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

Wednesday, March 31
10:30 AM – 12:00 Noon
SESSION 32: Hydrologic and Hydraulic Modeling II

A GIS-Based Approach to Natural Stream Channel Design Construction - Karen Warner, BCI Engineers & Scientists, Lakeland, FL (co-authors: Aziza Khan, John Kiefer, Kristen Blanton)

West-Central Florida is a major phosphate mining region requiring reclamation of stream channels using natural channel design procedures. Stream creation techniques have evolved from allowing channels to self-adjust via natural weathering processes to carefully constructing the riparian system mechanically. This design converts an existing ditch into a reclaimed stream designed to provide a hydrologic and ecological connection between an on-site reclaimed swamp and a downstream preserved wetland and stream segment. BCI developed regional curve regressions that relate bankfull discharge and channel geometry to drainage area in regions of similar climate, geology, and vegetation from data gathered from over 40 near-natural streams sites statewide. Using this regional data and other site specific data it was possible to determine the appropriate natural meandering stream planform design to mimic. The valley flat, slope, width, depth, and cross sectional area were then designed to accommodate this natural planform. Survey and Light Detection and Ranging (LiDAR) data were combined to create a high resolution Triangulated Irregular Network (TIN) for the existing topography which was then used as the base for the proposed upland confined stream design. The natural stream planform to be mimicked, and the calculated streambed, valley, slope, sill and tie in connections were then burned into the existing TIN with the use of ArcInfo. Spatial and Volumetric analysis were used to calculate volumes and help design a planting plan for the bank, floodscape and terrestrial buffer zones of the stream. Construction plans were created in ArcMap using a third-party Geographic Information Systems (GIS) plug-in cross-sectional tool showing cross-sections, tie-in points and other features. GIS is a cost-effective tool which has allowed scientists and engineers who are readily familiar with GIS to directly apply stream knowledge, geomorphologic analysis and design into this software. GIS has become a fundamental tool in our innovative natural stream restoration techniques to place the design of a natural stream that will fit and function between wetlands.

Basemap and DFIRM Database Development using SWMM Model Output - Krystal Forgenie, CDM, Jacksonville, FL (co-author: Erin Hardin)

Basemap and DFIRM Database Development using SWMM Model Output By: Krystal Forgenie (CDM), Erin Hardin (CDM) and William J. Joyce, P.E. (City of Jacksonville) The City of Jacksonville is in the process of updating their Stormwater Management Plan which includes updates to the current flood zones and Digital Flood Insurance Rate Maps (DFIRM) which were last updated in 1989. Due to the flat topography of an extensive stream network, the City of Jacksonville used the Stormwater Management Model (SWMM) developed by the Environmental Protection Agency (EPA) because of its ability to dynamically model the large hydraulic networks. Both the hydrology and the hydraulics of the system were modeled in SWMM. While using SWMM provided detailed accurate information, it did not automatically produce a readily useable FEMA Compliant Dataset for integrating flood data. SWMM was paired with a Geographic Information System (GIS) to create datasets that met Federal Emergency Management Agency (FEMA) Standards. The model output did not automatically associate the Water Surface Elevation (WSE) data with spatial files. The floodway data was extracted from SWMM output and incorporated into GIS and interpolated in order to represent the WSE data spatially for DFIRM production purposes. Additionally, GIS was used to acquire channel cross sections that could be integrated into SWMM to provide detailed data for more accurate hydrologic analysis. This allowed for the creation of transects that achieved FEMA Guidelines and Specifications using LiDAR (Light Detection and Ranging). In summary this presentation will outline the process involved in integrating the output results from the EPA's SWMM Model into a GIS to provide updated floodplain data for DFIRM production.

Modeling Upland Erosion Potential in the Le Sueur Watershed: A GIS Mediated Application of the WEPP Model - Fukhrudin Maalim, Florida International University, Miami, FL (co-authors: Melesse, A., Belmont, P.)

Abstract The Le Sueur River, southern Minnesota, is the largest contributor of sediment to the Minnesota River, which is impaired for turbidity under Section 303d of the Clean Water Act. Sediment loading driven by water induced erosion is a complex process whose comprehension and prediction is important for effective analysis, planning and management of water resources. The Water Erosion Prediction Project (WEPP), a continuous simulation, process-based model can simulate the erosion process and serve as a tool for identifying potential sediment sources. However, its application is restricted especially when working with large watersheds with extensive spatial heterogeneity and complex terrain profiles. Prediction within an acceptable range of accuracy depends on inherent model capabilities as well as the correct derivation and preparation of model input parameters. WEPP simulations can be enhanced by using digital sources of information through the linkage with Geographic Information Systems (GIS). The Geo-spatial interface for WEPP (GeoWEPP) utilizes digital geo-referenced datasets such as digital elevation models (DEM) to discretize topographical parameters and integrate land use and soil maps as well as land management practices; essential input parameters for the WEPP model. The DEM, crop data layer and STATSGO soil map of the study area were obtained. These datasets were re-projected into UTMs and converted into the American Standard Code for Information Interchange (ASCII) format. Text files linking the GIS data and the WEPP parameter files used during the simulation process were constructed for the soils and land cover datasets. Thirty year climate data for the area was obtained and processed for use by the WEPP model. The watershed was divided into sub-catchments and a 30-year simulation was run for each sub-catchment. WEPP re-runs were performed for randomly selected hill-slopes to assess the impact of different land cover and management practices on soil conservation. As a GIS based interface, GeoWEPP enhances the application of the WEPP model. Reliability and functionality of results is increased by this multi-tooled ArcView project which, as a custom geospatial modeling solution further demonstrates the versatility of GIS and its indispensability as a fundamental tool for effective water resource management.

Combining Spatial Analysis and Multivariate Statistical Methods to Characterize Watershed Water Quality Conditions - Andrew Gamble, IUPUI, Indianapolis, IN (co-author: Meghna Babbar-Sebens)

This research performs a comparative study of techniques for combining spatial data and multivariate statistical methods for characterizing water quality conditions in a river basin. The study has been performed on the White River basin in central Indiana, and uses seventeen physical and chemical water quality parameters collected from 44 different monitoring sites, along with various spatial layers related to land use land cover, soil characteristics, terrain characteristics, eco-regions, etc. Various parameters related to the spatial layers were analyzed using ArcHydro tools and were included in the multivariate analysis methods for the purpose of creating classification equations that relate spatial and spatio-temporal attributes of the watershed to water quality data at monitoring stations. The study compares the use of various statistical estimates (mean, geometric mean, trimmed mean, and median) of monitored water quality variables to represent annual and seasonal water quality conditions. The relationship between these estimates and the spatial data is then modeled via linear and non-linear multivariate methods. The linear statistical multivariate method uses a combination of principal component analysis, cluster analysis, and discriminant analysis, whereas the non-linear multivariate method uses a combination of artificial neural networks techniques. The research provides an insight into the variability and uncertainty in the interpretation of the various statistical estimates and statistical models, when water quality monitoring data is combined with spatial data for characterizing general spatial and spatio-temporal trends. Finally, an appropriate strategy for model combination is proposed to summarize the interpretations of the statistical analysis.