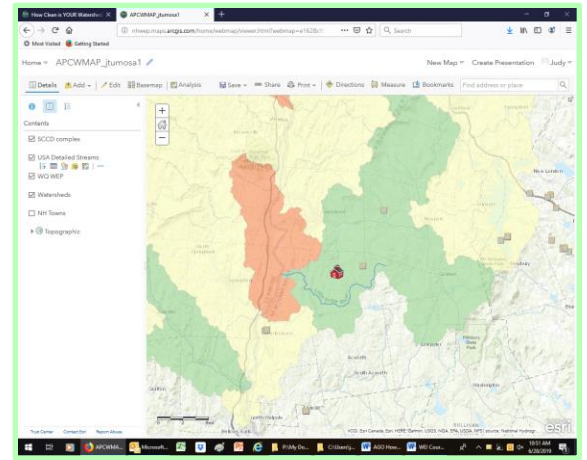


How Clean is YOUR Watershed?

Teacher Resources
Updated June 2019



Lesson overview

Students will explore ArcGIS Online and map watershed data from a U.S. Forest Service GIS analysis titled “Forests, Water and People: Drinking water supply and forest lands in the Northeast and Midwest United States” (Barnes et Al, 2009.)

The dataset students will explore, the “Ability to Produce Clean Water” or APCW, is an index that predicts how clean the water is in each watershed.

APCW was created by an overlay or “sandwich” of six data layers: percent Forest Land, percent Agricultural Land, percent Riparian Forest Cover, Soil Erodibility, Road Density, and Housing Density.

They will identify high, medium, and low APCW; discover how a watershed scored high or low, and make a map of their watershed.

Estimated Time

One or Two, 60-minute periods

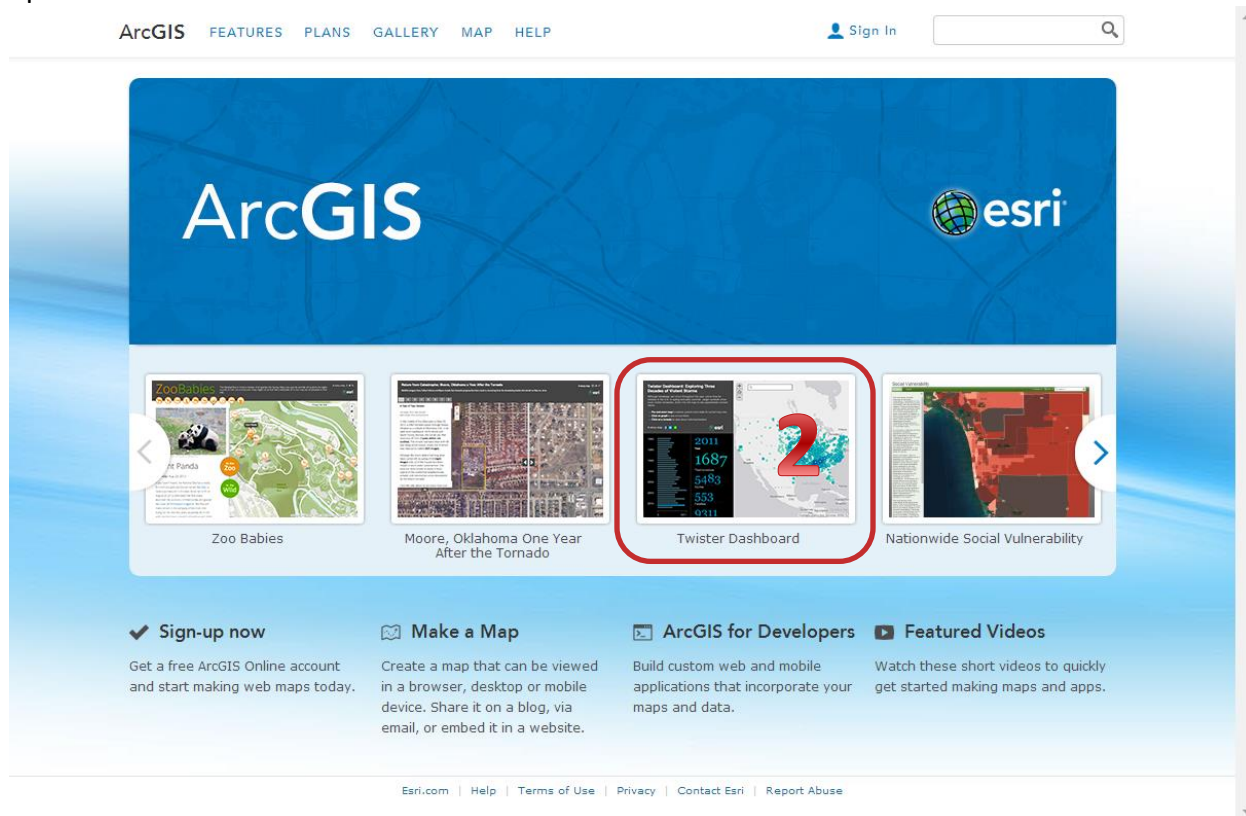
Objectives

After completing this lesson, a student is able to do the following:

- Launch ArcGIS Online and open a map
- Explore the map: pan, zoom, change basemap, turn layers on and off
- Add layers, symbolize data, and create a map note
- Find their school
- Query data
- Explore a feature table
- Save and share your map
- Create a web app
- Create Metadata!

Task 1: Launch ArGIS Online from your browser and open a map or app.

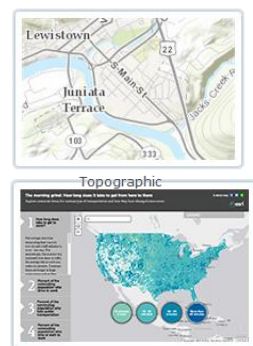
1. Open your favorite browser. Google Chrome, Firefox, or Safari are preferred over Internet Explorer. Navigate to:
<http://www.arcgis.com/home/>
2. In the middle of the screen are several sample maps and apps. Click on one that interests you to open it.



What is the difference between a Map and an App?

Maps: Displays about an area of the world which the viewer can use and alter (such as by adding new contents); tend to have a generic interface; a user can often save a copy of someone else's map into the user's own account; after creation, maps can be turned into apps.

Apps: Displays about an area of the world which the viewer can use but typically not enhance and save; tends to have a custom interface and focused content.



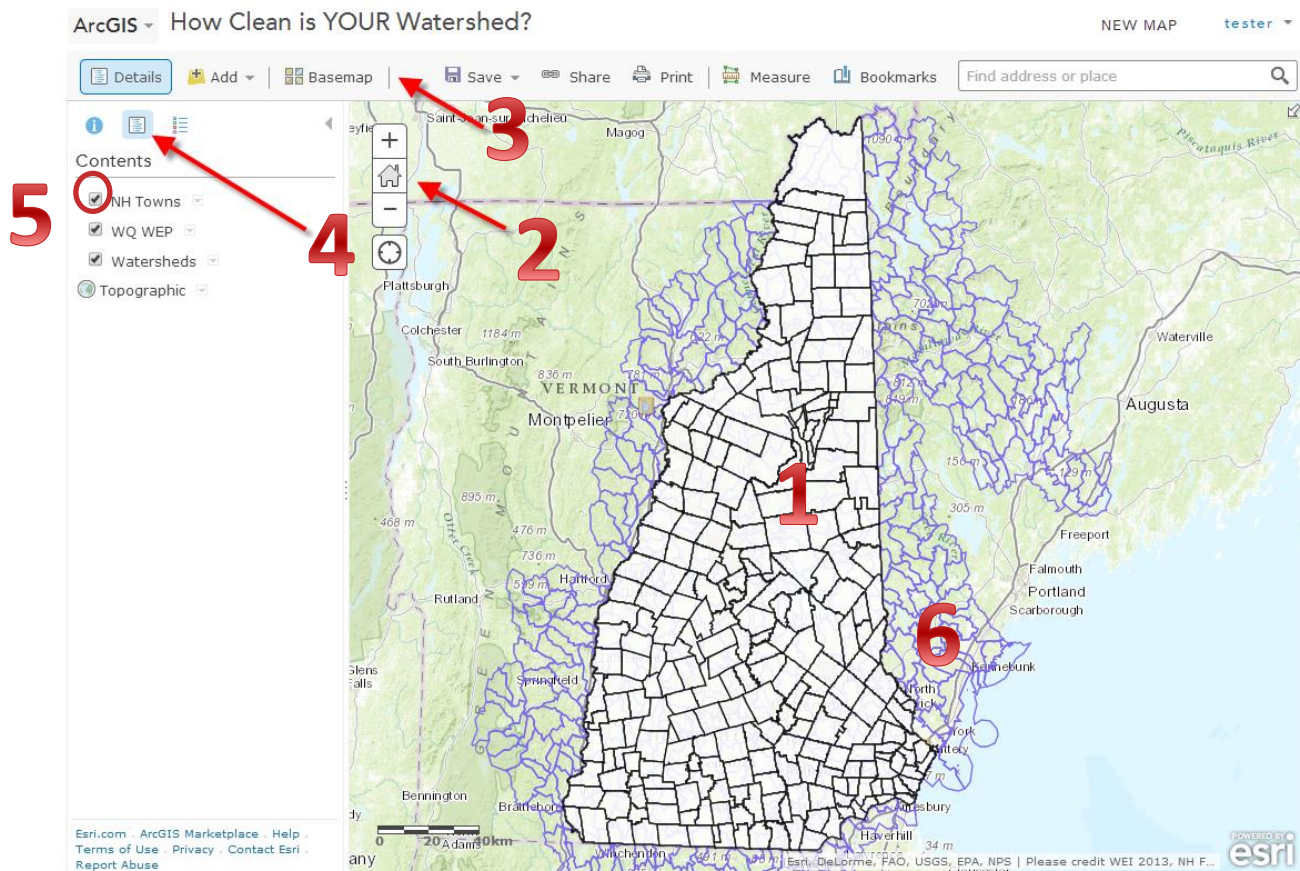
Courtesy of ESRI Skillbuilder



Share one thing you learned about this map or app with your class.

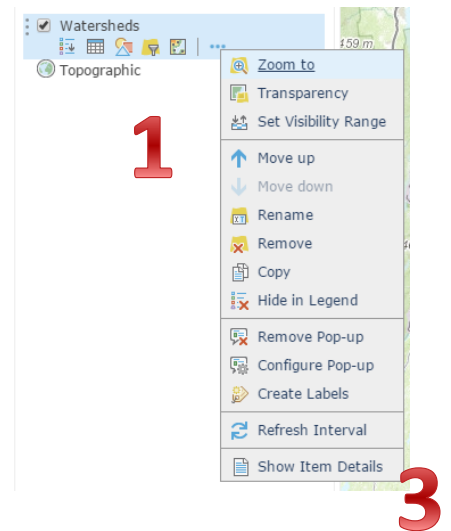
Task 2: Sign In and Explore the Map

1. Return to <http://www.arcgis.com/home/> and click Sign In on the top right of your screen. Sign into the **NH Fish and Game Watershed Education Program (NHWEP)** organizational account using your user name and password. **Click on the Home tab and in the ribbon of maps, find the map entitled "How Clean is YOUR Watershed?_Teacher Resources"**. Click on it to open in the ArcGIS.com Map Viewer.
2. Explore the map:
 - 1) **Pan:** Click and hold to move the map around.
 - 2) **Zoom:** Use the + and – signs or hold shift and draw a box. Click the "House" button to return to the full map.
 - 3) **Change the Basemap:** Pick a different background map.
 - 4) **Turn layers on and off:** Make sure you are in the Contents tab, and then click the layers on and off. Turn off the NH Towns layer so you can see what is underneath.
 - 5) **Change the order of layers:** If you hover over a layer, three dots appear. If you click on the dots and hold down your mouse, you can drag a layer above or below the other layers. Drag NH towns to the bottom of the list. *Note: you cannot put layers below the basemap!*
 - 6) **Click features to get info:** If you click on a watershed, a popup will appear. These are fields from the table attached to the feature. (More about that later!)



Task 3: Show Table and Show Item Details.

1. Hover over the Watersheds layer, click on the “Show Table” icon (small table) under the Watersheds layer name.
2. A table will appear under your map. Click on one of the rows in the table. Notice that one of the watersheds will also be highlighted in the map.
3. What do all these field names mean? To learn more about a layer, click on the three dots under the layer and select “Show Item Details.” A new window will appear that describes the layer, what the field names mean, and how and when the data was created. This is called METADATA or “data about data.”



Question 1.

What is the ability to produce clean water?
 What does the field PER_FOR describe?
 What does the field HUC_8 describe?

Question 2. After reading the item details, or metadata, for the Watersheds layer, you learned that the ability to produce clean water was created by calculating the following land use characteristics. Would a high or low amount of each IMPROVE a watershed’s water quality?

Land Use Characteristic	HIGH or LOW?
Forest Land	
Agricultural Land	
Riparian Forest Cover	
Soil Erodibility	
Road Density	
Housing Density	




We will review Question 1 and 2 as a class.

Task 3: Find a Place and Add Map Notes

1. Go back to you map (it should be the tab to the left of your metadata window.) Let’s find your school. Type the name of your school or town in the search box on the upper right of your map. You may need to zoom out to see your entire school. Click on the watershed that your school resides in.

Question 3. What is the HU12_name of the watershed your school is in?
 What is the percent forested land in your watershed?
 What is the HUC_8 code for your watershed?

- Now we will add a Map Note to mark your school's location. Click  and Select Add Map Notes. Click **Create** to finish. You are now editing data! You will notice the Edit tab is underlined.
- Click on the pushpin icon and then click on your school in the map. Give your map note a title and description. If you have an Image that is on the web, you can add the URL here. Click the Details tab to stop editing. To change the icon, click on "Change Symbol", and click on the upside down pyramid to see the options. For this exercise, scroll down to "People Places", click on the school house symbol and click OK.
- Your Map Notes are now a layer in your map and you see the "Map Notes" name in your contents pane. Click on the three dots under that layer, click on "Rename", and give the layer the name you want.

Task 4: Save your map

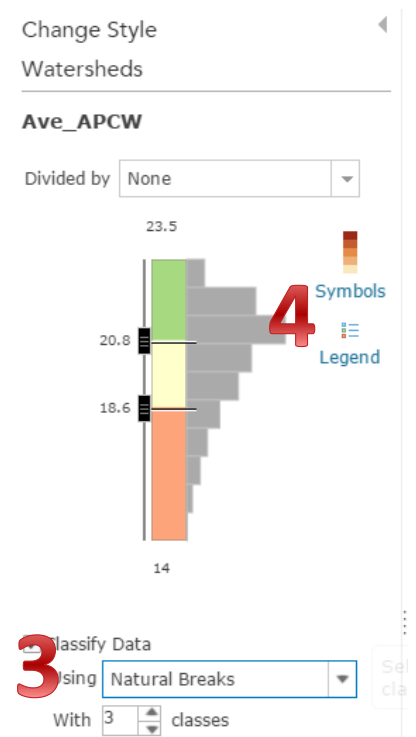
- Save your map! Since this map is not saved in your account yet, you will need to click on Save and select Save As. Name the map **APCWMap_yourname**. Also add a tag with your initials so you can find your map later! Now the map is in your "My Content".
- Click Share. Here you can copy the link to the map to e-mail if you choose.
- You can also select who you want to share the map with: Everyone (public) or a Group.




Review: ArcGIS Online allows you to open up maps created by other users and save them to your account to use and modify (We will learn to make a map from scratch later!) Metadata gives us more information about the data in the map. Without it you would have to guess what all those fields mean!

Task 5: Symbolize your data

- You can customize your map by changing the symbols of layer based on any field in the table. Click on the "Change Style" icon under the Watersheds layer name. You can symbolize the watersheds by any field in the table by clicking the drop down box under "Choose an attribute to show". For example, if you select the "HUC_8" field, you will see which watersheds are grouped together into larger watersheds. *To learn more about HUC codes, see the last page of this lesson.*
- Select the field "Ave_APCW." Then choose the first drawing style "Counts and Amounts (Color)." Click the "Options" button to customize they style.
- Click the check box "Classify Data" and select Natural Breaks and 3 classes.

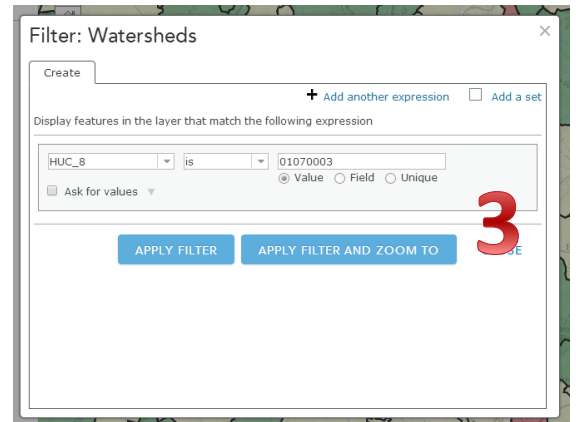


- Click the Symbols button and change to a Red to Green color ramp. Click the Legend Button if you want to modify the individual symbol colors or change the label (ie change 14.2-18.6 to “Low APCW”). Click Ok when you are finished with your changes. Click “Done” to exit the Change Styles window.

Task 6: Filter your Data

There are a lot of watersheds in our state. When creating a map, sometimes show less is more meaningful! We will filter our watershed data so we only see the watersheds that are in the same subbasin (HUC_8) as our watershed.

- Open the Table for the Watershed Layer. Note how many features are displayed.
- Click on the “Filter” icon (small yellow box) under the Watersheds layer name.
- Remember your HUC_8 code from Question 3? We want to display features that match the expression: HUC_8 is -----
- Click Apply Filter and Zoom to.
- Now look at the number of features in your table. Is it less?
- If you click on the Ave_APCW field name in the table you can sort the table or show statistics. Sort the table to answer Question 4.

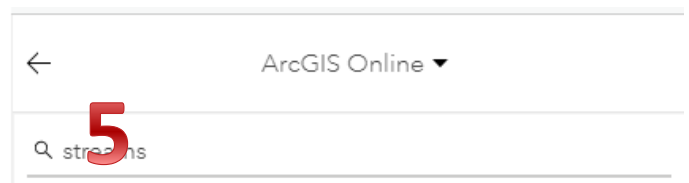


Question 4. What watershed in your Subbasin has the highest Ave_APCW?
Lowest?
Where does your watershed fit (above average, below average, etc...)?

Task 7: Add additional data layers

ArcGIS Online has several thousand data layers that you can add to your map.


- Click Add on the top left next to the Details tab and select “Search for Layers”
- At “My Content” at the top of the content pane, click on the black triangle, then click on “ArcGIS Online”.
- Next to the magnifying glass symbol, type “USA Detailed Streams”, press enter.
- Click on the “+” to add the “USA Detailed Streams” layer by Esri. Once added, notice the + changes to a -.
- Click the back arrow to return to your Contents.
- Change the symbol to a blue line. Filter by river name; hint, use “NAME is *your river name.*”

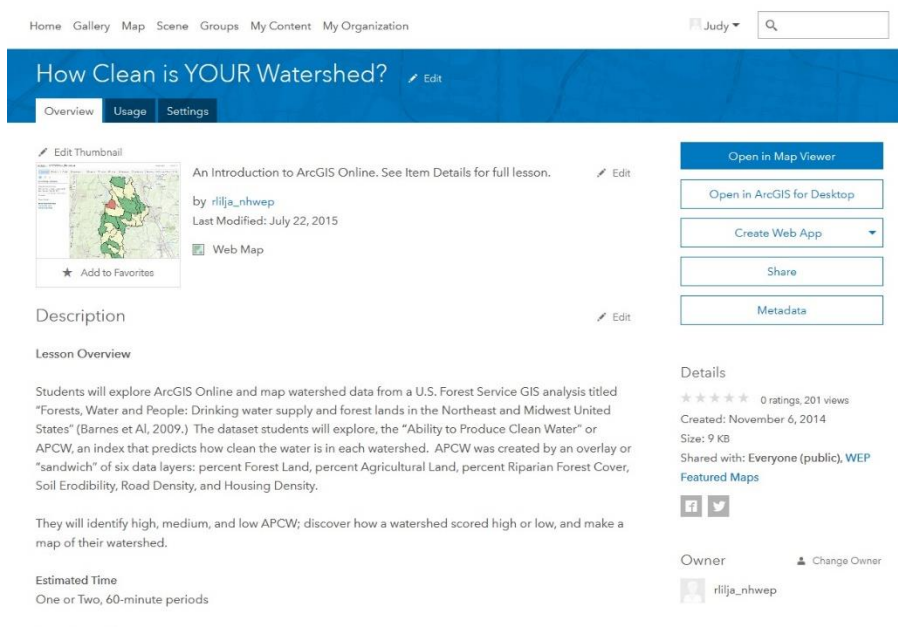


What else would be interesting to know about your watershed? Search ArcGIS Online for other data layers. You may need to “enable popups” for data that you add to you map in order to get information about it when you click on a feature.

- Save your map! Click Save and Save again – no need to Save as unless you want to rename your map.

Task 8: Create Metadata!

We talked about metadata at the beginning of this lesson. You should fill out at minimum: who created the map/app, when it was created, and what it should be used for. You can access the Item Details for your map from the map itself under the  icon or from the My Content page. Either way, once you are in the item details, you can click Edit to change the details. Click Save when you have completed your metadata!



The screenshot shows the ArcGIS Online interface for an item titled "How Clean is YOUR Watershed?". The page includes a navigation bar with "Home", "Gallery", "Map", "Scene", "Groups", "My Content", and "My Organization". The item title is "How Clean is YOUR Watershed?" with an "Edit" link. Below the title are tabs for "Overview", "Usage", and "Settings". The main content area is divided into several sections: "Edit Thumbnail" with a map thumbnail and "Add to Favorites" button; "Description" with a pencil icon to edit; "Lesson Overview" with a detailed text description of the map's purpose and data sources; "Estimated Time" listed as "One or Two, 60-minute periods"; "Details" section showing "0 ratings, 201 views", "Created: November 6, 2014", "Size: 9 KB", and "Shared with: Everyone (public), WEP Featured Maps"; and "Owner" information for user "rlilja_nhwep" with a "Change Owner" link. On the right side, there are buttons for "Open in Map Viewer", "Open in ArcGIS for Desktop", "Create Web App", "Share", and "Metadata".



Review: Great work! You now know how to symbolize layers, filter data to show only features that meet certain criteria, add new data, and create metadata. Now create your own map! Click “New Map” on the top of your Watershed Map and use your skills to build a map on any topic!

References: (Barnes et Al, 2009) Barnes, Martina; Todd, Albert; Whitney Lilja, Rebecca ; Barten, Paul. June 2009. *Forests, Water and People: Drinking water supply and forest lands in the Northeast and Midwest United States*. United States Department of Agriculture Forest Service, Northeastern Area State and Private Forestry, 11 Campus Boulevard, Suite 200, Newtown Square, PA 19073. NA-FR-01-08.

http://www.na.fs.fed.us/watershed/fwp_preview.shtm

What is a Watershed?

“When looking at the location of rivers and the amount of stream flow in rivers, the key concept is the river's "watershed". What is a watershed? Easy, if you are standing on ground right now, just look down. You're standing, and everyone is standing, in a watershed. A watershed is the area of land where all of the water that falls in it and drains off of it goes into the same place. Watersheds can be as small as a footprint or large enough to encompass all the land that drains water into rivers that drain into Chesapeake Bay, where it enters the Atlantic Ocean.”

“A watershed is an area of land that drains all the streams and rainfall to a common outlet such as the outflow of a reservoir, mouth of a bay, or any point along a stream channel. The word watershed is sometimes used interchangeably with drainage basin or catchment. Ridges and hills that separate two watersheds are called the drainage divide. The watershed consists of surface water--lakes, streams, reservoirs, and wetlands--and all the underlying ground water. Larger watersheds contain many smaller watersheds. It all depends on the outflow point; all of the land that drains water to the outflow point is the watershed for that outflow location. Watersheds are important because the stream flow and the water quality of a river are affected by things, human-induced or not, happening in the land area "above" the river-outflow point.”

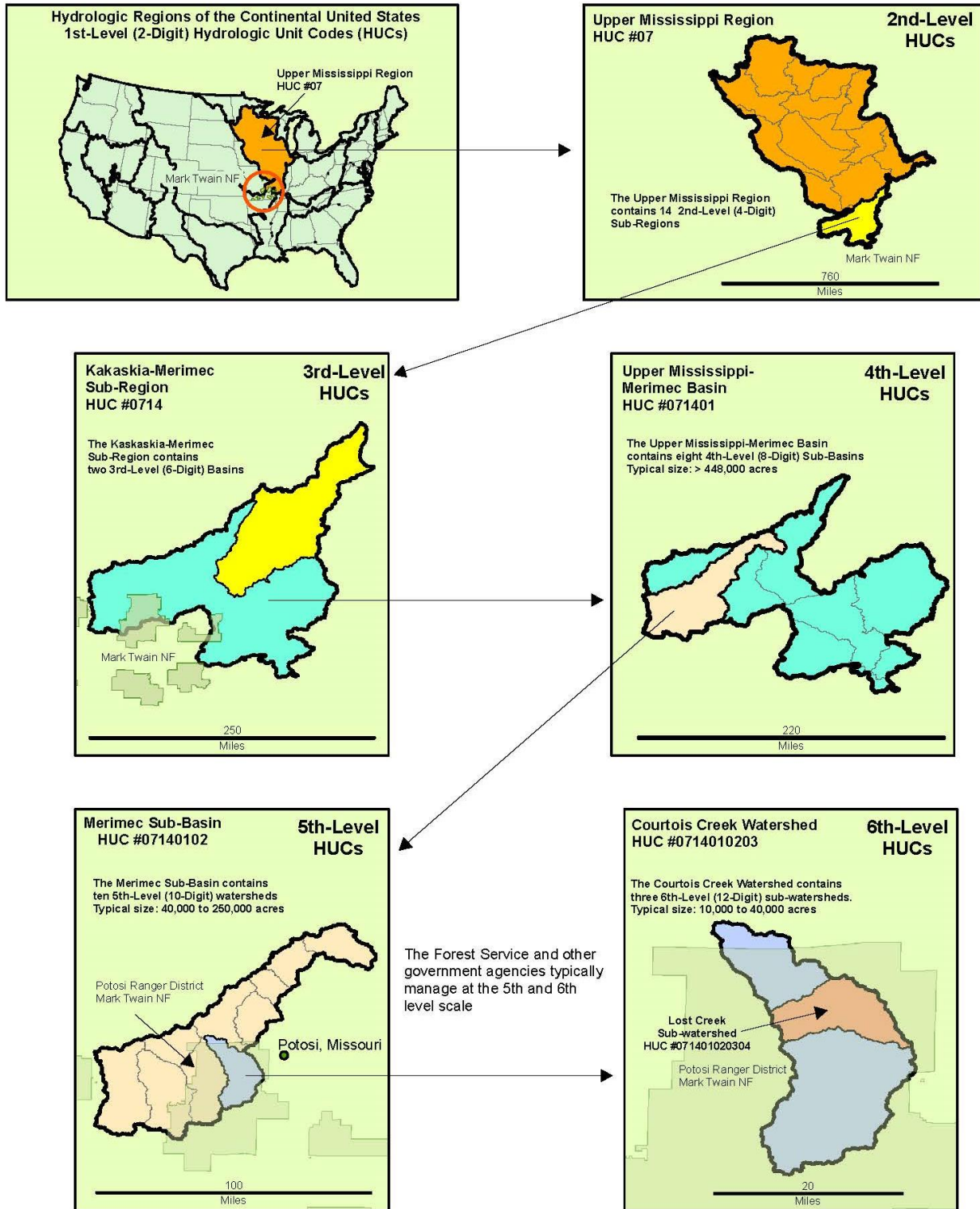
From USGS Science in Your Watershed: <http://water.usgs.gov/wsc/>

Since watersheds nest into each other and combine to form larger ones, a system for their classification had to be developed. This system, developed by the United States Geological Survey (USGS), is known as the HUC system, which stands for Hydrologic Unit Code. The United States is divided into 21 major geographic areas known as regions. Each region drains either a major river or is a combination of rivers draining an area. A two digit HUC code would identify the region (01 to 21). Further subdivisions occur as follows:

Name	Level	Digit	Number of HUCs
Region	1	2	21
Subregion	2	4	222
Basin	3	6	352
Subbasin	4	8	2149
Watershed	5	10	22 000
Subwatershed	6	12	160 000

<http://www.ncgc.nrcs.usda.gov/products/datasets/watershed/facts.html>

Hydrologic Unit Code Hierarchy



Student Worksheet

Name:

Map Link:

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