Quantum GIS Training

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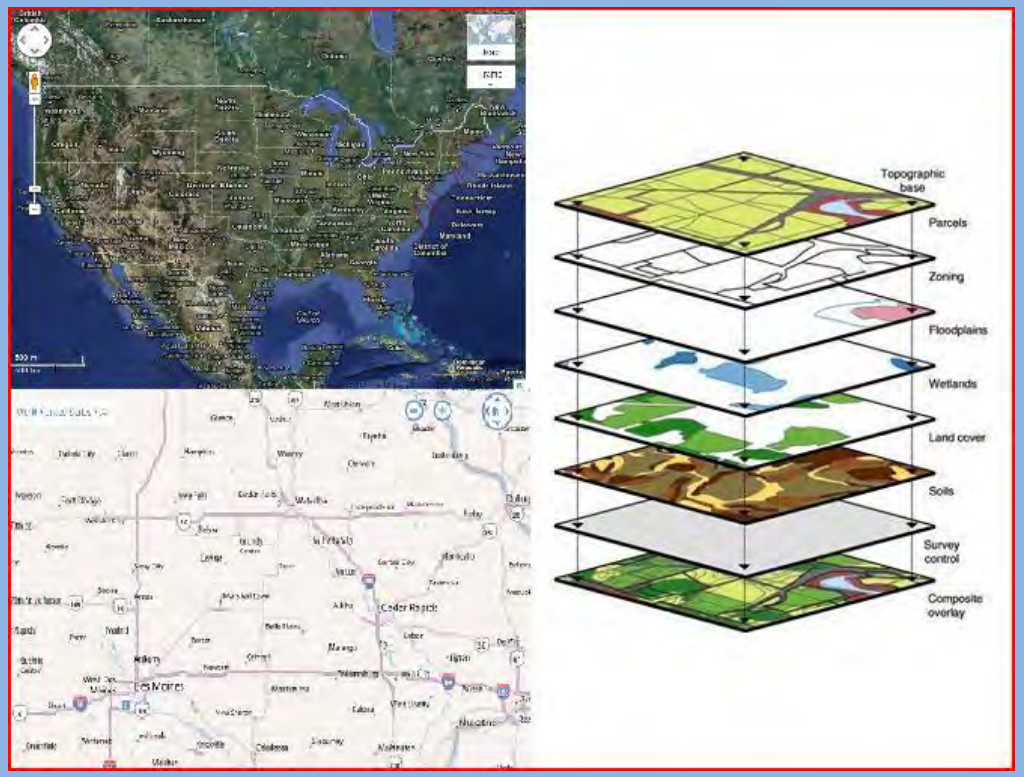
What is GIS?

GIS – (Geographic Information Systems) Used as a system for storing and manipulating geographical information on computer. Allows users to investigate, manage, and develop spatial data.



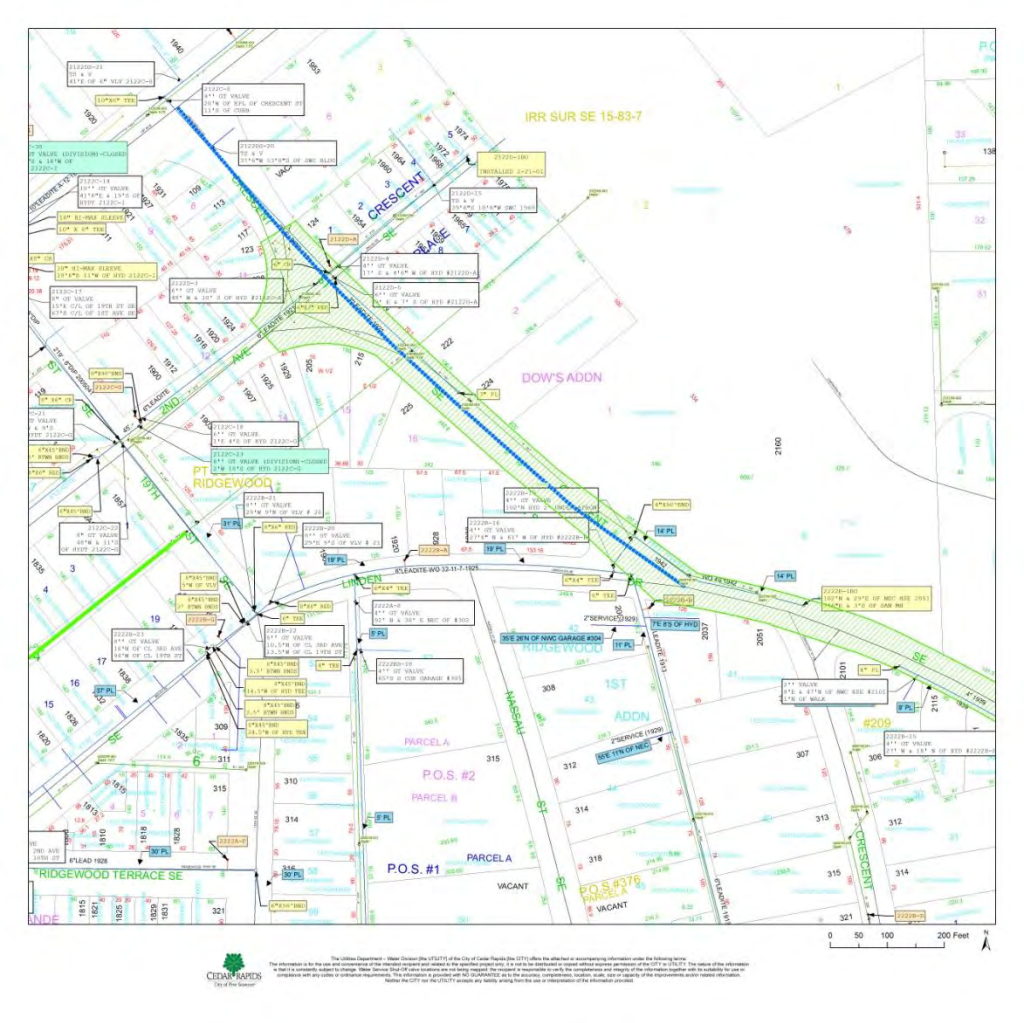
Who uses GIS?

Cedar Rapids, IA

Planning
- New pipelines
- Housing developments
- Disasters readiness

Monitoring
- Infrastructure
- Current needs

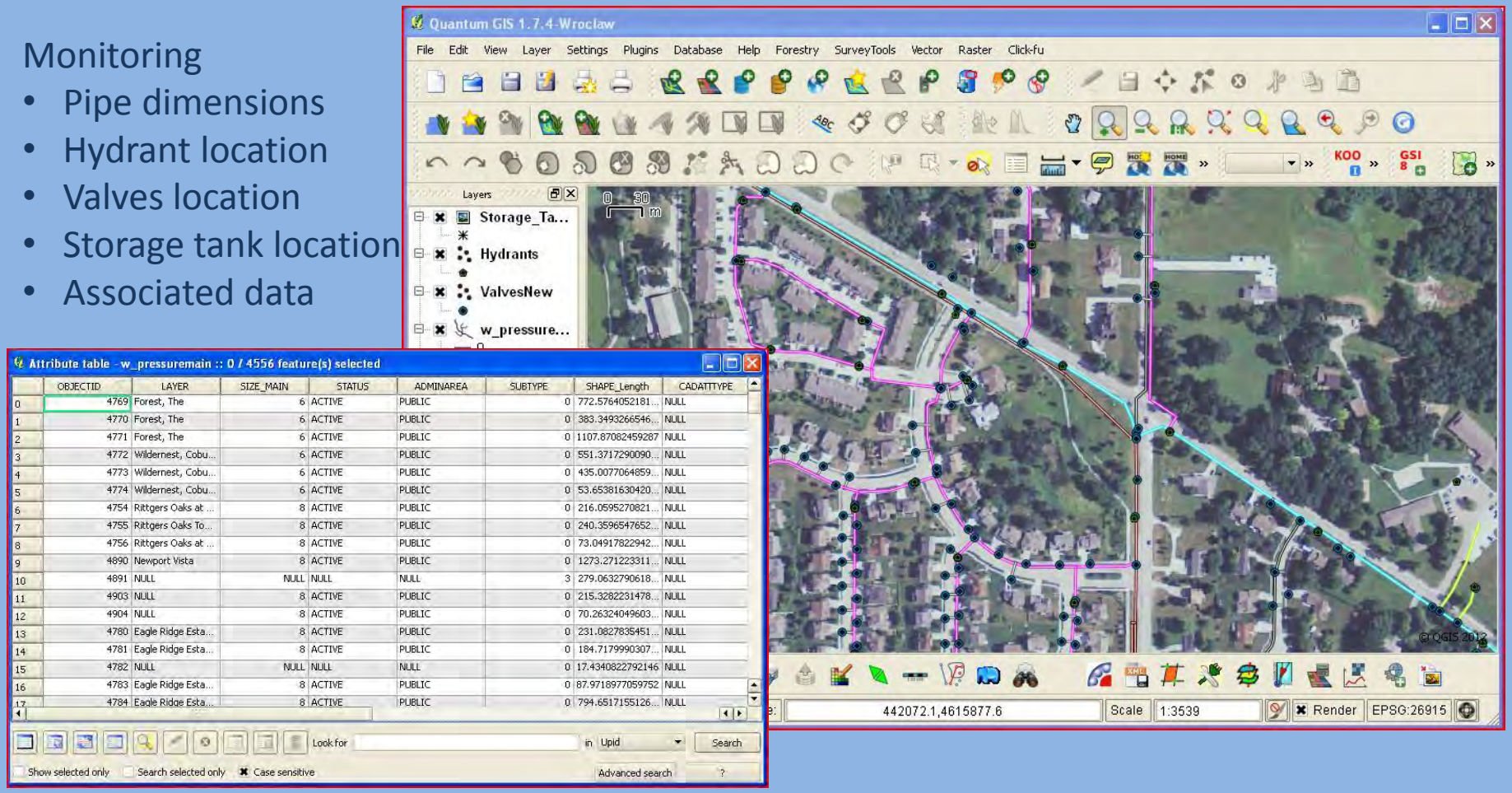
Record Keeping
- Updating attributes
- Location accuracy
- Database Queries



Who uses GIS?

Johnston, IA

Monitoring
- Pipe dimensions
- Hydrant location
- Valves location
- Storage tank location
- Associated data



What is QGIS?

Quantum GIS (QGIS) is an open source geographic information system (GIS). This robust software is a free alternative to proprietary GIS software like ESRI products which are oftentimes very expensive.

What's nice about QGIS is that it incorporates very similar functions and features as its closed source counterparts by using a congruent graphical user interface (GUI). The GUI allows users to display, manipulate and create spatial data. It supports a variety of spatial data file extensions (.shp, .tif, .csv, .img, etc.), and is compatible on Linux, Unix, Mac, and Windows operating systems.

What is Open Source?

Open source refers to "open source code" used to develop the software. It is organic, meaning it is constantly growing bigger and better, as programmers from all over the world write and develop more scripts.

Overview

Today you will learn understand:

- How Quantum GIS can help you
- GIS Data Formats
- Basic Projection principles
- How to alter data symbology
- How to create data
- How to edit data
- How to georeference data
- Linking data to the web
- Joining datasets (tabular/spatial)
- Basic SQL
- How to make a thematic map

What You Should Have

- Jump Drive
  - Quantum GIS
  - GPS Babel
  - Spatial Data
    - Rasters
    - Vectors
  - Iowa Source Water Materials
  - Training Materials
- Handouts
  - GIS Outline
  - GIS Vocabulary
  - Jump Drive Contents

Vector Data

1. Points - A single coordinate (x y) represents a discrete geographic location

2. Lines - Multiple coordinates (x1 y1, x2 y2, x3 y4, ... xn yn) strung together in a certain order, like drawing a line from Point (x1 y1) to Point (x2 y2) and so on. These parts between each point are considered line segments. They have a length and the line can be said to have a direction based on the order of the points. Technically, a line is a single pair of coordinates connected together, whereas a line string is multiple lines connected together.

3. Polygons - When lines are strung together by more than two points, with the last point being at the same location as the first, we call this a polygon. A triangle, circle, rectangle, etc. are all polygons. The key feature of polygons is that there is a fixed area within them.

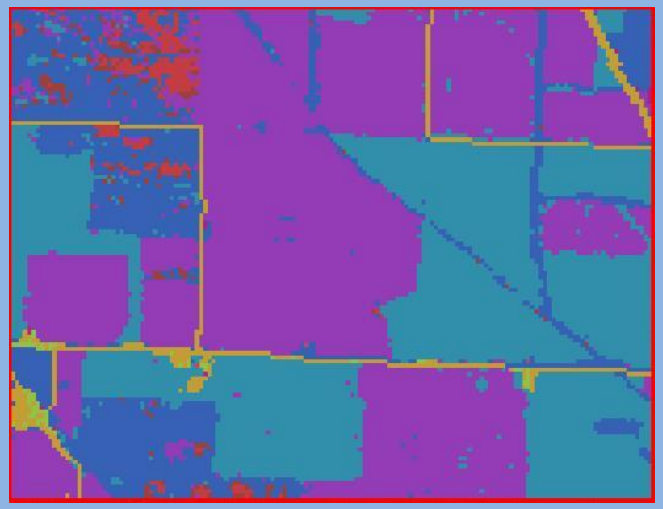
***No Spaces Allowed When Naming GIS Files**

Iowa Cities 2012.shp = WRONG

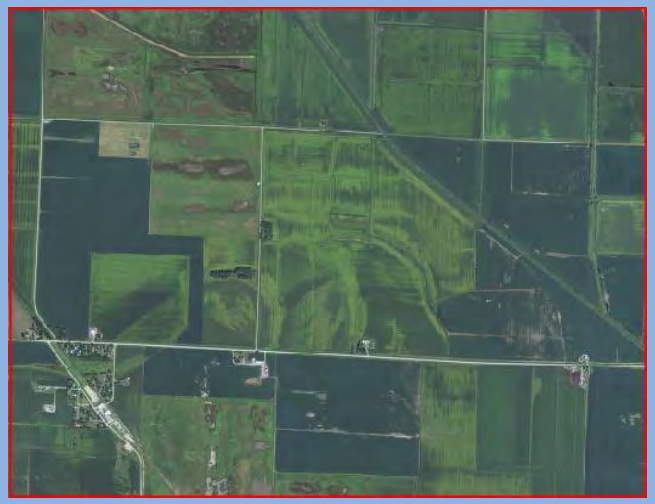
Iowa_Cities_2012.shp =RIGHT

Raster Data

Raster Types: A raster is a regular grid made up of cells, or in the case of imagery, pixels. They have a fixed number of rows and columns. Each cell has a numeric value and has a certain geographic size (e.g. 30x30 meters in size). Rasters cells can correlate to a fixed group like in the Cropland Data Layer (1: Corn, 3: Rice, 5: Soy) or they can maintain floating values for one category like an elevation grid (1,1.25,1.5,1.6).

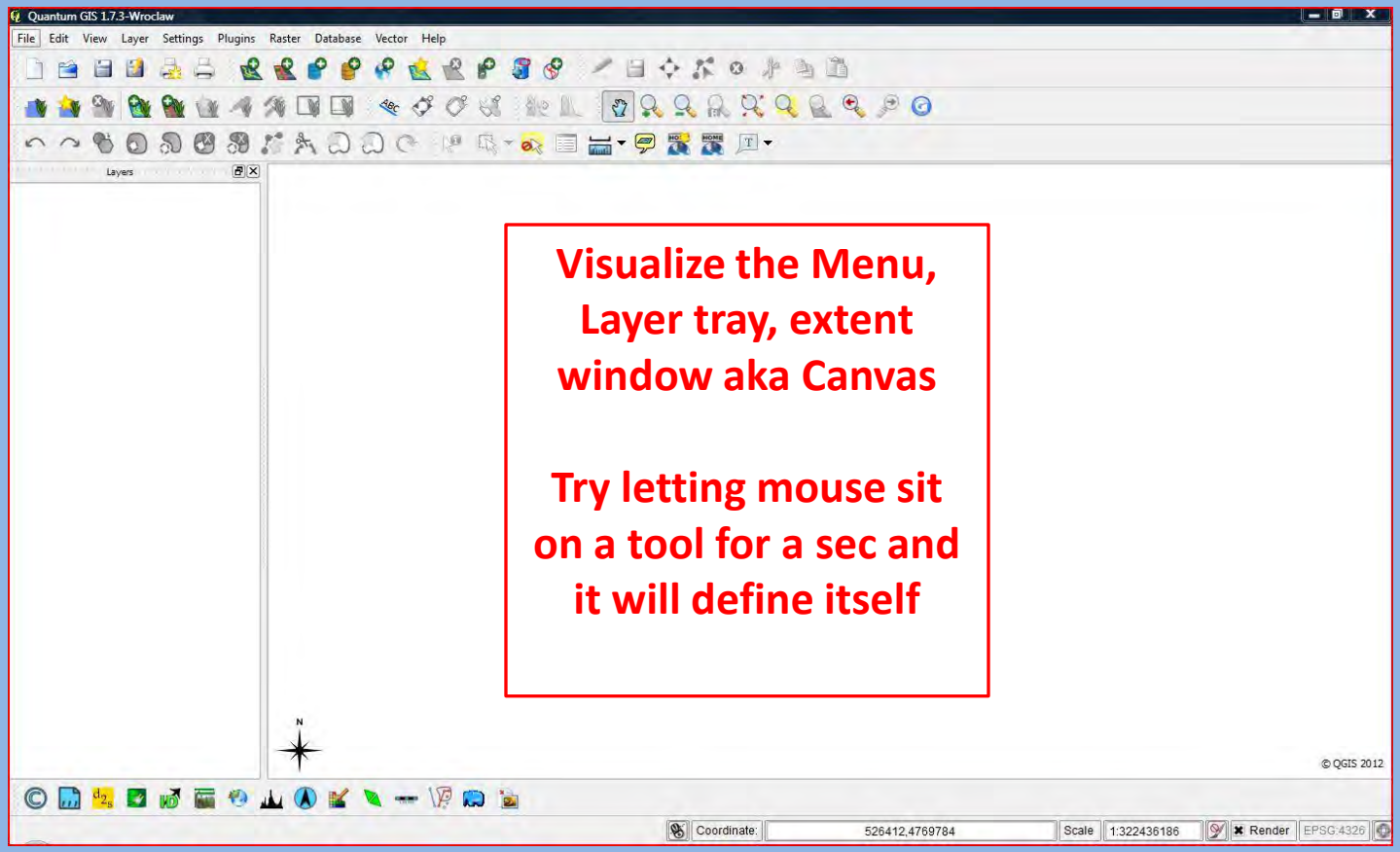


FIXED VALUE (CATEGORY) RASTER



FLOATING VALUE RASTER

QGIS Graphical User Interface (GUI)



Visualize the Menu, Layer tray, extent window aka Canvas

Try letting mouse sit on a tool for a sec and it will define itself

Figure 0.1

QGIS Graphical User Interface (GUI)

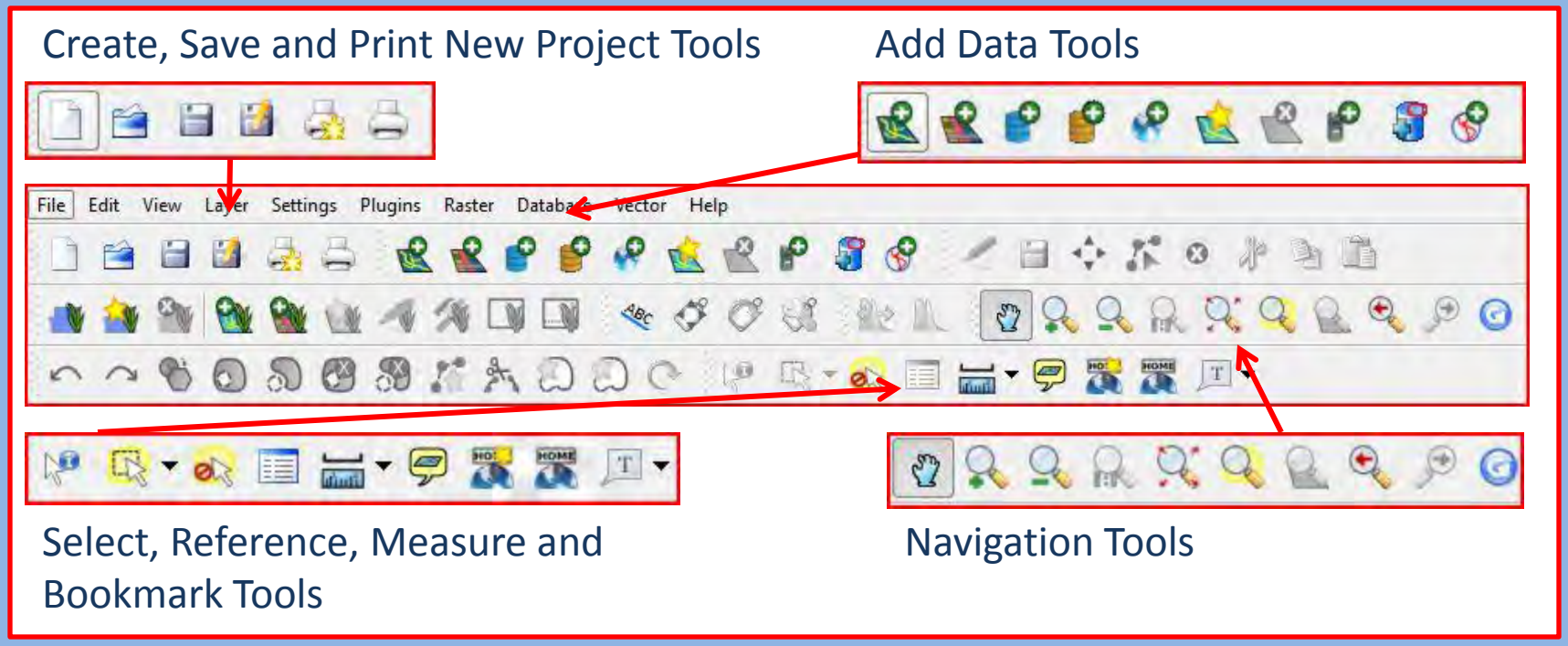


Figure 0.2

QGIS Graphical User Interface (GUI)

Visualize the Menu, Layer tray, extent window aka Canvas

Try letting mouse sit on a tool for a sec and it will define itself

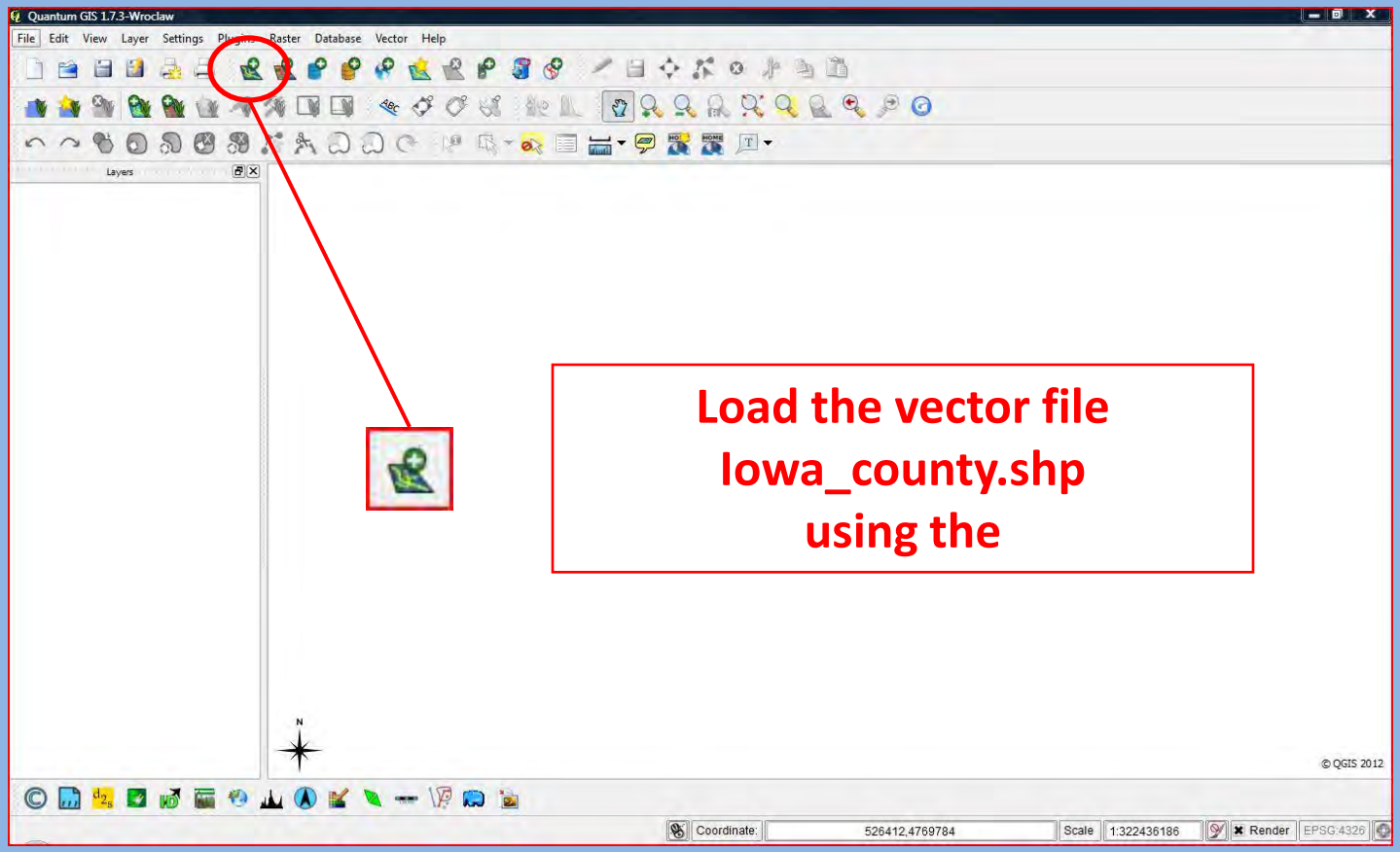


Figure 0.3

Enable on the fly projection

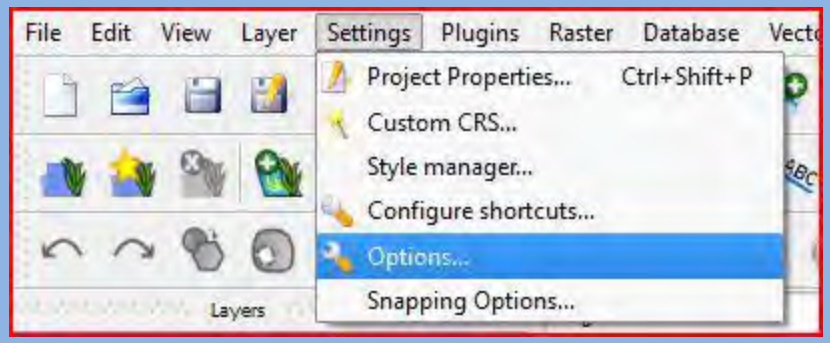


Figure 1.1

DEFINE: A CRS is a Coordinate Reference System that defines the projection ellipsoid and datum (NAD-83 UTM ZONE 15)

NOTE: Whenever you install QGIS "enable on the fly projection" must be established.

1) after you have opened QGIS and added a shapefile
2) go to the settings drop down and scroll down to options (seen in figure 1.1)
3) in the options window select the **CRS tab** (seen in figure 1.2 on next slide)
4) in the **"Default Coordinate Reference System for new projects"** section click on the **"select…"** button next to the white box. (Seen in figure 1.2)
5) this will bring up a the **"Coordinate Reference Systems Selector"** box (seen in figure 1.3)
6) in the search section in the middle of the window enter in **"26915"** , then click **"Find",** after that then click **"OK"** at the bottom of the window.
7)next you should see **"EPSG:26915 - NAD83 / UTM zone 15N"** in the white box next to the select button.
8) below the white box click the **"enable on the fly reprojection by default"**
9)Then repeat steps 4-7 above for the **"Coordinate Reference System for new layers"** section below the **"Default Coordinate Reference System for new projects"** section.
10) Once you have finished steps 4-7 for the **"Coordinate Reference System for new layers"** section, click the button for **"Used default CRS displayed below"** on top of the white box.
11) After than close out QGIS and restart, then add the Iowa_county.shp, if done correctly you should see a scale bar in the upper left hand-side in km rather than degrees.

Enable on the fly projection

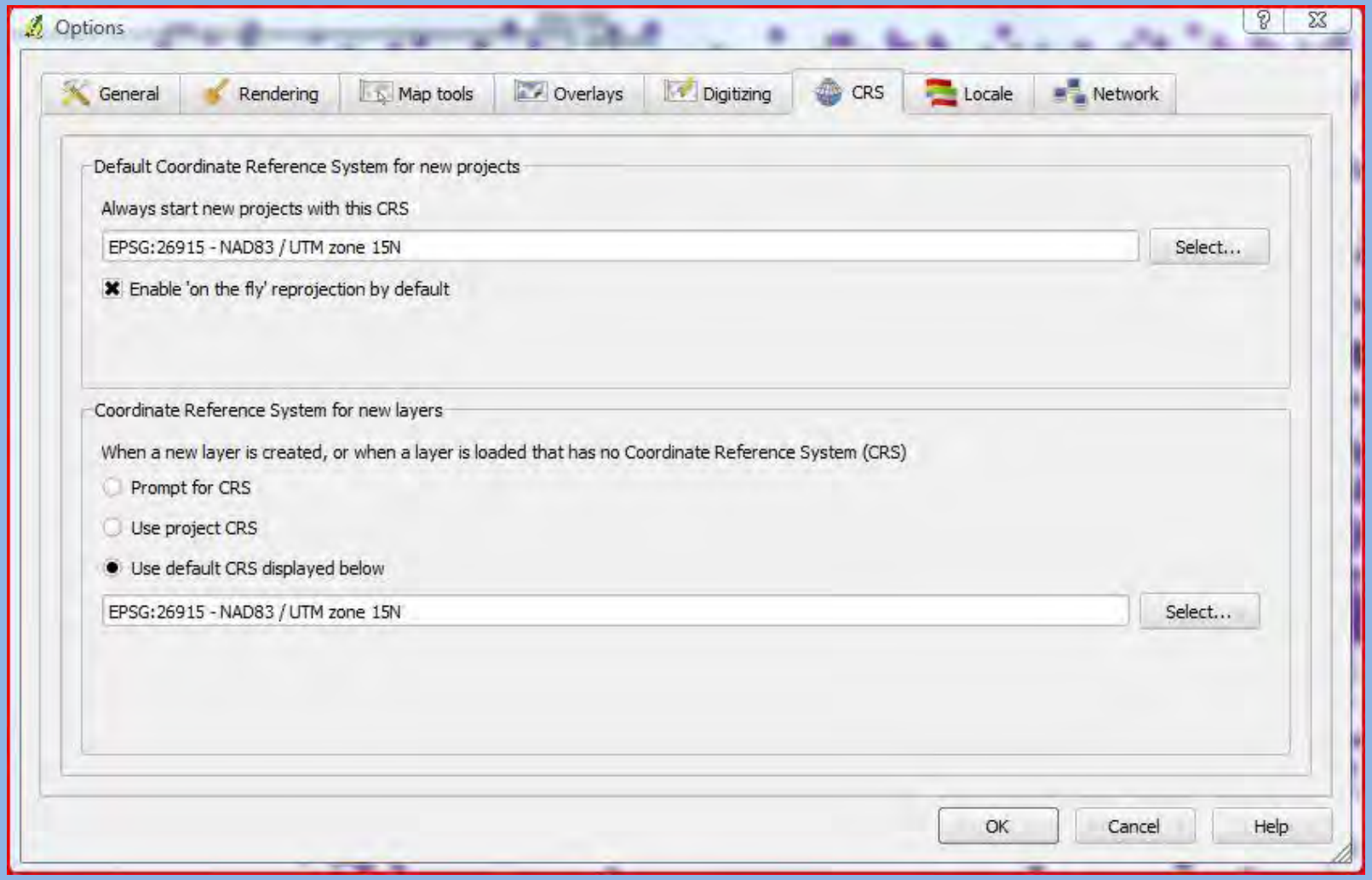


Figure 1.2

Enable on the fly projection

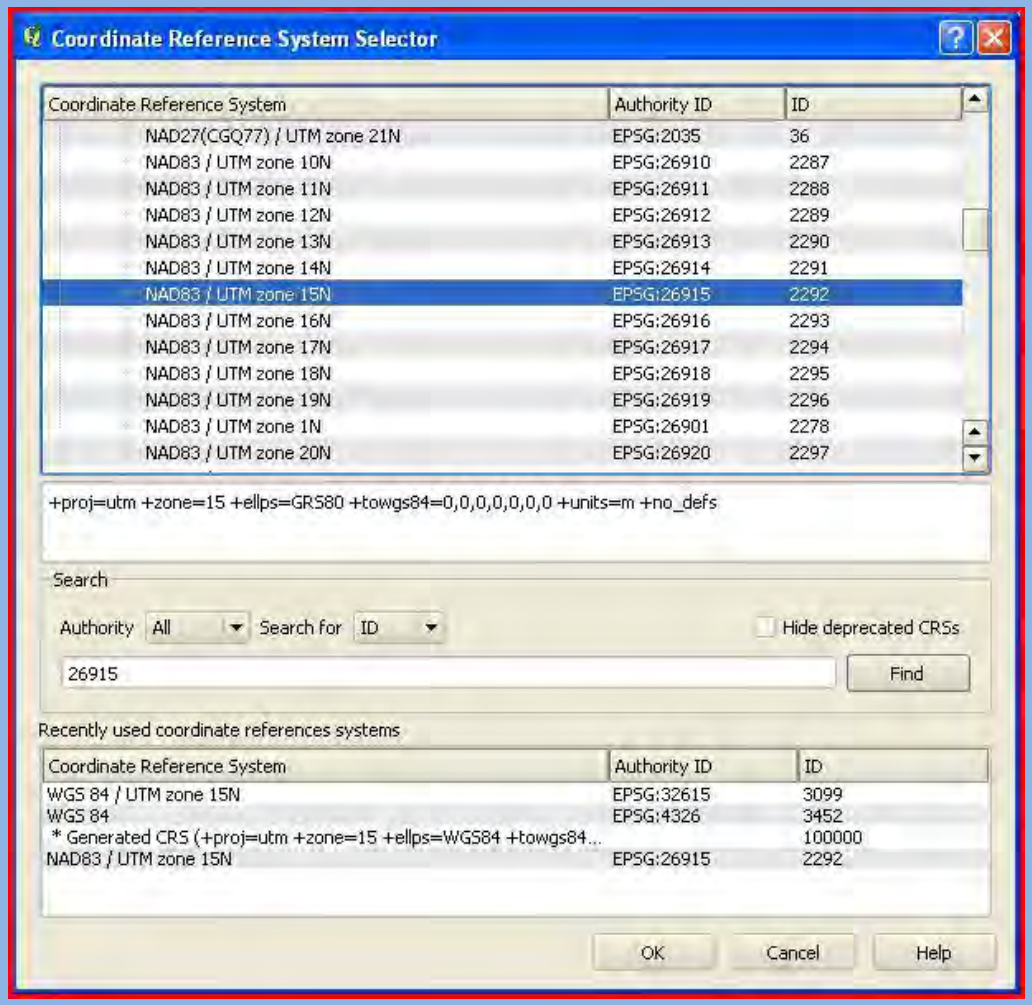


Figure 1.3

Load Raster Data

Figure 2.0

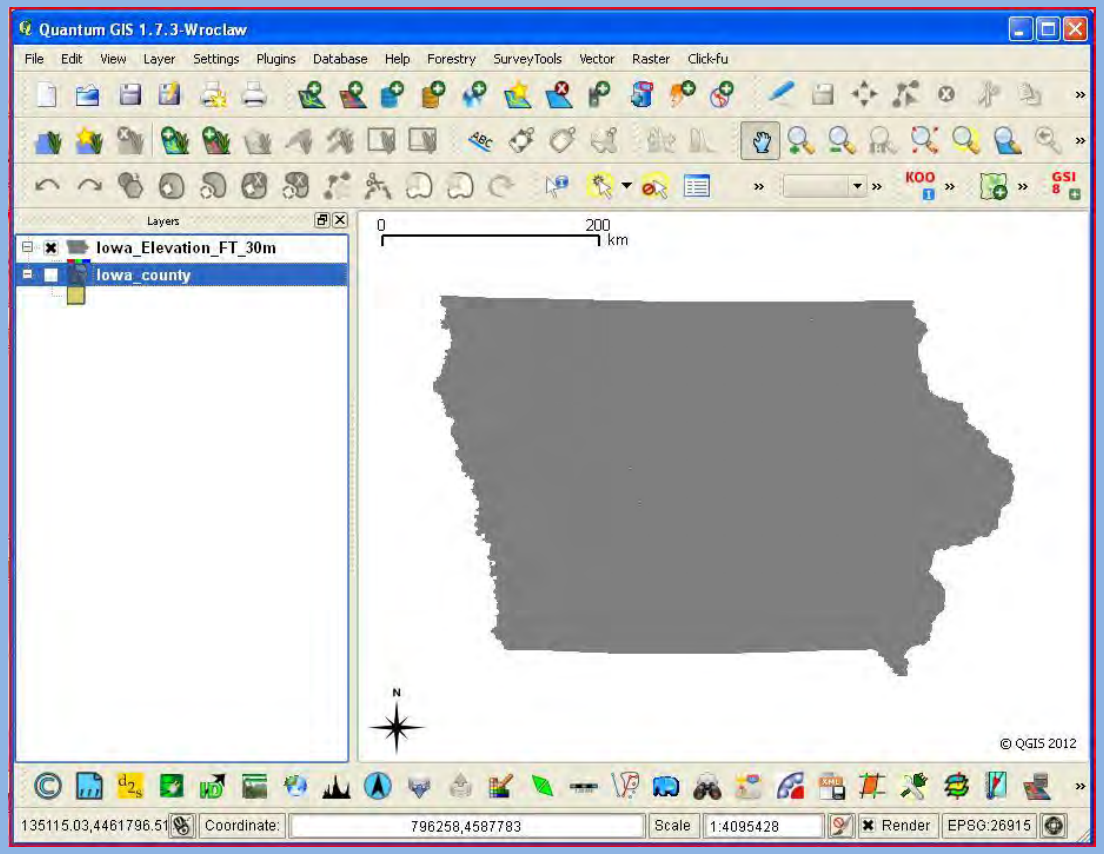


Figure 2.1

1) Load the raster file Iowa_Elevation_FT_30m.tif (as seen in figure 2.0). After you have loaded the raster (seen in figure 2.1), you will notice that it is all in one color.
2) In the layer try on the left of the viewer right click on the Iowa_Elevation_FT_30m layer and scroll down to properties.
3) In the properties window select the style tab seen in the upper left hand corner of figure 2.2 (on the next slide).
4) In the **"Style"** window look to the middle section title **"Single Band Properties"** and in the box next to **"Color Map"** use the drop down menu to select **"Pseudocolor".**
5) In the lower right hand corner of the **"Style"** window click on the **"Apply button"** and then click on the **"OK"** button.
6) If executed correctly you will see a choropleth map showing high elevations in red and low elevations in blue.

Raster Symbology (Float)

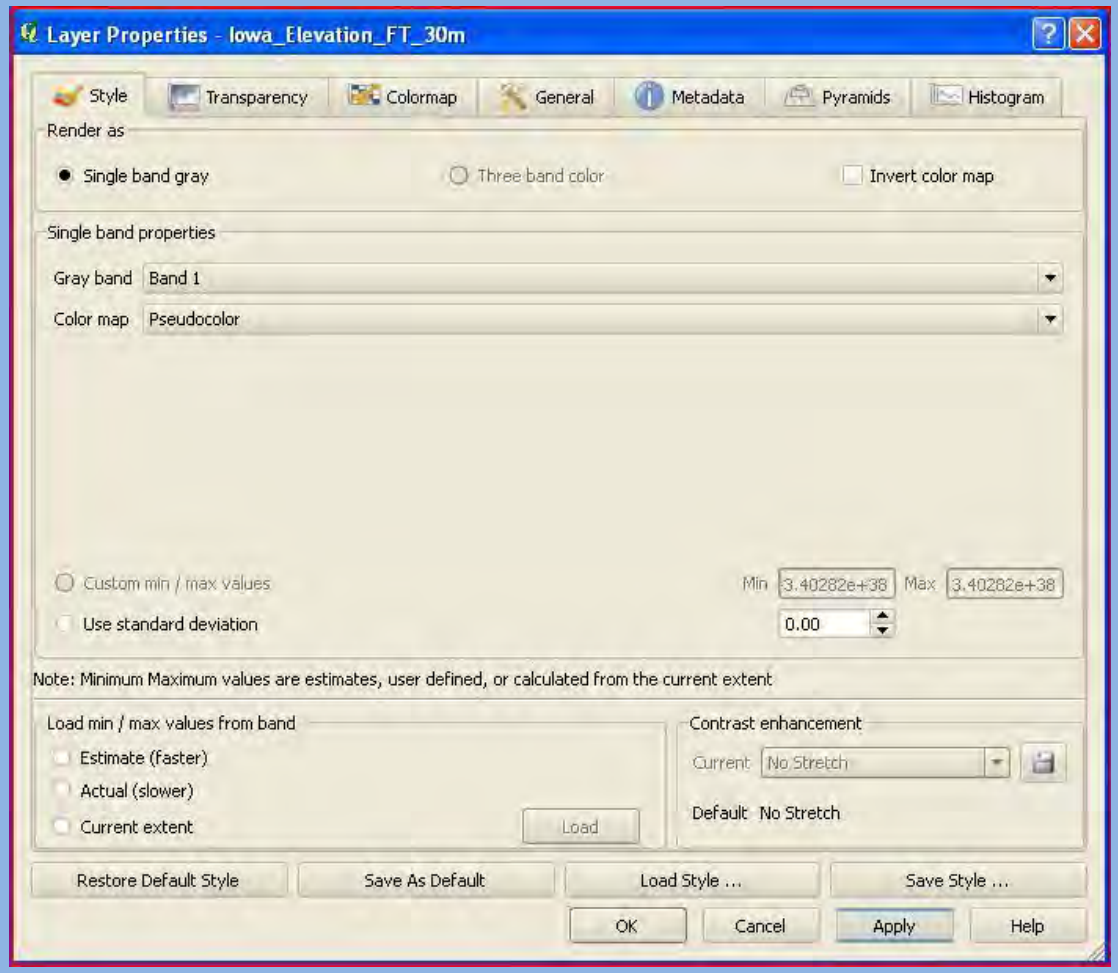


Figure 2.2

DEFINE: A choropleth map is a thematic map in which areas are shaded or patterned in proportion to the measurement of the statistical variable being displayed on the map, such as elevation.

Simple Vector Symbology

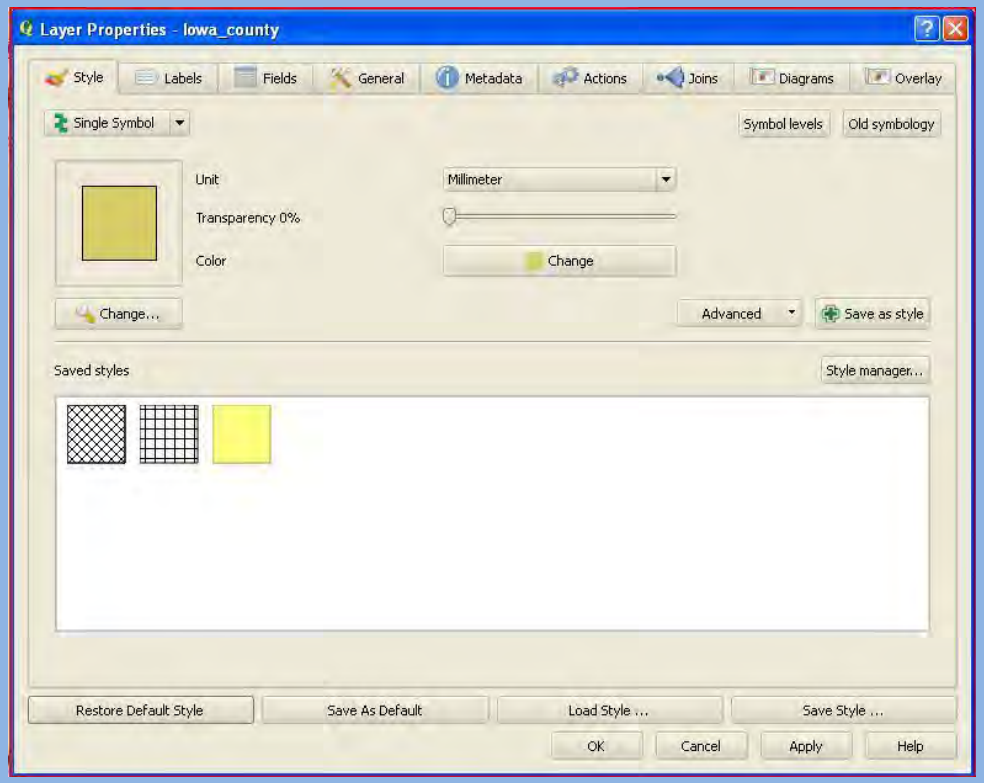


Figure 3.1

1) Using your mouse select the Iowa_county layer and hold down the left clicker of your mouse. Then gently move the mouse upwards/forwards so that the Iowa_county layer is above the Iowa_Elevation_FT_30m layer in the tray.
2) You will notice that all you see now is the counties, we now want to make the counties see-through with some simple vector symbology customizing.
3)) In the layer try on the left of the viewer right click on the Iowa_county layer and scroll down to properties.
3) In the properties window select the style tab seen in the upper left hand corner of figure 2.2 (you did this with the previous raster file).
4) Notice that the style menu looks different from the Raster style menu (seen in figure 3.1). Click on the **"Change"** button below the colored box near the left edge. This will bring up a **"Symbol properties"** window.
5) In the symbol properties window go to the layer property **"Fill style"** on the right hand side and change the fill to **"No Brush".** Then change the **"Border width"** to 0.75. (seen in figure 3.2) Then Click **"OK",** and then another **"OK"** in the later **"Layer Properties"** box.

Simple Vector Symbology

Figure 3.2

Save Your Work

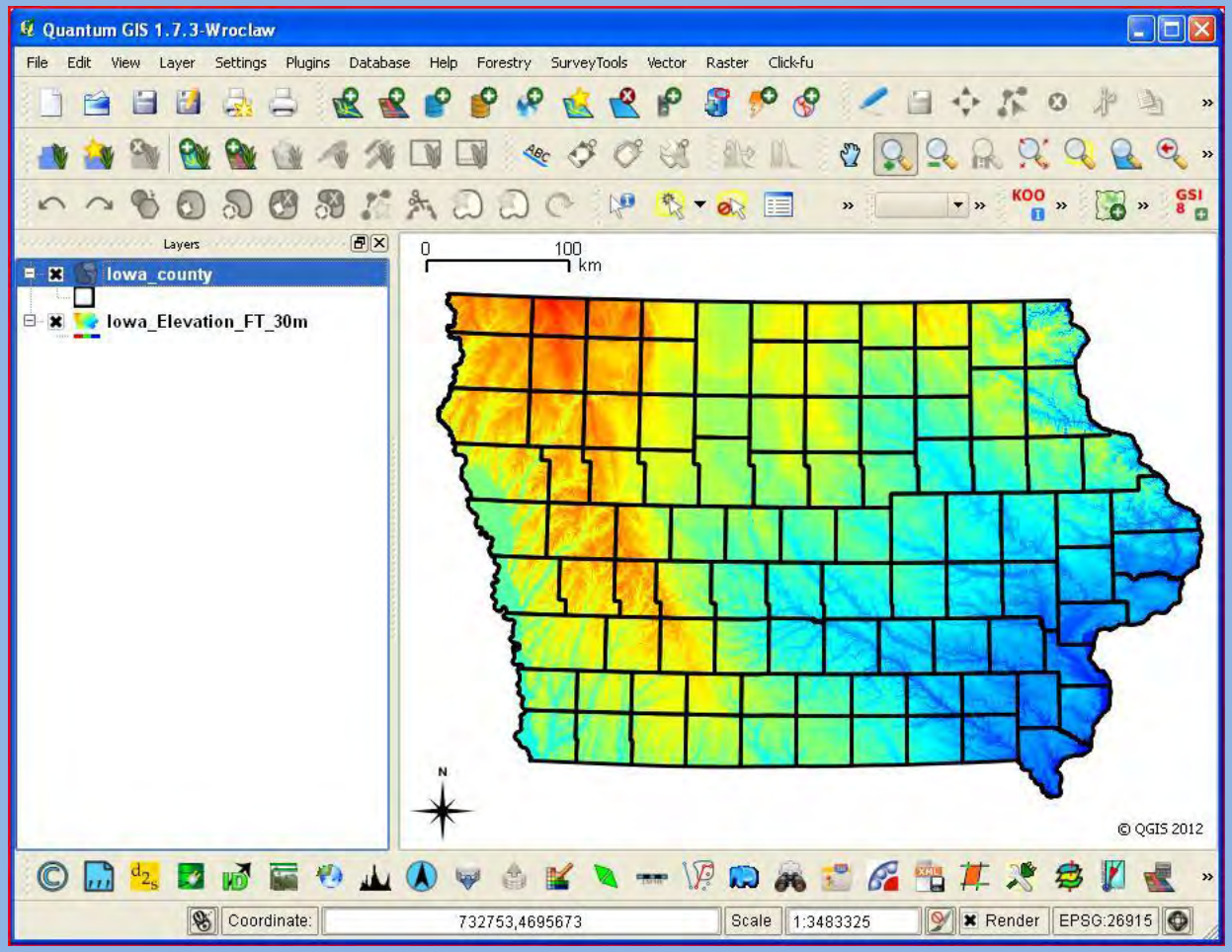


Figure 3.3

1) In the upper left hand main menu bar click on the File button and scroll down to **"save project as"** function.
2) This will allow you to save your work (symbology and all) to a .qgs file or a QGIS map file. You will notice in the icon menu you can click on the same button as well.

3) Once you have established a .qgs file you can save all updates and changes with the **"Save file"** icon.

Navigate

Use the blue hand or **"Pan Map"** tool to steer through the viewer or canvas.

Click on the **"Zoom in"** and **"Zoom out"** magnifiers to zoom in and out.

Highlight a layer in you layer tray and click on the **"Zoom full"** tool to return to the layer extent.

Select, Reference and Measure

Use the **"Select feature by rectangle"** tool to grab numerous features by dragging a rectangle over them.

Use the **"Deselect"** tool to cancel any existing selections for highlighted layers.

Use the **"Measure"** tool to find line distances, areas and angles.

Saving Layer Properties

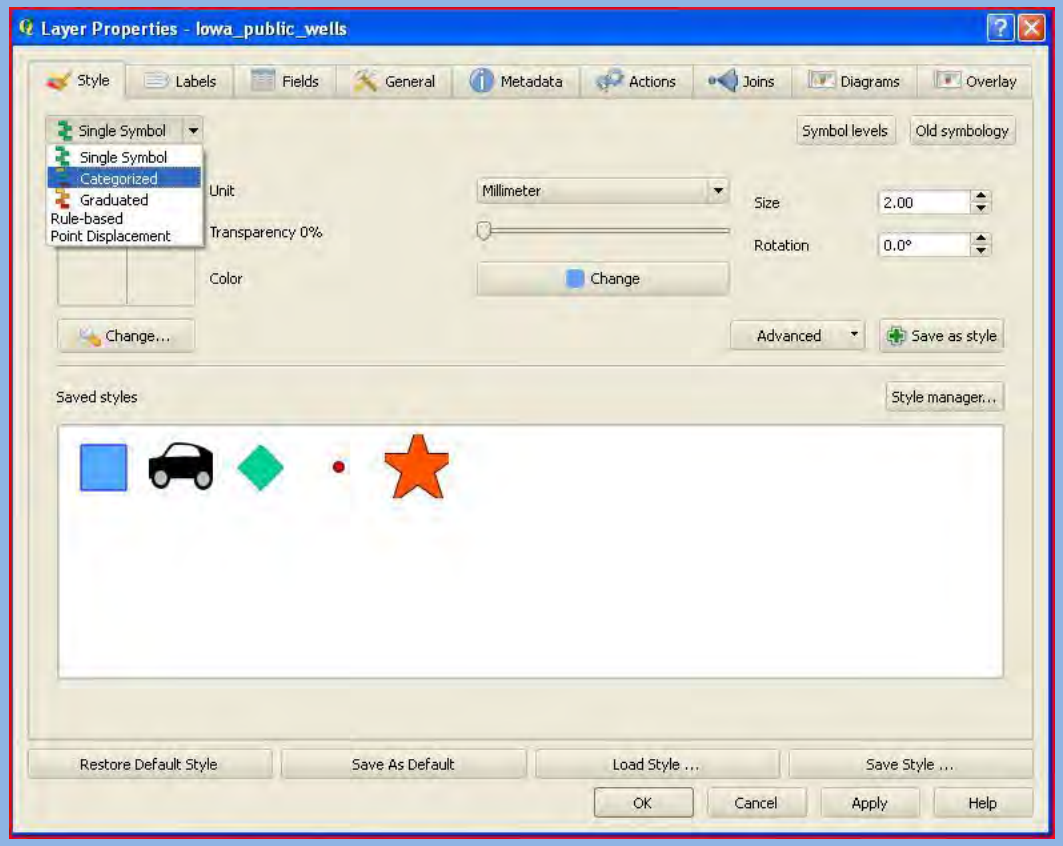


Figure 4.1

1) Add the **Iowa_public_wells.shp** to your recently saved **".qgs"** file.
2) Once the wells are added right click on the layer and bring up the layer properties window.
3) In the layer properties under the **"Style"** tab click the drop down menu for the thematic type directly under the **"style"** tab with and scroll down to **"Categorized"** (as seen in figure 4.1)

Saving Layer Properties

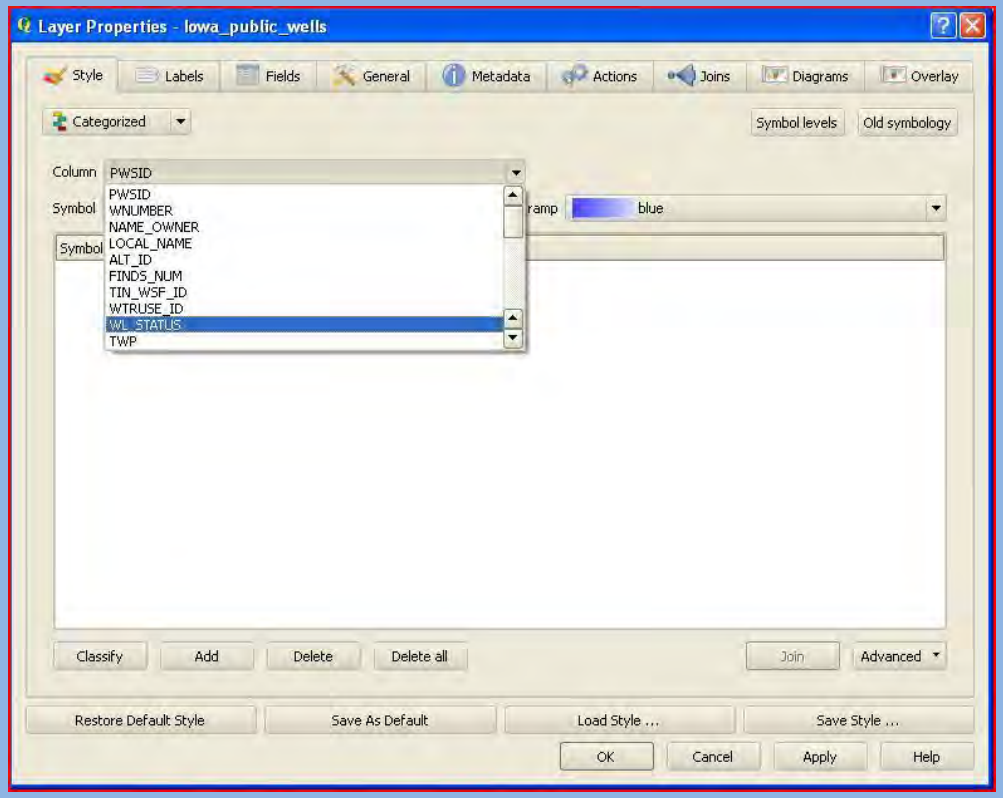


Figure 4.2

1) Then use the **"Column"** drop down to define which field you would like to classify. Please use the field **"WL_STATUS".** (as seen in figure 4.2)
2) Under the white box in the lower left hand side click on the **"Classify button"** this will bring up all possible categories for the **"WL_STATUS"** category and apply a default color ramp.
3) You can alter the symbol type and size within the **"Symbol"** drop down menu. In addition, you can change the color scheme with the **"Color ramp"** drop down, found above the white box.
4) You can also change individual category shapes and colors by clicking on the individual shape next to a specific class.
5) Once you are happy with your changes to the **"WL_STATUS"** you will want to save your edits a .qml file. To do this you will need to click on the **"Save Style…"** button in the lower right hand corner. Be sure to save the .qml in the same folder as where the shapefile is in. Once the .qml is named and saved correctly (see figure 4.3), then click the **"Save as Default"** button to the left of the **"Save Style"** button.
6) Then click **"Apply"** in the lower right hand corner followed by **"OK".**

Saving Layer Properties

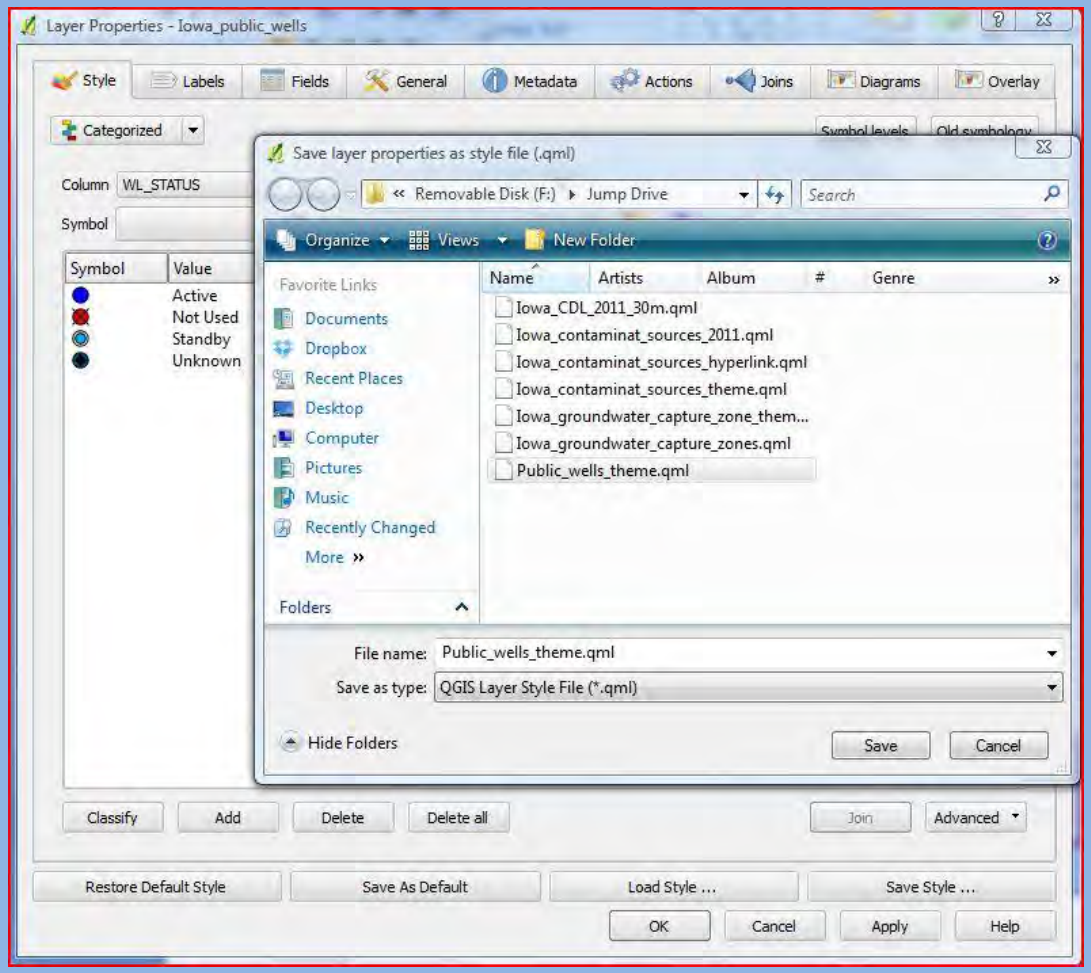


Figure 4.3

1) Check to see if your theme was preserved by removing your layer and re-adding it to your QGIS session . If done correctly all your changes should be preserved. See my changes on figure 4.4 on the next slide.

Saving Layer Properties

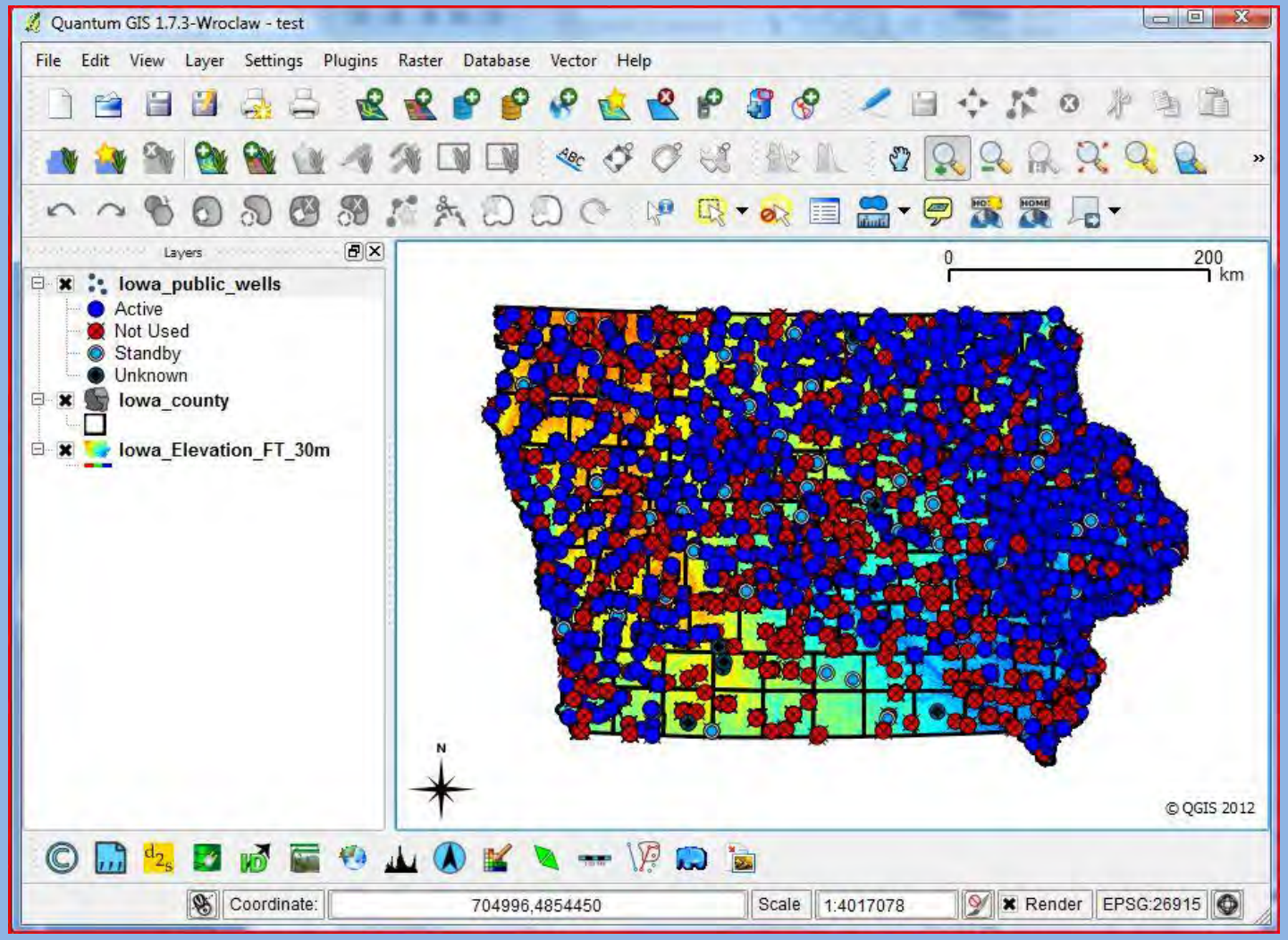


Figure 4.4

Loading a WMS layer

More WMS layers can be found at:
http://ortho.gis.iastate.edu/tools.html

Figure 4.5

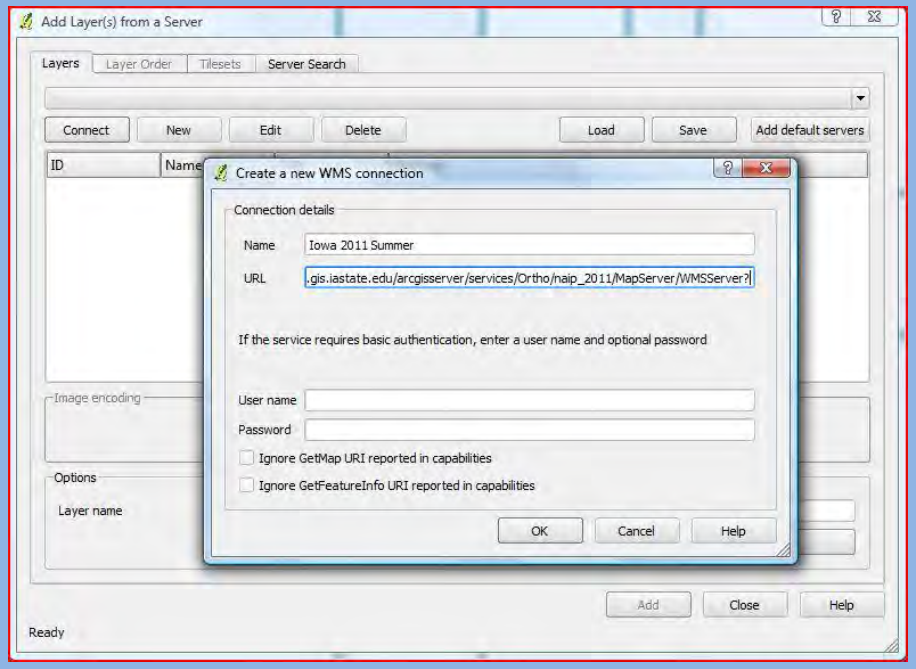


Figure 4.6

1) Click on the **"Add WMS layer"** button (as seen in figure 4.5), this will bring up the **"Add layer(s) from a Server"** window.
2) In the **"Add layer(s) from a Server"** window click on the **"New"** button in the upper left hand side near **"Connect".** This will pop up the **"Create a new WMS connection"** window (as seen in figure 4.6)
3) Name the layer Iowa 2011 Summer in the **"Name"** box and in the **"URL"** box below enter in this link: http://ortho.gis.iastate.edu/arcgisserver/services/Ortho/naip_2011/MapServer/WMSServer?, once added then click on the **"OK"** button.
4) Now you should see **"Iowa 2011 Summer"** in the layers drop down menu, click on **"Save"** and then click on **"Connect".**
5) Once the layers appears click on the **ID:1, Name:0, Title:naip_2011, Abstract:naip_2011**, once its highlighted in blue then click the **"Add"** button in the lower right hand corner. Once the layer has loaded (may take a minute) then click **"Close".** Be sure to save you .qgs file and the WMS link will be saved for future reference.

***WMS layers serve as an excellent base maps for reference when making maps**

Loading a WMS layer

The Iowa 2011 Summer WMS layer will serve as a good base map for future mapping projects (see WMS layer in figure 4.7).

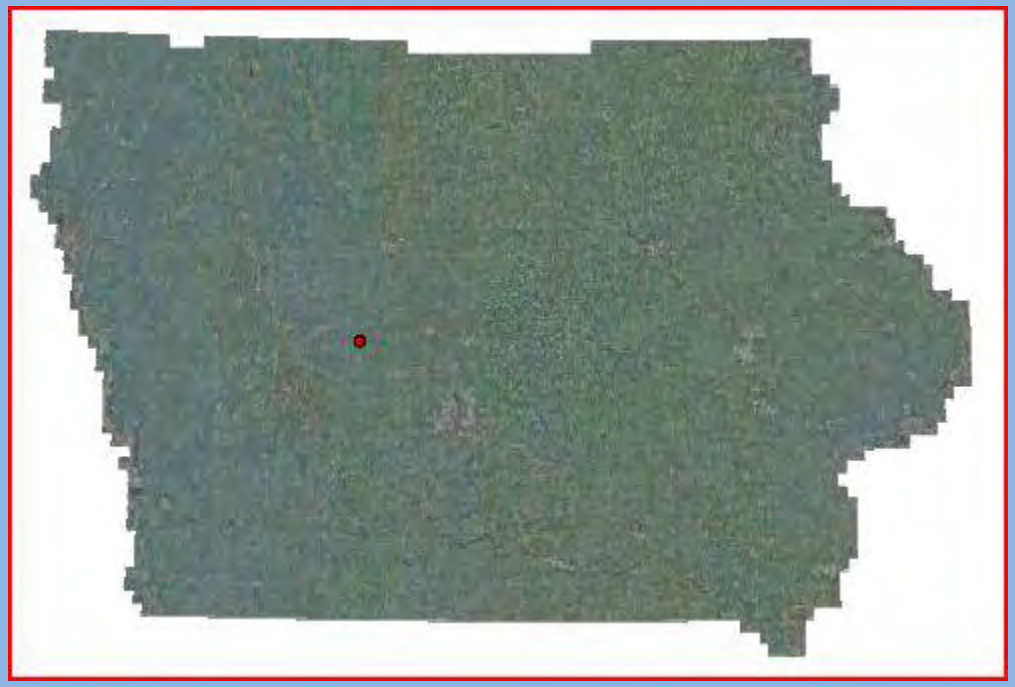


Figure 4.6

Pulling Data From a GPS

1) Open GPS Babel(refer to figure 4.7). From the **"Input"** section (this example is specific to a Garmin GPS, other input are possible) select **"Device",** followed by **"Garmin serial/USB protocol"** for the Format drop down, and **"usb:"** as the Device name.
2) Next , for the **"Translation Options"** select the **"Waypoints", "Routes", "Tracks"**. And for **"Output"** select **"File"** and a **"GPX XML"** Format.
3)Map to the desired location of where you will save the data, then click **"Apply"** in the lower right hand corner. If successful you will see a **"Successful"** message in the box below **"Output".**

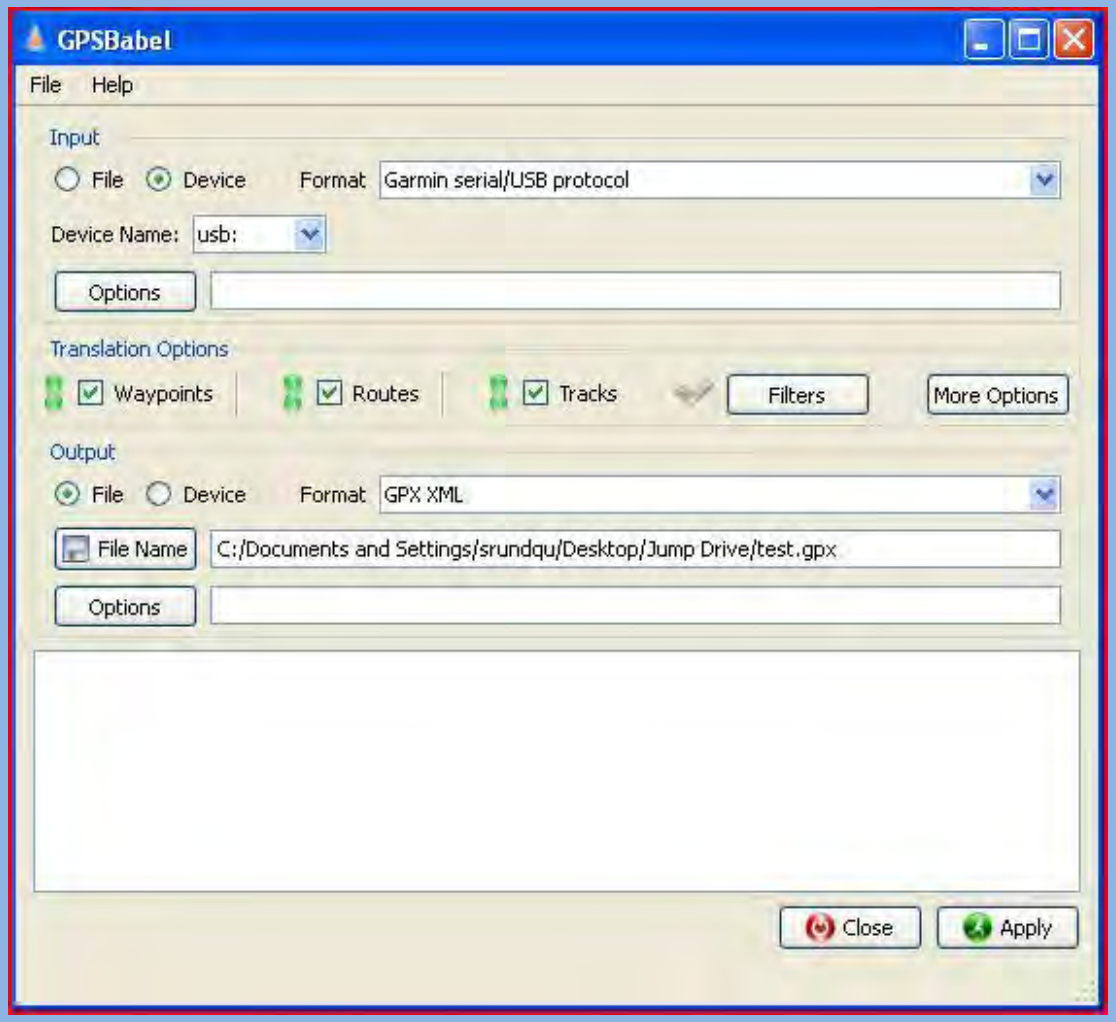


Figure 4.7

Pulling Data From a GPS

Once you have successfully pulled the data from the GPS unit to your computer, you can then change the data into a shapefile (.shp). To do this click the **"Add Vector"** button. When looking for the .gpx file be sure to establish the .gpx file in the **"Files of type:"** dropdown box(as seen in figure 4.8). Once you have opened the .gpx file a **"select vector layers to add.."** window will pop up(as seen in figure 4.9). Mouse over the layers and highlight the ones you wish to turn into shapefiles. In this case select **"waypoints", "tracks"**, and **"track_points"**, then click **"OK".**

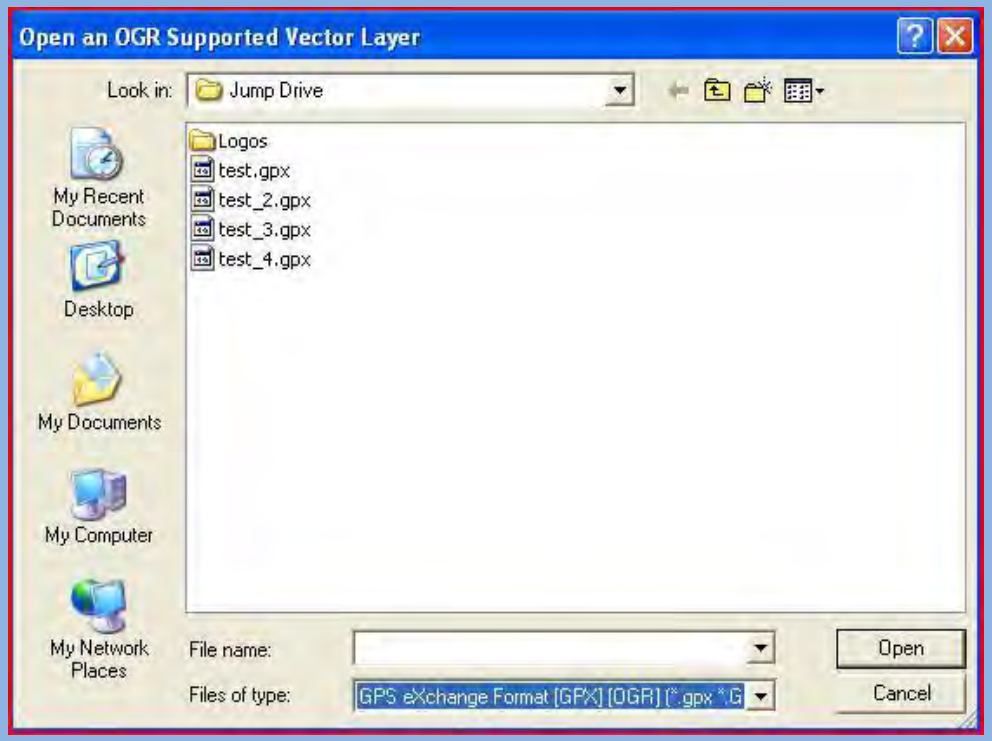


Figure 4.8

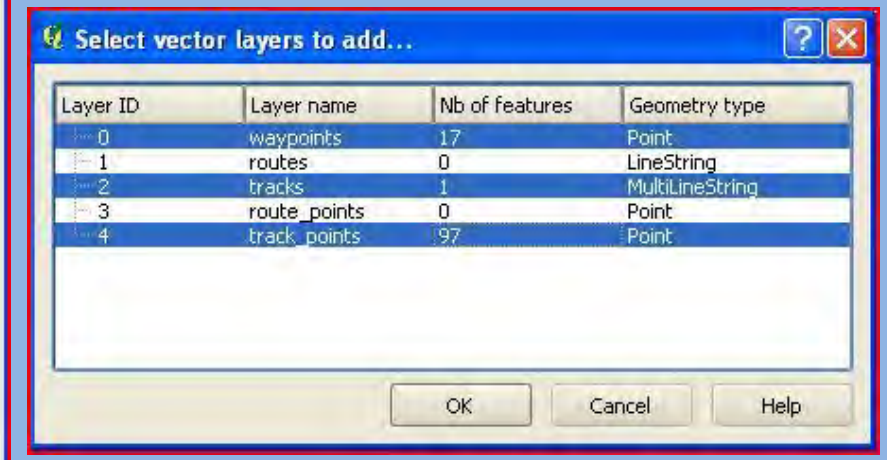


Figure 4.9

Pulling Data From a GPS

Once added you should see layers in the layer try(as seen in figure 4.9.1), these are the .gpx files. To turn these files into shapefiles (.shp) simply right click on the layer and scroll down to **"save as…".** In the **"Save vector layer as"** window save the .gpx as an **"ESRI Shapefile"** in the Format type. Map a pathway to the folder where you would like to save the file, and then in the CRS box save as a **"WGS 84 / UTM zone 15N"(**as seen in figure 4.9.2), you have to use the **"Browse"** button to find the CRS. Then click **"OK".** *we cannot save directly as NAD 83 / UTM zone 15N because the GPS points were captured in WGS 84, used by Garmin.

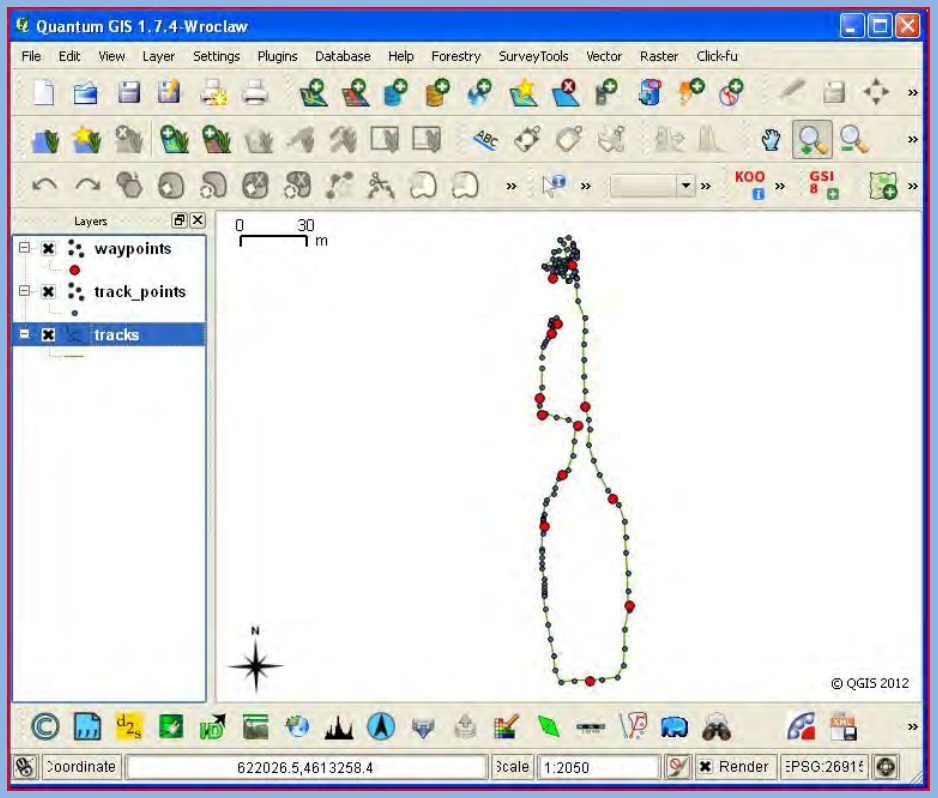


Figure 4.9.1

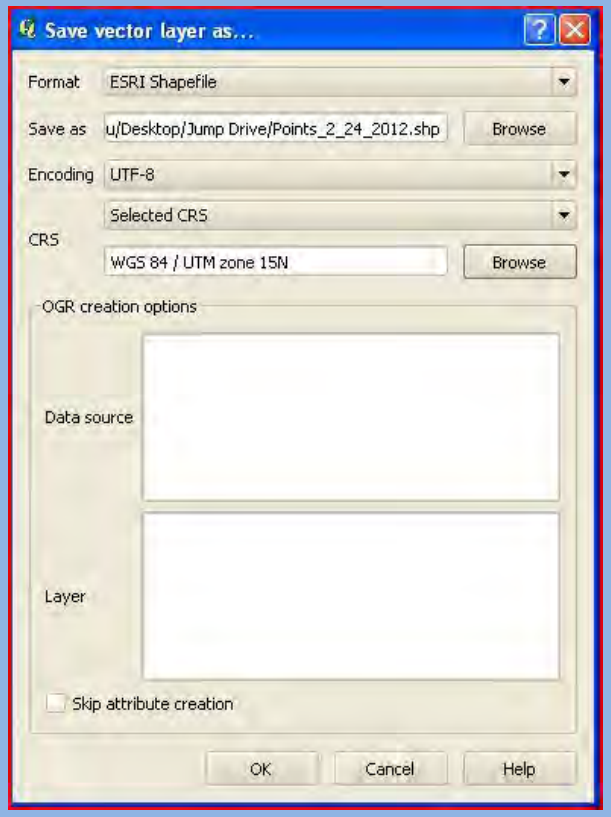


Figure 4.9.2

Pulling Data From a GPS

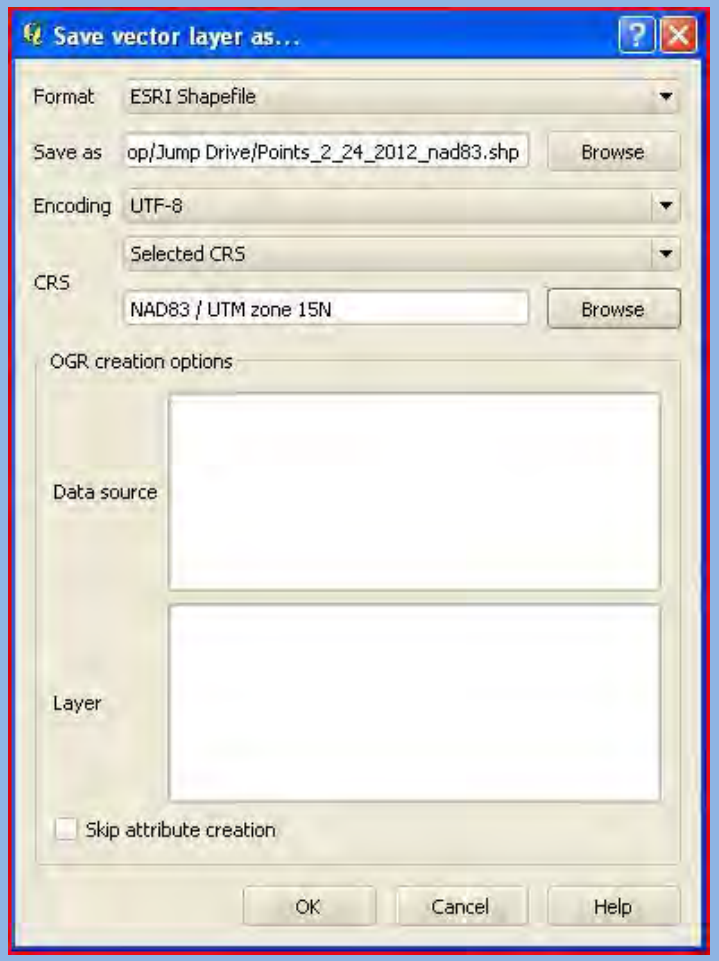


Figure 4.9.3

If you would like to re-project your newly created shapefile to **"NAD 83 / UTM zone 15N",** simply add the shapefile (you may have to navigate back to the .shp extenstion in the **"Files of type:"** box) to QGIS, right click on the layer and select **"save as…",** and browse for the **"NAD 83 / UTM zone 15N"** CRS (as seen in figure 4.9.3).

Labels

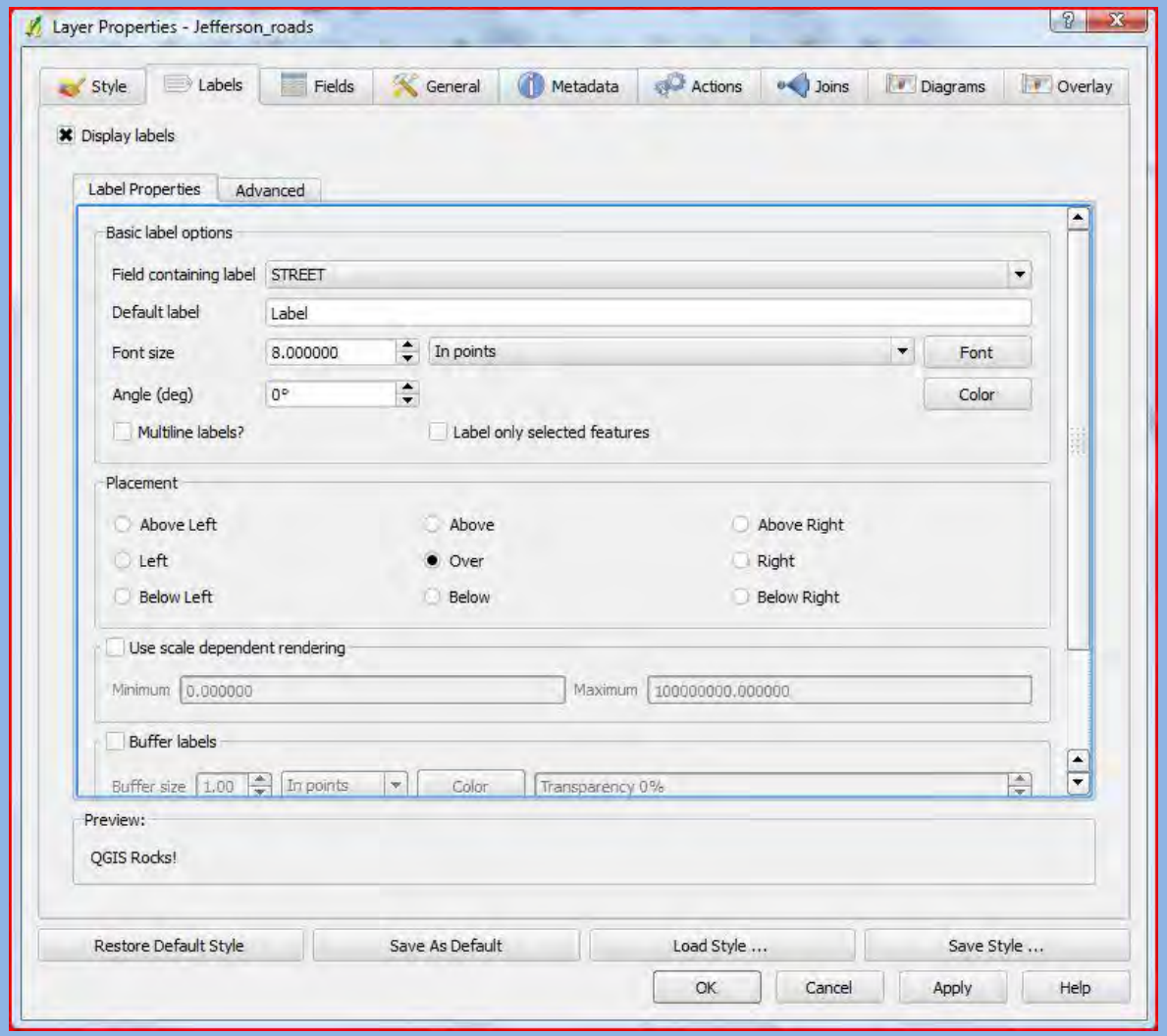


Figure 5.1

1) One way to display a good reference on a map is to display labels for landmarks (in this case roads). To begin applying labels lets add some data that we will use in the next lesson for georeferencing. Please add the Jefferson_roads.shp to the viewer.
2) When Jefferson_roads.shp is added then zoom to it's extent by right clicking on it an scrolling to **"zoom to extent"**
3) Once added navigate to the layer properties by double clicking the layer in the layer tray. When the **"Layer properties"** window appears, click on the tab title **"Labels".** (you may notice that everything in the window is grayed out), simply click the box below the label tab titled **"Display labels"** and everything should activate 1(see figure 5.1 to the left).
4) Next in the **"label properties"** section, find the field containing the layer in the **"Field containing label"** dropdown. In this case **"STREET",** then change the font size to **"8.0",** click **"Apply"** and then **"OK".**

Labels

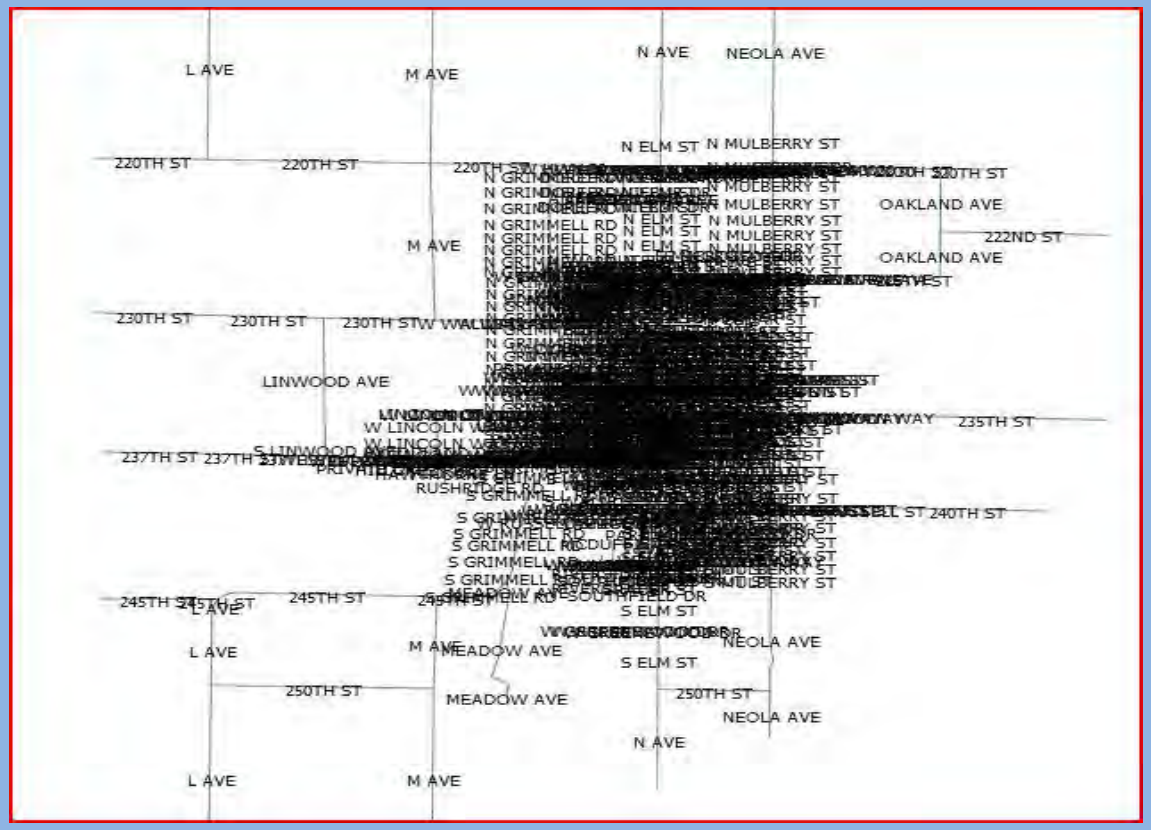


Figure 5.1

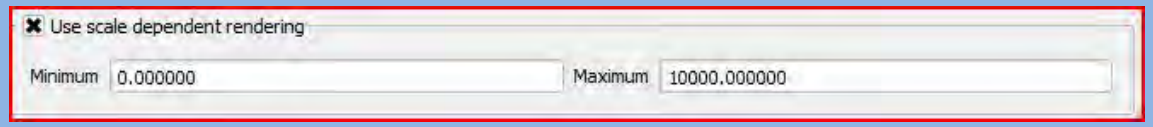


Figure 5.2

When your viewer comes back into frame you will notice a giant blob of letters, this is because each segment within the line file is attributed with a street name. To make things a bit more manageable you can set the extent to which labels appear. To do this follow the steps bellow.

1) Go back into the label properties and within the **"Use scale dependent rendering"** section click the box to activate the function and set the maximum to 10000 (as seen in figure 5.2), this means labels will only be visible when zoomed in to 9999 meters or less otherwise they will not appear. To make the label style, and rendering extent permanent you can create an accompanying .qml for the Jefferson_roads layer by saving it in the same folder and setting as the default like in lesson 4.

2) Trying zooming in and out to see if labels adhere to the extent that you set.

Geo-referencing a Paper Map

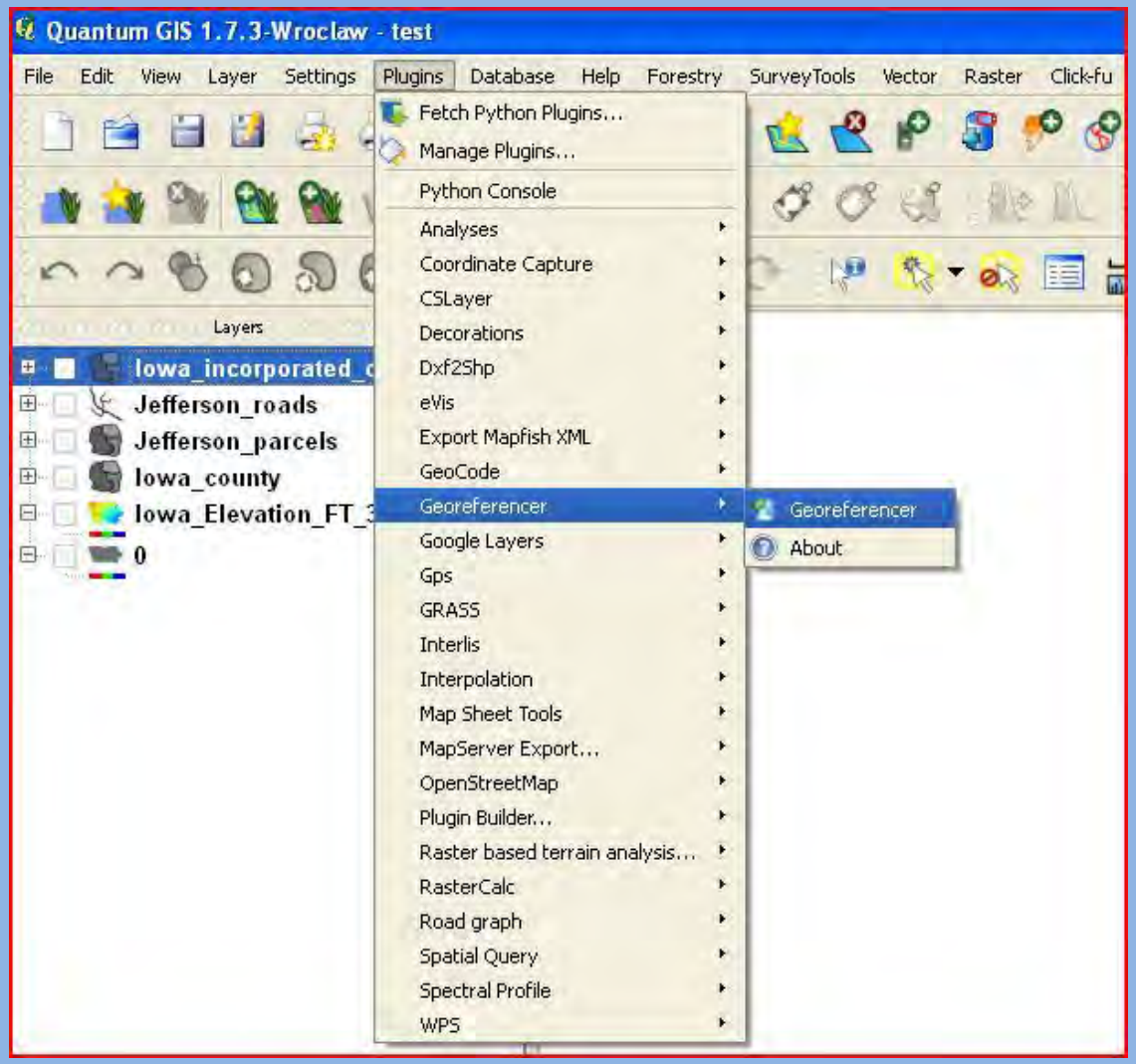


Figure 6.1

Now that you have established labels for the roads layer we can try georeferencing an old paper map turned into a .tif image.

1) To begin georeferencing you will need to click on the **"Plugin"** drop down menu and scroll to **"Georeferencer"** and then to the right again to **"Georeferencer".** (as seen in figure 6.1).

2) Once the **"Georeferencer"** window appears click on the add raster button and insert the Jefferson_1.tif into the viewer (see figure 6.2 on the next slide).

Geo-referencing a Paper Map

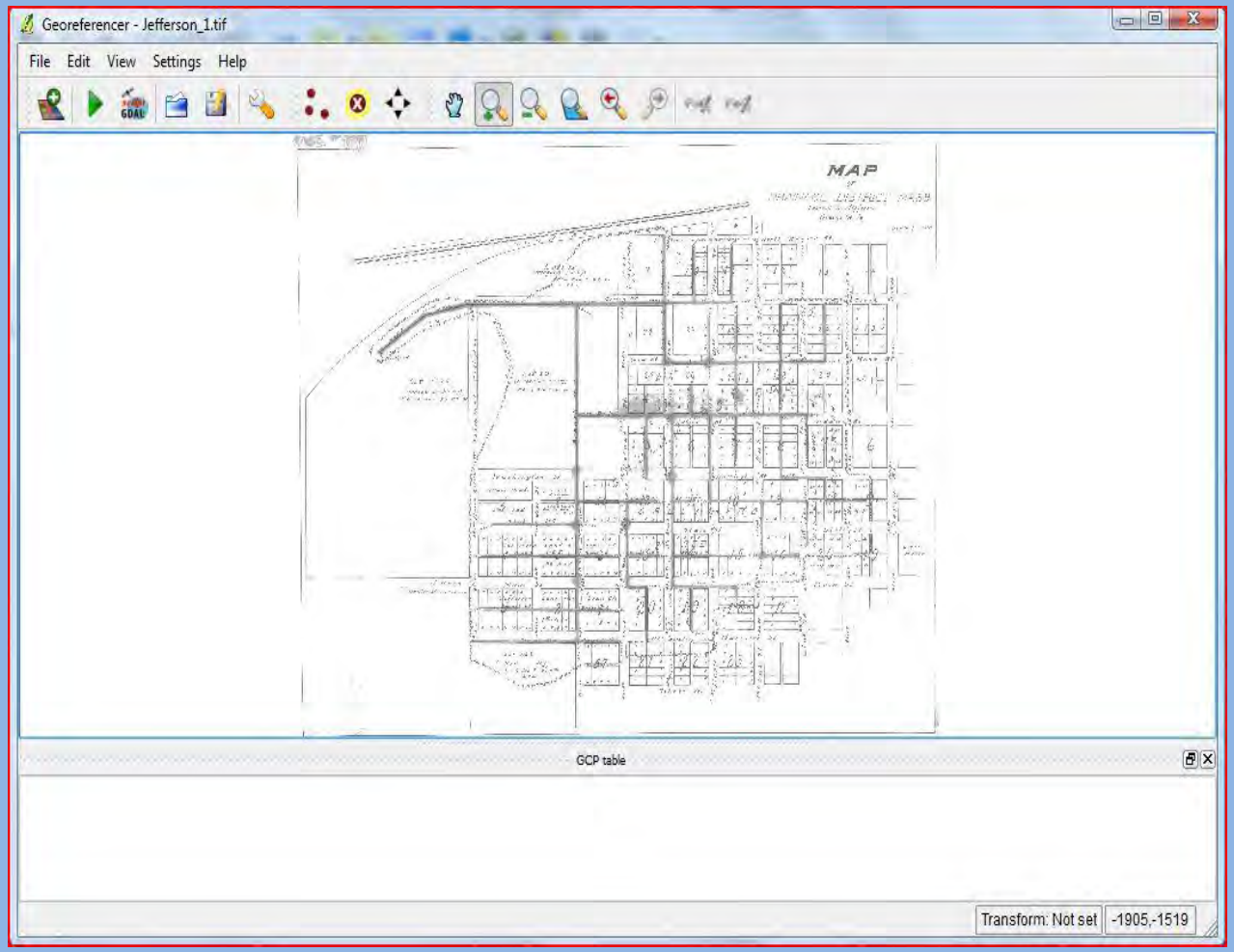


Figure 6.2

This is where being familiar with the navigation tools will be handy because this requires a lot of zooming in and out.

3) In the **"Georeferencer"** window zoom into the center of the map, then click on the blue hand **"Pan Map"** tool so you are able to read the street names on the map (explore the map a bit and become familiar with the some streets).

4) Minimize your **"Georeferencer"** window and zoom into the center of your Jefferson_roads layer and the labels should appear (find some intersections that where on the old map image).

5) Now maximize your old map image and find like intersections. Once you have discovered at least 4 like corners between the digital road file and the map image then we can begin georeferencing.

Geo-referencing a Paper Map

Figure 6.3

Figure 6.6

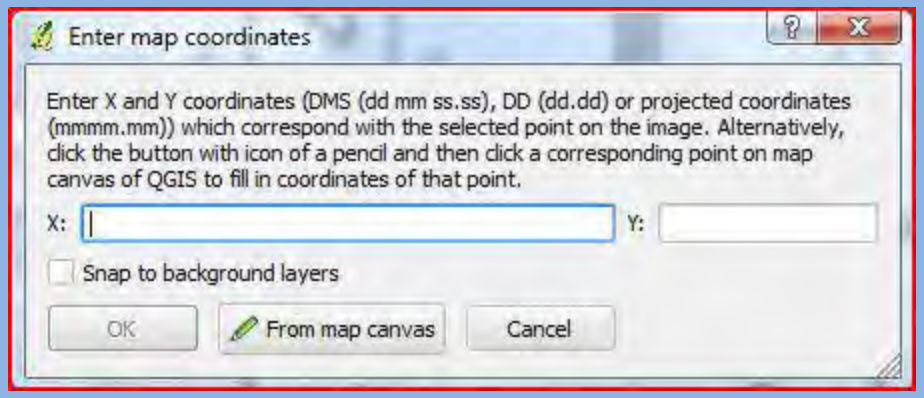


Figure 6.4

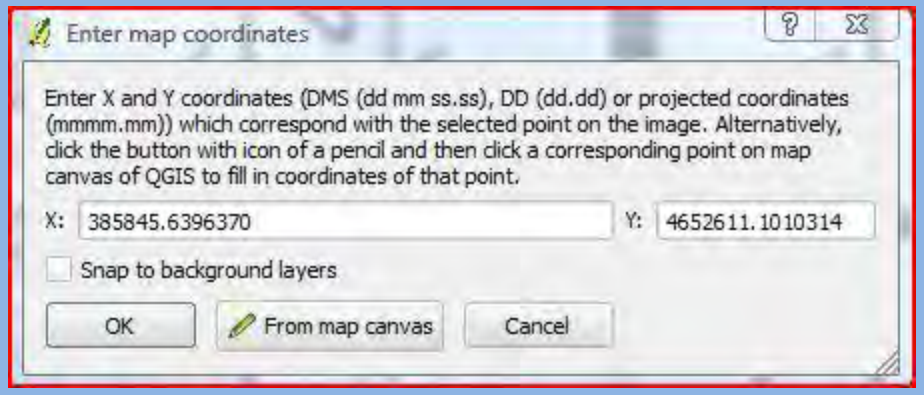


Figure 6.5

6) Begin marking corresponding points on the map image and the Jefferson _roads layer with the **"Add point"** tool (as seen in figure 6.3).

I used the following intersections:

Oak and Washington
Harrison and Elm
Reed and Pinet
High and State

7) Once you find the first intersection zoom into a point where you can see the dot in the intersection of the map image. Then click on the **"Add point"** tool, which will bring up an **"X"** or cross-hairs and click on the dot in the center. Once clicked an **"Enter map coordinates"** window will pop up (as seen in figure 6.4), this window wants to know where to take a reference point from, rather than entering and X-Y, click on the **"From map canvas"** button. This will bring you to the QGIS view, from there click on the intersection mid point or zoom in closer to find it. If you choose to zoom you will have to click on the **"From map canvas"** button again to activate the **"X"** marker. Once you click the corresponding reference point in the QGIS viewer the **"georeferencer"** window will pop back up, with and X and Y populated (as seen in figure 6.5). After this simply clikc **"OK".** If done correctly you will see a red dot on the image map and the coordinated in a table below. Repeat this step for the remaining three intersections. You can also remove a bad point by clicking to **"Delete Point"** (as seen in figure 6.6).

Geo-referencing a Paper Map

Figure 6.6

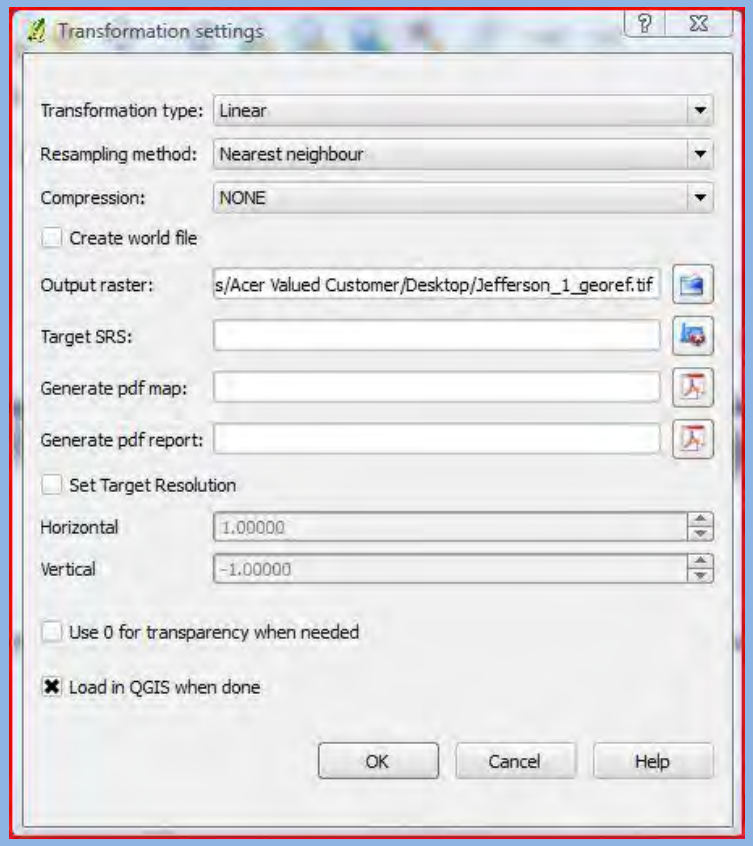


Figure 6.7

8) Once you have four control points listed in the table below the **"Georeferencer"** then click on the **"Start georeferencing"** tool (as seen in figure 6.6).
9) You will see a pop-up that wants you enter in a transformation type, click **"OK".** This will bring you to a **"Transformation Settings"** window. In the settings you will have to specify two things (as seen in figure 6.7), first **"Transformation type"** set to **"Linear",** to learn more about methods Google **"Georeferencing transformation types"**. Second you will want to generate a geo-tif (basically the same map image with a spatial reference), do this by saving the tif to the **"Your_Data"** folder on the jump drive. Now you can click the **"load in QGIS when done"** and click **"OK".**
10) If done correctly you should see the .tif loaded into your QGIS viewer. You have successfully georeferenced an image, now lets more on to creating a layer. Close the **"georeferencer"** window. This will ask you to save the GCP points? At this point we can click **"discard"** however in the future its good to keep the GCPs around, so you wouldn't have to re-do all the control points.

Creating Vector Data

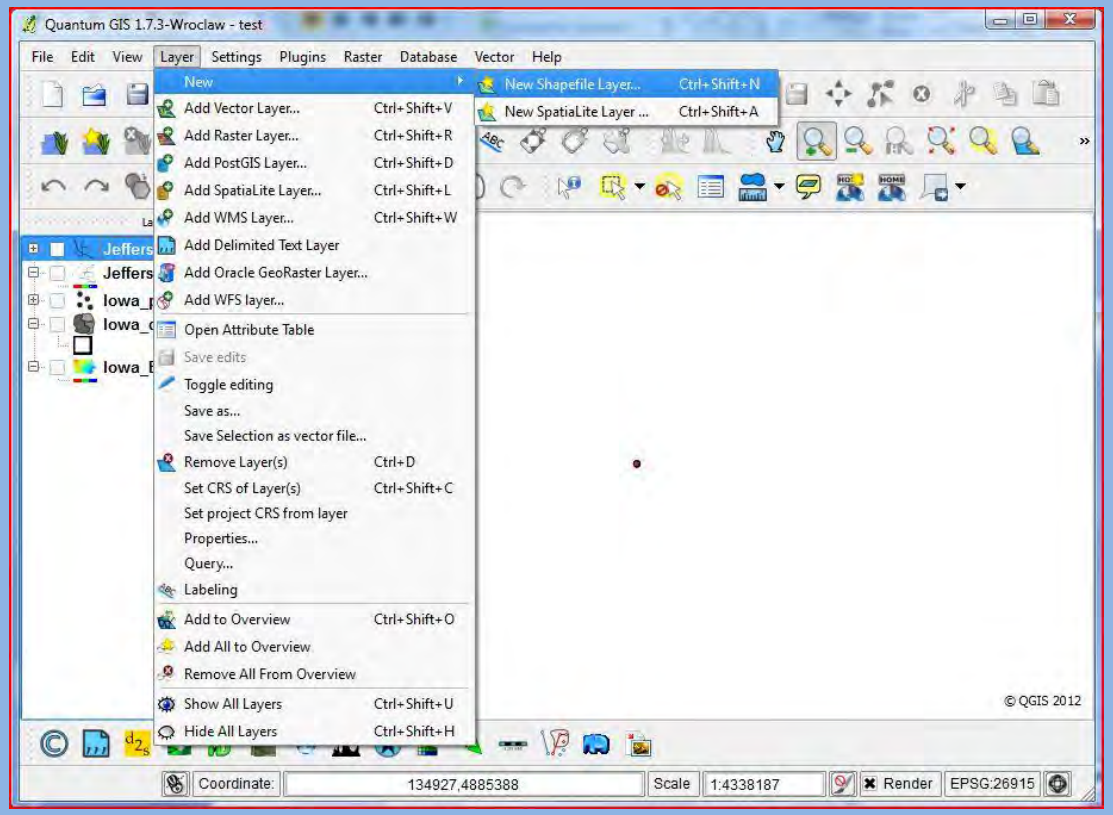


Figure 7.1

Using the editing tools we can create a polygon for the drainage area in the old Jefferson map we just georefernced.
1) Under the **"Layer"** drop down in the QGIS viewer scroll to **"new"** then right to **"New Shapefile Layer…"** (as seen in figure 7.1)

Creating Vector Data

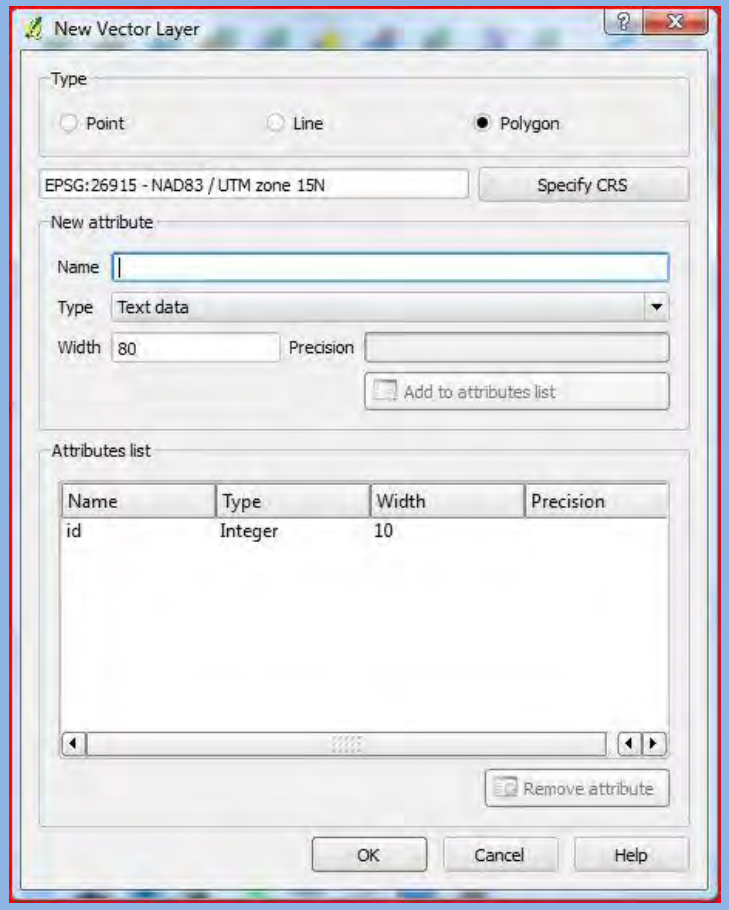


Figure 7.2

Figure 7.3

Figure 7.4

2) In the **"new vector layer"** window that pops up (as seen in figure 7.2) make sure and check the **"polygon"** button and verify that the projection is set to **NAD-83/UTM 15N**. Once that is done click **"OK".** This will prompt you to save the layer, save in the **"Your_Data"** folder on the jump drive. Name it Jefferson_Drainage.shp and save in a easy to find place. The empty layer should appear in your layer tray.

3) Select your blank layer and click on the **"toggle edit"** or blue pen (as seen in figure 7.3), this opens an edit session on what ever layer is selected (jefferson_drainage). Once in edit session click on the **"Capture polygon"** tool(as seen in figure 7.4).

4) Now zoom into the georeferenced image so that you are close enough to make out the squiggly dash marks which delineate the drainage area. Once visible re-click the Jefferson_Drainage layer which should still be in an active edit session. Once highlighted click on the **"Capture Polygon"** tool, move the mouse onto the view and begin tracing the drainage outline. Make many points and try and capture as much detail as possible. Once you come upon the edge of the viewer, simply move the mouse the **"Pan Map"** button to move the map over, but be sure to maintain the spot where you left off in the viewer. Once you are ready again click on the **"Capture Polygon"** tool.

5) When you are finished outlining the drainage boundary hit a right click on the mouse and an attribute window should appear for an ID number. Enter **"1"**, then click **"OK".** This commits your polygon to record. Now simply turn off the editing session by clicking on the **"toggle edit"** tool. And click **"save"** when asked to save changes.

Congrats, you have created some spatial data, now change the layer symbology to **"No Brush"** (as seen in figure 7.5 on the next slide)

Creating Vector Data

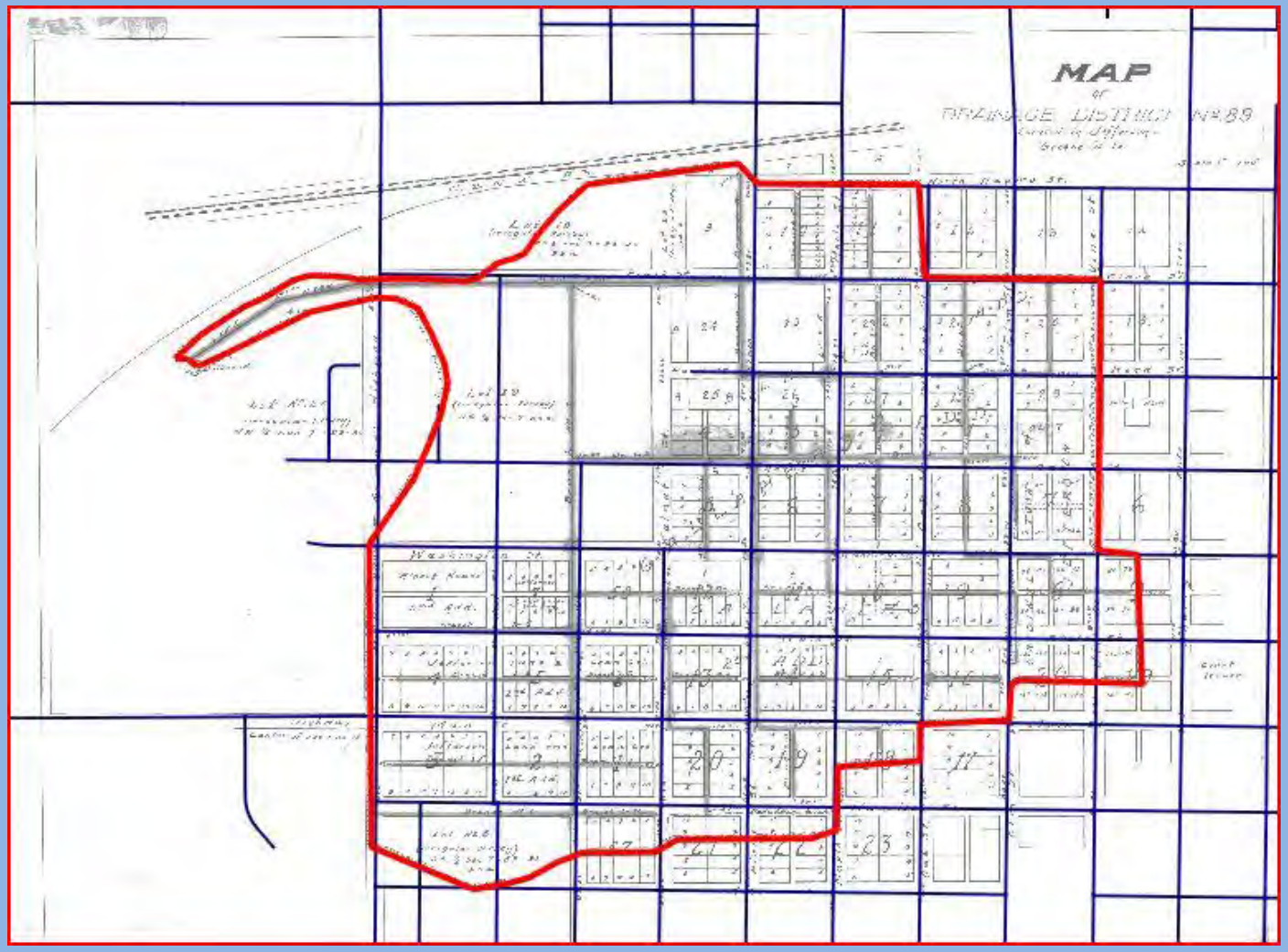


Figure 7.5

Editing Vector Data

In some cases you may want to refine your data by editing individual nodes or moving the entire polygon. By highlighting the Jefferson drainage layer you just created activate the editing pen (as seen in figure 7.6) you will see all the individual nodes appear. On in an editing session click on the **"Move Feature(s)"** tool to move the entire polygon in any direction(as seen in figure 7.7). You can also delete, add, or move individual nodes with the **"Node tool"** seen in figure 7.7 below.

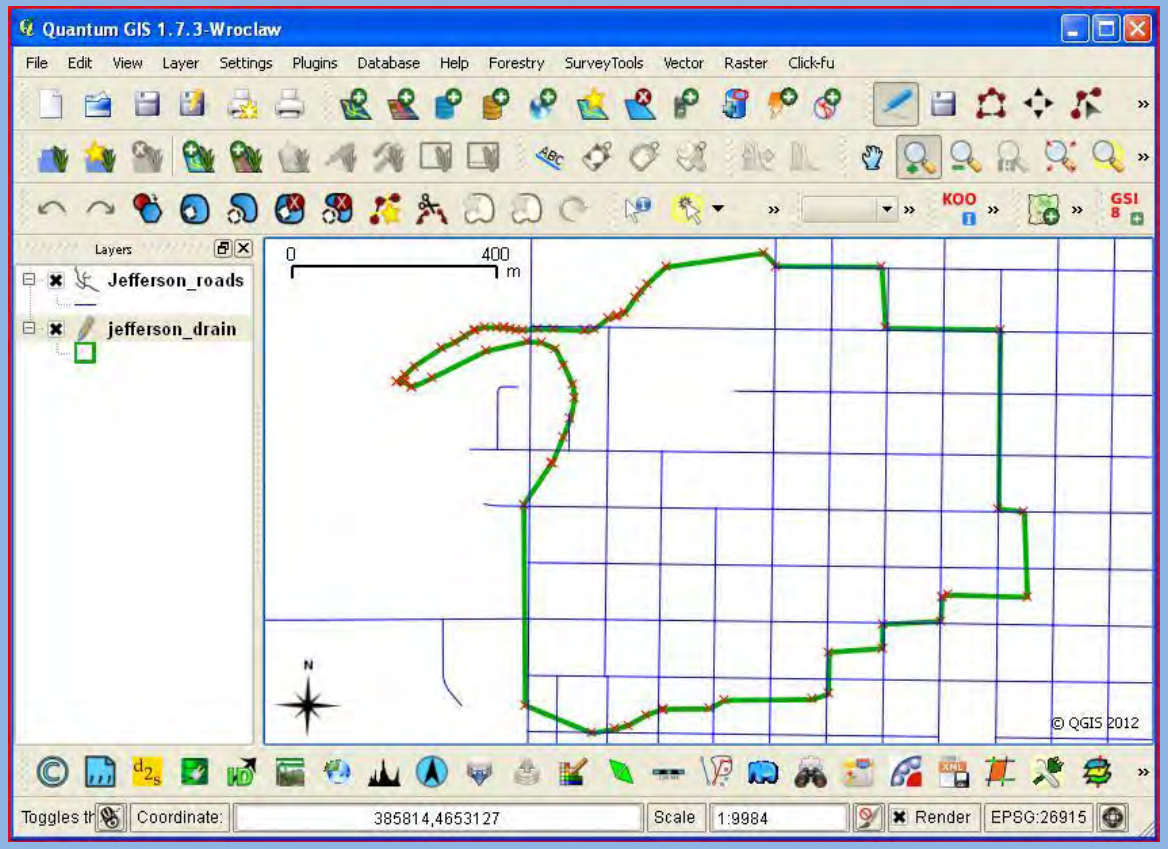


Figure 7.6

Figure 7.5

Move Feature(s)

Node Tool

Editing Vector Data

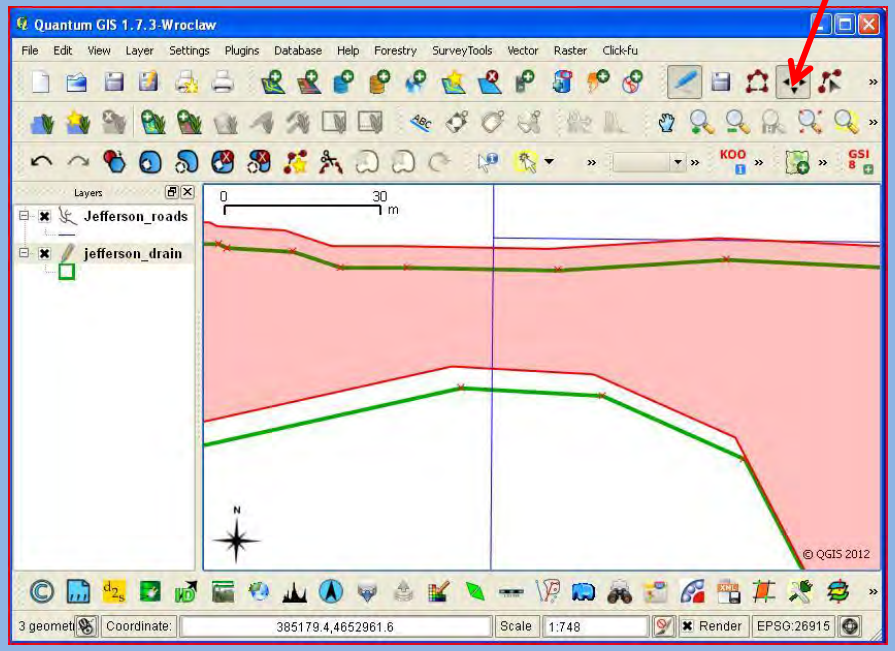


Figure 7.8

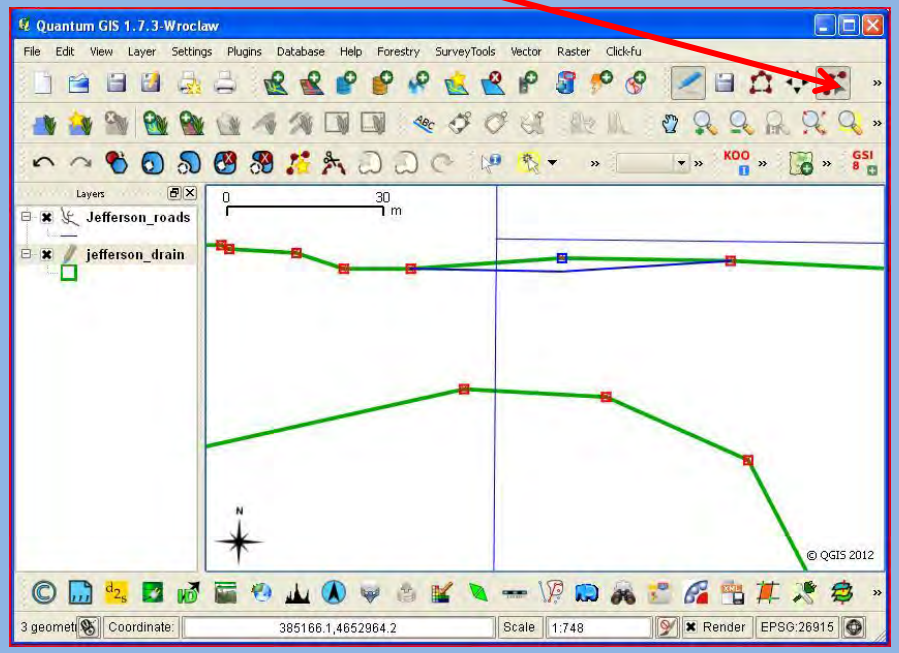


Figure 7.9

When moving a feature a highlighted feature will show you a real time placement of your feature from it's old location (as seen in figure 7.8). While using the **"Node tool"** in figure 7.9 above you can toggle individual nodes represented by red squares. Once you are happy with your edits simply click on the blue edit pen tool and a prompt will appear asking you to confirm your changes.

Summarize Vector Data

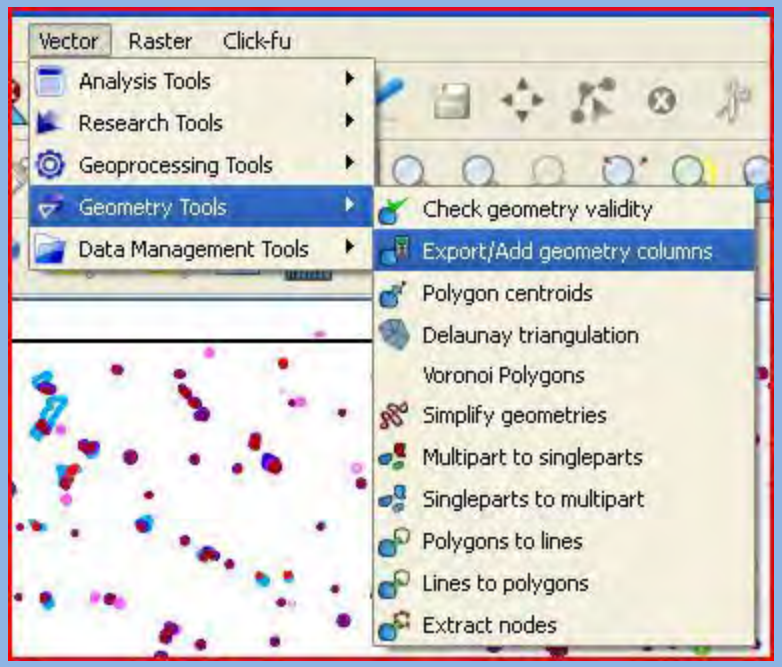


Figure 7.6

1)By using the **"geometry tools"** (as seen in figure 7.6) under the **"Vector"** menu you can summarize your newly created vector for GIS area. Simply specify the file output and save to the **"Your_Data"** folder on the jump drive..(as seen in figure 7.7)

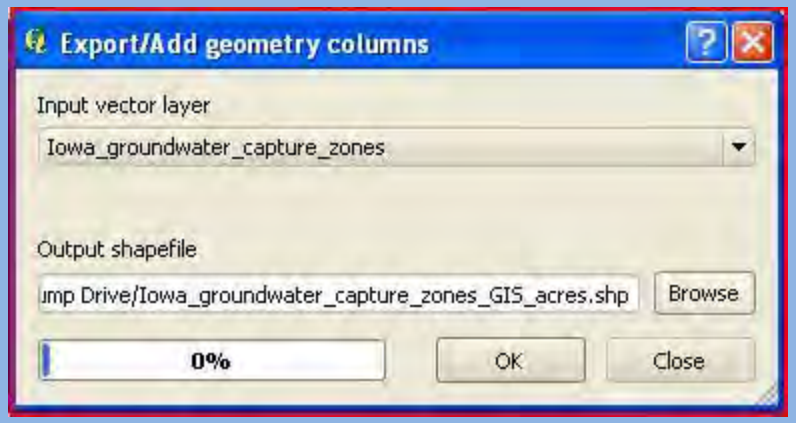


Figure 7.7

Saving Vectors as KML*

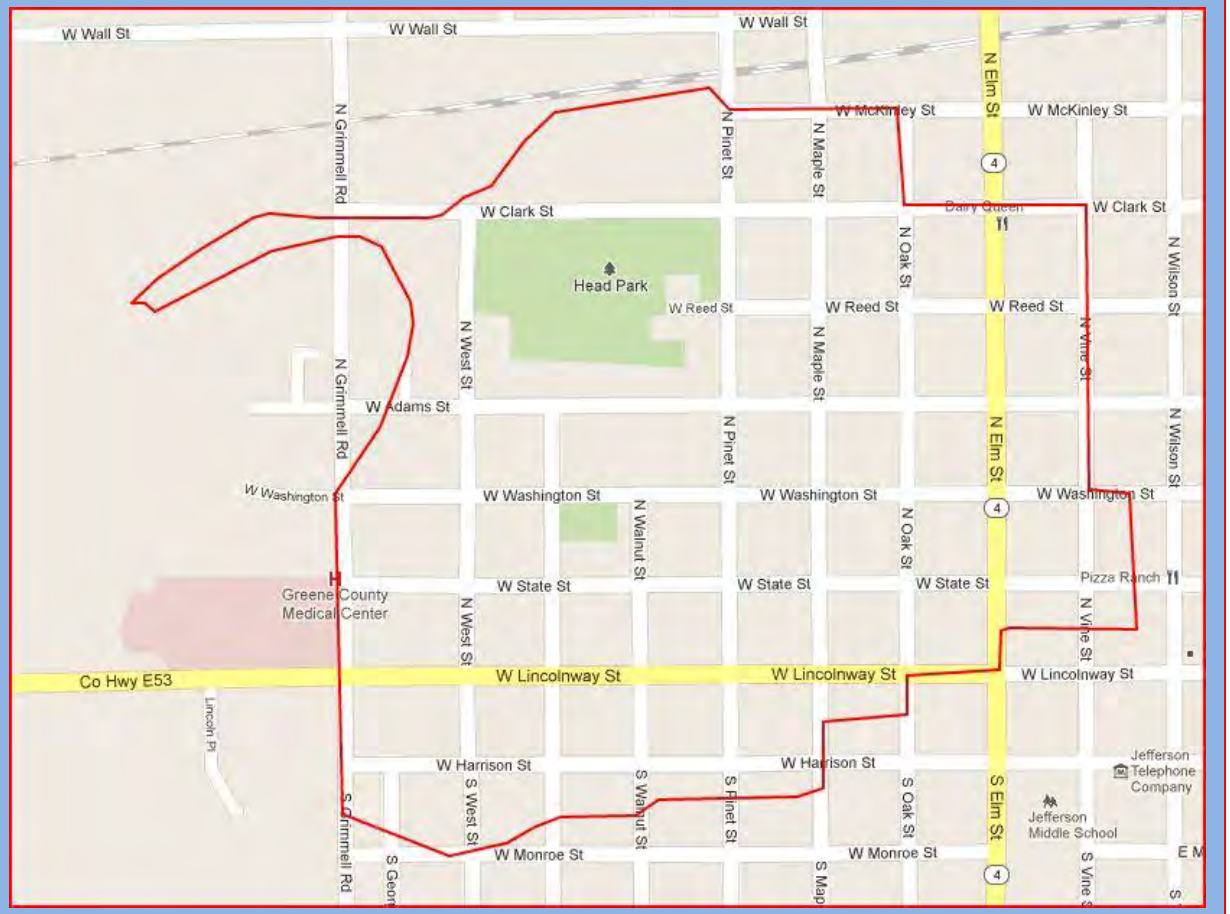


Figure 7.6

Once quick way to share and proliferate data is through a KML file which can be projected on google maps or google earth. 1) Right click on the layer Jefferson_drainage that you just created and scroll down to **"Save as".** Once click you will see a **"Save vector layer as"** window. This provide you many extension to choose from, however in this case choose **"Keyhole Markup Language [KML]".** Name it appropriately and save to the **"Your_Data"** folder on the jump drive. **(*this will only work if you have a Google account)** Open a browser and go to Google maps(this can also be done in Google Earth). Once in Google maps click on the **"My Places"** button in the upper left hand corner. Once there click the red **"Create Map"** button, then click on the blue text **"Import".** An **"Import KML"** window will appear, from there click browse and find your Jefferson _Drainage KML file. Then click upload file. In a minute or so you should be able to see you vector displayed on top of Google's base layers (as seen in figure 7.6). You can now share this map by clicking on the **"link"** button in the upper left hand side.

Establishing Hyperlinks

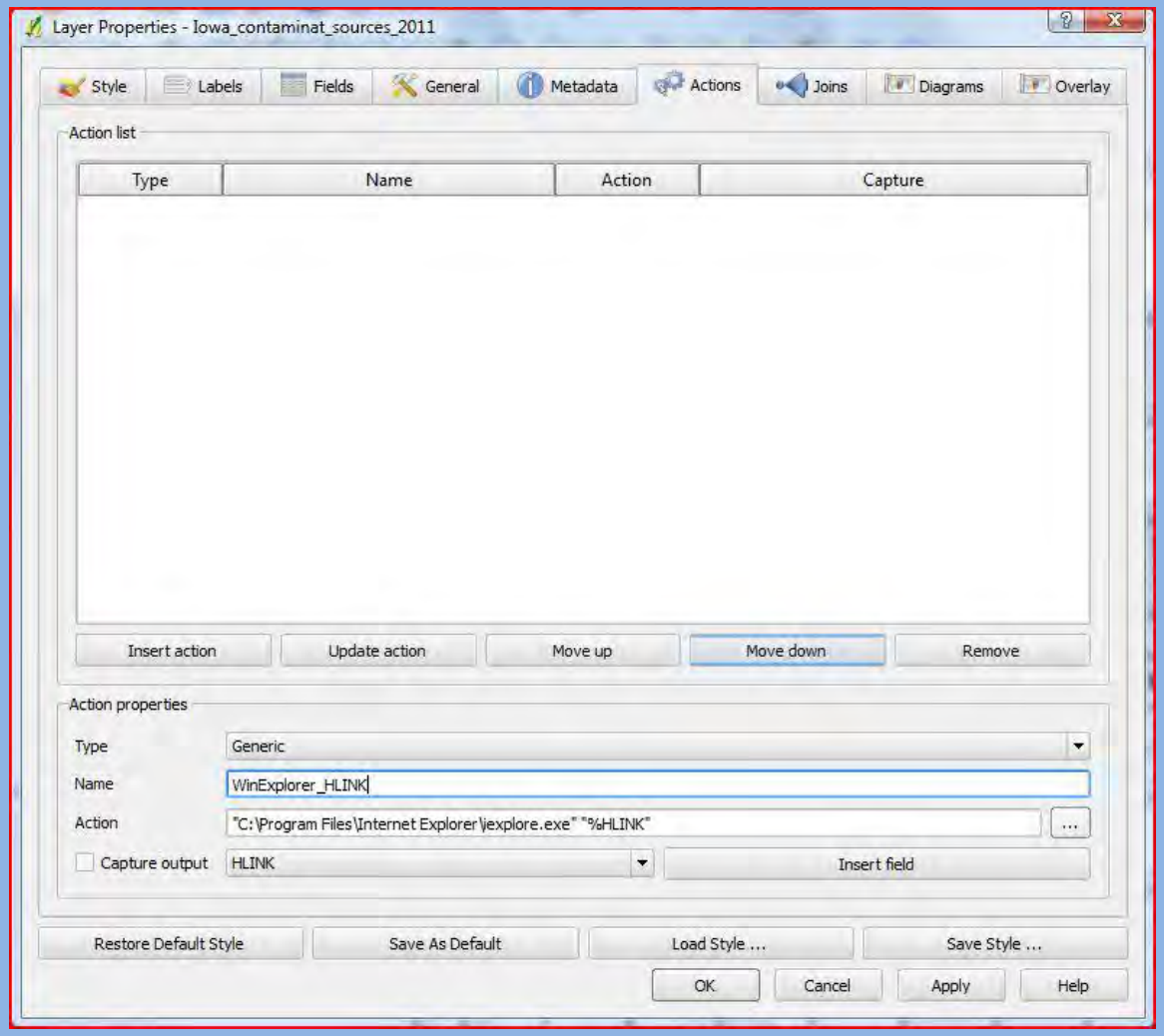


Figure 8.1

Setting an action within a layer can help for easy investigation via the web ala a hyperlink.

1)Add the **Iowa_contaminat_sources_2011.shp** to QGIS viewer. You will notice that a theme or .qml has already been populated.

2) Right click on the **"Internet explorer Icon"** on the desktop scroll to **"properties"** and copy the path the browsers .exe file in a text file for temp use.

3)Double click on the layer to bring up the **"Layer properties"** window. Then click on the **"Actions"** tab(as seen in figure 8.1).

4) Under the **"Action Properties"** enter in **"WinExplore_HLINK",** then for **"Action"** enter in the browser .exe in double quotes followed by a space the double quotes then navigate to the field **"HLINK"** in the dropdown below and click **"insert field"** you should see a **"%HLINK",** close the double quotes (as seen in figure 8.1).

5) Under the **"Action list"** section click on the **"Insert Action"** button on the left hand side. You should now see you action in the list box. Now click the save style and name the .qml. Then click on the **"save as default"** button, then **"Apply",** then **"OK".**

Establishing Hyperlinks

Figure 8.2

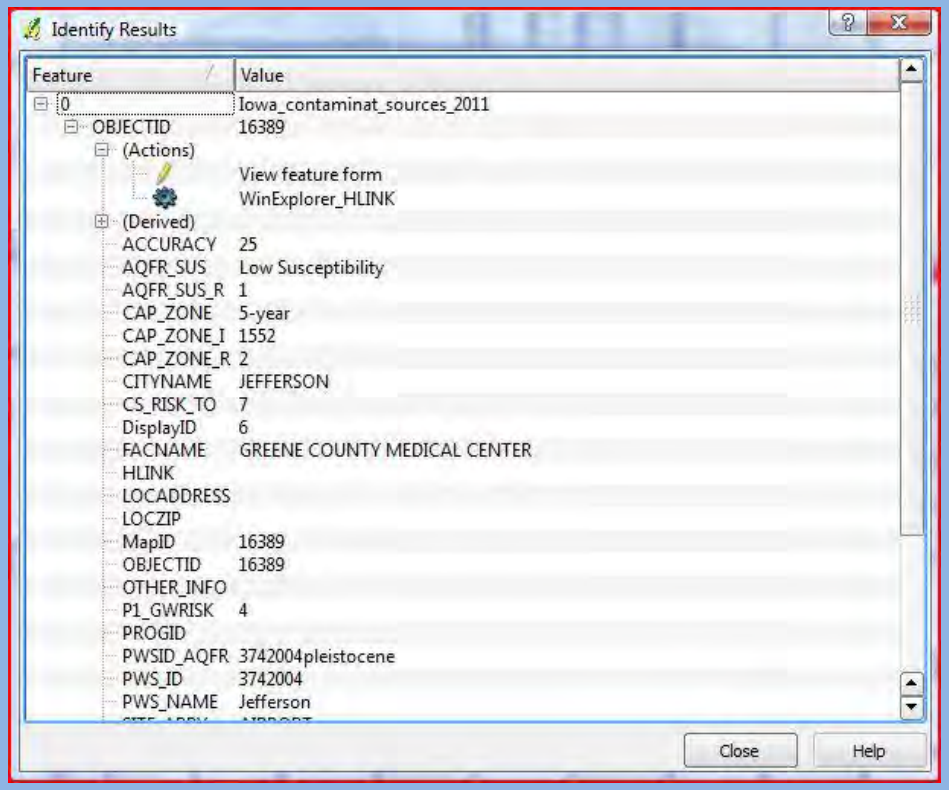


Figure 8.3

Now test out your hyperlinks.
1) Zoom into an area where you can see good separation between contaminant points.
2) Use the **"Identify Features"** tool (as seen in figure 8.2) to select a specific point. Once the attributes appear in the **"identify results"** window click on the maximize box next to **"(Actions)",** you should see a new action called **"WinExplorer_HLINK"**(as seen in figure 8.3) double click on the blue gear and you should see an internet explorer page open with the specific contaminant record of that point on the Iowa DNR Facility Explorer.

Tabular Joins

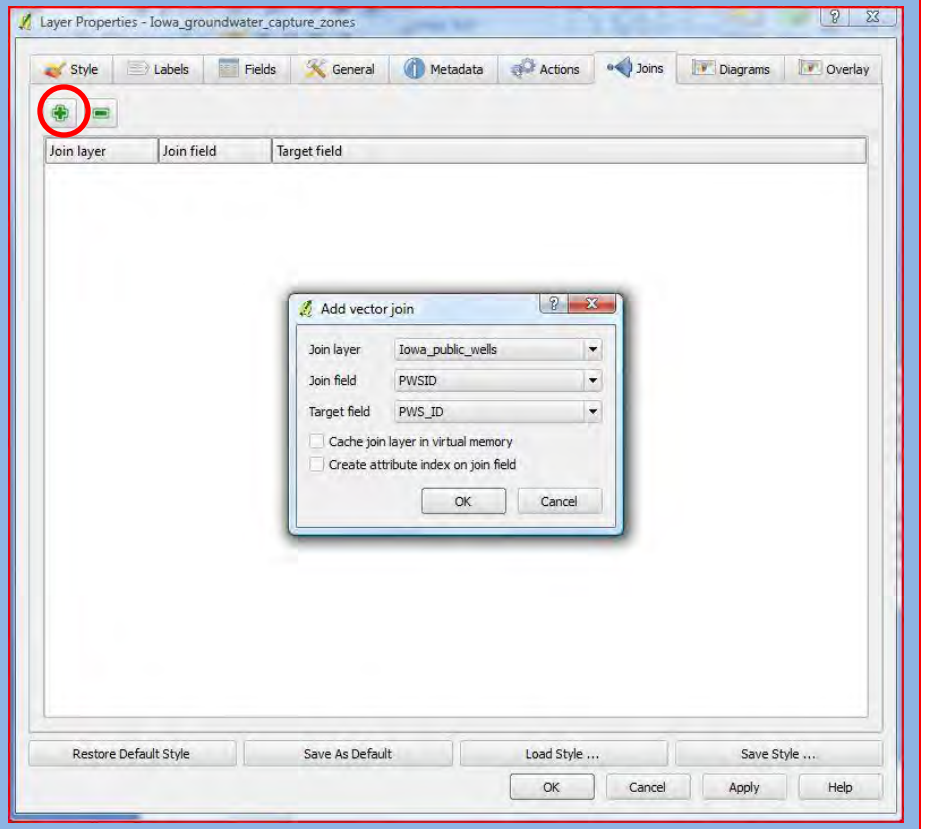


Figure 9.1

Lets say someone wants to know how the status of wells within groundwater capture zones. One problem the Groundwater capture zone layer does not have well status field, but the public wells do, time to join the two datasets on one shared key PWSID.

1) Add the **Iowa_groundwater_capture_zones.shp** to the QGIS viewer. Now right click on the layer and scroll to the **"Open Attribute table"** function. This brings up all the data associated with this geometry. Make note of the name of the last field to the far right in the table. Ex out the attribute table and double click the groundwater capture zone layer to bring up the layer properties. Scroll to the **"Joins"** tab.

2) In the join box click on the green plus or add icon. This represents the data you will join to the groundwater capture zone layer(as seen in figure 9.1).

3) In the **"Add vector join"** box, navigate to the Iowa_public_wells layer for **"Join Layer"** then **"PWSID"** for the **"Join Field"** and **"PWS_ID"** for the target field. Then click **"OK".**

3) Once Identified in the **"Join layer"** box click **"Apply"** then **"OK".**

4) Now right click on the layer and scroll to the **"Open Attribute table"** function. You will notice that all the well data has been added onto the end of the table where PWSID and PWS_ID match. To turn off a join simply go back to the **"Join"** tab in the **"layer properties"** and highlight the join and click the green minus sign (circled in red on figure 9.1)

Spatial Joins

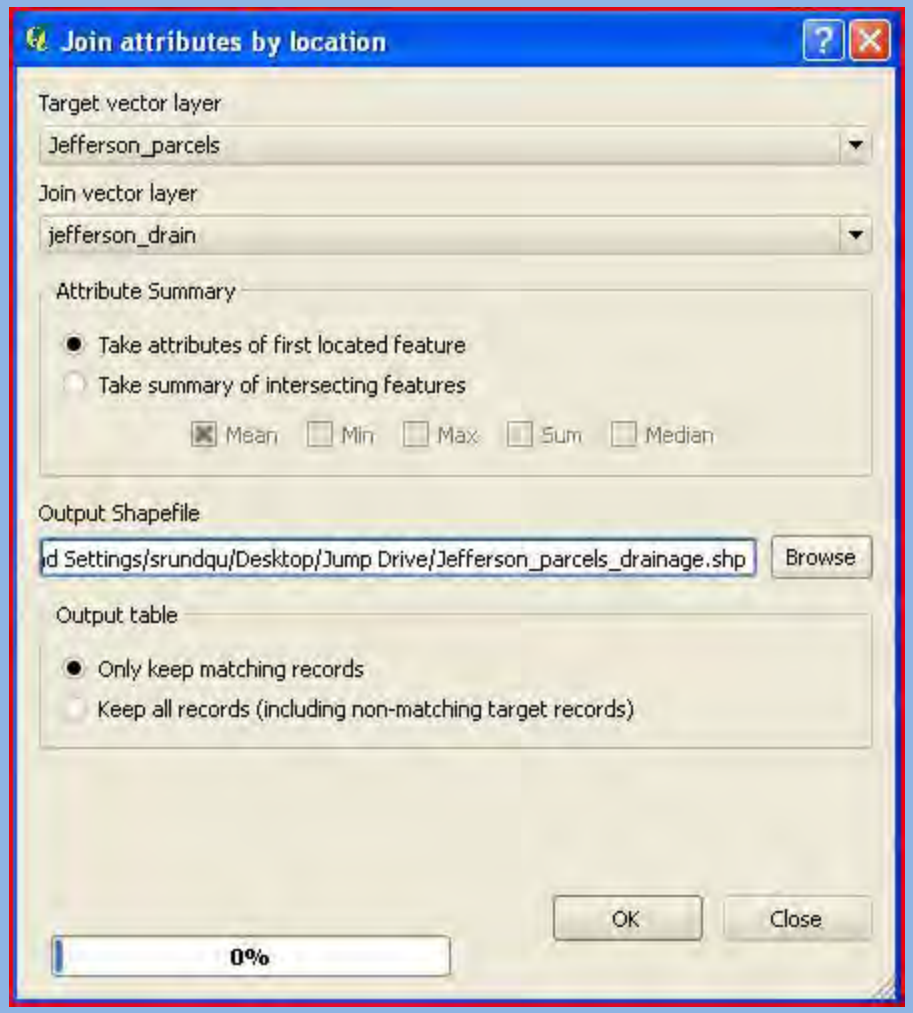


Figure 10.2

1) For a spatial join of intersecting records go to the **"Vector"** tab on the main menu bar in the QGIS GUI. Then scroll down to **"Data Management tools"** then right to **"Join attributes by location"** (as seen in figure 10.1).
2) That brings up the **"Join attributes by location"** window where you specify the **"target vector layer"** in this case the Jefferson parcels layer we created, and the **"Join vector layer"** which we will use the Jefferson drainage layer (as seen in figure 10.2). Save the files as **"Jefferson_parcels_drainage"** to the **"Your_Data"** folder on the jump drive.

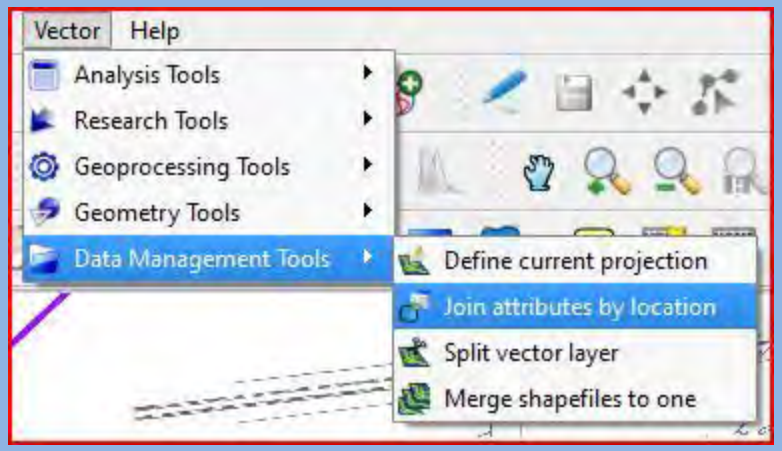
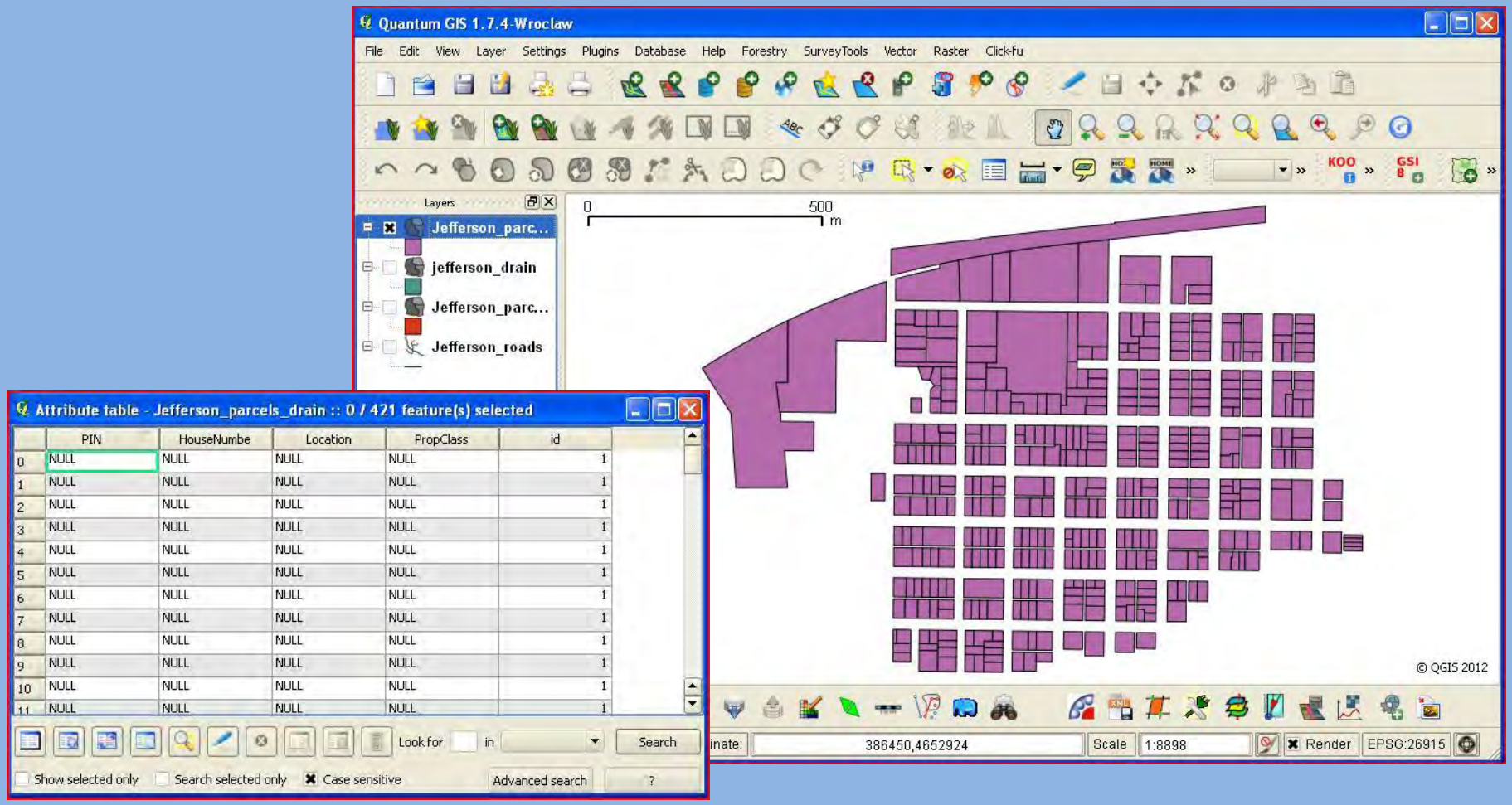


Figure 10.1

Spatial Joins

If done correctly you should see a new shapefile showing all areas that intersect spatially and the drainage attributes appended to the parcels (as seen below).



Other Vector Tools

There are a variety of other vector tools that you can explore under the **"Vector"** tab on the main menu bar of the QGIS GUI (as seen in figure 10.3)

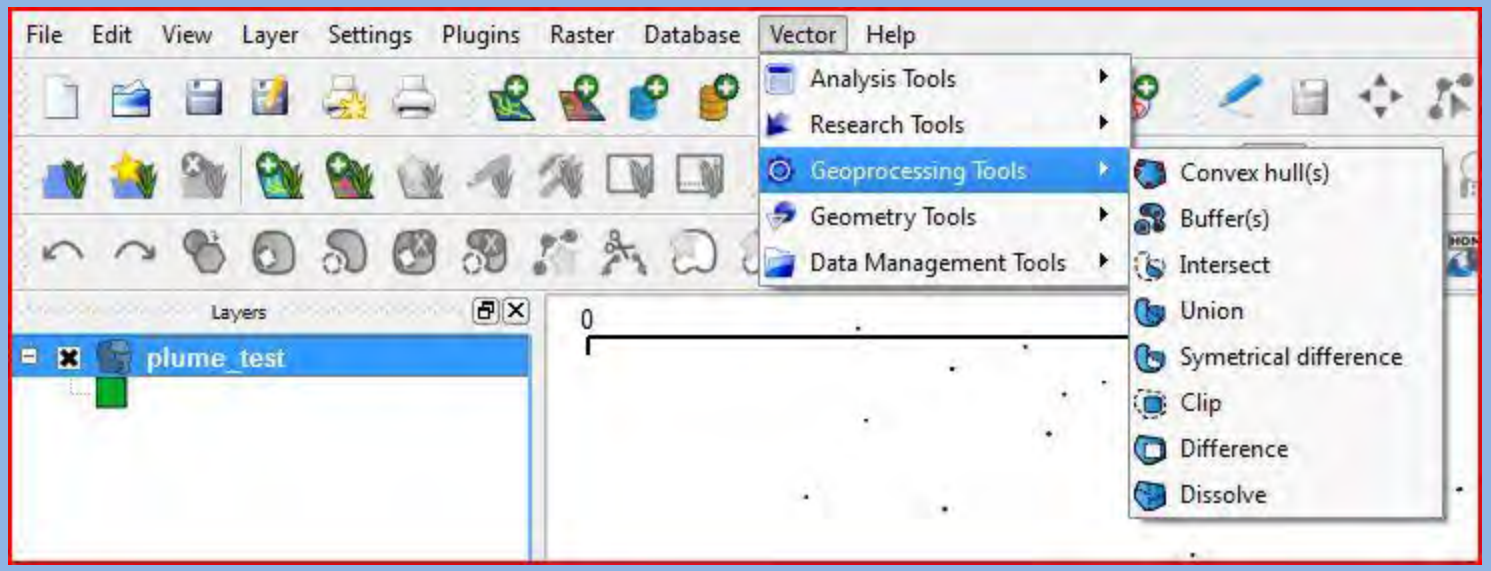


Figure 10.3

Standard Query Language (SQL)

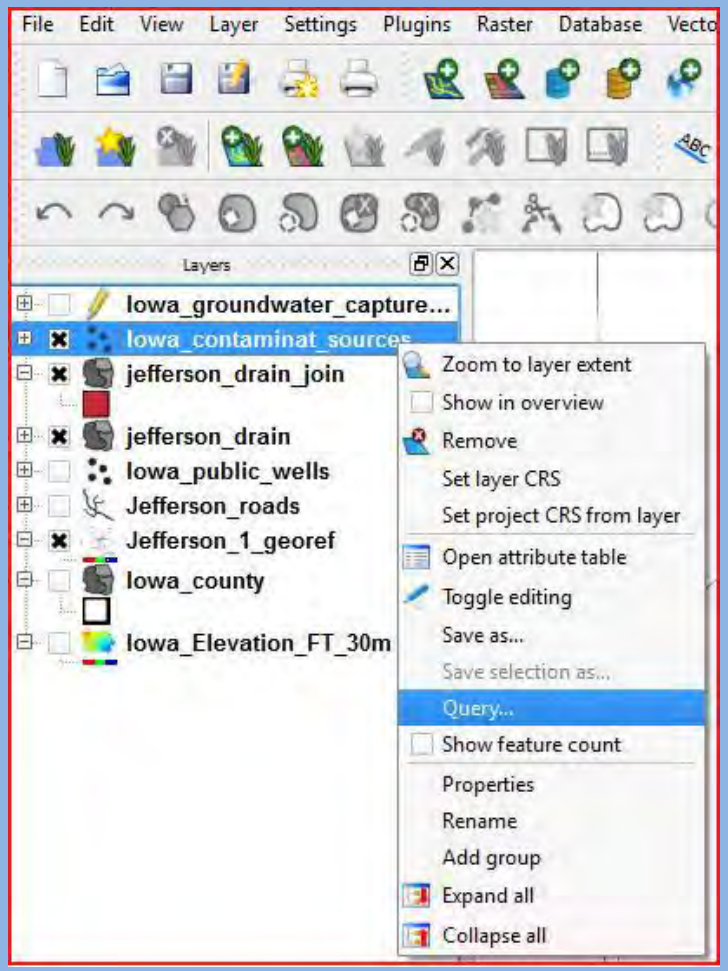


Figure 11.1

Lets say you want to find all the contaminant sources within the drainage area we created from the old paper map image.

1) To begin, right click on the Iowa contaminant sources layer and scroll down to **"Query…"**

2) Now you will see the **"Query builder"** window which allows you to choose a specific field, display sample or all values within that field, and provides you with operators to single out your desired qualifiers.

*When writing a query always be aware that extra spaces, missing quotations, and improper use of operators can prevent a query from running. Always **"Test"** your query first before committing to make sure it works.

Standard Query Language (SQL)

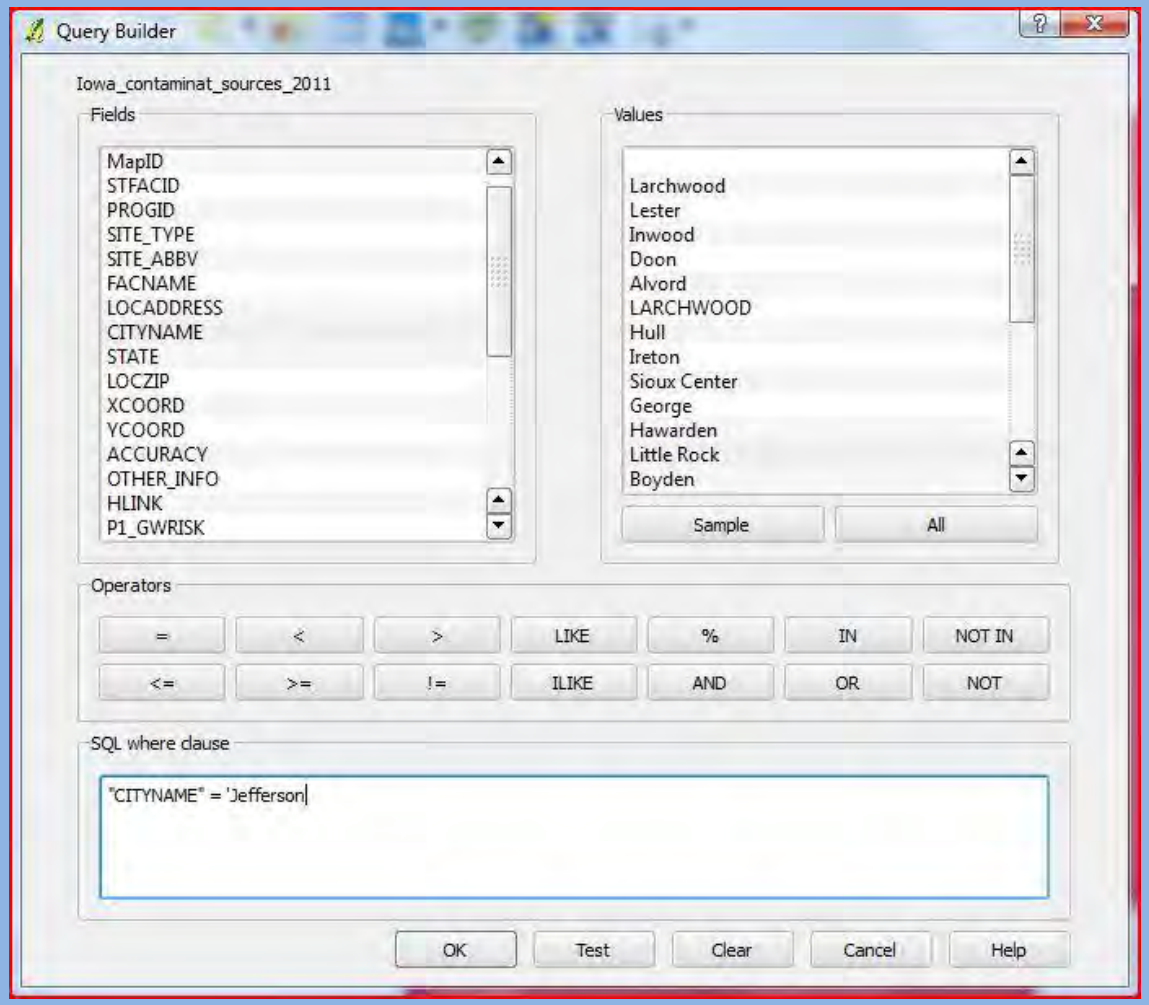


Figure 11.2

3) As detail in the figure to the left (11.2), you can see that by double clicking **"CITYNAME"** then he **"="** operator followed by **'Jefferson'** in single quotes we have a basic query.

"CITYNAME" = 'Jefferson'

An easy way to find out if values are in single quotes is to double click on one in the **"Values"** box and then delete it from the statement.

4) The next step is to test the query by hitting **"Test"**, after doing this you will realize that your query does indeed work and you have 137 results(as seen in figure 11.3). Then click **"OK",** now your contaminant layer will only display contaminants in Jefferson.

5) Note that only queried features will be visible in the map viewer.

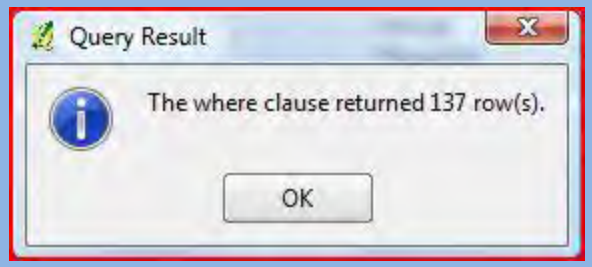


Figure 11.3

Standard Query Language (SQL)

5) Using operators: **AND vs. OR**, in the query tool try querying and testing contaminants from **Jefferson AND Ames** (as seen in figure 11.4), as well as **Jefferson OR Ames**(as seen in figure 11.3), if done correctly **Jefferson AND Ames** should yield **"0 Rows"** and **Jefferson OR Ames** will return **"990 Rows".**

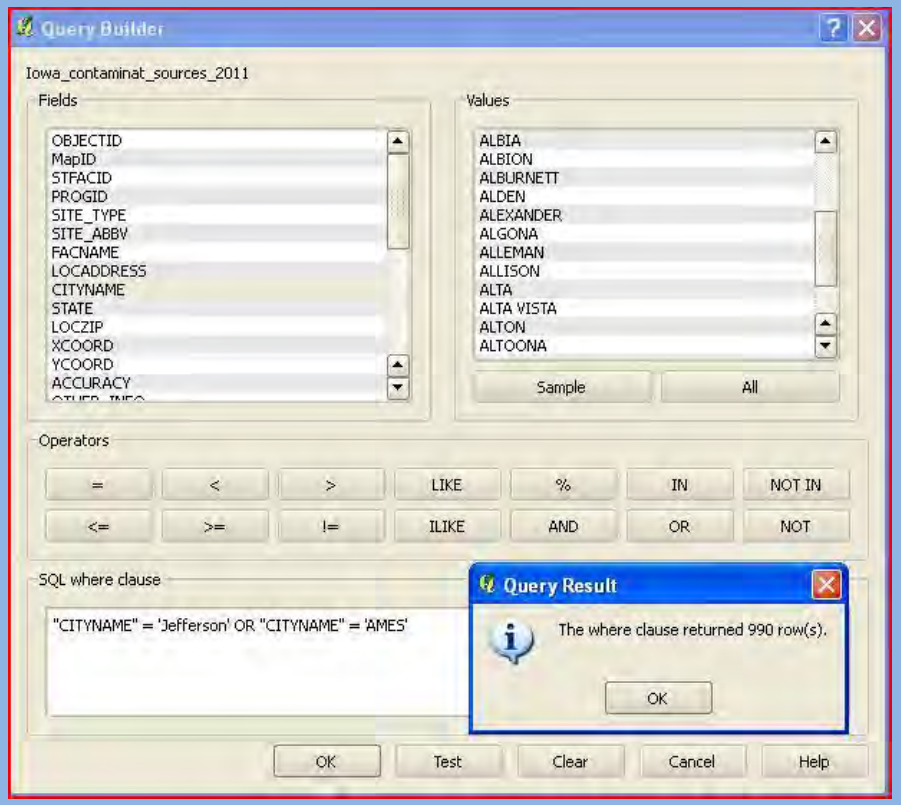


Figure 11.3

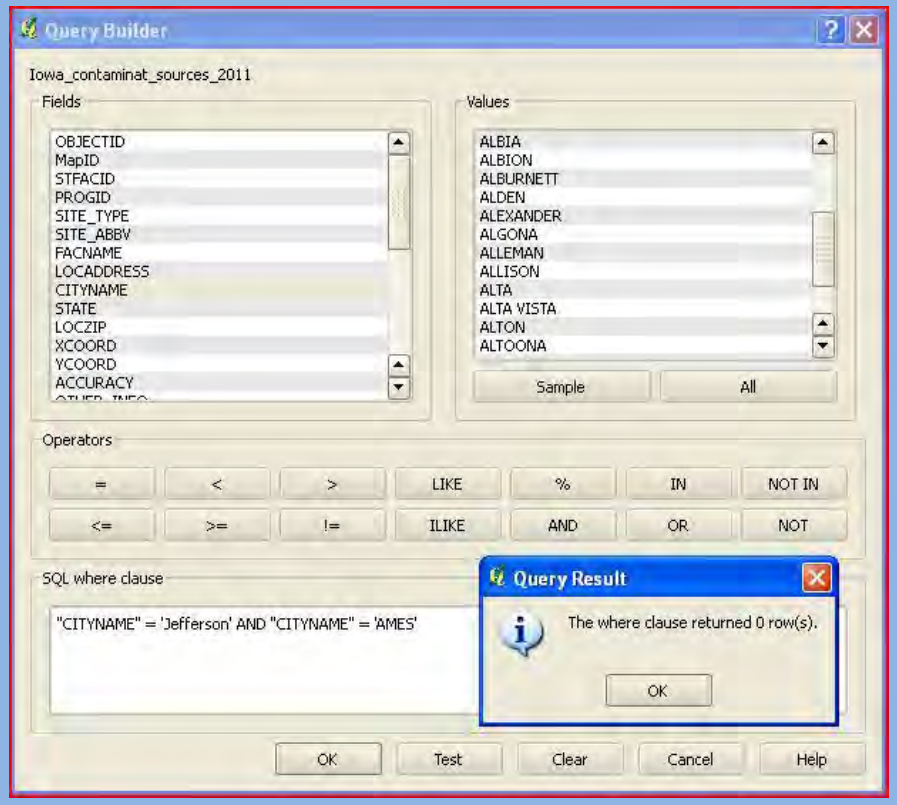


Figure 11.4

Create a Point

We want to make a map of a proposed well with 200ft, 400ft, and 1,000ft buffers around it. Zoom to the Jefferson drainage polygon, then go to layer, and select **"New"** and scroll right to **"New shapefile layer...".** Under the **"type"** section select point. In the CRS box below make sure to enter in the **"EPSG:26915 - NAD83 / UTM zone 15N".**

Under the **"New attribute"** section create a new field called **"well_type"** next to the **"Name"** box. then for **"type"** select **"text data",** and for **"width"** select **"25"** (this specifies the maximum amount of characters your text field can have). Then click on the **"Add to attributes list"** box, you should see it underneath id in the **"Attributes list"** section. click **"OK".** You will now be prompted to save your file, name it **"proposed_well_jefferson"** and save it to the jump drive in the **"Your_Data"** folder.

Now highlight the **"proposed_well"** shapefile in the layer tray. Next click on the blue pen to activate the **"toggle editor"** (as seen in figure 12.1), from there click on the add point tool (circled in red in figure 12.1 below) and in the viewer click a point near the drainage. Next you will be prompted to attribute the point **"id",** enter **"1"** and the point **"well_type"** enter in **"proposed",** then click **"OK".** Click on the **"toggle editing"** tool again to stop editing and save your changes.

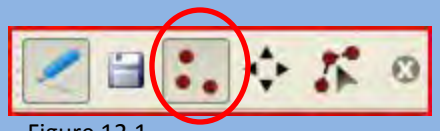


Figure 12.1

Create Buffers

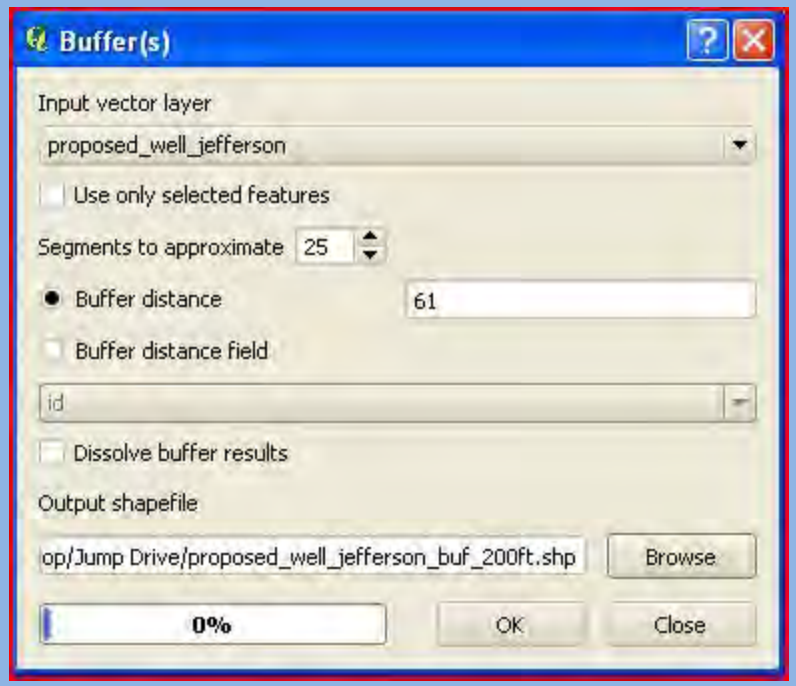


Figure 12.2

Now that we have a location for our proposed well, we can create buffers of 200ft, 400ft, and 1,00ft buffers around it. One thing we must remember when creating buffers is our map units. Since UTMs are measured in meters we will need to convert meters to feet.

200 feet = 60.96 meters (61 meters)
400 feet = 121.92 meters (122 meters)
1000 feet = 304.8 meters (305 meters)

To create a buffer click on the **"Vector"** tab of the main menu, then **"Geoprocessing tools",** to **"buffer(s)".** When the buffer tool window appears(see figure 12.2) navigate to the **"proposed_well_jefferson"** in the **"input vector layer "**box. Then for the **"Segements to approximate"** box, enter in **"25".** For the **"Buffer distance"** enter in the **"61"**. Then save the file to the **"Your_Data"** folder on the jump drive as **"proposed_well_jefferson_buf_200ft.shp",** click **"OK"** and the **"Yes"** when you see **"Would you like to add the new layer to the TOC?"** . Repeat the buffer process for **"122"/ "proposed_well_jefferson_buf_400ft.shp",** and **"305"/ "proposed_well_jefferson_buf_1000ft.shp".** Once all three buffers have been created simply click the **"close"** button in the lower right hand corner.
For all three buffers make change the **"fill style"** to no brush in the **"style"** tab.

Create Buffer Attributes

Now we will name the buffers within the attributes. To do this open the attribute table for the "**proposed_well_jefferson_buf_1000ft.shp",** once opened, click on the **"toggle editing"** pen at the bottom of the attribute table. Now click on the **"add new column"** tool (circled in red on figure 12.3). In the **"Add column"** window **"Name"** the new field **"dist",** for **"Type"** use a **"Text(string)"** and for "**width"** enter in **"25",** then click **"OK".** Once finished you will see the value **"NULL"** in the newly added column, double click on the **"NULL"** and change it to **"1000 ft",** once finished click on the **"toggle editing"** tool again and save changes. Repeat this for the 400ft and 200ft buffers(as seen in figure 12.4).

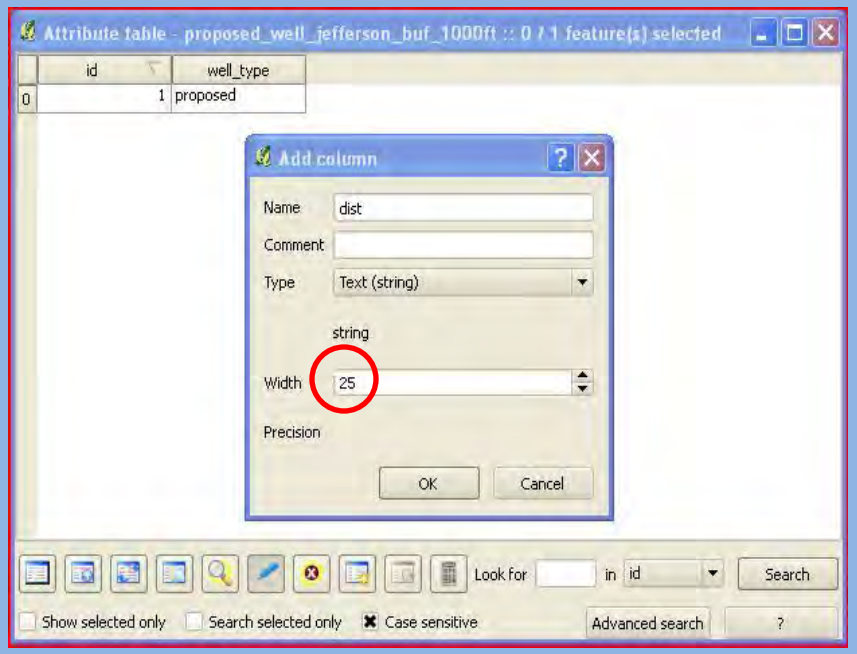


Figure 12.3

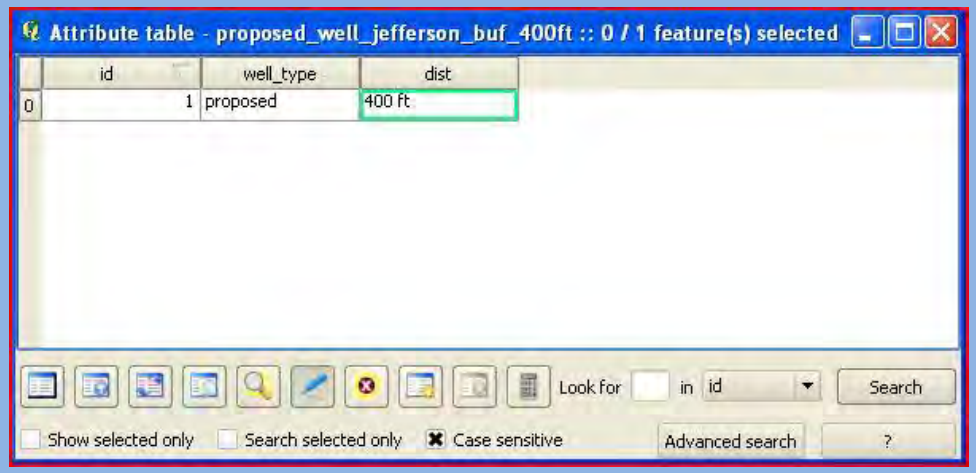


Figure 12.4

Create Buffer Labels

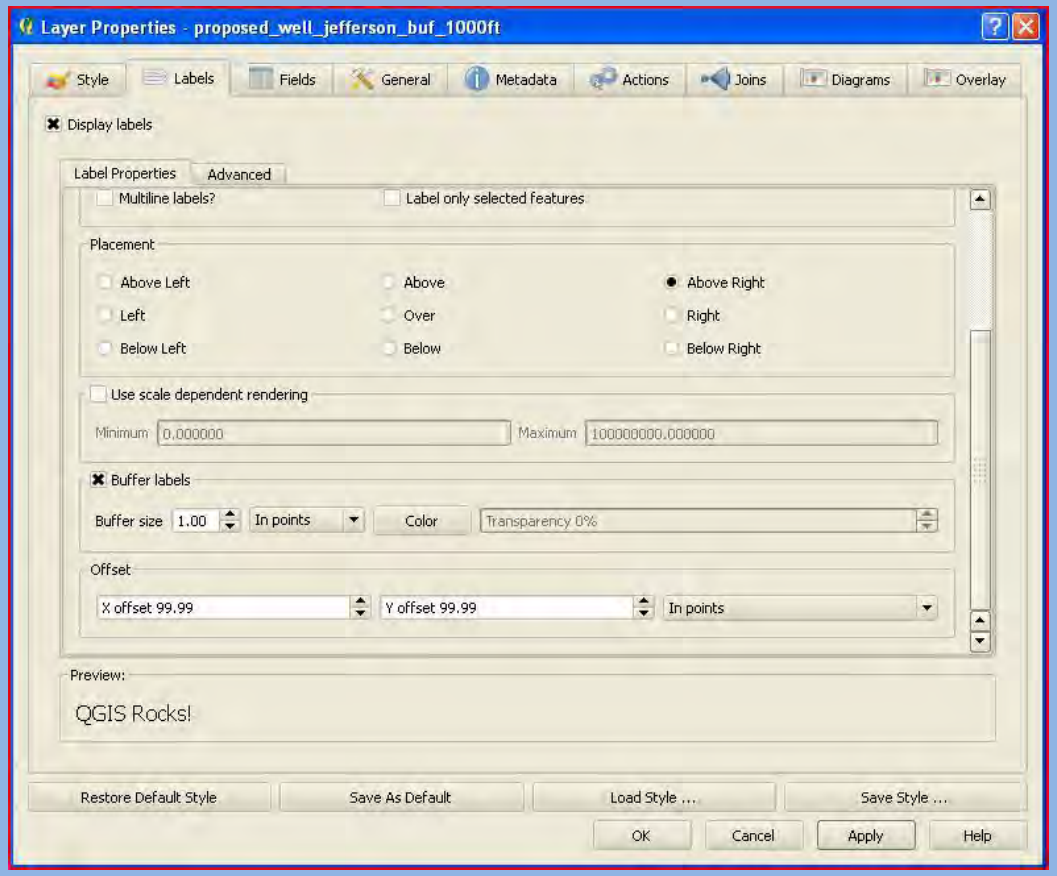


Figure 12.4

To begin making a map, zoom to the 1000 ft buffer for the proposed well (**proposed_well_jefferson_buf_1000ft.shp**). Next, display the labels for all three buffers using the newly created **"dist"** field, and for **"Placement"** select **"Above Right",** for **"Buffer labels"** select **"Buffer size"** as **"1"** and for **"Offset"** select **"X offset"** as **"99.99"** and **"Y offset"** as **"99.99".** Then click **"Apply"** (as seen in figure 12.4). Repeat these steps for the other two buffers, but for the **"X and Y offsets"** use **45.45** for the **400ft buffer** and **10.10** for the **200ft buffer**.

Making a Map

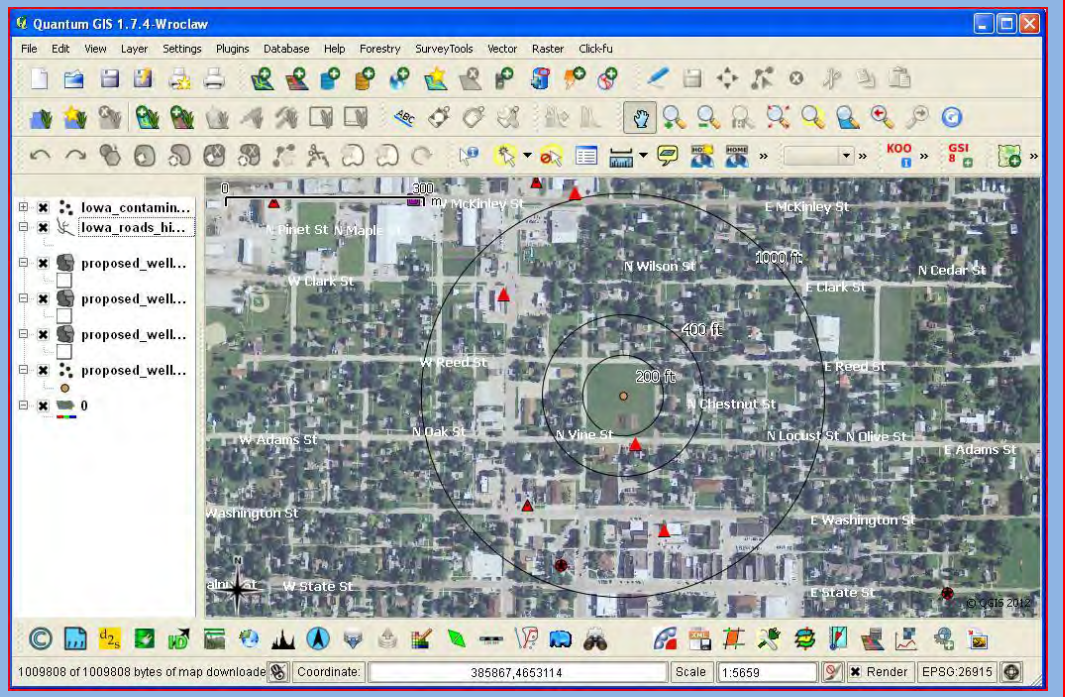


Figure 12.5

To start making a map we will need a base layer for visual reference, please add the WMS layer, and move it below all the vectors in the layer tray. You should have the following vectors on your map in this order.

Iowa_contaminat_sources_2011.shp
Iowa_roads_hiway.shp
proposed_well_jefferson.shp
proposed_well_jefferson_buf_1000ft.shp
proposed_well_jefferson_buf_400ft.shp
proposed_well_jefferson_buf_200ft.shp
And the WMS layer on the bottom

We also want to add labels for the **"Iowa_roads_hiway"** layer. You will want to open the **"layer properties"** and select **"labels",** then **"X"** the box for **"Display labels".** In the label properties section use the **"field containing label"** and select **"Name"**, for **"default label"** delete **"Label",** for **"color"** change to **"White",** and for **"font"** select **"10"** and **"bold".** Then click **"OK".** Next, reopen the layer properties for the roads layer and select the **"style"** tab, select the **"Change…"** tool and change the **"pen style"** to **"no pen",** click **"OK",** then **"OK"** again. If done correctly you QGIS viewer should look similar to the one in figure 12.5. Notice the road lines are not visible but the labels are. The buffers should be labeled as well.

Once you are finished with the roads layer labels, feel free to customize the symbology on your own, like making the buffer line thicker or changing the well symbol for example.

Making a Map

Figure 12.6

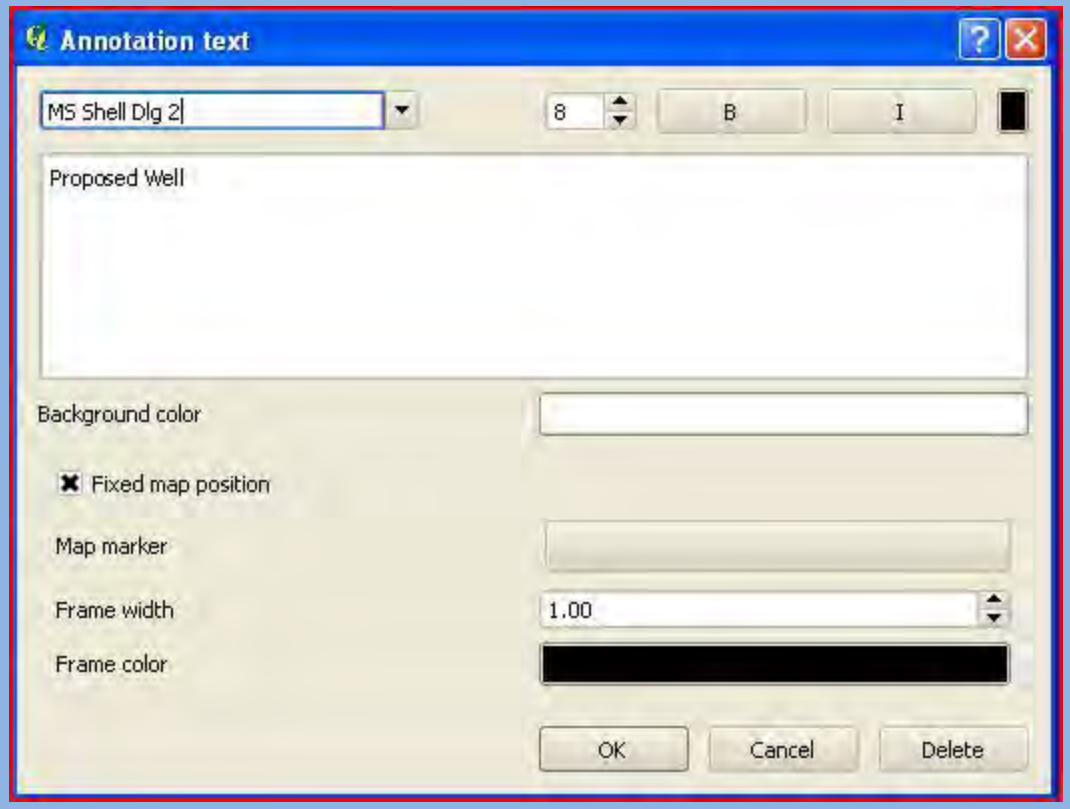


Figure 12.7

In this step we will add an annotated label for the proposed well point. To do this click on the **"Text animation"** (as seen in figure 12.6) tool near the measurement tools. Once activated, move the mouse so it sits on top of the proposed well point, click the mouse and a label and point will appear(the label will have the text **"QGIS rocks!".** Once the label is visible double click it to edit the annotation text and symbols (as seen in figure 12.7). Change the map marker **"Size"** to **"0"** and it will disappear, and enter in the text **"Proposed Well".** Once finished you can resize the text box by moving the mouse over a corner to, then clicking the corner to resize it and move it. Once you are happy with your label, activate the **"Pan Map"** (blue hand) tool.

If done correctly you should see a resemblance to the screen shot on the next slide in figure 12.8.

Making a Map

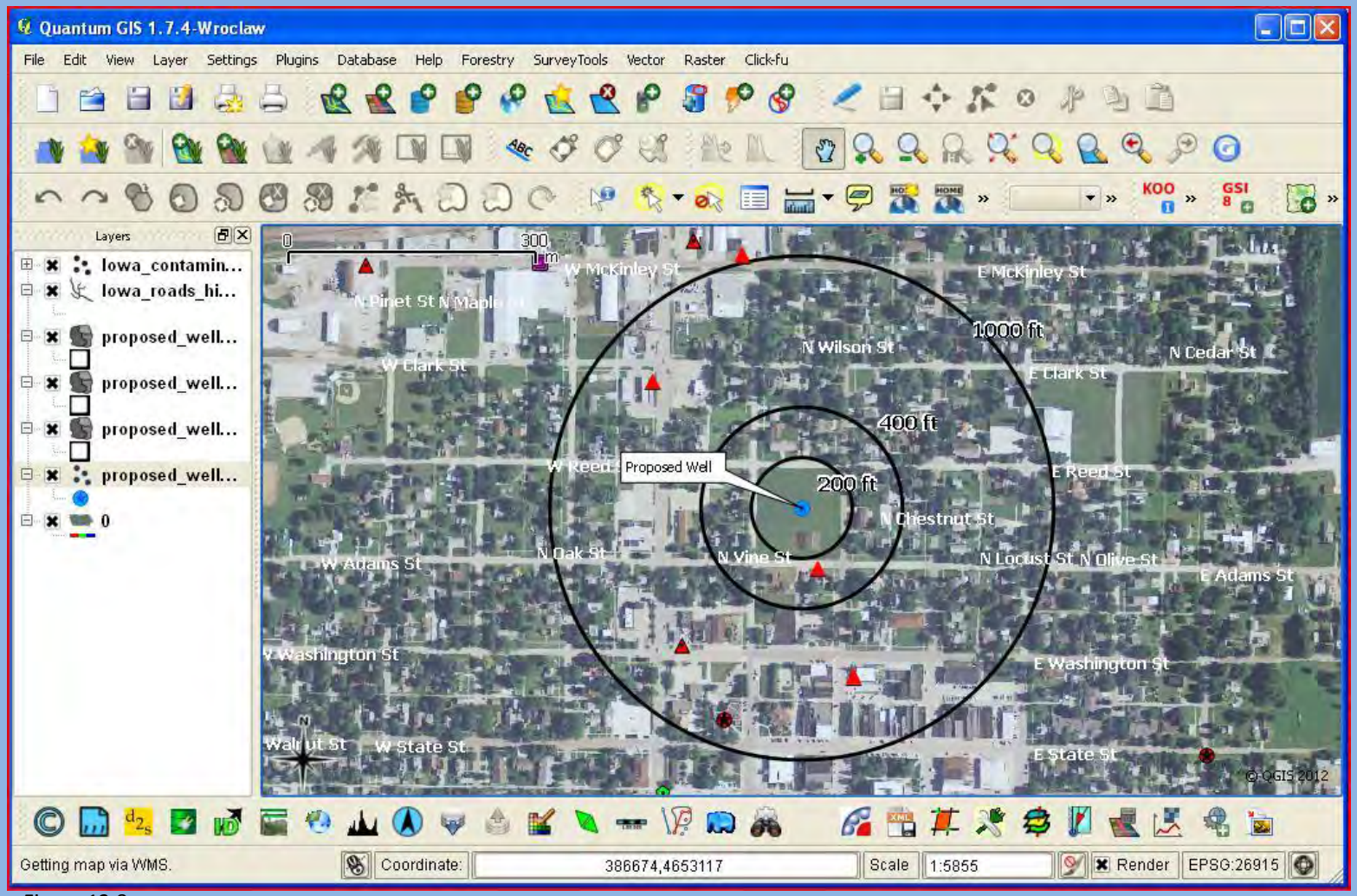


Figure 12.8

Making a Map

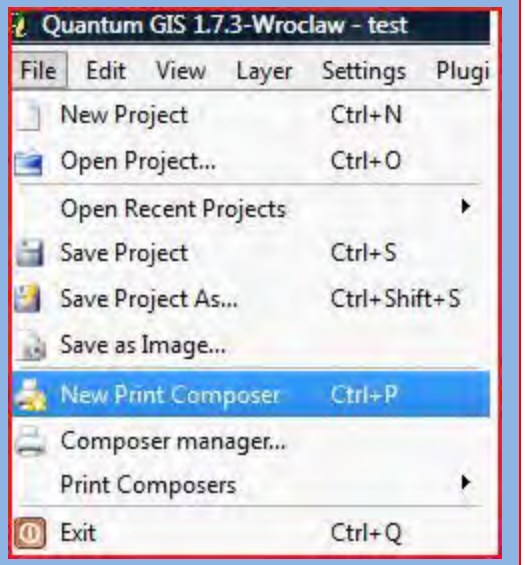


Figure 13.1

Lets make a map showing contaminants in and nearby the contaminants along with the proposed well, the three buffers, with base map of the 2011 Summer Naips.

1) Once you are comfortable with the symbology of all the layers, you can begin to create your map.

2) Activate the **"Print composer"** (as seen in the figure 13.1).

3) Under the **"GENERAL"** tab in the **"Composition"** section, set: **"SIZE" to ANSI A (Letter;8.5x11 inches)** then change: **Quality** from **300 dpi** to **150 dpi**

X out: the print to raster box,

use the add new map tool to create you map extent (circled in red on figure 13.2) by holding the mouse clicker and letting go, be sure to save room for a legend(see example on figure 13.3 on the next slide).

once added go to the "Item" tab

under the "MAP" section x out the "Lock layers from map item"

4) Use the print composer toolbar to create a map shown at the top of the print composer (as seen in figure 12.2.

Figure 13.2

Add New Map

Making a Map

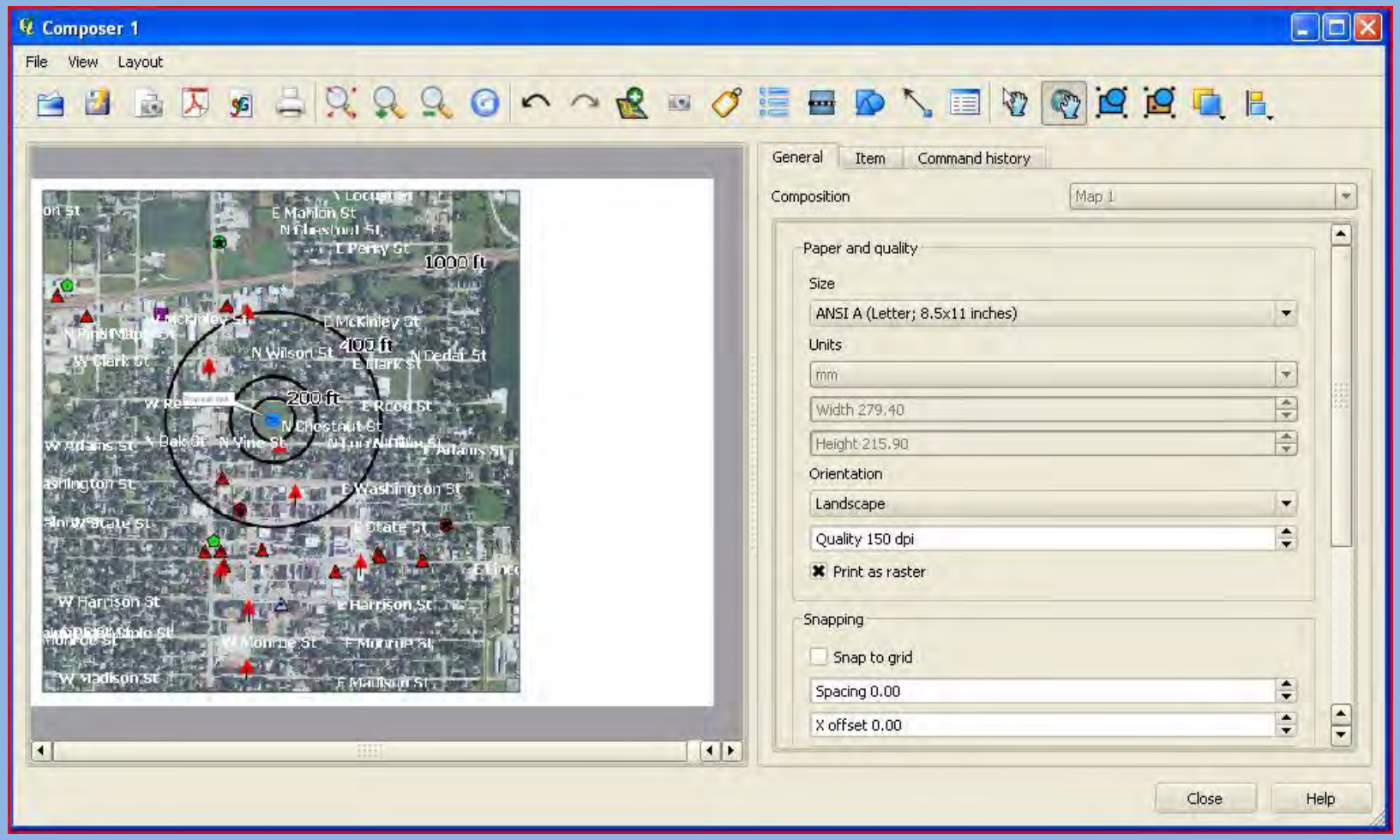


Figure 13.3

Making a Map

Next lets add a scale bar, to do this simply click on the **"Add new scalebar "** tool on the compose menu (as seen circled in red on figure 13.4). Once activated click the mouse in the lower right hand corner of the map. A scale bar should appear. Now click on the scalebar in the map to edit the item. In the right hand side click on the **"Item"** tab next to **"General"** to customize the scalebar. Now change **"Segment size (Map units)"** to **"75.00"** , next in the **"Map units per bar unit"** change the second box to **"4 Right segments".** Now, further down the item list you will see a blank box titled **"Unit label",** here enter in **"Meters**". Next, at the bottom of the item list you will see the text **"General Options",** click on it. This brings up a general options list. Here just un-X the box titled **"Show Frame".** Now your legend is complete, you may want to re-center it once you are finished. When done it should look similar to the figure 13.5 on the next slide.

***if any item should appear locked, just right click on the item to unlock it**

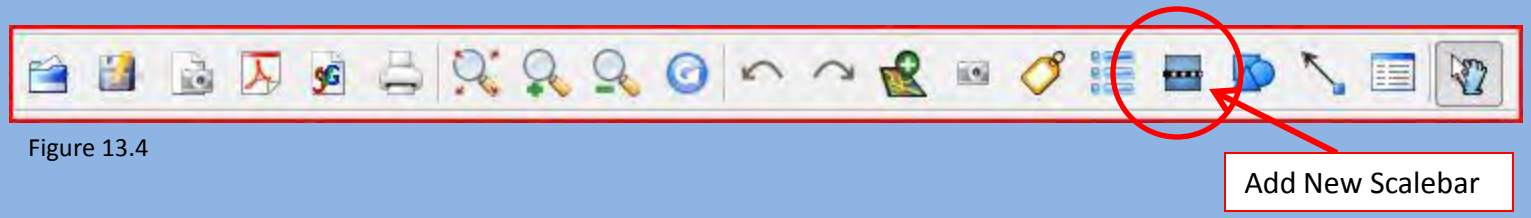


Figure 13.4

Making a Map

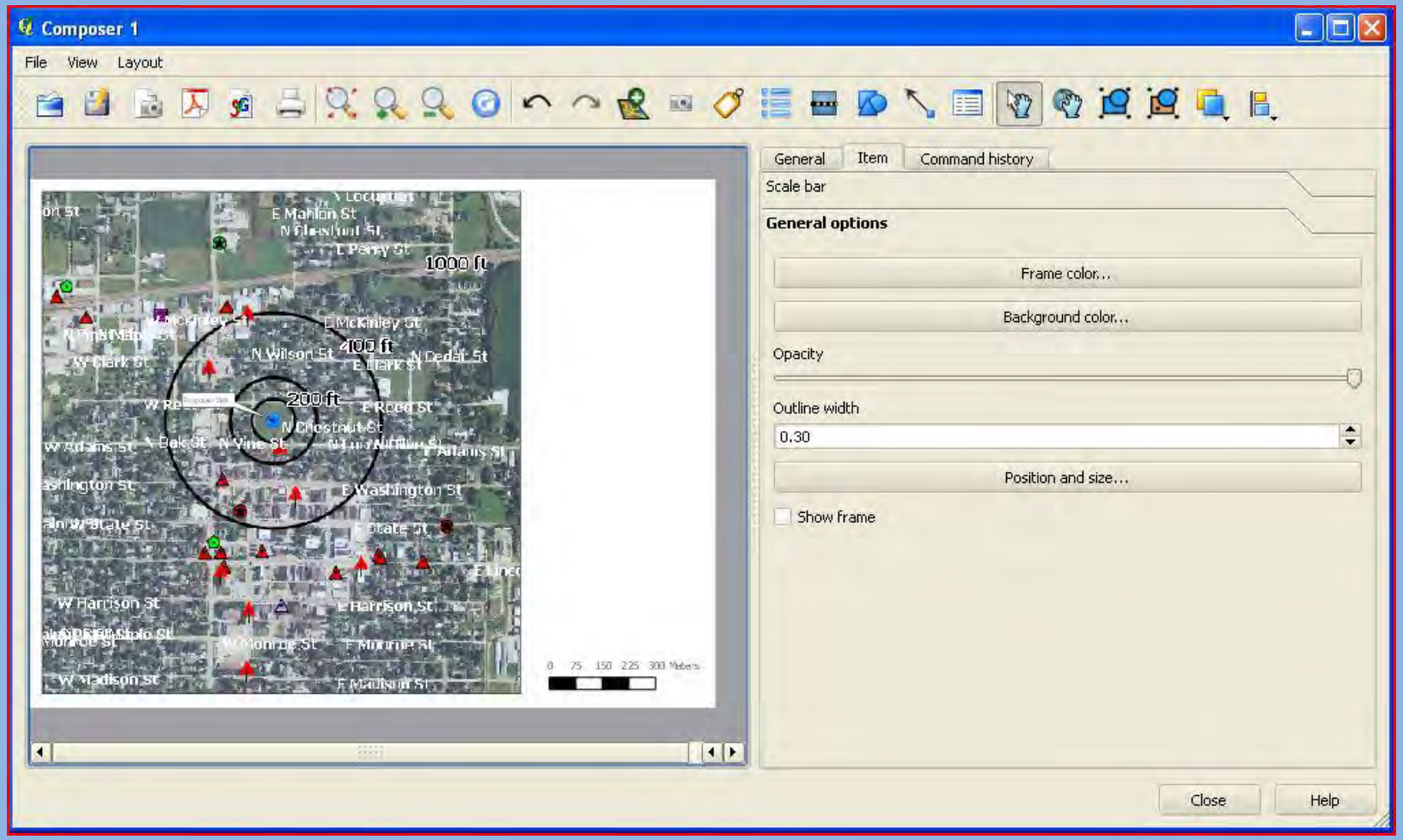


Figure 13.5

Making a Map

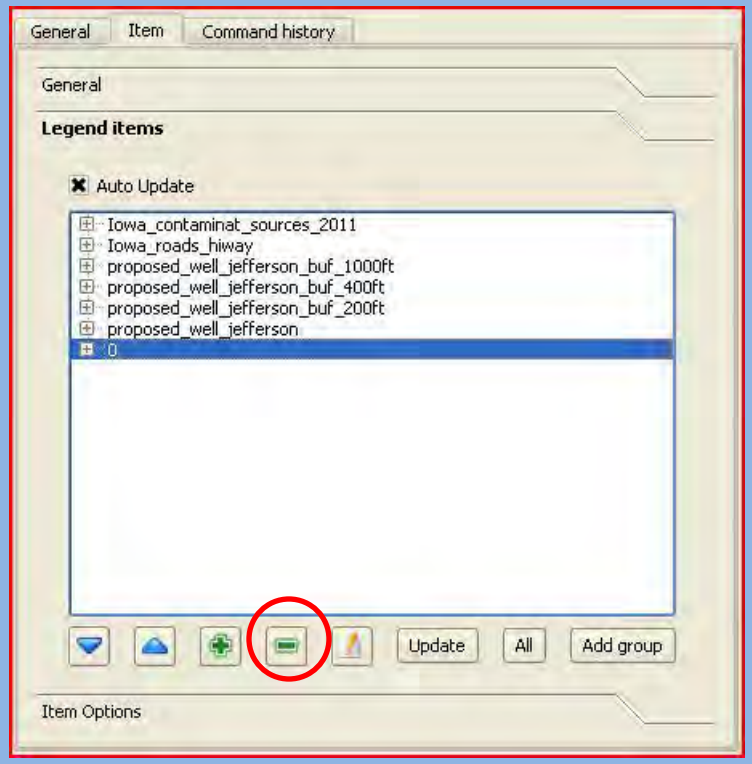


Figure 13.6

Next lets add a vector legend, to do this activate the **"Add new vect legend"** tool (as seen in figure 13.7). Once activated click on the black space above the scale bar and to the right of the map. You should notice a giant legend going off the page, we will fix this next. In the **"Item"** menu to the left delete the word **"Legend"** from the **"Title"** box. Next change the **"Item font"** to **"10"** and the **"Symbol width"** to **"6.00 mm",** the **"Symbol height"** to **"3.00 mm",** the **"Layer space "** to **"1.00 mm"** and the **"Symbol space"** to **"1.00 mm".** Then click on the text **"Legend items"** towards the bottom of the menu. Then highlight all the layers but the Iowa contaminants layer and delete them using the green minus symbol circled on figure 13.6. When only the **"Iowa_contaminant_sources_2011"** is showing click on the **"Item options"** text towards the bottom left hand side of the menu. Once in the **"item options"** menu un-X the show frame box. Now you can re-center you legend above the scale bar. Your map should resemble the map in figure 13.8 on the next slide.

***if any item should appear locked, just right click on the item to unlock it**

Figure 13.7

Add New Vect Legend

Making a Map

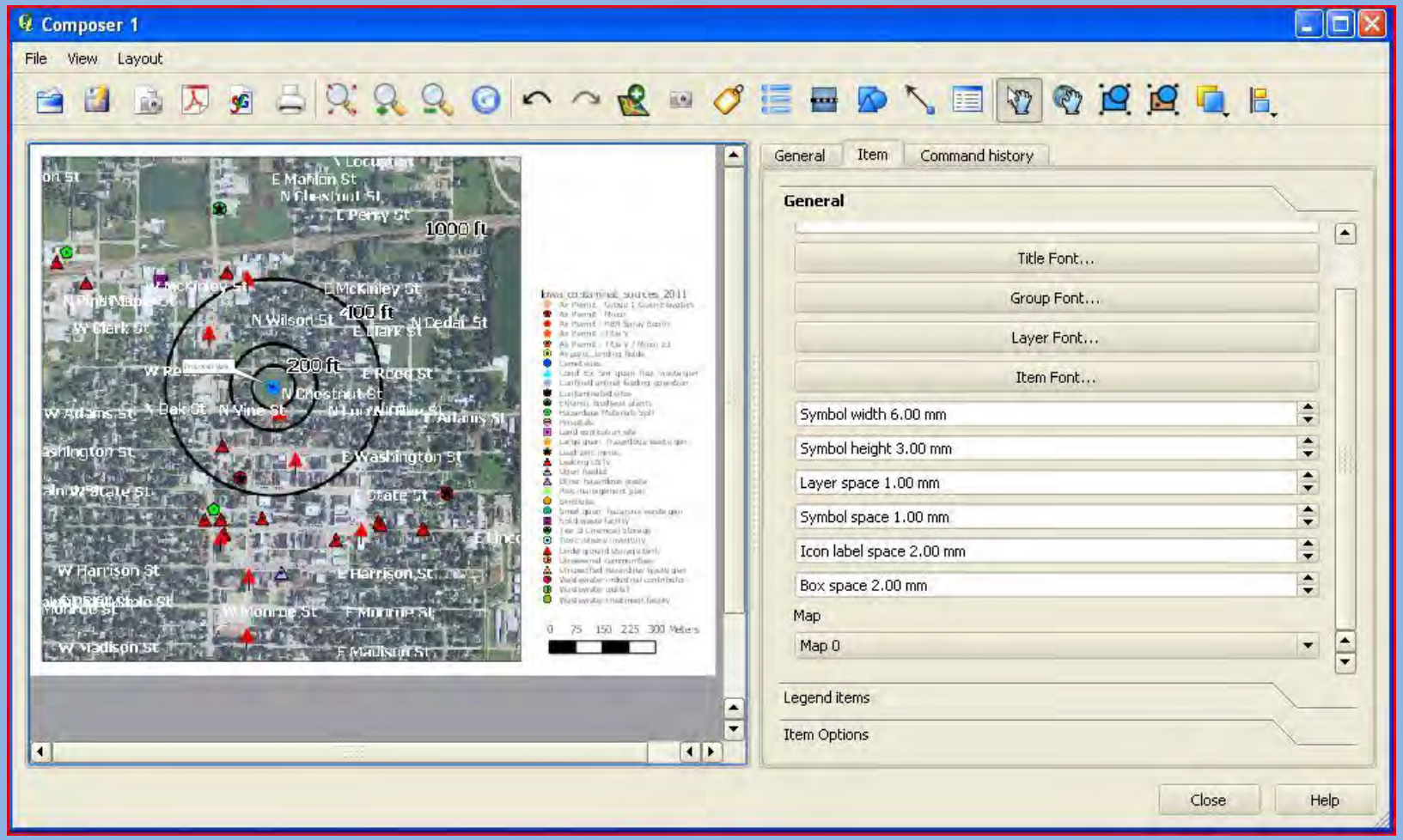


Figure 13.8

Making a Map

Next we will add a title using the **"Add new label"** tool circled in red on figure 13.9 below. Once activated click on the map above the legend. In the Item menu to the right you will see the default **"Quantum GIS",** erase that and type in **"Proposed Well for Jefferson, IA".** Change the **"Font"** to **"20"** and **"Bold"** and click on the **"Center"** button for **"Horizontal alignment"**. Once you are finished you will have to re-size the text window and position it towards the top of the page so all text is visible. Now, click on the **"General options"** text at the bottom of the menu and un-X the **"show frame"** box. If done correctly you map should resemble the map on the next slide for figure 13.10.

***if any item should appear locked, just right click on the item to unlock it**

Figure 13.9

Making a Map

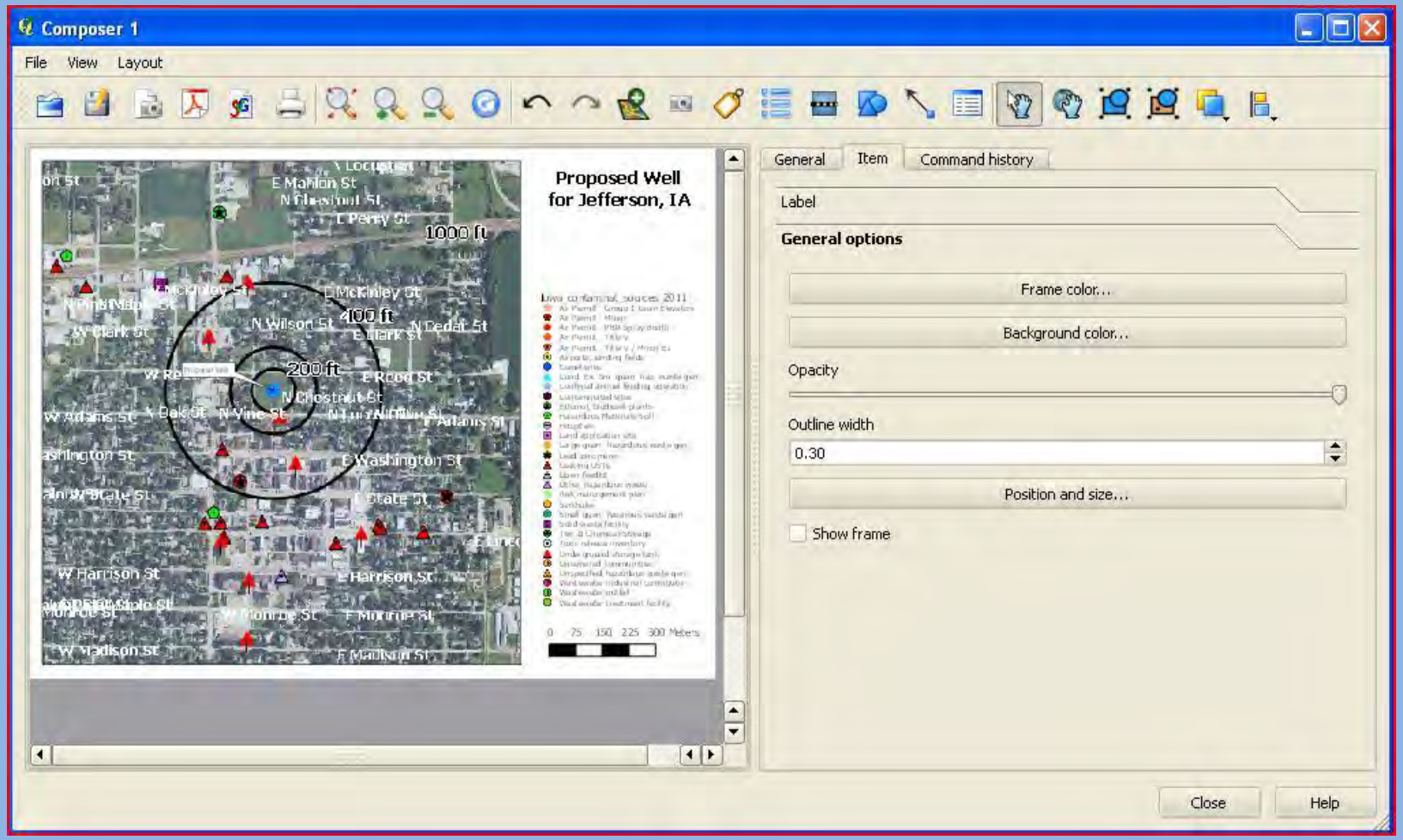


Figure 13.10

Making a Map

Lets say we want a compass rose on our map, to do this we must use the **"Add image"** tool(as seen in figure 13.11 below). Once activated click on the space between the title and the legend. A blank box will appear, in the item menu to the right, scroll through the images under the **"Preview"** box, from there choose a compass rose. Once you have a compass rose picked out click on the **"General options"** text and un-X the **"Show frame"** box. Now you should be able to position your compass rose in between the legend and title. If done correctly, your map should resemble the map on the next slide in figure 13.12.

***if any item should appear locked, just right click on the item to unlock it**

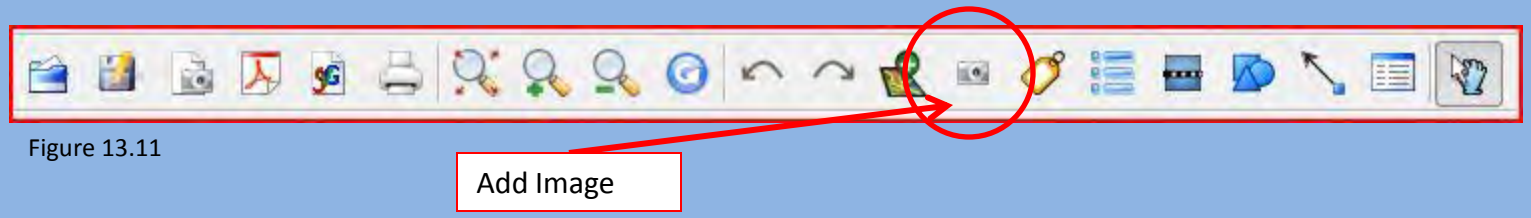


Figure 13.11

Making a Map

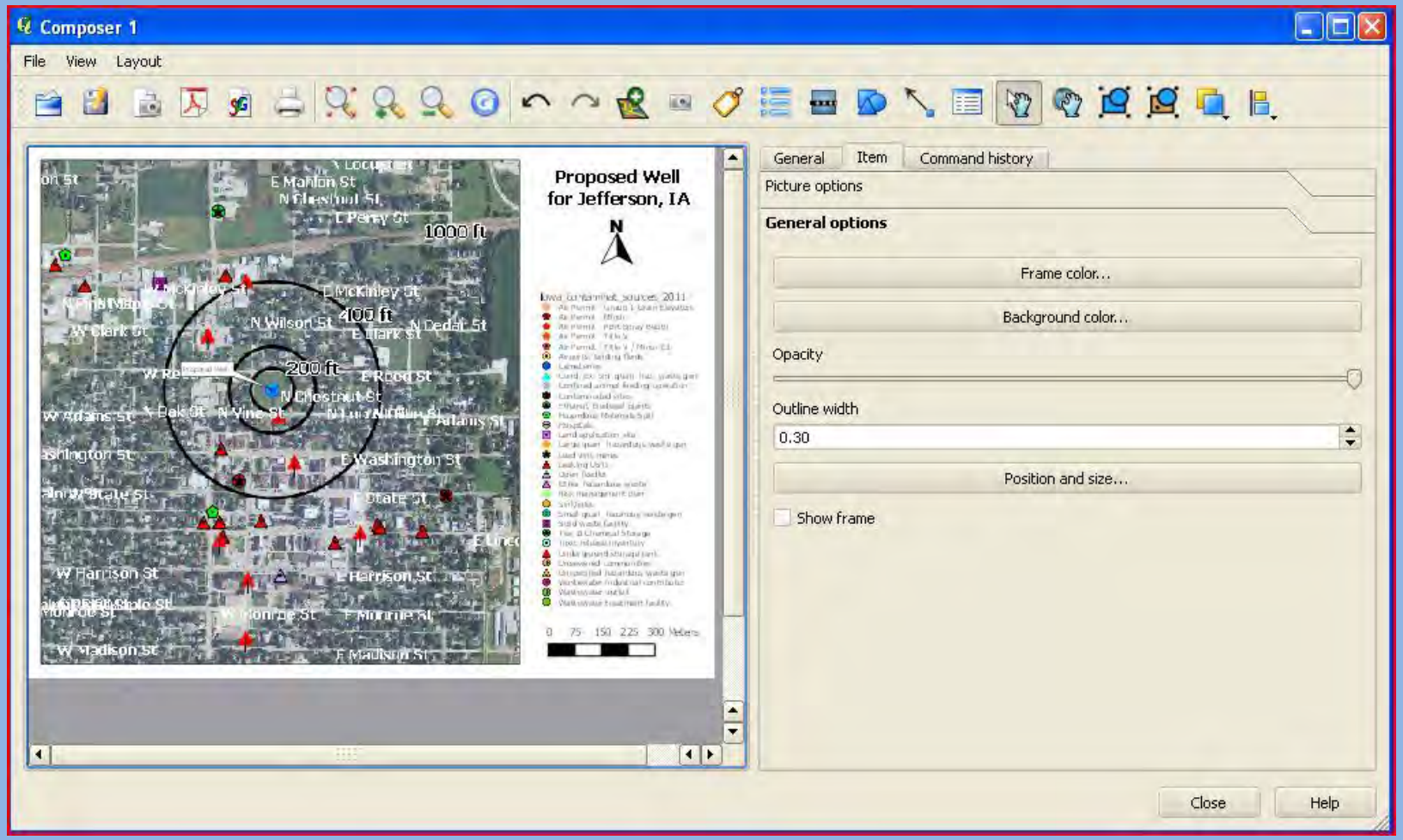


Figure 13.12

Making a Map

Now we have made it to the final moment, printing the map to a PDF. To do this click on the **"Export to PDF"** tool as seen circled in figure 13.13 below. Save the map to the **"Your_Data"** folder on the jump drive as **"Jefferson_proposed_well_map.pdf".** Once you have saved the map you can save this composer session as a template for future use. To do this simply click on **"File"** in the upper left hand corner scroll to save as template" and save to the **"Your_Data"** folder on the jump drive as **"proposed_well_temp.qpt".** In the future, should you want to maintain this map with a different extent, simply open the **"print composer",** click on **"File"** and then **"load template"** and navigate to your saved **.QPT** file. Now look and see if you PDF resembles to map on the next slide.

***if your map does not show the WMS base map layer you did not correctly follow the steps in text box next to figure 13.1**

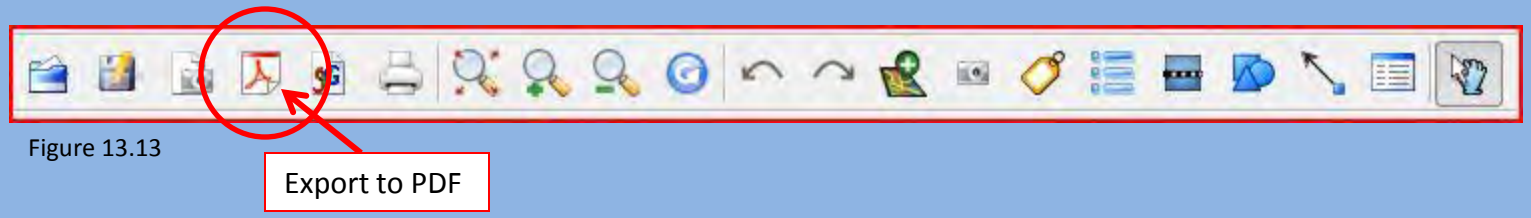


Figure 13.13

Making a Map

Proposed Well for Jefferson, IA

N

Iowa_contaminat_sources_2011

- Air Permit - Group 1 Grain Elevators
- Air Permit - Minor
- Air Permit - PBR Spray Booth
- Air Permit - Title V
- Air Permit - Title V / Minor EI
- Airports, landing fields
- Cemeteries
- Cond. Ex. Sm. quan. haz. waste gen.
- Confined animal feeding operation
- Contaminated sites
- Ethanol, biodiesel plants
- Hazardous Materials Spill
- Hospitals
- Land application site
- Large quan. hazardous waste gen.
- Lead-zinc mines
- Leaking USTs
- Open feedlot
- Other hazardous waste
- Risk management plan
- Sinkholes
- Small quan. hazarous waste gen.
- Solid waste facility
- Tier II Chemical Storage
- Toxic release inventory
- Underground storage tank
- Unsewered communities
- Unspecified hazardous waste gen.
- Wastewater industrial contributor
- Wastewater outfall
- Wastewater treatment facility

0 75 150 225 300 Meters

Figure 13.14

Conclusion

Hopefully you understand:

- How Quantum GIS can help you
- GIS Data Formats
- Basic Projection principles
- How to alter data symbology
- How to create data
- How to edit data
- How to georeference data
- Linking data to the web
- Joining datasets (tabular/spatial)
- Basic SQL
- How to make a thematic map

Questions and Concerns?

“Google It”

QGIS Help Forum:
http://forum.qgis.org/

Homework…

Your map should look similar to the map on the left and maintain the following three characteristics, listed below:

1) **Have multiple legend items.**
2) **Have a logo or image along with a compass rose.**
3) **Must be printed in a "portrait" page orientation.**

Extra Credit: Print a map with two extents.

Make a PDF map and send it to me at:
soren.rundquist@dnr.iowa.gov

Once I receive an finished map I will send you an FTP link to LiDar data and/or flood map data.

Source Water