GIS and Flood Analyses of the Kromma Kill Watershed

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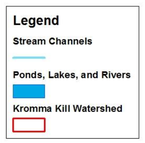
Introduction

In the wake of suburbanization many issues have arisen as people have built more and more standing structures that alter the landscape. One of the main issues with urban development is the flooding that occurs in unwanted places. The disruption of natural drainage systems and the ineffective installation of man-made drainage systems lead to unwanted flooding. The use of detention ponds and storm water pipe networks are the most common ways to overcome drainage issues during development.

The aim of this project is to provide insight into the sources of flooding in the Kromma Kill Watershed (Albany County, NY) by using GIS technology to map and analyze the watershed.

Kromma Kill Watershed Study Area

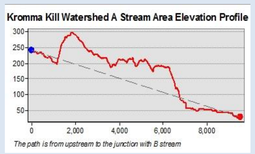


This is the Study Area invloved in all of the data analysis for this project. The analysis included comparing average slope and impervious land cover to the distance from the outlet. The width of the stream channel was also examined as a relationship to the distance to the outlet. This map displays the outline of the watershed boundary, the stream channels examined, and the ponds, lakes and rivers located within the study area.

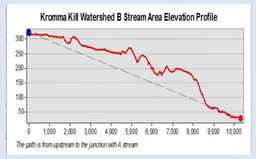
Methods

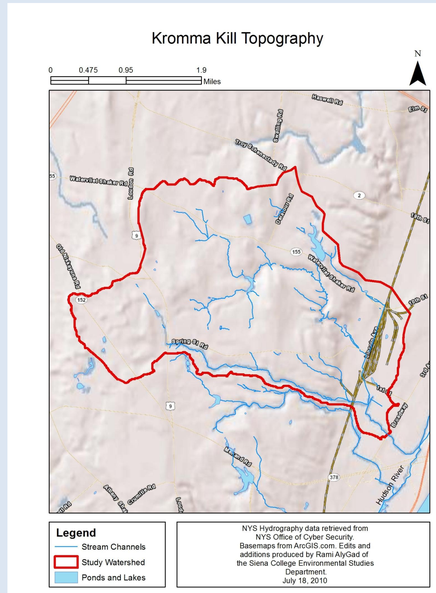
- Generate a detailed watershed map of the Kromma Watershed.
- Generate maps showing the watershed's properties, such as percent imperviousness and topography.
- Generate maps depicting the effects of development or alteration to the natural drainage network.
- Use Zonal Statistics and Microsoft Excel to generate impervious area and percent impervious curves.
- Use 3D Analysis tools used to present the two streams Linepath Elevation Profile
- Generate a width function curve manually.

Watershed Topography

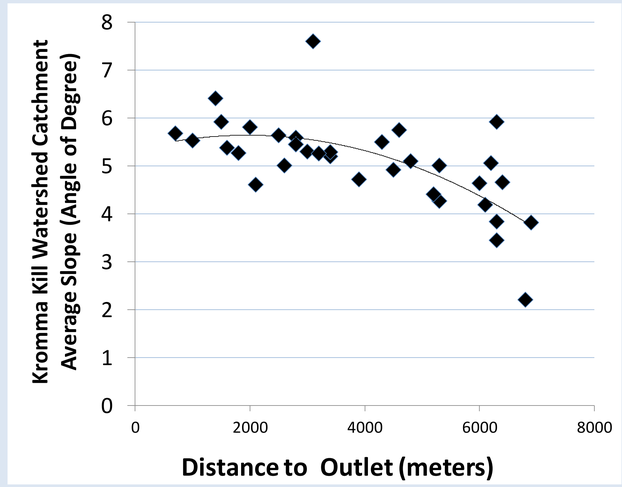


The above and below graphs represent the Stream Area Elevation Profile for the North and South stream branches located within the Kromma Kill Watershed. The Northern stream (Stream A) has a higher peaks and slopes at larger distances from the outlet compared to the Southern stream (Stream B), which has a more gradual decline in elevation as it approaches the outlet.



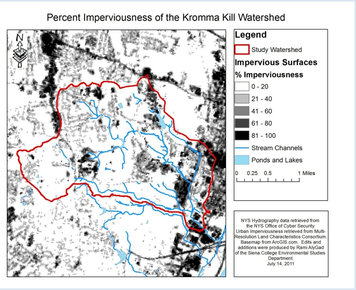


The topographic map (left) shows us that there is a steep slope in the downstream portion of the watershed. This slope can exacerbate flooding and stream bank erosion from the high flow velocities.

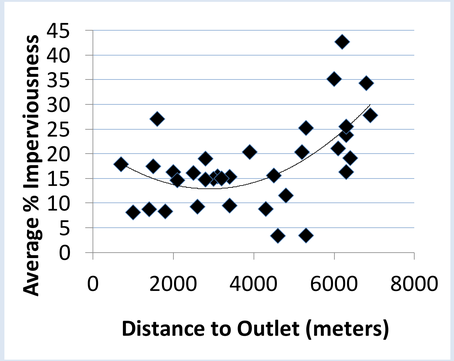


The above graph displays the analysis of average slope for the various subbasins located at different distances from the watershed outlet. Average slope has lower values at greater distances from the watershed outlet.

Watershed Development

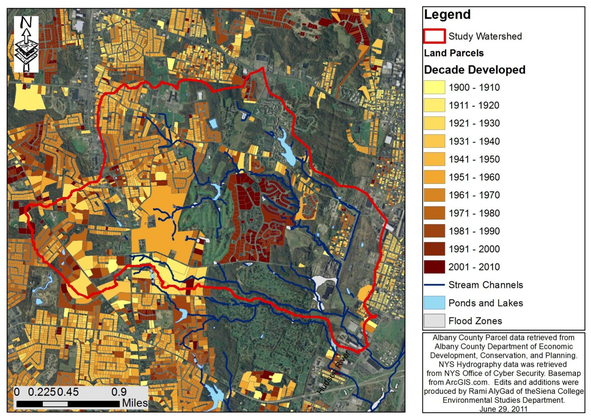


The impervious surfaces map is a good starting point for extracting possible sources of increased runoff flows. When observing this map, we see that there are a handful of areas that are fifty plus percent impervious. These highly impervious areas include the following: Siena College, East Hills Residential Development, Lakeshore Apartment Residential Development, Altech Steel Plant, and much of Menands (which is built on the Hudson River flood plain).



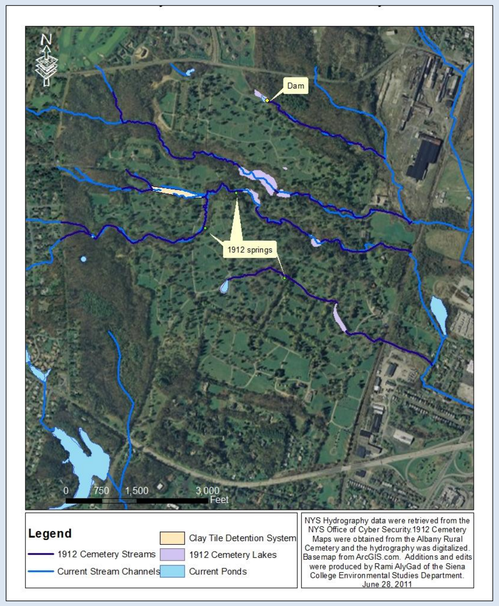
The above graph displays the analysis of average percent impervious land cover for the various subbasins located at different distances from the watershed outlet. The percent impervious land cover increases with greater distances from the watershed outlet.

Kromma Kill Watershed Development



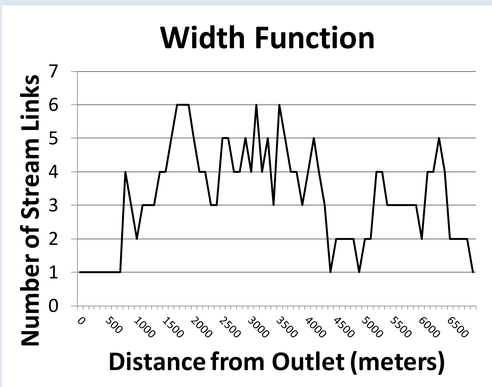
In this map, we used the Albany County Parcel dataset to create a map that categorizes parcels within the watershed by decade built. One thing that stands out is the recent development of the East Hills neighborhood in the center of the watershed.

Drainage Network Structure



This map shows alteration of the natural stream channel. In 1912, there were multiple holding ponds/lakes that slowed down flows. Furthermore, the 1912 stream channels were more meandering in nature and have been straightened out through development over the past century.

The width function depicts the number of stream channel links at a given distance from the watershed outlet. The information relates to the capacity of the stream channel to accommodate storm water runoff.



Results and Conclusions

The results of this study can be summarized as follows:

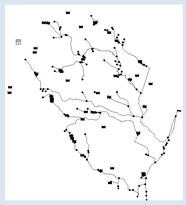
- The slope of the watershed decreases with increasing distance from the watershed outlet while the percent impervious increases with distance from the outlet.
- Width function analyses indicate that drainage density decreases with increasing distance to the outlet.
- Age of development varies throughout the watershed.
- Over the last century, alterations to the stream channel network include the straightening of channels and removal of holding ponds.

Based on detailed mapping of watershed, we can see the complexity of dealing with stormwater management in urban areas. It seems as if multiple factors may contribute to the flooding. Impervious surfaces, alteration of natural hydraulics, and inefficiency of stormwater management components all contribute to the increase in peak flows and flooding in the Kromma Kill Watershed.

Future Work

- Closer examination of natural drainage system capacity
- Historical analysis of development and flooding history
- Further analysis of width function can be done to analyze drainage network pipe density
- Practical methods to prevent flooding issues
- Refinement of a stormwater model that will incorporate the GIS analyses shown here.

Preliminary Stormwater Management Model



References

NYS DEC (Digital elevation model)
Bureau of Healthcom Network Systems Management – NYS Aquifers
1:24,000 NYS Office of Cyber Security – Hydrography data
Colonie Division for Storm Water Management – Storm Pipe Network
Multi-Resolution Land Characteristics Consortium – Impervious Land Cover data
Albany Rural Cemetery – Historical maps
ArcGIS.com – Bing Aerial Basemaps