

# Creating Maps in QGIS: A Quick Guide

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## Overview

Quantum GIS, often referred to as QGIS, is an open-source GIS desktop application, which can be installed on various system operation platforms, including Windows, Mac OS X, GNU/Linux, FreeBSD, Android. It is unlike ArcGIS which purchasing a license is required to use. QGIS is free for everyone to use, so many small organizations around the world use QGIS rather than ArcGIS. Moreover, QGIS offers numerous plugins for various functions. Since the software is open source, there is abundant documentation for functions not covered in this tutorial, submitted by web community support workers and voluntary developers. This tutorial introduces users to the basic concepts and major functions of QGIS to get them started with the software. The two major steps, browsing data and making maps, are divided into three and four parts respectively as outlined in the following table:

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*Note: This document can be read in a “non-linear” manner:*

- Possible problems are covered in coloured regions: Knowing ways to address these problems are not quite relevant to the main process, but might be useful in future practices. Hence, they are written in coloured regions. You may wish to skip when no error messages pop up and everything is well-functioning.
- Section number and title are shown at some pages: If you know what kind of problem you have, you can “jump” to the section where it discusses it.

# 1. Browse Geospatial Data

## 1.1. Load data

To launch QGIS in Windows, click on the QGIS desktop icon . QGIS adds a different place name and version number, which is where we get “3.36 Maidenhead” from on the window title. Since, the versions can change often, be sure that you download the latest LTR (Long Term Release). This will ensure that you have the most stable iteration of QGIS that is updated yearly. The main interface of QGIS can be divided into five regions shown in Figure 1.

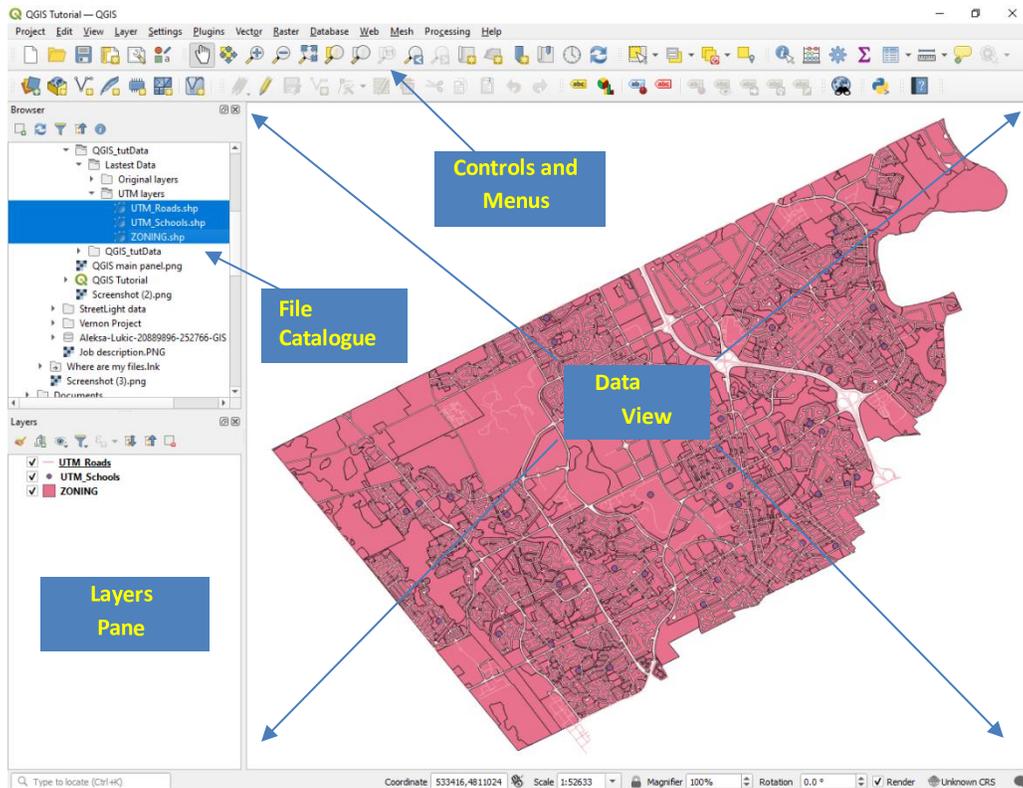


Figure 1 - Structure of the Main Window of QGIS

In the file catalogue, browse to the folder where data are stored, and drag the files from that folder into the **data view pane** or **layers pane** to add data shown in Figure 2. These later versions of QGIS have been designed to know what file types are being dragged and dropped into the layers pane when files are dropped into the data view pane. With the catalogue and layers pane always present on top of each other on the left aids in file management.

Load all data from your data folder listed in Figure 2 into QGIS.

- **UTM\_Schools.shp**: All school locations in the City of Waterloo
- **UTM\_Roads.shp**: Road network in the City of Waterloo
- **ZONING.shp**: zoning boundaries of the City of Waterloo

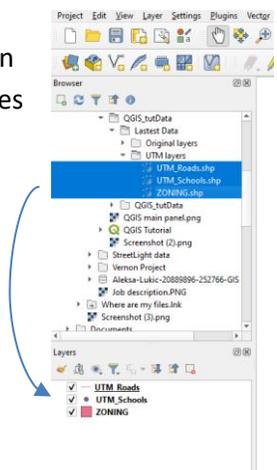


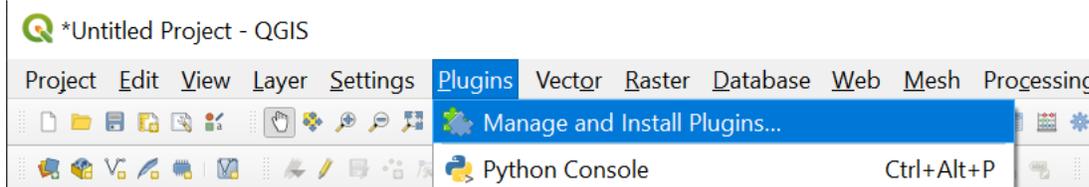
Figure 2 - TOC: Drag files to layers

### **Frequently-used File Formats in QGIS:**

- **Feature Data:** Feature data are usually organized as points, lines, and polygons in vector format.
  - **Shapefile:** The most commonly used geospatial data format. Although it appears to be one file in GIS, shapefile includes **multiple files** of the same file name, but different extensions. \*.shp, \*.dbf, and \*.shx are must-have.
  - **Geodatabase:** These files are based on Microsoft Access (\*.mdb). Geodatabases are able to store multiple layers (different geospatial data)
  - **ESRI File Geodatabase:** A \*.gdb directory can be accessed in QGIS, but not in a conventional way. To add files from your gdb, navigate to Layer > Add your .gdb folder and select it. You can then choose what layers from the gdb you wish to add.
  - **Google Earth:** \*.kml and \*.kmz (zipped KML) are Google Earth file formats, which are popular in Location-Based Service now. Many websites support kml and kmz files.
  - **GML and GeoJSON:** Open source geospatial data standard, which is also popular in online applications.
  - **GPS:** The track of GPS records can be imported into QGIS as \*.gpx files. This function is very useful in surveying.
  - **CSV:** \*.csv files stand for comma separated value, one of the most widely used spreadsheet file format.
- **Raster Data:** Raster data uses grid to represent a region with values as a “field”. Images explicitly have the parameter of resolution. Typical raster data is:
  - **GeoTIFF:** They have the file extension of \*.tif. The key difference between normal TIFF file and GeoTIFF is that GeoTIFF has projection information. Hence, normal TIFF files cannot be correctly added to the desired location.
  - **GeoJPEG:** Similar to GeoTIFF, but they have \*.jpg extension.
  - **Usage:** Raster data can be air photos, satellite images, or digital elevation data (DEM).

## **1.2. Add a Basemap**

QGIS provides the flexibility of using popular web maps as its base layer (or background), such as Google Maps, OSM (Open Street Map), and Bing Maps. These can be accessed through an external plugin (Figure 3).



**Figure 3 – Plugins Dropdown Menu**

To add a Basemap, go to **Plugins > Manage and Install Plugins**, which will open the Installer dialog (Figure 4).

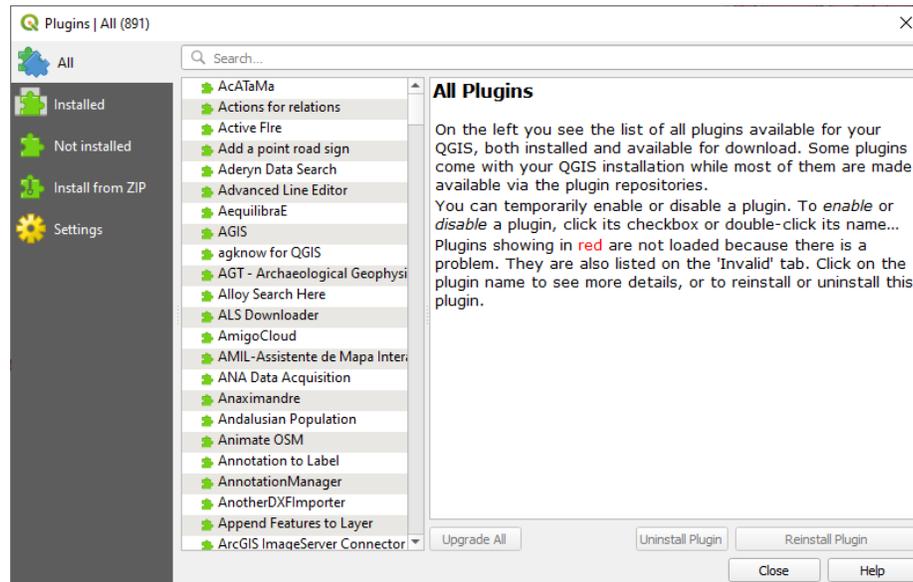


Figure 4 - Plugin Installer Window

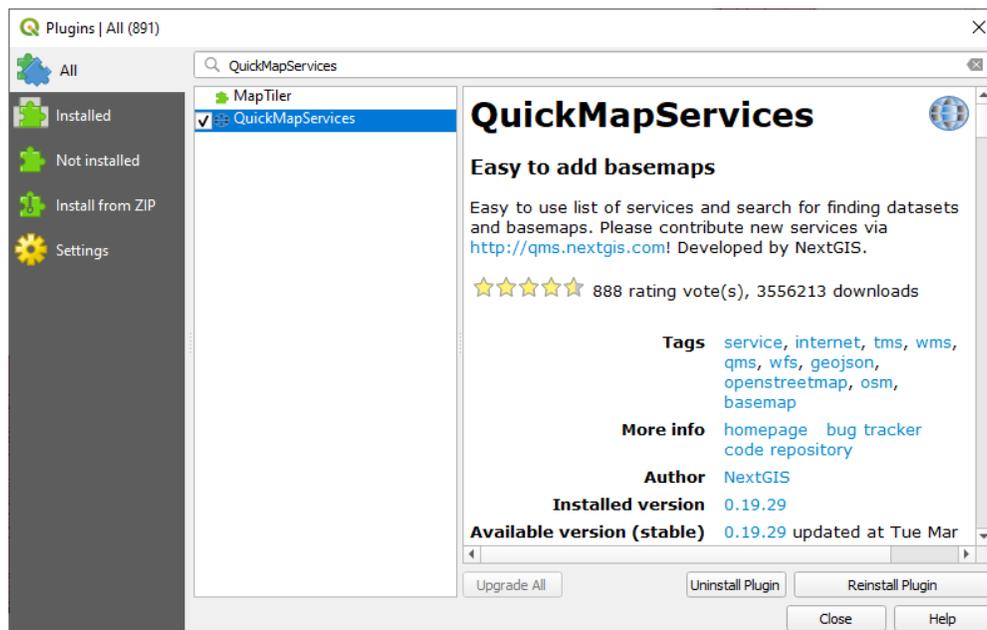


Figure 5 - Plugin Installer Window for QuickMapServices

In the **Plugins** window, search for QuickMapServices (this can be done by typing “QuickMapServices” in the filter), then select the “QuickMapServices Plugin” and click the **Install Plugin** button. Once the plugin finishes installing, there will be a checkbox checked beside that plugin, indicating the plugin has been installed and enabled (Figure 5).

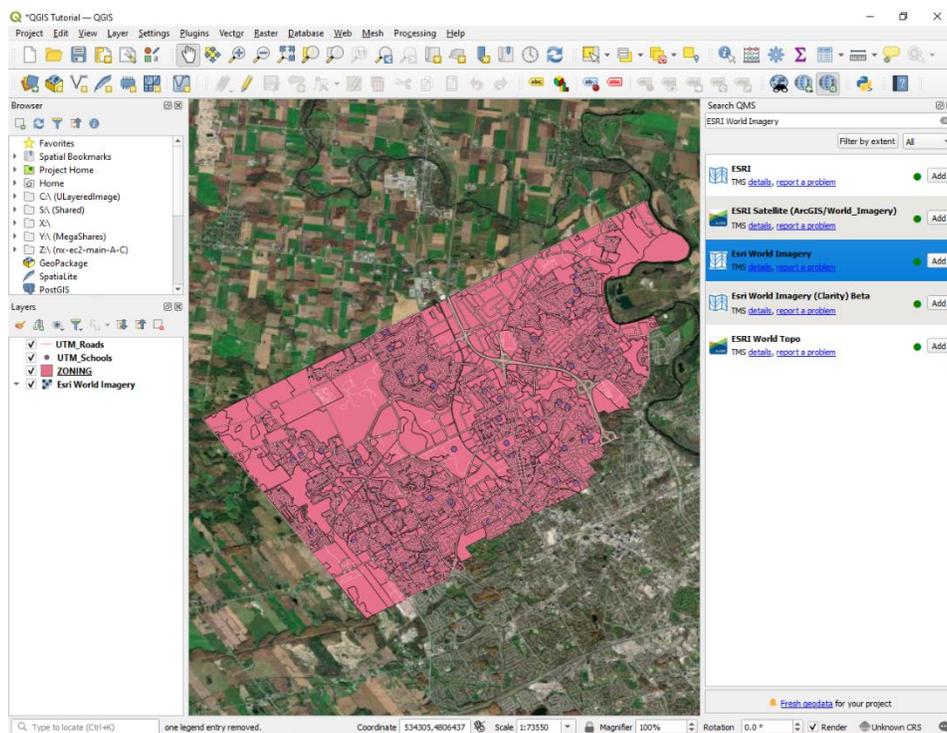


Figure 6 – Added ESRI World Imagery

Now, base map layers such as OpenStreetMap and ESRI World Imagery, can be added from the **Search QMS Panel** > right side of the screen (Figure 6). Search QMS Panel can be opened by clicking on the icon  on the top-right corner of the screen.

*\*Please note that the Figures in this tutorial will not include Basemaps.*

### ***Brief Introduction to Geographic Information Terms:***

- ***Vector Data:*** Vector data contains two parts: a geographic feature on the map (i.e. bus stops) and an associated record in the table with all its attributes (i.e. routes, arriving times, etc). The separation of attribute table and geographic feature would be critical because most operations in GIS are organized based on attribute-based classification.
- ***Raster Data:*** Raster data is a set of cells with values, which is normally added as a reference to background in mapping or included for supplementary analysis.
- ***Networks:*** A kind of typical networks is roads. Finding the nearest way to a destination via roads is a frequently used operation. Please find more in the further reading if interested.

### 1.3. Browse Geographic Features

Most controls for data browsing are located in the toolbar (Figure 7), which are also available under the **View** menu. If you cannot find this toolbar, go to **View > Toolbars** and check the **Map Navigation Toolbar** on.



Figure 7 - Toolbar with Data Browsing Controls

Most of the icons are self-explanatory. If you are unsure of what each function represents, hover your pointer over the icons. Pop-up text will appear, giving out further explanations.

It's important to note that in QGIS, all layer-related operations must be executed after the target layer has been selected (i.e. feature identification, feature selection, and attribute table operations).

There are several ways to open the attribute table. In this tutorial, only two of the most common ways are presented. To open the attribute table, you can either right-click the layer and select **Open attribute table** or click the open attribute table button  in the toolbar (Figure 8 & Figure 9).

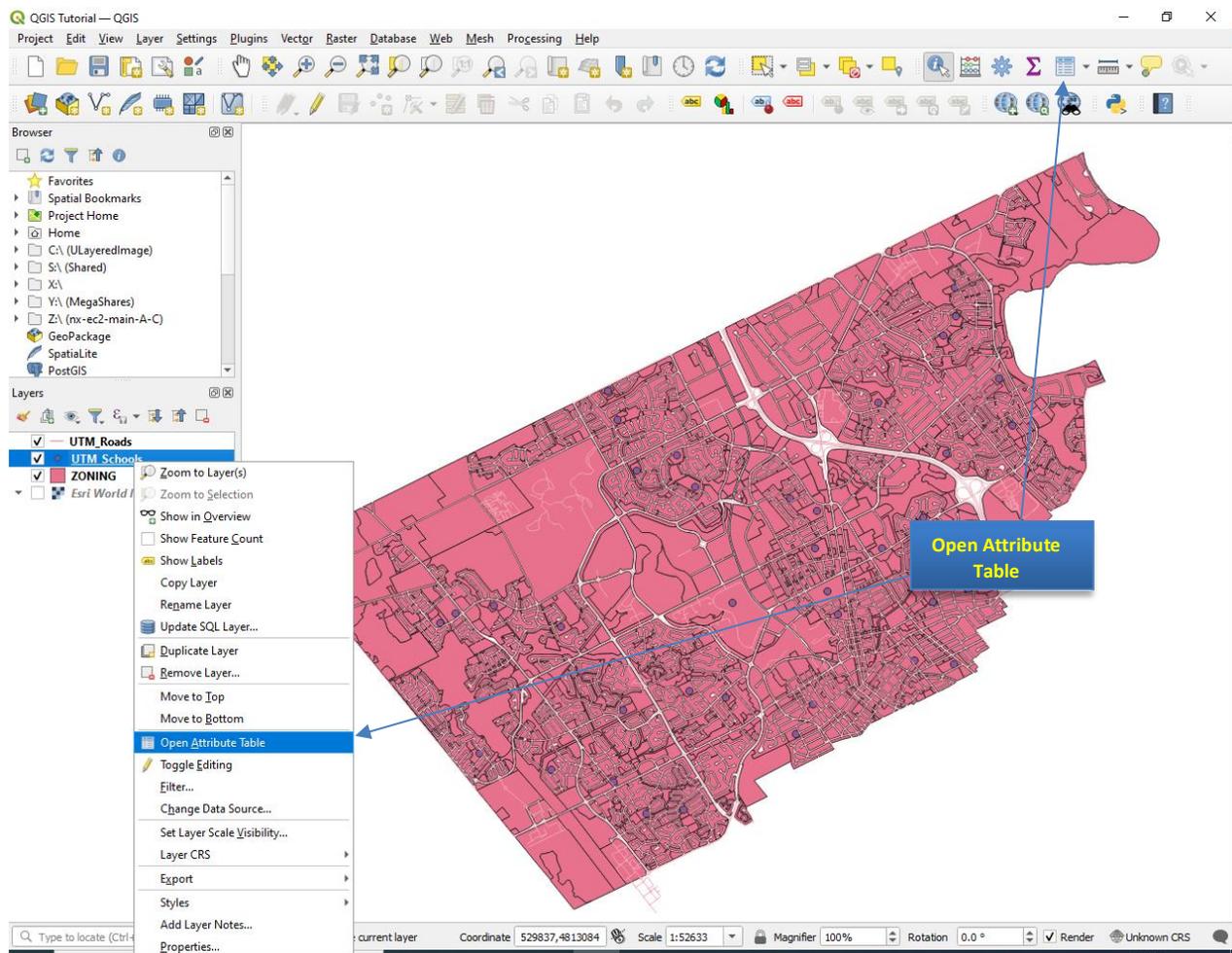


Figure 8 – Locations of the Open Attribute Table

FID	ADDRESS	NAME	TYPE	CLASS	URL	LONGITUDE	LATITUDE
1	500 HALLMARK...	KidsAbility	PRIVATE	ALTERNATIVE	<a href="https://www.ki...">https://www.ki...</a>	-80.5182858870...	43.49837561668...
2	90 MOORE AVE S	Elizabeth Ziegle...	PUBLIC	ELEMENTARY	<a href="http://elz.wrds...">http://elz.wrds...</a>	-80.5120208762...	43.46466059014...
3	254 NEILSON AVE	St. Agnes Cath...	CATHOLIC	ELEMENTARY	<a href="http://stagnes...">http://stagnes...</a>	-80.5022224855...	43.47390247755...
4	280 GLENRIDGE...	Mere-Elisabeth...	FRENCH SEPAR...	ELEMENTARY	<a href="http://www.crd...">http://www.crd...</a>	-80.5103268933...	43.48324356344...
5	158 BRIDGEPOR...	Ecole L'Harmonie	PRIVATE	ELEMENTARY	<a href="http://www.wr...">http://www.wr...</a>	-80.5087179746...	43.47225982081...
6	520 CHESAPEA...	Lester B. Pearso...	PUBLIC	ELEMENTARY	<a href="http://lbp.wrds...">http://lbp.wrds...</a>	-80.5065721352...	43.50710972403...
7	32 CENTRAL ST	MacGregor Pub...	PUBLIC	ELEMENTARY	<a href="http://www.wr...">http://www.wr...</a>	-80.5257754269...	43.47064452286...
8	165 LOURDES ST	Our Lady of Lo...	CATHOLIC	ELEMENTARY	<a href="http://lourdes...">http://lourdes...</a>	-80.5302766226...	43.45894495267...
9	710 LAURELWO...	Abraham Erb P...	PUBLIC	ELEMENTARY	<a href="http://abe.wrds...">http://abe.wrds...</a>	-80.5971539992...	43.46985595744...
10	135 AMOS AVE	Centennial Pub...	PUBLIC	ELEMENTARY	<a href="http://cnw.wrds...">http://cnw.wrds...</a>	-80.5524589449...	43.46078192965...
11	323 KEATS WAY	Keatsway Publ...	PUBLIC	ELEMENTARY	<a href="http://kea.wrds...">http://kea.wrds...</a>	-80.5459618331...	43.45983670609...
12	265 SANDOWN...	Sandowne Publ...	PUBLIC	ELEMENTARY	<a href="http://snd.wrds...">http://snd.wrds...</a>	-80.5060958838...	43.49168874191...
13	640 NEW HAM...	Millen Woods P...	PUBLIC	ELEMENTARY	<a href="http://mil.wrds...">http://mil.wrds...</a>	-80.5044063827...	43.51339223867...
14	270 QUICKFALL...	Lincoln Heights...	PUBLIC	ELEMENTARY	<a href="http://lnh.wrds...">http://lnh.wrds...</a>	-80.5077561849...	43.48206728506...
15	485 THORNDALE...	Holy Rosary Ca...	CATHOLIC	ELEMENTARY	<a href="http://holyrosa...">http://holyrosa...</a>	-80.5537337509...	43.4451951563575
16	580 ROLLING H...	N.A. MacEache...	PUBLIC	ELEMENTARY	<a href="http://nam.wrds...">http://nam.wrds...</a>	-80.5617901373...	43.48959519979...

Figure 9 - Attribute Table Window

There are many ways to choose a subset of features in QGIS. By default, **Select Single Feature** is selected; however, additional options can be seen by clicking the dropdown arrow  next to the icon, which displays different methods of feature selection (Figure 10). Note that **Rectangle** uses a drag-and-release drawing action; **Polygon** draws vertexes with single-clicks and a right-click to finish; **Freehand** draws based on your mouse movements; **Radius** draws a circle around the starting point. You can specify the radius by manually entering a value or choosing a value on the upper-right corner of the screen (Figure 11). Click **Enter** on your keyboard immediately after you specify the radius.

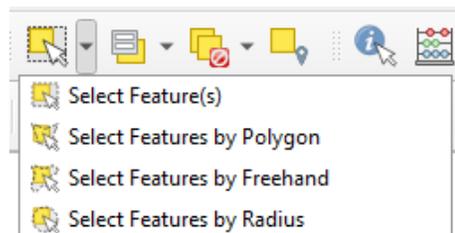


Figure 10 - Selecting Features Options

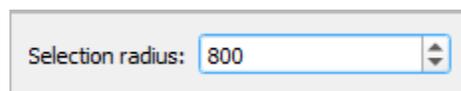


Figure 11 – Selection Radius Box

Another way to select features is to select by certain criteria: common attributes, spatial relationships or arithmetic bounds. In the Attribute Table, click on **Select Features Using an Expression** , which allows you to create selection expressions with one or more expressions at the same time (Figure 12).



### **Geospatial Data Projections:**

- *The globe is not flat, but a map is. Therefore, any kind of projection used for map making distorts real space to a certain degree. Hence, when Google Maps or any other third-party layer is included, different projections are likely to be used, leading to a problem of mismatch.*
- *To obtain the projection information of a layer (and the map) right-click on the layer, then select **Properties**. Projection information is located under the **Information** tab.*
- *You can specify (check the projection code) by clicking the **Specify CRS** button on the bottom-right corner of the screen. Some of the frequently used projections are:*
  - *WGS 84: Used in GPS systems with longitude/latitude measurement. You can find it using ESPG code 4326;*
  - *Pseudo Mercator: Used by major online mapping services, including Google, Microsoft, and OpenStreetMap. Its ESPG code is 3857;*
  - *UTM zone system: UTM system is often employed in northern country mapping.  
Waterloo, Ontario, Canada belongs to UTM zone 17N, which can be found with ESPG: 26917.*
- *If have different projections, go to the menu **Settings > Options**, and in the **Coordinate Reference System (CRS)** tab, select “Use a default CRS” in “When a new project is created” under “**CRS for Projects**” to choose a desirable CRS for the project and select “Use project CRS” in “When a new layer is created, or when a layer is loaded that has no CRS” under “**CRS for Layers**”. Make sure the default CRS you choose between projects and layers is the same. Restart QGIS if there are still some problems. QGIS has ‘Project on the Fly’ so that layers will visually line up over one another. If you are measuring distances in QGIS it is best to have all the layers in the same CRS.*

## **2. Mapping**

### **2.1. Distinction between Geospatial Data and Map Components**

In QGIS, the mapping process is split into two major categories: production and publishing. The production side (referred to as the **Data View**) allows for data manipulation (analysis) and representation (symbology); the publishing side (referred to as the **Layout View**) provides the tools and space for setting up the final product for printing or otherwise sharing the map (i.e. a map legend, a north arrow, a scale bar, etc.).

- **Data View** displays map allows is where one can manipulate the layers using tools to change the layer order, customize symbology, and edit spatial data.
- **Layout View** is accessed through the **Print Layout**, which opens in a new window and allows you to create the map page for final publication (this topic is covered in detail in section 2.3).

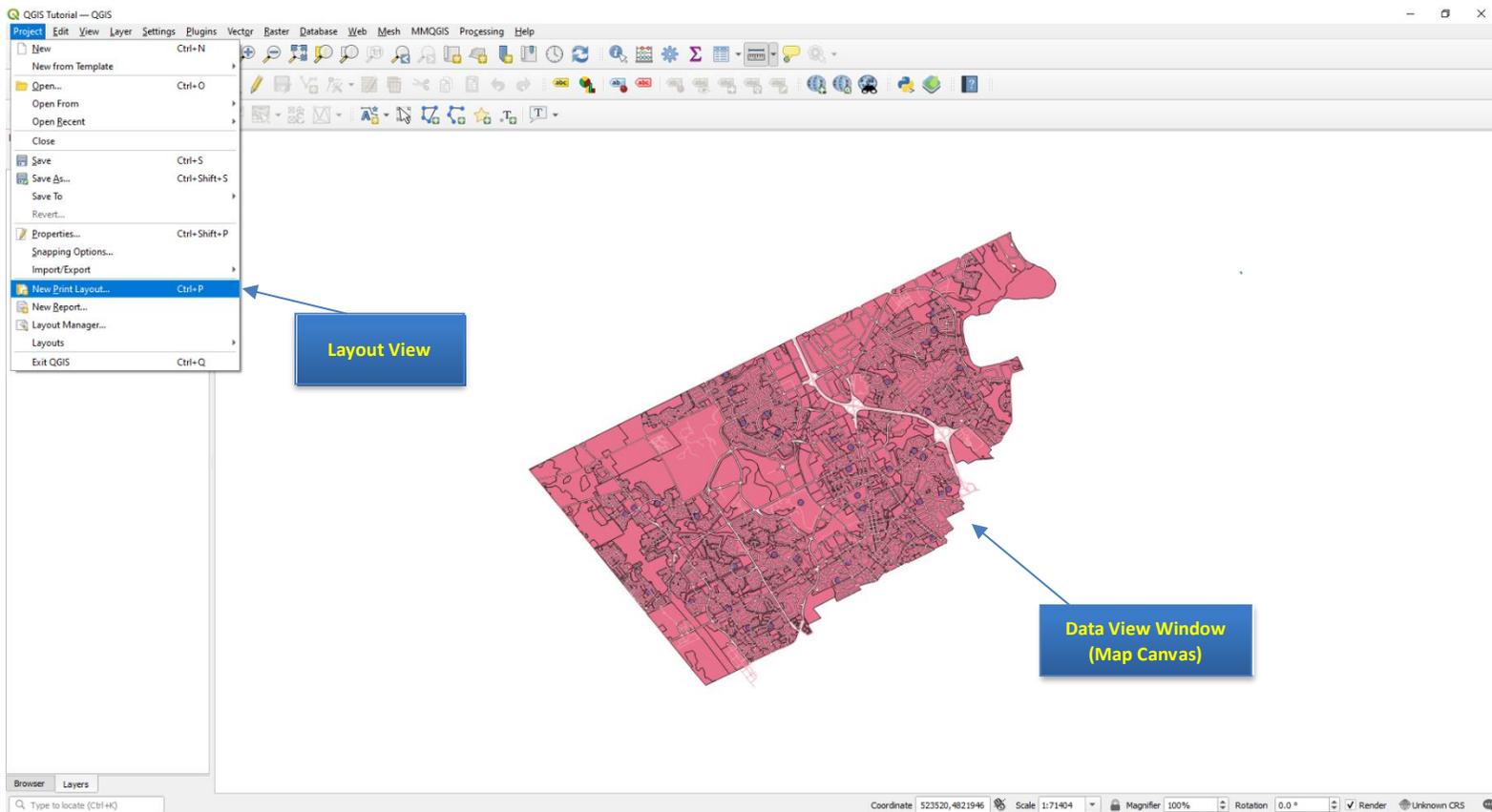


Figure 13 - Switch between Data View and Layout View

## 2.2. Key Options of Geospatial Data Representations

Some of the main options for changing geospatial data representations include layer order, layer transparency, symbology, labels, and annotation. Apart from layer order and annotation, all of these are accessed through the **Properties** dialog box, by right-clicking on the layer and choosing **Properties** (Figure 14) or by double-clicking on the layer. You should then navigate to either the **Symbology** or **Labels** tab accordingly (Figure 15). The various options are covered in the sections that follow.

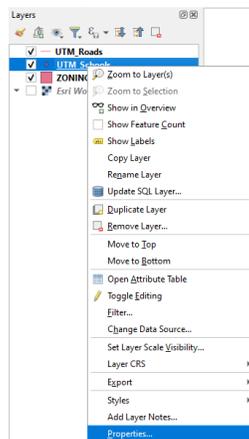


Figure 14 - Pop-up Menu of a Layer

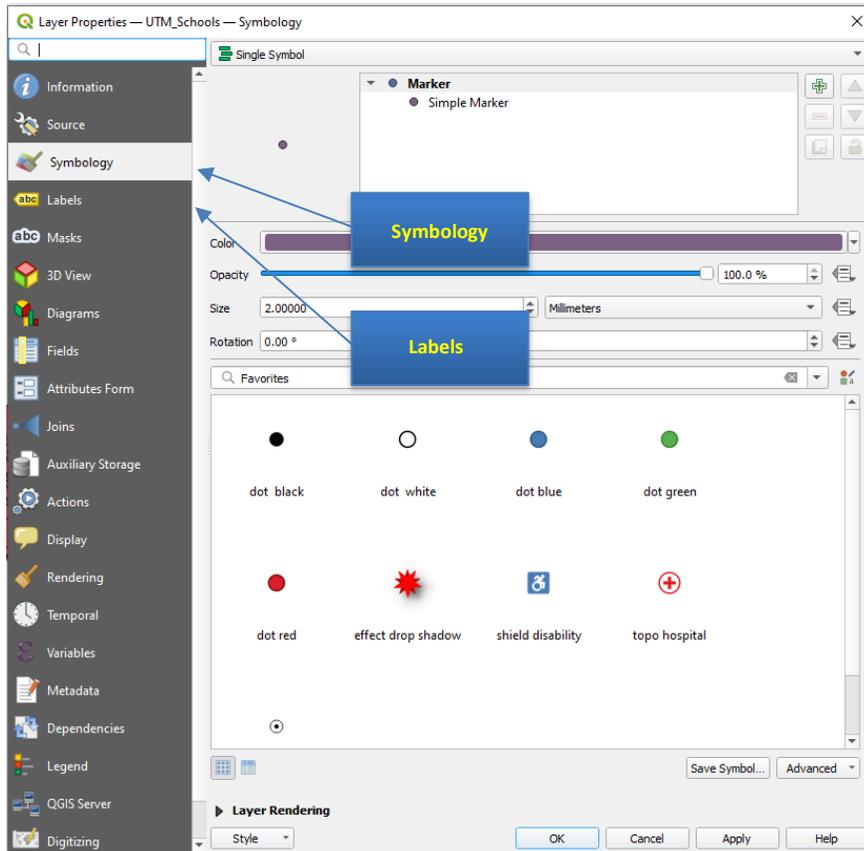


Figure 15 – Layer Properties Dialog Window

### 2.2.1. Layer Order and Transparency

The polygon layer (ZONING.shp) can be set as ‘no fill’ polygons allowing the overlaying line and point layers to be visible. The detailed steps will be introduced after the explaining the concept of layer order. Please note however, Figures in this tutorial **do not** include base maps.

#### Layer Order

QGIS displays geospatial data accordingly to the order shown in the table of contents: the bottom layer is drawn on the screen first and covered by upper layers. Hence, the layer on the top in the table of contents are displayed as the top layer in the map.

When a point feature layer is put under a polygon feature layer, the point feature is covered by the polygon and therefore not visible. You can make such layers temporarily visible by deselecting the box next to the layer that’s blocking your view (Figure 16). Alternatively, you can drag layers up and down (on top or beneath) to change their order for display.

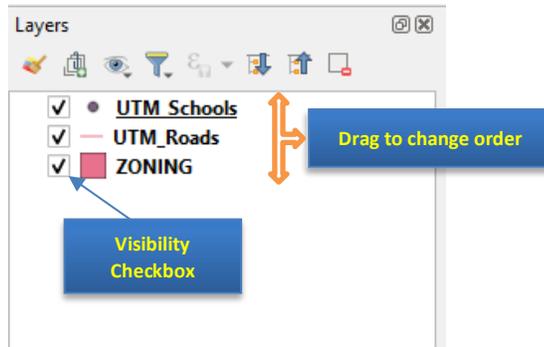


Figure 16 - Layer Visibility and Order Control

### Layer Visibility

Sometimes you want to have the best of both worlds: show the polygon *and* the basemap imagery. Reordering layers or turning them on and off doesn't satisfy both needs, but layer transparency and hollow symbology can help. As mentioned previously in the tutorial, **double-click the polygon** (ZONING) to open the Layer Properties window (Figure 17). Then switch to the **Symbology** tab and you can make polygons hollow by changing the **Fill Style** from Solid to No Brush.

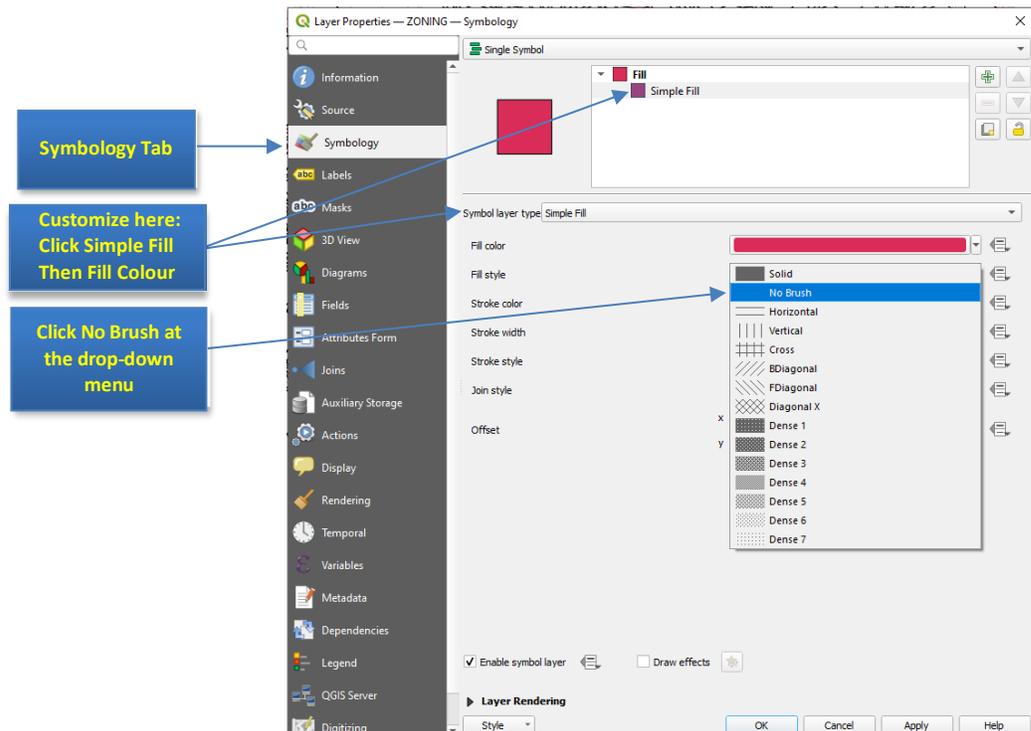


Figure 17 – Layer Properties, Style Symbology

## 2.2.2. Symbology and Label

### Symbology

Symbology is a critical component of map-making, and in QGIS, symbols are classified into three types:

- Marker symbols (for points)
- Line symbols (for lines)
- Fill and Outline symbols (for polygons)

Each type of symbol can consist of one or more **symbol layers**.

Double-click the layer (UTM\_Schools). Then switch to the **Symbology** tab and click Simple Marker (Figure 18). This customization window contains several different elements.

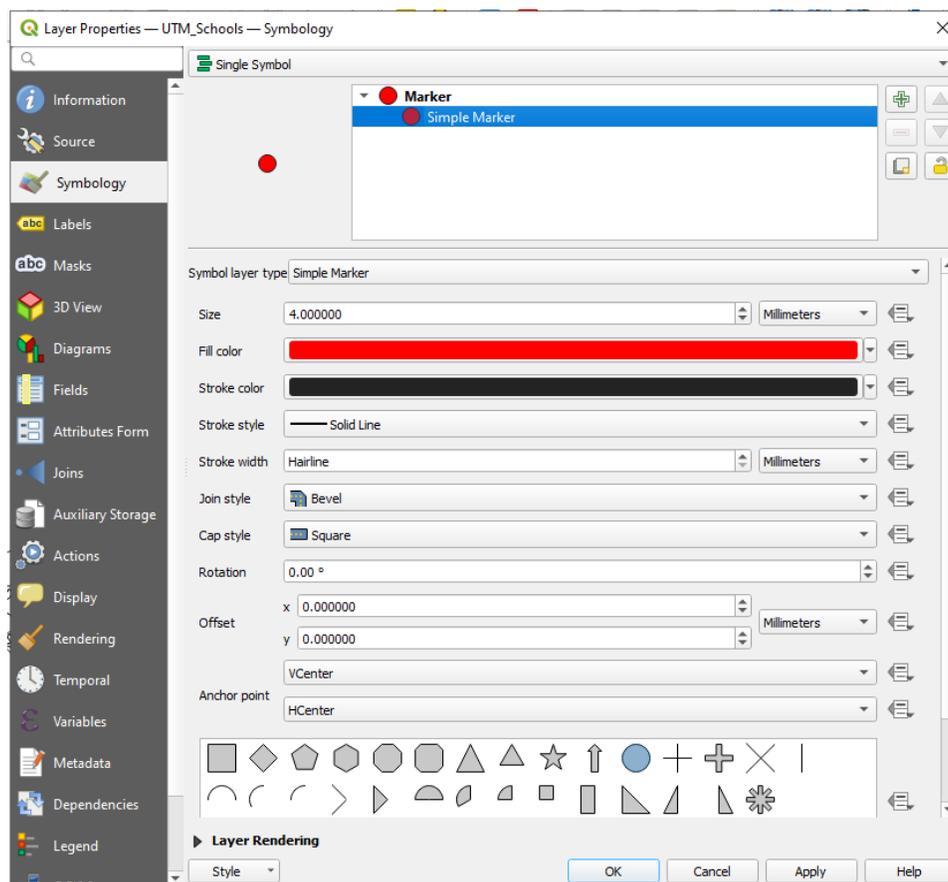


Figure 18 – Simple Marker Customization Window

Notice that the **Symbol layer type** dropdown menu gives you different types of symbols. In most cases, you simply choose a symbol from those available. The symbol options change depending on the type of feature (point, line, or polygon) being changed (i.e. lines won't be an option if you're changing the symbol of a point feature).

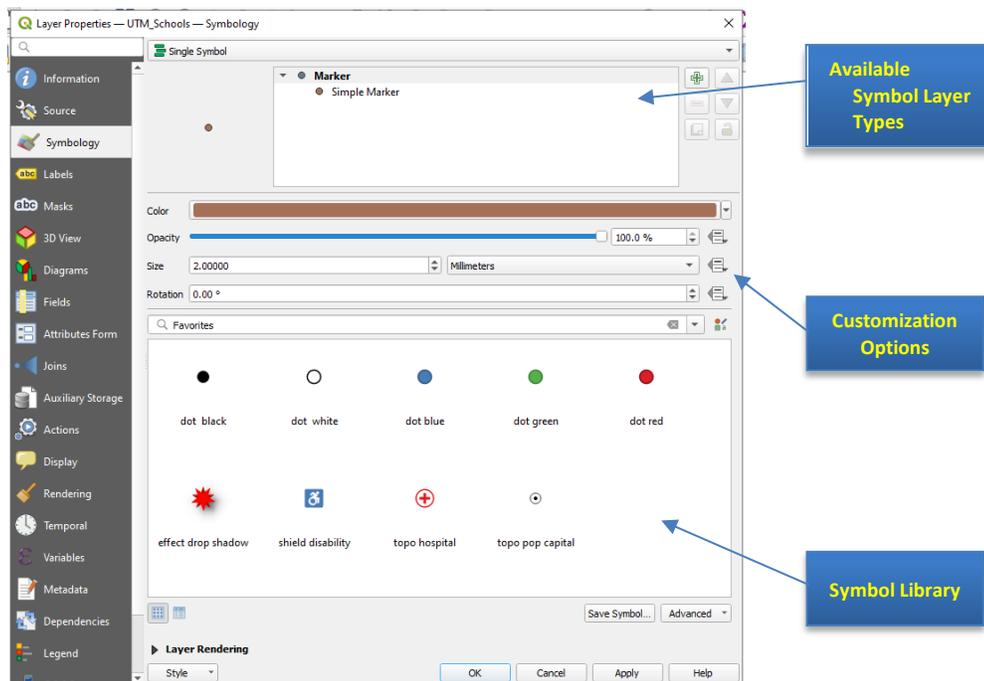


Figure 19 – Point Symbology Customization Window

There may be times when you want to differentiate symbols within a layer based on an attribute of the feature. For instance, one might want to know which schools are public, private, catholic, French separate, college, or university in the **UTM\_Schools** layer; different types will be marked in colors. To do so, **double-click** on the school layer, and go to the **Symbology** tab, which is the same as shown in Figure 19. However, instead of the default **Single Symbol** option, select the **Categorized** option from the dropdown menu (Figure 20).

1. Click on **Single Symbol**, and make sure **Categorized** is chosen.
2. From the **Value** dropdown menu, select **TYPE** as the value to be Classified.
3. **(Optional)** Click on the **Color ramp** dropdown and/or **Symbol** selector to assign an appropriate color scheme and symbol.
4. Click on the **Classify** button to add all distinct values based on the TYPE attribute.

*Note: You need to change the colour before clicking Classify, otherwise the symbols need to be changed manually one at a time or to be all deleted and added again after choosing a color scheme. Also, there are cases where some of the symbol layers such as SVG Markers come in fixed color and cannot be changed.*

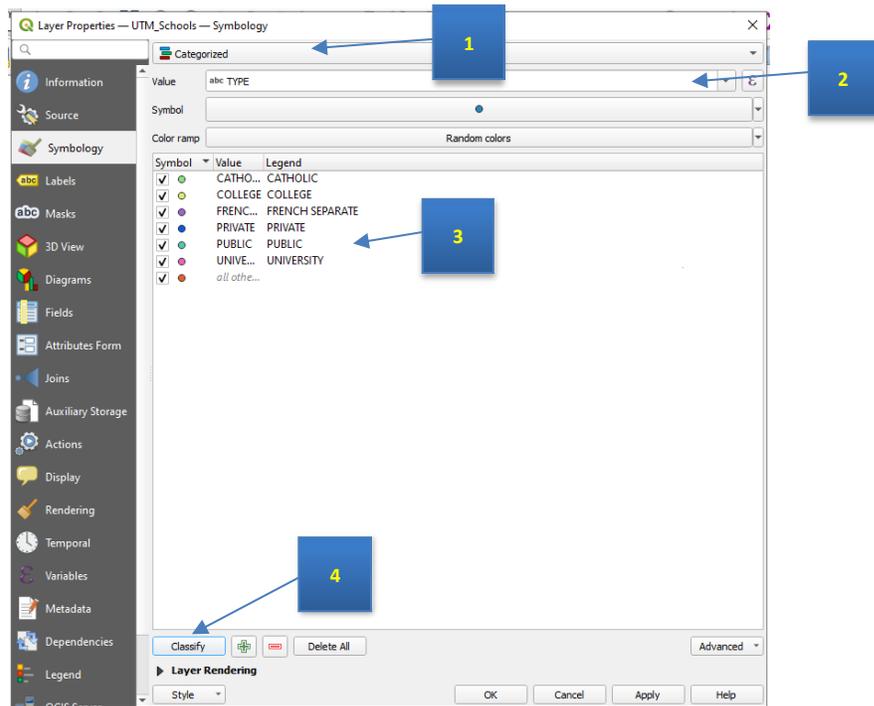


Figure 20 - Classifying Features Using Different Colours

You may want to change individual symbols rather than to use a specific colour ramp, in which case simply double-click the class you want to change the symbol for (Figure 21).

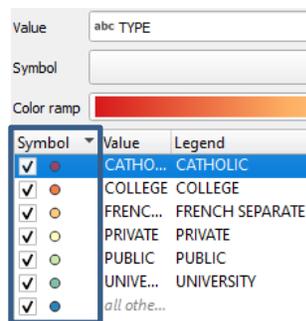


Figure 21 - Classified Symbols and Further Customization

## Labels

The labels are an important feature of any map. Labels make your map more useful, informative, and visually appealing. To add labels to your map, **double-click** on the layer you are adding labels to (in this instance, choose the **UTM\_Schools** layer). Then follow the steps below:

1. Select the **Labels** tab (No Labels by default) and select **Single Labels** from the dropdown menu (Figure 22).
2. Choose the attribute you want to display on the map in the **Value** dropdown menu (Figure 22).
3. Change **Font**, **Font Size** and other **Placement** options, so that it is clearly shown on the map.

4. You can click on the **Apply** button to see the effect until it is satisfactory. Then click on **OK** to save your setting and exit.
5. **(Optional)** If you think the added labels are not distinct on the map background, you can make a buffer background around the texts. Select the **Buffer** tab and check **Draw text buffer**, which adds a halo around the text of the label (Figure 23).

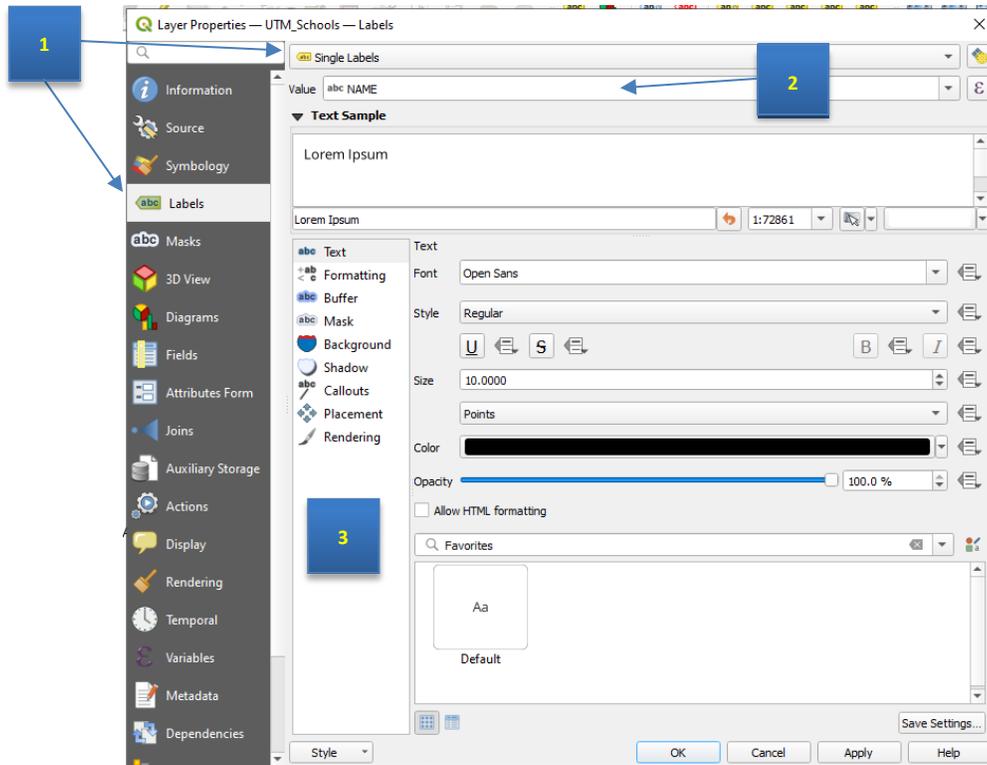


Figure 22 - Label Setting Window

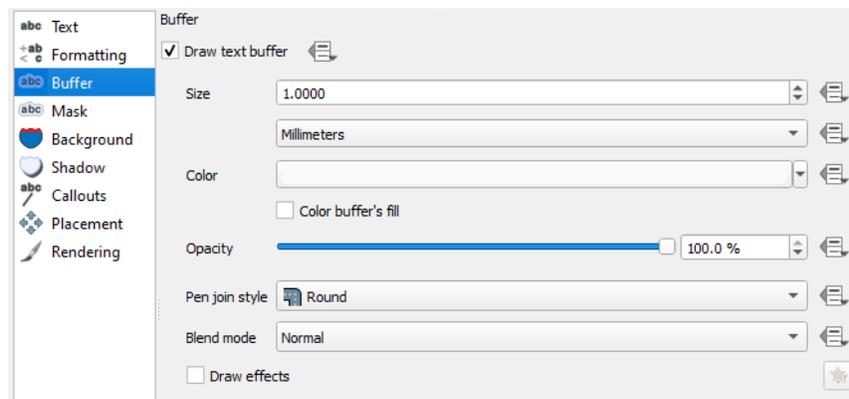


Figure 23 – Add Text Buffer for Clearer Labels

### ***Symbology Types and Their Normal Usage:***

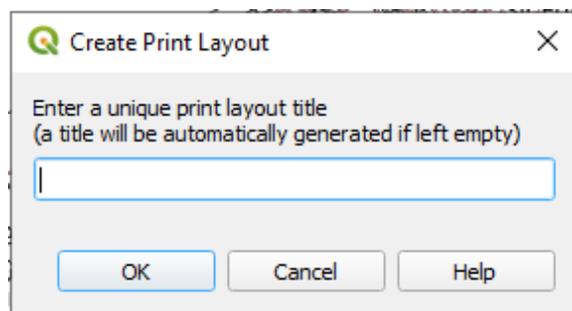
- ***Single Symbol:*** Mainly used for displaying the extent of your chosen geographic features on a map.
- ***Categorized Symbol:*** Also called the unique values, they can be applied to all kinds of attribute-based classifications in forms of distinct user-defined symbol (mainly based on colours).
- ***Graduated Symbol:*** Graduated symbol are only applicable to attributes associated with numbers. It often depicts numerical variables into forms of comparable sizes.
- ***Rule Based:*** Condenses classified layer features based on querying.
- ***Diagram Overlay:*** QGIS has the capacity of placing multiple layers of different attributes into an independent tab called diagrams. Spatial information such as the population percentage with different age intervals at different locations can be easily shown.

## **2.3. Map Layout and Map Components**

When the geospatial data and its representations are satisfactory, you can add other map components in another window via **Project > New Print Layout**. After assigning a title in the **Create Print Layout** pop-up window (Figure 24), you would be able to manage multiple layouts via **Project > Layout Manager**.

Key components of a map include:

- Title (Purpose/Content)
- Scale (Measurement)
- North Arrow (Orientation)
- Legend (how to interpret the map)
- Reference (where you obtain the data).



**Figure 24 – Create Print Layout Pop-up Window**

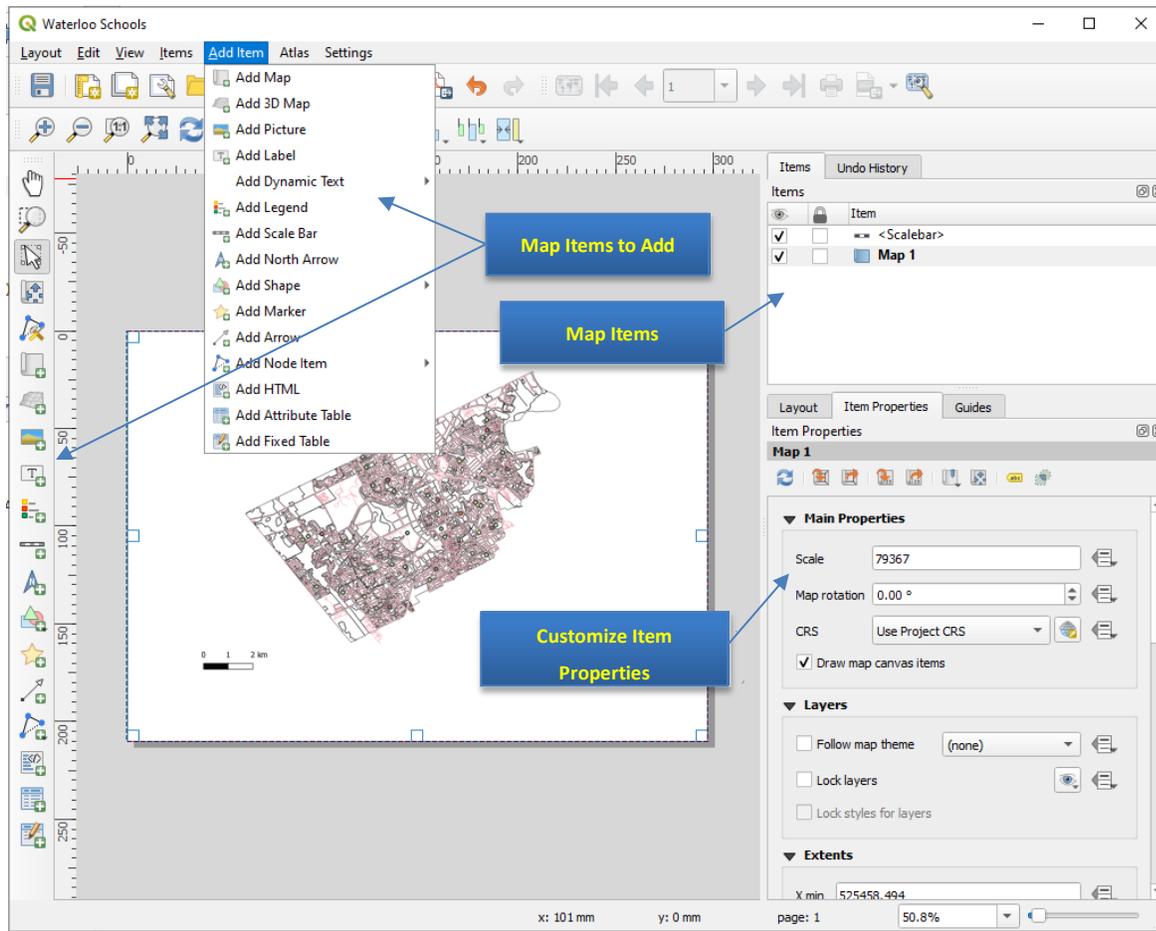


Figure 25 - Map Layout Window

The **Add Map**  button under the **Add Items** menu at the top or on the left sidebar of the window adds the main map to your Map Layout window (Figure 25) and is done by clicking and dragging a rectangle on the paper to define display area and extent. Map title and reference can be added by using the **Add Label**  tool to create text boxes. Click to automatically create a text box and then click on the spot where you want to place the title at. Create a separate text box for reference.

In the Print Layout, you can customize the properties of all components by selecting the **Item** and switching to the **Item Properties** tab. For instance, if you want to change the font of the title, click the title first (so that it is selected) and change to the **Item Properties** tab. There is a button called **Font** where you can find all the properties there.

The **Add Scale Bar**  button adds a scale bar to your map. Before you add a scale bar on your map, make sure to set the coordinate system of your map to **NAD83 / UTM zone 17N (EPSG:26917)** by clicking the button on the lower-right of the main window. After doing that, click on the tool and then select the spot you want the scale to be. You can change the scale bar **Item Properties** like **Scalebar units** and **Style**. You can change the scale bar to be numeric (i.e. 1:5,000,000) or different bar/line forms by selecting the an option in the **Style** dropdown menu. All the options can be tested by changing them around (Figure 26).

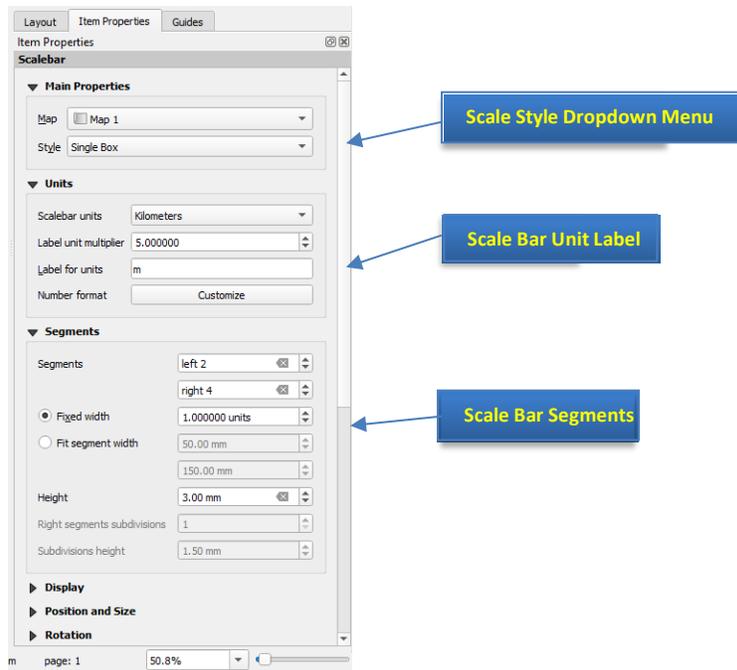


Figure 26 - Scale Bar (or Text) Properties Window

All maps should have a north arrow, which can be added using the **Add North Arrow**  button.

Another item that virtually all maps should have (unless it's extremely obvious what the different components of the map are) is a legend. This can be added in the same way as other items in that you

click on the **Add Legend**  button and adjust formatting as needed. The major options are located under **Legend Items**. You can fine-tune in other options below **Legend Items** (Figure 27).

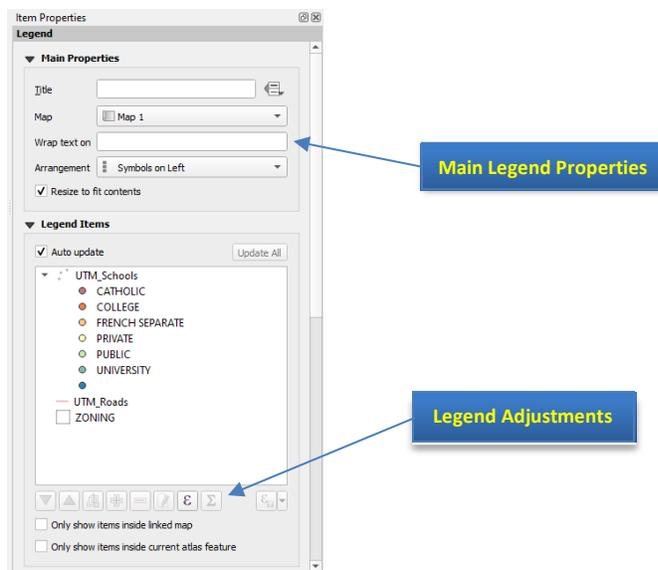


Figure 27 - Legend Properties Window

The Legend tool automatically generates a legend based on all the layers available for the map – this is displayed in the **Legend Items**. To change the Legend layout, uncheck **Auto Update** to disconnect it from the project. Be sure you have done all your work and are ready to visualize it. If not, check back **Auto Update** or click **Update All** button to bring in new legend items which will undo you changes.

- Add/Remove Layers: You can decide the layers to be added to the legend by clicking  to add or  to remove.
- Change the Display Orders: The legend items will be displayed strictly in the order shown in the **Legend Items** pane. You can change the order by clicking a layer first and move it up  or move it down .
- Change Layer Names: Often times, the name displayed in the legend would be difficult to interpret. For instance, users won't know what "ZONING" means. To change the name, select the layer and click the edit button  to change it to a more meaningful name: 'Property Boundaries (Waterloo City)' or double-click "ZONING" to edit the name.

Another method is to **double-click** on the 'ZONING' layer in the **Layers** pane (main window). Go to the **Source** tab (By default) and change the name in **Layer name**. The layer's new name will be automatically updated on the legend. *You can use either method to change 'UTM\_Roads' to 'Waterloo Streets' and 'UTM\_Schools' to 'Schools'* (Figure 28 & Figure 29)



Figure 28 - The Source Tab to Change Layer Name

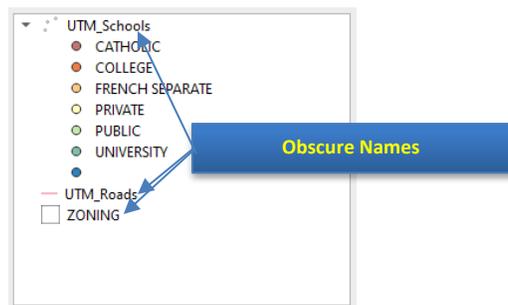


Figure 29 - An Example of Legend before Customization

**Components that are also frequently required:**

- Author of the Map: Users may want to know who creates the map.
- Data Source: Where the map layers come from.
- Data Saved (Created/Modified): The more frequent a region changes, the more important it is for users to know when the map is created.
- Coordinate System: The globe is not flat, but a map is. Any kind of projection used to make the map distorts the reality in some way. Hence, it is critical for users to know how reliable their measurements on the map are, especially for pilots and navigators.

## 2.4. Export Maps

When you are satisfied with everything on the map and are ready to deliver, you can export your map as an image, PDF, SVG, or print a hard copy. All options are under the **Layout** dropdown menu at the top (Figure 30).

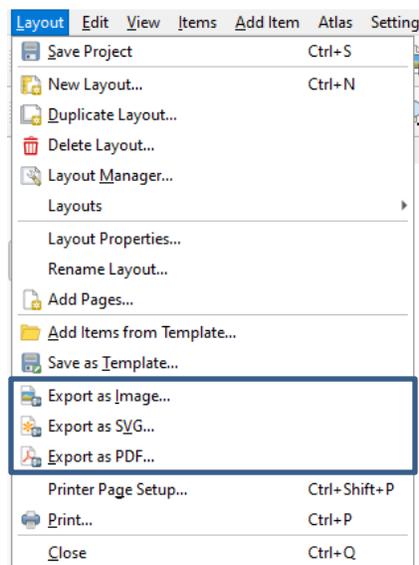


Figure 30 - Export Map Options

You can specify the directory and file name of the map in this dialog. There are more file format options available in the **Save as type** dialog box (Figure 31). The most frequently used formats are PNG, JPEG, and PDF. PNG and JPEG are popular image file formats. Both are easy to be inserted into Word as an image, whereas PDF is best used for sharing. The printed copy of PDF will be identical regardless of your computer (and printer) environment.

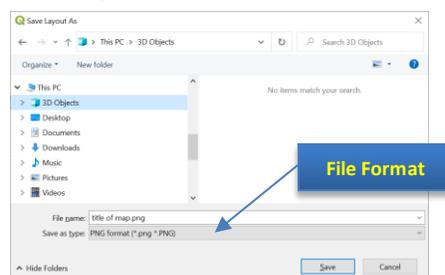


Figure 31 - Export Map Dialog

For a good resolution set the **Export Resolution** of your map between **300 dpi** (By default) and **600 dpi** (Figure 32). Remember, the higher the resolution the larger the file will be.

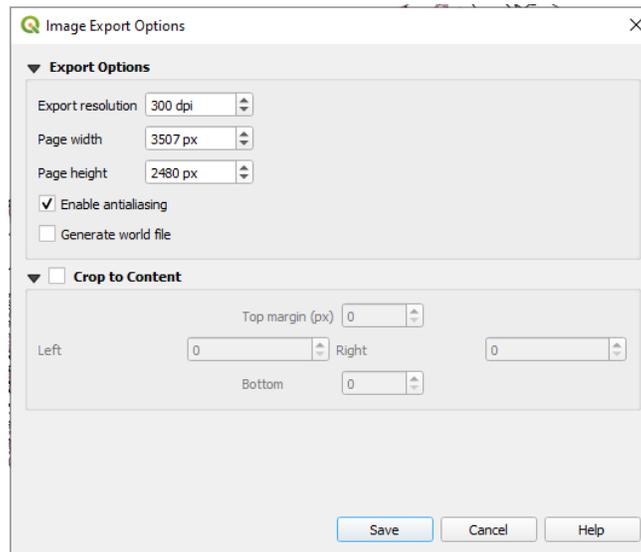


Figure 32 – Image Export options Window

Other than export map to image file formats, you can directly print out hardcopies of your map by **Layout > Print**. You can also customize page and printer setup via **Layout > Page Setup**. Page orientation (portrait and landscape), page size, etc. All these operations are intuitive and very similar to other applications, such as Microsoft Word.

#### ***Brief Explanation of Graphic File Formats:***

- ***SVG file:*** Scalable Vector Graphics, an open-source vector graphic standard. It is becoming more and more popular and can be accepted by many vendors;
- ***BMP file:*** BitMap file, which is a mature loss-less uncompressed raster format. The quality is great. But its file size tends to be huge. It can be used if you need both high-quality output and compatibility;
- ***PNG file:*** Portable Network Graphics, which is an open-source standard designed to replace BMP and GIF. It is a true-color loss-less raster file format. PNG file is slightly larger than JPEG (compressed with quality loss). And some old browsers and operating systems do not support PNG files;
- ***TIFF file:*** Tagged Image File Format. A major raster graphic file format provided by Adobe (AI for vector). Best to be used for raster file editing on Adobe Products, such as Photoshop;
- ***GIF file:*** Graphics Interchange Format. An uncompressed raster file format with 256-color limitation. Hence, if your map contains only a few colors (vector-based data), GIF is a good candidate.

And finally, an example of how your map can look using the steps in this tutorial (Figure 33).

### Location and Type of Education Institutes in Waterloo City

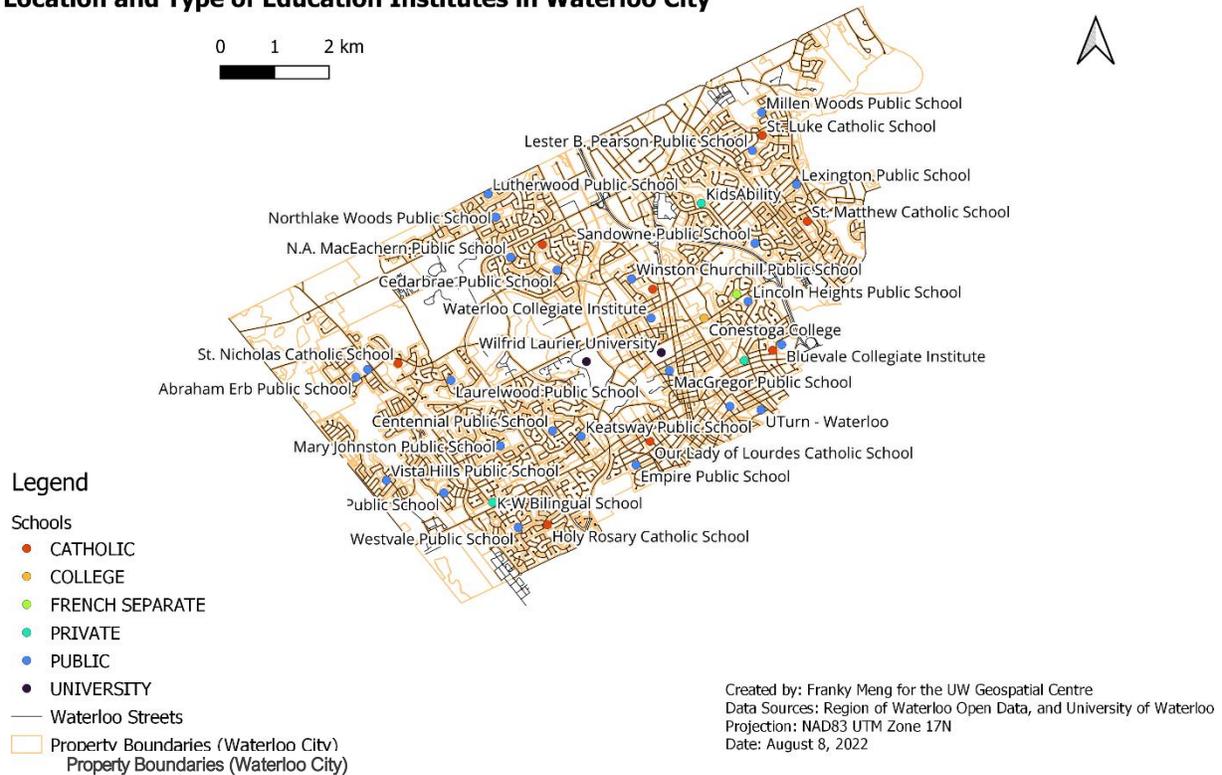


Figure 33 – Final Map Product

This tutorial covered some of the basics of QGIS. If you have any questions on learning more about ArcGIS and how to incorporate it into research, please contact us.

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*Updated by Ian Woodmansey for the University of Waterloo Geospatial Centre (2024)*