An Introduction to the NWI+ Web Mapper
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The NWI+ web mapper is an online mapping tool that allows users to display a collection of special National Wetlands Inventory (NWI) project wetland data on different types of base maps. The mapper is an ESRI product while the wetlands data were produced by the U.S. Fish and Wildlife Service and its cooperators. The mapper was developed by Virginia Tech's Conservation Management Institute (CMI, Blacksburg, VA) to make available special project data that it was mainly producing for the Northeast Region of the U.S. Fish and Wildlife Service, NWI Program. Data are hosted by Virginia Tech's Center for Geospatial Information Technology, College of Natural Resources and Environment at: http://nwiplus.cmi.vt.edu/nwiplusmapper/.

Besides showing wetland types classified according to the Cowardin et al. (1979) classification system which is the Service's standard classification, the data include hydrogeomorphic classification as recommended by the Federal Geographic Data Committee (LLWW descriptors – landscape position, landform, water flow path, and waterbody type) and a preliminary assessment of wetland functions at the landscape-level (up to 11 functions), plus for a few projects, the location and type of potential wetland restoration sites and potential wetland areas (e.g., undeveloped hydric soils that were not mapped as NWI wetlands due to a lack of a recognizable wetland photo-signature) may be displayed. For the latter projects, technical reports have been prepared (to access them click on "NWI+ Reports" on the upper right of the mapper; some may be accessed at: http://www.aswm.org/wetland-science/9494-nwi-regional-publicatoins-of-interest).

The mapper was originally designed to display data using a wide range of colors, but due to technology changes, the sheer volume of data, plus a lack of funding for upgrades, the mapper now shows data in black and white (shades of gray). As a result the legend tool does not show anything. This "Introduction" was revised in 2017 to reflect the changes in the system. At the end of this document, I've also added a quick demonstration consisting of screenshots to guide users through the process.

Format of the Mapper

The mapper will open to a map of the United States with project areas outlined in red ("NWI+ Footprints"). 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", "Show NWI+ Bookmarks", "Map Contents", "Show Legend", "Search", "Measure", and "Print". To the right of these icons is a list of topics that will take you to various websites such as the Service's NWI (national website), Region 5's NWI website, and Virginia Tech's CMI website.
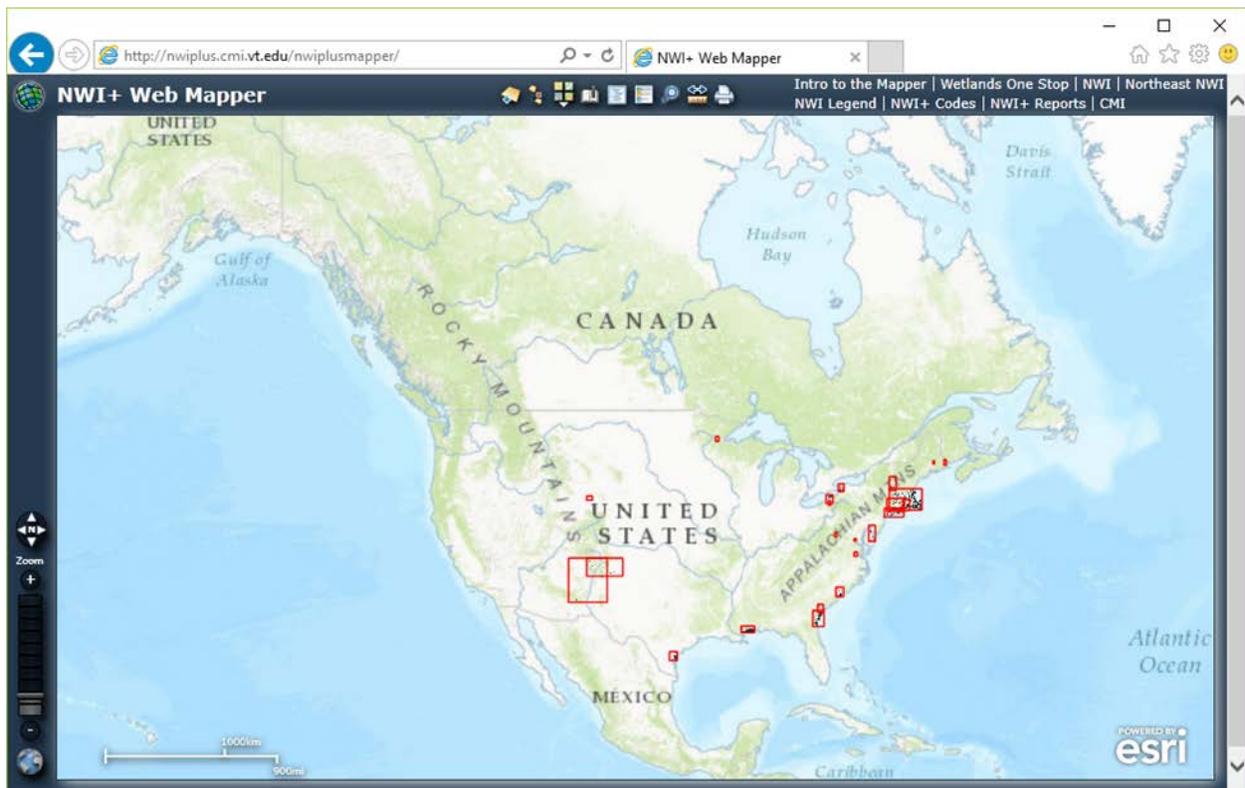
What the Icons Do

Nine tools are available at the top center of the frame.

1. Browse
2. Remove Layer
3. Change Basemap
4. Bookmarks
5. Map Contents
6. Show Legend Tool
7. Search
8. Measure
9. Print

"Browse" – allows you to add other geospatial data to the mapper. For example you could add other base maps and imagery from a pre-chosen list or add geospatial data from a website.

"Remove Layer" – remove a layer that you've added by highlighting the name of the data layer.

"Choose Basemap" – select the type of base map you'd like to display the data on – maps or imagery.

"Bookmarks" – provides a partial list of the project names where NWI+ data are available.

"Map Contents" – perhaps the most important icon – clicking on this will produce a table of contents on the right side of the map. Boxes are located to the left of each data layer. Two boxes are marked as default ("NWI+ Footprints" shows the project areas while the "NWI+ Landscape" shows wetlands classified by landscape position). To view other data layers, click off the "NWI+ Landscape" checkmark, then click on the box of the topic of interest. A summary of each of the NWI + data layers is in the next section.

"Show Legend" – was designed to display a series of legends related to the layers in map contents when color-coding was employed. This function is no longer working due to use of shades of gray for displaying polygons. User must click on dots to get classifications.

"Search" – allows you 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. For example, NWI data for the entire country can be added by clicking on "ArcGIS Online" then typing in "national wetlands inventory" then simply click on "Add" and the FWS NWI data will be added to the mapper for this session. The NWI data will be the first layer on the list and all its contents (data layers) will be active. The first NWI layer is "Wetlands Data" that will show the location/type of wetlands and deepwater habitats for the entire country, but *you'll need to zoom in to see the data*. Throughout this mapper, the first box checked will take precedence over others checked. In other words, that data will overlie other data that are checked, so you'll have to uncheck the boxes for data layers that are not of interest...that will remove them from view.

"Measure" – allows you to measure length and area on the map (use the freehand polygon to draw an irregularly shaped polygon). Click on a polygon to calculate its size in acres, hectares, etc.

"Print" – allows you to prepare a map of the data in view and either send it to your printer or to produce a pdf image for storing on your computer. You can also use the "Print Screen" key on your keyboard to do the same. This will allow you to print the legend alongside of the map just as the image you are viewing.

The NWI+ Data Layers

Originally the mapper displayed data using a wide range of colors, but due to database changes, the sheer volume of data, plus a lack of funding for upgrades, the mapper now shows data in black and white (shades of gray) with the exception of the footprints.

"NWI+ Footprints" – shows project areas where NWI+ data are available in red boxes. The titles of the projects give an idea of the level of quality control. "First Approximations" are essentially first-run GIS analyses without significant quality review for enhanced classifications and prediction of wetland functions; their findings should be considered very preliminary. Projects not designated as "first approximations" have had some level of quality control and technical reports have been published that describe study limitations.

"Wetland Codes" – places dots on the wetlands so that user can click on the dot to get the wetland classification by NWI type and by LLWW type.

"NWI – Common Types" – shows mapped wetlands and deepwater habitats by Cowardin et al. types; be sure to also open "Wetland Codes" for accessing classifications.

"NWI+ Landscape" – shows mapped wetlands classified by landscape; be sure to also open "Wetland Codes" for accessing classifications.

"NWI+ Landform" – shows mapped wetlands classified by landform; be sure to also open "Wetland Codes" for accessing classifications.

"NWI+ WaterFlowPath" - shows mapped wetlands classified by water flow; be sure to also open "Wetland Codes" for accessing classifications.

"NWI+ Rest Type 1 Soil Codes" – should be viewed with "NWI+ Restoration Type1" – shows dots that when clicked on identify the soil type for this former wetland site (hydric soil but not wetland today??).

"NWI+ Restoration Type1" – shows former wetlands (based on hydric soils data) that have been developed but are in a land use that may be suitable for restoration; many are drained hydric soils that are now in agricultural use. A legend lists the major types of these former wetlands (color-coded to type).

"NWI+ Restoration Type2" – shows existing wetlands that have been altered in some way that has affected their natural functions. A legend indicates the nature of the restoration type. 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. The alterations include ditched (d), diking/impoundment (h), excavation (x) and farmed wetlands (f). Many are partly drained wetlands, while others are ponds created by excavating former vegetated wetlands or diking vegetated wetlands to create open water habitat and altering the hydrology of remaining marshes and swamps.

"NWI+ P-WetArea Codes" – should be viewed with "NWI+ P-WetAreas" – shows dots that when clicked on identify the soil type for these hydric soil areas that may support wetlands.

"NWI+ P-WetAreas" – shows hydric soil areas (mapped by USDA Natural Resources Conservation Service) 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" shows 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 (uncommon or highly diverse wetland plant communities – based on NWI codes only), and WBIRD (waterfowl and waterbird habitat). *For the function data layer, the color black represents a wetland predicted to provide the specified function at a high level, while the dark gray color signifies predicted moderate level of performance for the function. Wetlands without such shading are predicted to have little or no performance of the specified function.* Note: Shading is for wetlands only as deepwater habitats were not evaluated for function. Also some base maps show some nonwetland features in light gray (e.g., urban areas, government facilities, and parks). To view the predicted function for a wetland of interest, simply click on the functions individually and see how the color changes (be sure to view only one function at a time via Map Contents).

Adding Other Data Layers to the Web Mapper

To increase the functionality of the NWI+ Web Mapper, you can add other GIS data to the mapper. For this use the "Search" tool (magnifying glass) on the tool bar at the top of the mapper; you may need an ArcGIS account to perform this function for some databases. Before using this tool, you may want to check off any marked box (NWI+ data layer) that can be seen when viewing "Map Contents." By doing this only the base map or image will be visible on the mapper (i.e., all the NWI+ data layers are turned off). To obtain another GIS data layers simply click on the "Search" tool (the magnifying glass) on the tool bar above the map, then click on the ArcGIS Online tab (middle tab) and type the name of a layer you wish to view in the space provided (e.g., NHD data, NWI wetlands, Presence of hydric soils), then click on the magnifying glass to the right of the line. This will produce a list of data sets related to that topic. Scroll down the list and choose the one you are interested in, then add it to the NWI+ web mapper by simply

clicking on the word "Add" to the right of the layer name. The layer will appear in the Map Contents window at the top of the list (i.e., when "Map Contents" is open), but the data may not be visible because of scale-dependency. Zoom in as necessary to view the data; recognize that such data may not be available for all locations. A scale bar on the bottom of the map identifies the relative scale (linear dimensions). To view the legend for a data layer, double-click on the name of the layer in "Map Contents" and on any other name that opens up below the layer name. To remove the layer, use the "Remove" icon on the toolbar.

QUICK VISUAL DEMONSTRATION

Once you open the mapper at: http://nwiplus.cmi.vt.edu/nwiplusmapper/, the initial view displays a topographic base map from ESRI and two overview layers:

- NWI+ Footprints (show where NWI+ data are available)
- NWI+ Landscape (default data set displayed; can change through Map Contents)
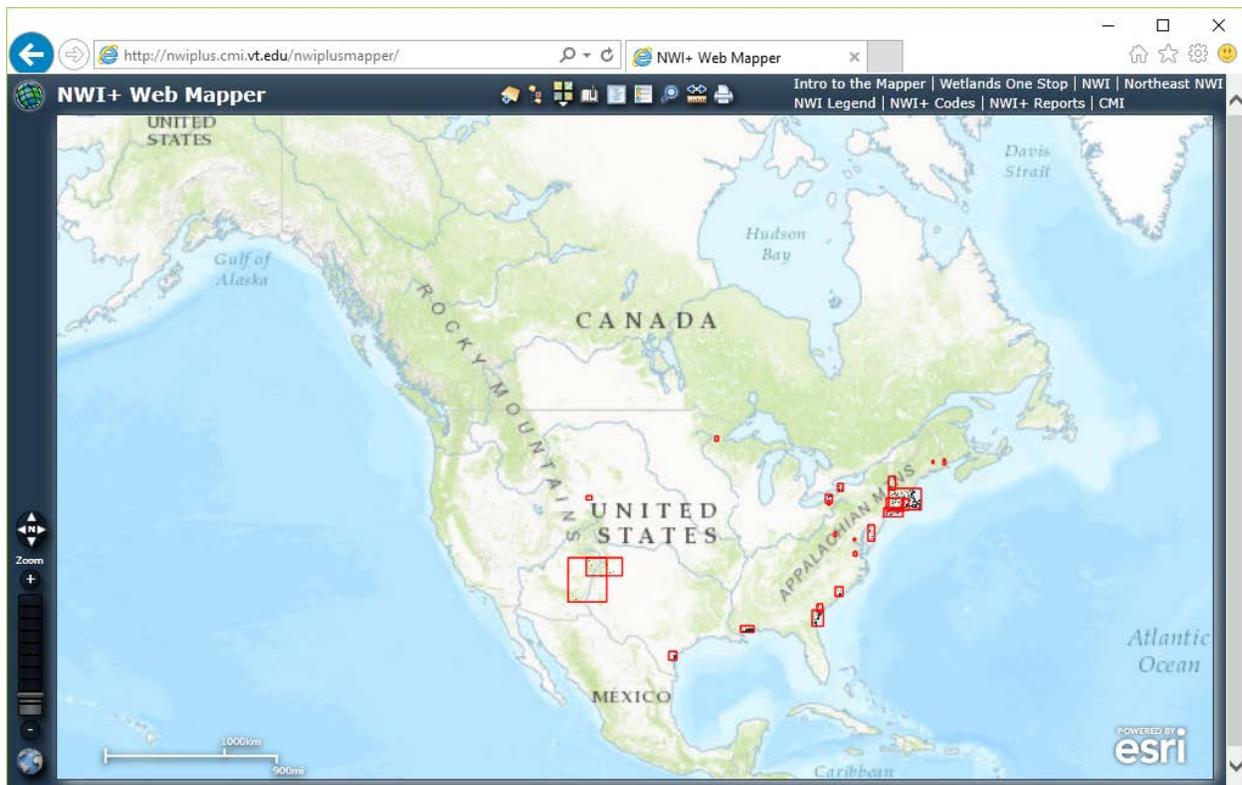
Nine tools are available at the top center of the frame.

- Browse
- Remove Layer
- Change Basemap
- Bookmarks
- Map Contents
- Show Legend Tool
- Search
- Measure
- Print

To view codes (classification) click the **Map Contents** tool and check the categories to display on the map. The Map Contents button opens the Map Contents panel. From this panel, select the categories to be displayed on the map. As you can see the NWI+ Landscape box is checked as it is the initial data layer opened.
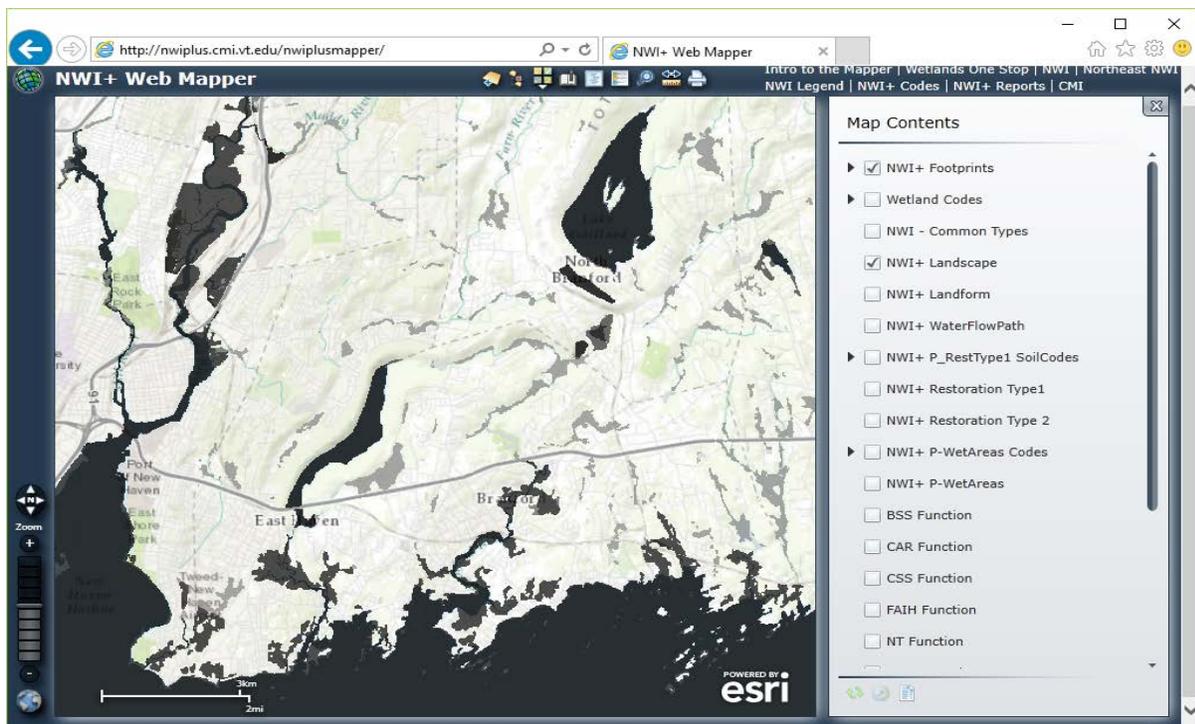
To view the classifications, check the **Wetland Codes** category in the Map Contents. This provides circles and dots in each wetland. The numbers you see in the red circles represent the number of wetland units in the area. You must zoom in to access the dot on a specific wetland.
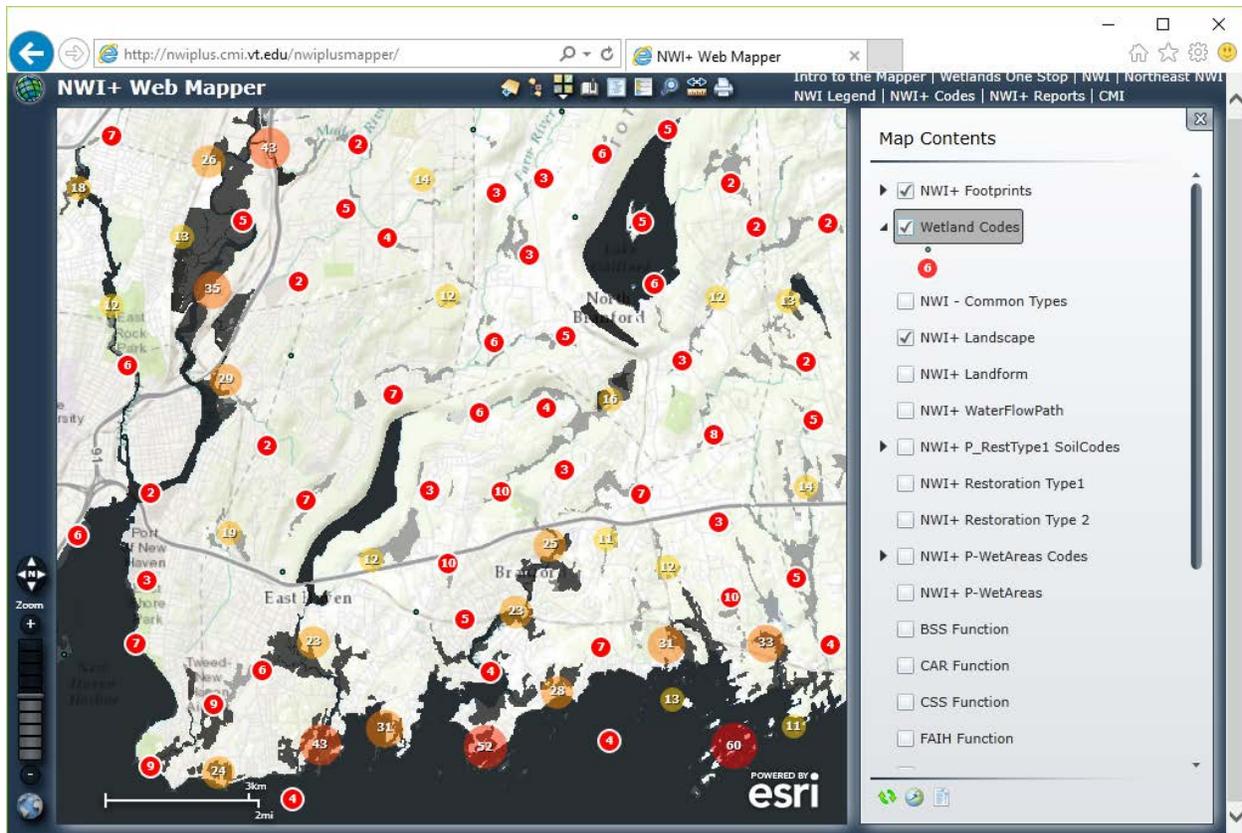
After zooming in you will begin to see small dots (green dots) that represent the access point for obtaining the classification for an individual wetland unit. On the image below you will see that some wetlands still are marked by the red circles. To view their codes you must zoom in further. Recognized that many wetlands may be comprised of multiple units based largely on differences in vegetation and water regime which also may affect their LLWW classification.
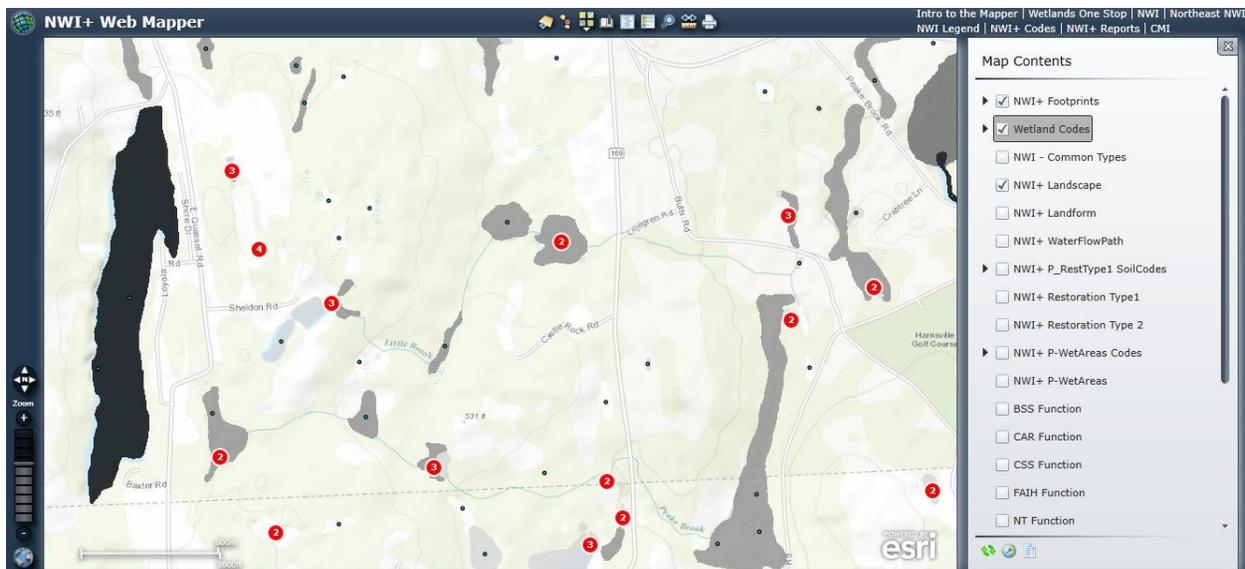
The numbers contained by a circle represent clusters of features. Click on the number to view and cycle through a table of attributes for each feature, or zoom in to view the individual features as green dots representing a single feature and click the green dot for attributes. In the example above, the red circles indicate multiple wetland units (at that scale) where you need to zoom in, whereas the small dots indicate individual wetland units that can be click on to view the attributes table.

In the following example, I clicked on the area in the center of the image – the one with the number 2 in a red circle (which means that the wetland has two units). When I did this the first of two attribute tables appeared. This one is for a palustrine emergent wetland (PEM1E) – the table shows the NWI attribute, the LLWW code, and the size of the unit in acres. You'll also see at the top: "1 of 2" meaning there is another unit in this wetland. Click on the arrow on the upper right to view the second attribute table (for a palustrine forested wetland – PFO1E) which is shown in the second image below. In this case, while the NWI codes are different due to differences in dominant vegetation, the wetland is represented as a single LLWW type – LS1BATH (a lotic stream basin, throughflow) based on hydrogeomorphic properties.

If you want to see the location/shape of the individual units for this wetland, simply change the data layer in view to the NWI types by clicking on **NWI – Common Types** data layer. You will then see, the shape of the two polygons that make up this wetland as in the image below.