

THE GEOSPATIAL DESKTOP

OPEN SOURCE GIS AND MAPPING

GARY SHERMAN

FIGURES AND ILLUSTRATIONS

THE GEOSPATIAL DESKTOP: OPEN SOURCE GIS AND MAPPING
by Gary Sherman

Published by Locate Press

COPYRIGHT © 2012 GARY SHERMAN
ALL RIGHTS RESERVED
978-0-9868052-1-9

No part of this work may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage or retrieval system, without the prior written permission of the copyright owner and the publisher.

Direct permission requests to info@locatepress.com, or mail to
Locate Press, PO Box 4844, Williams Lake, BC, Canada V2G 2V8.

Editor Tyler Mitchell
Cover Design Julie Springer
Interior Design Based on Tufte- \LaTeX
Publisher Website <http://www.locatepress.com>
Book Website <http://geospatialdesktop.com>

List of Figures

3.1	GIS functions	5
3.2	Bird sightings: The bigger the dot, the more birds	6
3.3	A 200-foot buffer around the lakes	7
4.1	Some OSGIS applications in relation to class of user	8
5.1	uDig Data Sources Dialog	9
5.2	uDig displaying world borders	10
5.3	Classifying countries by population	11
5.4	Countries classified by population	12
5.5	Viewing attributes in uDig	12
5.6	QGIS with sample data loaded	13
5.7	QGIS vector layer properties	14
5.8	Nicely rendered world borders layer	15
5.9	QGIS continuous color renderer settings	16
5.10	QGIS continuous color renderer results	17
5.11	QGIS graduated renderer settings	18
5.12	QGIS graduated renderer results	19
5.13	Unique value renderer for birds	20
5.14	Viewing birds by name	21
5.15	QGIS unique renderer settings for a geologic map	22
5.16	QGIS unique renderer result	23
5.17	QGIS Identify results	23
5.18	Attribute table for the cities layer	24
5.19	Search Query Builder	25
5.20	Attribute action enabled in QGIS	26
6.1	Montana topographic map in QGIS	27
6.2	NASA world mosaic viewed in QGIS	28
6.3	QGIS raster properties dialog box	29
6.4	Semitransparent digital elevation model draped over a DRG	30
6.5	QGIS raster pyramids dialog box	31
6.6	Grid of silver values	32
6.7	Grid of silver values in pseudocolor	33
7.1	Creating a new shapefile in QGIS	34
7.2	QGIS with new layer ready to edit	35

7.3	Entering attributes for a feature	36
7.4	Results of digitizing lakes in QGIS	37
7.5	Digitized Streams	38
7.6	Problems with the digitized streams	39
7.7	Digitized streams with corrections	40
9.1	Loading shapefiles into PostGIS using SPIT	41
9.2	Creating a new PostGIS connection in QGIS	42
9.3	List of available PostGIS layers	43
9.4	PostGIS query builder in QGIS	44
9.5	PostGIS layers created with the query builder	45
9.6	PostGIS connect dialog box in uDig	46
10.1	Digitizing a plat	47
10.2	The QGIS Delimited Text plugin	48
10.3	Earthquakes rendered in QGIS by magnitude	49
10.4	GPS plugin in QGIS	50
10.5	Track and waypoint loaded from GPS unit	51
10.6	Uploading to the GPS	52
10.7	Georeferencing an image with QGIS	53
10.8	Transformation Settings for Georeferencing an Image with QGIS	54
12.1	Results of line-of-sight analysis in GRASS	55
12.2	Raising sea level by 100 meters	56
12.3	Hillshade with no exaggeration (left) and 4X exaggeration (right)	57
12.4	Colored shaded relief map created with GRASS	58
12.5	Merged GTOPO30 DEM	59
12.6	Overlapping collars on DRGs	60
12.7	Seamless display of clipped DRGs	61
12.8	Rivers and the quadrangle for clipping	62
12.9	Rivers clipped to a quadrangle boundary	63
13.1	Hemisphere view of Earth created with GMT	64
13.2	Globe centered on 180/65	65
13.3	Alaska coastline generated with GMT	66
13.4	Volcanoes plotted on a Robinson projection using GMT	67
13.5	Alaska derived from the world mosaic	67
13.6	Alaska mosaic warped to Alaska Albers projection	68
13.7	VRT raster over the parcel shapefile	69
14.1	The GRASS Plugin Toolbar	70
14.2	Selecting a GRASS mapset in QGIS	70
14.3	The GRASS tools in QGIS	71
14.4	The GRASS Toolbox Ready to Run r.composite	72
14.5	GRASS edit tools in QGIS	73
14.6	Adding attributes to a GRASS feature	73

14.7	Adding columns to the new GRASS map table	74
14.8	Editing the attributes of an existing feature	74
14.9	Completed city map with water wells	75
14.10	GRASS browser in QGIS	76
14.11	Buffer module ready to buffer eagle nest locations	77
14.12	Buffered eagle nests created with GRASS and QGIS	78
14.13	Roads buffered using GRASS in QGIS	79
14.14	Result of each type of vector overlay operation	80
14.15	Timber stands and stream buffers	81
14.16	Eligible logging areas after vector subtraction	82
14.17	Setting up to contour a DEM	83
14.18	Result of contouring the DEM	84
14.19	Mapcalc model for converting DEM from meters to feet	85
15.1	Changing the window title with Python	86
15.2	Installing the Plugin Builder	87
15.3	Plugin Builder Ready to Generate the Zoom to Point Plugin	87
15.4	Results of Generating the ZoomToPoint Plugin	88
15.5	Plugin dialog box in Qt Designer	89
15.6	ZoomToPoint plugin in use	90
15.7	Volcanoes shapefile created with Python script	91
16.1	Applications grouped by underlying programming language	92
18.1	GRASS database selection/creation dialog box	93
18.2	Choosing the WGS 84 projection for the GRASS location	94
18.3	Default region settings for a WGS 84 world location	95
18.4	GRASS start-up form	96
18.5	GRASS location parameters	97
18.6	GRASS location and mapset created and ready to use	98
18.7	World mosaic in GRASS	99
18.8	GRASS thematic map showing world population	100
18.9	Adding a Column to a GRASS Vector Map	101
18.10	Results of digitizing lakes in GRASS	102
19.1	Metadata for the world borders layer	103
19.2	QGIS Geospatial Bookmarks dialog box	104
19.3	QGIS Plugin Manager	104

3 Introduction

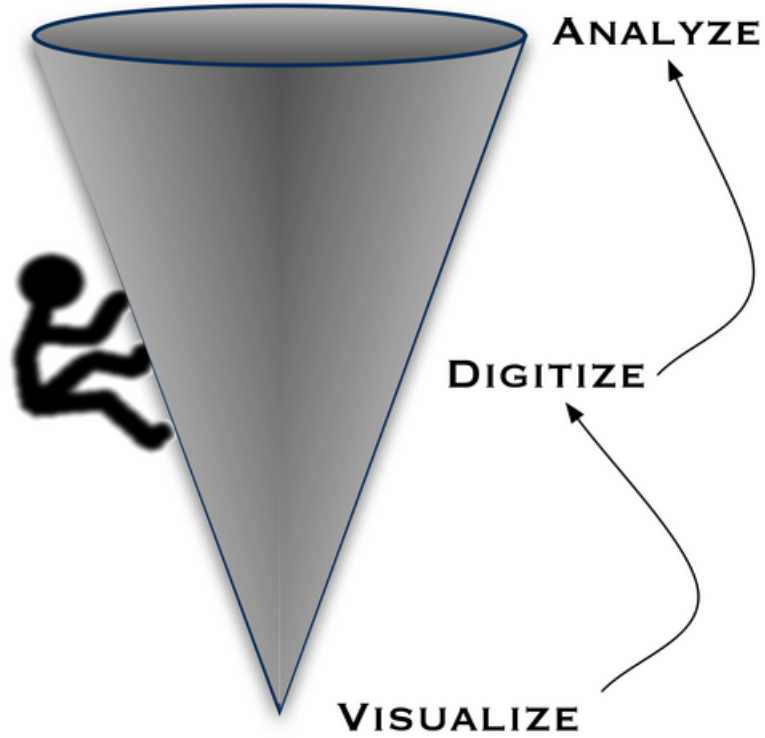


Figure 3.1: GIS functions



Figure 3.2: Bird sightings: The bigger the dot, the more birds

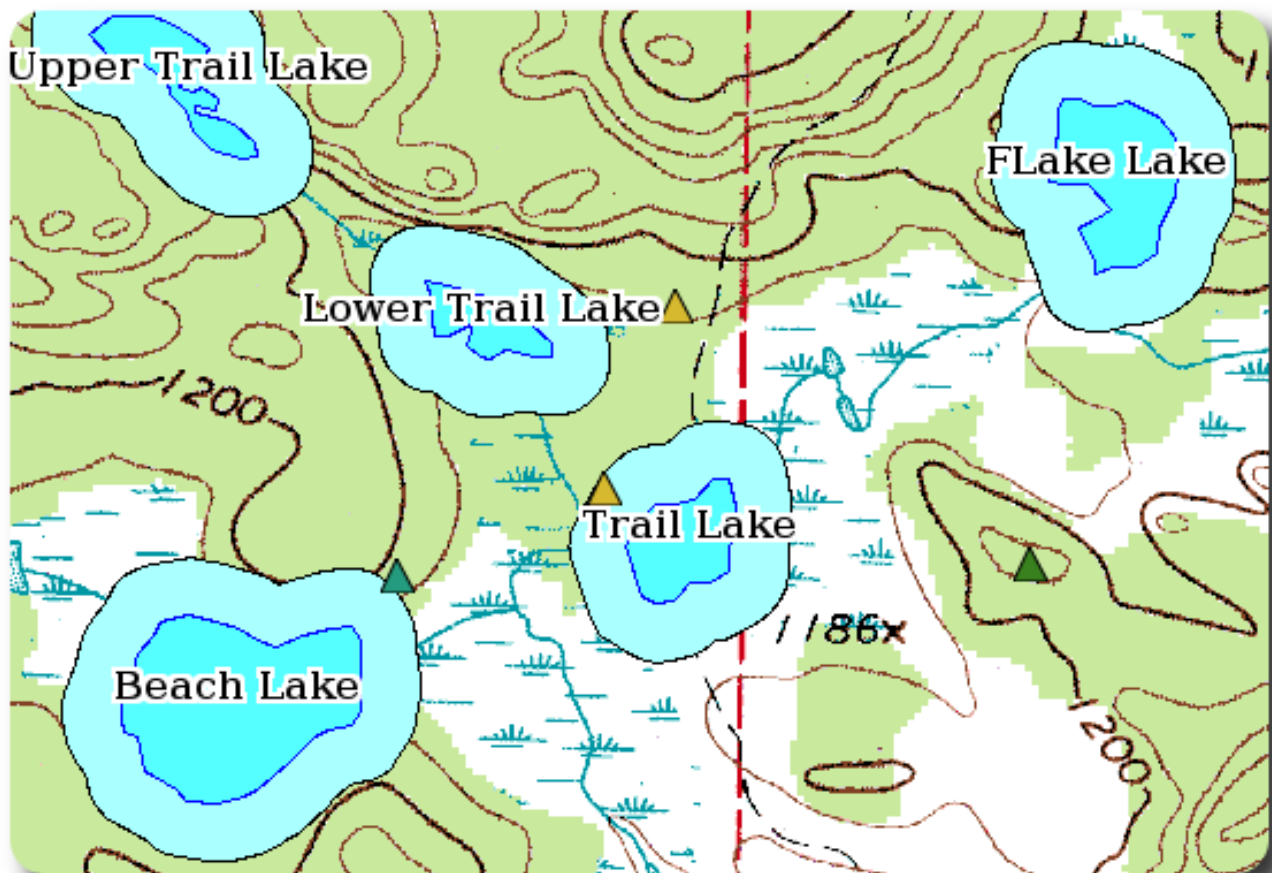


Figure 3.3: A 200-foot buffer around the lakes

4 Getting Started

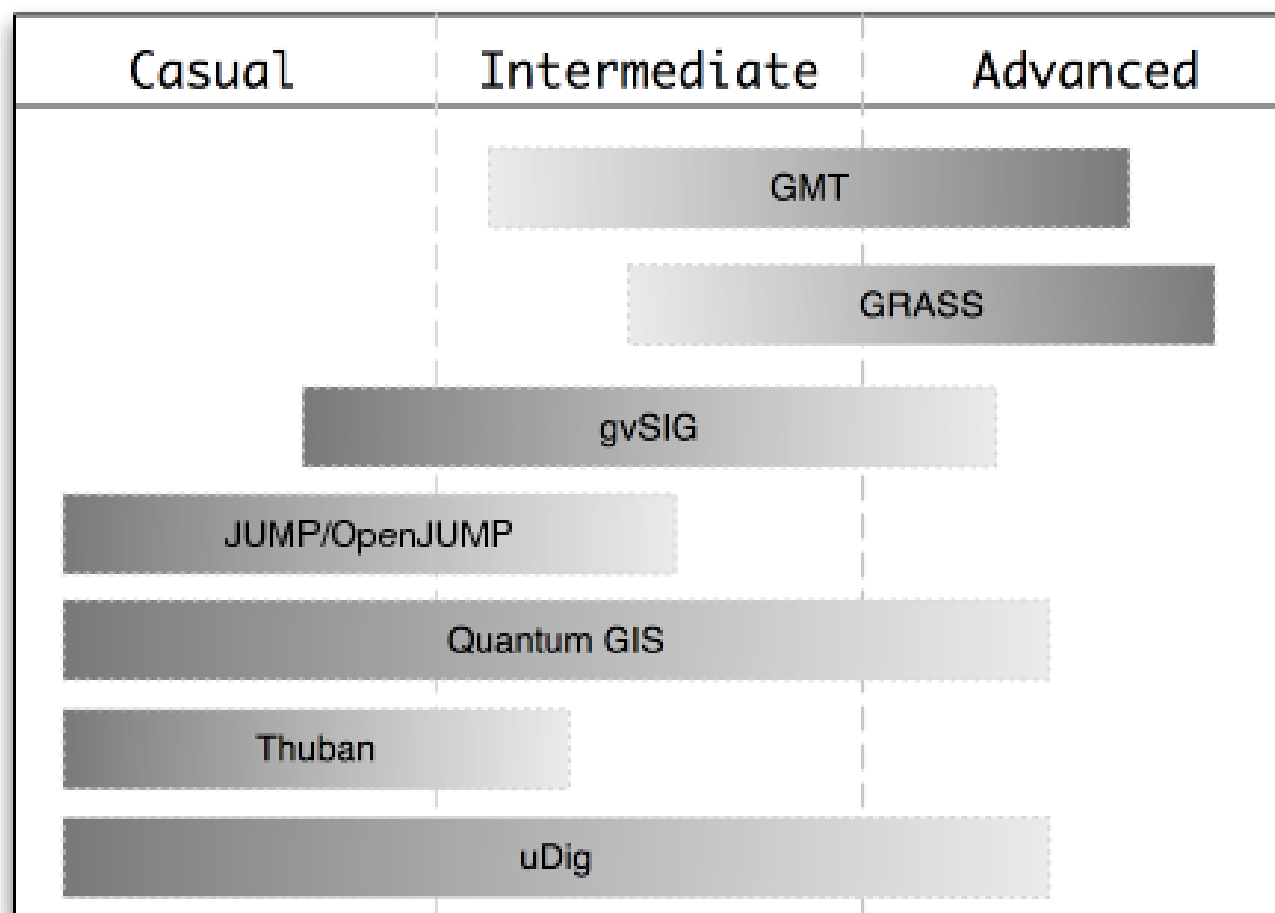


Figure 4.1: Some OSGIS applications in relation to class of user

5 Working with Vector Data

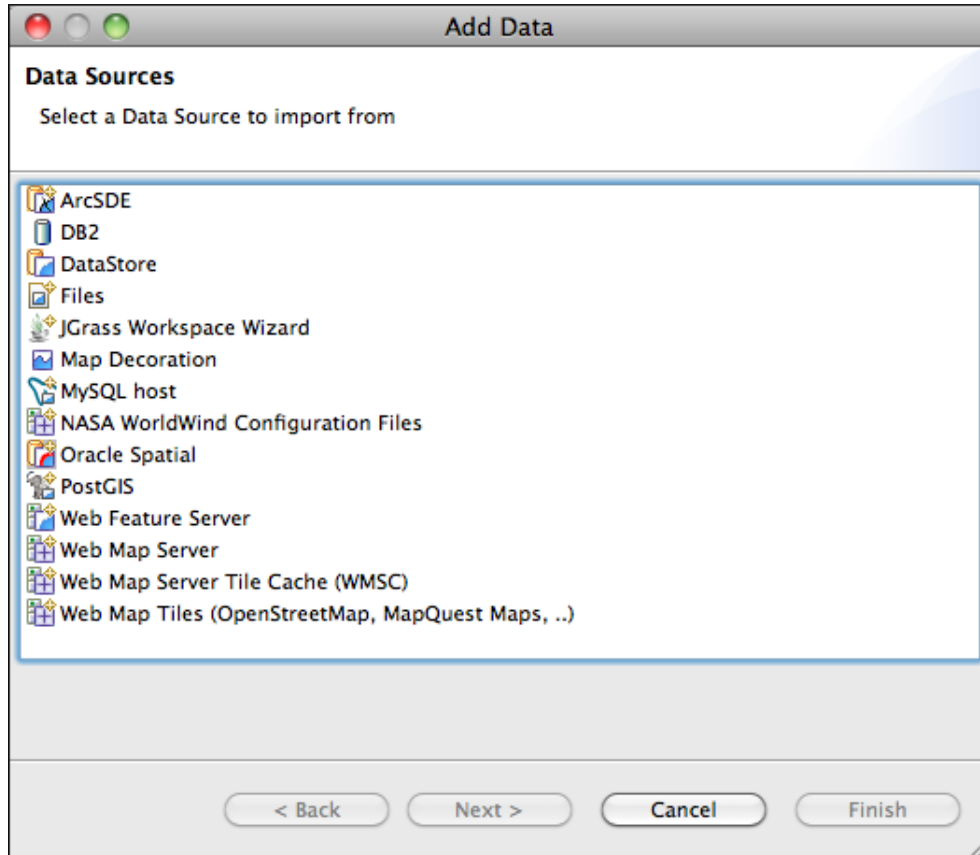


Figure 5.1: uDig Data Sources Dialog

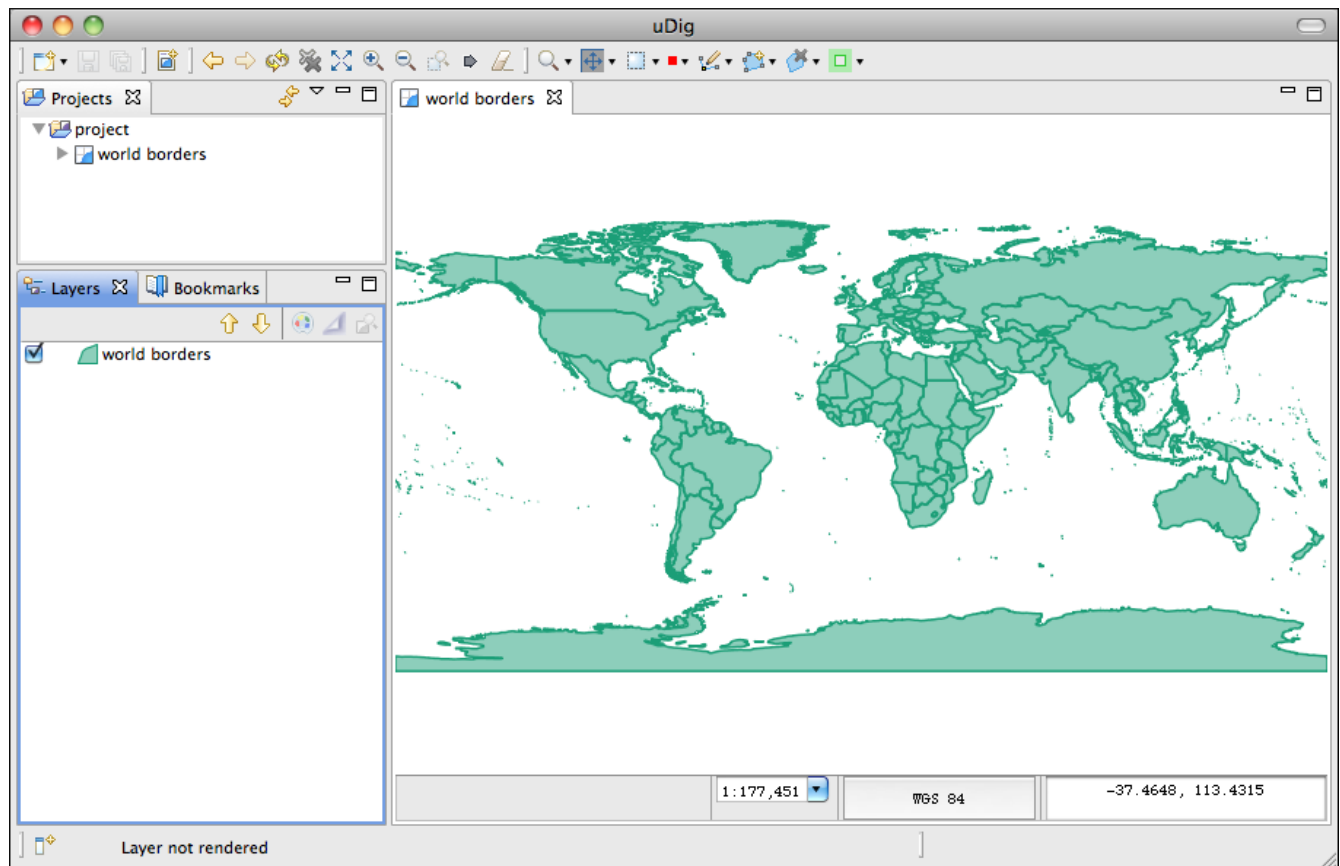


Figure 5.2: uDig displaying world borders

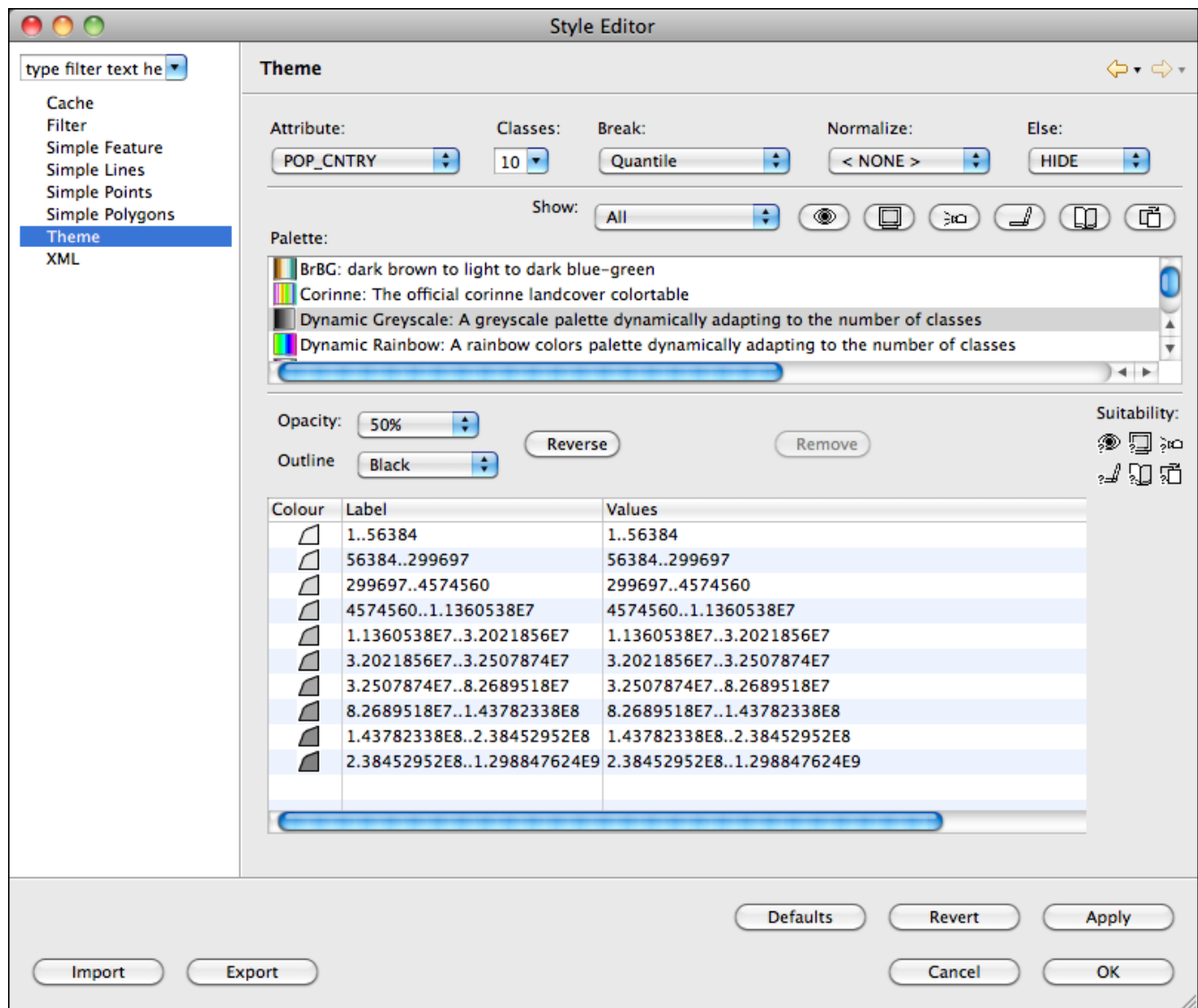


Figure 5.3: Classifying countries by population

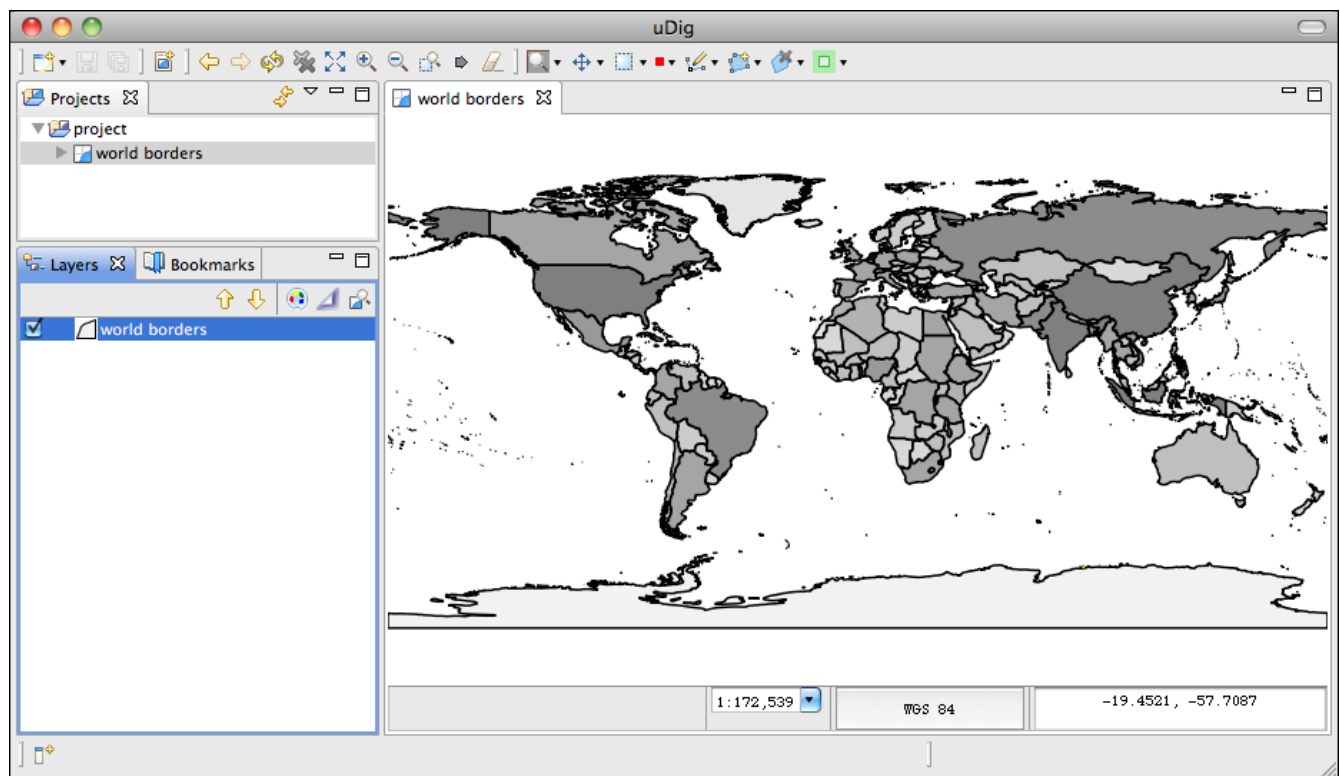


Figure 5.4: Countries classified by population

Catalog

Web Catalog

Search

Default Feature Editor

Table View

Progress View

Any

search

All

Features Selected: 0

FID	FAT	FIPS_CNTRY	CNTRY_NAME	AREA	POP_CNTRY
world_borders.1037	3	AF	Afghanistan	647500.0	2.8513677E7
world_borders.6	6	AL	Albania	28748.0	3544808.0
world_borders.4	4	AG	Algeria	2381740.0	3.2129324E7
world_borders.15	10	AQ	American Samoa	199.0	57902.0
world_borders.16	10	AQ	American Samoa	199.0	57902.0
world_borders.17	10	AQ	American Samoa	199.0	57902.0
world_borders.18	10	AQ	American Samoa	199.0	57902.0
world_borders.19	10	AQ	American Samoa	199.0	57902.0

Figure 5.5: Viewing attributes in uDig

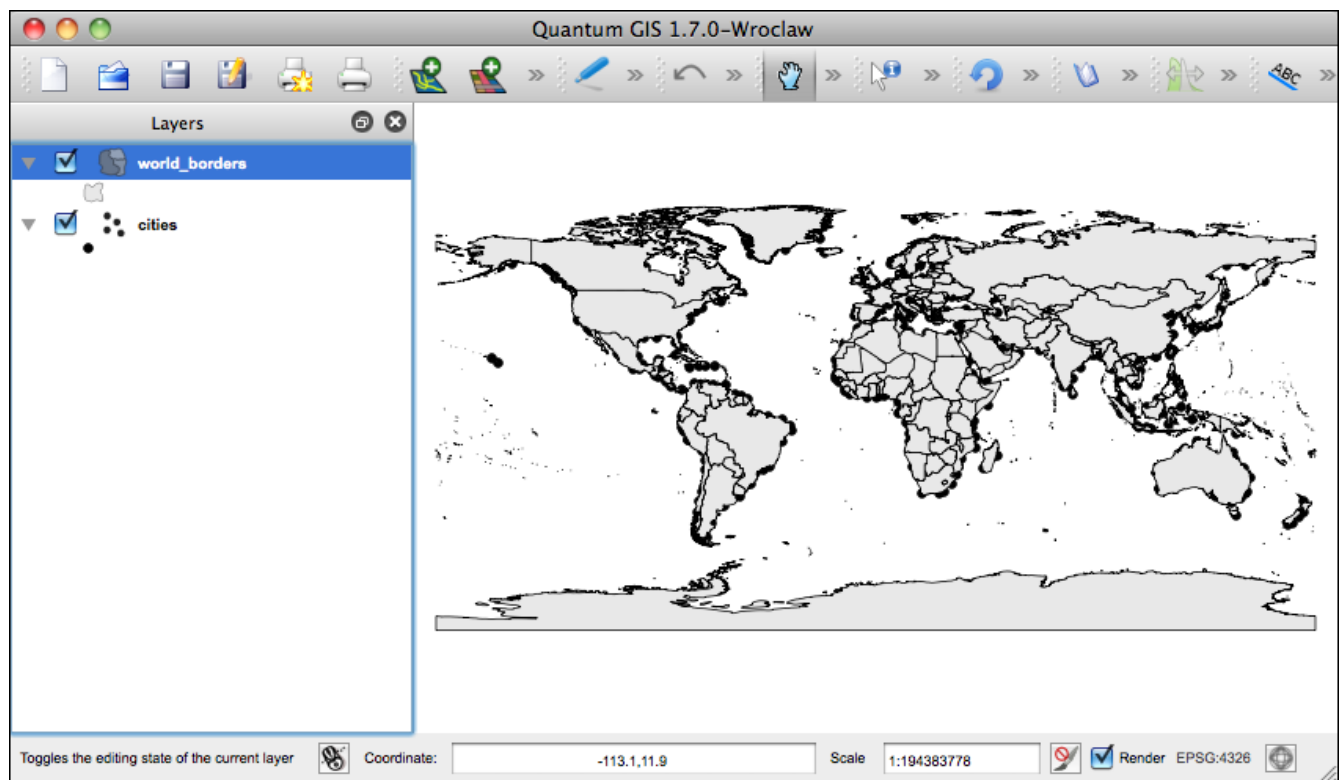


Figure 5.6: QGIS with sample data loaded

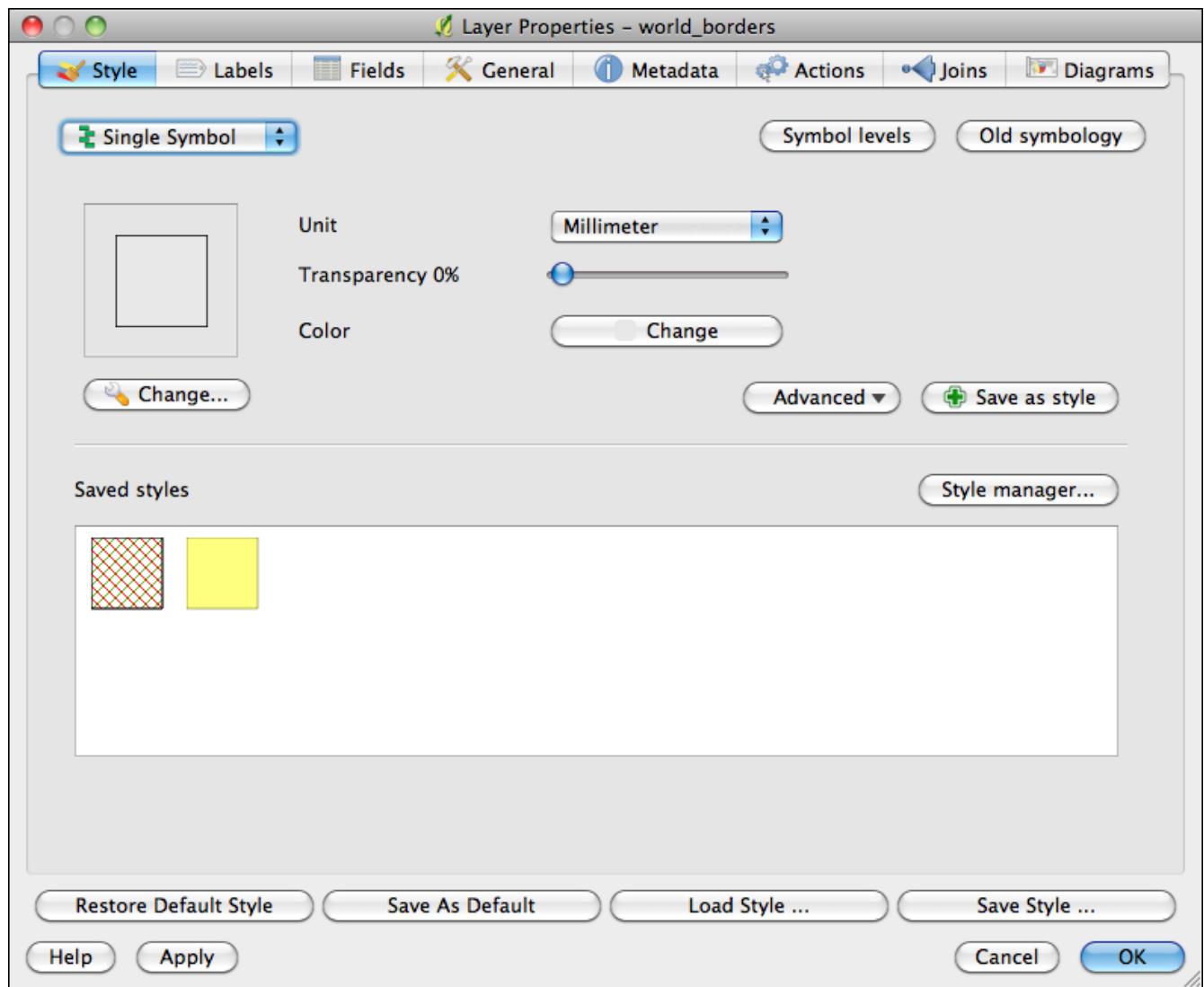


Figure 5.7: QGIS vector layer properties

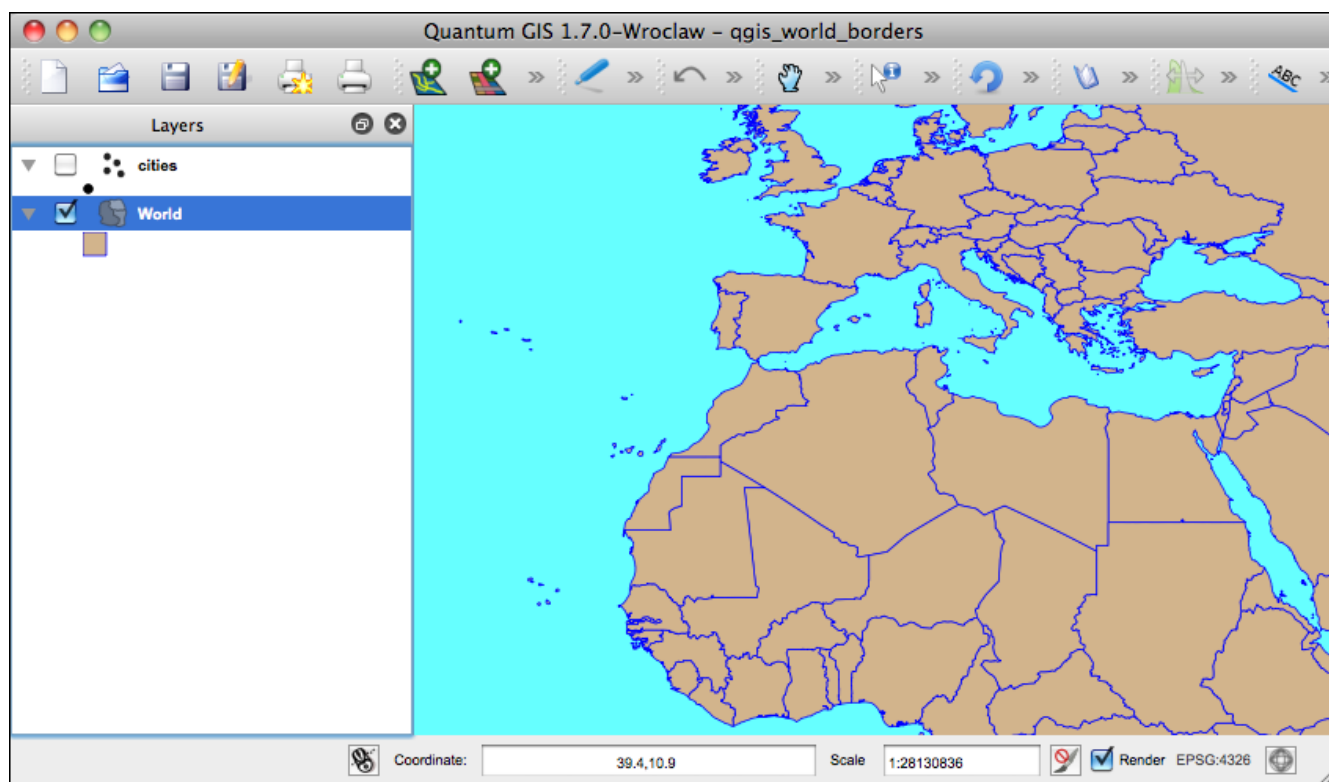


Figure 5.8: Nicely rendered world borders layer

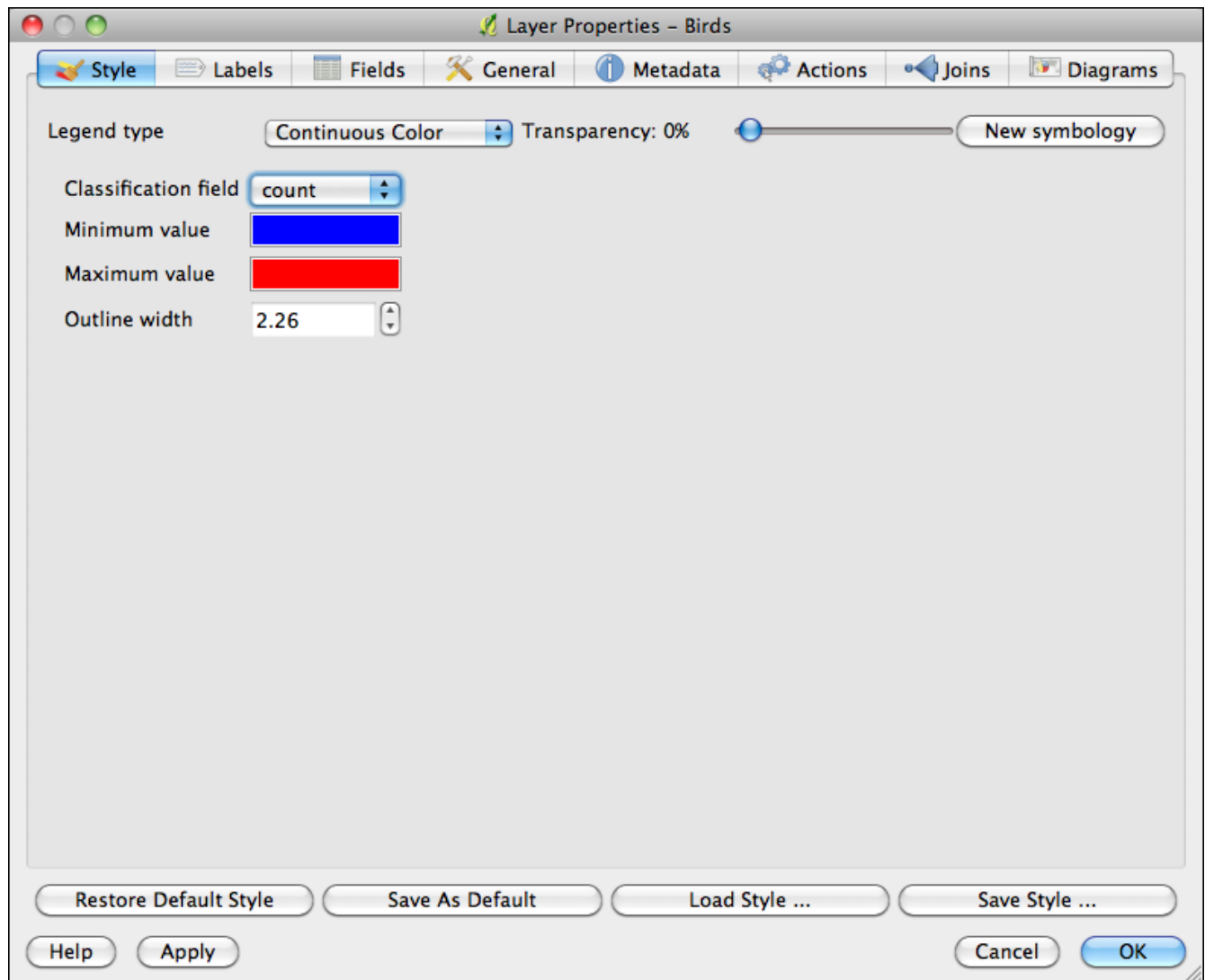


Figure 5.9: QGIS continuous color renderer settings

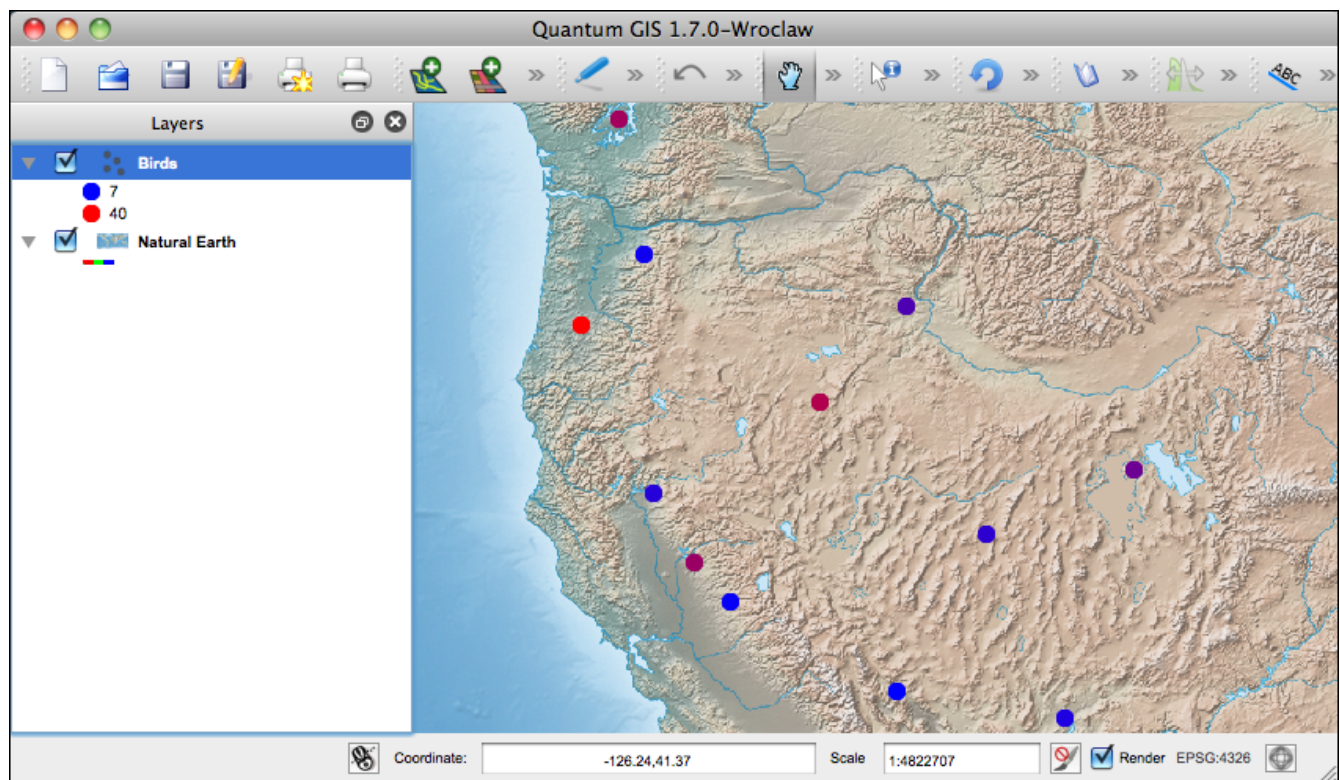


Figure 5.10: QGIS continuous color renderer results

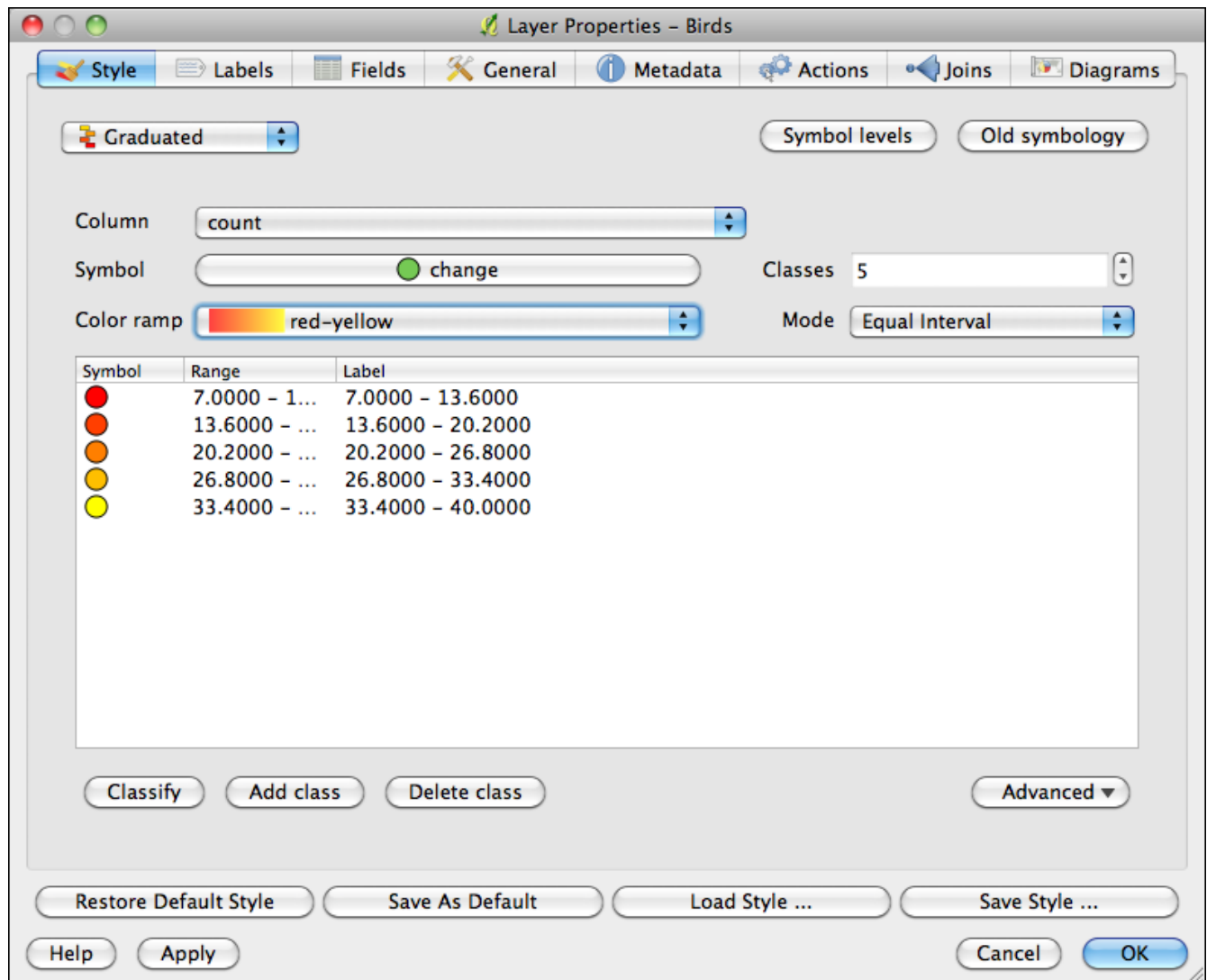


Figure 5.11: QGIS graduated renderer settings

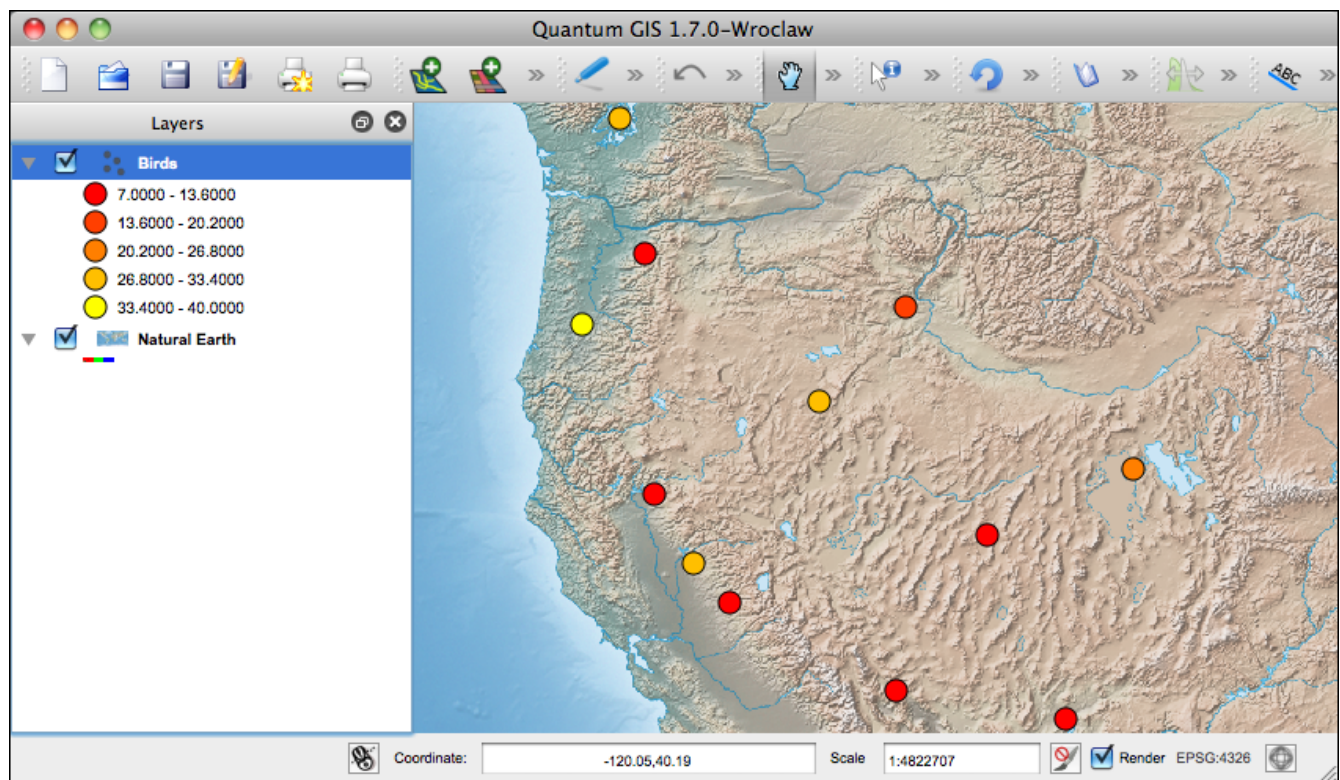


Figure 5.12: QGIS graduated renderer results

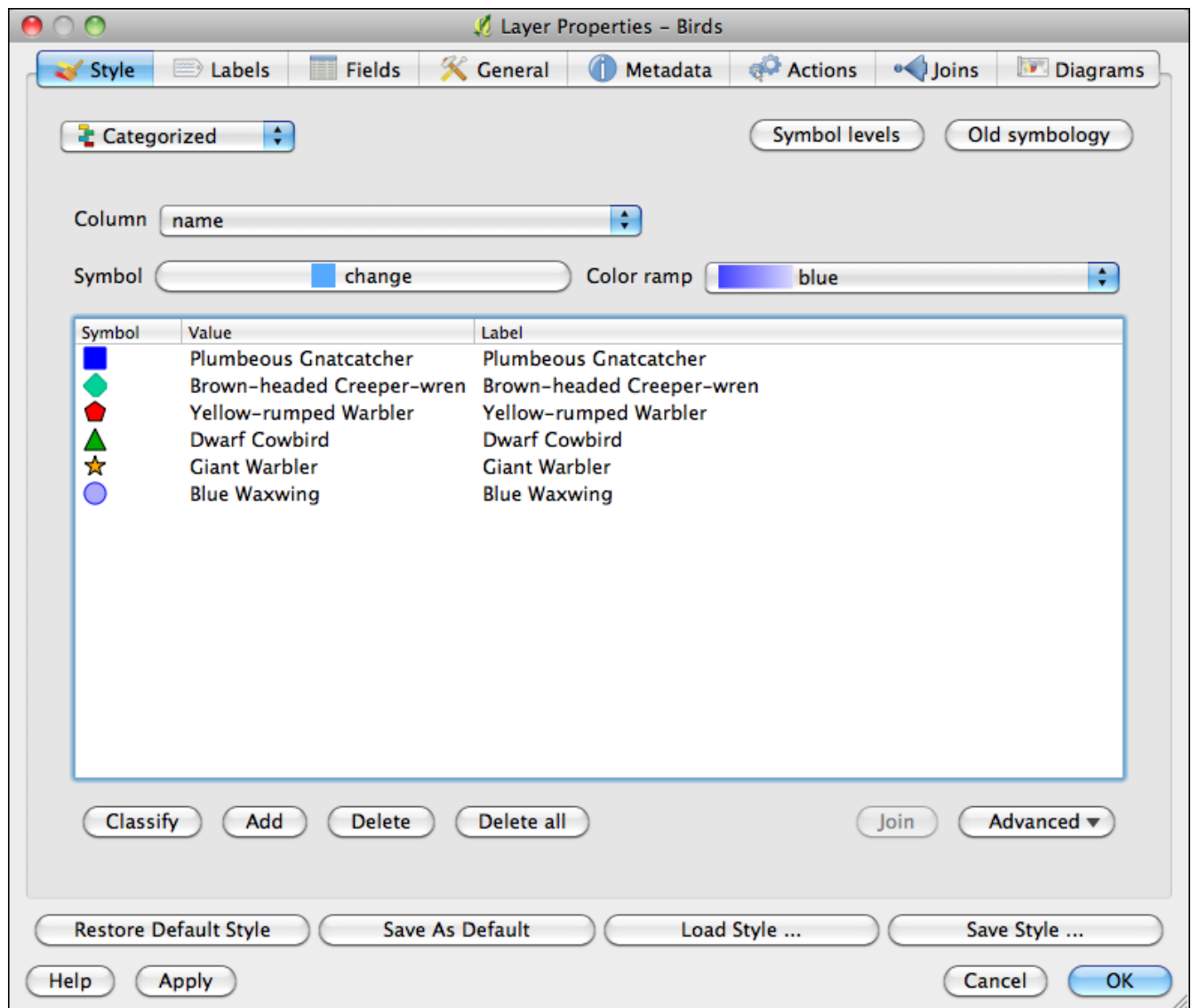


Figure 5.13: Unique value renderer for birds

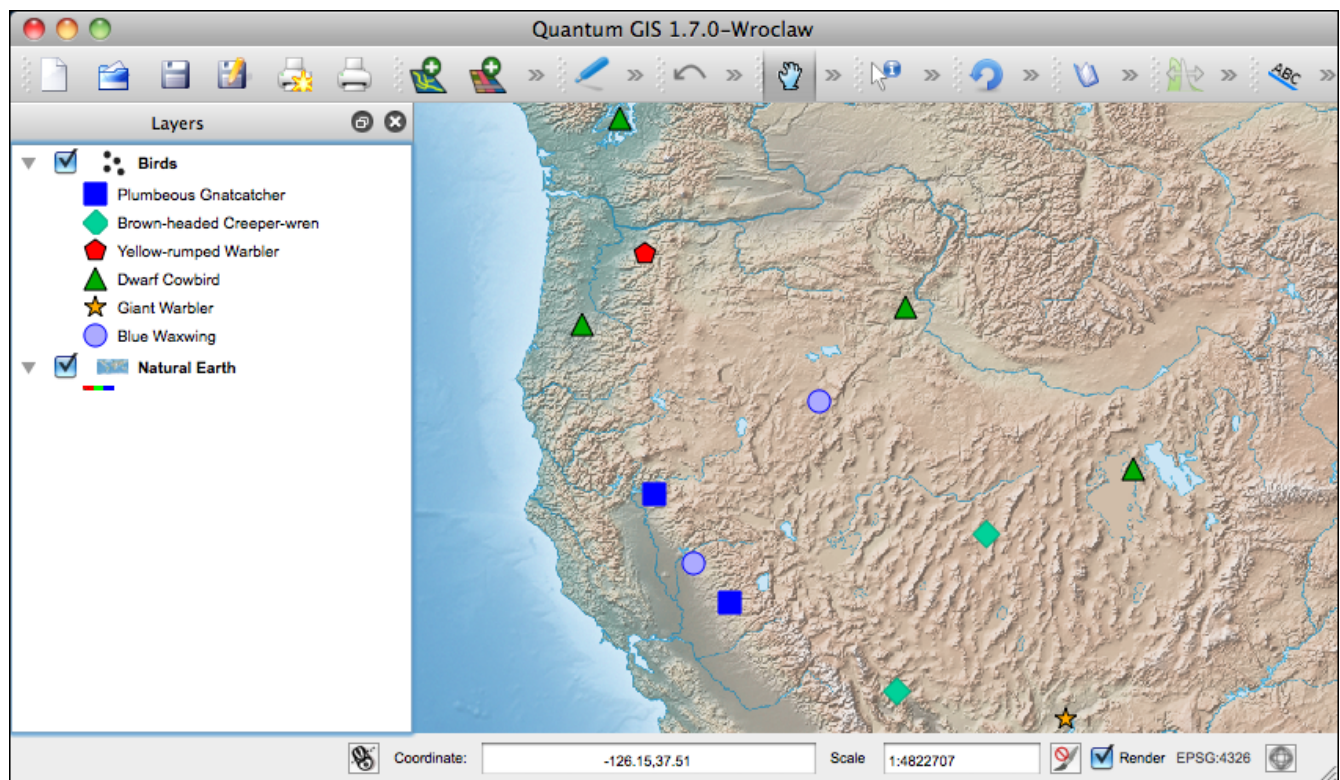


Figure 5.14: Viewing birds by name

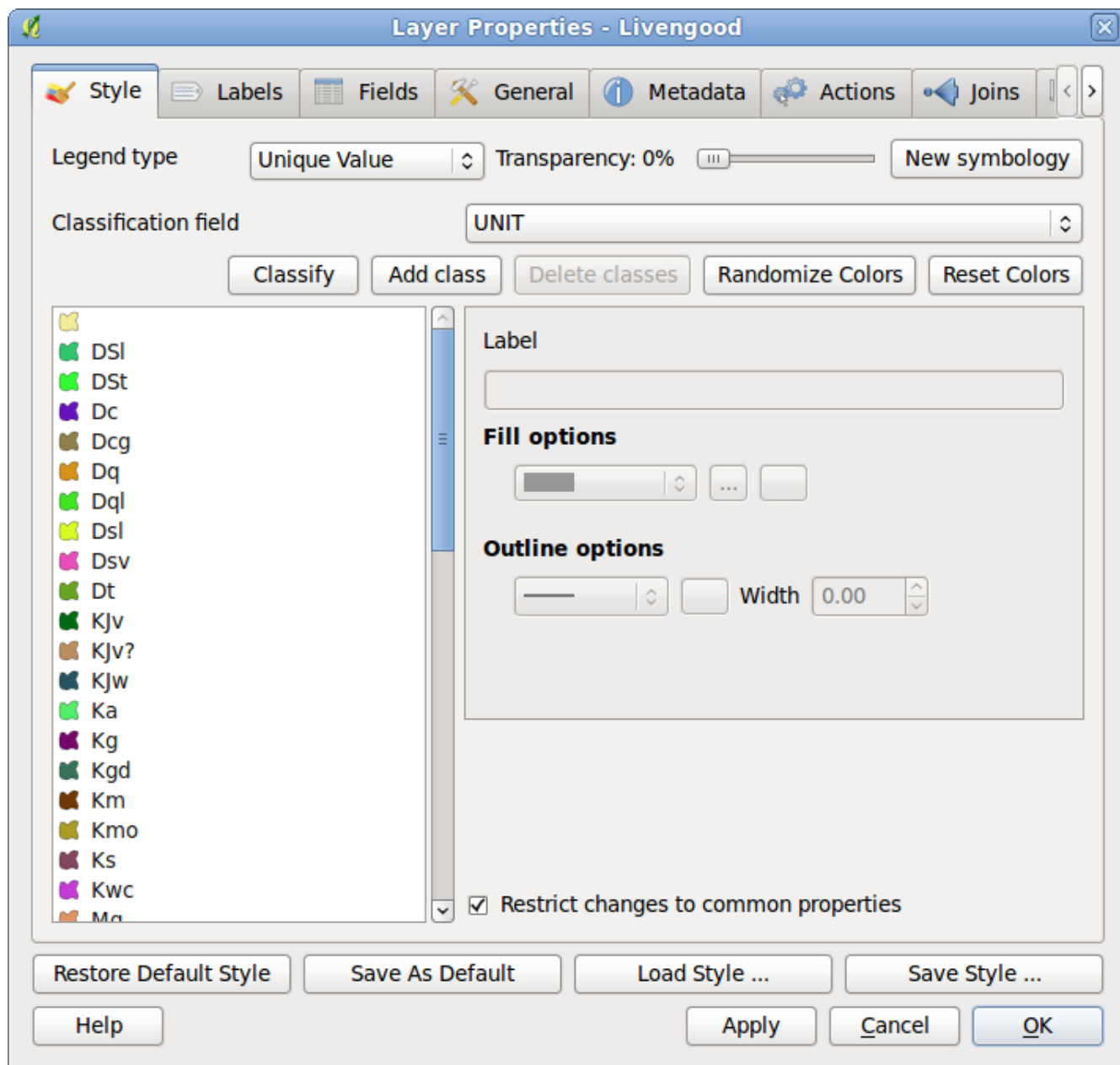


Figure 5.15: QGIS unique renderer settings for a geologic map

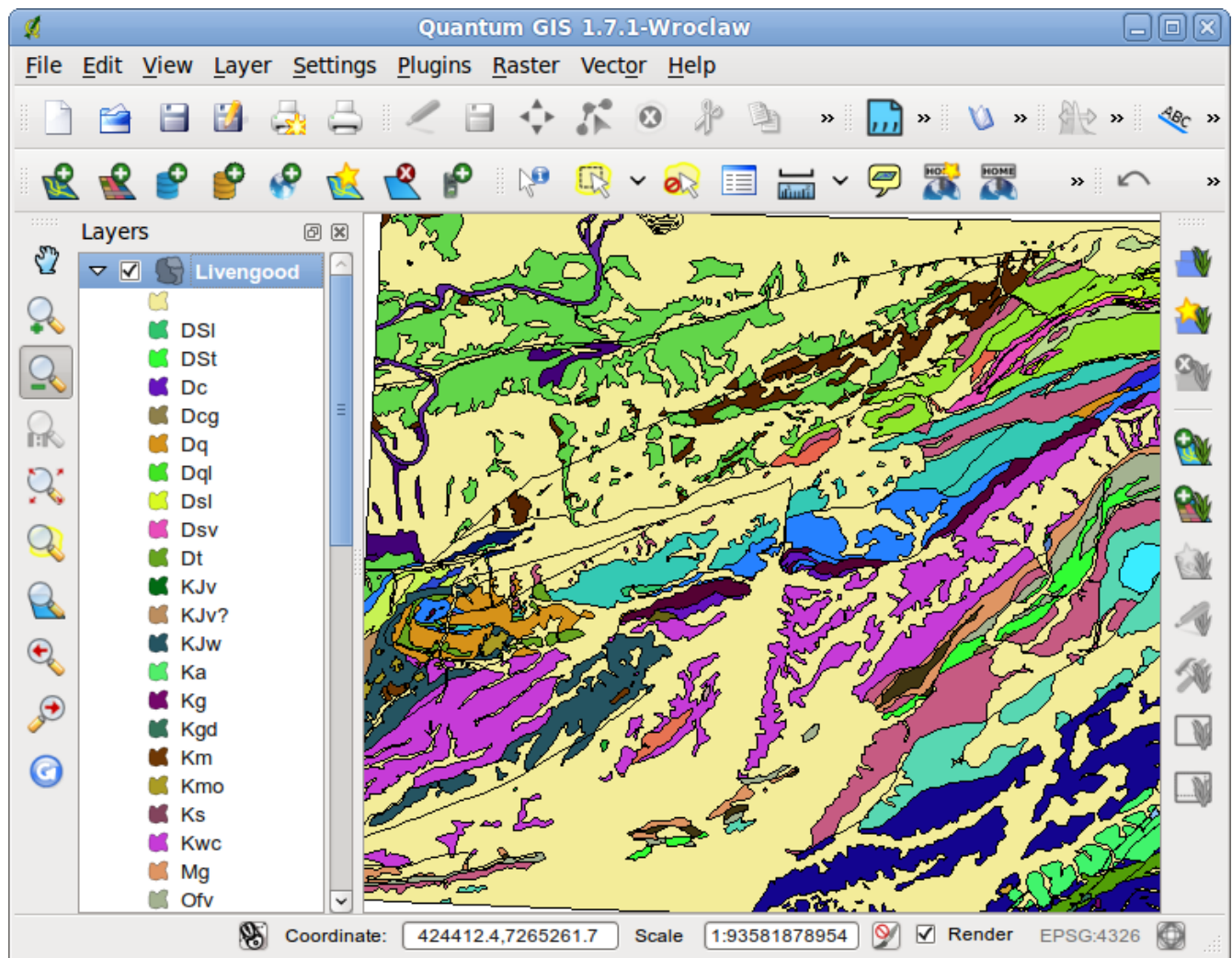


Figure 5.16: QGIS unique renderer result

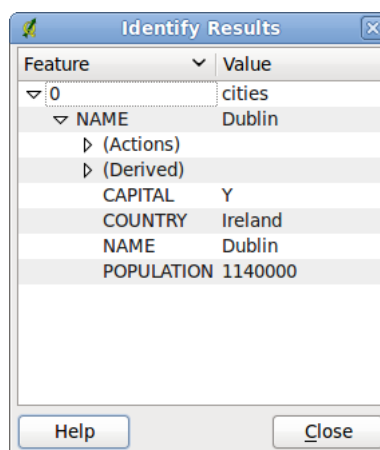


Figure 5.17: QGIS Identify results

Attribute table - cities :: 0 / 606 feature(s) selected

	NAME	COUNTRY	POPULATION	CAPITAL
0	Abidjan	Ivory Coast	1950000	Y
1	Abu Zaby	Untd Arab Em	242975	Y
2	Acapulco	Mexico	301902	N
3	Accra	Ghana	1250000	Y
4	Adana	Turkey	777554	N
5	Adelaide	Australia	977721	N
6	Aden	Yemen	318000	N
7	Adis Abeba	Ethiopia	1500000	Y
8	Agadez	Niger	50164	N
9	Ahmadabad	India	2400000	N
10	Al Basra	Iraq	616700	N
11	Aleppo	Syria	1216000	N
12	Alexandria	Egypt	3350000	N
13	Algiers	Algeria	2547983	Y

Look for in

☐ Show selected only ☐ Search selected only ☒ Case sensitive

Figure 5.18: Attribute table for the cities layer

Search query builder

cities

Fields

NAME
COUNTRY
POPULATION
CAPITAL

Values

'N'
'Y'

Sample All

Operators

=	<	>	LIKE	%	IN	NOT IN
<=	>=	!=	ILIKE	AND	OR	NOT

SQL where clause

POPULATION > 2000000 AND CAPITAL = 'Y'

Help Test Clear Save... Load... Cancel OK

Figure 5.19: Search Query Builder

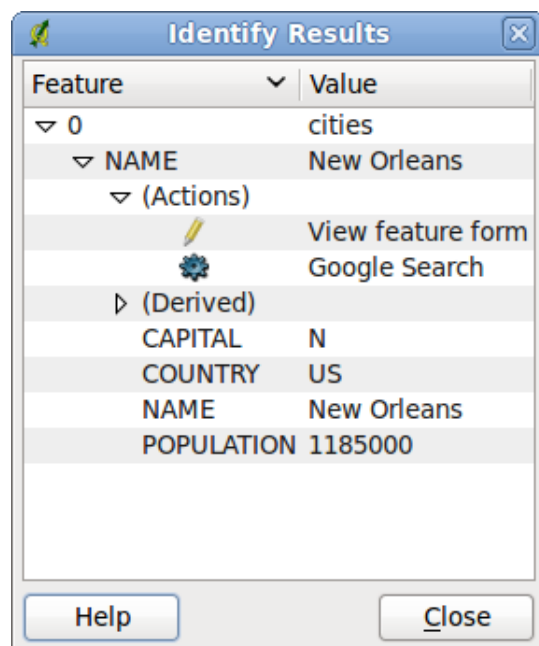


Figure 5.20: Attribute action enabled in QGIS

6 Working with Raster Data

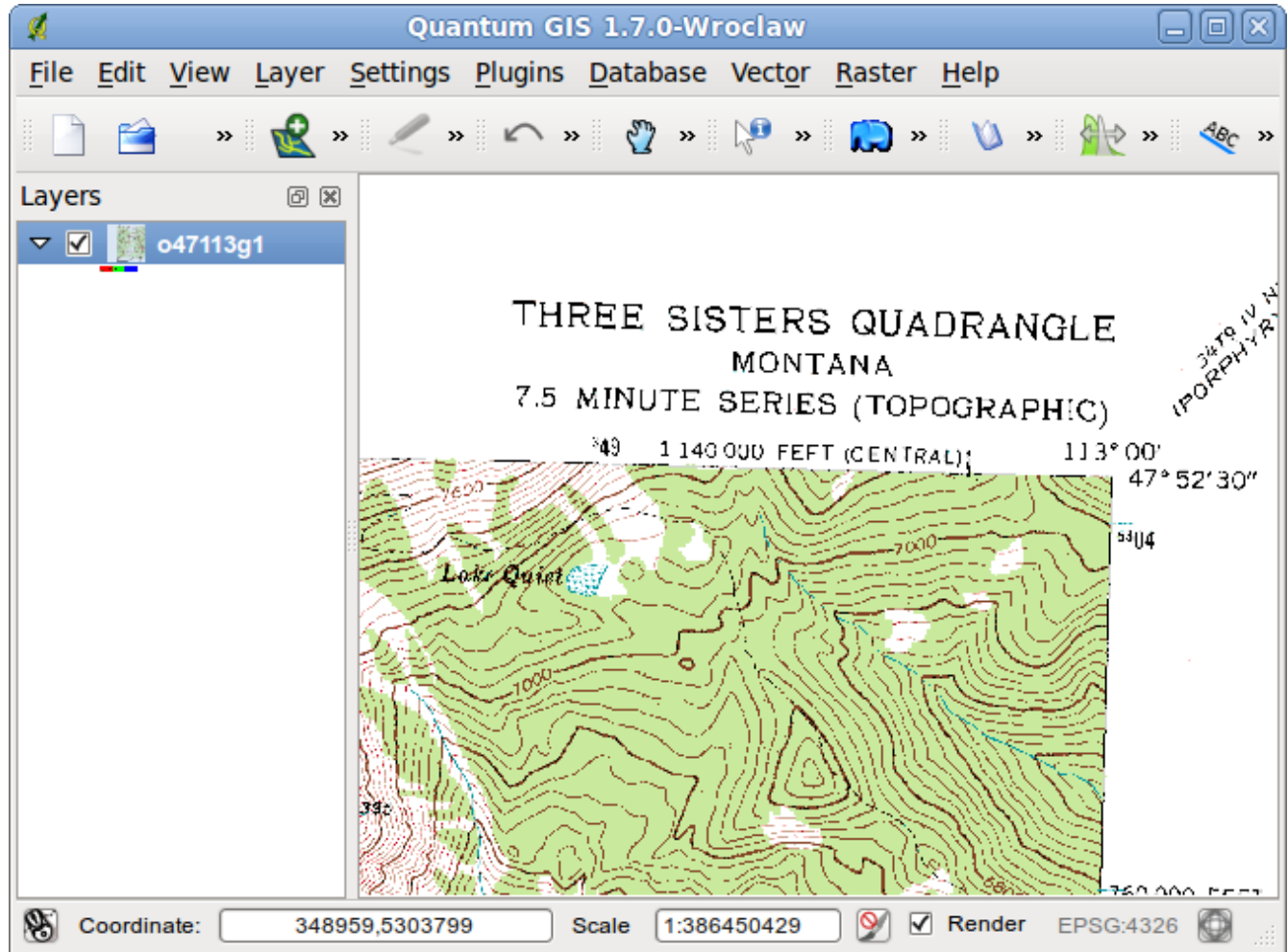


Figure 6.1: Montana topographic map in QGIS

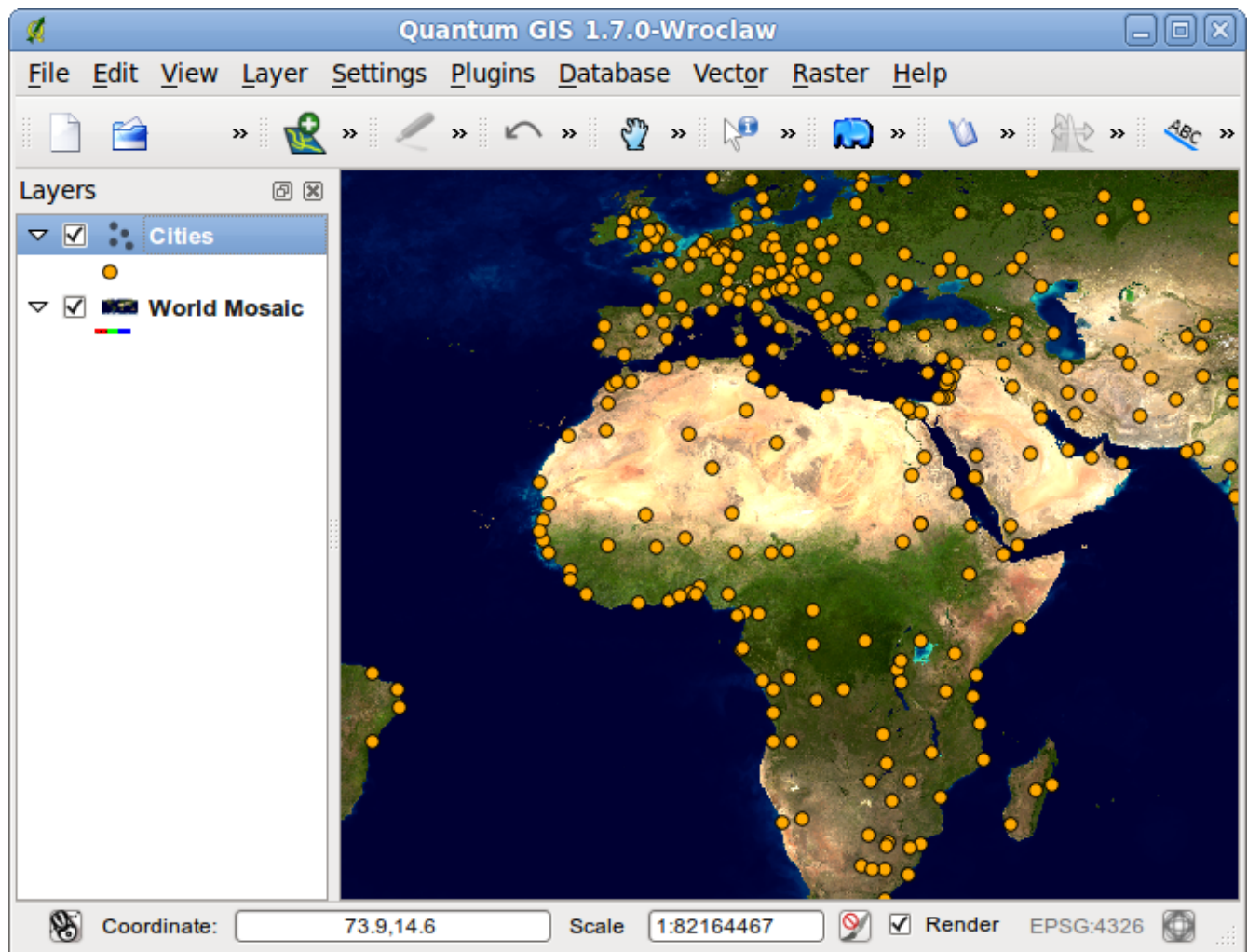


Figure 6.2: NASA world mosaic viewed in QGIS

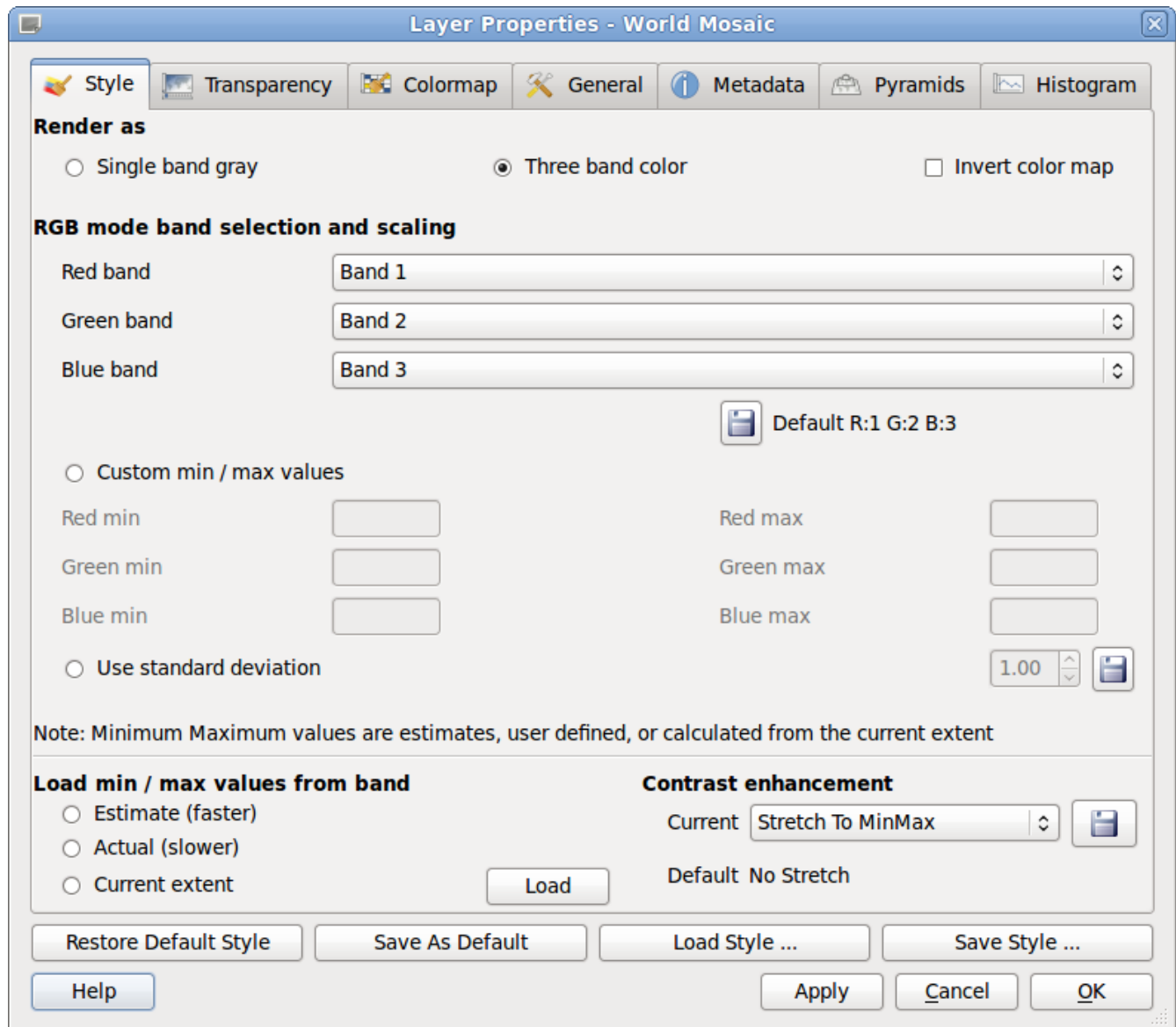


Figure 6.3: QGIS raster properties dialog box

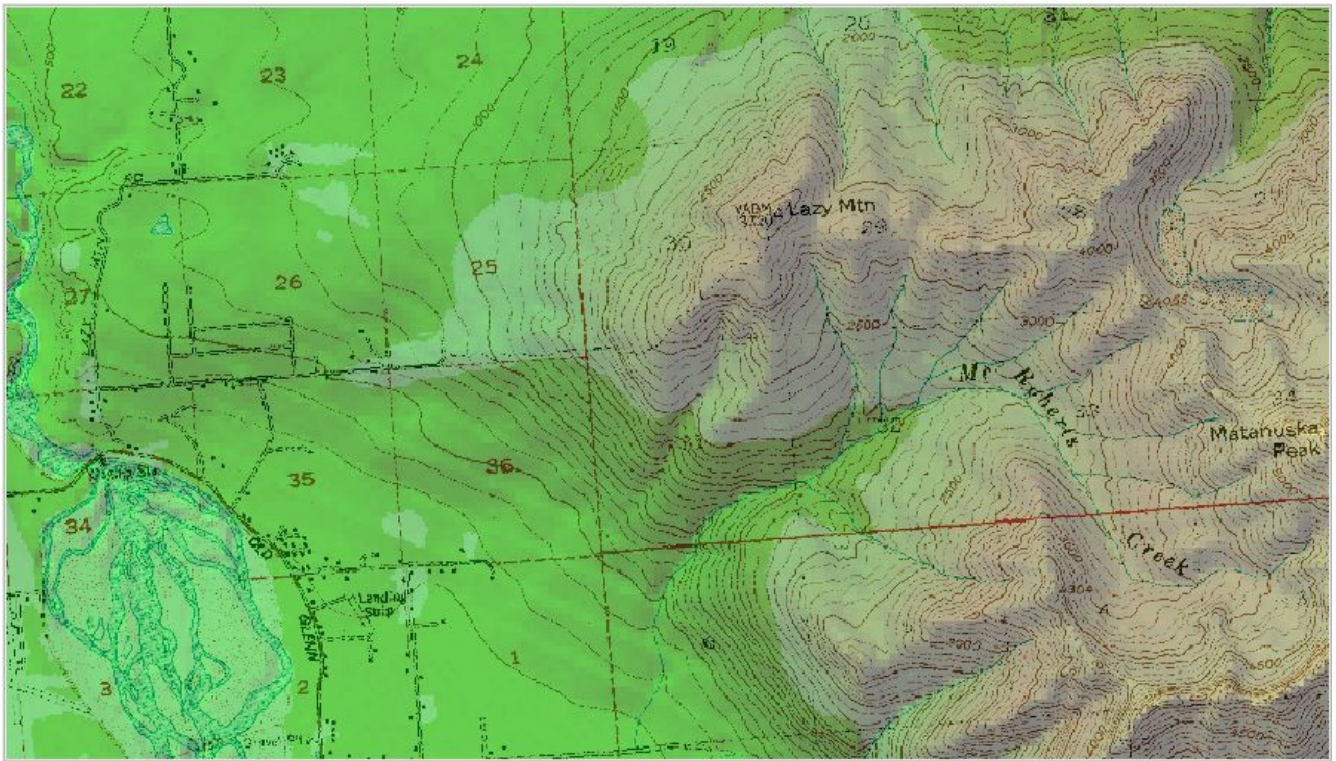


Figure 6.4: Semitransparent digital elevation model draped over a DRG

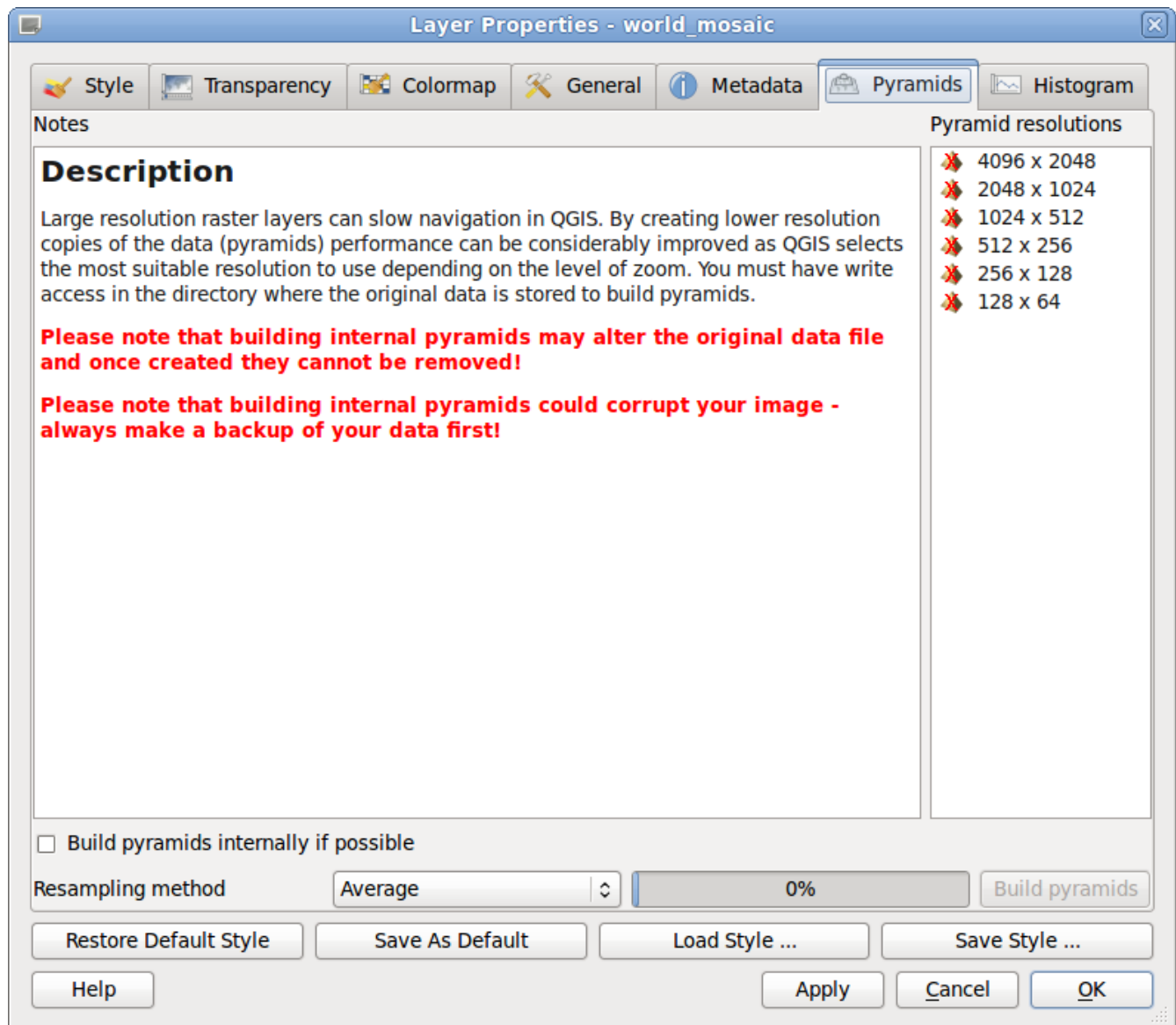


Figure 6.5: QGIS raster pyramids dialog box

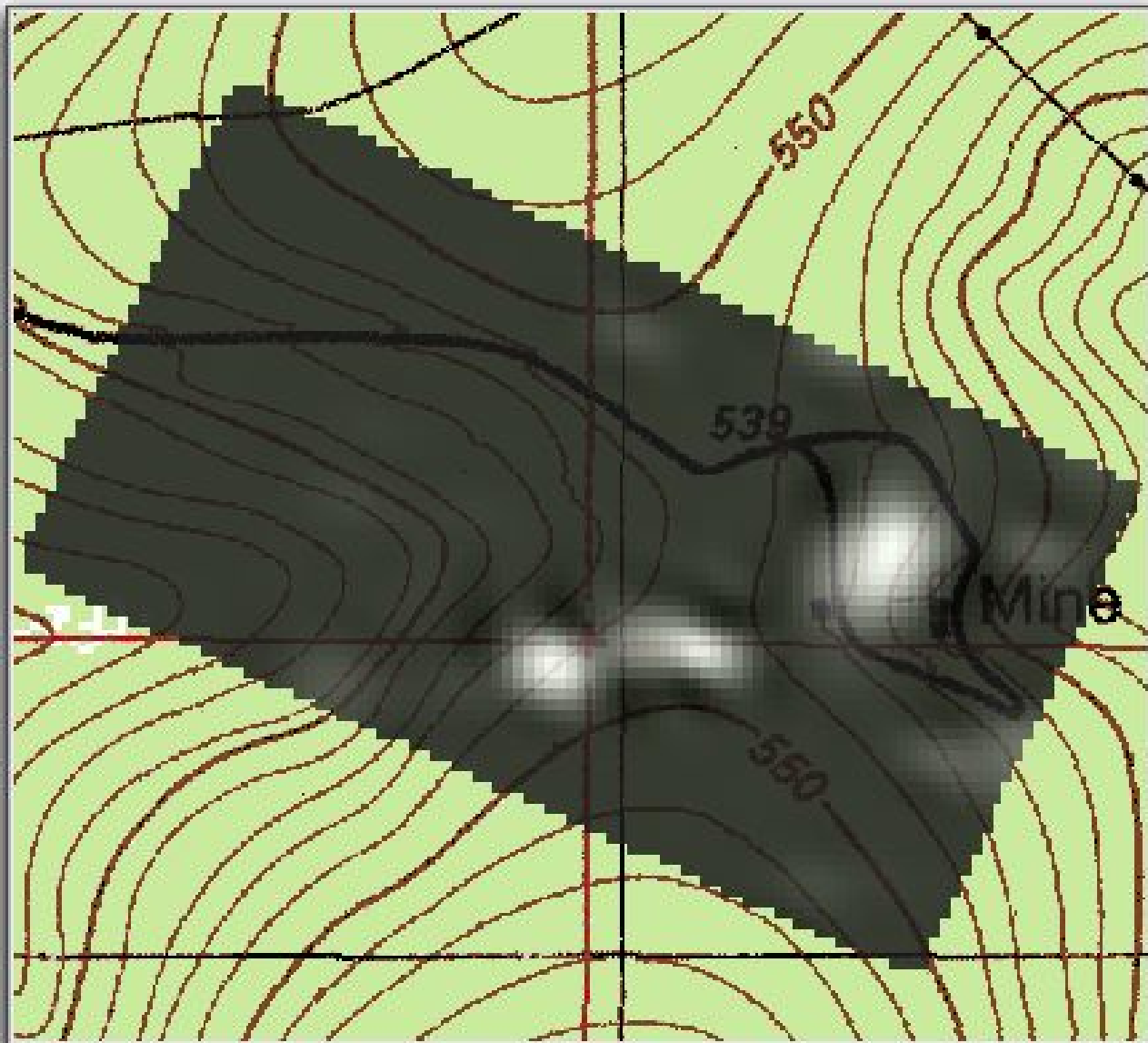


Figure 6.6: Grid of silver values

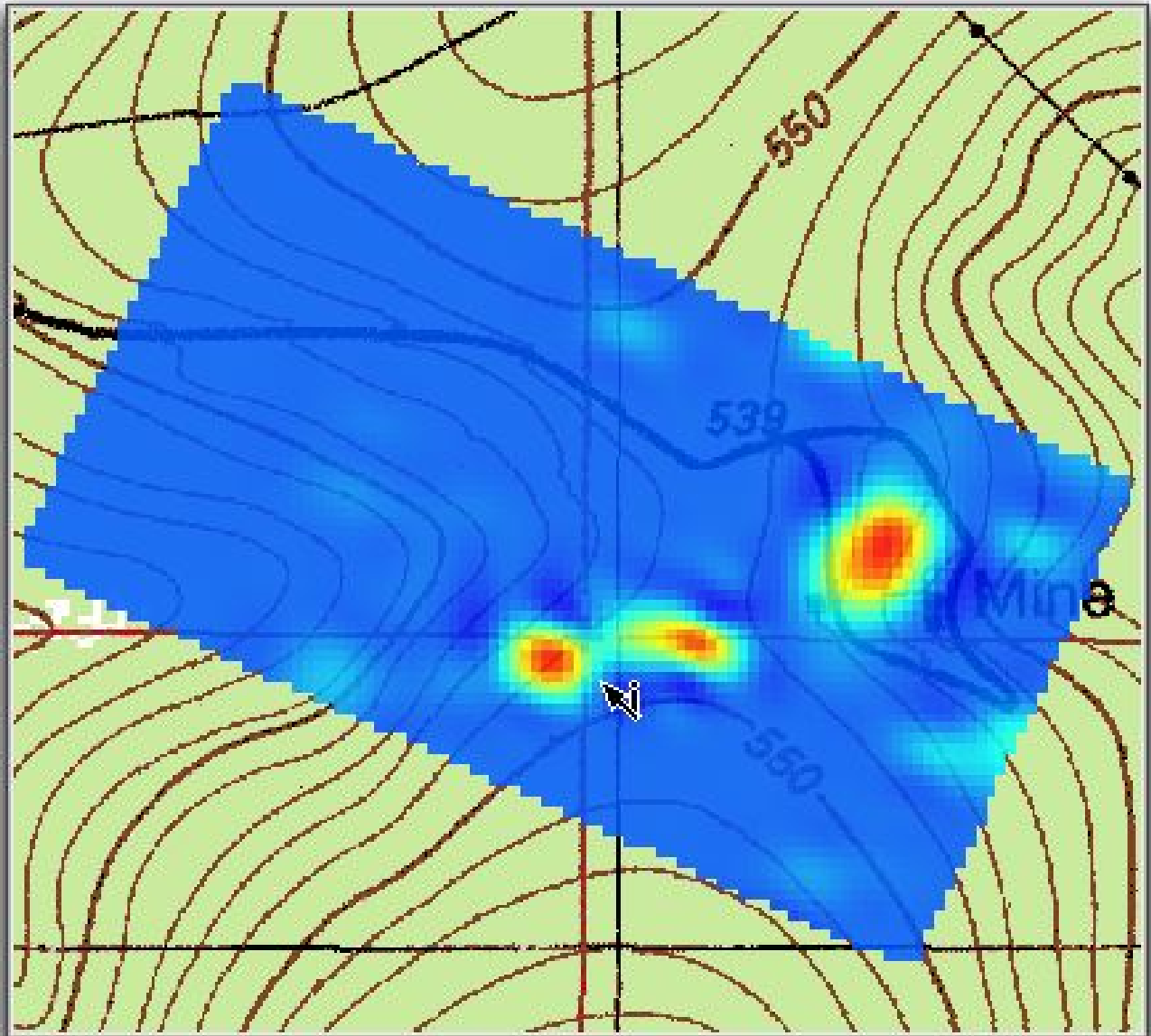
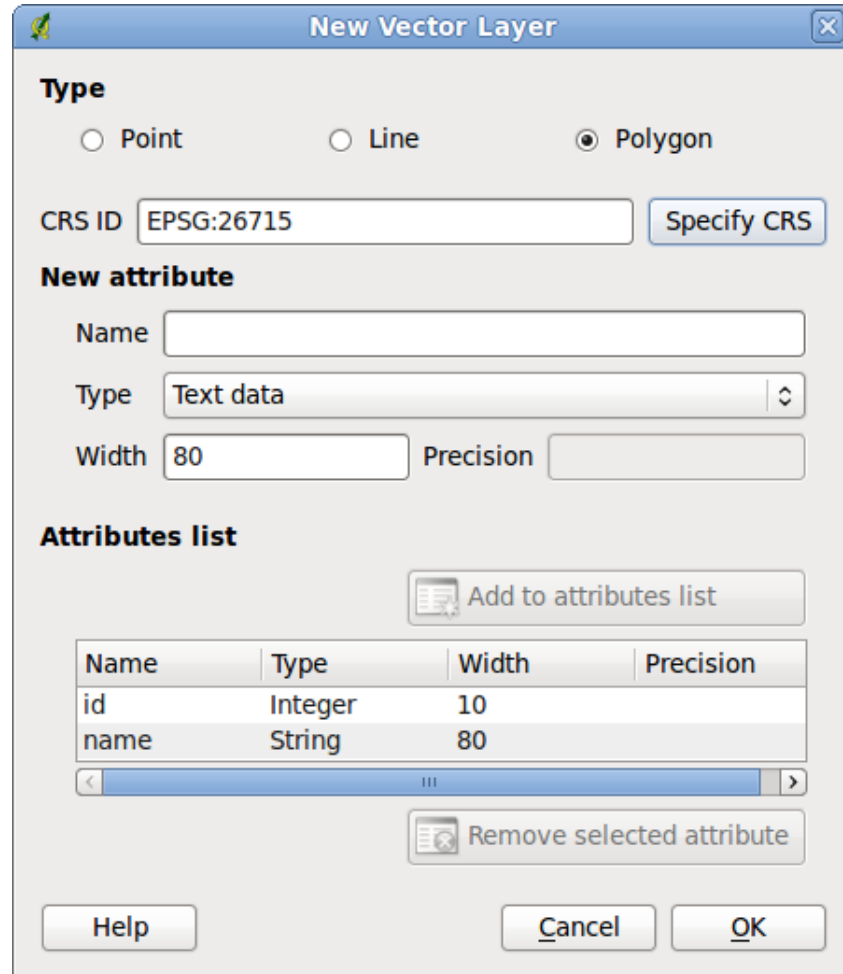


Figure 6.7: Grid of silver values in pseudocolor

7 Digitizing and Editing Vector Data



New Vector Layer

Type

☐ Point ☐ Line ☒ Polygon

CRS ID [Specify CRS](#)

New attribute

Name

Type

Width Precision

Attributes list

[Add to attributes list](#)

Name	Type	Width	Precision
id	Integer	10	
name	String	80	

[Remove selected attribute](#)

[Help](#) [Cancel](#) [OK](#)

Figure 7.1: Creating a new shapefile in QGIS

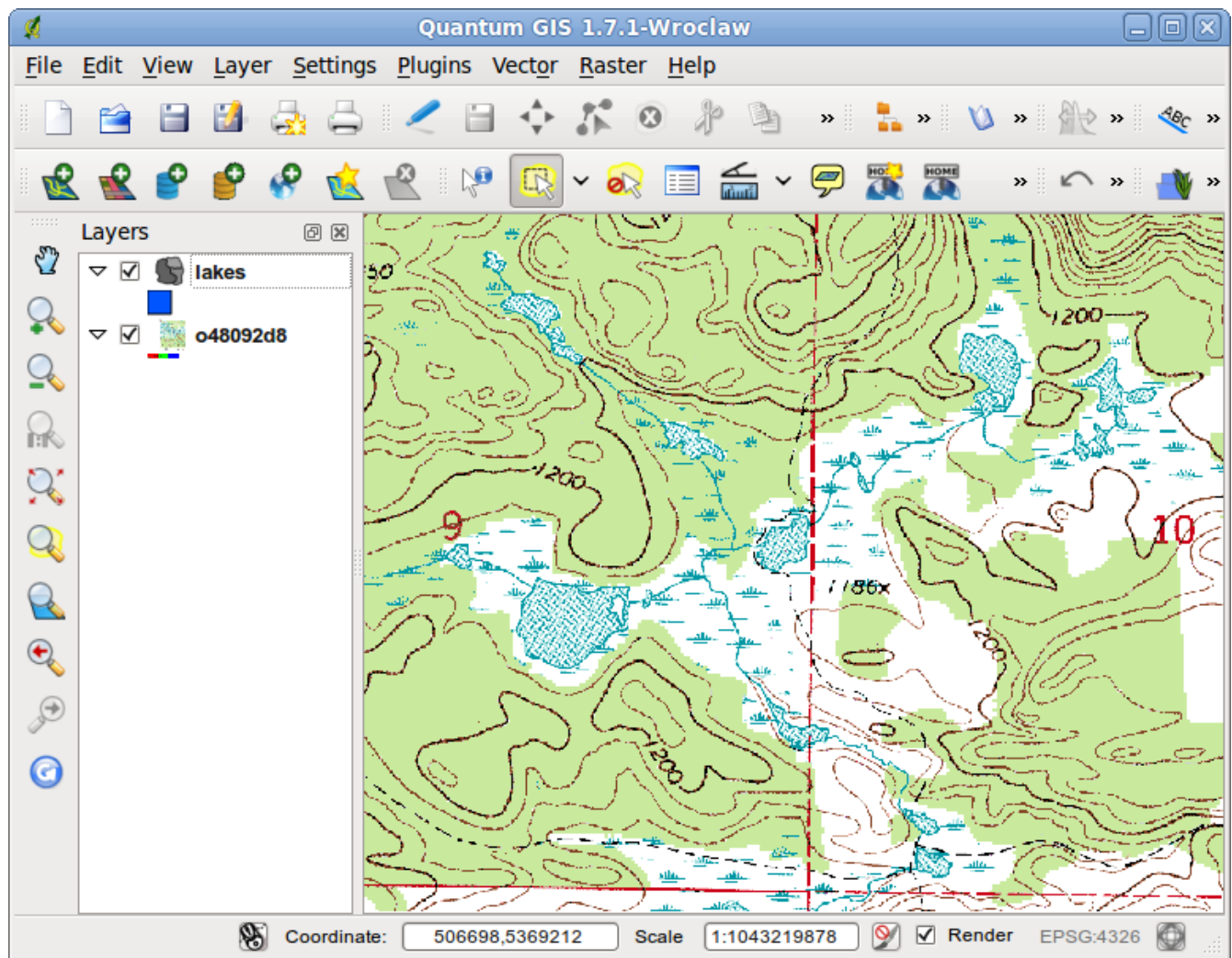


Figure 7.2: QGIS with new layer ready to edit

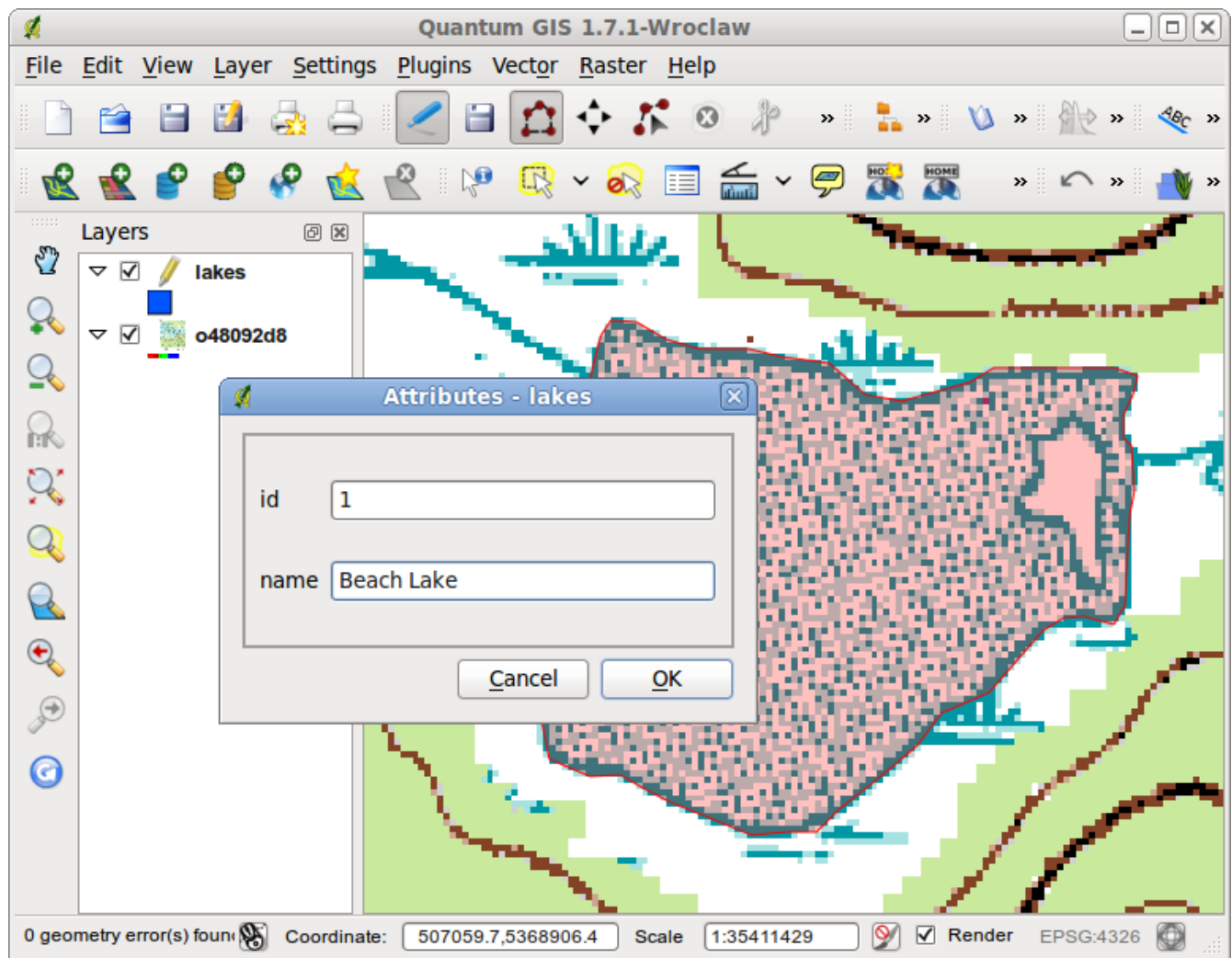


Figure 7.3: Entering attributes for a feature

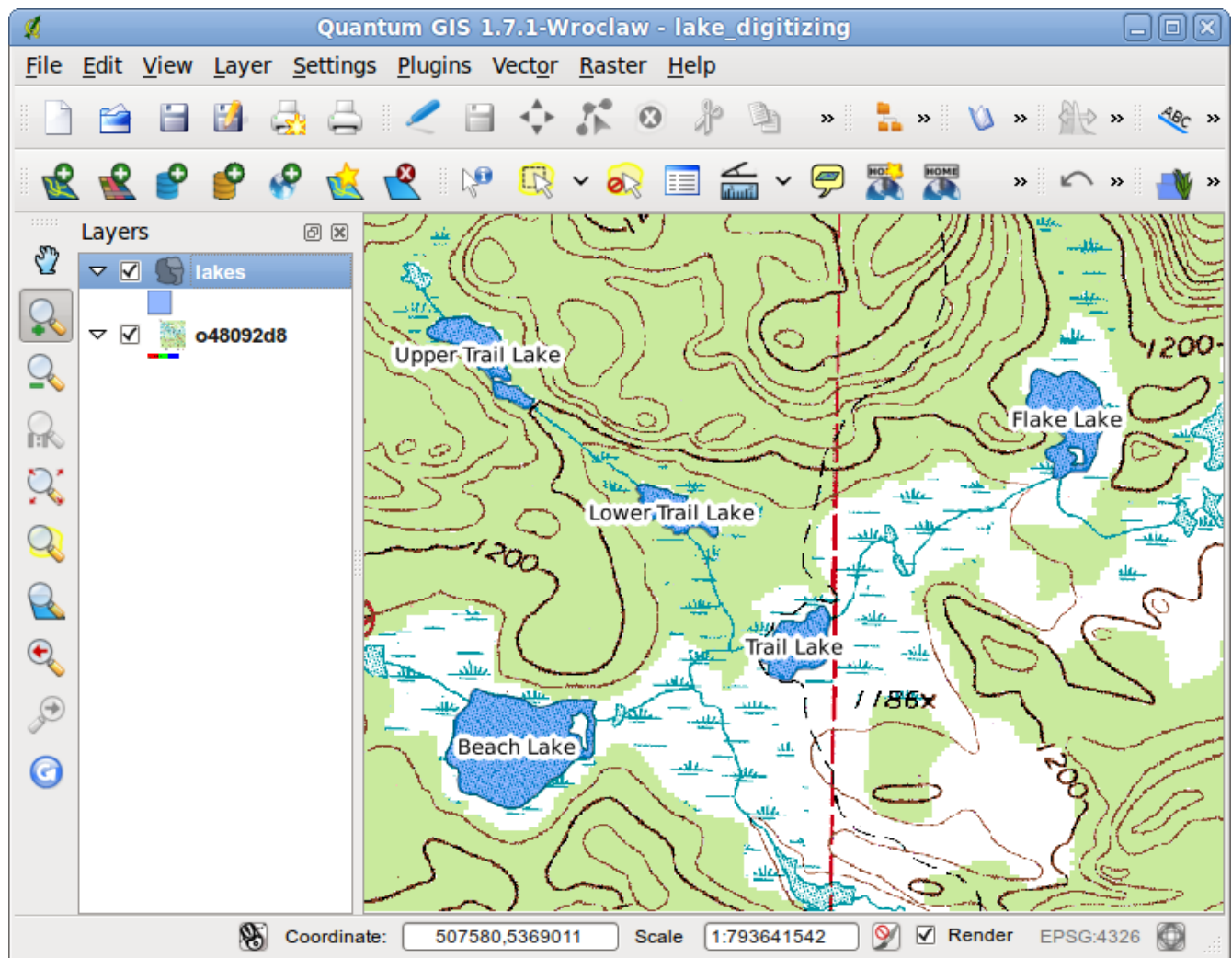


Figure 7.4: Results of digitizing lakes in QGIS

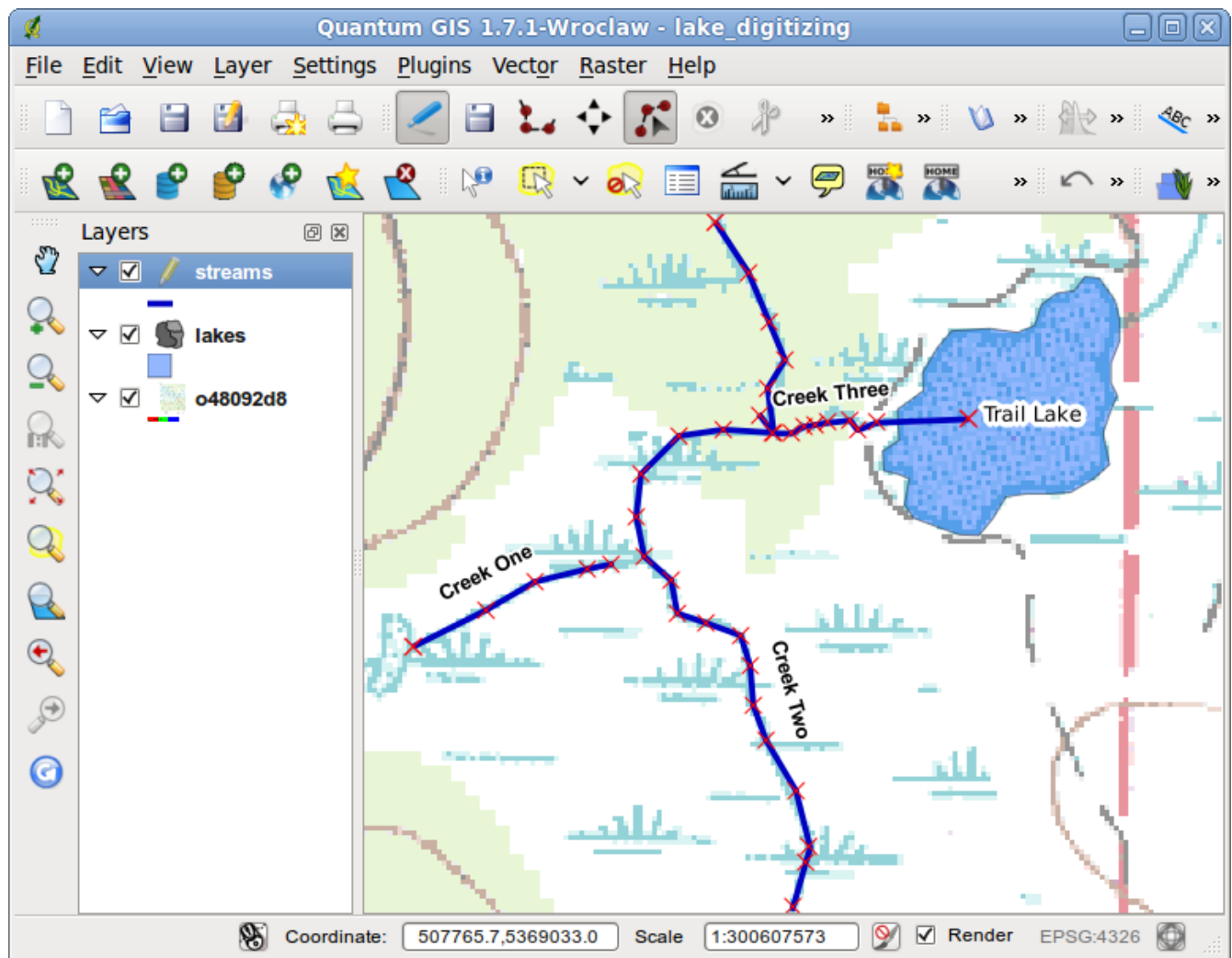


Figure 7.5: Digitized Streams

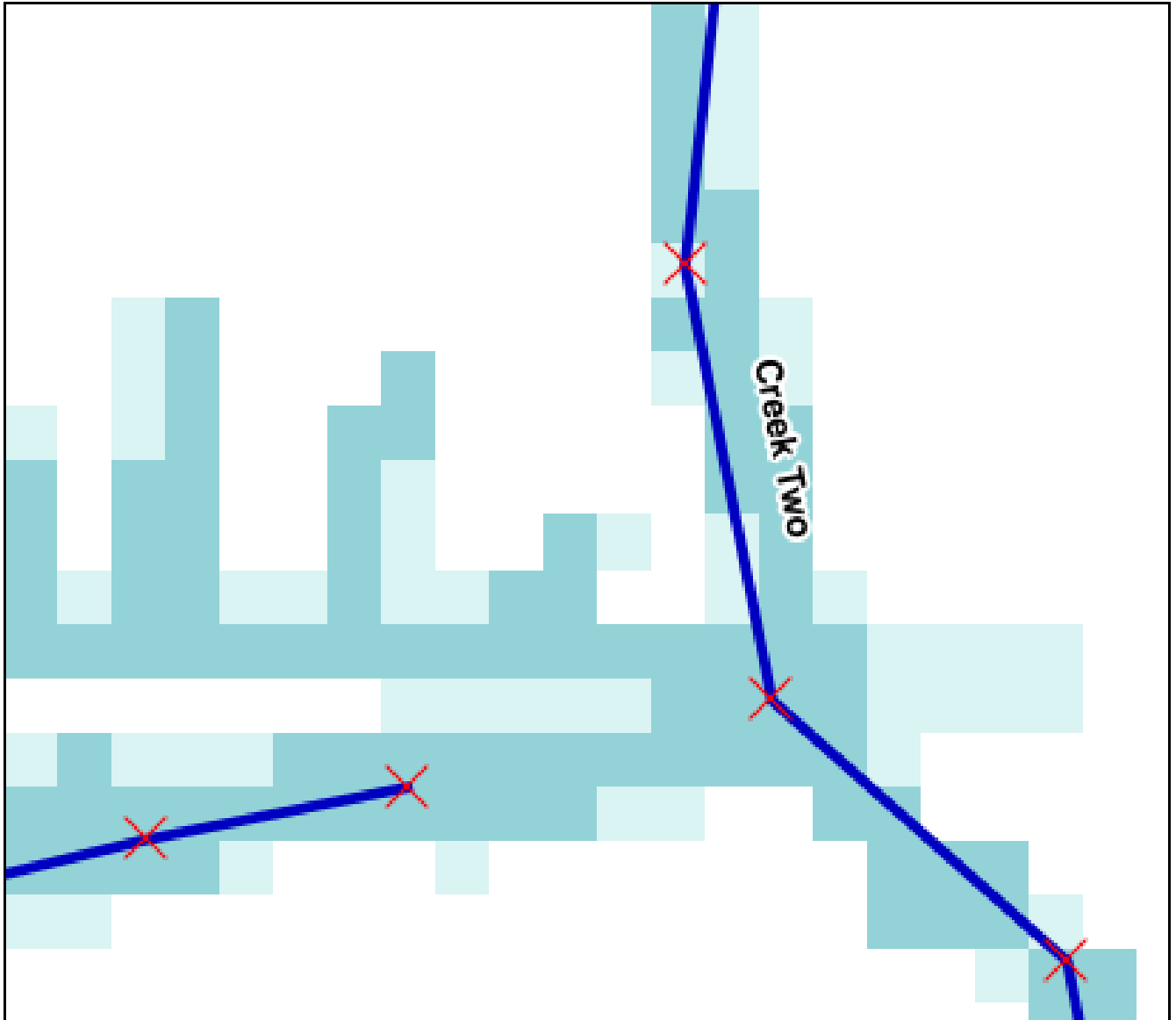


Figure 7.6: Problems with the digitized streams

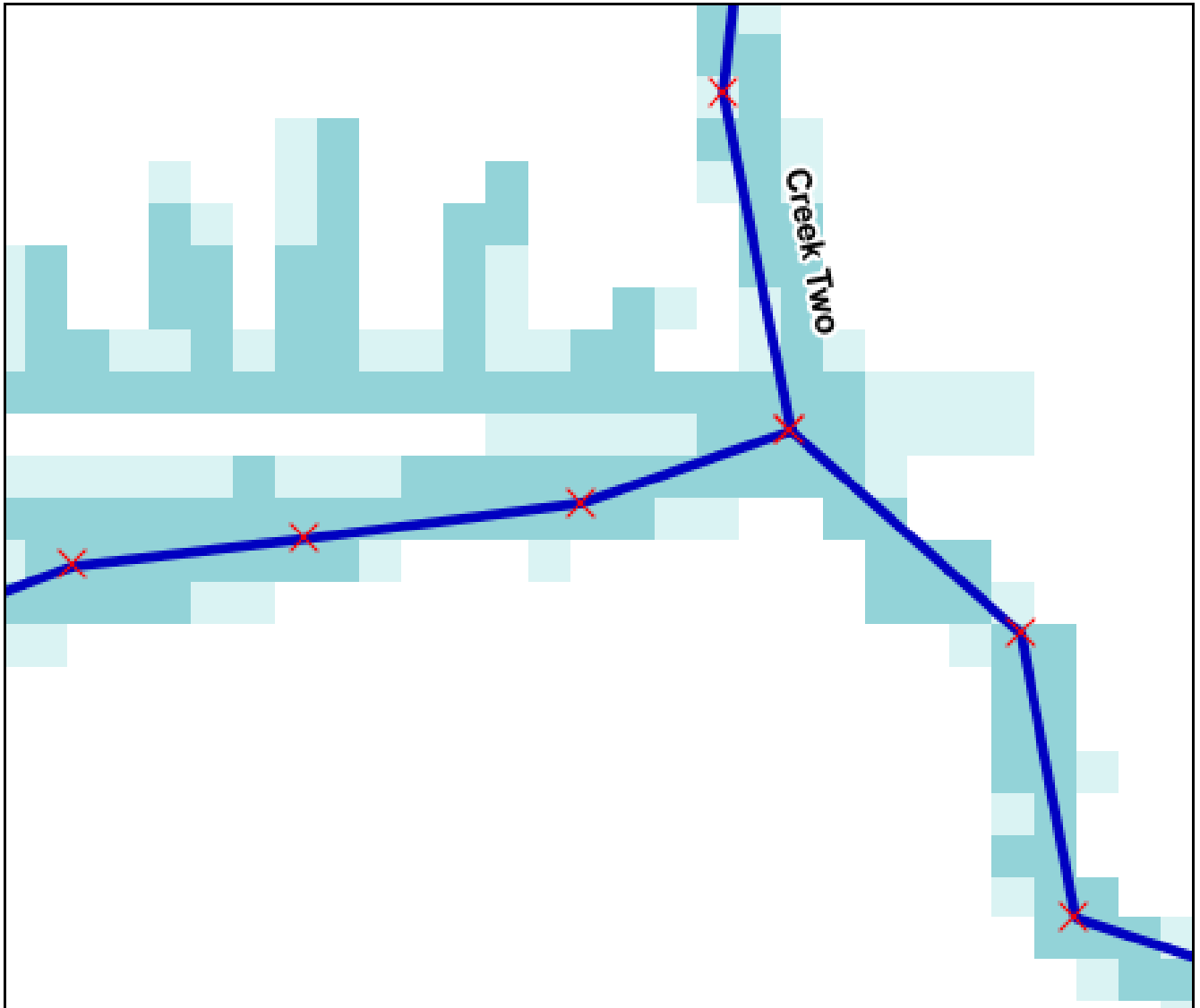


Figure 7.7: Digitized streams with corrections

9 Spatial Databases

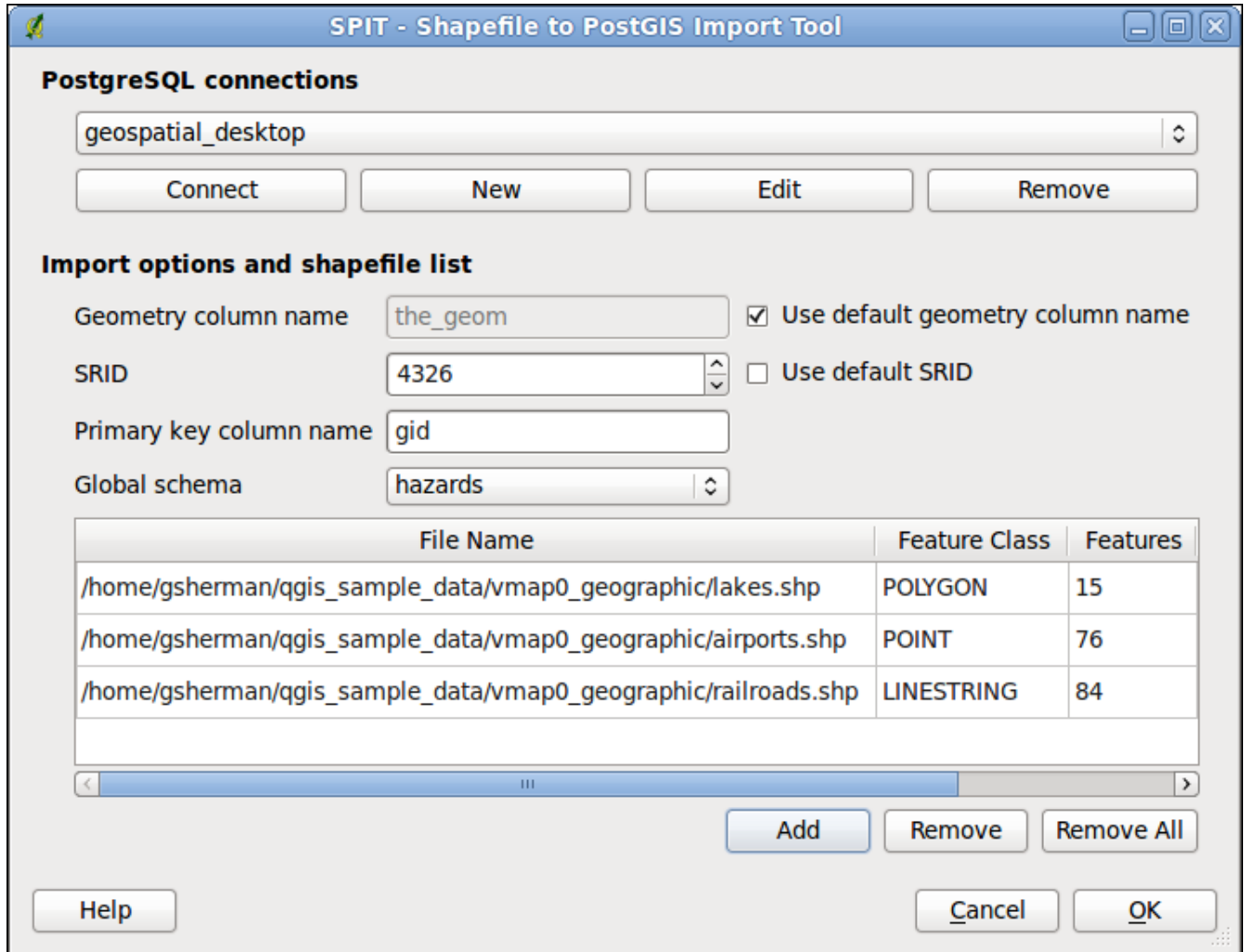


Figure 9.1: Loading shapefiles into PostGIS using SPIT

Create a New PostGIS connection

Connection Information

Name:

Service:

Host:

Port:

Database:

SSL mode:

Username:

Password:

☒ Save Username

☒ Save Password

☐ Only look in the geometry_columns table

☐ Only look in the 'public' schema

☐ Also list tables with no geometry

☐ Use estimated table metadata

Figure 9.2: Creating a new PostGIS connection in QGIS

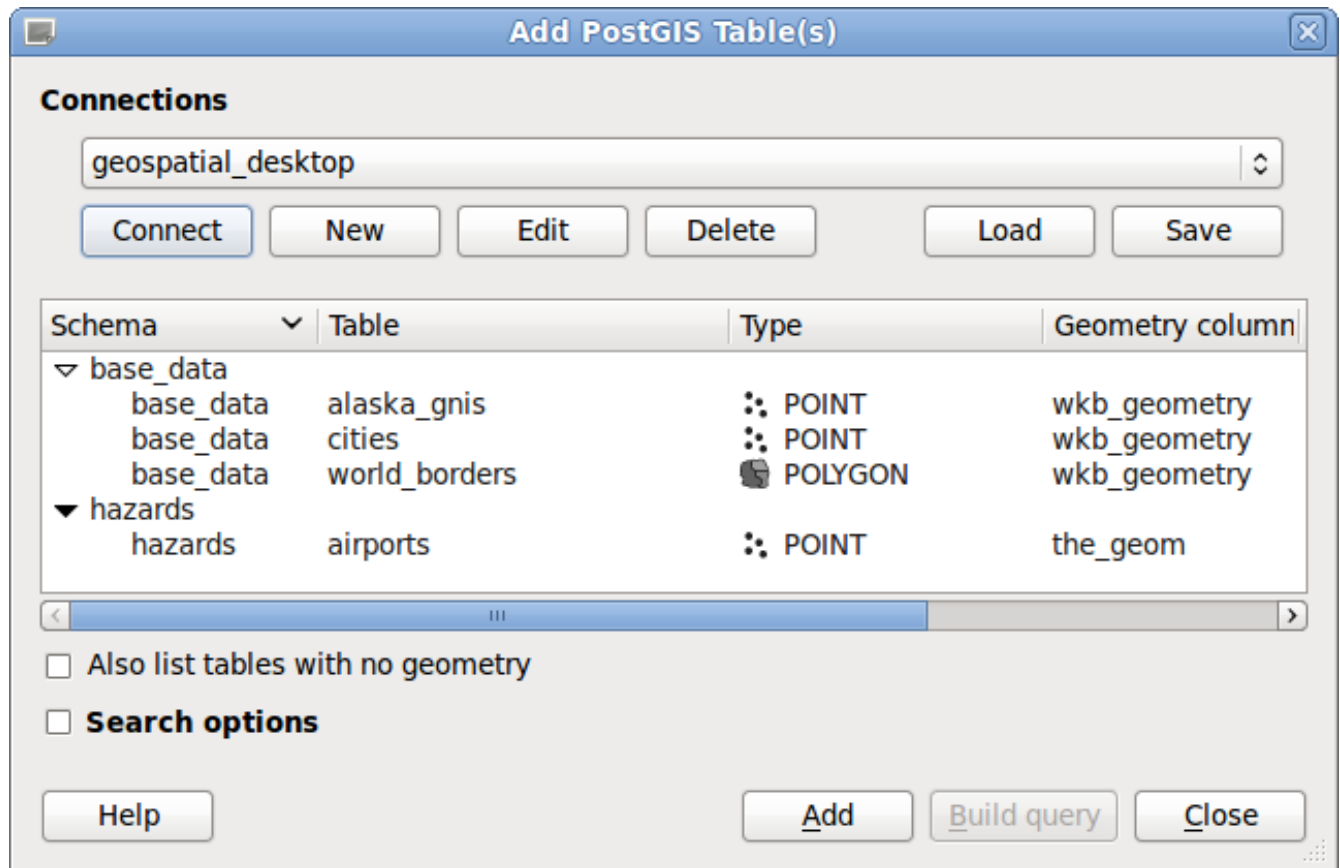


Figure 9.3: List of available PostGIS layers

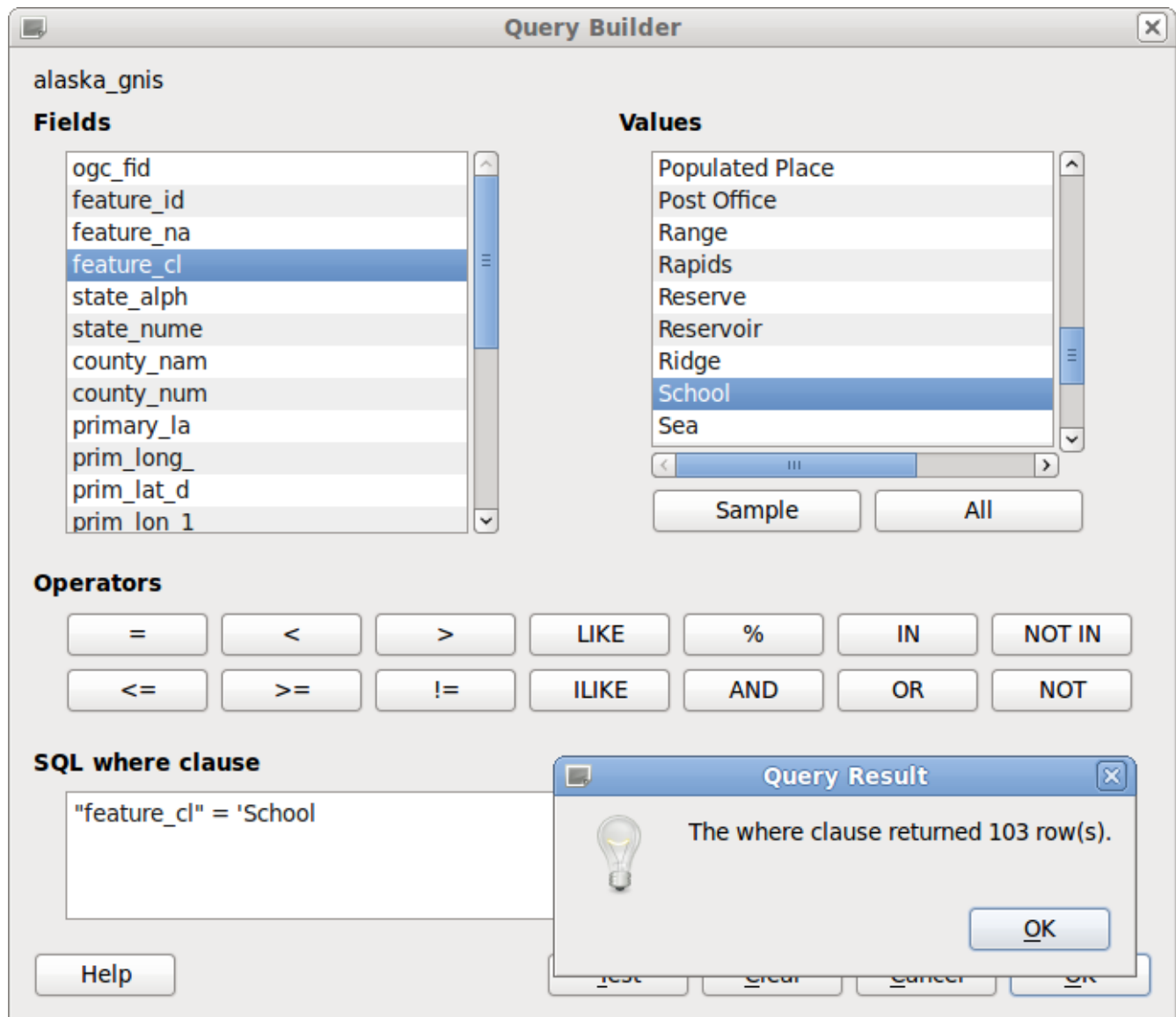


Figure 9.4: PostGIS query builder in QGIS

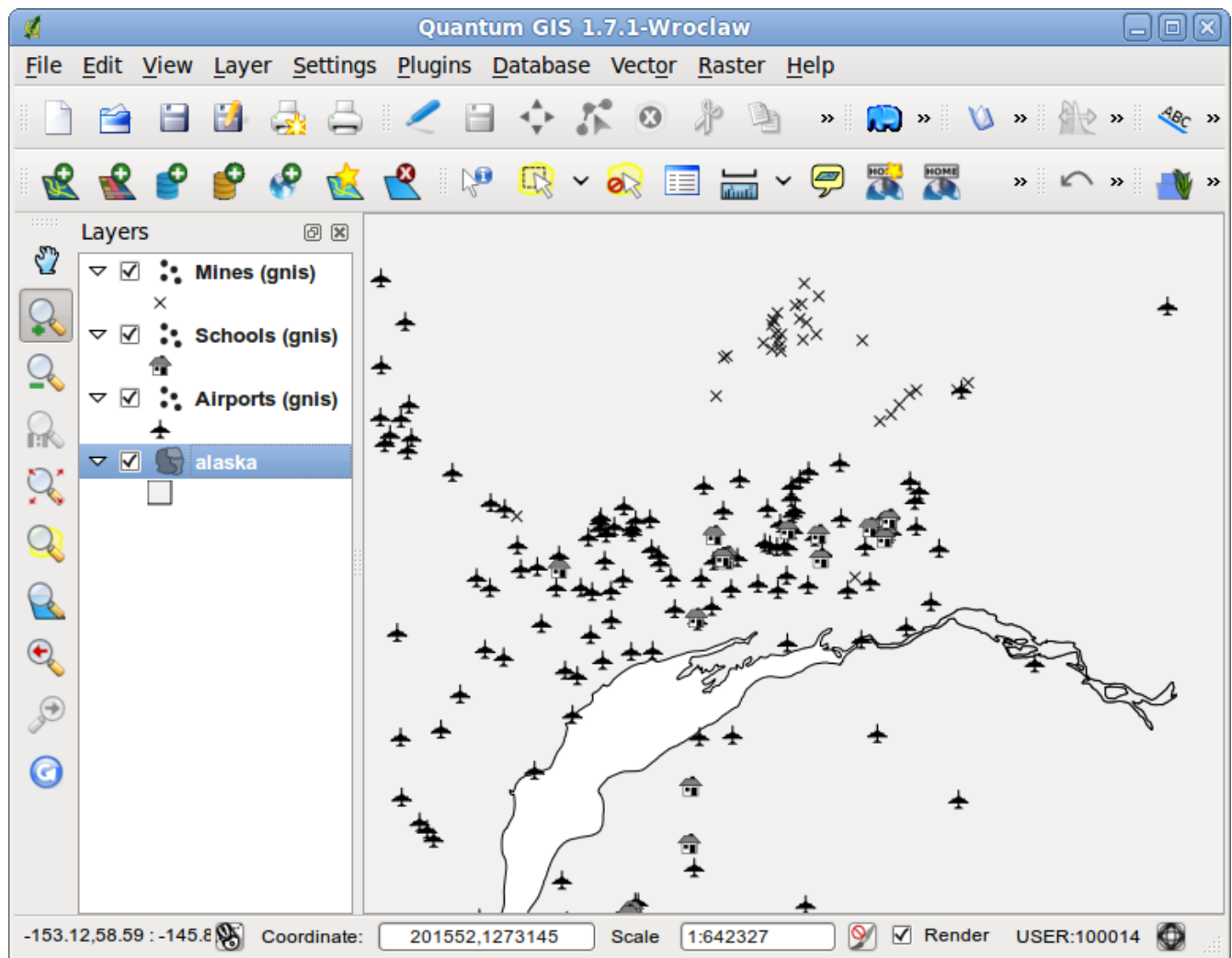


Figure 9.5: PostGIS layers created with the query builder

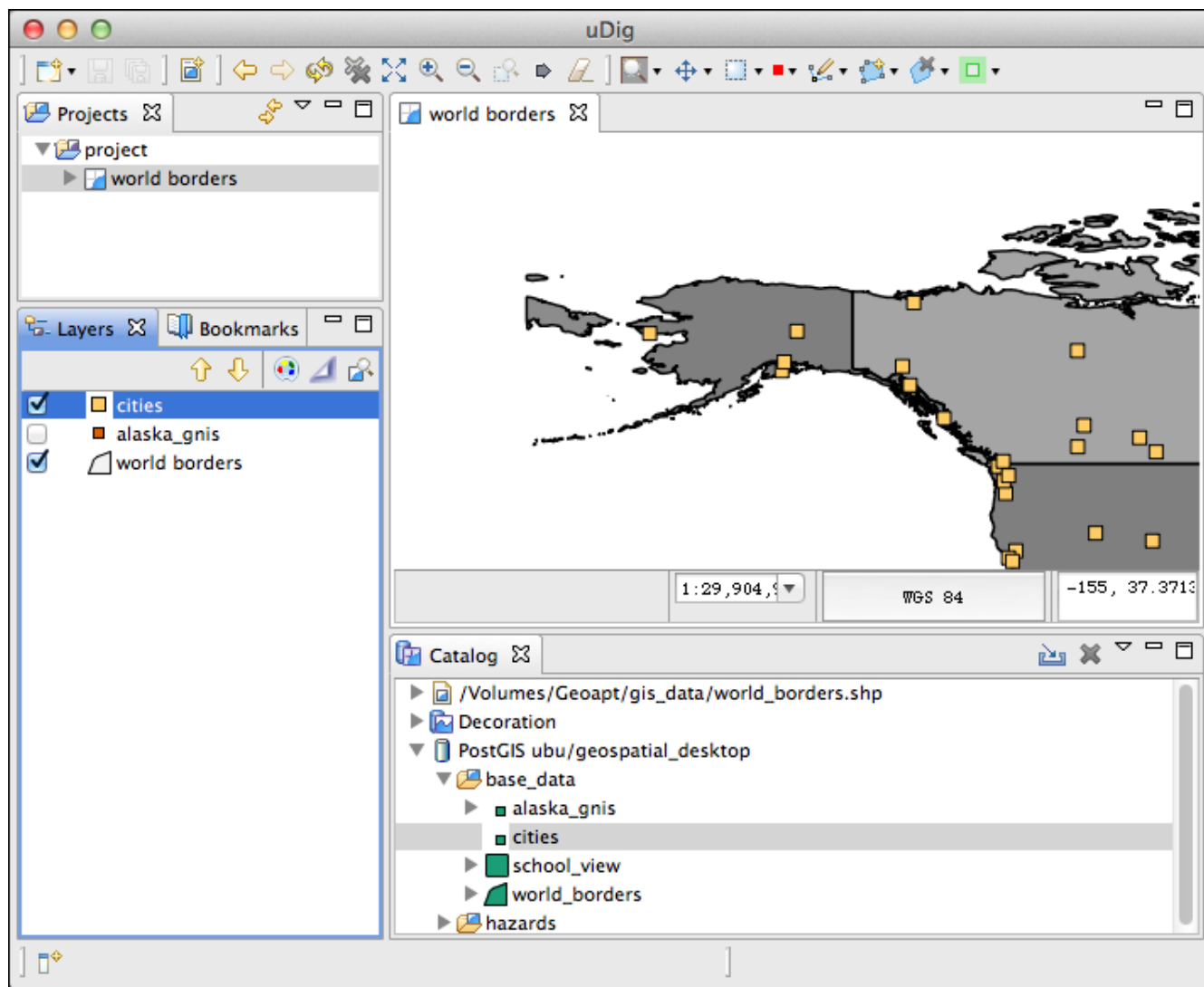


Figure 9.6: PostGIS connect dialog box in uDig

10 Creating Data

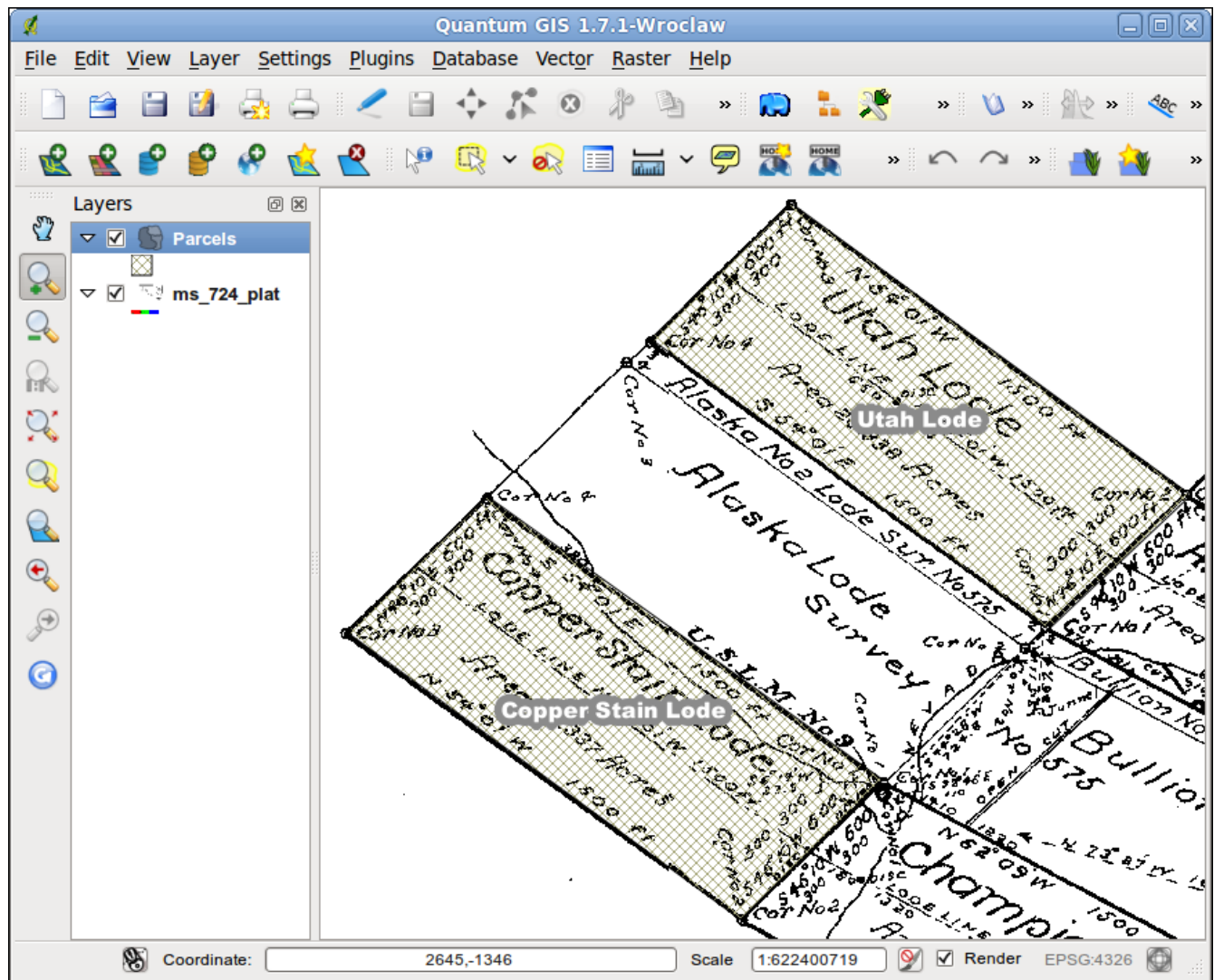


Figure 10.1: Digitizing a plat

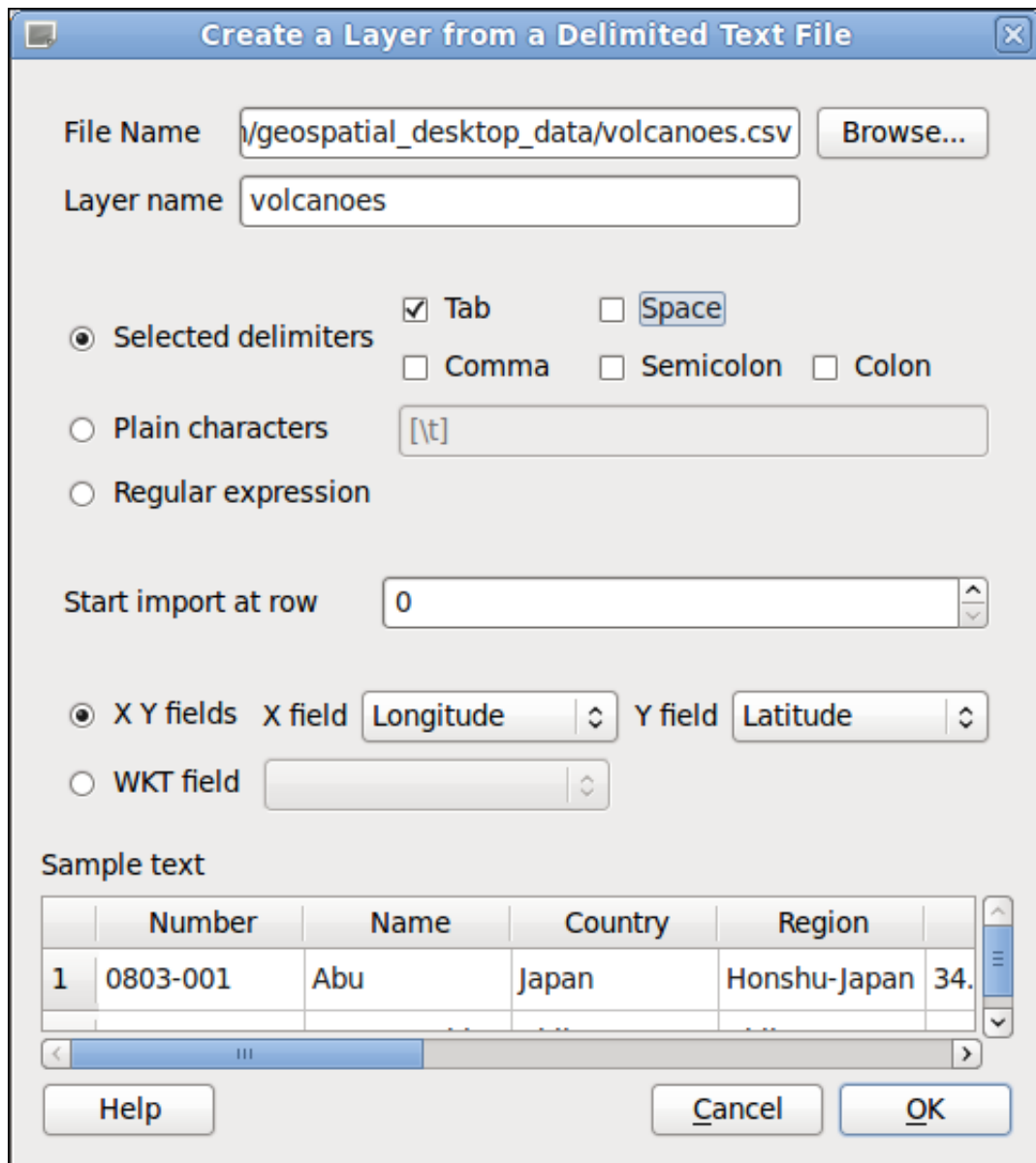


Figure 10.2: The QGIS Delimited Text plugin

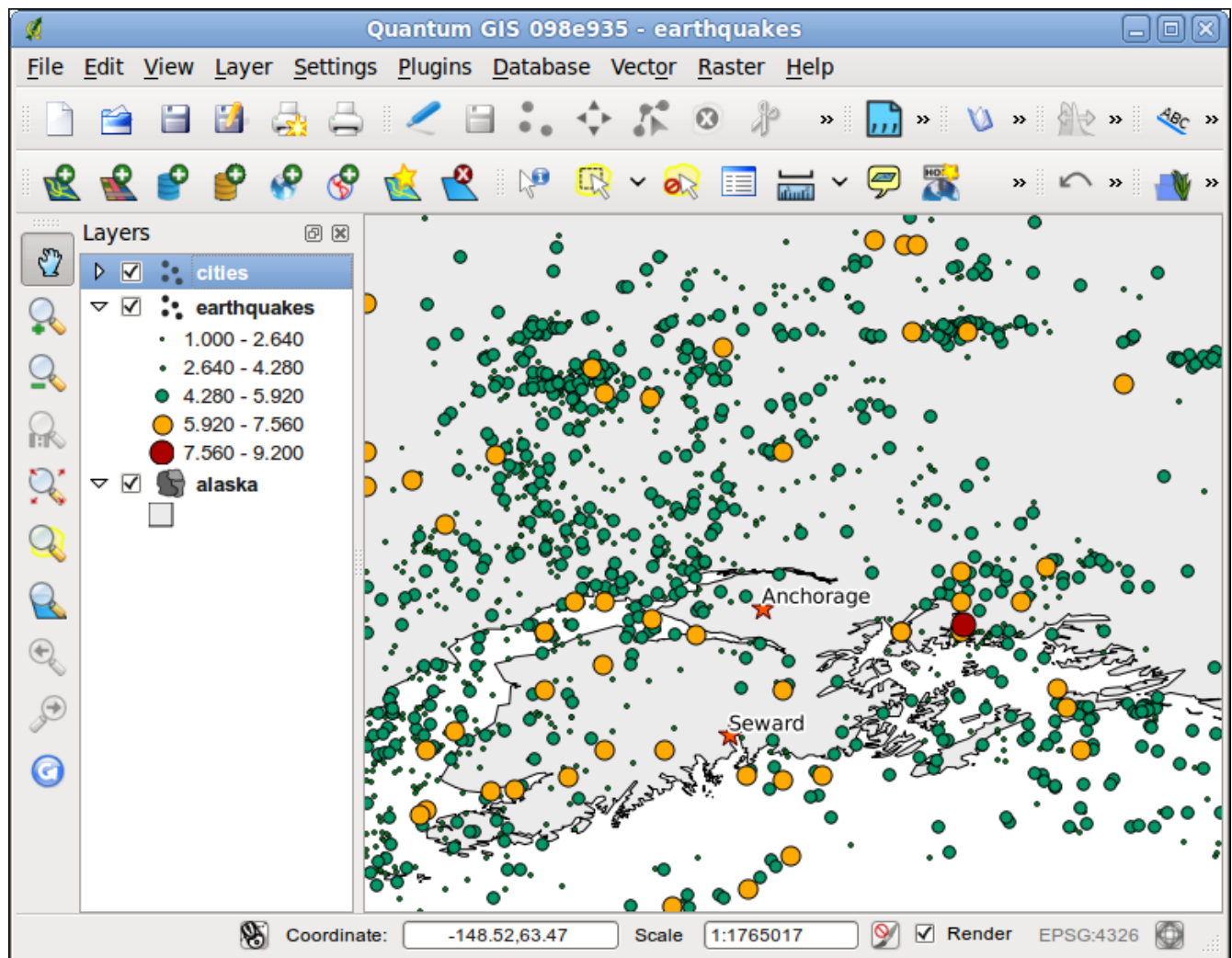


Figure 10.3: Earthquakes rendered in QGIS by magnitude

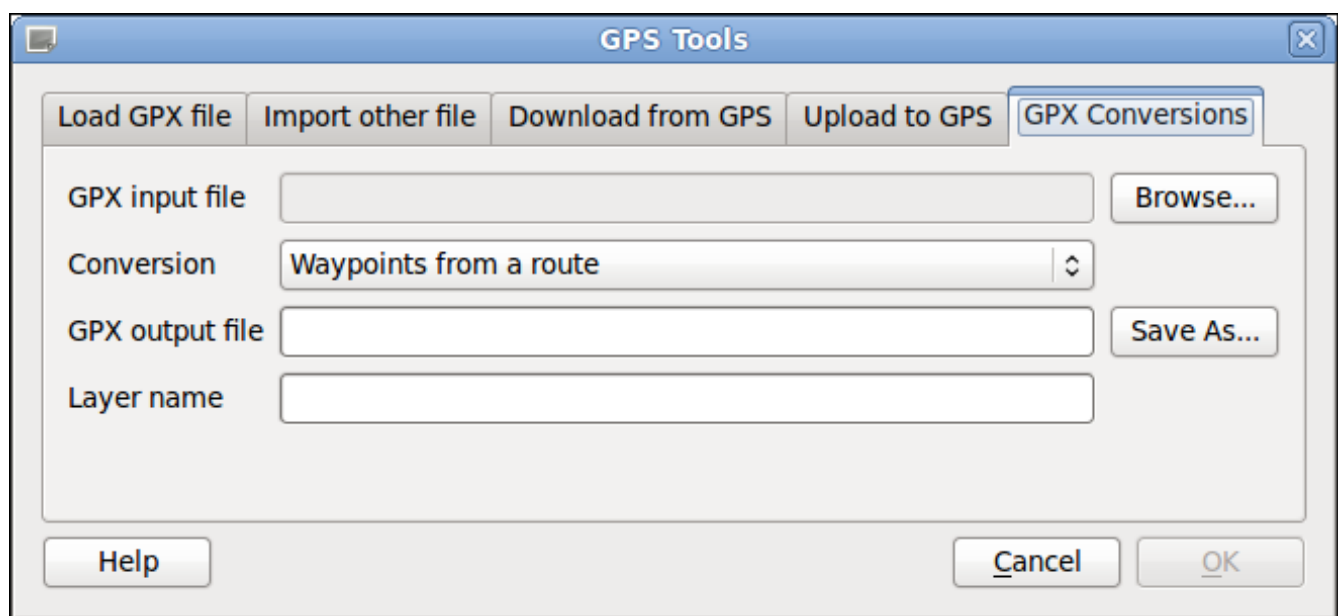


Figure 10.4: GPS plugin in QGIS

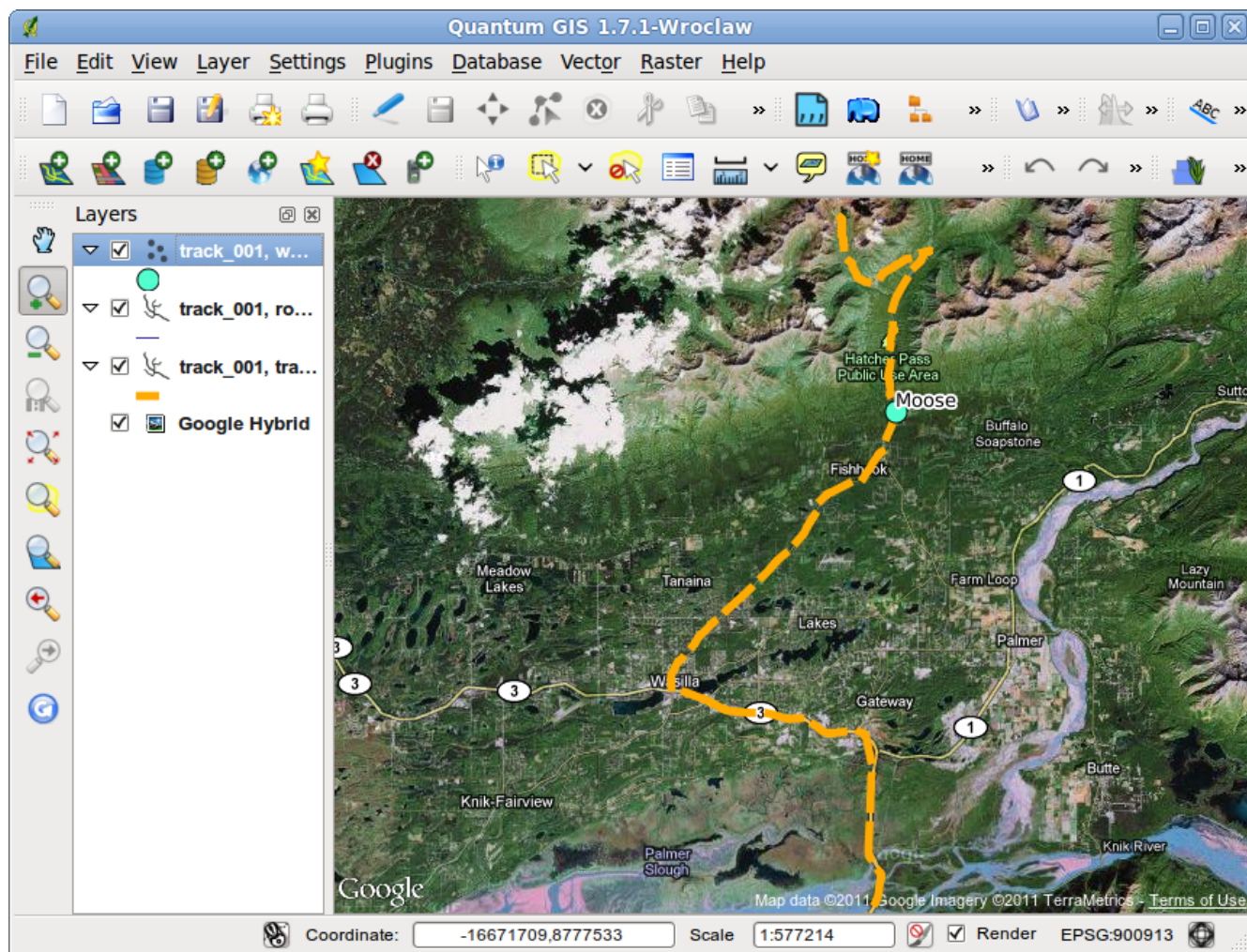


Figure 10.5: Track and waypoint loaded from GPS unit

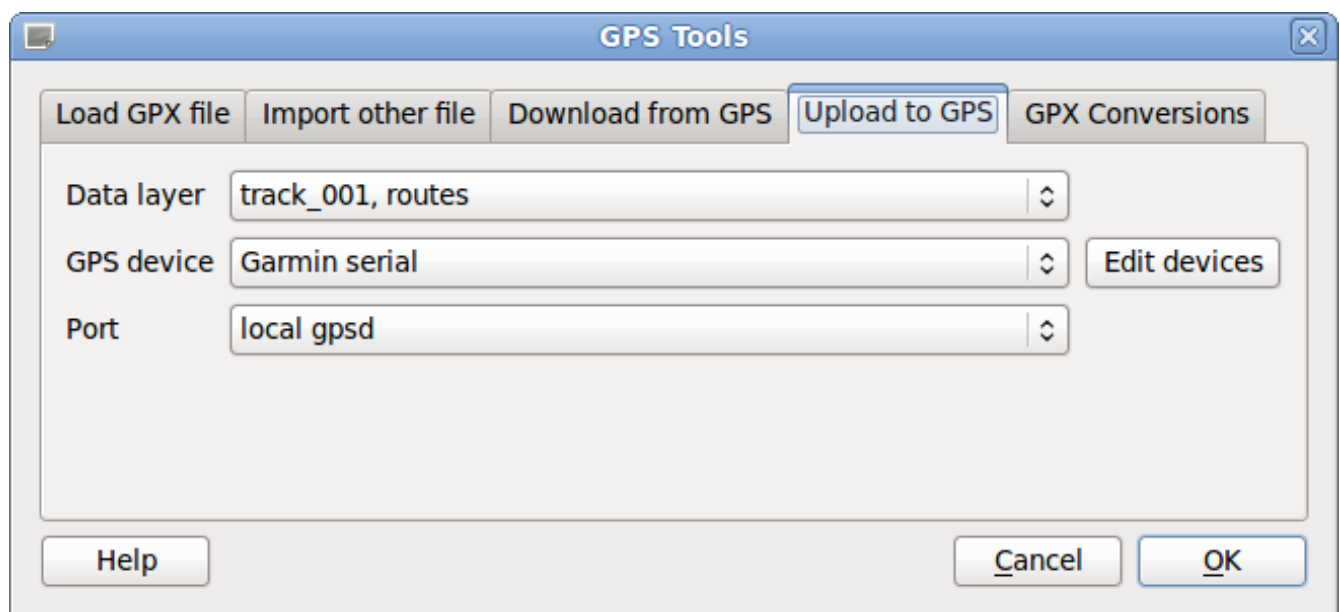


Figure 10.6: Uploading to the GPS

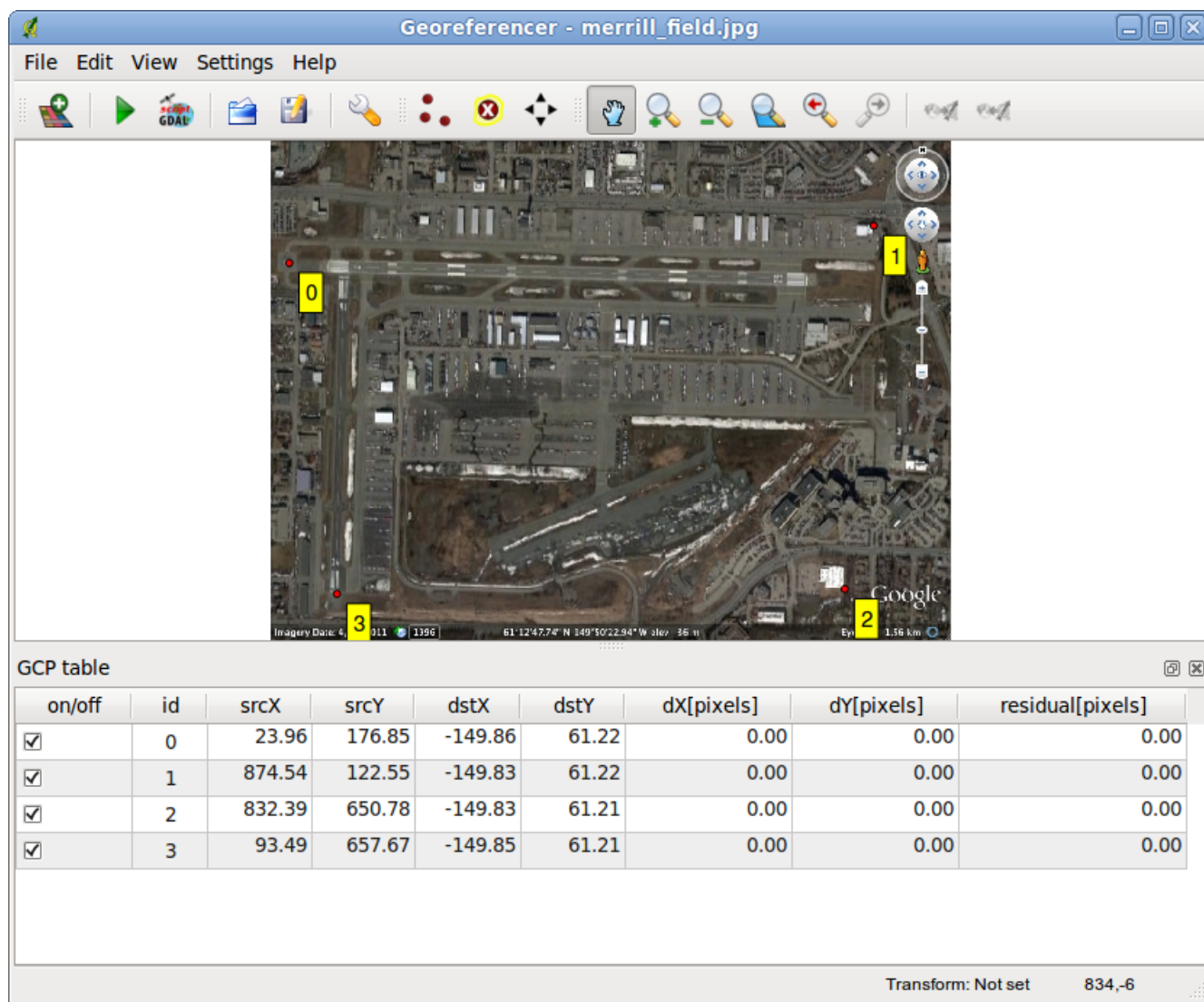


Figure 10.7: Georeferencing an image with QGIS

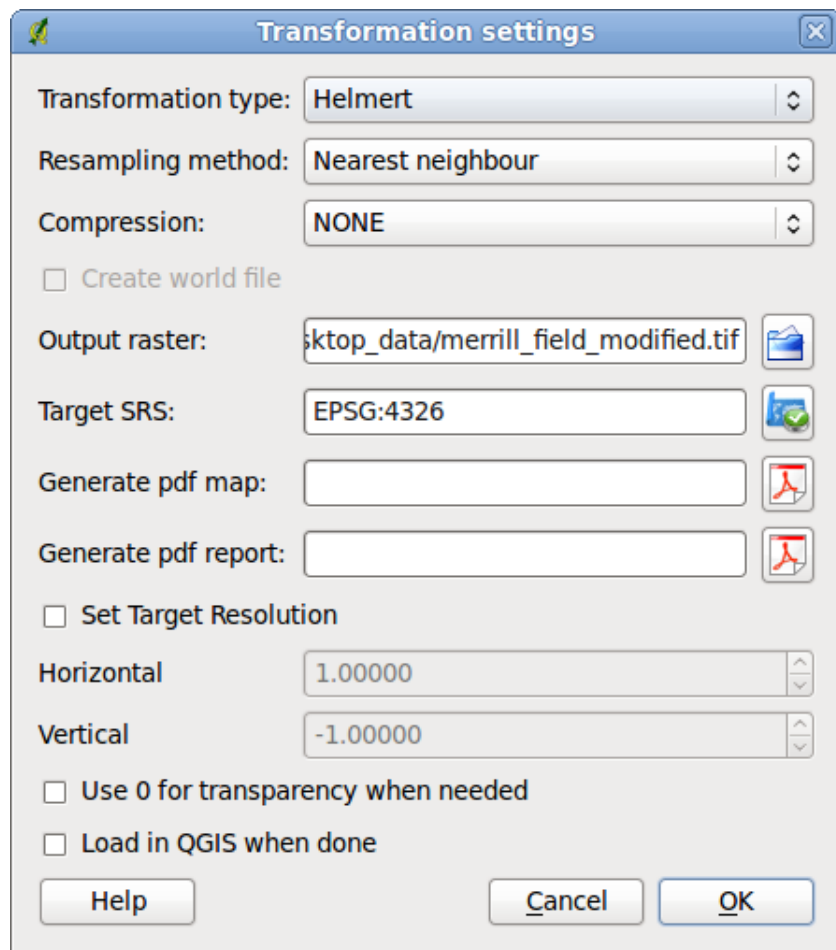


Figure 10.8: Transformation Settings for Georeferencing an Image with QGIS

12 Geoprocessing

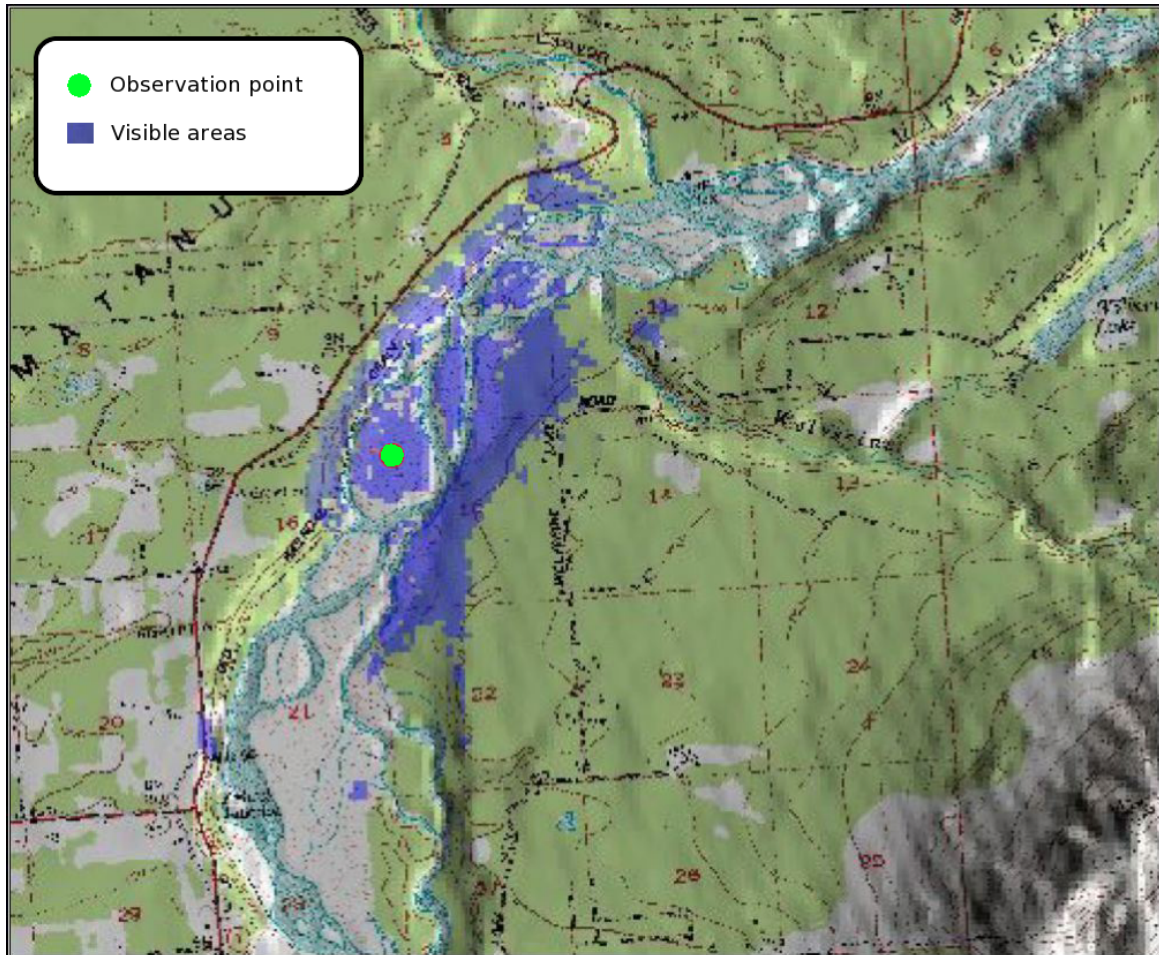


Figure 12.1: Results of line-of-sight analysis in GRASS



Figure 12.2: Raising sea level by 100 meters

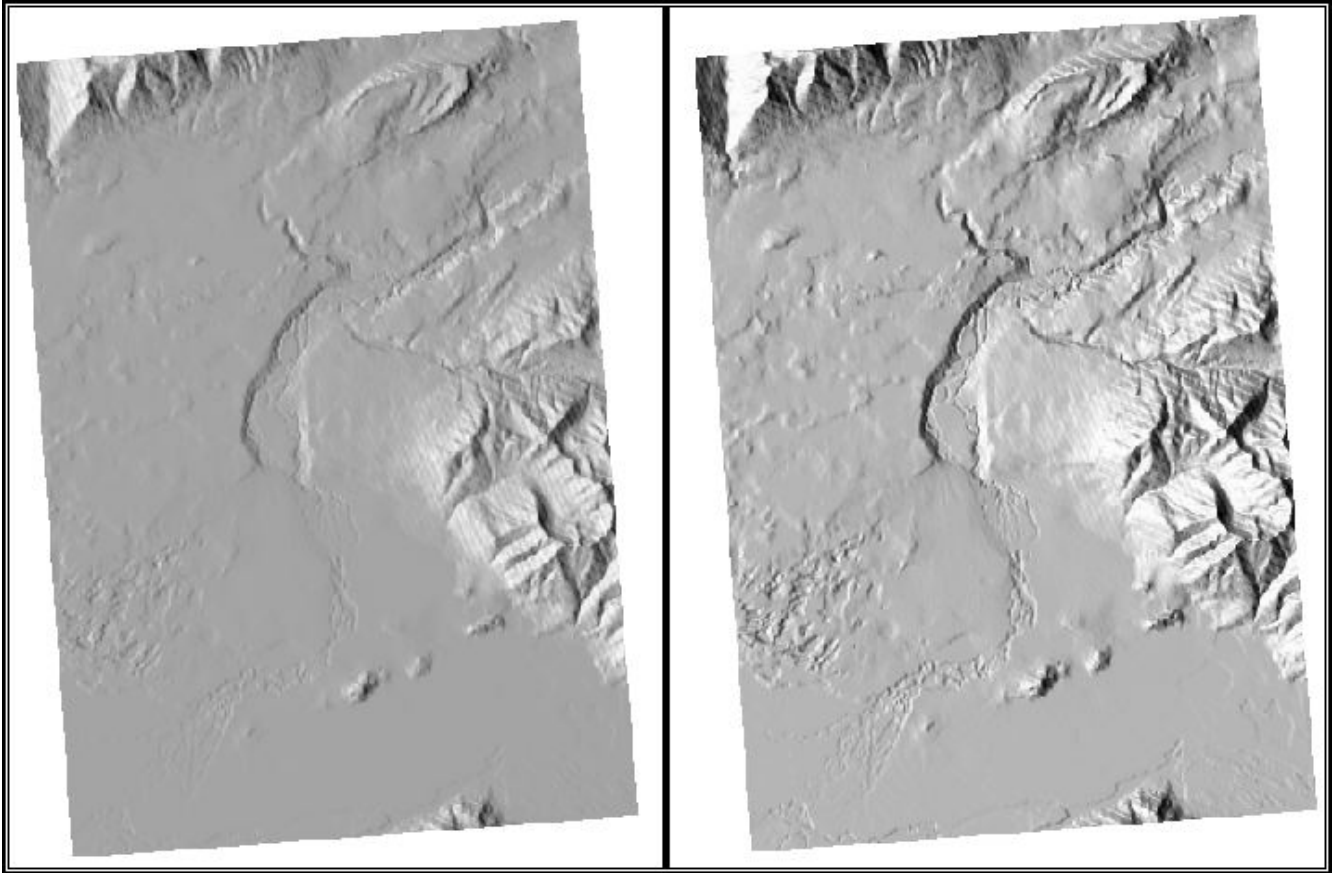


Figure 12.3: Hillshade with no exaggeration (left) and 4X exaggeration (right)

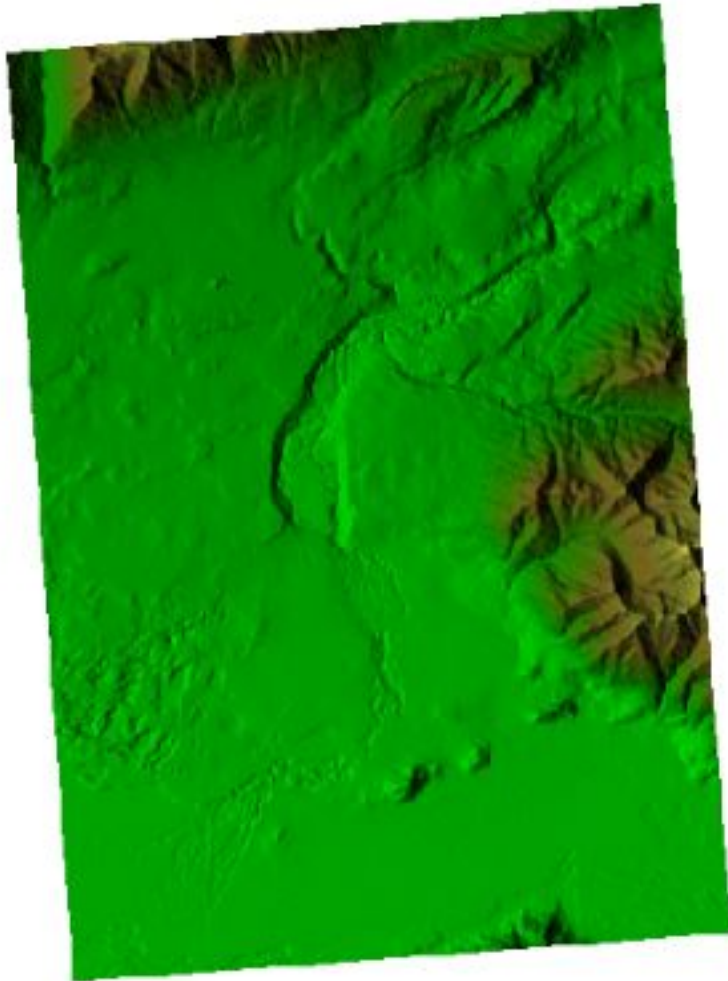


Figure 12.4: Colored shaded relief map created with GRASS

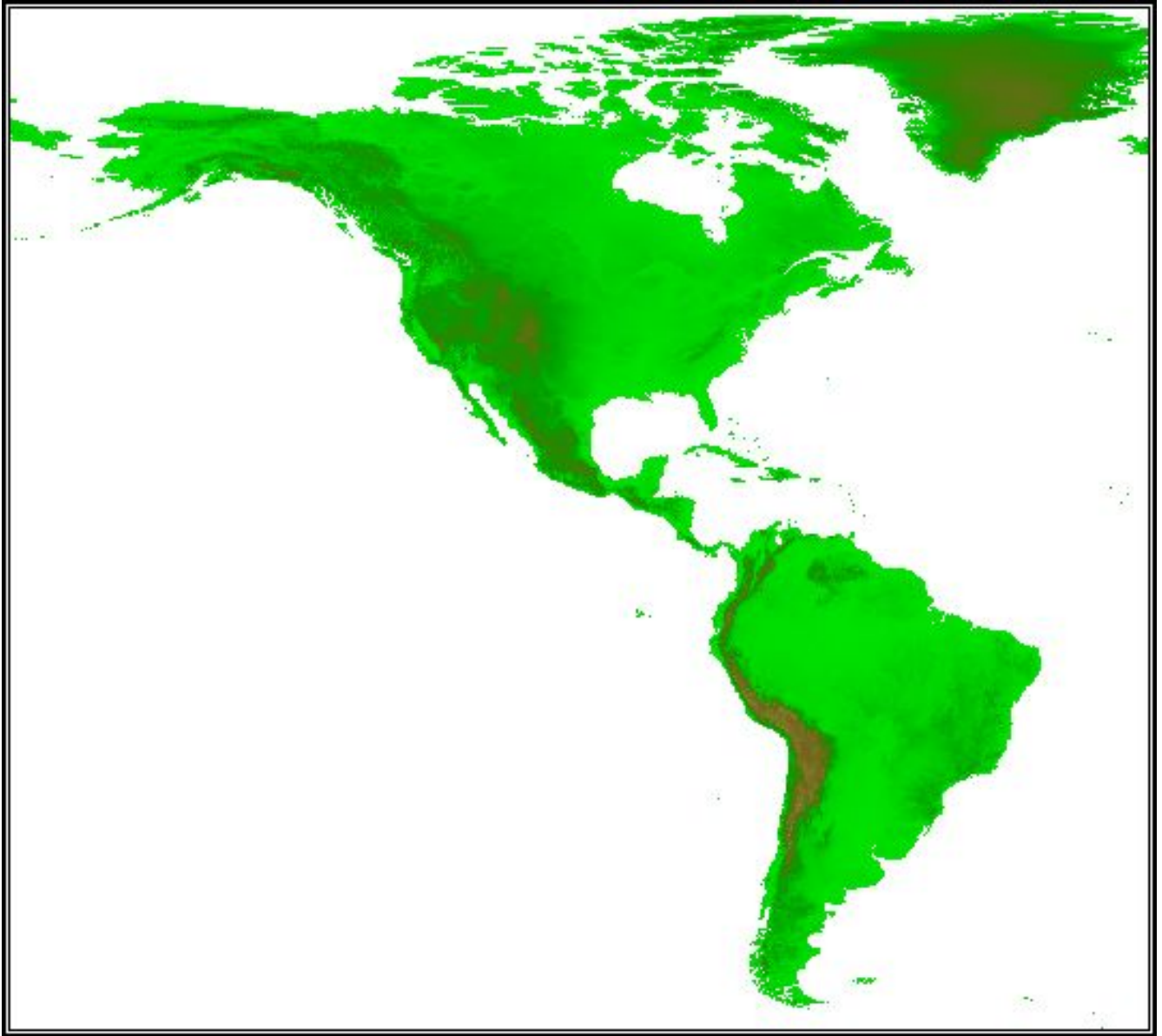


Figure 12.5: Merged GTOPO30 DEM

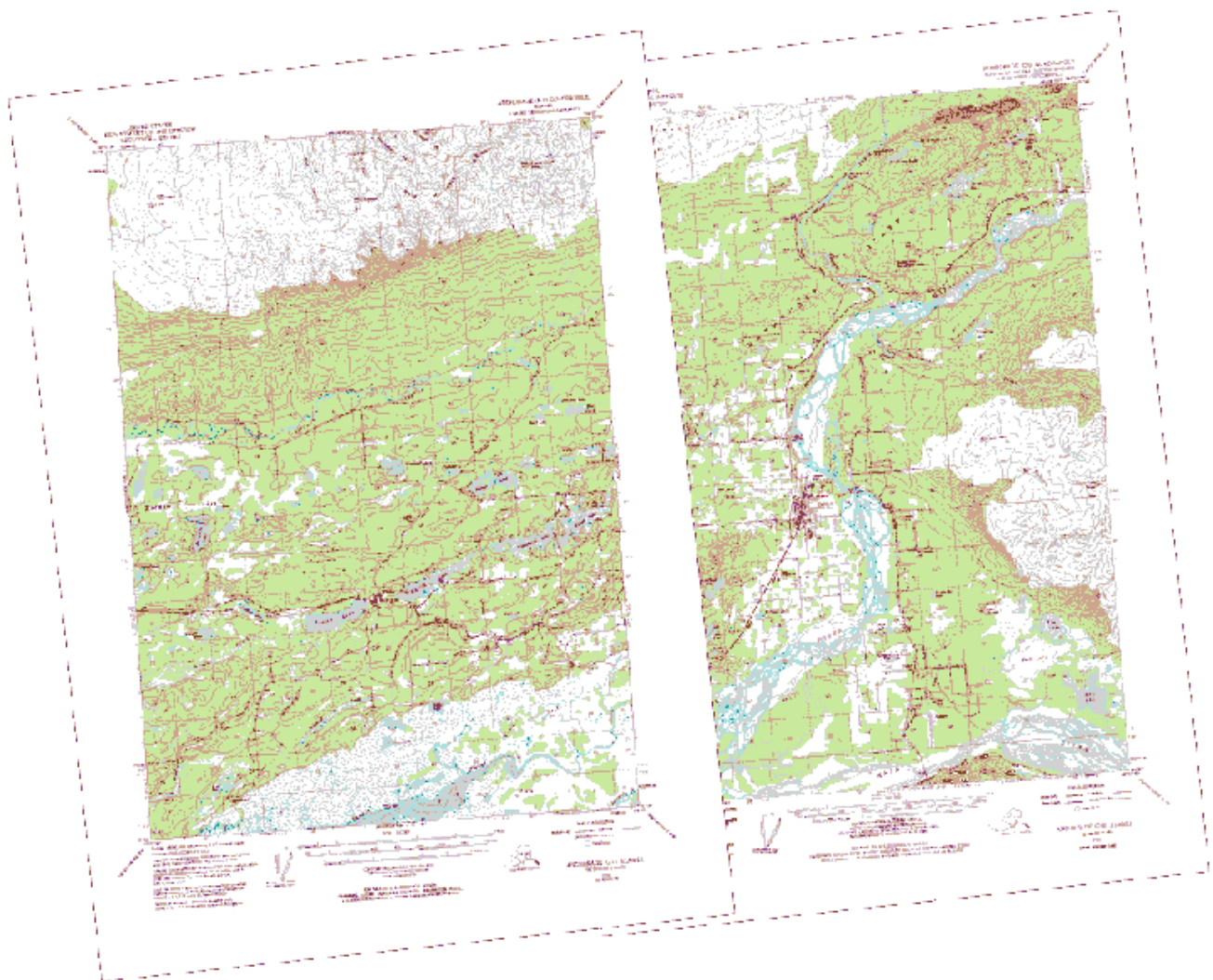


Figure 12.6: Overlapping collars on DRGs

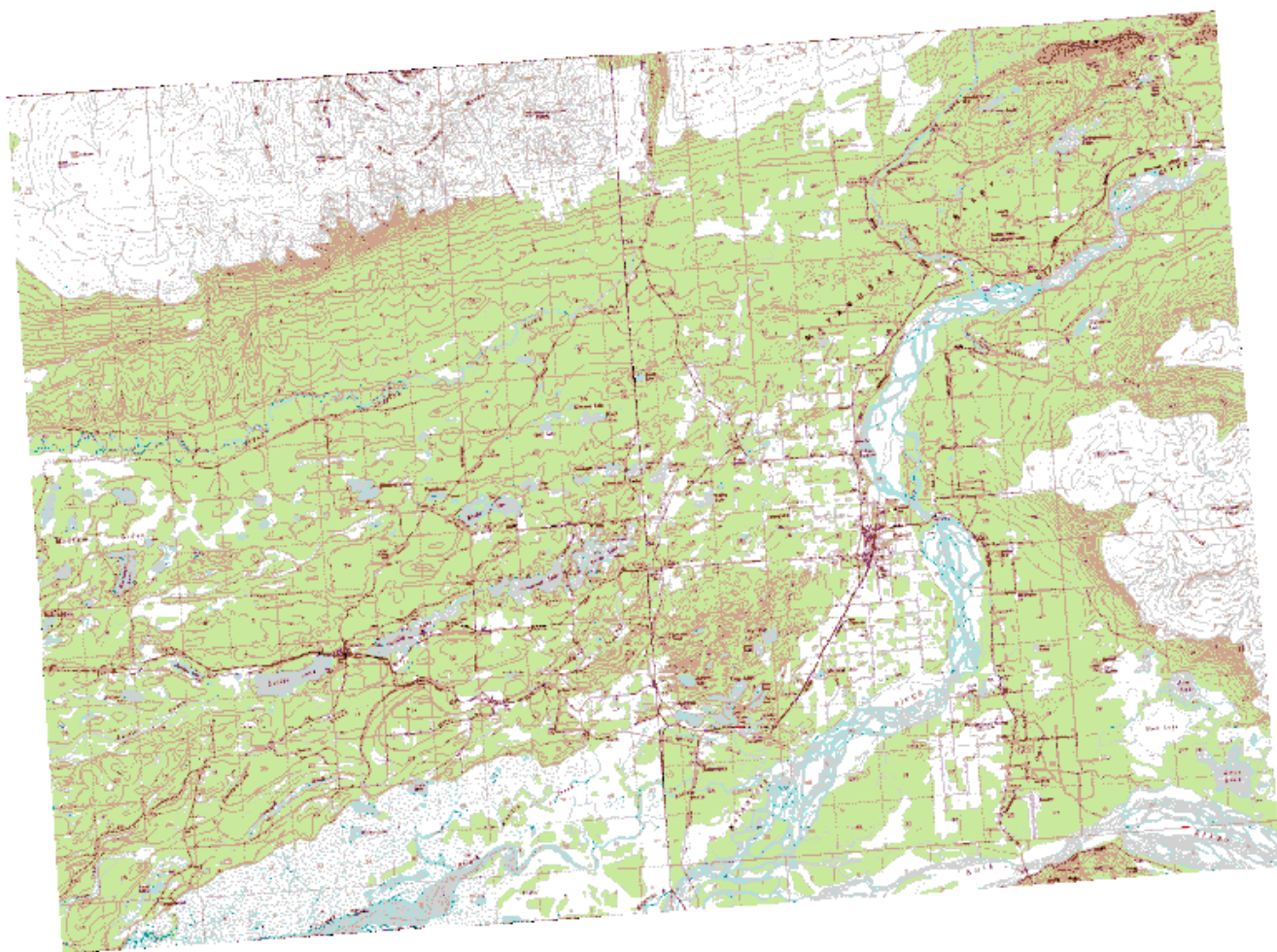


Figure 12.7: Seamless display of clipped DRGs

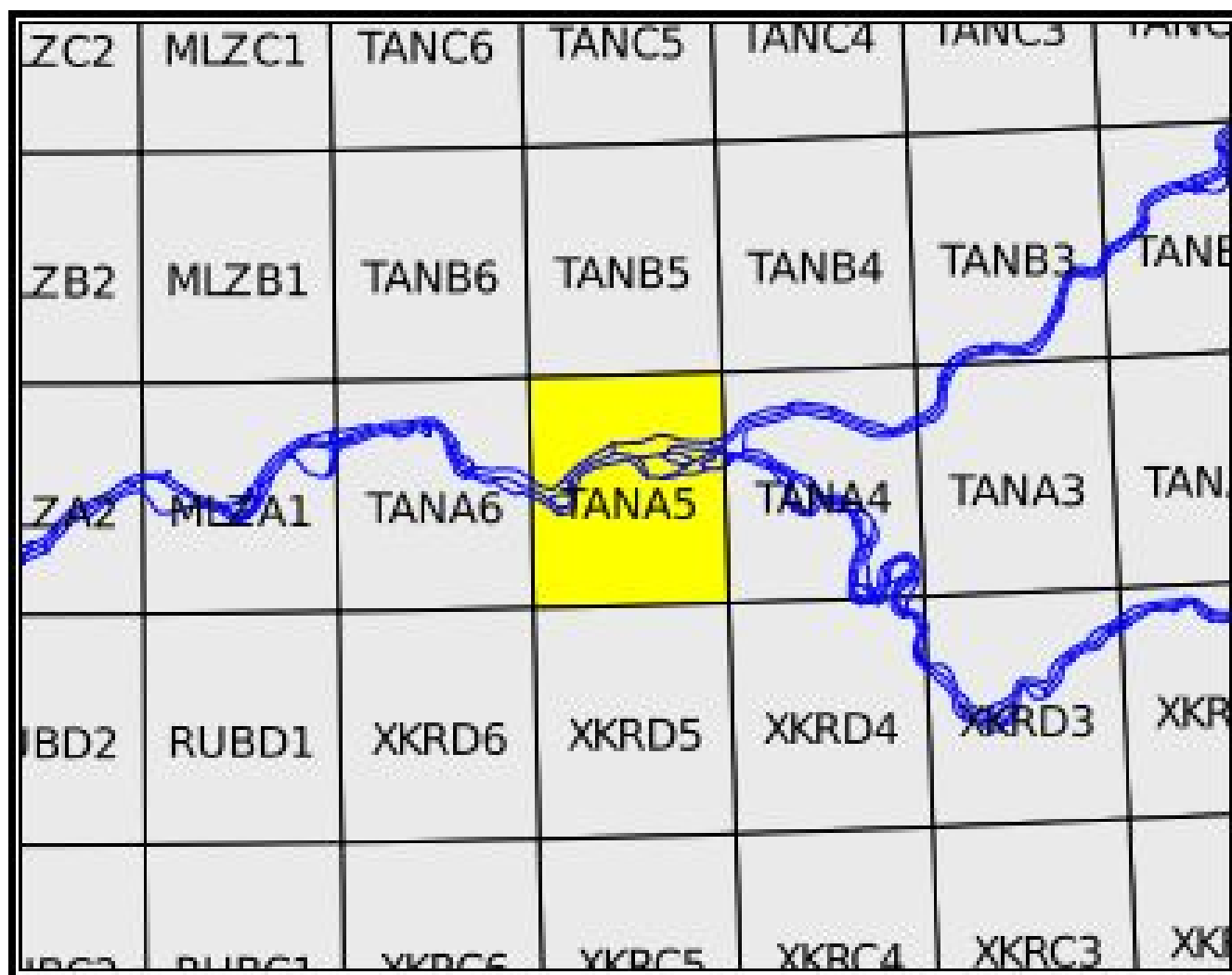


Figure 12.8: Rivers and the quadrangle for clipping

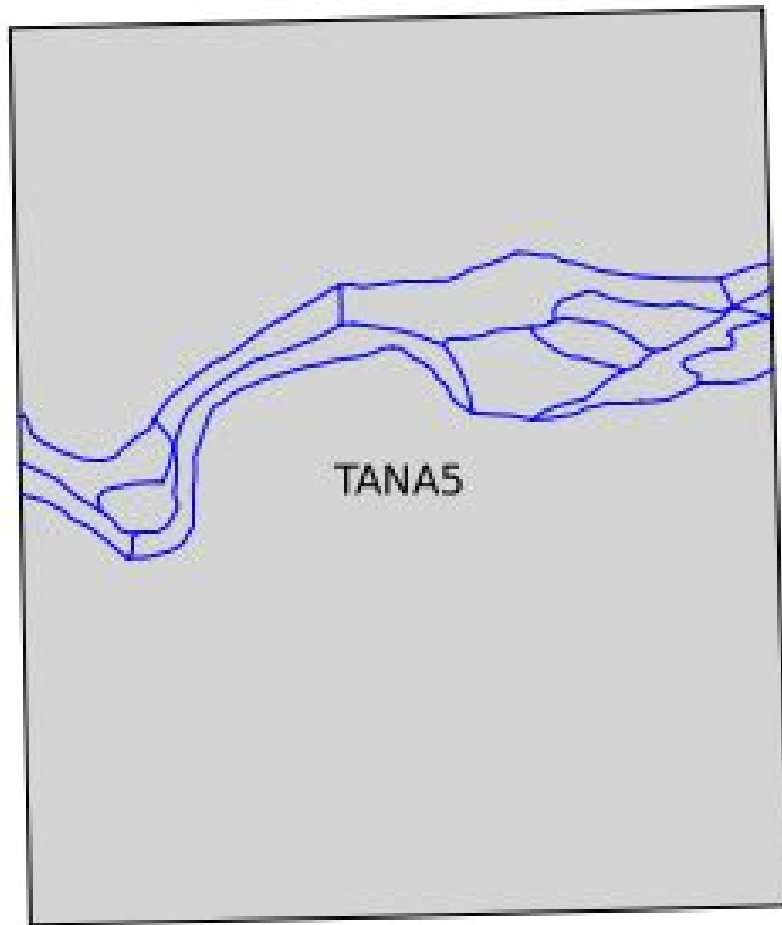


Figure 12.9: Rivers clipped to a quadrangle boundary

13 Using Command-Line Tools

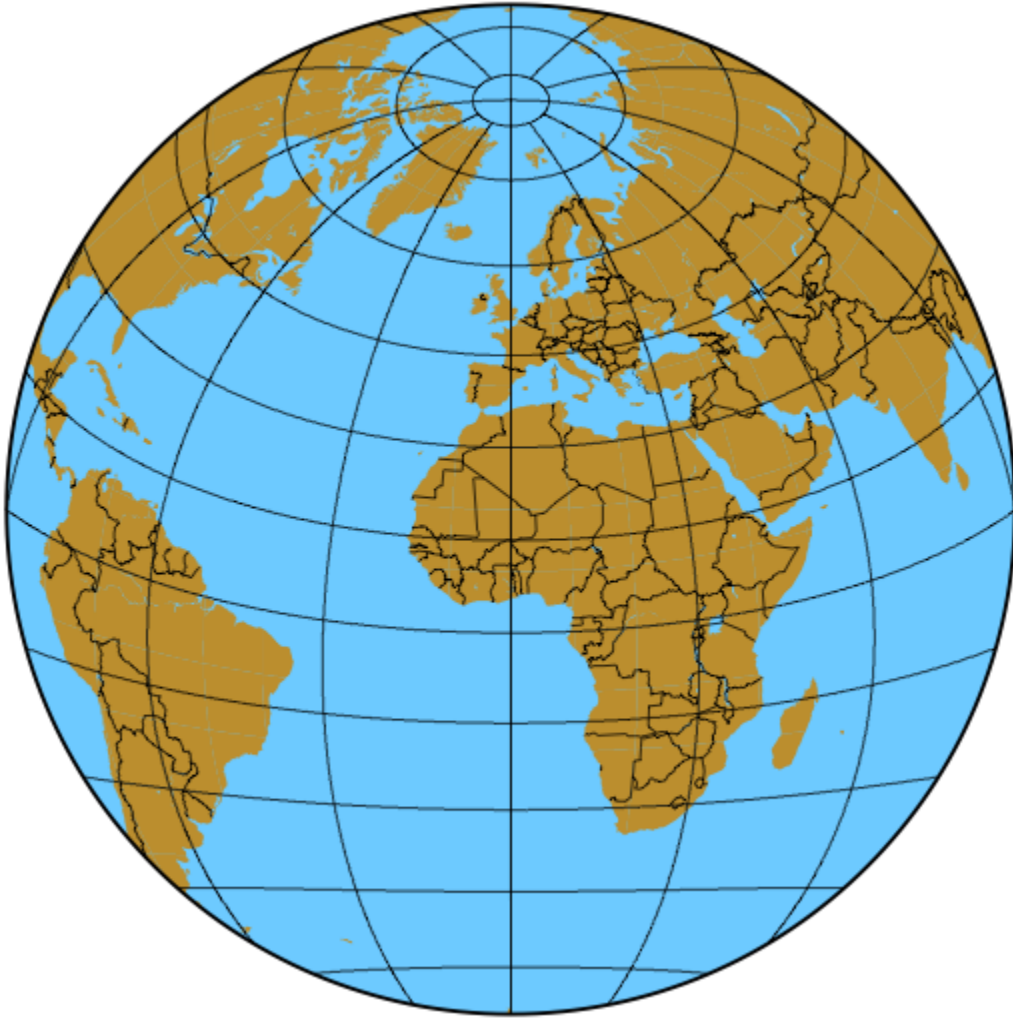


Figure 13.1: Hemisphere view of Earth created with GMT

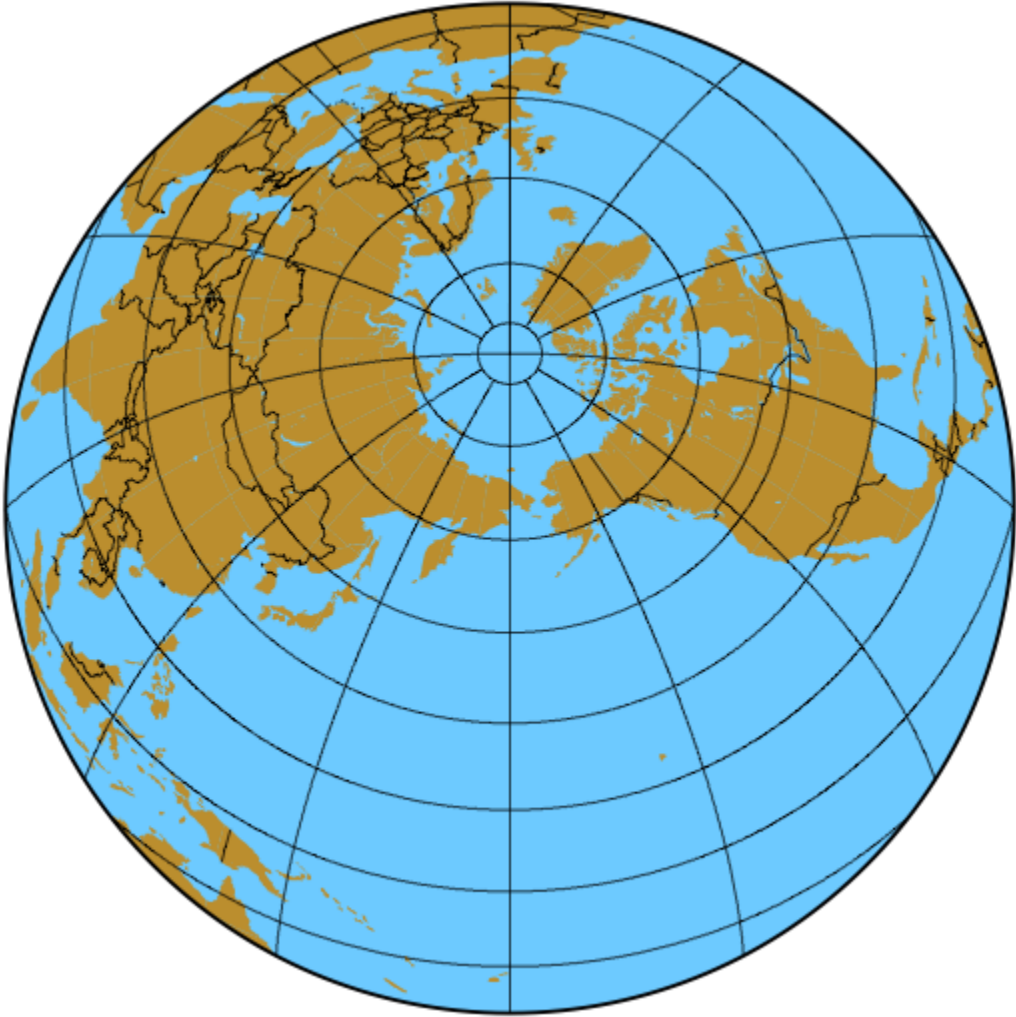


Figure 13.2: Globe centered on 180/65

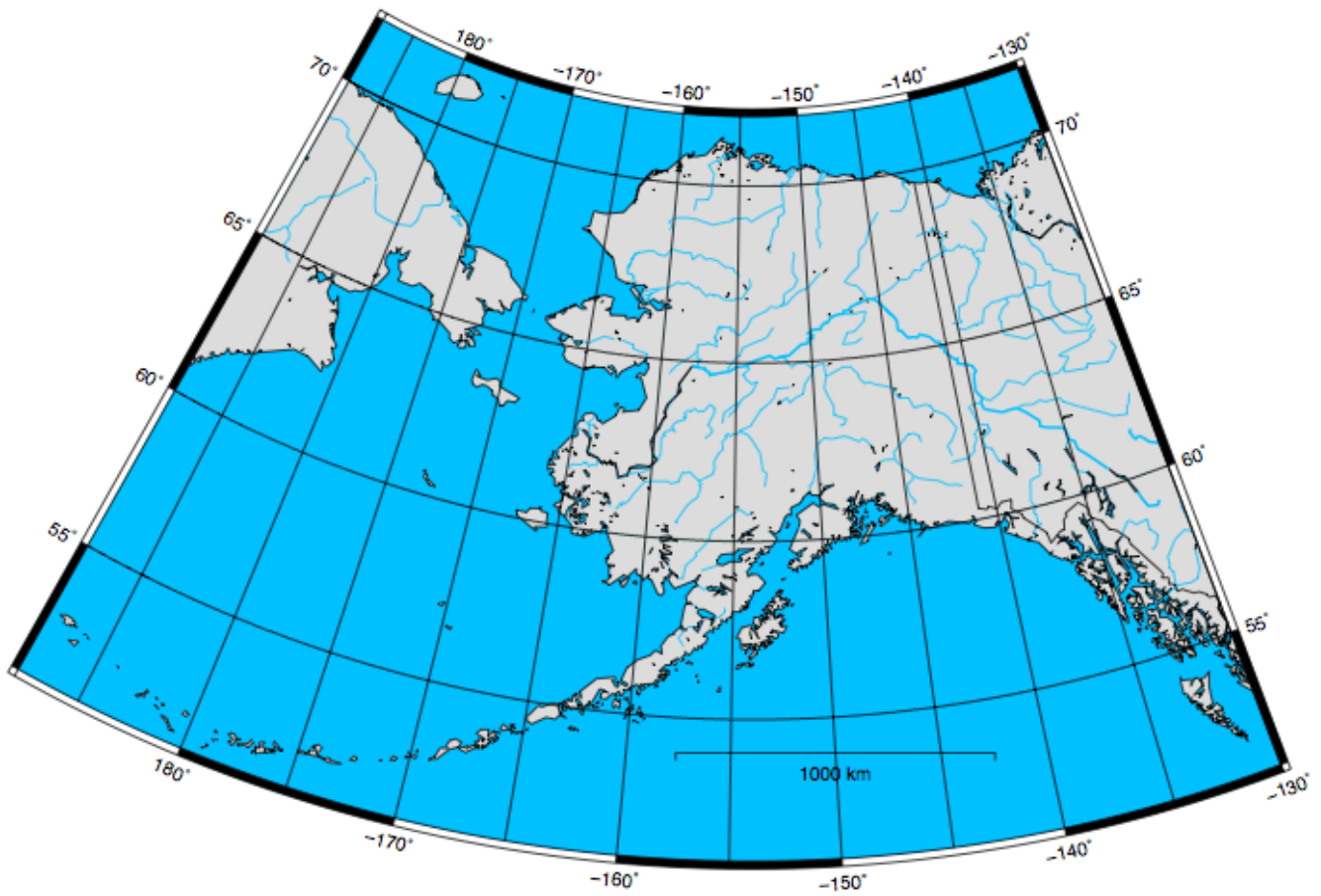


Figure 13.3: Alaska coastline generated with GMT

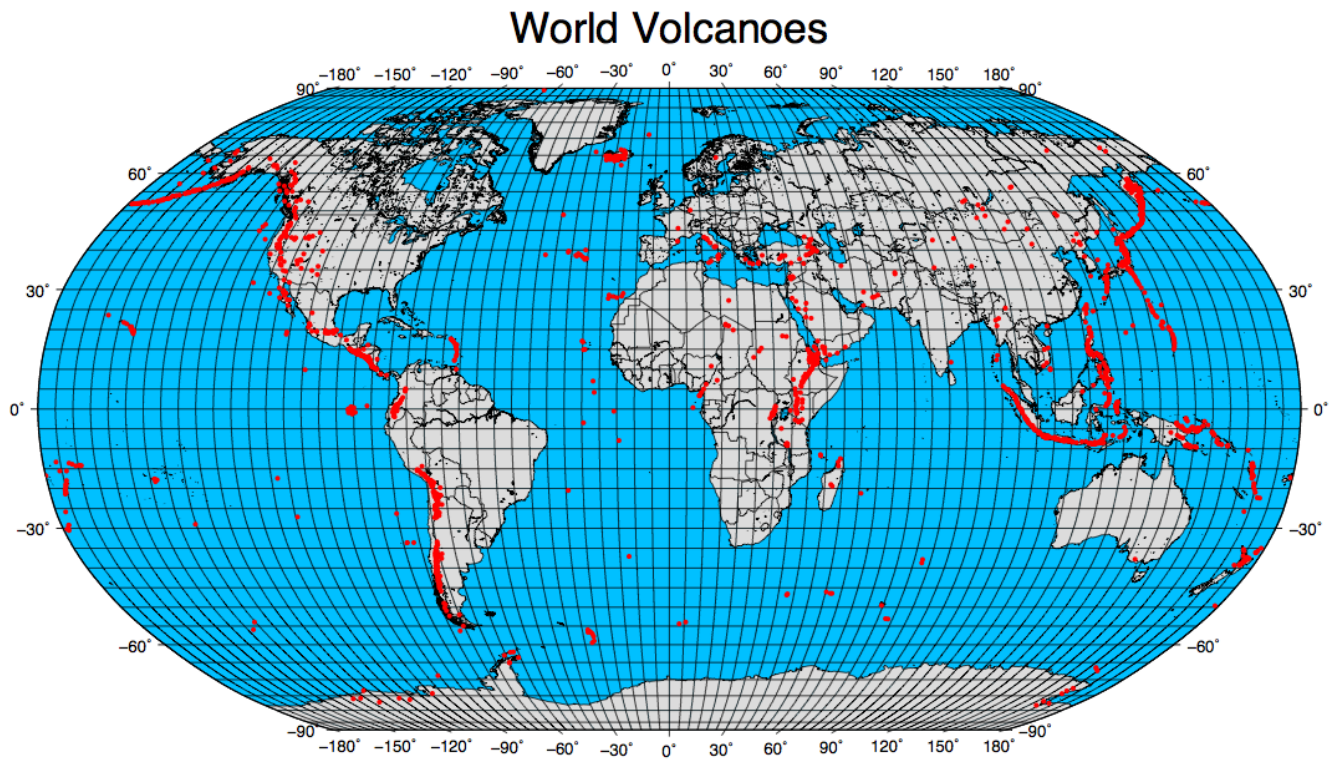


Figure 13.4: Volcanoes plotted on a Robinson projection using GMT



Figure 13.5: Alaska derived from the world mosaic



Figure 13.6: Alaska mosaic warped to Alaska Albers projection

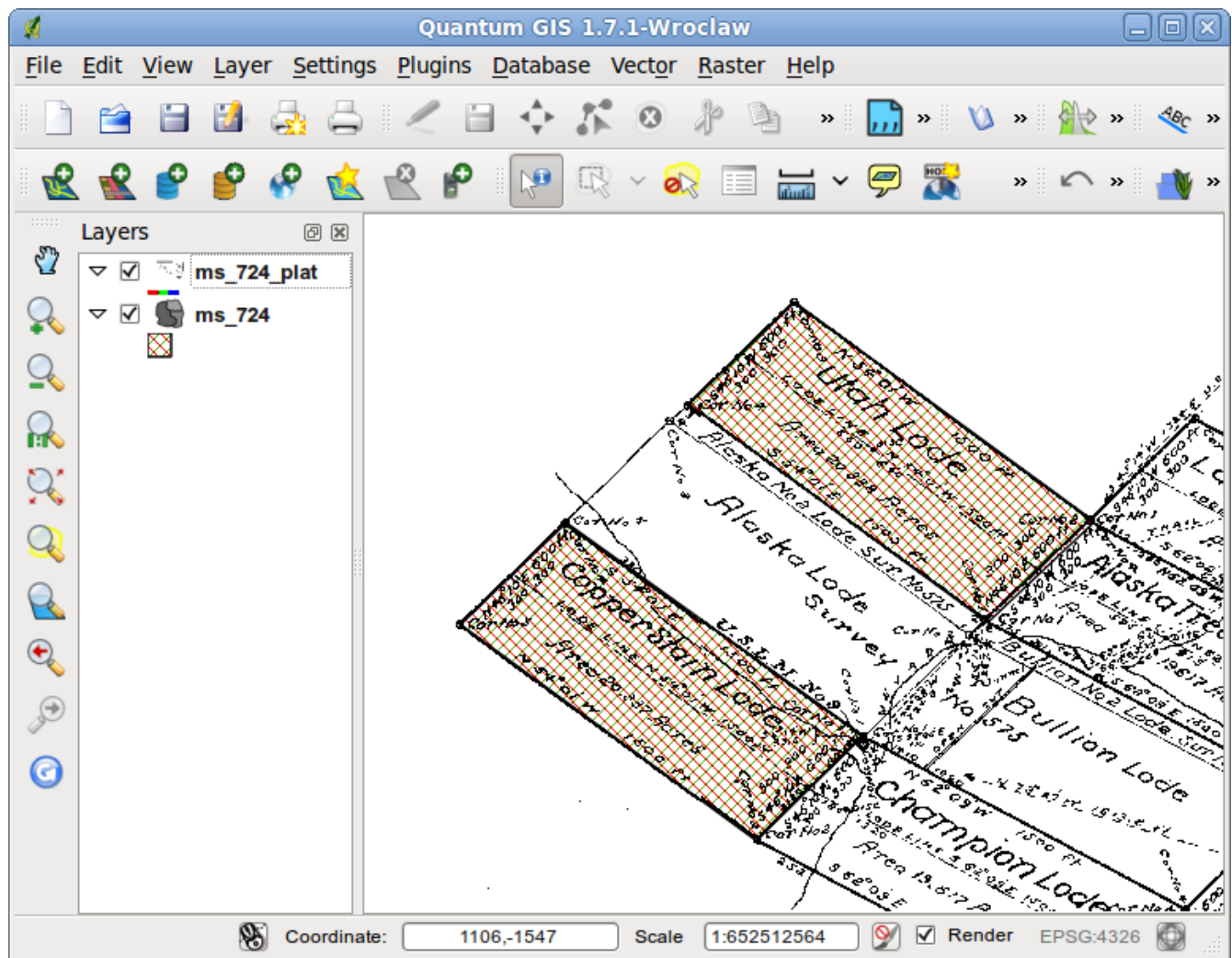


Figure 13.7: VRT raster over the parcel shapefile

14 Getting the Most Out of QGIS and GRASS Integration



Figure 14.1: The GRASS Plugin Toolbar

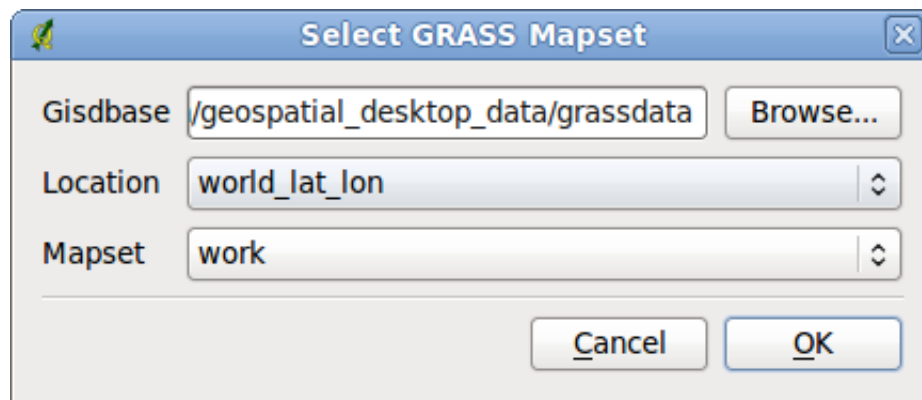


Figure 14.2: Selecting a GRASS mapset in QGIS

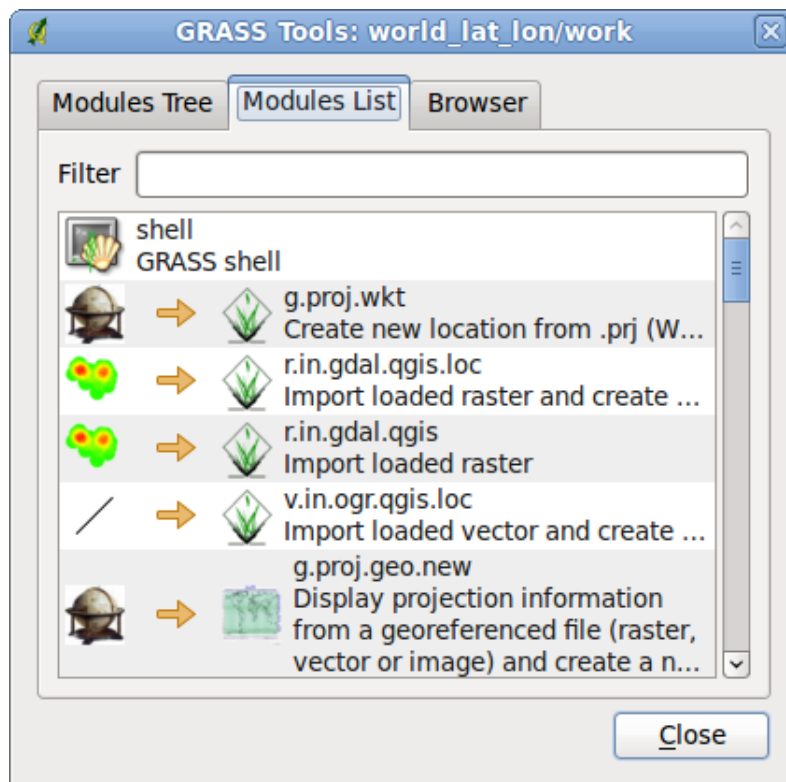


Figure 14.3: The GRASS tools in QGIS

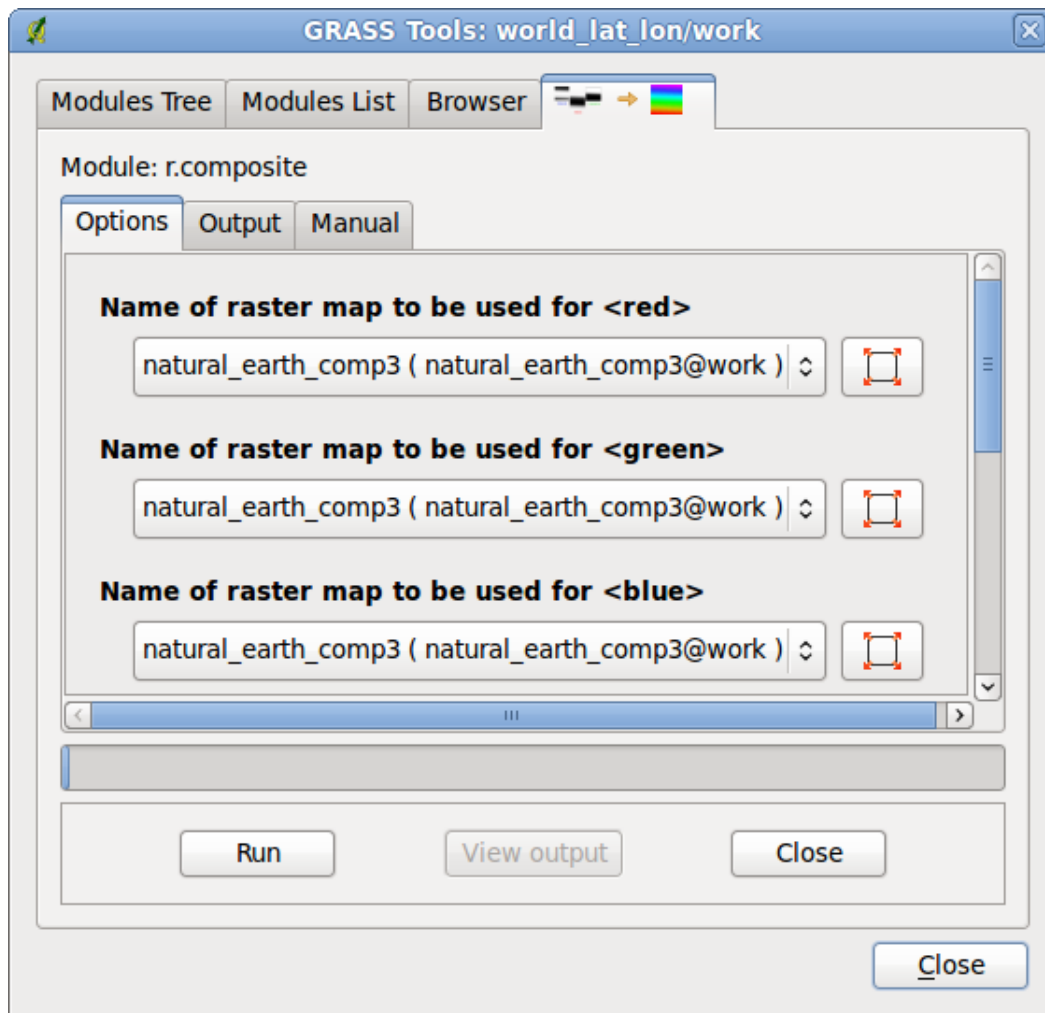


Figure 14.4: The GRASS Toolbox Ready to Run r.composite

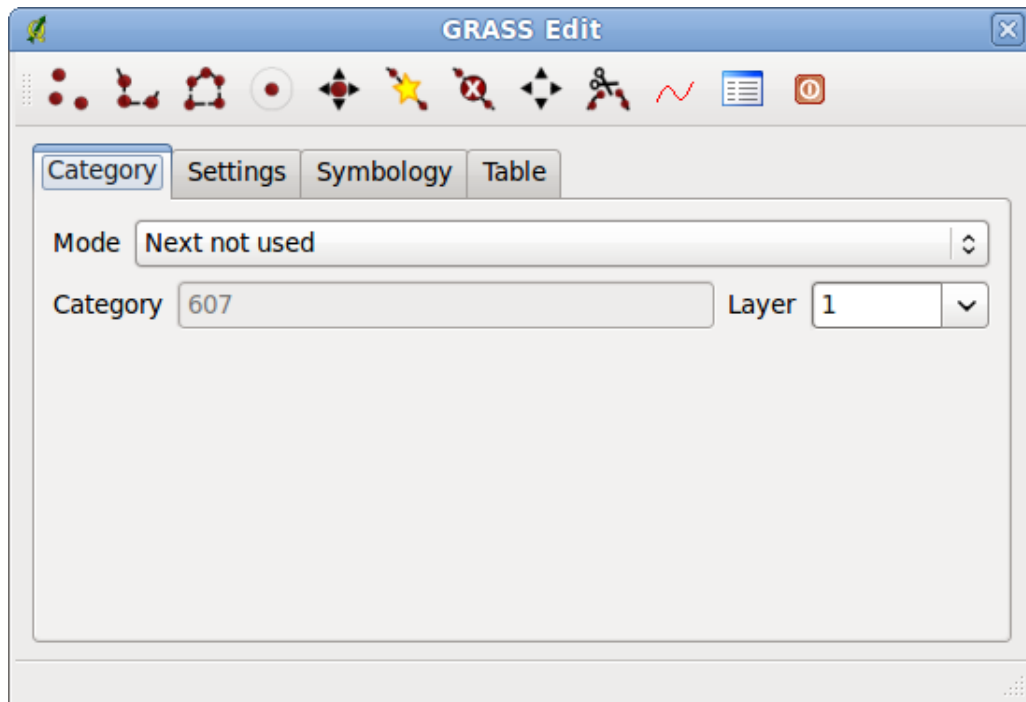


Figure 14.5: GRASS edit tools in QGIS

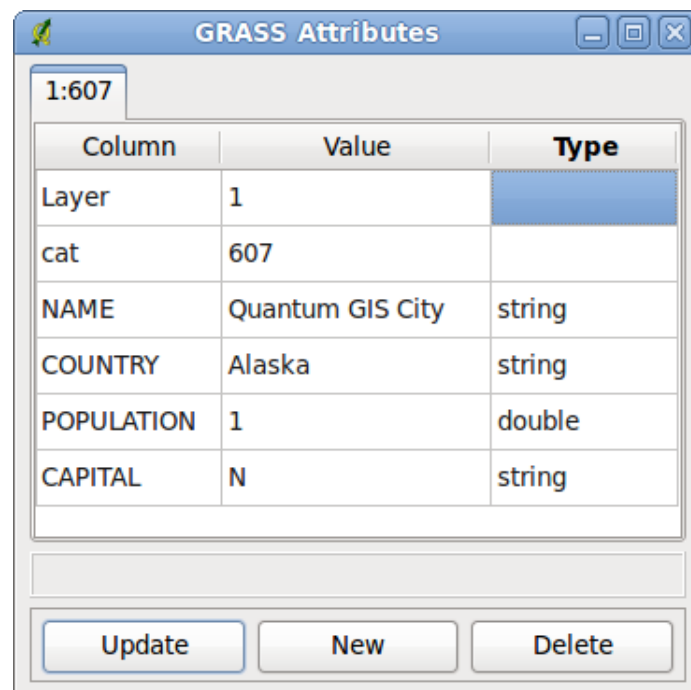


Figure 14.6: Adding attributes to a GRASS feature

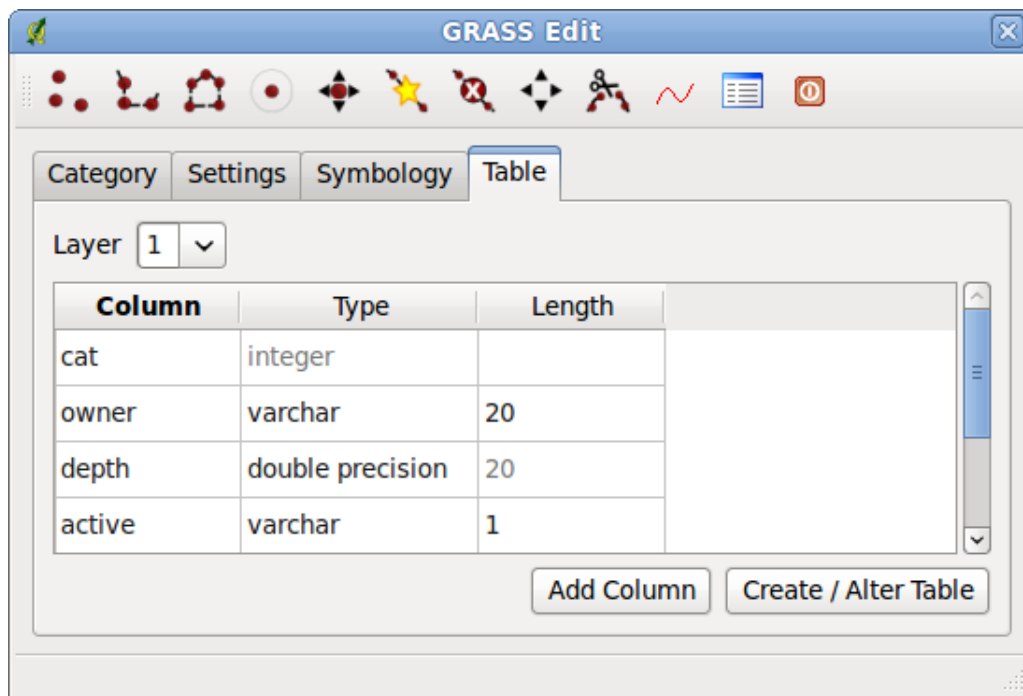


Figure 14.7: Adding columns to the new GRASS map table

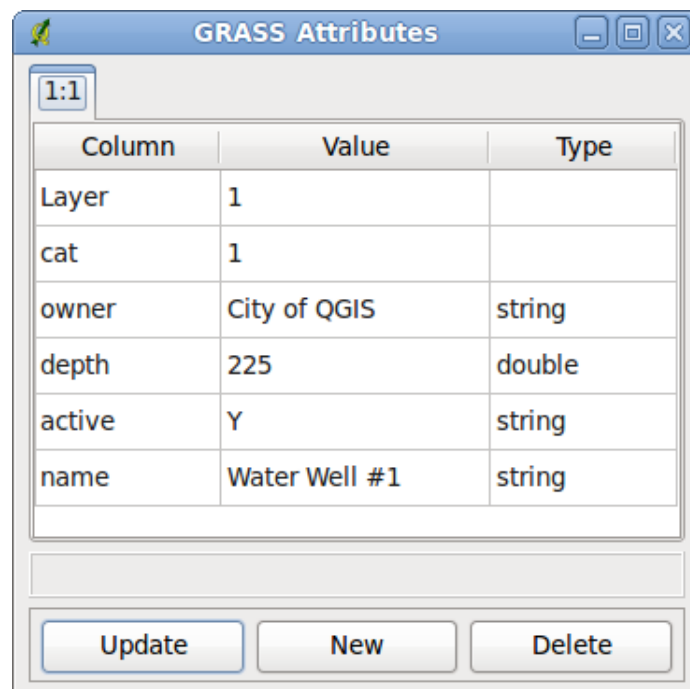


Figure 14.8: Editing the attributes of an existing feature

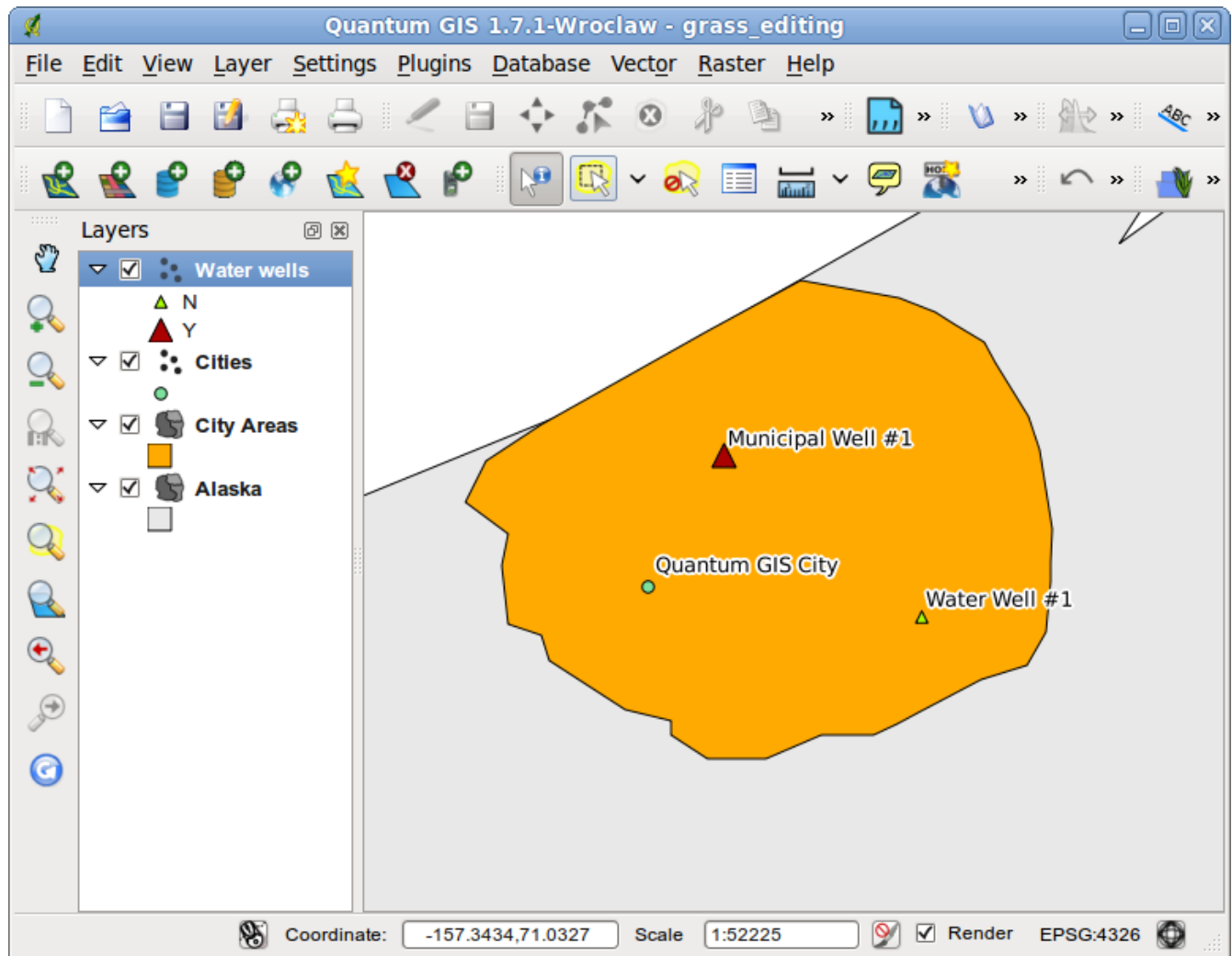


Figure 14.9: Completed city map with water wells

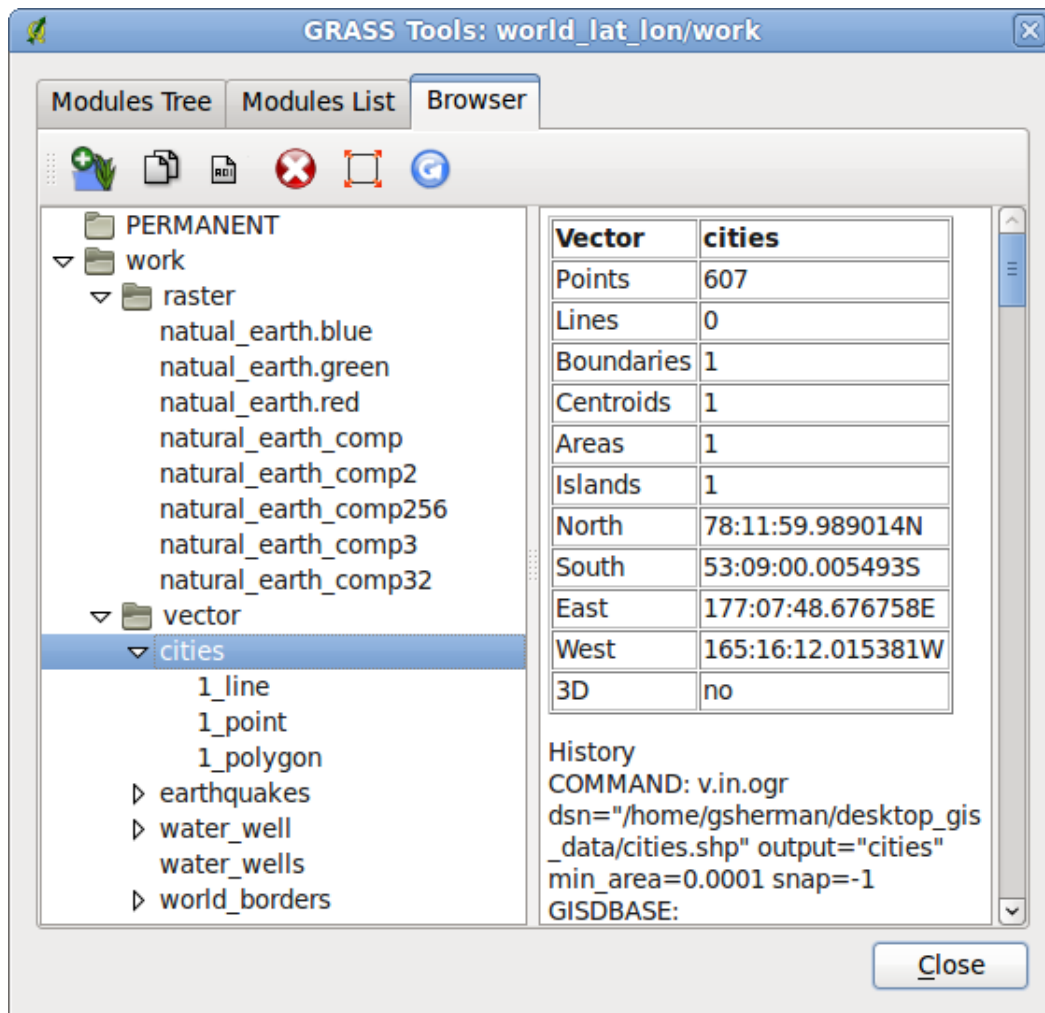


Figure 14.10: GRASS browser in QGIS

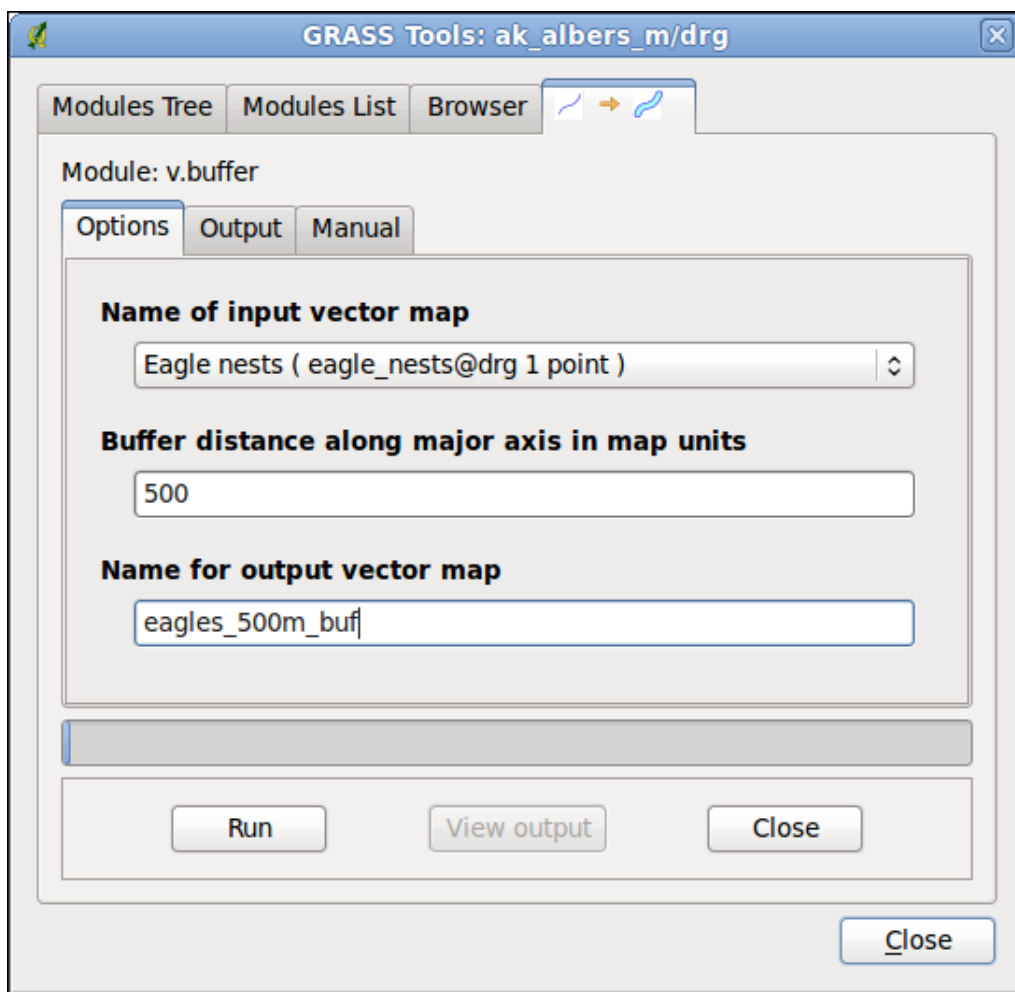


Figure 14.11: Buffer module ready to buffer eagle nest locations

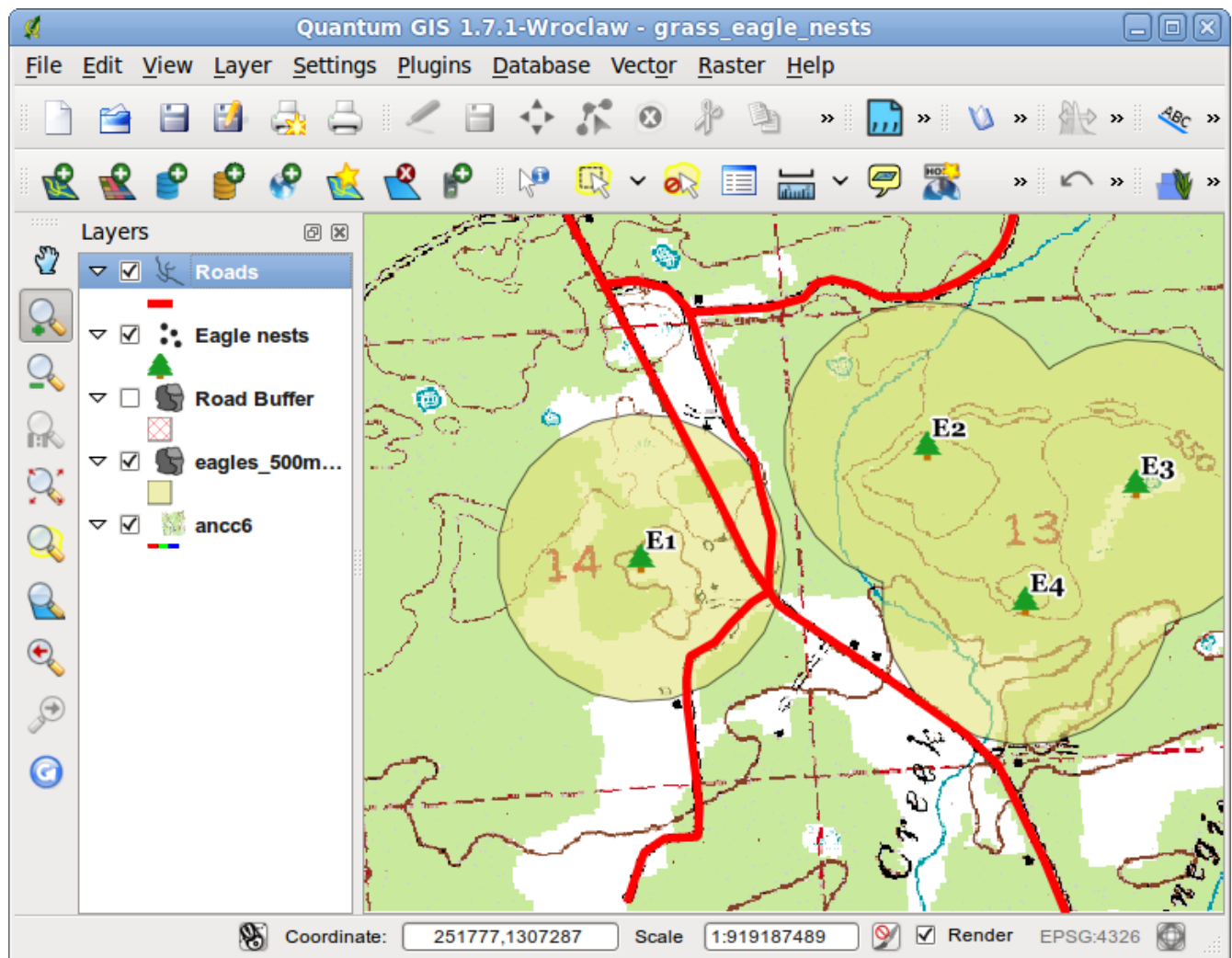


Figure 14.12: Buffered eagle nests created with GRASS and QGIS

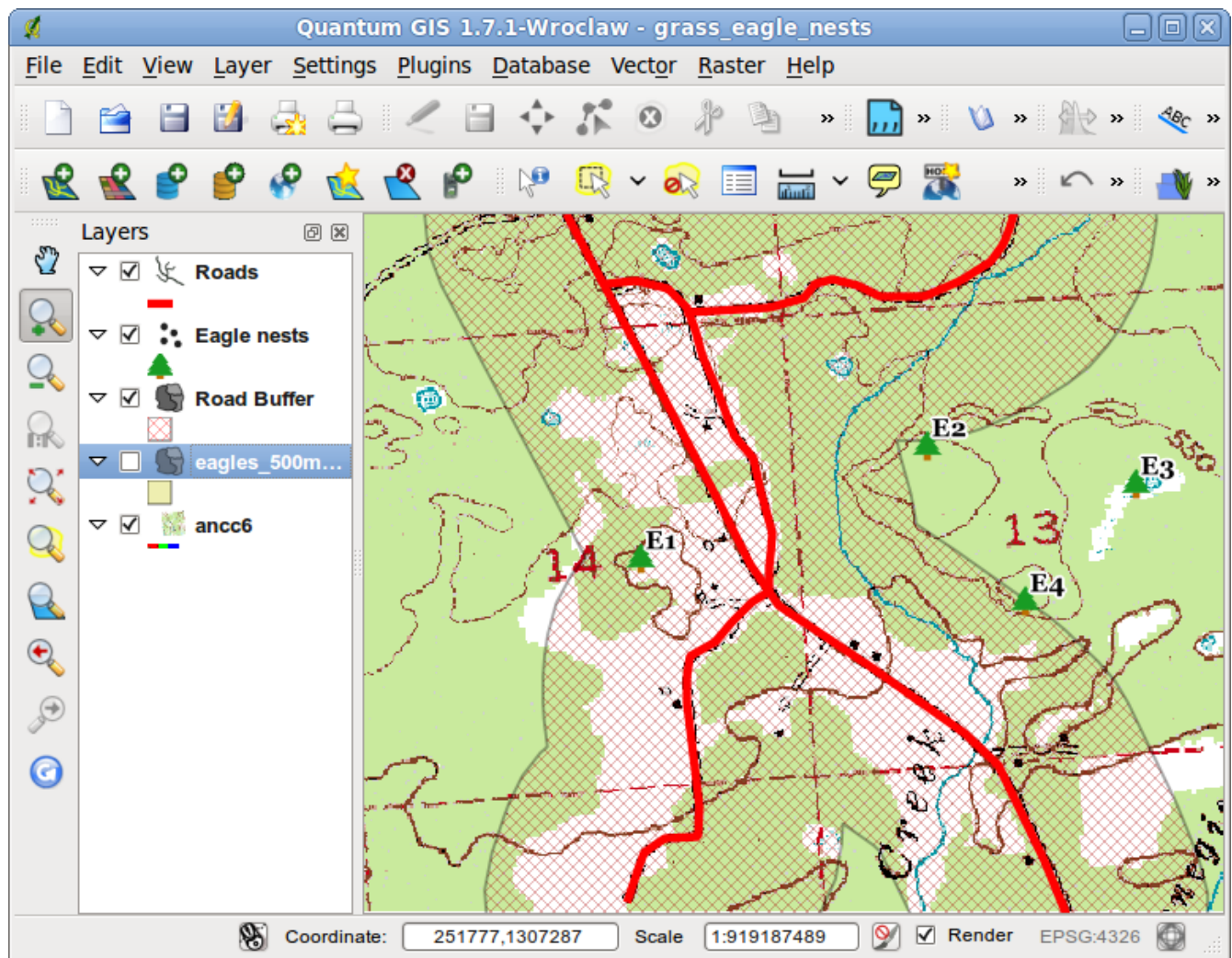


Figure 14.13: Roads buffered using GRASS in QGIS

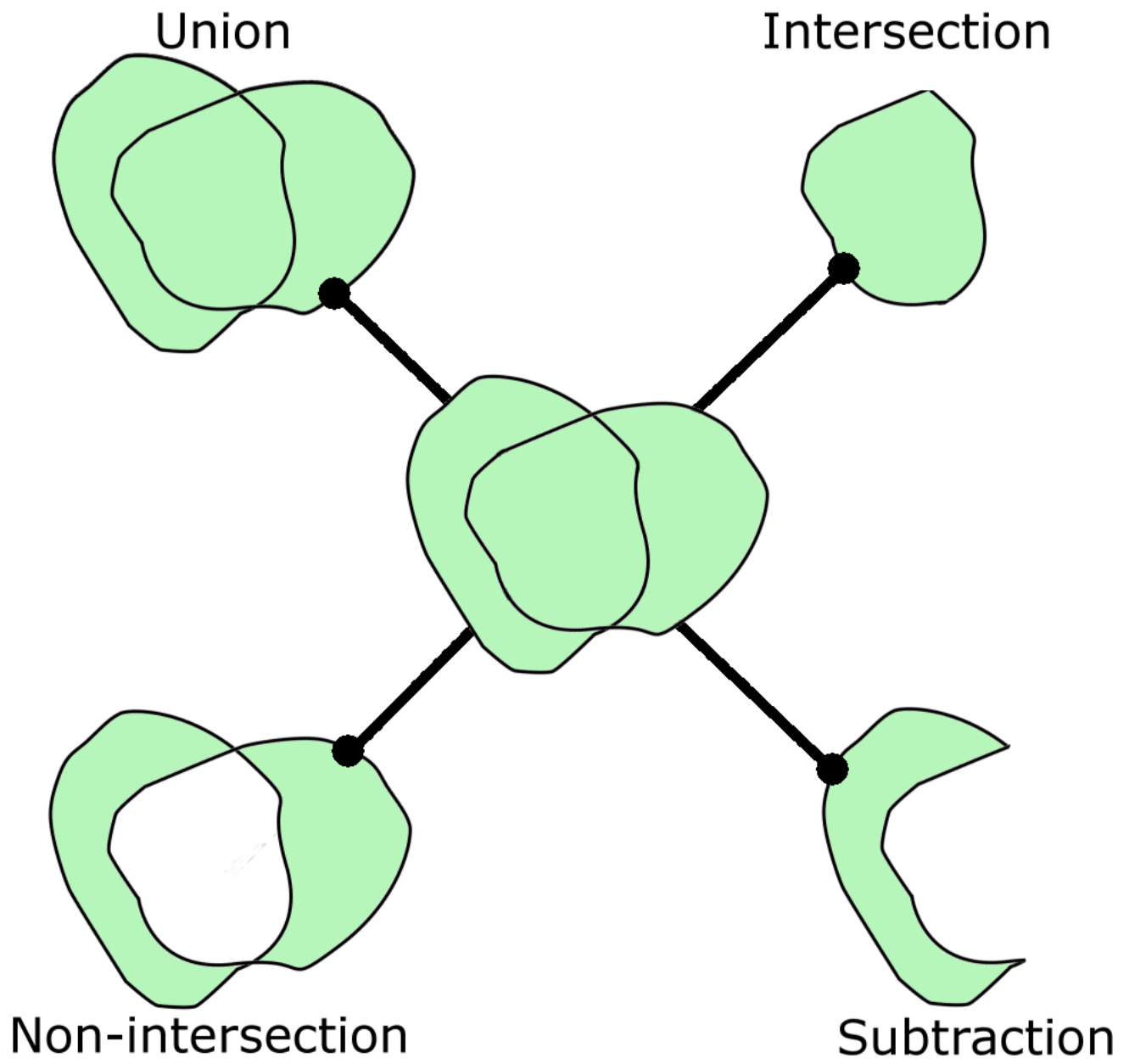


Figure 14.14: Result of each type of vector overlay operation

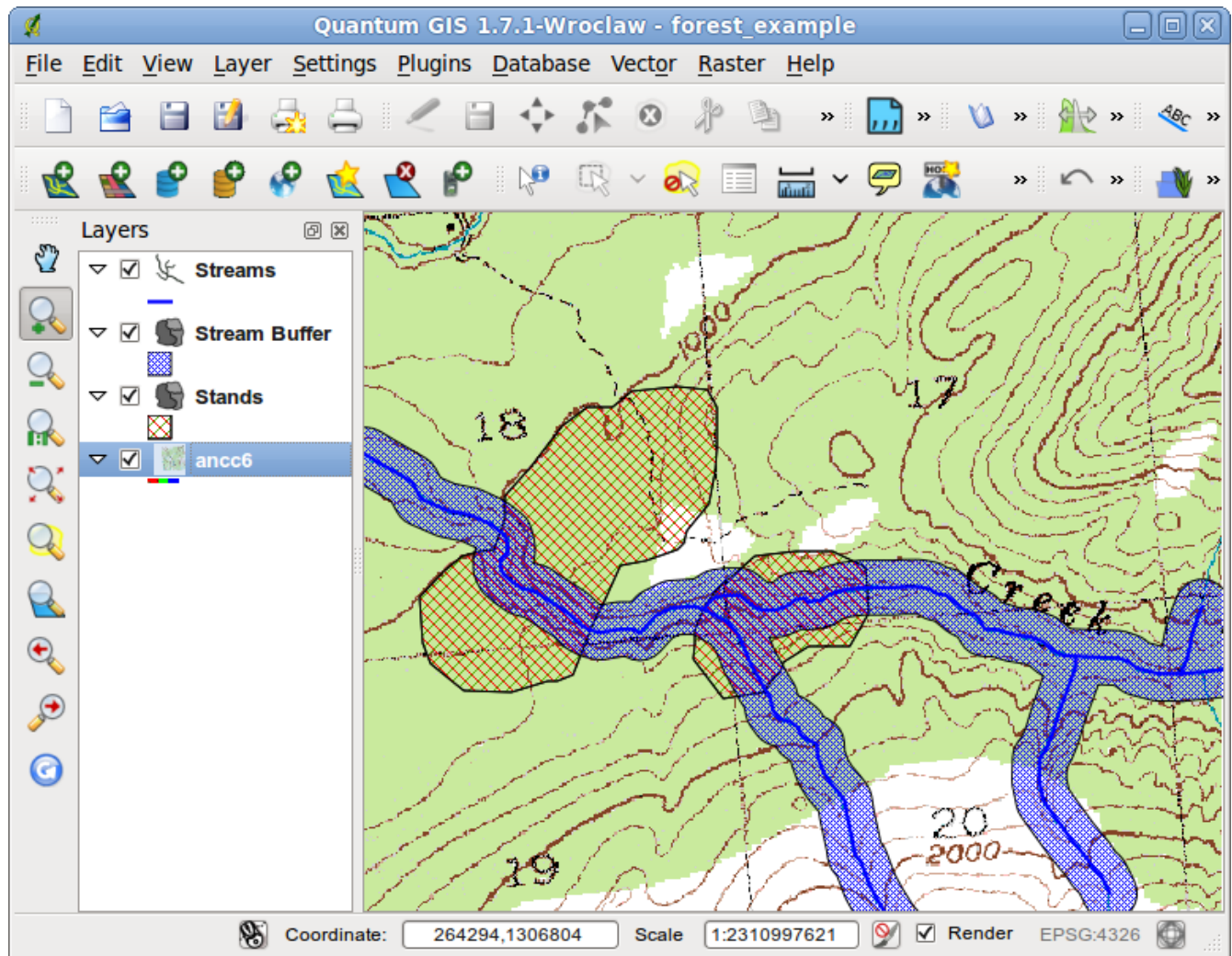


Figure 14.15: Timber stands and stream buffers

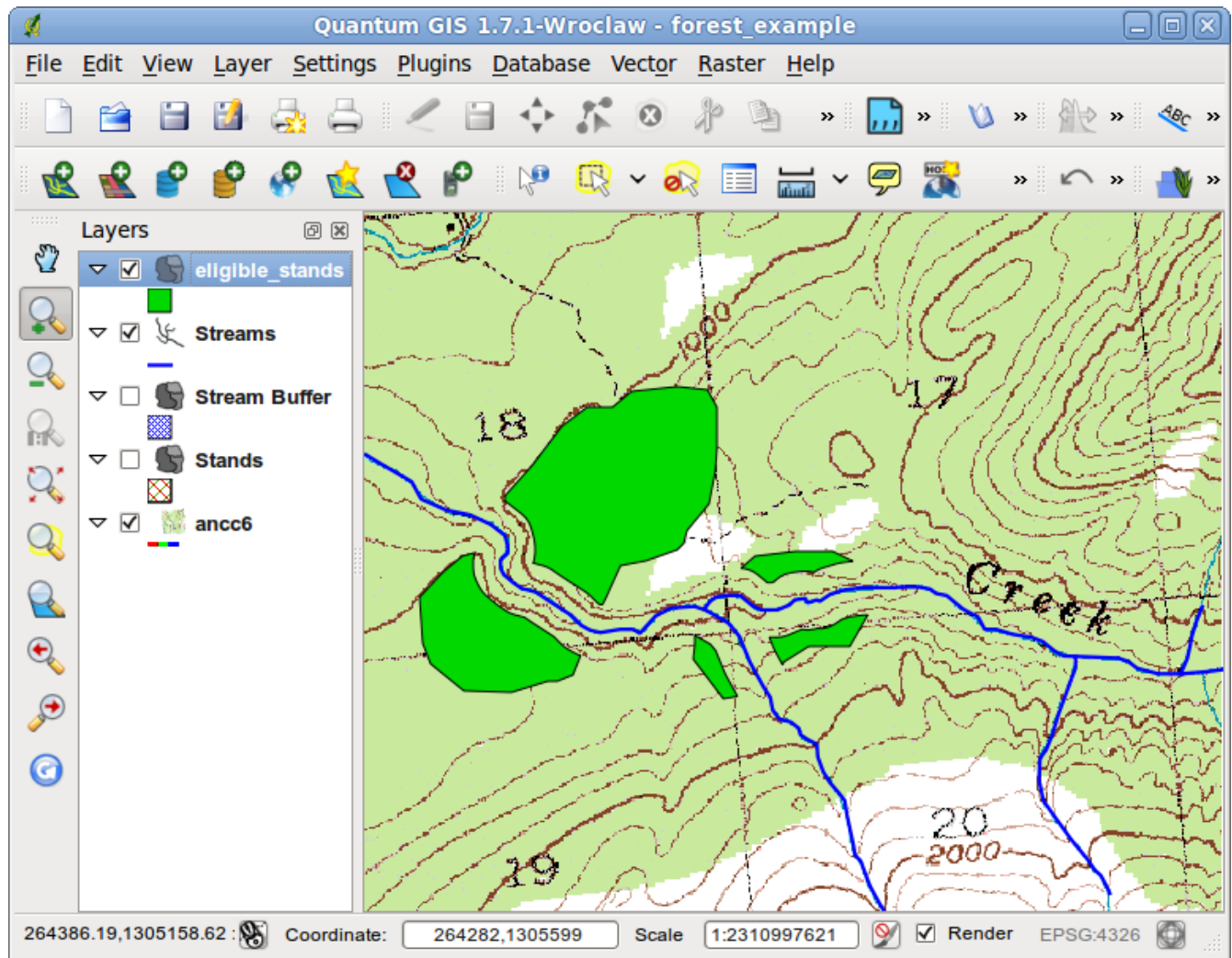


Figure 14.16: Eligible logging areas after vector subtraction

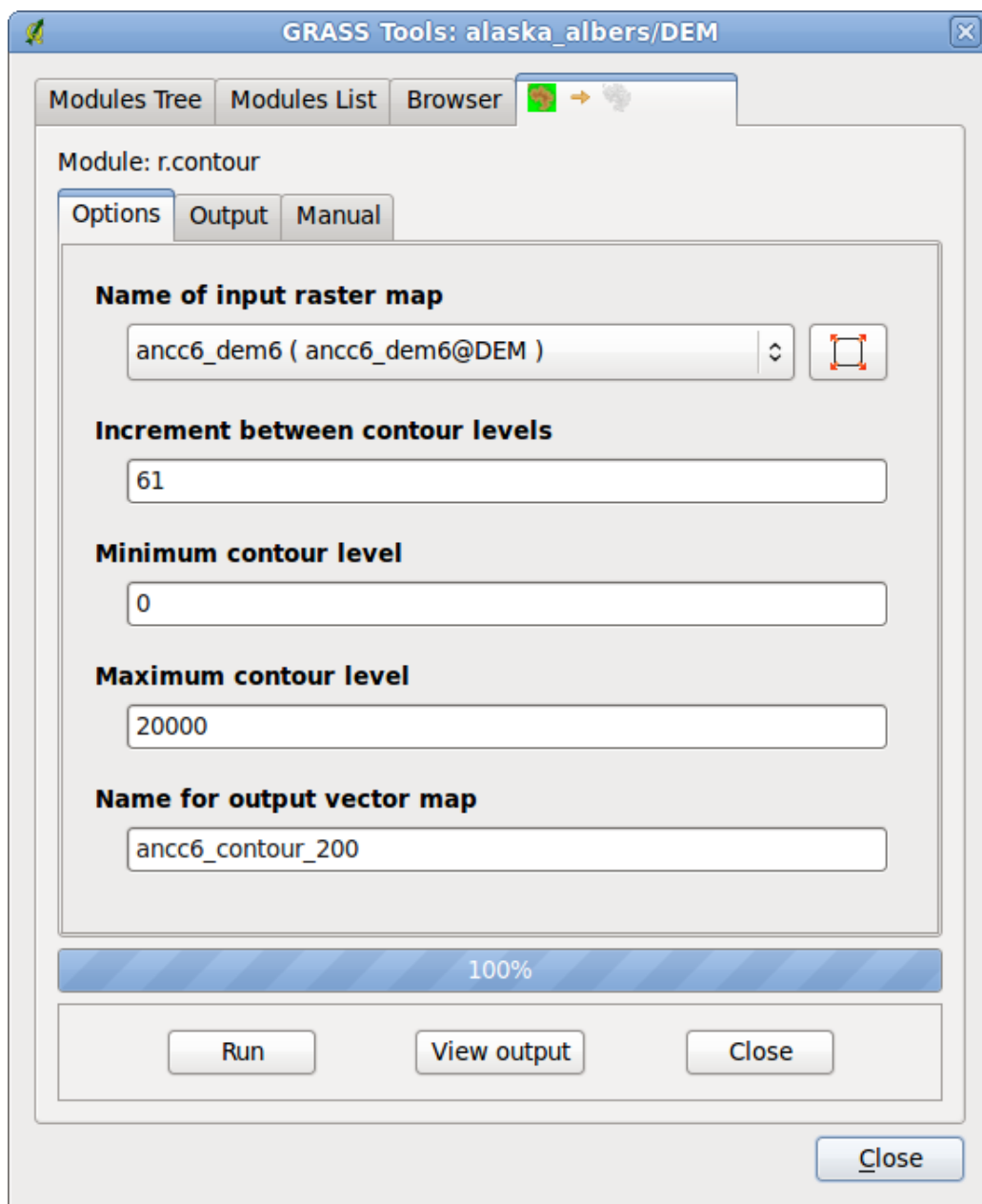


Figure 14.17: Setting up to contour a DEM

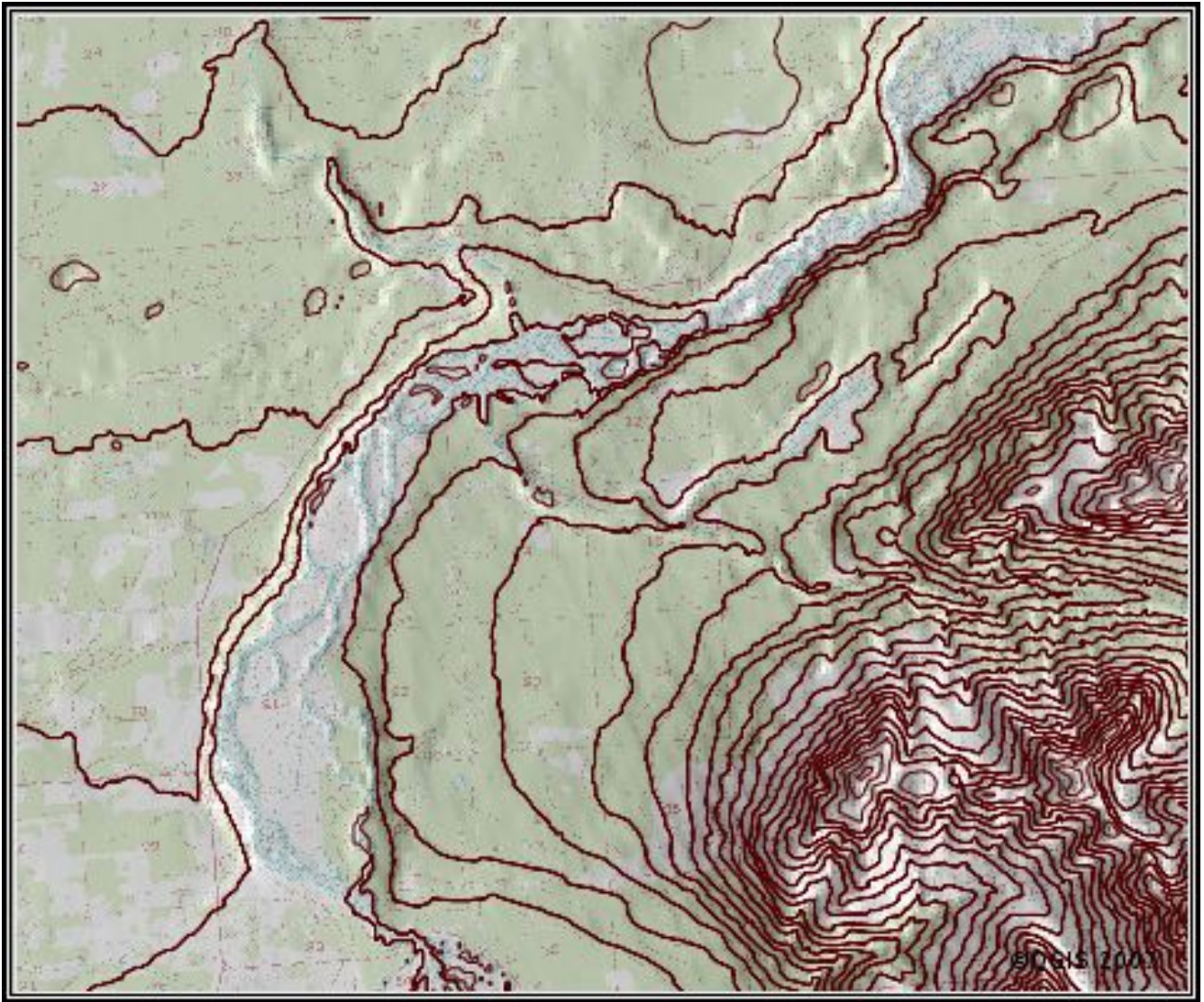


Figure 14.18: Result of contouring the DEM

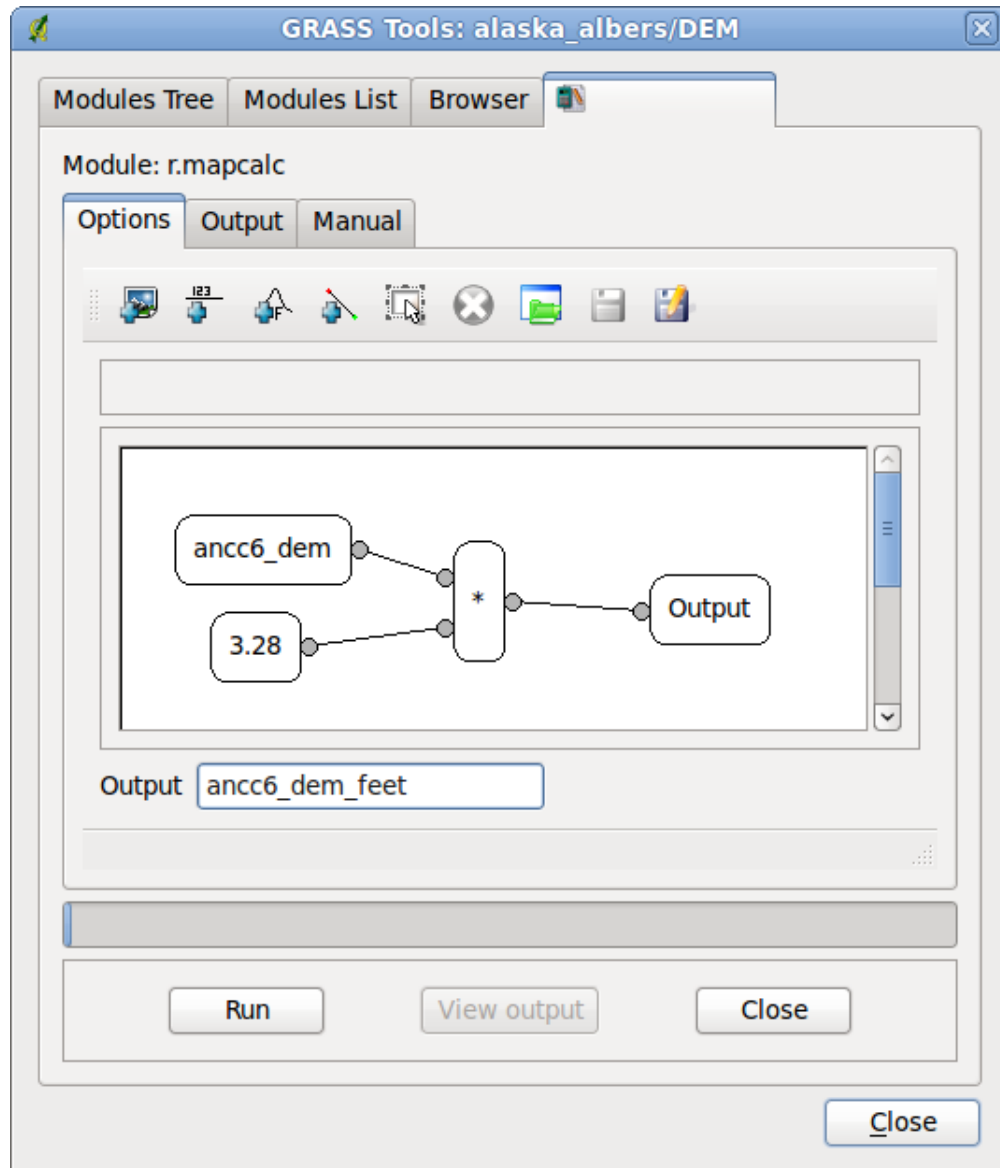


Figure 14.19: Mapcalc model for converting DEM from meters to feet

15 GIS Scripting

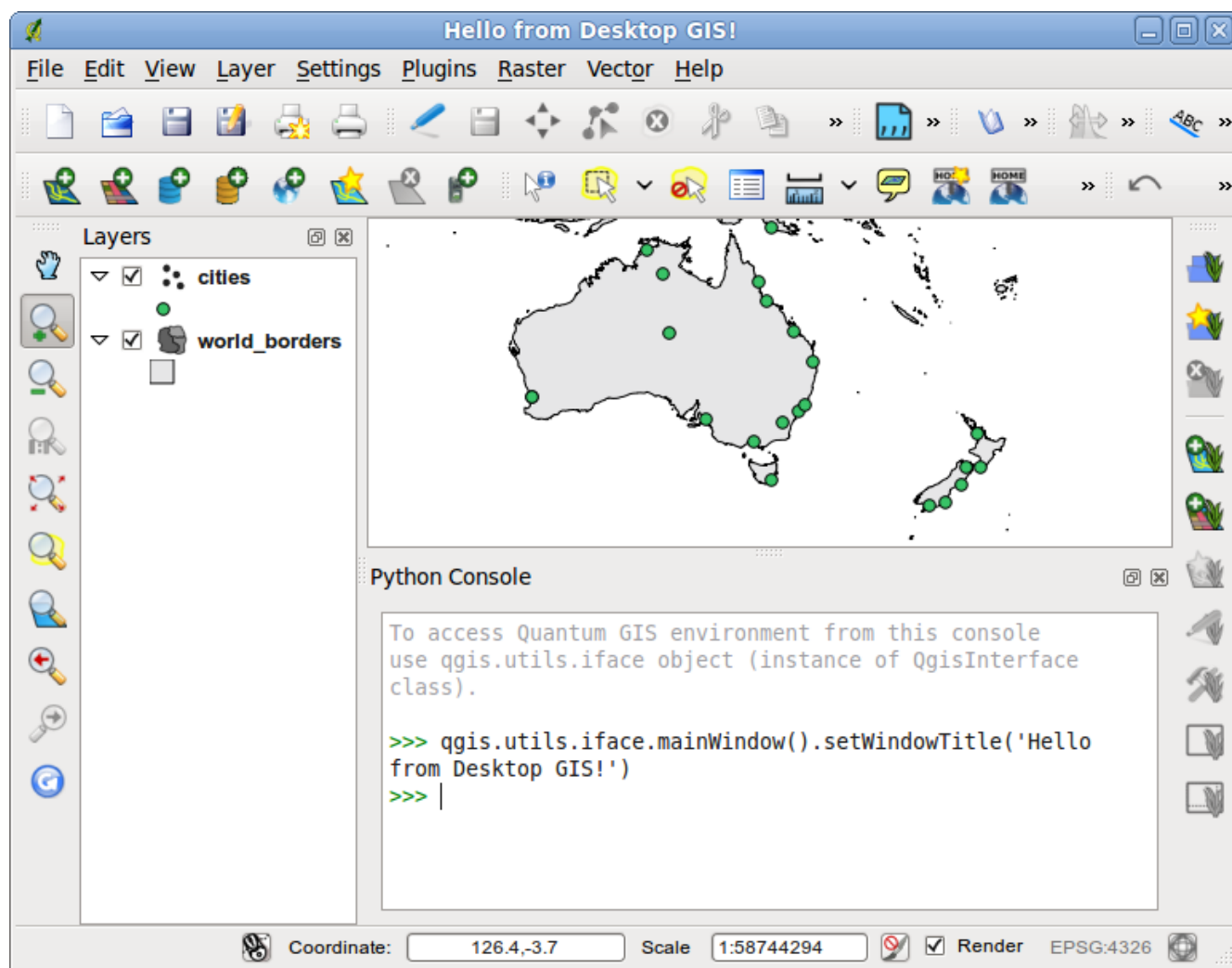


Figure 15.1: Changing the window title with Python

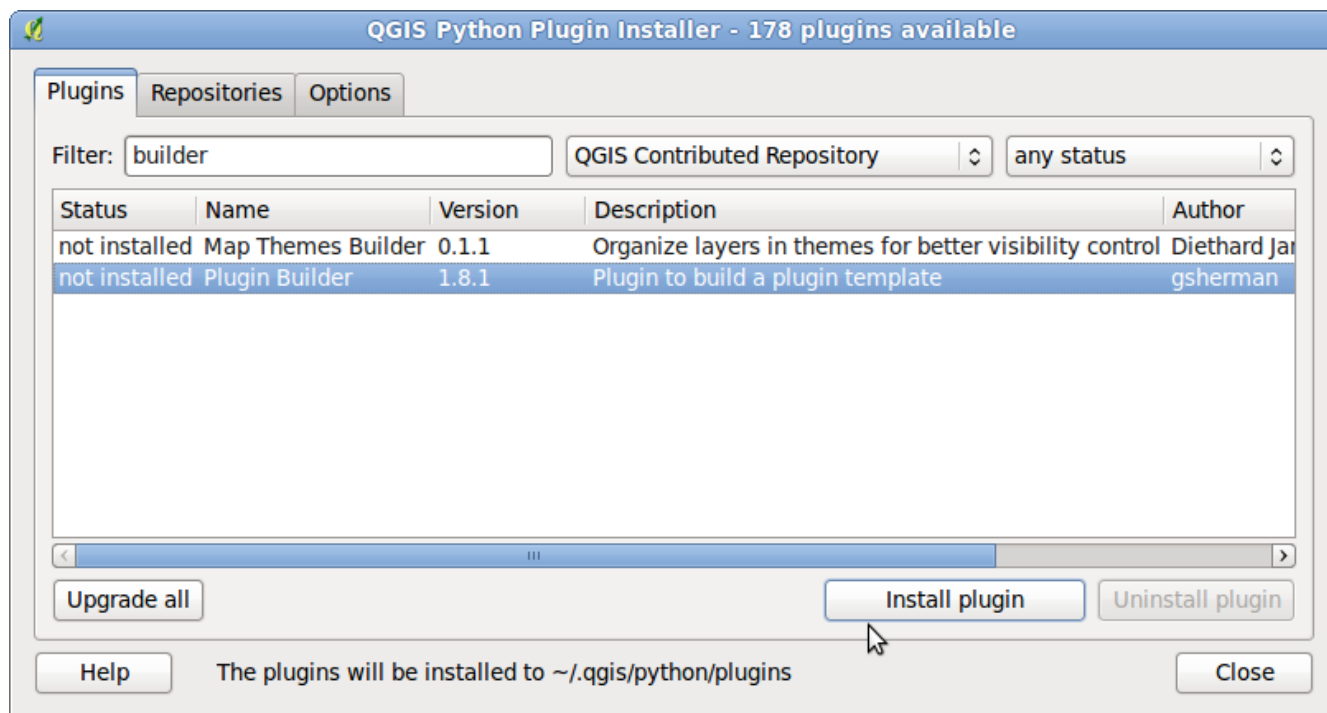


Figure 15.2: Installing the Plugin Builder

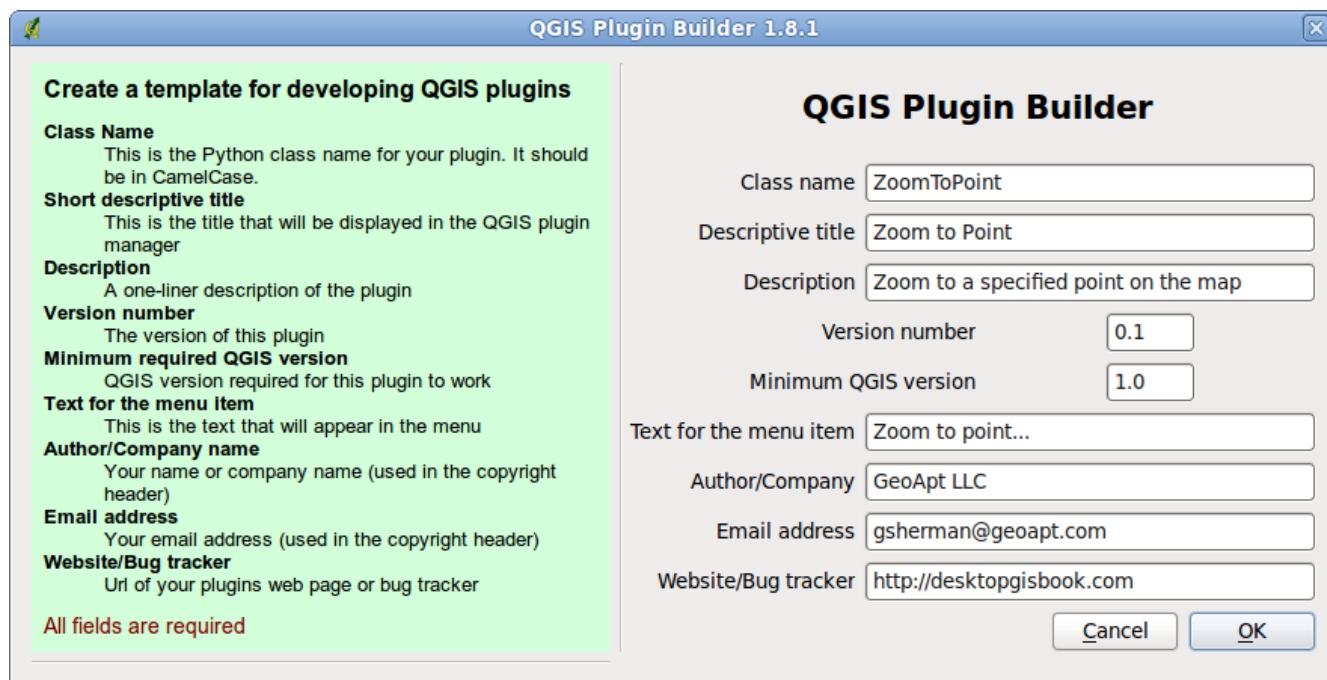


Figure 15.3: Plugin Builder Ready to Generate the Zoom to Point Plugin

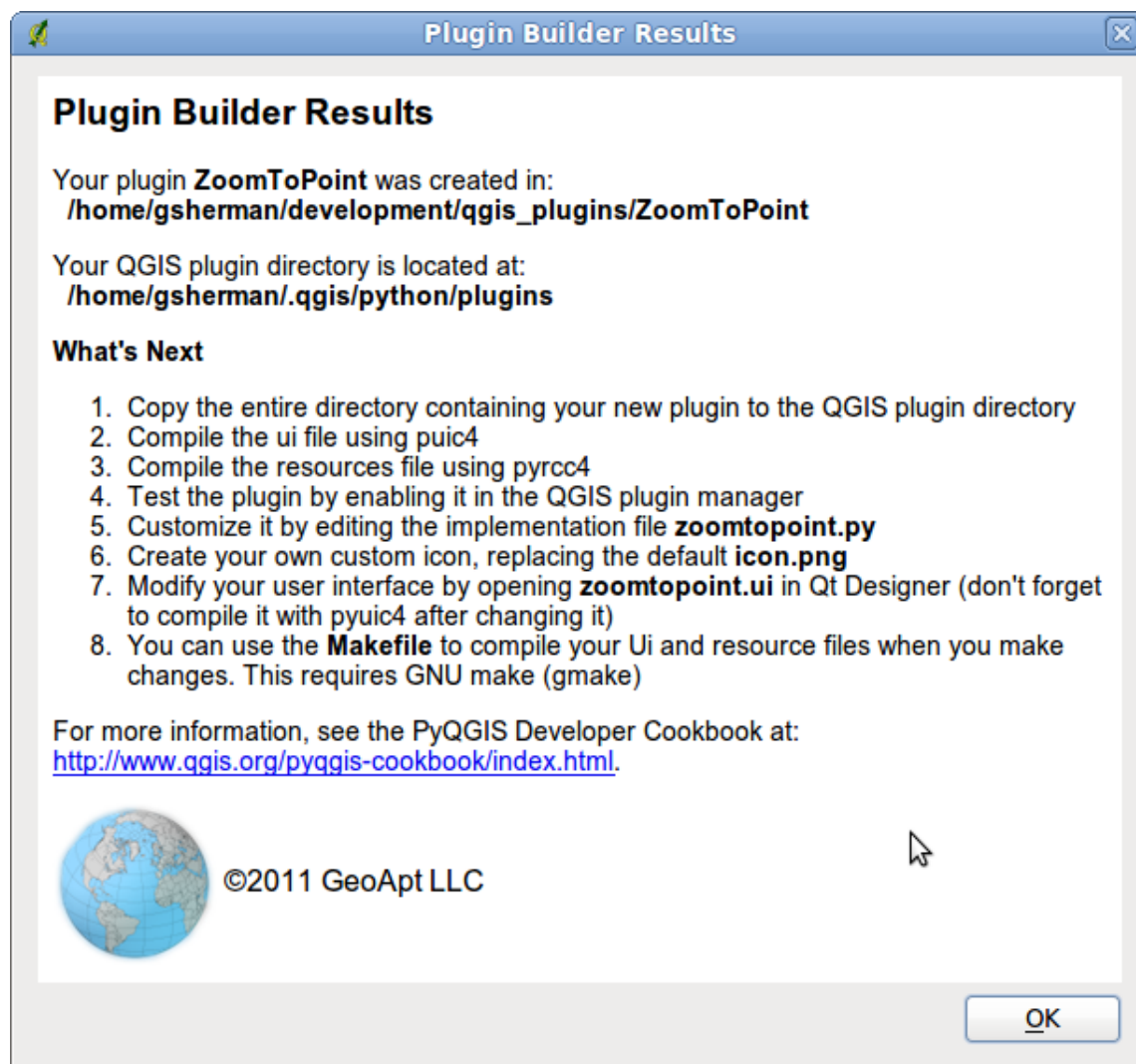


Figure 15.4: Results of Generating the ZoomToPoint Plugin

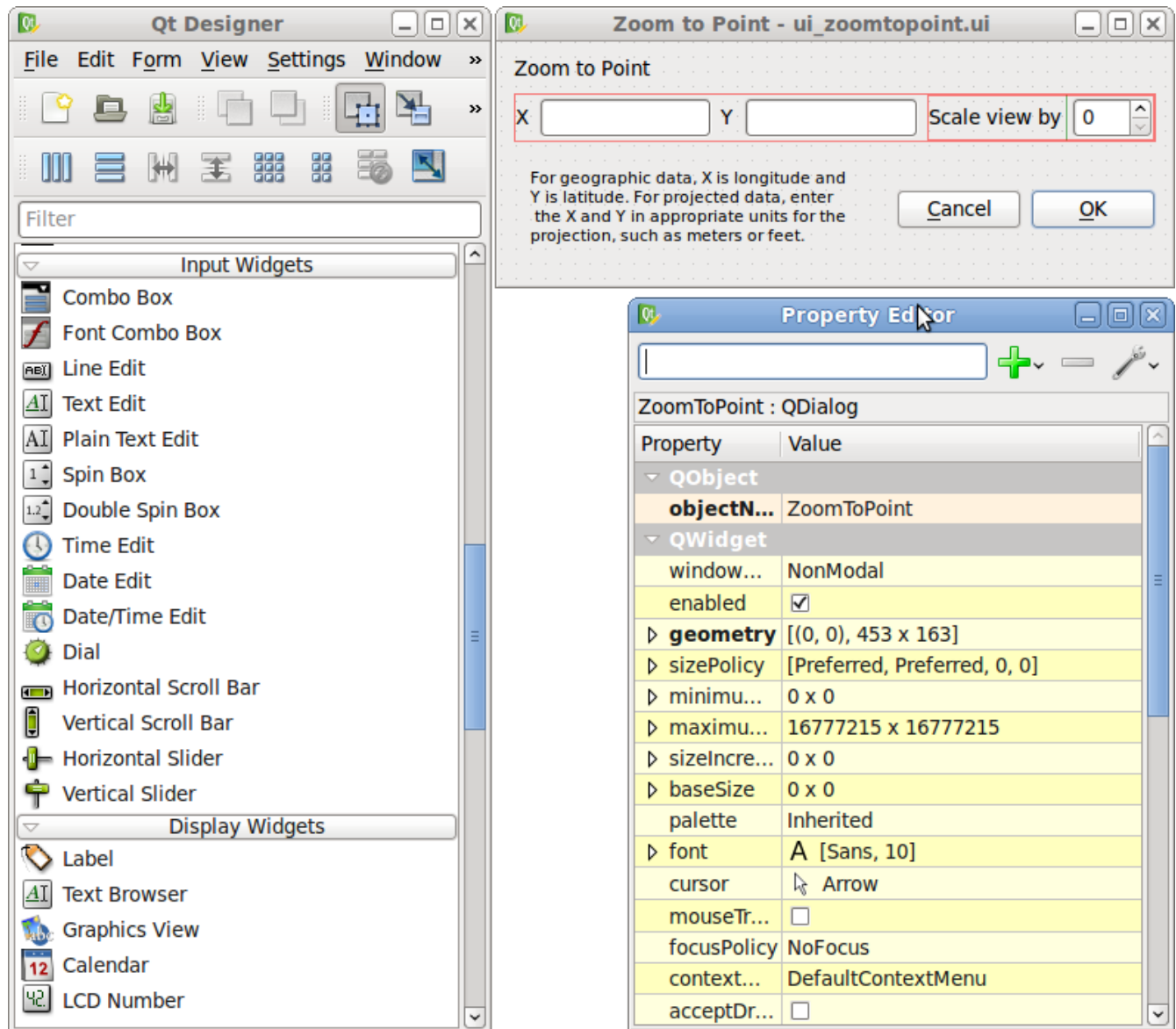


Figure 15.5: Plugin dialog box in Qt Designer

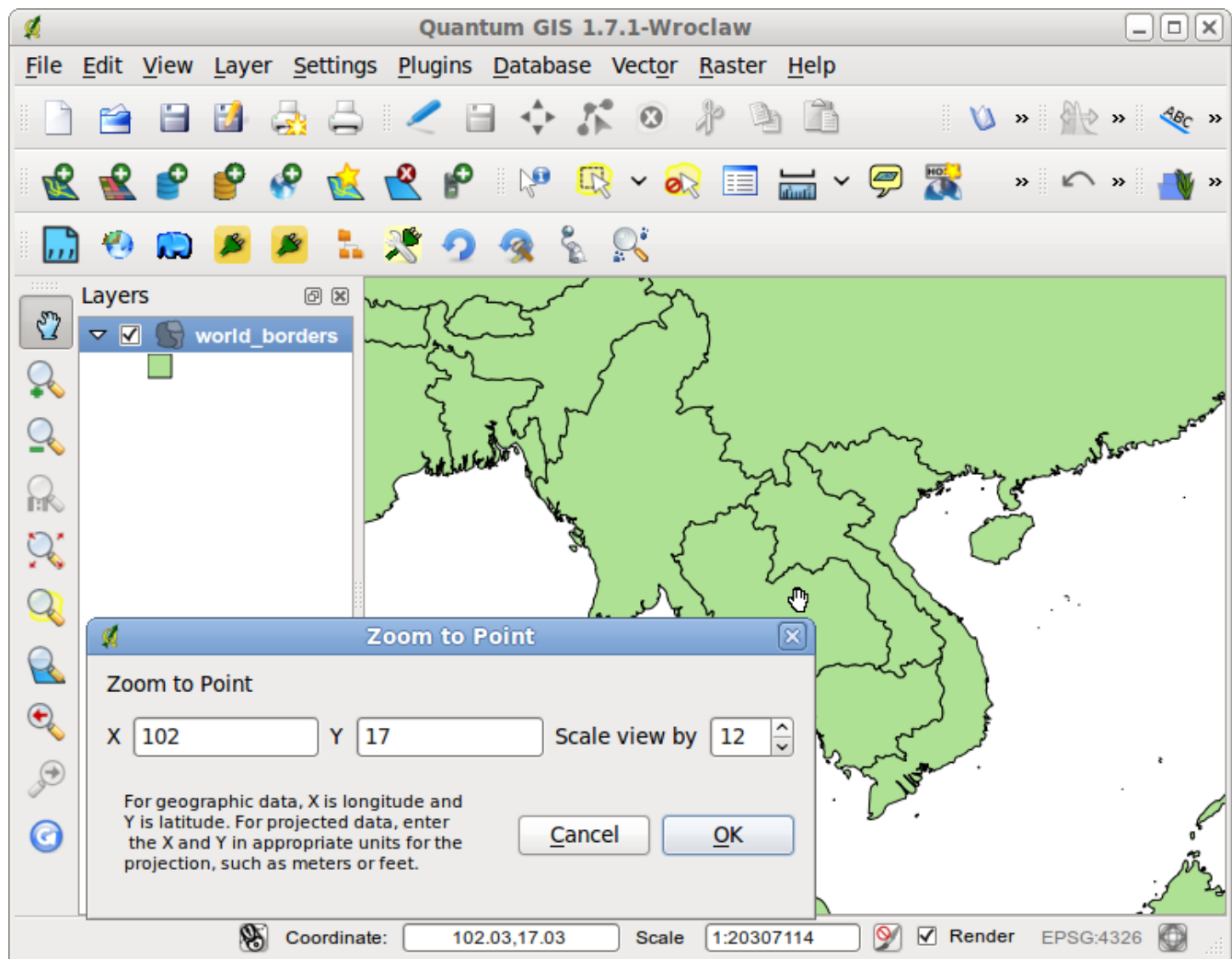


Figure 15.6: ZoomToPoint plugin in use

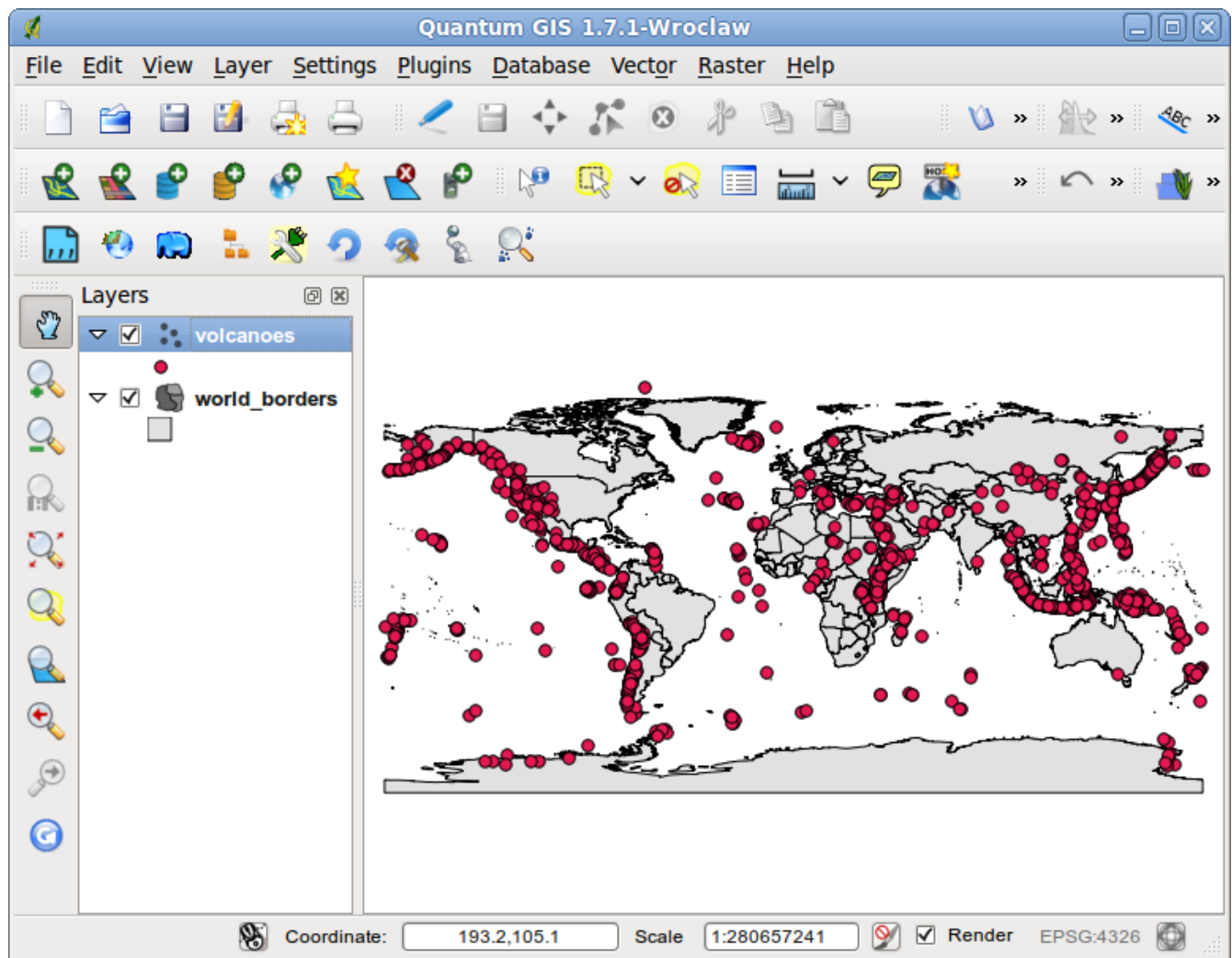


Figure 15.7: Volcanoes shapefile created with Python script

16 Appendix A: Survey of Desktop GIS Software

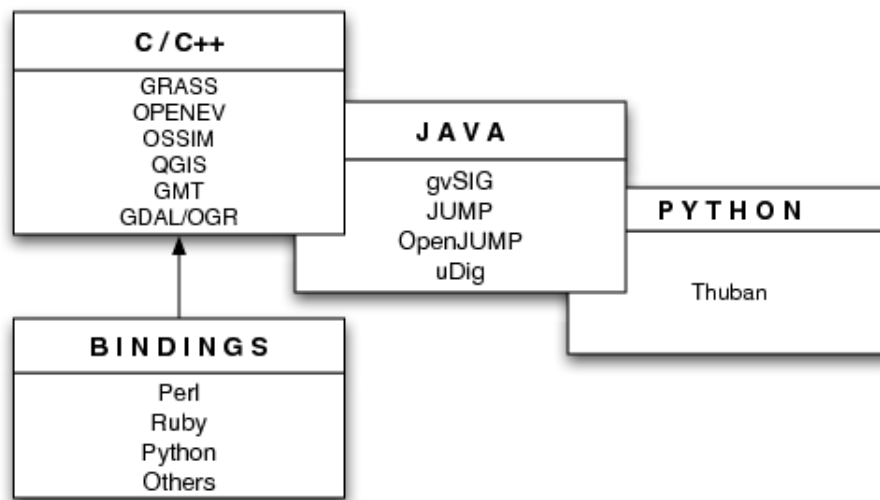


Figure 16.1: Applications grouped by underlying programming language

18 GRASS Basics

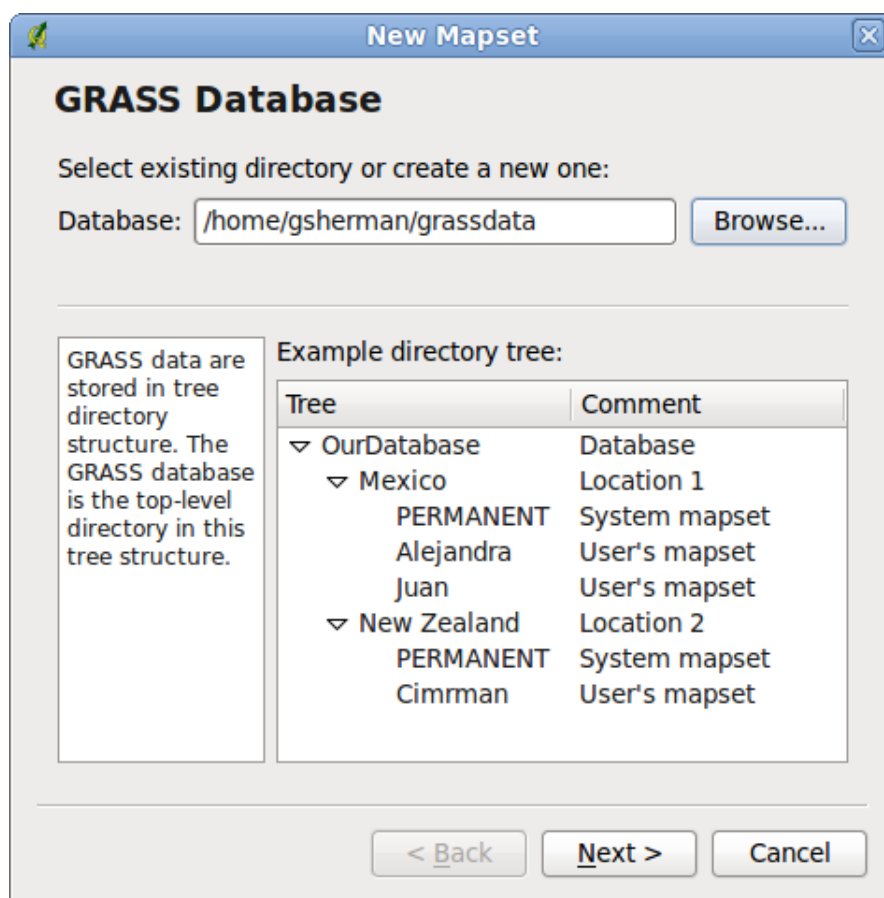


Figure 18.1: GRASS database selection/creation dialog box

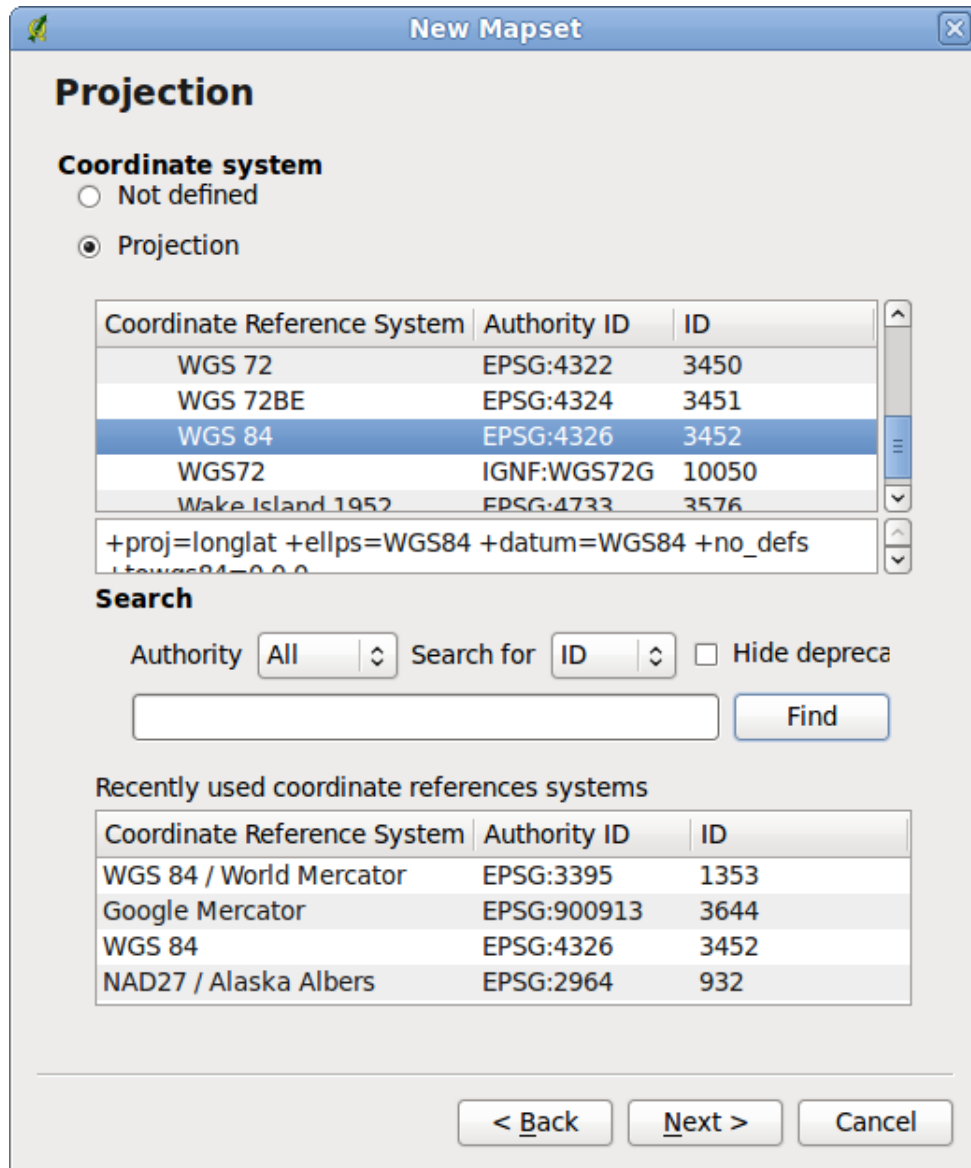


Figure 18.2: Choosing the WGS 84 projection for the GRASS location

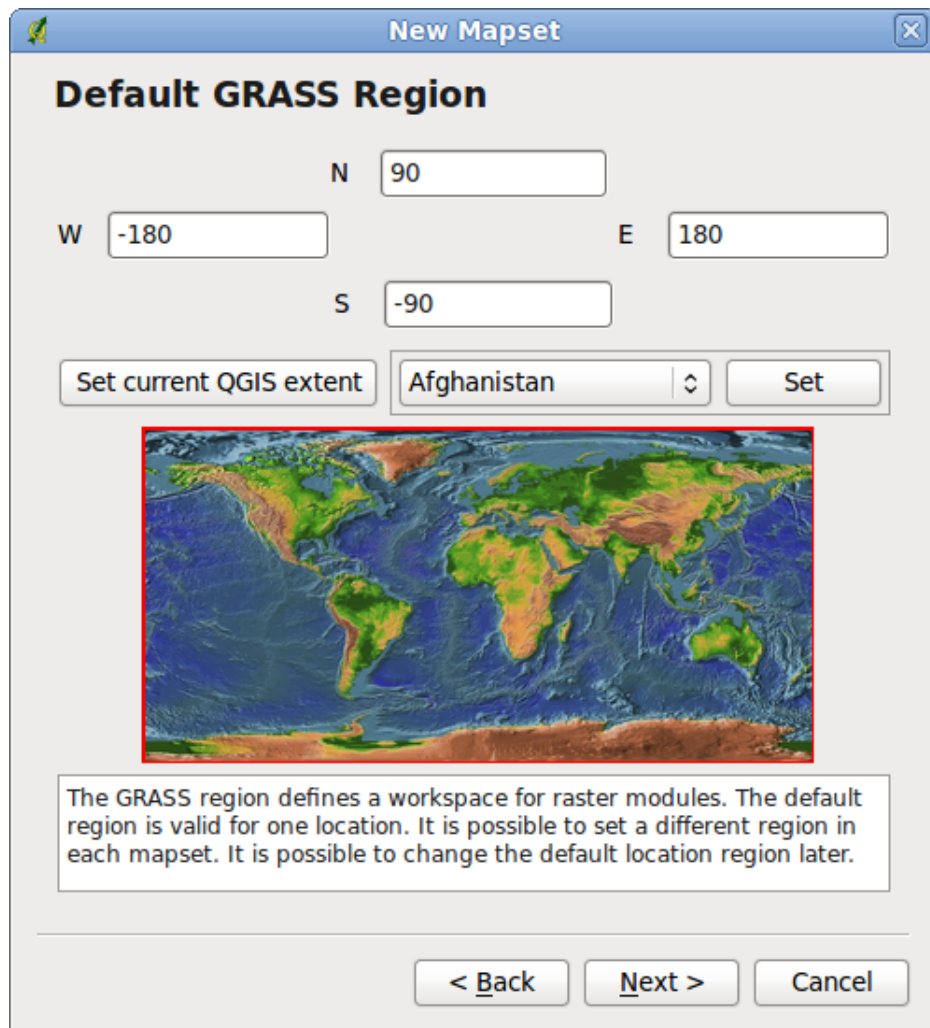


Figure 18.3: Default region settings for a WGS 84 world location

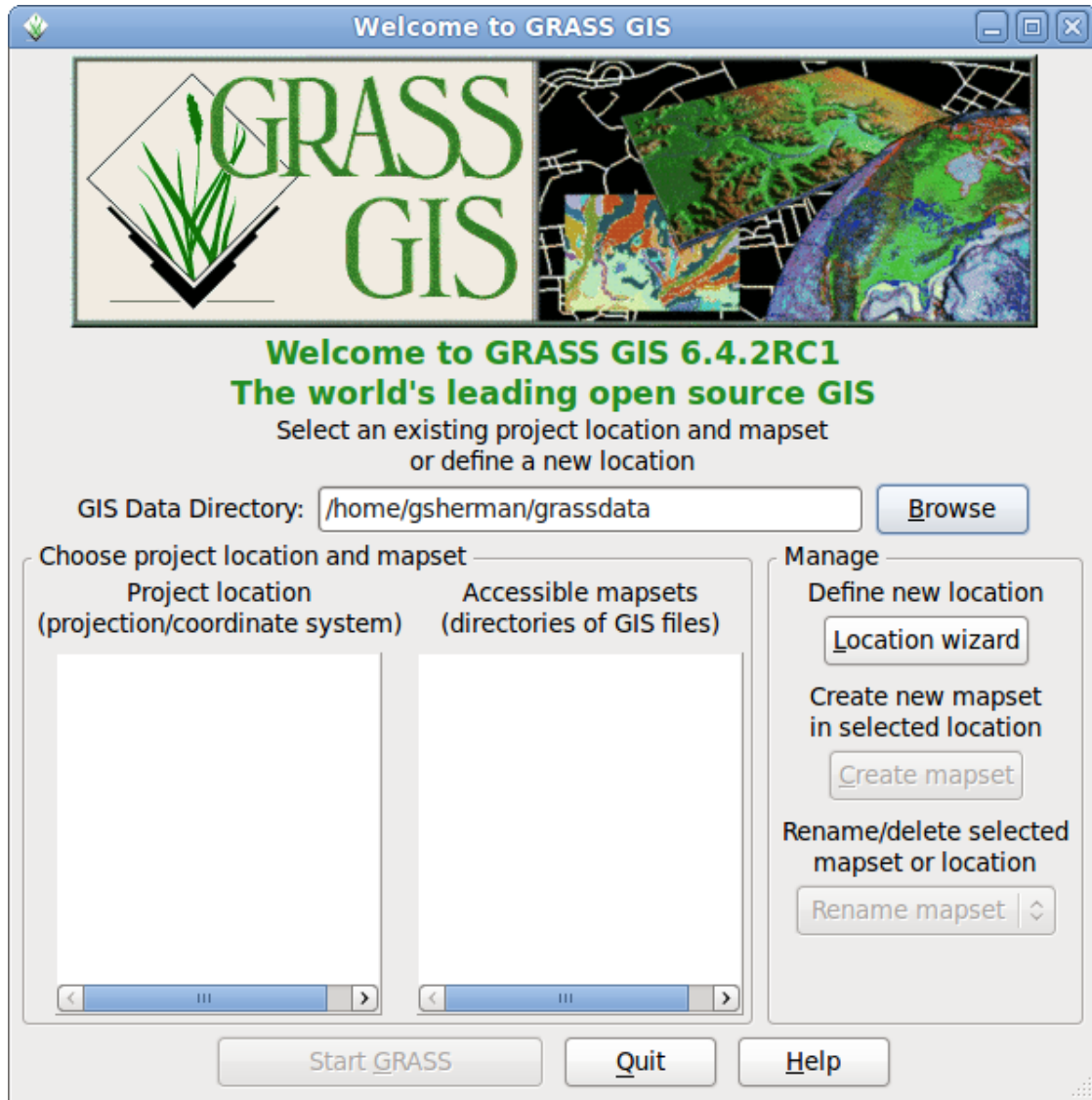


Figure 18.4: GRASS start-up form

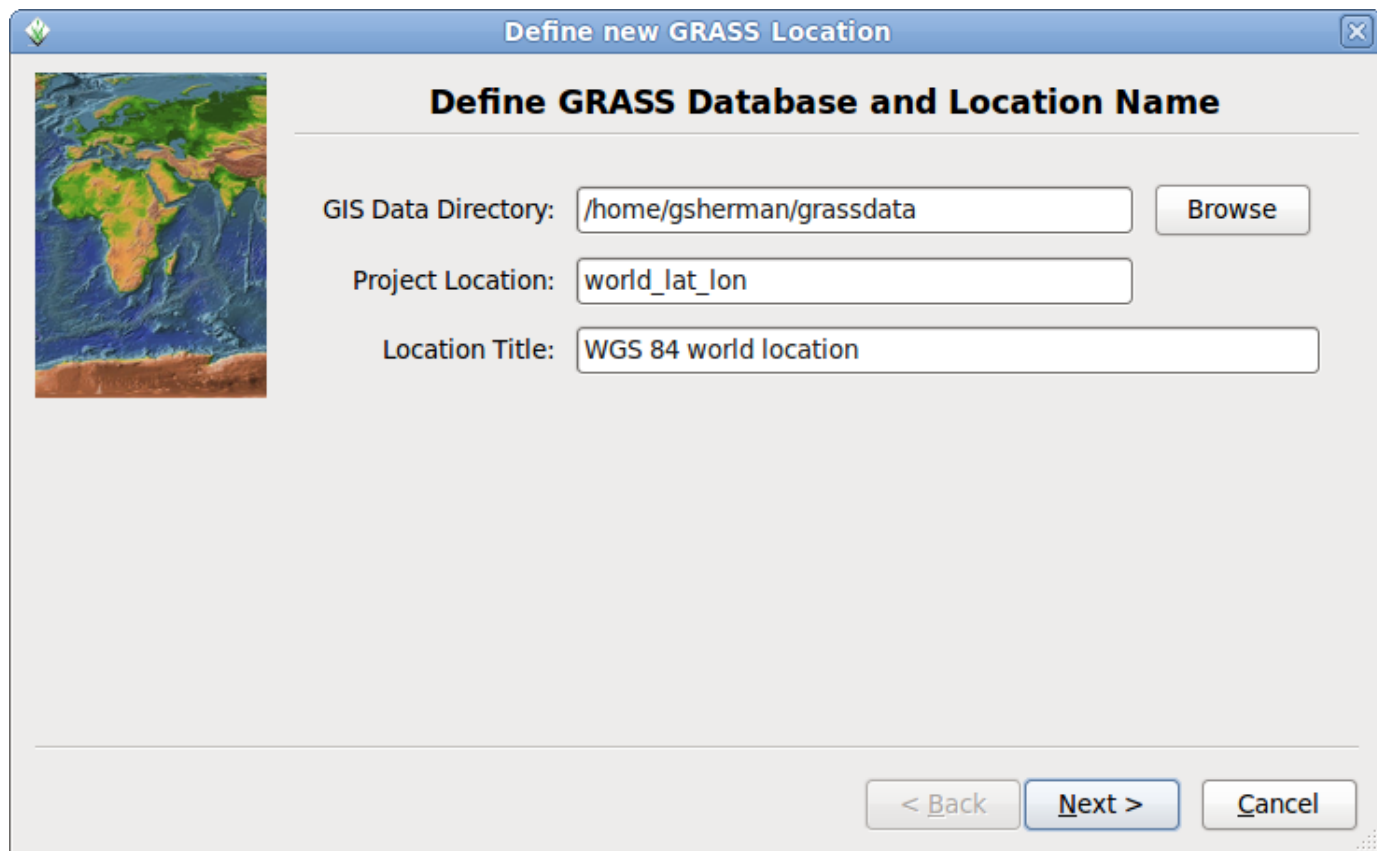


Figure 18.5: GRASS location parameters

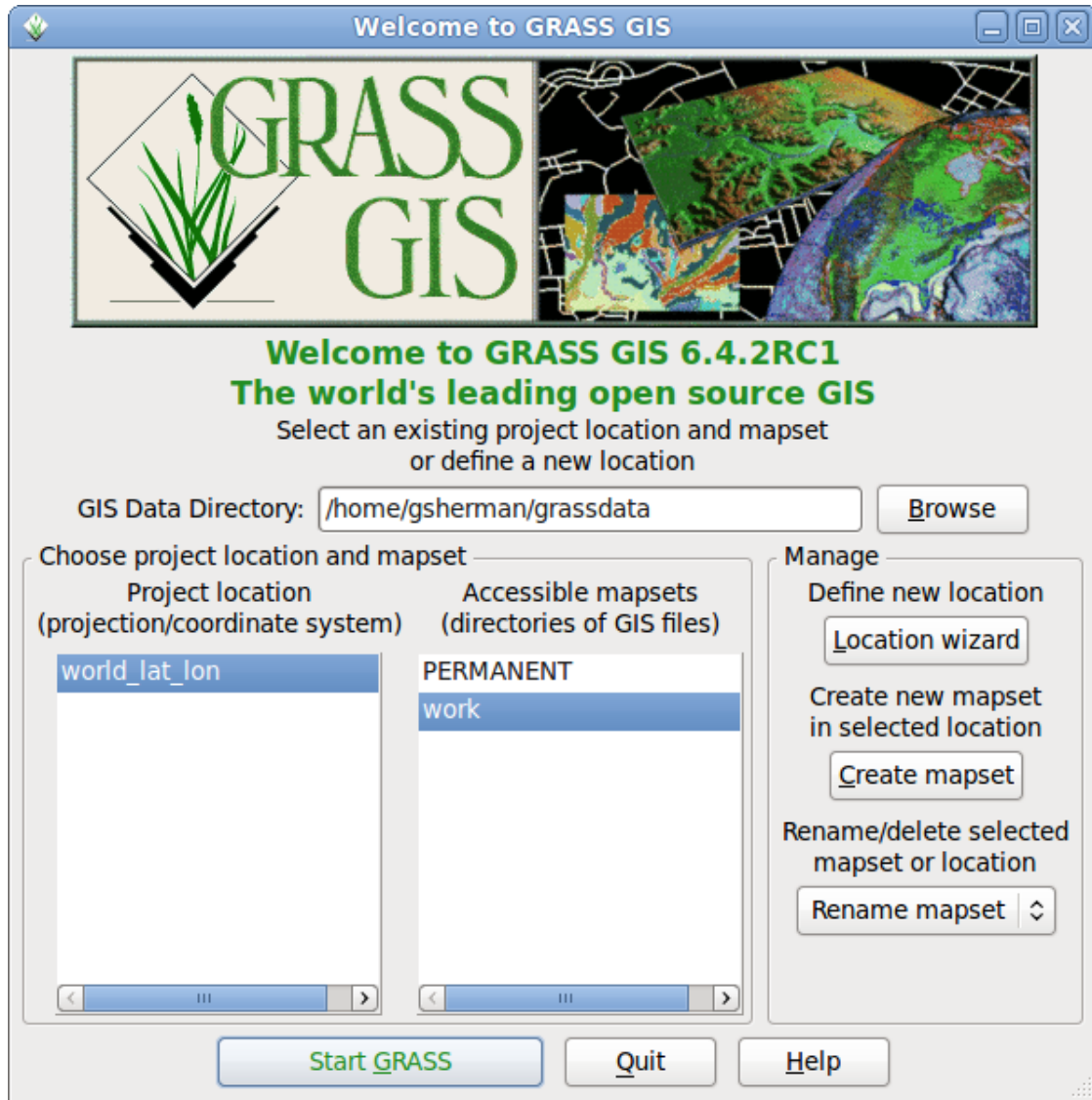


Figure 18.6: GRASS location and mapset created and ready to use

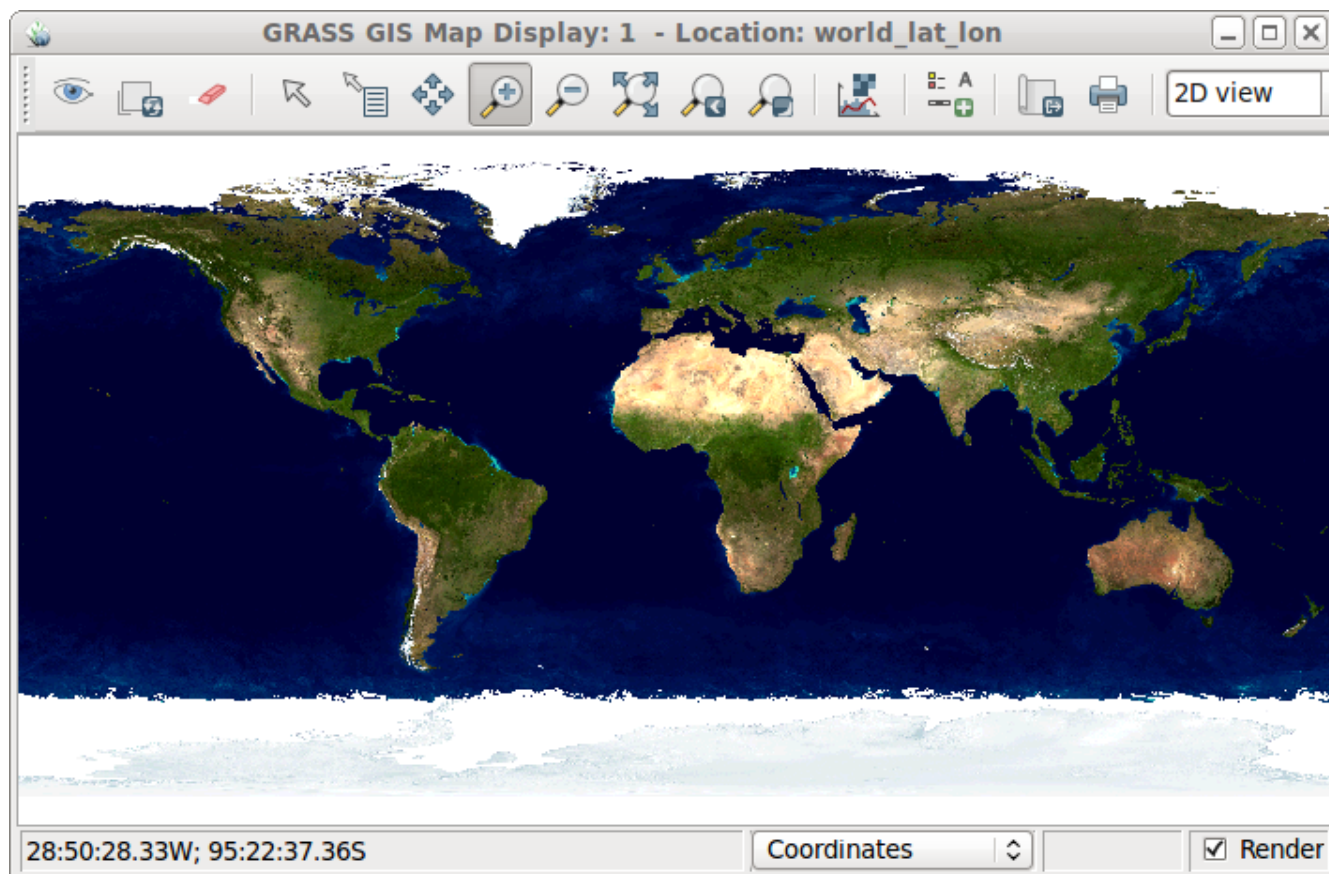


Figure 18.7: World mosaic in GRASS

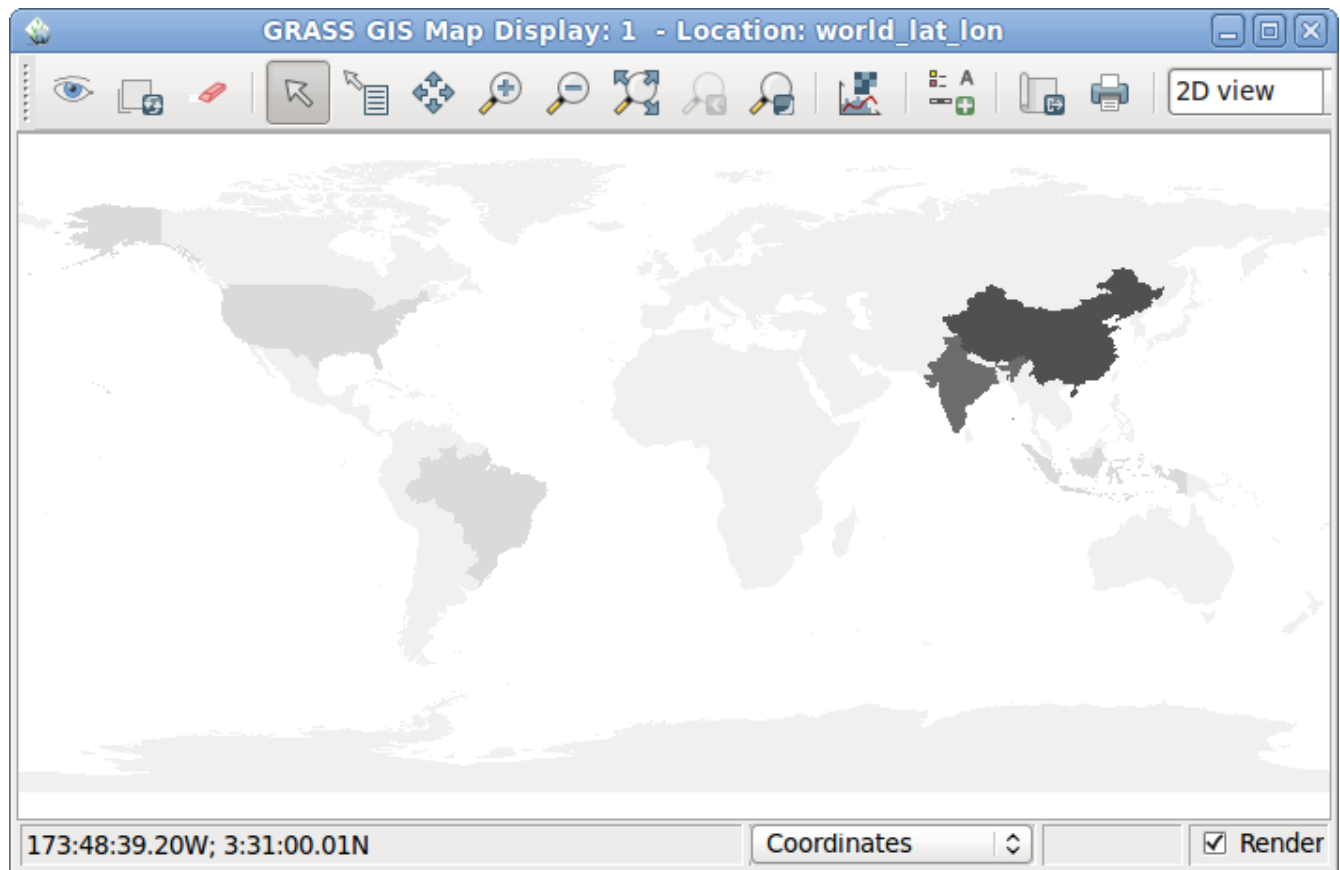


Figure 18.8: GRASS thematic map showing world population

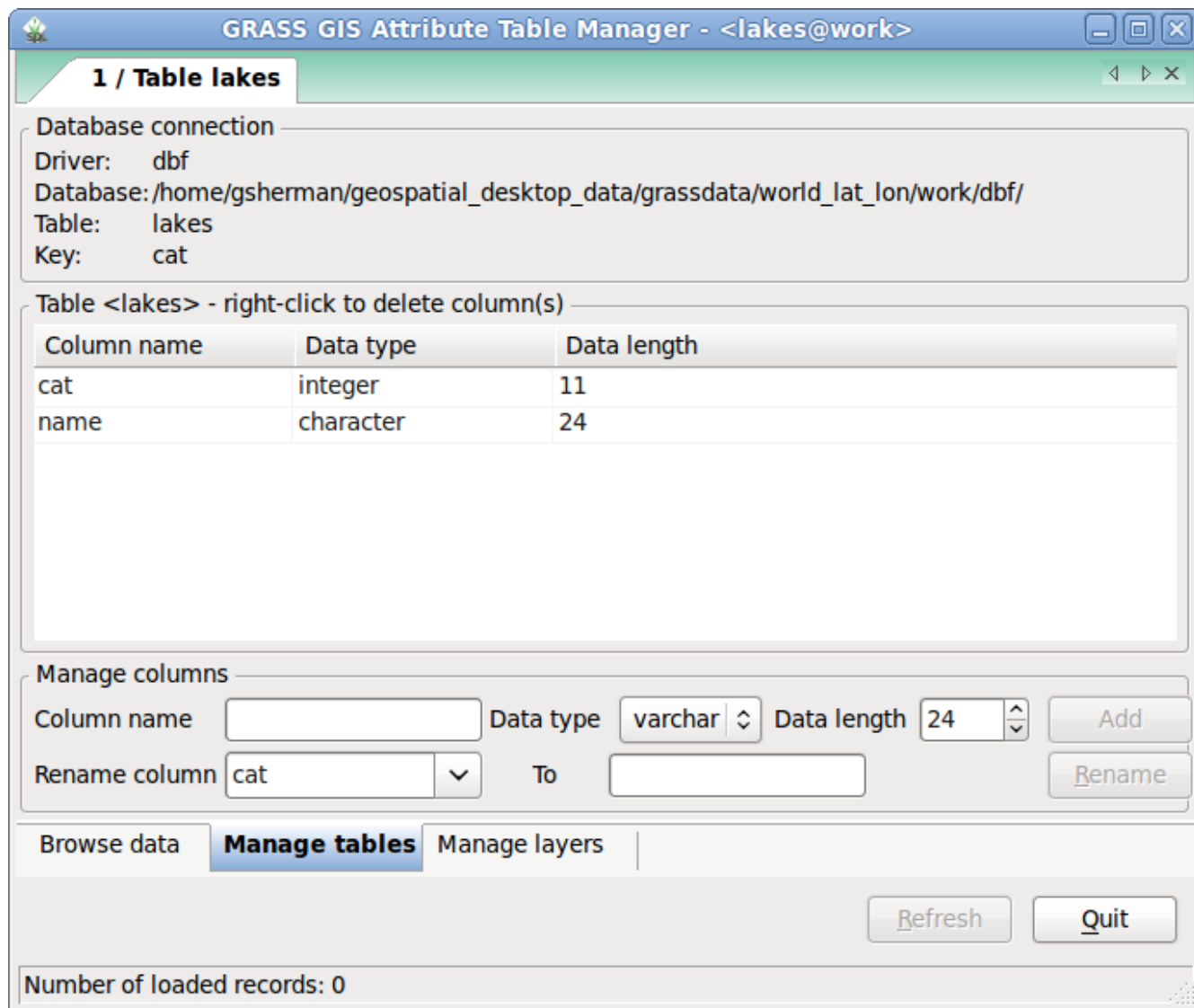


Figure 18.9: Adding a Column to a GRASS Vector Map

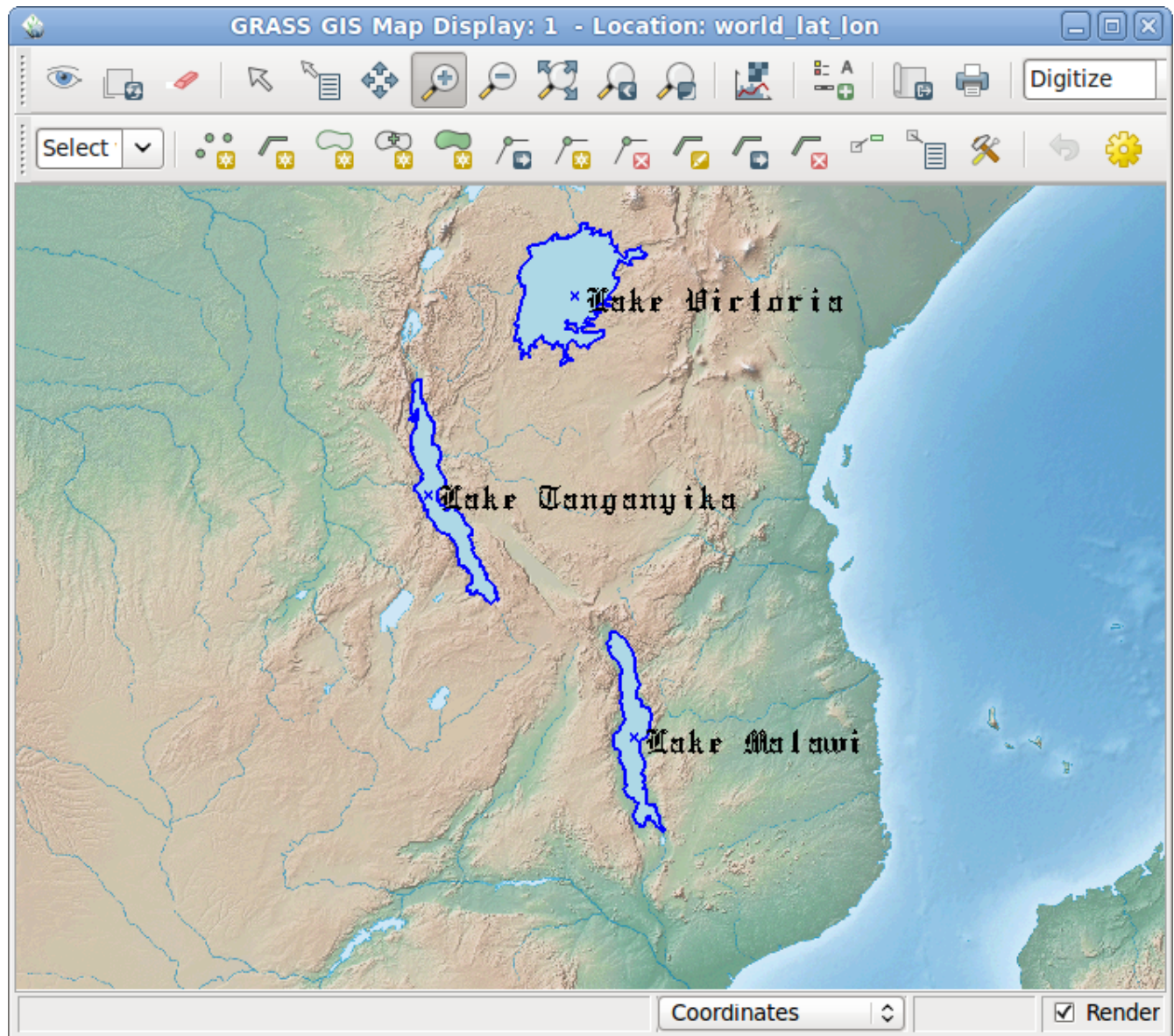


Figure 18.10: Results of digitizing lakes in GRASS

19 Quantum GIS Basics

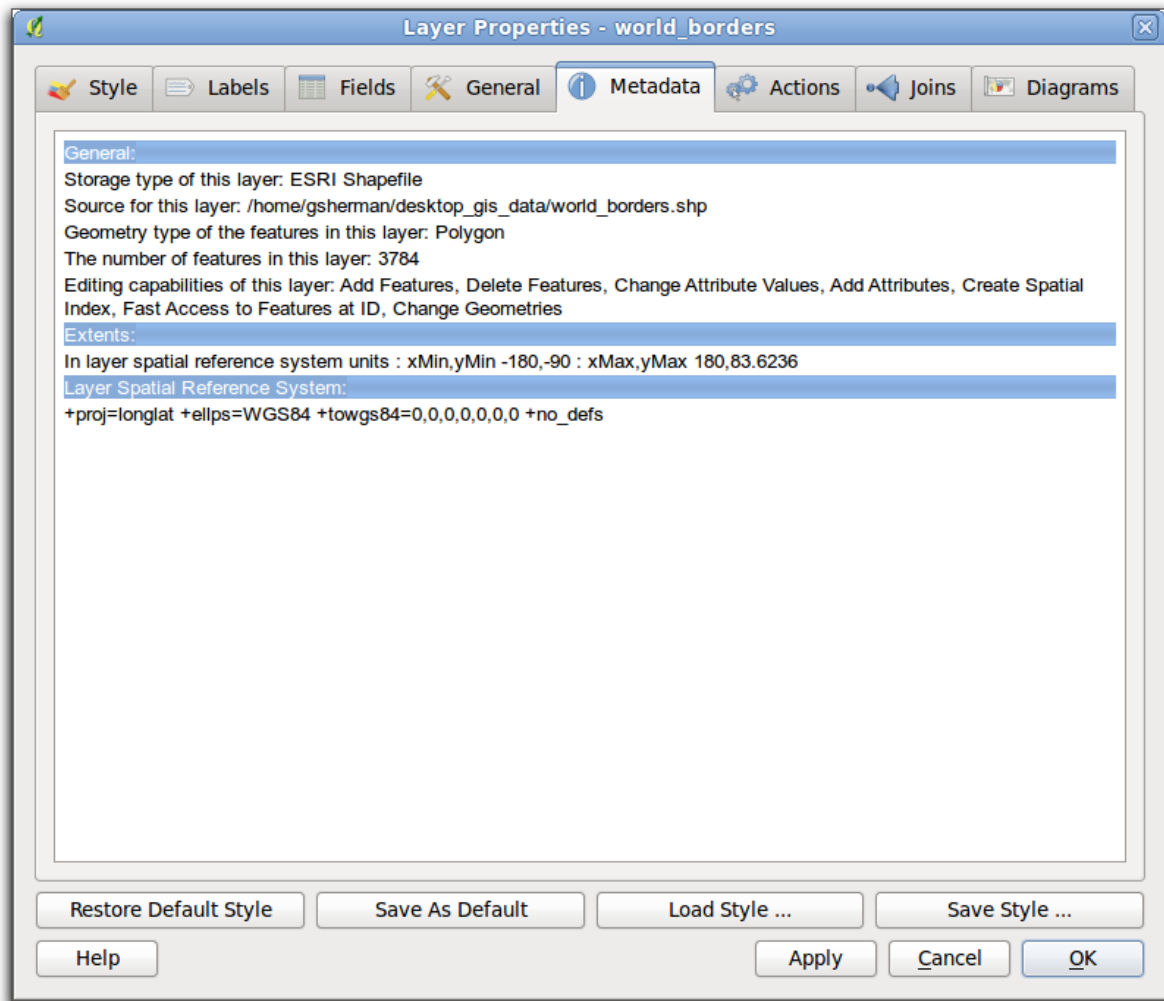


Figure 19.1: Metadata for the world borders layer

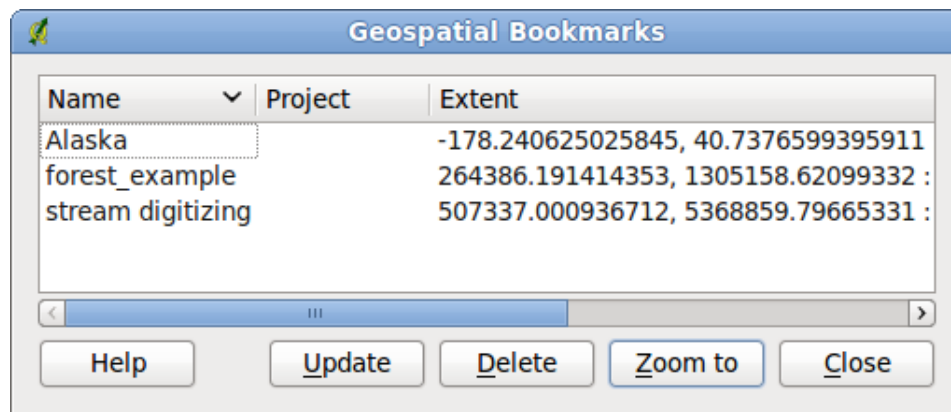


Figure 19.2: QGIS Geospatial Bookmarks dialog box

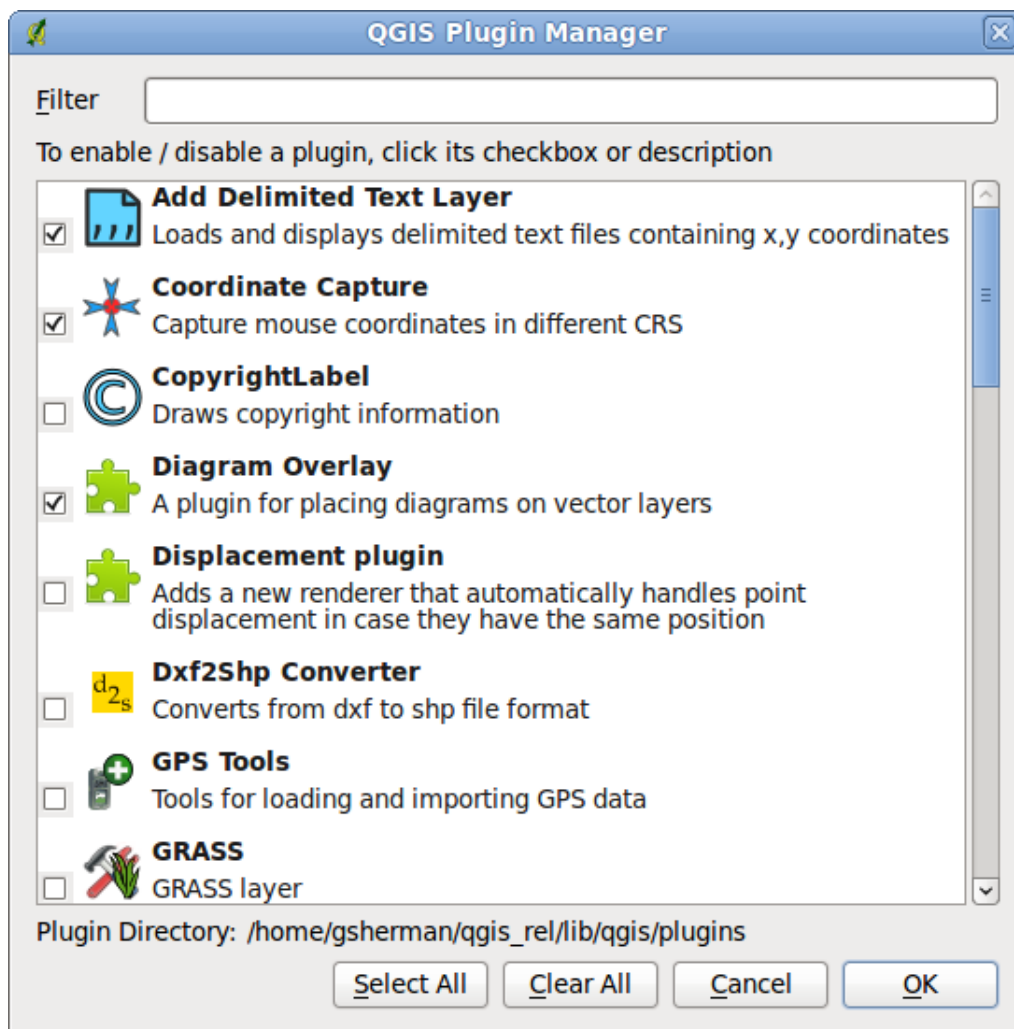


Figure 19.3: QGIS Plugin Manager