The NWI+ Web Mapper—Expanded Data for Wetland Conservation

An online mapping tool developed by the U.S. Fish and Wildlife Service's National Wetlands Inventory Program allows users to display NWI wetland data on a variety of maps for multiple purposes, and utilizes the LLWW descriptors.

By Ralph Tiner

Over the past decade, the Northeast Region of the U.S. Fish and Wildlife Service (NE-FWS) has been working with several states (CT, DE, GA, MA, MD, ME, MI, NM, NY, OR, PA, and WI) to expand the information produced by the National Wetlands Inventory Program (NWI). Since its creation in the mid-1970s, the NWI has prepared wetland maps (now geospatial data) that show wetlands interpreted from aerial imagery and classified according to the Cowardin et al. (1979) system. While this is very useful information for natural resource planners, additional work is required to expand its utility for landscape-level functional assessment. A 2010 article in the *National Wetlands Newsletter* (Tiner, 2010) summarized a procedure used to add hydrogeomorphic-type descriptors to existing NWI data to create what is now called an "NWI+ database." By adding hydrogeomorphic-type descriptors for landscape position, landform, water flow path, and waterbody type properties ("LLWW descriptors"; Tiner 2011) to the NWI data, the new database has increased functionality over the conventional NWI database. The new version has improved characterization that better links wetlands to neighboring waterbodies, helps further aggregate wetlands of similar form and function, and allows the data to be used to predict wetland functions for large geographic areas. The Wetlands Subcommittee of the Federal Geographic Data Committee recommended adding these LLWW descriptors to wetland mapping projects to achieve this expanded functionality (Wetlands Subcommittee 2009).

The NE-FWS has attempted to incorporate these new descriptors in all of its recent updates and now NWI+ databases are or will soon be available for several states—Connecticut, Delaware, Massachusetts, New Jersey, and Rhode Island—and some rather large areas in Maryland, New York, Vermont, and Virginia. The state of Connecticut funded the effort for their state, while Delaware provided funds for two of the state's three counties. Beyond the Northeast, the NWI has conducted pilot studies across the country to test its applicability elsewhere: Horry and Jasper Counties (SC), the Mississippi coastal zone, Corpus Christi region (TX), Shirley Basin (WY), Ventura River Watershed (CA), and Wasilla (AK).

Several states have also been building NWI+ databases for selected areas. Georgia Department of Natural Resources, Coastal Resources Division now has an NWI+ database for six of its coastal counties. The Michigan Department of Natural Resources and En-

vironment and the Montana Natural Heritage Program have used the techniques to predict the cumulative impact of wetland losses on functions for selected watersheds (e.g., Fizzell 2007; Newlon and Bums 2009). Michigan is working with other organizations to do similar analyses for other watersheds, while Montana is attempting to develop an automated routine to aid in LLWW classification with visions of applying the techniques to their statewide wetland inventory. New Mexico is conducting a pilot demonstration of these techniques for evaluating wetland functions in a watershed in the northeastern part of the state. Minnesota is interested in applying the LLWW descriptors for their statewide wetlands inventory (Minnesota DNR 2009). A multi-organizational effort by state and federal agencies applied these techniques to Wisconsin's Upper St. Croix Watershed. Portland State University has prepared a statewide preliminary NWI+ database from existing NWI data in cooperation with the Oregon Department of State Lands, Wetlands and Waterways Division.

Besides creating a database for geographic information system (GIS) users, a major product of the NWI+ databases is a summary report for resource managers and natural resource planners that provides a more detailed description of the wetlands in the study area emphasizing connectivity among wetlands and waterbodies along with a landscape-level assessment of wetland functions. Examples of the summary reports can be found at: http://www.fws.gov/northeast/EcologicalServices/wetlandspubs.html (look under "Watershed-based wetland studies"). Since the study areas are often large geographic regions, the challenge was to present the geospatial ("map") data visually to show these connections and wetlands predicted to perform each of 11 functions at significant levels. The earlier NWI+ reports included small-scale maps in the report, but this was deemed to be a less desirable approach due to the lack of detail that could be interpreted. Producing larger maps was expensive and impractical from a distribution standpoint. With online mapping tools readily available, we decided to use that technology to display the NWI+ data. While the earlier reports included maps, more recent ones refer readers to an online mapper for the display of wetlands by type and by function.

THE NWI+ WEB MAPPER

The NWI+ web mapper is an online mapping tool that allows users to display a collection of special NWI project wetland data

on different types of base maps. The base mapper is an ESRI product while the wetlands data are produced by the U.S. Fish and Wildlife Service and its cooperators. The NWI+ web mapper was developed by Virginia Tech's Conservation Management Institute to make special project data available that it was mainly producing for the NE-FWS. Besides showing wetland types classified according to the Cowardin et al. (1979), the web mapper displays wetlands classified by three of four LLWW descriptors (landscape position, landform, and water flow path according to Tiner 2011) and wetlands predicted to be significant for performing each of 11 functions. Some special projects produced other valuable information including an inventory of potential wetland restoration sites and an inventory of what are called "potential wet areas" (e.g., "P-wet areas"—undeveloped hydric soils that were not mapped as NWI wetlands due to a lack of a recognizable wetland photo-signature). All these data layers can be viewed on the NWI+ web mapper. The NWI+ web mapper is hosted by the Association of State Wetland Managers, a national leader in informing the public on key wetland issues. One section of their website is devoted to wetland mapping: "Wetlands One-Stop Mapping" (http://aswm.org/wetland-science/wetlands-one-stop-mapping). In addition to hosting the mapper, the site provides links to all state GIS and state wetland resource agency websites and other valuable linkages that provide information for people interested in wetland conservation.

The NWI+ web mapper provides a framework that other organizations can utilize to display their NWI+ data if they produce data compatible with the structure of the database. At a minimum, NWI+ data developers should follow the standard classification of LLWW descriptors so that data layers for landscape position, landform, and water flow path could be added to the NWI+ web mapper. It is, however, recognized that some agencies may prefer to address functions beyond those considered in the NWI+ approach and may also not be interested in some NWI+ functions in their analyses. In any event, we would like the NWI+ web mapper to provide links to similar results produced by other organizations.

Format of the Mapper

The mapper will open to a map of the United States with project areas outlined in red. Above the map is a tool bar that includes several icons from left to right (each icon is described in the next section): "Browse," "Remove Layer," "Choose Basemap," "Bookmarks," "Map Contents," "Legend," "Search," and "Print" (Table 1). To the right of these icons is a list of topics that will take the user to various websites such as the Service's NWI (national website), Region 5's NWI website, and Virginia Tech's CMI website. Note that some aspects of the mapper will change over time due to technology advances.

The NWI+ Data Layers

Currently, a total of 22 data layers may be available for a given project area (Table 2). Remember that the restoration and P-wet areas layers were only prepared for some projects.

Table 1. List of the NWI+ Web Mapper Icons and Their Functions

"Browse"	adds other geospatial data (e.g., imagery or geospatial data) to the mapper
"Remove Layer"	removes a layer that user has added
"Choose Basemap"	selects the type of basemap on which to display the data
"Bookmarks"	provides the outlines for the project names where NWI+ data are available (Note: The date in the project name refers to the effective date of the inventory data)
"Map Contents"	produces a table of contents on the right side of the map; boxes are located to the left of each data layer - to view data layers, click on the box of the topic of interest
"Legend"	displays all the legends - one for each data layer; these legends are universal; some projects do not include all layers
"Search"	allows user to zoom into a particular address by clicking on "Place" and then typing the address in the box, or to search "The Web" to find geospatial data to add to the mapper (e.g., add NWI data for the entire country to the mapper)
"Print"	allows user to prepare a map of the data in view and either send it to a printer or to produce a pdf image for storing on a computer

Using the NWI+ Web Mapper

Once a user opens the mapper, a map of the United States with red boxes will appear. The boxes outline project areas where NWI+ data are available. Place the cursor over a box to see the project name and the effective date of the inventory. Zoom into your area of interest or type in an address using the "Search" function. Click on the "Map Contents" to view the list of layers.

Availability of Data Layers

Remember that while "Map Contents" shows all possible layers, only NWI Types (or NWI-Common Types), NWI+ Landscape, NWI+ Landform, NWI+ Water Flow Path, and the 11 functions are available for all areas. To see if the other layers have any data for your area of interest, click off the default layer (NWI+ Landscape) and put a check in the box of the optional layers (e.g., NWI+ Restoration Type 1). If colored polygons come into view, then there are data for the area of interest, and if nothing shows up, there are no data for that layer.

Viewing a Layer

The first layer that comes into view (default layer) is NWI+ Landscape. To view the classifications for an individual wetland, also click on the "Wetland Codes" box. Users will see a series of dots or numbers; the latter represent areas where the user needs to zoom

Table 2. List of NWI+ Data Layers

"NWI+ Footprints"	project areas where NWI+ data are available
"Wetland Codes"	adds dots on the mapper for accessing the wetland classification by NWI type and by LLWW type; click on a dot to get a table with classifications for the wetland of interest
"NWI-Common Types"	wetlands and deepwater habitats by Cowardin et al. types with some common names used, such as marsh, swamp, beach, and tidal flat
"NWI+ Landscape"	wetlands classified by landscape position
"NWI+ Landform"	wetlands classified by landform
"NWI+ WaterFlowPath"	wetlands classified by water flow path
"NWI+ Rest Type 1 Soil Codes"	adds dots for accessing the soil type for this former wetland site
"NWI+ Restoration Type1"	former wetlands (hydric soils data that have been developed but are in a land use that may be suitable for restoration)
"NWI+ Restoration Type2"	existing wetlands that have been altered in some way to affect their natural functions; to view their classification and the nature of the alteration, check the box for "Wetland Codes" and then on the dot in the wetland of interest
"NWI+ P-WetArea Codes"	adds dots for accessing the soil type for these hydric soil areas that may support wetland; should be viewed with "NWI+ P-WetAreas"
"NWI+ P-WetAreas"	hydric soil areas that are in "natural vegetation" but lacked an identifiable wetland photo-signature and were not mapped as wetlands by the NWI; given that they have not been developed, it is quite possible that they may support wetlands to some degree
"_____ Function"	wetlands predicted to perform specific functions at significant levels (e.g., high or moderate): "BSS" (bank and shoreline stabilization), "CAR" (carbon sequestration), "CSS" (coastal storm surge detention), "FAIH" (fish and aquatic invertebrate habitat), NT (nutrient transformation), OWH (other wildlife habitat), SM (streamflow maintenance), SR (sediment and other particulate retention), SWD (surface water detention – for freshwater wetlands only), UWPC (unique, uncommon or highly diverse wetland plant communities for the particular study area = "regionally significant" based on NWI and LLWW codes only), and WBIRD (waterfowl and waterbird habitat)

in further to see the dots. Click on a dot to get a table showing the NWI and LLWW classifications. For a single wetland complex, there are more than one NWI but only one landscape code, for example. Refer to the classification documents to interpret the codes (they should be listed at the top of the mapper).

Printing a Map

While the mapper has a "Print" function (icon on toolbar), to print the map with the legend (when both are in view on the screen), use the Internet browser. Go to "File" then "Print Setup" (put in landscape mode) and then "Print" (Figure 1 (see p. 22)). It is possible to make a PDF to work with in another program such as Adobe Photoshop, if additional labeling is desired, or to use the map in a presentation.

FUTURE PLANS

As mentioned, we would like to add NWI+ data from other sources to the mapper. This can only be done where the data are compatible with the methods and the outputs employed during NWI+ data development (contact the author for details). In any event, the plan is to show or list where these data are available by adding something like "Links to Other NWI+ Data" on the mapper or to the ASWM "Wetlands One-Stop Mapping" page. Places where older NWI+ data were generated may be shown on the map in some fashion or will be listed as a separate topic on the ASWM mapping page. Reports are posted under NWI+ Reports.

Figure 1. Example of map showing wetlands by landscape position and accompanying legend for an area along the Connecticut coast. Note: Color-coding for types are not readily depicted through this black and white figure.

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