UNIVERSITY OF CAMBRIDGE

ARCADIA

MAHSA Training

QGIS and its Application in Archaeology

Level I / Beginner Training

MAHSA

Mapping Archaeological Heritage in South Asia

Tutorial 3 - Identifying and Digitising Map Historical Features

This tutorial was developed by Azadeh Vafadari, MAHSA Project Training Coordinator, as part of the MAHSA training initiative.

Developed by:
MAHSA Training Team

Lead Editor:
Azadeh Vafadari

Lead Contributor:
Jack Tomaney

Date:
Version 3.0 - March 2026

Contents

Introduction

This tutorial builds on the skills developed in the previous tutorials by focusing on the identification and digitisation of archaeological and historical features from georeferenced maps. Digitising is a key process in GIS that allows features visible on maps or imagery to be converted into structured spatial data for analysis, interpretation, and mapping.

You will learn how to identify features of archaeological interest, such as mounds, settlements, and heritage sites, from Survey of India historic maps, and record them as vector data using point and polygon shapefiles. The tutorial also introduces the creation and management of attribute data (i.e. metadata for each feature), enabling you to store descriptive information about each feature.

By the end of this tutorial, you will have developed a workflow for transforming visual information from historic maps into organised geospatial datasets, which can be used for research, analysis, and map production.

Key Takeaways

By completing this tutorial, you should be able to:

- Understand the purpose and importance of digitising features in GIS and archaeology
- Systematically identify archaeological and historical features from georeferenced maps
- Create and manage polygon and point shapefiles in QGIS
- Digitise features accurately using appropriate geometry types (points vs polygons)
- Add, edit, and manage attribute data associated with spatial features
- Modify and correct attribute table entries, including deleting and updating records
- Add new fields to enrich your dataset with additional information
- Use the Field Calculator to automate tasks such as generating IDs and calculating polygon areas
- Extract and store coordinate data (latitude and longitude) for point features
- Maintain clean, structured, and well-documented geospatial datasets
- Combine digitised data with previous skills to produce a final map output

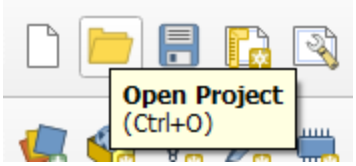
Digitising map features

Having georeferenced our map in tutorial 2, we now want to get some archaeologically relevant information out of it. We can use this data for many purposes, such as research, analysis, or to make our own map.

1. Load your project

First, we need to open QGIS and load the project that we made in tutorial 2.

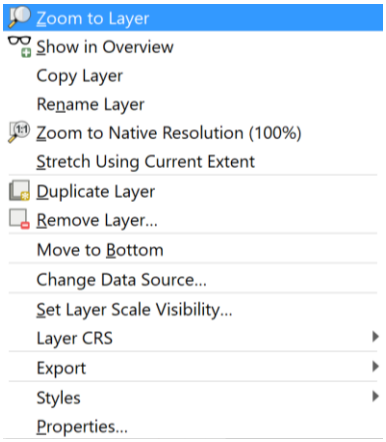
- To begin, open QGIS.
- Navigate to *Project > Open Project* or click on the project button.



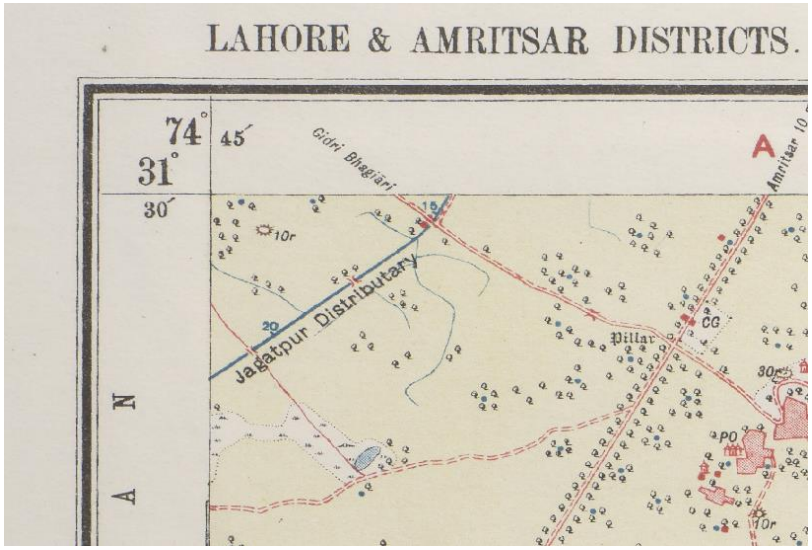
Your project should open up to where you saved it at the end of tutorial 2.

2. Find features to digitise and create a polygon shapefile and a point shapefile

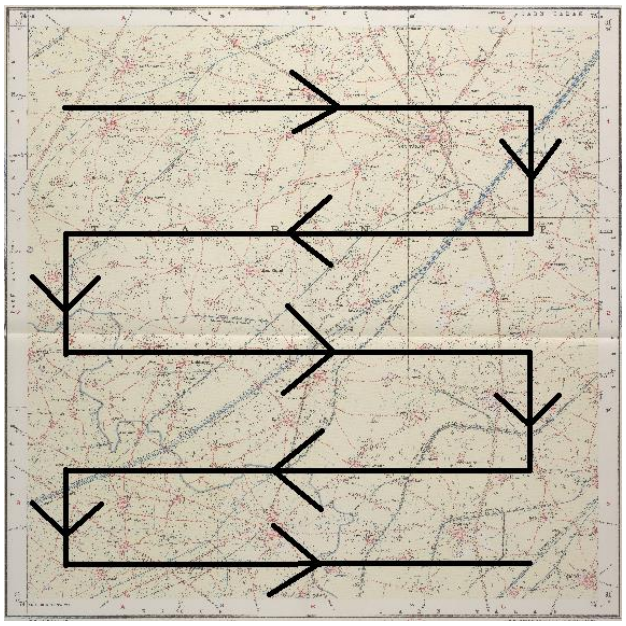
- Zoom to your georeferenced map by right clicking on the georeferenced map layer in the Layers Panel, and selecting *Zoom to Layer*.



- Zoom into the top left corner of your map, using the scroll wheel on your mouse, or the zoom buttons in the toolbar, until you are at a scale where you can comfortably identify potential features. The first features you should be looking out for are mounds, which can be of archaeological importance and are therefore significant to the MAHSA project. A guide to identifying different mound features can be found in the table on page 2 of *The MAHSA Guide to Understanding Survey of India Historical Maps*. Please note that the image below may not be the same as the map you are using.



- It is recommended to move in a systematic way when searching for historic features on the map, for example from west to east until you reach the top right corner of the map, then south until you have a new area of the map shown on your screen, then back across the map east to west, and so on. An example of how to move around the map is shown in the diagram below. Working in a way such as this is important as you can make sure that you cover the whole map.



When you have found your first potential archaeological mound feature, you need to create a shapefile to save the features in.

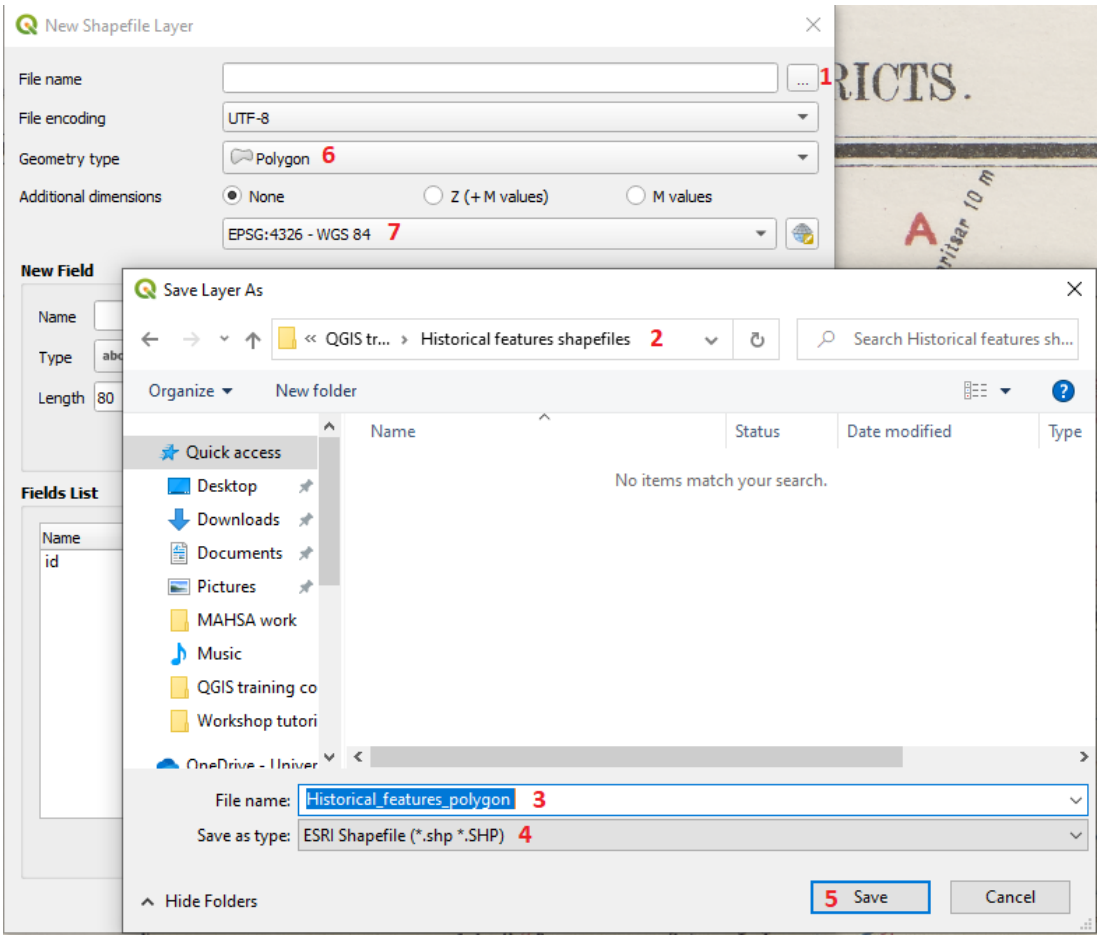
We will be creating two shapefiles, one will be a polygon shapefile which will be used to digitise mound features (the first three features in the guide), and the other will be a point shapefile which will be used to digitise other potential archaeological features (the remaining features in the guide).

Creating a polygon and point shapefile

First, we will create a Polygon shapefile.

- Click on the toolbar, click the 'New Shapefile Layer' button

- Now enter a file name and save location. Click the Browse […] button (step 1 in the image below), create a new folder for your shapefile in your GIS folder, open it (step 2), and then make a file name for your shapefile such as *Historical_features_polygon* (step 3).
- Make sure the *Save as type:* is *ESRI Shapefile (*.shp *.SHP)* (step 4) and click save (step 5).
- In the Geometry type dropdown, select *Polygon* (step 6).
- Make sure the CRS is set to the same CRS as your project, which should be *ESPG: 4326 – WGS 84* (step 7)



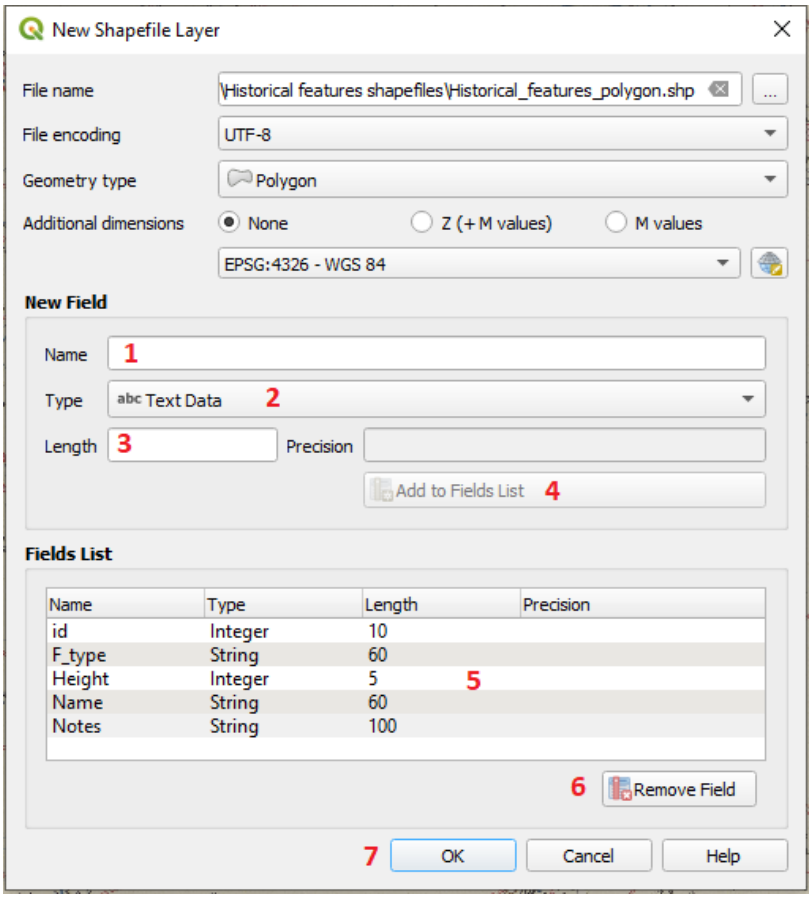
Now we can start to design our shapefile to include columns for the different information that we want to record. For this tutorial we want to add the following 4 fields to record the type of the feature, its height, name, and any additional notes. *Note that in your own work and research, you can add as many columns for the relevant information that you might want to record about the feature you are recording*.

- Name = '*F_type'*; Type = *Text (string);* Length = '*60'*
- Name = '*Height'*; Type = *Integer (32 bit)*; Length = '*5'*
- Name = '*Name'*; Type = *Text (string);* Length = '*60'*
- Name = '*Notes'*; Type = *Text (string);* Length = '*100'*

To add the fields:

- For each field:
  - Input the name into *Name* (step 1 in the below image). Field names are limited to 10 characters.
  - Define the data *Type* e.g. *Text (string)* (step 2)
  - Define the Length of the field e.g. if we are using text data the Length number is the maximum number of characters that is allowed in this field. (step 3)
  - Click *Add to Fields List* (step 4). The new field will appear in the Fields List section (step 5).

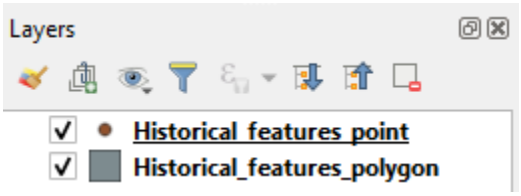
- If you have made a mistake or no longer want a field, you can click on it and click *Remove Field* (step 6). An '*id*' field should automatically be created, do not remove this.
- Click on OK to create the polygon shapefile (step 7).



We now have created our polygon shapefile, which will be automatically added to the Layers List. Now we need to create our point shapefile.

- Repeat the steps above, however make sure the name of the file is *Historical_features_point* and that the geometry type is set to *Point.*

Once complete, we will have two shapefiles loaded in the Layer List in which we can record data about historical features found on our historic map.

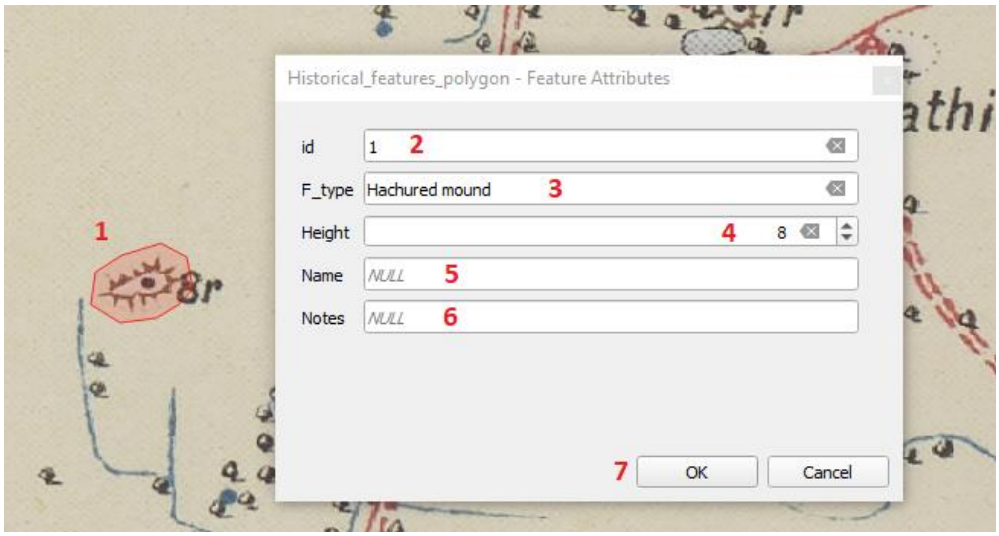


Adding digitised features to shapefiles

1. Adding features to a polygon shapefile

We will start by using the polygon shapefile to digitise the three types of mound features (Hachured mound, Form line mound, Shaded relief mound) noted in *The MAHSA guide to understanding survey of India historical maps.*

- Click on your polygon shapefile in the Layers Panel.
- Click the Toggle Edit button on the Toolbar 
- Click the Add Polygon/Point/Line Feature button on the Toolbar 
- Draw around your site, using left clicks to create a new node, and right-click when you have finished. A red, partly transparent polygon should be drawn (step 1 in the image below).
- A box will open for you to enter information about the feature. For mound features please fill in the following information into each field:
    - ***Id*** (step 2) – This is a unique id for this feature. The first feature will be 1, for the second 2 and so on. Please note, you can automatically fill out this column after you have finished entering all sites (see Inserting IDs automatically)
    - ***F_type*** (step 3) – F_type stands for '*Feature type'* Enter the type of mound it is (either Hachured mound, Form line mound, Shaded relief mound).
    - ***Height*** (step 4) – Some mounds have relative height labels next to them, which are written as a number followed by the letter 'r', for example:
      SCREENSHOT OF MOUND HEIGHT
      Enter the relative height number (without the 'r') into this field. If the mound does not have any height information associated with it then leave this field blank.
    - ***Name*** (step 5) – Some archaeological features will have names associated with them. However, most mounds will not. If there is no name associated with your feature leave this field blank.
    - ***Notes*** (step 6) – this field is for you to enter any further notes about the feature. If you see something interesting then you may want to enter it in this field, however if there is nothing interesting to note then leave it blank.
- Click OK (step 7) when you have finished and the feature will be added to your shapefile.



- Repeat these steps for all mound features on your map, making sure to occasionally save your edits by clicking on the *Save Layer Edits* button on the toolbar  .

You may want to occasionally check the information about the features in your shapefile. To do this:

- Right-click the shapefile on the Layers Panel and select 'Attribute Table'.
- The attribute table will appear, and you will see the features that have been added to the shapefile.

	id	F_type	Height	Name	Notes
1	1	Hachured mound	8	NULL	NULL
2	2	Hachured mound	8	NULL	Graves symbol present inside mound symbol
3	3	Form line mound	NULL	NULL	NULL

Once you are happy with your mound features polygon shapefile:

- Click on the *Save Layer Edits* button on the toolbar 
- Click on the *Toggle Editing* button on the toolbar to turn stop editing 

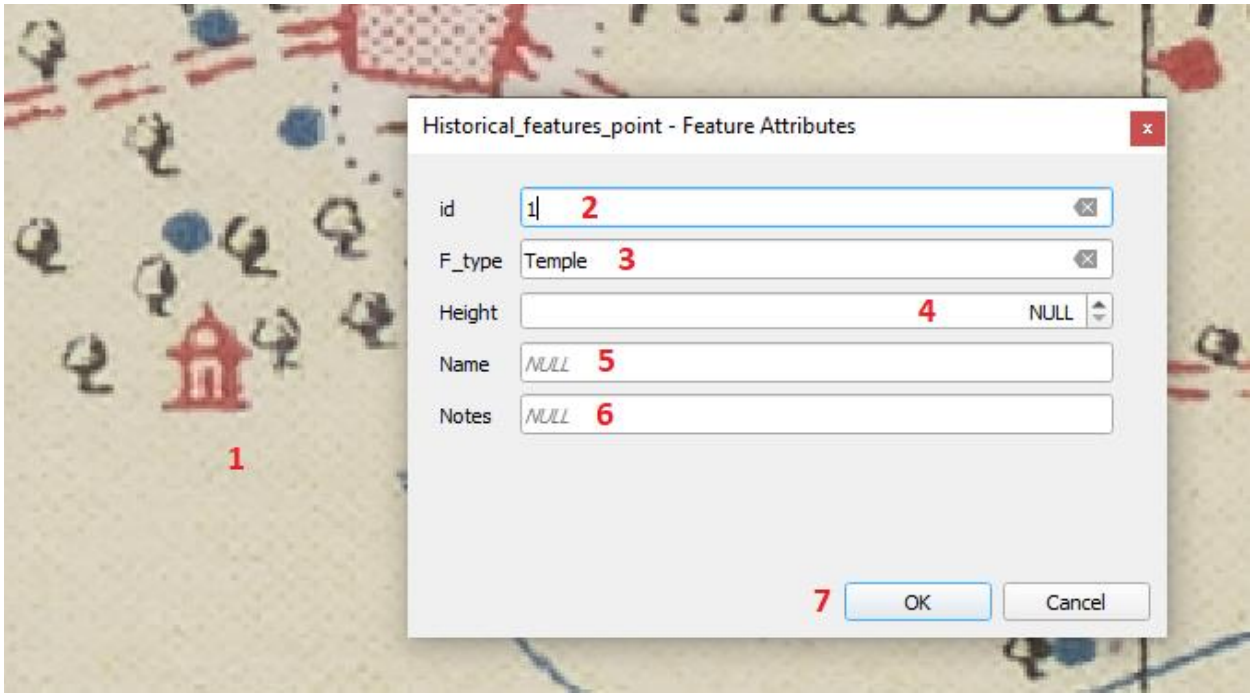
2. *Adding features to a point shapefile*

We will now use the point shapefile to digitize the remaining potential archaeological features (Graves, Deserted village/Ruins, Fortress, Mosque, Temple, Antiquities) noted in *The MAHSA guide to understanding survey of India historical maps*. Please note that not all these features may be in your map sheet, however you should still look out for them.

- Click on your point shapefile in the Layers Panel.
- Click the Toggle Edit button on the Toolbar 
- Click the Add Polygon/Point/Line Feature button on the Toolbar 
- Left click on the centre of your site to place a point (step 1). You will not see a point until the feature has actually been created.
- A box will open for you to enter information about the feature. For point features please fill in the following information into each field:
    - ***Id*** (step 2) – This is a unique id for this feature. For the first feature enter 1, for the second enter 2 and so on.
    - ***F_type*** (step 3) – Enter the type of feature that the point is indicating (either Graves, Deserted village/Ruins, Fortress, Mosque, Temple, Antiquities).
    - ***Height*** (step 4) – It is very unlikely that you will need to enter the height of any point features, however if a feature does have a height marker associated with it, enter it here.
    - ***Name*** (step 5) – Some archaeological features will have names associated with them. However, most will not. If there is a name associated with your feature, enter it here. If there is no name associated with your feature leave this field blank.

- ***Notes*** (step 6) – this field is for you to enter any further notes about the feature. If you see something interesting then you may want to enter it in this field, however if there is nothing interesting to note then leave it blank.

- Click OK (step 7) when you have finished and the feature will be added to your shapefile.



- Repeat these steps for all non-mound archaeological features on your map, making sure to occasionally save your edits by clicking on the *Save Layer Edits* button on the toolbar  .

You may want to occasionally check the information about the features in your shapefile. To do this:

- Right-click the shapefile on the Layers Panel and select 'Attribute Table'.
- The attribute table will appear, and you will see the features that have been added to the shapefile.

	id	F_type	Height	Name	Notes
1	1	Graves	NULL	NULL	Grave site is within the boundaries of a hachured mound
2	2	Temple	NULL	NULL	NULL
3	3	Fortress	NULL	NULL	NULL
4	4	Temple	NULL	NULL	NULL

Once you are happy with the features in your point shapefile:

- Click on the *Save Layer Edits* button on the toolbar 
- Click on the *Toggle Editing* button on the toolbar to turn stop editing 

Editing attributes and features, and enriching data in a shapefile

Geospatial data is rarely static and often needs to be edited, have new information added, or have new fields added to enrich the data. This section will guide you through how to make changes to a shapefile, and how to use the field calculator to enrich the attribute data.

Editing values of the attribute table

After completing your point and polygon shapefiles, you may realise that there are mistakes in the data, or that you are able to fill out more fields that you initially missed. To do this, you will need to edit the relevant shapefiles dowing the followings:

- In the layers panel, left click on the layer that you want to edit and click on the start editing icon  .
- Right click on the layer and open the attribute table. You will now see that the attribute table is editable, and you can make changes to any of the fields for any of the attributes.
- As an example, I may have initially forgotten to add the height of a temple or I may have received new information about its height after creating the shapefile, and I therefore want to add this information in. To do this I will click on the cell in the height field for the correct corresponding record and enter the correct value.

	ID	F_type	Height	Name	Notes
1	1	Temple	20	NULL	NULL
2	2	Mosque	NULL	NULL	NULL
3	3	Fortress	15	NULL	NULL
4	4	Graves	NULL	NULL	NULL

  - Be careful not to accidently editing any fields or records that you do not want to change.
- Once editing is complete, click on the save button and stop editing.

Deleting records

If you want to delete a record that you have entered into the attribute table follow these steps:

- In the layers panel, left click on the layer that you want to edit and click on the start editing icon  .
- Select the record that you want to delete. This can be done either through the map window or the attribute table:

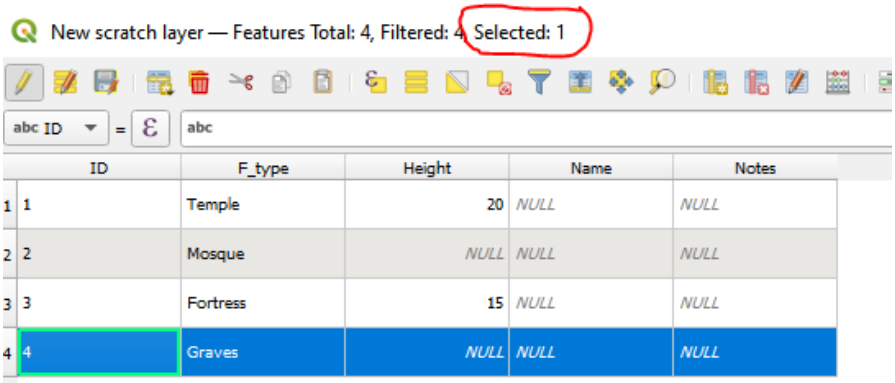
1. Selecting a record in the map window

- To select a record to delete through the map window, click on the select features icon in the main QGIS taskbar  .
- In the map window, zoom to the record you want to select and left click and hold to draw a box around it.

The record will now turn yellow and is selected.

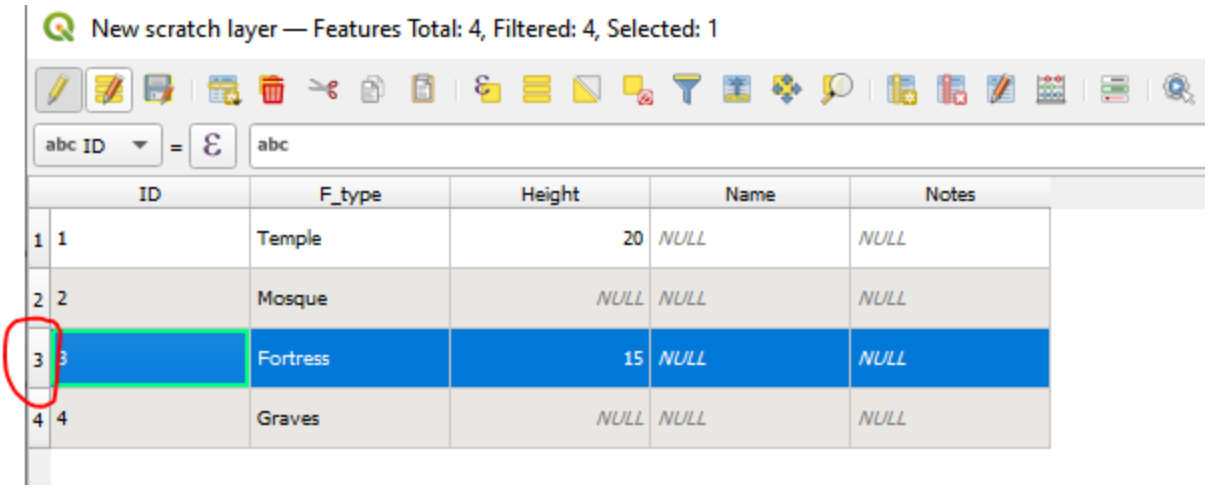
2. Selecting a record in the attribute table

- If you want to select the record via the attribute table, right click on the layer and open the attribute table.
- Any already selected records will be highlighted blue, and the number of selected records will be shown at the top of the attribute table window:



	ID	F_type	Height	Name	Notes
1	1	Temple	20	NULL	NULL
2	2	Mosque	NULL	NULL	NULL
3	3	Fortress	15	NULL	NULL
4	4	Graves	NULL	NULL	NULL

- If you have records selected that you do not want selected, click on the 'Deselect all features from the layer' icon  . You should now see that there are no features selected.
- To select that records that you want to delete using the attribute table, click on the number next to the record you want to select (indicated by the red circle in the image below), and it will highlight blue

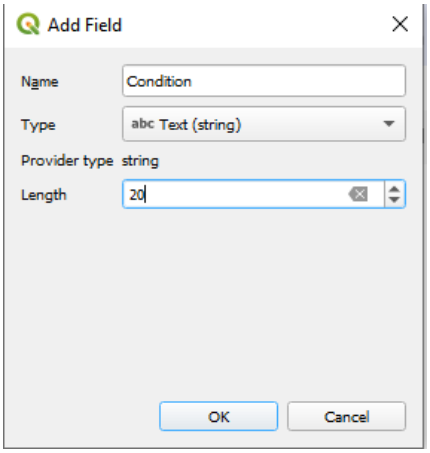


- Once all record you want to delete are selected (make sure there are none selected that you don't want to delete!), click on the 'Delete selected features' icon  . This is found both in the attribute table, and in the main QGIS taskbar.
- Once you have finished, save and stop editing the layer.

Adding fields in the attribute table

You may want to retrospectively add or delete entire fields in your attribute table. In this example we will add a new field called condition, in which we will input the current condition of the records.

- In the layers panel, left click on the layer that you want to edit and click on the start editing icon  .
- Right click on the layer and open the attribute table.
- Click on the 'New field' icon in the attribute table  .
- A box for adding a new field will appear in which you can enter information about the field (similar to when you first created the table):



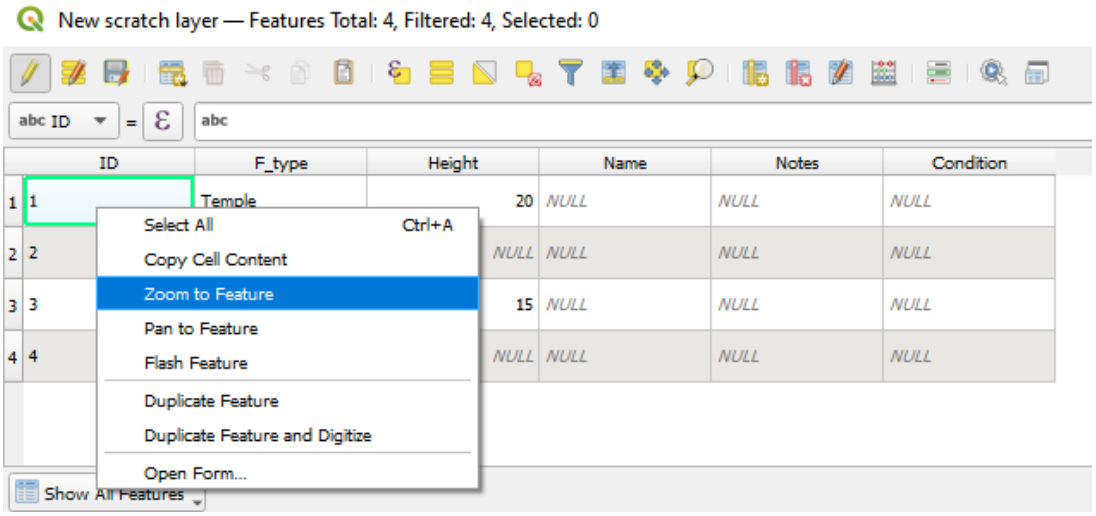
- Enter the correct information and then click on OK.

- You will now see that a new field has been added onto the end of your attribute table called 'Condition':

	ID	F_type	Height	Name	Notes	Condition
1	1	Temple	20	NULL	NULL	NULL
2	2	Mosque	NULL	NULL	NULL	NULL
3	3	Fortress	15	NULL	NULL	NULL
4	4	Graves	NULL	NULL	NULL	NULL

- You can now add a short description of the current condition of each record in your attribute table. Use the terms: 'Excellent', 'Good', 'Partially damaged', 'Completely damaged', 'Unknown'.

A tip to quickly zoom to a record in the map window from the attribute table so that you can enter the condition is to right click on the record you want to zoom to in the attribute table, and click on 'Zoom to Feautre'.



The map window will zoom to this record, and you can assess the condition of the site using satellite imagery and add it to the condition field.

Inserting IDs automatically

In the attribute table you can automate some cell entries. One entry that you might want to automate is the *ID* field. This was mentioned previously in the tutorial that you do not need to fill this in and can do it at a later time.

To do this, we will use the field calculator in the attribute table, that is a great tool for enhancing data in an attribute table.

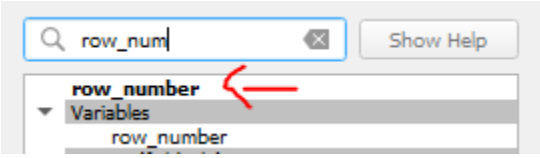
- First, in the layers panel, left click on the layer that you want to edit and click on the start editing icon  .
- Right click on the layer and open the attribute table.
- Click on the 'Field calculator' icon  .

A new window will open, this is the field calculator. The field calculator allows you to perform calculations on the basis of existing attribute values or defined functions. This can be very useful for enhancing data.

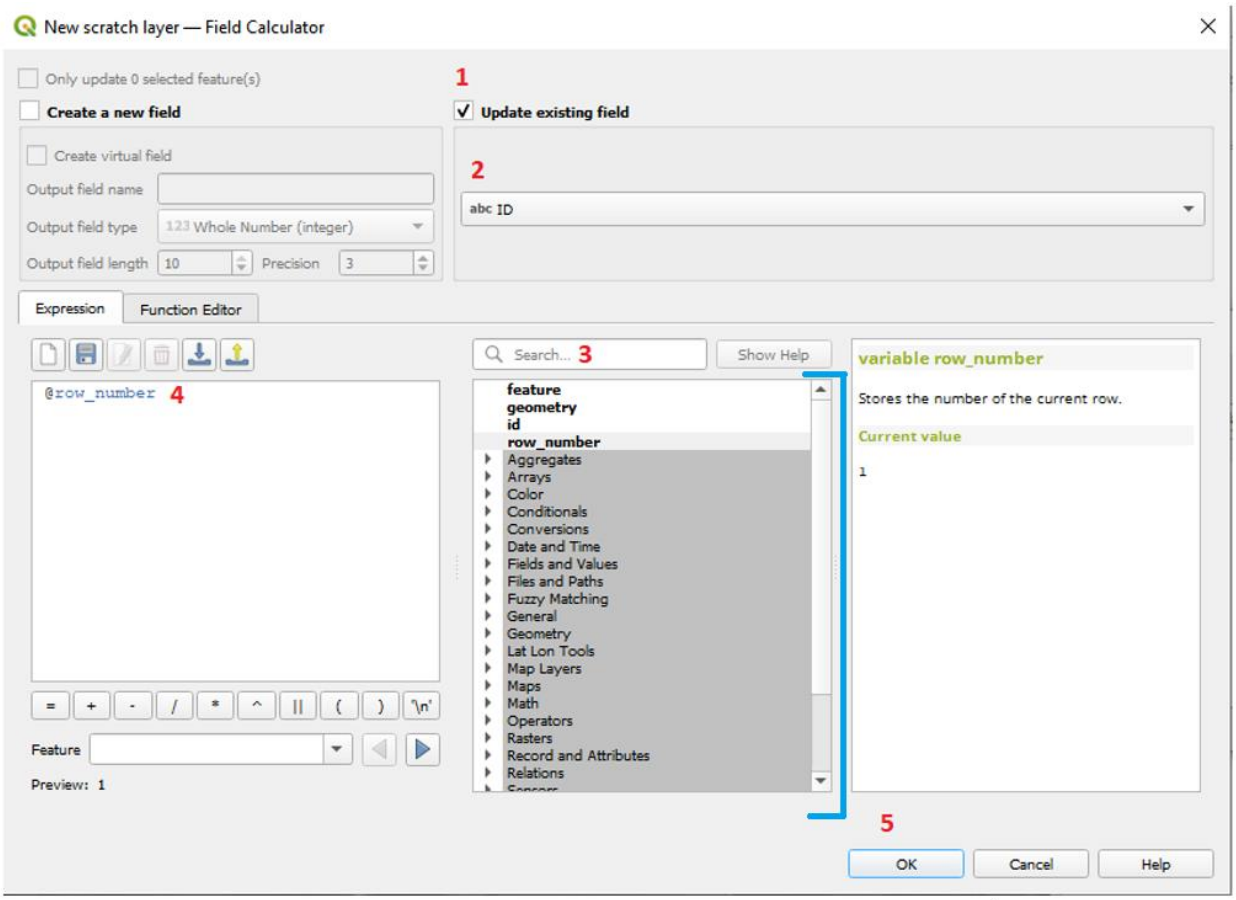
We will only briefly cover the field calculator in these tutorials so to learn more about it please view the QGIS documentation - https://docs.qgis.org/3.34/en/docs/user_manual/working_with_vector/attribute_table.html#using-the-field-calculator

The field calculator allows you to create a new field based on an expression, or update current fields based on an expression.

- In this case we want to update a current field, the *ID* field based on an expression. Therefore you need to click on the 'Update existing field' checkbox (step 1 in the below image).
- You can now chose which field to update, select 'ID' (step 2).
- The next step is to choose the expression, essentially telling QGIS what you want input into this field. In the centre of the window you will see a box with many different categories of expressions, such as 'Aggregates', 'Arrays', 'Colors' etc. (these have been highlighted by a blue line in the below image. It is possible to search through all of these prebuilt expressions and chose the one you want, however in this example we know that we want the ID field to be input with its row number. So in the search box type *row_number*. You will see that the expression options are reduced to only show those that include the wording that you have entered in the search box. Double click on the first row_number option:



  and it will move across the the left expression box (step 4).
- Now click on OK (step 5).



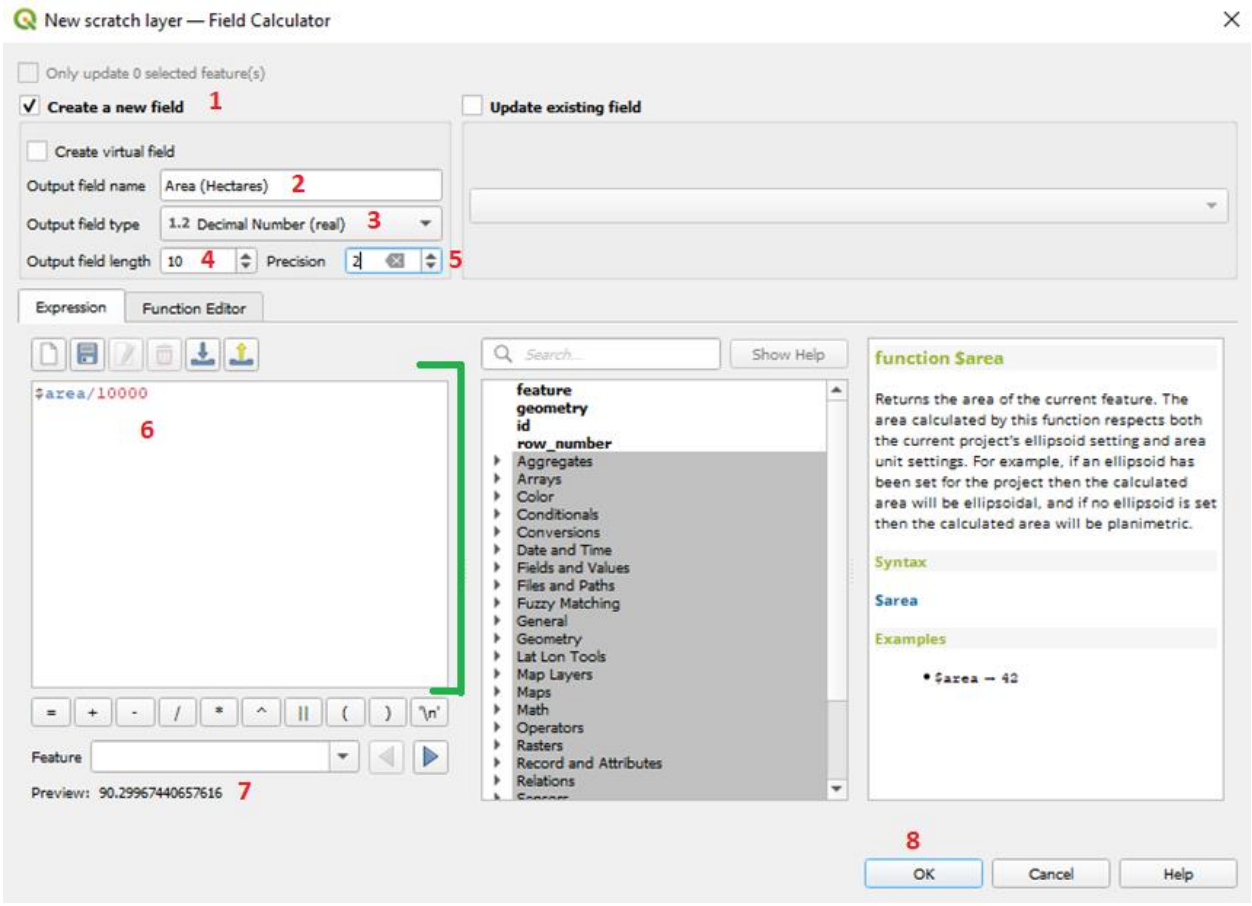
- The field calculator window will disappear, and you will now see that the ID field in your attribute table has been filled with numbers starting at 1 and increasing by 1.
    - ❖ **Please note** that this is not dynamic, and if you enter new records into your attribute table they will not automatically update with a new ID number. Therefore you should rerun this step everytime you want to add new ID numbers in bulk to the attribute table.
- Click saved and stop editing.

Using the field calculator to calculate areas for polygons

Another good use for the field calculator is to use it to add a field in your polygon attribute table that shows the area that each polygon covers. To do this:

- First, in the layers panel, left click on the polygon layer that you want to edit and click on the start editing icon  .
- Right click on the layer and open the attribute table.
- Click on the 'Field calculator' icon  .
- This time, we want to create a new field rather than update an already existing filed. Check the 'Create a new field' checkbox (step 1 in the image below).
- In the 'Output field name' box type 'Area (Hectares)' (step 2). In this tutorial we will calculate the area in hectares as this is a common way of recording area.

- In the ‘Output field type’ box select ‘Decimal Number (real)’. This is because we want to record the area in a decimal number (step 3).
- Set the ‘Output field length’ to 10 (step 4).
- Set the ‘Precision’ to 2 (step 5). This is because we want the number to be stored to 2 decimal places.
- In the expression box (indicated by a green line) type in the expression *$area/10000* (step 6). We are inputting this expression because the code *$area* calculates the area of each polygon based on the ellipsoid that the CRS uses. As we are using WGS 84, this code will return the area in metres squared. One hectare is equivalent to 10000 metres squared, therefore we add */10000* to the end of the expression to return the area value in hectares.
- A preview of the output will be shown underneath the expression box (step 7).



- When you are happy with your inputs, click on OK (Step 8).
- You will now see in your attribute table that each record now has an area value in hectares displayed in a new field.

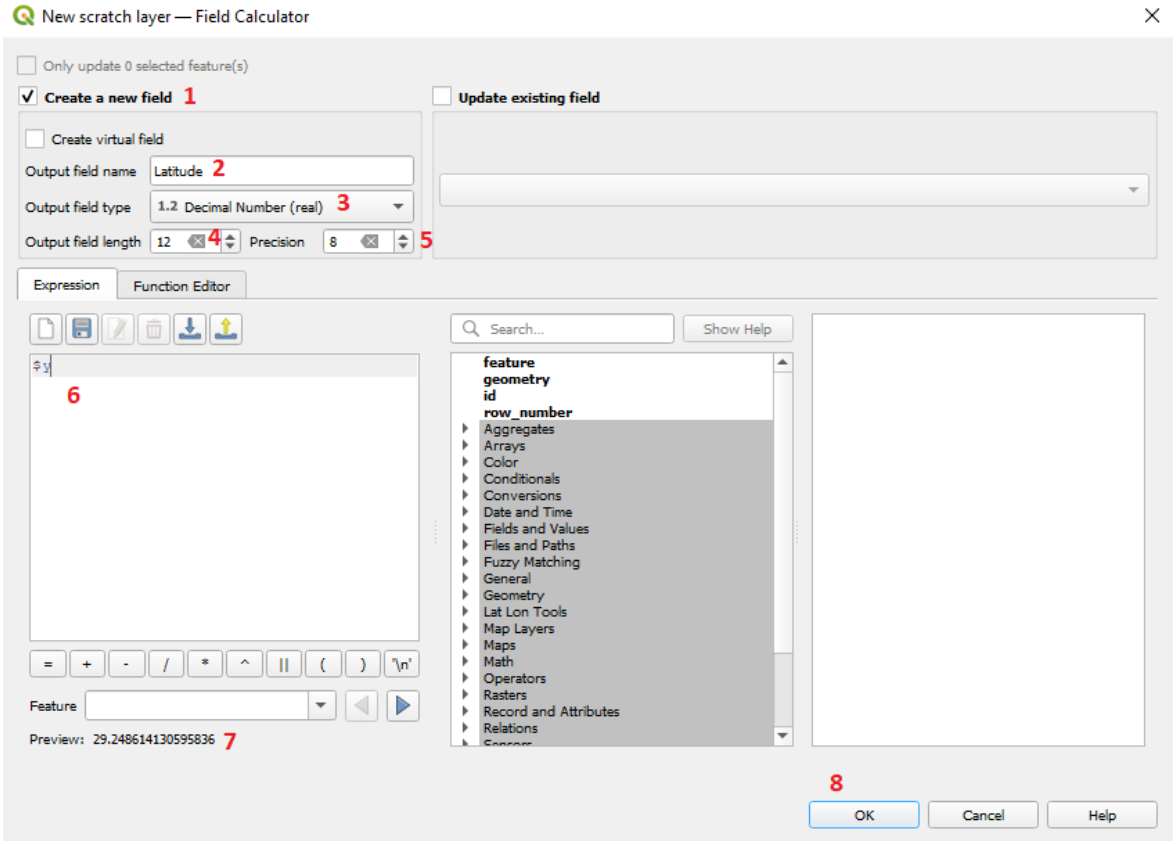
	ID	F_type	Height	Name	Notes	Condition	Area (Hectares)
1	1	Hachure mound	20	NULL	NULL	Good	90.30
2	2	Form line mound	5	NULL	NULL	Good	46.88
3	3	Hachure mound	50	NULL		Excellent	16.97

- Click saved and stop editing.

Add coordinates for points in a point shapefile

In you point shapefile it may be useful to have the coordinates of each points recorded in the attribute table, this can be very useful when sharing data or using your attribute table in another programme such as Excel. This is also an action that can be done in the field calculator.

- First, in the layers panel, left click on the polygon layer that you want to edit and click on the start editing icon  .
- Right click on the layer and open the attribute table.
- Click on the 'Field calculator' icon  .
- We want to create two new fields, one for Latitude, and one for Longitude. These will have to be created one at a time, so follow the next steps twice, first for Latitude and then for Longitude.
- Check the 'Create a new field' checkbox (step 1 in the image below).
- In the 'Output field name' box type either 'Latitude' (if this is your first iteration through the steps) or 'Longitude' (if you have already added the latitude field) (step 2).
- In the 'Output field type' box select 'Decimal Number (real)'. This is because we want to record the coordinates in a decimal number (step 3).
- Set the 'Output field length' to 12 (step 4).
- Set the 'Precision' to 8 (step 5). This is because we want the decimal degree coordinate value to be to 8 decimal places.
- In the expression box type in either the expression *$y* (for latitude) or *$x* (for longitude) (step 6). This expression will return the current latitude or longitude coordinate for each point feature.



- A preview of the output will be shown underneath the expression box (step 7).
- When you are happy with your inputs, click on OK (Step 8).
- Make sure you have done these steps twice, one for latitude and once for longitude.
- You will now see in your attribute table that each record now has a field showing the latitude and the longitude of the point.

	ID	F_type	Height	Name	Notes	Condition	Latitude	Longitude
1	1	Temple	20	NULL	NULL	NULL	29.24861413	71.14402349
2	2	Mosque	NULL	NULL	NULL	NULL	29.22350893	71.41515970
3	3	Fortress	15	NULL	NULL	NULL	29.40426640	72.25869459
4	4	Graves	NULL	NULL	NULL	NULL	29.73565511	71.14904453

- Click saved and stop editing.

PRACTICE: Follow this tutorial's steps to find and digitise archaeological features you observe on your map

- Study the map symbology of the Survey of India potential archaeological and heritage features
- Create two shapefile: polygon shapefile to record mound features and the point shapefile to record any other archaeological and heritage features
- Identify and add digitised shapefile to the polygon and point shapefile
- Practice editing and adding new fields to the shapefiles.
- Add the area field to the polygon shapefile and the latitude and longitude fields to the point shapefile.

ACTIVITY: Making a final map

We are finishing this tutorial with an activity for you to make and export a final map/image (as a jpeg) using the historic map sheet that you georeferenced in tutorial 2 and the features that you have digitised in this tutorial. You will use the QGIS skills that you have learned throughout the course in the 3 tutorials to create this map.

The final image/map should include:

- Your georeferenced map overlaying a basemap (you may select if you want your georeferenced map to be partly transparent).
- Your two digitised archaeological features shapefiles, with the symbology set to denote what type of feature it is by using different colours.
- Standard map features to give your map context, such as:
    - Scale bar;
    - North Arrow;
    - Legend;
    - Title