NWIPlus: Geospatial Database for Watershed-level Functional Assessment

While much government attention has focused on creating methods for site-specific analysis of wetland functions for evaluating the impacts of proposed development and for predicting the condition of wetlands through probabilistic sampling, the U.S. Fish and Wildlife Service has been developing techniques to use its National Wetlands Inventory (NWI) data to predict wetland functions for watersheds.

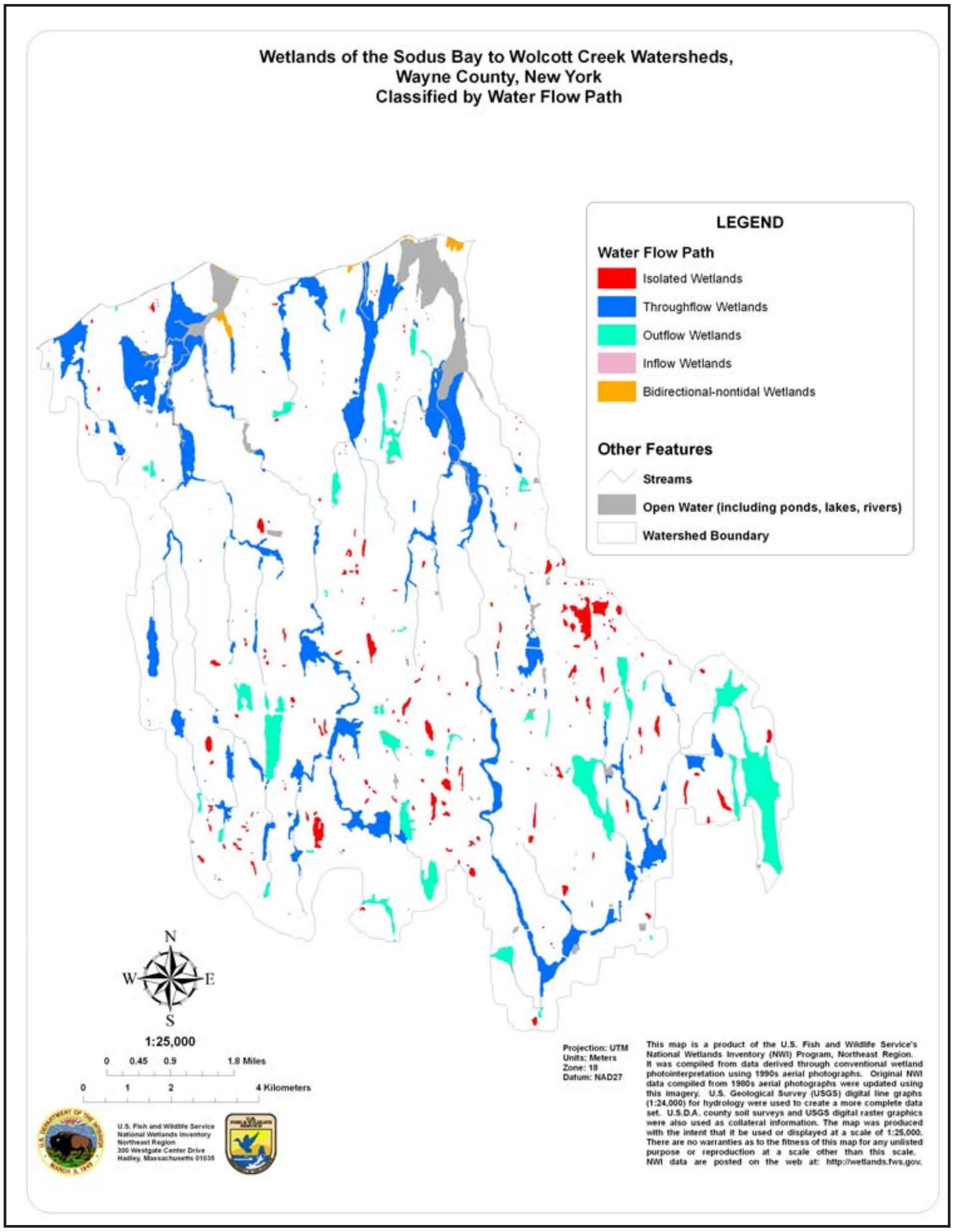

Figure 1. Map showing water flow path of wetlands.

What is NWIPlus?

Recognizing the value of adding hydrogeomorphic properties to the NWI database (i.e., increased functionality), the NWI created a set of hydrogeomorphic-type descriptors that could be added to NWI types to facilitate predicting wetland functions. The combination of these attributes with traditional NWI types can be called "NWIPlus" resulting in an enhanced NWI database.

The new attributes describe landscape position (relation of a wetland to a waterbody if present: marine - ocean, estuarine - tidal brackish, lotic - river/stream, lentic - lake/reservoir, and terrene – not affected by such waters), landform (physical shape of the wetland – basin, flat, floodplain, fringe, island, and slope), water flow path (inflow, outflow, throughflow, isolated, bidirectional-nontidal, and bidirectional-tidal), and waterbody type (different types of estuaries, rivers, lakes, and ponds) – "LLWW descriptors" (LLWW stands for the first letter in each descriptor). Dichotomous keys have been developed to interpret these attributes (Tiner 2003a).

LLWW descriptors are added to the NWI database by interpreting topography from digital raster graphics (DRGs), stream courses from national hydrographic data (NHD), and waterbody types from aerial imagery. The interpretations were initially done manually by trained wetland image analysts, but today automated tools are available for GIS-based classifications which then are reviewed and edited by the analysts. This effort now increases the NWI workload by less than 10%.

Besides providing more features that can be used to predict wetland functions from the NWI database, NWIPlus makes it possible to better characterize the nation's wetlands. For example, now all the palustrine wetlands which account for 95% of the wetlands in the conterminous U.S. can be linked to rivers, streams, lakes, ponds where appropriate, so the acreage of floodplain wetlands, lakeside wetlands, and geographically isolated wetlands can be reported. The Wetlands Subcommittee of the Federal Geographic Data Committee (FGDC) recognized the "value-added" of the

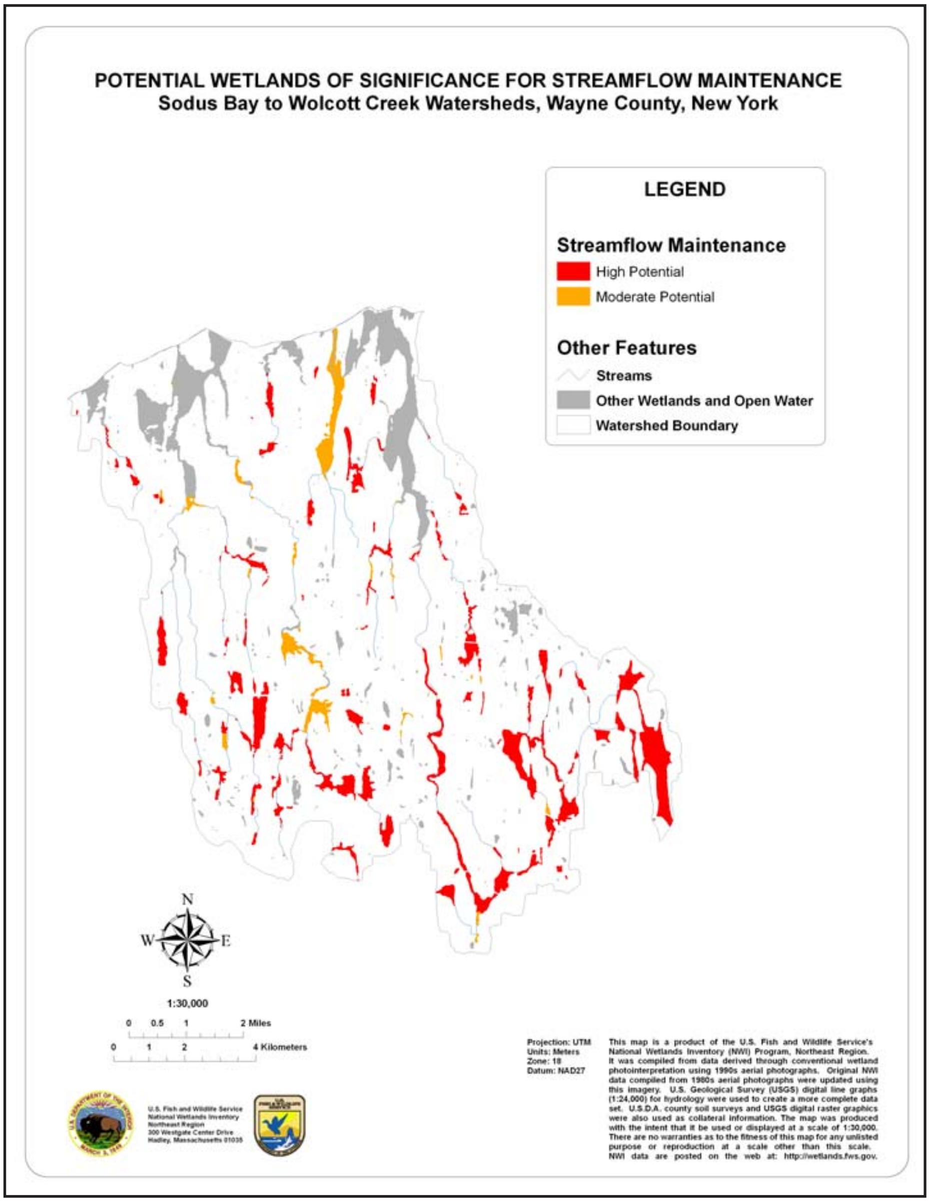

Figure 2. Example map showing wetlands of significance for streamflow maintenance.

LLWW descriptors and recommended that they be included in wetland mapping to increase the functionality of wetland inventory databases (FGDC Wetlands Subcommittee 2009).

NWIPlus for Functional Assessment

The impetus for the NWIPlus was to provide a convenient and consistent means of using NWI data to predict wetland functions for watersheds or other large geographic areas. Correlations between the parameters in the NWIPlus database and a number of wetland functions have been developed in working with scientists from various agencies in the Northeast (Tiner 2003b). To date, eleven functions can be predicted by this expert-designed assessment method: 1) surface water detention, 2) streamflow maintenance, 3) nutrient transformation, 4) sediment and particulate retention, 5) carbon sequestration, 6) shoreline stabilization, 7) coastal storm surge detention, 8) provision of fish and shellfish habitat, 9) provision of waterfowl and waterbird habitat, 10) provision of habitat for other wildlife, and 11) conservation of biodiversity. For biodiversity conservation, the prediction emphasizes regionally significant wetland types as well as locally uncommon types based on NWI results. At this time, it does not incorporate data from other sources such as state natural heritage programs which could be added by others.

The emphasis is on using NWIPlus to generate a preliminary watershed-based assessment of wetland functions. It is a starting point for wetland evaluation, not the end point. The correlations will be updated as needed and have, in one known case, been modified by a state (i.e., Montana) to incorporate local knowledge of wetlands into the functional relationships and to emphasize functions important to the state.

The watershed assessment approach applying NWIPlus has been called "Watershed-based Preliminary Assessment of Wetland Functions" (W-PAWF) since it produces a first-cut evaluation based on map information. It is an inventory-based assessment method that evaluates every mapped wetland based on properties contained in the NWIPlus database. It applies general knowledge about wetlands and their functions to produce a watershed overview highlighting wetlands predicted to perform certain functions at high or moderate levels. It does not account for the opportunity that a wetland has to provide a higher level of function resulting from a certain land-use practice upstream or the presence of certain structures or land-uses downstream. For example, two wetlands of equal size and like vegetation may be in the right landscape position to retain sediments. One may be downstream of a land-clearing operation that has generated considerable suspended sediments in the water column, while the other is downstream from an undisturbed forest. The first wetland is trapping more sediment due to increased suspended sediment, while the second wetland is not doing so at the same rate. W-PAWF is designed to reflect the potential of a wetland to provide a function. It also does not consider the condition of the adjacent upland (e.g., level of outside disturbance) or the actual water quality of the associated waterbody which may be regarded as important metrics for assessing the "health" or condition of individual wetlands.

The final product of this inventory-based assessment is a report containing a narrative description of the study area, methods, wetland types, and functions plus a series of thematic maps showing wetlands by type (NWI, landscape position, landform, and water flow path) and wetlands of significance for each of 11 functions (Figures 1 and 2). Accompanying digital geospatial data are also available for other analyses. For examples of reports, go to the FWS's Conservation library: http://library.fws.gov/WetlandPublications.html or to the NWI website (http://www.fws.gov/wetlands/; click on the "documents search engine"icon and then type in "wetland characterization" or "functional assessment").

Applications of NWIPlus Data

Adoption of these data by others has proven the value of this expanded data. To date NWIPlus data have been used to: 1) better characterize wetlands and relate wetlands to waterbodies and various functions (e.g., Tiner and Bergquist. 2007, Newlon and Burns 2009), 2) increase public awareness of the functions of wetlands and understanding that all wetlands are not alike in either form or function (e.g., New York City Department of Environmental Protection 2009, Homsey 2009), 3) assist agencies in developing wetland conservation strategies (e.g., Berner 2009, Martin 2008, Maryland Department of Environment 2006, 2004), 4) help agencies evaluate the effect of recent court decisions on wetlands (e.g., isolated wetlands; Vance 2009), 5) stratify wetlands for research purposes (e.g., Jacobs et al. 2009), 6) estimate the effect of wetland trends on the capacity of watershed's to provide wetland services (e.g., Kudray and Schemm 2008), and 7) assessing the cumulative effect of historic wetland loss on functions (e.g., Tiner 2005, Fizzell 2007).

NWIPlus data have been generated by the FWS for wetland inventory projects in 15 states (AK, CA, CT, DE, ME, MD, MA, MS, NJ, NY, PA, RI, SC, TX, WY) to date. It has become a standard practice for updating NWI data in the Northeast and will be considered for updates elsewhere depending on regional priorities and budgets. Using NWIPlus data, W-PAWF has been applied or will be applied to numerous areas in the country by the FWS. Several states have begun using these LLWW descriptors in their inventories to create an NWIPlus database. For example, the state of Montana is applying these attributes to aid in assessing wetland functions for its watersheds (e.g., Kudray and Schemm 2008, Newlon and Burns 2009). The states of Michigan and Delaware have applied the descriptors to wetland inventory projects. Minnesota has included these descriptors in its requirements for updating NWI data (Minnesota Department of Natural Resources 2009). Wetland mapping projects in five other states are planning to create NWIPlus data (GA, KS, NM, OK, and WI).

Conclusion

Adding LLWW descriptors to the NWI database creates a more functional and powerful database – NWIPlus. It can be used in formulating wetland conservation strategies to help prioritize wetlands for acquisition, restoration, or strengthened protection, as an educational tool to improve the public's understanding of wetland functions and as a cumulative impact assessment tool to estimate the impact of wetland losses and gains on watershed functions. By creating NWIPlus data, the results of wetland inventories can better describe the variability between and among wetlands and include watershed-based or landscape-level wetland functional assessments.

For more than three decades, NWI maps have been used by various levels of government in compiling natural resource inventories, watershed planning, and improving wetland protection. Now, by enhancing NWI data and using it for wetland functional assessment, they have a more valuable tool at their disposal for resource conservation and management.

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April 2010