1. Download Federal Electoral Districts and add to map document

Federal Electoral Districts (FEDs) are the geographic areas for which one Member of Parliament is elected. It is downloaded as a shapefile which can then be viewed in ArcMap.

1) In an internet browser, go to www.statcan.gc.ca
2) After you've selected English, click **Browse by key resource** and select **Maps and Geography**
3) Click on **Geographic Products**
4) Click on **Boundary Files**
5) Select **2011** as Census Year
6) In the form, select **English** for Language, **ArcGIS (.shp)** as format, and **Federal Electoral Districts (2003 Representation Order) – Cartographic Boundary File**.

7) Click **Continue** then select the link on the following page. It should look like this:

gfed000b11a_e.zip (ZIP Version, 51674.0kb)

8) Wait a moment for it to download. Spend that time trying to make sense of the gobbledygook name. Or not. We don't care.
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:

▲ 📁 AmazingMap
   ▲ 📁 Shapefiles
      ▲ 📁 FEDs
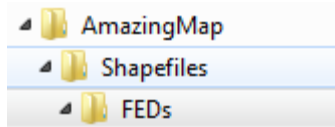
10) Unzip the file. If you don't, you'll get an error when you try to import it into ArcMap.

11) Your folder should now look something like this:

| Name	Date modified	Type	Size
📕 92-160-g2011001-eng.pdf	28/11/2011 1:57 PM	Adobe Acrobat D...	547 KB
📊 gfed000b11a_e.dbf	18/11/2011 4:23 PM	DBF File	78 KB
📄 gfed000b11a_e.prj	18/11/2011 3:39 PM	PRJ File	1 KB
Ⓐ gfed000b11a_e.shp	18/11/2011 4:23 PM	DWG TrueView Sh...	67,737 KB
🔳 gfed000b11a_e.shx	18/11/2011 4:23 PM	DWG TrueView Co...	3 KB
📦 gfed000b11a_e.zip	10/11/2014 4:16 PM	Compressed (zipp...	51,674 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).

12) You're done the download! Yay! Give yourself a pat on the back!

13) Now, open ArcMap by clicking on *Start* > *Programs* > *ArcGIS* > *ArcMap*. Once ArcMap opens, add the dataset by clicking on *File* > *Add Data...* Navigate to the project's folder and find the shapefile. Click *Ok* to add the shapefile to ArcMap.
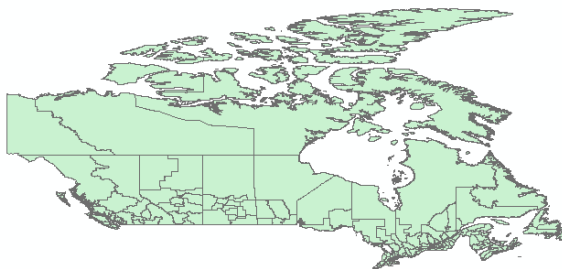
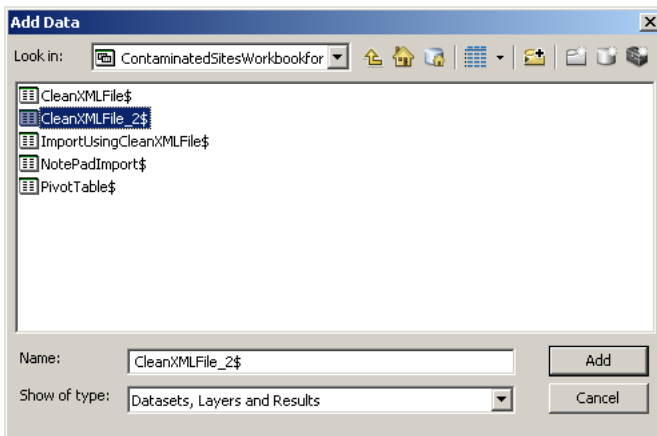

14) In the Table of Contents, right click on *Layers* > *Properties* and select the *Coordinate System* tab. Scroll down and select the *Layers* folder. You'll notice that the shapefile has a coordinate system of *GCS_North_American_1983*. This is important information for later on in the exercise. Click *Ok* to close the dialog box.
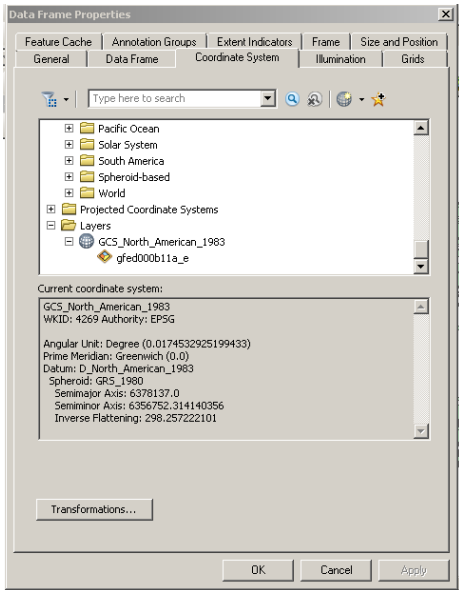
2. Add and Display Federal Contaminated Sites

The Federal Contaminated Sites was downloaded as an Excel file. Included in the data of this Excel file are rows for latitude and longitude, which we'll use to display in ArcMap. We're in luck, because these latitude and longitude are in the same coordinate system as our Federal Electoral District boundaries. Yay! If you don't have this file, go to http://madgic.library.carleton.ca/deposit/GIS/ and download it.

1) In ArcMap, add the contaminatesSitesWorkbookforArcGIS.xlsx. Click on *File* > *Add Data…*
1) ArcMap will then ask you which sheet you'd like to view. Select *CleanXMLFile_2$*

2) In the *Table of Contents* on the left, right click on *CleanXMLFile_2$* and select *Display XY Data…*
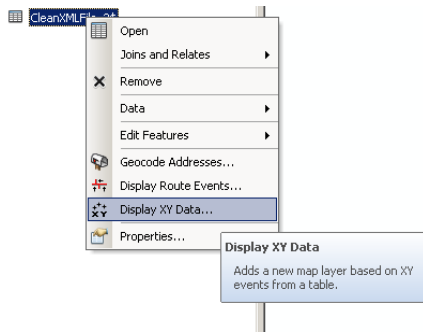
3) In the following dialog, ensure that the *X Field* corresponds to *Longitude* and *Y Field* to *Latitude*. Notice here that we'll be keeping the default coordinate system of the input coordinates to *GCS_North_American_1983*.
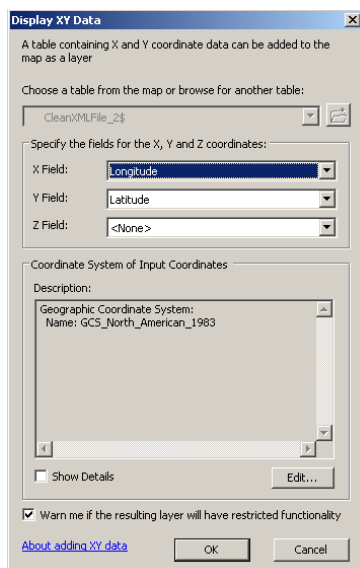
4) Click *Ok*. This will display the longitude and latitude of each contaminated sites record for Canada in that particular coordinate system.
5) In the Table of Contents, right click on *CleanXMLFile_2$ Events* > *Data* > *Export Data*…Save it your AmazingMap > Shapefile folder and name it **contaminated_sites.shp**. When prompted to add the file in ArcMap, agree. Now, we have a permanent point file of the locations of the contaminated sites.
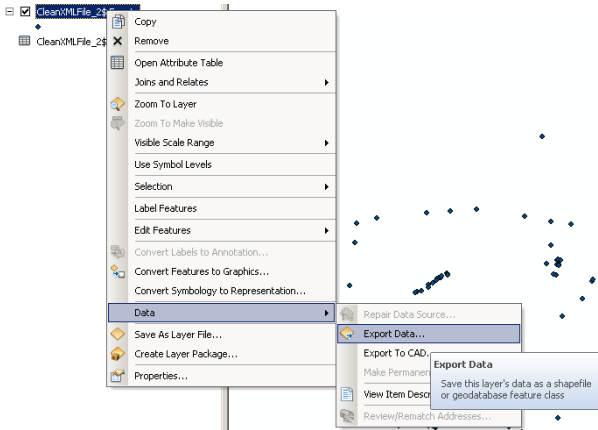
6) You should now have 2 layers in ArcMap. In the **Table of Contents**, ensure that the **contaminated_sites.shp** is on top of the **federal electoral district** boundary.
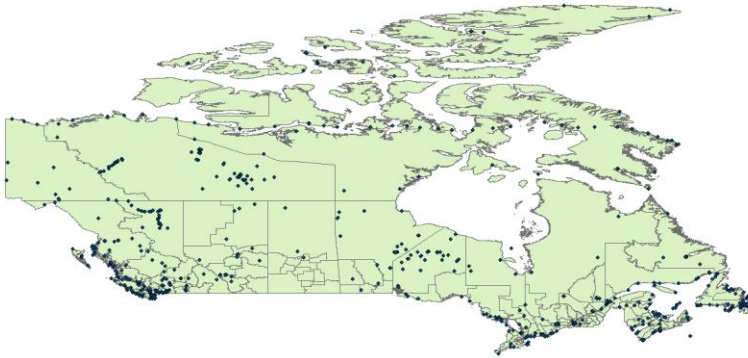
3. Querying and Extracting

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

1) Right click on the **contaminated_sites.shp** in the table of contents, select **Open Attribute Table**.
2) You will note that there are over 700 features in the dataset. In order to query the data, click on the **Select By Attributes** button 🔲 on the attribute table toolbar.
3) The **Select by Attributes dialog box** will appear, which 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 **high priority for Action** sites.

Field names

Query components

Query statement

a. Click the **Verify** button. You want to see this:

b. If your expression was successfully verified, click **Apply**. You should notice at the bottom of the attribute table that it now says something like (648 out of 777 selected). Click the Show Selected Records button in the attribute table to view only the selected features.

c. Right click **contaminated_sites.shp** in the Table of Contents.

d. Select **Data > Export Data…**

e. In the Export Data dialog box, make sure **Selected features** is in the Export drop-down menu.

f. Browse to where you would like to save your file. We recommend naming it something helpful, such as **contaminated_priority.shp**. Ensure that you Save as type **Shapefile**. Click **Save**.

g. Click **OK**.

h. Wait for the Export Progress box to complete.

i. Click **Yes** to add exported data to map as a layer.

j. Click on the checkbox beside **contaminated_sites** to turn it off and view only your new layer.

4. Calculate how many points are found in a polygon

Sometimes it is helpful to know how many instances of something (like contaminated sites) occur within a particular area (like FEDs).

1) Right click on the FED shapefile (gfed000b11a_e) and select *Zoom To Layer* to view it at its extents. It should look something like this with the *contaminated_priority* layer turned on as well.
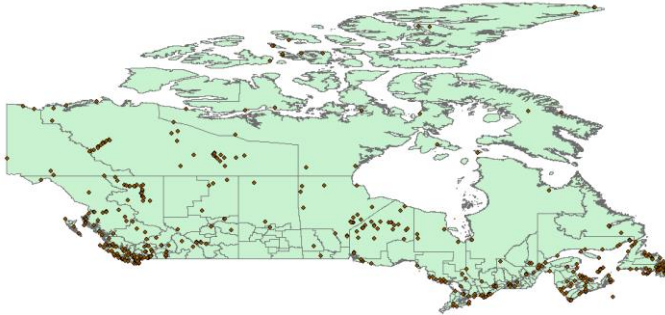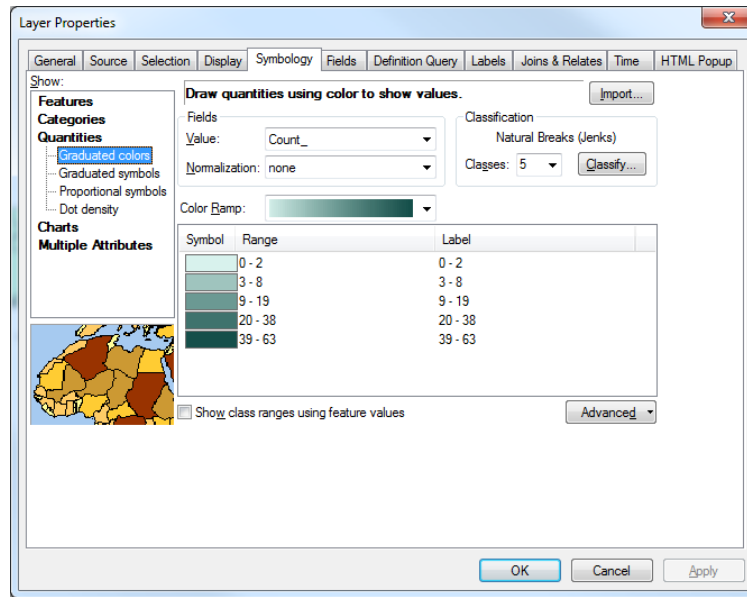

2) In order to find out how many high priority contaminated sites are in each FED, we will perform a spatial join. Right-click on **gfed000b11a_e**. Select **Joins and Relates > Join…**

3) Fill out the Join Data dialog box as seen here:
   a. Join data from another layer based on spatial location (we want to find out which high priority points fall within the FED polygons)
   b. Choose the layer: *contaminated_priority*
   c. Summarize by **Sum** (this will provide a total number of contaminated sites within each electoral district)
   d. Browse to the location you wish to save your resulting shapefile, and name it something helpful like *FED_PrioritySites*.
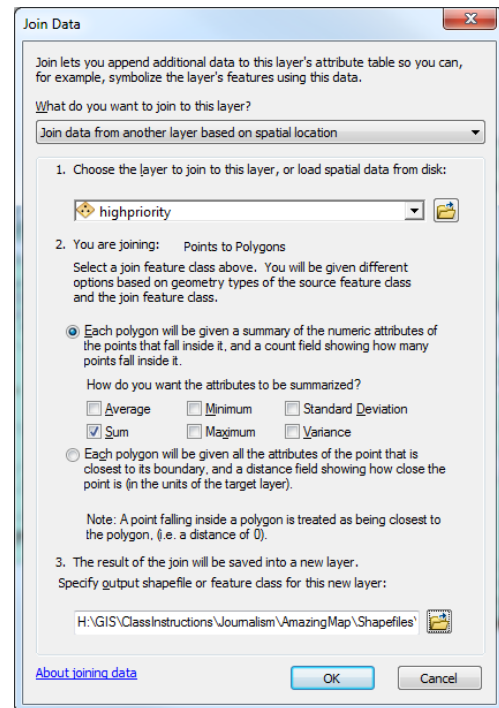
4) Click *OK*

5) *FED_PrioritySites* will be added to your map. Right-click and **Open Attribute Table**.

6) Note the **Count_** field. This gives a total of contaminated sites within each electoral district.

7) Double-click on the **Count_** field name to sort it numerically (ascending). Double-click it again to sort descending.

8) To symbolize the FED_PrioritySites shapefile based on the Count_ field, close the table and in the table of contents right-click *FED_PrioritySites* and select **Properties…**

9) Click the **Symbology** tab in the Layer Properties dialog box.

10) Click **Quantities > Graduated Colors**.

Prepared by Joël Rivard and Rebecca Bartlett, Carleton University Library, Nov. 2014

11) Fill it in as seen below:

a. Value field should be **Count_**
b. Pick your favourite colour ramp. As you are showing density, 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:
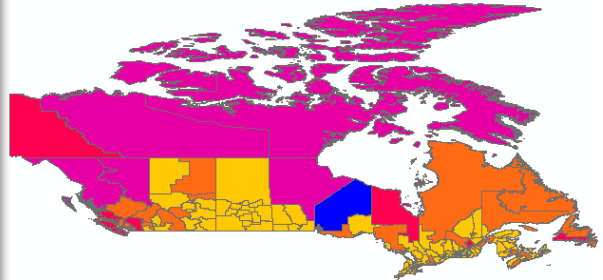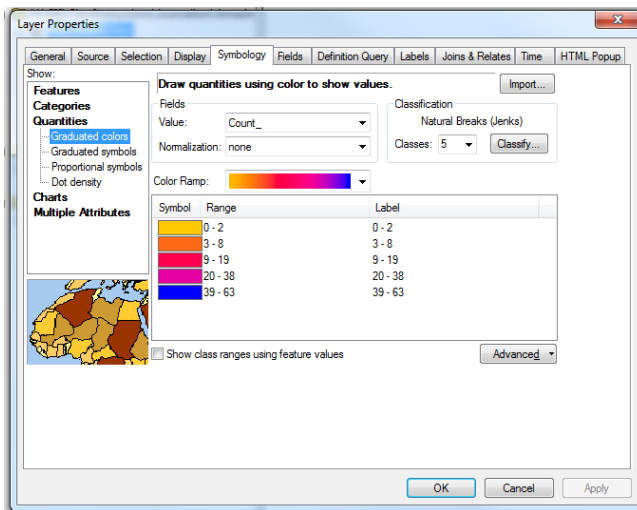
12) Your on-screen map should now look something like this, with the darker hues showing us which FEDs have the most contaminated sites.
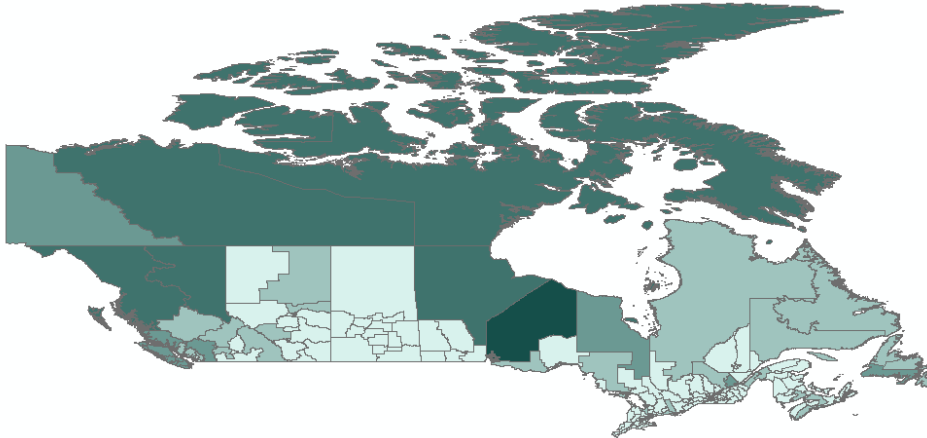

13) Let's not spend too much time here as section 8 focuses on creating our map layout and making sure that our map looks just right!

5. Extracting British Columbia FEDs

Selecting features from a shapefile allows users to identify or more easily locate a subset of features on your map. You'll most likely work with selected features when you are querying, exploring, analyzing, or editing data. Applying a selection is also a way of specifying the features for which you want to calculate statistics, view attributes, move, export as a new layer, and so on.

1) Right-click on **FED_PrioritySites** and select **Open Attribute Table**
2) Click the attribute table menu drop-down arrow and select **Select by Attributes…** or click the Select by Attributes button:
3) Like with the querying we did earlier, we will construct an expression to select only FEDs in British Columbia. In this case, the expression is "PRNAME" LIKE 'British Columbia / Colombie-Britannique'
4) Click the **Verify** button to confirm that the expression is valid.
5) Click **Apply**. You should now have 36 of 308 selected in the attribute table.
6) Close the **Select by Attributes** window.
7) We're now going to export ONLY the selected British Columbia FEDs. To do this, right click **FED_PrioritySites**.
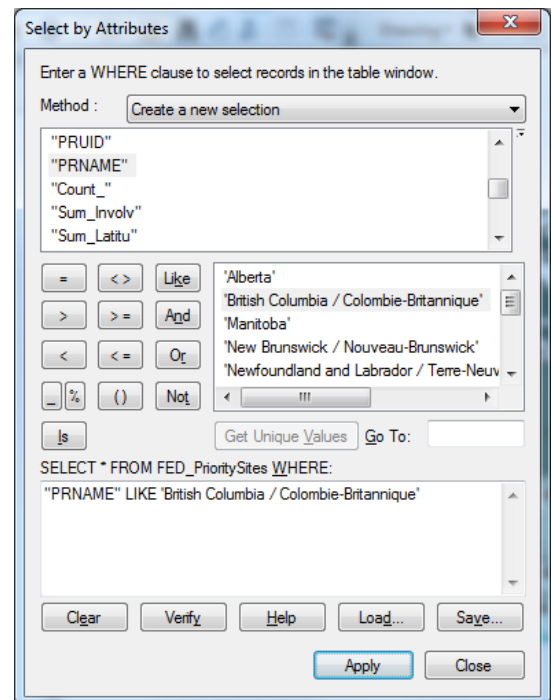
8) In the menu, select *Data… > Export Data…*
9) In the dialog box, make sure that it says *Export: Selected Features* (as shown below)
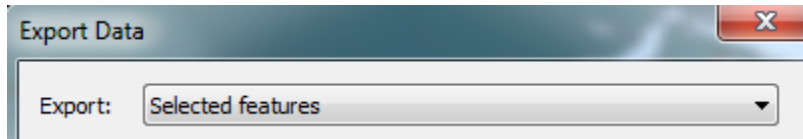
10) Browse to your project folder and save the file. We saved it as *FED_PrioritySites_BC.shp*.
11) Add it to your map when prompted.

6. Downloading and Joining Census Data

We now want to look at the census data for the FEDs in British Columbia to perhaps find a pattern. The Census includes information about population & language while the National Household Survey (NHS) includes data about income, immigration, workplace, and more.

1) We're going to use the Canadian Census Analyzer from the University of Toronto. The URL is http://dc1.chass.utoronto.ca.proxy.library.carleton.ca/census/. You will need to be on Carleton campus or sign in with your Carleton ID from elsewhere.
2) On the resulting page, click *Federal Electoral District* from the list under Census Profile Tables.
3) Then select *2011 (cumulative) FEDs 2003 Representation Order*. The following page is where we'll make our selections.
4) UNCHECK the checkbox by the letter A in the by Name tab.
5) Click the *by Province* tab and select British Columbia. In the resulting list below, click the *check all* link.

6) Scroll down to *Step 2: Specify NHS Profile Variables for Retrieval* and click the *Inc* tab (far right)
7) Check off *Total income in 2010, Median income*, and *Average income*

| Citiz, Imm | Imm, Gen | Eth,Relig, Aborig | Lang,Mobi, Edu | Wk,LFS, Occ | Ind, Wk | Trans | Hous | Inc |

Income of individuals in 2010 (part 1) - Both sexes

☑ Total income in 2010 of population aged 15 years and over; Both sexes (v2293)
    ☐ Without income; Both sexes (v2294)
    ☐ With income; Both sexes (v2295)
        ☐ Under $5,000; Both sexes (v2296)
        ☐ $5,000 to $9,999; Both sexes (v2297)
        ☐ $10,000 to $14,999; Both sexes (v2298)
        ☐ $15,000 to $19,999; Both sexes (v2299)
        ☐ $20,000 to $29,999; Both sexes (v2300)
        ☐ $30,000 to $39,999; Both sexes (v2301)
        ☐ $40,000 to $49,999; Both sexes (v2302)
        ☐ $50,000 to $59,999; Both sexes (v2303)
        ☐ $60,000 to $79,999; Both sexes (v2304)
        ☐ $80,000 to $99,999; Both sexes (v2305)
        ☐ $100,000 and over; Both sexes (v2306)
            ☐ $100,000 to $124,999; Both sexes (v2307)
            ☐ $125,000 and over; Both sexes (v2308)
  ☑ Median income $; Both sexes (v2309)
  ☑ Average income $; Both sexes (v2310)

8) Scroll down to *Step 3: Specify the output details and submit query*
9) Include *Province Code* and *FED Code* in the result

10) Because the data will be joined to a shapefile, select *dBase (DBF) file* as output format
11) Click *Submit Query* then download both files (data and header) and save in project folder. Next, we'll join the NHS data to the **FED_PrioritySites_BC** shapefile in ArcMap.
12) In ArcMap, right click **FED_PrioritySites_BC**, the select *Joins and Relates>Join....*
13) We will do a non-spatial join by joining attributes from a table, so select *Join attributes from a table* in the drop-down menu.
14) In #2, browse to the NHS data file in DBF format that is in your project folder.
15) Return to #1 and select *FEDUID* as the field to match.

16) In #3, select ***COL0*** as the field in the table to base the join on. (You can figure out it's COL0 by looking at the header file and noting that it's the GEOUID.)
17) Click ***OK***.
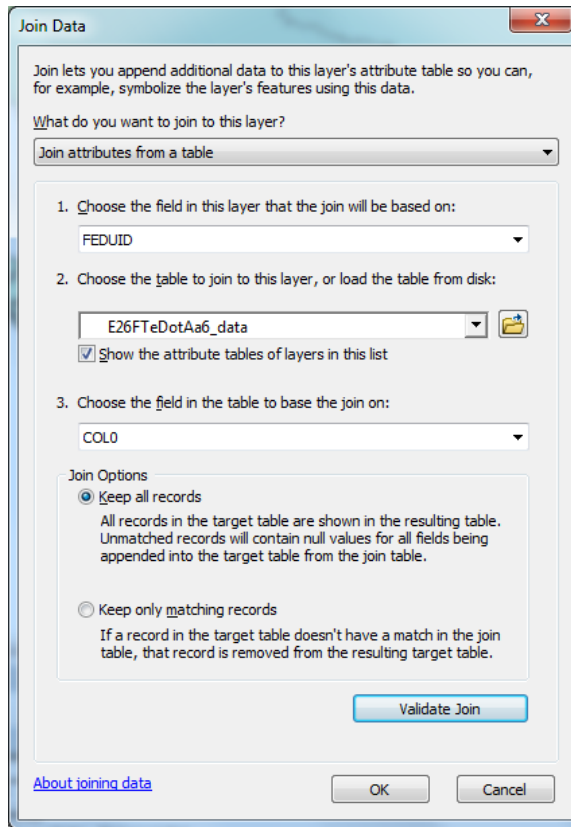
18) To make the join permanent, we have to export the data. But before doing so, let's change the coordinate system of our map. As we saw earlier, the current coordinate system of the map is ***GCS_North_American_1983***. This coordinate system is not a proper coordinate system to use for this particular area as if doesn't properly display our information cartographically. In addition, if we were ever to take any measurements, they would be somewhat meaningless as these would be done in degrees, seconds and minutes.

19) To change the coordinate system, in the table of contents, right click on *Layers* > *Properties*. Select the *Coordinate System* tab and in the search box, type in *Canada Lambert Conformal Conic*. Select *Canada Lambert Conformal Conic* and click *Ok*.
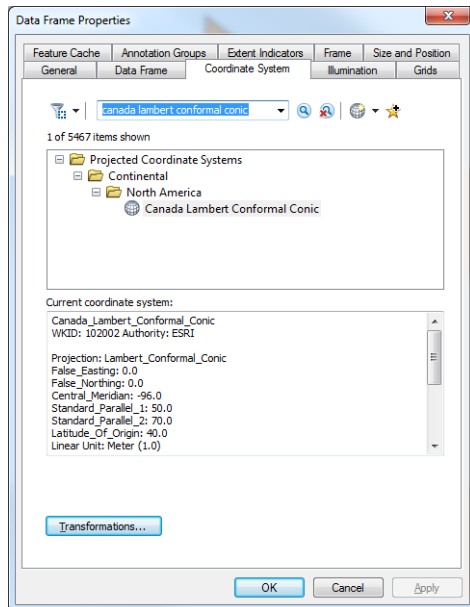
20) Now, let's make that join permanent. In the table of contents, right click *FED_PrioritySites_BC > Data > Export Data…* Make sure you select *the data frame* coordinate system (which we setup in the previous step). Save the file as **FED_PrioritySites_BC_IncomeLCC.shp**
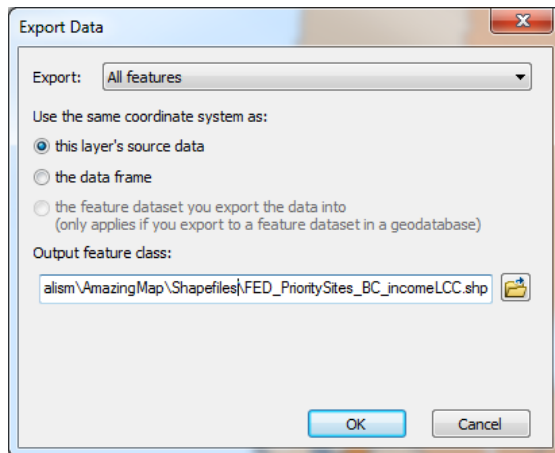
21) When asked to add the layer to the map, say yes.
22) Remove the **FED_PrioritySites_BC** from the table of contents.

7. Symbology and labels

Let's take a look at how we can use symbology and labels to provide us with layers of information from the same shapefile.

1) Open the attribute table for **FED_PrioritySites_BC_IncomeLCC** to view the table with the NHS data joined to it. Note that the column names for the table are not helpfully named. We can change that!

2) Right click on **FED_PrioritySites_BC_IncomeLCC** and select *Properties…*.

3) Click on the *Fields* tab

4) On the left you will see a list of all the fields. Scroll to the bottom to see COL0, COL1, etc. COL3, COL4 and COL5 are the ones we are interested in as they have the income data as noted in the header file. On the right of the window, change the *Alias* to something helpful for each field. Use the header file that was downloaded from the census analyzer if you forget what COL3, COL4 and COL5 mean. This is what will be displayed in the attribute table. Click Apply when done.
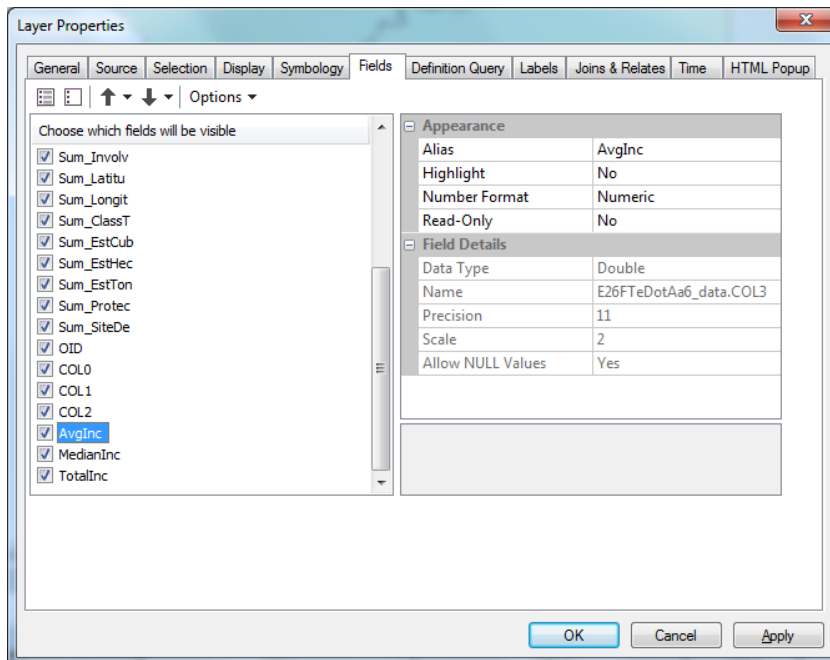
COL0	COL1	COL2	AvgInc	MedianInc	TotalInc
59001	59	001	35638	26401	105830
59002	59	002	36846	26795	104885
59003	59	003	33944	25725	111745
59004	59	004	37624	29031	88065

5) Change the symbology of **FED_PrioritySites_BC_IncomeLCC** to a colour ramp based on *Average Income*. (Refer back to page 6 if you need a quick reminder on how to do that.) Click *Apply*.

6) Now let's label each FED with the number of high priority contaminated sites! Whee!

7) In *Properties*, select the *Labels* tab.

8) Check the *Label features in this layer* box, with method *Label all features the same way*.

9) Set the label field to *Count_*.

10) Choose your label font. In the example it's Arial, size 12, bold, white.

11) Click **OK**.
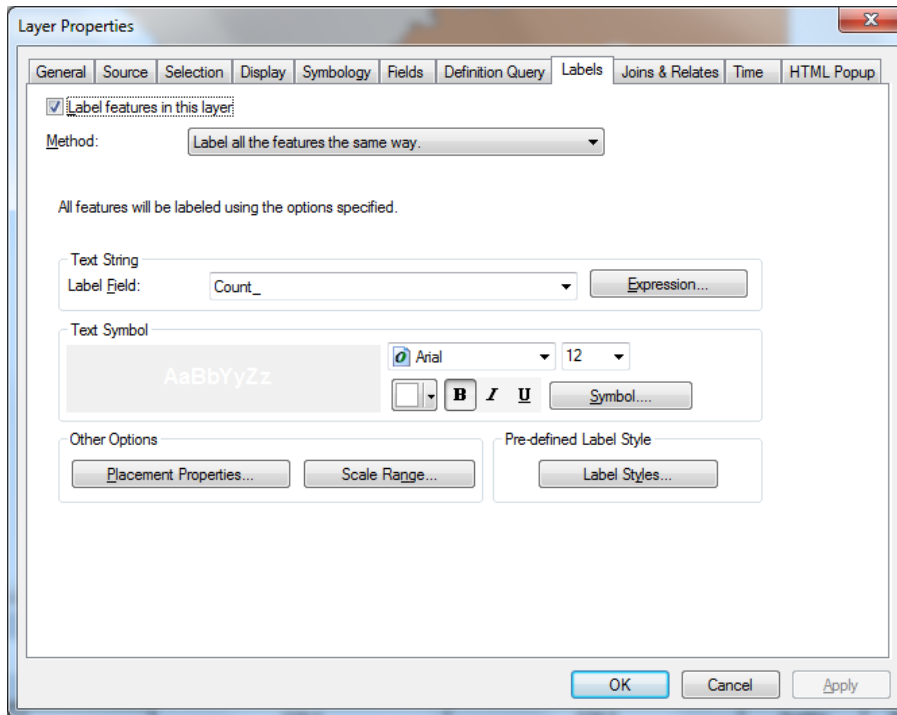
12) Your map should now look something like this:
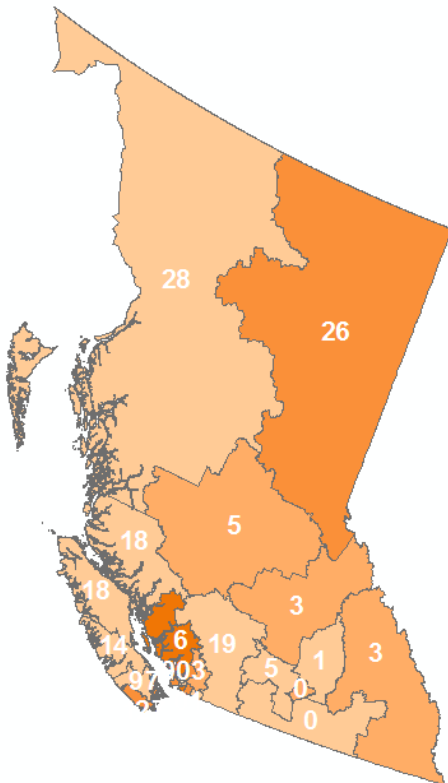
8. Creating a Map Layout

To create a map layout, you'll want to work with it in layout view. In layout view, you will be able to place and arrange map elements such scale bar, a legend and a map title.

1) In the menu, select *View* > *Layout View*. This will open the Layout view with your current map. To return to the previous view, click on *View* > *Data View*.
2) You'll notice that the default layout view is in portrait mode. Since the shape of the city of Ottawa is better viewed in landscape, in the menu, click on *File* > *Page and Print Setup*. Change the orientation to Landscape. You may also want to change the units of measurement from centimeters to inches. Click *Ok*.
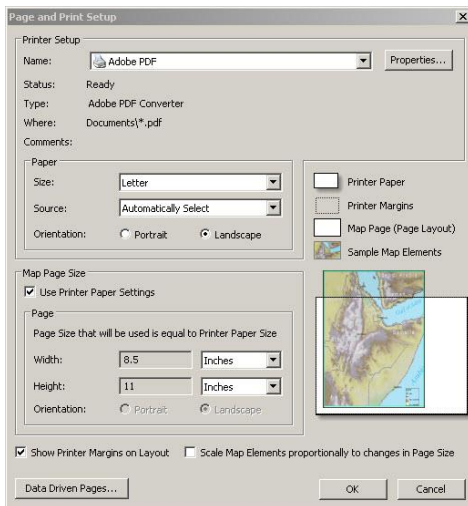
3) Resize the grid around the map to match up with the dotted lines in the layout view. The dotted lines represent the margins of the layout.
4) Using the *zoom* and *pan* tools from the *Tools Toolbar*, zoom into your area of the map. Please keep in mind that there are two types of zoom tools available as indicated below.

Tools Toolbar ⟶
Layout View Toolbar ⟶

12) For map layers to display with meaningful labels in your map layout, change the layer name in the Table of Contents.
   a. In the *Table of Contents*, double click on the name of the layer that you want to change.
   b. In the *Properties* Window click the *General* tab.
   c. Change the layer name to your desired name and click *Close*.
13) Change the colours and symbols of the shapefiles
   a. In the *Table of Contents*, double click on the symbol and in the *symbol selector* window, select the desired colour, size and symbol.

Adding Other Map Elements

Adding a North Arrow

1. In the menu, select *Insert* > *North Arrow*.
2. Select a north arrow and click *OK*. The north arrow will be added to a random location on the map, usually somewhere in the centre.
3. Click and drag the north arrow into place on your map.
4. Resize the north arrow by clicking and dragging a selection handle.

Adding a Scale Bar

1. In the menu, select *Insert* > *Scale Bar*.
2. Select a scale bar and click *Ok*.

Optional: If you'd like to edit in more detail the scale bar, follow these instructions.

3. Click Properties to modify the scale bar's properties.
4. Click the Scale and Units tab.
5. Click the arrow buttons to set the number of divisions.
6. Click the arrow buttons to set the number of subdivisions.
7. Click the When resizing drop-down arrow and click how you want the scale bar to respond when the map scale changes:
   a. Adjust width – the width of the scale bar will vary with the map scale. The division value and number of divisions remain constant.
   b. Adjust division value – the division value will vary with the map scale. The number of divisions and the width of the scale bar remain constant.
   c. Adjust number of divisions – the number of divisions will vary with the map scale.
8. Choose the units for the scale bar.
9. Click Symbol and choose a test style for the scale bar labels.
10. Click OK and OK again to close the dialog box.
11. Click and drag the scale bar into place on your map.

Adding a Legend

1. In the menu, select *Insert* > *Legend*. The Legend wizard appears.
2. By default, all the layers on the map will appear as legend items in the legend. To remove a legend item, select it, and click the *left arrow* button.
3. Use the *Up* and *Down* arrow buttons to order the legend items.
4. Click *Next*.
5. Type a title for the legend.
6. Set the text color, font, and size as desired, and click *Next*.
7. Select a border, background and/or drop shadow as desired by clicking their respective drop-down boxes. Click *Next*.

8. Select a legend item in the list to modify the symbol patch.
9. Set the patch properties as desired and click **Next**.
10. Set the spacing between legend elements by typing a value in the appropriate box.
11. Click **Finish**.
12. Click and drag the legend into place on your map.

Adding a Title to a Map

1. In the menu, select **Insert** > **Title**.
2. Type in the title in the box. Click **OK**.
3. Click and drag the title into place on your map.
4. The title can also be formatted using the **Draw** toolbar.