

Creating and Editing GIS Data in QGIS

(Course: B003)

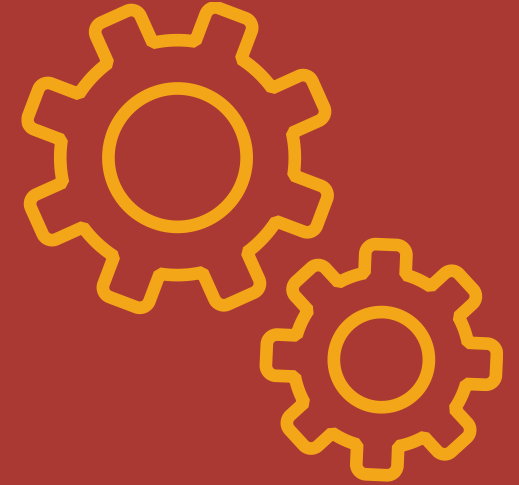
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Science Information Network
EARTH INSTITUTE | COLUMBIA UNIVERSITY

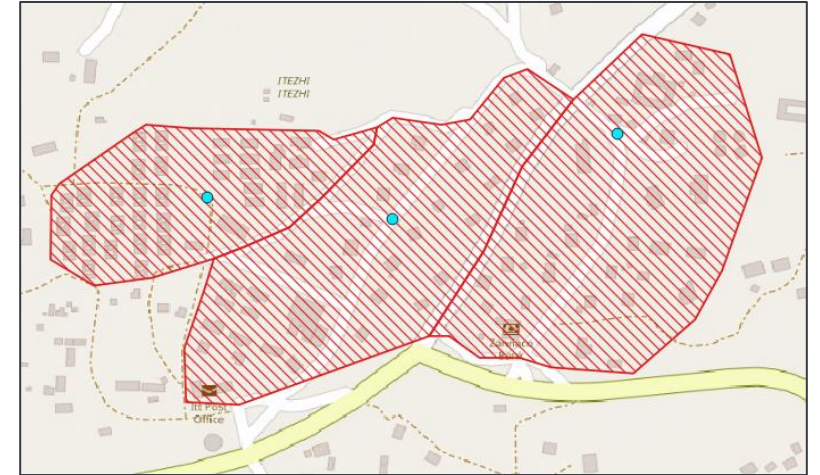
Creating and Editing GIS Data

- Introduction
- Spatial data formats
 - Shapefile and Geopackage
- Creating or editing map features
- Snapping and topology
- Creating or editing attribute data
- Managing attribute fields
- Field calculator
- Saving your edits!



Creating and Editing GIS Data

- **Create your own data:** e.g. creating new survey locations (points), delineating new health facility catchment areas (polygons), new roads (lines), etc.
- **Edit existing datasets:** e.g. adjust boundaries, move health post locations, etc.
- In a single QGIS editing session you can create or edit two different elements of a dataset:
 - *map data – points, lines, polygons*
 - *Attribute data – table-based information*



Data Formats: Shapefile

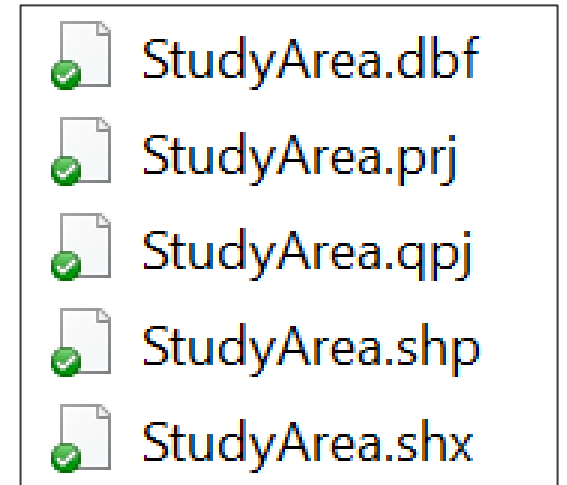
A common file type used in QGIS is the shapefile (.shp). Shapefiles are an ESRI vector format, made up of several components:

Core:

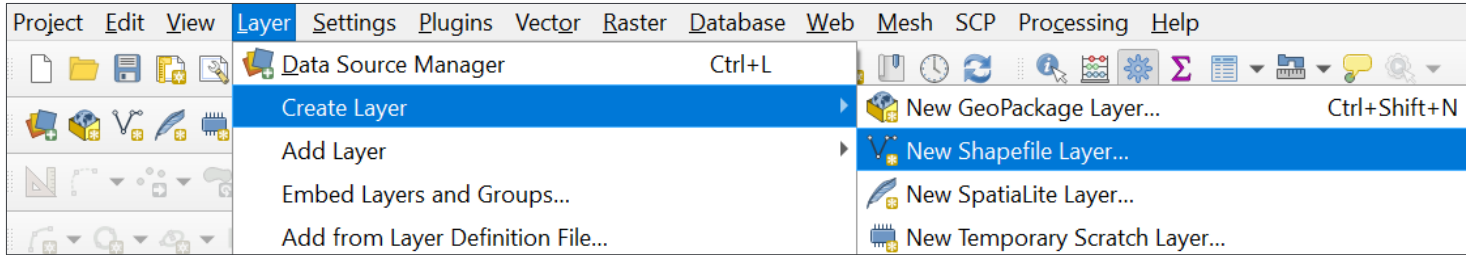
- **.shp** – stores the map object information
- **.dbf** – stores the attribute information of the features
- **.shx** – stores the index of the feature geometry

Additional:

- **.qpj** – projection information (QGIS)
- **.qml** – Style information
- **.qix** – spatial index
- **.prj** – projection information (ESRI)
- **.qmd** – QGIS specific metadata



Creating a new Shapefile



- To create a new shapefile go to:
 - *Layer > Create Layer > New Shapefile Layer*
- *New Shapefile Layer* window >>>
 - set the attributes and the coordinate system for the new dataset.

The 'New Shapefile Layer' dialog box is shown. It contains the following fields and options:

- File name:** An empty text input field.
- File encoding:** A dropdown menu set to 'UTF-8'.
- Geometry type:** An empty dropdown menu.
- Additional dimensions:** Radio buttons for 'None' (selected), 'Z (+ M values)', and 'M values'.
- Coordinate System:** A dropdown menu set to 'EPSG:4326 - WGS 84'.
- New Field:** A section with a 'Name' input field, a 'Type' dropdown menu set to 'abc Text Data', a 'Length' input field set to '80', and a 'Precision' input field. Below these is an 'Add to Fields List' button.
- Fields List:** A table with columns 'Name', 'Type', 'Length', and 'Precision'. It contains one entry: 'id' with Type 'Integer' and Length '10'. Below the table is a 'Remove Field' button.
- Buttons:** 'OK', 'Cancel', and 'Help' buttons at the bottom right.



Creating a new Shapefile

Specify your dataset to be Points, Lines or Polygons.

Create your attribute table columns.

Depending on the data type you choose you will specify field width and precision.

Remember: shapefile attribute names are limited to 10 characters

File name: ita\Vector\General\Global_adm2.shp

File encoding: UTF-8

Geometry type: Point

Include Z dimension: Include M values:

Coordinate Reference System: EPSG:4326 - WGS 84

New Field

Name: AREA

Type: 1.2 Decimal number

Length: 20 Precision: 6

Add to Fields List

Fields List

| Name | Type | Length | Precision |
|------------|---------|--------|-----------|
| id | Integer | 10 | |
| CNTRYNAME | String | 80 | |
| ISO | Integer | 3 | |
| POPULATION | Real | 20 | |
| AREA | Real | 20 | 6 |

Remove Field

OK Cancel Help

Specify the desired Coordinate Reference System

- 1.2 Decimal number
- abc Text data
- 123 Whole number
- 1.2 Decimal number
- Date

When you click **Add to fields list** they will appear in this window



Data Formats: Geopackage

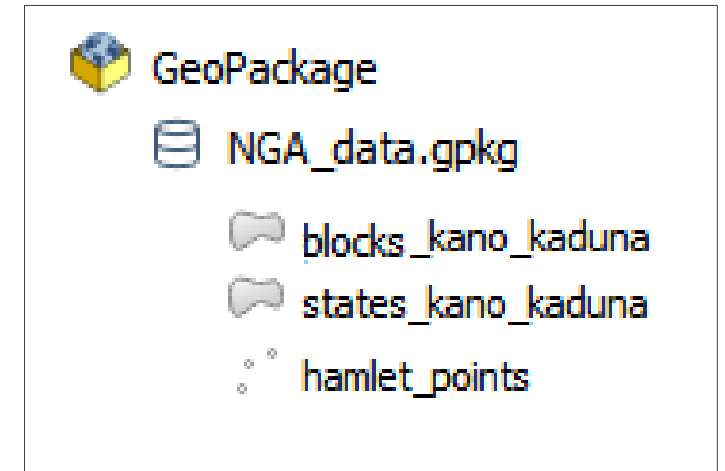
GPKG - The default spatial data format from QGIS V3 onwards

Pros:

- Open standard, SQLite DB
- Broad compatibility (ArcGIS, GDAL, QGIS, R, Python,...)
- Everything is contained in a single file
- More lightweight than a real geodatabase, but just as fast
- Faster rendering, loading, panning and zooming than with shapefiles

Cons:

- Metadata not yet fully implemented
- Raster support is relatively limited



Creating a new GeoPackage Layer

Specify your dataset to be Points, Lines or Polygons.

Create your attribute table fields (columns); depending on the data type you choose you will specify field width and precision.

Note: GeoPackages enforce no limit on field header characters

New GeoPackage Layer

Database: c:\cises\Data\Database\GPKG_TrainingData.gpkg

Table name: GPKG_built_up_areas

Geometry type: Polygon

Include Z dimension Include M values

Coordinate Reference System: EPSG:4326 - WGS 84

New Field

Name: []

Type: abc Text data

Maximum length: 80

Add to Fields List

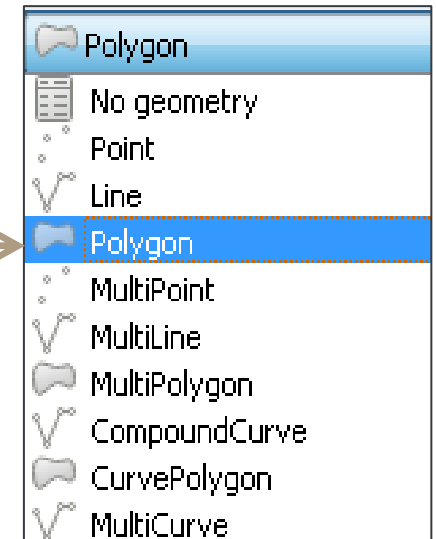
Fields List

| Name | Type | Length |
|----------------|------|--------|
| SettlementName | text | 80 |

Remove Field

Advanced Options

OK Cancel Help



Specify the desired Coordinate Reference System

When you click **Add to fields list** they will appear in this window



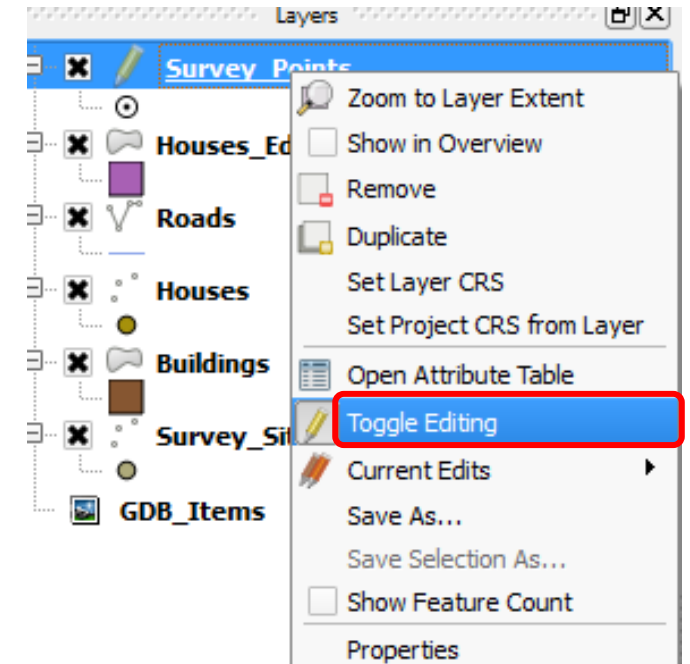
Start Editing

To start editing...

- Locate the **Digitising** toolbar:

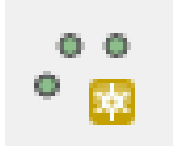


- Click a layer in the Layers panel, to make it **active**, and either:
 - Click the **Toggle editing** button from the digitising toolbar (highlighted above), or
 - Right-click on the layer to select **Toggle editing**



Draw new features

The capture tool button (on the Digitising toolbar) will change depending on the object type of the layer:



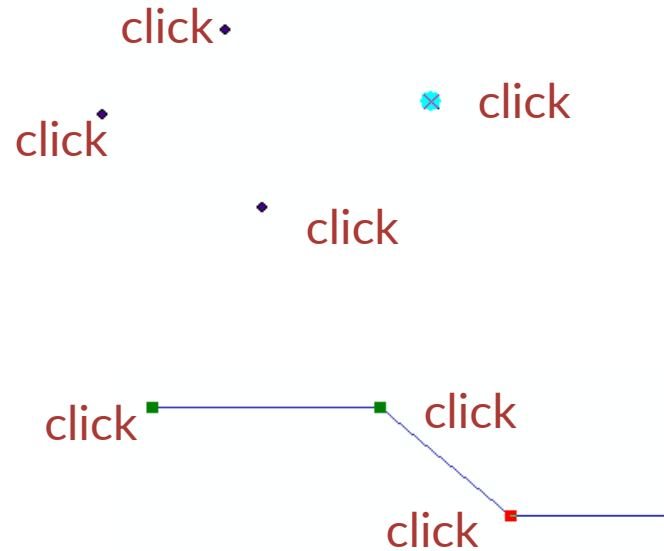
Capture points



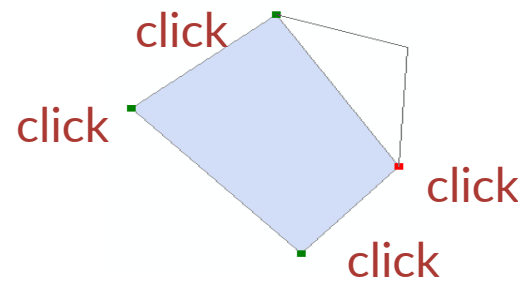
Capture lines



Capture polygons



Right-click to finish drawing

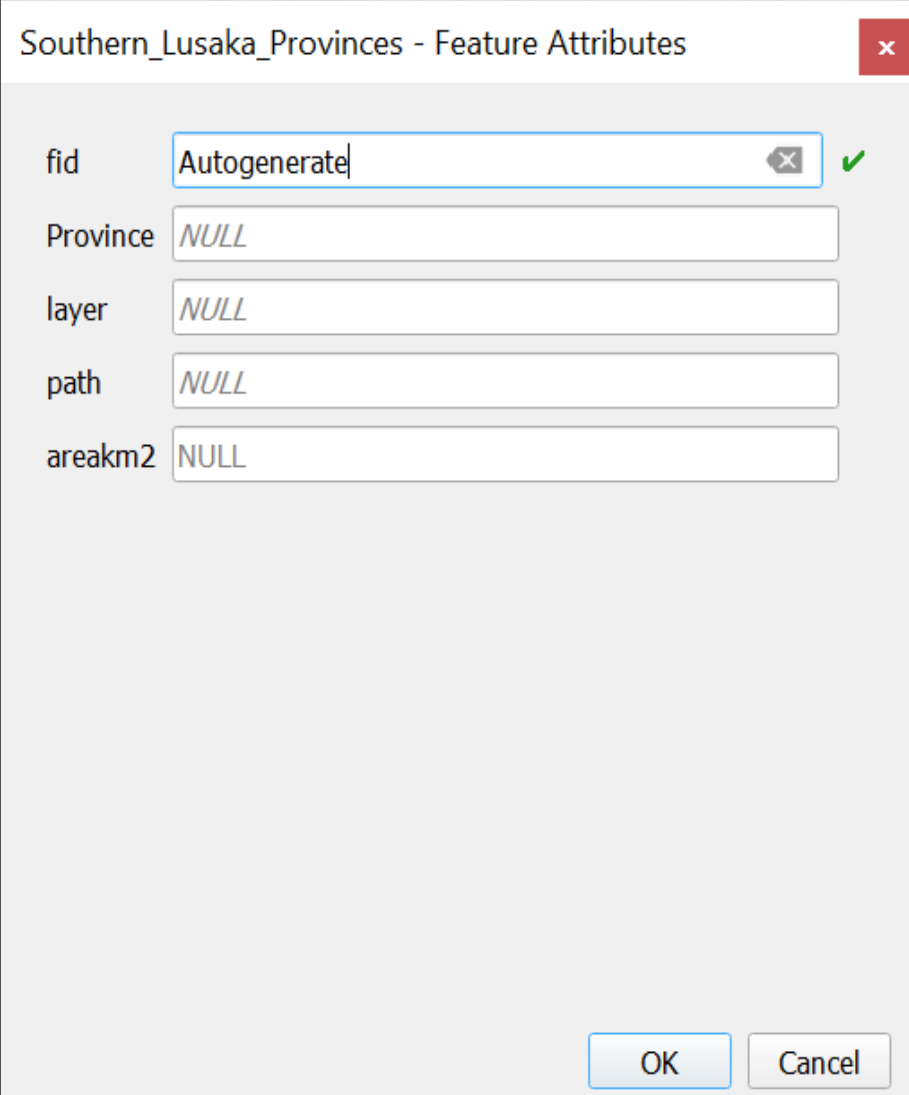


Right-click to finish drawing



Editing: adding attribute data to features

- When you finish drawing a new feature, an Attribute window will pop up
- You enter the attributes for your new feature
- You can disable this pop up in **Settings**, if you wish



Southern_Lusaka_Provinces - Feature Attributes

fid Autogenerate ✓

Province NULL

layer NULL

path NULL

areakm2 NULL

OK Cancel



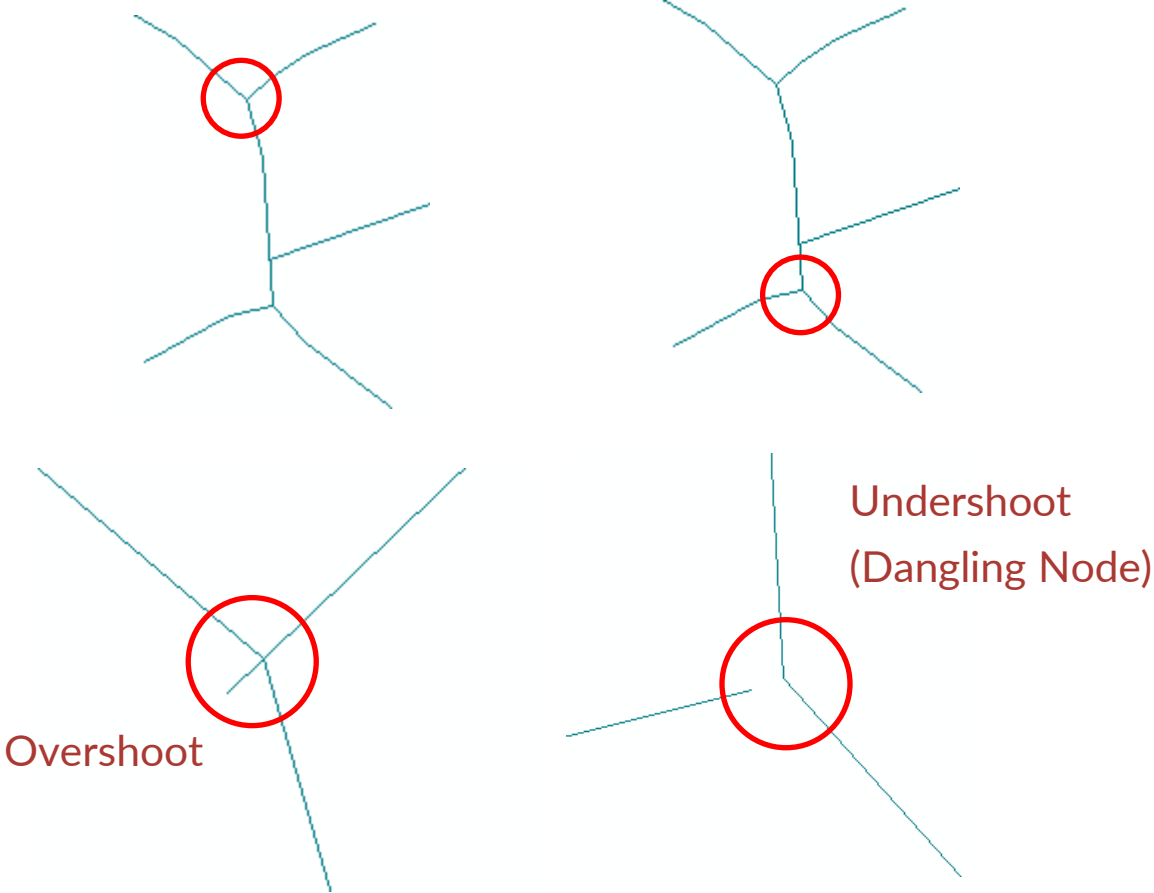
Snapping (for accurate digitising)

- Use snapping to ensure that features you digitise touch/align with each other
- Due to the high precision used to store coordinates by QGIS, it is virtually impossible to exactly capture the location of an existing feature when digitising without using snapping
- Snapping options are:
 - Snap to vertex
 - Snap to segment (feature edge)
 - Snap to vertex and segment

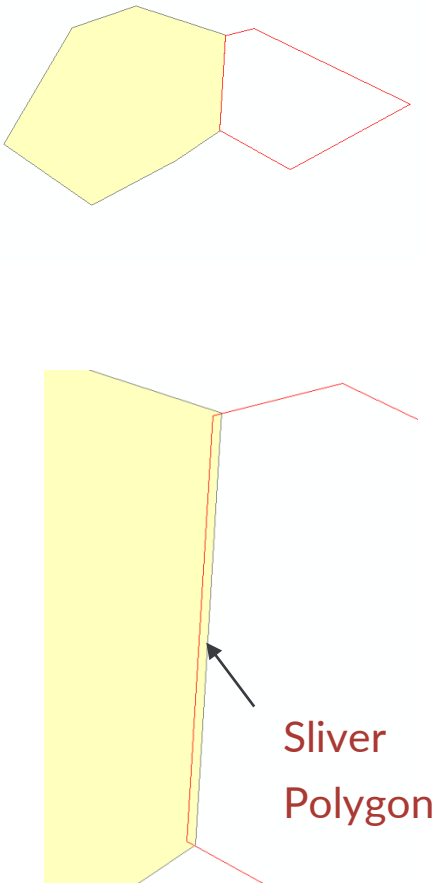


Snapping - why bother?

Lines



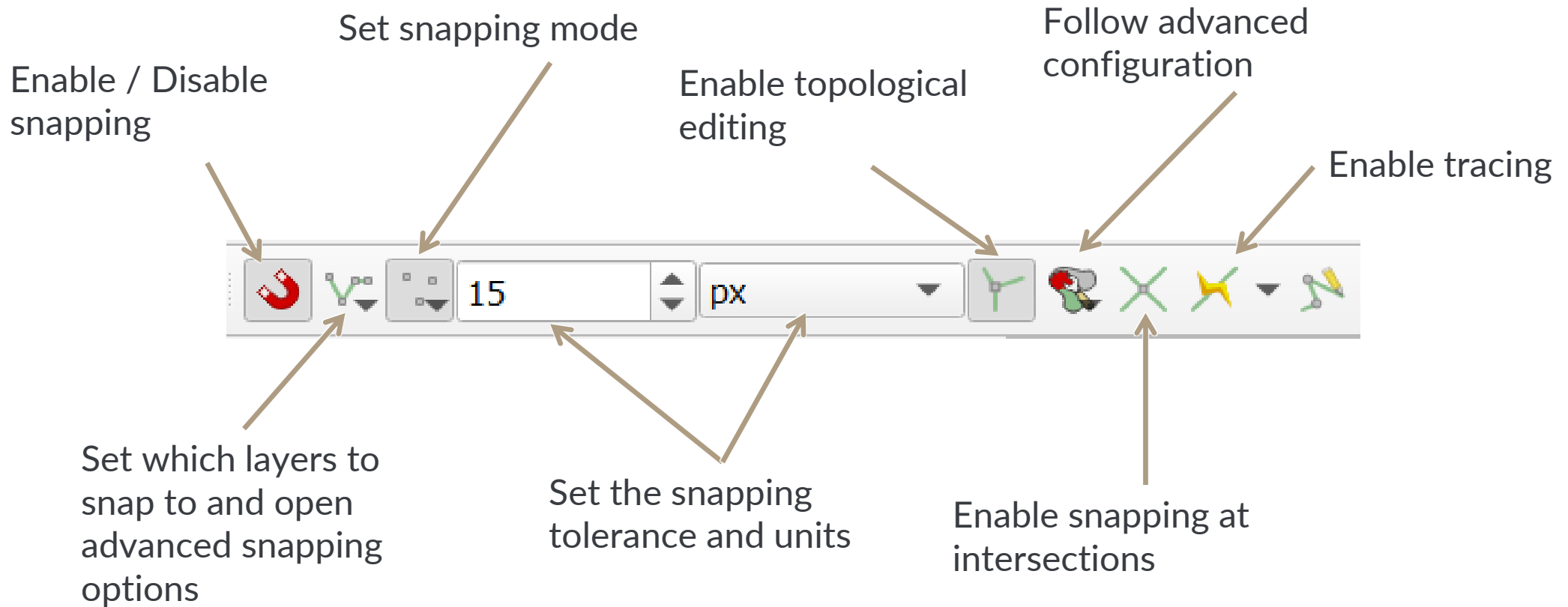
Polygons



Snapping Options

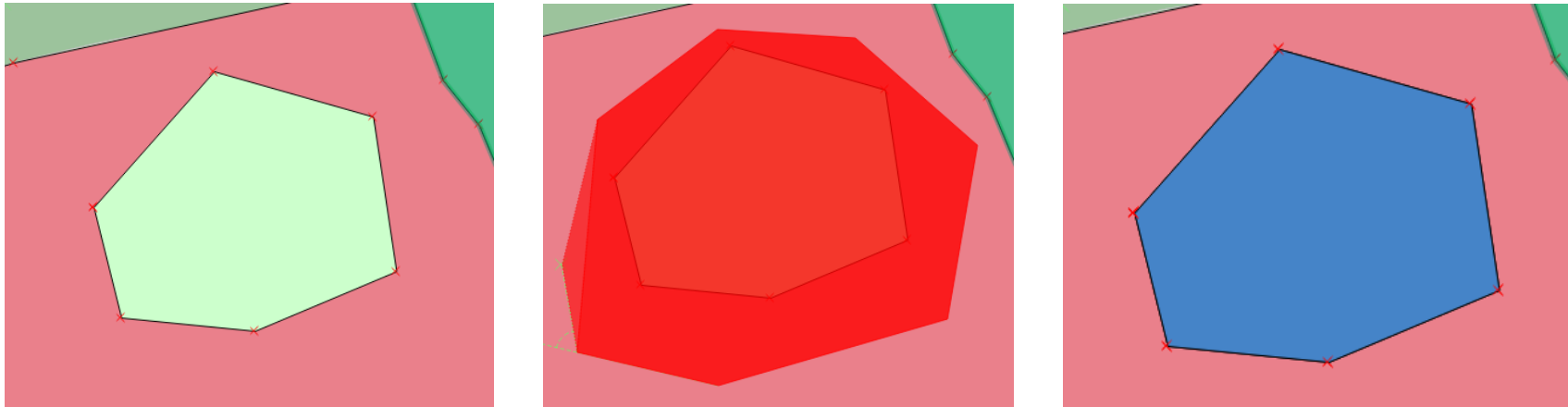
Snapping options located here:

View > Toolbars > Snapping Toolbar:

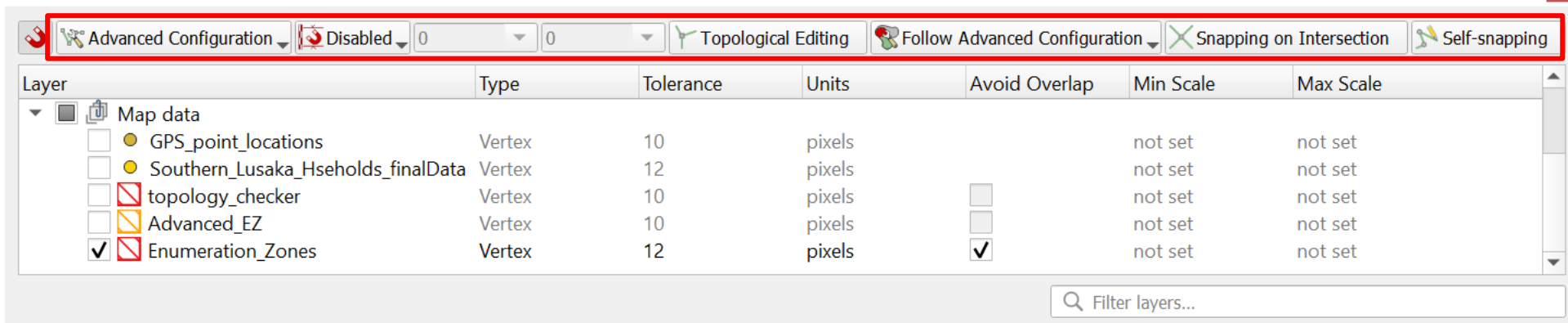


Topological Editing

- Topology helps minimize errors such as gaps and overlaps
- Ticking Avoid Intersections in snapping allows for quick hole filling



Project Snapping Settings



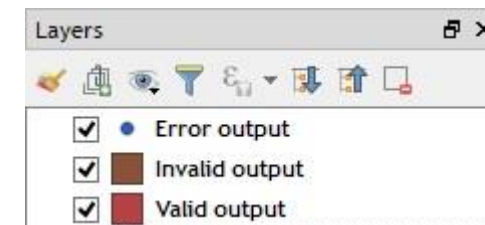
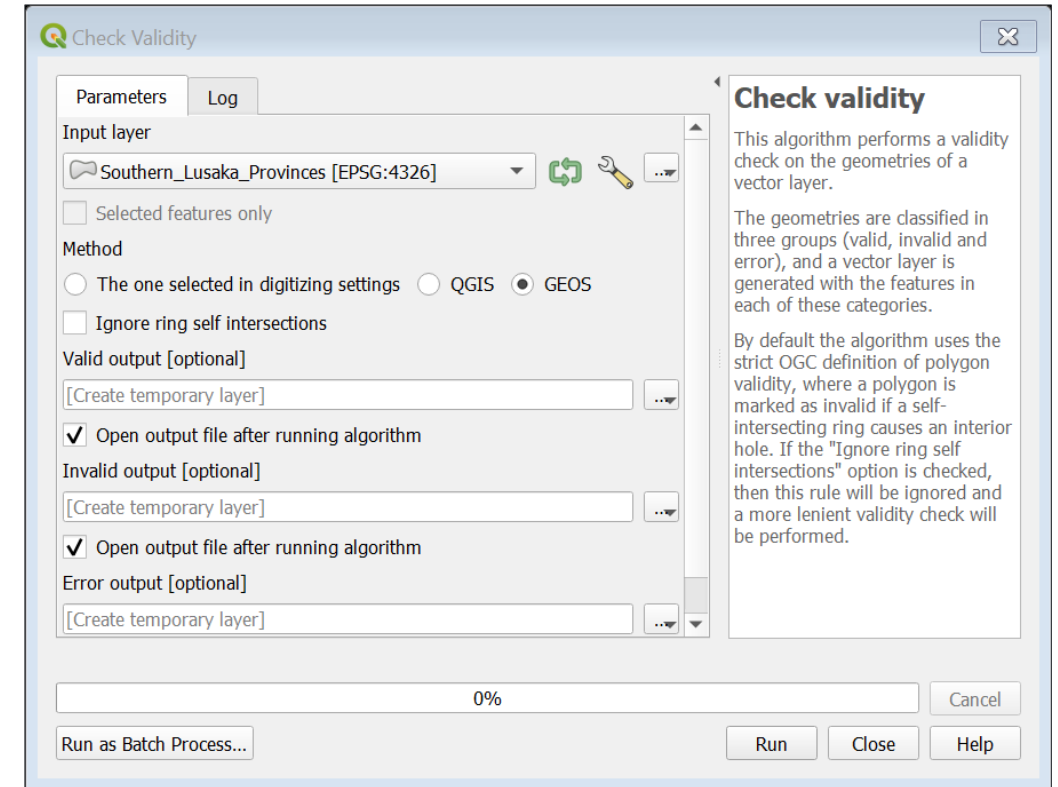
| Layer | Type | Tolerance | Units | Avoid Overlap | Min Scale | Max Scale |
|------------------------------------|--------|-----------|--------|-------------------------------------|-----------|-----------|
| Map data | | | | | | |
| GPS_point_locations | Vertex | 10 | pixels | | not set | not set |
| Southern_Lusaka_Hseholds_finalData | Vertex | 12 | pixels | | not set | not set |
| topology_checker | Vertex | 10 | pixels | <input type="checkbox"/> | not set | not set |
| Advanced_EZ | Vertex | 10 | pixels | <input type="checkbox"/> | not set | not set |
| Enumeration_Zones | Vertex | 12 | pixels | <input checked="" type="checkbox"/> | not set | not set |



Topological Editing

Simple Checking

- Go to **Vector > Geometry Tools > Check the validity of the geometry.**
- Select the layer and click OK
- Any errors are listed and 3 layers are created (**Valid output, Invalid output and Error output**)



Topological Editing

Topology checker Plugin

- Go to Menu **Vector > Topology Checker**
- Click on the **Configuration** button for adding or deleting Topology rules.
- **Add** a rule, e.g. « **must not overlap** » to avoid the overlapping on polygon layer.



Tool icon

Validate all

Topology Checker Panel

| Error | Layer | Feature ID |
|-------|-------|------------|
|-------|-------|------------|

Show errors Topology not checked yet

Configuration

Topology Rule Settings

Current Rules

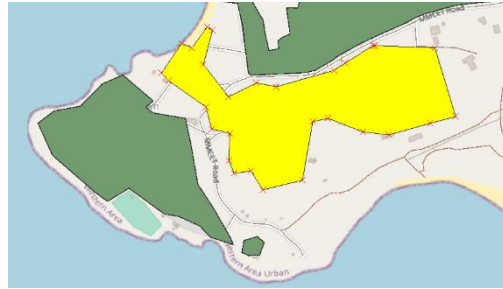
Southern_Lusaka_Provinces must not overlap

Add Rule Delete Rule

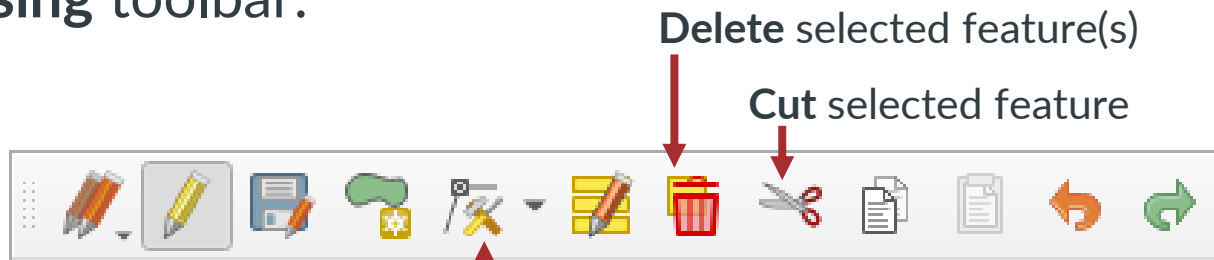
| Rule | Layer #1 | Layer #2 |
|------|----------|----------|
|------|----------|----------|

Edit Existing Features

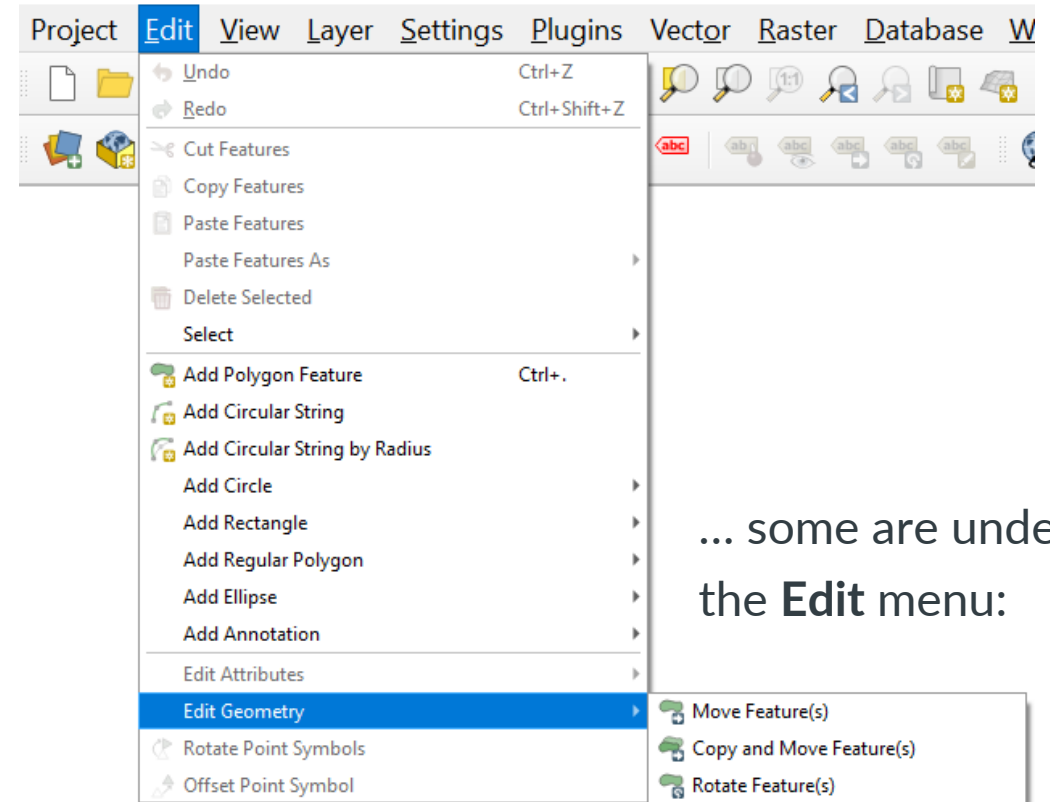
- To edit features, first you must select it, via the Selection toolbar



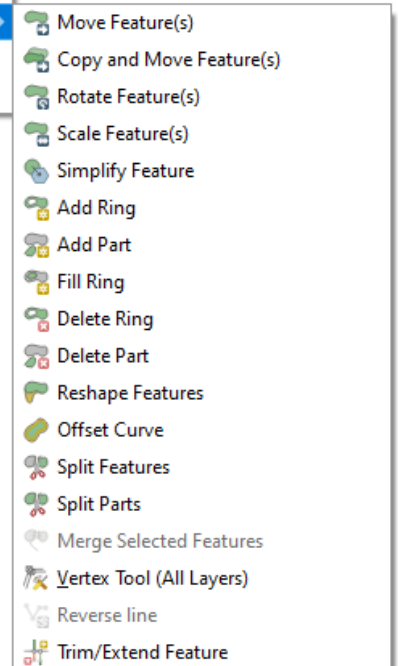
- Then you have many options ... some are on the Digitising toolbar:



Vertex Tool – delete, move or add vertices to lines or polygons

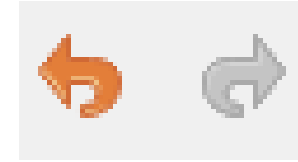


... some are under the Edit menu:



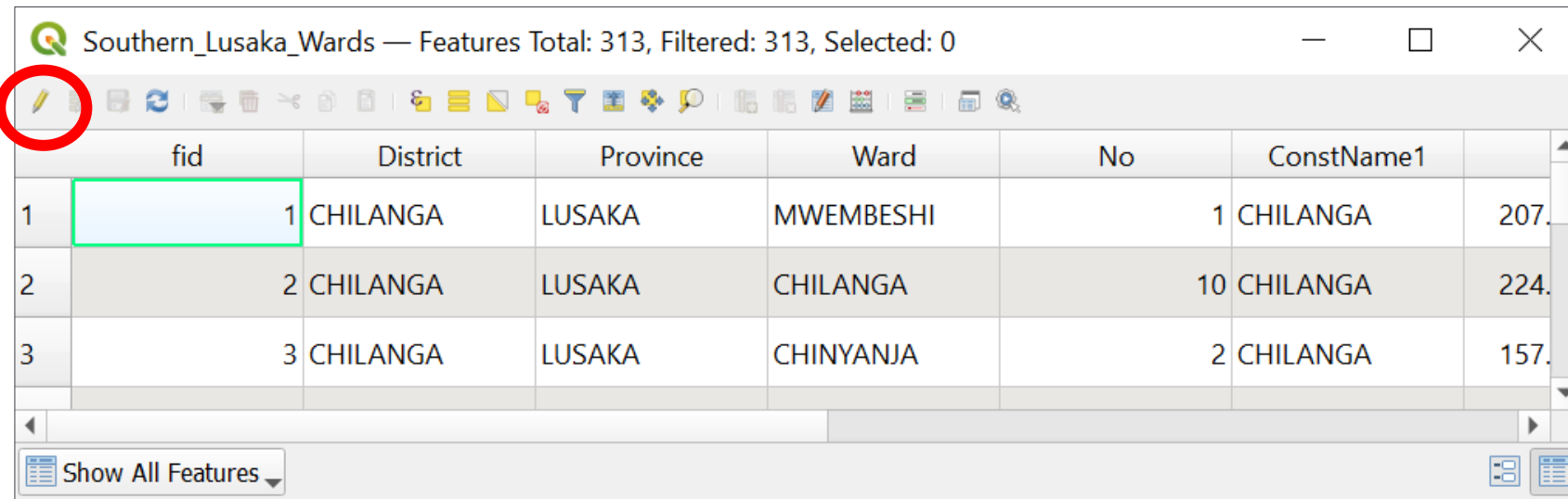
Correcting Mistakes

- Use the **Undo** and **Redo** commands from the **Edit** menu or the corresponding buttons from the **Digitising** toolbar
- The Undo / Redo window maintains a list of sequential edits since the last save
- Clicking at a location on the list undoes or redoes edits to that point in the list



Adding/Editing Attributes

- In the Attribute Table window, use the **Toggle Editing Mode** button to start/stop editing the table or right-click the layer in the layers panel & select **Toggle Editing**
- Type directly into the Attribute Table



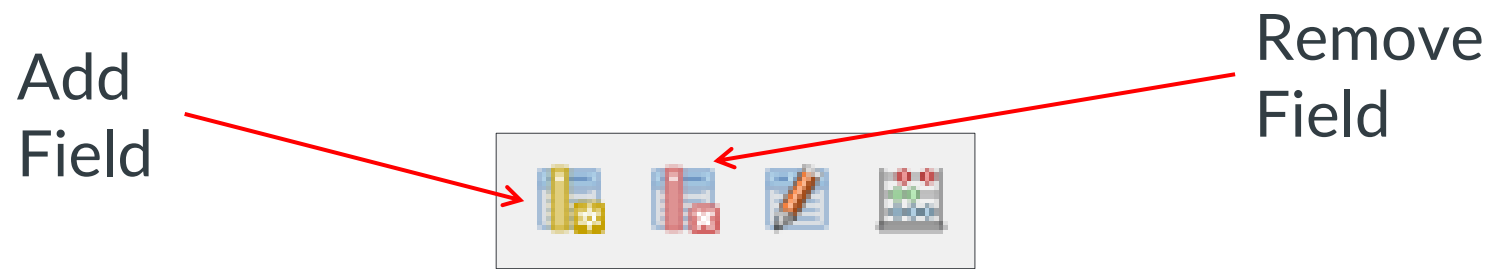
| | fid | District | Province | Ward | No | ConstName1 | |
|---|-----|----------|----------|-----------|----|------------|------|
| 1 | 1 | CHILANGA | LUSAKA | MWEMBESHI | 1 | CHILANGA | 207. |
| 2 | 2 | CHILANGA | LUSAKA | CHILANGA | 10 | CHILANGA | 224. |
| 3 | 3 | CHILANGA | LUSAKA | CHINYANJA | 2 | CHILANGA | 157. |

Show All Features



Managing Attribute Fields - Basic

- Attribute fields can be added or removed from the Attribute Table, and *Layer Properties > Fields* tab



- To use the Add and Remove buttons, the dataset must be in edit mode (toggled by pressing the yellow pencil button)



Managing Attribute Fields - Advanced

- The Refactor Fields tool from the Processing Toolbox provides more options for edit your table structure
- Allows fields to be added, removed, reordered and renamed

Refactor Fields

Parameters Log

Input layer
Southern_Lusaka_Wards [EPSG:4326]

Selected features only

Fields mapping

| | Source Expression | Name | Type | Length | Prec |
|---|-------------------|------------|--------------------------------|--------|------|
| 0 | 123 fid | fid | Whole number (integer - 64bit) | 0 | 0 |
| 1 | abc District | District | Text (string) | 50 | 0 |
| 2 | abc Province | Province | Text (string) | 50 | 0 |
| 3 | abc Ward | Ward | Text (string) | 50 | 0 |
| 4 | 123 No | No | Whole number (integer - 32bit) | 0 | 0 |
| 5 | abcName1 | ConstName1 | Text (string) | 50 | 0 |
| 6 | 1.2 Area | Area | Decimal number (double) | 0 | 0 |

Load fields from template layer: Advanced_EZ Load Fields

Refactored
[Create temporary layer]

Open output file after running algorithm

0%

Run as Batch Process... Run Close Help

Refactor fields
This algorithm allows editing the structure of the attributes table of a vector layer. Fields can be modified in their type and name, using a fields mapping.
The original layer is not modified. A new layer is generated, which contains a modified attribute table, according to the provided fields mapping.
Rows in orange have constraints in the template layer from which these fields were loaded. Treat this information as a hint during configuration. No constraints will be added on an output layer nor will they be checked or enforced by the algorithm.



Field Calculator



Southern_Lusaka_Wards — Features Total: 313, Filtered: 313, Selected: 1

123 fid = 123

| fid | District |
|-----|------------|
| 1 | 1 CHILANGA |
| 2 | 2 CHILANGA |
| 3 | 3 CHILANGA |

Show All Features

Only update 1 selected features

Create a new field Update existing field

Create virtual field

Output field name:

Output field type: Whole number (integer)

Output field length: 0 Precision: 3

Expression Function Editor

row_number

- Aggregates
- Arrays
- Color
- Conditional
- Conversion
- Date and Time
- Fields and Values
- Files and Paths
- Fuzzy Matching
- General

Feature: 1

Preview:

OK Cancel Help

- Allows you to re-calculate fields or add new fields with new values such as Area and Length
- Can also be applied to text fields, for example adding to or removing characters from a text string



Field Calculator



Attribute table - BWEA_Windfarms_July07 :: Features total: 24, filtered: 24, selected: 0

| Developer | Operator | Owner | Latitude | Longitude | Easting | Northing | TurbineNum | PowerMW | CapacityMW | |
|-----------|-------------------|-------------------|-------------------|-----------|-----------|-------------------|-------------------|---------|----------------------|----------------------|
| 4 | EnergyTech | NULL | NIK Energy | 51 43 27N | 05 00 26W | 192401.2690000... | 207107.1959999... | 1 | 0.500000000000000... | 0.500000000000000... |
| 13 | Tegni | Tegni | Tegni | 52 53 01N | 03 35 18W | 293217.9390000... | 332974.7170000... | 1 | 0.600000000000000... | 0.600000000000000... |
| 2 | Tegni | NULL | NULL | 52 54 01N | 04 23 18W | 239454.6099999... | 336318.3420000... | 1 | 0.850000000000000... | 0.850000000000000... |
| 7 | Energiekontor | GT O+M | Co WP Mombkg ... | 53 08 08N | 03 43 00W | 285253.9170000... | 361197.3910000... | 1 | 1.300000000000000... | 1.300000000000000... |
| 9 | Tegni | Tegni | Tegni | 52 54 01N | 03 35 18W | 293258.9209999... | 334828.5569999... | 2 | 0.850000000000000... | 1.700000000000000... |
| 16 | E.ON UK Renewa... | RES | E.on Renewables | 52 24 12N | 03 52 56W | 272048.6190000... | 280034.7899999... | 8 | 0.300000000000000... | 2.400000000000000... |
| 8 | Cwmni Gwynt Te... | GT O+M | Cwmni Gwynt Te... | 53 08 08N | 03 43 24W | 284807.9639999... | 361208.1070000... | 2 | 1.300000000000000... | 2.600000000000000... |
| 12 | Nuon Renewables | Nuon Renewables | Nuon Renewables | 51 51 28N | 04 34 40W | 222581.3550000... | 220828.7989999... | 5 | 0.720000000000000... | 3.600000000000000... |
| 10 | Windjen Power Ltd | Windjen Power Ltd | Windjen Power Ltd | 51 59 17N | 04 26 43W | 232191.3610000... | 235000.9120000... | 3 | 1.300000000000000... | 3.900000000000000... |
| 19 | New World Power | RES | RES | 51 52 09N | 04 33 25W | 224060.2619999... | 222044.6250000... | 11 | 0.500000000000000... | 5.500000000000000... |

- Calculations on numerical fields
- Calculate area / length geometry

Field Calculator

Only update 0 selected features

Create a new field Update existing field

Create virtual field

Output field name: Total_Cap_Turb

Output field type: Decimal number (real)

Output field length: 0 Precision: 3

Expression: "CapacityMW" / "TurbineNum"

Function Editor: Fuzzy Matching, General, Geometry, Map Layers, Maps, Math, Operators, Rasters, Record and Attributes, String, Variables

Query:
How efficient is each of these windfarms, and how do they compare?

Answer:
Capacity MW (per wind farm) / Turbine Number = Capacity per turbine

| Total_Cap_Turb |
|----------------|
| 0.5 |
| 1.18 |
| 1.18 |
| 1.18 |
| 2 |
| 1.18 |
| 0.5 |
| 0.77 |
| 0.77 |
| 1.18 |
| 0.77 |
| 1.18 |
| 1.39 |
| 1.67 |



Field Calculation - Geometry

| | REF_CODE | NAME | MEASURE | HOTLINK |
|---|----------|------------------|---------|------------------|
| 0 | UKF | EAST MIDLANDS | 15815 | WWW.STATISTIC... |
| 1 | UKH | EAST OF ENGLAND | 19575 | WWW.STATISTIC... |
| 2 | UKI | LONDON | 1595 | WWW.STATISTIC... |
| 3 | UKC | NORTH EAST | 8676 | WWW.STATISTIC... |
| 4 | UKD | NORTH WEST | 14918 | WWW.STATISTIC... |
| 5 | UKJ | SOUTH EAST | 19413 | WWW.STATISTIC... |
| 6 | UKK | SOUTH WEST | 24477 | WWW.STATISTIC... |
| 7 | UKG | WEST MIDLANDS | 13004 | WWW.STATISTIC... |
| 8 | UKE | YORKSHIRE AND... | 15564 | WWW.STATISTIC... |

| | REF_CODE | NAME | MEASURE | HOTLINK | Area_m2 |
|---|----------|------------------|---------|------------------|----------------|
| 0 | UKF | EAST MIDLANDS | 15815 | WWW.STATISTIC... | 15766370543.03 |
| 1 | UKH | EAST OF ENGLAND | 19575 | WWW.STATISTIC... | 19509772862.35 |
| 2 | UKI | LONDON | 1595 | WWW.STATISTIC... | 1590527479.17 |
| 3 | UKC | NORTH EAST | 8676 | WWW.STATISTIC... | 8643343103.12 |
| 4 | UKD | NORTH WEST | 14918 | WWW.STATISTIC... | 14867133077.75 |
| 5 | UKJ | SOUTH EAST | 19413 | WWW.STATISTIC... | 19365281276.65 |
| 6 | UKK | SOUTH WEST | 24477 | WWW.STATISTIC... | 24421349603.88 |
| 7 | UKG | WEST MIDLANDS | 13004 | WWW.STATISTIC... | 12969039954.44 |
| 8 | UKE | YORKSHIRE AND... | 15564 | WWW.STATISTIC... | 15511016499.53 |

Field Calculator

Only update 0 selected features

Create a new field Update existing field

Create virtual field

Output field name: Area_m2

Output field type: Decimal number (real)

Output field length: 0 Precision: 3

Expression Editor

\$area

Function Editor

- Fuzzy Matching
- General
- Geometry
 - affine transform
 - angle_at_vertex
 - area
 - azimuth
 - boundary
 - bounds
 - bounds_height

function \$area

Returns the area of the current feature. The area calculated by this function respects both the current project's ellipsoid setting and area unit settings. For example, if an ellipsoid has been set for the project then the calculated area will be ellipsoidal, and if no ellipsoid is set then the calculated area will be planimetric.

Syntax

OK Cancel Help

You are editing information on this layer but the layer is currently not in edit mode. If you click OK, edit mode will automatically be turned on.

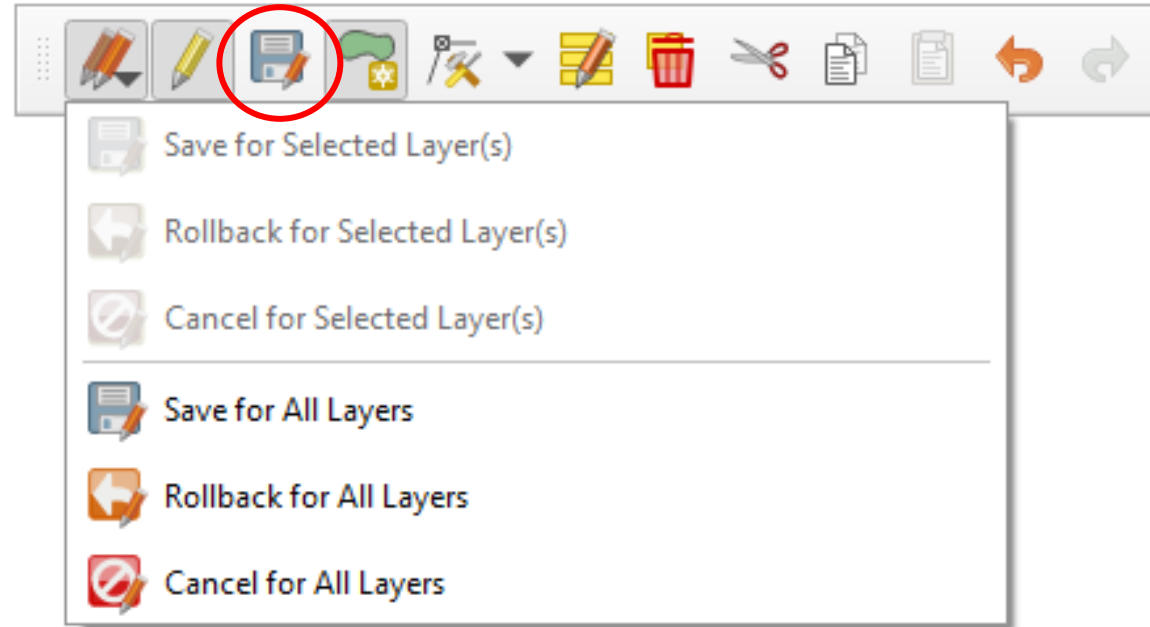
Ensure CRS is set to UTM or some other
Map Projection

Use the function *Area\$* to calculate values
in the units of the CRS e.g. metres



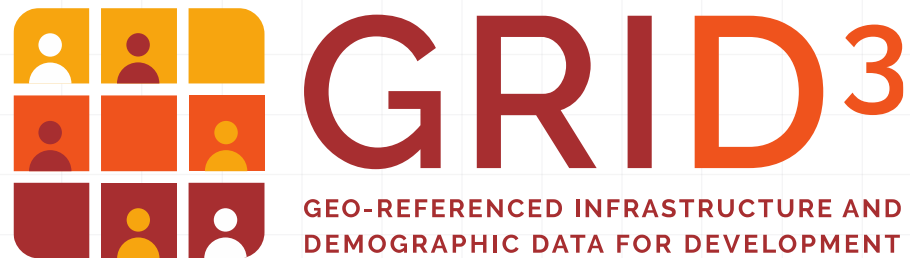
Saving your edits

- All edits (both map features and attribute data) are saved using the Save Edits button on the **Digitising** toolbar



- **Save your edits regularly as you work!**
- The red pencils icon allows for speedy saving across multiple layers
- You will be prompted to save new edits when you stop editing or try to close the programme





Questions?

For GRID3 project updates and information, visit us online at:

@GRID3Global



www.grid3.org



www.learn.grid3.org

Or follow our partners on Twitter at @Flowminder, @WorldPopProject, @UNFPA, @PopDevUNFPA, and @CIESIN

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