

Watershed Mapping

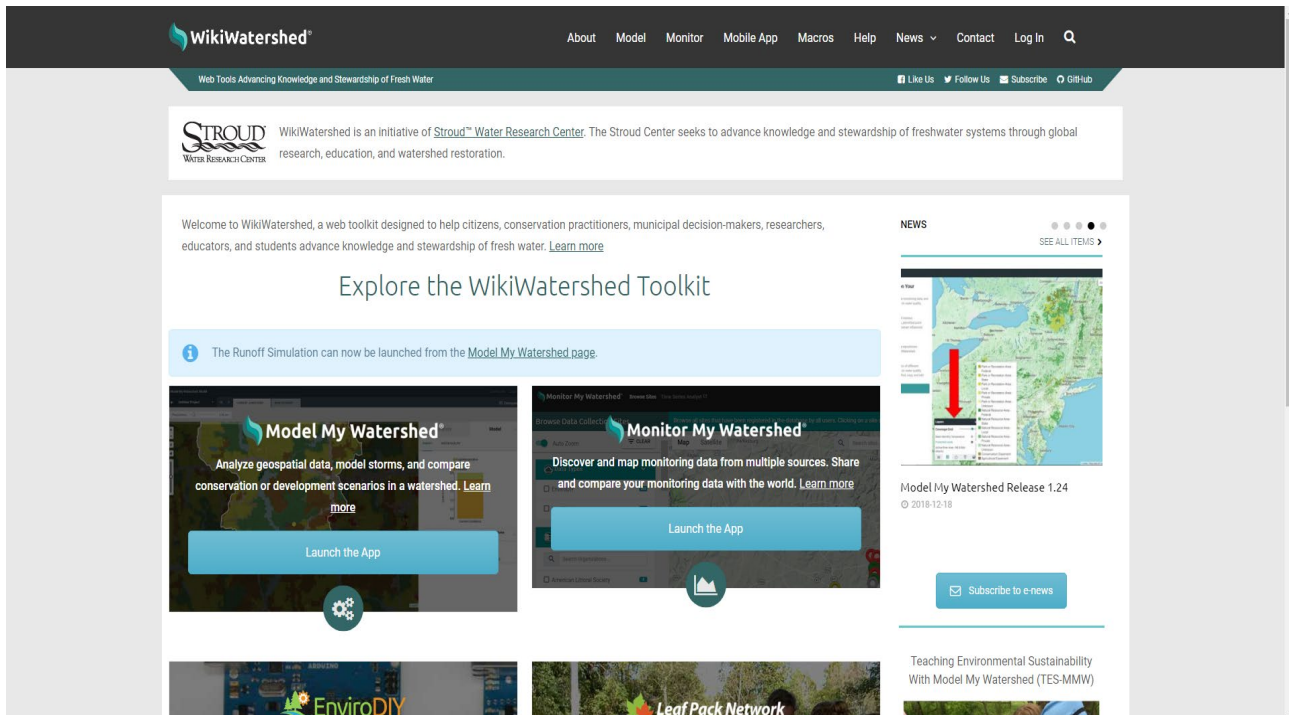
OBJECTIVES

- Visualize the structure of a local watershed
- Examine how watersheds are impacted by climate and human pressures
- Practice working with online Geographic Information Systems (GIS)

ROADMAP

Today in lab, we'll explore some properties of the watershed that houses the University of La Verne. Specifically, we will use a free web app to visualize our watershed, learn about its land cover and other properties, and evaluate the impact land use has on the local water cycle. We can also explore scenarios using the web app to see how the hydrological cycle would change with changing precipitation and/or climate change.

This lab uses a web application called Model My Watershed, developed by researchers from the Stroud Freshwater Research Center (Avondale, PA) and Penn State, and found on the WikiWatershed website (see screenshot below). It is an interactive, online, hydrologic modeling tool that allows users to calculate water budgets for various storm intensities, generic land cover types, and soil textures for a generic patch of land ("Micro Model") or for an area you have defined in your own watershed ("Watershed Model"). The app helps to investigate various water management best practices in urban/suburban neighborhoods (although it is not effective in Western states away from urban areas). Essentially, this web app puts the power of Geographical Information Systems (GIS) in the hands of the public, which is an essential tool to gather information and conduct analyses using real spatially- oriented data. Land use data come from the National Land Cover Database (NLCD), which is the official resource on land use in the US that is updated every five years. There is a tremendous amount of computational load in running this web app, and this computation is done on a powerful commercial remote server. You just see the products of these calculations on your computer when you use the app.



Background: What's a Watershed?

THE SCIENCE

A **watershed** delineates the land area over which precipitation and runoff flow to reach a stream and its outlet, usually a reservoir, lake, or the ocean. Imagine a watershed as a bowl, with the outlet of your focal stream or river being the water that gathers in the bottom.

A watershed typically includes not one stream, but many. We can describe interconnected waterways according to their **stream order** (see diagram in left margin). First order streams sit at the top of a watershed, arising from groundwater springs, snow melt, or other precipitation. When two first order streams merge, they form a second order stream. Second order streams come together to make third order streams, and so on until the waterway reaches its end.

THE ISSUE

Studying a single river in isolation doesn't give us the whole picture. Delineating watersheds allows us to broaden our understanding of hydrology and consider the path water takes to reach our focal river or bay, often traveling through other waterways or over land with varying exposure to pollutants, development, and protected status. What happens upstream affects everything downstream!



Finding Your Watershed

Name:

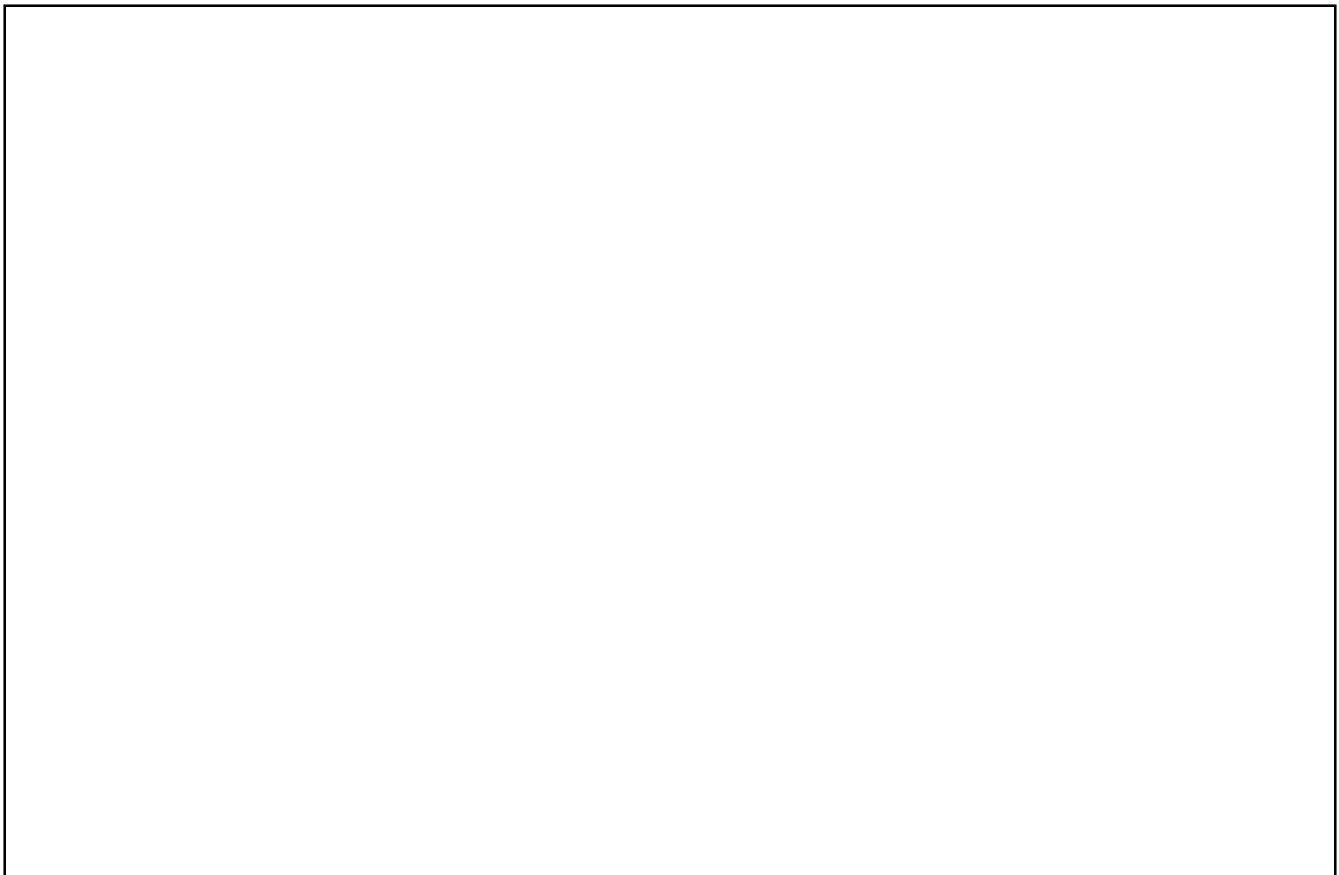
First, open a web browser and navigate to www.wikiwatershed.org. You should see the screen from page one of this lab. You will see a variety of useful tools related to water quality available. Find the “Model My Watershed” box and click on “Launch the App.”

To the left of the interactive map, click “Get Started.” Use the interactive map or the search bar at the top right to navigate to Seal Beach, CA, which is where La Verne’s watershed eventually drains into San Pedro Bay. To activate the stream network, find the “Layers” box on your screen. Under the “Streams” tab, click on “Continental US Medium Resolution Stream Network.” This adds a layer of data that includes southern California streams.

Next select your watershed. Find the stream that is closest to Seal Beach (this should be the San Gabriel River). On the left-hand menu, click on ‘Delineate Watershed,’ select ‘Continental US Medium Resolution’ from the dropdown menu, then move the cross to the point right on the stream nearest its end. When you do, the entire watershed will be highlighted.

If you’d like, you can change from the map view to the amazing satellite view. On the lower right-hand corner of the layers box, click the icon that looks like a stack of papers and choose ‘Satellite.’

Using the ‘print screen’ function, take a screenshot of your watershed and upload it here:



Land and Stream Data

Name:

To the left of your map, you will see data pertaining to the watershed you've delineated. This data comes from an 'on the spot' analysis of the watershed you selected along with the NLCD data.

What is the total length of streams in your watershed?

What is the maximum stream order found in your watershed?

What's the mean channel slope of your stream (percent drop in elevation)?

Click on the 'Land' tab to observe a breakdown of the land use estimated from the NLCD database. Use the numbers from the table to determine the area and percentage of the following land use categories, combining as necessary:

	Developed, Open Space	Developed, Other (Combined)	Forest (Combined)	Pasture & Crops (Combined)	Wetlands (Combined)
Area					
Percentage					

Do you think your watershed is healthy or degraded, or somewhere in between? State and justify your answer using the available land use data.

In order to improve the health of your watershed, detail the land use categories that would need to be increased or decreased and why they are important.

Other Information Available

Name:

Other information on your watershed can be found by clicking on the headings at the top of the box to the left. Some information, such as point sources and water quality, are currently only available for the Delaware River watershed, since that is where the model was developed.

What infiltration rate does most of the soil have in this watershed and what is the percentage?

Why would infiltration rate of the soil be important in knowing how the watershed functions?

What are the maximum and minimum temperatures and precipitation levels for your watershed, and when do they occur?

How many livestock animals are present in the watershed and what type?

Does the information in part (d) line up with what you know about the watershed? How do you think they determined this information?

Go back to the layers box. There is more information that can be displayed on the interactive map. Navigate to the “Coverage Grid” tab and click on ‘Protected Lands’ to observe which land has protection from development. Next to the ‘protected lands’ layer you will see a small ‘i’. Click on this to observe the color-coded key of protected lands types.

What kinds of protected lands are in your watershed?

Do the majority of your watershed’s protected lands cover lower-order streams or higher-order streams? Why do you think this is important?

Model My Watershed

Name:

Another major capacity of the WikiWatershed page is to be able to model the fate of precipitation and the amount of pollutants coming from your watershed. Specifically, loads of nitrogen, phosphorous, and TSS (sediment) are available as modeled quantities.

In the left-hand panel, click on 'Model' then select the 'Site Storm Model'. Given a certain level of precipitation over 24 hours, the app is able to predict the fate of the precipitation as evaporation from plants, runoff into the waterway, and infiltration into the soil. The slider bar at the top right controls the level of precipitation in the 24 hour storm.

Use the slider bar to select different levels of precipitation, then record the resulting water depth that the model predicts would go to evapotranspiration, infiltration, and runoff.

	Evapotranspiration	Infiltration	Runoff
2.5 cm (~1 in)			
5 cm (~2 in)			
10 cm (~4 in)			

Why do you think you saw the patterns in the table above? What characteristics of the watershed play a role in determining how much precipitation ends up as evapotranspiration versus infiltration versus runoff?

Model My Watershed

Name:

In the same modeling window, click now on the 'Water Quality' tab. Displayed are the loading rates of nitrogen (N), phosphorous (P), and total suspended solids (TSS, aka sediment). As you did for the previous table, use the slider bar to select different levels of precipitation, then record the loading rates for TSS, N and P under each of the following conditions:

	N	P	TSS
2.5 cm (~1 in)			
5 cm (~2 in)			
10 cm (~4 in)			

Explain the change in the N, P, and TSS values as precipitation increases. What characteristics of the watershed may account for these results?

One of the predictions for climate change is a decrease in the amount of precipitation received in southern California. Based on your explorations in this lab, what changes may occur in watersheds like this one as a result?