GIS for Designers
VT | A+D | SU22

TUTORIAL 2 | TOPOGRAPHY, BUFFER AND CLIP

Zoom: Thursday 05.26, 6:30-7:30pm
https://virginiatech.zoom.us/j/2981092726

Goals

- Add topography to your Appalachian city map.
- Learn where to find topographic data online.
- Learn how to extract topography lines from data.
- Understand how this can be used for studio classes.
- Learn how to use buffer and clip tools to reduce data size.

Introduction

Using the base map from Tutorial 1, in Tutorial 2 you will download USGS topographic data and use a simple QGIS tool to extract contour lines from it. From there, you will crop the topography lines to your area of interest (topo lines can be very heavy, so think strategically about what you want to show). You will also practice graphic design and map export skills, as in Tutorial 1.

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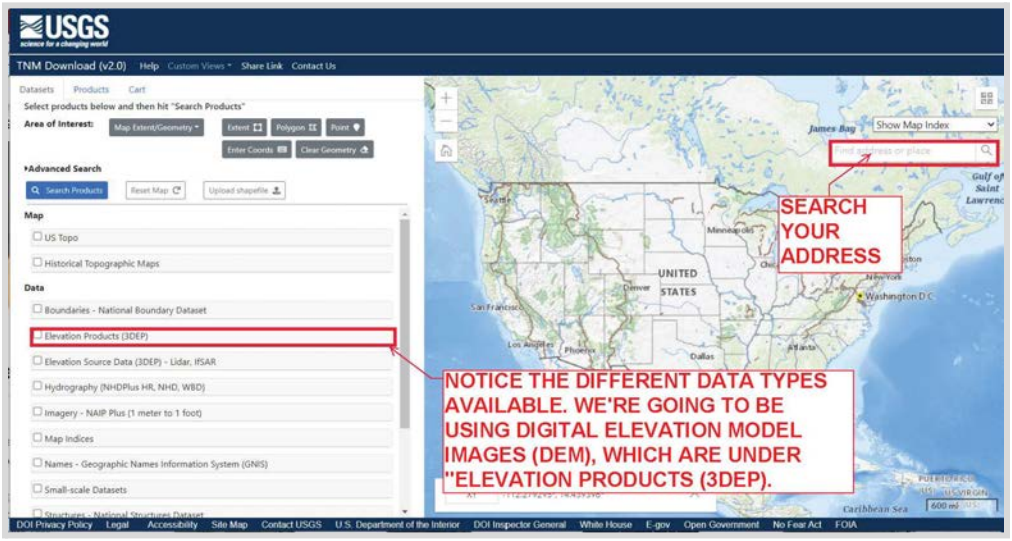
Step 1: Download DEM data for your city from USGS (note: if USGS website is not working, please skip to Step 1c)

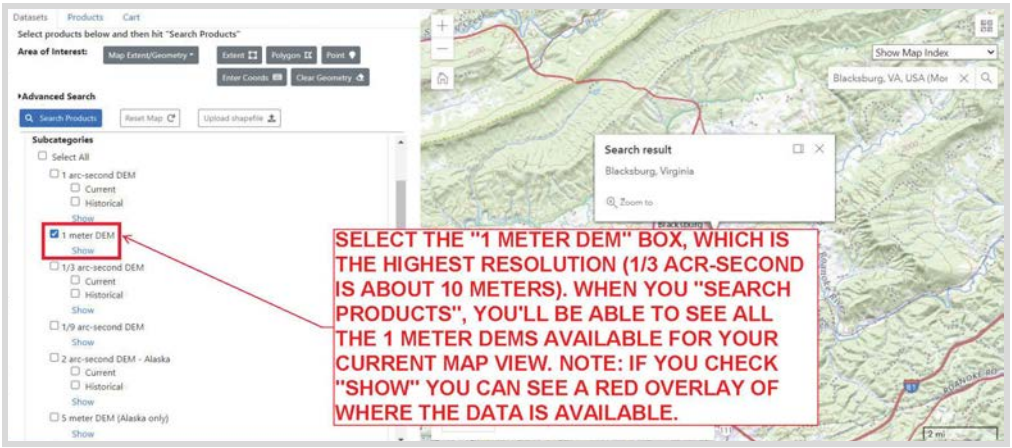
1a Visit the USGS earthexplorer site: https://apps.nationalmap.gov/downloader/#/. Search for your city from Tutorial 1.



s

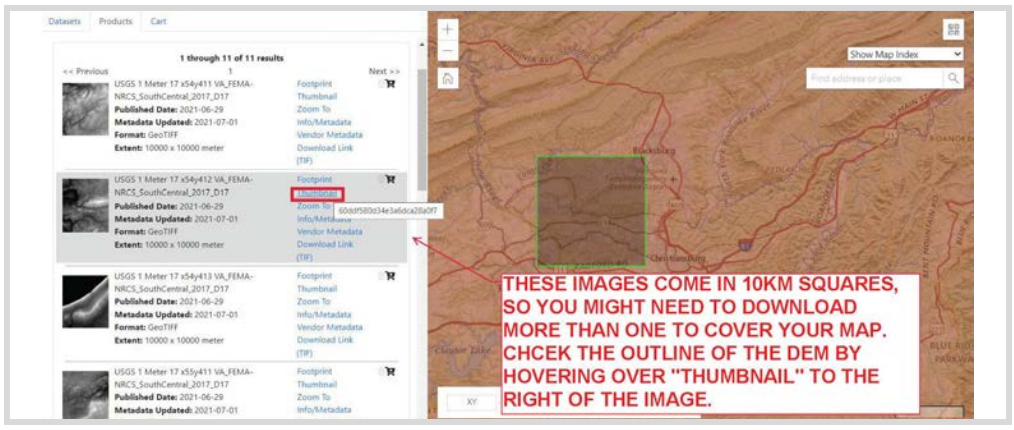
1b On the left panel, check “Elevation Products”, and then “1 meter DEM”. “Search Products” to see a list of the DEMs in the area on the map.

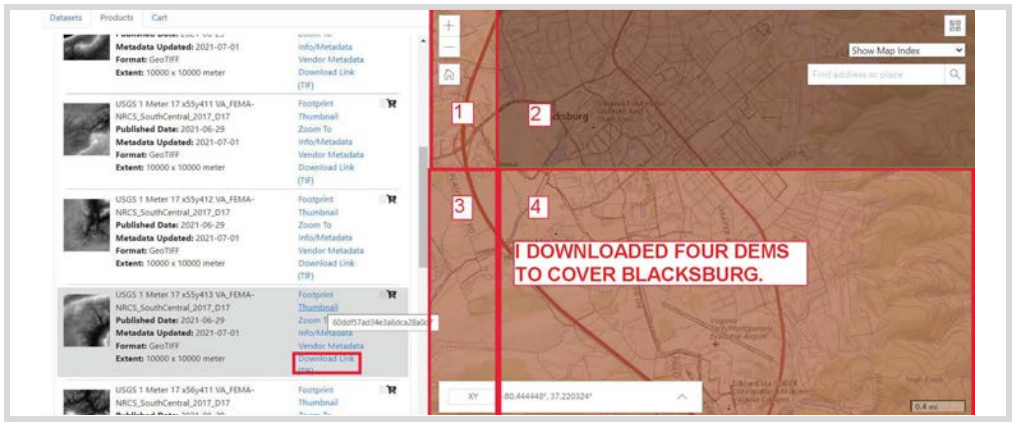
A **Digital Elevation Model** (DEM) is a raster image of the bare land surface (excluding trees, buildings, or other surface objects) drawn only in black and white, where each pixel color corresponds to a specific topographic height. We will be using GeoTIFF DEMs, which are TIFFs (image file) with embedded geographic information.



Note: If 1 meter DEM is not available, check 1/9 arc second; otherwise check ⅓ arc second, which is available for the entire country.

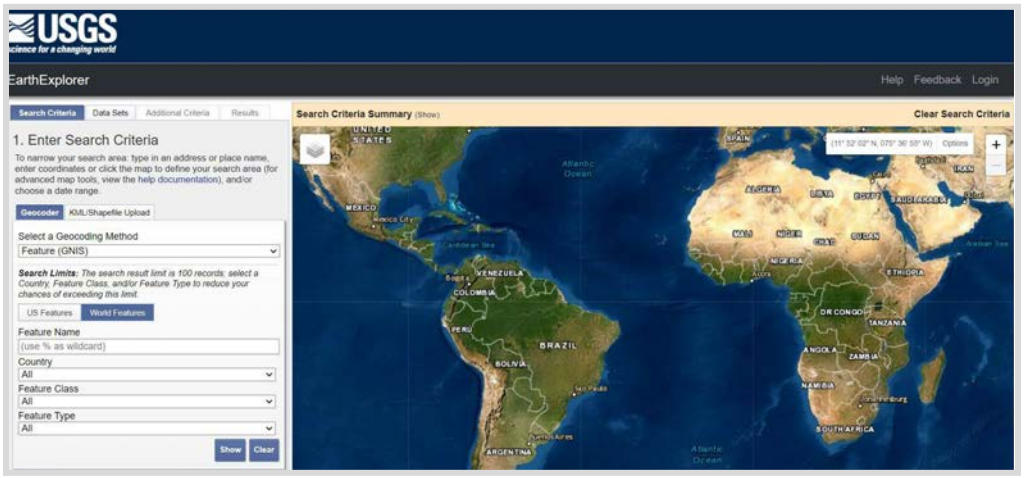
Hover over “Thumbnail” to see each DEM’s outline on the map. Download the one or ones located in your map area by clicking “Download Link” in the left panel.



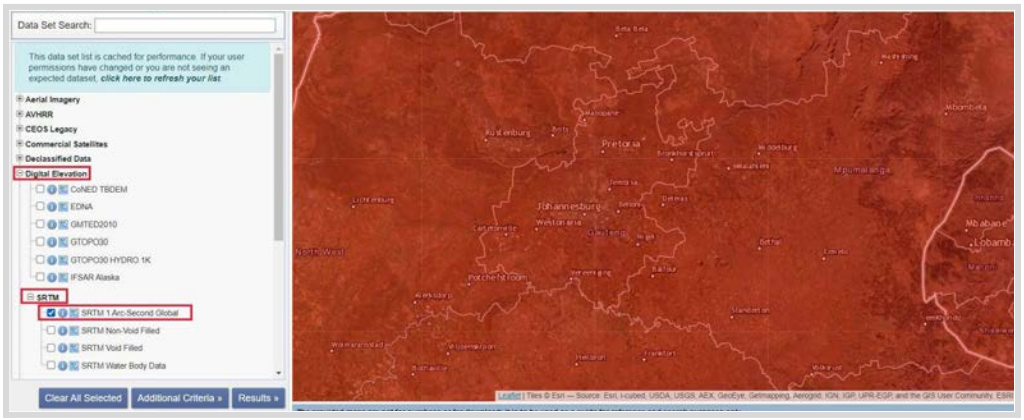


1c if USGS website it NOT working,, visit the USGS earthexplorer site: https://earthexplorer.usgs.gov/. Note: you’ll **need to create a free account to download this data.**

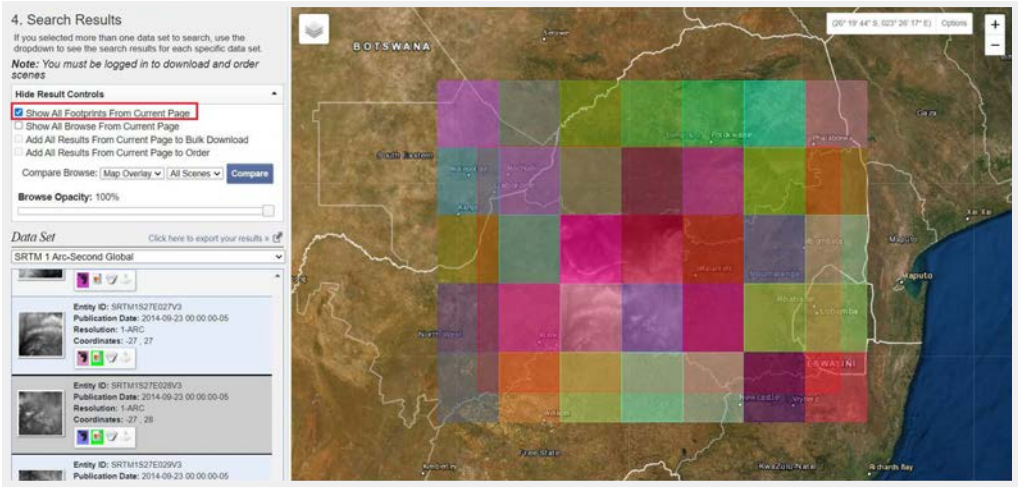
First, **Zoom to your city.**

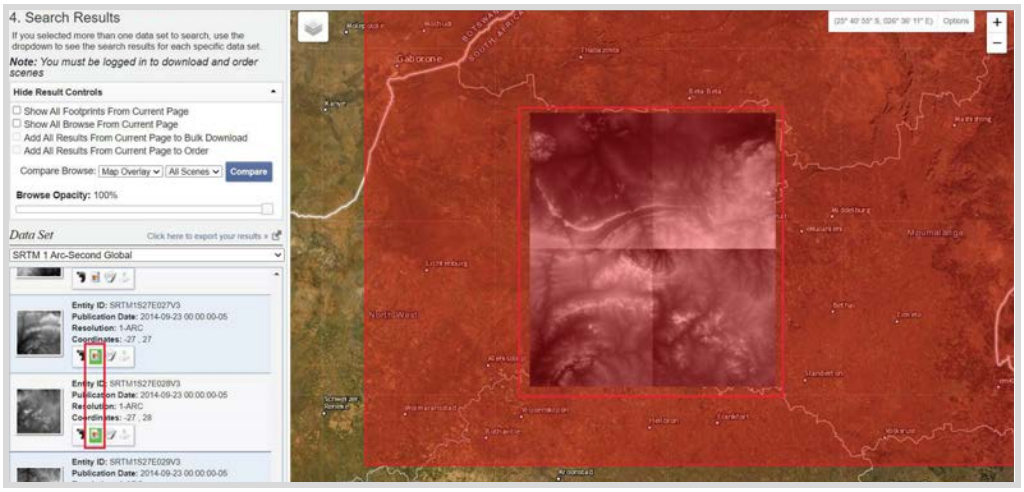


1d To define our “Search Criteria”, we’ll scroll down and select “Use Map”. Then, in the next tab “Data Sets”, open “Digital Elevation” and then **“SRTM”**. This stands for Space Shuttle Radar Topography Mission, which surveyed the entire planet down to **1-arc second** resolution (about 30 meters).



1e Now, check “Show All Footprints” to see the results on your map. You can click the Image icon (beside the foot) in the Data Set results to see the image in the map.

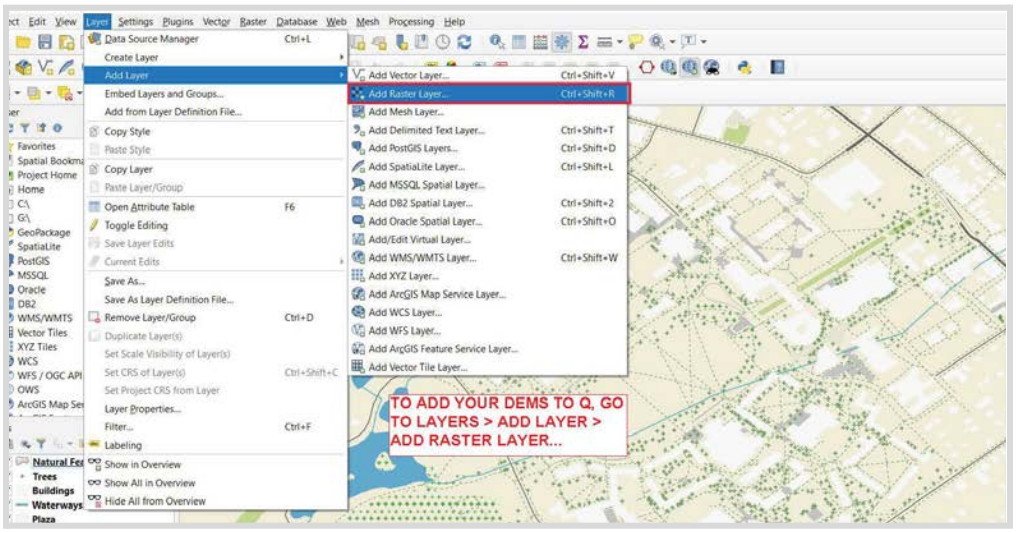




1f Download the DEMs that you need from your free account.

Step 2: Import the DEM into QGIS as a Raster Layer.

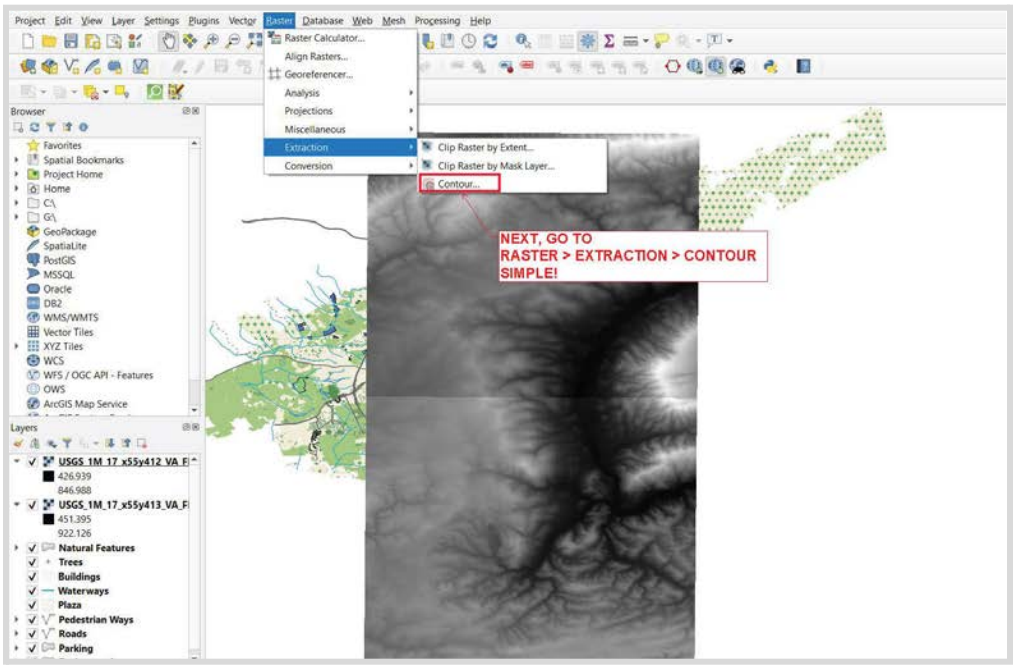
2a In your QGIS file from Tutorial 1, go to “Layer” > “Add Layer” > “Add Raster Layer…”



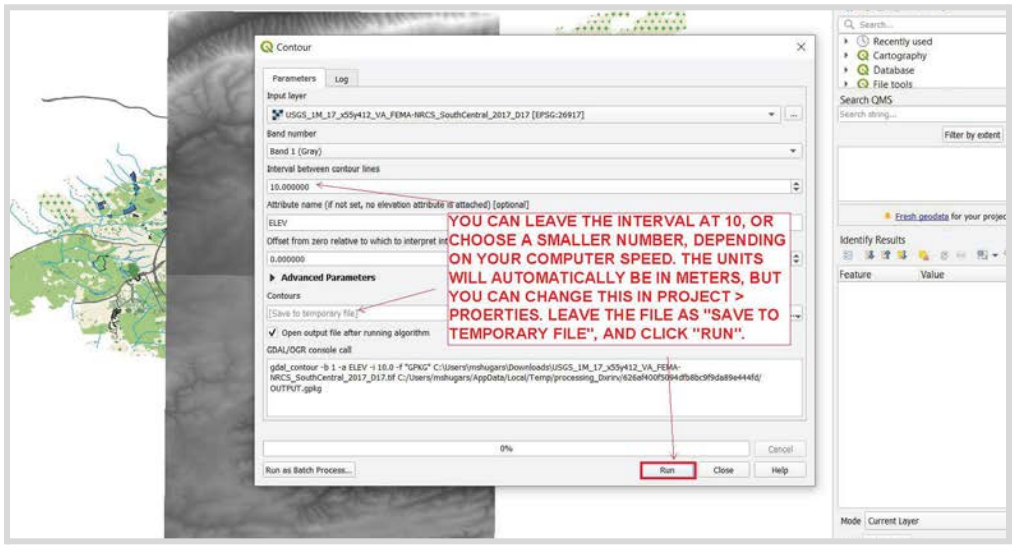
2b Click the ellipses (...) and navigate to your downloaded DEM image. Click “Add” to add the layer to your map. You can add multiple DEM layers by changing the Source location without closing the Data Source Manager window.

Step 3: Extract topography lines with Raster > Extraction > Topography.

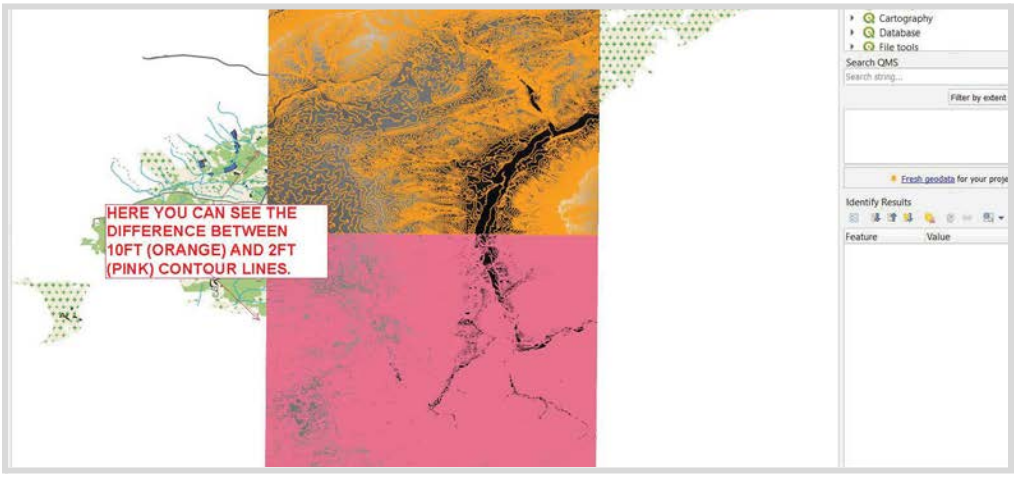
3a In the top menu, go to “Raster” > “Extraction” > “Contour…”



3b For “Input Layer”, select one of your DEM layers. Choose an interval for your contour lines. Since each DEM is 10 kilometers wide, it can take a long time to draw contour lines at small intervals. For the sake of this exercise, you can leave the interval at 10 (meters), or make it smaller if your computer is rockin. Finally, click “Run” to create the contours layer. **This may take several minutes**.



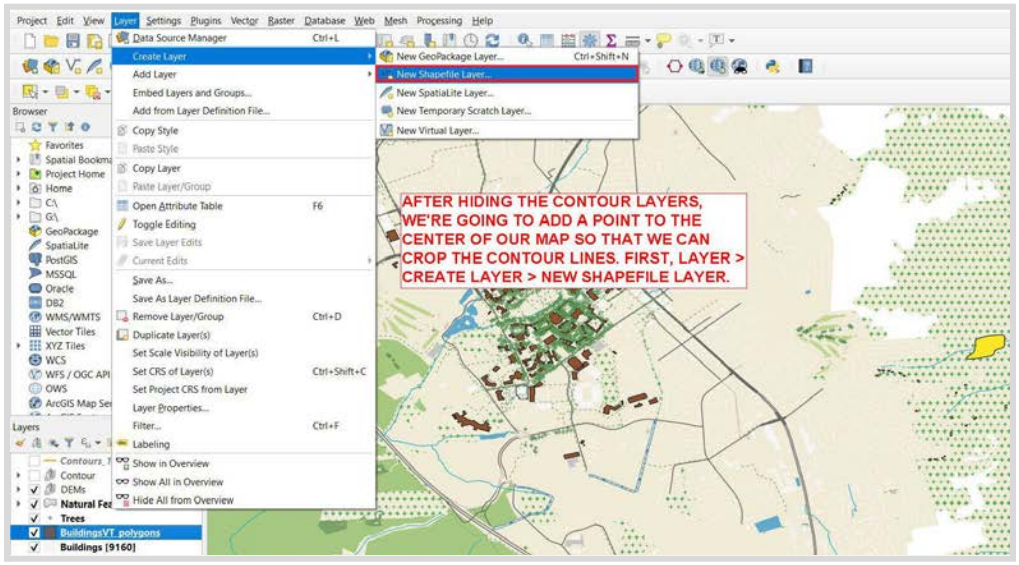
See the difference, zoomed out and zoomed in, between 10 foot (orange) and 2 foot (pink) contour lines:



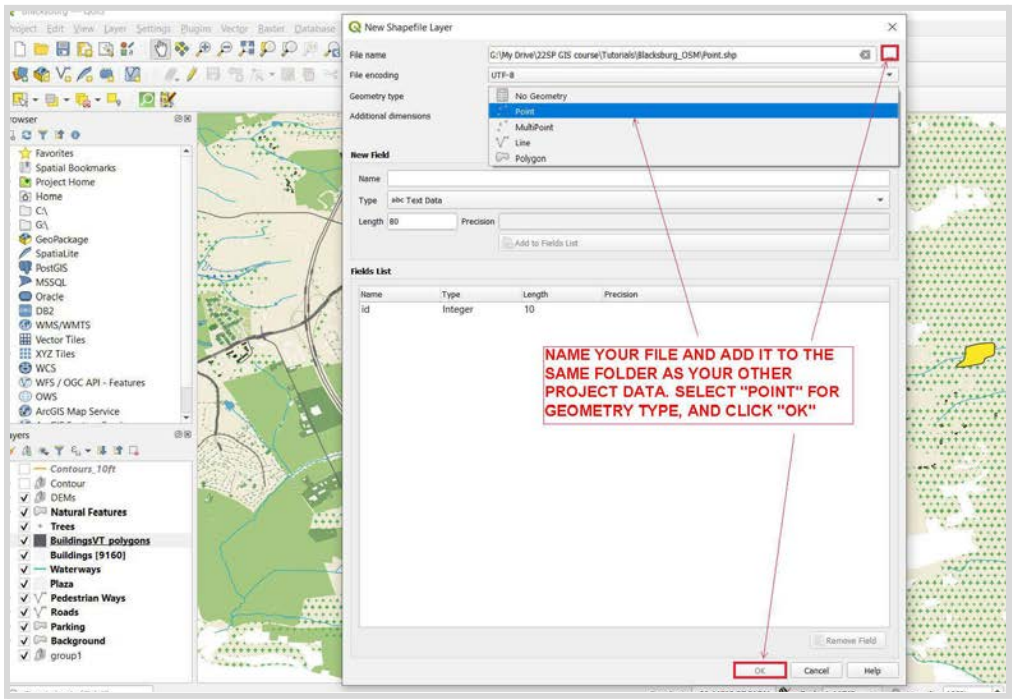
3c Here you can see all four of my DEMs contoured at 2ft intervals. At this point I wanted to clean up my layers so I could easily turn them on and off, and collapse them for easier navigation. You can group layers by selecting multiple layers, right clicking, and selecting “Group Selected”.

Step 4: Draw a point at the center of your town (or map area of interest).

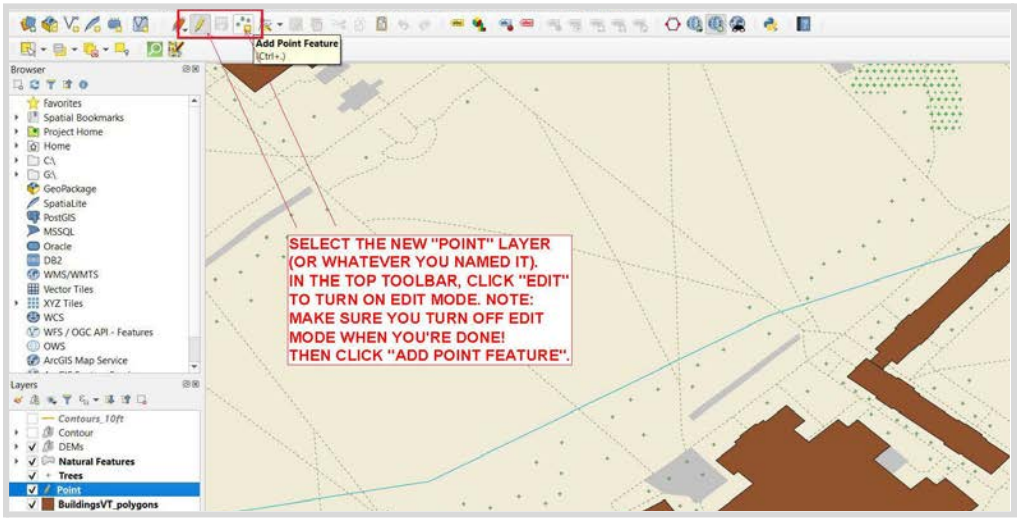
4a First create a new layer for your point with the “Layer” menu, “Create Layer” > “New Shapefile Layer”.

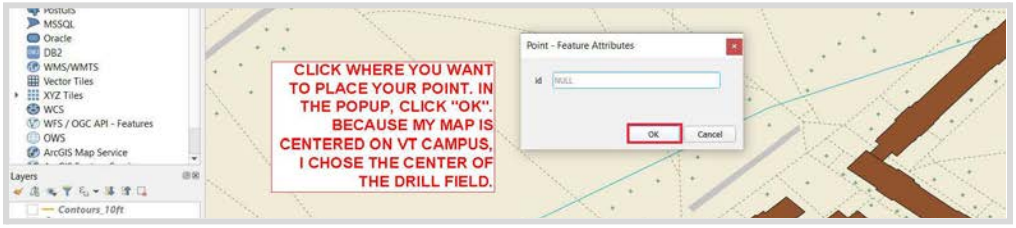


4b Follow the ellipses (...) beside “File Name” to name and locate your new layer in your Data folder. Select “Point” for “Geometry Type”. Then click “Ok” to add the new layer to your map.

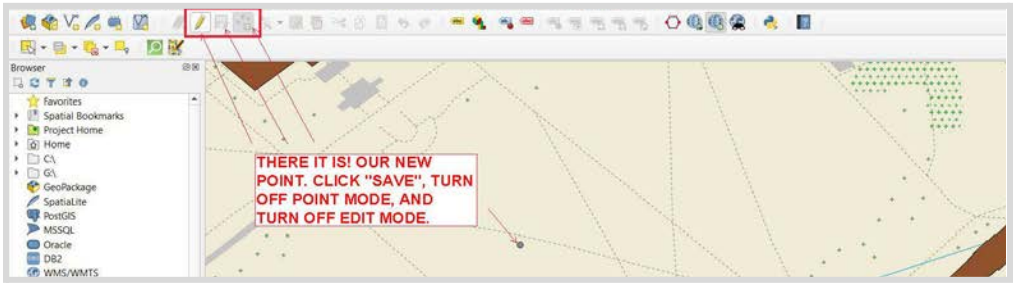


4c Select your new layer, and then in the top menu bar toggle on “Edit” (the pencil). This makes your layer’s features editable. Note that you can edit features on any of your layers – for instance, if you don’t like the shape of Cowgill Hall, you can change it. Next, click the “Add Point Feature” icon to the right of Edit. Notice that your cursor has changed from the Pan hand to a target. Now, simply click to place your new point.

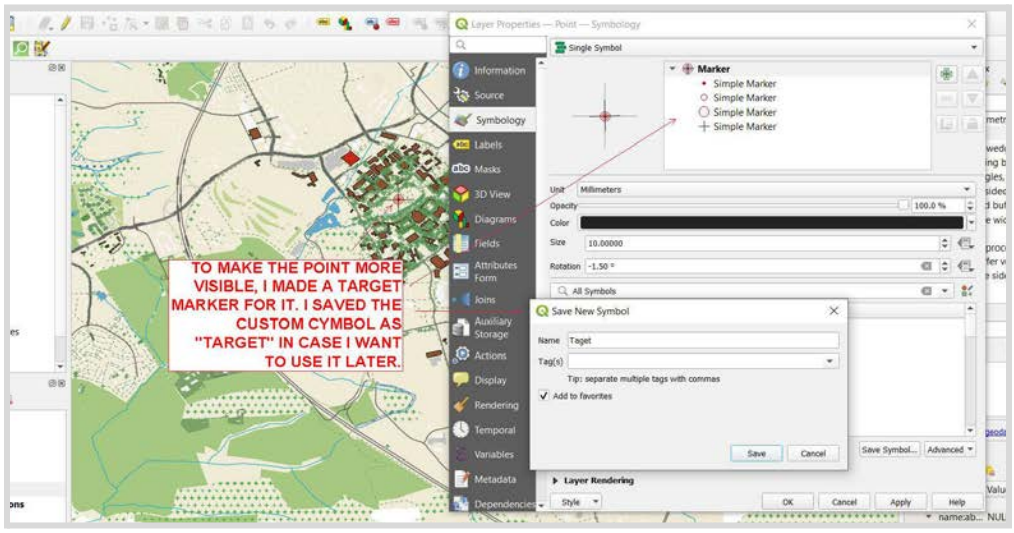


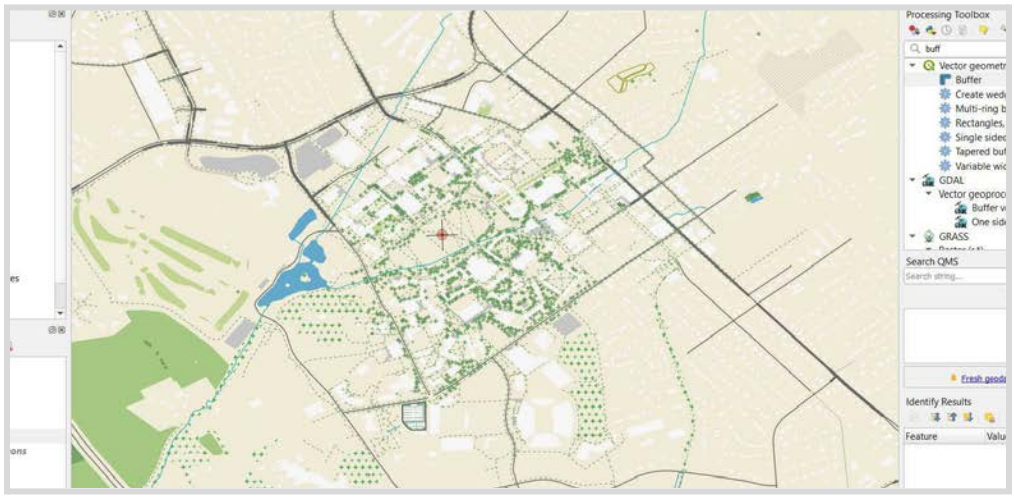


Once you’ve placed your point, Save with the icon beside Edit, and then click “Edit’ to leave edit mode.



4d Optionally, decorate your point with some unnecessary symbology bling.

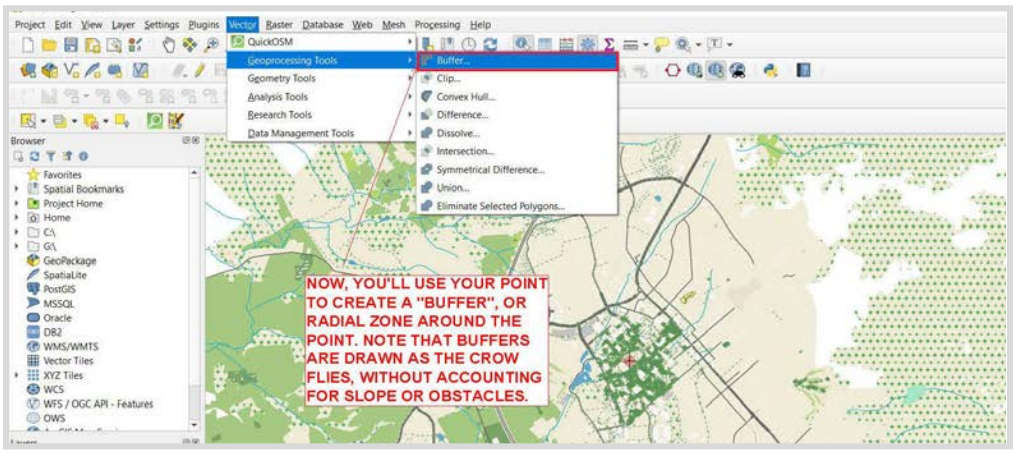




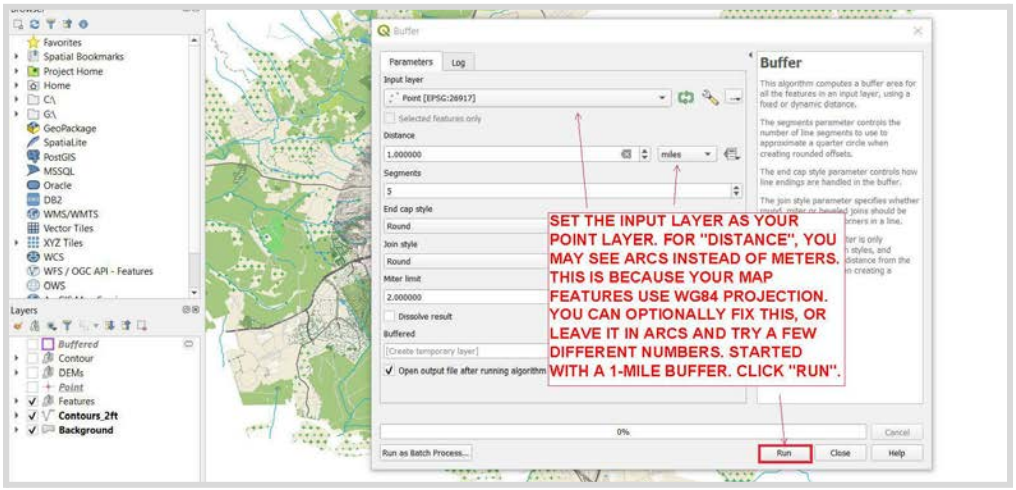
Step 5: Use your point to draw a buffer.

A **buffer** is a circle centered on a chosen point or feature, or series of features. Buffers can be used, for instance, to visualize the number of subway stations within a half mile radius of low income housing projects. Note that buffers are drawn in straight line distance, without regard for topography, which limits their use in measuring true travel time or experienced distance.

5a Go to the “Vector” menu, “Geoprocessing Tools > “Buffer…”

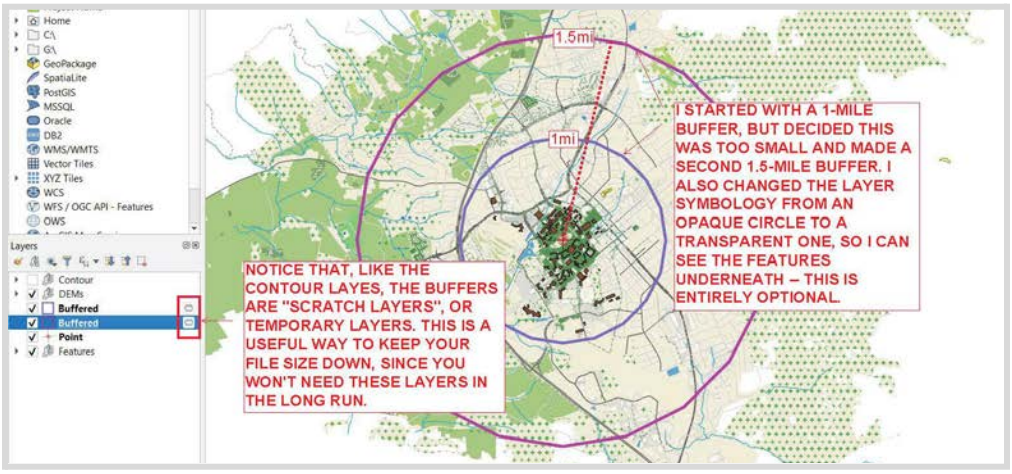


5b Use your point layer for “Input Layer”. Choose a distance or angle, and click “Run”.



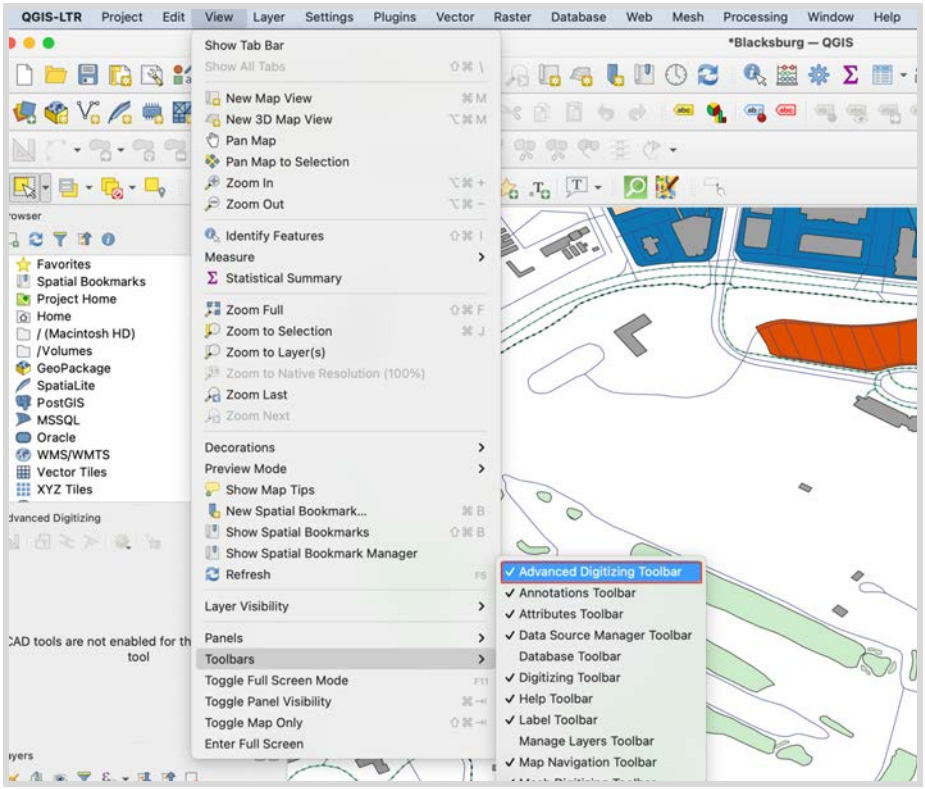
Note: You may see “degrees” instead of “meters” in the “Distance” drop-down menu. This happens when your Input layer uses a coordinate reference system (CRS) that distorts distance at your project location. Make sure to check that your project CRS is set to the correct UTM (see Tutorial 1, Step 1b) and retry the buffer.

5c Try different buffer distances until you find one that includes all the contour information you want to keep. Though my PDF map doesn't show 1.5 miles away from campus, I wanted to buffer at that distance to include some Blacksburg landmarks, in case I want to use this map later for something else.



5d If your buffer and point disappear, this indicates a CRS issue with your point layer.

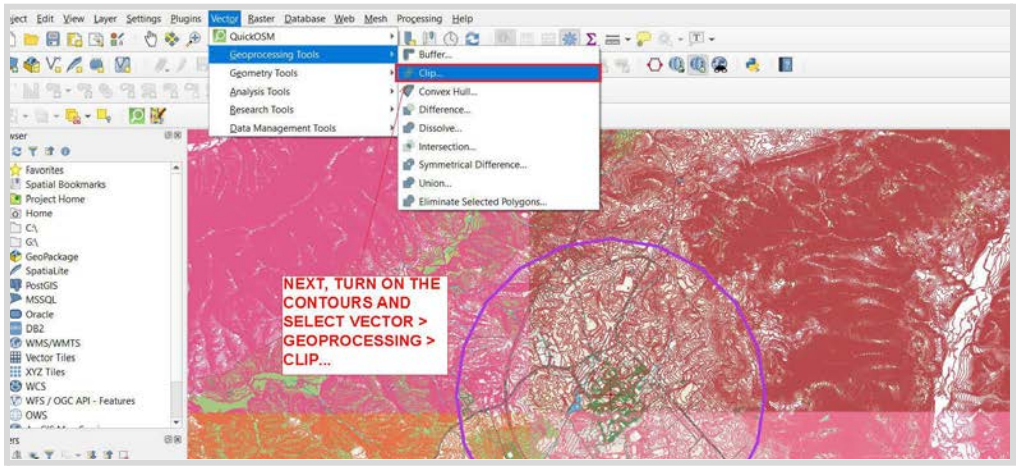
The easiest way to fix this, if you keep having this problem, is to manually move your buffer / point layers to where you want them. To do this, first make sure that your "Advanced Digitizing Toolbar" is turned on (View > Toolbars > check "Advanced Digitizing Toolbar").



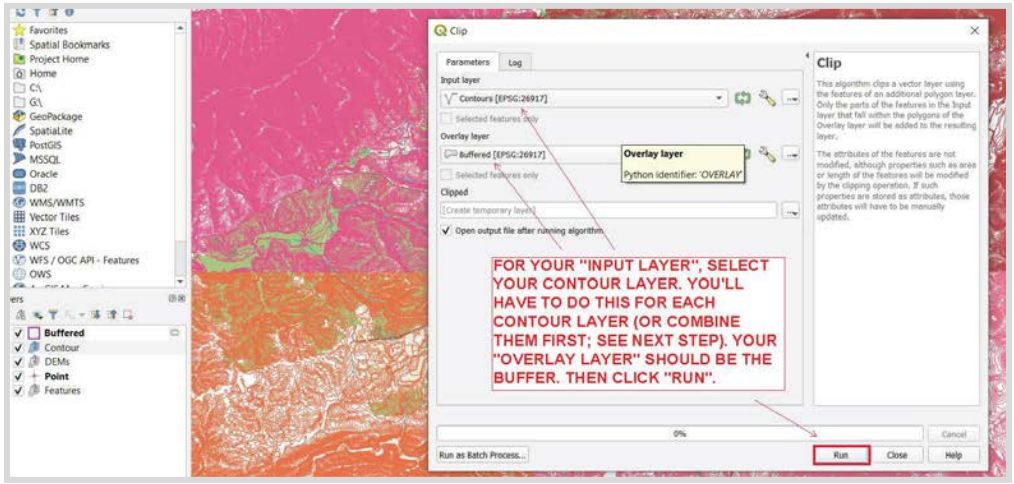
Then zoom to your buffer layer to figure out where it's gone (right click > "Zoom to Layer(s)"). Next, select your buffer layer. Click "Toggle Editing" (the pencil in your top toolbar). Then click "Move Feature" (green blob with cursor). Click on your buffer, and then click on the new place on the map where you want your buffer to go (eg where your other map features are).

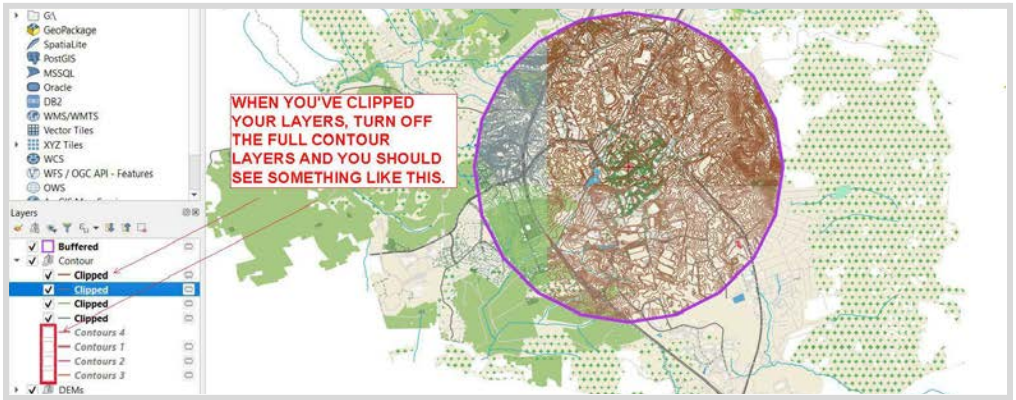
Step 6: Use the buffer to clip your contour lines.

6a In the “Vector” menu, select “Geoprocessing Tools” > “Clip…”

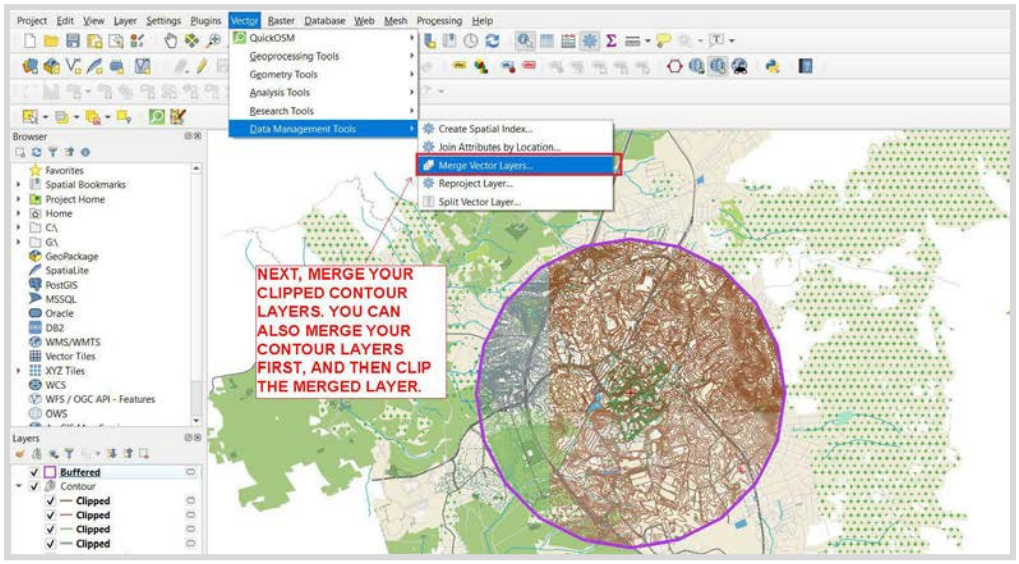


6b Use your contour layer for the “Input Layer”. Your “Overlay Layer” should be your buffer. Click “Run”. Note: you’ll either repeat this step for each contour layer, or skip to step 7c and combine contour layers before you clip them.

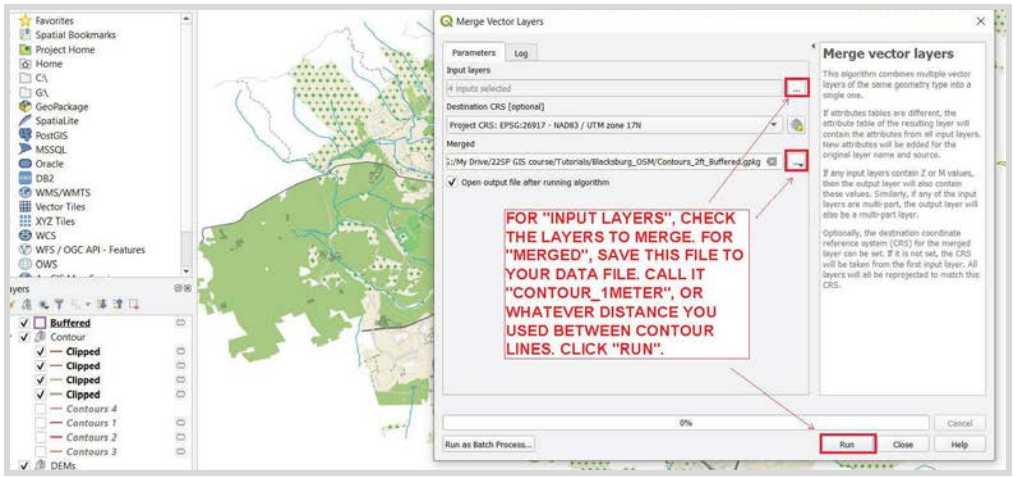




6c Merge your contour layers (before or after clipping them) with the “Vector” menu, “Data Management Tools” > “Merge Vector Layers…”

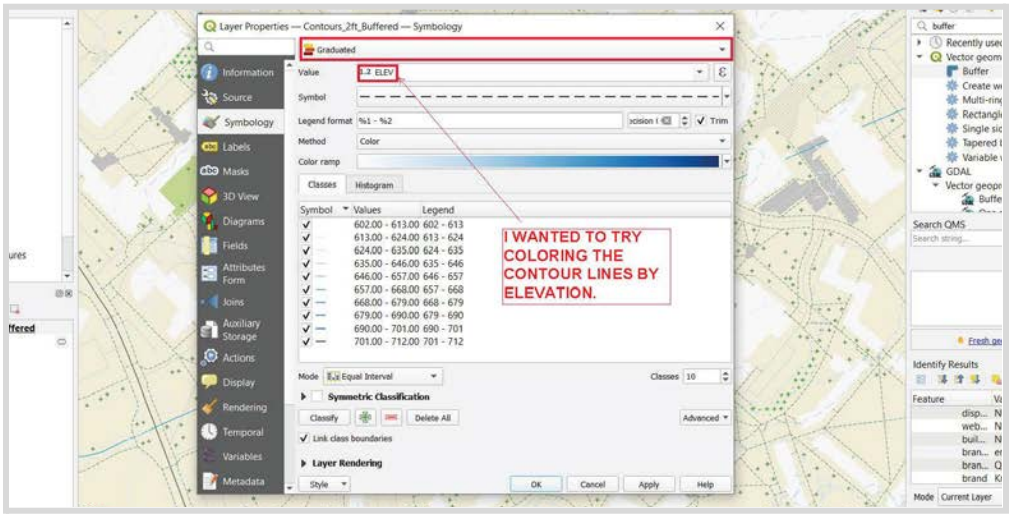


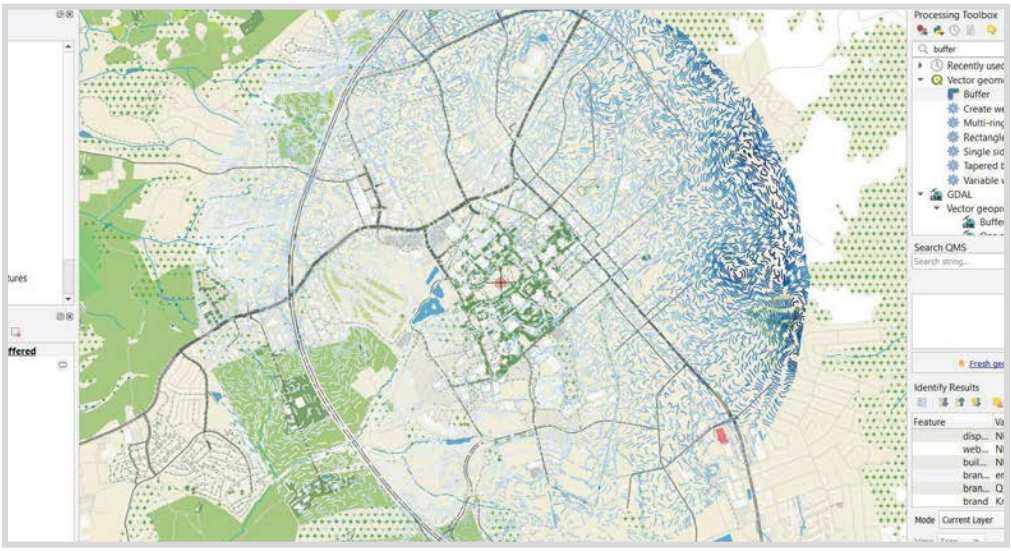
Choose the layers to merge with the ellipses (...) beside “Input Layers”. Name your new layer and save it to your data folder with the “Merged” box. Note: if merging contour lines BEFORE clipping, leave the file as a scratch file (“Create temporary layer” in the “Merged” box), and instead save the file to your data folder in the clipping step 7b.

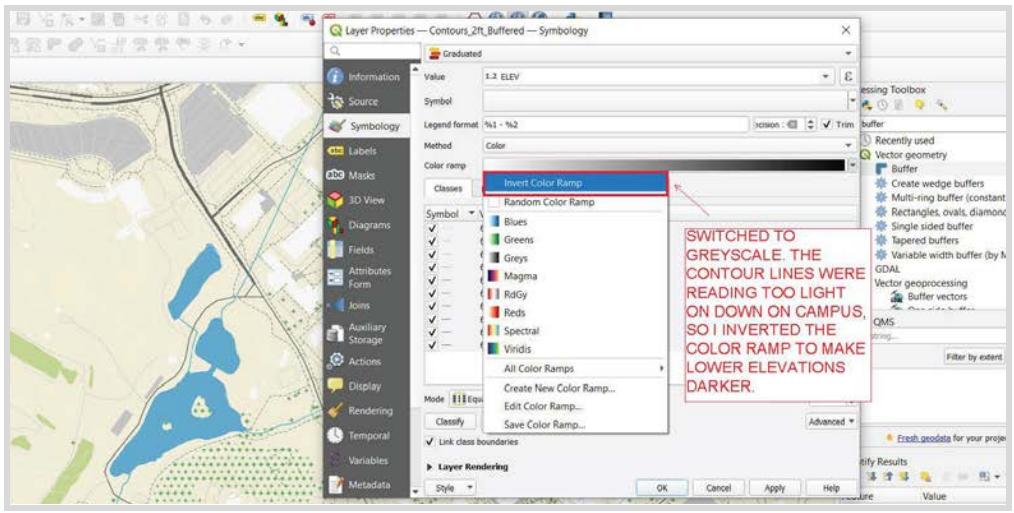


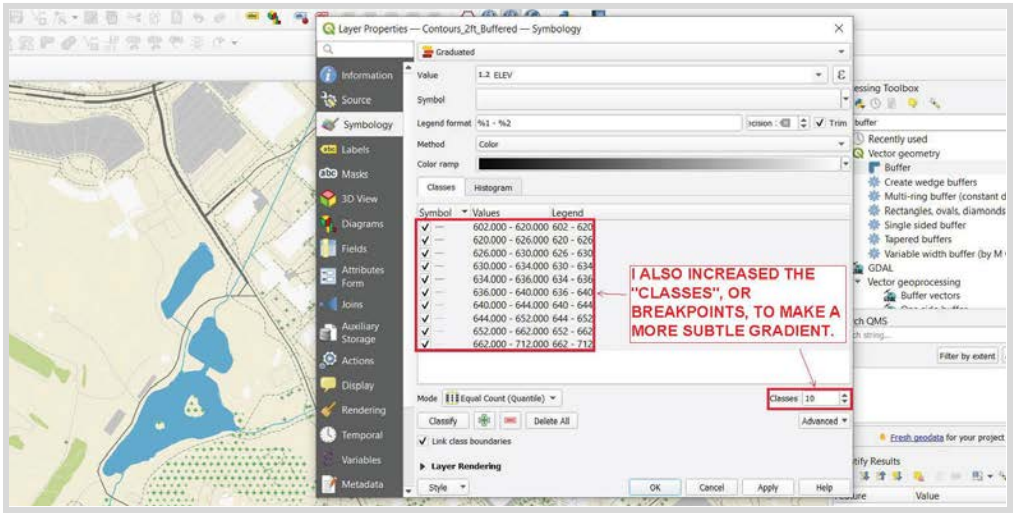
Step 7: Style contour lines. Try adding elevation labels.

7a Style contour lines as desired. Here are a few things that I tried: firstly, coloring them by elevation:






Layer Properties — Contours_2ft_Buffered — Symbology
Graduated
Information
Source
Symbology
Labels
Masks
3D View
Diagrams
Fields
Attributes Form
Joins
Auxiliary Storage
Actions
Display
Rendering
Temporal
Variables
Metadata
Value
1.2 ELEV
Symbol
Legend format
Method
Color
Color ramp
Classes
Invert Color Ramp
Random Color Ramp
Blues
Greens
Greys
Magma
RdGy
Reds
Spectral
Viridis
All Color Ramps
Create New Color Ramp...
Edit Color Ramp...
Save Color Ramp...
Classify
Link class boundaries
Layer Rendering
Style
OK
Cancel
Apply
Help
SWITCHED TO GREYSCALE. THE CONTOUR LINES WERE READING TOO LIGHT ON DOWN ON CAMPUS, SO I INVERTED THE COLOR RAMP TO MAKE LOWER ELEVATIONS DARKER.


Layer Properties — Contours_2ft_Buffered — Symbology
Graduated
Value
1.2 ELEV
Symbol
Legend format
Method
Color
Color ramp
Classes
Histogram
Symbol
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Legend
602.000 - 620.000 602 - 620
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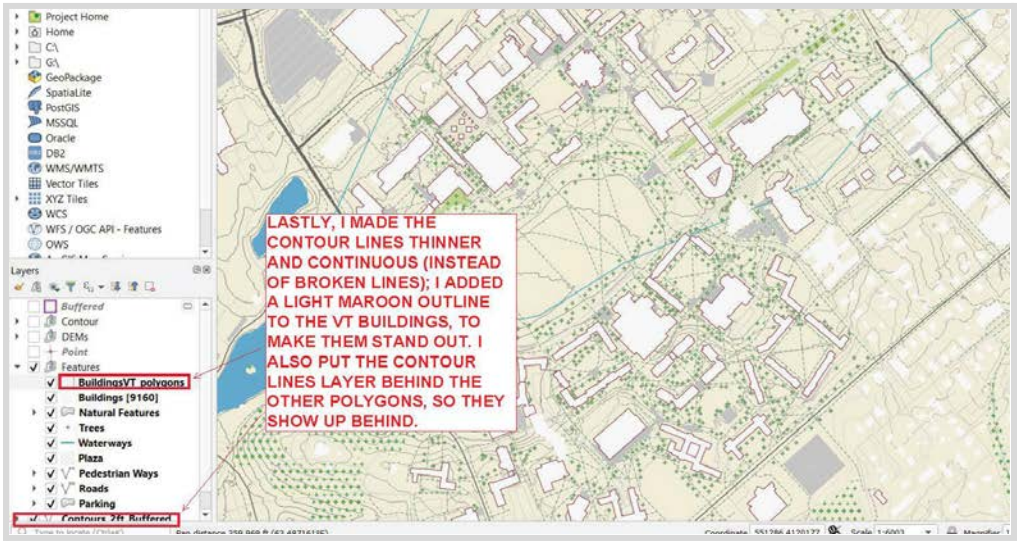
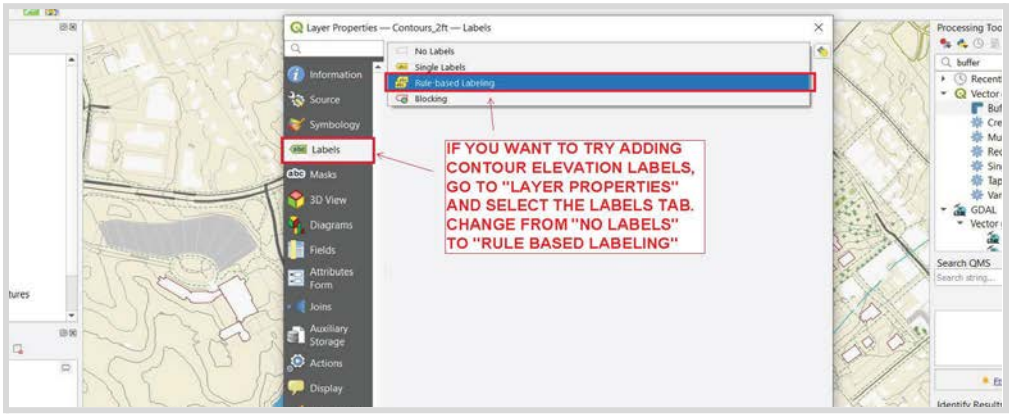
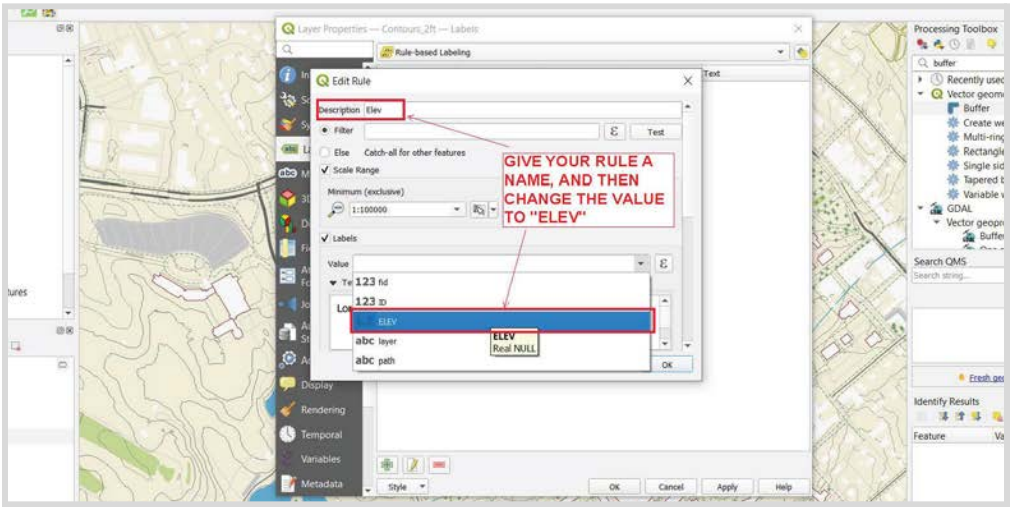
626.000 - 630.000 626 - 630
630.000 - 634.000 630 - 634
634.000 - 636.000 634 - 636
636.000 - 640.000 636 - 640
640.000 - 644.000 640 - 644
644.000 - 652.000 644 - 652
652.000 - 662.000 652 - 662
662.000 - 712.000 662 - 712
I ALSO INCREASED THE "CLASSES", OR BREAKPOINTS, TO MAKE A MORE SUBTLE GRADIENT.
Mode
Equal Count (Quantile)
Classes 10
Classify
Delete All
Advanced
Link class boundaries
Layer Rendering
Style
OK
Cancel
Apply
Help

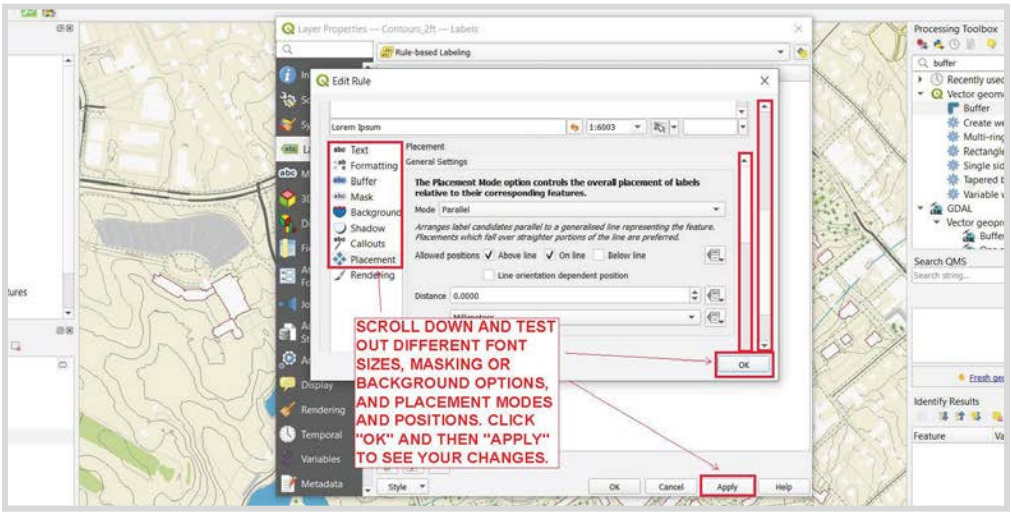

Project Home
Home
C:\
G:\
GeoPackage
SpatiaLite
PostGIS
MSSQL
Oracle
DB2
WMS/WMTS
Vector Tiles
XYZ Tiles
WCS
WFS / OGC API - Features
OWS
Layers
Buffered
Contour
DEMs
Point
Features
BuildingsVT_polygons
Buildings [9160]
Natural Features
Trees
Waterways
Plaza
Pedestrian Ways
Roads
Parking
Contours_2ft_Buffered
LASTLY, I MADE THE CONTOUR LINES THINNER AND CONTINUOUS (INSTEAD OF BROKEN LINES); I ADDED A LIGHT MAROON OUTLINE TO THE VT BUILDINGS, TO MAKE THEM STAND OUT. I ALSO PUT THE CONTOUR LINES LAYER BEHIND THE OTHER POLYGONS, SO THEY SHOW UP BEHIND.

7b I also added labels to indicate contour elevation. In “Layer Properties” you’ll see a “Labels” tab. Select “Rule Based Labeling”.

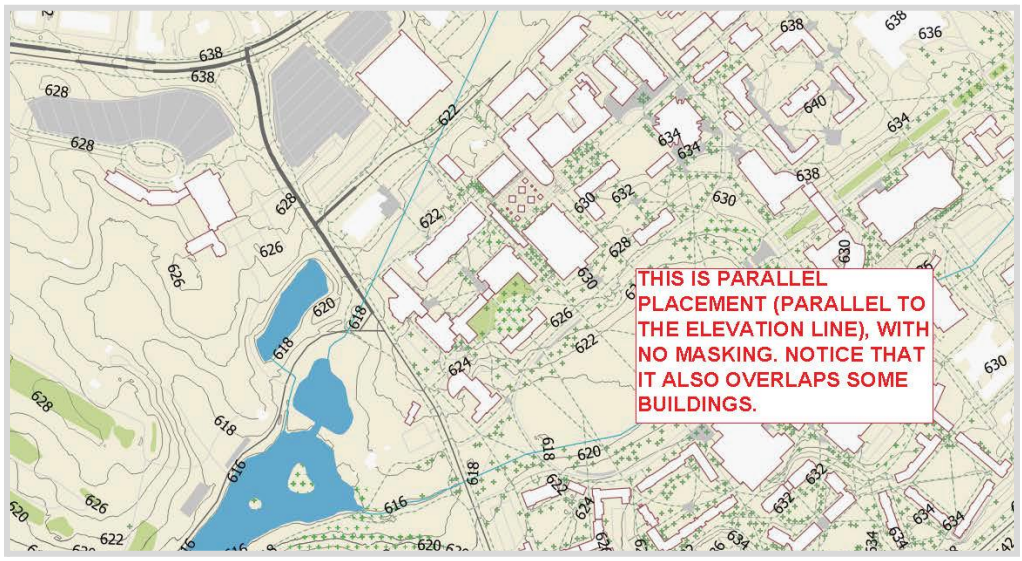


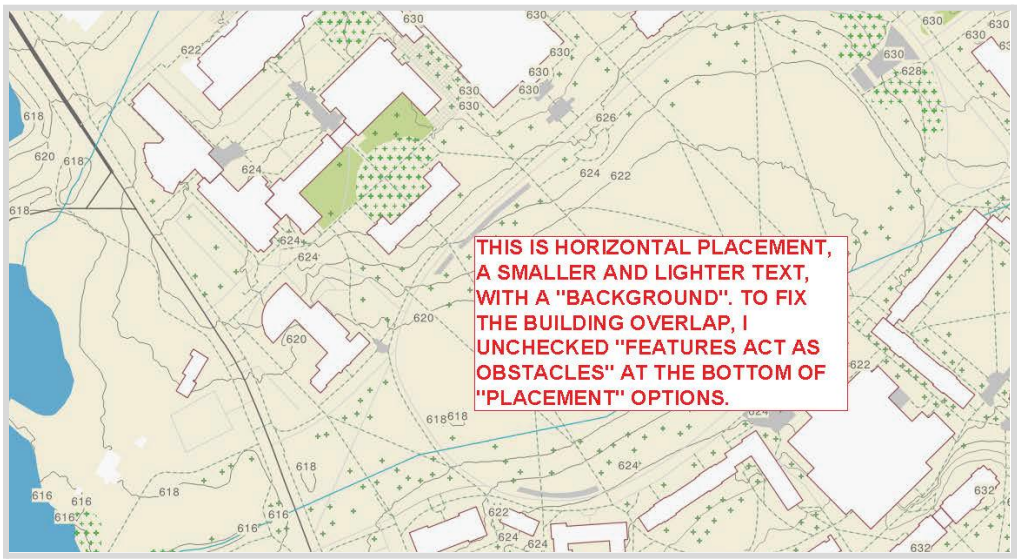
Name your rule and select “elev” as the “Value”. Try different appearances with “Text”, “Formatting”, “Placement”, “Mask”, and so on.





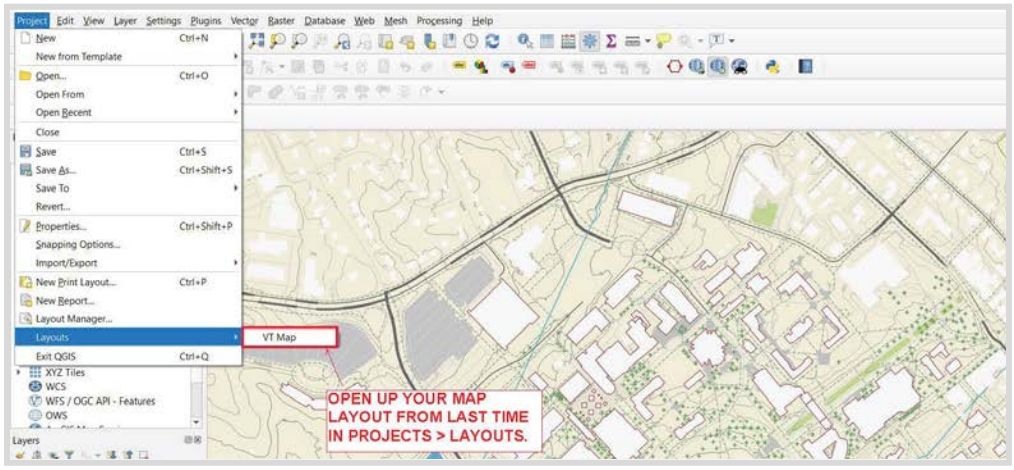
See a couple examples of label graphics:



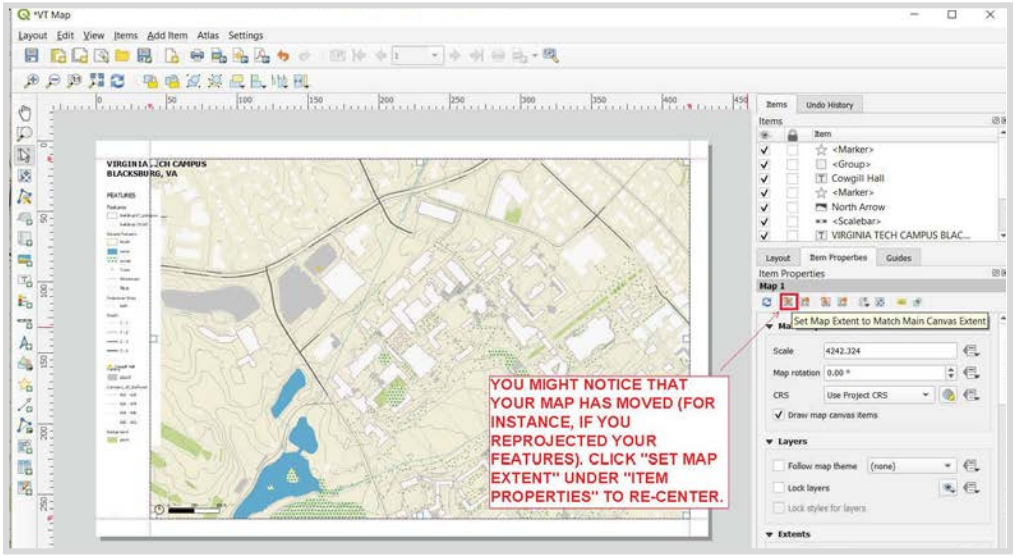


Step 8: Re-export your PDF map.

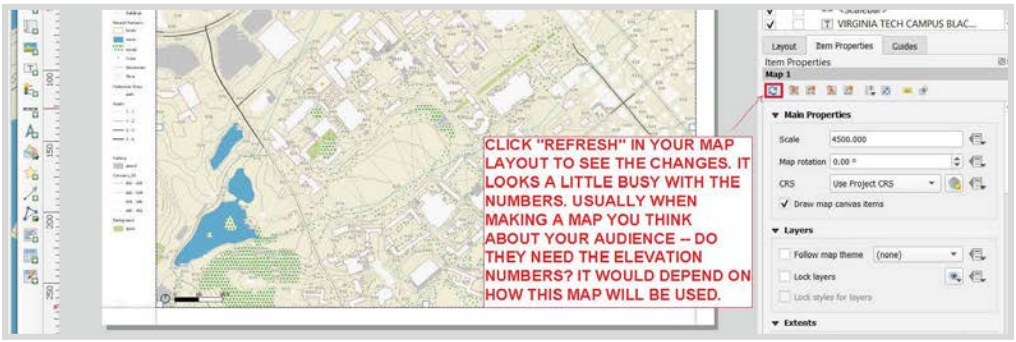
8a Open your Map Layout from last time (“Project” > “Layouts”)



8b You may need to reset your map with the “Set Map Extents to Match” button in the “Item Properties” window.



Try “Refresh” if you’ve made changes to your map that haven’t shown up. When it looks good, export your new PDF.



- **Bonus** -

Step 9: Examine how your previous data correlates to the topography. What kinds of buildings are on steeper or flatter ground? How do rivers relate to the topography? Identify and zoom in on interesting observations. Export these as separate maps for your Tutorial Assignment 1&2 submission.