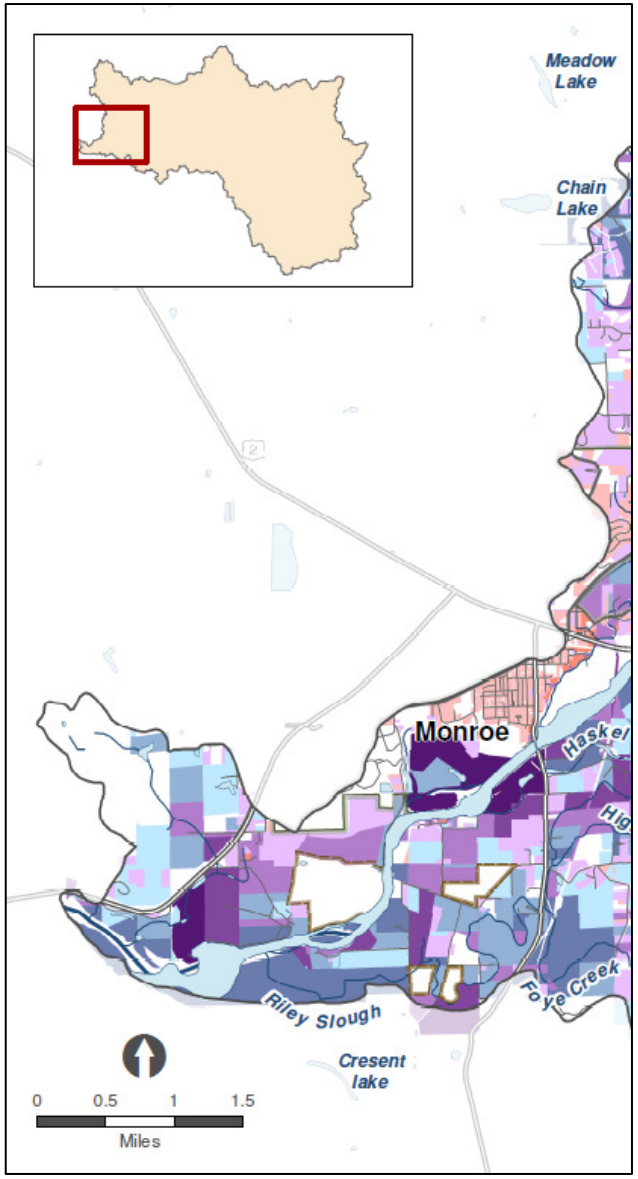


GIS in Land Protection Assessment and Mapping

A comparison of tools and spatial analysis in ArcGIS and QGIS

Karsten Vennemann, Seattle

TERRA GIS
TERRESTRIAL ENVIRONMENT REGIONAL ANALYSIS

Background

- Real world analysis
  "Skykomish Basin Land Protection Assessment & Mapping" Project for Snohomish County under a federal grant from the EPA
- Work performed jointly by
  Forterra (formerly Cascade Land Conservancy) and
  Core GIS (a Seattle based GIS Consulting Company)
- Goals of the project: **evaluate riparian ecological resources** based on **value and threat**
  in order to inform near- and long-term strategies to **protect wildlife habitat in support of salmon recovery**
- Compare spatial analysis for conservation planning in ArcGIS 10.2/10.4 and QGIS 2.14

Approach - Presentation Topic

- Use Skykomish project as a real world example
  Original work done in ArcGIS 10.4
- Re-create key parts of the analysis in QGIS 2.14
  - proof of concept **NOT** exactly replicate entire analysis
  - goal to compare work flows and tools
  - highlight similarities and differences
- Determine key analytic tools & compare workflow
  - Overview of important tools used in the analysis
  - Compare availability, name and use

Assumptions and Goals

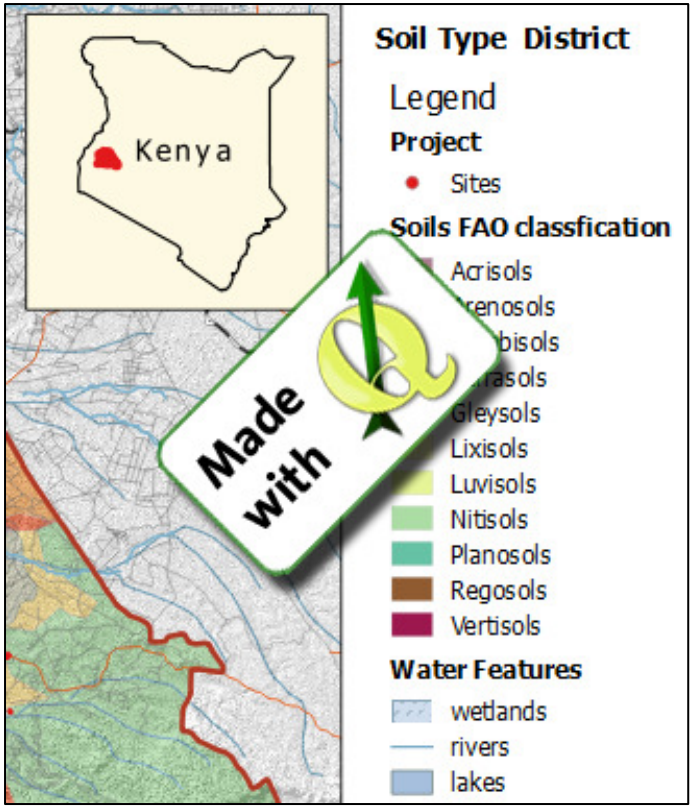
- Presentation audience mostly familiar with ArcGIS
- A comparison of tools in ArcGIS and QGIS is valuable for new users of QGIS
- Proof of concept
  Real world example will showcase the analytic power of QGIS & associated toolset
- To help new QGIS users to jumpstart spatial analysis in conservation planning and beyond

Next in the presentation

- Overview of QGIS
- Review of Skykomish Project work
- ArcGIS – QGIS Comparison of Key analysis tools used in the Skykomish Project
  - Overview slides
  - More detailed look at three tasks /analysis
- Conclusions

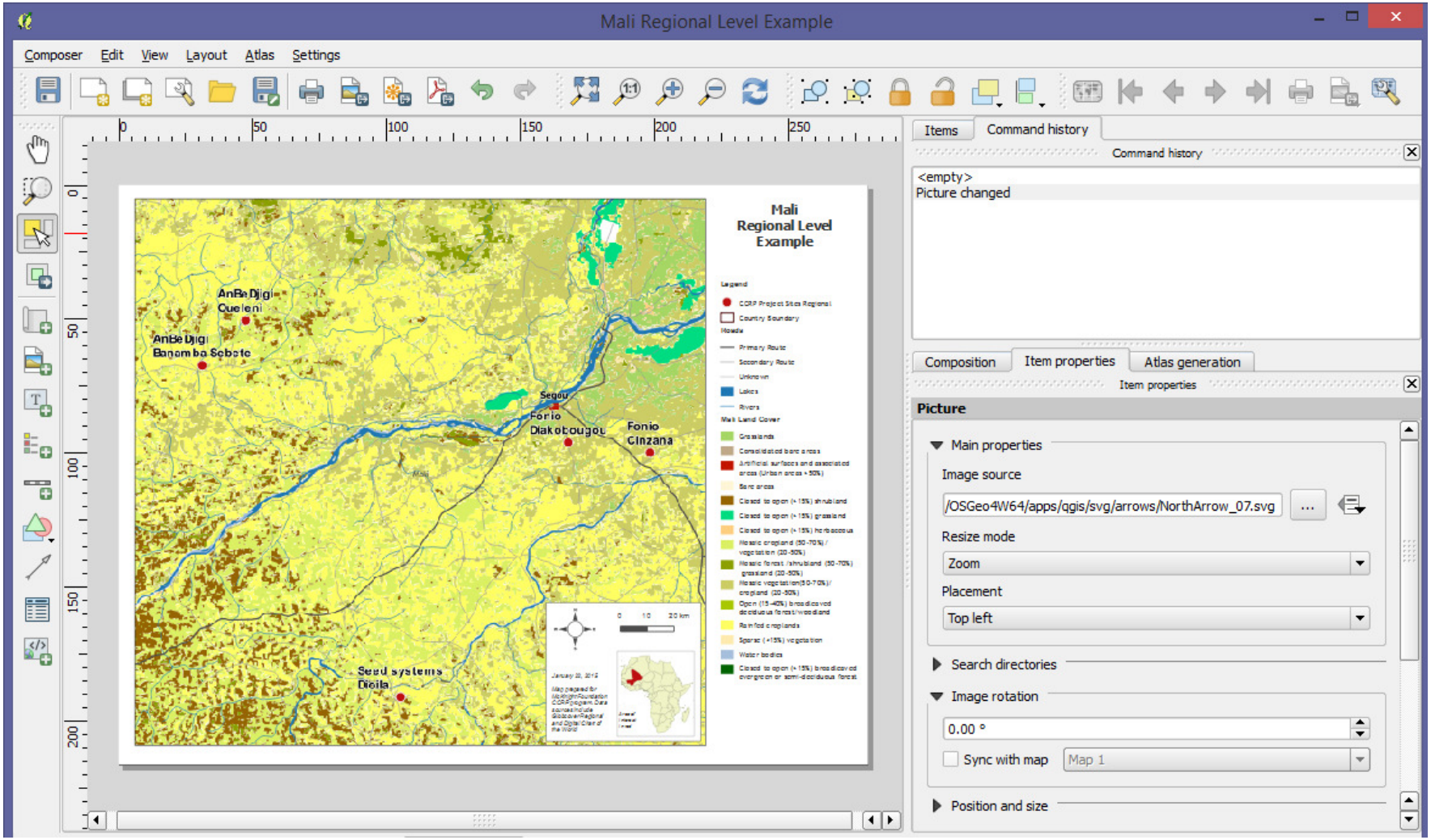
Overview - QGIS

a very capable and flexible Desktop GIS



QGIS - Desktop GIS

originally a GIS viewing environment QGIS for the Linux desktop but is available for Solaris, Windows and Mac. Support for many data formats



QGIS Facts

Main supporter of **Quantum GIS**	Gary Sherman and others
Type	Desktop GIS Viewer
Functionality	Can be used as a UI to GRASS GIS with GRASS Plug-in, Python bindings allow for programmatic interaction
Operating systems	Multi platform
Project started	2002
Implementation	C++, Depends on QT widget
OS libraries	OGR/GDAL
PostGIS support	Yes
License	GPL

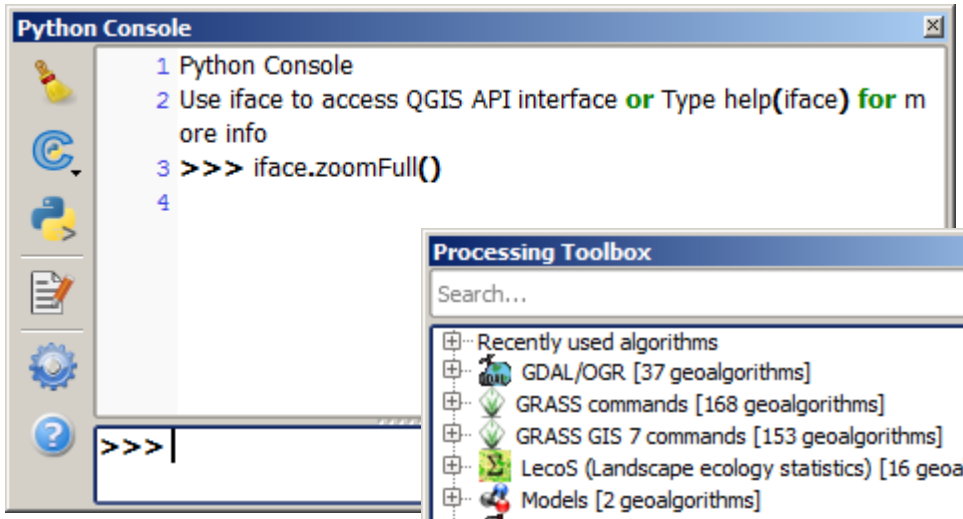
QGIS Highlights

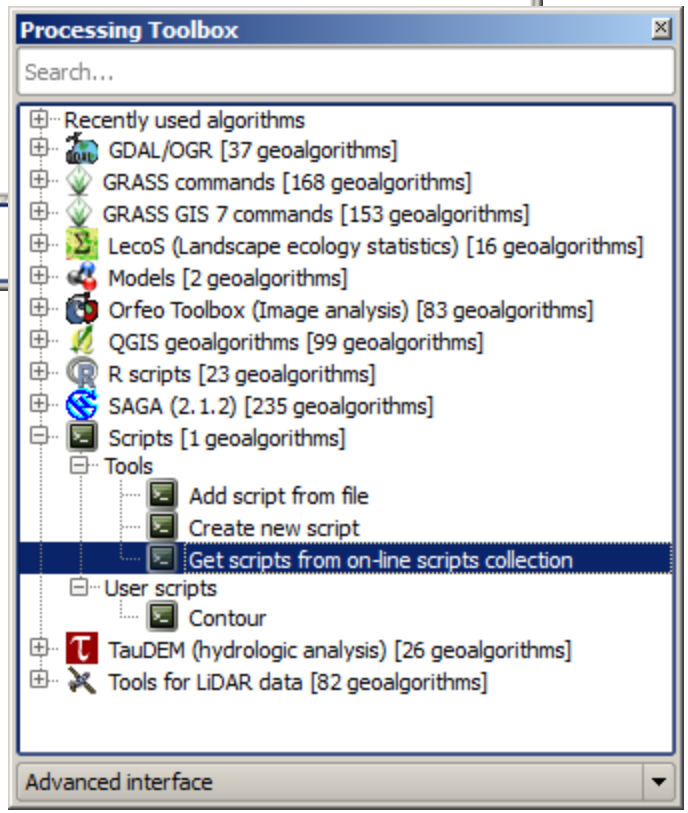
- „Intermediate“ Desktop GIS
- all basic and intermediate GIS Functionality
- support for many input formats
- easily extensible and highly customizable
- extended comprehensive Analytic capabilities
  -> Processing Tools and modeler
- automation and custom tool development via
  - Python scripting (Python bindings and pyQT integration)
  - Enables plug-in and user interface development
- Very active User and Developer Community
  - rapid development, good community support

QGIS - Python Interface

Three Options

- Python console
- Processing tools
- Plugins





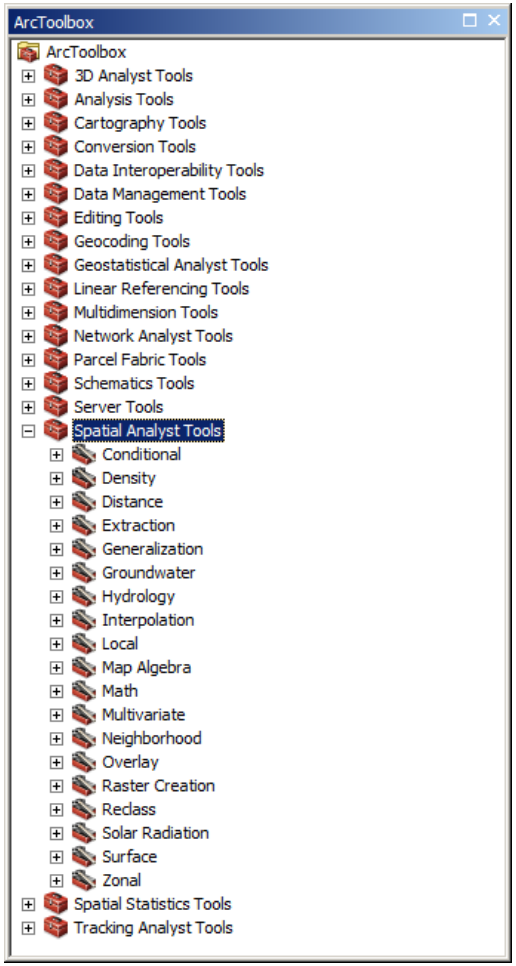
Tools such as

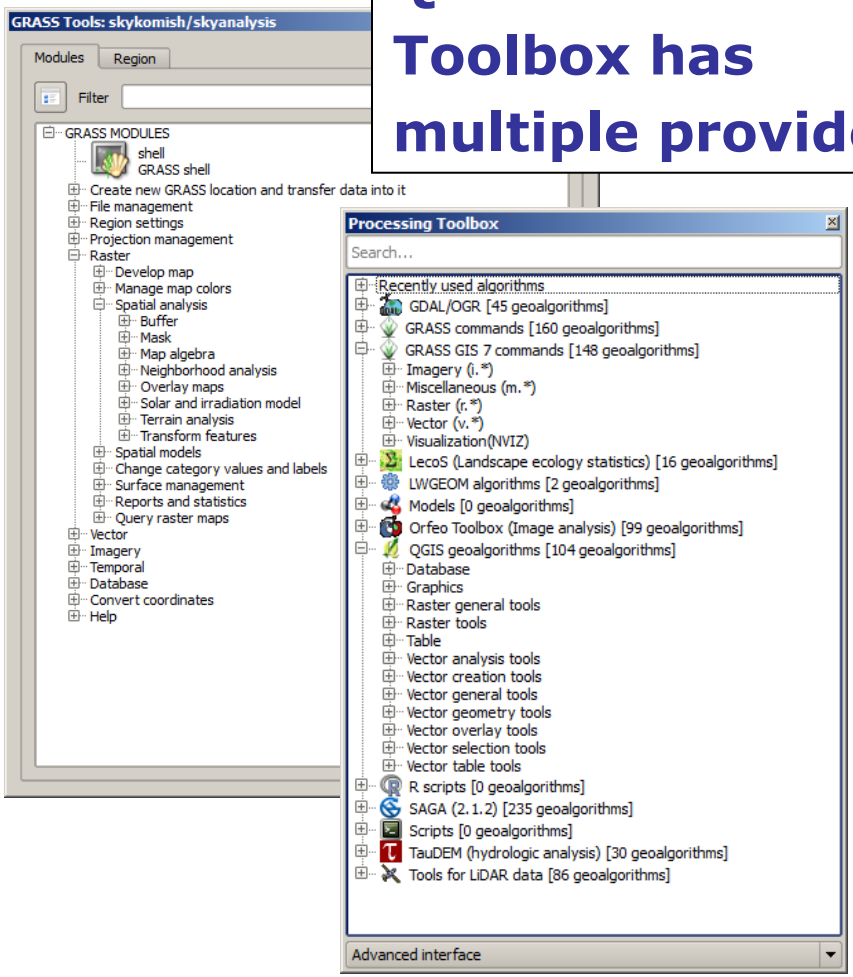
- WinPython (IDE + QT Designer)
- QT Designer
- *Plugin-Builder* **Plugin** ☺

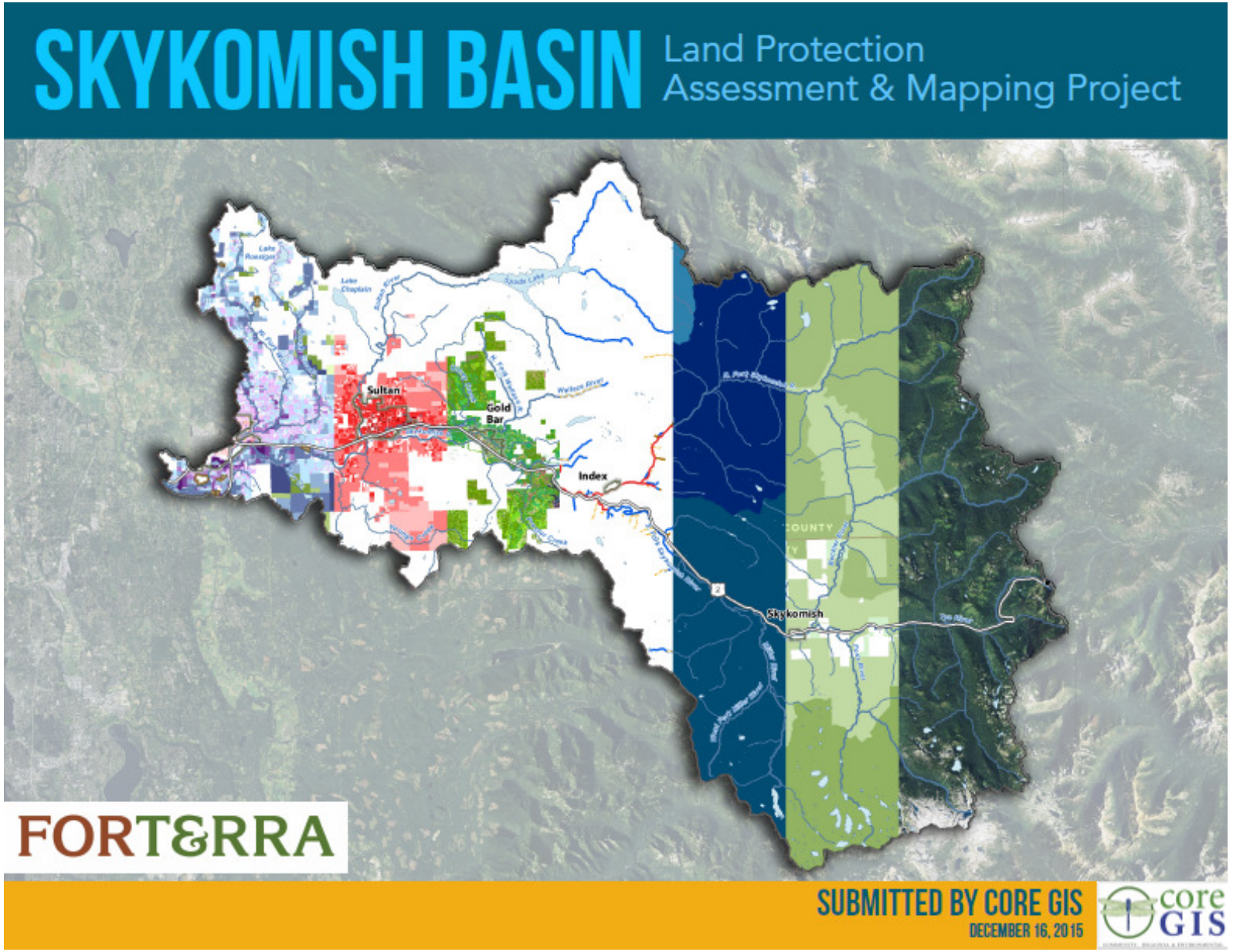
Tool comparison ArcGIS - QGIS

Both have a rich set of tools

QGIS Processing Toolbox has multiple providers







by Matt Stevenson, Core GIS, Seattle

Variables Identified for the Analysis

Score Variables

Conservation

- Salmon Population
- Salmon Stream Length
- Floodplain
- Low Lying Acres
- Upland Wetlands
- Forested Acres
- Acres Of Forested Buffer
- Acres Of Trees 90'+ Within Buffer
- Pervious Surface
- Unweighted Conservation
- Weighted Conservation

Development

- Land Value
- Urban Growth Area
- Surrounding Development
- Percent Slope
- Potential Development
- Unweighted Development
- Weighted Development

Assessment Maps

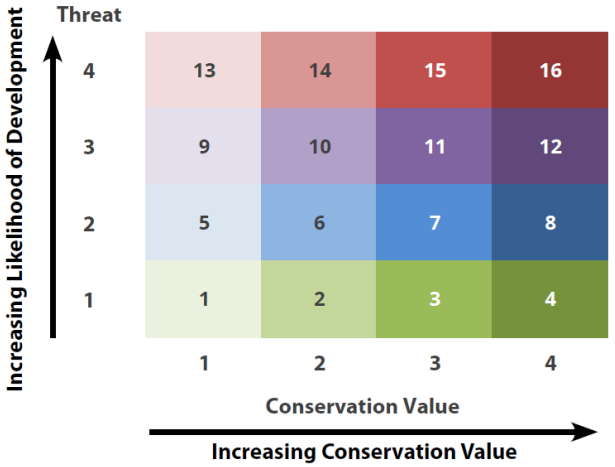
- Unweighted Assessment
- Weighted Assessment

Overview of the Skykomish Basin Project

- Score calculation for each of the variables in the development and conservation categories
- Each calculated score for the variables was standardized to a 0-4 rating scale
- Result maps created using a 4*4 matrix of Conservation Value & Development Threat that was developed for the project
- A weighted result of the initial matrix based map was created as the final result / synthetic map

Synthetic map - Skykomish Basin Project based on 4*4 matrix

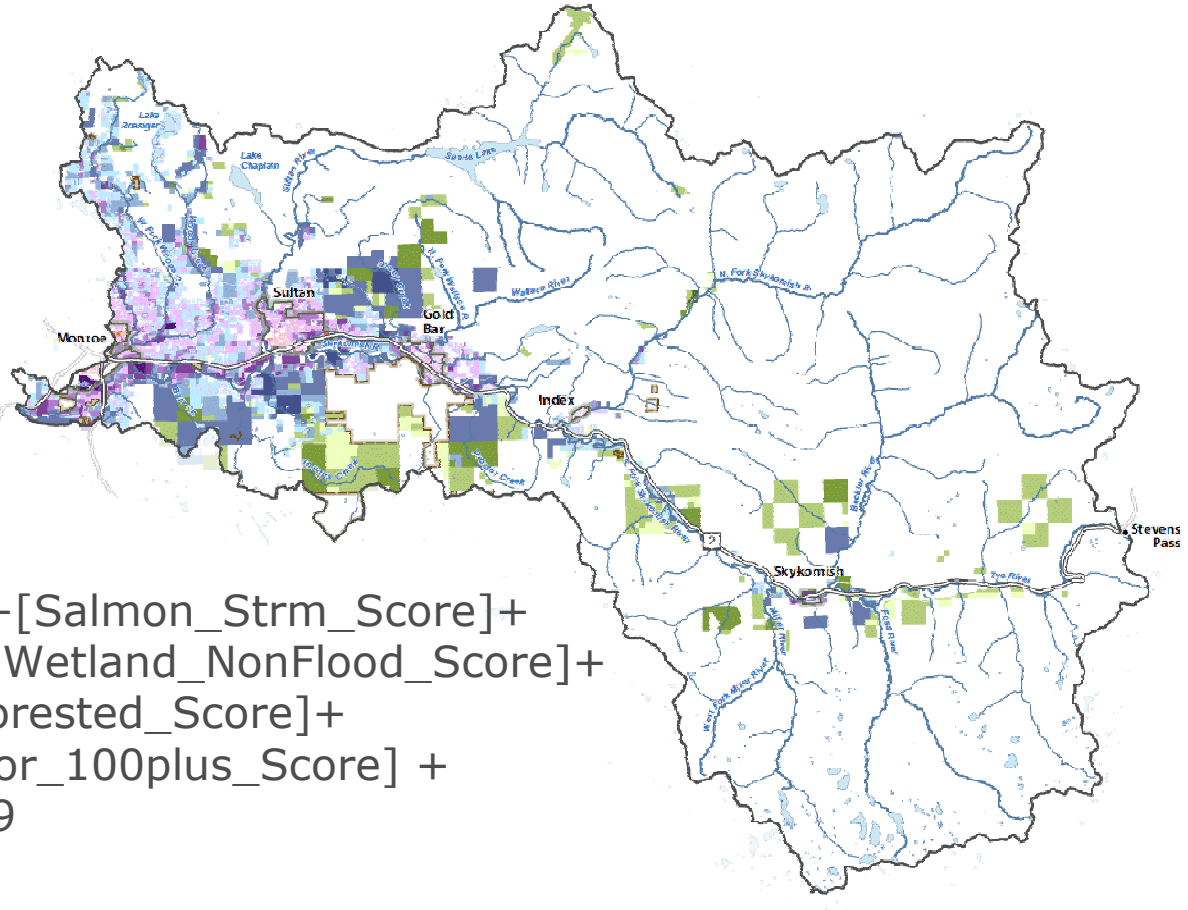
- convey the relative conservation value and likelihood of development for every parcel
- a top-level picture of conservation opportunities at the parcel level



Credit
Matt Stevenson
Core GIS, Seattle

Example- Unweighted Conservation Score

- added the scores for all nine variables together and divided by nine



([Salmon_Spp_Score]+[Salmon_Strm_Score]+
[Floodplain_Score]+ [Wetland_NonFlood_Score]+
[Low_elv_Score]+ [Forested_Score]+
[For_Buff_Score]+ [For_100plus_Score] +
[Pervious_score]) / 9

Key analysis and tools used - Skykomish Basin Project

Analysis	description	ArcGIS Tool used	QGIS tool
Surrounding development evaluation	summarize attributes of polygon neighbors	Polygon Neighbors tool	python script OR using SQL query in PostGIS or via DB
Urban Growth Area Score	calculate distance between each parcel and the nearest UGA	near tool	
Salmon Population Score	counted the number of salmon populations present within or adjacent to each parcel.	euclidean allocation	proximity
Salmon Stream Length Score	extended parcel boundaries until they met	euclidean allocation	region growing algorythm
Slope Score	Slope tool with the percent option	slope	slope
		zonal statistics	zonal statistics tabulate area
General / multi purpose	surface tools	aspect contour hillshade dissolve clip union vector - raster conversion	aspect contour hillshade dissolve clip union vector - raster conversion

Spatial Analyst
ArcInfo
Grass Plug-In
SCP Plug-In
PostGIS based

Analysis using simple attribute column calculations are not listed

Key analysis and tools used - Skykomish Basin Project

Analysis	description	ArcGIS Tool used	QGIS tool
Floodplain Score	intersected floodplain + parcels calculated acreage of floodplain	intersect	intersect
300' Buffer on Perennial Streams		buffer, union + dissolve	buffer, union + dissolve
Upland Weltands Score	used the floodplain to erase wetlands from the NWI layer	erase	difference
Low-Lying Relative to Channel	sustract river height raster from the bare earth elevation raster	raster calculator	raster calculator
Forest Height	subtracted the bare earth raster from the first return LiDAR	raster calculator	raster calculator
Land Cover Classification			
Calculate Normalized Difference Vegetation Index (NDVI)	using 1m resolution NAIP 4 band imagery	raster calculator	raster calculator SCP Plug-In
Create two texture layers (bands)	focal mean 7*7 range	focal mean tool	r.neighbors tool (via Grass Plugin)
Maximum likelyhood analysis	using signatures of 96 training polygons	maximum likelihood tool	maximum likelyhood analysis

Spatial Analyst
ArcInfo
Grass Plug-In
SCP Plug-In
PostGIS based

Analysis using simple attribute column calculations are not listed

A more Detailed Look

Comparison of Analysis in ArcGIS 10.4 and QGIS 2.14

- Surrounding Development Score

  neighboring Polygon developed or not

- Land Cover Classification

Surrounding Development Score

Neighboring Polygon developed or NOT

The map shows a score for each parcel based on the percentage of developed parcels surrounding it.

Scores were determined as shown:

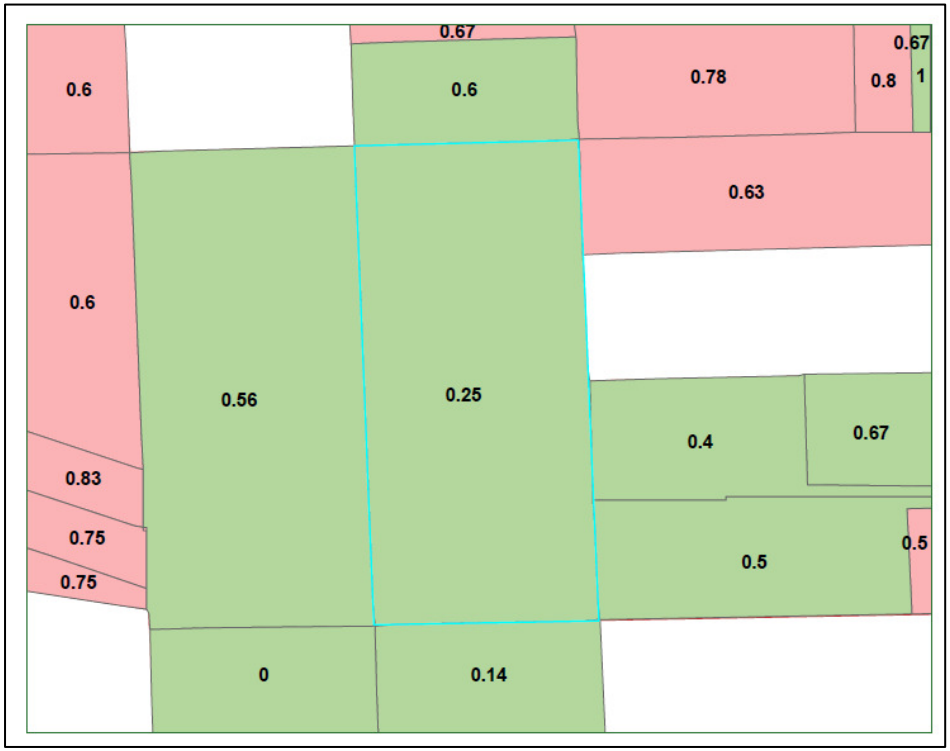
4 = 75 - 100%

3 = 50 - 74.9%

2 = 25 - 40.9%

1 = 0.1 - 24.9%

0 = 0

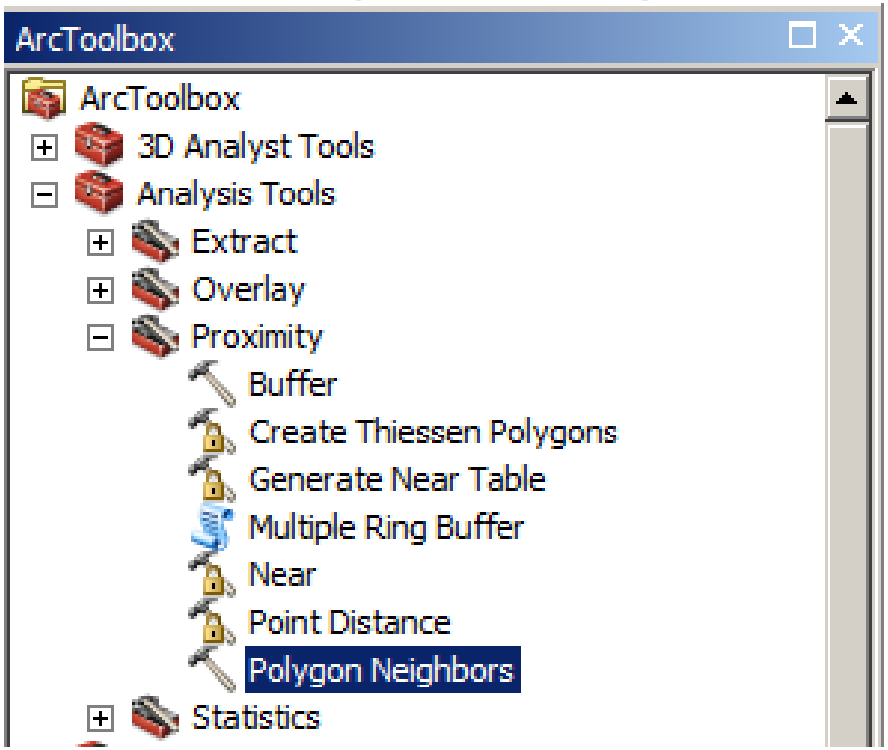


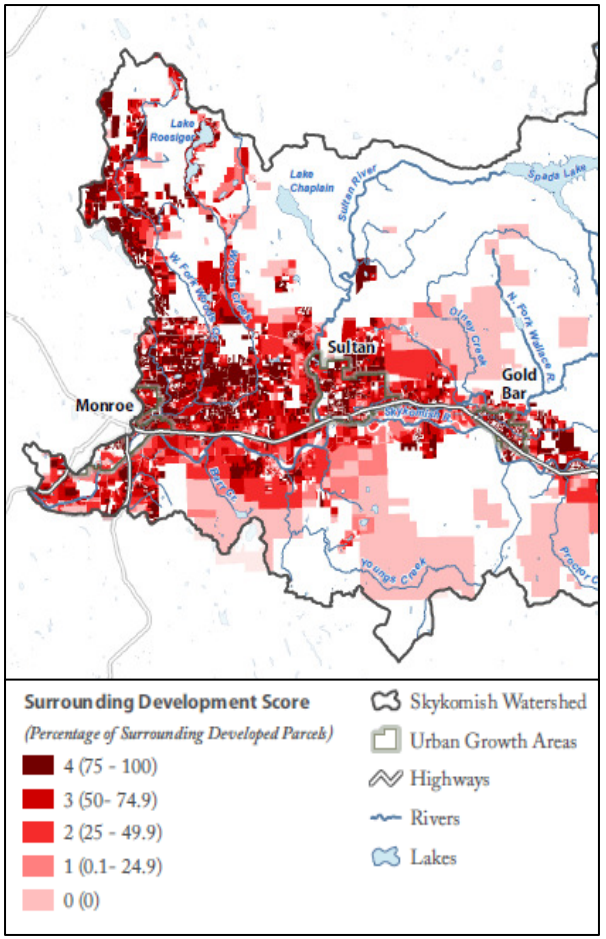
Credit: Matt Stevenson
Core GIS, Seattle

Surrounding Development Score

neighboring Polygon developed or not

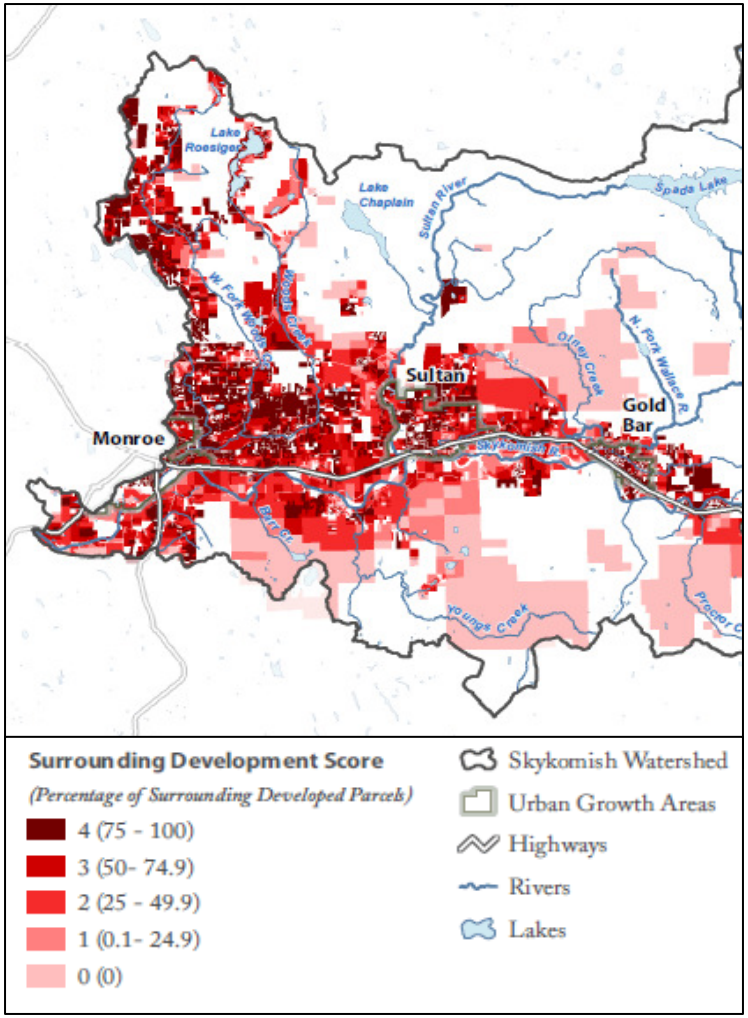
ArcGIS
Polygon Neighbors

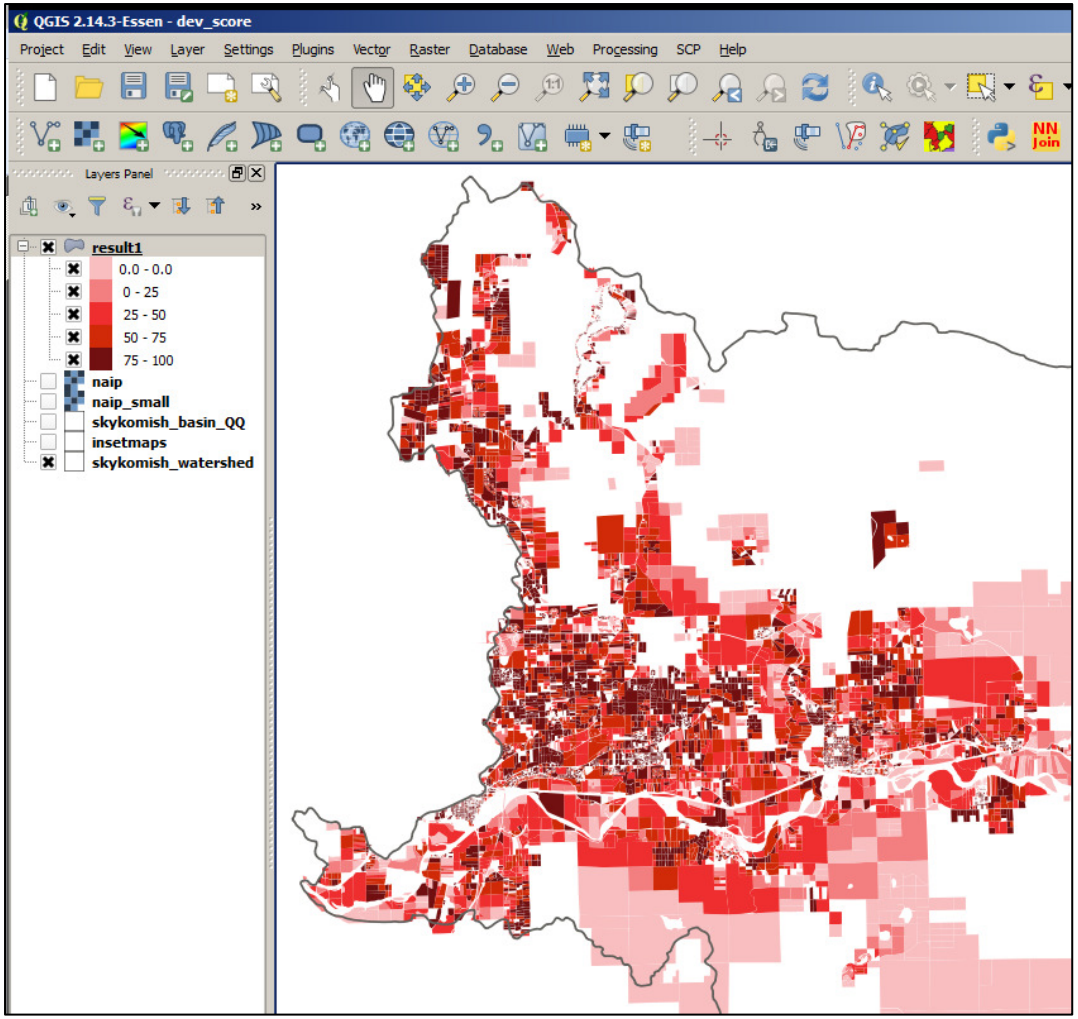




Map by M. Stevenson

QGIS - Surrounding Development Score





ArcGIS - Map by M. Stevenson

QGIS - Map by K.Vennemann

QGIS - Surrounding Development Score

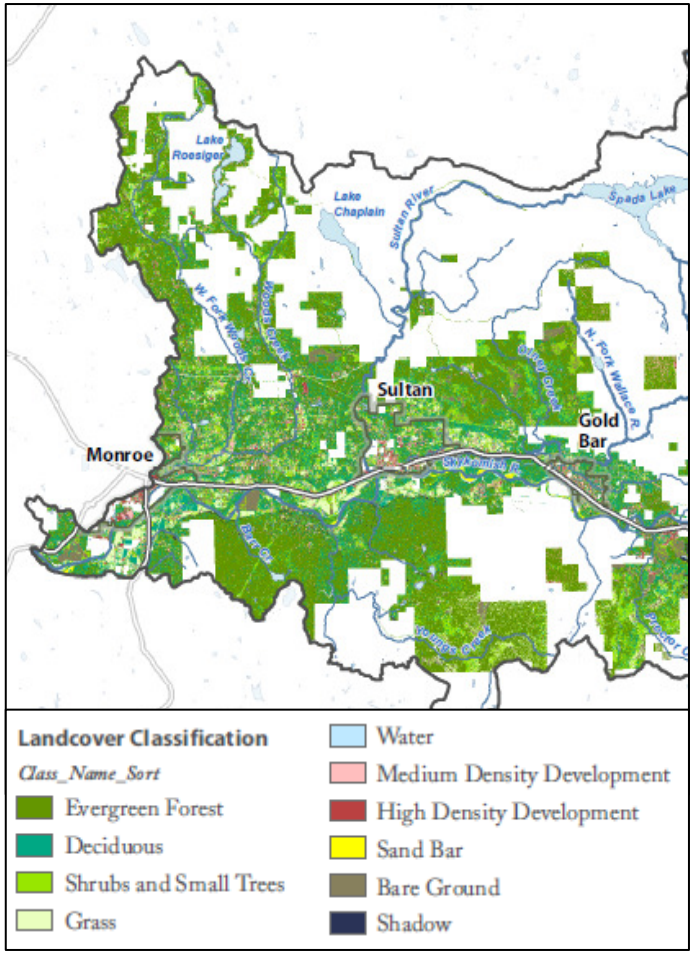
- Import data to PostGIS or Spatialite
- Run SQL query to create result layer

```
SELECT row_number() over (order by a1.parcel_id) as serial_number,
COALESCE(SUM(a2.mkimp),0) as nb_devscore, a1.parcel_id, count(1) as
nb_parcels_num,st_collect(a1.geom) as geom
Into newresults
FROM parcelsresult a1
LEFT OUTER JOIN parcelsresult a2 ON NOT
a1.parcel_id = a2.parcel_id
AND st_intersects(a2.geom, a1.geom)
GROUP BY a1.parcel_id
```

- Alternatively use python script neighbors.py

Land Cover Classification - Skykomish Basin

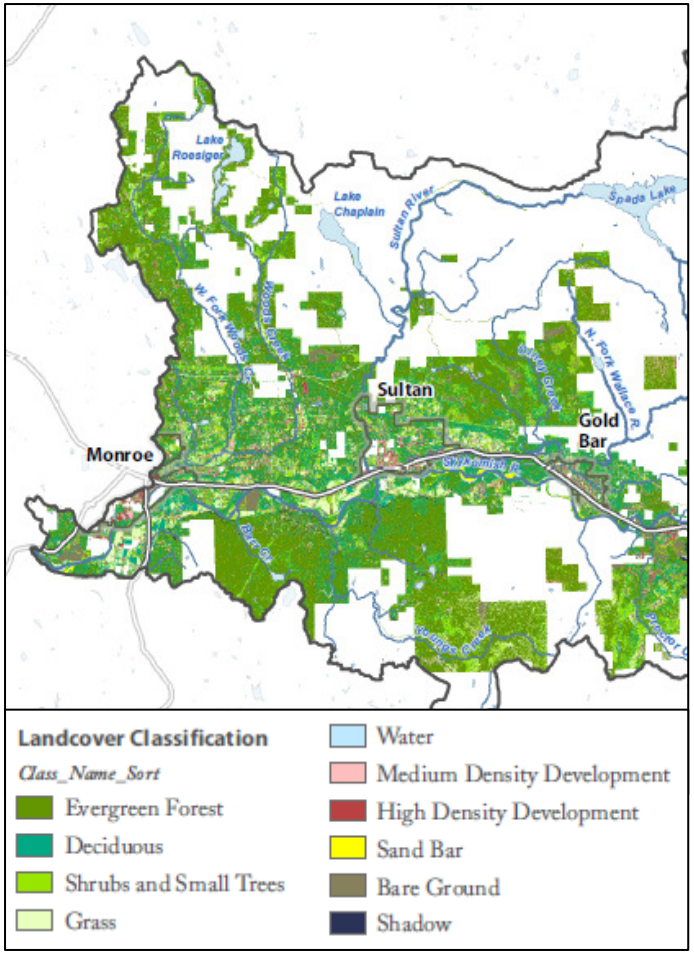
Derived from 2013 NAIP 4-band 1m orthophotos



Map by M. Stevenson
Core GIS, Seattle

Land Cover Classification - Skykomish Basin

- Calculating Normalized Difference Vegetation Index (NDVI)
  = (Near IR - Red) / (Near IR + Red)
- Produce texture layer
  Focal Mean tool with a 7x7 moving window + RANGE variable (Band2Rng7x7" + "Band4Rng7x7") / 2
- 96 Training Polygons
- Maximum Likelihood tool to generate classified land cover



Credit: Matt Stevenson
Core GIS, Seattle

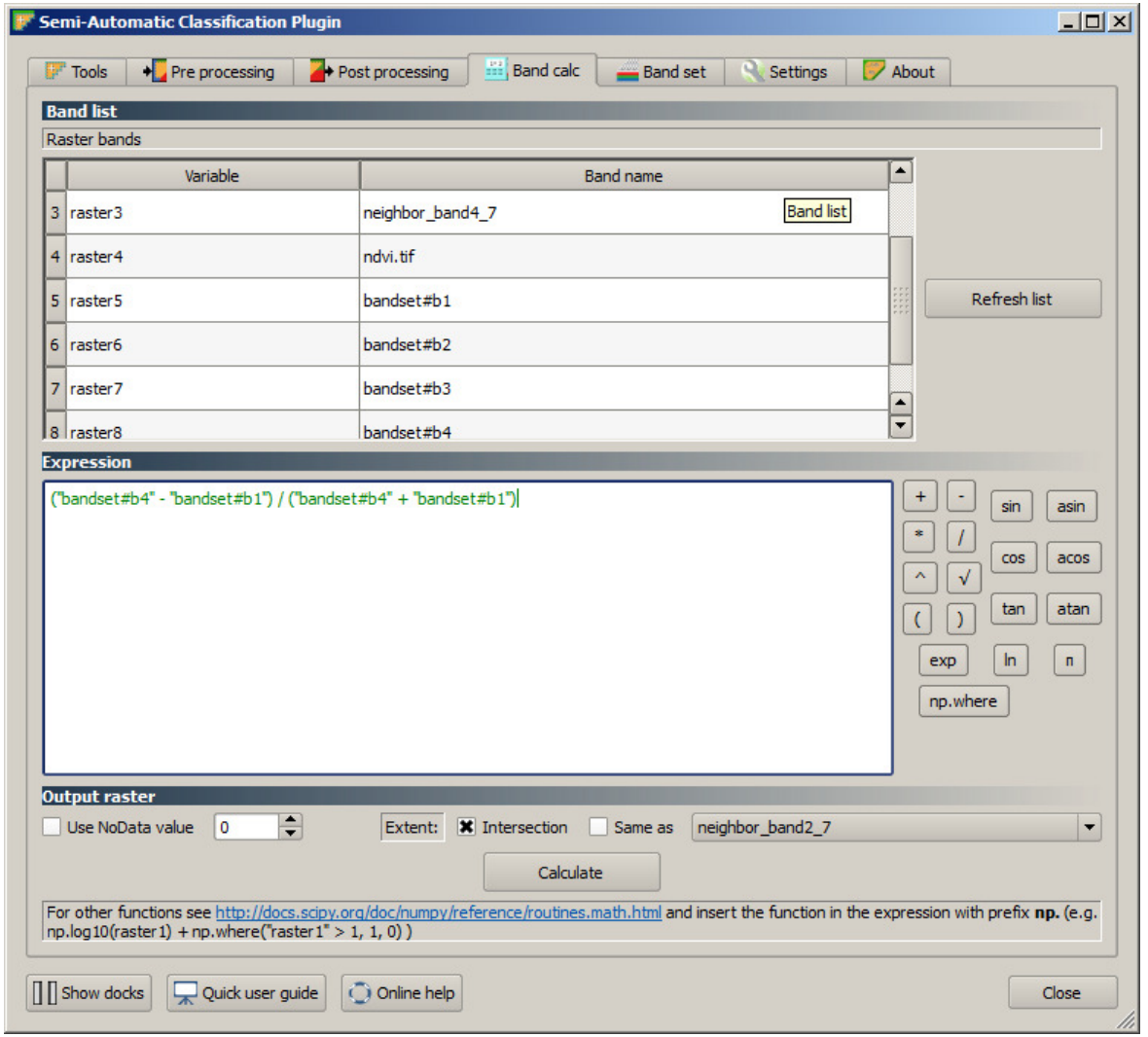
QGIS - Land Cover Classification

- Calculating Normalized Difference Vegetation Index (NDVI)
  (Near IR - Red) / (Near IR + Red)
  → Calculate using the SCP Plug-In
- Produce texture layer Focal Mean tool with a 7x7 moving window + RANGE variable
  (Band2Rng7x7" + "Band4Rng7x7")/ 2
  → Using Grass Plug-In r.neighbors Tool
- 96 Training Polygons import
- Signature Creation for 6 bands
  → Import or create signatures to SCP ROI creation Window
- Maximum Likelihood tool to generate classified land cover
  → Run in SCP Classification Window

QGIS - Land Cover Classification

Calculating Normalized Difference Vegetation Index (NDVI)

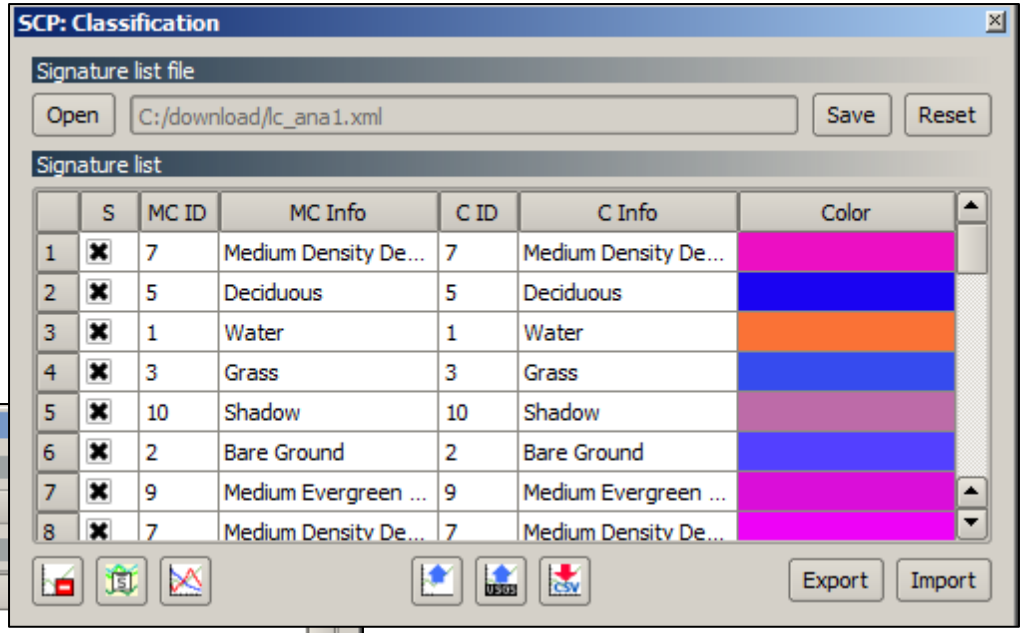
using the SCP Plug-In Main window

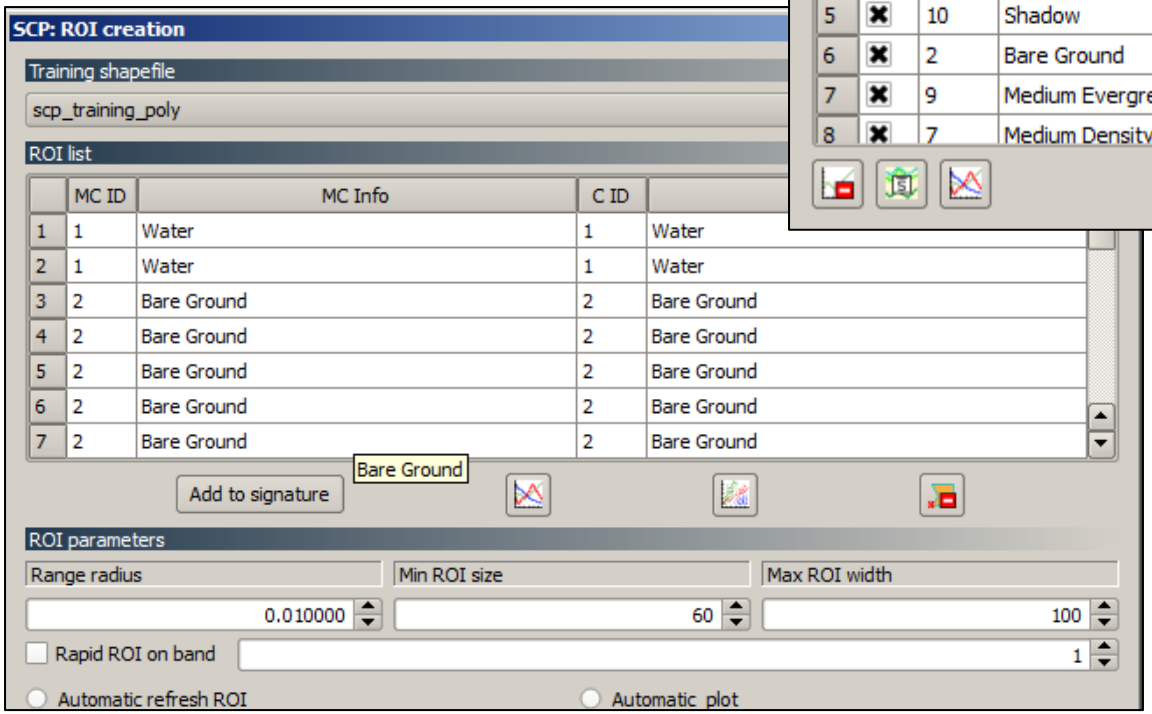


QGIS - Land Cover Classification

create or import signatures
to SCP Signature List

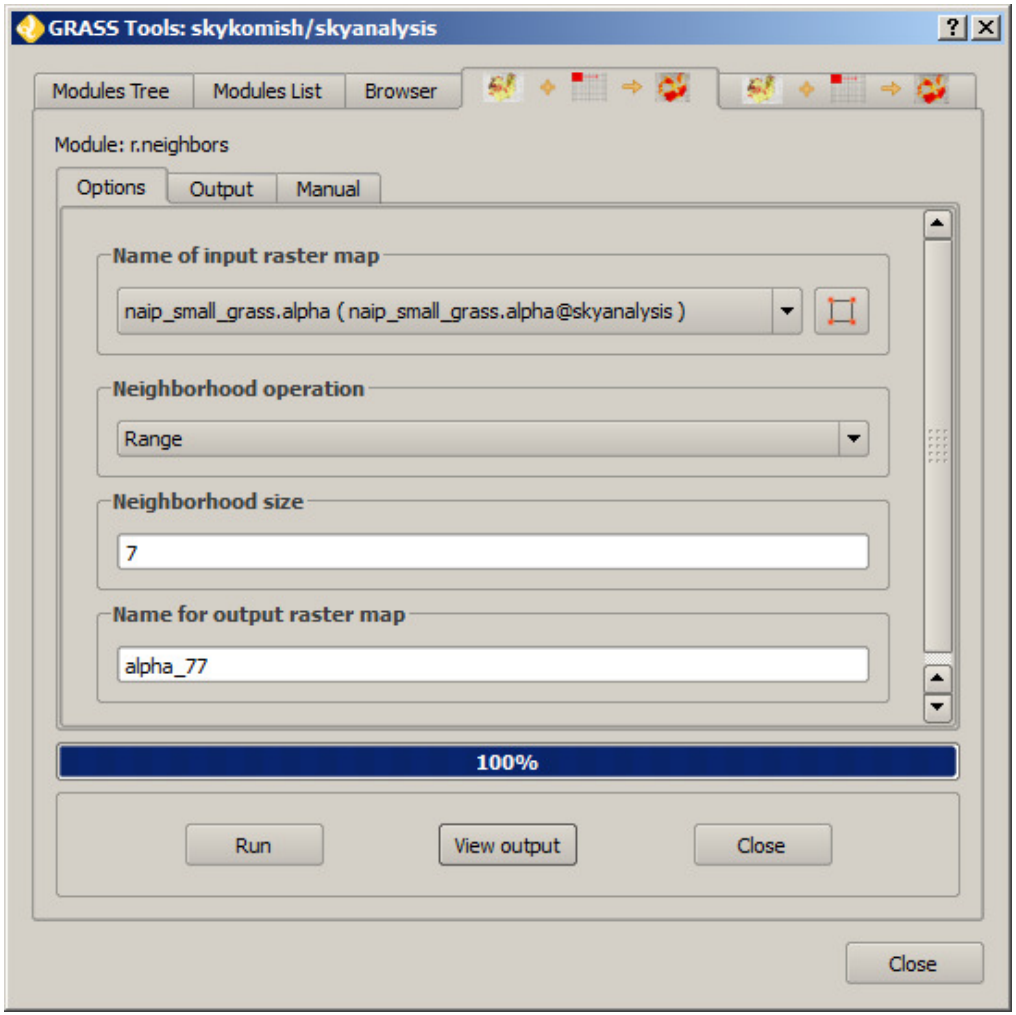
import Training Polygons into
SCP ROI creation Window





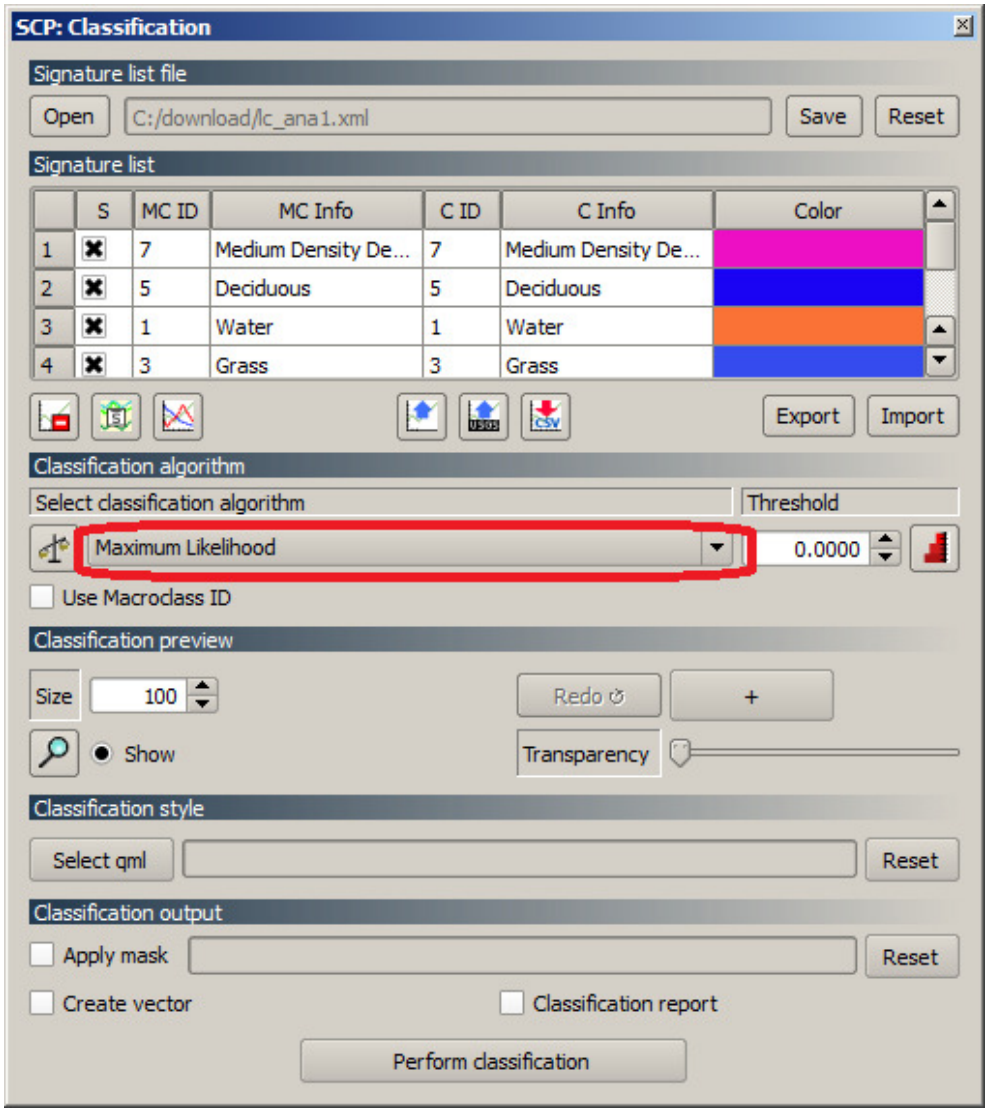
QGIS - Land Cover Classification

Produce texture layer
Using Grass Plug-In
r.neighbors Tool



QGIS - Land Cover Classification

Maximum Likelihood Run in SCP Classification Window



Conclusions I

- Both ArcGIS and QQGIS have extensive and often similar analytic capabilities
- As expected - some tools are very similar while others require a different approach, or are simply listed under a different name
- QGIS has a comprehensive toolset capable of replicating the entire analysis done for the Skykomish Project
- The QGIS Processing tool box makes analysis providers of other GIS system available in QGIS

Conclusions II

- The GRASS Plug-in for QGIS allows to access the full power of GRASS GIS from within QGIS
- The Semi-automatic Classification Plug-in (SCP) makes remote sensing available in QGIS. Imagery can be browsed and downloaded from with in QGIS (Landsat and Sentinel archives)
- Remote Sensing Capability is also included in ArcGIS via the Spatial Analyst toolbox
- As expected moving between tools for the same analyses requires getting used to differing tools, tool names, syntax, and work flows