Kansas Department of Transportation

TECHNICAL SUMMARY

Estimating Design Discharges for Drainage Structures in Western Kansas

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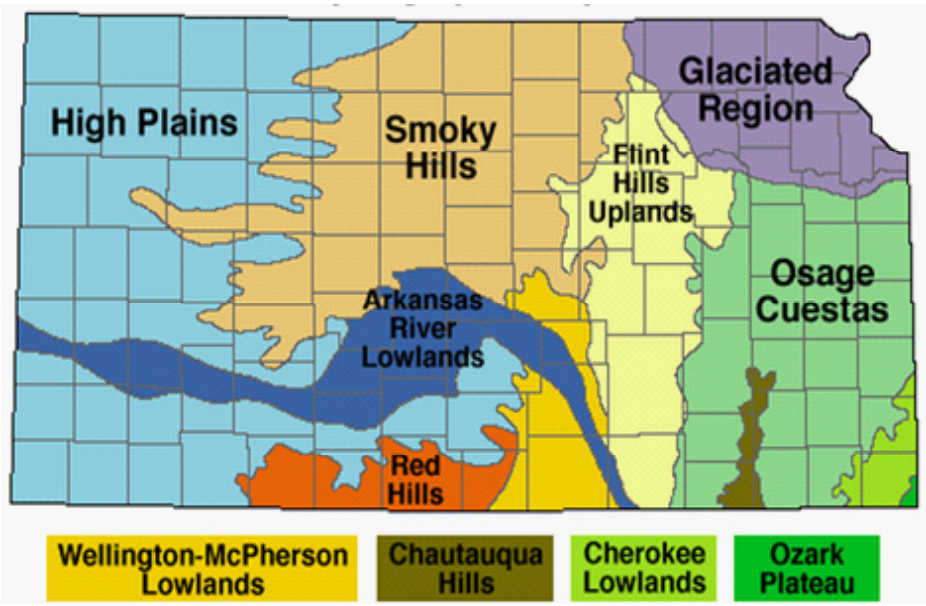

(Source: Kansas Geological Survey)

FIGURE 1.4
Generalized Physiographic Regions of Kansas

Introduction

KDOT engineers have expressed concern that the hydrologic methods in the current KDOT Design Manual (Volume I, Part C, 2011) may lead to over-sizing of drainage structures in Western Kansas. Some new structures designed by the current methods are much larger than the previous structures at these locations or existing structures directly upstream or downstream, where the older structures had no known history of overtopping. There are reasons to suspect that current methods may not be well suited to small watersheds in Western Kansas, particularly for areas with high soil permeability.

This report examines the applicability of KDOT's current hydrologic methods to Western Kansas and develops new Rational C values and flood-frequency regression equations for this region. In addition, KDOT's current hydrologic methods are compared with those of nearby state DOTs.

Project Objective

Regional flood frequency analyses were performed on this data set using Generalize Least Squares regression in WREG 1.0. Soil permeability was found not to be a significant predictor variable. Regression equations were developed for Western Kansas, but our comparisons show that these equations are not a substantial improvement over existing regression equations. Based on an evaluation of available methods, we recommend the Extended Rational method for watershed areas > 640 ac and < 30 mi^2 and the USGS four-parameter regression equation for watersheds ≥ 30 mi^2 in both Western and Eastern Kansas.

Project Description

In order to develop new flood-frequency regression equations and recommendations for Rational C values for Western Kansas, we assembled a data set of all USGS gaging stations that met the following criteria: (1) at least 10 years of peak flow records, (2) watershed area less than 100 mi^2, (3) unregulated watersheds (no major lakes or reservoirs), and (4) watersheds within 100 miles of the Kansas border and west of 97.5° longitude. The resulting data set contains 156 stations, 62 of which are in Kansas.

Project Results

An analysis of Rational C values indicates that C values currently used for design in Western Kansas are too high for recurrence intervals below 100 years. New Rational C values for Western Kansas were developed and checked against regression methods for consistency. Our proposed C values for Western Kansas are lower than the current values for all recurrence intervals below 100 years. We also propose certain adjustments to the Rational C values for Eastern Kansas. We recommend that urban open spaces and pervious surfaces within the right-of-way be considered equivalent to pasture/range rather than cropland in both Western and Eastern Kansas.

Project Information

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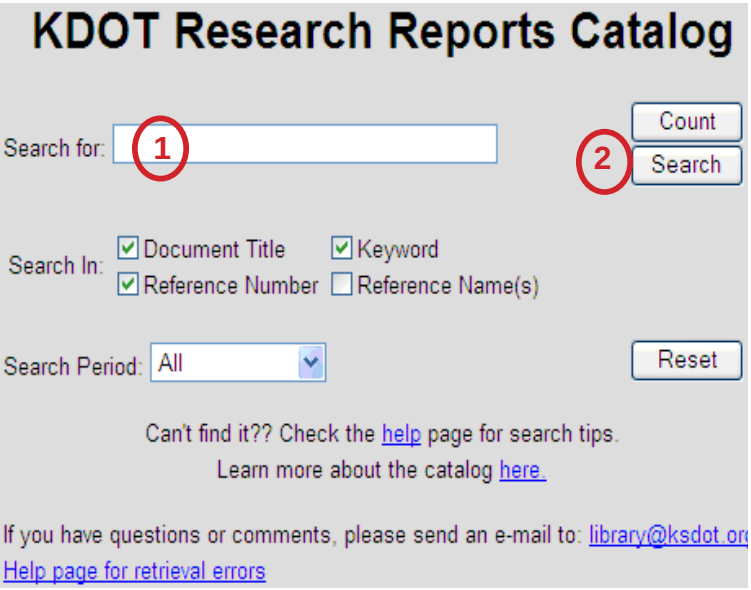

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