of the total number of applications for water appropriation received since 1937 have been submitted in the last 4-year period, 1956-59 inclusive. Over 85 percent of the total appropriation permit applications were made since January 1, 1951.

Prior to removal of the municipal exemption in 1959 applications for the use of water for irrigation contributed by far the largest share of the increase in appropriation permit requests. Figure 8 shows the number of appropria-

tion permit applications for each calendar year and illustrates the importance of irrigation requests in these yearly totals. It also shows the increase in 1959 in the "other" category, made up largely of municipal requests.

The rapid increase in the number of applications suggests that much more water is being used under the permit system in recent years. While a few of the permits are for a short-term, once-only basis, most of them run for an indeterminate period. The new permits granted in each year thus add to the authorizations of previous years (figure 9). Because the amount of water use authorized varies widely among individual permits, the increase in numbers does not necessarily indicate a proportional increase in the amount of water being appropriated.

### DISTRIBUTION OF PERMITS BY PURPOSE

The permit system covers the use of water for a variety of purposes. In the past some of these uses have been only partially subject to the permit requirement because of the exemption for use within municipalities. With the removal of this exemption by the 1959 Minnesota Legislature, permits will be required for all future expansion except for domestic uses.

On the basis of permit numbers, irrigation was a relatively minor use until 1951 (figure 8). Between 1937 and 1951 this type of water use accounted for less than one-half of the permit applications received each year with the exception of 1940. Starting in 1951 and for each subsequent year, except 1959, irrigation has accounted for over one-half and sometimes over three-quarters of total appropriation permits.

The smaller number of permits for industrial uses can largely be explained by the fact that a large share of these uses occurred within cities and were therefore exempt during this period.



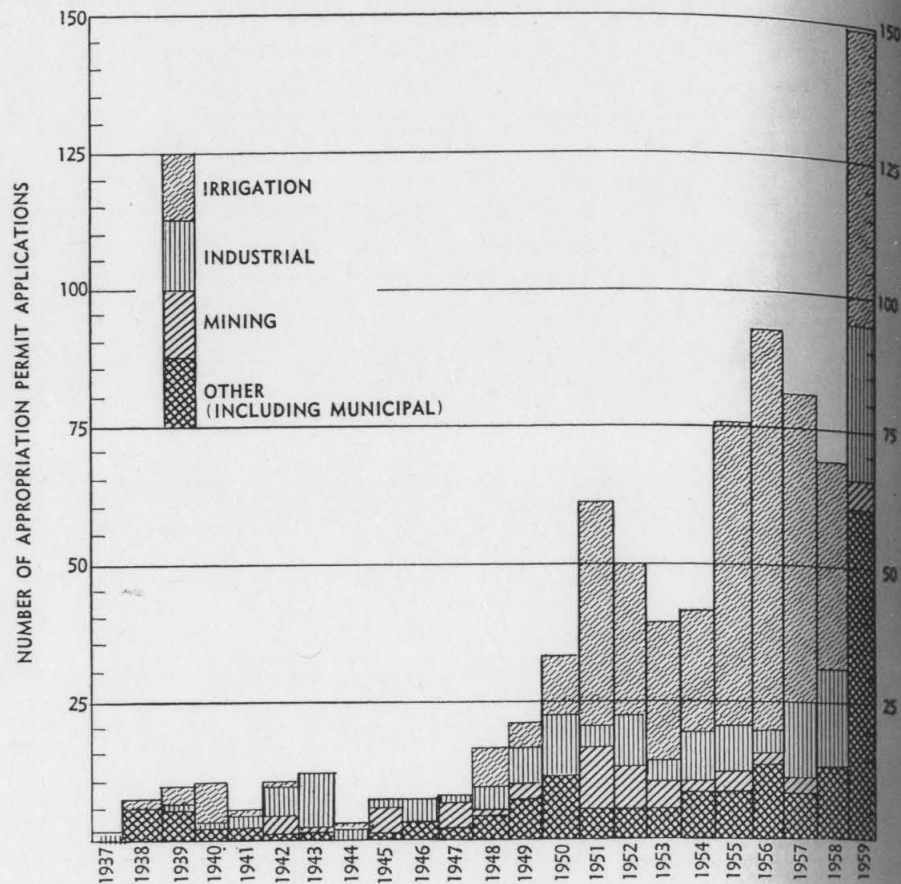


Fig. 8. Number of appropriation permit applications per year by use—1937 to 1959

The water needed for mining operations is largely withdrawn outside cities and permits are required in most cases. The location of the point of taking has been the determining factor in the municipal exemption. If a municipality wanted to go outside the city limits to drill a well or remove water from a lake or stream a permit had to be obtained. This accounts for the permits issued for municipal use although it is emphasized that these cover only a small proportion of the water used by municipal water systems.

When the uses are compared on the basis of volume of water a different

picture emerges. To obtain the distribution pattern in recent years the appropriation permits issued from January 1, 1954 to January 1, 1960 were selected for further study. Table 2 contains information on permit numbers and water use authorized during this 6-year period. It was compiled by adding the maximum acre-feet authorized by each permit. Since almost all the permits continue in force from year to year these amounts represent additions for each year to the total authorized.

Although the permits issued for irrigation were more numerous over this 6-year period, the amount of water

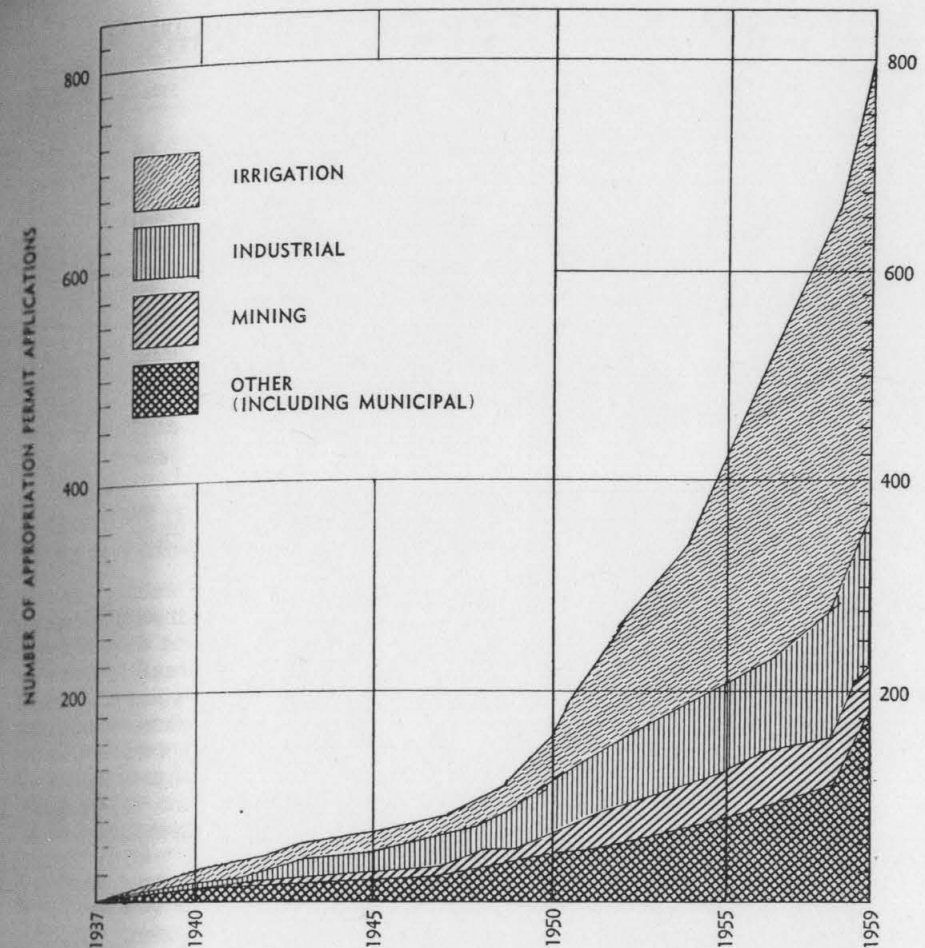


Fig. 9. Cumulative total of appropriation permit applications—1937 to 1959

authorized was less than in each of the three other major-use classes: mining, other industrial, and municipal. The relatively small volume involved in each irrigation permit can be seen by comparing the average of 40.7 acre-feet per permit, shown in table 2, with the much larger authorizations for other purposes.

The small size of the typical irrigation permit is further emphasized in table 3 which compares the percent of acre-feet authorized with the percent of permits issued for each purpose.

During this 6-year period, 57.5 percent of the permits issued were for irrigation but these accounted for only 6.3 percent of the water use authorized. The other three major uses accounted for a much smaller percentage of the permits but because of the larger average size involved greater amounts of water.

In practice the actual withdrawal of water in any year is almost always less than the maximum authorized. The figures in the tables thus tend to overstate the volume used. Another modify-

Table 2. Appropriation permits issued, by type of use, 1954-59

	1954	1955	1956	1957	1958	1959	1954-59	Average per permit
<b>Irrigation</b>								
Number of permits .....	17	48	58	35	34	50	242	
Acre-feet .....	522	2,258	2,185	1,253	1,589	2,040	9,847	40.7
<b>Mining</b>								
Number of permits .....	1	3	2	3	.....	5	114	
Acre-feet .....	300	2,022	8,065	277	.....	1,704	12,368	883.4
<b>Other industrial</b>								
Number of permits .....	7	6	9	13	15	27	77	
Acre-feet .....	5,264	264	3,414	6,110	3,480	7,450	25,982	337.4
<b>Municipal</b>								
Number of permits .....	2	2	2	5	9	40	60	
Acre-feet .....	2,330	194	236	7,521	3,092	89,648	103,021	1,717.0
<b>Other</b>								
Number of permits .....	1	4	6	2	5	10	28	
Acre-feet .....	42	92	239	774	510	2,923	4,580	163.6
<b>Total</b>								
Number of permits .....	28	63	77	58	63	132	421	
Acre-feet .....	8,458	4,830	14,139	15,935	8,671	103,765	155,798	370.1

ing characteristic is that some water use is consumptive and some is non-consumptive. By some standards, irrigation is regarded as consumptive since water is removed from a lake or stream and is not returned directly to the source. However, a portion of the water may be returned by recharge through the ground. A considerable amount of

the water used for industrial purposes is returned to the source though this is frequently at a different location or downstream from the point of original withdrawal. Despite these modifying factors the authorized volume can be regarded as a rough approximation of the increased utilization of appropriated water for the various purposes.

Table 3. Appropriation permits—percentage distribution, by type of use, 1954-59

	1954	1955	1956	1957	1958	1959	1954-59
	percent						
<b>Irrigation</b>							
Number of permits .....	60.7	76.2	75.3	60.3	54.0	37.9	57.5
Amount of water .....	6.2	46.7	15.5	7.9	18.3	2.0	6.3
<b>Mining</b>							
Number of permits .....	3.6	4.8	2.6	5.2	.....	3.8	3.3
Amount of water .....	3.5	41.9	57.0	1.7	.....	1.6	8.0
<b>Other Industrial</b>							
Number of permits .....	25.0	9.5	11.7	22.4	23.8	20.4	18.3
Amount of water .....	62.2	5.5	24.1	38.3	40.1	7.2	16.7
<b>Municipal</b>							
Number of permits .....	7.1	3.2	2.6	8.6	14.3	30.3	14.3
Amount of water .....	27.6	4.0	1.7	47.2	35.7	86.4	66.1
<b>Other</b>							
Number of permits .....	3.6	6.3	7.8	3.5	7.9	7.6	6.8
Amount of water .....	0.5	1.9	1.7	4.9	5.9	2.8	2.9
<b>Total</b>							
Number of permits .....	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Amount of water .....	100.0	100.0	100.0	100.0	100.0	100.0	100.0

## Farmers' Impressions of Permit Conditions

Some of the irrigation permits have been in force for several years and the permittees have had an opportunity to gain impressions of the permit system from their own experiences. In an effort to sample these impressions, 30 farmers who have permits to appropriate water for irrigation were interviewed in 11 counties. The counties visited were: Becker, Brown, Clay, Freeborn, Grant, Jackson, Martin, Mower, Otter-tail, Sherburne, and Wright.

### FARMERS IRRIGATING WITHOUT A PERMIT

The farmers were asked how they found out that a permit was required to irrigate. Some farmers answered that they learned of the requirement from farm papers, through personal investigation, from the game warden, or soil conservation technician. One farmer said he remembered when the law was passed. The majority of the farmers stated that they first learned of the permit requirement from an irrigation equipment agent or salesman.

There are probably some farmers irrigating without a permit although those who do have permits said almost universally that they knew of none. Most farmers interviewed agreed that it was a simple matter to get a permit and few were worried that the permit would not be granted. The consensus among the farmers seemed to be that irrigating is expensive—requiring equipment costing from \$1,500 to over \$6,000. Anyone planning this expenditure should be certain that he is fulfilling all requirements before spending this much on equipment. In fact, some farmers with permits had not yet bought irrigation systems, and most of the farmers who were irrigating obtained the permit before buying equip-ment.

### THE PERMIT REVOCATION PROVISION

One of the conditions of the permit is that the Commissioner of Conserva-tion may terminate it at any time. This authority is conferred by Minnesota statutes which require that this condi-tion be stated on every permit issued. The farmers interviewed were asked whether this, or any other condition on their permit, hindered them in buying irrigation equipment or buying better or more expensive equipment. Only 4 of the 30 farmers interviewed answered that this condition hindered them, one saying that it was one of the reasons why he had not bought equipment and another saying that he bought less ex-pensive equipment. Most of the farm-ers said that the conditions caused them no concern and that they were not disturbed by the possibility that the Division of Waters might terminate their permits.

### THE ACRE-FEET LIMITATION

The acre-feet limitation on the irri-gation permit varies with every permit situation and is one of the most im-portant conditions. In most cases this is determined on the basis of 6 inches of additional moisture for each acre to be irrigated. The farmers who were interviewed were asked if they thought 6 inches of additional moisture was sufficient to supplement the natural rainfall in their area. They were also asked if they had ever irrigated up to the maximum set by the acre-feet limitations on their permits.

Of 24 farmers answering the first question, 5 answered flatly that they thought more than 6 inches was needed each year; 5 answered that they thought it was sufficient to supplement the natural rainfall. Thirteen farmers said

that a 6-inch supplement was not enough in a dry year but would be in a normal year while one thought it was enough only in a wet year. Despite the general criticism of the limit only 2 farmers out of the 30 had ever used up their acre-feet allocation in any given year.

The acre-feet limitation deserves further consideration. It was adopted in the late 1940's after consultation with the Department of Agricultural Engineering, University of Minnesota. Staff members in the Department were of the opinion that 6 inches of supplemental water was generally sufficient under normal circumstances. Recent research at the University confirms that this amount of additional moisture is usually adequate in all parts of the state. However, there may be difficulties arising when an amount that is usually sufficient is set as the maximum that can be used under all conditions. There are undoubtedly cases in dry years when a crop should get more than 6 inches of additional moisture.

There is some question whether the single rate is appropriate for all areas of Minnesota in view of the considerable variation in rainfall and water-holding capacity of the soil. Ideally, individual conditions should be considered together with the adequacy of the supply for each permit issued. Much time and money would be needed to investigate each situation, and it is possible that the major variations could be accounted for satisfactorily by dividing the state into areas or zones and adopting a suitable rate for each zone. As more information is compiled from the pumping records submitted by farmers, the Division will obtain better data by which to test the adequacy of this allotment.

A farmer is unlikely to have to make a choice between letting his crops suffer and the violation of his permit conditions. The intent of the provision is to limit the total volume of water used; it is not intended to limit the application to 6 inches on each acre.

For example, assume that a farmer has a permit to irrigate 40 acres with a limitation of 20 acre-feet. If he irrigates all 40 acres he is limited to an average of 6 inches per acre. However, in any particular year he may irrigate 20 or 30 acres. He is still permitted to use up to 20 acre-feet without violating his permit, and so he can apply more than 6 inches per irrigated acre.

### GENERAL IMPRESSIONS

Although it was the consensus among the farmers interviewed that there was no real water problem in the state at the present time, most of them thought that the permit system or some alternative regulation of water use was necessary. Only 1 farmer out of 25 answering raised any significant objection to the permit requirement. Most of them felt that there probably would be a water problem in the future and that it was a good idea to begin regulation now.

Some pointed out, however, that many industrial users were not regulated. There was particular objection to the use of water for air conditioning which some considered to be a waste of water. Some farmers, especially those irrigating from a large lake or river, could not see the necessity of regulating the amount of water they used since it appeared to them to be a mere "drop in a bucket." Farmers generally did not object to procuring a permit, however, as long as the Division of Waters was liberal with the amount of water allotted. One farmer pointed out that there is no need to worry that farmers who are irrigating will waste water because the cost of irrigating runs too high. Many expressed the opinion that the amount of water allotted to each farmer for irrigation should depend on the type of soil on the farm and the crops grown, as well as upon the area in which the farm is located. The 6 inches per acre limitation appeared to them to be somewhat arbitrary.

## Security of Rights Granted by Permits

There has not been a court test of the constitutionality of the permit system in Minnesota. In view of this there is always the possibility that some change may be brought about through action in the courts. Additional change may result from administrative decisions affecting the security of rights granted by the permit. Present administrative procedures have not been subjected to the test of a severe drought similar to that in 1934-36. Consequently, there remain many uncertainties regarding possible development in the event of an acute water shortage.

Anyone wishing to use water for irrigation or any other purpose except domestic use must first secure a permit from the Division of Waters to appropriate water. Upon obtaining the permit he is legally authorized to use up to the prescribed amount in the manner specified. There is no guarantee that he may enjoy that right indefinitely. In fact, each permit contains a condition that it may be cancelled at any time by the Commissioner of Conservation, if necessary, for the conservation of the state's water and in the interest of the public health and welfare. One may question the security of this right. A permit holder must, of course, comply with all provisions—including the report on the amount of water used each year. Even though he meets all these conditions, there remains the possibility of cancellation in the public interest. To date no permit has been cancelled for any reason other than a failure to comply with the conditions or at the request of the permittee. Past experience gives no definite answer to the question: How secure is this right? However, a look at the basic water doctrine existing in Minnesota may give some indication of what might happen.

The situation relating to ground water would differ from that relating to water from lakes or streams so they must be considered separately.

### GROUND WATER

Security in retaining the right to pump ground water for irrigation seems well established. There remains the possibility of physical difficulties if neighboring landowners also pump large quantities of water with a consequent lowering of the water table. The likelihood that this may occur will vary widely among areas because of the differences in quantity and availability of ground water.

From a legal viewpoint it should be noted that the Minnesota courts have recognized the rule of "reasonable use" for ground water. This generally means that landowners have the right to pump as much water from ground sources as they can reasonably use. Irrigation would logically be regarded as a reasonable use. It would seem then that a farmer can be fairly confident that his permit will not be cancelled as long as he complies with the conditions.

### NATURAL SURFACE WATER-COURSES

The security of the right to take water from lakes and streams for irrigation is not as clearly defined. To aid in assessing possible developments it is beneficial to examine the several water doctrines existing in the United States. The 17 western states recognize the system of prior appropriation (with, in some cases, elements of the riparian doctrine) while the doctrine of riparian rights prevails in the 31 eastern states including Minnesota.

### **Prior Appropriation Doctrine**

This system gives the person who first uses water for a beneficial purpose a higher priority. Under this doctrine it is not necessary for him to own land abutting the lake or stream. If the supply should become inadequate to meet all the needs of the appropriators, the one who is first in time is first in right. Therefore, the senior appropriators would have a right to an undiminished supply and those who acquired their rights most recently would have to forego all water use. This leaves the senior appropriator in a very secure position but junior appropriators have uncertain rights.

### **Riparian Doctrine**

The riparian doctrine recognizes that the owner of land adjacent to a stream or body of water has the right to use the water. He may use as much as he needs for domestic purposes and may also use the water for other purposes subject to the equal rights of each riparian owner above and below him to make use of the water for similar purposes.

There are generally two types of uses recognized in the riparian system: natural and artificial. The natural uses, sometimes called domestic uses, include the use of water for drinking, cooking, and other household uses, and watering livestock. For these purposes an upstream riparian user may use as much water as he needs even if it means that someone further down the stream gets none. However, note that this applies only to natural uses. In the case of artificial uses, which usually include irrigation and industrial consumption, all riparian users share equal rights. If there is not enough water to go around each owner must curtail his use to per-

mit other riparian owners to exercise their legal rights. Here there is no priority in time of use and the first person to withdraw water from a particular source derives no advantage from that fact. A riparian landowner retains his right of use even if he does not exercise it because it is regarded as a property right incident to the ownership of his land.

Limited use of surface water on non-riparian land is permitted in some states that generally follow the riparian doctrine but only on the condition that the use has no adverse effect on riparian owners and does not interfere with any use by riparian owners.

### **Applications in Minnesota**

Although no published court decision deals explicitly with the features of the Minnesota permit system, there have been numerous cases involving the use of water from natural surface watercourses. The Minnesota courts have consistently held that riparian owners can make a reasonable use of these waters. Presumably, an irrigator would be entitled to his share of the water in excess of that needed for natural or domestic uses. This would mean that in the event of water shortage, possibly brought on by other riparians exercising their rights, he might have to reduce his consumption but probably would not need to fear complete cancellation.

Some irrigators have asked whether or not the length of time a permit is held would affect the rights. The answer would seem to be no. The Minnesota Supreme Court has rejected the argument that prior use grants any special rights. This, in fact, is one of the primary distinctions between the riparian doctrine and the appropriation doctrine.