Field Assessment of Culvert Impacts on Stream Channel Morphology

Jessica T. Roberts, EI
M.S. Candidate
jess_roberts@ncsu.edu

NC STATE UNIVERSITY

Greg Jennings, PhD, PE
Professor
jennings@ncsu.edu






The Culvert Assessment Tool (CAT) is a rapid, qualitative and quantitative tool that has been developed to assist in the observation and collection of data pertaining to culvert, surrounding stream channel morphology, and stream stability.

Objectives

Relate stream stability to culvert and channel dimensions

•Determine relation between culvert slope and stream observations

•Determine relation between area of culvert and stream channel cross sectional area

Background

Culverts are *traditionally defined as simple hydraulic structures* that *convey a flow* under a road or other obstruction and are primarily used to divert stream or rainfall runoff to prevent *erosion* and *flooding* on highways.

Culvert Functions

- Convey water and sediment
- Transportation network support
- Support Channel Morphology
- Reduce Stream Impacts
  - Aggradation
  - Degradation
- Aid Aquatic Organism
  - habitat
  - passage

Field Study

85 randomly selected sites in Wake County, NC

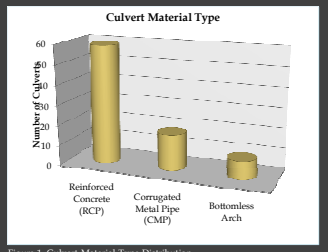


Figure 1. Culvert Material Type Distribution

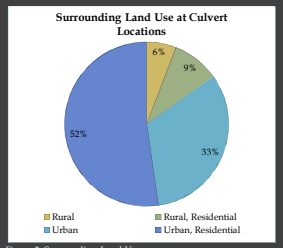


Figure 2. Surrounding Land Use

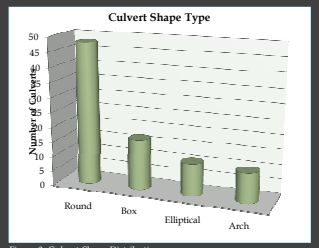


Figure 3. Culvert Shape Distribution

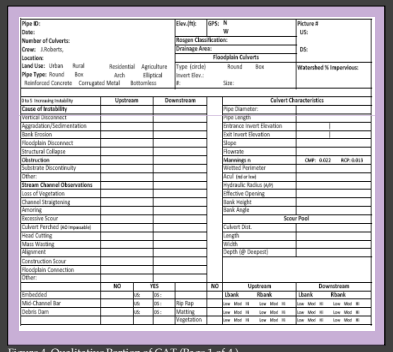
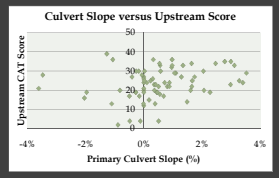
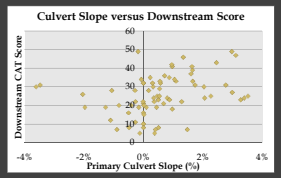


Figure 4. Qualitative Portion of CAT (Page 1 of 4)





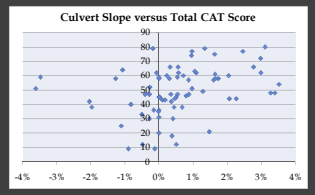


Figure 5 (Clockwise Left to Right). Culvert Slope vs. Upstream Score, Culvert vs. Downstream Score, and Culvert Slope vs. Total CAT Score.

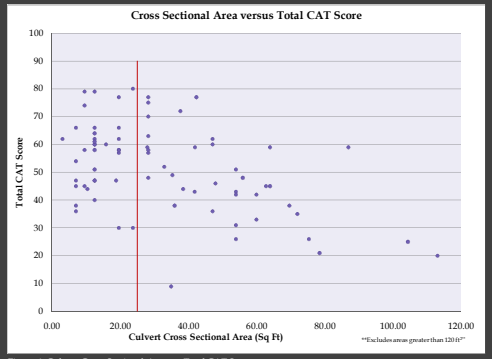


Figure 6. Culvert Cross Sectional Area vs. Total CAT Score

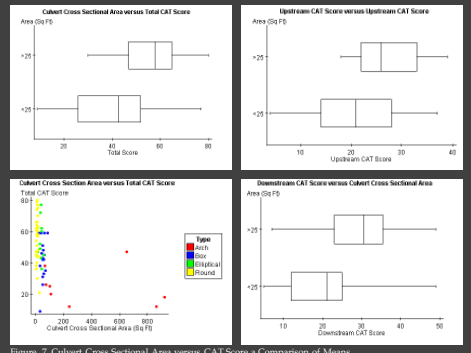


Figure 7. Culvert Cross Sectional Area versus CAT Score a Comparison of Means

Assessment Methodology

CAT Score

Cause of Instability
Stream Channel Observations

Culvert Characteristics

- Diameter
- Pipe Length
- Pipe Slope

Channel Geometry/Characteristics

- Survey 4 Cross Sections
  - (2) within 0-20′ of face
  - (2) 20-250′ up/down stream
- Pebble Count

Benefits

Field Tested
Rapid
Qualitative/Quantitative
Potential Prediction Tool

Conclusions

• Majority of the sites are urban sites with round, reinforce concrete piped culverts.

•Cross sectional area of the culvert and the slope impact CAT score.

•The difference in means of CAT Scores is larger for downstream compared to upstream.

•CAT score increases, indicating instability as slope increases.

•Culverts with smaller cross sectional have higher CAT scores.






Acknowledgements

Stream Restoration Program at NCSU · North Carolina Ecosystem Enhancement Program · North Carolina Division of Water Quality · North Carolina Department of Transportation · City of Raleigh · Town of Cary · Town of Apex · Barbara Doll & Jan Patterson · Drs Bill Hunt, Greg Jennings & Rich McLaughlin · Jessica Blake