Infiltration of Highway Stormwater Runoff

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Introduction

- Infiltration is a function of soil type, water content, time of water application, saturated hydraulic conductivity (K_{sat})
- Commonly used as a secondary treatment for highway stormwater runoff
- Determining the rate is challenging due to the uncertainty in estimating both the long and short term values
- Values for a single site can vary significantly with coefficients of variation as high as 400% (Reynolds et al., 2002)
- Poor estimates of infiltration rates can result in facilities that are undersized and risk overflow onto roadways or that are oversized and inefficiently utilize resources
- Many factors can affect infiltration rates including compaction due to development, lack of effective pre-treatment, testing apparatus, and the geometry of the facility (Arriaga et al., 2010; Massman, 2003; Pitt et al., 2002)
- It is important to consider depth: trenches are typically excavated and filled with coarse soils and geotextiles for filtration and storage purposes

Double-Ring Infiltrometer

- Measures the in-situ saturated hydraulic conductivity and cumulative infiltration
- Concentric ring configuration accounts for lateral flow from beneath the annular space

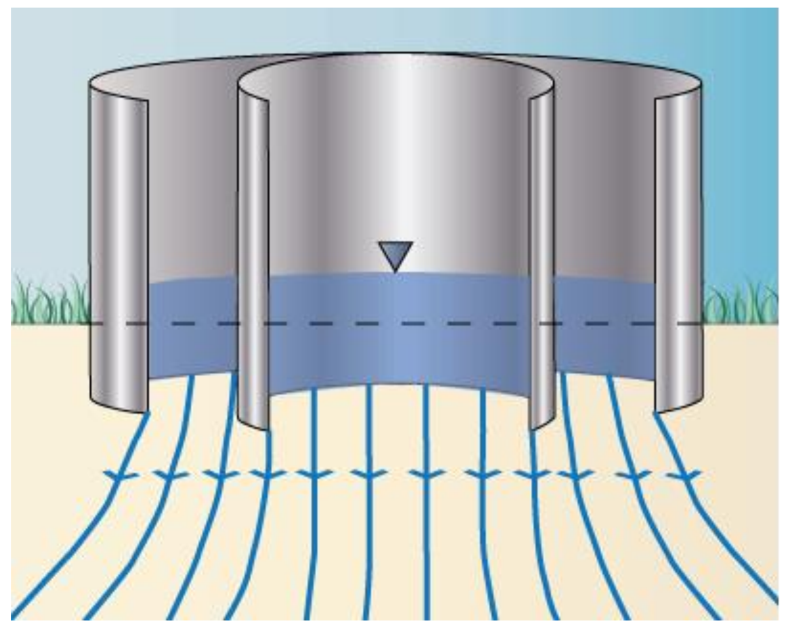


Image of DRI Set-Up from Hilbec

Objective

In this study, infiltration rates will be measured in the field at sites in varying physiographic regions of Georgia using a double-ring infiltrometer at incremental depths. Field measured values will then be compared with lab based estimates from hydraulic conductivity testing as well as published soils data from the USDA Soil Survey database.

Published Soils Data

Several methods are utilized to obtain a first cut estimation for site consideration:

- Published soils data from SSURGO; e.g. Soil Type, HSG, K_{SAT}
- Web Soil Survey
- USDA or USCS soil classification and subsequent empirical relationships; e.g. Hazen, Kozeny-Carmen

Data Analysis

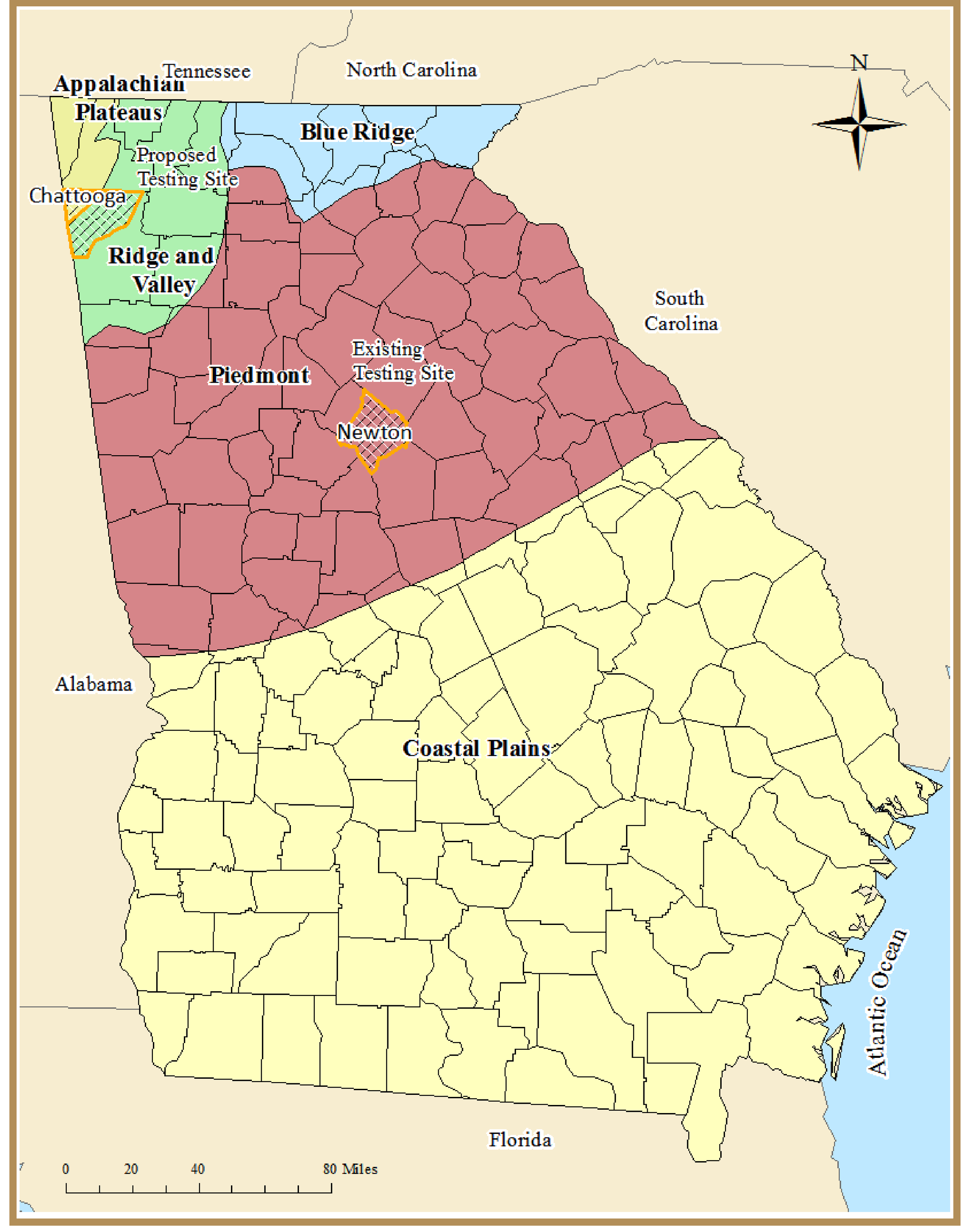
- Reynolds et al. 2002, proposed a model for evaluating field saturated hydraulic conductivity (K_{fs}) and quasi-steady state infiltration rate (q_s) using a double-ring infiltrometer
- The method considers relative importance of flow due to:
  1. Hydrostatic pressure of ponded water
  2. Capillarity of adjacent soils and soils beneath wetting front
  3. Gravity
- Capillary effects tend to dominate in fine grained soils while hydrostatic pressure effects dominate in coarse grained soils

$$K_{fs} = \frac{q_s}{\left[\left(\frac{H}{C_1 d + C_2 a}\right) + \left(\frac{1}{\alpha(C_1 d + C_2 a)}\right)\right] + 1}$$

q_s = quasi-steady state infiltration rate
K_{fs}= field saturated hydraulic conductivity
H = height of ponded water
a = radius of ring (center)
α = marcoscopic capillary length
C_1 and C_2 are empirical constants

Site Selection

- Sites selected based in their physiographic location in the state of Georgia
- Current site in Newton County which is in the Piedmont region
- Future sites to be selected in the Ridge and Valley and Coastal Plains regions



Acknowledgements

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