Department of Geography and the Environment
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In 2016, Villanova purchased a SPOT-6 satellite image with the Pennsylvania View (PA View) grant funding. The goal was to use the imagery to demonstrate for students how remote sensing technology can be used to undertake scientific geospatial analysis, in this case, evaluating imagery for water quality issues related to agricultural runoff. Unfortunately, there was not any SPOT imagery available of the Lancaster County study area (the Conestoga River and its unnamed tributaries) for the date range we desired (post Tropical Storm Lee (September 2, 2011) and flooding around September 4, 2011), so we were unable to perform the water quality analysis from storm effects. However, we were still able to perform the visual analysis of the agricultural areas in our study area using SPOT imagery from a later date. The study area is Upper Leacock Township in Lancaster County, Pennsylvania. One of the Villanova geography professors, Dr. J. Harold Leaman, is a non-till farmer in the township and is also on the board of supervisors for the township. Our Remote Sensing class was able to interview Dr. Leaman to learn about efforts by his township to work with local farmers interested in implementing environmentally sustainable farming practices. We analyzed the imagery with Dr. Leaman as he pointed out farms next to small, tributary creeks which feed into the Conestoga River. He showed us the farms that the township is working with to secure grants from the USDA for implementing riparian buffers and streambank fencing.

Heavy rains contribute to water quality issues in Lancaster County along the Conestoga River and its tributaries adjacent to farmland. For example, in 2011 Tropical Storm Lee caused significant damage, including moving the Pinetown Covered Bridge off of its moorings and twisting the entire structure in Upper Leacock Township. Often in heavy rains such as this, there is significant runoff from adjacent agricultural areas. One of the ways of improving water quality in the head water streams is to install stream bank fencing to keep cattle out of the water, and to keep the hooves from breaking down the stream banks.

Government agencies and the general public are increasingly aware of farm management, especially how it affects streams. Stream bank fencing is a very noticeable commitment to clean water and a strong “good neighbor” policy. Buffers provide habitat for a host of wildlife from songbirds to waterfowl to game animals. Improvements to fish habitat are large and rapid. Reduced bank erosion protects property like fields, buildings, lanes and bridges. Stream bank fencing reduces the amount of nutrients, sediments, farm chemicals and bacteria entering streams. This protects water uses of many types, from fisheries to recreation like swimming to public water supplies. Stream fencing and buffers improve important aspects of watershed function. Flood frequency and severity decrease, as does associated damage to life, property and infrastructure. Groundwater recharge increases. Bank erosion and corresponding sedimentation is reduced, protecting property and reducing maintenance issues. When a substantial portion of a watershed has buffers, these benefits can be of major economic importance in terms of damage prevention and avoided maintenance costs, such as the Pinetown Covered Bridge.[1]

Even more effective is the creation of riparian buffers of grass and trees. Riparian buffers are important for good water quality. Riparian zones help to prevent sediment, nitrogen, phosphorus, pesticides and other pollutants from reaching a stream. Riparian buffers are most effective at improving water quality when they include a native grass or herbaceous filter strip along with deep rooted trees and shrubs along the stream. Riparian vegetation slows floodwaters, thereby helping to maintain stable streambanks and protect downstream property. By slowing down floodwaters and rainwater runoff, the riparian vegetation allows water to soak into the ground and recharge groundwater. Slowing floodwaters allows the riparian zone to function as a site of sediment deposition, trapping sediments that build stream banks and would otherwise degrade our streams and rivers.[2]

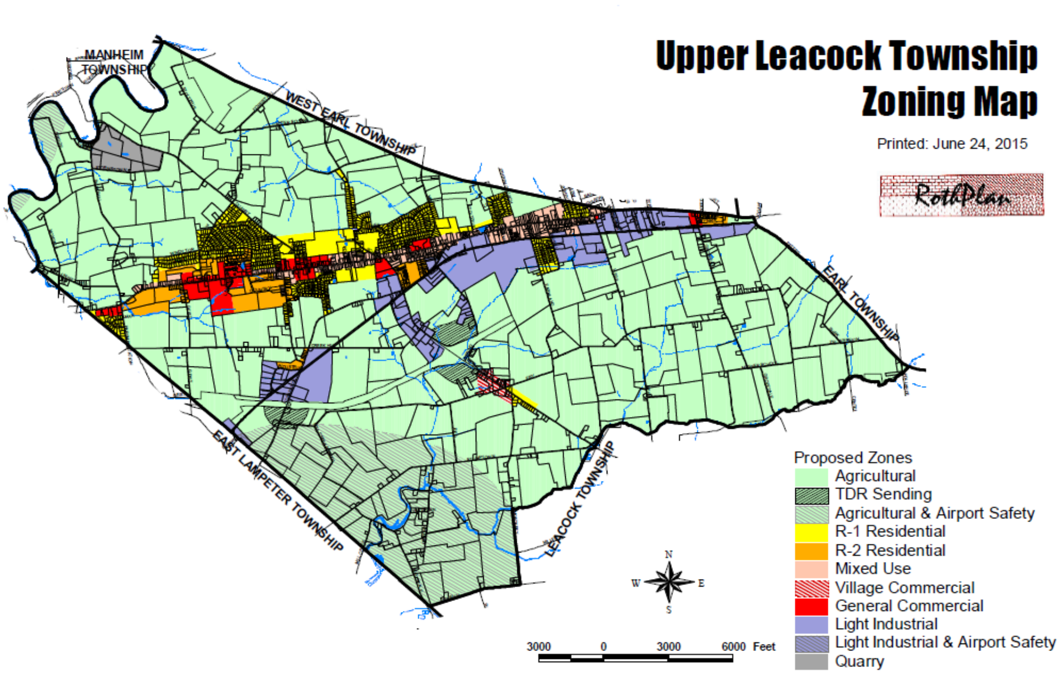

Figure 1. Upper Leacock Township Zoning Map. Note large zone of agriculture in the township and the many blue unnamed tributaries draining into the Conestoga River.

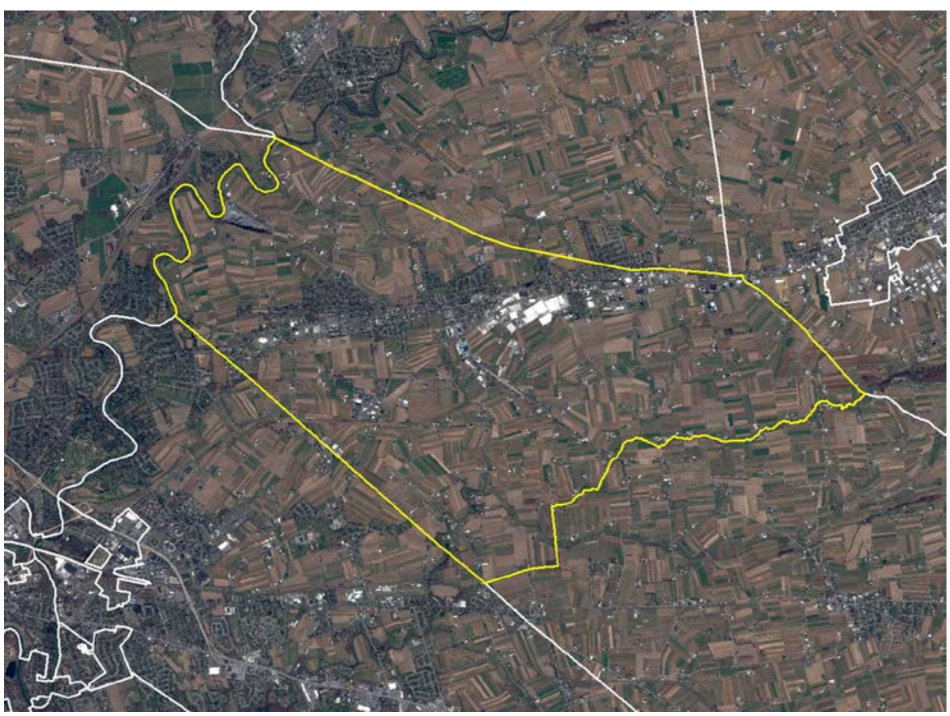

Figure 2. SPOT satellite imagery of Upper Leacock Township with township boundary shapefile overlay. Imagery displayed in ArcGIS.

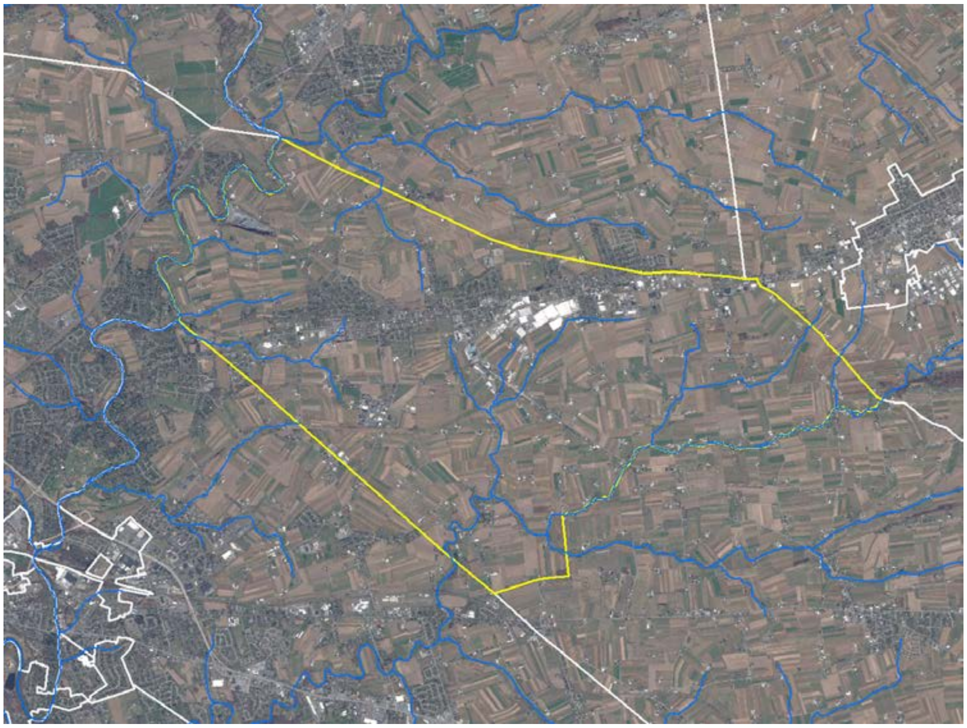

Figure 3. SPOT satellite imagery of Upper Leacock Township with USGS streams and river data layer displayed. Imagery displayed in ArcGIS.

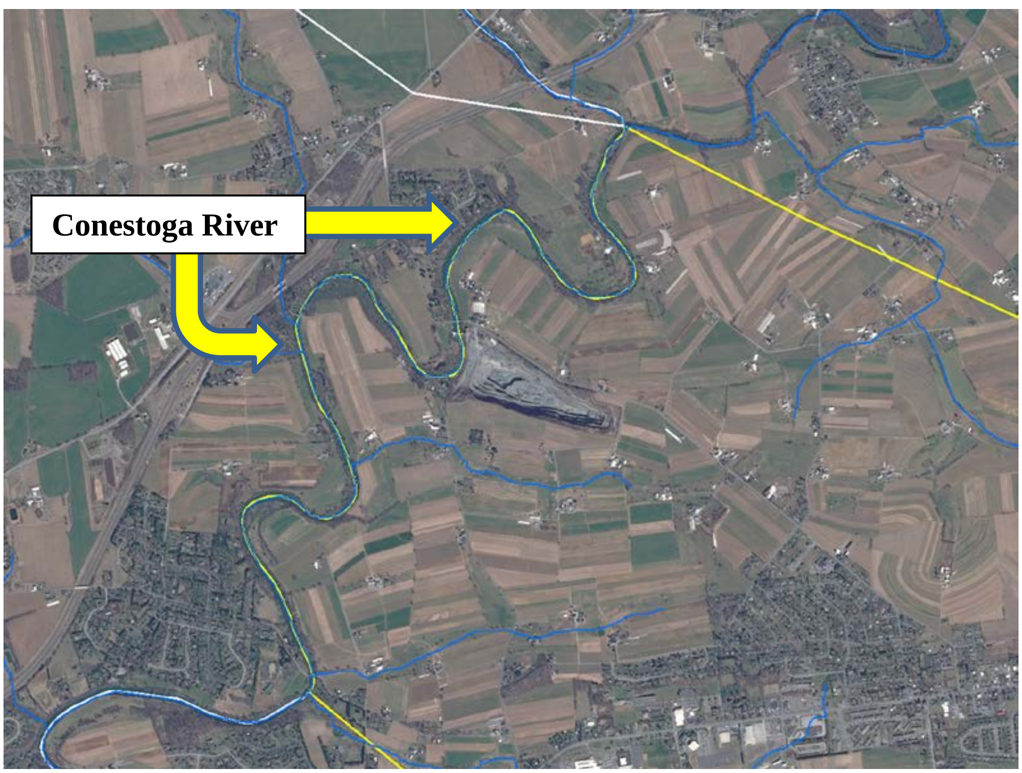

Figure 4. SPOT satellite imagery of the western border of Upper Leacock Township with USGS streams and river data layer displayed. The western border is the Conestoga River shown flowing from the upper right to the lower left. Imagery displayed in ArcGIS.

Figure 5. SPOT satellite imagery of Upper Leacock Township with USGS streams and river data layer displayed. These farms along the unnamed tributaries were pointed out by Dr. Leaman as farms working with USDA grant funding to mitigate streambank erosion. Imagery displayed in ArcGIS.

<u>Summary</u>

Students in our Remote Sensing class were able to view the SPOT satellite imagery in ArcGIS, and working with Dr. Leaman, were able to manipulate the imagery (zoom, pan, scroll), display various data layers provided by ArcGIS, and annotate features in the imagery. Overall the project provided practical experience using ArcGIS to display and analyze satellite imagery, and to understand a real environmental issue facing farming communities and the potential mitigation options that can be implemented. This project can be used as a lab exercise in future remote sensing, GIS or environmental studies classes.

Purchased SPOT-6 Archive Satellite Imagery:

- AOI: Lancaster, PA
- Product: 1.5m 4-Band Pan-Sharpened (Orthorectified-3A) Product
- Date of Imagery: April 6, 2014
- Incident Angle: 19.6 degrees
- Scene ID:DS_SPOT6_201404061534046_FR1_FR1_SE1_SE1_W076N41_06986
- Resampling Method: Cubic Convolution
- Bit Depth: 16-Bit
- Dynamic Range Adjustment (DRA): Off
- Projection / Datum: UTM / WGS84
- Format: GeoTiff (.tif)

Citations:

[1] PA Chesapeake Bay Foundation, Conservation Info Sheet #5, 'Benefits of Streambank Fencing and Riparian Buffers'

[2] North Carolina State University Stream Restoration Program, Stream Notes, Riparian Buffers

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