Applications of Remote Sensing in Watershed Management : Riparian Buffer Zones

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Riparian Buffer Zones

Figure 1.
Riparian area showing clear Riparian Forest Buffer that acts as filter between the surrounding agricultural land and the watershed. (USDA)

Riparian buffer zones (RBZ) are delineated transition zones around a riparian area used to help protect and maintain water quality to safeguard watersheds and play a role in environmental restoration. RBZ's act as filter or cushion for pollutants from agricultural runoff as well as from urban development by slowing runoff and trapping harmful pollutants. They are often used in watershed management to preserve floodplains, wetlands, wildlife habitat, aquatic species, protect from erosion, and catch sediment, nutrients, and pesticides. Riparian areas are experiencing degradation due to anthropogenic activity. Buffer zones are determined by various inputs such as proximity to anthropogenic activity, stream order, groundwater, vegetation, soil composition, and slope. RBZ's help watershed managers in restoring natural stream process.

Vegetation Spectral Signature

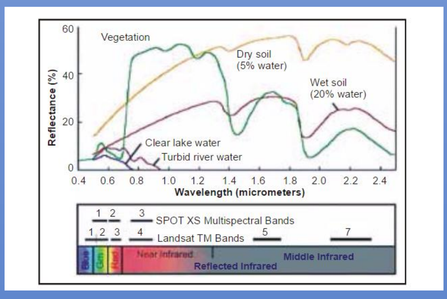

Figure 2. A spectral response curve of different landcover types. Vegetation reflects high in NIR and Green portion of spectrum (Aggarwal, 2004)

Vegetation has a unique spectral signature in the visible and near-infrared portions of the spectrum.
Chlorophyll heavily absorbs in the red and blue portion of the spectrum and slightly less in the green, which is why vegetation appears green
It also reflects high in the near-infrared which gives information on how healthy the vegetation is. Water absorbs more heavily in the visible and near-infrared and reflects shorter wavelengths such as in the blue portion of the spectrum. This information helps to differentiate between land cover types and ultimately in the analysis of land cover composition. More vegetation in RBZ's provide higher filtering capabilities.

Airborne Remote Sensing

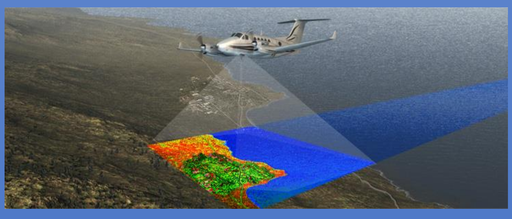

Figure 3. Aircraft equipped with digital cameras and sensors are a flexible options to obtain imagery for vegetation analysis. Aerial imagery is often incorporated in studies today due to its ability to focus on one specific location at a fine resolution. (Northrop Grumman Corporation, 2017)

Airborne remote sensing utilizes aircraft and other airborne platforms with attached digital aerial cameras that can include multispectral as well as hyperspectral sensors to capture aerial imagery. Aerial photography is much more flexible than satellite data because of the ability to do flights at anytime and imagery often comes back in a matter of hours after a flight is done. Although it is more flexible there can often be tradeoffs between higher resolution and higher coverage. In the past aerial photography was the most reliable source for RBZ analysis due to its finer resolution. Satellite imagery was only effective on riparian zones wider than 30m. Vegetations types were often over/underestimated due to coarse grain size.

High Resolution Remote Sensing

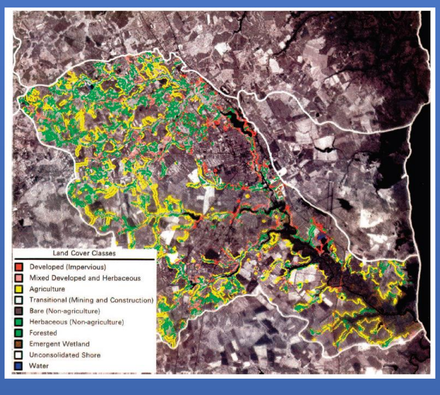

Figure 4. Example of a land cover classification of a watershed in St. Jones, Delaware. Landcover is classified within 60 m of the stream. Areas with higher anthropogenic activity could be potential areas for stricter management practices or areas prone to degradation (Klemas, 2014).

Examples of high resolution Satellites:

- Land Satellite (Landsat) Thematic mapper (TM) 30m.
- Systeme Pour L'Observation de la Terre (SPOT) 10-20m p
- Ikonos (1999) (pushbroom) .45-.9m
- Quickbird 2001 (pushbroom) .445-.90
- ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) 15-60 m

With the use of high resolution imagery information can be analyzed by individual pixels to more accurately determine land cover types present using either supervised or unsupervised classification. Supervised requires the user to submit training data that are samples of representative areas of each land cover type. Classification of land cover is based on the spectral signature of each target. For example classification tree algorithms provide continuous estimates of land cover types. It divides image into similar sections based on certain thresholds using nonparametric rules from multispectral data. These rules are based on training data that help predict land cover type. Based on this training data pixels determined to be within a certain threshold will be classified as a specific land cover type. This aids in determining the percent of tree cover in a riparian area that can be used to asses the width of the buffer and overall riparian health. Classification schemes output relative land cover types including forest, agricultural land, wetland, grass, bare ground, water, and impervious surfaces. These outputs in turn provide information on the health of the vegetation, percent forest cover, sediment, and vegetation type.

Object oriented classification along with the use of spectral and textural bands increase the accuracy of classification.. This high spatial resolution along with texture allows the identification of individual plant species in an area. Certain species act as overall indicators of vegetation health, ground water depth, and stream and bank composition.

Laser

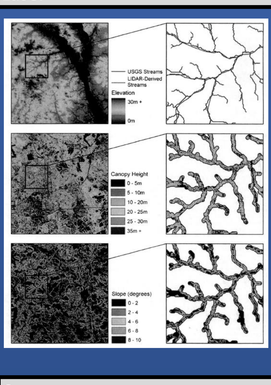

Figure 5. Map of a Riparian Buffer Zone around a watershed. Lidar provides detailed information of a given area with high resolution imagery that individual species as well as their characteristics can be derived. Lidar is one the best ways to conduct Riparian Buffer Zone assessments in that it provides detailed information of the give area. This important when making decisions on areas to manage as well as understanding the geomorphology (Goetz, 2006).

What is LiDaR?
Lidar uses light pulses sent to a specific target that measure the distance based on the time it takes for the light to be reflected back to the instrument. It can create 3D models of the ground and vegetation. It can be used to calculate area and topography. LiDAR provides specific vegetation information such as the number of trees in an area, their height, and can also determine stand type. Aids in creation of Digital Elevation Models (DEMS) and Digital Surface Models (DSM).

Sources

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