Chapter 5: Introduction to QGIS Projects, Data Layers, and The Map View

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- Creating a Quantum Project and Adding Data Layers
- QGIS Browser
- Opening an Existing QGIS Project
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- Understanding Extents, Map Units, and Scale
- The Measuring Tool
- What is Metadata?

QGIS

QGIS is the free and open source GIS software program we will use to explore geographic data in the following exercises. It has already been installed on the computers in this lab. You can learn more about QGIS and download it to your computer at **http://qgis.org**. In this exercise we will use QGIS to load and examine geographic data and apply imagery as a background.

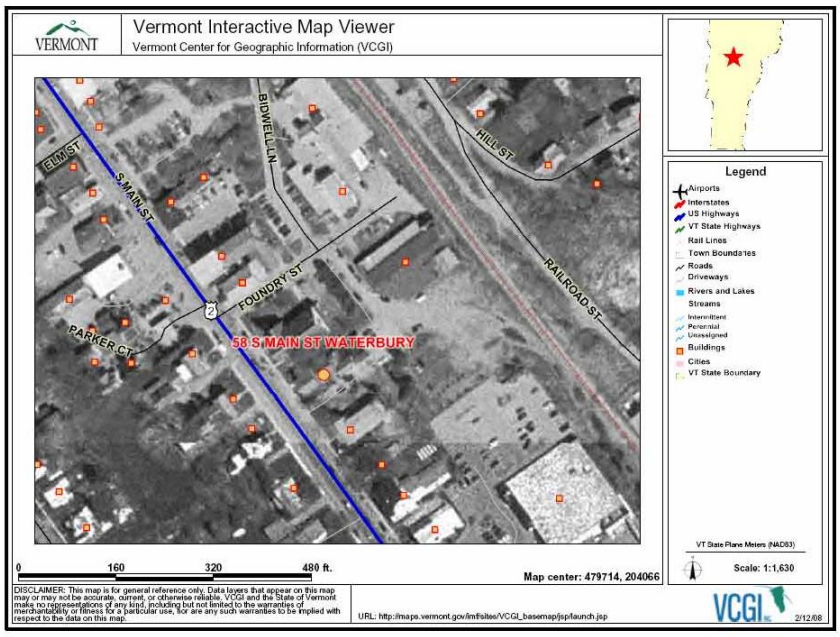
About Geographic Data Types

Within QGIS, we are able to use data layers in the form of **Shapefiles, Images, other Raster formats, and Services**.

> **Shapefiles** are geospatial data files that hold vector-based data.
> Vector data layers are **points**, **lines** (arcs, polylines), and **polygons** (closed shapes with defined area). Other Vector data format that QGIS works with include GeoJSON.
>
> **Images** are an example of raster-based datasets that are made up of cells, organized in columns and rows, that contain data. Raster imagery includes digital USGS topographic maps, aerial photography (Orthophotography), and satellite imagery.
>
> **Services** are internet-based methods of connecting to data that resides on a remote server. We will learn more about services in the Data Acquisition chapter.

The map created in Chapter 3 highlights some of these different data types on the **Map** and in the **Legend** where:

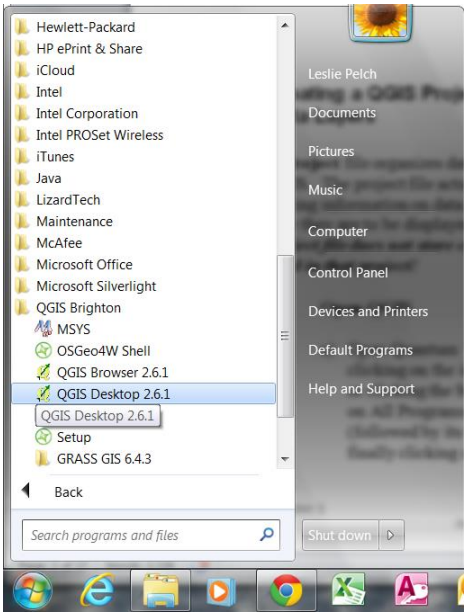
- **Points** are buildings
- **Lines (arcs, polylines)** are driveways, roads, and other line features
- **Polygons** are the VT State Boundary, city boundaries, ponds, rivers and lakes
- **Imagery** appears as a background



Map and Legend from Chapter 3

Creating a QGIS Project and Adding Data Layers

A **Project** file organizes data layers for use in QGIS. The project file acts like a "folder" storing information on data file locations and how they are to be displayed in the map view. ***A project file does not store copies of the data used in that project!***

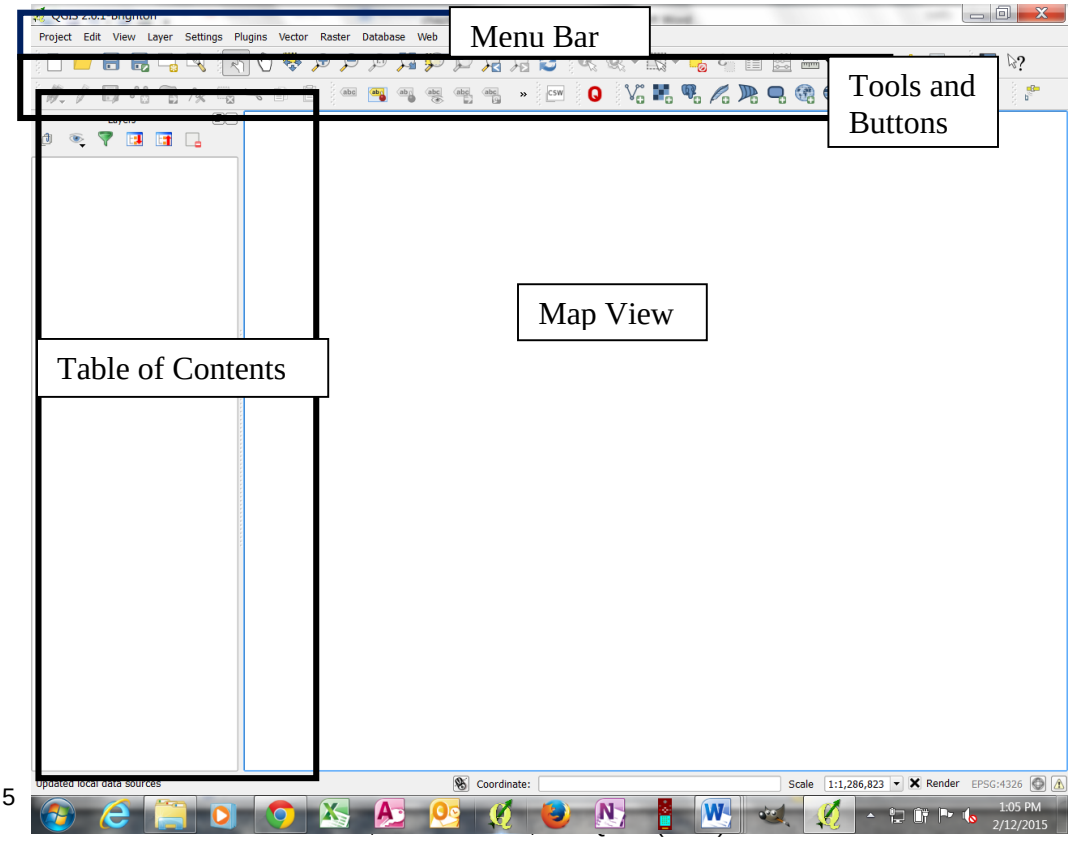


1. **Opening QGIS**

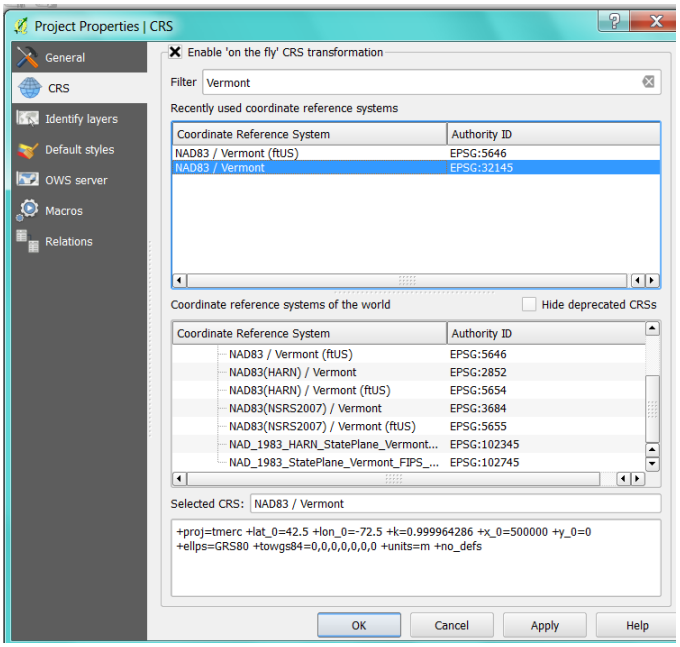
   Open QGIS by either double clicking on the icon on your desktop, or clicking the Start button, clicking on All Programs, clicking on QGIS (followed by its version name), and finally clicking on QGIS Desktop.

   The interface is similar in appearance to the Interactive Map Viewer from Chapter 3 including the **Table of Contents titled "Layers"** (currently blank)**,** a **menu bar, tools and buttons,** and a **map view** (also currently blank).

   We are creating a new PROJECT therefore windows appear empty and tools and buttons are grayed out and unavailable until we add data layers.



2. Setting The Coordinate System



In order to set the Project's Coordinate System and indicate that we want the software to transform any "foreign" data into that coordinate system, select the following from the menu bar:

Project > Project Properties

This will open the Project Properties window. Choose the **Coordinate Reference System (CRS) Tab** and check the box at the top of this section that says "Enable on the fly CRS Transformation." This empowers the software to transform data in a different coordinate system into a coordinate system that matches what the project has been set to.

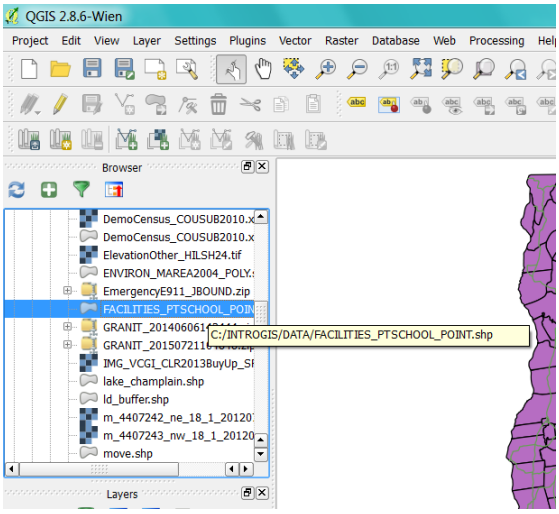
Type "Vermont"(no quotes) in the "Filter" box and then highlight **NAD 83/Vermont** before clicking on OK. Do not choose the (ftUS) option. Note that the "Authority ID" is EPSG: 32145. You can use this code to filter, and you will also check to make sure you have set the CRS properly by looking for this code below and to the right of your Map View.

3. Adding Data Layers: Shapefiles

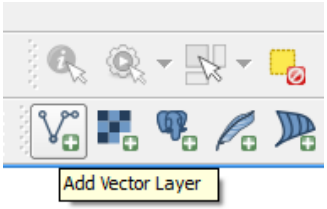
1. If the Browser panel is not already enabled, Click on View>Panels>Browser.

2. There are many different ways to add data layers, but the easiest is to use the Browser panel, as this is basically a file browser embedded in your project. Simply navigate to your data layers and then "drag and drop" them into your map. See the section Before You Begin for more information on files and directory locations.

3. Navigate to c:/INTROGIS/DATA and try dragging and dropping the layer called FACILITIES_PTSCHOOL_POINT

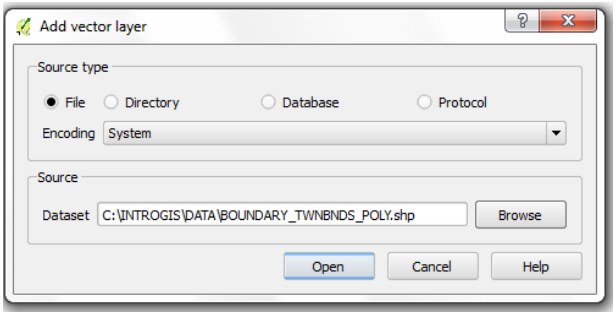


4. The other easy way to add data is to use the add data icons on the tool bar. Click on the add vector layer button found on the toolbar. Other options include Raster layer, Post GIS layer, Spatial Lite layer, and WMS (Web Map Service) layer. If you hover your cursor over any icon, a brief text description appears.



5. In the Add Vector Layer window click the "browse" button and navigate to C:\INTROGIS\DATA.

6. In the Chooser window Click on the Shapefile BOUNDARY_TWNBND_POLY.shp and Click the "Open" button.



7. Click the "Open" button in the Add Vector Layer window.

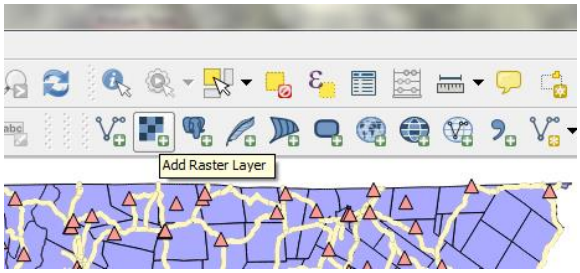
   In your project you will now see the shapefile of VT town boundaries listed in the Layers list and displayed in the map view.

8. Add the following layer using whichever method you prefer: TRANS_RDSMAJ1_LINE.shp

4. Adding Imagery (Raster Layer)

QGIS can use images and display them as background layers in the project file. Specific file types supported by QGIS include Arc/Info Binary Grid, Arc/Info ASCII Grid, GRASS Raster, GeoTIFF, JPEG, Spatial Data Transfer Standard Grids (with some limitations), USGS ASCII DEM, Erdas Imagine.

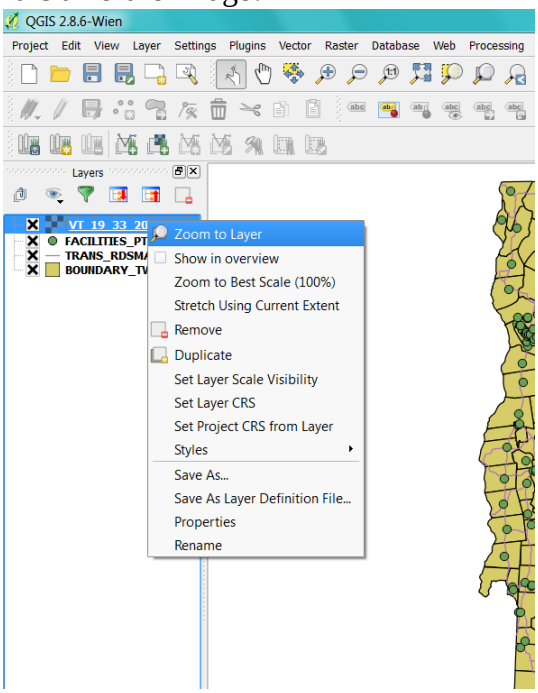
a) To add an image you can click the Add Raster Layer button found on the toolbar or drag and drop it using the Browser panel.



b) You will probably need to re-navigate to the C:\INTROGIS\DATA folder and then choose the ortho image or other rater data layer indicated by your instructor. Make sure to add the file with the .jp2 extension if it is an ortho image!

c) Click Open and then Open again to add the image to your project.

d) After adding it to your project, right click on the name of this image in layers list and choose "zoom to layer extent"



5. Changing Layer Visibility and Order in the Table of Contents

The image file has been added to the project file and appears in the Table of Contents but it may be blocking the view of the vector layers added earlier, or it may not be visible if other opaque layers are being drawn over it.

NOTE: The order in which the layers are listed in the legend also controls visibility.

Layers at the top of the legend are drawn on top of those below it.

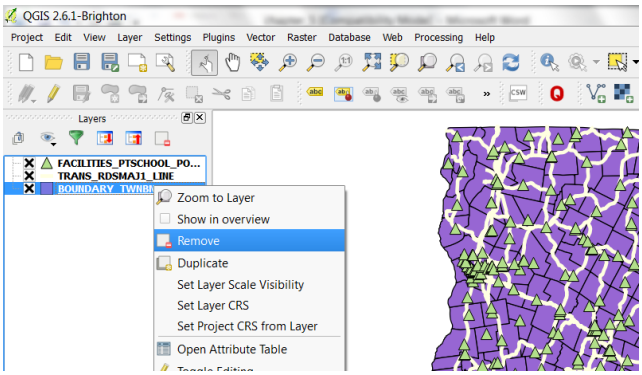
a) We can move the ortho image to the bottom or top of the Table of Contents by clicking on the name of the layer, holding the left button down, and dragging the layer to the bottom or top of the list (or wherever we want it to end up).

b) We could also click to remove the √ from the check box for the ortho imagery layer (or any other layer) in the Table of Contents to turn off visibility and view layers below.

6. Removing Layers

Let's remove the layer BOUNDARY_TWNBND_POLY.shp so that we can see the roads and school points displayed on the ortho imagery.

a) Highlight, or make Active, the Vermont Town Boundary layer by left-clicking on the layer BOUNDARY_TWNBND_POLY.shp in the Table of Contents.



b) Right click on the layer in the table of contents and select **Remove**.

7. Saving the Project

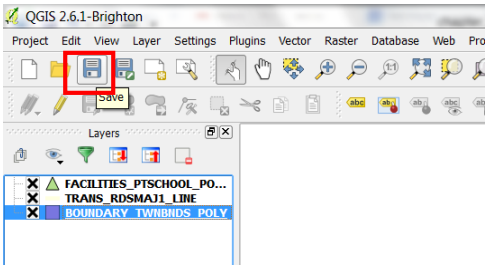
When saving a project **you are not saving actual data files.**

A saved project file includes information about the path to each data layer included as well as your choices about symbology, labels, and layer order.

Saving the project frequently is important to avoid losing any changes you have made.

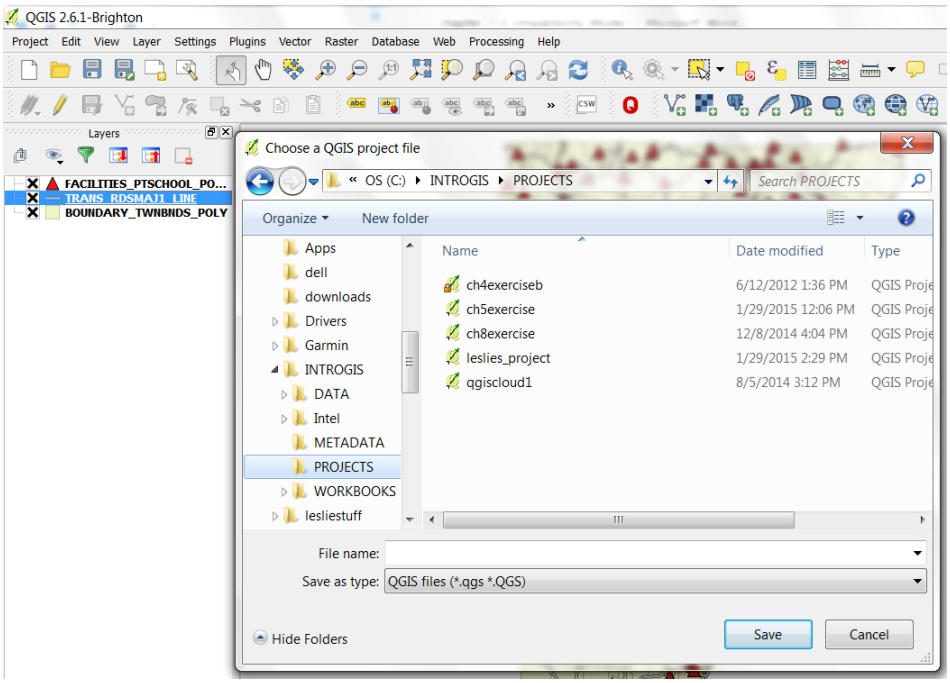
Note: It is useful to save your project file in the same location as your data files or an adjacent folder.

a) To save the project file click on the **Save** icon in the tool bar.



Note: You can also **Save** from menu options by clicking on Project and then Save Project.

b) In the Save window you will navigate to the directory where you wish to save files and save the project with a descriptive name. After you save the project, click on the blank page icon (New Project). This will open a new blank project (it is simply a way to close the project you just created).



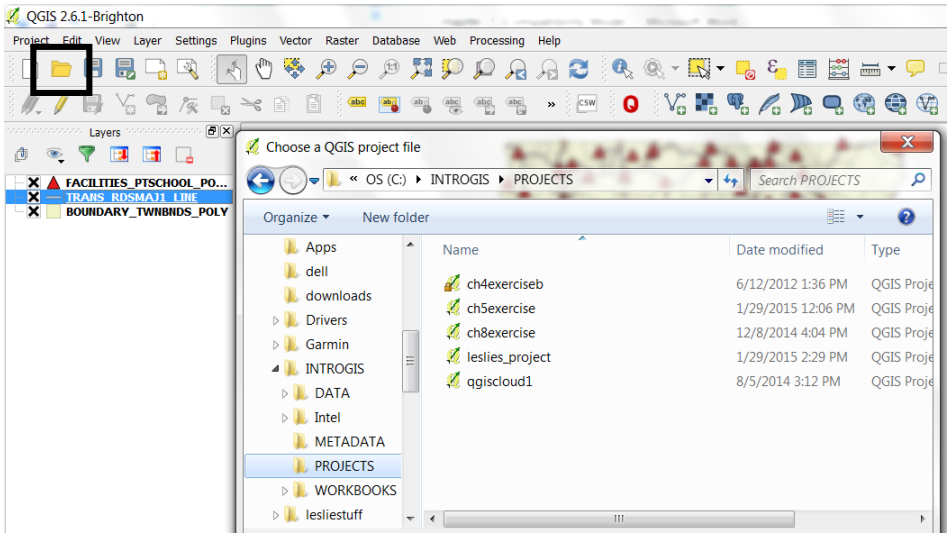
Opening an Existing QGIS Project

In this Exercise we begin with a project that has been previously saved.

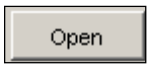
1. Open an existing QGIS Project

a) Open QGIS

b) Click the Open Project button in the toolbar.



c) In the Open Project window, navigate to the C:\INTROGIS\PROJECTS directory and select the file **ch5exercise.qgs**

d) Click 

The Layers list should show three (3) visible data layers:

Airports	TRANS_AIRPORTS_POINT
Major Roads	TRANS_RDSMAJ1_LINE
Town Boundaries	BOUNDARY_TWNBNDS_POLY

The Zoom and Pan Toolbar

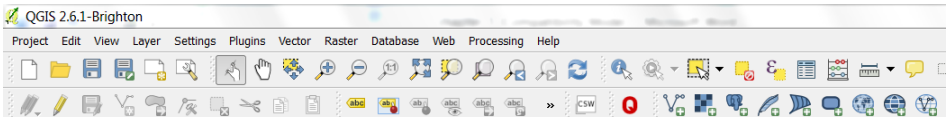
The ability to view an area of interest on a map in the view is an essential component of a GIS application.

In QGIS, **Tools** and **Buttons** can be used to Zoom and Pan the map.
In addition, working with the **Extent** and **Scale** changes what is seen of the Map

Tools are those buttons in the toolbar that, when selected, change the appearance of the cursor in the map view but do not instantly change what we see in the map view. The cursor is now a specific tool to accomplish a defined task.

Other **Buttons** in the toolbar and menu are items that will respond immediately when selected to change the display in the map view.

1. The Zoom-Pan Toolbar

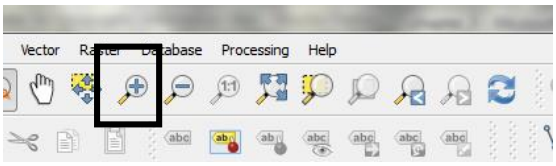


The Zoom-Pan Toolbar contains the set of Tools and Buttons used in the instructions below.

2. Zoom In and Zoom Out Tools

To use the Zoom In tool:

a) Click on the Zoom In button in the toolbar



When selected the button should look as if it is depressed and the cursor in the map view should look like a magnifying glass with crosshairs in it.

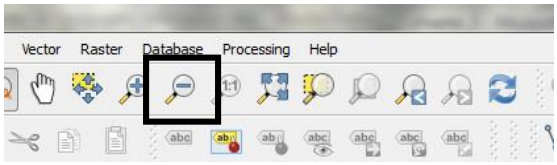
b) Zoom in on the map using the cursor and a left-click of the mouse. You will zoom in a pre-set amount.

c) Zoom in on the map by drawing a box around an area of interest.

d) To draw a box click the left mouse key to define the upper left corner of a box, hold the mouse key down and drag to the lower right hand corner of the box (the box you are drawing will be grey/blue and see-through as you draw it).

To use the **Zoom Out** tool:

e) Click on the Zoom Out button in the toolbar



When selected the button should look as if it is depressed and the cursor in the map view should look like a magnifying glass with a minus sign in it.

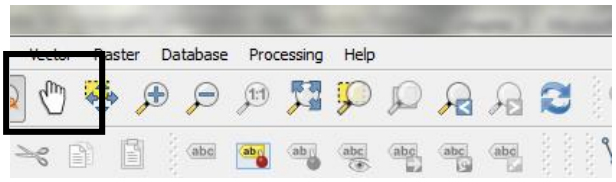
f) Zoom out on the map using the cursor and a left-click of the mouse.

Note: You can also draw a box with the Zoom out tool but the results are difficult to control. Go ahead and try.

g) Use the Zoom In and Zoom Out tools to zoom in and out on the symbols representing airports in the state.

3. The Pan Tool

The Pan tool allows users to shift the location or center of the map in the view using the cursor, while maintaining the zoom level or scale of the map.



To use the **Pan** tool:

a) Click on the Pan tool in the toolbar

When selected the button should look as if it is depressed and the cursor in the map view should look like a hand.

b) Click and hold the left mouse button and drag the map.

When you let up on the left mouse button, the map should redraw.

c) Zoom in on the map and use the Pan tool to follow the boundary of the State of Vermont.

4. Extent

Often when using the Zoom In, Zoom Out, and Pan tools it is easy to get lost on the map. To help find our way on the map we can use buttons that define **Extent**.

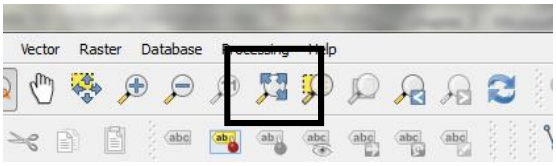
The geographic **Extent** of a data layer is specified by the coordinates that define its rectangular limits (*i.e.*, xmin, ymin and xmax, ymax).

Thus, in the map view the Extent defines the area of the Earth's surface that is visible.

Buttons available in the Zoom-Pan toolbar allow the user to zoom to a selected extent to help view data in the map.

a) Use the Zoom In tool to zoom in anywhere on the map.

b) Click on the **Full Extent** button in the toolbar to zoom out to the area covered by all the data layers



The **Full Extent** is defined by the geographic extent of all the data layers.

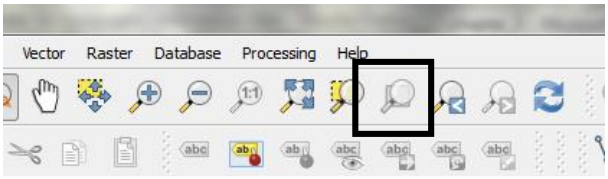
The map should now show Vermont and all the datasets.

Each data layer also has an **Extent**. Each data layer in your table of contents has a different extent or bounding rectangle.

c) Add another vector layer called ENVIRON_MAREA2004_POLY.shp

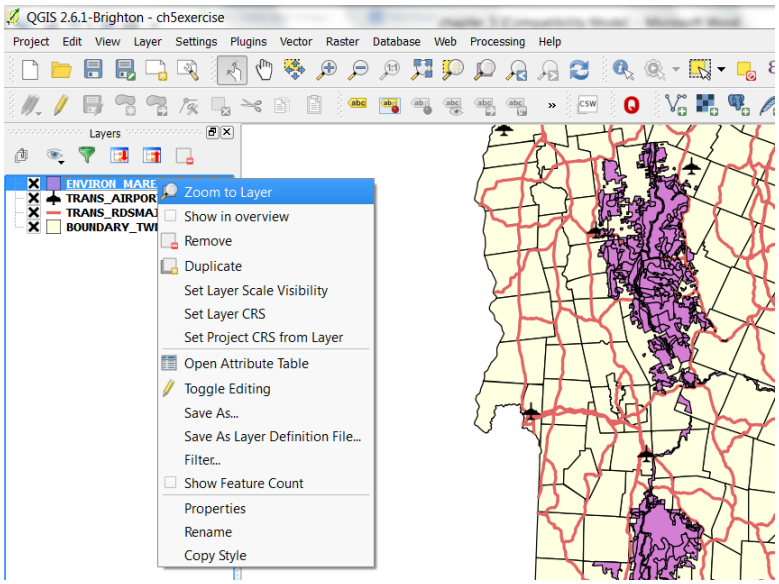
d) Left click on ENVIRON_MAREA2004_POLY.shp in the Table of Contents so that it becomes the active layer and appears highlighted.

e) Click on the **Zoom to Layer** button in the toolbar to view the extent of this layer

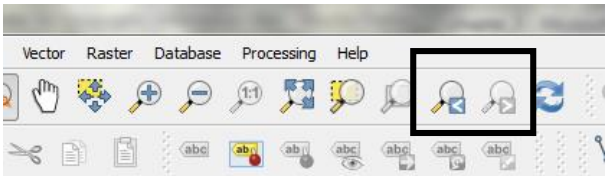


You will notice that the map has zoomed in on only a portion of the state since the management boundaries for the Green Mountain National Forest do not cover the entire state of Vermont.

Note: It is also possible to Zoom to Layer by right-clicking on the layer in the Table of Contents and selecting from the list of options.



f) In the toolbar you can use the **Zoom Last** and **Zoom Next** buttons to move back and forth between viewed extents.



Note: The buttons are grayed out and unavailable until you have changed extents in the map view.

Understanding Extent, Map Units, and Scale

1. **Extent**

The Extent is defined using specific coordinates that define rectangular limits (*i.e.*, xmin, ymin and xmax, ymax). These coordinates are the Map Units in which geographic data is stored.

2. **Map Units**

Setting, or defining, Map Units in the project is critical when displaying data layers, locating real world coordinates, and determining scale. We set the map units when we set the Coordinate Reference System for the project.

Why Meters?

The data layers we have been using are all referenced using the Vermont State Plane Coordinate System using Meters as Map Units.

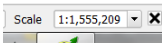
As was described in Chapter 1, all Vermont GIS data should be projected in a coordinate system and datum called "VT State Plane Meters NAD 83". This is important to know because you may obtain or create data that is not in this format; you need to know what projection and datum your data are in so that you can deal with it. If your data has a .prj (projection) file and if you have enabled on the fly CRS transformation, the software will scale the data appropriately. If, however your data does not have a .prj file, you will have to answer the question "what CRS is this data" when you try to bring it into your project.

3. **Scale**

Zoom to the Full Extent and view the Scale in the Status Bar at the bottom of the map view.

When you zoom in, zoom out, or resize the map, the scale changes. These changes are shown in the Status Bar.

The scale at the bottom of the program window is a representative fraction (RF). This fraction is a familiar way to present scale in cartography and is generally expressed as a one to something relationship (*ex* 1:5,000).



A one to five thousand scale means that one inch on a map (or in this case on the screen of this particular computer) equals 5,000 inches on the ground (real life). A scale of 1:250,000 means that one inch on a map (or screen) equals 250,000 inches on the ground, and is a relatively smaller scale (compared to 1:5,000). This way of

expressing scale is "unit-independent" meaning it doesn't matter whether you are measuring feet, miles, meters, or chains, because the same units must be used on both sides of the fraction. One centimeter on the map equals 250,000 centimeters on the ground, for instance, when the scale is 1:250,000.

You may be more familiar with scale expressed using different units, i.e. 1 inch = 10 miles. Pay attention to how scale is being expressed!

Note: scale on a hardcopy map is set and only changes if, for example, you copy and change enlargement or size of output. Scale on the screen changes when you change the size of the window in the interface. It is also important to remember that different computer monitors are different sizes.

Understanding the scale is important and will be used to set layer properties that change the visibility of data layers in **Chapter 7: Layer Properties**.

It is possible to zoom to a user-defined scale in the map view.

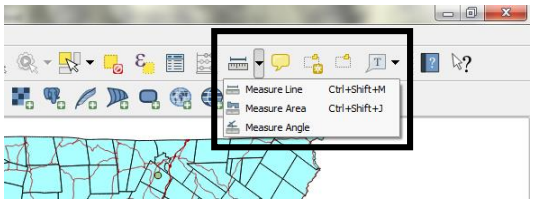
a) To Zoom to a chosen scale type a number like 100,000 in the scale box at the bottom of the map view then hit enter.

   The map view will now display the map at 1:100,000 scale (*i.e* 1 inch on the screen is equal to 100,000 inches on the ground).

b) Experiment using different map scales (*ex* 1:24,000, 1:1,000,000) and note the changes that occur with the map.

The Measuring Tool

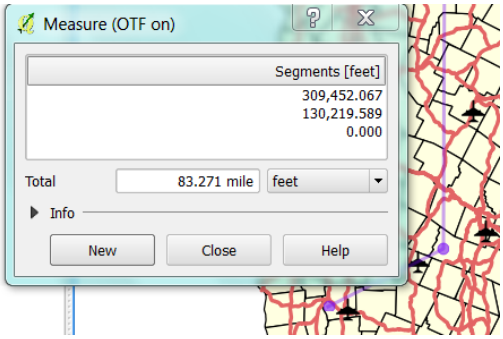
The Measuring Tool allows the user to interactively measure distances on the map.



Note: Map Units must be set to the correct value before using the Measure Tool. This was done in the steps above when the Project Coordinate System was set to VT State Plane Meters.

To use the Measuring Tool:

1. Zoom to the Full Extent
2. Click on the small arrow to the right of the Measuring Tool in the toolbar. Choose whether you with to measure with a line, area, or angle. When selected the button should look as if it is depressed and the cursor in the map view should be a crosshairs (+) symbol.
3. The Measure Window indicates the length of each segment of line that you define by clicking on the map. Double clicks will define segments, and right clicks will end that measurement.
4. You can change the unit of measurement in the Measure Window, and you will notice that the units of the "total" is appropriate to the scale of the measurement. I.e. total feet may be in miles or total meters may be in kilometers.
5. If you wish to change the default measurement units or color of the measuring "rubber band," click on the "Settings" menu and choose "Options." Go to the "Map Tools" area and change the "Measure Tools" options.



6. Try measuring the length of the state, or follow I-89 for its length (notice that each time you click you can start a new segment of the same measurement). You can STOP measuring (but keep the box open) by right clicking on your last point.

What is Metadata?

What questions do you have about the data we have seen and used so far? The answers to those questions would probably be found in the Metadata. Metadata is information about data. When using GIS we are referring to the information that would tell potential users about the specific properties of each geographic data layer.

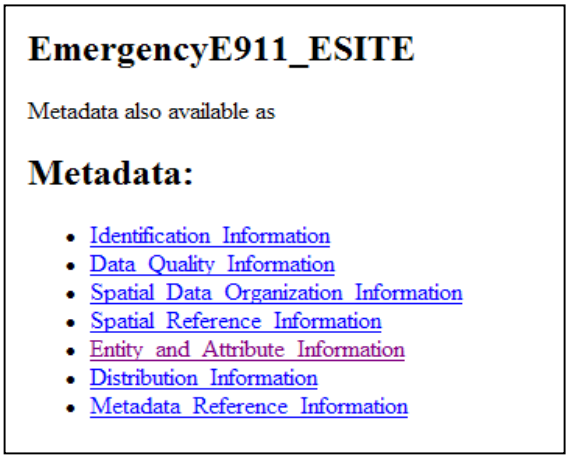
For example, data layers are often created for an intended purpose. Potential users will want to know who created the data, when it was created and for what purpose. Also, metadata should contain descriptive information about the type of data features (*ex.*point, line, polygon, image) as well as information about coordinate systems and projections. Without this information it would be very difficult for users to assess the usefulness of a particular data layer for their applications, to determine compatibility with other GIS data, or to evaluate data accuracy and quality.

An example of metadata can be found in the METADATA directory.

1. Viewing Metadata

a) Use a Browser (*ex* Internet Explorer, Mozilla Firefox) to **Open a File** and navigate to the METADATA directory.

b) Open the file **EmergencyE911_ESITE.htm**

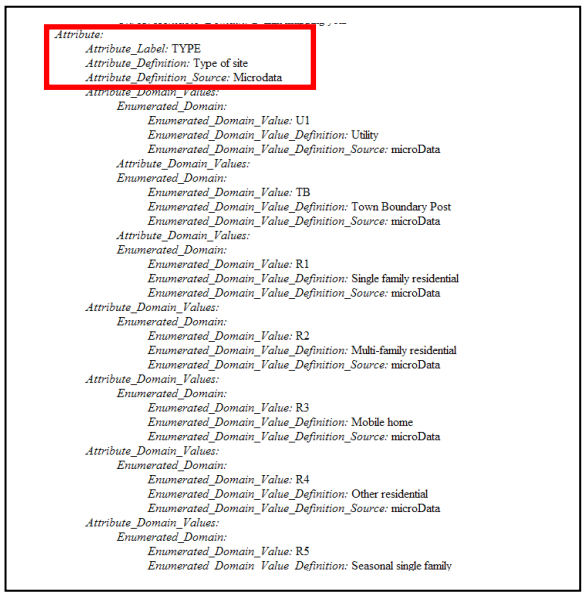


Metadata includes many categories of information. In this example we will determine what the TYPE attribute codes mean.

c) Click to select **Entity and Attribute Information**.

For this task we are interested in ***Attribute_Label: TYPE,*** which is followed by the code values and their definitions.

Information found in the Identification Information section includes date, creator, and abstract – often very useful information. Additional information about Metadata will be found in the remaining exercises.



Additional Resources for Working with QGIS:

You will find lots of help working with QGIS by simply googling your questions. There are numerous Youtube videos, step by step tutorials, forums discussing issues, etc. that you can find if you use the right search terms!

Try simply typing your question first, and if that doesn't stir anything up try some combinations of relevant words that balance the need to narrow the search with the need to keep it wide enough to find something!

Examples:

- http://qgis.org/en/docs/index.html
- http://www.qgistutorials.com/en/
- https://www.youtube.com/user/VTgeospatial