The Urban Tree Canopy Mapper: An Overview

John McGee
Dept. Forest Resources and Environmental Conservation
Virginia Tech
jmcg@vt.edu

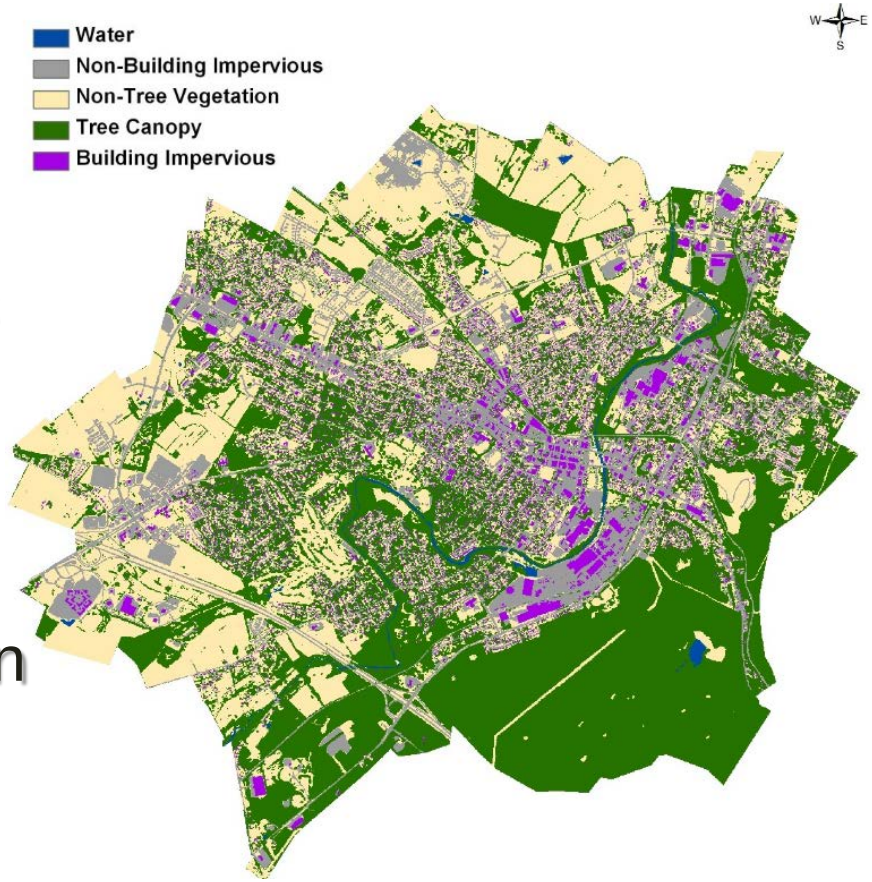
In conjunction with:
Eric Wiseman, Susan Day, Barbara White, & Lola Roghair

Urban Tree Canopy Assessments

- You can't have a UTC mapper without tree canopy data!
- Assessing UTC: a 'top down' approach
  - Aerial photography
  - Leaf-on
  - High resolution
  - 3 visible bands + the near infrared
  - Lidar data (if available)
  - Remote sensing software required
  - A solid investment of time and expertise…

UTC Assessment Classification

- Water
- Buildings Impervious
- Non-building impervious
- Tree Canopy
- Non Tree Vegetation



UTC Assessments

Abingdon
Arlington County
Ashland
Blacksburg
Charlottesville
Chesapeake
Fredericksburg
Front Royal
Lexington
Luray
Lynchburg
Manassas
Newport News
Norfolk
Portsmouth
Radford
Richmond
Roanoke City
Salem
Vinton
Virginia Beach
Waynesboro
Winchester
Woodstock

A Report on the City of Richmond's Existing and Possible Urban Tree Canopy

Key Terms

UTC: Urban tree canopy (UTC) is the layer of leaves, branches, and stems of trees that cover the ground when viewed from above.
Land Cover: Physical features on the earth mapped from satellite or aerial imagery such as trees, or water.
Existing UTC: The amount of UTC present within parcel boundaries.
Possible UTC: The amount of land that is theoretically available for the establishment of tree canopy within parcel boundaries. Possible UTC excludes areas covered by tree canopy, roads, buildings, and water. It is the combination of Possible UTC - Vegetation and Possible UTC - Impervious.
Possible UTC - Vegetation: The amount of land that is theoretically available for the establishment of tree canopy in non-tree vegetation areas within parcel boundaries. This excludes areas covered by tree canopy, impervious surfaces, and water.
Possible UTC - Impervious: The amount of land that is theoretically available for the establishment of tree canopy in impervious areas within parcel boundaries. This includes impervious areas (roads, parking lots, and sidewalks) except for buildings.

Project Background

The analysis of Richmond's urban tree canopy (UTC) was carried out at the request of the Virginia Department of Forestry in collaboration with the City of Richmond and the Chesapeake Bay Program. The analysis was performed by the Virginia Geospatial Extension Program (VGEP) at Virginia Tech's Department of Forest Resources and Environmental Conservation in consultation with the Spatial Analysis Laboratory (SAL) of the University of Vermont.

The goal of the project was to apply the USDA Forest Service's UTC assessment protocols to the City of Richmond. This analysis was conducted based on year 2008 data.

Why is Tree Canopy Important?

Urban tree canopy (UTC) is the layer of leaves, branches, and stems of trees that cover the ground when viewed from above. Urban tree canopy provides many benefits to communities including improving water quality, conserving energy, lowering City temperatures, reducing air pollution, enhancing property values, providing wildlife habitat, facilitating social and educational opportunities, and providing aesthetic benefits.

Figure 1: Land cover for the City of Richmond.

How Much Tree Canopy Does Richmond Have?

Figure 1 shows the UTC analysis for Richmond, which is derived from high resolution aerial imagery. 16,121 acres of Richmond is covered by tree canopy (termed Existing UTC). This corresponds to 40% of the total land area within the City (Table 1). An additional 13,329 acres of the City could theoretically be improved to support urban tree canopy (termed Possible UTC), Table 2.

UTC Classes	Existing UTC		
	Acres	% Total Land Area*	% Land Area
Tree Canopy	16,120.8	40.3%	41.9%
Non-Tree Vegetation	8,916.5	22.3%	23.2%
Non-Building Impervious	9,331.5	23.3%	24.2%
Buildings Impervious	4,138.7	10.3%	10.7%
Water	1,501.6	3.8%	0.0%
Total Area	40,009.2	100.0%	100.0%

Table 1: Existing UTC area and percentages for the City.

**% Total Land Area includes area covered by water.*

Summary reports and assessment data were provided to the localities. Also provided mentoring and support (workshops, etc.).

UTC Community Assessments

- Lots of data…
- Lots of different ways to ‘look at the data’
- Lots of potential stakeholders that could utilize the data
- Unfortunately, the UTC data can be difficult to access if you are not a ‘GIS person’
  - We did not want these assessments just sitting on the shelf.

These concerns led to the development of the UTC Mapper

The UTC Mapper

Advantages:

- No Software required
  - (Except for a silverlight plugin)
- User-friendly & visual
  - “this is kind of like using GoogleEarth”
- Interactive
  - Zoom-in & out, pan, etc.
- Print locally
- Save graphics to PowerPoint / Word / etc.

The UTC Mapper

Advantages (continued):

- Generate user-defined UTC metrics
  - By neighborhood, school district, HOA, multiple city blocks, or any other region…
- Generate UTC metrics by subwatershed (level 6 / 12 digit)

- **Expandable:**
  - By geography and functionality!

The UTC Mapper

Disadvantages:

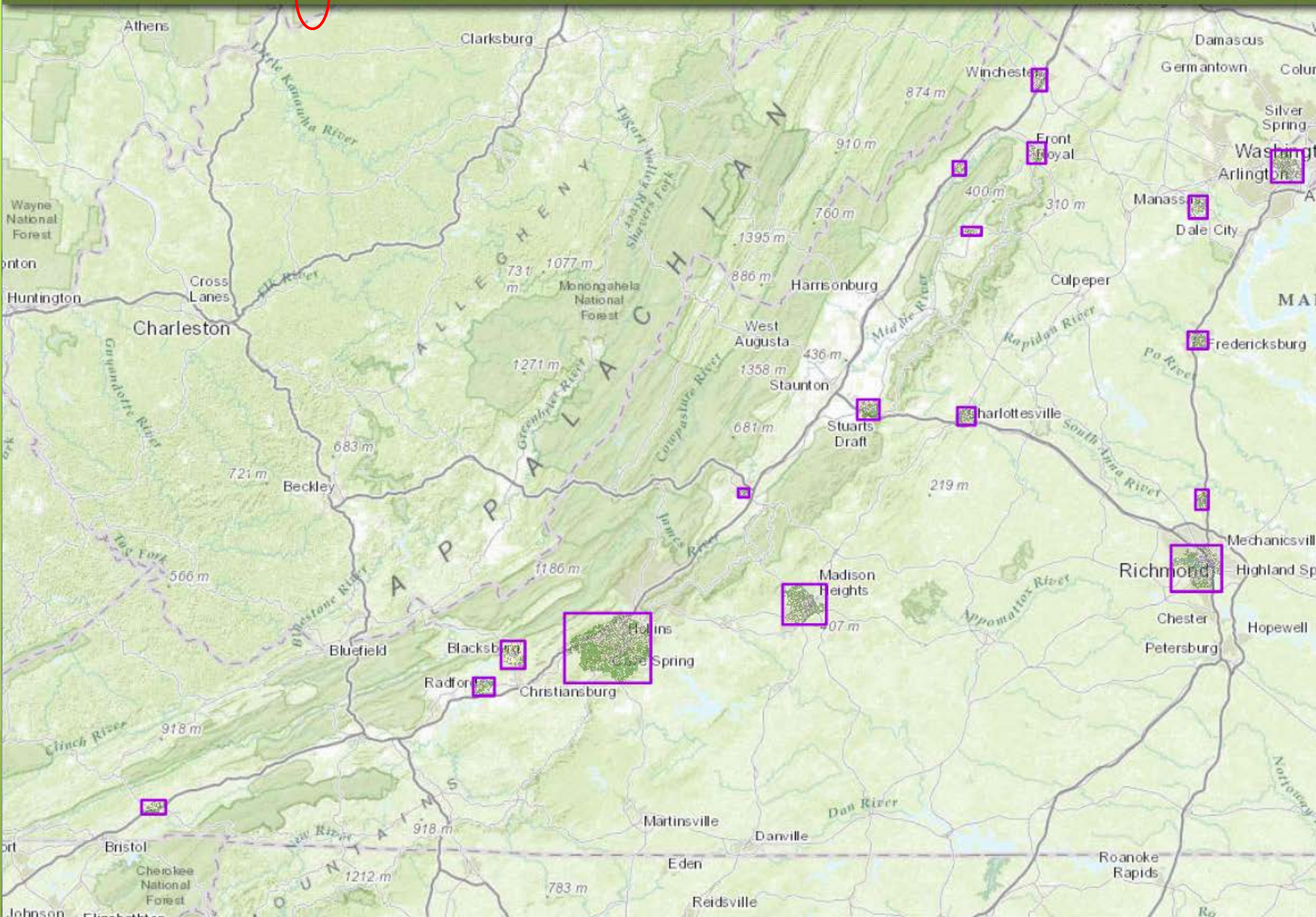
- Internet connection required (it is online after all…)
- Based on Silverlight:
  - This currently only runs on laptop / desktop computers (Apple and Windows OS);
  - Should work with a windows-based tablet;
  - I would be ‘surprised’ if you can get the mapper will work on an Android-based or IOS-based mobile device (iPhone/iPad, Google Nexus tablet, etc.).

So let's take a quick tour of the Urban Tree Canopy Mapper!

http://utcmapper.frec.vt.edu/

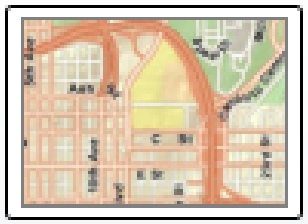
Virginia Urban Tree Canopy Mapper

Quick Start Bookmarks Feedback



Virginia Urban Tree Canopy Mapper

Quick Start Bookmarks Feedback

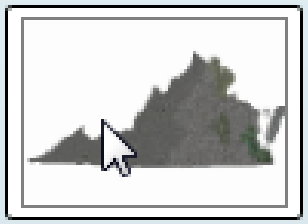


Streets

Topographic

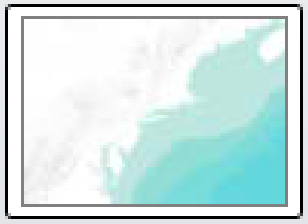
Imagery

USA Topo Maps



VBMP Most Recent Imagery

Light Gray Canvas



Terrain

OpenStreetMap

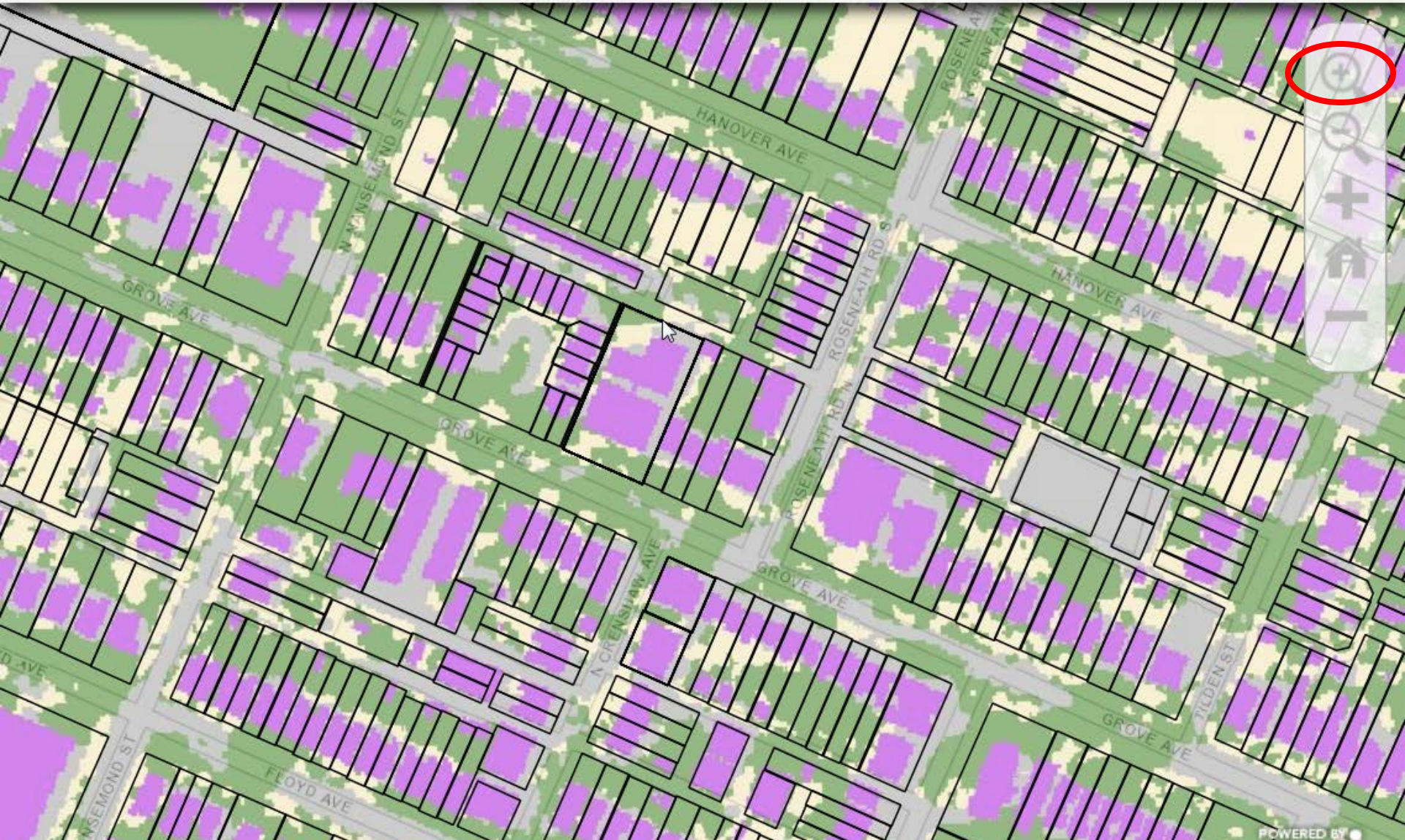
Virginia Urban Tree Canopy Mapper

Partners and Sponsors

Quick Start Bookmarks Feedback

Land Cover Key

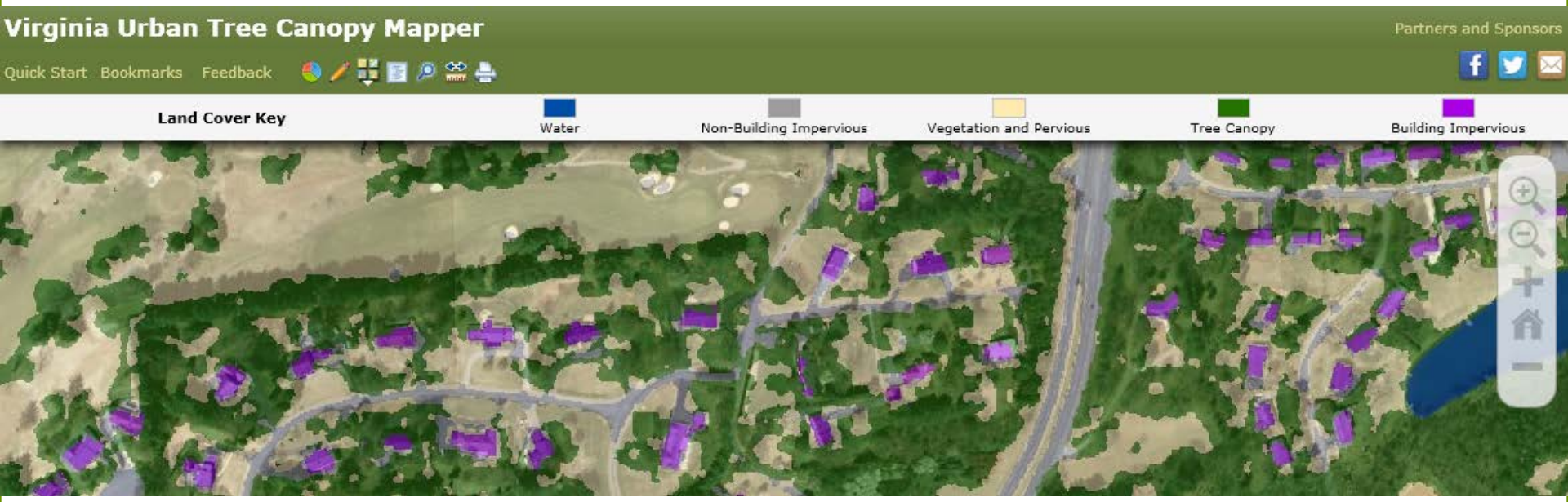
Water | Non-Building Impervious | Vegetation and Pervious | Tree Canopy | Building Impervious



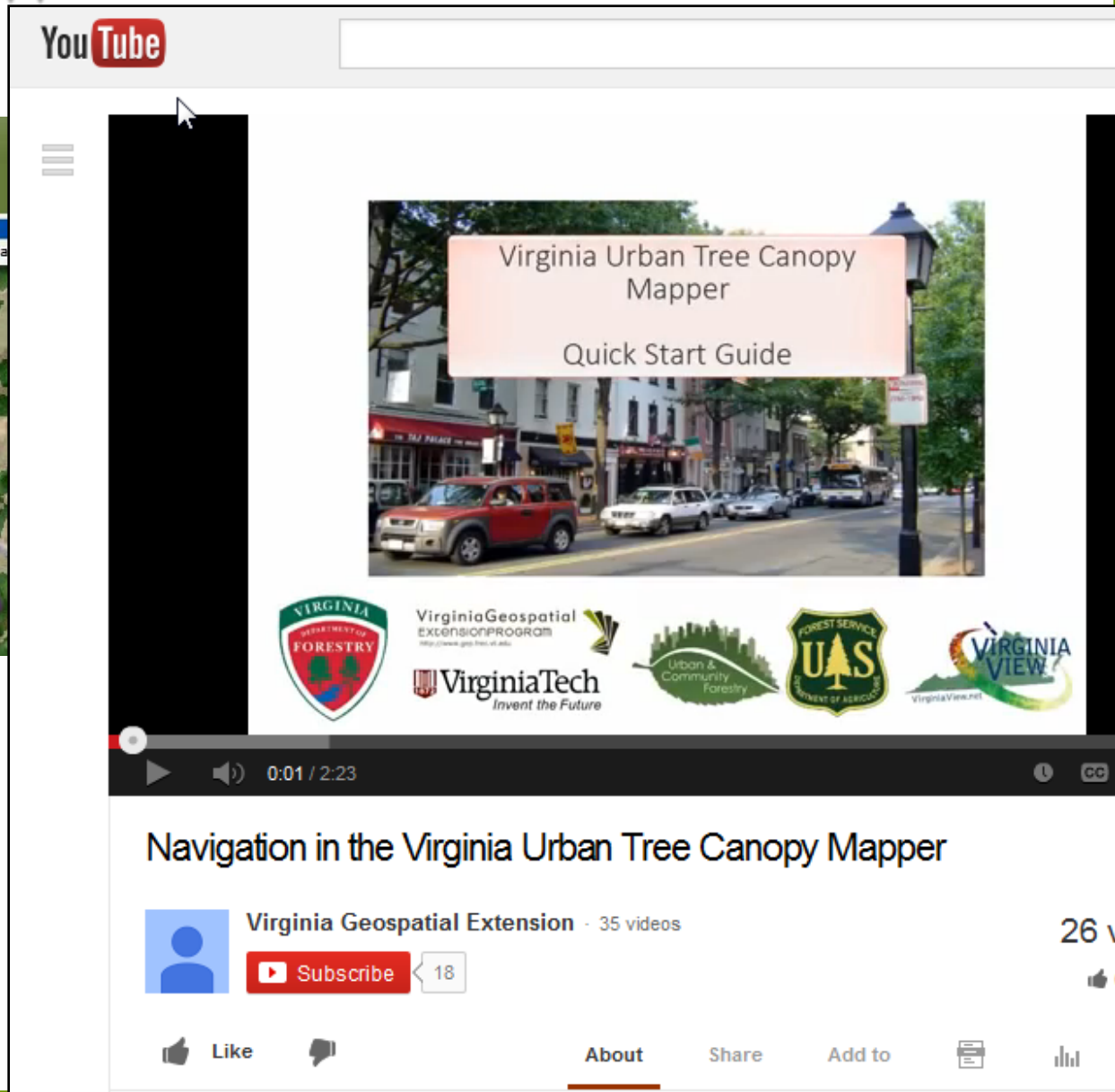
UTC Mapper: A Distributed System…

- The basemaps (aerial photography / topographic maps) are streaming from one server
- Local parcel data is streaming from a different server (City of Richmond, etc.)
- UTC data is streaming from a different server
- The UTC Mapper integrates it all..
- Advantage: Updates made to the basemaps / parcels are incorporated into the mapper instantly

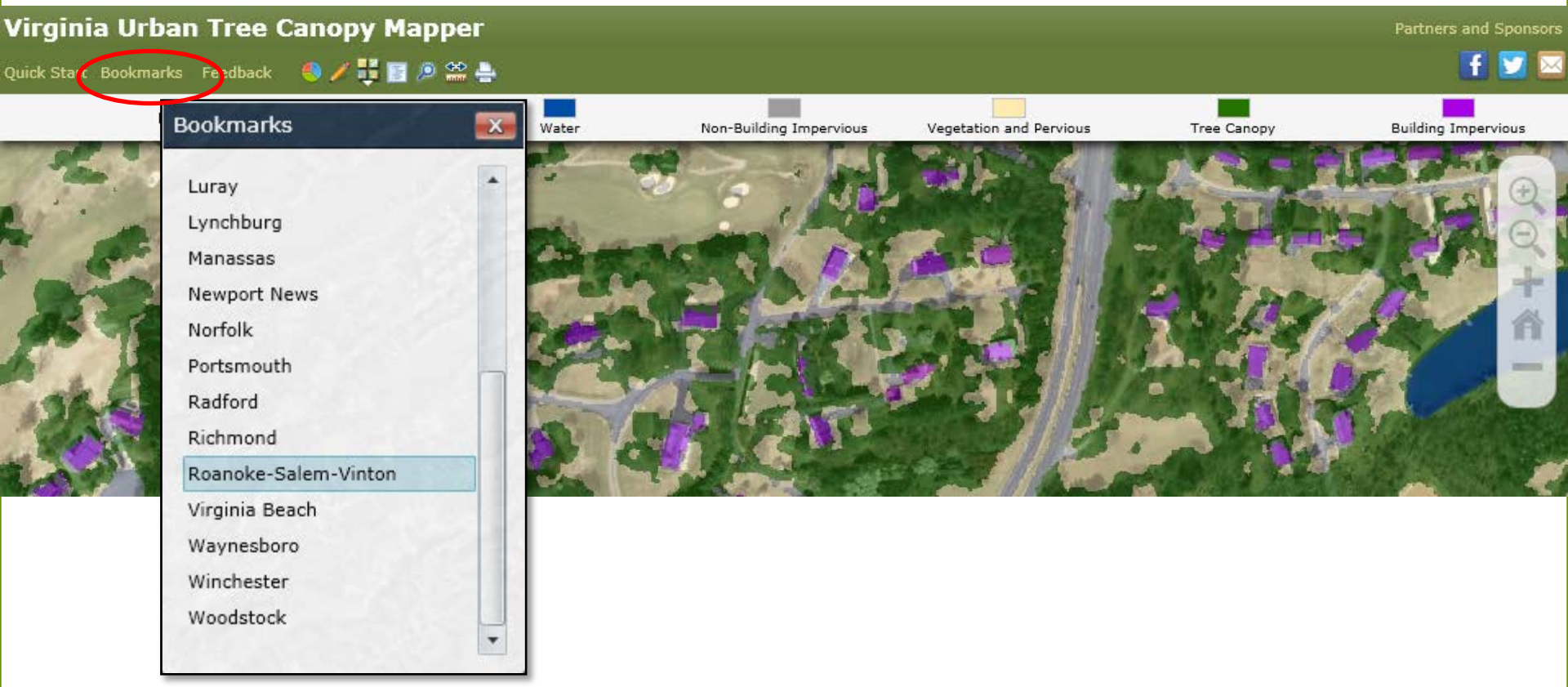
UTC Mapper: Tools Overview



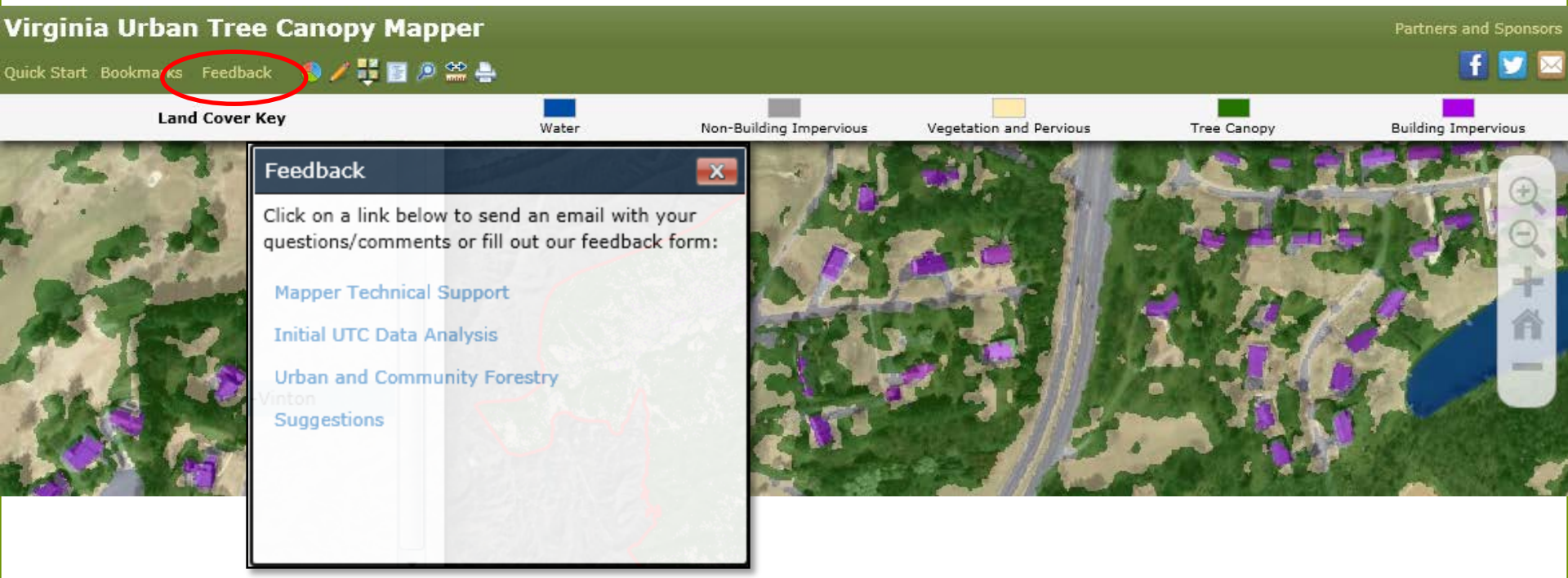
UTC Mapper: Tools Overview

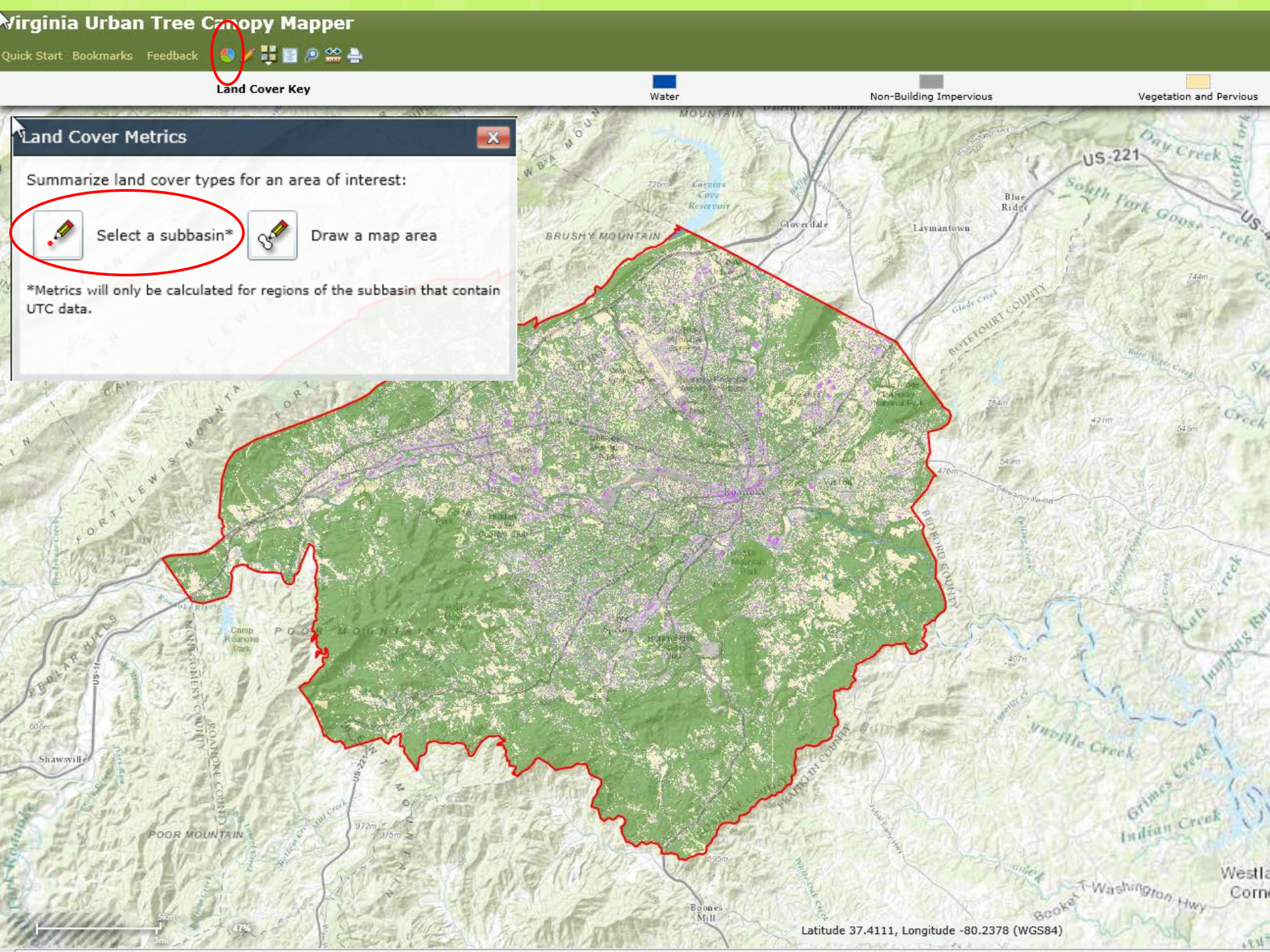


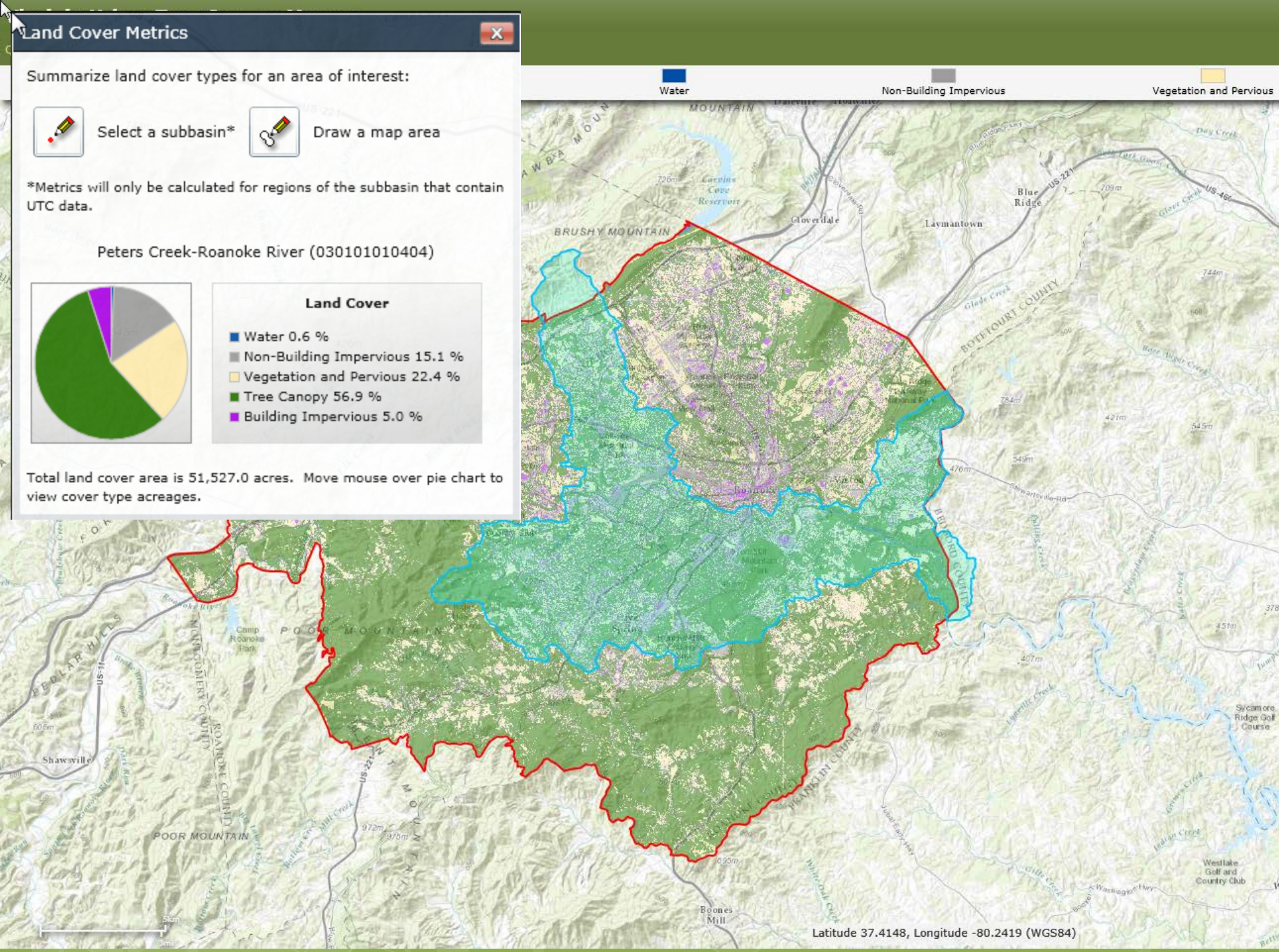
UTC Mapper: Tools Overview

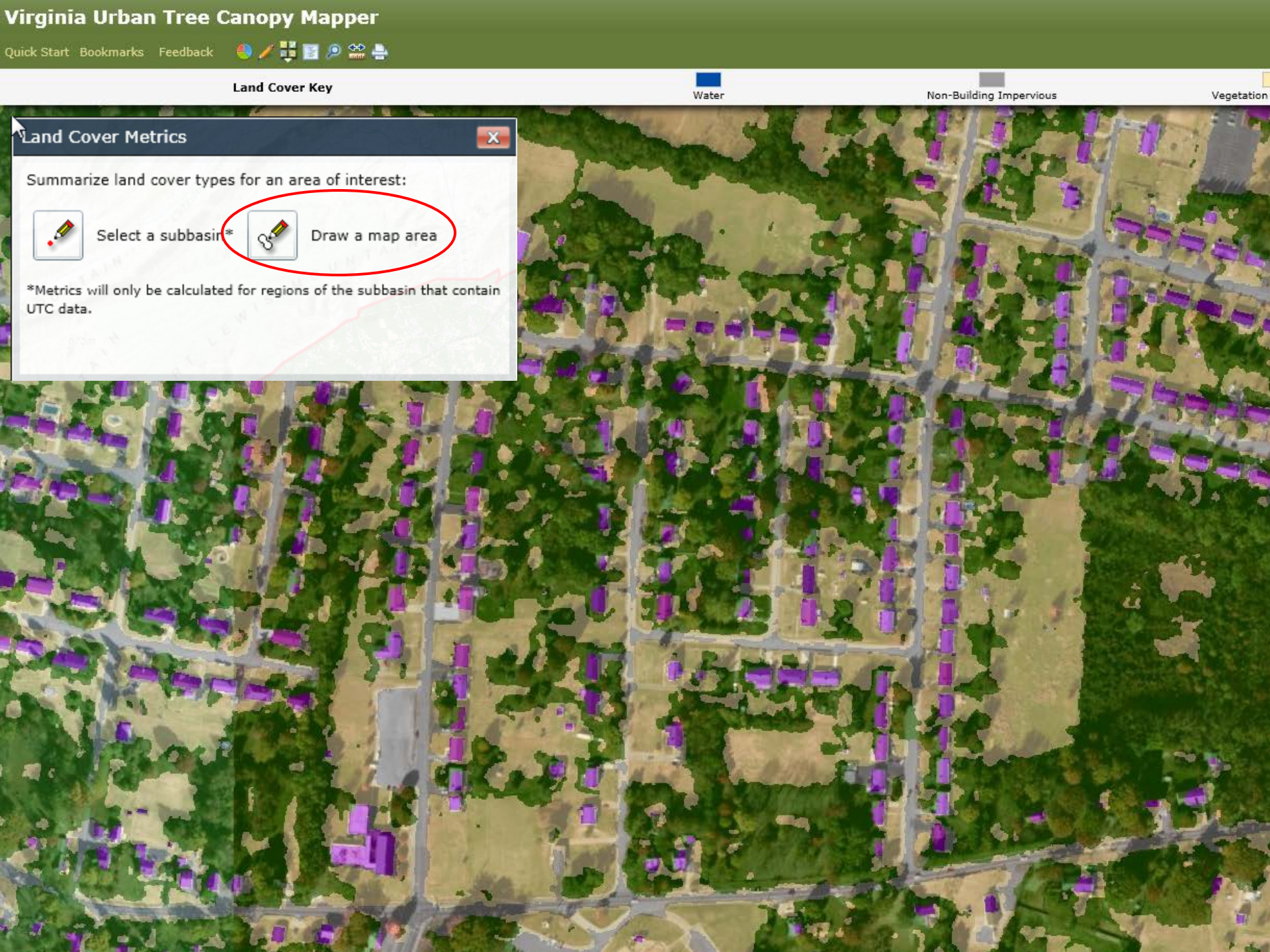


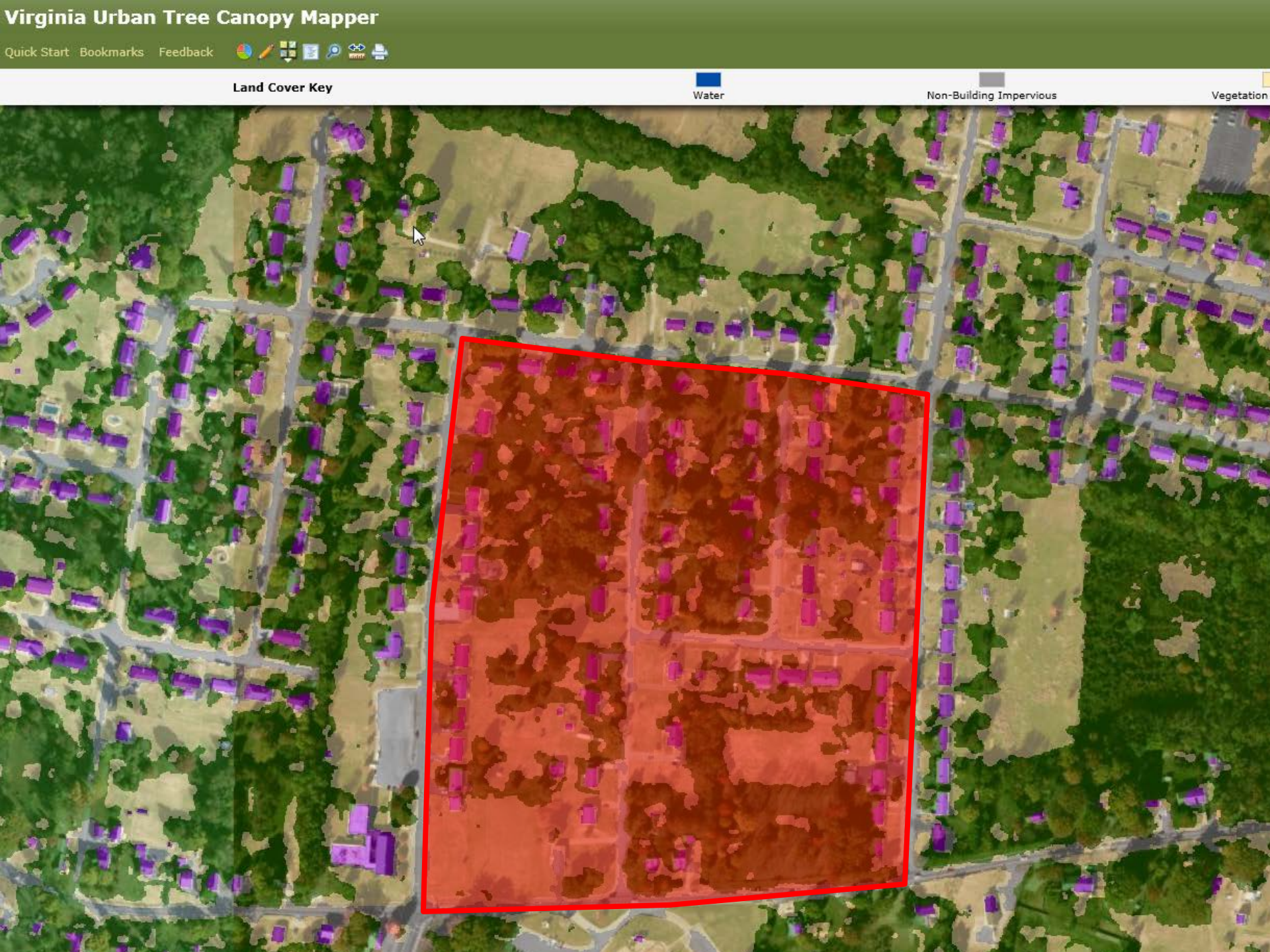
UTC Mapper: Tools Overview




Virginia Urban Tree Canopy Mapper
Quick Start
Bookmarks
Feedback
Land Cover Key
Water
Non-Building Impervious
Vegetation and Pervious
Land Cover Metrics
Summarize land cover types for an area of interest:
Select a subbasin*
Draw a map area
*Metrics will only be calculated for regions of the subbasin that contain UTC data.
US-221
BRUSHY MOUNTAIN
POOR MOUNTAIN
Shawsville
Boones Mill
Latitude 37.4111, Longitude -80.2378 (WGS84)


Land Cover Metrics
Summarize land cover types for an area of interest:
Select a subbasin*
Draw a map area
*Metrics will only be calculated for regions of the subbasin that contain UTC data.
Peters Creek-Roanoke River (030101010404)
Land Cover
Water 0.6 %
Non-Building Impervious 15.1 %
Vegetation and Pervious 22.4 %
Tree Canopy 56.9 %
Building Impervious 5.0 %
Total land cover area is 51,527.0 acres. Move mouse over pie chart to view cover type acreages.
Water
Non-Building Impervious
Vegetation and Pervious
BRUSHY MOUNTAIN
POOR MOUNTAIN
Cloverdale
Laymantown
Blue Ridge
Shawsville
Boones Mill
Latitude 37.4148, Longitude -80.2419 (WGS84)


Virginia Urban Tree Canopy Mapper
Quick Start
Bookmarks
Feedback
Land Cover Key
Water
Non-Building Impervious
Vegetation
Land Cover Metrics
Summarize land cover types for an area of interest:
Select a subbasin*
Draw a map area
*Metrics will only be calculated for regions of the subbasin that contain UTC data.


Virginia Urban Tree Canopy Mapper
Quick Start
Bookmarks
Feedback
Land Cover Key
Water
Non-Building Impervious
Vegetation

Land Cover Key | Water | Non-Building Impervious | Vegetation

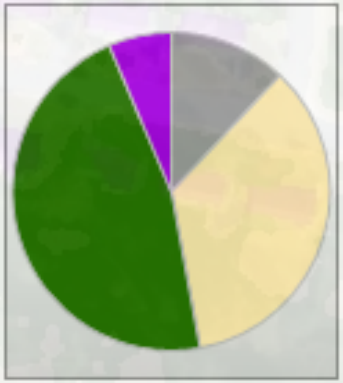
Land Cover Metrics

Summarize land cover types for an area of interest:

Select a subbasin* Draw a map area

*Metrics will only be calculated for regions of the subbasin that contain UTC data.

Area of Interest (48.3 acres)



Land Cover

- Water 0.0 %
- Non-Building Impervious 12.0 %
- Vegetation and Pervious 35.2 %
- Tree Canopy 46.6 %
- Building Impervious 6.4 %
- No Data 0.0 %

Move mouse over pie chart to view cover type area (acres).

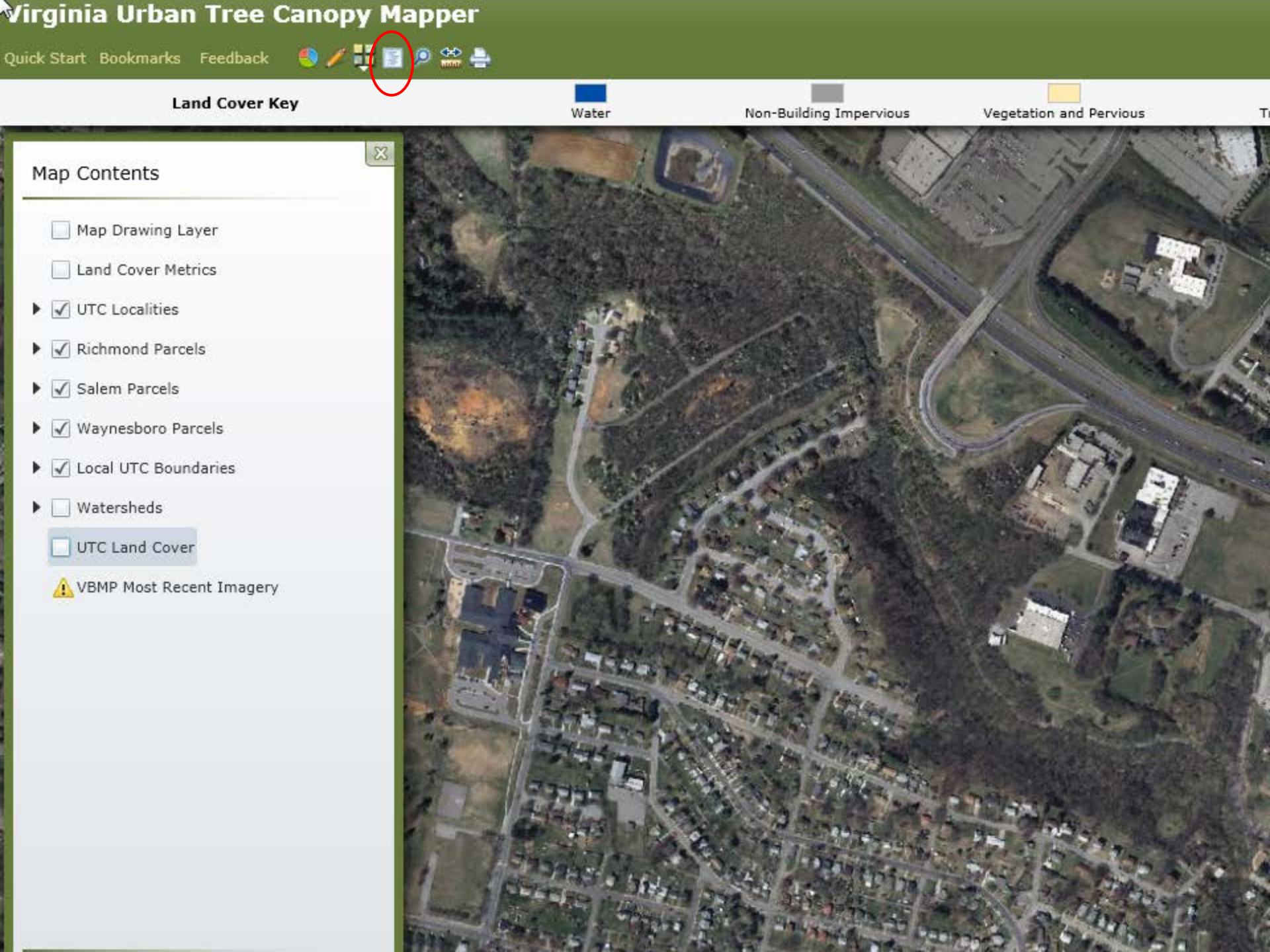
Virginia Urban Tree Canopy Mapper

Quick Start Bookmarks Feedback

Land Cover Key Water Non-Building Impervious Vegetation and Pervious Tr

Map Contents

- [ ] Map Drawing Layer
- [ ] Land Cover Metrics
- [x] UTC Localities
- [x] Richmond Parcels
- [x] Salem Parcels
- [x] Waynesboro Parcels
- [x] Local UTC Boundaries
- [ ] Watersheds
- [x] UTC Land Cover
- [ ] VBMP Most Recent Imagery


Virginia Urban Tree Canopy Mapper
Quick Start
Bookmarks
Feedback
Land Cover Key
Water
Non-Building Impervious
Vegetation and Pervious
Map Contents
Map Drawing Layer
Land Cover Metrics
UTC Localities
Richmond Parcels
Salem Parcels
Waynesboro Parcels
Local UTC Boundaries
Watersheds
UTC Land Cover
VBMP Most Recent Imagery

Virginia Urban Tree Canopy Mapper

Quick Start Bookmarks Feedback

Land Cover Key

Water

Non-Building Impervious

Vegetation and Pervious

Tree Can

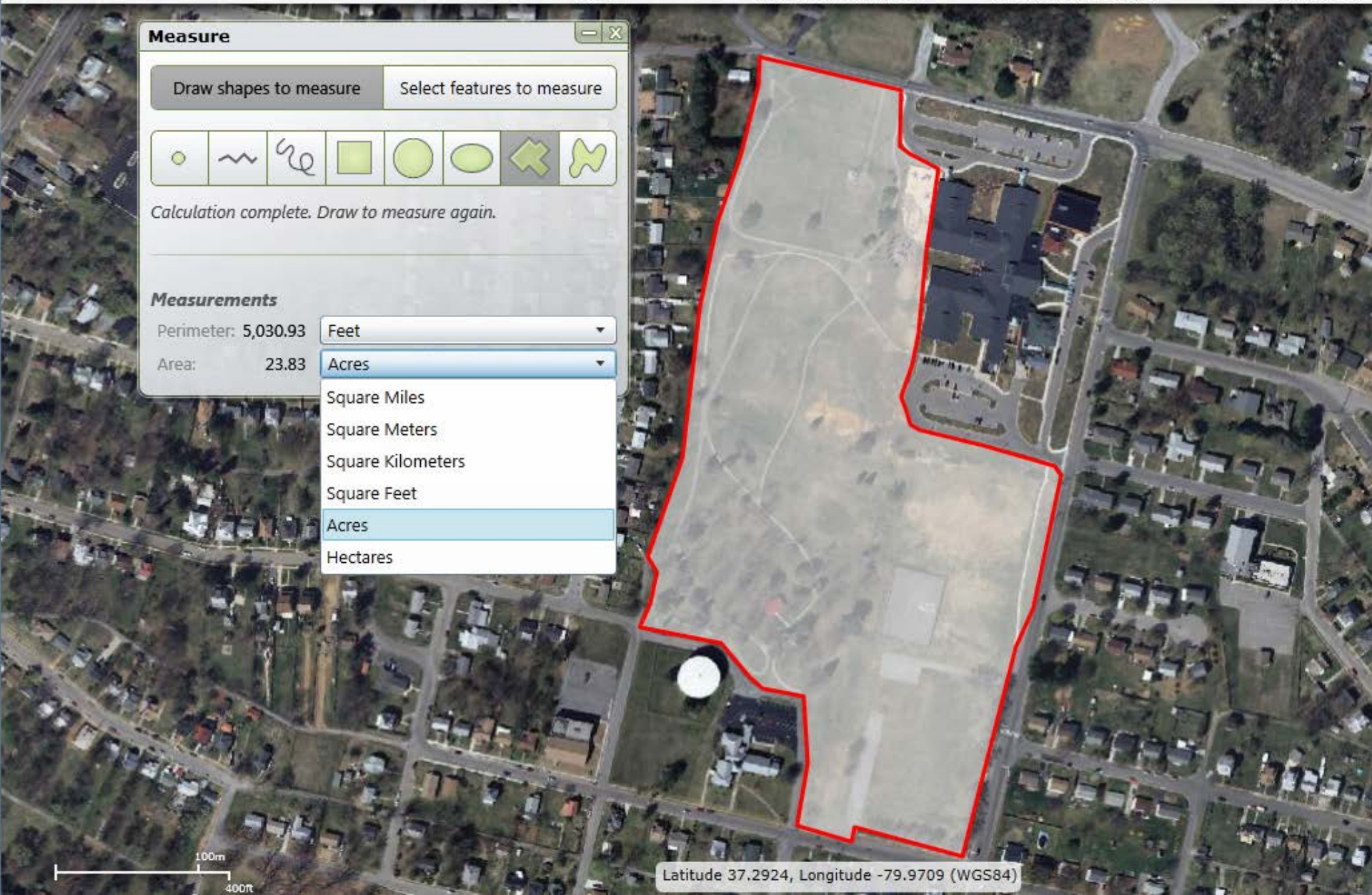
100m

Virginia Urban Tree Canopy Mapper

Quick Start Bookmarks Feedback

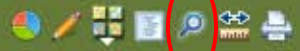
Land Cover Key

Water | Non-Building Impervious | Vegetation and Pervious | Tree Canopy



Virginia Urban Tree Canopy Mapper

Quick Start Bookmarks Feedback



Land Cover Key

Water

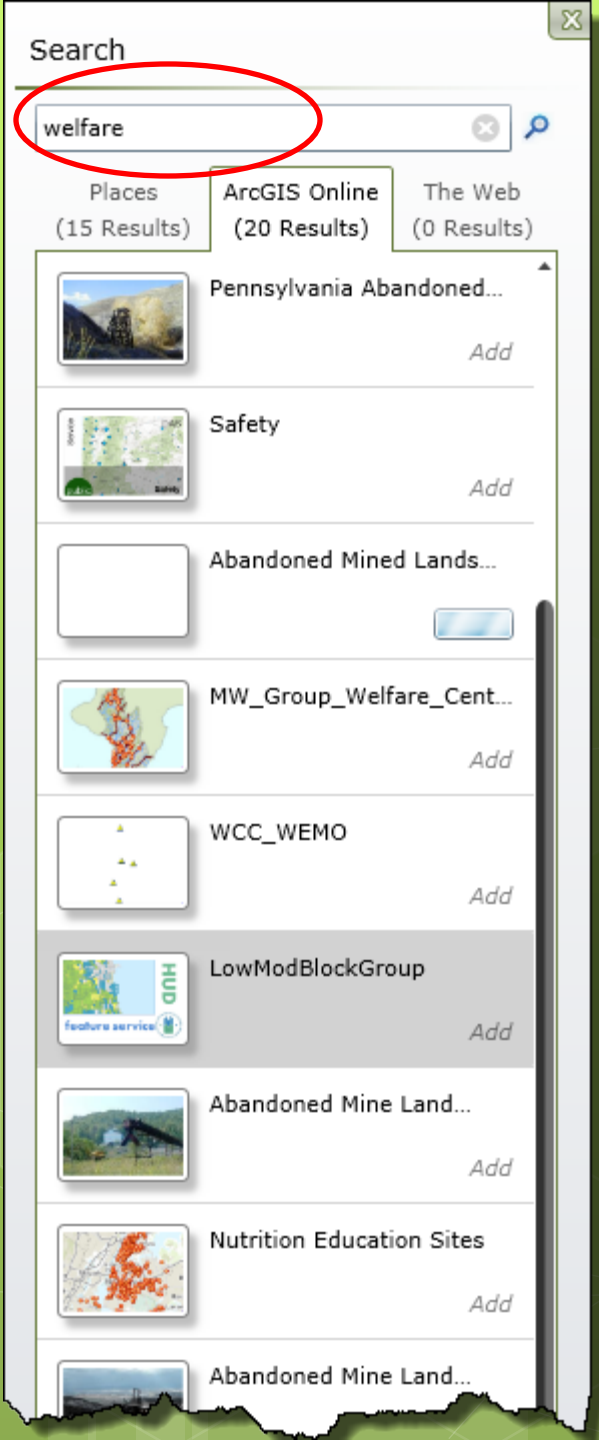
Non-Building Impervious

Vegetation and Pervious

Tree Can

100m

Exploring UTC and Environmental Equity Issues…



Exploring UTC and Environmental Equity Issues…

Search

welfare

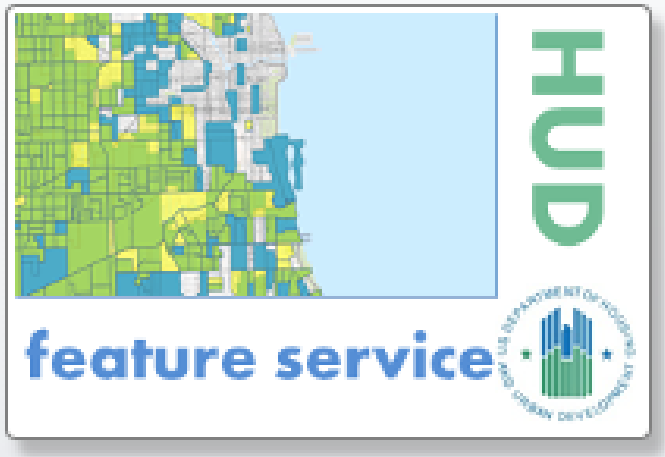
Places (15 Results) | ArcGIS Online (20 Results) | The Web (0 Results)

- Pennsylvania Abandoned… Add
- Safety Add
- Abandoned Mined Lands…
- MW_Group_Welfare_Cent… Add
- WCC_WEMO Add
- LowModBlockGroup Add
- Abandoned Mine Land… Add
- Nutrition Education Sites Add
- Abandoned Mine Land…

LowModBlockGroup

Feature Service by HUD_AGOL_ADMIN

Service Details



This service shows two special tabulations of Census 2000 and American Community Survey (ACS) 2006-2010 data to identify areas where 51% or more of individuals are in low or moderate income families.

Copyright:

HUD has not officially adopted the 2006-2010 ACS low- and moderate-income data; this service is for advisory purposes only so that HUD staff and HUD Grantees may become familiar with the new data.

Rating: ☆☆☆☆☆

Virginia Urban Tree Canopy Mapper

Quick Start Bookmarks Feedback

Land Cover Key

Search

income

Places (2 Results) | ArcGIS Online (355 Results) | The Web (4 Results)

USA Population Density... Add

USA Median Household... Add

USA Tapestry... Add

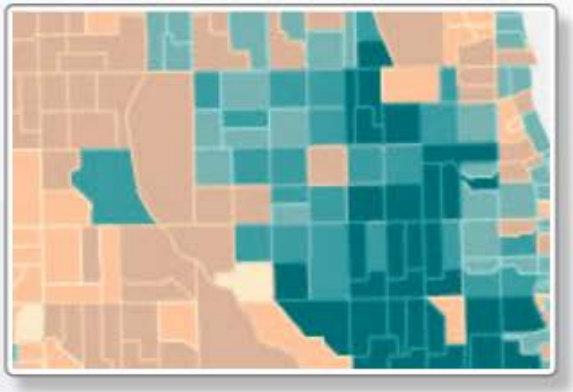
USA Diversity Index...

1 2 3 4 5 6 7 ...

USA Median Household Income (Extended Support)

Map Service by esri

Service Details



This map service shows the median household income in the United States in 2012.

Copyright:

esri This work is licensed under the Esri Master License Agreement.

View Summary | View Terms of Use

Rating: ★★★★☆

Virginia Urban Tree Canopy Mapper

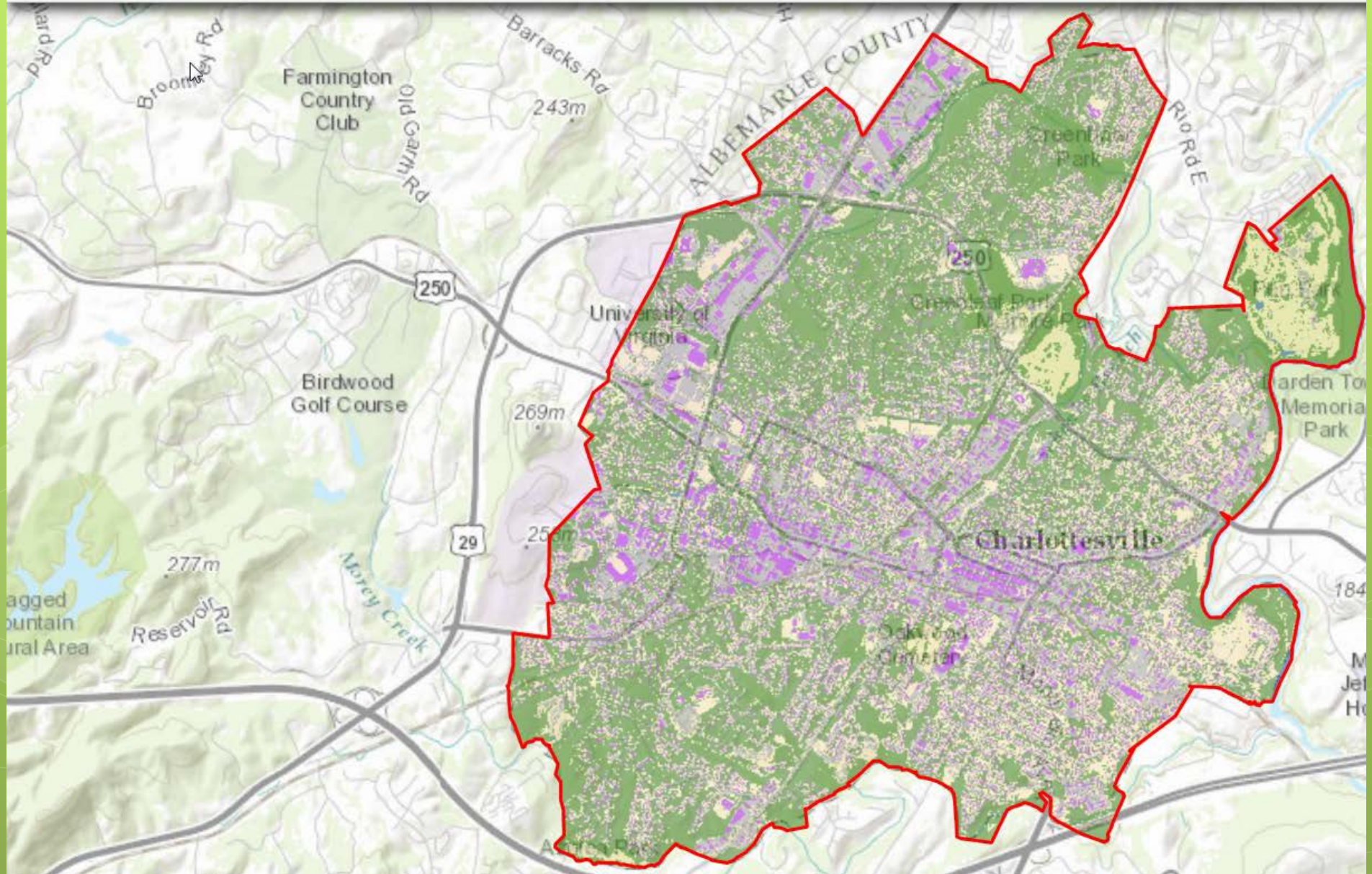
Quick Start Bookmarks Feedback

Land Cover Key

Water

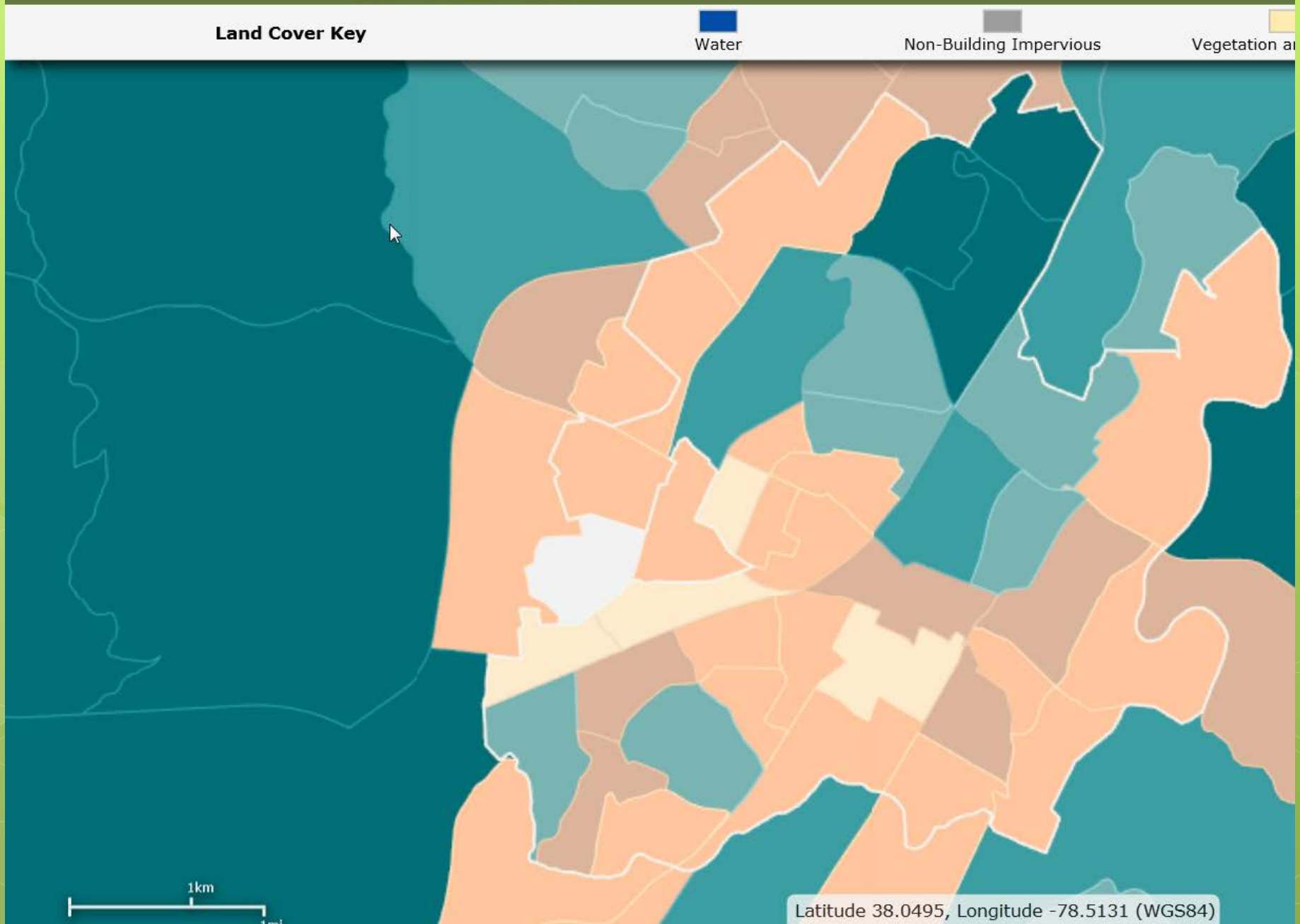
Non-Building Impervious

Vegetation a



Virginia Urban Tree Canopy Mapper

Quick Start Bookmarks Feedback



Virginia Urban Tree Canopy Mapper

Quick Start Bookmarks Feedback

Land Cover Key

Search

income

Places (2 Results) | ArcGIS Online (355 Results) | The Web (4 Results)

USA Population Density... Add

USA Median Household... Remove

USA Tapestry... Add

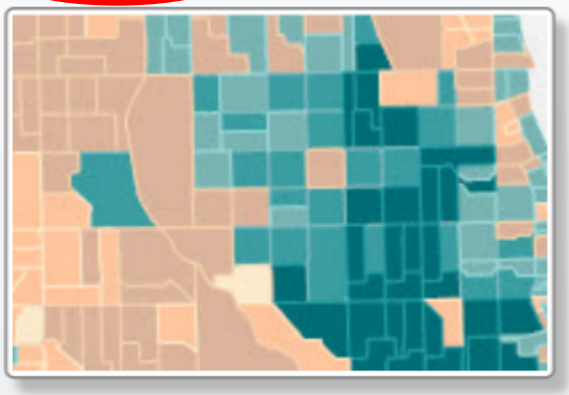
USA Diversity Index...

1 2 3 4 5 6 7 ...

USA Median Household Income (Extended Support)

Map Service by esri

Service Details



This map service shows the median household income in the United States in 2012.

Copyright:

esri

This work is licensed under the Esri Master License Agreement.

View Summary | View Terms of Use

Rating: ★★★★☆

Demographics/USA_Median_Household_Income (MapServer)

View In: ArcMap ArcGIS Explorer ArcGIS JavaScript Google Earth ArcGIS.com Map Bing Maps (terms of use) Google Maps (terms of use)

View Footprint In: Google Earth

Service Description: This map shows the median household income in the United States in 2012. Information for the 2012 Median Household Income is an estimate of income for calendar year 2012. Income amounts are expressed in current dollars, including an adjustment for inflation or cost-of-living increases. The median is the value that divides the distribution of household income into two equal parts. The median household income in the United States overall was $50,157 in 2012. This map shows Esri's 2012 estimates using Census 2010 geographies. The geography depicts States greater than 50m scale, Counties at 7.5m to 50m scale, Census Tracts at 200k to 7.5m scale, and Census Block Groups less than 200k scale. Scale Range: 1:591,657,528 down to 1:72,224. For more information on this map, including the terms of use, visit us online.

Map Name: Layers

Legend

All Layers and Tables

Layers:

- Median Household Income (0)
  - Block Groups (1)
  - Tracts (2)

Tracts (2)

More than $82,000

$68,001 to $82,000

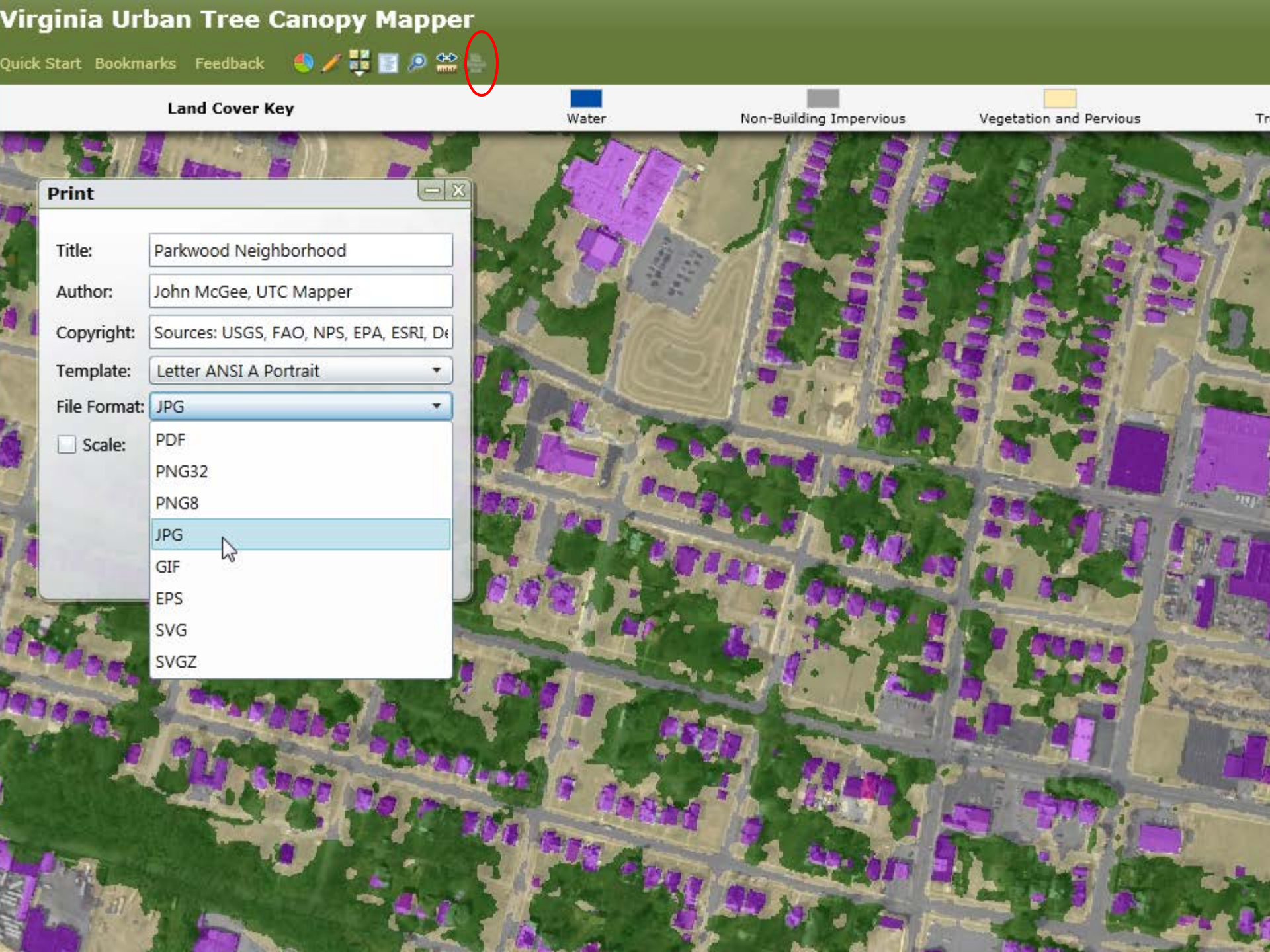
$53,001 to $68,000

$39,001 to $53,000 (US median: $50,157)

$24,001 to $39,000

$24,000 or less

No households


Virginia Urban Tree Canopy Mapper
Quick Start
Bookmarks
Feedback
Land Cover Key
Water
Non-Building Impervious
Vegetation and Pervious
Print
Title:
Parkwood Neighborhood
Author:
John McGee, UTC Mapper
Copyright:
Sources: USGS, FAO, NPS, EPA, ESRI, D
Template:
Letter ANSI A Portrait
File Format:
JPG
Scale:
PDF
PNG32
PNG8
JPG
GIF
EPS
SVG
SVGZ

…and voila!

- Just make sure to enable popups from the UTC Mapper in your browser…
- Refer to the video tutorial (for printing) for step by step instruction!

Questions?

Please come and talk with either:

- Eric Wiseman
- Susan Day
- John McGee
- Barbara White

Urban & Community Forestry

Forest Service U.S. Department of Agriculture

Virginia Department of Forestry

VirginiaTech College of Natural Resources and Environment

VirginiaGeospatial Extension Program
gep.frec.vt.edu