QGIS Practical 8: Landslide Susceptibility Map

In this practical exercise, you will create a Landslide Susceptibility Map, and work with raster data and analytical tools to understand how many settlements are located in areas of high susceptibility to landslides, and may therefore need evacuating, and how many people live in those areas as well.

This is the first time within this course that we will not only visualise and symbolise data but also use it to perform some geospatial analysis.

1.0 Planning your map project

As you start working on your product, it is a good idea to take a step back and reflect on what you want the final product to look like. Also remember, that map projects are often iterative in nature. You may start with a simple product, that you can then use as a base for the next versions, or other products altogether.

Here are some points to take into consideration as you start your work:

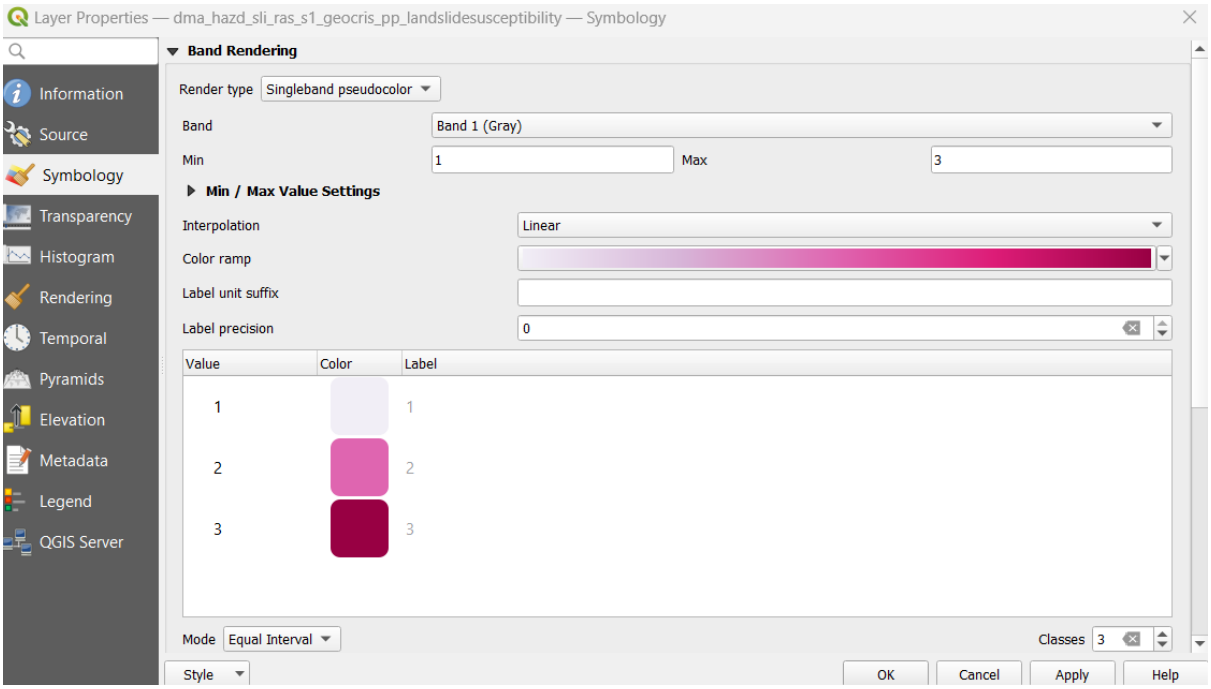
- Who is this product for?
- What data do I need?
- What is the status of those datasets? Are they fit for purpose? Is any cleaning necessary?
    - Always open the datasets and inspect them to make sure they are indeed fit for purpose. You can start by opening them to do a visual check, but it is also always a good idea to open the attribute table and have a sense of how the information they contain is organized.
- Is there anything I should warn my final user about? Anything about how to read the map, any caveats regarding the data, its use, and its shareability?

2.0 Getting Started

- Start a new project and add the following datasets:
    - The Admin 1 layer for the country: dma_admn_ad1_py_s0_unocha_pp_parish in GIS\2_Active_Data\201_admn
    - The Settlements layer: dma_stle_stl_pt_s3_osm_pp_settlements in GIS\2_Active_Data\213_stle

- The Population raster layer: dma_popu_pop_ras_s2_worldpop_pp_100m_2020 in GIS\2_Active_Data\212_popu
- The Landslide Susceptibility raster layer: dma_hazd_sli_ras_s1_geocris_pp_landslidesusceptibility in GIS\2_Active_Data\208_hazd

- Right-click on Admin 1 layer and select the first option, **Zoom to Layers.**
- At this point, you would normally spend some time choosing the appropriate symbology for each dataset. In this case, however, we are going to do some analysis first, so the only symbology we need right now is the one that will help us visually in our analytical work.
    - Landslide Susceptibility: Right-click to open its **Layer properties** and access its **Symbology**. This layer has 3 values, from 1 to 3, 1 being not very susceptible to 3 being very susceptible to landslides. We want to clearly visualize these areas.
        - Click on **Render type** and choose **Singleband pseudocolor**
        - At the bottom right corner, choose **Equal Interval** as **Mode** and reduce the number of classes in the bottom right corner to 3
        - **Apply** and **OK**!



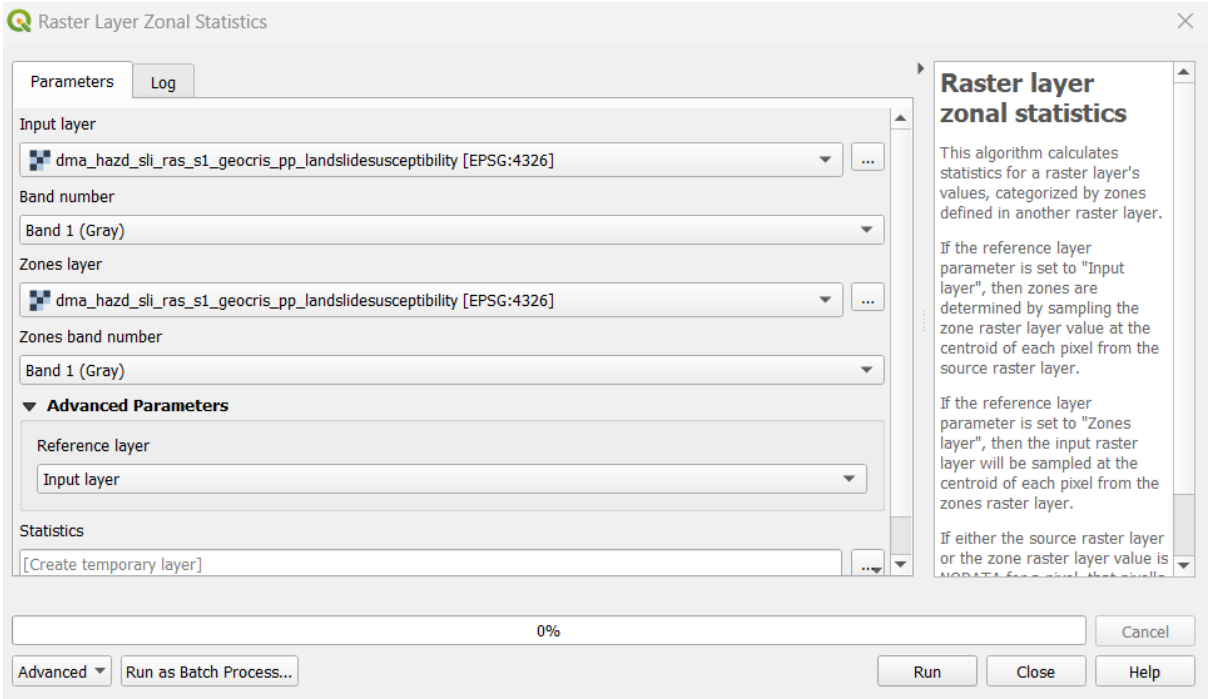
Depending on the color palette you chose, the areas that are most susceptible to landslides might be the darker ones.

We now want to:

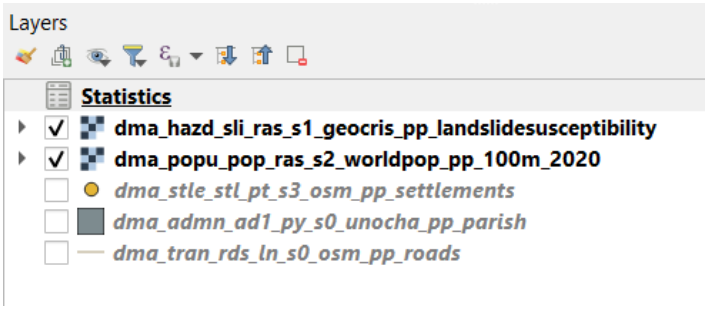
- Calculate the amount of people living in each landslide susceptibility area.
- Extract areas with landslide susceptibility level 3
- Create a vector file out of those areas, which we can use more easily to interact with the rest of our data
- Apply a small buffer around this new vector file of areas with landslide susceptibility level 3. This is because we don't lose any information based on the fact a settlement may falls just outside a line.
- Select all settlements that are located within that area
- Before you move on to the next step, take a moment to save your project as **"Landslide_Susceptibility_Map" in** GIS\3_Mapping\33_Map_Projects.

3.0 Calculating how many people live in each landslide susceptibility zone

1. Open the **Processing Toolbox** by clicking on the cog icon  in the upper menu. The Toolbox will open on the right.
2. In the search bar, look for **Raster Layer Zonal Statistics**
3. Choose the Population raster layer as Input, the Landslides as **Zones Layer,** and click on **Run**

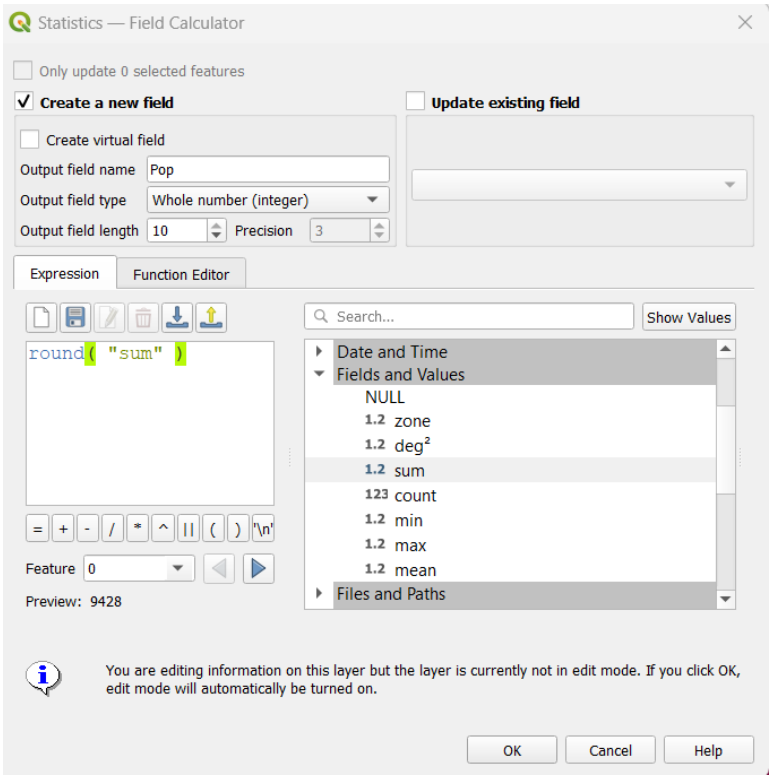


The output is a table that is now shown in the **Layers list.** Open it up to look at the result.

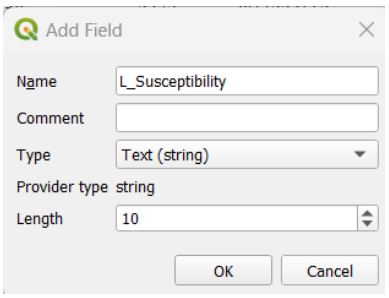


As we are going to add it to our final map, we need to clean up how the numbers look.

1. Click on **Field Calculator** and create a new field called Pop, in which we are going to round the total population numbers



2. Let's also create a new field to make the susceptibility levels human readable. This time we will use the **Add Field** button and work directly on the table.
   - Pick a descriptive name and change the **Type** to Text



- And modify the values so that you have Low for 1, Medium for 2 and High for 3.

Pop	L_Susceptibility
14194	Medium
42827	Low
11918	Low

Done! We will use this later in the final map product.

4.0 Obtaining a vector of areas with landslide susceptibility level 3

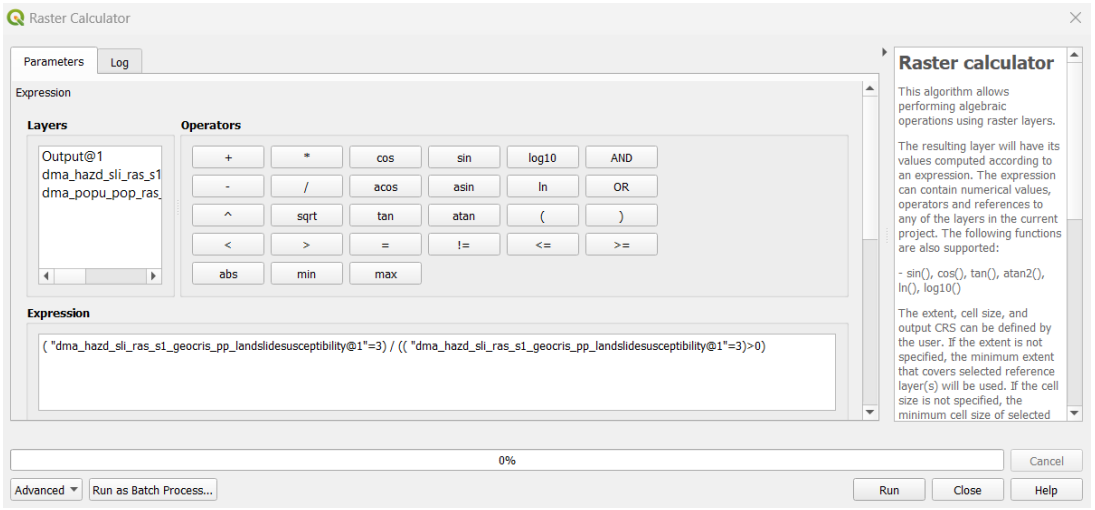
1. Open the **Processing Toolbox** by clicking on the cog icon  in the upper menu. The Toolbox will open on the right.
2. In the search bar, look for **Raster Calculator**
3. Compose the following expression, by double-clicking on the landslide layer, and the various operators.

```
(
"dma_hazd_sli_ras_s1_geocris_pp_landslidesusceptibility@1"=3)
/ ((
"dma_hazd_sli_ras_s1_geocris_pp_landslidesusceptibility@1"=3)
>0)
```

If we wrote simply landslide layer = 3, that would also have worked, but it would have created a layer that had 2 values:

- 1 for when the expression is TRUE, so all pixels that have value 3
- 0 for all other pixels, where the expression is FALSE

Writing it this way ensures that only the pixels with value 3 are retained in the final layer.

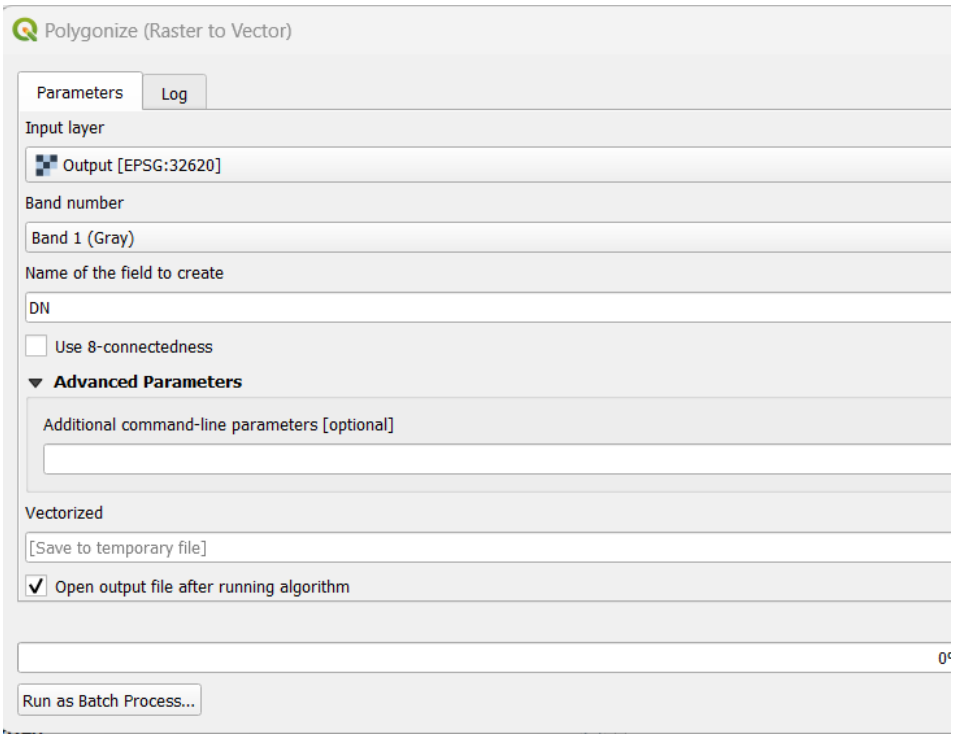


4. Scrolling down, as **Reference Layer,** use the landslide dataset, and click on **Run**

Let's now turn this into a vector file!

5. In the Processing Toolbox, search for **Polygonize - Raster to Vector**

6. Choose the temporary Output from Raster Calculator as **Input**, and leave the other parameters unchanged



You should now have another temporary file, called **Vectorized**.

We can now apply a buffer.

- But first, let's search in the **Processing Tool** for **Reproject Layer** (under Vector general), choosing **WGS84 / UTM one 20 N** as a Target CRS, and our temporary Vectorized as input. This is because when working with buffers and distances in general, it is easier to work with a projected coordinate system that allows you to set distances in the metric system, rather than in degrees.

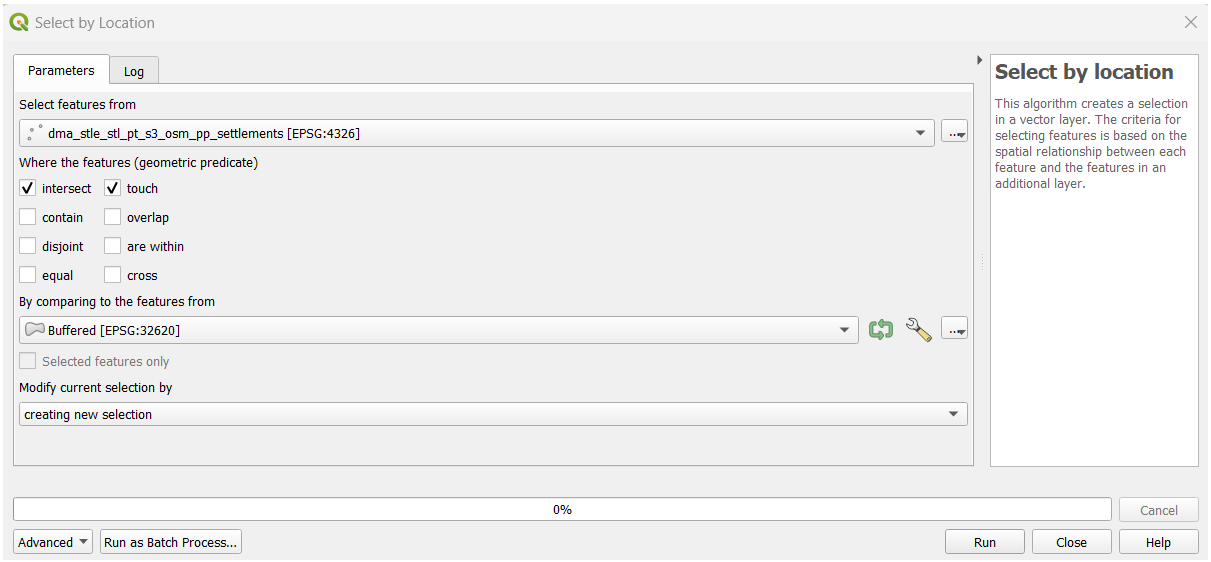
7. Back in the **Processing Toolbox**, search for **Buffer**
8. Make sure the **Reprojected** is the **Input**, change the distance to 50 meters, and check the **Dissolve result** checkbox (this will ensure we create one smooth polygon rather than many overlapping)

9. You can save this output in GIS\2_Active_Data\208_hazd, choosing a name that respects the naming convention (it must say these are high landslide susceptibility areas), by right-clicking and choosing **Export** on the **Layer properties.**

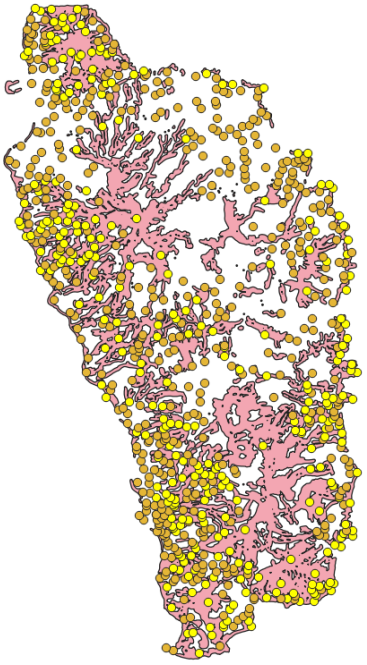
10. We can clean up our layer list from all the intermediate outputs. Remove them with the **Remove Layer** button.

5.0 Obtaining a list of settlements that fall within areas of high landslide susceptibility

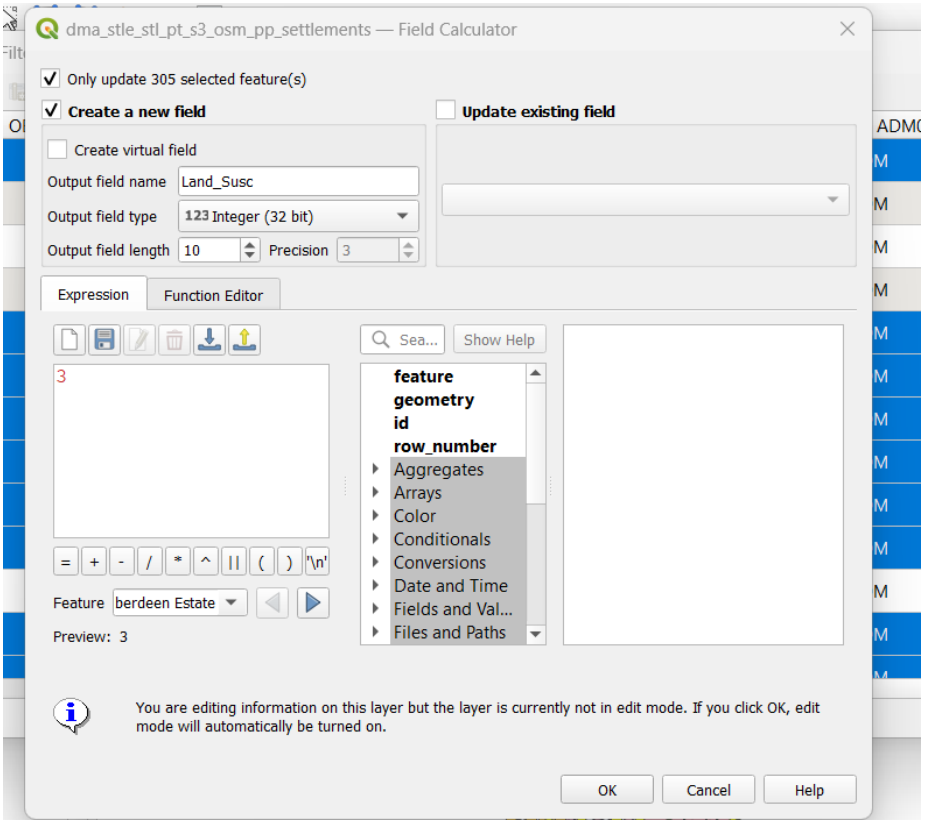
1. In the top menu, select **Vector**, **Research Tools**, and **Select by Location**
2. With the settlements as Input and the High Susceptibility Areas as Comparison layer, check on the parameters that make sense to you, for example, intersect and touch



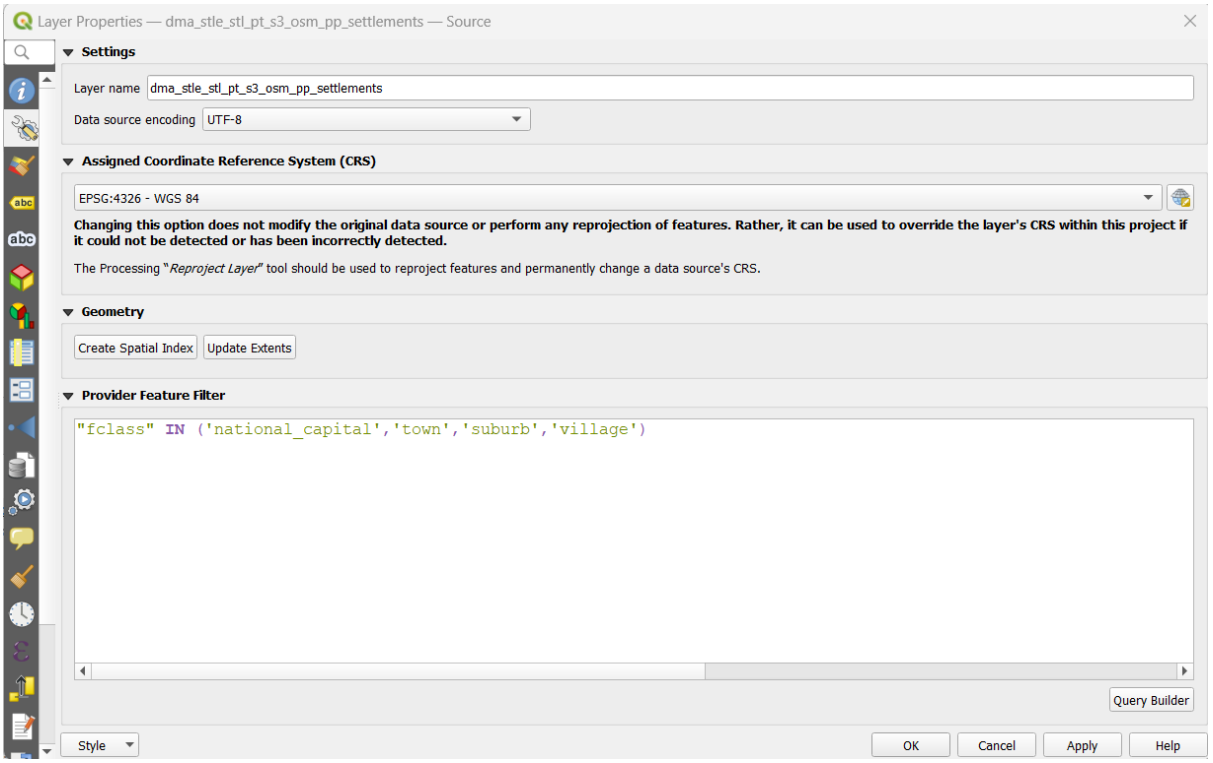
You will now see those settlements highlighted in yellow on the map, and in blue in the settlements layer's attribute table



3. Right-click on the Settlements layer to open its **Attribute Table** and click on **Field Calculator** 
4. We are going to add a column that says these are in areas that are highly susceptible to landslides.
    a. Make sure you have checked the option to update only selected features.
    b. Add a new column called Land_Susc, and write 3 as a value



5. Once you have OKed this, make sure you save and close the editing session on the Attribute Table by clicking on the 3rd first, and then 1st icon at the top left 
6. Now, even if we press on Deselect  on the upper left menu, we will still have a record of which settlements are most at risk, thanks to that new field.
7. Now, while you may want to print the attribute table and share it with colleagues for planning, we won't be able to add the full list on the final map product. Go ahead and apply a Query, using **Query Builder** (**Properties, Source, Query Builder**) to select only the capital, towns, suburbs and villages.



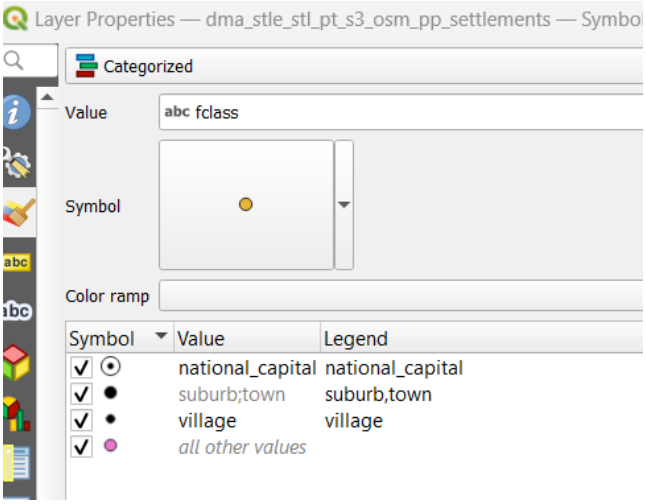
6.0 Reviewing and final aesthetics

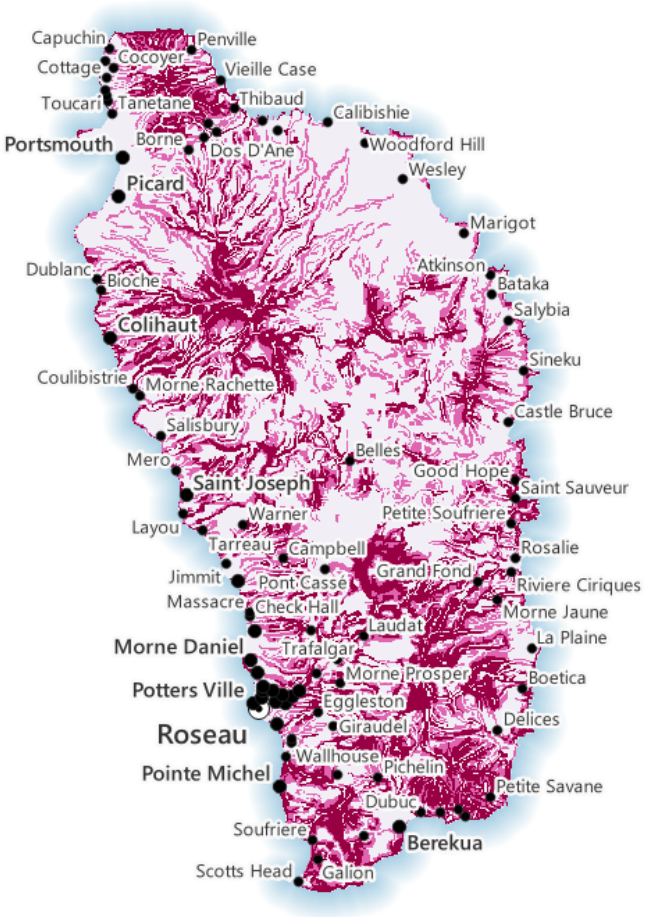
It is time to look at the symbology and aesthetics of the final product.

- Add the feather:

1. Right-click on the dma_admn_ad1_py_s1_unocha_pp_parish dataset and choose **Duplicate.** Make sure this copy is at the very bottom of the layers list, but above the basemap.
2. Right-click on and find the **Symbology menu** for this duplicate layer in its **Properties** window.
3. At the very top, in the dropdown window, choose **Inverted Polygons**.
4. Click on **Simple Fill** under the **Fill option**, and find in the **Symbol layer type** dropdown the option **Shapeburst Fill**
5. As Gradient colors, choose light blue as the first color, and white as the second, and adjust the distance so that it is about 4 or 5 millimeters.
6. **Apply** and **SAVE**!

- Style the Settlements, so that each category has a different symbol and a label of a slightly different size, in order of importance. You can group smaller settlements like hamlets, villages, and isolated dwellings in one single category by highlighting them while pressing on your keyboard “ctrl” and right-clicking to find the option **Merge**





7.0 Landslide Susceptibility Map Layout

You are now ready to move onto the Map Layout workspace to create your map document.

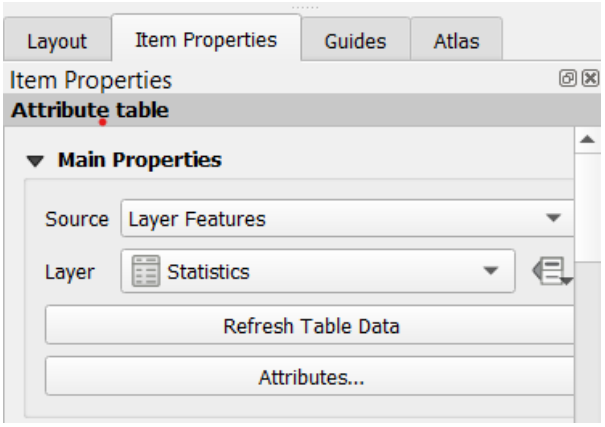
1. If you previously saved a map document as a template - well done you! That saves a lot of time. You can find your template by clicking on **Project**, and then on **Layout Manager**. Under **New from Template,** choose one of your Portrait templates!

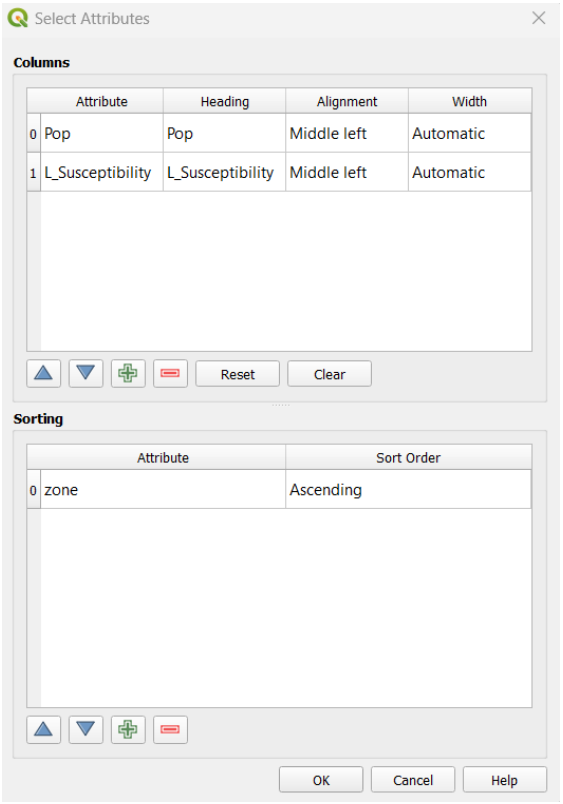
2. If not, from the **Project** menu select **New Print Layout**. You will be prompted to enter a title. Click **OK.**

You can refer back to Practical # 4 to know how the Print Layout Workspace works and how to get to your final product.

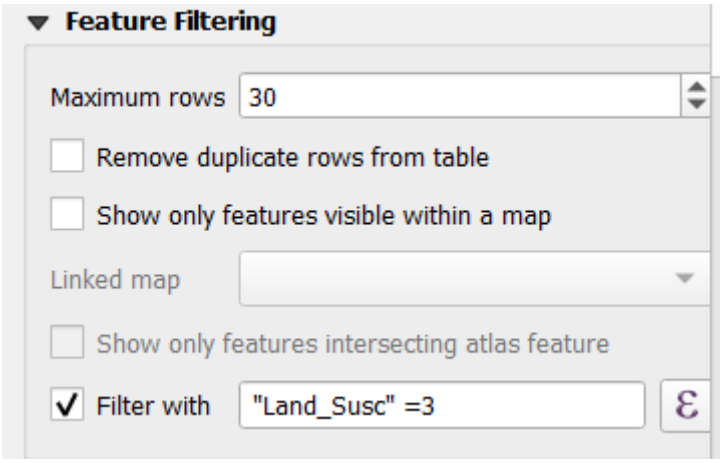
For this map, we will add various elements.

1. With the **Add Map** tool,  add your map to cover the full length of the page
2. Let's now add two tables - the one with population by landslide susceptibility zone and the list of settlements in highly susceptible areas:
    - in the upper menu, click on **Add Item**, and **Add attribute table,** and draw a rectangle in the area in which you want it.
7. In the **Main properties** menu of the attribute table on the right, select the **Statistics** layer and click on **Attributes** to choose which ones to keep in the final table. We can just keep the new text categories, and the rounded population values, so select all the others and click on the red minus.

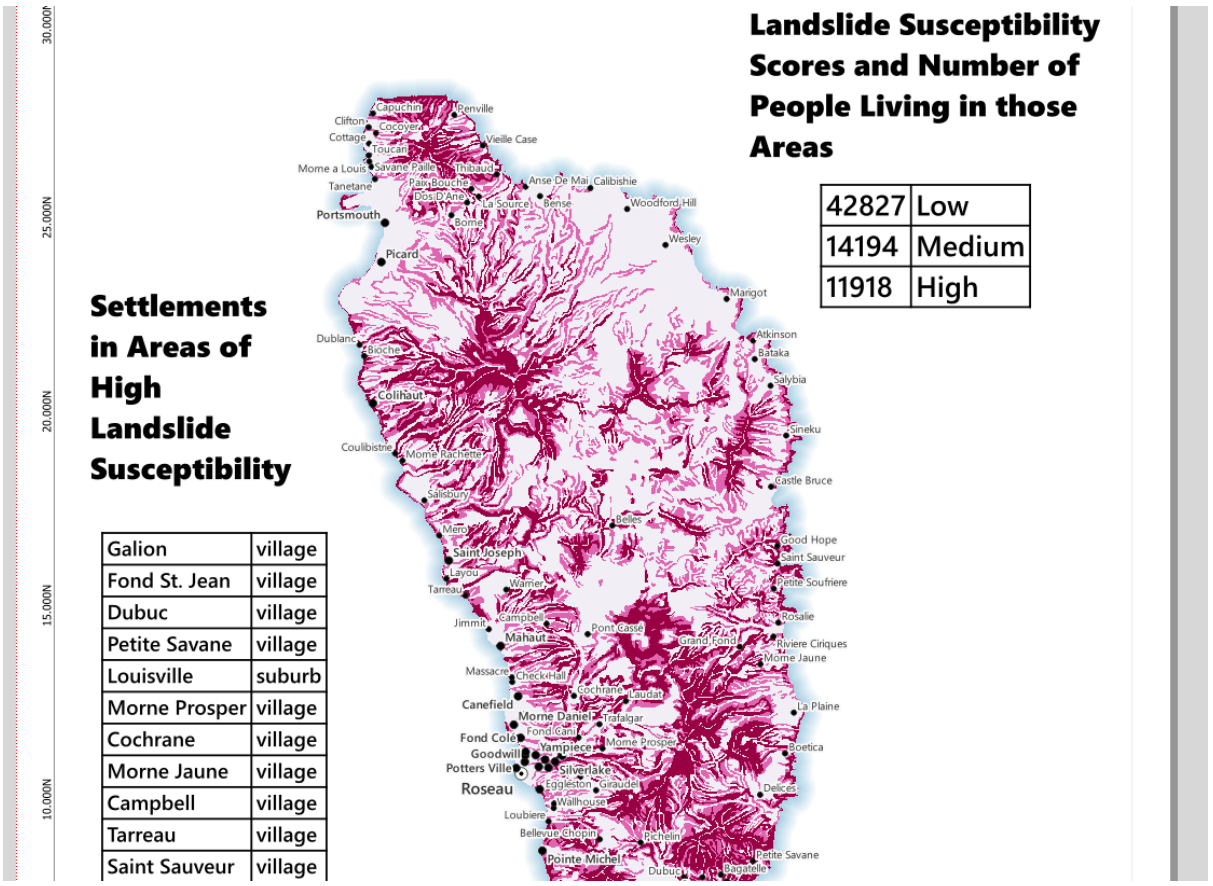




8. You can add with the green plus an attribute in the **Sorting** section, the attribute "zone" to make sure the table is sorted according to the number, in an ascending fashion.
9. You can scroll down to choose a font and a size that you like, and under **Appearance,** you can hide the headers by choosing **No Header** as **Display header** option**.** You can then add some text that explains what the table contains using the **Add label** tool
10. Add another attribute table, this time selecting the Settlements dataset as **Layer**.
11. Once again, let's get rid of all attributes, but the name and the place by clicking on **Attributes,** selecting all other attributes, and removing them with the red minus
12. Scroll down and click on **Filter with**, to write an expression such as: **"Land_Susc"=3** and filter out all elements that are not in areas of high susceptibility.



13. Once again, format the table, change the font, its size, remove the headers, and add a text element to explain what is in the table.



14. Now spend some time adding all the final elements, such as a descriptive title, description, data sources, legend, and scalebar.

15. When you are happy, export and Save!

8.0 Saving a project

Saving a project allows you to return to it later and continue working on it.

1. From the project menu select **Save**
2. If it is the first time saving the project, use the menu prompted by QGIS to save the project within the folder ..GIS\3_Mapping\33_Map_Projects and change its name to call it "**Landslide_Susceptibility_Map**."

9.0 Summary

In this session, you started getting familiar with geospatial analysis and working with raster data.

Well done!