

Integrating stormwater drainage into the U.S. Geological Survey's StreamStats application for the Mystic River Watershed

USGS-Urban Waters Federal Partnership Joint Project
In cooperation with U.S. Environmental Protection Agency, Region 1

2022 National Stormwater Roundtable – Boston, MA

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In this presentation we will:

- Provide an overview of StreamStats and the project
- Demonstrate the stormwater functionality in the Mystic River Basin StreamStats application
- Discuss the basin characteristics that are available
- Provide a brief summary of the processing methods
- Identify benefits of StreamStats urban-stormwater applications
- Provide links to the products

StreamStats is a geospatial web app used to delineate basins, compute basin characteristics, and estimate flow statistics.

USGS StreamStats Report About Help

Regression Based Scenarios

- Peak-Flow Statistics** (Annotated: Estimate flow statistics)
- Low-Flow Statistics
- Flow-Duration Statistics
- August Flow-Duration Statistics
- Bankfull Statistics
- Probability Statistics

Basin Characteristics

Select All Basin Characteristics (Annotated: Compute basin characteristics)

Select	Parameter	Description
<input type="checkbox"/>	ACRSDF	Area underlain by stratified drift
<input type="checkbox"/>	BSLDEM10M	Mean basin slope computed from

Exploration Tools

Layers

- Base Maps
- Application Layers
- National Layers
- MA Map Layers

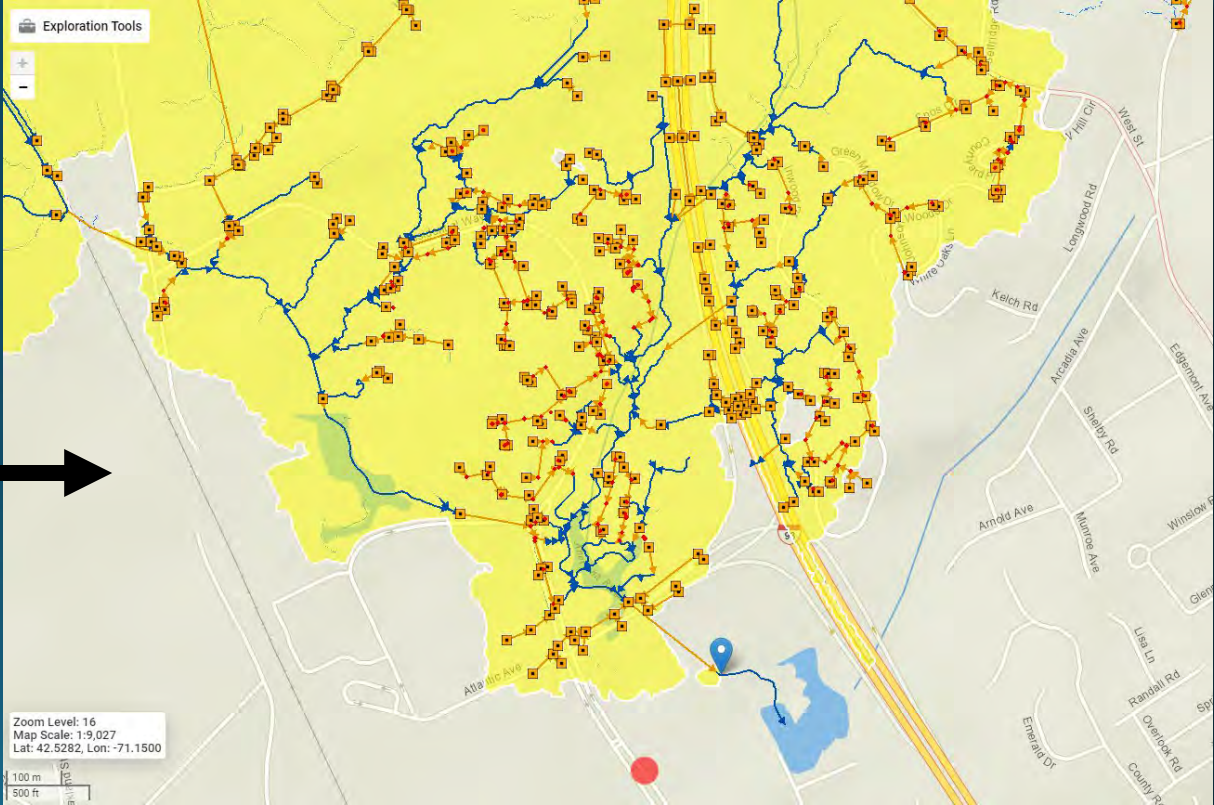
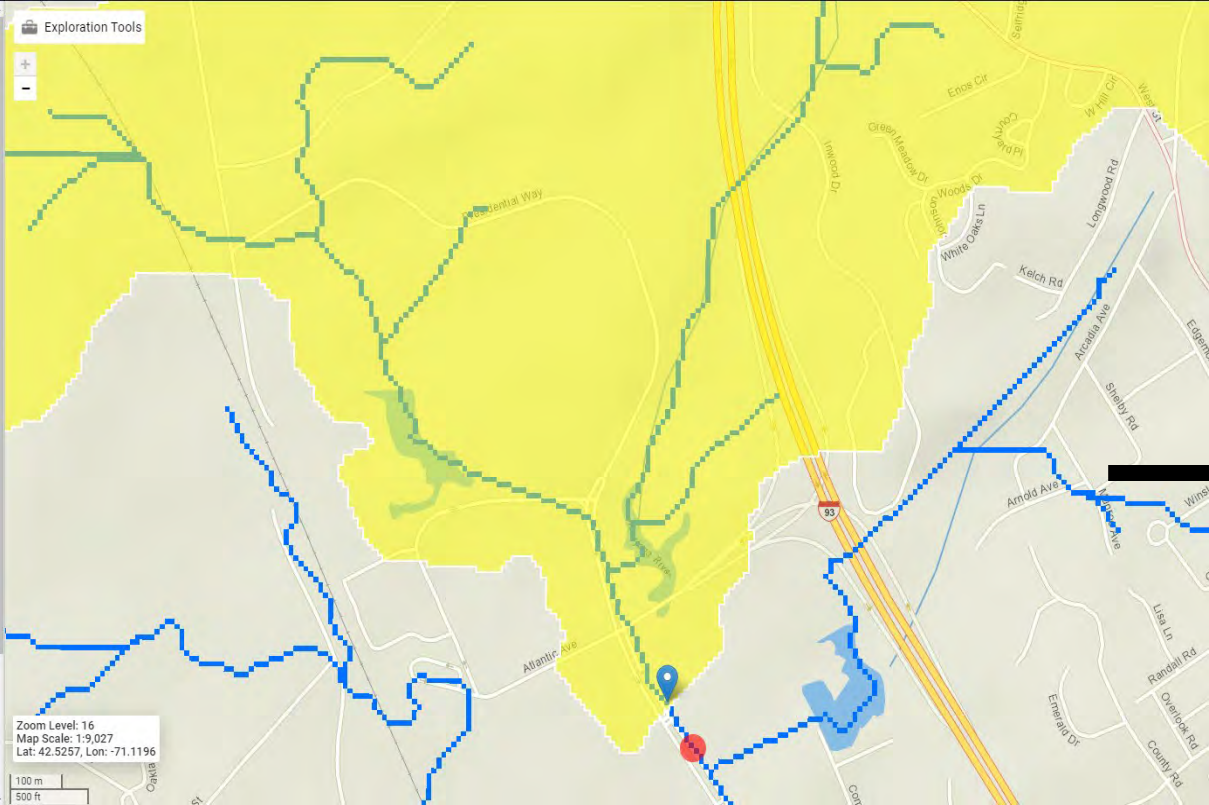
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Map Scale: 1:36,111
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500 m
2000 ft

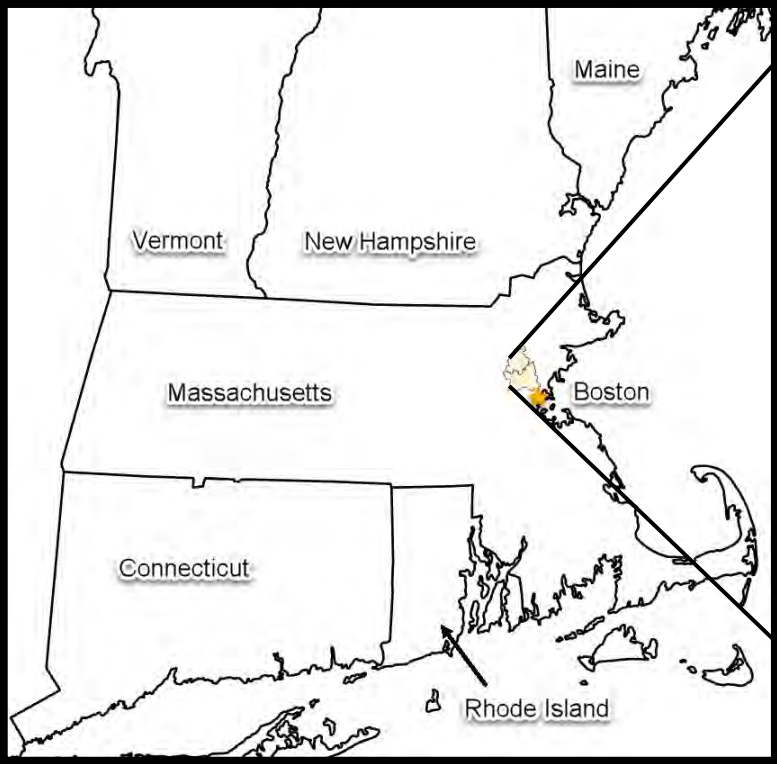
Delinate topographic drainage areas

<https://streamstats.usgs.gov>

We have added municipal storm drain data to the USGS StreamStats application for the Mystic River Watershed.



The Mystic River Watershed is a highly urbanized basin north of Boston, Massachusetts.



~ 42 %
Impervious
area

¹MassGIS 2016 Land Cover



This project is the first watershed-scale effort to represent urban hydrology in StreamStats by incorporating manmade infrastructure such as storm drains and culverts.

- ~ 36,000 catch basins
- ~ 62,000 pipes (including culverts)
- ~ 5000 stream segments
- data were also reviewed in a 300-meter buffer zone surrounding the basin

Flow is diverted away from Fresh Pond in Cambridge.

USGS StreamStats [Development Version: Not for public consumption] [Report](#) [About](#) [Help](#)

SELECT A STATE / REGION
Mystic River Basin ⓘ

IDENTIFY A STUDY AREA
Basin Delineated >

Step 5: Your delineation is complete. You can now clear, edit, or download your basin, or choose a state or regional study specific function (if available). Click **continue** when you are ready.

Clear Basin

Edit Basin

State/Region Specific Functions
The following additional functions are available for Mystic River Basin.

Download Basin

or

Continue

Exploration Tools
+
-

Arlington

Beaver Brook

Epy Pond

Belmont Town of Belmont

Fresh Pond

Layers

- Gray
- Dark Gray
- Imagery
- Shaded Relief

Application Layers ▾

- National Layers ▾
- MRB Map Layers ▲

- ExcludePolys
- StreamGrid
- T

Zoom Level: 14
Map Scale: 1:36,111
Lat: 42.3911, Lon: -71.1042

500 m
2000 ft

Leaflet | Esri, NAVTEQ, DeLorme

Water flows solely through a pipe network in Somerville.



StreamStats [Development Version: Not for public consumption]

Report About Help

SELECT A STATE / REGION
Mystic River Basin

IDENTIFY A STUDY AREA
Basin Delineated

Step 5: Your delineation is complete. You can now clear, edit, or download your basin, or choose a state or regional study specific function (if available). Click **continue** when you are ready.

Clear Basin

Edit Basin

State/Region Specific Functions

The following additional functions are available for Mystic River Basin.

Download Basin

OR

Continue

Exploration Tools

+
-



Zoom Level: 18
Map Scale: 1:2,256
Lat: 42.3885, Lon: -71.0963

30 m
100 ft

Layers

Base Maps

- National Geographic
- National Map
- Streets
- World Topographic
- Gray
- Dark Gray
- Imagery
- Shaded Relief

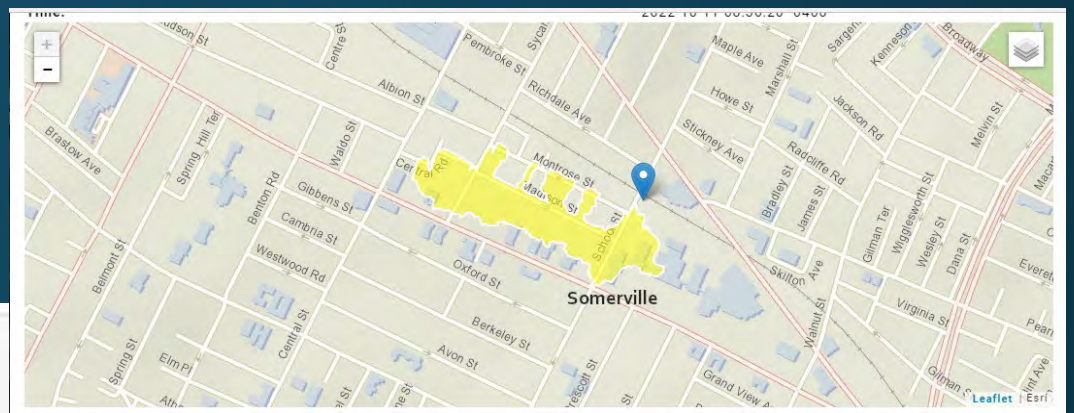
Application Layers

National Layers

Landcover basin characteristics and nutrient loads can be computed for StreamStats delineations.

Phosphorus Source Category by Land Use	Land Surface Cover	P Load Export Rate, lbs/acre/year
Commercial and Industrial	Directly connected impervious	1.78
	Pervious	See* DevPERV
Multi-Family and High-Density Residential	Directly connected impervious	2.32
	Pervious	See* DevPERV
Medium -Density Residential	Directly connected impervious	1.96
	Pervious	See* DevPERV
Low Density Residential - "Rural"	Directly connected impervious	1.52
	Pervious	See* DevPERV
Highway	Directly connected impervious	1.95^
	Pervious	See* DevPERV
Forest	Directly connected impervious	1.52
	Pervious	0.13
Open Land	Directly connected impervious	1.52
	Pervious	See* DevPERV
Agriculture	Directly connected impervious	1.52
	Pervious	0.45
*Developed Land Pervious (DevPERV)- Hydrologic Soil Group A	Pervious	0.03
*Developed Land Pervious (DevPERV)- Hydrologic Soil Group B	Pervious	0.12
*Developed Land Pervious (DevPERV) - Hydrologic Soil Group C	Pervious	0.21

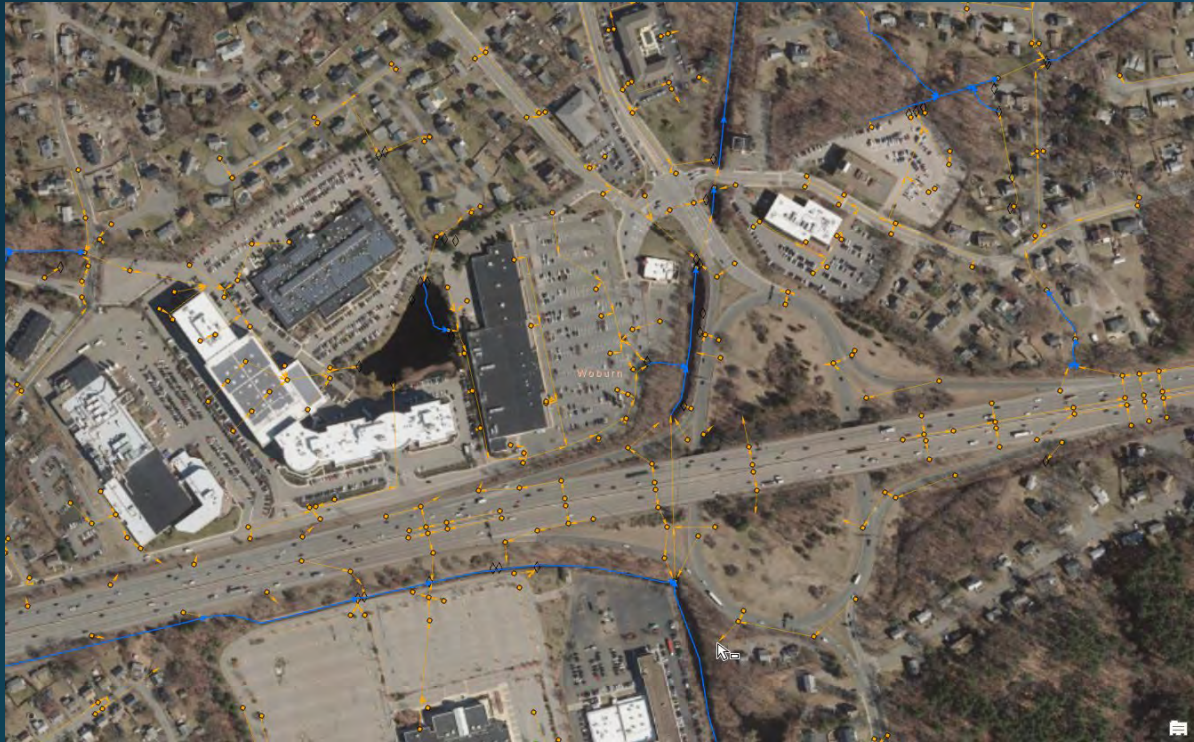
A StreamStats report provides basin characteristics and drainage area.



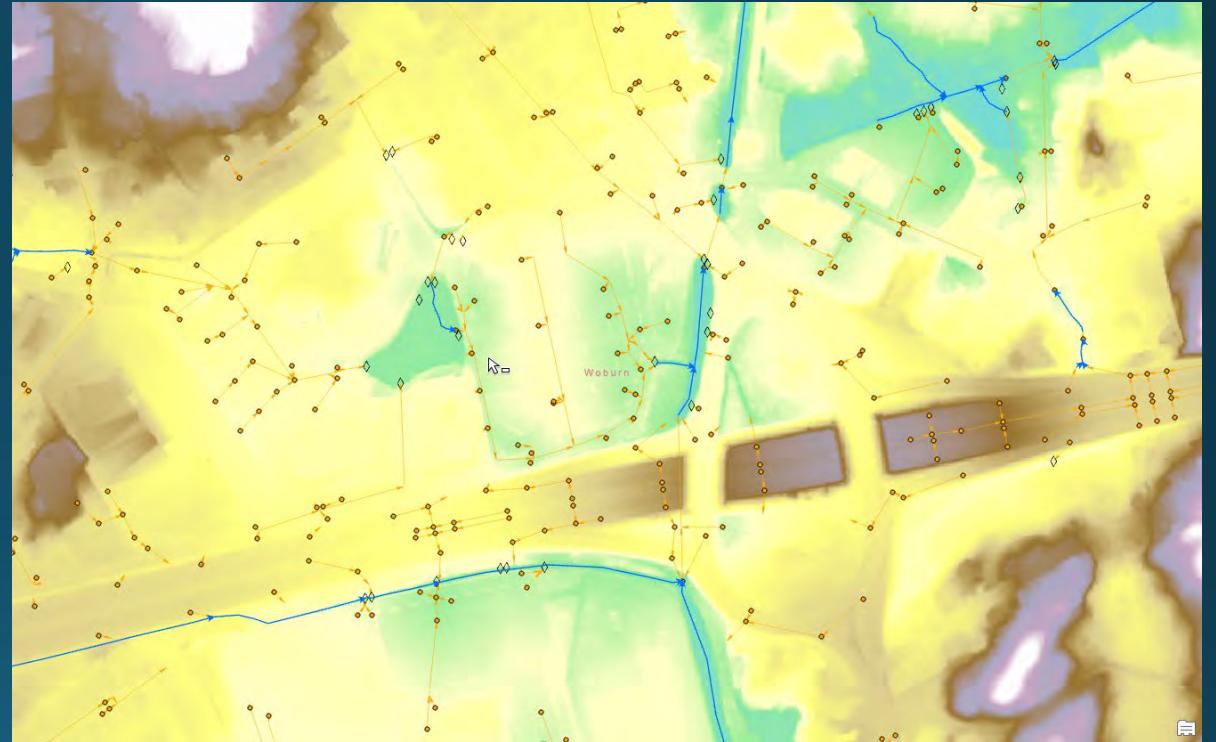
Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
AG_IMPERV	Percentage of area covered by agricultural land that is also impervious	0	percent
AG_PERV	Percentage of area covered by agricultural land that is also not classed as impervious	0	percent
COMM_IND	Percent of area covered by commercial and industrial land uses	15.95	percent
DEV_OP_IMP	Percent of area classed as developed open land that is also impervious	0	percent
DRNAREA	Area that drains to a point on a stream	0.0172	square miles
FOR_PERV	Percentage of area covered by forest land that is also not classed as impervious	13.56	percent
FRST_IMPRV	Percentage of area covered by forest land that is also impervious	0	percent
HIGHWAY	Percent of area covered by highways and their associated right-of-way areas	20.31	percent
MD_RES	Percent Medium-Density Residential	9.47	percent
MF_HD_RES	Percent Multi-Family and High-Density Residential	33.68	percent
PV_HSG_A	Percent of area in SSURGO hydrologic soils group A and not classed as impervious	0	percent
PV_HSG_B	Percent of area in SSURGO hydrologic soils group B and not classed as impervious	0	percent
PV_HSG_C	Percent of area in SSURGO hydrologic soils group C and not classed as impervious	0	percent
PV_HSG_D	Percent of area in SSURGO hydrologic soils group D and not classed as impervious	7.03	percent
WATER	Percent of area covered by open water (lakes, ponds, reservoirs)	0	percent

High-resolution elevation and hydrography data were used in conjunction with municipal data to build a geometric network.

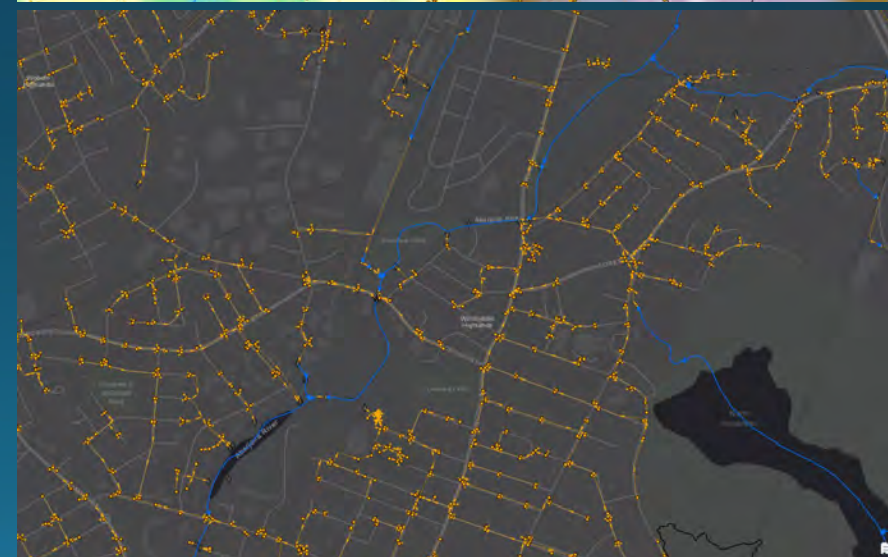
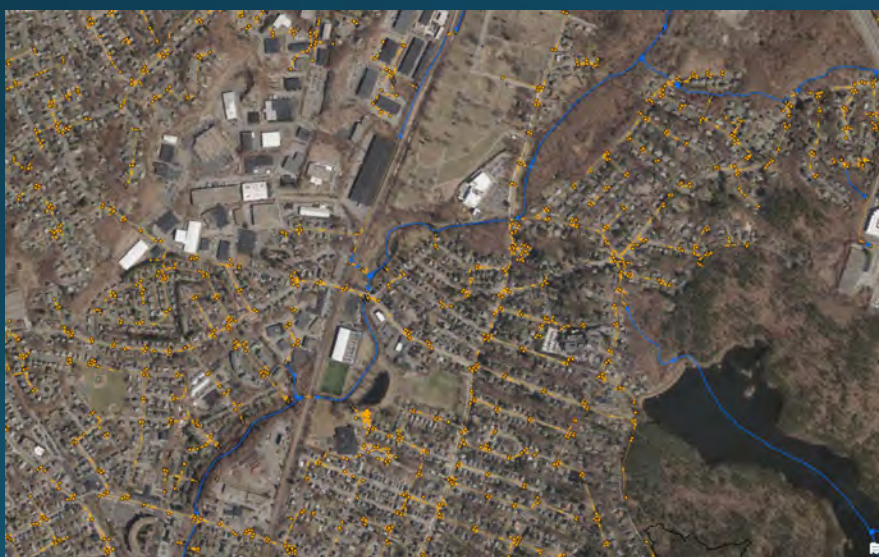
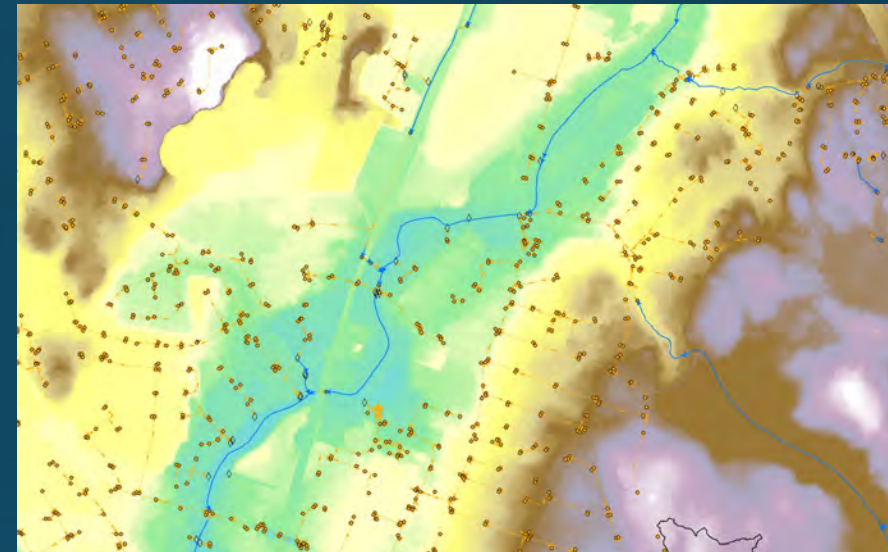
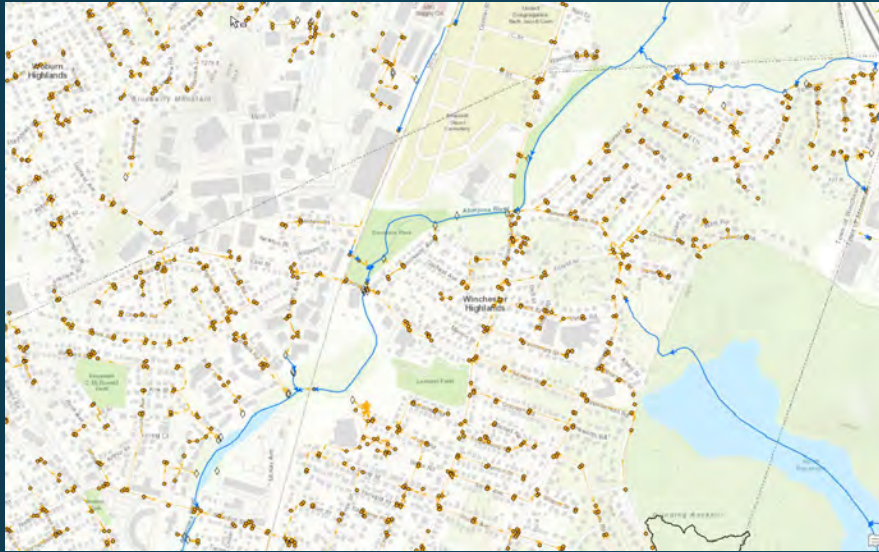


Route 38 Underpass and Middlesex Canal, Woburn



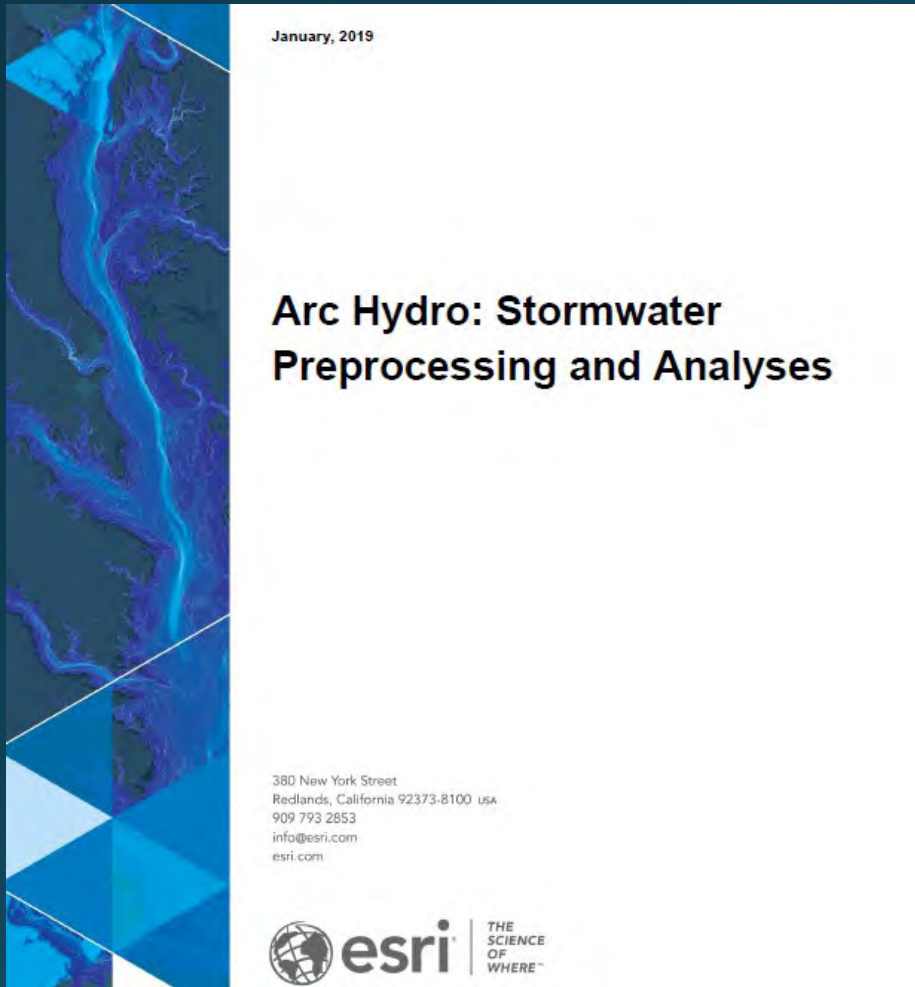
1-meter-resolution digital elevation model (DEM)

Editing is required to ensure connectivity within the network. We used several base maps to help make editing decisions.



Winchester Highlands and the Aberjona River

ArcHydro tools were used to create the stormwater network through iterative processing.



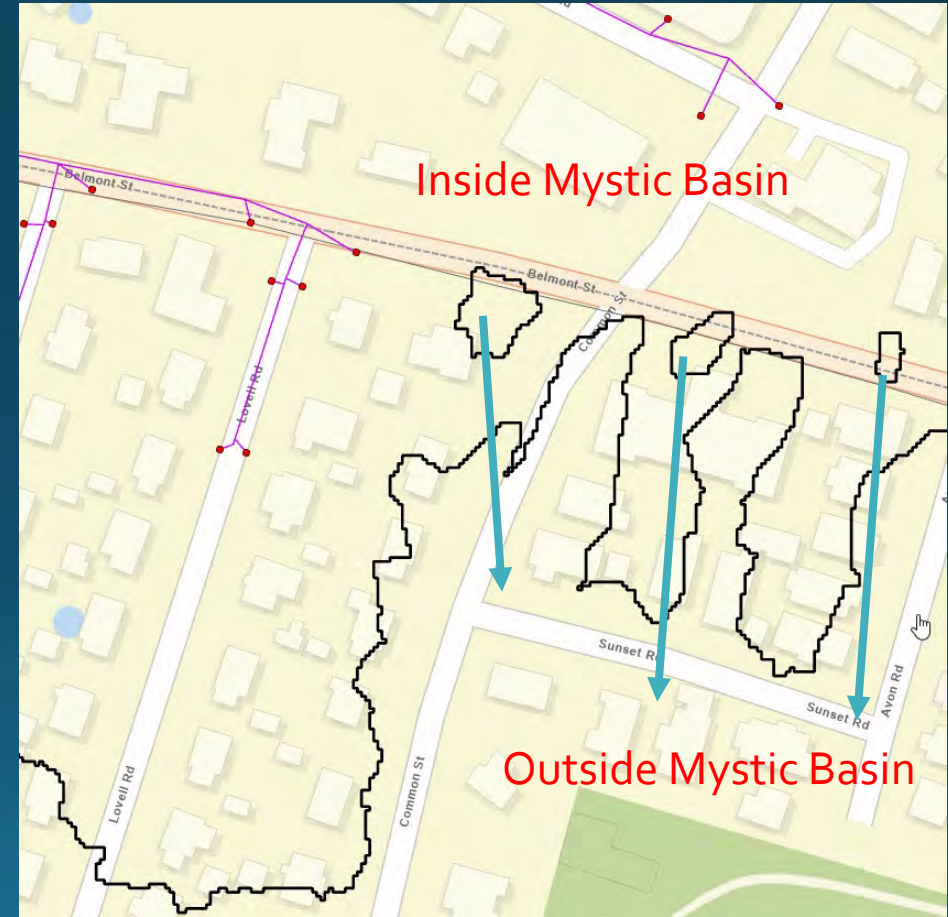
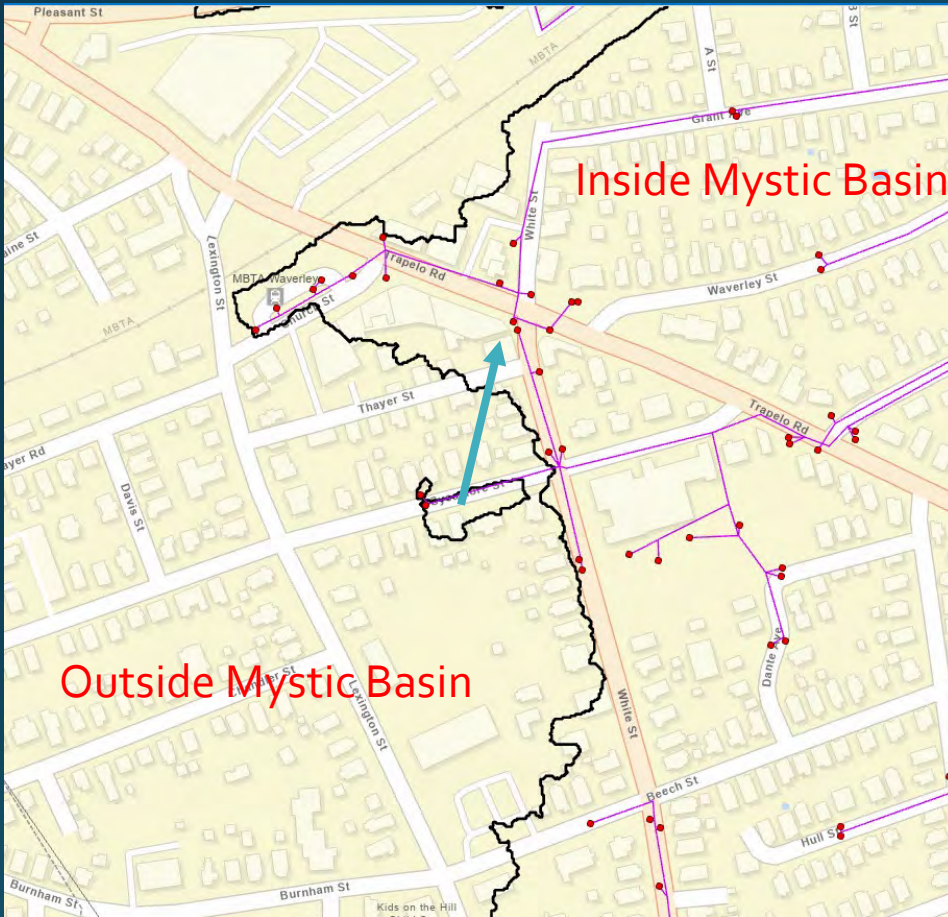
Inputs:
DEM
Pipes
Streams
Inlets
Outlet



Outputs:
DEM derivatives
Catchment polygons
Overland connectors*
ArcHydro Stormwater Network*

* Unique to the Stormwater Preprocessing and Analysis tools

In some places the Mystic Basin was modified in uniquely-urban ways.



Enhancing StreamStats with urban infrastructure data can support efforts to:

- Mitigate flooding
- Map culverts
- Identify illicit discharges
- Meet permit requirements
- Address water-quality concerns
- and the foundation for much more

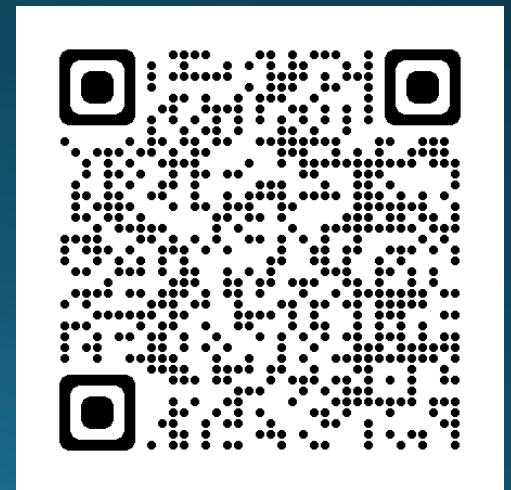
Collaboration at Federal, State and local levels was integral to the success of the project.

- Collaborators:
 - USGS “Mystic” Team
 - EPA Region 1
 - Laura Schifman – MA DEP Statewide Stormwater Program Manager
 - Neil MacGaffey MassGIS
 - Municipalities
 - Mystic River Watershed Association
 - Mystic River Steering Committee
 - ESRI (ArchHydro Team)



There are two new data releases associated with the project.

- DEM and derivatives data release
 - Digital Elevation Model (DEM)
 - Flow Direction Grid
 - Catchment areas (to catch basins and streams)
 - <https://doi.org/10.5066/P9FHAFG7>
- Basin Characteristics data release
 - Landcover characteristics for Massachusetts Small MS4 Permit Pollutant Loading Export Rates
 - <https://doi.org/10.5066/P9HJSN2Q>



Access the development version of this tool at
<https://streamstats.usgs.gov/ss/>

The screenshot displays the StreamStats web application interface. The top navigation bar includes the USGS logo and the text "StreamStats", along with links for "Report", "About", and "Help". The main content area is divided into a left sidebar and a central map.

Left Sidebar:

- A blue header bar with the text "SELECT A STATE / REGION" and a right-pointing arrow.
- A grey box containing the text: "Step 1: Use the map or the search tool to identify an area of interest. At zoom level 8 or greater State/Region selection will be enabled."
- A search bar with the placeholder text "Search for a place", which is circled in red.
- Four menu items: "IDENTIFY A STUDY AREA", "SELECT SCENARIOS", "BUILD A REPORT", and "Tell us how you use StreamStats!".
- A footer note: "POWERED BY WIM".

Central Map:

- A topographic map of the United States with various geographical features labeled.
- An "Exploration Tools" panel on the left side of the map with zoom in (+) and zoom out (-) buttons.
- A "Layers" panel on the right side of the map with a close button (X) and two options: "Base Maps" and "National Layers" (checked).
- A red square highlights the city of Boston on the map.
- A status box at the bottom left of the map displays: "Zoom Level: 4", "Map Scale: 1:36,978,596", and "Lat: 45.5217, Lon: -76.4648".
- A scale bar at the bottom left shows "500 km" and "300 mi".
- The bottom right corner of the map includes the text "Leaflet | Esri".

Thank you

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