Center for TMDL and Watershed Studies

Effect of FTABLE Generation Method on Instream Fecal Bacteria Concentrations Simulated Using HSPF

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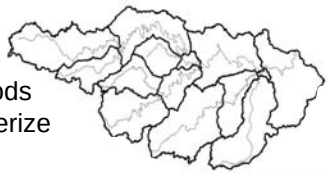
Presentation Outline

- Motivation
- Model parameters (FTABLES)
- Previous research
- Research objective
- Methods
- Results/Discussion
- Conclusions
- Future Study

Motivation

- TMDL Development
  - Watershed - scale studies
  - Bacteria
  - Hydrological Simulation Program-FORTRAN (HSPF)
- Compare data collection methods used to characterize the stream



Hydraulic Function Tables (FTABLES)

- Represent channel geometry

Depth (ft)	Area (ft^2)	Volume (ac-ft)	Discharge (ft^3/s)
0.01	114.1	0	0
0.09	114.58	10.25	2.06
0.8	118.4	93.49	80.19
1.5	122.12	177.16	227.65
4.78	139.65	606.21	1609.66
7.21	146.23	954.22	3303.57
14.55	166.06	2100.05	11123.22

Hydraulic Function Tables (FTABLES)

- FTABLES are volume-based

Depth (ft)	Area (ft^2)	Volume (ac-ft)	Discharge (ft^3/s)
0.01	114.1	0	0
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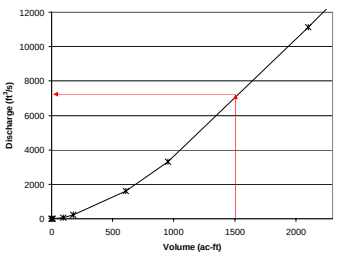
Hydraulic Function Tables (FTABLES)

- Linear Interpolation



Volume (ac-ft)	Discharge (ft^3/s)
0	0
10.25	2.06
93.49	80.19
177.16	227.65
606.21	1609.66
954.22	3303.57
2100.05	11123.22

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FTABLE Generation Data

- Field-based surveys
  - Stream cross-sections
- Digital-based data
  - 30 meter Digital Elevation Models
  - NRCS Regional Hydraulic Geometry Curves

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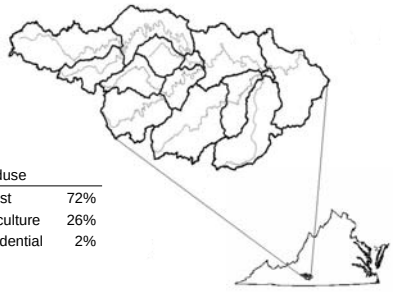
Pigg River Watershed



Landuse	
Forest	72%
Agriculture	26%
Residential	2%

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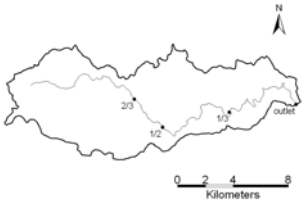
Field-based FTABLES



Field Scenario	Cross-sectional profiles used	Total number of cross sections processed
"outlet"	outlet	14
"half"	outlet, 1/2	28
"third"	outlet, 1/3, 2/3	42
"all"	outlet, 1/3, 1/2, 2/3	56

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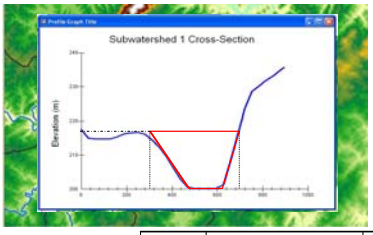
Digital-based FTABLE



FTABLE entry	Relevant NRCS Equation	Calculation for FTABLE entry
Stage	Mean stage (ft) = 1.56 * $DA^{0.301}$	NRCS bankfull mean depth
Surface Area	Top Width (ft) = 13.7*$DA^{0.376}$	NRCS bankfull top width * GIS measured reach length
Volume	Cross-sectional area (ft²) = 21.5 * $DA^{0.675}$	NRCS bankfull cross-sectional area * GIS measured reach length
Discharge	Discharge (ft³/s) = 89.6 * $DA^{0.721}$	NRCS bankfull discharge

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Research Objective

The objective of this study is to examine the effects of FTABLE generation method on simulated instream fecal bacteria concentrations.

- 4 Field-based Scenarios

Field Scenario	Cross-sectional profiles used
"outlet"	outlet
"half"	outlet, 1/2
"third"	outlet, 1/3, 2/3
"all"	outlet, 1/3, 1/2, 2/3

- 1 Digital-based Scenario
  - NRCS Equations
  - DEM

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Dataset Generation

- Climate Generator (CLIGEN)
  - Independent weather inputs
    - Precipitation
    - Temperature
  - Rocky Mount, Virginia
    - Station number 447338
- Monte Carlo Simulations with HSPF
  - 5 scenarios
  - 75 simulations

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Response Variables

- Long-term Average Concentration
  - Averaged over the analysis period
- Water Quality Criterion Violation Rate
  - Length of time the daily average concentration exceeds the single sample criterion (400 cfu/100ml)
- Total Bacteria Die-off
  - Calculated in HSPF
  - Summed over the analysis period

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Analysis

- Visual Comparison
  - Daily average bacteria concentrations
- Box and whisker plots
  - Response variables
- Pair-wise Student's t-test
  - Bonferroni correction

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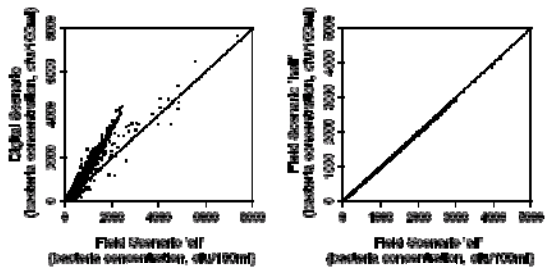
Visual Comparison



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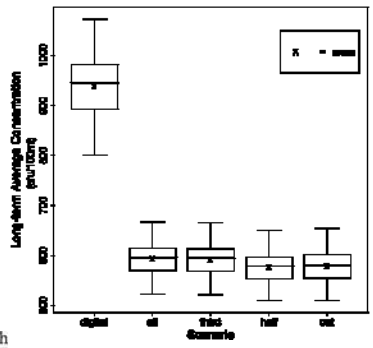
Long-term Average Concentration



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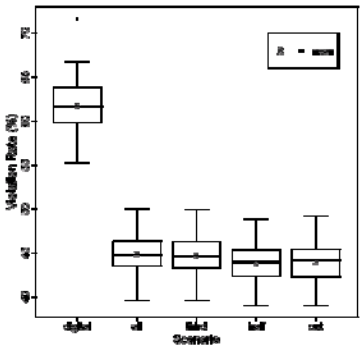
Water Quality Criteria Violation Rates



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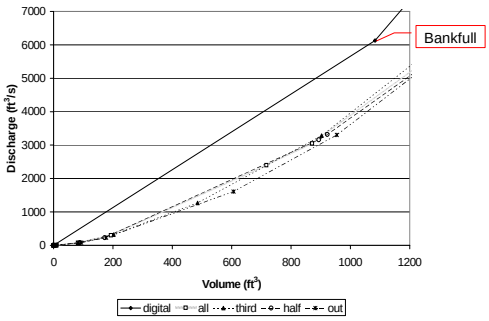
Volume Discharge Relationship



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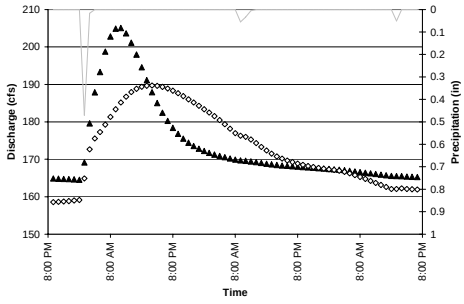
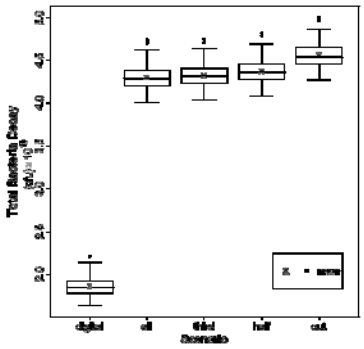
Simulated Hydrograph

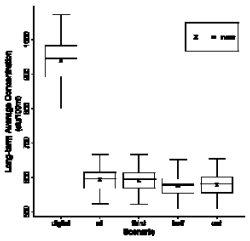


Bacteria Die-off

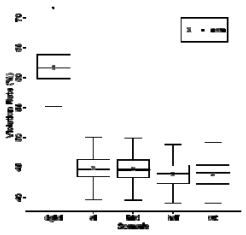


Conclusions

Long-term average concentration



Violation Rates



Conclusions

- Field-based FTABLES showed no practical differences
- Digital-based FTABLES resulted in **higher** long-term average bacteria concentrations
- Digital-based FTABLES resulted in **higher** violation rates
- Digital-based FTABLES resulted in **lower** total bacteria die-off

Future Research

- Compare the effect of each scenario on additional HSPF calibration parameters
- Investigate watershed scale effects

Questions??

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