

11. Advanced Vector Analysis

Purpose

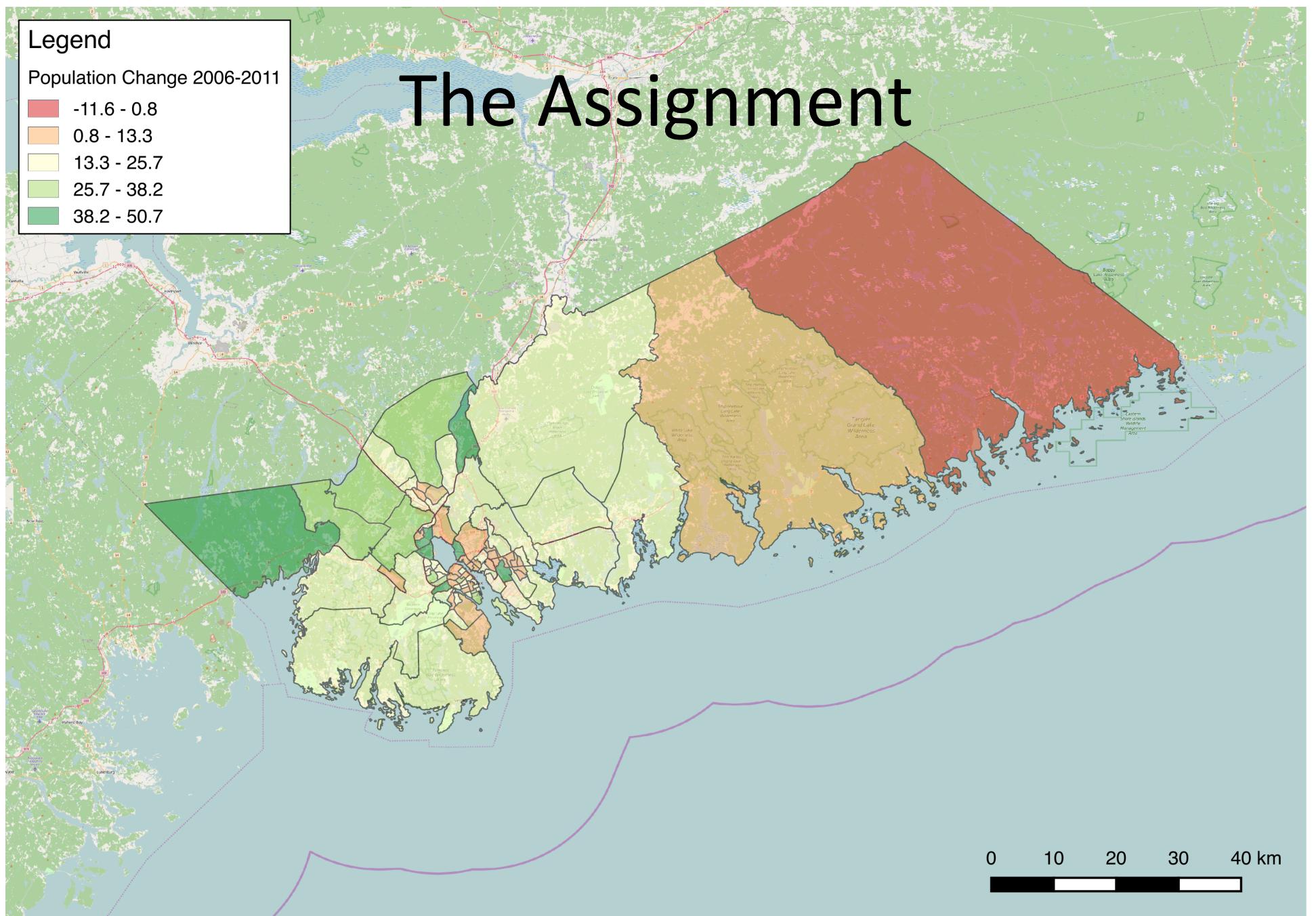
- Use the “Join” feature to combine geographic information with census data
- Use the “select by expression” and attribute table sorting to examine spatial trends
- Apply a graduated layer style to visualize spatial trends

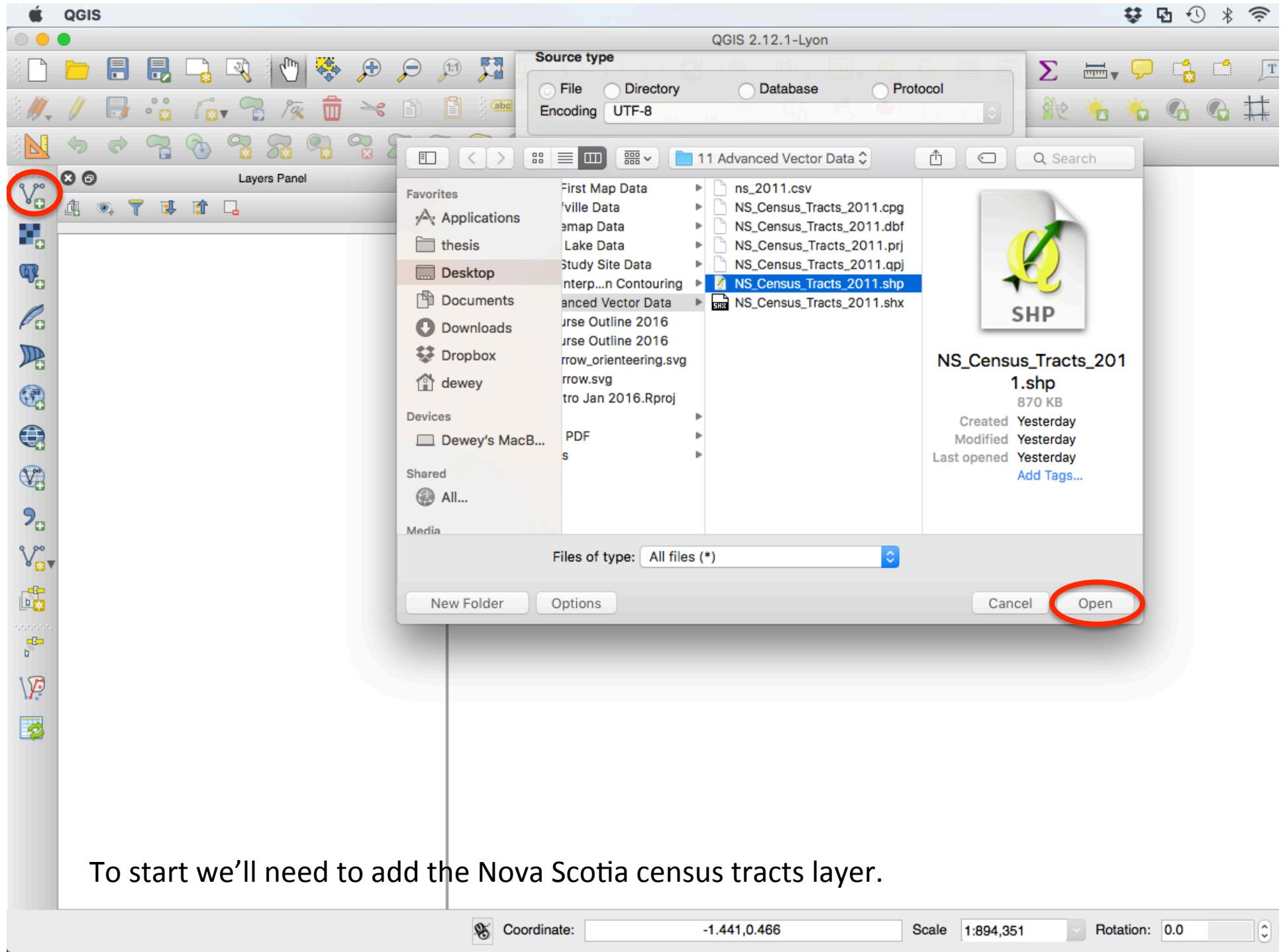
Legend

Population Change 2006-2011

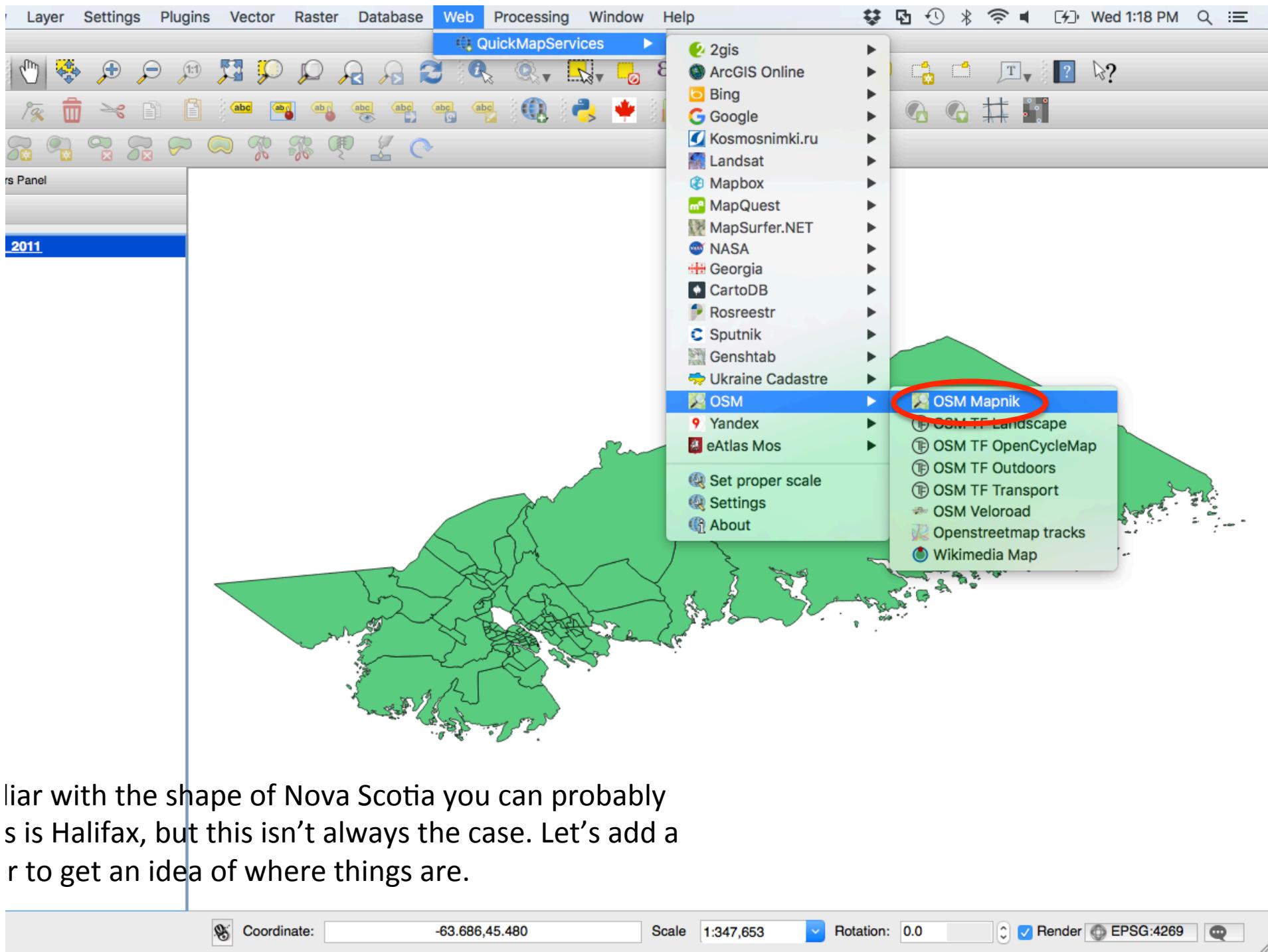
- 11.6 - 0.8
- 0.8 - 13.3
- 13.3 - 25.7
- 25.7 - 38.2
- 38.2 - 50.7

The Assignment

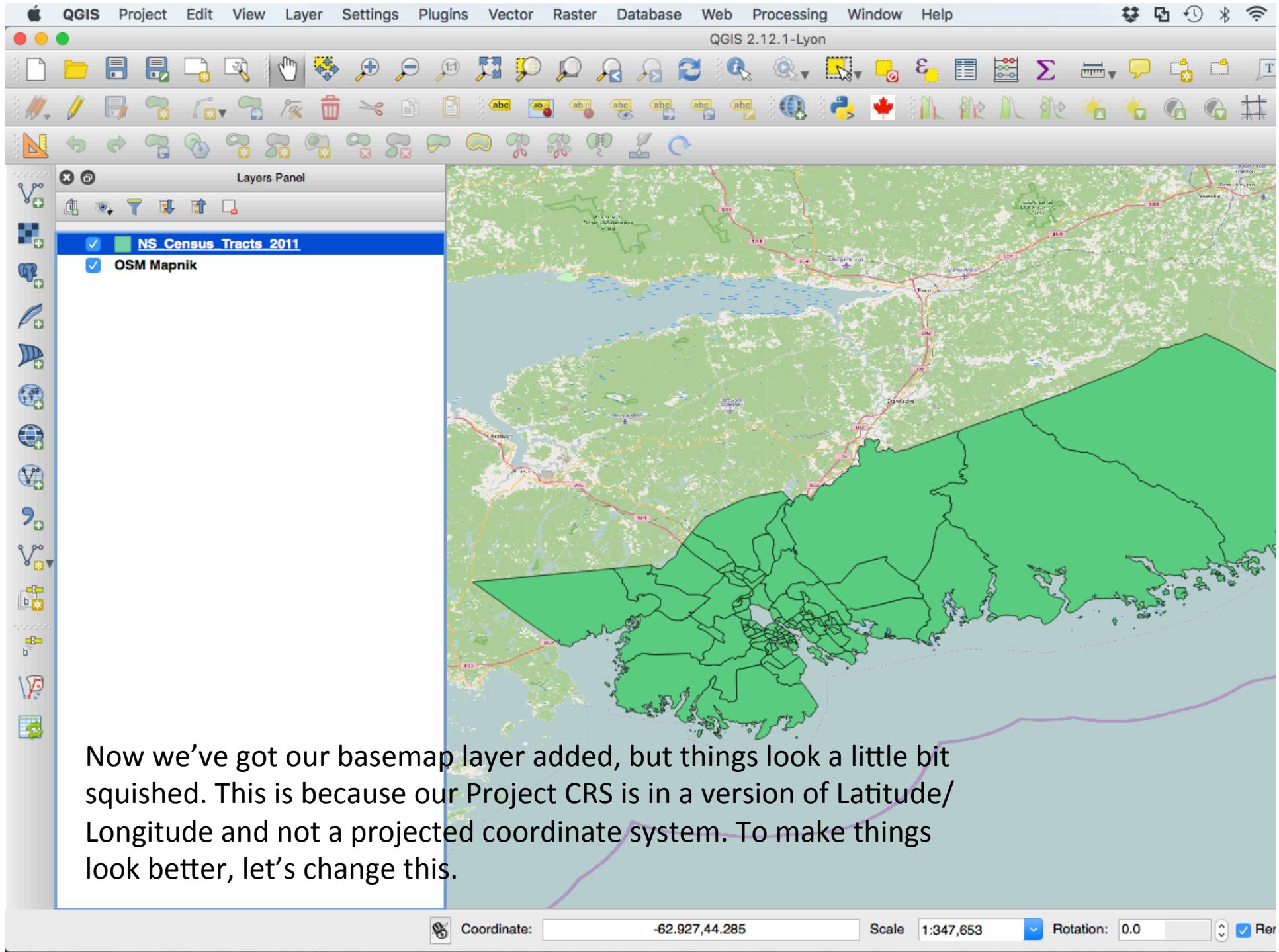




To start we'll need to add the Nova Scotia census tracts layer.



liar with the shape of Nova Scotia you can probably
s is Halifax, but this isn't always the case. Let's add a
r to get an idea of where things are.



Now we've got our basemap layer added, but things look a little bit squished. This is because our Project CRS is in a version of Latitude/Longitude and not a projected coordinate system. To make things look better, let's change this.

QGIS Project Edit View Layer Settings Plugins Vector Raster Database Web Processing Window Help

Project Properties | CRS

Enable 'on the fly' CRS transformation

Filter

Recently used coordinate reference systems

Coordinate Reference System	Authority ID
WGS 84 / UTM zone 21N	EPSG:32621
NAD83 / UTM zone 10N	EPSG:26910
NAD83 / BC Albers	EPSG:3005
WGS 84	EPSG:4326
Canada_Albers_Equal_Area_Conic	EPSG:102001
WGS 84 / World Mercator	EPSG:3395
NAD83 / UTM zone 20N	EPSG:26920
WGS 84 / Pseudo Mercator	EPSG:3857

Coordinate reference systems of the world Hide deprecated CRSs

Coordinate Reference System	Authority ID
Segara (Jakarta) / NEIEZ	EPSG:5329
Segara (Jakarta) / NEIEZ (deprecated)	EPSG:2934
Segara / NEIEZ	EPSG:3000
Sphere_Mercator	EPSG:53004
WGS 84 / Mercator_41	EPSG:3752
WGS 84 / Mercator_41	EPSG:3994
WGS 84 / PDC Mercator	EPSG:3349
WGS 84 / PDC Mercator	EPSG:3832
WGS 84 / Pseudo Mercator	EPSG:3857
WGS 84 / Simple Mercator	OSGEO:41001
WGS 84 / World Mercator	EPSG:3395
World_Mercator	EPSG:54004

Selected CRS: WGS 84 / World Mercator

```
+proj=merc +lon_0=0 +k=1 +x_0=0 +y_0=0 +datum=WGS84 +units=m +no_defs
```

Help Apply Cancel OK

Coordinate: -62.491,44.092 Scale: 1:347,653 Rotation: 0.0 Refresh

General CRS Identify layers Default styles OWS server Macros Relations Variables

NS_Census Tra OSM Mapnik

World Mercator is usually a good bet for viewing dataset you have, unless it's in the far north or south.

Now Nova Scotia looks a little more recognizable. Now let's take a look at the attribute table for the layer we just added.

The screenshot shows the QGIS application interface. The top menu bar includes Project, Edit, View, Layer, Settings, Plugins, Vector, Raster, Database, Web, Processing, Window, and Help. The toolbar below has various icons for file operations, selection, measurement, and analysis. The Layers Panel on the left lists 'NS Census Tracts 2011' and 'OSM Mapnik' with checkboxes. The main canvas displays a map of Nova Scotia with green census tract boundaries and place names like Parrsboro, Wolfville, Hantsport, Windsor, New Ross, Mahone Bay, Bridgewater, Lunenburg, Stewiacke, Kentville, and Westville. A red circle highlights the attribute table icon (a grid icon) in the toolbar. The bottom status bar shows coordinates (-7009279, 5488516), scale (1:976,102), rotation (0.0), and a refresh button.

QGIS 2.12.1-Lyon

Layers Panel

Attribute table - NS_Census_Tracts_2011 :: Features total: 92, filtered: 92, selected: 0

PRNAME CTNAME_NUM

0	Nova Scotia ...	120.00
1	Nova Scotia ...	140.00
2	Nova Scotia ...	100.00
3	Nova Scotia ...	121.07
4	Nova Scotia ...	102.00
5	Nova Scotia ...	17.00
6	Nova Scotia ...	104.01
7	Nova Scotia ...	26.03
8	Nova Scotia ...	26.04
9	Nova Scotia ...	105.02
10	Nova Scotia ...	123.02
11	Nova Scotia ...	23.00
12	Nova Scotia ...	121.06
13	Nova Scotia ...	143.01
14	Nova Scotia ...	4.02
15	Nova Scotia ...	113.00

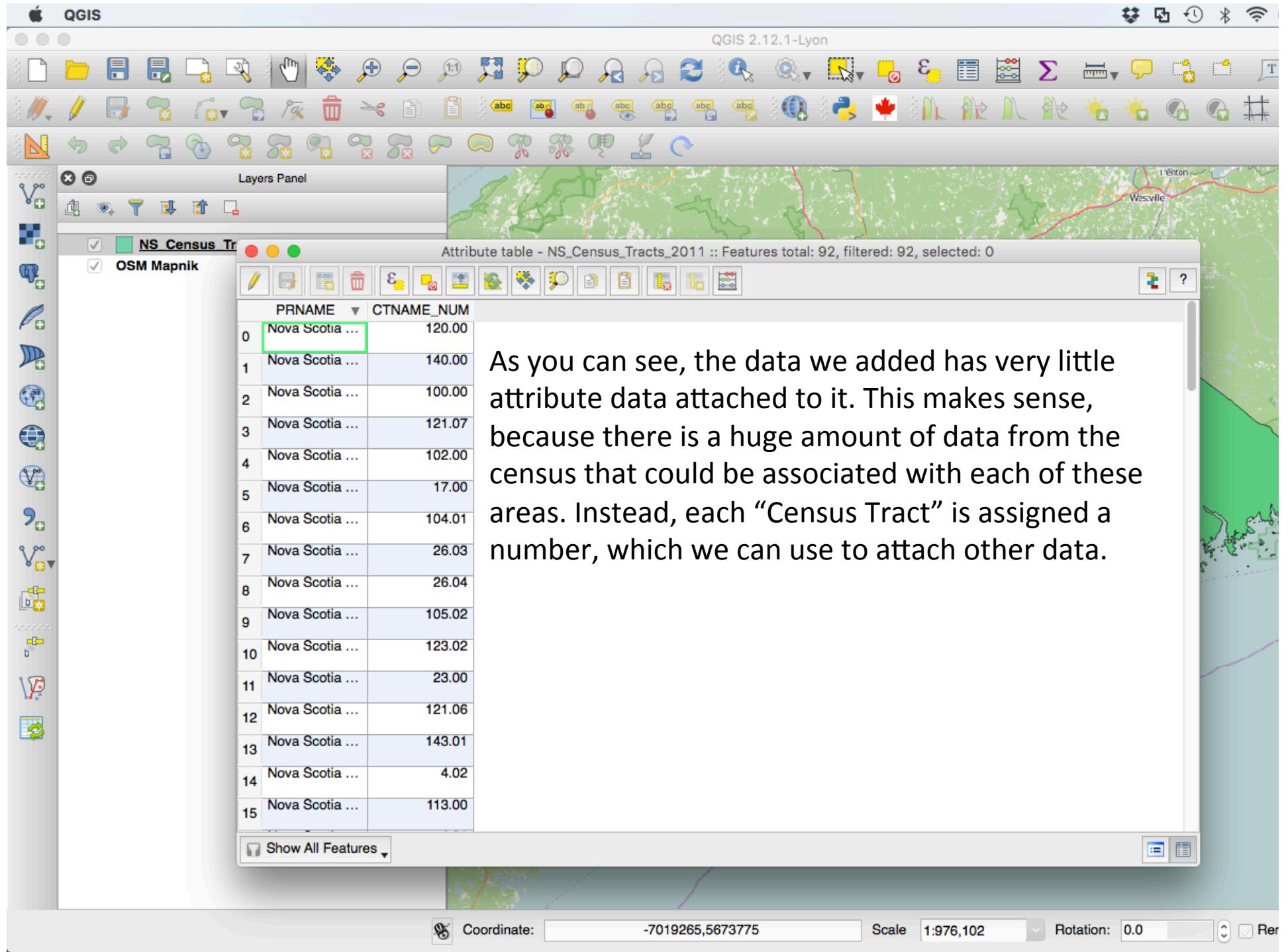
Show All Features

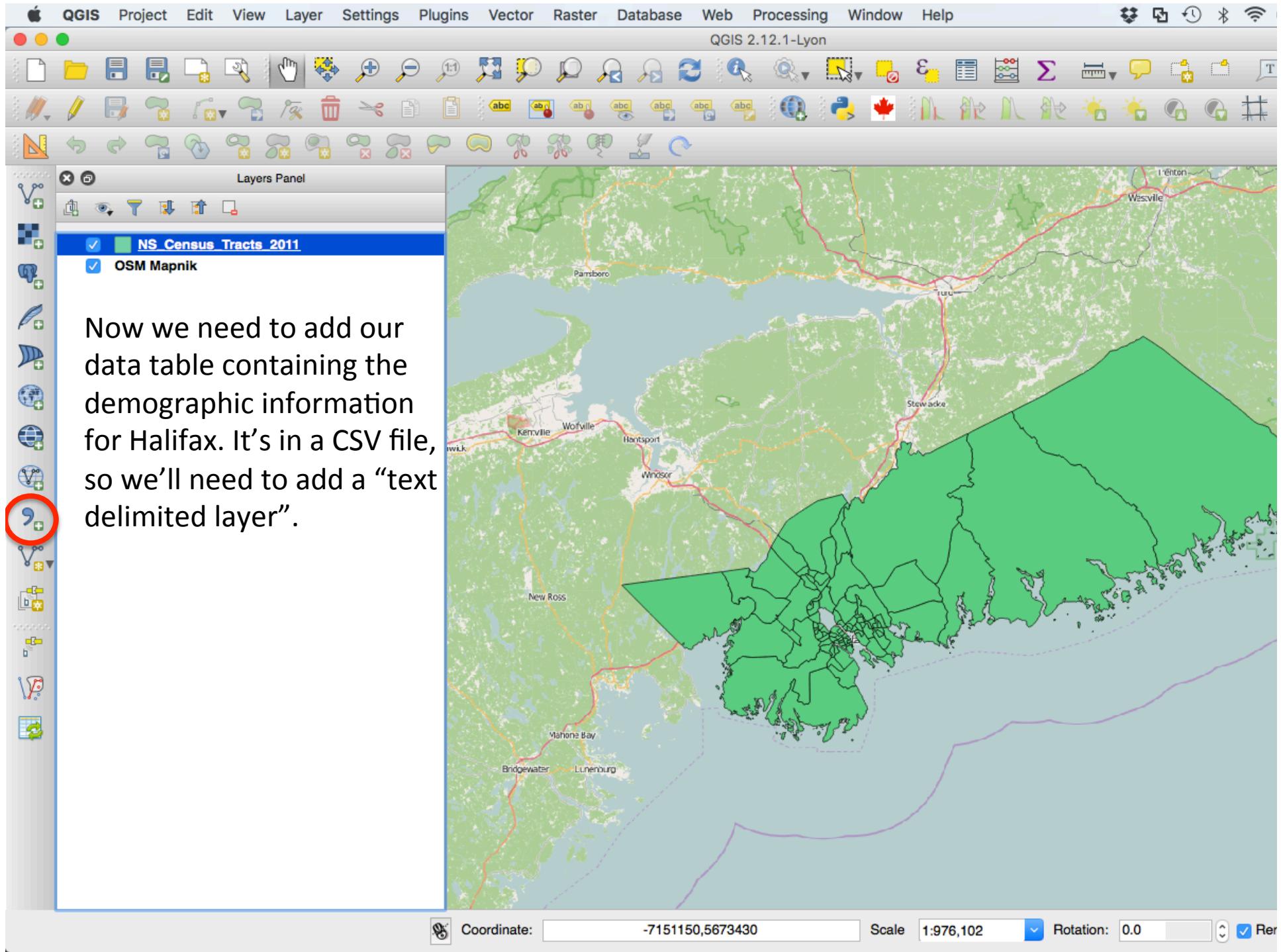
Coordinate: -7019265,5673775

Scale: 1:976,102

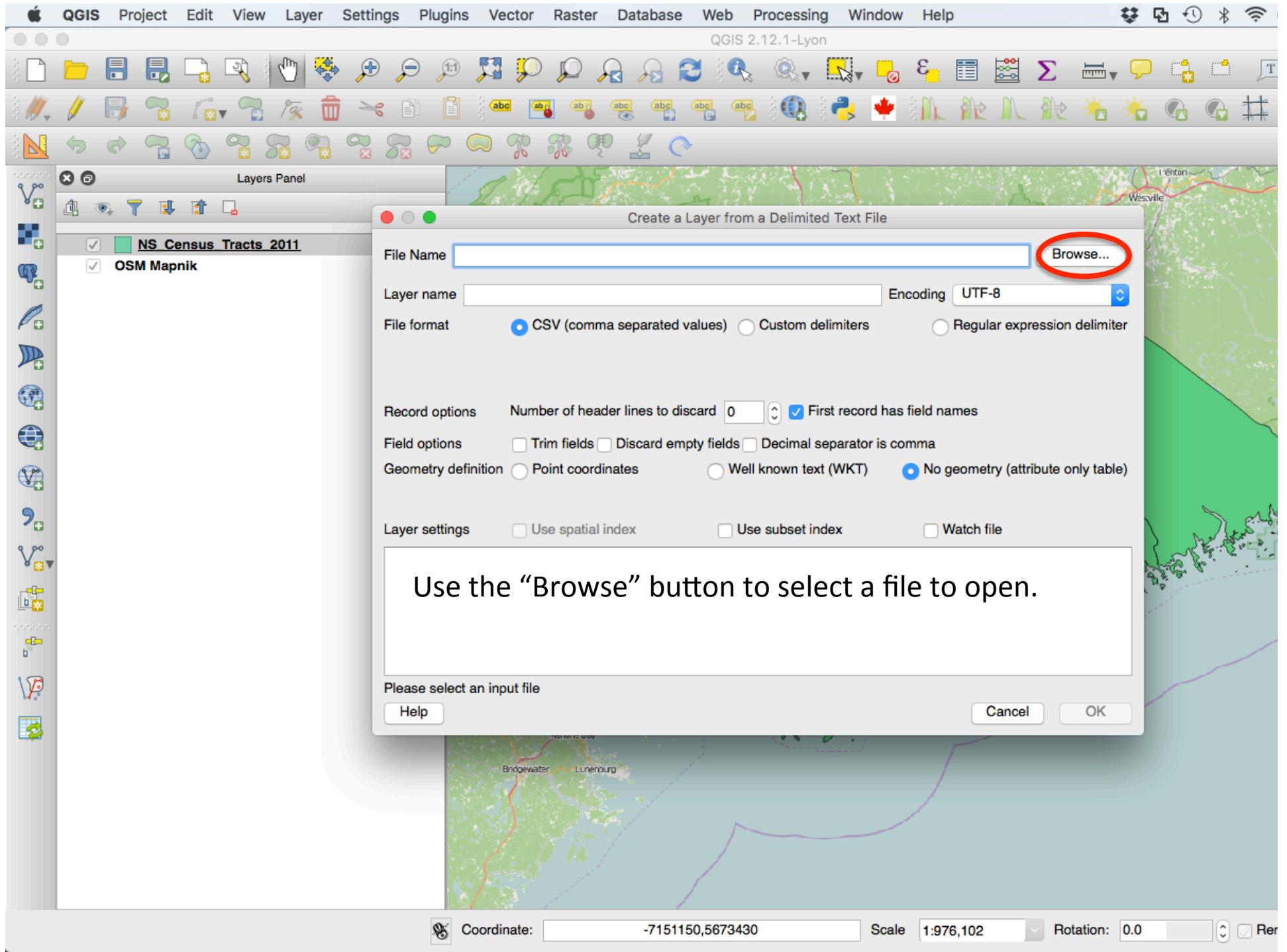
Rotation: 0.0

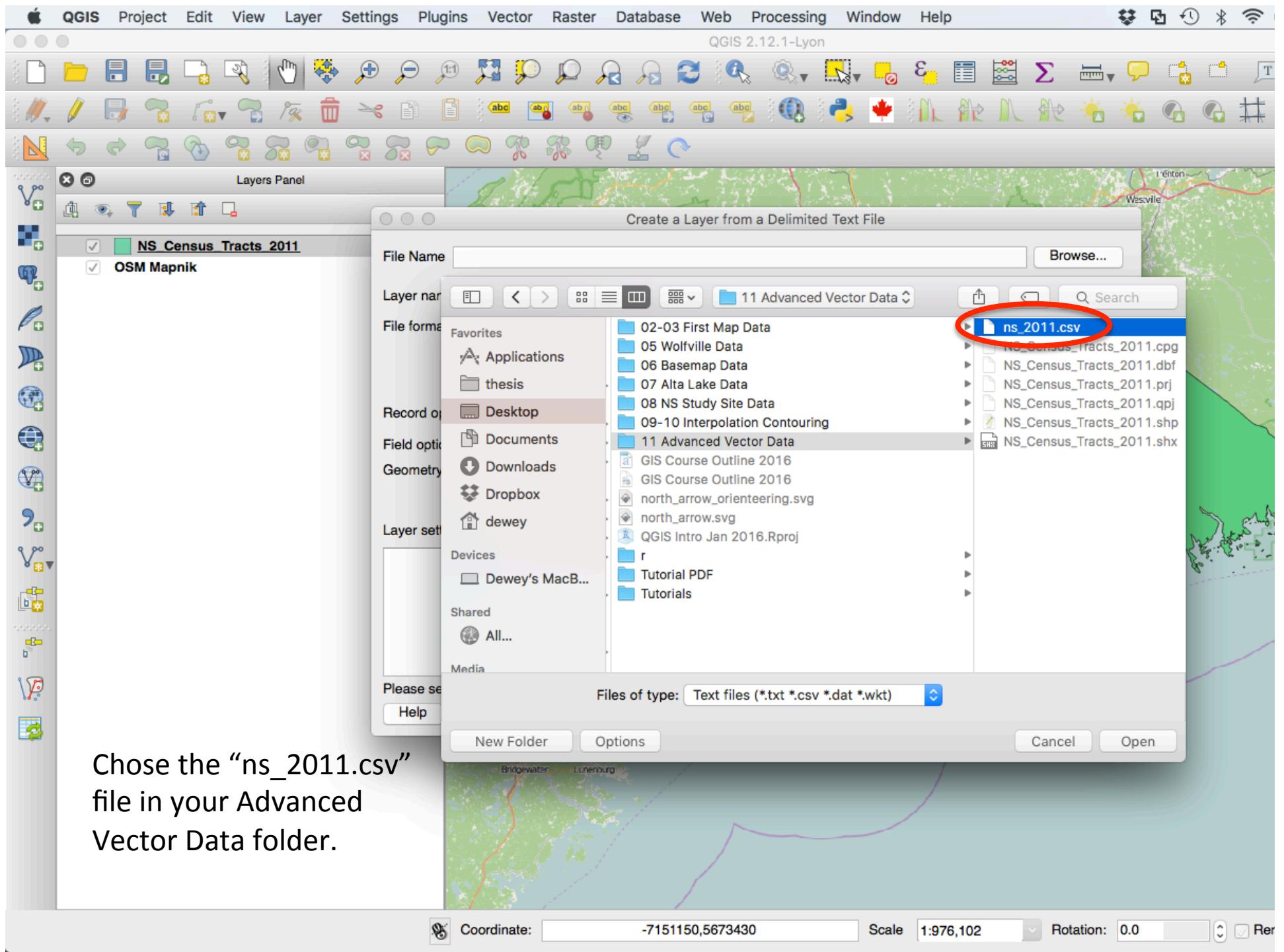
As you can see, the data we added has very little attribute data attached to it. This makes sense, because there is a huge amount of data from the census that could be associated with each of these areas. Instead, each “Census Tract” is assigned a number, which we can use to attach other data.





Now we need to add our data table containing the demographic information for Halifax. It's in a CSV file, so we'll need to add a "text delimited layer".





Chose the “ns_2011.csv”
file in your Advanced
Vector Data folder.

Screenshot of QGIS 2.12.1-Lyon showing the "Create a Layer from a Delimited Text File" dialog box. The dialog box is centered over a map of Nova Scotia, Canada, with various census tract layers visible.

The dialog box settings are as follows:

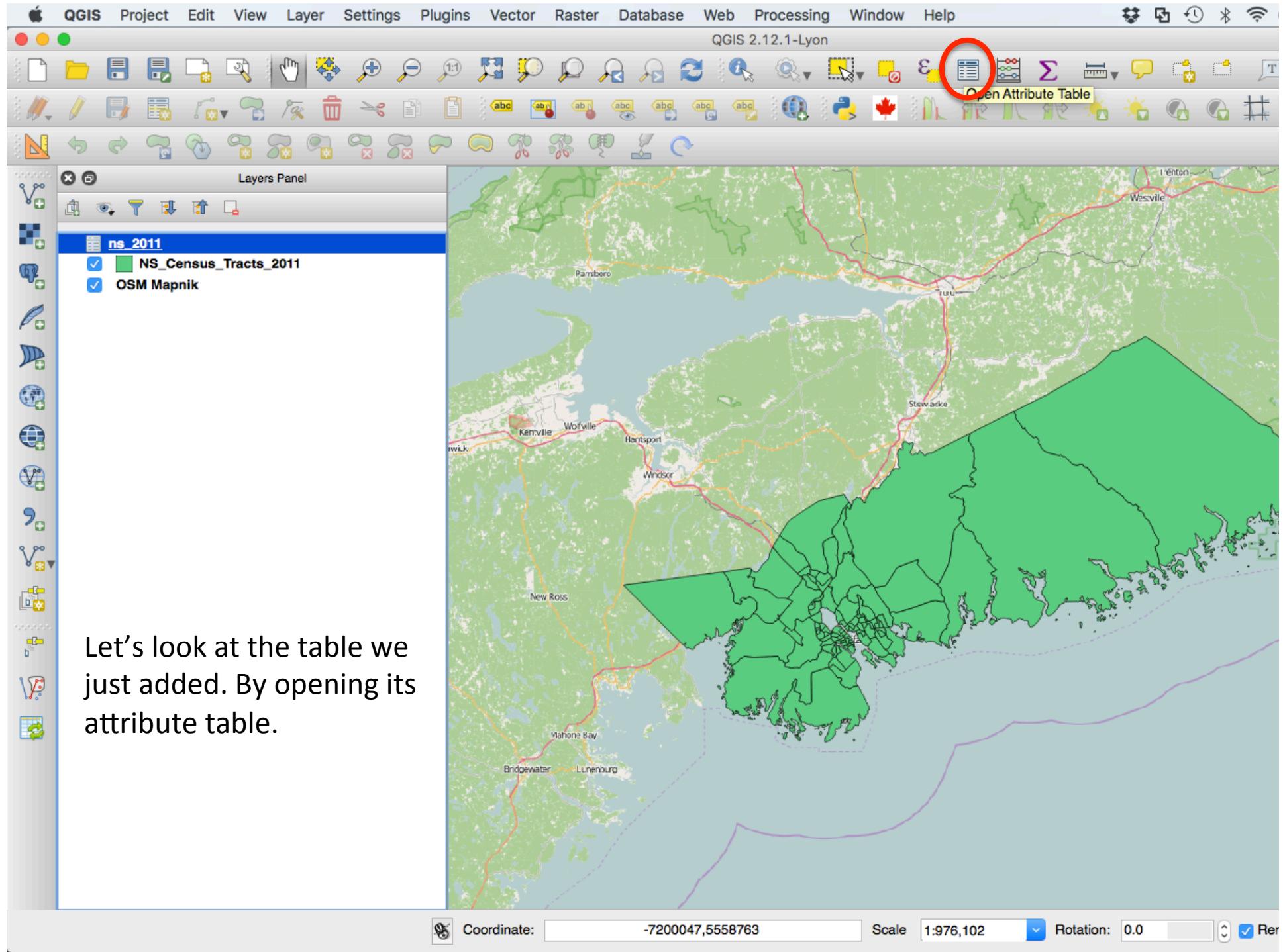
- File Name:** /Users/dewey/Desktop/QGIS Intro Jan 2016/11 Advanced Vector Data/ns_2011.csv
- Layer name:** ns_2011
- Encoding:** UTF-8
- File format:** CSV (comma separated values) (selected)
- Record options:** Number of header lines to discard: 0, First record has field names (checked)
- Field options:** Trim fields, Discard empty fields, Decimal separator is comma (unchecked)
- Geometry definition:** Point coordinates, Well known text (WKT), No geometry (attribute only table) (selected)
- Layer settings:** Use spatial index, Use subset index, Watch file (unchecked)

A red circle highlights the "No geometry (attribute only table)" option under Geometry definition. Another red circle highlights the "OK" button at the bottom right of the dialog box.

Below the dialog box, a text box contains the following explanatory text:

There is no position information associated with this CSV file, which makes sense because it only contains demographic data. We need to tell QGIS not to look for any geometry before we add the layer.

Coordinate: -7151150,5673430 Scale: 1:976,102 Rotation: 0.0



The table we just added contains several categories of demographic data, but doesn't have any information about the location. To make this data meaningful, we need to attach it to our NS_Census_Tracts layer.

QGIS 2.12.1-Lyon

Layers Panel

Attribute table - ns_2011 :: Features total: 92, filtered: 92, selected: 0

	Prov_Name	CT_Name	11_Pop_Change	med_age	pop_density	total_pop
0	Nova Scotia	1	3	36.7	658.9	3759
1	Nova Scotia	2	-0.6	45.2	465.5	5363
2	Nova Scotia	3	15.1	29.4	1284.3	3036
3	Nova Scotia	4.01	4.9	26.8	7106	3418
4	Nova Scotia	4.02	10.1	27.1	9585.6	4649
5	Nova Scotia	5	0.1	41	2342.6	1797
6	Nova Scotia	6	-3	30.2	2976.7	3122
7	Nova Scotia	7	-3.6	53.1	1459.2	1716
8	Nova Scotia	8	4.6	28.1	5472.4	2763
9	Nova Scotia	9	6.7	30.4	3134.3	1984
10	Nova Scotia	10	7	32.2	6056.1	5029
11	Nova Scotia	11	2.5	29.2	7279.2	5910
12	Nova Scotia	12	2.2	28.9	5096.2	2650
13	Nova Scotia	13	0.2	40.5	3278.6	2617
14	Nova Scotia	14	2	51.8	2234.1	4104
15	Nova Scotia	15	-1.2	39.1	2296.2	4691

Coordinate: -7048534,5677218 Scale: 1:976,102 Rotation: 0.0

QGIS Project Edit View Layer Settings Plugins Vector Raster Database Web Processing Window Help

QGIS 2.12.1-Lyon

Layers Panel

ns_2011

OSM

- Zoom to Layer
- Show in Overview
- Remove
- Duplicate
- Set Layer Scale Visibility
- Set Layer CRS
- Set Project CRS from Layer
- Styles
- Open Attribute Table
- Toggle Editing
- Save As...
- Save As Layer Definition File...
- Filter...
- Show Feature Count
- Properties**
- Rename

We will do this using the “Join” feature. To join the layers, first open the properties dialog for the NS_Census_Tracts layer.

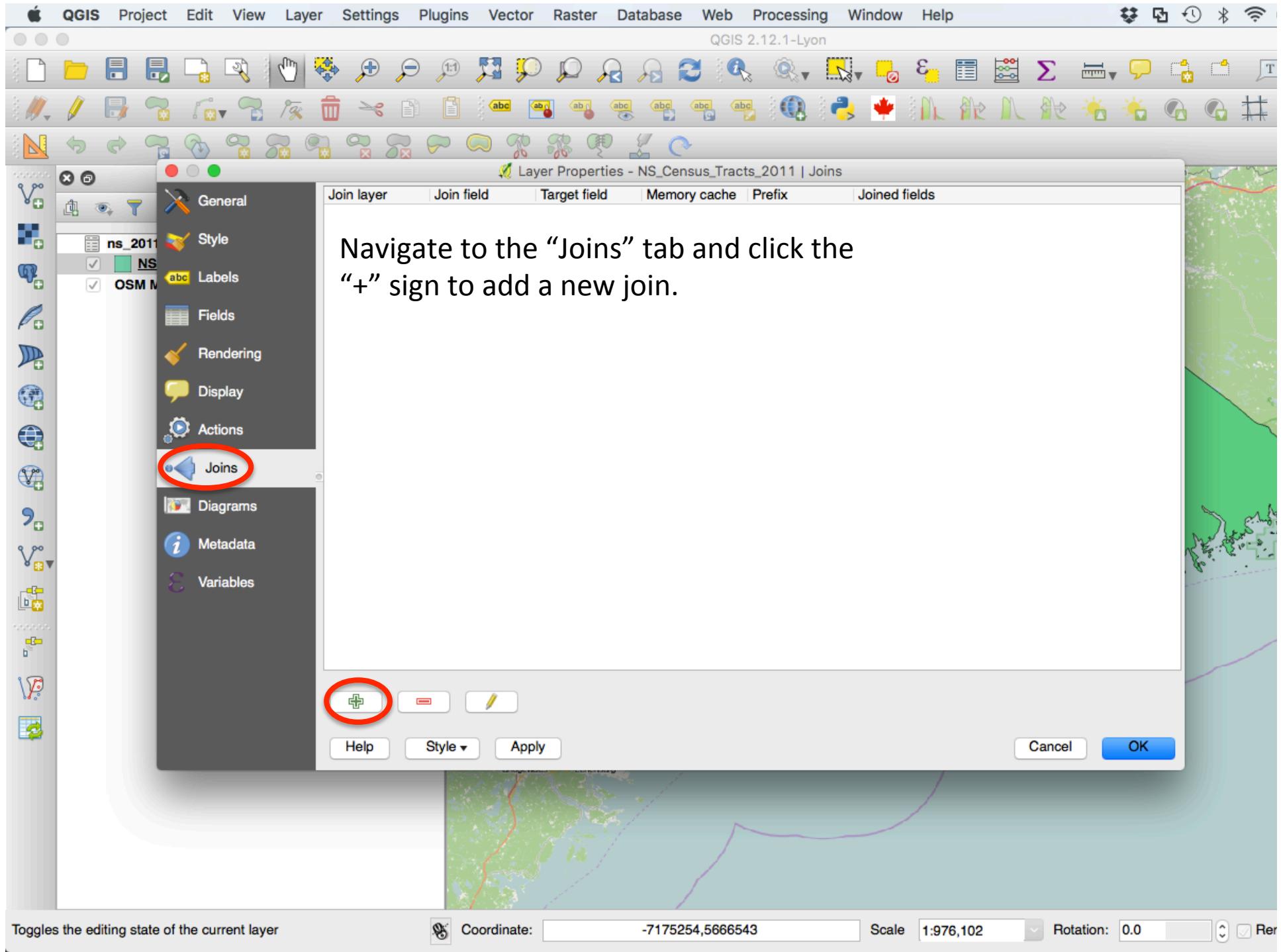
Toggles the editing state of the current layer

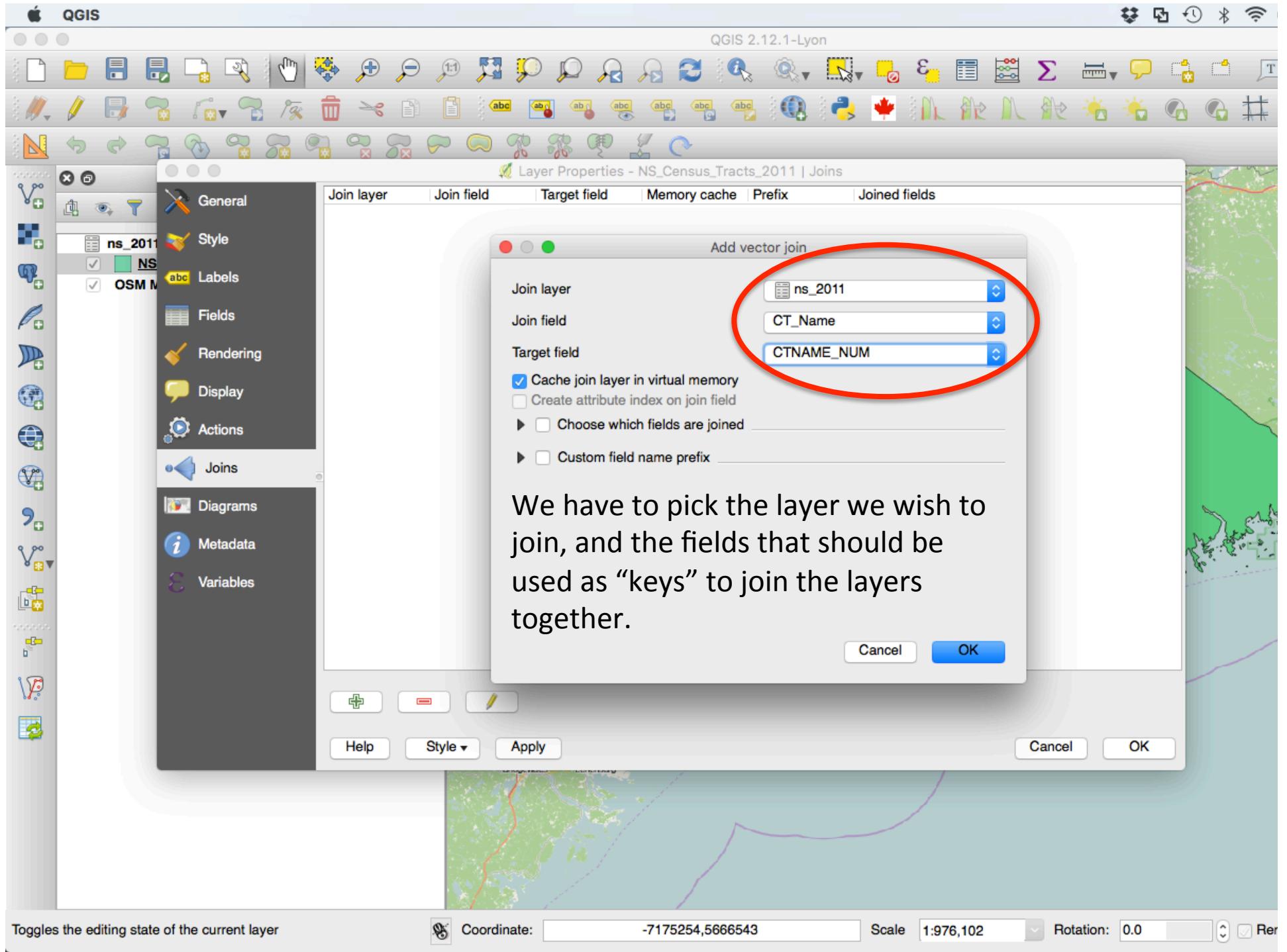
Coordinate: -7175254,5666543

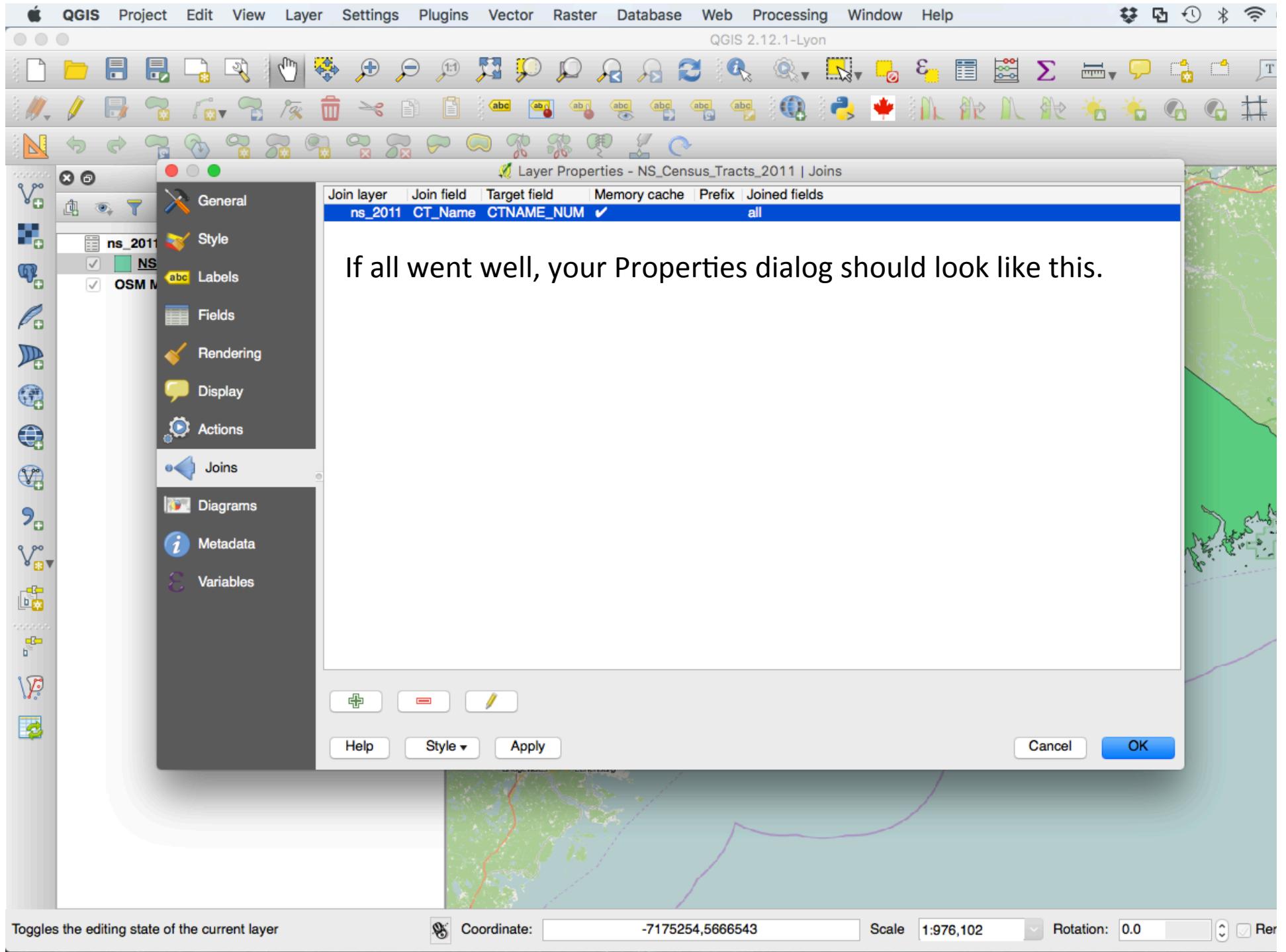
Scale: 1:976,102

Rotation: 0.0

Rendering: [checkbox checked]







Now let's look at the attribute table for the NS_Census_Tracts layer.

The screenshot shows the QGIS application interface. The top menu bar includes Project, Edit, View, Layer, Settings, Plugins, Vector, Raster, Database, Web, Processing, Window, and Help. Below the menu is a toolbar with various icons for file operations, selection, and editing. The main window features a 'Layers Panel' on the left containing a list of layers: 'ns_2011' (with 'NS_Census_Tracts_2011' selected), 'OSM Mapnik', and several other layers represented by small icons. To the right is a map of Nova Scotia, Canada, showing green census tract boundaries, roads, and place names like Parrsboro, Wolfville, Hantsport, Windsor, Stewiacke, Mahone Bay, Bridgewater, Lunenburg, and Tiverton. A context menu is open over the 'NS_Census_Tracts_2011' layer, listing options such as 'Zoom to Layer', 'Show in Overview', 'Remove', 'Duplicate', 'Set Layer Scale Visibility', 'Set Layer CRS', 'Set Project CRS from Layer', 'Styles', 'Open Attribute Table' (which is circled in red), 'Toggle Editing', 'Save As...', 'Save As Layer Definition File...', 'Filter...', 'Show Feature Count', 'Properties', and 'Rename'. At the bottom of the screen, there are status bars for 'Coordinate' (-7175254,5674808), 'Scale' (1:976,102), 'Rotation' (0.0), and a 'Toggles the editing state of the current layer' button. The title bar indicates 'QGIS 2.12.1-Lyon'.

QGIS 2.12.1-Lyon

You'll notice some new columns in the attribute table that were

	PRNAME	CTNAME_NUM	2011_Prov	2011_Pop_1_06_11	Pop_C	s_2011_med_ag	2011_pop_dens	s_2011_total_pc
0	Nova Scotia ...	120.00	Nova Scotia	4.8	45.4	93.0	2202	
1	Nova Scotia ...	140.00	Nova Scotia	0.4	42.4	37.8	6431	
2	Nova Scotia ...	100.00	Nova Scotia	0.8	42.2	528.8	3112	
3	Nova Scotia ...	121.07	Nova Scotia	5.8	38.2	689.6	4879	
4	Nova Scotia ...	102.00	Nova Scotia	2.6	40.5	3259.5	4298	
5	Nova Scotia ...	17.00	Nova Scotia	19.6	40.5	933	2710	
6	Nova Scotia ...	104.01	Nova Scotia	-0.4	49.6	1638.2	2045	
7	Nova Scotia ...	26.03	Nova Scotia	2.5	39.3	2450.5	3425	
8	Nova Scotia ...	26.04	Nova Scotia	0	33.2	6148.1	4035	
9	Nova Scotia ...	105.02	Nova Scotia	-2.8	42.3	2231.7	4724	
10	Nova Scotia ...	123.02	Nova Scotia	-3.2	42.6	320.8	4209	
11	Nova Scotia ...	23.00	Nova Scotia	-0.5	33.9	2745.6	4218	
12	Nova Scotia ...	121.06	Nova Scotia	6.3	35.5	861.2	5604	
13	Nova Scotia ...	143.01	Nova Scotia	21	41.1	17.8	4975	
14	Nova Scotia ...	4.02	Nova Scotia	10.1	27.1	9585.6	4649	
15	Nova Scotia ...	113.00	Nova Scotia	48.3	28	345.4	1059	

Show All Features

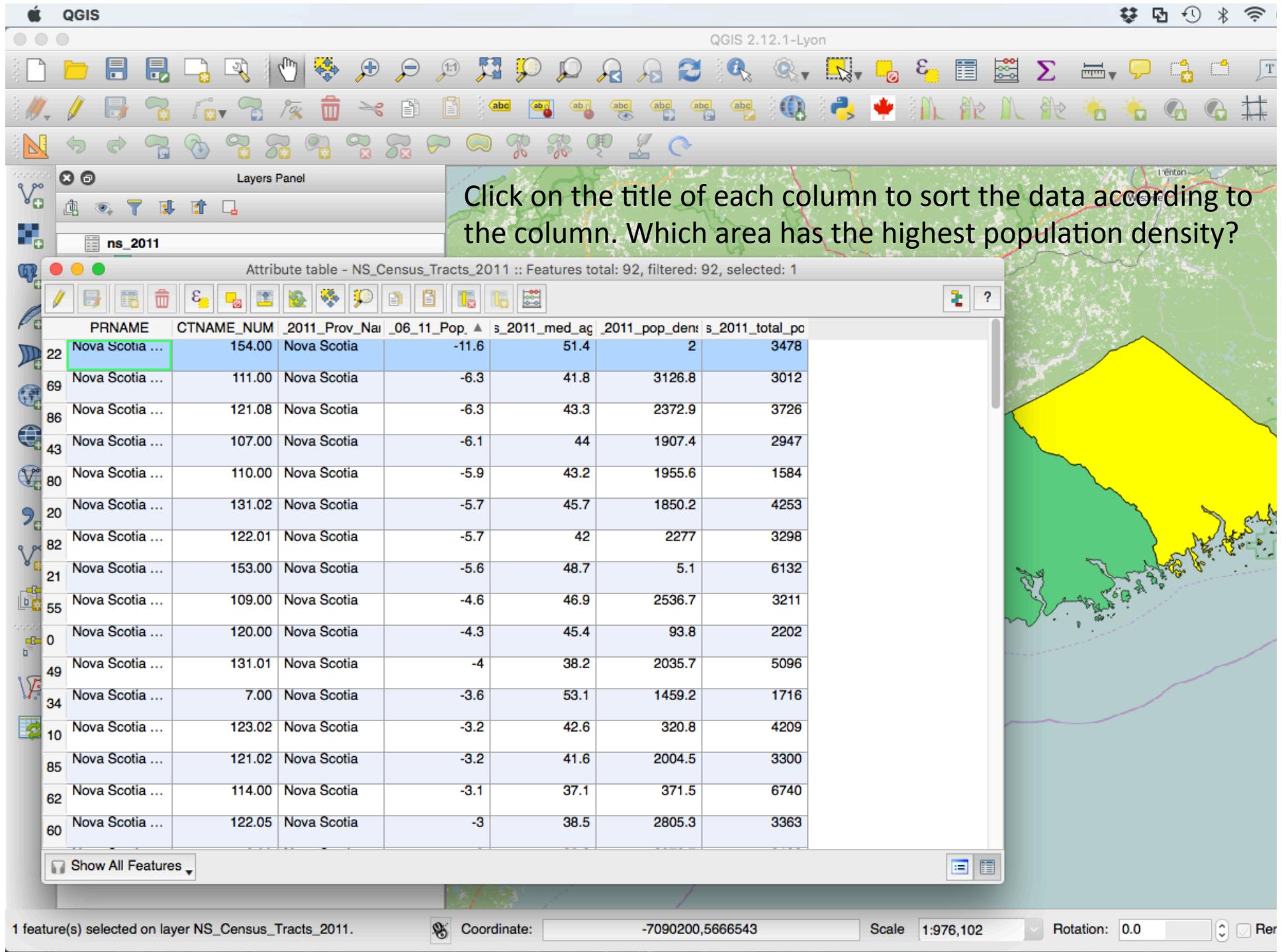
Toggles the editing state of the current layer

Coordinate: -7175254,5674808

Scale: 1:976,102

Rotation: 0.0

Re



Sometimes we need to search for data based on more complicated criteria. We can do this using the Select By Expression Tool.

QGIS 2.12.1-Lyon

View Layer Settings Plugins Vector Raster Database Web Processing Window Help

Pan Map Pan Map to Selection Zoom In Zoom Out Select Identify Features Measure Statistical Summary Zoom Full Zoom to Layer Zoom to Selection Zoom Last Zoom Next Zoom to Native Resolution (100%) Decorations Map Tips New Bookmark... Show Bookmarks Refresh Panels Toolbars Toggle Full Screen Mode Enter Full Screen

Select Feature(s) Select Features by Polygon Select Features by Freehand Select Features by Radius Select By Expression... Deselect Features from All Layers

Coordinate: -7124291,5675496 Scale 1:976,102 Rotation: 0.0

The screenshot shows the QGIS application interface. The main window displays a map of Nova Scotia, Canada, with several layers visible, including roads and administrative boundaries. A green polygon layer, labeled 'NS_Census', is currently selected. A context menu is open over this layer, specifically the 'Select' submenu under 'View'. The 'Select By Expression...' option is highlighted with a yellow box. The 'View' menu also lists other selection tools like 'Identify Features', 'Measure', and 'Statistical Summary', as well as zooming options like 'Zoom Full' and 'Zoom to Native Resolution (100%)'. The bottom of the screen shows the coordinate (-7124291, 5675496), scale (1:976,102), and rotation (0.0) information.

The syntax of your expressions is usually pretty simple. In this case, we'll write an expression that selects every feature where the "ns_2011_06_11_Pop_Change" attribute is greater than 0. Press "Select" when you're done. Use the "Fields and Values" helper to help you find the name of your field.

QGIS 2.12.1-Lyon

Layers Panel

ns_2011

✓ NS_Census_Tracts_2011

✓ OSM Mapnik

Select by expression - NS_Census_Tracts_2011

Expression Function Editor

= + - / * ^ || ()

"ns_2011_06_11_Pop_Change" > 0

Output preview: 0

Search

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 isn't supported, before the layer is actually

Values Search

Load values all unique 10 samples

Fuzzy Matching

General

Geometry

Math

Operators

Record

String

Variables

Recent (Selection)

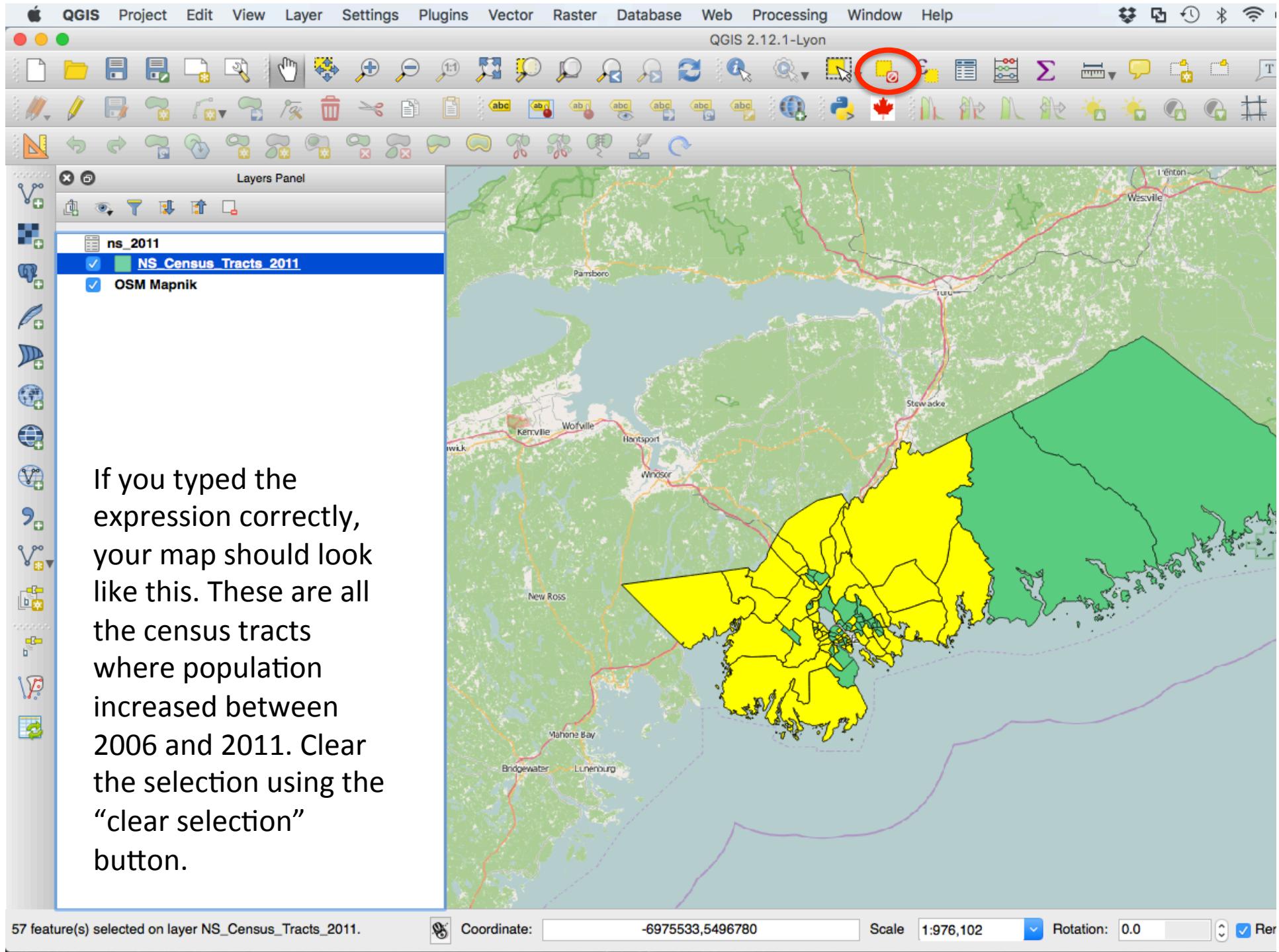
Select Close

Coordinate: -7185240,5485073

Scale 1:976,102

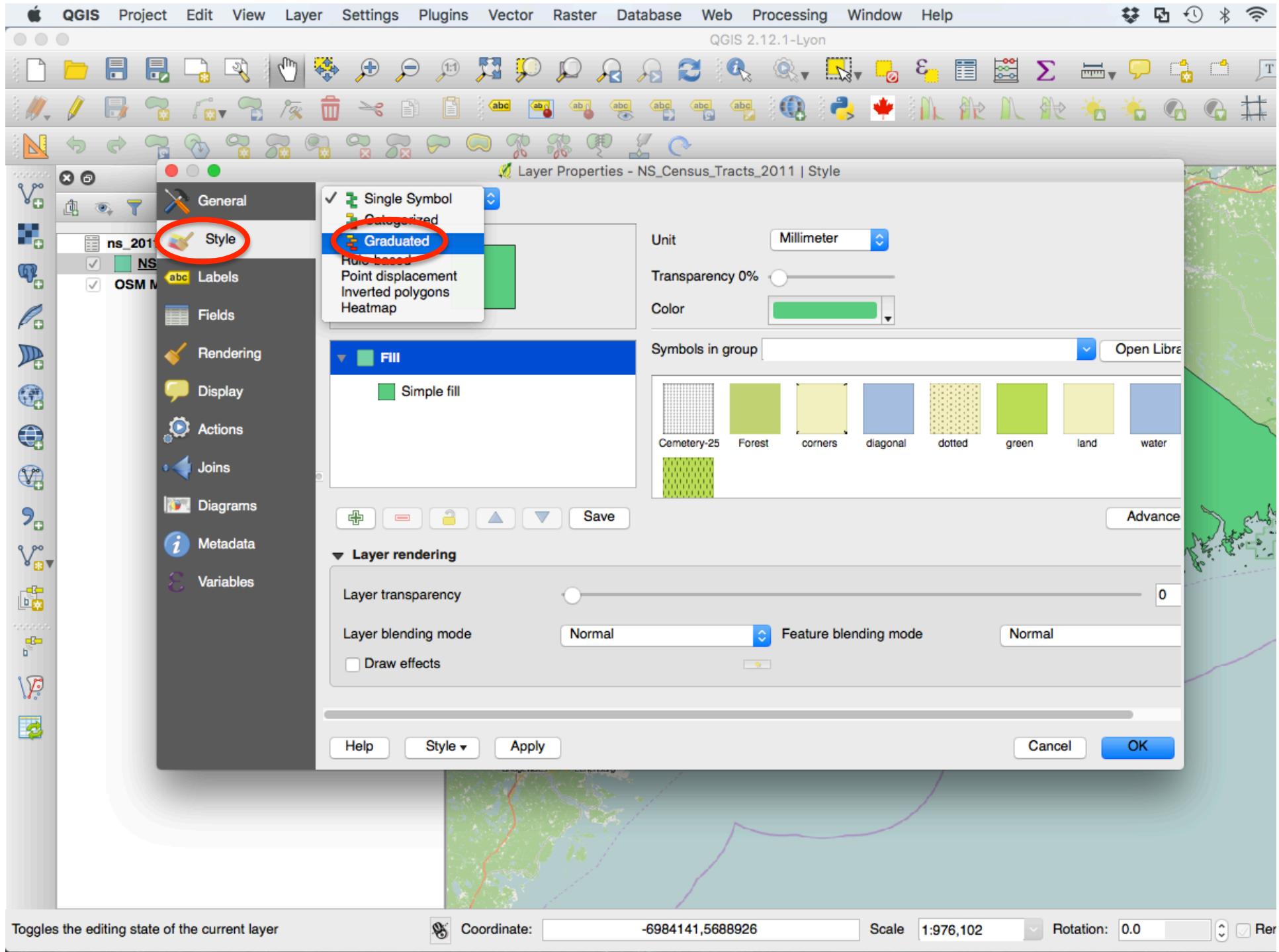
Rotation: 0.0

Re



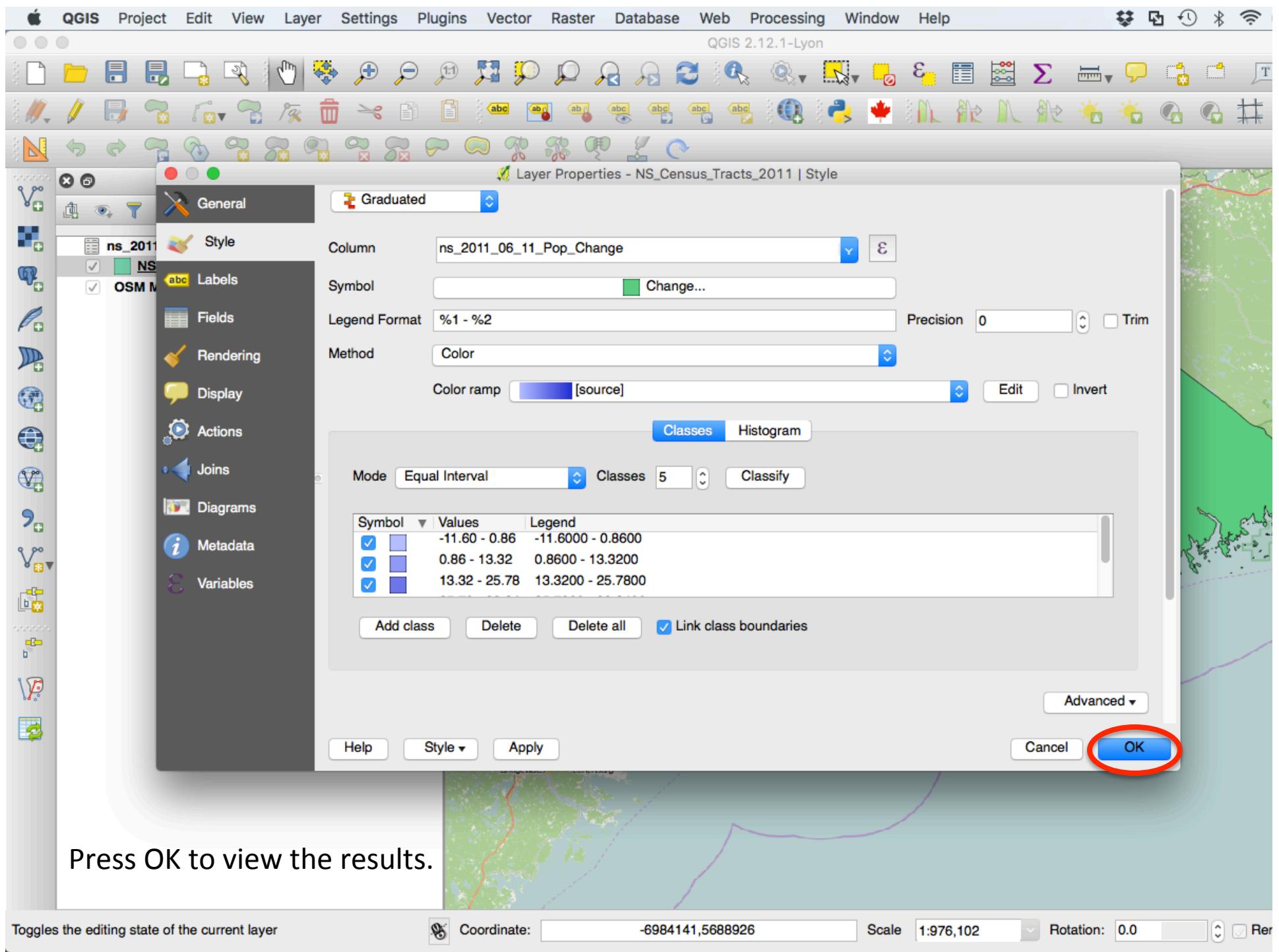
Another way to examine spatial trends is to use a “graduated style”, that is to use demographics data to apply a colour to each polygon. Open the Layer Properties dialog.

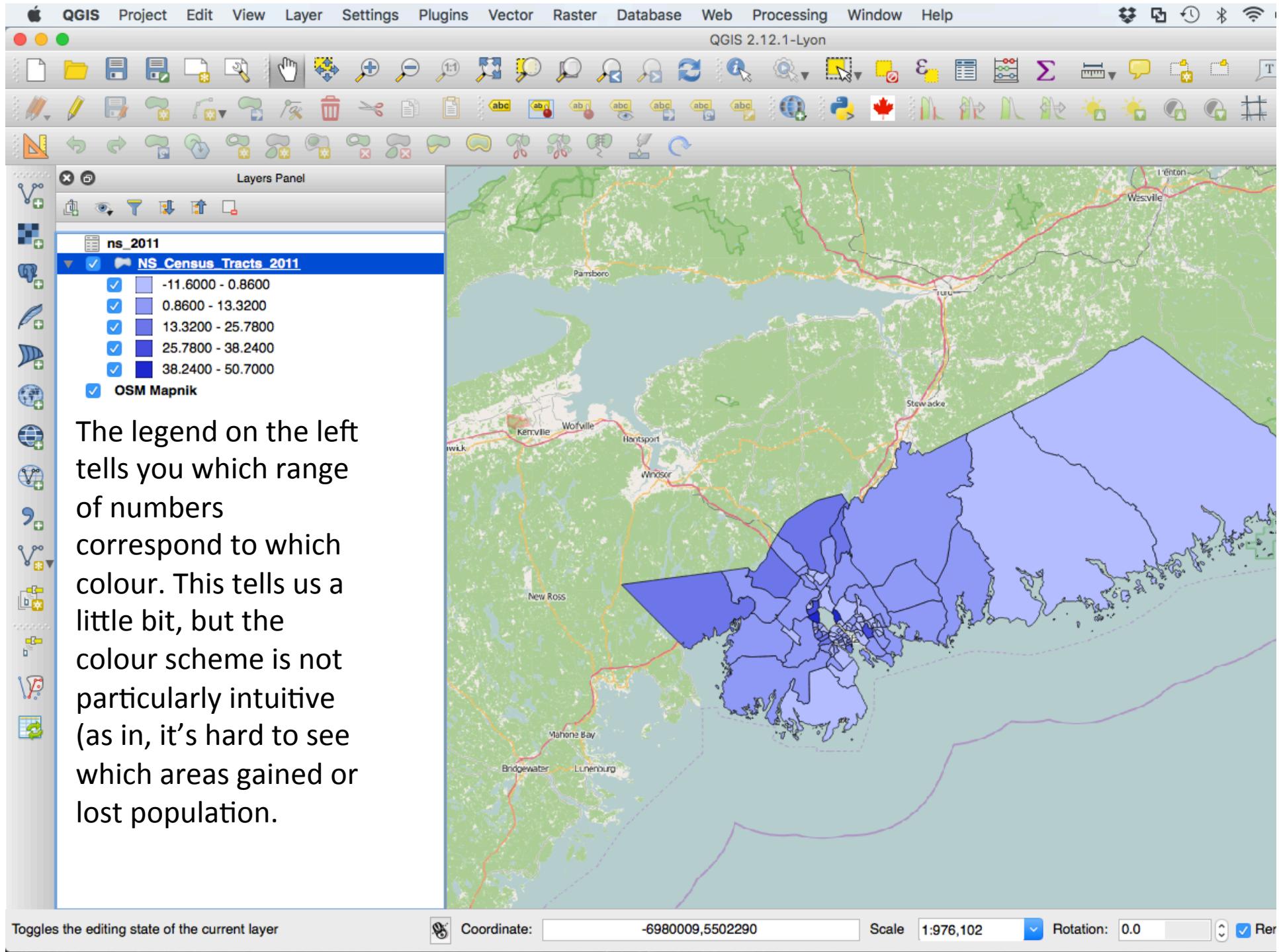
The screenshot shows the QGIS application interface. The top menu bar includes Project, Edit, View, Layer, Settings, Plugins, Vector, Raster, Database, Web, Processing, Window, and Help. Below the menu is a toolbar with various icons for file operations, selection, and editing. The main workspace displays a map of Nova Scotia, Canada, with green polygons representing administrative boundaries and orange lines representing roads. A context menu is open over one of the green polygons, listing options such as Zoom to Layer, Show in Overview, Remove, Duplicate, Set Layer Scale Visibility, Set Layer CRS, Set Project CRS from Layer, Styles, Open Attribute Table, Toggle Editing, Save As..., Save As Layer Definition File..., Filter..., Show Feature Count, Properties (which is highlighted and circled in red), and Rename.

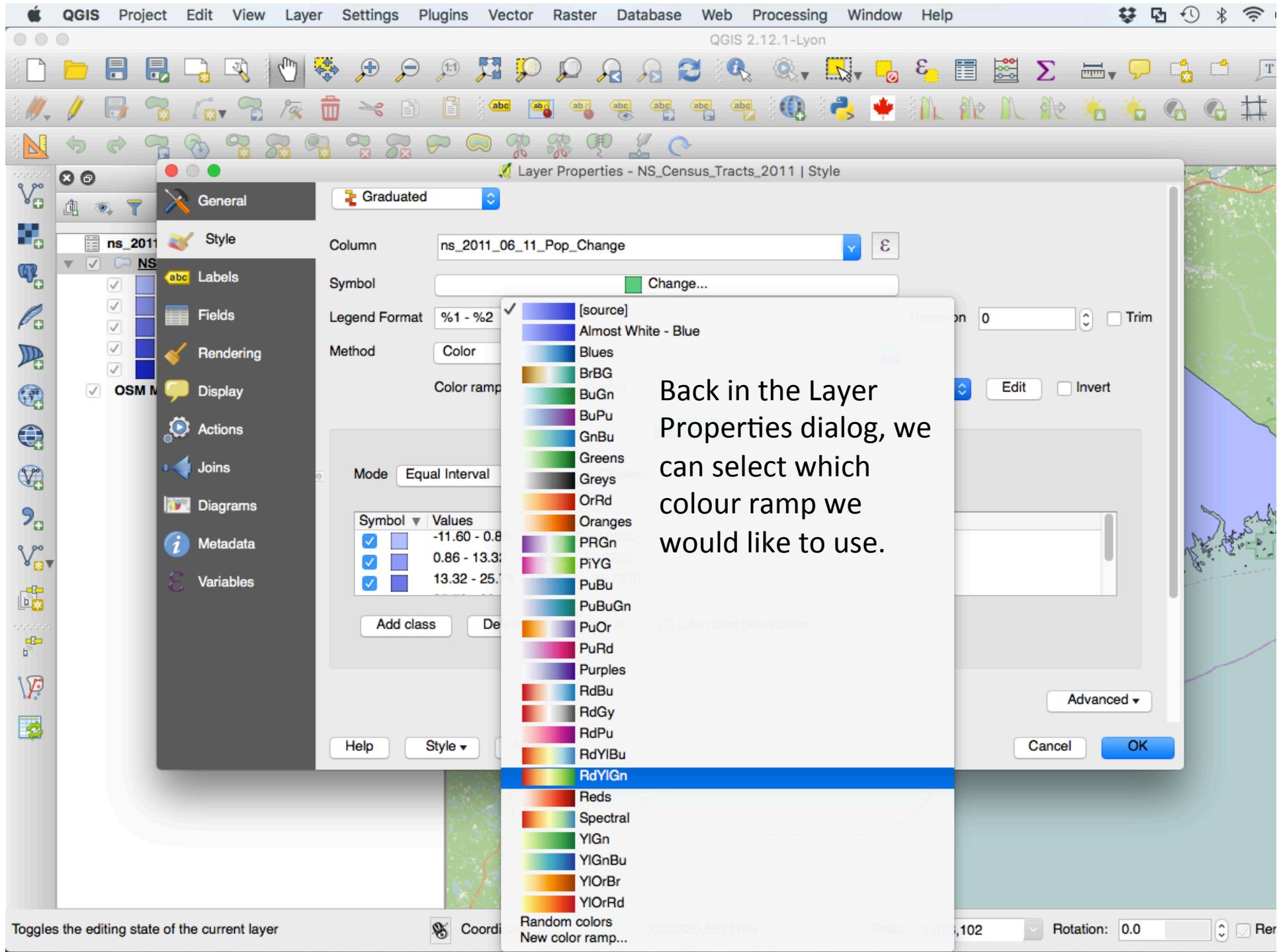


Screenshot of QGIS 2.12.1-Lyon showing the Layer Properties dialog for the "NS_Census_Tracts_2011" layer. The "Style" tab is selected. The "Column" dropdown is set to "ns_2011_06_11_Pop_Change". The "Symbol" dropdown shows "ns_2011_06_11_Pop_Change" highlighted. The "Method" dropdown is set to "Color". The "Color ramp" is set to "Almost White - Blue". The "Mode" dropdown is set to "Equal Interval". The "Classes" input field is set to "5". The "Classify" button is circled in red. The "Advanced" button is visible at the bottom right.

Select the column you would like to use for a graduated style and click Classify.







QGIS Project Edit View Layer Settings Plugins Vector Raster Database Web Processing Window Help

QGIS 2.12.1-Lyon

General

Graduated

Column: ns_2011_06_11_Pop_Change

Symbol: Change...

Legend Format: %1 - %2

Precision: 0

Method: Color

Color ramp: RdYlGn

Mode: Equal Interval

Classes: 5

Legend:

Symbol	Values	Legend
Red	-11.60 - 0.86	-11.6000 - 0.8600
Orange	0.86 - 13.32	0.8600 - 13.3200
Yellow	13.32 - 25.78	13.3200 - 25.7800

Add class Delete Delete all Link class boundaries

Advanced ▾

Help Style ▾ Apply Cancel OK

Coordinate: -7203835,5571159 Scale: 1:976,102 Rotation: 0.0

Layer Properties - NS_Census_Tracts_2011 | Style

ns_2011

Labels

Fields

Rendering

Display

Actions

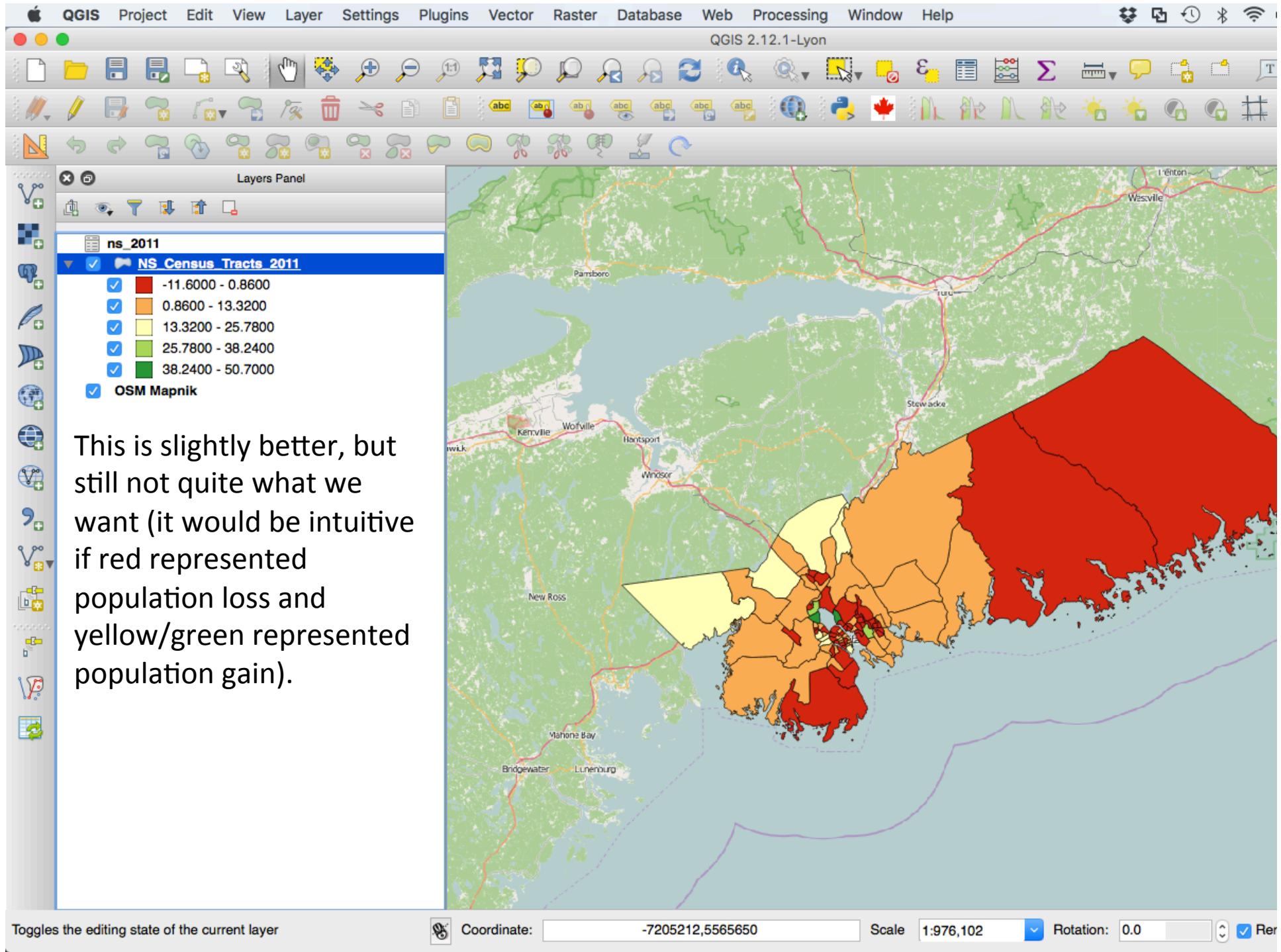
Joins

Diagrams

Metadata

Variables

OSM M



QGIS Project Edit View Layer Settings Plugins Vector Raster Database Web Processing Window Help

QGIS 2.12.1-Lyon

General

Graduated

Column: ns_2011_06_11_Pop_Change

Symbol: Change...

Legend Format: %1 - %2

Precision: 0

Method: Color

Color ramp: [source]

Classes Histogram

We can customize the range of values for colours using the “histogram” tab. Click “Load Values” to load the histogram.

Histogram bins: 50

Show mean value:

Show standard deviation:

Load values

Advanced ▾

Help Style ▾ Apply Cancel OK

Coordinate: -7205212,5565650 Scale: 1:976,102 Rotation: 0.0

Toggles the editing state of the current layer

Layer Properties - NS_Census_Tracts_2011 | Style

ns_2011

Labels

Fields

Rendering

Display

Actions

Joins

Diagrams

Metadata

Variables

OSM M

The screenshot shows the QGIS application interface with the 'Style' dialog open for the 'ns_2011' layer. The 'Graduated' style is chosen. In the 'Classes' tab of the histogram, a callout box points to the 'Load values' button, which is highlighted with a red circle. The histogram itself shows a distribution of values from 0 to 1,000 with 50 bins. The main map view on the right displays census tract boundaries colored according to the population change values.

QGIS Project Edit View Layer Settings Plugins Vector Raster Database Web Processing Window Help

QGIS 2.12.1-Lyon

Layer Properties - NS_Census_Tracts_2011 | Style

General

Graduated

Column: ns_2011_06_11_Pop_Change

Symbol: Change...

Legend Format: %1 - %2

Precision: 0

Method: Color

Color ramp: [source]

Classes Histogram

Count

Histogram bins: 30

Advanced ▾

Help Style ▾ Apply Cancel OK

Coordinate: -7205212,5565650 Scale: 1:976,102 Rotation: 0.0

Now drag each line to customize the colour scheme.

