Assessing and Projecting Stream Patterns in Hydrogeomorphology in Low-Elevation Watersheds, Pitt County, North Carolina, USA

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Introduction

- Baseflow is a component of a stream's flow from groundwater recharge that serves as the backbone of small streams
- Adequate amounts of baseflow in small low-elevation streams are vital for maintaining stable stream geometry and preserving stream biota
- Both "physiographic setting" (topography, slope, etc.) and "urban development & infrastructure" (TIA) account for surficial groundwater recharge
- Stream channel incision and watershed impervious area are two noted factors causing baseflow fluctuations
- Creating an ArcGIS Suitability Model for groundwater recharge generation may aid policymakers and city engineers

Research Questions

1. How do stream channel incision and land cover type influence baseflow in small streams in the Atlantic Coastal Plain (ACP)?

2. How do channel incision and land cover type interact within small streams?

3. Can baseflow generation be accurately mapped using an ArcGIS Suitability Model for groundwater recharge?

4. What sort of relationship can be visually determined between observed baseflow field values and the Model's baseflow projections?

Methods

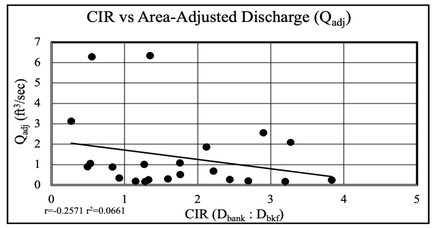
22 stream sites selected with varying proximity to city of Greenville and smaller watershed areas (>1.5 mi^2)

4 Components:

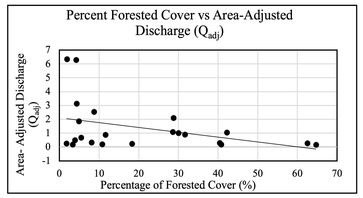
- 1. Field measurement of streamflow (discharge)
- 2. Field/ArcGIS calculation of channel incision ratio (CIR) to represent the degree of channel incision
- 3. Calculation of watershed land cover percentages (percent TIA and percent forested cover) in ArcGIS
- 4. Generation of an ArcGIS Suitability Map to project groundwater recharge generation across Pitt County, NC

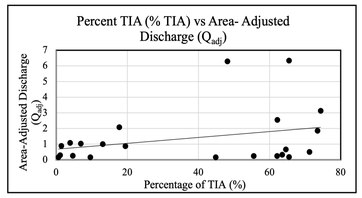
Land Cover – Incision Analysis

- Increased incision (higher CIR values) correlated with a decrease in baseflow (represented as area-adjusted discharge)

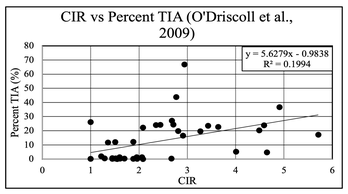


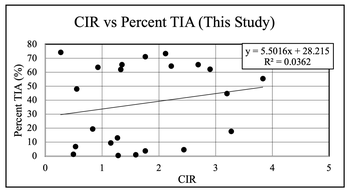
- Increased total impervious area (TIA) was associated with an increase in baseflow (represented as area-adjusted discharge)
- Increased percent forested cover was associated with a decrease in baseflow (represented as area-adjusted discharge)





- CIR did have a positive correlation compared to percent watershed TIA (aligned with findings from O'Driscoll et al. (2009) in Pitt County) but with less certainty (lower R^2 value)

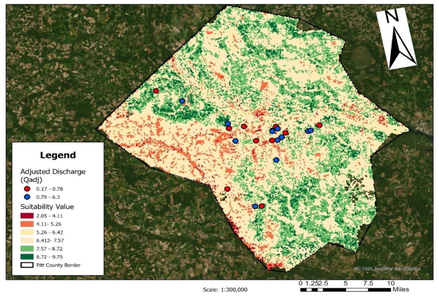




ArcGIS Suitability Model

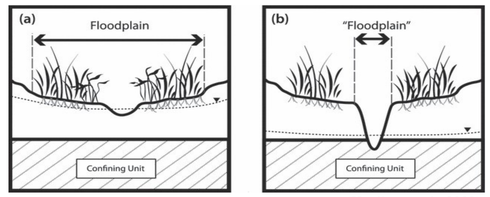
- Model overlays ArcGIS layers of physiographic conditions (topographic slope, stream drainage density, soil drainage class) and an indicator of urbanization (land cover type)
- Output of the Suitability Model is a 900 m^2 raster illustrating groundwater recharge generation across Pitt County
- Areas of projected groundwater recharge generation did not visually align with observed baseflow measurements from the field

Suitability Model Output (right): Patches of higher groundwater recharge generation (colored in green) observed in northern and southeastern Pitt County, patches of lower groundwater recharge generation (colored in red) sited in western and central Pitt County.



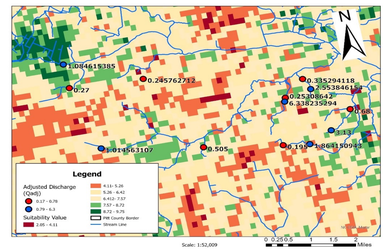
Discussion/Conclusion

- Decrease in baseflow with incision associated with a drawdown in the water table as part of the urban stream syndrome (USS)
- Development of an urban flow regime associated wth water table drawdown, higher amounts of runoff, and a decrease in baseflow



(Hardison et al., 2009)

- Vegetation along stream paths characteristic of forested watersheds could cause a decrease in baseflow due to their geomorphologic influenc
- The presence of in-stream vegetation and exposed roots lining stream banks can increase stream friction and reduce stream velocity
  - Reduced stream velocity can cause an increase in deposition that can "raise" the stream and disconnect the stream from the water table
- Findings suggest that high amounts of forested cover and excess channel incision are independent factors of baseflow decreases
- Zoom in to central Pitt County on the Suitability Model shows that streams in closer proximity to the city of Greenville had lower amounts baseflow
- Visual observations from the Model map suggest that the combination of incision and urban land cover might combine to generate lower baseflow in streams



Acknowledgements/References

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