Watershed Assessment of White Deer Creek

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Abstract

For conservation organizations looking to improve the quality of local watersheds, watershed assessments are a necessary first step in order to determine how to allocate their efforts. A watershed assessment consists of both qualitative and quantitative spatial data compiled to provide an overall characterization of the entire watershed. From this information, spatial analysis of the data using QGIS can be completed to reveal portions of the watershed that are in most need of restoration. Ideally, a watershed assessment will provide a holistic view of all of the current resources that exist within a watershed. Comparing this to the desired conditions, watershed assessments serve as a quick and efficient information database that can be used when making and prioritizing conservation decisions. The watershed assessment for White Deer Creek was conducted by selecting and examining nine sites of varying characteristics along the entirety of the creek, as well as one site on the largest tributary to the creek, Sand Spring Run. Field data collection was comprised of aquatic biodiversity surveys, habitat assessments, velocity gradient readings, and water quality. This information was then combined with a LiDAR-based digital elevation model, historical land use data, soil characteristics, bedrock maps, and climate data. Together, a watershed characterization was completed for White Deer Creek.

White Deer Creek

The White Deer Creek watershed examined in this study covers approximately six square kilometers of land and spans across portions of Pennsylvania’s Centre, Clinton, Union, and Lycoming Counties. The basin contains 118 kilometers of mapped streams, of which the largest body is White Deer Creek. Most notably, White Deer Creek is a tributary of the West Branch of the Susquehanna River, meeting the larger river in Watontown, Pa (see Figure 1), where a digital elevation map of the watershed was created using the LiDAR data.

Site Selection

To start the investigation, ten sites were selected along White Deer Creek that would be used for the field data collection portion of the assessment. When selecting the sites, the goal was to encompass all the unique habitat characteristics that exist on the creek within the survey area. These characteristics included presence of dams, restoration structures, and bedrock among others. Furthermore, both stocked and non-stocked sections of the creek were selected for the survey, as well as one site on a tributary to White Deer Creek, Sand Spring Run. Considering accessibility, effort was made to place the sites equidistant from one another and span the entire length of the creek. Figure 3 identifies the ten study sites and their subwatersheds.

Climate Data

Spatial climate variability in the watershed is identified using the average annual temperature (Figure 6) and the mean annual rainfall value (Figure 7). The average annual temperature and precipitation totals increases as the elevation of the watershed increases. While time variability of climate was not quantified as part of this study, understanding how climate is changing in time is important to developing a holistic characterization of the watershed that could be used in the future for resource management, conservation and restoration decisions. Warmer air temperatures, increased in snowfall rate, and intensity of extreme weather can all have adverse effects. The possible side effects of these phenomena could include reduced dissolved oxygen levels in White Deer Creek and its tributaries, worsened habitat for cold-water fish, and increased pollutant deposition from runoff among others.

Collected Field Data

The field data collection consisted of a fish biodiversity survey, a qualitative habitat assessment, and water quality testing. The fish survey of the creek was completed via electrofishing 100 meter sections of the creek at each site (see Figures 4 and 5). Each section of river was passed through for three trials to ensure the biodiversity of that particular section was accurately represented. Due to weather conditions, six of the ten sites were able to be tested in the summer of 2015. Results from these six sites are summarized in table 1 according to species percentage and average size. The habitat assessments were completed using the standard EPA protocol field data sheets, and all assessments were done by the same individual to ensure consistency. The overall habitat score is out of 200, where a score of 161-200 is considered optimal, 101-160 is suboptimal, and less than 101 is poor. The results for all ten study sites are given in table 2. Water quality was tested using a handheld sonde that could quantify water temperature, pH, specific conductance, percent dissolved oxygen, and turbidity. The water quality results for all ten study sites are displayed in table 3.

Spatial Data:

The other portion of watershed assessments consists of spatial data compiled on GIS technology. For this particular assessment information that was publicly available consisted of LiDAR elevation readings, historical land use, soil, bedrock, and climate data that was publicly available. A digital elevation map of the watershed was created using the LiDAR data available from FASOA. Additionally, this information was used to graph an elevation profile across the entirety of white deer creek, on which the site locations were overlaid to show where the slope changes occurred.