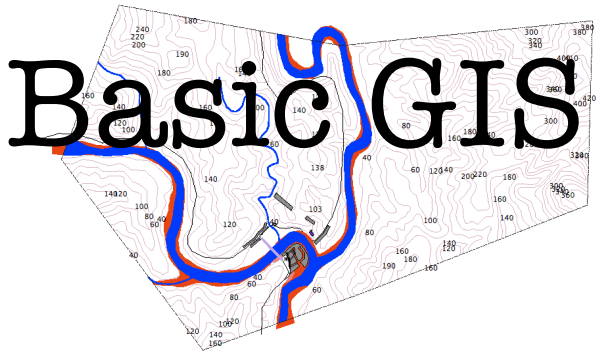
Getting Started with Open Source Geographic Information System



Basic GIS Training

Using Quantum GIS

For multi-hazard mapping of selected Barangays in Camarines Sur and Catanduanes

by Rick Jayson A. Tatlonghari

August 4-8, 2009

Carlos Hometel
Purok 5, Rawis, Legazpi City
Albay, Bicol

ACF INTERNATIONAL
Save the Children
EUROPEAN COMMISSION Humanitarian Aid
GENERALITAT VALENCIANA
Australian Government AusAID
MINISTERIO DE ASUNTOS EXTERIORES Y DE COOPERACIÓN
Agencia Española de Cooperación Internacional para el Desarrollo

Table of Contents

Preface

This training manual was created to have basic step-by-step guide on fundamental function of different tools of Quantum GIS. This training manual cannot guarantee that you will become a good practitioner of Geographic Information System (GIS) since GIS training is software specific. Furthermore, this training manual cannot guarantee you to become expert on GIS and its application on multi-hazard mapping. However, if you have great interest in GIS, upon completion of the training, you will gain enough knowledge on how GIS works and will be able to apply it not only in multi-hazard mapping but also in any field you have because of its various application.

For best results of the use of this training you should practice the three (3) working principles:

1. Never compare an apple to an orange – if you have experienced working with commercial software like ArcView, ArcGIS, MapInfo, Manifold and so forth NEVER compare it with open source. Otherwise you will become resistant with the software and will not learn how to use Quantum GIS or any other open source software. Learn how to adjust your self in any GIS working environment to have deep understanding on its application;

2. Always practice – Remember, "Excellence is a habit, not an act. It takes practice and perseverance." You cannot become an expert in just a week of training it takes years of practice to gain recognition in this field;

3. Imagine – As Albert Einstein said, "Imagination is more important than knowledge. For knowledge is limited to all we now know and understand, while imagination embraces the entire world, and all there ever will be to know and understand." This principle is the same in the world of GIS, the application of GIS is limited to the imagination of the user, once you have learned the concept of GIS and its basic functions you will able to learn the rest if you have great "imagination".

If you have any questions regarding the use of Quantum GIS or any GIS software you have, you may contact me with the following information for FREE within three (3) months period upon completion of this training:

Yahoo Messenger: rj3kings
Free Call (Sun-to-Sun only) : 0922-874-1144
Email: rick@geoinfometrics.com
Website: http://www.geoinfometrics.com

WELCOME to Basic Geographic Information Systems Training!

For those who are new with geographic information system (GIS), please go over to our brief introduction about GIS.

To be able to use this service, you need to have GIS Software.

In this training, Quantum GIS (developed by SourceForge in June 2002) will be utilized. Maps and data used in this training are from the Multi-Hazard Mapping Project of ACF. Concepts and information about GIS and its application are mainly borrowed from various sources from the Internet and used under the context of this training manual. The step-by-step procedure of this training manual is mainly from the experience and skills of the author.

Use of this Training Manual and Exercise Data

User may use the training manual and exercise data contained in the CD for non-commercial purposes, which include research, education, presentations, and non-commercial publications. User should understand and agree that user may not copy, reproduce, distribute without written authorization from concern ACF or author. Inquiries about permission should be directed to any of the said party by telephone, writing or email.

Basic GIS Training manual except its exercise data is deployed using the GNU General Public License.

Copyright

Data and information contained in this training manual is protected under the copyright laws applicable in the Philippines and standard international copyright law. In addition, certain information may be copyrighted by others.

Quantum GIS Tutorial-Manual

A. System Requirements for Quantum GIS

Windows OS:

Minimum: Pentium III / 256 MB RAM.

Recommended: Pentium IV / 512 MB RAM.

Operation System: Platforms Windows and Linux (Win98/XP, Linux Suse 8.2/9.0/9.2, Linux Debian (Lliurex))

MAC OS:

PC/Desktop with at least Pentium IV

Tiger OS, Leopard OS

B. Getting Started

This brief introduction about GIS will show you how to use open-source GIS software using Quantum GIS for basic-to-sophisticated analysis. After very short period of time you will be able to navigate the map application successfully even if you have no prior knowledge of Geographic Information System (GIS).

Initially, we need to tackle the concepts behind GIS that you need to know for you to appreciate this training. After that, we will show you how the mapping tools work that you will use to explore the layer/map and how GIS performs for hazard mapping information sharing.

C. Concept behind GIS

1. Features like House (e.g. Nipa Hut) and Place (e.g. Sea Shore) have attributes associated to them.

For example, House (Nipa Hut). We have so many records and information about house. We could use database to record and share the data and information about house (e.g. Tax Mapping System). The type of house, material used, owner, status, current market value, location, photos and so forth are the attributes stored in the database. Each house is one record in the database and each column (e.g. type of house, material used and owner) is called field.

Location becomes important in the attributes if someone ask "where". Yes, location attributes in the database becomes relevant to each house to gather more information,

which relates to each situation.

But is this really answer the question "where"? Like if we put in the database that we can found a particular house in Brgy. Binagasbasan and Brgy. Sta. Elena with coordinates X1, Y1 and X2, Y2 respectively does it really answer "where"?

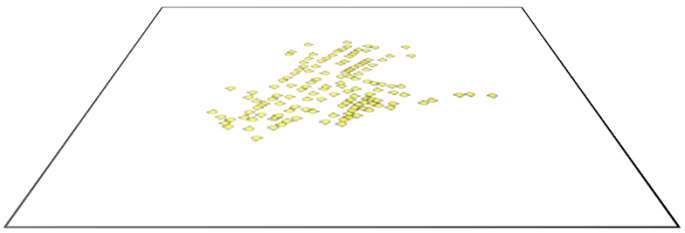
To enable us to picture out the exact location of each house we need to map it and identify which attributes belong to which house. And this actually is the foundation of geographic information system (GIS).

GIS answer the question "where" and provide information which also answers the questions "what", "why" and "how". Like, "what houses that can be found in <5masl but >10masl?", "why there's a place that people should not build their house?", and "how a particular barangay will response in any hazard situation?".

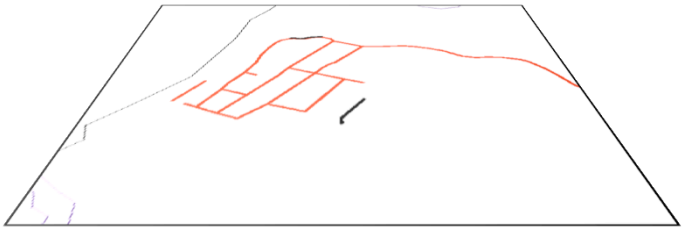
2. Each data is presented by layers/themes/maps.

Let's go back to our example, data/information of house is represented by one or more layers in GIS. In fact, any information can be constituted as a layer. Rivers, road and land cover types could also added as layers for us to have more reliable information that will entirely answer the questions "why" and "how".

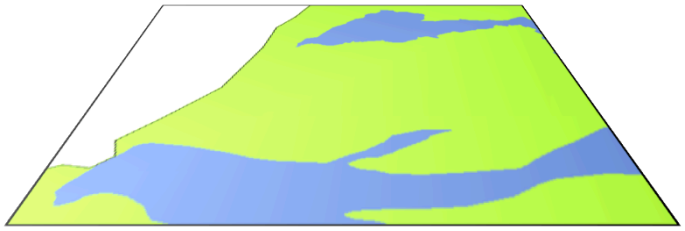
In GIS, we have vector and raster layers that can represent features (e.g. houses, bridges, and river areas) in one of various ways. Vector layers are represented by point, line and polygon.



Point layer can represents house, church, electrical post, bridge, ground control points, marker, etc.



Line layers can represent rivers, road, trail, water system, etc.



Polygon layers can represent country boundary, administrative, hazard area, etc.

Raster layers are stored in a grid or pixel format. This grid also contains information. A good example of raster layer is photograph such as aerial photo or satellite image from Google earth or photograph from your digital camera.

Unlike the vector layers, raster layers do not have attributes however it all contains pixel values. Each pixel/grid may represent particular features in the ground such as trees, grass, rice field, elevation, climate, building, road, river and so forth.

Layers are also called "coverages", themes and the most popular "shapefiles". You may view and examine layers independently or simultaneously. As you work with GIS-MHM you will be able to turn different layers on and off as necessary.

D. Definition of GIS

Geographic Information System (GIS) is an organized collection of computer hardware, software, geographical data and personnel designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information". (ESRI 1995)

"GIS is an integrated system of computer hardware, software, and trained personnel linking topographic, demographic, utility, facility, image and other resource data that is geographically referenced." (NASA)

Congratulations! You are now equipped with simple but complete concept in GIS!

E. GIS tool in Multi-Hazard Mapping (GIS-MHM)

GIS-MHM is a project of Acción contra el Hambre with agreement with concern agency. This project aims to set-up comprehensive and sustainable multi-hazard and vulnerability geodatabase of 15 Barangays in Bicol Region, namely:

1. Barangay 1 Poblacion, Garchitorena, Camarines Sur
2. Santa Cruz, Cabusao, Camarines Sur
3. Guiamlong, Caramoran, Catanduanes
4. Inalmasinan, Caramoran, Catanduanes
5. Hitoma, Caramoran, Catanduanes
6. Iyao, Caramoran, Catanduanes
7. Salvacion, Caramoran, Catanduanes
8. Obi, Caramoran, Catanduanes
9. San Marcos, San Miguel, Catanduanes
10. J.M. Alberto, San Miguel, Catanduanes
11. Pagsangahan, San Miguel, Catanduanes
12. Tobrehon, San Miguel, Catanduanes
13. Kilikilihan, San Miguel, Catanduanes
14. Solong, San Miguel, Catanduanes
15. Santa Elena, San Miguel, Catanduanes
16. Binagasbasan, Garchitorena, Camarines Sur*
17. Pandan, Cabusao, Camarines, Sur*

*Not included in the contract but was able to include as requested by ACF field staff.

This was developed to display geospatial all related data and information on interactive maps using open-source GIS software (Quantum GIS).

Similar with any commercial and expensive GIS software, Quantum GIS can be used to carry out basic mapping operations and accomplish simple-to-sophisticated spatial queries, and visualizing patterns of species distribution, status and concerns in Bicol Regions. You may turn various map layers on and off, zoom a particular area or layers you want to see, move the layers in the display window using pan, view the attributes of the layer in table or graphical form, perform distance measurement, read the coordinates of the map, view interactively the descriptive statistics, perform mapping queries interactively, print the map with attributes/graph, scale and legend, and you can save, add it in your favorites or bookmark for later viewing.

Main Page

When you open the Quantum GIS main page through your computer, you will see a new window that looks similar to the example you see here (Figure 1).

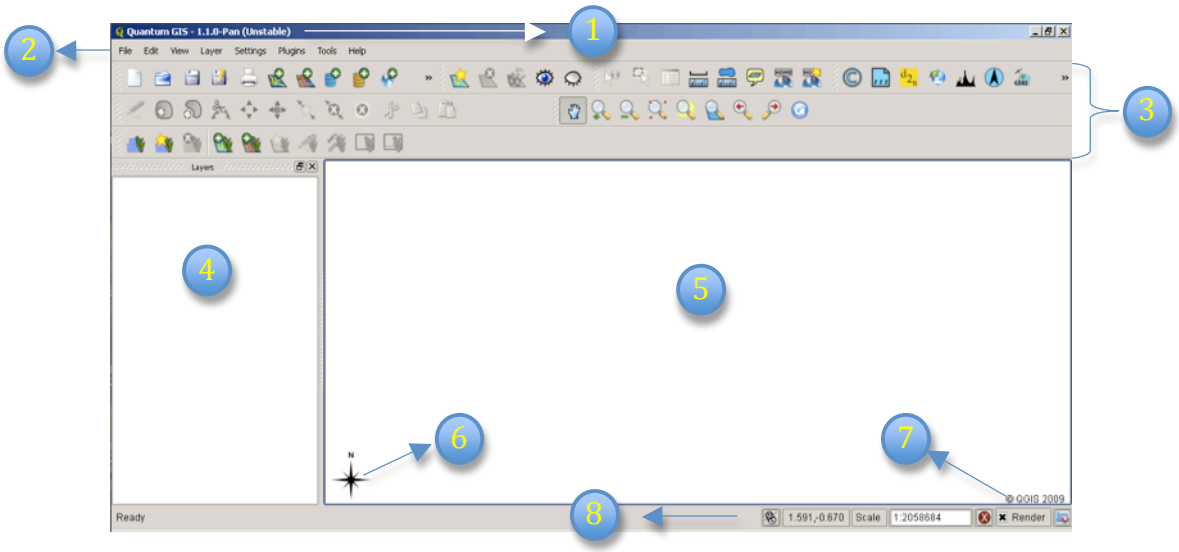


Figure 1. Default Quantum GIS Main Page.

Interface

Quantum GIS interface change from one project to another depending on the required interface of the project. Below are the basic menus that you will encounter in Quantum GIS for GIS-MHM.

Definition:

1. Title of the Project - Shows the title of project that you are going to see/view.

2. Menu Bar This provides access to various Quantum GIS features using a standard hierarchical menu.

3. Toolbars This provide access to most of the same functions as the menus, plus additional tools for interacting with the map. Shows the command for zoom in, zoom out, pan, back to original view, go back to previous extent, go to next extent, object-information, coordinate read-out, measure, print and help.

4. Table of Contents/Map Legend - Shows the layers that can be turn on ☒ or off ☐ and its legend, attributes symbol and query symbol available for corresponding project.

5. Display Window - Shows the feature/s that you have turn on ☒ from the table of contents.

6. Cardinal Direction - Shows the geographic orientation on earth. These are north, east, west and south commonly denoted by their initials - N, E, W, and S.

7 Copyright Logo Shows the copyright of the particular project.

8 Status Bar - Shows you your current position in map coordinates (e.g. meters or decimal degrees) as the mouse pointer is moved across the map view. To the left of the coordinate display in the status bar is a small button that will toggle between showing coordinate position or the view extents of the map view as you pan and zoom in and out.

Congratulations! You are now familiar with the different parts and components of Quantum GIS for GIS-MHM!

F. Exploring the Quantum GIS Toolbars and other Components for GIS-MHM.

This is the final section of the tutorial. In here, you will able to know on how to use in details the different mapping tools and other components of Quantum GIS for GIS-MHM.

Navigation Toolbars

 Zoom in

Click once in the map to zoom in or drag a box over the particular area.

 Zoom out

Click once in the map.

 Panning

Click in the map, hold down the mouse button, and drag in any direction.

 Zoom to Full

Click to return to default view or view the full map layer/s.

 Go back to previous extent

Click to go back to the previous view.

 Go to next extent

Click to view the next extent of the map/layer.

 Zoom to Selection

Click to view the selected part of map layer/s.

 Zoom to Layer

Click to view a particular map layer.

 Refresh

Click to refresh the display window.

Object-information

 Identify Features

Click to activate and point to the layers you want to view the information.

 Select Features

Click to activate and point to the layers you want to select.

 Open Attribute Table

Click to open the table of a layer.

 Measure Line

Click to activate and point to the layer if you want to measure the distance. Use the mouse to draw a line representing the distance you wish to measure. The line can have one or more line segments. Double-click to end the line. The length you measured is displayed in the browser status bar or in the textbox.

 Measure Area

Click to activate and point to the polygon feature if you want to measure the area.

Table of Contents Menu

 Turns layer on or off

Click the box to turn on  or off the layer/s.

 Folder icon in the Table of Contents

This represents a group of layers in the table of contents.

 Grayed color means only selected layers are visible in the group of layers.

Georeferencing Tool

 Georeferencer

This tool enables you to rectify unreferenced raster map (i.e. *.jpg format).

Editing Tools

 Toggle Editing

This tool activates editing and creating new layer sessions. When this tool is activated the rest of the tool in editing session will be activated too.

 Capture Point

This tool edits and creates point features.

 Capture Line

This tool edits and creates line features.

 Capture Polygon

This tool edits and creates polygon features.

 Add Ring

Creates ring type additional features in an existing polygon layer. This can only be seen when you edit polygon features.

 Add Island

Creates additional polygon features in an existing polygon layer. This can only be seen when you edit polygon features.

 Split Features

Divide the features into two. This can only be seen when you edit line and polygon features.

 Move Feature

This tool helps in moving all type of feature (point, line, and polygon) to the target position.

 Move Vertex

This tool helps in vertex adjustment in all type of features (point, line, and polygon).

 Add Vertex

This tool helps in supplying additional vertex in line and polygon features only.

 Delete Vertex

This tool helps you in eliminating unwanted vertex in line and polygon features only.

Note: Vertex (plural vertices) is an intermediate points along a line curve, or arc. They represent the critical points of inflection along the arcs, thereby reflecting its shape.

 Delete Selected

This tool helps you in eliminating unwanted selected features whether point, line or polygon.

 Cut Features,  Copy Features and  Paste Feature

Similar to any production related software, this tools helps you in transferring or copying features into another layer whether point, line or polygon.

Other Important Tools

 New Project

Enables you to create a new project.

 Open Project

Tool use to open an existing/previous project created in Quantum GIS.

 Save Project

Enables you to save the project.

 Save Project As

Enables you to save the project in another format.

 Print Composer

Enables you to print the map/layers including the title, table of contents, map overview, scale bar, graph/attributes present in the layer, author and map information, logo, toolbar, and other components present in the main page of the project.

 Add Vector Layer

Enables you to add any readable existing vector format layer.

 Add Raster Layer

Enables you to add any readable existing raster format layer.

 Add PostGIS Layer

Enables you to add layer from any existing Postgre Database.

 Add SpatiaLite Layer

Enables you to connect from any existing Spatialite Database.

 Add WMS Layer

Enables you to add any existing web mapping service (WMS) (e.g. TerraServer Digital Raster Graphic (DRG), SRTM, digital elevation of the earth). This requires Internet connection and most of the sites require payment to connect.

 Gps Tools

Enables you to connect from any type of GPS.

 Add WFS Layer

Enables you to add any existing web feature service (WFS). Similar to WMS this requires Internet connection and most of the sites require payment to connect. Unlike WMS, WFS is XML-Encoded geospatial data (GML to be exact), including both geometry AND attribute information.

 New Vector Layer

Enables you to create a new layer or feature similar with Editing Tool.

 Remove Layer

Enables you to delete unwanted layer/feature. Similar with Delete Selected Tool.

 Add to Overview

Enables you to add an overview map in an Overview window.

 Show All Layers

Tool use to easily view all the layers in the Table of Contents.

 Hide All Layers

Tool use to easily hide all the layers in the Table of Contents.

Help

Provides the basic instruction on toolbar, table of contents and other tools.

Again, Congratulations! You are now well equipped to use this service. Don't forget to share it!

Before we proceed in our exercises, you need to install the Quantum GIS software found in your CD. Follow the instruction below or instructions found in the "software directory" in your CD to install the Quantum GIS:

1. Install first the QGIS-1.1.0-0-Setup.exe
2. Then install the Microsoft C Runtime Libraries (vcredist_x86.exe).

Note: Free to distribute by Quantum GIS (www.qgis.org).

Exercise No. 1: Creation of GIS File Directory

1. Right click on Start menu and select Explore.
2. Navigate to your desire directory and create new folder. Name the folder as ACF GIS or whatever name you want.
3. Inside the ACF GIS or (whatever name) folder, create sub-folders and name it as Vector and Raster.
4. Every time you create new layer or features, or you have collected new files, create a folder for each and place it in corresponding sub-folder (Vector or Raster).
5. Test the files you have transferred. Click  to add vector layers and click  to add raster files.
6. For vector, click the  to view the information inside the features.
7. Always test the files you have acquired before peacefully storing it.

Note:

Most of the times, the threats to your information aren't from other people but from natural or technological causes. Although there is no way to control or prevent these problems, you can prepare for it and try to minimize the damage:

a. Protect your computer against power surges and brief outages – i.e. during a lightning storm or construction work that increases the odds of power surges, consider shutting your computer down and unplugging it from all power sources.

b. Back up all of your data - regularly backing up your data on a CD or network reduces the stress and other negative consequences that result from losing important information (see Real-World Warnings Keep You Safe Online for more information).

> *Tip: If you are constantly adding or changing data, you may find weekly backups to be the best alternative; if your content rarely changes, you may decide that your backups do not need to be as frequent.*

c. Identify people who could, legitimately or not, gain physical access to your computer—family members, roommates, co-workers, members of a cleaning crew, and maybe others.

d. Lock your computer when you are away from it. Even if you only step away from your computer for a few minutes, it's enough time for someone else to destroy or corrupt your information. Locking your computer prevents another person from being able to simply sit down at your computer and access all of your information.

e. Disconnect your computer from the Internet when you aren't using it - likelihood that attackers or viruses scanning the network for available computers will target your computer becomes much higher if your computer is always connected unless you have very good firewall.

f. Evaluate your security settings - it is important to examine the settings, particularly the security settings, and select options that meet your needs without putting you at increased risk.

Generally:

a. Use and maintain anti-virus software and a firewall - Protect yourself against viruses and Trojan horses that may steal or modify the data on your own computer and leave you vulnerable by using anti-virus software and a firewall (see Understanding Anti-Virus Software and Understanding Firewalls for more information). Make sure to keep your virus definitions up to date.

b. Regularly scan your computer for spyware - Spyware or adware hidden in software programs may affect the performance of your computer and give attackers access to your data. Use a legitimate anti-spyware program to scan your computer and remove any of these files (see Recognizing and Avoiding Spyware for more information). Many anti-virus products have incorporated spyware detection.

c. Keep software up to date - Install software patches so that attackers cannot take advantage of known problems or vulnerabilities (see Understanding Patches for more information). Many operating systems offer automatic updates. If this option is available, you should turn it on.

d. Evaluate your software's settings - The default settings of most software enable all available functionality. However, attackers may be able to take advantage of this functionality to access your computer. It is especially important to check the settings for software that connects to the internet (browsers, email clients, etc.). Apply the highest level of security available that still gives you the functionality you need.

e. Avoid unused software programs - Do not clutter your computer with unnecessary software programs. If you have programs on your computer that you do not use, consider uninstalling them. In addition to consuming system resources, these programs may contain vulnerabilities that, if not patched, may allow an attacker to access your computer.

f. Consider creating separate user accounts - If there are other people using your computer, you may be worried that someone else may accidentally access, modify, and/or delete your files. Most operating systems (including Windows XP and Vista, Mac OS X, and Linux) give you the option of creating a different user account for each user, and you can set the amount of access and privileges for each account. You may also choose to have separate accounts for your work and personal purposes. While this approach will not completely isolate each area, it does offer some additional protection. However, it will not protect your computer against vulnerabilities that give an attacker administrative privileges. Ideally, you will have separate computers for work and personal use; this will offer a different type of protection.

g. Establish guidelines for computer use - If there are multiple people using your computer, especially children, make sure they understand how to use the computer and internet safely. Setting boundaries and guidelines will help to protect your data (see Keeping Children Safe Online for more information).

h. Use passwords and encrypt sensitive files - Passwords and other security features add layers of protection if used appropriately (see Choosing and Protecting Passwords and Supplementing Passwords for more information). By encrypting files, you ensure that unauthorized people can't view data even if they can physically access it. You may also want to consider options for full disk encryption, which prevents a thief from even starting your laptop without a passphrase. When you use encryption, it is important to remember your passwords and passphrases; if you forget or lose them, you may lose your data.

i. Follow corporate policies for handling and storing work-related information - If you use your computer for work-related purposes, make sure to follow any corporate policies for handling and storing the information. These policies were likely established to protect proprietary information and customer data, as well as to protect you and the company from liability. Even if it is not explicitly stated in your corporate policy, you should avoid allowing other people, including family members, to use a computer that contains corporate data.

j. Dispose of sensitive information properly - Simply deleting a file does not completely erase it. To ensure that an attacker cannot access these files, make sure that you adequately erase sensitive files.

Source: US national Cyber Alert System, 2009.

Exercise No. 2: Usefulness of Excel in GIS

1. Open **binagasbasan exercise no 2a.xls**
2. Follow the steps on "how to convert degrees in DMS format to decimal format".

How to covert degrees in DMS format to decimal format:

a. Start at the Seconds and divide it by 60 (i.e. 56.22408/60).

b. Then add the Minutes and divide it by 60 again (i.e. [6/60+8]/60).

c. The Second and Minutes will become (i.e. .5656178).

d. Now add the Degree (e.g. 123) for final result (i.e. 123.5656178).

How to covert degrees in decimal format to DMS format:

a. The whole units of degrees will remain the same (i.e. in 123.5656178° longitude, start with 123°).

b. Multiply the decimal by 60 (i.e. .5656178 * 60 = 33.937068).

c. The whole number becomes the minutes (i.e. 33').

d. Take the remaining decimal and multiply by 60. (i.e. .937068 * 60 = 56.22408).

e. The resulting number becomes the seconds (i.e. 56.22408"). Seconds can remain as a decimal.

f. Take your three sets of numbers and put them together, using the symbols for degrees (°), minutes (‘), and seconds (") (i.e. 123°33'56.22408" longitude)

Tips:

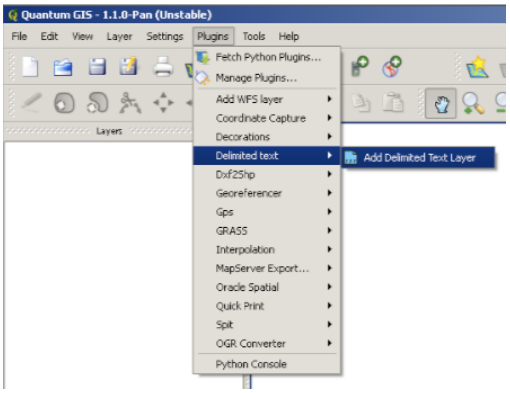
i. You can choose between decimal degrees and degrees, minutes, and seconds on your GPS.

ii. Once you have degrees, minutes, and seconds, it's often easier to find your location on most maps (especially topographic maps).

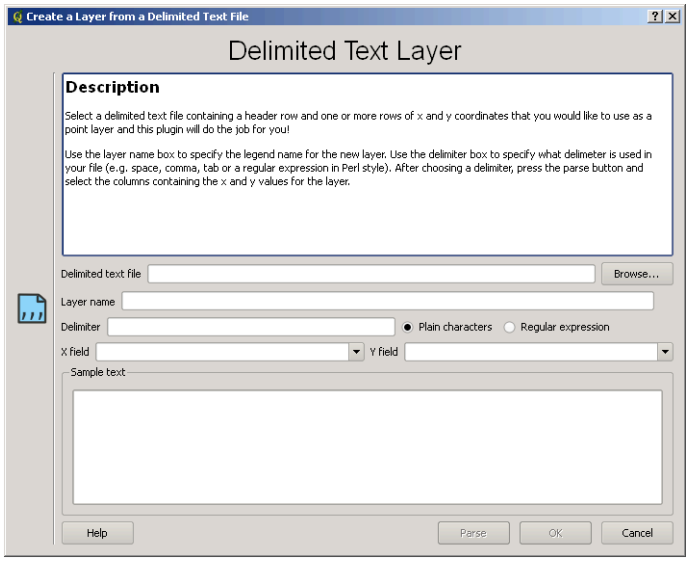
iii. Though there are 360 degrees in a circle, each degree is divided into sixty minutes and each minute is divided into sixty seconds.

3. Write the formula in the next active cell and then drag it to complete the computation.
4. Save the file "**binagasbasan exercise no 2a.xls**" to *.CSV file.

5. Go to Quantum GIS, then click Plugins select Delimited text and click Add Delimited Add Text Layer.



A new dialog box will appear.



In "Browse" menu, find the *.csv file you want to add. You may change the "Layer name" based on your preferences or use the default file name of your *.csv file. Choose the appropriate "delimiter" to be used in your file then click "Parse". Select your desired X and Y field then click "OK" to view the new map feature.

6. Repeat this process in "**inalmasinan exercise no 2b.xls**" but you need to delete all "," (comma) to avoid error. This time, you will see more detailed data and information.

7. If you wan to save your work click "Save Project" icon  .

Note:

What is Database?

A Database is an integrated collection of logically related records or files that is stored in a computer system which consolidates records previously stored in separate files into a common pool of data records that provides data for many applications. The structure is achieved by organizing the data according to a database model. The model that is most commonly used today is the relational model. Other models such as the hierarchical model and the network model use a more explicit representation of relationships.

Often abbreviated DB. A collection of information organized in such a way that a computer program can quickly select desired pieces of data. You can think of a database as an electronic filing system.

Traditional databases are organized by fields, records, and files. A field is a single piece of information; a record is one complete set of fields; and a file is a collection of records. For example, a telephone book is analogous to a file. It contains a list of records, each of which consists of three fields: name, address, and telephone number.

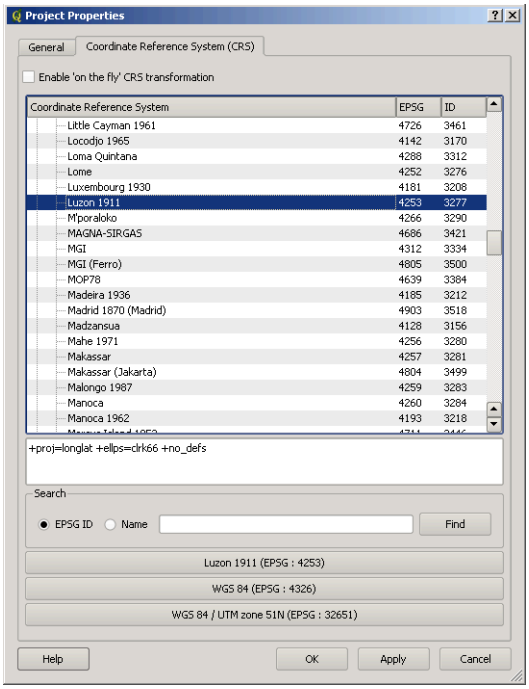
What is metadata?

Metadata describes how and when and by whom a particular set of data was collected, and how the data is formatted. Metadata is essential for understanding information stored in data warehouses and has become increasingly important in XML-based Web applications.

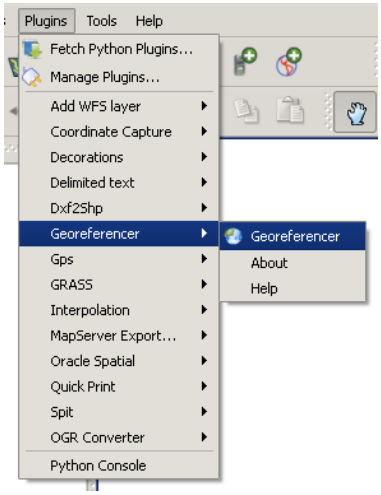
Source: Wikipedia

Exercise No. 3: Working, Saving and Moving Quantum GIS files and project

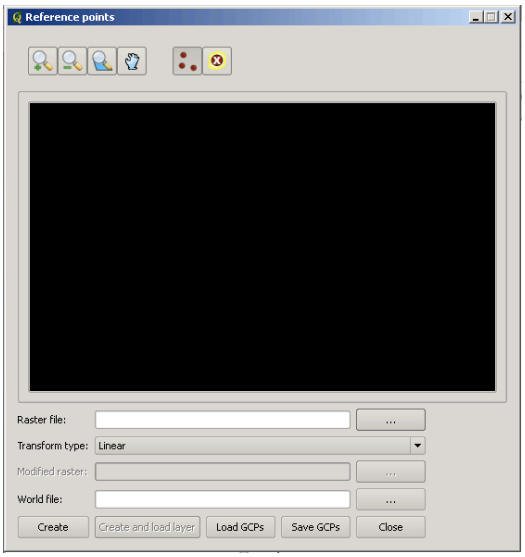
1. Open Quantum GIS .
2. Transfer Exercise No. 3 folder to your desire directory and identify the source of the "datum".
3. Set the coordinate reference system (CRS) by clicking this icon found at the lower right (facing the window) portion of the Quantum GIS interface.
4. In a new dialogue box click the appropriate CRS to be used then click "OK".

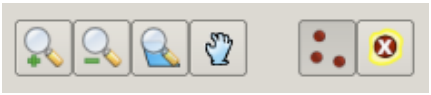


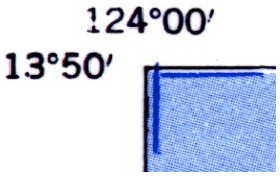
5. Click the Georefencer icon or go to "Plugins" then select "Georeferencer" and click "Georefencer".



6. A new dialogue box will prompt.



7. On a "Raster file" menu, select the map you want to rectify (in this exercise we will use 3861 III Hitoma.jpg, large scan map from NAMRIA).
8. Do not change the "Transform type", we will use "Linear" in transformation since we are going to use only four (4) points in this exercise.
9. Use this tool  to navigate, to add and to delete ground control points (GCPs).
10. Zoom the portion you have identified to add GCP then click "Add Point". Place the cross cursor (+) to the target location.

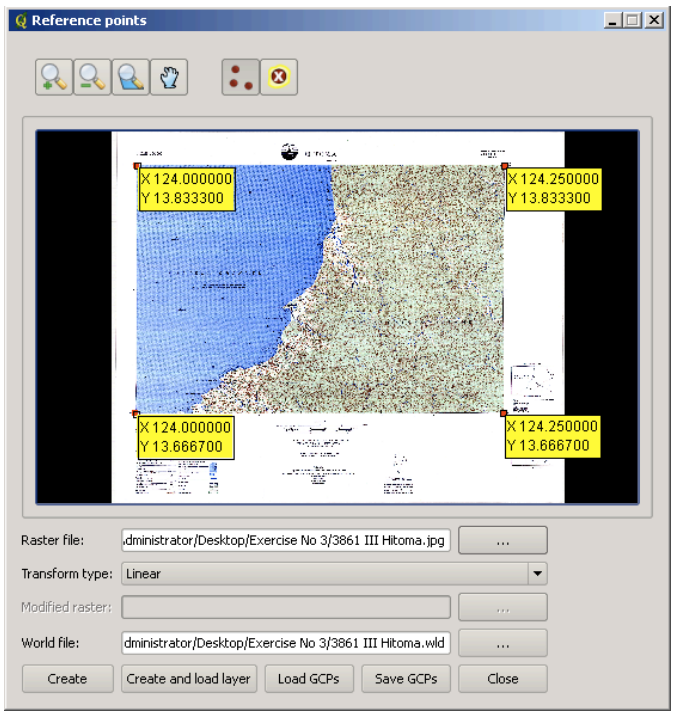


11. In a new dialogue box, enter the coordinates in decimal format (you can choose from existing georeference map or known coordinates just like NAMRIA map).

    Note:

    X = Longitude = Easting
    Y = Latitude = Northing

You need at least four (4) GCPs to correctly georeference the map.



12. When you completed the required GCPs click "Create and load layer" and close the "georeferencer". You will notice that "3861 III Hitoma" will appear in "table of contents" of Quantum GIS. This time, its georeference based on its source.
13. Go to the Exercise No. 3 folder, you will notice this file "3861 III Hitoma.wld", this file (World file) stored the GCPs that you have added. If you found that you have entered wrong GCPs or you want to rectify it in another CRS, you can delete it to return the map in its original/raw file.
14. Save the project for the next exercise.

Exercise No. 4: **Introduction to Digitizing**

Digitizing - A method of data capture that involves the conversion of data in analogue form, such as maps and aerial photographs, into digital form that is directly readable by a computer.

Types of Digitizing:

Tablet Digitizing – the process of converting the geographic features on an analog map into digital format using a digitizing tablet, or digitizer, which is connected to a computer.

On-screen digitizing - the process of acquiring vector graphics by tracing the raster image displayed on the computer screen. This can be done manually or with the aid of computer software. Also commonly referred to as heads-up digitizing.

Key Board Digitizing - the process of creating vector graphics by encoding alphanumeric information using keyboard. This can also be done manually or with the aid of computer software.

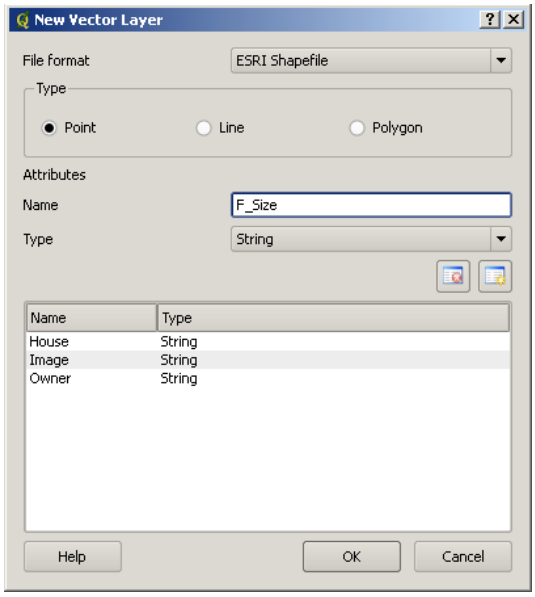
1. Open **Quantum GIS project (*.qgs) from Exercise No. 3.**
2. Click the "New Vector Layer" icon  .
3. In the new dialogue box, choose the type of vector you want to use (point, line, polygon).
4. In the "Name" menu, type your desire attributes name (i.e. House).
5. Choose the type of attributes from drop down menu (Real, Integer, String). Then click "Add Field" icon  .

Note:

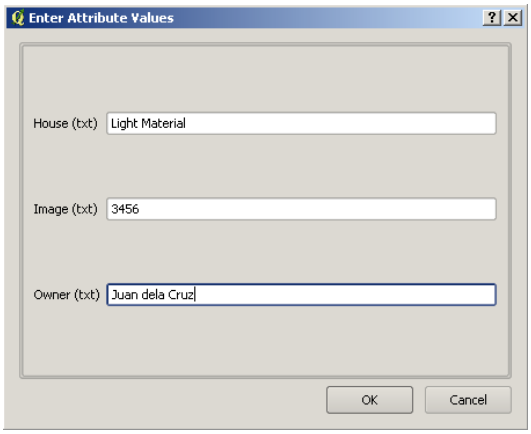
Real – Numbers that are automatically generated.

Integer – An integer identifier assigned by the user to relate geographic features and corresponding attribute data.

String – A series of alphanumeric characters of any length.



6. Repeat this process if you want to add more attributes in your shapefile. Otherwise, click "Ok" to finish it and to start saving the new shapefile.
7. A new dialogue box will prompt, in here, find the directory where you want to store the newly created shapefiles.
8. In the "File name" menu, type your desire file name and click "Save" to proceed in digitizing. You will notice this newly created feature in the "table of contents". Repeat the process from no. 2 to here if you want to add more features (i.e. point, line and polygon).
9. To begin the digitizing process, click the "Toggle editing" icon  .
10. Use the navigation tools  to select, view or choose your target area to be digitized.
11. Use the editing tools  to start creating/modifying feature/s.
12. Every time you will add feature (i.e. capture point, capture line, and capture polygon) a new dialogue box will appear (Enter Attributes Value). Type the data (based on the type of attributes you have chosen in No. 5) on the space provided. Click "OK" when finish or "Cancel" if you want to discontinue the process.



13. When you are done in adding/modifying features click the "Toggle editing" icon  to stop the process. In a new dialogue box, click "Save" if you want to save your work otherwise "Discard" or "Cancel" if you want to continue adding/modifying feature.

TIP: Always save your work from time to time by repeating the saving process of No. 13.

Exercise No. 5: **Introduction to Query and Analysis**

Query is a questions or request used for selecting features. This is usually appears in the form of a statement or logical expression. In GIS, it contains a field, an operator, and a value. While analysis, is the process of breaking a complex topic or substance into smaller parts to gain a better understanding of it. In GIS, it usually starts by figuring out what information you need. This is most often in the form of a question.

Once you have a functioning GIS containing your geographic information, you can begin to ask simple questions such as:

Where are flood zone areas?

Who owns the house inside the “high flood zone” area?

What are house or building type found inside the “high flood zone” area?

and analytical questions such as:

Where are all the sites that can be considered as “safe zone” or “hazard zone”?

What is the dominant type of house in the area?

If I built an evacuation area here, how long would it take for the people to reach this area?

GIS provides both simple point-and-click query capabilities and sophisticated analysis tools to provide timely information to managers and analysts alike. GIS technology really comes into its own when used to analyze geographic data, to look for patterns and trends, and to undertake "what if" scenarios. Modern GIS systems have many powerful analytical tools, but two are especially important:

A. Proximity Analysis

   How many houses are located within 15m from the shore line?
   What is the total number of people living within 15m from the shore line?
   How far is the evacuation area from this identified hazard zone?

   To answer such questions, GIS technology uses a process called “geoprocessing” such as buffering, intersect, union and clip to determine the proximity relationship between features.

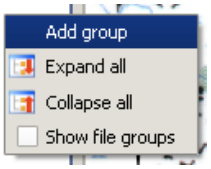
B. Overlay Analysis The integration of different data layers involves a process called overlay. At its simplest, this could be a visual operation, but analytical operations require one or more data layers to be joined physically. This overlay,

or spatial join, can integrate data on soils, slope, and vegetation, or land ownership with tax assessment.

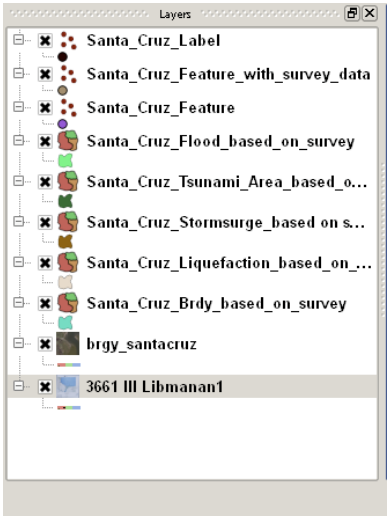
Activity:

1. Open Quantum GIS.
2. From folder Exercise No. 4, add all the features found inside this folder. Use these icons to add vector  or raster  data.

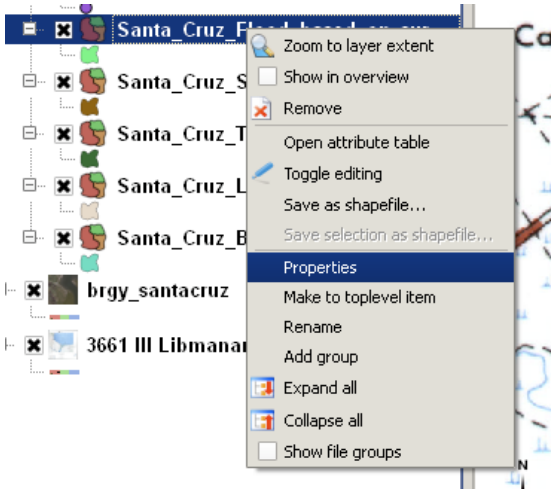
3. Now right click inside the "table of contents" then click "Add group". Drag all the features you want to group (i.e. layer based on survey or layer based on NSO boundary).



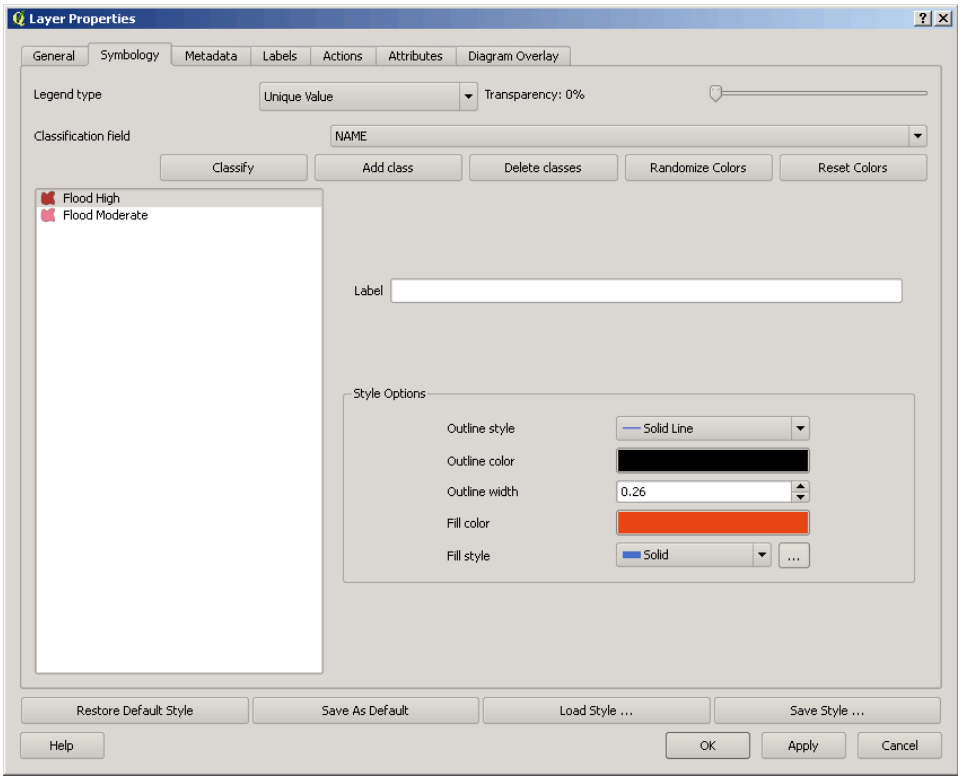
4. Since Quantum GIS has no capability to automatically arrange the features by its type in the "table of contents" (for now), arrange the features from point to polygon (point will be the top feature, next is line feature then polygon feature) by dragging each layer. This will help you to more visualize the scenario in the real world.



5. To change the color and style of the feature/s, right click each layer then choose "Properties".



In a new dialogue box, click "Symbology" tab then choose "Legend type" from drop down menu then select the "Classification field" you want to use from drop down menu and then click "Classify" button. Click each layer to activate the color option from "Style Options" portion. You can also set the layer transparency to overview the satellite/NAMRIA as base map by sliding the "Transparency" slide bar. Click "OK" when you finish.



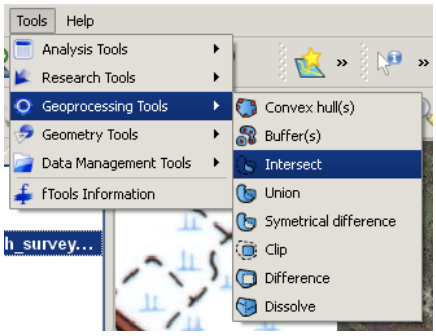
Note:

High Susceptibility = Color **RED**
Moderate Susceptibility = Color **PINK**
Low Susceptibility = Color **YELLOW**

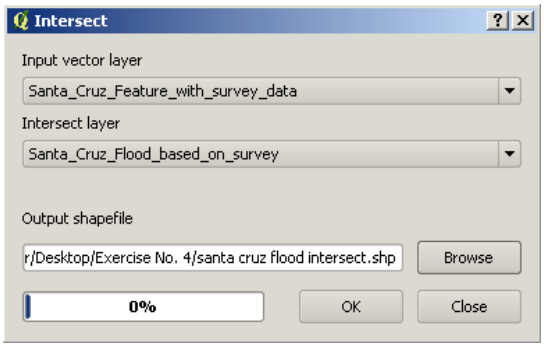
6. By simple investigation process in the map you can immediately see the houses that are considered at risk.
7. Save the project for our next exercise.

Exercise No. 6: **Query and Analysis: Using Geoprocessing Tools**

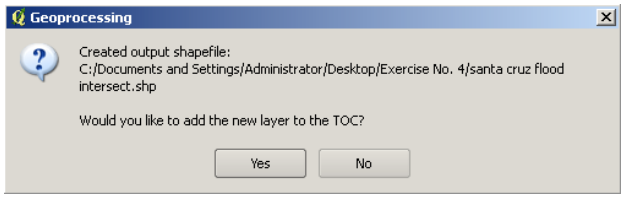
1. Open **Quantum GIS project (*..qgs) from Exercise No. 5.**
2. Now go to "Tools" menu then "Geoprocessing Tools" and then click "Intersect".



3. In a new dialogue box, select the files you want to input as layer from drop down menu (i.e. Santa_Cruz_Feature_with_survey_data) and then choose "Intersect layer" from drop down menu (i.e. Santa_Cruz_Flood_based_on_survey). Then navigate the directory where you want to save your new files by clicking "Browse". Click "OK" when you are done.



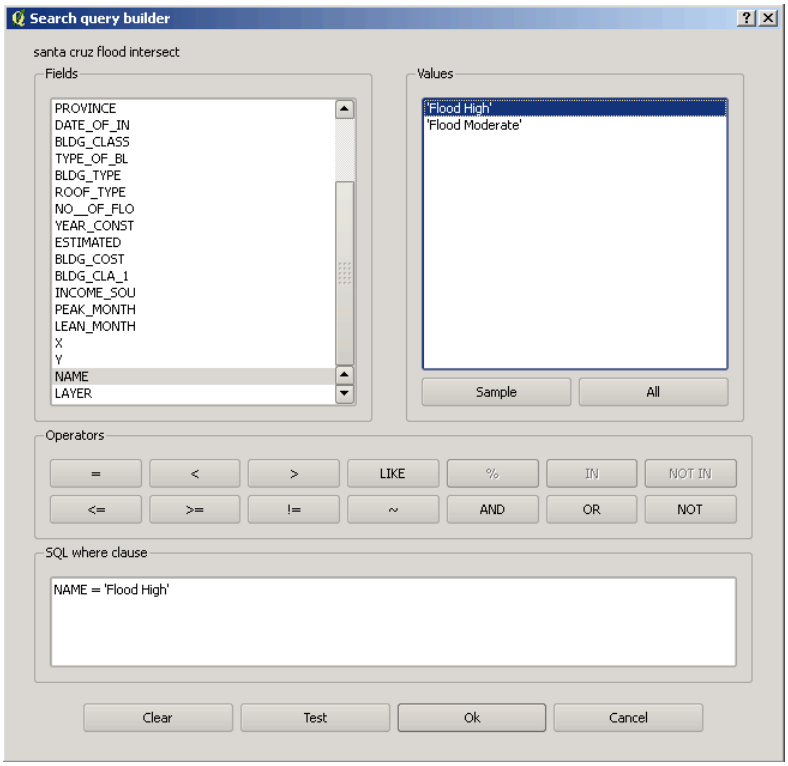
A new dialogue box will appear, click "Yes" if you asked to add new layer otherwise, click "No". Close when you are finish.



4. Now, click the newly added layer then click "Open Attribute Table" icon or right click the layer and choose "Open Attribute Table".
5. Navigate the table, you will notice that the attributes of the "Santa_Cruz_Flood_based_on_survey" was added at the end of

"Santa_Cruz_Feature_with_survey_data". In simple investigation or choosing these field name in "Symbology" will give you simple analysis about the status of each houses.

6. Now, click the "Advance search" button found at the right side of the Attribute Table window.
7. Now, choose the field you want to use in "Search query builder" window by double clicking it (i.e. NAME) then choose the operator you want to use (i.e. =) then click "All" button on the "Values" and finally double click the "Values" you want to use (i.e. 'Flood High'). Click "OK" when you are done.



8. You will notice that the system will automatically count your query. Click "OK" to view the results.

9. Use this button  found at the lower left of the "Attribute" window to "Move

the top" the results.

10. You can mark this button 

to show only the selected records.
11. You can view the results in the map window by clicking this icon  . Minimize the "Attribute" window and you will notice the selected layer will be highlighted.
12. Repeat the process if you want to query something.
13. If you are going to use the buffer in "Geoprocessing Tools" better to "Project" the layer using UTM. This will give you easy measurement (i.e. meter) than in degree.

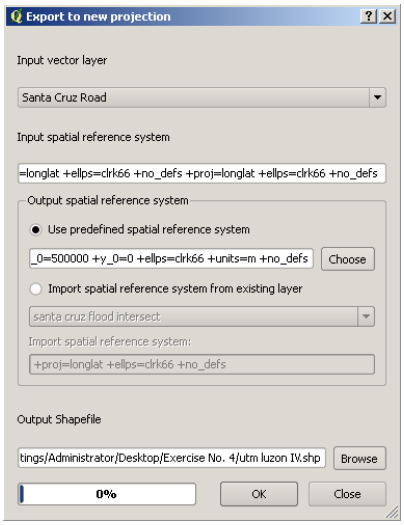
Exercise No. 7: **Projection**

This is a mathematical process that transforms feature locations from the earth's curved surface to a map's flat surface. A projected coordinates system employs a projection to transform locations expressed as latitude and longitude values to X,Y coordinates.

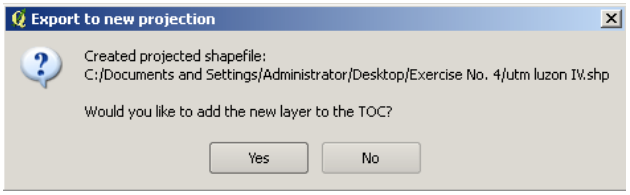
Projections cause distortions in one o more of these spatial properties: distance, area, shape, and direction.

Different projections have unique characteristics and serve differing purposes.

1. Open **Quantum GIS project (*.qgs) from Exercise No. 6.**
2. Activate the layer you want to project.
3. Now go to "Tools" menu then "Data Management Tools" and then click "Export New Projection".
4. In a new dialogue box, select the vector layer from drop down menu then choose the spatial reference you want to use (please refer to the CRS reference included in your CD). Navigate the directory where you want to save your "projected" layer then click "OK" to begin the process. Otherwise, click "Close" to cancel.



5. Click "Yes" to add the created projected layer.

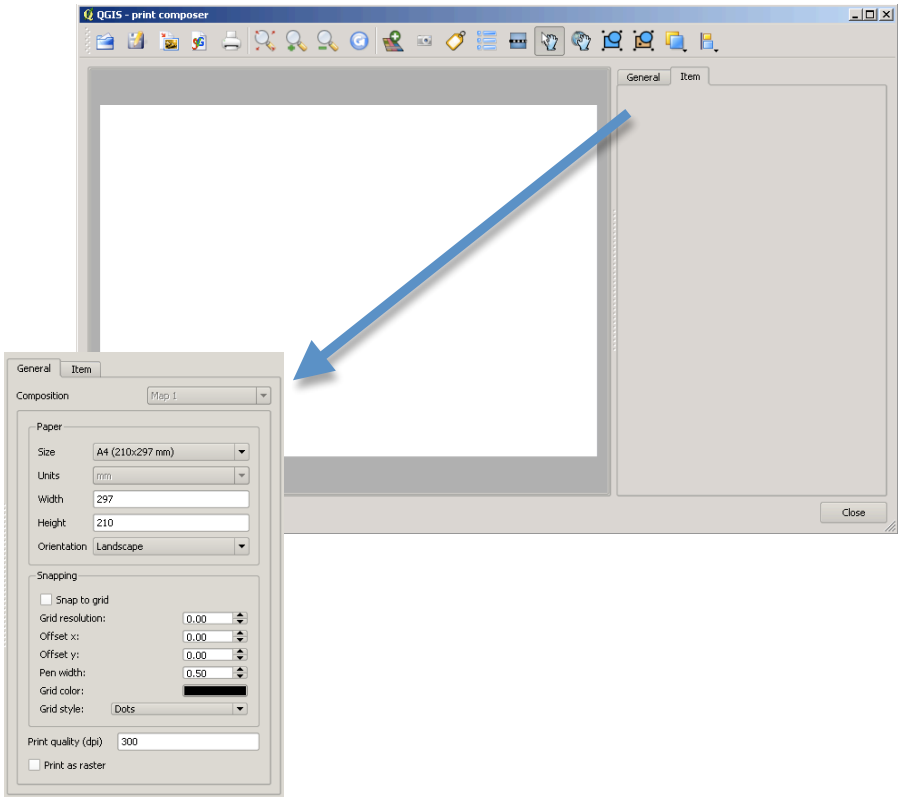


6. Close the "Export New Projection" if you are done.
7. Don't forget to save your exercise.

Exercise No. 8: **Map Layout**

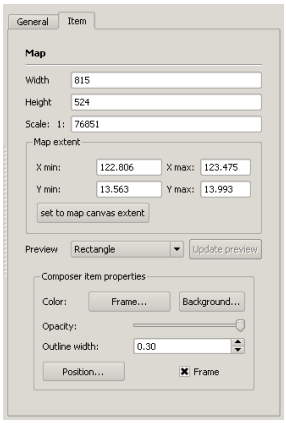
Map layout is a compilation of map elements laid out and organized on a page. Common map elements include one or more data frames each containing an ordered set of map layers, a scale bar, cardinal direction, map title, descriptive text, and a legend. In here, Layout view is found in "Print Composer" where you add map surrounds, frames and other finishing touches to a map. What you see on the layout is what you get if you print or export the map to the same page size.

1. Open **Quantum GIS project (*.qgs) from Exercise No. 6.**
2. Click the Print Composer icon  .
3. In a new dialogue box, click the "General" tab menu to choose your target paper size.



In here, you can change the settings of your desire map.

4. Click "Add new map" icon  and draw a square inside the view page to view the target map. In here, you will notice that the "Item" tab menu is now activated.



5. In the "Item" tab menu, select "Cache" as type of map preview from "Preview" drop down menu.
6. Click "Update preview" to view map.
7. Use this tool bar to customize your map  .
8. Basically, use this icon  to add north arrow and your logo in the map, this icon  to add legend, this icon  to add label, and this icon  to add scale bar.
9. Click this icon  when you are finish and ready to print otherwise click "Close" to cancel.

Exercise No. 9a: **Tutorial on GPS**

Global Positioning System (GPS) is a space-based radionavigation system that provides reliable positioning, navigation, and timing services to civilian users on a continuous worldwide basis -- freely available to all, anywhere, and anytime. It uses a constellation of between 24 and 32 medium Earth orbit satellites that transmit precise radiowave signals, which allow GPS receivers to determine their current location, the time, and their velocity.

The GPS is made up of three parts: satellites orbiting the Earth; control and monitoring stations on Earth; and the GPS receivers owned by users. GPS satellites broadcast signals from space that are picked up and identified by GPS receivers. Each GPS receiver then provides three-dimensional location (latitude, longitude, and altitude) plus the time.

Note: Before, the highest quality signal was reserved for military use, while the signal available for civilian use was intentionally degraded ("Selective Availability", SA). Selective Availability was ended in 2000, improving the precision of civilian GPS from about 100m to about 20m.

1. Open the GPS.
2. Go to open area (meaning keep away from tallest structures).
3. Start reading; wait until 3D reading is available.
4. Record the reading.

Exercise No. 9b: **GPS-to-GIS Data Transfer**

1. Connect the cable from GPS to computer (be sure you have active sync installed in your computer).
2. Transfer the files you have capture in the field.
3. Once it was transfer, your file is now ready to view.
4. Disabled the device once the file transfer is complete.

Exercise No. 9c: **GIS-to-GPS Data Transfer**

1. Connect the cable from GPS to computer (be sure you have active sync installed in your computer).
2. Transfer the files you want to use in field survey.
3. Once it was transfer, your file is now ready to view.
4. You can use the files or rectified image as basis in GPS surveying.