QGIS Basic Geoprocessing & Cartography Guide

## Overview

The government of Uganda wants to help its rural population gain access to health care. It wants you to figure out what Ugandan districts will need hospitals. However, the government wants to take precautions of its people's future health by keeping hospitals away from factories and having transportation access by building them near roads and outskirts of cities. The purpose of this lab will be to import and analyze data into QGIS through basic geoprocessing tools.

## Data Requirements

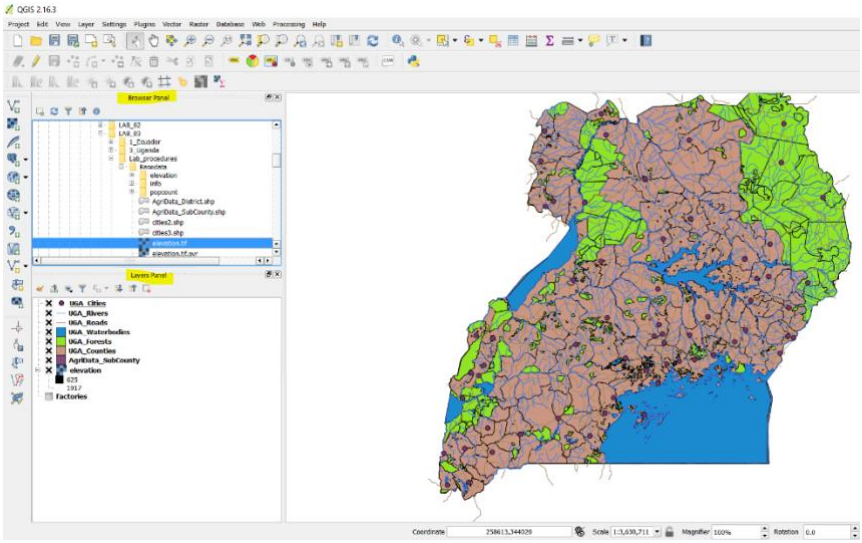
You will find all the data required for this lab in : Lab_03/Lab_procedures/Basedata

UGA_Waterbodies.shp , UGA_Rivers.shp, UGA_Forests.shp, UGA_Counties.shp
UGA_Cities.shp, AgriData_SubCount.shp, Factories.dbf, Elevation.tif

## Procedures

### Part 1. Importing Data

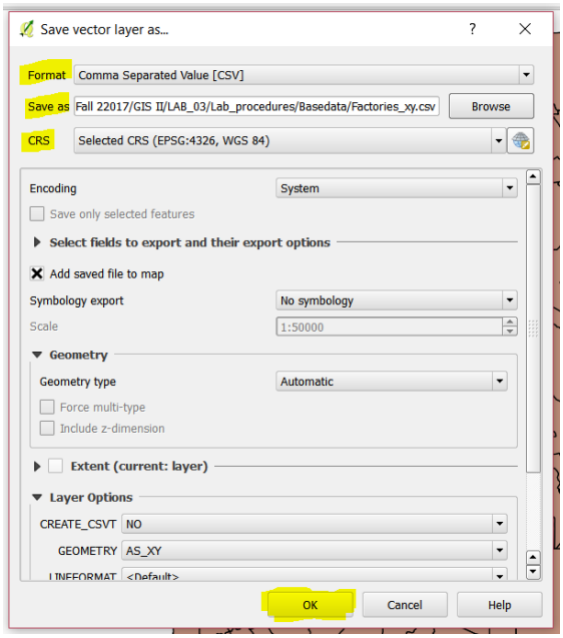
1. Open up an instance of QGIS by double clicking on the icon.
2. Go the "Browser Panel" screen in the left corner of the screen and go to your hard drive. Follow this file path: Lab_03/Lab_procedures/Basedata.
3. Once you reach the "Basedata" folder make sure to expand it so that you can see all the vector and raster layers.
4. To import layers, left click on the layer file and drag it to the center of the screen, or into "Layer Panel" underneath the "Browser Panel."
5. Go ahead and drag all the layers.
6. When you drag layers into QGIS, it will stack layers in random order and assign random colors that are not helpful. Make sure to put large geography towards the bottom.




*QGIS lets you order the layers by clicking on the layer in "Layer Panel" and dragging them up or down. The "**X**" marked next to the layer name lets you know if the layer is displayed. You can toggle between displaying and hiding a layer by left clicking on the "X".*

7. Go ahead and hide all the layers except UGA_Counties. Removing layers you are not currently working will help you notice major and subtle changes.
8. We are now going to import the location of the factories in Uganda based upon their longitude and latitude.
9. Right click on the **Factories** table, and select "Open Attribute Table". You will see and "X" and "Y" columns. These are the longitude and latitude of the factories, respectively.

10. In order to visually represent these factories as a point layer you will first have to convert the table into a **" Comma Separated Value (CSV) File."**
11. Right click on the **Factories** table and select "save as" this will cause a wizard to appear.
12. At the top of the menu is the "Format" field. Select "Comma Separated Value (CSV)."
13. Underneath "Format" is the "Save as" field. Save the new table in Lab_03/Lab_procedures/Basedata. Save the table as **Factories_xy.** Click Save.
14. QGIS will automatically assign the projection of other data sources to fill in the CRS field. Keep (EPSG;4326, WGS 84). Click "OK."
15. **Factories_xy** table should appear in the Layers Panel.
16. Click on "Add Delimited Text Layer"  button to the bottom left of the Browser Panel. This will open up a wizard.
17. Click "Browse" for the "file name" field and select **Factories_xy.csv** file. Leave all of the default settings. Click "OK." .
18. A **Factories_xy** point file should now appear in the Layer Panel. Make sure to move it up with other point files.

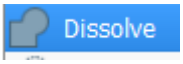



*NOTE. Another wizard may appear asking for the coordinate system. QGIS usually automatically projects the data. FOR DISPLAY PURPOSES ONLY.*

19. Right Click on the **Factories_xy** layer and select "save as."
20. Choose the "ESRI shape file" as the format.
21. Change the "CRS" to "WGS 84/ UTM 36 N" by clicking the 
22. Click "OK."

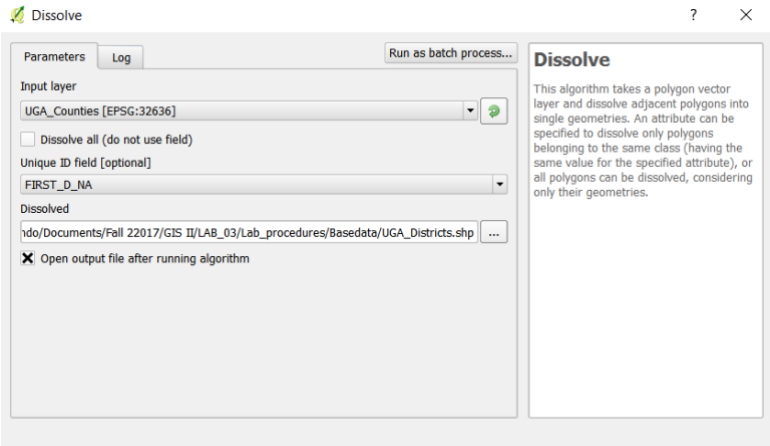
**Part Two. Dissolving**

Dissolving data sets allows for smaller units of geography to aggregate together based upon a feature, and form large units of geography. In this case, you will be dissolving county data into district data since the Uganda government is interested in this project at the district level.

1. Click on the "**vector**" label at the top left of the screen.
2. Go down the menu to "**Geoprocessing Tools**" and then select "**Dissolve**" 

3. A dissolve wizard will appear. The "Input Layer" is the layer that you want to dissolve. Select UGA_Counties.
4. Un-select "Dissolve all" because we want to keep the features.
5. You then want to select which "Unique ID field" to dissolve the layer by. Select the field "FIRST_D_NA" which represents the name of the District, which the county resides in.
6. Save the new layer to Lab_03/Lab_procedures/Basedata. Name the layer UGA_District.shp. Click "OK." Click "Run."

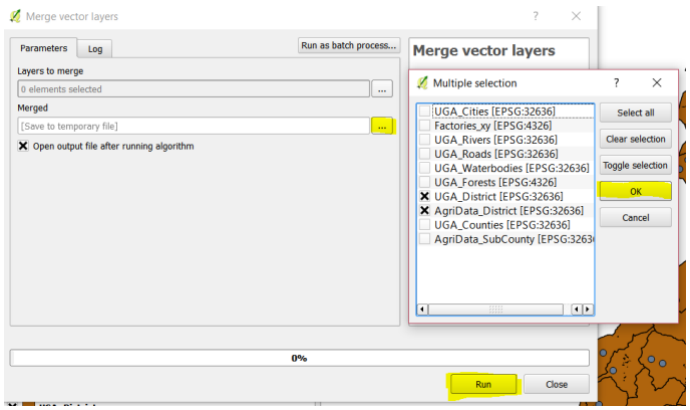
7. A new layer should appear in the Layer Panel as "Dissolved," rename as UGA_District. This new layer has kept all of the attributes that the counties had, but aggregated them into districts.
8. Repeat this same process with **AgriData_SubCounty** as the input layer, de-select "Dissolve all", and choose "**D_Name"** as the "Unique ID field" to dissolve by.
9. A new "dissolve" layer should appear in the Layer Panel. Rename it to something more appropriate. Hide UGA_Counties and AgriData_SubCounty, as you will no longer be working with them.




## Part Three. Merging

*Merging data sets allow two shapefiles to combine and still keep the features and attributes from both data sets. You will be doing this with the UGA_District and the AgriData_District sets to create one shape file with both their geometry and their attributes of population and urbanization.*

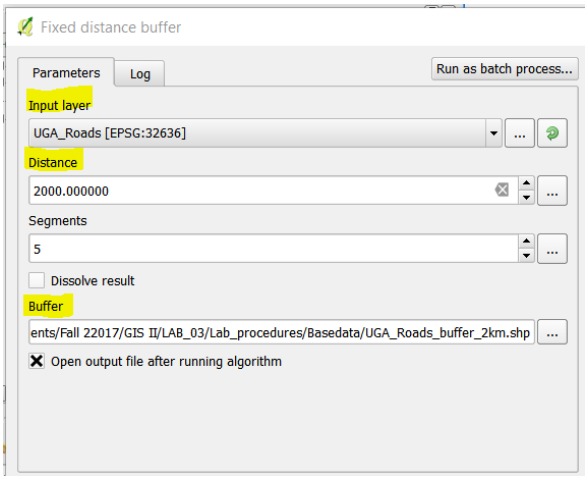
1. Click on "vector." Select "Data Management." Select "Merge vector layers."
2. Click on the ellipsis in the "Layers to Merge" field. This will open up the selection of available layers to merge. Click on the boxes next to UGA_District and AgriData_District to select them for merging. Click "OK."
3. Save the new feature layer to Lab_03/Lab_procedures/Basedata and name it UGA_District_Merged.shp. Click "RUN."
4. Remember to rename the new "Merged" layer as UGA_District_Merged. Hide UGA_District and AgriData_Distrct layers and move them to the bottom of the Layers Panel.

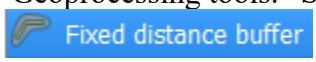

5. If you open up UGA_District_Merged attribute table you will see that this layer contains all of the data of the two data sets merged.

## Part Four. Buffers

*In order to find out what land is suitable to construct hospitals, you will construct buffers around features the Uganda government wants the hospitals close or far away from.*



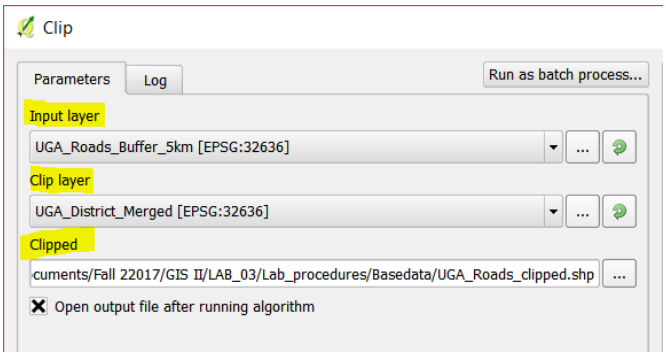

1. The first buffer will around roads. The Uganda government wants these new hospitals to be at most 2km away from current roads.
2. To create a buffer click on "vector" at the top left. Select "Geoprocessing tools." Select "Fixed Distance Buffer."




3. Select **UGA_Roads** layer for the in "Input Layer."
4. Since you are working with a coordinate system, the unit of measurement is in meters. Type in 2000 for "Distancce."
5. Save the new feature layer to Lab_03/Lab_procedures/Basedata. Save the layer as **UGA_Roads_buffer_2km.** Follow this format when you create buffers.
6. Click "Run."
7. A "Buffer" layer should appear in the Layer Panel. Go ahead and rename it to something more appropriate so that you do not get confused between buffers. Make sure to do this for every new buffer layer you create.
8. Zoom into the roads, and you toggle between displaying the road buffer layer. You should notice that the road buffer layer is thicker because the area it covers is at most 2km away.
9. Go ahead and repeat this same process for the other feature layers and their respective buffer distance.
    a. Factories – 5km buffer
    b. Cities – 20km buffer

## Part Five. Clipping

*Clipping allows you to cut or "clip" features off by using another layer to intersect. This is similar to using a layer to act like a cookie cutter and remove features we do not need. In this case, we want to get rid of the buffers that cross the Uganda border.*




1. Click on the "**vector**" label at the top left of the screen.
2. Go down the menu to "**Geoprocessing Tools**" and then select "**Clip**"
3. The Clip wizard will appear.
4. The "**Input Layer**" is the layer that you want to get clip. Select **UGA_Roads_buffer_2km** by clicking the dropdown menu.
5. The "**Clip Layer**" is the layer you want to use to clip the input layer. Select **UGA_District_Merged** by clicking the drop down menu.
6. Click on the ellipsis next to field under "Clipped" and select "**Save file to**" to save this layer to Lab_03/Lab_procedures/Basedata. Rename this new feature layer "**UGA_Roads_Clipped**"
7. Click **"Run"** to complete the clip function.
8. The Clip function will create a new feature layer "**Clipped"**. Make sure to rename it to something appropriate so you do not get confused between multiple clipped layers.

9. Make sure to move the new **UGA_Road_Clipped** layer above larger geography. You will notice that roads no longer go past the **UGA_District_Merged layer**.
10. Repeat this process with the other buffer layers as the "Input Layer" and **UGA_District_Merged** as the "Clip Layer."

**Part Six. Intersect & Analysis**

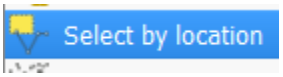
*Now that you have clipped away any data that is outside the boundary of Uganda, you have to find what locations are accessible to the rural population. To do this you have to find locations that are 2km from a road and accessible to a city within 5km. This requires an intersection function.*

1. Click on "Vector" at the top left of the screen Select "Geoprocessing Tools." Select "Intersection."

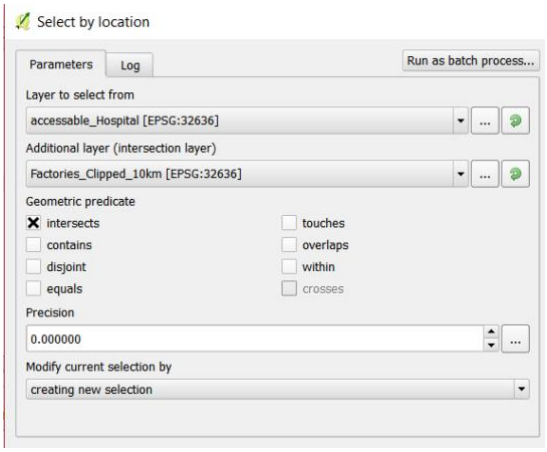

2. In the "Input Layer" field, select **Factories_Clipped_10km.**
3. In the "Intersect Layer" field, select **UGA_Roads_Clipped**.
4. Save the new feature layer to Lab_03/Lab_procedures/Basedata. Name the layer **Accessible_Hospital.shp**.
5. Click "Run."
6. QGIS will create a new "Intersection" layer in the Layers Panel. Go ahead and rename this to "Accessible_Hospital."


*This layer shows what hospitals would be accessible to the rural population, but it does not demonstrate if it is 10m away from a factory. A "Select by Function" will help find which accessible areas are equal to or less than 10km away from a factory, and which ones are not.*

7. Click on "Vector" in the top left hand corner. Select "Research Tools." Click on "Select by location."




8. Choose Accessible_Hospital in the "Layer to select from" field.
9. Select Factories_Clipped_10km in "Intersection Layer" field.
10. Choose "Intersect" for Geometric predicate.
11. Leave other default settings. Click "Run."

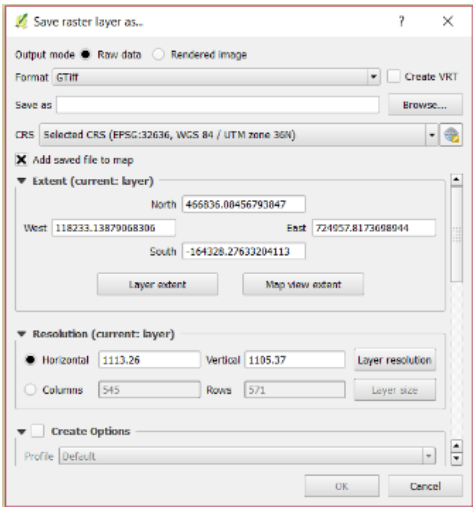



*The Yellow highlighted areas will be accessible hospitals, but are within 10km of a factory, which makes them inadequate choices. The remaining Blue areas are ideal locations to set up hospitals. However, this not entirely accurate. The intersect function through "select by location" will select the entire polygon that intersects the factory buffer, instead of only the actual area within the buffer. To get a more accurate analysis you will have to clip the accessable_hosptial layer with the factories_buffer layer.*

12. Click on "Vector." Select "Geoprocessing tools." Choose "Clip."
13. Select accessible_hospital as the "Input Layer."
14. Select factoires_buffer_5km as the "Clip Layer."
15. Save the layer to Lab_03/Lab_procedures/Basedata. Save the layer as inadequate_hospital_area.
16. Click "Run."
17. Make sure to rename the new layer to something appropriate in the Layer Panel

**Part Eight. Raster Analysis**

*Many other variables can be taken into account when choosing appropriate sites for development. An important factor is elevation. This next part is to show what are other methods to use, but will not be taken into the end product of the map.*




1. Right click on the Eleveatio.tif file in the Layer panel and select "save as."
2. Change the "CRS" to "WGS 84/ UTM 36N.
3. Save it to Lab_03/Lab_procedures/Basedata. Name it **Elevation_meters**.
4. Click "OK."
5. Elevation_meters should appear in the Layer Panel.
6. Go to "Raster" next to "Vector." Select "Terrain Analysis." Choose "Ruggedness index."
7. This will pop up a new wizard.
8. Save the export layer to Lab_03/Lab_procedures/Basedata and name it Terrain_ruggedness.tif.
9. Click "OK."
10. A new raster layer should appear in the layer panel.
11. This new layer demonstrates the heterogeneity of the terrain in Uganda.

**Part 7. Finishing Map**

1. Scale your map appropriately and make sure you check any layers you wish to include in your map
2. Go to Project → New Print Composer
3. Zoom so that the white page nearly fills the screen
4. Click the add new map icon
5. Starting at a corner, click and drag so that the box covers the page

**Leave a little space on the edges*

*You will find all of your typical map features under the Layout tab.*

6. Add a title using the "Add Label" feature
7. Create an appropriate title for the map on the right hand dialogue box (remember what features your map shows)
8. Adjust other properties such as alignment, display, etc. to make the title look good
9. Add a scalebar by clicking Layout → Add Scalebar, and drag your mouse where you wish
10. Edit the scalebar to make it look good, exploring all options
11. Add a legend by clicking Layout → Add Legend, and drag your mouse where you wish
12. Under "Legend Items" delete unnecessary items by clicking on them and then clicking the red dash
13. Rename your legend items to something more map friendly by clicking the layer and then clicking on the pencil and paper icon
14. Explore the legend settings to make it look nice
15. To add a north arrow, you must first click "Add Arrow" under "Layout" and drag out the size of the arrow.
16. Add an "N" underneath your arrow through the "Add Label" feature.
17. Add a metadata text box the same way you added the title
18. When you are satisfied with your map, click Composer → Export as PDF

*Congratulations on finishing!*