

CHAPTER 7 - ANNUAL YIELD (RUNOFF)

FIGURES

	<u>Page</u>
7-1 Annual Yield in Acre Feet Per Square Mile 80% Chance (80 years out of 100 years)	7-3
7-2 Annual Yield in Acre Feet Per Square Mile 50% Chance (50 years out of 100 years)	7-4
7-3 Major Land Resource Areas	7-5

## CHAPTER 7 - ANNUAL YIELD (RUNOFF)

Information on annual runoff is very limited on small watersheds. The annual runoff from a watershed has a direct relationship to the watershed yield. The water yield of a watershed by years, seasons or months is used in the planning and design of some water resource projects, especially those involving irrigation, reservoirs for municipal and industrial water, or recreational water storage. The hydrologist can supply estimates of water yields, as required, or supply a method to determine the water yield at a particular site. The runoff maps in this chapter and the evaporation values from Chapter 8 provide some of the basic data needed to make a water yield study on a particular site.

The Annual Runoff Values shown on Figures 7-1 and 7-2 were developed from USGS Gaging Stations. The Gaging Stations located between the Missouri Plateau and the Red River Valley of the North (see Figure 7-3), in the Glacial Drift Prairie, reflect the runoff stored in the numerous potholes and depressions. The retention of water in these various potholes and depressions is particularly significant for the smaller frequency floods.

When selecting runoff values for smaller frequency floods within the Glacial Drift Prairie (see Figure 7-3), it may be necessary to increase the runoff values for the well defined drainage areas that do not have numerous potholes and depressions. Figures 7-1 and 7-2 reflect a storage condition within the Glacial Drift Prairie. When this condition does not exist, the runoff values need to be increased.

Individual judgement and the accuracy required will be the basis for the final determination.

In some cases a special study may be necessary.

Estimating Runoff - Supplement

YIELD DETERMINATION

The volume of reliable annual water yield from a given drainage area can be the governing factor in determining the feasibility of (1) waterspreading, (2) fish and wildlife structures, (3) recreation structures, (4) irrigation impoundments, or (5) stockwater developments.

Figures 7-1 and 7-2 may be used to determine the volume of runoff that can be expected annually for the designated percent chance. Runoff (R) from snowmelt for the dependable (80 percent chance) and questionable (50 percent chance) should be used for waterspreading.

Annual runoff (R) for the 80% chance (Figure 7-1) should be used to offset annual use, seepage 1/ and evaporation losses for impoundment type structures.

The 80% chance annual runoff curve (Figure 7-1) can be used to estimate the period (usually 1 to 3 years) for the initial filling of reservoirs.

The 50% chance annual runoff curve for higher risk (Figure 7-2) can be used to estimate filling periods for successive years of higher runoff.

Example of use of Figures 7-1 and 7-2 2/.

1. Find: The total annual runoff that can be expected from a 160 acre watershed in Burleigh County 80 years out of 100 years (80% chance).

Solution: From Figure 7-1 read (interpolate) 16 acre feet per square mile

$$\frac{160 \text{ ac.}}{640 \text{ ac.}} \times 16 = .25 \times 16 = \underline{\underline{4 \text{ acre feet}}}$$

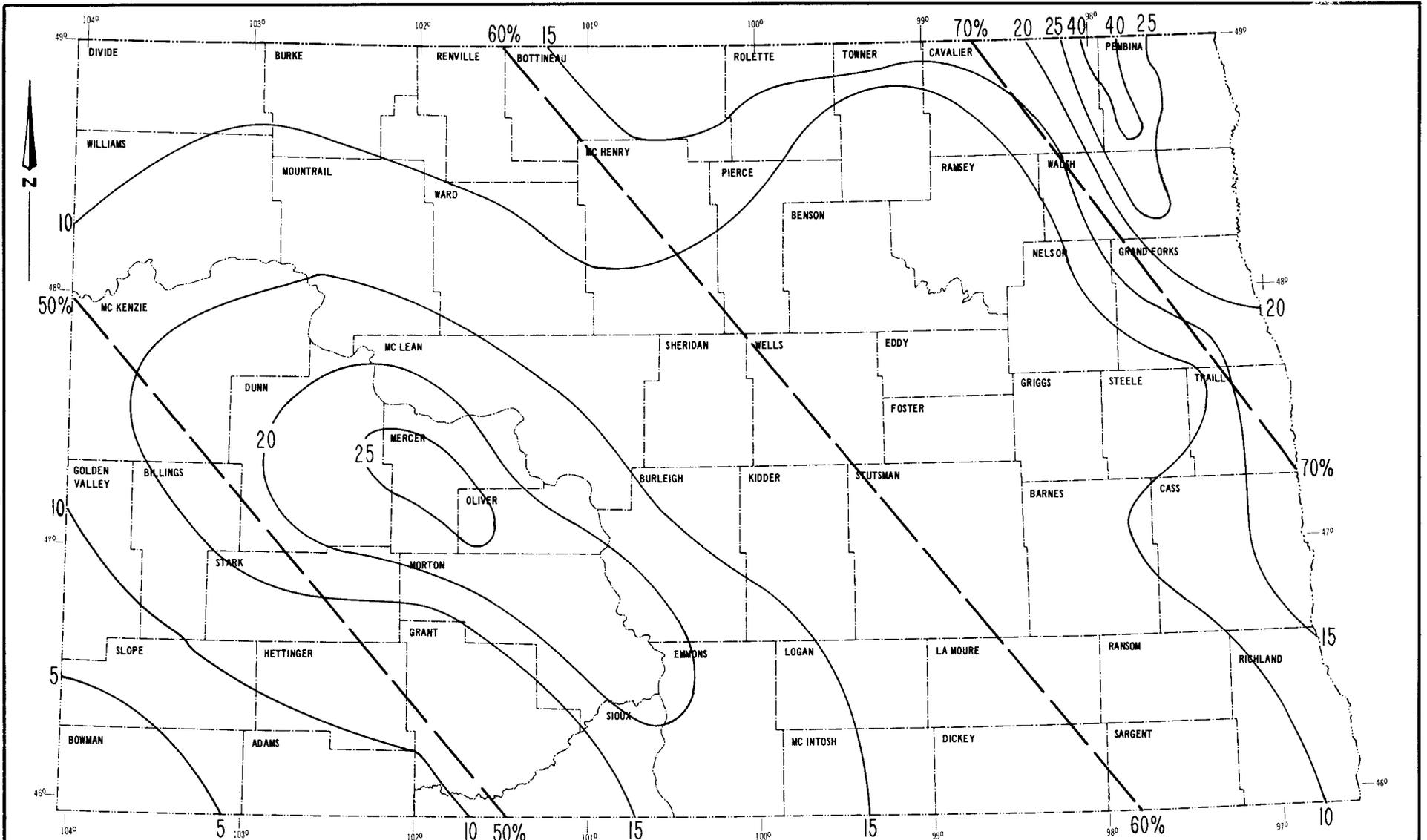
2. Find: The total annual snowmelt runoff that can be expected from a 160 acre watershed in Burleigh County 80 years out of 100 years (80% chance).

Solution: From problem 1 total annual runoff equals 4 acre feet. From Figure 7-1 read (interpolate) that 56% of the annual runoff is snowmelt.

$$0.56 \text{ (56\%)} \times 4.0 \text{ acre feet} = \underline{\underline{2.24 \text{ acre feet}}}$$

1/ Can be ignored in most cases.

2/ Use Figure 7-2 to determine runoff for 50% chance.



ANNUAL YIELD IN ACRE FEET PER SQUARE MILE  
80% CHANCE (80 YEARS OUT OF 100 YEARS)

**NORTH DAKOTA**

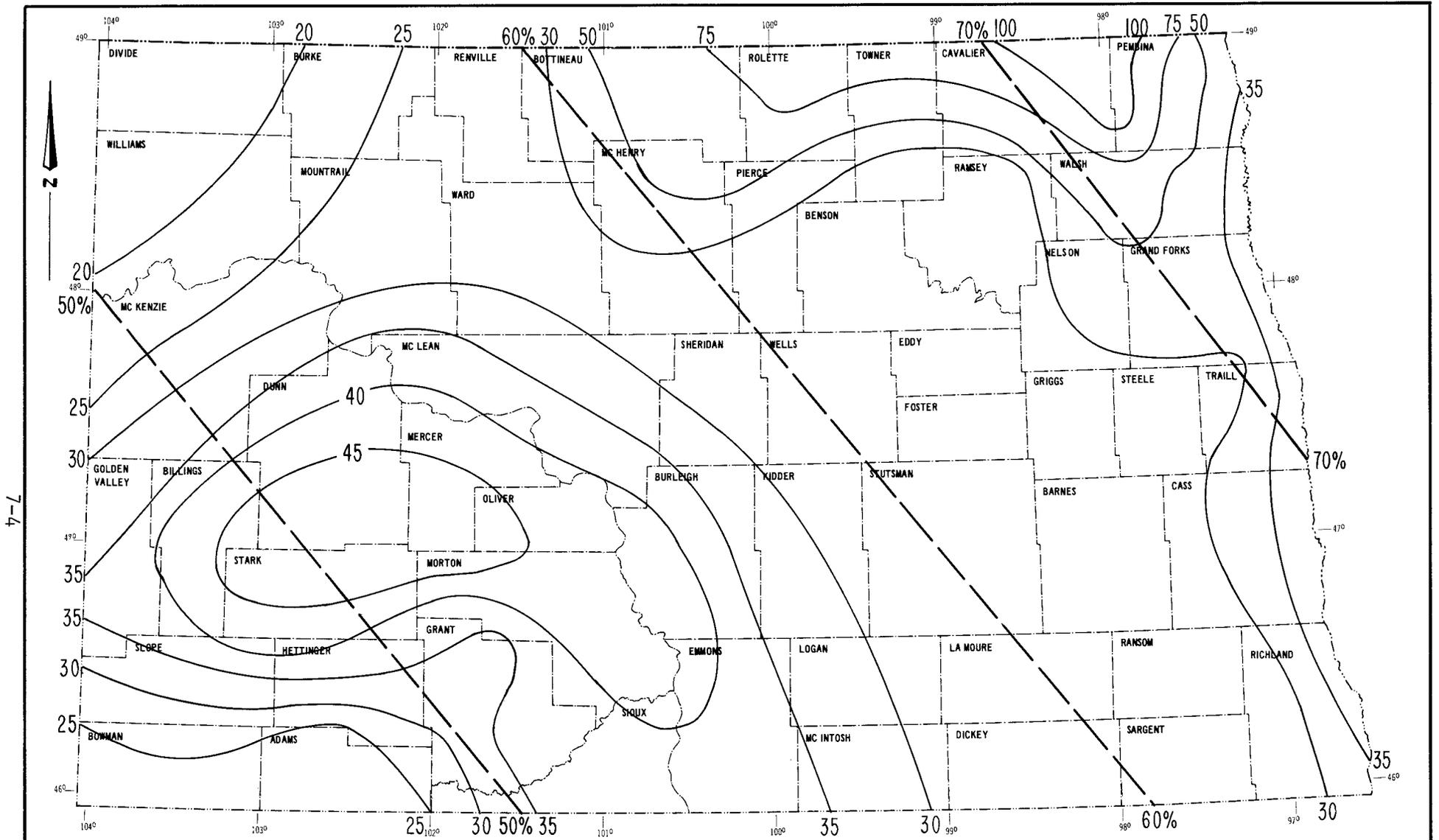
BASE MAP SOURCE:  
FAMILY OF MAPS 5,S-32,814 (9-74)  
ALBERS EQUAL AREA PROJECTION

————— EXPECTED PERCENT OF RUNOFF FROM SNOWMELT  
ACRE FEET/SQUARE MILE ÷ 53.3 = INCHES OF RUNOFF

SCALE 0 10 20 30 40 50 MILES  
0 20 40 60 80 KILOMETERS  
1/2,482,800

FIGURE 7-1

7-3



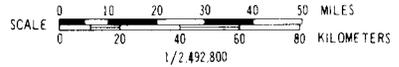
**ANNUAL YIELD IN ACRE FEET PER SQUARE MILE  
50% CHANCE (50 YEARS OUT OF 100 YEARS)**

**NORTH DAKOTA**

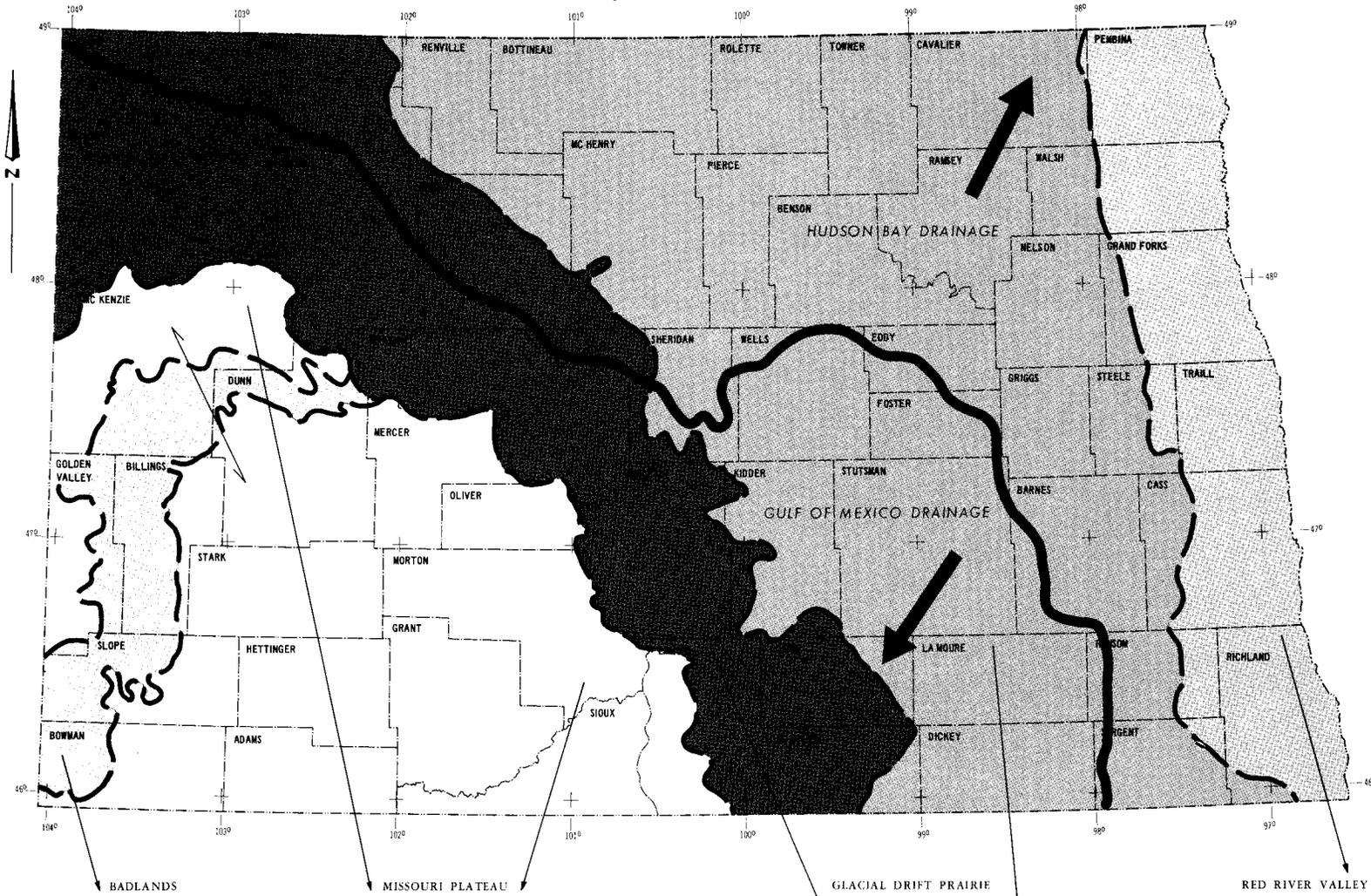
FIGURE 7-2

BASE MAP SOURCE:  
FAMILY OF MAPS 5-S-32,814 (9-74)  
ALBERS EQUAL AREA PROJECTION

————— EXPECTED PERCENT OF RUNOFF FROM SNOWMELT  
ACRE FEET/SQUARE MILE ÷ 53.3 = INCHES OF RUNOFF



# NORTH DAKOTA Major Land Resource Areas



**BADLANDS**  
Scenic area where geologic erosion has exposed broad canyons, ravines, gorges and gulches. Shallow and moderately deep, sloping to steep soils and Badland. The soils generally have very slow infiltration rates and water transmission rates. Natural surface drainage is well defined.

**MISSOURI PLATEAU**  
Moderately rolling plain with scattered buttes. Moderately deep and shallow, gently sloping to rolling soils. The soils generally have a moderate infiltration and water transmission rates. Natural surface drainage is well defined.

**Dark Brown Soils**  
Belt of hills on the west edge of the glaciated area. Deep, nearly level to steep soils. The soils generally have moderate infiltration and water transmission rates. Runoff water is stored in depressions and potholes. The depressions and potholes are generally deeper than those in the Black Soils.

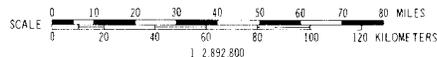
**Black Soils**  
Undulating topography with thousands of small ponds and potholes. Deep, nearly level to gently rolling soils. The soils generally have moderate infiltration and water transmission rates. Runoff water is stored in depressions and potholes.

**RED RIVER VALLEY OF THE NORTH**  
Ancient glacial lake bottom with rich black soils. Deep, nearly level soils. The soils have slow to very slow infiltration rates and water transmission rates.

7-5

FIGURE 7-3

SOURCE:  
SCS DRAWING S. 5-32, 814 AND  
INFORMATION FROM FIELD TECHNICIANS  
ALBERS EQUAL AREA PROJECTION



1-22-79