



STORAGE EFFECTS AT CULVERTS

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By: Bruce M. McEnroe and Scott A. Gonzalez, both with University of Kansas

R E S E A R C H

Introduction

Temporary ponding of water on the upstream side of a culvert serves to reduce the peak discharge that the culvert must convey. In most cases the discharge reduction resulting from detention storage is minor and can be neglected in design. However, in some cases the storage effect is substantial, and accounting for it may result in a more economical design.

Project Objective

This report presents new methods for quickly estimating the effects of detention storage on the performance of existing culverts and the sizing of new culverts. These methods, which do not require hydrograph routing, are applicable to pipe and box culverts operating under inlet control with no overtopping of the roadway. Peak discharges can be computed by the Rational method, USGS regression equations or any other appropriate method. Water-surface areas at two or more stages are needed to define an approximate depth-area relationship. The required areas can be estimated from existing topographic maps or measured in the field by one person with a rotating laser level and a GPS unit.

Project Description

Analyses of seven pipe-culvert sites in Johnson County showed that detention-storage design would reduce the required pipe diameter by at least one increment at five of the seven sites, and by two or more increments at three of the sites. Similar analyses of ten box-culvert sites showed that detention-storage design would reduce the required span by more than 10% at three of the ten sites. Our test results indicate that storage effects are less likely to be significant for large culverts than for small culverts.

Project Results

The design of a culvert for detention storage rather than peak flow generally requires another survey, extra design effort and the purchase of additional right-of-way or a drainage easement for the storage area. Detention-storage design is economically justifiable only if cost saving on the culvert exceeds these added costs. In locations where storage effects are significant but detention-storage design is not economically justifiable, the culvert should be designed for peak flow.

Report Information

For technical information on this report, please contact: Bruce McEnroe, University of Kansas; 1530 West 15th Street, Room 2150D, Lawrence, Kansas 66045-7609; Phone: 785-864-2925; Fax: 785-864-5631; email: mckenroe@ku.edu.

For a copy of the full report, please contact: KDOT Library; 700 SW Harrison Street, Topeka, Kansas 66603-3754; Phone: 785-291-3854; Fax: 785-291-3717; e-mail: library@ksdot.org.