Introduction to QGIS (version 2.18) and Geoprocessing using the Census of Canada

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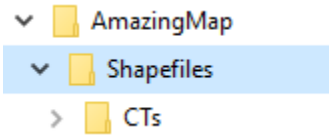
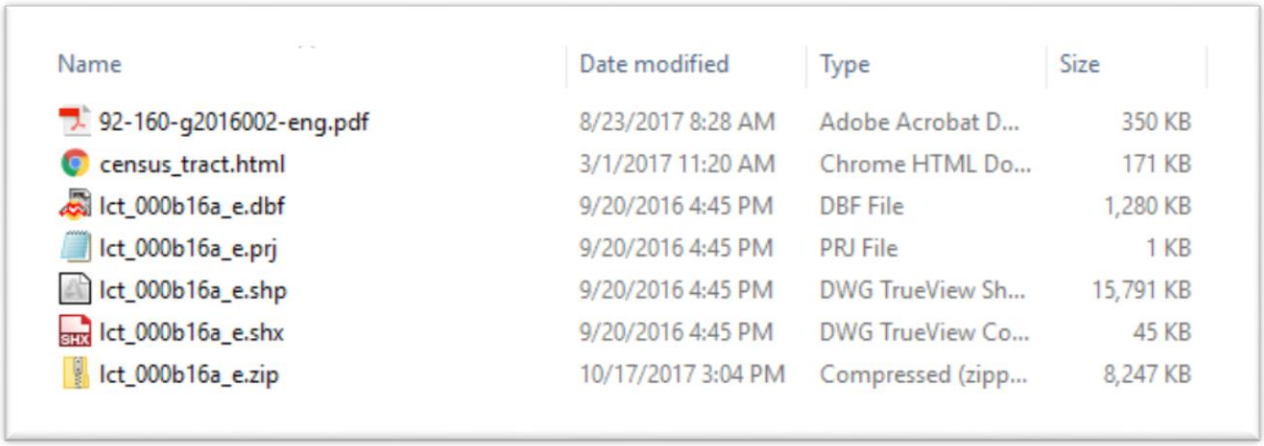
1. Download Census Tracts shapefile and add to map document

Census Tracts (CTs) are geographic areas in Census Metropolitan Areas (CMAs) that have a population of 2500-8000. 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*** in the menu bar
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 ***Census tracts*** and ***Cartographic Boundary File*** then the ***Continue*** button
8) Click the ***lct_000b16a_e.zip (ZIP Version, 8247.0 kb)*** link
9) 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:



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



Name	Date modified	Type	Size
92-160-g2016002-eng.pdf	8/23/2017 8:28 AM	Adobe Acrobat D...	350 KB
census_tract.html	3/1/2017 11:20 AM	Chrome HTML Do...	171 KB
lct_000b16a_e.dbf	9/20/2016 4:45 PM	DBF File	1,280 KB
lct_000b16a_e.prj	9/20/2016 4:45 PM	PRJ File	1 KB
lct_000b16a_e.shp	9/20/2016 4:45 PM	DWG TrueView Sh...	15,791 KB
lct_000b16a_e.shx	9/20/2016 4:45 PM	DWG TrueView Co...	45 KB
lct_000b16a_e.zip	10/17/2017 3:04 PM	Compressed (zipp...	8,247 KB

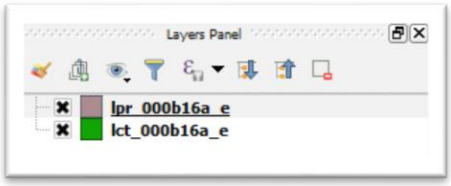
This is as good a time as any to note that shapefiles look like multiple different files when you view them in Windows Explorer. If you ever copy and paste them somewhere, you need to have all the parts (e.g.: all the files that have the same name before the file extension – there may be

up to 8 of them). For more on shape files, please consult pages 121 and 148 of The Data Journalist.

12) You're done the download!
13) 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.
    a. You could also have the project folder open in Windows Explorer and just drag and drop the .shp file in. Either way works!
14) You'll notice that much of the country is missing – this is normal! Remember that census tracts are only in cities with a population of over 100,000.

15) 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.
16) Because we will want our map to look reasonably nice, let's follow steps 1-13 except download the ***Provinces/territories, Cartographic Boundary File*** and unzip it and add it to QGIS. Your map should now look something like this:

17) If you're wondering why the census tracts seem to have disappeared, it's because that layer is below the provinces/territories layer in the Layers Panel:



18) Click and drag **lct_000b16a_e** above the provinces/territories layer to view it on top. The layers always show top to bottom. You can also turn the layers on and off with the checkbox.

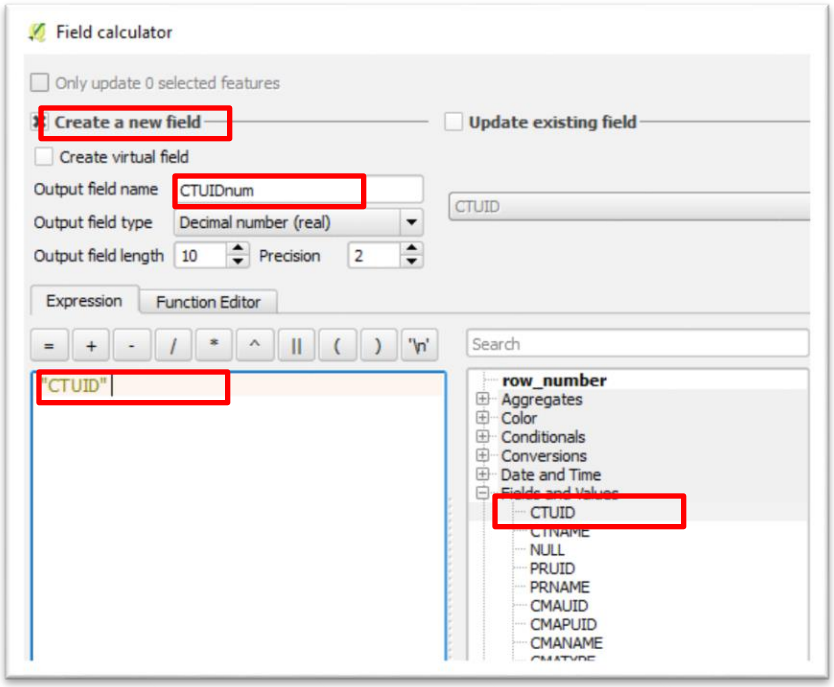
2. Ensuring the data can be joined

In order to join the **CT** shapefile and the **CT data text files**, ***we need to have a field that includes identical data***. For example, it's not possible to join a text (string) field to a number field. Specifically, in this case, the CT identification numbers have decimals (.00, .01, etc.) and those are critical. ***We need to make sure those fields are both numeric and have 2 decimal places for each entry***.

1) Right-click the **lct_000b16a_e** shapefile and select ***Properties***, then click the ***Fields*** tab
2) Note that the CTUID field is type QString. This means it's a text field and we want it to be a numeric field.

3) Click the **Open field calculator** button
    a. Make sure **Create a new field** is checked
    b. In **Output field name**, enter **CTUIDnum**

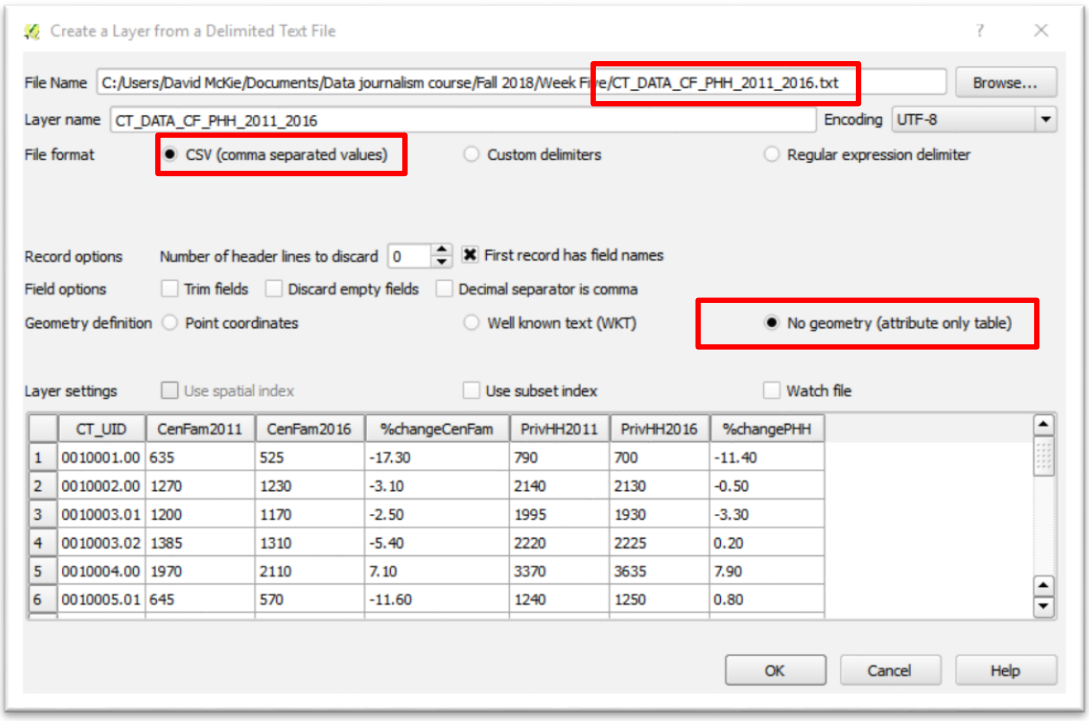
c. **Output field type** needs to be Decimal number (real)
d. **Output field length** is 10, **Precision** is 2
    i. Length is how many digits are in the number, and precision is how many digits appear after the decimal; we want .00 to show up for whole numbers so we'll force that precision by giving it a value of 2



e. In the Expression area, click **Fields and Values** and then double-click **CTUID**
f. Click OK

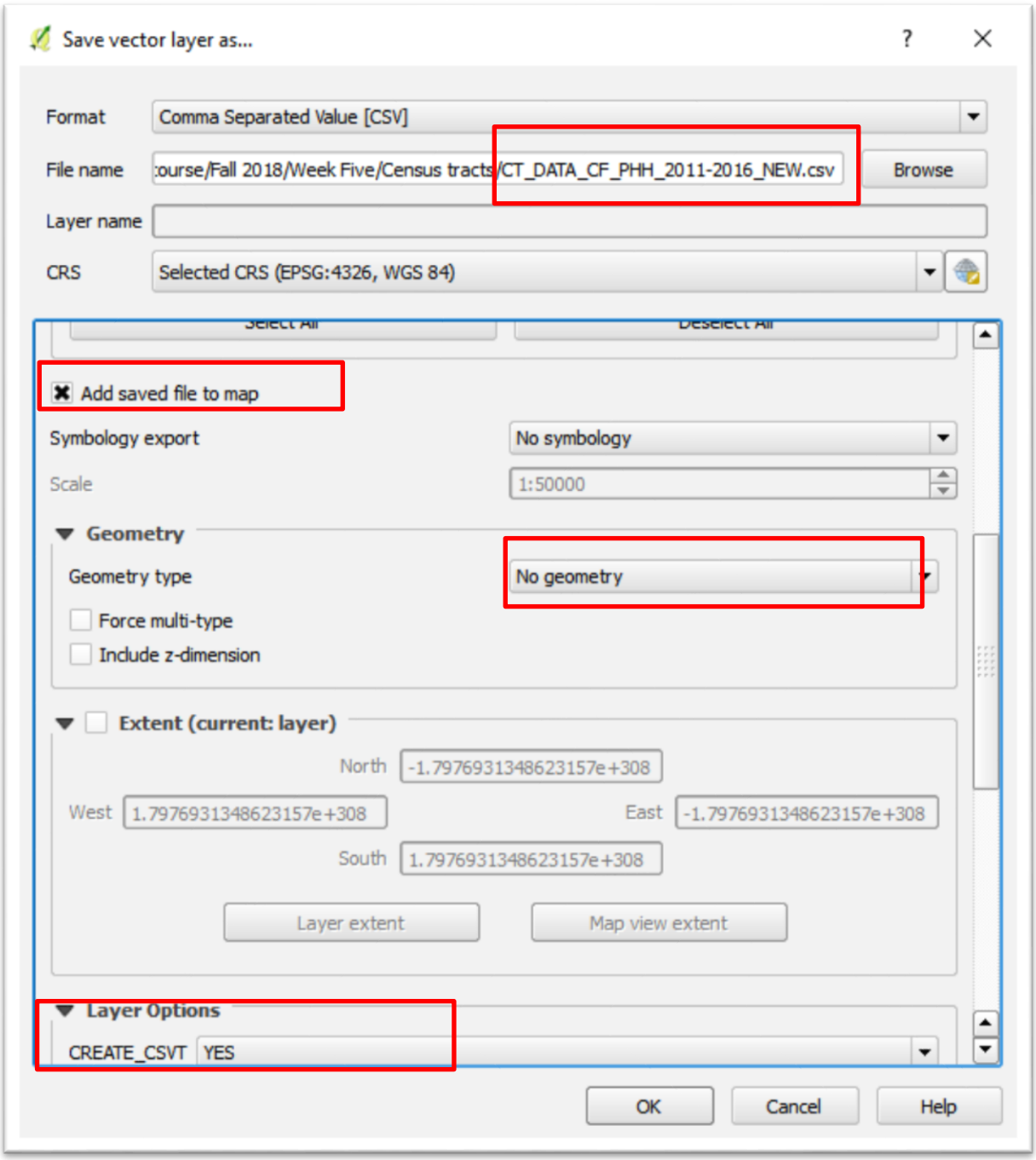
4) In the list of fields, you should see a new field on the bottom called CTUIDnum
5) Click **Toggle editing mode (pencil icon)** to stop editing and close the attribute table – this may take a few moments. Also, be sure to save the entire project after each step.
6) Now, we need to do the same thing for **"CT_DATA_CF_PHH_2011_2016.txt"** file which can be downloaded from a zipped folder by clicking **here**. Before moving to the following step, it's worth cautioning that working with this file is a bit more involved.
7) In QGIS, go to **Layer > Add Layer > Add Delimited Text Layer**
8) Browse to the file in the "**CT_DATA_CF_PHH_2011_2016.txt"**
    a. File format: CSV
    b. Geometry definition: No geometry (attribute table only)
    c. Click OKAY. When the file shows up in the Layers window, close the delimited text dialog box.

d.

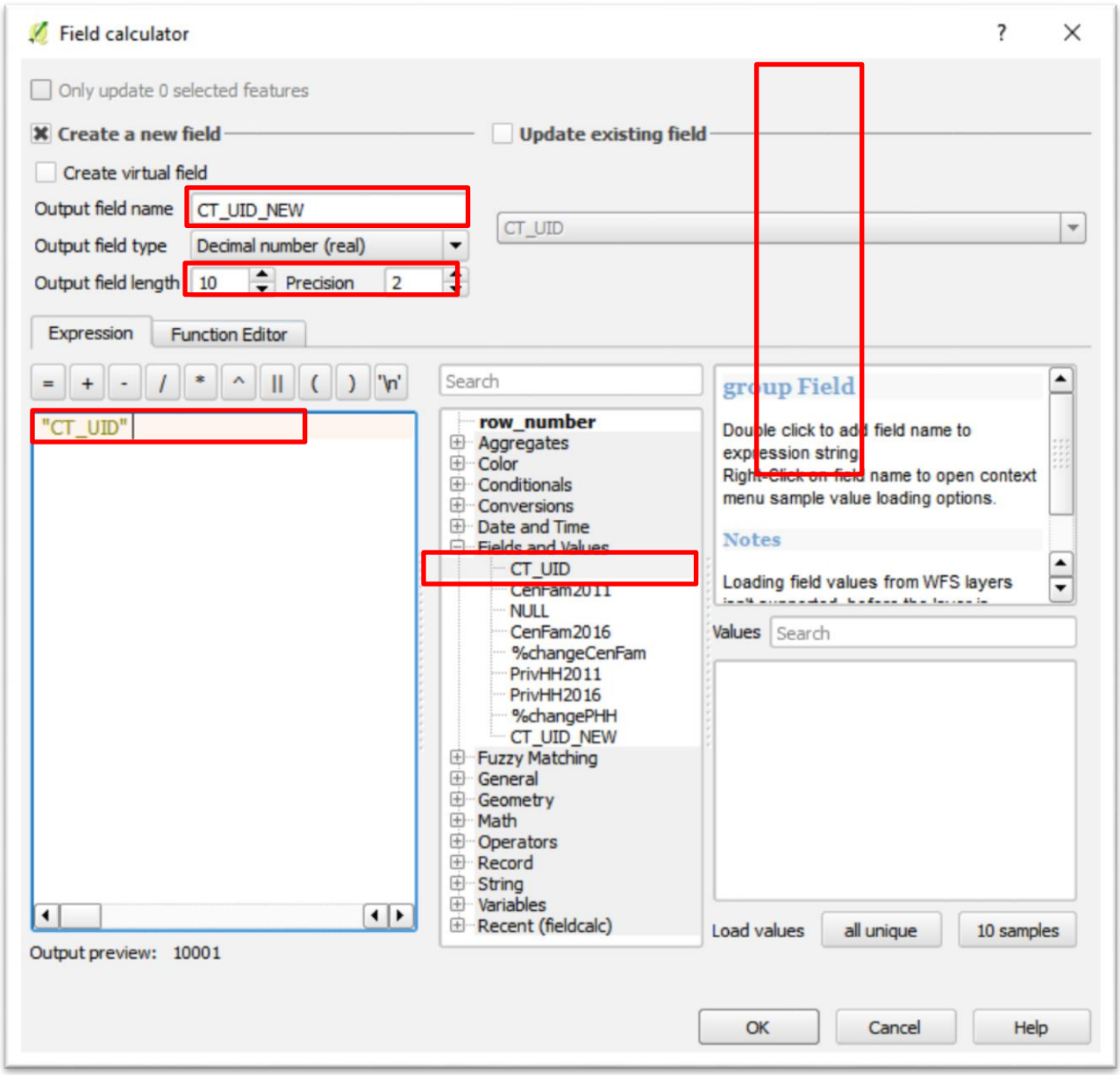


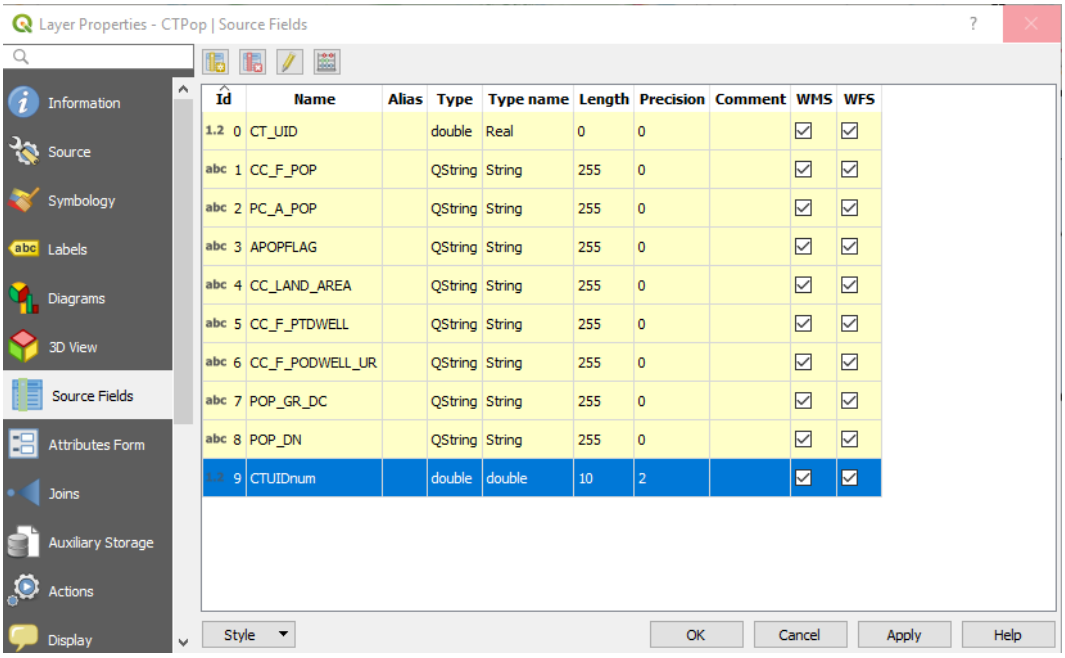
In order to reformat the ID column, as we did in steps 1-5, we must export this file by following the next steps:

9) To export to CSV, right-click on **CT_DATA_CF_PHH_2011_2016.txt > Export > Save features as…**
   a. Format: Comma Separated Value
   b. File name: **CT_DATA_CF_PHH_2011_2016.txt_New**.csv
   c. Rename the file to something like "DwellingCounts_2016_forQGIS"
   d. Click the arrow beside **Select fields to export and their export options** and choose which fields you'd like to export. In this case, we can keep all of them.
   e. **The Add saved file to map** option should already be selected, if not, do so.
   f. Click the arrow beside **Geometry** and in the drop-down list, select **No Geometry**
   g. Use the vertical scroll bar to the right to obtain "Layer options"
   h. At the "**CREATE_CSVT" prompt, select "YES"**
   i. See image below to ensure you've selected the correct options, then click OK



10) Delete the old txt file from your menu, and open the attribute table for **your new csv file.**
11) Repeat steps 1-5, except you want to copy the values in the **CT_UID** field, so the result should look like this.


Field calculator
Only update 0 selected features
Create a new field
Update existing field
Create virtual field
Output field name
CT_UID_NEW
Output field type
Decimal number (real)
Output field length
10
Precision
2
CT_UID
Expression
Function Editor
= + - / * ^ || ( ) '\n'
"CT_UID"
Search
row_number
Aggregates
Color
Conditionals
Conversions
Date and Time
Fields and Values
CT_UID
CenFam2011
NULL
CenFam2016
%changeCenFam
PrivHH2011
PrivHH2016
%changePHH
CT_UID_NEW
Fuzzy Matching
General
Geometry
Math
Operators
Record
String
Variables
Recent (fieldcalc)
group Field
Double click to add field name to expression string
Right-Click on field name to open context menu sample value loading options.
Notes
Loading field values from WFS layers
Values
Search
Load values
all unique
10 samples
Output preview: 10001
OK
Cancel
Help



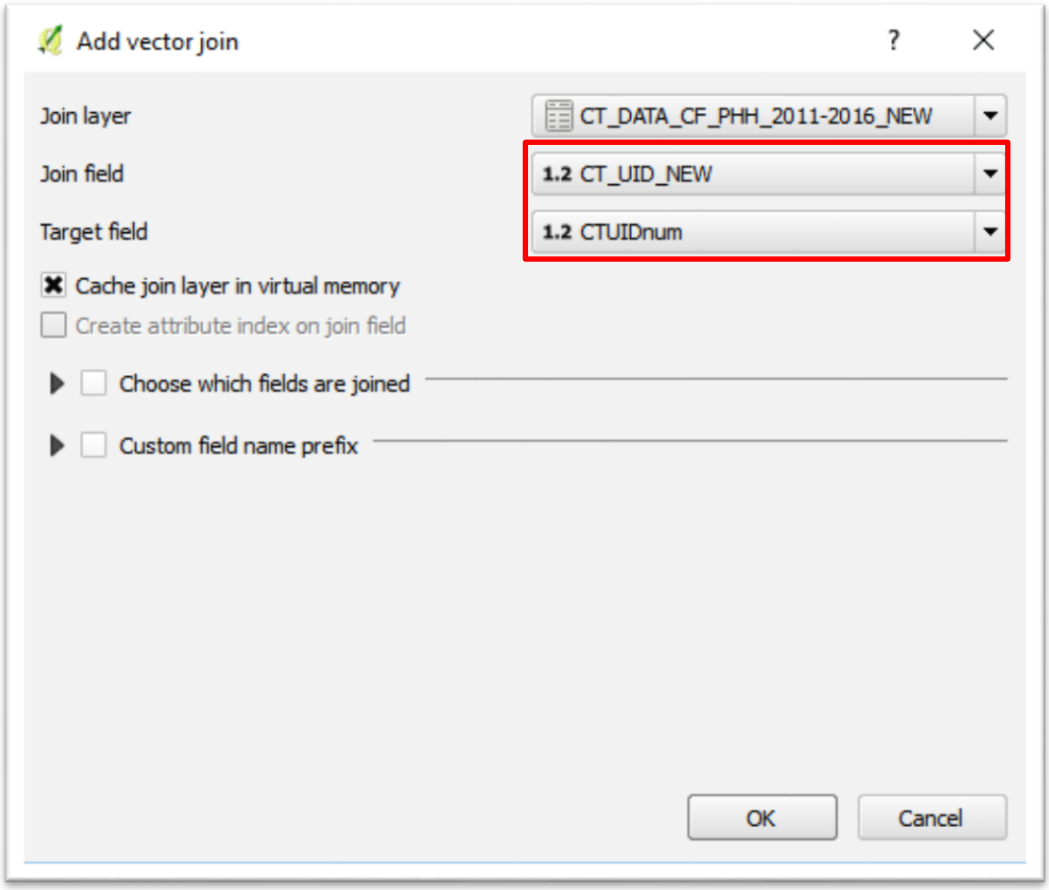
12) Toggle the Edit button (remember, it may take a few moments to process) and close the Properties dialog box.

3. Joining Census Data

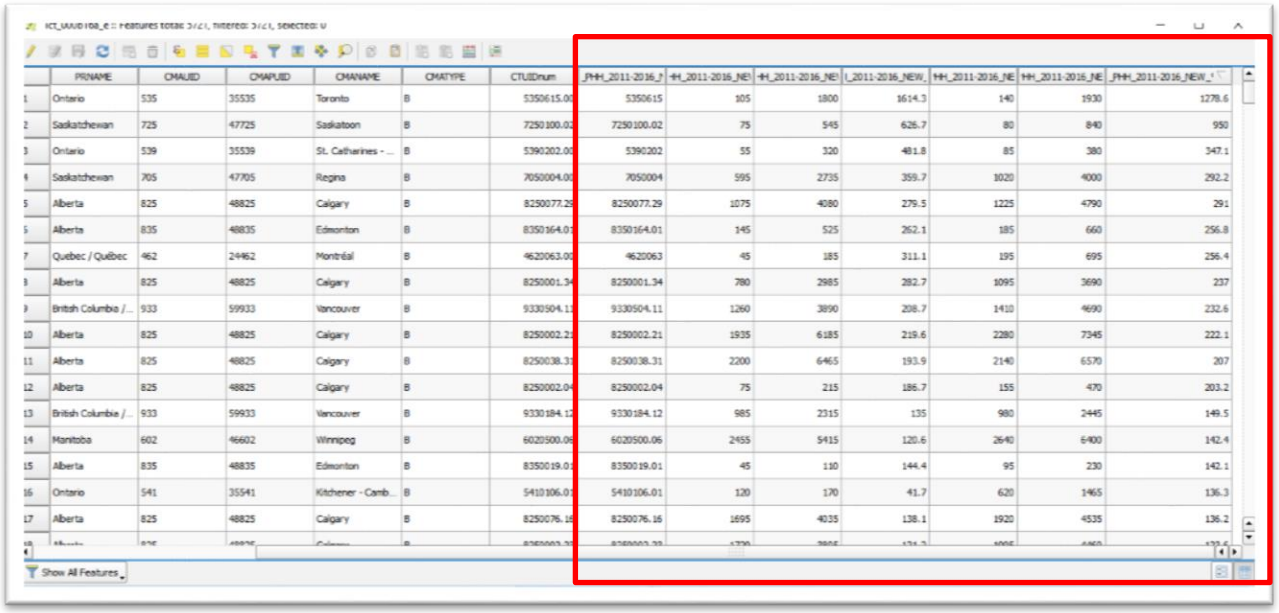
We're at the most critical point! Attention to detail is key.

1) Right click on the **lct_000b16a_e** polygon file and select **Properties**.
2) Click Joins, then click the green plus sign
3) Ensure that join of the table data to the polygon is based on a common field. In this case, it's **CT_UID_NEW** and **CTUIDnum** which are the unique census tract identification numbers that we

just made sure are numeric and have all the required decimal places.



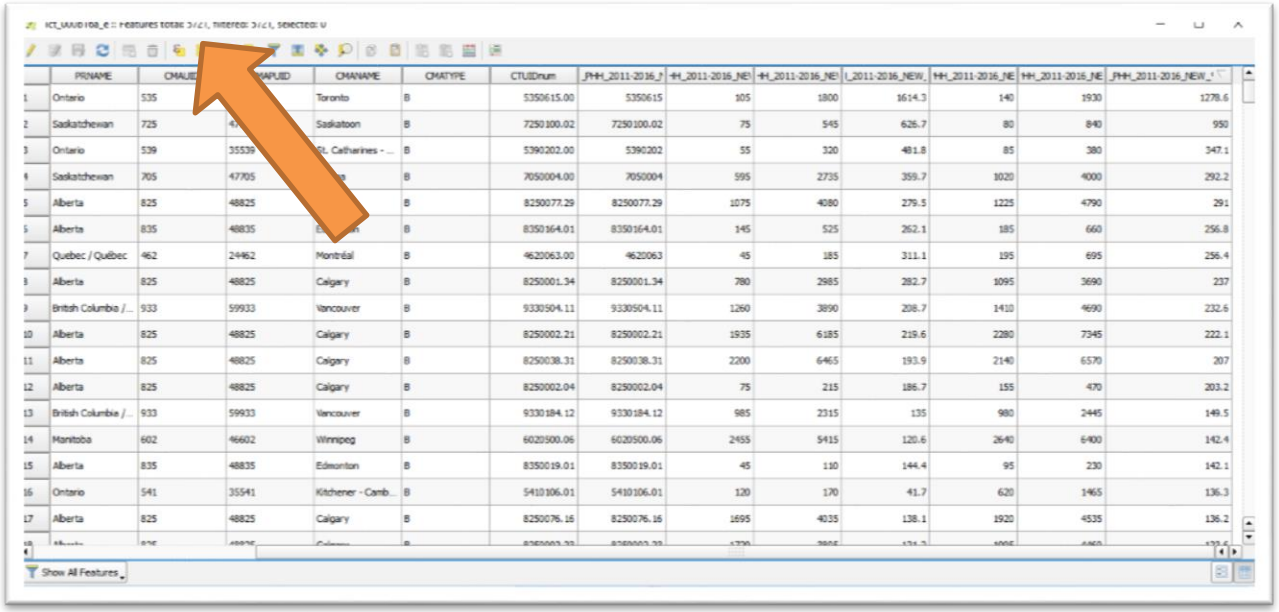
4) Check off Custom field name prefix then click the down arrow. Enter something short, like **Dw2016_**
    a. If the prefix is long, it will take up the entire field name when exported later on and it'll be difficult to tell which data the field contains
5) Click **OK**. Then **Apply**. Then **Close**.
6) Right-click on the **CT shapefile** to check that the join worked. You should see data added to the attribute table:



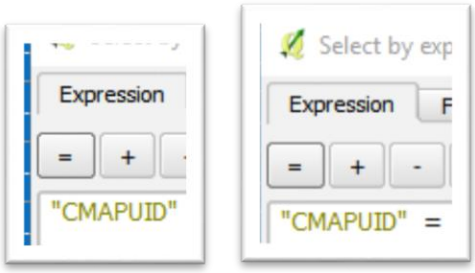
4. Querying and Extracting

When confronted with a large dataset you may want to use the querying capabilities of QGIS to extract one or more subsets.

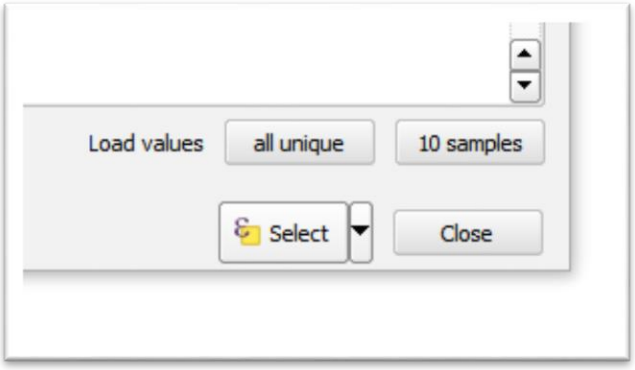
1) Right click on the ***lct_00616a_e*** and select ***Open Attribute Table***.
2) You will note that there are 5721 features in the dataset.



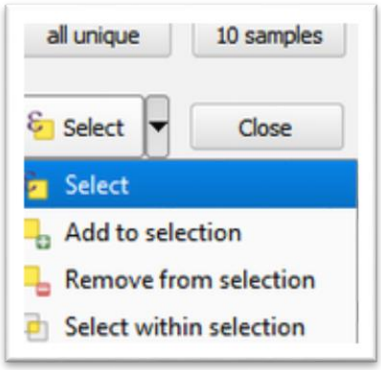
3) In order to query the data, click on the ***Select features using an expression*** button  on the attribute table toolbar.
4) The ***Select by expression*** dialog box will appear. It allows you to create a query statement that will select features that conform to the parameters you set. In this example, we will search for only ***Ottawa*** census tracts by using the ***CMAPUID*** field.
    a. Start off by making the ***Select by expression*** dialog box wider. It will make sense shortly.
    b. In the middle window, **click the + sign** beside **Fields and Values** to see all the fields in the attribute table.
    c. Double-click ***CMAPUID***. It will show up in the Expression window.



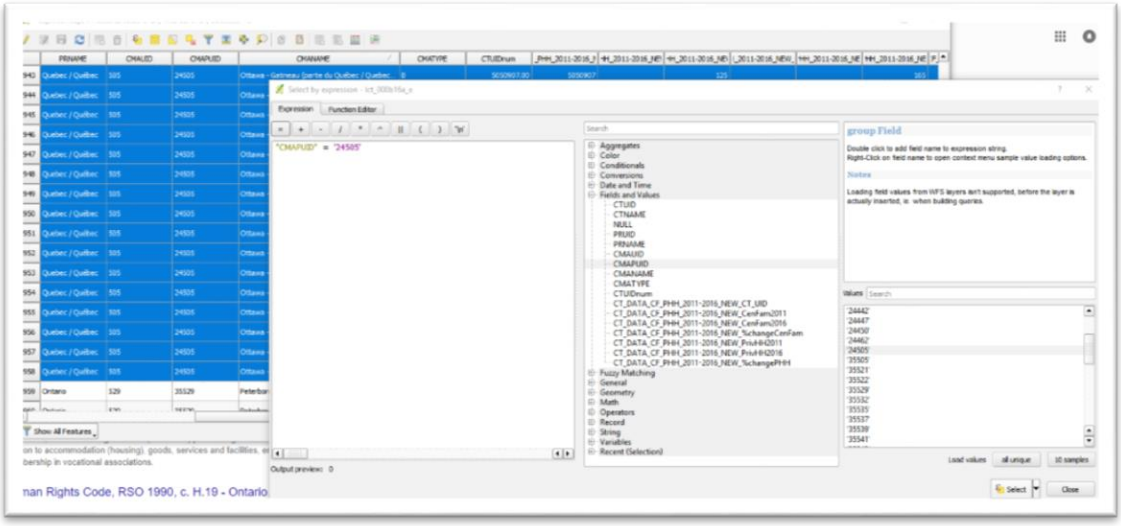
    d. Select the "="
    e. Census Metropolitan ID field for Ottawa is the number 35505
    f. On the right, beside ***Load values*** click the ***all unique*** button.



    g. ***Double-click on the number 35505 from the list.***

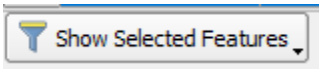


h. Click the **Select** button to the bottom right.



i. Click **Close**.

j. In the bottom left of the attribute table, you can click the Show All Features button and select Show Selected Features instead.

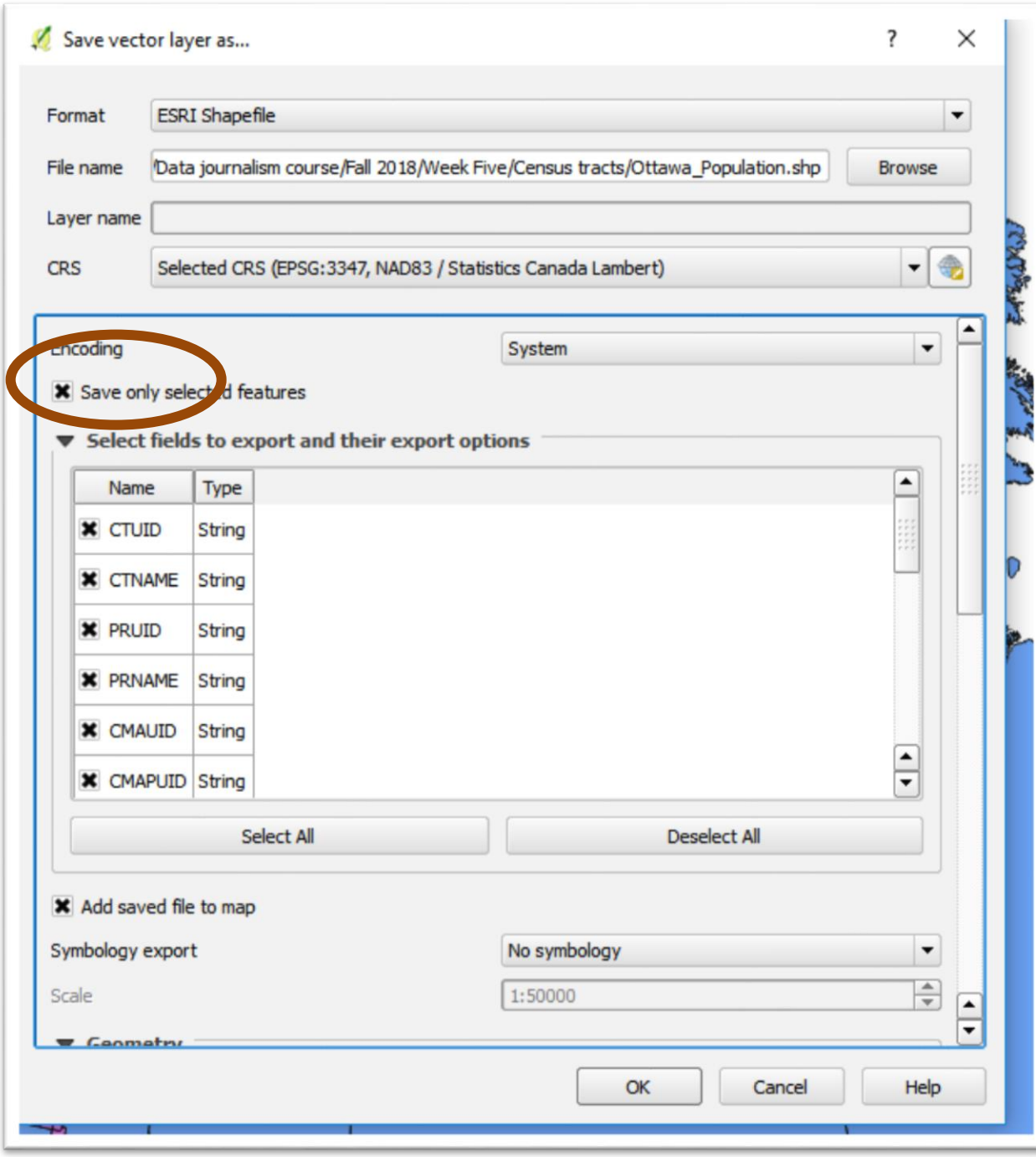


k. Close the attribute table.

5) The selected features are only temporary and we want to deal ONLY with the Ottawa CTs, so we'll export the currently-selected census tracts to a new shapefile.

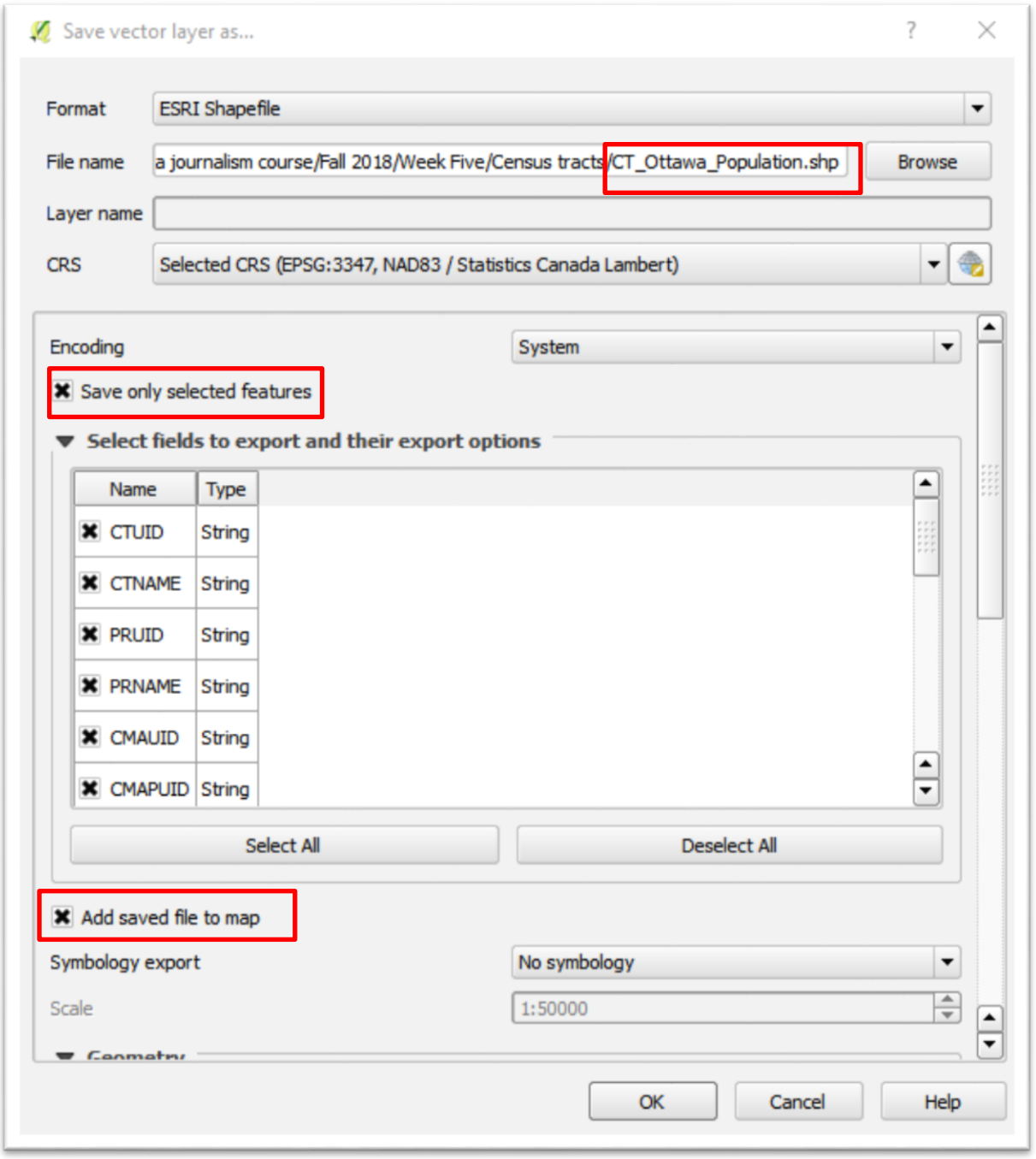
a. Right-click on ***lct_000b16a_e*** and select **Save As…** from the menu

b. **Before you do anything else**, select the ***Save only selected features*** option.



c. Browse to where you would like to save your file. We recommend naming it something helpful, such as ***CT_Ottawa_Population.shp***. Ensure that you save as type **ESRI**

Shapefile



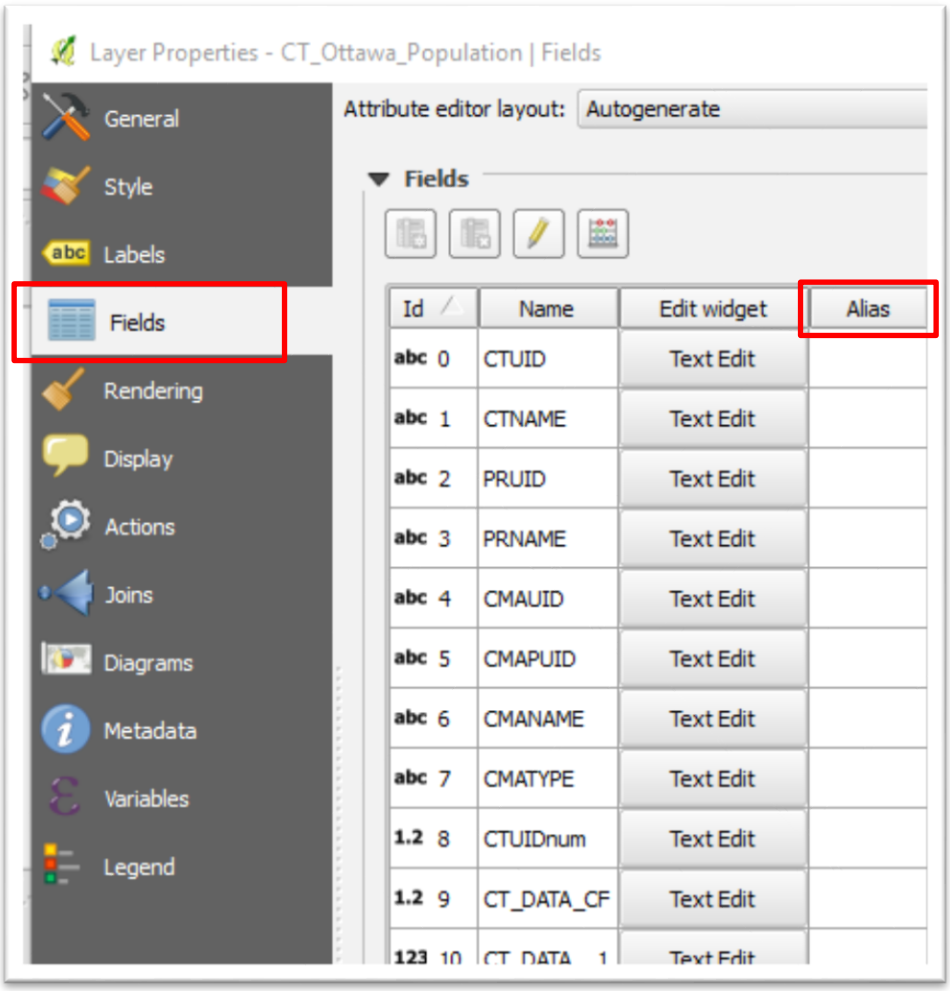
d. Click ***Save*** and then ***OK in the "Save vector layer as" dialog box***.
e. Wait a moment for it to export and add the file.
f. Right-click on ***lct_000b16a_e*** and select ***Remove***.

g. Right-click on CT_Ottawa_Population file and select ***Zoom to layer***.

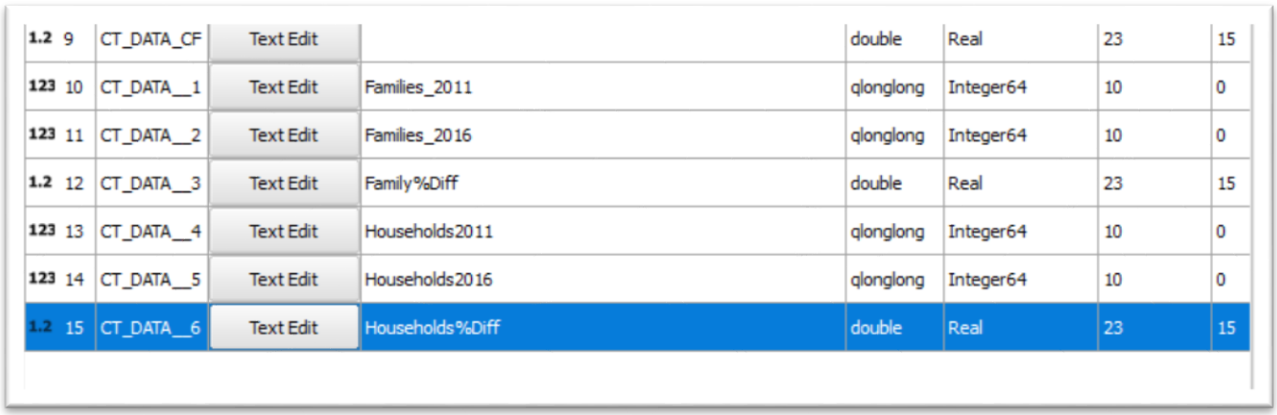
5. Creating new column heads or "aliases"

1) If you open the attribute table, you'll notice that the new layer joining the census tracts to the data has names for the columns that contain the data we will "symbolize" in the next section. This is because QGIS can't handle long titles. We could have shortened the titles in the original csv file. But we can also follow these steps to achieve the same ends.
2) If you can't remember the column names, you can use the original csv or txt file as a reference.
3) Open the new CT_Ottawa_Population layer to open the Properties option

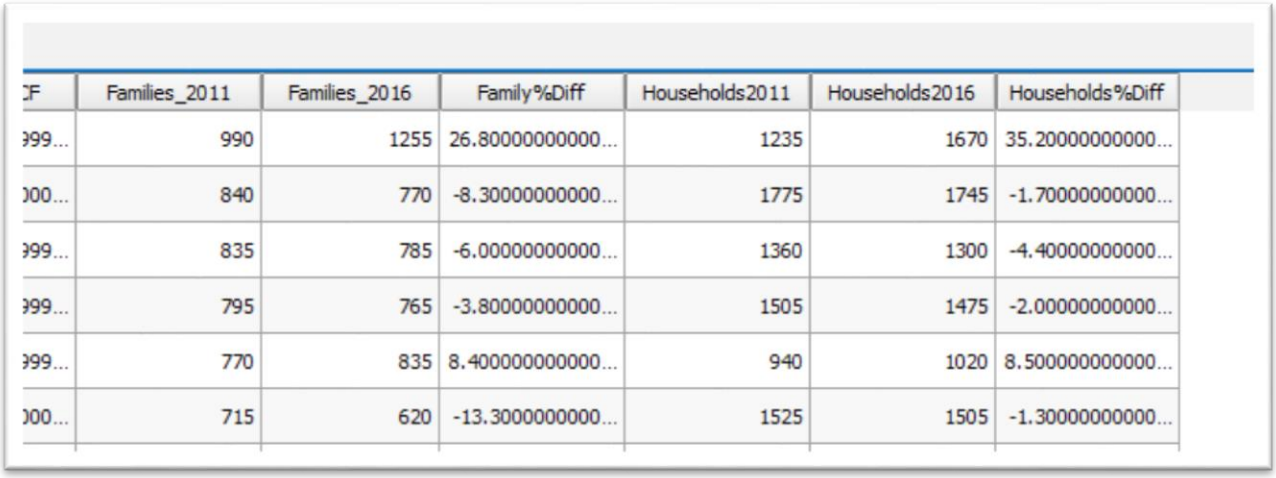
4) Select “Fields” from the menu to the left of the dialogue box.



5) You can type new – and shortened – field names into the “Alias” column



6) Select Apply, then OK. And open the attribute table. **Be sure to save your project after each step.**

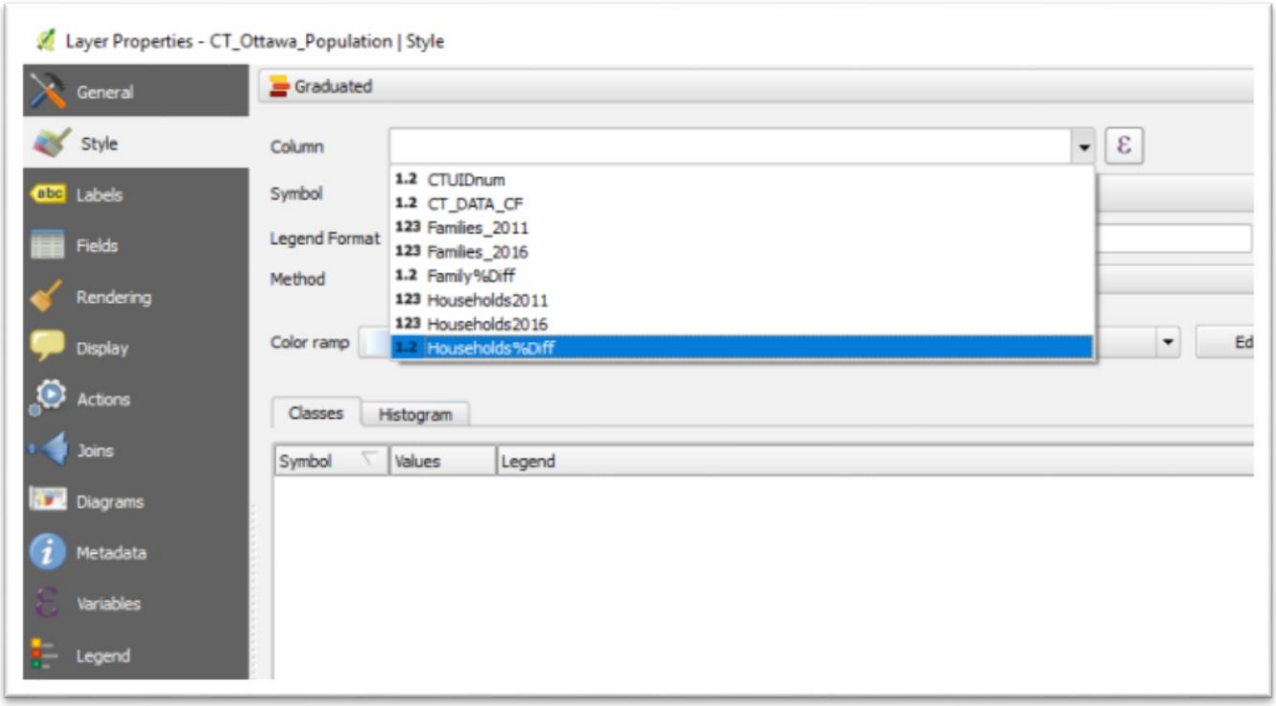


CF	Families_2011	Families_2016	Family%Diff	Households2011	Households2016	Households%Diff
999...	990	1255	26.80000000000...	1235	1670	35.20000000000...
000...	840	770	-8.30000000000...	1775	1745	-1.70000000000...
999...	835	785	-6.00000000000...	1360	1300	-4.40000000000...
999...	795	765	-3.80000000000...	1505	1475	-2.00000000000...
999...	770	835	8.400000000000...	940	1020	8.500000000000...
000...	715	620	-13.3000000000...	1525	1505	-1.30000000000...

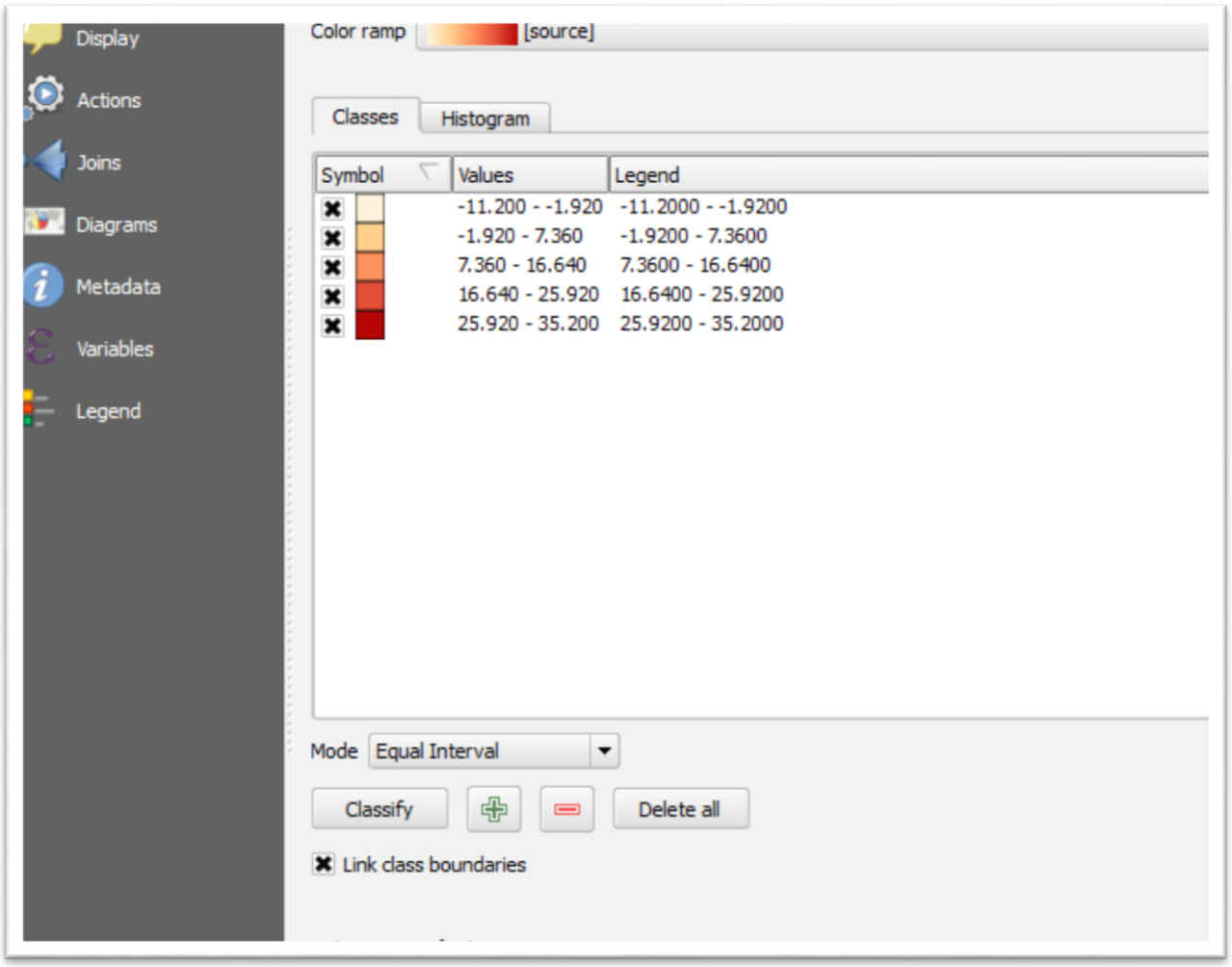
7) Now we can symbolize!

6. Symbology

1) To symbolize right-click on the ***CT_Ottawa_Population*** 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 **Households%Diff**

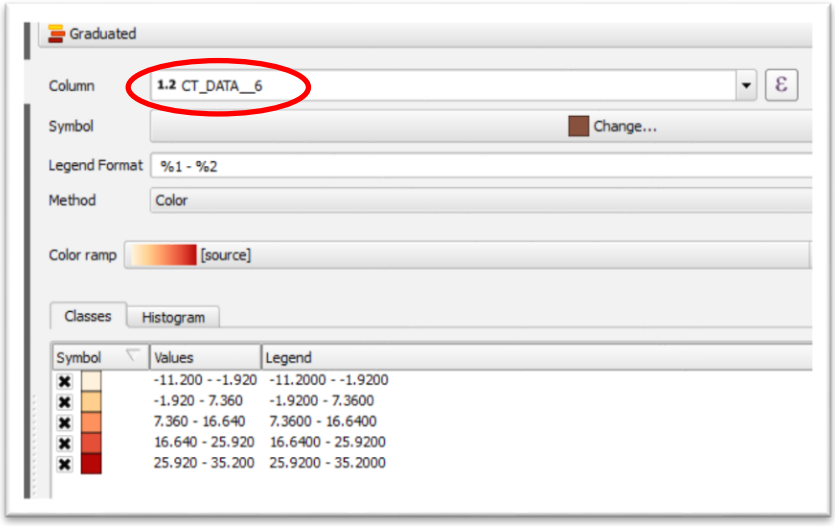


5) Select a colour ramp, then click the **Classify** button



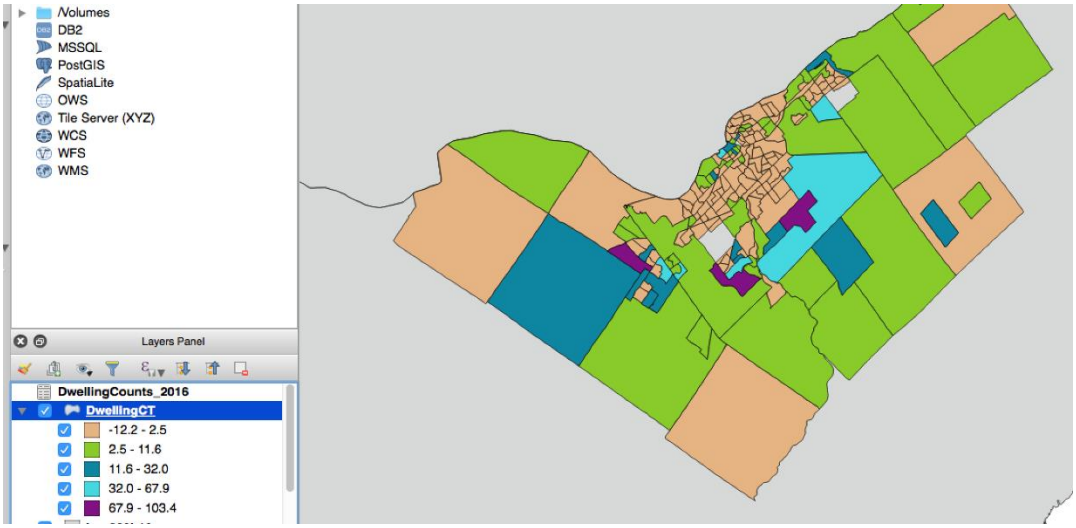
6) It should be filled in as you see below: (NOTE: depending on your version of QGIS, your dialog box may look slightly different.)

a. Column should be **Households%Diff (since the new name is only an alias, it won't be displayed in the "Column" box of the layer properties dialog box.**



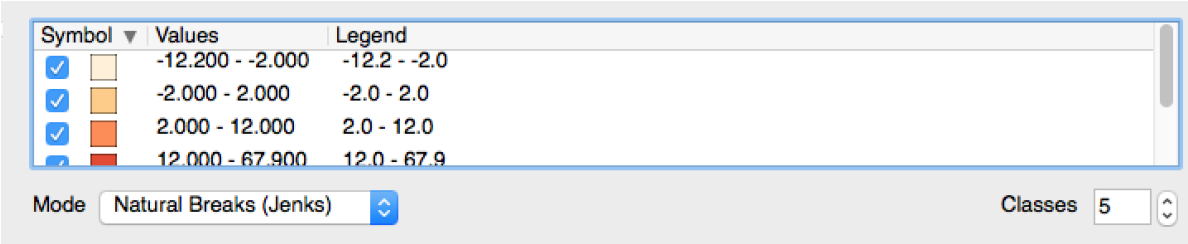
b. Under the **Classes** tab, Mode should be **Natural Breaks (Jenks)** with 5 classes
    i. You can play around with this if you'd like

c. 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 CTs have higher and lower population changes.

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:

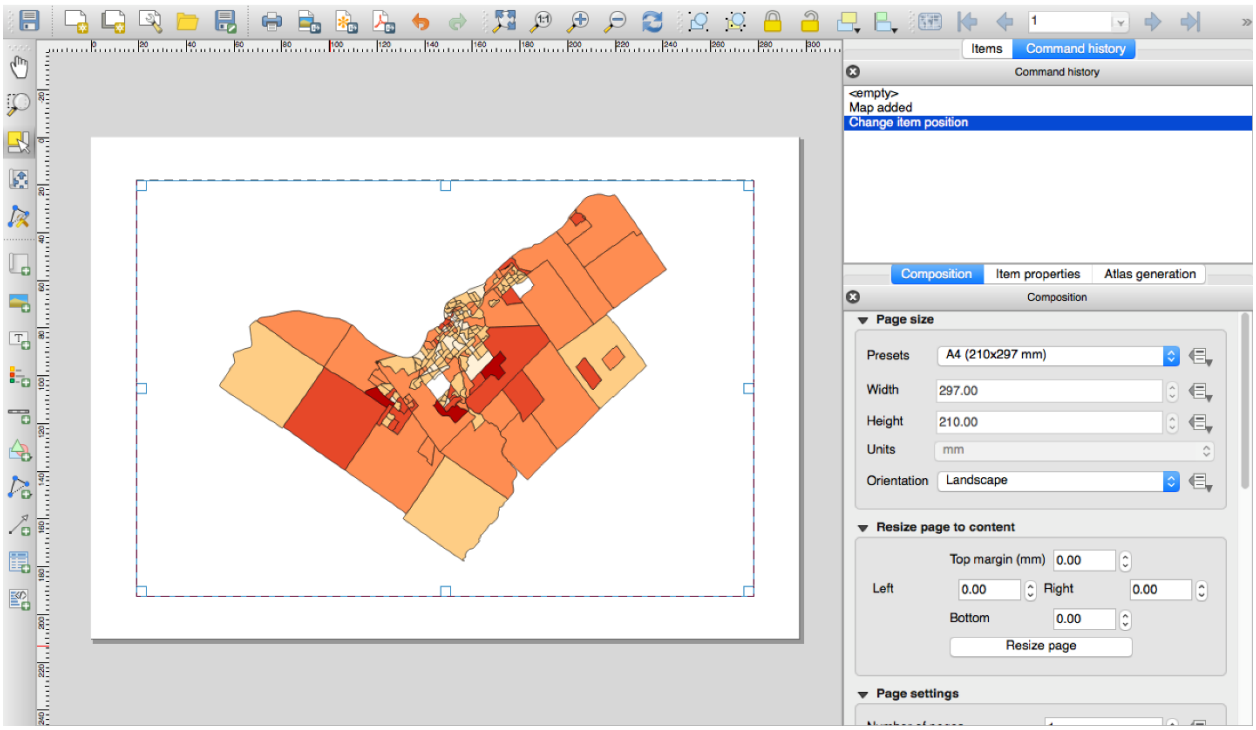


You can also edit the legend text, as you can see above.

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 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. To add your map of CTs, click ***Layout > Add Map***, then draw a box that is just inside the perimeter of the page.



5) Under Item Properties tab, under Extents, click the **Set to map canvas extent** button to centre the layer.
6) If the CTs 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 CTs smaller and a smaller number will make the CTs larger.
7) The QGIS composer is remarkably finicky. Maneuver (including deleting and re-adding) the map around until you're reasonably satisfied.

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.
3. By default, all the layers on the map will appear as legend items in the legend.
4. 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.
5. 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.
6. 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**.
7. There are a lot of options in the Legend panel, from font selections to spacing to background colour.

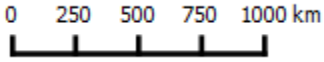
8. You can click and drag the legend into place on your map.

Adding a North Arrow

1. In the menu, select ***Layout*** > ***Add Image***.
2. Draw a box where you would like to see your north arrow.
3. 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**.
4. 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

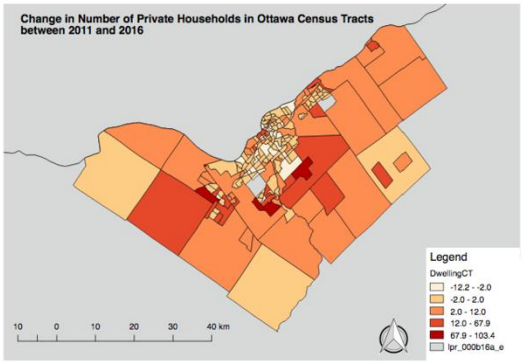
1. In the menu, select ***Layout*** > ***Add Scalebar***.
2. Draw a box where you would like to see the scale bar.
3. In the Item properties tab, you can select one of six styles under the **Style** dropdown.
4. Choose the units for the scale bar under **Units**.
5. Adjust the segments in the **Segments**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



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

Adding a Title to a Map

1. In the menu, select ***Layout*** > ***Add Label***.
2. Draw a box where you'd like your title to be (you can move it later).
3. Type your title into the **Main properties** text box.
4. 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.