Introduction to Quantum GIS

This exercise is designed to familiarize you with some basic concepts and capabilities of QGIS. You will explore the abilities of Quantum GIS to visualize, navigate, manipulate, and analyze geographic datasets.

Specifically, you will learn how to:

- Create a map project
- Add layers to your project
- Display data to your specifications (e.g. colors, symbols, line weights)
- Navigate the data using the zoom, pan, and full extent tools
- Identify features and their attribute data
- Query the map based on your criteria
- Create Buffers around points
- Create a map layout

In order to explore these concepts, we will use the datasets listed below to select the best locations for community sponsored produce stands. In our imagined scenario, the City of Berkeley has assigned you with the task of identifying lower income communities with limited access to fresh fruits and vegetables. The City would like to identify five civic buildings that are in close proximity to these neighborhoods and place weekly produce stands on their property. Therefore, you're final product will be a map depicting the location of these potential sites and their service areas.

Dataset

You will be working with several data layers from different sources. Note that a layer is comprised of several different files with the same name and different extensions. All these files of the same name must be in a folder together for the software to read them.

Berkeley_dem.tif – a raster "digital elevation model" displaying elevation for the City of Berkeley and surrounding areas.
Berkeley_shd.tif – a raster grid file displaying shaded relief based on elevation.
BerkeleyBlockGroups.shp – polygons containing demographic information for census block groups
Fruit_Vegetable_and_FarmersMarkets.shp – shows point locations for fruit and vegetable markets, as well as Farmers Markets
BerkeleyLimits.shp – polygon of city boundary
County.shp – polygon of Alameda and Contra Costa Boundaries.
PublicSites.shp – point locations of public buildings, institutions, and churches. This layer was created by combining three shapefiles and removing buildings on the Cal campus.

*** Note that all data layers are in the following projection:**
Projection: Universal Transverse Mercator (UTM)
Datum: North American Datum 1983 (NAD83)
Zone: 10 North

Display Data

In this section you will add layers to your map project and change their display properties.

Add Data

1. Open QGIS by going to Start > All Programs > Quantum GIS > Quantum GIS.

2. In QGIS, go to Layer > Add Vector Layer or Click on the *Add Data* button: 

3. Click the *Browse* button, then navigate to the folder with your data in it, and click 'OK'. The folder's contents should appear in the window.

4. Add all of the shapefiles to QGIS. You can select multiple files at once by holding the *Ctrl* or *Shift* keys.

5. Next, go to Layer > Add Raster Layer or Click on the *Add Data* button: 

6. Set the "Files of Type" to *GeoTIFF* and add **Berkeley_dem.tif** and **Berkeley_shd.tif** to the map.

7. Check the boxes to the left of the layer name off and on. As you can see, this makes the layer visible or not visible in the data frame.

8. Click and drag the layers in the table of contents to rearrange their order. Arrange the layers in this order, from top to bottom:

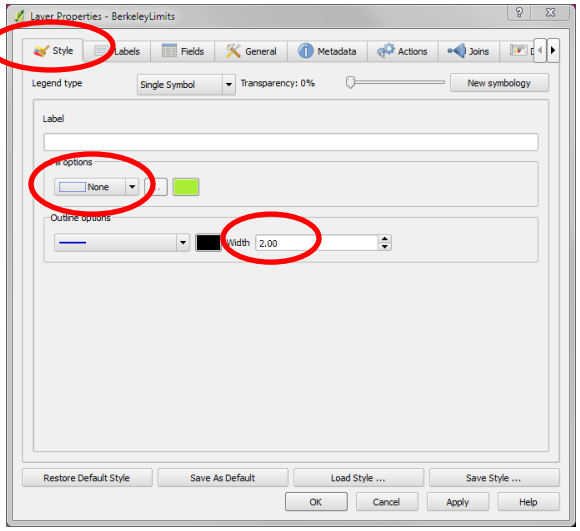
    a. **PublicSites**
    b. **Fruit_Vegetable_and_FarmersMarkets**
    c. **BerkeleyLimits**
    d. **BerkeleyBlockGroups**
    e. **County**
    f. **Berkeley_shd**
    g. **Berkeley_dem**

9. Click the *Save* Button, navigate to your working directory (the same directory that your data is in), and name the file as **'*LASTNAME*_GIS_workshop.qgs'**. Save your work repeatedly throughout this project. A project file (.qgs) will save your display and layers, however it only points to the selected data files. Data files are maintained separately from the project file.

Layer properties

1. Change the **BerkeleyLimits** polygon to an outline by double clicking its name in the table of contents. Go to the "Style" tab, and

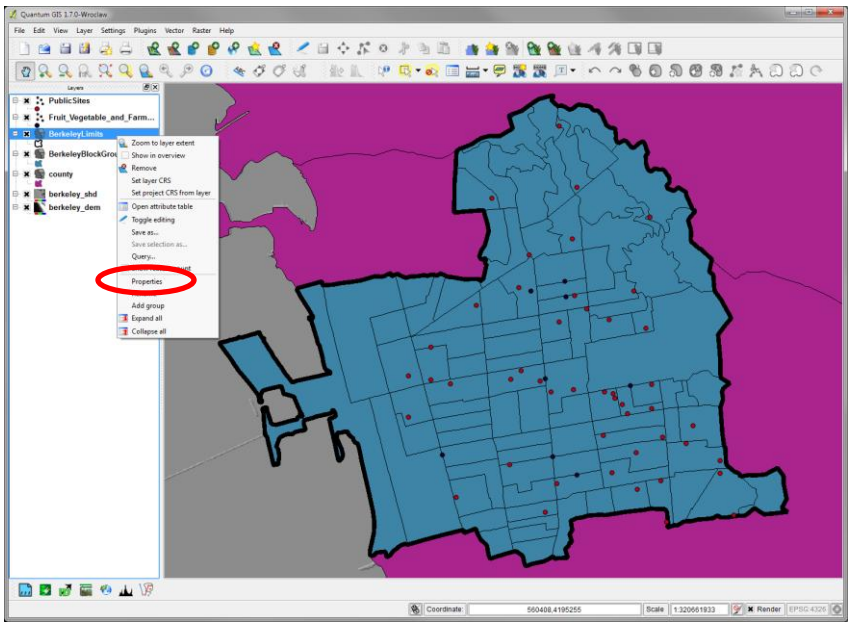
2. Increase the width in "Outline options" to *2.0*, and Set the "Fill options" to *None*.



3. Right-click **BerkeleyLimits** and select *Zoom to Layer Extent*.

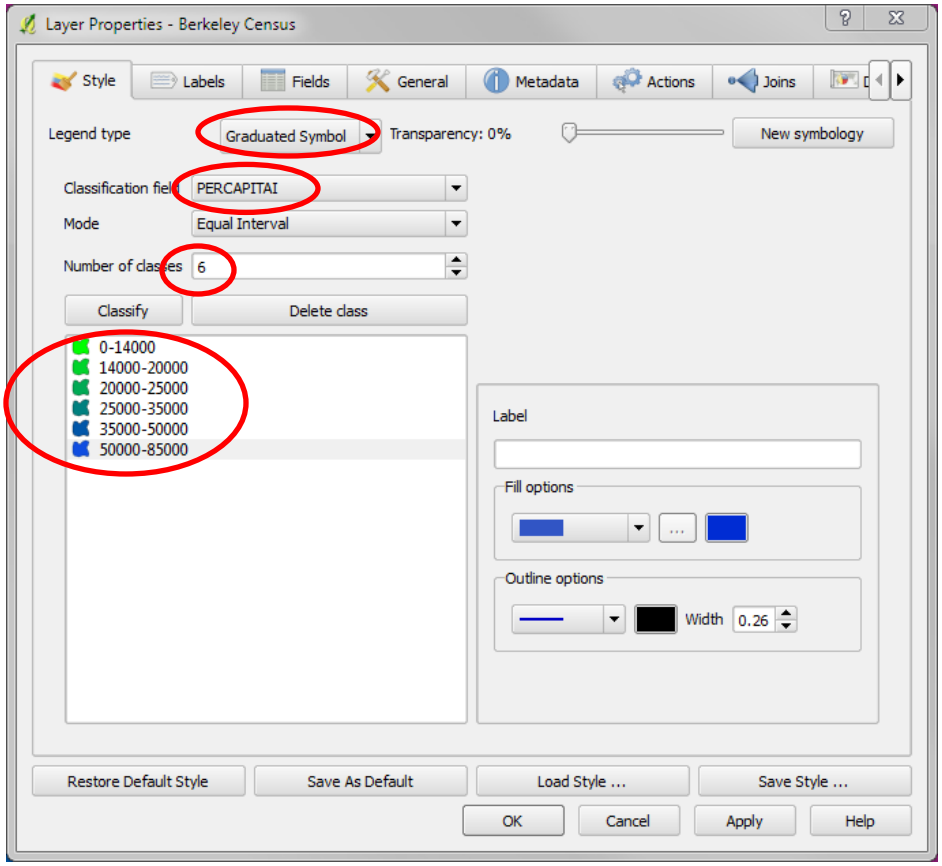
4. Right-click on the layer: **BerkeleyBlockGroups**. A context menu appears – Stop for a minute and look at the options in this context menu. This menu contains several important options.

5. Choose *Properties* to open the *Layer Properties* (same as double-clicking). The *Layer Properties* dialog appears. You can access the properties for the other layers in the same manner.



6. Click on the *General* tab. You can change the "Display Name" of layer here. This only changes how the name is displayed, it does not change the name of the actual file. Type **Berkeley Census**.

7. Click on the *Style* tab and change the "Legend Type" to *Graduated Symbol*. In the drop-down menu for "Classification Field" and Select *PERCAPITAI* (Per Capita Income). These settings will assign color to each polygon based on their per capita income. Set the number of classes to "6", and click the *Classify* button.

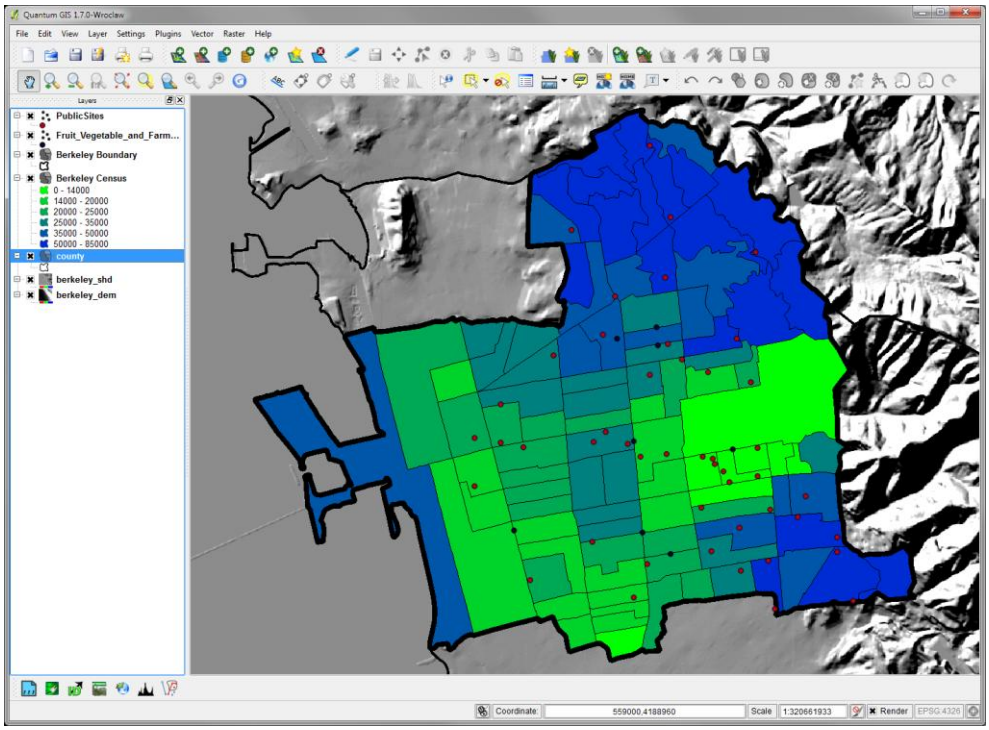


8. Redefine the bins for each class by double clicking the number range for each bin and manually entering the lower and upper values as seen below:

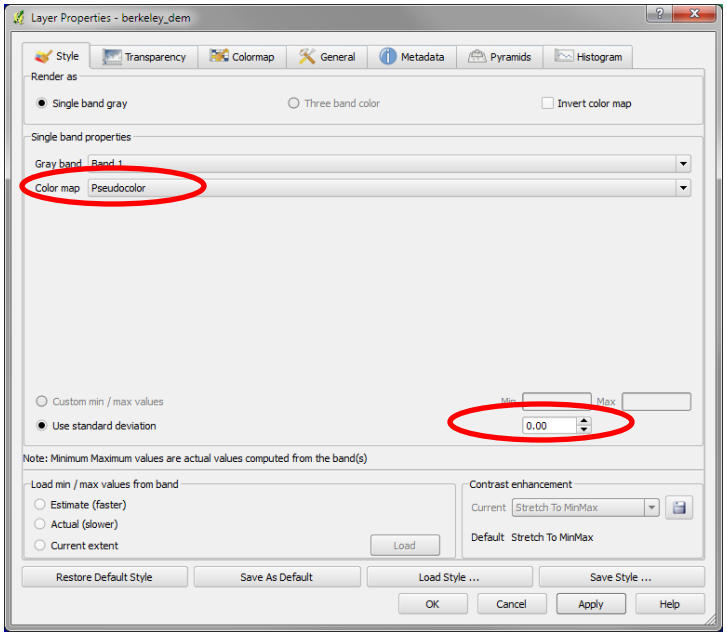
0-14000
14000-20000
20000-25000
25000-35000
35000-50000
50000-85000

Click **OK**, and you will see the census blocks vary in color according to Per Capita Income.

9. Using the same steps as in items 1 and 2 above, set the County layer's Fill options to *None* so that you can see the topography beneath.



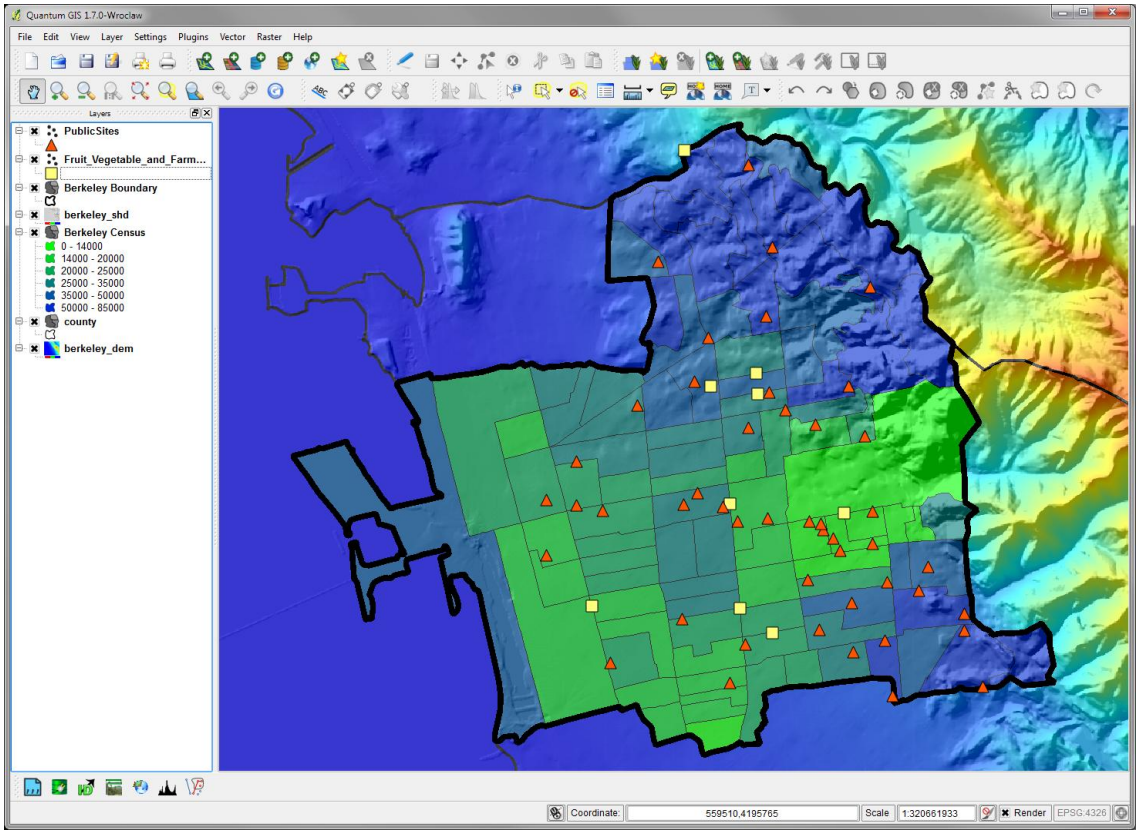
10. Change the symbols for the other **vector layers** so that they are easily distinguishable from the **Berkley Census**. You can change the symbols for layers by clicking on their symbol (colored rectangle under the layer name) as described in step 1 of this section. Be sure to make your symbols colors that will stand out and are large enough to see.



11. To adjust the Style for the **raster layers**, access the *layer properties* menu for **berkeley_dem** and go to the *Symbology* tab. Set the color map to *Pseudocolor*, and set the option for "Use Standard Deviation" to 1.00.

12. Lastly, open the *Layer Properties* for **Berkeley_shd** and go to the *Transparency* tab. Set the *Global Transparency* to **60%**, which will create a 3D effect with the DEM. You can adjust transparency

on any layer to maximize viewing. Also try moving the semi-transparent **Berkeley_shd** layer above the polygon layers.



Navigation

1. Explore the data using some of the navigation tools in the Toolbar:

2. Use the magnifying glass tools to draw a rectangle around an area to zoom in or to zoom out.

3. Click on the full extent button  to see your entire dataset.

4. Experiment with the other navigation tools to see what they do.

Working with Attribute Data

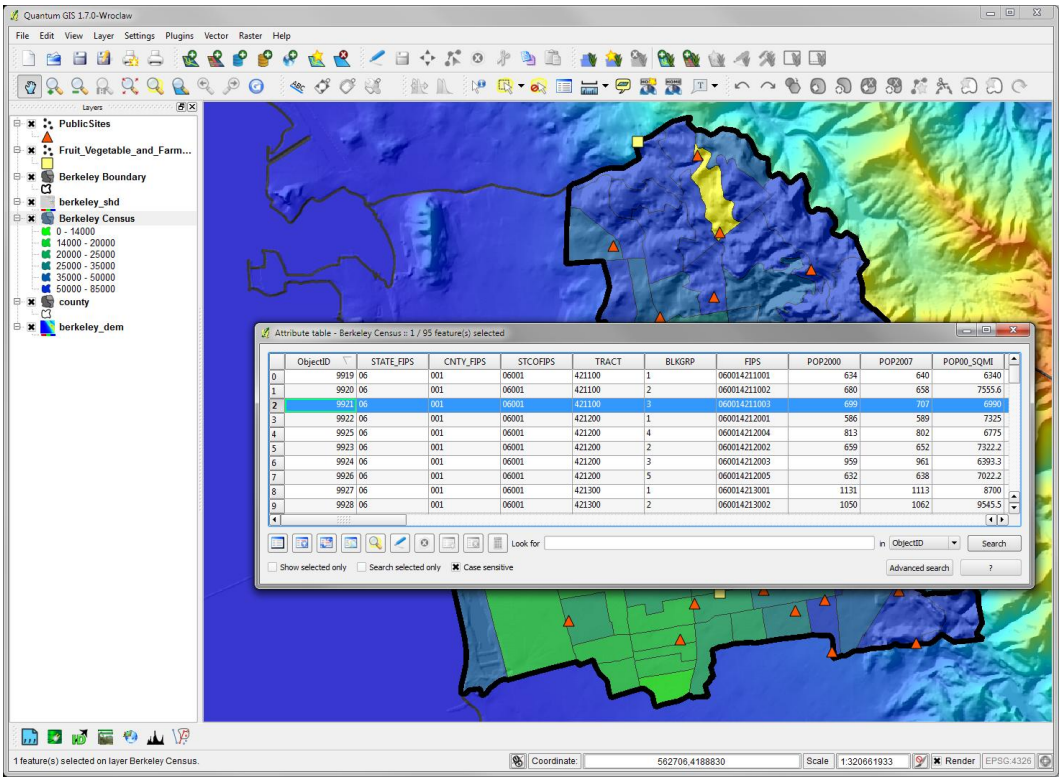
Every spatial unit, such as a polygon, point, or pixel may be assigned several values that are associated with relevant attributes. These values are stored in the database file (.dbf) and may be viewed in an attribute table or using the identify tool. This section explores attribute tables and some tools to query them.

Attribute Tables

1. Right-click on **Berkeley Census** and select "Open Attribute Table."

2. Explore the table. Each row corresponds to a spatial feature and each column represents an attribute.

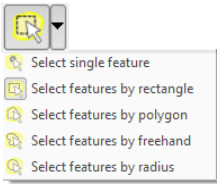
3. Click on the grey box at the beginning of a row, and the corresponding feature is highlighted in yellow on the map. Click the  button, and the map zooms in to the selected feature.



4. Click the *Unselect all* button  at the bottom of the attribute table's window to clear selection.

Select Features

1. In the previous section, we selected features from the attributes table. You can also select them directly on the map. Re-adjust your zoom level then choose the *Select Features* button from the *Tools* toolbar.

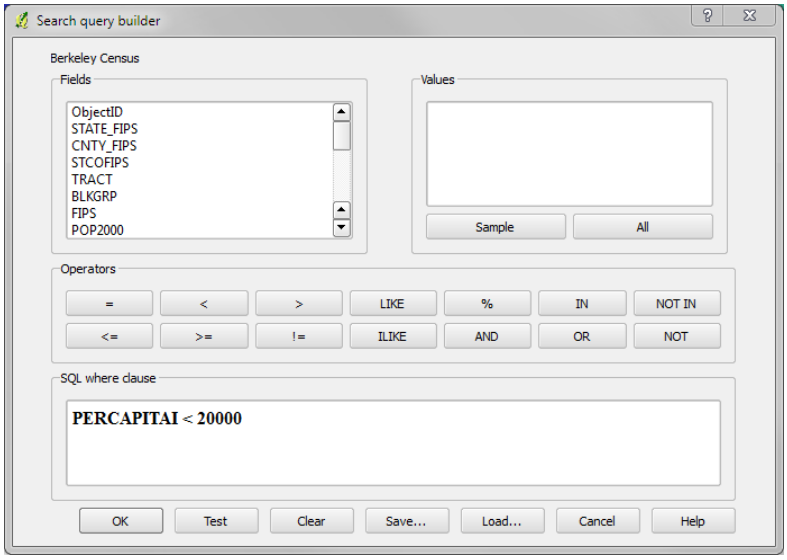


2. Click inside of a polygon. Hold the *Ctrl* key to make multiple selections, or drag over a large area while holding the *shift* key. You will notice that features are highlighted both on the map and in the attribute table. There are several different tools for selection that you can try.

3. Alternatively, you can also select features based on their attribute values. Clear the selected values in the attribute table, and Click on the "Advanced Search" button in the bottom right hand corner.

4. The query bulder function is similar to a calculator. We want QGIS to select features from **Berkeley Census** where Per Capita Income (**PERCAPITAI**) is less than 20,000 dollars. Double-click on listed terms to insert them into a formula and click on the mathematical buttons to insert these. Write the statement as seen below:

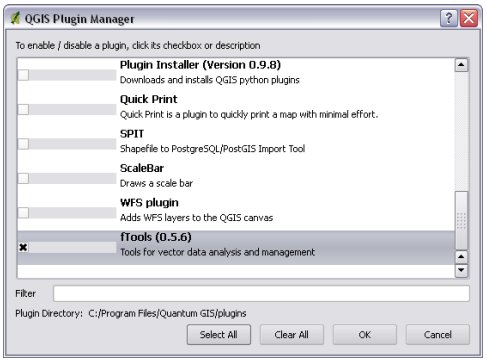
PERCAPITAI < 20000



5. Click *OK*.
6. To export the selected areas, and create a new shapefile with only these areas, Right-click **Berkeley Census** in the table of contents, and click *Save Selection as*. Set the Format to *ESRI Shapefile* and browse to *C:\WorkSpace\Intro_QGIS\outputs* and name the new shapefile **low_income_areas.shp**, and accept the default projection. You can add this new file to your map.

Basic Spatial Analyses

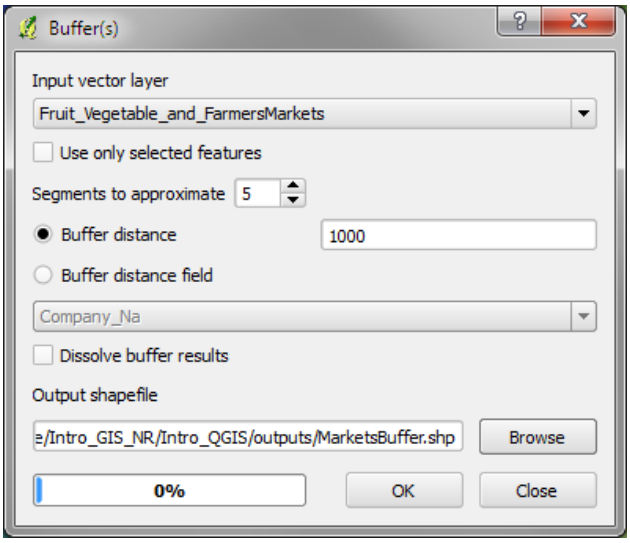
Much of the power of GIS lies in its ability to analyze spatial data. This section introduces simple spatial analysis tools.



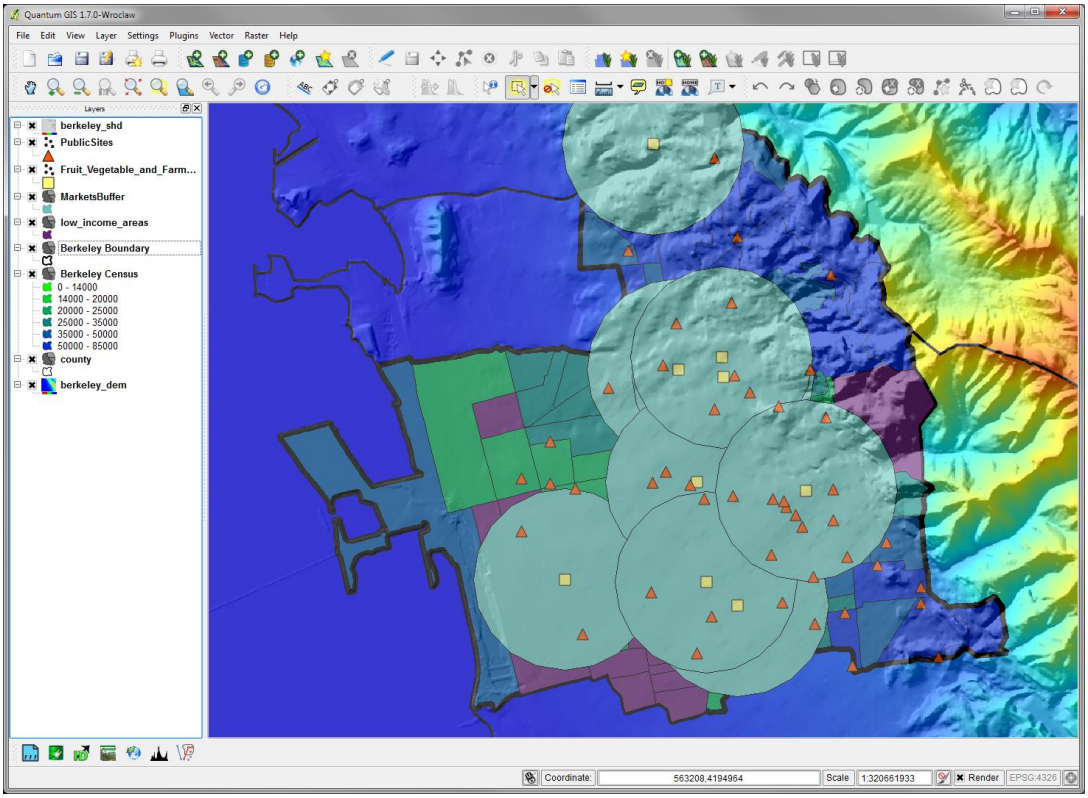
1. Open the Plugin Manager by selecting *Plugins* > *Manage Plugins*. Here you will find many additional tools that extend the capabilities of QGIS. Check fTools at the bottom of the list, this plugin contains a series of valuable analysis tools that will show up as a drop down menu called "Vector." Take a look to see what is available.

2. Choose *Vector > Geoprocessing Tools > Buffer(s).*

3. As seen in the figure below, use the drop-down list to select **Fruit_Vegetable_and_FarmersMarkets** as the *input vector layer*. Set a buffer distance of 1000 (units are in meters), and click browse to select a folder and name to save the new buffer polygon shapefile. Name the new file **MarketsBuffer.shp** and click **OK.**



4. Click "Yes" to add the new file to your map, and close the buffer dialog box.



Difference

1. Choose *Vector > Geoprocessing Tools > Difference*.

2. Using this tool, we will identify the low income areas that are greater than 1km from a fruit and vegetable or farmers market. Set **low_income_areas** as the *Input vector area*, and **MarketsBuffer** and the *Difference Layer*.

3. Save the new feature as **underserved.shp**.

4. Click *OK*.

5. Turn off the **Buffer** layer. Your new layer should show only low income areas that are greater than 1km from markets.

6. Clear your selected features by clicking on *View > deselect features from all layers* in the drop down menu at the top of the window.

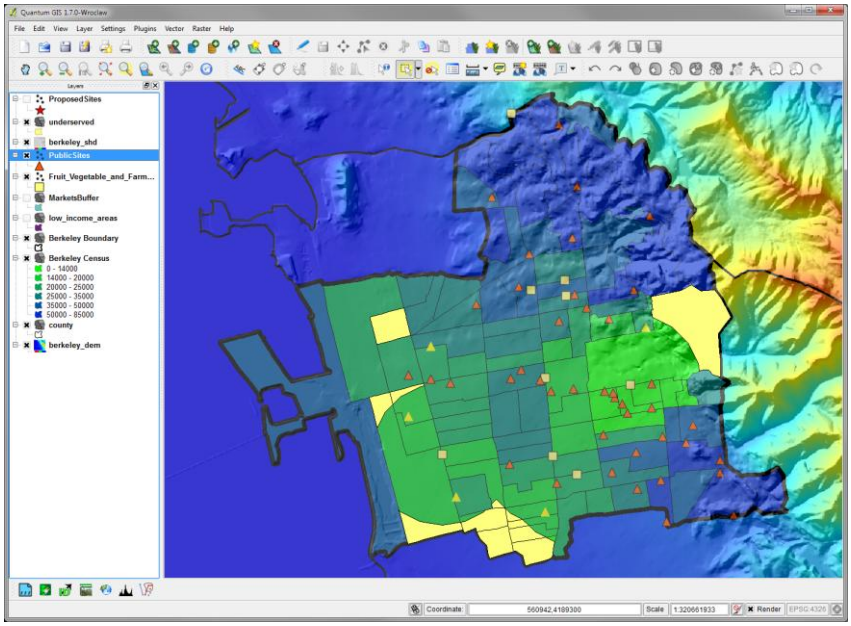
Expert Opinion

Since the city is asking you to choose these sites, we can't let the GIS do all of the work. Select five sites from the candidates based on their service areas and your knowledge of the area. Which sites will best serve the community?

1. Choose the *Selection* tool  .

2. Make sure that **PublicSites** and **UnderservedAreas** are both visible on your map.

3. Use the *Select feature* tool and highlight five Public Sites that could represent good sites for community produce stands, based on their proximity to underserved areas. Hold the *Ctrl* key to select multiple features.



4. Right click **PublicSites.shp** in the table of contents and *Save selection as* to create a new output of your five selected points. Name the file **ProposedSites.shp**.

5. Hide the other public sites, and create *1km* buffer around **ProposedSites** using the steps described in the previous buffer section.

Exporting Data

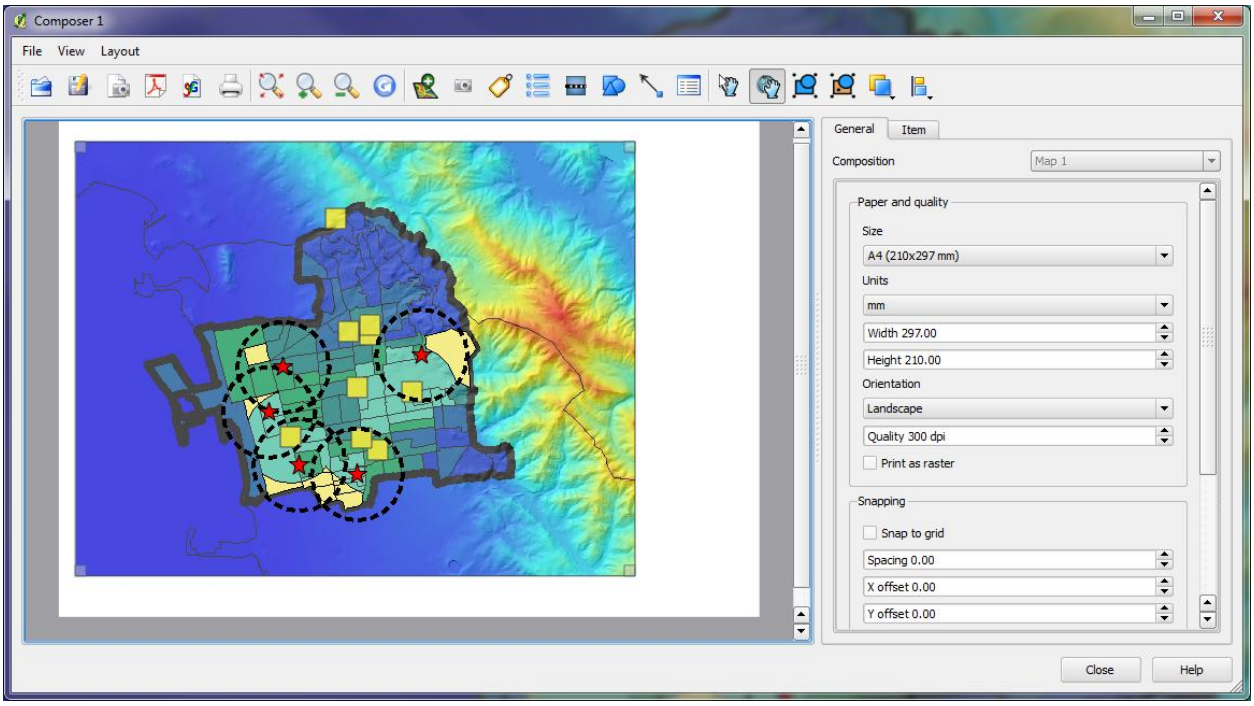
Most people do not have access to GIS, so we must consider how we will share our data with the rest of the world. This section will teach you how to export your data to other formats while emphasizing quality map design.

Print Layouts

1. Adjust your layers symbology to create a compelling map layout in your viewer before entering the QGIS print composer.

2. Enter the Print Composer by selecting File > Print Composer in the drop-down menus.

3. In the new window that opens, click the Add Map tool  , and drag a box over the blank workspace.



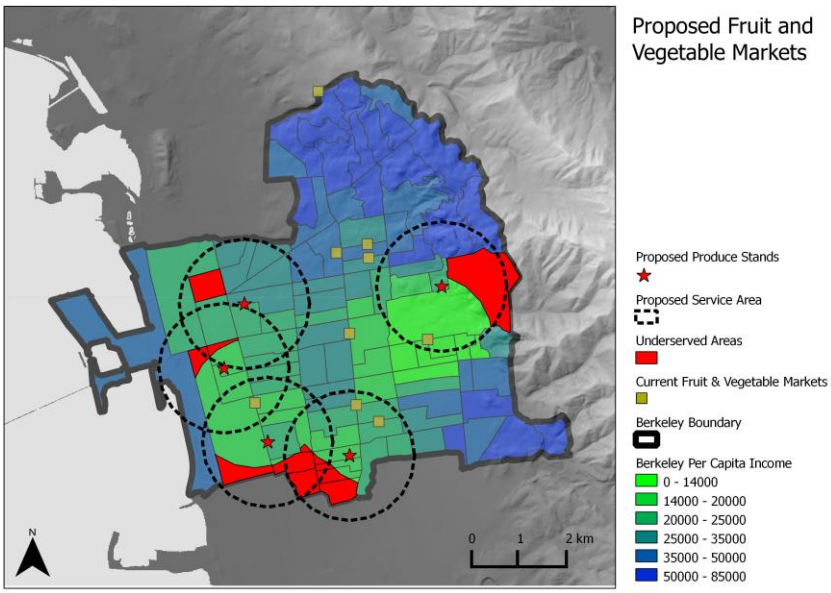
4. Add a scale bar to the map using the *add new scalebar* tool  and clicking on the map. You can adjust the style and numbering under the Item tab while the scale bar is highlighted.

5. Change the "Map units per bar units" to *1000* to convert meters to kilometers, and add *km* to the "unit label."

6. Add a legend to the map by selecting the *add legend* tool  and click to place on the layout. Use the options under the *Item* tab to adjust the legend to your liking. You can move items up and down and edit their names here.

7. Add a title to the map using the *add new label* tool  . You can adjust the text under the item tab, and size and position by dragging the blue squares on the map.

8. Spend some time making adjustments to the map (layer colors and textures) and don't be afraid to make your map unique.



Export as digital image

1. Under the *General* tab, you can adjust the *Print Quality* of your map. Choose lower resolution (72-100 dpi) for powerpoint, and higher resolution (300-600) for print.

2. Choose the *Export as image* button to save your map layout. You can choose from several different file types to output.

3. Use the drop down menu to *save as type* .jpg. Name the map **Berkeley_map.jpg**. Find your file in Windows Explorer and open it to view!