

**American Water Resources Association**  
**2010 SUMMER SPECIALTY CONFERENCE**  
**GIS & Water Resources VI**  
**March 29 – 31, 2010**  
Orlando, FL

**Wednesday, March 31**  
**1:30 PM – 3:00 PM**  
**SESSION 40: Land Use II**

**Developing a GIS and Database Analysis Framework for Estimating Current and Future Water Use in a Stream Impairment and Buildout Water Demand Analysis - Parker Wittman, Aspect Consulting, LLC, Seattle, WA (co-author: Erick Miller)**

An analysis framework composed of GIS tools (ArcGIS ModelBuilder) and database utilities for subbasin-specific estimation of current and future water use was developed in this study. The framework was developed to streamline analysis and to allow water use estimates to be updated as new data becomes available in the future. The water use estimates were developed as part of a stream impairment analysis commissioned by the Water Resource Inventory Area (WRIA) 16 Planning Unit in Washington State. The study area is located on the west (WRIA 16) and south shores (WRIA 14B) of Hood Canal and includes all catchments between the Skokomish and Dosewallips Rivers and along the south shore of Hood Canal. The objective of the study was to provide a relative ranking of the impairment potential for each stream reach within the WRIAs based on salmonid habitat conditions, streamflow data and current and future water use. Various ArcGIS ModelBuilder tools were developed to aggregate current water use estimates from assorted data inputs (well logs, water rights, census data, water service areas, etc.). Water use estimates were developed using both source-based and population-based estimates. Additionally, a buildout water-use estimate was developed on a parcel-by-parcel basis using zoning data and assumptions based on county land use plans and regulations. This future buildout analysis was developed to evaluate impacts of future groundwater withdrawals on streamflow. By using spatial data inputs and employing a database frontend with flexible lookup tables and queries, a framework was developed to permit future full buildout water use estimates to be readily updated. Further, ModelBuilder and other GIS workflows were developed to associate and aggregate the current and future estimates with delineated subbasins allowing for the correlation of consumptive use estimates with other study data inputs such as salmonid habitat conditions and stream aggradation. As a WRIA wide effort, compiling and analyzing data over large regions, this study was not intended to provide data related to specific land use actions, rather its intent is to allow a prioritization of basins for further study and implementation of projects.

**LiDAR Mapping of Wetlands Areas – Ross Gordon, AECOM Water, Houston, TX (co-author: Kelly Krenz Doe)**

Advanced GIS processing of high-resolution topography data was used to assess wetland hydrology. The forested wetland hydrology has been difficult to study with conventional remote sensing methods and the collection of this data in the field is often cost prohibitive. Aerial photographs and historical topographic maps have typically been used to assist in the identification of wetland areas, but the ability of these data sets to detect hydrology is limited, especially in forested areas. High-resolution topography datasets, such as Light Detection and Ranging (LiDAR), offer a unique view of the topography and hydrology underneath the forest canopy. As part of the preliminary assessment of the Luce Bayou Interbasin Transfer Project, high-resolution LiDAR topography data was collected for the proposed water canal alignment between the Trinity River and Lake Houston. This topography data was processed using the 'fill sinks' grid processing tool inside the Arc Hydro extension for ArcGIS version 9.3. The 'fill sinks' function analyzes an elevation grid and identifies depressions or sinks where water collects and is unable to flow downhill. These sinks or depressions are representative of a disjointed wetland hydrology and indicate continually wet soils and the likely presence of wetland ecosystems. The 'fill sinks' function determines the extent of these sinks or depressions by determining the ponding elevation and spread inside each sink which would result in the overtopping of the depression and the continued flow of water downhill towards a receiving stream. Areas showing as large depressions represent pervasive wetlands while areas with a dense concentration of small independent sinks represent a more dispersed mosaic wetland. A comparison of field determined wetland areas and LiDAR determined wetland areas on the mitigation property showed significant improvements in the digital identification of wetland areas

compared to an analysis of aerial photographs alone. Furthermore, the analysis proved to identify predominant wetland features with a high degree of accuracy.

**Estimating Connected Impervious Areas as a Function of Rainfall Depth - Ahmed Said, ECT, Tampa, FL**  
(co-authors: Harry Downing, Mahmood Nachabe)

Percent imperviousness is a key factor regarding the expected amount of runoff in an urbanized area. Imperviousness occurs from land alterations that change the predevelopment hydrology, especially land cover and its effects on surface infiltration. An urbanized watershed can be divided into three general types: Directly Connected Impervious Area (DCIA), Not or Non-Directly Connected Impervious Area (NDCIA), and Pervious Area (PA). Runoff from DCIAs is conveyed directly to stormwater sewers while runoff from NDCIA may pass through a PA before it reaches the drainage system. The amount of NDCIA connected to the stormwater drainage system is highly unknown, yet it is often the dominant fraction in most urban environments. Total Impervious Area (TIA) is defined as the sum of DCIA and NDCIA. In the past, several methods have been applied to estimate TIA. Among these methods are direct field measurements of portioned runoff, empirical equations, runoff-rainfall relationships, and interpretation from satellite images such as the National Land Cover Data (NLCD). While empirical relationships have been developed for different land cover, more accurate methods for determining impervious surfaces need to be developed. High resolution remote sensing methods has promise, but still has issues that need to be overcome. In this study, we review existing methods and illustrate the use of a technique applied in three counties in central-west Florida. Centralia and Willow Sink watersheds in Hernando County were analyzed in detail using 2001 NLCD and a technique implemented whereby the roads, parking lots, sidewalks, rooftops, etc. were quantified. The result of this research indicated that impervious surfaces become increasingly effective in generating stormwater runoff with increased rainfall depth and decreases in infiltration. We propose to estimate a variable DCIA that is a function of rainfall depth. Variable DCIA reaches its maximum value when enough rainfall has occurred to connect runoff from all impervious surfaces (TIA). The new approach was tested with rainfall-runoff data on a small, but highly urbanized catchment in Temple Terrace, FL. The results of this research are encouraging and can be used to better understand the impact of urbanization on stormwater runoff and improve hydrologic modeling.

**A Comprehensive Approach to Assessing Sustainability for Transportation Projects - Michele Aitkenhead, McCormick Taylor, Baltimore, MD**

This session will present details of a unique Indirect and Cumulative Effects (ICE) Analysis performed for the Intercounty Connector, a controversial transportation project located in close proximity to Washington DC. The analysis consisted of predicting future development based on housing and employment estimates from an expert land use panel. Estimates were converted into potential development parcels based on land use and zoning using a customized GIS model. Potential resource impacts were then assessed based on potential new development parcels. In addition we will discuss other tools that could help to advance this type of ICE Analysis. These tools will help to fully examine a broad spectrum of future sustainability measures based on the development potential previously identified in the ICE Analysis. „X Consider Green Infrastructure Discuss the benefits of delineating a Green Infrastructure network and assessing potential impacts based on the previously identified future land use scenario. Utilize GIS to develop a GI network for your project area that is reflective of the valuable resources it contains. Assess these areas looking at smart growth principles to identify where development could/should occur. „X Effects on Climate Change Discuss how future land use scenarios will contribute to climate change. Consider: VMT growth, congestion, changing development and land use patterns, green construction material and rapidly changing fuel and vehicle technologies. Discuss how to assess these impacts based on the previously identified future land use scenario.