Quantum GIS

User and Installation Guide

Version 0.9.1 *'Ganymede'*

Preamble

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This document has been set with LaTeX . It is available as LaTeX source code and online as HTML and PDF document via `http://www.qgis.org`.

Translated versions of this document can be downloaded via the documentation area of the QGIS project as well. More information about this document and about translating it is available via: `http://wiki.qgis.org/qgiswiki/DocumentationWritersCorner`.

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Internet: http://www.qgis.org

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1. Forward

Welcome to the wonderful world of Geographical Information Systems (GIS)! Quantum GIS (QGIS) is an Open Source Geographic Information System. The project was born in May of 2002 and was established as a project on SourceForge in June of the same year. We've worked hard to make GIS software (which is traditionaly expensive commerical software) a viable prospect for anyone with basic access to a Personal Computer. QGIS currently runs on most Unix platforms, Windows, and OS X. QGIS is developed using the Qt toolkit (`http://www.trolltech.com`) and C++. This means that QGIS feels snappy to use and has a pleasing, easy to use graphical user interface.

QGIS aims to be an easy to use GIS, providing common functions and features. The initial goal was to provide a GIS data viewer. QGIS has reached that point in its evolution and is being used by many for their daily GIS data viewing needs. QGIS supports a number of raster and vector data formats, with new support easily added using the plugin architecture (see Appendix A for a full list of currenly supported data formats). QGIS is released under the GNU General Public License (GPL). Developing QGIS under this license means that you can inspect and modify the source code and guarantees that you, our happy user will always have access to a GIS program that is free of cost and can be freely modified. You should have received a full copy of the license with your copy of QGIS, and you also find it as Appendix I.

Note: The latest version of this document can always be found at
http://qgis.org/docs/userguide.pdf

1.1. Features

QGIS has many common GIS features and functions. The major features are listed below, devided into Core Features and Plugins.

Core Features

- Raster and vector support by the OGR library
- Support for spatially enabled PostgreSQL tables using PostGIS
- GRASS integration, including view, edit, and analysis
- Digitizing GRASS and OGR/Shapefile
- Map Composer
- OGC support

- Overview panel
- Spatial bookmarks
- Identify/Select features
- Edit/View/Search attributes
- Feature labeling
- On the fly projection
- Save and restore projects
- Export to Mapserver map file
- Change vector and raster symbology
- Extensible plugin architecture

Plugins

- Add WFS Layer
- Add Delimited Text Layer
- Decorations (Copyright Label, North Arrow and Scale bar)
- Georeferencer
- GPS Tools
- GRASS
- Graticule Creator
- PostgreSQL Geoprocessing functions
- SPIT Shapefile to PostgreSQL/PostGIS Import Tool
- Python Console
- openModeller

1.2. Whats New in 0.9

Version 0.9.0 brought some very interesting new features to you.

- Python language bindings to write plugins in Python and to create GIS enabled applications in Python that use the QGIS libraries
- Removed automake build system - QGIS now needs CMake for compilation
- Many new GRASS modules added to the GRASS toolbox
- Map Composer updates
- Fix for 2.5D shapefiles
- Improvements to the Georeferencer
- Localization support extended to 26 languages

QGIS 0.9.1 concentrates on stabilization and feature enhancement.

- 66 bugfixes and feature improvements
- New window arrangement feature for the Georeferencer
- New locale tab in the options dialog
- Download progress information for WMS and WFS data
- More GRASS modules added to the GRASS toolbox

2. Introduction To GIS

A Geographical Information System (GIS)(1)[1] is a collection of software that allows you to create, visualise, query and analyse geospatial data. Geospatial data refers to information about the geographic location of an entity. This often involves the use of a geographic coordinate, like a latitude or longitude value. Spatial data is another commonly used term, as are: geographic data, GIS data, map data, location data, coordinate data and spatial geometry data.

Applications using geospatial data perform a variety of functions. Map production is the most easily understood function of geospatial applications. Mapping programs take geospatial data and render it in a form that is viewable, usually on a computer screen or printed page. Applications can present static maps (a simple image) or dynamic maps that are customised by the person viewing the map through a desktop program or a web page.

Many people mistakenly assume that geospatial applications just produce maps, but geospatial data analysis is another primary function of geospatial applications. Some typical types of analysis include computing:

1. distances between geographic locations
2. the amount of area (e.g., square metres) within a certain geographic region
3. what geographic features overlap other features
4. the amount of overlap between features
5. the number of locations within a certain distance of another
6. and so on...

These may seem simplistic, but can be applied in all sorts of ways across many disciplines. The results of analysis may be shown on a map, but are often tabulated into a report to support management decisions.

The recent phenomena of location-based services promises to introduce all sorts of other features, but many will be based on a combination of maps and analysis. For example, you have a cell phone that tracks your geographic location. If you have the right software, your phone can tell you what kind of restaurants are within walking distance. While this is a novel application of geospatial technology, it is essentially doing geospatial data analysis and listing the results for you.

[1] This chapter is by Tyler Mitchell (`http://www.oreillynet.com/pub/wlg/7053`) and used under the Creative Commons License. Tyler is the author of *Web Mapping Illustrated*, published by O'Reilly, 2005.

2.1. Why is all this so new?

Well, it's not. There are many new hardware devices that are enabling mobile geospatial services. Many open source geospatial applications are also available, but the existence of geospatially focused hardware and software is nothing new. Global positioning system (GPS) receivers are becoming commonplace, but have been used in various industries for more than a decade. Likewise, desktop mapping and analysis tools have also been a major commercial market, primarily focused on industries such as natural resource management.

What is new, is how the latest hardware and software is being applied and who is applying it. Traditional users of mapping and analysis tools were highly trained GIS Analysts or digital mapping technicians trained to use CAD-like tools. Now, the processing capabilities of home PC's and open source software packages have enabled an army of hobbyists, professionals, web developers, etc. to interact with geospatial data. The learning curve has come down. The costs have come down. The amount of geospatial technology saturation has increased.

How is geospatial data stored? In a nutshell, there are two types of geospatial data in widespread use today. This is in additional to traditional tabular data that is also widely used by geospatial applications.

2.1.1. Raster Data

One type of geospatial data is called raster data or simply "a raster". The most easily recognised form of raster data is digital satellite imagery or air photos. Elevation shading or digital elevation models are also typically represented as raster data. Any type of map feature can be represented as raster data, but there are limitations.

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).

Multiple overlapping rasters are used to represent images using more than one colour value (i.e. one raster for each set of red, green and blue values is combined to create a colour image). Satellite imagery also represents data in multiple "bands". Each band is essentially a separate, spatially overlapping raster where each band holds values of certain wavelengths of light. As you can imagine, a large raster takes up more file space. A raster with smaller cells can provide more detail, but takes up more file space. The trick is finding the right balance between cell size for storage purposes and cell size for analytical or mapping purposes.

2.1.2. Vector Data

Vector data is also used in geospatial applications. If you stayed awake during trigonometry and coordinate geometry classes, you will already be familiar with some of the qualities of vector data. In its simplest sense, vectors are a way of describing a location by using a set of coordinates. Each coordinate refers to a geographic location using a system of x and y values.

This can be thought of in reference to a Cartesian plane - you know, the diagrams from school that showed an x and y-axis. You might have used them to chart declining retirement savings or increasing compound mortgage interest, but the concepts are essential to geospatial data analysis and mapping.

There are various ways of representing these geographic coordinates depending on your purpose. This is a whole area of study for another day - map projections.

Vector data takes on three forms, each progressively more complex and building on the former.

1. Points - A single coordinate (x y) represents the 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.

3. Getting Started

This chapter gives a quick overview of running QGIS with data available on the QGIS web page.

3.1. Installation

Building QGIS from source is documented in Appendix **??** for windows, Appendix **??** for Mac OSX and Appendix **??** for GNU/Linux. The Installation instructions are distributed with the QGIS source code and also available at `http://qgis.org`.

Standard installer packages are available for Windows and Mac OS X. For many flavors of GNU/Linux binary packages are provided. Get the latest information on binary packages at the QGIS website at `http://download.qgis.org`.

3.2. Sample Data

If you do not have any GIS data handy, you can obtain an Alaska dataset from the QGIS web site at `http://qgis.org`. The projection for the data is Alaska Albers Equal Area with unit meter:

```
PROJCS["NAD_1927_Albers",
    GEOGCS["GCS_North_American_1927",
DATUM ["D_North_American_1927",
     SPHEROID["Clarke_1866", 6378206.4,294.9786982]],
     PRIMEM["Greenwich",0.0],
     UNIT["Degree", 0.0174532925199433]],
    PROJECTION["Albers"],
    PARAMETER["False_Easting", 0.0],
    PARAMETER["False_Northing",0.0],
    PARAMETER["Central_Meridian",-154.0],
    PARAMETER["Standard_Parallel_1", 55.0],
    PARAMETER["Standard_Parallel_2",65.0],
    PARAMETER ["Latitude_Of_Origin",50.0],
    UNIT["Meter",1.0]]
```

For use with GRASS, a sample GRASS database (e.g. Spearfish) can be obtained from the official GRASS GIS-website `http://grass.itc.it/download/data.php`. The projection of the Spearfish dataset is UTM Zone 13, Northern Hemisphere:

```
PROJCS["UTM Zone 13, Northern Hemisphere",
```

```
    GEOGCS["clark66",
        DATUM["North_American_Datum_1927",
            SPHEROID["clark66",6378206.4,294.9786982]],
        PRIMEM["Greenwich",0],
        UNIT["degree",0.0174532925199433]],
    PROJECTION["Transverse_Mercator"],
    PARAMETER["latitude_of_origin",0],
    PARAMETER["central_meridian",-105],
    PARAMETER["scale_factor",0.9996],
    PARAMETER["false_easting",500000],
    PARAMETER["false_northing",0],
    UNIT["meter",1]]
```

These data sets will be used as a basis for many of the examples and screenshots in this document.

3.3. Starting QGIS

Assuming that QGIS is installed in the PATH, you can start QGIS by typing: **qgis** at a command prompt or by double clicking on the QGIS application link (or shortcut) on the desktop. Under MS Windows, start QGIS using the Start menu shortcut, and under Mac OS X, double click the icon in your Applications folder.

3.3.1. Command Line Options

QGIS supports a number of options when started from the command line. To get a list of the options, enter `qgis --help` on the command line. The usage statement for QGIS is:

```
qgis --help
Quantum GIS - 0.9.0 'Ganymede'
Quantum GIS (QGIS) is a viewer for spatial data sets, including
raster and vector data.
Usage: qgis [options] [FILES]
  options:
        [--snapshot filename]   emit snapshot of loaded datasets to given file
        [--lang language]       use language for interface text
        [--project projectfile] load the given QGIS project
        [--extent xmin,ymin,xmax,ymax]  set initial map extent
        [--help]                this text

  FILES:
    Files specified on the command line can include rasters,
```

```
vectors, and QGIS project files (.qgs):
 1. Rasters - Supported formats include GeoTiff, DEM
    and others supported by GDAL
 2. Vectors - Supported formats include ESRI Shapefiles
    and others supported by OGR and PostgreSQL layers using
    the PostGIS extension
```

Tip 1 EXAMPLE USING COMMAND LINE ARGUMENTS

You can start QGIS by specifying one or more data files on the command line. For example, assuming you are in your data directory, you could start QGIS with two shapefiles and a raster file set to load on startup using the following command: `qgis ak_shade.tif alaska.shp majrivers.shp`

Command line option `--snapshot`

This option allows you to create a snapshot in PNG format from the current view. This comes in handy when you have a lot of projects and want to generate snapshots from your data.

Currently it generates a PNG-file with 800x600 pixels. A filename can be added after `--snapshot`.

Command line option `--lang`

Based on your locale QGIS, selects the correct localization. If you like to change your language, you can provide another language with this option.

Command line option `--project`

Starting QGIS with an existing project file is also possible. Just add the command line option `-project` followed by your project name and QGIS will open with all layers loaded described in the given file.

Command line option `--extent`

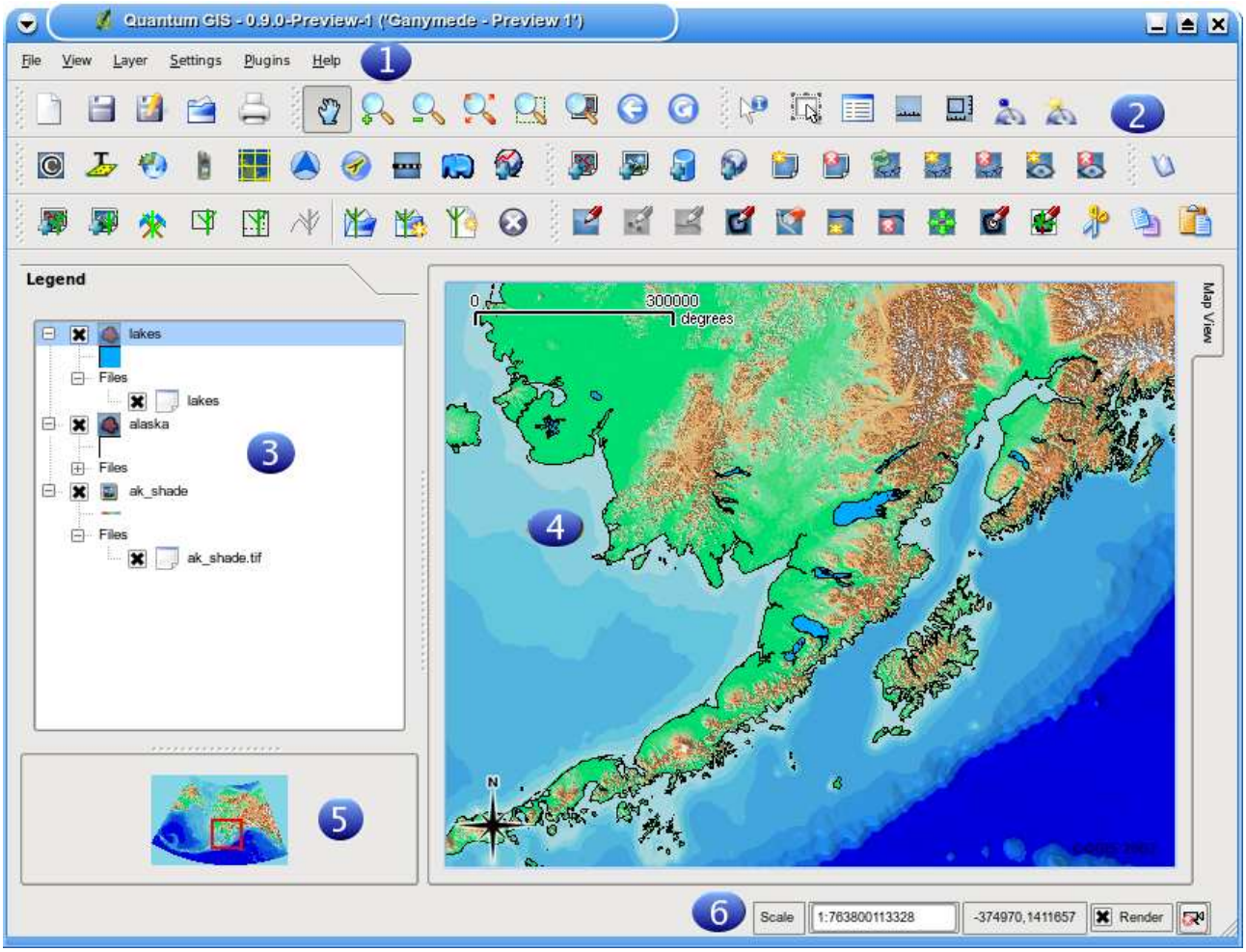
To start with a specific map extent use this option. You need to add the bounding box of your extent in the following order separated by a comma:

```
--extent xmin,ymin,xmax,ymax
```

3.4. QGIS GUI

When QGIS starts, you are presented with the GUI as shown below (the numbers 1 through 6 in blue ovals refer to the six major areas of the interface as discussed below):

Figure 1: Main window with alaska sample data (GNU/Linux with KDE)



Note: Your window decorations (title bar, etc.) may appear different depending on your operating system and window manager.

The QGIS GUI is divided into six areas:

1. Menu Bar
2. Tool Bar
3. Map Legend
4. Map View
5. Map Overview
6. Status Bar

These six components of the QGIS interface are described in more detail in the following sections.

3.4.1. Menu Bar

The menu bar provides access to various QGIS features using a standard hierarchical menu. The top-level menus and a summary of some of the functions provided are:

- **File**
  - **New Project** - see Section 3.7
  - **Open Project** - see Section 3.7
  - **Open Recent Projects** - see Section 3.7
  - **Save Project** - see Section 3.7
  - **Save Project As** - see Section 3.7
  - Save as Image
  - Export to MapServer Map - see Section 9
  - Print - see Section 10
  - Exit
- **View**
  - Zoom Full
  - Zoom To Selection
  - Zoom To Layer
  - Zoom Last
  - Refresh
  - Show Bookmarks
  - New Bookmark
  - Show most toolbars
  - Hide most toolbars
  - Toolbar Visibility
- **Layer**
  - **Add a Vector Layer** - see Section 4
  - **Add a Raster Layer** - see Section 5
  - **Add a PostGIS Layer** - see Section 4.2
  - **Add a WMS Layer** - see Section 6.2
  - Remove Layer
  - New Vector Layer - see Section 4.4.3

  - In Overview
  - Add All To Overview
  - Remove All From Overview
  - Hide All Layers
  - Show All Layers
- **Settings**
  - **Project Properties** - see Section 3.7
  - **Custom Projection** - see Section 7.3
  - **Options** - see Section 3.8
- **Plugins** - (Futher menu items are added by plugins as they are loaded.)
  - Plugin Manager - see Section 11.1.2
- **Help**
  - Help Contents
  - QGIS Homepage
  - Check QGIS Version
  - About

3.4.2. Toolbars

The toolbars provide access to most of the same functions as the menus, plus additional tools for interacting with the map. Each toolbar item has popup help available. Hold your mouse over the item and a short description of the tool's purpose will be displayed.

Every menubar can be moved around according to your needs. Additionally every menubar can be switched off using your right mouse button context menu holding the mouse over the toolbars.

Tip 2 REAPPEARING TOOLBARS

If you have accidentally hidden all your toolbars, you can get them back by choosing `Show most toolbars` from the View|Toolbars menu.

3.4.3. Map Legend

The map legend area is used to set the visibility and z-ordering of layers. Z-ordering means that layers listed nearer the top of the legend are drawn over layers listed lower down in the legend. The checkbox in each legend entry can be used to show or hide the layer.

Layers can be grouped in the legend window by adding a layer group and dragging layers into the group. To do so, go with the mouse to the legend window, right click, choose 'Add group'. A new folder appears. Now drag the layers to the folder symbol. It is then possible to toggle the visibility of all the layers in the group with one click. To bring layers out of a group, go with the mouse to the layer symbol, right click, choose 'Make to toplevel item'. To give the folder a new name, choose 'Rename' in the right click menu of the group.

The content of the right mouse button context menu depends on if the loaded legend item you hold your mouse over is a raster or a vector layer. For GRASS vector layers the 'toggle editing' is not available. See section 8.5 for infos on editing GRASS vector layers.

- **Right mouse button menue for raster layers**
  - Zoom to layer extend
  - Zoom to best scale (100%)
  - Show in overview
  - Remove
  - Properties
  - Rename
  - Add Group
  - Expand all
  - Collapse all
  - Show file groups
- **Right mouse button menue for vector layers**
  - Zoom to layer extend
  - Show in overview
  - Remove
  - Open attribute table
  - Toggle editing (not available for GRASS layers)
  - Save as shapefile
  - Save selection as shapefile
  - Properties
  - Rename
  - Add Group
  - Expand all
  - Collapse all

  - Show file groups

- **Right mouse button menue for layer groups**
  - Remove
  - Rename
  - Add Group
  - Expand all
  - Collapse all
  - Show file groups

If several vector data sources have the same vector type and the same attributes, their symbolisations may be grouped. This means that if the symbolisation of one data source is changed, the others automatically have the new symbolisation as well. To group symbologies, open the right click menu in the legend window and choose 'Show file groups'. The file groups of the layers appear. It is now possible to drag a file from one file group into another one. If this is done, the symbologies are grouped. Note that QGIS only permits the drag if the two layers are able to share symbology (same vector type and same attributes).

3.4.4. Map View

This is the 'business end' of QGIS - maps are displayed in this area! The map displayed in this window will depend on the vector and raster layers you have chosen to load (see sections that follow for more information on how to load layers). The map view can be panned (shifting the focus of the map display to another region) and zoomed in and out. Various other operations can be performed on the map as described in the toolbar description above. The map view and the legend are tightly bound to each other - the maps in view reflect changes you make in the legend area.

Tip 3 ZOOMING THE MAP WITH THE MOUSE WHEEL

You can use the mouse wheel to zoom in and out on the map. Place the mouse cursor inside the map area and roll it forward (away from you) to zoom in and backwards (towards you) to zoom out. The mouse cursor is the center where the zoom occurs. You can customize the behavior of the mouse wheel zoom using the `Map tools` tab under the Settings|Options menu.

3.4.5. Map Overview

The map overview area provides a full extent view of layers added to it. Within the view is a rectangle showing the current map extent. This allows you to quickly determine which area of the map you are currently viewing. Note that labels are not rendered to the map overview even if the layers in the map overview have been set up for labeling. You can add a single layer to the overview by right-clicking on

it in the legend and choosing *Add to overview*. You can also add or remove all layers to the overview using the Overview tools on the toolbar.

You can also grab the red rectangle showing your current extent and pan around; the map view will update accordingly.

3.4.6. Status Bar

The 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. The status bar also shows the view extents of the map view as you pan and zoom in and out. A progress bar in the status bar shows progress of rendering as each layer is drawn to the map view. In some cases, such as the gathering of statistics in raster layers, the progress bar will be used to show the status of lengthy operations. On the right side of the status bar is a small checkbox which can be used to temporarily prevent layers being rendered to the map view (see Section 3.5 below). At the far right of the status bar is a projector icon. Clicking on this opens the projection properties for the current project.

3.5. Rendering

By default, QGIS renders all visible layers whenever the map canvas must be refreshed. The events that trigger a refresh of the map canvas include:

- Adding a layer
- Panning or zooming
- Resizing the QGIS window
- Changing the visibility of a layer or layers

QGIS allows you to control the rendering process in a number of ways.

3.5.1. Scale Dependent Rendering

Scale dependent rendering allows you to specify the minimum and maximum scales at which a layer will be visible. To set scale dependency rendering, open the properties dialog by double-clicking on the layer in the legend. On the *General* tab, set the minimum and maximum scale values and then click on the *Use scale dependent rendering* checkbox.

You can determine the scale values by first zooming to the level you want to use and noting the scale value in the QGIS status bar.

3.5.2. Controlling Map Rendering

Map rendering can be controlled in the following ways:

Suspending Rendering

To suspend rendering, click the *Render* checkbox in the lower right corner of the statusbar. When the *Render* box is not checked, QGIS does not redraw the canvas in response to any of the events described in Section 3.5. Examples of when you might want to suspend rendering include:

- Add many layers and symbolize them prior to drawing
- Add one or more large layers and set scale dependency before drawing
- Add one or more large layers and zoom to a specific view before drawing
- Any combination of the above

Checking the *Render* box enables rendering and causes and immediate refresh of the map canvas.

Setting Layer Add Option

You can set an option to always load new layers without drawing them. This means the layer will be added to the map, but its visibility checkbox in the legend will be unchecked by default. To set this option, choose *Options* from the *Settings* menu and click on the *Rendering* tab. Check the *New layers added to the map are not displayed* checkbox. Any layer added to the map will be off (invisible) by default.

Updating the Map Display During Rendering

You can set an option to update the map display as features are drawn. By default, QGIS does not display any features for a layer until the entire layer has been rendered. To update the display as features are read from the datastore, choose *Options* from the *Settings* menu and click on the *Rendering* tab. Set the feature count to an appropriate value to update the display during rendering. Setting a value of 0 disables update during drawing (this is the default). Setting a value too low will result in poor performance as the map canvas is continually updated during the reading of the features. A suggested value to start with is 500.

3.6. Measuring

Measuring works within projected coordinate systems only (e.g., UTM). If the loaded map is defined with a geographic coordinate system (latitude/longitude), the results from line or area measurements will be incorrect. To fix this you need to set an appropriate map coordinate system.

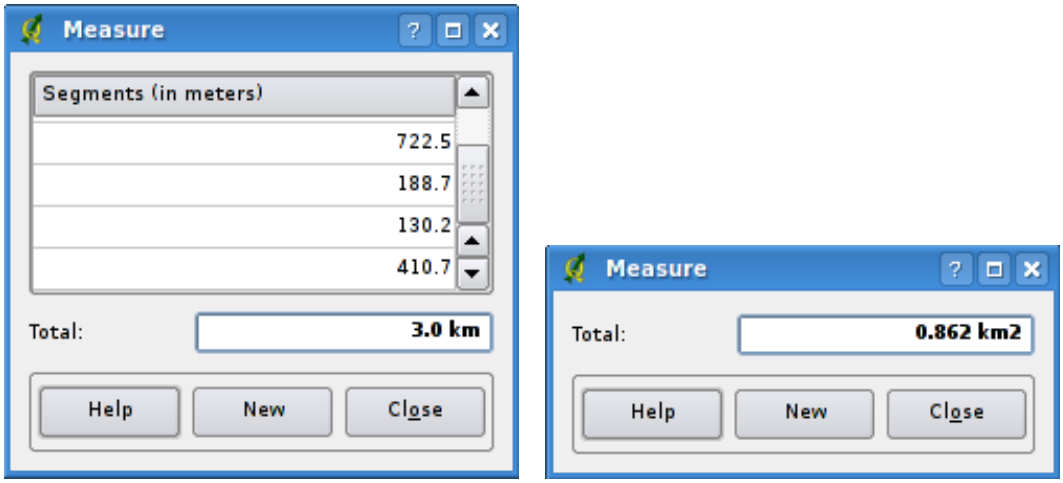
3.6.1. Measure length

 QGIS is also able to measure real distances between given points according to a defined ellipsoid. Therefore choose *Options* from the *Settings* menu, click on the *Map tools* tab and choose the appropriate ellipsoid. The tool then allows you to click points on the map. Each segment-length shows up in the measure-window and additionaly the total length is printed. To stop measuring click your right mouse button.

3.6.2. Measure areas

 Also areas can be measured. The window only shows the accumulated area-size in the measure window (see figure 2).

Figure 2: Measure tools in action



(a) Measure lines (b) Measure areas

3.7. Projects

The state of your QGIS session is considered a Project. QGIS works on one project at a time. Settings are either considered as being per-project, or as a default for new projects (see Section 3.8).

QGIS can save the state of your workspace into a project file using the menu option *File->Save Project*.

Loading saved projects is a similar process.

The kinds of information saved in a project file include:

- Layers added
- Layer properties, including symbolization
- Projection for the map view
- Last viewed extent

The project file is saved in XML format, so it is possible to edit the file outside QGIS if you know what you are doing.

The file format was updated several times compared to earlier QGIS versions. Project files from older QGIS versions may not work properly anymore.

3.8. GUI Options

 Some basic options for QGIS can be selected using the Options dialog. Select the *Settings* entry from the menu and choose *Options* (Alt-O). The tabs where you can optmize your options are:

General Tab

- ask to save project changes when required

Appearance Tab

- Hide or show splash screen at startup
- Change the icon theme
- Change Selection and backgroud Color
- Make layer names appear with Capitals

Rendering Tab

- Update features during drawing or not until all features have been read.
- Set new layer visible or unvisible when loaded
- Make lines appear less jagged at the expense of some drawing performance
- Fix problems with incorrectly filled polygons
- Continously redraw when dragging the legend/map divider

Map tools Tab

- Define Search Radius as a percentage of the map width
- Define Ellipsoid for distance calculations
- Set Rubberband Color for Measure Tool
- Define Mouse wheel action (Zoom, Zoom and recenter, Nothing)
- Set Zoom factor for wheel mouse

Projection Tab

- Define what to do, when a layer is loaded without projection information
  - Prompt for projection
  - Project wide default projection will be used
  - Global default projection displayed below will be used

Locale Tab

- Overwrite system locale and use defined locale instead
- Information about active system locale

Help Browser Tab

- Define Browser to display help documents

You can modify the options according to your needs. Some of the changes may require a restart of QGIS before they will be effective.

On GNU/Linux everything is saved in:

```
$HOME/.config/QuantumGIS/qgis.conf
```

This is a normal text file consisting of blocks, where QGIS saves its current display options, PostGIS and WMS connections, and other settings.

On Windows settings are stored in the registry under:

```
\\HKEY_CURRENT_USER\Software\QuantumGIS\qgis
```

On OS X you can find your settings in:

```
$HOME/Library/Preferences/org.qgis.qgis.plist
```

3.9. Spatial Bookmarks

Spatial Bookmarks allow you to “bookmark” a geographic location and return to it later.

3.9.1. Creating a Bookmark

To create a bookmark:

1. Zoom or pan to the area of interest.
2. Select the menu option *View->New Bookmark* or type Ctrl-B.
3. Enter a descriptive name for the bookmark (up to 255 characters).
4. Click *OK* to add the bookmark or *Cancel* to exit without adding the bookmark.

Note that you can have multiple bookmarks with the same name.

3.9.2. Working with Bookmarks

To use or manage bookmarks, select the menu option *View->Show Bookmarks*. The bookmarks dialog allows you to zoom to or delete a bookmark. You can not edit the bookmark name or coordinates.

3.9.3. Zooming to a Bookmark

From the Bookmarks dialog, select the desired bookmark by clicking on it, then click the *Zoom To* button. You can also zoom to a bookmark by double-clicking on it.

3.9.4. Deleting a Bookmark

To delete a bookmark from the Bookmarks dialog, click on it then click the *Delete* button. Confirm your choice by clicking *Yes* or cancel the delete by clicking *No*.

4. Working with Vector Data

QGIS supports vector data in a number of formats, including those supported by the OGR library data provider plugin, such as ESRI shapefiles, MapInfo MIF (interchange format) and MapInfo TAB (native format). QGIS also supports PostGIS layers in a PostgreSQL database using the PostgreSQL data provider plugin. Support for additional data types (eg. delimited text) is provided by additional data provider plugins.

This section describes how to work with two common formats: ESRI shapefiles and PostGIS layers. Many of the features available in QGIS work the same regardless of the vector data source. This is by design and includes the identify, select, labeling, and attributes functions.

Working with GRASS vector data is described in Section 8.

4.1. ESRI Shapefiles

ESRI Shapefile support is provided by a library of functions known as the OGR Simple Feature Library `http://www.gdal.org/ogr`. See Appendix A.1 for a list of all supported formats in OGR.

A shapefile actually consists of a minimum of three files:

- .shp file containing the feature geometries
- .dbf file containing the attributes in dBase format
- .shx index file

Ideally it comes with another file with a .prj suffix. This describes the projection information for the shapefile.

There can be more files belonging to a shapefile dataset. To have a closer look at this we recommend the technical specification for the shapefile format. This can be found at
`http://www.esri.com/library/whitepapers/pdfs/shapefile.pdf` .

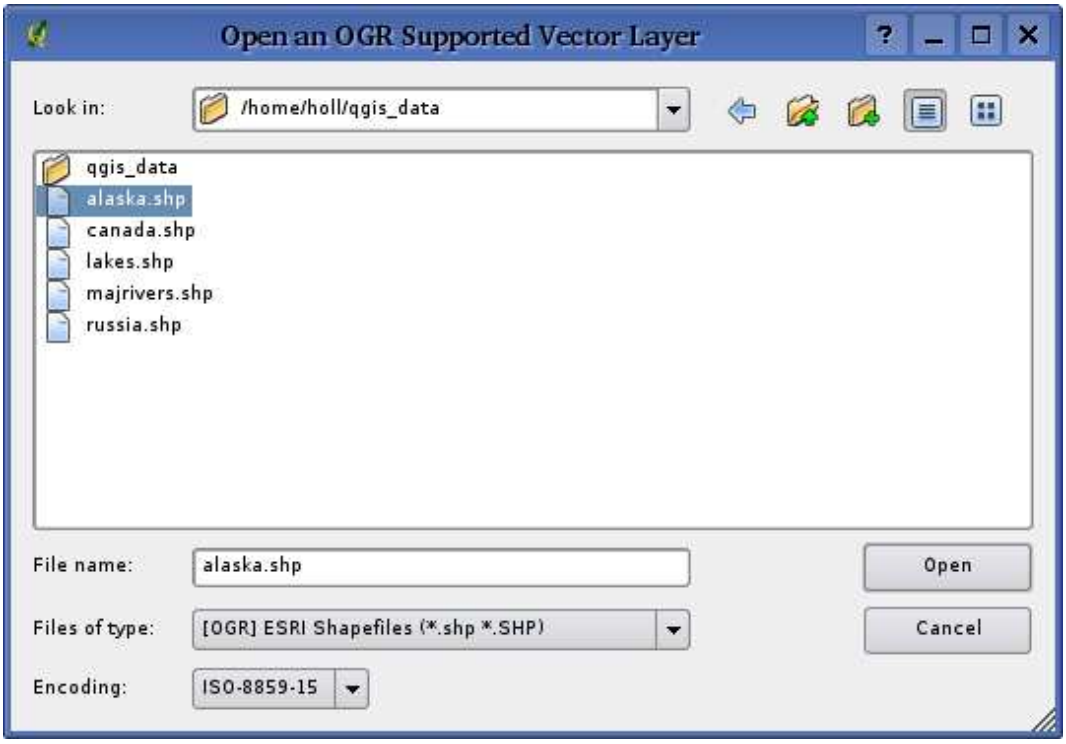
4.1.1. Loading a Shapefile

 To load a shapefile, start QGIS and click on the *Add a vector layer* toolbar button. This same tool can be used to load any of the formats supported by the OGR library.

Clicking on the tool brings up a standard open file dialog (see Figure 3) which allows you to navigate the file system and load a shapefile or other supported data source. The selection box *File of type* allows you to preselect some OGR supported file formats.

You can also select the Encoding type for the shapefile if desired.

Figure 3: Open OGR Data Source Dialog



Selecting a shapefile from the list and clicking OK loads it into QGIS. Figure 4 shows QGIS after loading the alaska.shp file.

Tip 4 LAYER COLORS

When you add a layer to the map, it is assigned a random color. When adding more than one layer at a time, different colors are assigned to each.

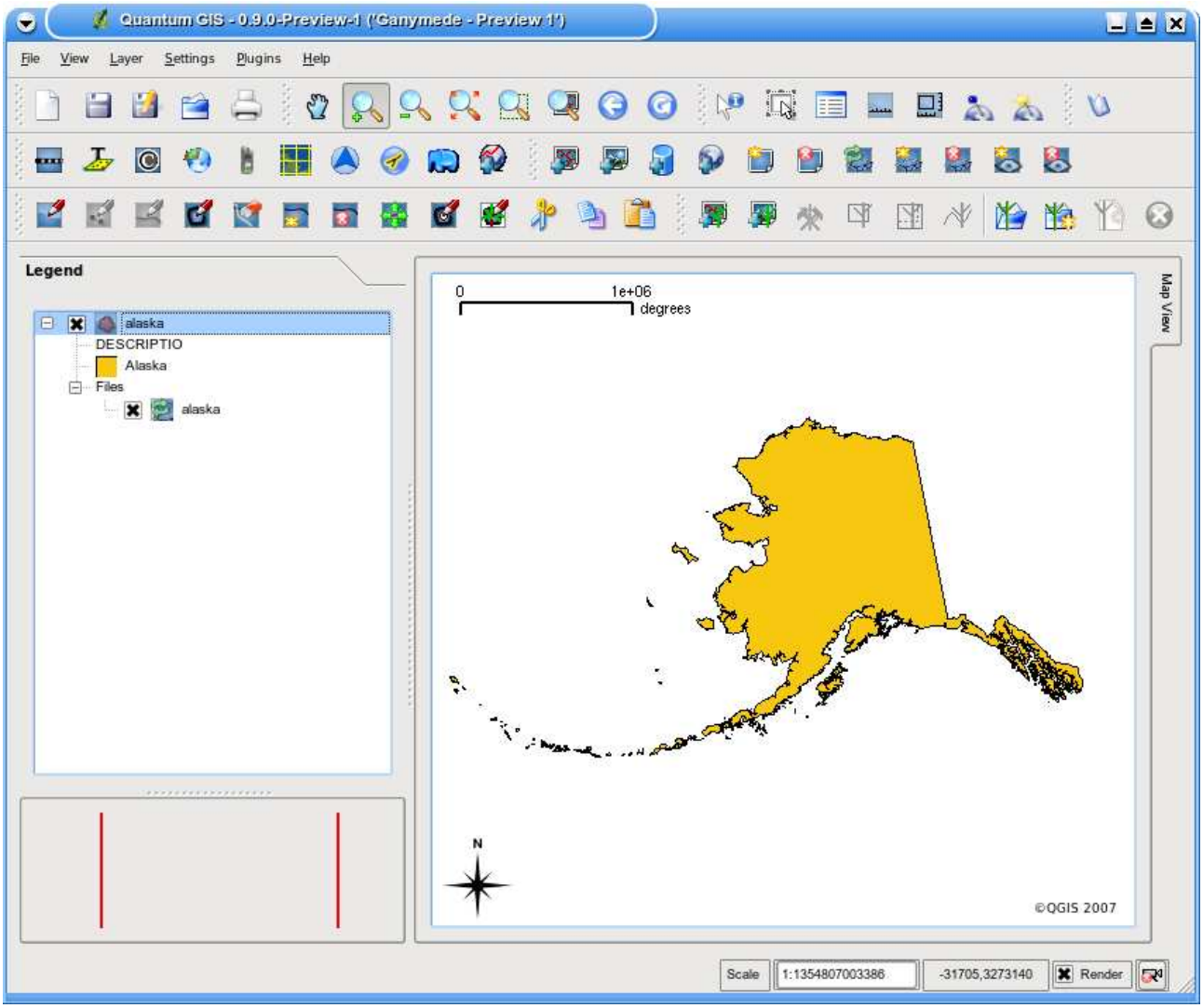
Once loaded, you can zoom around the shapefile using the map navigation tools. To change the symbology of a layer, open the layer properties dialog by double clicking on the layer name or by right-clicking on the name in the legend and choosing *Properties* from the popup menu. See Section 4.3.1 for more information on setting symbology of vector layers.

4.1.2. Improving Performance

To improve the performance of drawing a shapefile, you can create a spatial index. A spatial index will improve the speed of both zooming and panning. Spatial indexes used by QGIS have a *.qix* extension.

Use these steps to create the index:

Figure 4: QGIS with Shapefile of Alaska loaded



- Load a shapefile
- Open the *Layer Properties* dialog by double-clicking on the shapefile name in the legend or by right-clicking and choosing *Properties* from the popup menu.
- In the tab *General* click the *Create* button on the Spatial Index panel

4.1.3. Loading a MapInfo Layer

To load a MapInfo layer, click on the *Add a vector layer* toolbar bar button and change the file type filter to *MapInfo (*.mif *.tab *.MIF *.TAB)* and select the layer you want to load.

4.1.4. Loading an ArcInfo Coverage

Loading an an ArcInfo coverage is done using the same method as with a shapefiles and MapInfo layers. Click on the *Add a vector layer* toolbar button to open the layer dialog and change the file type filter to *All files (*.*)*. Navigate to the coverage directory and select one of the following files (if present in your coverage)

- .lab - to load a label layer (polygon labels, or standing points
- .cnt - to load a polygon centroid layer
- .arc - to load an arc (line) layer
- .pal - to load a polygon layer

4.2. PostGIS Layers

PostGIS layers are stored in a PostgreSQL database. The advantage of PostGIS is the spatial indexing, filtering, and query capability. Using PostGIS, vector functions such as select and identify work more accurately than with OGR layers in QGIS.

To use PostGIS layers you must:

- Create a stored connection in QGIS to the PostgreSQL database (if one is not already defined)
- Connect to the database
- Select the layer to add to the map
- Optionally provide a SQL *where* clause to define which features to load from the layer
- Load the layer

4.2.1. Creating a stored Connection

 The first time you use a PostGIS data source, you must create a connection to the PostgreSQL database that contains the data. Begin by clicking on the *Add a PostGIS Layer* toolbar button. The *Add PostGIS Table(s)* dialog will be displayed. To access the connection manager, click on the *New* button to display the *Create a New PostGIS Connection* dialog. The parameters required for a connection are shown in Table 1.

Once the parameters have been filled in, you can test the connection by clicking on the *Test Connection* button. To save the password with the connection information, check the *Save Password* option.

Table 1: PostGIS Connection Parameters

Name	A name for this connection. Can be the same as *Database*
Host	Name of the database host. This must be a resolvable host name the same as would be used to open a telnet connection or ping the host
Database	Name of the database
Port	Port number the PostgreSQL database server listens on. The default port is 5432.
Username	User name used to login to the database
Password	password used with *Username* to connect to the database

Tip 5 QGIS USER SETTINGS AND SECURITY

Your customized settings for QGIS are stored based on the operating system. On Linux/Unix, the settings are stored in your home directory in .qt/qgisrc. On Windows, the settings are stored in the registry. Depending on your computing environment, storing passwords in your QGIS settings may be a security risk.

4.2.2. Loading a PostGIS Layer

 Once you have one or more connections defined, you can load layers from the PostgreSQL database. Of course this requires having data in PostgreSQL. See Section 4.2.4 for a discussion on importing data into the database.

To load a layer from PostGIS, perform the following steps:

- If the PostGIS layer dialog is not already open, click on the *Add a PostGIS Layer* toolbar button
- Choose the connection from the drop-down list and click *Connect*
- Find the layer you wish to add in the list of available layers
- Select it by clicking on it. You can select multiple layers by holding down the shift key while clicking. See Section 4.5 for information on using the PostgreSQL Query Builder to further define the layer.
- Click on the *Add* button to add the layer to the map

Tip 6 POSTGIS LAYERS

Normally a PostGIS layer is defined by an entry in the geometry_columns table. From version 0.8.1 on, QGIS can load layers that do not have an entry in the geometry_columns table. This includes both tables and views. Defining a spatial view provides a powerful means to visualize your data. Refer to your PostgreSQL manual for information on creating views.

4.2.3. Some details about PostgreSQL layers

This section contains some details on how QGIS accesses PostgreSQL layers. Most of the time QGIS should simply provide you with a list of database tables that can be loaded, and load them on request. However, if you have trouble loading a PostgreSQL table into QGIS, the information below may help you understand any QGIS messages and give you direction on changing the PostgreSQL table or view definition to allow QGIS to load it.

QGIS requires that PostgreSQL layers contain a column that can be used as a unique key for the layer. For tables this usually means that the table needs a primary key, or have a column with a unique constraint on it. QGIS additionally requires that this column be of type int4 (an integer of size 4 bytes). If a table lacks these items, the oid column will be used instead. Performance will be improved if the column is indexed (note that primary keys are automatically indexed in PostgreSQL).

If the PostgreSQL layer is a view the same requirements exist, but views don't have primary keys or columns with unique constraints on them. In this case QGIS will try to find a column in the view that is derived from a table column that is suitable. If one cannot be found, QGIS will not load the layer. If this occurs, the solution is to alter the view so that it does include a suitable column (a type of int4 and either a primary key or with a unique constraint, preferably indexed).

4.2.4. Importing Data into PostgreSQL

shp2pgsql

Data can be imported into PostgreSQL using a number of methods. PostGIS includes a utility called *shp2pgsql* that can be used to import shapefiles into a PostGIS enabled database. For example, to import a shapefile named lakes into a PostgreSQL database named gis_data, use the following command:

```
shp2pgsql -s 2964 lakes.shp lakes_new | psql gis_data
```

This creates a new layer named lakes_new in the the gis_data database. The new layer will have a spatial reference identifier (SRID) of 2964. See Section 7 for more information on spatial reference systems and projections.

Tip 7 EXPORTING DATASETS FROM POSTGIS

Like the import-tool *shp2pgsql* there is also a tool to export PostGIS-datasets into shapefiles: *pgsql2shp*. This is shipped within your PostGIS distribution.

SPIT Plugin

 QGIS comes with a plugin named SPIT (Shapefile to PostGIS Import Tool). SPIT can be used to load multiple shapefiles at one time and includes support for schemas. To use SPIT, open the Plugin Manager from the Tools menu and load the plugin by checking the box next to the SPIT plugin and click Ok. The SPIT icon will be added to the plugin toolbar.

To import a shapefile, click on the SPIT tool in the toolbar to open the dialog. You can add one or more files to the queue by clicking on the *Add* button. To process the files, click on the Import button. The progress of the import as well as any errors/warnings will be displayed as each shapefile is processed.

Tip 8 IMPORTING SHAPEFILES CONTAINING POSTGRESQL RESERVED WORDS

If a shapefile is added to the queue containing fields that are reserved words in the PostgreSQL database a dialog will popup showing the status of each field. You can edit the field names prior to import and change any that are reserved words (or change any other field names as desired). Attempting to import a shapefile with reserved words as field names will likely fail.

ogr2ogr

Beside *shp2pgsql* and *SPIT* there is another tool for feeding geodata in PostGIS: *ogr2ogr*. This is part of your GDAL installation. To import a shapefile into PostGIS, do the following:

```
ogr2ogr -f "PostgreSQL" PG:"dbname=postgis host=myhost.de user=postgres \
password=topsecret" alaska.shp
```

This will import the shapefile alaska.shp into the PostGIS-database *postgis* using the user *postgres* with the password *topsecret* on host *myhost.de*.

Note that OGR must be built against PostgreSQL to support PostGIS. You can see this by typing

```
ogrinfo --formats | grep -i post
```

4.2.5. Improving Performance

Retrieving features from a PostgreSQL database can be time consuming, especially over a network. You can improve the drawing performance of PostgreSQL layers by ensuring that a spatial index exists on each layer in the database. PostGIS supports creation of a GiST (Generalized Search Tree) index to speed up spatial searches of the data.

The syntax for creating a GiST[2] index is:

[2] GiST index information is taken from the PostGIS documentation available at http://postgis.refractions.net

```
CREATE INDEX [indexname] ON [tablename]
  USING GIST ( [geometryfield] GIST_GEOMETRY_OPS );
```

Note that for large tables, creating the index can take a long time. Once the index is created, you should perform a *VACUUM ANALYZE*. See the PostGIS documentation (4) for more information.

The following is an example of creating a GiST index:

```
gsherman@madison:~/current$ psql gis_data
Welcome to psql 8.0.0, the PostgreSQL interactive terminal.

Type:  \copyright for distribution terms
       \h for help with SQL commands
       \? for help with psql commands
       \g or terminate with semicolon to execute query
       \q to quit

gis_data=# CREATE INDEX sidx_alaska_lakes ON alaska_lakes
gis_data-# USING GIST (the_geom GIST_GEOMETRY_OPS);
CREATE INDEX
gis_data=# VACUUM ANALYZE alaska_lakes;
VACUUM
gis_data=# \q
gsherman@madison:~/current$
```

4.3. The Vector Properties Dialog

The vector properties dialog provides information about a layer, symbology settings, and labeling options. If your vector layer has been loaded from a PostgreSQL / PostGIS datastore, you can also alter the underlying SQL for the layer - either by hand editing the SQL on the *General* tab, or by invoking the query builder dialog on the *General* tab. To access the properties dialog, double-click on a layer in the legend or right-click on the layer and select Properties from the popup menu.

4.3.1. Symbology Tab

QGIS supports a number of symbology renderers to control how vector features are displayed. Currently the following renderers are available:

Single symbol - a single style is applied to every object in the layer.

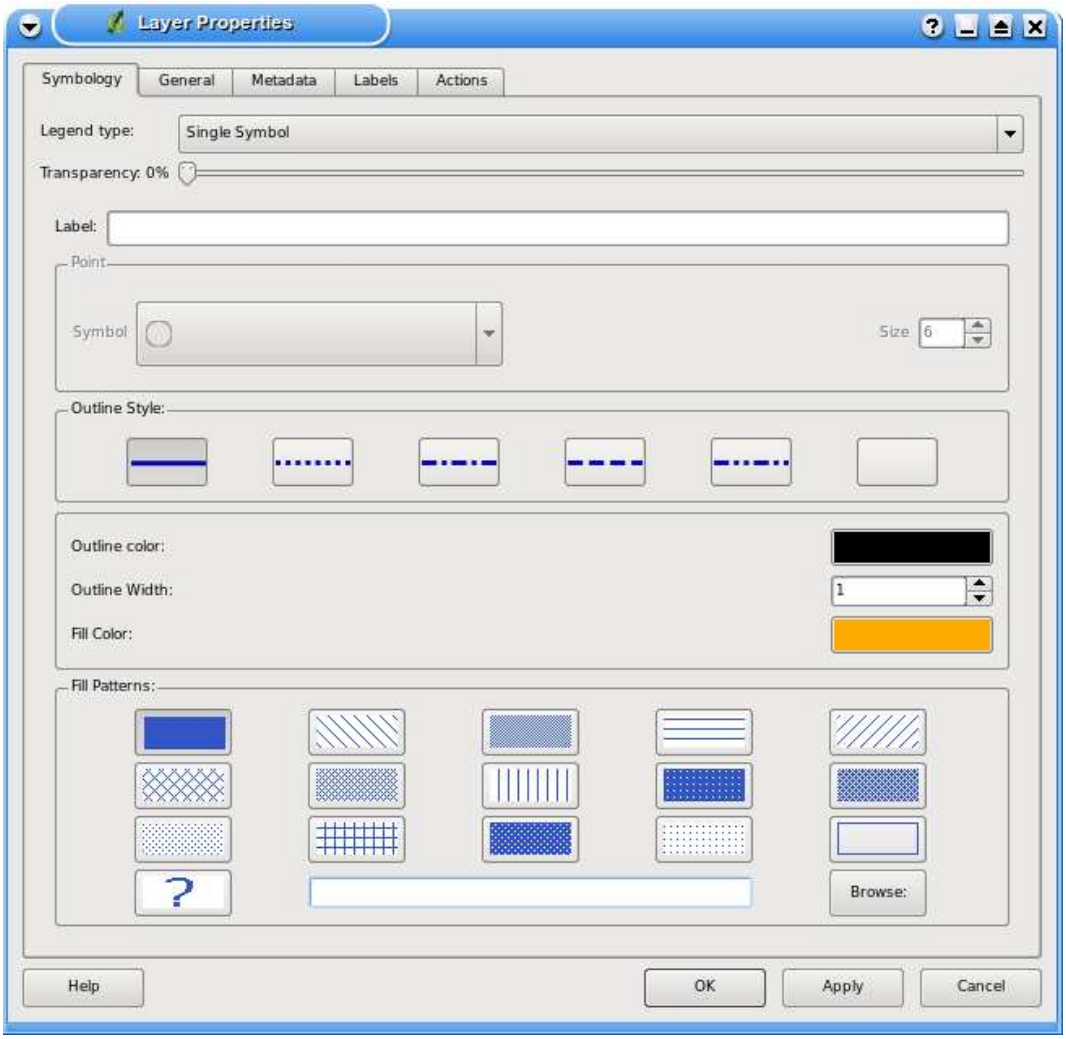
Graduated symbol - objects within the layer are displayed with different symbols classified by the values of a particular field.

Continuous colour - objects within the layer are displayed with a spread of colours classified by the numerical values within a specified field.

Unique value - objects are classified by the unique values within a specified field with each value having a different symbol.

To change the symbology for a layer, simply double click on its legend entry and the vector layer properties dialog will be shown..

Figure 5: Vector Layer Properties Dialog



New in v0.9 is a function to use image files stored on your computer as fill pattern for vector-layers.

Vector transparency

QGIS 0.9.1 allows to set a transparency for every vector layer. This can be done with the slider right below the legend type (see fig. 5). This is very useful for overlaying several vector layers.

4.3.2. General Tab

The General tab is essentially like that of the raster dialog. It allows you to change the display name, set scale dependent rendering options, create a spatial index of the vector file (only for OGR supported formats and PostGIS), and view or change the projection.

The *Query Builder* button allows you to create a subset of the features in the layer - but this button currently only is available when you open the attribute table and select the *Advanced ...* button.

4.3.3. Metadata Tab

The Metadata tab contains information about the layer, including specifics about the type and location, number of features, feature type, and the editing capabilities. The projection and attribute fields and their data type are displayed on this tab. This is a quick way to get information about the layer.

4.3.4. Labels Tab

The Labels tab allows you to enable labeling features and control a number of options related to placement, style, and buffering.

We will illustrate this by labelling the lakes shapefile of the qgis_example_dataset:

1. Load the shapefiles alaska.shp and lakes.shp in QGIS
2. Zoom in a bit to your favorite area with some lakes
3. Make the *lakes* layer active
4. Open the properties dialog
5. Click on the “Labels” tab
6. Check the “Display labels” checkbox to enable labeling
7. Choose the field to label with. We’ll use *NAMES*
8. Enter a default for lakes that have no name. The default label will be used each time QGIS encounters a lake with no value in the *NAMES* field.

9. Click *Apply*

Now we have labels. How do they look? They are probably too big and poorly placed in relation to the marker symbol for the lakes.

Click on the “Font Style” tab and use the *Font* and *Colour* buttons to set the font and color.

To change the position of the font relative to the feature:

1. Click on the “Font Alignment” tab
2. Change the placement by selecting one of the radio buttons in the “Placement” group. To fix our labels, choose the “Right” radio button.
3. Click *Apply* to see your changes without closing the dialog

Things are looking better, but the label is still too close to the marker. To fix this we can use the options on the “Position” tab. Here we can add offsets for the X and Y directions. Adding an X offset of 5 will move our labels off the marker and make them more readable. Of course if your marker symbol or font is larger, more of an offset will be required.

The last adjustment we’ll make is to “buffer” the labels. This just means putting a backdrop around them to make them stand out better. To buffer the lakes labels:

1. Click the “Buffer” tab
2. Click the “Buffer Labels?” checkbox to enable buffering
3. Choose a size for the buffer using the spin box
4. Choose a color by clicking on *Colour* and choosing your favorite from the color selector
5. Click *Apply* to see if you like the changes

If you aren’t happy with the results, tweak the settings and then test again by clicking *Apply*.

A buffer of 2 points seems to give a good result. Notice you can also specify the buffer size in map units if that works out better for you.

The remaining tabs on the Label tab allow you control the appearance of the labels using attributes stored in the layer. The “Data” tabs allow you to set all the parameters for the labels using fields in the layer.

4.3.5. Actions Tab

QGIS provides the ability to perform an action based on the attributes of a feature. This can be used to perform any number of actions, for example, running a program with arguments built from the attributes of a feature or passing parameters to a web reporting tool.

Actions are useful when you frequently want to run an external application or view a web page based on one or more values in your vector layer. An example is performing a search based on an attribute value. This concept is used in the following discussion.

Defining Actions

Attribute actions are defined from the vector layer properties dialog. To define an action, open the vector layer properties dialog and click on the *Actions* tab. Provide a descriptive name for the action. The action itself must contain the name of the application that will be executed when the action is invoked. You can add one or more attribute field values as arguments to the application. When the action is invoked any set of characters that start with a % followed by the name of a field will be replaced by the value of that field. The special characters %% will be replaced by the value of the field that was selected from the identify results or attribute table (see Using Actions below). Double quote marks can be used to group text into a single argument to the program, script or command. Double quotes will be ignored if proceeded by a backslash.

Two example actions are shown below:

- `konqueror http://www.google.com/search?q=%nam`
- `konqueror http://www.google.com/search?q=%%`

In the first example, the web browser konqueror is invoked and passed a URL to open. The URL performs a Google search on the value of the *nam* field from our vector layer. Note that the application or script called by the action must be in the path or you must provided the full path. To be sure, we could rewrite the first example as: `/opt/kde3/bin/konqueror http://www.google.com/search?q=%nam`. This will ensure that the konqueror application will be executed when the action is invoked.

The second example uses the %% notation which does not rely on a particular field for its value. When the action is invoked, the %% will be replaced by the value of the selected field in the identify results or attribute table.

Using Actions

Actions can be invoked from either the *Identify Results* dialog or the *Attribute table* dialog. To invoke an action, right click on the record and choose the action from the popup menu. Actions are listed in the popup menu by the name you assigned when defining the actions. Click on the action you wish to invoke.

If you are invoking an action that uses the %% notation, right-click on the field value in the *Identify Results* dialog or the *Attribute table* that you wish to pass to the application or script.

Here is another example that pulls data out of a vector layer and inserts it into a file using bash and the 'echo' command (so it will only work on GNU/Linux and perhaps Mac OS X). The layer in question has fields for a species name (taxon_name), latitude (lat) and longitude (long). I would like to be able to make a spatial selection of a localities and export these field values to a text file for the selected record (shown in yellow in the QGIS map area). Here is the action to achieve this:

```
bash -c "echo \"%taxon_name %lat %long\" >> /tmp/species_localities.txt"
```

After selecting a few localities and running the action on each one, opening the output file will show something like this:

```
Acacia mearnsii -34.0800000000 150.0800000000
Acacia mearnsii -34.9000000000 150.1200000000
Acacia mearnsii -35.2200000000 149.9300000000
Acacia mearnsii -32.2700000000 150.4100000000
```

As an exercise we create an action that does a Google search on the *lakes* layer. First we need to determine the URL needed to perform a search on a keyword. This is easily done by just going to Google and doing a simple search, then grabbing the URL from the address bar in your browser. From this little effort we see that the format is: `http://google.com/search?q=qgis`, where *qgis* is the search term. Armed with this information, we can proceed:

- Make sure the *lakes* layer is loaded
- Open the properties dialog by double-clicking on the layer in the legend, or right-click and choose *Properties* from the popup menu
- Click on the "Actions" tab
- Enter a name for the action, for example "Google Search"
- For the action, we need to provide the name of the external program to run. In this case, we can use Firefox. If the program is not in your path, you need to provide the full path.
- Following the name of the external application, add the URL used for doing a Google search, up to but not included the search term: `http://google.com/search?q=`
- The text in the "Action" field should now look like this:
  `firefox http://google.com/search?q=`

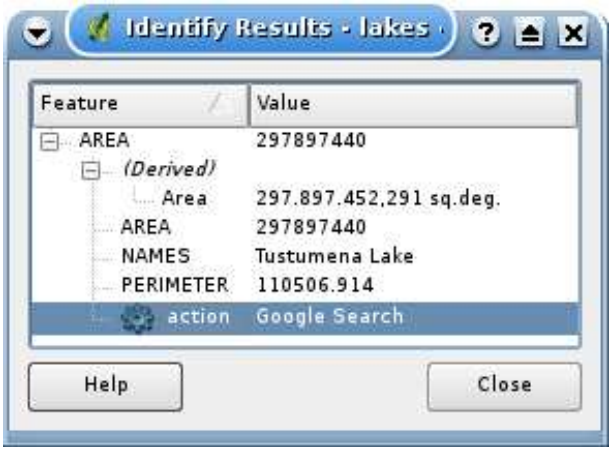
- Click on the drop-down box containing the field names for the *lakes* layer. It's located just to the right of the *Insert Field* button.
- From the drop-down box, select *NAMES* and click *Insert Field*
- Your action text now looks like this:
  `firefox http://google.com/search?q=%NAMES`

This completes the action and it is ready to use. The final text of the action should look like this:

```
firefox http://google.com/search?q=%NAMES
```

We can now use the action. Close the properties dialog and zoom in to an area of interest. Make sure the *lakes* layer is active and identify a city. In the result box you'll now see that our action is visible:

Figure 6: Select feature and choose action



When we click on the action, it brings up Firefox and navigates to the URL `http://www.google.com/search?q=Tustumena`. It is also possible to add further attribute fields to the action. Therefore you can add a "+" to the end of the action text, select another field and click on *Insert Field*. In this example there is just no other field available that would make sense to search for.

You can define multiple actions for a layer and each will show up in the Identify Results dialog. You can also invoke actions from the attribute table by selecting a row and right-clicking, then choosing the action from the popup menu.

You can think of all kinds of uses for actions. For example, if you have a point layer containing locations of images or photos along with a file name, you could create an action to launch a viewer to display the image. You could also use actions to launch web-based reports for an attribute field or combination of fields, specifying them in the same way we did in our Google search example.

4.4. Editing

QGIS supports basic capabilities for editing spatial data. Before reading any further you should note that at this stage editing support is still preliminary. Before performing any edits, always make a backup of the dataset you are about to edit.

Note - the procedure for editing GRASS layers is different - see Section 8.5 for details.

4.4.1. Setting the Snap Tolerance

Before we can edit vertices, we need to set the snapping tolerance. This is the distance QGIS uses to "search" for the polygon and vertex you are trying to edit when you click on the map. If you aren't within the snap tolerance, QGIS won't find and select the vertex for editing. Tolerance is set in map units so you may find you need to experiment to get it set right. If you specify too big of a tolerance, QGIS may snap to the wrong vertex, especially if you are dealing with a large number of vertices in close proximity. Set it too small and it won't find anything and it will pop up an annoying warning to that effect.

To set the snap tolerance, choose *Project Properties* from the *Settings* menu and click on the "General" tab. Remember the tolerance is in map units. For our little digitizing project, the units are in decimal degrees. Your results may vary, but something on the order of 0.05 to 0.1 should be fine.

4.4.2. Editing an Existing Layer

By default, QGIS loads layers read-only: This is a safeguard to avoid accidentally editing a layer if there is a slip of the mouse. However, you can choose to edit any layer as long as the data provider supports it, and the underlying data source is writable (i.e. its files are not read-only).

Layer editing is most versatile when used on PostgreSQL/PostGIS data sources.

Tip 9 DATA INTEGRITY

Please consider backing up your data source before you start editing, and also at regular intervals during editing. QGIS is still at a pre-version 1.0 stage, and so may not be able to protect your data in all situations.

All editing sessions start by choosing the *Allow editing* option. This can be found in the context menu after right clicking on the legend entry for that layer. Alternately, you can use the  *Toggle editing* button from the toolbar to start of stop the editing mode.

Tip 10 EDITING A MAP IS DIFFERENT TO EDITING AN ATTRIBUTE TABLE

In this version of QGIS, the *Start editing*/*Stop editing* couplet on the map view acts separately to the *Start Editing*/*Stop Editing* couplet on the attribute table.

Tip 11 SAVE REGULARLY

Remember to toggle *Allow editing* off or select the *Stop editing* button regularly. This allows you to save your changes thus far, and also confirms that your data source can accept all your changes.

Tip 12 CONCURRENT EDITS

This version of QGIS does not track if somebody else is editing a feature at the same time as you. The last writer wins.

Once the layer is in edit mode, markers will appear at the vertices.

You can perform the following editing functions:

- Add Features (point, line and polygone)
- Move Selected Features
- Split Selected Feature
- Delete Selected Features
- Add Vertex of a Feature
- Delete Vertex of a Feature
- Move Vertex of a Feature
- Add Ring
- Add Island
- Cut Selected Features
- Copy Selected Features
- Paste Selected Features

Adding Features

Before you start adding features, use the pan and zoom tools to first navigate to the area of interest.

Then you can use the *Capture Point*, *Capture Line* or *Capture Polygon* icon on the toolbar to put the QGIS cursor into digitizing mode.

For each feature, you first digitize the geometry, then enter its attributes.

To digitize the geometry, left-click on the map area to create the first point of your new feature.

Tip 13 ZOOM IN BEFORE EDITING

Before editing a layer, you should zoom in to your area of interest first. This avoids waiting while all the vertex markers are rendered across the entire layer.

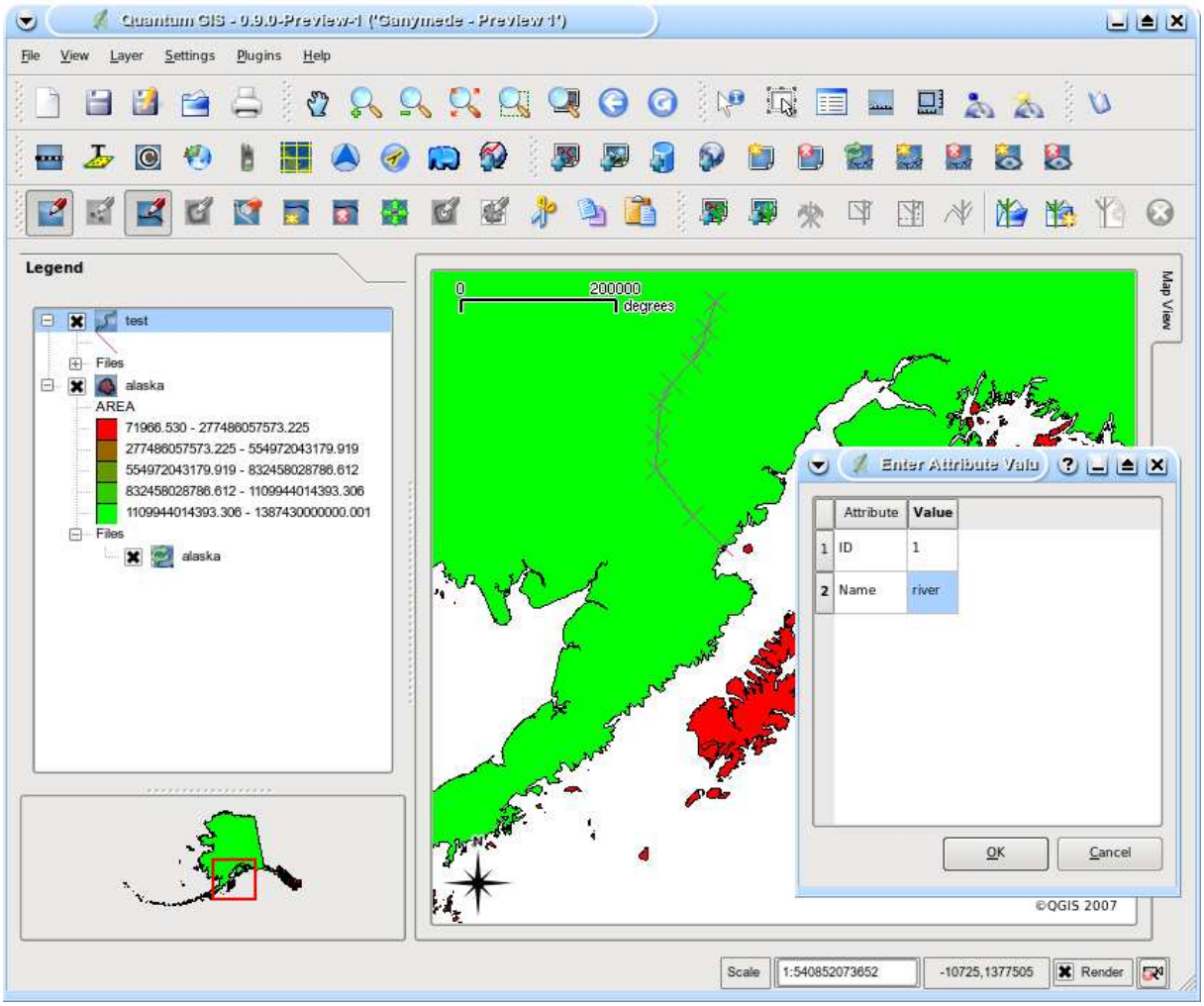
Tip 14 VERTEX MARKERS

This version of QGIS does not allow you to change the vertex markers used.

For lines and polygons, keep on left-clicking for each additional point you wish to capture. When you have finished adding points, right-click anywhere on the map area to confirm you have finished entering the geometry of that feature.

The attribute window will appear, allowing you to enter the information for the new feature. Figure 7 shows setting attributes for a fictitious new river in Alaska.

Figure 7: Vector Digitizing Attributes Capture Dialog



Tip 15 ATTRIBUTE VALUE TYPES

In the current version of QGIS, the attributes dialog box does not check that the data entered matches the type expected (e.g. numeric vs. text). Make sure of this before pressing *Ok*, otherwise you may find the error will be caught later when you try to save your changes.

Editing Vertices of a Feature

For both PostgreSQL/PostGIS and shapefile-based layers, the verticies of features can be edited.

Verticies can be directly edited, that is, you don't have to choose which feature to edit before you can change its geometry. In some cases, several features may share the same vertex and so the following rules apply when the mouse is pressed down near map features:

- **Lines** - The nearest line to the mouse position is used as the target feature. Then (for moving and deleting a vertex) the nearest vertex on that line is the editing target.
- **Polygons** - If the mouse is inside a polygon, then it is the target feature; otherwise the nearest polygon is used. Then (for moving and deleting a vertex) the nearest vertex on that polygon is the editing target.

You will need to set the property *Settings->Project Properties->General->Snapping Tolerance* to a number greater than zero. Otherwise QGIS will not be able to tell which feature is being edited.

Adding Vertices of a Feature

You can add new verticies to a feature by using the *Add Vertex* icon on the toolbar.

Note, it doesn't make sense to add more verticies to a Point feature!

In this version of QGIS, verticies can only be added to an *existing* line segment of a line feature. If you want to extend a line beyond its end, you will need to move the terminating vertex first, then add a new vertex where the terminus used to be.

Moving Vertices of a Feature

You can move verticies using the *Move Vertex* icon on the toolbar.

Deleting Vertices of a Feature

You can delete verticies by using the *Delete Vertex* icon on the toolbar.

Note, it doesn't make sense to delete the vertex of a Point feature! Delete the whole feature instead.

Similarly, a one-vertex line or a two-vertex polygon is also fairly useless and will lead to unpredictable results elsewhere in QGIS, so don't do that.

Warning: A vertex is identified for deletion as soon as you click the mouse near an eligible feature. To undo, you will need to toggle Editing off and then discard your changes. (Of course this will mean that other unsaved changes will be lost, too.)

Add Ring

New in v0.9

You can create ring polygons in QGIS. This means inside an existing area it is possible to digitize further polygons, that will occur as a 'whole', so only the area in between the boundaries of the outer and inner polygons remain as a ring polygon.

Add Island

New in v0.9

You can add island polygons to a selected multipolygon. The new island polygone has to be digitized outside the selected multipolygon.

Cutting, Copying and Pasting Features

Selected features can be cut, copied and pasted between layers in the same QGIS project, as long as destination layers are set to *Allow editing* beforehand.

Features can also be pasted to external applications as text: That is, the features are represented in CSV format with the geometry data appearing in the OGC Well-Known Text (WKT) format.

However in this version of QGIS, text features from outside QGIS cannot be pasted to a layer within QGIS.

When would the copy and paste function come in handy? Well, it turns out that you can edit more than one layer at a time and copy/paste features between layers. Why would we want to do this? Say we need to do some work on a new layer but only need one or two lakes, not the 5,000 on our *big_lakes* layer. We can create a new layer and use copy/paste to plop the needed lakes into it.

As an example we are copying some lakes to a new layer:

1. Load the layer you want to copy from (source layer)
2. Load or create the layer you want to copy to (target layer)
3. Start editing for both layers
4. Make the source layer active by clicking on it in the legend
5. Use the select tool to select the feature(s) on the source layer

6. Click on the *Copy Features* tool
7. Make the destination layer active by clicking on it in the legend
8. Click on the *Paste Features* tool
9. Stop editing and save the changes

What happens if the source and target layers have different schemas (field names and types are not the same)? QGIS populates what matches and ignores the rest. If you don't care about the attributes being copied to the target layer, it doesn't matter how you design the fields and data types. If you want to make sure everything - feature and its attributes - gets copied, make sure the schemas match.

Tip 16 CONGRUENCY OF PASTED FEATURES

If your source and destination layers use the same projection, then the pasted features will have geometry identical to the source layer. However if the destination layer is a different projection then QGIS cannot guarantee the geometry is identical. This is simply because there are small rounding-off errors involved when converting between projections.

Deleting Selected Features

If we want to delete an entire polygon, we can do that by first selecting the polygon using the regular *Select Features* tool. You can select multiple features for deletion. Once you have the selection set, use the *Delete Selected* tool to delete the features. There is no undo function, but remember your layer isn't really changed until you stop editing and choose to save your changes. So if you make a mistake, you can always cancel the save.

The *Cut Features* tool on the digitizing toolbar can also be used to delete features. This effectively deletes the feature but also places it on a "spatial clipboard". So we cut the feature to delete. We could then use the paste tool to put it back, giving us a one-level undo capability. Cut, copy, and paste work on the currently selected features, meaning we can operate on more than one at a time.

Tip 17 FEATURE DELETION SUPPORT

When editing ESRI shapefiles, the deletion of features only works if QGIS is linked to a GDAL version 1.3.2 or greater. The OS X and Windows versions of QGIS available from the download site are built using GDAL 1.3.2 or higher.

Snap Mode

QGIS allows digitized verticies to be snapped to other verticies of the same layer. To set the snapping tolerance, go to *Settings->Project Properties->General->Snapping Tolerance*. Note that the snapping tolerance is in map units.

Saving Edited Layers

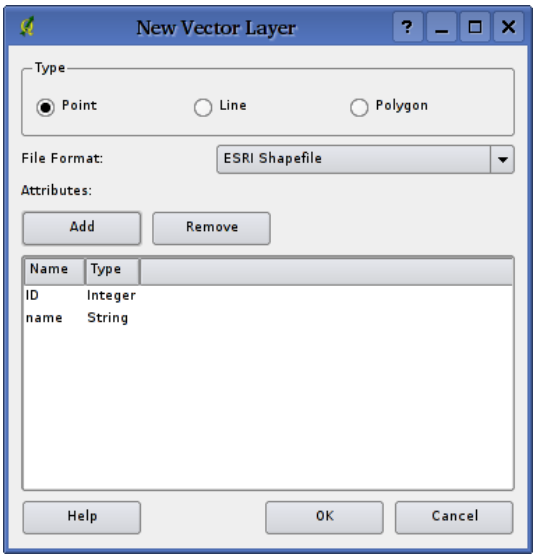
When a layer is in editing mode, any changes remain in the memory of QGIS. Therefore they are not committed/saved immediately to the data source or disk. When you turn editing mode off (or quit QGIS for that matter), you are then asked if you want to save your changes or discard them.

If the changes cannot be saved (e.g. disk full, or the attributes have values that are out of range), the QGIS in-memory state is preserved. This allows you to adjust your edits and try again.

4.4.3. Creating a New Layer

To create a new layer for editing, choose *New Vector Layer* from the *Layer* menu. The *New Vector Layer* dialog will be displayed as shown in Figure 8. Choose the type of layer (point, line, or polygon).

Figure 8: Creating a New Vector Dialog



Note that QGIS does not yet support creation of 2.5D features (i.e. features with X,Y,Z coordinates) or measure features. At this time, only shapefiles can be created. In a future version of QGIS, creation of any OGR or PostgreSQL layer type will be supported.

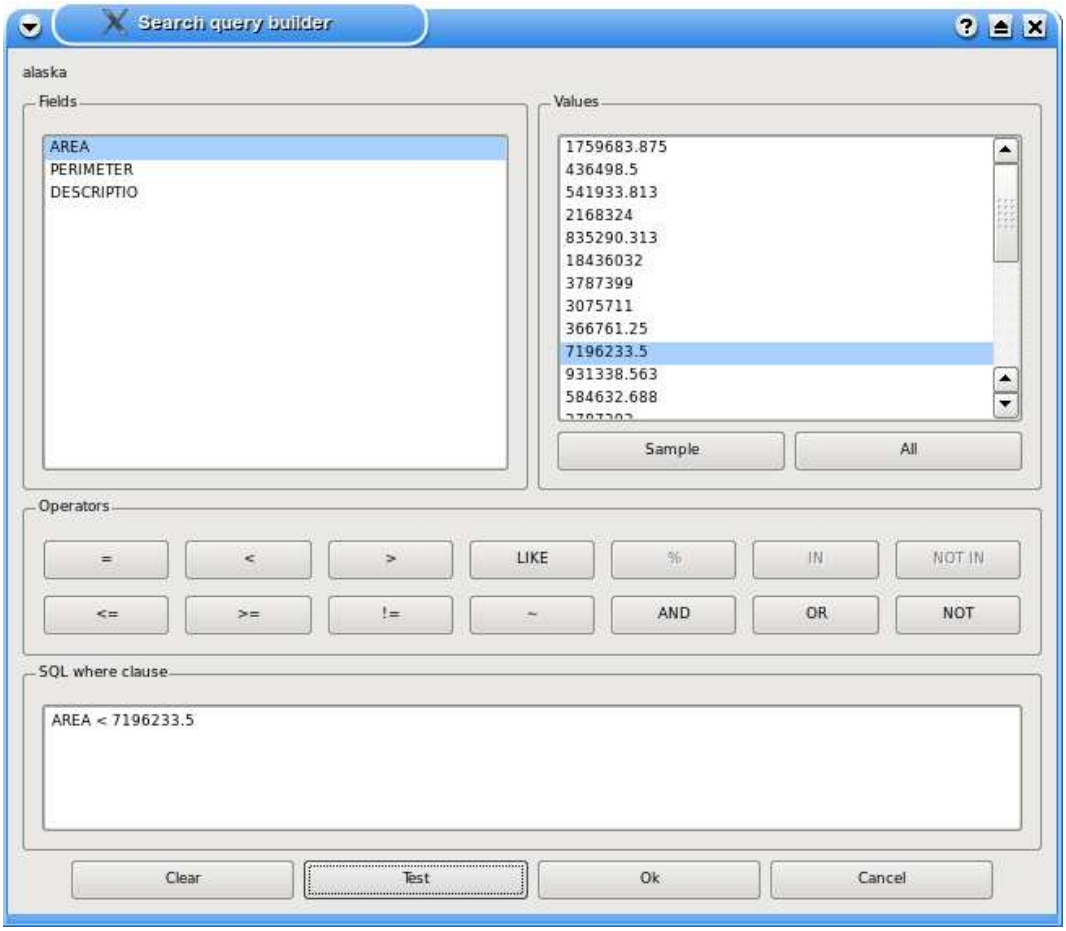
Creation of GRASS-layers is supported within the GRASS-plugin. Please refer to section 8.8 for more information on creating GRASS vector layers.

To complete the creation of the new layer, add the desired attributes by clicking on the *Add* button and specifying a name and type for the attribute. Only real, integer, and string attributes are supported. Once you are happy with the attributes, click Ok and provide a name for the shapefile. QGIS will automatically add a .shp extension to the name you specify. Once the layer has been created, it will be added to the map and you can edit it in the same way as described in Section 4.4.2 above.

4.5. Query Builder

The Query Builder allows you to define a subset of a table and display it as a layer in QGIS. It can be used for all OGR supported formats, GRASS files and PostGIS layers. For example, if you have a towns layer with a population field you could select only larger towns by entering *population > 100000* in the SQL box of the query builder. Figure 9 shows an example of the query builder populated with data from a PostGIS layer with attributes stored in PostgreSQL.

Figure 9: Query Builder



The query builder lists the layer's database fields in the list box on the left. You can get a sample of the data contained in the highlighted field by clicking on the *Sample* button. This retrieves the first 25 distinct values for the field from the database. To get a list of all possible values for a field, click on the *All* button. To add a selected field or value to the query, double-click on it. You can use the various buttons to construct the query or you can just type it into the SQL box.

To test a query, click on the *Test* button. This will return a count of the number of records that will be included in the layer. When satisfied with the query, click *Ok*. The SQL for the where clause will be

shown in the SQL column of the layer list.

Tip 18 CHANGING THE LAYER DEFINITION

You can change the layer definition after it is loaded by altering the SQL query used to define the layer. To do this, open the vector layer properties dialog by double-clicking on the layer in the legend and click on the *Query Builder* button on the *General* tab. See Section 4.3 for more information.

4.5.1. Query PostGIS layers

To query a loaded PostGIS layer there are two options. The first is to click on the button *Open Table* to open the attribute table of the PostGIS layer. Then choose the *Advanced...* button at the bottom. This starts the Query Builder that allows to define a subset of a table and display it as described in Section 4.5.

The second option to load a PostGIS layer, is to open the *Layer Properties* dialog by double-clicking on the PostGIS layer name in the legend or by right-clicking and choosing *Properties* from the popup menu. In the tab *General* click the *Query Builder* button at the bottom.

4.5.2. Query OGR formats and GRASS files

To query a loaded GRASS file or OGR supported format you currently need to click on the button *Open Table* to open the corresponding attribute table and choose the *Advanced...* button. This starts the Query Builder and allows to define a subset of a table and display it as described in Section 4.5.

The second option to start the Query Builder as decribed in Section 4.5.1 is currently not supported for OGR and GRASS-layers.

5. Working with Raster Data

QGIS supports a number of raster data formats. This section describes how to work with raster data in QGIS.

5.1. What is raster data?

Raster data in GIS are matrices of discrete cells that represent features on, above or below the earth's surface. Each cell in the raster grid is the same size, and cells are usually rectangular (in QGIS they will always be rectangular). Typical raster datasets include remote sensing data such as aerial photography or satellite imagery and modelled data such as an elevation matrix.

Unlike vector data, raster data typically do not have an associated database record for each cell.

In GIS, a raster layer would have georeferencing data associated with it which will allow it to be positioned correctly in the map display to allow other vector and raster data to be overlaid with it. QGIS makes use of georeferenced rasters to properly display the data.

5.2. Raster formats supported in QGIS

QGIS supports a number of different raster formats. Currently tested formats include:

- Arc/Info Binary Grid
- Arc/Info ASCII Grid
- GRASS Raster
- GeoTIFF
- Spatial Data Transfer Standard Grids (with some limitations)
- USGS ASCII DEM
- Erdas Imagine

Because the raster implementation in QGIS is based on the GDAL library, other raster formats implemented in GDAL are also likely to work, but have not yet been tested. See Appendix A.2 for more details.

5.3. Loading raster data in QGIS

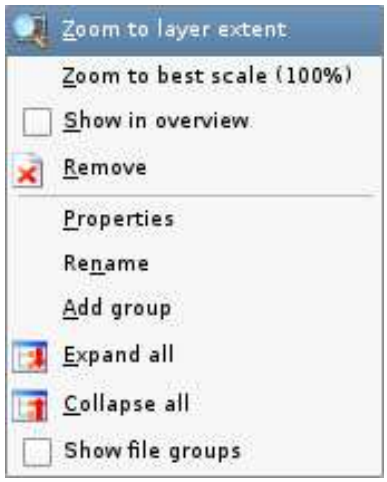
 Raster layers are loaded either by clicking on the *Load Raster* icon or by selecting the *View -> Add Raster Layer* menu option. More than one layer can be loaded at the same time by holding down the Control key and clicking on multiple items in the file dialog.

Please refer to section 8.2 if you intend to load GRASS rasterdata.

5.4. Raster Properties Dialog

To view and set the properties for a raster layer, right click on the layer name. This displays the raster layer context menu that includes a number of items that allow you to:

Figure 10: Raster context menu



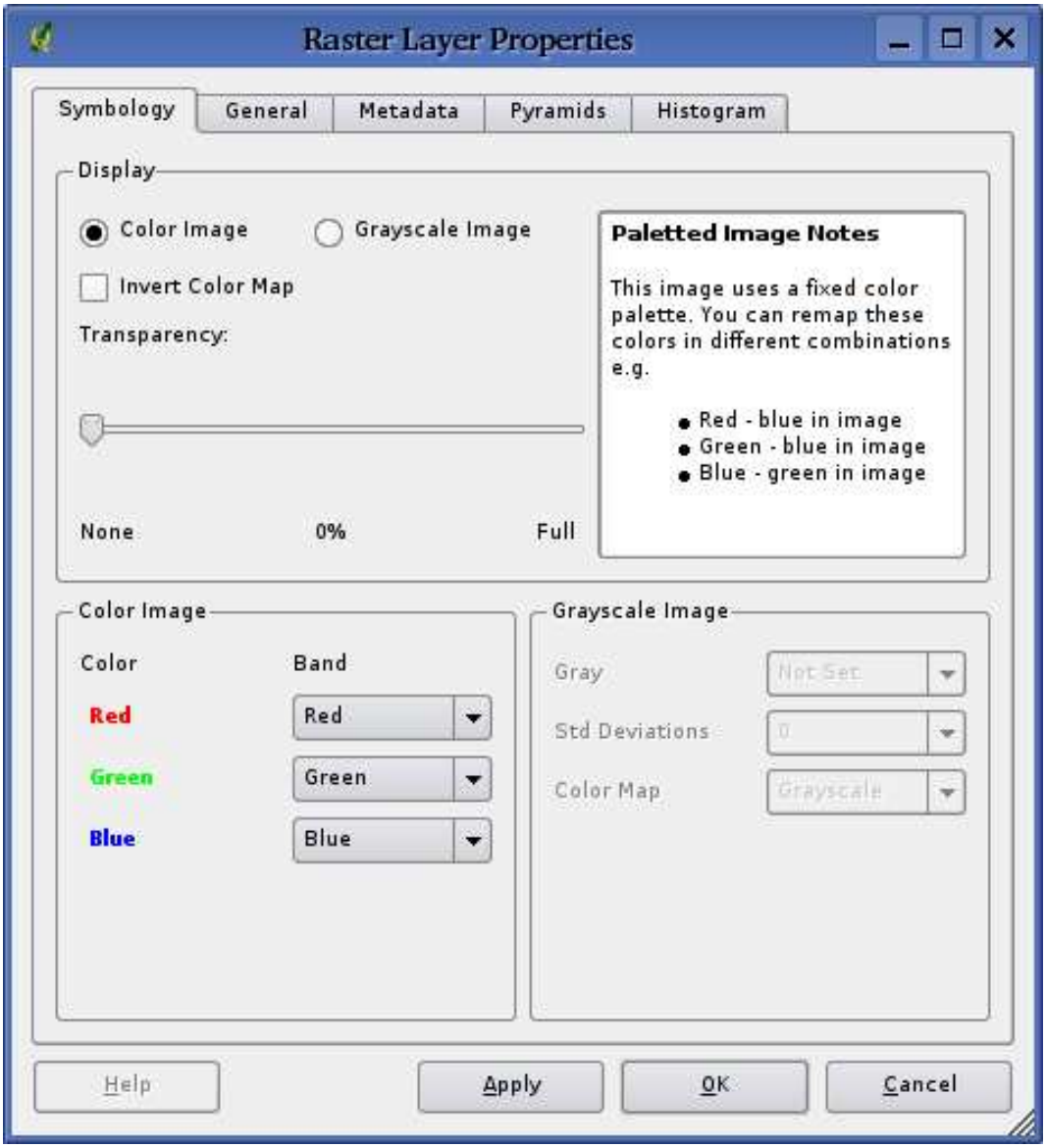
- Zoom to the full extent of the raster
- Zoom to the best scale of the raster
- Show the raster in the map overview window
- Remove the layer from the map
- Open the raster layers properties
- Rename the layer
- Add a layer group
- Expand legend tree view

- Collapse legend tree view
- Show file groups

Choose *Properties* from the context menu to open the raster properties dialog for the layer.

Figure 11 shows the properties dialog. There are five tabs on the dialog: *Symbology*, *General*, *Metadata*, *Pyramids* and *Histogram*.

Figure 11: Raster Layers Properties Dialog



5.4.1. Symbology Tab

QGIS supports three forms of raster layers:

- Single Band Grayscale Rasters
- Palette Based RGB Rasters
- Multiband RGB Rasters

From these three basic layer types, eight forms of symbolised raster display can be used:

- Single Band Grayscale
- Single Band Pseudocolor
- Paletted Grayscale (where only the red, green or blue component of the image is displayed)
- Paletted Pseudocolor (where only the red, green or blue component of the image is displayed, but using a pseudocolor algorithm)
- Paletted RGB
- Multiband Grayscale (using only one of the bands to display the image)
- Multiband Pseudocolor (using only one of the bands shown in pseudocolor)
- Multiband RGB (using any combination of three bands)

QGIS can invert the colors in a given layer so that light colors become dark (and dark colors become light). Use the *Invert Color Map* checkbox to enable / disable this behavior.

QGIS has the ability to display each raster layer at varying transparency levels. Use the transparency slider to indicate to what extent the underlying layers (if any) should be visible though the current raster layer.

QGIS can restrict the data displayed to only show cells whose values are within a given number of standard deviations of the mean for the layer. This is useful when you have one or two cells with abnormally high values in a raster grid that are having a negative impact on the rendering of the raster. This option is only available for pseudocolor images.

Tip 19 VIEWING A SINGLE BAND OF A MULTIBAND RASTER

If you want to view a single band (for example Red) of a multiband image, you might think you would set the Green and Blue bands to “Not Set”. But this is not the correct way. To display the Red band, set the image type to grayscale, then select Red as the band to use for Gray.

5.4.2. General Tab

The General tab displays basic information about the selected raster, including the layer source and display name in the legend (which can be modified). This tab also shows a thumbnail of the layer, its legend symbol, and the palette.

Additionally scale-dependent visability can be set in this tab. You need to check the checkbox and set an appropriate scale where your data will be displayed in the map canvas.

Also the spatal reference system is printed here as a PROJ.4-string. This can be modified by hitting the *Change* button.

5.4.3. Metadata Tab

The Metadata tab displays a wealth of information about the raster layer, including statistics about each band in the current raster layer. Statistics are gathered on a ’need to know’ basis, so it may well be that a given layers statistics have not yet been collected.

Tip 20 GATHERING RASTER STATISTICS

To gather statistics for a layer, select pseudocolor rendering and click the *Apply* button. Gathering statistics for a layer can be time consuming. Please be patient while QGIS examines your data!

5.4.4. Pyramids Tab

Large resolution raster layers can slow navigation in QGIS. By creating lower resolution copies of the data (pyramids), performance can be considerably improved as QGIS selects the most suitable resolution to use depending on the level of zoom.

You must have write access in the directory where the original data is stored to build pyramids. Several resampling methods can be used to calculate the pyramides:

- Average
- Nearest Neighbour
- Average Magphase

Please note that building pyramids may alter the original data file and once created they cannot be removed. If you wish to preserve a 'non-pyramided' version of your raster, make a backup copy prior to building pyramids.

5.4.5. Histogram Tab

The histogram tab allows you to view the distribution of the bands or colors in your raster. You must first generate the raster statistics by clicking the *Refresh* button. You can choose which bands to display by selecting them in the list box at the bottom right of the dialog. Two different chart types are allowed: Barcharts and Linegraphs.

Once you view the histogram, you'll notice that the band statistics have been populated on the metadata tab.

6. Working with OGC Data

QGIS supports WMS and WFS as data sources. The support for WFS is preliminary at this time. WMS support is native; WFS is implemented using a plugin.

6.1. What is OGC Data

The Open Geospatial Consortium (OGC), is an international organization with more than 300 commercial, governmental, nonprofit and research organisations worldwide. Its members develop and implement standards for geospatial content and services, GIS data processing and exchange.

Describing a basic data model for geographic features an increasing number of specifications are developed to serve specific needs for interoperable location and geospatial technology, including GIS. Further information can be found under `http://www.opengeospatial.org/`.

Important OGC specifications are:

- **WMS** - Web Map Service
- **WFS** - Web Feature Service
- **WCS** - Web Coverage Service
- **CAT** - Web Catalog Service
- **SFS** - Simple Features for SQL
- **GML** - Geography Markup Language

OGC services are increasingly being used to exchange geospatial data between different GIS implementations and data stores. QGIS can now deal with three of the above specifications, being SFS (though support of the PostgreSQL / PostGIS data provider, see Section 4.2); WFS and WMS as a client.

6.2. WMS Client

6.2.1. Overview of WMS Support

 QGIS currently can act as a WMS client that understands WMS 1.1, 1.1.1 and 1.3 servers. It has particularly been tested against publicly accessible servers such as DEMIS and JPL OnEarth.

WMS servers act upon requests by the client (e.g. QGIS) for a raster map with a given extent, set of layers, symbolisation style, and transparency. The WMS server then consults its local data sources, rasterizes the map, and sends it back to the client in a raster format. For QGIS this would typically be JPEG or PNG.

WMS is generically a REST (Representational State Transfer) service rather than a fully-blown Web Service. As such, you can actually take the URLs generated by QGIS and use them in a web browser to retrieve the same images that QGIS uses internally. This can be useful when troubleshooting problems, as there are several brands of WMS servers in the market and they all have their own interpretation of the WMS standard.

WMS layers can be added quite simply, as long as you know the URL to access the WMS server, you have a serviceable connection to that server, and the server understands HTTP as the data transport mechanism.

6.2.2. Selecting WMS Servers

The first time you use the WMS feature, there are no servers defined. You can begin by clicking the *Add WMS layer* button inside the toolbar, or through the Layer menu.

The dialog for adding layers from the WMS server pops up. Fortunately you can add some servers to play with by clicking the *Add default servers* button. This will add at least three WMS servers for you to use, including the NASA (JPL) WMS server. To define a new WMS server in the *Server Connections* section, select *New*. Then enter in the parameters to connect to your desired WMS server, as listed in table 2:

Table 2: WMS Connection Parameters

Name	A name for this connection. This name will be used in the Server Connections drop-down box so that you can distinguish it from other WMS Servers.
URL	URL of the server providing the data. This must be a resolvable host name; the same format as you would use to open a telnet connection or ping a host.
Proxy Host	Network address or host name of the proxy server you would use to access this WMS server, or leave blank if no proxy is needed.
Proxy Port	Port number of the proxy server.
Proxy User	User name used to login to the proxy server.
Proxy Password	Password used to login to the proxy server.

At least *Name* and *URL* are required entries; the proxy entries can be left blank if you have a clear path to your WMS server.

Once the new WMS Server has been created, it will be preserved across future QGIS sessions.

Tip 21 ON WMS SERVER URLS

Be sure, when entering in the WMS server URL, that you have the base URL. For example, you shouldn't have fragments such as `request=GetCapabilities` or `version=1.0.0` in your URL.

Table 3 shows some example WMS URLs to get you started. These links were last checked in December 2006, but could change at any time:

Table 3: Example Public WMS URLs

Name	URL
Atlas of Canada	http://atlas.gc.ca/cgi-bin/atlaswms_en?
DEMIS	http://www2.demis.nl/wms/wms.asp?wms=WorldMap&
Geoscience Australia	http://www.ga.gov.au/bin/getmap.pl?dataset=national
NASA JPL OnEarth	http://wms.jpl.nasa.gov/wms.cgi?
QGIS Users	http://qgis.org/cgi-bin/mapserv?map=/var/www/maps/main.map&

An exhaustive list of WMS servers can be found at `http://wms-sites.com`.

6.2.3. Loading WMS Layers

Once you have successfully filled in your parameters you can select the *Connect* button to retrieve the capabilities of the selected server. This includes the Image encoding, Layers, Layer Styles, and Projections. Since this is a network operation, the speed of the response depends on the quality of your network connection to the WMS server. While downloading data from the WMS server, the download progress is visualized in the left bottom of the WMS Plugin dialog

Your screen should now look a bit like Figure 12, which shows the response provided by the NASA JPL OnEarth WMS server.

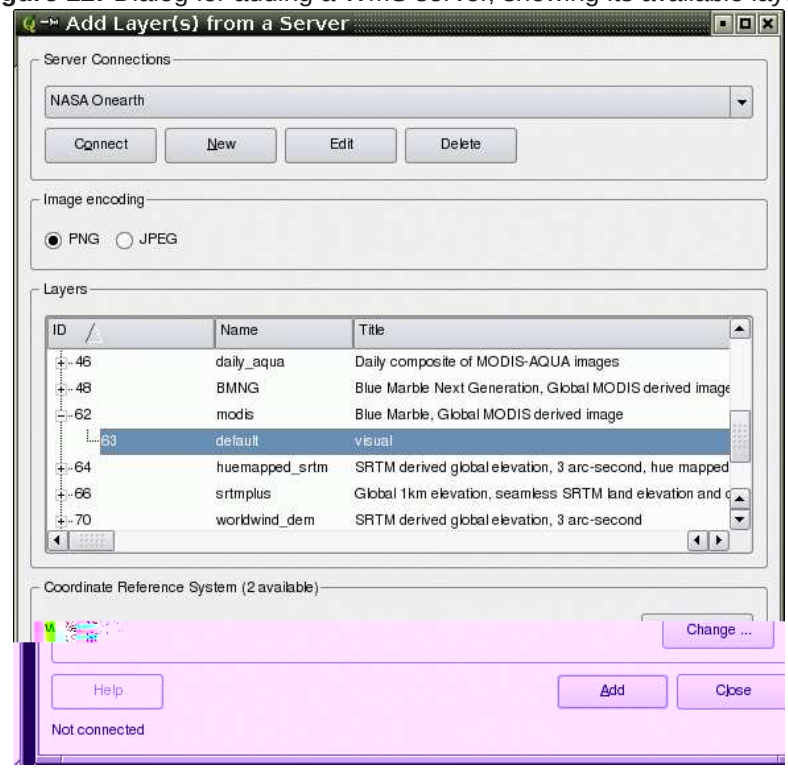
Image Encoding

The *Image encoding* section now lists the formats that are supported by both the client and server. Choose one depending on your image accuracy requirements.

Tip 22 IMAGE ENCODING

You will typically find that a WMS server offers you the choice of JPEG or PNG image encoding. JPEG is a lossy compression format, whereas PNG faithfully reproduces the raw raster data.
Use JPEG if you expect the WMS data to be photographic in nature and/or you don't mind some loss in picture quality. This trade-off typically reduces by 5 times the data transfer requirement compared to PNG.
Use PNG if you want precise representations of the original data, and you don't mind the increased data transfer requirements.

Figure 12: Dialog for adding a WMS server, showing its available layers



Layers

The *Layers* section lists the layers available from the selected WMS server. You may notice that some layers are expandible, this means that the layer can be displayed in a choice of image styles.

You can select several layers at once, but only one image style per layer. When several layers are selected, they will be combined at the WMS Server and transmitted to QGIS in one go.

Tip 23 WMS LAYER ORDERING

In this version of QGIS, WMS layers rendered by a server are overlaid in the order listed in the Layers section, from top to bottom of the list. If you want to overlay layers in the opposite order, then you can select *Add WMS layer* a second time, choose the same server again, and select the second group of layers that you want to overlay the first group.

Transparency

In this version of QGIS, the transparency setting is hard-coded to be always on, where available. Therefore no option for it exists on-screen.

This, in theory, allows you to overlay WMS layers on other layers (raster, vector or WMS) and still see through to those lower layers.

Tip 24 WMS LAYER TRANSPARENCY

The availability of WMS image transparency depends on the image encoding used: PNG and GIF support transparency, whilst JPEG leaves it unsupported.

Coordinate Reference System

A Coordinate Reference System is the OGC terminology for a QGIS Projection.

Each WMS Layer can be presented in multiple CRSs, depending on the capability of the WMS server. You may notice that the *x* changes in the *Coordinate Reference System (x available)* header as you select and deselect layers from the *Layers* section.

To choose a CRS, select *Change...* and a screen similar to Figure 14 in Section 7.2 will appear. The main difference with the WMS version of the screen is that only those CRSs supported by the WMS Server will be shown.

Tip 25 WMS PROJECTIONS

For best results, make the WMS layer the first layer you add in the project. This allows the project projection to inherit the CRS you used to render the WMS layer. On-the-fly projection (see Section 7.2.1) can then be used to fit any subsequent vector layers to the project projection. In this version of QGIS, if you add a WMS layer later, and give it a different CRS to the current project projection, unpredictable results can occur.

6.2.4. Using the Identify Tool

Once you have added a WMS server, and if any layer from a WMS server is queryable, you can then use the *Identify* tool to select a pixel on the map canvas. A query is made to the WMS server for each selection made.

The results of the query are returned in plain text. The formatting of this text is dependent on the particular WMS server used.

6.2.5. Viewing Properties

Once you have added a WMS server, you can view its properties by right-clicking on it in the legend, and selecting *Properties*.

Metadata Tab

The Metadata tab displays a wealth of information about the WMS server, generally collected from the Capabilities statement returned from that server.

Many definitions can be gleaned by reading the WMS standards (5), (6), but here are a few handy definitions:

- **Server Properties**
  - **WMS Version** - The WMS version supported by the server.
  - **Image Formats** - The list of MIME-types the server can respond with when drawing the map. QGIS supports whatever formats the underlying Qt libraries were built with, which is typically at least `image/png` and `image/jpeg`.
  - **Identity Formats** - The list of MIME-types the server can respond with when you use the Identify tool. Currently QGIS supports the `text-plain` type.
- **Layer Properties**
  - **Selected** - Whether or not this layer was selected when its server was added to this project.
  - **Visible** - Whether or not this layer is selected as visible in the legend. (Not yet used in this version of QGIS.)
  - **Can Identify** - Whether or not this layer will return any results when the Identify tool is used on it.
  - **Can be Transparent** - Whether or not this layer can be rendered with transparency. This version of QGIS will always use transparency if this is *Yes* and the image encoding supports transparency .
  - **Can Zoom In** - Whether or not this layer can be zoomed in by the server. This version of QGIS assumes all WMS layers have this set to *Yes*. Deficient layers may be rendered strangely.
  - **Cascade Count** - WMS servers can act as a proxy to other WMS servers to get the raster data for a layer. This entry shows how many times the request for this layer is forwarded to peer WMS servers for a result.
  - **Fixed Width**, **Fixed Height** - Whether or not this layer has fixed source pixel dimensions. This version of QGIS assumes all WMS layers have this set to nothing. Deficient layers may be rendered strangely.
  - **WGS 84 Bounding Box** - The bounding box of the layer, in WGS 84 coordinates. Some WMS servers do not set this correctly (e.g. UTM coordinates are used instead). If this is the case, then the initial view of this layer may be rendered with a very “zoomed-out” appearance by QGIS. The WMS webmaster should be informed of this error, which they may know as the WMS XML elements `LatLonBoundingBox`, `EX_GeographicBoundingBox` or the CRS:84 `BoundingBox`.
  - **Available in CRS** - The projections that this layer can be rendered in by the WMS server. These are listed in the WMS-native format.
  - **Available in style** - The image styles that this layer can be rendered in by the WMS server.

6.2.6. WMS Client Limitations

Not all possible WMS Client functionality had been included in this version of QGIS. Some of the more notable exceptions follow:

Editing WMS Layer Settings

Once you've completed the *Add WMS layer* procedure, there is no ability to change the settings.

A workaround is to delete the layer completely and start again.

WMS Servers Requiring Authentication

Only public WMS servers are accessible. There is no ability to apply a user name and password combination as an authentication to the WMS server.

6.3. WFS Client

In QGIS, a WFS layer behaves pretty much like any other vector layer. You can identify and select features and view the attribute table. The WFS plugin doesn't support editing at this time.

Adding a WFS layer is very similar to the procedure used with WMS. The difference is there are no default servers defined, so we have to add our own.

6.3.1. Loading a WFS Layer

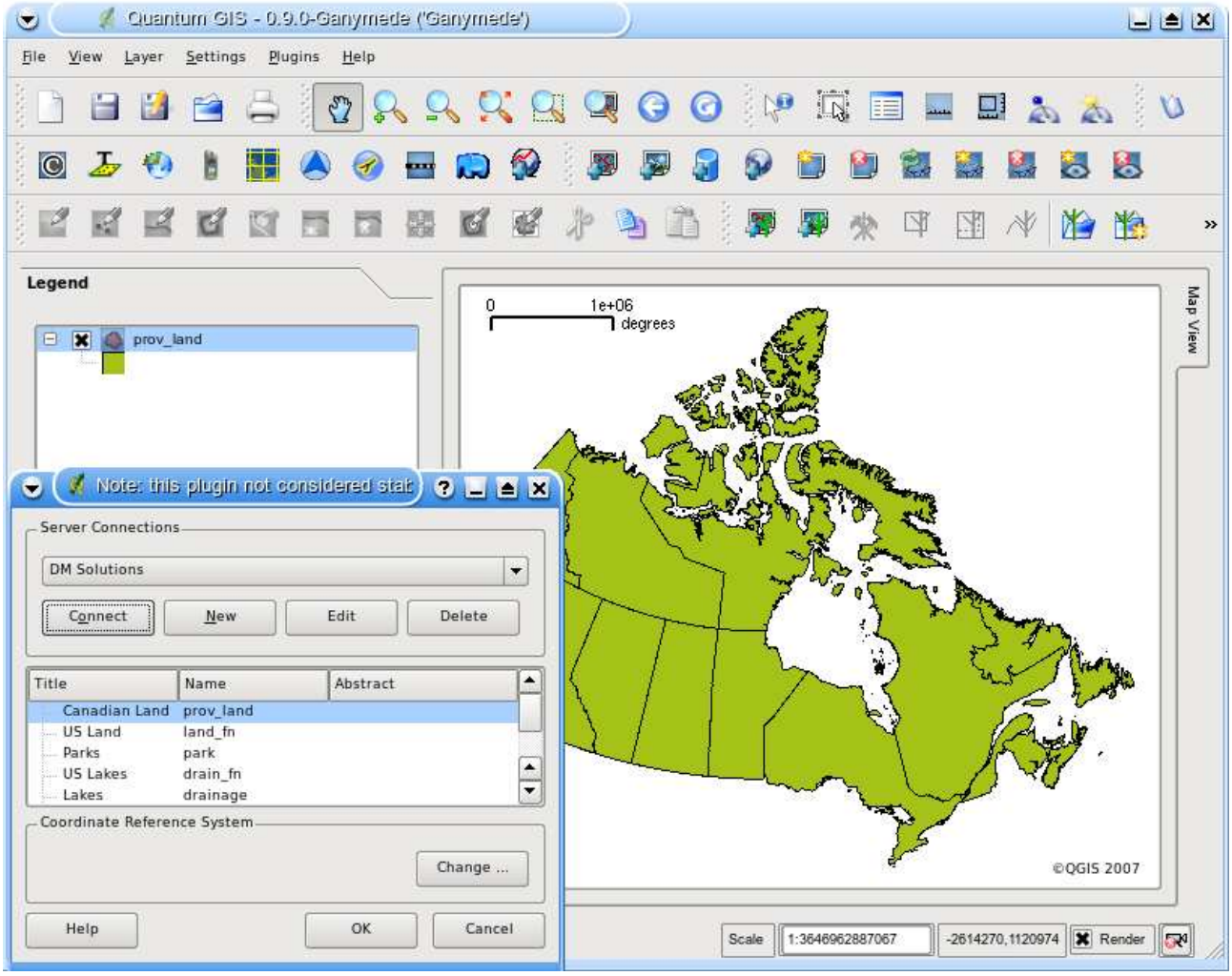
As an example we use the DM Solutions WFS server and display a layer. The URL is:

```
http://www2.dmsolutions.ca/cgi-bin/mswfs_gmap?VERSION=1.0.0&SERVICE=
wfs&REQUEST=GetCapabilities
```

1. Make sure the WFS plugin is loaded; if not, open the Plugin Manager and load it
2. Click on the *Add WFS Layer* tool on the plugins toolbar
3. Click on *New*
4. Enter "DM Solutions" as the name
5. Enter the URL (see previous page)
6. Click *OK*

7. Choose “DM Solutions” from the drop-down box
8. Click *Connect*
9. Wait for the list of layers to be populated
10. Click on the “Canadian Land” layer
11. Click *Add* to add the layer to the map
12. Wait patiently for the features to appear

Figure 13: Adding a WFS layer



You’ll notice the download progress is visualized in the left bottom of the QGIS main window. Once the layer is loaded, you can identify and select a province or two and view the attribute table.

Remember this plugin is still experimental. You might also experience random behavior and crashes. You can look forward to improvements in a future version of the plugin.

Tip 26 FINDING WMS AND WFS SERVERS

You can find additional WMS and WFS servers by using Google or your favorite search engine. There are a number of lists, some of them maintained and some not, that list public servers you can use.

7. Working with Projections

QGIS supports on-the-fly (OTF) projection of vector layers. This feature allows you to display layers with different coordinate systems and have them overlay properly.

7.1. Overview of Projection Support

QGIS has support for approximately 2,700 known projections. Projections are stored in a Sqlite database that is installed with QGIS. Normally you do not need to manipulate the database directly. In fact, doing so may cause projection support to fail. Custom projections are stored in a user database. See Section 7.3 for information on managing your custom projections.

The projections available in QGIS are based on those defined by EPSG and are largely abstracted from the spatial_references table in PostGIS version 1.x. Note that the identifiers used in QGIS do not correspond to the EPSG or PostGIS spatial reference identifiers. The EPSG and PostGIS identifiers are present in the database and can be used to specify a projection in QGIS.

In order to use OTF projection, your data must contain information about its coordinate system. For PostGIS layers QGIS uses the spatial reference identifier that was specified when the layer was created. For data supported by OGR, QGIS relies on the presence of a format specific means of specifying the coordinate system. In the case of shapefiles, this means a file containing the Well Known Text (WKT) specification of the the coordinate system. The projection file has the same base name as the shapefile and a prj extension. For example, a shapefile named lakes.shp would have a corresponding projection file named lakes.prj.

7.2. Getting Started

At startup, QGIS does not have OTF projection enabled. To use OTF projection, you must open the *Project Properties* dialog, select a projection for the map, and enable projections. There are two ways to open the *Project Properties* dialog:

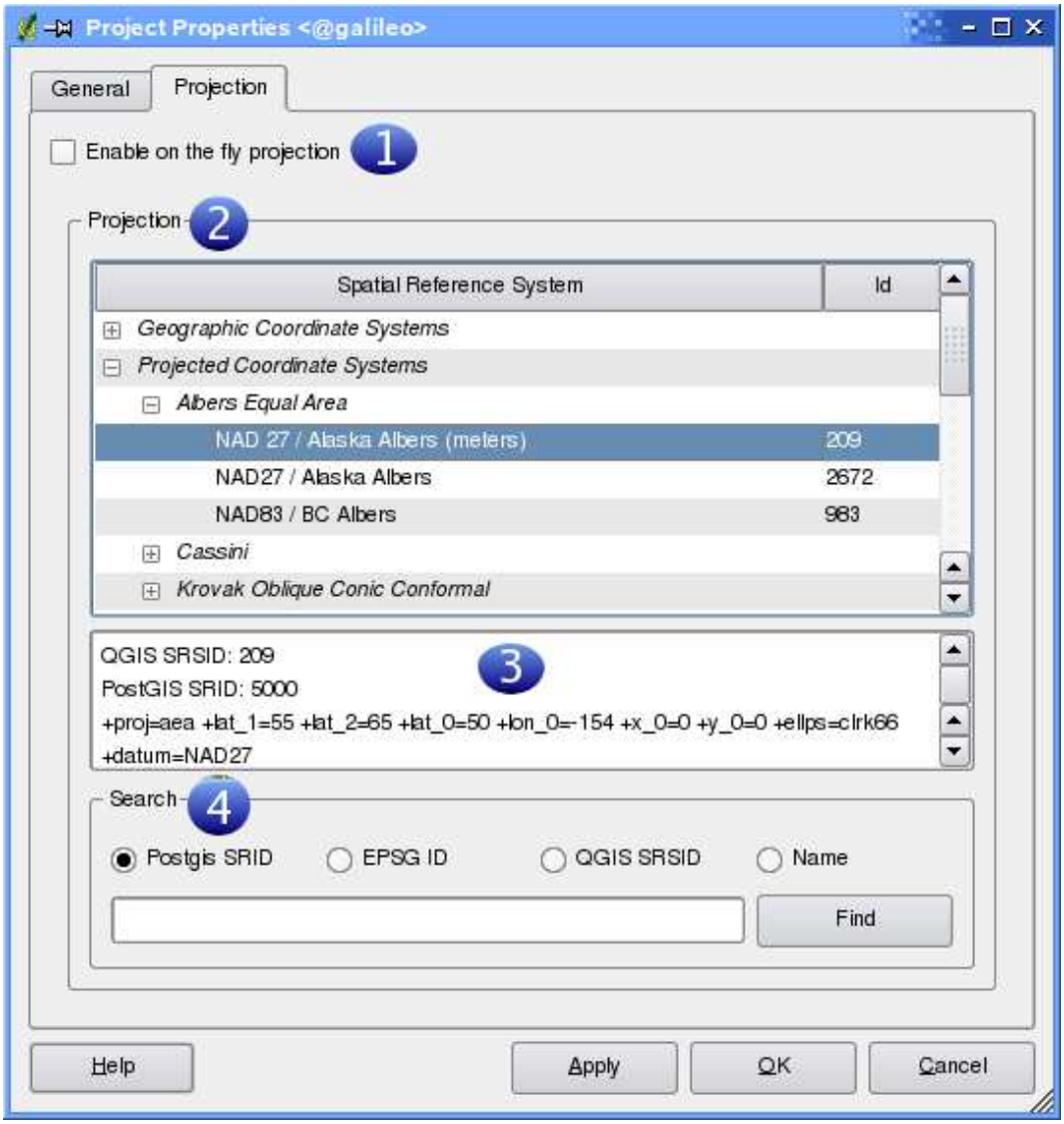
1. Select *Project Properties* from the *Settings* menu
2. Click on the projector icon in the lower right-hand corner of the statusbar

Tip 27 PROJECT PROPERTIES DIALOG

If you open the *Project Properties* dialog from the Settings menu, you must click on the *Projection* tab to view the projection settings. Opening the dialog from the projector icon will automatically bring the *Projection* tab to the front.

The Projection dialog contains four important components as numbered in Figure 14 and described below.

Figure 14: Projection Dialog (GNU/Linux)



1. **Enable projections** - this checkbox is used to enable or disable OTF projection. When off, no projection takes place and each layer is drawn using the coordinates as read from the data source. When on, the coordinates in each layer are projected to the coordinate system of the map canvas.
2. **Projections** - this is a list of all projection supported by QGIS, including Geographic, Projected, and Custom coordinate systems. To use a coordinate system, select it from the list by expanding the appropriate node and selecting the projection. The active projection is pre-selected.

3. **Proj4 text** - this is the projection string used by the Proj4 projection engine. This text is read-only and provided for informational purposes.
4. **Search** - if you know the PostGIS, EPSG, QGIS SRSID identifier or the name for a projection, you can use the search feature to find it. Enter the identifier and click on *Find*.

7.2.1. Specifying a Projection

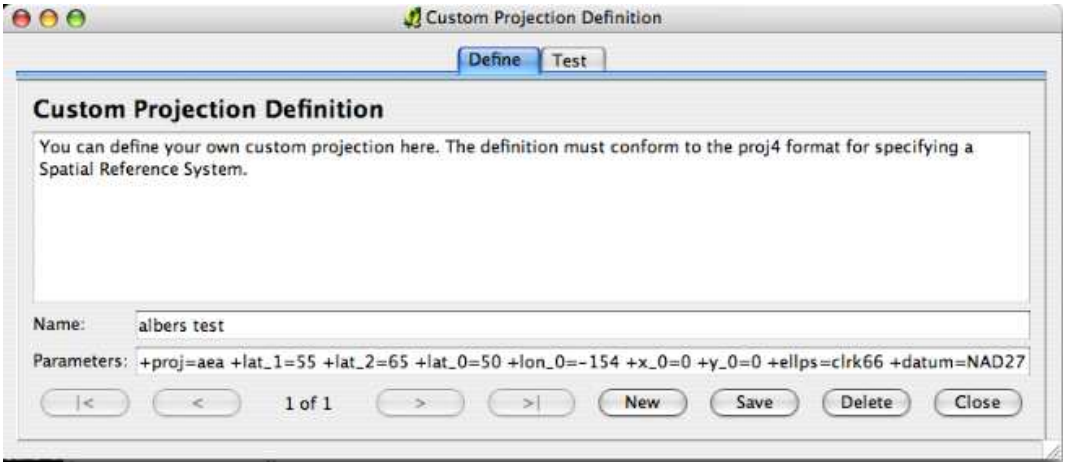
QGIS automatically sets the map projection to the coordinate system of the first layer loaded. One way to specify the map projection is to first load a layer with the projection you want for the entire map. Then open the *Project Properties* dialog and click on the *Enable on the fly projection* checkbox. You can now close the *Project Properties* dialog and add additional layers to the map.

If you have already added layers and want to enable OTF projection, open the *Project Properties* dialog and find the projection or geographic coordinate system you want to use in the list of projections. Alternatively you can use the search feature as described in the previous section.

7.3. Custom Projections

If QGIS doesn't have the projection you need, you can define a custom projection. To define a projection, select *Custom Projections* from the *Settings* menu. Custom projections are stored in your QGIS user database. In addition to your projections, this database contains your spatial bookmarks and other custom data.

Figure 15: Custom Projection Dialog (OS X)



At version 0.9.1 of QGIS, defining a custom projection requires a good understanding of the Proj.4 projection library. To begin, refer to Cartographic Projection Procedures for the UNIX Environment

- A User's Manual by Gerald I. Evenden, U.S. Geological Survey Open-File Report 90-284, 1990 (available at `ftp://ftp.remotesensing.org/proj/OF90-284.pdf`). This manual describes the use of the *proj* and related command line utilities. The cartographic parameters used with *proj* and described in the user manual are the same as those used by QGIS.

The Custom Projections dialog requires only two parameters to define a user projection:

1. a descriptive name, and
2. the cartographic parameters.

To create a new projection, click the *New* button and enter a descriptive name and the projection parameters. Figure 15 shows the dialog with an example projection. The parameters shown were entered based on a knowledge of the projection and the information found in OF90-284.

You can test your projection parameters to see if they give sane results by clicking on the *Test* tab and pasting your projection parameters into the *Parameters* field. Then enter known WGS 84 latitude and longitude values in North and East fields respectively. Click on *Calculate* and compare the results with the known values in your projected coordinate system.

8. GRASS Integration

The GRASS (3) plugin provides access to GRASS from within QGIS. This includes the ability to view, edit, and create data, as well as perform analysis using the GRASS geoprocessing modules.

In this chapter we'll introduce the plugin and some of the ways you can use it to work with GRASS data. The following features are provided with the GRASS plugin:

-  Add GRASS vector layers
-  Add GRASS raster layers
-  GRASS Toolbox
-  Changing the GRASS region
-  Vector layers digitizing
-  Open existing mapset
-  Create new GRASS mapset
-  Create new GRASS vector layer
-  Close GRASS mapset

8.1. Starting QGIS with GRASS

To use GRASS features from within QGIS, you must load the GRASS plugin with the plugin manager (see Section 11.1.2) just like all QGIS plugins. After you load it, a new toolbar will appear on the user interface.[3]

After loading the plugin, you can immediately load an existing GRASS dataset using the appropriate toolbar buttons for vector and raster data (see Section 8.2), or you can create a new GRASS location with QGIS (see Section 8.3).

[3] The GRASS plugin is unique in that it creates its own toolbar

8.2. Loading GRASS Data

With the GRASS plugin, you can load vector or raster layer using the appropriate button on the toolbar. As an example we use the spearfish sample location in UTM projection (see Section 3.2).

1. Download the spearfish_grass60data-0.3.zip file
2. Create a new folder *grassdata* and unzip the spearfish_grass60data-0.3.zip into it.
3. Start QGIS
4. In the GRASS toolbar, click on the *Open mapset* icon to bring up the *Select GRASS mapset* wizard.
5. For *Gisdbase* browse and enter the path to the newly created folder *grassdata*.
6. You should now be able to select the location *spearfish60* and the mapset *PERMANENT* or *user1*.
7. Click *OK*. Notice that some of the tools in the GRASS toolbar that were disabled are now enabled.
8. Click on *Add GRASS raster layer*, choose the *map name* geology and click *OK*. The geology map will be visualized.
9. Click on *Add GRASS vector layer*, choose the *map name* roads and click *OK*. Now the roads map will be overlayed on top of the geology.

As you see, it is very simple to load GRASS raster and vector layers in QGIS. See following sections for editing GRASS data and creating new locations.

Tip 28 GRASS DATA LOADING

If you have problems loading data or QGIS terminates abnormally, check to make sure you have loaded the GRASS plugin properly as described in Section 8.1.

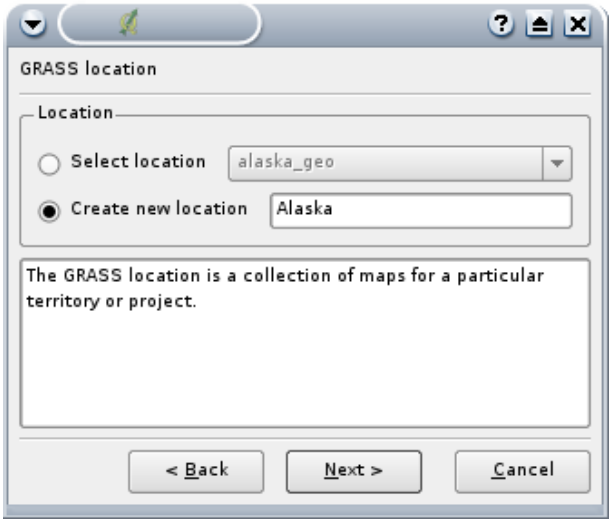
8.3. Creating a Location

GRASS stores data in a “location” which represents a specific area with a specific coordinate system. In order to use GRASS data, we must import it into a *location*.[4]

Here is an example how to create a GRASS location in Albers Equal Area projection with unit meter for the QGIS sample data (see Section 3.2).

[4] This is not strictly true - you can view external data sets without importing them

Figure 16: Creating a GRASS location in QGIS



1. Start QGIS
2. Make sure the GRASS plugin is loaded
3. Load the *alaska.shp* shapefile (see Section 4.1.1).
4. In the GRASS toolbar, click on the *New mapset* tool to bring up the mapset wizard
5. Each location is stored in a directory. Select an existing data directory or create a new one for storing the location
6. Click *Next*
7. We can use this wizard to create a new mapset within an existing location or create a new location altogether. Click “Create new location” radio button
8. Enter a name for the location - we’ll use Alaska
9. Click *Next*
10. Define the projection by clicking on the “Projection” radio button to enable the projection list
11. We are using Albers Equal Area Alaska (meters) projection. Since we happen to know that its PostGIS SRID is 5000, we enter it in the search box. (If you want to repeat this process for another layer and haven’t memorized the PostGIS SRID, click on the projector icon in the lower right-hand corner of the statusbar (see Section 7.2).)
12. Click *Find* to select the projection
13. Click *Next*

14. To define the default region, we have to enter the bounds in the north, south, east, and west direction. Here we simply click on the button *Set current QGIS extent*.
15. Click *Next*
16. We need to define a mapset within our new location. Name it whatever you like - your username is a good choice
17. Check out the summary to make sure it's correct
18. Click *Finish*
19. The mapset and location are created and opened as the current working set
20. Notice that some of the tools in the GRASS toolbar that were disabled are now enabled for us to use

If that seemed like a lot of steps, it's really not all that bad and a very quick way to create a location. Our location is now ready for use. To view the default region, zoom out. Clicking the *Display Current Grass Region* tool toggles the display region on and off.

8.4. Vector Data Model

It is important to understand the GRASS vector data model prior to digitizing. In general, GRASS uses a topological vector model. This means that areas are not represented as closed polygons, but by one or more boundaries. A boundary between two adjacent areas is digitized only once, and it is shared by both areas. Boundaries must be connected without gaps. An area is identified (labeled) by the centroid of the area.

Besides boundaries and centroids, a vector map can also contain points and lines. All these geometry elements can be mixed in one vector and will be represented in different so called 'layers' inside QGIS.

It is possible to store more 'layers' in one vector dataset. For example, fields, forests and lakes can be stored in one vector. Adjacent forest and lake can share the same boundary, but they have separate attribute tables. It is also possible to attach attributes to boundaries. For example, the boundary between lake and forest is a road, so it can have a different attribute table.

The 'layer' of the feature is defined by 'layer' inside GRASS. 'Layer' is the number which defines if there are more than one layer inside the dataset, e.g. if the geometry is forest or lake. For now, it can be only a number, in the future GRASS will also support names as fields in the user interface.

Attributes can be stored in external database tables, for example DBF, PostgreSQL, MySQL, SQLITE3, etc.

Attributes in database tables are linked to geometry elements using 'category'. 'Category' (key, ID) is an integer attached to geometry primitives, and it is used as the link to one column in the database table.

Tip 29 LEARNING THE GRASS VECTOR MODEL

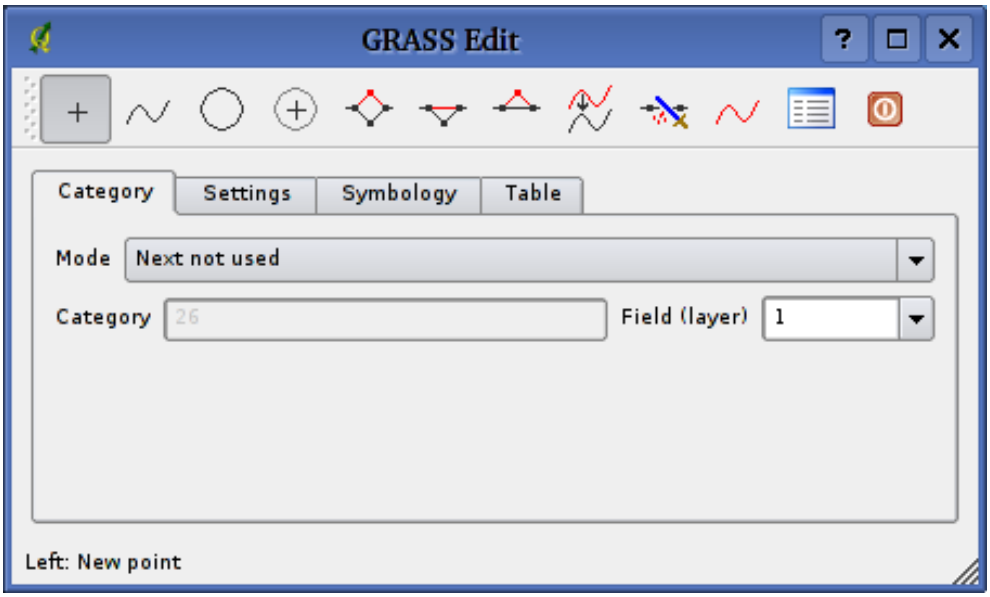
The best way to learn the GRASS vector model and its capabilities is to download one of the many GRASS Tutorials where the vector model is described more deeply. See `http://grass.itc.it/gdp/manuals.php` for more information, books and tutorials in several languages.

8.5. Digitizing and Editing Tools

 The digitizing tools for GRASS vector layers are accessed using the *Edit GRASS Vector Layer* tool on the toolbar. Make sure you have loaded a GRASS vector and it is the selected layer in the legend before clicking on the edit tool. If you would like to create a new GRASS vector, you need to use the toolbar-entry Plugins->GRASS->Create new GRASS vector layer

Figure 17 shows the GRASS Edit dialog that is displayed when you click on the edit tool.

Figure 17: GRASS Edit Dialog



The tools and settings are discussed in the following sections.

8.5.1. Toolbar

Table 4 lists the digitizing tools provided by the GRASS plugin. These correspond to the tool buttons in the toolbar(s) across the top of the dialog.

Table 4: GRASS Digitizing Tools

Icon	Tool	Purpose
	New Point	digitize new point
	New Line	digitize new line (finish by selecting new tool)
	New Boundary	digitize new boundary (finish by selecting new tool)
	New Centroid	digitize new centroid (label existing area)
	Move vertex	select one vertex of existing line or boundary and identify new position
	Add vertex	add a new vertex to existing line
	Delete vertex	delete one vertex from existing line (confirm selected vertex by another click)
	Move line	select existing line and click on new position
	Split line	split an existing line to 2 parts
	Delete line	delete existing line (confirm selected line by another click)
	Edit attributes	edit attributes of existing element (note that one element can represent more features, see above)
	Exit	close digitizing session (rebuilds topology afterwards)

8.5.2. Category Tab

This tab allows you to set the way in which the category will be assigned to each new feature and/or assign a category to a feature.

- Mode: what category should be attached to geometry
  - Next not used - next category not yet used in vector file
  - Manual entry - define the category in the 'Category'-entry field
  - No category - digitize geometry without entering any category

- Category - a number (ID) attached to digitized feature
- Field (layer) - feature (attribute table) identification

Tip 30 CREATING ADDITIONAL 'LAYERS' WITH QGIS

If you would like to add more layers to your dataset, just add a new number in the 'Field (layer)' entry box and press return. In the Table tab you can create your new table connected to your new layer.

8.5.3. Settings Tab

This tab allows you to set the snapping in screen pixels. This is the threshold in pixels in which new points or line ends are snapped to existing nodes. This helps prevent gaps or dangles between boundaries. The default is set to 10 pixels.

8.5.4. Symbology Tab

This tab allows you to view and set symbology and color settings for various geometry types and their topological status (e.g. closed / opened boundary).

8.5.5. Table Tab

This tab provides information about the database table for a given 'layer'. Here you can add, modify or create new database tables for the current layer.

Tip 31 GRASS EDIT PERMISSIONS

You must be the owner of the GRASS mapset you want to edit. It is impossible to edit vectors in mapsets which are not yours, even if you have write permissions.

8.6. Region Tool

 The current region (window) in GRASS is very important for all raster modules. All newly-created rasters have the extension and resolution of the current region, regardless of their original region. The region is stored in $LOCATION/$MAPSET/WIND file, and it defines north, south, east, west, number of columns, number of rows, horizontal and vertical spatial resolution.

It is possible to switch on/off the GRASS region in the QGIS canvas using the *Display Current GRASS Region* button.

With the *Edit Current GRASS Region* you can open a tool in which you can change the current region and symbology of the GRASS region rectangle on the QGIS canvas. When the tool is running, it is also possible to select a new region interactively with your mouse on the QGIS canvas.

8.7. GRASS Toolbox

 The GRASS toolbox provides analytic functions from GRASS within QGIS. To use the GRASS toolbox you need to have opened a mapset where you have write-permission. This is needed because QGIS will most probably create new datasets which need to be written to a valid mapset.

Therefore you need to start QGIS from within a GRASS session. Then your current mapset will be opened for writing.

Another option for opening a mapset for writing is provided through the GRASS plugin entry. Use Plugins->GRASS->Open mapset.

If you have a greyed out GRASS toolbox button, make sure you open a valid mapset for writing, since the GRASS plugin needs a mapset to store its results.

The toolbox also provides a very useful data browser for browsing through your current location and the mapsets it contains.

8.7.1. Modules inside the toolbox

The GRASS toolbox provide a collection of GRASS modules which can be used from within QGIS. They are grouped in thematic blocks which can be defined by the user (see Section 8.7.3).

When clicking on a module a new tab will be added to your toolbox which provides three new subtabs:

1. Options
2. Output
3. Manual

Options

This tab provides you with a very simplified entry field where you need to select the needed maps and enter parameters to run the selected module. Note, that these options are kept as simple as possible in order to keep the structure clear. If you need more of the module's options, feel free to use the GRASS shell to run the module.

Output

This tab provides you with the output generated from the running module. After you hit the 'run' button, the module switches to the Output-tab and you will see information about the process. If all goes well, you will see `Successfully finished` at the end.

Manual

This tab shows the help page of each GRASS module. You can have a look at the manual-page if you want to get a deeper knowledge about the purpose of the module. You may have recognized that some modules have more options and parameters than given in the 'Options' tab. This is correct and done by design. To keep the GUI simple as possible only the needed options and parameters are put in the Options tab. But you can always use the GRASS shell to run the module with all its parameters.

Tip 32 DISPLAY RESULTS IMMEDIATELY

If you want to display your calculation results immediately in your map canvas, you can use the 'View Output' button at the bottom of the module tab.

8.7.2. GRASS Browser

Another useful feature is the GRASS browser. In Figure 19(a) you can see the current location with its mapsets.

The browser on the left allows you to browse through all your mapsets inside your selected location.

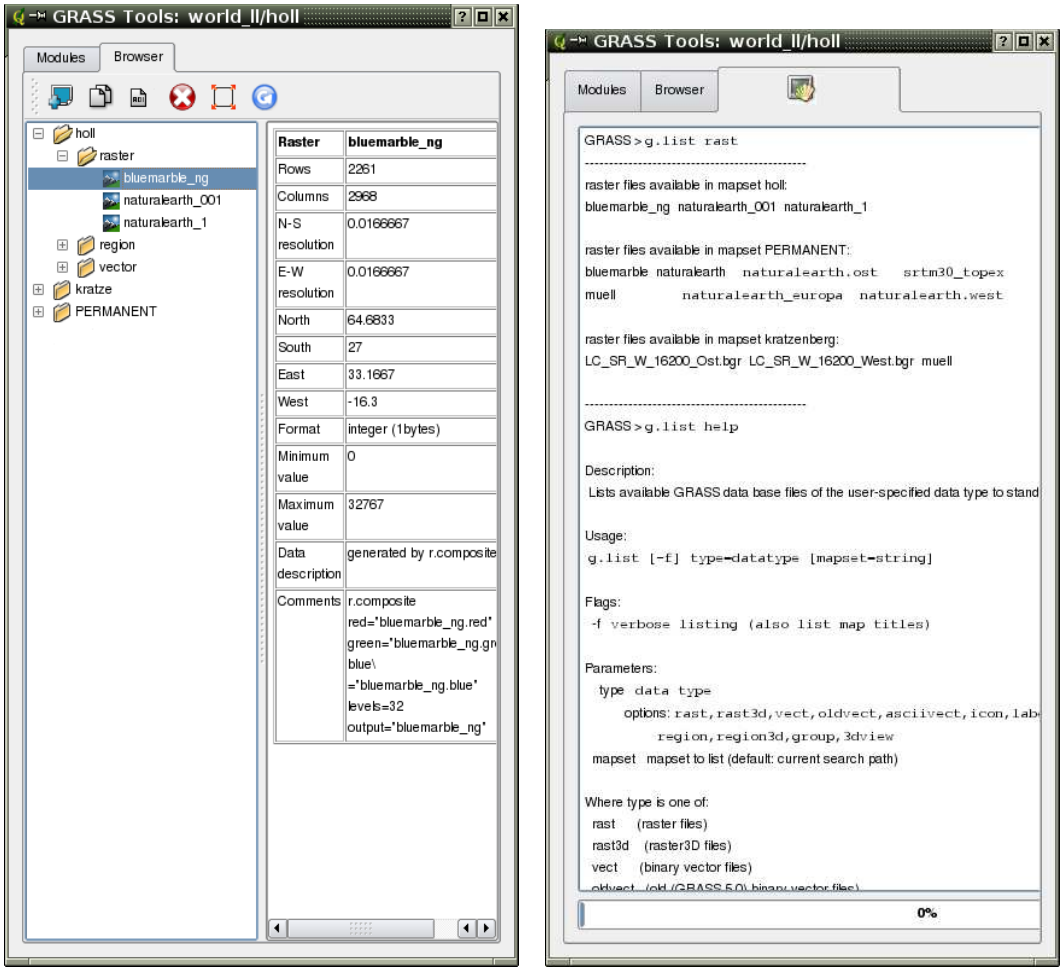
The right side of the browser window shows some meta information for the selected dataset, e.g. resolution, bounding box, data source, attribute table for vector data. . .

The toolbar inside the browser tab gives you the following tools for the selected dataset:

-  Add selected map to canvas
-  Copy selected map
-  Rename selected map
-  Delete selected map
-  Set current region to selected map
-  Refresh browser window

The 'Rename' and 'Delete' buttons are only available in your current mapset. All other tools also work on maps from other mapsets as well.

Figure 18: GRASS toolbox



(a) GRASS browser inside the toolbox (b) GRASS shell inside the toolbox

8.7.3. Customizing the modules section

Nearly all GRASS modules can be adopted to the GRASS toolbox. A XML interface is provided to parse the very simple XML files which configure the modules inside the toolbox.

A brief description of adding new modules, changing the modules group, etc. can be found on the QGIS wiki at `http://wiki.qgis.org/qgiswiki/Adding_New_Tools_to_the_GRASS_Toolbox`.

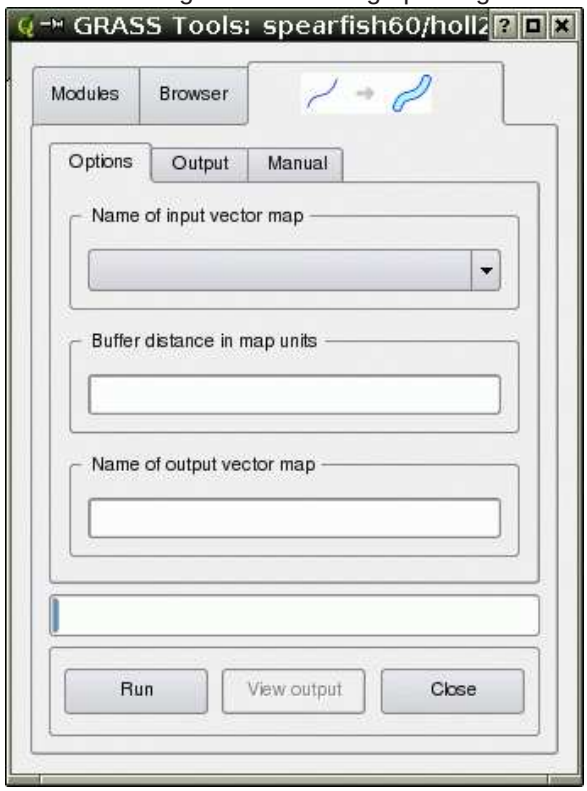
A sample XML file for generating the module `v.buffer` (v.buffer.qgm) looks like this:

```
<?xml version="1.0" encoding="UTF-8"?>
```

```
<!DOCTYPE qgisgrassmodule SYSTEM "http://mrcc.com/qgisgrassmodule.dtd">

<qgisgrassmodule label="Vector buffer" module="v.buffer">
        <option key="input" typeoption="type" layeroption="layer" />
        <option key="buffer"/>
        <option key="output" />
</qgisgrassmodule>
```

Figure 19: Module generated through parsing the XML-file



The parser reads this definition and creates a new tab inside the toolbox when you select the module:

8.8. Creating a new GRASS layer

With this version of QGIS it is also possible to create new vectors from within GRASS very easily.

Just select *Plugins->GRASS->Create new GRASS layer* from the toolbar, give a new name in the text box and start digitizing. If you encounter a greyed-out button, make sure you have a working mapset enabled. If you forgot how to enable a mapset have a look at Section 8.2.

Since GRASS is able to organize all sort of geometries in one layer, there is no need to select the geometry. This only applies to shapefile creation (see sec. 4.4.3).

Some hints to make your digitizing more useful:

- Make sure to create an attribute table with its needed columns before you start digitizing if you would like to assign attributes to your digitized object. Go to the table tab inside the digitize window.
- If you plan to create a polygon layer, consider setting the mode to *No category*. Then start digitizing the boundaries which actually do not need an entry in the attribute table. If you have done this, change back to *Next not used* and start digitizing the centroids, which hold the attribute information of a polygon.

9. Making MapServer Map Files

QGIS can be used to create map files for MapServer. You use QGIS to "compose" your map by adding and arranging layers, symbolizing them, and customizing the colors.

In order to use the MapServer exporter, you must have Python on your system and QGIS must have been compiled with support for it.

9.1. Creating the Project File

To create a MapServer map file:

1. Add your layers to QGIS
2. Symbolize your layers, setting the renderer and colors
3. Arrange the layers in the order you want them to appear in MapServer
4. Save your work to a QGIS project file

This gets us to the point where we are ready to create the map file.

Tip 33 MAPSERVER EXPORT REQUIRES A QGIS PROJECT FILE

This has been a source of confusion for a number of people. The MapServer export tool operates on a saved QGIS project file, **not** the current contents of the map canvas and legend. When using the tool, you need to specify a QGIS project file as input.

9.2. Creating the Map File

The exporter tool (*msexport*) is installed in your QGIS binary directory and can be used independently of QGIS.

From QGIS you can start the exporter by choosing *Export to MapServer Map...* from the *File* menu.

Here is a summary of the input fields:

Map file
: Enter the name for the map file to be created. You can use the button at the right to browse for the directory where you want the map file created.

Qgis project file
: Enter the full path to the QGIS project file (.qgs) you want to export. You can use the button at the right to browse for the QGIS project file.

Map Name
A name for the map. This name is prefixed to all images generated by the mapserver.

Map Width
Width of the output image in pixels.

Map Height
Height of the output image in pixels.

Map Units
Units of measure used for output

Image type
Format for the output image generated by MapServer

Web Template
Full path to the MapServer template file to be used with the map file

Web Header
Full path to the MapServer header file to be used with the map file

Web Footer
Full path to the MapServer footer file to be used with the map file

Only the Map file and QGIS project file inputs are required to create a map file, however you may end up with a non-functional map file, depending on your intended use. Although QGIS is good at creating a map file from your project file, it may require some tweaking to get the results you want - but it's still way better than writing a map file from scratch.

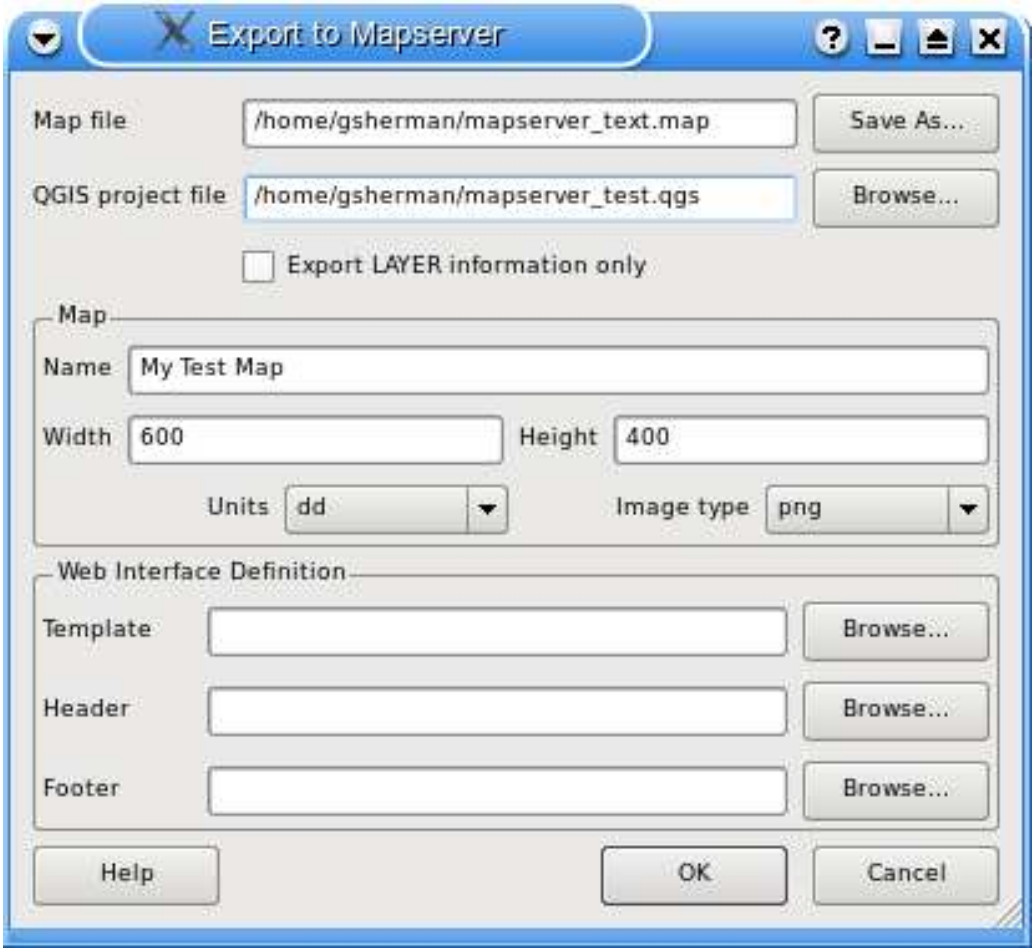
Creating a Map File

Let's create a map file using the shape files *alaska*, *lakes* and *rivers* layers from the qgis_sample_-data:

1. Load the *alaska*, *rivers* and *lakes* layers into QGIS
2. Change the colors and symbolize the data as you like
3. Save the project using *Save Project* from the *File* menu
4. Open the exporter by clicking on *Export to MapServer Map...* in the *File* menu
5. Enter a name for your new map file
6. Browse and find the project file you just saved
7. Enter a name for the map

8. Enter 600 for the width and 400 for the height
9. Our layers are in decimal degrees so we don't need to change the units
10. Choose "png" for the image type
11. Click *OK* to generate the map file

Figure 20: Export to MapServer map module in QGIS



You'll notice there is no feedback on the success of your efforts. This is an enhancement scheduled for the next version.

You can view the map file in an editor or using *less*. If you take a look, you'll notice that the export tool adds the metadata needed to enable our map file for WMS.

9.3. Testing the Map File

Let's test our work by using the *shp2img* command to create an image from the map file. The *shp2img* utility is part of MapServer, but is also distributed with FWTools. To create an image from our map:

- Open a terminal window
- If you didn't save your map file in your home directory, change to the directory where you saved it
- Run shp2img
- View the created image

Assuming our map file was named *mapserver_test.map*, the shp2img command is:

```
shp2img -m mapserver_test.map -o mapserver_test.png
```

This creates a PNG for us to view, containing all the layers that were on when we saved the QGIS project. In addition, the extent of the PNG will be the same as when we saved the project.

If you plan to use the map file to serve WMS requests, you probably don't have to tweak anything. If you plan to use it with a mapping template or a custom interface, you may have a bit of manual work to do. To see how easy it is to go from QGIS to serving maps on the web, take a look at Christopher Schmidt's 5 minute flash video. [5]

[5] `http://openlayers.org/presentations/mappingyourdata/`

10. Map Composer

The map composer is a feature that provides limited layout and printing capabilities. The composer allows you to add elements such as the QGIS map canvas, legend, scalebar, images, and text. You can size and position each item and adjust the properties to create your layout. The result can be printed, exported as an image, or exported to SVG.

To access the map composer, click on the *Print* button in the toolbar or choose *Print* from the *File* menu.

10.1. Using Map Composer

To use the map composer, first add the layers you want to print to QGIS. The layers should be rendered and symbolized to your liking prior to composing the map.

Opening the map composer provides you with a blank canvas to which you can add the current map view, legend, scalebar, and text. Figure 21 shows the initial view of the map composer before any elements are added.

The map composer has two tabs: *General* and *Item*. The *General* tab allows you to set the paper size, orientation, and resolution for the map. The *Item* tab displays the properties for the currently selected map element. By selecting an element on the map (eg. legend, scalebar, text, etc.) and clicking on the *Item* tab, you can customize the settings.

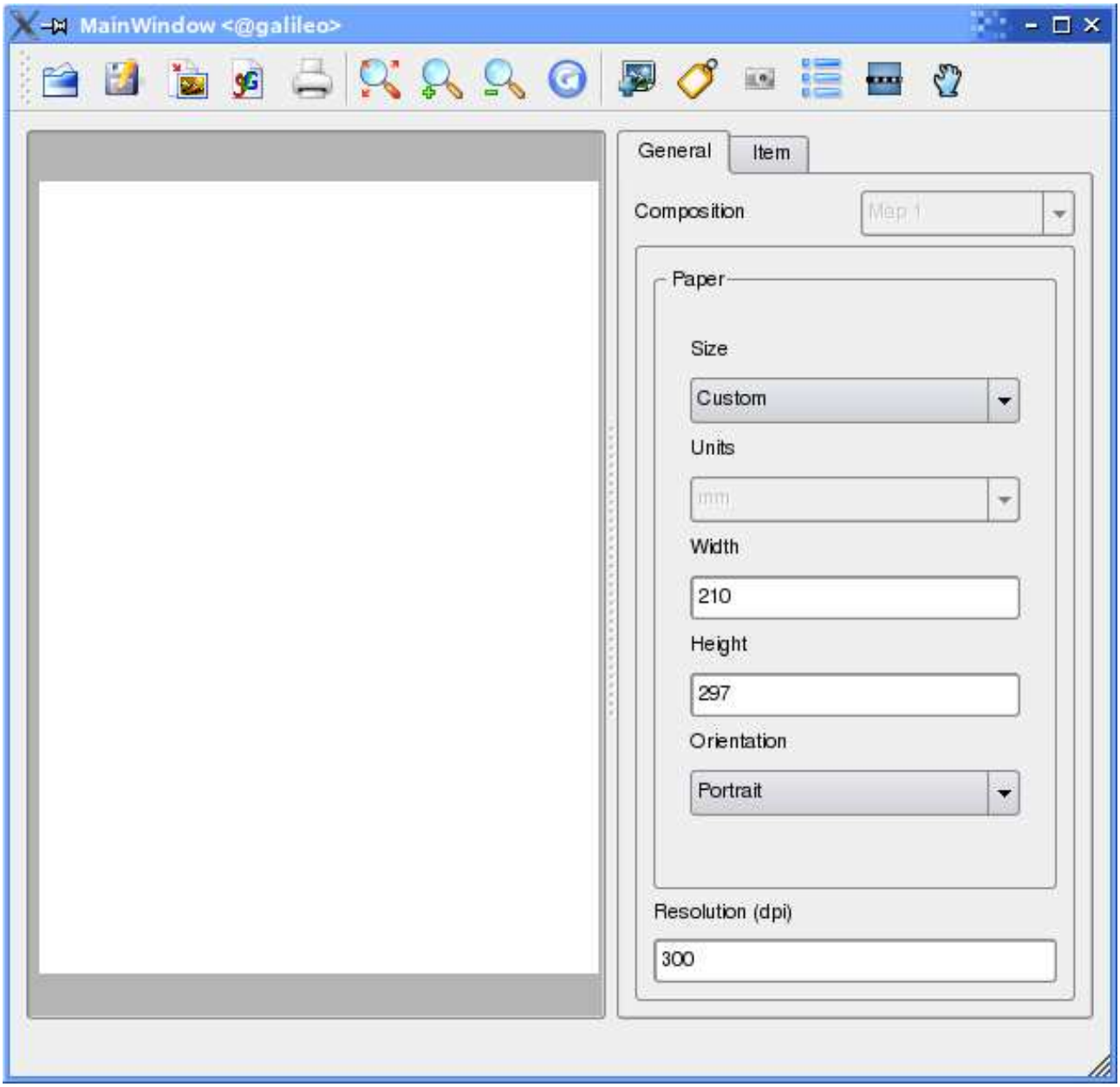
You can add multiple elements to the composer. This allows you to have more than one map view and legend in the composer. Each element has its own properties and in the case of the map, its own extent.

10.1.1. Adding a Map to the Composer

 To add the QGIS map canvas to the map composer, click on the *Add a new map* button in toolbar. Drag a rectangle on the composer canvas to add the map. You can resize the map later by clicking on the *Select/move item* button, clicking on the map, and dragging one of the handles in the corner of the map. With the map selected, you can also resize the map by specifying the width and height on the Item properties tab.

The map is linked to the QGIS map canvas. If you change the view on the map canvas by zooming or panning, you can update the map composer view by selecting the map in composer and clicking on the *Set Extent* button. You can also change the composer view by specifying a map scale. To set the view to a specific scale:

Figure 21: Map Composer



1. Choose *Scale (calculate extent)* from the *Set* drop-down box
2. Enter the scale denominator in the scale box
3. Press Enter

10.1.2. Adding other Elements to the Composer

 Already existing QGIS templates can be used to easily load and adapt map layouts. To open an existing template, click on the *Open Template* button. Choose a template and customize its appearance.

 To add a logo, north arrow or any kind of image to the composer, click on the *Add Image* button. The image will be placed on the composer canvas and you can move it where you like.

 A legend can be added to the composer canvas and customized to show only the desired layers. To add a legend, click on the *Add Vector Legend* button. The legend will be placed on the composer canvas and you can move it where you like. Click on the *Items* tab to customize the appearance of the legend, including which layers are shown.

 To add a scalebar to the composer, click on the *Add Scalebar* button. Use the *Item* tab to customize the segment size, number of segments, scalebar units, size, and font for the scalebar.

 You can add text labels to the composer by clicking on the *Add New Label* button. Use the *Item* tab while the text is selected to customize the settings or change the default text.

Figure 22 shows the map composer after adding each type of map element.

10.1.3. Other Features

The map composer has navigation tools to zoom in and out. To zoom in, click the zoom in tool. The map composer canvas will be scaled by a factor to 2. Use the scrollbars to adjust the view to the area of interest. Zooming out works in a similar fashion.

If you find the view in an inconsistent state, you can use the refresh button to redraw the map composer canvas.

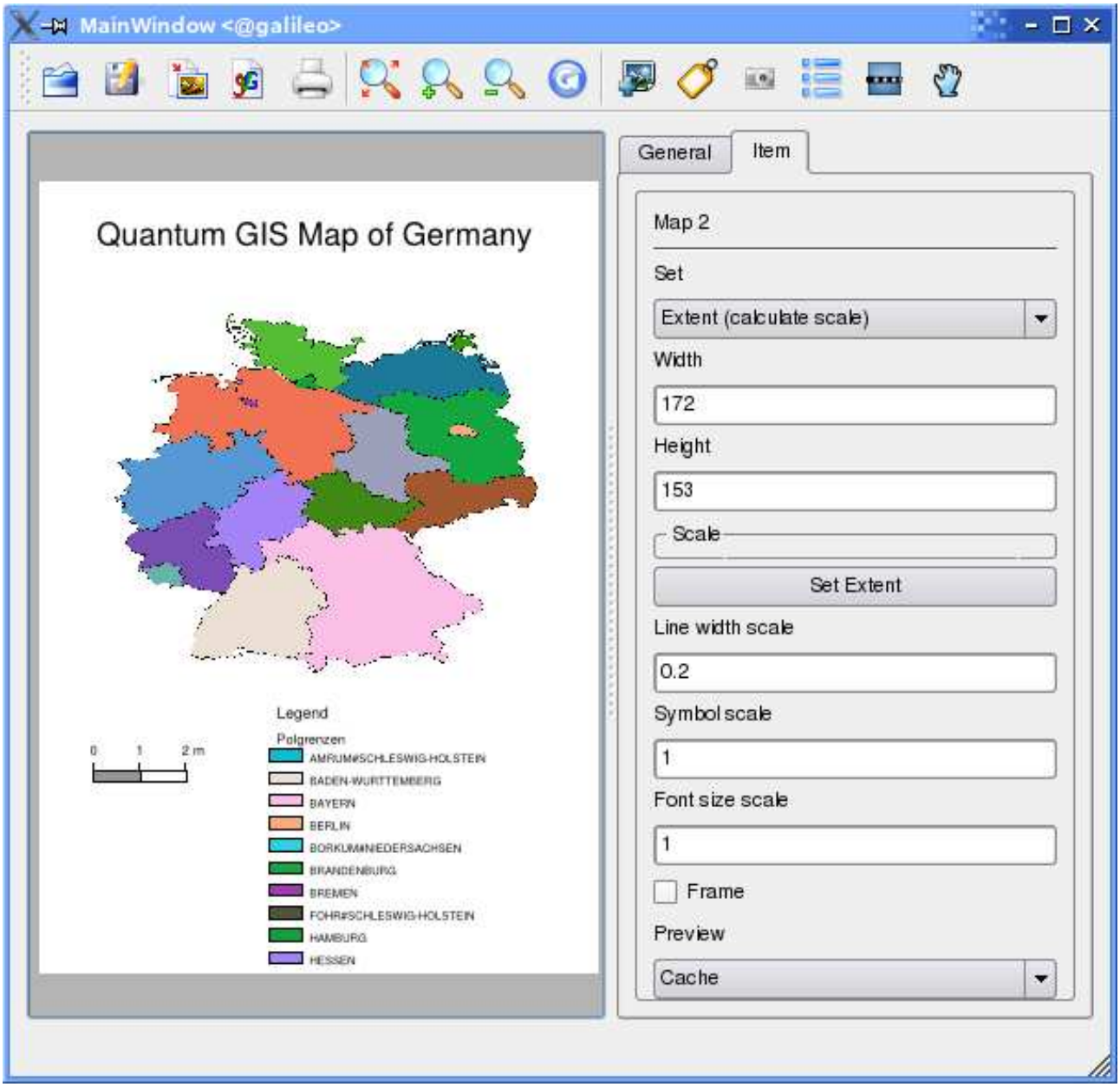
10.1.4. Creating Output

The map composer allows you to print the map to a printer, export to a PNG, or export to SVG. Each of these functions is available from the composer toolbar.

 To save the composer canvas as a templates, click on the *Save Template As* button. Browse to the directory you like and save a template to use it again for another map canvas.

 It is possible to export the result as an image by clicking on the *Export as image* button.

Figure 22: Map Composer with map view, legend, scalebar, and text added



To export the composer canvas as an SVG (Scalable Vector Graphic), click on the *Export as SVG* button. **Note:** Currently the SVG output is very basic. This is not a QGIS problem, but a problem of the underlaying Qt library. This will be sorted out in future versions.

11. Using Plugins

11.1. An Introduction to Using Plugins

QGIS has been designed with a plugin architecture. This allows new features/functions to be added to the application. Many of the features in QGIS are actually implemented as plugins.

There are two types of plugins in QGIS: core and user-contributed. A core plugin is maintained by the QGIS development team and is part of every QGIS distribution. A user-contributed plugin is an external plugin that is maintained by the individual author. The QGIS SVN website (`http://svn.qgis.org`) serves some user contributed plugins.

11.1.1. Finding and Installing a Plugin

When you install QGIS, all of the core plugins are included (see chapter 11.1.4).

Typically user-contributed plugins are distributed in source form and require compiling. For instructions on building and installing a user-contributed plugin, see the documentation included with the plugin.

11.1.2. Managing Plugins

Managing plugins consists of loading or unloading them from QGIS. Loaded plugins are "remembered" when you exit the application and restored the next time you run QGIS.

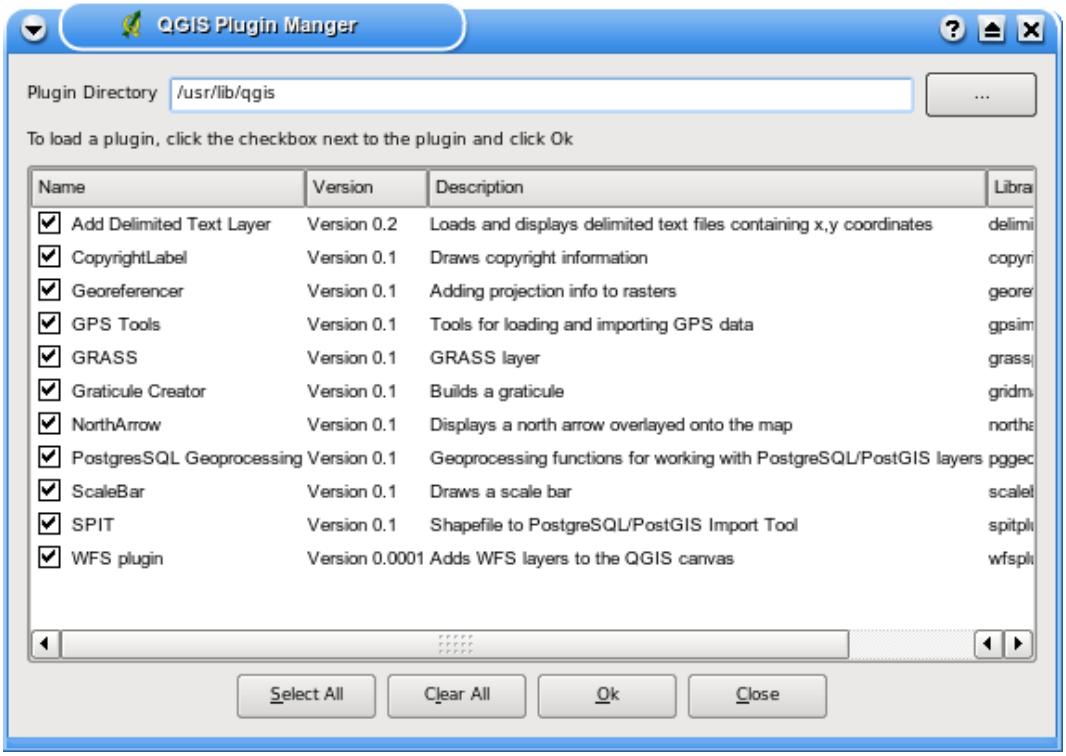
To manage plugins, open the *Plugin Manager* from the *Tools* menu. The Plugin Manager displays all the available plugins and their status (loaded or unloaded). Figure 23 shows the Plugin Manager dialog.

Typically all QGIS plugins are installed in the same location. This location is shown in the Plugin Directory text field. You can tell QGIS to load plugins from another location by specifying a different directory.

Tip 34 CRASHING PLUGINS

If you find that QGIS crashes on startup, a plugin may be at fault. You can stop all plugins from loading by editing your stored settings file (see 3.8 for location). Locate the plugins settings and change all the plugin values to false to prevent them from loading. For example, to prevent the Delimited text plugin from loading, the entry in $HOME/.config/QuantumGIS/qgis.conf on Linux should look like this:`Add Delimited Text Layer=false`.Do this for each plugin in the [Plugins] section. You can then start QGIS and add the plugins one at a time from the Plugin Manger to determine which is causing the problem.

Figure 23: Plugin Manager



11.1.3. Data Providers

Data Providers are "special" plugins that provides access to a data store. By default, QGIS supports PostGIS layers and disk-based data stores supported by the GDAL/OGR library (Appendix A.1). A Data Provider plugin extends the ability of QGIS to use other data sources.

Data Provider plugins are registered automatically by QGIS at startup. They are not managed by the Plugin Manager but are used behind the scenes when a corresponding data type is added as a layer in QGIS.

11.1.4. Core Plugins

QGIS currently contains 9 core plugins that can be loaded using the Plugin Manager. Table 5 lists each of the core plugins along with a description of their purpose and the toolbar-icon. Note the GRASS plugin is not included below because it installs its own toolbar (see section 8 for a discussion of available features in the GRASS plugin).

Table 5: QGIS Core Plugins

Icon	Plugin	Description
	Copyright Label	Display a copyright label on the map canvas
	Delimited Text	Load a delimited text file containing x,y coordinates as a point layer
	GPS Tools	Load and display GPS data
	Graticule Creator	Create a latitude/longitude grid and save as a shapefile
	Scalebar	Add a scalebar to the map canvas
	North Arrow	Add a north arrow to the map canvas
	PostgreSQL Geoprocessing	Buffer a PostGIS layer
	SPIT	Shapefile to PostGIS Import Tool - import shapefiles into PostgreSQL
	Georeferencer[a]	Georeferencing rasterlayers
	WFS	Load and display WFS layer

[a]The georeferencer-plugin is only available if you have installed the gsl-libraries and headers during compile-time. Please check the installation-chapter **??** for details.

Tip 35 PLUGINS SETTINGS SAVED TO PROJECT

When you save a .qgs project, any changes you have made to NorthArrow, ScaleBar and Copyright plugins will be saved in the project and restored next time you load the project.

11.1.5. External Plugins

QGIS also comes with some externally developed plugins. They are not shipped with the default distribution. However, they can be compiled and used within QGIS.

Currently the external plugins are only available directly from SVN. To check out all available external plugins do the following:

```
svn co https://svn.qgis.org/repos/qgis/trunk/external_plugins external_qgis_plugins
```

This will create a folder `external_qgis_plugins` in your current folder. Each subdirectory has its own compile and install instructions. Read them carefully in order to build the plugin.

11.1.6. Plugin templates

If you like to develop your own QGIS-plugin the main sources include a nice script which guides you through the process of creating your own template-directory-structure within the QGIS-source-tree. The script lives in `QGIS/src/plugins/plugin_builder.pl`.

The only thing to do is coding your functions into the plugin (and of course contribute your plugin the the QGIS-development-team).

Beside that the QGIS-wiki (`http://wiki.qgis.org`) and the QGIS-blog (`http://blog.qgis.org`) provide useful articles about writing your own plugin as well. Check the websites for details!

11.2. Using the Decorations Plugins

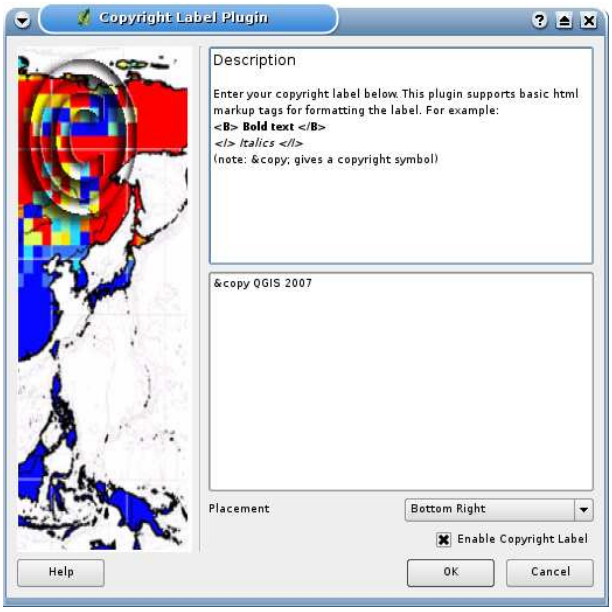
The “Decoration” plugins include the following:

- Copyright Label Plugin
- North Arrow Plugin
- Scale Bar Plugin

These “decorate” the map by adding cartographic elements.

11.2.1. Copyright Label Plugin

Figure 24: Copyright Plugin



The title of this plugin is a bit misleading - you can add any random text to the map.

1. Make sure the plugin is loaded
2. Click on the *Copyright Label* tool on the Plugins toolbar
3. Enter the text you want to place on the map. You can use HTML as shown in the example
4. Choose the placement of the label from the drop-down box

5. Make sure the “Enable Copyright Label” checkbox is checked
6. Click *OK*

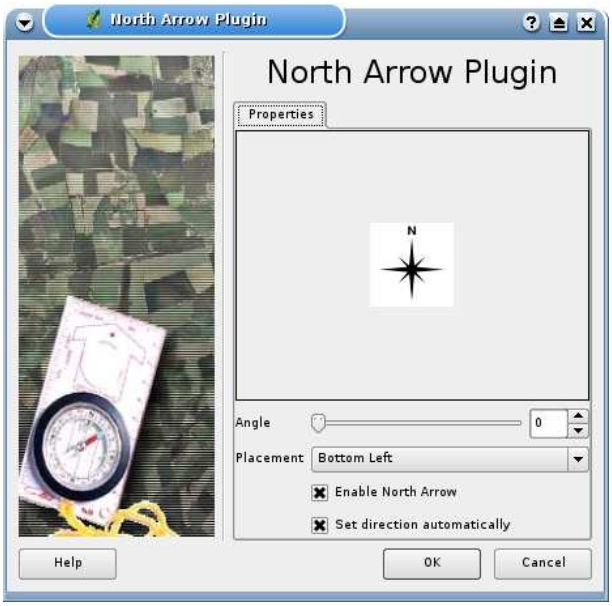
In the example above, the first line is in bold, the second (created using
) contains a copyright symbol, followed by our company name in italics.

11.2.2. North Arrow Plugin

The North Arrow plugin places a simple north arrow on the map canvas. At present there is only one style available. You can adjust the angle of the arrow or let QGIS set the direction automatically. If you choose to let QGIS determine the direction, it makes its best guess as to how the arrow should be oriented.

For placement of the arrow you have four options, corresponding to the four corners of the map canvas.

Figure 25: North Arrow Plugin



11.2.3. Scale Bar Plugin

The Scale Bar plugin adds a simple scale bar to the map canvas. You control the style and placement, as well as the labeling of the bar.

QGIS only supports displaying the scale in the same units as your map frame. So if the units of your layers are in meters, you can't create a scale bar in feet. Likewise if you are using decimal degrees, you can't create a scale bar to display distance in meters.

To add a scale bar:

1. Open the plugin dialog by clicking on the *Scale Bar* tool on the Plugins toolbar
2. Choose the placement from the drop-down list
3. Choose the style
4. Select the color for the bar, or use the default black color
5. Set the size of the bar and its label
6. Make sure the "Enable scale bar" checkbox is checked
7. Optionally choose to automatically snap to a round number when the canvas is resized
8. Click *OK*

Figure 26: Scale Bar Plugin

11.3. Using the GPS Plugin

11.3.1. What is GPS?

GPS, the Global Positioning System, is a satellite-based system that allows anyone with a GPS receiver to find their exact position anywhere in the world. It is used as an aid in navigation, for example in airplanes, in boats, and by hikers. The GPS receiver uses the signals from the satellites to calculate its latitude, longitude and (sometimes) elevation. Most receivers also have the capability to store locations (known as *waypoints*), sequences of locations that make up a planned *route*, and a tracklog or *track* of the receivers movement over time. Waypoints, routes, and tracks are the three basic feature types in GPS data. QGIS displays waypoints in point layers while routes and tracks are displayed in linestring layers.

11.3.2. Loading GPS data from a file

There are dozens of different file formats for storing GPS data. The format that QGIS uses is called GPX (GPS eXchange format), which is a standard interchange format that can contain any number of waypoints, routes, and tracks in the same file.

 To load a GPX file you need to use the *GPS Tools* plugin. When this plugin is loaded a button with a small handheld GPS device will show up in the toolbar (the device looks a bit like a mobile phone). Clicking on this button will open the *GPS Tools* dialog (see figure 27).

Figure 27: The *GPS Tools* dialog window

Use the browse button [...] to select the GPX file, then use the checkboxes to select the feature types you want to load from that GPX file. Each feature type will be loaded in a separate layer when you click OK.

11.3.3. GPSBabel

Since QGIS uses GPX files you need a way to convert other GPS file formats to GPX. This can be done for many formats using the free program GPSBabel, which is available at `http://www.gpsbabel.org`. This program can also transfer GPS data between your computer and a GPS device. QGIS uses GPSBabel to do these things, so it is recommended that you install it. However, if you just want to load GPS data from GPX files you will not need it. Version 1.2.3 of GPSBabel is known to work with QGIS, but you should be able to use later versions without any problems.

11.3.4. Importing GPS data

To import GPS data from a file that is not a GPX file, you use the tool *Import other file* in the *GPS Tools* dialog. Here you select the file that you want to import, which feature type you want to import from it, where you want to store the converted GPX file, and what the name of the new layer should be.

When you select the file to import you must also select the format of that file by using the menu in the file selection dialog (see figure 28). All formats do not support all three feature types, so for many formats you will only be able to choose between one or two types.

11.3.5. Downloading GPS data from a device

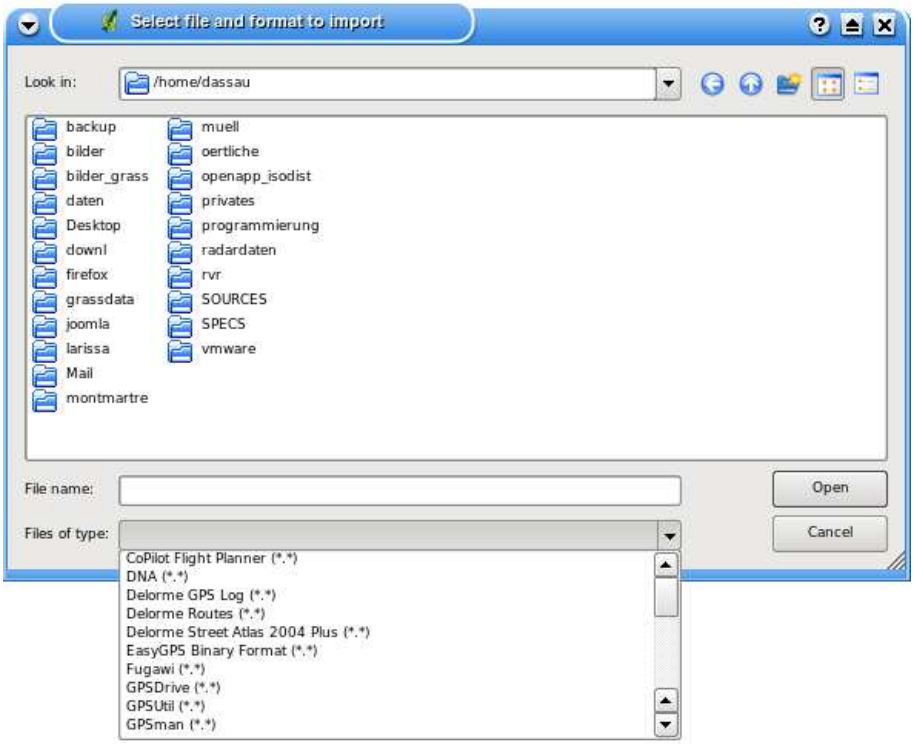
QGIS can use GPSBabel to download data from a GPS device directly into vector layers. For this you use the tool *Download from GPS* (see Figure 29), where you select your type of GPS device, the port that it is connected to, the feature type that you want to download, the GPX file where the data should be stored, and the name of the new layer.

The device type you select in the GPS device menu determines how GPSBabel tries to communicate with the device. If none of the device types works with your GPS device you can create a new type (see section 11.3.7).

The port is a file name or some other name that your operating system uses as a reference to the physical port in your computer that the GPS device is connected to. On Linux this is something like /dev/ttyS0 or /dev/ttyS1 and on Windows it's COM1 or COM2.

When you click OK the data will be downloaded from the device and appear as a layer in QGIS.

Figure 28: File selection dialog for the import tool



11.3.6. Uploading GPS data to a device

You can also upload data directly from a vector layer in QGIS to a GPS device, using the tool *Upload to GPS*. The layer must be a GPX layer. To do this you simply select the layer that you want to upload, the type of your GPS device, and the port that it's connected to. Just as with the download tool you can specify new device types if your device isn't in the list.

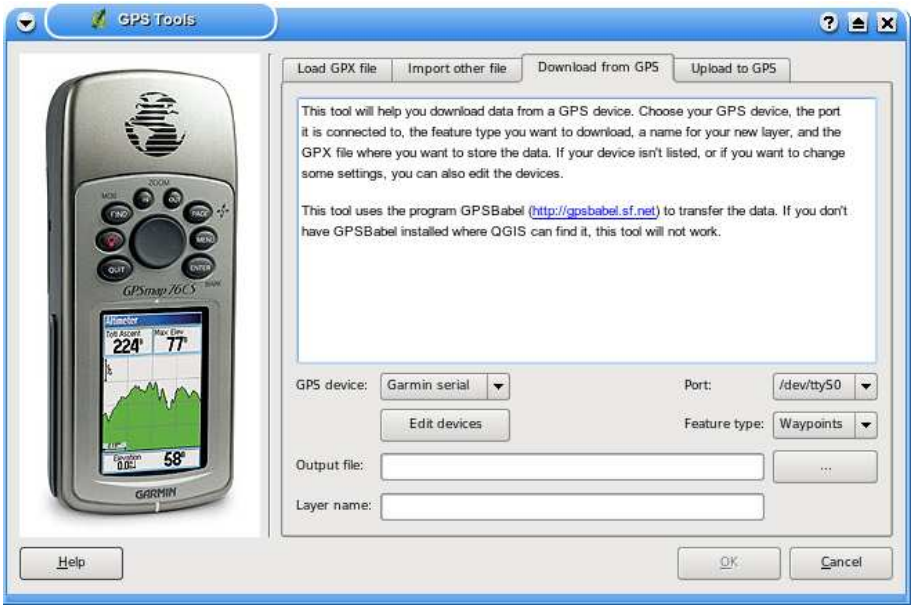
This tool is very useful together with the vector editing capabilities of QGIS. You can load a map, create some waypoints and routes, and then upload them and use them in your GPS device.

11.3.7. Defining new device types

There are lots of different types of GPS devices. The QGIS developers can't test all of them, so if you have one that does not work with any of the device types listed in the download and upload tools you can define your own device type for it. You do this by using the *GPS device editor*, which you start by clicking the *Edit devices* button in the download or the upload window.

To define a new device you simply click the *New device* button, enter a name, a download command, and an upload command for your device, and click the *Update device* button. The name will be listed

Figure 29: The download tool



in the device menus in the upload and download windows, and can be any string.

The download command is the command that is used to download data from the device to a GPX file. This will probably be a GPSBabel command, but you can use any other command line program that can create a GPX file. QGIS will replace the keywords *%type*, *%in*, and *%out* when it runs the command.

%type will be replaced by "-w" if you are downloading waypoints, "-r" if you are downloading routes, and "-t" if you are downloading tracks. These are command line options that tell GPSBabel which feature type to download.

%in will be replaced by the port name that you choose in the download window, and *%out* will be replaced by the name you choose for the GPX file that the downloaded data should be stored in. So if you create a device type with the download command "gpsbabel %type -i garmin -o gpx %in %out" (this is actually the download command for the predefined device type "Garmin serial") and then use it to download waypoints from port "/dev/ttyS0" to the file "output.gpx", QGIS will replace the keywords and run the command "gpsbabel -w -i garmin -o gpx /dev/ttyS0 output.gpx".

The upload command is the command that is used to upload data to the device. The same keywords are used, but *%in* is now replaced by the name of the GPX file for the layer that is being uploaded, and *%out* is replaced by the port name. You can learn more about GPSBabel and it's available command line options at `http://www.gpsbabel.org`

Once you have created a new device type it will appear in the device lists for the download and upload tools.

11.4. Using the Delimited Text Plugin

The Delimited Text plugin allows you to load a delimited text file as a layer in QGIS.

11.4.1. Requirements

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

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

An example of a valid text file might look like this:

```
name|latdec|longdec|cell|
196 mile creek|61.89806|-150.0775|tyonek d-1 ne|
197 1/2 mile creek|61.89472|-150.09972|tyonek d-1 ne|
a b mountain|59.52889|-135.28333|skagway c-1 sw|
apw dam number 2|60.53|-145.75167|cordova c-5 sw|
apw reservoir|60.53167|-145.75333|cordova c-5 sw|
apw reservoir|60.53|-145.75167|cordova c-5 sw|
aaron creek|56.37861|-131.96556|bradfield canal b-6|
aaron island|58.43778|-134.81944|juneau b-3 ne|
aats bay|55.905|-134.24639|craig d-7|
```

Some items of note about the text file are:

1. The example text file uses | as delimiter. Any character can be used to delimit the fields.
2. The first row is the header row. It contains the fields name, latdec, longdec, and cell
3. No quotes (") are used to delimit text fields
4. The x coordinates are contained in the *longdec* field
5. The y coordinates are contained in the *latdec* field

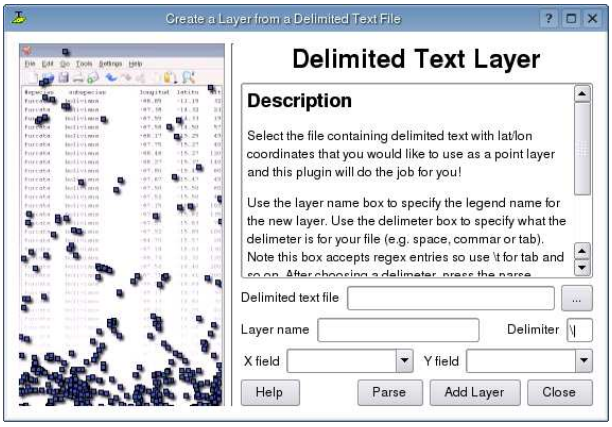
11.4.2. Using the Plugin

To use the plugin you must have QGIS running and use the Plugin Manager to load the plugin:

Start QGIS, then Open the Plugin Manager by choosing the *Tools*|*Plugin Manager* menu. The Plugin Manager displays a list of available plugins. Plugins that are already loaded have a check mark to the left of their name. Click on the checkbox to the left of the *Add Delimited Text Layer* plugin and click Ok to load it as described in Section 11.1.2.

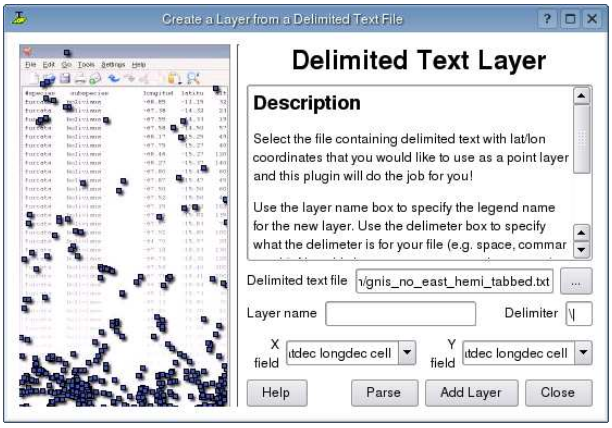
A new toolbar icon is now present:  Click on the icon to open the Delimited Text dialog as shown in Figure 30.

Figure 30: Delimited Text Dialog



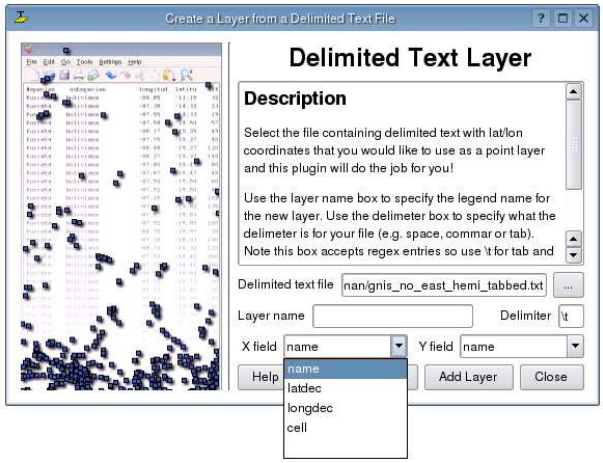
First select the file to import by clicking on the ellipsis button:  Select the desired text file from the file dialog Once the file is selected, the plugin attempts to parse the file using the last used delimiter, in this case | (see Figure 31).

Figure 31: File Selected



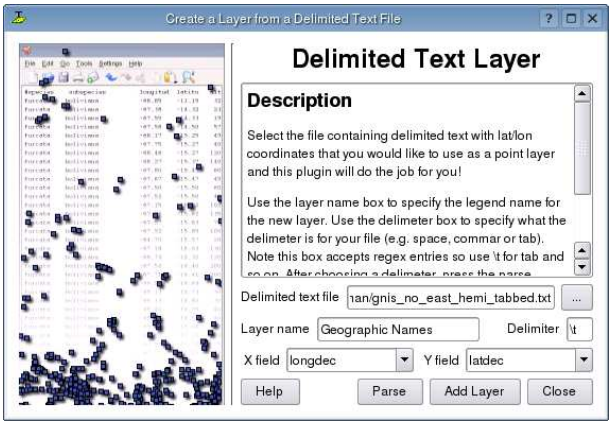
In this case the delimiter | is not correct for the file. The file is actually tab delimited. Note that the X and Y field drop down boxes do not contain valid field names.

Figure 32: Fields Parsed from Text File



To properly parse the file, change the delimiter to tab using \t (this is a regular expression for the tab character). After changing the delimiter, click *Parse*. The drop down boxes now contain the fields properly parsed as shown in Figure 32.

Figure 33: Selecting the X and Y Fields



Choose the X and Y fields from the drop down boxes and enter a Layer name as shown in Figure 33. To add the layer to the map, click *Add Layer*. The delimited text file now behaves as any other map layer in QGIS.

11.5. Using the Graticule Creator Plugin

The graticule creator allows to create a “grid” of points, line, or polygons to cover our area of interest. All units must be entered in decimal degrees. The output is a shapefile which can be projected on the fly to match your other data.

Figure 34: Create a graticule layer

Here is an example how to create a graticule:

1. Make sure the plugin is loaded
2. Click on the *Graticule Creator* tool on the plugins toolbar
3. Choose the type of graticule you which to create: point, line, or polygon
4. Enter the latitude and longitude for the lower left and upper right corners of the graticule
5. Enter the interval to be used in constructing the grid. You can enter different values for the X and Y directions (longitude, latitude)
6. Choose the name and location of the shapefile to be created
7. Click *OK* to create the graticule and add it to the map canvas

11.6. Using the Georeferencer Plugin

The georeferencer plugin allows to generate world files for rasters. Therefore you select points on the raster, add their coordinates, and the plugin will compute the world file parameters. The more coordinates you provide the better the result will be.

As an example we will generate a world file for a topo sheet of South Dakota from SDGS. It can later be visualized together with in the data of the GRASS spearfish60 location. You can download the topo sheet here:
`http://grass.itc.it/sampledata/spearfish_toposheet.tar.gz`

As a first step we download the file and untar it.

```
wget http://grass.itc.it/sampledata/spearfish_toposheet.tar.gz
tar xvzf spearfish_toposheet.tar.gz
cd spearfish_toposheet
```

The next step is to start QGIS, load the georeferencer plugin and select the file spearfish_topo24.tif.

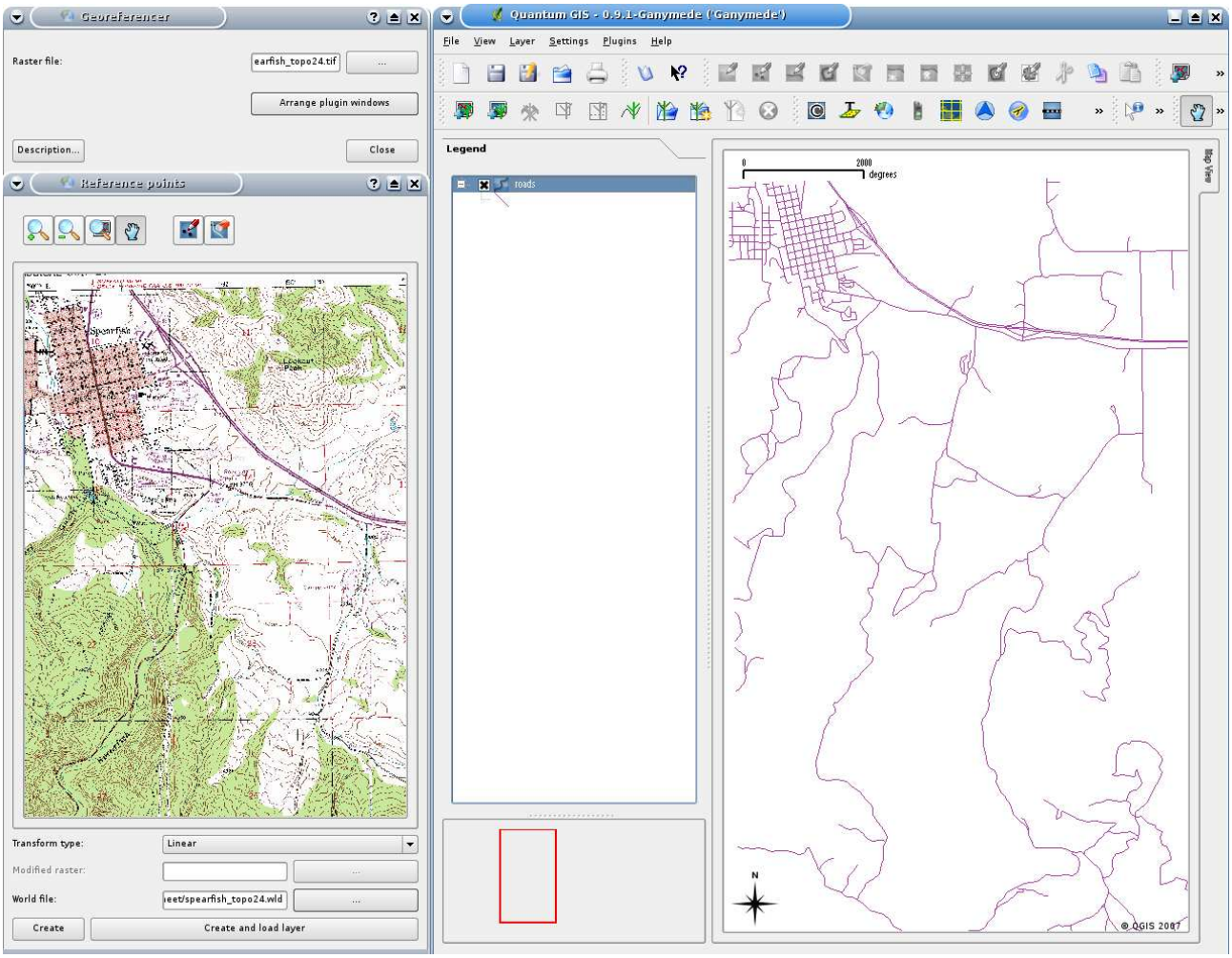
Figure 35: Select an image to georeference

Now click on the button *Arrange plugin window* to open the image in the georeferencer and to arrange it with the reference map in the qgis map canvas on your dekstop.

With the button *Add Point* you can start to add points on the raster image and enter their coordinates, and the plugin will compute the world file parameters (see figure 37). The more coordinates you provide the better the result will be. For the procedure you have two option.

1. You click on a point in the raster map and enter the X and Y coordinates manually

Figure 36: Arrange plugin window with the qgis map canvas



2. You click on a point in the raster map and choose the button *from map canvas* to add the X and Y coordinates with the help of a georeference map already loaded in QGIS.

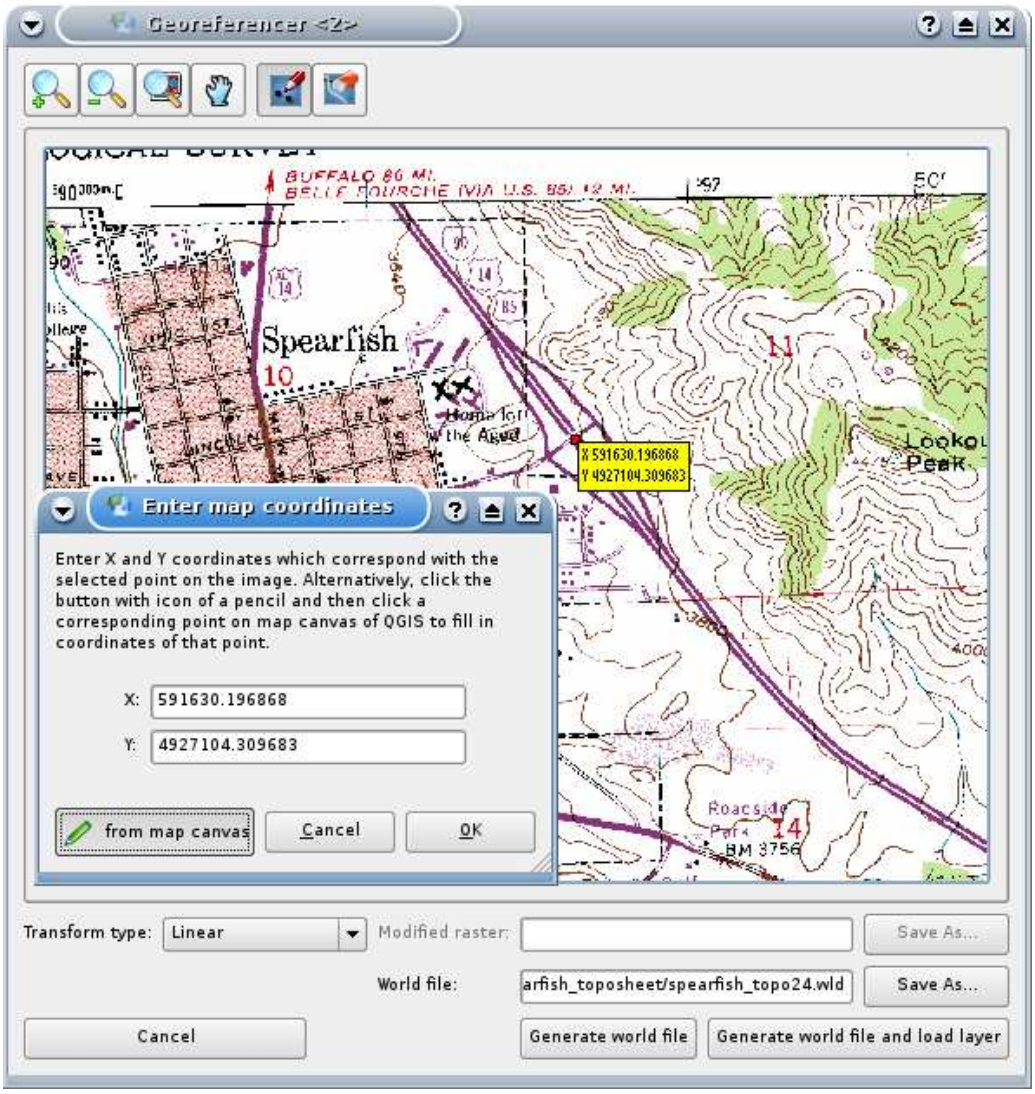
For this example we use the second option and enter the coordinates for the selected points with the help of the *roads* map provided with the *spearfish60* location from:
`http://grass.itc.it/sampledata/spearfish_grass60data-0.3.tar.gz`

If you don't know how to integrate the spearfish60 location with the GRASS plugin, information are provided in Section 8.

As you can see in Figure 37, the georeferencer provides buttons to zoom, pan, add and delete points in the image.

After you added enough points to the image you need to select the transformation type for the geo-

Figure 37: Add points to the raster image



referencing process and save the resulting world file together with the Tiff. In our example we choose linear transformation although a helmert transformation might be sufficient as well.

Tip 36 CHOOSING THE TRANSFORMATION TYPE

The linear (affine) transformation is a 1st order transformation and used for scaling, translation and rotation of geometrically correct images. With the helmert transformation you simply add coordinate information to the image like geocooding. If your image is contorted you will need to use software that provides 2nd or 3rd order polynomial transformation, e.g. GRASS GIS.

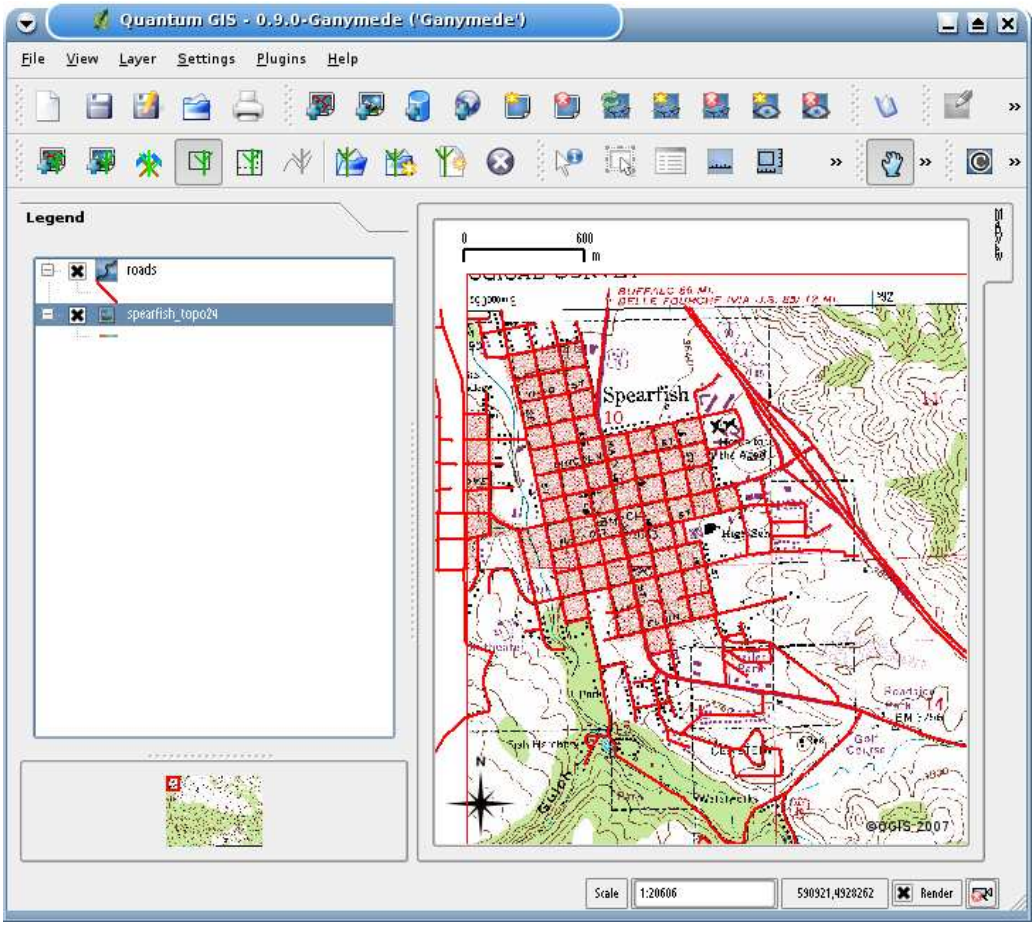
The points we added to the map will be stored in a *spearfish_topo24.tif.points* file together with the raster image. This allows us to reopen the georeferencer plugin and to add new or delete existing

points to optimize the result. The *spearfish_topo24.tif.points* file of this example shows the points:

```
mapX     mapY     pixelX  pixelY
591630.196867999969982  4927104.309682800434530 591647  4.9271e+06
608453.589164100005291  4924878.995150799863040 608458  4.92487e+06
602554.903929700027220  4915579.220743400044739 602549  4.91556e+06
591511.138448899961077  4915952.302661700174212 591563  4.91593e+06
602649.526155399973504  4919088.353569299913943 602618  4.91907e+06
```

We used 5 coordinate points to georeference the raster image. To get correct results it is important to disperse the points regulary in the image. Finally we check the result and load the new georeferenced map *spearfish_topo24.tif* and overlay it with the map *roads* of the spearfish60 location.

Figure 38: Georeferenced map with overlayed roads from spearfish60 location



11.7. Using the Python Plugin

Writing plugins in Python is much simpler than using C++. To create a PyQGIS plugin, you need QGIS 0.9, Python, PyQt, and the Qt developer tools (2).

When QGIS starts up it scans certain directories looking for both C++ and Python plugins. For a file (shared library, DLL, or python script) to be recognized as a plugin it has to have a specific signature. For Python scripts it's pretty simple. QGIS looks in the following locations under the installation directory:

- **Linux and other Unix**: ./share/qgis/python/plugins
- **Mac OS X**: ./Contents/MacOS/share/qgis/python/plugins
- **Windows**: .\share\QGIS\python\plugins

Each Python plugin is contained in its own directory. When QGIS starts up it will scan each subdirectory in *share/qgis/python/plugins* and initialize any plugins it finds. Once that's done, the plugin will show up in the plugin manager.

Let's create a plugin to fill a gap in the QGIS interface. This plugin will allow us to create a new PostGIS layer for us to digitize. It will be a simple plugin and pretty rough, but it illustrates how to get started writing your own PyQGIS plugins.

11.7.1. Setting up the Structure

The first thing we need to do is set up the structure for our plugin. In this example we'll be developing our plugin on Linux but the method is the same, just adapt some of the file system commands as appropriate for your platform. QGIS is installed in a directory named *qgis_09* in our home directory. Let's create the directory for the plugin.

```
mkdir ~/qgis_09/share/qgis/python/plugins/new_layer
```

To get started, we need to create the following files in the *new_layer* directory (we'll need some additional files in a bit):

```
__init__.py
resources.py
resources.qrc
newlayer.py
```

11.7.2. Making the Plugin Recognizable

Initializing the plugin is done in the *__init__.py* script. For our *NewLayer* plugin the script contains:

```
1 # load NewLayer class from file newlayer.py
2 from newlayer import NewLayer
3 def name():
4   return "New PostGIS layer"
5 def description():
6   return "Creates a new empty Postgis layer"
7 def version():
8   return "Version 0.1"
9 def classFactory(iface):
10   return NewLayer(iface)
```

The mandatory things a plugin must return are a name, description, and version, all of which are implemented in our script above. Each method simply returns a string with the appropriate information. The other requirement is the *classFactory* method that must return a reference to the plugin itself (line 10), after receiving the **iface** object as an argument. With this simple code, QGIS will recognize our script as a plugin.

11.7.3. Resources

In order to have a nice icon for our plugin, we need a resources file which we'll name *resources.qrc*. This is just a simple XML file that defines the icon resource:

```
 <RCC>
    <qresource prefix="/plugins/newlayer">
        <file>icon.png</file>
    </qresource>
</RCC>
```

The resource file uses a prefix to prevent naming clashes with other plugins - using the name of the plugin is usually sufficient. The *icon.png* file is is just a PNG image that will be used in the toolbar when the plugin is activated. You can use any image, as long as it's 22x22 pixels (so it fits on the toolbar).

To turn the resource file into something the plugin can use, it must be compiled using the PyQt resource compiler:

```
pyrcc4 -o resources.py resources.qrc
```

The *-o* switch is used to specify the output file. Now that we have resources, we need a way to collect the information needed for creating a new layer.

11.7.4. Creating the GUI

Normally we would use the same tool that C++ developers use to create a GUI: Qt Designer. This is a visual design tool that allows you to create dialog and main windows by dragging and dropping widgets and defining their properties.

To design our NewLayer plugin we could get quite fancy and include widgets for field types and other options. However, since our time is limited, we'll use another means to collect the information we need to create the table. This will illustrate the concepts and then you can venture further using the tutorials on the QGIS blog.

To collect the user input, we'll use the *QInputDialog* class from the Qt library. This prompts the user for a single line of input. While it will make our plugin a little crude, it serves to illustrate the concepts.

All we need to write now is the Python code to collect the input and create the table.

11.7.5. Creating the Plugin

Now that we have the preliminaries out of the way, we can get down to writing the code that does the actual work. Let's start by looking at the things we need to import and the initialization of the plugin in *newlayer.py*.

```
1 # Import the PyQt and QGIS libraries
2 from PyQt4.QtCore import *
3 from PyQt4.QtGui import *
4 from qgis.core import *
5 import psycopg
6 # Initialize Qt resources from file resources.py
7 import resources
8
9 # Our main class for the plugin
10 class NewLayer:
11
12  def __init__(self, iface):
13    # Save reference to the QGIS interface
14    self.iface = iface
```

```
15
16  def initGui(self):
17    # Create action that will start plugin configuration
18    self.action = QAction(QIcon(":/plugins/newlayer/icon.png"),\
19      "New PosGIS Layer", self.iface.getMainWindow())
20    QObject.connect(self.action, SIGNAL("activated()"), self.run)
21
22    # Add toolbar button and menu item
23    self.iface.addToolBarIcon(self.action)
24    self.iface.addPluginMenu("&New PostGIS Layer...", self.action)
25
26  def unload(self):
27    # Remove the plugin menu item and icon
28    self.iface.removePluginMenu("&New PostGIS Layer...",self.action)
29    self.iface.removeToolBarIcon(self.action)
```

In lines 2 through 7 we import the libraries needed for the plugin. This includes the PyQt libraries, the QGIS core library, and the Python PostgreSQL library psycopg. Every Python script that uses the QGIS libraries and PyQt needs to import the QtCore and QtGui libraries, as well as the QGIS core library. This gives us access to the PyQt wrappers for our Qt objects (like our input dialog) and the QGIS core libraries. We also need to import the *resources.py* file we created with the icon definition.

In line 10 we declare the class **NewLayer**. In the *__init__* method (lines 12 through 14) our class is initialized and passed the **iface** object from QGIS via the *classFactory* method in line 10 of __init__.py. We store **iface** as a member variable so we can use it later.

In lines 16 through 24 we initialize the GUI elements for the plugin. In Qt, a **QAction** is used to create a user interface action that can be used to create both a menu and toolbar item. In our plugin, we use it for both. In line 18 we create the action using our icon resource (note the prefix we specified in *resources.qrc*). We also provide some text that will appear when it is used in a menu or during a mouseover, and lastly we need to specify the “parent”. In a plugin, the parent is the main window of QGIS. The **iface** object that we stored during initialization allows us to get the reference to the main window in line 19.

Once the action is created, we can add it to both the toolbar and the *Plugins* menu (lines 23 and 24). That takes care of initializing the GUI for the plugin. The other thing we need to do is clean up after ourself when the plugin is unloaded. The *unload* method takes care of this by removing the menu item and the tool from the toolbar (lines 28 and 29).

This takes care of the initialization stuff and getting our plugin to load and unload nicely. Now let’s look at the code that does the actual work. It’s all contained in the *run* method.

```
30 def run(self):
```

```
31  # Get the user input, starting with the table name
32  table_name = QInputDialog.getText(None, "Table Name?", \
33    "Name for new PostGIS layer")
34  if table_name[0].length() > 0:
35    # Get the field names and types
36    fields = QInputDialog.getText(None, "Field Names", \
37     "Fields (separate with a comma)")
38    parts = fields[0].split(',')
39    # Create the SQL statement
40    sql = "create table " + table_name[0] + " (id int4 primary key, "
41    for fld in parts:
42     sql += fld + " varchar(10), "
43    sql = sql[0:-2]
44    sql += ")"
45    # Connect to the database
46    # First get the DSN
47    dsn = QInputDialog.getText(None, "Database DSN", \
48     "Enter the DSN for connecting to the database (dbname=db user=user)")
49    if dsn[0].length() > 0:
50     con = psycopg.connect(str(dsn[0]))
51     curs = con.cursor()
52     curs.execute(str(sql))
53     con.commit()
54     # add the geometry column
55     curs.execute("select AddGeometryColumn('" + str(table_name[0]) + \
56       "', 'the_geom', 4326, 'POLYGON', 2)")
57     con.commit()
58     # create the GIST index
59     curs.execute("create index sidx_" + str(table_name[0]) + " on " + \
60       str(table_name[0]) + " USING GIST(the_geom GIST_GEOMETRY_OPS)")
61       con.commit()
```

The first thing we need to do is use the **QInputDialog** to get the name of the table to create. This is done in line 32 where we prompt for it.

In line 34 we check to see if the user actually entered anything before proceeding.

Next we need to get the field names. For this example we are keeping it very simple. Every field will be a varchar(10), meaning we can store up to 10 characters in it. If we really want to make this plugin useful, we would need to provide a way for the user to specify the type. In line 36 we prompt the user to enter a comma delimited list of field names.

We then split this list into its components for use in constructing the SQL statement (line 38).

Figure 39: Enter new PostGIS table name

Figure 40: Enter field names for new PostGIS table

Line 40 contains the first part of the SQL statement. Note we are creating the table with an integer id field that will be the primary key. We then iterate through the field list, appending the appropriate code to the SQL statement (line 41).

Once we have all the fields added to the SQL statement, we chop off the trailing characters we don't want (line 43) and then add the closing parenthesis to complete the statement (line 44).

Now we are ready to connect to the database and create the table. To access the database, we are using psycopg (`http://www.initd.org`). In order to connect we need to specify the data source name (DSN) with the name of the database, the user, and a password if necessary. If we are running both QGIS and PostgreSQL on the same machine we usually don't need to specify a password. In this case, the DSN will look something like this:

dbname=gis_data user=gsherman

To get the DSN, we prompt the user with a **QInputDialog** in line 47.

If the user enters a DSN then we can proceed with the connection to the database in line 50. We get a cursor from the connection in line 51 and then execute the SQL statement to create the table and commit the change in lines 52 through 53. This creates the table, but for it to be a valid layer and ready for us to use it needs a couple more things.

Figure 41: Enter DSN for connection to PostGIS database

First it needs a geometry column. We purposely didn't include one when we created the table so we could use the *AddGeometryColumn* function to create it. This function adds a geometry column to the table and then puts an entry in the *geometry_columns* table for us. In line 55 we specify the table name, the name we want for the geometry column, the SRID, feature type, and the dimension of the feature.

The last thing to do is create a spatial index on the table so we get optimum performance when doing spatial searches and displaying the data in QGIS. In line 59 we have cobbled together the SQL to create the index. The actual statement looks like this:

```
create index sidx_park_land on park_land
   USING GIST(the_geom GIST_GEOMETRY_OPS);
```

11.7.6. Issues and Problems

Our plugin is now complete. Now lets look at some of the things that are wrong with it or where we could improve it:

- We could use an improved GUI, one that lets the user enter all the needed information on one dialog
- The user can't specify field types
- There is limited error checking in the dialog
  - If you don't enter any fields, the plugin fails
  - There is no error checking on any of the database operations
- There is no feedback from the plugin once it completes

With all the issues, it still serves as a primordial plugin that illustrates the process and helps get you started with your own plugin development.

11.7.7. Adding Feedback

Let's fix one of the small problems by adding some feedback at the end of the process. We'll just add a message box to tell the user that everything is done and to check the database to make sure the table was created.

To do this, we just add the following code after line 61:

```
# show the user what happened
QMessageBox.information(None, "Results", "Table " + str(table_name[0]) + \
" has been created. Check your database to confirm.")
```

When the table is created, the user sees this:

Figure 42: Message Box with Plugin results

11.7.8. Summary

Writing a QGIS plugin in Python is pretty easy. Some plugins won't require a GUI at all. For example, you might write a plugin that returns the map coordinates for the point you click on the map. Such a plugin wouldn't require any user input and could use a standard Qt **QMessageBox** to display the result.

You can also write plugins for QGIS in C++, but that's another story. You can find tutorials on writing QGIS plugins in both C++ and Python on the QGIS blog at:

`http://blog.qgis.org`

12. Creating Applications

One of the goals of QGIS is to provide not only an application, but a set of libraries that can be used to create new applications. This goal has been realized with the refactoring of libraries that took place after the release of 0.8. With the release of 0.9, development of standalone applications using either C++ or Python is possible.

In this chapter we'll take a brief look at the process for creating a standalone Python application. The QGIS blog has several examples of creating PyQGIS[6] applications. We'll use one of them as a starting point to get a look at how to create an application.

The features we want in the application are:

- Load a vector layer
- Pan
- Zoom in and out
- Zoom to the full extent of the layer
- Set custom colors when the layer is loaded

This is a pretty minimal feature set. Let's start by designing the GUI using Qt Designer.

12.1. Designing the GUI

Since we are creating a minimalistic application, we'll take the same approach with the GUI. Using Qt Designer, we create a simple MainWindow with no menu or toolbars. This gives us a blank slate to work with. To create the MainWindow:

1. Create a directory for developing the application and change to it
2. Run Qt Designer
3. The "New Form" dialog should appear. If it doesn't, choose *New Form...* from the *File* menu.
4. Choose "Main Window" from the templates/forms list
5. Click *Create*
6. Resize the new window to something manageable

[6] An application created using Python and the QGIS bindings

7. Find the Frame widget in the list (under Containers) and drag it to the main window you just created
8. Click outside the frame to select the main window area
9. Click on the *Lay Out in a Grid* tool. When you do, the frame will expand to fill your entire main window
10. Save the form as *mainwindow.ui*
11. Exit Qt Designer

Now compile the form using the PyQt interface compiler:

```
pyuic4 -o mainwindow_ui.py mainwindow.ui
```

This creates the Python source for the main window GUI. Next we need to create the application code to fill the blank slate with some tools we can use.

12.2. Creating the MainWindow

Now we are ready to write the **MainWindow** class that will do the real work. Since it takes up quite a few lines, we'll look at it in chunks, starting with the import section and environment setup:

```
1 # Loosely based on:
2 #   Original C++ Tutorial 2 by Tim Sutton
3 #   ported to Python by Martin Dobias
4 #   with enhancements by Gary Sherman for FOSS4G2007
5 # Licensed under the terms of GNU GPL 2
6
7 from PyQt4.QtCore import *
8 from PyQt4.QtGui import *
9 from qgis.core import *
10 from qgis.gui import *
11 import sys
12 import os
13 # Import our GUI
14 from mainwindow_ui import Ui_MainWindow
15 # Import our resources (icons)
16 import resources
17
```

```
18 # Environment variable QGISHOME must be set to the 0.9 install directory
19 # before running this application
20 qgis_prefix = os.getenv("QGISHOME")
```

Some of this should look familiar from our plugin, especially the PyQt4 and QGIS imports. Some specific things to note are the import of our GUI in line 14 and the import of our resources file on line 16.

Our application needs to know where to find the QGIS installation. Because of this, we set the QGISHOME environment variable to point to the install directory of QGIS 0.9. In line 20 we store this value from the environment for later use.

Next we need to create our **MainWindow** class which will contain all the logic of our application.

```
21 class MainWindow(QMainWindow, Ui_MainWindow):
22
23   def __init__(self):
24     QMainWindow.__init__(self)
25
26     # Required by Qt4 to initialize the UI
27     self.setupUi(self)
28
29     # Set the title for the app
30     self.setWindowTitle("FOSS4G2007 Demo App")
31
32     # Create the map canvas
33     self.canvas = QgsMapCanvas()
34     # Set the background color to light blue something
35     self.canvas.setCanvasColor(QColor(200,200,255))
36     self.canvas.enableAntiAliasing(True)
37     self.canvas.useQImageToRender(False)
38     self.canvas.show()
39
40     # Lay our widgets out in the main window using a
41     # vertical box layout
42     self.layout = QVBoxLayout(self.frame)
43     self.layout.addWidget(self.canvas)
44
45     # Create the actions for our tools and connect each to the appropriate
46     # method
47     self.actionAddLayer = QAction(QIcon(":/foss4g2007/mActionAddLayer.png"),
48     \
49         "Add Layer", self.frame)
```

```
50      self.connect(self.actionAddLayer, SIGNAL("activated()"), self.addLayer)
51      self.actionZoomIn = QAction(QIcon(":/foss4g2007/mActionZoomIn.png"), \
52          "Zoom In", self.frame)
53      self.connect(self.actionZoomIn, SIGNAL("activated()"), self.zoomIn)
54      self.actionZoomOut = QAction(QIcon(":/foss4g2007/mActionZoomOut.png"), \
55          "Zoom Out", self.frame)
56      self.connect(self.actionZoomOut, SIGNAL("activated()"), self.zoomOut)
57      self.actionPan = QAction(QIcon(":/foss4g2007/mActionPan.png"), \
58          "Pan", self.frame)
59      self.connect(self.actionPan, SIGNAL("activated()"), self.pan)
60      self.actionZoomFull = QAction(QIcon(":/foss4g2007/mActionZoomFullExtent.png"), \
61          "Zoom Full Extent", self.frame)
62      self.connect(self.actionZoomFull, SIGNAL("activated()"),
63      self.zoomFull)
64
65      # Create a toolbar
66      self.toolbar = self.addToolBar("Map")
67      # Add the actions to the toolbar
68      self.toolbar.addAction(self.actionAddLayer)
69      self.toolbar.addAction(self.actionZoomIn)
70      self.toolbar.addAction(self.actionZoomOut);
71      self.toolbar.addAction(self.actionPan);
72      self.toolbar.addAction(self.actionZoomFull);
73
74      # Create the map tools
75      self.toolPan = QgsMapToolPan(self.canvas)
76      self.toolZoomIn = QgsMapToolZoom(self.canvas, False) # false = in
77      self.toolZoomOut = QgsMapToolZoom(self.canvas, True) # true = out
```

Lines 21 through 27 are the basic declaration and initialization of the **MainWindow** and the set up of the user interface using the *setupUi* method. This is required for all applications.

Next we set the title for the application so it says something more interesting than 'MainWindow' (line 30). Once that is complete, we are ready to complete the user interface. When we created it in Designer, we left it very sparse—just a main window and a frame. You could have added a menu and the toolbar using Designer, however we'll do it with Python.

In lines 33 through 38 we set up the map canvas, set the background color to a light blue, and enable antialiasing. We also tell it not to use a QImage for rendering (trust me on this one) and then set the canvas to visible by calling the *show* method.

Next we set the layer to use a vertical box layout within the frame and add the map canvas to it in line 43.

Lines 48 to 63 set up the actions and connections for the tools in our toolbar. For each tool, we create a **QAction** using the icon we defined in our resources file. Then we connect up the *activated* signal from the tool to the method in our class that will handle the action. This is similar to how we set things up in the plugin example.

Once we have the actions and connections, we need to add them to the toolbar. In lines 66 through 72 we create the toolbar and add each tool to it.

Lastly we create the three map tools for the application (lines 75 through 77). We'll use the map tools in a moment when we define the methods to make our application functional. Let's look at the methods for the map tools.

```
78   # Set the map tool to zoom in
79   def zoomIn(self):
80     self.canvas.setMapTool(self.toolZoomIn)
81
82   # Set the map tool to zoom out
83   def zoomOut(self):
84     self.canvas.setMapTool(self.toolZoomOut)
85
86   # Set the map tool to
87   def pan(self):
88    self.canvas.setMapTool(self.toolPan)
89
90   # Zoom to full extent of layer
91   def zoomFull(self):
92     self.canvas.zoomFullExtent()
```

For each map tool, we need a method that corresponds to the connection we made for each action. In lines 79 through 88 we set up a method for each of the three tools that interact with the map. When a tool is activated by clicking on it in the toolbar, the corresponding method is called that "tells" the map canvas it is the active tool. The active tool governs what happens when the mouse is clicked on the canvas.

The zoom to full extent tool isn't a map tool—it does its job without requiring a click on the map. When it is activated, we call the *zoomFullExtent* method of the map canvas (line 92). This completes the implementation of all our tools except one—the add layer tool. Let's look at it next:

```
93   # Add an OGR layer to the map
94   def addLayer(self):
95     file = QFileDialog.getOpenFileName(self, "Open Shapefile", ".", "Shapefiles
96     (*.shp)")
```

```
97      fileInfo = QFileInfo(file)
98
99      # Add the layer
100      layer = QgsVectorLayer(file, fileInfo.fileName(), "ogr")
101
102     if not layer.isValid():
103       return
104
105     # Change the color of the layer to gray
106     symbols = layer.renderer().symbols()
107     symbol = symbols[0]
108     symbol.setFillColor(QColor.fromRgb(192,192,192))
109
110     # Add layer to the registry
111     QgsMapLayerRegistry.instance().addMapLayer(layer);
112
113     # Set extent to the extent of our layer
114     self.canvas.setExtent(layer.extent())
115
116     # Set up the map canvas layer set
117     cl = QgsMapCanvasLayer(layer)
118     layers = [cl]
119     self.canvas.setLayerSet(layers)
```

In the *addLayer* method we use a **QFileDialog** to get the name of the shapefile to load. This is done in line 96. Notice that we specify a "filter" so the dialog will only show files of type *.shp*.

Next in line 97 we create a **QFileInfo** object from the shapefile path. Now the layer is ready to be created in line 100. Using the **QFileInfo** object to get the file name from the path we specify it for the name of the layer when it is created. To make sure that the layer is valid and won't cause any problems when loading, we check it in line 102. If it's bad, we bail out and don't add it to the map canvas.

Normally layers are added with a random color. Here we want to tweak the colors for the layer to make a more pleasing display. Plus we know we are going to add the *world_borders* layer to the map and this will make it look nice on our blue background. To change the color, we need to get the symbol used for rendering and use it to set a new fill color. This is done in lines 106 through 108.

All that's left is to actually add the layer to the registry and a few other housekeeping items (lines 111 through 119). This stuff is standard for adding a layer and the end result is the world borders on a light blue background. The only thing you may not want to do is set the extent to the layer, if you are going to be adding more than one layer in your application.

That's the heart of the application and completes the **MainWindow** class.

12.3. Finishing Up

The remainder of the code shown below creates the **QgsApplication** object, sets the path to the QGIS install, sets up the *main* method and then starts the application. The only other thing to note is that we move the application window to the upper left of the display. We could get fancy and use the Qt API to center it on the screen.

```
120 def main(argv):
121   # create Qt application
122   app = QApplication(argv)
123
124   # Initialize qgis libraries
125   QgsApplication.setPrefixPath(qgis_prefix, True)
126   QgsApplication.initQgis()
127
128   # create main window
129   wnd = MainWindow()
130   # Move the app window to upper left
131   wnd.move(100,100)
132   wnd.show()
133
134   # run!
135   retval = app.exec_()
136
137   # exit
138   QgsApplication.exitQgis()
139   sys.exit(retval)
140
141
142 if __name__ == "__main__":
143   main(sys.argv)
```

12.4. Running the Application

Now we can run the application and see what happens. Of course if you are like most developers, you've been testing it out as you went along.

Before we can run the application, we need to set some environment variables. On Linux or OS X:

```
export LD_LIBRARY_PATH=$HOME/qgis_09/lib
export PYTHONPATH=$HOME/qgis_09/share/qgis/python
export QGISHOME=$HOME/qgis_09
```

For Windows:

```
set PATH=C:\qgis;%PATH%
set PYTHONPATH=C:\qgis\python
set QGISHOME=C:\qgis
```

In the case of Linux or OS X, we assume that QGIS is installed in your home directory in *qgis_09*. For Windows, QGIS is installed in *C:\qgis*.

When the application starts up, it looks like this:

Figure 43: Starting the new demo application

To add the *world_borders* layer, click on the *Add Layer* tool and navigate to the data directory. Select the shapefile and click *Open* to add it to the map. Our custom fill color is applied and the result is:

Figure 44: Adding a layer the demo application

Creating a PyQGIS application is really pretty simple. In less than 150 lines of code we have an application that can load a shapefile and navigate the map. If you play around with the map, you'll notice that some of the built-in features of the canvas also work, including mouse wheel scrolling and panning by holding down the *Space* bar and moving the mouse.

Some sophisticated applications have been created with PyQGIS and more are in the works. This is pretty impressive, considering that this development has taken place even before the official release of QGIS 0.9.

Tip 37 DOCUMENTATION FOR PYQGIS

Whether you are writing a plugin or a PyQGIS application, you are going to need to refer to both the QGIS API documentation (`http://qgis.org`) and the PyQt Python Bindings Reference Guide (`http://www.riverbankcomputing.com/Docs/PyQt4/pyqt4ref.html`). These documents provide information about the classes and methods you'll use to bring your Python creation to life.

13. Help and Support

13.1. Mailinglists

QGIS is still under active development and as such it won't always work like you expect it to. The preferred way to get help is by joining the qgis-users mailing list.

qgis-users

Your questions will reach a broader audience and answers will benefit others. You can subscribe to the qgis-users mailing list by visiting the following URL:
`http://lists.qgis.org/cgi-bin/mailman/listinfo/qgis-user`

qgis-developer

If you are a developer facing problems of a more technical nature, you may want to join the qgis-developer mailing list here:
`http://lists.qgis.org/cgi-bin/mailman/listinfo/qgis-developer`

qgis-commit

Each time a commit is made to the QGIS code repository an email is posted to this list. If you want to be up to date with every change to the current code base, you can subscribe to this list at:
`http://lists.qgis.org/cgi-bin/mailman/listinfo/qgis-commit`

qgis-trac

This list provides email notification related to project management, including bug reports, tasks, and feature requests. You can subscribe to this list at:
`http://lists.qgis.org/cgi-bin/mailman/listinfo/qgis-trac`

qgis-doc

This list deals with topics like documentation, context help, user-guide and translation efforts. If you like to work on the user-guide as well, this list is a good starting point to ask your questions. You can subscribe to this list at:
`http://lists.qgis.org/cgi-bin/mailman/listinfo/qgis-doc`

qgis-psc

This list is used to discuss Steering Committee issues related to overall management and direction of Quantum GIS. You can subscribe to this list at:
`http://mrcc.com/cgi-bin/mailman/listinfo/qgis-psc`

You are welcome to subscribe to any of the lists. Please remember to contribute to the list by answering questions and sharing your experiences. Note that the qgis-commit and qgis-trac are designed for notification only and not meant for user postings.

13.2. IRC

We also maintain a presence on IRC - visit us by joining the #qgis channel on `irc.freenode.net`. Please wait around for a response to your question as many folks on the channel are doing other things and it may take a while for them to notice your question. Commercial support for QGIS is also available. Check the website `http://qgis.org/content/view/90/91` for more information.

If you missed a discussion on IRC, not a problem! We log all discussion so you can easily catch up. Just go to `http://logs.qgis.org` and read the IRC-logs.

13.3. BugTracker

While the qgis-users mailing list is useful for general 'how do I do xyz in QGIS' type questions, you may wish to notify us about bugs in QGIS. You can submit bug reports using the QGIS bug tracker at `http://svn.qgis.org/trac`. When creating a new ticket for a bug, please provide an email address where we can request additional information.

Please bear in mind that your bug may not always enjoy the priority you might hope for (depending on its severity). Some bugs may require significant developer effort to remedy and the manpower is not always available for this.

Feature requests can be submitted as well using the same ticket system as for bugs. Please make sure to select the type **enhancement**.

If you have found a bug and fixed it yourself you can submit this patch also. Again, the lovely trac ticketsystem at `http://svn.qgis.org/trac` has this type as well. Select **patch** from the type-menu. Someone of the developers will review it and apply it to QGIS.
Please dont be alarmed if your patch is not applied straight away - developers may be tied up with other committments.

13.4. Blog

The QGIS-community also runs a weblog (BLOG) at `http://blog.qgis.org` which has some interesting articles for users and developers as well. You are invited to contribute to the blog after registering yourself!

13.5. Wiki

Lastly, we maintain a WIKI web site at `http://wiki.qgis.org` where you can find a variety of useful information relating to QGIS development, release plans, links to download sites, message translation-hints and so on. Check it out, there are some goodies inside!

A. Supported Data Formats

A.1. Supported OGR Formats

At the date of this document, the following formats are supported by the OGR library. Formats known to work in QGIS are indicated in **bold**.

- **Arc/Info Binary Coverage**
- Comma Separated Value (.csv)
- DODS/OPeNDAP
- **ESRI Shapefile**
- FMEObjects Gateway
- GML
- IHO S-57 (ENC)
- **Mapinfo File**
- Microstation DGN
- OGDI Vectors
- ODBC
- Oracle Spatial
- PostgreSQL[7]
- **SDTS**
- SQLite
- UK .NTF
- U.S. Census TIGER/Line
- VRT - Virtual Datasource

[7] QGIS implements its own PostgreSQL functions. OGR should be built without PostgreSQL support

A.2. GDAL Raster Formats

At the date of this document, the following formats are supported by the GDAL library. Note that not all of these format may work in QGIS for various reasons. For example, some require external commercial libraries. Only those formats that have been well tested will appear in the list of file types when loading a raster into QGIS. Other untested formats can be loaded by selecting the *All other files (*)* filter. Formats known to work in QGIS are indicated in **bold**.

- **Arc/Info ASCII Grid**
- **Arc/Info Binary Grid (.adf)**
- Microsoft Windows Device Independent Bitmap (.bmp)
- BSB Nautical Chart Format (.kap)
- VTP Binary Terrain Format (.bt)
- CEOS (Spot for instance)
- First Generation USGS DOQ (.doq)
- New Labelled USGS DOQ (.doq)
- Military Elevation Data (.dt0, .dt1)
- ERMapper Compressed Wavelets (.ecw)
- ESRI .hdr Labelled
- ENVI .hdr Labelled Raster
- Envisat Image Product (.n1)
- EOSAT FAST Format
- FITS (.fits)
- Graphics Interchange Format (.gif)
- **GRASS Rasters**[8]
- **TIFF / GeoTIFF (.tif)**
- Hierarchical Data Format Release 4 (HDF4)
- **Erdas Imagine (.img)**

[8] GRASS raster support is supplied by the QGIS GRASS data provider plugin

- Atlantis MFF2e
- Japanese DEM (.mem)
- **JPEG JFIF (.jpg)**
- JPEG2000 (.jp2, .j2k)
- JPEG2000 (.jp2, .j2k)
- NOAA Polar Orbiter Level 1b Data Set (AVHRR)
- Erdas 7.x .LAN and .GIS
- In Memory Raster
- Atlantis MFF
- Multi-resolution Seamless Image Database MrSID
- NITF
- NetCDF
- OGDI Bridge
- PCI .aux Labelled
- PCI Geomatics Database File
- Portable Network Graphics (.png)
- Netpbm (.ppm,.pgm)
- **USGS SDTS DEM (*CATD.DDF)**
- SAR CEOS
- **USGS ASCII DEM (.dem)**
- X11 Pixmap (.xpm)

B. Installation Guide

The following chapters provide build and installation information for QGIS Version 0.9.1. This document corresponds almost to a LaTeX conversion of the INSTALL.t2t file coming with the QGIS sources from November, 29th 2007.

A current version is also available at the wiki, see: http://wiki.qgis.org/qgiswiki/BuildingFromSource

B.1. General Build Notes

At version 0.8.1 QGIS no longer uses the autotools for building. QGIS, like a number of major projects (eg. KDE 4.0), now uses cmake for building from source. The configure script in this directory simply checks for the existence of cmake and provides some clues to build QGIS.

For complete information, see the wiki at: http://wiki.qgis.org/qgiswiki/Building_with_CMake

B.2. An overview of the dependencies required for building

Required build deps:

- CMake >= 2.4.3
- Flex, Bison

Required runtime deps:

- Qt >= 4.2.0
- Proj >= ? (known to work with 4.4.x)
- GEOS >= 2.2 (3.0 is supported, maybe 2.1.x works too)
- Sqlite3 >= ? (probably 3.0.0)
- GDAL/OGR >= ? (1.2.x should work)

Optional dependencies:

- for GRASS plugin - GRASS >= 6.0.0
- for georeferencer - GSL >= ? (works with 1.8)

- for postgis support and SPIT plugin - PostgreSQL >= ?
- for gps plugin - expat >= ? (1.95 is OK)
- for mapserver export and PyQGIS - Python >= ? (probably 2.3)
- for PyQGIS - SIP >= 4.5, PyQt >= 4.1

Recommended runtime deps:

- for gps plugin - gpsbabel

C. Building under windows using msys

C.1. MSYS:

MSYS provides a unix style build environment under windows. We have created a zip archive that contains just about all dependencies.

Get this:

http://qgis.org/uploadfiles/msys/msys.zip

and unpack to c:\msys

If you wish to prepare your msys environment yourself rather than using our pre-made one, detailed instructions are provided elsewhere in this document.

C.2. Qt4.3

Download qt4.3 opensource precompiled edition exe and install (including the download and install of mingw) from here:

http://www.trolltech.com/developer/downloads/qt/windows

When the installer will ask for MinGW, you don't need to download and install it, just point the installer to c:\msys\mingw

When Qt installation is complete:

Edit C:\Qt\4.3.0\bin\qtvars.bat and add the following lines:

```
set PATH=%PATH%;C:\msys\local\bin;c:\msys\local\lib
set PATH=%PATH%;"C:\Program Files\Subversion\bin"
```

I suggest you also add C:\Qt\4.3.0\bin\ to your Environment Variables Path in the windows system preferences.

If you plan to do some debugging, you'll need to compile debug version of Qt: C:\Qt\4.3.0\bin\qtvars.bat compile_debug

Note: there is a problem when compiling debug version of Qt 4.3, the script ends with this message "mingw32-make: *** No rule to make target 'debug'. Stop.". To compile the debug version you have to go out of src directory and execute the following command:

```
c:\Qt\4.3.0 make
```

C.3. Flex and Bison

*** Note I think this section can be removed as it should be installed int the msys image already. TS

Get Flex http://sourceforge.net/project/showfiles.php?group_id=23617&package_id=16424 (the zip bin) and extract it into c:\msys\mingw\bin

C.4. Python stuff: (optional)

Follow this section in case you would like to use Python bindings for QGIS. To be able to compile bindings, you need to compile SIP and PyQt4 from sources as their installer doesn't include some development files which are necessary.

C.4.1. Download and install Python - use Windows installer

(It doesn't matter to what folder you'll install it)

http://python.org/download/

C.4.2. Download SIP and PyQt4 sources

```
\htmladdnormallink{http://www.riverbankcomputing.com/Downloads/sip4/}
\htmladdnormallink{http://www.riverbankcomputing.com/Downloads/PyQt4/GPL/}
```

Extract each of the above zip files in a temporary directory. Make sure to get versions that match your current Qt installed version.

C.4.3. Compile SIP

```
c:\Qt\4.3.0\bin\qtvars.bat
python configure.py -p win32-g++
make
make install
```

C.4.4. Compile PyQt

```
c:\Qt\4.3.0\bin\qtvars.bat
python configure.py
make
make install
```

C.4.5. Final python notes

/!\ You can delete the directories with unpacked SIP and PyQt4 sources after a successfull install, they're not needed anymore.

C.5. Subversion:

In order to check out QGIS sources from the repository, you need Subversion client. This installer should work fine:

http://subversion.tigris.org/files/documents/15/36797/svn-1.4.3-setup.exe

C.6. CMake:

CMake is build system used by Quantum GIS. Download it from here:

http://www.cmake.org/files/v2.4/cmake-2.4.6-win32-x86.exe

C.7. QGIS:

Start a cmd.exe window (Start -> Run -> cmd.exe) Create development directory and move into it

```
md c:\dev\cpp
cd c:\dev\cpp
```

Check out sources from SVN For svn head:

```
svn co https://svn.qgis.org/repos/qgis/trunk/qgis
```

For svn 0.8 branch

```
svn co https://svn.qgis.org/repos/qgis/branches/Release-0_8_0 qgis0.8
```

C.8. Compiling:

As a background read the generic building with CMake notes at the end of this document.

Start a cmd.exe window (Start -> Run -> cmd.exe) if you don't have one already. Add paths to compiler and our MSYS environment:

```
c:\Qt\4.3.0\bin\qtvars.bat
```

For ease of use add c:\Qt\4.3.0\bin\ to your system path in system properties so you can just type qtvars.bat when you open the cmd console. Create build directory and set it as current directory:

```
cd c:\dev\cpp\qgis
md build
cd build
```

C.9. Configuration

```
cmakesetup ..
```

NOTE: You must include the '..' above.

Click 'Configure' button. When asked, you should choose 'MinGW Makefiles' as generator.

There's a problem with MinGW Makefiles on Win2K. If you're compiling on this platform, use 'MSYS Makefiles' generator instead.

All dependencies should be picked up automatically, if you have set up the Paths correctly. The only thing you need to change is the installation destination (CMAKE_INSTALL_PREFIX) and/or set 'Debug'.

For compatibility with NSIS packaging cripts I recommend to leave the install prefix to its default c:\program files\

When configuration is done, click 'OK' to exit the setup utility.

C.10. Compilation and installation

```
make
make install
```

C.11. Run qgis.exe from the directory where it's installed (CMAKE_INSTALL_PREFIX)

Make sure to copy all .dll:s needed to the same directory as the qgis.exe binary is installed to, if not already done so, otherwise QGIS will complain about missing libraries when started.

The best way to do this is to download both the QGIS current release installer package from http://qgis.org/uploadfiles/testbuilds/ and install it. Now copy the installation dir from C:\Program Files\Quantum GIS into c:\Program Files\qgis-0.8.1 (or whatever the current version is. The name should strictly match the version no.) After making this copy you can uninstall the release version of QGIS from your c:\Program Files directory using the provided uninstaller. Double check that the Quantum GIS dir is completely gone under program files afterwards.

Another possibility is to run qgis.exe when your path contains c:\msys\local\bin and c:\msys\local\lib directories, so the DLLs will be used from that place.

C.12. Create the installation package: (optional)

Downlad and install NSIS from (http://nsis.sourceforge.net/Main_Page)

Now using windows explorer, enter the win_build directory in your QGIS source tree. Read the READMEfile there and follow the instructions. Next right click on qgis.nsi and choose the option 'Compile NSIS Script'.

D. Building on Mac OSX using frameworks and cmake (QGIS $>$ 0.8)

In this approach I will try to avoid as much as possible building dependencies from source and rather use frameworks wherever possible.

D.1. Install XCODE

I recommend to get the latest xcode dmg from the Apple XDC Web site. Install XCODE after the ˜941mb download is complete.

D.2. Install Qt4 from .dmg

You need a minimum of Qt4.2. I suggest getting the latest (at time of writing).

```
ftp://ftp.trolltech.com/qt/source/qt-mac-opensource-4.3.2.dmg
```

If you want debug libs, Qt also provide a dmg with these:

```
ftp://ftp.trolltech.com/qt/source/qt-mac-opensource-4.3.2-debug-libs.dmg
```

I am going to proceed using only release libs at this stage as the download for the debug dmg is substantially bigger. If you plan to do any debugging though you probably want to get the debug libs dmg. Once downloaded open the dmg and run the installer. Note you need admin access to install.

After installing you need to make two small changes:

First edit `/Library/Frameworks/QtCore.framework/Headers/qconfig.h` and change

/!\ Note this doesnt seem to be needed since version 4.2.3

`QT_EDITION_UNKNOWN` to `QT_EDITION_OPENSOURCE`

Second change the default mkspec symlink so that it points to macx-g++:

```
cd /usr/local/Qt4.3/mkspecs/ sudo rm default sudo ln -sf macx-g++ default
```

D.3. Install development frameworks for QGIS dependencies

Download William Kyngesburye's excellent all in one framework that includes proj, gdal, sqlite3 etc

```
http://www.kyngchaos.com/files/software/unixport/AllFrameworks.dmg
```

Once downloaded, open and install the frameworks.

William provides an additional installer package for Postgresql/PostGIS. Its available here:

```
http://www.kyngchaos.com/software/unixport/postgres
```

There are some additional dependencies that at the time of writing are not provided as frameworks so we will need to build these from source.

D.3.1. Additional Dependencies : GSL

Retrieve the Gnu Scientific Library from

```
curl -O ftp://ftp.gnu.org/gnu/gsl/gsl-1.8.tar.gz
```

Then extract it and build it to a prefix of /usr/local:

```
tar xvfz gsl-1.8.tar.gz
cd gsl-1.8
./configure --prefix=/usr/local
make
sudo make install
cd ..
```

D.3.2. Additional Dependencies : Expat

Get the expat sources:

```
http://sourceforge.net/project/showfiles.php?group_id=10127
```

```
tar xvfz expat-2.0.0.tar.gz
cd expat-2.0.0
./configure --prefix=/usr/local
make
sudo make install
cd ..
```

D.3.3. Additional Dependencies : SIP

Retrieve the python bindings toolkit SIP from

```
http://www.riverbankcomputing.com/Downloads/sip4/
```

Then extract and build it to a prefix of /usr/local:

```
tar xvfz sip-<version number>.tar.gz
cd sip-<version number>
python configure.py
make
sudo make install
cd ..
```

D.3.4. Additional Dependencies : PyQt

Make sure you have the latest python fom

```
http://www.python.org/download/mac/
```

If you encounter problems compiling PyQt using the instructions below you can also try adding python from your frameworks dir explicitly to your path e.g.

```
export PATH=/Library/Frameworks/Python.framework/Versions/Current/bin:$PATH$
```

Retrieve the python bindings toolkit for Qt from

```
http://www.riverbankcomputing.com/Downloads/PyQt4/GPL/
```

Then extract and build it to a prefix of /usr/local:

```
tar xvfz PyQt-mac<version number here>
cd PyQt-mac<version number here>
python configure.py
yes
make
sudo make install
cd ..
```

D.3.5. Additional Dependencies : Bison

The version of bison available by default on Mac OSX is too old so you need to get a more recent one on your system. Download if from:

```
curl -O http://ftp.gnu.org/gnu/bison/bison-2.3.tar.gz
```

Now build and install it to a prefix of /usr/local :

```
tar xvfz bison-2.3.tar.gz
cd bison-2.3
./configure --prefix=/usr/local
make
sudo make install
cd ..
```

D.4. Install CMAKE for OSX

Get the latest release from here:

```
http://www.cmake.org/HTML/Download.html
```

At the time of writing the file I grabbed was:

```
curl -O http://www.cmake.org/files/v2.4/cmake-2.4.6-Darwin-universal.dmg
```

Once downloaded open the dmg and run the installer

D.5. Install subversion for OSX

The http://sourceforge.net/projects/macsvn/ project has a downloadable build of svn. If you are a GUI inclined person you may want to grab their gui client too. Get the command line client here:

```
curl -O http://ufpr.dl.sourceforge.net/sourceforge/macsvn/Subversion_1.4.2.zip
```

Once downloaded open the zip file and run the installer.

You also need to install BerkleyDB available from the same http://sourceforge.net/projects/macsvn/. At the time of writing the file was here:

```
curl -O http://ufpr.dl.sourceforge.net/sourceforge/macsvn/Berkeley_DB_4.5.20.zip
```

Once again unzip this and run the installer therein.

Lastly we need to ensure that the svn commandline executeable is in the path. Add the following line to the end of /etc/bashrc using sudo:

```
sudo vim /etc/bashrc
```

And add this line to the bottom before saving and quiting:

```
export PATH=/usr/local/bin:$PATH:/usr/local/pgsql/bin
```

/usr/local/bin needs to be first in the path so that the newer bison (that will be built from source further down) is found before the bison (which is very old) that is installed by MacOSX

Now close and reopen your shell to get the updated vars.

D.6. Check out QGIS from SVN

Now we are going to check out the sources for QGIS. First we will create a directory for working in:

```
mkdir -p ~/dev/cpp cd ~/dev/cpp
```

Now we check out the sources:

Trunk:

```
svn co https://svn.qgis.org/repos/qgis/trunk/qgis qgis
```

For svn 0.8 branch

```
svn co https://svn.qgis.org/repos/qgis/branches/Release-0_8_0 qgis0.8
```

For svn 0.9 branch

```
svn co https://svn.qgis.org/repos/qgis/branches/Release-0_9_0 qgis0.9
```

The first time you check out QGIS sources you will probably get a message like this:

```
Error validating server certificate for 'https://svn.qgis.org:443':
- The certificate is not issued by a trusted authority. Use the fingerprint to
  validate the certificate manually!  Certificate information:
- Hostname: svn.qgis.org
- Valid: from Apr  1 00:30:47 2006 GMT until Mar 21 00:30:47 2008 GMT
- Issuer: Developer Team, Quantum GIS, Anchorage, Alaska, US
- Fingerprint: 2f:cd:f1:5a:c7:64:da:2b:d1:34:a5:20:c6:15:67:28:33:ea:7a:9b
  (R)eject, accept (t)emporarily or accept (p)ermanently?
```

I suggest you press 'p' to accept the key permanently.

D.7. Configure the build

CMake supports out of source build so we will create a 'build' dir for the build process . By convention I build my software into a dir called 'apps' in my home directory. If you have the correct permissions you may want to build straight into your /Applications folder (although personally I dont really recommend this). The instructions below assume you are building into a pre-existing ${HOME}/apps directory ...

```
cd qgis
mkdir build
cd build
cmake -D CMAKE_INSTALL_PREFIX=$HOME/apps/ -D CMAKE_BUILD_TYPE=Release ..
```

To use a specific GRASS version, You can optionally use the following cmake invocation (with modifications to suite your system (thanks William Kyngesburye for this hint):

```
cmake -D CMAKE_INSTALL_PREFIX=${HOME}/apps/ \
      -D GRASS_INCLUDE_DIR=/Applications/GRASS-6.3.app/Contents/Resources/include \
      -D GRASS_PREFIX=/Applications/GRASS-6.3.app/Contents/Resources \
      -D CMAKE_BUILD_TYPE=Release \
      ..
```

D.8. GEOS Issues

I had some issues with GEOS headers so I made the following edits:

In file /Library/Frameworks/GEOS.framework/Headers/io.h, comment out line 61

In file /Library/Frameworks/GEOS.framework/Headers/geom.h, comment out line 145

D.9. Building

Now we can start the build process:

```
make
```

If all built without errors you can then install it:

```
make install
```

E. Building on GNU/Linux

E.1. Building QGIS with Qt4.x

Requires: Ubuntu Edgy / Debian derived distro

These notes are for if you want to build QGIS from source. One of the major aims here is to show how this can be done using binary packages for ***all*** dependencies - building only the core QGIS stuff from source. I prefer this approach because it means we can leave the business of managing system packages to apt and only concern ourselves with coding QGIS!

This document assumes you have made a fresh install and have a 'clean' system. These instructions should work fine if this is a system that has already been in use for a while, you may need to just skip those steps which are irrelevant to you.

E.2. Prepare apt

The packages qgis depends on to build are available in the "universe" component of Ubuntu. This is not activated by default, so you need to activate it:

1. Edit your /etc/apt/sources.list file. 2. Uncomment the all the lines starting with "deb"

Also you will need to be running (K)Ubuntu 'edgy' or higher in order for all dependencies to be met.

Now update your local sources database:

```
sudo apt-get update
```

E.3. Install Qt4

```
sudo apt-get install libqt4-core libqt4-debug  \
libqt4-dev libqt4-gui libqt4-qt3support libqt4-sql lsb-qt4 qt4-designer \
qt4-dev-tools qt4-doc qt4-qtconfig uim-qt gcc libapt-pkg-perl resolvconf
```

/!\ ***A Special Note:*** If you are following this set of instructions on a system where you already have Qt3 development tools installed, there will be a conflict between Qt3 tools and Qt4 tools. For example, qmake will point to the Qt3 version not the Qt4. Ubuntu Qt4 and Qt3 packages are designed to live alongside each other. This means that for example if you have them both installed you will have three qmake exe's:

```
/usr/bin/qmake -> /etc/alternatives/qmake
/usr/bin/qmake-qt3
/usr/bin/qmake-qt4
```

The same applies to all other Qt binaries. You will notice above that the canonical 'qmake' is managed by apt alternatives, so before we start to build QGIS, we need to make Qt4 the default. To return Qt3 to default later you can use this same process.

You can use apt alternatives to correct this so that the Qt4 version of applications is used in all cases:

```
sudo update-alternatives --config qmake
sudo update-alternatives --config uic
sudo update-alternatives --config designer
sudo update-alternatives --config assistant
sudo update-alternatives --config qtconfig
sudo update-alternatives --config moc
sudo update-alternatives --config lupdate
sudo update-alternatives --config lrelease
sudo update-alternatives --config linguist
```

Use the simple command line dialog that appears after running each of the above commands to select the Qt4 version of the relevant applications.

E.4. Install additional software dependencies required by QGIS

```
sudo apt-get install gdal-bin libgdal1-dev libgeos-dev proj \
libgdal-doc libhdf4g-dev libhdf4g-run python-dev \
libgsl0-dev g++ libjasper-1.701-dev libtiff4-dev subversion \
```

```
libsqlite3-dev sqlite3 ccache make libpq-dev flex bison cmake txt2tags \
python-qt4 python-qt4-dev python-sip4 sip4 python-sip4-dev
```

/!\ Debian users should use libgdal-dev above rather

/!\ ***Note:*** For python language bindings SIP >= 4.5 and PyQt4 >= 4.1 is required! Some stable GNU/Linux distributions (e.g. Debian or SuSE) only provide SIP < 4.5 and PyQt4 < 4.1. To include support for python language bindings you may need to build and install those packages from source.

E.5. GRASS Specific Steps

/!\ ***Note:*** If you don't need to build with GRASS support, you can skip this section.

Now you can install grass from dapper:

```
sudo apt-get install grass libgrass-dev libgdal1-grass
```

/!\ You may need to explicitly state your grass version e.g. libgdal1-1.3.2-grass

E.6. Setup ccache (Optional)

You should also setup ccache to speed up compile times:

```
cd /usr/local/bin
sudo ln -s /usr/bin/ccache gcc
sudo ln -s /usr/bin/ccache g++
```

E.7. Prepare your development environment

As a convention I do all my development work in $HOME/dev/<language>, so in this case we will create a work environment for C++ development work like this:

```
mkdir -p ${HOME}/dev/cpp
cd ${HOME}/dev/cpp
```

This directory path will be assumed for all instructions that follow.

E.8. Check out the QGIS Source Code

There are two ways the source can be checked out. Use the anonymous method if you do not have edit privileges for the QGIS source repository, or use the developer checkout if you have permissions to commit source code changes.

1. Anonymous Checkout

```
cd ${HOME}/dev/cpp
svn co https://svn.qgis.org/repos/qgis/trunk/qgis qgis
```

2. Developer Checkout

```
cd ${HOME}/dev/cpp
svn co --username <yourusername> https://svn.qgis.org/repos/qgis/trunk/qgis qgis
```

The first time you check out the source you will be prompted to accept the qgis.org certificate. Press 'p' to accept it permanently:

```
Error validating server certificate for 'https://svn.qgis.org:443':
   - The certificate is not issued by a trusted authority. Use the
     fingerprint to validate the certificate manually!  Certificate
     information:
   - Hostname: svn.qgis.org
   - Valid: from Apr  1 00:30:47 2006 GMT until Mar 21 00:30:47 2008 GMT
   - Issuer: Developer Team, Quantum GIS, Anchorage, Alaska, US
   - Fingerprint:
     2f:cd:f1:5a:c7:64:da:2b:d1:34:a5:20:c6:15:67:28:33:ea:7a:9b (R)eject,
     accept (t)emporarily or accept (p)ermanently?
```

E.9. Starting the compile

I compile my development version of QGIS into my ~/apps directory to avoid conflicts with Ubuntu packages that may be under /usr. This way for example you can use the binary packages of QGIS on your system along side with your development version. I suggest you do something similar:

```
mkdir -p ${HOME}/apps
```

Now we create a build directory and run ccmake:

```
cd qgis
mkdir build
cd build
ccmake ..
```

When you run ccmake (note the .. is required!), a menu will appear where you can configure various aspects of the build. If you do not have root access or do not want to overwrite existing QGIS installs (by your packagemanager for example), set the CMAKE_BUILD_PREFIX to somewhere you have write access to (I usually use /home/timlinux/apps). Now press 'c' to configure, 'e' to dismiss any error messages that may appear. and 'g' to generate the make files. Note that sometimes 'c' needs to be pressed several times before the 'g' option becomes available. After the 'g' generation is complete, press 'q' to exit the ccmake interactive dialog.

Now on with the build:

```
make
make install
```

It may take a little while to build depending on your platform.

E.10. Running QGIS

Now you can try to run QGIS:

```
$HOME/apps/bin/qgis
```

If all has worked properly the QGIS application should start up and appear on your screen.

F. Creation of MSYS environment for compilation of Quantum GIS

F.1. Initial setup

F.1.1. MSYS

This is the environment that supplies many utilities from UNIX world in Windows and is needed by many dependencies to be able to compile.

Download from here:

http://puzzle.dl.sourceforge.net/sourceforge/mingw/MSYS-1.0.11-2004.04.30-1.exe

Install to `c:\msys`

All stuff we're going to compile is going to get to this directory (resp. its subdirs).

F.1.2. MinGW

Download from here:

http://puzzle.dl.sourceforge.net/sourceforge/mingw/MinGW-5.1.3.exe

Install to `c:\msys\mingw`

It suffices to download and install only `g++` and `mingw-make` components.

F.1.3. Flex and Bison

Flex and Bison are tools for generation of parsers, they're needed for GRASS and also QGIS compilation.

Download the following packages:

http://gnuwin32.sourceforge.net/downlinks/flex-bin-zip.php

http://gnuwin32.sourceforge.net/downlinks/bison-bin-zip.php

http://gnuwin32.sourceforge.net/downlinks/bison-dep-zip.php

Unpack them all to `c:\msys\local`

F.2. Installing dependencies

F.2.1. Getting ready

Paul Kelly did a great job and prepared a package of precompiled libraries for GRASS. The package currently includes:

- zlib-1.2.3
- libpng-1.2.16-noconfig
- xdr-4.0-mingw2
- freetype-2.3.4
- fftw-2.1.5
- PDCurses-3.1
- proj-4.5.0
- gdal-1.4.1

It's available for download here:

http://www.stjohnspoint.co.uk/grass/wingrass-extralibs.tar.gz

Moreover he also left the notes how to compile it (for those interested):

http://www.stjohnspoint.co.uk/grass/README.extralibs

Unpack the whole package to `c:\msys\local`

F.2.2. GDAL level one

Since Quantum GIS needs GDAL with GRASS support, we need to compile GDAL from source - Paul Kelly's package doesn't include GRASS support in GDAL. The idea is following:

1. compile GDAL without GRASS
2. compile GRASS
3. compile GDAL with GRASS

So, start with downloading GDAL sources:

http://download.osgeo.org/gdal/gdal141.zip

Unpack it to some directory, preferably `c:\msys\local\src`.

Start MSYS console, go to gdal-1.4.1 directory and run the commands below. You can put them all to a script, e.g. build-gdal.sh and run them at once. The recipe is taken from Paul Kelly's instructions - basically they just make sure that the library will be created as DLL and the utility programs will be dynamically linked to it...

```
CFLAGS="-O2 -s" CXXFLAGS="-O2 -s" LDFLAGS=-s ./configure --without-libtool
--prefix=/usr/local --enable-shared --disable-static --with-libz=/usr/local
--with-png=/usr/local
make
make install
rm /usr/local/lib/libgdal.a
g++ -s -shared -o ./libgdal.dll -L/usr/local/lib -lz -lpng ./frmts/o/*.o
./gcore/*.o ./port/*.o ./alg/*.o ./ogr/ogrsf_frmts/o/*.o
./ogr/ogrgeometryfactory.o ./ogr/ogrpoint.o ./ogr/ogrcurve.o
./ogr/ogrlinestring.o ./ogr/ogrlinearring.o ./ogr/ogrpolygon.o
./ogr/ogrutils.o ./ogr/ogrgeometry.o ./ogr/ogrgeometrycollection.o
./ogr/ogrmultipolygon.o ./ogr/ogrsurface.o ./ogr/ogrmultipoint.o
./ogr/ogrmultilinestring.o ./ogr/ogr_api.o ./ogr/ogrfeature.o
./ogr/ogrfeaturedefn.o ./ogr/ogrfeaturequery.o ./ogr/ogrfeaturestyle.o
./ogr/ogrfielddefn.o ./ogr/ogrspatialreference.o ./ogr/ogr_srsnode.o
./ogr/ogr_srs_proj4.o ./ogr/ogr_fromepsg.o ./ogr/ogrct.o ./ogr/ogr_opt.o
./ogr/ogr_srs_esri.o ./ogr/ogr_srs_pci.o ./ogr/ogr_srs_usgs.o
./ogr/ogr_srs_dict.o ./ogr/ogr_srs_panorama.o ./ogr/swq.o
./ogr/ogr_srs_validate.o ./ogr/ogr_srs_xml.o ./ogr/ograssemblepolygon.o
./ogr/ogr2gmlgeometry.o ./ogr/gml2ogrgeometry.o
install libgdal.dll /usr/local/lib
cd ogr
g++ -s ogrinfo.o -o ogrinfo.exe -L/usr/local/lib -lpng -lz -lgdal
g++ -s ogr2ogr.o -o ogr2ogr.exe -lgdal -L/usr/local/lib -lpng -lz -lgdal
g++ -s ogrtindex.o -o ogrtindex.exe -lgdal -L/usr/local/lib -lpng -lz -lgdal
install ogrinfo.exe ogr2ogr.exe ogrtindex.exe /usr/local/bin
cd ../apps
g++ -s gdalinfo.o -o gdalinfo.exe -L/usr/local/lib -lpng -lz -lgdal
g++ -s gdal_translate.o -o gdal_translate.exe -L/usr/local/lib -lpng -lz -lgdal
g++ -s gdaladdo.o -o gdaladdo.exe -L/usr/local/lib -lpng -lz -lgdal
g++ -s gdalwarp.o -o gdalwarp.exe -L/usr/local/lib -lpng -lz -lgdal
g++ -s gdal_contour.o -o gdal_contour.exe -L/usr/local/lib -lpng -lz -lgdal
g++ -s gdaltindex.o -o gdaltindex.exe -L/usr/local/lib -lpng -lz -lgdal
g++ -s gdal_rasterize.o -o gdal_rasterize.exe -L/usr/local/lib -lpng -lz -lgdal
install gdalinfo.exe gdal_translate.exe gdaladdo.exe gdalwarp.exe
```

```
gdal_contour.exe gdaltindex.exe gdal_rasterize.exe /usr/local/bin
```

Finally, manually edit `gdal-config` in `c:\msys\local\bin` to replace the static library reference with -lgdal:

```
CONFIG_LIBS="-L/usr/local/lib -lpng -lz -lgdal"
```

GDAL build procedure can be greatly simplified to use libtool with a libtool line patch: configure gdal as below: ./configure –with-ngpython –with-xerces=/local/ –with-jasper=/local/ –with-grass=/local/grass-6.3.cvs/ –with-pg=/local/pgsql/bin/pg_config.exe

Then fix libtool with: mv libtool libtool.orig cat libtool.orig | sed 's/max_cmd_len=8192/max_cmd_-len=32768/g' > libtool

Libtool on windows assumes a line length limit of 8192 for some reason and tries to page the linking and fails miserably. This is a work around.

Make and make install should be hassle free after this.

F.2.3. GRASS

Grab sources from CVS or use a weekly snapshot, see:

http://grass.itc.it/devel/cvs.php

In MSYS console go to the directory where you've unpacked or checked out sources (e.g. `c:\msys\local\src\grass-6.3.cvs`)

Run these commands:

```
export PATH="/usr/local/bin:/usr/local/lib:$PATH"
./configure --prefix=/usr/local --bindir=/usr/local
--with-includes=/usr/local/include --with-libs=/usr/local/lib --with-cxx
--without-jpeg --without-tiff --without-postgres --with-opengl=windows
--with-fftw --with-freetype --with-freetype-includes=/usr/local/include/freetype2
--without-x --without-tcltk --enable-x11=no --enable-shared=yes
--with-proj-share=/usr/local/share/proj
make
make install
```

It should get installed to `c:\msys\local\grass-6.3.cvs`

By the way, these pages might be useful:

- http://grass.gdf-hannover.de/wiki/WinGRASS_Current_Status
- http://geni.ath.cx/grass.html

F.2.4. GDAL level two

At this stage, we'll use GDAL sources we've used before, only the compilation will be a bit different.

But first in order to be able to compile GDAL sources with current GRASS CVS, you need to patch them, here's what you need to change:

http://trac.osgeo.org/gdal/attachment/ticket/1587/plugin_patch_grass63.diff

(you can patch it by hand or use patch.exe in `c:\msys\bin`)

Now in MSYS console go to the GDAL sources directory and run the same commands as in level one, only with these differences:

1. when running `./configure` add this argument: `-with-grass=/usr/local/grass-6.3.cvs`
2. when calling `g++` on line 5 (which creates libgdal.dll), add these arguments: `-L/usr/local/grass-6.3.cvs/lib -lgrass_vect -lgrass_dig2 -lgrass_dgl -lgrass_rtree -lgrass_linkm -lgrass_dbmiclient -lgrass_dbmibase -lgrass_I -lgrass_gproj -lgrass_vask -lgrass_gmath -lgrass_gis -lgrass_datetime`

Then again, edit `gdal-config` and change line with CONFIG_LIBS

```
CONFIG_LIBS="-L/usr/local/lib -lpng -L/usr/local/grass-6.3.cvs/lib
-lgrass_vect -lgrass_dig2 -lgrass_dgl -lgrass_rtree -lgrass_linkm
-lgrass_dbmiclient -lgrass_dbmibase -lgrass_I -lgrass_gproj -lgrass_vask
-lgrass_gmath -lgrass_gis -lgrass_datetime -lz -L/usr/local/lib -lgdal"
```

Now, GDAL should be able to work also with GRASS raster layers.

F.2.5. GEOS

Download the sources:

http://geos.refractions.net/geos-2.2.3.tar.bz2

Unpack to e.g. `c:\msys\local\src`

To compile, I had to patch the sources: in file `source/headers/timeval.h` line 13. Change it from:

```
#ifdef _WIN32
```

to:

```
#if defined(_WIN32) && defined(_MSC_VER)
```

Now, in MSYS console, go to the source directory and run:

```
./configure --prefix=/usr/local
make
make install
```

F.2.6. SQLITE

You can use precompiled DLL, no need to compile from source:

Download this archive:

http://www.sqlite.org/sqlitedll-3_3_17.zip

and copy sqlite3.dll from it to `c:\msys\local\lib`

Then download this archive:

http://www.sqlite.org/sqlite-source-3_3_17.zip

and copy sqlite3.h to `c:\msys\local\include`

F.2.7. GSL

Download sources:

ftp://ftp.gnu.org/gnu/gsl/gsl-1.9.tar.gz

Unpack to `c:\msys\local\src`

Run from MSYS console in the source directory:

```
./configure
make
make install
```

F.2.8. EXPAT

Download sources:

http://dfn.dl.sourceforge.net/sourceforge/expat/expat-2.0.0.tar.gz

Unpack to `c:\msys\local\src`

Run from MSYS console in the source directory:

```
./configure
make
make install
```

F.2.9. POSTGRES

We're going to use precompiled binaries. Use the link below for download:

```
http://wwwmaster.postgresql.org/download/mirrors-ftp?file=\%2Fbinary\%2Fv8.2.4\
%2Fwin32\%2Fpostgresql-8.2.4-1-binaries-no-installer.zip
```

copy contents of pgsql directory from the archive to `c:\msys\local`

F.3. Cleanup

We're done with preparation of MSYS environment. Now you can delete all stuff in `c:\msys\local\src` - it takes quite a lot of space and it's not necessary at all.

G. Building with MS Visual Studio

/!\ This section describes a process where you build all dependencies yourself. See the section after this for a simpler procedure where we have all the dependencies you need pre-packaged and we focus just on getting Visual Studio Express set up and building QGIS.

Note that this does not currently include GRASS or Python plugins.

G.1. Setup Visual Studio

This section describes the setup required to allow Visual Studio to be used to build QGIS.

G.1.1. Express Edition

The free Express Edition lacks the platform SDK which contains headers and so on that are needed when building QGIS. The platform SDK can be installed as described here:

http://msdn.microsoft.com/vstudio/express/visualc/usingpsdk/

Once this is done, you will need to edit the <vsinstalldir>\Common7\Tools\vsvars file as follows:

Add `%PlatformSDKDir%\Include\atl` and `%PlatformSDKDir%\Include\mfc` to the `@set INCLUDE` entry.

This will add more headers to the system INCLUDE path. Note that this will only work when you use the Visual Studio command prompt when building. Most of the dependencies will be built with this. You will also need to perform the edits described here to remove the need for a library that Visual Studio Express lacks:

http://www.codeproject.com/wtl/WTLExpress.asp

G.1.2. All Editions

You will need stdint.h and unistd.h. unistd.h comes with GnuWin32 version of flex & bison binaries (see later). stdint.h can be found here:

http://www.azillionmonkeys.com/qed/pstdint.h.

Copy both of these to <vsinstalldir>\VC\include.

G.2. Download/Install Dependencies

This section describes the downloading and installation of the various QGIS dependencies.

G.2.1. Flex and Bison

Flex and Bison are tools for generation of parsers, they're needed for GRASS and also QGIS compilation.

Download the following packages and run the installers:

http://gnuwin32.sourceforge.net/downlinks/flex.php

http://gnuwin32.sourceforge.net/downlinks/bison.php

G.2.2. To include PostgreSQL support in Qt

If you want to build Qt with PostgreSQL support you need to download PostgreSQL, install it and create a library you can later link with Qt.

Download from .../binary/v8.2.5/win32/postgresql-8.2.5-1.zip from an PostgreSQL.org Mirror and install.

PostgreSQL is currently build with MinGW and comes with headers and libraries for MinGW. The headers can be used with Visual C++ out of the box, but the library is only shipped in DLL and archive (.a) form and therefore cannot be used with Visual C++ directly.

To create a library copy following sed script to the file mkdef.sed in PostgreSQL lib directory:

```
/Dump of file / {
```

```
s/Dump of file \([^  ]*\)$/LIBRARY \1/p
a\
EXPORTS
}
/[  ]*ordinal hint/,/^[ ]*Summary/ {
 /^[  ]\+[0-9]\+/ {
   s/^[  ]\+[0-9]\+[  ]\+[0-9A-Fa-f]\+[  ]\+[0-9A-Fa-f]
    \+[  ]\+\([^  =]\+\).*$/ \1/p
 }
}
```

and process execute in the Visual Studio C++ command line (from Programs menu):

```
cd c:\Program Files\PostgreSQL\8.2\bin
dumpbin /exports ..\bin\libpq.dll | sed -nf ../lib/mkdef.sed >..\lib\libpq.def
cd ..\lib
lib /def:libpq.def /machine:x86
```

You'll need an sed for that to work in your path (e.g. from cygwin or msys).

That's almost it. You only need to the include and lib path to INCLUDE and LIB in vcvars.bat respectively.

G.2.3. Qt

Build Qt following the instructions here:

http://wiki.qgis.org/qgiswiki/Building_QT_4_with_Visual_C%2B%2B_2005

G.2.4. Proj.4

Get proj.4 source from here:

http://proj.maptools.org/

Using the Visual Studio command prompt (ensures the environment is setup properly), run the following in the src directory:

```
nmake -f makefile.vc
```

Install by running the following in the top level directory setting PROJ_DIR as appropriate:

```
set PROJ_DIR=c:\lib\proj

mkdir %PROJ_DIR%\bin
mkdir %PROJ_DIR%\include
mkdir %PROJ_DIR%\lib

copy src\*.dll %PROJ_DIR%\bin
copy src\*.exe %PROJ_DIR%\bin
copy src\*.h %PROJ_DIR%\include
copy src\*.lib %PROJ_DIR%\lib
```

This can also be added to a batch file.

G.2.5. GSL

Get gsl source from here:

http://david.geldreich.free.fr/downloads/gsl-1.9-windows-sources.zip

Build using the gsl.sln file

G.2.6. GEOS

Get geos from svn (svn checkout http://svn.refractions.net/geos/trunk geos). Edit geos\source\makefile.vc as follows:

Uncomment lines 333 and 334 to allow the copying of version.h.vc to version.h.

Uncomment lines 338 and 339.

Rename geos_c.h.vc to geos_c.h.in on lines 338 and 339 to allow the copying of geos_c.h.in to geos_c.h.

Using the Visual Studio command prompt (ensures the environment is setup properly), run the following in the top level directory:

```
nmake -f makefile.vc
```

Run the following in top level directory, setting GEOS_DIR as appropriate:

```
set GEOS_DIR="c:\lib\geos"

mkdir %GEOS_DIR%\include
mkdir %GEOS_DIR%\lib
mkdir %GEOS_DIR%\bin

xcopy /S/Y source\headers\*.h %GEOS_DIR%\include
copy /Y capi\*.h %GEOS_DIR%\include
copy /Y source\*.lib %GEOS_DIR%\lib
copy /Y source\*.dll %GEOS_DIR%\bin
```

This can also be added to a batch file.

G.2.7. GDAL

Get gdal from svn (svn checkout https://svn.osgeo.org/gdal/branches/1.4/gdal gdal).

Edit nmake.opt to suit, it's pretty well commented.

Using the Visual Studio command prompt (ensures the environment is setup properly), run the following in the top level directory:

```
nmake -f makefile.vc
```

and

```
nmake -f makefile.vc devinstall
```

G.2.8. PostGIS

Get PostGIS and the Windows version of PostgreSQL from here:

http://postgis.refractions.net/download/

Note the warning about not installing the version of PostGIS that comes with the PostgreSQL installer. Simply run the installers.

G.2.9. Expat

Get expat from here:

http://sourceforge.net/project/showfiles.php?group_id=10127

You'll need expat-win32bin-2.0.1.exe.

Simply run the executable to install expat.

G.2.10. CMake

Get CMake from here:

http://www.cmake.org/HTML/Download.html

You'll need cmake-<version>-win32-x86.exe. Simply run this to install CMake.

G.3. Building QGIS with CMAKE

Get QGIS source from svn (svn co https://svn.qgis.org/repos/qgis/trunk/qgis qgis).

Create a 'Build' directory in the top level QGIS directory. This will be where all the build output will be generated.

Run Start–>All Programs–>CMake–>CMake.

In the 'Where is the source code:' box, browse to the top level QGIS directory.

In the 'Where to build the binaries:' box, browse to the 'Build' directory you created in the top level QGIS directory.

Fill in the various *_INCLUDE_DIR and *_LIBRARY entries in the 'Cache Values' list.

Click the Configure button. You will be prompted for the type of makefile that will be generated. Select Visual Studio 8 2005 and click OK.

All being well, configuration should complete without errors. If there are errors, it is usually due to an incorrect path to a header or library directory. Failed items will be shown in red in the list.

Once configuration completes without error, click OK to generate the solution and project files.

With Visual Studio 2005, open the qgis.sln file that will have been created in the Build directory you created earlier.

Build the ALL_BUILD project. This will build all the QGIS binaries along with all the plugins.

Install QGIS by building the INSTALL project. By default this will install to c:\Program Files\qgis<version> (this can be changed by changing the CMAKE_INSTALL_PREFIX variable in CMake).

You will also either need to add all the dependency dlls to the QGIS install directory or add their respective directories to your PATH.

H. Building under Windows using MSVC Express

/!\ Note: Building under MSVC is still a work in progress. In particular the following dont work yet: python, grass, postgis connections.

/!\ This section of the document is in draft form and is not ready to be used yet.

Tim Sutton, 2007

H.1. System preparation

I started with a clean XP install with Service Pack 2 and all patches applied. I have already compiled all the dependencies you need for gdal, expat etc, so this tutorial wont cover compiling those from source too. Since compiling these dependencies was a somewhat painful task I hope my precompiled libs will be adequate. If not I suggest you consult the individual projects for specific build documentation and support. Lets go over the process in a nutshell before we begin:

* Install XP (I used a Parallels virtual machine) * Install the premade libraries archive I have made for you * Install Visual Studio Express 2005 sp1 * Install the Microsoft Platform SDK * Install command line subversion client * Install library dependencies bundle * Install Qt 4.3.2 * Check out QGIS sources * Compile QGIS * Create setup.exe installer for QGIS

H.2. Install the libraries archive

Half of the point of this section of the MSVC setup procedure is to make things as simple as possible for you. To that end I have prepared an archive that includes all dependencies needed to build QGIS except Qt (which we will build further down). Fetch the archive from:

`http://qgis.org/uploadfiles/msvc/qgis_msvc_deps_except_qt4.zip`

Create the following directory structure:

```
c:\dev\cpp\
```

And then extract the libraries archive into a subdirectory of the above directory so that you end up with:

```
c:\dev\cpp\qgislibs-release
```

/!\ Note that you are not obliged to use this directory layout, but you should adjust any instructions that follow if you plan to do things differently.

H.3. Install Visual Studio Express 2005

First thing we need to get is MSVC Express from here:

http://msdn2.microsoft.com/en-us/express/aa975050.aspx

The page is really confusing so dont feel bad if you cant actually find the download at first! There are six coloured blocks on the page for the various studio family members (vb / c# / j# etc). Simply choose your language under the 'select your language' combo under the yellow C++ block, and your download will begin. Under internet explorer I had to disable popup blocking for the download to be able to commence.

Once the setup commences you will be prompted with various options. Here is what I chose :

* Send useage information to Microsoft (No) * Install options: * Graphical IDE (Yes) * Microsoft MSDN Express Edition (No) * Microsoft SQL Server Express Edition (No) * Install to folder: C:\Program Files\Microsoft Visual Studio 8\ (default)

It will need to download around 90mb of installation files and reports that the install will consume 554mb of disk space.

H.4. Install Microsoft Platform SDK2

Go to this page:

http://msdn2.microsoft.com/en-us/express/aa700755.aspx

Start by using the link provided on the above page to download and install the platform SDK2.

The actual SDK download page is once again a bit confusing since the links for downloading are hidden amongst a bunch of other links. Basically look for these three links with their associated 'Download' buttons and choose the correct link for your platform:

```
PSDK-amd64.exe  1.2 MB  Download
PSDK-ia64.exe   1.3 MB  Download
PSDK-x86.exe    1.2 MB  Download
```

When you install make sure to choose 'custom install'. These instructions assume you are installing into the default path of:

```
C:\Program Files\Microsoft Platform SDK for Windows Server 2003 R2\
```

We will go for the minimal install that will give us a working environment, so on the custom installation screen I made the following choices:

```
Configuration Options
  + Register Environmental Variables            (Yes)
Microsoft Windows Core SDK
  + Tools                                       (Yes)
    + Tools (AMD 64 Bit)                        (No unless this applies)
    + Tools (Intel 64 Bit)                      (No unless this applies)
  + Build Environment
    + Build Environment (AMD 64 Bit)            (No unless this applies)
    + Build Environment (Intel 64 Bit)          (No unless this applies)
    + Build Environment (x86 32 Bit)            (Yes)
  + Documentation                               (No)
  + Redistributable Components                  (Yes)
  + Sample Code                                 (No)
  + Source Code                                 (No)
    + AMD 64 Source                             (No)
    + Intel 64 Source                           (No)
Microsoft Web Workshop                          (Yes) (needed for shlwapi.h)
  + Build Environment                           (Yes)
  + Documentation                               (No)
  + Sample Code                                 (No)
  + Tools                                       (No)
Microsoft Internet Information Server (IIS) SDK (No)
Microsoft Data Access Services (MDAC) SDK       (Yes) (needed by GDAL for odbc)
  + Tools
```

```
    + Tools (AMD 64 Bit)                        (No)
    + Tools (AMD 64 Bit)                        (No)
    + Tools (x86 32 Bit)                        (Yes)
  + Build Environment
    + Tools (AMD 64 Bit)                        (No)
    + Tools (AMD 64 Bit)                        (No)
    + Tools (x86 32 Bit)                        (Yes)
  + Documentation                               (No)
  + Sample Code                                 (No)
Microsodt Installer SDK                         (No)
Microsoft Table PC SDK                          (No)
Microsoft Windows Management Instrumentation    (No)
Microsoft DirectShow SDK                        (No)
Microsoft Media Services SDK                    (No)
Debuggin Tools for Windows                      (Yes)
```

/!\ Note that you can always come back later to add extra bits if you like.

/!\ Note that installing the SDK requires validation with the Microsoft Genuine Advantage application. Some people have a philosophical objection to installing this software on their computers. If you are one of them you should probably consider using the MINGW build instructions described elsewhere in this document.

The SDK installs a directory called

```
C:\Office10
```

Which you can safely remove.

After the SDK is installed, follow the remaining notes on the page link above to get your MSVC Express environment configured correctly. For your convenience, these are summarised again below, and I have added a couple more paths that I discovered were needed:

1) open Visual Studio Express IDE

2) Tools -> Options -> Projects and Solutions -> VC++ Directories

3) Add:

```
Executable files:
  C:\Program Files\Microsoft Platform SDK for Windows Server 2003 R2\Bin

Include files:
```

```
  C:\Program Files\Microsoft Platform SDK for Windows Server 2003 R2\Include
  C:\Program Files\Microsoft Platform SDK for Windows Server 2003 R2\Include\atl
  C:\Program Files\Microsoft Platform SDK for Windows Server 2003 R2\Include\mfc
Library files: C:\Program Files\Microsoft Platform SDK for Windows Server 2003 R2\Lib
```

4) Close MSVC Express IDE

5) Open the following file with notepad:

```
C:\Program Files\Microsoft Visual Studio 8\VC\VCProjectDefaults\corewin_express.vsprops
```

and change the property:

```
AdditionalDependencies="kernel32.lib"
```

To read:

```
AdditionalDependencies="kernel32.lib user32.lib gdi32.lib winspool.lib comdlg32.lib
                        advapi32.lib shell32.lib ole32.lib oleaut32.lib uuid.lib"
```

The notes go on to show how to build a mswin32 application which you can try if you like - I'm not going to recover that here.

H.5. Edit your vsvars

Backup your vsvars32.bat file in

```
C:\Program Files\Microsoft Visual Studio 8\Common7\Tools
```

and replace it with this one:

```
@SET VSINSTALLDIR=C:\Program Files\Microsoft Visual Studio 8
@SET VCINSTALLDIR=C:\Program Files\Microsoft Visual Studio 8\VC
@SET FrameworkDir=C:\WINDOWS\Microsoft.NET\Framework
@SET FrameworkVersion=v2.0.50727
@SET FrameworkSDKDir=C:\Program Files\Microsoft Visual Studio 8\SDK\v2.0
@if "%VSINSTALLDIR%"=="" goto error_no_VSINSTALLDIR
@if "%VCINSTALLDIR%"=="" goto error_no_VCINSTALLDIR
```

```
@echo Setting environment for using Microsoft Visual Studio 2005 x86 tools.

@rem
@rem Root of Visual Studio IDE installed files.
@rem
@set DevEnvDir=C:\Program Files\Microsoft Visual Studio 8\Common7\IDE

@set PATH=C:\Program Files\Microsoft Visual Studio 8\Common7\IDE;
C:\Program Files\Microsoft Visual Studio 8\VC\BIN;
C:\Program Files\Microsoft Visual Studio 8\Common7\Tools;
C:\Program Files\Microsoft Visual Studio 8\SDK\v2.0\bin;
C:\WINDOWS\Microsoft.NET\Framework\v2.0.50727;
C:\Program Files\Microsoft Visual Studio 8\VC\VCPackages;%PATH%
@rem added by Tim
@set PATH=C:\Program Files\Microsoft Platform SDK for Windows Server 2003
     R2\Bin;%PATH%
@set INCLUDE=C:\Program Files\Microsoft Visual Studio 8\VC\INCLUDE;%INCLUDE%
@rem added by Tim
@set INCLUDE=C:\Program Files\Microsoft Platform SDK for Windows Server 2003
     R2\Include;%INCLUDE%
@set INCLUDE=C:\Program Files\Microsoft Platform SDK for Windows Server 2003
     R2\Include\mfc;%INCLUDE%
@set INCLUDE=%INCLUDE%;C:\dev\cpp\qgislibs-release\include\postgresql
@set LIB=C:\Program Files\Microsoft Visual Studio 8\VC\LIB;
C:\Program Files\Microsoft Visual Studio 8\SDK\v2.0\lib;%LIB%
@rem added by Tim
@set LIB=C:\Program Files\Microsoft Platform SDK for Windows Server 2003
     R2\Lib;%LIB%
@set LIB=%LIB%;C:\dev\cpp\qgislibs-release\lib
@set LIBPATH=C:\WINDOWS\Microsoft.NET\Framework\v2.0.50727

@goto end

:error_no_VSINSTALLDIR
@echo ERROR: VSINSTALLDIR variable is not set.
@goto end

:error_no_VCINSTALLDIR
@echo ERROR: VCINSTALLDIR variable is not set.
@goto end
```

```
:end
```

H.6. Environment Variables

Right click on 'My computer' then select the 'Advanced' tab. Click environment variables and create or augment the following "'System"' variables (if they dont already exist):

```
Variable Name:     Value:
-------------------------------------------------------------------------
EDITOR             vim
INCLUDE            C:\Program Files\Microsoft Platform SDK for Windows Server
                   2003 R2\Include\.
LIB                C:\Program Files\Microsoft Platform SDK for Windows Server
                   2003 R2\Lib\.
LIB_DIR            C:\dev\cpp\qgislibs-release
PATH               C:\Program Files\CMake 2.4\bin;
                   %SystemRoot%\system32;
                   %SystemRoot%;
                   %SystemRoot%\System32\Wbem;
                   C:\Program Files\Microsoft Platform SDK for Windows Server
                   2003 R2\Bin\.;
                   C:\Program Files\Microsoft Platform SDK for Windows Server
                   2003 R2\Bin\WinNT\;
                   C:\Program Files\svn\bin;C:\Program Files\Microsoft Visual
                   Studio 8\VC\bin;
                   C:\Program Files\Microsoft Visual Studio 8\Common7\IDE;
                   "c:\Program Files\Microsoft Visual Studio 8\Common7\Tools";
                   c:\Qt\4.3.2\bin;
                   "C:\Program Files\PuTTY"
QTDIR              c:\Qt\4.3.2
SVN_SSH            "C:\\Program Files\\PuTTY\\plink.exe"

== Building Qt4.3.2 ==

You need a minimum of Qt 4.3.2 here since this is the first version to officially
support building the open source version of Qt for windows under MSVC.

Download Qt 4.x.x source for windows from
```

http:\\www.trolltech.com

```
Unpack the source to
```

c:\Qt\4.x.x\

```
=== Compile Qt ===

Open the Visual Studio C++ command line and cd to c:\Qt\4.x.x where you
extracted the source and enter:

configure -platform win32-msvc2005
nmake
nmake install

Add -qt-sql-odbc -qt-sql-psql to the configure line if your want odbc and
PostgreSQL support build into Qt.

/!\ Note: For me in some cases I got a build error on qscreenshot.pro. If you
are only interested in having the libraries needed for building Qt apps, you
can probably ignore that. Just check in c:\Qt\4.3.2\bin to check all dlls and
helper apps (assistant etc) have been made.

=== Configure Visual C++ to use Qt ===

After building configure the Visual Studio Express IDE to use Qt:

1) open Visual Studio Express IDE

2) Tools -> Options -> Projects and Solutions -> VC++ Directories

3) Add:
```

Executable files: $(QTDIR)\bin

Include files: $(QTDIR)\include $(QTDIR)\include\Qt $(QTDIR)\include\QtCore $(QTDIR)\include\QtGui $(QTDIR)\include\QtNetwork $(QTDIR)\include\QtSvg $(QTDIR)\include\QtXml $(QTDIR)\include\Qt3Support $(LIB_DIR)\include (needed during qgis compile to find stdint.h and unistd.h)

Library files: $(QTDIR)\lib

Source Files: $(QTDIR)\src

```
Hint:  You can also add
```

QString = t=<d->data, su>, size=<d->size, i>

```
to AutoExp.DAT in C:\Program Files\Microsoft Visual Studio 8
\Common7\Packages\Debugger before
```

[Visualizer]

```
That way the Debugger will show the contents of QString when you point at or
watch a variable in the debugger.  There are probably much more additions -
feel free to add some - I just needed QString and took the first hit in google
I could find.
```

```
== Install Python ==

Download http://python.org/ftp/python/2.5.1/python-2.5.1.msi and install it.
```

```
== Install SIP ==

Download http://www.riverbankcomputing.com/Downloads/sip4/sip-4.7.1.zip
and extract it into your c:\dev\cpp directory.
From a Visual C++ command line cd to the directory where you extract SIP and run:
```

c:\python25\python configure.py -p win32-msvc2005 nmake nmake install

```
== Install PyQt4 ==

Download http://www.riverbankcomputing.com/Downloads/PyQt4/GPL/PyQt-win-gpl-4.3.1.zip
and extract it into your c:\dev\cpp directory.
From a Visual C++ command line cd to the directory where you extracted PyQt4 and run:
```

c:\python25\python configure.py -p win32-msvc2005 nmake nmake install “”

H.7. Install CMake

Download and install cmake 2.4.7 or better, making sure to enable the option

```
Update path for all users
```

H.8. Install Subversion

You ”’must”’ install the command line version if you want the CMake svn scripts to work. Its a bit tricky to find the correct version on the subversion download site as they have som misleadingly named similar downloads. Easiest is to just get this file:

http://subversion.tigris.org/downloads/1.4.5-win32/apache-2.2/svn-win32-1.4.5.zip

Extract the zip file to

```
C:\Program Files\svn
```

And then add

```
C:\Program Files\svn\bin
```

To your path.

H.9. Initial SVN Check out

Open a cmd.exe window and do:

```
cd \
cd dev
cd cpp
svn co https://svn.qgis.org/repos/qgis/trunk/qgis
```

At this point you will probably get a message like this:

```
C:\dev\cpp>svn co https://svn.qgis.org/repos/qgis/trunk/qgis
Error validating server certificate for 'https://svn.qgis.org:443':
 - The certificate is not issued by a trusted authority. Use the
   fingerprint to validate the certificate manually!
Certificate information:
 - Hostname: svn.qgis.org
 - Valid: from Sat, 01 Apr 2006 03:30:47 GMT until Fri, 21 Mar 2008 03:30:47 GMT
 - Issuer: Developer Team, Quantum GIS, Anchorage, Alaska, US
 - Fingerprint: 2f:cd:f1:5a:c7:64:da:2b:d1:34:a5:20:c6:15:67:28:33:ea:7a:9b
(R)eject, accept (t)emporarily or accept (p)ermanently?
```

Press 'p' to accept and the svn checkout will commence.

H.10. Create Makefiles using cmakesetup.exe

I wont be giving a detailed description of the build process, because the process is explained in the first section (where you manually build all dependencies) of the windows build notes in this document. Just skip past the parts where you need to build GDAL etc, since this simplified install process does all the dependency provisioning for you.

```
cd qgis
mkdir build
cd build
cmakesetup ..
```

Cmakesetup should find all dependencies for you automatically (it uses the LIB_DIR environment to find them all in c:\dev\cpp\qgislibs-release). Press configure again after the cmakesetup gui appears and when all the red fields are gone, and you have made any personalisations to the setup, press ok to close the cmake gui.

Now open Visual Studio Express and do:

File -> Open -> Project / Solution

Now open the cmake generated QGIS solution which should be in :

```
c:\dev\cpp\qgis\build\qgisX.X.X.sln
```

Where X.X.X represents the current version number of QGIS. Currently I have only made release built dependencies for QGIS (debug versions will follow in future), so you need to be sure to select 'Release' from the solution configurations toolbar.

Next right click on ALL_BUILD in the solution browser, and then choose build.

Once the build completes right click on INSTALL in the solution browser and choose build. This will by default install qgis into c:\program files\qgisX.X.X.

H.11. Running and packaging

To run QGIS you need to at the minimum copy the dlls from c:\dev\cpp\qgislibs-release\bin into the c:\program files\qgisX.X.X directory.

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Version 2, June 1991

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Literature

[1] T. Mitchell. Web mapping illustrated, published by o'reilly, 2005.

[2] G. Sherman. Shuffing quantum gis into the open source gis stack, free and open source software for geospatial (foss4g) conference victoria, bc, 2007.

Web-References

[3] GRASS GIS. `http://grass.itc.it`, 2006.

[4] PostGIS. `http://postgis.refractions.net/`, 2006.

[5] Web Map Service (1.1.1) Implementation Specification. `http://portal.opengeospatial.org`, 2002.

[6] Web Map Service (1.3.0) Implementation Specification. `http://portal.opengeospatial.org`, 2004.

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