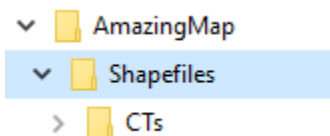


Introduction to QGIS (version 2.18) and Spatial Joins

Rebecca Bartlett, GIS & Digital Resources Librarian, October 2018

1. Download electoral wards for the City of Ottawa

- 1) In an internet browser, go to <http://data.ottawa.ca/>.
- 2) In the search bar, search for *ward*
- 3) Select **Wards 2014**
- 4) Click the **Go to resource** link for **wards-2014:shp** and download the shapefile
- 5) Once it has downloaded, copy the ZIP folder into the project folder for today's class. We suggest a hierarchy like this, but we're particular about this stuff:



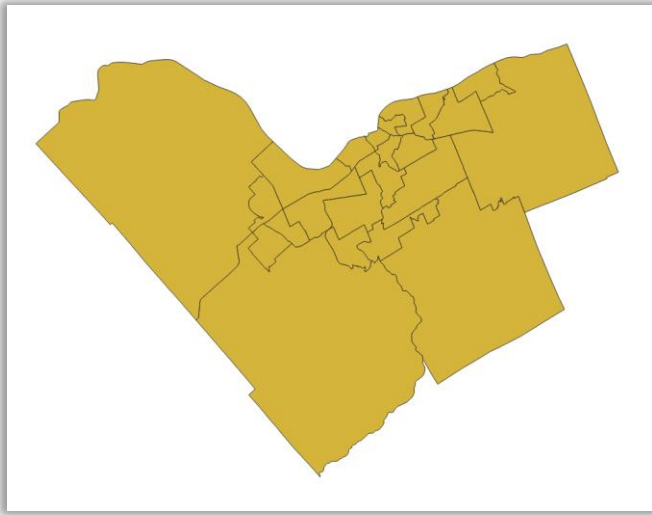
- 6) Unzip the file. If you don't, you may get an error when you try to import it into QGIS.
- 7) Once unzipped, your folder should look something like this:

A screenshot of a Windows Explorer window showing a folder containing several files. The files are listed in a table with columns for Name, Date modified, and Type.

Name	Date modified	Type
wards-2014_shp.dbf	2018-04-24 12:02	DBF File
wards-2014_shp.prj	2018-04-24 12:02	PRJ File
wards-2014_shp.sbn	2018-04-24 12:02	SBN File
wards-2014_shp.sbx	2018-04-24 12:02	SBX File
wards-2014_shp.shp	2018-04-24 12:02	AutoCAD Shape S...
wards-2014_shp.shp.xml	2018-04-24 12:02	XML Document
wards-2014_shp.shx	2018-04-24 12:02	AutoCAD Compil...

This is as good a time as any to note that shapefiles look like multiple different files when you view them in Windows Explorer. If you ever copy and paste them somewhere, you need to have all the parts (e.g.: all the files that have the same name before the file extension – there may be up to 8 of them). For more on shape files, please consult pages 121 and 148 of The Data Journalist.

- 8) You're done the download!
- 9) Open QGIS. Once QGIS opens, add the dataset by clicking on **Layer > Add Layer > Add Vector Layer...** Browse to the project's folder and find the shapefile. Click on the ".shp" and click **Ok** to add the shapefile to QGIS' data frame, which is the space to the right.
 - a. You could also have the project folder open in Windows Explorer or Finder and just drag and drop the ".shp" file in. Either way works!
- 10) You should now see the Ottawa wards, and it should look something like this:

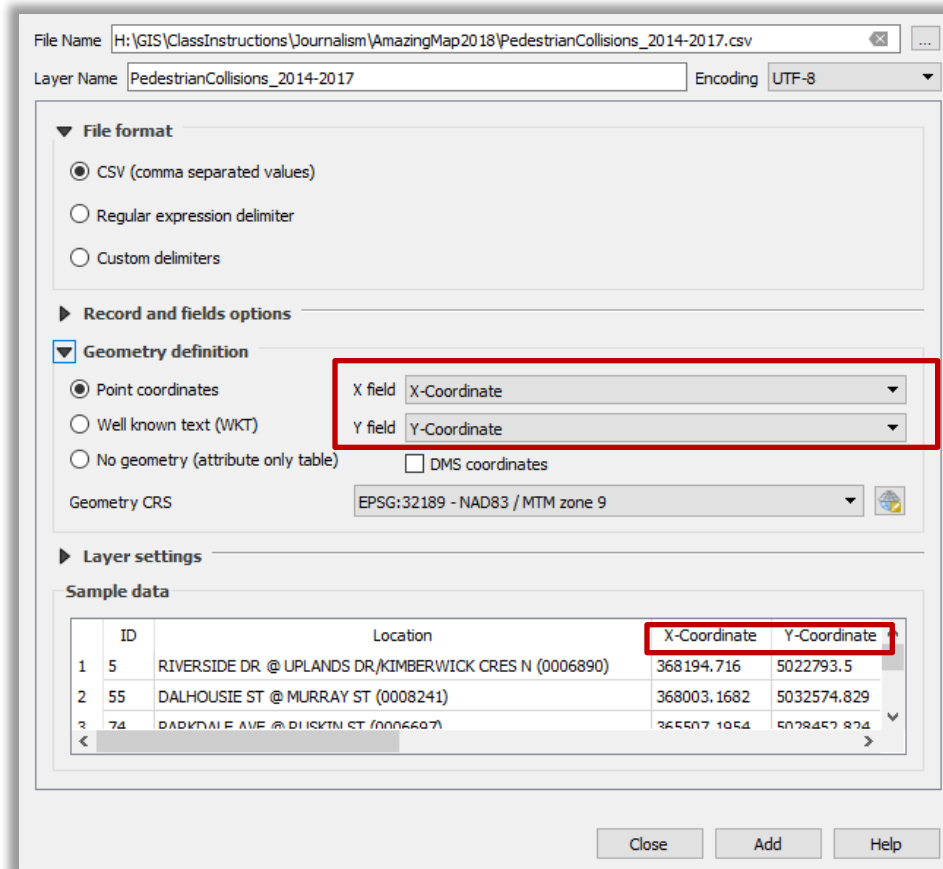


- 11) Click **View > Panels** and make sure **Browser** and **Layers** are both selected. If one of those options is unselected, then check the box beside it so the panel appears in the menu to the left.

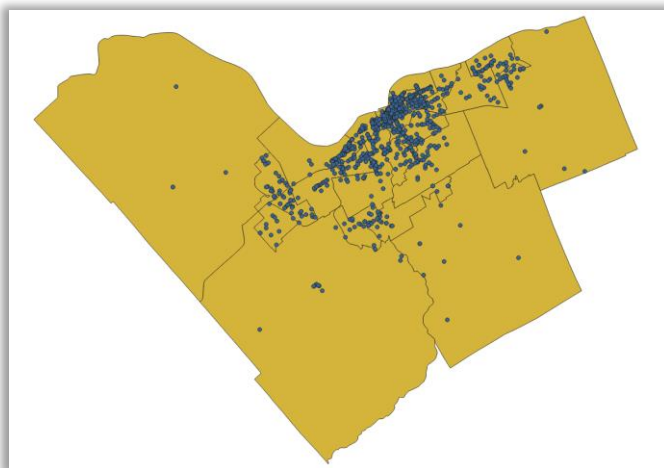
2. Adding the pedestrian collision data

What we'll do now is add a spreadsheet of vehicular collisions involving pedestrians that includes X and Y coordinates measured in metres.

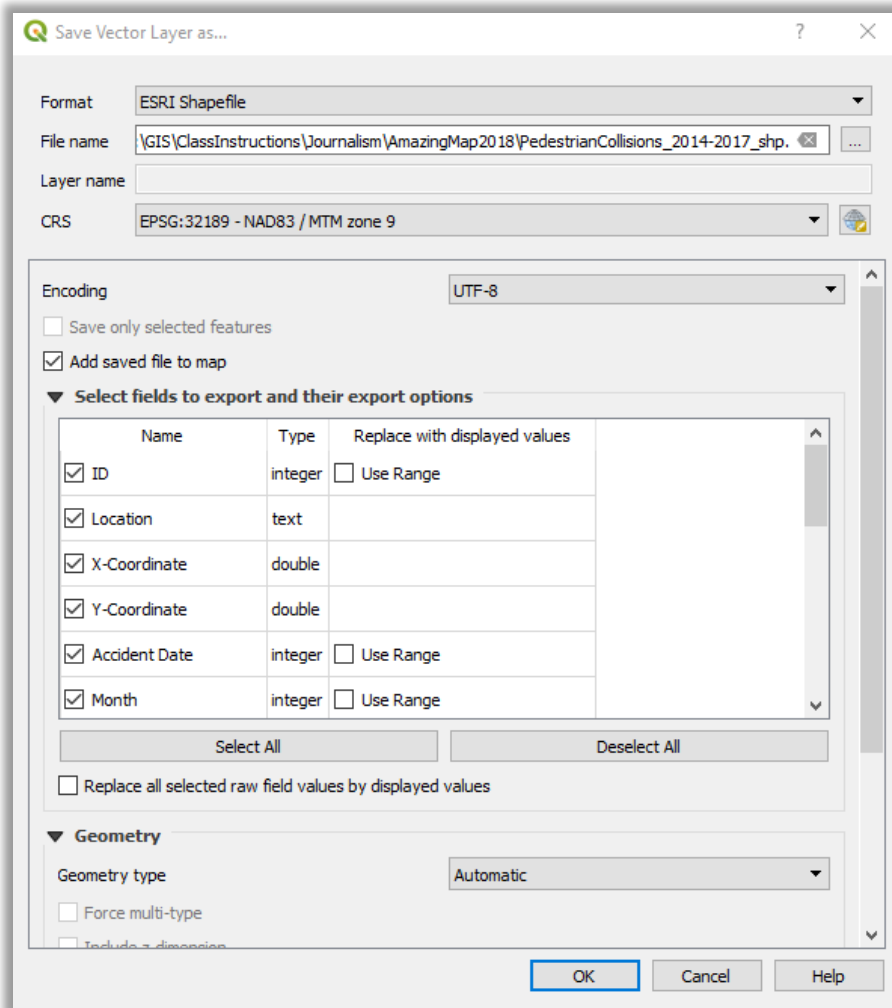
- 1) Open zip folder that contains Excel file [Pedestrians hit by Ottawa ward 2014-2017.xlsx](#)
- 2) Note the "Pedestrian Condition" column on the far right
- 3) Filter the field to include only pedestrian collisions (tip: everything but blank entries in that field)
- 4) Copy those entries to a new sheet or Excel file
- 5) Save that sheet/file as a CSV file, such as PedestrianCollisions_2014-2017.csv
- 6) In QGIS, click **Layer > Add Layer > Add delimited text layer**
- 7) In the dialog box, ensure the following items are entered:
 - a. File format: CSV
 - b. Geometry definitions: Point coordinates – X field is X-Coordinate and Y field is Y-coordinate
 - c. Geometry CRS is EPSG 32189 (search for 32189) **NOTE:** depending on what version of QGIS you're using, the interface might be slightly different. The key is making sure the X and Y coordinates are properly identified, otherwise the points won't appear on the map situated in the Qgis data frame.



8) Click Add, then Close. The points should now be visible over the wards:



9) Although the points in the CSV file are displayed, we want to save them as a shapefile to conduct analysis. Right-click on the PedestrianCollisions_2014-2017 csv file and select "Save As...". Give the file a name and make sure that the [Coordinate Reference System \(CRS\)](#) is EPSG 32189 (it should be the default).

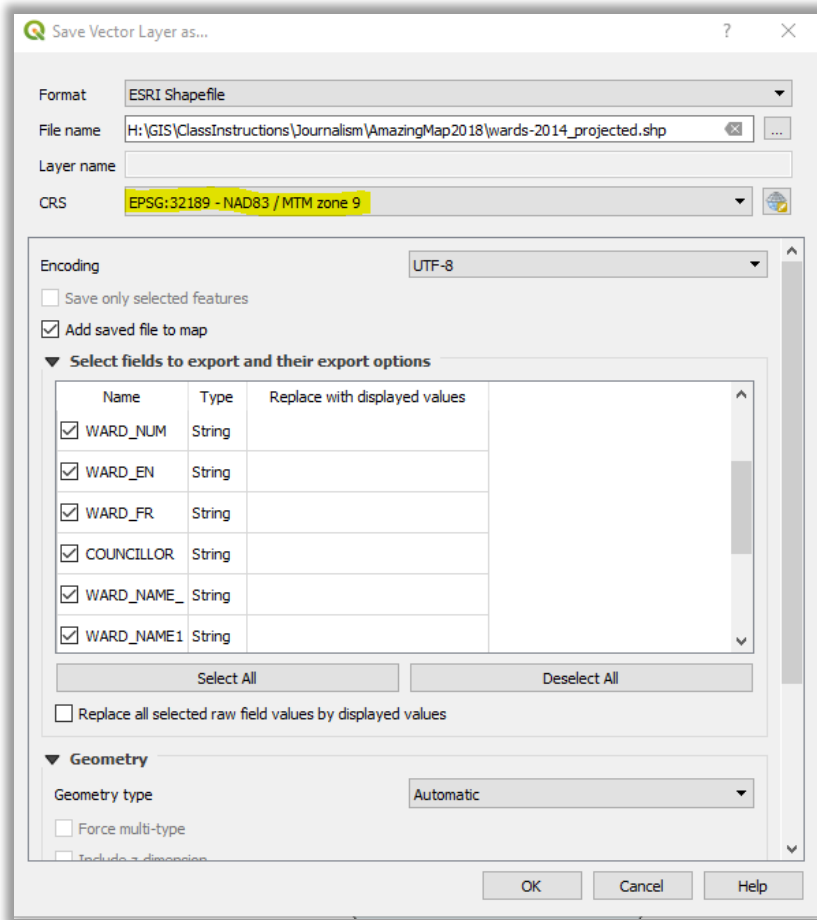


10) Once the new shapefile of pedestrian collisions is added to the map, remove the CSV file from the map.

3. Changing the projection of the Wards shapefile

Because what we'll be doing is counting how many pedestrian collisions occur in each ward, it is best practice to have all the files used in the analysis in the same projection. We will convert the wards shapefile to the same projection as the collisions we just added.

- 1) Right-click on the **wards-2014_shp** file and Save As...
- 2) In the dialog box, we want to make sure that the CRS is the same as the pedestrian file. In the CRS drop-down list, **EPSG:32189 – NAD83/MTM zone 9** should be visible since we already used it in this QGIS document. Click it.
- 3) Browse to your project folder, name the file something helpful, and click OK.



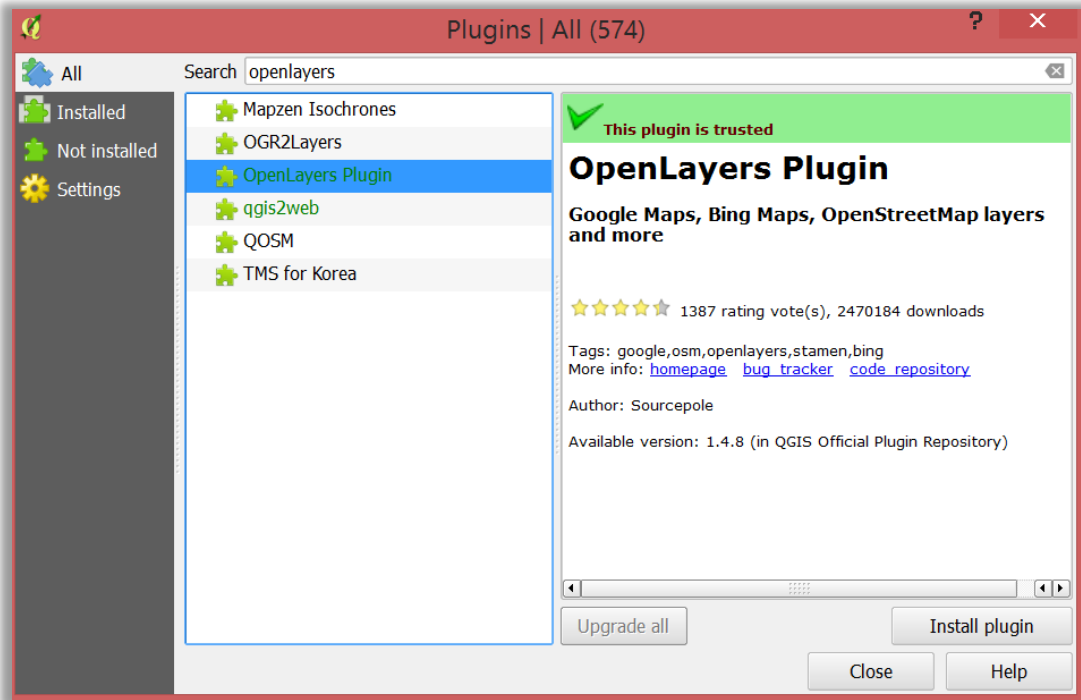
- 4) Once the new projected wards file is in the Layers list, remove the wards-2014_shp file.

4. Add a basemap

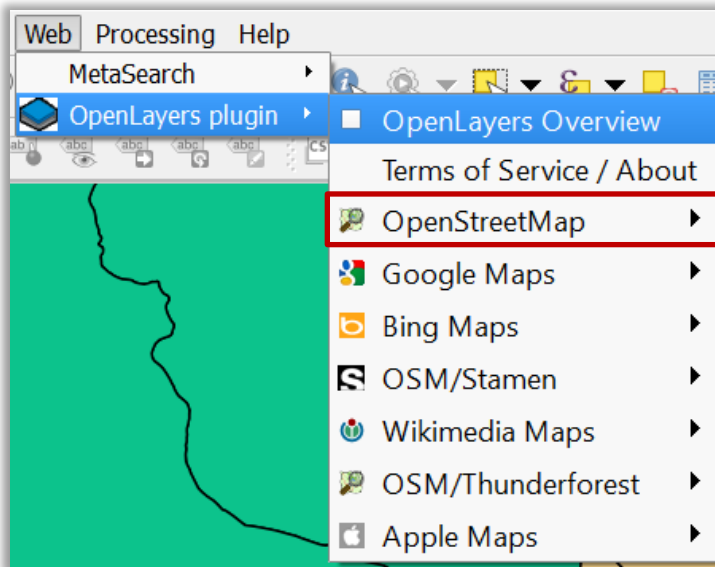
A basemap is a pre-made map that you can add to your QGIS document so that roads, water, and other features are visible. It is a helpful way to let you know if your shapefiles are in the right location to get your bearings.

One thing to point out is that we're adding the basemap after changing the projections as, generally speaking, web basemaps will adjust to the shapefiles (called "projecting on-the-fly"). However, if you add the basemap first, the shapefiles may project on-the-fly to the basemap's projection.

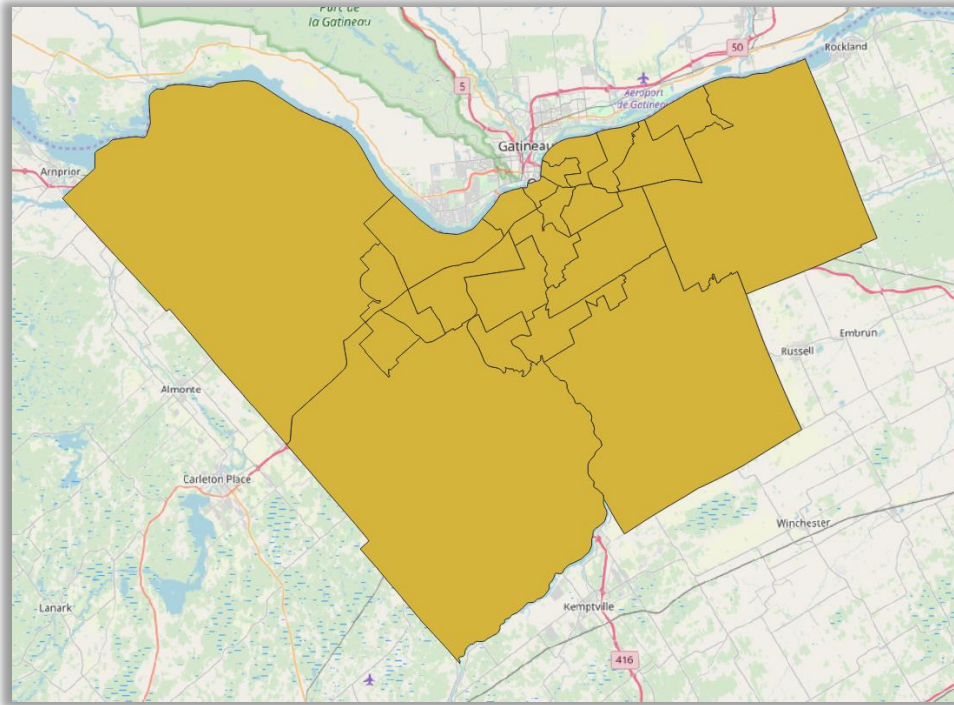
- 1) Go to Plugins > Manage and Install Plugins
- 2) Search for "openlayers" (all one word). Find "OpenLayers Plugin" in the list, click it, and then click Install Plugin.



- 3) Wait a moment while it downloads and installs, then Close the dialog box.
- 4) To access the OpenLayers Plugin, go to Web > "OpenLayers plugin". You'll see a list of map options, from Google to Bing to OpenStreetMap.



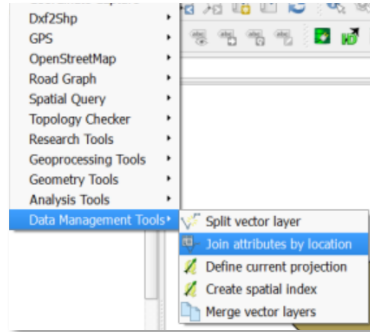
- 5) Select an OpenStreetMap from the list. (Bear in mind that since we're using an older version of the software, some of the options may not be available anymore.) Wait a moment or two for it to load. You may also need to click on the layer and move it to the bottom of the Layers list.



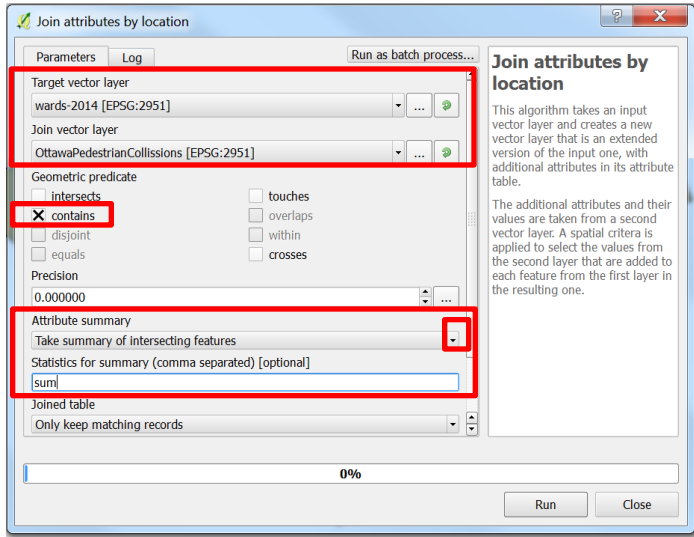
5. Finding out how many pedestrian collisions occurred in each ward

A spatial join is done by using GIS software to count how many (in this case) points fall within each individual polygon. It's like having a dozen chocolate chip cookies and the computer counting how many chocolate chips (collision locations) are in each cookie (ward).

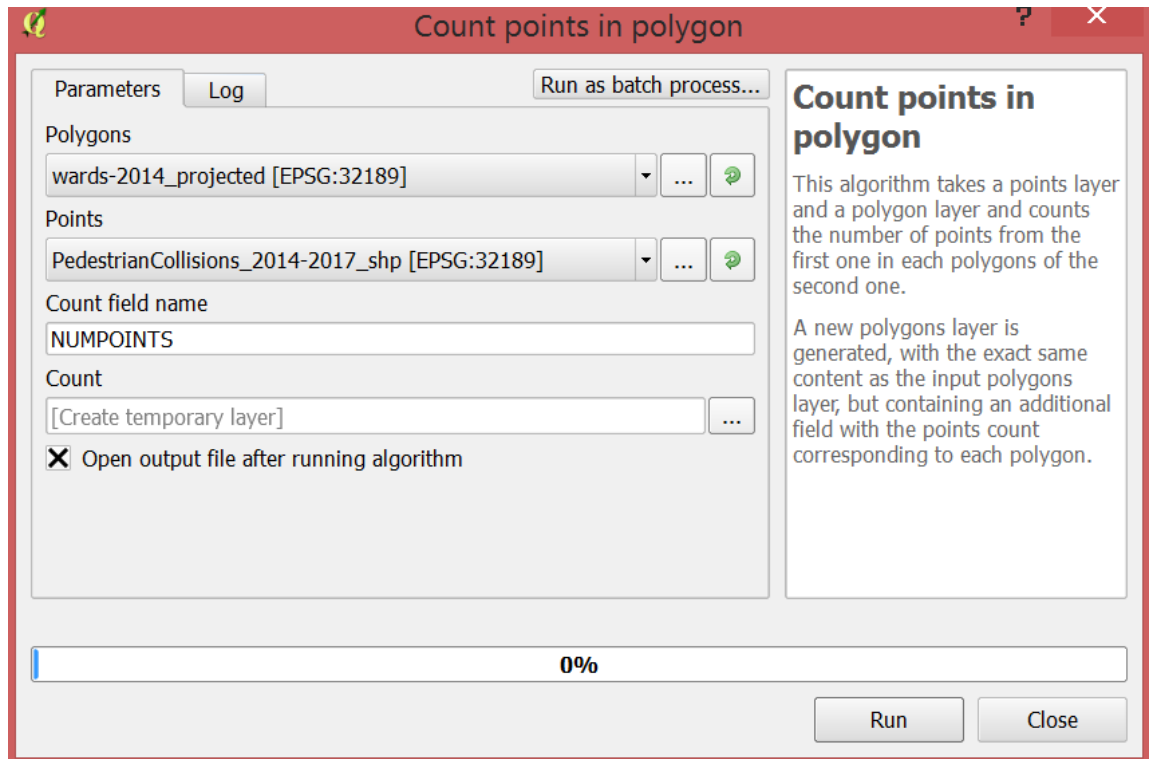
- 1) In QGIS, go to **Vector > Analysis tools > Count points in polygon...**
- 2) NOTE: If you don't have a "Count points in polygon" option you can use the "Join attributes by location" option that can be found by going to **Vector > Data Management Tools > Join**



attributes by location



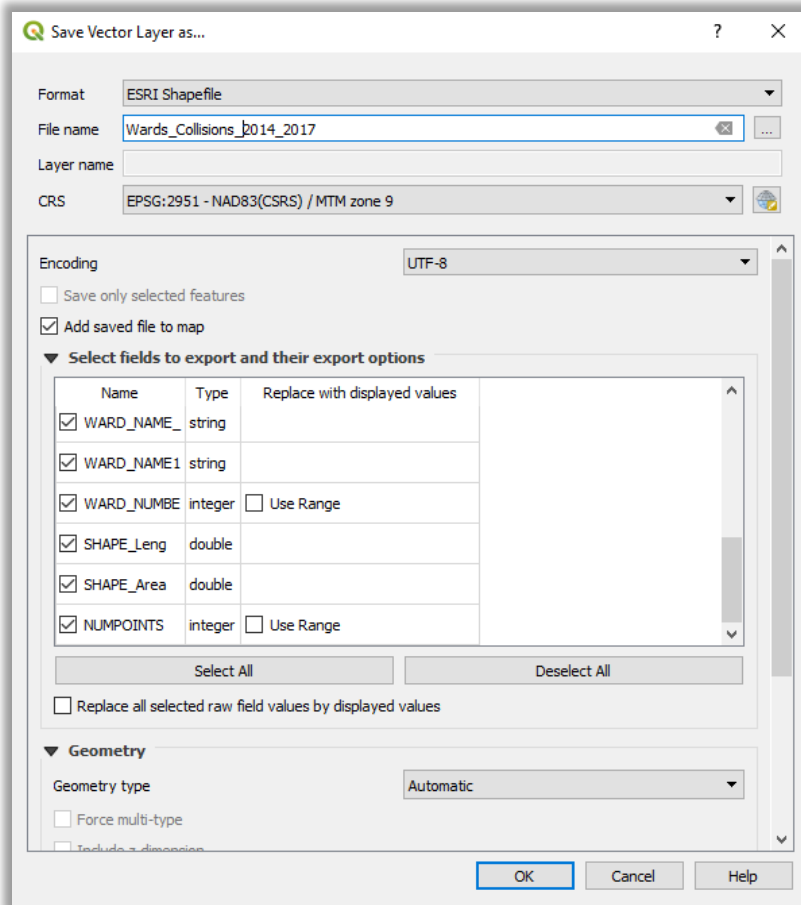
- a. Target vector layer: wards-2014
 - b. Join vector layer: OttawaPedestrianCollisions
 - c. Geometric predicate: “contains”
 - d. Attribute summary: select the “Take summary of intersecting features” option from the drop-down menu
 - e. Statistics for summary: “sum”
 - f. **This process will generate a COUNT field at the far right of the attribute table (NOTE: the EPSG is different in the above screen shot than the ones used for the points-in-polygon option below. The key is making sure the coordinate systems are the same.)**
- 3) If you have the “Count points in Polygon option, then you can skip the second step.
 - 4) Ensure the following details are correct in the dialog box (which may look slightly different, depending on what version of QGIS you’re using):
 - a. Polygons: projected wards shapefile (should show that [EPSG:32189])
 - b. Points: pedestrian collisions shapefile (should show [EPSG:32189])
 - c. Count field name: NUMPOINTS (or rename it if you’d like)
 - d. Check off Open output file after running algorithm



- 5) Click Run. If necessary, close dialog box when it's done.
- 6) A new Count file should appear in Layers. Open the attribute table. At the far right of the table will be a NUMPOINTS field that indicates how many collisions occurred within that ward.

	DESCRIPTIC	NAME	NAME_FR	WARD_NUM	WARD_EN	WARD_FR	:OUNCILLOF	/ARD_NAME	/ARD_NAME	/ARD_NUMB	SHAPE_Leng	SHAPE_Area	NUMPOINTS
1	KANATA S...	Ward 23	Quartier 23	23	KANATA S...	KANATA-S...	Allan Hubley	Kanata South	Kanata-Sud	23	19871.785...	16418739...	30
2	BAY - Mark...	Ward 7	Quartier 7	7	BAY	BAIE	Mark Taylor	Bay	Baie	7	39722.032...	64174613...	80
3	OSGOODE...	Ward 20	Quartier 20	20	OSGOODE	OSGOODE	George Da...	Osgoode	Osgoode	20	105838.74...	46356158...	8
4	BEACON H...	Ward 11	Quartier 11	11	BEACON H...	BEACON H...	Tim Tierney	Beacon Hill...	Beacon Hill...	11	26012.651...	19598778...	48
5	COLLEGE -...	Ward 8	Quartier 8	8	COLLEGE	COLLÃ"GE	Rick Chiarelli	College	CollÃ"ge	8	40055.357...	46077373...	70
6	GLOUCES...	Ward 22	Quartier 22	22	GLOUCES...	GLOUCES...	Michael Qa...	Gloucester...	Gloucester...	22	45545.496...	37013497...	22
7	KANATA N...	Ward 4	Quartier 4	4	KANATA N...	KANATA-N...	Marianne ...	Kanata North	Kanata-Nord	4	25997.770...	24235080...	25
8	KNOXDAL...	Ward 9	Quartier 9	9	KNOXDAL...	KNOXDAL...	Keith Egli	Knoxdale-...	Knoxdale-...	9	36533.316...	47513023...	50
9	RIVER - Ril...	Ward 16	Quartier 16	16	RIVER	RIVIÃ"RE	Riley Brock...	River	RiviÃ"re	16	32244.191...	26892629...	64
10	CAPITAL -...	Ward 17	Quartier 17	17	CAPITAL	CAPITALE	David Cher...	Capital	Capitale	17	19243.225...	10961789...	79
11	KITCHISSI...	Ward 15	Quartier 15	15	KITCHISSI...	KITCHISSI...	Jeff Leiper	Kitchissippi	Kitchissippi	15	16441.444...	15130226...	70
12	GLOUCES...	Ward 10	Quartier 10	10	GLOUCES...	GLOUCES...	Diane Deans	Gloucester...	Gloucester...	10	45788.222...	76159003...	36
13	ALTA VIST...	Ward 18	Quartier 18	18	ALTA VISTA	ALTA VISTA	Jean Cloutier	Alta Vista	Alta Vista	18	19302.220...	20433121...	65
14	STITTSVIL...	Ward 6	Quartier 6	6	STITTSVIL...	STITTSVIL...	Shad Qadri	Stittsville	Stittsville	6	22036.367...	23212974...	11
15	RIDEAU-V...	Ward 12	Quartier 12	12	RIDEAU-V...	RIDEAU-V...	Mathieu Fl...	Rideau-Va...	Rideau-Va...	12	15172.590...	7951860.2...	255
16	RIDEAU-R...	Ward 13	Quartier 13	13	RIDEAU-R...	RIDEAU-R...	Tobi Nussb...	Rideau-Ro...	Rideau-Ro...	13	25921.094...	19838707...	70
17	INNES - Jo...	Ward 2	Quartier 2	2	INNES	INNES	Jody Mitic	Innes	Innes	2	33018.165...	40385597...	23
18	ORLÃ%A...	Ward 1	Quartier 1	1	ORLÃ%A...	ORLÃ%A...	Bob Monette	OriÃ@ans	OriÃ@ans	1	29237.165...	25385948...	39
19	CUMBER...	Ward 10	Quartier 10	10	CUMBER...	CUMBER...	Stephen Bl...	Cumberland	Cumberland	10	98704.871...	27082656...	21

- 7) The new Count file is temporary, so save the Count file as a shapefile

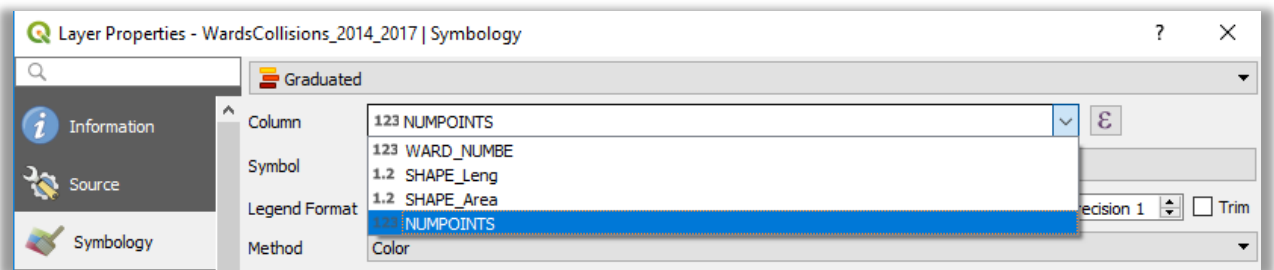


- 8) Once the shapefile is in your layers list, you can open the attribute table to view the number of pedestrian collisions in each ward in the NUMPOINTS column. Click the column title to sort the values in ascending and descending order:

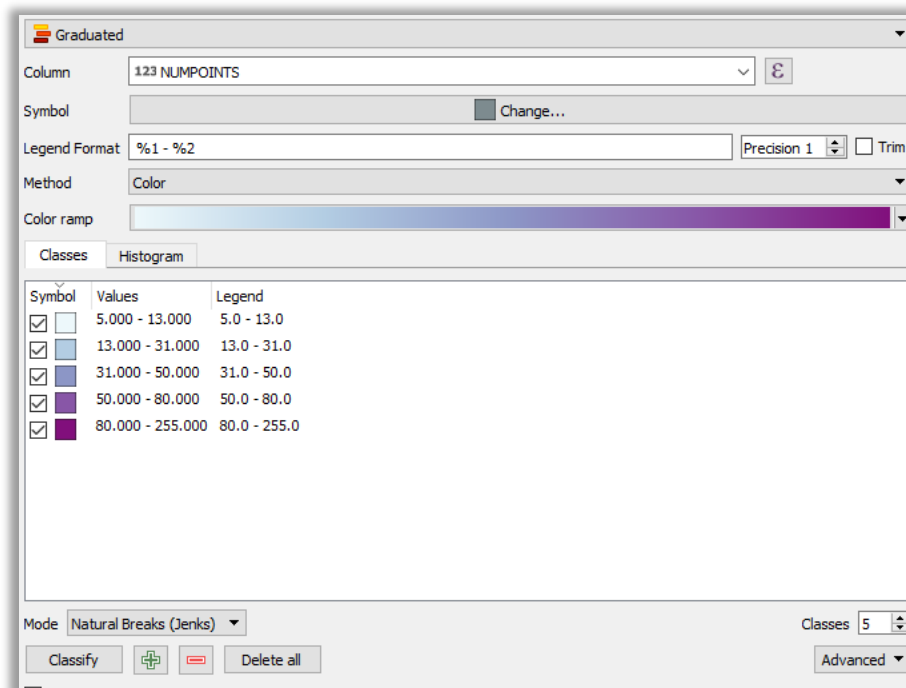
	WARD_NUM	WARD_EN	WARD_FR	COUNCILLOR	WARD_NAME_	WARD_NAME1	WARD_NUMBE	SHAPE_Leng	SHAPE_Area	NUMPOINTS
1	19	CUMBERLAND	CUMBERLAND	Stephen Blais	Cumberland	Cumberland	19	98794.87109299...	379836566.8330...	31
2	21	RIDEAU-GOULBOURN	RIDEAU-GOULBOURN	Scott Moffatt	Rideau-Goulbourn	Rideau-Goulbourn	21	131359.0582559...	736559935.9429...	13
3	2	INNIES	INNIES	Jody Mitic	Innes	Innes	2	33018.16531850...	40385597.67400...	23
4	1	ORLÉANS	ORLÉANS	Bob Monette	Orléans	Orléans	1	29237.16511280...	25385948.95899...	39
5	3	BARRHAVEN	BARRHAVEN	Jan Harder	Barrhaven	Barrhaven	3	29730.22406310...	26227247.18210...	27
6	14	SOMERSET	SOMERSET	Catherine McKenney	Somerset	Somerset	14	11458.28432370...	6380164.708669...	239
7	5	WEST CARLETON-MARCH	WEST CARLETON-MARCH	Eli El-Chantry	West Carleton - March	West Carleton - March	5	122388.2169830...	765569539.7890...	5
8	20	OSGOODE	OSGOODE	George Darouze	Osgoode	Osgoode	20	105838.7423210...	463561580.8949...	8
9	11	BEACON HILL-CYRVILLE	BEACON HILL-CYRVILLE	Tim Tierney	Beacon Hill-Cyrville	Beacon Hill-Cyrville	11	26012.65108430...	19598778.37480...	48
10	23	KANATA SOUTH	KANATA-SUD	Allan Hubley	Kanata South	Kanata-Sud	23	19871.78583090...	16418739.58819...	30
11	7	BAY	BAIE	Mark Taylor	Bay	Baie	7	39722.03234710...	64174613.78869...	80
12	4	KANATA NORTH	KANATA-NORD	Marianne Wilkinson	Kanata North	Kanata-Nord	4	25997.77003750...	24235080.59530...	25
13	9	KNOXDALÉ-MERIVALE	KNOXDALÉ-MERIVALE	Keith Egli	Knoxdale-Merivale	Knoxdale-Merivale	9	36533.31687420...	47513023.65839...	50
14	8	COLLEGE	COLLÈGE	Rick Chiarelli	College	Collège	8	40055.35718350...	46077373.44680...	70
15	22	GLOUCESTER-SOUTH NEPEAN	GLOUCESTER-NEPEAN-SUD	Michael Qaagsh	Gloucester-South Nepean	Gloucester-Nepean-Sud	22	45545.49608820...	37013497.11969...	22
16	15	KITCHISSIPPI	KITCHISSIPPI	Jeff Leiper	Kitchissippi	Kitchissippi	15	16441.44468520...	15130226.04890...	70

6. Symbolizing the wards with pedestrian collisions

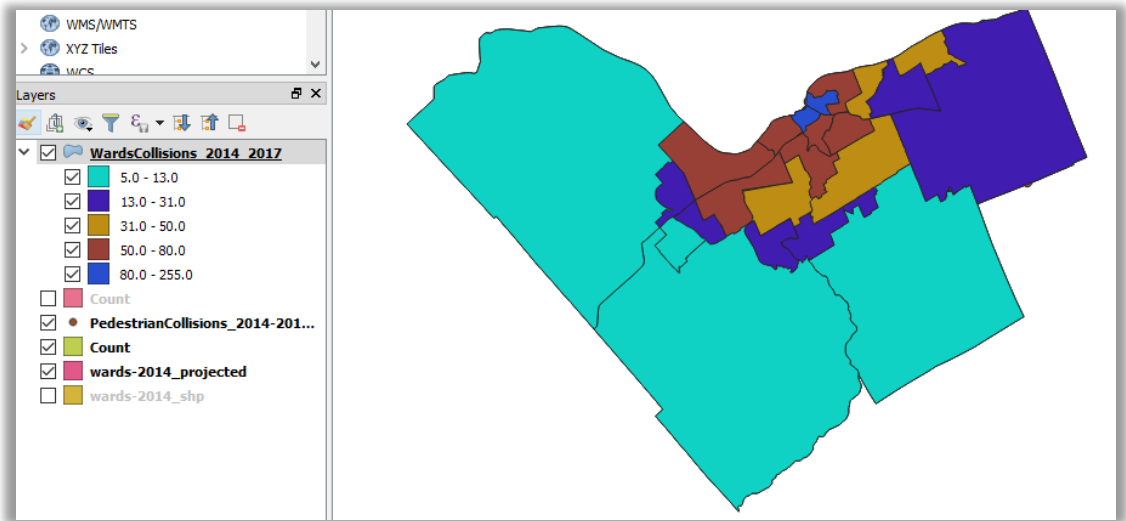
- 1) To symbolize based on number of pedestrian collisions, right-click on the **WardCollisions_2014_2017** shapefile and select **Properties**.
- 2) Click the **Style** tab in the Layer Properties dialog box.
- 3) Click **Graduated** in the drop-down box at the top
- 4) For Column, select **NUMPOINTS**



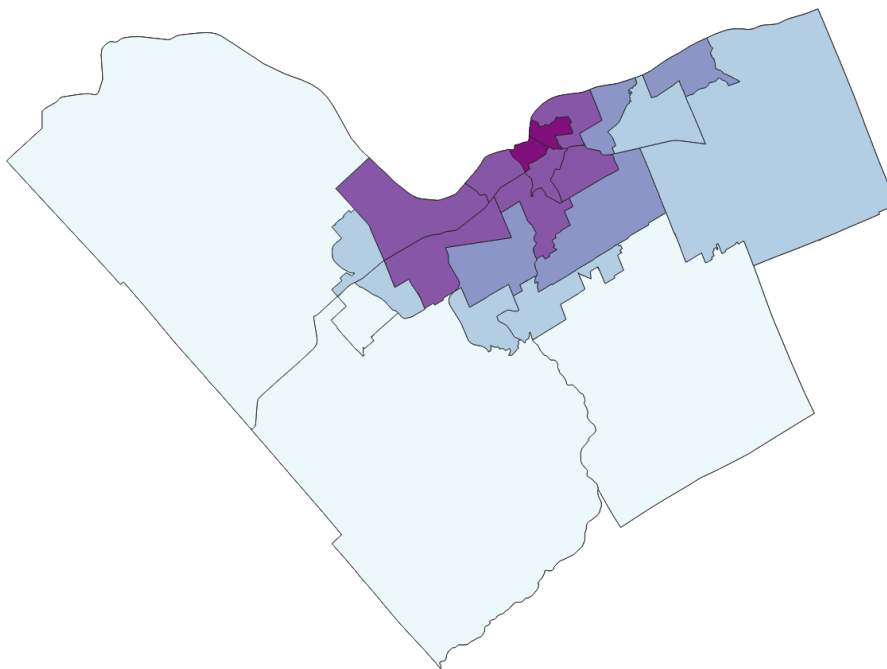
- 5) Select a colour ramp, then click the **Classify** button
- 6) It should be filled in as you see below: (NOTE: depending on your version of QGIS, your dialog box may look slightly different.)



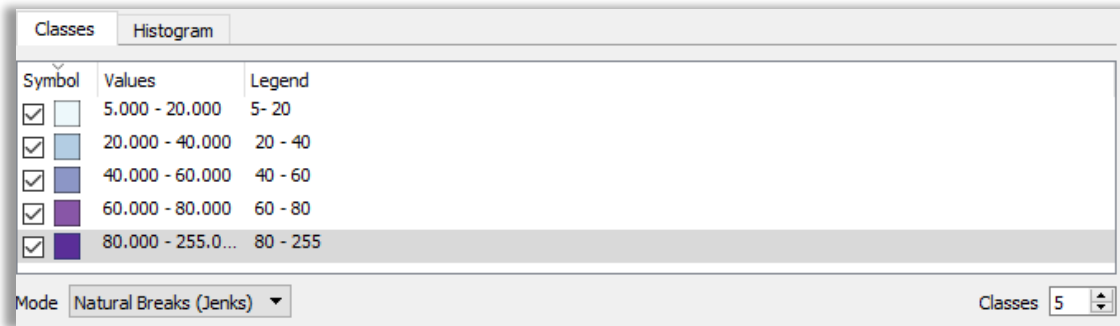
- a. Under the **Classes** tab, Mode should be **Natural Breaks (Jenks)** with 5 classes
 - i. You can play around with this if you'd like
- b. Pick your favourite colour ramp. As you are showing intervals, go with something that's the same hue, but with varying intensity. If you go with a many-coloured ramp your map becomes meaningless, like so:



7) Your on-screen map should now look something like this, with the darker hues showing us which wards have higher and lower counts of pedestrian collisions.

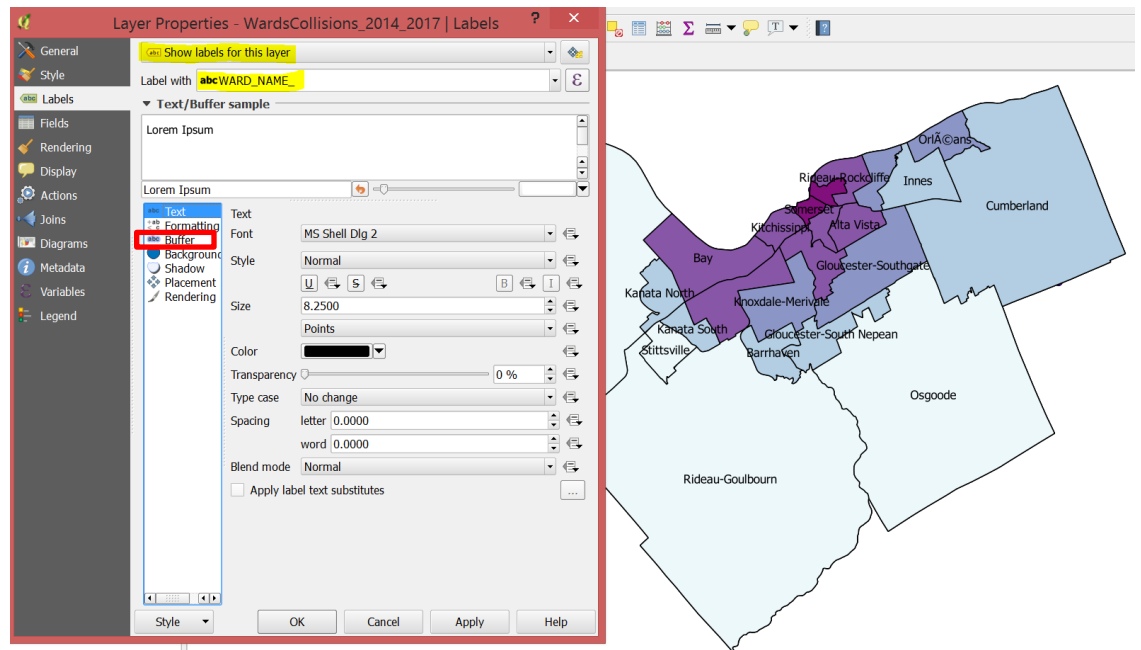


8) You can also manually adjust the intervals. For example, you can set the classes to 5 and then edit the values to reflect rounder numbers, like so:

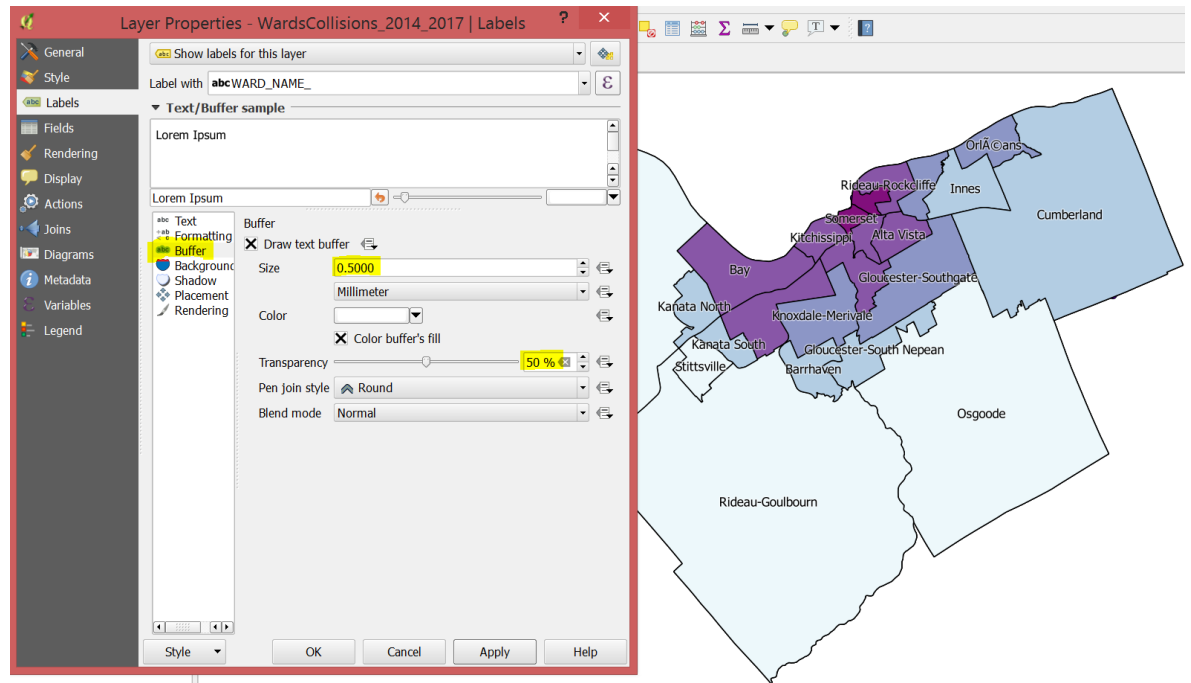


You can also edit the legend text, as you can see above (eliminated decimal points).

- 9) Adding labels is also done in Properties. Click the Labels tab and include the following settings:
 - a. Show labels for this layer (top dropdown)
 - b. Label with: WARD_NAME_
 - c. Click Apply



- 10) You'll notice that the labels can be hard to read. There are multiple ways to make labels easier to read but for this example, we'll add a text buffer:
 - a. Click the Buffer icon below Text (middle left of the Properties > Style dialog box)
 - b. Check Draw text buffer
 - c. Size: 0.5 millimeters
 - d. Color: white (default)
 - e. Transparency: 50%
 - f. Click Apply

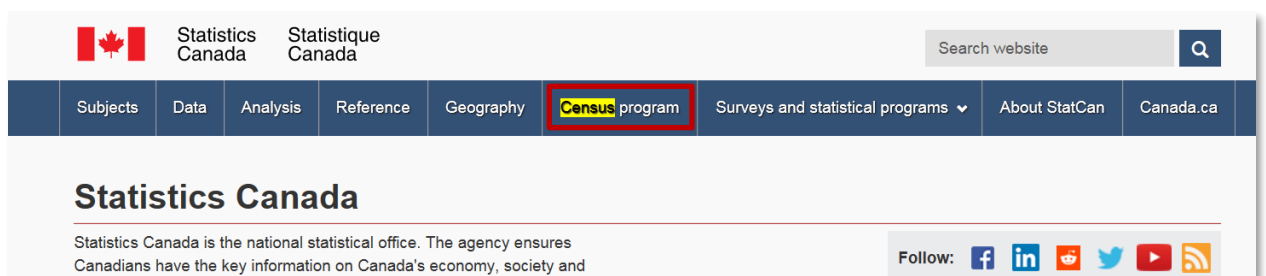


11) There are dozens of settings, but this is a good start until we create our map layout later on.

7. Download Federal Electoral District shapefile and add to map document

338 Federal Electoral Districts (FEDs) cover all of Canada and can be useful when looking at the whole country in smaller pieces than provinces and territories, but still are a reasonable number to deal with. Each FED is an area represented by one Member of Parliament. The data is downloaded as a shapefile which can then be viewed in QGIS.

- 1) In an internet browser, go to statcan.gc.ca.
- 2) After you've selected English, click **Census program** tab in the horizontal menu bar at the top

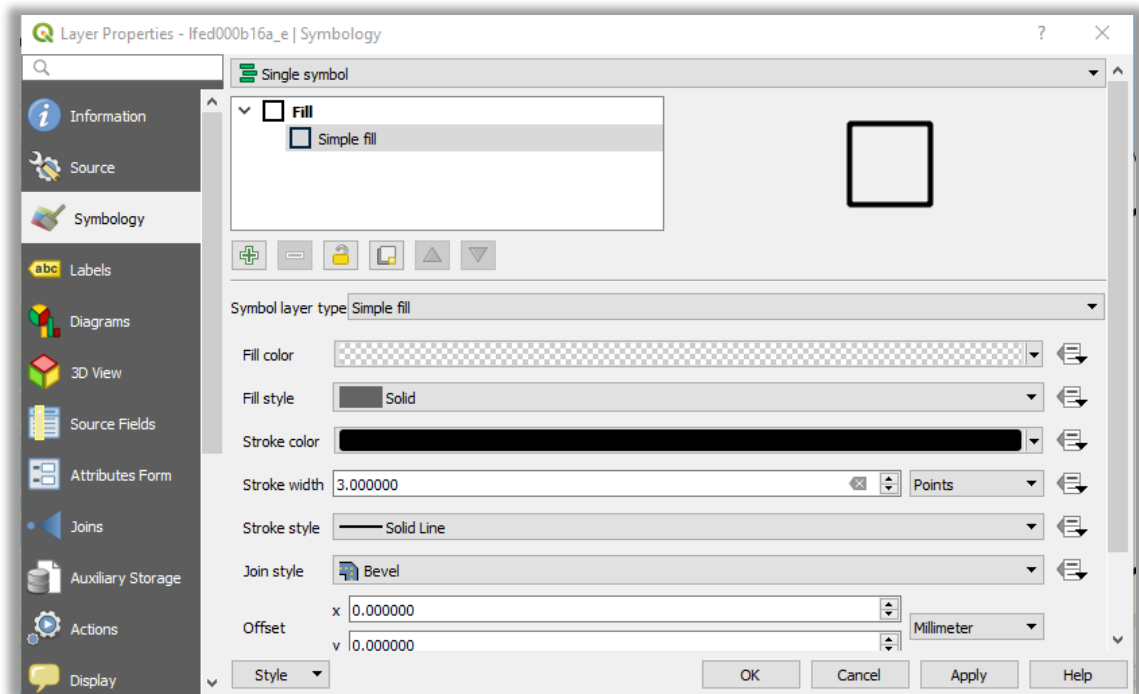


- 3) Scroll down and under Information and services, click on **Geography**
- 4) Scroll down to Spatial information products and click **Boundary files**
- 5) In Boundary files options, select **English** and **ArcGIS (.shp)** format
- 6) Select census year 2016
- 7) Click the radio button for **Federal electoral districts (2013 Representation Order)** and **Cartographic Boundary File**, and then the **Continue** button
- 8) Click the **Ifed000b16a_e.zip (ZIP version, 32,065.0 kb)** link

9) Unzip it and add the “.shp” to QGIS

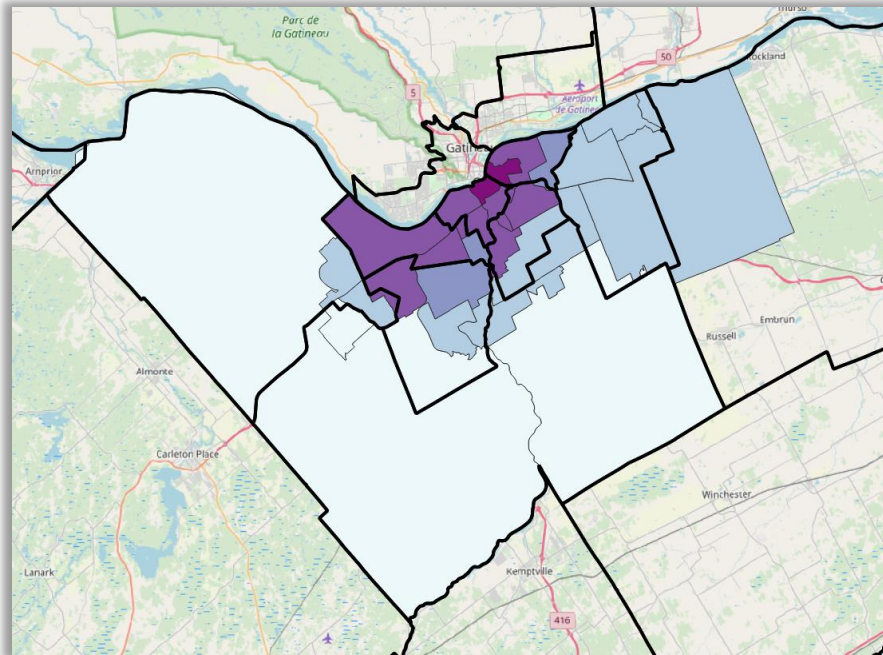
10) To see only the borders of the FEDs so you can view what areas are within them, we'll use the following symbology:

- a. Keep the Ifed000b16a_e file at the top of the layer list
- b. Right-click the layer and select Properties
- c. In the Styles tab, keep the Single symbol and Simple fill
- d. Click on Simple Fill. New options will appear below.
 - i. Fill color: check the Transparent Fill box at the top
 - ii. Stroke color: select whichever colour you'd like
 - iii. Stroke width: 3 and select Points in the drop-down menu



e. Click Apply

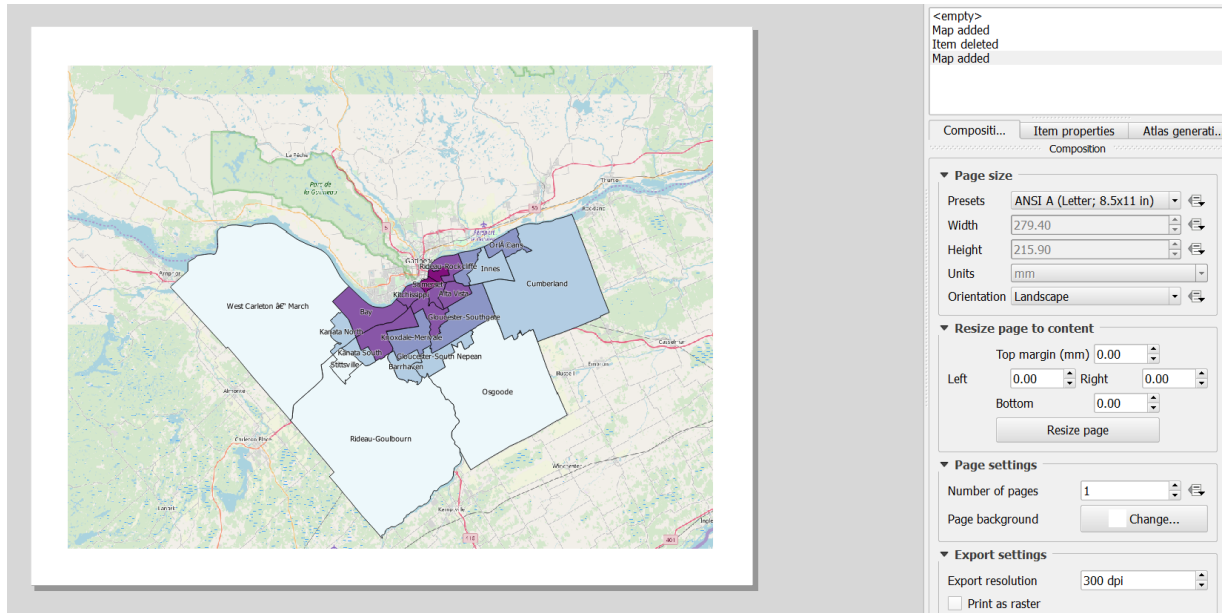
f. You should now have fairly thick borders indicating where the FED boundaries are.



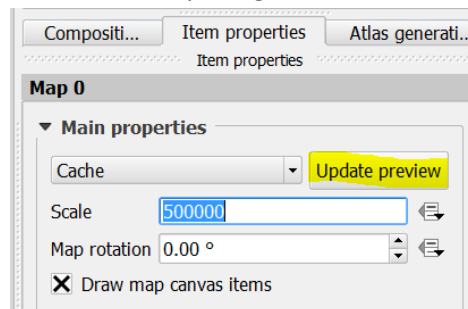
8. Creating a Map Layout

To create a map layout in QGIS, you need to make a Composer. This will enable you to place and arrange map elements such as scale bar, a legend, and a map title.

- 1) Start off by right-clicking the layer you want to create a layout for, and select **Zoom to layer**.
- 2) In the menu, select **Project > New Print Composer**.
- 3) In the Composer title dialog box, give your new composition a name. Click **OK**.
- 4) A new Composer window will appear. Under Page size > Presets, find and select ANSI A (Letter; 8.5x11 in)
- 5) To add your map of wards and pedestrian collisions, click **Layout > Add Map**, then draw a box that is just inside the perimeter of the page.





- 6) Under Item Properties tab, under Extents, click the **Set to map canvas extent** button to centre the layer.
- 7) If the wards are either too large or too small for your liking, fiddle with the **Scale** under **Item properties** on the right.
 - a. A larger number will make the wards smaller and a smaller number will make the wards larger.
- 8) The QGIS composer is remarkably finicky. Maneuver (including deleting and re-adding) the map around until you're reasonably satisfied.
- 9) The labels we added earlier may also become an issue: some aren't showing, they're too small, etc. You can go back and forth from the Composer and the main QGIS map window to adjust the Properties and finesse the labels.
 - a. If you make any changes, you need to go to **Item Properties > Update Preview** to refresh the map image



Adding Other Map Elements

Adding a Legend

1. In the menu, select **Layout > Add Legend**.
2. Draw a box where you would like your legend to appear.

- By default, all the layers on the map will appear as legend items in the legend.
- To remove a legend item, you need to **uncheck the Auto update checkbox** and then manually remove the layers you don't want in your legend using the red minus button. 
- To change the name of a legend item as it shows up in the legend, click the legend item and then the **Edit** button to change its title in the legend. 
- If you would like to change the title of your legend (or prefer that it doesn't have a title at all), change it in the Title textbox under **Main properties**.
- There are a lot of options in the Legend panel, from font selections to spacing to background colour.
- You can click and drag the legend into place on your map.

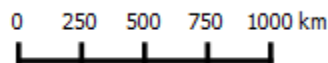
Adding a North Arrow

- In the menu, select **Layout > Add Image**.
- Draw a box where you would like to see your north arrow.
- In the **Item properties** panel on the right, click on the **Search Directories** submenu, and under **Image search paths** find the one ending in **/arrows**.
- Select an arrow that meets your needs. You could always design your own if you feel creative, or just go for a Star Trek vibe (never a bad idea):



Adding a Scale Bar

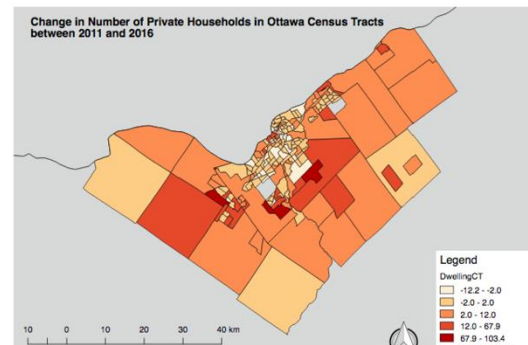
- In the menu, select **Layout > Add Scalebar**.
- Draw a box where you would like to see the scale bar.
- In the Item properties tab, you can select one of six styles under the **Style** dropdown.
- Choose the units for the scale bar under **Units**.
- Adjust the segments in the **Segments** area.
 - E.g.: left 0 and right 4 on a Line Ticks Up style will look something like this:



- Click and drag the scale bar into place on your map.

Adding a Title to a Map

- In the menu, select **Layout > Add Label**.
- Draw a box where you'd like your title to be (you can move it later).
- Type your title into the **Main properties** text box.
- Adjust the font as you see fit and move it around until you resign yourself to the lack of design elements included in QGIS.



This is not a very pretty map. You can make a nicer one.

