

QGIS Practical 9: Critical Infrastructure Map

In this practical exercise, you will build a Critical Infrastructure Map.

- A Critical Infrastructure Map helps with understanding where resources of different types are located, and general access routes and avenues.
- It is also very important as it will be most likely updated with the status or damage to each facility, once the information starts to come in.

We are starting to work at a fairly large scale. We are probably at the city or town level, we will need to zoom in significantly and find data that is appropriate for the detail required.

In this exercise, we will focus on hospitals and main medical centers, fire and police stations, transport networks, and education facilities, but there are other types of critical locations you may want to keep in mind for an emergency, for example - the location and status of shelters, water, wastewater, and electricity networks, banks and ATMs, markets, communication towers.

We will select the relevant data according to our scale of work and our final desired output.

1.0 Planning your map project

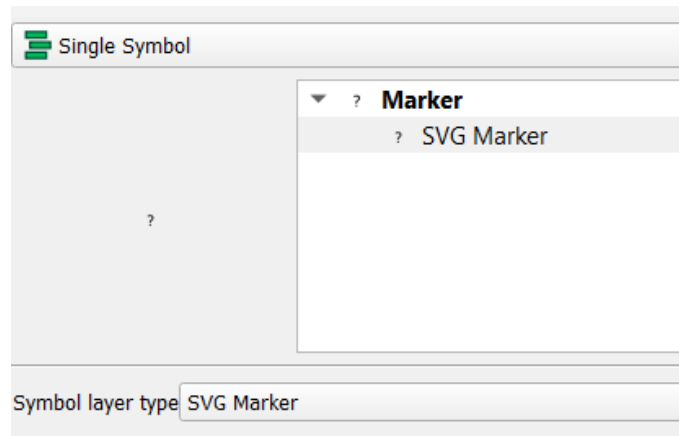
As you start working on your product, it is a good idea to take a step back and reflect on what you want the final product to look like. Also remember, that map projects are often iterative in nature. You may start with a simple product, that you can then use as a base for the next versions, or other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

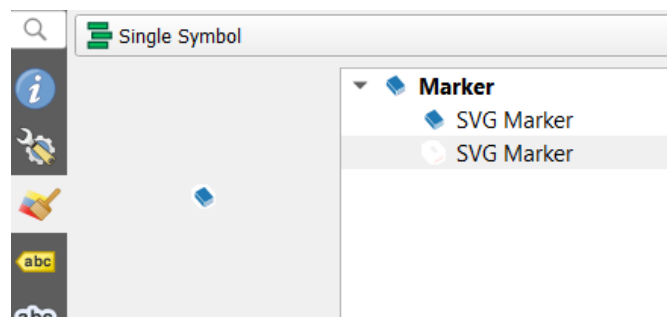
1. Start a new project and add the following datasets:
 - o The Admin 1 layer for the country: brb_admn_ad1_py_s1_gadm_pp_parish in GIS\2_Active_Data\201_admn
 - o The Roads layer: brb_tran_rds_ln_s0_osm_pp_roads.shp in GIS\2_Active_Data\214_tran
 - o The Airports layer: brb_tran_air_pt_s0_ourairports_pp in GIS\2_Active_Data\214_tran
 - o The Ports layer: brb_tran_por_pt_s0_worldports_pp in GIS\2_Active_Data\214_tran
 - o The Points of Interest dataset: brb_pois_poi_pt_s3_osm_pp in GIS\2_Active_Data\211_pois
 - o The health centers layer: brb_heal_heal_pt_s3_ghmp_pp_healthsites in GIS\2_Active_Data\209_heal
 - o And finally, the education facilities: brb_educ_edu_pt_s3_osm_pp_schools in GIS\2_Active_Data\205_educ
2. Right-click on Admin 1 layer and select the first option, **Zoom to Layers**.
3. Spend some time choosing the appropriate symbology for the following datasets:
 - o Airports, Hospitals: These are point datasets, and **Single Symbol** will be great for these. If we had information about damage, we could add a field in each dataset that specifies whether that facility is damaged or not, in which case we may use a categorized symbology. But for now, we will choose a **Single Symbol** for each, and in the **Simple Marker** category "Topology," you will find some great options for these.
Note: the health facilities layer currently contains a lot more than just hospitals - we will filter this later in the session.
 - o For the Admin 1 dataset, choose this time a transparent fill, with a black outline. Add a label that contains both the name of the parish, and perhaps, its PCode.
 - To add two labels at the same time you can use the expression tool in the single labels panel and copy for example this expression:
"ADM1_EN" || "\n" || "ADM1_PCODE"
 - o For datasets such as education facilities and ports you may need to be a little more creative: click on **Simple Marker** and select **SVG Marker** as Symbol layer type



- o Browse the images that appear in the window below to find something appropriate for each of these categories. Could a book represent schools?
- o To make sure the symbols are clearly readable on the map, also select an appropriate size, and add a white outline. This can be achieved by doing the following:
 - Add a second symbol, the same, by clicking on the green plus icon at the upper right-hand corner of the menu, and move it below the first using the arrows next to the green plus.



- Change its size so that it is slightly bigger than your main symbol
- Change the **Fill color** to transparent
- Change the **Stroke color** to white
- Change the **Stroke width** to a value such as 1



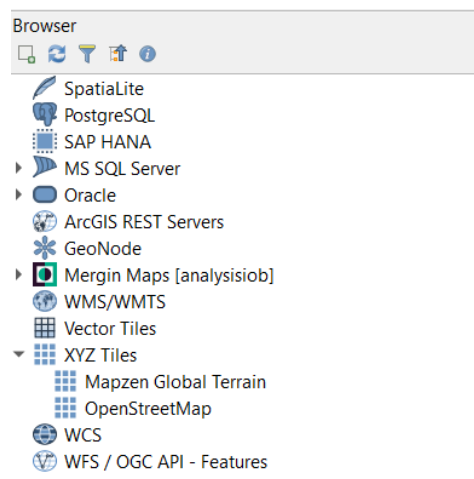
- o Repeat for the ports layer!

- o You can leave the points of interest and the roads for now, we will work with them a little later.
4. Take a final moment to look at all of your symbology.
 - o Are you completely happy with how everything looks? Is the information clearly displayed? Can you differentiate between different items on the map?
 - o Make your final adjustments now. Remember to check and adjust the order of the layers. Should a layer be on top of another?
 5. Before you move on to the next step, take a moment to save your project as **“Critical_Infrastructure_Map”** in GIS\3_Mapping\33_Map_Projects.

3.0 Working at a large scale: basemaps and overview maps

When working at this scale, the map product might benefit from a good amount of detail. This can be achieved by using a basemap.

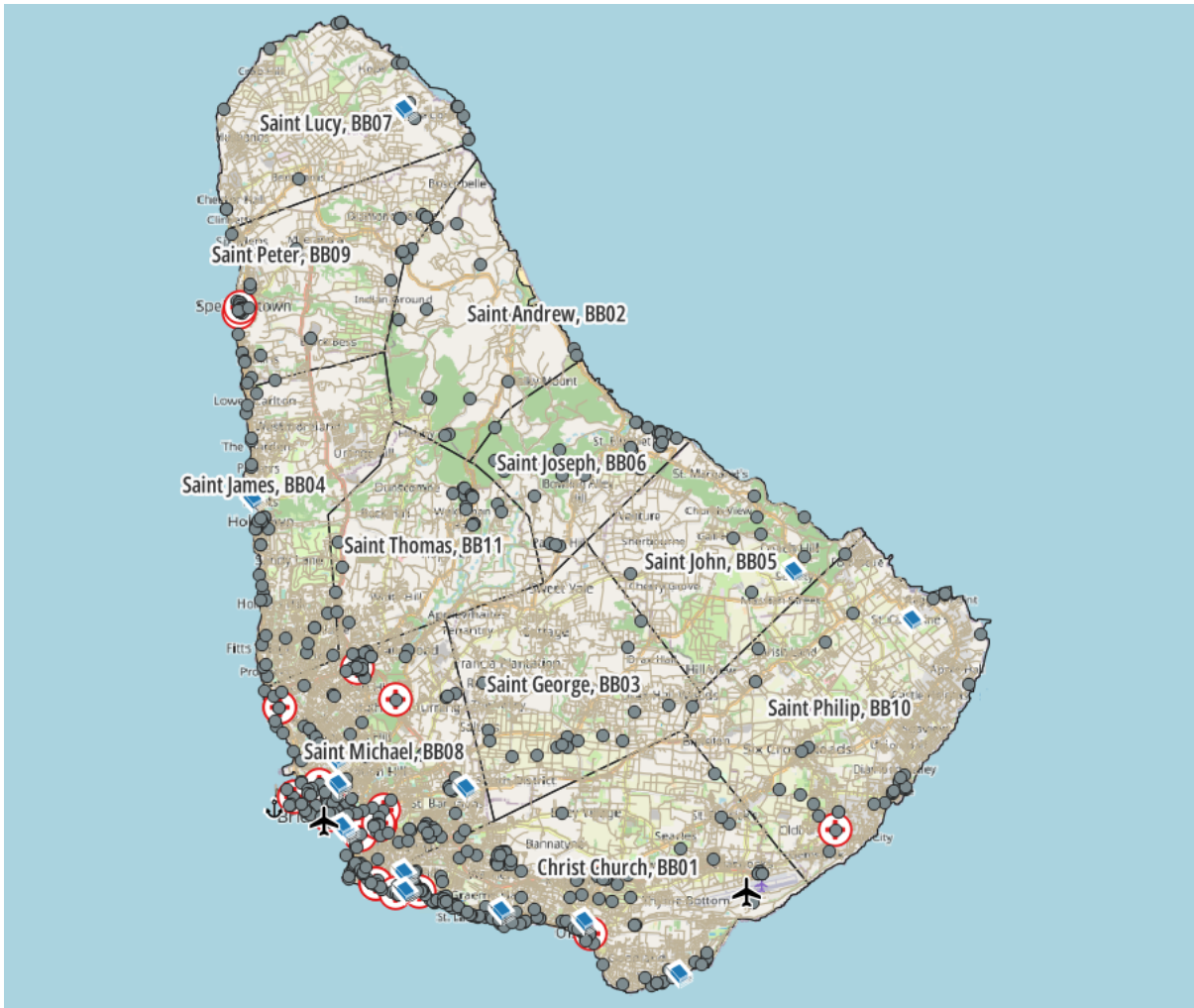
1. In the **Layer Browser**, navigate to **XYZ Tiles**, and select **OpenStreetMap** to import it. It will now show in the layers list.



As you can see, the basemap is a visual layer with a lot of detail. There are many different types of basemaps, and this one is great for orientation as it has roads and points of interest.


Though it looks similar, a basemap is different from the vector layers we have been working with. It is an image, and as such, you can't view the various elements' attribute tables, or select any particular feature. It is meant to be used as a visual aid, but cannot help in terms of analysis.

Your map workspace will now look something like this - clearly a little confused.



We will now spend some time selecting the appropriate information and working on representing everything clearly. We will also create some order in the Layers list, which is always a good idea when we start to work on products with many different datasets.

3.1 Organising the layers list

1. In the Layers list, click on **Add Group**  and call it “Transportation Network”
2. While pressing “ctrl” on your keyboard, select the Airports, Ports, and the Roads datasets and drag and drop them into the new group
3. Move the Group at the top, just above the Admin 1 layer. You can now control these 3 datasets with a single click.
4. And a second one for “Education and Health”

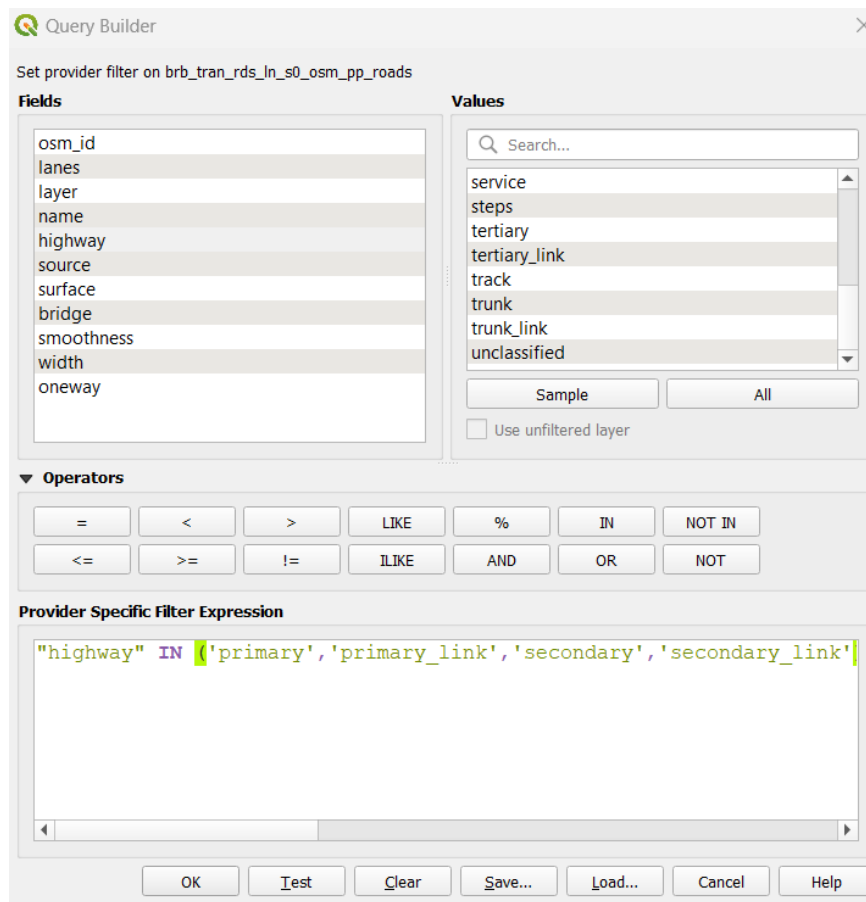
This looks a lot clearer!

- brb_pois_poi_pt_s3_osm_pp**
- ▼ Transportation Network
 - ✈ **brb_tran_air_pt_s0_ourairports_pp**
 - ⚓ **brb_tran_por_pt_s0_worldports_pp**
 - **brb_tran_rds_ln_s0_osm_pp_roads**
- ▼ Education & health
 - ♦ **brb_educ_edu_pt_s3_osm_pp_schools**
 - ⊕ **brb_heal_heal_pt_s3_osm_pp_healthsites**
- brb_admn_ad1_py_s1_gadm_pp_parish**
- ▼ OpenStreetMap

3.2 Selecting relevant data from general datasets: Filtering and Selecting by Attribute

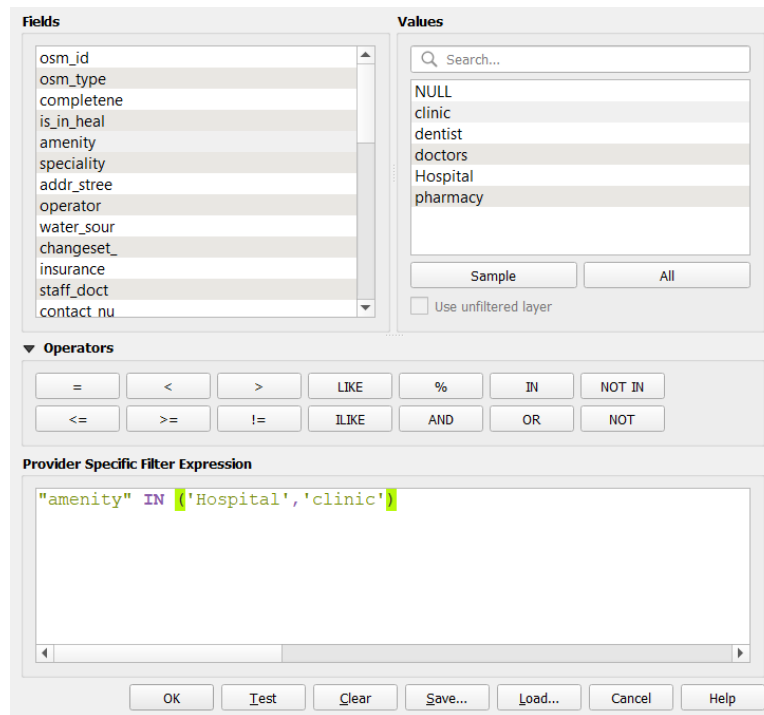
As we have a lot of road detail from the basemap, we don't need to keep all the minor roads in our roads dataset.

1. Right-click on the roads dataset and open its **Attribute Table** to remind yourself of the categories of roads it contains. Look for major roads!
2. Right-click again to open its **Properties**, and under **Source** click on **Query Builder**.
3. Double-click on the various elements to form the following expression




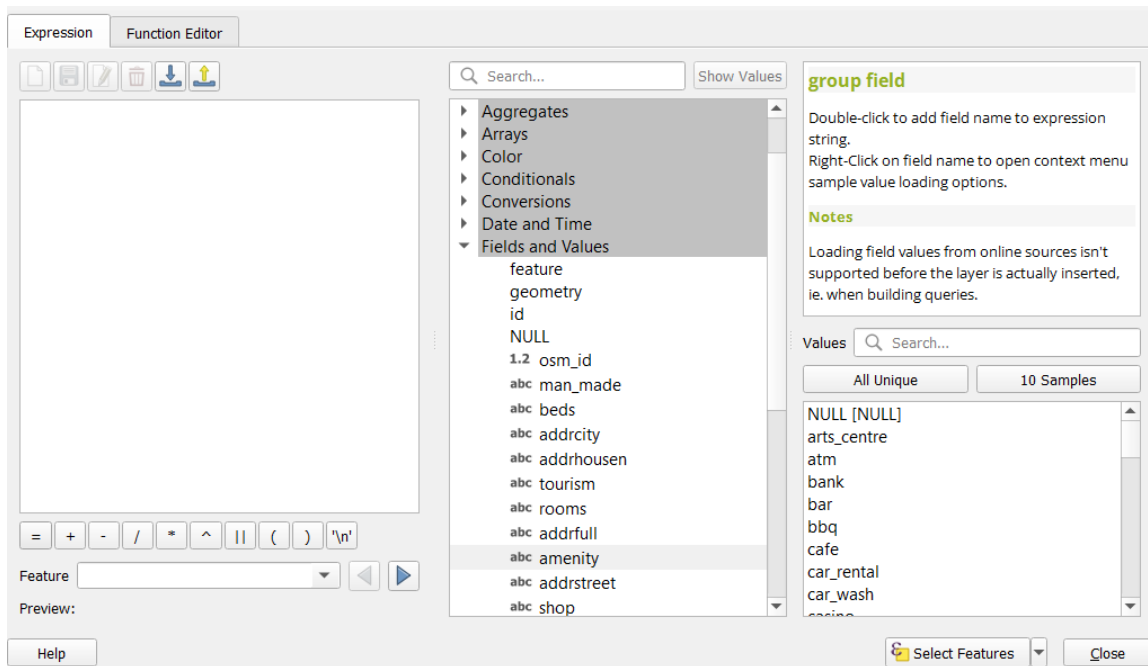
4. Have a pan around and zoom in to look at the result. Pick a nice and bright color, and adjust the line width if necessary, for these main roads.

- Do the same for the Health facilities layer: if you look at the attribute table, you will notice that the layer contains pharmacies and doctors. Let's make sure only Hospitals and major health centers are included.

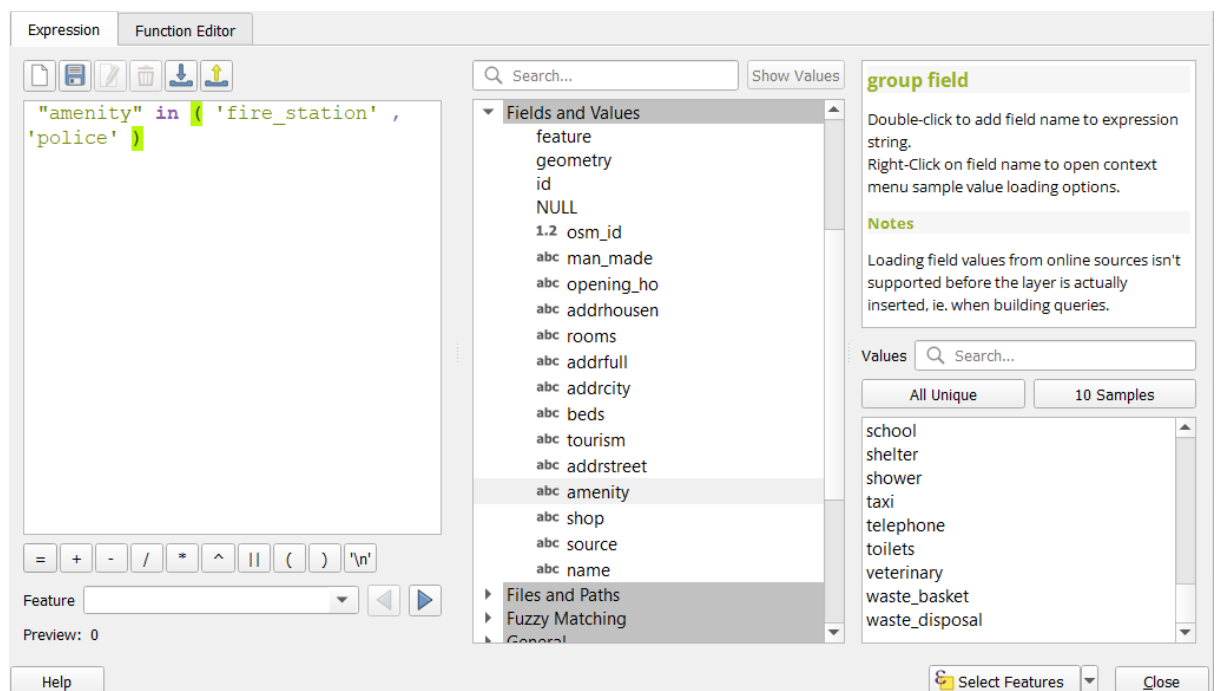


The screenshot shows a GIS software interface with a 'Fields' list on the left and a 'Values' list on the right. The 'Fields' list includes attributes like 'osm_id', 'osm_type', 'completene', 'is_in_heal', 'amenity', 'speciality', 'addr_stree', 'operator', 'water_sour', 'changeset_', 'insurance', 'staff_doct', and 'contact_nu'. The 'Values' list includes 'NULL', 'clinic', 'dentist', 'doctors', 'Hospital', and 'pharmacy'. Below these lists are 'Sample' and 'All' buttons, and a checkbox for 'Use unfiltered layer'. A section titled 'Operators' contains buttons for various comparison and logical operators. A text area labeled 'Provider Specific Filter Expression' contains the expression: `"amenity" IN ('Hospital', 'clinic')`. At the bottom are buttons for 'OK', 'Test', 'Clear', 'Save...', 'Load...', 'Cancel', and 'Help'.

- Finally, let's look at the points of interest dataset. Open the **Attribute Table** and familiarise yourself with its content and structure. While there are many interesting features in this dataset, we are particularly interested in authorities such as police, and fire stations. On the **Attribute Table** window, click on **Select features using an expression** 
 - Open up the **Fields and Values** middle section, click on **Amenity**, and on **All Unique** on the right-hand side to view all the categories in the dataset



- Compose the following expression by typing or double-clicking on the various elements, to select authorities points, then click **Select Features**



You should now see on the Attribute Table that some features are highlighted in blue, and the points are highlighted in yellow on the map.

- At the bottom left corner of the Attribute Table, change the drop down menu to read **Show Selected Features**

13	2888852904.00...	NULL
14	3381355994.00...	NULL
15	3448719941.00...	NULL
16	3448719947.00...	NULL
17	3448719948.00...	tower
18	3448719953.00...	NULL
19	3842977495.00...	NULL

Show All Features ▾

brb_pois_poi_pt_s3_osm_pp — Features Total: 803, Filtered: 3, Selected: 3

	osm_id	man_made	addrcity	name	source	shop	rooms	addrfull	ac
1	445314328	NULL	NULL	Holetown Polic...	NULL	NULL	NULL	NULL	NULL
2	8600460717	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
3	9683921029	NULL	Arch Hall	Arch Hill Fire St...	NULL	NULL	NULL	NULL	NULL

10. We are going to export this as a new dataset: you can close the attribute table (it will maintain the selection), right-click on the points of interest, select **Export**, and the second option, **Save Selected Features As**. Navigate to GIS\2_Active_Data\211_pois and call it brb_pois_poi_pt_s0_osm_pp_authorities.
11. You can now pick a symbol for your new dataset, and remove the points of interest from the Layers list.
 - You will need to use a categorised symbology, and search for a symbol that is appropriate for authorities by clicking again on **Simple Marker** and select **SVG Marker** as Symbol layer type - like you did for the schools
 - Browse the images that appear in the window below to find something appropriate for each of these categories? A flame symbol for fire stations? Handcuffs or badges for police?

4.0 Reviewing and final aesthetics

You are almost done! Have a final look, and make sure all the information is clearly visible. Move the cities above the other layers, for example. One final, aesthetic option is to add a feather of water around the islands:

1. Right-click on the brb_admn_ad1_py_s1_gadm_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**

- As Gradient colors, choose transparent as the first color (as we have the sea from the basemap already!), and white as the second, and adjust the distance so that it is about 4 or 5 millimeters.
- Apply** and **SAVE!**




5.0 Critical Infrastructure Map Layout

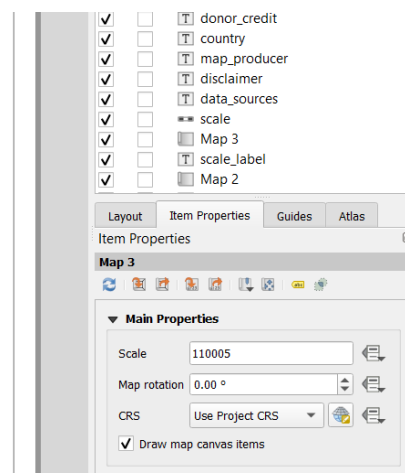
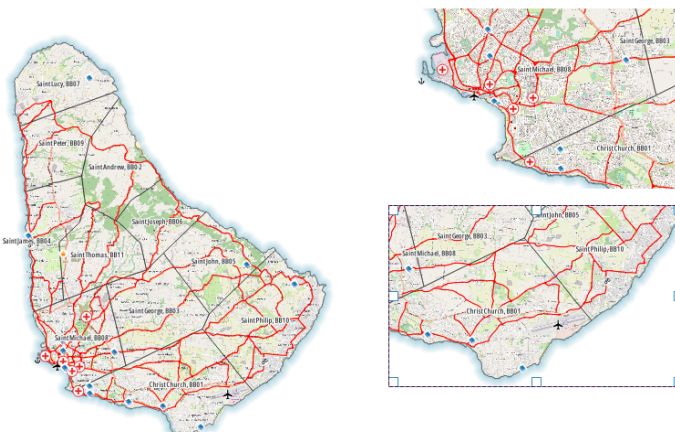
You are now ready to move onto the Map Layout workspace to create your map document.

- 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 Landscape templates!
- 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.

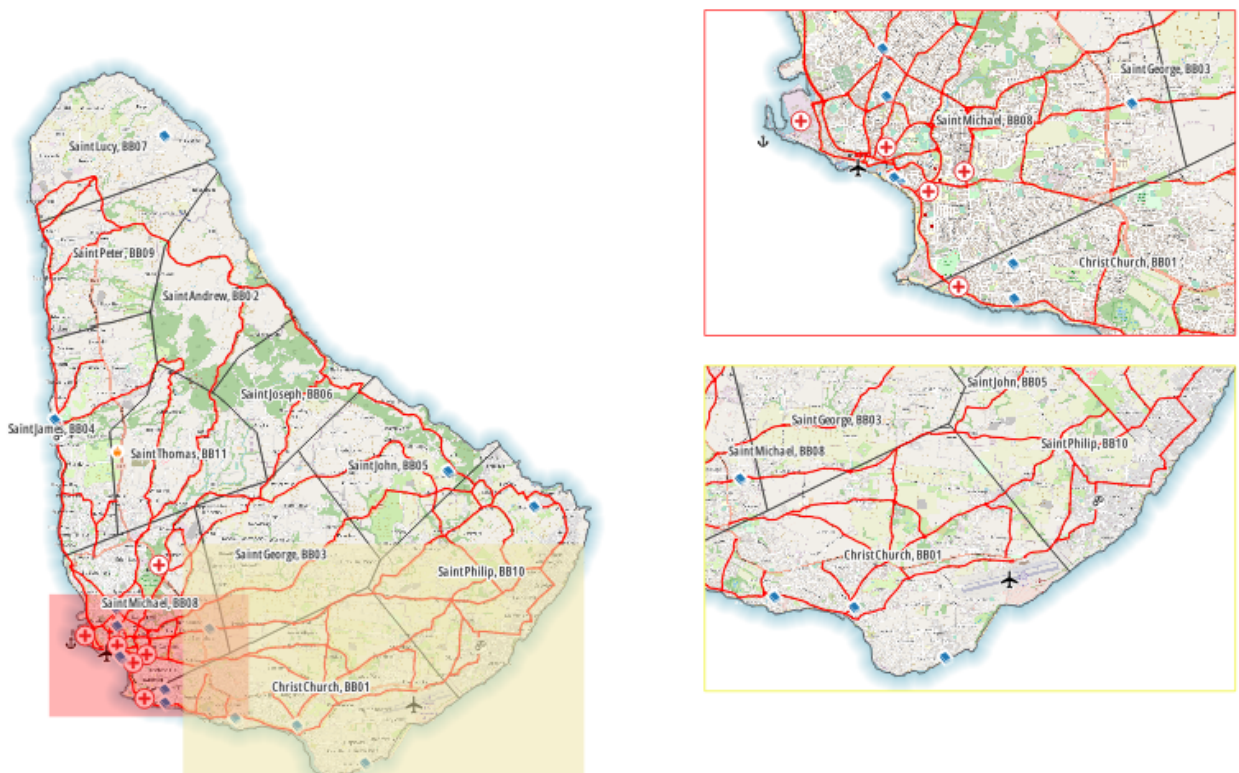
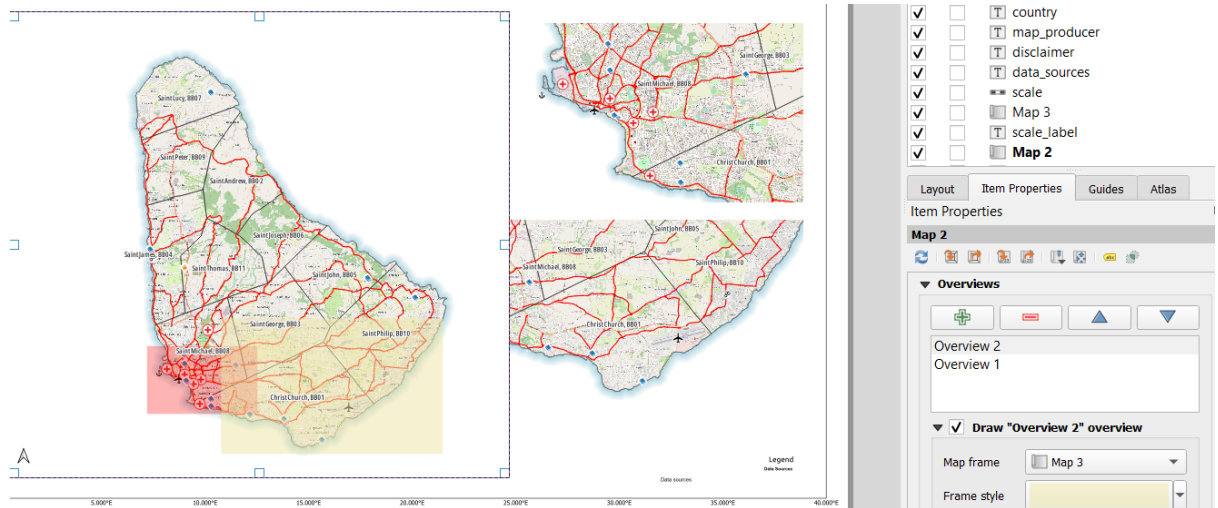
For this map, we will add various elements.

- Start with your landscape page, and add on the left side a main map of the country. Now, because these maps are very busy with information, we are going to zoom into some of the areas with more points
- With the **Add Map** tool,  add a second map on the top right side of the page, and a third just underneath.
- With the **Select Tool**,  click on the second map and adjust the zoom in the **Main Properties** menu on the right, and Pan around the map  to create a nice overview of Bridgetown



- And do the same for the third map, this time focusing on the south of the island.
- Back on the **Main Map**, using the **Select Tool** to open its Item Properties menu on the right, scroll down to **Overviews**, click on the green plus, and select the Bridgetown Map in the dropdown below to create a highlighted area on the main

map that shows where the area in the overview is located. Repeat again for the Carriacou overview, perhaps choosing a different color, by clicking on the **Frame Style**. If you wish, you may go back to the two overview maps and add a frame of the color of the two highlighted areas on the main map, to make sure it is clear which represents which area.



6. Now spend some time adding all the final elements, such as a descriptive title, description, data sources, legend, and scalebar.
7. When you are happy, **Export** and **Save!**

6.0 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 “**Critical_Infrastructure_Map.**”

7.0 Summary

In this session, you produced a very important product in a response and learned how to work with basemaps at larger scales.

Well done!