Chapter 6: Data Acquisition Methods, Procedures, and Issues

In this Exercise:

- Data Acquisition
- Downloading Geographic Data
- Accessing Data Via Web Map Service
- Using Data from a Text File or Spreadsheet w/Coordinates
- Joining Tabular Data
- Downloading Data from a GPS
- Creating and Editing Data
- Online Data Resources

This exercise requires an active Internet connection!

Data Acquisition

The data used in previous exercises has been provided on a CD or loaded directly on the computer.

In many situations users will want to build projects that include data acquired from other sources. In addition, users will frequently add data that they themselves have created to overlay with available geographic data.

The process of **Data Acquisition** involves a number of specific tasks that can be challenging. Procedures typically include:

- Locating and reviewing the properties of available geographic data
- Downloading files
- Extracting contents from compressed files (used to reduce file size)
- Transferring all relevant files to directories for use in the GIS application

There are a number of issues to consider when beginning the Data Acquisition process that can be identified by viewing available **Metadata**.

Data Acquisition and Metadata

Metadata should always accompany geographic data. As mentioned in previous chapters, metadata is the information that will tell potential users about the specific properties of geographic data layers. All VCGI metadata follows a federal format, however any metadata is better than none! Even a brief paragraph about who created it, why, and when as well as definitions of codes can be invaluable. Ask for information about the data when you get it from a source other than VCGI, and create simple metadata if you create new GIS data.

1. GIS File Formats

Geographic data may be available in a variety of file formats. Thus far we have used ESRI **Shapefiles** and **Imagery** in JPEG2000 or TIFF format.

QGIS can use data and data services of the following types:

- PostGIS and SpatiaLite
- Most vector formats supported by the OGR library, including ESRI shapefiles, MapInfo, SDTS and GML
- Raster formats supported by the GDAL library, such as digital elevation models, aerial photography or landsat imagery
- GRASS locations and mapsets
- Online spatial data served as OGC-compliant WMS, WMS-C (Tile cache), WFS and WFS-T

A growing collection of open source software and utilities for GIS that may be useful for file conversions can be found on the Open Source Geospatial Foundation Website (http://www.osgeo.org/).

Metadata, as well as any online description, should include **Distribution Information** describing the format of the available digital data.

Metadata:

- Identification Information
- Data Quality Information
- Spatial Data Organization Information
- Spatial Reference Information
- Entity and Attribute Information
- Distribution Information
- Metadata Reference Information

Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Format_Name: SHP
Format_Specification: ESRI Shapefile format (compressed to ZIP format)
Format_Information_Content: geospatial data
File_Decompression_Technique: ZIP decompression software

2. Coordinate Reference System (CRS)

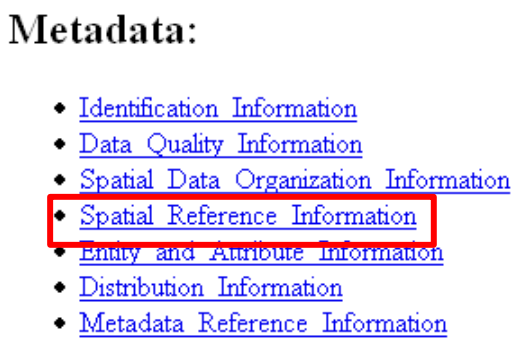
In Chapter 5, we set the Coordinate Reference System to VT State Plane Meters, NAD 83. We also turned on the "Enable on the fly CRS

transformation" option because this allows the software to transform data from whatever coordinate system and project it is natively in to the coordinate system and projection that we have set for our project. By doing so, we ensure that the data lines up and scales properly.

The software is able to perform these functions because of a file associated with each shapefile with the following extension: .prj.

a) Open your file browser (outside of QGIS) and navigate to the C:\INTROGIS\DATA FOLDER
b) Right click on a file with a .prj extension and choose Open With and then Notepad. Note that this file is simply a text file defining the projection, coordinate system, units, and datum for this shapefile.
c) Projection files give GIS software the information they need to transform the data into whatever projection, coordinate system, and datum the project is set to. This allows all data layers to line up and scale properly.
d) **TIP:** if you have a shapefile that does not have a .prj file, but you actually do know that it is the same projection and coordinate system as other data you have (e.g. VT State Plane Meters NAD 83…) you can simply make a copy of an existing .prj file and "save as" with a name that exactly matches the new data's name. This makes the new .prj file part of the new shapefile and indicates to GIS software what its coordinate system and reference system are.

The **Spatial Reference Information** section of metadata will list information describing the coordinate system.



For example, the Vermont State Plane Coordinate System is a Coordinate System that has been projected. This means that the geographic data has been translated from a spheroid surface (the earth) onto a flat map. Metadata will include the projection (Transverse

Mercator), the datum (NAD83), map units (Meters), as well as other specific values.

Understanding the specific values defined by a Coordinate System and Projection is critical when adding and assembling data themes in a GIS project and application (see below).

Downloading Geographic Data

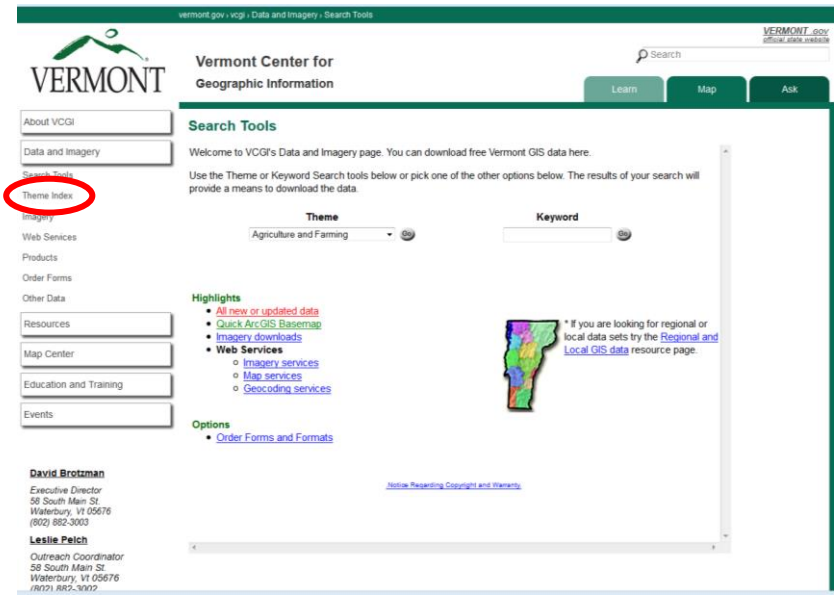
Geographic data is available online from a wide variety of sources and websites.

1. Vermont

The main source of public GIS data in Vermont is the **Data and Imagery** section of the VCGI website (http://vcgi.vermont.gov/). This online resource is available to users who wish to search for and download free Vermont GIS data from VCGI. Many of the data sets created by regional, state, and federal organizations are found here. Available data varies in content, scale, age, and accuracy.

It is important to refer to the associated metadata for each data layer.

Data is organized by Themes (categories) that may be searched on the warehouse site using the Theme search engine or the Theme Index page to view availability. The Keyword search provides another method for finding specific data layers.

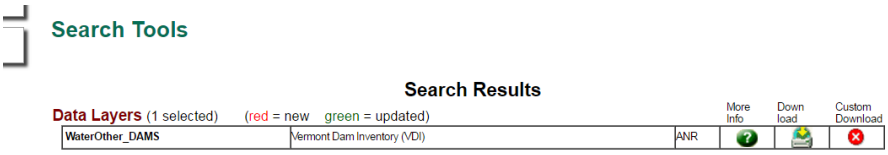


A. To understand the steps involved when acquiring data from the VCGI website, follow the instructions below to download a new data layer.

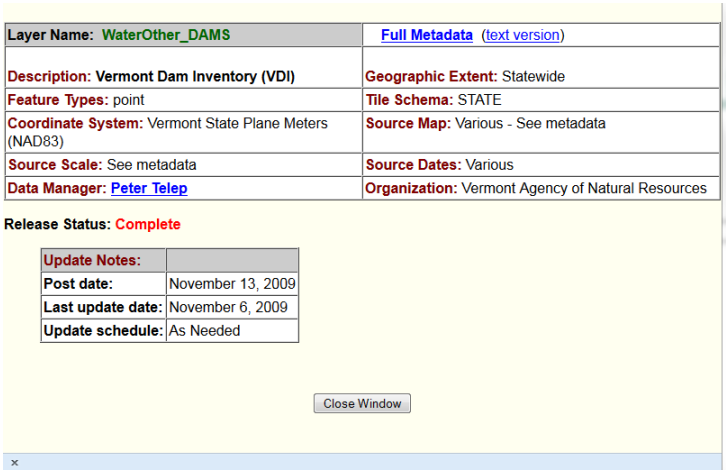
a) From the **Data and Imagery** page (http://vcgi.vermont.gov/warehouse/search_tools) type “dams” into the Keyword search

b) Click “Go”

c) Search results will display one (1) data layer, WaterOther_DAMS.



d) Click **More Info** to view additional information about this layer.



Layer Name: WaterOther_DAMS	Full Metadata (text version)
Description: Vermont Dam Inventory (VDI)	Geographic Extent: Statewide
Feature Types: point	Tile Schema: STATE
Coordinate System: Vermont State Plane Meters (NAD83)	Source Map: Various - See metadata
Source Scale: See metadata	Source Dates: Various
Data Manager: Peter Telep	Organization: Vermont Agency of Natural Resources

Release Status: Complete

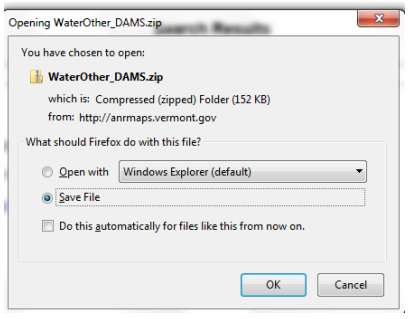
Update Notes:	
Post date:	November 13, 2009
Last update date:	November 6, 2009
Update schedule:	As Needed

Close Window

e) Click on **Full Metadata** to view the metadata file.

f) Close the metadata window when done.

g) In the Search Results window click on **Download** in order to download the whole statewide data layer.



h) In the Save As window change the name of the file to **dams.ZIP** and navigate to a directory where you have been instructed to save files and save this file.

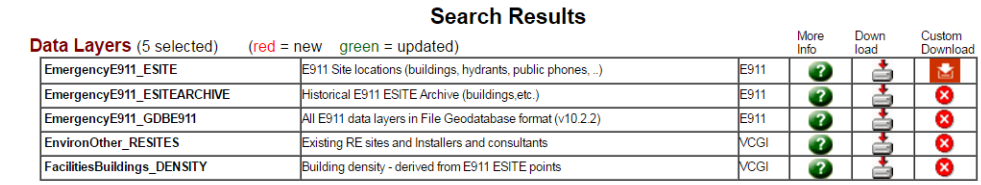
i) Using a file manager, navigate to where you have saved the file, right click and choose "extract all." Make sure to save the unzipped data to an appropriate folder.

When extracted there will be four (4) files that together are necessary for the ESRI Shapefile of dams in Vermont (points).

Name	Type	Size	Date Modified
EMERGENCY_DAMS_POINT.dbf	DBF File	1,169 KB	2/5/2007 1:55 PM
EMERGENCY_DAMS_POINT.prj	PRJ File	1 KB	2/5/2007 1:55 PM
EMERGENCY_DAMS_POINT.shp	SHP File	59 KB	2/5/2007 1:55 PM
EMERGENCY_DAMS_POINT.shx	SHX File	8 KB	2/5/2007 1:55 PM

B. Some data offers the "Custom Data Download" option as well.

a. One example is the data created by the E-911 board to represent each address in Vermont with one point – the esite data layer:

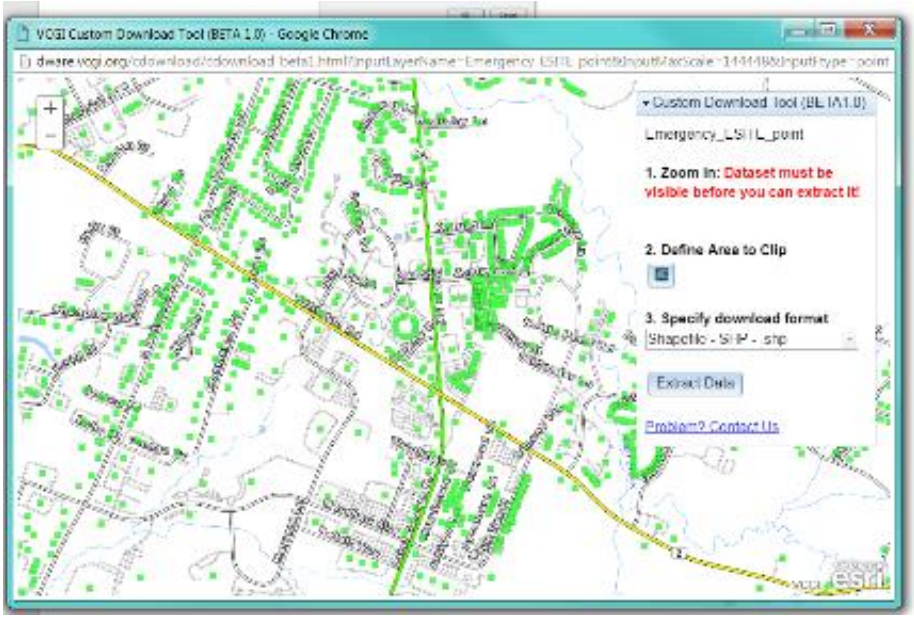


Search Results

Data Layers (5 selected) (red = new green = updated)

			More Info	Down load	Custom Download
EmergencyE911_ESITE	E911 Site locations (buildings, hydrants, public phones, ..)	E911			
EmergencyE911_ESITEARCHIVE	Historical E911 ESITE Archive (buildings,etc.)	E911			
EmergencyE911_GDBE911	All E911 data layers in File Geodatabase format (v10.2.2)	E911			
EnvironOther_RESITES	Existing RE sites and Installers and consultants	VCGI			
FacilitiesBuildings_DENSITY	Building density - derived from E911 ESITE points	VCGI			

b. Clicking on the Custom Download icon opens up a new window containing an interactive map. The first thing you will do is zoom in until you can actually see the layer you are hoping to download (the esite points, in this case).

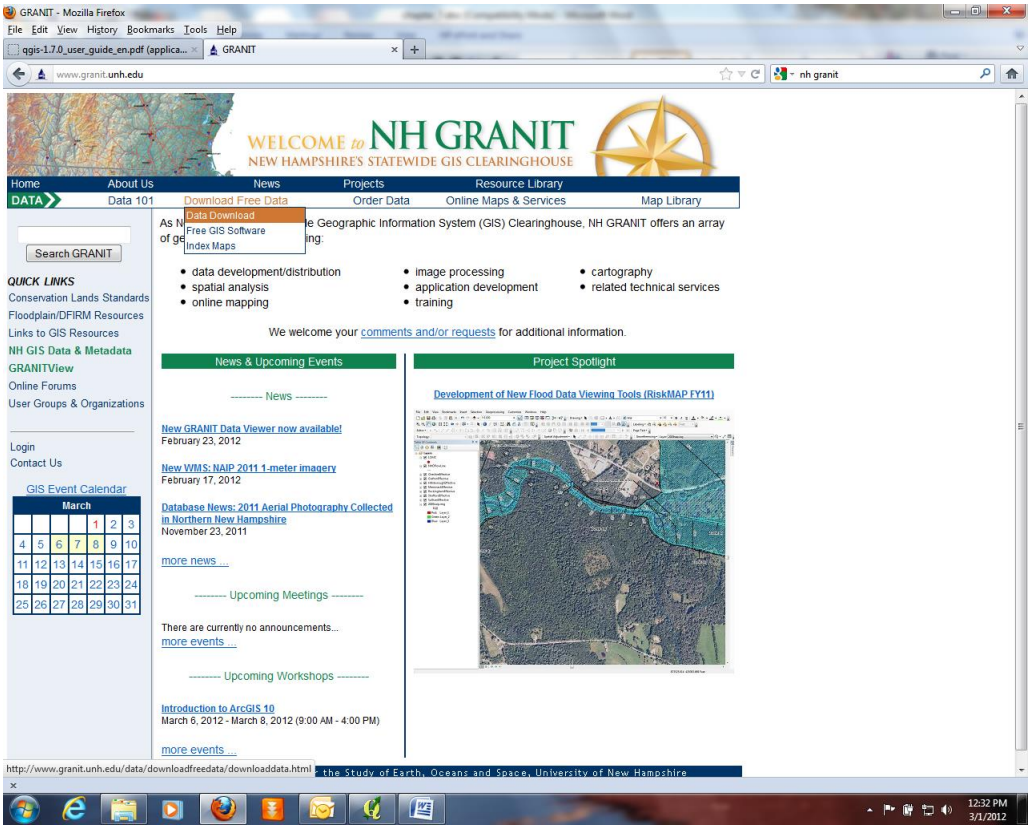


c. Once you have zoomed/panned in to your area of interest, click on the Define Area to Clip icon to turn your cursor into a drawing tool. Then click on the map (one click for each vertex) to define your area. Double click to finish and close your polygon!

d. Finally, choose your download format and click on the Extract Data button to download a .zip file containing your data to your computer. You will need to extract or unzip the data before using it in a desktop GIS program.

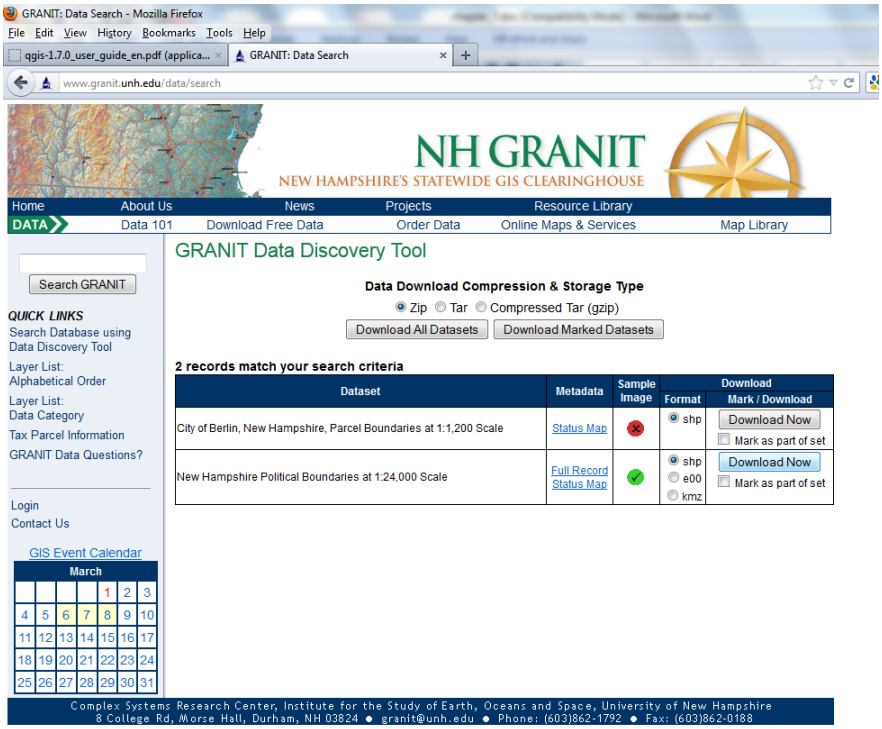
2. Data from Other Sources: NH Granit

a) Go to **http://www.granit.unh.edu/**
b) Click on "Download Free Data">>"Data Download"



c) Click on " GRANIT Data Discovery Tool (DDT)"
d) Next to the words "Search by theme keyword:" type "Town" in the box
e) Click on the "Search" button

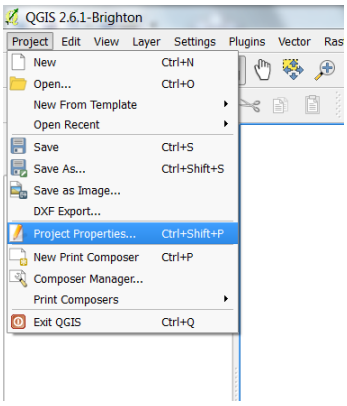
f) Download the data called "New Hampshire Political Boundaries at 1:24,000 Scale" by clicking on the "Download Now" button (notice the various settings and options, but leave them set to their defaults)



g) Save the .zip file in an appropriate location and then extract it to access the two shapefiles within: pba.shp (line data) and pbp.shp (polygon data). Each of these shapefiles contains political boundaries including town, county, and state. Check the metadata (the .html file) for the codes that allow you to symbolize the data.

h) Open QGIS

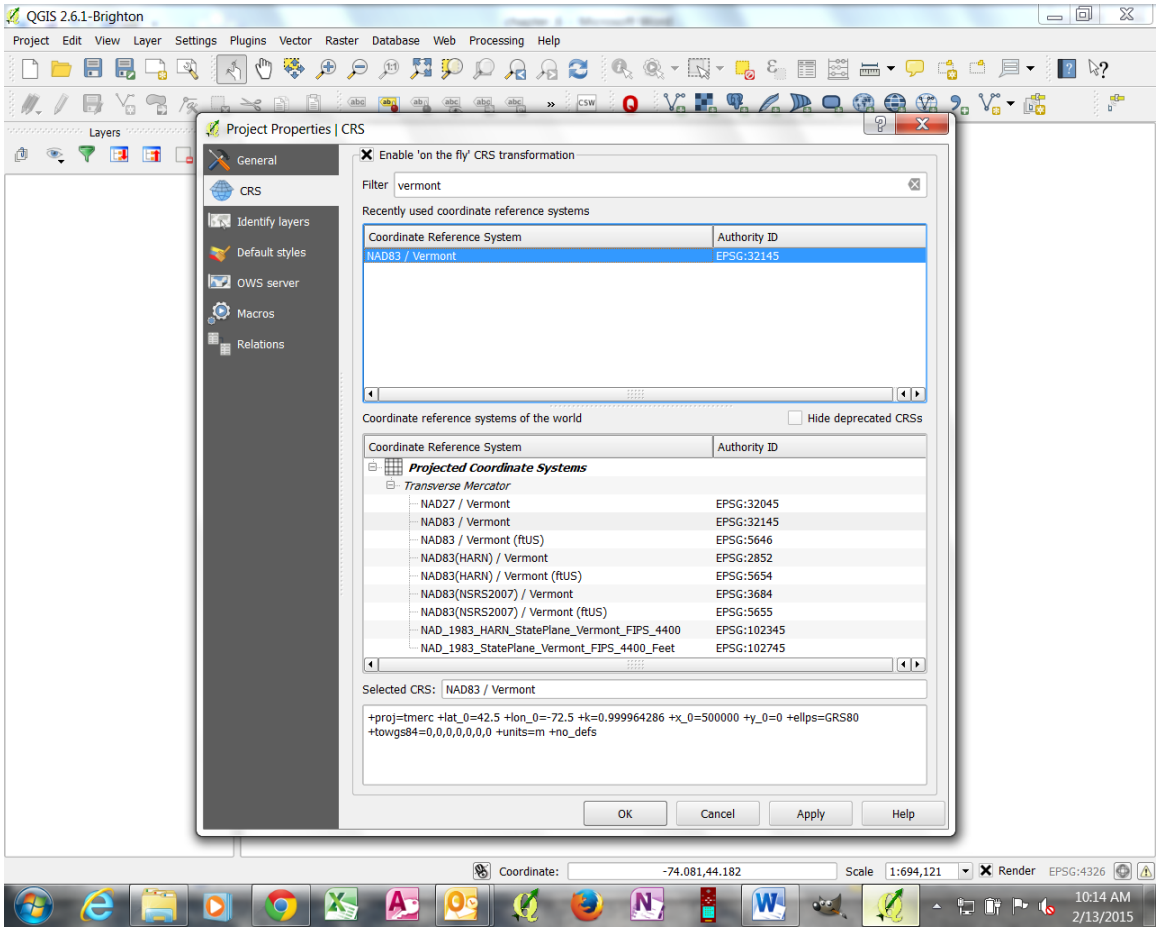
i) Click on the Project menu and then Project Properties



j) In the CRS tab, turn on “enable ‘on the fly’ CRS transformation”

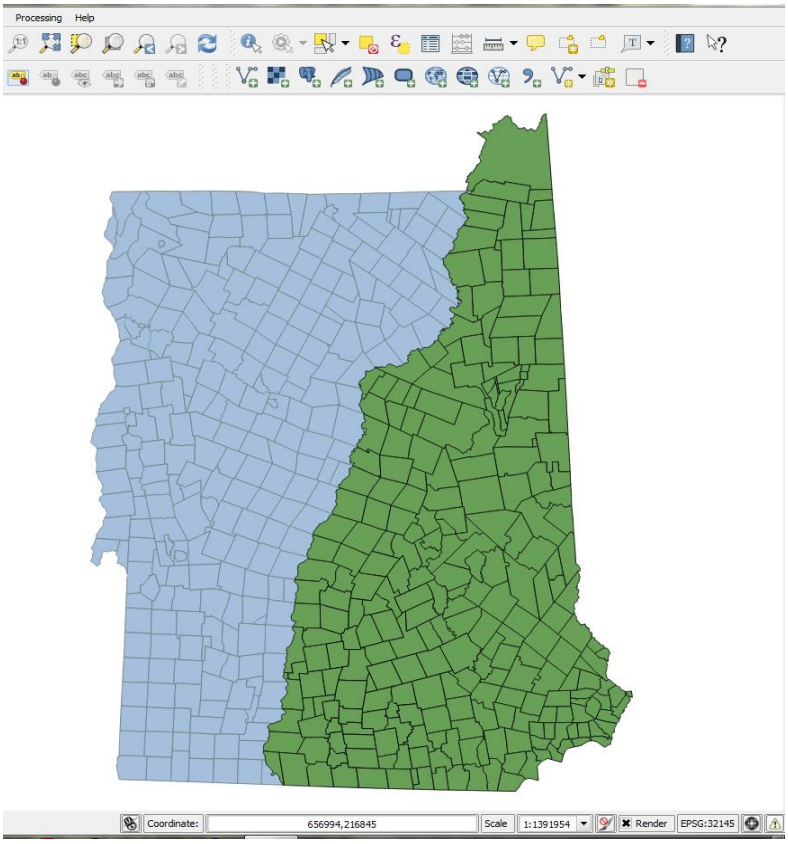
k) Type Vermont in the Filter

l) Choose NAD83/Vermont and then click OK



m) One of the files associated with the shapefiles you downloaded from Granite is the .prj file (projection file) which basically says "this data is in NH State Plane Feet NAD 83 coordinate system" The software is able to do the mathematical transformation necessary to re-project the data into VT State Plane Meters. This is why the VT and NH Town boundaries will line up and scale properly.

n) Setting the project to a particular projection and coordinate system also tells the software how to interpret measurements. If it knows the units of the coordinates are meters, it can calculate the distance and area measurements.

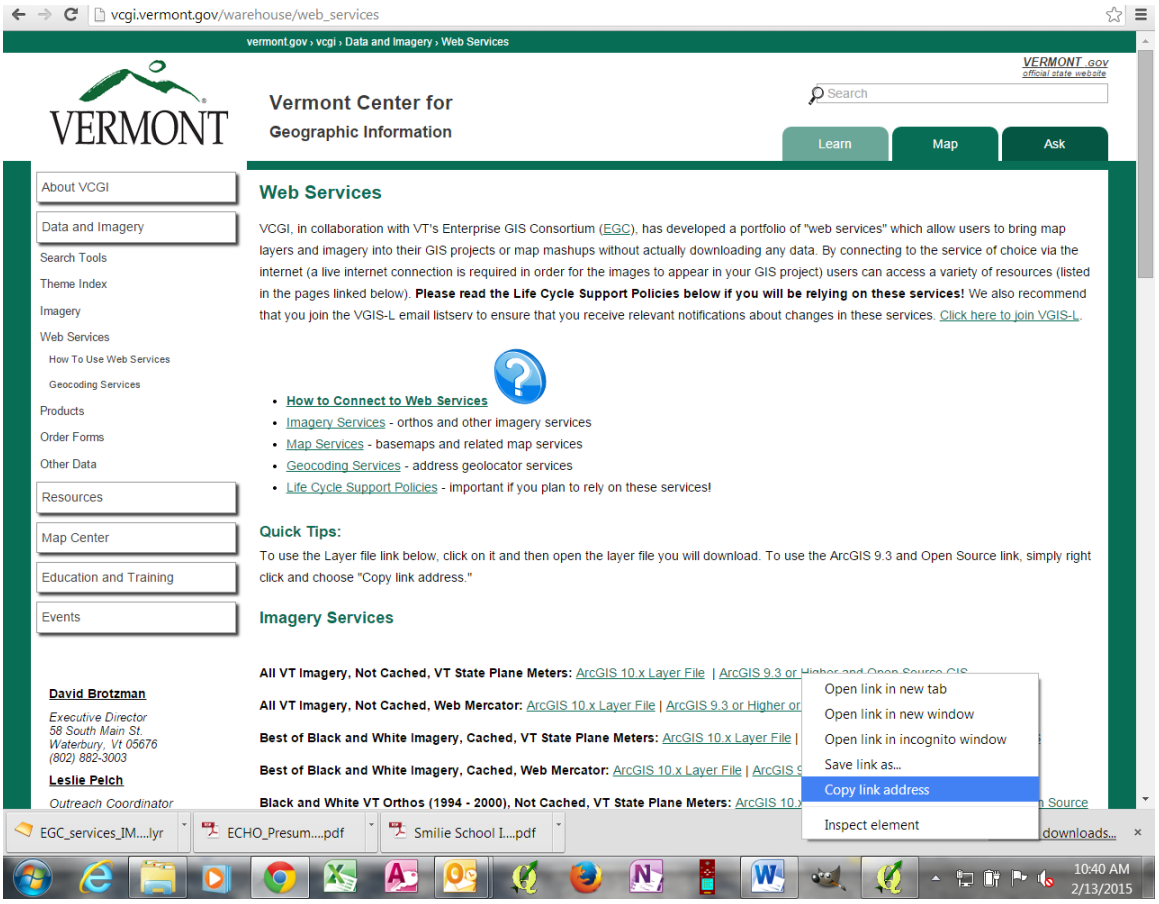

Processing
Help
Coordinate:
656994,216845
Scale
1:1391954
Render
EPSG:32145

3. Accessing Data Via Web Map Service

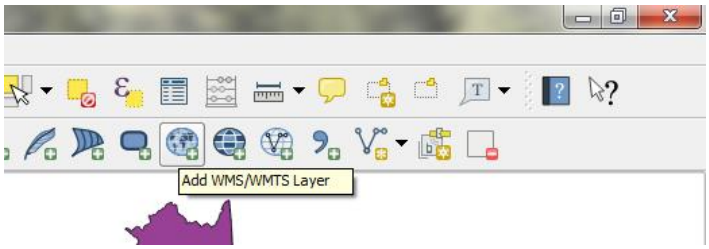
VCGI, in collaboration with VT's Enterprise GIS Consortium (EGC), has developed a portfolio of "web services" which allow users to bring map layers and imagery into their GIS projects or map mashups without actually downloading any data. By connecting to the service of choice via the internet (a live internet connection is required in order for the images to appear in your GIS project) users can access a variety of resources (listed at the Web Services Page at VCGI's web site - **http://vcgi.vermont.gov/warehouse/web_services**).

a) Go to VCGI's web services page and note that in order to connect via an open source GIS software (like QGIS), you simply right click on the words next to your service of choice that say: "ArcGIS 9.3 or Higher and Open Source GIS." Try the **Best of Color Imagery, Cached, VT State Plane Meters**.

b) Choose "Copy Link Address" (Chrome) or "Copy Shortcut" (Internet Explorer).

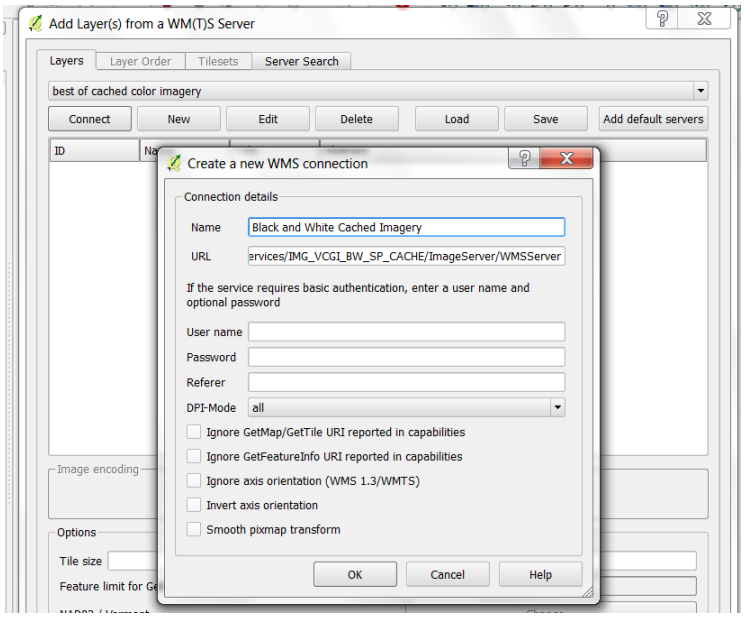


c) Go back to QGIS and Click on the "Add WMS/WMTS Layer" button in QGIS or in the Browser pane, right click on WMS and click on "New Connection"



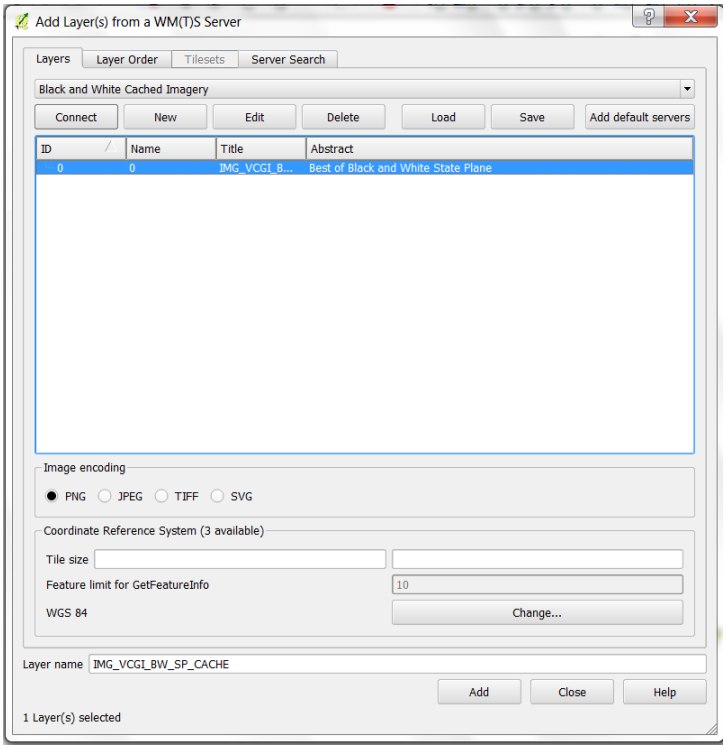
d) Click on New in the "Add Layer(s) from a WM(T)S Server window"

e) Paste the URL you copied into the appropriate box and type a name into the Name box in the Create a New WMS Connection Window



f) Click OK

g) Click Connect



h) Click on the service to highlight it

i) Type a name in the Layer Name box (or leave the default)

j) **Make sure that the Image encoding is set to PNG or JPG**! Leaving it set to TIF results in a washed out image.

k) Click Add then close the "Add Layer(s) from a WM(T)S Server" window.

NOTE: If you add the VCGI Basemap Service, you will be better off adding individual layers from it rather than trying to add the whole thing at once. For some reason, QGIS does not interpret such a complicated service well, and much of the information is lost.

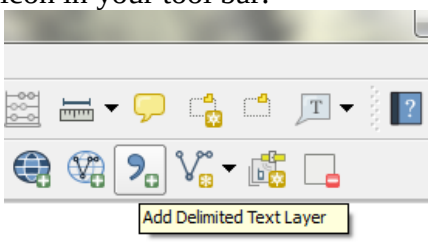
4. Data From a Text File or Spreadsheet Containing Coordinates

It is possible to use data from a delimited text file in a QGIS project if that data contains x, y coordinates of a known coordinate reference system (such as latitude longitude). If your data is stored in a spreadsheet, simply do a "save as" to create a .csv version of it (comma separated values).

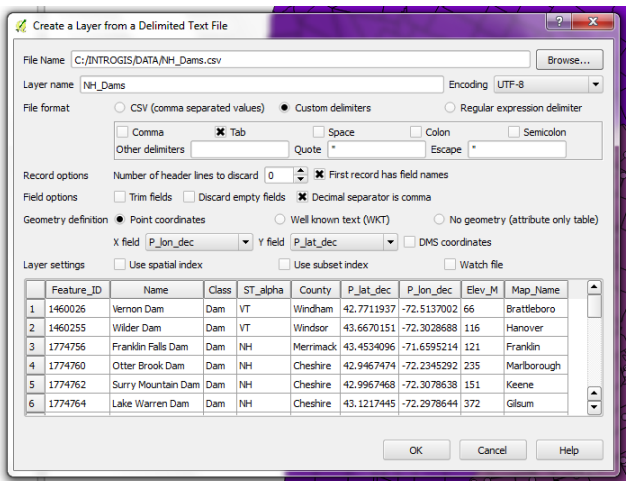
To view a delimited text file as layer, the text file must contain:

1. A delimited header row of field names. This must be the first line in the text file.
2. The header row must contain an X and Y field. These fields can have any name.
3. The x and y coordinates must be specified as a number. The coordinate system is not important, though you do need to know WHAT coordinate system it is.

We will use a function called "Add delimited text layer." You should see the following icon in your tool bar:

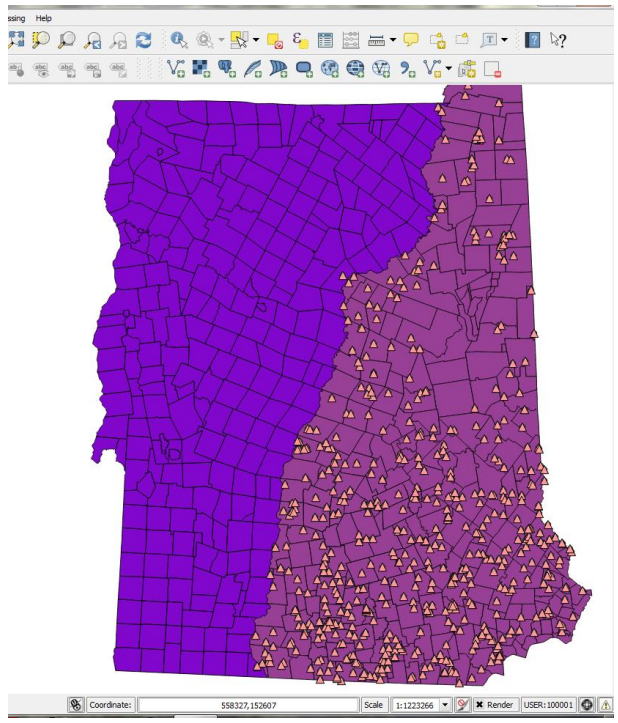


When you click on it a dialog box opens that allows you to indicate where your comma or tab delimited text file is located and which fields contain the latitude and longitude coordinates. You can use the file called "NH_DAMS.csv" found in your DATA directory or another file that your instructor may indicate.



Navigate to the location of the file, and make sure that all information in the dialog box is correct (is data delimited by tab or comma? Does the first row/record contain field names? Which fields contain the x/longitude info and y/latitude info?). The bottom window in the box will show what the data looks like based on the information you have provided, so you can make sure you have filled in the correct answers.

After you click on "OK" Quantum will ask you what Coordinate System the data is in. If you have latitude and longitude coordinates, choose from the "Geographic Coordinate Systems" and find "WGS 1984." Click "OK" and the data should appear on your map in the correct area!



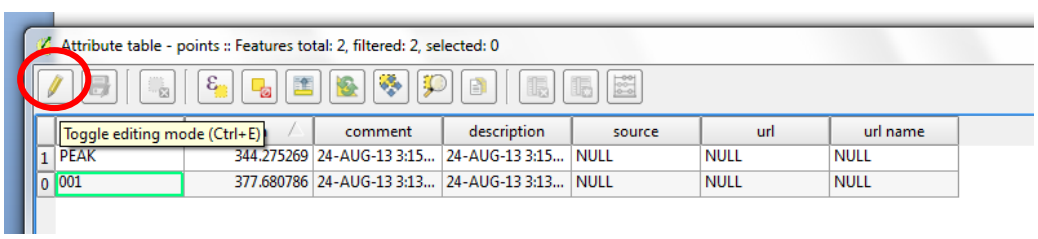
Editing, Joining, and Creating Data

1. Editing Data

We can edit our data if we need to add or change attributes or add or move features. We can only edit shapefiles , not .gpx or text file or joined data. You can always save your .gpx or text file or joined data out as a new shapefile, however, that you can then edit.

In order to edit the attributes of a data layer, we will highlight it, right click and then choose Open Attribute Table

a) Click on the Toggle Editing icon to turn on editing



b) Once editing is turned on, you can click on any of the values in the attribute table and change them by double clicking and typing.

c) Hold your cursor over the other icons at the top of the attribute table window to see what they do. Notice that you can add a new column and you can delete columns. You ARE changing the data when you perform these actions, so be careful!
d) Click on the Field Calculator button to see that you can calculate values to populate new or existing fields. We'll do more with this function in the next section.
e) When you turn editing off, you will be asked whether you want to save changes.

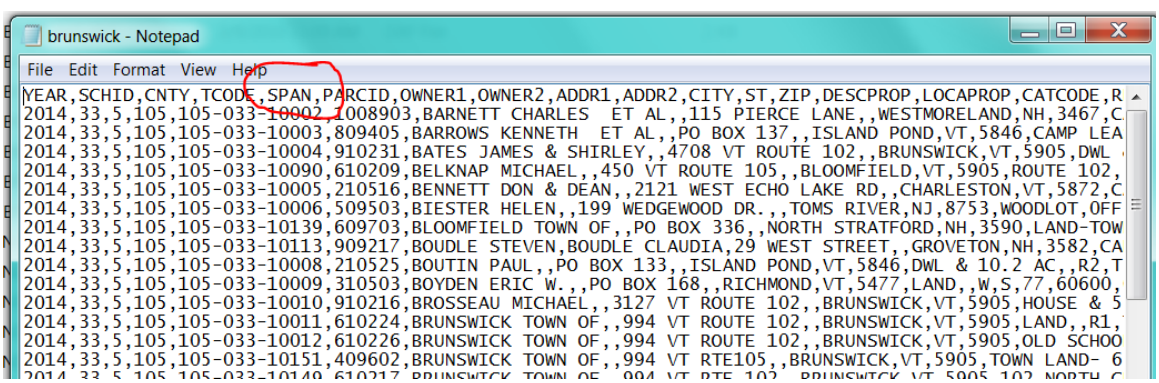
2. Joining Data from a Text File Via a Common Attribute

Another way to create geospatial data is to <u>join</u> tabular data to existing geospatial data. A great example of the usefulness of the join is when one has parcel boundary data and tabular grand list (assessment) data. We want to join that table to the existing parcel boundary data so that we can explore information like parcel size, value, value per acre, type of property (residential, commercial, etc.) and value reduction based on Use Value Appraisal status (Current Use).

Before considering any table joins, the most vital aspect to consider is the JOIN FIELD. The join field must contain matching values (in the same format, such as STRING or INTEGER) in both the source table (grand list) and the target layer (parcel boundaries).

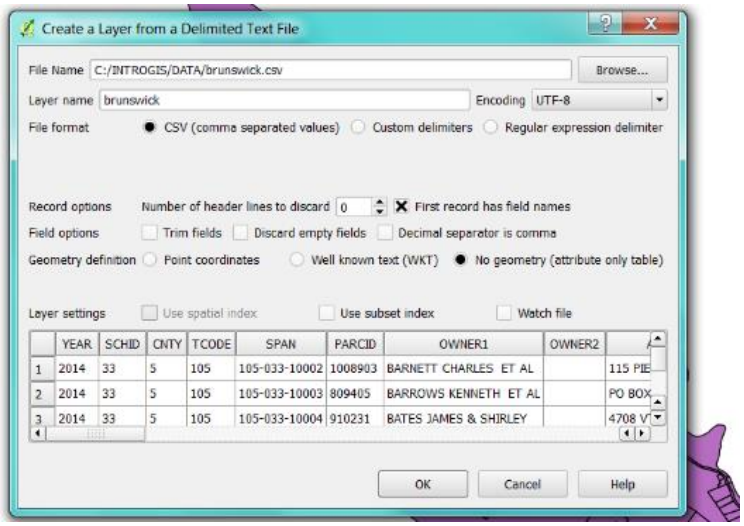
In our example, we have the SPAN or School Parcel Accounting Number – an identifier that is unique statewide and located in both the grand list and the parcel data for Brunswick.

a. Let's start by looking at the two files we will join. Open the Brunswick.csv file in a text editor like Notepad. We can see that one of the columns is named "SPAN"

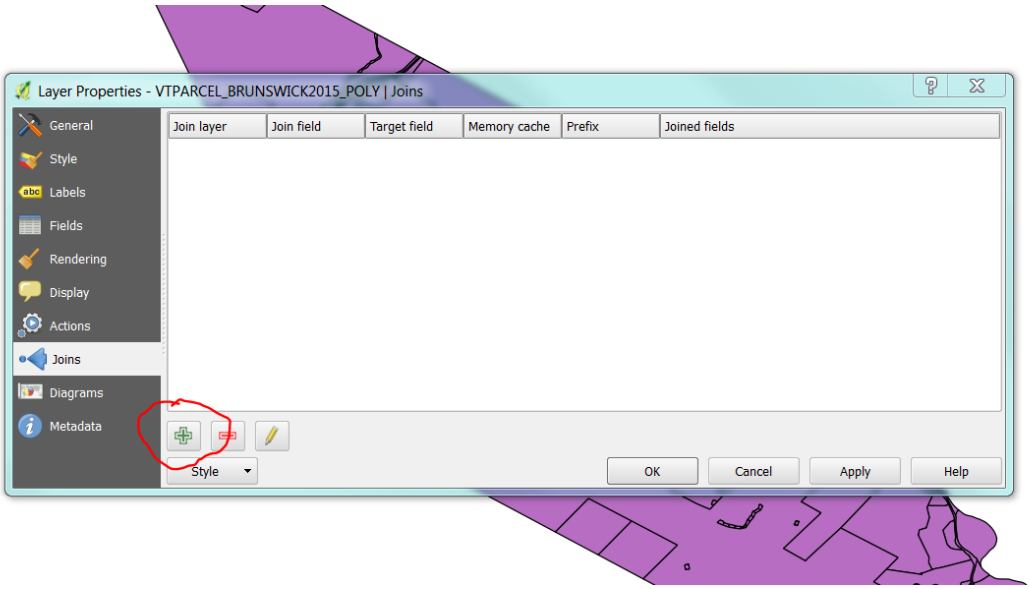


b. Open or create a project containing the VT_BRUNSWICK2015_POLY parcel data. Take a look at the Attribute table to make sure it contains SPAN (the join attributes do not need to have the same name, but they do need to contain the same type of data and have some matching values!).

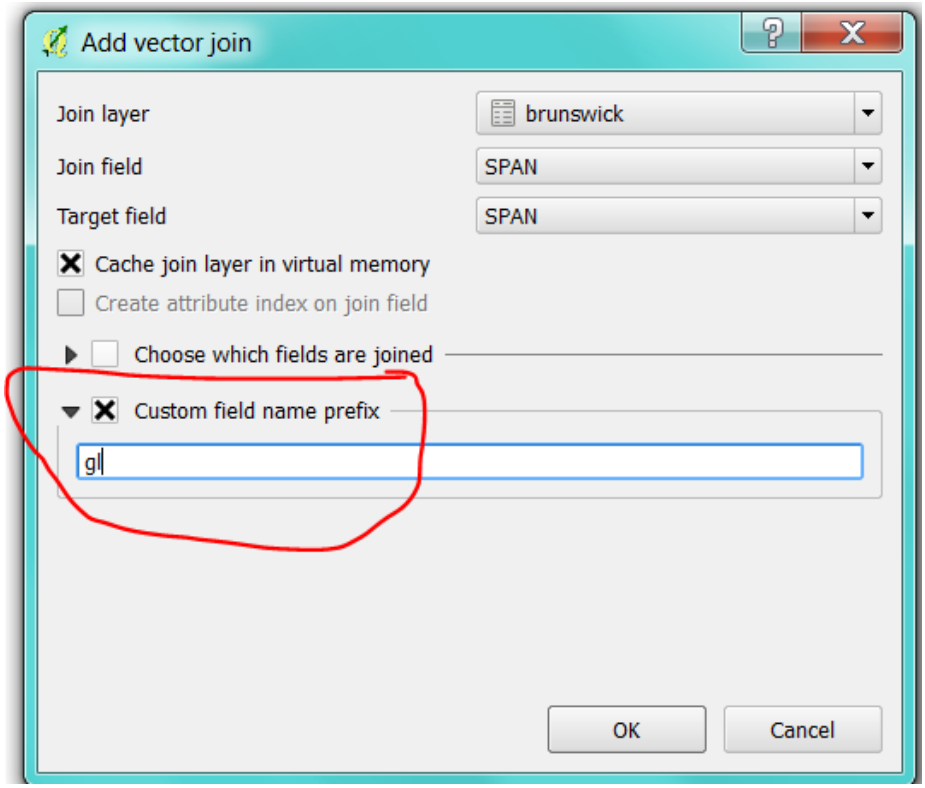
c. Click on the Add Delimited Text Layer button and choose brunswick.csv, the Brunswick grand list.
d. Make sure that you set the File Format to CSV (Comma Separated Values) and that you check the No Geometry (attribute only table) option



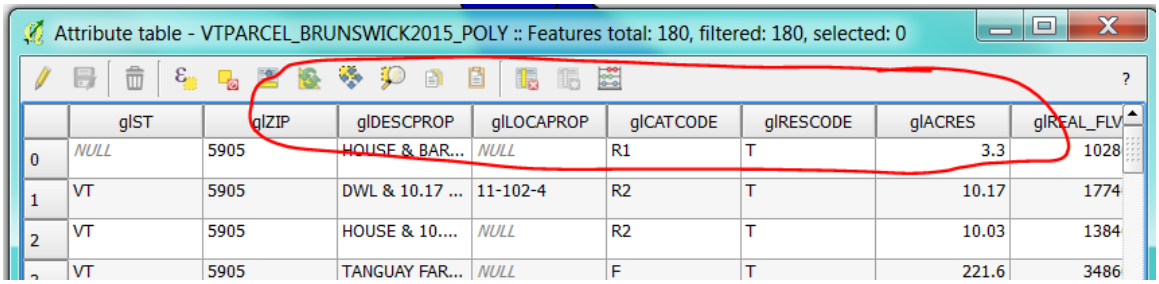
e. Click OK, this will bring the grand list table into your project
f. Right click on the Brunswick parcel boundaries layer in the layer list and choose Properties
g. Choose the Joins section
h. Click on the green Plus sign near the bottom of the dialogue box
i. Choose the correct Join Layer (the CSV file you just brought in)
j. Make sure the Join field and the Target field are correct and match (SPAN)



k. Click to put a check in the box to create a Custom field name prefix and type in something that is only one or two letters like “gl” for grand list.
l. Click OK and OK again



m. Open the attribute table to see if the new set of attributes were successfully joined to your Town Boundary layer (look for the custom prefix you chose as well).

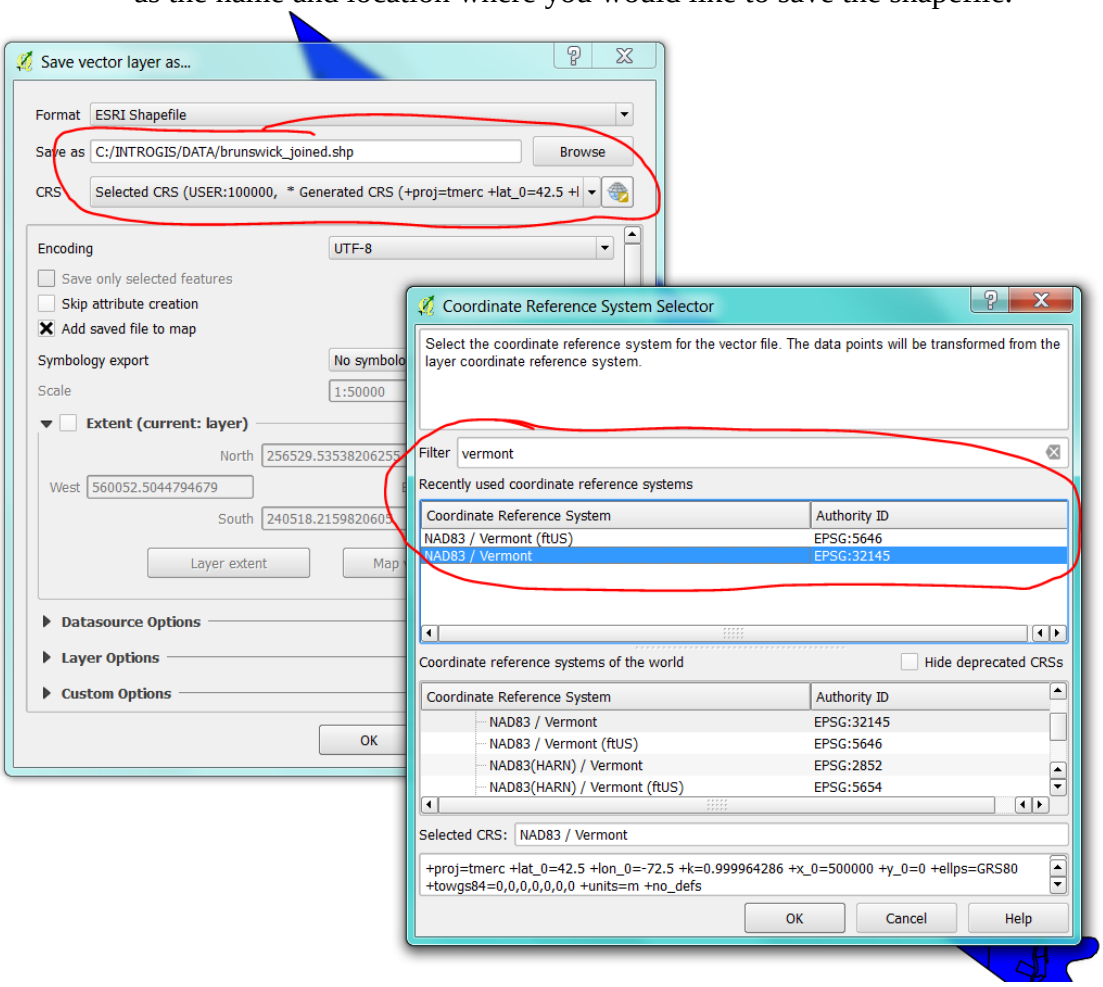


	glST	glZIP	glDESCPROP	glLOCAPROP	glCATCODE	glRESCODE	glACRES	glREAL_FLV
0	NULL	5905	HOUSE & BAR...	NULL	R1	T	3.3	1028
1	VT	5905	DWL & 10.17 ...	11-102-4	R2	T	10.17	1774
2	VT	5905	HOUSE & 10....	NULL	R2	T	10.03	1384
3	VT	5905	TANGUAY FAR...	NULL	F	T	221.6	3486

A few things to note about this joined data:

- The join only exists in this project. ***We have not edited or changed the table or the shapefile in any way.*** If you were to create a new project with this same shapefile, you would NOT automatically see the grand list information in the attribute table. When you save <u>this project</u> and open it again later you WILL see that the join persists.

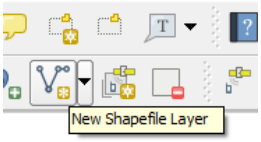
- In order to save the join in a more permanent and transferable manner we can simply create a new shapefile using "Save as"
    n. Right click on the name of the parcel shapefile in the list of layers
    o. Choose "Save as"
    p. Set the file type (to shapefile or perhaps GeoJson, an open source format) as well as the name and location where you would like to save the shapefile.

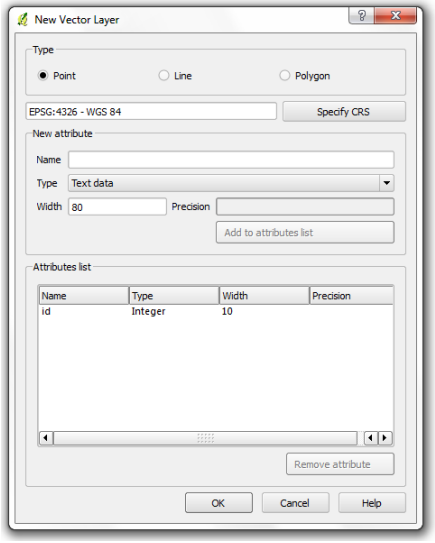


    q. Make sure to set the CRS as appropriate – we will make sure that any data we create is VT State Plane Meters, so we click on the icon to the right of the default CRS, type "vermont" (no quotes) in the filter, click on the Vermont State Plane Meters CRS (EPSG code 32145), and then click on OK.
    r. Click OK again and after a moment you will see that the new shapefile has been added to your project.
    s. Open the attribute table to confirm that the joined data is in the attribute table.

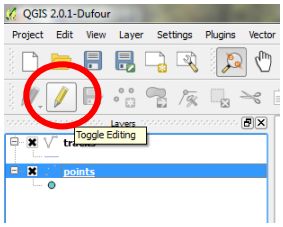
3. Creating New Vector Data

a. Click on the New Shapefile Layer button





b. Set the type of data you wish to create: Point, Line, or Polygon
c. Specify the Coordinate Reference System
d. Add attribute fields, choosing their specifications carefully
e. Click OK when you are done creating your shapefile
f. Save your new shapefile to an appropriate location
g. Zoom to a level appropriate to the data you wish to create
h. Click on the Toggle Editing button to turn editing on.
i. Click on the Add Feature button next to the editing toggle and then start clicking on the map to add features.



j. If you are creating point features you will be given the opportunity to fill in the attribute fields each time you click to add a point.
k. If you are creating line or polygon features, you will right click to indicate you are done with that particular feature, and then you will be able to edit the attributes.

Online Resources:

The most important Vermont "other data source" and technical advice resource: Regional Planning Commissions. Other states have organizations similar to VCGI, and many federal agencies make GIS data available for download or web map service. You will find links to their contact information as well as links to other GIS organizations here: http://vcgi.vermont.gov/resources/othergis