



# STROUD<sup>TM</sup>



## WATER RESEARCH CENTER

ADVANCING KNOWLEDGE AND STEWARDSHIP OF FRESH WATER SYSTEMS  
THROUGH RESEARCH, EDUCATION, AND RESTORATION

# PHYSICAL MONITORING AND METRICS

Learning objective:

- Understand effective means of monitoring watershed hydrology, sediment loads, and physical habitat quality

# Turbidity

- Fine sediment transport (suspended load)
- Cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in air



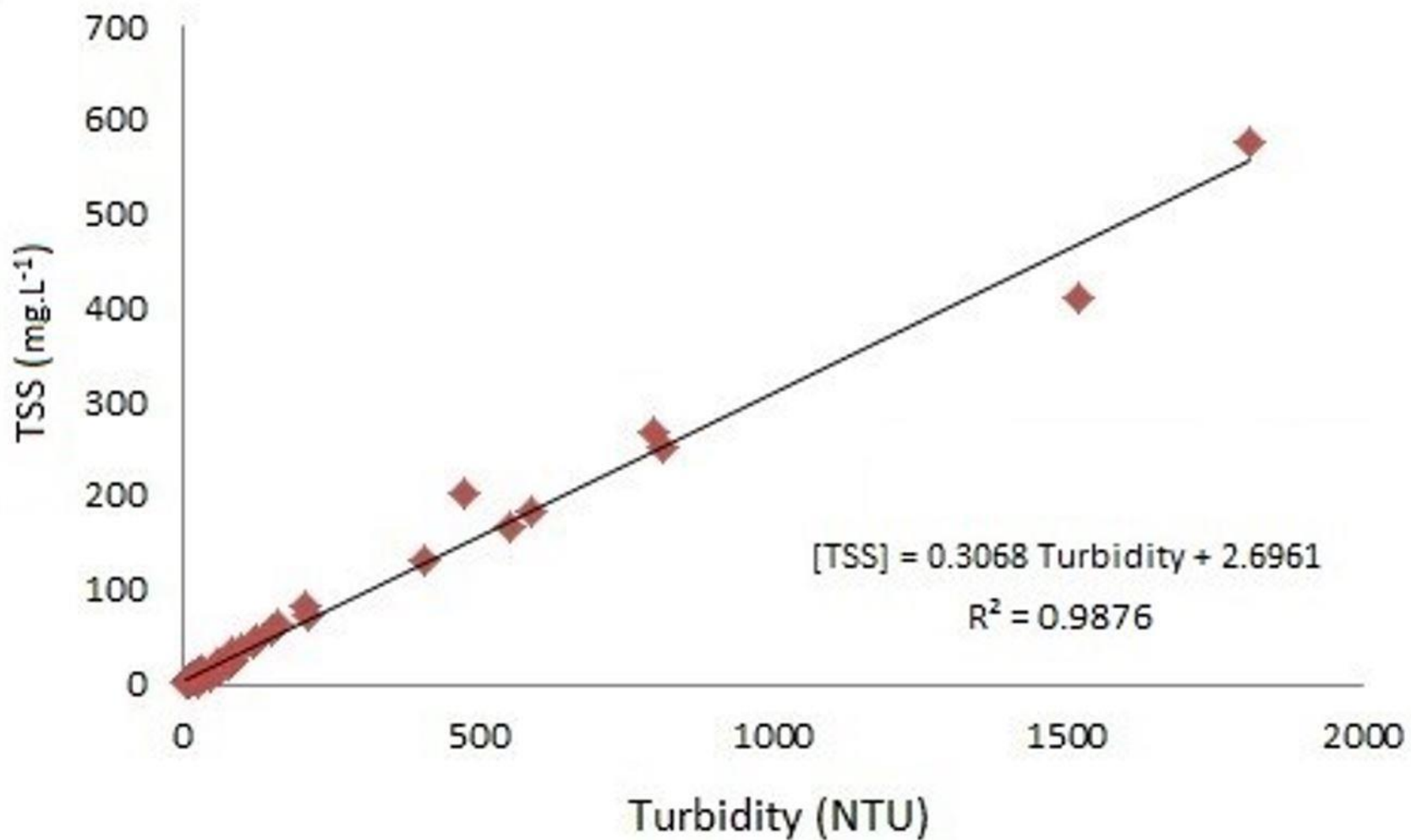
Mississippi River at its confluence  
with the St. Croix



# Turbidity

- Measured by shining a light through the water and is reported in nephelometric turbidity units (NTU)





# Turbidity

- Affects light penetration and productivity, recreational values, and habitat quality, and cause lakes to fill in faster.

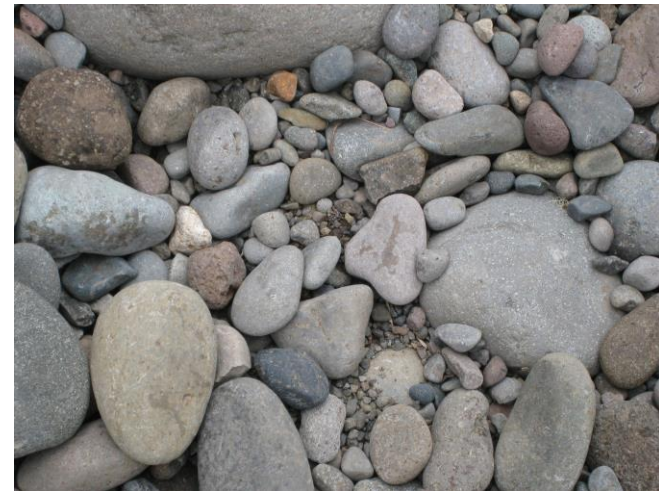
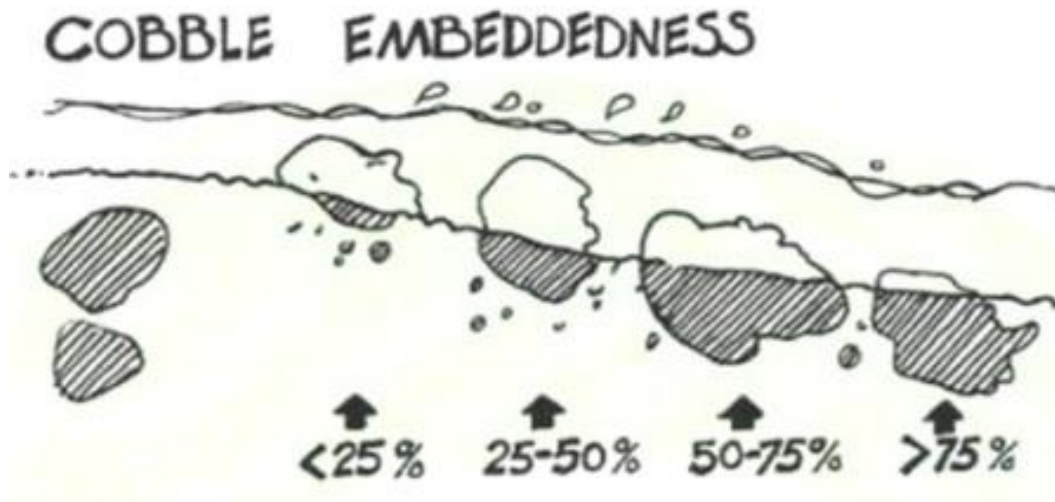


# Turbidity

- Increases sedimentation and siltation, resulting in harm to habitat areas for fish and other aquatic life
- Particles also provide attachment places for other pollutants and pathogens (e.g. metals and bacteria)

# Turbidity

- Substrate Embeddedness
  - Smothers gravels
  - Eliminates invert and fish habitats



<http://www.dep.wv.gov/WWE/getinvolved/sos/Pages/SOPhabitat.aspx>



Low fine sediment



Inter-gravel spaces free

High fine sediment



Inter-gravel spaces clogged  
with fine sediments

# Turbidity

- Pool infilling ( $V^*$  metric)

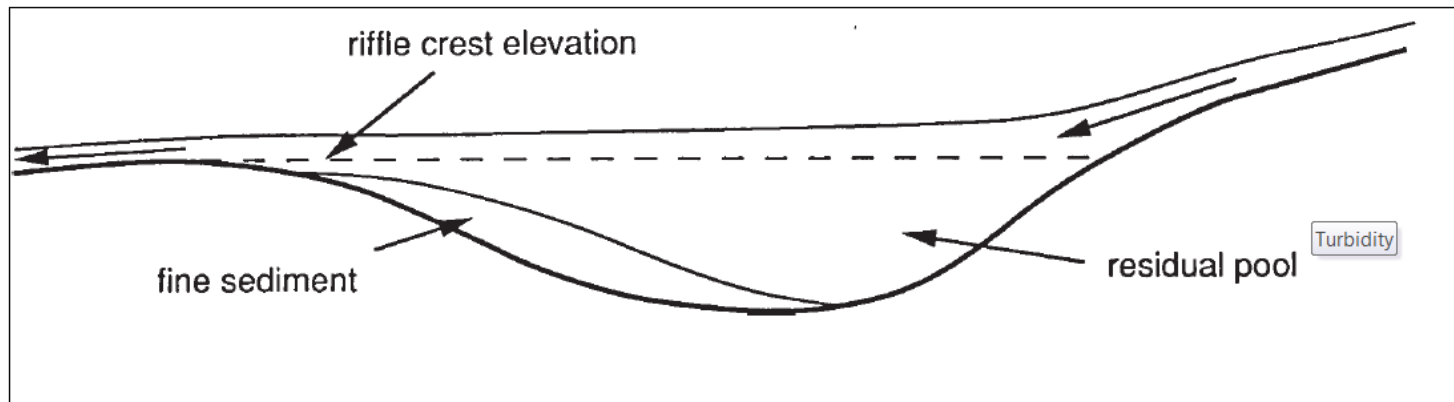


Figure 1. Representative pool in Three Creeks, a tributary to Willow Creek in Six Rivers National Forest

# Velocity/flow/depth/stage

- Many streams have USGS gages to measure stage and flow
- This information is sometimes needed on at a specific location on a stream and/or on streams without a USGS gage.
- Monitoring the velocity/stage/flow in a stream can give us information about variations in inputs to streams

# Method Selection based on Physical Setting

- 3 factors to consider: physical setting, velocity, water depth
- Small channel – flume/v-notch weir or salt dilution method
- Medium – velocity profile via wading rod/current meter
- Large – velocity profile from bridge or tethered profiler (ADCP)



Figure 10-2.—Equipment for making wading measurements with a current meter. Note tag line for marking stations.

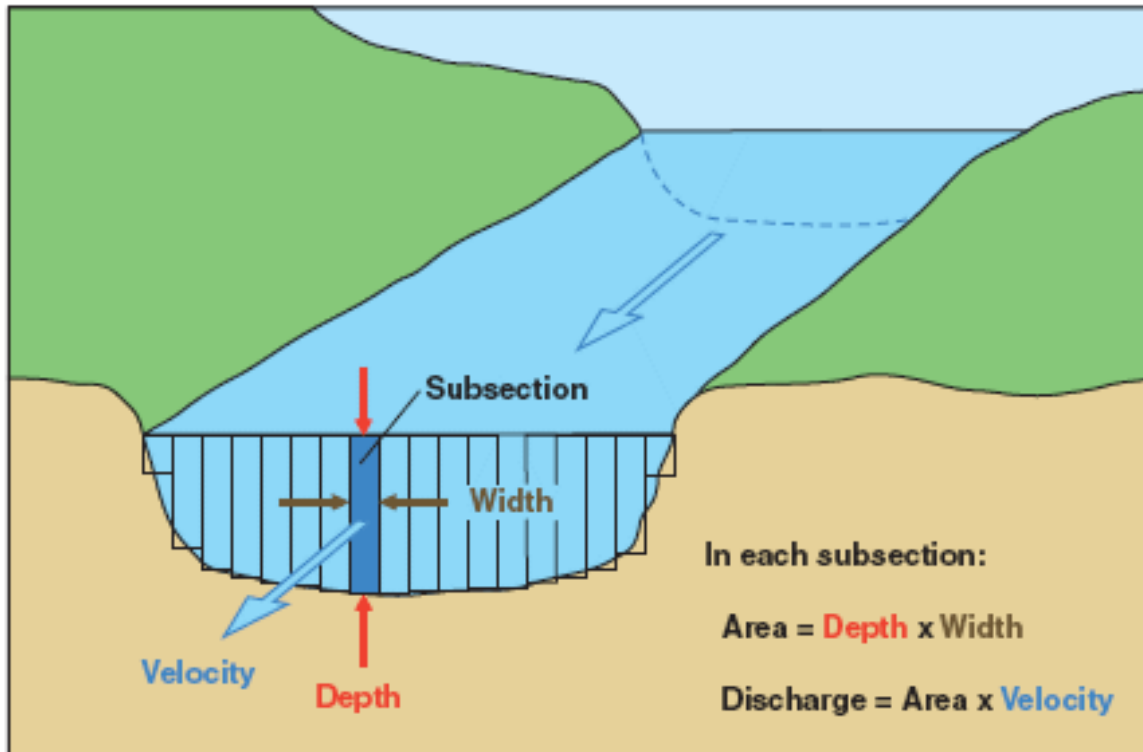


Figure 10-4.—Type A crane and current-meter assembly in position on bridge.



# Measurement of Discharge

- Velocity profiling method



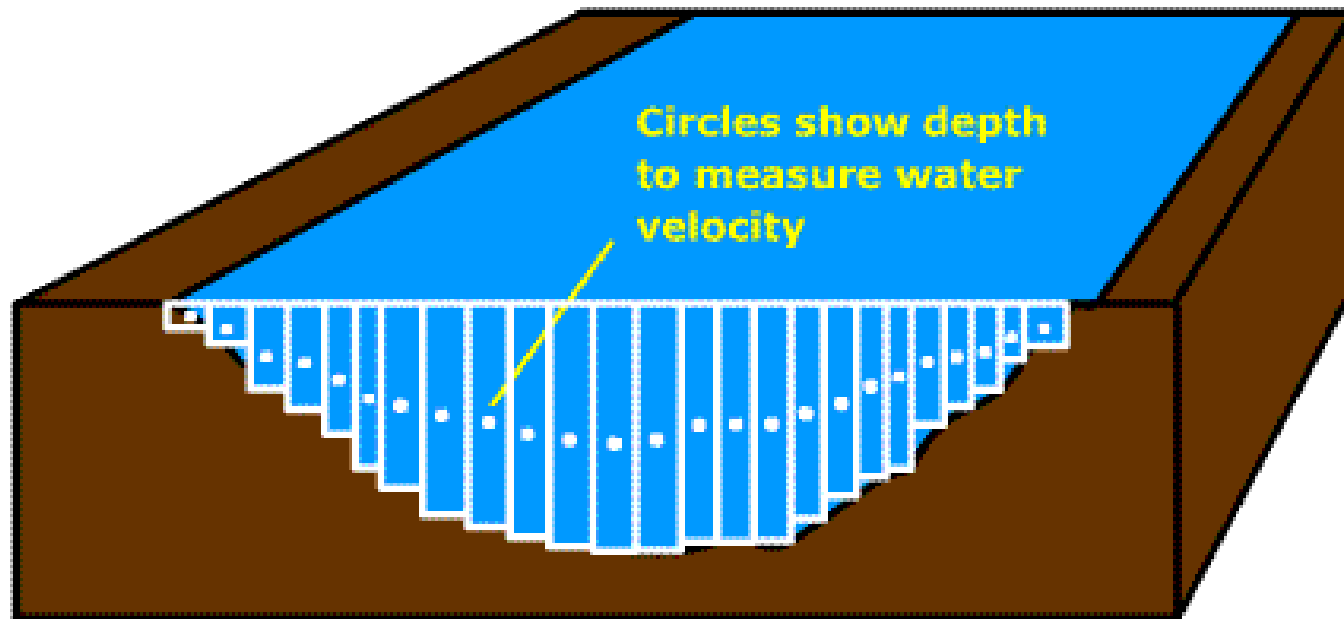
<https://water.usgs.gov/edu/streamflow2.html>

Current-meter discharge measurements are made by determining the discharge in each subsection of a channel cross section and summing the subsection discharges to obtain a total discharge.

# Velocity Measurements

- 0.6 method (60% below surface)
- Also, need average of velocity (20-40s)

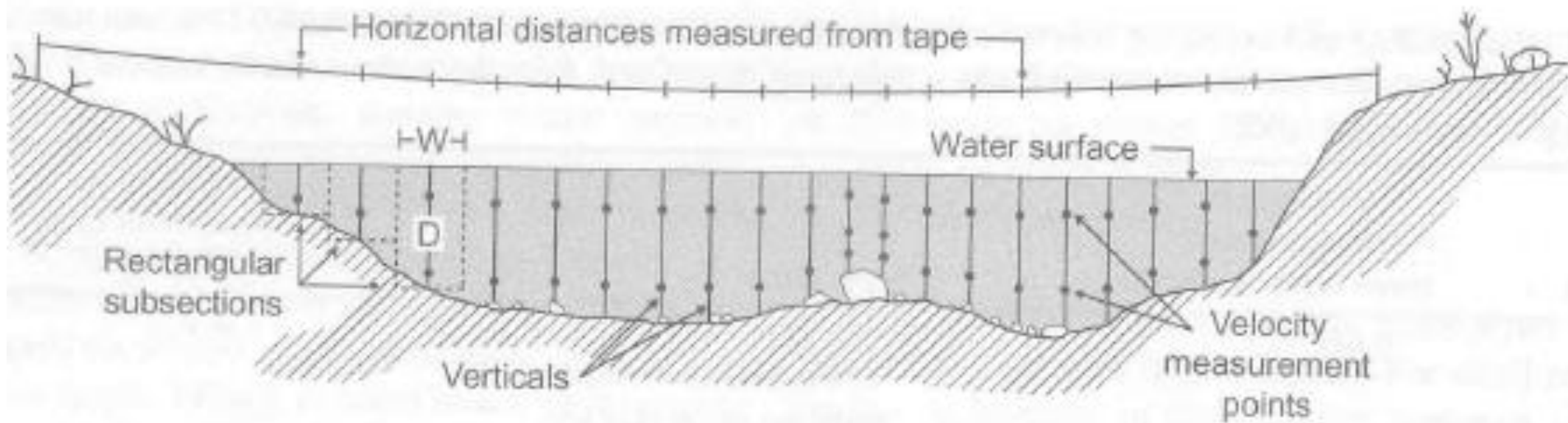
$$\text{Measurement depth} = 0.4 * \text{depth}$$



See rectangular subsections

# Current meter set-up showing position of the tape and depth/velocity stations

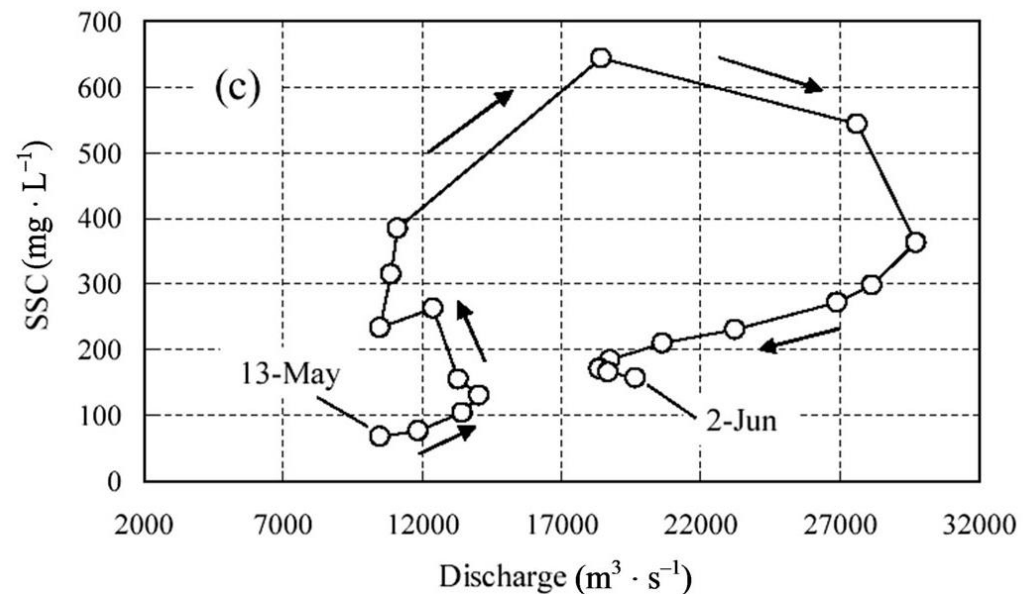
Shows the 0.8 and 0.2 method



Gordon et al., 2004

# Advantages of Continuous Data Collection

- Can adjust for seasonal impacts on sediment transport





# Wikiwatershed.org

- Model My Watershed is a free online tool for getting land use, soils, hydrology and water quality info for your stream or watershed

The screenshot shows the WikiWatershed website interface. At the top is a dark navigation bar with the 'WikiWatershed' logo on the left and links for 'About', 'Model', 'Monitor', 'Manage', 'News', 'Videos', 'Help', 'Donate', and a search icon on the right. Below this is a teal banner with the text 'Web tools advancing knowledge and stewardship of fresh water' and social media icons on the right. The main content area features the Stroud Water Research Center logo and a paragraph stating that WikiWatershed is presented by the Stroud Center, which seeks to advance knowledge and stewardship of freshwater systems through global research, education, and watershed restoration. Below this is a teal banner titled 'Explore the WikiWatershed Toolkit'. Underneath are three cards: 'Model My Watershed' (highlighted with a red circle), 'Model Micro Site Runoff', and 'EnviroDIY'. Each card includes a description, a 'Learn more' link, and a 'Launch the App' or 'Visit EnviroDIY' button. The 'Model My Watershed' card also features a gear icon at the bottom.

WikiWatershed

About Model Monitor Manage News Videos Help Donate

Web tools advancing knowledge and stewardship of fresh water

Contact

STROUD WATER RESEARCH CENTER

WikiWatershed is presented by [Stroud™ Water Research Center](#). The Stroud Center seeks to advance knowledge and stewardship of freshwater systems through global research, education, and watershed restoration.

### Explore the WikiWatershed Toolkit

#### Model My Watershed®

Analyze real geo-data, model storms, and compare conservation or development scenarios in a watershed.

[Learn more](#)

Launch the App

#### Model Micro Site Runoff

Explore how land use and soil determine runoff for the Site Storm Model package of Model My Watershed.

[Learn more](#)

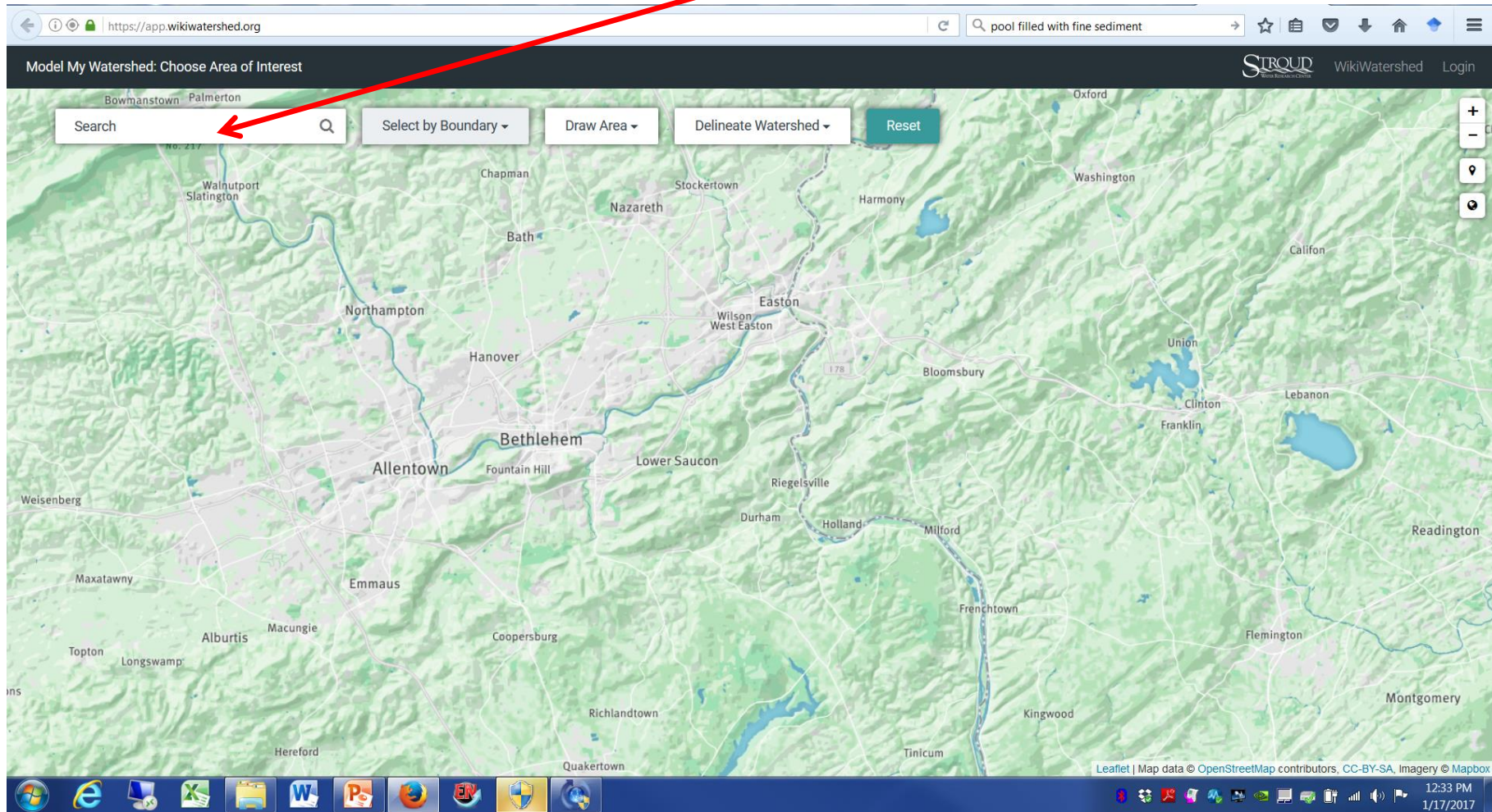
Launch the App

#### EnviroDIY™

Join a community of do-it-yourself enthusiasts sharing open-source ideas for environmental science and monitoring.

Visit EnviroDIY

Works all over the lower 48 states, with extra features in the Delaware River Basin  
Input your town, street address or point of interest here:



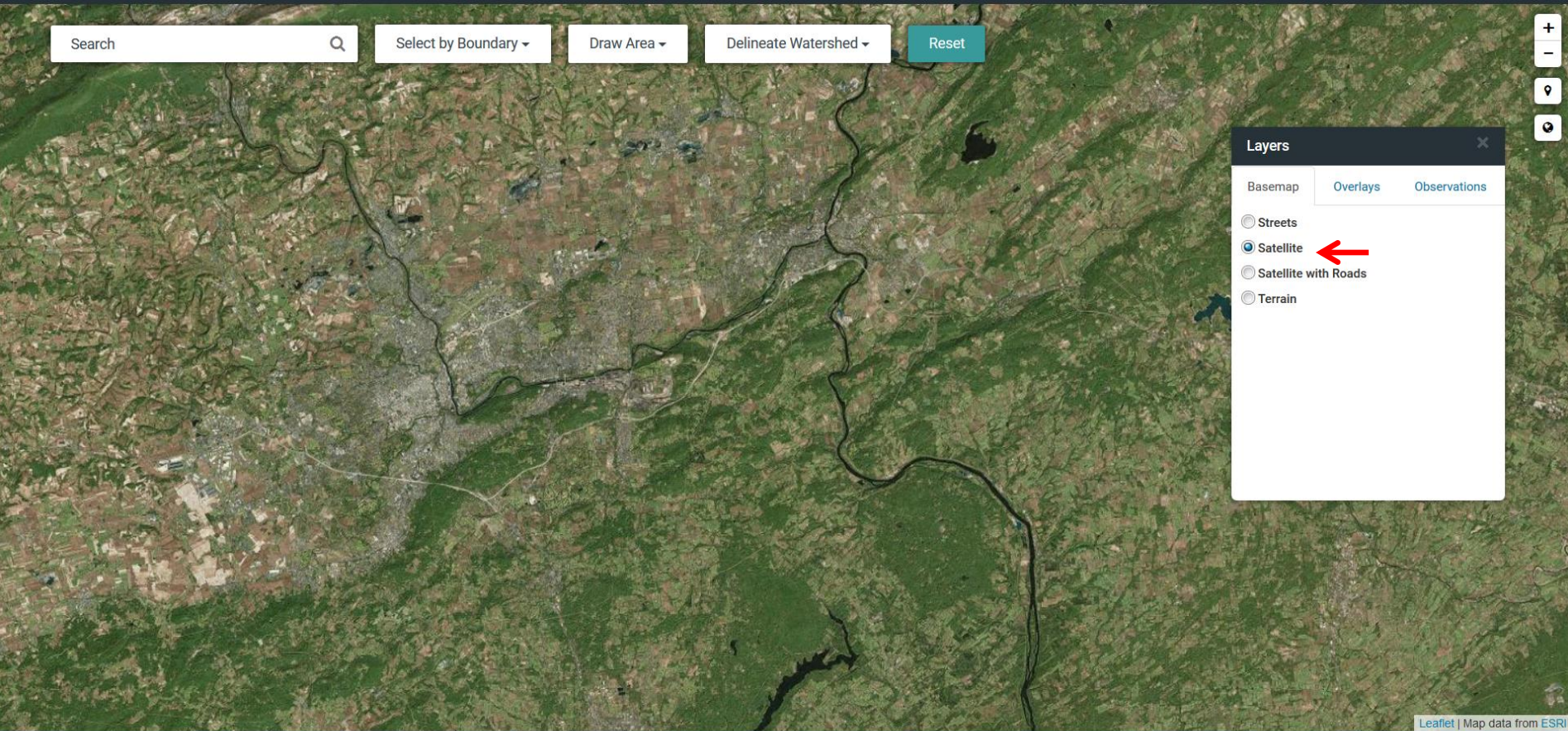


The overlay button gives options for the basemap view as well as overlays

The screenshot displays the 'Model My Watershed: Choose Area of Interest' interface on the website <https://app.wikiwatershed.org/#>. The map shows the Allentown region with various towns labeled, including Northampton, Bethlehem, and Allentown. A red arrow points from the text above to the 'Layers' panel on the right side of the map. The 'Layers' panel has three tabs: 'Basemap', 'Overlays', and 'Observations'. The 'Overlays' tab is selected, and a red arrow points to the 'Streets' option, which is currently selected. Other options in the 'Overlays' tab include 'Satellite', 'Satellite with Roads', and 'Terrain'. The 'Basemap' tab is also visible, and the 'Observations' tab is at the bottom. The map is a topographic view with green terrain and blue water bodies. The interface includes a search bar, a 'Select by Boundary' dropdown, a 'Draw Area' dropdown, a 'Delineate Watershed' dropdown, and a 'Reset' button. The bottom of the screen shows a Windows taskbar with various application icons and a system clock indicating 12:38 PM on 1/17/2017.



Search [magnifying glass icon] Select by Boundary ▾ Draw Area ▾ Delineate Watershed ▾ Reset



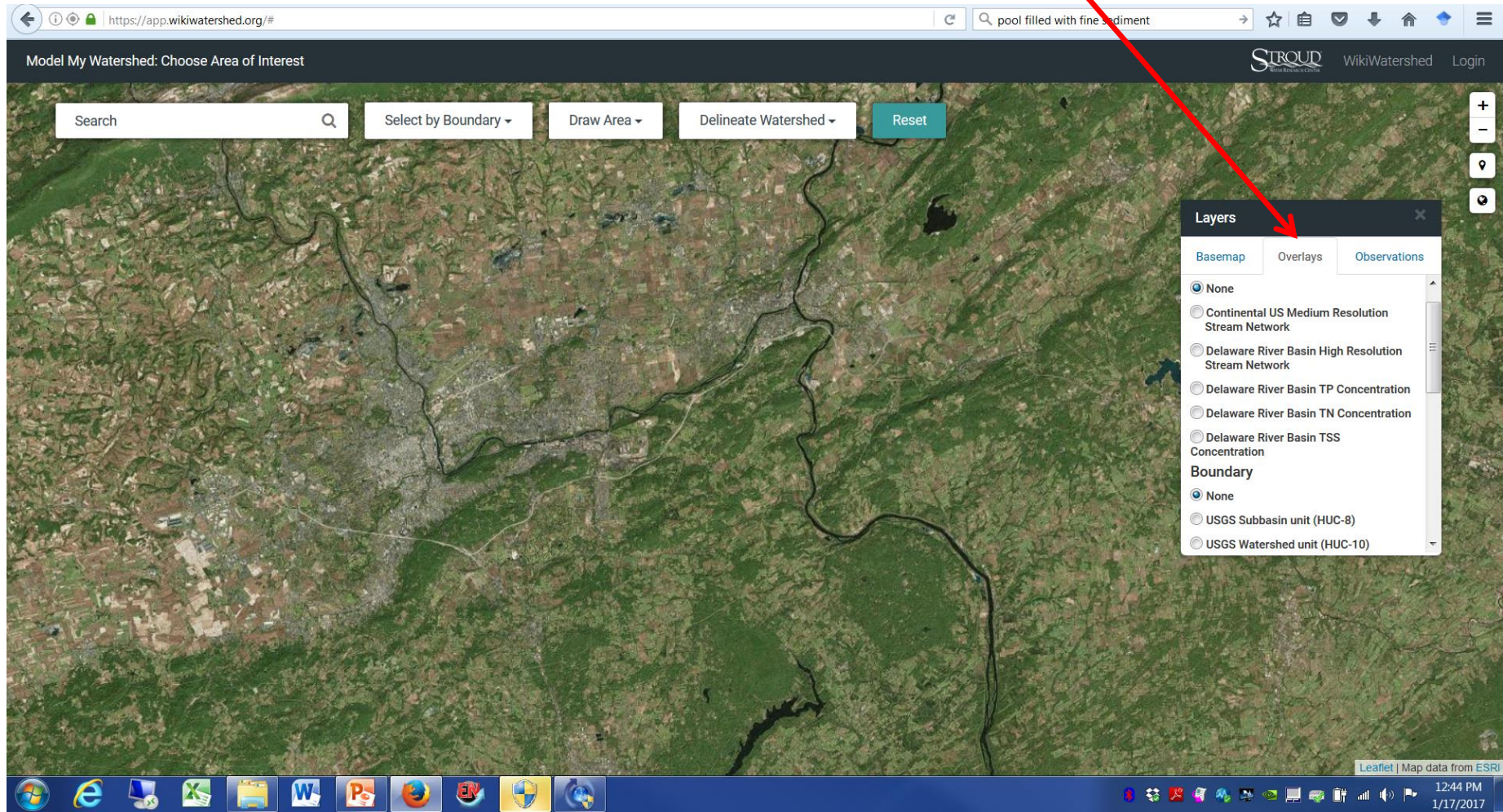
**Layers** [close icon]

Basemap | **Overlays** | Observations

- ☐ Streets
- ☒ **Satellite** ←
- ☐ Satellite with Roads
- ☐ Terrain

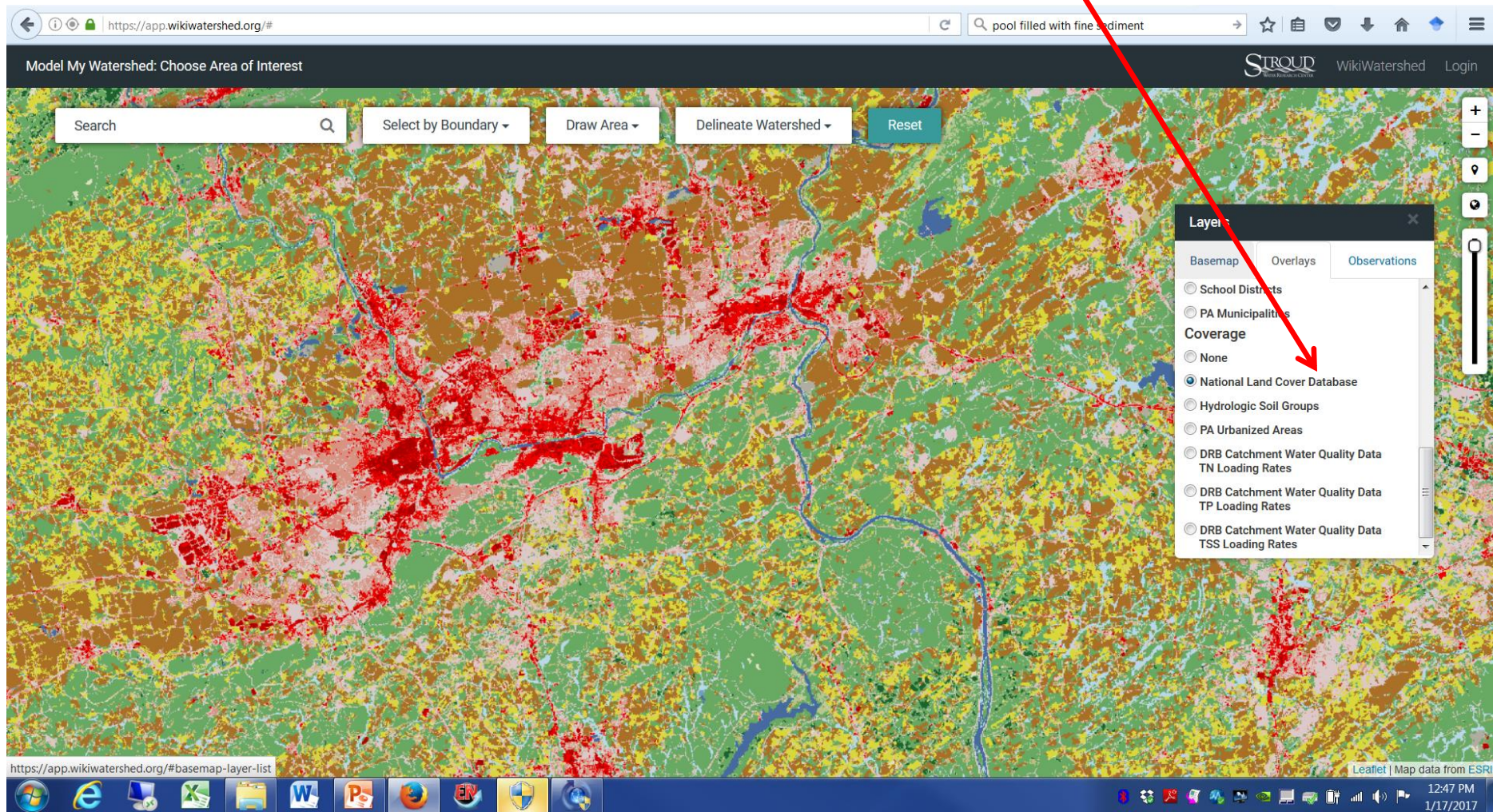


Overlays tab gives options for stream network, land cover, soils, and boundaries





National Land Cover Database overlay selected (red is urban, green is forest, etc.)





Can select area of interest by pre-existing boundary options

The screenshot shows the 'Model My Watershed: Choose Area of Interest' web application. The browser address bar displays 'https://app.wikiwatershed.org/#'. The search bar contains the text 'pool filled with fine sediment'. The main map area shows a satellite view of a watershed with various boundary lines. A red arrow points to the 'Select by Boundary' dropdown menu, which is open and lists the following options: USGS Subbasin Unit (HUC-8), USGS Watershed Unit (HUC-10), USGS Subwatershed Unit (HUC-12), County Lines, Congressional Districts, and School Districts. The 'USGS Subwatershed Unit (HUC-12)' option is currently selected. The map also features a 'Little Bushkill Creek' label and a 'Reset' button. The bottom of the screen shows a Windows taskbar with various application icons and a system clock indicating 12:50 PM on 1/17/2017.

Model My Watershed: Choose Area of Interest

Search

Select by Boundary

Draw Area

Delineate Watershed

Reset

USGS Subbasin Unit (HUC-8)

USGS Watershed Unit (HUC-10)

USGS Subwatershed Unit (HUC-12)

County Lines

Congressional Districts

School Districts

Little Bushkill Creek

Leaflet | Map data from ESRI

12:50 PM 1/17/2017



Or you can draw your own watershed that contributes to your specific point of interest. Activate DRB high resolution network, zoom in, and then place the mark on the streamline closest to your point of interest.

Model My Watershed: Choose Area of Interest

Search

Select by Boundary

Draw Area

Delineate Watershed

Reset

Delaware High Resolution

Mid-Atlantic Medium Resolution

Layers

Basemap

Overlays

Observations

Streams

None

Continental US Medium Resolution Stream Network

Delaware River Basin High Resolution Stream Network

Delaware River Basin TP Concentration

Delaware River Basin TN Concentration

Delaware River Basin TSS Concentration

Boundary

None

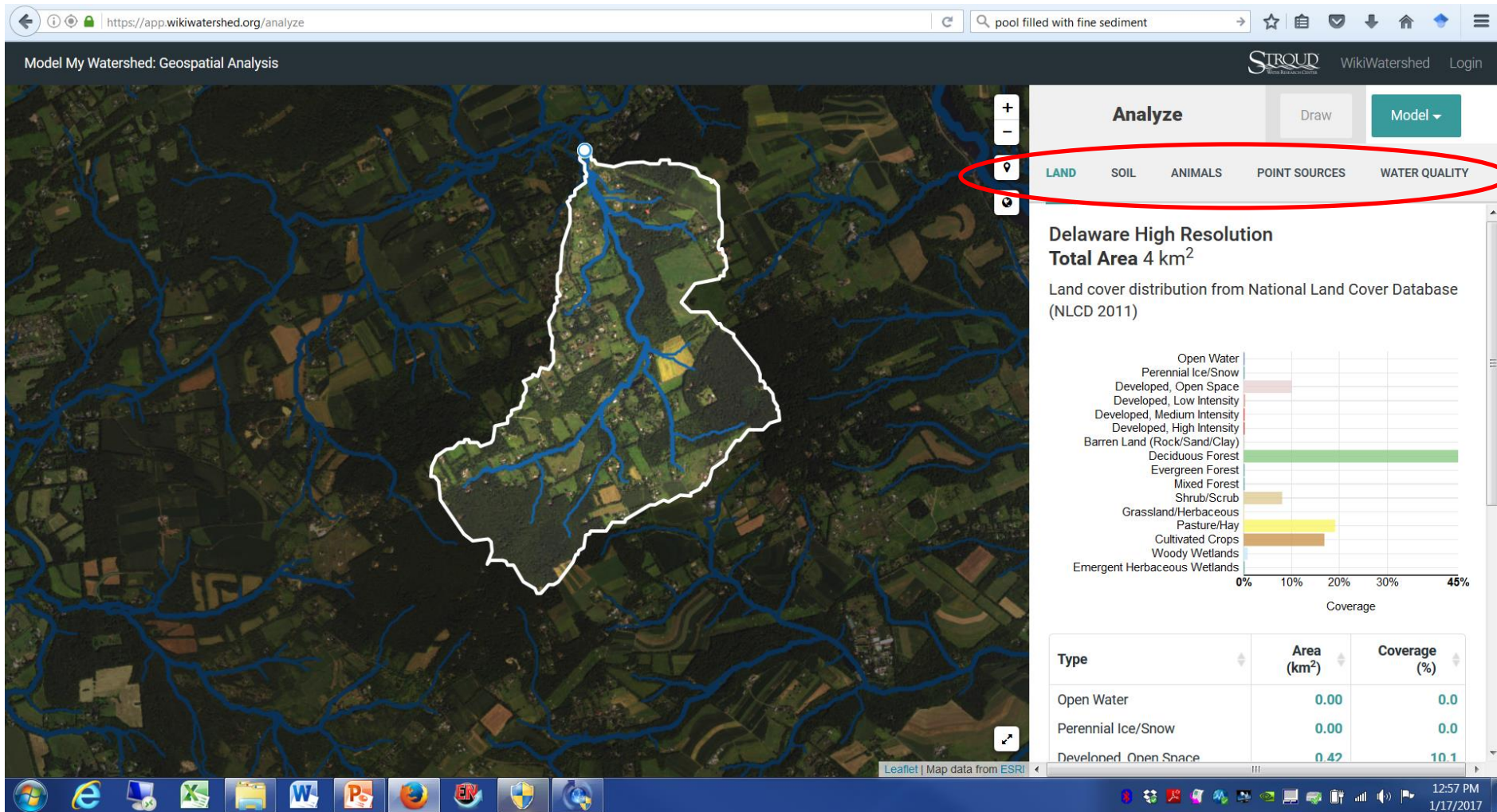
USGS Subbasin unit (HUC-8)

Leaflet | Map data from ESRI

12:53 PM 1/17/2017



Draws the watershed contributing to your point and reports data on right of screen



You can model the hydrology and water quality of your watershed or area using the Watershed Multi-Year Model

Model My Watershed: Geospatial Analysis

STROUD  
Water Research Center

WikiWatershed Login

Analyze Draw Model

LAND SOIL ANIMALS PC

Site Storm Model  
Watershed Multi-Year Model

Delaware High Resolution  
Total Area 4 km<sup>2</sup>

Land cover distribution from National Land Cover Database (NLCD 2011)

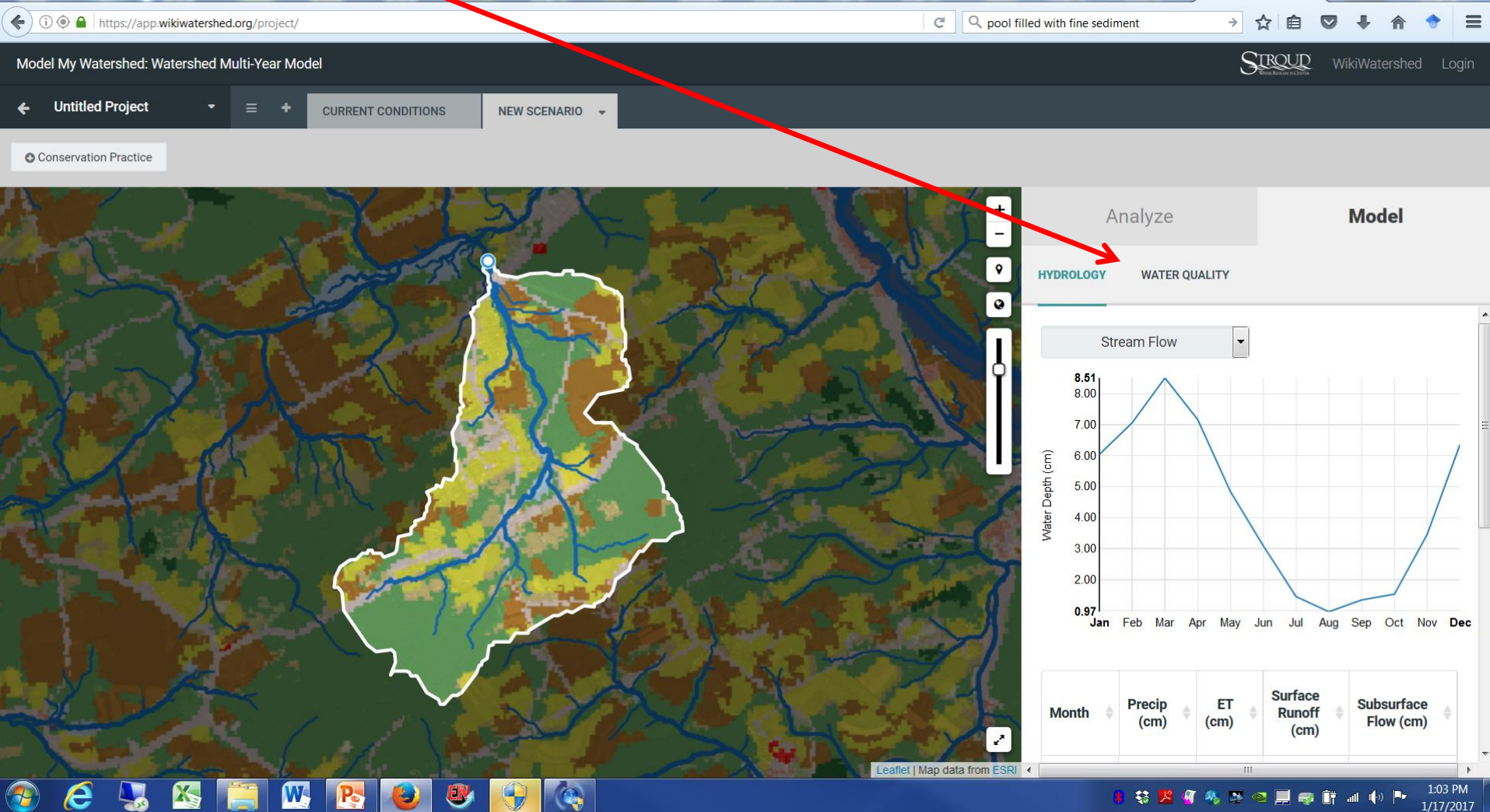
Type	Area (km <sup>2</sup> )	Coverage (%)
Open Water	0.00	0.0
Perennial Ice/Snow	0.00	0.0
Developed, Open Space	0.42	10.1

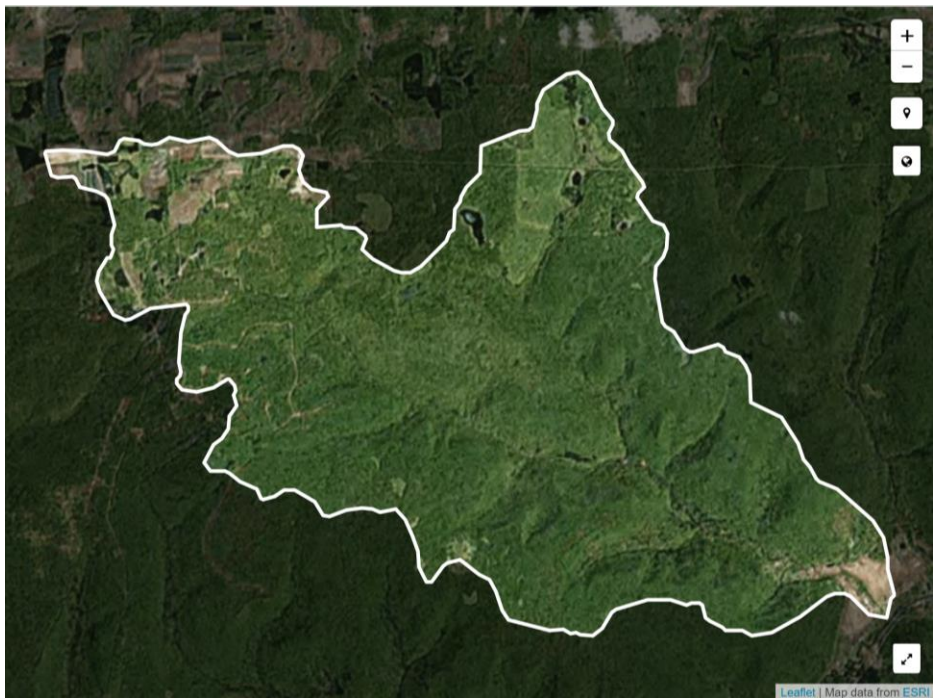
Leaflet | Map data from ESRI

1:00 PM 1/17/2017



The Watershed Multi-Year Model outputs several hydrological and water quality parameters





Sources	Sediment	Total Nitrogen	Total Phosphorus
Total Loads (kg)	237,247.9	9,611.9	846.6
Loading Rates (kg/ha)	55.09	2.23	0.20
Mean Annual Concentration (mg/l)	10.40	0.42	0.04
Mean Low-Flow Concentration (mg/l)	29.80	0.77	0.13

Sources	Sediment	Total Nitrogen	Total Phosphorus
Total Loads (kg)	899,103.2	13,439.0	1,486.1
Loading Rates (kg/ha)	152.92	2.29	0.25
Mean Annual Concentration (mg/l)	29.74	0.44	0.05
Mean Low-Flow Concentration (mg/l)	101.35	0.80	0.15





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