KS652.0106 State Supplement–Introduction

(a) General information

The Kansas supplements to the chapters in the National Engineering Handbook Part 652 (NEH 652), *Irrigation Guide*, cover all areas of Kansas. These are considered adequate for the entire state except for differences that affect the irrigation requirements for crops. Seasonal net irrigation requirements are given for each county in Tables KS4-1 and KS4-2. Net irrigation requirements by months are given as a percentage of the seasonal total in Tables KS4-3 and KS4-4.

This material was developed to assist technicians and others working with Kansas irrigators to provide general planning criteria on various methods of irrigation commonly used in the state. When the system is installed and operated in accordance with basic data, the irrigator is assured that the irrigation system will be capable of supplying the amounts of water needed by plants for optimum production and, with proper seasonal adjustments, that irrigation water can be applied efficiently.

The irrigation planner must be aware that every irrigation system should minimize erosion and that every system should account for drainage. Usually a desirable drainage system for gravity irrigation is the tailwater pit and pump-back system. The need for erosion control and drainage should be kept fully in mind when developing the conservation irrigation plan.

Recommendations relating to economic evaluation of irrigation are included in Chapter 11. The economics of irrigation are usually an individual field or farm determination.

Figure KS1-1 is a map of the organized groundwater management districts (GMDs) in Kansas, and Figure KS1-2 shows the irrigation districts in Kansas.

(b) Irrigation methods and design

Basic information and design guidance for the commonly used methods of water application are given in Sections KS652.0505 and KS652.0605. The specific methods adapted for each soil group, each crop, and each slope group are listed, and applicable specifications are given.

The sprinkler irrigation guidance is not shown in the irrigation design sheets because of the numerous sprinkler types available and their varied requirements. However, the suitability of sprinkler irrigation for use in each soil group, crop, and slope group is shown in the irrigation design sheets. Drip (trickle) irrigation, subsurface drip irrigation (SDI), and sprinkler criteria and installation guidance are given in Chapter 6 and Section KS652.0605.

(c) Slope groupings for surface irrigation design

Field slopes were divided into groups for reasonable irrigation management and to prevent too great a spread for one set of recommendations. The slope ranges with the applicable design slope are shown below.

Slope Range Percent	Design Slope Percent
0.00 to 0.04	Level
0.05 to 0.14	0.1
0.15 to 0.25	0.2
0.26 to 0.55	0.4
0.56 to 1.0	0.7
1.1 to 2.0	1.5
2.1 to 4.0	3.0
4.1 to 8.0	6.0

(d) Control of erosion

The Kansas supplements to NEH 652 contain the maximum field slope recommendations for each crop and method along with companion practices such as terraces and contouring for the various soils under normal conditions to prevent excessive water erosion—whether by irrigation or by

rainfall. These supplements also designate irrigation water application rates, stream sizes, length of run, and time of irrigation to minimize erosion.

For Natural Resources Conservation Service (NRCS) Land Capability Class VI soil, refer to the procedure below to calculate the design field slope.

The conservation treatment of irrigated land for wind and water erosion is listed in the Field Office Technical Guide (FOTG), Section I, Erosion Prediction.

Procedure for sprinkler irrigation system to calculate the design field slope on Class VI land
If the Class VI soil comprises less than 5 percent of total system irrigated acreage, the weighted average field slope will be used.

If Class VI soil is presently in sod and will stay that way, the weighted average field slope will be used. The grassed area will not be used in the calculation of weighted average field slope. If Class VI soil makes up between 5 percent and 25 percent of the irrigated land, the design slope will be midway between the weighted field average slope and the highest slope.

If Class VI soil is greater than 25 percent of total irrigated acreage, the system will be designed using the slope group of the highest slope.

System design will be based on slope group in Section KS652.0505 as determined using the methods above. If the higher-sloped land is situated such that only a portion of the system needs to be designed for higher slopes, the remainder of the system can be designed at lower slope requirements.

System design will be based on a 1-inch net application depth. This is done since constant water losses (for example, canopy evaporation) become a higher percentage of gross application depth as application depth decreases.
In order to ensure that total field irrigation application efficiency is not adversely affected by design needs for high slope areas, no plan will be approved that would exclusively require impact nozzles to meet needed wetted diameters.

This procedure in no way relieves the system owner and/or operator from responsibility if irrigation runoff occurs from the more highly sloped land. In the event that there is irrigation runoff or excessive irrigation water migration from the higher-sloped land, additional design restrictions can be required by the Kansas Division of Water Resources (DWR) or the GMD, and this possibility should be clearly stated in the irrigation plan.

(e) Irrigated soils

Soil scientists have placed all soils into soil intake families based on their water intake characteristics. For irrigation purposes, soils with similar intake characteristics were then placed into irrigation design groups for use in designing irrigation systems. Section KS652.0204 lists the irrigated soils of Kansas with their designated design group.

(f) Conservation treatment specifications

Section IV of the FOTG contains specifications for conservation treatment practices and standards and specifications for such irrigation component practices as sprinkler system, microirrigation, land leveling, underground irrigation pipeline, canal and ditch lining, farm irrigation structures, tailwater recovery systems, etc.

(g) Procedure for irrigation land development

(1) Criteria for irrigation systems
The design of all irrigation systems shall follow the criteria in Section KS652.0605 and conform to the requirements outlined in the applicable Kansas conservation practice standards in the FOTG.

(2) Basic information
The following basic information must be available or be provided for use in planning and designing an irrigation system:

***(i) A water quality analysis*—**All water supplies for irrigation systems should be analyzed before they are used. It is especially important for SDI systems that a water quality analysis, including problems with sand or grit, is obtained prior to system design.

A water quality analysis is provided by the irrigator. For information on a water quality analysis, refer to Agriculture Handbook No. 60, *Diagnosis and Improvement of Saline and Alkali Soils*, Chapter 5, "Quality of Irrigation Water." Usual salinity limits of water are based on electrical conductivity (millimhos [mmhos] per centimeter) as follows:

< 0.75 mmho–Safe water
0.75-2.25 mmhos–Safe where drainage is adequate
> 2.25 mmhos–Very limited use on high salt tolerance crops in large quantities and very good subsoil drainage

Note: Convert mmhos to micromhos by multiplying by 1,000:
0.75 mmho x 1,000 = 750 micromhos

For detailed information, refer to Chapter 13.

***(ii) Quantity of water available*—**Water right information shall be obtained from DWR for the authorized place of use. This may include consultation with the local GMDs. Refer to Figure KS1-1 for addresses and phone number for the GMDs.

***(iii) Topographic or grid map*—**Depending on the amount of detail needed, this information may be obtained from maps developed remotely by others or by in-the-field survey methods.

(iv) Soils information from Section KS652.0204

Soils not listed in Section KS652.204—The soil scientist will make the following determinations in the field:

- Effective soil depth, texture, permeability, slope, and the erosion and fertility potential.
- Intake family with the effective rooting depth and water holding capacity.

Preparation of soils report—The soil scientist will then prepare a soils report and submit it to the state soil scientist for review. Upon the concurrence of the state soil scientist that the soil is suitable for irrigation, all field offices will be advised to list this information in the appropriate place in Section KS652.0204.

(3) Guidelines
In developing an overall irrigation system plan, the following guidelines should be observed and included:

***(i) Conservation cropping system*—**This will be developed in accordance with Conservation Practice Standard (CPS) 328, Conservation Crop Rotation. This may be listed on the irrigation development plan or in the case file with adequate cross references.

***(ii) Amount of land to be developed for irrigation*—**This will depend on the planned cropping system, the intensity of irrigation desired by the irrigator, and the amount of irrigation water available.

To determine the maximum irrigated acres, use the procedure outlined in Section KS652.0106(h) below. This indicates the crop acres that can be completely irrigated throughout the growing season with no limitation of crop production due to moisture.

In some cases, the irrigator may want or have to adjust his system operation to something less than maximum as far as pumping time and water use are concerned. Factors such as high energy costs, restrictions on water use, type of cropping system, and other items may dictate this choice. Usually irrigations will be limited to several pre-selected times during critical crop-growing periods. There may be other instances where the irrigator will use the same irrigation frequency—except the irrigator

will use the maximum water available and adjust the irrigated acres accordingly.

If supplemental irrigation is planned, the amount of irrigated acres will usually be determined by the irrigation intensity desired. For example, in southeast Kansas where average annual rainfall is from 37 to 42 inches, the amount of irrigated acreage is usually based on providing 2 to 8 one-inch net applications. The primary purpose is to provide supplemental moisture during a 7- to 10-day dry period that usually occurs each summer at a critical stage of crop growth.

(iii) Lands subject to flood scour and/or deposition more frequently than once every 10 years—These lands will not be developed for irrigation.

(iv) Fields planned for land leveling—These fields shall meet the requirements of CPS 464, Irrigation Land Leveling.

(v) Adequate drainage—The irrigation plan shall provide for adequate drainage as outlined in CPS 464 and CPS 607, Surface Drain, Field Ditch.

(vi) Tailwater recovery pits—These will be part of the irrigation plan if required under the conditions listed in CPS 447, Irrigation System, Tailwater Recovery.

(h) Irrigation acreage related to water supply

(1) Irrigation efficiency

The condition of the land, water transmission lines, and system situation has a bearing on how efficiently water is delivered from the source to the crops. Irrigation system efficiencies shown in Section KS652.0605 are generally applicable if the irrigation system is managed to where the amount of water applied will meet, but not exceed, the consumptive use rates of the crops being grown.

(2) Area the water supply will adequately irrigate using a traditional gravity irrigation system

Water supply related to irrigation acreage can vary considerably with farm conditions and management situations. The relationship stated below is a general recommendation only.

The following chart for gravity irrigation gives a factor value (F) to establish a relationship of water delivery volume to acres that can be irrigated as expressed by the formula:

Maximum Irrigated Acres = Well gpm x F

Delivery Efficiency	Summer Irrigation Factor F	Winter Irrigation Factor F
50%	.10	.20
60%	.12	.24
70%	.14	.28
85%	.17	.34

Example KS1-1

Given: Well delivers 1200 gallons per minute (gpm). Area to be irrigated in both summer and winter is properly leveled, has underground pipe and surface-gated pipe delivery, and has suitable drainage (for example, 70% delivery efficiency).

Maximum area that can be gravity-irrigated in summer:

1200 x 0.14 = 168 acres

Maximum area that can be gravity-irrigated in winter:

1200 x 0.28 = 336 acres

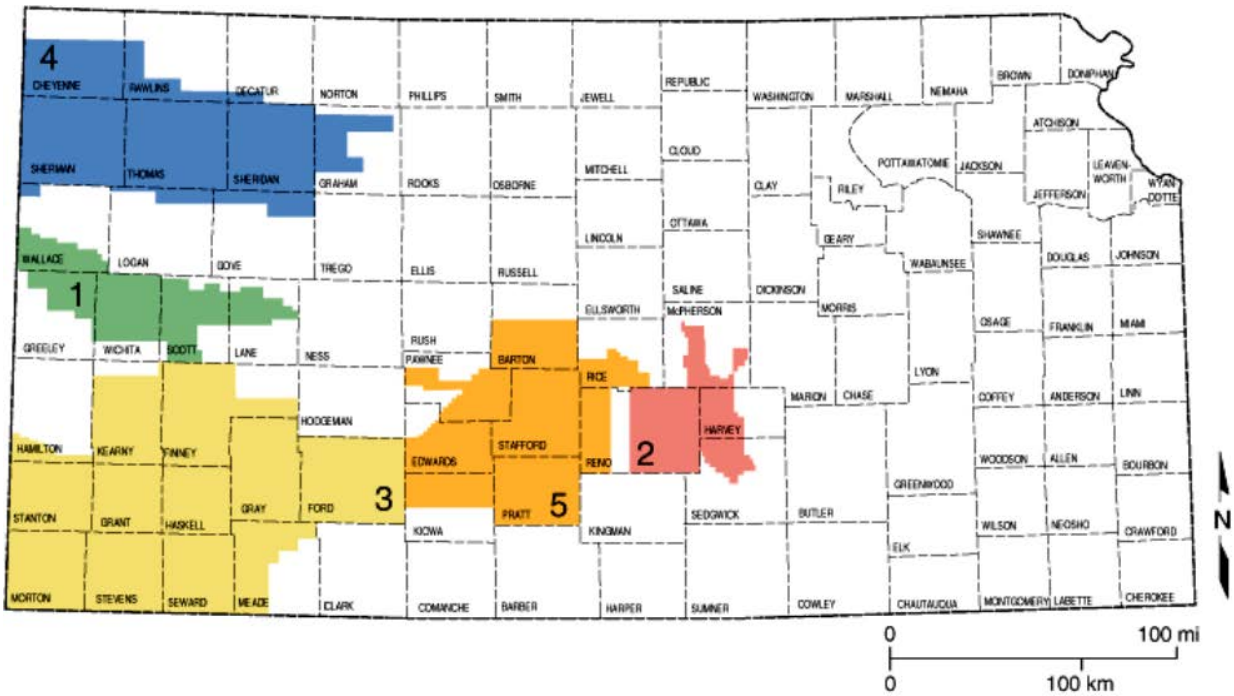
Maximum area that can be gravity-irrigated where winter acreage and summer acreage are combined as a total (separate water demand periods):

168 + 336 = 504 acres

(3) Area the water supply will adequately irrigate using a sprinkler irrigation system

Center pivot sprinkler irrigation acreage can be determined using the gpm per acre values listed in Section KS652.0408.

Figure KS1-1 Groundwater management districts



GMD #1–Western Kansas

Jan King, Manager
906 West 5th
Scott City, KS 67871
620-872-5563
http://www.gmd1.org/

GMD #2–Equus Beds

Tim Boese, Manager
313 Spruce
Halstead, KS 67056
316-835-2224
http://www.gmd2.org/

GMD #3–Southwest Kansas

Mark Rude, Executive Director
2009 E. Spruce Street
Garden City, KS 67846
620-275-7147
http://www.gmd3.org/

GMD #4–Northwest Kansas

Katherine Wilkens-Wells, Manager
1290 West 4th
Colby, KS 67701
785-462-3915
http://www.gmd4.org

GMD #5–Big Bend

Orrin Feril, Manager
125 South Main Street
Stafford, KS 67578
620-234-5352
http://www.gmd5.org

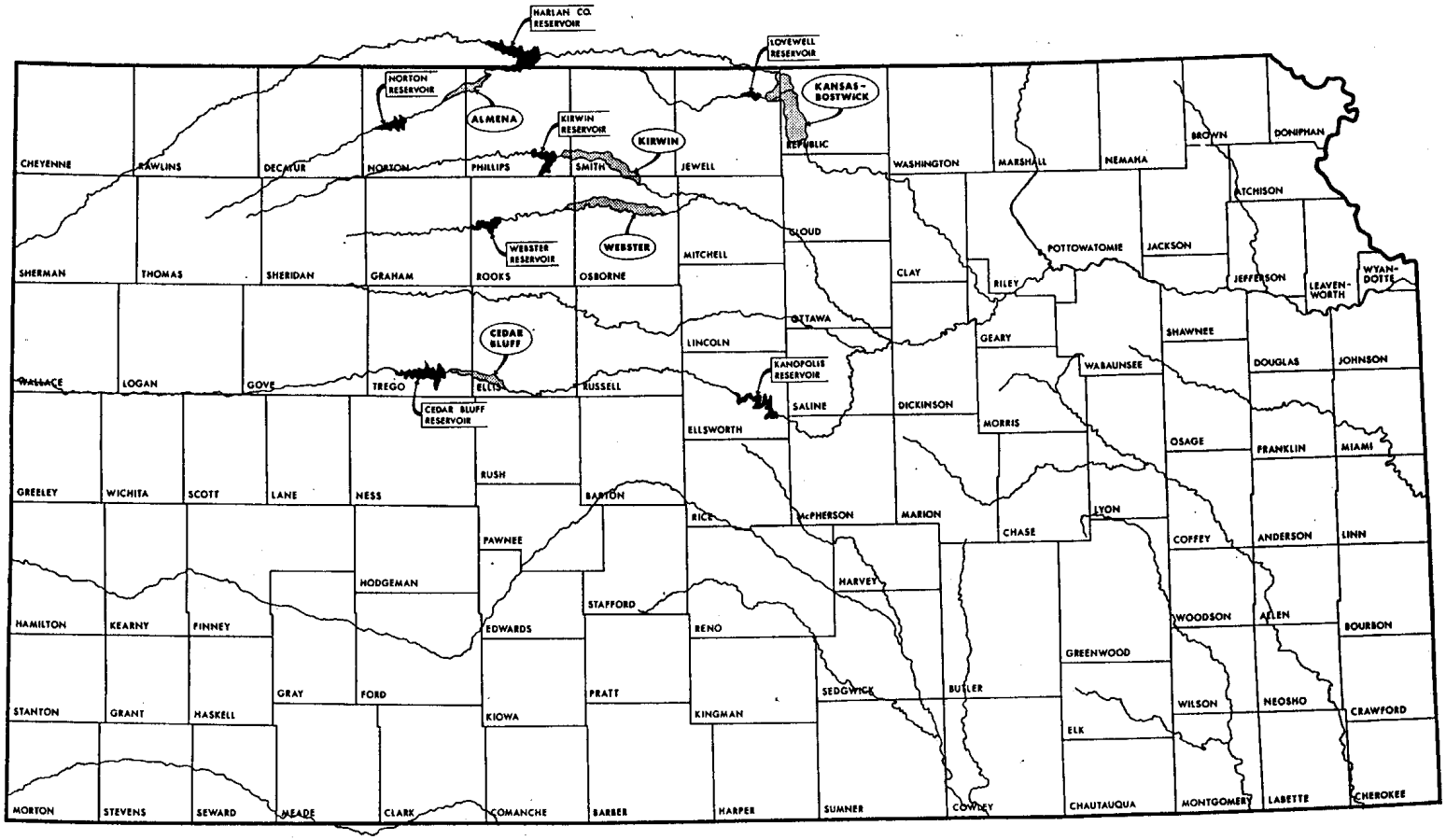



Figure KS1-2 Irrigation Districts in Kansas, 1967