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The Quality of Minnesota Waters for Irrigation

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WHEN CONSIDERING A WATER SUPPLY FOR IRRIGATION, one must be concerned with the quantity of water available, the quality of the water, and the legal rights to its use. This bulletin is primarily concerned with the second factor.

A review of the history of irrigated agriculture shows many instances where crop production declined markedly after a few successful years of irrigation. Once-productive soils are known to have become barren wastes as a result of the accumulation of chemical salts within the root zone.

A permanent agriculture under irrigation depends upon several factors such as soil drainage, salt tolerance of crops, farm management practices, and the quantity and quality of the irrigation water. The most important of these is probably drainage since it greatly affects most of the other factors.

With the increased use of irrigation in Minnesota, new sources of water are being used. Some of the waters being considered are known to be of low quality. The object of this study was to bring together in as compact and usable form as possible all data relative to the presence and concentration of salts found in Minnesota waters, with special emphasis toward their suitability for irrigation purposes.

Drainage and the Soil-Leaching Process

All irrigation waters contain a certain amount of dissolved mineral salts, varying from practically none to very large amounts. Being a constituent of water, salt is added to the soil each time the crop is irrigated. Plants take up very little of the dissolved minerals from irrigation water. Therefore, most of the minerals carried into the root zone of the soil with the irrigation water remain in the soil or in the unused portion of the water. Where soil drainage is impaired, these mineral salts accumulate and a salinity problem develops. With good drainage, however, an accumulation of salt can be prevented by applying excess water to the soil to flush or leach the salt from the root zone. To prevent an accumulation of salt in the root zone, the amount of salt leached from the soil must be equal to or greater than that introduced by the irrigation water. For this reason, soils that cannot be readily drained should not be irrigated with waters that have a high salt content.

Because of poor drainage conditions, salts tend to accumulate in fine textured soils, or in soils having a claypan located relatively near the surface. A soil in which the salt accumulation is sufficient to reduce crop yields is known as a saline soil. A white deposit on the surface in the spring of the year is usually indicative of a saline soil condition.

Irrigation Water Quality

Irrigation waters are given quality classifications according to the amount and kind of salts present. Certain salts

are beneficial to crops, while others impair plant growth even when present in small amounts. Normally the major constituents found in irrigation waters are the calcium, magnesium, potassium, and sodium cations, and the bicarbonate, sulfate, and chloride anions. Boron, potassium, silica, carbonates, and nitrates are sometimes present but usually only in low concentration. Small amounts of other substances may also be found in some waters but their influence on the quality of the water for irrigation use is not considered to be important and are usually neglected.

Wide differences also occur in the ability of plants to withstand salt. Those changes which occur within a plant, as a result of an increase in salt concentration, are not thoroughly understood. The ease with which a plant obtains water from the soil appears to be related to the osmotic pressure of the soil solution. As the osmotic pressure increases, with an increase in the salt concentration, it becomes more difficult for the plant to extract water from the soil, thus causing wilting to occur. Table 1, showing the relative tolerance of various crops to salt constituents in the soil solution, has been compiled by the U. S. Salinity Laboratory (Richards, 1954).

Those characteristics of a water supply which appear to be most important in determining its suitability for irrigation purposes are: total concentration of soluble salts; percentage of sodium to other cations; and the concentration of boron.

Total Concentration of Salts

The total concentration of soluble salts in an irrigation water supply is usually expressed in terms of its electrical conductivity, since a large proportion of the inorganic salts dissolved in water are ionized. These ions can conduct an electric current and use of this easily measured property is made to determine the total salt concentration. The unit of electrical conductivity is mhos per centimeter, measured at a temperature of 25° C. The conductivity is calculated by measuring the electrical resistance between two platinum electrodes, using a calibrated conductivity cell and a Wheatstone bridge. Because most natural waters have electrical conductivity values of much less than one mho per centimeter, for pur-

Table 1. Relative tolerance of crops to salt constituents in the soil solution, arranged in order of decreasing tolerance

Type of crop	Tolerant	Semitolerant		Sensitive
Fruits		Grape		Pear Plum Apricot Apple Peach
Field and truck	Sugar beet Garden beet Milo Rape Kale	Alfalfa Flax Tomato Asparagus Sorghum (grain) Barley (grain) Rye (grain) Oats (grain)	Cantaloupe Lettuce Carrot Spinach Squash Onion Pepper Wheat (grain)	Vetch Peas Celery Cabbage Artichoke Eggplant Potato Green bean
Forage	Salt grass Bermuda grass Rhodes grass Wild rye Wheat grass	White sweet clover Yellow sweet clover Perennial rye grass Mountain brome Birdsfoot trefoil Sudan grass Tall fescue	Rye (hay) Wheat (hay) Oats (hay) Orchard grass Meadow fescue Reed canary Smooth brome	White Dutch clover Alsike clover Red clover Ladino clover

poses of convenience in recording or expressing such results the measured value is multiplied by 10^6 and reported as micromhos per centimeter (μmhos/cm). For example, sample 2-90 taken from the Des Moines River near Windom in Cottonwood County has a measured conductivity of 0.000794 mho/cm. The conductivity for the sample is reported in table 4 as 0.000794×10^6, or 794 micromhos/cm.

In some instances it is convenient to estimate the weight of dissolved salts being applied each year to a given soil through the irrigation water. There is no simple relationship between electrical conductivity and total dissolved solids (T.D.S.). For most natural waters, however, an approximate value of total dissolved solids (in parts per million) can be obtained by multiplying the conductivity (in micromhos) by the factor 0.64.

Thus, the above mentioned Des Moines River sample, which has a conductivity of 794 micromhos, has a calculated T.D.S. of about 508 ppm. The total dissolved solids in tons per acre-foot of water can be obtained by multiplying the T.D.S. concentration in parts per million by the factor 0.00136. This is based on the fact that an acre-foot of water weighs 2.72 million pounds.

In Minnesota waters, the total salt concentration usually varies between 0-5,000 micromhos in electrical conductivity units, or from 0-3,200 parts per million of total dissolved solids. In some instances, however, water pumped from deep wells located along the western boundary of the state, have much higher concentrations. The water from the Humboldt well in Kittson County, sample 1-10 in table 6, showed T.D.S. of 57,220 ppm (89,400 micromhos). This is an artesian well—the water flowing from a coarse sand and gravel formation located at a depth of about 175 feet. Other wells along the western boundary have indicated T.D.S. values from 6,400 to 16,000 ppm. Fortunately, however, wells of this type seem to be the exception rather than the rule. Total salt concentrations in most waters from lakes, streams, and other surface supplies were found to be less than 1,500 micromhos, or 960 ppm of dissolved solids.

Sodium Adsorption Ratio

When water high in sodium is applied to a soil, some of the sodium is taken up by the clay in the soil. The clay exchanges calcium and magnesium for the incoming sodium. This ion exchange, or "base exchange" as it is sometimes known, alters the physical characteristics of the soil.

The calcium, magnesium, potassium, and sodium cations, therefore, determine to a considerable extent the physical characteristics of the soil, since such ionic constituents of irrigation water react with the base-exchange material of the soil. In proper proportions, calcium and magnesium tend to encourage good structural and tilth conditions. The presence of large amounts of sodium, however, causes the soil to become sticky and plastic when wet and also impermeable to both air and water. Upon drying such a soil shrinks and cracks badly, forming hard clods that are difficult to till. Sodium may also cause direct injury to plants. With sodium-sensitive crops, the plants may become injured before the physical condition of the soil starts to deteriorate noticeably.

The risk involved in using water containing sodium for irrigation is evaluated in terms of the sodium adsorption ratio (SAR). This ratio provides a simple expression for relating the sodium condition within the soil solution to the soil's capacity for adsorption of sodium.

The sodium adsorption ratio, as defined by the United States Salinity Laboratory (Richards, 1954), can be expressed by the equation:

$$SAR = \frac{Na^+}{\sqrt{\frac{Ca^{++} + Mg^{++}}{2}}} \quad (1)$$

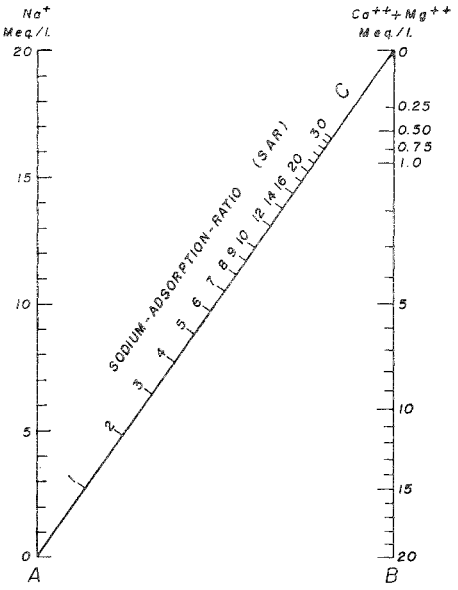

Fig. 1. Nomograph for determining sodium adsorption ratio.

where SAR is the sodium adsorption ratio and the indicated concentration of ions (calcium, sodium, and magnesium) are in milliequivalents per liter. If SAR values are to be obtained from a large number of water samples, a nomograph of equation (1) should be made as shown in figure 1.

Effect of Boron on Soils and Crop Growth

Boron is found in practically all natural waters but usually does not occur in concentrations sufficient to cause injury to the plant. Although boron is one of the most important minor elements necessary for plant growth, concentrations only slightly above optimum become toxic. Certain plant species are able to tolerate or may even require considerably more boron than others. For instance, alfalfa appears to make maximum growth when irrigated with water containing from 1.0 to 2.0 ppm of boron. On the other hand, the more boron-sensitive crops such as fruits, nuts, beans, etc., may show considerable damage when irrigated with water containing as little as 1.0 ppm of boron. The relative boron tolerance of crops was determined by Eaton (1939), and his results, with minor modifications, are shown in table 2.

Table 2. Relative tolerance to boron of plants common to Minnesota*

Tolerant	Semitolerant	Sensitive
Asparagus	Sunflower	Black walnut
Sugar beets	Potato	English walnut
Mangels	Tomato	Artichoke
Garden beets	Sweetpea	Navy beans
Alfalfa	Radish	American elm
Gladiolus	Field pea	Plum
Broadbean	Rose	Pear
Onion	Barley	Apple
Turnip	Wheat	Grape
Cabbage	Corn	Stone fruits
Lettuce	Milo	Blackberry
Carrot	Oats	
	Pumpkin	
	Pepper	
	Lima beans	

* In each group, the plants first named are considered more tolerant and the last named more sensitive.

Quality Classifications of Irrigation Water

The waters analyzed in this study were grouped according to their source as surface, shallow-well, and deep-well waters. These are shown in tables 4, 5, and 6, respectively. A shallow well was defined as any well having a free or unconfined water table surface within 20 feet of the ground surface. Within each group, the waters were given a quality classification based on the combined effect of total salt concentration (electrical conductivity) and the sodium adsorption ratio.

Quality classifications were made in accordance to the diagram shown in figure 2, as recommended by the United States Salinity Laboratory (Richards, 1954). To use figure 2, the electrical conductivity (in micromhos per centimeter) and the relative concentrations of sodium, calcium, and magnesium

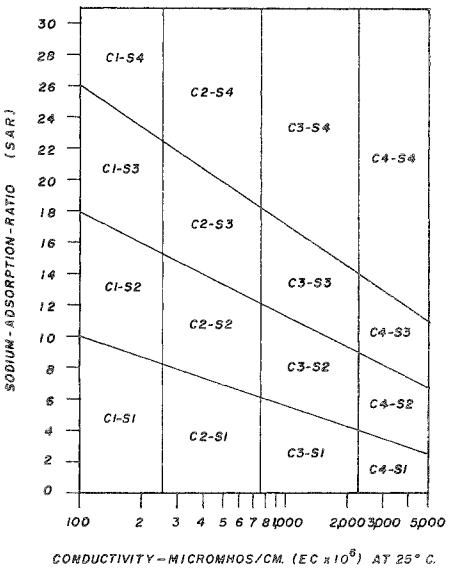

Fig. 2. Irrigation water quality classifications, on the basis of total salt concentration and sodium percentage. (Recommended standard of U. S. Salinity Laboratory.)

salts (SAR) are required. With such a diagram the dependence of the sodium hazard (S) on the total salt concentration (C) is taken into account.

Waters are divided into four classes according to their total salt concentration (expressed as electrical conductivity) with the dividing points between classes being at 250, 750, and 2,250 micromhos per centimeter. There are also four classifications from the standpoint of sodium hazard. No constant and definite dividing points can be established between classes for sodium hazard, however, since such is dependent upon the total salt concentration. For example, a water sample having a SAR value of 8.0 may receive a sodium hazard classification of S1, S2, or S3, depending on its total salt concentration. With figure 2, therefore, each water sample is classified according to both its salt concentration (or salinity) hazard and the sodium hazard. Thus, a given sample may fall into any one of 16 U. S. Salinity Laboratory classifications, depending on these two conditions. The classification obtained for each sample is shown in tables 4, 5, and 6.

To understand the significance and interpretation of the quality classifications obtained from figure 2, the U. S. Salinity Laboratory recommendations (Richards, 1954) are summarized below. In making these classifications and recommendations, however, it is assumed that the water is to be used under average conditions with respect to climate, salt tolerance of the crop, texture, and infiltration capacity of the soil, drainage, and management practices. If other than average conditions exist for any one or more of the above conditions, proper allowance should be made.

Low-Salinity Water (C1). Can be used for irrigation with most crops and on most soils with little likelihood that soil salinity will develop.

Medium-Salinity Water (C2). Can be used if a moderate amount of leaching occurs. Plants with good or moderate salt tolerance can be grown without special practices for salinity control.

High-Salinity Water (C3). Should be used on soils with good drainage. Special practices for salinity control may be necessary with restricted drainage, and plants with good salt tolerance should be selected.

Very High-Salinity Water (C4). Can be used only under conditions where the soil is permeable, drainage is adequate, and considerable leaching provided through excess irrigation water or precipitation.

Low-Sodium Water (S1). Can be used on almost all soils with little danger of the development of harmful levels of exchangeable sodium.

Medium-Sodium Water (S2). This water should be used on coarse-textured or organic soils with good permeability and drainage conditions. An appreciable sodium hazard may occur in fine-textured soils having high cation-exchange capacity, especially under low-leaching conditions.

High-Sodium Water (S3). This water may produce harmful levels of exchangeable sodium in most soils and will require good drainage, high leaching, and organic matter conditions.

Very High-Sodium Water (S4). Generally unsatisfactory for irrigation purposes except at low or medium salinity, where calcium from the soil or the use of gypsum or other amendments may make the use of these waters feasible.

Effect of Boron on Irrigation Water Quality

The occurrence of boron in water and its deleterious effects on some crops makes it necessary to consider this element in judging the quality of irrigation waters. To establish permissible limits of boron concentrations, one must acknowledge the relative tolerance of the crop as indicated in table 2. Scofield (1935) proposed the approximate limits shown in table 3, for three levels of crop tolerance.

Interpretation of Water Analysis

As indicated earlier, any method used to classify water for irrigation purposes should consider the effect of the salt constituents on both plants and soil. This is difficult to evaluate in field plants, however, since other variables may also affect plant response in any given case.

The U. S. Salinity Laboratory method for classifying the quality of irrigation waters according to their SAR values and total salt concentration has received wide acceptance throughout the world. As explained earlier, however, the recommendations for such classifications were based on average plant, soil, and climatic conditions. In Minnesota, as in most subhumid regions, irrigating is done on a supplemental basis because natural rainfall during the growing season is usually sufficient to supply the greater part of the crop's moisture needs. Such practice requires relatively small quantities of irrigation water each year. Also, the greatest need for irrigation in Minnesota occurs on coarse-textured, well-drained soils. Under such soil and rainfall conditions, a considerable amount of leaching usually occurs which greatly lessens the chances of salt accumulation within the root zone.

Field data and experience in Minnesota are not sufficient to establish definite quality limits for irrigation water. Until such data are available, however, it is proposed that tentative local classifications be made by means of figure 3. In figure 3, waters for irrigation use in Minnesota are classified as good, permissible, doubtful, and unsuitable.

It should be noted that figure 3 is basically similar to figure 2 except that lower quality waters are given more acceptable ratings in the former. This is to allow for the more favorable soil and climatic conditions under which the water is applied, as mentioned above. To illustrate, in table 6, sample 1-15 in Polk County is given a U. S. Salinity Laboratory classification of C4-S3. Under average soil and climatic conditions such a water supply would be unsuitable for use as an irrigation water. For Minnesota conditions, how-

Table 3. Permissible limits of boron for several classes of irrigation waters

Boron class	Sensitive crops	Semitolerant crops	Tolerant crops
	ppm	ppm	ppm
1	0.33 or less	0.67 or less	1.00 or less
2	0.33-0.67	0.67-1.33	1.00-2.00
3	0.67-1.00	1.33-2.00	2.00-3.00
4	1.00-1.25	2.00-2.50	3.00-3.75
5	1.25 or more	2.50 or more	3.75 or more

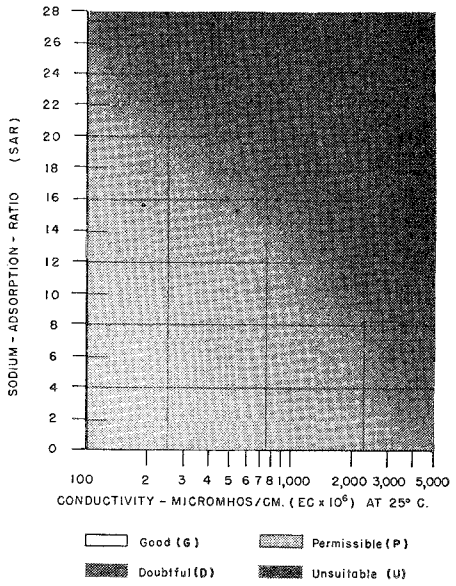

Fig. 3. Irrigation water quality classifications for Minnesota conditions.

ever, figure 3 gives this water the more favorable rating of "doubtful." Further studies and data may indicate that adjustments in figure 3 are necessary.

After having classified a given irrigation water supply from the standpoint of its total salt concentration and sodium adsorption ratio, next consideration should be given to its boron content. A water supply given a classification of "good," from the standpoint of the total salt concentration and SAR, may fall into a lower boron class as indicated by table 3.

In general, the waters of Minnesota are free from objectionable amounts of boron. Only in scattered instances were such problems found. Concentrations of boron in parts per million, and the boron classifications for crops having different degrees of tolerance, are shown in table 7. These data indicate that while the boron problem is more apt to be encountered in the southeastern and west-central portions of the state, the occurrence of such conditions is not confined to any small and definite area.

Summary

The chemical analysis of many samples of Minnesota waters were studied to classify them according to their suitability for irrigation. Part of these analyses were obtained through earlier investigations (Allison, 1932; Hall, *et al.*, 1911; Miller, 1925; and Thiel, 1947). For this study, however, it was necessary to convert much of the early data into terms from which irrigation water quality classifications could be made. All remaining samples were collected since 1957, and were analyzed and classified according to their total salt concentration, sodium adsorption ratio, and boron content (Allred and Young, 1959).

Waters from Minnesota lakes, ponds, streams, and other surface supplies were found, in general, to be of suitable quality for irrigation use. Wide variations in the quality of water from wells were noted, however, sometimes even within small areas. Moreover, the salinity hazard of a given water supply may vary according to the time of year the sample is taken. Year to year variations may also occur. It was impossible, without considerable cost, to consider these factors in this report. Hence, the

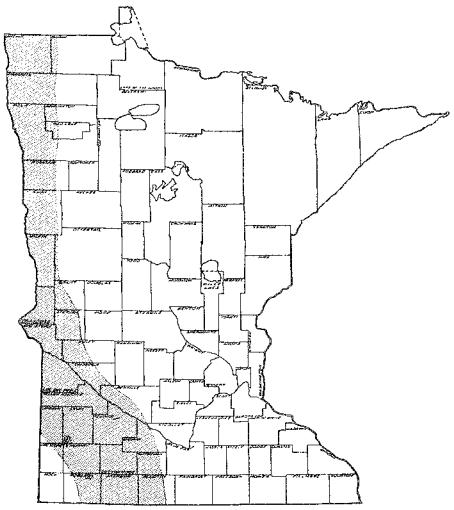

Fig. 4. Areas of Minnesota where some low-quality irrigation waters were found.

data given in tables 4, 5, 6, and 7 should be considered as representing average conditions that may exist in a given area. Any individual well water source may vary widely from the indicated salinity.

In the eastern three-fourths of the state, shown unshaded in figure 4, all groundwaters were uniformly high in quality. Wells yielding water of doubtful or unsuitable quality were found along the western edge of the state. However, all such low-quality waters were located within the shaded area of figure 4. In general, the seriousness of the problem was found to increase from the eastern edge of the shaded portion of figure 4 toward the western boundary of the state.

In appraising the quality of water for irrigation, first consideration should be given to the alkali and salinity hazards which might be present. Next consideration should be given to the boron content. Recommendations as to the use of a given water for irrigation must take into account such factors as soil drainability, soil texture, amount of water used, and farm management practices.

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Table 4. Chemical analysis of surface waters of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Anoka								
2-143	Coon Creek, 2 mi. E. of Anoka, Sec. 4 T131N R24W	1.7	4.6	.3	203	318	1.1	C2-S1	G
	Beltrami								
1-1	Red Lake near Redby	1.0	1.6	1.2	200	312	.8	C2-S1	G
	Benton								
2-252	Platte River at Royalton, Sec. 2 T38N R32W	.2	.2	.7	142	222	.2	C1-S1	G
2-254	Little Rock Creek, 4 mi. S. of Rice, Sec. 15 T37N R31W	.3	.2	1.0	164	256	.3	C2-S1	G
	Bigstone								
1-1	Bigstone Lake at Ortonville	1.6	2.2	3.9	559	874	.7	C3-S1	P
	Blue Earth								
2-267	Minnesota R. at Mankato, Sec. 23 T108N R26W	1.2	.3	2.7	457	715	1.0	C2-S1	G
2-270	Cobb R., ½ mi. S. of Beauford, Sec. 9 T106N R26W	.5	.4	1.2	248	388	.5	C2-S1	G
	Brown								
2-196	Cotton R., 7 mi. S. of Sleepy Eye, Sec. 6 T109N R32W	2.0	1.3	2.3	616	962	1.5	C3-S1	P
	Carver								
2-310	Carver Creek, 2½ mi. E. of Cologne, Sec. 8 T115N R24W	1.0	.4	1.2	319	498	1.1	C2-S1	G
2-311	Chaska Creek, 1½ mi. N. of Chaska, Sec. 5 T115N R23W	.2	.3	.4	266	415	.3	C2-S1	G

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 4. (Continued). Chemical analysis of surface waters of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Chippewa								
6-S5	SW¼ Sec. 15 T118N R41W, Chippewa R.	.6	5.4	10.3	402	627	.2	C3-S1	G
6-S9	SE¼ Sec. 19 T118N R37W, Hawk Creek	.5	6.9	14.8	524	808	.1	C3-S1	P
6-S10	NW¼ Sec. 18 T117N R37W, Hawk Creek	1.0	5.8	14.3	490	766	.1	C3-S1	P
2-302	Hawk Creek in Clara City, Sec. 7 T117N R37W	2.0	.3	2.5	567	886	1.7	C3-S1	P
	Chisago								
2-116	Sunrise R., S. Branch at Stacy, Sec. 32 T134N R21W	2.1	3.4	.5	155	243	1.5	C1-S1	G
2-118	Goose Creek, 1 mi. NE of Harris, Sec. 18, T136N R21W	.9	1.9	.8	184	288	.8	C2-S1	G
	Clay								
1-1	Buffalo R. at Stockwood	.6	4.4	3.0	397	621	.3	C2-S1	G
1-2	Buffalo R. at Winnipeg Junction	.1	4.0	4.0	367	574	.1	C2-S1	G
1-4	Red R. at Fargo	.1	3.3	3.0	307	480	.1	C2-S1	G
6-K28	SE¼ Sec 35 T140N R47W, N. Br. Buffalo R.	.7	6.0	10.6	545	850	.2	C3-S1	G
6-K39	Sec 16-21 T139N R47W, S. Branch Buffalo R.	.2	8.8	17.2	786	1,230	.1	C3-S1	P
6-K16	SE¼ Sec. 5-10 T141N R48W, N. Br. Buffalo R.	6.6	4.1	5.1	591	922	3.0	C3-S1	P
2-31	Buffalo R., 8 mi. W. of Hawley, Sec. 4 T139N R46W	.8	1.4	3.2	474	741	.5	C2-S1	G
	Clearwater								
2-58	Clearwater R. at Bagley	.3	1.5	2.5	318	498	.2	C2-S1	G
	Cottonwood								
2-90	DesMoines R. at Windom, Sec. 25 T105N R36W	2.9	1.4	1.9	507	794	2.2	C3-S1	P
	Dakota								
2-185	Vermillion R., 4 mi. N. of Hampton, Sec. 20 T114N R18W	.8	3.5	2.2	237	371	.5	C2-S1	G

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 4. (Continued). Chemical analysis of surface waters of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Dodge								
2-176	Zumbro R. at Mantorville, Sec. 33 T107N R16W	1.4	2.0	2.9	308	481	.9	C2-S1	G
2-117	Zumbro R., 2 mi. S. of Berne, Sec. 18 T108N R16W	1.0	1.8	2.7	280	437	.7	C2-S1	G
	Faribault								
2-273	Jones Creek, 6 mi. S. of Wells, Sec. 8 T102N R24W	.6	.3	2.2	359	562	.5	C2-S1	G
2-274	E. Fork Blue Earth R. at Blue Earth, Sec. 8 T102N R27W	.5	.2	.3	259	405	1.1	C2-S1	G
	Fillmore								
9-1	Root R. at Lanesboro	.2	3.0	1.6	384	601	.1	C2-S1	G
9-2	Root R. at Lanesboro	.3	3.7	1.7	447	700	.2	C2-S1	G
9-3	Root R. at Preston	.3	3.1	1.6	404	633	.2	C2-S1	G
2-162	Root R., 7 mi. E. of Whalen, Sec. 24 T103N R10W	.4	3.2	2.4	276	431	.2	C2-S1	G
	Freeborn								
2-152	Albert Lea Lake, 3 mi. E. of Albert Lea, Sec. 7 T102N R20W	6.2	1.8	3.2	556	870	3.9	C3-S1	P
	Goodhue								
2-181	Belle Creek, 1 mi. N. of Hader, Sec. 6 T111N R17W	.8	2.0	3.3	333	521	.5	C2-S1	G
2-183	Cannon R. at Cannon Falls, Sec. 6 T112N R17W	.7	1.9	2.6	310	486	.5	C2-S1	G
	Grant								
6-K6	Sec. 29 T128N R43W, Mustinka R.	7.8	15.1	22.6	1,516	1,831	1.8	C4-S1	P
2-6	Chippewa R., Sec. 1 T127N R41W	.3	2.6	1.5	357	558	.2	C2-S1	G
2-7	Worm Lake, Sec. 8 T127N R42W	.6	3.1	4.3	404	632	.2	C2-S1	G
2-232	Mustinka R., 1 mi. N. of Norcross, Sec. 21 T128N R44W	2.6	3.1	1.1	147	232	1.8	C1-S1	G

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 4. (Continued). Chemical analysis of surface waters of Minnesota with special emphasis on their suitability for for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Hennepin								
9-1	Mississippi R. above Minneapolis	.1	2.2	1.3	280	438	.1	C2-S1	G
9-2	Mississippi R. below Minneapolis	.1	2.1	1.0	260	407	.1	C2-S1	G
9-3	Mississippi R. at Minneapolis	.3	3.0	1.4	377	590	.2	C2-S1	G
9-4	Lake Minnetonka	.1	1.4	.7	166	259	.2	C2-S1	G
9-5	Lake Minnetonka	.2	1.4	.8	194	303	.3	C1-S1	G
	Houston								
2-166	Money Creek, 1 mi. S. of Money Creek, Sec. 18 T104N R7W	.2	2.9	2.5	240	391	.1	C2-S1	G
	Isanti								
2-133	Green Lake, Sec. 27 T136N R25W	1.7	2.5	.4	99	155	1.4	C1-S1	G
	Jackson								
6-S98	SW¼ Sec. 28 T104N R38W, Creek	5.8	6.9	5.9	716	866	2.3	C3-S1	P
2-93	DesMoines R. at Jackson, Sec. 24 T102N R35W	3.2	1.5	2.0	600	794	2.4	C3-S1	P
	Kanabec								
2-125	Ann R., 2½ mi. W. of Mora, Sec. 21 T139N R24W	.9	1.4	.7	138	216	.9	C1-S1	G
	Kittson								
1-1	Red R. at Drayton, N. Dakota	.5	2.8	1.6	264	413	.3	C2-S1	G
1-2	Red R. at St. Vincent	.7	2.5	1.9	284	444	.4	C2-S1	G
2-47	S. Branch Two Rivers at Lake Bronson	T	1.7	2.3	366	572	T	C2-S1	G
	Lac qui Parle								
6-M44	SW¼ Sec. 15 T117N R46W, Yellow Bank R.	1.7	13.4	14.3	755	1,181	.2	C3-S1	P
6-M47	E½ Sec. 33 T119N R46W, Yellow Bank R.	1.2	8.4	11.1	528	827	.3	C3-S1	P

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 4. (Continued). Chemical analysis of surface waters of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Lac qui Parle (Continued)								
6-M54	Sec. 15 T 117N R43W, Yellow Bank R.	1.9	9.8	11.6	605	946	.3	C3-S1	P
1-1	Big Stone Lake at Ortonville	1.6	2.2	3.9	431	521	.7	C3-S1	G
2-295	W. Branch Lac qui Parle R., 6 mi. W. of Dawson, Sec. 20 T117N R44W	1.3	.5	3.0	656	1,024	1.2	C3-S1	P
	Le Sueur								
2-263	Pepin Lake, 4 mi. S. of New Prague, Sec. 28 T112N R23W	.1	.2	.9	131	204	.1	C1-S1	G
	Lincoln								
2-1A	Lake Benton near outlet	.3	1.8	.4	154	241	.2	C1-S1	G
2-65	Ash Lake, Sec. 8 T111 R45W	2.2	1.0	2.3	493	770	1.7	C3-S1	P
	Lyon								
2-62	Three Mile Creek, 6 mi. W. of Marshall, Sec. 5 T111N R41W	3.6	3.7	2.2	851	1,330	2.1	C3-S1	P
2-64	Spring Fed Pond, Sec. 4 T112N R42W	2.6	2.4	2.3	666	1,040	1.7	C3-S1	P
	McLeod								
2-304	Crow R. in Hutchinson, Sec. 36 T117N R30W	.9	.4	1.7	433	676	.9	C2-S1	G
	Marshall								
2-42	Middle R. at Argyle, Sec. 10 T156N R48W	4.2	1.7	3.5	442	690	2.6	C2-S1	G
	Martin								
2-96	Fox Lake, Sec. 31 T103 R32	2.0	.6	2.2	267	417	1.7	C2-S1	G
2-99	Cedar Lake, Sec. 30 T104N R32W	2.2	.9	2.0	388	606	1.8	C2-S1	G

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 4. (Continued). Chemical analysis of surface waters of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Meeker								
2-27	Long Lake, S. of Grove City, Sec. 23 T119N R32W	.1	.5	1.2	229	358	.2	C2-S1	G
	Mille Lacs								
2-129	Rum R. at Milaca, Sec. 36 T138N R27W	.9	2.1	.6	139	217	.8	C1-S1	G
2-131	Silver Lake, Sec. 35 T136 N R26W	1.2	3.3	.6	148	232	.9	C1-S1	G
	Morrison								
1-1	Mississippi R. at Little Falls	0.2	1.5	1.1	124	194	0.2	C1-S1	G
1-2	Mississippi R. at Little Falls	0.9	2.1	1.1	183	285	1.6	C2-S1	G
	Mower								
2-154	Turtle Creek at Austin, Sec. 4 T102N R18W	1.0	3.9	2.7	354	553	.6	C2-S1	G
2-157	Deer Creek, 2 mi. E of Grand Meadow, Sec. 21 T103N R14W	2.0	1.7	1.7	282	441	1.6	C2-S1	G
	Murray								
2-80	Beaver Creek, ½ mi. N. of Slayton, Sec. 10 T106N R41W	4.8	2.9	2.7	1,081	1,690	2.9	C3-S1	P
2-83	N. end of Lake Shetek, Sec. 11 T108N R41W	3.4	2.6	2.2	800	1,250	2.2	C3-S1	P
	Nicollet								
2-278	Swan Lake, 2 mi. N. of Nicollet, Sec. 33 T110N R28W	.4	.2	2.7	303	474	.4	C2-S1	G
	Nobles								
6-S64	NW¼ Sec. 14 T101N R41W	0.4	4.0	10.3	332	520	0.1	C2-S1	G

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 4. (Continued). Chemical analysis of surface waters of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Norman								
6-K47	Sec. 20-29 T144N R48W Wild Rice R.	0.2	4.7	8.7	332	520	0.1	C2-S1	G
	Olmsted								
2-170	S. Branch Whitewater R., Sec. 18 T106N R11W	2.2	2.0	2.5	390	610	1.5	C2-S1	G
2-173	Bear Creek at Rochester, Sec. 1 T106N R14W	1.6	1.6	2.2	268	419	1.2	C2-S1	G
	Otter Tail								
1-1	Otter Tail R. at Fergus Falls	0.5	1.7	1.9	199	311	0.4	C2-S1	G
1-2	Otter Tail R. at Fergus Falls	0.2	2.0	1.6	202	317	0.1	C2-S1	G
1-3	Otter Tail R. at Fergus Falls	0.1	1.5	1.8	104	163	0.2	C1-S1	G
2-110	Otter Tail Lake, Sec. 1 T133N R40W	1.6	1.0	1.5	256	400	1.4	C2-S1	G
2-239	Otter Tail R., Sec. 2 T133N R41W	2.2	1.6	.9	207	324	1.5	C2-S1	G
	Pennington								
2-51	Thief R. at Thief River Falls	.2	1.5	1.4	194	304	2.1	C2-S1	G
	Pine								
2-121	Snake R. at Pine City, Sec. 33 T139N R21W	.6	2.1	.9	144	225	.5	C1-S1	G
	Pipestone								
2-70	Pipestone Creek, Pipestone Quarries Nat'l Mon., Sec. 2 T106N R46W	3.5	.9	1.6	407	637	3.1	C2-S1	G
	Polk								
1-1	Sandhill R. at Fertile	1.1	5.2	4.1	516	806	.4	C3-S1	P
1-2	Red Lake R. at Crookston	.1	2.8	1.4	214	334	.1	C2-S1	G
1-3	Red Lake R. at East Grand Forks	T	2.5	1.2	193	302	.1	C2-S1	G
2-38	Red Lake at Crookston	T	1.7	1.5	224	350	T	C2-S1	G

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 4. (Continued). Chemical analysis of surface waters of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Pope								
2-216	Chippewa R., 11 mi. S. of Cyrus, Sec. 29 T124N R40W	1.3	.9	.2	28	44	1.7	C1-S1	G
	Ramsey								
2-111	White Bear Lake, Sec 14 T130N R22W	1.3	2.3	.8	152	237	1.1	C1-S1	G
	Red Lake								
2-54	Clearwater R. at Plummer	.3	1.5	2.0	266	417	.2	C2-S1	G
	Redwood								
6-22	Sec. 12 T112N R40W	T	10.1	13.7	584	914	.1	C3-S1	P
2-84	Cottonwood R., 3 mi. W. of Tracy, Sec. 19 T110N R38W	4.6	2.8	2.5	787	1,230	2.9	C3-S1	P
	Renville								
6-Y160	Sec. 30 T116N R31W	.6	11.5	11.2	609	951	.1	C3-S1	P
6-S11	NE¼ Sec. 36 T117N R38W	.5	15.5	31.6	110	173	.1	C1-S1	G
2-287	W. fork Beaver Creek, 1½ mi. W. of Danube, Sec. 1 T115N R36W	.5	.3	2.6	529	827	.4	C3-S1	P
	Rice								
2-145	Cannon R. at Faribault, Sec. 30 T110N R20W	1.0	.3	2.3	271	424	.9	C2-S1	G
	Rock								
2-75	Rock R., 4 mi. E. of Luverne, Sec. 35 T102N R45W	2.7	1.3	1.8	422	659	2.2	C2-S1	G

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 4. (Continued). Chemical analysis of surface waters of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Scott								
2-261	Pleasant Lake, Sec. 11 T113N R23W	.1	.2	1.0	148	231	.2	C1-S1	G
2-262	Raven Stream, 4 mi. N. of New Prague, Sec. 16 T113N R23W	2.3	.4	3.6	504	788	1.6	C3-S1	P
	Sherburne								
2-137	St. Francis R., 3 mi. W. of Fremont, Sec. 11 T134N R27W	.6	3.3	.6	164	256	.4	C2-S1	G
2-139	Eagle Lake, 5 mi. N. of Big Lake, Sec. 31 T134N R27W	.9	2.5	.7	128	200	.7	C1-S1	G
	Sibley								
2-284	Middle Branch Rush R., 4½ mi. W. of Winthrop, Sec. 32 T113N R30W	.4	.6	3.4	642	1,003	.3	C3-S1	P
	Stearns								
1-1	Mississippi R. at St. Cloud	.6	2.2	1.2	237	371	.4	C2-S1	G
1-2	Sauk R. at Sauk Centre	.1	2.3	2.1	268	419	.1	C2-S1	G
2-24	Clearwater R. at bridge on hky. 55, Sec. 7 T121N R28W	.3	1.2	5.8	744	1,161	.1	C3-S1	P
2-25	Lake Koronis by hwy. 55, Sec. 35 T122N R32W	.2	1.0	1.7	259	405	.2	C2-S1	G
	Steele								
1-1	Straight R. at Owatonna	.2	3.4	2.1	451	705	.1	C2-S1	G
2-146	Maple Creek at Owatonna, Sec. 4 T107N R20W	2.0	3.2	3.0	377	589	1.1	C2-S1	G
2-190	Crane Creek at Medford, Sec. 8 T108N R20W	3.0	2.2	1.1	390	610	2.3	C2-S1	G

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† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 4. (Continued). Chemical analysis of surface waters of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Stevens								
2-219	Pomme de Terre R., 1 mi. E. of Morris, Sec. 25 T125N R42W	1.3	.1	.5	156	244	1.4	C1-S1	G
	Swift								
2-210	Shakopee Creek, 2 mi. E. of Kerkhoven, Sec. 27 T120N R37W	1.9	6.0	1.7	543	847	1.0	C3-S1	P
2-211	Chippewa R. W edge of Benson, Sec. 6 T121N R39W	.8	1.6	T	24	37	1.0	C1-S1	G
	Todd								
1-1	Crow R. N. of Staples	.7	2.3	1.9	248	388	.4	C2-S1	G
2-245	Wing R. at Hewitt, Sec. 22 T133N R35W	.1	.2	1.4	228	357	.1	C2-S1	G
2-248	Long Prairie R. at Browerville, Sec. 8 T130N R33W	.2	.4	2.9	303	474	.2	C2-S1	G
	Traverse								
1-2	Mustinka R. at Wheaton	1.9	4.9	4.9	688	1,075	.8	C3-S1	P
1-3	Mustinka R. at Wheaton	3.1	11.1	14.8	1,658	2,590	.6	C4-S1	P
2-228	Twelve-Mile Creek, 6 mi. E. of Wheaton, Sec. 18 T127N R45W	2.7	1.4	1.5	321	502	2.2	C2-S1	G
2-312	Mustinka R., Sec. 24 T128N R45W	5.6	7.2	3.5	927	1,448	2.4	C3-S1	P
	Wabasha								
1-2	Whitewater Creek at Weaver	.3	2.8	1.7	385	602	.2	C2-S1	G
2-191	Zumbro R. at Zumbro Falls, Sec. 6 T109N R13W	1.0	1.9	3.3	294	459	.6	C2-S1	G
2-194	Spring Creek at West Albany, Sec. 21 T110N R12W	.4	3.1	1.7	265	414	.3	C2-S1	G

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 4. (Continued). Chemical analysis of surface waters of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Wadena								
1-1	Crow Wing R. N. of Staples	.7	2.3	1.9	248	388	.4	C2-S1	G
	Waseca								
4-1	Clear Lake	.2	0.3	0.1	45	71	.5	C1-S1	G
4-2	Loon Lake	1.0	1.6	1.5	316	494	.8	C2-S1	G
	Washington								
2-115	Forest Lake, Sec. 9 T132N R21W	1.9	2.7	.8	160	251	1.4	C2-S1	G
	Watonwan								
2-100	Watonwan R., Sec. 21 T105N R32W	2.7	1.5	1.4	493	770	2.2	C3-S1	P
2-103	Lake St. James at St. James, Sec. 23 T106N R32W	2.1	.7	1.9	305	477	1.8	C2-S1	G
	Wilkin								
1-1	Ottertail R. at Breckenridge	.3	1.8	1.9	220	344	.2	C2-S1	G
1-2	Ottertail R. at Wahpeton	0.4	1.7	2.1	223	348	.3	C2-S1	G
2-236	Ottertail R. at Breckenridge, Sec. 3 T132N R47W	.8	1.1	1.4	57	87	.7	C1-S1	G
	Wright								
2-198	Crow R. E. edge of Delano, Sec. 12 T118N R25W	4.0	8.0	2.6	726	1,135	1.7	C3-S1	P
2-200	Howard Lake at Howard Lake, Sec. 34 T119N R27W	1.3	4.5	1.4	428	671	.7	C2-S1	G
	Yellow Medicine								
6-M57	NE¼ Sec. 20 T116N R41W	1.3	5.6	11.8	450	703	.4	C2-S1	G
6-M71	NE¼ Sec. 20 T115N R39W, Hazel Run	0.7	8.1	10.6	483	755	0.2	C3-S1	G
6-M79	NW¼ Sec. 3 T114N R39W, Yellow Medicine R.	1.5	13.1	16.0	767	1,200	0.2	C3-S1	P
6-Y218	SE¼ Sec. 25 T114N R44W, Yellow Medicine R.	6.4	19.0	27.4	1,345	2,100	1.3	C3-S1	P

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 4. (Continued). Chemical analysis of surface waters of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Yellow Medicine (Continued)								
6-Y220	N½ Sec. 5 T114N R44W, Lac qui Parle R.	0.7	11.2	13.8	632	987	0.1	C3-S1	P
6-Y221	N½ Sec. 2 T114N R45W, Lac qui Parle R.	1.9	16.1	18.3	732	1,426	0.3	C3-S1	P
6-Y223	E½ Sec 9 T114N R45W, Lac qui Parle R.	1.9	20.1	28.4	1,228	1,918	0.2	C3-S1	P
6-Y227	E½ Sec. 28 T115N R45W, Lazarus Creek	1.6	9.8	15.5	651	1,018	0.2	C3-S1	P
2-293	Lac qui Parle R., 7 mi. NE of Canby, Sec. 3 T115N R44W	.7	.5	2.6	695	1,086	.6	C3-S1	P

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 5. Chemical analysis of shallow wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Anoka								
4-1	Spring at Itasca	0.4	0.9	1.0	189	296	.3	C2-S1	G
2-142	Farm well, Sec. 23 T132N R25W	1.2	6.8	.6	256	401	.6	C2-S1	G
2-144	Farm well (15 ft.), Sec. 2 T131N R24W	1.8	3.2	.5	177	277	1.3	C2-S1	G
	Becker								
1-1	Pokegama Spring, Sec. 36 T139N R41W	1.3	3.9	1.9	344	538	.7	C2-S1	G
1-2	Spring ½ mi. S.E. of Pokegama Springs	1.7	3.1	1.0	280	437	1.1	C2-S1	G
1-3	C. C. Valentine well, Ponsford	.6	3.2	1.6	302	472	.3	C2-S1	G
1-4	Well 1 mi. W. of Detroit Lakes	1.0	4.0	2.9	444	694	.5	C2-S1	G
	Benton								
2-253	Farm well (18 ft.), Sec. 10 T37N R31W	.6	.2	.5	184	278	1.0	C2-S1	G
	Big Stone								
4-4	Public Supply Spring at Browns Valley	1.6	11.2	7.6	1,272	1,989	.5	C3-S1	P
2-223	Farm well (20 ft.), Sec. 7 T124N R45W	1.5	4.5	1.3	533	833	.9	C3-S1	P
	Blue Earth								
2-269	Farm well, Sec. 28 T108N R26W	2.4	.1	3.0	696	1,087	1.9	C3-S1	P
2-271	Farm well (20 ft.), Sec. 24 T105N R26W	.8	.6	2.9	736	1,149	.6	C3-S1	P
	Brown								
4-1	Spring at New Ulm	1.3	4.4	3.3	473	739	.6	C2-S1	G
2-59	Farm well (18 ft.), Sec. 18 T108N R33W	.2	1.5	2.0	356	556	.2	C2-S1	G
2-105	Farm well, Sec. 8 T108N R34W	3.2	1.8	2.3	666	1,040	2.2	C3-S1	P
	Carver								
4-3	Spring at Carver	.1	7.3	T	590	922	.1	C3-S1	G

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 5. (Continued). Chemical analysis of shallow wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Chippewa								
4-1	Spring N. of Montevideo	1.3	7.3	3.5	689	1,076	.6	C3-S1	P
2-298	Farm well, Sec. 15 T117N R40W	.7	.6	1.7	920	1,438	.6	C3-S1	P
2-299	Farm well, Sec. 13 T117N R40W	.7	.4	2.2	1,162	1,817	.6	C3-S1	P
	Chisago								
2-117	Farm well (20 ft.), Sec. 9 T135N R21W	3.0	2.9	.9	420	657	2.2	C2-S1	G
2-119	Farm well, Sec. 4 T137N R21W	.6	1.7	.7	193	302	.6	C2-S1	G
	Clay								
6-K34	NE¼ Sec. 9 T138N R48W	T	5.8	11.1	390	610	T	C2-S1	G
6-K33	SE¼ Sec. 11 T138N R48W	4.6	8.1	31.9	1,015	1,583	1.0	C3-S1	P
6-K30	SW¼ Sec. 17 T138N R48W	2.0	15.3	55.5	1,587	2,479	.3	C4-S1	P
6-K32	SE¼ Sec 25 T138N R48W	6.1	4.2	6.7	503	785	2.7	C3-S1	P
6-K23	NE¼ Sec. 2 T139N R47W	8.1	4.3	.8	374	585	5.0	C2-S1	G
6-K11	SW¼ Sec. 4 T139N R48W	26.2	4.7	2.6	1,125	1,759	13.0	C3-S3	D
6-K36	NE¼ Sec. 10 T139N R48W	.8	8.0	29.3	847	1,323	.2	C3-S1	P
6-K35	NW¼ Sec. 14 T139N R48W	3.0	10.6	21.8	869	1,357	.5	C3-S1	P
6-K29	NW¼ Sec. 21 T139N R48W	4.9	48.0	110.9	377	589	.5	C2-S1	G
6-K24	SE¼ Sec. 1 T140N R47W	90.7	28.4	666.9	16,620	26,000	2.1	C4-S4	U
6-K25	SW¼ Sec. 13 T140N R47W	10.1	30.0	47.7	2,188	3,420	1.6	C4-S1	D
6-K15	NE¼ Sec. 23 T140N R48W	15.7	3.3	T	692	1,081	12.3	C3-S3	D
6-K22	SW¼ Sec. 10 T141N R47W	3.5	16.8	13.2	894	1,396	.7	C3-S1	P
6-K20	SE¼ Sec. 32 T141N R47W	25.9	3.2	1.1	1,041	1,629	17.6	C3-S4	D
6-K21	NW¼ Sec. 33 T141N R47W	37.4	19.4	112.5	4,650	7,270	4.6	C4-S3	D
6-K13	NW¼ Sec. 19 T141N R48W	20.2	25.4	91.7	3,227	5,040	2.6	C4-S2	D
6-K40	SW¼ Sec. 24 T142N R47W	5.8	8.8	12.7	719	1,122	1.5	C3-S1	P
1-8	NW¼ Sec. 10 T139N R48W	2.7	9.1	12.8	1,341	2,098	.7	C3-S1	P
2-32	Farm well, Sec. 11 T139N R46W	.2	.9	1.4	214	334	.2	C2-S1	G

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Table 5. (Continued). Chemical analysis of shallow wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Clearwater								
2-57	Farm well (15 ft.), Sec. 22 T147N R38W	.1	1.5	1.2	295	461	.1	C2-S1	G
	Cottonwood								
6-Y333	Sec. 20 T105N R38W	.3	4.8	4.5	143	222	.1	C1-S1	G
2-87	Farm well, Sec. 31 T107N R35W	1.8	7.0	2.4	1,600	2,500	1.0	C4-S1	P
2-89	Farm well, Sec. 1 T105N R36W	2.7	1.4	1.5	427	667	2.2	C2-S1	G
	Dakota								
2-187	Farm Well (14 ft.), Sec. 18 T113N R19W	3.6	2.1	2.6	471	736	2.3	C2-S1	G
	Fillmore								
4-4	Spring at Lanesboro	.3	4.1	2.1	521	814	.1	C3-S1	P
4-5	Spring at Lanesboro	.1	3.6	2.0	459	717	.1	C2-S1	G
4-6	Spring at Spring Valley	.2	3.0	1.7	432	674	.1	C2-S1	G
4-7	Spring at Preston	.4	3.9	2.1	392	613	.1	C2-S1	G
4-8	Spring at Preston	.1	3.9	1.5	448	700	.1	C2-S1	G
4-13	R.R. well at Preston	1.9	9.2	4.0	1,101	1,720	.7	C3-S1	P
4-10	R.R. well at Spring Valley	.2	3.7	2.3	540	844	.1	C3-S1	P
2-161	Farm well (15 ft.), Sec. 25 T103N R10W	.6	3.6	1.9	250	391	.4	C2-S1	G
	Freeborn								
4-1	R.R. well at Albert Lea	.7	7.5	3.4	639	998	.3	C3-S1	P
4-2	R.R. well at Albert Lea	1.2	4.9	2.1	435	680	.6	C2-S1	G
4-3	R.R. well at Albert Lea	.6	5.8	2.7	486	760	.3	C3-S1	G
2-153	Farm well, Sec. 2 T102N R19W	3.5	2.5	3.7	534	834	2.0	C3-S1	P

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Table 5. (Continued). Chemical analysis of shallow wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Hennepin								
4-9	Englewood Spring	.1	3.4	2.1	438	684	.1	C2-S1	G
4-10	Englewood Spring	.1	3.4	2.1	445	696	.1	C2-S1	G
4-11	Glenwood Spring	.3	3.5	1.9	450	703	.2	C2-S1	G
4-12	St. Anthony Falls Spring	2.0	4.6	2.2	463	724	1.1	C2-S1	G
4-13	University of Minnesota Spring	.3	4.2	1.7	479	748	.1	C2-S1	G
4-14	Great Medicine Spring	.2	3.2	2.1	437	683	.1	C2-S1	G
	Houston								
4-1	Spring at Caledonia	.3	3.0	1.7	424	662	.2	C2-S1	G
4-2	Spring at Hokah	.2	2.4	2.3	374	584	.2	C2-S1	G
2-165	Farm well (9 ft.), Sec. 36 T104N R7W	.2	2.9	1.9	164	256	.1	C2-S1	G
	Isanti								
2-134	Farm well, Sec. 36 T136N R25W	2.1	4.2	.7	219	342	1.3	C2-S1	G
	Jackson								
4-1	Village well at Jackson	2.0	3.4	2.4	483	756	1.1	C3-S1	G
2-92	Farm well, Sec. 1 T102N R35W	2.1	3.7	1.8	928	1,450	1.3	C3-S1	P
	Kanabec								
2-126	Farm well (18 ft.), Sec. 36 T139N R24W	2.5	1.9	.7	153	239	2.2	C1-S1	G
2-127	Farm well (15 ft.), Sec. 33 T139N R25W	1.7	1.7	.5	83	129	1.6	C1-S1	G
	Kandiyohi								
2-205	Farm well, Sec. 1 T119N R33W	.7	6.0	1.4	394	617	.4	C2-S1	G
2-208	Farm well, Sec. 32 T120N R36W	1.1	1.4	2.0	397	621	.8	C2-S1	G

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Table 5. (Continued). Chemical analysis of shallow wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Kittson								
2-257	Farm well (18 ft.), Sec. 29 T164N R50W	2.1	.4	4.6	1,100	1,720	1.3	C3-S1	P
2-258	Farm well (18 ft.), Sec. 29 T164N R50W	2.2	.5	5.0	1,050	1,643	1.3	C3-S1	P
1-3	Dug well in Lancaster	12.1	8.6	7.3	1,600	2,500	4.3	C4-S2	P
1-4	N. Nordin well at Karlstad	5.1	6.9	3.6	976	1,526	2.2	C3-S1	P
1-5	A. Brown well at Humboldt	3.2	11.4	8.7	1,464	2,290	1.0	C4-S1	P
1-7	SW¼ Sec. 12 T161N R48W	2.3	3.8	11.3	960	1,500	.8	C3-S1	P
2-44	Farm well (20 ft.), Sec. 3 T159N R48W	14.0	7.5	23.6	6,590	10,300	3.6	C4-S3	D
2-45	Farm well (20 ft.), Sec. 2 T159N R48W	T	.8	2.4	124	192	T	C1-S1	G
2-46	Farm well (15 ft.), Sec. 13 T162N R48W	5.8	2.6	16.7	148	2,320	1.9	C4-S1	P
2-48	Farm well, Sec. 26 T159N R46W	.7	1.5	1.6	265	414	.6	C2-S1	G
	Lac qui Parle								
2-294	Farm well (18 ft.), Sec. 19 T116N R44W	1.3	.6	3.5	864	1,350	.9	C3-S1	P
	Le Sueur								
2-264	Farm well (20 ft.), Sec. 29 T111N R23W	.5	.4	3.2	493	770	.3	C3-S1	P
2-266	Farm well (20 ft.), Sec. 20 T110N R25W	.6	.5	2.6	444	695	.5	C2-S1	G
4-1	Spring, Sec. 14 T111N R26W	4.9	2.5	1.9	721	1,126	3.2	C3-S1	P
	Lincoln								
6-Y101	Sec. 1 T109N R44W	2.1	9.6	17.9	710	1,109	.4	C3-S1	P
4-1	Well at Hendricks	2.0	4.9	2.2	623	975	1.1	C3-S1	P
4-2	Village well at Lake Benton	1.1	7.3	3.7	735	1,149	.5	C3-S1	P
4-3	Test well at Lake Benton	1.1	9.3	4.5	863	1,350	.5	C3-S1	P
6-Y102	E½ Sec. 1 T109N R44W	1.2	3.1	15.0	431	672	.4	C2-S1	G
2-66	Farm well, Sec. 33 T111N R45W	3.4	6.0	2.4	1,330	2,080	1.7	C3-S1	P

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Table 5. (Continued). Chemical analysis of shallow wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Lyon								
6-143	Sec. 19 T110N R43W	1.1	4.6	1.0	366	573	.6	C2-S1	G
6-126	Sec. 6 T113N R40W	39.8	31.1	194.6	6,050	9,460	3.8	C4-S3	D
6-138	Sec. 7 T110N R42W	1.6	2.4	8.6	306	477	.6	C2-S1	G
6-141	Sec. 18 T109N R42W	2.6	7.7	16.8	655	1,024	.5	C3-S1	P
6-141A	Sec. 18 T109N R42W	2.3	8.1	7.4	479	749	.8	C2-S1	G
6-103	Sec. 25 T112N R41W	9.2	19.4	81.5	2,467	3,860	1.3	C4-S1	D
6-104	Sec. 25 T112N R41W	7.0	18.8	46.0	1,663	2,592	1.2	C4-S1	P
6-109	Sec. 25 T112N R41W	2.8	11.9	24.4	935	1,460	.6	C3-S1	P
6-111	Sec. 36 T112N R41W	5.3	6.6	12.1	629	981	1.8	C3-S1	P
6-120	Sec. 12 T111N R41W	4.7	22.4	30.5	1,442	2,252	.9	C4-S1	P
6-117	Sec. 24 T111N R41W	4.5	13.0	29.5	1,120	1,753	.8	C3-S1	P
6-118	Sec. 13 T111N R41W	3.6	20.1	52.4	1,741	2,720	.6	C4-S1	P
6-106	Sec. 25 T112N R41W	345.	118.4	389.9	23,730	37,050	21.6	C4-S4	U
6-136	Sec. 23 T109N R41W	.7	24.3	26.9	1,285	2,007	.1	C4-S1	P
6-135	Sec. 26 T109N R41W	3.0	7.1	6.4	462	715	1.2	C2-S1	G
6-135A	Sec. 26 T109N R41W	1.0	3.0	6.9	268	419	.4	C2-S1	G
6-144	Sec. 31 T113N R42W	15.0	29.1	138.7	4,050	6,330	1.6	C4-S3	D
6-130	Sec. 2 T113N R42W	127.3	130.2	438.1	17,250	26,990	7.6	C4-S4	U
6-121A	Sec. 30 T112N R40W	3.3	7.5	15.2	645	1,008	.9	C3-S1	P
6-121B	Sec. 30 T112N R40W	10.4	8.2	43.8	1,962	2,284	2.0	C4-S1	P
6-139	Sec. 16 T110N R42W	.9	29.0	13.6	1,192	1,862	.1	C3-S1	P
6-151	Sec. 4 T113N R41W	10.4	118.9	190.8	9,740	15,210	.8	C4-S2	D
6-152	Sec. 3 T113N R41W	20.9	13.5	104.6	3,146	4,918	2.7	C4-S2	D
6-154	Sec. 5 T113N R41W	1.4	2.2	14.5	399	624	.5	C2-S1	G
6-155	Sec. 9 T113N R41W	18.2	18.3	112.2	3,313	5,174	1.7	C4-S1	D
6-156	Sec. 3 T113N R41W	7.5	12.4	44.5	1,500	2,342	1.4	C4-S1	P
6-157	Sec. 3 T113N R41W	22.7	10.7	44.9	1,992	3,112	4.3	C4-S2	D
6-158	Sec. 4 T113N R41W	25.6	39.7	136.9	4,730	7,395	2.8	C4-S2	D

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Table 5. (Continued). Chemical analysis of shallow wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Lyon (Continued)								
6-159	Sec. 16 T113N R41W	2.3	6.0	73.6	375	586	.4	C2-S1	G
6-160	Sec. 17 T113N R41W	2.6	20.3	21.2	1,124	1,758	.4	C3-S1	P
6-M110	Sec. 7 T113N R41W	166.4	14.7	907.3	23,250	36,380	7.7	C4-S4	U
6-128	Sec. 12 T113N R42W	41.5	14.8	786.4	16,810	26,290	2.1	C4-S4	U
6-128A	Sec. 12 T113N R42W	9.2	19.3	79.0	2,424	3,784	1.3	C4-S1	D
6-128B	Sec. 12 T113N R42W	9.8	15.9	64.3	2,019	3,158	1.5	C4-S1	P
6-Y106	NE¼ Sec. 23 T112N R40W	3.4	8.2	22.2	805	1,260	.7	C3-S1	P
6-Y102	E½ Sec. 1 T109N R44W	1.2	3.1	15.0	430	672	.5	C2-S1	G
6-153	Sec. 24 T109N R40W	2.5	18.5	38.2	1,387	2,164	.5	C3-S1	P
6-Y103	SW¼ Sec. 1 T112N R41W	8.8	18.3	25.0	136	2,126	1.8	C3-S1	P
6-Y104	SE¼ Sec. 32 T112N R40W	.1	12.8	15.3	703	1,097	T	C3-S1	P
6-Y105	SE¼ Sec. 21 T112N R40W	2.4	3.0	9.0	363	568	.9	C2-S1	G
6-30.2	NW¼ Sec. 18 T112N R41W	44.0	23.3	100.0	417	6,515	5.6	C4-S3	D
6-31.2	NE¼ Sec. 13 T112N R42W	292.3	47.1	658.1	24,080	37,630	15.5	C4-S4	U
6-32.2	NE¼ Sec. 13 T112N R42W	1.4	27.6	8.5	1,064	1,664	.2	C3-S1	P
6-33.2	NE¼ Sec. 13 T112N R42W	15.8	12.9	23.4	1,420	2,203	3.6	C3-S1	P
6-34.2	NE¼ Sec. 13 T112N R42W	9.1	21.0	31.2	1,560	2,437	1.8	C4-S1	P
6-29.2	SW¼ Sec. 21 T113N R40W	26.9	33.5	56.9	3,130	4,790	4.0	C4-S2	D
4-1	Well at Minneota	3.7	8.9	6.2	1,167	1,823	1.4	C3-S1	P
	McLeod								
2-307	Farm well, Sec. 18 T115N R22W	.3	.4	1.2	306	479	.3	C2-S1	G
	Marshall								
6-K75	NW¼ Sec. 5 T154N R45W	1.3	4.7	9.0	378	591	.5	C2-S1	G
6-K74	NW¼ Sec. 6 T154N R45W	7.5	6.0	.5	477	745	4.1	C2-S1	P
6-K73	NE¼ Sec. 10 T154N R46W	12.4	3.0	1.0	552	863	8.7	C3-S2	P
6-K71	NE¼ Sec. 5 T154N R47W	5.3	28.3	32.0	1,670	2,611	1.0	C4-S1	P

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Table 5. (Continued). Chemical analysis of shallow wells of Minnesota with special emphasis on their suitability for irrigation

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		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Marshall (Continued)								
6-K50	SE¼ Sec. 6 T154N R48W	12.3	17.5	15.9	1,275	1,991	3.0	C3-S1	P
6-K51	NE¼ Sec. 4 T154N R49W	11.4	20.2	21.7	1,470	2,298	2.5	C4-S1	P
6-K52	NW¼ Sec. 5 T154N R49W	6.9	18.2	39.1	1,556	2,434	1.3	C4-S1	P
6-K53	NE¼ Sec. 2 T154N R50W	12.2	13.9	11.8	1,087	1,698	3.3	C3-S1	P
6-K77	SE¼ Sec. 16 T155N R46W	2.3	17.2	16.3	920	1,437	.5	C3-S1	P
6-K76	NE¼ Sec. 27 T155N R46W	8.0	8.9	20.4	954	1,489	2.1	C3-S1	P
6-K79	SW¼ Sec. 16 T155N R47W	4.4	9.3	31.2	1,032	1,612	.9	C3-S1	P
6-K78	NW¼ Sec. 22 T155N R47W	8.0	15.0	22.9	1,193	2,023	3.5	C3-S1	P
6-K72	SE¼ Sec. 35 T155N R47W	15.2	8.3	15.7	1,096	1,713	4.1	C3-S2	P
6-K59	SE¼ Sec. 1 T155N R48W	9.6	4.7	6.3	608	950	4.2	C3-S1	P
6-K60	NW¼ Sec. 9 T155N R48W	4.0	6.1	3.8	403	630	1.7	C2-S1	G
6-K58	NE¼ Sec. 20 T155N R48W	17.3	12.6	8.7	1,180	1,850	4.9	C3-S2	P
6-K49	SW¼ Sec. 34 T155N R48W	18.4	13.8	37.8	1,780	2,800	3.6	C4-S2	D
6-K62	NE¼ Sec. 8 T115N R49W	77.5	34.4	59.1	4,890	7,645	11.3	C4-S4	U
6-K57	SE¼ Sec. 14 T155N R49W	34.0	18.4	171.7	5,010	7,835	3.5	C4-S2	D
6-K56	SE¼ Sec. 18 T155N R49W	44.6	27.9	30.5	3,020	4,723	8.3	C4-S3	D
6-K64	NW¼ Sec. 2 T155N R50W	11.7	7.8	6.3	966	1,509	4.4	C3-S2	P
6-K55	SE¼ Sec. 15 T155N R50W	4.0	16.5	20.5	1,040	1,629	.8	C3-S1	P
6-K54	SW¼ Sec. 28 T155N R50W	7.9	8.1	16.8	849	1,327	2.2	C3-S1	P
6-K84	NW¼ Sec. 16 T156N R46W	7.4	8.4	T	526	823	3.8	C3-S1	P
6-K85	SW¼ Sec. 21 T156N R46W	18.6	15.4	1.2	1,160	1,813	6.6	C3-S2	P
6-K83	NW¼ Sec. 14 T156N R47W	7.6	6.2	6.6	589	921	2.9	C3-S1	P
6-K86	SW¼ Sec. 27 T156N R47W	17.7	8.8	1.0	903	1.427	8.0	C3-S2	D
2-49	Flowing well, Sec. 22 T157N R45W	3.6	1.0	2.8	431	673	2.6	C2-S1	G
6-K81	SE¼ Sec. 13 T156N R48W	1.8	10.6	16.5	704	1,100	.3	C3-S1	P
6-K69	NE¼ Sec. 21 T156N R48W	5.6	3.9	18.3	666	1,040	1.8	C3-S1	P
6-K61	SE¼ Sec. 31 T156N R48W	5.9	7.0	26.7	928	1,450	1.3	C3-S1	P
6-K68	SE¼ Sec. 17 T156N R49W	10.6	14.4	53.9	1,835	2,868	1.8	C4-S1	P

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 5. (Continued). Chemical analysis of shallow wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Marshall (Continued)								
6-K70	NE¼ Sec. 24 T156N R49W	28.5	9.0	23.5	1,737	2,712	6.9	C4-S2	D
6-K63	SW¼ Sec. 31 T156N R49W	62.8	23.4	26.5	3,453	5,390	11.5	C4-S4	D
6-K66	SE¼ Sec. 17 T156N R50W	14.7	3.5	33.1	1,254	1,961	3.4	C3-S1	P
6-K67	NW¼ Sec. 23 T156N R50W	8.7	19.8	94.6	2,700	4,220	1.1	C4-S1	D
6-K65	SW¼ Sec. 33 T156N R50W	21.8	3.1	80.2	2,385	3,730	3.4	C4-S2	D
1-1	Average of 38 wells (avg. depth 14 ft.)	12.1	14.5	24.4	1,843	2,883	2.8	C4-S1	P
	Martin								
2-95	Farm well, Sec. 16 T102N R33W	1.6	3.7	1.2	788	1,230	1.0	C3-S1	P
	Meeker								
2-203	Farm well, Sec. 24 T119N R30W	.4	5.9	1.8	387	606	.2	C2-S1	G
2-204	Farm well (20 ft.), Sec. 2 T119N R32W	.4	4.4	.8	329	515	.2	C2-S1	G
	Mille Lacs								
2-128	Farm well, Sec. 14 T133N R26W	2.9	3.3	.6	236	370	2.1	C2-S1	G
	Morrison								
1-3	Driven well, Motley School	2.6	3.0	1.5	434	678	1.7	C2-S1	G
2-251	Farm well (18 ft.), Sec. 32 T129N R29W	.3	.3	1.9	250	391	.2	C2-S1	G
	Mower								
4-1	Spring at Austin	.1	3.0	1.7	371	580	.1	C2-S1	G
4-2	R.R. well at Ramsey	.3	4.8	2.6	579	905	.1	C3-S1	P
4-4	R.R. well at Adams	.6	2.8	4.8	401	627	.3	C2-S1	G
2-156	Farm well (16 ft.), Sec. 19 T103N R15W	1.1	2.4	1.4	377	589	.8	C2-S1	G

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 5. (Continued). Chemical analysis of shallow wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Murray								
6-M104	Sec. 15 T106N R42W	1.3	17.4	12.0	811	1,268	.3	C3-S1	P
6-M105	Sec. 15 T106N R42W	.4	52.8	16.9	1,971	3,082	.1	C4-S1	P
6-M106	Sec. 15 T106N R42W	.9	10.0	11.8	566	884	.3	C3-S1	P
6-M107	Sec. 15 T106N R42W	.8	53.7	28.2	2,222	3,474	.1	C4-S1	P
6-M102	Sec. 22 T108N R39W	1.0	31.5	43.1	1,823	2,815	.2	C4-S1	P
6-M98A	Sec. 7 T108N R42W (Spring)	.1	10.4	12.2	568	888	T	C3-S1	P
4-1	R.R. well at Lake Wilson	2.4	5.3	2.9	654	1,022	1.3	C3-S1	P
4-2	R.R. well at Currie	.4	5.2	3.2	507	793	.3	C3-S1	G
4-3	R.R. well at Chandler	.5	5.2	2.6	458	717	.3	C2-S1	G
	Nobles								
4-2	Well at Wilmont	1.3	12.6	4.8	1,112	1,740	.5	C3-S1	P
2-77	Farm well, Sec. 21 T102N R40W	5.0	5.4	3.1	1,600	2,500	2.4	C4-S1	P
2-78	Farm well (20 ft.), Sec. 2 T102N R40W	3.2	3.1	2.5	890	1,390	1.9	C3-S1	P
	Norman								
6-K48	SW¼ Sec. 19 T144N R46W	8.2	35.8	71.0	2,720	4,280	1.1	C4-S1	P
6-K42	SW¼ Sec. 32 T144N R47W	T	3.9	13.5	399	623	T	C2-S1	G
6-K43	SE¼ Sec. 18 T144N R47W	.3	9.2	12.2	526	822	.1	C3-S1	P
6-K45	NE¼ Sec. 35 T145N R47W	2.8	6.0	8.9	451	705	1.0	C2-S1	G
6-K46	SW¼ Sec. 5 T145N R48W	4.5	23.4	38.4	1,610	2,514	.8	C4-S1	P
1-1	Well at Gary	2.2	4.9	2.5	670	1,046	1.2	C3-S1	P
1-2	NW¼ Sec. 17 T143N R47W	3.2	8.4	7.4	1,496	2,339	1.2	C4-S1	P
	Olmsted								
2-172	Farm well, Sec. 10 T106N R13W	.8	1.8	1.5	308	481	.6	C2-S1	G

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 5. (Continued). Chemical analysis of shallow wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Otter Tail								
6-K7	NW¼ Sec. 12 T134N R42W	8.8	4.9	T	627	980	5.6	C3-S2	P
2-108	Farm well (18 ft.), Sec. 2 T133N R40W	1.8	.9	2.0	303	474	1.5	C2-S1	G
2-109	Farm well (15 ft.), Sec. 1 T133N R40W	1.8	.6	2.2	336	526	1.5	C2-S1	G
2-240	Farm well (14 ft.), Sec. 1 T133N R40W	1.3	3.3	1.0	291	454	.9	C2-S1	G
2-242	Farm well, Sec. 1 T133N R40W	.3	.2	2.7	323	505	.2	C2-S1	G
2-244	Farm well (20 ft.), Sec. 15 T133N R38W	.2	.5	1.2	376	587	.2	C2-S1	G
	Pennington								
6-K75	NW¼ Sec. 5 T154N R45W	1.3	4.7	9.0	378	590	.4	C2-S1	G
6-K74	NW¼ Sec. 6 T154N R45W	7.5	6.0	.5	476	745	4.1	C2-S1	P
	Pine								
2-120	Farm well, Sec. 28 T138N R21W	.9	5.4	2.9	353	552	.5	C2-S1	G
	Pipestone								
6-39.2	Sec. 15 T108N R44W	676.4	29.8	634.4	36,930	57,700	37.1	C4-S4	U
4-3	Spring at Jasper	.6	2.4	1.6	269	421	.3	C2-S1	G
	Polk								
1-4	SE¼ Sec. 14 T147N R47W	1.1	3.4	2.2	460	719	.7	C2-S1	G
6-K74	NW¼ Sec 6 T154N R45W	7.5	6.0	.5	477	745	4.2	C2-S1	P
6-K73	NE¼ Sec. 10 T154N R46W	12.4	3.0	1.0	553	863	8.8	C3-S2	P
6-K71	NE¼ Sec. 5 T154N R47W	5.3	28.3	32.0	1,670	2,607	1.0	C4-S1	P
6-K50	SE¼ Sec. 6 T154N R48W	12.3	17.5	15.9	1,273	1,991	3.2	C3-S1	P
6-K51	NE¼ Sec. 4 T154N R49W	11.4	20.3	21.7	1,470	2,299	2.8	C4-S1	P
6-K52	NW¼ Sec. 5 T154N R49W	6.9	18.2	39.1	1,560	2,434	1.3	C4-S1	P
6-K53	NE¼ Sec. 2 T154N R50W	12.2	13.9	11.8	1,122	1,754	3.4	C3-S1	P

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 5. (Continued). Chemical analysis of shallow wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Pope								
1-3	Well at Westport	1.7	2.8	1.9	400	625	1.0	C2-S1	G
1-8	Spring at Glenwood	.8	5.0	1.9	465	727	.4	C2-S1	G
1-9	Spring at Glenwood	.2	1.9	2.3	266	416	.2	C2-S1	G
2-214	Farm well (15 ft.), Sec. 27 T123N R40W	1.8	1.4	2.2	400	625	1.3	C2-S1	G
2-215	Farm well, Sec. 15 T123N R40W	2.8	5.9	2.6	695	1,086	1.5	C3-S1	P
2-217	Farm well (20 ft.), Sec. 3 T124N R40W	1.5	4.0	2.1	464	725	.9	C2-S1	G
	Redwood								
6-Y118	Sec. 33 T112N R38W	1.3	6.0	8.4	400	625	.5	C2-S1	G
6-Y119	Sec. 28 T112N R38W	2.1	7.8	7.6	472	737	.8	C2-S1	G
6-Y110	NE¼ Sec. 23 T112N R36W	2.1	9.5	15.6	675	1,053	.5	C3-S1	P
6-Y111	SE¼ Sec. 23 T112N R36W	2.1	14.0	46.5	1,397	2,182	.4	C3-S1	P
6-Y112	E½ Sec. 33 T112N R36W	1.9	5.8	20.7	639	998	.5	C3-S1	G
6-Y113	SE¼ Sec. 28 T112N R36W	1.9	7.9	13.4	576	901	.6	C3-S1	G
6-Y107	NW¼ Sec. 35 T111N R37W	1.2	5.8	10.7	423	662	.5	C2-S1	G
6-Y108	SW¼ Sec. 2 T110N R37W	2.5	5.9	9.0	458	716	.9	C2-S1	G
6-Y109	NW¼ Sec. 34 T111N R37W	1.7	9.0	17.2	677	1,058	.4	C3-S1	P
6-Y114	SE¼ Sec. 21 T111N R38W	2.3	37.5	18.2	3,515	5,490	.4	C4-S1	D
6-Y115	E½ Sec. 33 T111N R38W	2.0	11.9	16.2	751	1,174	.5	C3-S1	P
6-Y116	NE¼ Sec. 9 T110N R38W	1.9	5.3	4.7	328	513	.8	C2-S1	G
6-Y117	S½ Sec. 15 T110N R38W	1.0	8.0	9.0	469	733	.4	C2-S1	G
6-36.2	NW¼ Sec. 7 T109N R37W	254.3	34.6	83.5	11,700	18,280	33.0	C4-S4	U
4-1	Spring at Redwood Falls	1.0	9.9	5.4	972	1,519	.5	C3-S1	P
4-2	Spring at Redwood Falls	1.0	7.9	4.1	732	1,142	.5	C3-S1	P
4-3	Well at Vesta	.1	2.7	.7	206	322	.1	C2-S1	G

* First digit of reference number indicates source of data as shown in References, page 9.

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 5. (Continued). Chemical analysis of shallow wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Renville								
6-Y170	SE¼ Sec. 1 T113N R34W	8.9	5.8	5.8	671	1,049	3.7	C3-S1	P
6-Y173	S½ Sec. 15 T114N R33W	2.6	5.1	5.3	350	546	1.1	C2-S1	G
6-Y175	Sec. 5 T114N R32W	.7	47.9	60.4	2,648	4,140	.1	C4-S1	P
6-Y199	N½ Sec. 11 T116N R35W	3.4	30.4	36.4	1,753	2,741	.6	C4-S1	P
6-Y189	E½ Sec. 23 T116N R34W	.2	18.5	16.0	1,119	1,747	.2	C3-S1	P
4-4	Spring at Morton	.4	5.6	2.8	563	880	.2	C3-S1	P
2-285	Farm well, Sec. 20 T113N R32W	.6	1.1	2.6	1,360	2,124	.4	C3-S1	P
2-286	Farm well, Sec. 20 T115N R32W	1.9	1.0	4.3	1,340	2,096	1.1	C3-S1	P
2-288	Farm well, Sec. 1 T115N R35W	1.3	.8	4.2	1,230	1,923	.8	C3-S1	P
	Rock								
4-1	City well at Luverne	.6	4.8	1.4	399	624	.4	C2-S1	G
4-2	Spring, Sec. 25 T103N R45W	.1	.7	.7	89	140	.4	C1-S1	G
4-3	Spring at Jasper	.6	2.4	1.6	294	458	.4	C2-S1	G
2-73	Farm well (15 ft.), Sec. 27 T102N R45W	2.0	1.5	1.8	442	690	1.6	C2-S1	G
	Scott								
4-1	Spring at Savage	T	3.9	1.8	463	723	.1	C2-S1	G
4-5	R.R. well at Savage	.1	3.6	2.4	481	751	.1	C3-S1	G
	Sherburne								
2-138	Farm well (18 ft.), Sec. 30 T134N R27W	.2	1.9	.8	202	316	.2	C2-S1	G
	Stearns								
1-3	Foley Brother's well at St. Cloud	.6	3.6	2.3	376	587	.4	C2-S1	G
1-4	Well at Belgrade	1.6	3.0	2.2	444	694	.9	C2-S1	G

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 5. (Continued). Chemical analysis of shallow wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Steele								
4-3	Spring at Owatonna	.2	10.8	2.0	639	998	.1	C3-S1	P
4-5	Spring at Owatonna	.4	2.8	1.2	365	570	.2	C2-S1	G
4-6	Spring at Owatonna	.6	2.1	1.2	324	506	.4	C2-S1	G
2-148	Farm well, Sec. 33 T107N R20W	1.6	2.0	2.8	356	556	1.0	C2-S1	G
	Swift								
6-M9	Sec 10 T120N R37W	2.9	21.0	31.7	1,350	2,108	.6	C3-S1	P
2-213	Farm well (20 ft.), Sec. 15 T122N R40W	1.5	5.6	1.3	537	840	.8	C3-S1	P
	Todd								
1-1	Well at Philbrook	2.1	3.1	1.8	474	741	1.3	C2-S1	G
1-2	Well at Clarissa	1.3	2.0	2.0	266	416	.9	C2-S1	G
1-3	Driven well at Motley School	2.6	3.0	1.5	388	608	1.7	C2-S1	G
2-241	Farm well (18 ft.), Sec. 22 T133N R35W	.3	.4	2.0	312	488	.3	C2-S1	G
2-247	Farm well (20 ft.), Sec. 7 T130N R33W	.2	.2	2.4	242	379	.2	C2-S1	G
	Traverse								
1-6	Spring at Browns Valley	1.6	11.2	7.6	1,120	1,754	.6	C3-S1	P
1-7	Spring NE¼ Sec. 28 T126N R48W	4.9	15.5	8.3	2,690	4,200	1.4	C4-S1	D
1-4	R.R. test well at Wheaton	.2	4.6	3.7	440	688	.2	C2-S1	G
2-226	Farm well, Sec. 26 T126N R46W	1.8	5.4	1.3	457	714	1.0	C2-S1	G
2-227	Farm well, Sec. 22 T127N R46W	7.4	4.9	1.7	695	1,086	4.1	C3-S1	P
	Wadena								
1-2	Spring near Wadena	.2	2.9	1.7	258	404	.2	C2-S1	G

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 5. (Continued). Chemical analysis of shallow wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Watonwan								
2-102	Farm well, Sec. 5 T105N R32W	1.9	7.1	2.0	865	1,350	.9	C3-S1	P
2-104	Farm well, Sec. 26 T107N R32W	1.3	.9	1.4	257	402	1.2	C2-S1	G
	Winona								
4-1	Spring at Stockton	.2	3.0	2.6	447	698	.1	C2-S1	G
4-2	Spring at Minnesota City	.1	3.6	2.5	489	763	.1	C3-S1	G
2-167	Farm well, Sec. 19 T105N R6W	.4	3.5	1.9	254	397	.2	C2-S1	G
2-169	Farm well, Sec. 23 T106N R10W	.8	2.3	2.3	150	234	.5	C1-S1	G
	Yellow Medicine								
6-Y222	E½ Sec. 21 T114N R45W	3.1	40.4	107.	3,381	5,280	.4	C4-S1	D
6-126	Sec. 6 T113N R40W	39.8	31.1	194.6	6,055	9,470	3.6	C4-S3	D
6-130	Sec. 2 T113N R42W	127.3	130.2	438.1	15,230	23,810	7.5	C4-S4	U
6-151	Sec. 4 T113N R41W	10.4	118.9	190.8	9,710	15,180	.8	C4-S4	D
6-152	Sec. 3 T113N R41W	20.9	13.5	104.6	3,141	4,913	2.7	C4-S2	D
6-154	Sec. 5 T113N R41W	1.4	2.2	14.5	399	624	.5	C2-S1	G
6-155	T113N R41W	18.2	18.3	112.2	3,313	5,176	2.3	C4-S2	D
6-156	Sec. 3 T113N R41W	7.5	12.4	44.5	1,499	2,341	1.4	C4-S1	P
6-157	Sec. 3 T113N R41W	22.7	10.7	44.9	1,989	3,109	4.3	C4-S2	D
6-158	Sec. 4 T113N R41W	25.6	39.7	136.9	4,728	7,390	2.7	C4-S2	D
2-292	Farm well, Sec. 3 T115N R42W	1.1	.7	3.6	1,190	1,861	.8	C3-S1	P

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*		Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Anoka								
4-2	Flowing well at Anoka	1.1	3.2	1.5	332	519	.6	C2-S1	G
2-140	Farm well (60 ft.), Sec. 29 T133N R25W	1.9	4.2	2.3	344	537	1.0	C2-S1	G
2-141	Farm well (165 ft.), Sec. 23 T133N R25W	1.2	3.5	2.4	279	436	.7	C2-S1	G
	Becker								
1-5	Mpls., St. Paul and S.S. R.R. well, Detroit Lakes, Sec. 29 T 139N R41W	.6	5.6	3.7	519	810	.3	C3-S1	G
1-6	Mpls., St. Paul and S.S. R.R. well, Detroit Lakes	.2	4.8	2.8	382	597	.1	C2-S1	G
1-7	Detroit Light and Land Co. well, Detroit Lakes	.2	4.9	3.2	414	646	.1	C2-S1	G
1-8	H. G. Frieler, Ogema, Sec. 19 T142N R41W	.9	3.5	2.8	406	635	.5	C2-S1	G
1-9	J. A. Danielson, Lake Park, Sec. 3 T139N R43W	4.2	11.3	7.9	1,374	2,146	1.4	C3-S1	P
1-10	NW¼ Sec. 13 T140N R41W	1.0	3.2	2.1	320	500	.6	C2-S1	G
1-11	SE¼ Sec. 18 T138N R37W	1.5	3.5	2.7	400	625	.8	C2-S1	G
1-12	SE¼ Sec. 10 T139N R42W	1.9	3.4	2.9	438	685	1.1	C2-S1	G
1-13	SE¼ Sec. 12 T139N R42W	1.4	3.0	2.5	400	625	.9	C2-S1	G
1-14	SW¼ Sec. 15 T139N R43W	2.6	5.0	4.1	636	994	1.2	C3-S1	P
2-14	A. Bloomquist Irrigation well, Sec. 10 T138N R41W	.2	3.5	1.1	390	609	.2	C2-S1	G
2-10	Farm well, Sec. 30 T140N R41W	.3	3.1	.8	390	609	.2	C2-S1	G
2-11	Frazee water supply, Sec. 35 T138N R40W	.3	3.6	1.4	400	625	.2	C2-S1	G
2-15	G. Lindlow Irrigation well, Sec. 22 T138N R40W	.1	2.2	1.2	228	357	.1	C2-S1	G
	Beltrami								
1-2	NE¼ Sec. 23 T146N R34W	.8	2.8	1.1	238	372	.4	C2-S1	G
1-3	SE¼ Sec. 19 T153N R30W	2.1	4.3	2.5	502	784	1.1	C3-S1	P
1-4	SW¼ Sec. 11 T153N R31W	1.6	3.6	3.0	390	610	.9	C2-S1	G
1-5	SW¼ Sec. 21 T146N R33W	1.1	4.2	2.1	520	812	.6	C3-S1	P
1-6	SE¼ Sec. 12 T149N R31W	.6	4.8	3.4	450	704	.3	C2-S1	G

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Beltrami (Continued)								
1-7	SE¼ Sec. 15 T147N R33W	.7	3.3	1.5	286	447	.4	C2-S1	G
1-8	NE¼ Sec. 19 T146N R32W	.9	4.2	2.1	360	562	.5	C2-S1	G
1-9	SW¼ Sec. 27 T149N R32W	1.0	4.3	3.2	436	681	.5	C2-S1	G
1-10	City well, Kelliher	2.1	3.1	2.5	340	531	1.3	C2-S1	G
1-13	NE¼ Sec. 17 T150N R33W	2.2	3.5	2.6	450	704	1.2	C2-S1	G
2-28	H. Butler farm, Sec. 14 T147N R34W	.1	1.2	1.2	247	386	T	C2-S1	G
	Benton								
2-255	Farm well (39 ft.), Sec. 4 T36N R31W	.5	.4	1.2	309	483	.5	C2-S1	G
2-256	Farm well (80 ft.), Sec. 15 T36N R31W	.3	.1	1.7	229	358	.3	C2-S1	G
	Big Stone								
4-1	Well at Ortonville, Sec. 9 T121N R46W	9.1	3.6	4.4	1,132	1,770	4.6	C3-S2	P
4-2	Hunters well at Ortonville, Sec. 9 T121N R46W	2.3	5.4	3.0	671	1,048	1.1	C3-S1	P
4-3	Well at Correll, Sec. 3 T120N R44W	4.6	6.5	5.9	915	1,430	1.9	C3-S1	P
4-5	Well at Graceville, Sec. 9 T124N R46W	5.5	18.3	24.1	2,946	4,600	1.2	C4-S1	D
4-7	R.R. well at Graceville, Sec. 9 T124N R46W	10.2	7.6	9.5	1,839	2,870	3.5	C4-S2	P
4-8	Well at Graceville, Sec. 9 T124N R46W	10.0	7.3	6.2	1,595	2,490	3.9	C4-S2	P
4-9	Village well at Clinton, Sec. 16 T123N R46W	9.2	4.1	3.0	1,165	1,820	4.6	C3-S2	P
4-10	Mill well at Graceville, Sec. 9 T124N R46W	12.7	.9	.8	1,044	1,630	17.5	C3-S4	D
4-11	New village well at Graceville, Sec. 9 T124N R46W	11.6	.8	.7	931	1,454	13.0	C3-S3	D
4-12	Well at Graceville, Sec. 9 T124N R46W	12.2	.8	.9	977	1,527	13.0	C3-S3	D
4-13	Well at Graceville, Sec. 9 T124N R46W	12.3	.8	.8	978	1,529	13.5	C3-S3	D
4-15	Lower village artesian well at Browns Valley	37.0	.8	.7	2,946	4,600	42.6	C4-S4	U
4-16	Upper village artesian well at Browns Valley	37.3	.8	.7	2,959	4,610	42.9	C4-S4	U
2-222	Farm well (160 ft.), Sec. 2 T124N R45W	1.6	5.3	1.7	533	833	.8	C3-S1	P
2-224	Farm well (70 ft.), Sec. 3 T124N R46W	6.0	5.4	2.2	711	1,110	3.2	C3-S1	P

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Blue Earth								
4-1	Village well at Mapleton	2.8	7.6	3.8	855	1,334	1.2	C3-S1	P
4-2	Village well at Amboy	3.1	8.5	4.8	1,037	1,620	1.3	C3-S1	P
4-3	Well at Hubbard Mills No. 1, Mankato	2.3	5.5	3.1	635	991	1.1	C3-S1	P
4-4	City well at Mankato	1.6	3.9	2.9	459	716	.8	C2-S1	G
4-5	Well at flour mill in Mankato	.9	6.3	4.3	654	1,020	.3	C3-S1	P
2-107	Farm well (127 ft), Sec. 18 T110N R31W	1.9	.6	1.7	438	685	1.8	C2-S1	G
2-268	Farm well (313 ft.), Sec. 28 T108N R26W	1.6	.6	2.7	430	672	1.2	C2-S1	G
	Brown								
4-2	Well at Roller Mill, Sleepy Eye	2.2	7.4	4.8	793	1,238	.8	C3-S1	P
4-3	City well, Sleepy Eye	3.0	11.1	7.2	1,300	2,030	1.0	C3-S1	P
4-4	Well at Sleepy Eye	1.7	7.5	4.9	798	1,246	.6	C3-S1	P
4-5	City well at New Ulm	5.9	3.8	2.7	789	1,232	3.2	C3-S1	P
4-6	Depot well at New Ulm	5.2	3.5	3.0	756	1,182	2.8	C3-S1	P
6-Y287	City well at Comfrey	1.6	10.0	15.0	858	1,341	.5	C3-S1	P
	Carver								
4-1	Well at Chanhassen	.7	7.5	4.4	695	1,085	.2	C3-S1	P
4-4	Well at Chanhassen	.3	3.4	2.6	310	484	.2	C2-S1	G
4-2	Well at Cologne	1.8	7.2	4.1	712	1,112	.6	C3-S1	P
4-5	Well at Cologne	1.6	7.2	4.3	707	1,105	.6	C3-S1	P
2-308	Farm well (100 ft.), Sec. 13 T115N R25W	2.2	.6	3.0	709	1,107	1.6	C3-S1	P
2-309	Farm well (142 ft.), Sec. 15 T115N R25W	.8	.9	1.7	714	1,116	.7	C3-S1	P
	Cass								
1-2	Farm well (20 ft.), Sec. 18 T143N R26W	1.3	4.8	2.5	440	688	.6	C2-S1	G
1-4	Village well at Federal Dam	1.7	5.2	3.4	498	778	.7	C3-S1	G

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Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Chippewa								
6-S16	SE¼ Sec. 18 T119N R37W	14.4	16.5	23.3	1,358	2,122	3.4	C3-S1	P
4-2	"Casgreves Well," Montevideo	1.5	5.0	2.6	461	720	.7	C2-S1	G
4-3	"Clarks Well," Montevideo	7.0	10.0	5.5	1,281	2,000	2.5	C3-S1	P
4-4	R.R. well at Milan	6.9	1.6	1.6	588	918	5.4	C3-S1	P
4-1	Well at Granite Falls	1.6	5.8	5.5	729	1,140	.6	C3-S1	P
2-300	Farm well (65 ft.), Sec. 3 T117N R39W	2.2	1.0	2.4	1,246	1,948	1.7	C3-S1	P
2-301	Farm well (80 ft.), Sec. 7 T117N R38W	1.6	.7	3.7	1,130	1,766	1.1	C3-S1	P
2-303	Farm well, Sec. 22 T117N R37W	2.8	.3	1.7	718	1,122	2.8	C3-S1	P
	Clay								
6-K37	NW¼ Sec. 9 T137N R48W	10.0	11.1	14.6	1,261	1,971	2.8	C3-S1	P
6-K38	NW¼ Sec. 16 T137N R48W	8.0	22.2	14.1	1,606	2,509	1.8	C4-S1	P
6-K31	SW¼ Sec. 17 T138N R48W	8.8	8.7	10.0	996	1,556	2.8	C3-S1	P
6-K26	NE¼ Sec. 8 T140N R47W	10.2	60.4	153.6	6,628	10,357	1.0	C4-S3	D
6-K19	SE¼ Sec. 19 T140N R47W	7.8	3.0	14.4	828	1,294	2.6	C3-S1	P
6-K12	NE¼ Sec. 6 T140N R48W	29.6	8.4	5.2	1,824	2,850	8.5	C4-S3	D
6-K10	SW¼ Sec. 32 T140N R48W	16.5	9.9	T	1,154	1,803	7.5	C3-S2	D
6-K27	SW¼ Sec. 35 T141N R47W	5.0	19.6	36.8	1,937	3,027	.9	C4-S1	P
6-K18	SW¼ Sec. 32 T142N R47W	2.4	8.0	14.5	783	1,224	.4	C3-S1	P
6-K17	NE¼ Sec. 3 T142N R48W	45.0	5.2	16.5	2,678	4,184	13.5	C4-S4	D
6-K14	NW¼ Sec. 28 T142N R48W	26.8	14.2	10.5	2,058	3,216	7.5	C4-S2	D
1-9	N½ Sec. 11 T139N R48W	12.1	25.0	57.6	5,756	9,000	1.9	C4-S3	D
1-10	SW¼ Sec. 33 T137N R44W	.9	4.8	2.5	462	721	.4	C2-S1	G
1-11	SW¼ Sec. 33 T141N R44W	1.0	6.2	4.8	652	1,020	.4	C3-S1	P
1-12	Hawley Co-Op Creamery, Hawley	2.1	5.1	4.4	704	1,100	.9	C3-S1	P
1-13	SE¼ Sec. 30 T141N R46W	2.0	4.8	3.1	544	850	1.0	C3-S1	P
1-14	NE¼ Sec. 1 T139N R48W	5.4	3.3	1.8	660	1,030	3.4	C3-S1	P
1-15	NE¼ Sec. 13 T138N R46W	.8	3.6	2.6	386	603	.4	C2-S1	G

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Clay (Continued)								
1-16	NW¼ Sec. 29 T139N R44W	2.0	6.0	3.6	570	890	.8	C3-S1	P
1-17	SE¼ Sec. 26 T137N R48W	6.8	6.1	3.8	1,024	1,600	3.0	C3-S1	P
1-18	SE¼ Sec. 15 T142N R47W	7.7	1.1	.8	600	937	7.8	C3-S2	P
1-19	SW¼ Sec. 2 T139N R48W	7.7	1.2	1.1	624	975	7.2	C3-S2	P
1-20	NW¼ Sec. 19 T139N R47W	4.2	1.6	1.1	452	706	3.5	C2-S1	P
1-21	S½ Sec. 6 T141N R48W	22.2	1.8	1.6	1,580	2,470	16.5	C4-S4	D
2-30	Farm well, Sec. 3 T139N R45W	.7	2.0	5.0	780	1,219	.3	C3-S1	P
2-33	Farm well, Sec. 16 T142N R46W	6.7	.7	1.0	506	807	7.3	C3-S2	P
	Clearwater								
1-1	Creamery well at Clearbrook	1.7	2.7	2.5	358	559	1.1	C2-S1	G
1-2	SE¼ Sec. 15 T150N R38W	3.2	3.0	1.7	492	769	2.1	C3-S1	P
1-3	SE¼ Sec. 20 T147N R36W	1.3	3.0	1.5	290	453	.8	C2-S1	G
1-4	NW¼ Sec. 3 T149N R38W	3.7	6.0	4.3	816	1,276	1.6	C3-S1	P
1-5	Well at M. J. Kolb, Bagley	1.4	3.7	2.0	390	610	.7	C2-S1	G
1-6	SE¼ Sec. 10 T149N R38W	3.5	2.7	2.0	434	678	2.3	C2-S1	G
1-7	SE¼ Sec. 12 T150N R38W	2.8	3.5	2.4	498	778	1.5	C3-S1	P
1-3	NW¼ Sec. 1 T144N R39W	2.3	2.6	3.6	520	813	1.2	C3-S1	P
2-29	Farm well (80 ft.), Sec. 21 T147N R36W	.1	2.2	2.0	366	572	.9	C2-S1	G
	Cottonwood								
6-Y282	City water, Mountain Lake	4.5	22.2	27.3	1,766	2,290	.9	C4-S1	P
6-Y287	City water, Comfrey	1.6	10.0	15.0	858	1,341	.5	C3-S1	P
4-1	R.R. well at Windom	1.1	6.6	4.8	713	1,114	.4	C3-S1	P
4-2	Village well at Mountain Lake	.8	6.6	3.4	611	955	.3	C3-S1	P
4-3	Well at Mountain Lake	4.6	15.6	8.6	1,846	2,880	1.2	C4-S1	P
4-4	Village well at Westbrook	5.1	11.7	6.4	1,501	2,347	1.7	C4-S1	P
4-5	Creamery well at Bingham Lake	4.1	15.1	8.4	1,729	2,700	1.0	C4-S1	P

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Cottonwood (Continued)								
4-7	R.R. well at Bingham Lake	5.4	10.9	6.2	1,545	2,412	1.9	C4-S1	P
4-8	Flour mill well at Westbrook	8.5	1.8	.7	1,710	2,670	7.5	C4-S2	D
4-9	R.R. well at Westbrook	4.6	14.3	8.1	1,677	2,620	1.2	C4-S1	P
4-10	R.R. well at Westbrook	12.6	7.9	3.8	1,797	2,810	4.8	C4-S2	D
6-Y255	Sec. 32 T107N R38W, Westbrook supply	7.6	28.9	29.8	2,232	3,489	1.4	C4-S1	D
6-Y261	Sec. 17 T108N R38W	15.0	22.8	18.3	2,053	3,208	3.3	C4-S1	D
2-88	Farm well (60 ft.), Sec. 35 T106N R36W	5.8	3.5	2.3	1,165	1,820	3.4	C3-S1	P
	Crow Wing								
2-1	Well in Emily	.7	1.0	.4	126	197	.7	C1-S1	G
2-3	Well at Remer	.8	3.3	1.5	302	472	.4	C2-S1	G
1-8	NW¼ Sec. 5 T131N R30W	1.3	2.1	1.9	292	459	.9	C2-S1	G
	Dakota								
4-1	R.R. well at Farmington	.3	4.3	2.1	356	557	.2	C2-S1	G
4-2	R.R. well at Farmington	.1	4.3	2.3	339	530	.1	C2-S1	G
4-3	R.R. well at Farmington	.3	4.3	2.2	354	553	.2	C2-S1	G
4-5	Private well at Farmington	.2	3.9	1.8	358	560	.2	C2-S1	G
4-4	Private well at Mendota	.3	2.5	3.1	303	474	.2	C2-S1	G
4-9	R.R. well at Mendota	.4	2.6	1.4	220	344	.3	C2-S1	G
4-10	R.R. well at Mendota	.4	2.6	1.4	220	344	.3	C2-S1	G
4-11	R.R. well at Mendota	2.1	4.9	3.2	580	907	1.0	C3-S1	G
4-6	R.R. well at Inver Grove	.3	3.4	2.3	295	461	.2	C2-S1	G
4-7	Well at South St. Paul	.2	2.4	1.9	263	411	.2	C2-S1	G
4-15	Well at South St. Paul	.2	2.6	1.2	254	397	.2	C2-S1	G
4-8	City well at Hastings	1.3	2.7	2.1	358	560	.8	C2-S1	G
4-16	City well at Hastings	.6	2.4	2.1	288	450	.3	C2-S1	G
4-12	R.R. well at Hastings	6.7	3.2	2.3	773	1,208	3.9	C3-S1	P

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Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Dakota (Continued)								
4-13	R.R. well at Hastings	7.8	4.2	2.6	897	1,401	4.2	C3-S1	P
4-14	Well at Hastings	3.8	3.7	2.5	620	969	2.2	C3-S1	P
2-184	Farm well (136 ft.), Sec. 19 T113N R18W	1.3	1.6	1.5	287	439	1.1	C2-S1	G
2-186	Farm well (361 ft.), Sec. 27 T127N R22W	.6	3.2	2.4	276	431	.4	C2-S1	G
	Dodge								
4-1	R.R. well at Claremont	.2	4.6	2.8	377	589	.2	C2-S1	G
4-3	R.R. well at Claremont	.3	5.7	2.9	487	761	.2	C3-S1	G
4-2	R.R. well at Kasson	.3	3.6	1.7	289	451	.2	C2-S1	G
4-5	R.R. well at Dodge Center	.7	4.4	2.0	374	584	.3	C2-S1	G
4-4	City well at Hayfield	.4	4.4	2.3	326	509	.2	C2-S1	G
2-175	Farm well (65 ft.), Sec. 28 T107N R16W	1.1	1.9	2.7	298	466	.7	C2-S1	G
2-178	Farm well (300 ft.), Sec. 7 T108N R16W	.8	1.7	3.8	336	526	.5	C2-S1	G
	Douglas								
1-1	S. Kohlas well, Carlos	1.2	3.4	2.6	430	672	.7	C2-S1	G
1-2	SW¼ Sec. 14 T130N R39W	.9	5.0	3.4	464	725	.4	C2-S1	G
1-3	SE¼ Sec. 13 T127N R39W	1.4	4.4	3.6	528	825	.7	C3-S1	P
1-4	Village well, Osakis	2.4	3.8	3.2	552	863	1.3	C3-S1	P
1-5	SE¼ Sec. 16 T127 N R37W	.8	4.2	2.5	388	606	.4	C2-S1	G
1-6	SW¼ Sec. 23 T129N R39W	1.4	8.7	4.8	880	1,374	.5	C3-S1	P
1-7	NE¼ Sec. 36 T129N R36W	1.1	4.0	4.8	366	572	.5	C2-S1	G
1-8	City well at Evansville	2.0	4.7	3.7	520	812	1.0	C3-S1	P
1-9	NE¼ Sec. 8 T127N R40W	5.8	5.3	7.7	1,202	1,878	2.2	C3-S1	P
1-10	NE¼ Sec. 16 T129N R38W	1.5	5.5	5.0	612	956	.6	C3-S1	P
1-11	NW¼ Sec. 36 T130N R41W	1.0	6.4	4.2	644	1,006	.4	C3-S1	P
2-4	G. Bowman well (137 ft.), Sec. 27 T128N R36W	.7	6.6	10.7	581	908	.2	C3-S1	P
2-5	J. Brandon well (111 ft.), Sec. 33 T128N R39W	.5	3.6	4.0	409	640	.2	C2-S1	G

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10⁶)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Faribault								
4-1	R.R. well at Delavan	1.2	5.5	3.0	520	812	.5	C3-S1	P
4-2	R.R. well at Huntley	.4	4.5	2.7	386	603	.2	C2-S1	G
4-3	R.R. well at Huntley	.5	4.8	2.9	426	665	.2	C2-S1	G
4-5	R.R. well at Huntley—New Source	.7	5.1	3.1	462	721	.3	C2-S1	G
4-6	R.R. well at Wells	4.0	4.1	2.4	615	961	2.1	C3-S1	P
4-7	R.R. and village well at Winnebago	3.5	8.4	4.4	1,083	1,693	1.3	C3-S1	P
4-8	Village well at Winnebago	1.8	9.2	4.5	944	1,474	.7	C3-S1	P
4-9	Village well at Wells	3.4	4.0	2.4	558	871	1.9	C3-S1	P
4-10	City well at Blue Earth	3.6	8.9	4.1	1,044	1,632	1.4	C3-S1	P
4-11	R.R. well at Elmore	2.4	4.8	2.6	603	941	1.2	C3-S1	P
2-272	Farm well (117 ft.), Sec. 21 T103N R24W	1.8	.2	1.9	482	752	1.8	C3-S1	P
2-275	Farm well (183 ft.), Sec. 24 T103N R28W	.9	.1	3.2	285	445	.7	C2-S1	G
	Fillmore								
4-9	R.R. well at Rushford	1.2	5.6	1.8	456	713	.6	C2-S1	G
4-12	R.R. well at Mabel	.1	3.0	1.7	241	377	.1	C2-S1	G
4-14	R.R. well at Mabel	.3	3.4	2.0	295	461	.2	C2-S1	G
4-15	R.R. well at Canton	.4	4.5	2.6	389	608	.2	C2-S1	G
4-18	R.R. well at Fountain	.2	3.9	2.0	305	477	.1	C2-S1	G
4-19	Village well at Fountain	.1	4.1	2.7	301	470	.1	C2-S1	G
4-20	Village well at Fountain	.2	3.8	1.9	296	462	.1	C2-S1	G
4-16	Village well at Harmony	.1	4.2	2.5	327	511	.1	C2-S1	G
4-17	Stockyards well at Canton	.3	4.4	2.5	352	550	.2	C2-S1	G
2-159	Farm well (185 ft.), Sec. 36 T103N R12W	.6	3.5	1.7	272	426	.4	C2-S1	G
2-160	Farm well (180 ft.), Sec. 35 T103N R12W	.8	2.6	3.3	464	725	.5	C2-S1	G

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Freeborn								
4-4	City well at Albert Lea	.8	5.0	2.5	423	661	.3	C2-S1	G
4-5	R.R. well at Albert Lea	.4	4.9	2.5	623	973	.1	C3-S1	P
2-150	Farm well (230 ft.), Sec. 25 T104N R21W	2.9	4.5	2.9	397	621	1.5	C2-S1	G
2-151	Farm well (230 ft.), Sec. 2 T102N R21W	2.0	4.9	3.3	426	667	1.0	C2-S1	G
	Goodhue								
2-179	Farm well (65 ft.), Sec. 6 T109N R16W	1.0	2.1	2.5	274	428	.7	C2-S1	G
2-180	Farm well (70 ft.), Sec. 27 T111N R17W	1.1	2.0	2.8	326	510	.7	C2-S1	G
2-182	Farm well (70 ft.), Sec. 19 T112N R17W	.8	1.8	1.7	276	431	.6	C2-S1	G
	Grant								
6-Y517	Sec. 7 T129N R42W	3.4	6.5	11.8	724	1,132	1.1	C3-S1	P
1-2	SW¼ Sec. 8 T127N R41W	1.4	5.5	3.8	592	925	.6	C3-S1	P
1-3	SE¼ Sec. 32 T130N R44W	6.1	5.7	3.6	958	1,497	2.8	C3-S1	P
1-4	NE¼ Sec. 6 T127N R42W	6.2	20.4	12.4	2,654	4,130	1.5	C4-S1	D
1-5	W½ Sec. 28 T128N R43W	5.1	10.6	8.0	1,538	2,400	1.6	C4-S1	P
1-6	R.R. well at Hoffman	.5	4.8	4.6	514	804	.5	C3-S1	P
1-7	NE¼ Sec. 22 T127N R44W	5.6	4.5	2.4	794	1,240	2.9	C3-S1	P
1-8	SE¼ Sec. 10 T127N R41W	1.0	5.7	4.3	614	959	.4	C3-S1	P
1-9	SW¼ Sec. 18 T130N R43W	6.2	5.2	4.2	952	1,488	3.0	C3-S1	P
1-10	NW¼ Sec. 34 T130N R42W	2.7	4.0	2.7	520	813	1.4	C3-S1	P
1-11	NW¼ Sec. 36 T130N R41W	1.0	6.4	4.2	644	1,006	.4	C3-S1	P
1-12	SW¼ Sec. 27 T128N R44W	7.0	5.6	3.4	1,016	1,587	3.2	C3-S1	P
1-16	Sec. 30 T131N R43W	5.1	2.7	2.0	588	920	3.2	C3-S1	P
2-230	Farm well (140 ft.), Sec. 15 T124N R44W	7.0	6.4	1.7	784	1,233	3.5	C3-S1	P
2-8	Farm well, Sec. 18 T130N R42W	1.3	6.2	6.2	2,060	3,220	.5	C4-S1	P
2-231	Farm well (129 ft.), Sec. 34 T128N R44W	7.0	4.2	1.4	598	935	4.2	C3-S1	P
2-233	Farm well (156 ft.), Sec. 17 T128N R44W	6.8	4.4	1.5	726	1,135	3.9	C3-S1	P

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Hennepin								
4-6	Well in Minneapolis (formation found in glacial drift)	.5	1.8	.9	201	314	.3	C2-S1	G
4-7	Well in Minneapolis (formation found in glacial drift)	.9	2.6	1.2	271	423	.6	C2-S1	G
4-8	Well in Minneapolis (formation found in glacial drift)	.5	1.6	.6	170	266	.4	C2-S1	G
4-15	Well in Minneapolis (St. Peter)	.2	2.3	3.0	304	475	.2	C2-S1	G
4-16	Well in Minneapolis (St. Peter)	T	3.4	2.1	404	631	.1	C2-S1	G
4-17	Well in Minneapolis (St. Peter)	.3	3.8	2.3	504	788	.2	C3-S1	G
4-18	Well in Minneapolis (St. Peter)	.3	3.2	2.0	281	439	.2	C2-S1	G
4-19	Well in Minneapolis (St. Peter)	.2	3.1	2.1	276	431	.1	C2-S1	G
4-20	Well in Minneapolis (New Richmond)	.2	2.7	2.4	273	427	.1	C2-S1	G
4-21	Well in Minneapolis (New Richmond)	.1	3.8	2.6	341	533	.1	C2-S1	G
4-22	Well in Minneapolis (New Richmond)	.6	3.4	2.2	322	503	.4	C2-S1	G
4-23	Well in Minneapolis (New Richmond)	.6	3.5	2.4	330	516	.3	C2-S1	G
4-24	Well in Minneapolis (Jordan)	.5	3.8	2.1	342	535	.3	C2-S1	G
4-25	Well in Minneapolis (Jordan)	.3	4.5	3.0	392	613	.2	C2-S1	G
4-27	Well in Minneapolis (Jordan)	.2	4.2	2.6	375	586	.1	C2-S1	G
4-28	Well in Minneapolis (St. Lawrence)	.8	6.8	3.4	614	960	.4	C3-S1	P
4-29	Well in Minneapolis (St. Lawrence)	.6	3.8	2.0	376	587	.2	C2-S1	G
4-30	Well in Minneapolis (Dresbach, etc.)	.2	2.6	3.0	292	456	.1	C2-S1	G
4-31	Well in Minneapolis (Dresbach, etc.)	.1	3.9	2.3	326	510	.1	C2-S1	G
4-32	Well in Minneapolis (Dresbach, etc.)	.1	4.4	2.5	371	580	.1	C2-S1	G
4-33	Well in Minneapolis (Dresbach, etc.)	.2	4.8	2.6	374	584	.1	C2-S1	G
4-34	Well in Minneapolis (Dresbach, etc.)	.1	3.9	2.4	331	518	.1	C2-S1	G
4-35	Well in Minneapolis (Dresbach, etc.)	.2	4.6	2.7	380	594	.1	C2-S1	G
4-36	Well in Minneapolis (Dresbach, etc.)	.1	3.2	2.2	281	439	.1	C2-S1	G
4-37	Well in Minneapolis (Dresbach, etc.)	.1	3.1	2.0	275	430	.1	C2-S1	G

* First digit of reference number indicates source of data as shown in References, page 9.

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Hennepin (Continued)								
4-38	Well in Minneapolis (Dresbach, etc.)	.5	4.0	2.1	347	542	.2	C2-S1	G
4-39	Well in Minneapolis (Dresbach, etc.)	.1	3.0	2.2	300	469	.1	C2-S1	G
4-1	Well in Chanhassen	.7	2.5	4.4	695	1,086	.2	C3-S1	P
4-4	Well in Chanhassen	.3	3.4	2.6	310	484	.2	C2-S1	G
4-1	Well in Delano	1.0	5.1	2.5	471	736	.5	C2-S1	G
2-196	Farm well (186 ft.), Sec. 34 T118N R23W	2.9	4.8	2.0	463	724	1.6	C2-S1	G
2-197	Farm well (140 ft.), Sec. 16 T118N R24W	.9	4.9	2.1	381	595	.5	C2-S1	G
	Houston								
4-3	R.R. well at Houston	1.1	5.1	2.6	466	728	.6	C2-S1	G
4-5	R.R. well at Spring Grove	.5	6.8	1.2	441	689	.2	C2-S1	G
4-6	R.R. well at River Junction	.1	3.4	2.6	300	469	.1	C2-S1	G
4-7	R.R. well at Houston	2.0	3.2	2.0	404	631	1.2	C2-S1	G
4-8	Village well at Caledonia	.4	3.1	2.3	286	447	.2	C2-S1	G
4-9	Village well at Caledonia	.4	3.5	2.6	322	503	.2	C2-S1	G
4-10	Village well at Hokah	.3	3.8	2.4	279	436	.2	C2-S1	G
2-163	Farm well (400 ft.), Sec. 28 T104N R7W	.5	3.5	2.2	245	383	.3	C2-S1	G
2-164	Farm well (300 ft.), (Artesian), Sec. 33 T104N R47W	.8	3.2	2.1	234	365	.5	C2-S1	G
	Hubbard								
1-1	Ressler Market, Park Rapids	4.3	5.5	1.8	610	953	2.2	C3-S1	P
1-2	Nevis Hotel, Nevis	1.1	2.2	1.5	222	347	.8	C2-S1	G
1-3	SW¼ Sec. 33 T145N R32W	1.2	2.8	1.4	246	384	.8	C2-S1	G
2-18	Bender Irrigation well, Sec. 10 T140N R33W	.3	2.6	.6	221	345	.2	C2-S1	G
	Isanti								
2-132	Farm well (37 ft.), Sec. 22 T136N R25W	1.7	3.8	1.2	201	314	1.1	C2-S1	G
2-135	Farm well (70 ft.), Sec. 8 T134N R25W	.9	2.9	1.8	301	471	.6	C2-S1	G

* First digit of reference number indicates source of data as shown in References, page 9.

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	meq/l	meq/l	meq/l	ppm	μmhos/cm		Quality classification	
		Salt concentration†			Total dissolved	Electrical conductivity		U.S.	
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Jackson								
4-2	Village well at Alpha	2.3	5.8	3.2	671	1,048	1.0	C3-S1	P
4-3	Well at Okabena	.8	8.1	3.6	766	1,197	.3	C3-S1	P
4-4	Well at Prairie Junction	3.6	11.0	6.7	1,326	2,070	1.2	C3-S1	P
4-5	Mill well at Lakefield	2.6	4.9	3.9	692	1,081	1.2	C3-S1	P
4-6	Village well at Lakefield	1.2	5.9	3.4	593	926	.5	C3-S1	P
4-7	Village well at Lakefield	.3	7.9	3.7	662	1,034	.1	C3-S1	P
4-8	A. Johnson farm, 5 mi. S. of Windom	1.6	7.9	4.7	845	1,320	.5	C3-S1	P
4-9	R.R. well at Heron Lake	10.0	6.5	12.2	1,855	2,895	3.3	C4-S1	D
4-10	R.R. well at Heron Lake	4.9	13.8	6.7	1,807	2,820	1.5	C4-S1	P
2-91	Farm well (60 ft.), Sec. 35 T103N R35W	4.2	5.6	2.4	1,388	2,170	2.1	C3-S1	P
2-94	Farm well (80 ft.), Sec. 15 T102N R34W	13.2	3.9	2.5	2,067	3,230	7.4	C4-S2	D
	Kanabec								
2-124	Farm well (80 ft.), Sec. 5 T139N R23W	.6	1.7	.7	152	238	.6	C2-S1	G
	Kandiyohi								
4-1	Village well at Atwater	.3	4.4	3.0	421	658	.1	C2-S1	G
4-2	N. Anderson well at Willmar	.3	11.1	6.2	1,012	1,580	.1	C3-S1	P
4-3	City well at Willmar	2.2	3.2	2.9	464	725	1.2	C2-S1	G
2-26	Farm well (169 ft.), Sec. 29 T121N R36W	.7	1.7	2.7	504	788	.4	C3-S1	G
2-206	Farm well (96 ft.), Sec. 8 T119N R33W	1.3	4.9	2.2	542	847	.7	C3-S1	P
2-207	Farm well (105 ft.), Sec. 9 T119N R34W	1.6	4.9	1.7	762	1,190	.9	C3-S1	P
2-209	Farm well (81 ft.), Sec. 31 T120N R36W	1.1	1.8	1.9	318	497	.8	C2-S1	G
	Kittson								
1-6	St. Vincent village	2.6	6.4	11.8	1,120	1,750	1.2	C4-S1	P
1-8	NE¼ Sec. 30 T161N R49W	7.2	21.4	11.4	2,480	3,875	1.6	C4-S1	D
1-9	NE¼ Sec. 11 T160N R50W	5.3	16.0	8.2	1,800	2,815	1.5	C4-S1	P

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Kittson (Continued)								
1-10	Humboldt salt water well	803.8	77.5	90.8	57,220	89,400	87.4	C4-S4	U
2-43	Farm well (133 ft.), Sec. 3 T159N R48W	19.0	3.9	9.0	4,000	6,250	7.5	C4-S3	D
	Koochiching								
2-11	SE¼ Sec. 14 T152N R28W	1.6	4.0	3.0	446	696	.8	C2-S1	G
2-12	R.R. well at Gemmell	1.3	4.0	2.4	372	581	.7	C2-S1	G
	Lac qui Parle								
4-6	East village well at Dawson	9.0	.5	.6	697	1,090	12.1	C3-S3	D
6-Y228	E½ Sec. 4 T115N R45W	4.9	6.6	5.6	628	981	2.0	C3-S1	P
2-296	Farm well (200 ft.), Sec. 16 T117N R44W	4.9	.2	1.7	1,564	2,445	5.0	C4-S2	D
2-297	Farm well (100 ft.), Sec. 15 T117N R42W	1.7	.6	3.4	855	1,337	1.2	C3-S1	P
	Lake of the Woods								
1-1	NE¼ Sec. 1 T158N R31W	1.1	3.5	2.6	540	845	.6	C3-S1	P
1-2	NW¼ Sec. 30 T161N R32W	1.6	2.7	2.9	376	587	.8	C2-S1	G
1-3	SE¼ Sec. 33 T161N R31W	4.6	3.9	3.3	730	1,140	2.3	C3-S1	P
1-4	Hotel well, Williams	.9	3.1	1.9	306	478	.5	C2-S1	G
1-2	Well at Roosevelt	1.4	2.5	1.6	280	438	1.0	C2-S1	G
	Le Sueur								
4-2	R.R. well at Le Sueur	.3	4.0	2.5	363	567	.2	C2-S1	G
4-3	City well at Waterville	.3	2.7	2.6	294	459	.1	C2-S1	G
4-4	Brewery well at Montgomery	2.2	3.5	1.2	487	761	1.4	C3-S1	G
4-5	Flour mill well at New Prague	1.5	5.5	3.0	578	903	.8	C3-S1	P
4-6	City well at Montgomery	2.7	3.8	3.0	512	800	1.5	C3-S1	P
4-8	R.R. well at Montgomery	2.1	4.5	3.2	531	830	1.1	C3-S1	P
4-10	Creamery well at Cleveland	.8	4.0	2.6	369	577	.4	C2-S1	G

* First digit of reference number indicates source of data as shown in References, page 9.

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^3)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Le Sueur (Continued)								
4-11	R.R. well at Kasota	3.3	5.7	3.3	687	1,074	1.6	C3-S1	P
4-12	City well at Le Sueur	1.5	2.7	1.7	366	572	1.0	C2-S1	G
2-265	Farm well (190 ft.), Sec. 29 T111N R23W	2.3	.2	2.8	445	695	2.0	C2-S1	G
	Lincoln								
4-4	Driven well at Lake Benton	1.2	10.3	5.2	1,016	1,587	.4	C3-S1	P
4-5	Well at Lake Benton	1.2	9.0	4.8	855	1,336	.4	C3-S1	P
4-6	Driven well at Lake Benton	.2	6.5	2.5	527	824	.1	C3-S1	P
4-7	Creamery well at Tyler	8.6	20.3	8.0	2,337	3,650	2.3	C4-S1	D
4-8	R.R. well at Tyler	11.2	15.9	10.4	2,427	3,790	3.2	C4-S2	D
4-9	R.R. well at Tyler	7.2	15.5	8.5	1,994	3,110	2.0	C4-S1	P
4-10	R.R. well at Lake Benton	.9	6.0	3.9	628	980	.3	C3-S1	P
6-Y217	NE¼ Sec. 33 T114N R44W	6.3	22.0	38.8	2,119	3,311	1.1	C4-S1	D
2-2A	Well at Ivanhoe (300 ft.), Sec. 34 T112N R45W	2.1	3.7	.9	1,183	1,850	1.3	C3-S1	P
2-3A	Well at Ivanhoe (27 ft.), Sec. 34 T112N R45W	.7	5.5	1.1	659	1,030	.3	C3-S1	P
2-67	Farm well (75 ft.), Sec. 17 T110N R45W	3.6	4.3	2.2	1,081	1,690	2.0	C3-S1	P
2-68	Farm well (150 ft.), Sec. 30 T109N R45W	4.6	4.4	3.5	1,254	1,960	2.3	C3-S1	P
	Lyon								
6-37	Sec. 23 T109N R40W	6.4	10.1	12.9	1,030	1,609	1.8	C3-S1	P
6-140	Sec. 5 T111N R41W (Marshall City supply)	29.2	21.0	18.5	2,643	4,130	6.6	C4-S2	D
6-M86	Sec. 5 T111N R41W	4.7	23.7	42.9	2,216	3,462	.8	C4-S1	P
6-M87	Sec. 5 T111N R41W	16.9	25.8	23.1	2,385	3,726	3.4	C4-S2	D
4-2	Village well at Minneota	7.4	7.1	5.8	1,370	2,140	2.9	C3-S1	P
4-3	R.R. well at Marshall	4.6	10.3	7.3	1,387	2,165	1.5	C3-S1	P
4-4	City well at Marshall	4.9	.8	6.1	1,230	1,920	2.6	C3-S1	P
4-5	Well at Tracy	9.0	15.3	7.8	1,943	3,040	2.5	C4-S1	P
4-6	Well at Marshall Bottling Works	9.3	1.5	1.3	836	1,308	7.9	C3-S2	P

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Lyon (Continued)								
4-7	Well at H. H. Adair at Marshall	9.7	2.0	1.1	854	1,332	7.7	C3-S2	P
4-8	SE¼ Sec. 3 T111N R41W	19.0	2.9	1.6	1,793	2,804	13.0	C4-S3	D
4-10	SE¼ Sec. 17 T111N R41W	19.4	1.0	1.3	1,663	2,600	18.0	C4-S4	D
4-11	Flow well at old mill in Marshall	12.3	16.4	8.0	2,449	3,830	3.9	C4-S2	D
4-12	Flow well at Marshall	7.3	13.0	6.2	1,789	2,795	2.3	C4-S1	P
4-13	Flow well at Marshall	15.0	10.4	11.4	2,473	3,865	4.5	C4-S2	D
4-14	Flow well of Railway in Marshall	15.3	16.2	8.1	2,774	4,340	4.3	C4-S2	D
4-15	City well at Tracy	7.7	6.9	3.0	1,244	1,944	3.5	C3-S1	P
4-16	City well at Tracy	6.6	6.9	2.7	1,150	1,798	3.0	C3-S1	P
4-17	Well at Tracy	8.8	6.5	2.7	1,271	1,987	4.2	C3-S1	P
4-18	City well at Cottonwood	33.8	1.9	2.6	2,669	4,165	22.0	C4-S4	U
4-19	Flowing well at W. Rush, Minneota	22.1	4.4	5.7	2,274	3,555	14.0	C4-S4	D
6-K267	Sec. 4 T108N R42W	6.8	19.2	15.9	1,482	2,316	1.6	C4-S1	P
6-M62	E½ Sec. 33 T114N R42W	43.6	6.8	8.1	2,486	3,884	15.5	C4-S4	D
2-61	Artesian well (360 ft.), Sec. 11 T111N R42W	8.8	1.0	1.6	1,229	1,920	7.7	C3-S2	D
2-63	Farm well (100 ft.), Sec. 5 T112N R42W	5.9	2.0	2.2	727	1,135	4.1	C3-S1	P
	McLeod								
4-1	Well at Hutchinson	.2	3.9	2.0	303	474	.1	C2-S1	G
4-2	Well at Brownton—L. Arnold	1.3	7.4	4.1	740	1,158	.5	C3-S1	P
4-3	Village well at Lester Prairie	2.2	6.8	3.6	731	1,143	1.0	C3-S1	P
4-4	Well at Glencoe	.3	5.6	3.8	496	775	.1	C3-S1	G
4-5	Well at Glencoe	.7	5.6	4.0	529	826	.2	C3-S1	P
4-6	Well at Hutchinson	.2	3.8	2.0	308	481	.1	C2-S1	G
4-7	Well at Brownton—flour mill	2.0	4.8	3.5	550	860	1.0	C3-S1	P
4-8	Well at Brownton	1.6	4.4	3.1	467	730	.8	C2-S1	G
4-9	"Bullick," well at Brownton	2.0	4.8	3.4	550	860	1.0	C3-S1	P
4-10	Hayden's well at Glencoe	1.4	5.8	3.4	549	858	.6	C3-S1	P

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Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	McLeod (Continued)								
4-11	Flowing well at Hutchinson, flour mill	1.0	5.1	3.2	531	829	.4	C3-S1	P
4-12	Flowing well at Conrad Farm, 1½ mi. E. Biscay	1.0	4.9	4.4	568	887	.4	C3-S1	P
4-13	Creamery well at Glencoe	1.8	5.8	3.9	609	951	.8	C3-S1	P
4-14	"Bretchet's" well at Glencoe	1.8	6.0	4.2	622	973	.8	C3-S1	P
4-15	Well at Stewart	3.8	2.0	1.9	425	665	2.7	C2-S1	G
4-16	Village well at Brownton	2.7	3.5	2.7	491	767	1.4	C3-S1	G
4-17	Village well at Brownton	2.7	3.7	2.8	481	752	1.4	C3-S1	G
4-18	Village well at Stewart	4.1	2.1	.8	449	702	3.2	C2-S1	G
4-19	City well at Glencoe	2.9	3.9	3.3	565	884	1.5	C3-S1	P
4-20	City well at Glencoe	3.1	3.8	3.5	600	936	1.6	C3-S1	P
4-21	City well at Glencoe	7.6	3.7	2.7	870	1,360	4.2	C3-S1	P
2-305	Farm well (80 ft.), Sec. 26 T116N R29W	1.3	.7	1.4	582	910	1.3	C3-S1	P
2-306	Farm well (255 ft.), Sec. 26 T116N R29W	1.5	.4	2.3	592	926	1.3	C3-S1	P
	Mahnomen								
1-1	School well, NE¼ Sec. 1 T144N R41W	2.2	5.3	3.5	604	944	1.1	C3-S1	P
1-2	Campbell well at Waubun	1.1	4.5	3.4	480	750	.4	C2-S1	G
1-3	NW¼ Sec. 1 T144N R39W	2.3	2.6	3.6	520	813	1.2	C3-S1	P
1-5	NE¼ Sec. 5 T145N R40W (Weber)	2.4	6.5	6.1	920	1,438	.9	C3-S1	P
1-6	NE¼ Sec. 32 T146N R40W (Winckler)	2.4	3.3	3.9	512	800	1.2	C3-S1	P
1-4	Well of Dr. Franta, Mahnomen	3.7	4.0	2.6	624	975	2.0	C3-S1	P
	Marshall								
6-K80	NE¼ Sec. 25 T155N R48W	7.0	7.5	15.6	1,000	1,563	2.0	C3-S1	P
6-K82	SE¼ Sec. 17 T156N R47W	5.0	6.3	27.7	1,159	1,811	1.0	C3-S1	P
1-2	NE¼ Sec. 29 T155N R47W	5.6	8.1	8.6	1,326	2,070	1.9	C3-S1	P
1-3	SW¼ Sec. 32 T158N R48W	33.3	26.7	15.8	4,490	7,020	7.5	C4-S3	D
1-4	SE¼ Sec. 31 T158N R48W	25.6	16.6	8.6	3,210	5,020	7.0	C4-S2	D

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Marshall (Continued)								
1-5	SE¼ Sec. 34 T155N R48W	16.3	3.3	3.2	1,580	2,470	9.1	C4-S3	D
1-6	SW¼ Sec. 34 T155N R48W	71.0	24.3	5.9	7,020	10,970	18.5	C4-S4	U
1-7	N½ Sec. 5 T157N R49W	102.5	15.6	10.7	8,940	13,970	28.5	C4-S4	U
1-10	NW¼ Sec. 16 T155N R43W	3.7	1.8	2.8	478	746	2.4	C2-S1	G
1-8	Drilled well of A. Johnson—Newfolden	4.3	1.9	2.4	466	729	2.9	C2-S1	G
1-9	Well at Middle River	2.3	1.9	4.2	484	756	1.3	C3-S1	G
2-41	Farm well, Sec. 34 T156N R48W	9.6	2.2	23.0	2,285	3,570	2.7	C4-S2	D
2-50	Farm well, Sec. 4 T155N R43W	4.4	1.0	2.4	438	685	3.3	C2-S1	G
	Martin								
4-1	R.R. well, Fox Lake	.2	3.3	1.6	322	503	.1	C2-S1	G
4-2	Mill well at Welcome	.6	5.3	3.9	477	745	.2	C2-S1	G
4-3	Well at M. Davidson, NE¼ Sec. 28 T103N R29W	5.0	9.0	2.3	1,085	1,695	2.1	C3-S1	P
4-4	Well of G. Clunick, Sec. 33 T104N R29W	.8	7.0	4.4	772	1,207	.2	C3-S1	P
4-5	Well at Granada	3.5	10.5	5.0	1,158	1,809	1.2	C3-S1	P
4-6	Former C.M.S.P. R.R. well, Fairmont	4.3	9.8	4.8	1,182	1,850	1.5	C3-S1	P
4-7	Well at Fairmont	.7	9.7	4.7	890	1,390	.2	C3-S1	P
4-8	Village well at Welcome	4.1	6.8	5.5	1,018	1,589	1.6	C3-S1	P
4-9	Farm well at Welcome	7.6	10.6	4.8	1,522	2,380	2.7	C4-S1	P
4-10	Village well at Sherburn	.8	5.8	2.6	579	905	.3	C3-S1	P
4-11	Village well at Sherburn	1.7	6.0	3.9	735	1,149	.7	C3-S1	P
4-12	Village well at Sherburn	1.5	9.4	4.8	923	1,440	.5	C3-S1	P
4-13	Village well at Sherburn	1.8	9.3	4.8	935	1,460	.6	C3-S1	P
4-14	Village well at Fairmont	3.1	10.9	5.6	1,211	1,892	1.1	C3-S1	P
4-2	R.R. well at Huntley	.4	4.5	2.7	386	603	.1	C2-S1	G
4-3	R.R. well at Huntley	.6	4.8	2.9	426	665	.2	C2-S1	G
4-5	R.R. well at Huntley (new)	.7	5.1	3.1	462	721	.3	C2-S1	G

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Martin (Continued)								
2-97	Farm well (120 ft.), Sec. 6 T103N R32W	8.2	2.1	2.2	1,069	1,670	5.6	C3-S2	P
2-98	Farm well (110 ft.), Sec. 20 T104N R32W	2.2	2.6	2.0	621	971	1.4	C3-S1	P
	Meeker								
4-1	Village well at Eden Valley	.7	4.6	2.2	439	687	.3	C2-S1	G
4-2	Well at J. McNulty, Litchfield	.8	5.7	2.6	550	860	.3	C3-S1	P
4-3	Well at Grove City, W. Main Street	.9	7.7	2.6	684	1,068	.3	C3-S1	P
4-5	Village well at Dassel	.4	4.2	2.7	399	624	.2	C2-S1	G
4-6	Village well at Grove City	.8	3.4	2.0	349	546	.4	C2-S1	G
4-4	NW¼ Sec. 10 T121N R31W	.3	4.4	2.2	382	597	.2	C2-S1	G
2-202	Farm well (95 ft.), Sec. 28 T119N R29W	.3	5.9	2.2	381	595	.2	C2-S1	G
	Mille Lacs								
2-130	Farm well (80 ft.), Sec. 30 T137N R26W	1.0	4.4	2.2	304	474	.6	C2-S1	G
	Morrison								
1-4	SE¼ Sec. 16 T129N R31W	1.3	3.7	2.6	392	613	.7	C2-S1	G
1-7	NE¼ Sec. 22 T130N R31W	.6	2.9	1.8	286	447	.3	C2-S1	G
1-8	NW¼ Sec. 5 T131N R30W	1.3	2.1	1.9	292	456	.9	C2-S1	G
1-5	Creamery well No. 1 at Randall	.6	3.5	2.4	342	534	.3	C2-S1	G
1-9	Creamery well No. 2 at Randall	1.7	.7	2.2	218	341	1.2	C2-S1	G
1-6	Well at J. Harmonick Farm, Flensburg	.6	4.2	2.6	396	619	.3	C2-S1	G
2-249	Farm well (67 ft.), Sec. 22 T129N R31W	.6	.7	2.3	461	720	.5	C2-S1	G
2-250	Farm well (60 ft.), Sec. 27 T129N R30W	.5	.3	1.0	279	437	.7	C2-S1	G
	Mower								
4-3	R.R. well at LeRoy	.5	4.8	.8	342	535	.3	C2-S1	G
4-5	R.R. well at Dexter	.3	3.7	2.0	315	492	.2	C2-S1	G

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Mower (Continued)								
4-6	City well at Austin	.3	3.1	1.7	253	395	.2	C2-S1	G
4-8	R.R. well at Austin	.7	3.3	1.2	245	383	.5	C2-S1	G
4-9	City well at Austin	.3	3.4	2.0	279	436	.2	C2-S1	G
2-155	Farm well (144 ft.), Sec. 3 T102N R17W	1.3	2.0	2.1	356	556	.9	C2-S1	G
2-158	Farm well (75 ft.), Sec. 21 T103N R14W	1.0	1.3	3.4	374	585	.7	C2-S1	G
	Murray								
6-M98	SE¼ Sec. 7 T108N R42W	4.7	30.1	23.1	1,990	3,109	.9	C4-S1	P
6-Y245	Farm well (100 ft.)	4.4	27.2	22.6	1,842	2,879	1.0	C4-S1	P
6-Y259	Farm well (100 ft.)	14.9	21.5	14.4	1,898	2,965	3.6	C4-S1	P
6-Y267	Sec. 4 T108N R42W	6.8	19.2	15.9	1,482	2,316	1.7	C4-S1	P
4-4	Well at Iona Hotel	2.7	8.1	2.6	826	1,290	1.2	C3-S1	P
4-5	Well at Lake Wilson—flowing	.1	7.0	3.3	587	916	.1	C3-S1	P
4-6	Well at Currie	4.1	11.5	4.1	1,525	2,380	1.4	C4-S1	P
4-7	Well at Fulda	6.0	13.2	9.9	1,865	2,915	1.6	C4-S1	P
4-8	R.R. well at Avoca	5.5	8.8	4.5	1,211	1,890	2.1	C3-S1	P
4-9	Village well at Iona	1.4	17.9	7.1	1,599	2,500	.3	C4-S1	P
4-10	Village well at Slayton	.7	12.0	4.7	1,054	1,650	.2	C3-S1	P
4-11	Village well at Fulda	4.7	14.9	8.3	1,792	2,800	1.4	C4-S1	P
4-12	Village well at Fulda	5.2	12.4	7.8	1,686	2,630	1.8	C4-S1	P
2-81	Farm well (75 ft.), Sec. 15 T107N R45W	4.0	4.0	2.6	1,248	1,950	2.2	C3-S1	P
2-82	Farm well (100 ft.), Sec. 15 T108N R41W	6.4	3.4	2.1	966	1,510	3.9	C3-S1	P
	Nicollet								
2-276	Farm well (200 ft.), Sec. 32 T109N R27W	1.7	.4	1.4	508	794	1.8	C3-S1	P
2-277	Farm well (311 ft.), Sec. 33 T110N R28W	1.6	.1	1.7	492	770	1.7	C3-S1	G
2-279	Farm well (42 ft.), Sec. 29 T111N R28W	3.0	.7	2.9	1,181	1,848	2.2	C3-S1	P

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Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
2-280	Farm well (150 ft.), Sec. 9 T111N R28W	2.4	.3	3.0	730	1,140	1.9	C3-S1	P
	Nobles								
6-S79	City well at Worthington	3.5	19.8	17.6	1,379	2,154	.8	C3-S1	P
4-1	Village well at Adrian	2.0	3.4	3.1	529	826	1.1	C3-S1	P
4-3	R.R. well at Bigelow	2.5	9.7	5.8	1,217	1,900	.9	C3-S1	P
4-4	City well at Worthington	3.0	9.8	6.2	1,164	1,820	1.1	C3-S1	P
4-5	City well at Worthington	.9	8.9	4.9	907	1,420	.3	C3-S1	P
4-6	Village well at Wilmont	4.1	21.7	13.1	2,540	3,970	.9	C4-S1	D
2-76	Farm well (60 ft.), Sec. 14 T102N R41W	3.1	4.7	2.6	1,229	1,920	1.6	C3-S1	P
2-79	Farm well (100 ft.), Sec. 2 T102N R40W	7.2	5.2	2.1	1,420	2,220	3.8	C3-S1	P
	Norman								
6-K41	SE¼ Sec. 30 T144N R47W	5.3	13.8	23.5	1,368	2,137	1.2	C3-S1	P
6-K44	NE¼ Sec. 10 T144N R47W	3.0	14.0	26.3	1,339	2,170	.9	C3-S1	P
1-3	NW¼ Sec. 10 T145N R43W	8.8	9.9	6.8	1,724	2,690	3.0	C4-S1	D
1-4	Creamery well at Lockhart	2.4	3.2	2.1	450	704	1.4	C2-S1	G
1-5	R.R. well at Twin Valley	.1	4.2	3.5	353	552	.1	C2-S1	G
1-6	Village well No. 3 at Shelly	7.7	1.9	1.2	678	1,060	6.1	C3-S2	P
1-7	NE¼ Sec 18 T143N R47W	4.3	1.8	1.5	526	822	3.2	C3-S1	P
1-8	Well in Perley	19.6	1.9	1.4	1,550	2,420	15.5	C4-S4	D
1-9	City well at Ada	6.7	1.1	.9	594	929	6.4	C3-S2	P
1-10	Village well No. 2 at Shelly	19.7	.5	.1	1,324	2,070	36.0	C3-S4	U
1-11	Well of H. Brekhus, Sec. 12 T146N R43W	5.5	3.6	2.7	670	1,047	3.0	C3-S1	P
6-K17	NE¼ Sec. 3 T142N R48W	45.0	5.2	16.5	2,678	4,184	13.6	C4-S4	D
2-34	Farm well, Sec. 15 T143N R46W	9.1	.7	3.0	704	1,098	6.7	C3-S2	P
2-35	Farm well, Sec. 4 T144N R46W	6.2	1.2	9.8	467	730	2.7	C2-S1	G
2-36	Farm well, Sec. 21 T146N R46W	1.1	1.4	2.3	405	633	.8	C2-S1	G

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Olmsted								
4-1	City well at Rochester	.4	4.0	1.8	320	500	.2	C2-S1	G
4-2	City well at Rochester	.3	3.8	1.2	290	453	.2	C2-S1	G
4-3	R.R. well at Eyota	.1	3.2	1.4	241	377	.1	C2-S1	G
4-4	R.R. well at Rochester	.5	3.6	2.6	343	536	.3	C2-S1	G
4-5	Hospital well at Rochester	.2	3.9	1.5	290	453	.1	C2-S1	G
2-171	Farm well (90 ft.), Sec. 20 T106N R11W	1.0	1.7	1.7	325	508	.8	C2-S1	G
2-174	Farm well (220 ft.), Sec. 35 T107N R15W	1.3	1.9	2.6	326	510	.8	C2-S1	G
	Otter Tail								
1-4	Well at Parkers Prairie	.6	3.8	2.0	400	625	.3	C3-S1	G
1-5	Well at Henning	2.3	4.0	3.0	559	874	1.2	C3-S1	P
1-6	R.R. well at Henning	1.1	4.3	2.7	442	691	.5	C3-S1	G
1-7	Well at Fergus Falls	.6	3.6	2.6	396	619	.3	C2-S1	G
1-8	Well at Henning	.8	5.4	2.3	458	716	.4	C2-S1	G
1-9	Well at Fergus Falls	1.4	4.3	3.2	508	794	.7	C3-S1	G
1-10	Well at Fergus Falls	2.3	3.3	3.4	426	666	1.2	C2-S1	G
1-11	Well at M. Engfer, Sec. 24 T131N R38W	1.1	5.9	3.4	510	797	.5	C3-S1	G
1-12	Well at Parkers Prairie	1.0	3.2	1.7	300	469	.5	C2-S1	G
1-13	Well at Fergus Falls	3.6	6.2	3.9	580	906	1.5	C3-S1	P
1-14	Well at D. Danielson, Sec. 31 T134N R42W	1.2	4.7	3.2	484	756	.5	C3-S1	G
1-15	Well at Fergus Falls State Hospital	.7	5.1	3.3	341	533	.3	C2-S1	G
1-16	Well at H. Fabian, Sec. 30 T131N R43W	5.1	2.7	2.0	588	920	3.2	C3-S1	P
2-243	Farm well (40 ft.), Sec. 1 T133N R40W	.4	.2	2.7	302	472	.3	C2-S1	G
2-9	Farm well, Sec. 5 T134N R43W	.9	7.6	4.0	581	908	.3	C3-S1	P
2-13	M. Tallrud irrigation well, Sec. 17 T137N R42W	.1	1.4	.8	200	313	.1	C2-S1	G
2-16	W. Hackett irrigation well, Sec. 13 T137N R40W	.2	2.1	.4	272	425	.2	C2-S1	G
2-17	R. Perry irrigation well, Sec. 14 T136N R39W	.4	3.6	1.1	367	574	.2	C2-S1	G

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Pennington								
1-2	Creamery well at Thief River Falls	3.4	3.3	3.7	600	937	1.8	C3-S1	P
1-3	O. Ihle well at Thief River Falls	3.4	1.4	2.7	512	800	2.3	C3-S1	P
1-4	Model steam laundry well at Thief River Falls	4.0	1.6	2.6	488	763	2.6	C3-S1	P
1-1	SE¼ Sec. 36 T153N R44W	3.6	2.1	1.9	450	704	2.5	C2-S1	P
1-5	Sec. 21 T154N R41W	3.6	1.6	2.1	400	625	2.6	C2-S1	G
1-6	NE¼ Sec. 1 T153N R41W	4.0	1.5	2.1	440	688	2.8	C2-S1	G
1-7	SE¼ Sec. 36 T154N R44W	2.9	.6	.9	276	431	2.7	C2-S1	G
1-8	NW¼ Sec. 5 T153N R42W	3.6	.6	.9	308	481	4.0	C2-S1	G
1-9	NW¼ Sec. 9 T152N R45W	4.0	1.2	1.4	386	604	3.3	C2-S1	G
1-9	NE¼ Sec. 32 T152N R43W	5.6	.9	1.1	458	715	5.6	C2-S1	G
2-52	Farm well, Sec. 12 T153N R43W	4.8	2.4	6.8	1,017	1,590	2.2	C3-S1	P
2-53	Farm well, Sec. 8 T152N R42W	2.2	.9	1.2	303	474	2.1	C2-S1	G
	Pine								
2-122	Farm well, Sec. 8 T140N R21W	1.0	5.0	2.0	276	432	.5	C2-S1	G
2-123	Farm well (80 ft.), Sec. 7 T140N R21W	1.2	2.1	1.8	262	410	.9	C2-S1	G
	Pipestone								
4-1	Village well at Edgerton	.5	6.2	1.7	504	787	.2	C3-S1	G
4-2	R.R. well at Hatfield	.4	4.8	2.5	385	601	.2	C2-S1	G
4-4	Well near Jasper	1.2	8.0	5.6	845	1,320	.4	C3-S1	P
4-5	City well at Pipestone	.7	4.2	3.4	442	691	.3	C2-S1	G
4-6	Well at Pipestone	1.4	3.6	2.3	425	665	.8	C2-S1	G
4-7	Well at Pipestone	4.0	5.2	4.0	833	1,300	1.8	C3-S1	P
2-69	Farm well (170 ft.), Sec. 25 T107N R46W	3.8	3.0	2.2	890	1,390	2.3	C3-S1	P
2-71	Farm well (200 ft.), Sec. 8 T105N R45W	4.6	4.0	2.6	1,100	1,720	2.6	C3-S1	P

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† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Polk								
1-5	SW¼ Sec. 13 T152N R50W	1.2	4.2	3.3	540	845	.5	C3-S1	P
1-6	NW¼ Sec. 2 T152N R50W	71.0	19.4	11.0	6,828	10,670	18.3	C4-S4	U
1-7	W½ Sec. 28 T150N R48W	4.7	5.3	2.3	718	1,122	2.2	C3-S1	P
1-8	NW¼ Sec. 23 T149N R46W	2.9	2.8	4.0	504	788	1.4	C3-S1	P
1-9	Otto Bergin well at Beltrami	3.0	1.1	2.4	438	685	2.2	C2-S1	G
1-10	SW¼ Sec. 13 T147N R46W	3.0	2.3	1.9	434	678	1.6	C2-S1	G
1-11	SE¼ Sec. 36 T153N R50W	115.5	35.6	18.8	10,840	16,950	22.1	C4-S4	U
1-12	SW¼ Sec. 35 T153N R49W	42.3	10.7	6.8	4,366	6,840	14.0	C4-S3	U
1-13	NW¼ Sec. 27 T150N R48W	27.9	3.9	2.6	2,196	3,430	14.0	C4-S4	D
1-14	Well at Freeman	5.0	1.2	1.0	615	961	4.7	C3-S1	P
1-15	NW¼ Sec. 8 T153N R47W	21.2	3.4	2.6	1,734	2,710	11.5	C4-S3	D
1-16	E. S. Corser well at Carmen	4.7	1.8	1.5	458	716	3.6	C2-S1	P
1-17	SW¼ Sec. 13 T147N R47W	11.2	.2	.2	700	1,094	23.0	C3-S4	D
1-18	T. M. Boyer well in Beltrami	19.4	.8	.7	1,368	2,137	23.0	C3-S4	U
1-19	SW¼ Sec. 33 T149N R41W	2.1	4.5	3.3	500	781	1.1	C3-S1	G
1-20	Town well at McIntosh	2.5	3.7	3.6	528	825	1.2	C3-S1	P
1-21	Town well at Fosston	1.8	3.5	3.4	456	713	.9	C2-S1	G
2-37	Farm well, Sec. 18 T148N R46W	6.0	1.0	1.0	492	770	6.0	C3-S1	P
2-39	Well at Crookston (Experiment Station)	8.4	.7	1.2	666	1,040	6.0	C3-S2	P
2-40	Farm well, Sec. 34 T153N R47W	11.0	1.2	1.9	1,254	1,960	8.8	C3-S2	D
2-56	Farm well, Sec. 22 T148N R41W	1.4	1.2	2.5	501	782	1.0	C3-S1	G
	Pope								
1-10	R.R. well at Glenwood	.5	3.4	2.3	311	486	.2	C2-S1	G
1-11	R.R. well at Sedan	.4	4.1	2.6	358	560	.2	C2-S1	G
1-1	NE¼ Sec. 15 T126N R37W	.9	4.3	2.7	462	722	.4	C2-S1	G
1-2	Well at Villard	2.3	3.1	3.0	468	731	1.3	C2-S1	G
1-4	Sec. 36 T124N R38W	1.3	4.1	2.5	464	725	.6	C2-S1	G

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Pope (Continued)								
1-12	R.R. well at Lowry	1.4	1.5	5.4	508	794	.7	C3-S1	G
1-5	Well at Lowry	2.0	7.0	4.4	764	1,192	.8	C3-S1	P
1-6	Well at Starbuck	1.9	7.0	4.2	780	1,220	.8	C3-S1	P
1-7	Well at Starbuck	1.5	9.1	5.8	1,046	1,634	.5	C3-S1	P
	Ramsey								
4-1	Public supply—avg. of 5	.2	2.2	1.4	191	298	.1	C2-S1	G
4-2	From glacial drift—avg. of 9	.3	2.7	1.8	280	438	.2	C2-S1	G
4-3	From St. Peter formation—avg. of 9	.3	2.8	1.8	254	397	.2	C2-S1	G
4-4	From New Richmond formation—avg. of 4	.3	2.9	1.9	261	408	.2	C2-S1	G
4-5	From Jordan formation—avg. of 14	.3	2.9	1.8	246	384	.2	C2-S1	G
4-6	From Dresbach, etc. formation—avg. of 6	.3	2.6	1.6	236	369	.2	C2-S1	G
2-112	Farm well (103 ft.), Sec. 34 T130N R32W	.9	4.1	1.9	289	452	.5	C2-S1	G
	Red Lake								
1-1	SE¼ Sec. 27 T151N R44W	3.0	5.2	.7	564	881	1.7	C3-S1	P
1-2	SW¼ Sec. 12 T150N R44W	4.0	2.8	2.4	492	769	2.4	C3-S1	P
1-3	SW¼ Sec. 28 T151N R44W	2.3	2.7	2.6	470	735	1.3	C2-S1	G
1-4	NE¼ Sec. 15 T150N R44W	3.4	2.8	3.2	468	731	1.9	C2-S1	G
1-7	NW¼ Sec. 16 T151N R40W	4.4	2.6	2.5	560	875	2.6	C3-S1	P
1-8	SW¼ Sec. 30 T151N R44W	7.9	.8	.8	640	1,000	9.0	C3-S2	D
1-9	NE¼ Sec. 32 T152N R43W	5.6	.9	1.1	458	715	5.6	C2-S1	P
1-10	NE¼ Sec. 14 T150N R44W	6.3	.5	.6	500	780	8.6	C3-S2	P
1-5	Creamery well at Plummer	3.5	3.7	3.3	620	970	1.8	C3-S1	P
1-6	Village well at Oklee	3.3	3.0	2.3	566	885	2.0	C3-S1	P
2-55	Farm well, Sec. 23 T150N R42W	1.2	1.4	2.3	403	630	.9	C2-S1	G

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Redwood								
4-4	Well at Vesta	.4	4.2	2.3	377	589	.2	C2-S1	G
4-5	R.R. well at Walnut Grove	12.9	25.5	17.0	3,468	5,430	2.8	C4-S2	D
4-6	R.R. well at Wabasso	1.2	6.2	3.9	647	1,010	.5	C3-S1	P
4-7	Well at Sanborn	1.8	11.1	8.2	1,296	2,026	.5	C3-S1	P
4-8	R.R. well at Sanborn	5.6	9.8	4.0	1,280	2,000	2.1	C3-S1	P
4-9	Well at Revere	.1	3.6	1.6	1,173	1,836	.1	C3-S1	P
4-10	Well at Walnut Grove	15.3	.8	1.0	1,345	2,100	16.0	C3-S4	D
4-11	Well at Walnut Grove	18.4	2.8	1.0	1,816	2,840	13.3	C4-S4	D
4-12	R.R. well at Walnut Grove	16.6	1.6	.6	1,339	2,090	16.0	C3-S4	D
2-85	Sec. 16 T110N R38W	9.6	1.5	1.7	986	1,540	7.5	C3-S2	D
2-86	Sec. 15 T110N R37W	5.3	1.8	2.2	698	1,074	3.8	C3-S1	P
	Renville								
2-289	Farm well (80 ft.), Sec. 1 T115N R35W	1.6	.3	3.4	604	944	1.2	C3-S1	P
6-Y187	Farm well, Olivia	7.4	4.8	7.8	628	981	2.9	C3-S1	P
6-Y215	Farm well, Olivia	.3	8.2	12.8	500	781	.1	C3-S1	G
4-1	Village well at Renville	1.6	2.9	4.0	483	755	.7	C3-S1	G
4-2	Hotel well at Buffalo Lake	.9	13.3	10.1	1,456	2,275	.3	C4-S1	P
4-3	R.R. well at Bird Island	2.3	14.1	8.9	1,538	2,400	.6	C4-S1	P
4-5	Well at J. Bird farm, Sec.1 T113N R34W	3.0	2.8	2.6	534	835	1.7	C3-S1	P
4-6	R.R. well at Renville	3.7	3.1	2.4	539	843	2.1	C3-S1	P
4-7	R.R. well at Renville	3.6	7.4	6.5	1,041	1,628	1.3	C3-S1	P
4-8	Village well at Renville	4.3	3.3	2.1	610	953	2.5	C3-S1	P
4-9	Village well at Olivia	4.4	2.1	1.9	476	744	3.1	C2-S1	P
4-10	Village well at Olivia	4.0	2.2	2.3	483	755	2.6	C3-S1	P
4-11	Village well at Bird Island	2.4	2.7	2.2	382	597	1.4	C2-S1	G
4-12	Well at Hector	4.8	2.9	3.3	607	950	2.7	C3-S1	P
4-13	Village well at Hector	4.2	3.1	3.4	618	966	2.3	C3-S1	P

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Renville (Continued)								
4-14	R.R. well at Hector	4.2	3.3	3.8	596	930	2.2	C3-S1	P
4-15	Well near Morton	1.3	16.9	13.1	1,945	3,040	.3	C4-S1	P
4-18	Well near Stewart	4.1	2.1	.8	449	702	3.2	C2-S1	P
	Rice								
4-1	City well at Faribault	.5	3.6	1.7	309	482	.3	C2-S1	G
4-2	Well at Faribault	.3	4.0	2.1	334	522	.2	C2-S1	G
4-4	Well at Lonsdale	1.9	10.2	7.7	1,174	1,835	.6	C3-S1	P
4-6	Well at Lonsdale	1.5	4.9	3.5	506	790	.8	C3-S1	G
4-7	Well at Lonsdale	.8	4.9	3.4	508	794	.4	C3-S1	G
4-9	Village well at Lonsdale	1.5	5.1	3.4	509	795	.8	C3-S1	G
4-10	R.R. well at Northfield	.5	4.5	2.6	376	588	.3	C2-S1	G
4-11	Well at Northfield	.1	4.3	2.5	350	547	.1	C2-S1	G
4-12	City well at Northfield	.2	4.8	2.8	352	550	.1	C2-S1	G
4-13	City well at Northfield	.4	4.7	2.6	391	610	.2	C2-S1	G
4-14	Well at Faribault	.8	4.6	2.5	402	628	.4	C2-S1	G
4-15	Well at Faribault	1.2	4.8	2.6	490	765	.6	C3-S1	G
4-16	Well at Faribault	.4	4.7	2.4	392	612	.2	C2-S1	G
4-17	Well at Faribault	.8	4.5	2.4	400	625	.4	C2-S1	G
4-18	City well at Faribault	.3	4.9	2.5	391	610	.2	C2-S1	G
2-188	Farm well (80 ft.), Sec. 29 T111N R20W	.9	1.9	2.7	256	400	.7	C2-S1	G
2-189	Farm well (200 ft.), Sec. 19 T109N R20W	1.2	1.9	.6	317	495	1.1	C2-S1	G
	Rock								
4-2	Well at Hardwick	2.7	7.6	3.4	768	1,200	1.1	C3-S1	P
4-4	Village well at Hardwick	.3	4.0	3.0	393	615	.2	C2-S1	G
2-72	Farm well (175 ft.), Sec. 14 T103N R45W	2.7	1.4	1.8	521	814	2.1	C3-S1	P
2-74	Farm well (180 ft.), Sec. 10 T101N R45W	7.2	3.1	2.2	986	1,540	4.4	C3-S2	P

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Roseau								
1-1	Well at Warroad School	2.6	3.0	3.1	454	710	1.4	C2-S1	G
1-2	Well at Roosevelt	1.4	2.5	1.6	280	438	1.0	C2-S1	G
1-3	Well at Badger Creamery	3.3	3.5	4.9	646	1,010	1.6	C3-S1	P
1-4	Well at Roseau Creamery	5.3	1.2	1.9	512	800	4.2	C3-S1	P
1-5	Well at Greenbush Creamery	4.2	1.3	2.2	490	765	3.1	C3-S1	P
1-6	SE¼ Sec. 6 T160N R41W	4.3	1.1	1.2	400	625	4.0	C2-S1	P
	Scott								
4-2	Well at Belle Plaine	.1	3.6	2.1	291	454	.1	C2-S1	G
4-3	R.R. well at Belle Plaine	8.4	6.9	4.7	1,212	1,895	3.5	C3-S1	P
4-4	Well at Belle Plaine	T	3.7	2.1	307	479	.1	C2-S1	G
4-6	Well at Shakopee	1.4	9.6	8.4	1,025	1,551	.4	C3-S1	P
4-7	Well at Jordan	.5	4.6	2.6	420	656	.3	C2-S1	G
4-8	R.R. well at Merriam Junction	2.1	4.8	3.1	576	900	1.1	C3-S1	P
4-5	Flour mill well at New Prague	1.5	5.5	3.0	578	903	.8	C3-S1	P
2-259	Farm well (165 ft.), Sec. 6 T113N R25W	.1	.3	2.5	322	503	.1	C2-S1	G
2-260	Farm well (110 ft.), Sec. 10 T113N R23W	.9	.5	2.9	413	646	.7	C2-S1	G
	Sherburne								
2-136	Farm well (44 ft.), Sec. 18 T134N R26W	.6	1.6	.5	138	216	.6	C1-S1	G
4-9	Hotel at Elk River	.3	2.7	1.7	260	406	.2	C2-S1	G
4-5	Village well at Monticello	.1	2.8	2.1	276	431	.1	C2-S1	G
	Sibley								
4-15	Well at Stewart	3.8	2.0	1.9	425	625	2.7	C2-S1	G
4-18	Well at Stewart	4.1	2.1	.8	449	702	3.2	C2-S1	P
2-281	Farm well (150 ft.), Sec. 8 T112N R28W	2.0	.3	3.0	695	1,086	1.5	C3-S1	P

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Sibley (Continued)								
2-282	Farm well (42 ft.), Sec. 35 T113N R29W	.2	1.0	3.6	909	1,436	.2	C3-S1	P
2-283	Farm well (375 ft.), Sec. 35 T113N R29W	1.7	.4	3.0	682	1,064	1.3	C3-S1	P
	Stearns								
1-5	Well at Rockville	.5	3.0	1.9	326	510	.2	C2-S1	G
1-6	City well at St. Cloud	.4	3.0	2.5	316	494	.2	C2-S1	G
1-7	NE¼ Sec. 26 T125N R31W	.8	2.8	1.8	268	419	.5	C2-S1	G
1-8	NW¼ Sec. 17 T125N R33W	1.2	5.1	2.7	466	729	.5	C2-S1	G
1-9	NE¼ Sec. 18 T125N R31W	1.1	5.7	4.0	558	871	.4	C3-S1	P
1-10	NE¼ Sec. 29 T124N R34W	1.3	4.8	3.4	464	725	.6	C2-S1	G
1-11	S½, N½ Sec. 35 T124N R32W	1.2	3.6	2.7	440	689	.6	C2-S1	G
1-12	SE¼ Sec. 5 T124N R31W	7.3	1.1	1.0	594	925	7.0	C3-S2	P
4-1	Village well at Eden Valley	.7	4.6	2.2	439	687	.3	C2-S1	G
2-1	Well on College of St. Benedict, St. Joseph Sec. 9 T124N R29W	.3	3.6	.4	400	625	.2	C2-S1	G
2-2	Farm well, Sec. 25 T126N R34W	.7	7.4	15.8	1,260	1,922	.2	C3-S1	P
2-3	Gopher Poultry Farm, Sec. 23 T126N R34W	.2	2.7	.5	367	574	.2	C2-S1	G
	Steele								
4-7	R.R. well at Owatonna	1.3	6.1	3.9	594	927	.6	C3-S1	P
4-8	R.R. well at Owatonna	1.0	4.9	3.0	459	717	.5	C2-S1	G
4-9	R.R. well at Owatonna	.6	5.1	2.6	429	670	.3	C2-S1	G
4-10	R.R. well at Owatonna	.6	3.5	2.6	426	666	.3	C2-S1	G
4-12	R.R. well at Owatonna	1.3	6.1	3.2	609	951	.6	C3-S1	P
4-14	R.R. well at Blooming Prairie	.5	5.1	2.8	453	708	.3	C2-S1	G
4-15	R.R. well at Blooming Prairie	1.0	6.6	3.4	608	949	.4	C3-S1	P
2-147	Farm well (140 ft.), Sec. 32 T107N R20W	.7	2.5	2.6	327	511	.4	C2-S1	G
2-149	Farm well (180 ft.), Sec. 29 T105N R20W	1.4	2.8	1.9	281	439	.9	C2-S1	G

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Stevens								
1-2	Sec. 18 T126N R41W	1.4	5.8	4.7	664	1,037	.6	C3-S1	P
1-3	SW¼ Sec. 9 T125N R42W	9.3	21.9	12.0	2,800	4,380	2.2	C4-S1	D
1-5	Sec. 27 T123N R43W	4.7	13.1	7.6	1,660	2,590	1.5	C4-S1	P
1-7	NW¼ Sec. 12 T123N R44W	10.8	11.0	5.3	1,812	2,830	3.8	C4-S2	D
1-10	SE¼ Sec. 22 T126N R44W	5.6	4.6	2.7	852	1,330	2.9	C3-S1	P
1-4	Well at Hancock	3.4	7.0	4.9	916	1,430	1.4	C3-S1	P
1-6	Creamery well at Chokio	12.0	9.4	6.1	1,778	2,775	4.3	C4-S2	D
1-8	Creamery well at Alberta	10.8	10.2	5.8	1,810	2,830	3.8	C4-S2	D
1-9	Creamery well at Donnely	7.2	12.8	8.4	1,880	2,940	2.1	C4-S1	P
1-1	City well at Morris	.2	6.4	4.0	639	999	.1	C3-S1	P
2-218	Farm well (120 ft.), Sec. 29 T125N R41W	3.4	5.3	2.1	640	1,000	1.8	C3-S1	P
2-220	Farm well (156 ft.), Sec. 16 T125N R42W	7.2	8.4	2.1	966	1,510	3.2	C3-S1	P
2-221	Farm well (60 ft.), Sec. 24 T126N R43W	8.5	9.4	2.5	1,290	2,020	3.5	C3-S1	P
	Swift								
4-1	Well at Appleton	1.8	7.2	5.1	847	1,323	.7	C3-S1	P
4-2	Well at Appleton	.2	10.7	3.9	821	1,283	.1	C3-S1	P
4-3	Well at Appleton	1.6	8.0	3.4	732	1,144	.6	C3-S1	P
4-4	Well at Benson	2.0	8.7	3.9	861	1,346	.8	C3-S1	P
4-5	City well at Benson	.6	3.5	3.6	425	665	.3	C2-S1	G
2-212	Farm well (45 ft.), Sec. 7 T120N R37W	2.1	8.5	.9	711	1,110	1.0	C3-S2	P
	Todd								
1-3	Long Prairie Electric Co. well	2.5	5.8	2.6	551	861	1.2	C3-S1	P
1-4	Browerville Iron Works well	5.6	9.6	5.3	979	1,530	2.1	C3-S1	P
1-5	Well at Staples	.8	3.7	1.7	328	513	.4	C2-S1	G
1-6	Well ¾ mi. N. of Long Prairie	1.2	5.4	2.4	488	763	.5	C3-S1	G
1-7	Well 6 mi. E. of Bertha	1.0	6.4	3.4	554	866	.4	C3-S1	P

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^3)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Todd (Continued)								
1-8	Village well at Burtrum	1.0	2.9	2.0	326	510	.6	C2-S1	G
1-9	Sec. 33 T132N R33W	.6	2.7	2.1	314	491	.4	C2-S1	G
1-10	Sec. 33 T128N R34W	1.0	4.6	3.5	504	788	.4	C3-S1	G
1-11	SW¼ Sec. 15 T131N R34W	3.0	1.8	1.4	418	655	2.3	C2-S1	G
1-12	Garage well at Hewitt	12.8	.4	.2	848	1,324	22.0	C3-S4	D
1-13	Sec. 20 T127N R32W	1.7	2.0	3.0	326	510	.9	C2-S1	G
1-14	School well at Staples	2.0	1.5	1.6	256	400	1.5	C2-S1	G
1-4	Village well at Osakis	2.4	3.8	3.2	552	863	1.3	C3-S1	P
1-7	NE¼ Sec. 36 T129N R36W	1.1	4.0	4.8	366	572	.5	C2-S1	G
2-246	Farm well (84 ft.), Sec. 19 T131N R34W	.2	.3	1.7	303	474	.2	C2-S1	G
	Traverse								
1-9	Village well at Dumont	5.6	24.1	19.9	3,277	5,120	1.2	C4-S1	D
1-21	Lower village flowing well at Brown's Valley	37.0	0.8	0.7	2,946	4,600	42.6	C4-S4	U
1-22	Upper village flowing well at Brown's Valley	37.3	0.8	0.7	2,959	4,625	42.9	C4-S4	U
1-25	Salt water city well at Wheaton	39.5	0.5	0.6	2,800	4,375	52.0	C4-S4	U
1-26	Hotel well at Dumont	34.4	1.2	0.8	2,662	4,160	33.0	C4-S4	U
1-5	R.R. test well at Wheaton	.4	4.5	3.3	396	619	.2	C3-S1	G
1-10	Well at Wheaton	T	7.3	4.0	579	890	T	C3-S1	P
1-12	City well at Wheaton	11.9	8.9	5.7	1,704	2,665	4.5	C4-S2	P
1-18	City well at Wheaton	7.7	3.7	2.1	917	1,432	4.4	C3-S1	P
1-20	Lower village well at Brown's Valley	35.9	0.8	0.5	2,450	3,860	31.5	C4-S4	U
1-19	City well at Wheaton	14.5	.7	.7	966	1,510	17.5	C3-S4	D
1-8	NE¼ Sec. 14 T126N R46W	15.0	22.9	14.1	3,600	5,630	3.5	C4-S2	D
1-11	SW¼ Sec. 26 T128N R45W	5.3	5.4	3.3	868	1,357	2.5	C3-S1	P
1-13	Sec. 19 T129N R45W	3.7	4.9	3.3	710	1,110	1.7	C3-S1	P
1-14	NE¼ Sec. 35 T128N R45W	4.8	5.0	2.5	828	1,293	2.5	C3-S1	P
1-15	SE¼ Sec. 32 T129N R47W	5.1	2.4	2.1	628	981	3.3	C3-S1	P

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Traverse (Continued)								
1-16	NE¼ Sec. 27 T125N R46W	7.0	2.7	1.7	728	1,138	4.6	C3-S1	P
1-23	NW¼ Sec. 27 T125N R49W	51.5	.9	.8	3,448	5,390	56.0	C4-S4	U
1-24	SE¼ Sec. 22 T126N R47W	38.1	.6	.7	2,786	4,355	48.0	C4-S4	U
1-27	NW¼ Sec. 24 T129N R46W	22.6	.3	.3	1,494	2,335	36.0	C4-S4	U
2-225	Farm well (120 ft.), Sec. 25 T125N R46W	1.3	4.5	1.3	423	662	.7	C2-S1	G
2-313	Farm well, Sec. 24 T128N R45W	7.3	5.2	2.5	640	1,000	3.7	C3-S1	P
	Wabasha								
4-4	R.R. well at Lake City	.8	4.8	2.9	431	674	.4	C2-S1	G
4-5	City well at Lake City	.4	3.8	2.2	332	519	.2	C2-S1	G
4-5	City well at Lake City	.5	4.0	2.2	315	492	.3	C2-S1	G
4-7	R.R. well at Wabasha	.3	3.0	2.3	298	466	.2	C2-S1	G
4-8	Village well at Plain View	.1	2.8	2.1	260	406	.1	C2-S1	G
2-192	Farm well (250 ft.), Sec. 32 T110N R13W	.6	2.1	2.2	283	443	.4	C2-S1	G
2-193	Farm well (70 ft.), Sec. 31 T110N R12W	.8	2.0	1.9	277	433	.6	C2-S1	G
2-195	Farm well (50 ft.), Sec. 18 T111N R12W	.8	3.8	1.2	241	376	.5	C2-S1	G
	Wadena								
1-3	City well at Wadena	1.1	4.0	2.0	370	578	.6	C2-S1	G
1-4	New city well at Wadena	1.2	4.6	2.0	460	719	.6	C2-S1	G
1-5	SE¼ Sec. 8 T135N R35W	1.0	4.6	2.2	424	664	.5	C2-S1	G
1-5	Well at Staples	.8	3.7	1.7	328	513	.4	C2-S1	G
1-14	School well at Staples	2.0	1.5	1.6	256	400	1.5	C2-S1	G
	Waseca								
4-3	Well at Janesville	.7	4.7	2.5	420	656	.4	C2-S1	G
4-4	R.R. well at Waseca	2.8	5.0	3.4	669	1,044	1.4	C3-S1	P

* First digit of reference number indicates source of data as shown in References, page 9.

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Waseca (Continued)								
4-5	R.R. well at Waseca	3.4	4.3	2.4	604	944	1.9	C3-S1	P
4-6	City well at Waseca	1.0	4.8	2.3	436	681	.5	C2-S1	G
	Washington								
4-1	R.R. well at Afton	.3	2.2	1.6	215	336	.2	C2-S1	G
2-113	Farm well (63 ft.), Sec. 8 T131N R21W	1.0	4.5	.7	189	295	.6	C2-S1	G
2-114	Farm well (120 ft.), Sec. 32 T132N R21W	1.7	6.6	1.7	256	400	.8	C2-S1	G
	Watonwan								
6-Y364	St. James water supply	9.7	24.6	26.8	2,080	3,250	1.9	C4-S1	D
6-Y389	Madelia water supply	2.3	8.2	11.6	717	1,120	.7	C3-S1	P
4-1	R.R. well at St. James	.6	5.5	3.3	502	785	.2	C3-S1	G
4-2	Well at St. James	1.0	7.3	4.6	763	1,190	.3	C3-S1	P
4-3	R.R. well at Madelia	.2	5.1	2.1	452	706	.1	C2-S1	G
4-4	Well at Odin	3.1	12.0	6.2	1,315	2,056	1.0	C3-S1	P
4-5	R.R. well at Odin	4.3	11.6	6.3	1,393	2,177	1.4	C3-S1	P
4-6	Creamery well at Butterfield	4.3	11.8	6.5	1,302	2,036	1.4	C3-S1	P
4-7	Well at Madelia	3.0	5.3	2.4	677	1,060	1.4	C3-S1	P
4-8	Farm well, Sec. 9 T106N R31W	1.0	8.1	3.9	810	1,265	.4	C3-S1	P
4-9	Creamery well at St. James	3.0	16.3	9.7	1,853	2,895	.6	C4-S1	P
4-10	West well at St. James	5.3	16.2	9.5	1,994	3,110	1.5	C4-S1	D
4-11	Well at Madelia	4.6	8.1	2.9	1,006	1,570	1.9	C3-S1	P
4-12	East well at St. James	4.3	11.4	6.3	1,396	2,180	1.4	C3-S1	P
4-13	R.R. well at Butterfield	19.3	1.3	.8	1,618	2,524	19.0	C4-S4	U
2-101	Farm well (45 ft.), Sec. 33 T106N R32W	3.2	3.2	2.6	1,050	1,640	1.9	C3-S1	P

* First digit of reference number indicates source of data as shown in References, page 9.

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration† Na	Ca	Mg	Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Wilkin								
1-3	NW ¼ Sec. 34 T135N R47W	6.6	15.7	18.3	2,728	4,260	1.5	C4-S1	D
1-5	SW¼ Sec. 2 T131N R46W	5.7	4.9	3.2	832	1,300	2.8	C3-S1	P
1-6	NE¼ Sec. 32 T135N R45W	2.0	3.6	3.7	544	850	1.0	C3-S1	P
1-7	SE¼ Sec. 22 T130N R45W	8.2	2.9	2.6	834	1,302	4.9	C3-S1	P
1-8	NW¼ Sec. 26 T130N R47W	1.8	2.4	4.5	536	837	1.0	C3-S1	P
1-10	NE¼ Sec. 28 T133N R47W	2.3	4.2	3.0	592	925	1.2	C3-S1	P
1-11	NE¼ Sec. 22 T133N R45W	.8	7.0	4.5	790	1,233	.3	C3-S1	P
1-12	SW¼ Sec. 10 T130N R46W	14.9	.8	.7	1,052	1,643	17.0	C3-S4	D
1-15	SW¼ Sec. 16 T132N R47W	26.1	.6	.5	1,902	2,970	35.0	C4-S4	U
1-17	SE¼ Sec. 16 T133N R47W	5.9	2.3	1.4	640	1,000	4.3	C3-S1	P
1-19	W½ Sec. 12 T134N R48W	14.2	2.5	1.2	1,242	1,940	10.4	C3-S3	D
1-4	Well at Everdale	3.5	3.9	2.9	566	885	1.8	C3-S1	P
1-9	Well at Breckenridge	5.1	3.7	1.9	712	1,112	3.0	C3-S1	P
1-14	Well at Breckenridge	12.5	.6	.3	949	1,480	18.0	C3-S4	D
1-13	Well at Doran	7.7	2.7	2.0	768	1,200	4.9	C3-S1	P
1-16	Well at Wahpeton, N. D.	13.4	.4	.2	1,004	1,570	25.0	C3-S4	U
1-18	Well at Kent	15.3	2.0	.9	1,178	1,840	12.5	C3-S3	D
1-10	SW¼ Sec. 33 T137N R44W	.9	4.8	2.5	462	721	.4	C2-S1	G
2-234	Farm well (320 ft.), Sec. 22 T131N R46W	.9	3.1	.9	890	1,390	.6	C3-S1	P
2-235	Farm well (220 ft.), Sec. 24 T132N R47W	11.2	1.6	.6	890	1,390	10.8	C3-S3	D
2-237	Farm well (220 ft.), Sec. 32 T133N R46W	6.4	2.7	1.4	470	735	4.4	C2-S1	P
	Winona								
4-3	R.R. well at Winona	.5	3.9	1.8	323	505	.3	C2-S1	G
4-4	R.R. well at Winona	.3	2.7	2.0	260	407	.2	C2-S1	G
4-5	R.R. well at Winona	.1	2.9	2.3	327	511	.1	C2-S1	G
4-7	R.R. well at Winona	.2	3.2	5.5	303	473	.1	C2-S1	G
4-8	R.R. well at Dakota	T	3.1	2.1	284	444	.1	C2-S1	G

* First digit of reference number indicates source of data as shown in References, page 9.

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‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Winona (Continued)								
4-10	Creamery well at St. Charles	.7	4.1	2.6	392	613	.4	C2-S1	G
4-11	R.R. well at St. Charles	.3	3.9	1.6	292	456	.2	C2-S1	G
4-12	Village well at Lewiston	.2	2.3	1.7	219	342	.1	C2-S1	G
4-13	R.R. well at Stockton	.2	2.7	2.1	255	398	.1	C2-S1	G
4-14	R.R. well at Stockton	.2	3.4	2.4	314	491	.1	C2-S1	G
4-15	City well at St. Charles	.5	3.4	2.3	314	491	.3	C2-S1	G
4-16	City well at St. Charles	.3	4.2	1.2	298	466	.2	C2-S1	G
4-17	City well at St. Charles	.4	4.9	2.0	407	635	.2	C2-S1	G
4-18	Well at Winona	2.2	2.6	1.7	405	633	1.5	C2-S1	G
4-19	Well at Winona	1.5	2.5	1.5	388	606	1.1	C2-S1	G
4-20	Well at Winona	1.0	2.3	1.1	436	681	.8	C2-S1	G
4-21	Well at Winona	6.2	3.2	2.1	519	810	3.8	C3-S1	P
4-22	Well at Winona	4.3	2.6	1.6	519	810	3.0	C3-S1	P
4-23	City well at Winona	.9	3.3	1.6	336	525	.6	C2-S1	G
4-24	City well at Winona	1.8	4.2	2.4	471	735	1.0	C2-S1	G
2-168	Farm well (308 ft.), Sec. 27 T106N R7W	.2	2.2	2.3	150	234	.2	C1-S1	G
	Wright								
4-1	Village well at Delano	1.0	5.1	2.5	471	735	.5	C2-S1	G
4-2	Well at Buffalo	2.9	2.5	3.0	469	732	1.8	C2-S1	G
4-3	Village well at Cokato	.7	4.8	2.8	455	711	.4	C2-S1	G
4-4	Well at Buffalo	.2	2.1	1.2	208	325	.2	C2-S1	G
4-5	Village well at Monticello	.1	2.8	2.1	276	431	.1	C2-S1	G
4-6	Well at Waverly	.5	5.2	3.5	485	758	.3	C3-S1	G
4-7	Well at Waverly	.8	3.8	3.0	431	674	.4	C2-S1	G
4-8	R.R. well at Buffalo	.2	5.0	3.2	435	680	.1	C2-S1	G
4-9	Hotel at Elk River	.3	2.7	1.7	260	406	.2	C2-S1	G
2-199	Farm well (87 ft.), Sec. 4 T118N R25W	.8	4.9	1.8	413	645	.5	C2-S1	G

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 6. (Continued). Chemical analysis of deep wells of Minnesota with special emphasis on their suitability for irrigation

Reference number*	Source and location of sample	Salt concentration†			Total dissolved solids	Electrical conductivity (EC × 10^6)	SAR‡	Quality classification	
		Na	Ca	Mg				U.S. Salinity Lab.	Minnesota
		meq/l	meq/l	meq/l	ppm	μmhos/cm			
	Wright (Continued)								
2-201	Farm well (140 ft.), Sec. 1 T118N R28W	2.2	5.1	1.7	424	662	1.2	C2-S1	G
2-22	Farm well (60 ft.), Sec. 10 T119N R25W	.7	2.5	5.2	743	1,161	.3	C3-S1	P
2-23	Flowing well, Sec. 14 T119N R25W	.5	.7	2.7	336	526	.4	C2-S1	G
	Yellow Medicine								
6-M62	E½ Sec. 33 T114N R42W	43.6	6.8	8.1	2,486	3,884	15.5	C4-S4	D
6-M82	SE¼ Sec. 29 T113N R39W	3.8	30.0	59.9	2,823	4,411	.6	C4-S1	D
6-Y217	NE¼ Sec. 33 T114N R44W	6.3	22.0	38.8	2,119	3,311	1.1	C4-S1	P
6-Y219	SE¼ Sec. 10 T114N R43W	11.2	28.5	52.4	2,932	4,581	1.8	C4-S1	D
6-Y224	Sec. 4 T114N R45W	2.7	21.7	20.2	1,486	2,321	.5	C4-S1	P
6-Y228	E½ Sec. 4 T115N R45W	4.9	6.6	5.6	628	982	2.0	C3-S1	P
4-1	Well at Granite Falls	1.6	5.8	5.5	729	1,140	.6	C3-S1	P
4-2	Well at Echo	2.4	19.2	14.2	2,053	3,210	.6	C4-S1	P
4-3	Well at Echo	2.0	17.8	11.3	1,971	3,080	.3	C4-S1	P
4-4	Well at Wood Lake	6.0	8.5	5.3	1,353	2,115	2.3	C3-S1	P
4-5	Well at Hanby Falls	9.1	1.1	.8	759	1,186	9.0	C3-S2	D
2-290	Farm well (80 ft.), Sec. 9 T115N R40W	1.9	.1	2.6	432	676	1.6	C2-S1	G
2-291	Farm well (80 ft.), Sec. 8 T115N R40W	2.0	.7	3.6	1,254	1,960	1.3	C3-S1	P

* First digit of reference number indicates source of data as shown in References, page 9.

† To obtain parts per million multiply tabulated meq/l value by equivalent weight.

‡ Sodium adsorption ratio.

Note: G = good, P = permissible, D = doubtful, and U = unsuitable.

Table 7. Boron content of Minnesota waters (classification made according to limits in table 3)

Reference number*	Source and location of samples	Boron concentration	Boron class		
			Sensitive	Semitolerant	Tolerant
	SURFACE WATERS	ppm			
	Anoka				
2-143	Coon Creek, 2 mi. E. of Anoka, Sec. 4 T131N R24W	.28	1	1	1
	Benton				
2-252	Platte R. at Royalton, Sec. 2 T38N R32W	T	1	1	1
	Blue Earth				
2-267	Minnesota R. at Mankato, Sec. 23 T108N R26W	1.19	4	2	2
2-270	Cobb R., ½ mi. S. of Beauford, Sec. 9 T106N R26W	1.19	4	2	2
	Brown				
2-160	Cottonwood R., 7 mi. S. of Sleepy Eye, Sec. 6 T109N R32W	.19	1	1	1
	Carver				
2-310	Carver Creek, 2½ mi. E. of Cologne, Sec. 8 T115N R24W	.12	1	1	1
2-311	Chaska Creek, 3½ mi. N. of Chaska, Sec. 5 T115N R23W	.14	1	1	1
	Chippewa				
2-302	Hawk Creek in Clara City, Sec. 7 T117N R37N	T	1	1	1
	Chisago				
2-116	Sunrise R., S. Branch at Stacy, Sec. 32 T134N R21W	T	1	1	1
2-118	Goose Creek, 1 mi. N. of Harris, Sec. 18 T136N R21W	.20	1	1	1
	Cottonwood				
2-90	Des Moines R. at Windom, Sec. 25 T105N R36W	.60	2	1	1
	Dakota				
2-185	Vermillion R., 4 mi. N. of Hampton, Sec. 20 T114N R18W	.72	3	2	1
	Dodge				
2-176	Zumbro R. at Mantorville, Sec. 33 T107N R16W	.62	2	1	1
2-177	Zumbro R., 2 mi. S. of Berne, Sec. 18 T108N R16W	.54	2	1	1
	Faribault				
2-273	Jones Creek, 6 mi. S. of Wells, Sec. 8 T102N R24W	1.44	5	3	2
2-274	East Fork of Blue Earth R. at Blue Earth, Sec. 8 T102N R27W	1.50	5	3	2

* First digit of reference number indicates source of data as shown in References, page 9.

Table 7. (Continued). Boron content of Minnesota waters (classifications made according to limits in table 3)

Reference number*	Source and location of samples	Boron concentration	Boron class		
			Sensitive	Semitolerant	Tolerant
	SURFACE WATERS (Continued)	ppm			
	Goodhue				
2-181	Belle Creek, 1 mi. N. of Hader, Sec. 6 T111N R17W	.36	2	1	1
2-183	Cannon R. at Cannon Falls, Sec. 6 T112N R17W	1.47	5	3	2
	Grant				
2-6	Chippewa R., Sec. 1 T127N R41W	.58	2	1	1
2-232	Mustinka R., 1 mi. N. of Norcross, Sec. 21 T128N R44W	.66	2	1	1
	Houston				
2-166	Money Creek, 1 mi. S. of Money Creek, Sec. 18 T104N R7W	.04	1	1	1
	Isanti				
2-133	Green Lake, Sec. 27 T136N R25W	.02	1	1	1
	Jackson				
2-93	Des Moines R. at Jackson, Sec. 24 T102N R35W	.34	2	1	1
	Kanabec				
2-125	Ann R., 2½ mi. W. of Mora, Sec. 21 T139N R24W	.15	1	1	1
	Kittson				
2-47	S. Branch Two Rivers at Lake Bronson	T	1	1	1
	Lac qui Parle				
2-295	W. Branch Lac qui Parle R., 6 mi. W. of Dawson, Sec. 20 T117N R44W	.42	2	1	1
	Le Sueur				
2-263	Pepin Lake, 4 mi. S. of New Prague, Sec. 28 T112N R23W	1.16	4	2	2
	Lincoln				
2-1A	Lake Benton near outlet	.79	3	2	1
2-65	Ash Lake, Sec. 8 T111N R45W	T	1	1	1
	McLeod				
2-304	Crow R. in Hutchinson, Sec. 36 T117N R30W	.17	1	1	1
	Marshall				
2-42	Middle R. at Argyle, Sec. 10 T156N R48W	T	1	1	1
	Martin				
2-96	Fox Lake, Sec. 31 T103N R32W	T	1	1	1
	Mille Lacs				
2-129	Rum R. at Milaca, Sec. 36 T138N R27W	1.95	5	3	2
2-131	Silver Lake, Sec. 35 T136N R26W	T	1	1	1

* First digit of reference number indicates source of data as shown in References, page 9.

Table 7. (Continued). Boron content of Minnesota waters (classifications made according to limits in table 3)

Reference number*	Source and location of samples	Boron concentration	Boron class		
			Sensitive	Semitolerant	Tolerant
	SURFACE WATERS (Continued)	ppm			
	Mower				
2-154	Turtle Creek at Austin, Sec. 4 T102N R18W	T	1	1	1
2-157	Deer Creek, 2 mi. E. of Grand Meadow, Sec. 21 T103N R14W	T	1	1	1
	Murray				
2-80	Beaver Creek, ½ mi. N. of Slayton, Sec. 10 T106N R41W	.05	1	1	1
2-83	North end of Lake Shetek, Sec. 11 T108N R41W	.05	1	1	1
	Olmsted				
2-170	S. Branch Whitewater R., Sec. 18 T106N R11W	.29	1	1	1
2-173	Bear Creek at Rochester, Sec. 1 T106N R14W	.35	2	1	1
	Otter Tail				
2-110	Otter Tail Lake, Sec. 1 T133N R40W	.29	1	1	1
2-239	Otter Tail R., Sec. 2 T133N R41W	.35	2	1	1
	Pine				
2-121	Snake R. at Pine City, Sec. 33 T139N R21W	T	1	1	1
	Pope				
2-216	Chippewa R., 11 mi. S. of Cyrus, Sec. 29 T124N R40W	.25	1	1	1
	Red Lake				
2-54	Clearwater R. at Plummer	.36	2	1	1
	Redwood				
2-84	Cottonwood R., 3 mi. W. of Tracy, Sec. 19 T110N R35W	.12	1	1	1
	Renville				
2-287	W. Fork of Beaver Creek, 1½ mi. W. of Danube, Sec. 1 T115N R36W	T	1	1	1
	Rice				
2-145	Cannon R. at Faribault, Sec. 30 T110N R20W	2.50	5	5	3
	Scott				
2-261	Pleasant Lake, Sec. 11 T113N R23W	.50	2	1	1
2-262	Raven Stream, 4 mi. N. of New Prague, Sec. 16 T113N R23W	.14	1	1	1
	Sherburne				
2-137	St. Francis R., 3 mi. W. of Fremont, Sec. 11 T134N R27W	.28	1	1	1
2-139	Eagle Lake, 5 mi. N. of Big Lake, Sec. 31 T134N R37W	.10	1	1	1
	Sibley				
2-284	Middle Branch Rush R., 4½ mi. W. of Winthrop, Sec. 32 T113N R30W	.25	1	1	1

* First digit of reference number indicates source of data as shown in References, page 9.

Table 7. (Continued). Boron content of Minnesota waters (classifications made according to limits in table 3)

Reference number*	Source and location of samples	Boron concentration	Boron class		
			Sensitive	Semitolerant	Tolerant
	SURFACE WATERS (Continued)	ppm			
	Stearns				
2-24	Clearwater R. at bridge on Hwy. 55, Sec. 7 T121N R28W	.32	1	1	1
	Steele				
2-146	Maple Creek at Owatonna, Sec. 4 T107N R20W	.02	1	1	1
2-190	Crane Creek at Medford, Sec. 8 T108N R20W	.08	1	1	1
	Swift				
2-210	Shakopee Creek, 2 mi. E. of Kerkhoven, Sec. 27 T120N R37W	1.86	5	3	2
2-211	Chippewa R., W edge of Benson, Sec. 6 T121N R39W	1.04	4	2	2
	Todd				
2-345	Wing R. at Hewitt, Sec. 22 T133N R35W	.28	1	1	1
2-248	Long Prairie at Browerville, Sec. 8 T130N R33W	.64	2	1	1
	Traverse				
2-228	Twelve Mile Creek, 6 mi. E. of Wheaton, Sec. 18 T127N R45W	.36	2	1	1
2-312	Mustinka R., Sec. 24 T128N R45W	T	1	1	1
	Wabasha				
2-191	Zumbro R. at Zumbro Falls, Sec. 6 T109N R13W	.35	2	1	1
2-194	Spring Creek at West Albany, Sec. 21 T110N R12W	1.47	5	3	2
	Washington				
2-115	Forest Lake, Sec. 9 T132N R21W	.55	2	1	1
	Watonwan				
2-100	Watonwan R., Sec. 21 T105N R32W	.37	2	1	1
	Wilkin				
2-236	Otter Tail R. at Breckenridge, Sec. 3 T132N R47W	.35	2	1	1
	Wright				
2-198	Crow R. E. edge of Delano, Sec. 12 T118N R25W	.25	1	1	1
2-200	Howard Lake, Sec. 34 T119N R27W	.36	2	1	1
	Yellow Medicine				
2-293	Lac qui Parle R., 7 mi. NE of Canby, Sec. 3 T115N R44W	.42	2	1	1
	SHALLOW WELLS				
	Anoka				
2-142	Farm well, Sec. 33 T132N R25W	1.00	1	1	1
2-144	Farm well (15 ft.), Sec. 2 T131N R24W	T	1	1	1

* First digit of reference number indicates source of data as shown in References, page 9.

Table 7. (Continued). Boron content of Minnesota waters (classifications made according to limits in table 3)

Reference number*	Source and location of samples	Boron concentration	Boron class		
			Sensitive	Semitolerant	Tolerant
	SHALLOW WELLS (Continued)	ppm			
	Big Stone				
2-223	Farm well, Sec. 7 T124N R45W	.07	1	1	1
	Blue Earth				
2-269	Farm well, Sec. 28 T108N R26W	.60	2	1	1
2-271	Farm well (20 ft.), Sec. 24 T105N R26W	.50	2	1	1
	Brown				
2-59	(18 ft.), Sec. 18 T108N R33W	.09	1	1	1
2-105	Sec. 8 T108N R32W	.33	1	1	1
	Chippewa				
2-298	Farm well, Sec. 15 T117N R40W	.25	1	1	1
2-299	Farm well, Sec. 13 T117N R40W	.12	1	1	1
	Clay				
2-32	Farm well, Sec. 11 T139N R46W	1.27	5	2	2
	Clearwater				
2-57	Farm well (15 ft.), Sec. 22 T147N R38W	.25	1	1	1
	Cottonwood				
2-89	Farm well, Sec. 1 T105N R36W	.17	1	1	1
	Dakota				
2-187	Farm well (14 ft.), Sec. 18 T113N R19W	.11	1	1	1
	Fillmore				
2-161	Farm well (15 ft.), Sec. 25 T103N R10W	.08	1	1	1
	Houston				
2-165	Farm well (9 ft.), Sec. 36 T104N R7W	.03	1	1	1
	Jackson				
2-92	Farm well, Sec. 1 T102N R35W	.26	1	1	1
	Kanabec				
2-126	Farm well (18 ft.), Sec. 36 T139N R24W	.33	2	1	1
2-127	Farm well (15 ft.), Sec. 33 T139N R25W	T	1	1	1
	Kandiyohi				
2-205	Farm well, Sec. 1 T119N R33W	.33	2	1	1
2-208	Farm well, Sec. 32 T120N R36W	.35	2	1	1
	Kittson				
2-257	Farm well (18 ft.), Sec. 29 T164N R50W	T	1	1	1
2-258	Farm well (18 ft.), Sec. 29 T164N R50W	.26	1	1	1
2-46	(15 ft.), Sec. 13 T162N R48W	.26	1	1	1
	Lac qui Parle				
2-294	Farm well (18 ft.), Sec. 19 T116N R44W	.25	1	1	1
	Le Sueur				
2-264	Farm well (20 ft.), Sec. 29 T111N R23W	.97	3	2	1
2-266	Farm well (20 ft.), Sec. 20 T110N R25W	1.25	5	2	2

* First digit of reference number indicates source of data as shown in References, page 9.

Table 7. (Continued). Boron content of Minnesota waters (classifications made according to limits in table 3)

Reference number*	Source and location of samples	Boron concentration	Boron class		
			Sensitive	Semitolerant	Tolerant
	SHALLOW WELLS (Continued)	ppm			
	McLeod				
2-307	Farm well, Sec. 18 T115N R22W	T	1	1	1
	Marshall				
2-49	Flowing well, Sec. 22 T157N R42W	.42	2	1	1
	Martin				
2-95	Farm well, Sec. 16 T112N R33W	.32	1	1	1
	Meeker				
2-203	Farm well, Sec. 24 T119N R30W	.42	2	1	1
2-204	Farm well (20 ft.), Sec. 2 T119N R32W	.35	2	1	1
	Mille Lacs				
2-128	Farm well, Sec. 14 T138N R26W	.65	2	1	1
	Mower				
2-156	Farm well (16 ft.), Sec. 19 T103N R15W	T	1	1	1
	Olmsted				
2-172	Farm well, Sec. 10 T106N R13W	.50	2	1	1
	Otter Tail				
2-108	Farm well (18 ft.), Sec. 2 T133N R40W	.05	1	1	1
2-109	Farm well (15 ft.), Sec. 1 T133N R40W	.79	3	2	1
2-240	Farm well (14 ft.), Sec. 1 T133N R40W	.36	2	1	1
2-242	Farm well, Sec. 1 T133N R40W	T	1	1	1
2-244	Farm well (20 ft.), Sec. 15 T133N R38W	.66	2	1	1
	Renville				
2-285	Farm well, Sec. 20 T113N R32W	.35	2	1	1
2-286	Farm well, Sec. 20 T115N R32W	.50	2	1	1
2-288	Farm well, Sec. 1 T115N R25W	.25	1	1	1
	Sherburne				
2-138	Farm well (18 ft.), Sec. 30 T134N R27W	T	1	1	1
	Steele				
2-148	Farm well, Sec. 33 T107N R20W	.28	1	1	1
	Todd				
2-247	Farm well (20 ft.), Sec. 7 T130N R33W	.44	2	1	1
	Traverse				
2-226	Farm well, Sec. 26 T126N R46W	.28	1	1	1
2-227	Farm well, Sec. 22 T127N R46W	.46	2	1	1
	Watonwan				
2-102	Farm well, Sec. 5 T105N R32W	.34	2	1	1
	Winona				
2-167	Farm well, Sec. 19 T105N R6W	.07	1	1	1
2-169	Farm well, Sec. 23 T106N R10W	.36	2	1	1

* First digit of reference number indicates source of data as shown in References, page 9.

Table 7. (Continued). Boron content of Minnesota waters (classifications made according to limits in table 3)

Reference number*	Source and location of samples	Boron concentration	Boron class		
			Sensitive	Semitolerant	Tolerant
	DEEP WELLS	ppm			
	Anoka				
2-140	Farm well (60 ft.), Sec. 29 T133N R25W	.37	2	1	1
2-141	Farm well (164 ft.), Sec. 23 T133N R25W	.05	1	1	1
	Becker				
2-14	Farm well, Sec. 10 T138N R41W	2.71	5	5	3
2-10	Farm well, Sec. 30 T140N R41W	.58	2	1	1
2-15	Irrigation well, G Lindlow, Sec. 22 T138N R40W	1.19	4	2	2
	Beltrami				
2-28	H. Butler farm, Sec. 14 T147N R34W	.07	1	1	1
	Benton				
2-256	Farm well (80 ft.), Sec. 15 T36N R31W	.14	1	1	1
	Big Stone				
2-222	Farm well (160 ft.), Sec. 2 T124N R45W	T	1	1	1
2-224	Farm well (70 ft.), Sec. 3 T124N R46W	.36	2	1	1
	Blue Earth				
2-107	Farm well (127 ft.), Sec. 18 T110N R31W	.25	1	1	1
2-268	Farm well (313 ft.), Sec. 28 T108N R26W	.72	3	2	1
	Carver				
2-308	Farm well (100 ft.), Sec. 13 T115N R25W	.33	2	1	1
2-309	Farm well (142 ft.), Sec. 15 T115N R25W	.25	1	1	1
	Chippewa				
2-300	Farm well (65 ft.), Sec. 3 T117N R39W	.36	2	1	1
2-301	Farm well (80 ft.), Sec. 7 T117N R38W	.22	1	1	1
2-303	Farm well, Sec. 22 T117N R37W	.11	1	1	1
	Clay				
2-33	Farm well, Sec. 16 T142N R46W	T	1	1	1
	Cottonwood				
2-88	Farm well (60 ft.), Sec. 35 T106N R36W	.45	2	1	1
	Dakota				
2-184	Farm well (136 ft.), Sec. 19 T113N R18W	.94	3	2	1
2-186	Farm well (361 ft.), Sec. 27 T127N R22W	.36	2	1	1
	Dodge				
2-175	Farm well (60 ft.), Sec. 28 T107N R16W	.28	1	1	1
2-178	Farm well (300 ft.), Sec. 7 T108N R16W	.51	2	1	1
	Douglas				
2-4	Bowman well (137 ft.), Sec. 27 T128N R36W	.83	3	2	1
	Faribault				
2-272	Farm well (117 ft.), Sec. 21 T103N R24W	1.88	5	3	2
2-275	Farm well (183 ft.), Sec. 24 T103N R28W	2.00	5	4	3
	Fillmore				
2-159	Farm well (185 ft.), Sec. 36 T103N R12W	T	1	1	1

* First digit of reference number indicates source of data as shown in References, page 9.

Table 7. (Continued). Boron content of Minnesota waters (classifications made according to limits in table 3)

Reference number*	Source and location of samples	Boron concentration	Boron class		
			Sensitive	Semitolerant	Tolerant
	DEEP WELLS (Continued)	ppm			
	Freeborn				
2-150	Farm well (230 ft.), Sec. 25 T104N R21W	.09	1	1	1
	Goodhue				
2-179	Farm well (65 ft.), Sec. 6 T109N R16W	.03	1	1	1
2-182	Farm well (70 ft.), Sec. 19 T112N R17W	.65	2	1	1
	Grant				
2-230	Farm well (140 ft.), Sec. 15 T124N R44W	.51	2	1	1
2-8	Farm well, Sec. 18 T130N R42W	T	1	1	1
2-231	Farm well (129 ft.), Sec. 34 T128N R44W	.45	2	1	1
2-233	Farm well (156 ft.), Sec. 17 T128N R44W	.40	2	1	1
	Hennepin				
2-196	Farm well (186 ft.), Sec. 34 T118N R23W	.29	1	1	1
2-197	Farm well (140 ft.), Sec. 16 T118N R24W	.22	1	1	1
	Houston				
2-163	Farm well (400 ft.), Sec. 28 T104N R7W	.29	1	1	1
2-164	Farm well (300 ft.), Artesian, Sec. 33 T104N R7W	.94	3	2	1
	Hubbard				
2-18	Bender Irrigation well, Sec. 10 T140N R33W	T	1	1	1
	Isanti				
2-132	Farm well (37 ft.), Sec. 22 T136N R25W	T	1	1	1
2-135	Farm well (70 ft.), Sec. 8 T134N R25W	.15	1	1	1
	Jackson				
2-94	Farm well (80 ft.), Sec. 15 T102N R34W	.60	2	1	1
	Kanabec				
2-124	Farm well (80 ft.), Sec. 5 T139N R23W	T	1	1	1
	Kandiyohi				
2-206	Farm well (96 ft.), Sec. 8 T119N R33W	.61	2	1	1
2-207	Farm well (105 ft.), Sec. 9 T119N R34W	.07	1	1	1
2-209	Farm well (81 ft.), Sec. 31 T120N R36W	.75	3	2	1
	Kittson				
2-43	Farm well (133 ft.), Sec. 3 T159N R48W	.07	1	1	1
	Lac qui Parle				
2-296	Farm well (200 ft.), Sec. 16 T117N R44W	1.30	4	2	2
2-297	Farm well (100 ft.), Sec. 15 T117N R42W	.25	1	1	1
	Le Sueur				
2-265	Farm well (190 ft.), Sec. 29 T111N R23W	0.92	3	2	1
	Lincoln				
2-2A	Ivanhoe city well (300 ft.), Sec. 34 T112N R45W	5.38	5	5	5
2-3A	Ivanhoe city well (27 ft.), Sec. 34 T112N R45W	2.53	5	5	3

* First digit of reference number indicates source of data as shown in References, page 9.

Table 7. (Continued). Boron content of Minnesota waters (classifications made according to limits in table 3)

Reference number*	Source and location of samples	Boron concentration	Boron class		
			Sensitive	Semitolerant	Tolerant
	DEEP WELLS (Continued)	ppm			
	Lyon				
2-61	Artesian well (360 ft.), Sec. 11 T111N R42W	.14	1	1	1
2-63	Farm well (100 ft.), Sec. 5 T112N R42W	.17	1	1	1
	Marshall				
2-41	Farm well, Sec. 34 T156N R48W	.01	1	1	1
2-50	Farm well, Sec. 4 T155N R43W	.04	1	1	1
	Martin				
2-97	Farm well (120 ft.), Sec. 6 T103N R32W	.25	1	1	1
2-98	Farm well (100 ft.), Sec. 20 T104N R32W	.60	2	1	1
	Meeker				
2-202	Farm well (92 ft.), Sec. 28 T119N R29W	T	1	1	1
	Mille Lacs				
2-130	Farm well (80 ft.), Sec. 30 T137N R26W	.83	3	2	1
	Morrison				
2-249	Farm well (67 ft.), Sec. 22 T129N R31W	.97	3	2	1
2-250	Farm well (60 ft.), Sec. 27 T129N R30W	.28	1	1	1
	Mower				
2-158	Farm well (75 ft.), Sec. 21 T103N R14W	.06	1	1	1
	Murray				
2-81	Farm well (75 ft.), Sec. 15 T107N R45W	.32	1	1	1
2-82	Farm well (110 ft.), Sec. 15 T108N R41W	.14	1	1	1
	Nicollet				
2-276	Farm well (200 ft.), Sec. 32 T109N R27W	1.07	4	2	2
2-280	Farm well (150 ft.), Sec. 9 T111N R28W	T	1	1	1
	Nobles				
2-79	Farm well (100 ft.), Sec. 2 T102N R40W	.28	1	1	1
	Norman				
2-35	Farm well, Sec. 15 T144N R46W	.01	1	1	1
2-36	Farm well, Sec. 21 T164N R46W	T	1	1	1
	Olmsted				
2-171	Farm well (90 ft.), Sec. 20 T106N R11W	.35	2	1	1
2-174	Farm well (220 ft.), Sec. 35 T107N R15W	.53	2	1	1
	Otter Tail				
2-13	M. Tallrud irrigation well, Sec. 17 T137N R42W	1.34	5	3	2
2-16	W. Hackett irrigation well, Sec. 13 T137N R40W	2.82	5	5	3
2-17	R. Perry irrigation well, Sec. 14 T136N R39W	1.30	5	2	2
	Pennington				
2-52	Farm well, Sec. 12 T153N R43W	.31	1	1	1
2-53	Farm well, Sec. 8 T152N R42W	.44	2	1	1

* First digit of reference number indicates source of data as shown in References, page 9.

Table 7. (Continued). Boron content of Minnesota waters (classifications made according to limits in table 3)

Reference number*	Source and location of samples	Boron concentration	Boron class		
			Sensitive	Semitolerant	Tolerant
	DEEP WELLS (Continued)	ppm			
	Pine				
2-122	Farm well, Sec. 8 T140N R21W	.41	2	1	1
	Pipestone				
2-69	Farm well (170 ft.), Sec. 25 T107N R46W	T	1	1	1
2-71	Farm well, Sec. 8 T105N R45W	T	1	1	1
	Polk				
2-37	Farm well, Sec. 18 T148 R56W	T	1	1	1
2-40	Farm well, Sec. 34 T153N R47W	.04	1	1	1
2-56	Farm well, Sec. 22 T148N R41W	.39	2	1	1
	Red Lake				
2-55	Farm well, Sec. 23 T150N R42W	.19	1	1	1
	Redwood				
2-85	Farm well, Sec. 16 T110N R38W	.69	3	2	1
2-86	Farm well, Sec. 15 T110N R37W	.50	2	1	1
	Renville				
2-289	Farm well (80 ft.), Sec. 1 T115N R35W	.30	1	1	1
	Rice				
2-188	Farm well (80 ft.), Sec. 29 T111N R20W	.29	1	1	1
2-189	Farm well (200 ft.), Sec. 19 T109N R20W	.18	1	1	1
	Rock				
2-72	Farm well (175 ft.), Sec. 14 T103N R45W	T	1	1	1
	Scott				
2-260	Farm well (110 ft.), Sec. 10 T113N R23W	T	1	1	1
	Sherburne				
2-136	Farm well (44 ft.), Sec. 18 T134N R26W	.43	2	1	1
	Sibley				
2-281	Farm well (150 ft.), Sec. 8 T112N R28W	.08	1	1	1
2-283	Farm well (375 ft.), Sec. 35 T113N R29W	T	1	1	1
	Stearns				
2-2	Farm well, Sec. 25 T126N R34W	1.62	5	3	2
2-3	Gopher Poultry Farm, Sec. 23 T126N R34W	1.19	4	2	2
	Steele				
2-147	Farm well (140 ft.), Sec. 32 T107N R20W	T	1	1	1
2-149	Farm well (180 ft.), Sec. 29 T105N R20W	T	1	1	1
	Swift				
2-212	Farm well (45 ft.), Sec. 7 T120N R37W	.69	3	2	1
	Todd				
2-246	Farm well (84 ft.), Sec. 19 T131N R34W	.64	2	1	1
	Traverse				
2-225	Farm well (120 ft.), Sec. 25 T125N R46W	.25	1	1	1
2-313	Farm well, Sec. 24 T128N R45W	.08	1	1	1

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Table 7. (Continued). Boron content of Minnesota waters (classifications made according to limits in table 3)

Reference number*	Source and location of samples	Boron concentration	Boron class		
			Sensitive	Semitolerant	Tolerant
	DEEP WELLS (Continued)	ppm			
	Wabasha				
2-192	Farm well (250 ft.), Sec. 32 T110N R13W	1.08	4	2	2
2-193	Farm well (70 ft.), Sec. 31 T110N R12W	.20	1	1	1
2-195	Farm well (50 ft.), Sec. 8 T111N R12W	.03	1	1	1
	Washington				
2-113	Farm well (63 ft.), Sec. 8 T131N R21W	.11	1	1	1
2-114	Farm well (120 ft.), Sec. 32 T132N R21W	T	1	1	1
	Watonwan				
2-101	Farm well (45 ft.), Sec. 33 T106N R32W	.47	2	1	1
	Wilkin				
2-235	Farm well (220 ft.), Sec. 24 T134N R47W	1.00	4	2	2
2-237	Farm well (220 ft.), Sec. 32 T133N R46W	.44	2	1	1
	Winona				
2-188	Farm well (308 ft.), Sec. 27 T106N R7W	T	1	1	1
	Wright				
2-199	Farm well (87 ft.), Sec. 4 T118N R25W	T	1	1	1
2-201	Farm well (140 ft.), Sec. 1 T118N R28W	.17	1	1	1
2-22	Farm well (60 ft.), Sec. 10 T119N R25W	.32	1	1	1
2-23	Flowing well, Sec. 14 T119N R25W	.25	1	1	1
	Yellow Medicine				
2-290	Farm well (80 ft.), Sec. 9 T115N R40W	.44	2	1	1
2-291	Farm well (80 ft.), Sec. 8 T115N R40W	.06	1	1	1

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